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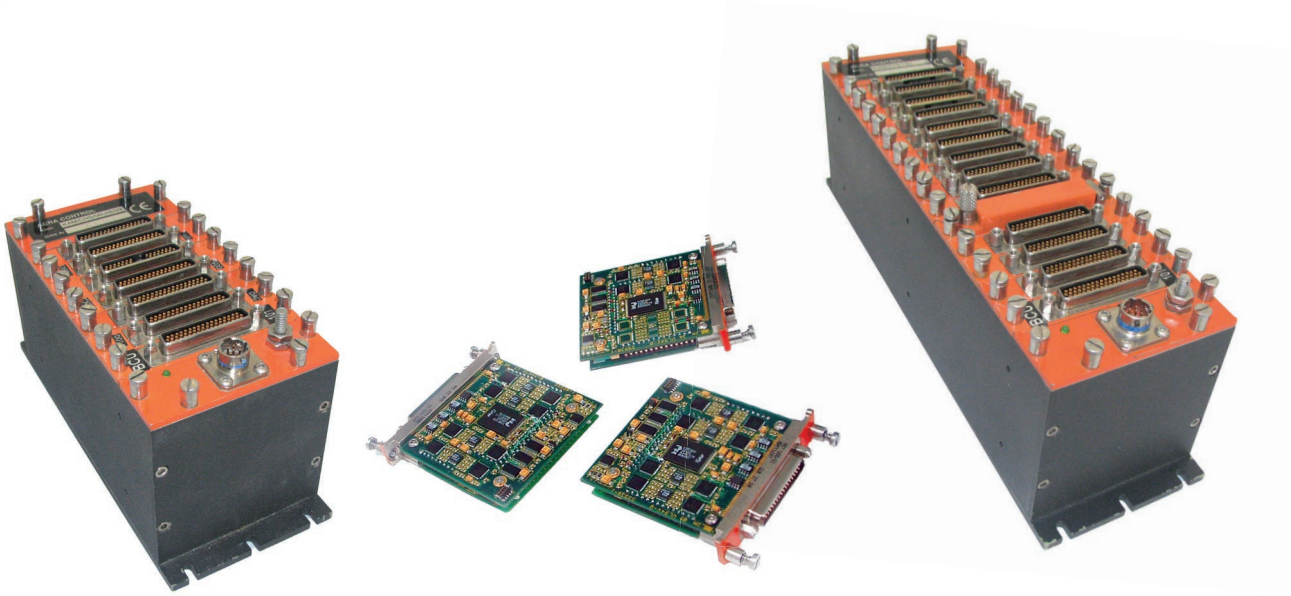
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CURTISS-WRIGHT

Acra KAM-500
Databook





Acra KAM-500 Databook

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The Acra KAM-500 Databook (HW/BK/0002 | 2 May. 2024) comprises data sheets for Acra modules and chapters on Environmental Specifications, Equipment Interface and so on. All controlled documents contained in the Acra KAM-500 Databook are issued by date. The following is a list of the controlled documents contained in the Acra KAM-500 Databook and their issue dates.

Hardware product	Issue date | reference number
3D drawings	10 Oct. 2019 | DST/X/034
ACC/HSK/001	9 Jun. 2016 | DST/J/064
ACC/TRF/002	31 Oct. 2023 | DST/AC/020
ACD/BAC/002/B	30 Nov. 2016 | DST/W/106
ACD/BAC/003/B	9 Feb. 2015 | DST/W/107
ACD/BAC/004/B	9 Feb. 2015 | DST/W/108
ACD/BAC/005	9 Feb. 2015 | DST/W/017
ACD/BAC/006	20 Dec. 2023 | DST/AB/003
ACD/BAC/007	20 Dec. 2023 | DST/AB/004
ACD/BAC/011	17 Jun. 2020 | DST/AG/007
ACD/CJB/001	23 Feb. 2015 | DST/P/014
ACD/CJB/002	16 Apr. 2015 | DST/W/018
ACD/CJB/003	16 Apr. 2015 | DST/Y/042
ACD/CJB/005	5 Dec. 2016 | DST/AB/001
ACM/EXT/001/B	9 Feb. 2015 | DST/K/003
BAC/PSU/007	9 Feb. 2015 | DST/W/118
Cables	11 Feb. 2022 | DST/J/062
CON/KAD/002/CP	8 Mar. 2022 | DST/R/008
CON/KAD/002/SR	23 Jun. 2021 | DST/R/009
CON/KAD/003/CP	23 Jun. 2021| DST/S/042
CON/KAD/004	16 Apr. 2015 | DST/S/040
CON/KAD/005/CP	23 Jun. 2021 | DST/S/041
CON/KAD/005/SR	23 Jun. 2021 | DST/T/095
CON/KAD/008/CP	2 Feb. 2022 | DST/T/066
CON/KAD/008/SR	23 Jun. 2021 | DST/T/067
CON/KAD/010	23 Jun. 2021 | DST/W/016
CON/KAD/020/CP	5 Jan. 2024 | DST/AJ/027
CON/KAD/030/CP	5 Jan. 2024 | DST/AJ/028
CON/KAD/050/CP	5 Jan. 2024 | DST/AJ/029
CON/KAD/080/CP	5 Jan. 2024 | DST/AJ/030
CON/PSU/007	17 Apr. 2015 | DST/W/115
CON/PSU/007/CS1	13 Sep. 2023 | DST/S/039
CON/SAV/001	17 Apr. 2015 | DST/AB/005
CON/SAV/002	7 Apr. 2016 | DST/AB/006
CON/SAV/003	17 Apr. 2015 | DST/AB/008
Handling precautions	11 May 2016 | DST/U/055

Hardware product	Issue date | reference number
JIG/UNI/001/D	28 Sep. 2021 | DST/AE/019
KAD/ABM/101	2 Sep. 2021 | DST/V/064
KAD/ABM/102/B	18 May 2017 | DST/Y/008
KAD/ABM/102/B/EM1	13 Aug. 2021 | DST/Y/051
KAD/ABM/103	14 Jun. 2022 | DST/X/055
KAD/ADC/008	27 Sep. 2022 | DST/N/053
KAD/ADC/010/C	17 Apr. 2015 | DST/R/046
KAD/ADC/011/C	18 Mar. 2015 | DST/R/044
KAD/ADC/105/B	17 Jan. 2022 | DST/U/028
KAD/ADC/106/C	15 Jun. 2023 | DST/U/033
KAD/ADC/109/C/S1	19 May 2021 | DST/T/097
KAD/ADC/109/C/S2	1 Jun. 2021 | DST/U/031
KAD/ADC/111	20 Feb. 2018 | DST/X/058
KAD/ADC/112	13 Apr. 2018 | DST/V/080
KAD/ADC/113/B	6 Jan. 2023 | DST/V/059
KAD/ADC/115	9 Feb. 2022 | DST/Y/031
KAD/ADC/115/DT	8 Feb. 2024 | DST/AJ/021
KAD/ADC/115/NRTD	3 Oct. 2023 | DST/AJ/014
KAD/ADC/116	25 May 2023 | DST/S/083
KAD/ADC/117/B	17 Jan. 2022 | DST/U/034
KAD/ADC/117/EC1	20 Jun. 2018 | DST/T/098
KAD/ADC/118	24 Apr. 2018 | DST/P/065
KAD/ADC/120	24 Apr. 2018 | DST/R/006
KAD/ADC/126/B	13 Apr. 2018 | DST/V/060
KAD/ADC/129/S1	27 Feb. 2024 | DST/S/085
KAD/ADC/129/S2	1 Jun. 2021 | DST/V/081
KAD/ADC/130	13 Apr. 2018 | DST/W/123
KAD/ADC/134/B	28 Feb. 2024 | DST/AA/014
KAD/ADC/135/B	21 May 2021 | DST/AA/017
KAD/ADC/136/C	8 Nov. 2023 | DST/AC/006
KAD/ADC/141	9 Feb. 2022 | DST/AC/014
KAD/ARR/101	13 Apr. 2015 | DST/U/047
KAD/ARI/103/B	23 Jan. 2023 | DST/Y/044
KAD/BCU/101/E	18 Apr. 2023 | DST/Y/029
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Hardware product	Issue date | reference number
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KAD/CBM/101	22 Aug. 2016 | DST/P/064
KAD/CBM/102	12 Jan. 2023 | DST/L/043
KAD/CBM/103	25 Oct. 2022 | DST/V/071
KAD/CBM/104	11 Jun. 2020 | DST/V/072
KAD/CBM/105	10 Aug. 2016 | DST/Y/038
KAD/CBM/107	30 Jan. 2019 | DST/Z/016
KAD/CDC/103	14 Apr. 2022 | DST/AG/006
KAD/DAC/001/B	9 Nov. 2016 | DST/S/050
KAD/DEC/103	16 Sep. 2021 | DST/V/074
KAD/DSI/102/B	15 Nov. 2023 | DST/Y/009
KAD/DSI/104	15 Nov. 2023 | DST/W/091
KAD/EBM/102/B	4 May 2022 | DST/AB/026
KAD/EBM/103	9 Nov. 2016 | DST/W/086
KAD/EBM/104	6 Oct. 2016 | DST/AB/020
KAD/ENC/005/B	21 Dec. 2022 | DST/P/005
KAD/ENC/106	29 May 2020 | DST/S/092
KAD/ENC/111	22 Aug. 2016 | DST/W/078
KAD/ETH/101/B	15 Aug. 2016 | DST/W/128
KAD/ETH/102	30 Jun. 2017 | DST/V/073
KAD/EXC/101	25 Oct. 2023 | DST/AA/016
KAD/FBM/103/B	31 Jul. 2017 | DST/T/085
KAD/FBM/105/B	21 Dec. 2022 | DST/AA/004
KAD/IBM/101	2 Feb. 2021 | DST/AA/005
KAD/LDC/101	19 Oct. 2021 | DST/P/048
KAD/MAT/101	5 Apr. 2024 | DST/Y/047
KAD/MBM/101	18 Jun. 2021 | DST/X/012
KAD/MBM/102	18 Jun. 2021 | DST/X/054
KAD/MDC/103	17 Jun. 2021 | DST/S/052
KAD/MEM/004/B	17 Jun. 2021 | DST/T/054
KAD/MSB/103/C	8 Jun. 2021 | DST/V/006
KAD/PBM/104	15 Nov. 2023 | DST/AC/013
KAD/SDC/101	3 Jun. 2022 | DST/W/033
KAD/SDI/103	22 May 2015 | DST/U/015
KAD/SWI/101	16 Apr. 2015 | DST/W/009
KAD/SWI/102	21 Jan. 2021 | DST/V/065
KAD/SWI/107	16 Apr. 2015 | DST/Y/025
KAD/SWI/108	18 Jan. 2022 | DST/Y/045
KAD/TDC/102/B	28 Feb. 2022 | DST/Y/012
KAD/TDC/107	13 Apr. 2018 | DST/V/032
KAD/UAR/102/C	23 Jan. 2023 | DST/X/084
KAD/UBM/103	27 Sep. 2022 | DST/Y/060
KAD/UBM/105	25 Oct. 2022 | DST/AB/014
KAD/UBM/106	26 Feb. 2020 | DST/AF/038
KAD/VDC/001	19 Jan. 2021 | DST/N/065
KAD/VID/106/B	12 Oct. 2023 | DST/AB/032
KAM/CDC/101	24 Apr. 2018 | DST/S/032
KAM/CHS/02F	21 Feb. 2020 | DST/X/033
KAM/CHS/03F	21 Feb. 2020 | DST/P/062
KAM/CHS/03U/E	9 Jul. 2021 | DST/W/042
KAM/CHS/04L/B	16 Apr. 2015 | DST/N/043
KAM/CHS/05F/SC	18 Jan. 2022 | DST/S/004
KAM/CHS/06U/E	9 Jul. 2021 | DST/W/052
KAM/CHS/09U/E	9 Jul. 2021 | DST/W/057
KAM/CHS/12R/E	12 Jan. 2016 | DST/AB/027
KAM/CHS/13U/E	9 Jul. 2021 | DST/W/065
KAM/DMY/001	9 Feb. 2015 | DST/U/002
KAM/MEM/103/C	19 Oct. 2023 | DST/AB/029
KAM/MEM/113	26 Oct. 2022 | DST/X/067
KAM/PSU/011/B	19 Oct. 2023 | DST/Z/021
KAM/PSU/012/B	9 Jan. 2023 | DST/W/043
KAM/PSU/014	16 Apr. 2015 | DST/Y/024
KAM/TCG/105	14 Jul. 2023 | DST/Z/025
KAM/TCG/106	18 Jul. 2023 | DST/AG/014
KIT/001	22 Jun. 2021 | DST/J/063
LID/001	23 Feb. 2015 | DST/J/061
SAM/DEC/008	19 Apr. 2016 | DST/Z/010

Acra KAM-500 Databook chapters

Chapter	Reference number | issue date
Introducing the ACRA KAM-500	HW/SPF/0005 | 10 Apr. 2015
Environmental Specifications	QD/HW/SPF/L/0001 | 4 Feb. 2020
Equipment Interface	QD/HW/SPF/L/0002 | 4 Feb. 2020

See “Revision histories” on page 1241 for details of any revisions to hardware products and controlled documents since the last release of the Acra KAM-500 Databook.

About this book

This book gives a full technical overview of the Acra KAM-500, an advanced rugged and compact system for airborne data acquisition developed by Curtiss Wright. It contains the following major sections and appendices:

- “Introducing the Acra KAM-500” introduces the Acra KAM-500, explaining key concepts and design goals.
- “Introducing data sheets”contains data sheets for all chassis, user-modules and accessories for the Acra KAM-500.
- “Environmental specifications” describes the standards the Acra KAM-500 meets and the design considerations taken by Curtiss Wright to meet them. All Acra KAM-500 modules have been specifically designed to operate in harsh aerospace test environments.
- “Equipment interface” describes wiring considerations for the Acra KAM-500.
- “Appendices” contains lists of Abbreviations and Controlled Documents from this book.
- “Revision histories” outlines the revision histories of all hardware products and controlled documents in the Acra KAM-500 Databook

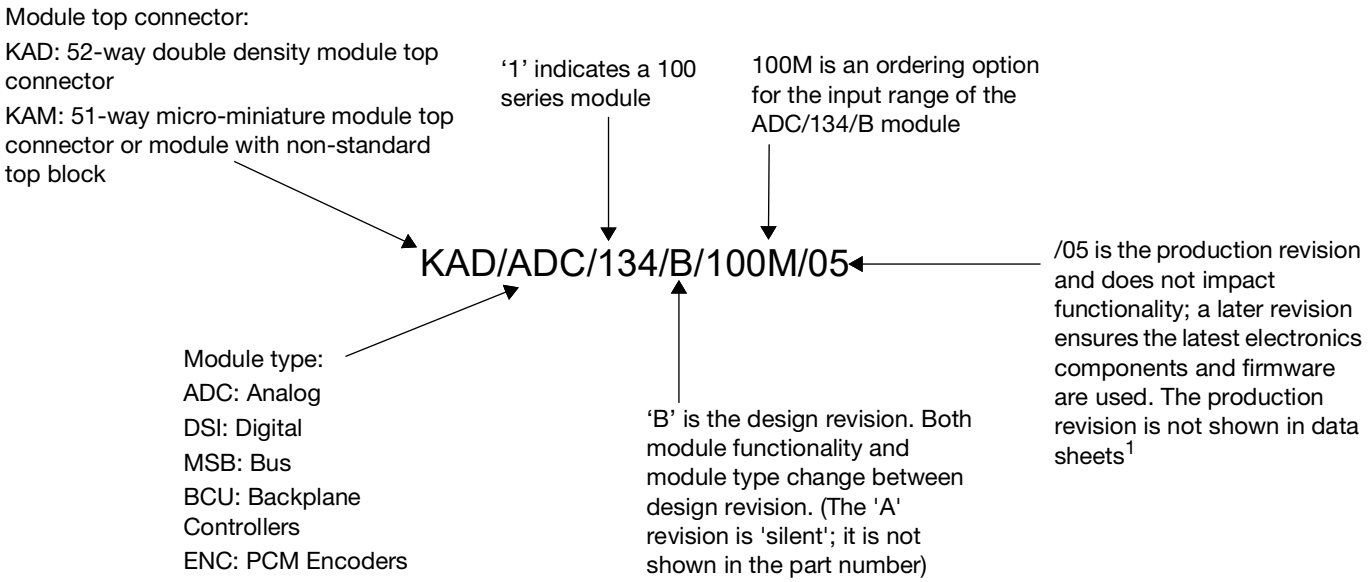
Suggested Reading Paths

Managers or other personnel requiring a brief overview of the features of the Acra KAM-500	“Introducing the Acra KAM-500”
Engineers responsible for installing Acra KAM-500 modules	“Handling precautions”
Engineers requiring a full technical overview of any or all chassis, user-modules and accessories for the Acra KAM-500	“Introducing data sheets”
Engineers seeking evidence of the Acra KAM-500’s ruggedness and ability to operate in harsh aerospace test environments	“Introducing the Acra KAM-500” “Environmental specifications”
Engineers responsible for wiring to and from the Acra KAM-500	“Introducing the Acra KAM-500” “Equipment interface”
Test engineers responsible for power consumption and dissipation analysis	“Introducing the Acra KAM-500”
Engineers responsible for installing the Acra KAM-500	“Introducing the Acra KAM-500” “Equipment interface”
Personnel responsible for ordering Acra KAM-500 components	“Introducing the Acra KAM-500” “Introducing data sheets” “Part-numbering scheme”
Engineers wishing to know the revision histories of hardware products and controlled documents	“Revision histories”

Part-numbering scheme

The part numbering scheme describes the different module ordering information, which is shown at the top of the last page of a data sheet. See “Introducing data sheets” on page xiii.

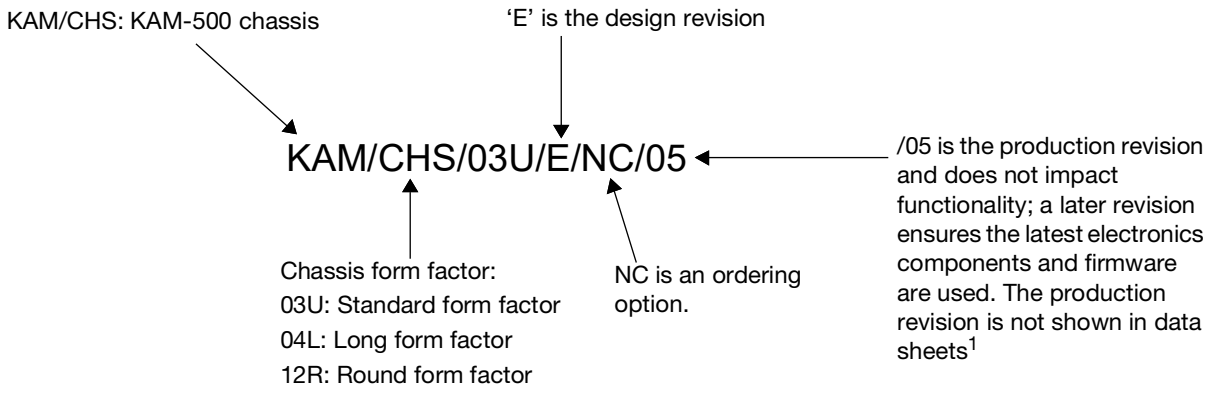
For modules:



[1] When ordering modules it is not required to specify the production revision; the latest revision is provided by default. However, when contacting support, always provide the part number including the production revision or module serial number.

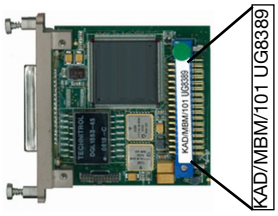
/ET: Extended Temperature, is a non-standard ordering option. For example the KAD/ADC/118/100M/ET/01 is the same as KAD/ADC/118/100M/01 but suitable for applications that require extended temperature. Not all modules offer /ET variants.

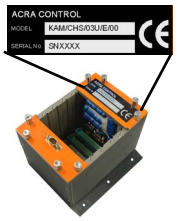
For chassis:



Where to find the part number and serial number

The label with the serial number and part number (including production revision) for all modules is fixed onto one side of the board of the module. Other products such as chassis, recorders and switches have the label fixed onto the top, bottom, rear or side of the housing.









IMPORTANT! Be sure to check the part number on your purchase order as it may not include the production revision (last two digits). This may cause an issue when a shipment arrives as the part number on the product and shipping documents include the production revision, which may not align with the purchase order.

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CON/KAD/004 Mating connector for CON/KAD/002/CP (female, DD, 52-way) . . . 1119
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CON/KAD/005/SR Mating connector for KAD/TDC/002 (DD, 52-way, rear grommet) . . . 1127
CON/KAD/008/CP Mating connector (DD, 52-way, rear grommet, no mating screws) . . . 1131
CON/KAD/008/SR Mating connector for KAD/TDC/002 (DD, 52-way, rear grommet, no mating screws) . . . 1135
CON/KAD/010 Mating connector for KAD/TDC/102 and KAD/TDC/107 (DD, 52-way, 3 built-in temperature sensors) . . . 1139
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HANDLING PRECAUTIONS

Handling procedures for installing hardware modules

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The greatest risk of damage to hardware modules is when inserting or removing a module from a chassis. If care is not taken, surface mount components can be dislodged or broken off. To reduce this risk, follow all precautions in this document and use the ACC/TOL/030 (tool to aid insertion/removal of modules).

Electrostatic considerations

	Always ensure that proper ElectroStatic Discharge (ESD) precautions are in place before handling or storing Curtiss-Wright equipment.

Modules outside a chassis are vulnerable to electrostatic damage. Specifically the pins that connect to the backplane and top block connector pins are at risk.

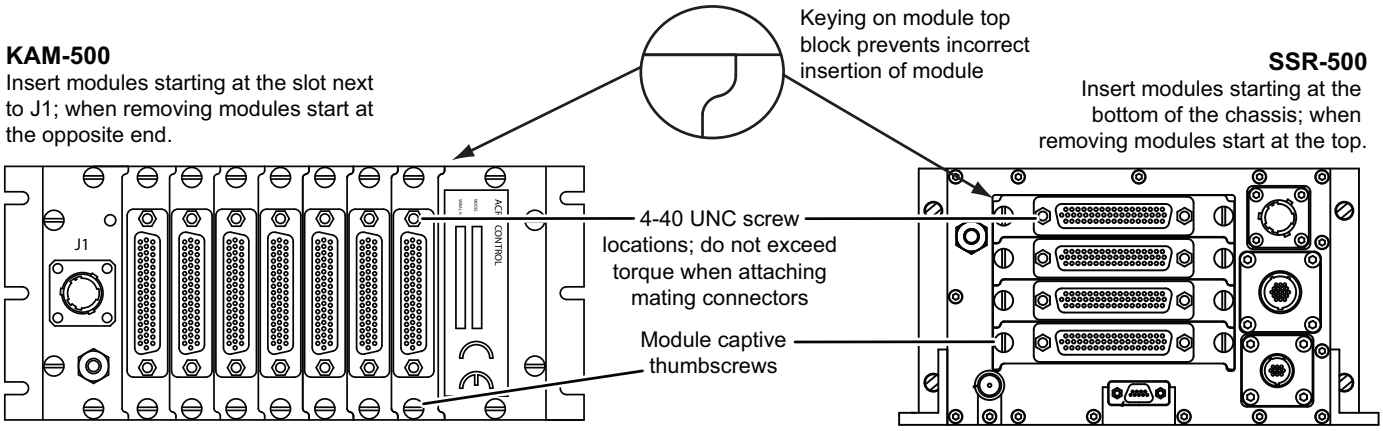
- When transporting or storing modules, ensure that they are placed in antistatic bags.
- In a laboratory environment, use antistatic mats and wrist straps.
- When antistatic equipment is not available, touch some metal frame (on an aircraft for example) to discharge static from your body before removing the module from the antistatic bag. Only handle the module by the electrically-isolated top block.
- Do not touch any pins on the module.

Module screw torque settings

The following are the recommended torque settings for module screws.

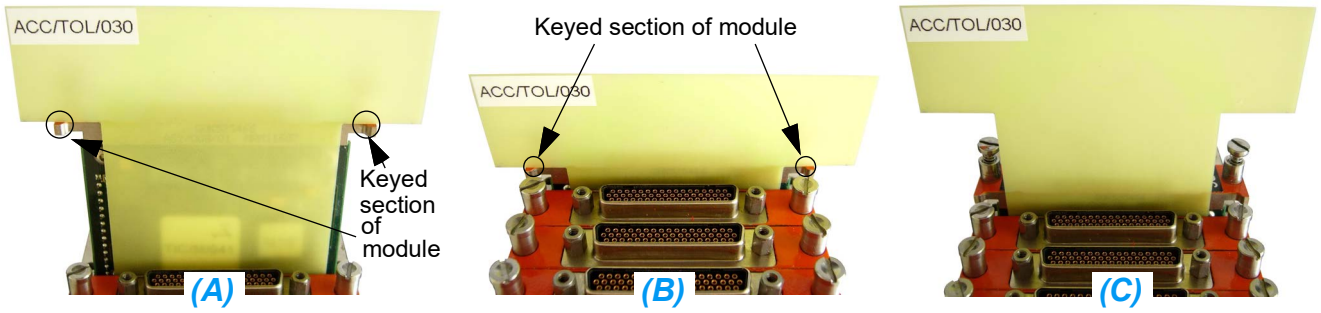
Screw type	Location	Recommended torque setting
Spring-mounted captive thumbscrews	On each module	0.6Nm (0.44 foot pound-force)
4-40 UNC stainless steel screw (See warning below on overtightening these screws.)	Mating connector: CON/KAD/0xx	0.4Nm (0.295 foot pound-force) When tightening the 4-40 UNC screws, turn each side alternately one turn until tightened.
2-56 UNC stainless steel screw (See warning below on overtightening these screws.)	Mating connector: 9-way, 51-way micro-miniature such as ACC/CON/008/04	0.28Nm (0.21 foot pound-force) When tightening the 2-56 UNC screws, turn each side alternately one turn until tightened.

WARNING: Do not overtighten the UNC screws. If the 4-40 UNC screws on the mating connectors have too much torque applied to them, they can damage the module by loosening the nut that holds the jack post in place. If you are using a torque screwdriver, apply the correct torque. If you do not have a torque screwdriver, tighten the screws firmly, but do not overtighten them. If the 2-56 UNC screws are overtightened, the screw head can be sheared off.



Inserting a module

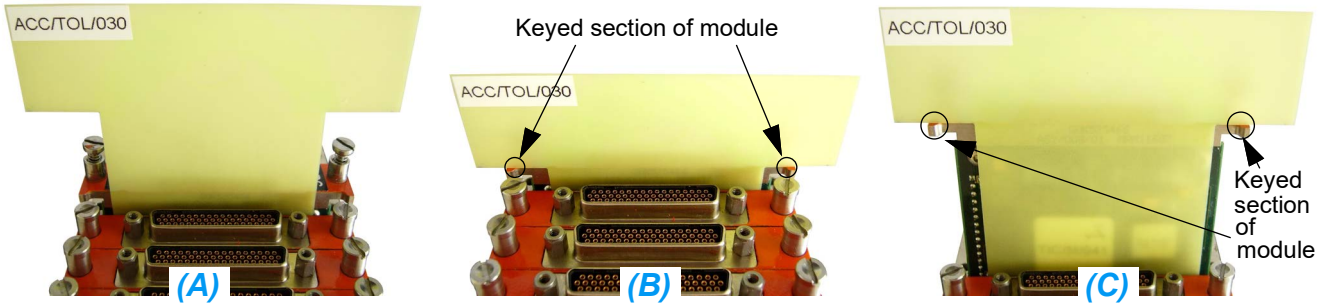
When inserting more than one module: in a KAM-500 chassis, start at the slot nearest J1 (power connector); in an SSR-500 chassis, start at the bottom of the chassis. Use an ACC/TOL/030 to prevent damage to adjacent modules.



1. Disconnect the power cable from the chassis.
2. Loosen adjacent module screws. This allows some “wriggle room” for the module you are inserting and should allow thumbscrews to be aligned with their threaded holes.
3. Place the ACC/TOL/030 alongside the module to be inserted ensuring the arms sit on the keyed section of the module top block (A).
4. With the module and ACC/TOL/030 perpendicular to the chassis and aligned with the chassis grooves (B), insert them into the chassis.
5. Carefully remove the ACC/TOL/030 (C), leaving the module in the slot.
6. Press the module firmly into the connector on the chassis.
7. Tighten the captive thumbscrews to torque 0.6Nm (0.44 foot pound-force).

Removing a module

When removing more than one module: from a KAM-500 chassis, start at the slot furthest from J1 (power connector); from an SSR-500 chassis, start at the top of the chassis.



1. Disconnect the power cable from the chassis.
2. Loosen adjacent module screws. This allows some “wriggle room” for the module you are removing.
3. Remove any cables/mating connectors from the module that you are removing.
4. Completely loosen the captive thumbscrews.
5. Holding the loosened thumbscrews, firmly pull the module upwards approximately 7mm (0.25 inch) to free it from the connector on the chassis. Care must be taken to avoid exerting lateral (sideways) force on the screws when extracting the module as this can result in bending of the screws.
6. Once the module is free from the chassis connector, slot the ACC/TOL/030 between the module to be removed and the adjacent module (A).
7. Ensure the ACC/TOL/030 is fully inserted so that the arms sit on the keyed section of the module top block (B).
8. Hold the ACC/TOL/030 and module perpendicular to prevent them touching adjacent modules as you remove them from the chassis (C).

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Introducing data sheets

Title of the data sheet

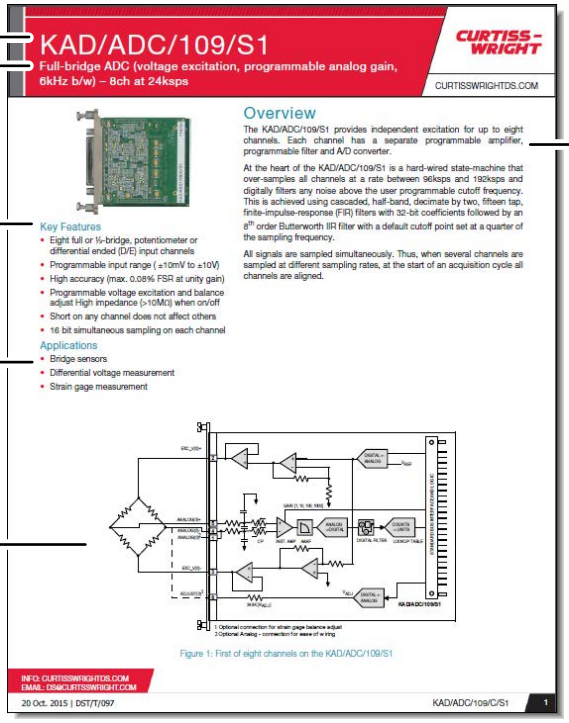
Unique description of the module

Key features, especially those that differentiate this product from other revisions

Suggested uses for the module

A block diagram of the module. It also shows, where possible, the essential pin numbers (for example, the first channel or bus)

A description of the module and its features



KAD/ADC/109/S1

Full-bridge ADC (voltage excitation, programmable analog gain, 6kHz b/w) – 8ch at 24ksps

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Overview

The KAD/ADC/109/S1 provides independent excitation for up to eight channels. Each channel has a separate programmable amplifier, programmable filter and A/D converter.

At the heart of the KAD/ADC/109/S1 is a hard-wired state-machine that over-samples all channels at a rate between 96ksps and 192ksps and digitally filters any noise above the user programmable cutoff frequency. This is achieved using cascaded, half-band, decimate by two, fifteen tap, finite-impulse-response (FIR) filters with 32-bit coefficients followed by an 8th order Butterworth IIR filter with a default cutoff point set at a quarter of the sampling frequency.

All signals are sampled simultaneously. Thus, when several channels are sampled at different sampling rates, at the start of an acquisition cycle all channels are aligned.

Key Features

- Eight full or ½-bridge, potentiometer or differential ended (D/E) input channels
- Programmable input range (±10mV to ±10V)
- High accuracy (max. 0.08% FSR at unity gain)
- Programmable voltage excitation and balance adjust High impedance (>10MΩ) when on/off
- Short on any channel does not affect others
- 16 bit simultaneous sampling on each channel

Applications

- Bridge sensors
- Differential voltage measurement
- Strain gage measurement

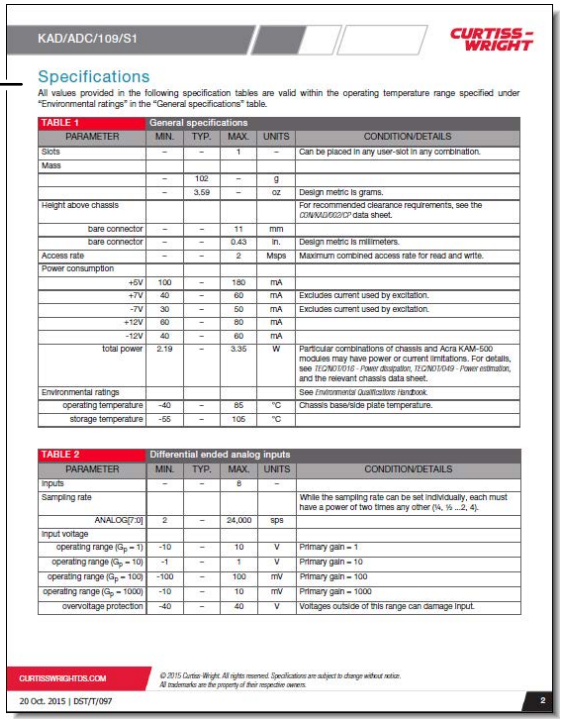
Figure 1: First of eight channels on the KAD/ADC/109/S1

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Details the specifications of the inputs and outputs for the module



KAD/ADC/109/S1

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under "Environmental ratings" in the "General specifications" table.

TABLE 1 General specifications

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	102	–	g	
	–	3.59	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements, see the *CONNXD/SSD/PD* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	100	–	180	mA	
+7V	40	–	60	mA	Excludes current used by excitation.
-7V	30	–	50	mA	Excludes current used by excitation.
+12V	60	–	80	mA	
-12V	40	–	60	mA	
total power	2.19	–	3.35	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TECN/0016 - Power dissipation*, *TECN/0049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualifications Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2 Differential ended analog inputs

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	8	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG[7:0]	2	–	24,000	sps	
Input voltage					
operating range (G_p = 1)	-10	–	10	V	Primary gain = 1
operating range (G_p = 10)	-1	–	1	V	Primary gain = 10
operating range (G_p = 100)	-100	–	100	mV	Primary gain = 100
operating range (G_p = 1000)	-10	–	10	mV	Primary gain = 1000
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.

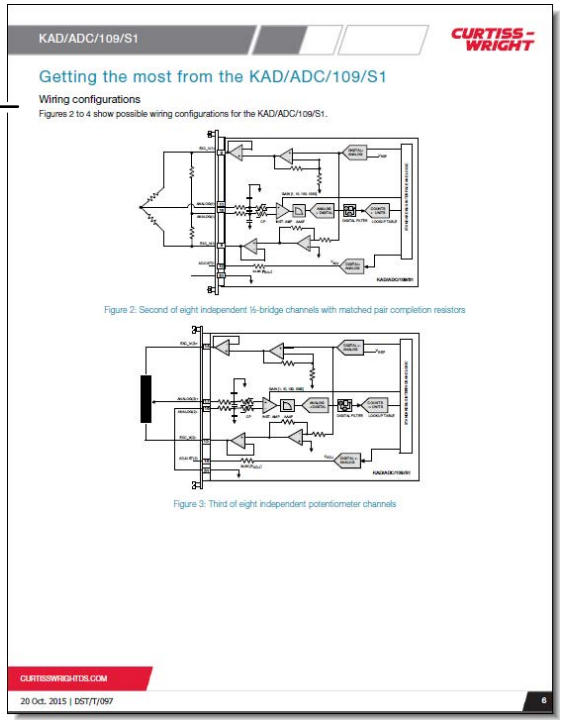
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2

Getting the most from is an informal discussion on how best to use the module. This section highlights common mistakes and answers some frequently asked questions



KAD/ADC/109/S1

Getting the most from the KAD/ADC/109/S1

Wiring configurations

Figures 2 to 4 show possible wiring configurations for the KAD/ADC/109/S1.

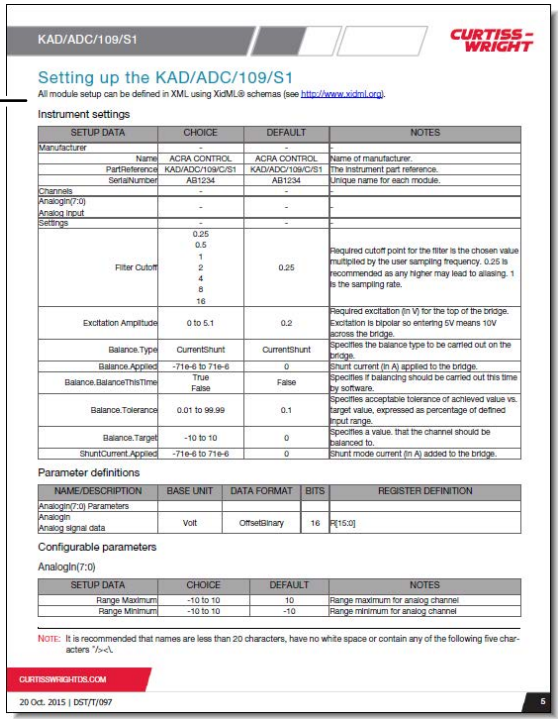
Figure 2: Second of eight independent ½-bridge channels with matched pair completion resistors

Figure 3: Third of eight independent potentiometer channels

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These tables show parameter, instrumentation, packages, and datalink setup information required or supplied by the module, in particular parameters to be read or written to the module and settings available within the module. For more details about XidML, see www.xidml.org



KAD/ADC/109/S1

Setting up the KAD/ADC/109/S1

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer			
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/109/C/S1	KAD/ADC/109/C/S1	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
AnalogIn(7:0)			
Analog Input	-	-	-
Settings	-	-	-
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.
Excitation Amplitude	0 to 5.1	0.2	Required excitation (in V) for the top of the bridge. Excitation is bipolar so entering 5V means 10V across the bridge.
Balance.Type	CurrentShunt	CurrentShunt	Specifies the balance type to be carried out on the bridge.
Balance.Applied	-71e-6 to 71e-6	0	Shunt current (in A) applied to the bridge.
Balance.BalanceThisTime	True False	False	Specifies if balancing should be carried out this time by software.
Balance.Tolerance	0.01 to 99.99	0.1	Specifies acceptable tolerance of achieved value vs. target value, expressed as percentage of defined input range.
Balance.Target	-10 to 10	0	Specifies a value. that the channel should be balanced to.
ShuntCurrent.Applied	-71e-6 to 71e-6	0	Shunt mode current (in A) added to the bridge.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
AnalogIn(7:0) Parameters				
AnalogIn Analog signal data	Volt	OffsetBinary	16	P[15:0]

Configurable parameters

AnalogIn(7:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-10 to 10	10	Range maximum for analog channel
Range Minimum	-10 to 10	-10	Range minimum for analog channel

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters '/>-<\.

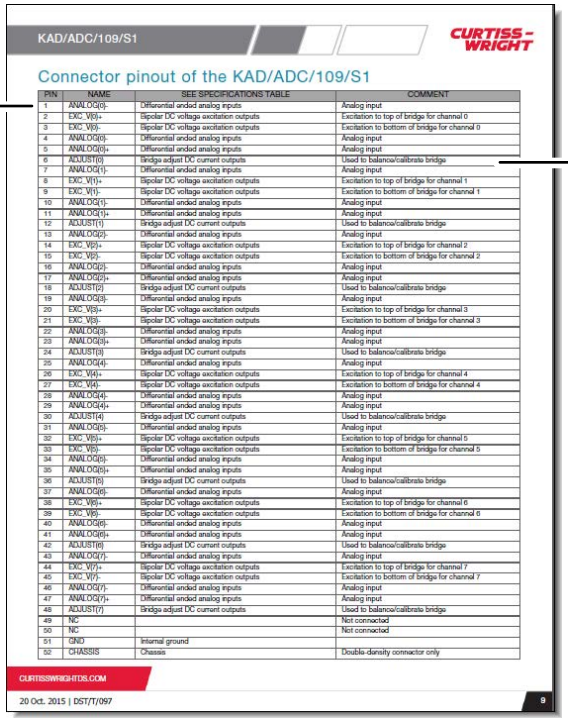
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Name and description of each connector pin. For more information refer to the "Equipment interface" section of the Acra KAM-500 Databook

Pins that are part of address/data busses or multiple channels have a bracketed number as suffix. These numbers always start

+ and - suffix always indicate a differential-ended pair


KAD/ADC/109/S1

Connector pinout of the KAD/ADC/109/S1

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	ANALOG(0)-	Differential ended analog inputs	Analog input
2	EXC_V(0)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 0
3	EXC_V(0)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 0
4	ANALOG(0)-	Differential ended analog inputs	Analog input
5	ANALOG(0)+	Differential ended analog inputs	Analog input
6	ADJUST(0)	Bridga adjust DC current outputs	Used to balance/calibrate bridge
7	ANALOG(1)-	Differential ended analog inputs	Analog input
8	EXC_V(1)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 1
9	EXC_V(1)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 1
10	ANALOG(1)-	Differential ended analog inputs	Analog input
11	ANALOG(1)+	Differential ended analog inputs	Analog input
12	ADJUST(1)	Bridga adjust DC current outputs	Used to balance/calibrate bridge
13	ANALOG(2)-	Differential ended analog inputs	Analog input
14	EXC_V(2)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 2
15	EXC_V(2)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 2
16	ANALOG(2)-	Differential ended analog inputs	Analog input
17	ANALOG(2)+	Differential ended analog inputs	Analog input
18	ADJUST(2)	Bridga adjust DC current outputs	Used to balance/calibrate bridge
19	ANALOG(3)-	Differential ended analog inputs	Analog input
20	EXC_V(3)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 3
21	EXC_V(3)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 3
22	ANALOG(3)-	Differential ended analog inputs	Analog input
23	ANALOG(3)+	Differential ended analog inputs	Analog input
24	ADJUST(3)	Bridga adjust DC current outputs	Used to balance/calibrate bridge
25	ANALOG(4)-	Differential ended analog inputs	Analog input
26	EXC_V(4)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 4
27	EXC_V(4)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 4
28	ANALOG(4)-	Differential ended analog inputs	Analog input
29	ANALOG(4)+	Differential ended analog inputs	Analog input
30	ADJUST(4)	Bridga adjust DC current outputs	Used to balance/calibrate bridge
31	ANALOG(5)-	Differential ended analog inputs	Analog input
32	EXC_V(5)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 5
33	EXC_V(5)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 5
34	ANALOG(5)-	Differential ended analog inputs	Analog input
35	ANALOG(5)+	Differential ended analog inputs	Analog input
36	ADJUST(5)	Bridga adjust DC current outputs	Used to balance/calibrate bridge
37	ANALOG(6)-	Differential ended analog inputs	Analog input
38	EXC_V(6)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 6
39	EXC_V(6)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 6
40	ANALOG(6)-	Differential ended analog inputs	Analog input
41	ANALOG(6)+	Differential ended analog inputs	Analog input
42	ADJUST(6)	Bridga adjust DC current outputs	Used to balance/calibrate bridge
43	ANALOG(7)-	Differential ended analog inputs	Analog input
44	EXC_V(7)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 7
45	EXC_V(7)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 7
46	ANALOG(7)-	Differential ended analog inputs	Analog input
47	ANALOG(7)+	Differential ended analog inputs	Analog input
48	ADJUST(7)	Bridga adjust DC current outputs	Used to balance/calibrate bridge
49	NC		Not connected
50	NC		Not connected
51	GND	Internal ground	
52	CHASSIS	Chassis	Double-density connector only

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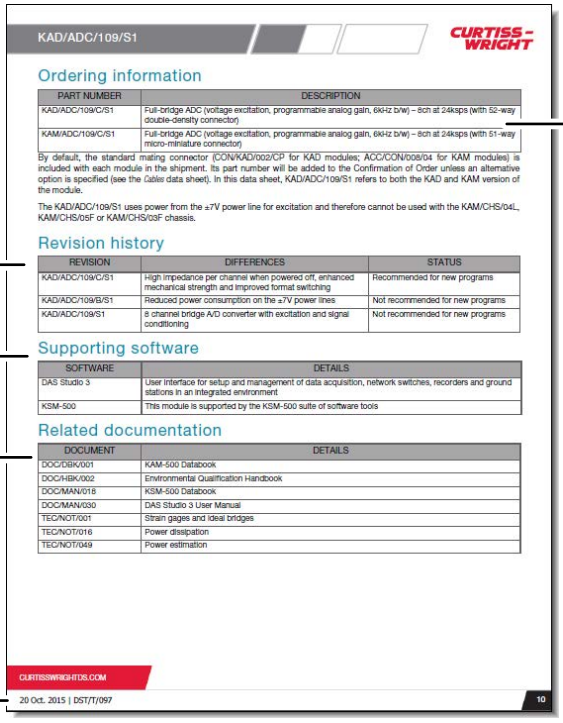
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Connector pinout comments are intended for the engineer responsible for wiring

The revision history lists the differences between this module and earlier revisions

Supporting software for the module

Related documentation for the module


KAD/ADC/109/S1

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/109/C/S1	Full-bridge ADC (voltage excitation, programmable analog gain, 6kHz b/w) – 8ch at 24ksps (with 52-way double-density connector)
KAM/ADC/109/C/S1	Full-bridge ADC (voltage excitation, programmable analog gain, 6kHz b/w) – 8ch at 24ksps (with 51-way micro-miniature connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; ACC/CON/008/04 for KAM modules) is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/ADC/109/S1 refers to both the KAD and KAM version of the module.

The KAD/ADC/109/S1 uses power from the ±7V power line for excitation and therefore cannot be used with the KAM/CHS/04L, KAM/CHS/05F or KAM/CHS/03F chassis.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/109/C/S1	High impedance per channel when powered off, enhanced mechanical strength and improved format switching	Recommended for new programs
KAD/ADC/109/B/S1	Reduced power consumption on the ±7V power lines	Not recommended for new programs
KAD/ADC/109/S1	8 channel bridge A/D converter with excitation and signal conditioning	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/001	Strain gages and ideal bridges
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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Document reference number

Ordering information addresses questions such as:

"Does this part come as standard when I order any other part?"

"What else do I need to order?"

"What ordering options are there?"

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Chassis and basic modules

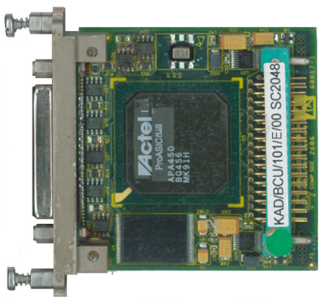
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KAD/BCU/101

IRIG-106 backplane controller and encoder

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Key Features

- 100% IRIG-106 compliant encoder
- Fully software programmable: Up to 10 PCM codes at up to 20 Mbps; 5 to 250K words per major frame and 5 to32K words per minor frame; 4 to 64 bits and parity (odd/even/none) programmable word by word
- Supports any sync word and sub-frame strategy
- ARINC-573/717 compatible output
- Can operate as a master or a slave in distributed system

Applications

- Encoding data in IRIG-106 Ch.4 PCM stream

Overview

The KAD/BCU/101 functions as two modules in one; an encoder and a backplane controller. The encoder is functionally identical to the KAD/ENC/005 and encodes data from any Acra KAM-500 module in an IRIG-106 Chapter 4 PCM stream.

Parameters to be transmitted are stored in pre-defined locations in RAM. Each parameter has a word definition that includes the bits per word, Most Significant Bit (MSB) (sent first or last), and parity. The encoder has differential ended RS-422 outputs for clock and data, along with buffered TTL outputs for NRZ-L and the bit/word/minor-frame/major-frame pulses. It also supports Cyclical Redundancy Checking (CRC) insertion at the end of minor frames.

Up to 15 formats (instruction sequences), can be stored at any time. Format selection is via four single ended discrete (0-5V) input pins on the I/O (Input/Output) connector. As up to 64 chassis can be programmed using a single programming link, there are also six discrete I/O pins to set a chassis number. These six inputs are pulled to ground internally if left open circuit.

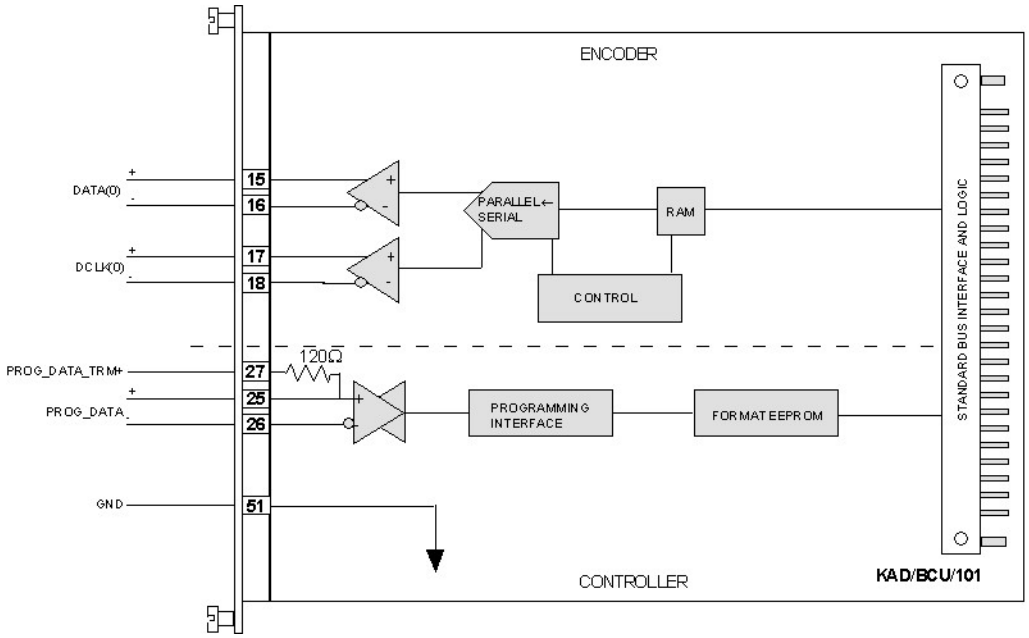


Figure 1: Encoder shown with differential ended PCM outputs only; controller shown with programming I/O only

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Use in controller slot only (J2).
Mass					
	–	75	–	g	
	–	2.65	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	261	–	950.4	mA	The maximum value shown here is when all PCM outputs are enabled. Disabling a PCM output reduces power consumption by 100 mA. (See “PCM encoder outputs” on page 11.)
±7V	0	–	0	mA	
+12V	0	–	8.8	mA	
-12V	0	–	0	mA	
total power	1.3	–	4.86	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	RS-422 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	1	–	
Signaling rate					
X_SYNC_IN	–	1	–	Mbps	

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TABLE 2	RS-422 inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Input voltage					
operating range	-7	–	12	V	Do not exceed operating range.
logic 0	–	–	-0.2	V	V_{IN+} - V_{IN-}.
logic 1	0.2	–	–	V	V_{IN+} - V_{IN-}.
overvoltage protection	-60	–	60	V	Voltages outside of this range can damage input.
ESD protection	-15	–	15	kV	Human Body Model.
Input resistance					
between inputs	–	270	–	kΩ	Module powered on.
between inputs	–	270	–	kΩ	Module powered off.
between inputs	–	120	–	kΩ	Module powered on and inputs terminated.
between inputs	–	120	–	kΩ	Module powered off and inputs terminated.
each input to GND	–	345	–	kΩ	Module powered on.
each input to GND	–	160	–	kΩ	Module powered off.

TABLE 3	BTTL inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	11	–	
Signaling rate					
FORMAT[3:0]	–	–	500	kHz	Must be stable for 8 µs before start of acquisition cycle.
CHASSIS_ID[5:0]	–	–	–	–	Is assumed never to change while powered on.
MEM-TRIGGER	–	–	1	MHz	Minimum pulse width, signal active high.
Input voltage					
operating range	0	–	5.5	V	
logic 0	–	–	0.8	V	
logic 1	2	–	–	V	
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.
Input resistance					
each input to GND	100	–	–	kΩ	Module powered on.
each input to GND	50	–	–	kΩ	Module powered off.

TABLE 4	High-speed RS-422 outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	8	–	
Signaling rate					
DATA[3:0]	–	–	20	Mbps	RZ, NRZ-L/M/S, RNRZ-L 15.
DATA[3:0]	–	–	8	Mbps	Biø-L/M/S, DM-M/S.
DCLK[3:0]	–	–	20	MHz	
Output voltage					
operating range	-15	–	20	V	
logic 0	–	–	-2	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
logic 1	2	–	–	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
short circuit current	–	–	250	mA	
short circuit duration	90	–	–	s	Only one output may be shorted at a time.
overvoltage protection	-27	–	27	V	
ESD protection	-5	–	5	kV	Human Body Model.
Output resistance	–	65	–	Ω	R_{LOAD} = 100Ω.

TABLE 5	Low-speed RS-422 outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	2	–	
Signaling rate					
X_SYNC_OUTA	–	1	–	Mbps	
X_SYNC_OUTB	–	1	–	Mbps	
Output voltage					
operating range	-7	–	12	V	
logic 0	–	–	-2	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
logic 11	2	–	–	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
short circuit current between outputs	–	–	66	mA	
short circuit current between output and GND	–	–	104	mA	
short circuit duration	∞	–	–	s	Only one output may be shorted at a time.
overvoltage protection	-60	–	60	V	
ESD protection	-15	–	15	kV	Human Body Model.
Output resistance	–	25	–	Ω	

TABLE 6	BVDD outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	1	–	
Range	4.8	5	5.1	V	
Current output					
compliance[1]	–	–	12	mA	For driving chassis and format lines.
short circuit current	–	–	23	mA	
short circuit duration	∞	–	–	s	To GND.
Output resistance	–	220	–	Ω	

1. Currents in excess of the maximum value result in output voltages below the minimum voltage required to be detected as a logic 1 for a standard BTTL input.

TABLE 7	BTTL outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	6	–	
Signaling rate					
DATA	–	–	16	Mbps	
DCLK	–	–	16	MHz	
NRZ_L	–	–	16	Mbps	
WORD_PULSE	–	–	16	MHz	High for last bit of any word.
MINOR_PULSE	–	–	4	MHz	High for last word of minor frame.
MAJOR_PULSE	–	–	4	MHz	High for last word of major frame.
Output voltage					
logic 0	–	–	0.2	V	Sinking 0.1 mA through 100Ω output resistance.
logic 1	4.8	–	–	V	Sourcing 0.1 mA through 100Ω output resistance.
short circuit current	–	–	50	mA	
short circuit duration	∞	–	–	s	To GND.
Output resistance	100	–	–	Ω	

TABLE 8	RS-485				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Channels	–	–	1	–	
Signaling rate					
PROG_DATA	–	–	1	Mbps	
Input voltage					
operating range	-7	–	12	V	
logic 0	–	–	-0.2	V	V_{IN+} - V_{IN-}.
logic 1	0.2	–	–	V	V_{IN+} - V_{IN-}.
overvoltage protection	-60	–	60	V	
ESD protection	-15	–	15	kV	Human Body Model.

TABLE 8	RS-485 (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Output voltage					
operating range	-7	–	12	V	
logic 0	–	–	-2	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
logic 1	2	–	–	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
short circuit current between outputs	–	–	66	mA	
short circuit current between output and GND	–	–	104	mA	
short circuit duration	∞	–	–	s	Only one output may be shorted at a time.
Input resistance					
between inputs	–	270	–	kΩ	Module powered on/off.
between inputs	–	120	–	kΩ	Module powered on/off and inputs terminated.
each input to GND	–	345	–	kΩ	Module powered on.
each input to GND	–	160	–	kΩ	Module powered off.
Output resistance	–	25	–	Ω	

TABLE 9	Synchronization specification				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Time accuracy					
instantaneous error	–	–	125	ns	After X-SYNC synchronization achieved to a KAM/TCG/102.
instantaneous error	–	–	250	ns	After X-SYNC synchronization achieved to a KAD/BCU/101.
Time to synchronize	0.2	–	4,000	ms	Up to two acquisition cycles.

Setting up the KAD/BCU/101

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/BCU/101/E	KAD/BCU/101/E	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Settings	-	-	-
DAU ID	0 to 63	0	An ID which identifies the DAU, typically set on DAU controllers such as CAIS and PCM controllers.
PCM Channel 1 Enable	True False	True	Enables PCM-OUT channel 1. (Electrical copy of Channel 0. See “PCM encoder outputs” section for further information.)
PCM Channel 2 Enable	True False	True	Enables PCM-OUT channel 2. (Electrical copy of Channel 0. See “PCM encoder outputs” section for further information.)
PCM Channel 3 Enable	True False	True	Enables PCM-OUT channel 3. (Electrical copy of Channel 0. See “PCM encoder outputs” section for further information.)
ARINC 717/573 Mode	True False	False	When enabled DCLK output becomes inverse of PCM output.
Shunt Mode	True False	False	Enable Shunt Mode. Used by modules supporting simulated shunt across their sensors.
Channels	-	-	-
PCM-OUT(3:0) PCM Output	-	-	IRIG 106 Chapter 4 PCM output.
Settings	-	-	-
Stream ID	00 to FFFFFFFF	FFFFFFFF	iNET-X stream ID for selected channel if a packet is generated via the assertion of Packetization Enabled. This setting is only supported in DAS Studio 3.
Packetization Enabled	True False	False	Enables the transmission via an iNET-X transmitter module (for example KAD/ETH/102) of an iNET-X packet containing the contents of this channel. This setting is only supported in DAS Studio 3.
PCM Code	NRZ-L NRZ-M NRZ-S DM-M DM-S Bi-Phase-L Bi-Phase-M Bi-Phase-S RNRZ-L-15 RZ	NRZ-L	Specifies the PCM encoding used.
Clock Phase	0 180	0	Indicates the phase of the data clock in degrees.

SETUP DATA	CHOICE	DEFAULT	NOTES
Polarity	True False	True	Specifies the polarity used to transmit, where True means that data is not inverted.
Bit Rate	500 to 20000000	6400000	Specifies the number of bits transmitted per second.
X_SYNC X_SYNC bi-directional	-	-	Chassis synchronization signal out.
Settings	-	-	-
Cable Length	0 to 20	0	The length of the cable carrying the X_SYNC signal in meters.
Delay	1 to 10	7	The delay on the X_SYNC signal in nano seconds/meter.
X_SYNC Inhibit	True False	False	Overrides chassis ID and sets module to be an X_SYNC slave rather than an X_SYNC master.
PROG RS-422 Input	-	-	Connection used to program the system configuration.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
IrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
TimeHi Time in hours and minutes at the start of the acquisition cycle.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
TimeLo Time in seconds and centiseconds at the start of the acquisition cycle.	Second	BCD	16	R[31:16] R(15) Reserved - Reserved for future use. R[14:8] Seconds - Seconds 0 to 59. R[7:0] Centiseconds - Centiseconds 0 to 99.
TimeMicro Time in microseconds at the start of the acquisition cycle.	Second	BCD	16	R[15:0] R[15:0] Microseconds - Microseconds 0 to 9999.
Status Present status of KAD/BCU/101.	BitVector	BitVector	16	R[15:0] R(15) Mem trigger status - MEM_TRIGGER pin status. 0: Not triggered. 1: Trigger active. R(13) X_SYNC in lock - X_SYNC in lock. 0: Not in lock. 1: In lock. R(11) X_SYNC Error - Errors in X_SYNC since last read. 0: X_SYNC Ok. 1: Error with X_SYNC signal. R[10:8] Reserved - Reserved for future use. R[7:4] Mode - Current mode. R[3:0] Reserved - Reserved for future use.
ReadCounter Increments every read.	Count	OffsetBinary	16	R[15:0]

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/BCU/101

The KAD/BCU/101 is divided into two parts; a backplane controller and a PCM encoder. The backplane controller organizes data transfer over the Acra KAM-500 backplane, and the PCM encoder encodes data in a PCM stream.

Backplane controller inputs and outputs

The KAD/BCU/101 has the following backplane controller inputs and outputs:

PROG_DATA±

This differential ended RS-485 bi-directional bus is for data transfer during programming (not terminated internally). The associated pins are electrically repeated on the connector to ease use in distributed systems.

CHASSIS_ID[5:0]

These six single ended BTTL inputs are for setting the chassis number in distributed systems. When left unconnected, these inputs set the chassis number to 0, which is the ID number for the master chassis in a distributed master/slave system. (See “Addressing multiple chassis” on page 13.)

Backplane controller and PCM encoder inputs

The following inputs affect both the backplane controller and the PCM encoder:

FORMAT[3:0]

These four single ended BTTL inputs are for setting the format (see “Understanding formats” on page 12). When left unconnected, these inputs set the format number to 0. After the format select lines change, the new format takes effect on the first bit of the first word of the next major frame. Fifteen formats are available (0_{16} to E_{16} in hexadecimal format; FORMAT(0) is the Least Significant Bit [LSB]).

X_SYNC_IN±

This differential ended RS-422 input is for a slave chassis (CHASSIS_ID[5:0] ≠ 0 in a distributed system) and is connected to the X_SYNC_OUT± of the X_SYNC generating unit. A synchronization sequence is transmitted at the end of each major frame to synchronize operation in a distributed system (see “Synchronization of multiple chassis” on page 13).

PCM encoder outputs

The KAD/BCU/101 has the following four PCM encoder outputs. These four outputs are electrical copies of each other; three of them can be disabled to save power consumption of 300 mA (100 mA each) on the 5 volt line.

DATA[3:0]±

These four differential ended outputs comprise three RS-422 outputs and a PCM coded data output. DATA(3) is internally terminated with a 120Ω resistor. DATA[3:1] can be disabled in software in order to reduce power consumption. As the RS-422 standard doesn't require termination at the driver, and because a new and improved RS-422 device is being used, DATA[2:0] are not internally terminated. DATA(3) is internally terminated with a 120Ω resistor for future use. DATA[3:1] are electrical copies of DATA(0).

DCLK[3:0]±

These are four differential ended RS-422 outputs. These differential Data CLocK (DCLK) signals consist of a transition at the start and center of each bit transmitted. DCLK(3) is internally terminated with a 120Ω resistor. DCLK[3:1] can be disabled in software in order to reduce power consumption. As the RS-422 standard doesn't require termination at the driver, and because a new and improved RS-422 device is being used, DCLK[2:0] are not internally terminated. DCLK(3) is internally terminated with a 120Ω resistor for future use. DCLK[3:1] are electrical copies of DCLK(0).DATA

This is a single ended BTTL output with 100Ω resistor in series.

DCLK

This is a single ended BTTL clock output with 100Ω resistor in series. It becomes the inverse of the DATA output when the module is configured to generate an ARINC-573/717 data stream.

WORD_PULSE

This is a single ended BTTL output with 100Ω resistor in series. It’s high for the last bit of each word. Its falling edge is aligned to the end of the last bit of each word.

MINOR_PULSE

This is a single ended BTTL output with 100Ω resistor in series. It’s high for the last word of each minor frame. Its falling edge is aligned to the end of the last bit of each minor frame.

MAJOR_PULSE

This is a single ended BTTL output with 100Ω resistor in series. It’s high for the last word of each major frame. Its

falling edge is aligned to the end of the last bit of each major frame.

Timing, bit-rates and commutation

The following figure shows examples of timing for NRZL and Bi-Phase L (BIØ-L). For maximum bit-rates and supported PCM transmission, see “Specifications” on page 4.

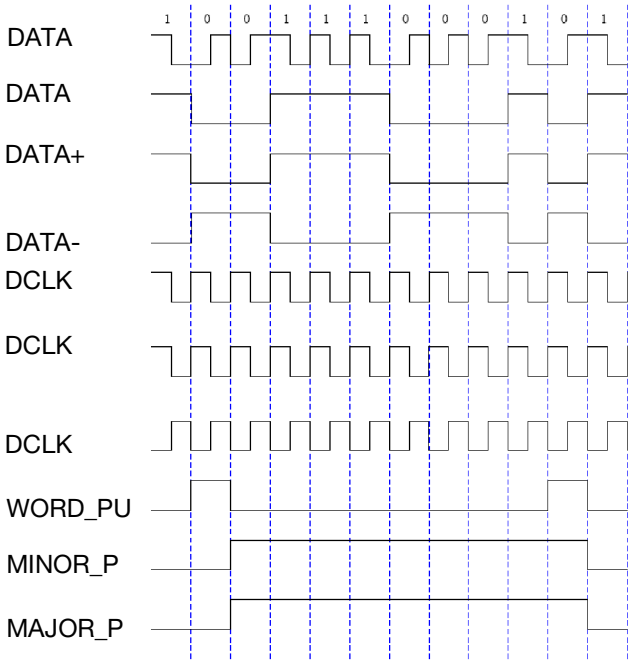


Figure 2: Timing for outputs

The KAD/BCU/101 allows variable word lengths and non-standard commutation (that is, samples of a specific parameter not evenly spaced in the PCM frame). To avoid difficulties with minimum word transit time, we recommend using a default word length (for example, 16 bits) and evenly spaced commutation.

Minimum word transmit time

The minimum word transmit time is 500 ns for the KAD/BCU/101. Therefore at 20Mbps the minimum word size is 10 bits (20Mbps × 500ns = 10 bits). In the example of a 16-bit parameter fragmented in a 2 × 12-bit subframe, the 4-bit LSB has also to be considered in the minimum word transmit time.

NOTE: Word size cannot go above 16 bits, therefore any sync word which is more then 16 bits is split into two words.

ARINC-573 setup

When the ARINC-573/717 mode of operation is selected, the DCLK output becomes the logical inverse of the DATA output and is used as the DATA- output for the ARINC-573/717 system. The DATA output is used as the DATA+ output for the ARINC-573/717 system.

Understanding formats

Formats are user-created configurations used by Acra KAM-500 equipment. They are designed using software tools and programmed into the hardware. Typical formats contain information about the following:

- PCM frame rate and PCM code used
- The number of bits per word
- The number of words per minor frame
- The number of minor frames in a major frame
- Parameters and sample rates for modules active in that format

In the format example in the following figure, a chassis contains one backplane controller and three data acquisition modules. All modules have six channels.

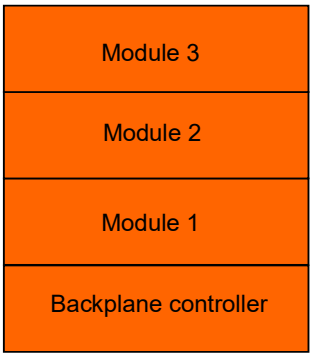


Figure 3: Format example

During a series of tests, there could be two distinct test scenarios.

Scenario 1

MinorFrame0	M1 Ch.1	M1 Ch.2	M1 Ch.3		M2 Ch.4	M2 Ch.5	M2 Ch.6	M3 Ch.4	M3 Ch.5	M3 Ch.6		Sync Pattern
MinorFrame 1	M1 Ch.1	M1 Ch.2	M1 Ch.3									Sync Pattern
MinorFrame 2	M1 Ch.1	M1 Ch.2	M1 Ch.3		M2 Ch.4	M2 Ch.5	M2 Ch.6	M3 Ch.4	M3 Ch.5	M3 Ch.6		Sync Pattern
MinorFrame 3	M1 Ch.1	M1 Ch.2	M1 Ch.3									Sync Pattern
MinorFrame 4	M1 Ch.1	M1 Ch.2	M1 Ch.3		M2 Ch.4	M2 Ch.5	M2 Ch.6	M3 Ch.4	M3 Ch.5	M3 Ch.6		Sync Pattern
MinorFrame 5	M1 Ch.1	M1 Ch.2	M1 Ch.3									Sync Pattern
MinorFrame 6	M1 Ch.1	M1 Ch.2	M1 Ch.3		M2 Ch.4	M2 Ch.5	M2 Ch.6	M3 Ch.4	M3 Ch.5	M3 Ch.6		Sync Pattern
MinorFrame 7	M1 Ch.1	M1 Ch.2	M1 Ch.3									Sync Pattern

M = Module; Ch. = Channel

Figure 4: Major frame structure (1)

In the scenario illustrated in the previous figure, the information of interest is as follows:

- Channels 1/2/3 on Module 1 sampled at 2048 sps
- Channels 4/5/6 on Module 2 and Module 3 sampled at 1024 sps

Scenario 2

MinorFrame0	M1 Ch.4	M1 Ch.5	M1 Ch.6	M3 Ch.5	M2 Ch.4	M2 Ch.5	M2 Ch.6	M3 Ch.5	Sync Pattern
MinorFrame 1				M3 Ch.5				M3 Ch.5	Sync Pattern
MinorFrame 2	M1 Ch.4	M1 Ch.4	M1 Ch.6	M3 Ch.5				M3 Ch.5	Sync Pattern
MinorFrame 3				M3 Ch.5				M3 Ch.5	Sync Pattern
MinorFrame 4	M1 Ch.4	M1 Ch.4	M1 Ch.6	M3 Ch.5	M2 Ch.4	M2 Ch.5	M2 Ch.6	M3 Ch.5	Sync Pattern
MinorFrame 5				M3 Ch.5				M3 Ch.5	Sync Pattern
MinorFrame 6	M1 Ch.4	M1 Ch.4	M1 Ch.6	M3 Ch.5				M3 Ch.5	Sync Pattern
MinorFrame 7				M3 Ch.5				M3 Ch.5	Sync Pattern

M = Module; Ch. = Channel

Figure 5: Major frame structure (2)

In the scenario illustrated in the previous figure, the information of interest is as follows:

- Channels 4/5/6 on Module 1 sampled at 1024 sps
- Channels 4/5/6 on Module 2 sampled at 512 sps
- Channel 5 on Module 3 sampled at 4096 sps

A separate format can be created for each of the above scenarios as in these examples:

(Scenario 1) Format 0 (FORMAT[3:0] = [0,0,0,0])

(Scenario 2) Format 1 (FORMAT[3:0] = [0,0,0,1])

The Acra KAM-500 system changes to the appropriate format if the format select lines equal one of these values. There are 15 available formats for user application.

Addressing multiple chassis

There are six chassis select lines permitting you to define any address from 0-63. Any slot can be used to distribute information to and from two additional chassis using the appropriate Curtiss-Wright equipment.

CHASSIS_ID[5:0] must be unique for each chassis in the distributed system, otherwise the system cannot be programmed or used correctly.

CHASSIS_ID[5:0] = 000000 is used to identify the master chassis.

Synchronization of multiple chassis

Synchronization of multiple chassis is achieved using X_SYNC. X_SYNC is a broadcast synchronization signal with a 1 µs resolution, transmitted by the X_SYNC source and received by all X_SYNC targets. X_SYNC contains information about the time, format used, and the start of the acquisition cycle.

The controller in the master chassis (CHASSIS_ID[5:0] = 0) generates X_SYNC if no other X_SYNC source is installed in the master chassis.

If an X_SYNC source is present in the master chassis, the KAD/BCU/101 in the master chassis acts as an X_SYNC slave, X_SYNC being provided by the alternative X_SYNC source.

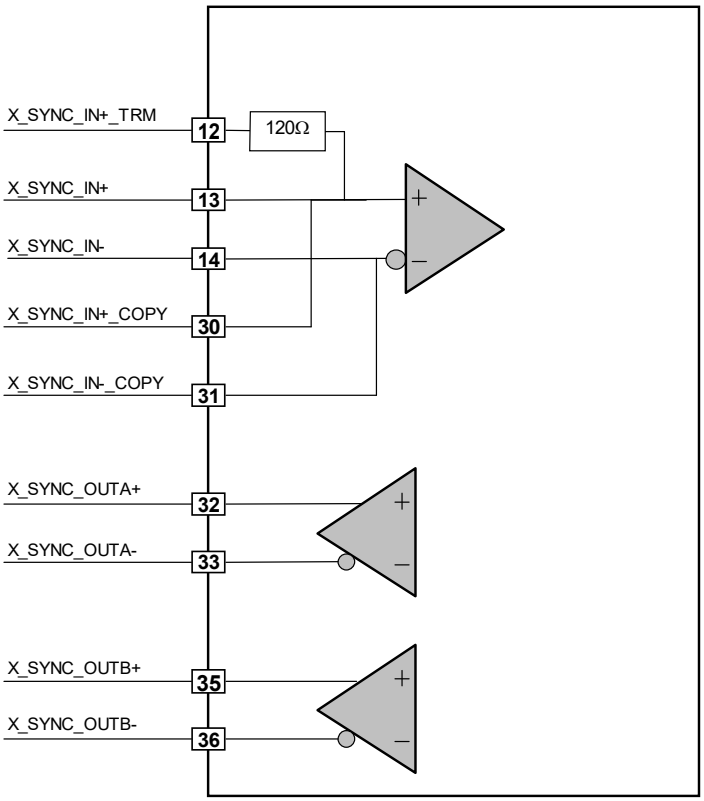


Figure 6: X_SYNC in the KAD/BCU/101

Considerations when implementing a distributed system

Distributed systems often have chassis separated by distances of many feet. Sending X_SYNC over these cables results in delays. To compensate for this, review the *Cables* data sheet for the cable used to determine the delay induced by that cable.

NOTE: To reduce crosstalk noise, we recommend using high quality, shielded twisted pair cabling between chassis.

The delay is calculated as cable length (feet) multiplied by delay parameter per foot. These details can be entered into the KSM-500 setup window when creating the distributed system format.

The resolution for the adjustment of X_SYNC is 125 ns. A maximum of 1.5 µs can be used as a delay. Consider the following scenarios:

Master with single slave scenario

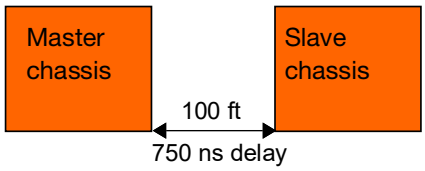


Figure 7: Master with single slave

In the previous figure, a master and slave chassis are separated by 100 feet of cable, and the cable has a propagation delay of 7.5 ns/foot. The delay in sending X_SYNC to the slave is 750 ns. In this case, the master acquisition cycle is delayed by 750 ns so that the slave and master trigger simultaneously.

Master with two slaves scenario

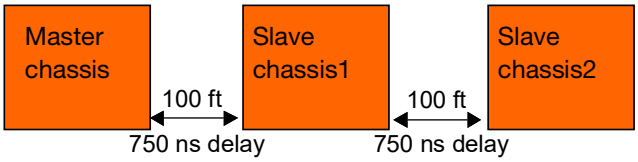


Figure 8: Master with two slaves

In the previous figure, a master and two slaves are each separated by 100 feet of cable, and the cable has a propagation delay of 7.5 ns/foot. The delay in sending X_SYNC to Slave chassis1 is 750 ns, and a further delay of 750ns in sending X_SYNC to Slave chassis2.

In this case, the master acquisition cycle is delayed by 2 × 750 ns = 1.5 µs, and the delay is programmed into Slave chassis1 as 750 ns so that both slaves and the master trigger simultaneously.

NOTE: X_SYNC_OUTB is an electronic copy of X_SYNC_OUTA.

Wiring termination

For help wiring the X_SYNC_IN_TRM+ and PROG_DATA_TRM+, see Figure 5, “Recommended wiring diagram for the distributed Acra KAM-500 system,” in the *Acra KAM-500 Databook*.

Memory recording trigger (MEM-TRIGGER)

The MEM-TRIGGER input controls the state of Mem Trigger Status (bit R[15]) in the Status register. This pin can be used to provide an external input to the Data Acquisition Unit, allowing memory modules to be triggered by an operator-controlled switch or external circuitry.

CRC generation

The KAD/BCU/101 supports insertion of CRC at the end of every minor frame (CRC generation is supported in KSM-500 only).

The KAD/BCU/101 only supports CRC insertion when using a CRC-CCITT (Comité Consultatif International de Télégraphique et Téléphonique) polynomial with the following specifications:

- Width = 16 bits
- Truncated polynomial = 0x1021
- Initial value = 0xFFFF
- Input data is not reflected
- Output CRC is not reflected
- No XOR (eXclusive OR) is performed on the output CRC

Connector pinout of the KAD/BCU/101

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	FORMAT(0)	BTTL inputs	Format select line; internally pulled to 0; LSB
2	FORMAT(1)	BTTL inputs	Format select line; internally pulled to 0
3	FORMAT(2)	BTTL inputs	Format select line; internally pulled to 0
4	CHASSIS_ID(0)	BTTL inputs	Chassis identifier/address; internally pulled to 0; LSB
5	CHASSIS_ID(1)	BTTL inputs	Chassis identifier/address; internally pulled to 0
6	CHASSIS_ID(2)	BTTL inputs	Chassis identifier/address; internally pulled to 0
7	CHASSIS_ID(3)	BTTL inputs	Chassis identifier/address; internally pulled to 0
8	FORMAT(3)	BTTL inputs	Format select line; internally pulled to 0; MSB
9	GND	Internal ground	
10	BVDD	BVDD outputs	5V buffered with 220Ω resistor; used to set FORMAT and CHASSIS_ID
11	MEM-TRIGGER	BTTL inputs	Trigger for memory recording; internally pulled to 0
12	X_SYNC_IN_TRM+	RS-422 inputs	Synchronization in; with internal 120Ω resistor
13	X_SYNC_IN+	RS-422 inputs	Synchronization in; not internally terminated
14	X_SYNC_IN-	RS-422 inputs	Synchronization in; not internally terminated
15	DATA(0)+	High-speed RS-422 outputs	PCM output 0
16	DATA(0)-	High-speed RS-422 outputs	PCM output 0
17	DCLK(0)+	High-speed RS-422 outputs	Bit clock for PCM output 0
18	DCLK(0)-	High-speed RS-422 outputs	Bit clock for PCM output 0
19	WORD_PULSE	BTTL outputs	High for last bit of word
20	MINOR_PULSE	BTTL outputs	High for last word of minor frame
21	MAJOR_PULSE	BTTL outputs	High for last word of major frame
22	DATA	BTTL outputs	PCM output or DATA+ for ARINC-573 out
23	DCLK	BTTL outputs	Bit clock for PCM or DATA- for ARINC-573 out
24	NRZ_L	BTTL outputs	Uncoded PCM output
25	PROG_DATA+	RS-485	Programming data line; not internally terminated
26	PROG_DATA-	RS-485	Programming data line; not internally terminated
27	PROG_DATA_TRM+	RS-485	Programming data line; with internal 120Ω resistor
28	PROG_DATA+_COPY	RS-485	Copy of Pin 25
29	PROG_DATA-_COPY	RS-485	Copy of Pin 26
30	X_SYNC_IN+_COPY	RS-422 inputs	Copy of Pin 13
31	X_SYNC_IN-_COPY	RS-422 inputs	Copy of Pin 14
32	X_SYNC_OUTA+	Low-speed RS-422 outputs	Synchronization out; internally terminated with 120Ω
33	X_SYNC_OUTA-	Low-speed RS-422 outputs	Synchronization out; internally terminated with 120Ω
34	DATA(1)+	High-speed RS-422 outputs	PCM output 1
35	X_SYNC_OUTB+	Low-speed RS-422 outputs	Synchronization out; internally terminated with 120Ω
36	X_SYNC_OUTB-	Low-speed RS-422 outputs	Synchronization out; internally terminated with 120Ω
37	CHASSIS_ID(4)	BTTL inputs	Chassis identifier/address; internally pulled to 0
38	CHASSIS_ID(5)	BTTL inputs	Chassis identifier/address; internally pulled to 0; MSB
39	DATA(1)-	High-speed RS-422 outputs	PCM output 1
40	DCLK(1)+	High-speed RS-422 outputs	Bit clock for PCM output 1
41	DCLK(1)-	High-speed RS-422 outputs	Bit clock for PCM output 1
42	DATA(2)+	High-speed RS-422 outputs	PCM output 2
43	DATA(2)-	High-speed RS-422 outputs	PCM output 2
44	DCLK(2)+	High-speed RS-422 outputs	Bit clock for PCM output 2
45	DCLK(2)-	High-speed RS-422 outputs	Bit clock for PCM output 2
46	DATA(3)+	High-speed RS-422 outputs	PCM output 3; internally terminated with 120Ω
47	DATA(3)-	High-speed RS-422 outputs	PCM output 3; internally terminated with 120Ω
48	DCLK(3)+	High-speed RS-422 outputs	Bit clock for PCM output 3; internally terminated with 120Ω
49	DCLK(3)-	High-speed RS-422 outputs	Bit clock for PCM output 3; internally terminated with 120Ω
50	CHASSIS	Chassis	
51	GND	Internal ground	
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/BCU/101/E	IRIG-106 backplane controller and encoder (with 52-way double-density connector)
KAM/BCU/101/E	IRIG-106 backplane controller and encoder (with 51-way micro-miniature connector)

For KAD module orders, one ACC/ASY/022/C programming cable is included with each order, while a standard mating connector, CON/KAD/002/CP, is included with each KAD module in the order. For KAM module orders, one ACC/ASY/021/04 programming cable is included with each module in the order, while a standard mating connector, ACC/CON/008/04, is included with each KAM module in the order. Their part numbers will be added to the Confirmation of Order unless an alternative is specified (see the *Cables* data sheet). In this data sheet, KAD/BCU/101 refers to both the KAD and KAM versions of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/BCU/101/E	Improved noise immunity on X_SYNC lines	Recommended for new programs
KAD/BCU/101/D	Increased allowable bit rates and added a read counter; supports CRC insertion at the end of minor frames	Not recommended for new programs
KAD/BCU/101/C	Extended common mode drivers for PCM and X_SYNC	Not recommended for new programs
KAD/BCU/101/B	Supports ADC/005 programming (requires kProgram 1.6 or later) and supports distributed system with external synchronization	Not recommended for new programs
KAD/BCU/101	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/024	Evolution of Pulse Code Modulation
TEC/NOT/027	IRIG 106-96 Chapter 4
TEC/NOT/049	Power estimation

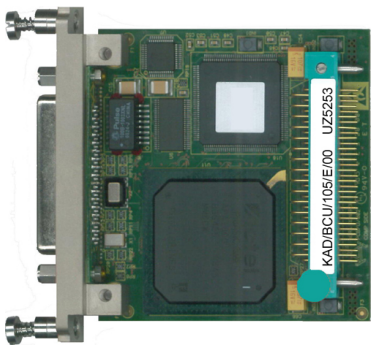
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/BCU/105

Ethernet backplane controller - IENA compatible

CURTISSWRIGHTDS.COM



Key Features

- Single 100BaseTx Ethernet channels
- Fixed user-assigned IP address
- Responds to ARP and PING messages
- Programs and verifies Acra KAM-500 hardware
- Synchronization with PTPv1 Grandmaster
- Jumbo packet support, up to 64Kbyte

Applications

- Ethernet based data acquisition systems

Overview

The KAD/BCU/105 is a full-duplex 100BaseTX Ethernet Acra KAM-500 backplane controller, programmer, and IPv4 packet generator. Its Ethernet interface supports auto sensing with a link speed of 100BaseTX. The IPv4 packet generator has IP fragmentation support.

In acquisition mode some or all acquired data is transferred from the backplane to the onboard CVT. Onboard, it is packetized into a user-defined structure. Once full, the packet is transmitted via UDP.

Any number of user-defined IENA packet structures can be handled simultaneously. Different packet identifiers, packet sizes and destination IP addresses can be individually programmed for each packet type. Destination IP addresses can be unicast, multicast, or broadcast.

Upon reception of a programming packet, the module immediately exits acquisition mode and switches to program/verify mode. In program/verify mode it can read or write data blocks to or from any module within an Acra KAM-500 chassis.

The Acra KAM-500 backplane controller supports chassis programming via Ethernet. Synchronization is achieved using an external IEEE 1588-2004 Precision Time Protocol version 1 (PTPv1) source.

The KAD/BCU/105 supports IPv4 networks with fixed IP address allocation, including user-assignment of the module's IP address. The module is factory-programmed with a unique Ethernet MAC address.

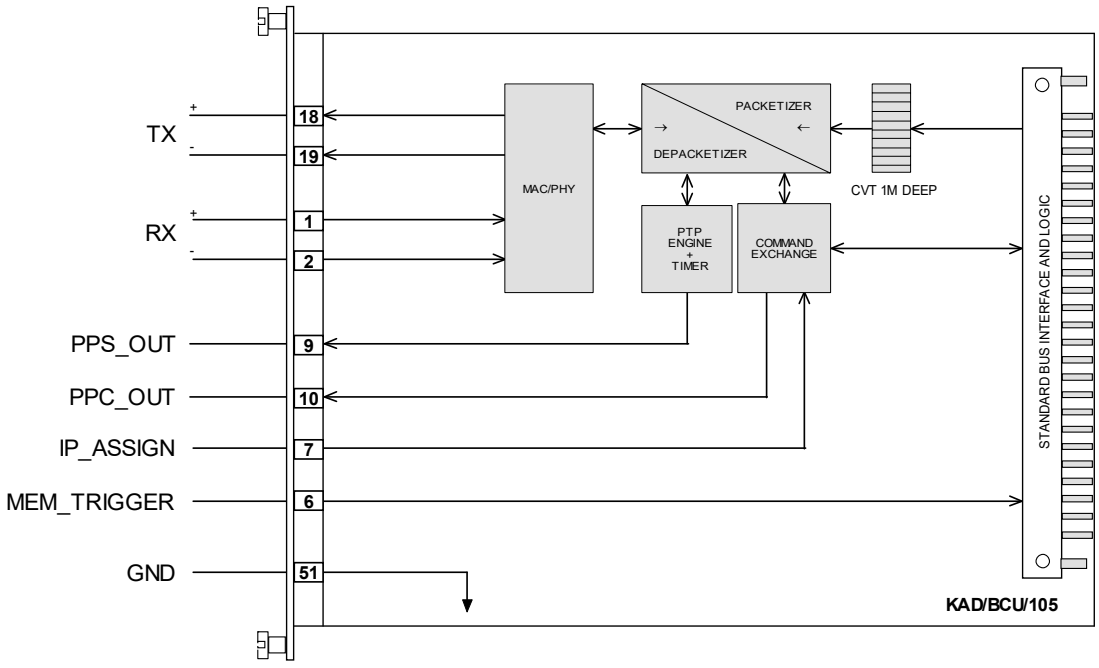


Figure 1: Ethernet interface, PPS and PPC outputs, MEM Trigger and IP Assign inputs of the KAD/BCU/105

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Use in controller slot only (J2).
Mass					
	–	75	–	g	
	–	2.65	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate over the backplane for read and write.
Power consumption					
+5V	311	–	414	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	1.55	–	2.07	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Synchronization specification				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Time accuracy					Measured over the full operating temperature range with temperature changing at up to 1°C per minute.
mean error	–	200	350	ns	Mean of PPS errors calculated over +/-60 seconds from any reading.
error within 500ns	99.5	100	100	%	
instantaneous error	–	0.1	1.5	µs	After synchronization is achieved, with no loss of connection to Grandmaster.
Time to synchronize					Measured from a power-up of the test chassis, using a Meinberg M600 IEEE 1588 Grandmaster, supplying PTPv1 messages to the KAD/BCU/105 via OnTime T208 switch, configured in IEEE 1588 transparent mode.
1µs	–	39	–	s	
250ns	–	52	–	s	

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TABLE 3	BTTL inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	2	–	
Input voltage					
operating range	0	–	5.5	V	
logic 0	–	–	0.8	V	
logic 1	2	–	5.5	V	
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.
Input resistance					
each input to GND	–	41	–	kΩ	Module powered on.
each input to GND	–	41	–	kΩ	Module powered off.

TABLE 4	BTTL outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	2	–	
Signaling rate					
PPS_OUT	–	–	1	Hz	
Output voltage					
logic 0	–	–	0.44	V	Sinking 24mA.
logic 1	3.76	–	–	V	Sourcing 24mA.
short circuit current	–	–	50	mA	
short circuit duration	∞	–	–	s	To GND.
Output resistance	–	121	–	Ω	

TABLE 5	BVDD outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	1	–	
Range	4.8	5	5.1	V	
Current output					
compliance[1]	–	–	12	mA	
short circuit current	–	–	23	mA	
short circuit duration	∞	–	–	s	To GND.
Output resistance	–	211	–	Ω	

1. Currents in excess of the maximum value shown will result in output voltages below the minimum voltage required to be detected as a logic 1 for a standard BTTL input.

TABLE 6	Ethernet interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs/outputs	–	–	1	–	IEEE 802.3 compatible -100BaesTX operation only.

Setting up the KAD/BCU/105

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/BCU/105/E	KAD/BCU/105/E	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Settings	-	-	-
Is Leap Year	False True	False	Specifies if the current year is a leap year.
Channels	-	-	-
Ethernet Ethernet Output	-	-	Represents a typical Ethernet channel on a networked device
Settings	-	-	-
IP Address	0.0.0.0 to 255.255.255.255	192.168.2.1	Specifies the IP Address of the instrument
PPSOut TTL Output	-	-	Pulse per second.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
DayOfYear Day of Year, 1-365 in normal years, 1-366 in leap years	BitVector	BitVector	16	R[15:0] R[15:10] Reserved R[9:0] DayOfYear - Day of Year 1 to 366.
IrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
TimeHi Hours and minutes at the start of the acquisition cycle.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
TimeLo Seconds and centiseconds at the start of the acquisition cycle.	Second	BCD	16	R[31:16] R(15) Reserved R[14:8] Seconds - Seconds 0 to 59. R[7:0] Centiseconds - Centiseconds 0 to 99.
TimeMicro Microseconds at the start of the acquisition cycle.	Second	BCD	16	R[15:0] R[15:0] Microseconds - Microseconds 0 to 9999.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Report Report status of module.	BitVector	BitVector	16	R[15:0] R(15) Event - Event occurred since last read R(14) Programming - Module in Programming mode R(13) IP Configuration - Module in IP Configuration mode R(12) BIST - Module in BIST mode R[11:10] Reserved - Reserved for future use R(9) EEPROM failure - Configuration reading failure. This indicates a hardware error detected on the module. R(8) Invalid configuration - Invalid configuration. The module has been programmed with an EEPROM image that cannot produce a valid acquisition cycle. R(7) Rx Error - Unexpected Ethernet frame received. An Ethernet frame was received that was invalid in some way. R(6) Rx Overflow - Ethernet receive buffer overflow. The module is receiving packets faster than they can be processed. Packets which can cause this include those addressed to the broadcast MAC address, the module's own MAC address, or the PTP multicast MAC address. R(5) BIST failed - BIST failed. A '1' here indicates that the built-in self-test has detected an error in the module's RAM. R(4) Watchdog timeout - Watchdog timeout. A '1' here indicates that the module has failed, and has been reset by the internal watchdog timer. This also interrupts the acquisition cycle. R(3) RAM error - Internal memory access error. R(2) Memory overflow - Memory overflow. The module was delayed in sending an Ethernet frame, with the result that there was insufficient memory for acquired data. R(1) Time Source Lost - Missed more than five consecutive PTP packets R(0) Out Of Synch - On the last update PTP error was greater than 500 ns
Status Reports status of memory trigger pin	BitVector	BitVector	16	R[15:0] R[14:0] Reserved - Reserved for future use R(15) MemTrigger - MEM_TRIGGER pin status

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/BCU/105

The Ethernet cabling standard (EIA/TIA-568-B) recommends the use of Category 5 cable.

Achieving a full-duplex link

Ethernet connection between two link partners can be established via auto-negotiation or by forcing them into fixed speeds.

NOTE: During auto-negotiation, both the speed and the duplex capability can be successfully detected and the link can be configured to full-duplex operation. If either of the partners is in forced link speed, then the link is established using the parallel detection algorithm, which does not recognize the difference between full and half-duplex. In this scenario, the link defaults to half-duplex mode. This scenario applies to both 10BaseT and 100BaseT.

NOTE: In a half-duplex link, where simultaneous transmitting and receiving is taking place, packet drops occur. Therefore, to achieve a full-duplex link, it is important to ensure the partner connected to a fixed speed module such as the KAD/BCU/105/E, is also configured to be in the corresponding fixed mode speed.

User-assignment of IP address

Unlike the KAD/ETH/101, the KAD/BCU/105 does not have a 32-bit top-block pin-out, which enables the module's IP address to be hard-wired. Instead, the KSM-500 software is used to configure the module with a user-assigned IP address. The mechanism works as follows:

A top-block pin (pin#7 = IP_ASSIGN) is connected to BVDD to put the module into IP Assign mode. When in this mode, the module will assume a default hard-wired IP address. The IP address 239.0.0.0 is used, as it is an administratively scoped IP multicast address (defined by IETF RFC2365), within the local network control block of addresses. It can be used to transmit packets to a network element using a multicast Ethernet MAC address (01-00-5E-00-00-00), and is limited to the local network, such that it will not be forwarded by a router.

An IP address configuration packet is sent to the module for the purpose of configuring the module with a user-assigned IP address. The user-assigned IP address is stored in EEPROM on the module for subsequent reference.

The KAD/BCU/105 module is then released from IP address configuration mode by removing BVDD from top-block pin#7.

NOTE: Only one module on the network should be set to IP Assign mode at any time. This prevents other KAD/BCU/105 modules from simultaneously processing the configuration packets and thus mistakenly acquiring the same user-assigned IP address.

Once an IP address has been configured, the KAD/BCU/105 responds to ARP requests searching for the MAC address of that IP address.

NOTE: The KAD/BCU/105 does not respond to Unicast-ARP Requests. That is, Broadcast-ARP must be used.

Internet Group Management Protocol

The KAD/BCU/105 uses Internet Group Management Protocol version 2 (IGMPv2) to inform switches that it wishes to receive PTP messages. If a switch between the KAD/BCU/105 and the PTP Grandmaster uses IGMP to control multicast traffic, the KAD/BCU/105 will not start synchronizing to the PTP Grandmaster until after it receives, and responds to, an IGMP query from the switch. To minimize this delay, the KAD/BCU/105 will periodically send unsolicited IGMP join requests if it does not receive any PTP messages.

Packet fragmentation

Ethernet packet sizes range between 64 bytes and 1518 bytes. Ideally, application data packets are designed to fit, with their headers, in 1518-byte Ethernet packets. Packets larger than this can be transmitted over Ethernet by high level protocols such as IP, but they get fragmented (split into smaller pieces). Fragmented packets must then be reassembled by the receiving device to recreate the original IP packet. Packet fragmentation is undesirable for the following reasons:

- Fragments may arrive out of order and complicate reassembly of the data.
- Fragments may be lost, rendering all other fragments of the frame useless.
- The process of fragmenting and reassembling the data is time-consuming.

NOTE: Switches and routers which support IEEE 802.1Q VLAN tagging support Ethernet packets of up to 1522 bytes, including the 4-byte IEEE 802.1Q VLAN tag.

Networked Acra KAM-500 system and acquisition cycles

In a networked data acquisition system, all chassis with KAD/BCU/105 controllers are able to acquire data synchronously by synchronizing their acquisition cycles using

PTPv1. A requirement is that the length of acquisition cycle is an integer divisor of two seconds and the maximal length of acquisition cycle is two seconds. If the KAD/BCU/105 has to adjust it's clock by more than 500µs, data acquisition ceases until the next two-second boundary. This happens once after power-up and once when the module synchronizes with a time master. If a memory module, such as the KAM/MEM/103, in the Acra KAM-500 chassis is configured to Always Log, it records this adjustment as an event.

The following table lists all possible acquisition cycle frequencies.

0.5	2.5	12.5	62.5	312.5	1562.5
1	5	25	125	625	3125
2	10	50	250	1250	6250
4	20	100	500	2500	
8	40	200	1000	5000	
16	80	400	2000	10000	
32	160	800	4000		
64	320	1600	8000		
128	640	3200			
256	1280	6400			
512	2560				

To get the most from networked Acra KAM-500 data acquisition systems, it is essential that PTPv1 Ethernet switches are used. For a list of suitable switches, contact Curtiss-Wright support (acra-support@curtisswright.com).

PTP restrictions

By default, a PTP Grandmaster sends sync messages at two-second intervals. Although the protocol allows for sync message intervals of between one and 64 seconds, intervals should not be above two seconds. The KAD/BCU/105 has been designed based on sync messages arriving at two-second intervals. If it was to accept a Grandmaster with a longer sync interval, clock drift between sync messages would degrade the clock accuracy of the KAD/BCU/105. When time on a KAD/BCU/105 changes by more than 500µs, the KAD/BCU/105's acquisition cycle is halted for up to two seconds. This means, for example, when a Grandmaster switches between GPS/IRIG time sources or entering/exiting free running mode, synchronization is lost, and the KAD/BCU/105 stops sending packets for up to two seconds whilst it resynchronizes. The sequence number of the first packet transmitted after resynchronization is reset to zero.

The KAD/BCU/105 ignores a PTP Grandmaster if it sends messages more than four seconds apart.

Mid-year leap seconds and IENA time

PTP time is based on the time recorded by atomic clocks, such as the time signal from GPS satellites. This is more accurate than Coordinated Universal Time (UTC), on which terrestrial clocks are based, because the rotation of the earth varies slightly. For this reason, UTC is occasionally adjusted by lengthening or shortening the last minute of a month by one second. Of the 24 leap seconds that were added from 1972 to 2008, most were conveniently applied at the end of the last minute of the year. However, nine occurred on the 31st of June in various years.

The PTP Grandmaster reports the number of seconds by which UTC currently differs from PTP time, but not whether any of them has happened since this year began.

A problem arises when the KAD/BCU/105 is started after a leap second has occurred during the current year. IENA time is based on the start of the current year in UTC. This means the KAD/BCU/105 must calculate when the current year began.

If the KAD/BCU/105 starts to synchronize with a Grandmaster in the second half of a year, it does not know whether a leap second was applied in June of the current year. For this reason, the KAD/BCU/105 always calculates the start of the current year by assuming every hour since the start of the year has had 3,600 seconds.

Connector pinout of the KAD/BCU/105

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	RX+	Ethernet interface	Ethernet interface
2	RX-	Ethernet interface	Ethernet interface
3	GND	Internal ground	
4	BVDD	BVDD outputs	5V; internally buffered with 220Ω resistor
5	CHASSIS	Chassis	
6	MEM_TRIGGER	BTTL inputs	Trigger for memory recording; internally pulled to 0
7	IP_ASSIGN	BTTL inputs	IP Assign mode; internally pulled to 0
8	DNC		Do not connect
9	PPS_OUT	BTTL outputs	One pulse per second
10	PPC_OUT	BTTL outputs	One pulse per acquisition cycle
11	DNC		Do not connect
12	DNC		Do not connect
13	DNC		Do not connect
14	DNC		Do not connect
15	GND	Internal ground	
16	DNC		Do not connect
17	DNC		Do not connect
18	TX+	Ethernet interface	Ethernet interface
19	TX-	Ethernet interface	Ethernet interface
20	CHASSIS	Chassis	
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/BCU/105/E	Ethernet backplane controller - IENA compatible

By default, one ACC/ASY/023/C cable is included with each order, while a standard mating connector, CON/KAD/002/CP, is included with each module in the order. Their part numbers will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). Additional items must be ordered separately; refer to Related Products for options.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/BCU/105/E	Improved IRIG time sync after power-up	Recommended for new programs
KAD/BCU/105/D	Improved PTPv1 synchronization with third party boundary clocks	Not recommended for new programs
KAD/BCU/105/C	Improved synchronization at varying temperatures; improved randomization of PTP messages to avoid flooding switches	Not recommended for new programs
KAD/BCU/105/B	First release	Not recommended for new programs

Supporting software

MODULE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related products

MODULE	DETAILS
NET/CON/002	1.5m female micro-miniature, circular connector to KAD Ethernet cable

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/032	Using Ethernet for data acquisition
TEC/NOT/049	Power estimation
TEC/NOT/053	Using the KAD/BCU/105

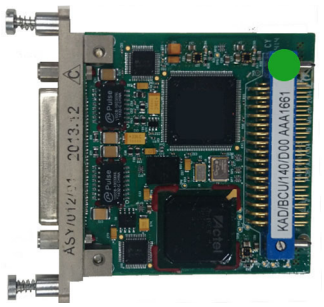
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/BCU/140

Ethernet backplane controller - IENA/iNET-X compatible, PTPv1 client or Grandmaster, PTPv2 client, dual Ethernet output

CURTISSWRIGHTDS.COM



Key Features

- Bi-directional, full-duplex Ethernet connection with auto-sensing
- Mirrored Ethernet output supporting redundant IENA and iNET-X transmission
- IENA and iNET-X compatible packetization structures
- Supports aperiodic transmission
- Synchronization with a network time source using PTPv1 or PTPv2 or acts as PTPv1 Grandmaster
- Programming and verification of Acra KAM-500 chassis using TFTP

APPLICATIONS

- Ethernet based data acquisition systems

Overview

The KAD/BCU/140 is a full-duplex, Ethernet, Acra KAM-500 backplane controller packet programmer and an IPv4 data packets transmitter (via a 100BaseTX link interface).

The Acra KAM-500 backplane controller supports chassis programming via Ethernet using Trivial File Transfer Protocol (TFTP). Synchronization with an external PTPv1 Grandmaster is achieved using IEEE Std.1588-2004 (PTPv1) or IEEE Std. 1588-2008 (PTPv2).

Upon receipt of a programming packet, the module immediately exits acquisition mode and switches to program/verify mode.

In acquisition mode, some or all acquired data is transferred from the backplane to the onboard CVT. Onboard, it is packetized into either an IENA or an iNET-X application layer packet. Assembled packets are transmitted simultaneously on both Ethernet outputs. For asynchronous bus data, the KAD/BCU/140 supports aperiodic transmission for efficient bandwidth use, whereby a packet is not generated if no fresh data has been acquired from a packetizer user-module.

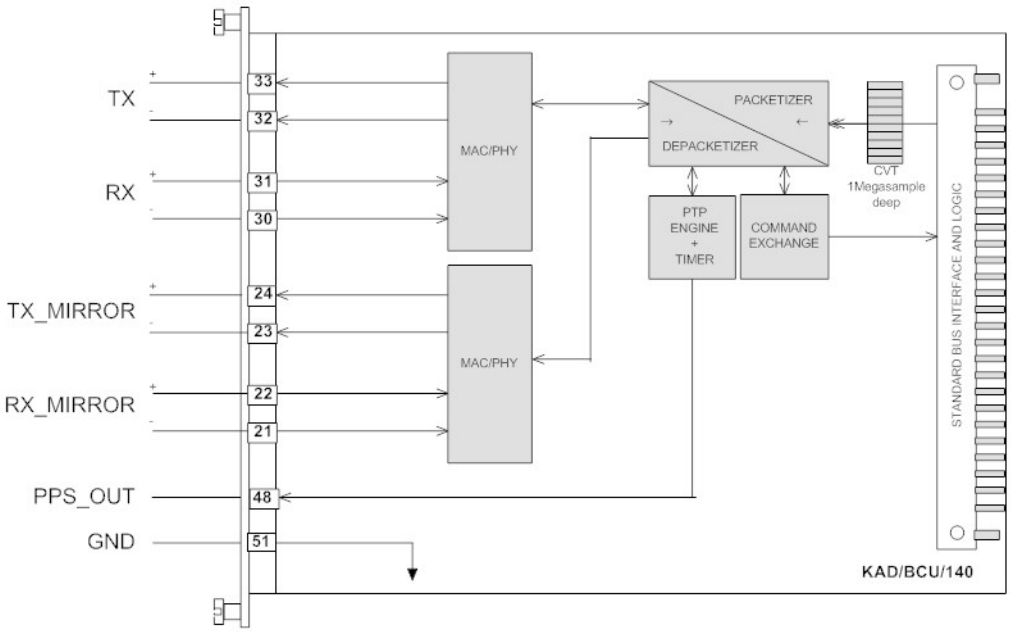


Figure 1: Ethernet interface and PPS output of the KAD/BCU/140

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under "Environmental ratings" in the "General specifications" table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Use in controller slot (J2) only.
Mass					
	–	75	–	g	
	–	2.65	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	328	–	405	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	1.64	–	2.03	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Synchronization specification				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Time accuracy					Measured over the full temperature range with temperature changing at up to 1°C per minute.
mean error	–	20	50	ns	Mean of Pulse Per Second (PPS) errors calculated over ±60 seconds from any reading.
instantaneous error	–	20	250	ns	After synchronization is achieved, with no loss of connection to the PTP Grandmaster.
Time to synchronize IEEE 1588-2004 (PTPv1)					Measured from a power-on of the test chassis, using a Meinberg M600 IEEE 1588 PTP Grandmaster, supplying PTPv1 messages to the KAD/BCU/140 via OnTime T208 switch, configured in IEEE 1588 transparent mode.
1 µs	–	11	–	s	
250 ns	–	20	–	s	
Time to synchronize IEEE Std 1588-2008 (PTPv2)					Measured from a power-on of the test chassis, using a Meinberg M600 IEEE 1588 PTP Grandmaster, supplying PTPv2 messages to the KAD/BCU/140 via OnTime T208 switch, configured in IEEE 1588 transparent mode. The protocol used[1] is the PTPv2 Delay Req protocol (also known as End-to-end delay request-response mechanism).
1 µs	–	16	–	s	
250 ns	–	20	–	s	

1. The PTPv2 Delay P2P protocol is not tested on the KAD/BCU/140 and is reserved for future use.

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TABLE 3	BTTL outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	1	–	
Signaling rate					
PPS_OUT	–	1	–	Hz	
Output voltage					
logic 0	–	–	0.44	V	Sinking 0.1 mA.
logic 1	3.76	–	–	V	Sourcing 0.1 mA.
short circuit current	–	–	50	mA	
short circuit duration	∞	–	–	s	To GND.
Output resistance	100	–	–	Ω	100Ω in series with standard TTL.

TABLE 4	Ethernet interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs/outputs	–	–	2	–	IEEE 802.3 compatible; 100BaseTX full-duplex only. The KAD/BCU/140 uses auto-negotiation to set the transmission speed. Ensure the Ethernet device it connects to also uses auto-negotiation and not fixed speed. Otherwise, packets may be dropped.

Setting up the KAD/BCU/140

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/BCU/140/D	KAD/BCU/140/D	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Settings	-	-	-
Is Leap Year	False True	False	Specifies if the current year is a leap year.
IP Address	0.0.0.0 to 255.255.255.255	192.168.28.1	Specifies the IP address of the instrument.
IENA Only System	True False	False	Specifies whether the system only uses IENA time-stamps, without year information. If the KAD/BCU/140/D is to be synchronized with a KAM/TCG/xxx that does not have a PTP_DAYS register, set to True.
Settings *Time*	-	-	Settings relating to synchronization and time conversions.
PTP Protocol	PTPv2 Delay Req PTPv2 Delay P2P[1] PTPv1	PTPv2 Delay Req	Determines supported IEEE 1588 protocol (PTP) where PTPv1 corresponds to IEEE 1588-2004 and PTPv2 corresponds to IEEE Std 1588-2008.
PTP Grandmaster	True False	False	Determines whether the module acts as a PTP Grandmaster.
PTP Leap Seconds	0 to 256	37	Current leap second count. Offset between PTP time and UTC time.
Synchronisation Level	500 to 10000	500	The unit considers itself in sync if the last calculated offset from its time master is less than this. Units are nanoseconds.
Settings *PTPv1*	-	-	-
PTPv1 Subdomain	_DFLT _ALT1 _ALT2 _ALT3	_DFLT	Name of the PTP version 1 subdomain to use.
PTPv1 Sync Interval	1 2	2	Interval, in seconds, between sync messages, if the module is operating as a PTPv1 Grandmaster.
Settings *PTPv2*	-	-	-
PTPv2 Subdomain	0 to 255	0	The PTPv2 subdomain to use.
Settings *Mode*	-	-	-
Shunt Mode	True False	False	Enable shunt mode. Used by modules supporting simulated shunt across their sensors.
Mode Event Count	0 to 7	1	Number of packets in Shunt or Mode burst events
Mode Protocol	IENA iNET-X	iNET-X	Choice between IENA and iNET-X for Shunt or Mode packets
Settings *IENA*	-	-	-
Fragmentation	True False	False	IENA packages bigger than 1,500 bytes are fragmented into smaller packages.

SETUP DATA	CHOICE	DEFAULT	NOTES
Processes	-	-	-
Shunt	-	-	Specifies the source for KShunt master module.
Fixed-Word(1023:0)	-	-	Process to facilitate fixed parameter definitions
Settings	-	-	-
Fixed Value	0000 to FFFF	DEAD	Value specifying the fixed data to be transmitted in the Fixed-Word parameter
Channels	-	-	-
Ethernet(1:0) *Ethernet Output*	-	-	Represents a typical Ethernet channel on a networked device.
Settings	-	-	-
PPSOut *TTL Output*	-	-	Pulse per second.

1. The PTPv2 Delay P2P protocol is not tested on the KAD/BCU/140 and is reserved for future use.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
DayOfYear Day of Year, February first is day 32.	BitVector	BitVector	16	**R[15:0]** R[15:10] Reserved - Reserved for future use. R[9:0] DayOfYear - Day of Year 1 to 366.
IrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
TimeHi Hours and minutes at the start of the acquisition cycle.	BitVector	BitVector	16	**R[47:32]** R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
TimeLo Seconds and centiseconds at the start of the acquisition cycle.	Second	BCD	16	**R[31:16]** R(15) Reserved R[14:8] Seconds - Seconds 0 to 59. R[7:0] Centiseconds - Centiseconds 0 to 99.
TimeMicro Microseconds at the start of the acquisition cycle.	Second	BCD	16	**R[15:0]** R[15:0] Microseconds - Microseconds 0 to 9999.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Report Report status of module.	BitVector	BitVector	16	**R[15:0]** R(15) Event - "1" if event occurred since last read. R[14:13] Reserved - Reserved for future use. R(12) Ethernet Link 1 Down - "1" if Ethernet Link 1 Down R(11) Ethernet Link 0 Down - "1" if Ethernet Link 0 Down R[10:9] Reserved - Reserved for future use. R(8) Invalid configuration - "1" if the module has been programmed with an EPROM image that cannot produce a valid acquisition cycle. R(7) Rx Error - "1" if unexpected Ethernet frame received. An Ethernet frame was received which was invalid in some way. This may indicate a problem with the network. R(6) Rx Overflow - "1" if Ethernet receive buffer overflow. The module is receiving packets faster than they can be processed. Packets which can cause this include those addressed to the broadcast MAC address, the module's own MAC address, or the PTP multicast MAC address. R(5) Reserved - Reserved for future use. R(4) Module Reset - Watchdog timeout. A 1 here indicates that the module's microprocessor has failed and has been reset by the internal watchdog timer. R[3:2] Reserved - Reserved for future use. R(1) Time Source Lost - "1" if missed more than five consecutive PTP packets. R(0) Out Of Sync - "1" if on the last update the measured time error relative to the time master was greater than the value specified by the Synchronisation Level setting.
PTPTimeError 2's complement value giving the difference between the Time sent by the Time Master, which may be a PTP Grandmaster or a TCG, and the BCU's PTP Time measured in nanoseconds.	BitVector	TwosComplement	16	**R[15:0]** R[15:0] PTPTimeError - Current value of the Time Error register.
ShuntValue Current value of shunt register.	BitVector	BitVector	16	**R[15:0]** R[15:4] Reserved - Reserved for future use. R[3:0] Shunt Value - Current value of shunt register.
TypeNumber Type number of the module	BitVector	BitVector	16	R[15:0]
Shunt Parameters				

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
ShuntRegister Sink register for parameter from module that is used as source of shunt is loaded here. Used by modules supporting simulated shunt across their sensors.	BitVector	BitVector	16	**R[15:0]** R[15:4] Reserved - Reserved for future use. R[3:0] Shunt Value - Current shunt mode value.
Fixed-Word(1023:0)Parameters				
Fixed-Word Parameter containing fixed data	BitVector	BitVector	16	R[15:0]

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/BCU/140

NOTE: It is recommended that Category 5 UTP, or better, Ethernet cables—as specified in the Ethernet cabling standard (TIA/EIA-568-B)—are used for 100BaseTX connections.

The KAD/BCU/140 uses the standardized iNET-X 52-pin top block pinout.

SNMP support

To enable discovery and basic configuration of the KAD/BCU/140, the module supports SNMPv2c.

The KAD/BCU/140 is configured with a default IP address of 192.168.28.1. To reset the IP address on the KAD/BCU/140, using variables from the Acra Management Information Base (MIB), do the following:

1. Send an SNMP-SET command to enable the `enableFailSafeIPSet` variable.
   This enables or disables write access to `ipSetVar` or related variables. The IP address can only be changed if this has a value of 1. The host resets this value to 0 when the IP address has been changed. However, if the host fails to reset the value, it reverts to 0 when the chassis is power cycled. The `enableFailSafeIPSet` variable also reverts to 0 if the variable is not updated and if no operation which depends on it, such as setting the IP address, occurs for five minutes.
2. Send an SNMP-SET command to configure the `ipSetVar` variable.
   The `IPSetVarType` variable is a combination of Interface index, MAC address, IP address, IP mask and Gateway IP address that are sent in a single SNMP-SET command packet. This is used when setting these variables on a chassis. The MAC address must match the current MAC address of the module. The packet to set this information may be broadcast. Each of these fields must be set since normal point-to-point communication may not be possible if some or all of these fields are not correctly set.
3. Verify that the values were set correctly by issuing an SNMP-GET command to read back the `ipSetVar` variable.

Similarly, the SNMP-GET command (used to query the `ipSetVar` variable) can be broadcast throughout the network to discover KAD/BCU/140s.

For more information on SNMP, see *TEC/NOT/058 - Overview of SNMP and using third party SNMP tools*. For a copy of the MIB text file, contact Curtiss-Wright support (acra-support@curtisswright.com).

Packetization and transmission

Packetization structures

The KAD/BCU/140 supports IENA and iNET-X packet structures. The acquired data in the chassis may be packetized as either IENA or iNET-X.

Aperiodic transmission support

One of the optimization features of the KAD/BCU/140 is aperiodic transmission where packets are generated only if traffic has been captured on a given bus. This feature is particularly suited to asynchronous busses such as MIL-STD-1553 and ARINC-429.

For example, in MIL-STD-1553, busses are asynchronous and there may be times when the traffic rate is low. MIL-STD-1553 packets are only generated when there is a full payload of data or when a timeout occurs making the recording of MIL-STD-1553 traffic very efficient.

NOTE: Aperiodic transmission is only possible when using modules which support it, for example the KAD/BCU/140 and packetizer bus monitor modules such as the KAD/ABM/102 and KAD/MBM/101.

Packet fragmentation

Ethernet packet sizes range between 64 bytes and 1518 bytes. Ideally, application data packets are designed to fit, with their headers, in 1518-byte Ethernet packets. Packets larger than this can be transmitted over Ethernet by high level protocols such as IP, but they are fragmented (split into smaller pieces). Fragmented packets must then be reassembled by the receiving device to recreate the original IP packet.

Packet fragmentation is undesirable for the following reasons:

- Fragments may arrive out of order and complicate reassembly of the data.
- Fragments may be lost, rendering all other fragments of the frame useless.
- The process of fragmenting and reassembling the data is time-consuming.

NOTE: Switches and routers which support IEEE 802.1Q tagging support Ethernet packets of up to 1522 bytes, including the 4-byte IEEE 802.1Q tag. Each IEEE 802.1Q tag contains, within its Tag Control Information (TCI) word, a 12-bit Virtual LAN (VLAN) ID and 3 bits of class of service (to distinguish traffic at lower level).

Networked Acra KAM-500 system and acquisition cycles

In a networked data acquisition system, all chassis with KAD/BCU/140 controllers are able to acquire data synchronously by synchronizing their acquisition cycles using PTPv1 or PTPv2. A requirement is that the length of acquisition cycle is an integer divisor of two seconds and the maximal length of acquisition cycle is two seconds.

If the KAD/BCU/140 has to adjust its clock by more than 500 µs, data acquisition ceases until the next two-second interval. This happens when the module synchronizes with a PTPv1 Grandmaster. If a memory module, such as the KAM/MEM/103, in an Acra KAM-500 chassis is configured to Always Log, then this adjustment results in the loss of an acquisition cycle of data at the time of adjustment, and a subsequent cycle of invalid data some time after the adjustment.

When the KAD/BCU/140 uses PTP synchronization, the timestamps of placed iNET-X packets can vary by ±16 ns. This is normal behavior and is due to the KAD/BCU/140's internal 64 MHz clock continually re-synchronizing with a PTPv1 Grandmaster.

The following table lists all possible acquisition cycle frequencies.

0.5	2.5	12.5	62.5	312.5	1562.5
1	5	25	125	625	3125
2	10	50	250	1250	6250
4	20	100	500	2500	
8	40	200	1000	5000	
16	80	400	2000	10000	
32	160	800	4000		
64	320	1600	8000		
128	640	3200			
256	1280	6400			
512	2560				

To get the most from networked Acra KAM-500 data acquisition systems, it is essential that, depending on the type of PTP Grandmaster used in the system, PTPv1 or PTPv2 Ethernet switches are used. For a list of suitable switches, contact Curtiss-Wright support (acra-support@curtisswright.com).

PTP support

By default, a PTPv1 Grandmaster sends sync messages at two-second intervals. Although the protocol allows for sync message intervals of between one and 64 seconds, intervals should not be above two seconds. The KAD/BCU/140 has been designed based on sync messages arriving at two-second intervals. If it was to accept a PTPv1 Grandmaster with a longer sync interval, clock drift between sync messages would degrade the clock accuracy of the KAD/BCU/140.

When the time on the KAD/BCU/140 changes by more than 500µs, the KAD/BCU/140's acquisition cycle is halted for up to two seconds. This means, for example, when a PTPv1 Grandmaster switches from IRIG or free running to GPS sources, the KAD/BCU/140 stops sending packets for up to two seconds while it resynchronizes. The sequence number of the first packet transmitted, after resynchronization, is reset to zero. The KAD/BCU/140 accepts a maximum PTPv2 Announce Interval of 2 seconds.

PTP time error update

A PTP time error is calculated whenever the PTP slave gets a validated time packet from the PTP master. That means a follow-up for which an appropriate sync has been received beforehand, after enough other information (delay request/response) has been assembled.

Default year

After power-on, the internal time on the KAD/BCU/140 starts at 1st January 2000, and continues from that time until the module receives time from a PTP Grandmaster or from a module in the same Acra KAM-500 chassis (such as the KAM/TCG/102).

Mid-year leap seconds and IENA time

PTP time is based on the time recorded by atomic clocks, such as the time signal from GPS satellites. This is more accurate than Coordinated Universal Time (UTC), on which terrestrial clocks are based, because the rotation of the earth varies slightly. For this reason, UTC is occasionally adjusted by lengthening or shortening the last minute of a month by one second. Of the 24 leap seconds that were added from 1972 to 2008, most were conveniently applied at the end of the last minute of the year. However, nine occurred on the 31st of June in various years.

The PTP Grandmaster reports the number of seconds by which UTC currently differs from PTP time, but not whether any of them has happened since this year began.

A problem arises when the KAD/BCU/140 is started after a leap second has occurred during the current year. IENA time is based on the start of the current year in UTC. This means the KAD/BCU/140 must calculate when the current year began.

If the KAD/BCU/140 starts to synchronize with a PTP Grandmaster in the second half of a year, it does not know

whether a leap second was applied in June of the current year. For this reason, the KAD/BCU/140 always calculates the start of the current year by assuming every hour since the start of the year has had 3,600 seconds.

Leap seconds

The KAD/BCU/140 uses PTP time and Coordinated Universal Time (UTC). For example, the module may get time from a KAD/TCG/102/D as UTC, and serve PTP time to other chassis. UTC is occasionally adjusted by a leap second, whereas PTP time is not, so the offset between UTC and PTP time can change for this reason. In order to convert between PTP time and UTC, the module needs to know the current offset between the two timescales. It can get this information from an external source, or from its PTP Leap Seconds instrument setting.

When there is no authoritative source available for the UTC offset, the module uses the PTP Leap Seconds setting from its EEPROM. Immediately after power-up, the module uses this setting to calculate consistent UTC and PTP times internally. If the module is operating as the PTP Grandmaster in a system, and for example is getting its time from a KAM/TCG/xxx, then it uses its EEPROM setting to calculate PTP time from the UTC time received from the KAM/TCG/xxx. It must do this because the KAM/TCG/xxx communicates UTC time over the backplane, and does not give information about the number of leap seconds.

If the module receives the current leap second count from an authoritative source, for example by synchronizing to an external PTP Grandmaster, then it ceases to use the value from the EEPROM, and uses the value received from the time source. This is because, if the module is programmed to synchronize to an external master, it assumes that the time master is to be considered correct, and that its information is to be considered more up-to-date than anything stored in the module. It continues to use the latest value received from the external source for as long as it continues to run, but the value cannot be stored in the EEPROM, because the EEPROM cannot be programmed except in programming mode. If the module is power-cycled, it reverts to the PTP Leap Seconds setting value.

If the KAD/BCU/140 is receiving UTC time, and is sending time as a PTP Grandmaster to a BCU in another chassis, then the UTC time on the slave chassis matches that on the master even if the leap second count is incorrect. This is because the master BCU sends its leap second count to the slave BCU as the currentUTCOffset field value in the PTP Sync packets. Therefore, the same value that is used in the master to calculate PTP time from UTC, is used on the slave to calculate the UTC time from the PTP.

Using the KAD/BCU/140 with a KAM/TCG/xxx

The KAD/BCU/140 can synchronize with a KAM/TCG/xxx module which is seeding time over the backplane. It can also send time from the KAM/TCG/xxx across a PTP network, as a PTPv1 time master. If there is a KAM/TCG/xxx in the Acra KAM-500 chassis, and Time Server is set to Master, DAS Studio 3 programs the KAD/BCU/140 to synchronize with the KAM/TCG/xxx.

KAM/TCG/xxx modules previous to the KAM/TCG/102/D do not support the seeding of the count of days since the PTP epoch to the KAD/BCU/140. Such modules, for example the KAM/TCG/102/B, can still be used if the system does not need to know what the current year is, that is, if only IENA timestamps (which are a count of microseconds elapsed since the start of the current year) are used. In such systems, select the IENA Only System setting (on the KAD/BCU/140 in DAS Studio 3). The KAD/BCU/140 then uses the Day of Year value from the KAM/TCG/102/B, and synthesizes a date in either 2000 or 2001, depending on the value of the Is Leap Year setting. If the KAD/BCU/140 is configured as a PTPv1 Grandmaster, all PTP slaves synchronize using a time which has the correct day of year, but in the year 2000 or the year 2001.

Time is passed over the backplane with a resolution of 1 µs. This means that the KAD/BCU/140 cannot detect an offset between its time and that from the KAM/TCG/xxx of less than 1 µs. The Synchronisation Level setting's default value of 500 ns is therefore inappropriate for synchronization with a KAM/TCG/xxx. A value of 1,500 ns is recommended in this case.

Address Resolution Protocol (ARP) and ping support

KAD/BCU/140 supports ARP and ping requests.

Shunt support

The KAD/BCU/140's Shunt Mode setting enables support of a network protocol which allows you to change the ShuntValue parameter synchronously on all chassis in an Acra KAM-500 system.

Changing of the ShuntValue parameter takes place when an event packet from a master chassis, or external source, has been received. If a change is scheduled, the ShuntValue parameter is always changed on a two-second interval boundary following receipt of the event packet.

Redundant Ethernet output

The KAD/BCU/140 has two Ethernet interfaces. One of these interfaces is used solely to transmit acquired Ethernet data for redundancy. The KAD/BCU/140 cannot be programmed, or

synchronized with PTP, via this interface and does not respond to ping requests on this interface. The Report parameter indicates the link status of both interfaces.

PTP synchronization does not occur over the redundant Ethernet port.

KAD/ADC/005 family of modules

The KAD/BCU/140 does not support programming of modules in the KAD/ADC/005 family, for example the KAD/ADC/006, KAD/ADC/009, KAD/CDC/001 and KAD/LDC/001. For a list of all KAD/ADC/005 family modules, contact Curtiss-Wright support (acra-support@curtisswright.com).

Connector pinout of the KAD/BCU/140

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DNC		Do not connect
2	DNC		Do not connect
3	DNC		Do not connect
4	DNC		Do not connect
5	DNC		Do not connect
6	DNC		Do not connect
7	DNC		Do not connect
8	DNC		Do not connect
9	CHASSIS	Chassis	
10	DNC		Do not connect
11	DNC		Do not connect
12	DNC		Do not connect
13	DNC		Do not connect
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	RX_MIRROR-	Ethernet interface	Mirror Ethernet interface
22	RX_MIRROR+	Ethernet interface	Mirror Ethernet interface
23	TX_MIRROR-	Ethernet interface	Mirror Ethernet interface
24	TX_MIRROR+	Ethernet interface	Mirror Ethernet interface
25	DNC		Do not connect
26	DNC		Do not connect
27	CHASSIS	Chassis	
28	DNC		Do not connect
29	DNC		Do not connect
30	RX-	Ethernet interface	Ethernet interface
31	RX+	Ethernet interface	Ethernet interface
32	TX-	Ethernet interface	Ethernet interface
33	TX+	Ethernet interface	Ethernet interface
34	DNC		Do not connect
35	DNC		Do not connect
36	CHASSIS	Chassis	
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	PPS_OUT	BTTL outputs	1PPS
49	DNC		Do not connect
50	CHASSIS	Chassis	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/BCU/140/D	Ethernet backplane controller - IENA/iNET-X compatible, PTPv1 client or Grandmaster, PTPv2 client, dual Ethernet output

By default, a CON/KAD/002/CP connector is included with each module in the order and a NET/CON/020 cable is included in each order. Their part numbers will be added to the Confirmation of Order unless an alternative option is specified (see the *Network cables* data sheet). Additional items must be ordered separately; refer to Related products for options.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/BCU/140/D	Addition of PTPv1 Grandmaster and PTPv2 slave; addition of Mirrored Ethernet output; addition of PTPTimeError parameter	Recommended for new programs
KAD/BCU/140/C	kShunt support available	Not recommended for new programs
KAD/BCU/140	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related products

PRODUCT	DETAILS
NET/CON/019	2 x 1.5m female micro-miniature, circular connectors to KAD Ethernet cable for KAD/BCU/140

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/032	Using Ethernet for data transmission
TEC/NOT/049	Power estimation
TEC/NOT/058	Overview of SNMP and using third party SNMP tools
TEC/NOT/067	IENA and iNET-X packet payload formats

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KAM/PSU/011

Power supply unit for Acra KAM-500 chassis (+5V, ±7V and ±12V) - 9-way connector



Key Features

- Supplies +5V, ±7V and ±12V for backplane
- Fully isolated
- No derating with temperature (-40°C to 85°C)
- Capacitor back-up: typically 24ms, dropping from 28V@ 40W
- Reverse polarity protection
- Indefinite short-circuit protection
- EMI filtering
- Supplies up to 5A on +5V power line

Applications

- Power supplies for data acquisition systems

Overview

The KAM/PSU/011 converts the nominal 28V aircraft power into the voltages needed by the Acra KAM-500 backplane.

The DC/DC converters used are the largest components of any Acra KAM-500 module, so the unit is split in two (one half at each end). This allows the components to be bolted to the housing and their weight to be evenly distributed in the Acra KAM-500 chassis.

The +5V supply is primarily for digital circuitry, the ±12V supply is primarily for analog circuitry, and the ±7V is exclusively for bridge excitation.

Unlike other Acra KAM-500 modules the KAM/PSU/011 can only be removed by first removing the sides. The KAM/PSU/011 is only supplied as part of the housing. The green LED indicates power on the +5V power line.

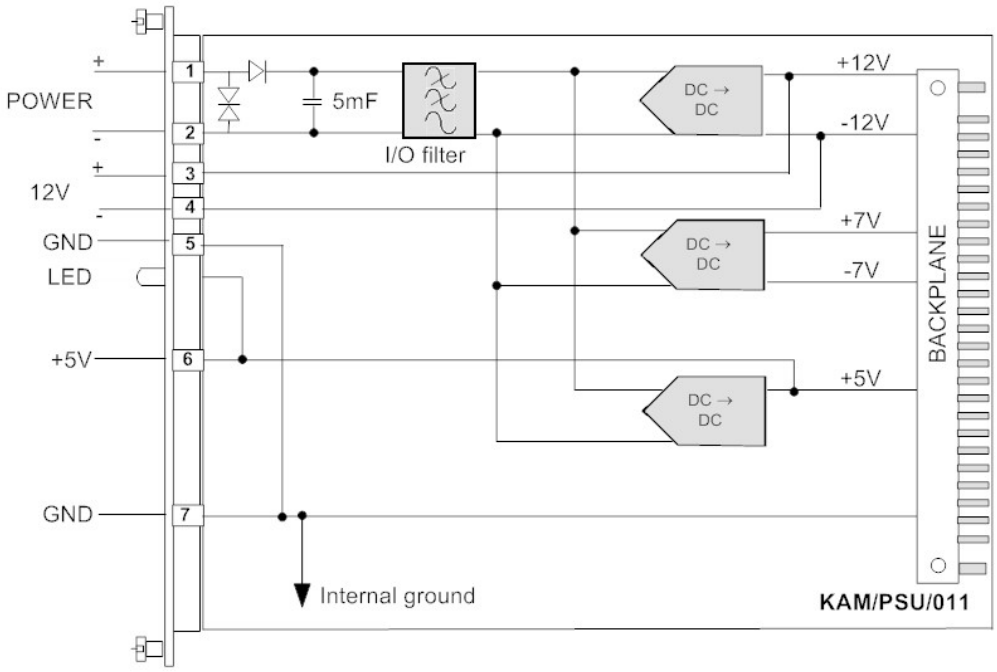


Figure 1: KAM/PSU/011 power supply unit

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	2	–	Occupies PSU slots at opposite ends of chassis.
Mass					
	–	538	–	g	
	–	1.18	–	oz	Design metric is grams.
Height above chassis					
bare connector	–	–	5	mm	
bare connector	–	–	0.19	in.	Design metric is millimeters.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Electrical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Input range	18	28	40	V	4.5A maximum, therefore 81W at 18V supply.
Reverse polarity protection	-40	–	–	V	
Current available					Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
+5V	–	–	5,000	mA	Short circuit protection; indefinite to GND.
+7V	–	–	2,000	mA	Short circuit protection; indefinite to GND.
-7V	–	–	2,000	mA	Short circuit protection; indefinite to GND.
+12V	–	–	1,250	mA	Short circuit protection; indefinite to GND.
-12V	–	–	1,250	mA	Short circuit protection; indefinite to GND.
Glitch immunity	–	24	–	ms	The 5mF capacitor has a 10% tolerance. (See “Getting the most from the KAM/PSU/011” on page 45.)
Efficiency	–	75	–	%	At full load.
Physical					
connector	–	–	–	–	
placement	–	–	–	–	Not removable.

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Getting the most from the KAM/PSU/011

When an Acra KAM-500 chassis with a KAM/PSU/011 is operated from a MIL-STD-704E compliant supply, the chassis is operational with a supply voltage in the range of 18 to 40VDC. This voltage range covers the normal (22 to 29VDC) and emergency (18 to 29VDC) modes of operation as defined in MIL-STD-704E. The Acra KAM-500 is in a non-operational but safe mode for supply voltages less than 18VDC. Operation with an input voltage greater than 40VDC is not permitted, except for very short transients as described in MIL-STD-704E.

The KAM/PSU/011 incorporates a 5mF capacitor backup, which provides a glitch immunity of typically 24ms, dropping from 28V at 40W. The power glitch ride-through time depends on the load as shown in the following figure.

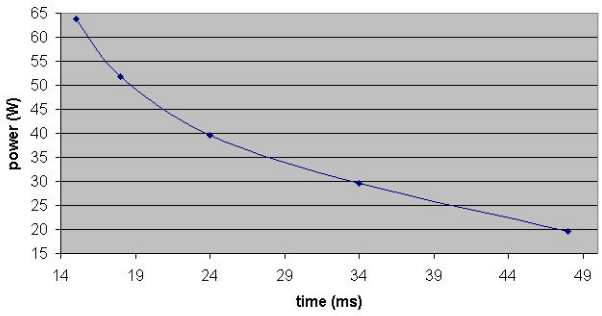


Figure 2: Glitch immunity versus load

±12V connector limitation

The ±12V pins from the KAM/PSU/011 connector is only meant to power sensors with a regulated power supply. Because these ±12V pins are coming directly from the backplane, they are exposed to outside noise, which can cause unwanted interference. These ±12V pins are also not protected.

Connector pinout of the KAM/PSU/011

PIN	NAME	DESCRIPTION	COMMENT
1	POWER+	Nominal 28V supply	Isolated internally; aircraft power
2	POWER-	Return for nominal 28V	Isolated internally; aircraft power
3	+12V	Internal +12V out	Current depends on internal loading
4	-12V	Internal -12V out	Current depends on internal loading
5	GND	Internal ground	
6	+5V	Internal +5V out	Current depends on internal loading
7	GND	Internal ground	
8	DNC		Do not connect
9	DNC		Do not connect

Ordering information

PART NUMBER	DESCRIPTION
KAM/PSU/011/B	Power supply unit for Acra KAM-500 chassis (+5V, ±7V and ±12V) - 9-way connector

Revision history

REVISION	DIFFERENCES	STATUS
KAM/PSU/011/B	Supplies up to 5A on +5V power line	Recommended for new programs
KAM/PSU/011	First release	Not recommended for new programs

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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KAM/PSU/012

+5V, ±7V and ±12V power supply unit for Acra KAM-500 chassis with 6-way connector

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Key Features

- Supplies +5V, ±7V and ±12V for backplane
- Fully isolated
- No derating with temperature (-40°C to 85°C)
- Capacitor back-up: 24ms dropping from 28V@ 40W typical
  (not applicable for KAM/PSU/012/NC)
- Reverse polarity protection
- Indefinite short-circuit protection
- EMI filtering
- Supplies up to 5A on +5V power line

Applications

- Power supplies for data acquisition systems

Overview

The KAM/PSU/012 converts the nominal 28V aircraft power into the voltages needed by the Acra KAM-500 backplane.

The DC/DC converters used are the largest components of any Acra KAM-500 module, so the unit is split in two (one half at each end). This allows the components to be bolted to the housing and their weight to be evenly distributed in the Acra KAM-500 chassis.

The +5V supply is primarily for digital circuitry, the ±12V supply is primarily for analog circuitry, and the ±7V is exclusively for bridge excitation.

Unlike other Acra KAM-500 modules the KAM/PSU/012 can only be removed by first removing the sides. The KAM/PSU/012 is only supplied as part of the housing. The green LED indicates power on the +5V power line.

For the KAM/PSU/012/NC, power glitch reservoir capacitors are removed.

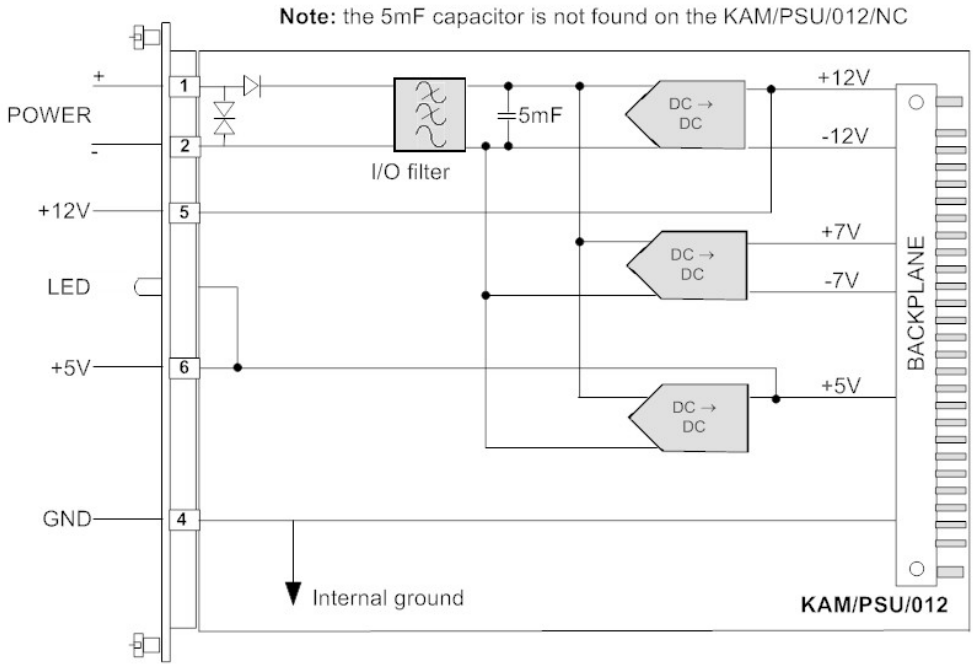


Figure 1: KAM/PSU/012 power supply

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under "Environmental ratings" in the "General specifications" table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	2	–	Occupies PSU slots at opposites ends of chassis.
Mass					
	–	538	–	g	
	–	1.18	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/PSU/007/FL/100* data sheet.
bare connector	–	–	10	mm	
bare connector	–	–	0.39	in.	Design metric is millimeters.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

NOTE: The KAM/PSU/012 is compliant with MIL-STD-704D and MIL-STD-704F input and transient requirements.

TABLE 2	Electrical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Input range	18	28	40	V	4.5A max. therefore 81W at 18V supply. The chassis operates with a supply voltage in the range of 18 to 40VDC.
Reverse polarity protection	-40	–	–	V	
Current available					Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
+5V	–	–	5,000	mA	Short circuit protection; indefinite to GND.
+7V	–	–	2,000	mA	Short circuit protection; indefinite to GND.
-7V	–	–	2,000	mA	Short circuit protection; indefinite to GND.
+12V	–	–	1,250	mA	Short circuit protection; indefinite to GND.
-12V	–	–	1,250	mA	Short circuit protection; indefinite to GND.
Glitch immunity	–	24	–	ms	For the KAM/PSU/012 and KAM/PSU/012/AG2, each 5mF capacitor has a 10% tolerance. (See "Getting the most from the KAM/PSU/012" on page 49.)
Efficiency	–	75	–	%	At full load.
Physical					
connector	–	–	–	–	
placement	–	–	–	–	Not removable.
Peak inrush current	–	38	–	A	Typically 80µS: Tr = 20µS; Tf = 60µS.

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Getting the most from the KAM/PSU/012

An Acra KAM-500 chassis with a KAM/PSU/012 is operational with a supply voltage in the range of 18 to 40VDC. The KAM/PSU/012 and KAM/PSU/012/AG2 incorporate a 5mF capacitor backup, which provides a glitch immunity of typically 24ms, dropping from 28V at 40W. The power glitch ride-through time depends on the load as shown in the following figure.

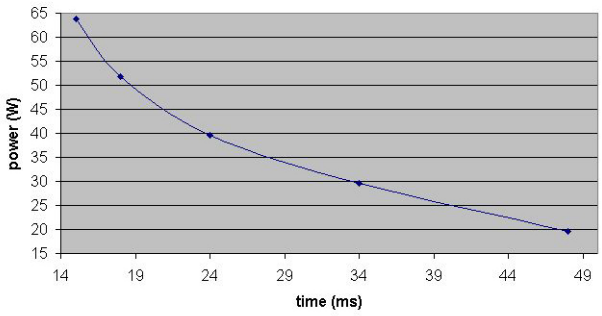


Figure 2: Glitch immunity versus load

+12V connector limitation

The +12V from the KAM/PSU/012 connector is only meant to power sensors with a regulated power supply. Because this 12V is coming directly from the backplane, it is exposed to outside noise, which can cause unwanted interference. This +12V pin is also not protected.

Connector pinout of the KAM/PSU/012 and KAM/PSU/012/NC

PIN	NAME	DESCRIPTION	COMMENT
1	POWER+	Nominal 28V supply	Isolated internally; aircraft power
2	POWER-	Return for nominal 28V	Isolated internally; aircraft power
3	CHASSIS	Chassis	
4	GND	Internal ground	
5	+12V	Internal +12V out	Current depends on internal loading
6	+5V	Internal +5V out	Current depends on internal loading

Connector pinout of KAM/PSU/012/AG2

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	POWER+	Nominal 28V supply	Isolated internally; aircraft power
2	POWER-	Return for nominal 28V	Isolated internally; aircraft power
3	-12V	Internal -12V	
4	GND	Internal ground	
5	+12V	Internal +12V	Current depends on internal loading
6	+5V	Internal +5V	Current depends on internal loading

Ordering information

PART NUMBER	DESCRIPTION
KAM/PSU/012/B	+5V, ±7V and ±12V power supply unit for Acra KAM-500 chassis with 6-way connector
KAM/PSU/012/B/AG2	+5V, ±7V and ±12V power supply unit for KAM-500 chassis with AG2 option
KAM/PSU/012/B/NC	+5V, ±7V, and ±12V power supply unit for KAM-500 chassis with NC option

By default, the standard mating connector, CON/PSU/007/FL/100, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAM/PSU/012 refers to all variations listed in “Specifications” on page 48.

Revision history

REVISION	DIFFERENCES	STATUS
KAM/PSU/012/B	Supplies up to 5A on +5V power line	Recommended for new programs
KAM/PSU/012	First release	Not recommended for new programs

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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KAM/PSU/014

Power supply unit for Acra KAM/CHS/02F (+5V and ±12V) - 6-way connector



Overview

The KAM/PSU/014 converts the nominal 28V aircraft power into the voltages needed by the KAM/CHS/02F chassis backplane.

The KAM/PSU/014 is only supplied as part of the KAM/CHS/02F housing.

The +5V supply is primarily for digital circuitry, the ±12V is primarily for analog circuitry.

The KAM/PSU/014 has one external bayonet power connector.

Key Features

- Supplies +5V and ±12V for backplane
- Fully isolated
- No derating with temperature (-40°C to 85°C)
- Reverse polarity protection
- Indefinite short-circuit protection
- EMI filtering

Applications

- Power supply for data acquisition system

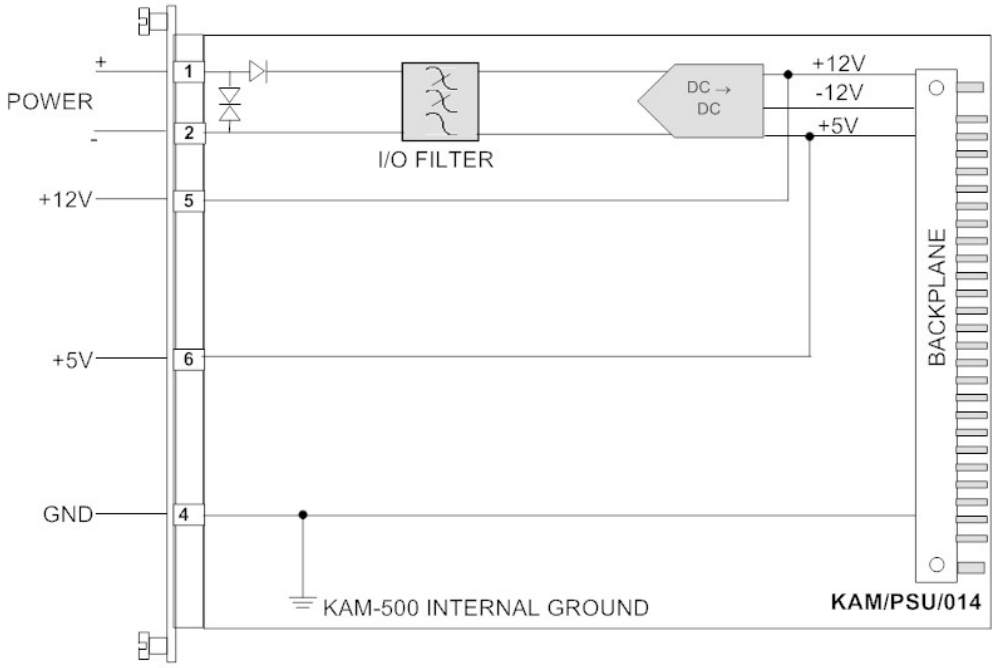


Figure 1: KAM/PSU/014 power supply

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
	–	204	–	g	
	–	7.19	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/PSU/007/FL/100* data sheet.
bare connector	–	–	9	mm	
bare connector	–	–	0.35	in.	Design metric is millimeters.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Electrical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Input range	18	28	40	V	15W max. output.
Reverse polarity protection	-40	–	–	V	
Current available					Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
+5V	–	–	1,500	mA	Short circuit protection; indefinite to GND.
±12V	–	–	310	mA	Short circuit protection; indefinite to GND.
Efficiency	–	75	–	%	At full load.
Physical					
connector	–	–	–	–	
placement	–	–	–	–	Not removable.

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Getting the most from the KAM/PSU/014

When an Acra KAM-500 chassis with a KAM/PSU/014 is operated from a MIL-STD-704E compliant supply, the chassis is operational with a supply voltage in the range of 18 to 40VDC. This voltage range covers the normal (22 to 29VDC) and emergency (18 to 29VDC) modes of operation as defined in MIL-STD-704E. The Acra KAM-500 is in a non-operational but safe mode for supply voltages less than 18VDC. Operation with an input voltage greater than 40VDC is not permitted, except for very short transients as described in MIL-STD-704E.

Connector pinout of the KAM/PSU/014

PIN	NAME	DESCRIPTION	COMMENT
1	POWER+	Nominal 28V supply	Isolated internally; aircraft power
2	POWER-	Return for nominal 28V	Isolated internally; aircraft power
3	CHASSIS	Chassis	
4	GND	Internal ground	
5	+12V	Internal +12V out	Current depends on internal loading
6	+5V	Internal +5V out	Current depends on internal loading

Ordering information

PART NUMBER	DESCRIPTION
KAM/PSU/014	Power supply unit for Acra KAM/CHS/02F (+5V and ±12V) - 6-way connector

By default, the standard mating connector, CON/PSU/007/FL/100, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAM/PSU/014	First release	Recommended for new programs

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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KAM/CHS/02F

Acra KAM-500 chassis (base-mounted power supply and housing) - 2 user-slots

CURTISSWRIGHTDS.com



Key Features

- Power supply unit and two user-slots
- 18 to 40VDC isolated power supply
- Rugged aluminum housing
- 8MHz x 16-bit digital backplane
- Special mounting orientation
- Operates as master or slave in distributed system

Applications

- Flight test instrumentation systems for limited spaces

Overview

The KAM/CHS/02F is a compact two user-slot Acra KAM-500 chassis, which along with the housing and backplane, includes a power supply unit.

The backplane has two slots for user-modules, which are polarized to prevent the insertion of the backplane controller module. The backplane has power supply lines and the standard 16-bit address/data bus with read/write control lines. The only ICs on the backplane are demultiplexers for user-module select.

This chassis has been specially designed for space-limited applications. As such, those modules which require excitation from ±7V are not suitable as the power supply does not supply these voltage levels.

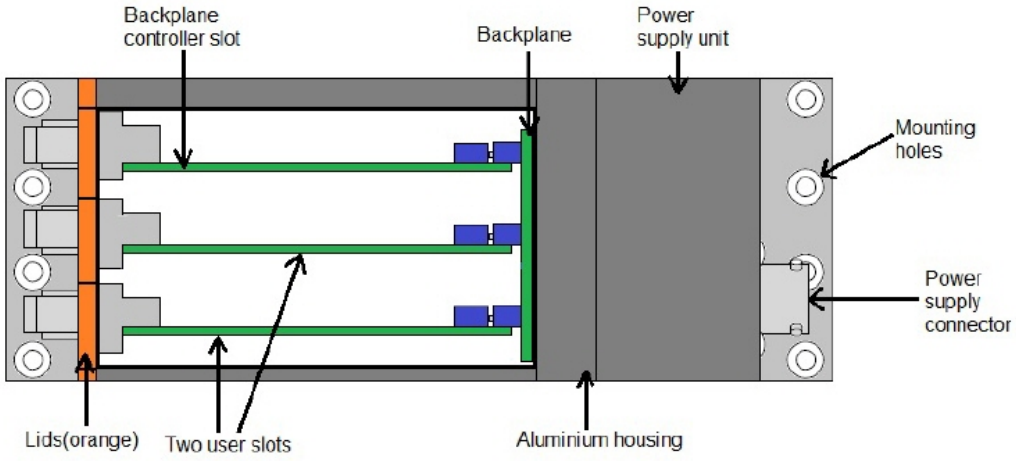


Figure 1: KAM/CHS/02F with PSU and two user-slots

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
User slots	–	–	2	–	
Dimensions					Design metric is millimeters.
height	–	84.2	–	mm	
height	–	3.31	–	in.	
length	–	136.5	–	mm	
length	–	5.37	–	in.	
width	–	50	–	mm	
width	–	1.97	–	in.	
Mass					Design metric is kilograms.
no modules or base plate	–	0.51	–	kg	
no modules or base plate	–	1.12	–	lb	
no modules, with base plate	–	0.59	–	kg	
no modules, with base plate	–	1.30	–	lb	
fully populated	–	0.81	–	kg	Typical module weight of 75g.
fully populated	–	1.79	–	lb	Typical module weight of 2.65oz.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Finish					Electroless nickel plated.
top parts	–	–	–	–	Painted REINORANGE RAL2004.
base, side and end plates	–	–	–	–	Painted black GRIGIO SCURO OPACO C604.

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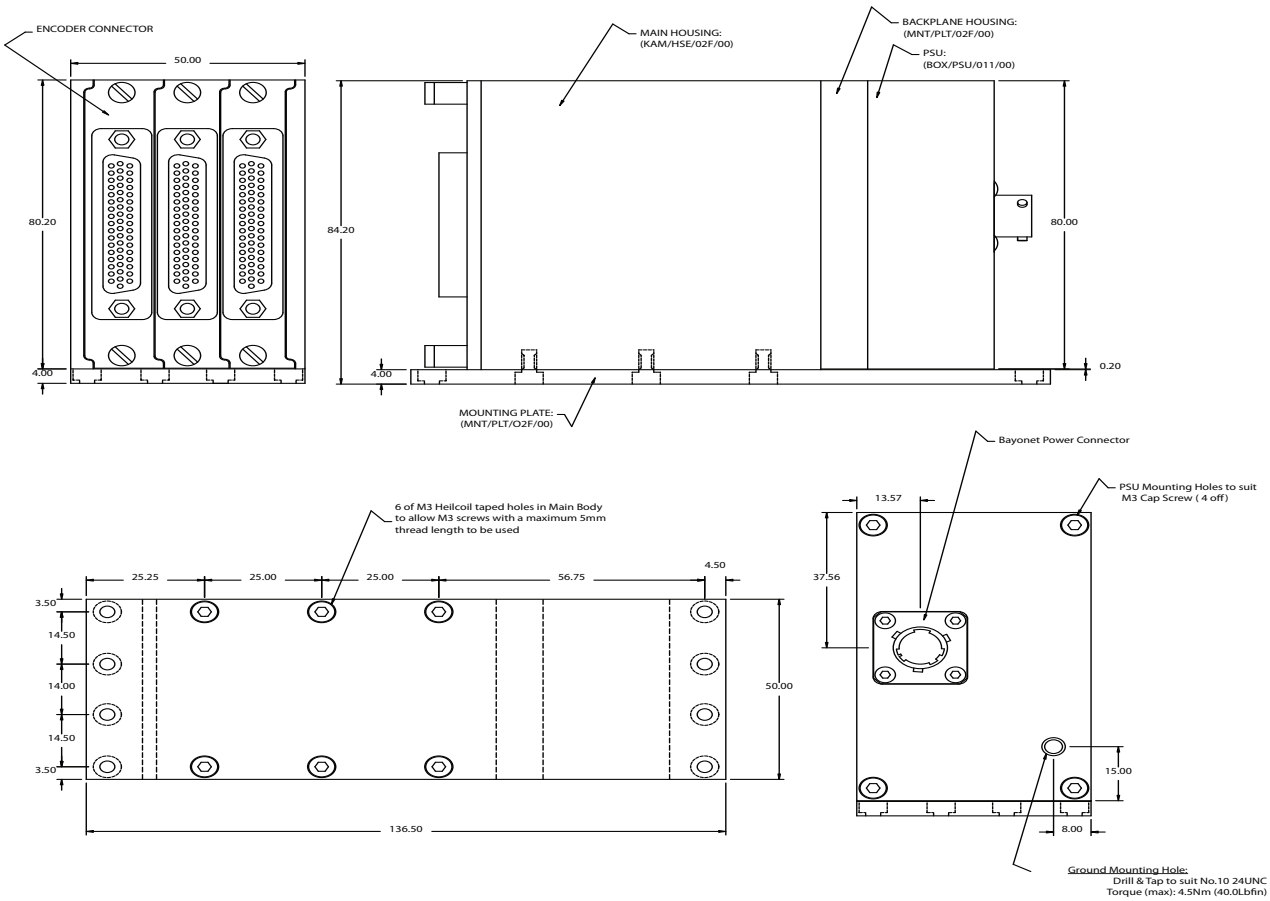


Figure 2: KAM/CHS/02F mechanical drawing

Getting the most from the KAM/CHS/02F

Slot J2 is always reserved for the backplane controller module. A controller is required in slot J2 for controlling and programming of user-modules. Due to mechanical constraints, only the KAD/BCU/xxx family of controllers can be used in the KAM/CHS/02F.

For mounting, we recommend the use of M3 × 10mm or 1/8th in. tooled steel or stainless steel screws to attach the chassis mounting plate to the mounting frame. Alternatively, if the attached mounting plate is not used, the chassis can be attached to the mounting frame or mounting plate using M3 screws pan/flat head with a maximum of 5mm of threaded insert.

Ground mounting bolt

The KAM/CHS/02F has a ground mounting hole that fits a 10-24 UNC bolt as shown in the previous figure, however the chassis does not ship with a ground mounting bolt pre-fitted.

The length of the threaded housing is 9.2mm (0.362 in.) and it is followed by an air gap of 11mm (0.433 in.). The maximum insertable length of the ground bolt is 20mm (0.787 in.) and the recommended insertable length is 10mm (0.393 in.).

An example of a suitable ground bolt for this application is a 10-24 UNC x 3/4 inch Imperial Hexalobular/Torx Pan Head Screws (DIN 7985) - A2 Stainless Steel, which can be externally fitted.

Connector pinout of the KAM/PSU/014

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	POWER+	Nominal Acra KAM-500 28V supply	Isolated internally; aircraft power
2	POWER-	Return for nominal 28V	Isolated internally; aircraft power
3	CHASSIS	Chassis	Current depends on internal loading
4	GND	Internal ground	
5	+12V		Acra KAM-500 internal +12V out; available current depends on internal loading
6	+5V		Acra KAM-500 internal +5V out; available current depends on internal loading

Ordering information

PART NUMBER	DESCRIPTION
KAM/CHS/02F	Acra KAM-500 chassis (base-mounted power supply and housing) - 2 user-slots

By default, the standard mating connector, CON/PSU/007/FL/100, is included with each chassis in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). Spare lids (ACM/LID/001) for unused user-slots can be supplied. These are optional items and must be ordered separately; refer to Related products.

Revision history

REVISION	DIFFERENCES	STATUS
KAM/CHS/02F	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related products

PRODUCT	DETAILS
ACM/LID/001	Spare user-slot lids and spare screws for the KAM-500 system
KAM/PSU/014	Power supply unit for KAM/CHS/02F

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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KAM/CHS/03F

Acra KAM-500 chassis (base-mounted power supply and housing) - 3 user-slots

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Key Features

- Power supply unit and three user-slots
- 18 to 40VDC isolated power supply
- Rugged aluminum housing
- 8MHz × 16-bit digital backplane
- Special mounting orientation
- Operates as master or slave in distributed system

Applications

- Flight test instrumentation systems for limited spaces

Overview

The KAM/CHS/03F is a compact three user-slot Acra KAM-500 chassis, which along with the housing and backplane, includes a KAM/PSU/008/B power supply unit.

The backplane has three slots for user-modules, which are polarized to prevent the insertion of the backplane controller module. The backplane has power supply lines and the standard 16-bit address/data bus with read/write control lines. The only ICs on the backplane are demultiplexers for user-module select.

This chassis has been specially designed for space-limited applications. As such, those modules which require excitation from ±7V are not suitable as the KAM/PSU/008/B does not supply these voltage levels.

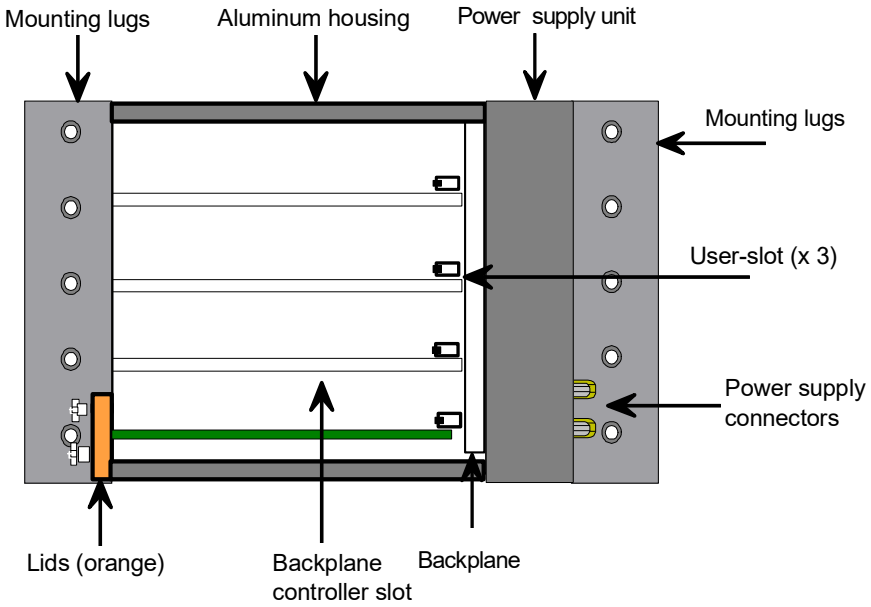


Figure 1: KAM/CHS/03F with PSU and three user-slots

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
User slots	–	–	3	–	
Dimensions					Design metric is millimeters.
height	–	84.2	–	mm	
height	–	3.31	–	in.	
length	–	121.5	–	mm	
length	–	4.78	–	in.	
width	–	64	–	mm	
width	–	2.51	–	in.	
Mass					Design metric is kilograms.
no modules or base plate	–	0.52	–	kg	
no modules or base plate	–	1.14	–	lb	
no modules, with base plate	–	0.60	–	kg	
no modules, with base plate	–	1.33	–	lb	
fully populated	–	0.89	–	kg	Typical module weight of 75g.
fully populated	–	1.97	–	lb	Typical module weight of 2.65oz.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Finish					Electroless nickel plated.
top parts	–	–	–	–	Painted REINORANGE RAL2004.
base, side and end plates	–	–	–	–	Painted black GRIGIO SCURO OPACO C604.

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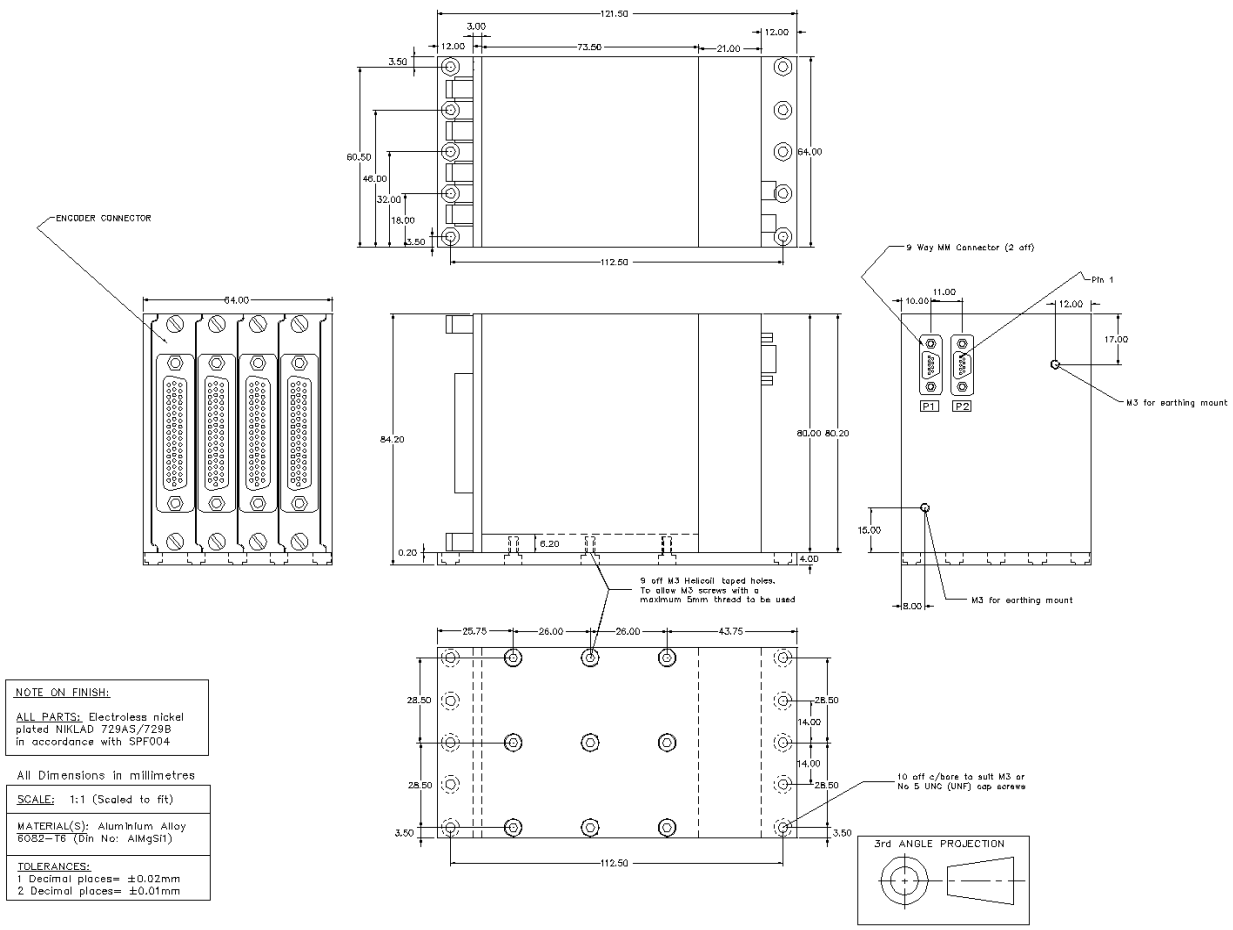


Figure 2: KAM/CHS/03F mechanical drawing

Getting the most from the KAM/CHS/03F

Slot J2 is always reserved for the backplane controller module. A controller is required in slot J2 for control and programming of user-modules. Due to mechanical constraints, only the KAD/BCU/xxx family of controllers can be used in the KAM/CHS/03F.

For mounting, we recommend the use of M3 × 10mm or 1/8th in. tooled steel or stainless steel screws to attach the chassis mounting plate to the mounting frame. Alternatively, if the attached mounting plate is not used, the chassis can be attached to the mounting frame or mounting plate using M3 screws pan/flat head with a maximum of 5mm of threaded insert.

Connector pinout of the KAM/PSU/008/B

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	POWER+	Nominal Acra KAM-500 28V supply	Isolated internally; aircraft power
2	POWER-	Return for nominal 28V	Isolated internally; aircraft power
3	+12V	Acra KAM-500 internal +12V out	Current depends on internal loading
4	GND	Internal ground	
5	+12V	Acra KAM-500 internal +12V out	Current depends on internal loading
6	GND	Internal ground	
7	+12V	Acra KAM-500 internal +12V out	Current depends on internal loading
8	GND	Internal ground	
9	DNC		Do not connect

NOTE: The KAM/PSU/008/B has two connectors, which are wired in parallel.

Ordering information

PART NUMBER	DESCRIPTION
KAM/CHS/03F	Acra KAM-500 chassis (base-mounted power supply and housing) - 3 user-slots

By default, the standard power connector, ACC/ASY/007/04, is included with each chassis in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). Spare lids (ACM/LID/001) for unused user-slots can be supplied. These are optional items and must be ordered separately; refer to Related products.

Revision history

REVISION	DIFFERENCES	STATUS
KAM/CHS/03F	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related products

PRODUCT	DETAILS
KAM/PSU/008/B	Regulates supplies, 28V nominal, uses 9-way micro-miniature connector
ACM/LID/001	Spare user-slot lids and spare screws for the KAM-500 system

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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KAM/CHS/03U

Acra KAM-500 chassis - 3 user-slots

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Key Features

- Power supply unit and three user-slots
- 18 to 40VDC isolated power supply
- Rugged aluminum housing
- 8MHz x 16-bit digital backplane
- Operates as master or slave in distributed system
- LED power-on indicator

Applications

- Flight test instrumentation systems for limited spaces

Overview

The KAM/CHS/03U is a compact three user-slot Acra KAM-500 chassis, which along with the housing and backplane, includes a power supply module which regulates power supplies to the backplane (isolated 28V nominal in).

The backplane has three connectors for user-modules, which are polarized to prevent the insertion of the backplane controller module. The backplane distributes power and connects address, data and control lines to the user-modules.

The only ICs on the backplane are demultiplexers for user-module select signal. Any user-module can be placed in any user-slot in any combination.

2.0A is available for bridge excitation.

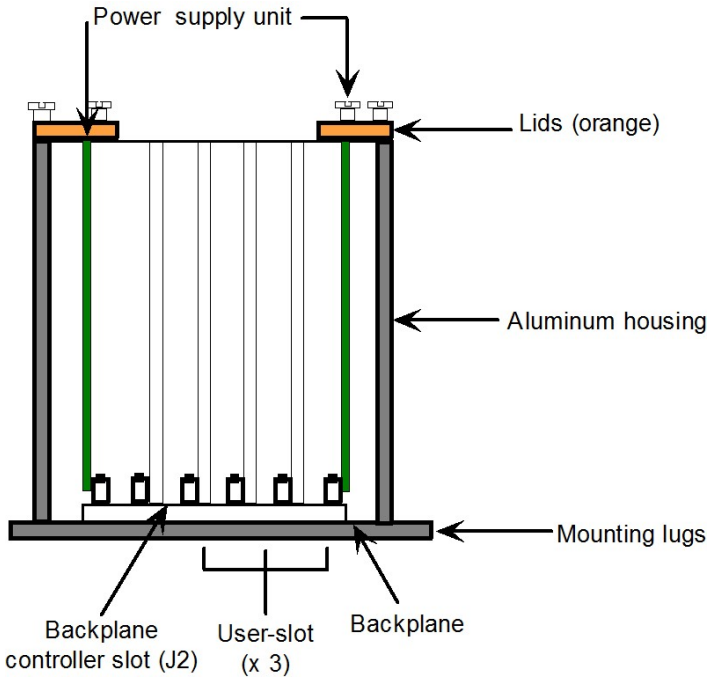


Figure 1: KAM/CHS/03U with PSU and three user-slots

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
User slots	–	–	3	–	
Dimensions					Design metric is millimeters.
height	–	98.5	–	mm	Includes module retention screws and ground bolt.
height	–	3.88	–	in.	Includes module retention screws and ground bolt.
length	–	140	–	mm	Includes mounting lugs.
length	–	5.51	–	in.	Includes mounting lugs.
width	–	80	–	mm	Excludes heat sinks.
width	–	3.15	–	in.	Excludes heat sinks.
Mass					Design metric is kilograms.
no modules	0.8	1.00	1.2	kg	
no modules	1.77	2.2	2.65	lb	
fully populated	1.1	1.30	1.5	kg	Typical module weight of 74g.
fully populated	2.42	2.87	3.31	lb	Typical module weight of 2.61oz.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Finish					Electroless nickel-plated.
top parts	–	–	–	–	Painted REINORANGE RAL2004.
base, side and end plates	–	–	–	–	Painted black GRIGIO SCURO OPACO C604.

Details and dimensions of this chassis, as shown in Figure 2 on page 65, refer to all variations of the chassis listed in “Ordering information” on page 67; the 9-way micro-miniature PSU connector is the only difference.

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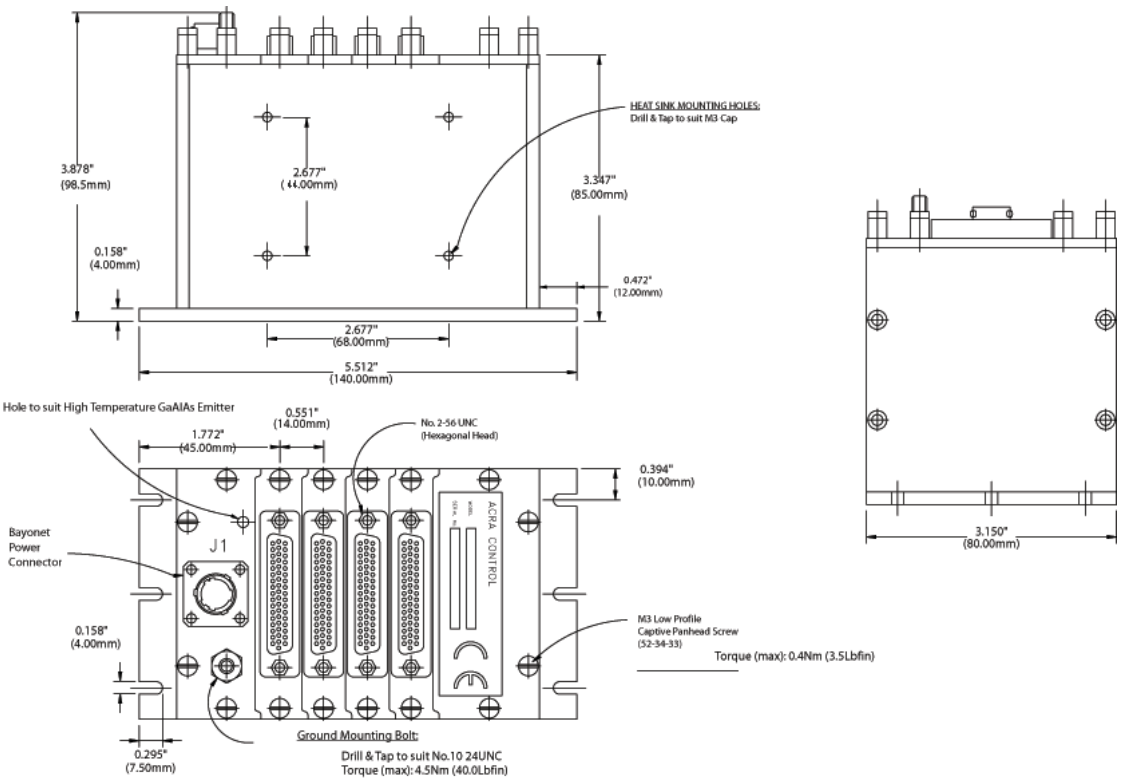


Figure 2: KAM/CHS/03U mechanical drawing

Getting the most from the KAM/CHS/03U

Where space permits, it is recommended that one or two heat sinks (ACC/HSK/001/03U) be used. Heat sinks must be ordered separately. Slot J2 is always reserved for the backplane controller module. A controller is required in slot J2 for control and programming of user-modules.

Connector pinout of the KAM/PSU/012/B and KAM/PSU/012/B/NC supplied with the KAM/CHS/03U and KAM/CHS/03U/NC

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	POWER+	Nominal KAM-500 28V supply	Isolated internally; aircraft power
2	POWER-	Return for nominal 28V	Isolated internally; aircraft power
3	CHASSIS	Chassis	
4	GND	Internal ground	
5	+12V	KAM-500 internal +12V	Current depends on internal loading
6	+5V	KAM-500 internal +5V	Current depends on internal loading

Connector pinout of the KAM/PSU/011/B supplied with the KAM/CHS/03U/MM

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	POWER+	Nominal KAM-500 28V supply	Isolated internally; aircraft power
2	POWER-	Return for nominal 28V	Isolated internally; aircraft power
3	+12V	KAM-500 internal +12V out	Current depends on internal loading
4	-12V	KAM-500 internal -12V out	Current depends on internal loading
5	GND	Internal ground	
6	+5V	KAM-500 internal +5V out	Current depends on internal loading
7	GND	Internal ground	
8	DNC		Do not connect
9	DNC		Do not connect

Ordering information

PART NUMBER	DESCRIPTION
KAM/CHS/03U/E	Acra KAM-500 chassis - 3 user-slots
KAM/CHS/03U/E/MM	Acra KAM-500 chassis - 3 user-slots
KAM/CHS/03U/E/NC	Acra KAM-500 chassis - 3 user-slots

By default, the standard mating connector, (CON/PSU/007/FL/100 for KAM/CHS/03U; or ACC/ASY/007/04 for KAM/CHS/03U/MM), is included with each chassis in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAM/CHS/03U refers to all variations of the chassis listed in the Ordering information table above. Spare lids (ACM/LID/001) for unused user-slots can be supplied. These are optional items and must be ordered separately; refer to Related products.

Revision history

REVISION	DIFFERENCES	STATUS
KAM/CHS/03U/E	PSU upgraded to 5A on +5V power line	Recommended for new programs
KAM/CHS/03U/D	PSU upgraded to 4A on +5V power line	Not recommended for new programs
KAM/CHS/03U/C	Includes KAM/PSU/010 with diode for power-up	Not recommended for new programs
KAM/CHS/03U/B	Includes KAM/PSU/007	Not recommended for new programs
KAM/CHS/03U	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related products

MODULE	DETAILS
ACM/LID/001	Spare user-slot lids and spare screws for the Acra KAM-500 system
ACC/HSK/001/03U	Optional heat sinks for a 3 user-slot KAM-500 system
BAC/PSU/007	Backshell for CON/PSU/007
CON/PSU/007	6-way nickel-plated bayonet standard PSU mating connector
KAM/PSU/011/B	Power supply unit for Acra KAM-500 chassis (+5V, ±7V and ±12V) - 9-way connector
KAM/PSU/012/B	+5V, ±7V and ±12V power supply unit for Acra KAM-500 chassis with 6-way connector
KAM/PSU/012/B/NC	+5V, ±7V, and ±12V power supply unit for KAM-500 chassis with glitch capacitors removed

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
DOC/HBK/002	Environmental Qualification Handbook
TEC/NOT/016	Power dissipation

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KAM/CHS/04L

Acra KAM-500 chassis, narrow form - 4 user-slots

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Key Features

- Power supply unit and four user-slots
- 18 to 40VDC isolated power supply
- Rugged aluminum housing
- 8MHz x 16-bit digital backplane
- Operates as master or slave in distributed system

Applications

- Flight test instrumentation systems

Overview

The KAM/CHS/04L is a compact four user-slot Acra KAM-500 chassis, which along with the housing and backplane, includes a KAM/PSU/006 power supply unit.

The backplane has four slots for user-modules, which are polarized to prevent the insertion of the backplane controller module. The backplane has power supply lines and the standard 16-bit address/data bus with read/write control lines. The only ICs on the backplane are demultiplexers for user-module select signal.

The KAM/CHS/04L does not contain any ±7V lines for excitation.

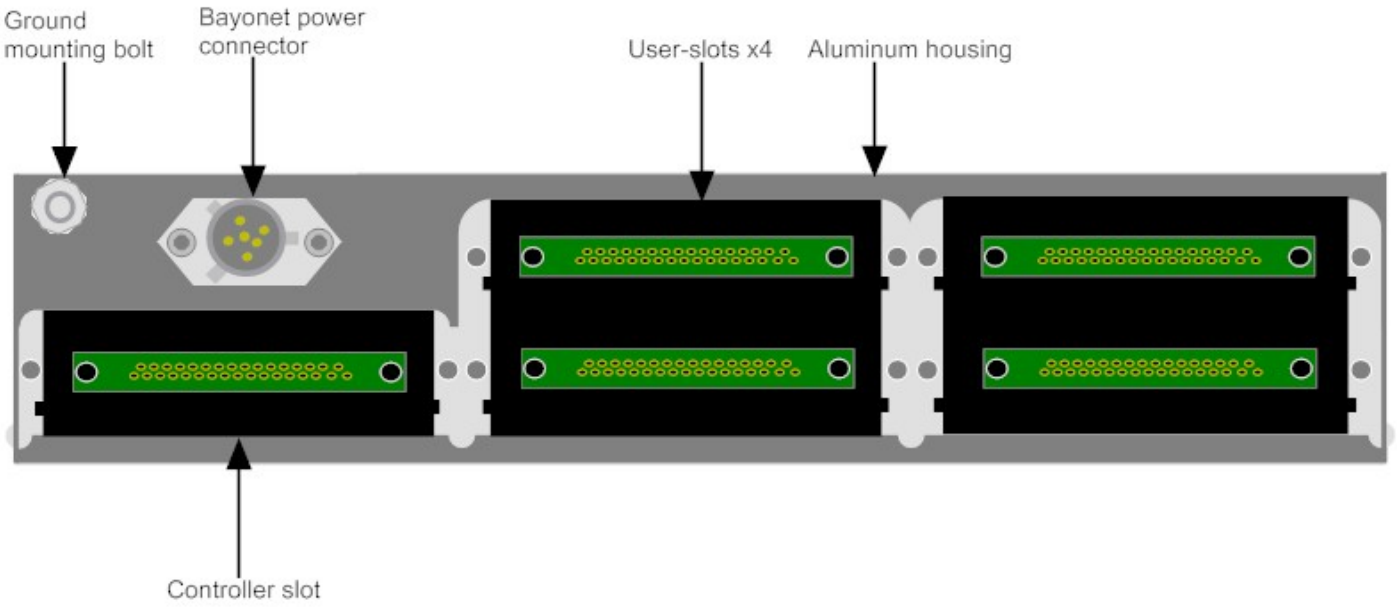


Figure 1: KAM/CHS/04L with PSU and four user-slots

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
User slots	–	–	4	–	
Dimensions					Design metric is millimeters.
height	–	98.5	–	mm	Includes module retention screws and ground bolt.
height	–	3.88	–	in.	Includes module retention screws and ground bolt.
length	–	242	–	mm	Includes mounting lugs.
length	–	9.52	–	in.	Includes mounting lugs.
width	–	40	–	mm	Excludes heat sinks.
width	–	1.6	–	in.	Excludes heat sinks.
Mass					Design metric is kilograms.
no modules	1.10	1.11	1.12	kg	Including power supply.
no modules	2.43	2.45	2.47	lb	Including power supply.
fully populated	1.47	1.48	1.49	kg	Typical module weight of 74g.
fully populated	3.25	3.27	3.29	lb	Typical module weight of 2.61oz.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Finish					Electroless nickel plated.
base, side and end plates	–	–	–	–	Painted black GRIGIO SCURO OPACO C604.

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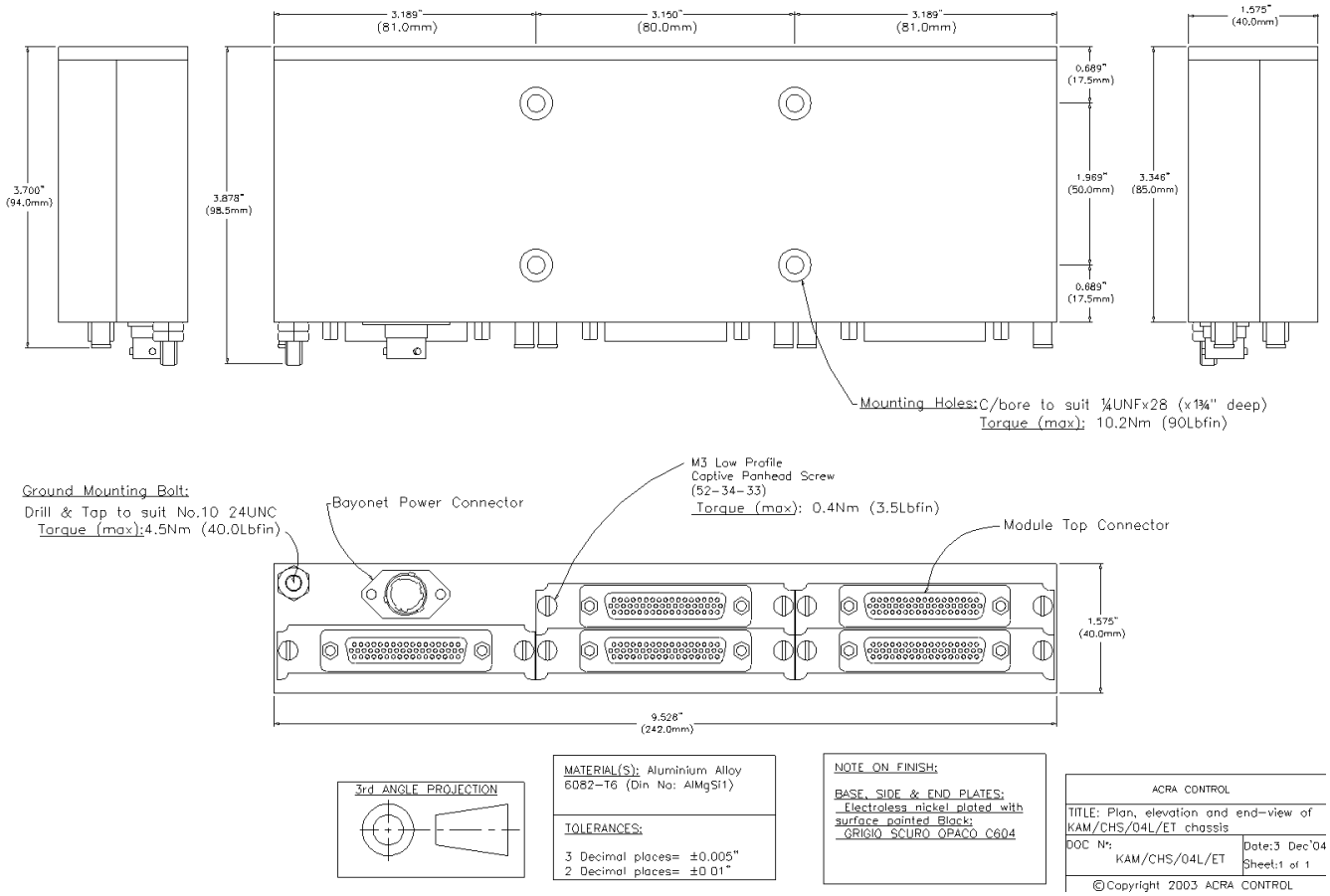


Figure 2: KAM/CHS/04L mechanical drawing

Getting the most from the KAM/CHS/04L

Modules requiring bridge excitation from ±7V lines cannot be used in this chassis. Some modules have ordering options to take their excitation power from ±12V lines. Check individual module data sheets for further details.

NOTE: The KAM/CHS/04L is recognized as a 4L chassis by KSM-500 tools (kSetup and xReport) when used with the KAD/BCU/001/B (and later revisions). When the KAM/CHS/04L is used with controllers or revisions earlier than the KAD/BCU/001/B, and revisions of software tools earlier than kConfig 1.2, kSetup 1.0, and xReport 1.2, it is displayed as KAM/CHS/13U.

Connector pinout of the KAM/PSU/006

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	POWER+	Nominal 28V supply	Isolated internally; aircraft power
2	POWER-	Return for nominal 28V	Isolated internally; aircraft power
3	CHASSIS	Chassis	
4	GND	Internal ground	
5	+12V	Internal +12V out	Current depends on internal loading
6	+5V	Internal +5V out	Current depends on internal loading

Ordering information

PART NUMBER	DESCRIPTION
KAM/CHS/04L/B	Acra KAM-500 chassis, narrow form - 4 user-slots

By default, the standard power connector, CON/PSU/007/FL/100, is included with each chassis in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAM/CHS/04L/B	Uses chassis size identification circuit	Recommended for new programs
KAM/CHS/04L/B/ET	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related products

MODULE	DETAILS
ACM/LID/001	Spare user-slot lids and spare screws for the Acra KAM-500 system
KAM/PSU/006/ET	Power Supply Unit for KAM/CHS/04L

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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KAM/CHS/05F/SC

Acra KAM-500 chassis - 5 user-slots



Key Features

- Power supply unit and five user-slots
- 18 to 40VDC isolated power supply
- Rugged aluminum housing
- 8MHz x 16-bit digital backplane
- Operates as master or slave in distributed system
- Special mounting orientation

Applications

- Flight test instrumentation systems in limited spaces

Overview

The KAM/CHS/05F/SC is a compact, five user-slot Acra KAM-500 chassis, which along with the housing and backplane, includes a KAM/PSU/013/SC power supply unit.

The backplane has five slots for user-modules, which are polarized to prevent the insertion of the backplane controller module. The backplane has power supply lines and the standard 16-bit address/data bus with read/write control lines. The only ICs on the backplane are demultiplexers for user-module select.

This chassis has been specially designed for space-limited applications. As such, those modules which require excitation from ±7V are not suitable as the KAM/PSU/013/SC does not supply these voltage levels.

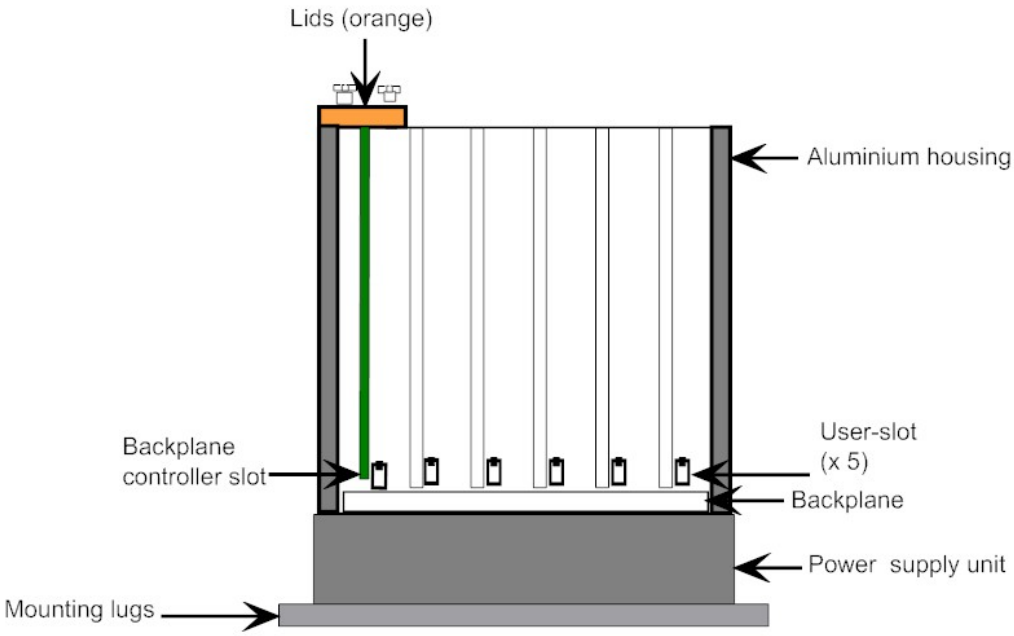


Figure 1: KAM/CHS/05F/SC with PSU and five user-slots

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
User slots	–	–	5	–	
Dimensions					Design metric is millimeters.
height	–	117.5	–	mm	Includes module retention screws and ground bolt.
height	–	4.62	–	in.	Includes module retention screws and ground bolt.
length	–	140	–	mm	Includes mounting lugs.
length	–	5.51	–	in.	Includes mounting lugs.
width	–	92	–	mm	Excludes heat sinks.
width	–	3.62	–	in.	Excludes heat sinks.
Mass					Design metric is kilograms.
no modules	–	1.116	–	kg	Including power supply.
no modules	–	2.46	–	lb	Including power supply.
fully populated	–	1.56	–	kg	Typical module weight of 74g.
fully populated	–	3.43	–	lb	Typical module weight of 2.61oz.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Finish					Electroless nickel plated.
top parts	–	–	–	–	Painted REINORANGE RAL2004.
base, side and end plates	–	–	–	–	Painted black GRIGIO SCURO OPACO C604.

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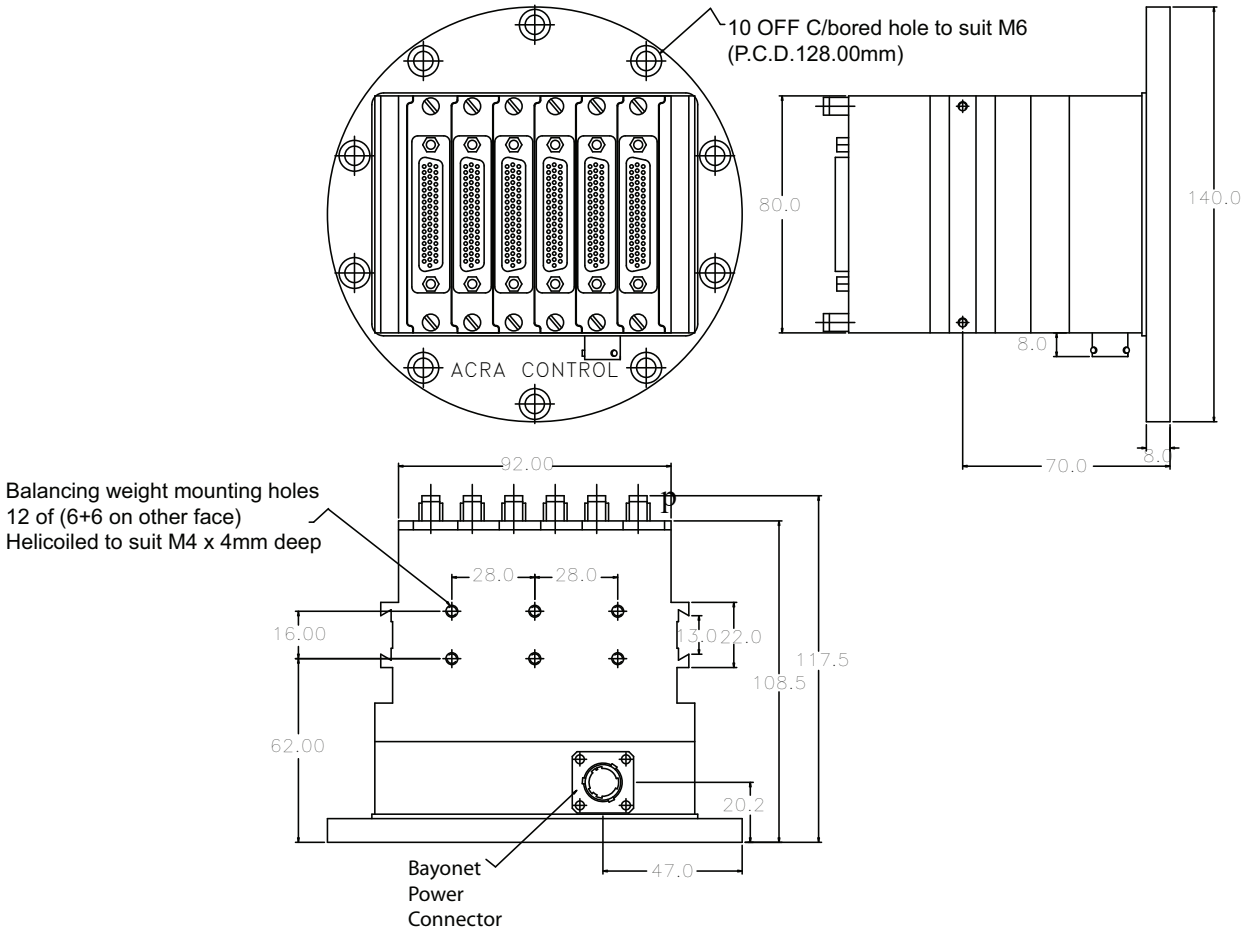


Figure 2: KAM/CHS/05F/SC mechanical drawing

Getting the most from the KAM/CHS/05F/SC

Slot J2 is always reserved for the backplane controller module. A controller is required in slot J2 for control and programming of user-modules. Due to mechanical constraints, only the BCU family of controllers can be used in the KAM/CHS/05F/SC.

User module required in chassis

When the chassis is only used with a BCU controller module and no user module is installed, the chassis enters a feedback loop where it is incapable of raising the output voltage to a sufficient level for the BCU to boot up. For this reason, a user module is required in the chassis.

Connector pinout of the KAM/PSU/013/SC

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	POWER+	Nominal 28V supply	Isolated internally; aircraft power
2	POWER-	Return for nominal 28V	Isolated internally; aircraft power
3	CHASSIS	Chassis	
4	GND	Internal ground	
5	+12V	Internal +12V	Current depends on internal loading
6	+5V	Internal +5V	Current depends on internal loading

Ordering information

PART NUMBER	DESCRIPTION
KAM/CHS/05F/SC	Acra KAM-500 chassis - 5 user-slots

By default, the standard power connector, CON/PSU/007/FL/100, is included with each chassis in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). Also included with each chassis in the shipment is ACC/WGT/006 - a bag of six weights which can be used for balancing.

Revision history

REVISION	DIFFERENCES	STATUS
KAM/CHS/05F/SC	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related products

PRODUCT	DETAILS
KAM/PSU/013/SC	+5V and ±12V power supply unit for Acra KAM-500 chassis

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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KAM/CHS/06U

Acra KAM-500 chassis - 6 user-slots

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Key Features

- Power supply unit and six user-slots
- 18 to 40 VDC isolated power supply
- Rugged aluminum housing
- 8 MHz x 16-bit digital backplane
- Operates as master or slave in distributed system
- LED power-on indicator

Applications

- Flight test instrumentation systems

Overview

The KAM/CHS/06U is a six user-slot Acra KAM-500 chassis, which along with the housing and backplane, includes a power supply module which regulates power supplies for the backplane (isolated 28V nominal in).

The backplane has six connectors for user-modules, which are polarized to prevent the insertion of the backplane controller module. The backplane distributes power and connects address, data and control lines to the user modules.

The only ICs on the backplane are demultiplexers for user-module select signal. Any user-module can be placed in any user-slot in any combination.

2.0A is available for bridge excitation.

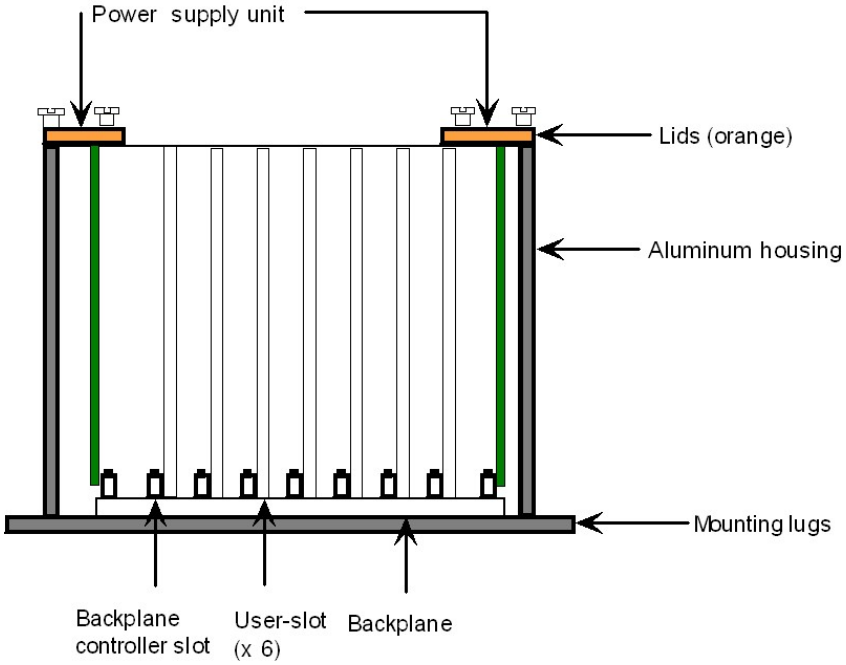


Figure 1: KAM/CHS/06U with PSU and six user-slots

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
User slots	–	–	6	–	
Dimensions					Design metric is millimeters.
height	–	98.5	–	mm	Includes module retention screws and ground bolt.
height	–	3.88	–	in.	Includes module retention screws and ground bolt.
length	–	182	–	mm	Includes mounting lugs.
length	–	7.17	–	in.	Includes mounting lugs.
width	–	80	–	mm	Excludes heat sinks.
width	–	3.15	–	in.	Excludes heat sinks.
Mass					Design metric is kilograms.
no modules	1.0	1.2	1.4	kg	Includes power supply. For variations of the chassis listed in “Specifications” on page 80, the mass ranges +/-200 g.
no modules	2.2	2.65	3.09	lb	Includes power supply.
fully populated	1.5	1.7	1.9	kg	Typical module weight of 75 g.
fully populated	3.31	3.75	4.19	lb	Typical module weight of 2.61 oz.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Finish					Electroless nickel-plated.
top parts	–	–	–	–	Painted REINORANGE RAL2004.
base, side and end plates	–	–	–	–	Painted black GRIGIO SCURO OPACO C604.
Chassis material	–	–	–	–	Aluminum alloy 6082-T6 (Din No: AlMgSi1).

Details and dimensions of this chassis as shown the following figure, refer to all variations of the chassis listed in “Ordering information” on page 83; the 9-way micro-miniature PSU connector is the only difference.

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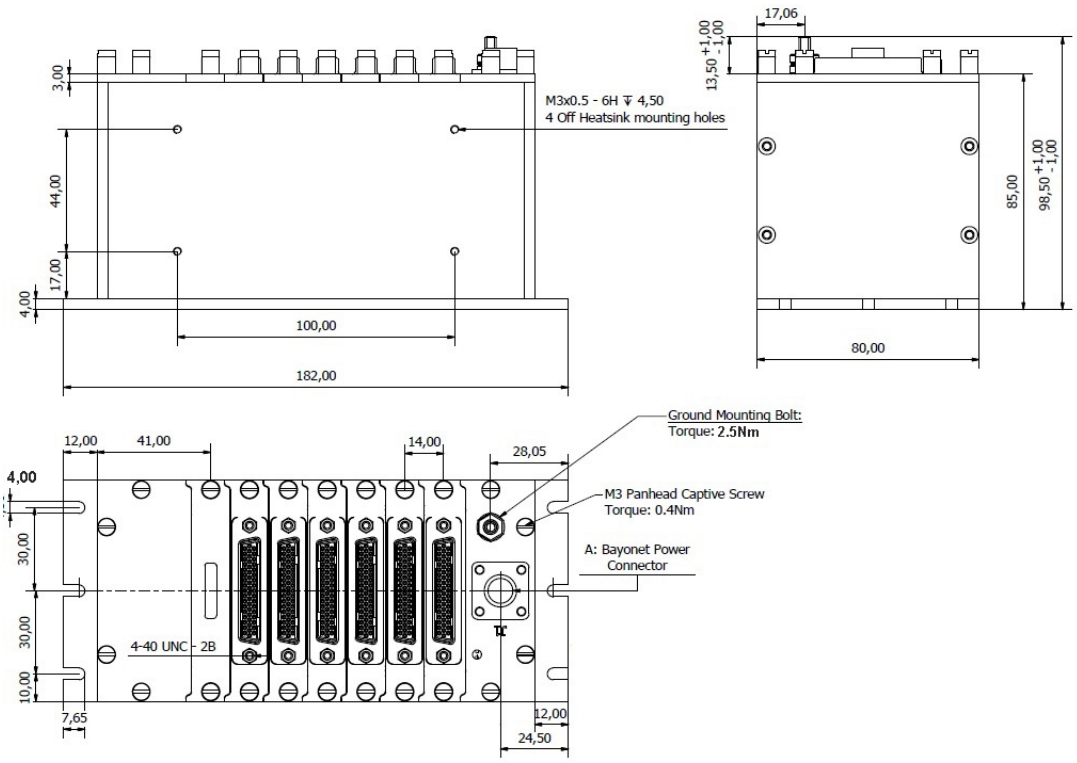


Figure 2: KAM/CHS/06U mechanical drawing

Getting the most from the KAM/CHS/06U

Where space permits, it is recommended that one or two heat sinks (ACC/HSK/001/06U) be used. Heat sinks must be ordered separately.

Slot J2 is always reserved for the backplane controller module. A controller is required in slot J2 for control and programming of user-modules.

Connector pinout of the KAM/PSU/012/B and KAM/PSU/012/B/NC supplied with the KAM/CHS/06U and KAM/CHS/06U/NC

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	POWER+	Nominal 28V supply	Isolated internally; aircraft power
2	POWER-	Return for nominal 28V	Isolated internally; aircraft power
3	CHASSIS	Chassis	
4	GND	Internal ground	
5	+12V	Internal +12V	Current depends on internal loading
6	+5V	Internal +5V	Current depends on internal loading

Connector pinout of the KAM/PSU/011/B supplied with the KAM/CHS/06U/MM

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	POWER+	Nominal 28V supply	Isolated internally; aircraft power
2	POWER-	Return for nominal 28V	Isolated internally; aircraft power
3	+12V	Internal +12V out	Current depends on internal loading
4	-12V	Internal -12V out	Current depends on internal loading
5	GND	Internal ground	
6	+5V	Internal +5V out	Current depends on internal loading
7	GND	Internal ground	
8	DNC		Not connected
9	DNC		Not connected

Ordering information

PART NUMBER	DESCRIPTION
KAM/CHS/06U/E	Acra KAM-500 chassis - 6 user-slots
KAM/CHS/06U/E/MM	Acra KAM-500 chassis - 6 user-slots (micro-miniature connector)
KAM/CHS/06U/E/NC	Acra KAM-500 chassis - 6 user-slots (no brown out capacitor)

By default, the standard mating connector, (CON/PSU/007/FL/100 for KAM/CHS/06U; or ACC/ASY/007/04 for KAM/CHS/06U/MM), is included with each chassis in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAM/CHS/06U refers to all variations of the chassis listed in the Ordering information table above. Spare lids (ACM/LID/001) for unused user-slots can be supplied. These are optional items and must be ordered separately; refer to Related products.

Revision history

REVISION	DIFFERENCES	STATUS
KAM/CHS/06U/E	PSU upgraded to 5A on +5V power line	Recommended for new programs
KAM/CHS/06U/D	PSU upgraded to 4A on +5V power line	Not recommended for new programs
KAM/CHS/06U/C	Includes KAM/PSU/010 with diode for power-up	Not recommended for new programs
KAM/CHS/06U/B	Includes KAM/PSU/007	Not recommended for new programs
KAM/CHS/06U	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related products

MODULE	DETAILS
ACM/LID/001	Spare user-slot lids and spare screws for the Acra KAM-500 system
ACC/HSK/001/06U	Optional heat sinks for the Acra KAM-500 system
BAC/PSU/007	Backshell for CON/PSU/007
CON/PSU/007	6-way nickel-plated bayonet standard PSU mating connector
KAM/PSU/011/B	Power supply unit for Acra KAM-500 chassis (+5V, ±7V and ±12V) - 9-way connector
KAM/PSU/012/B	+5V, ±7V and ±12V power supply unit for Acra KAM-500 chassis with 6-way connector
KAM/PSU/012/B/NC	+5V, ±7V, and ±12V power supply unit for Acra KAM-500 chassis with glitch capacitors removed

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
DOC/HBK/002	Environmental Qualification Handbook
TEC/NOT/016	Power dissipation

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAM/CHS/09U

Acra KAM-500 chassis - 9 user-slots

CURTISSWRIGHTDS.COM



Key Features

- Power supply unit and nine user-slots
- 18 to 40 VDC isolated power supply
- Rugged aluminum housing
- 8 MHz x 16-bit digital backplane
- Operates as master or slave in distributed system
- LED power-on indicator

Applications

- Flight test instrumentation systems

Overview

The KAM/CHS/09U is a nine user-slot Acra KAM-500 chassis, which along with the housing and backplane, includes a power supply module which regulates power supplies for the backplane (isolated 28V nominal in).

The backplane has nine connectors for user-modules, which are polarized to prevent the insertion of the backplane controller module. The backplane distributes power and connects address, data and control lines to the user-modules.

The only ICs on the backplane are demultiplexers for user-module select signal. Any user-module can be placed in any user-slot in any combination.

2.0A is available for bridge excitation.

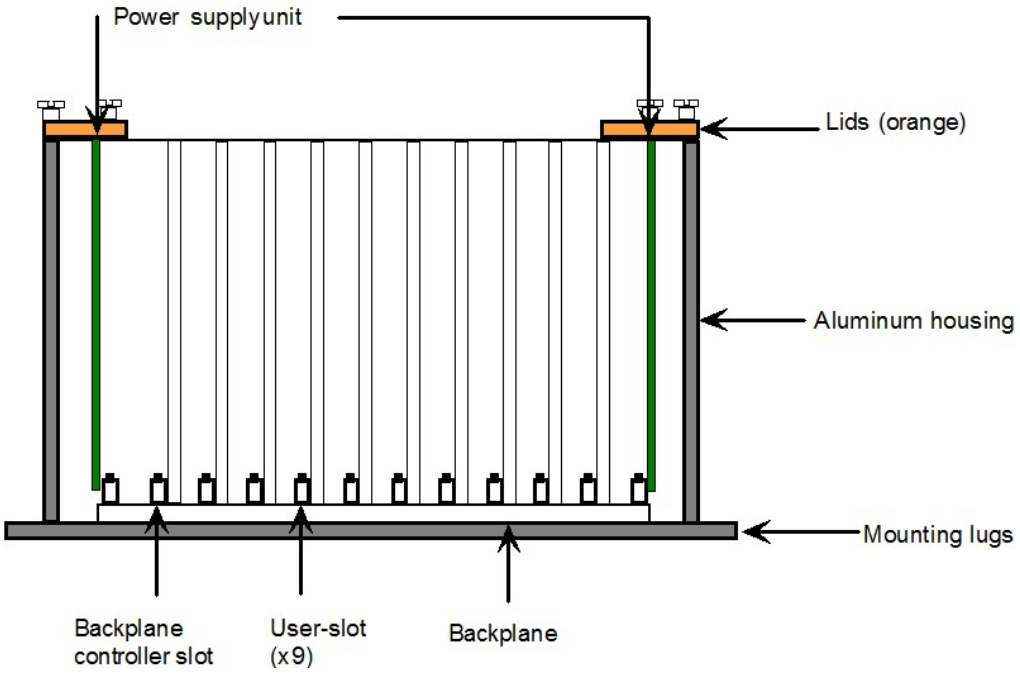


Figure 1: KAM/CHS/09U with PSU and nine user-slots

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
User slots	–	–	9	–	
Dimensions					Design metric is millimeters.
height	–	98.5	–	mm	Includes module retention screws and ground bolt.
height	–	3.88	–	in.	Includes module retention screws and ground bolt.
length	–	224	–	mm	Includes mounting lugs.
length	–	8.82	–	in.	Includes mounting lugs.
width	–	80	–	mm	Excludes heat sinks.
width	–	3.15	–	in.	Excludes heat sinks.
Mass					Design metric is kilograms.
no modules	1.2	1.4	1.6	kg	Includes power supply. For variations of the chassis listed in “Specifications” on page 86, the mass ranges +/-200 g.
no modules	2.65	3.09	3.52	lb	Includes power supply.
fully populated	1.95	2.15	2.35	kg	Typical module weight of 75 g.
fully populated	4.3	4.74	5.18	lb	Typical module weight of 2.61 oz.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Finish					Electroless nickel-plated.
top parts	–	–	–	–	Painted REINORANGE RAL2004.
base, side and end plates	–	–	–	–	Painted black GRIGIO SCURO OPACO C604.
Chassis material	–	–	–	–	Aluminum alloy 6082-T6 (Din No: AlMgSi1).

Details and dimensions of this chassis, as shown in the following figure, refer to all variations of the chassis listed in “Ordering information” on page 89; the 9-way micro-miniature PSU connector is the only difference.

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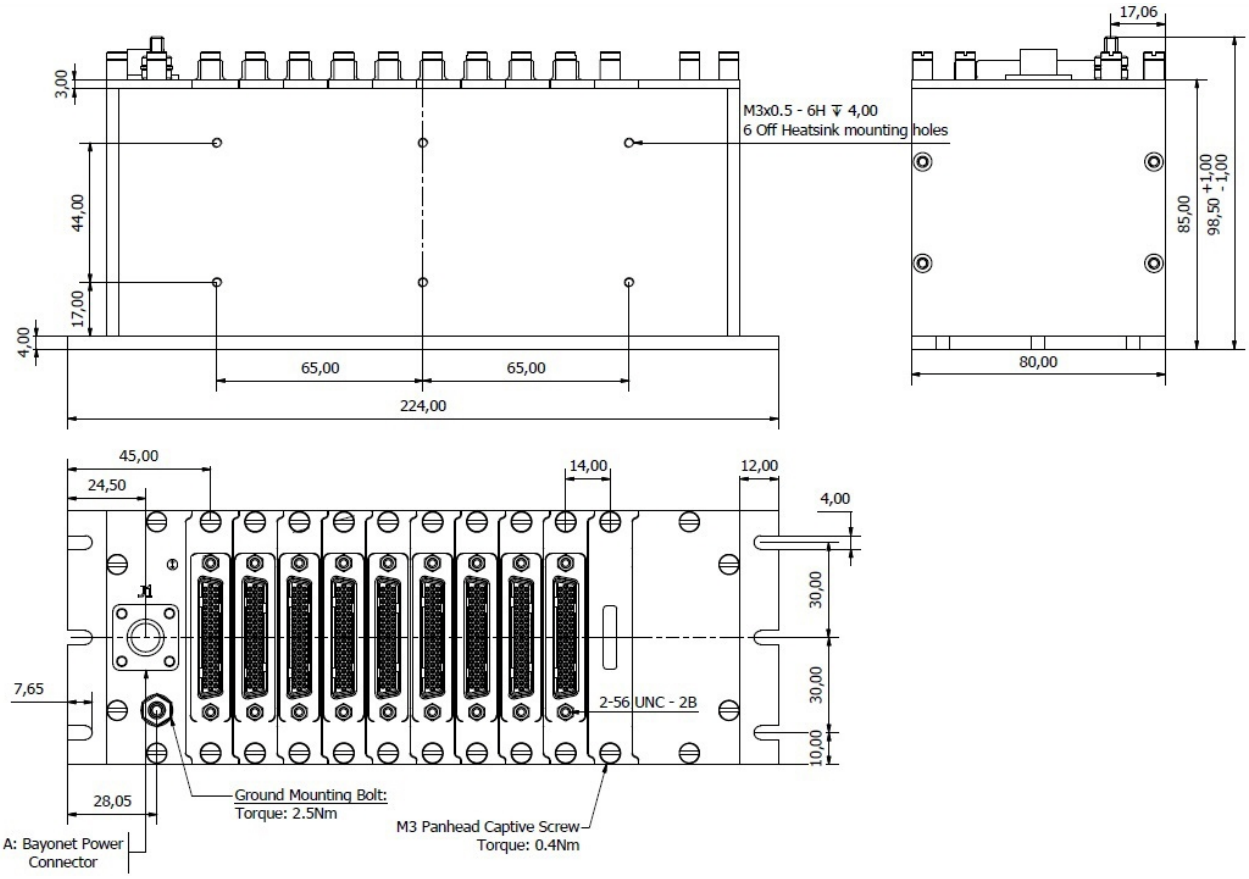


Figure 2: KAM/CHS/09U mechanical drawing

Getting the most from the KAM/CHS/09U

Where space permits, it is recommended that one or two heat sinks (ACC/HSK/001/09U) also be used. Heat sinks must be ordered separately.

Slot J2 is always reserved for the backplane controller module. A controller is required in slot J2 for control and programming of user-modules.

Connector pinout of the KAM/PSU/011/B supplied with the KAM/CHS/09U/MM

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	POWER+	Nominal 28V supply	Isolated internally; aircraft power
2	POWER-	Return for nominal 28V	Isolated internally; aircraft power
3	+12V	Internal +12V out	Current depends on internal loading
4	-12V	Internal -12V out	Current depends on internal loading
5	GND	Internal ground	
6	+5V	Internal +5V out	Current depends on internal loading
7	GND	Internal ground	
8	DNC		Not connected
9	DNC		Not connected

Connector pinout of KAM/PSU/012/B/AG2 supplied with the KAM/CHS/09U/AG2

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	POWER+	Nominal 28V supply	Isolated internally; aircraft power
2	POWER-	Return for nominal 28V	Isolated internally; aircraft power
3	-12V	Internal -12V	Current depends on internal loading
4	GND	Internal ground	
5	+12V	Internal +12V	Current depends on internal loading
6	+5V	Internal +5V	Current depends on internal loading

Connector pinout of the KAM/PSU/012/B and KAM/PSU/012/B/NC supplied with the KAM/CHS/09U and KAM/CHS/09U/NC

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	POWER+	Nominal 28V supply	Isolated internally; aircraft power
2	POWER-	Return for nominal 28V	Isolated internally; aircraft power
3	CHASSIS	Chassis	
4	GND	Internal ground	
5	+12V	Internal +12V	Current depends on internal loading
6	+5V	Internal +5V	Current depends on internal loading

Ordering information

PART NUMBER	DESCRIPTION
KAM/CHS/09U/E	Acra KAM-500 chassis - 9 user-slots
KAM/CHS/09U/E/AG2	Acra KAM-500 chassis - 9 user-slots (pin 3 connected to -12V)
KAM/CHS/09U/E/MM	Acra KAM-500 chassis - 9 user-slots (micro-miniature connector)
KAM/CHS/09U/E/NC	Acra KAM-500 chassis - 9 user-slots (no brown out capacitor)

By default, the standard mating connector, (CON/PSU/007/FL/100 for KAM/CHS/09U; or ACC/ASY/007/04 for KAM/CHS/09U/MM), is included with each chassis in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAM/CHS/09U refers to all variations listed in the Ordering information table above. Spare lids (ACM/LID/001) for unused user-slots can be supplied. These are optional items and must be ordered separately; refer to Related products.

Revision history

REVISION	DIFFERENCES	STATUS
KAM/CHS/09U/E	PSU upgraded to 5A on +5V power line	Recommended for new programs
KAM/CHS/09U/D	PSU upgraded to 4A on +5V power line	Not recommended for new programs
KAM/CHS/09U/C	Includes KAM/PSU/010 with diode for power-up	Not recommended for new programs
KAM/CHS/09U/B	Includes KAM/PSU/007	Not recommended for new programs
KAM/CHS/09U	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related products

MODULE	DETAILS
ACM/LID/001	Spare user-slot lids and spare screws for the Acra KAM-500 system
ACC/HSK/001/09U	Optional heat sinks for a 9 user-slot Acra KAM-500 system
BAC/PSU/007	Backshell for CON/PSU/007
CON/PSU/007	6-way nickel-plated bayonet standard PSU mating connector
KAM/PSU/011/B	Power supply unit for Acra KAM-500 chassis (+5V, ±7V and ±12V) - 9-way connector
KAM/PSU/012/B	+5V, ±7V and ±12V power supply unit for Acra KAM-500 chassis with 6-way connector
KAM/PSU/012/B/AG2	+5V, ±7V and ±12V power supply unit for Acra KAM-500 chassis with -12V on power supply
KAM/PSU/012/B/NC	+5V, ±7V, and ±12V power supply unit for Acra KAM-500 chassis with glitch capacitors removed

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual

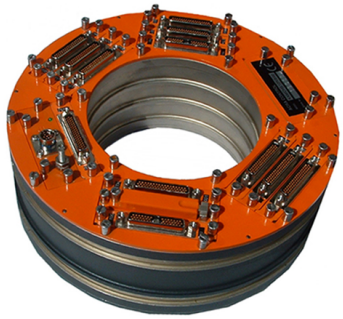
DOCUMENT	DETAILS
DOC/HBK/002	Environmental Qualification Handbook
TEC/NOT/016	Power dissipation

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KAM/CHS/12R

Acra KAM-500 circular form chassis with 12 user-slots

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Key Features

- Power supply unit and twelve user-slots
- 18 to 40VDC isolated power supply
- Rugged aluminum housing
- 8MHz x 16-bit digital backplane
- Operates as master or slave in distributed system
- LED power-on indicator
- Circular form factor

Applications

- Helicopter data acquisition systems

Overview

The KAM/CHS/12R is a twelve user-slot Acra KAM-500 chassis, which along with the housing and backplane, includes a power supply module, which regulates power supplies for the backplane (isolated 28V nominal in).

The backplane has twelve connectors for user-modules, which are polarized to prevent the insertion of the backplane controller module. The backplane distributes power and connects address, data and control lines to the user-modules.

The only ICs on the backplane are demultiplexers for user-module select signal. Any user-module can be placed in any user-slot in any combination.

2.0A is available for bridge excitation.

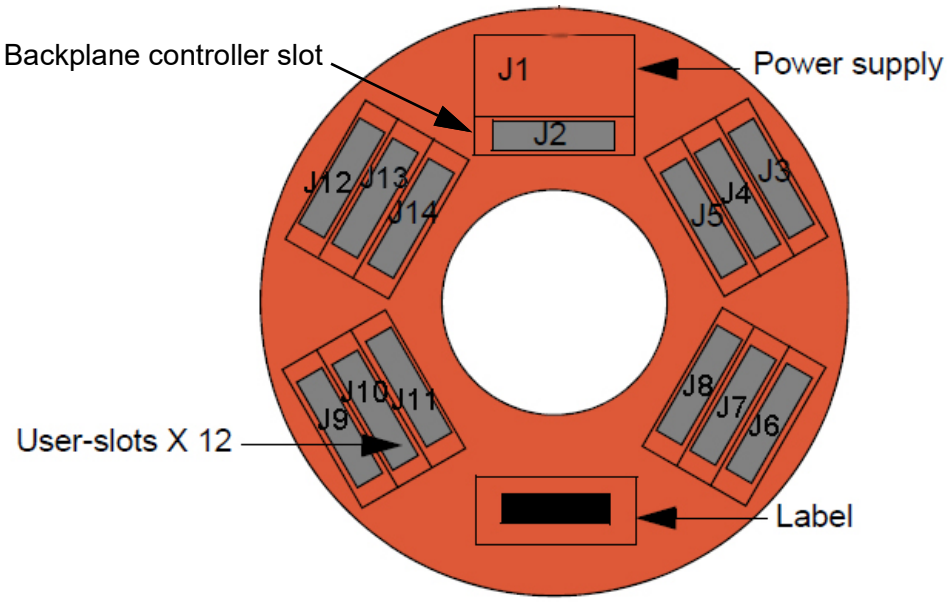


Figure 1: KAM/CHS/12R with PSU and twelve user-slots (PSU split in two for balancing)

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
User slots	–	–	12	–	
Dimensions					Design metric is millimeters.
height	–	98.5	–	mm	Includes module retention screws and ground bolt.
height	–	3.88	–	in.	Includes module retention screws and ground bolt.
diameter	–	250	–	mm	
diameter	–	9.84	–	in.	
Mass					Design metric is kilograms.
no modules	2.78	2.79	2.80	kg	Including power supply.
no modules	6.13	6.15	6.17	lb	Including power supply.
fully populated	3.74	3.75	3.76	kg	Typical module weight of 75g.
fully populated	8.18	8.28	8.38	lb	Typical module weight of 2.65oz.
Environmental ratings					See Environmental Qualifications Handbook.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Finish					Electroless nickel plated.
top parts	–	–	–	–	Painted REINORANGE RAL2004.
base, side and end plates	–	–	–	–	Painted black GRIGIO SCURO OPACO C604.
10-32 UNF Helicoil					Inserted into base, 1.5D, stainless steel

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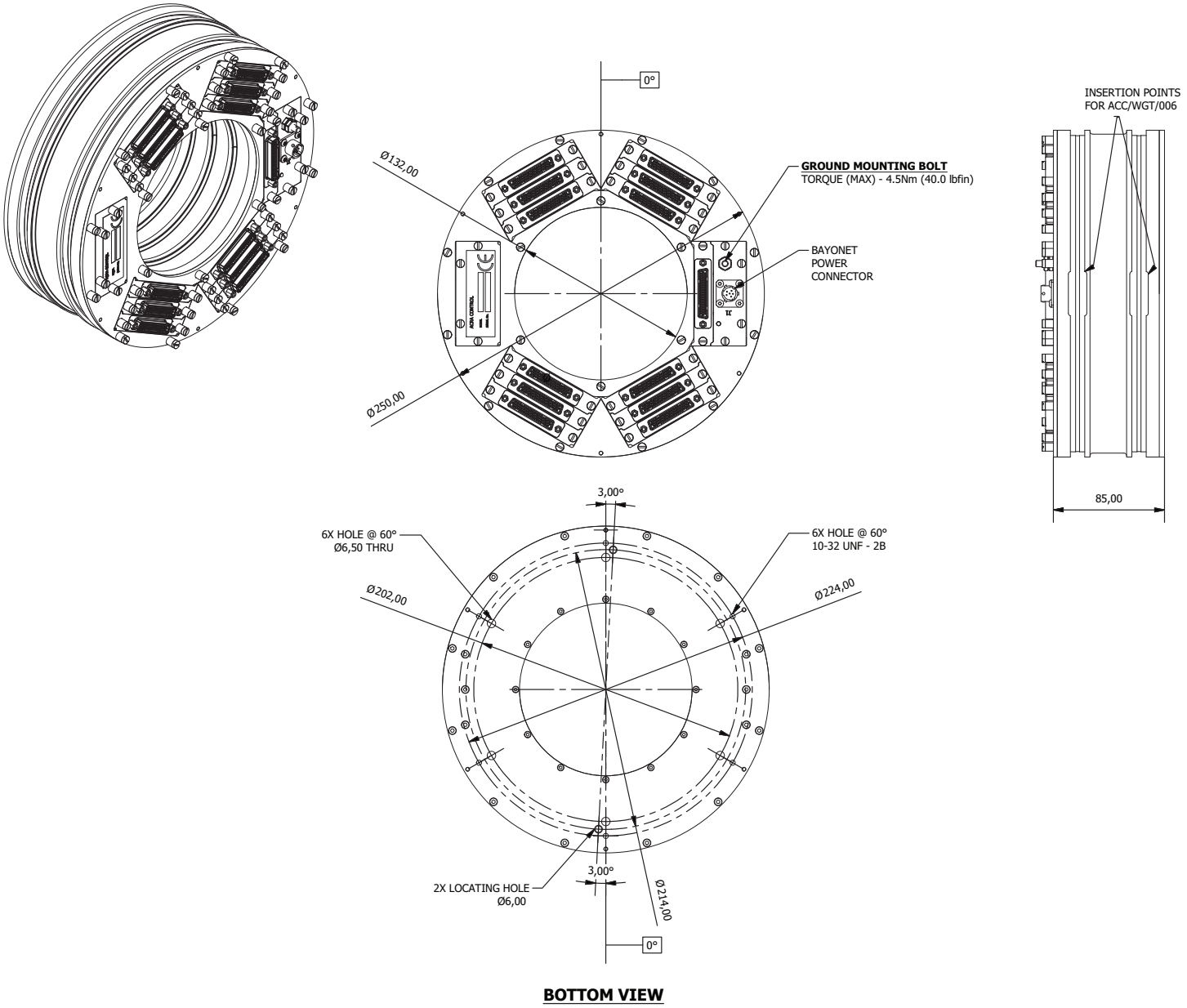


Figure 2: KAM/CHS/12R/E mechanical drawing

Getting the most from the KAM/CHS/12R

Curtiss-Wright recommends that balancing weights (ACC/WGT/006) be used (see the following figure).

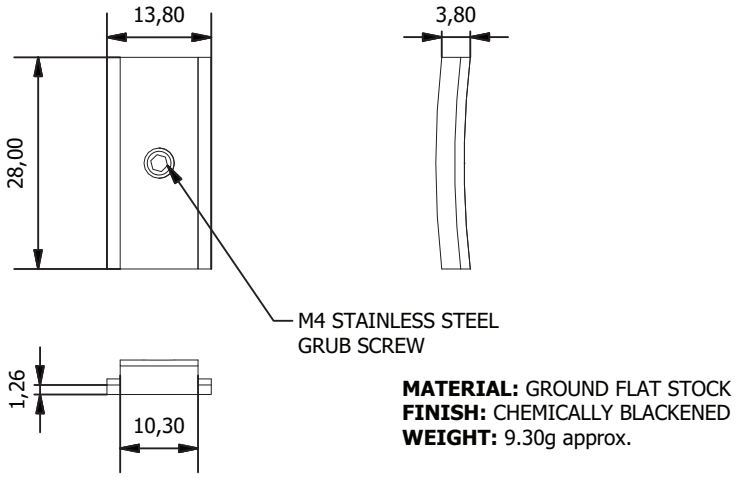


Figure 3: ACC/WGT/006 balancing weights

There are two dowel holes (6.00mm drilled H7 x 6mm deep), which are used as a guide for mounting the chassis. The dowel holes are labeled “Ref point A/B” in the following figure.

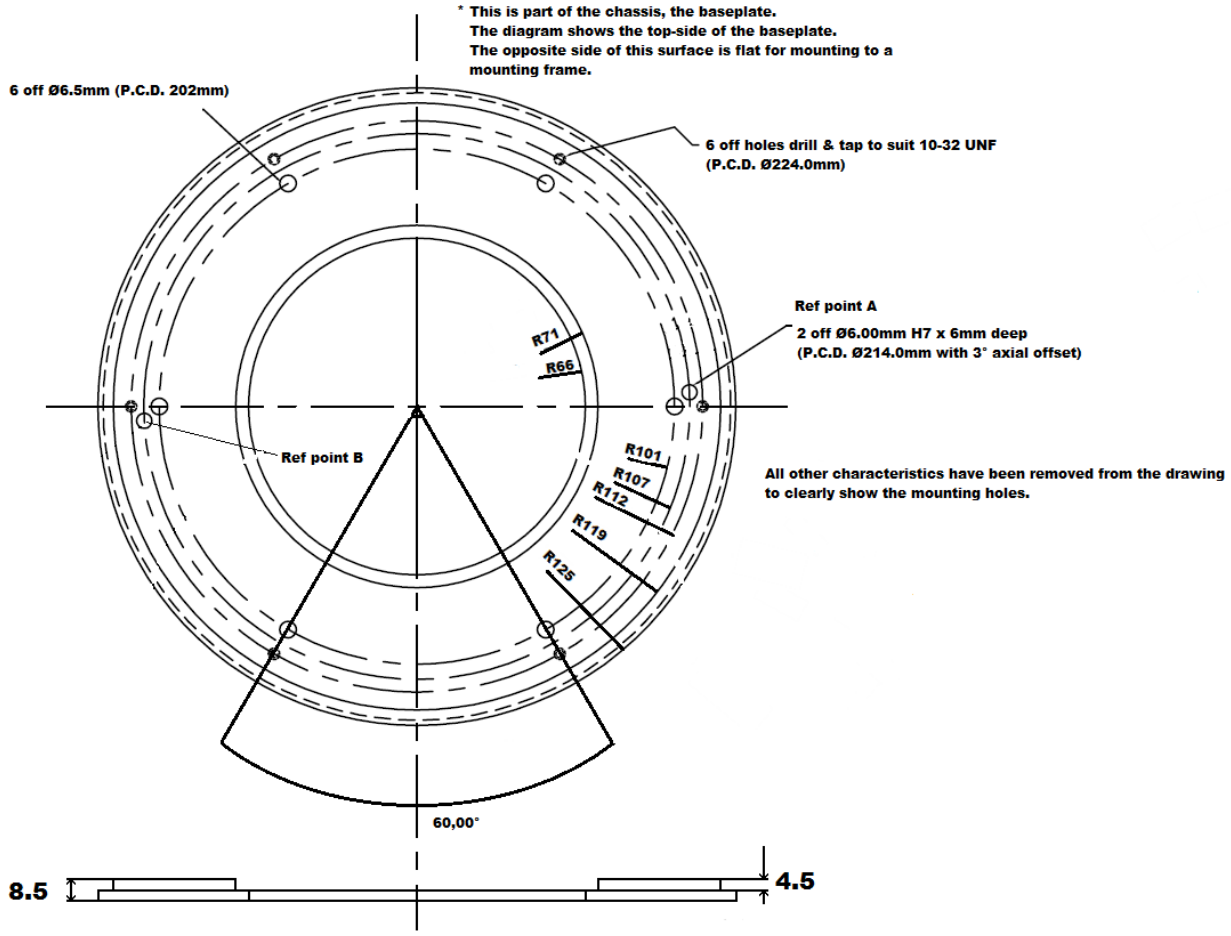


Figure 4: View of mounting holes for base plate

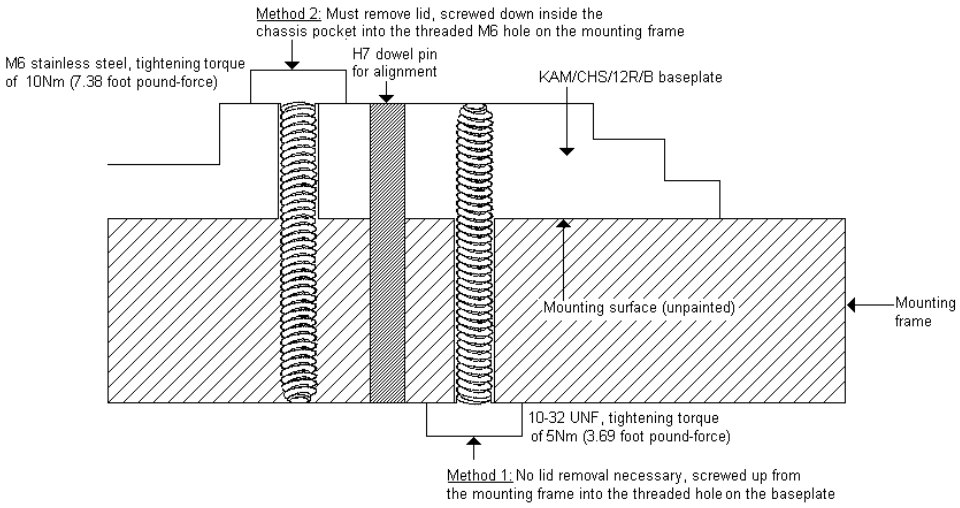


Figure 5: View of chassis mounting options

Chassis mounting

Method 1: A 10-32 UNF stainless steel bolt can be used to secure the chassis base plate from the mounting frame (recommended tightening torque of 5Nm [3.69 foot pound-force]).

Method 2: A 6mm stainless steel bolt can be used to secure the chassis base plate to the mounting frame after first removing the orange chassis lid and inserting the bolts through the pockets (recommended tightening torque of 10Nm [7.38 foot pound-force]).

Curtiss-Wright recommends the use of H7 dowel holes/pins for precision of assembly for both methods.

Connector pinout of the KAM/PSU/012

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	POWER+	Nominal KAM-500 28V supply	Isolated internally; aircraft power
2	POWER-	Return for nominal 28V	Isolated internally; aircraft power
3	CHASSIS	KAM-500 chassis	
4	GND	KAM-500 internal ground	
5	+12V	KAM-500 internal +12V	Current depends on internal loading
6	+5V	KAM-500 internal +5V	Current depends on internal loading

Ordering information

PART NUMBER	DESCRIPTION
KAM/CHS/12R/E	Acra KAM-500 circular form chassis with 12 user-slots

By default, the standard mating connector, CON/PSU/007/FL/100, is included with each chassis in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). Also included with each chassis in the shipment is ACC/WGT/006 - a bag of six weights which can be used for balancing.

Revision history

REVISION	DIFFERENCES	STATUS
KAM/CHS/12R/E	PSU upgraded to 5A on +5V power line	Recommended for new programs
KAM/CHS/12R/D	Includes KAM/PSU/012, 6-way bayonet connector, and supplies up to 4A on +5V power line	Not recommended for new programs
KAM/CHS/12R/D/MM	Includes KAM/PSU/011, 9-way micro-miniature connector, and supplies up to 4A on +5V power line	Not recommended for new programs
KAM/CHS/12R/C	Includes KAM/PSU/010 with diode for power-up, 6-way bayonet connector and LED	Not recommended for new programs
KAM/CHS/12R/C/MM	Includes KAM/PSU/009 with 9-way micro-miniature connector and diode for power-up	Not recommended for new programs
KAM/CHS/12R/B	Includes KAM/PSU/007 with 6-way bayonet connector and LED	Not recommended for new programs
KAM/CHS/12R	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related products

MODULE	DETAILS
ACM/LID/001	Spare user-slot lids and spare screws for the Acra KAM-500 system
KAM/PSU/012/B	+5V, ±7V and ±12V power supply unit for Acra KAM-500 chassis with 6-way connector

Related documentation

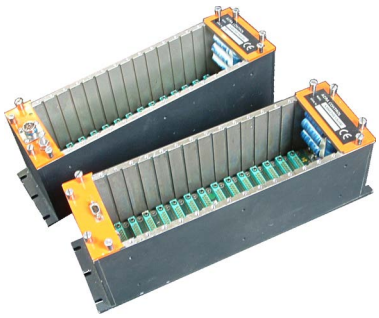
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation

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KAM/CHS/13U

Acra KAM-500 chassis - 13 user-slots

CURTISSWRIGHTDS.COM



Key Features

- Power supply unit and thirteen user-slots
- 18 to 40 VDC isolated power supply
- Rugged aluminum housing
- 8 MHz x 16-bit digital backplane
- Operates as master or slave in distributed system
- LED power-on indicator

Applications

- Flight test instrumentation systems

Overview

The KAM/CHS/13U is a thirteen user-slot Acra KAM-500 chassis, which along with the housing and backplane, includes a power supply module which regulates power supplies for the backplane (isolated 28V nominal in).

The backplane has thirteen connectors for user-modules, which are polarized to prevent the insertion of the backplane controller module. The backplane distributes power and connects address, data and control lines to the user-modules.

The only ICs on the backplane are demultiplexers for user-module select signal. Any user-module can be placed in any user-slot in any combination.

2.0A is available for bridge excitation.

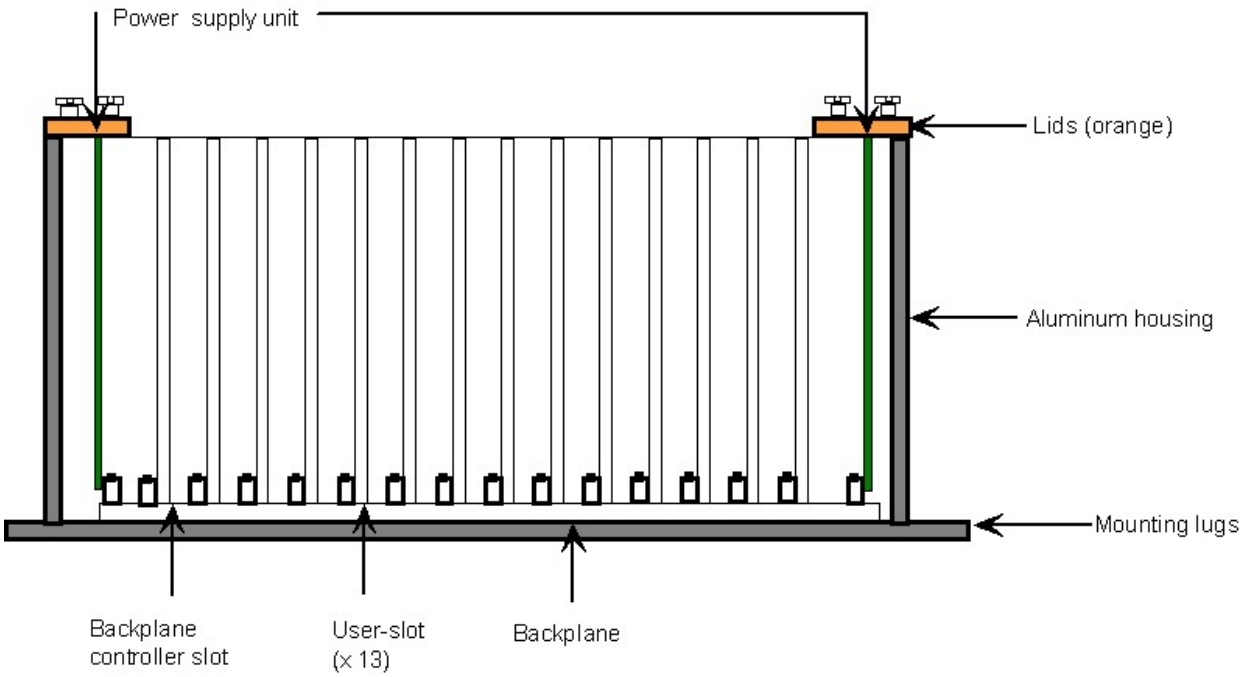


Figure 1: KAM/CHS/13U with PSU and thirteen user-slots

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
User slots	–	–	13	–	
Dimensions					Design metric is millimeters.
height	–	98.5	–	mm	Includes module retention screws and ground bolt.
height	–	3.88	–	in.	Includes module retention screws and ground bolt.
length	–	280	–	mm	Includes mounting lugs.
length	–	11.02	–	in.	Includes mounting lugs.
width	–	80	–	mm	Excludes heat sinks.
width	–	3.15	–	in.	Excludes heat sinks
Mass					Design metric is kilograms.
no modules	1.5	1.7	1.9	kg	Including power supply. For variations of the chassis listed in “Ordering information” on page 101, the mass ranges +/-200g.
no modules	3.3	3.75	4.19	lb	Includes power supply.
fully populated	2.5	2.7	2.9	kg	Typical module weight of 75g.
fully populated	5.51	5.95	6.39	lb	Typical module weight of 2.61 oz.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Finish					Electroless nickel-plated.
top parts	–	–	–	–	Painted REINORANGE RAL2004.
base, side and end plates	–	–	–	–	Painted black GRIGIO SCURO OPACO C604.
Chassis material	–	–	–	–	Aluminum alloy 6082-T6 (Din No: AlMgSi1).

Details and dimensions of this chassis, as shown in the following figure, refer to all variations listed in “Ordering information” on page 101; the 9-way micro-miniature PSU connector is the only difference.

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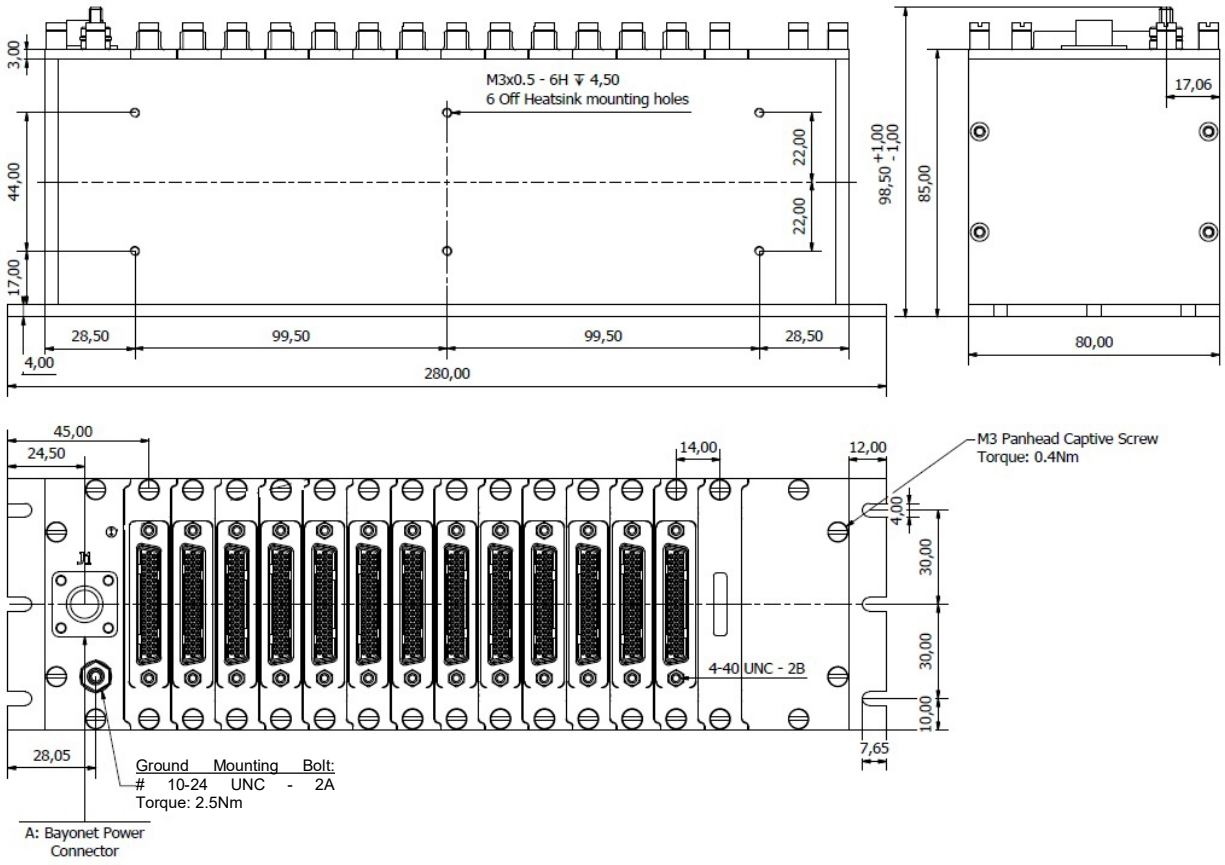


Figure 2: KAM/CHS/13U mechanical drawing

Getting the most from the KAM/CHS/13U

Where space permits, it is recommended that one or two heat sinks (ACC/HSK/001/13U) also be used. Heat sinks must be ordered separately.

Slot J2 is always reserved for the backplane controller module. A controller is required in slot J2 for control and programming of user-modules.

Connector pinout of the KAM/PSU/012/B and KAM/PSU/012/B/NC supplied with the KAM/CHS/13U and KAM/CHS/13U/NC

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	POWER+	Nominal 28V supply	Isolated internally; aircraft power
2	POWER-	Return for nominal 28V	Isolated internally; aircraft power
3	CHASSIS	Chassis	
4	GND	Internal ground	
5	+12V	Internal +12V	Current depends on internal loading
6	+5V	Internal +5V	Current depends on internal loading

Connector pinout of KAM/PSU/012/B/AG2 supplied with the KAM/CHS/13U/AG2

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	POWER+	Nominal 28V supply	Isolated internally; aircraft power
2	POWER-	Return for nominal 28V	Isolated internally; aircraft power
3	-12V	Internal -12V	Current depends on internal loading
4	GND	Internal ground	
5	+12V	Internal +12V	Current depends on internal loading
6	+5V	Internal +5V	Current depends on internal loading

Ordering information

PART NUMBER	DESCRIPTION
KAM/CHS/13U/E	Acra KAM-500 chassis - 13 user-slots
KAM/CHS/13U/E/AG2	Acra KAM-500 chassis - 13 user-slots (pin 3 connected to -12V)
KAM/CHS/13U/E/NC	Acra KAM-500 chassis - 13 user-slots (no brown out capacitor)

By default, the standard mating connector, CON/PSU/007/FL/100, is included with each chassis in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAM/CHS/13U refers to all variations of the chassis listed in the Ordering information table above. Spare lids (ACM/LID/001) for unused user-slots can be supplied. These are optional items and must be ordered separately; refer to Related products.

Revision history

REVISION	DIFFERENCES	STATUS
KAM/CHS/13U/E	PSU upgraded to 5A on +5V power line	Recommended for new programs
KAM/CHS/13U/D	PSU upgraded to 4A on +5V power line	Not recommended for new programs
KAM/CHS/13U/C	Includes KAM/PSU/010 with diode for power-up	Not recommended for new programs
KAM/CHS/13U/B	Includes KAM/PSU/007	Not recommended for new programs
KAM/CHS/13U	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related products

PRODUCT	DETAILS
ACC/HSK/001/13U	Optional heat sink for the Acra KAM-500 system
ACM/LID/001	Spare user-slot lids and spare screws for the Acra KAM-500 system
BAC/PSU/007	Backshell for CON/PSU/007
CON/PSU/007	6-way nickel-plated bayonet standard PSU mating connector
KAM/PSU/011/B	Power supply unit for Acra KAM-500 chassis (+5V, ±7V and ±12V) - 9-way connector
KAM/PSU/012/B	+5V, ±7V and ±12V power supply unit for Acra KAM-500 chassis with 6-way connector
KAM/PSU/012/B/AG2	+5V, ±7V and ±12V power supply unit for Acra KAM-500 chassis with -12V on power supply
KAM/PSU/012/B/NC	+5V, ±7V, and ±12V power supply unit for Acra KAM-500 chassis with glitch capacitors removed

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
DOC/HBK/002	Environmental Qualification Handbook
TEC/NOT/016	Power dissipation

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This document was reviewed on 14/10/2020 and does not contain technical data.

SAM/DEC/008

Ethernet based USB powered PCM decommutator

CURTISSWRIGHTDS.COM



Features

- IRIG-106 Ch. 4 compliant PCM decommutator
- USB 2.0 Type II compatible, no additional power source required
- 1Mbps programming link to Acra KAM-500 systems over X-PROG
- Choice of three PCM codes: BIØ-L, NRZ-L, or RNRZ-L-15
- Choice of RS-422 or TTL inputs
- Accepts PCM streams up to 10Mbps (8Mbps BIØ-L)
- 80 to 65,536 bits (including parity bits) per minor frame

Applications

- PCM decoding
- Programming legacy systems based on X-PROG

Overview

The SAM/DEC/008 decommutates IRIG-106 Ch.4 PCM streams and provides a high-speed programming link for Acra KAM-500 systems. The unit uses a single USB 2.0 connection in the ground station/programming PC.

The PCM decommutator accepts either differential ended RS-422 inputs or single ended TTL inputs. With BIØ-L codes only a single input is used. For other line codes, an additional data clock (DCLK) line is required. Any sync word up to 32 bits can be used to identify the start of a minor frame (including mask and alternating patterns). The SAM/DEC/008 can be configured with GS Works 8 or with custom APIs similar to those used with the SAM/DEC/007.

The programming link can be used to program multiple Acra KAM-500s. A bi-directional, differential ended (RS-422) pair of data lines (X-PROG) is used to transmit or receive data at 1Mbps.

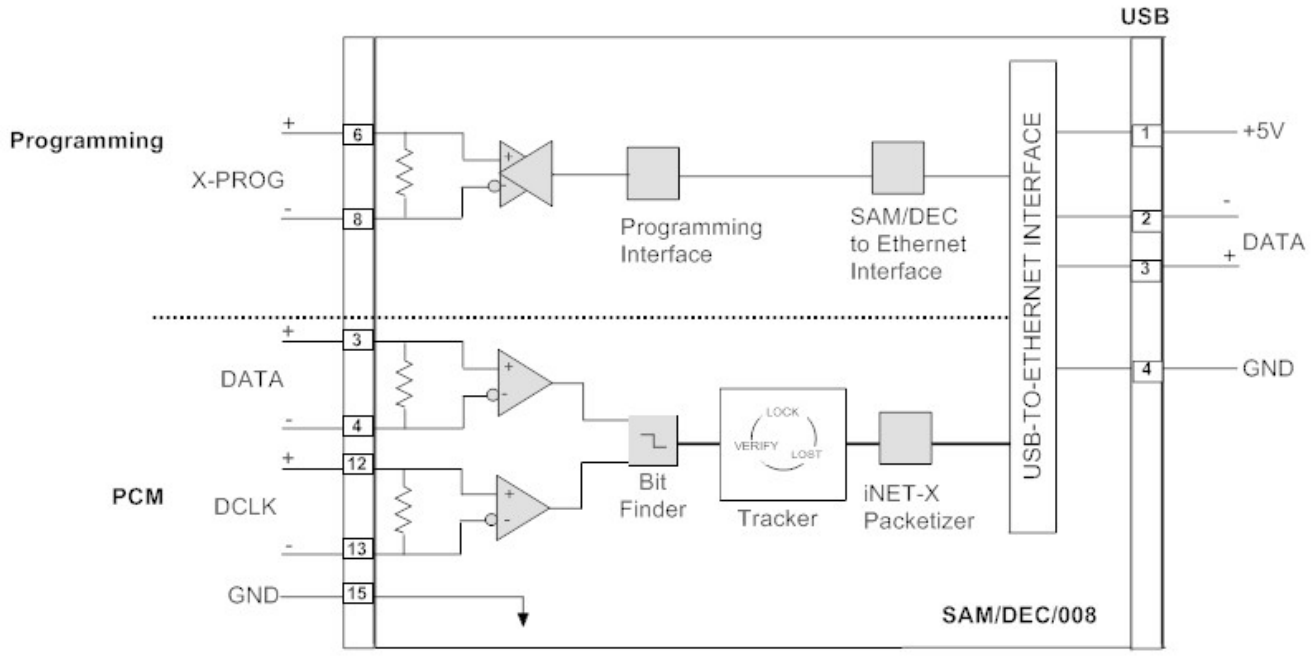


Figure 1: Programming link and differential ended PCM inputs

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	USB 2.0 compatible. Can be connected to any USB 2.0 port.
Mass					
	–	155	–	g	
	–	5.47	–	oz	Design metric is grams.
Power consumption					
+5V	–	500	–	mA	From USB port.
total power	–	2.5	–	W	
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	0	–	60	°C	Chassis base/side plate temperature.
storage temperature	-20	–	70	°C	

TABLE 2	BTTL inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	2	–	
Signaling rate					
DATA	–	–	10	Mbps	
DCLK	–	–	10	MHz	
Input voltage					
operating range	0	–	5.5	V	
logic 0	–	–	0.8	V	
logic 1	2	–	–	V	
overvoltage protection	0	–	5.5	V	Voltages outside of this range can damage input.
Input resistance					
each input to GND	–	27	–	MΩ	Module powered on.
each input to GND	–	53	–	kΩ	Module powered off.

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TABLE 3	RS-422 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	2	–	
Signaling rate					
DATA	–	–	10	Mbps	
DCLK	–	–	10	MHz	
Input voltage					
operating range	-7	–	12	V	Do not exceed operating range.
logic 0	–	–	0.2	V	V_{IN+} - V_{IN-}.
logic 1	0.2	–	–	V	V_{IN+} - V_{IN-}.
common mode voltage	-7	–	12	V	
overvoltage protection	-7	–	12	V	Voltages outside of this range can damage input.
ESD protection	-8	–	8	kV	Human Body Model.
Input resistance					
between inputs	–	120	–	Ω	Module powered on and inputs terminated.
between inputs	–	120	–	Ω	Module powered off and inputs terminated.
each input to GND	–	20	–	MΩ	Module powered on.
each input to GND	–	60	–	kΩ	Module powered off.

TABLE 4	RS-422 outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	1	–	
Signaling rate					
PROG_DCLK	–	1	–	MHz	
Output voltage					
absolute operating range	-0.3	–	6	V	Absolute voltage of the operating signal must stay within this range.
logic 0	–	–	-2	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
logic 1	2	–	–	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
common mode voltage	-7	–	12	V	
short circuit current	–	–	150	mA	
short circuit duration	∞	–	–	s	Only one output may be shorted at a time.
ESD protection	-15	–	15	kV	Human Body Model.
Output resistance	–	120	–	Ω	

TABLE 5	RS-485				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Channels	–	–	1	–	
Signaling rate					
X-PROG	–	–	1	Mbps	
Input voltage					
operating range	-7	–	12	V	
logic 0	–	–	0.2	V	V_{IN+} - V_{IN-}.
logic 1	0.2	–	–	V	V_{IN+} - V_{IN-}.
common mode voltage	-7	–	12	V	
overvoltage protection	-7	–	12	V	Voltages outside of this range can damage input.
ESD protection	-15	–	15	kV	Human Body Model.
Output voltage					
operating range	-7	–	12	V	
logic 0	–	–	-2	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
logic 1	2	–	–	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
common mode voltage	-7	–	12	V	
short circuit current	–	–	250	mA	
short circuit duration	∞	–	–	s	Only one output may be shorted at a time.
Input resistance					
between inputs	–	120	–	Ω	Module powered on and inputs terminated.
between inputs	–	120	–	Ω	Module powered off and inputs terminated.
each input to GND	–	20	–	MΩ	Module powered on.
each input to GND	–	60	–	kΩ	Module powered off.
Output resistance	–	120	–	Ω	

Setting up the SAM/DEC/008

Input type:	Differential ended (RS-422) or single ended (TTL)
Code:	BIØ-L or NRZ-L, RNRZ-L-15 and DCLK and polarity (true/false)
Bit-rate:	BIØ-L (1,000bps to 8Mbps) and NRZ-L, RNRZ-L-15 and DCLK (350bps to 10Mbps).
Word definition:	Data bits per word (4 to 16), Orientation (MSB first/last), Parity (Odd/even/none)
Syncword:	32 bits, plus mask, plus lock on true and inverse

Getting the most from the SAM/DEC/008

The SAM/DEC/008 is designed as an Ethernet-based device and is connected to a PC through a USB-to-Ethernet controller. It can be connected to a USB 2.0 port on any PC or laptop.

NOTE: In the event your USB port does not supply enough power, you may need to use an externally powered USB hub to connect the SAM/DEC/008.

Software such as DAS Studio 3 or KSM-500 configures an extra network connection during programming of an Acra KAM-500 chassis.

You must ground any RS-422 signals that are the source of the PCM stream or you must ground the Acra KAM-500 that is being programmed. This ensures the RS-422 signals do not float with respect to the SAM/DEC/008. For details on grounding, see *TEC/NOT/063 - Grounding and shielding of the Axon and Acra KAM-500*.

NOTE: Even though the SAM/DEC/008 supports 10 Mbps in NRL-L (RNZL-15), the decommutation software and/or the PC specifications may degrade this performance.

Drivers installation

The SAM/DEC/008 is detected by the operating system as a LAN9500 USB-to-Ethernet controller, and by default, drivers are automatically installed. However, depending on the operating system or security settings, drivers may need to be manually installed. In this case the drivers can be downloaded from the following website:

http://www.microchip.com/SWLibraryWeb/producttc.aspx?product=OBJ-LAN95xx-WINDOWS

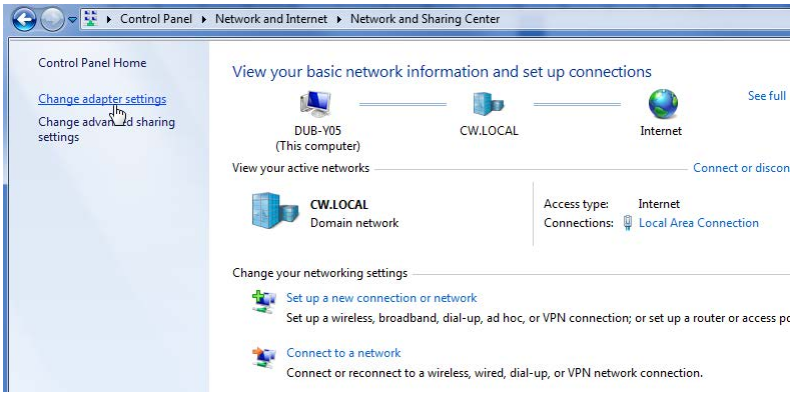
IP address considerations

Once installed, the hardware is displayed in Network Connections as a new network connection: LAN9500A USB2.0 to Ethernet 10/100 adapter (LAN9500A adapter).

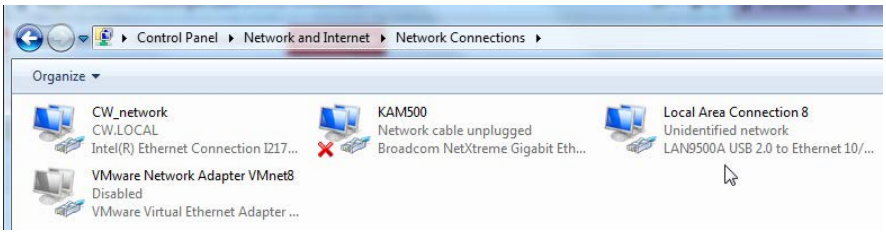
The IP address of the LAN9500A adapter incremented by 1, is automatically assigned to the SAM/DEC/008. To prevent these IP addresses from changing, ensure the LAN9500A adapter uses a static IP address. If it uses a dynamic (DHCP) IP address, its IP address may change when the PC is restarted. This in turn would change the IP address of the SAM/DEC/008, and could cause a network conflict.

Refer to the following to ensure the LAN9500A adapter has a static IP address:

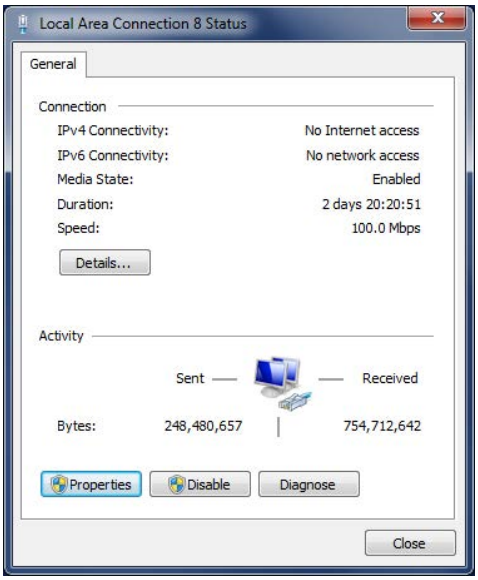
1. Go to **Control Panel** -> **Network and Internet** -> **Network and Sharing Center**.



2. Click **Change adapter settings**.

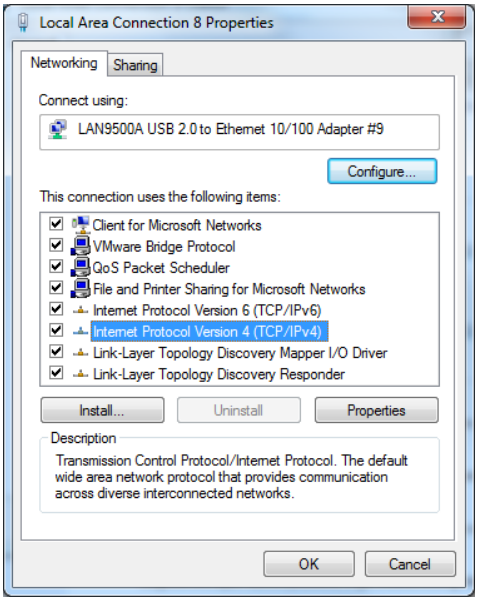


3. Right-click **Local Area Connection (LAN9500A USB2.0 to Ethernet)** and then click **Properties**.

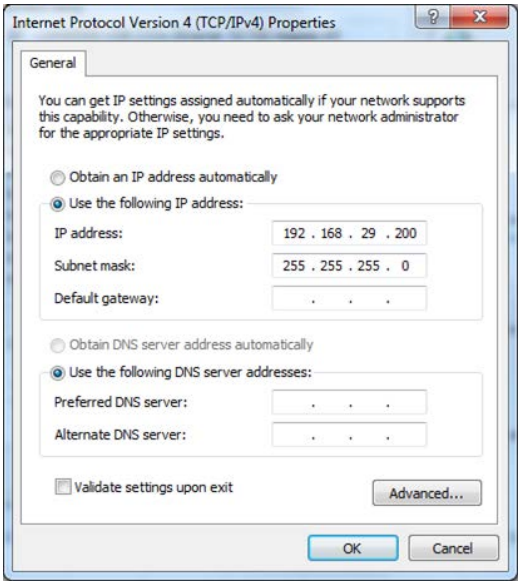


4. In the Local **Area Connection 8 Status dialog, click Properties.**

5. Select **Internet Protocol Version 4 (TCP/IPv4)** and then click **Properties**.

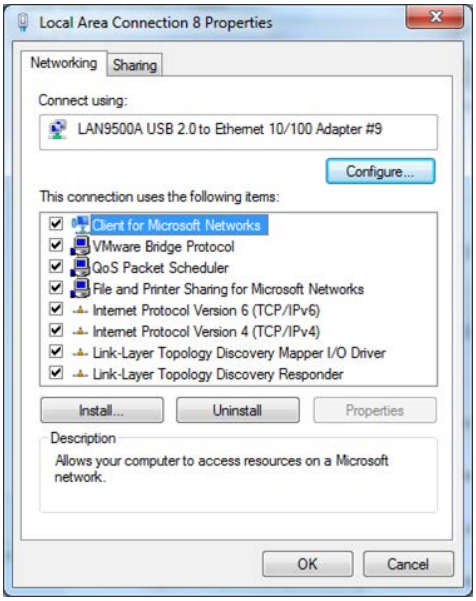


6. Click the **Use the following IP address** radio button and then type the IP address you want.

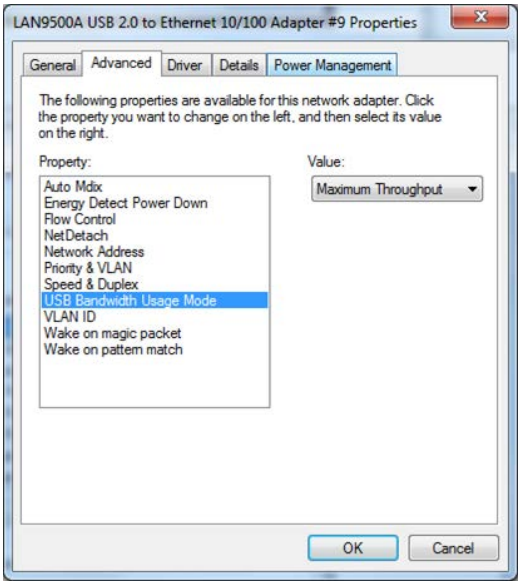


For example, if you use the IP address shown above, then the IP address of the SAM/DEC/008 will be 192.168.29.201.

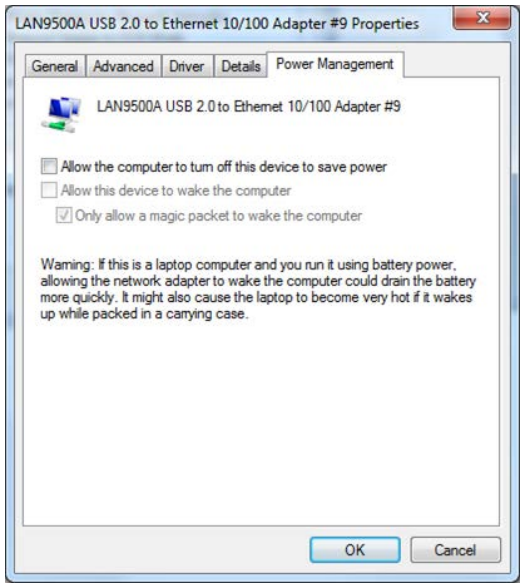
7. Click **OK**.



8. Select **Client for Microsoft Networks** and then click **Configure**.



9. In the **LAN9500A USB 2.0** properties dialog, select **USB Bandwidth Usage Mode** and then select **Maximum Throughput** from the drop-down menu.



10. On the **Power Management** tab, ensure **Allow the computer to turn off this device to save power** is not enabled.

Windows Firewall

Because Ethernet packets are sent and received across networks, you may need to configure your Windows Firewall settings to allow the SAM/DEC/008 to send and receive data.

Status LEDs

The SAM/DEC/008 has two status LEDs: a USB link LED and a PCM decom LED. Refer to the following table for LED descriptions.

LED	RED	BLUE	YELLOW	GREEN	PURPLE
USB link	Reset	System programming	Reserved	ARP - IP address configured and ready for use	SAM/DEC/008 configuration being loaded
PCM (decom)	No PCM lock[1]	N/A	Internal frame engine reset	PCM Decom lock (sync word found)	DCLK seen/recovered but no SYNC detected

1. The SAM/DEC/008 is a minor frame decoder, therefore PCM decom lock means minor frame lock. During normal operation of the SAM/DEC/008, this LED and the USB link LED should be green.

Connector pinout of the SAM/DEC/008

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DATA	BTTL inputs	PCM data stream; single ended alternative to pins 3 and 4
2	DCLK	BTTL inputs	PCM bit clock; single ended alternative to pins 12 and 13
3	DATA+	RS-422 inputs	PCM data stream; differential ended alternative to pin 1
4	DATA-	RS-422 inputs	PCM data stream; terminated by 120Ω resistor
5	DNC		Do not connect
6	X-PROG+	RS-485	Programming data; terminated by 120Ω resistor
7	DNC		Do not connect
8	X-PROG-	RS-485	Programming data; terminated by 120Ω resistor
9	DNC		Do not connect
10	DNC		Do not connect
11	DNC		Do not connect
12	DCLK+	RS-422 inputs	PCM bit clock; differential ended alternative to pin 2
13	DCLK-	RS-422 inputs	PCM bit clock; terminated by 120Ω resistor
14	DNC		Do not connect
15	GND	Internal ground	

Ordering information

PART NUMBER	DESCRIPTION
SAM/DEC/008	Ethernet based USB powered PCM decommutator

By default, a CON/USB/006 and an ACC/CON/012/00 cable are included with each SAM/DEC/008 card in the shipment. These part numbers will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). As well as the CON/USB/006 and ACC/CON/012/00 cables, an ACC/ASY/022 cable is needed for use with a PCM controller module; unless ordered, the ACC/ASY/022 is not included in the shipment.

Revision history

REVISION	DIFFERENCES	STATUS
SAM/DEC/008	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools
SWP/SDK/004	Software Development Kit for SAM/DEC/008

Related products

PRODUCT	DETAILS
GS Works 8	Real-time and post-test data visualization and analysis software for GTS-500

Related documentation

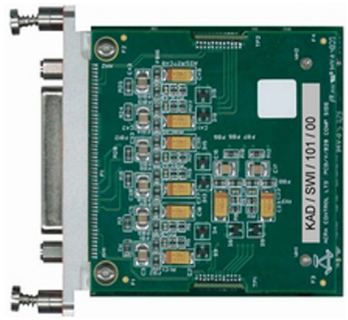
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/010	SAM/DEC programming interface
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/063	Grounding and shielding of the Acra KAM-500

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KAD/SWI/101

Ethernet switch - 3 to 1 aggregator



Key Features

- Four-port Ethernet network switch using a standard 52-way double-density connector
- 100BaseTX Ethernet links over copper wiring
- Store-and-forward operation
- Three-port to one-port link aggregation
- IEEE 1588v1 support with transparency mode of operation
- Live at power-up (static internal routing; no MAC address learning time delays)

Applications

- Airborne interconnection for data acquisition units and network data recorders in an Ethernet environment

Overview

The KAD/SWI/101 is a four-port 100BaseTX Ethernet switch designed for operating in harsh environments. Up to four Ethernet end nodes can be connected to the switch using CAT5 copper cabling with full-duplex connectivity between each of the three ingress ports and the egress or aggregator port.

The KAD/SWI/101 has a store-and-forward switching architecture; incoming Ethernet frames from the three input (ingress) Ethernet ports are stored before they are forwarded out on the aggregator Ethernet port. Both 802.3 and Ethernet II 802.1Q tagged frames are supported. The maximum-sized and minimum-sized Ethernet frames processed by the KAD/SWI/101 are 1522 bytes and 64 bytes respectively.

The KAD/SWI/101 transparently supports IEEE 1588v1 Precision Time Protocol (PTP) messages. This provides a greater degree of synchronization accuracy than would be achieved using a non-1588 switch, even under heavy network traffic conditions. For example, typically better than ±100ns error, when connecting with Curtiss-Wright's KAD/BCU/105 and KAD/BCU/140 (Ethernet backplane controller) is possible.

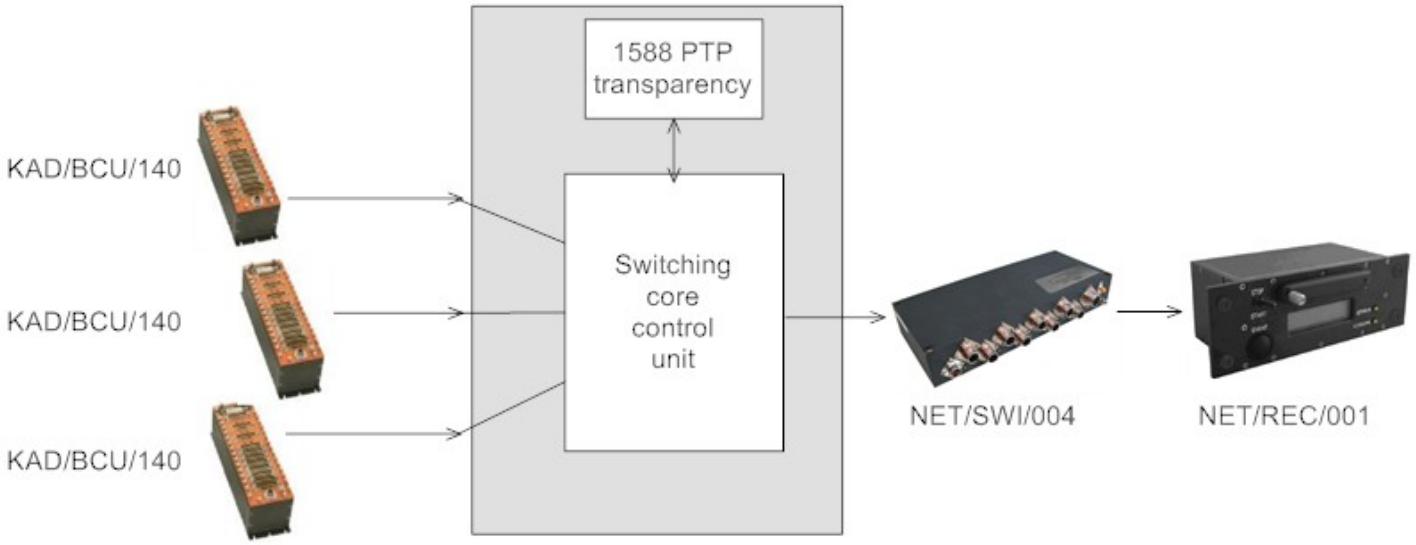


Figure 1: 3-to-1 aggregator Ethernet switch module

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	74	–	g	
	–	2.6	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	251	–	465	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	1.25	–	2.33	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Throughput	–	–	80	Mbps	
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Ethernet interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs/outputs	–	–	4	–	IEEE 802.3 compatible.

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Setting up the KAD/SWI/101

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/SWI/101	KAD/SWI/101	The instrument part reference.
SerialNumber	FA1234	FA1234	Unique name for each module.
Channels	-	-	-
DAU-Port(2:0) Ethernet Input	-	-	Input (ingress) port.
Aggregator-Port Ethernet Output	-	-	Output (egress) port that forwards the Ethernet frames received on the DAU ports.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
DAU-Port(2:0) Parameters				
DauActivity Number of packets received at this DAU port in the last second.	Count	OffsetBinary	16	R[15:0]
Aggregator-Port Parameters				
AggregatorActivity Number of packets received at aggregator port in the last second.	Count	OffsetBinary	16	R[15:0]

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/SWI/101

Network port mapping

TABLE 3	Port allocations	
PORT #	PORT ROLE	DESCRIPTION
0	DAU port	Input (ingress) port. Ethernet frames received on the DAU ports are stored and aggregated to be forwarded out the aggregator port. Typical Curtiss-Wright devices attached to the DAU port include: Ethernet controllers KAD/BCU/105 and KAD/BCU/140.
1	DAU port	Input (ingress) port. See port 0.
2	DAU port	Input (ingress) port. See port 0.
3	Aggregator port	Output (egress) port. Ethernet frames received from the DAU ports are forwarded and transmitted out on the aggregator port. Typical Curtiss-Wright devices attached to the aggregator port include: switches NET/SWI/001 and NET/SWI/004; recorders NET/REC/001 and SSR/CHS/001; and Ethernet bus monitor KAD/EBM/101.

Connector pinout of the KAD/SWI/101

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DNC		Do not connect
2	DNC		Do not connect
3	RX(3)-	Ethernet interface	DAU port 0
4	RX(3)+	Ethernet interface	DAU port 0
5	TX(3)-	Ethernet interface	DAU port 0
6	TX(3)+	Ethernet interface	DAU port 0
7	DNC		Do not connect
8	DNC		Do not connect
9	CHASSIS	Chassis	
10	DNC		Do not connect
11	DNC		Do not connect
12	RX(2)-	Ethernet interface	DAU port 1
13	RX(2)+	Ethernet interface	DAU port 1
14	TX(2)-	Ethernet interface	DAU port 1
15	TX(2)+	Ethernet interface	DAU port 1
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	RX(1)-	Ethernet interface	DAU port 2
22	RX(1)+	Ethernet interface	DAU port 2
23	TX(1)-	Ethernet interface	DAU port 2
24	TX(1)+	Ethernet interface	DAU port 2
25	DNC		Do not connect
26	DNC		Do not connect
27	CHASSIS	Chassis	
28	DNC		Do not connect
29	DNC		Do not connect
30	RX(0)-	Ethernet interface	Aggregator port
31	RX(0)+	Ethernet interface	Aggregator port
32	TX(0)-	Ethernet interface	Aggregator port
33	TX(0)+	Ethernet interface	Aggregator port
34	DNC		Do not connect
35	DNC		Do not connect
36	CHASSIS	Chassis	
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	CHASSIS	Chassis	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/SWI/101	Ethernet switch - 3 to 1 aggregator

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/SWI/101	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related products

SOFTWARE	DETAILS
NET/CON/004	100/1000BaseT Ethernet cable (30cm long) terminated with KAD connector (shield connected to chassis)

Related documentation

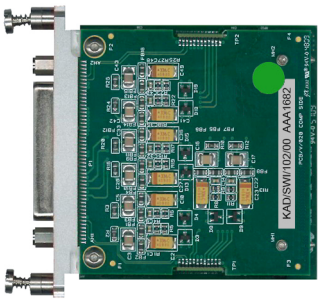
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
TEC/NOT/065	Using the KAD/SWI/101

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KAD/SWI/102

4-port Ethernet switch module with a dedicated programming port

CURTISSWRIGHTDS.COM



Key Features

- Four-port Ethernet network switch using a standard 52-way double-density connector
- 100BaseTX Ethernet links over copper wiring with auto-negotiation
- Store-and-forward operation
- Two-port to two-port link aggregation
- Additional port for programming or monitoring
- IEEE 1588v1 support with transparency mode of operation

Applications

- Airborne interconnection for data acquisition units and network data recorders in an Ethernet environment

Overview

The KAD/SWI/102 is a four-port Ethernet switch designed for operating in harsh environments and includes two input 100BaseTX ports aggregated to two 100BaseTX aggregator ports, one of which can be used as a dedicated programming port.

The KAD/SWI/102 has a store-and-forward switching architecture; incoming Ethernet frames from both ingress Ethernet ports are stored before they are forwarded out on the egress Ethernet port. The remaining fourth port is a dedicated programming port that may be used to program the system through the module. The hard-wired routing in the KAD/SWI/102 controls the flow of Ethernet frames being switched through the module. In this way, it can ensure that no Ethernet frames are returned to the external network. The KAD/SWI/102 has a network activity register associated with each Ethernet port. This register counts packets forwarded through the ports during a one second interval and can be read over the backplane. The KAD/BIT/102 module uses this register to identify when network link problems occur.

The KAD/SWI/102 transparently supports IEEE 1588 Precision Time Protocol version 1 messages. This provides a greater degree of synchronization accuracy than would be achieved using a non-1588 switch, even under heavy network traffic conditions. For example, ±100ns error (typically), when connected to a KAD/BCU/105/C (Ethernet backplane controller) is possible.

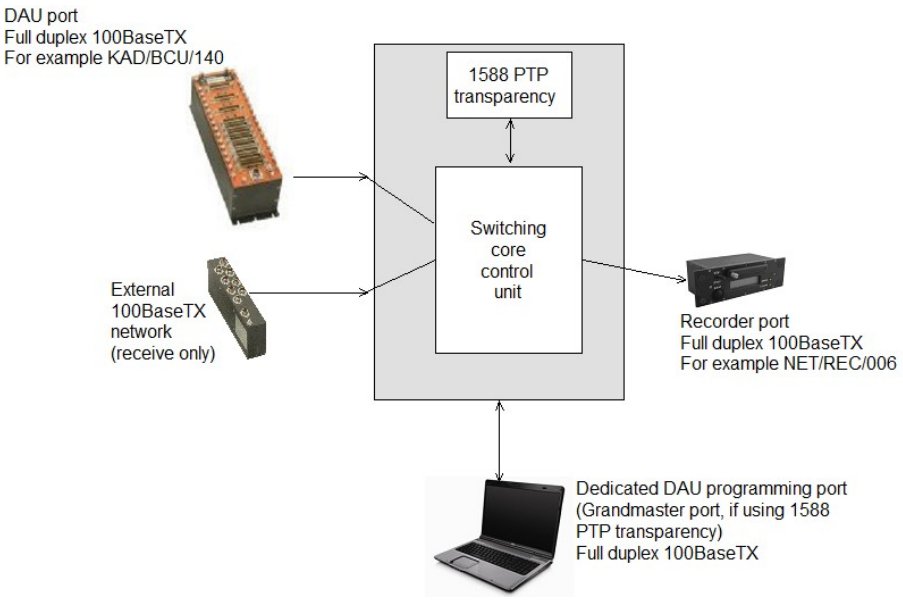


Figure 1: Four-port Ethernet switch

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	90	–	g	
	–	3.17	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	328	–	493	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	1.64	–	2.47	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Throughput	–	–	80	Mbps	
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Ethernet interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs/outputs	–	–	4	–	IEEE 802.3 compatible.

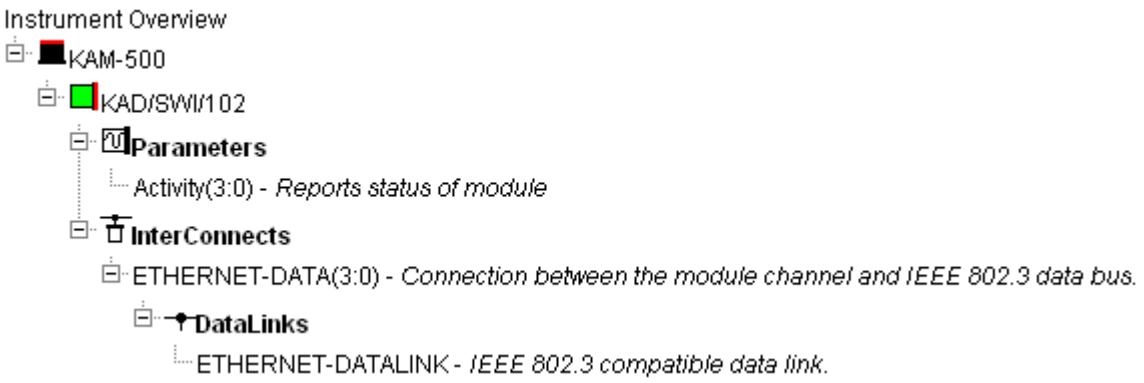
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Setting up the KAD/SWI/102

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

The following treeview provides an overview of setup configurations available for this module:

Treeview icons legend	
DAU: Data Acquisition Unit	Indicator: Indicates the firing of an event based on specific conditions
PC: Personal Computer	Parser slot: Area of memory reserved for storing parsed data
Instrument: Any component or module used in a data acquisition system	Snarfer: Captures all data transmitted on a bus and selectively stores it
DataLink: Connection for transmitting or receiving (defines both the data link and the physical layer)	Bridge: Electrical circuit usually used for measuring purposes
Package: Used to describe how data is transmitted or stored	PCMCIA card: Peripheral interface device usually for use in laptop computers
Parameter: Any register that can be read from an instrument	Multiplexer: Selects one of many input signals and outputs that signal on a signal line
Algorithm: Defines processing to be performed on data	Channels: Defines settings for input or output channels on an instrument
InterConnect: Represents a physical connection on an instrument	
PCI card: Circuit board that plugs into the PCI bus on a PC	



Setting up the module

The following table lists the setup configurations available for the KAD/SWI/102.

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/SWI/102	KAD/SWI/102	ACRA CONTROL part number.
SerialNumber	-	-	Unique name for each module.
InterConnects ETHERNET-DATA(3:0)	No character limit	Not Specified	Connection between the module channel and IEEE 802.3 data bus.

Setting up parameters

Parameter definitions

The following table lists all parameters that are available for the KAD/SWI/102.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Activity(3:0) Reports status of module	Count	OffsetBinary	16	Number of packets received on each port in the previous second.

Setting up data links

A data link is a connection for transmitting and receiving data. It defines both the data link and physical layers of the link. The following are data links supported by the KAD/SWI/102.

Non-programmable data links

NAME	DESCRIPTION
ETHERNET-DATA(3:0)	IEEE 802.3 compatible data link.

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/SWI/102

Network port mapping

PORT #	PORT ROLE	DESCRIPTION
0	DAU	Connected to a DAU (for example KAD/BCU/140). Traffic at this port is forwarded to the programming and recorder ports. Only the programming port can transmit to this port.
1	External	Can be used to monitor an external 100BaseTX network. This port is receive only and all packets received are forwarded to the programming and recorder ports.
2	Programming	Programming port. A PC can be connected to this port and used to program the DAU and recorder ports. All traffic at ports 0, 1 and 3 is relayed to this port so it can be used to monitor the system in real-time, or connected to an ingress port of a network switch (for example NET/SWI/001).
3	Recorder	Recorder port. All traffic on ports 0, 1 and 2 is forwarded to this port. This port can only transmit to the programming port.

Routing paths

The following figure illustrates the internal routing paths of the KAD/SWI/102.

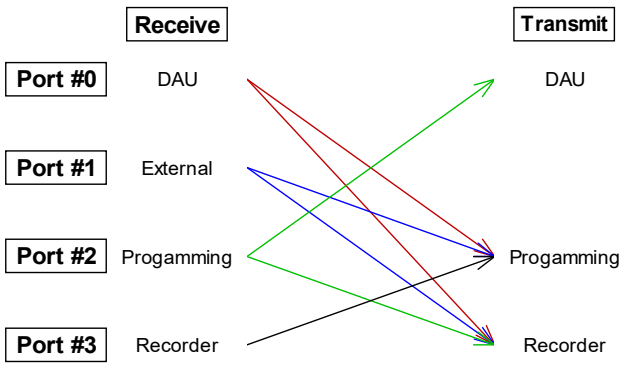


Figure 2: Internal routing

Connector pinout of the KAD/SWI/102

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DNC		Do not connect
2	DNC		Do not connect
3	RX(0)-	Ethernet interface	DAU interface to KAD/BCU/140 (for example)
4	RX(0)+	Ethernet interface	DAU interface to KAD/BCU/140 (for example)
5	TX(0)-	Ethernet interface	DAU interface to KAD/BCU/140 (for example)
6	TX(0)+	Ethernet interface	DAU interface to KAD/BCU/140 (for example)
7	DNC		Do not connect
8	DNC		Do not connect
9	CHASSIS	Chassis	
10	DNC		Do not connect
11	DNC		Do not connect
12	RX(1)-	Ethernet interface	External 100BaseTX RX only
13	RX(1)+	Ethernet interface	External 100BaseTX RX only
14	TX(1)-	Ethernet interface	External 100BaseTX RX only
15	TX(1)+	Ethernet interface	External 100BaseTX RX only
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	RX(2)-	Ethernet interface	Aggregator/broadcast port (programming)
22	RX(2)+	Ethernet interface	Aggregator/broadcast port (programming)
23	TX(2)-	Ethernet interface	Aggregator/broadcast port (programming)
24	TX(2)+	Ethernet interface	Aggregator/broadcast port (programming)
25	DNC		Do not connect
26	DNC		Do not connect
27	CHASSIS	Chassis	
28	DNC		Do not connect
29	DNC		Do not connect
30	RX(3)-	Ethernet interface	Aggregator port (recorder)
31	RX(3)+	Ethernet interface	Aggregator port (recorder)
32	TX(3)-	Ethernet interface	Aggregator port (recorder)
33	TX(3)+	Ethernet interface	Aggregator port (recorder)
34	DNC		Do not connect
35	DNC		Do not connect
36	CHASSIS	Chassis	
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	CHASSIS	Chassis	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/SWI/102	4-port Ethernet switch module with a dedicated programming port

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Network Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/SWI/102	First release	Recommended for new programs

Supporting software

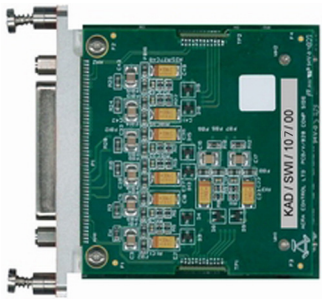
SOFTWARE	DETAILS
KSM-500	This module is only supported by using KC.exe with low level XID files.

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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Key Features

- Four Ethernet ports configured as two tap ports, 10BaseT or 100BaseTX (ingress); and two aggregator/monitor ports, 100BaseTX (egress)
- Ethernet traffic is forwarded between the ports of the tap port pair using a straight-through connection and a copy is forwarded to both of the aggregator/monitor ports using a store-and-forward operation
- Live at power-up (static internal routing; no MAC address learning time delays)

Applications

- Airborne network tap to aggregate data from an external aircraft 10/100BaseTX Ethernet network

Overview

The KAD/SWI/107 is an Ethernet tap module designed for operating in harsh environments. All connections use copper cabling, minimum specification CAT5.

Two individual ports of the KAD/SWI/107, which together implement a tap on the Ethernet link, are referred to as a tap port pair. One of these ports is referred to as the tap port; the other port is referred to as the paired tap port.

The tap port pair may be configured as 10BaseT or 100BaseTX and connect to the external Ethernet network. The pair of aggregator/monitor ports can only be 100BaseTX and connect directly to an Ethernet sink device such as a NET/REC/001 or a KAD/EBM/101.

The KAD/SWI/107 provides an active non-intrusive mechanism to monitor the traffic on an external network. Traffic received on each of the tap ports is forwarded to both of the aggregator/monitor ports and the paired tap port. The traffic forwarded to both the aggregator/monitor ports is identical, which allows for the data to be simultaneously recorded, analyzed, displayed, and parsed. Traffic received on the aggregator/monitor ports is not forwarded to the tap port pair.

There is a network activity register for each tap port that counts the number of packets received through each port and the packets forwarded through the other three ports during a one-second interval. Both registers can be read over the backplane.

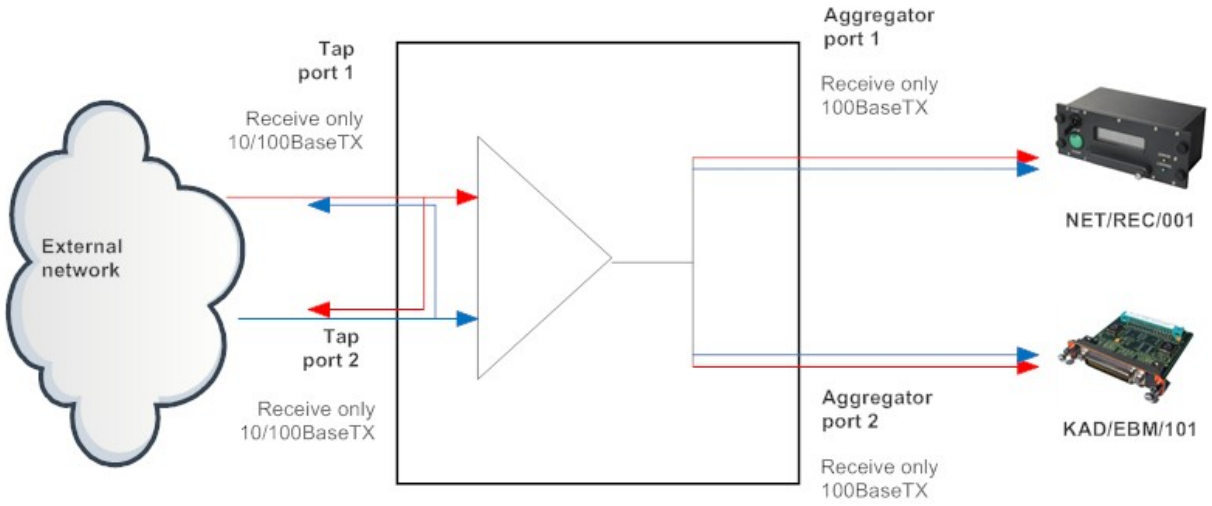


Figure 1: Four-port Ethernet tap module

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	90	–	g	
	–	3.2	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	308	–	464	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	1.54	–	2.32	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation*, *TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Throughput	–	–	70	Mbps	
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Ethernet interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs/outputs	–	–	4	–	IEEE 802.3 compatible.

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Setting up the KAD/SWI/107

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/SWI/107	KAD/SWI/107	The instrument part reference.
SerialNumber	FA1234	FA1234	Unique name for each module.
Settings	-	-	-
TAP Speed	10 100	100	-
Channels	-	-	-
TAP-Port(1:0) Ethernet bi-directional	-	-	TAP port.
Aggregator-Port(1:0) Ethernet Output	-	-	Output (egress) port that forwards the Ethernet frames received on the TAP ports.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
TAP-Port(1:0) Parameters				
TAPActivity Number of packets received in the last second.	Count	OffsetBinary	16	R[15:0]

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/SWI/107

Network port mapping

The ports are defined as follows:

- Tap port: Input (ingress) port. Ethernet frames received on each tap port are forwarded directly to the other tap port.
- Aggregator/monitor port: Output (egress) port. Ethernet frames received on both tap ports are stored and aggregated to be forwarded out via the monitor port. Each of the monitor ports has an identical copy of the Ethernet frames to be forwarded. The forwarded Ethernet frames can be received by multiple sink Ethernet end nodes and allows the simultaneous recording, processing, and displaying of Ethernet frames. Typical Curtiss-Wright devices attached to the aggregator port include: NET/REC/002, SSR/CHS/002, and KAD/EBM/101.

WARNING: The Aggregator/Monitor ports are for listening only; driving data into these ports can result in data droppage.

TABLE 3 Port allocations

PORT # RANGE	PORT ROLE	PORT SPEED	DESCRIPTION
1 to 2	Tap (ingress)	10BaseT/100BaseTX	Tap port that forwards the Ethernet frames received on the other tap port.
3 to 4	Aggregator/monitor (egress)	100BaseTX	Monitor port that aggregates and transmits Ethernet frames from the tap ports.

Routing paths

The following figure illustrates the internal routing paths of the KAD/SWI/107.

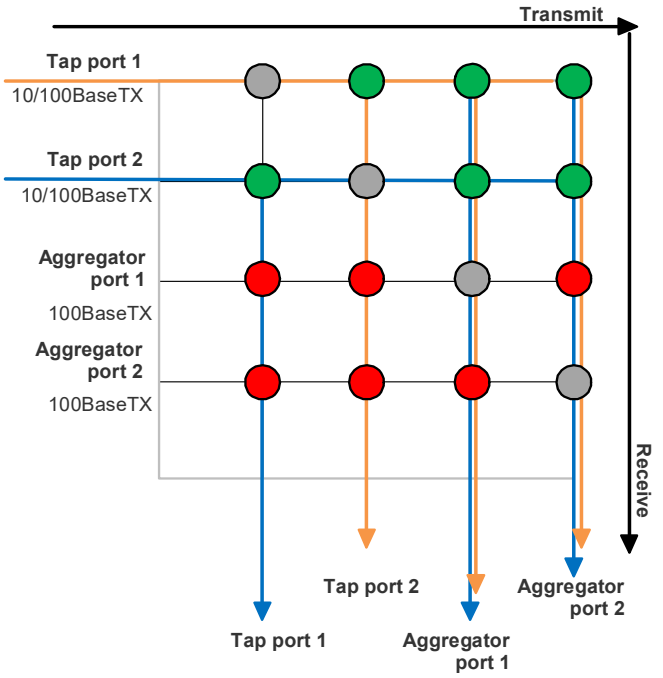


Figure 2: Internal routing

WARNING: All network connections in use during any loss of power recover automatically when power is resumed. However, traffic through the tap connection is interrupted during a power outage. We recommend that the KAD/SWI/107 is not used to tap a critical network link.

Connector pinout of the KAD/SWI/107

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DNC		Do not connect
2	DNC		Do not connect
3	RX(1)-	Ethernet interface	Tap port 1, 10BaseT/100BaseTX
4	RX(1)+	Ethernet interface	Tap port 1, 10BaseT/100BaseTX
5	TX(1)-	Ethernet interface	Tap port 1, 10BaseT/100BaseTX
6	TX(1)+	Ethernet interface	Tap port 1, 10BaseT/100BaseTX
7	DNC		Do not connect
8	DNC		Do not connect
9	CHASSIS	Chassis	
10	DNC		Do not connect
11	DNC		Do not connect
12	RX(2)-	Ethernet interface	Tap port 2, 10BaseT/100BaseTX
13	RX(2)+	Ethernet interface	Tap port 2, 10BaseT/100BaseTX
14	TX(2)-	Ethernet interface	Tap port 2, 10BaseT/100BaseTX
15	TX(2)+	Ethernet interface	Tap port 2, 10BaseT/100BaseTX
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	RX(3)-		Aggregator/monitor port 1
22	RX(3)+		Aggregator/monitor port 1
23	TX(3)-		Aggregator/monitor port 1
24	TX(3)+		Aggregator/monitor port 1
25	DNC		Do not connect
26	DNC		Do not connect
27	CHASSIS	Chassis	
28	DNC		Do not connect
29	DNC		Do not connect
30	RX(4)-	Ethernet interface	Aggregator/monitor port 2
31	RX(4)+	Ethernet interface	Aggregator/monitor port 2
32	TX(4)-	Ethernet interface	Aggregator/monitor port 2
33	TX(4)+	Ethernet interface	Aggregator/monitor port 2
34	DNC		Do not connect
35	DNC		Do not connect
36	CHASSIS	Chassis	
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	CHASSIS	Chassis	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/SWI/107	Ethernet tap module 4-port

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Network Cables* data sheet). Additional items must be ordered separately; refer to Related Products for options.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/SWI/107	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related products

MODULE	DETAILS
NET/CON/018	100/1000BaseT flexible Ethernet interface cable (4x30cm long) terminated with KAD connector used with KAD/SWI/108 and /107

Related documentation

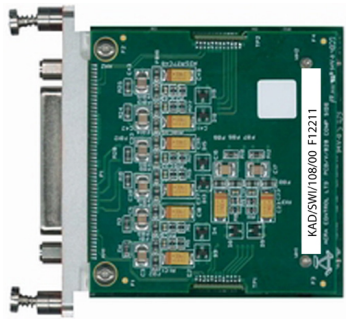
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/SWI/108

Ethernet switch (Xbar) - 4 port

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Key Features

- Four 10/100Mps Ethernet ports over copper wiring
- Configurable Xbar static forwarding table and user-selectable filter pass/reject selection criteria
- IEEE 1588-2004 Precision Time Protocol version 1 (PTPv1) transparency
- Live at power-on (configured static internal routing; no MAC address dynamic learning time delay)

Applications

- Airborne interconnection for data acquisition units, network data recorders, network tap, and onboard data processing stations in an Ethernet environment

Overview

The KAD/SWI/108 is an Ethernet switch designed for operating in harsh environments. The KAD/SWI/108 ports feature auto MDI/MDIX supporting straight-through or cross-over cables.

The KAD/SWI/108 has a store-and-forward Xbar switching fabric that is configured via a static forwarding table to define how incoming Ethernet frames received on a given port are forwarded to the output of one or more egress ports.

The output of each port has filtering capabilities allowing for selective forwarding of Ethernet frames to the connected end node. The KAD/SWI/108 can filter traffic using 8 x 16-bit frame fields such as MAC addresses, IP addresses, IP length, protocol type (UDP/TCP), UDP or TCP port numbers, with optional masking. Filtering options include generic user-configurable field selection, IENA, and iNET-X. Moreover, the filter can be configured for pass or reject selection criteria.

The KAD/SWI/108 does not retransmit Ethernet frames which are received with Frame Check Sequence errors.

Backplane registers provide visibility of network activity including packets received and transmitted per port as well as packets dropped due to buffer overflows.

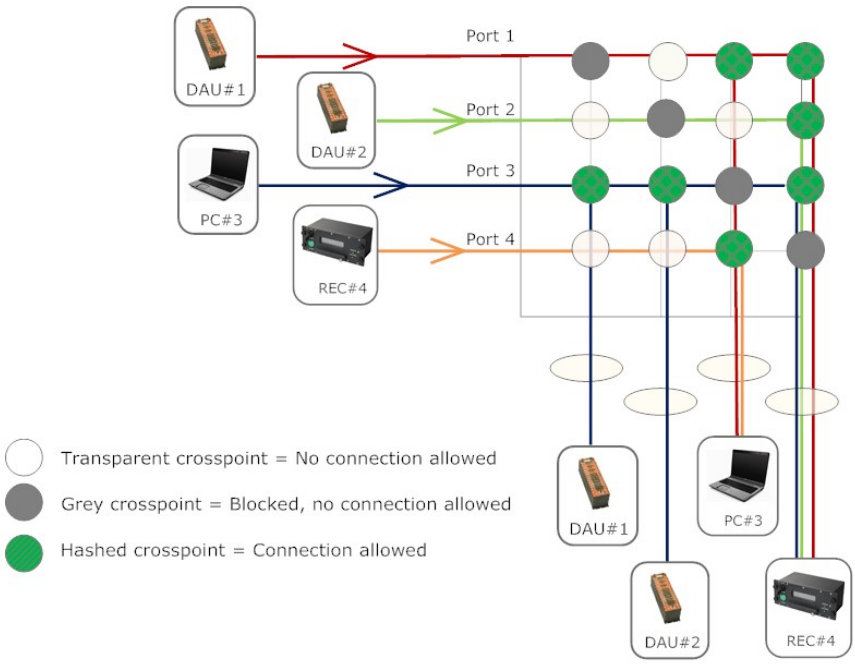


Figure 1: KAD/SWI//108 typical configuration

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	90	–	g	
	–	3.2	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	427	–	585	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	2.14	–	2.93	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Throughput					
100BaseTX	–	–	64	Mbps	64Mbps throughput for 100Mbps for each defined aggregator port.
10BaseT	–	–	6.4	Mbps	6.4Mbps throughput for 10Mbps for each defined aggregator port.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Ethernet interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs/outputs	–	–	4	–	IEEE 802.3 compatible.

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Setting up the KAD/SWI/108

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/SWI/108	KAD/SWI/108	The instrument part reference.
SerialNumber	FA1234	FA1234	Unique name for each module.
Settings Filtering	-	-	-
Filtering Mode	None Output Port Cross Point	None	-
VLAN Support	True False	False	-
Settings Filtering Classifiers	-	-	-
Classifier Offset(0)	UTF-8 String Regular Expression: ^(?:75[0-8]|7[0-4][0-9]|[0-6]?[0-9][0-9]?|Not Used)$	Not Used	Word offset into Ethernet frame for field used for filter.
Classifier Offset(1)	UTF-8 String Regular Expression: ^(?:75[0-8]|7[0-4][0-9]|[0-6]?[0-9][0-9]?|Not Used)$	Not Used	Word offset into Ethernet frame for field used for filter.
Classifier Offset(2)	UTF-8 String Regular Expression: ^(?:75[0-8]|7[0-4][0-9]|[0-6]?[0-9][0-9]?|Not Used)$	Not Used	Word offset into Ethernet frame for field used for filter.
Classifier Offset(3)	UTF-8 String Regular Expression: ^(?:75[0-8]|7[0-4][0-9]|[0-6]?[0-9][0-9]?|Not Used)$	Not Used	Word offset into Ethernet frame for field used for filter.
Classifier Offset(4)	UTF-8 String Regular Expression: ^(?:75[0-8]|7[0-4][0-9]|[0-6]?[0-9][0-9]?|Not Used)$	Not Used	Word offset into Ethernet frame for field used for filter.
Classifier Offset(5)	UTF-8 String Regular Expression: ^(?:75[0-8]|7[0-4][0-9]|[0-6]?[0-9][0-9]?|Not Used)$	Not Used	Word offset into Ethernet frame for field used for filter.

SETUP DATA	CHOICE	DEFAULT	NOTES
Classifier Offset(6)	UTF-8 String Regular Expression: ^(?:75[0-8]|7[0-4][0-9]|[0-6]?[0-9][0-9]?|Not Used)$	Not Used	Word offset into Ethernet frame for field used for filter.
Classifier Offset(7)	UTF-8 String Regular Expression: ^(?:75[0-8]|7[0-4][0-9]|[0-6]?[0-9][0-9]?|Not Used)$	Not Used	Word offset into Ethernet frame for field used for filter.
Channels	-	-	-
Switch-Port(4:1) Ethernet bi-directional	-	-	Standard port with configurable speed, routing, and filtering.
Settings Forwarding	-	-	Defines the port forwarding scheme.
Forwarded To	0 to F	F	Bitmap value defining which port packets are forwarded to. Port 1 corresponds to the LSB. A value of 0xB means forwarding to ports 1, 2 and 4
Settings Ethernet	-	-	Defines the port's configurable Ethernet characteristics.
Port Speed	100BASE-TX 10BASE-T	100BASE-TX	Selects the port's link speed.
Port Mode	Auto-negotiate connection Force connection	Auto-negotiate connection	Selects the link connection mode of this port.
Processes	-	-	-
Switch-Port(4:1)	-	-	Filtering
Settings	-	-	-
Strategy	Allow Block	Block	-

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Report Reports the status of the module.	BitVector	BitVector	16	R[15:0] R[15:8] Reserved - Reserved for future use. R(7) Error port 4 half-duplex connection - Error, port 4 connection is half-duplex. 1: Error, port 4 connection is half-duplex. 0: No error, port 4 connection is full-duplex. R(6) Error port 3 half-duplex connection - Error, port 3 connection is half-duplex. 1: Error, port 3 connection is half-duplex. 0: No error, port 3 connection is full-duplex. R(5) Error port 2 half-duplex connection - Error, port 2 connection is half-duplex. 1: Error, port 2 connection is half-duplex. 0: No error, port 2 connection is full-duplex. R(4) Error port 1 half-duplex connection - Error, port 1 connection is half-duplex. 1: Error, port 1 connection is half-duplex. 0: No error, port 1 connection is full-duplex. R(3) Error port 4 not connected - Error, port 4 is not connected. 1: Error, port 4 is not connected. 0: No error. R(2) Error port 3 not connected - Error, port 3 is not connected. 1: Error, port 3 is not connected. 0: No error. R(1) Error port 2 not connected - Error, port 2 is not connected. 1: Error, port 2 is not connected. 0: No error. R(0) Error port 1 not connected - Error, port 1 is not connected. 1: Error, port 1 is not connected. 0: No error.
TypeNumber Type Number of the module	BitVector	BitVector	16	R[15:0]
Switch-Port(4:1) Parameters				
RxPktCnt Number of packets received in the last second on this port.	Count	OffsetBinary	16	R[15:0]
RxErrCnt Number of packets received with errors in the last second on this port.	Count	OffsetBinary	16	R[15:0]

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
RxDropCnt Number of received packets dropped in the last second from the Input Queue buffer for this port due to overflow of the buffer. RxDropCnt does not increment for a disconnected port.	Count	OffsetBinary	16	R[15:0]
TxDropCnt Number of packets dropped in the last second from the Output Queue buffer for this port due to overflow of the buffer. TxDropCnt does not increment for a disconnected port.	Count	OffsetBinary	16	R[15:0]
TxPktCnt Number of packets transmitted in the last second on this port.	Count	OffsetBinary	16	R[15:0]

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/SWI/108

Auto MDI/MDIX only operates with Port Mode set to Auto-negotiate connection.

WARNING: All network connections in use during any loss of power recover automatically when power is resumed. However, traffic through the tap connection is interrupted during a power outage. We recommend that the KAD/SWI/108 is not used to tap a critical network link.

Inter-connecting KAD/SWI/108 modules

When connecting a KAD/SWI/108 module to another KAD/SWI/108 module it is necessary to configure the Port Mode setting for the inter-connecting Ethernet link to Auto-negotiate Connection. This configuration setting must be set for the inter-connecting port in both KAD/SWI/108 modules.

NOTE: Up to four KAD/SWI/108 modules can be cascaded.

RxDropCnt and TxDropCnt definitions

RxDropCnt measures any loss of packets from the Input Queue for the port due to buffer overflow. It does not count packets which are received from a disconnected port.

TxDropCnt measures any loss of packets from the Output Queue for the port due to buffer overflow. It does not count packets which are transmitted out of a disconnected port.

Static forwarding

The KAD/SWI/108 is configured with a static forwarding table whereby Ethernet frames received on an input port can be forwarded to any output port on the switch, although loop back from receive to transmit of the same port is not supported. The static forwarding table defines the allowed routing between the ports on the switch.

NOTE: Xbar switching fabric technology allows static forwarding tables and filters to be defined. This enables you to define custom port configurations and forward incoming Ethernet frames to multiple destinations for simultaneous telemetry, real-time monitoring and recording.

Example

Consider the following typical configuration (see Figure 2 on page 142) where the KAD/SWI/108 has two DAUs connected on ports 1, and 2, (labelled DAU#1 and DAU#2 respectively), a laptop (labelled PC#3) connected on port 3, and a network recorder (labelled REC#4) connected on port 4.

Having connected the devices to the KAD/SWI/108, the forwarding configuration between these devices is defined. The following table summarizes a typical forwarding configuration. In this example, all Ethernet frames transmitted by the two DAUs are forwarded to the network recorder (REC#4), and to the laptop (PC#3). Only the Ethernet frames transmitted by DAU#1 are forwarded to the laptop (PC#3). Frames from the laptop are forwarded to equipment connected to all ports. Frames from the network recorder are only forwarded to the laptop, PC#3, connected on port 3.

TABLE 3 KAD/SWI/108 forwarding example

PORT NUMBER	CONNECTED INPUT DEVICE	FORWARD ETHERNET INPUT TO OUTPUT PORTS
1	DAU#1	PC#3, REC#4
2	DAU#2	REC#4
3	PC#3	DAU#1, DAU#2, REC#4
4	REC#4	PC#3

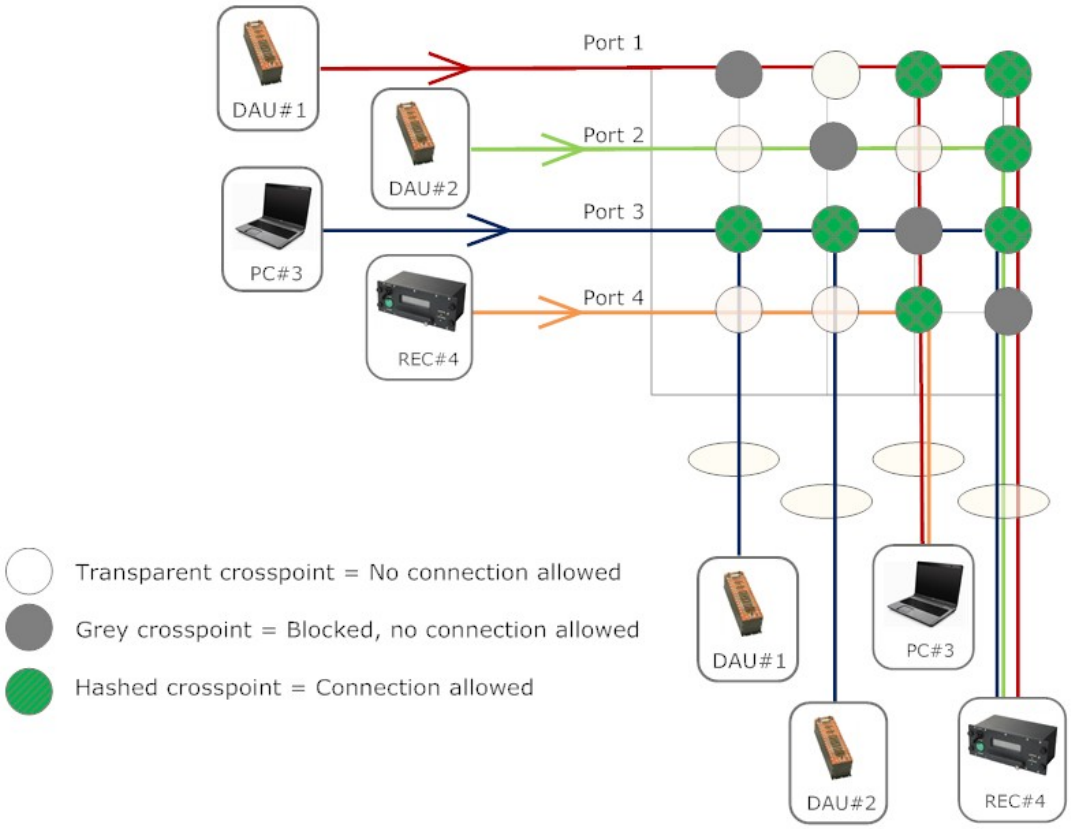


Figure 2: KAD/SWI//108 typical configuration

The previous figure illustrates the configuration of the Xbar switching fabric required to realize this forwarding configuration between the connected devices. The Xbar fabric comprises a fully interconnected matrix of crosspoints between the input and output lines. Ethernet frames received on a given port are never forwarded on itself, as indicated by the grey crosspoint, however Ethernet frames can potentially be forwarded to one or more ports as shown by the transparent crosspoints. A transparent crosspoint indicates a possible forwarding path or inter-connection between devices connected to the KAD/SWI/108. For example, Ethernet frames transmitted by DAU#1 connected on port 1 are never forwarded back to itself as shown by the grey crosspoint. However the Ethernet frames transmitted by DAU#1 are forwarded to REC#4 (the recorder) and PC#3 (the laptop). This allowed forwarding configuration is illustrated by the hashed crosspoints in the figure, whilst the transparent crosspoints indicate unused and therefore blocked crosspoints or forwarding paths.

PTP packets

The KAD/SWI/108 does not make exceptions for routing of PTP packets; they are treated like any other packet type. Therefore, if you block any traffic between ports it also applies to PTP packets.

Filtering

To allow for selective forwarding of Ethernet frames to the connected end nodes, the KAD/SWI/108 has filtering capabilities.

Filter configuration

The filter may be defined as either pass-through or reject. If the filter is set to pass-through, only Ethernet frames with fields which match the filter configuration (Generic, IENA or iNET-X fields) are forwarded. Conversely, if the filter is set to reject, Ethernet frames with those fields are not forwarded.

Packet filtering example

IP Packets can be filtered on the basis of frame/packet header field values and/or data. Eight fields may be specified within the Ethernet frame, where each field has 16-bit size and granularity.

- The traffic to be monitored is dialog involving node 1 (connected to port 1) and the other nodes connected to ports 2/3/4.
- TCP and UDP traffic are monitored.
- The network is configured with static IP addresses, that is, the IP address is predetermined and known (as opposed to dynamic IP addressing where a server allocates addresses to the network nodes using Dynamic Host Configuration Protocol [DHCP]). The IP address of node 1 is 192.168.1.55 (on a Windows PC the IP address can be determined from DOS shell using the command ipconfig /all).
- It is not essential to know the Ethernet MAC address (or Physical address) of node 1 or any of the nodes with which it is communicating, as the IP address is a unique identifier for the node on the network.

NOTE: Up to eight filter fields can be specified when configuring the KAD/SWI/108. These filter fields can be located anywhere in the packet. Unexpected results can occur when filter fields are located within the body of a packet and packets which are shorter than the filter field location are received. Under these circumstances the shorter packet can be filtered unexpectedly.

In this example, the KAD/SWI/108 is set up to filter packets sent by node 1, and packets destined for node 1.

- For packets sent by node 1, the IP source address field displays a value of 192.168.1.55.
- For packets destined for node 1, the IP destination address field displays a value of 192.168.1.55.
- 192.168.1.55 is a 32-bit number represented in hex notation as $C0A80137_{16}$.
- The IP source address field is located within an Ethernet frame in 16-bit fields 13 and 14.
- The IP destination address field is located within an Ethernet frame in 16-bit fields 15 and 16.
- TCP traffic can be identified when 06_{16} is displayed in the 8-bit IP protocol field.
- UDP traffic can be identified when 11_{16} is displayed in the 8-bit IP protocol field.
- The IP protocol field is located within an Ethernet frame in the lower byte of 16-bit field 11.

Thus the KAD/SWI/108 may be configured as follows:

- UDP traffic sent from node 1 is routed to port 2.
- UDP traffic sent to node 1 is routed to port 1.
- TCP traffic sent from node 1 is routed to port 3.
- TCP traffic sent to node 1 is routed to port 1.

In this case, five Ethernet frame fields (fields-11/13/14/15/16) are filtered as follows:

- xx11/C0A8/0137/xxxx/xxxx => route to port 2
- xx11/xxxx/xxxx/C0A8/0137 => route to port 1
- xx06/C0A8/0137/xxxx/xxxx => route to port 3
- xx06/xxxx/xxxx/C0A8/0137 => route to port 1

This is a simple example classifying data packets using only five of the eight available fields. More complicated filtering is possible, using, for example, the Ethernet MAC addresses in the case where IP addresses are not predetermined (in a network where a server allocates IP addresses using the DHCP protocol), or using fields to distinguish between higher-layer protocol packets such as HTTP (web browser traffic) or FTP (file transfer).

TABLE 4 Values of OffsetIndex_Words

FIELD NAME	OFFSET
Destination MAC address, word 0	0
Destination MAC address, word 1	1
Destination MAC address, word 2	2
Source MAC address, word 0	3
Source MAC address, word 1	4
Source MAC address, word 2	5
Frame type	6
IP version/IHL/ToS	7
IP packet size	8
IP ID	9
IP flags and fragment offset	10
IP TTL and protocol	11
IP header checksum	12
Source IP address, word 0	13
Source IP address, word 1	14
Destination IP address, word 0	15
Destination IP address, word 1	16
Source port no.	17
Destination port no.	18

TABLE 4	Values of OffsetIndex_Words
FIELD NAME	OFFSET
UDP Length; TCP seq word 0	19
UDP CSum; TCP seq word 1	20
IENA key; TCP Ack word 0	21
IENA size; TCP Ack word 1	22
iNET-X Stream ID word 0, IENA date 0; TCP offset/flags	23
iNET-X Stream ID word 1, IENA date 1; TCP window	24
iNET-X Stream ID word 2, IENA date 2; TCP Csum	25
IENA status; TCP urgent Ptr	26
IENA Seq;TCP Options (or TCP Data 0)	27

Connector pinout of the KAD/SWI/108

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DNC		Do not connect
2	DNC		Do not connect
3	RX(1)-	Ethernet interface	Port 1, 10BaseT/100BaseTX
4	RX(1)+	Ethernet interface	Port 1, 10BaseT/100BaseTX
5	TX(1)-	Ethernet interface	Port 1, 10BaseT/100BaseTX
6	TX(1)+	Ethernet interface	Port 1, 10BaseT/100BaseTX
7	DNC		Do not connect
8	DNC		Do not connect
9	CHASSIS	Chassis	
10	DNC		Do not connect
11	DNC		Do not connect
12	RX(2)-	Ethernet interface	Port 2, 10BaseT/100BaseTX
13	RX(2)+	Ethernet interface	Port 2, 10BaseT/100BaseTX
14	TX(2)-	Ethernet interface	Port 2, 10BaseT/100BaseTX
15	TX(2)+	Ethernet interface	Port 2, 10BaseT/100BaseTX
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	RX(3)-	Ethernet interface	Port 3, 10BaseT/100BaseTX
22	RX(3)+	Ethernet interface	Port 3, 10BaseT/100BaseTX
23	TX(3)-	Ethernet interface	Port 3, 10BaseT/100BaseTX
24	TX(3)+	Ethernet interface	Port 3, 10BaseT/100BaseTX
25	DNC		Do not connect
26	DNC		Do not connect
27	CHASSIS	Chassis	
28	DNC		Do not connect
29	DNC		Do not connect
30	RX(4)-	Ethernet interface	Port 4, 10BaseT/100BaseTX
31	RX(4)+	Ethernet interface	Port 4, 10BaseT/100BaseTX
32	TX(4)-	Ethernet interface	Port 4, 10BaseT/100BaseTX
33	TX(4)+	Ethernet interface	Port 4, 10BaseT/100BaseTX
34	DNC		Do not connect
35	DNC		Do not connect
36	CHASSIS	Chassis	
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	CHASSIS	Chassis	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/SWI/108	Ethernet switch (Xbar) - 4 port

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Network Cables* data sheet). Additional items must be ordered separately; refer to Related products for options.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/SWI/108	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related products

MODULE	DETAILS
NET/CON/018	100/1000BaseT flexible Ethernet interface cable (4x30cm long) terminated with KAD connector used with KAD/SWI/108 and /107
NET/CON/022	4 x 0.3m male micro-miniature, circular to KAD Ethernet cable for KAD/SWI/108

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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This document was reviewed on 14/10/2020 and does not contain technical data.

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KAD/ADC/010

Differential ended ADC (22kHz b/w) - 2ch at 100ksps



Key Features

- Two differential ended input channels
- Programmable Input range (±1V to ±10V)
- Accuracy (0.25% FSR typical)
- Shorting on any channel does not affect others
- 14-bit simultaneous sampling on each channel

Applications

- Analog signal acquisition
- FTI, OLM, HUMS

Overview

The KAD/ADC/010 is used to digitize up to two differential ended channels.

For each channel there is a choice of two inputs depending on the gain required. For example, ANALOG_A(0)± is used for an input range of ±10V for channel 0 and ANALOG_B(0)± is used for an input range of ±1V for channel 0. If in a setup, a range between ±10V is selected then ANALOG_A is used; and if a range between ±1V is selected, then ANALOG_B is automatically used.

At the heart of the KAD/ADC/010 is a hard-wired state machine that over-samples all channels and digitally filters any noise above the user-programmable cutoff frequency. This is achieved using cascaded, half-band, decimate by 2 × 15-tap Finite-Input Response (FIR) filters with 32-bit coefficients.

Both signals are sampled simultaneously. A linearization table for each channel can be used to compensate for non-linear sensors or to fine-tune gain and offset.

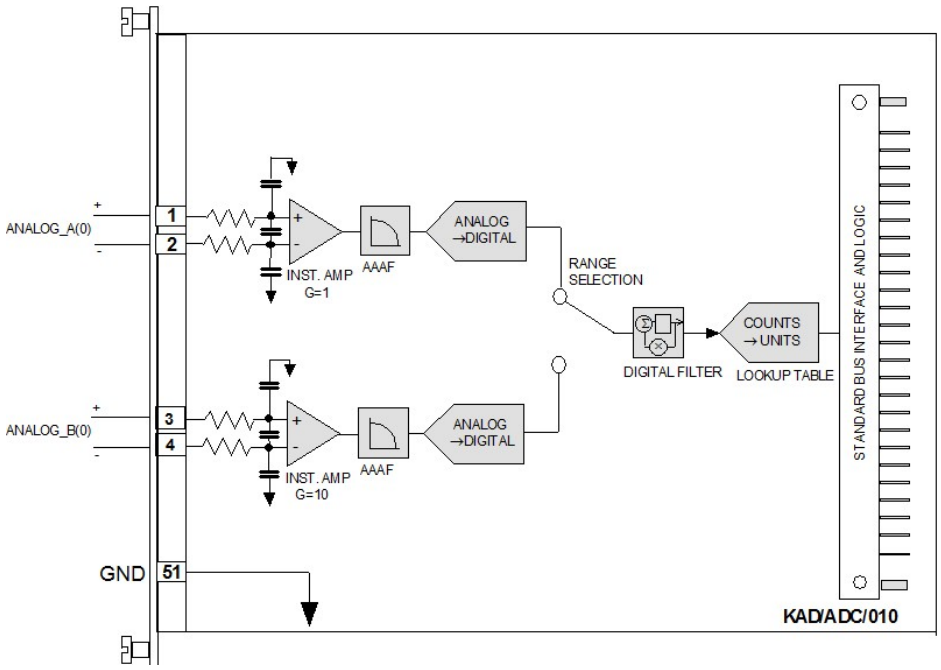


Figure 1: First of two differential channels on the KAD/ADC/010 set to use ±10V range signal path

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under "Environmental ratings" in the "General specifications" table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	75	–	g	
	–	2.64	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	0.5	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	200	–	330	mA	
±7V	0	–	0	mA	
±12V	5	–	30	mA	
total power	1.12	–	2.37	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Differential ended analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	2	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG_A[1:0]	–	–	10,000	sps	
ANALOG_B[1:0]	–	–	10,000	sps	
Input voltage					
operating range (ANALOG_A[1:0])	-10	–	10	V	Primary gain = 1
operating range (ANALOG_B[1:0])	-1	–	1	V	Primary gain = 10
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.
DC error					
gain = 1, 10	–	–	0.25	%FSR	
Effective number of bits					
gain = 1, 10	–	9	–	bits	

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TABLE 2	Differential ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Crosstalk					
gain = 1, 10	–	-72	–	dB	
Common mode					
voltage range	-10	–	10	V	Operational voltage range.
rejection ratio	–	72	–	dB	Applies within the above common mode voltage range, $0 \leq f \leq f_c$. (f_c : filter cutoff frequency)
Analog filter					Analog filter is Butterworth.
poles	–	–	1	–	
filter cutoff -3dB	18.7	22	25.3	kHz	
Digital filter					Digital filter is cascaded 15 tap FIR.
poles	–	–	–	–	Not applicable for FIR type filters.
filter cutoff -6dB	0.25	–	16	f_s	The maximum value is limited to 25kHz (f_s: sampling frequency).
0.1dB bandwidth	–	0.64	–	f_c	
aliasing to 0.1dB band	–	–	-9	dB	
aliasing to f_c	–	–	-14	dB	
Filter delay	–	190	–	ms	Where $f_{in} = f_c = 25Hz$ (f_{in} : input signal frequency). See “Understanding filter delays” on page 154.
Input resistance					
between inputs	25	–	–	kΩ	Module powered off.
between inputs	20	–	–	MΩ	Module powered on.
each input to GND	420	–	–	kΩ	Module powered off.
each input to GND	10	–	–	MΩ	Module powered on.

Setting up the KAD/ADC/010

All module setup can be defined in XML using XidML® schemas (see www.xidml.org).

The following treeview provides an overview of setup configurations available for this module:

XidML Legend

DAU: Data Acquisition Unit (PC: Personal Computer)

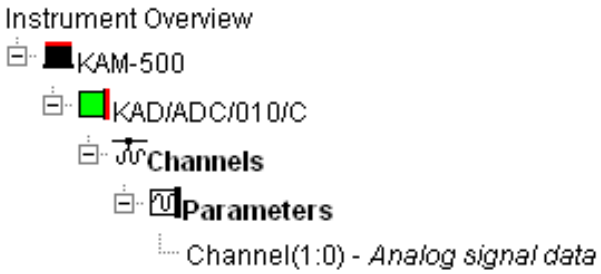
Instrument: Any component or module used in a data acquisition system

DataLink: Connection for transmitting or receiving (defines both the data link and the physical layer)

Package: Used to describe how data is transmitted or stored

Parameter: Any register that can be read from an instrument

Algorithm: Defines processing to be performed on data



Setting up the module

The following table lists the setup configurations available for the KAD/ADC/010.

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer			-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer
PartReference	KAD/ADC/010/C	KAD/ADC/010/C	ACRA CONTROL part number
SerialNumber			Unique name for each module
Settings	-	-	-
Module-Analog-In-1.2			-
Channel Channel(1:0)			Settings for this channel.
FilterCutoff	0.25, 0.5, 1, 2, 4, 8, 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is the recommended as the any higher may lead to aliasing. I is the sampling rate.

Setting up parameters

Parameter definitions

The following table lists all parameters that are available for the KAD/ADC/010.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Channel(1:0) Analog signal data	Volt	OffsetBinary	16:4	R[15:0] 0000:FFFF (hex)

Programmable elements

Channel(1:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
RangeMaximum	-10 to 10	10	-
RangeMinimum	-10 to 10	-10	-
SizeInBits	16:4	16	R[15:0] 0000:FFFF (hex)

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/010

Input resistance

Because the input resistance changes when the input ranges are exceeded, do not connect A and B together.

Bias current return path

If the signal source is isolated with respect to the Acra KAM-500 (for example a battery), a common-mode resistance between the negative input and ground (GND) should be used to provide a return for bias currents and reduce common-mode noise pick-up. Because the bias currents are in the order of nA, resistors up to 10kΩ can be used. In most cases a short (0Ω) is recommended.

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate are always sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. All filters cause a delay inversely proportional to the filter cutoff frequency (f_C).

The filter delay for the KAD/ADC/010 is:

$$T_D \approx T_A + \left(19.1 - \frac{20}{2^N}\right) \cdot \frac{1}{4 \cdot f_C}$$

$$N = INT(18.1 - \log_2(4 \cdot f_C))$$

INT is for the integer part of the value. For example, if x = 13.5, INT(x) = 13.

N cannot be lower than 1. If N is lower than 1, then use 1.

T_A (analog filter delay) ≈ 7µs

T_D is the filter delay

Connector pinout of the KAD/ADC/010

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	ANALOG_A(0)+	Differential ended analog inputs	Analog input (gain = 1)
2	ANALOG_A(0)-	Differential ended analog inputs	Analog input (gain = 1)
3	ANALOG_B(0)+	Differential ended analog inputs	Analog input (gain = 10)
4	ANALOG_B(0)-	Differential ended analog inputs	Analog input (gain = 10)
5	ANALOG_A(1)+	Differential ended analog inputs	Analog input (gain = 1)
6	ANALOG_A(1)-	Differential ended analog inputs	Analog input (gain = 1)
7	ANALOG_B(1)+	Differential ended analog inputs	Analog input (gain = 10)
8	ANALOG_B(1)-	Differential ended analog inputs	Analog input (gain = 10)
9	DNC		Do not connect
10	DNC		Do not connect
11	DNC		Do not connect
12	DNC		Do not connect
13	DNC		Do not connect
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
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34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	CHASSIS	Chassis	
51	GND	Internal ground	
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/010/C	Differential ended ADC (22kHz b/w) - 2ch at 100ksps (with 52-way double-density module top connector)
KAM/ADC/010/C	Differential ended ADC (22kHz b/w) - 2ch at 100ksps (with 51-way micro-miniature module top connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; or ACC/CON/008/04 for KAM modules) is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/ADC/010 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/010/C	Corrected potential EEPROM overwrite problem at address 00000_{16}	Recommended for new programs
KAD/ADC/010/B	Power from 5V line reduced to 1.3W allowing for a KAM/CHS/13U to be filled with 13 modules of this type	Not recommended for new programs
KAD/ADC/010	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

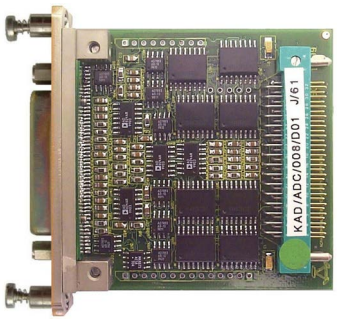
DOCUMENT	DETAILS
DOC/DBK/001	KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
TEC/NOT/016	Power dissipation
TEC/NOT/017	Accuracy on KAM-500 modules
TEC/NOT/019	An introduction to digital filtering
TEC/NOT/049	Power estimation

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ADC/008

Single ended ADC (programmable analog gain, three phase power monitor, 1kHz b/w) - 6ch at 20sps

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Key Features

- Three voltage and three current single ended input channels
- Programmable input range (±1V, ±10V) for signals in the frequency range of 10 to 1000Hz
- Accuracy (0.3% FSR typical) for 10V range
- 16-bit simultaneous sampling on each channel
- Measures voltage, current, RMS active power, and RMS apparent power

Applications

- Three-phase power monitoring

Overview

The KAD/ADC/008 is a monitor for 3-phase power lines. It measures 40 parameters associated with 3-phase power lines as follows:

- maximum, minimum, amplitude, root-mean-square and average (5x6=30 parameters)
- active, apparent power and their ratio (3 × 3 = 9 parameters)
- period of the VOLTAGE(0) = 1 parameter

The KAD/ADC/008 has a programmable gain amplifier and analog-to-digital converter and a 16,384-point conversion table for each of the six channels. All six channels are sampled simultaneously at 125ksps.

The algorithm waits for a positive-going-zero crossing on channel 0 and resets the maximum/minimum registers for each channel and the accumulators for the various averages. The algorithm ends on a positive-going-zero-crossing after at least 50ms. The processing algorithm is a hard-wired state machine with no micro-code or forbidden states.

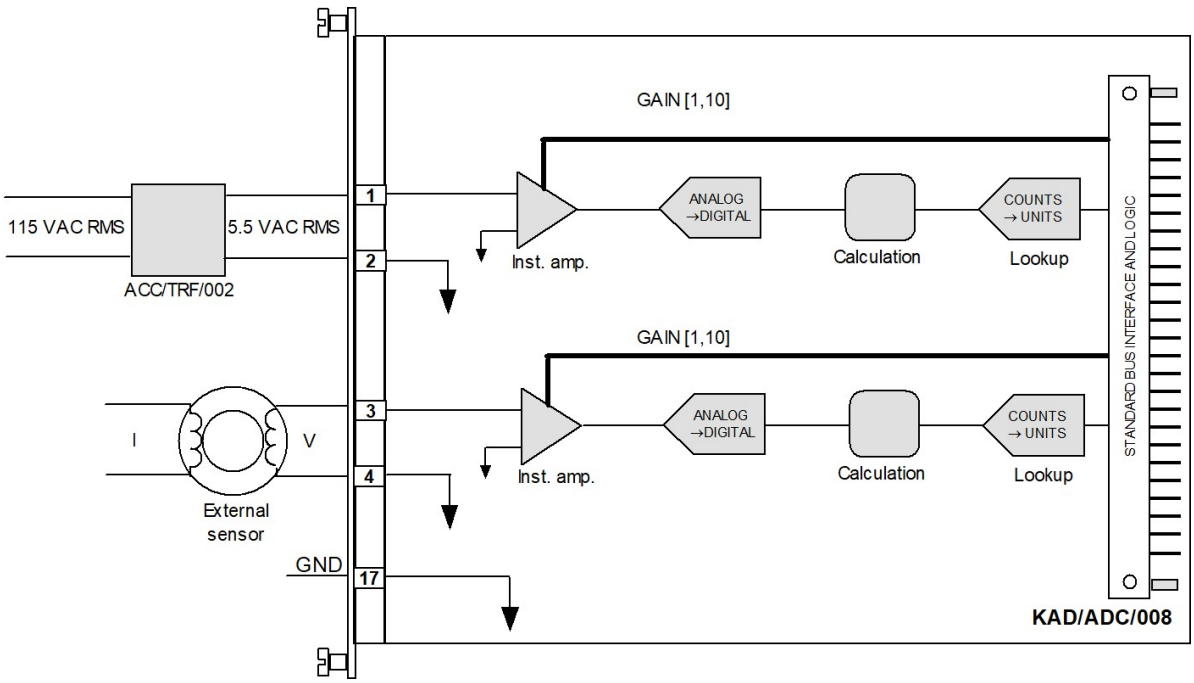


Figure 1: First of three phases on the KAD/ADC/008

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	70	–	g	
	–	2.48	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	0.5	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	220	–	280	mA	
±7V	0	–	0	mA	
±12V	25	–	45	mA	
total power	1.7	–	2.48	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Single ended analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	6	–	Three single ended VOLTAGE and CURRENT pairs. Requires voltage and current transformers to interface with aircraft power. See *TEC/NOT/037 - Using the KAD/ADC/008* for details.
Sampling rate					
	–	–	20	Hz	Rate that output registers are updated.
Input voltage					
operating range	-10	–	10	V	At gain 1.
operating range	-1	–	1	V	At gain 10.
overvoltage protection	-40	–	40	V	Voltages outside of this range may damage the input.

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TABLE 2	Single ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
DC error					
gain = 1	–	0.1	0.3	%FSR	
gain = 10	–	0.1	0.3	%FSR	
AC response					
	10	–	1000	Hz	
Input resistance					
each input to GND	2.2	–	–	kΩ	Module powered off.
each input to GND	10	–	–	MΩ	Module powered on.

Setting up the KAD/ADC/008

Setting up parameters

For channels Maximum and Minimum

SET-UP DATA	CHOICE	DEFAULT	NOTES
Name	No limit to characters	Maximum	The maximum or minimum value sampled over the sample period.
Base Unit	Volt	Volt	R[15:4] (000_{16} - FFF_{16}) for the range from $-V_{max}$ to $+V_{max}$ or $-I_{max}$ to $+I_{max}$. R[3:0] Reserved for future use. See *TEC/NOT/037 - Using the KAD/ADC/008* for conversion to engineering units.
maximum	-10 to 10	+5	
minimum	-10 to 10	-5	
Data Format	Offset binary	Offset binary	
Size In Bits	4 to 16	16	

For channel Average

SET-UP DATA	CHOICE	DEFAULT	NOTES
Name	No limit to characters	Average	The average values of the samples over the sample period.
Base Unit	Volt	Volt	R[15:0] (0000_{16} - $FFFF_{16}$) for the range from $-V_{max}$ to $+V_{max}$ or $-I_{max}$ to $+I_{max}$. See *TEC/NOT/037 - Using the KAD/ADC/008* for conversion to engineering units.
maximum	-10 to 10	0	Average of a sine wave is zero unless there is a DC offset present.
minimum	-10 to 10	0	
Data Format	Offset binary	Offset binary	
Size In Bits	4 to 16	16	

SET-UP DATA	CHOICE	DEFAULT	NOTES
Name	No limit to characters	Amplitude	Maximum - Minimum.
Base Unit	Volt	Volt	R[15:4] (000_{16} - FFF_{16}) for the range from 0 to 2 X V_{max} or 2 X I_{max}. R[3:0] Reserved for future use. See *TEC/NOT/037 - Using the KAD/ADC/008* for conversion to engineering units.
maximum	0 to 20	10	
minimum	0 to 20	10	
Data Format	Offset binary	Offset binary	
Size In Bits	4 to 16	16	

For channel RMS

SET-UP DATA	CHOICE	DEFAULT	NOTES
Name	No limit to characters	Root MeanSquare	The root-mean-square $rms = \sqrt{\frac{1}{N}\sum_{i=1}^{N} S_i^2}$
Base Unit	Volt	Volt	R[15:0] (0000_{16} - $FFFF_{16}$) for the range from 0 to V_{max} or I_{max}. See *TEC/NOT/037 - Using the KAD/ADC/008* for conversion to engineering units.
maximum	0 to 10	3.54	
minimum	0 to 10	3.54	
Data Format	Offset binary	Offset binary	
Size In Bits	4 to 16	16	

For channel 0 Period

SET-UP DATA	CHOICE	DEFAULT	NOTES
Name	No limit to characters	Channel delay	Average time between positive-going-zero crossings on VOLTAGE(0).
Base Unit	Seconds	Seconds	R[15:0] (0000_{16} - $FFFF_{16}$) for the range from 0 and 100ms. See *TEC/NOT/037 - Using the KAD/ADC/008* for conversion to engineering units.
maximum	100ms	2.5ms	
minimum	100µs	-2.5ms	
Data Format	Offset binary	Offset binary	
Size In Bits	4 to 16	16	

For phase Active power

SET-UP DATA	CHOICE	DEFAULT	NOTES
Name	No limit to characters	Active power	The active power for each phase $ACT = \frac{1}{N}\sum_{i=1}^{N} V_i \bullet I_i$
Base Unit	Watt	Watt	R[15:0] (0000_{16} - $FFFF_{16}$) for the range from $-V_{max}I_{max}$ to $-V_{max}I_{max}$. See *TEC/NOT/037 - Using the KAD/ADC/008* for conversion to engineering units.
maximum	-100 to 100	+35	
minimum	-100 to 100	-20	If the phase angle between V and I is > 180 then active power becomes negative.
Data Format	Offset binary	Offset binary	
Size In Bits	4 to 16	16	

For phase App power

SET-UP DATA	CHOICE	DEFAULT	NOTES
Name	No limit to characters	App power	The apparent power for each phase $Apparent_y = V_{rms_y} \bullet I_{rms_y}$
Base Unit	Watt	Watt	R[15:0] (0000_{16}-$FFFF_{16}$) for the range from 0 to $V_{max}I_{max}$. See *TEC/NOT/037 - Using the KAD/ADC/008* for conversion to engineering units.
maximum	0 to 100	25	
minimum	0 to 100	25	
Data Format	Offset binary	Offset binary	
Size In Bits	4 to 16	16	

For phase Power factor

SET-UP DATA	CHOICE	DEFAULT	NOTES
Name	No limit to characters	App power	The power factor for each phase FACTOR = ACT/APP.
Base Unit	Ratio	Ratio	R[15:0] (0000_{16}-$FFFF_{16}$) between -1 and 1. See *TEC/NOT/037 - Using the KAD/ADC/008* for conversion to engineering units.
maximum	-1 to 1	1	
minimum	-1 to 1	-1	
Data Format	Offset binary	Offset binary	
Size In Bits	4 to 16	16	

NOTE: It is recommended that names are less than 20 characters, have no white space, bold or italic characters or contain any of the following five characters "/><\.

Setting up instrumentation

This module uses the X-Module-Analog-In XidML schema. (See http://www.xidml.org).

For channels Analog(0) to Analog(5)

SET-UP DATA	CHOICES	DEFAULT	NOTES
Manufacturer			
name	ACRA CONTROL	ACRA CONTROL	
part reference	KAD/ADC/008	KAD/ADC/008	ACRA CONTROL part number.
serial number	Fixed 6 characters	FE1234	Unique number for each module.
Sub location	1 to 80 characters	MyDAU	Name of DAU.
slot	3 to N	3	The DAU slot the module fits into. First user-module goes into slot 3, where N is the number of user-slots +2 in the DAU.

Getting the most from the KAD/ADC/008

The KAD/ADC/008 usually requires external step-down transformers for voltage (such as the ACC/TRF/002) and requires external sensors for current.

The KAD/ADC/008 does not assume a sine wave shape but does assume each of the six channels is bipolar and is synchronous.

Total power can be calculated by summing $\sum_{i=1}^{3} \mathrm{ACT}$.

The KAD/ADC/008 is DC coupled. If there is a DC component in the input signal, it will be part of the measurement. To remove this DC component, a high pass filter can be used. The cutoff frequency of the filter will depend on the characteristics of the input signal. However, we recommend to set it at 50 to 80 times less than the input signal so as not to attenuate it or change its phase angle. The filter should be made up of an R/C network and not just a DC blocking cap, as this takes too long to settle.

See *TEC/NOT/037 - Using the KAD/ADC/008* for further details regarding conversion to engineering units, current sensors, and voltage transformers.

Connector pinout of the KAD/ADC/008

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	VOLTAGE(0)	Single ended analog inputs	This signal is considered 0° phase
2	GND	Internal ground	
3	CURRENT(0)	Single ended analog inputs	Voltage input (±10V)
4	GND	Internal ground	
5	VOLTAGE(1)	Single ended analog inputs	Voltage input (±10V)
6	GND	Internal ground	
7	CURRENT(1)	Single ended analog inputs	Voltage input (±10V)
8	GND	Internal ground	
9	VOLTAGE(2)	Single ended analog inputs	Voltage input (±10V)
10	GND	Internal ground	
11	CURRENT(2)	Single ended analog inputs	Voltage input (±10V)
12	GND	Internal ground	
13	DNC		Do not connect
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	GND	Internal ground	
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	DNC		Do not connect
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/008	Single ended ADC (programmable analog gain, three phase power monitor, 1kHz b/w) - 6ch at 20sps (with 52-way double density module top connector)
KAM/ADC/008	Single ended ADC (programmable analog gain, three phase power monitor, 1kHz b/w) - 6ch at 20sps (with 51-way micro-miniature module top connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; or ACC/CON/008/04 for KAM modules) is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/ADC/008 refers to both the KAD and KAM version of the module. Additional items must be ordered separately; refer to Related Products for options.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/008	3-phase power monitor module	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related products

MODULE	DETAILS
ACC/TRF/002	Power transformer for variable frequency supplies from 200 Hz to 900 Hz - 6ch
ACC/TRF/001/B	Power transformer - 6-ch (legacy product)

Related documentation

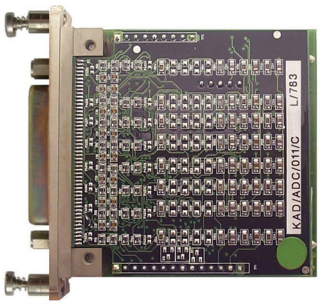
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
TEC/NOT/016	Power dissipation
TEC/NOT/037	Using the KAD/ADC/008
TEC/NOT/049	Power estimation

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This document was reviewed on 27/9/2022 and does not contain technical data.

KAD/ADC/011

Single ended ADC (0.66kHz or 1.17kHz b/w) - 48ch at 8.5ksps

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Key Features

- 48 single ended input channels
- Ordering input range (±10V, ±40V)
- Accuracy of 0.6% FSR typical for 10V variant, accuracy of 1.2% typical for 40V variant
- Short on any channel does not affect others
- 14-bit simultaneous sampling on channels 0 to 23 and 24 to 47

Applications

- Analog signal acquisition
- FTI, OLM, HUMS

Overview

The KAD/ADC/011 is used to condition and digitize up to 48 single ended analog channels. At the heart of the KAD/ADC/011 is a hard-wired state machine that over-samples all channels and digitally filters any noise above the user-programmable cutoff frequency. This is achieved using cascaded, half-band, decimate by 2 × 15-tap, Finite-Impulse-Response (FIR) filters with 32-bit coefficients.

Secondary gain and offset are achieved digitally according to requested input range.

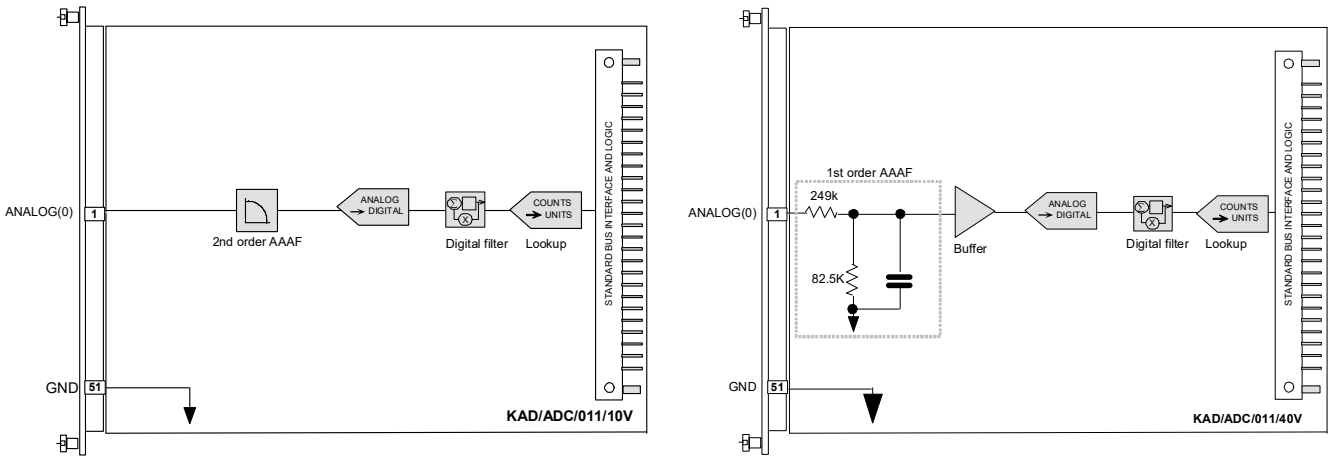


Figure 1: First of 48 channels on the KAD/ADC/011/10V and the KAD/ADC/011/40V

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under "Environmental ratings" in the "General specifications" table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	75	–	g	
	–	2.64	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	0.5	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	200	–	310	mA	
±7V	0	–	0	mA	
+12V	20	–	110	mA	
-12V	20	–	80	mA	
total power	1.48	–	3.83	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Single ended analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	48	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG[47:0]	1	–	8,500	sps	
Input voltage					
operating range (KAD/ADC/011/C/10V)	-10	–	10	V	
operating range (KAD/ADC/011/C/40V)	-40	–	40	V	
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.
DC error					
KAD/ADC/011/C/10V	–	–	0.6	%FSR	
KAD/ADC/011/C/40V	–	–	1.2	%FSR	
Effective number of bits					

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TABLE 2	Single ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
KAD/ADC/011/C/10V	8	9.5	–	bits	When $f_c \leq 250Hz$.
KAD/ADC/011/C/40V	8	9	–	bits	When $f_c \leq 1kHz$.
Crosstalk	–	-72	-55	dB	
Analog filter					Analog filter is Butterworth.
poles (KAD/ADC/011/C/10V)	–	–	2	–	
filter cutoff -3dB (KAD/ADC/011/C/10V)	560	660	760	Hz	
poles (KAD/ADC/011/C/40V)	–	–	1	–	
filter cutoff -3dB (KAD/ADC/011/C/40V)	990	1170	1350	Hz	
Digital filter					Digital filter is cascaded 15-tap FIR.
poles	–	–	–	–	Not applicable for FIR type filters.
filter cutoff -6dB	0.25	–	16	f_s	The maximum value is limited to 2.125kHz (f_s: sampling frequency).
0.1dB bandwidth	–	0.64	–	f_c	
aliasing to 0.1dB band	–	–	-27	dB	
aliasing to f_c	–	–	-28	dB	
Filter delay	–	190	–	ms	Where $f_{in} = f_c = 25Hz$ (f_{in} : input signal frequency). See “Understanding filter delays” on page 170.
Input resistance					
each input to GND (KAD/ADC/011/C/10V)	1	–	–	MΩ	Module powered off.
each input to GND(KAD/ADC/011/C/10V)	10	–	–	MΩ	Module powered on.
each input to GND (KAD/ADC/011/C/40V)	249	330	–	kΩ	Module powered off.
each input to GND(KAD/ADC/011/C/40V)	249	330	–	kΩ	Module powered on.

Setting up the KAD/ADC/011

All module setup can be defined in XML using XidML® schemas (see www.xidml.org).

The following treeview provides an overview of setup configurations available for this module:

XidML Legend

DAU: Data Acquisition Unit (PC: Personal Computer)

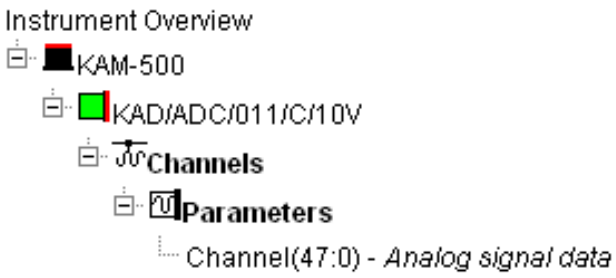
Instrument: Any component or module used in a data acquisition system

DataLink: Connection for transmitting or receiving (defines both the data link and the physical layer)

Package: Used to describe how data is transmitted or stored

Parameter: Any register that can be read from an instrument

Algorithm: Defines processing to be performed on data



Setting up the module

The following table lists the setup configurations available for the KAD/ADC/011/C/10V.

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer			-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer
PartReference	KAD/ADC/011/C/10V	KAD/ADC/011/C/10V	ACRA CONTROL part number
SerialNumber			Unique name for each module
Settings			-
Module-Analog-In-1.2			-
Channel Channel(47:0)			Settings for this channel.
FilterCutoff	0.25, 0.5, 1, 2, 4, 8, 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is the recommended as the any higher may lead to aliasing. I is the sampling rate.

Setting up parameters

Parameter definitions

The following table lists all parameters that are available for the KAD/ADC/011/C/10V.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Channel(47:0) Analog signal data	Volt	OffsetBinary	16:4	R[15:0] 0000:FFFF (hex)

Programmable elements

Channel(47:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
RangeMaximum	-10 to 10	10	-
RangeMinimum	-10 to 10	-10	-
SizeInBits	16:4	16	R[15:0] 0000:FFFF (hex)

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/011

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate are always sampled at the same time independently of how they are stored or transmitted. The KAD/ADC/011 follows this rule, but with one difference: The sampling time for channels 0 to 23 is lined up with the start of the acquisition cycle as described above; however the sampling time for channels 24 to 47 is delayed by 55µs. For most applications such a difference is negligible, but if the precise delay calculation is needed, then 55µs must be added to the filter delay formula below.

Before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. All filters cause a delay inversely proportional to the filter cutoff frequency (f_C).

The filter delay for the KAD/ADC/011 is:

$$T_D \approx T_A + \left(19.1 - \frac{20}{2^N}\right) \cdot \frac{1}{4 \cdot f_C}$$

$$N = INT(14.15 - \log_2(4 \cdot f_C))$$

INT is for the integer part of the value. For example, if x = 13.5, INT(x) = 13.

N cannot be lower than 1. If N is lower than 1, then use 1.

T_D is the filter delay

T_A (analog filter delay) ≈ 360µs.

Connector pinout of the KAD/ADC/011

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	ANALOG(0)	Single ended analog inputs	Analog input
2	ANALOG(1)	Single ended analog inputs	Analog input
3	ANALOG(2)	Single ended analog inputs	Analog input
4	ANALOG(3)	Single ended analog inputs	Analog input
5	ANALOG(4)	Single ended analog inputs	Analog input
6	ANALOG(5)	Single ended analog inputs	Analog input
7	ANALOG(6)	Single ended analog inputs	Analog input
8	ANALOG(7)	Single ended analog inputs	Analog input
9	ANALOG(8)	Single ended analog inputs	Analog input
10	ANALOG(9)	Single ended analog inputs	Analog input
11	ANALOG(10)	Single ended analog inputs	Analog input
12	ANALOG(11)	Single ended analog inputs	Analog input
13	ANALOG(12)	Single ended analog inputs	Analog input
14	ANALOG(13)	Single ended analog inputs	Analog input
15	ANALOG(14)	Single ended analog inputs	Analog input
16	ANALOG(15)	Single ended analog inputs	Analog input
17	ANALOG(16)	Single ended analog inputs	Analog input
18	ANALOG(17)	Single ended analog inputs	Analog input
19	ANALOG(18)	Single ended analog inputs	Analog input
20	ANALOG(19)	Single ended analog inputs	Analog input
21	ANALOG(20)	Single ended analog inputs	Analog input
22	ANALOG(21)	Single ended analog inputs	Analog input
23	ANALOG(22)	Single ended analog inputs	Analog input
24	ANALOG(23)	Single ended analog inputs	Analog input
25	ANALOG(24)	Single ended analog inputs	Analog input
26	ANALOG(25)	Single ended analog inputs	Analog input
27	ANALOG(26)	Single ended analog inputs	Analog input
28	ANALOG(27)	Single ended analog inputs	Analog input
29	ANALOG(28)	Single ended analog inputs	Analog input
30	ANALOG(29)	Single ended analog inputs	Analog input
31	ANALOG(30)	Single ended analog inputs	Analog input
32	ANALOG(31)	Single ended analog inputs	Analog input
33	ANALOG(32)	Single ended analog inputs	Analog input
34	ANALOG(33)	Single ended analog inputs	Analog input
35	ANALOG(34)	Single ended analog inputs	Analog input
36	ANALOG(35)	Single ended analog inputs	Analog input
37	ANALOG(36)	Single ended analog inputs	Analog input
38	ANALOG(37)	Single ended analog inputs	Analog input
39	ANALOG(38)	Single ended analog inputs	Analog input
40	ANALOG(39)	Single ended analog inputs	Analog input
41	ANALOG(40)	Single ended analog inputs	Analog input
42	ANALOG(41)	Single ended analog inputs	Analog input
43	ANALOG(42)	Single ended analog inputs	Analog input
44	ANALOG(43)	Single ended analog inputs	Analog input
45	ANALOG(44)	Single ended analog inputs	Analog input
46	ANALOG(45)	Single ended analog inputs	Analog input
47	ANALOG(46)	Single ended analog inputs	Analog input
48	ANALOG(47)	Single ended analog inputs	Analog input
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/011/C/40V	Single ended ADC (1.17kHz b/w, ±40V) - 48ch at 8.5ksps (with 52-way double-density connector)
KAD/ADC/011/C/10V	Single ended ADC (0.66kHz, ±10V) - 48ch at 8.5ksps (with 52-way double-density connector)
KAM/ADC/011/C/40V	Single ended ADC (1.17kHz b/w, ±40V) - 48ch at 8.5ksps (with 51-way micro-miniature connector)
KAM/ADC/011/C/10V	Single ended ADC (0.66kHz, ±10V) - 48ch at 8.5ksps (with 51-way micro-miniature connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; or ACC/CON/008/04 for KAM modules) is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/ADC/011 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/011/C	Fixed possible EEPROM overwrite at address 00000_{16}	Recommended for new programs
KAD/ADC/011/B	Reduced power consumption on the +5V line	Not recommended for new programs
KAD/ADC/011	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

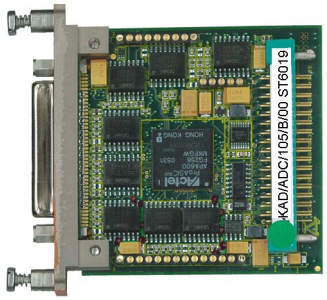
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
TEC/NOT/016	Power dissipation
TEC/NOT/019	An introduction to digital filtering
TEC/NOT/049	Power estimation

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ADC/105

Differential ended ADC (programmable analog gain, 6kHz b/w) - 8ch at 24ksps

CURTISSWRIGHTDS.COM



Key Features

- Eight differential ended input channels
- Programmable input range (±10mV to ±10V)
- High impedance (>10MΩ/44kΩ) when on/off
- Short on any channel does not affect others
- 16 bit simultaneous sampling on each channel

Applications

- Differential voltage measurement

Overview

The KAD/ADC/105 is used to condition and digitize up to eight differential ended analog channels.

At the heart of the KAD/ADC/105 is a hard-wired state-machine that over-samples all channels at a rate between 96ksps and 192ksps and digitally filters any noise above the user programmable cutoff frequency. This is achieved using cascaded, half-band, decimate by 2, 15 tap, finite-impulse-response (FIR) filters with 32-bit coefficients followed by an 8th order Butterworth IIR filter with a default cutoff point set at 25% of the sampling frequency.

All signals are sampled simultaneously. Thus, when several channels are sampled at different sampling rates, at the start of an acquisition cycle all channels will be aligned.

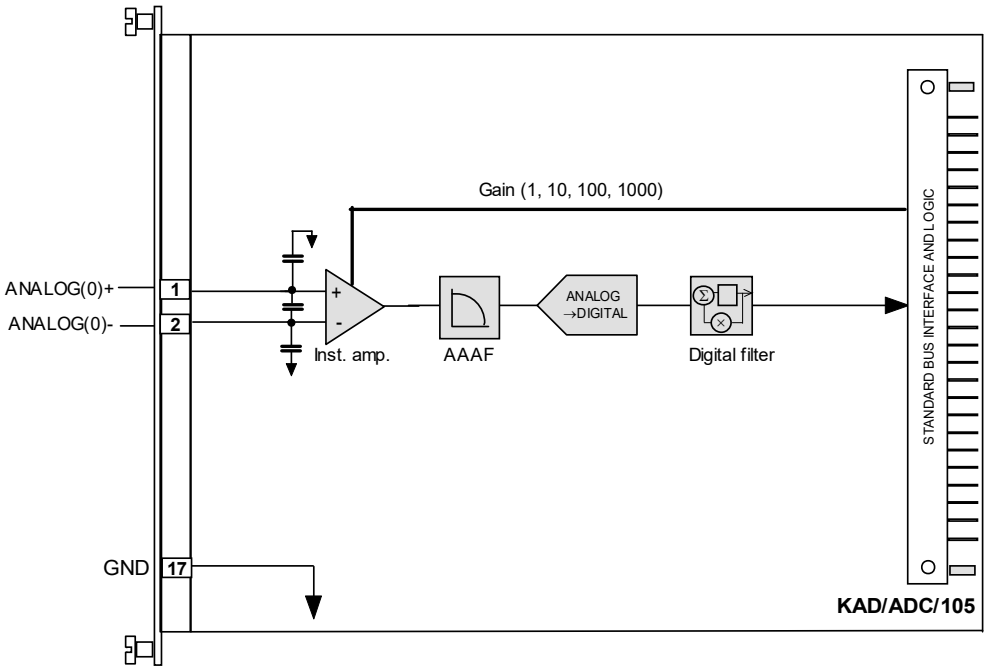


Figure 1: First of eight channels on the KAD/ADC/105

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	80	–	g	
	–	2.82	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	100	–	175	mA	
±7V	0	–	0	mA	
+12V	45	–	65	mA	
-12V	40	–	55	mA	
total power	1.52	–	2.31	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Differential ended analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	8	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG[7:0]	2	–	24000	sps	
Input voltage					
operating range (G_p = 1)	-10	–	10	V	Primary gain = 1
operating range (G_p = 10)	-1	–	1	V	Primary gain = 10
operating range (G_p = 100)	-100	–	100	mV	Primary gain = 100
operating range (G_p = 1000)	-10	–	10	mV	Primary gain = 1000
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.

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TABLE 2	Differential ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
DC error					DC signal averaged over 200 samples without excitation.
gain = 1, 10, 100	–	–	0.08	%FSR	
gain = 2, 20, 200	–	–	0.14	%FSR	
gain = 4, 40, 400	–	–	0.25	%FSR	
gain = 8, 80, 800	–	–	0.44	%FSR	
gain = 1000	–	–	0.3	%FSR	
gain = 2000	–	–	0.6	%FSR	
gain = 4000	–	–	1.2	%FSR	
Effective number of bits					
gain = 1, 10	13.5	–	–	bits	$f_c \leq$ 2kHz and secondary gain of 1 (f_c : filter cutoff frequency).
gain = 100	11.3	–	–	bits	$f_c \leq$ 2kHz and secondary gain of 1.
gain = 1000	8	–	–	bits	$f_c \leq$ 1kHz and secondary gain of 1.
Crosstalk					
gain = 1, 10, 100	–	–	-60	dB	
gain = 1000	–	–	-57	dB	
Common mode					
voltage range	-10	–	10	V	Operational voltage range.
rejection ratio	50	–	–	dB	Applies within the above common mode voltage range, $0 \leq f \leq f_c$.
Analog filter					Analog filter is Butterworth.
poles	–	–	4	–	
filter cutoff -3dB	–	12.5	–	kHz	±15% error.
Digital filter					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 6kHz (f_s: sampling frequency).
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-72	dB	
aliasing to f_c	–	–	-74	dB	
Filter delay	–	0.33	–	ms	Where $f_{in} = f_c$ = 6kHz (f_{in} : input signal frequency). See “Understanding filter delays” on page 178.
Input resistance					
between inputs	44	–	–	kΩ	Module powered off.
between inputs	10	–	–	MΩ	Module powered on.
each input to GND	22	–	–	kΩ	Module powered off.
each input to GND	10	–	–	MΩ	Module powered on.

Setting up the KAD/ADC/105

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

The following treeview provides an overview of setup configurations available for this module:

Treeview icons legend	
DAU: Data Acquisition Unit	Indicator: Indicates the firing of an event based on specific conditions
PC: Personal Computer	Parser slot: Area of memory reserved for storing parsed data
Instrument: Any component or module used in a data acquisition system	Snarfer: Captures all data transmitted on a bus and selectively stores it
DataLink: Connection for transmitting or receiving (defines both the data link and the physical layer)	Bridge: Electrical circuit usually used for measuring purposes
Package: Used to describe how data is transmitted or stored	PCMCIA card: Peripheral interface device usually for use in laptop computers
Parameter: Any register that can be read from an instrument	Multiplexer: Selects one of many input signals and outputs that signal on a signal line
Algorithm: Defines processing to be performed on data	Channels: Defines settings for input or output channels on an instrument
InterConnect: Represents a physical connection on an instrument	
PCI card: Circuit board that plugs into the PCI bus on a PC	



Setting up the module

The following table lists the setup configurations available for the KAD/ADC/105/B.

SETUP DATA	CHOICE	DEFAULT/EXAMPL	NOTES
Manufacturer			-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer
PartReference	KAD/ADC/105/B	KAD/ADC/105/B	ACRA CONTROL part number
SerialNumber			Unique name for each module
Settings	-	-	-
Module-Analog-In-1.2			-
Channel Channel(7:0)			Settings for this channel.
FilterCutoff	0.25, 0.5, 1, 2, 4, 8, 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.

Setting up parameters

Parameter definitions

The following table lists all parameters that are available for the KAD/ADC/105/B.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Channel(7:0) Analog signal data	Volt	OffsetBinary	16:4	R[15:0] 0000:FFFF (hex)

Programmable elements

Channel(7:0)

SETUP DATA	CHOICE	DEFAULT/EXAMPLE	NOTES
RangeMaximum	-10 to 10	10	-
RangeMinimum	-10 to 10	-10	-
SizeInBits	16:4	16	R[15:0] 0000:FFFF (hex)

Getting the most from the KAD/ADC/105

Bias current return path

If the signal source is isolated with respect to the Acra KAM-500 (for example a battery), a common-mode resistance between the negative input and ground (GND) should be used to provide a return for bias currents and reduce common-mode noise pick-up. Because the bias currents are in the order of nA, resistors up to 10kΩ can be used. In most cases a short (0Ω) is recommended.

Using high primary gains

For gains above 1,000, the gain-bandwidth product of the amplifier reduces the bandwidth to 1,000 Hz.

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate will always be sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. Figure 2 shows a delay for an 8th order filter where f_c = 1kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by 1kHz / f_c. The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1kHz / f_c). For example, an 8th order Butterworth filter with an f_c of 1kHz delays a 1kHz signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

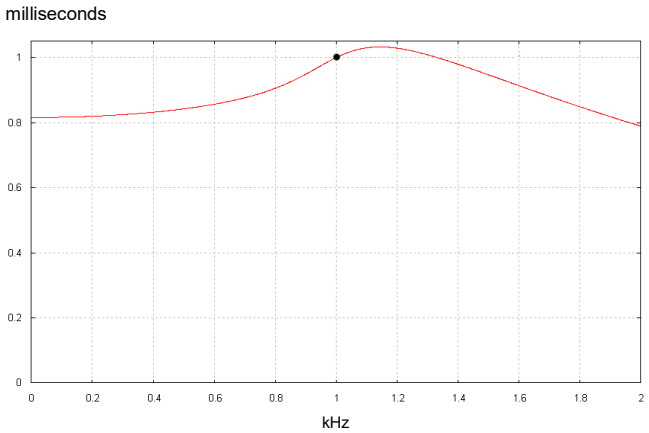


Figure 2: Filter delay for 8th order Butterworth filter where f_c = 1kHz

The filter delay for the KAD/ADC/105 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_A (analog filter delay) ≈ 0

f_c is the filter cutoff frequency.

Additional delay sources

Primary gains higher than 1 cause an additional delay from 1st order filters in the instrumentation amplifier. That additional delay is 2µs for a gain of 10, 15µs for a gain of 100, and 150µs for a gain of 1,000. In applications where time correlation is more important than suppression of aliasing, set the same cutoff point on all channels, even if the sampling rates are different.

Connector pinout of the KAD/ADC/105

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	ANALOG(0)+	Differential ended analog inputs	Analog input
2	ANALOG(0)-	Differential ended analog inputs	Analog input
3	ANALOG(1)+	Differential ended analog inputs	Analog input
4	ANALOG(1)-	Differential ended analog inputs	Analog input
5	ANALOG(2)+	Differential ended analog inputs	Analog input
6	ANALOG(2)-	Differential ended analog inputs	Analog input
7	ANALOG(3)+	Differential ended analog inputs	Analog input
8	ANALOG(3)-	Differential ended analog inputs	Analog input
9	ANALOG(4)+	Differential ended analog inputs	Analog input
10	ANALOG(4)-	Differential ended analog inputs	Analog input
11	ANALOG(5)+	Differential ended analog inputs	Analog input
12	ANALOG(5)-	Differential ended analog inputs	Analog input
13	ANALOG(6)+	Differential ended analog inputs	Analog input
14	ANALOG(6)-	Differential ended analog inputs	Analog input
15	ANALOG(7)+	Differential ended analog inputs	Analog input
16	ANALOG(7)-	Differential ended analog inputs	Analog input
17	GND	Internal ground	
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	DNC		Do not connect
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/105/B	Differential ended ADC (programmable analog gain, 6kHz b/w) - 8ch at 24ksps (with 52-way connector)
KAM/ADC/105/B	Differential ended ADC (programmable analog gain, 6kHz b/w) - 8ch at 24ksps (with 51-way connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; or ACC/CON/008/04 for KAM modules), is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/ADC/105 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/105/B	Improved format switching	Recommended for new programs
KAD/ADC/105	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

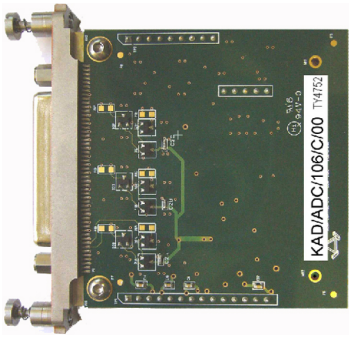
Related documentation

DOCUMENT	DETAILS
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
DOC/DBK/001	Acra KAM-500 Databook

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ADC/106

Accelerometer ADC (current excitation, programmable analog gain, 6kHz b/w) - 6ch ICP and 2ch D/E at 24ksps



Key Features

- Six accelerometer input channels with DC reject and two differential ended input channels
- Accelerometer input programmable range (±1V, ±10V)
- Differential ended input programmable range (±10mV to ±10V)
- Constant current source excitation on each accelerometer input channel (3.6mA typical)
- Short on any channel does not affect others
- 16 bit simultaneous sampling on each channel

Applications

- Accelerometer signal conditioning/digitalization and differential voltage measurement

Overview

The KAD/ADC/106 is used to condition and digitize up to eight differential ended analog channels. Six of these channels have a constant current source and high-pass (DC-reject) filter for use with ICP accelerometer devices.

At the heart of the KAD/ADC/106 is a hard-wired state-machine that oversamples all channels at a rate between 96ksps and 192ksps and digitally filters any noise above the user-programmable cutoff frequency.

This is achieved using cascaded, half-band, Finite-Impulse-Response (FIR) filters followed by an 8th order Butterworth IIR filter with a default cutoff point set at one quarter of the sampling frequency ($f_c = f_s / 4$).

All signals are sampled simultaneously (isochronously). Thus, when several channels are sampled at different sampling rates, at the start of an acquisition cycle all channels are aligned.

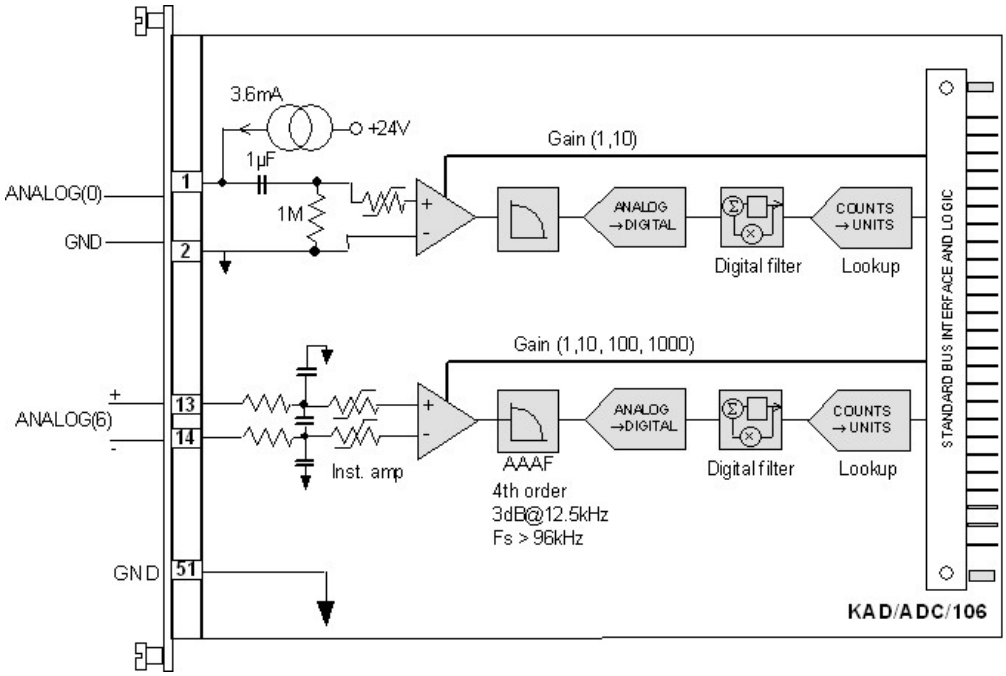


Figure 1: First of six accelerometer channels and first differential ended channel on the KAD/ADC/106

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	100	–	g	
	–	3.53	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	100	–	200	mA	
±7V	0	–	0	mA	
±12V	50	–	80	mA	Excludes current used by excitation. As a DC/DC converter is used, multiply excitation current by 1.5 to calculate +12V and -12V line currents.
total power	1.7	–	2.92	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	AC analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	6	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG[5:0]	2	–	24,000	sps	
Input voltage					
operating range (G_p = 1)	-10	–	10	V	Primary gain = 1.
operating range (G_p = 10)	-1	–	1	V	Primary gain = 10.
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.

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TABLE 2	AC analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
AC gain error					
gain = 1, 2, 4, 8, 10, 20, 40, 80	–	–	0.4	%FSR	For $f_{in} < 0.6f_c$ and 10Hz < f_{in} < 2kHz, note that the first limitation is mostly due to the natural attenuation of the IIR digital filter. The second limitation is due to the attenuation of analog filters in the signal path (f_{in} : input signal frequency; f_c : filter cutoff frequency).
Effective number of bits					
gain = 1, 10	13	–	–	bits	$f_c \leq$ 2kHz and secondary gain of 1.
Crosstalk					
gain = 1, 10	–	-72	-60	dB	The maximum crosstalk value given here represents the worst case scenario for f_{in} close to 6kHz; the typical value is met below 3kHz.
Analog filter					Analog filter is Butterworth.
High pass filter					
poles	–	–	1	–	
filter cutoff -3dB	–	0.16	–	Hz	±15% error.
Anti aliasing filter					
poles	–	–	4	–	
filter cutoff -3dB	–	12.5	–	kHz	±15% error.
Digital filter					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 6kHz (f_s : sampling frequency).
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-72	dB	
aliasing to f_c	–	–	-74	dB	
Filter delay	–	0.33	–	ms	Where $f_{in} = f_c$ = 6kHz. See “Understanding filter delays” on page 188.
Input impedance					
each input to GND	0.8	1	–	MΩ	Module powered off (measured at 3kHz).
each input to GND	250	300	–	kΩ	Module powered on (measured at 3kHz).

TABLE 3	Differential ended analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	2	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG [7:6]	2	–	24000	sps	
Input voltage					
operating range (G_p = 1)	-10	–	10	V	Primary gain = 1.
operating range (G_p = 10)	-1	–	1	V	Primary gain = 10.
operating range (G_p = 100)	-100	–	100	mV	Primary gain = 100.
operating range (G_p = 1000)	-10	–	10	mV	Primary gain = 1000.
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.
DC error					DC signal averaged over 200 samples without excitation.
gain = 1, 10, 100	–	–	0.08	%FSR	
gain = 2, 20, 200	–	–	0.14	%FSR	
gain = 4, 40, 400	–	–	0.25	%FSR	
gain = 8, 80, 800	–	–	0.44	%FSR	
gain = 1000	–	–	0.3	%FSR	
gain = 2000	–	–	0.6	%FSR	
gain = 4000	–	–	1.2	%FSR	
Effective number of bits					
gain = 1, 10	13.5	–	–	bits	$f_c \leq$ 2kHz and secondary gain of 1 (f_c : filter cutoff frequency).
gain = 100	11.3	–	–	bits	$f_c \leq$ 2kHz and secondary gain of 1.
gain = 1000	8	–	–	bits	$f_c \leq$ 1kHz and secondary gain of 1.
Crosstalk					
gain = 1, 10, 100	–	-72	-60	dB	The maximum crosstalk value given here represents the worst case scenario for f_{in} close to 6kHz; the typical value is met below 3kHz (f_{in} : input signal frequency).
gain = 1000	–	–	-45	dB	
Common mode					
voltage range	-10	–	10	V	Operational voltage range.
rejection ratio	50	–	–	dB	Applies within the above common mode voltage range, $0 \leq f \leq f_c$.
Analog filter					Analog filter is Butterworth.
poles	–	–	4	–	
filter cutoff -3dB	–	12.5	–	kHz	±15% error.

TABLE 3	Differential ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Digital filter					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 6kHz (f_s : sampling frequency).
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-72	dB	
aliasing to f_c	–	–	-74	dB	
Filter delay	–	0.33	–	ms	Where $f_{in} = f_c = 6kHz$ (f_{in} : input signal frequency). See “Understanding filter delays” on page 188.
Input resistance					
between inputs	10	–	–	MΩ	Module powered off.
between inputs	10	–	–	MΩ	Module powered on.
each input to GND	10	–	–	MΩ	Module powered off.
each input to GND	10	–	–	MΩ	Module powered on.

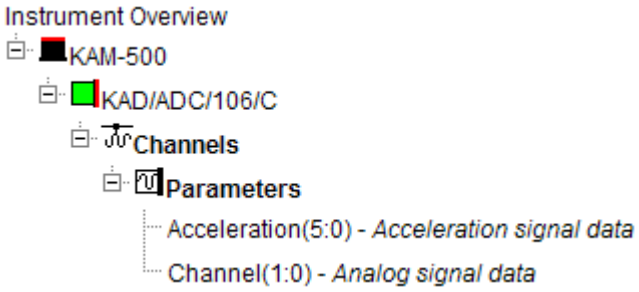
TABLE 4	Single ended DC current excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	6	–	Applied per channel.
Output current					
operating range	–	3.6	–	mA	
compliance	–	–	24	V	
short circuit current	–	–	4.9	mA	
short circuit duration	∞	–	–	s	
DC error					
error	–	–	1.6	mA	With a constant 2.2kΩ load.
noise	–	3	–	mV_{rms}	As measured on analog input.

Setting up the KAD/ADC/106

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

The following treeview provides an overview of setup configurations available for this module:

Treeview icons legend	
DAU: Data Acquisition Unit PC: Personal Computer Instrument: Any component or module used in a data acquisition system DataLink: Connection for transmitting or receiving (defines both the data link and the physical layer) Package: Used to describe how data is transmitted or stored Parameter: Any register that can be read from an instrument Algorithm: Defines processing to be performed on data InterConnect: Represents a physical connection on an instrument PCI card: Circuit board that plugs into the PCI bus on a PC	Indicator: Indicates the firing of an event based on specific conditions Parser slot: Area of memory reserved for storing parsed data Snarfer: Captures all data transmitted on a bus and selectively stores it Bridge: Electrical circuit usually used for measuring purposes PCMCIA card: Peripheral interface device usually for use in laptop computers Multiplexer: Selects one of many input signals and outputs that signal on a signal line Channels: Defines settings for input or output channels on an instrument



Setting up the module

The following table lists the setup configurations available for the KAD/ADC/106/C.

SETUP DATA	CHOICE	DEFAULT/EXAMPLE	NOTES
Manufacturer			-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/106/C	KAD/ADC/106/C	ACRA CONTROL part number.
SerialNumber			Unique name for each module.
Settings	-	-	-
Module-Analog-In-1.2			-
Channel Acceleration(5:0)			Settings for this channel.
FilterCutoff	0.25, 0.5, 1, 2, 4, 8, 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.
Channel Channel(1:0)			Settings for this channel.
FilterCutoff	0.25, 0.5, 1, 2, 4, 8, 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.

Setting up parameters

Parameter definitions

The following table lists all parameters that are available for the KAD/ADC/106/C.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Acceleration(5:0) Acceleration signal data	Volt	OffsetBinary	16:4	R[15:0] 0000:FFFF (hex)
Channel(1:0) Analog signal data	Volt	OffsetBinary	16:4	R[15:0] 0000:FFFF (hex)

Programmable elements

Acceleration(5:0)

SETUP DATA	CHOICE	DEFAULT/EXAMPLE	NOTES
SizeInBits	16:4	16	R[15:0] 0000:FFFF (hex)
RangeMinimum	-10 to 10	-10	-
RangeMaximum	-10 to 10	10	-

Channel(1:0)

SETUP DATA	CHOICE	DEFAULT/EXAMPLE	NOTES
SizeInBits	16:4	16	R[15:0] 0000:FFFF (hex)
RangeMinimum	-10 to 10	-10	-
RangeMaximum	-10 to 10	10	-

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/106

Signal return path

For channels 0 to 5, each signal is single ended so a return (GND) for the constant current must be provided. Return path effects are minimized if a GND pin on the module is used. These channels are band-pass filtered (that is, the DC component is also removed) so that when a sensor is first connected or powered on, it takes about 60 seconds to settle.

Bias current return path

For channels 6 and 7, if the signal source is isolated with respect to the Acra KAM-500 (for example a battery), a common-mode resistance between the negative input and ground (GND) should be used to provide a return for bias currents and reduce common-mode noise pick-up. Because the bias currents are in the order of nAs, resistors up to 10kΩ can be used. In most cases a short (0Ω) is recommended.

Using high primary gains

For gains above 1,000, the gain-bandwidth product of the amplifier reduces the bandwidth to 1,000 Hz.

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate are always sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. Figure 2 shows a delay for an 8th order filter where f_c = 1kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by 1kHz / f_c. The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1kHz / f_c). For example, an 8th order Butterworth filter with an f_c of 1kHz delays a 1kHz signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

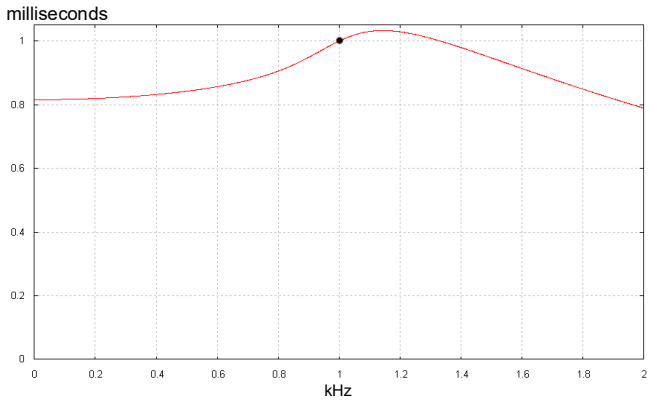


Figure 2: Filter delay for 8th order Butterworth filter where f_c = 1kHz

The filter delay for the KAD/ADC/106 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_D is the filter delay.

T_A (analog filter delay) ≈ 0

f_c is the filter cutoff frequency.

Additional delay sources

Primary gains higher than 1 cause an additional delay from 1st order filters in the instrumentation amplifier. That additional delay is 2µs for a gain of 10, 15µs for a gain of 100, and 150µs for a gain of 1,000. In applications where time correlation is more important than suppression of aliasing, set the same cutoff point on all channels, even if the sampling rates are different.

Temperature drift

For the ICP inputs, the isolation resistance of the capacitor used on the high-pass filter can drift over temperature, which can cause a theoretical offset of up to 50 mV. This drift in isolation resistance does not impact the overvoltage performance of the input.

Connector pinout of the KAD/ADC/106

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	ANALOG(0)	AC analog inputs	Constant current output
2	GND	Internal ground	
3	ANALOG(1)	AC analog inputs	Constant current output
4	GND	Internal ground	
5	ANALOG(2)	AC analog inputs	Constant current output
6	GND	Internal ground	
7	ANALOG(3)	AC analog inputs	Constant current output
8	GND	Internal ground	
9	ANALOG(4)	AC analog inputs	Constant current output
10	GND	Internal ground	
11	ANALOG(5)	AC analog inputs	Constant current output
12	GND	Internal ground	
13	ANALOG(6)+	Differential ended analog inputs	
14	ANALOG(6)-	Differential ended analog inputs	
15	ANALOG(7)+	Differential ended analog inputs	
16	ANALOG(7)-	Differential ended analog inputs	
17	GND	Internal ground	
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
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38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/106/C	Accelerometer ADC (current excitation, programmable analog gain, 6kHz b/w) - 6ch ICP and 2ch D/E at 24ksps (with 52-way double-density connector)
KAM/ADC/106/C	Accelerometer ADC (current excitation, programmable analog gain, 6kHz b/w) - 6ch ICP and 2ch D/E at 24ksps (with 51-way micro-miniature connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; or ACC/CON/008/04 for KAM modules), is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/ADC/106 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/106/C	High impedance per channel when powered off, enhanced mechanical strength and higher compliance voltage for current excitations	Recommended for new programs
KAD/ADC/106/B	Reduced power consumption on the ±7V power lines	Not recommended for new programs
KAD/ADC/106	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

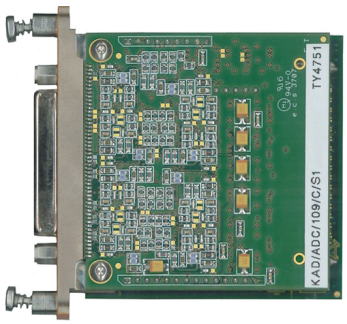
Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ADC/109/S1

Full-bridge ADC (voltage excitation, programmable analog gain, 6kHz b/w) – 8ch at 24ksps



Key Features

- Eight full or ½-bridge, potentiometer or differential ended input channels
- Programmable input range (±10mV to ±10V)
- High accuracy (max. 0.08% FSR at unity gain)
- Programmable voltage excitation and balance adjust
- High impedance (>10MΩ) when on/off
- Short on any channel does not affect others
- 16-bit simultaneous sampling on each channel

Applications

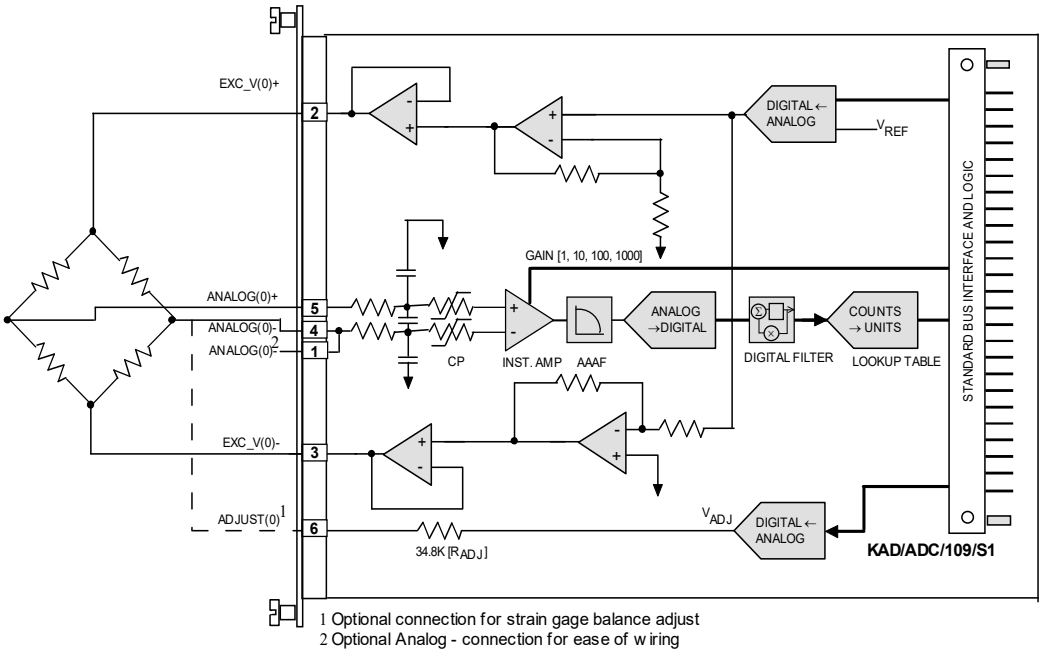
- Bridge sensors
- Differential voltage measurement
- Strain gage measurement

Overview

The KAD/ADC/109/S1 provides independent excitation for up to eight channels. Each channel has a separate programmable amplifier, programmable filter and A/D converter.

At the heart of the KAD/ADC/109/S1 is a hard-wired state-machine that over-samples all channels at a rate between 96ksps and 192ksps and digitally filters any noise above the user programmable cutoff frequency. This is achieved using cascaded, half-band, decimate by two, fifteen tap, finite-impulse-response (FIR) filters with 32-bit coefficients followed by an 8^{th} order Butterworth IIR filter with a default cutoff point set at a quarter of the sampling frequency.

All signals are sampled simultaneously. Thus, when several channels are sampled at different sampling rates, at the start of an acquisition cycle all channels are aligned.



1 Optional connection for strain gage balance adjust
2 Optional Analog - connection for ease of w iring

Figure 1: First of eight channels on the KAD/ADC/109/S1

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	102	–	g	
	–	3.59	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements, see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	100	–	180	mA	
+7V	40	–	60	mA	Excludes current used by excitation.
-7V	30	–	50	mA	Excludes current used by excitation.
+12V	60	–	80	mA	
-12V	40	–	60	mA	
total power	2.19	–	3.35	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualifications Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Differential ended analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	8	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG[7:0]	2	–	24,000	sps	
Input voltage					
operating range (G_p = 1)	-10	–	10	V	Primary gain = 1
operating range (G_p = 10)	-1	–	1	V	Primary gain = 10
operating range (G_p = 100)	-100	–	100	mV	Primary gain = 100
operating range (G_p = 1000)	-10	–	10	mV	Primary gain = 1000
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.

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TABLE 2	Differential ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
DC error					DC signal averaged over 200 samples without excitation.
gain = 1, 10, 100	–	–	0.08	%FSR	
gain = 2, 20, 200	–	–	0.14	%FSR	
gain = 4, 40, 400	–	–	0.25	%FSR	
gain = 8, 80, 800	–	–	0.44	%FSR	
gain = 1000	–	–	0.3	%FSR	
gain = 2000	–	–	0.6	%FSR	
gain = 4000	–	–	1.2	%FSR	
Effective number of bits					
gain = 1, 10	13.5	–	–	bits	$f_c \leq$ 2kHz and secondary gain of 1 (f_c : filter cutoff frequency).
gain = 100	11	–	–	bits	$f_c \leq$ 2kHz and secondary gain of 1.
gain = 1000	8	–	–	bits	$f_c \leq$ 1kHz and secondary gain of 1.
Crosstalk					
gain = 1, 10, 100	–	–	-60	dB	
gain = 1000	–	–	-45	dB	
Common mode					
voltage range	-10	–	10	V	Operational voltage range.
rejection ratio	50	–	–	dB	Applies within the above common mode voltage range, $0 \leq f \leq f_c$.
Analog filter					Analog filter is Butterworth.
poles	–	–	4	–	
filter cutoff -3dB	11.4	12	12.6	kHz	
Digital filter					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 6kHz (f_s: sampling frequency).
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-72	dB	
aliasing to f_c	–	–	-74	dB	
Filter delay	–	0.33	–	ms	Where $f_{in} = f_c$ = 6kHz (f_{in} : input signal frequency). See “Understanding filter delays” on page 199.
Input resistance					
between inputs	10	–	–	MΩ	Module powered off.
between inputs	10	–	–	MΩ	Module powered on.
each input to GND	10	–	–	MΩ	Module powered off.
each input to GND	10	–	–	MΩ	Module powered on.

TABLE 3	Bipolar DC voltage excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	8	–	
Output voltage					
operating range	0	–	5.1	V	Bi-polar excitation: 5V is 10V across the bridge.
resolution	–	–	1.8	mV	Bi-polar excitation: 1.8mV is 3.6mV across the bridge.
compliance	–	–	30	mA	Per channel.
short circuit current	–	–	125	mA	
short circuit duration	∞	–	–	s	To GND.
DC error					
error	–	–	0.3	%FSR	With a constant 350Ω load.
noise (gain = 1)	–	–	0.5	mV_{rms}	As measured on analog input.
noise (gain = 10)	–	–	0.05	mV_{rms}	As measured on analog input.
noise (gain = 100, 1000)	–	–	0.01	mV_{rms}	As measured on analog input.
Output resistance	–	0.5	–	Ω	

TABLE 4	Bridge adjust DC current outputs[1]				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	8	–	
Output current					
operating range	-71	–	71	µA	
resolution	–	35	–	nA	
DC error					
error	–	–	2	%FSR	With a constant 175Ω load. The impact of this error on the channel reading is less than 0.01%FSR (200 times lower than the error specified here).
drift	–	–	0.15	%FSR	Over temperature.
noise (gain = 1)	–	–	0.5	mV_{rms}	As measured on analog input.
noise (gain = 10)	–	–	0.05	mV_{rms}	As measured on analog input.
noise (gain = 100, 1000)	–	–	0.01	mV_{rms}	As measured on analog input.
Output resistance	–	34.8	–	kΩ	

1. The adjust line is intended for use in balancing strain gages and should not be used for asymmetric bridge transducers such as accelerometers or pressure transducers unless sensor re-calibration is carried out on a channel-by-channel basis.

Setting up the KAD/ADC/109/S1

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/109/C/S1	KAD/ADC/109/C/S1	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
AnalogIn(7:0) Analog Input	-	-	-
Settings	-	-	-
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.
Excitation Amplitude	0 to 5.1	0	Required excitation (in V) for the top of the bridge. Excitation is bipolar so entering 5V means 10V across the bridge.
Balance.Type	CurrentShunt	CurrentShunt	Specifies the balance type to be carried out on the bridge.
Balance.Applied	-71e-6 to 71e-6	0	Shunt current (in A) applied to the bridge.
Balance.BalanceThisTime	True False	False	Specifies if balancing should be carried out this time by software.
Balance.Tolerance	0.01 to 99.99	0.1	Specifies acceptable tolerance of achieved value vs. target value, expressed as percentage of defined input range.
Balance.Target	-10 to 10	0	Specifies a value. that the channel should be balanced to.
ShuntCurrent.Applied	-71e-6 to 71e-6	0	Shunt mode current (in A) added to the bridge.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
AnalogIn(7:0) Parameters				
AnalogIn Analog signal data	Volt	OffsetBinary	16	R[15:0]

Configurable parameters

AnalogIn(7:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-10 to 10	10	Range maximum for analog channel
Range Minimum	-10 to 10	-10	Range minimum for analog channel

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/109/S1

Wiring configurations

Figures 2 to 4 show possible wiring configurations for the KAD/ADC/109/S1.

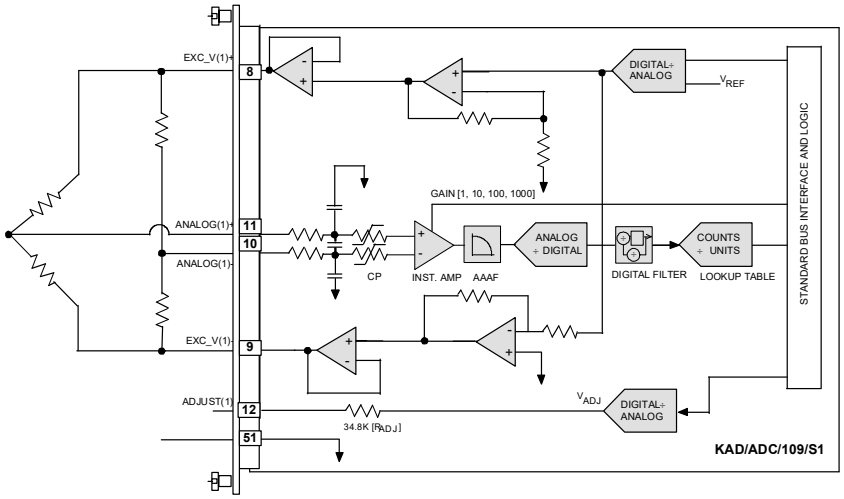


Figure 2: Second of eight independent ½-bridge channels with matched pair completion resistors

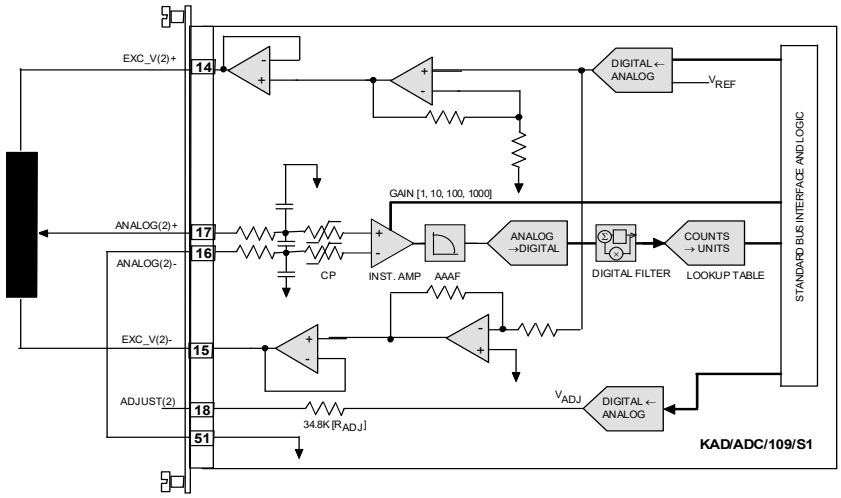


Figure 3: Third of eight independent potentiometer channels

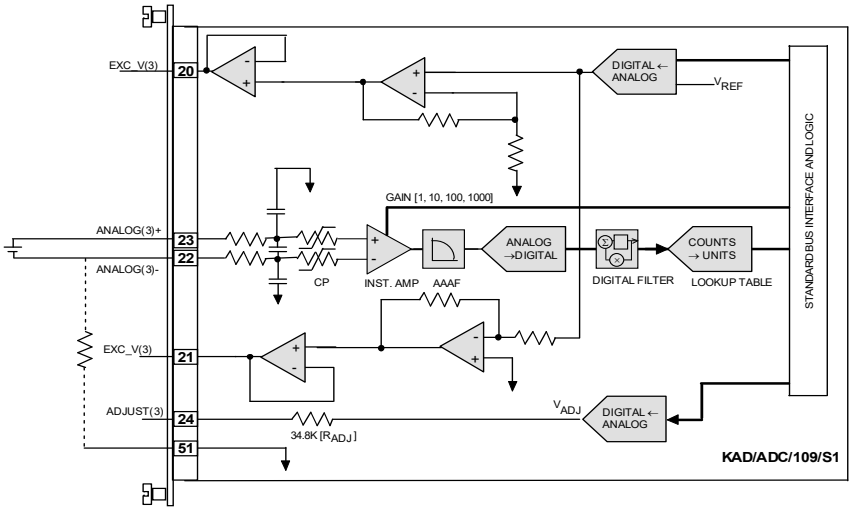


Figure 4: Fourth of eight independent differential ended channels

Bias current return path

As shown in Figure 4 on page 197, the analog inputs can be used as differential inputs (that is, not from a bridge). In this case, if the signal source is isolated with respect to the KAM-500 (for example a battery), a common-mode resistance between the negative input and ground (GND) should be used to provide a return for bias currents and reduce common-mode noise pick-up. Because the bias currents are in the order of nAs, resistors up to 10kΩ can be used. In most cases a short (0Ω) is recommended.

NOTE: When analog inputs are used as differential inputs, setting the excitation and balance to zero reduces quiescent currents of the module.

Using high primary gains

For gains above 1,000, the gain-bandwidth product of the amplifier reduces the bandwidth to 1,000 Hz.

Excitation setup

Excitation can contribute error to the overall measurement, so it is recommended to use as close as possible to full-scale excitation, to minimize the percentage error.

For optimal accuracy ensure each channel uses its corresponding excitation. If the excitation is not used, it should be set to the minimum value.

Excitation drift on potentiometer configurations

Curtiss-Wright recommends a full-bridge input configuration for the KAD/ADC/109/S1. With this configuration the differential input amplifier removes common mode voltage or common mode pickup noise on the input lines.

For potentiometer circuits where the negative input is tied to ground, excitation drift can have a direct impact on the input signal either as a gain or an offset error. Note that excitation can drift up to 0.3% on an FSR of 5.1V. In the case where both excitation lines drift in the same direction, an offset error is seen in the measurement. The worst case offset is 0.3% of 5.1V and results in a 5.3mV offset of the measurement. This does not happen when full-bridge configurations.

Curtiss-Wright recommends that the negative input is tied to GND as shown in Figure 3 on page 196.

Source load error caused by the balance adjust circuit

The balance circuit has an impedance of R_{ADJ} and is connected to the ANALOG(x)- input of the module. This connection is performed internally on the module. In some bridge configurations, R_{ADJ} loads the source signal causing a quantifiable error. An example schematic for a full-bridge configuration loaded with balance resistance is shown in the following figure.

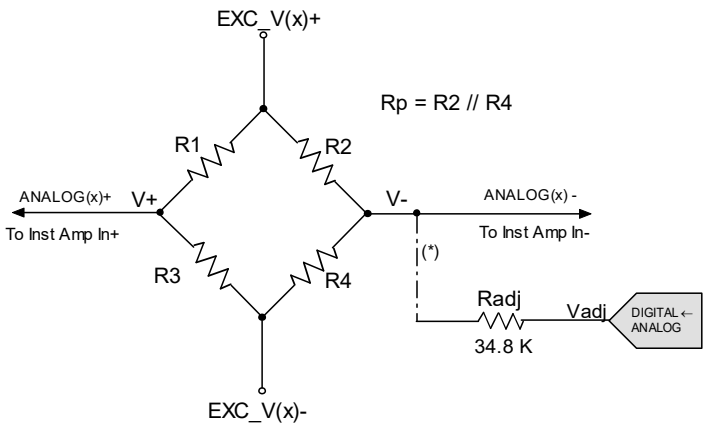


Figure 5: Full-bridge configuration loaded with balance resistance

The DC error specification is checked as a differential input, so it does not include loading by R_{ADJ} which causes an additional gain error.

In the previous figure, the gain error only occurs when the active leg of the bridge is connected to ANALOG(x)-. In this situation, ANALOG(x)- is loaded by R_{ADJ}, forming a resistor divider with the resistance of bridge visible from the ANALOG(x)- input.

The gain error on ANALOG(x)- input can be quantified as follows:

$$Error = -\left(\frac{R_P}{R_P + R_{adj}}\right) \times 100\%$$

where $R_P = R_2$ in parallel with R_4

This additional gain error depends on the resistance of the bridge and can be typically -0.5% for a 350Ω bridge with its active leg connected to ANALOG(x)-, and -0.172% for a 120Ω bridge.

In the case of a full-bridge with two active legs, only one leg of the bridge is affected. Therefore the gain error of voltage across the bridge is half of the above quoted figures, that is, -0.25% for a 350Ω bridge.

For a symmetrical input range, the error can be expressed as %FSR error by further dividing the value by two, yielding to ±0.125% FSR for a 350Ω bridge.

Note that the gain error due to R_{ADJ} does not apply when:

- using a wheatstone bridge with the active elements (typically strain gages) placed only on the leg of the bridge connected to ANALOG(x)+
- the leg of the bridge connected to ANALOG(x)- is populated with completion resistors (half-bridge with completion resistors)
- using only differential ended inputs with signal source isolated from module ground
- using only inputs in single ended configuration, connecting the signal to ANALOG(x)+ (ANALOG(x)- must be connected to ground). This data sheet shows an example potentiometer application, which is not affected by this gain error.

Modules with R_{ADJ} connected externally might show this additional gain error offset but only if the balance adjust circuit is used and in the cases stated previously.

NOTE: Gain error can be compensated at post processing, as the nominal resistance of the bridge is known.

Compensation for lead resistance (Excitation Mode set to Voltage)

In bridge applications, if the lead resistance can be measured or estimated, add the voltage drop across the leads to the excitation voltage. For example, for 0.5Ω leads in a 350Ω full-bridge, where ±2.5V (5V) is desired across the bridge, the

excitation should be set to 2.5V + (0.5 × 5 / 350) = 2.507.

NOTE: When Excitation Mode is set to Current, the lead's resistance does not need to be compensated for. If sense lines are required, see the KAD/ADC/109/S2.

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate will always be sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. The following figure shows a delay for an 8^{th} order filter where f_c = 1kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by 1kHz / f_c. The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1kHz/ f_c). For example, an 8^{th} order Butterworth filter with an f_c of 1kHz delays a 1kHz signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

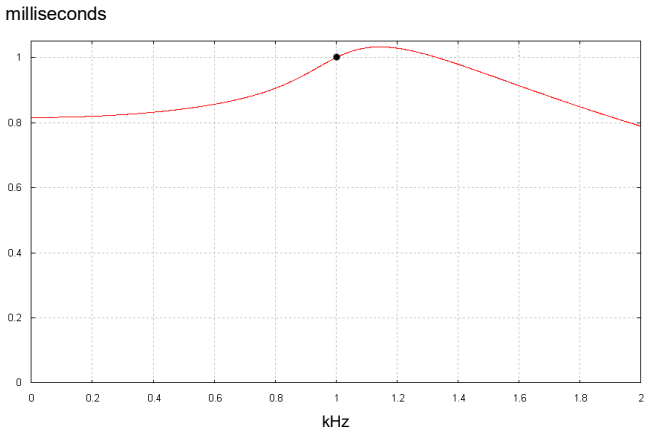


Figure 6: Filter delay for 8^{th} order Butterworth filter where f_c = 1kHz

The filter delay for the KAD/ADC/109/S1 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_D is the filter delay

T_A (analog filter delay) ≈ 0

f_c is the filter cutoff frequency.

Additional delay sources

Primary gains higher than 1 cause an additional delay from 1^{st} order filters in the instrumentation amplifier. That additional delay is 2µs for a gain of 10, 15µs for a gain of 100, and 150µs for a gain of 1,000. In applications where time correlation is more important than suppression of aliasing, set the same cutoff point on all channels, even if the sampling rates are different.

Connector pinout of the KAD/ADC/109/S1

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	ANALOG(0)-	Differential ended analog inputs	Analog input
2	EXC_V(0)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 0
3	EXC_V(0)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 0
4	ANALOG(0)-	Differential ended analog inputs	Analog input
5	ANALOG(0)+	Differential ended analog inputs	Analog input
6	ADJUST(0)	Bridge adjust DC current outputs	Used to balance/calibrate bridge
7	ANALOG(1)-	Differential ended analog inputs	Analog input
8	EXC_V(1)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 1
9	EXC_V(1)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 1
10	ANALOG(1)-	Differential ended analog inputs	Analog input
11	ANALOG(1)+	Differential ended analog inputs	Analog input
12	ADJUST(1)	Bridge adjust DC current outputs	Used to balance/calibrate bridge
13	ANALOG(2)-	Differential ended analog inputs	Analog input
14	EXC_V(2)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 2
15	EXC_V(2)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 2
16	ANALOG(2)-	Differential ended analog inputs	Analog input
17	ANALOG(2)+	Differential ended analog inputs	Analog input
18	ADJUST(2)	Bridge adjust DC current outputs	Used to balance/calibrate bridge
19	ANALOG(3)-	Differential ended analog inputs	Analog input
20	EXC_V(3)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 3
21	EXC_V(3)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 3
22	ANALOG(3)-	Differential ended analog inputs	Analog input
23	ANALOG(3)+	Differential ended analog inputs	Analog input
24	ADJUST(3)	Bridge adjust DC current outputs	Used to balance/calibrate bridge
25	ANALOG(4)-	Differential ended analog inputs	Analog input
26	EXC_V(4)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 4
27	EXC_V(4)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 4
28	ANALOG(4)-	Differential ended analog inputs	Analog input
29	ANALOG(4)+	Differential ended analog inputs	Analog input
30	ADJUST(4)	Bridge adjust DC current outputs	Used to balance/calibrate bridge
31	ANALOG(5)-	Differential ended analog inputs	Analog input
32	EXC_V(5)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 5
33	EXC_V(5)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 5
34	ANALOG(5)-	Differential ended analog inputs	Analog input
35	ANALOG(5)+	Differential ended analog inputs	Analog input
36	ADJUST(5)	Bridge adjust DC current outputs	Used to balance/calibrate bridge
37	ANALOG(6)-	Differential ended analog inputs	Analog input
38	EXC_V(6)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 6
39	EXC_V(6)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 6
40	ANALOG(6)-	Differential ended analog inputs	Analog input
41	ANALOG(6)+	Differential ended analog inputs	Analog input
42	ADJUST(6)	Bridge adjust DC current outputs	Used to balance/calibrate bridge
43	ANALOG(7)-	Differential ended analog inputs	Analog input
44	EXC_V(7)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 7
45	EXC_V(7)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 7
46	ANALOG(7)-	Differential ended analog inputs	Analog input
47	ANALOG(7)+	Differential ended analog inputs	Analog input
48	ADJUST(7)	Bridge adjust DC current outputs	Used to balance/calibrate bridge
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/109/C/S1	Full-bridge ADC (voltage excitation, programmable analog gain, 6kHz b/w) – 8ch at 24ksps (with 52-way double-density connector)
KAM/ADC/109/C/S1	Full-bridge ADC (voltage excitation, programmable analog gain, 6kHz b/w) – 8ch at 24ksps (with 51-way micro-miniature connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; ACC/CON/008/04 for KAM modules) is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/ADC/109/S1 refers to both the KAD and KAM version of the module.

The KAD/ADC/109/S1 uses power from the ±7V power line for excitation and therefore cannot be used with the KAM/CHS/04L, KAM/CHS/05F, KAM/CHS/03F, or KAM/CHS/02F chassis.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/109/C/S1	High impedance per channel when powered off, enhanced mechanical strength and improved format switching	Recommended for new programs
KAD/ADC/109/B/S1	Reduced power consumption on the ±7V power lines	Not recommended for new programs
KAD/ADC/109/S1	8 channel bridge A/D converter with excitation and signal conditioning	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/001	Strain gages and ideal bridges
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

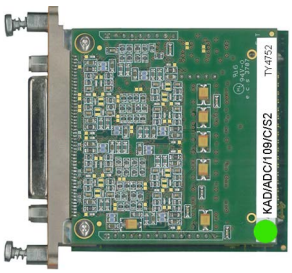
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ADC/109/S2

Full-bridge ADC (voltage excitation, programmable analog gain, sense lines, 6kHz b/w) – 8ch at 24ksps

CURTISSWRIGHTDS.com



Key Features

- Eight full or ½-bridge, potentiometer or differential ended input channels
- Programmable input range (±10mV to ±10V)
- High accuracy (max. 0.08% FSR at unity gain)
- Programmable voltage excitation and balance adjust
- Short on any channel does not affect others
- 16-bit simultaneous sampling on each channel

Applications

- Bridge sensors
- Strain gage measurement
- Differential voltage measurement

Overview

The KAD/ADC/109/S2 has eight channels of signal conditioning and data acquisition for differential voltages, strain gage or bridge measurements. In addition to the measurement channel, the KAD/ADC/109/S2 provides independent bipolar excitation for up to eight channels. Each differential ended signal has a separate programmable amplifier, filter and A/D converter.

At the heart of the KAD/ADC/109/S2 is a hard-wired state-machine that over-samples all channels at a rate between 96ksps and 192ksps and digitally filters any noise above the user-programmable cutoff frequency. This is achieved using cascaded, half-band, decimate by two, 15 tap, Finite-Impulse-Response (FIR) filters with 32-bit coefficients followed by an 8thth order Butterworth Infinite-Impulse-Response (IIR) filter with a default cutoff point set at a quarter of the sampling frequency. All signals are sampled simultaneously. Thus, when several channels are sampled at different sampling rates, all channels are aligned at the start of an acquisition cycle.

The KAD/ADC/109/S2 is intended for use with strain gages, and should not be used for asymmetric bridge transducers such as accelerometers, pressure transducers unless sensor re-calibration is carried out on a channel-by-channel basis. If the sense lines or internal offset adjust (balance feature) are not required, refer to the KAD/ADC/109/S1.

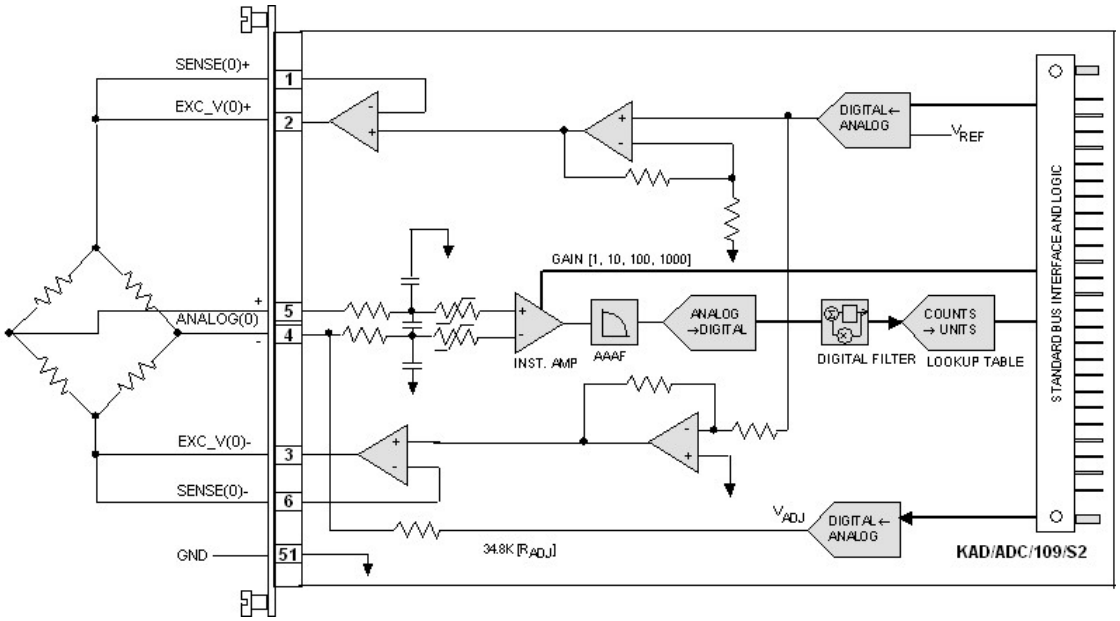


Figure 1: First of eight channels on the KAD/ADC/109/S2

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	105	–	g	
	–	3.71	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	100	–	180	mA	
+7V	40	–	60	mA	Excludes current used by excitation.
-7V	30	–	50	mA	Excludes current used by excitation.
+12V	60	–	80	mA	
-12V	40	–	60	mA	
total power	2.19	–	3.35	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Differential ended analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	8	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG[7:0]	2	–	24,000	sps	
Input voltage					
operating range (G_p = 1)	-10	–	10	V	Primary gain = 1
operating range (G_p = 10)	-1	–	1	V	Primary gain = 10
operating range (G_p = 100)	-100	–	100	mV	Primary gain = 100
operating range (G_p = 1000)	-10	–	10	mV	Primary gain = 1000
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.

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TABLE 2	Differential ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
DC error					DC signal averaged over 200 samples. Quoted specifications are for inputs only. Figures do not include excitation error or the affect of loading the source signal connected to the ANALOG(x)- input of the module. See “Source load error caused by the balance adjust circuit” on page 209.
gain = 1, 10, 100	–	–	0.08	%FSR	
gain = 2, 20, 200	–	–	0.14	%FSR	
gain = 4, 40, 400	–	–	0.25	%FSR	
gain = 8, 80, 800	–	–	0.44	%FSR	
gain = 1000	–	–	0.3	%FSR	
gain = 2000	–	–	0.6	%FSR	
gain = 4000	–	–	1.2	%FSR	
Effective number of bits					
gain = 1, 10	13.5	–	–	bits	$f_c \leq$ 2kHz and secondary gain of 1 (f_c : filter cutoff frequency).
gain = 100	11	–	–	bits	$f_c \leq$ 2kHz and secondary gain of 1.
gain = 1000	8	–	–	bits	$f_c \leq$ 1kHz and secondary gain of 1.
Crosstalk					
gain = 1, 10, 100	–	–	-60	dB	
gain = 1000	–	–	-45	dB	
Common mode					
voltage range	-10	–	10	V	Operational voltage range.
rejection ratio	50	–	–	dB	Applies within the above common mode voltage range, $0 \leq f \leq f_c$.
Analog filter					Analog filter is Butterworth.
poles	–	–	4	–	
filter cutoff -3dB	11.4	12	12.6	kHz	
Digital filter					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 6kHz (f_s: sampling frequency).
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-72	dB	
aliasing to f_c	–	–	-74	dB	
Filter delay	–	0.33	–	ms	Where $f_{in} = f_c$ = 6kHz (f_{in} : input signal frequency). See “Understanding filter delays” on page 210.
Input resistance					
between inputs	10	–	–	MΩ	Module powered off.
between inputs	10	–	–	MΩ	Module powered on.
single ended input to GND	10	–	–	MΩ	Module powered off. Measured on ANALOG(x)+ input.
single ended input to GND	10	–	–	MΩ	Module powered on. Measured on ANALOG(x)+ input.
single ended input to GND	–	34.8	–	kΩ	Module powered on. Measured on ANALOG(x)- input.
single ended input to GND	43	52	–	kΩ	Module powered off. Measured on ANALOG(x)- input.

TABLE 3	Bipolar DC voltage excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	8	–	Applied per channel.
Output voltage					
operating range	0	–	5.1	V	Bi-polar excitation: 5V is 10V across the bridge.
resolution	–	1.8	–	mV	Bi-polar excitation: 1.8mV is 3.6mV across the bridge.
compliance	–	–	30	mA	Per channel.
short circuit current	–	–	125	mA	
short circuit duration	∞	–	–	s	
DC error					
error	–	–	0.3	%FSR	With a constant 350Ω load. This figure includes drift.
drift	–	–	0.1	%FSR	Over operating temperature.
noise (gain = 1)	–	–	0.5	mV_{rms}	As measured on analog input.
noise (gain = 10)	–	–	0.05	mV_{rms}	As measured on analog input.
noise (gain = 100, 1000)	–	–	0.01	mV_{rms}	As measured on analog input.
Output resistance	–	0.5	–	Ω	

TABLE 4	Balance current outputs[1]				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	8	–	Applied per channel. Connected internally with corresponding ANALOG(x)- input.
Output current					
operating range	-71	–	71	µA	
resolution	–	35	–	nA	
DC error					
error	–	–	2	%FSR	With a constant 175Ω load. The impact of this error on the channel reading is less than 0.01%FSR (200 times lower than the error specified here).
drift	–	–	0.15	%FSR	Over temperature.
noise (gain = 1)	–	–	0.5	mV_{rms}	As measured on analog input.
noise (gain = 10)	–	–	0.05	mV_{rms}	As measured on analog input.
noise (gain = 100, 1000)	–	–	0.01	mV_{rms}	As measured on analog input.
Output resistance	–	34.8	–	kΩ	

1. The balance current output is permanently connected to ANALOG(x)- input. The line is intended for balancing strain gages, so the module should not be used for asymmetric bridge transducers such as accelerometers or pressure transducers unless sensor re-calibration is carried out on a channel-by-channel basis.

Setting up the KAD/ADC/109/S2

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/109/C/S2	KAD/ADC/109/C/S2	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
AnalogIn(7:0) Analog Input	-	-	-
Settings	-	-	-
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.
Excitation Amplitude	0 to 5.1	0.2	Required excitation (in V) for the top of the bridge. Excitation is bipolar so entering 5V means 10V across the bridge.
Balance.Type	CurrentShunt	CurrentShunt	Specifies the balance type to be carried out on the bridge.
Balance.Applied	-71e-6 to 71e-6	0	Shunt current (in A) applied to the bridge.
Balance.BalanceThisTime	True False	False	Specifies if balancing should be carried out this time by software.
Balance.Tolerance	0.01 to 99.99	0.1	Specifies acceptable tolerance of achieved value vs. target value, expressed as percentage of defined input range.
Balance.Target	-10 to 10	0	Specifies a value. that the channel should be balanced to.
ShuntCurrent.Applied	-71e-6 to 71e-6	0	Shunt mode current (in A) added to the bridge

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
AnalogIn(7:0) Parameters				
AnalogIn Analog signal data	Volt	OffsetBinary	16	R[15:0]

Configurable parameters

AnalogIn(7:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-10 to 10	10	Range maximum for analog channel
Range Minimum	-10 to 10	-10	Range minimum for analog channel

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/109/S2

Wiring configurations

Figures 2 to 4 show possible wiring configurations for the KAD/ADC/109/S2.

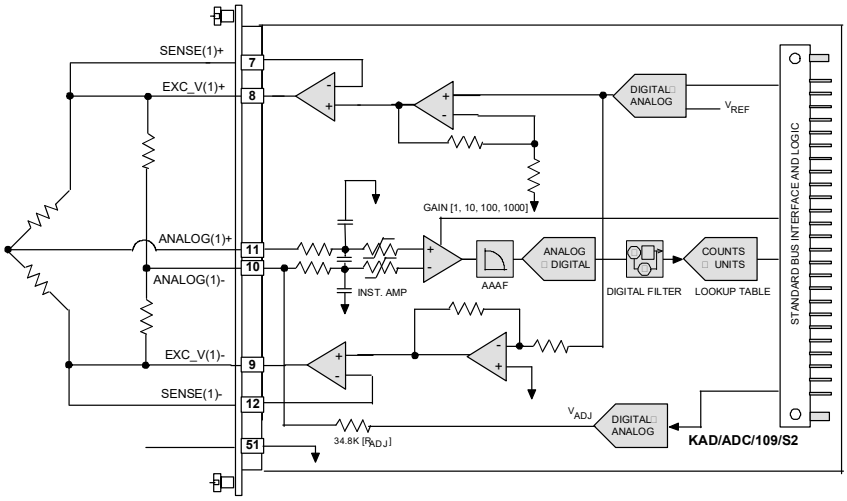


Figure 2: Second of eight independent ½-bridge channels with matched pair completion resistors

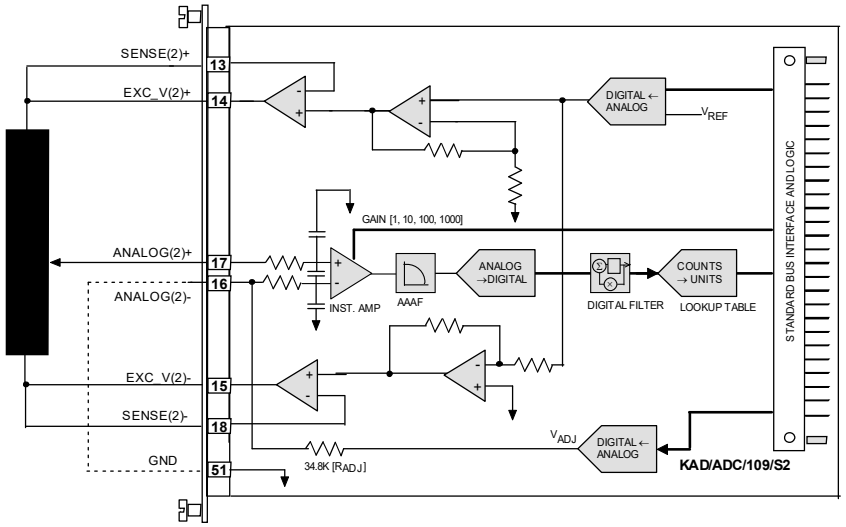


Figure 3: Third of eight independent potentiometer channels

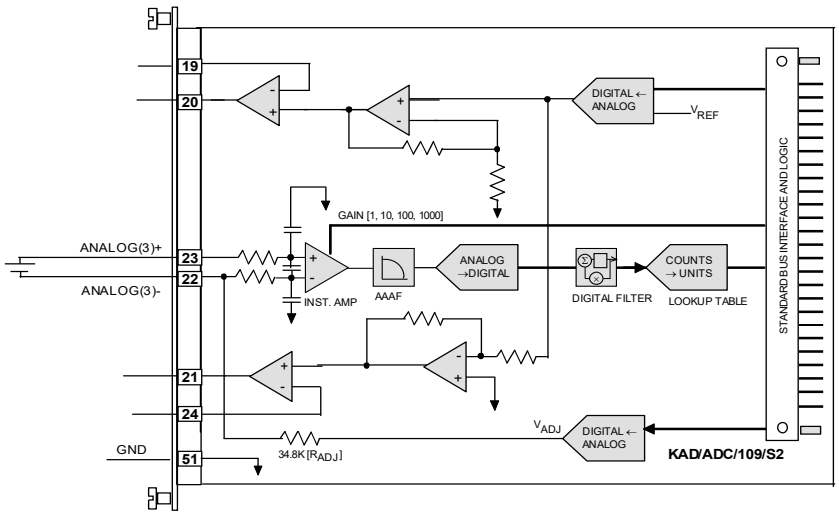


Figure 4: Fourth of eight independent differential ended channels

Bias current return path

As shown in Figure 4 on page 209, the analog inputs can be used as differential inputs (that is, not from a bridge). In this case, if the signal source is isolated with respect to the Acra KAM-500 (for example a battery), a common-mode resistance between the negative input and ground (GND) should be used to provide a return for bias currents and reduce common-mode noise pick-up. Because the bias currents are in the order of nAs resistors up to 10kΩ can be used. In most cases a short (0Ω) is recommended.

NOTE: When analog inputs are used as differential inputs, setting the excitation and balance to zero reduces quiescent currents of the module.

Using high primary gains

For gains above 1,000, the gain-bandwidth product of the amplifier reduces the bandwidth to 1,000 Hz.

Excitation setup

Excitation can contribute error to the overall measurement, so it is recommended to use as close as possible to full-scale excitation, to minimize the percentage error.

For optimal accuracy ensure each channel uses its corresponding excitation. If the excitation is not used, it should be set to the minimum value.

Excitation drift on potentiometer configurations

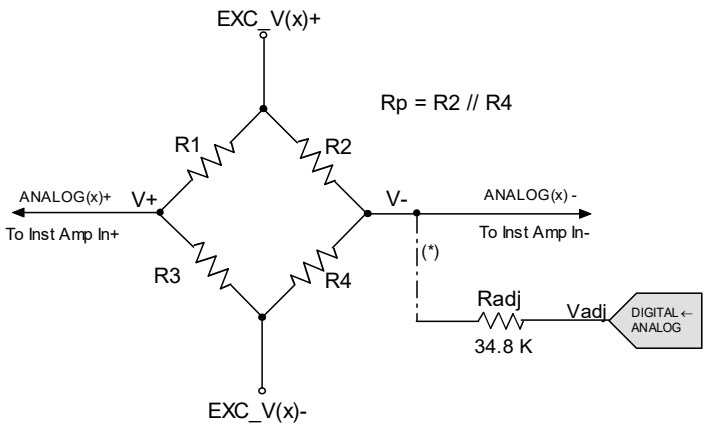
We recommend a full-bridge input configuration for the KAD/ADC/109/S2. With this configuration the differential input amplifier removes common mode voltage or common mode pickup noise on the input lines.

For potentiometer circuits where the negative input is tied to ground, excitation drift can have a direct impact on the input signal either as a gain or an offset error. Note that excitation can drift up to 0.3% on an FSR of 5.1V. In the case where both excitation lines drift in the same direction, an offset error is seen in the measurement. The worst case offset is 0.3% of 5.1V and results in a 5.3mV offset of the measurement. This does not happen with full-bridge configurations.

We recommend that the negative input is tied to GND as shown in Figure 3 on page 208. If the negative input is floating, the drift of the digital/analog converter related to the balancing input directly adds further offset error to the measurement.

Source load error caused by the balance adjust circuit

The balance circuit has an impedance of R_{ADJ} and is connected to the ANALOG(x)- input of the module. This connection is performed internally on the module. In some bridge configurations, R_{ADJ} loads the source signal causing a quantifiable error. An example schematic for a full-bridge configuration loaded with balance resistance is shown in the following figure.



(*) Connection between V- and Radj is internal or external depending on module

Figure 5: Full-bridge configuration loaded with balance resistance

The DC error specification is checked as a differential input, so it does not include loading by R_{ADJ} which causes an additional gain error.

In the previous figure, the gain error only occurs when the active leg of the bridge is connected to ANALOG(x)-. In this situation, ANALOG(x)- is loaded by R_{ADJ}, forming a resistor divider with the resistance of bridge visible from the ANALOG(x)- input.

The gain error on ANALOG(x)- input can be quantified as follows:

$$Error = -\left(\frac{R_P}{R_P + R_{adj}}\right) \times 100\%$$

where $R_P = R_2$ in parallel with R_4

This additional gain error depends on the resistance of the bridge and can be typically -0.5% for a 350Ω bridge with its active leg connected to ANALOG(x)-, and -0.172% for a 120Ω bridge.

In the case of a full-bridge with two active legs, only one leg of the bridge is affected. Therefore the gain error of voltage across the bridge is half of the above quoted figures, that is, -0.25% for a 350Ω bridge.

For a symmetrical input range, the error can be expressed as %FSR error by further dividing the value by two, yielding to ±0.125% FSR for a 350Ω bridge.

Note that the gain error due to R_{ADJ} does not apply when:

- using a wheatstone bridge with the active elements (typically strain gages) placed only on the leg of the bridge connected to ANALOG(x)+
- the leg of the bridge connected to ANALOG(x)- is populated with completion resistors (half-bridge with completion resistors)
- using only differential ended inputs with signal source isolated from module ground
- using only inputs in single ended configuration, connecting the signal to ANALOG(x)+ (ANALOG(x)- must be connected to ground). This data sheet shows an example potentiometer application, which is not affected by this gain error.

Modules with R_{ADJ} connected externally might show this additional gain error offset but only if the balance adjust circuit is used and in the cases stated previously.

NOTE: Gain error can be compensated at post processing, as the nominal resistance of the bridge is known.

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate are always sampled at the same time independently of how they are stored or

transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. The following figure shows a delay for an 8th order filter where f_c = 1kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1kHz / f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1kHz / f_c). For example, an 8th order Butterworth filter with an f_c of 1kHz delays a 1kHz signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

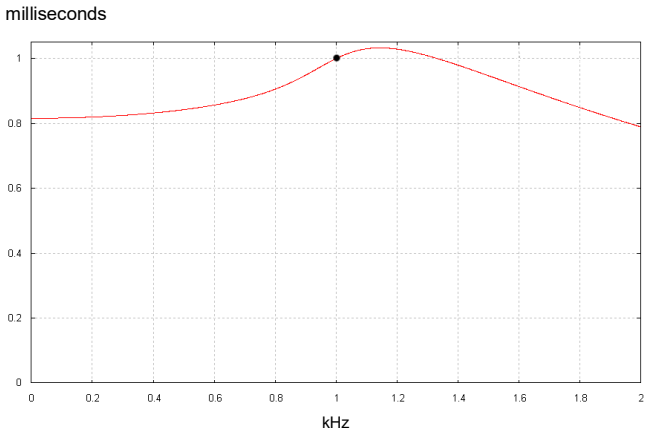


Figure 6: Filter delay for 8th order Butterworth filter where f_c = 1kHz

The filter delay for the KAD/ADC/109/S2 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_D is the filter delay

T_A (analog filter delay) ≈ 0

Additional delay sources

Primary gains higher than 1 cause an additional delay from 1st order filters in the instrumentation amplifier. That additional delay is 2µs for a gain of 10, 15µs for a gain of 100, and 150µs for a gain of 1,000. In applications where time correlation is more important than suppression of aliasing, set the same cutoff point on all channels, even if the sampling rates are different.

Sense lines

Sense lines are used to eliminate error due to voltage drop across lead resistance. Sense lines can not be left unconnected; they should be connected as close as possible to the bridge. If however, the sense lines are connected close to the module (that is, far from the bridge) and the lead resistance can be measured or estimated, add the voltage drop across the leads to the excitation voltage. For example, for 0.5Ω leads in a 350Ω full-bridge where ±5V (10V) is desired across the bridge, the excitation must be set to 5V + (0.5 × 10/350) = ±5.014.

Connector pinout of the KAD/ADC/109/S2

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	SENSE(0)+	Bipolar DC voltage excitation outputs	Sense line from top of bridge
2	EXC_V(0)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge
3	EXC_V(0)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge
4	ANALOG(0)-	Differential ended analog inputs	Analog input connected to internal adjust
5	ANALOG(0)+	Differential ended analog inputs	Analog input
6	SENSE(0)-	Bipolar DC voltage excitation outputs	Sense line from bottom of bridge
7	SENSE(1)+	Bipolar DC voltage excitation outputs	Sense line from top of bridge
8	EXC_V(1)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge
9	EXC_V(1)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge
10	ANALOG(1)-	Differential ended analog inputs	Analog input connected to internal adjust
11	ANALOG(1)+	Differential ended analog inputs	Analog input
12	SENSE(1)-	Bipolar DC voltage excitation outputs	Sense line from bottom of bridge
13	SENSE(2)+	Bipolar DC voltage excitation outputs	Sense line from top of bridge
14	EXC_V(2)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge
15	EXC_V(2)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge
16	ANALOG(2)-	Differential ended analog inputs	Analog input connected to internal adjust
17	ANALOG(2)+	Differential ended analog inputs	Analog input
18	SENSE(2)-	Bipolar DC voltage excitation outputs	Sense line from bottom of bridge
19	SENSE(3)+	Bipolar DC voltage excitation outputs	Sense line from top of bridge
20	EXC_V(3)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge
21	EXC_V(3)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge
22	ANALOG(3)-	Differential ended analog inputs	Analog input connected to internal adjust
23	ANALOG(3)+	Differential ended analog inputs	Analog input
24	SENSE(3)-	Bipolar DC voltage excitation outputs	Sense line from bottom of bridge
25	SENSE(4)+	Bipolar DC voltage excitation outputs	Sense line from top of bridge
26	EXC_V(4)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge
27	EXC_V(4)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge
28	ANALOG(4)-	Differential ended analog inputs	Analog input connected to internal adjust
29	ANALOG(4)+	Differential ended analog inputs	Analog input
30	SENSE(4)-	Bipolar DC voltage excitation outputs	Sense line from bottom of bridge
31	SENSE(5)+	Bipolar DC voltage excitation outputs	Sense line from top of bridge
32	EXC_V(5)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge
33	EXC_V(5)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge
34	ANALOG(5)-	Differential ended analog inputs	Analog input connected to internal adjust
35	ANALOG(5)+	Differential ended analog inputs	Analog input
36	SENSE(5)-	Bipolar DC voltage excitation outputs	Sense line from bottom of bridge
37	SENSE(6)+	Bipolar DC voltage excitation outputs	Sense line from top of bridge
38	EXC_V(6)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge
39	EXC_V(6)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge
40	ANALOG(6)-	Differential ended analog inputs	Analog input connected to internal adjust
41	ANALOG(6)+	Differential ended analog inputs	Analog input
42	SENSE(6)-	Bipolar DC voltage excitation outputs	Sense line from bottom of bridge
43	SENSE(7)+	Bipolar DC voltage excitation outputs	Sense line from top of bridge
44	EXC_V(7)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge
45	EXC_V(7)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge
46	ANALOG(7)-	Differential ended analog inputs	Analog input connected to internal adjust
47	ANALOG(7)+	Differential ended analog inputs	Analog input
48	SENSE(7)-	Bipolar DC voltage excitation outputs	Sense line from bottom of bridge
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/109/C/S2	Full-bridge ADC (voltage excitation, programmable analog gain, sense lines, 6kHz b/w) – 8ch at 24ksps (with 52-way double-density connector)
KAM/ADC/109/C/S2	Full-bridge ADC (voltage excitation, programmable analog gain, sense lines, 6kHz b/w) – 8ch at 24ksps (with 51-way micro-miniature connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; ACC/CON/008/04 for KAM modules) is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/ADC/109/S2 refers to both the KAD and KAM version of the module.

The KAD/ADC/109/S1 uses power from the ±7V power line for excitation and therefore cannot be used with the KAM/CHS/04L, KAM/CHS/05F, KAM/CHS/03F, KAM/CHS/02F, or KAM/CHS/02F chassis.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/109/C/S2	High impedance per channel when powered off, enhanced mechanical strength and improved format switching	Recommended for new programs
KAD/ADC/109/B/S2	Reduced power consumption on the ±7V power lines	Not recommended for new programs
KAD/ADC/109/S2	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/001	Strain gages and ideal bridges
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

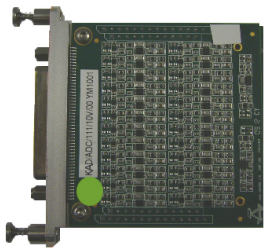
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ADC/111

Single ended ADC (1kHz b/w) - 48ch at 4ksps

CURTISSWRIGHTDS.com



Key Features

- 48 single ended input channels
- Ordering input range of ±10V or ±40V
- High accuracy (0.01% FSR typical for /10V variant and 0.05% for /40V variant
- 16-bit simultaneous sampling on each channel

Applications

- Analog signal acquisition
- FTI, OLM, HUMS

Overview

The KAD/ADC/111 is used to condition and digitize up to 48 single ended analog channels using a 16-bit A/D per channel.

At the heart of the KAD/ADC/111 is a hard-wired state-machine that oversamples all channels at a rate between 16ksps and 32ksps and digitally filters any noise above the user-programmable cutoff frequency. This is achieved using cascaded, half-band, Finite-Impulse-Response (FIR) filters followed by an 8th order Butterworth IIR filter with a default cutoff point set at one quarter of the sampling frequency ($f_c = f_s / 4$).

All signals are sampled simultaneously. Therefore, when several channels are sampled at different sampling rates, at the start of an acquisition cycle, all channels are aligned.

The KAD/ADC/111 is available with two different input ranges (±40V, ±10V). The input range must be specified when ordering.

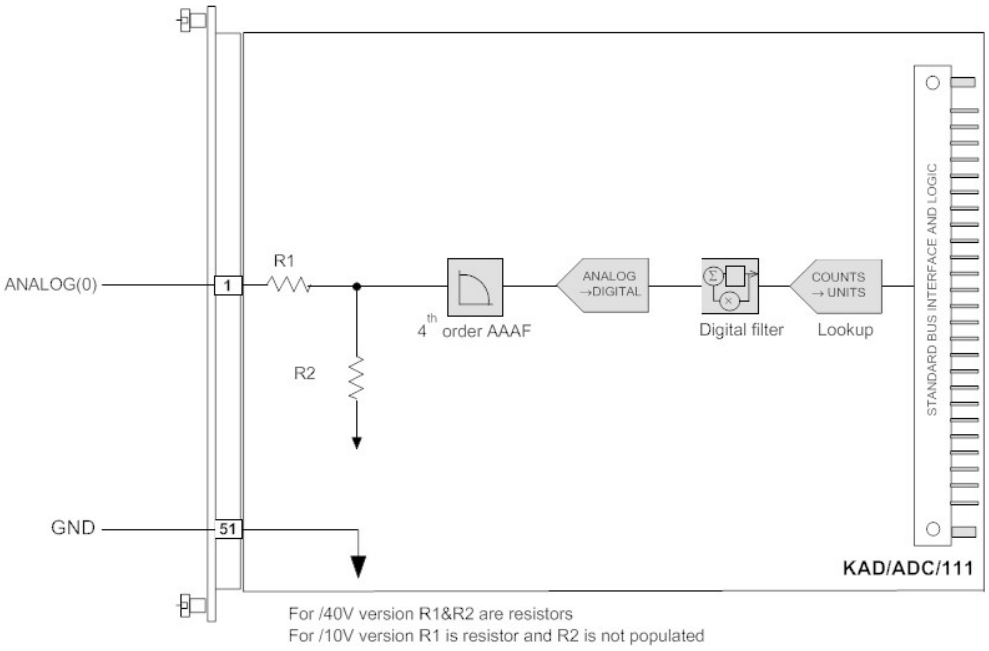


Figure 1: First of 48 channels on the KAD/ADC/111

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under "Environmental ratings" in the "General specifications" table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	90	–	g	
	–	3.18	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	215	250	275	mA	
±7V	0	–	0	mA	
±12V	45	60	80	mA	
total power	2.16	2.69	3.3	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Single ended analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	48	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG[47:0]	1.0	–	4,000	sps	
Input voltage					
operating range (KAD/ADC/111/10V)	-10	–	10	V	
operating range (KAD/ADC/111/40V)	-40	–	40	V	
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.
DC error					DC signal averaged over 200 samples.
gain = 1	–	0.01	0.05	%FSR	KAD/ADC/111/10V.
gain = 2	–	–	0.08	%FSR	KAD/ADC/111/10V.
gain = 4	–	–	0.14	%FSR	KAD/ADC/111/10V.
gain = 8	–	–	0.25	%FSR	KAD/ADC/111/10V.

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TABLE 2	Single ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
gain = 1	–	0.05	0.08	%FSR	KAD/ADC/111/40V.
gain = 2	–	–	0.12	%FSR	KAD/ADC/111/40V.
gain = 4	–	–	0.22	%FSR	KAD/ADC/111/40V.
gain = 8	–	–	0.35	%FSR	KAD/ADC/111/40V.
AC gain error					
for 0Hz < $f_{in} \leq$ 100Hz	–	0.1	0.3	%FSR	Gain = 1, f_s = 4ksps, $f_c = f_s / 4$ (f_{in} : input signal frequency; f_s : sampling frequency; f_c : filter cutoff frequency).
for 100Hz < $f_{in} \leq$ 300Hz	–	0.1	0.35	%FSR	Gain = 1, f_s = 4ksps, $f_c = f_s / 4$.
for 300Hz < $f_{in} \leq$ 650Hz	–	0.2	0.6	%FSR	Gain = 1, f_s = 4ksps, $f_c = f_s / 4$.
Effective number of bits	12.5	13	–	bits	$f_c \leq$ 1kHz. Secondary gain of 1.
Crosstalk	–	-80	-75	dB	$f_c \leq$ 1kHz. Secondary gain of 1.
Analog filter					Analog filter is Butterworth.
poles	–	–	4	–	
filter cutoff -3dB	1.9	2	2.1	kHz	
Digital filter					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -6dB	0.25	–	16	f_s	The maximum value is limited to 1kHz (f_s : sampling frequency).
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-72	dB	
aliasing to f_c	–	–	-74	dB	
Filter delay	–	2	–	ms	Where $f_{in} = f_c$ = 1kHz. See “Unused single ended inputs” on page 219.
Input resistance					
each input to GND	100	–	–	kΩ	Module powered off, KAD/ADC/111/10V.
each input to GND	10	–	–	MΩ	Module powered on, KAD/ADC/111/10V.
each input to GND	300	350	–	kΩ	Module powered off, KAD/ADC/111/40V.
each input to GND	390	400	–	kΩ	Module powered on, KAD/ADC/111/40V.

Setting up the KAD/ADC/111

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

NOTE: The PartReference, RangeMaximum, and RangeMinimum settings are specific to each module variant as shown under “Specifications” on page 216. Only one variant is shown below.

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/111/10V	KAD/ADC/111/10V	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
Analog(47:0) Analog Input	-	-	Settings for this channel.
Settings	-	-	-
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Analog(47:0) Parameters				
Analog Analog signal data.	Volt	OffsetBinary	16	R[15:0]

Configurable parameters

Analog(47:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-10 to 10	10	-
Range Minimum	-10 to 10	-10	-

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/111

Unused single ended inputs

Unused inputs should not be left floating, as this may increase current consumption from the ±12V backplane lines. Floating inputs may cause the output voltage of the internal amplifiers to approach one of the supply rails, which causes increased quiescent currents within specific channel circuits. Each unused single ended input must be shorted to GND.

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate will always be sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. The following figure shows a delay for an 8^{th} order filter where f_c = 1kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1kHz / f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1kHz / f_c). For example, an 8^{th} order Butterworth filter with an f_c of 1kHz delays a 1kHz signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

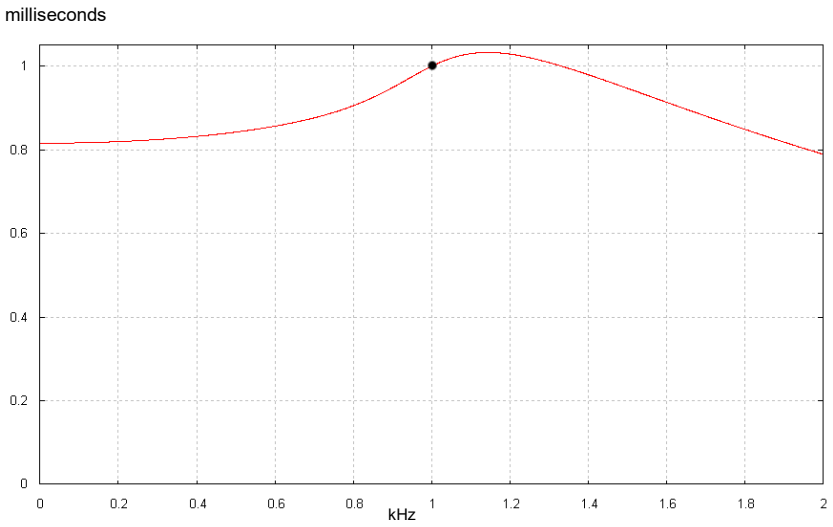


Figure 2: Filter delay for 8^{th} order Butterworth filter where f_c = 1kHz

The filter delay for the KAD/ADC/111 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_D is the filter delay

T_A (analog filter delay) ≈ 0

Connector pinout of the KAD/ADC/111

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	ANALOG(0)	Single ended analog inputs	Analog input
2	ANALOG(1)	Single ended analog inputs	Analog input
3	ANALOG(2)	Single ended analog inputs	Analog input
4	ANALOG(3)	Single ended analog inputs	Analog input
5	ANALOG(4)	Single ended analog inputs	Analog input
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44	ANALOG(43)	Single ended analog inputs	Analog input
45	ANALOG(44)	Single ended analog inputs	Analog input
46	ANALOG(45)	Single ended analog inputs	Analog input
47	ANALOG(46)	Single ended analog inputs	Analog input
48	ANALOG(47)	Single ended analog inputs	Analog input
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/111/10V	Single ended ADC (1kHz b/w) - 48ch at 4ksps, with ±10V input range (with 52-way double-density connector)
KAD/ADC/111/40V	Single ended ADC (1kHz b/w) - 48ch at 4ksps, with ±40V input range (with 52-way double-density connector)
KAM/ADC/111/10V	Single ended ADC (1kHz b/w) - 48ch at 4ksps, with ±10V input range (with 51-way micro-miniature module top connector)
KAM/ADC/111/40V	Single ended ADC (1kHz b/w) - 48ch at 4ksps, with ±40V input range (with 51-way micro-miniature module top connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; or ACC/CON/008/04 for KAM modules), is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/ADC/111 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/111	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

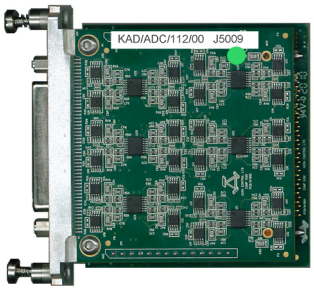
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/019	An introduction to digital filtering
TEC/NOT/049	Power estimation

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ADC/112

Differential ended ADC (3kHz b/w) - 24ch at 12ksps



Key Features

- 24 differential ended input channels
- Ordering input range from ±100mV to ±40V
- High accuracy (0.01% FSR typical)
- High input resistance (>1MΩ) when on/off for /100mV, /1V, and /10V variant
- 16-bit simultaneous sampling on each channel

Applications

- Differential voltage measurement

Overview

The KAD/ADC/112 is used to condition and digitize up to 24 differential ended analog channels using a 16-bit A/D per channel. At the heart of the KAD/ADC/112 is a hard-wired state-machine that over-samples all channels at a rate between 48ksps and 96ksps and digitally filters any noise above the user-programmable cutoff frequency.

This is achieved using cascaded, half-band, finite-impulse-response (FIR) filters followed by an 8th order Butterworth IIR filter with a default cutoff point set at one quarter of the sampling frequency ($f_c = f_s / 4$). All signals are sampled simultaneously. Thus, when several channels are sampled at different sampling rates, at the start of an acquisition cycle all channels are aligned.

The KAD/ADC/112 is available with four different input ranges (±40V, ±10V, ±1V, ±100mV). The input range must be specified when ordering.

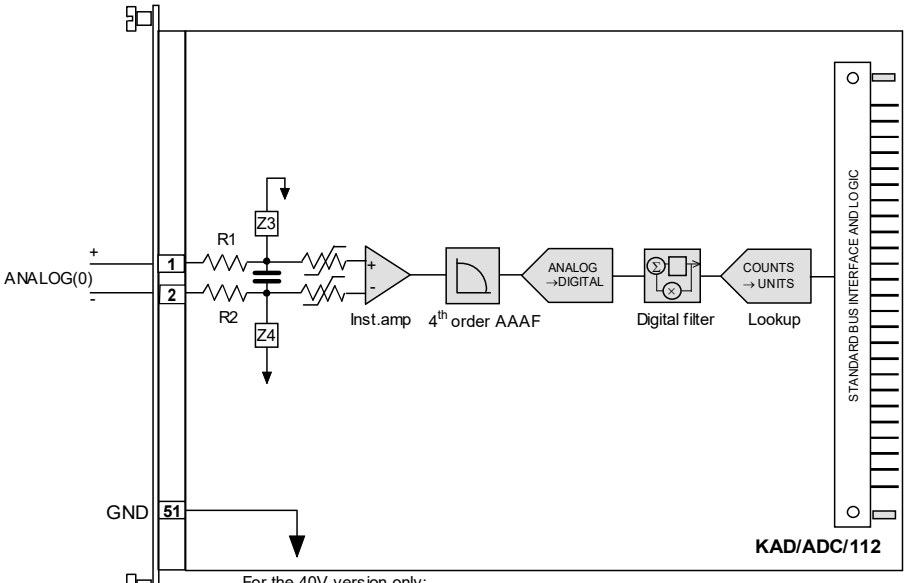


Figure 1: First of 24 channels on the KAD/ADC/112

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	86	–	g	
	–	3.03	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	100	–	200	mA	
±7V	0	–	0	mA	
±12V	50	–	100	mA	
total power	1.7	–	3.4	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Differential ended analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	24	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
Channel[23:0]	0.5	–	12,000	sps	
Input voltage					
operating range (KAD/ADC/112/40V)	-40	–	40	V	Primary gain = 0.25.
operating range (KAD/ADC/112/10V)	-10	–	10	V	Primary gain = 1.
operating range (KAD/ADC/112/1V)	-1	–	1	V	Primary gain = 10.
operating range (KAD/ADC/112/100M)	-100	–	100	mV	Primary gain = 100.
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.

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TABLE 2	Differential ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
DC error					DC signal averaged over 200 samples without excitation.
gain = 1	–	0.01	0.05	%FSR	KAD/ADC/112/10V, KAD/ADC/112/1V.
gain = 2	–	0.02	0.08	%FSR	KAD/ADC/112/10V, KAD/ADC/112/1V.
gain = 4	–	0.04	0.14	%FSR	KAD/ADC/112/10V, KAD/ADC/112/1V.
gain = 8	–	0.08	0.25	%FSR	KAD/ADC/112/10V, KAD/ADC/112/1V.
gain = 1	–	0.02	0.08	%FSR	KAD/ADC/112/100M.
gain = 2	–	0.04	0.14	%FSR	KAD/ADC/112/100M.
gain = 4	–	0.08	0.25	%FSR	KAD/ADC/112/100M.
gain = 8	–	0.16	0.44	%FSR	KAD/ADC/112/100M.
gain = 1,2,4	–	0.05	0.35	%FSR	KAD/ADC/112/40V.
gain = 8	–	0.1	0.5	%FSR	KAD/ADC/112/40V.
AC gain error					
for 0Hz < f_{in} ≤ 300Hz	–	0.02	0.1	%FSR	Gain = 1, f_s = 12kHz, f_c = f_s / 4 (f_{in} : input signal frequency; f_s : sampling frequency; f_c : filter cutoff frequency).
for 300Hz < f_{in} ≤ 1kHz	–	0.1	0.2	%FSR	Gain = 1, f_s = 12kHz, f_c = f_s / 4.
for 1kHz < f_{in} ≤ 2kHz	–	0.2	0.6	%FSR	Gain = 1, f_s = 12kHz, f_c = f_s / 4.
Effective number of bits					
	11.5	13	–	bits	f_c ≤ 1kHz or f_{in} ≤ 0.5kHz. Secondary gain of 1.
	10.5	12	–	bits	f_c > 1kHz and f_{in} > 0.5kHz. Secondary gain of 1.
Crosstalk					
	–	-86	-74	dB	f_{in} ≤ 0.5kHz.
Common mode					
voltage range	-40	–	40	V	Operational voltage range (KAD/ADC/112/40V).
voltage range	-10	–	10	V	Operational voltage range (KAD/ADC/112/10V, KAD/ADC/112/1V, KAD/ADC/112/100M).
rejection ratio (KAD/ADC/112/40V)	62	70	–	dB	Applies within the above common mode voltage range, 0 ≤ f ≤ 100Hz.
rejection ratio (KAD/ADC/112/10V)	70	74	–	dB	Applies within the above common mode voltage range, 0 ≤f ≤ 100Hz.
rejection ratio (KAD/ADC/112/1V)	80	90	–	dB	Applies within the above common mode voltage range, 0 ≤ f ≤ 100Hz.
rejection ratio (KAD/ADC/112/100M)	80	90	–	dB	Applies within the above common mode voltage range, 0 ≤ f ≤ 100Hz.
Analog filter					Analog filter is Butterworth.
poles	–	–	4	–	
filter cutoff -3dB	5.7	6	6.3	kHz	
Digital filter					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 3kHz.
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-72	dB	
aliasing to f_c	–	–	-74	dB	

TABLE 2	Differential ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Filter delay	–	0.66	–	ms	Measured for $f_{in} = f_c = 3kHz$ (f_{in} : input signal frequency). See “Understanding filter delays” on page 228.
Input resistance					
between inputs	10	–	–	MΩ	Module powered off (KAD/ADC/112/10V, KAD/ADC/112/1V, KAD/ADC/112/100M).
between inputs	10	–	–	MΩ	Module powered on (KAD/ADC/112/10V, KAD/ADC/112/1V, KAD/ADC/112/100M).
each input to GND	10	–	–	MΩ	Module powered off (KAD/ADC/112/10V, KAD/ADC/112/1V, KAD/ADC/112/100M).
each input to GND	10	–	–	MΩ	Module powered on (KAD/ADC/112/10V, KAD/ADC/112/1V, KAD/ADC/112/100M).
between inputs	150	160	–	kΩ	Module powered off (KAD/ADC/112/40V).
between inputs	150	160	–	kΩ	Module powered on (KAD/ADC/112/40V).
each input to GND	75	80	–	kΩ	Module powered off (KAD/ADC/112/40V).
each input to GND	75	80	–	kΩ	Module powered on (KAD/ADC/112/40V).
Input impedance					
each input to ground	–	300	–	kΩ	Module powered on (measured at 3kHz; KAD/ADC/112/10V, KAD/ADC/112/1V, KAD/ADC/112/100M).
between inputs	–	300	–	kΩ	Module powered on (measured at 3kHz; KAD/ADC/112/10V, KAD/ADC/112/1V, KAD/ADC/112/100M).
each input to GND	–	80	–	kΩ	Module powered on (measured at 3kHz; KAD/ADC/112/40V).
between inputs	–	160	–	kΩ	Module powered on (measured at 3kHz; KAD/ADC/112/40V).

Setting up the KAD/ADC/112

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/112/10V	KAD/ADC/112/10V	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
Analog(23:0) Analog Input	-	-	Settings for this channel.
Settings	-	-	-
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Analog(23:0) Parameters				
Analog Analog signal data.	Volt	OffsetBinary	16	R[15:0]

Configurable parameters

Analog(23:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-10 to 10	10	Range maximum for analog channel
Range Minimum	-10 to 10	-10	Range minimum for analog channel

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/112

Bias current return path

If the signal source is isolated with respect to the Acra KAM-500 (for example a battery), a common-mode resistance between the negative input and ground (GND) should be used to provide a return for bias currents and reduce common-mode noise pick-up. Because the bias currents are in the order of nA, resistors up to 10kΩ can be used. In most cases a short (0Ω) is recommended.

NOTE: The KAD/ADC/112/40V input divider provides a return path to GND, so no additional return path is required. The divider input series resistor for KAD/ADC/112/40V is the order of 60kΩ. It is still beneficial to provide an external return path to GND so that the crosstalk picked up by an external cable will be minimized.

Unused differential ended inputs

Unused inputs should not be left floating, as this may increase current consumption from the ±12V backplane lines. Floating inputs may cause the output voltage of the instrumentation amplifier to approach one of the supply rails, which causes increased quiescent currents within specific channel circuits. Each unused differential ended input should be shorted together within its pair or connected to GND.

NOTE: The KAD/ADC/112/40V input divider pulls both inputs to GND so the inputs can be left floating.

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate will always be sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. Figure 2 shows a delay for an 8^{th} order filter where f_c = 1kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1kHz / f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1kHz / f_c). For example, an 8^{th} order Butterworth filter with an f_c of 1kHz delays a 1kHz signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

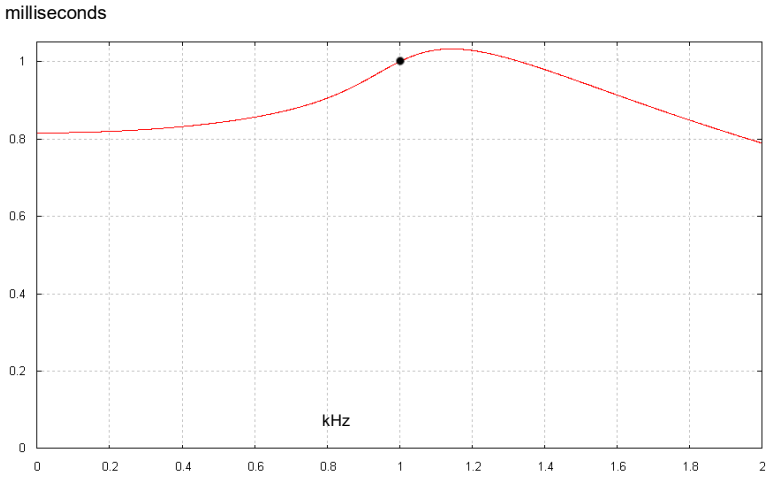


Figure 2: Filter delay for 8^{th} order Butterworth filter where f_c = 1kHz

The filter delay for the KAD/ADC/112 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_D is the filter delay

T_A (analog filter delay) ≈ 0

Additional delay sources

Modelling an 8th order Butterworth filter with an IIR digital filter causes small phase and amplitude errors as shown in Figure 3 and Figure 4.

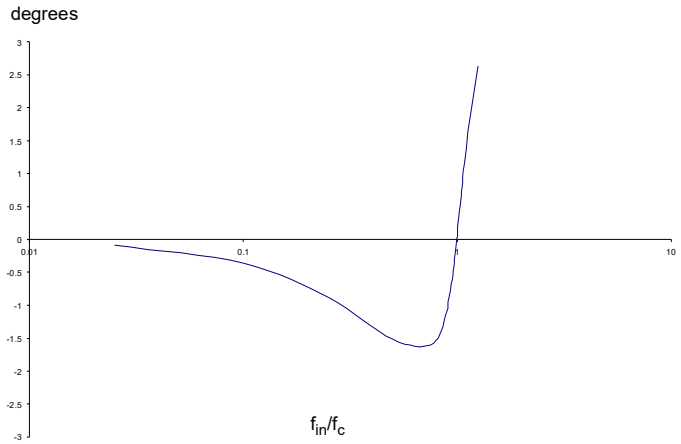


Figure 3: Delay error (ideal minus actual delay)

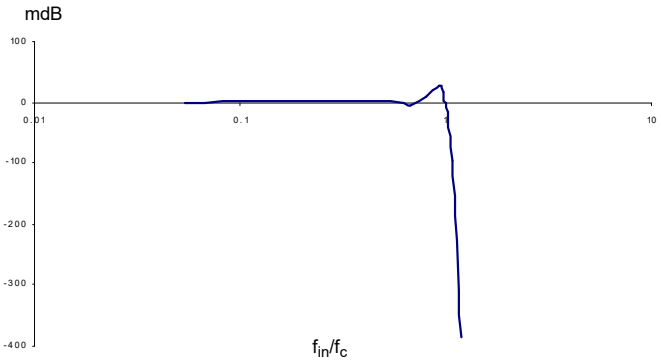


Figure 4: Amplitude error (ideal minus actual attenuation)

Connector pinout of the KAD/ADC/112

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	ANALOG(0)+	Differential ended analog inputs	Analog input
2	ANALOG(0)-	Differential ended analog inputs	Analog input
3	ANALOG(1)+	Differential ended analog inputs	Analog input
4	ANALOG(1)-	Differential ended analog inputs	Analog input
5	ANALOG(2)+	Differential ended analog inputs	Analog input
6	ANALOG(2)-	Differential ended analog inputs	Analog input
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46	ANALOG(22)-	Differential ended analog inputs	Analog input
47	ANALOG(23)+	Differential ended analog inputs	Analog input
48	ANALOG(23)-	Differential ended analog inputs	Analog input
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/112/40V	Differential ended ADC (3kHz b/w, ±40V) - 24ch at 12ksps (52-way double-density module top connector)
KAD/ADC/112/10V	Differential ended ADC (3kHz b/w, ±10V) - 24ch at 12ksps (52-way double-density module top connector)
KAD/ADC/112/1V	Differential ended ADC (3kHz b/w, ±1V) - 24ch at 12ksps (52-way double-density module top connector)
KAD/ADC/112/100M	Differential ended ADC (3kHz b/w, ±100mV) - 24ch at 12ksps (52-way double-density module top connector)
KAM/ADC/112/40V	Differential ended ADC (3kHz b/w, ±40V) - 24ch at 12ksps (with 51-way micro-miniature module top connector)
KAM/ADC/112/10V	Differential ended ADC (3kHz b/w, ±10V) - 24ch at 12ksps (with 51-way micro-miniature module top connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; or ACC/CON/008/04 for KAM modules) is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/ADC/112 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/112	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	These modules are supported by the KSM-500 suite of software tools

Related documentation

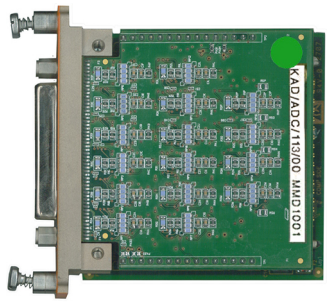
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ADC/113

1/4-bridge ADC (current excitation, PT100 temp. sensors, 3kHz b/w) - 16ch at 12ksps



Key Features

- 16 ¼-bridge, 3-wire, input channels for PT100 RTD-type sensors
- Input range of -200°C to 660°C
- High accuracy (0.87°C between -50 and 200°C @ 2mA)
- Programmable constant current excitation per group of four channels
- Short on any channel does not affect others
- 16-bit simultaneous sampling on each channel

Applications

- Temperature measurements with RTD PT100

Overview

The KAD/ADC/113 provides independent excitation for up to 16 channels and is intended for PT100 Resistance Temperature Detector (RTD) type sensors. Each channel has a separate programmable digital filter and A/D converter. At the heart of the KAD/ADC/113 is a hard-wired state-machine that oversamples all channels at a rate between 48ksps and 96ksps and digitally filters any noise above the user-programmable cutoff frequency. This is achieved using cascaded, half-band, Finite-Impulse-Response (FIR) filters followed by an 8^{th} order Butterworth Infinite-Impulse-Response (IIR) filter with a default cutoff point set at one quarter of the sampling frequency ($f_c = f_s / 4$).

All signals are sampled simultaneously. Therefore, when several channels are sampled at different sampling rates, at the start of an acquisition cycle all channels are aligned. The current through the RTD is programmable from 1mA to 2mA in steps of 0.5µA. The excitation current through the RTD is kept constant. As the resistance changes, the voltage across the RTD (and hence as seen by the amplifier) changes linearly.

A linearization table for each channel can be used to compensate for non-linear sensors or to fine-tune gain and offset.

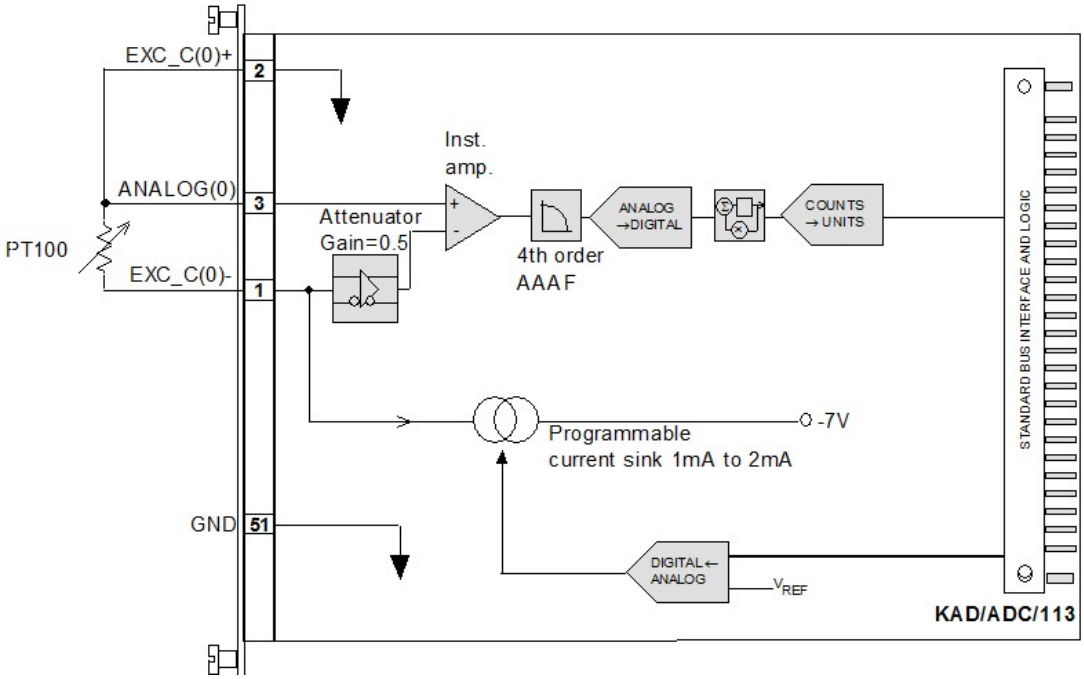


Figure 1: First of 16 channels on the KAD/ADC/113

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	92	–	g	
	–	3.24	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	80	–	120	mA	
+7V	25	–	40	mA	
-7V	30	–	45	mA	Excludes current used by excitation.
±12V	0	–	0	mA	
total power	0.785	–	1.2	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

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TABLE 2	RTD inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	16	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG(x)	2	–	12,000	sps	
Input temperature					
full scale range	-200	–	660	°C	
DC error					Temperature averaged over 200 measurement points.
for FSR of -200°C to 660°C	–	–	0.27	%FSR	With 1mA excitation current set.
for FSR of -60°C to 250°C	–	–	0.35	%FSR	With 2mA excitation current set.
Effective number of bits	10.5	–	–	bits	$0 \le f \le 250$Hz (f: input signal frequency).
Crosstalk	–	–	-72	dB	Between channels on the same module.
Analog filter cutoff					
poles	–	–	4	–	
filter cutoff -3dB	5.7	6	6.3	kHz	
Digital filter					
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 3kHz. (f_s: sampling frequency)
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-72	dB	
aliasing to f_c	–	–	-72	dB	
Filter delay	–	0.66	–	ms	At f_c of 3kHz (f_c: filter cutoff frequency). See “Understanding filter delays” on page 237.

TABLE 3	Single ended DC current excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	16	–	Applied in groups of four channels.
Output current					
operating range	1	–	2	mA	
resolution	–	0.5	–	µA	
compliance	-0.5	–	0	V	
short circuit current	–	–	2	mA	Depends on user setting.
short circuit duration	∞	–	–	s	
DC error					
error	–	–	0.25	%FSR	With a constant 100Ω load. Correction included within channel reading, see DC error in “RTD inputs” on page 235.
noise	–	–	0.5	$°C_{rms}$	Measured as subtraction of rms noise visible on read values with and without excitation used.

Setting up the KAD/ADC/113

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/113/B	KAD/ADC/113/B	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
Temperature(15:0) Analog Input	-	-	Settings for this channel
Settings	-	-	-
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.
Excitation Amplitude	0.001 to 0.00200	0.0016	Required excitation (in A) for the top of the bridge, in 0.51µA steps. Applied to each group of 4 channels.
Linearization Algorithm Reference	Algorithm Reference URL-Defined-Algorithm	MyPT100SensorTypeLook Up	URL algorithm describing a PT100 RTD-type sensor for this channel

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Temperature(15:0) Parameters				
Temperature Temperature signal data	Celsius	OffsetBinary	16	R[15:0]

Configurable parameters

Temperature(15:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-200 to 660	540	-
Range Minimum	-200 to 660	-200	-

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/113

Lead error compensation

The feedback line ANALOG(x) carries no current. Ideally it should be connected close to the gage to help compensate for lead resistances (assuming that both EXC_C(x)+ and EXC_C(x)- lead resistances are the same). If operating with two wires, and the ANALOG(x) and excitation lines (EXC_C(x)+) are connected close to the module (not the gage), the error introduced is primarily an offset error (because the circuit is linear with respect to resistance) and can be adjusted for.

Use two-wire operation carefully. Estimation of cable resistance should consider temperature drift over the temperature range the cable operates (copper temperature coefficient is approximately 0.4%/°C). Depending on the wire length and diameter, the drift may cause noticeable error of measurement. In general, it may become an issue for thinner and longer cables.

Setting the range and excitation

For any temperature range required, errors can be minimized by using as much as possible of the 0 to 500mV input range of the A/D.

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate are always sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. The following diagram shows a delay for an 8th order filter where f_c = 1kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1kHz / f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1kHz / f_c). For example, an 8th order Butterworth filter with an f_c of 1kHz delays a 1kHz signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

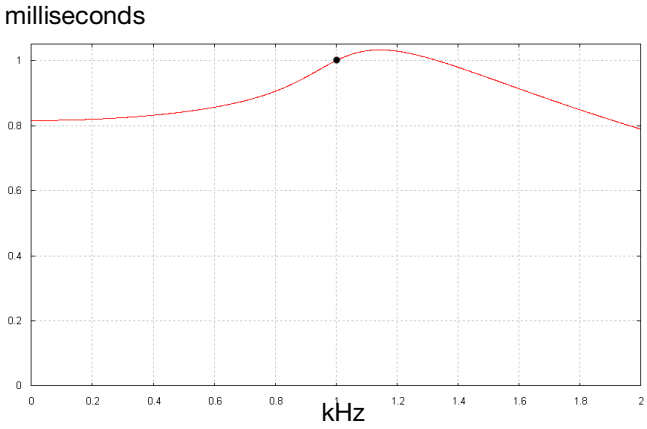


Figure 2: Filter delay for 8th order Butterworth filter where f_c = 1kHz

The filter delay for the KAD/ADC/113 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_A (analog filter delay) ≈ 0

T_D is the filter delay

Connector pinout of the KAD/ADC/113

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	EXC_C(0)-	Single ended DC current excitation outputs	Excitation group 0
2	EXC_C(0)+	Single ended DC current excitation outputs	Excitation group 0
3	ANALOG(0)	RTD inputs	
4	EXC_C(1)-	Single ended DC current excitation outputs	Excitation group 0
5	EXC_C(1)+	Single ended DC current excitation outputs	Excitation group 0
6	ANALOG(1)	RTD inputs	
7	EXC_C(2)-	Single ended DC current excitation outputs	Excitation group 0
8	EXC_C(2)+	Single ended DC current excitation outputs	Excitation group 0
9	ANALOG(2)	RTD inputs	
10	EXC_C(3)-	Single ended DC current excitation outputs	Excitation group 0
11	EXC_C(3)+	Single ended DC current excitation outputs	Excitation group 0
12	ANALOG(3)	RTD inputs	
13	EXC_C(4)-	Single ended DC current excitation outputs	Excitation group 1
14	EXC_C(4)+	Single ended DC current excitation outputs	Excitation group 1
15	ANALOG(4)	RTD inputs	
16	EXC_C(5)-	Single ended DC current excitation outputs	Excitation group 1
17	EXC_C(5)+	Single ended DC current excitation outputs	Excitation group 1
18	ANALOG(5)	RTD inputs	
19	EXC_C(6)-	Single ended DC current excitation outputs	Excitation group 1
20	EXC_C(6)+	Single ended DC current excitation outputs	Excitation group 1
21	ANALOG(6)	RTD inputs	
22	EXC_C(7)-	Single ended DC current excitation outputs	Excitation group 1
23	EXC_C(7)+	Single ended DC current excitation outputs	Excitation group 1
24	ANALOG(7)	RTD inputs	
25	EXC_C(8)-	Single ended DC current excitation outputs	Excitation group 2
26	EXC_C(8)+	Single ended DC current excitation outputs	Excitation group 2
27	ANALOG(8)	RTD inputs	
28	EXC_C(9)-	Single ended DC current excitation outputs	Excitation group 2
29	EXC_C(9)+	Single ended DC current excitation outputs	Excitation group 2
30	ANALOG(9)	RTD inputs	
31	EXC_C(10)-	Single ended DC current excitation outputs	Excitation group 2
32	EXC_C(10)+	Single ended DC current excitation outputs	Excitation group 2
33	ANALOG(10)	RTD inputs	
34	EXC_C(11)-	Single ended DC current excitation outputs	Excitation group 2
35	EXC_C(11)+	Single ended DC current excitation outputs	Excitation group 2
36	ANALOG(11)	RTD inputs	
37	EXC_C(12)-	Single ended DC current excitation outputs	Excitation group 3
38	EXC_C(12)+	Single ended DC current excitation outputs	Excitation group 3
39	ANALOG(12)	RTD inputs	
40	EXC_C(13)-	Single ended DC current excitation outputs	Excitation group 3
41	EXC_C(13)+	Single ended DC current excitation outputs	Excitation group 3
42	ANALOG(13)	RTD inputs	
43	EXC_C(14)-	Single ended DC current excitation outputs	Excitation group 3
44	EXC_C(14)+	Single ended DC current excitation outputs	Excitation group 3
45	ANALOG(14)	RTD inputs	
46	EXC_C(15)-	Single ended DC current excitation outputs	Excitation group 3
47	EXC_C(15)+	Single ended DC current excitation outputs	Excitation group 3
48	ANALOG(15)	RTD inputs	
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/113/B	1/4-bridge ADC (current excitation, PT100 temp. sensors, 3kHz b/w) - 16ch at 12ksps (with 52-way double-density connector)
KAM/ADC/113/B	1/4-bridge ADC (current excitation, PT100 temp. sensors, 3kHz b/w) - 16ch at 12ksps (with 51-way micro-miniature connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; ACC/CON/008/04 for KAM modules) is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/ADC/113 refers to both the KAD and KAM version of the module.

The KAD/ADC/113 uses power from the ±7V power line for excitation and therefore can not be used with KAM/CHS/04L, KAM/CHS/05F or KAM/CHS/03F. If the maximum excitation current is drawn from each channel, then the maximum number of KAD/ADC/113s per chassis is limited to five.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/113/B	Corrected an issue with signal distortion in slave chassis, or in chassis externally receiving X_Sync signals, or in chassis containing a KAD/BCU/105 receiving IEEE 1588 PTP	Recommended for new programs
KAD/ADC/113	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/023	Resistance temperature detectors
TEC/NOT/049	Power estimation

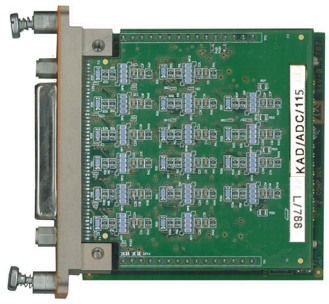
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KAD/ADC/115

¼-bridge ADC (current excitation, PT1000 temp. sensors, 6.25kHz b/w) - 16ch at 25ksps

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Key Features

- 16 ¼-bridge, 2-wire, input channels for PT1000 RTD-type sensors
- Input range of -200°C to 660°C
- High accuracy (±1.4°C between 0 and 200°C @ 500µA, ±2°C between 0 and 350°C @ 400µA)
- Programmable constant current excitation
- Short on any channel does not affect others
- 16-bit simultaneous sampling on each channel

Applications

- Temperature measurements with RTD PT1000

Overview

The KAD/ADC/115 provides independent excitation for up to 16 channels and is intended for PT1000 Resistance Temperature Detector (RTD) type sensors.

Each channel has a separate programmable digital filter and A/D converter.

At the heart of the KAD/ADC/115 is a hard-wired state-machine that oversamples all channels at a rate between 100ksps and 200ksps and digitally filters any noise above the user-programmable cutoff frequency. This is achieved using cascaded, half-band, finite-impulse-response filters followed by an 8th order Butterworth Infinite-Impulse-Response (IIR) filter with a default cutoff point set at one quarter of the sampling frequency ($f_c = f_s / 4$).

All signals are sampled simultaneously. Thus, when several channels are sampled at different sampling rates, at the start of an acquisition cycle, all channels are aligned.

The excitation current through the RTD is kept constant. As the resistance changes, the voltage across the RTD (and hence as seen by the amplifier) changes linearly.

A linearization table for each channel can be used to compensate for non-linear sensors or to fine-tune gain and offset.

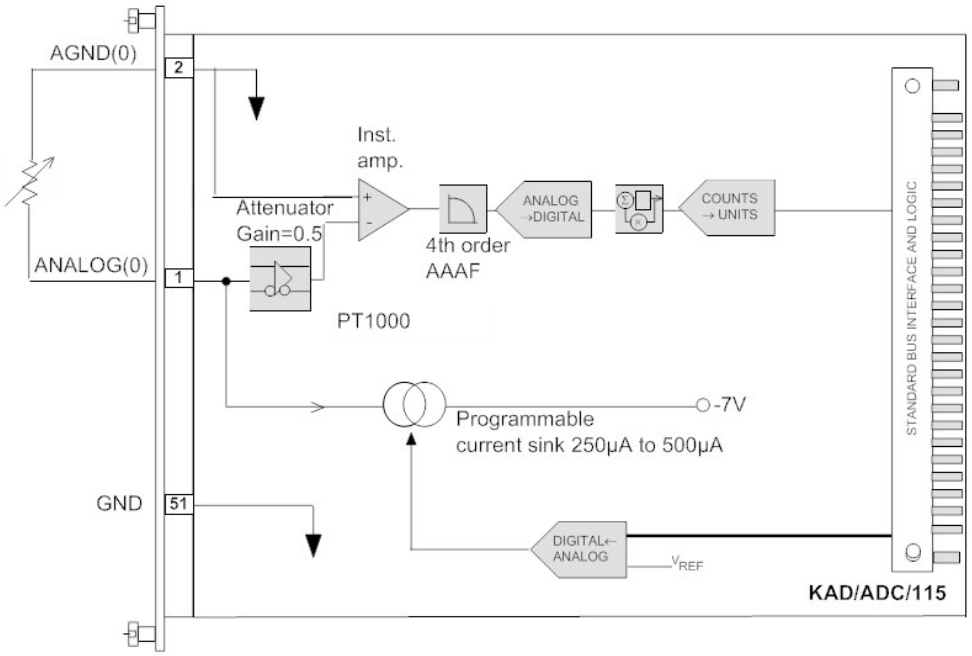


Figure 1: First of 16 channels on the KAD/ADC/115

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	85	–	g	
	–	2.99	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	130	–	150	mA	
+7V	10	–	19	mA	
-7V	50	–	75	mA	Excludes current used by excitation.
+12V	35	–	90	mA	
-12V	30	–	85	mA	
total power	1.85	–	3.51	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Single ended DC current excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	16	–	Applied in groups of four channels.
Output current					
operating range	250	–	500	µA	
resolution	–	5	–	µA	
compliance	2	–	–	V	The product of the sensor resistance and the excitation current must not exceed this value.
short circuit current	–	–	500	µA	
short circuit duration	∞	–	–	s	
DC error					
error	–	–	0.25	%FSR	With a constant 1,000Ω load. Correction included within channel reading, see DC error in “RTD inputs” on page 243.
noise	–	–	0.5	$°C_{rms}$	Measured as subtraction of rms noise visible on read values with and without excitation used.

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TABLE 3	RTD inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	16	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG(x)	0.5	–	25,000	sps	
Input temperature					
full scale range	-200	–	660	°C	
DC error					Temperature averaged over 200 measurement points.
for FSR of -200°C to 660°C	–	–	2.4	°C	When excitation current set to 250µA.
for FSR of 0°C to 350°C	–	–	2	°C	When excitation current set to 400µA.
for FSR of 0°C to 200°C			1.4	°C	When excitation current set to 500µA.
Effective number of bits	12	–	–	bits	$0 \le f \le 0.6f_c$ (f_c: filter cutoff frequency)
Crosstalk	–	–	-72	dB	Between channels on the same module.
Analog filter cutoff					
poles	–	–	4	–	
filter cutoff -3dB	11.9	12.5	13.1	kHz	
Digital filter					
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 3kHz (f_s: sampling frequency).
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-72	dB	
aliasing to f_c	–	–	-74	dB	
Filter delay	–	0.66	–	ms	At f_c of 3kHz (See “Understanding filter delays” on page 245).

Setting up the KAD/ADC/115

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/115	KAD/ADC/115	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
Temperature(15:0) Analog Input	-	-	1/4-bridge A/D converter with excitation and signal conditioning for PT1000.
Settings	-	-	-
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.
Linearization Algorithm Reference	UTF-8 String	.\LookupFiles\RTD\PT1000_385.LU	URL algorithm describing a PT1000 RTD-type sensor for this channel.
Excitation Amplitude	250E-6 to 500E-6	400E-6	Required excitation (in µA) for the top of the bridge, in 5µA steps. Applied to each group of four channels.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Temperature(15:0) Parameters				
Temperature Temperature signal data	Celsius	OffsetBinary	16	R[15:0]

Configurable parameters

Temperature(15:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-200 to 660	350	-
Range Minimum	-200 to 660	0	-

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/115

Lead error compensation

The KAD/ADC/115 is configured for two-wire operation where lead resistance needs to be considered primarily as an offset error. Relative to the resistance of a PT1000 sensor, the offset error should be negligible. However estimation of cable resistance should consider temperature drift over the temperature range the cable operates (copper temperature coefficient is approximately 0.4% per °C). Depending on the wire length and diameter, the drift may cause noticeable error of measurement. In general, it may become an issue for thinner and longer cables.

Setting excitation current

The KAD/ADC/115 can operate with up to 1V across the PT1000 sensor. However, to achieve the best accuracy, calibration is applied by the Field Programmable Gate Array in the digital domain; cable length IR voltage drops must also be considered. Therefore, we recommend you select an excitation current that does not exceed 0.95V across the PT1000 sensor, for the maximum resistance of the selected temperature range.

The KAD/ADC/115's design has been verified at 500µA between 0 and 200°C, at 400µA between 0 and 350°C, and at 250µA between -200 to 660°C.

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate will always be sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. The following figure shows a delay for an 8th order filter where f_c = 1kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1kHz / f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1kHz / f_c). For example, an 8th order Butterworth filter with an f_c of 1kHz delays a 1kHz signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

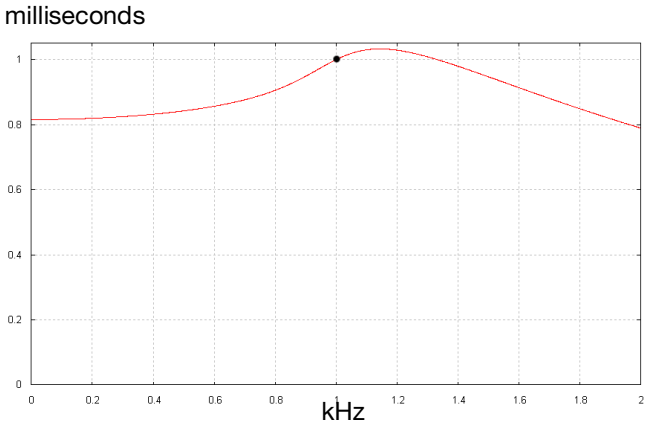


Figure 2: Filter delay for 8th order Butterworth filter where f_c = 1kHz

The filter delay for the KAD/ADC/115 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_A (analog filter delay) ≈ 0

T_D is the filter delay

Connector pinout of the KAD/ADC/115

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	ANALOG(0)	RTD inputs	PT1000 inputs
2	AGND(0)		Analog (0) ground return
3	DNC		Do not connect
4	ANALOG(1)	RTD inputs	PT1000 inputs
5	AGND(1)		Analog (1) ground return
6	DNC		Do not connect
7	ANALOG(2)	RTD inputs	PT1000 inputs
8	AGND(2)		Analog (2) ground return
9	DNC		Do not connect
10	ANALOG(3)	RTD inputs	PT1000 inputs
11	AGND(3)		Analog (3) ground return
12	DNC		Do not connect
13	ANALOG(4)	RTD inputs	PT1000 inputs
14	AGND(4)		Analog (4) ground return
15	DNC		Do not connect
16	ANALOG(5)	RTD inputs	PT1000 inputs
17	AGND(5)		Analog (5) ground return
18	DNC		Do not connect
19	ANALOG(6)	RTD inputs	PT1000 inputs
20	AGND(6)		Analog (6) ground return
21	DNC		Do not connect
22	ANALOG(7)	RTD inputs	PT1000 inputs
23	AGND(7)		Analog (7) ground return
24	DNC		Do not connect
25	ANALOG(8)	RTD inputs	PT1000 inputs
26	AGND(8)		Analog (8) ground return
27	DNC		Do not connect
28	ANALOG(9)	RTD inputs	PT1000 inputs
29	AGND(9)		Analog (9) ground return
30	DNC		Do not connect
31	ANALOG(10)	RTD inputs	PT1000 inputs
32	AGND(10)		Analog (10) ground return
33	DNC		Do not connect
34	ANALOG(11)	RTD inputs	PT1000 inputs
35	AGND(11)		Analog (11) ground return
36	DNC		Do not connect
37	ANALOG(12)	RTD inputs	PT1000 inputs
38	AGND(12)		Analog (12) ground return
39	DNC		Do not connect
40	ANALOG(13)	RTD inputs	PT1000 inputs
41	AGND(13)		Analog (13) ground return
42	DNC		Do not connect
43	ANALOG(14)	RTD inputs	PT1000 inputs
44	AGND(14)		Analog (14) ground return
45	DNC		Do not connect
46	ANALOG(15)	RTD inputs	PT1000 inputs
47	AGND(15)		Analog (15) ground return
48	DNC		Do not connect
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/115	¼-bridge ADC (current excitation, PT1000 temp. sensors, 6.25kHz b/w) - 16ch at 25ksps

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

The KAD/ADC/115 uses power from the ±7V power lines for excitation and therefore can not be used with KAM/CHS/04L, KAM/CHS/05F, KAM/CHS/03F, or KAM/CHS/02F. If the maximum excitation current is drawn from each channel, then the maximum number of KAD/ADC/115s per chassis is limited to five.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/115	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/023	Resistance temperature detectors
TEC/NOT/049	Power estimation

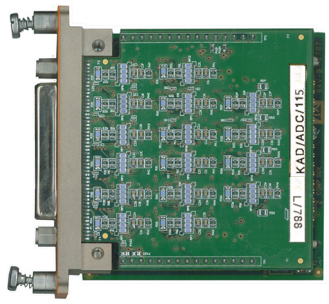
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ADC/115/DT

¼-bridge ADC (current excitation, DT temp. sensors, 6.25 kHz b/w) - 16ch at 25 ksps

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Key Features

- 16 ¼-bridge, 2-wire, input channels for DT-type sensors
- Input range of 0 to 1.95V. This gives a temperature range of -271°C to 225°C for a DT-670 sensor.
- Programmable constant current excitation
- Short on any channel does not affect others
- 16-bit simultaneous sampling on each channel

Applications

- Temperature measurements with Diode Thermometry sensors such as the DT-670 from Lake Shore Cryotronics, Inc.

Overview

The KAD/ADC/115/DT provides independent excitation for up to 16 channels and is intended for Diode Thermometry (DT) type sensors such as the DT-670 sensors from Lake Shore Cryotronics, Inc.

Each channel has a separate programmable digital filter and A/D converter.

At the heart of the KAD/ADC/115/DT is a hard-wired state-machine that oversamples all channels at a rate between 100 ksps and 200 ksps and digitally filters any noise above the user-programmable cutoff frequency. This is achieved using cascaded, half-band, finite-impulse-response filters followed by an 8^{th} order Butterworth Infinite-Impulse-Response (IIR) filter with a default cutoff point set at one quarter of the sampling frequency ($f_c = f_s / 4$).

All signals are sampled simultaneously. Thus, when several channels are sampled at different sampling rates, at the start of an acquisition cycle, all channels are aligned.

The excitation current through the DT sensor is kept constant. As the temperature changes, the voltage across the DT sensor (and hence as seen by the amplifier) changes.

A linearization table for each channel can be used to compensate for non-linear sensors or to fine-tune gain and offset.

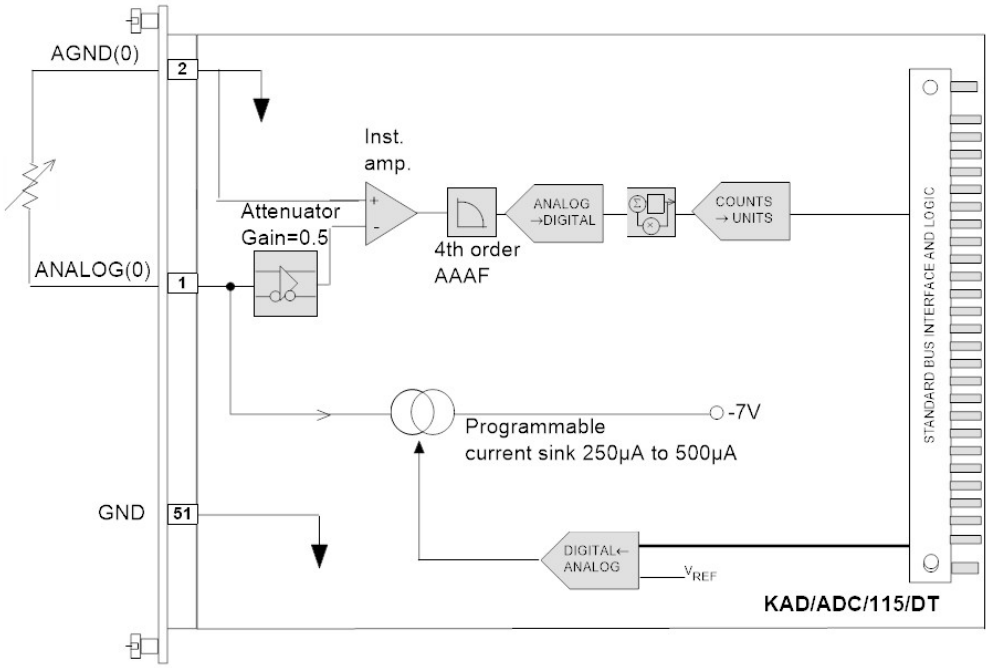


Figure 1: First of 16 channels on the KAD/ADC/115/DT

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	85	–	g	
	–	2.99	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	–	–	150	mA	
+7V	–	–	0	mA	
-7V	–	–	15	mA	Excludes current used by excitation.
+12V	–	–	90	mA	
-12V	–	–	85	mA	
total power	–	–	2.96	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Single ended DC current excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	16	–	Applied in groups of four channels.
Output current					
operating range	250	–	500	µA	
resolution	–	5	–	µA	
compliance	2	–	–	V	The product of the sensor resistance and the excitation current must not exceed this value.
short circuit current	–	–	500	µA	
short circuit duration	∞	–	–	s	
DC error					
error	–	–	0.25	%FSR	With a constant 1,000Ω load. Correction included within channel reading, see DC error in “DT inputs” on page 251.
noise	–	–	0.5	$°C_{rms}$	Measured as subtraction of rms noise visible on read values with and without excitation used.

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TABLE 3	DT inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	16	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG(x)	0.5	–	25,000	sps	
Input voltage					
full scale range	0	–	2	V	Module input range is 0 to 2V; limited to 1.95V.
DC error					Averaged over 200 measurement points.
voltage accuracy	–	–	1.9	mV	For accuracy in temperature, see “Accuracy” on page 253.
Effective number of bits	12	–	–	bits	$0 \le f \le 0.6f_c$ (f_c: filter cutoff frequency).
Crosstalk	–	–	-72	dB	Between channels on the same module.
Analog filter cutoff					
poles	–	–	4	–	
filter cutoff -3dB	11.9	12.5	13.1	kHz	
Digital filter					
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 3 kHz (f_s: sampling frequency).
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-72	dB	
aliasing to f_c	–	–	-74	dB	
Filter delay	–	0.66	–	ms	At f_c of 3 kHz (See “Understanding filter delays” on page 253).

Setting up the KAD/ADC/115/DT

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/115/DT	KAD/ADC/115/DT	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
Temperature(15:0) *Analog Input*	-	-	A/D converter with excitation and signal conditioning for a temperature diode
Settings	-	-	-
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.
Linearization Algorithm Reference	UTF-8 String	.\LookupFiles\Diode Thermometry\DT-670_lookuptable.LU	URL algorithm describing a temperature diode sensor for this channel.
Excitation Amplitude	250E-6 to 500E-6	250E-6	Required excitation (in uA) for the top of the bridge, in 5uA steps. Applied to each group of 4 channels.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Temperature(15:0) Parameters				
Temperature Temperature signal data	Celsius	OffsetBinary	16	R[15:0]

Temperature(15:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-271 to 225	150	-
Range Minimum	-271 to 225	-200	-

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/115/DT

Lead error compensation

The KAD/ADC/115/DT is configured for two-wire operation where lead resistance needs to be considered primarily as an offset error. Relative to the resistance of a DT sensor, the offset error should be negligible. However estimation of cable resistance should consider temperature drift over the temperature range the cable operates (copper temperature coefficient is approximately 0.4% per °C). Depending on the wire length and diameter, the drift may cause noticeable error of measurement. In general, it may become an issue for thinner and longer cables.

Setting excitation current

The KAD/ADC/115/DT can operate with up to 2V across the DT sensor. However, to achieve the best accuracy, calibration is applied by the Field Programmable Gate Array in the digital domain; cable length IR voltage drops must also be considered. Therefore, we recommend you select an excitation current that does not exceed 1.95V across the DT sensor, for the maximum resistance of the selected temperature range.

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate will always be sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. The following figure shows a delay for an 8th order filter where f_c = 1 kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1 kHz / f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1 kHz / f_c). For example, an 8th order Butterworth filter with an f_c of 1 kHz delays a 1 kHz signal by 1ms; a filter with an f_c of 10 Hz delays a 10 Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

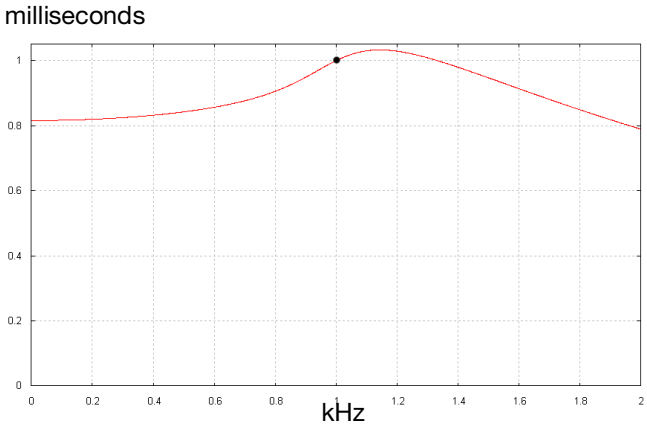


Figure 2: Filter delay for 8th order Butterworth filter where f_c = 1kHz

The filter delay for the KAD/ADC/115/DT is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_A (analog filter delay) ≈ 0

T_D is the filter delay

Accuracy

The KAD/ADC/115/DT module takes a voltage and then converts it to a temperature based on a linearization lookup file that is provided as part of the XidML file in DAS Studio 3. Depending on the linearization curve the accuracy in degrees Celsius will vary.

As an example assume a DT-670 sensor (https://www.lakeshore.com/products/categories/overview/temperature-products/cryogenic-temperature-sensors/dt-670-silicon-diodes) is used. The generic curve for the DT-670 is as follows:

KELVIN	°C	OHMS
1.4	-271.75	1.64429
1.5	-271.65	1.64299
1.6	-271.55	1.64157
1.7	-271.45	1.64003
1.8	-271.35	1.63837
1.9	-271.25	1.6366
2	-271.15	1.63472
2.1	-271.05	1.63274
2.2	-270.95	1.63067
2.3	-270.85	1.62852
2.4	-270.75	1.62629
2.5	-270.65	1.624

KELVIN	°C	OHMS
2.6	-270.55	1.62166
2.7	-270.45	1.61928
2.8	-270.35	1.61687
2.9	-270.25	1.61445
3	-270.15	1.612
3.1	-270.05	1.60951
3.2	-269.95	1.60697
3.3	-269.85	1.60438
3.4	-269.75	1.60173
3.5	-269.65	1.59902
3.6	-269.55	1.59626
3.7	-269.45	1.59344
3.8	-269.35	1.59057
3.9	-269.25	1.58764
4	-269.15	1.58465
4.2	-268.95	1.57848
4.4	-268.75	1.57202
4.6	-268.55	1.56533
4.8	-268.35	1.55845
5	-268.15	1.55145
5.2	-267.95	1.54436
5.4	-267.75	1.53721
5.6	-267.55	1.53
5.8	-267.35	1.52273
6	-267.15	1.51541
6.5	-266.65	1.49698
7	-266.15	1.47868
7.5	-265.65	1.46086
8	-265.15	1.44374
8.5	-264.65	1.42747
9	-264.15	1.41207
9.5	-263.65	1.39751
10	-263.15	1.38373
10.5	-262.65	1.37065
11	-262.15	1.3582
11.5	-261.65	1.34632
12	-261.15	1.33499
12.5	-260.65	1.32416
13	-260.15	1.31381
13.5	-259.65	1.3039
14	-259.15	1.29439
14.5	-258.65	1.28526

KELVIN	°C	OHMS
15	-258.15	1.27645
15.5	-257.65	1.26794
16	-257.15	1.25967
16.5	-256.65	1.25161
17	-256.15	1.24372
17.5	-255.65	1.23596
18	-255.15	1.2283
18.5	-254.65	1.2207
19	-254.15	1.21311
19.5	-253.65	1.20548
20	-253.15	1.197748
21	-252.15	1.181548
22	-251.15	1.162797
23	-250.15	1.140817
24	-249.15	1.125923
25	-248.15	1.119448
26	-247.15	1.115658
27	-246.15	1.11281
28	-245.15	1.110421
29	-244.15	1.108261
30	-243.15	1.106244
31	-242.15	1.104324
32	-241.15	1.102476
33	-240.15	1.100681
34	-239.15	1.09893
35	-238.15	1.097216
36	-237.15	1.095534
37	-236.15	1.093878
38	-235.15	1.092244
39	-234.15	1.090627
40	-233.15	1.089024
42	-231.15	1.085842
44	-229.15	1.082669
46	-227.15	1.079492
48	-225.15	1.076303
50	-223.15	1.073099
52	-221.15	1.069881
54	-219.15	1.06665
56	-217.15	1.063403
58	-215.15	1.060141
60	-213.15	1.056862
65	-208.15	1.048584

KELVIN	°C	OHMS
70	-203.15	1.040183
75	-198.15	1.031651
77.35	-195.8	1.027594
80	-193.15	1.022984
85	-188.15	1.014181
90	-183.15	1.005244
95	-178.15	0.996174
100	-173.15	0.986974
105	-168.15	0.97765
110	-163.15	0.968209
115	-158.15	0.958657
120	-153.15	0.949
125	-148.15	0.939242
130	-143.15	0.92939
135	-138.15	0.919446
140	-133.15	0.909416
145	-128.15	0.899304
150	-123.15	0.889114
155	-118.15	0.878851
160	-113.15	0.868518
165	-108.15	0.85812
170	-103.15	0.847659
175	-98.15	0.837138
180	-93.15	0.82656
185	-88.15	0.815928
190	-83.15	0.805242
195	-78.15	0.794505
200	-73.15	0.78372
205	-68.15	0.772886
210	-63.15	0.762007
215	-58.15	0.751082
220	-53.15	0.740115
225	-48.15	0.729105
230	-43.15	0.718054
235	-38.15	0.706964
240	-33.15	0.695834
245	-28.15	0.684667
250	-23.15	0.673462
255	-18.15	0.662223
260	-13.15	0.650949
265	-8.15	0.639641
270	-3.15	0.628302

KELVIN	°C	OHMS
273.15	0	0.621141
275	1.85	0.61693
280	6.85	0.605528
285	11.85	0.594097
290	16.85	0.582637
295	21.85	0.571151
300	26.85	0.559639
305	31.85	0.548102
310	36.85	0.536542
315	41.85	0.524961
320	46.85	0.513361
325	51.85	0.501744
330	56.85	0.490106
335	61.85	0.478442
340	66.85	0.46676
345	71.85	0.455067
350	76.85	0.443371
355	81.85	0.43167
360	86.85	0.41996
365	91.85	0.408237
370	96.85	0.396503
375	101.85	0.384757
380	106.85	0.373002
385	111.85	0.361235
390	116.85	0.349453
395	121.85	0.337654
400	126.85	0.325839
405	131.85	0.314008
410	136.85	0.302161
415	141.85	0.290298
420	146.85	0.278416
425	151.85	0.266514
430	156.85	0.254592
435	161.85	0.242653
440	166.85	0.230697
445	171.85	0.21873
450	176.85	0.206758
455	181.85	0.194789
460	186.85	0.182832
465	191.85	0.170901
470	196.85	0.15901
475	201.85	0.147191

KELVIN	°C	OHMS
480	206.85	0.13548
485	211.85	0.123915
490	216.85	0.112553
495	221.85	0.101454
500	226.85	0.090681

If this is the linearization curve provided to DAS Studio 3 then the accuracy of 1.9 mV at the input, and assuming the error of 1.25 uA for the excitation has no effect, will result in an accuracy of +/-1.2°C for this sensor linearization curve.

Connector pinout of the KAD/ADC/115/DT

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	ANALOG(0)	DT inputs	DT inputs
2	AGND(0)		Analog (0) ground return
3	DNC		Do not connect
4	ANALOG(1)	DT inputs	DT inputs
5	AGND(1)		Analog (1) ground return
6	DNC		Do not connect
7	ANALOG(2)	DT inputs	DT inputs
8	AGND(2)		Analog (2) ground return
9	DNC		Do not connect
10	ANALOG(3)	DT inputs	DT inputs
11	AGND(3)		Analog (3) ground return
12	DNC		Do not connect
13	ANALOG(4)	DT inputs	DT inputs
14	AGND(4)		Analog (4) ground return
15	DNC		Do not connect
16	ANALOG(5)	DT inputs	DT inputs
17	AGND(5)		Analog (5) ground return
18	DNC		Do not connect
19	ANALOG(6)	DT inputs	DT inputs
20	AGND(6)		Analog (6) ground return
21	DNC		Do not connect
22	ANALOG(7)	DT inputs	DT inputs
23	AGND(7)		Analog (7) ground return
24	DNC		Do not connect
25	ANALOG(8)	DT inputs	DT inputs
26	AGND(8)		Analog (8) ground return
27	DNC		Do not connect
28	ANALOG(9)	DT inputs	DT inputs
29	AGND(9)		Analog (9) ground return
30	DNC		Do not connect
31	ANALOG(10)	DT inputs	DT inputs
32	AGND(10)		Analog (10) ground return
33	DNC		Do not connect
34	ANALOG(11)	DT inputs	DT inputs
35	AGND(11)		Analog (11) ground return
36	DNC		Do not connect
37	ANALOG(12)	DT inputs	DT inputs
38	AGND(12)		Analog (12) ground return
39	DNC		Do not connect
40	ANALOG(13)	DT inputs	DT inputs
41	AGND(13)		Analog (13) ground return
42	DNC		Do not connect
43	ANALOG(14)	DT inputs	DT inputs
44	AGND(14)		Analog (14) ground return
45	DNC		Do not connect
46	ANALOG(15)	DT inputs	DT inputs
47	AGND(15)		Analog (15) ground return
48	DNC		Do not connect
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/115/DT	¼-bridge ADC (current excitation, DT temp. sensors, 6.25 kHz b/w) - 16ch at 25 ksps

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

The KAD/ADC/115/DT uses power from the ±7V power lines for excitation and therefore can not be used with KAM/CHS/04L, KAM/CHS/05F, KAM/CHS/03F, or KAM/CHS/02F.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/115/DT	Supports Diode Thermometry type sensors that have an inverse temperature-to-voltage relationship compared to PT1000 sensors	Recommended for new programs that require Diode Thermometry type sensors
KAD/ADC/115/NRTD	Supports NRTD type sensors that have an inverse temperature-to-resistance relationship compared to PT1000 sensors	Recommended for new programs that require NRTD type sensors
KAD/ADC/115	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment

Related documentation

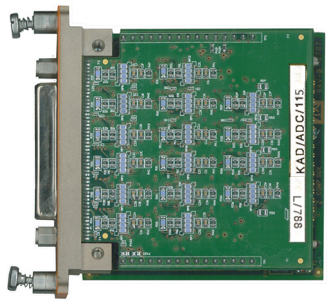
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/023	Resistance temperature detectors
TEC/NOT/049	Power estimation

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KAD/ADC/115/NRTD

¼-bridge ADC (current excitation, NRTD temp. sensors, 6.25kHz b/w) - 16ch at 25ksps

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Key Features

- 16 ¼-bridge, 2-wire, input channels for NRTD-type sensors
- Input range of 0 to 0.95V. This gives a temperature range of -245°C to -50°C for a CX-1080 NRTD sensor.
- Programmable constant current excitation
- Short on any channel does not affect others
- 16-bit simultaneous sampling on each channel

Applications

- Temperature measurements with NRTD sensors such as the CX-1080 from Lake Shore Cryotronics, Inc.

Overview

The KAD/ADC/115/NRTD provides independent excitation for up to 16 channels and is intended for Negative Resistance Temperature Detector (NRTD) type sensors such as the Cernox family of sensors from Lake Shore Cryotronics, Inc.

Each channel has a separate programmable digital filter and A/D converter.

At the heart of the KAD/ADC/115/NRTD is a hard-wired state-machine that oversamples all channels at a rate between 100ksps and 200ksps and digitally filters any noise above the user-programmable cutoff frequency. This is achieved using cascaded, half-band, finite-impulse-response filters followed by an 8th order Butterworth Infinite-Impulse-Response (IIR) filter with a default cutoff point set at one quarter of the sampling frequency ($f_c = f_s / 4$).

All signals are sampled simultaneously. Thus, when several channels are sampled at different sampling rates, at the start of an acquisition cycle, all channels are aligned.

The excitation current through the NRTD is kept constant. As the resistance changes, the voltage across the NRTD (and hence as seen by the amplifier) changes.

A linearization table for each channel can be used to compensate for non-linear sensors or to fine-tune gain and offset.

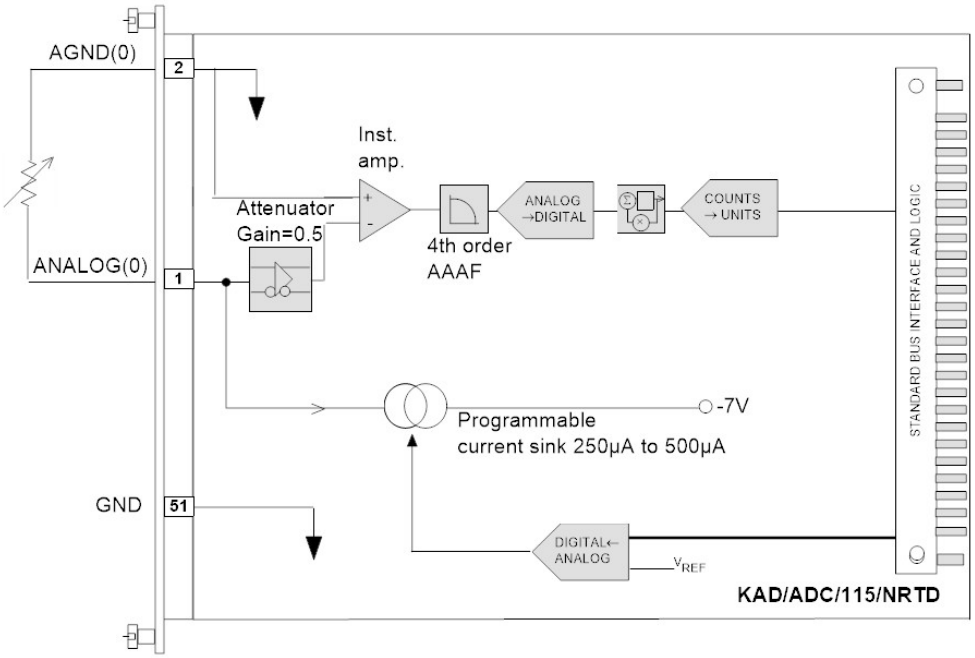


Figure 1: First of 16 channels on the KAD/ADC/115/NRTD

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	85	–	g	
	–	2.99	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	130	–	150	mA	
+7V	10	–	19	mA	
-7V	50	–	75	mA	Excludes current used by excitation.
+12V	35	–	90	mA	
-12V	30	–	85	mA	
total power	1.85	–	3.51	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

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TABLE 2	Single ended DC current excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	16	–	Applied in groups of four channels.
Output current					
operating range	250	–	500	µA	
resolution	–	5	–	µA	
compliance	2	–	–	V	The product of the sensor resistance and the excitation current must not exceed this value.
short circuit current	–	–	500	µA	
short circuit duration	∞	–	–	s	
DC error					
error	–	–	0.25	%FSR	With a constant 1,000Ω load. Correction included within channel reading, see DC error in “NRTD inputs” on page 261.
noise	–	–	0.5	$°C_{rms}$	Measured as subtraction of rms noise visible on read values with and without excitation used.

TABLE 3	NRTD inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	16	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG(x)	0.5	–	25,000	sps	
Input voltage					
full scale range	0	–	1	V	Module input range is 0 to 1V; limited to 0.95V.
DC error					Averaged over 200 measurement points.
voltage accuracy	–	–	1.9	mV	For accuracy in temperature, see “Accuracy” on page 264.
Effective number of bits	12	–	–	bits	$0 \le f \le 0.6f_c$ (f_c: filter cutoff frequency)
Crosstalk	–	–	-72	dB	Between channels on the same module.
Analog filter cutoff					
poles	–	–	4	–	
filter cutoff -3dB	11.9	12.5	13.1	kHz	
Digital filter					
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 3kHz (f_s: sampling frequency).
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-72	dB	
aliasing to f_c	–	–	-74	dB	
Filter delay	–	0.66	–	ms	At f_c of 3kHz (See “Understanding filter delays” on page 264).

Setting up the KAD/ADC/115/NRTD

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/115/NRTD	KAD/ADC/115/NRTD	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
Temperature(15:0) *Analog Input*	-	-	1/4-bridge A/D converter with excitation and signal conditioning for NTRD.
Settings	-	-	-
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.
Linearization Algorithm Reference	UTF-8 String	.\Lookup-Files\RTD\NRTD_look-uptable.LU	URL algorithm describing an NRTD-type sensor for this channel.
Excitation Amplitude	250E-6 to 500E-6	250E-6	Required excitation (in uA) for the top of the bridge, in 5uA steps. Applied to each group of 4 channels.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Temperature(15:0) Parameters				
Temperature Temperature signal data	Celsius	OffsetBinary	16	R[15:0]

Temperature(15:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-245 to -50	-50	-
Range Minimum	-245 to -50	-243	-

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/115/NRTD

Lead error compensation

The KAD/ADC/115/NRTD is configured for two-wire operation where lead resistance needs to be considered primarily as an offset error. Relative to the resistance of a NRTD sensor, the offset error should be negligible. However estimation of cable resistance should consider temperature drift over the temperature range the cable operates (copper temperature coefficient is approximately 0.4% per °C). Depending on the wire length and diameter, the drift may cause noticeable error of measurement. In general, it may become an issue for thinner and longer cables.

Setting excitation current

The KAD/ADC/115/NRTD can operate with up to 1V across the NRTD sensor. However, to achieve the best accuracy, calibration is applied by the Field Programmable Gate Array in the digital domain; cable length IR voltage drops must also be considered. Therefore, we recommend you select an excitation current that does not exceed 0.95V across the NRTD sensor, for the maximum resistance of the selected temperature range.

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate will always be sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. The following figure shows a delay for an 8th order filter where f_c = 1kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1kHz / f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1kHz / f_c). For example, an 8th order Butterworth filter with an f_c of 1kHz delays a 1kHz signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

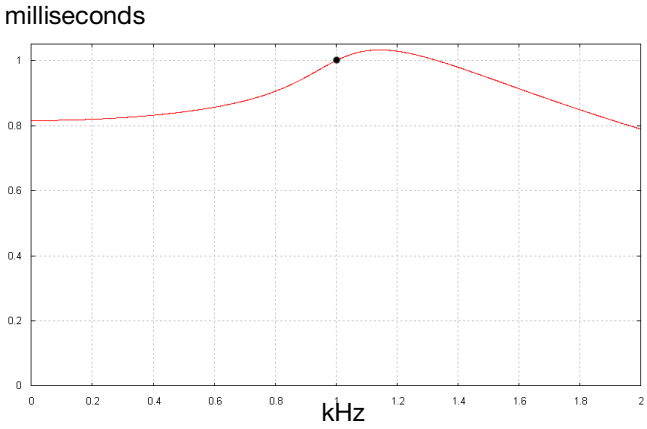


Figure 2: Filter delay for 8th order Butterworth filter where f_c = 1kHz

The filter delay for the KAD/ADC/115/NRTD is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_A (analog filter delay) ≈ 0

T_D is the filter delay

Accuracy

The KAD/ADC/115/NRTD module takes a voltage input, determines the resistance of that reading based on the excitation current and then converts it to a temperature based on a linearization lookup file that is provided as part of the XidML file in DAS Studio 3. Depending on the linearization curve the accuracy in degrees Celsius will vary.

As an example assume a CX-1080 sensor (https://www.lakeshore.com/products/categories/overview/temperature-products/cryogenic-temperature-sensors/cernox) is used. The generic curve for the CX-1080 is as follows:

KELVIN	°C	OHMS
20	-253.15	6158
30	-243.15	3320
40	-233.15	2168
50	-223.15	1565
77.35	-195.8	836.5
100	-173.15	581.1
150	-123.15	328.8
200	-73.15	220.9
250	-23.15	163.7
300	26.85	129.4
350	76.85	107
400	126.85	91.46

KELVIN	°C	OHMS
420	146.85	86.55

If this is the linearization curve provided to DAS Studio 3 then the accuracy of 1.9mV at the input with an accuracy of 1.25uA for the excitation will result in the following accuracies in degrees Celsius.

KELVIN	°C	OHMS	WORST CASE ACCURACY (°C)
20	-253.15	6158	0.03
30	-243.15	3320	0.07
40	-233.15	2168	0.13
50	-223.15	1565	0.29
77.35	-195.8	836.5	0.68
100	-173.15	581.1	1.52
150	-123.15	328.8	3.54
200	-73.15	220.9	6.68
250	-23.15	163.7	11.14
300	26.85	129.4	17.05
350	76.85	107	24.58
400	126.85	91.46	N/A
420	146.85	86.55	N/A

Connector pinout of the KAD/ADC/115/NRTD

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	ANALOG(0)	NRTD inputs	NRTD inputs
2	AGND(0)		Analog (0) ground return
3	DNC		Do not connect
4	ANALOG(1)	NRTD inputs	NRTD inputs
5	AGND(1)		Analog (1) ground return
6	DNC		Do not connect
7	ANALOG(2)	NRTD inputs	NRTD inputs
8	AGND(2)		Analog (2) ground return
9	DNC		Do not connect
10	ANALOG(3)	NRTD inputs	NRTD inputs
11	AGND(3)		Analog (3) ground return
12	DNC		Do not connect
13	ANALOG(4)	NRTD inputs	NRTD inputs
14	AGND(4)		Analog (4) ground return
15	DNC		Do not connect
16	ANALOG(5)	NRTD inputs	NRTD inputs
17	AGND(5)		Analog (5) ground return
18	DNC		Do not connect
19	ANALOG(6)	NRTD inputs	NRTD inputs
20	AGND(6)		Analog (6) ground return
21	DNC		Do not connect
22	ANALOG(7)	NRTD inputs	NRTD inputs
23	AGND(7)		Analog (7) ground return
24	DNC		Do not connect
25	ANALOG(8)	NRTD inputs	NRTD inputs
26	AGND(8)		Analog (8) ground return
27	DNC		Do not connect
28	ANALOG(9)	NRTD inputs	NRTD inputs
29	AGND(9)		Analog (9) ground return
30	DNC		Do not connect
31	ANALOG(10)	NRTD inputs	NRTD inputs
32	AGND(10)		Analog (10) ground return
33	DNC		Do not connect
34	ANALOG(11)	NRTD inputs	NRTD inputs
35	AGND(11)		Analog (11) ground return
36	DNC		Do not connect
37	ANALOG(12)	NRTD inputs	NRTD inputs
38	AGND(12)		Analog (12) ground return
39	DNC		Do not connect
40	ANALOG(13)	NRTD inputs	NRTD inputs
41	AGND(13)		Analog (13) ground return
42	DNC		Do not connect
43	ANALOG(14)	NRTD inputs	NRTD inputs
44	AGND(14)		Analog (14) ground return
45	DNC		Do not connect
46	ANALOG(15)	NRTD inputs	NRTD inputs
47	AGND(15)		Analog (15) ground return
48	DNC		Do not connect
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/115/NRTD	¼-bridge ADC (current excitation, NRTD temp. sensors, 6.25kHz b/w) - 16ch at 25ksps

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

The KAD/ADC/115/NRTD uses power from the ±7V power lines for excitation and therefore can not be used with KAM/CHS/04L, KAM/CHS/05F, KAM/CHS/03F, or KAM/CHS/02F. If the maximum excitation current is drawn from each channel, then the maximum number of KAD/ADC/115/NRTDs per chassis is limited to five.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/115/NRTD	Supports NRTD type sensors that have an inverse temperature-to-resistance relationship compared to PT1000 sensors	Recommended for new programs that require NRTD type sensors
KAD/ADC/115	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/023	Resistance temperature detectors
TEC/NOT/049	Power estimation

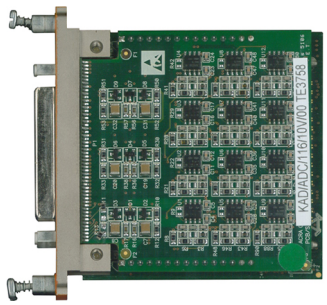
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ADC/116

Accelerometer ADC (current excitation, programmable analog gain, 3 kHz b/w) – 12ch at 12 ksps

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Key Features

- 12 accelerometer input channels with DC-reject
- Ordering Input range (1V, 10V)
- Accuracy 0.4% FSR max. at 10 Hz
- Constant current source excitation on each channel (3.6 mA typical)
- Short on any channel does not affect others
- 16-bit simultaneous sampling on each channel

Applications

- Accelerometer signal conditioning and digitalization
- Suitable for ICP©, Isotron©, and Deltatron© sensors

Overview

The KAD/ADC/116 is used to condition and digitize up to 12 accelerometer-type input channels. Each of these channels has a constant current source and AC coupled (DC-reject) inputs for use with integrated charge-amp piezoelectric accelerometer devices.

At the heart of the KAD/ADC/116 is a hard-wired state-machine that over-samples all channels at a rate between 48 ksps and 96 ksps and digitally filters any noise above the user-programmable cutoff frequency. This is achieved using cascaded, half-band, Finite-Impulse-Response (FIR) filters followed by an 8^{th} order Butterworth IIR filter with a default cutoff point set at one quarter of the sampling frequency ($f_c = f_s / 4$).

All signals are sampled simultaneously. This means that even when several channels are sampled at different sampling rates, the sample at the start of the acquisition is always synchronized.

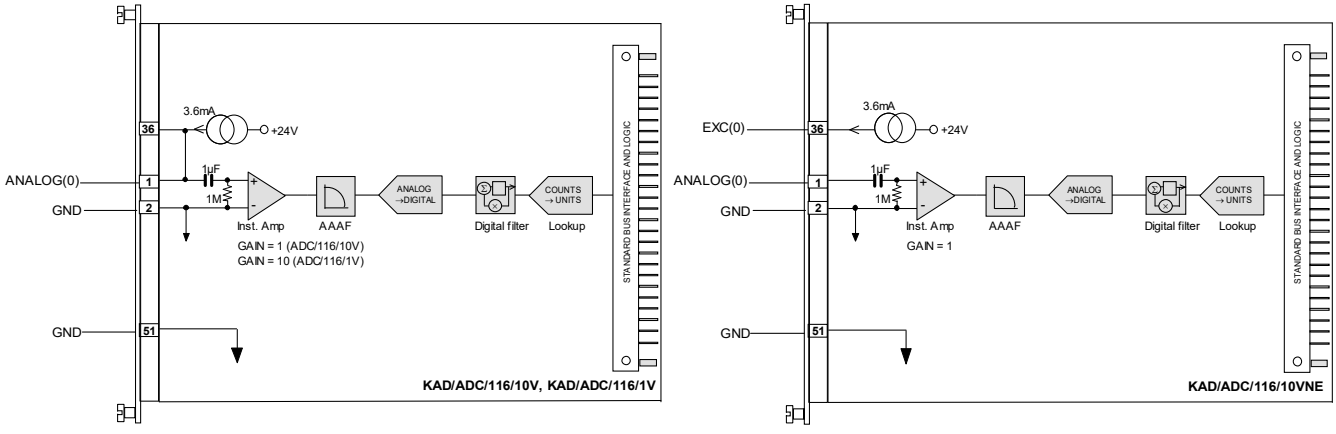


Figure 1: First of 12 accelerometer channels on the KAD/ADC/116/10V, KAD/ADC/116/1V and KAD/ADC/116/10VNE

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	90	–	g	
	–	3.17	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	100	–	140	mA	
±7V	0	–	0	mA	
±12V	45	–	65	mA	Excludes current used by excitation. As a DC/DC converter is used, multiply excitation current by 1.5 to calculate +12V and -12V line currents.
total power	1.58	–	2.26	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	AC analog inputs (for KAD/ADC/116/10V and KAD/ADC/116/1V shorted internally with DC current excitation outputs)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	12	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG[11:0]	2	–	12,000	sps	
Input voltage					
operating range	-10	–	10	V	KAD/ADC/116/10V, KAD/ADC/116/10VNE.
operating range	-1	–	1	V	KAD/ADC/116/1V.
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.

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TABLE 2	AC analog inputs (for KAD/ADC/116/10V and KAD/ADC/116/1V shorted internally with DC current excitation outputs) (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
AC gain error					
gain = 1	–	–	0.4	%FSR	For 10 Hz < f_{in} < 0.6f_c. f_c < 2 kHz.
gain = 2	–	–	0.4	%FSR	For 10 Hz < f_{in} < 0.6f_c. f_c < 2 kHz.
gain = 4	–	–	0.4	%FSR	For 10 Hz < f_{in} < 0.6f_c. f_c < 2 kHz.
gain = 8	–	–	0.4	%FSR	For 10 Hz < f_{in} < 0.6f_c. f_c < 2 kHz.
Effective number of bits	12	–	–	bits	For 10 Hz < f_{in} < 0.6f_c. f_c < 2 kHz.
Crosstalk	–	–	-72	dB	
Analog filters					Analog filters are Butterworth.
High pass filter					
poles	–	–	1	–	
filter cutoff -3 dB	–	0.16	–	Hz	
Anti aliasing filter					
poles	–	–	4	–	
filter cutoff -3 dB	5.7	6	6.3	kHz	
Digital filter					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3 dB	0.25	–	16	f_s	The maximum value is limited to 3 kHz (f_s : sampling frequency).
0.1 dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1 dB band	–	–	-70	dB	
aliasing to f_c	–	–	-74	dB	
Filter delay	–	0.66	–	ms	Measured for f_{in} = f_c = 3 kHz (f_{in} : input signal frequency; f_c : filter cutoff frequency). See “Understanding filter delays” on page 275.
Input impedance					
each input to GND	20	25	–	kΩ	Module powered off (measured at 3 kHz).
each input to GND	200	250	–	kΩ	Module powered on (measured at 3 kHz).

TABLE 3	Single ended DC current excitation outputs (for KAD/ADC/116/10V and KAD/ADC/116/1V shorted internally with AC analog inputs)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	12	–	Applied in groups of four channels.
Output current					
operating range	–	3.6	–	mA	
compliance	–	–	24	V	
short circuit current	–	3.6	4.9	mA	
short circuit duration	∞	–	–	s	
DC error					
error	–	–	1.3	mA	With a constant 2.2k load.
noise	–	3	–	mV_{rms}	As measured on analog input.
Output resistance	–	90	–	kΩ	

Setting up the KAD/ADC/116

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/116/10V	KAD/ADC/116/10V	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
Acceleration(11:0) Analog Input	-	-	-
Settings	-	-	-
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Acceleration(11:0) Parameters				
Acceleration Acceleration signal data	Volt	OffsetBinary	16	R[15:0]

Configurable parameters

Acceleration(11:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-10 to 10	10	Range maximum for analog channel
Range Minimum	-10 to 10	-10	Range minimum for analog channel

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/116

Signal return path

For channels 0 to 11 each signal is single ended so a return GND for the constant current must be provided. Return path effects are minimized if a GND pin on the module is used. These channels are band-pass filtered (that is, the DC component is also removed) so that when a sensor is first connected or powered it takes about 60 seconds to settle.

Current excitation

The KAD/ADC/116 has three ordering options; the KAD/ADC/116/10V, KAD/ADC/116/1V and KAD/ADC/116/10VNE.

The KAD/ADC/116/10V and KAD/ADC/116/1V have internally connected current excitation to each ANALOG input pin as shown in the following figure. When internally provided current excitations are to be used, the KAD/ADC/116/10V or KAD/ADC/116/1V can reduce the number of wires inside the top-block connector back shell. In that case EXC(x) pins are not connected as they are connected internally.

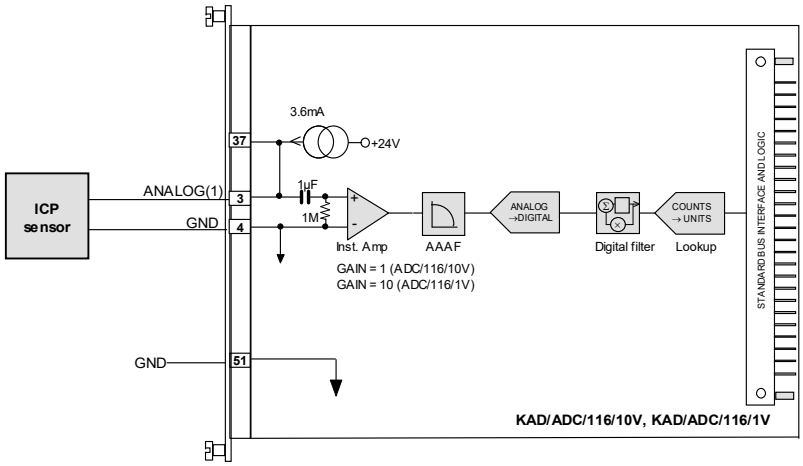


Figure 2: Second of 12 accelerometer channels on the KAD/ADC/116/10V and KAD/ADC/116/1V with ICP sensor connected

The KAD/ADC/116/10VNE provides current excitations, which are not connected internally with ANALOG input pins. This allows the use of external excitations. However, when required, internal excitation EXC(x) are provided on the top-block, and still can be used by connecting them to ANALOG pins as shown in the following figure.

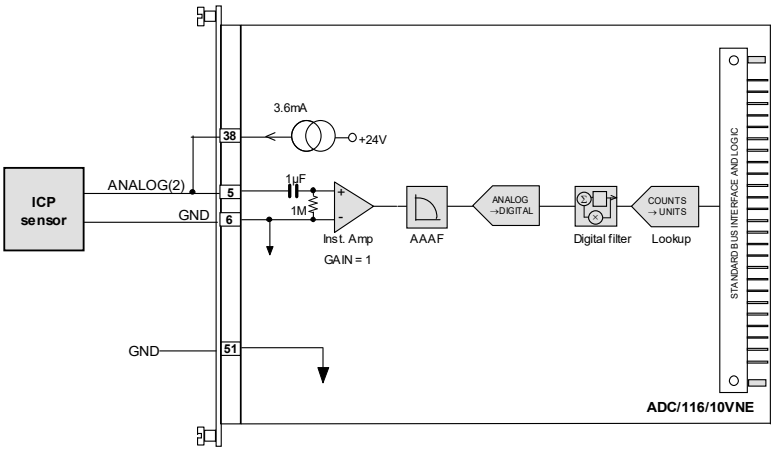


Figure 3: Third of 12 accelerometer channels on the KAD/ADC/116/10VNE with ICP sensor connected using internal current excitation

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate are always sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. The following figure shows a delay for an 8^{th} order filter where f_c = 1 kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1 kHz / f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1 kHz / f_c). For example, an 8^{th} order Butterworth filter with an f_c of 1 kHz delays a 1 kHz signal by 1 ms; a filter with an f_c of 10 Hz delays a 10 Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

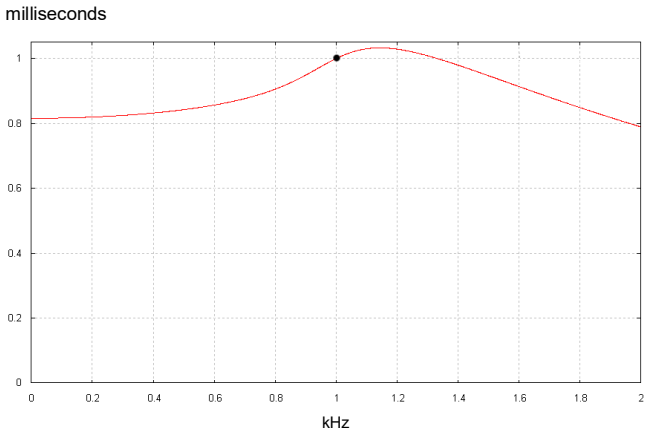


Figure 4: Filter delay for 8^{th} order Butterworth filter where f_c = 1kHz

The filter delay for the KAD/ADC/116 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_D is the filter delay

T_A (analog filter delay) ≈ 0

Temperature drift

The isolation resistance of the capacitor used on the high-pass filter can drift over temperature, which can cause a theoretical offset of up to 50 mV. This drift in isolation resistance does not impact the overvoltage performance of the input.

Connector pinout of the KAD/ADC/116

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	ANALOG(0)	AC analog inputs (connected with EXC(0) internally)	EXC(0) not connected on 10VNE
2	GND	Internal ground	
3	ANALOG(1)	AC analog inputs (connected with EXC(1) internally)	EXC(1) not connected on 10VNE
4	GND	Internal ground	
5	ANALOG(2)	AC analog inputs (connected with EXC(2) internally)	EXC(2) not connected on 10VNE
6	GND	Internal ground	
7	ANALOG(3)	AC analog inputs (connected with EXC(3) internally)	EXC(3) not connected on 10VNE
8	GND	Internal ground	
9	ANALOG(4)	AC analog inputs (connected with EXC(4) internally)	EXC(4) not connected on 10VNE
10	GND	Internal ground	
11	ANALOG(5)	AC analog inputs (connected with EXC(5) internally)	EXC(5) not connected on 10VNE
12	GND	Internal ground	
13	ANALOG(6)	AC analog inputs (connected with EXC(6) internally)	EXC(6) not connected on 10VNE
14	GND	Internal ground	
15	ANALOG(7)	AC analog inputs (connected with EXC(7) internally)	EXC(7) not connected on 10VNE
16	GND	Internal ground	
17	GND	Internal ground	
18	DNC		Do not connect
19	ANALOG(8)	AC analog inputs (connected with EXC(8) internally)	EXC(8) not connected on 10VNE
20	GND	Internal ground	
21	ANALOG(9)	AC analog inputs (connected with EXC(9) internally)	EXC(9) not connected on 10VNE
22	GND	Internal ground	
23	ANALOG(10)	AC analog inputs (connected with EXC(10) internally)	EXC(10) not connected on 10VNE
24	GND	Internal ground	
25	ANALOG(11)	AC analog inputs (connected with EXC(11) internally)	EXC(11) not connected on 10VNE
26	GND	Internal ground	
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	EXC(0)	Single ended DC current excitation outputs	
37	EXC(1)	Single ended DC current excitation outputs	
38	EXC(2)	Single ended DC current excitation outputs	
39	EXC(3)	Single ended DC current excitation outputs	
40	EXC(4)	Single ended DC current excitation outputs	
41	EXC(5)	Single ended DC current excitation outputs	
42	EXC(6)	Single ended DC current excitation outputs	
43	EXC(7)	Single ended DC current excitation outputs	
44	EXC(8)	Single ended DC current excitation outputs	
45	EXC(9)	Single ended DC current excitation outputs	
46	EXC(10)	Single ended DC current excitation outputs	
47	EXC(11)	Single ended DC current excitation outputs	
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/116/10V	Accelerometer ADC (current excitation, programmable analog gain, 3 kHz b/w, ±10V) – 12ch at 12 ksps (with 52-way double-density top connector); current excitations connected internally to analog inputs
KAD/ADC/116/10VNE	Accelerometer ADC (current excitation, programmable analog gain, 3 kHz b/w, ±10V) – 12ch at 12 ksps (with 52-way double-density top connector); current excitations not connected internally to analog inputs but provided on top connector as separate pin
KAD/ADC/116/1V	Accelerometer ADC (current excitation, programmable analog gain, 3 kHz b/w, ±1V) – 12ch at 12 ksps (with 52-way double-density top connector); current excitations connected internally to analog inputs
KAM/ADC/116/10V	Accelerometer ADC (current excitation, programmable analog gain, 3 kHz b/w, ±10V) – 12ch at 12 ksps (with 51-way micro miniature top connector); current excitations connected internally to analog inputs
KAM/ADC/116/10VNE	Accelerometer ADC (current excitation, programmable analog gain, 3 kHz b/w, ±10V) – 12ch at 12 ksps (with 51-way micro miniature top connector); current excitations not connected internally to analog inputs but provided on top connector as separate pin
KAM/ADC/116/1V	Accelerometer ADC (current excitation, programmable analog gain, 3 kHz b/w, ±1V) – 12ch at 12 ksps (with 51-way micro miniature top connector); current excitations connected internally to analog inputs

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; or ACC/CON/008/04 for KAM modules) is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/ADC/116 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/116	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
KSM-500	This module is supported by the KSM-500 suite of software tools
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/012	Piezoelectric Effect and Charge Amplifiers
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

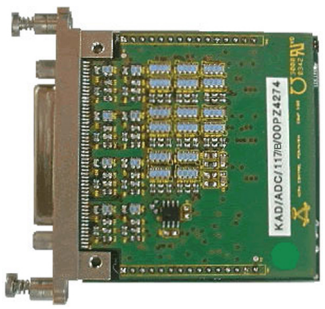
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ADC/117

Full-bridge ADC (current excitation, programmable analog gain, 6kHz b/w) - 8ch at 24ksps

CURTISSWRIGHTDS.COM



Key Features

- Eight full bridge or differential ended input channels
- Programmable input range (±10mV to ±10V)
- Programmable current excitation
- Short on any channel does not affect others
- 16-bit simultaneous sampling on each channel

Applications

- Bridge applications with long leads/barriers
- General purpose voltage measurement

Overview

The KAD/ADC/117 has eight channels of signal conditioning and data acquisition for differential voltages, strain gage and bridge measurements. In addition to the measurement channel, the KAD/ADC/117 provides independent constant current excitation for up to eight channels. Each differential ended signal has a separate programmable amplifier, filter and A/D converter.

At the heart of the KAD/ADC/117 is a hard-wired state-machine that over-samples all channels at a rate between 96ksps and 192ksps and digitally filters any noise above the user-programmable cutoff frequency. This is achieved using cascaded, half-band, decimate by 2, 15 tap, finite-impulse-response (FIR) filters with 32-bit coefficients followed by 8th order Butterworth (IIR) filter with a default cutoff point set to a quarter of the sampling frequency. All signals are sampled simultaneously. Thus, when several channels are sampled at different sampling rates, at least at the start of an acquisition cycle all channels are aligned.

The excitation current is programmable (0mA to 20mA in 5µA steps) and is kept constant. As the resistance changes, the voltage across the bridge (and hence as seen by the amplifier) changes linearly.

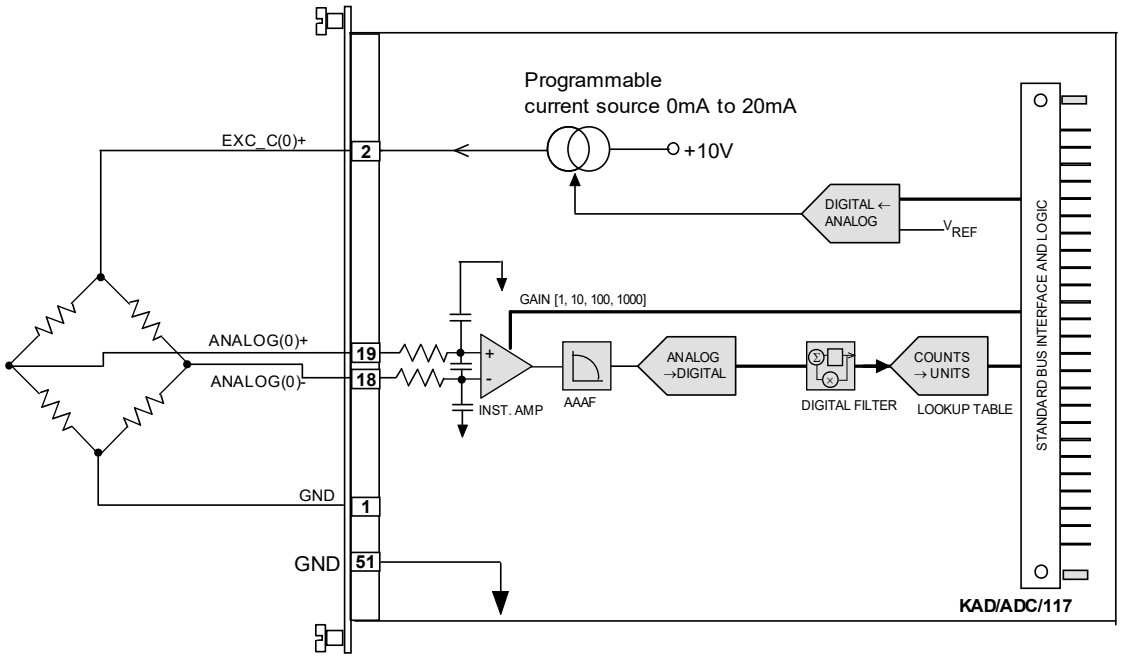


Figure 1: First of eight channels on the KAD/ADC/117

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	94	–	g	
	–	3.32	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					KAD/ADC/117
+5V	90	–	175	mA	
+7V	80	–	110	mA	Excludes current used by excitation. As a DC/DC converter is used, multiply excitation current by 2.2 to calculate +7V line current.
-7V	0	–	0	mA	
±12V	30	–	50	mA	
total power	1.97	–	2.85	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Power consumption					KAD/ADC/117/E12
+5V	90	–	175	mA	
+7V	0	–	0	mA	
-7V	0	–	0	mA	
+12V	100	–	120	mA	Excludes current used by excitation. As a DC/DC converter is used, multiply excitation current by 1.25 to calculate +12V line current.
-12V	30	–	50	mA	
total power	2.01	–	2.92	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

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TABLE 2	Differential ended analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	8	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG[7:0]	2	–	24,000	sps	
Input voltage					
operating range (G_p = 1)	-10	–	10	V	Primary gain = 1.
operating range (G_p = 10)	-1	–	1	V	Primary gain = 10.
operating range (G_p = 100)	-100	–	100	mV	Primary gain = 100.
operating range (G_p = 1000)	-10	–	10	mV	Primary gain = 1000.
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.
DC error					DC signal averaged over 200 samples without excitation.
gain = 1, 10, 100	–	–	0.08	%FSR	
gain = 2, 20, 200	–	–	0.14	%FSR	
gain = 4, 40, 400	–	–	0.25	%FSR	
gain = 8, 80, 800	–	–	0.44	%FSR	
gain = 1000	–	–	0.3	%FSR	
gain = 2000	–	–	0.6	%FSR	
gain = 4000	–	–	1.2	%FSR	
Effective number of bits					
gain = 1, 10	13.5	–	–	bits	$f_c \leq$ 2kHz and secondary gain of 1 (f_c : filter cutoff frequency).
gain = 100	11.3	–	–	bits	$f_c \leq$ 2kHz and secondary gain of 1.
gain = 1000	8	–	–	bits	$f_c \leq$ 1kHz and secondary gain of 1.
Crosstalk					
gain = 1, 10, 100	–	–	-60	dB	
gain = 1000	–	–	-40	dB	
Common mode					
voltage range	-10	–	10	V	Operational voltage range.
rejection ratio	50	–	–	dB	Applies within the above common mode voltage range, $0 \leq f \leq f_c$.

TABLE 2	Differential ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Analog filter					Analog filter is Butterworth.
poles	–	–	4	–	
filter cutoff -3dB	10.8	12	13.2	kHz	
Digital filter					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 6kHz (f_s : sampling frequency).
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-72	dB	
aliasing to f_c	–	–	-74	dB	
Filter delay	–	0.33	–	ms	Where $f_{in} = f_c = 6kHz$ (f_{in} : input signal frequency). See “Understanding filter delays” on page 284.
Input resistance					
between inputs	44	–	–	kΩ	Module powered off.
between inputs	10	–	–	MΩ	Module powered on.
each input to GND	22	–	–	kΩ	Module powered off.
each input to GND	10	–	–	MΩ	Module powered on.

TABLE 3	Single ended DC current excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	8	–	Applied per channel.
Output current					
operating range	0	–	20	mA	
resolution	–	5	–	µA	
compliance	0	–	10	V	
short circuit current	–	–	20	mA	
short circuit duration	∞	–	–	s	
DC error					
error	–	–	0.3	%FSR	With a constant 350Ω load.
noise (gain = 1)	–	–	0.5	mV_{rms}	As measured on analog input.
noise (gain = 10)	–	–	0.05	mV_{rms}	As measured on analog input.
noise (gain = 100, 1000)	–	–	0.01	mV_{rms}	As measured on analog input.

Setting up the KAD/ADC/117

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/117/B	KAD/ADC/117/B	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
Analog(7:0) Analog Input	-	-	-
Settings	-	-	-
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.
Excitation Amplitude	0 to 0.02	0	Required excitation (in A) for the top of the bridge.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Analog(7:0) Parameters				
Analog Analog signal data	Volt	OffsetBinary	16	R[15:0]

Configurable parameters

Analog(7:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-10 to 10	10	Range maximum for analog channel
Range Minimum	-10 to 10	-10	Range minimum for analog channel

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/117

Bias current return path

As shown in the following figure, the analog inputs can be used as differential inputs (that is, not from a bridge). In this case, if the signal source is isolated with respect to the Acra KAM-500 (for example a battery), a common-mode resistance between the negative input and ground (GND) should be used to provide a return for bias currents and reduce common-mode noise pick-up. Because the bias currents are in the order of nAs resistors up to 10kΩ can be used. In most cases a short (0Ω) is recommended.

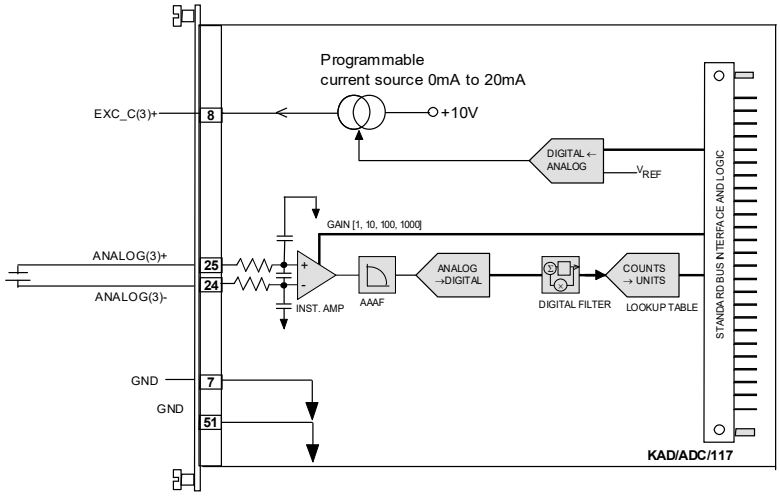


Figure 2: Fourth of 8 independent differential ended channels

NOTE: When analog inputs are used as differential inputs, setting the excitation to zero reduces quiescent currents of the module.

Using high primary gains

For gains above 1,000, the gain-bandwidth product of the amplifier reduces the bandwidth to 1,000 Hz.

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate will always be sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. The following figure shows a delay for an 8^{th} order filter where f_c = 1kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1kHz / f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1kHz / f_c). For example, an 8^{th} order Butterworth filter with an f_c of 1kHz delays a 1kHz signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

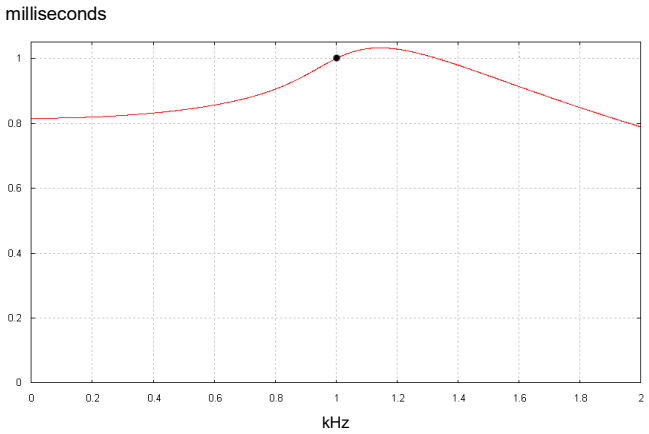


Figure 3: Filter delay for 8th order Butterworth filter where f_c = 1kHz

The filter delay for the KAD/ADC/117 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_D is the filter delay

T_A (analog filter delay) ≈ 0

f_c is the filter cutoff frequency

Additional delay sources

Primary gains higher than 1 cause an additional delay from 1st order filters in the instrumentation amplifier. That additional delay is 2µs for a gain of 10, 15µs for a gain of 100, and 150µs for a gain of 1,000. In applications where time correlation is more important than suppression of aliasing, set the same cutoff point on all channels, even if the sampling rates are different.

Connector pinout of the KAD/ADC/117

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	GND	Internal ground	
2	EXC_C(0)+	Single ended DC current excitation outputs	Excitation to top of bridge
3	GND	Internal ground	
4	EXC_C(1)+	Single ended DC current excitation outputs	Excitation to top of bridge
5	GND	Internal ground	
6	EXC_C(2)+	Single ended DC current excitation outputs	Excitation to top of bridge
7	GND	Internal ground	
8	EXC_C(3)+	Single ended DC current excitation outputs	Excitation to top of bridge
9	GND	Internal ground	
10	EXC_C(4)+	Single ended DC current excitation outputs	Excitation to top of bridge
11	GND	Internal ground	
12	EXC_C(5)+	Single ended DC current excitation outputs	Excitation to top of bridge
13	GND	Internal ground	
14	EXC_C(6)+	Single ended DC current excitation outputs	Excitation to top of bridge
15	GND	Internal ground	
16	EXC_C(7)+	Single ended DC current excitation outputs	Excitation to top of bridge
17	DNC		Do not connect
18	ANALOG(0)-	Differential ended analog inputs	Analog input
19	ANALOG(0)+	Differential ended analog inputs	Analog input
20	ANALOG(1)-	Differential ended analog inputs	Analog input
21	ANALOG(1)+	Differential ended analog inputs	Analog input
22	ANALOG(2)-	Differential ended analog inputs	Analog input
23	ANALOG(2)+	Differential ended analog inputs	Analog input
24	ANALOG(3)-	Differential ended analog inputs	Analog input
25	ANALOG(3)+	Differential ended analog inputs	Analog input
26	ANALOG(4)-	Differential ended analog inputs	Analog input
27	ANALOG(4)+	Differential ended analog inputs	Analog input
28	ANALOG(5)-	Differential ended analog inputs	Analog input
29	ANALOG(5)+	Differential ended analog inputs	Analog input
30	ANALOG(6)-	Differential ended analog inputs	Analog input
31	ANALOG(6)+	Differential ended analog inputs	Analog input
32	ANALOG(7)-	Differential ended analog inputs	Analog input
33	ANALOG(7)+	Differential ended analog inputs	Analog input
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/117/B	Full-bridge ADC (current excitation, programmable analog gain, 6kHz b/w) - 8ch at 24ksps (uses ±7V for excitation)
KAD/ADC/117/B/E12	Full-bridge ADC (current excitation, programmable analog gain, 6kHz b/w) - 8ch at 24ksps (uses ±12V for excitation)

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

The KAD/ADC/117 uses power from ±7V for excitation and therefore cannot be used with the KAM/CHS/04L, KAM/CHS/05F, KAM/CHS/02F. or KAM/CHS/03F chassis. The KAD/ADC/117/E12 uses power from ±12V, so it can be used with the KAM/CHS/04L, KAM/CHS/05F, KAM/CHS/02F, or KAM/CHS/03F chassis.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/117/B	Improved format switching	Recommended for new programs
KAD/ADC/117	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

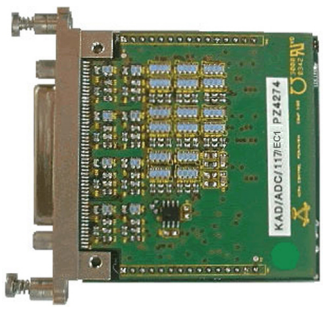
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
TEC/NOT/001	Strain gages and ideal bridges
TEC/NOT/016	Power dissipation
TEC/NOT/019	An introduction to digital filtering
TEC/NOT/049	Power estimation

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KAD/ADC/117/EC1

Full-bridge ADC (current excitation, programmable analog gain, configurable FIR/IIR filter, 3.75kHz b/w) - 8ch at 24ksps



Key Features

- Eight full bridge or differential ended input channels
- Programmable input range (±10mV to ±10V)
- High accuracy (0.08% FSR typical)
- Programmable current excitation per channel
- Short on any channel does not affect others
- 16-bit simultaneous sampling on each channel
- Two filtering mode: IIR and FIR
- Linear bridge operation – constant current

Applications

- Bridge applications with long leads/barriers
- General purpose voltage measurement

Overview

The KAD/ADC/117/EC1 has eight channels of signal conditioning and data acquisition for differential voltages, strain gage and bridge measurements. In addition to the measurement channel, the KAD/ADC/117/EC1 provides independent constant current excitation for up to eight channels. Each differential ended signal has a separate programmable amplifier, filter and A/D converter.

At the heart of the KAD/ADC/117/EC1 is a hard-wired state-machine that over-samples all channels and digitally filters any noise above the user-programmable cutoff frequency. This is achieved using cascaded, half-band, decimate by 2, 15 tap, finite-impulse-response (FIR) filters with 32-bit coefficients followed by an 8th order Butterworth (IIR) filter with a default cutoff point set to 25% of the sampling frequency. The IIR filter is bypassed in FIR mode with samples output directly from the FIR filter. All signals are sampled simultaneously. Thus, when several channels are sampled at different sampling rates, at least at the start of an acquisition cycle all channels will be aligned.

The excitation current is programmable (0mA to 20mA in 5µA steps) and is kept constant. As the resistance changes, the voltage across the bridge (and hence as seen by the amplifier) changes linearly.

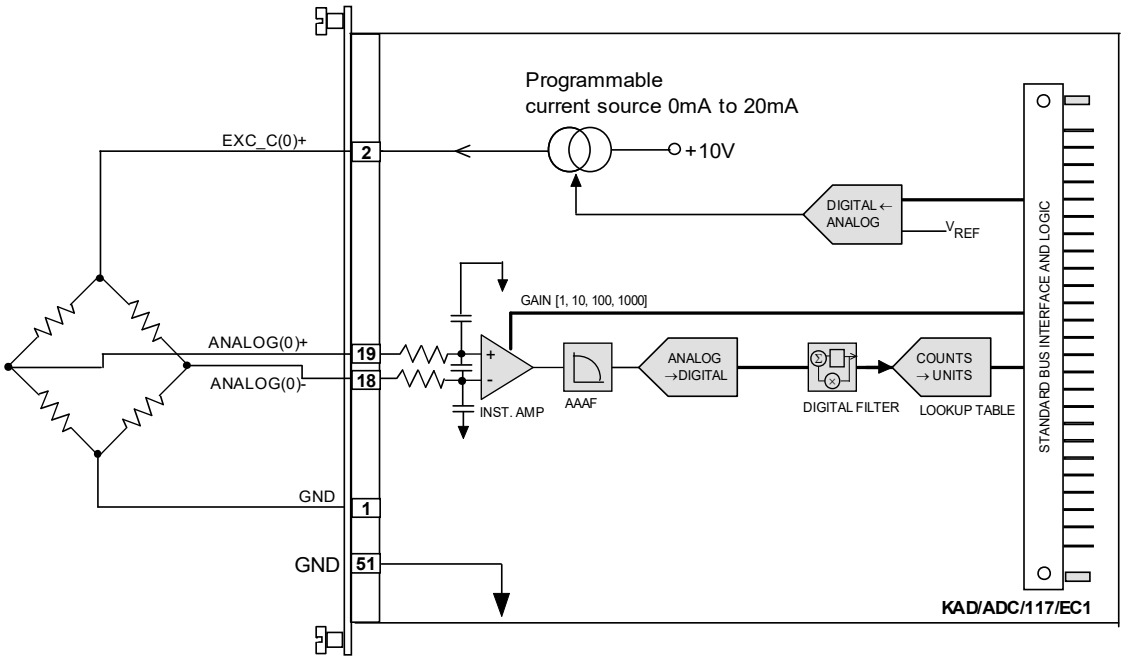


Figure 1: First of eight channels on the KAD/ADC/117/EC1

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	95	–	g	
	–	3.35	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	90	–	130	mA	
+7V	80	–	110	mA	Excludes current used by excitation. As a DC/DC converter is used, multiply excitation current by 2.2 to calculate +7V line current.
-7V	0	–	0	mA	
+12V	50	–	60	mA	
-12V	30	–	50	mA	
total power	1.97	–	2.74	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Differential ended analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	8	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG[7:0]	2	–	24000	sps	26000sps is allowed in FIR mode.
Input voltage					
operating range (G_p = 1)	-10	–	10	V	Primary gain = 1
operating range (G_p = 10)	-1	–	1	V	Primary gain = 10
operating range (G_p = 100)	-100	–	100	mV	Primary gain = 100
operating range (G_p = 1000)	-10	–	10	mV	Primary gain = 1000
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.

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TABLE 2	Differential ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
DC error					DC signal averaged over 200 samples without excitation.
gain = 1, 10, 100	–	–	0.08	%FSR	
gain = 2, 20, 200	–	–	0.14	%FSR	
gain = 4, 40, 400	–	–	0.25	%FSR	
gain = 8, 80, 800	–	–	0.44	%FSR	
gain = 1000	–	–	0.3	%FSR	
gain = 2000	–	–	0.6	%FSR	
gain = 4000	–	–	1.2	%FSR	
Effective number of bits (IIR mode)					
gain = 1, 10	13.5	–	–	bits	$f_c \leq$ 2kHz and secondary gain of 1 (f_c : filter cutoff frequency).
gain = 100	11.3	–	–	bits	$f_c \leq$ 2kHz and secondary gain of 1.
gain = 1000	9	–	–	bits	$f_c \leq$ 2kHz and secondary gain of 1.
Effective number of bits (FIR mode)					
gain = 1, 10	12	–	–	bits	$f_c \leq$ 2kHz and secondary gain of 1.
gain = 100	11.3	–	–	bits	$f_c \leq$ 2kHz and secondary gain of 1.
gain = 1000	8.5	–	–	bits	$f_c \leq$ 2kHz and secondary gain of 1.
Crosstalk					
gain = 1, 10, 100	–	–	-60	dB	
gain = 1000	–	–	-40	dB	
Common mode					
voltage range	-10	–	10	V	Operational voltage range.
rejection ratio	50	–	–	dB	Applies within the above common mode voltage range, $0 \leq f \leq f_c$.
Analog filter					Analog filter is Butterworth.
poles	–	–	4	–	
filter cutoff -3dB	3.37	3.75	4.13	kHz	
Digital filter (IIR mode)					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 6kHz (f_s : sampling frequency).
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-72	dB	
aliasing to f_c	–	–	-74	dB	

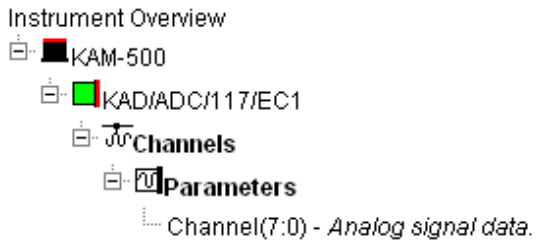
TABLE 2	Differential ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Digital filter (FIR mode)					Digital filter is cascaded 15 tap FIR.
poles	–	–	–	–	Not applicable for FIR-type filters.
filter cutoff -6dB	0.25	–	16	f_s	The maximum value is limited to 6.5kHz (f_s : sampling frequency).
0.1dB bandwidth	–	0.64	–	f_c	
aliasing to 0.1dB band	–	–	-40	dB	
aliasing to f_c	–	–	-47	dB	
Filter delay					
IIR mode	–	4.08	–	ms	Where $f_{in} = f_c = 500Hz$ (f_{in} : input signal frequency). See “Understanding filter delays (IIR filter mode)” on page 295.
FIR mode	–	9.05	–	ms	Where $f_{in} = f_c = 500Hz$. See “Understanding filter delays (FIR filter mode)” on page 295.
Input resistance					
between inputs	44	–	–	kΩ	Module powered off.
between inputs	10	–	–	MΩ	Module powered on.
each input to GND	22	–	–	kΩ	Module powered off.
each input to GND	10	–	–	MΩ	Module powered on.

TABLE 3	Single ended DC current excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	8	–	Applied per channel.
Output current					
operating range	0	–	20	mA	
resolution	–	5	–	µA	
compliance	0	–	10	V	
short circuit current	–	–	20	mA	
short circuit duration	∞	–	–	s	
DC error					
error	–	–	0.3	%FSR	With a constant 350Ω load.
noise (gain = 1)	–	–	0.5	mV_{rms}	As measured on analog input.
noise (gain = 10)	–	–	0.05	mV_{rms}	As measured on analog input.
noise (gain = 100, 1000)	–	–	0.01	mV_{rms}	As measured on analog input.

Setting up the KAD/ADC/117/EC1

All module setup can be defined in XML using XidML® schemas (see www.xidml.org).

The following treeview provides an overview of setup configurations available for this module:



XidML Legend

DAU: Data Acquisition Unit (PC: Personal Computer)

Instrument: Any component or module used in a data acquisition system

DataLink: Connection for transmitting or receiving (defines both the data link and the physical layer)

Package: Used to describe how data is transmitted or stored

Parameter: Any register that can be read from an instrument

Algorithm: Defines processing to be performed on data

Setting up the module

The following table lists the setup configurations available for the KAD/ADC/117/EC1.

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer			-
Name	ACRA CONTROL	ACRA CONTROL	-
PartReference	KAD/ADC/117/EC1	KAD/ADC/117/EC1	-
SerialNumber			-
Settings			-
Module-Analog-In-1.2			-
Channel Channel(7:0)			Settings for this channel
FilterCutoff	0.25, 0.5, 1, 2, 4, 8, 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.
ExcitationAmplitude	0 to 0.02	0	Required excitation current (in A) for the bridge.
FilterType	IIR FIR	IIR	Filtering mode selection.

Setting up parameters

Parameter definitions

The following table lists all parameters that are available for the KAD/ADC/117/EC1.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Channel(7:0) Analog signal data.	Volt	OffsetBinary	16:4	R[15:0] 0000:FFFF (hex)

Programmable elements

Channel(7:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
RangeMaximum	-10 to 10	10	-
RangeMinimum	-10 to 10	-10	-
SizeInBits	16:4	16	R[15:0] 0000:FFFF (hex)

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/117/EC1

Bias current return path

As shown in the following figure, the analog inputs can be used as differential inputs (that is, not from a bridge). In this case, if the signal source is isolated with respect to the Acra KAM-500 (for example a battery), a common-mode resistance between the negative input and ground (GND) should be used to provide a return for bias currents and reduce common-mode noise pick-up. Because the bias currents are in the order of nAs, resistors up to 10kΩ can be used. In most cases a short (0Ω) is recommended.

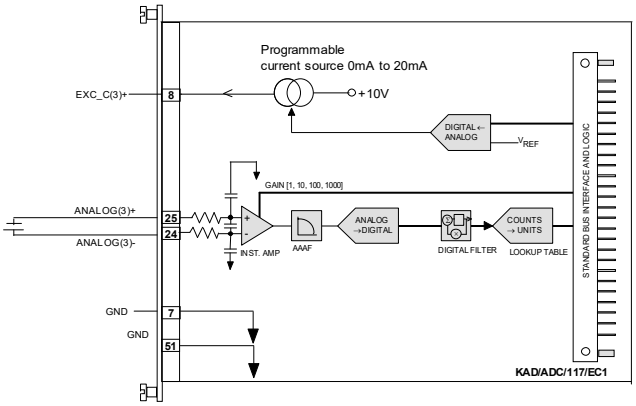


Figure 2: Fourth of 8 independent differential ended channels

NOTE: When analog inputs are used as differential inputs, setting the excitation to zero reduces quiescent currents of the module.

Using high primary gains

For gains above 1,000, the gain-bandwidth product of the amplifier reduces the bandwidth to 1,000 Hz.

Understanding filter delays (FIR filter mode)

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate will always be sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c).

The filter delay for this mode is:

$$T_D \approx T_A + \left(19.1 - \frac{20}{2^N}\right) \cdot \frac{1}{4 \cdot f_C}$$

$$N = INT(15.7 - \log_2(4 \cdot f_C))$$

T_D is the filter delay

INT is for the integer part of the value. For example, if x = 13.5, INT(x) = 13.

f_c is the filter cutoff frequency.

N cannot be lower than 1. If N is lower than 1, then use 1.

T_A (analog filter delay) ≈ 125µs.

Understanding filter delays (IIR filter mode)

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate will always be sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. The following figure shows a delay for an 8th order filter where f_c = 1kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1kHz/ f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1kHz/ f_c). For example, an 8th order Butterworth filter with an f_c of 1kHz delays a 1kHz signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

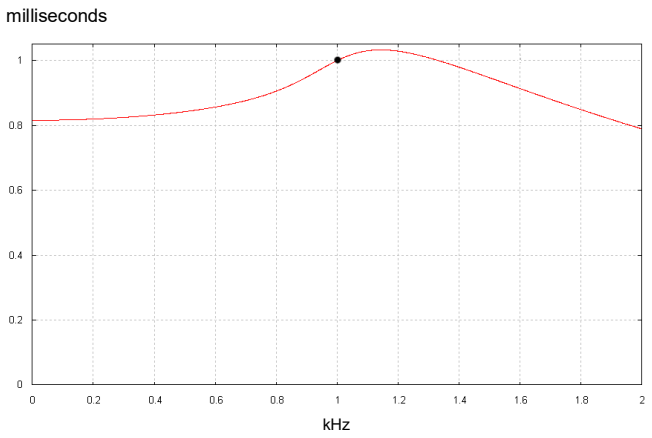


Figure 3: Filter delay for 8th order Butterworth filter where f_c = 1kHz

The filter delay for this mode is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_D is the filter delay

T_A (analog filter delay) ≈ 82µs

f_c is the filter cutoff frequency.

Additional delay sources

Primary gains higher than 1 cause an additional delay from 1st order filters in the instrumentation amplifier. That additional delay is 2µs for a gain of 10, 15µs for a gain of 100, and 150µs for a gain of 1,000. In applications where time correlation is more important than suppression of aliasing, set the same cutoff point on all channels, even if the sampling rates are different.

Delay differences to reference modules

The KAD/ADC/117/EC1 was developed to provide configurable filter characteristics similar to the KAD/ADC/117 module (IIR mode) and the KAD/ADC/014/D module (FIR mode). However as the original modules have different AAAF filters, schematics, components and FPGA architectures, a compromise had to be made in achieving this. The KAD/ADC/117/EC1 AAAF filter f_c and order were chosen to follow both reference modules in the closest way, but with slight differences, especially close to the AAAF f_c point.

The delay difference between the KAD/ADC/117/EC1 in FIR mode and the KAD/ADC/014/D is lower than 80µs (or a time equivalent of 2° of phase difference, whichever value is bigger).

The delay difference between the KAD/ADC/117/EC1 in IIR mode and the KAD/ADC/117 is approximately 82µs up to 1.8kHz. However at around f_c of AAAF (3.75kHz) the delay difference will be bigger: about 100us.

Connector pinout of the KAD/ADC/117/EC1

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	GND	Internal ground	
2	EXC_C(0)+	Single ended DC current excitation outputs	Excitation to top of bridge
3	GND	Internal ground	
4	EXC_C(1)+	Single ended DC current excitation outputs	Excitation to top of bridge
5	GND	Internal ground	
6	EXC_C(2)+	Single ended DC current excitation outputs	Excitation to top of bridge
7	GND	Internal ground	
8	EXC_C(3)+	Single ended DC current excitation outputs	Excitation to top of bridge
9	GND	Internal ground	
10	EXC_C(4)+	Single ended DC current excitation outputs	Excitation to top of bridge
11	GND	Internal ground	
12	EXC_C(5)+	Single ended DC current excitation outputs	Excitation to top of bridge
13	GND	Internal ground	
14	EXC_C(6)+	Single ended DC current excitation outputs	Excitation to top of bridge
15	GND	Internal ground	
16	EXC_C(7)+	Single ended DC current excitation outputs	Excitation to top of bridge
17	DNC		Do not connect
18	ANALOG(0)-	Differential ended analog inputs	
19	ANALOG(0)+	Differential ended analog inputs	
20	ANALOG(1)-	Differential ended analog inputs	
21	ANALOG(1)+	Differential ended analog inputs	
22	ANALOG(2)-	Differential ended analog inputs	
23	ANALOG(2)+	Differential ended analog inputs	
24	ANALOG(3)-	Differential ended analog inputs	
25	ANALOG(3)+	Differential ended analog inputs	
26	ANALOG(4)-	Differential ended analog inputs	
27	ANALOG(4)+	Differential ended analog inputs	
28	ANALOG(5)-	Differential ended analog inputs	
29	ANALOG(5)+	Differential ended analog inputs	
30	ANALOG(6)-	Differential ended analog inputs	
31	ANALOG(6)+	Differential ended analog inputs	
32	ANALOG(7)-	Differential ended analog inputs	
33	ANALOG(7)+	Differential ended analog inputs	
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/117/EC1	Full-bridge ADC (current excitation, programmable analog gain, configurable FIR/IIR filter, 3.75kHz b/w) - 8ch at 24ksps

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

The KAD/ADC/117/EC1 uses power from ±7V for excitation and therefore cannot be used with the KAM/CHS/04L, KAM/CHS/05F, KAM/CHS/03F, or KAM/CHS/02F chassis.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/117/EC1	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

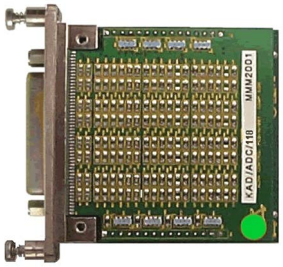
Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/001	Strain gages and ideal bridges
TEC/NOT/016	Power dissipation
TEC/NOT/019	An introduction to digital filtering
TEC/NOT/049	Power estimation

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ADC/118

Full-bridge ADC (voltage excitation, 3kHz b/w) - 12ch at 12ksps



Key Features

- 12 full or 1/2 bridge, potentiometer or differential ended input channels
- Ordering input range (±100mV, ±1V, ±10V)
- High accuracy (0.12% FSR maximum for /1V, /10V, /100mV variant)
- Programmable voltage excitation per three channels and balance adjust per channel
- Shorts only affect channels sharing excitation
- 16-bit simultaneous sampling on each channel

Applications

- High impedance bridge sensors
- Differential voltage measurement
- Strain gage measurement

Overview

The KAD/ADC/118 is used to condition and digitize up to 12 differential ended analog channels. At the heart of the KAD/ADC/118 is a hard-wired state-machine that over-samples all channels at a rate between 48ksps and 96ksps and digitally filters any noise above the user-programmable cutoff frequency.

This is achieved using cascaded, half-band, Finite-Impulse-Response (FIR) filters followed by an 8th order Butterworth Infinite-Impulse-Response (IIR) filter with a default cutoff point set at one quarter of the sampling frequency ($f_c = f_s / 4$). All signals are sampled simultaneously. Thus, when several channels are sampled at different sampling rates, at the start of an acquisition cycle all channels are aligned.

The KAD/ADC/118 is similar to the KAD/ADC/120 but includes support for channel balancing. The KAD/ADC/118 is available with three different input ranges (±10V, ±1V, ±100mV). The input range must be specified when ordering.

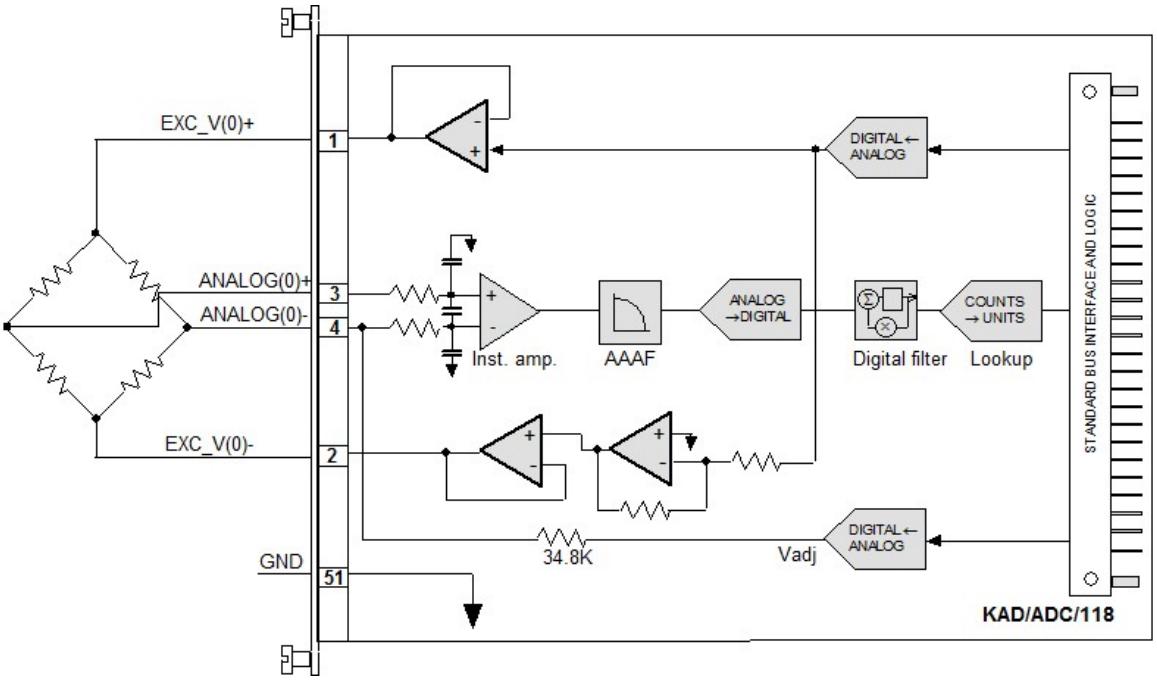


Figure 1: First of 12 channels on the KAD/ADC/118

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	95	–	g	
	–	3.36	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	100	–	160	mA	
±7V	40	–	60	mA	Excludes current used by excitation.
+12V	30	–	50	mA	
-12V	20	–	30	mA	
total power	1.66	–	2.6	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Differential ended analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	12	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG[11:0]	2	–	12,000	sps	
Input voltage					
operating range (KAD/ADC/118/10V)	-10	–	10	V	
operating range (KAD/ADC/118/1V)	-1	–	1	V	
operating range (KAD/ADC/118/100M)	-100	–	100	mV	
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.

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TABLE 2	Differential ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
DC error					DC signal averaged over 200 samples without excitation. The DC error specifications claimed here are input channel specifications only. The total system error may differ as it must include excitation error and depends on the sensor configuration (full-bridge, half-bridge or potentiometer).
gain = 1	–	–	0.12	%FSR	
gain = 2	–	–	0.21	%FSR	
gain = 4	–	–	0.36	%FSR	
gain = 8	–	–	0.65	%FSR	
Effective number of bits					
KAD/ADC/118/10V, KAD/ADC/118/1V	13.5	–	–	bits	$f_c \leq$ 1kHz and secondary gain of 1 (f_c: filter cutoff frequency).
KAD/ADC/118/100M	11.3	–	–	bits	$f_c \leq$ 1kHz and secondary gain of 1.
Crosstalk					
KAD/ADC/118/100M, KAD/ADC/118/1V	–	–	-64	dB	
KAD/ADC/118/10V	–	–	-72	dB	
Common mode					
voltage range	-10	–	10	V	Operational voltage range.
rejection ratio (KAD/ADC/118/100M, KAD/ADC/118/1V)	72	–	–	dB	Applies within the above common mode voltage range, $0 \leq f \leq f_c$.
rejection ratio (KAD/ADC/118/10V)	68	–	–	dB	Applies within the above common mode voltage range, $0 \leq f \leq f_c$.
Analog filter					Analog filter is Butterworth.
poles	–	–	4	–	
filter cutoff -3dB	5.4	6	6.6	kHz	
Digital filter					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 3kHz.
0.1dB bandwidth	–	0.64	–	f_c	
aliasing to 0.1dB band	–	–	-70	dB	
aliasing to f_c	–	–	-74	dB	
Filter delay	–	0.66	–	ms	Measured for $f_{in} = f_c$ = 3kHz (f_{in}: input signal frequency). See “Understanding filter delays” on page 306.
Input resistance					
between inputs	40	54	–	kΩ	Module powered off.
between inputs	10	–	–	MΩ	Module powered on.
single ended input to GND	25	29	–	kΩ	Module powered off.
each input to GND	10	–	–	MΩ	Module powered on.
single ended input to GND	15	18	–	kΩ	Module powered off. Measured at the ANALOG- input.
single ended input to GND	10	–	–	MΩ	Module powered on. Measured at the ANALOG- input.

TABLE 3	Bipolar DC voltage excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	12	–	Set in groups of four.
Output voltage					
operating range	0	–	5.1	V	Bi-polar excitation: 5V is 10V across the bridge.
resolution	–	1.8	–	mV	
compliance	–	–	30	mA	Per channel.
short circuit current	–	–	125	mA	
short circuit duration	∞	–	–	s	To GND.
DC error					
error	–	–	0.3	%FSR	With a constant 350Ω load.
noise (KAD/ADC/118/10V)	–	–	0.5	mV_{rms}	As measured on analog input.
noise (KAD/ADC/118/1V)	–	–	0.05	mV_{rms}	As measured on analog input.
noise (KAD/ADC/118/100M)	–	–	0.01	mV_{rms}	As measured on analog input.
Output resistance	–	0.6	–	Ω	

TABLE 4	Bridge adjust DC current outputs[1]				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	12	–	Internally connected with corresponding ANALOG(x)- input.
Output current					
operating range	-71	–	71	µA	
resolution	–	560	–	nA	
DC error					
error	–	–	2	%FSR	With a constant 175Ω load. The impact of this error on the channel reading in a 350Ω full-bridge configuration is less than 0.01%FSR (200 times lower than the error specified here).
drift	–	–	0.15	%FSR	Over temperature.
noise (KAD/ADC/118/10V)	–	–	0.5	mV_{rms}	As measured on analog input.
noise (KAD/ADC/118/1V)	–	–	0.05	mV_{rms}	As measured on analog input.
noise (KAD/ADC/118/100M)	–	–	0.01	mV_{rms}	As measured on analog input.
Output resistance	–	34.8	–	kΩ	

1. The adjust line is permanently connected to ANALOG(x)- input. The line is intended for balancing strain gages, so the module should not be used for asymmetric bridge transducers such as accelerometers or pressure transducers unless sensor re-calibration is carried out on a channel-by-channel basis.

Setting up the KAD/ADC/118

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/118/10V	KAD/ADC/118/10V	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
Analog(11:0) Analog Input	-	-	-
Settings	-	-	-
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.
Excitation Amplitude	0 to 5.1	5	Required excitation (in V) for the top of the bridge. Excitation is bipolar so entering 5V means 10V across the bridge.
Balance.Type	CurrentShunt	CurrentShunt	Specifies the balance type to be carried out on the bridge.
Balance.Applied	-71e-6 to 71e-6	0	Shunt current (in A) applied to the bridge.
Balance.BalanceThisTime	True False	False	Specifies if balancing should be carried out this time by software.
Balance.Tolerance	0.01 to 99.99	0.1	Specifies acceptable tolerance of achieved value vs. target value, expressed as percentage of defined input range.
Balance.Target	-10 to 10	0	Specifies a value. that the channel should be balanced to.
ShuntCurrent.Applied	-71e-6 to 71e-6	0	Shunt mode current (in A) added to the bridge

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Analog(11:0) Parameters				
Analog Analog signal data	Volt	OffsetBinary	16	R[15:0]

Configurable parameters

Analog(11:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-10 to 10	10	Range maximum for analog channel
Range Minimum	-10 to 10	-10	Range minimum for analog channel

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/118

Wiring configurations

The following figures show possible wiring configurations for the KADADC/118.

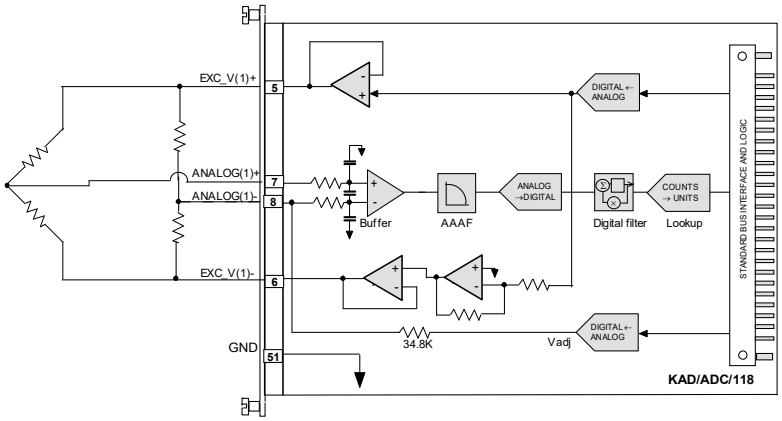


Figure 2: Second of 12 half-bridge channels with matched pair completion resistors

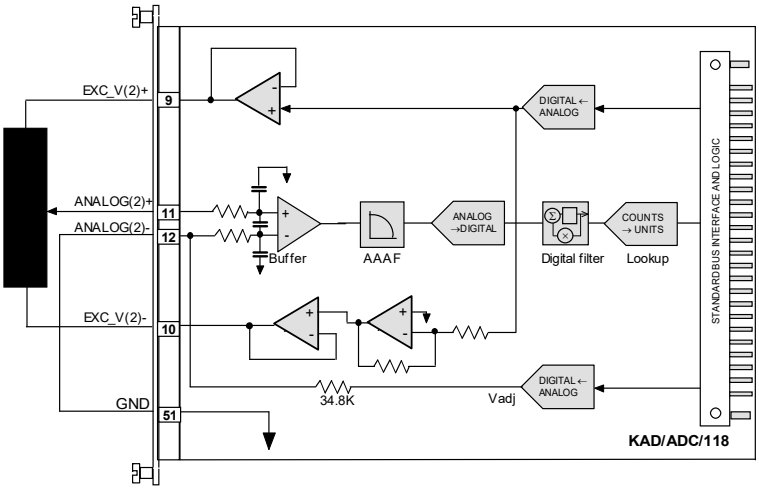


Figure 3: Third of 12 potentiometer channels

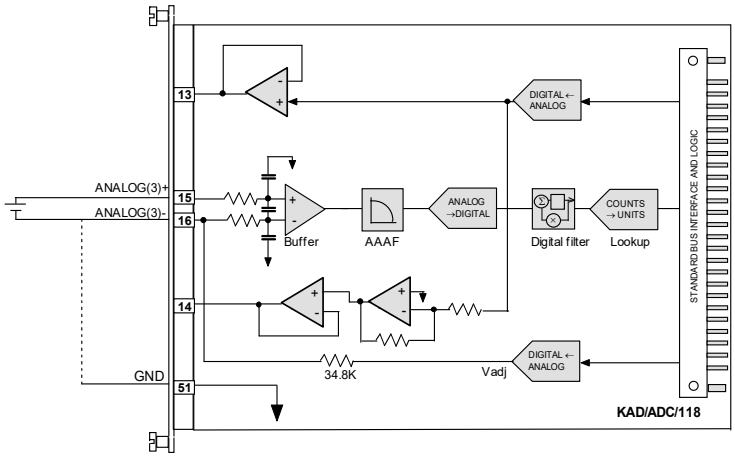


Figure 4: Fourth of 12 differential ended channels

Bias current return path

As shown in Figure 4 on page 304, the analog inputs can be used as differential inputs (that is, not from a bridge). In this case, if the signal source is isolated with respect to the Acra KAM-500 (for example a battery), a common-mode resistance between the negative input and ground (GND) should be used to provide a return for bias currents and reduce common-mode noise pick-up. Because the bias currents are in the order of nAs resistors up to 10kΩ can be used. In most cases a short (0Ω) is recommended.

NOTE: When analog inputs are used as differential inputs, setting the excitation and balance to zero reduces quiescent currents of the module.

Excitation setup

Excitation can contribute error to the overall measurement, so it is recommended to use as close as possible to full-scale excitation, to minimize the percentage error.

For optimal accuracy ensure each channel uses its corresponding excitation. If the excitation is not used, it should be set to the minimum value.

Excitation drift on potentiometer configurations

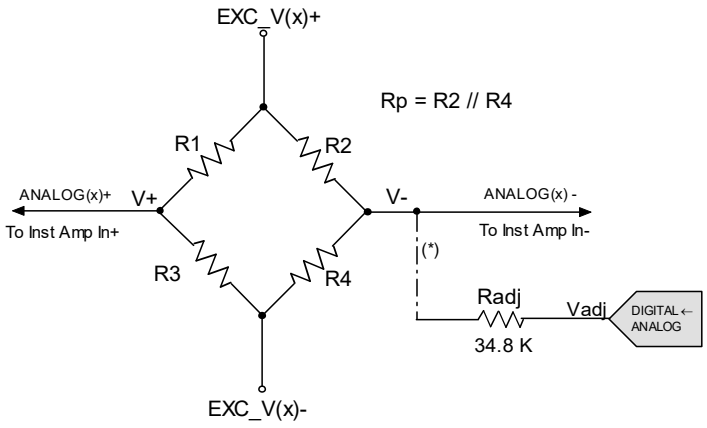
We recommend a full-bridge input configuration for the KAD/ADC/118. With this configuration the differential input amplifier removes common mode voltage or common mode pickup noise on the input lines.

For potentiometer circuits where the negative input is tied to ground, excitation drift can have a direct impact on the input signal either as a gain or an offset error. Note that excitation can drift up to 0.3% on an FSR of 5.1V. In the case where both excitation lines drift in the same direction an offset error is seen in the measurement. The worst case possible offset is 0.3% of 5.1V and results in a worst case 15.3mV offset of the measurement. This does not happen with full-bridge configurations.

We recommend that the negative input is tied to ground as shown in Figure 3 on page 304. If the negative input is floating, the drift of the digital/analog converter related to the balancing input directly adds further offset error to the measurement.

Source load error caused by the balance adjust circuit

The balance circuit has an impedance of R_{ADJ} and is connected to the ANALOG(x)- input of the module. This connection is performed internally on the module. In some bridge configurations, R_{ADJ} loads the source signal causing a quantifiable error. An example schematic for a full-bridge configuration loaded with balance resistance is shown in the following figure.



(*) Connection betw een V- and Radj is internal or external depending on module

Figure 5: Full-bridge configuration loaded with balance resistance

The DC error specification is checked as a differential input, so it does not include loading by R_{ADJ} which causes an additional gain error.

In the previous figure, the gain error only occurs when the active leg of the bridge is connected to ANALOG(x)-. In this situation,

ANALOG(x)- is loaded by R_{ADJ}, forming a resistor divider with the resistance of bridge visible from the ANALOG(x)- input.

The gain error on ANALOG(x)- input can be quantified as follows:

$$Error = -\left(\frac{R_P}{R_P + R_{adj}}\right) \times 100\%$$

where $R_P = R_2$ in parallel with R_4

This additional gain error depends on the resistance of the bridge and can be typically -0.5% for a 350Ω bridge with its active leg connected to ANALOG(x)-, and -0.172% for a 120Ω bridge.

In the case of a full-bridge with two active legs, only one leg of the bridge is affected. Therefore the gain error of voltage across the bridge is half of the above quoted figures, that is, -0.25% for a 350Ω bridge.

For a symmetrical input range, the error can be expressed as %FSR error by further dividing the value by two, yielding to ±0.125% FSR for a 350Ω bridge.

Note that the gain error due to R_{ADJ} does not apply when:

- using a wheatstone bridge with the active elements (typically strain gages) placed only on the leg of the bridge connected to ANALOG(x)+
- the leg of the bridge connected to ANALOG(x)- is populated with completion resistors (half-bridge with completion resistors)
- using only differential ended inputs with signal source isolated from module ground
- using only inputs in single ended configuration, connecting the signal to ANALOG(x)+ (ANALOG(x)- must be connected to ground). This data sheet shows an example potentiometer application, which is not affected by this gain error.

Modules with R_{ADJ} connected externally might show this additional gain error offset but only if the balance adjust circuit is used and in the cases stated previously.

NOTE: Gain error can be compensated at post processing, as the nominal resistance of the bridge is known.

Compensation for lead resistance

In bridge applications, if the lead resistance can be measured or estimated, add the voltage drop across the leads to the excitation voltage. For example, for each 0.5Ω lead in a 350Ω full-bridge, where ±2.5V (5V) is desired across the bridge, the excitation should be set to 2.5V + (0.5 × 5 / 350) = 2.507.

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate will always be sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. Figure 6 on page 307 shows a delay for an 8^{th} order filter where f_c = 1kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by 1kHz/ f_c. The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by 1kHz/ f_c. For example, an 8^{th} order Butterworth filter with an f_c of 1kHz delays a 1kHz signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

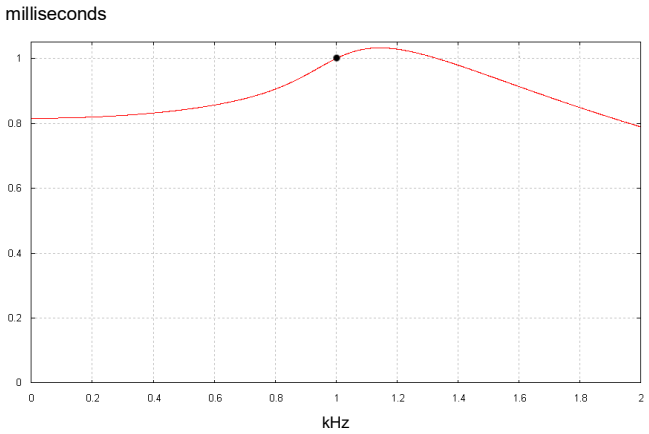


Figure 6: Filter delay for 8th order Butterworth filter where f_c = 1kHz

The filter delay for the KADADC/118 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_A (analog filter delay) ≈ 0

T_D is the filter delay

Connector pinout of the KAD/ADC/118

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	EXC_V(0)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 0
2	EXC_V(0)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 0
3	ANALOG(0)+	Differential ended analog inputs	Analog input
4	ANALOG(0)-	Differential ended analog inputs/Bridge adjust DC current outputs	Analog input
5	EXC_V(1)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 1
6	EXC_V(1)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 1
7	ANALOG(1)+	Differential ended analog inputs	Analog input
8	ANALOG(1)-	Differential ended analog inputs/Bridge adjust DC current outputs	Analog input
9	EXC_V(2)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 2
10	EXC_V(2)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 2
11	ANALOG(2)+	Differential ended analog inputs	Analog input
12	ANALOG(2)-	Differential ended analog inputs/Bridge adjust DC current outputs	Analog input
13	EXC_V(3)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 3
14	EXC_V(3)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 3
15	ANALOG(3)+	Differential ended analog inputs	Analog input
16	ANALOG(3)-	Differential ended analog inputs/Bridge adjust DC current outputs	Analog input
17	GND	Internal ground	
18	GND	Internal ground	
19	EXC_V(4)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 4
20	EXC_V(4)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 4
21	ANALOG(4)+	Differential ended analog inputs	Analog input
22	ANALOG(4)-	Differential ended analog inputs/Bridge adjust DC current outputs	Analog input
23	EXC_V(5)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 5
24	EXC_V(5)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 5
25	ANALOG(5)+	Differential ended analog inputs	Analog input
26	ANALOG(5)-	Differential ended analog inputs/Bridge adjust DC current outputs	Analog input
27	EXC_V(6)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 6
28	EXC_V(6)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 6
29	ANALOG(6)+	Differential ended analog inputs	Analog input
30	ANALOG(6)-	Differential ended analog inputs/Bridge adjust DC current outputs	Analog input
31	EXC_V(7)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 7
32	EXC_V(7)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 7
33	ANALOG(7)+	Differential ended analog inputs	Analog input
34	ANALOG(7)-	Differential ended analog inputs/Bridge adjust DC current outputs	Analog input
35	EXC_V(11)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 11
36	EXC_V(8)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 8
37	EXC_V(8)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 8
38	ANALOG(8)+	Differential ended analog inputs	Analog input
39	ANALOG(8)-	Differential ended analog inputs/Bridge adjust DC current outputs	Analog input
40	EXC_V(9)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 9
41	EXC_V(9)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 9
42	ANALOG(9)+	Differential ended analog inputs	Analog input
43	ANALOG(9)-	Differential ended analog inputs/Bridge adjust DC current outputs	Analog input
44	EXC_V(10)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 10
45	EXC_V(10)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 10
46	ANALOG(10)+	Differential ended analog inputs	Analog input
47	ANALOG(10)-	Differential ended analog inputs/Bridge adjust DC current outputs	Analog input
48	EXC_V(11)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 11
49	ANALOG(11)+	Differential ended analog inputs	Analog input
50	ANALOG(11)-	Differential ended analog inputs/Bridge adjust DC current outputs	Analog input
51	GND	Internal ground	
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/118/10V	Full-bridge ADC (voltage excitation, 3kHz b/w, ±10V) - 12ch at 12ksps (with 52-way double-density connector)
KAD/ADC/118/1V	Full-bridge ADC (voltage excitation, 3kHz b/w, ±1V) - 12ch at 12ksps (with 52-way double-density connector)
KAD/ADC/118/100M	Full-bridge ADC (voltage excitation, 3kHz b/w, ±100mV) - 12ch at 12ksps (with 52-way double-density connector)
KAM/ADC/118/10V	Full-bridge ADC (voltage excitation, 3kHz b/w, ±10V) - 12ch at 12ksps (with 51-way micro-miniature connector)
KAM/ADC/118/1V	Full-bridge ADC (voltage excitation, 3kHz b/w, ±1V) - 12ch at 12ksps (with 51-way double-density connector)
KAM/ADC/118/100M	Full-bridge ADC (voltage excitation, 3kHz b/w, ±100mV) - 12ch at 12ksps (with 51-way double-density connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; or ACC/CON/008/04 for KAM modules), is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/ADC/118 refers to both the KAD and KAM version of the module. The KAD/ADC/118 uses power from the +7V for excitation and therefore can not be used with KAM/CHS/04L, KAM/CHS/02F, KAM/CHS/03F, or KAM/CHS/05F. If the maximum excitation current is drawn from each channel, then the maximum number of KAD/ADC/118s per chassis is limited to five.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/118/10V	KAD/ADC/118 with ±10V input range	Recommended for new programs
KAD/ADC/118/100M	KAD/ADC/118 with ±100mV input range	Recommended for new programs
KAD/ADC/118/1V	KAD/ADC/118 with ±1V input range	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

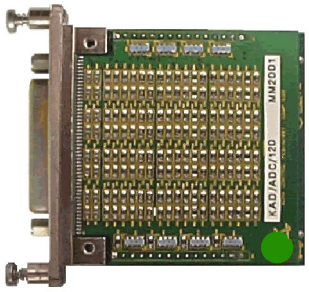
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/001	Strain gages and ideal bridges
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ADC/120

Full-bridge ADC (voltage excitation, 3kHz b/w) - 12ch at 12ksps



Key Features

- 12 full or ½-bridge, potentiometer or differential ended input channels
- Ordering input range (±100mV, ±1V, ±10V)
- High accuracy (max. 0.12% FSR at unity gain)
- Programmable voltage excitation per group of three channels
- High impedance (>10MΩ/50kΩ) when on/off
- Shorts only affect channels sharing excitation
- 16-bit simultaneous sampling on each channel

Applications

- Strain gage measurement
- Differential voltage measurement

Overview

The KAD/ADC/120 is used to condition and digitize up to twelve differential ended analog channels.

At the heart of the KAD/ADC/120 is a hard-wired state-machine that over-samples all channels at a rate between 48ksps and 96ksps and digitally filters any noise above the user-programmable cutoff frequency.

This is achieved using cascaded, half-band, Finite-Impulse-Response (FIR) filters followed by an 8th order Butterworth Infinite-Impulse-Response (IIR) filter with a default cutoff point set at one quarter of the sampling frequency ($f_c = f_s / 4$).

All signals are sampled simultaneously. Thus, when several channels are sampled at different sampling rates, at the start of an acquisition cycle all channels are aligned.

The KAD/ADC/120 is similar to the KAD/ADC/118 but does not support channel balancing. The KAD/ADC/120 is available with three different input ranges (±10V, ±1V, ±100mV). The input range must be specified when ordering.

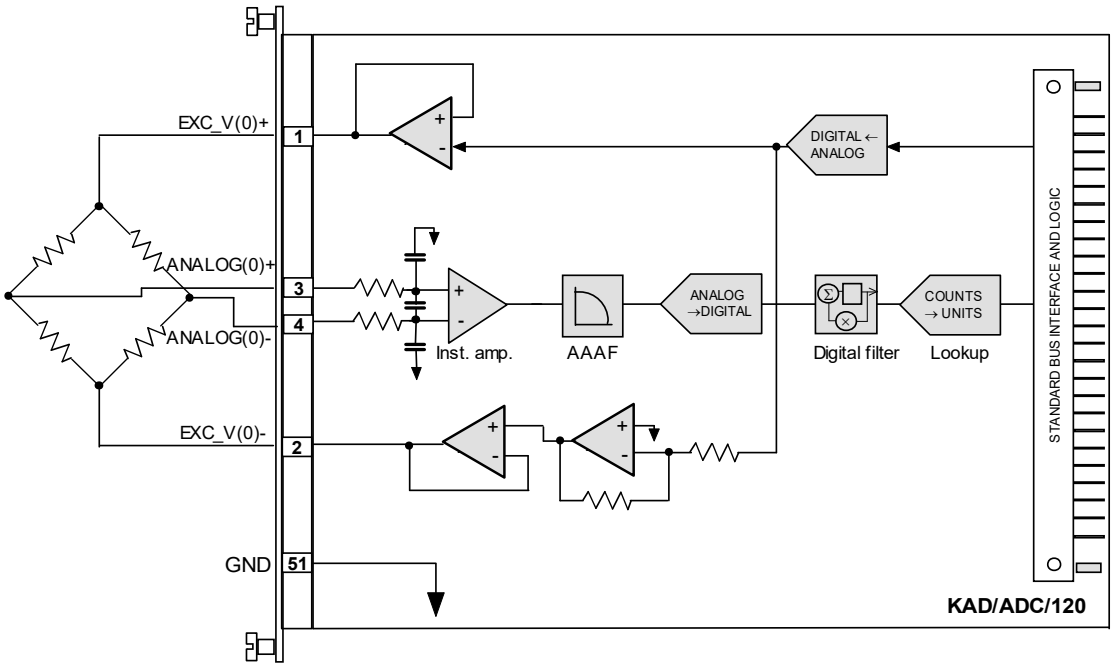


Figure 1: First of 12 channels on the KAD/ADC/120

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	95	–	g	
	–	3.35	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	100	–	160	mA	
±7V	40	–	60	mA	Excludes current used by excitation.
+12V	30	–	50	mA	
-12V	20	–	30	mA	
total power	1.66	–	2.6	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Differential ended analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	12	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG[11:0]	2	–	12000	sps	
Input voltage					
operating range (KAD/ADC/120/10V)	-10	–	10	V	Primary gain = 1.
operating range (KAD/ADC/120/1V)	-1	–	1	V	Primary gain = 10.
operating range (KAD/ADC/120/100M)	-100	–	100	mV	Primary gain = 100.
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.

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TABLE 2	Differential ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
DC error					DC signal averaged over 200 samples without excitation.
gain = 1	–	–	0.12	%FSR	
gain = 2	–	–	0.2	%FSR	
gain = 4	–	–	0.3	%FSR	
gain = 8	–	–	0.5	%FSR	
Effective number of bits					
KAD/ADC/120/10V, KAD/ADC/120/1V	13.5	–	–	bits	$f_c \leq$ 1kHz and secondary gain of 1 (f_c : filter cutoff frequency). $f_c = 0.25f_s$
KAD/ADC/120/100M	11.3	–	–	bits	$f_c \leq$ 1kHz and secondary gain of 1.
Crosstalk					
KAD/ADC/120/100M, KAD/ADC/120/1V	–	–	-64	dB	
KAD/ADC/120/10V	–	–	-72	dB	
Common mode					
voltage range	-10	–	10	V	Operational voltage range.
rejection ratio	72	–	–	dB	Applies within the above common mode voltage range, $0 \leq f \leq f_c$.
Analog filter					Analog filter is Butterworth.
poles	–	–	4	–	
filter cutoff -3dB	–	6	–	kHz	
Digital filter					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 3kHz. (f_s : sampling frequency)
0.1dB bandwidth	–	0.64	–	f_c	
aliasing to 0.1dB band	–	–	-70	dB	
aliasing to f_c	–	–	-74	dB	
Filter delay	–	0.66	–	ms	Measured for $f_{in} = f_c$ = 3kHz (f_{in} : input signal frequency). See “Understanding filter delays” on page 318.
Input resistance					
between inputs	50	65	–	kΩ	Module powered off.
between inputs	10	–	–	MΩ	Module powered on.
single ended input to GND	25	30	–	kΩ	Module powered off.
single ended input to GND	10	–	–	MΩ	Module powered on.

TABLE 3	Bipolar DC voltage excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	12	–	Set in groups of four.
Output voltage					
operating range	0	–	5.1	V	Bi-polar excitation: 5V is 10V across the bridge.
resolution	–	1.8	–	mV	
compliance	–	–	30	mA	Per channel.
short circuit current	–	–	125	mA	
short circuit duration	∞	–	–	s	To GND.
DC error					
error	–	–	0.3	%FSR	With a constant 350Ω load.
noise (KAD/ADC/120/10V)	–	–	0.5	mV_{rms}	As measured on analog input.
noise (KAD/ADC/120/1V)	–	–	0.05	mV_{rms}	As measured on analog input.
noise (KAD/ADC/120/100M)	–	–	0.01	mV_{rms}	As measured on analog input.
Output resistance	–	0.6	–	Ω	

Setting up the KAD/ADC/120

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/120/10V	KAD/ADC/120/10V	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
Analog(11:0) Analog Input	-	-	-
Settings	-	-	-
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.
Excitation Amplitude	0 to 5.1	5	Required excitation (in V) for the top of the bridge. Excitation is bipolar so entering 5V means 10V across the bridge.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Analog(11:0) Parameters				
Analog Analog signal data	Volt	OffsetBinary	16	R[15:0]

Configurable parameters

Analog(11:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-10 to 10	10	Range maximum for analog channel
Range Minimum	-10 to 10	-10	Range minimum for analog channel

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/120

Wiring configurations

Figures 2 to 4 show possible wiring configurations for the KAD/ADC/120.

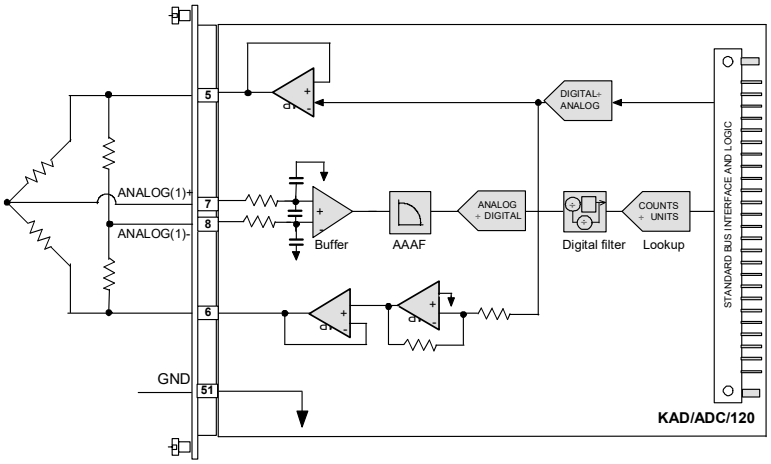


Figure 2: Second of 12 half-bridge channels with matches pair completion resistors

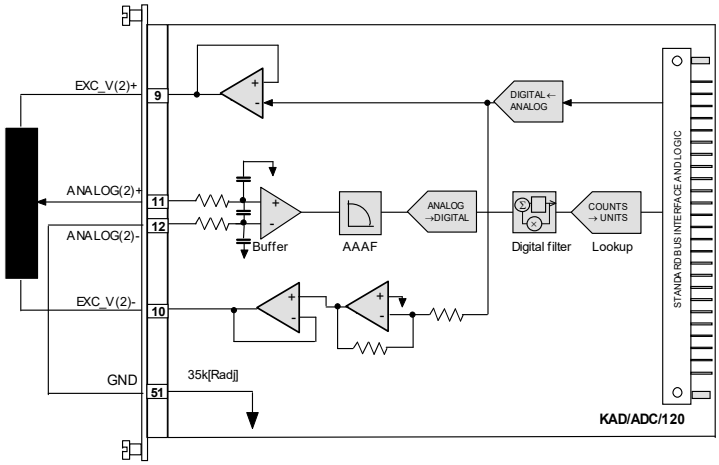


Figure 3: Third of 12 potentiometer channels

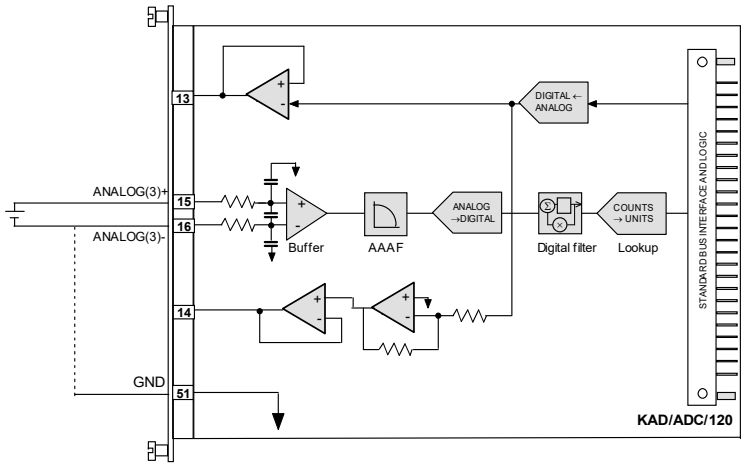


Figure 4: Fourth of 12 differential-ended channels

Bias current return path

As shown in Figure 4 on page 317, the analog inputs can be used as differential inputs (that is, not from a bridge). In this case, if the signal source is isolated with respect to the Acra KAM-500 (for example a battery), a common-mode resistance between the negative input and ground (GND) should be used to provide a return for bias currents and reduce common-mode noise pick-up. Because the bias currents are in the order of nAs resistors up to 10kΩ can be used. In most cases a short (0Ω) is recommended.

NOTE: When analog inputs are used as differential inputs, setting the excitation to zero reduces quiescent currents of the module.

Excitation setup

Excitation can contribute error to the overall measurement, so it is recommended to use as close as possible to full-scale excitation, to minimize the percentage error.

For optimal accuracy ensure each channel uses its corresponding excitation. If the excitation is not used, it should be set to the minimum value.

Compensation for lead resistance

In bridge applications, if the lead resistance can be measured or estimated, add the voltage drop across the leads to the excitation voltage. For example, for each 0.5Ω lead in a 350Ω full-bridge, where ±2.5V (5V) is desired across the bridge, the excitation should be set to 5V + (0.5 x 5 / 350) = ±2.507.

NOTE: When Excitation Mode is set to Current, the leads resistance does not need to be compensated for.

Excitation drift on potentiometer configurations

We recommend a full-bridge input configuration for the KAD/ADC/120. With this configuration the differential input amplifier removes common mode voltage or common mode pickup noise on the input lines.

For potentiometer circuits where the negative input is tied to ground, excitation drift can have a direct impact on the input signal either as a gain or an offset error. Note that excitation can drift up to 0.3% on an FSR of 5.1V. In the case where both excitation lines drift in the same direction an offset error is seen in the measurement. The worst case possible offset is 0.3% of 5.1V and results in a worst case 15.3mV offset of the measurement. This does not happen with full-bridge configurations. We recommend that the negative input is tied to ground as shown in Figure 3 on page 316.

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate are always sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. Figure 5 on page 318 shows a delay for an 8^{th} order filter where f_c = 1kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1kHz / f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1kHz / f_c). For example, an 8^{th} order Butterworth filter with an f_c of 1kHz delays a 1kHz signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

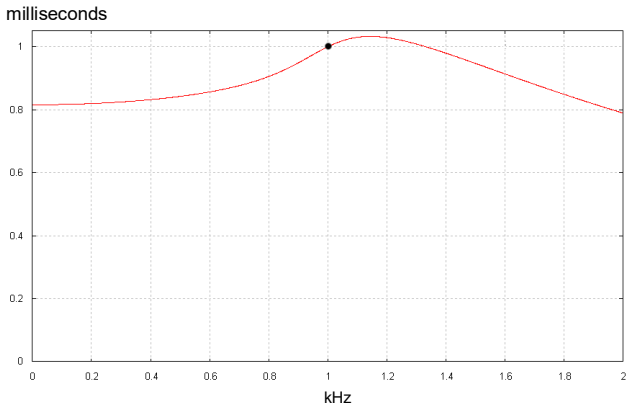


Figure 5: Filter delay for 8^{th} order Butterworth filter where f_c = 1kHz

The filter delay for the KAD/ADC/120 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_D is the filter delay

T_A (analog filter delay) ≈ 0

Connector pinout of the KAD/ADC/120

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	EXC_V(0)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 0
2	EXC_V(0)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 0
3	ANALOG(0)+	Differential ended analog inputs	Analog input
4	ANALOG(0)-	Differential ended analog inputs	Analog input
5	EXC_V(1)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 1
6	EXC_V(1)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 1
7	ANALOG(1)+	Differential ended analog inputs	Analog input
8	ANALOG(1)-	Differential ended analog inputs	Analog input
9	EXC_V(2)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 2
10	EXC_V(2)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 2
11	ANALOG(2)+	Differential ended analog inputs	Analog input
12	ANALOG(2)-	Differential ended analog inputs	Analog input
13	EXC_V(3)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 3
14	EXC_V(3)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 3
15	ANALOG(3)+	Differential ended analog inputs	Analog input
16	ANALOG(3)-	Differential ended analog inputs	Analog input
17	GND	Internal ground	
18	GND	Internal ground	
19	EXC_V(4)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 4
20	EXC_V(4)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 4
21	ANALOG(4)+	Differential ended analog inputs	Analog input
22	ANALOG(4)-	Differential ended analog inputs	Analog input
23	EXC_V(5)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 5
24	EXC_V(5)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 5
25	ANALOG(5)+	Differential ended analog inputs	Analog input
26	ANALOG(5)-	Differential ended analog inputs	Analog input
27	EXC_V(6)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 6
28	EXC_V(6)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 6
29	ANALOG(6)+	Differential ended analog inputs	Analog input
30	ANALOG(6)-	Differential ended analog inputs	Analog input
31	EXC_V(7)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 7
32	EXC_V(7)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 7
33	ANALOG(7)+	Differential ended analog inputs	Analog input
34	ANALOG(7)-	Differential ended analog inputs	Analog input
35	EXC_V(11)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 11
36	EXC_V(8)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 8
37	EXC_V(8)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 8
38	ANALOG(8)+	Differential ended analog inputs	Analog input
39	ANALOG(8)-	Differential ended analog inputs	Analog input
40	EXC_V(9)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 9
41	EXC_V(9)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 9
42	ANALOG(9)+	Differential ended analog inputs	Analog input
43	ANALOG(9)-	Differential ended analog inputs	Analog input
44	EXC_V(10)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 10
45	EXC_V(10)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 10
46	ANALOG(10)+	Differential ended analog inputs	Analog input
47	ANALOG(10)-	Differential ended analog inputs	Analog input
48	EXC_V(11)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 11
49	ANALOG(11)+	Differential ended analog inputs	Analog input
50	ANALOG(11)-	Differential ended analog inputs	Analog input
51	GND	Internal ground	
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/120/10V	Full-bridge ADC (voltage excitation, 3kHz b/w, ±10V) - 12ch at 12ksps (52-way double-density connector)
KAD/ADC/120/1V	Full-bridge ADC (voltage excitation, 3kHz b/w, ±1V) - 12ch at 12ksps (52-way double-density connector)
KAD/ADC/120/100M	Full-bridge ADC (voltage excitation, 3kHz b/w, ±100mV) - 12ch at 12ksps (52-way double-density connector)
KAM/ADC/120/10V	Full-bridge ADC (voltage excitation, 3kHz b/w, ±10V) - 12ch at 12ksps (51-way micro-miniature connector)
KAM/ADC/120/1V	Full-bridge ADC (voltage excitation, 3kHz b/w, ±1V) - 12ch at 12ksps (51-way micro-miniature connector)
KAM/ADC/120/100M	Full-bridge ADC (voltage excitation, 3kHz b/w, ±100mV) - 12ch at 12ksps (51-way micro-miniature connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; or ACC/CON/008/04 for KAM modules), is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/ADC/120 refers to both the KAD and KAM version of the module.

The KAD/ADC/120 uses power from the +7V power line for excitation and therefore can not be used with KAM/CHS/04L, KAM/CHS/05F or KAM/CHS/3F. If the maximum excitation current is drawn from each channel, then the maximum number of KAD/ADC/120s per chassis is limited to four.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/120	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

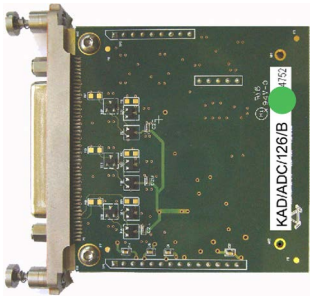
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/001	Strain gages and ideal bridges
TEC/NOT/016	Power dissipation
TEC/NOT/019	An introduction to digital filtering
TEC/NOT/049	Power estimation

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ADC/126

Accelerometer ADC (current excitation, programmable analog gain, 25kHz b/w) - 4ch at 100ksps

CURTISSWRIGHTDS.COM



Key Features

- Four accelerometer input channels with DC-reject
- Programmable input range (±1V, ±10V)
- High accuracy (gain error of 0.1% FSR typical at 10kHz)
- Constant current source excitation on each channel (3.6mA typical)
- Short on any channel does not affect others
- 16-bit simultaneous sampling on each channel

Applications

- Accelerometer signal conditioning and digitalization
- Suitable for ICP©, Isotron©, Piezotron© and Deltatron© sensors

Overview

The KAD/ADC/126 is used to condition and digitize up to four single ended analog channels. All of these channels have a constant current source and high-pass (DC-reject) filter for use with integrated charge-amp piezoelectric (ICP) accelerometer devices.

At the heart of the KAD/ADC/126 is a hard-wired state machine that over-samples all channels at a rate between 200ksps and 400ksps and digitally filters any noise above the user-programmable cutoff frequency.

This is achieved using cascaded, half-band, Finite-Impulse-Response (FIR) filters followed by an 8th order Butterworth IIR filter with a default cutoff point set at one quarter of the sampling frequency ($f_c = f_s / 4$).

All signals are sampled simultaneously (isochronously). Thus, when several channels are sampled at different sampling rates, at the start of an acquisition cycle all channels are aligned.

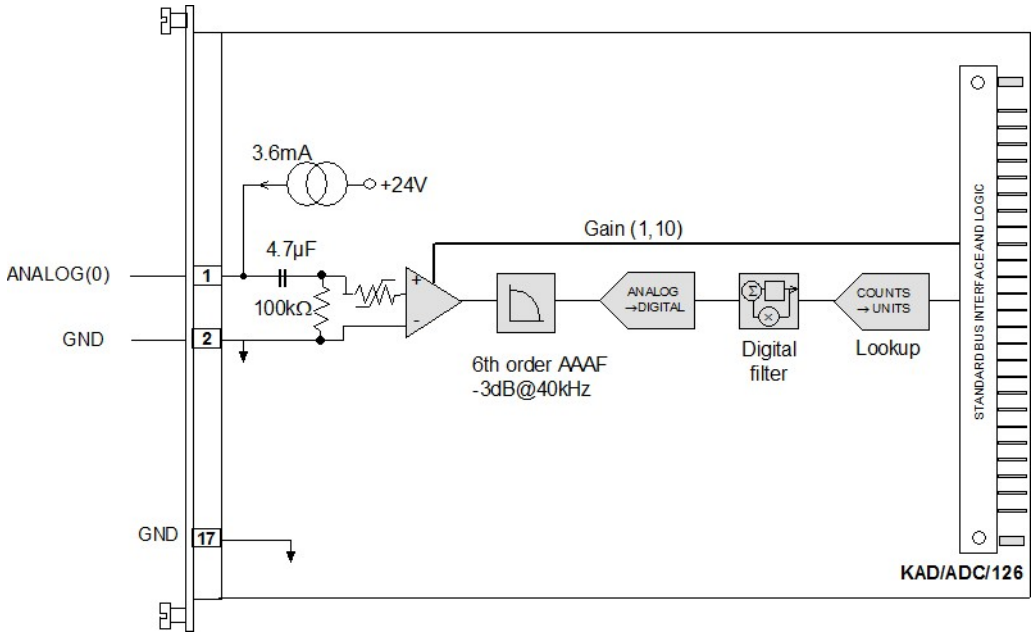


Figure 1: First of four accelerometer channels and first D/E channel on the KAD/ADC/126

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	90	–	g	
	–	3.18	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	120	–	215	mA	
±7V	0	–	0	mA	
+12V	65	–	95	mA	Excludes current used by excitation. As a DC/DC converter is used, multiply excitation current by 1.5 to calculate +12V line current.
-12V	50	–	75	mA	Excludes current used by excitation. As a DC/DC converter is used, multiply excitation current by 1.5 to calculate -12V line current.
total power	1.98	–	3.12	W	
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	AC analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	4	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½...2, 4).
ANALOG[3:0]	2	–	100,000	sps	
Input voltage					
operating range (G_p = 1)	-10	–	10	V	Primary gain=1
operating range (G_p = 10)	-1	–	1	V	Primary gain=10
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.
AC gain error					
Primary gain = 1, 10	–	0.02	0.1	%FSR	For 10Hz < f_{in} ≤ 3kHz, f_s = 100kHz, f_c = F_s / 4 (f_{in} : input signal frequency ; f_s : sampling frequency ; f_c : filter cutoff frequency)

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TABLE 2	AC analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Primary gain = 1, 10	–	0.1	0.4	%FSR	For 3kHz < f_{in} ≤ 10kHz, f_s = 100kHz, $f_c = F_s/4$
Primary gain = 1, 10	–	0.35	0.95	%FSR	For 10kHz < f_{in} ≤ 15kHz, f_s = 100kHz, $f_c = F_s/4$
Effective number of bits					
gain = 1, 10	12	13.5	–	bits	f_{in} ≤ 25kHz and secondary gain of 1
Crosstalk					
gain=1, 10	–	-96	-90	dB	f_{in}≤ 25kHz and secondary gain of 1
Analog filter					Analog filter is Butterworth.
High pass filter					
poles	–	–	1	–	
filter cutoff -3dB	0.28	0.33	0.38	Hz	
Anti aliasing filter					
poles	–	–	6		
filter cutoff -3dB	38	40	42	kHz	
Digital filter					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 25kHz (f_s: sampling frequency).
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-80	dB	
aliasing to f_c	–	–	-80	dB	
Filter delay	–	200	–	µs	Where $f_{in} = f_c$ = 10kHz.
Input impedance					
each input to GND	–	100	–	kΩ	Module powered off (measured at 3kHz).
each input to GND	–	65	–	kΩ	Module powered on (measured at 3kHz).

TABLE 3	Single ended DC current excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	4	–	Applied per channel. Connected internally with ANALOG(x) inputs
Output current					
operating range	–	3.6	–	mA	
compliance	0	–	24	V	
short circuit current	–	–	4.9	mA	
short circuit duration	∞	–	–	s	
DC error					
error	–	–	1.3	mA	With a constant 2.2kΩ load.
noise	–	3	–	mV_{rms}	As measured on analog input.

Setting up the KAD/ADC/126

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/126/B	KAD/ADC/126/B	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
Acceleration(3:0) Analog Input	-	-	Settings for this channel.
Settings	-	-	-
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Acceleration(3:0) Parameters				
Acceleration Acceleration signal data.	Volt	OffsetBinary	16	R[15:0]

Configurable parameters

Acceleration(3:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-10 to 10	10	-
Range Minimum	-10 to 10	-10	-

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/126

Signal return path

Each channel is single ended so a return (GND) for the constant current must be provided. Return path effects are minimized if a ground pin on the module is used. These channels are band-pass filtered (that is, the DC component is also removed) so that when a sensor is first connected or powered, it takes about 60 seconds to settle.

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate will always be sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. The following figure shows a delay for an 8th order filter where f_c = 1kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1kHz / f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1kHz / f_c). For example, an 8th order Butterworth filter with an f_c of 1kHz delays a 1kHz signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

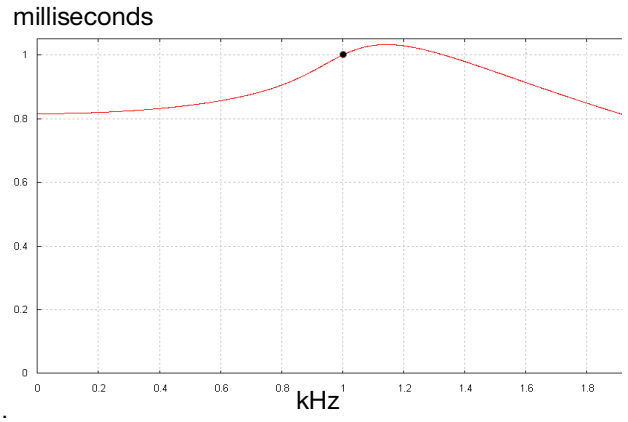


Figure 2: Filter delay for 8th order Butterworth filter where f_c = 1kHz

The filter delay for the KAD/ADC/126 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_A (analog filter delay) ≈ 0

T_D is the filter delay

Additional delay sources

Primary gains higher than 1 cause an additional delay from 1st order filters in the instrumentation amplifier. That additional delay is 2µs for a gain of 10, 15µs for a gain of 100, and 150µs for a gain of 1,000. In applications where time correlation is more important than suppression of aliasing, set the same cutoff point on all channels, even if the sampling rates are different.

Connector pinout of the KAD/ADC/126

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	ANALOG(0)	AC analog inputs	Constant current output
2	GND	Internal ground	
3	ANALOG(1)	AC analog inputs	Constant current output
4	GND	Internal ground	
5	ANALOG(2)	AC analog inputs	Constant current output
6	GND	Internal ground	
7	ANALOG(3)	AC analog inputs	Constant current output
8	GND	Internal ground	
9	DNC		Do not connect
10	GND	Internal ground	
11	DNC		Do not connect
12	GND	Internal ground	
13	DNC		Do not connect
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	GND	Internal ground	
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/126/B	Accelerometer ADC (current excitation, programmable analog gain, 25kHz b/w) - 4ch at 100ksps (with 52-way double-density connector)
KAM/ADC/126/B	Accelerometer ADC (current excitation, programmable analog gain, 25kHz b/w) - 4ch at 100ksps (with 51-way micro-miniature connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; or ACC/CON/008/04 for KAM modules), is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/ADC/126 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/126/B	Corrected an issue with signal distortion in slave chassis, or in chassis externally receiving X_Sync signals, or in chassis containing a KAD/BCU/105 receiving IEEE 1588 PTP	Recommended for new programs
KAD/ADC/126	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

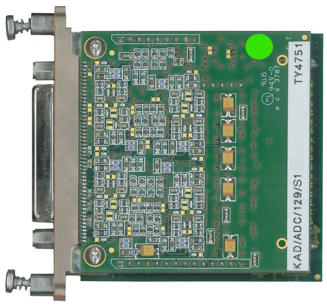
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ADC/129/S1

Full-bridge ADC (voltage excitation, programmable analog gain, 25kHz b/w) - 4ch at 100ksps

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Key Features

- Four full or ½-bridge, potentiometer or differential ended input channels
- Programmable input range (±10mV to ±10V)
- High accuracy (0.02% FSR typical for range of ±1V and ±10V)
- Programmable voltage excitation with balance per channel
- High input resistance (>10MΩ) when on/off
- Short on any channel does not affect others
- 16-bit simultaneous sampling on each channel

Applications

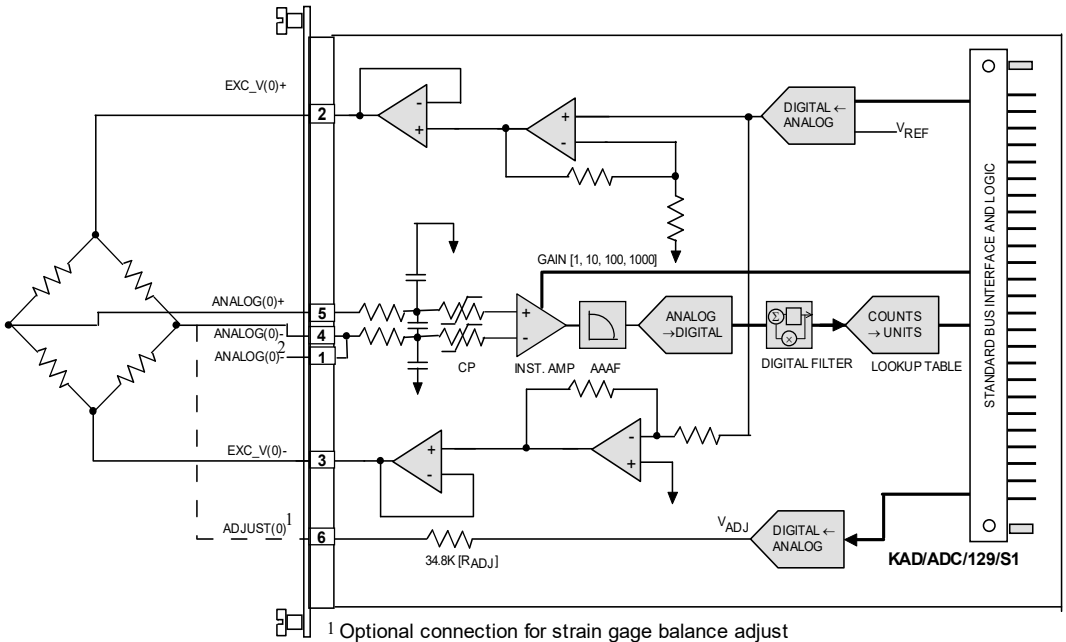
- Bridge sensors and strain gage measurement
- Differential voltage measurement

Overview

The KAD/ADC/129/S1 provides independent excitation for up to four channels. Each channel has a separate programmable amplifier, programmable filter and 16-bit A/D converter.

At the heart of the KAD/ADC/129/S1 is a hard-wired state-machine that over-samples all channels at a rate between 200ksps and 400ksps and digitally filters any noise above the user-programmable cutoff frequency. This is achieved using cascaded, half-band, decimate by two, fifteen tap, finite-impulse-response (FIR) filters followed by an 8th order Butterworth IIR filter with a programmable cutoff point. The cutoff point default setting is a quarter of the sampling frequency.

All signals are sampled simultaneously. Thus, when several channels are sampled at different sampling rates, at the start of an acquisition cycle all channels are aligned.



1 Optional connection for strain gage balance adjust
2 Optional ANALOG(X)- connection for ease of wiring with ADJUST(X)

Figure 1: First of four channels on the KAD/ADC/129/S1

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	90	–	g	
	–	3.17	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements, see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	100	–	180	mA	
+7V	15	–	30	mA	Excludes current used by excitation.
-7V	10	–	25	mA	Excludes current used by excitation.
+12V	50	–	80	mA	
-12V	40	–	70	mA	
total power	1.75	–	3.09	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Differential ended analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	4	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG[3:0]	2	–	100,000	sps	
Input voltage					
operating range (G_p = 1)	-10	–	10	V	Primary gain = 1
operating range (G_p = 10)	-1	–	1	V	Primary gain = 10
operating range (G_p = 100)	-100	–	100	mV	Primary gain = 100
operating range (G_p = 1000)	-10	–	10	mV	Primary gain = 1000
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.

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TABLE 2	Differential ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
DC error					DC signal averaged over 200 samples without excitation.
gain = 1, 10	–	0.02	0.08	%FSR	
gain = 2, 20	–	–	0.14	%FSR	
gain = 4, 40	–	–	0.25	%FSR	
gain = 8, 80	–	–	0.44	%FSR	
gain = 100	–	0.04	0.18	%FSR	
gain = 200	–	–	0.33	%FSR	
gain = 400	–	–	0.6	%FSR	
gain = 800	–	–	1.2	%FSR	
gain = 1000	–	0.3	1.5	%FSR	
AC gain error					Note that the figures presented here include analog anti-aliasing filter and digital filter amplitude errors. For gain ≥ 1000, an additional error exists, which is caused by a much lower bandwidth of instrumentation amplifier for that gain, which is typically 60kHz (-3dB point), and has the shape of a 1st order filter.
	–	–	0.1	%FSR	For $f_{in} \leq 3kHz$, $f_s = 100kHz$, $f_c = f_s / 4$ (f_{in} : input signal frequency; f_s : sampling frequency; f_c : filter cutoff frequency)
	–	–	0.35	%FSR	For $3kHz < f_{in} \leq 10kHz$, $f_s = 100kHz$, $f_c = f_s / 4$.
	–	–	0.8	%FSR	For $10kHz < f_{in} \leq 15kHz$, $f_s = 100kHz$, $f_c = f_s / 4$.
Effective number of bits					
gain = 1, 10	12	13.5	–	bits	$f_c \leq 25kHz$ and secondary gain of 1 (f_c : filter cutoff frequency).
gain = 100	11.5	12.5	–	bits	$f_c \leq 25kHz$ and secondary gain of 1.
gain = 1000	9	10.5	–	bits	$f_c \leq 25kHz$ and secondary gain of 1.
Crosstalk					
gain = 1, 10	–	-100	-90	dB	$f_c \leq 25kHz$ and secondary gain of 1.
gain = 100	–	-90	-80		$f_c \leq 25kHz$ and secondary gain of 1.
gain = 1000	–	-80	-72	dB	$f_c \leq 25kHz$ and secondary gain of 1.
Common mode					
voltage range	-10	–	10	V	Operational voltage range.
rejection ratio	72	80	–	dB	Applies within the above common mode voltage range, $0 \leq f \leq f_c$.

TABLE 2	Differential ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Analog filter					Analog filter is Butterworth.
poles	–	–	6	–	
filter cutoff -3dB	38	40	42	kHz	
Digital filter					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 25kHz (f_s : sampling frequency).
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-80	dB	
aliasing to f_c	–	–	-80	dB	
Filter delay	–	200	–	µs	Where $f_{in} = f_c = 10kHz$ (f_{in} : input signal frequency). See “Source load error caused by the balance adjust circuit” on page 337.
Input resistance					
between inputs	10	–	–	MΩ	Whether module powered on or off.
each input to GND	10	–	–	MΩ	Whether module powered on or off.
Input impedance					
each input to GND	–	300	–	kΩ	Whether module powered on or off (measured at 3kHz).
between inputs	–	300	–	kΩ	Whether module powered on or off (measured at 3kHz).

TABLE 3	Bipolar DC voltage excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	4	–	
Output voltage					Applied per channel.
operating range	0	–	5.1	V	Bi-polar excitation: 5V is 10V across the bridge.
resolution	–	–	1.8	mV	Bi-polar excitation: 1.8mV is 3.6mV across the bridge.
compliance	–	–	30	mA	Per channel.
short circuit current	–	–	125	mA	
short circuit duration	∞	–	–	s	To GND.
DC error					
error	–	0.1	0.3	%FSR	With a constant 350Ω load.
noise (gain = 1)	–	–	0.5	mV_{rms}	As measured on analog input.
noise (gain = 10)	–	–	0.05	mV_{rms}	As measured on analog input.
noise (gain = 100, 1000)	–	–	0.01	mV_{rms}	As measured on analog input.
Output resistance	–	0.5	–	Ω	

TABLE 4	Bridge adjust DC current outputs[1]				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	4	–	
Output current					Applied per channel.
operating range	-71	–	71	µA	
resolution	–	35	–	nA	
DC error					
error	–	–	2	%FSR	With a constant 175Ω load. The impact of this error on the channel reading is less than 0.01%FSR (200 times lower than the error specified here).
drift	–	–	0.15	%FSR	Over temperature.
noise (gain = 1)	–	–	0.5	mV_{rms}	As measured on analog input.
noise (gain = 10)	–	–	0.05	mV_{rms}	As measured on analog input.
noise (gain = 100, 1000)	–	–	0.01	mV_{rms}	As measured on analog input.
Output resistance	–	34.8	–	kΩ	

1. The adjust line is intended for use in balancing strain gages and should not be used for asymmetric bridge transducers such as accelerometers or pressure transducers unless sensor re-calibration is carried out on a channel-by-channel basis.

Setting up the KAD/ADC/129/S1

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/129/S1	KAD/ADC/129/S1	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
AnalogIn(3:0) Analog Input	-	-	-
Settings	-	-	-
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.
Excitation Amplitude	0 to 5.1	0.2	Required excitation (in V) for the top of the bridge. Excitation is bipolar so entering 5V means 10V across the bridge.
Balance.Type	CurrentShunt	CurrentShunt	Specifies the balance type to be carried out on the bridge.
Balance.Applied	-71e-6 to 71e-6	0	Shunt current (in A) applied to the bridge.
Balance.BalanceThisTime	True False	False	Specifies if balancing should be carried out this time by software.
Balance.Tolerance	0.01 to 99.99	0.1	Specifies acceptable tolerance of achieved value vs. target value, expressed as percentage of defined input range.
Balance.Target	-10 to 10	0	Specifies a value. that the channel should be balanced to.
ShuntCurrent.Applied	-71e-6 to 71e-6	0	Shunt mode current (in A) added to the bridge

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
AnalogIn(3:0) Parameters				
AnalogIn Analog signal data	Volt	OffsetBinary	16	R[15:0]

Configurable parameters

AnalogIn(3:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-10 to 10	10	Range maximum for analog channel
Range Minimum	-10 to 10	-10	Range minimum for analog channel

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/129/S1

Wiring configurations

Figures 2 to 4 show possible wiring configurations for the KAD/ADC/129/S1.

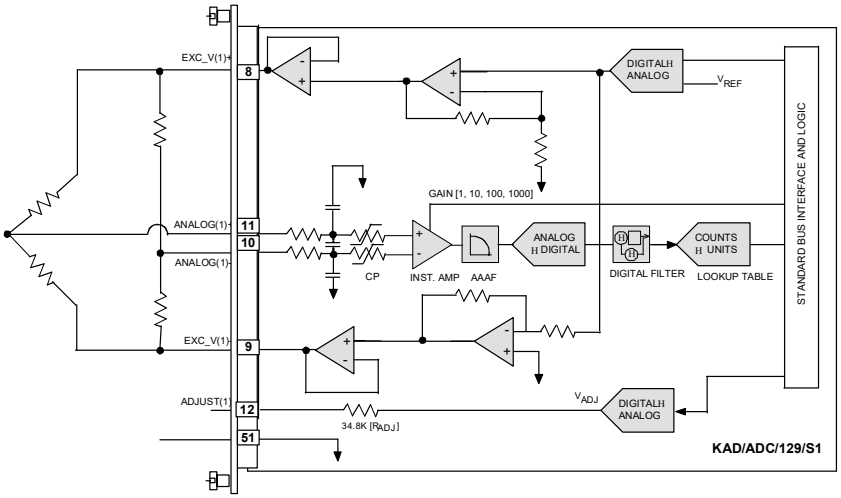


Figure 2: Second of 4 independent ½-bridge channels with matched pair completion resistors

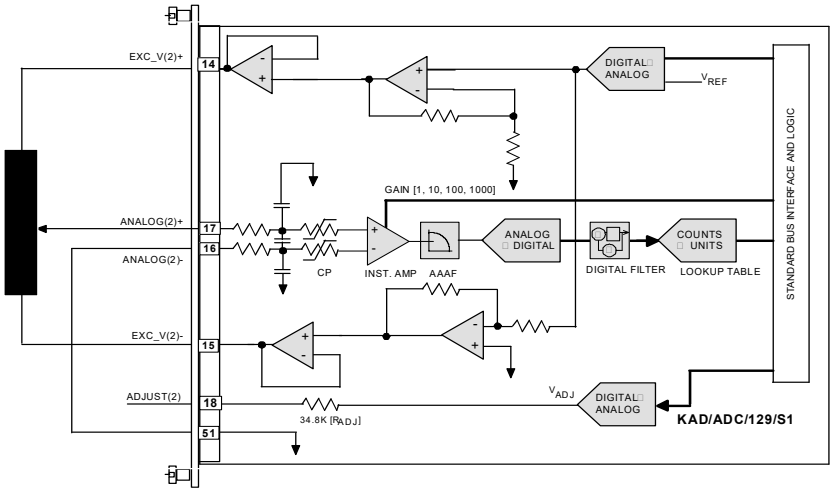


Figure 3: Third of 4 independent potentiometer channels

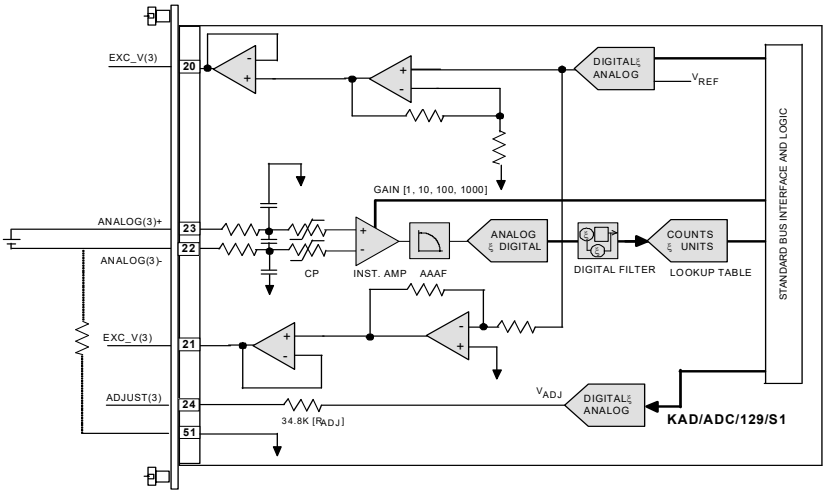


Figure 4: Fourth of 4 independent differential ended channels

Bias current return path

As shown in Figure 4 on page 336, the analog inputs can be used as differential inputs (that is, not from a bridge). In this case, if the signal source is isolated with respect to the Acra KAM-500 (for example a battery), a common-mode resistance between the negative input and ground (GND) should be used to provide a return for bias currents and reduce common-mode noise pick-up. Because the bias currents are in the order of nA, resistors up to 10kΩ can be used. In most cases a short (0Ω) is recommended.

NOTE: When analog inputs are used as differential inputs, setting the excitation and balance to zero reduces quiescent currents of the module.

Using high primary gains

For gains above 1000, the gain-bandwidth product of the amplifier reduces the bandwidth of the instrumentation amplifier to approximately 60kHz. The effect of attenuation can be seen for input signals with frequencies of 10kHz and higher.

Excitation setup

Excitation can contribute error to the overall measurement, so it is recommended to use as close as possible to full-scale excitation, to minimize the percentage error.

For optimal accuracy ensure each channel uses its corresponding excitation. If the excitation is not used, it should be set to the minimum value.

Compensation for lead resistance (Excitation Mode set to Voltage)

In bridge applications, if the lead resistance can be measured or estimated, add the voltage drop across the leads to the excitation voltage. For example, for each 0.5Ω lead in a 350Ω full-bridge, where ±2.5V (5V) is desired across the bridge, the excitation should be set to 2.5V + (0.5 × 5 / 350) = 2.507.

NOTE: When Excitation Mode is set to Current, the lead's resistance does not need to be compensated for. If sense lines are required, see the KAD/ADC/129/S2.

Excitation drift on potentiometer configurations

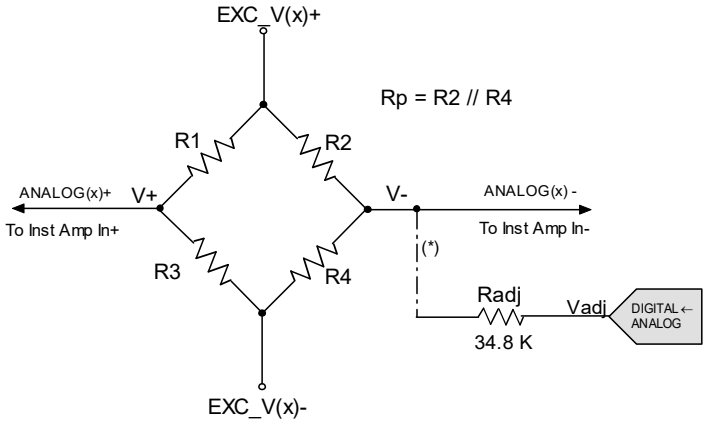
Curtiss-Wright recommends a full-bridge input configuration for the KAD/ADC/129/S1. With this configuration the differential input amplifier removes common mode voltage or common mode pickup noise on the input lines.

For potentiometer circuits where the negative input is tied to ground, excitation drift can have a direct impact on the input signal either as a gain or an offset error. Note that excitation can drift up to 0.3% on an FSR of 5.1V. In the case where both excitation

lines drift in the same direction an offset error is seen in the measurement. The worst case possible offset is 0.3% of 5.1V and results in a worst case 15.3mV offset of the measurement. This does not happen with full-bridge configurations. Curtiss-Wright recommends that the negative input is tied to ground as shown in Figure 3 on page 335.

Source load error caused by the balance adjust circuit

The balance circuit has an impedance of R_{ADJ} and is connected to the ANALOG(x)- input of the module. This connection is performed externally to the module if balance adjustment is required. In some bridge configurations, R_{ADJ} loads the source signal causing a quantifiable error. An example schematic for a full-bridge configuration loaded with balance resistance is shown in the following figure.



(*) Connection betw een V- and Radj is internal or external depending on module

Figure 5: Full-bridge configuration loaded with balance resistance

The DC error specification is checked as a differential input, so it does not include loading by R_{ADJ} which causes an additional gain error.

In the previous figure, the gain error only occurs when the active leg of the bridge is connected to ANALOG(x)-. In this situation, ANALOG(x)- is loaded by R_{ADJ}, forming a resistor divider with the resistance of bridge visible from the ANALOG(x)- input.

The gain error on ANALOG(x)- input can be quantified as follows:

$$Error = -\left(\frac{R_P}{R_P + R_{adj}}\right) \times 100\%$$

where $R_P = R_2$ in parallel with R_4

This additional gain error depends on the resistance of the bridge and can be typically -0.5% for a 350Ω bridge with its active leg connected to ANALOG(x)-, and -0.172% for a 120Ω bridge.

In the case of a full-bridge with two active legs, only one leg of the bridge is affected. Therefore the gain error of voltage across the bridge is half of the above quoted figures, that is, -0.25% for a 350Ω bridge.

For a symmetrical input range, the error can be expressed as %FSR error by further dividing the value by two, yielding to ±0.125% FSR for a 350Ω bridge.

Note that the gain error due to R_{ADJ} does not apply when:

- using a wheatstone bridge with the active elements (typically strain gages) placed only on the leg of the bridge connected to ANALOG(x)+
- the leg of the bridge connected to ANALOG(x)- is populated with completion resistors (half-bridge with completion resistors)
- using only differential ended inputs with signal source isolated from module ground
- using only inputs in single ended configuration, connecting the signal to ANALOG(x)+ (ANALOG(x)- must be connected to

ground). This data sheet shows an example potentiometer application, which is not affected by this gain error.

Modules with R_{ADJ} connected externally might show this additional gain error offset but only if the balance adjust circuit is used and in the cases stated previously.

NOTE: Gain error can be compensated at post processing, as the nominal resistance of the bridge is known.

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate are always sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. The following figure shows a delay for an 8^{th} order filter where f_c = 1kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1kHz / f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1kHz / f_c). For example, an 8^{th} order Butterworth filter with an f_c of 1kHz delays a 1kHz signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

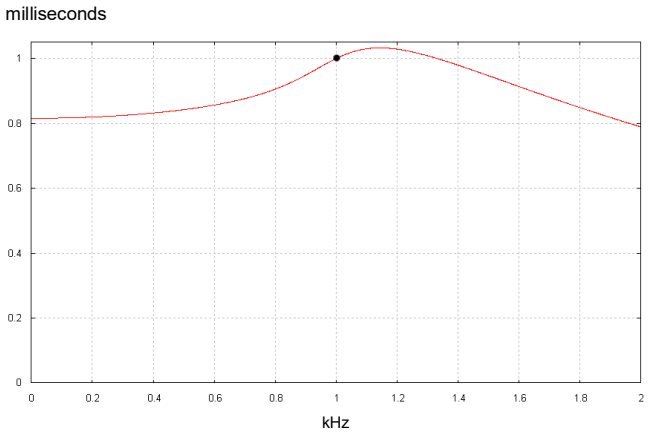


Figure 6: Filter delay for 8^{th} order Butterworth filter where f_c = 1kHz

The filter delay for the KAD/ADC/129/S1 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_D is the filter delay

T_A (analog filter delay) ≈ 0

Additional delay sources

Primary gains higher than 10 cause an additional delay from 1st order filters in the instrumentation amplifier. That additional delay is in the order of 0.25µs, for a gain of 100, and 2.5µs for a gain of 1,000.

In applications where time correlation is more important than suppression of aliasing, set the same cutoff point on all channels, even if the sampling rates are different.

Connector pinout of the KAD/ADC/129/S1

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	ANALOG(0)-	Differential ended analog inputs	Analog input
2	EXC_V(0)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 0
3	EXC_V(0)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 0
4	ANALOG(0)-	Differential ended analog inputs	Analog input
5	ANALOG(0)+	Differential ended analog inputs	Analog input
6	ADJUST(0)	Bridge adjust DC current outputs	Used to balance/calibrate bridge
7	ANALOG(1)-	Differential ended analog inputs	Analog input
8	EXC_V(1)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 1
9	EXC_V(1)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 1
10	ANALOG(1)-	Differential ended analog inputs	Analog input
11	ANALOG(1)+	Differential ended analog inputs	Analog input
12	ADJUST(1)	Bridge adjust DC current outputs	Used to balance/calibrate bridge
13	ANALOG(2)-	Differential ended analog inputs	Analog input
14	EXC_V(2)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 2
15	EXC_V(2)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 2
16	ANALOG(2)-	Differential ended analog inputs	Analog input
17	ANALOG(2)+	Differential ended analog inputs	Analog input
18	ADJUST(2)	Bridge adjust DC current outputs	Used to balance/calibrate bridge
19	ANALOG(3)-	Differential ended analog inputs	Analog input
20	EXC_V(3)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge for channel 3
21	EXC_V(3)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge for channel 3
22	ANALOG(3)-	Differential ended analog inputs	Analog input
23	ANALOG(3)+	Differential ended analog inputs	Analog input
24	ADJUST(3)	Bridge adjust DC current outputs	Used to balance/calibrate bridge
25	DNC		Do not connect
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/129/S1	Full-bridge ADC (voltage excitation, programmable analog gain, 25kHz b/w) - 4ch at 100ksps (with 52-way double-density connector)
KAM/ADC/129/S1	Full-bridge ADC (voltage excitation, programmable analog gain, 25kHz b/w) - 4ch at 100ksps (with 51-way micro-miniature connector)

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

The KAD/ADC/129/S1 uses power from the ±7V for excitation and therefore cannot be used with the KAM/CHS/04L, KAM/CHS/05F, KAM/CHS/03F, or KAM/CHS/02F chassis. In this data sheet, KAD/ADC/129/S1 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/129/S1	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
TEC/NOT/001	Strain gages and ideal bridges
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ADC/129/S2

Full-bridge ADC (voltage excitation, programmable analog gain, sense lines, 25kHz b/w) - 4ch at 100ksps

CURTISSWRIGHTDS.COM



Key Features

- Four full or ½-bridge, potentiometer or differential ended input channels
- Programmable input range (±10mV to ±10V)
- High accuracy (0.02% FSR typical for range of 1V and 10V)
- Programmable voltage excitation with separate sense lines and balance adjust
- Short on any channel does not affect others
- 16-bit simultaneous sampling on each channel

Applications

- Bridge sensors and strain gage measurement
- Differential voltage measurement

Overview

The KAD/ADC/129/S2 has four channels of signal conditioning and data acquisition for differential voltages, strain gage or bridge measurements. In addition to the measurement channel, the KAD/ADC/129/S2 provides independent bipolar excitation for up to four channels. Each differential ended signal has a separate programmable amplifier, filter and A/D converter.

At the heart of the KAD/ADC/129/S2 is a hard-wired state-machine that over-samples all channels at a rate between 200ksps and 400ksps and digitally filters any noise above the user-programmable cutoff frequency. This is achieved using cascaded, half-band, decimate by 2 x 15-tap, Finite-Impulse-Response (FIR) filters followed by an 8th order Butterworth Infinite-Impulse-Response (IIR) filter with a default cutoff point set at a quarter of the sampling frequency. All signals are sampled simultaneously. Thus, when several channels are sampled at different sampling rates, all channels will be aligned at the start of an acquisition cycle.

The KAD/ADC/129/S2 is intended for use with strain gages, and should not be used for asymmetric bridge transducers such as accelerometers, pressure transducers unless sensor re-calibration is carried out on a channel-by-channel basis. If the sense lines or internal offset adjust (balance feature) are not required, refer to the KAD/ADC/129/S1.

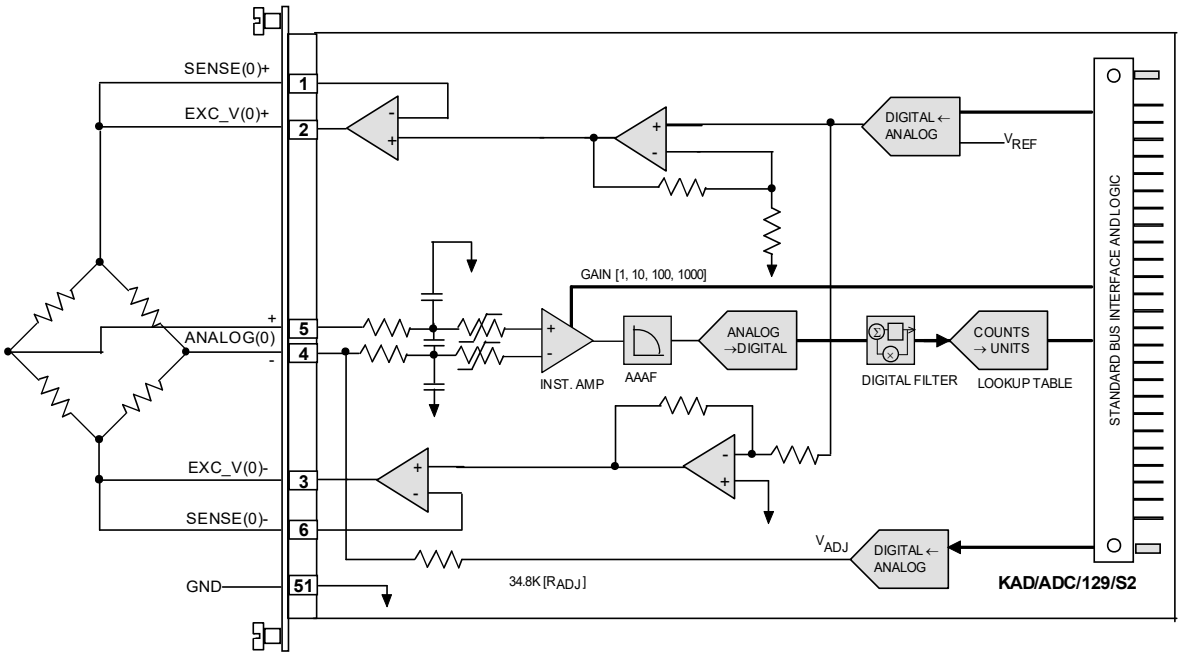


Figure 1: First of four channels on the KAD/ADC/129/S2

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	90	–	g	
	–	3.17	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	100	–	180	mA	
+7V	15	–	30	mA	Excludes current used by excitation.
-7V	10	–	25	mA	Excludes current used by excitation.
+12V	50	–	80	mA	
-12V	40	–	70	mA	
total power	1.75	–	3.09	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Differential ended analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	4	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG[3:0]	2	–	100,000	sps	
Input voltage					
operating range (G_p = 1)	-10	–	10	V	Primary gain = 1.
operating range (G_p = 10)	-1	–	1	V	Primary gain = 10.
operating range (G_p = 100)	-100	–	100	mV	Primary gain = 100.
operating range (G_p = 1000)	-10	–	10	mV	Primary gain = 1000.
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.

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TABLE 2	Differential ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
DC error					DC signal averaged over 200 samples without excitation.
gain = 1, 10	–	0.02	0.08	%FSR	
gain = 2, 20	–	–	0.14	%FSR	
gain = 4, 40	–	–	0.25	%FSR	
gain = 8, 80	–	–	0.44	%FSR	
gain = 100	–	0.04	0.18	%FSR	
gain = 200	–	–	0.33	%FSR	
gain = 400	–	–	0.6	%FSR	
gain = 800	–	–	1.2	%FSR	
gain = 1000	–	0.3	1.5	%FSR	
AC gain error					Note that the figures presented here include analog anti-aliasing filter and digital filter amplitude errors. For gain ≥1000, an additional error exists, which is caused by a much lower bandwidth of instrumentation amplifier for that gain, which is typically 60kHz (-3dB point), and has the shape of a 1st order filter.
	–	0.02	0.1	%FSR	For $f_{in} \leq 3$kHz, f_s= 100kHz, $f_c = f_s / 4$ (f_{in}: input signal frequency; f_s : sampling frequency; f_c: filter cutoff frequency).
	–	0.1	0.35	%FSR	For 3kHz < $f_{in} \leq$ 10kHz, f_s= 100kHz, $f_c = f_s / 4$.
	–	0.35	0.8	%FSR	For 10kHz< $f_{in} \leq$ 15kHz, f_s= 100kHz, $f_c = f_s / 4$.
Effective number of bits					
gain = 1, 10	12	13.5	–	bits	$f_c \leq$ 25kHz and secondary gain of 1 (f_c: filter cutoff frequency).
gain = 100	11.5	12.5	–	bits	$f_c \leq$ 25kHz and secondary gain of 1.
gain = 1000	9	10.5	–	bits	$f_c \leq$ 25kHz and secondary gain of 1.
Crosstalk					
gain = 1, 10, 100	–	-100	-90	dB	$f_{in} \leq$ 25kHz and secondary gain of 1.
gain = 1000	–	-80	-72	dB	$f_{in} \leq$ 25kHz and secondary gain of 1.
Common mode					
voltage range	-10	–	10	V	Operational voltage range.
rejection ratio	72	80	–	dB	Applies within the above common mode voltage range, $0 \leq f \leq f_c$.
Analog filter					Analog filter is Butterworth.
poles	–	–	6	–	
filter cutoff -3dB	38	40	42	kHz	
Digital filter					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 25kHz (f_s: sampling frequency).
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-80	dB	
aliasing to f_c	–	–	-80	dB	

TABLE 2	Differential ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Filter delay	–	200	–	µs	Where $f_{in} = f_c = 10kHz$ (f_{in}: input signal frequency).
Input resistance					
between inputs	10	–	–	MΩ	Whether module powered on or off.
single ended input to GND	–	34.8	–	kΩ	Module powered on Measured on ANALOG(x)- input.
single ended input to GND	43	52	–	kΩ	Module powered off. Measured on ANALOG(x)- input.
single ended input to GND	10	–	–	MΩ	Whether module powered on or off. Measured on ANALOG(x)+ input.
Input impedance					
between inputs	–	300	–	kΩ	Module powered on (measured at 3kHz).
single ended input to GND	–	300	–	kΩ	Module powered on (measured at 3kHz).

TABLE 3	Bipolar DC voltage excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	4	–	Applied per channel.
Output voltage					
operating range	0	–	5.1	V	Bi-polar excitation: 5V is 10V across the bridge.
resolution	–	1.8	–	mV	Bi-polar excitation: 1.8mV is 3.6mV across the bridge.
compliance	–	–	30	mA	Per channel.
short circuit current	–	–	125	mA	
short circuit duration	∞	–	–	s	
DC error					
error	–	0.1	0.3	%FSR	With a constant 350Ω load.
noise (gain = 1)	–	–	0.5	mV_{rms}	As measured on analog input.
noise (gain = 10)	–	–	0.05	mV_{rms}	As measured on analog input.
noise (gain = 100, 1000)	–	–	0.01	mV_{rms}	As measured on analog input.
Output resistance	–	0.2	–	Ω	

TABLE 4	Balance current outputs[1]				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	4	–	Applied per channel. Connected internally with corresponding ANALOG(x)- input.
Output current					
operating range	-71	–	71	µA	
resolution	–	35	–	nA	
DC error					
error	–	–	2	%FSR	With a constant 175Ω load. The impact of this error on the channel reading is less than 0.01%FSR (200 times lower than the error specified here).
drift	–	–	0.15	%FSR	Over temperature.
noise (gain = 1)	–	–	0.5	mV_{rms}	As measured on analog input.
noise (gain = 10)	–	–	0.05	mV_{rms}	As measured on analog input.
noise (gain = 100, 1000)	–	–	0.01	mV_{rms}	As measured on analog input.
Output resistance	–	34.8	–	kΩ	

1. The balance line is permanently connected to ANALOG(x)- input. The line is intended for balancing strain gages, so the module should not be used for asymmetric bridge transducers such as accelerometers or pressure transducers unless sensor re-calibration is carried out on a channel-by-channel basis.

Setting up the KAD/ADC/129/S2

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/129/S2	KAD/ADC/129/S2	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
AnalogIn(3:0) Analog Input	-	-	-
Settings	-	-	-
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.
Excitation Amplitude	0 to 5.1	0.2	Required excitation (in V) for the top of the bridge. Excitation is bipolar so entering 5V means 10V across the bridge.
Balance.Type	CurrentShunt	CurrentShunt	Specifies the balance type to be carried out on the bridge.
Balance.Applied	-71e-6 to 71e-6	0	Shunt current (in A) applied to the bridge.
Balance.BalanceThisTime	True False	False	Specifies if balancing should be carried out this time by software.
Balance.Tolerance	0.01 to 99.99	0.1	Specifies acceptable tolerance of achieved value vs. target value, expressed as percentage of defined input range.
Balance.Target	-10 to 10	0	Specifies a value. that the channel should be balanced to.
ShuntCurrent.Applied	-71e-6 to 71e-6	0	Shunt mode current (in A) added to the bridge

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
AnalogIn(3:0) Parameters				
AnalogIn Analog signal data	Volt	OffsetBinary	16	R[15:0]

Configurable parameters

AnalogIn(3:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-10 to 10	10	Range maximum for analog channel
Range Minimum	-10 to 10	-10	Range minimum for analog channel

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/129/S2

Wiring configurations

Figures 2 to 4 show possible wiring configurations for the KAD/ADC/129/S2.

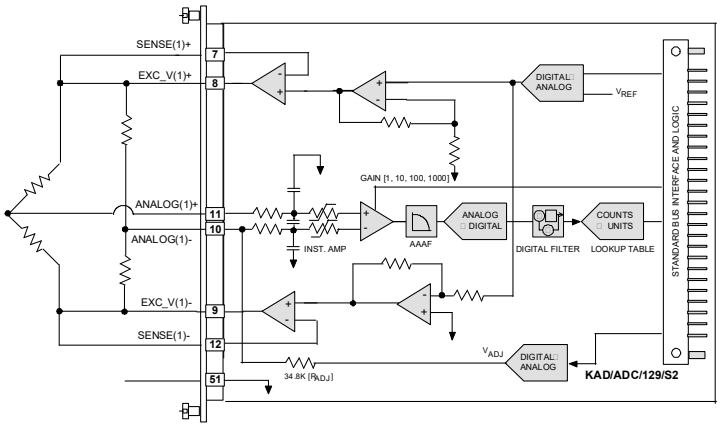


Figure 2: Second of 4 independent ½-bridge channels with matched pair completion resistors

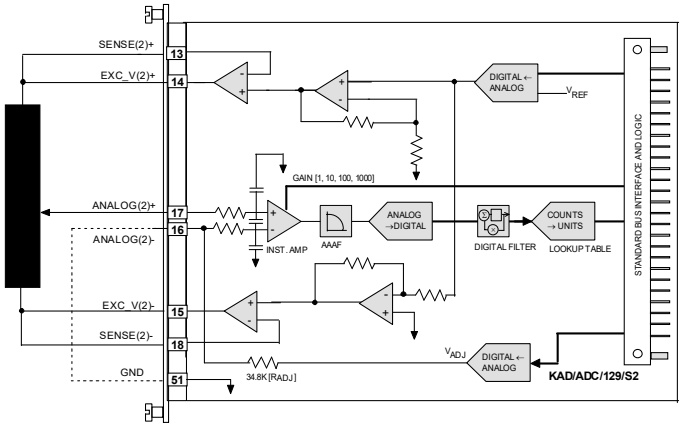


Figure 3: Third of 4 independent potentiometer channels

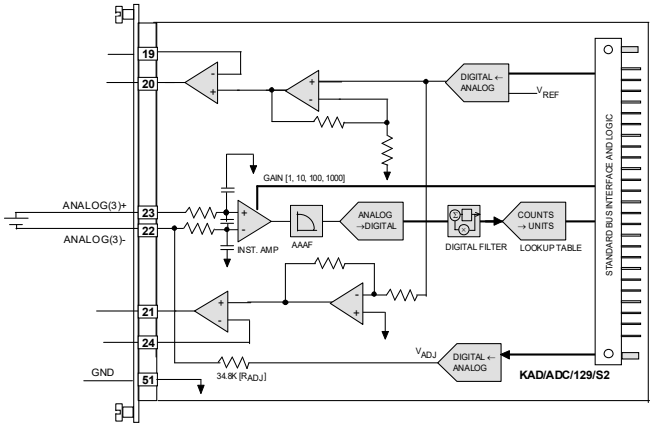


Figure 4: Fourth of 4 independent differential ended channels

Bias current return path

As shown in Figure 4 on page 347, the analog inputs can be used as differential inputs (that is, not from a bridge). In this case, if the signal source is isolated with respect to the Acra KAM-500 (for example a battery), a common-mode resistance between the negative input and ground (GND) should be used to provide a return for bias currents and reduce common-mode noise pick-up. Because the bias currents are in the order of nAs resistors up to 10kΩcan be used. In most cases a short (0Ω) is recommended.

NOTE: When analog inputs are used as differential inputs, setting the excitation and balance to zero reduces quiescent currents of the module.

Using high primary gains

For gains above 1000, the gain-bandwidth product of the amplifier reduces the bandwidth of the instrumentation amplifier to approximately 60kHz. The effect of attenuation can be seen for input signals with frequencies of 10kHz and higher.

Excitation setup

Excitation can contribute error to the overall measurement, so it is recommended to use as close as possible to full-scale excitation, to minimize the percentage error.

For optimal accuracy ensure each channel uses its corresponding excitation. If the excitation is not used, it should be set to the minimum value.

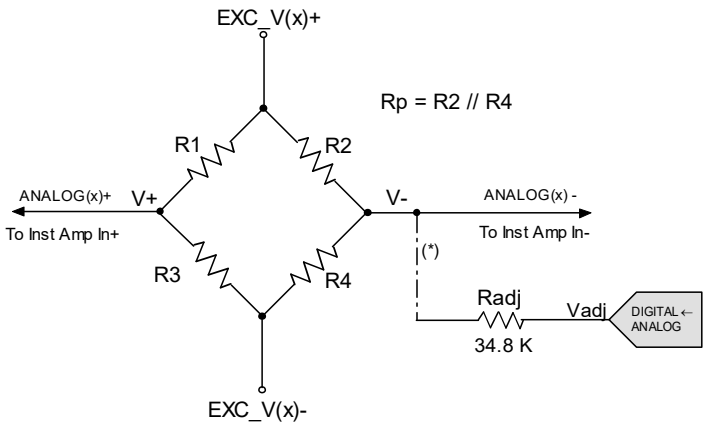
Excitation drift on potentiometer configurations

Curtiss-Wright recommends a full-bridge input configuration for the KAD/ADC/129/S2. With this configuration the differential input amplifier removes common mode voltage or common mode pickup noise on the input lines.

For potentiometer circuits where the negative input is tied to ground, excitation drift can have a direct impact on the input signal either as a gain or an offset error. Note that excitation can drift up to 0.3% on an FSR of 5.1V. In the case where both excitation lines drift in the same direction an offset error is seen in the measurement. The worst case possible offset is 0.3% of 5.1V and results in a worst case 15.3mV offset of the measurement. This does not happen with full-bridge configurations. We recommend that the negative input is tied to ground as shown in Figure 3 on page 347. If the negative input is floating, the drift of the digital/analog converter related to the balancing input directly adds further offset error to the measurement.

Source load error caused by the balance adjust circuit

The balance circuit has an impedance of R_{ADJ} and is connected to the ANALOG(x)- input of the module. This connection is performed internally on the module. In some bridge configurations, R_{ADJ} loads the source signal causing a quantifiable error. An example schematic for a full-bridge configuration loaded with balance resistance is shown in the following figure.



(*) Connection betw een V- and Radj is internal or external depending on module

Figure 5: Full-bridge configuration loaded with balance resistance

The DC error specification is checked as a differential input, so it does not include loading by R_{ADJ} which causes an additional gain error.

In the previous figure, the gain error only occurs when the active leg of the bridge is connected to ANALOG(x)-. In this situation, ANALOG(x)- is loaded by R_{ADJ}, forming a resistor divider with the resistance of bridge visible from the ANALOG(x)- input.

The gain error on ANALOG(x)- input can be quantified as follows:

$$Error = -\left(\frac{R_P}{R_P + R_{adj}}\right) \times 100\%$$

where $R_P = R_2$ in parallel with R_4

This additional gain error depends on the resistance of the bridge and can be typically -0.5% for a 350Ω bridge with its active leg connected to ANALOG(x)-, and -0.172% for a 120Ω bridge.

In the case of a full-bridge with two active legs, only one leg of the bridge is affected. Therefore the gain error of voltage across the bridge is half of the above quoted figures, that is, -0.25% for a 350Ω bridge.

For a symmetrical input range, the error can be expressed as %FSR error by further dividing the value by two, yielding to ±0.125% FSR for a 350Ω bridge.

Note that the gain error due to R_{ADJ} does not apply when:

- using a wheatstone bridge with the active elements (typically strain gages) placed only on the leg of the bridge connected to ANALOG(x)+
- the leg of the bridge connected to ANALOG(x)- is populated with completion resistors (half-bridge with completion resistors)
- using only differential ended inputs with signal source isolated from module ground
- using only inputs in single ended configuration, connecting the signal to ANALOG(x)+ (ANALOG(x)- must be connected to ground). This data sheet shows an example potentiometer application, which is not affected by this gain error.

Modules with R_{ADJ} connected externally might show this additional gain error offset but only if the balance adjust circuit is used and in the cases stated previously.

NOTE: Gain error can be compensated at post processing, as the nominal resistance of the bridge is known.

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate will always be sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. The figure below shows a delay for an 8^{th} order filter where f_c = 1kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1kHz / f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1kHz / f_c). For example, an 8^{th} order Butterworth filter with an f_c of 1kHz delays a 1kHz signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

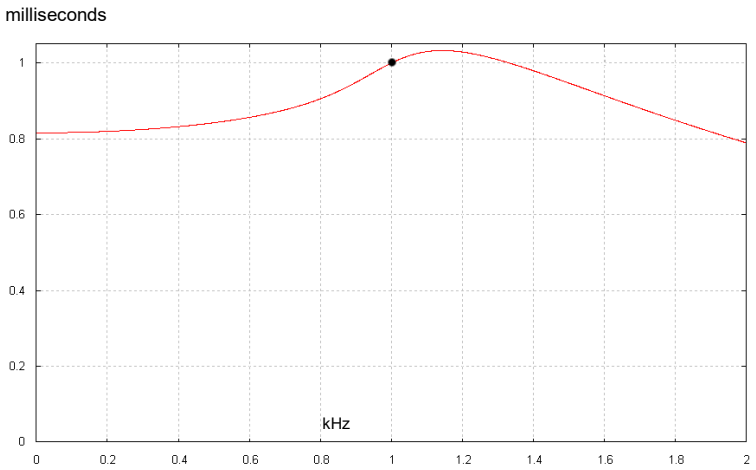


Figure 6: Filter delay for 8th order Butterworth filter where f_C = 1kHz

The filter delay for the KAD/ADC/129/S2 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_D is the filter delay

T_A (analog filter delay) ≈ 0

Additional delay sources

Primary gains higher than 10 cause an additional delay from 1st order filters in the instrumentation amplifier. That additional delay is in the order of 0.25µs, for a gain of 100, and 2.5µs for a gain of 1,000.

In applications where time correlation is more important than suppression of aliasing, set the same cutoff point on all channels, even if the sampling rates are different.

Sense lines

Sense lines are used to eliminate error due to voltage drop across lead resistance. Sense lines can not be left unconnected; they should be connected as close as possible to the bridge. If however, the sense lines are connected close to the module (that is, far from the bridge) and the lead resistance can be measured or estimated, add the voltage drop across the leads to the excitation voltage. For example, for 0.5Ω leads in a 350Ω full-bridge where ±5V (10V) is desired across the bridge, the excitation must be set to 5V + (0.5 × 10/350) = ±5.014.

Connector pinout of the KAD/ADC/129/S2

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	SENSE(0)+	Bipolar DC voltage excitation outputs	Sense line from top of bridge
2	EXC_V(0)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge
3	EXC_V(0)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge
4	ANALOG(0)-	Differential ended analog inputs	Analog input connected to internal adjust
5	ANALOG(0)+	Differential ended analog inputs	Analog input
6	SENSE(0)-	Bipolar DC voltage excitation outputs	Sense line from bottom of bridge
7	SENSE(1)+	Bipolar DC voltage excitation outputs	Sense line from top of bridge
8	EXC_V(1)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge
9	EXC_V(1)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge
10	ANALOG(1)-	Differential ended analog inputs	Analog input connected to internal adjust
11	ANALOG(1)+	Differential ended analog inputs	Analog input
12	SENSE(1)-	Bipolar DC voltage excitation outputs	Sense line from bottom of bridge
13	SENSE(2)+	Bipolar DC voltage excitation outputs	Sense line from top of bridge
14	EXC_V(2)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge
15	EXC_V(2)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge
16	ANALOG(2)-	Differential ended analog inputs	Analog input connected to internal adjust
17	ANALOG(2)+	Differential ended analog inputs	Analog input
18	SENSE(2)-	Bipolar DC voltage excitation outputs	Sense line from bottom of bridge
19	SENSE(3)+	Bipolar DC voltage excitation outputs	Sense line from top of bridge
20	EXC_V(3)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge
21	EXC_V(3)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge
22	ANALOG(3)-	Differential ended analog inputs	Analog input connected to internal adjust
23	ANALOG(3)+	Differential ended analog inputs	Analog input
24	SENSE(3)-	Bipolar DC voltage excitation outputs	Sense line from bottom of bridge
25	DNC		Do not connect
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/129/S2	Full-bridge ADC (voltage excitation, programmable analog gain, sense lines, 25kHz b/w) - 4ch at 100ksps

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

The KAD/ADC/129/S2 uses power from the ±7V power line for excitation and therefore cannot be used with KAM/CHS/04L, KAM/CHS/05F, KAM/CHS/03F, or KAM/CHS/02F.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/129/S2	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
KSM-500	This module is supported by the KSM-500 suite of software tools

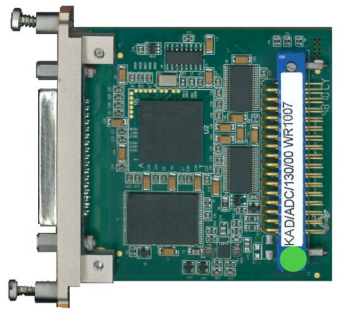
Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/001	Strain gages and ideal bridges
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ADC/130

±200V differential ended ADC (3kHz b/w) - 4ch at 12ksps



Key Features

- Four differential ended input channels
- Input range (±200V)
- High accuracy (0.05% FSR typical)
- 16-bit simultaneous sampling on each channel

Applications

- Differential high voltage (±200V) measurement

Overview

The KAD/ADC/130 is used to condition and digitize up to four differential ended analog channels. At the heart of the KAD/ADC/130 is a hard-wired state-machine that over-samples all channels at a rate between 48ksps and 96ksps and digitally filters any noise above the user-programmable cutoff frequency.

This is achieved using cascaded, half-band, finite-impulse-response (FIR) filters followed by an 8th order Butterworth IIR filter with a default cutoff point set at one quarter of the sampling frequency ($f_c = f_s / 4$). All signals are sampled simultaneously. Thus, when several channels are sampled at different sampling rates, at the start of an acquisition cycle all channels are aligned.

The KAD/ADC/130 is available with a ±200V input range. If another range is required, contact Curtiss-Wright support (acra-support@curtisswright.com).

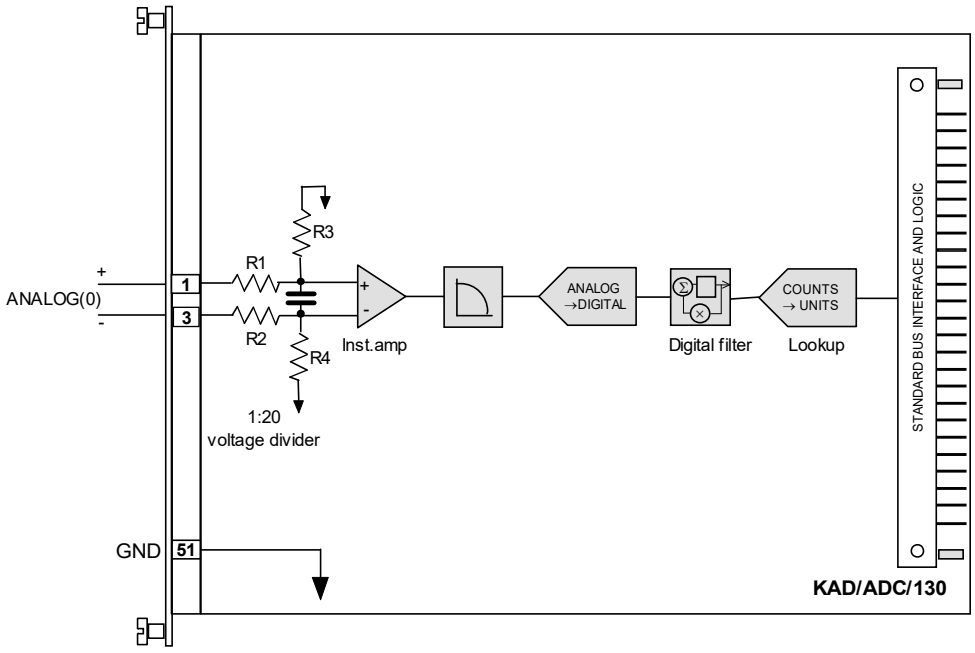


Figure 1: First of 4 channels on the KAD/ADC/130

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	65	–	g	
	–	2.29	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	50	–	90	mA	
±7V	10	–	20	mA	
±12V	10	–	25	mA	
total power	0.88	–	1.33	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualifications Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Differential ended analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	4	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG[3:0]	2	–	12,000	sps	
Input voltage					
operating range	-200	–	200	V	Primary gain=0.05.
overvoltage protection	-210	–	210	V	Voltages outside of this range can damage input.
DC error					DC signal averaged over 200 samples.
gain = 1,2,4	–	0.05	0.35	%FSR	
gain = 8	–	0.1	0.5	%FSR	
AC gain error					
for 0Hz < f_{in} ≤ 300Hz	–	0.02	0.1	%FSR	Gain = 1, f_s = 12kHz, f_c = f_s / 4 (f_{in} : input signal frequency; f_s : sampling frequency; f_c : filter cutoff frequency).
for 300Hz < f_{in} ≤ 1kHz	–	0.1	0.2	%FSR	Gain = 1, f_s= 12kHz, f_c = f_s / 4.
for 1kHz < f_{in} ≤ 2kHz	–	0.2	0.6	%FSR	Gain = 1, f_s= 12kHz, f_c = f_s / 4.

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TABLE 2	Differential ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Effective number of bits					
	11.5	13	–	bits	Secondary gain of 1.
Crosstalk	–	-90	-70	dB	
Common mode					
voltage range	-200	–	200	V	Operational voltage range.
rejection ratio	–	60	–	dB	Applies within the above common mode voltage range, $0 \leq f \leq f_c$.
Analog filter					Analog filter is Butterworth.
poles	–	–	4	–	
filter cutoff -3dB	5.7	6	6.3	kHz	
Digital filter					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 3kHz.
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-72	dB	
aliasing to f_c	–	–	-74	dB	
Filter delay	–	20	–	ms	Measured for $f_{in} = f_c = 100Hz$ (f_{in} : input signal frequency). See “Understanding filter delays” on page 357.
Input resistance					
between inputs	–	210	–	kΩ	Module powered off.
between inputs	–	210	–	kΩ	Module powered on.
each input to GND	–	105	–	kΩ	Module powered off.
each input to GND	–	105	–	kΩ	Module powered on.
Input impedance					
each input to GND	–	100	–	kΩ	Module powered on (measured at 3kHz).
between inputs	–	200	–	kΩ	Module powered on (measured at 3kHz).

Setting up the KAD/ADC/130

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/130	KAD/ADC/130	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
AnalogIn(3:0) Analog Input	-	-	Settings for this channel.
Settings	-	-	-
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
AnalogIn(3:0) Parameters				
AnalogIn Analog signal data.	Volt	OffsetBinary	16	R[15:0]

Configurable parameters

AnalogIn(3:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
RangeMaximum	-200 to 200	200	-
RangeMinimum	-200 to 200	-200	-

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/130

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate will always be sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. The following figure shows a delay for an 8^{th} order filter where f_c = 1kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1kHz/ f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1kHz/ f_c). For example, an 8^{th} order Butterworth filter with an f_c of 1kHz delays a 1kHz signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

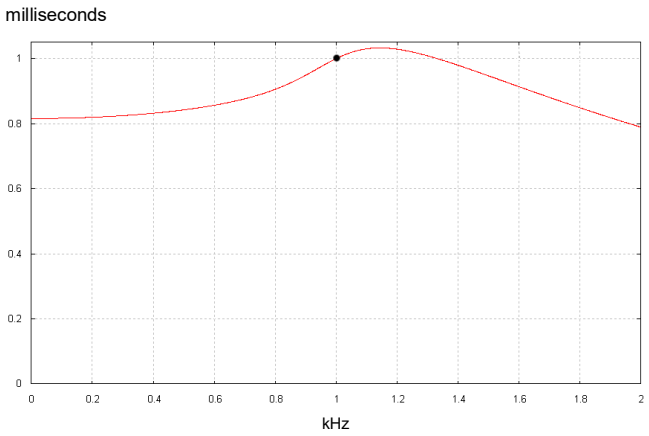


Figure 2: Filter delay for 8^{th} order Butterworth filter where f_c = 1kHz

The filter delay for the KAD/ADC/130 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_D is the filter delay

T_A (analog filter delay) ≈ 0

f_c is the filter cutoff frequency.

Connector pinout of the KAD/ADC/130

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	ANALOG(0)+	Differential ended analog inputs	Analog input
2	DNC		Do not connect
3	ANALOG(0)-	Differential ended analog inputs	Analog input
4	DNC		Do not connect
5	ANALOG(1)+	Differential ended analog inputs	Analog input
6	DNC		Do not connect
7	ANALOG(1)-	Differential ended analog inputs	Analog input
8	DNC		Do not connect
9	ANALOG(2)+	Differential ended analog inputs	Analog input
10	DNC		Do not connect
11	ANALOG(2)-	Differential ended analog inputs	Analog input
12	DNC		Do not connect
13	ANALOG(3)+	Differential ended analog inputs	Analog input
14	DNC		Do not connect
15	ANALOG(3)-	Differential ended analog inputs	Analog input
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/130	±200V differential ended ADC (3kHz b/w) - 4ch at 12ksps

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/130	First release	Recommended for new programs

Supporting software

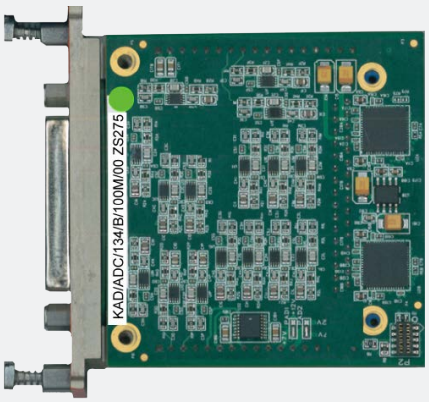
SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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KAD/ADC/134

Full/1/2-bridge ADC (voltage excitation, strain gages, shunt resistor, 6.25 kHz b/w) - 16ch at 25 ksps

The KAD/ADC/134 is used to condition and digitize up to 16 differential ended analog channels.

At the heart of the KAD/ADC/134 is a hard-wired state-machine that oversamples all channels at a rate between 100 ksps and 200 ksps and digitally filters any noise above the user-programmable cutoff frequency.

This is achieved using cascaded, half-band, Finite-Impulse-Response (FIR) filters followed by an 8th order Butterworth IIR filter with a default cutoff point set at one quarter of the sampling frequency ($f_c = f_s / 4$). In FIR mode, the IIR filter is bypassed, with samples being outputted directly from the FIR filter. All signals are sampled simultaneously. Thus, when several channels are sampled at different sampling rates, at the start of an acquisition cycle all channels are aligned.

Excitation on the KAD/ADC/134 is programmable using four D/A converters, each of which is connected to two pairs of drivers. If more than eight excitations are required, each excitation output can be connected to two bridges.

The KAD/ADC/134 is available with a ±100 mV, 1V, and ±10V input range.

Key Features

- 16 full or ½ bridge, potentiometer or differential-ended input channels
- Ordering input range (100 mV, 1V, 10V)
- High accuracy (<0.02% FSR typical)
- 8 programmable bipolar voltage excitation outputs
- Short on any channel does not affect others
- 16-bit simultaneous sampling on each channel

Applications

- High impedance bridge sensors
- Differential voltage measurement
- Strain gage measurement

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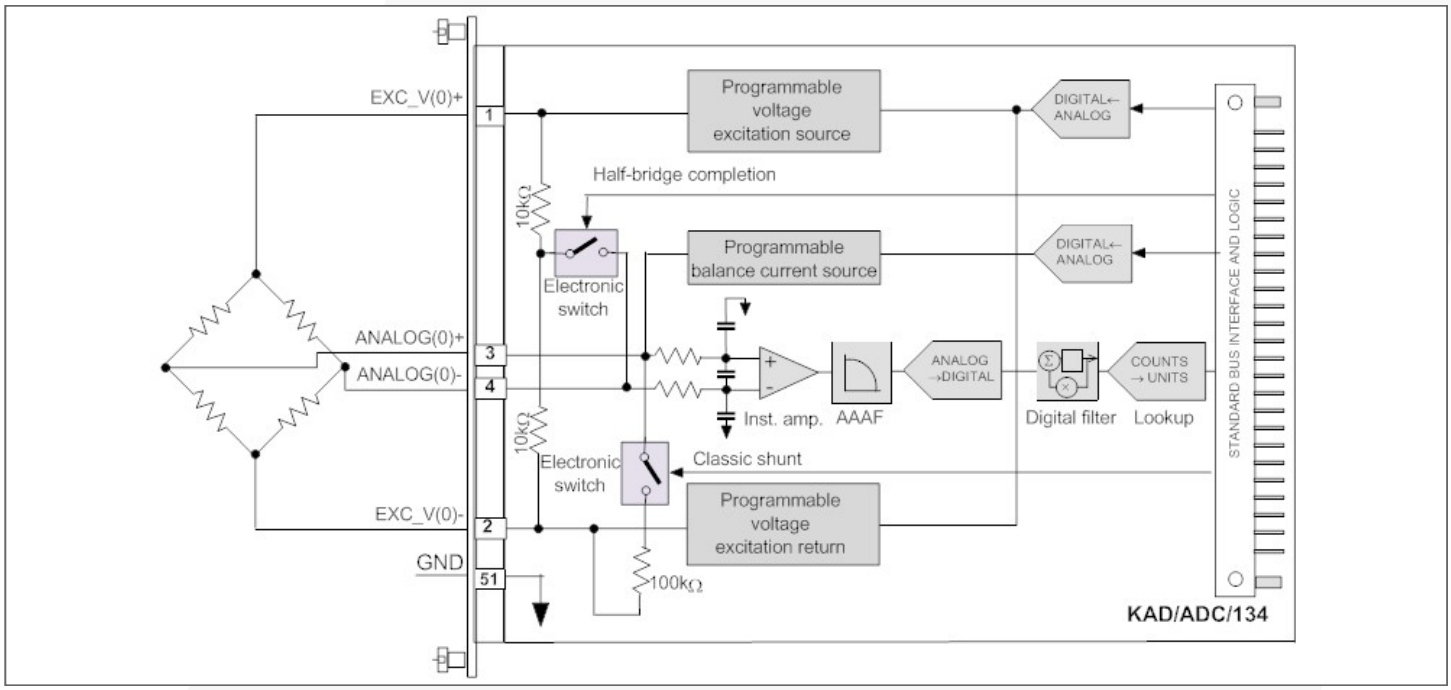


Figure 1: First of 16 channels on the KAD/ADC/134

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Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

Table 1 General specifications

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	95	–	g	
	–	3.35	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					To attain these figures for ±12V, see “Unused differential ended inputs” on page 374.
+5V	135	160	180	mA	
+7V	10	20	30	mA	Excludes current used by excitation.
-7V	15	25	35	mA	Excludes current used by excitation.
+12V	50	60	95	mA	No floating inputs. See “Unused differential ended inputs” on page 374.
-12V	55	70	100	mA	No floating inputs. See “Unused differential ended inputs” on page 374.
total power	2.11	2.68	3.70	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

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Table 2 Differential ended analog inputs

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	16	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG[15:0]	0.5	–	25,000	sps	For IIR setting of Filter Mode.
ANALOG[15:0]	4	–	25,000	sps	For FIR setting of Filter Mode.
Input voltage					
operating range	-10	–	10	V	KAD/ADC/134/10V. Primary gain = 1.
operating range	-1	–	1	V	KAD/ADC/134/1V. Primary gain = 10.
operating range	-100	–	100	mV	KAD/ADC/134/100m. Primary gain = 100.
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.
DC error					DC signal averaged over 200 samples without excitation.
gain = 1	–	0.01	0.05	%FSR	KAD/ADC/134/10V, KAD/ADC/134/1V.
gain = 2	–	0.02	0.08	%FSR	KAD/ADC/134/10V, KAD/ADC/134/1V.
gain = 4	–	0.04	0.14	%FSR	KAD/ADC/134/10V, KAD/ADC/134/1V.
gain = 8	–	0.08	0.25	%FSR	KAD/ADC/134/10V, KAD/ADC/134/1V.
gain = 1	–	0.02	0.08	%FSR	KAD/ADC/134/100m.
gain = 2	–	0.04	0.14	%FSR	KAD/ADC/134/100m.
gain = 4	–	0.08	0.25	%FSR	KAD/ADC/134/100m.
gain = 8	–	0.16	0.44	%FSR	KAD/ADC/134/100m.
AC gain error					
for 0 Hz < f_{in} ≤ 2 kHz	-	0.1	0.3	%FSR	Filter Mode set to either FIR or IIR. Gain = 1, f_s = 25 kHz, f_c = f_s / 4 (f_{in} : input signal frequency; f_s : sampling frequency; f_c : filter cutoff frequency).
for 2 kHz < f_{in} ≤ 4 kHz	-	0.25	0.5	%FSR	Filter Mode set to IIR: Gain = 1, f_s = 25 kHz, f_c = f_s / 4.
for 2 kHz < f_{in} ≤ 3.5 kHz	-	0.25	0.5	%FSR	Filter Mode set to FIR: Gain = 1, f_s = 25 kHz, f_c = f_s / 4.
Effective number of bits	11.5	12	–	bits	Secondary gain of 1 at 25 ksps, f_c = f_s / 4.
Crosstalk	–	-90	-80	dB	
Common mode					
voltage range (KAD/ADC/134/100m, KAD/ADC/134/1V)	-5	–	6	V	Operational voltage range. Both inputs remain within the range of -5V to +6V with respect to internal GND (pin 51).
voltage range (KAD/ADC/134/10V)	-5	–	5	V	Operational voltage range. Tested with a Full Scale Range (±10V) differential input signal, that is, both inputs remain within ±15V of internal GND (pin 51).
rejection ratio (KAD/ADC/134/100m, KAD/ADC/134/1V)	70	80	–	dB	Applies within the above common mode voltage range, 0 ≤ f ≤ f_c.
rejection ratio (KAD/ADC/134/10V)	73	80	–	dB	Applies within the above common mode voltage range, 0 ≤ f ≤ f_c.

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Table 2 Differential ended analog inputs (continued)

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Analog filter					Analog filter is Butterworth.
poles	–	–	4	–	
filter cutoff -3 dB	11.9	12.5	13.1	kHz	
Digital filter					For IIR setting of Filter Mode, digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3 dB	0.25	–	16	f_s	The maximum value is limited to 6.25 kHz.
0.1 dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1 dB band	–	–	-65	dB	
aliasing to f_c	–	–	-65	dB	
Filter delay	–	2.0	–	ms	Measured for $f_{in} = f_c = 1$ kHz (f_{in} : input signal frequency). See “Understanding filter delays (IIR filter mode)” on page 373.
Digital filter					For FIR setting of Filter Mode, digital filter is 15-tap Kaiser window, Beta 4 FIR filter.
poles	–	–	–	–	
filter cutoff -6 dB	0.25	–	16	f_s	The maximum value is limited to 6.25 kHz.
0.1 dB bandwidth	–	0.64	–	f_c	
aliasing to 0.1 dB band	–	–	-63	dB	
aliasing to f_c	–	–	-53	dB	
Filter delay	–	4.0	–	ms	Measured for $f_{in} = f_c = 1$ kHz (f_{in} : input signal frequency). See “Understanding filter delays (FIR filter mode)” on page 373.
Input resistance					
between inputs	8	–	–	MΩ	Module powered off.
between inputs	10	–	–	MΩ	Module powered on.
single ended input to GND	10	–	–	MΩ	Module powered off and measured at ANALOG(x)+.
single ended input to GND	10	–	–	MΩ	Module powered on and measured at ANALOG(x)+.
single ended input to GND	10	–	–	MΩ	Module powered off and measured at ANALOG(x)-.
single ended input to GND	10	–	–	MΩ	Module powered on and measured at ANALOG(x)-.

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Table 2 Differential ended analog inputs (continued)

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Shunt resistor					Shunt resistor can be enabled between ANALOG(x)+ and EXC_V(x)-.
resistance	–	100	–	kΩ	Nominal resistance of shunt resistor.
error	–	0.1	–	%	Initial resistor tolerance.
Half-bridge completion					
resistance	–	10	–	kΩ	Nominal resistance of each of completion resistors.
matching	–	0.05	–	%	Initial resistor ratio tolerance.
tracking TCR	–	2	–	ppm/°C	Tracking Temperature Coefficient of Resistance (TCR)
Input impedance					
between inputs	1	–	–	MΩ	Module powered on/off. Measured for f_{in} = 3 kHz with 70.7 mV_{rms} signal.
single ended input to GND	1	–	–	MΩ	Module powered off and measured at ANALOG(x)+ for f_{in} = 3 kHz with 70.7 mV_{rms} signal.
single ended input to GND	1	–	–	MΩ	Module powered on and measured at ANALOG(x)- for f_{in} = 3 kHz with 70.7 mV_{rms} signal.

Table 3 Bipolar DC voltage excitation outputs

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	8	–	Each output shared between two channels. Applied in groups of four channels.
Output voltage					
operating range	0	–	5.1	V	Bi-polar excitation: 5V is 10V across the bridge.
resolution	–	78	–	µV	
compliance	–	–	15	mA	Per channel. Note that 30 mA is shared per two channels. See “KAD/ADC/134 shared excitations” on page 372.
short circuit current	–	–	125	mA	
short circuit duration	∞	–	–	s	Short on one channel affects the other channel, which uses the same excitation driver.
DC error					
error	–	0.1	0.2	%FSR	With a constant 175Ω load (loaded with two 350Ω bridges).
drift	–	–	0.1	%FSR	Over temperature. Included in error above specification.
noise	–	–	0.01	mV_{rms}	As measured on analog input.
Output resistance	–	0.3	0.5	Ω	

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Table 4 Balance current outputs

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	16	–	Internally connected with corresponding ANALOG(x)+ input.
Output current					
operating range	-100	–	100	µA	
resolution	–	53	–	nA	
DC error					
error	–	0.1	0.6	%FSR	With a constant 175Ω load. The impact of this error on the channel reading is usually negligible.
drift	–	0.08	0.2	%FSR	Over temperature.
noise	–	0.003	0.01	mV_{rms}	As measured on analog input.
Output resistance	2.5	6	–	MΩ	

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Setting up the KAD/ADC/134

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

NOTE: The Balance.Target, PartReference, RangeMaximum, and RangeMinimum settings are specific to each module variant as shown under “Ordering information” on page 376. Only one variant is shown below.

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/134/B/100m	KAD/ADC/134/B/100m	The instrument part reference.
SerialNumber	AAA/1234	AAA/1234	Unique name for each module.
Channels	-	-	-
Analog(15:0) Analog Input	-	-	-
Settings	-	-	-
Filter Mode	IIR FIR	IIR	Specifies filter mode for specific channel. IIR is 8th order Butterworth IIR filter, and FIR is 15-tap Kaiser window Beta = 4 FIR filter.
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.
Excitation Amplitude	0 to 5.1	0.2	Required excitation (in V) for the top of the bridge. Excitation is bipolar, that means entering 5V means 10V across the bridge.
Balance.Type	CurrentShunt	CurrentShunt	Specifies the balance type to be carried out on the bridge.
Balance.Applied	-100e-6 to 100e-6	0	Shunt current (in A) applied to the bridge.
Balance.BalanceThisTime	True False	False	Specifies if balancing should be carried out this time by software.
Balance.Tolerance	0.01 to 99.99	0.1	Specifies acceptable tolerance of achieved value vs. target value, expressed as percentage of defined input range.
Balance.Target	-0.1 to 0.1	0	Specifies a value that the channel should be balanced to.
ShuntCurrent.Applied	-100e-6 to 100e-6	0	Shunt mode current (in A) added to the bridge.
Classic Shunt	Disabled Enabled	Disabled	Specifies if switch connecting classic shunt resistor is to be enabled between EXC(x)- and ANALOG(x)+ nets.
Enable Half Bridge Completion Resistors	Disabled Enabled	Disabled	Specifies if switch connecting internal completion resistors for half bridge with ANALOG(x)- is to be enabled.

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Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Analog(15:0) Parameters				
Analog Analog signal data	Volt	OffsetBinary	16	R[15:0]

Configurable parameters

Analog(15:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
RangeMaximum	-10 to 10	10	Range maximum for analog channel.
RangeMinimum	-10 to 10	-10	Range minimum for analog channel.

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Getting the most from the KAD/ADC/134

Wiring configurations

Figures 2 to 5 in this section, show possible wiring configurations for the KAD/ADC/134.

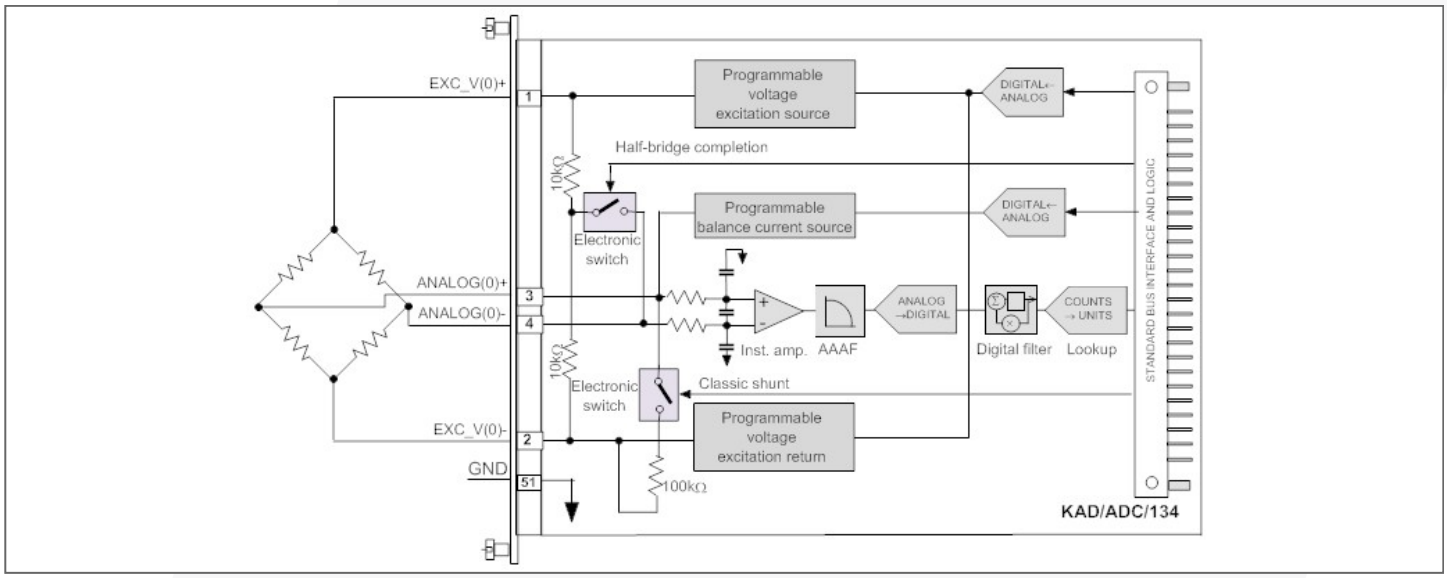


Figure 2: First channel in full-bridge configuration

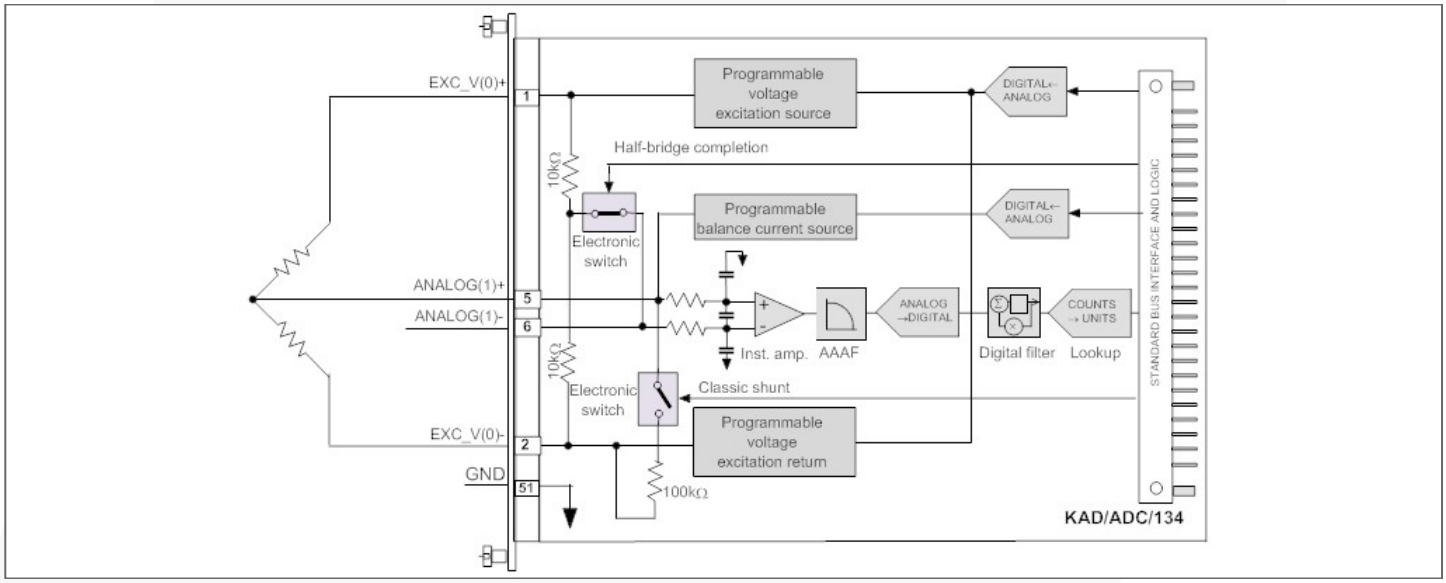


Figure 3: Second channel in half-bridge configuration, with matched pair of internal completion resistors enabled

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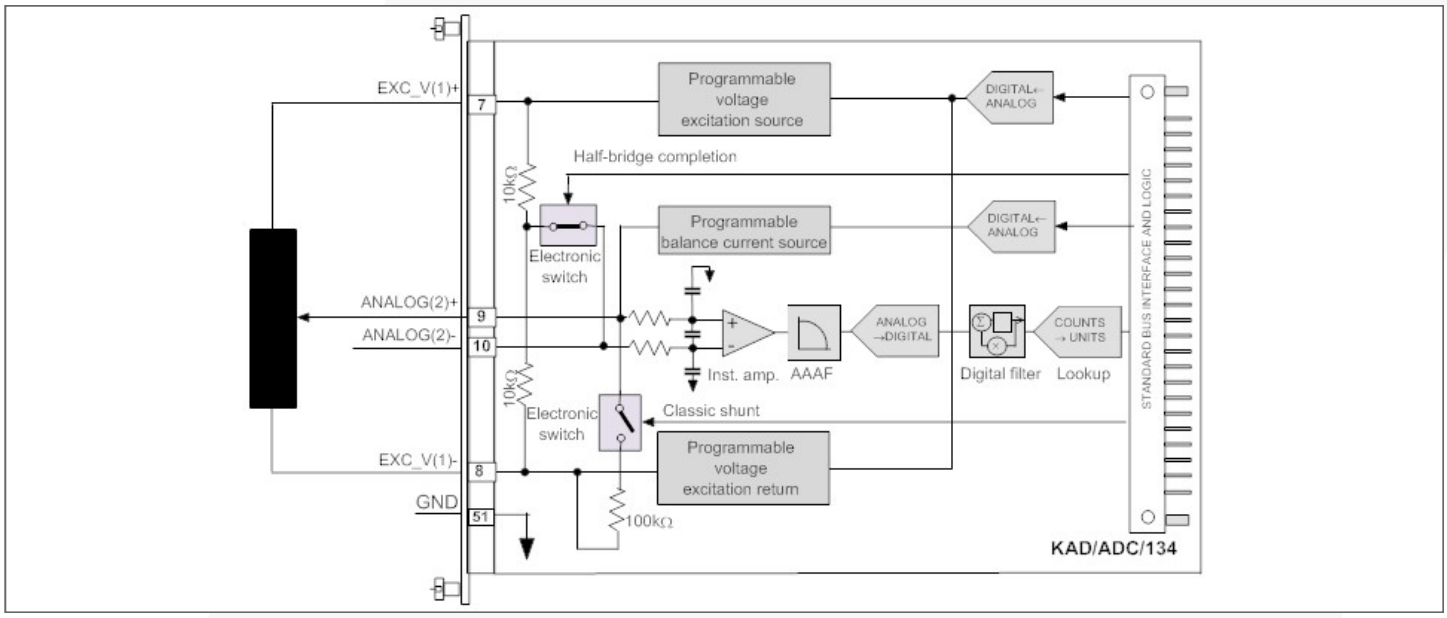


Figure 4: Third channel in potentiometer configuration, with matched pair of internal completion resistors enabled (recommended)

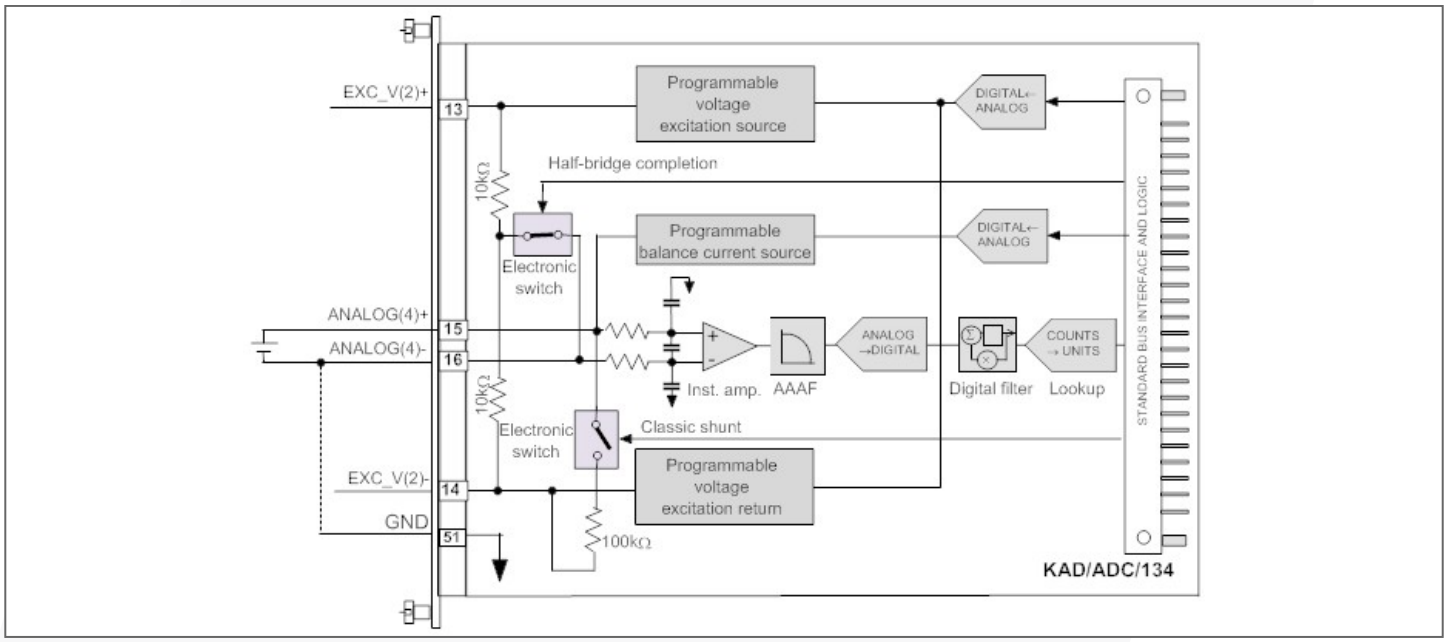


Figure 5: Fifth channel in differential ended configuration, with matched pair of internal completion resistors enabled (bias current return path)

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Bias current return path

As shown in Figure 5 on page 371, the analog inputs can be used as differential inputs (that is, not from a bridge). In this case, if the signal source is isolated with respect to the Acra KAM-500 (for example a battery), a common-mode resistance between the negative input and ground (GND) should be used to provide a return for bias currents and reduce common-mode noise pick-up. Bias currents are in the order of nA. In order to correctly setup return path for bias currents, excitation for a specific channel should be set to voltage mode (any value from range), and either completion resistors should be enabled to internally pull-down to around 0V (middle voltage between bipolar excitation) or an external path to GND should be used, for example short (0Ω) to GND (as shown by the dotted line in Figure 5 on page 371).

NOTE: When analog inputs are used as differential inputs, setting the balance to zero is required.

KAD/ADC/134 shared excitations

The KAD/ADC/134 has 16 differential input channels and eight symmetrical excitation channels that can each provide a total of 30 mA. There are more input channels than excitations, this means that excitations must be shared across sensors if there are more sensors than excitations.

The rules for shared excitations are:

1. The same voltage must be selected for them.
2. The total current drawn must not exceed 30 mA.

The following example includes two 350Ω full bridges. It uses the KAD/ADC/134 inputs ANALOG(0) and ANALOG(1). It shares the excitation output EXC_V(0).

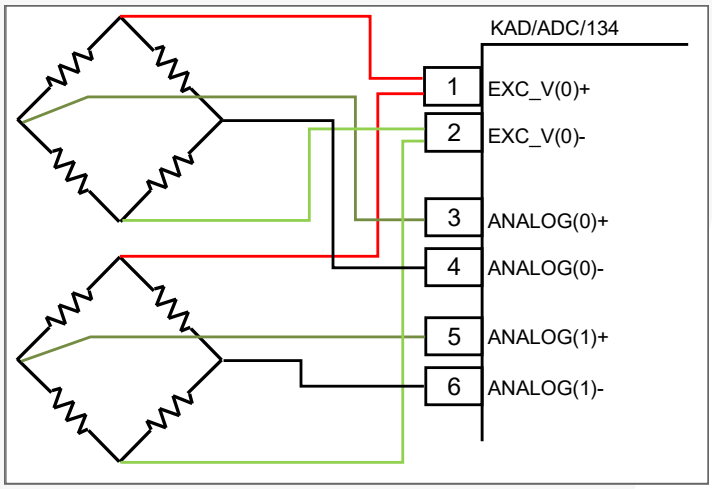


Figure 6: Sample wiring of bridge sensors with shared excitation

It is important to ensure that the current does not exceed 15 mA for each bridge. If all resistors are exactly 350Ω then there is the current i down each bridge arm with the following equation.

i = ((EXC_V+) - (EXC_V-)) / (350+350)

The excitation voltage must be set up in such a way that the current is less than 7.5 mA per arm (there are four arms, two per sensor, and 30 mA available).

Therefore the limit is nominally:

((EXC_V+) - (EXC_V-)) = 700 x 0.0075

((EXC_V+) - (EXC_V-)) = 5.25

also EXC_V+ = - EXC_V-

So maximum excitation should nominally be a maximum ±2.625V for the 350Ω bridge. Allowing 5% tolerance, 2.5V is recommended for the bridge.

Excitation setup

Excitation can contribute error to the overall measurement, so it is recommended to use as close as possible to full-scale excitation, to minimize the percentage error.

For optimal accuracy ensure each channel uses its corresponding excitation. If the excitation is not used, it should be set to the minimum value.

Excitation drift on potentiometer configurations

We recommend a full-bridge input configuration for the KAD/ADC/134. With this configuration the differential input amplifier removes common mode voltage or common

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mode pickup noise on the input lines. A similar configuration can be achieved with a potentiometer by using completion resistors, however, only the common mode voltage error present in the excitation would be compensated.

NOTE: For the KAD/ADC/134, internal completion resistors can be enabled by changing the Enable Half Bridge Completion Resistors setting to Enabled (see Figure 4 on page 371).

Compensation for lead resistance

In bridge applications, if the lead resistance can be measured or estimated, add the voltage drop across the leads to the excitation voltage. For example, for each 0.5Ω lead in a 350Ω full-bridge, where ±2.5V (5V) is desired across the bridge, the excitation should be set to 2.5V + (0.5 x 5 / 350) = 2.507.

Understanding filter delays (IIR filter mode)

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate are always sampled at the same time, independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies. The Acra KAM-500 filters signals using over-sampling signal processing techniques. The following figure shows a delay for an 8th order filter where f_c = 1 kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1 kHz. / f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1 kHz. / f_c). For example, an 8th order Butterworth filter with an f_c of 1 kHz. delays a 1 kHz. signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

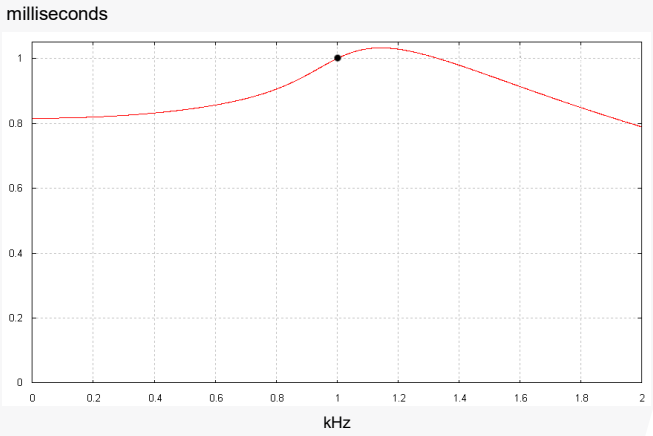


Figure 7: Filter delay for 8th order Butterworth filter where f_c = 1 kHz

The filter delay for the KAD/ADC/134 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_D is the filter delay

T_A (analog filter delay) ≈ 0

Understanding filter delays (FIR filter mode)

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate are always sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies. The Acra KAM-500 filters signals using over-sampling signal processing techniques. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c).

The filter delay for this mode is:

$$T_D \approx T_A + \frac{4}{f_c}$$

T_D is the filter delay

T_A (analog filter delay) ≈ 0

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Unused differential ended inputs

Unused inputs should not be left floating, as this may increase current consumption from the ±12V backplane lines. Floating inputs may cause the output voltage of the instrumentation amplifier to approach one of the supply rails, which causes increased quiescent currents within specific channel circuits. Each unused differential ended input should be shorted together within its pair or connected to GND.

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Connector pinout of the KAD/ADC/134

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	EXC_V(0)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge
2	EXC_V(0)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge
3	ANALOG(0)+	Differential ended analog inputs	Analog input
4	ANALOG(0)-	Differential ended analog inputs	Analog input
5	ANALOG(1)+	Differential ended analog inputs	Analog input
6	ANALOG(1)-	Differential ended analog inputs	Analog input
7	EXC_V(1)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge
8	EXC_V(1)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge
9	ANALOG(2)+	Differential ended analog inputs	Analog input
10	ANALOG(2)-	Differential ended analog inputs	Analog input
11	ANALOG(3)+	Differential ended analog inputs	Analog input
12	ANALOG(3)-	Differential ended analog inputs	Analog input
13	EXC_V(2)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge
14	EXC_V(2)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge
15	ANALOG(4)+	Differential ended analog inputs	Analog input
16	ANALOG(4)-	Differential ended analog inputs	Analog input
17	ANALOG(5)+	Differential ended analog inputs	Analog input
18	ANALOG(5)-	Differential ended analog inputs	Analog input
19	EXC_V(3)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge
20	EXC_V(3)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge
21	ANALOG(6)+	Differential ended analog inputs	Analog input
22	ANALOG(6)-	Differential ended analog inputs	Analog input
23	ANALOG(7)+	Differential ended analog inputs	Analog input
24	ANALOG(7)-	Differential ended analog inputs	Analog input
25	EXC_V(4)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge
26	EXC_V(4)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge
27	ANALOG(8)+	Differential ended analog inputs	Analog input
28	ANALOG(8)-	Differential ended analog inputs	Analog input
29	ANALOG(9)+	Differential ended analog inputs	Analog input
30	ANALOG(9)-	Differential ended analog inputs	Analog input
31	EXC_V(5)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge
32	EXC_V(5)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge
33	ANALOG(10)+	Differential ended analog inputs	Analog input
34	ANALOG(10)-	Differential ended analog inputs	Analog input
35	ANALOG(11)+	Differential ended analog inputs	Analog input
36	ANALOG(11)-	Differential ended analog inputs	Analog input
37	EXC_V(6)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge
38	EXC_V(6)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge
39	ANALOG(12)+	Differential ended analog inputs	Analog input
40	ANALOG(12)-	Differential ended analog inputs	Analog input
41	ANALOG(13)+	Differential ended analog inputs	Analog input
42	ANALOG(13)-	Differential ended analog inputs	Analog input
43	EXC_V(7)+	Bipolar DC voltage excitation outputs	Excitation to top of bridge
44	EXC_V(7)-	Bipolar DC voltage excitation outputs	Excitation to bottom of bridge
45	ANALOG(14)+	Differential ended analog inputs	Analog input
46	ANALOG(14)-	Differential ended analog inputs	Analog input
47	ANALOG(15)+	Differential ended analog inputs	Analog input
48	ANALOG(15)-	Differential ended analog inputs	Analog input
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	

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Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/134/B/100m	Full/½-bridge ADC (voltage excitation, strain gages, shunt resistor, 6.25 kHz b/w, ±100 mV) - 16ch at 25 ksps
KAD/ADC/134/B/1V	Full/½-bridge ADC (voltage excitation, strain gages, shunt resistor, 6.25 kHz b/w, ±1V) - 16ch at 25 ksps
KAD/ADC/134/B/10V	Full/½-bridge ADC (voltage excitation, strain gages, shunt resistor, 6.25 kHz b/w, ±10V) - 16ch at 25 ksps

By default, the standard mating connector (CON/KAD/002/CP) is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

The KAD/ADC/134 uses power from the ±7V power line for excitation and therefore cannot be used with the KAM/CHS/04L, KAM/CHS/05F, KAM/CHS/03F, or KAM/CHS/02F chassis.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/134/B	High impedance per channel when powered off; improvements to digital filter type selection patterns and module power-on specifications	Recommended for new programs
KAD/ADC/134	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

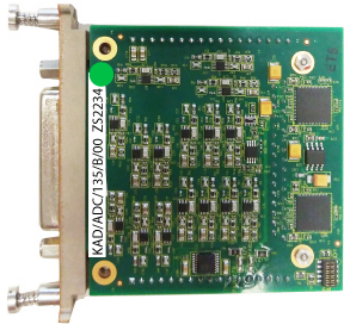
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/001	Strain gages and ideal bridges
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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KAD/ADC/135

Full/½-bridge ADC (voltage/current excitation, programmable analog gain, FIR/IIR, 6.25 kHz b/w) - 12ch at 25 ksps

CURTISSWRIGHTDS.com



Key Features

- 12 full or ½-bridge, potentiometer or differential ended input channels
- Programmable input range (±2.4 mV to ±2.5V)
- High accuracy (0.02% FSR typical)
- Programmable current or voltage excitation per 3 channels and balance adjust per channel
- Shorts only affect channels sharing excitation
- 16-bit simultaneous sampling on each channel
- Completion resistors and classic shunt

Applications

- Bridge sensors and strain gage measurement
- Differential voltage measurement

Overview

The KAD/ADC/135 is used to condition and digitize up to 12 differential ended analog channels using simultaneous sampling 16-bit A/D for each channel. At the heart of the KAD/ADC/135 is a hard-wired state-machine that oversamples all channels at a rate between 100 ksps and 200 ksps and digitally filters any noise above the user-programmable cutoff frequency.

This is achieved using cascaded, half-band, 15-tap, Finite-Impulse-Response (FIR) Kaiser window filters followed by an 8th order Butterworth IIR filter with a default cutoff point set at one quarter of the sampling frequency ($f_c = f_s / 4$). The IIR filter is bypassed in FIR mode with samples output directly from the FIR filter. All signals are sampled simultaneously. When several channels are sampled at different sampling rates, at the start of an acquisition cycle all channels are aligned.

The KAD/ADC/135 supports programmable primary gain, excitation type (current or voltage, with compliance up to 30 mA / ±5.1V), digital filter type as well as completion resistors and high accuracy. Unlike other analog modules, the maximum input voltage range is limited to ±2.5V.

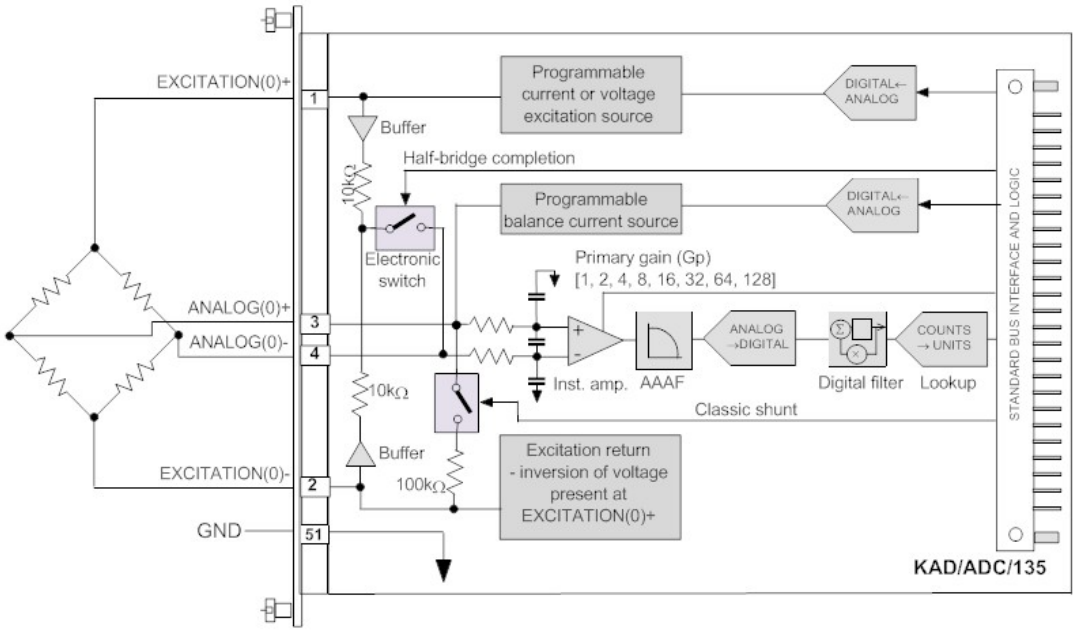


Figure 1: First of twelve channels of the KAD/ADC/135

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	95	–	g	
	–	3.35	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					KAD/ADC/135
+5V	150	165	180	mA	
+7V	90	120	150	mA	Excludes current used by excitation. Includes floating inputs. See “Unused differential ended inputs” on page 389.
-7V	15	25	35	mA	Excludes current used by excitation.
+12V	45	60	75	mA	
-12V	30	40	50	mA	
total power	2.39	3.04	3.70	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Power consumption					KAD/ADC/135/E12
+5V	150	165	180	mA	
±7V	0	0	0	mA	
+12V	100	150	180	mA	Excludes current used by excitation. Includes floating inputs. See “Unused differential ended inputs” on page 389.
-12V	50	70	90	mA	Excludes current used by excitation.
total power	2.55	3.47	4.14	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

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TABLE 2	Differential ended analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	12	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG[11:0]	0.5	–	25,000	sps	For IIR setting of Filter Mode.
ANALOG[11:0]	4	–	25,000	sps	For FIR setting of Filter Mode.
Input voltage					
operating range	-2.5/Gp	–	2.5/Gp	V	Gp is the primary gain. It is automatically selected during software setup based on the Range Maximum and Range Minimum values that are specified for each channel. A further digital or secondary gain (Gs) of values 2, 4, or 8 can be added to primary gain 128.
operating range (Gp = 1)	-2.5	–	2.5	V	Primary gain = 1.
operating range (Gp = 128)	-19.5	–	19.5	mV	Primary gain = 128.
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.
operating range (Gp = 128, Gs = 8)	-2.4	–	2.4	mV	Primary gain = 128; secondary or digital gain = 8.
DC error					DC signal averaged over 200 samples without excitation. The DC error specifications claimed here are input channel specifications only. The total system error may differ as it must include excitation error and depends on the sensor configuration (full-bridge, half-bridge or potentiometer).
Gp = 1, 2, 4, 8	–	0.02	0.06	%FSR	
Gp = 16, 32	–	0.025	0.08	%FSR	
Gp = 64	–	0.03	0.1	%FSR	
Gp = 128	–	0.06	0.18	%FSR	
Gp = 128; Gs = 2	–	0.06	0.18	%FSR	Gs is the secondary or digital gain.
Gp = 128; Gs = 4	–	0.1	0.22	%FSR	Gs is the secondary or digital gain.
Gp = 128; Gs = 8	–	0.2	0.32	%FSR	Gs is the secondary or digital gain.
AC gain error					
for 0 Hz < f_{in} ≤ 2 kHz	–	0.1	0.3	%FSR	For IIR setting of Filter Mode. Gain = 1, f_s = 25 kHz, $f_c = f_s / 4$ (f_{in} : input signal frequency; f_s : sampling frequency; f_c : filter cutoff frequency).
for 2 kHz < f_{in} ≤ 3 kHz	–	0.25	0.5	%FSR	Gain = 1, f_s = 25 kHz, $f_c = f_s / 4$.
for 3 kHz < f_{in} ≤ 4 kHz	–	0.5	0.8	%FSR	Gain = 1, f_s = 25 kHz, $f_c = f_s / 4$.
Effective number of bits					
Gp = 1, 2, 4	12.5	14.5	–	bits	$f_c \leq$ 6.25 kHz and secondary gain of 1.
Gp = 8, 16	12.0	14.0	–	bits	$f_c \leq$ 6.25 kHz and secondary gain of 1.
Gp = 32, 64	11.0	12.5	–	bits	$f_c \leq$ 6.25 kHz and secondary gain of 1.
Gp = 128	10.0	11.5	–	bits	$f_c \leq$ 6.25 kHz and secondary gain of 1.

TABLE 2	Differential ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Crosstalk					
Gp = 1, 2, 4, 8, 16	-80	-90	–	dB	
Gp = 32 to 128	-72	-82	–	dB	
Common mode					
voltage range	-1.5	–	1.5	V	Operational voltage range. Tested with a Full Scale Range (±2.5V) differential input signal, that is, both inputs remain within ±4V of internal GND (pin 51).
rejection ratio (Gp = 1 to 128)	76	100	–	dB	Applies within the above common mode voltage range, $0 \leq f \leq f_c$.
Analog filter					Analog filter is Butterworth.
poles	–	–	4	–	
filter cutoff -3dB	11.9	12.5	13.1	kHz	
Digital filter					For IIR setting of Filter Mode, digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3 dB	0.25	–	16	f_s	The maximum value is limited to 6.25 kHz.
0.1 dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1 dB band	–	–	-72	dB	
aliasing to f_c	–	–	-74	dB	
Filter delay	1.99	2.0	2.01	ms	Measured for $f_{in} = f_c = 1$ kHz (f_{in} : input signal frequency). See “Understanding filter delays (IIR filter mode)” on page 388.
Digital filter					For FIR setting of Filter Mode, digital filter is 15-tap Kaiser window, Beta 4 FIR filter.
poles	–	–	–	–	Not applicable for FIR type filters.
filter cutoff -6 dB	0.25	–	16	f_s	The maximum value is limited to 6.25 kHz.
0.1 dB bandwidth	–	0.64	–	f_c	
aliasing to 0.1 dB band	–	–	-63	dB	
aliasing to f_c	–	–	-53	dB	
Filter delay	3.99	4.0	4.01	ms	Measured for $f_{in} = f_c = 1$ kHz (f_{in} : input signal frequency). See “Understanding filter delays (FIR filter mode)” on page 389.
Input resistance					
between inputs	10	–	–	MΩ	Module powered off.
between inputs	1	–	–	MΩ	Module powered on.
single ended input to GND	10	–	–	MΩ	Module powered on/off and measured at ANALOG(x)+.
single ended input to GND	10	–	–	MΩ	Module powered on/off and measured at ANALOG(x)-.
Input impedance					
between inputs	1	–	–	MΩ	Module powered off. Measured for f_{in} = 1 kHz with $1V_{rms}$ signal.
between inputs	400	–	–	kΩ	Module powered on. Measured for f_{in} = 1 kHz with $1V_{rms}$ signal.
single ended input to GND	1	–	–	MΩ	Module powered off and measured at ANALOG(x)+ for f_{in} = 1 kHz with 1 V_{rms} signal.

TABLE 2	Differential ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
single ended input to GND	500	–	–	kΩ	Module powered on and measured at ANALOG(x)+ for f_{in} = 1 kHz with 1 V_{rms} signal.
single ended input to GND	1	–	–	MΩ	Module powered off and measured at ANALOG(x)- for f_{in} = 1 kHz with 1 V_{rms} signal.
single ended input to GND	500	–	–	kΩ	Module powered on and measured at ANALOG(x)- for f_{in} = 1 kHz with 1 V_{rms} signal.
Shunt resistor					Shunt resistor can be enabled between ANALOG(x)+ and EXC_V(x)-.
resistance	–	100	–	kΩ	Nominal resistance of shunt resistor.
error	–	0.1	–	%	Initial resistor tolerance.
Half-bridge completion					
resistance	–	10	–	kΩ	Nominal resistance of each completion resistor. See “Error and drift for half-bridge configurations” on page 388.
matching	–	0.01	–	%	Initial resistor ratio tolerance. See “Error and drift for half-bridge configurations” on page 388.
tracking TCR	–	1	–	ppm/°C	Tracking Temperature Coefficient of Resistance (TCR). See “Error and drift for half-bridge configurations” on page 388.

TABLE 3	Bipolar programmable DC voltage/current excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	12	–	Set in groups of three.
Output voltage					Excitation Mode set to Voltage.
operating range	1.0	–	5.1	V	Bi-polar excitation: 5V is 10V across the bridge. Minimum value setting is to be used when excitation is not loaded with external loads.
resolution	–	78	–	µV	
compliance	–	–	30	mA	Per channel.
short circuit current	–	–	125	mA	Short of EXCITATION(x)+ or EXCITATION(x)- to GND.
short circuit duration	∞	–	–	s	To GND.
Output current					Excitation Mode set to Current.
operating range	0	–	30	mA	0A setting is to be used when excitation is not used or not loaded with external loads. When using with loads, current must be set so that voltage across the bridge is within the compliance range specified below.
resolution	–	475	–	nA	
compliance	2.0	–	10.2	V	Across the bridge.
short EXCITATION(x)+ to GND	–	–	30	mA	
short EXCITATION(x)- to GND	–	–	125	mA	
short circuit duration	∞	–	–	s	To GND.
DC error					
error	–	0.1	0.2	%FSR	With a constant 350Ω load. Excitation Mode set to Voltage.
drift	–	0.05	0.1	%FSR	Over temperature with a constant 350Ω load. Excitation Mode set to Voltage. Included in error specification above.
error	–	0.15	0.3	%FSR	With a constant 350Ω load. Excitation Mode set to Current.
drift	–	0.1	0.2	%FSR	Over temperature with a constant 350Ω load. Excitation Mode set to Current. Included in error specification above.
noise (GP = 1)	–	0.03	0.1	mV_{rms}	As measured on analog input; bridge unbalanced to 90% of FSR.
noise (GP = 32)	–	0.003	0.01	mV_{rms}	As measured on analog input; bridge unbalanced to 90% of FSR.
noise (GP = 128)	–	0.003	0.01	mV_{rms}	As measured on analog input; bridge unbalanced to 90% of FSR.
Output resistance					
	–	0.1	0.3	Ω	Excitation Mode set to Voltage. Measured between EXCITATION(x)+ and EXCITATION(x)-.
	0.5	1.0	–	MΩ	Excitation Mode set to Current. Measured between EXCITATION(x)+ and EXCITATION(x)-.

TABLE 4	Bridge adjust DC current outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	12	–	Internally connected with corresponding ANALOG(x)+ input.
Output current					
operating range	-100	–	100	µA	
resolution	–	53	–	nA	
DC error					
error	–	0.54	0.75	%FSR	With a constant 175Ω load. The impact of this error on the channel reading is usually negligible.
drift	–	0.07	0.2	%FSR	Over temperature.
noise	–	0.002	0.01	mV_{rms}	As measured on analog input with Gp = 128.
Output resistance	10	30	–	MΩ	

Setting up the KAD/ADC/135

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/135/B	KAD/ADC/135/B	The instrument part reference.
SerialNumber	AAA/1234	AAA/1234	Unique name for each module.
Channels	-	-	-
Analog(11:0) Analog Input	-	-	-
Settings	-	-	-
Filter Mode	IIR FIR	IIR	Specifies filter mode for specific channel. IIR is 8th order Butterworth IIR filter, and FIR is 15-tap Kaiser window Beta = 4 FIR filter.
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.
Excitation Mode	Voltage Current	Voltage	Excitation mode can be either Voltage or Current.
Excitation Amplitude	0 to 5.1 0 to 30e-3	1.0	Required excitation (in V or A depends on Excitation Mode) for the top of the bridge. Excitation is bipolar, that means for Excitation Mode set to Voltage, entering 5V means 10V across the bridge. Excitation Mode = Voltage. Excitation Mode = Current.
Settings Balance	-	-	-
Balance.Type	CurrentShunt	CurrentShunt	Specifies the balance type to be carried out on the bridge.
Balance.Applied	-100e-6 to 100e-6	0	Shunt current (in A) applied to the bridge.
Balance.BalanceThisTime	True False	False	Specifies if balancing should be carried out this time by software.
Balance.Tolerance	0.01 to 99.99	0.1	Specifies acceptable tolerance of achieved value vs. target value, expressed as percentage of defined input range.
Balance.Target	-2.5 to 2.5	0	Specifies a value that the channel should be balanced to.
Settings Shunt			
Classic Shunt	Disabled Enabled	Disabled	Specifies whether the switch that connects the classic shunt resistor is to be enabled between EXC(x)- and ANALOG(x)+ nets.
ShuntCurrent.Applied	-100e-6 to 100e-6	0	Shunt mode current (in A) added to the bridge.
Enable Half Bridge Completion Resistors	Disabled Enabled	Disabled	Specifies if switch connecting internal completion resistors for half bridge with ANALOG(x)- is to be enabled.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Analog(11:0) Parameters				
Analog Analog signal data	Volt	OffsetBinary	16	R[15:0]

Configurable parameters

Analog(11:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-2.5 to 2.5	2.5	Range maximum for analog channel.
Range Minimum	-2.5 to 2.5	-2.5	Range minimum for analog channel.

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/135

Wiring configurations

Figures 2 to 5 show possible wiring configurations for the KAD/ADC/135.

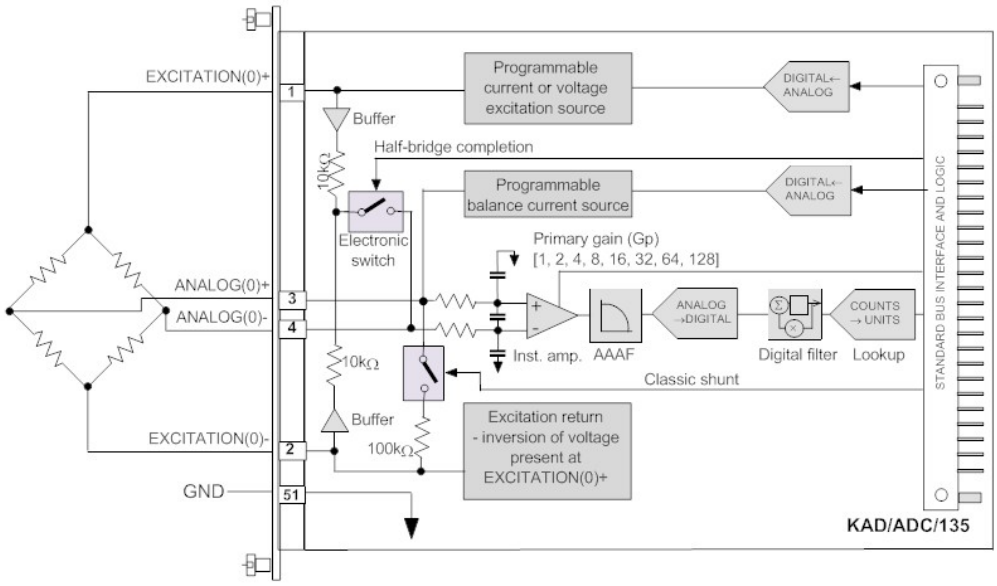


Figure 2: First channel in full-bridge configuration

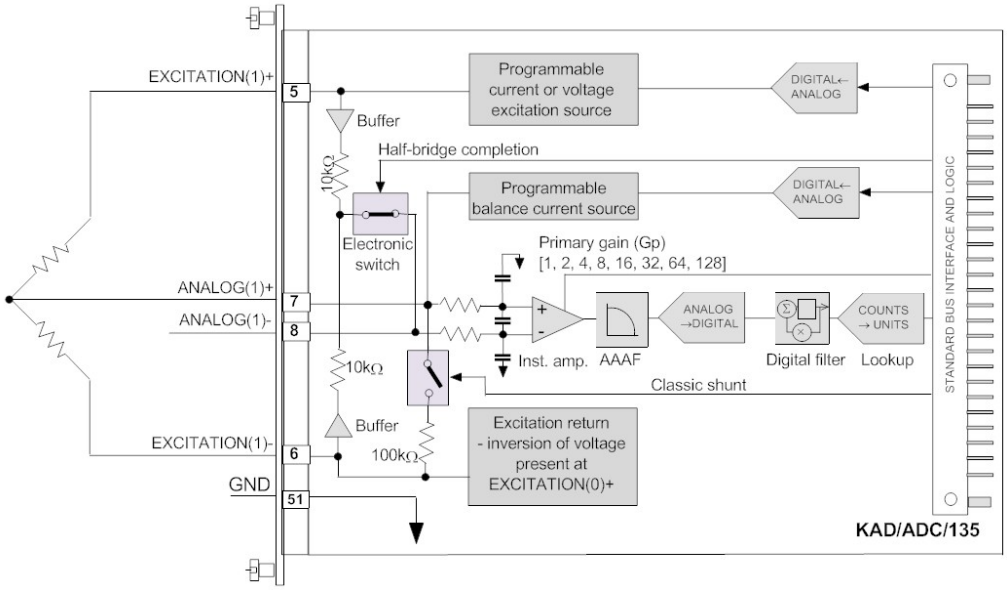


Figure 3: Second channel in half-bridge configuration, with matched pair of internal completion resistors enabled

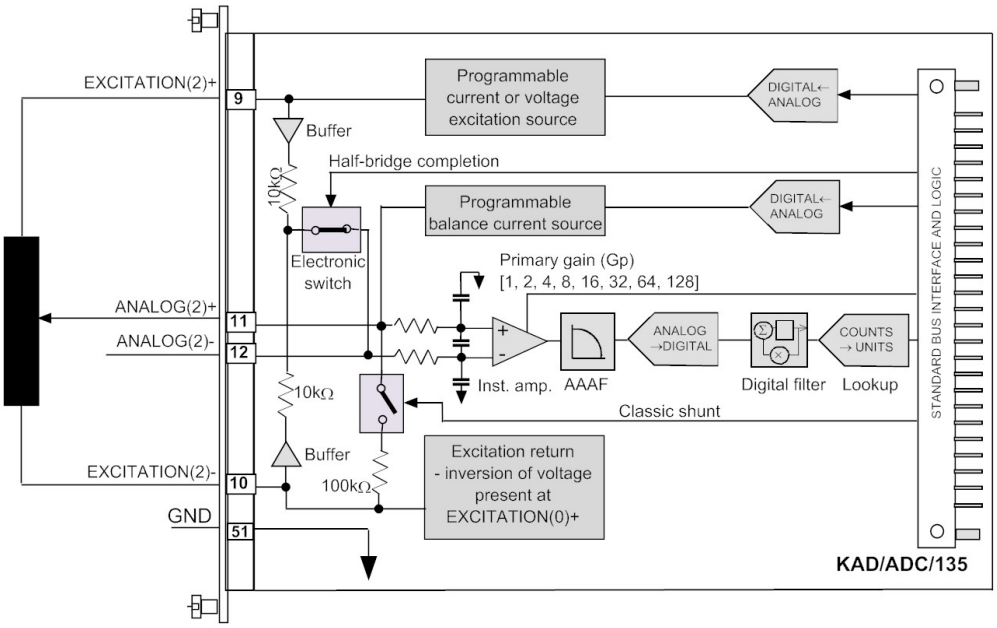


Figure 4: Third channel in potentiometer configuration, with matched pair of internal completion resistors enabled

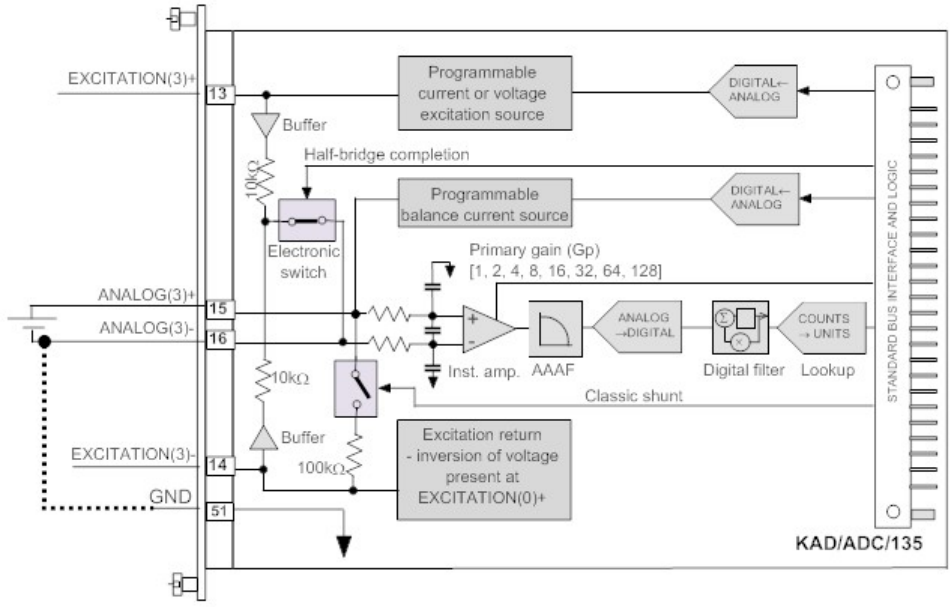


Figure 5: Fourth channel in differential ended configuration, with matched pair of internal completion resistors enabled (bias current return path)

Bias current return path

As shown in the previous figure, the analog inputs can be used as differential inputs (that is, not from a bridge). In this case, if the signal source is isolated with respect to the Acra KAM-500 (for example a battery), a common-mode resistance between the negative input and ground (GND) should be used to provide a return for bias currents and reduce common-mode noise pick-up. Bias currents are in the order of nAs. In order to correctly set up the return path for bias currents, excitation for a specific channel should be set to voltage mode (any value from range), and either completion resistors should be enabled to internally pull-down to around 0V (middle voltage between bipolar excitation) or an external path to GND should be used, for example short (0Ω) to GND (as shown by the dotted line in the previous figure).

NOTE: When analog inputs are used as differential inputs, setting the balance to zero is required.

Excitation setup

Excitation can contribute error to the overall measurement, so it is recommended to use as close as possible to full-scale excitation, to minimize the percentage error.

For optimal accuracy ensure each channel uses its corresponding excitation. If the excitation is not used, it should be set to the minimum value.

Excitation drift on potentiometer configurations

We recommend a full-bridge input configuration for the KAD/ADC/135. With this configuration the differential input amplifier removes common mode voltage or common mode pickup noise on the input lines. A similar configuration can be achieved with a potentiometer by using completion resistors, however, only the common mode voltage error present in the excitation is compensated for.

NOTE: For the KAD/ADC/135, internal completion resistors can be enabled by changing the Enable Half Bridge Completion Resistors setting to Enabled (see Figure 4 on page 387).

Error and drift for half-bridge configurations

For half-bridge configurations, internal completion resistors can be enabled by setting Enable Half Bridge Completion Resistors to Enabled. These matched resistors have a defined matching error, as well as tracking TCR, which may result in an additional error of measurement. The initial matching error can be compensated for by balancing the bridge. This is done by setting the balance current to a value which nulls the reading for the ambient temperature at which balancing was carried out. However, the tracking TCR error introduced is the result of the drift of the matching ratio as the temperature changes, and so cannot be compensated for.

For example, when the voltage across the bridge is 10V, then 2 ppm / °C causes 5 µV / °C of drift on the channel being read. For a 60°C ambient temperature change, tracking TCR is responsible for 300 µV of drift.

Compensation for lead resistance (Excitation Mode set to Voltage)

In bridge applications, if the lead resistance can be measured or estimated, add the voltage drop across the leads to the excitation voltage. For example, for 0.5Ω leads in a 350Ω full-bridge, where ±2.5V (5V) is desired across the bridge, the excitation should be set to 5V + (0.5 × 5 / 350) = ±2.507.

NOTE: When Excitation Mode is set to Current, the leads resistance does not need to be compensated for.

Understanding filter delays (IIR filter mode)

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate are always sampled at the same time, independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. The following figure shows a delay for an 8th order filter where f_c = 1 kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1 kHz / f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1 kHz / f_c). For example, an 8th order Butterworth filter with an f_c of 1 kHz delays a 1 kHz signal by 1ms; a filter with an f_c of 10 Hz delays a 10 Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

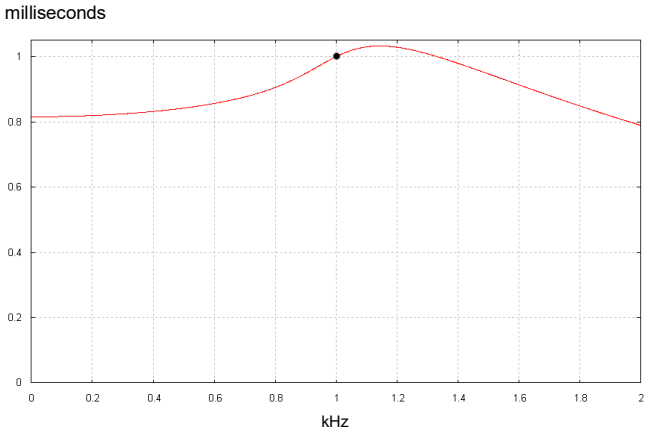


Figure 6: Filter delay for 8th order Butterworth filter where f_c = 1kHz

The filter delay for the KAD/ADC/135 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_D is the filter delay

T_A (analog filter delay) ≈ 0

Understanding filter delays (FIR filter mode)

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate are always sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies. The Acra KAM-500 filters signals using over-sampling signal processing techniques. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c).

The filter delay for this mode is:

$$T_D \approx T_A + \frac{4}{f_c}$$

T_D is the filter delay

T_A (analog filter delay) ≈ 0

Unused differential ended inputs

Unused inputs may increase current consumption from the +7V (standard variant) or +12V (E12 variant) backplane lines. Floating inputs may cause the output voltage of the instrumentation amplifier to approach one of the supply rails, which causes increased quiescent currents within specific channel circuits. This can correspond to approximately 1.33 mA per channel on the standard variant or 2.5 mA per channel for the E12 variant. It is recommended that each unused differential ended input is connected to GND.

Connector pinout of the KAD/ADC/135

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	EXCITATION(0)+	Bipolar programmable DC voltage/current excitation outputs	Excitation to top of bridge for channel 0
2	EXCITATION(0)-	Bipolar programmable DC voltage/current excitation outputs	Excitation to bottom of bridge for channel 0
3	ANALOG(0)+	Differential ended analog inputs	Analog input
4	ANALOG(0)-	Differential ended analog inputs	Analog input
5	EXCITATION(1)+	Bipolar programmable DC voltage/current excitation outputs	Excitation to top of bridge for channel 1
6	EXCITATION(1)-	Bipolar programmable DC voltage/current excitation outputs	Excitation to bottom of bridge for channel 1
7	ANALOG(1)+	Differential ended analog inputs	Analog input
8	ANALOG(1)-	Differential ended analog inputs	Analog input
9	EXCITATION(2)+	Bipolar programmable DC voltage/current excitation outputs	Excitation to top of bridge for channel 2
10	EXCITATION(2)-	Bipolar programmable DC voltage/current excitation outputs	Excitation to bottom of bridge for channel 2
11	ANALOG(2)+	Differential ended analog inputs	Analog input
12	ANALOG(2)-	Differential ended analog inputs	Analog input
13	EXCITATION(3)+	Bipolar programmable DC voltage/current excitation outputs	Excitation to top of bridge for channel 3
14	EXCITATION(3)-	Bipolar programmable DC voltage/current excitation outputs	Excitation to bottom of bridge for channel 3
15	ANALOG(3)+	Differential ended analog inputs	Analog input
16	ANALOG(3)-	Differential ended analog inputs	Analog input
17	GND	Internal ground	
18	GND	Internal ground	
19	EXCITATION(4)+	Bipolar programmable DC voltage/current excitation outputs	Excitation to top of bridge for channel 4
20	EXCITATION(4)-	Bipolar programmable DC voltage/current excitation outputs	Excitation to bottom of bridge for channel 4
21	ANALOG(4)+	Differential ended analog inputs	Analog input
22	ANALOG(4)-	Differential ended analog inputs	Analog input
23	EXCITATION(5)+	Bipolar programmable DC voltage/current excitation outputs	Excitation to top of bridge for channel 5
24	EXCITATION(5)-	Bipolar programmable DC voltage/current excitation outputs	Excitation to bottom of bridge for channel 5
25	ANALOG(5)+	Differential ended analog inputs	Analog input
26	ANALOG(5)-	Differential ended analog inputs	Analog input
27	EXCITATION(6)+	Bipolar programmable DC voltage/current excitation outputs	Excitation to top of bridge for channel 6
28	EXCITATION(6)-	Bipolar programmable DC voltage/current excitation outputs	Excitation to bottom of bridge for channel 6
29	ANALOG(6)+	Differential ended analog inputs	Analog input
30	ANALOG(6)-	Differential ended analog inputs	Analog input
31	EXCITATION(7)+	Bipolar programmable DC voltage/current excitation outputs	Excitation to top of bridge for channel 7
32	EXCITATION(7)-	Bipolar programmable DC voltage/current excitation outputs	Excitation to bottom of bridge for channel 7
33	ANALOG(7)+	Differential ended analog inputs	Analog input
34	ANALOG(7)-	Differential ended analog inputs	Analog input
35	EXCITATION(11)+	Bipolar programmable DC voltage/current excitation outputs	Excitation to top of bridge for channel 11
36	EXCITATION(8)+	Bipolar programmable DC voltage/current excitation outputs	Excitation to top of bridge for channel 8
37	EXCITATION(8)-	Bipolar programmable DC voltage/current excitation outputs	Excitation to bottom of bridge for channel 8
38	ANALOG(8)+	Differential ended analog inputs	Analog input
39	ANALOG(8)-	Differential ended analog inputs	Analog input
40	EXCITATION(9)+	Bipolar programmable DC voltage/current excitation outputs	Excitation to top of bridge for channel 9
41	EXCITATION(9)-	Bipolar programmable DC voltage/current excitation outputs	Excitation to bottom of bridge for channel 9
42	ANALOG(9)+	Differential ended analog inputs	Analog input
43	ANALOG(9)-	Differential ended analog inputs	Analog input
44	EXCITATION(10)+	Bipolar programmable DC voltage/current excitation outputs	Excitation to top of bridge for channel 10
45	EXCITATION(10)-	Bipolar programmable DC voltage/current excitation outputs	Excitation to bottom of bridge for channel 10
46	ANALOG(10)+	Differential ended analog inputs	Analog input
47	ANALOG(10)-	Differential ended analog inputs	Analog input
48	EXCITATION(11)-	Bipolar programmable DC voltage/current excitation outputs	Excitation to bottom of bridge
49	ANALOG(11)+	Differential ended analog inputs	Analog input
50	ANALOG(11)-	Differential ended analog inputs	Analog input
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/135/B	Full/½-bridge ADC (voltage/current excitation, programmable analog gain, FIR/IIR, 6.25 kHz b/w) - 12ch at 25 ksps (uses ±7V for excitation)
KAD/ADC/135/B/E12	Full/½-bridge ADC (voltage/current excitation, programmable analog gain, FIR/IIR, 6.25 kHz b/w) - 12ch at 25 ksps (uses ±12V for excitation)

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

The KAD/ADC/135 uses power from the ±7V power line for excitation and therefore cannot be used with KAM/CHS/04L, KAM/CHS/05F, KAM/CHS/03F, or KAM/CHS/02F. The KAD/ADC/135/E12 uses power from the ±12V power line, so it can be used with the aforementioned chassis.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/135/B	Lower power consumption; programmable classic shunt resistor added; high impedance per channel when powered off; minimal excitation output compliance is 0V; configurable filter mode per channel; individually configurable analog gains	Recommended for new programs
KAD/ADC/135	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/001	Strain gages and ideal bridges
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

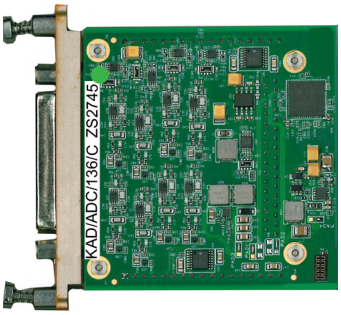
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ADC/136

Flexible ADC (full/½-bridge, ICP, RTD thermocouple, FIR/IIR, 12.5kHz b/w) - 8ch at 50ksps

CURTISSWRIGHTDS.COM



Key Features

- Eight flexible input channels
- Programmable input range (±40mV to ±10V)
- High accuracy (0.02% FSR typical)
- Programmable current or voltage excitation per channel (10.2V/32mA)
- High input resistance when on/off
- Short on any channel does not affect others
- 16 bit simultaneous sampling with two output streams with FIR or IIR on each channel
- Completion resistors and classic shunt

Applications

- Applications with a mix of voltage, strain temperature and acceleration sensors

Overview

The KAD/ADC/136 is used to condition and digitize up to eight analog channels. Each channel can be configured for use in differential ended or single ended voltage measurement, ICP sensor, RTD sensor, thermocouple, full-bridge, half-bridge, or potentiometer mode.

For each thermocouple channel, it is necessary to select the Junction Compensation Channel setting. Internally, the KAD/ADC/136 performs linearization for RTD and thermocouple modes.

At the heart of the KAD/ADC/136 is a hard-wired state-machine that oversamples all channels at a rate between 100ksps and 200ksps and digitally filters any noise above the user-programmable cutoff frequency. This is achieved using cascaded, half-band FIR filters. If IIR filtering mode is selected, the last digital filter in the filtering chain is an 8th order Butterworth IIR filter; when FIR mode is selected, the last digital filter in the filtering chain is a Kaiser window FIR filter. There are two independently configurable output streams per channel, allowing different sample rate, cutoff, and filter type to be selected for each output stream. All signals are sampled simultaneously. When several channels are sampled at different sampling rates, at the start of an acquisition cycle all channels are aligned.

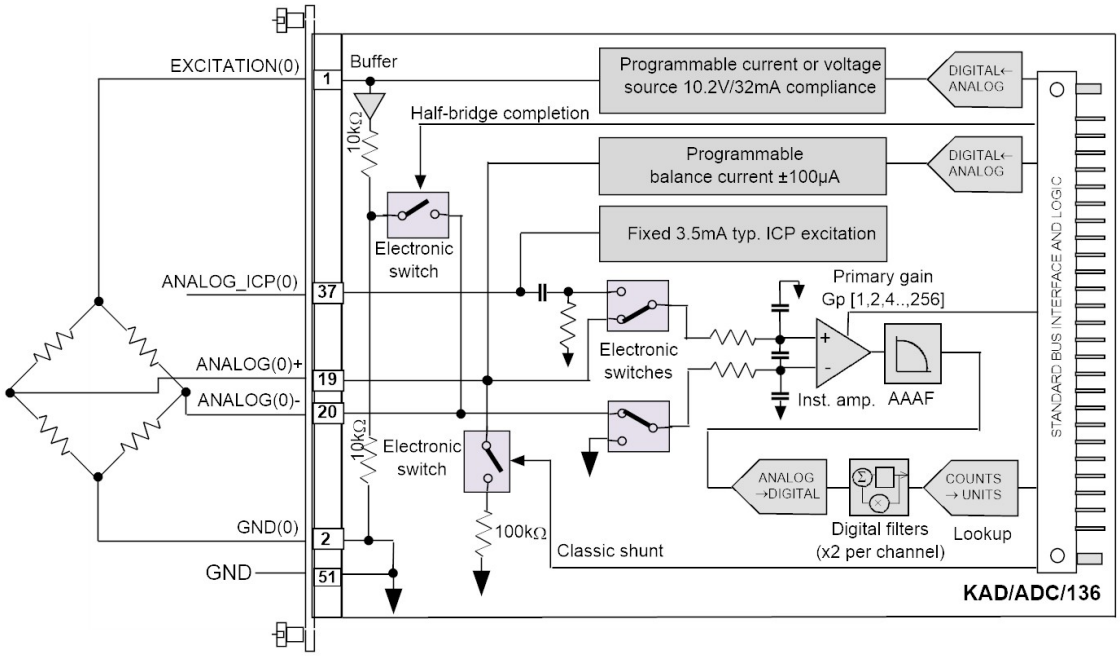


Figure 1: First of eight flexible channels programmed for full-bridge input configuration

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	95	–	g	
	–	3.35	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					KAD/ADC/136.
+5V	105	180	195	mA	
+7V	110	130	145	mA	Excludes current used for Excitation(x) outputs. As a DC/DC converter is used, multiply excitation current by 2.35.
-7V	115	125	135	mA	
+12V	15	25	35	mA	Excludes current used for ICP sensors. As a DC/DC converter is used, multiply ICP output current by 2.7 to calculate line current.
-12V	5	15	25	mA	
total power	2.34	3.17	3.66	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation*, *TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Power consumption					KAD/ADC/136/E12.
+5V	105	180	195	mA	
±7V	0	–	0	mA	
+12V	95	110	120	mA	Excludes current used for Excitation(x) outputs or ICP sensors. As a DC/DC converter is used, multiply excitation current by 1.35 or multiply ICP output current by 2.7 to calculate line current.
-12V	70	80	90	mA	
total power	2.51	3.18	3.50	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation*, *TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

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TABLE 2	Flexible analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	8	–	With two independently configurable output streams per channel.
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG[7:0] or ANALOG_ICP[7:0]	0.5	–	50,000	sps	For IIR setting of Filter Mode on each output stream.
ANALOG[7:0] or ANALOG_ICP[7:0]	0.5	–	50,000	sps	For FIR setting of Filter Mode on each output stream.
Input voltage					Differential ended voltage across the ANALOG(x)± input or the AC voltage level on the ANALOG_ICP(x) input.
operating range	-10/Gp	–	10/Gp	V	Gp is the primary gain. It is automatically selected during software setup based on the Range Maximum and Range Minimum values that are specified for each channel.
operating range (Gp = 1)	-10	–	10	V	Primary gain = 1.
operating range (Gp = 256)	-39.06	–	39.06	mV	Primary gain = 256.
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.
ANALOG(x)± single ended voltage range	-10	–	10	V	Specifications defined in this data sheet for ANALOG(x)± inputs are valid only when this condition is met.
DC error when Input Mode set to Voltage					DC signal averaged over 200 samples without excitation. The DC error specifications claimed here are input channel specifications for both differential ended and single ended setup only. To calculate the total system error for full-bridge and half-bridge modes, the error related to excitation must also be considered.
Gp = 1, 2, 4, 8, 16, and 32	–	0.02	0.08	%FSR	
Gp = 64	–	0.03	0.1	%FSR	
Gp = 128	–	0.03	0.13	%FSR	
Gp = 256	–	0.04	0.18	%FSR	

TABLE 2	Flexible analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
DC error when Input Mode set to Thermocouple					DC signal averaged over 200 samples. Includes error from the RTD channel nominated as a reference junction channel. Specification valid for PT100 sensor within -55°C to 125°C at 2mA.
error	–	1.0	2.5	°C	For a grounded or isolated K-type thermocouple, when the FSR range is between -50°C and 150°C. This error includes the cold junction measurement error and is met for an ambient temperature change rate of up to 1°C per minute using an ACD/CJB/005. Many other thermocouple types are supported. Contact Curtiss-Wright support (acra-support@curtisswright.com) for further information.
error	–	1.5	3.5	°C	For a grounded or isolated K-type thermocouple, when the FSR range is outside the range of -50°C to 150°C, and for measured temperatures above -150°C. This error includes the cold junction measurement error and is met for an ambient temperature change rate of up to 1°C per minute using an ACD/CJB/005. Many other thermocouple types are supported. Contact Curtiss-Wright support (acra-support@curtisswright.com) for further information.
DC error when Input Mode set to RTD sensor					DC signal averaged over 200 samples. Includes error of excitation set to 2mA.
for FSR of -50°C to 200°C	–	0.25	0.75	°C	For a PT100 sensor, with excitation set to 2mA.
for FSR of -200°C to 660°C	–	0.6	1.8	°C	For a PT100 sensor, with excitation set to 2mA.
AC gain error when Input Mode set to ICP sensor					
Gp = 1...16	–	0.1	0.3	%	For 10Hz < $f_{in} \leq$ 1.5kHz, f_s = 50kHz, $f_c = f_s / 4$ (f_{in} : input signal frequency; f_s : sampling frequency; f_c : filter cutoff frequency).
Gp = 1...16	–	0.2	0.5	%	For 1.5kHz < $f_{in} \leq$ 5kHz, f_s = 50kHz, $f_c = f_s / 4$.
Gp = 1...16	–	0.3	0.75	%	For 5kHz < $f_{in} \leq$ 7.5kHz, f_s = 50kHz, $f_c = f_s / 4$.
Effective number of bits					
Gp = 1, 2, 4, 8, and 16	12	13.5	–	bits	$f_c \leq$ 1kHz and secondary gain of 1.
Gp = 32...128	11	12.5	–	bits	$f_c \leq$ 1kHz and secondary gain of 1.
Gp = 256	10	12.0	–	bits	$f_c \leq$ 1kHz and secondary gain of 1.
Gp = 1, 2, 4, 8, and 16	8.5	11.5	–	bits	1kHz < $f_c \leq$ 12.5kHz and secondary gain of 1.
Gp = 32...128	9.5	11.0	–	bits	1kHz < $f_c \leq$ 12.5kHz and secondary gain of 1.
Gp = 256	9	10.5	–	bits	1kHz < $f_c \leq$ 12.5kHz and secondary gain of 1.
Crosstalk					
Gp = 1...256	–	-100	-80	dB	ANALOG(x)±.
Gp = 1...32	–	-100	-80	dB	ANALOG_ICP(x). No specifications are claimed for higher Gp ranges, as it is assumed they are of no practical use.
Common mode					For ANALOG(x)±.
voltage range	-10	–	10	V	Operational voltage range.
rejection ratio (Gp = 1...256)	90	105	–	dB	Applies within specified common mode voltage range; $f_{in} \leq$ 1kHz.

TABLE 2	Flexible analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
rejection ratio (Gp = 1...256)	66	80	–	dB	Applies within specified common mode voltage range; 1kHz < f_{in} ≤ 12.5kHz.
Analog filter					Analog filter is Butterworth.
High pass filter					Applicable only for ANALOG_ICP(x) inputs.
poles	–	–	1	–	
filter cutoff -3dB	0.13	0.16	0.19	Hz	
Anti aliasing filter					
poles	–	–	6	–	
filter cutoff -3dB	19	20	21	kHz	
Digital filter					For IIR setting of Filter Mode, digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 12.5kHz (f_s: sampling frequency).
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to f_c band	–	–	-72	dB	Measured with $1V_{pp}$ signal, for f_{in} ≤ 100kHz (f_{in} : input signal frequency).
aliasing to f_c band	–	–	-60	dB	Measured with $1V_{pp}$ signal, for f_{in} > 100kHz.
Filter delay	1.99	2.0	2.01	ms	Measured for f_{in} = f_c = 1kHz. This value does not include the difference in delay caused by the high pass filter when an ANALOG_ICP(x) input is used.
Digital filter					For FIR setting of Filter Mode, digital filter is 15-tap Kaiser window, Beta 4, half-band FIR filter.
poles	–	–	–	–	
filter cutoff -6dB	0.25	–	16	f_s	The maximum value is limited to 12.5kHz.
0.1dB bandwidth	–	0.64	–	f_c	
aliasing to 0.1dB band	–	–	-63	dB	Measured with $1V_{pp}$ signal.
aliasing to f_c	–	–	-53	dB	Measured with $1V_{pp}$ signal.
Filter delay	3.99	4.0	4.01	ms	Measured for f_{in} = f_c = 1kHz. This value does not include the difference in delay caused by the high pass filter when an ANALOG_ICP(x) input is used.
Input resistance					
between inputs	5	–	–	MΩ	Module powered on/off and measured between ANALOG(x)+ and ANALOG(x)-.
single ended input to GND	2	20	–	MΩ	Module powered on/off and measured at ANALOG(x)+ and ANALOG(x)-. Typical value claimed for input voltage ±5V or less. Minimum value claimed when the module is powered off and input voltage is at ±10V.
Input impedance					All measurements carried out with 1kHz $1V_{rms}$ signal.
between inputs	–	0.5	–	MΩ	Module powered on. Measured between ANALOG(x)+ and ANALOG(x)-.
between inputs	–	2.5	–	MΩ	Module powered off. Measured between ANALOG(x)+ and ANALOG(x)-.
single ended input to GND	–	0.8	–	MΩ	Module powered on and measured at ANALOG(x)+ or ANALOG(x)-.

TABLE 2	Flexible analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
single ended input to GND	–	2.7	–	MΩ	Module powered off and measured at ANALOG(x)+ or ANALOG(x)-.
Shunt resistor					Shunt resistor can be enabled between ANALOG(x)+ and GND.
resistance	–	100	–	kΩ	Nominal resistance of shunt resistor.
error	–	0.1	–	%	Initial resistor tolerance.
Half-bridge completion					Enabled when Input Mode is set to Half-bridge.
resistance	–	10	–	kΩ	Nominal resistance of each completion resistor. See “Error and drift for half-bridge configurations” on page 407.
matching	–	0.01	–	%	Initial resistor ratio tolerance. See “Error and drift for half-bridge configurations” on page 407.
tracking TCR	–	1	–	ppm/°C	Tracking Temperature Coefficient of Resistance (TCR). See “Error and drift for half-bridge configurations” on page 407.

TABLE 3	Uni-polar programmable DC voltage/current excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	8	–	
Output voltage					Excitation mode set to Voltage.
operating range	0	–	10.2	V	Uni-polar excitation. Minimal value setting is to be used when excitation is not loaded with external loads.
resolution	–	200	–	µV	
compliance	–	–	32	mA	Per channel. To GND.
short circuit current	–	65	–	mA	
short circuit duration	∞	–	–	s	To GND.
Output current					Excitation mode set to Current.
operating range	0	–	32	mA	0A setting is to be used when excitation is not used or is not loaded with external loads. When Excitation Amplitude is set to 3mA or lower, then excitation operates in low range mode (FSR of 3mA), otherwise it operates in high range mode (FSR of 32mA).
resolution	–	500	–	nA	
compliance	0	–	10.2	V	
short circuit current	–	–	32	mA	
short circuit duration	∞	–	–	s	To GND.
DC error					
error	–	0.03	0.08	%FSR	With a constant 350Ω load. Excitation Mode set to Voltage. Includes drift.
error	–	0.06	0.14	%FSR	With a constant 175Ω load. Excitation Mode set to Current for low or high range (3mA or 32mA FSR). Includes drift.
noise	–	–	0.5	mV_{rms}	As measured on analog input; bridge unbalanced to 90% of FSR.
Output resistance					
	–	0.1	0.18	Ω	Excitation Mode set to Voltage.
	–	1	–	MΩ	Excitation Mode set to Current.

TABLE 4	Balance current outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	8	–	Internally connected with corresponding ANALOG(x)+ input.
Output current					
operating range	-100	–	100	µA	
resolution	–	53	–	nA	
DC error					
error	–	0.1	0.3	%FSR	With a constant 175Ω load. The impact of this error on the channel reading is usually negligible.
noise	–	–	15	μV_{rms}	As measured on analog input with Gp = 256.
Output resistance	5	10	–	MΩ	

TABLE 5	Single ended DC current excitation outputs (internal ICP excitations)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	8	–	Internally connected with corresponding ANALOG_ICP(x) input.
Constant current output	3	3.5	4	mA	
Output voltage	0	–	27.5	V	
Short circuit duration	∞	–	–	s	
Noise	–	3	–	mV_{rms}	As measured on analog input.

Setting up the KAD/ADC/136

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/136/C	KAD/ADC/136/C	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
Analog(7:0)(1:0) Analog Input	-	-	-
Settings	-	-	-
Input Mode	Differential ended voltage Single ended voltage Full-bridge Half-bridge Thermocouple RTD sensor ICP sensor	Differential ended voltage	Specifies operation mode of input.
Filter Mode(0)	IIR FIR	IIR	Specifies filter mode for specific channel. IIR is 8th order Butterworth IIR filter, and FIR is 15-tap Kaiser window Beta = 4 FIR filter.
Filter Mode(1)	IIR FIR	IIR	Specifies filter mode for specific channel 2nd parameter. IIR is 8th order Butterworth IIR filter, and FIR is 15-tap Kaiser window Beta = 4 FIR filter.
Filter Cutoff(0)	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate. Setting for 1st channel parameter.
Filter Cutoff(1)	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate. Setting for 2nd channel parameter.
Excitation Mode	Voltage Current	Voltage	Excitation mode, can be either Voltage or Current.

SETUP DATA	CHOICE	DEFAULT	NOTES
Excitation Amplitude	0 to 10.2 0 to 32e-3	5.0	Required excitation (in V or A depends on Excitation Mode) for the top of the bridge. Excitation is unipolar. Excitation Mode = Voltage Excitation Mode = Current
Balance.Type	CurrentShunt	CurrentShunt	Specifies the balance type to be carried out on the bridge.
Balance.Applied	-100e-6 to 100e-6	0	Shunt current (in A) applied to the bridge.
Balance.BalanceThisTime	True False	False	Specifies if balancing should be carried out this time by software.
Balance.Tolerance	0.01 to 99.99	0.1	Specifies acceptable tolerance of achieved value vs. target value, expressed as percentage of defined input range.
Balance.Target	-10 to 10	0	Specifies a value. that the channel should be balanced to.
ShuntCurrent.Applied	-100e-6 to 100e-6	0	Shunt mode current (in A) added to the bridge.
Classic Shunt	Disabled Enabled	Disabled	Specifies if switch connecting classic shunt resistor is to be enabled between ANALOG(x)+ and GND nets.
Linearization Algorithm Reference	UTF-8 String	.\LookupFiles\OneToOne.lu	Specifies a URL where a specific linearization lookup file can be found.
Junction Compensation Channel	0 to 7	0	This setting is applicable for Input Mode set to Thermocouple. It defines which channel is used as reference junction compensation. Only RTD sensors are supported as possible junction compensation.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Analog(7:0)(1:0) Parameters				
Analog(7:0)(1:0) Analog signal data	Volt Volt Volt Volt Volt Celsius Celsius Volt	OffsetBinary OffsetBinary OffsetBinary OffsetBinary OffsetBinary OffsetBinary OffsetBinary OffsetBinary	16	R[15:0] Default condition Input Mode = Differential ended voltage Input Mode = Single ended voltage Input Mode = Full-bridge Input Mode = Half-bridge Input Mode = Thermocouple Input Mode = RTD sensor Input Mode = ICP sensor

Configurable parameters

Analog(7:0)(1:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum			Range maximum for analog channel.
	-10 to 10	10	Default condition
	-10 to 10		Input Mode = Differential ended voltage
	-10 to 10		Input Mode = Single ended voltage
	-10 to 10		Input Mode = Full-bridge
	-10 to 10		Input Mode = Half-bridge
	-270 to 2320		Input Mode = Thermocouple
	-200 to 660		Input Mode = RTD sensor
	-10 to 10		Input Mode = ICP sensor
Range Minimum			Range minimum for analog channel.
	-10 to 10	-10	Default condition
	-10 to 10		Input Mode = Differential ended voltage
	-10 to 10		Input Mode = Single ended voltage
	-10 to 10		Input Mode = Full-bridge
	-10 to 10		Input Mode = Half-bridge
	-270 to 2320		Input Mode = Thermocouple
	-200 to 660		Input Mode = RTD sensor
	-10 to 10		Input Mode = ICP sensor

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/136

Unipolar excitation and unbalanced power consumption

Care must be taken when calculating the overall power consumption of the chassis specifically for unbalanced power consumption on the different power lines. For more information, refer to *TEC/NOT/049 - Power estimation*.

Wiring configurations

Figures 2 to 9 show possible wiring configurations for the KAD/ADC/136.

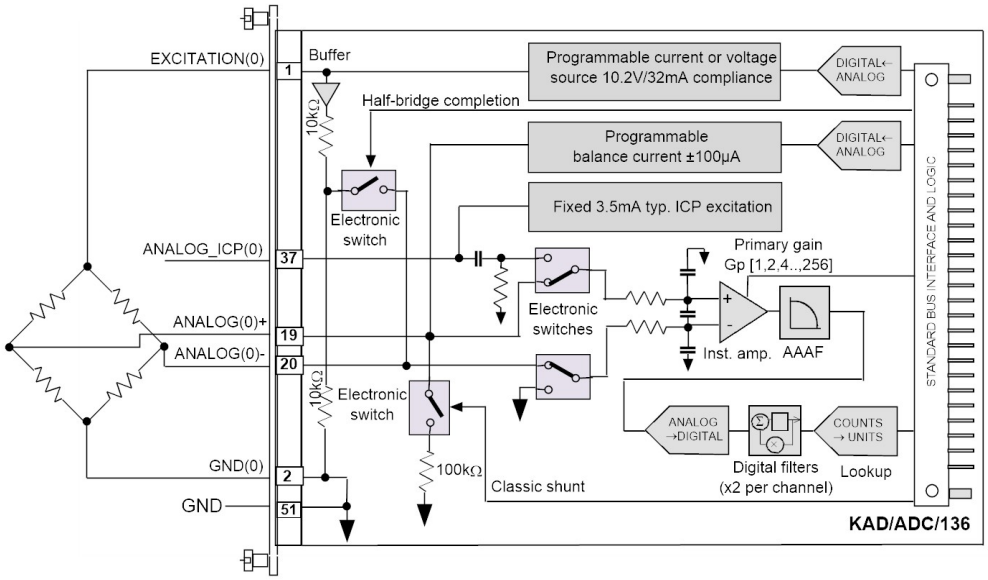


Figure 2: First channel in full-bridge configuration

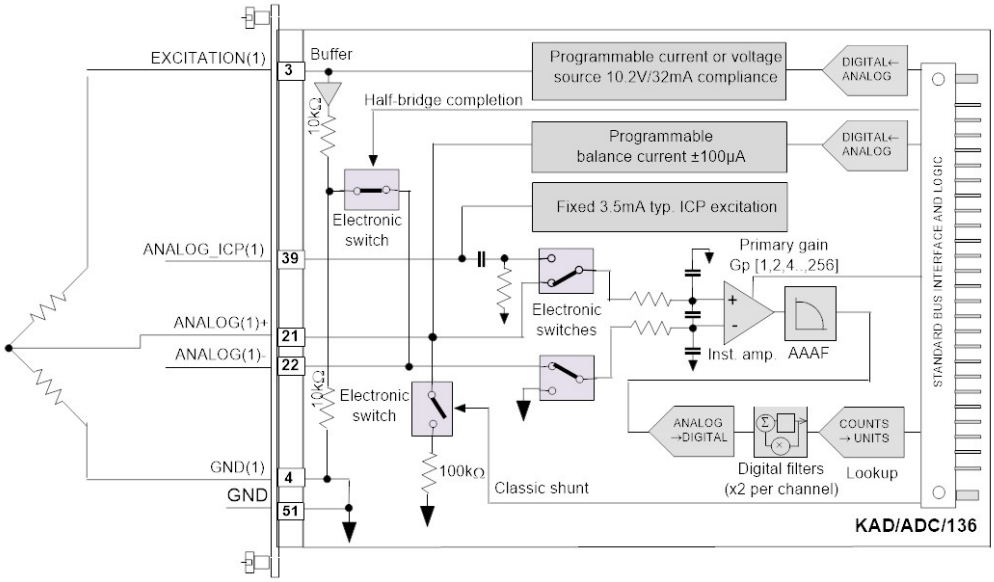


Figure 3: Second channel in half-bridge configuration, with matched pair of internal completion resistors enabled

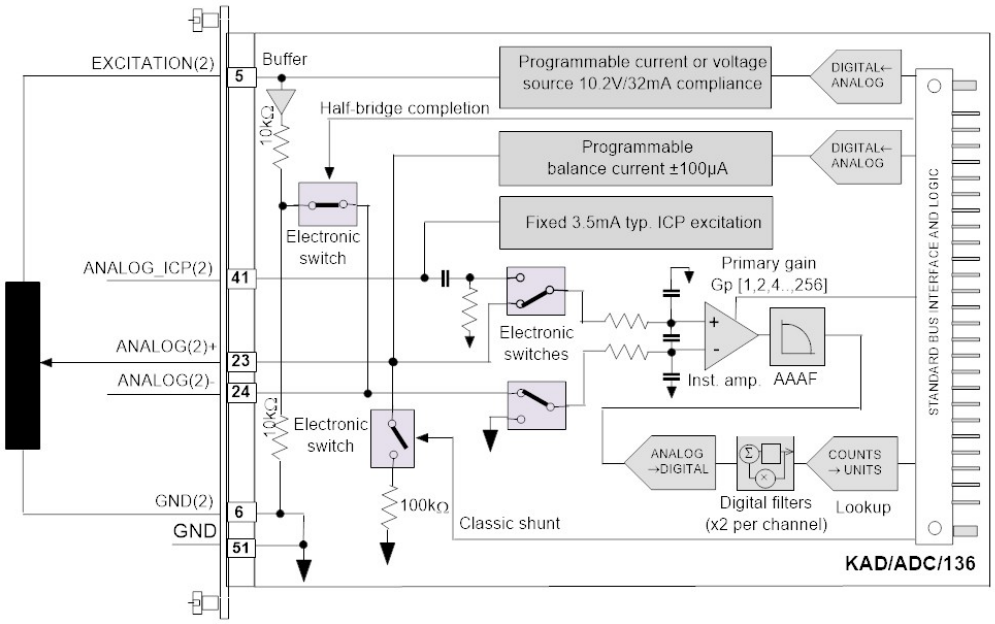


Figure 4: Third channel in potentiometer configuration, with matched pair of internal completion resistors enabled

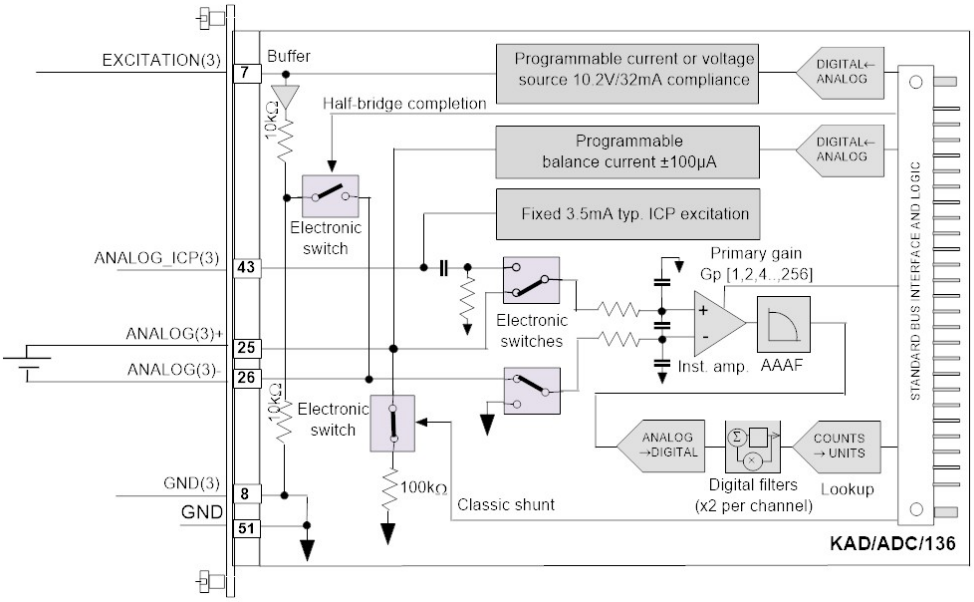


Figure 5: Fourth channel in differential ended configuration, with internal shunt resistor enabled (bias current return path)

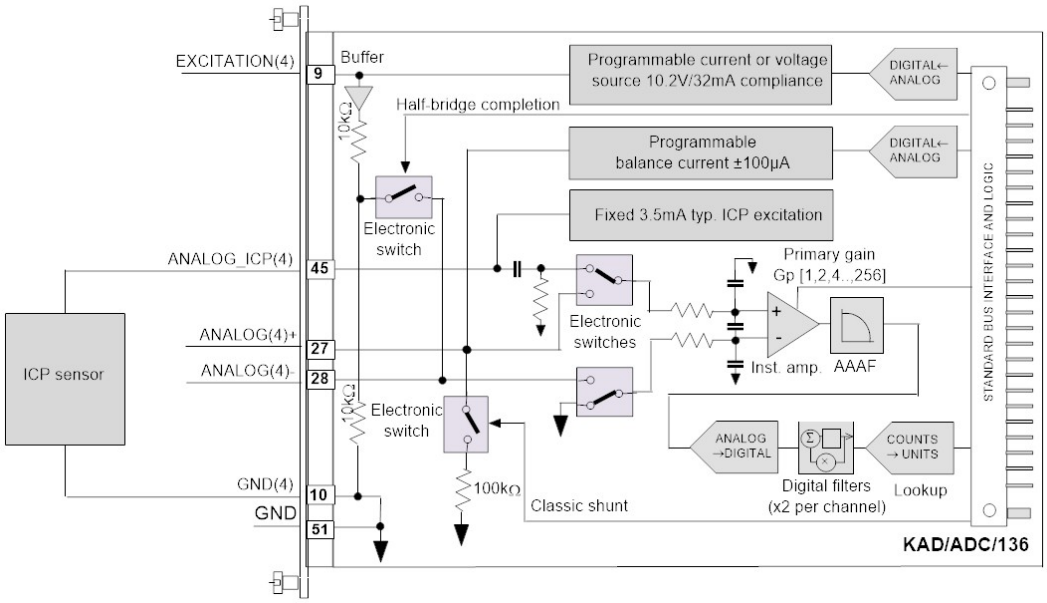
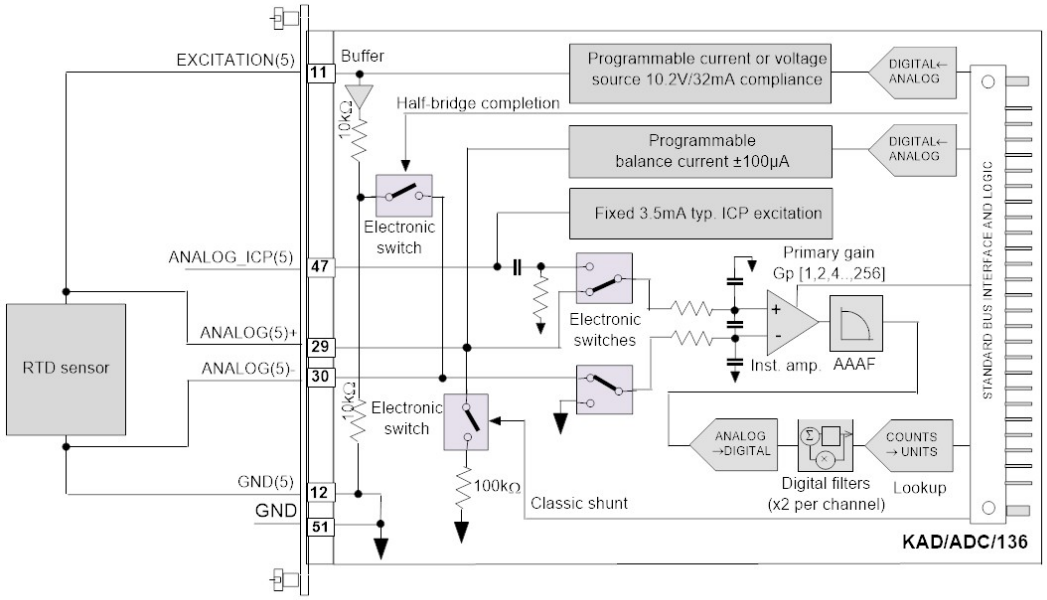


Figure 6: Fifth channel in ICP sensor configuration



*EXCITATION(5) Excitation Mode programmed as Current with e.g. 2mA Excitation Amplitude

Figure 7: Sixth channel in 4-wire RTD sensor configuration

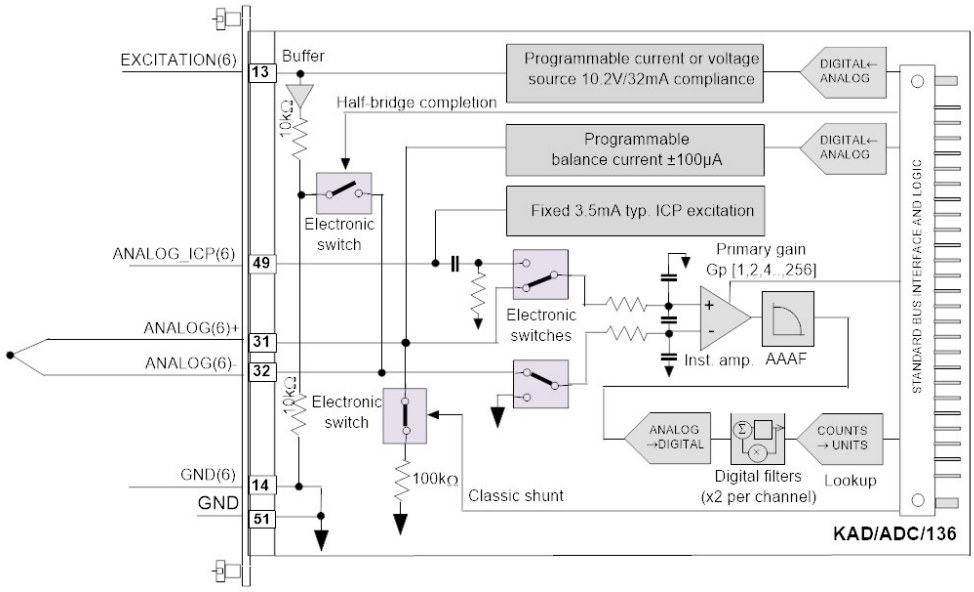


Figure 8: Seventh channel in thermocouple configuration, with internal shunt resistor enabled (bias current return path)[1]

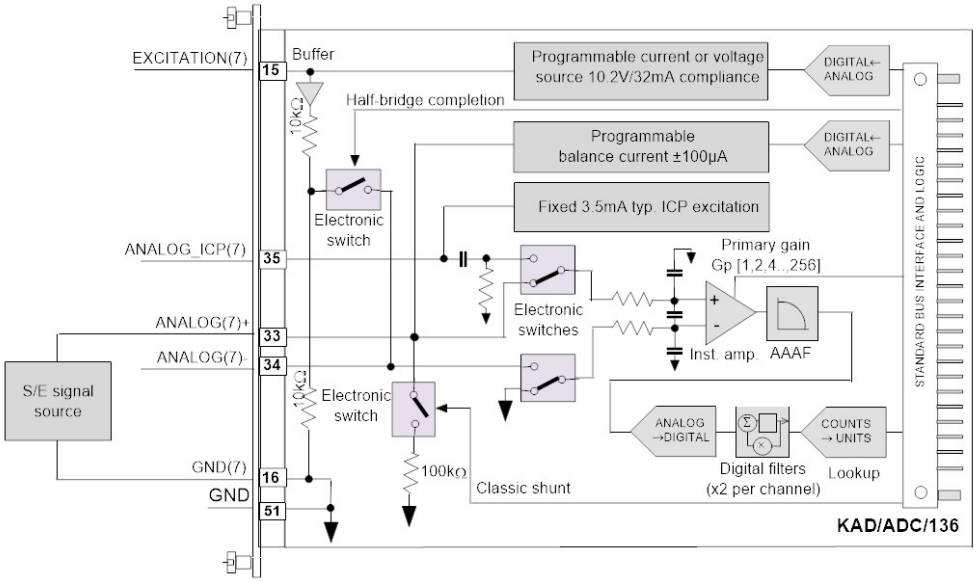


Figure 9: Eighth channel in single ended configuration

Bias current return path

As shown in Figure 5 on page 404, the analog inputs can be used as differential inputs (that is, not from a bridge). In this case, if the signal source is isolated with respect to the Acra KAM-500 (for example a battery), a common-mode resistance between one of the inputs and ground (GND) must be used to provide a return for bias currents, and reduce common-mode noise pick-up. Bias currents are in the order of nAs. To correctly set up the return path for bias currents, either internal shunt resistors must be enabled to internally pull-down to GND or an external path to GND must be used, for example short (0Ω) to GND. Figure 5 on page 404 shows the internal shunt resistor that provides a return path for the bias current.

1. Requires one channel to be defined as the junction compensation channel.

NOTE: When analog inputs are used as differential inputs, setting Balance.Applied to zero is required.
To enable the internal shunt resistor, set the Classic Shunt setting to Enabled.

Excitation setup

Excitation can contribute error to the overall measurement, so it is recommended to use as close as possible to full-scale excitation, to minimize the percentage error.

For optimal accuracy, ensure each channel uses its corresponding excitation. If the excitation is not used, it should be set to the minimum value.

Excitation drift on potentiometer configurations

We recommend a full-bridge input configuration for the KAD/ADC/136 (see Figure 2 on page 403). With this configuration, the differential input amplifier removes common mode voltage or common mode pickup noise on the input lines. A similar configuration can be achieved with a potentiometer by using completion resistors. However, only the common mode voltage, which is added to both inputs as a result of excitation drift, is compensated for.

NOTE: For the KAD/ADC/136, internal completion resistors can be enabled by setting Input Mode to Half-bridge (see Figure 3 on page 403).

Error and drift for half-bridge configurations

For half-bridge configurations, internal completion resistors are enabled when Input Mode is set to Half-bridge. These matched resistors have a defined matching error, as well as tracking TCR, which may result in an additional error of measurement. The initial matching error can be compensated for by balancing the bridge. This is done by setting the balance current to a value which nulls the reading for the ambient temperature at which balancing was carried out. However, the tracking TCR error introduced is the result of the drift of the matching ratio as the temperature changes, and so cannot be compensated for.

For example, when the voltage across the bridge is 10V, then 1ppm / °C causes 10µV / °C of drift on the channel being read. For a 60°C ambient temperature change, tracking TCR is responsible for 600µV of drift.

Compensation for lead resistance (Excitation Mode set to Voltage)

In bridge applications, if the lead resistance can be measured or estimated, add the voltage drop across the leads to the excitation voltage. For example, for 0.5Ω leads in a 350Ω full-bridge, where 5V is desired across the bridge, the excitation should be set to 5V + (0.5 × 2 × 5 / 350) = 5.014.

NOTE: When Excitation Mode is set to Current, the lead resistance does not need to be compensated for.

Using channels with thermocouples

When Input Mode is set to Thermocouple for a specific channel, the channel has thermocouple linearization and cold junction compensation applied to all readings. The channel's Junction Compensation Channel setting indicates which channel is used to measure the reference junction temperature. For a channel that has been nominated as the reference junction channel, its Input Mode must be set to RTD sensor; for accuracy purposes its range must be set to -55 to 125°C. When grounded thermocouples are used, the Classic Shunt for that channel must be set to Disabled. To provide a bias current return path when isolated thermocouples are used, the Classic Shunt for that channel must be set to Enabled. If using channels with thermocouples, you may use an ACD/CJB/005 cold-junction block (for details of this product, see "Related products" on page 410). The ACD/CJB/005 has a built-in PT100 temperature sensor (connected to channel 0), and allows the seven remaining channels to be used for thermocouples.

Using a channel's RTD sensors

When Input Mode is set to RTD sensor for a specific channel, the channel can then be used with RTD sensors (for example PT100). Sensor linearization is implemented via a specified lookup file. For such a channel, the Excitation Mode is set to Current.

The current excitation circuit provided on this module has an additional low range setting, intended primarily for RTD sensor measurements. This low range setting is automatically selected when Excitation Amplitude is less than or equal to 3mA. A setting of 1.5 to 3mA is recommended for most PT100 sensor measurements as this allows sufficient voltages across a PT100 sensor (avoiding too much noise). Also, such a setting is low enough to avoid too much error being caused by self-heating of most types of PT100 sensors. However, if other types of sensors are used, for example a PT1000 sensor, the self-heating related error of a sensor at 3mA may be significant (due to a higher sensor resistance, resulting in power being dissipated at the sensor). In this case, excitation amplitude must be lowered (for example, to 1mA). Setting the amplitude below 1mA may add error related to excitation accuracy/drift. All of these factors should be considered for the type of sensor used.

Understanding filter delays (IIR filter mode)

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate are always sampled at the same time, independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies. The Acra KAM-500 filters signals using over-sampling signal processing techniques. The following figure shows a delay for an 8th order filter where f_c = 1kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1kHz / f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1kHz / f_c). For example, an 8th order Butterworth filter with an f_c of 1kHz delays a 1kHz signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

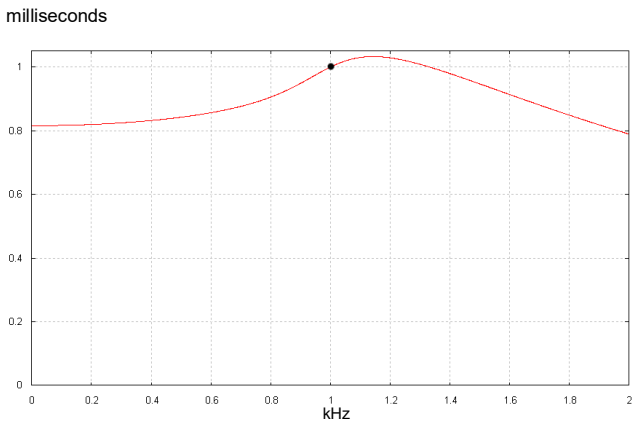


Figure 10: Filter delay for 8th order Butterworth filter where f_c = 1kHz

The filter delay for the KAD/ADC/136 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_D is the filter delay

T_A (analog filter delay) ≈ 0

Understanding filter delays (FIR filter mode)

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate are always sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies. The Acra KAM-500 filters signals using over-sampling signal processing techniques. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c).

The filter delay for this mode is:

$$T_D \approx T_A + \frac{4}{f_c}$$

T_D is the filter delay

T_A (analog filter delay) ≈ 0

Error when using digital/secondary gain (Gs)

The KAD/ADC/136/C offers a selection of analog/primary gains (Gp) carried out by an instrumentation amplifier (symmetrical vs. GND: to provide the highest possible gain to fit the required channel input voltage range) and digital offset and gain, which are used to shift and scale the reading to exactly the required channel input voltage range. The digital/secondary gain (Gs) is achieved by an internal multiplication within the digital signal processing path.

The worst case %FSR error increase is the error figure from Table 2 multiplied by the secondary gain.

As the specified %FSR error is stated for primary gain settings (Gs=1), then the absolute error figure (example in volts) does not change when any channel reading is multiplied by secondary gain, thus as FSR narrows, %FSR error must be multiplied accordingly.

For example:

Gs = 2: Error = 2 × worst case error at primary gain setting

Gs = 4: Error = 4 × worst case error at primary gain setting

Gs = 8: Error = 8 × worst case error at primary gain setting

Use of GND(x) pins

All GND(x) and GND pins are internally connected to the same ground plane, however one GND(x) ground pin per channel is designated per excitation channel to provide an independent current return path for each excitation channel. This minimizes the influence that any excitation channel may have on another. This is the configuration with which the data sheet specifications are guaranteed.

The layout of all channels within the top-block connector was designed so that channels are grouped together to achieve optimum performance and more intuitive cable preparation.

Connector pinout of the KAD/ADC/136

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	EXCITATION(0)	Uni-polar programmable DC voltage/current excitation outputs	
2	GND(0)		Grounding for specific channel
3	EXCITATION(1)	Uni-polar programmable DC voltage/current excitation outputs	
4	GND(1)		Grounding for specific channel
5	EXCITATION(2)	Uni-polar programmable DC voltage/current excitation outputs	
6	GND(2)		Grounding for specific channel
7	EXCITATION(3)	Uni-polar programmable DC voltage/current excitation outputs	
8	GND(3)		Grounding for specific channel
9	EXCITATION(4)	Uni-polar programmable DC voltage/current excitation outputs	
10	GND(4)		Grounding for specific channel
11	EXCITATION(5)	Uni-polar programmable DC voltage/current excitation outputs	
12	GND(5)		Grounding for specific channel
13	EXCITATION(6)	Uni-polar programmable DC voltage/current excitation outputs	
14	GND(6)		Grounding for specific channel
15	EXCITATION(7)	Uni-polar programmable DC voltage/current excitation outputs	
16	GND(7)		Grounding for specific channel
17	DNC		Do not connect; reserved for future use
18	DNC		Do not connect; reserved for future use
19	ANALOG(0)+	Flexible analog inputs	
20	ANALOG(0)-	Flexible analog inputs	
21	ANALOG(1)+	Flexible analog inputs	
22	ANALOG(1)-	Flexible analog inputs	
23	ANALOG(2)+	Flexible analog inputs	
24	ANALOG(2)-	Flexible analog inputs	
25	ANALOG(3)+	Flexible analog inputs	
26	ANALOG(3)-	Flexible analog inputs	
27	ANALOG(4)+	Flexible analog inputs	
28	ANALOG(4)-	Flexible analog inputs	
29	ANALOG(5)+	Flexible analog inputs	
30	ANALOG(5)-	Flexible analog inputs	
31	ANALOG(6)+	Flexible analog inputs	
32	ANALOG(6)-	Flexible analog inputs	
33	ANALOG(7)+	Flexible analog inputs	
34	ANALOG(7)-	Flexible analog inputs	
35	ANALOG_ICP(7)	Flexible analog inputs	
36	CHASSIS(0)	Chassis	Use for shielding purposes
37	ANALOG_ICP(0)	Flexible analog inputs	
38	CHASSIS(1)	Chassis	Use for shielding purposes
39	ANALOG_ICP(1)	Flexible analog inputs	
40	CHASSIS(2)	Chassis	Use for shielding purposes
41	ANALOG_ICP(2)	Flexible analog inputs	
42	CHASSIS(3)	Chassis	Use for shielding purposes
43	ANALOG_ICP(3)	Flexible analog inputs	
44	CHASSIS(4)	Chassis	Use for shielding purposes
45	ANALOG_ICP(4)	Flexible analog inputs	
46	CHASSIS(5)	Chassis	Use for shielding purposes
47	ANALOG_ICP(5)	Flexible analog inputs	
48	CHASSIS(6)	Chassis	Use for shielding purposes
49	ANALOG_ICP(6)	Flexible analog inputs	
50	CHASSIS(7)	Chassis	Use for shielding purposes
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/136/C	Flexible ADC (full/½-bridge, ICP, RTD thermocouple, FIR/IIR, 12.5kHz b/w) - 8ch at 50ksps (uses ±7V)
KAD/ADC/136/C/E12	Flexible ADC (full/½-bridge, ICP, RTD thermocouple, FIR/IIR, 12.5kHz b/w) - 8ch at 50ksps (uses ±12V)

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). Optionally, an ACD/CJB/005 (which includes an ACD/BAC/002/B and a CON/KAD/012) can be ordered. The KAD/ADC/136 uses power from the ±7V power line for some circuits and therefore cannot be used with KAM/CHS/04L, KAM/CHS/05F, KAM/CHS/03F, or KAM/CHS/02F. The KAD/ADC/136/E12 uses power from the ±12V power line, so it can be used with the aforementioned chassis.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/136/C	Improves Common Mode Rejection Ratio; improves ICP input noise immunity; disables ANALOG(x)- while in singled ended configuration	Recommended for new programs
KAD/ADC/136/B	Improved accuracy of excitation circuit at low settings (added 3mA low range), resulting in improved RTD measurements and therefore overall thermocouple accuracy; better specification half bridge completion resistors; high impedance per channel when powered off	Not recommended for new programs
KAD/ADC/136	First release	Not recommended for new programs

Supporting software

MODULE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related products

MODULE	DETAILS
ACD/CJB/005	Cold junction block for KAD/ADC/136 (built-in sensor, straight-through backshell) - 7ch

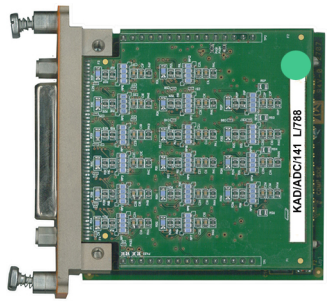
Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/001	Strain gages and ideal bridges
TEC/NOT/010	Thermocouples
TEC/NOT/016	Power dissipation
TEC/NOT/019	Digital filtering
TEC/NOT/023	Resistance temperature detectors
TEC/NOT/049	Power estimation

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ADC/141

¼-bridge ADC (current excitation, RTD temp. sensors, 3.125kHz b/w) - 16ch at 12.5ksps



Key Features

- 16 × ¼-bridge 3-wire input channels for PT50/PT100 RTD sensors
- Input range -200°C to 750°C
- High accuracy (0.87°C between -50 and 200°C @ 2mA for PT100; 2.6°C between -200 and 750°C @ 2mA for PT50)
- Programmable constant current excitation per group of four channels
- Short on any channel does not affect others
- 16-bit simultaneous sampling on each channel

Applications

- Temperature measurements with PT50 or PT100 RTD sensors

Overview

The KAD/ADC/141 provides independent excitation for up to 16 channels and is intended for RTD type sensors.

Each channel has a separate programmable digital filter and A/D converter.

At the heart of the KAD/ADC/141 is a hard-wired state-machine that oversamples all channels at a rate between 50ksps and 100ksps and digitally filters any noise above the user-programmable cutoff frequency. This is achieved using cascaded, half-band, finite-impulse-response filters followed by an 8^{th} order Butterworth infinite-impulse-response filter with a default cutoff point set at one quarter of the sampling frequency ($f_c = f_s / 4$).

All signals are sampled simultaneously. Thus, when several channels are sampled at different sampling rates, at the start of an acquisition cycle, all channels are aligned.

The excitation current through the RTD is kept constant. As the resistance changes, the voltage across the RTD (and hence as seen by the amplifier) changes linearly.

A linearization table for each channel can be used to compensate for non-linear sensors or to fine-tune gain and offset.

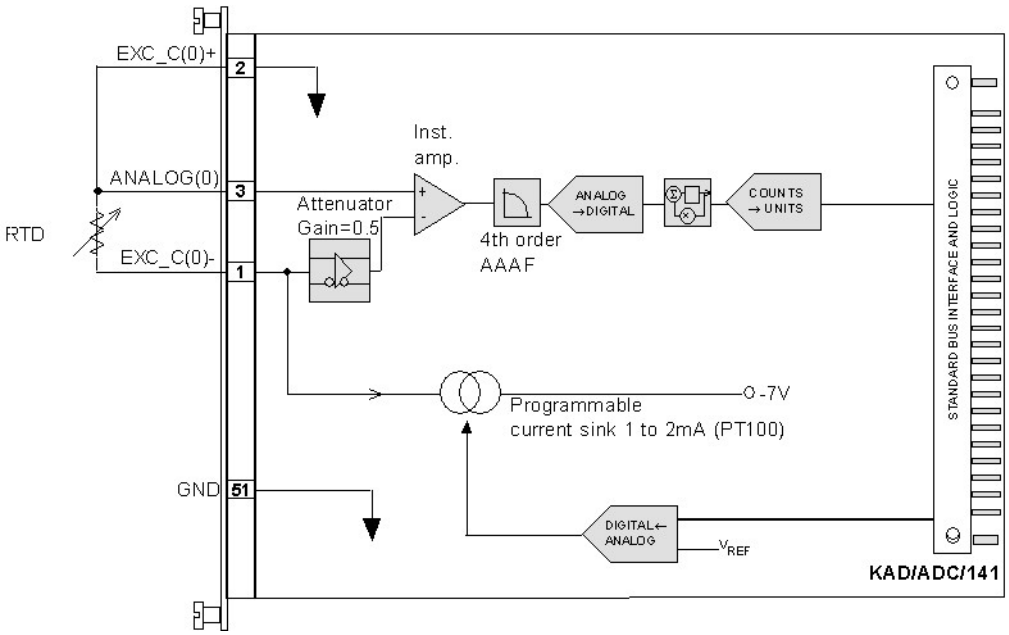


Figure 1: First of 16 channels on the KAD/ADC/141

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	90	–	g	
	–	3.07	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	145	–	160	mA	
+7V	45	–	50	mA	
-7V	40	–	45	mA	Excludes current used by excitation.
+12V	10	–	10	mA	
-12V	0	–	0	mA	
total power	1.44	–	1.6	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

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TABLE 2	Single ended DC current excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	16	–	Applied in groups of four channels.
Output current					
operating range	1	–	2	mA	
resolution	–	0.5	–	µA	
compliance	-4	–	–	V	The product of the sensor resistance and the excitation current must not exceed -1V (values exceeding this level will overdrive the devices inputs).
short circuit current	–	–	2	mA	Depends on user setting.
short circuit duration	–	–	∞	s	
DC error					
error (PT50)	–	–	–	–	Error included within channel accuracy, see DC error in “RTD inputs” on page 413.
error (PT100)	–	–	–	–	Error included within channel accuracy, see DC error in “RTD inputs” on page 413.
noise (PT50)	–	–	1	$°C_{rms}$	Measured as rms noise visible on read values with and without excitation used.
noise (PT100)	–	–	0.5	$°C_{rms}$	Measured as rms noise visible on read values with and without excitation used.

TABLE 3	RTD inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	16	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG(x)	0.5	–	12,500	sps	
Input temperature					
full scale range (PT100)	-200	–	750	°C	
DC error					Temperature averaged over 200 measurement points.
for FSR of -200°C to 750°C (PT50)	–	0.20	0.27	%FSR	When excitation current set to 2mA.
for FSR of -200°C to 750°C (PT100)	–	0.20	0.27	%FSR	When excitation current set to 1mA.
for FSR of -50°C to 200°C (PT100)	–	0.15	0.35	%FSR	When excitation current set to 2mA.
Effective number of bits	12	–	–	bits	$0 \le f \le f_c$ (f_c: filter cutoff frequency)
Crosstalk	–	–	-72	dB	Between channels on the same module.

TABLE 3	RTD inputs (continued) (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Analog filter cutoff					Analog filter is Butterworth.
poles	–	–	4	–	
filter cutoff -3dB	5.82	6.125	6.43	kHz	
Digital filter					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 3.125kHz (f_s: sampling frequency).
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-72	dB	
aliasing to f_c	–	–	-74	dB	
Filter delay	1.99	2	2.01	ms	$f_{in} = f_c$ = 1kHz (see “Understanding filter delays” on page 416).

Setting up the KAD/ADC/141

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/141	KAD/ADC/141	The instrument part reference.
SerialNumber	AAA1234	AAA1234	Unique name for each module.
Channels	-	-	-
Temperature(15:0) Analog Input	-	-	1/4-bridge A/D converter with excitation and signal conditioning for PT50/PT100.
Settings	-	-	-
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.
Linearization Algorithm Reference	UTF-8 String	.\LookupFiles\RTD\PT_385.LU	URL algorithm describing a PT50/100 RTD-type sensor for this channel.
Excitation Amplitude	1E-3 to 2E-3	1E-3	Required excitation current (in 0.5µA steps). Applied to each group of four channels.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Temperature(15:0) Parameters				
Temperature Temperature signal data	Celsius	OffsetBinary	16	R[15:0]

Configurable parameters

Temperature(15:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-200 to 750	350	-
Range Minimum	-200 to 750	0	-

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/141

Lead error compensation

The feedback line ANALOG(x) carries no current. Ideally it should be connected close to the gage to help compensate for lead resistances (assuming that both EXC_C(x)+ and EXC_C(x)- lead resistances are the same). If operating with two wires, and the ANALOG(x) and excitation lines (EXC_C(x)+) are connected close to the module (not the gage), the error introduced is primarily an offset error (because the circuit is linear with respect to resistance) and can be adjusted for.

Use two-wire operation carefully. Estimation of cable resistance should consider temperature drift over the temperature range the cable operates (copper temperature coefficient is approximately 0.4%/°C). Depending on the wire length and diameter, the drift may cause noticeable error of measurement. In general, it may become an issue for thinner and longer cables.

Setting the range and excitation

For any temperature range required, errors can be minimized by using as much as possible of the 0 to 1V input range of the A/D. For the best accuracy, use 2mA excitation, as the card calibration was optimized using this excitation during manufacture. An excitation current of 2mA is recommended for all input temperature ranges. The 1mA excitation current is provided for applications where it is necessary to reduce the RTD sensor self-heating temperature error by a factor of four of the 2mA excitation error.

The KAD/ADC/141 has been verified for PT100 sensors at 2mA between -50 and 200°C and at 1mA between -200 and 750°C. It has been verified for PT50 sensors at 2mA between -200 and 750°C.

Settings for unused channels

For each unused channel, the three pins of each channel should be shorted together and, where possible, each channel's excitation current set to 1mA.

Pinout compatibility

The KAD/ADC/141 is pin compatible with the KAD/ADC/113.

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate will always be sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. The following figure shows a delay for an 8th order filter where f_c = 1kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1kHz / f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1kHz / f_c). For example, an 8th order Butterworth filter with an f_c of 1kHz delays a 1kHz signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

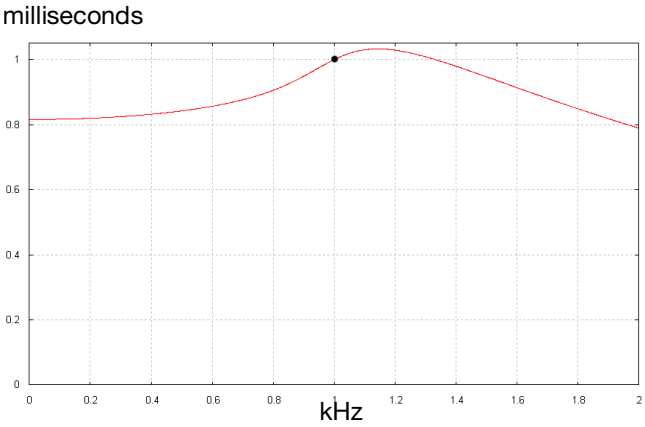


Figure 2: Filter delay for 8th order Butterworth filter where f_c = 1kHz

The filter delay for the KAD/ADC/141 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_A (analog filter delay) ≈ 0

T_D is the filter delay

Connector pinout of the KAD/ADC/141

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	EXC_C(0)-	Single ended DC current excitation outputs	Excitation group 0
2	EXC_C(0)+	Single ended DC current excitation outputs	Excitation group 0
3	ANALOG(0)	RTD inputs	
4	EXC_C(1)-	Single ended DC current excitation outputs	Excitation group 0
5	EXC_C(1)+	Single ended DC current excitation outputs	Excitation group 0
6	ANALOG(1)	RTD inputs	
7	EXC_C(2)-	Single ended DC current excitation outputs	Excitation group 0
8	EXC_C(2)+	Single ended DC current excitation outputs	Excitation group 0
9	ANALOG(2)	RTD inputs	
10	EXC_C(3)-	Single ended DC current excitation outputs	Excitation group 0
11	EXC_C(3)+	Single ended DC current excitation outputs	Excitation group 0
12	ANALOG(3)	RTD inputs	
13	EXC_C(4)-	Single ended DC current excitation outputs	Excitation group 1
14	EXC_C(4)+	Single ended DC current excitation outputs	Excitation group 1
15	ANALOG(4)	RTD inputs	
16	EXC_C(5)-	Single ended DC current excitation outputs	Excitation group 1
17	EXC_C(5)+	Single ended DC current excitation outputs	Excitation group 1
18	ANALOG(5)	RTD inputs	
19	EXC_C(6)-	Single ended DC current excitation outputs	Excitation group 1
20	EXC_C(6)+	Single ended DC current excitation outputs	Excitation group 1
21	ANALOG(6)	RTD inputs	
22	EXC_C(7)-	Single ended DC current excitation outputs	Excitation group 1
23	EXC_C(7)+	Single ended DC current excitation outputs	Excitation group 1
24	ANALOG(7)	RTD inputs	
25	EXC_C(8)-	Single ended DC current excitation outputs	Excitation group 2
26	EXC_C(8)+	Single ended DC current excitation outputs	Excitation group 2
27	ANALOG(8)	RTD inputs	
28	EXC_C(9)-	Single ended DC current excitation outputs	Excitation group 2
29	EXC_C(9)+	Single ended DC current excitation outputs	Excitation group 2
30	ANALOG(9)	RTD inputs	
31	EXC_C(10)-	Single ended DC current excitation outputs	Excitation group 2
32	EXC_C(10)+	Single ended DC current excitation outputs	Excitation group 2
33	ANALOG(10)	RTD inputs	
34	EXC_C(11)-	Single ended DC current excitation outputs	Excitation group 2
35	EXC_C(11)+	Single ended DC current excitation outputs	Excitation group 2
36	ANALOG(11)	RTD inputs	
37	EXC_C(12)-	Single ended DC current excitation outputs	Excitation group 3
38	EXC_C(12)+	Single ended DC current excitation outputs	Excitation group 3
39	ANALOG(12)	RTD inputs	
40	EXC_C(13)-	Single ended DC current excitation outputs	Excitation group 3
41	EXC_C(13)+	Single ended DC current excitation outputs	Excitation group 3
42	ANALOG(13)	RTD inputs	
43	EXC_C(14)-	Single ended DC current excitation outputs	Excitation group 3
44	EXC_C(14)+	Single ended DC current excitation outputs	Excitation group 3
45	ANALOG(14)	RTD inputs	
46	EXC_C(15)-	Single ended DC current excitation outputs	Excitation group 3
47	EXC_C(15)+	Single ended DC current excitation outputs	Excitation group 3
48	ANALOG(15)	RTD inputs	
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/141	¼-bridge ADC (current excitation, RTD temp. sensors, 3.125kHz b/w) - 16ch at 12.5ksps

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

The KAD/ADC/141 uses power from the ±7V power lines for excitation and therefore can not be used with KAM/CHS/04L, KAM/CHS/05F, KAM/CHS/03F, or KAM/CHS/02F.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/141	Supports both PT50 and PT100 sensors	Recommended for new programs
KAD/ADC/141/PT100	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment

Related documentation

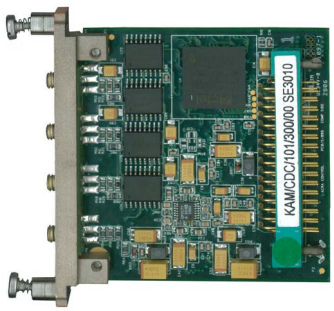
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/023	Resistance temperature detectors
TEC/NOT/049	Power estimation

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAM/CDC/101

Charge-to-digital converter (piezoelectric sensors) - 4ch at 24ksps

CURTISSWRIGHTDS.com



Features

- 4 channel charge-to-digital converter for piezoelectric devices
- Programmable Input range (±100mV, ±10V)
- Accuracy 3% FSR error from all sources typical (for 3Hz on 1kHz on 6kHz version; and 3Hz to 100Hz for 300Hz version)
- High bandwidth with programmable filters (0.5Hz to 6kHz)
- 2nd order Butterworth 0.5Hz high pass filter
- Standard SMC (10-32) sockets per channel
- 16-bit simultaneous sampling on each channel

Applications

- Measurement using piezoelectric devices

Overview

The KAM/CDC/101 is used to digitize signals from charge-based sensors such as piezoelectric devices used for accelerometers. Each is independent and consists of a charge-to-voltage converter (charge-mode amplifier) followed by a second order high pass filter, sixth order low pass filter, programmable gain amplifier, a second order low pass filter and a separate A/D as illustrated in the diagram below.

At the heart of the KAM/CDC/101 is a hard-wired state-machine that over-samples all channels at a rate between 96ksps and 192ksps, and digitally filters any noise above the user-programmable cutoff frequency. This is achieved using cascaded, half-band, decimate by 2, 15 tap, Finite-Impulse-Response (FIR) filters with 32-bit coefficients followed by an 8^{th} order Butterworth IIR filter with a default cutoff point set at a quarter of the sampling frequency.

Unlike most Acra KAM-500 modules, the input connectors are SMC (10-32) sockets for each channel.

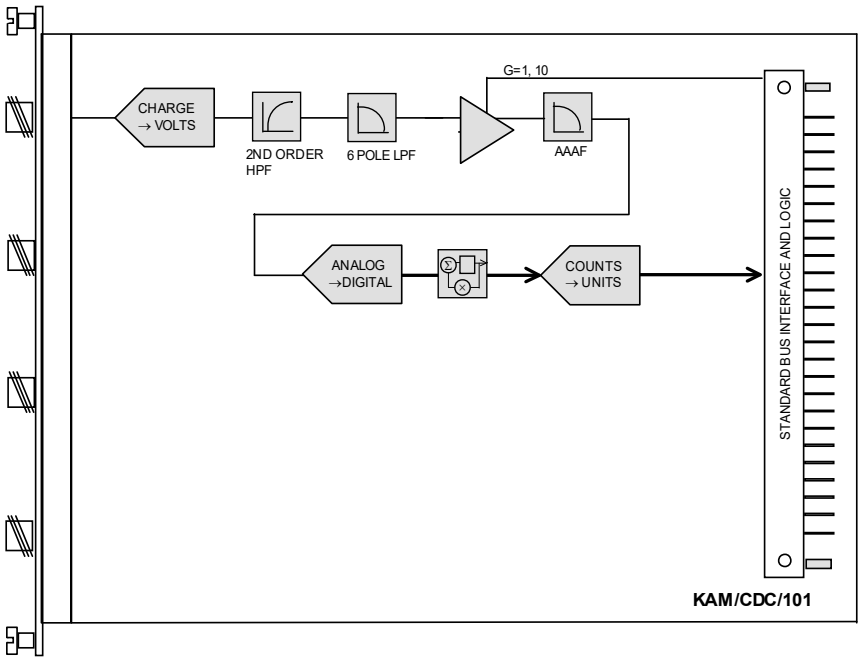


Figure 1: First of four independent charge channels

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	70	–	g	
	–	2.47	–	oz	Design metric is grams.
Height above chassis					
bare connector	–	–	2.6	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	130	–	135	mA	
±7V	0	–	0	mA	
+12V	42	–	64	mA	
-12V	30	–	50	mA	
total power	1.514	–	2.043	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Charge converter analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	4	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG	2	–	24000	sps	
Input charge					
operating range (G_p = 1)	-10	–	10	nC	Primary gain = 1.
operating range (G_p = 10)	-1	–	1	nC	Primary gain = 10.
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.

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TABLE 2	Charge converter analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
AC gain error					
gain = 1, 10	–	–	3	%FSR	Within 3Hz - 1kHz for 6kHz version; within 3Hz - 100Hz for 300Hz version.
gain = 2, 20	–	–	3	%FSR	Within 3Hz - 1kHz for 6kHz version; within 3Hz - 100Hz for 300Hz version.
gain = 4, 40	–	–	3	%FSR	Within 3Hz - 1kHz for 6kHz version; within 3Hz - 100Hz for 300Hz version.
gain = 8, 80	–	–	3	%FSR	Within 3Hz - 1kHz for 6kHz version; within 3Hz - 100Hz for 300Hz version.
Effective number of bits					
gain = 1	12.5	–	–	bits	For 10Hz < f_{in} < f_c (f_{in}: input signal frequency, f_c: filter cutoff frequency)
gain = 10	10.5	–	–	bits	For 10Hz < f_{in} < f_c
Crosstalk					
gain = 1	–	–	-72	dB	For f_{in} < 200Hz on 300Hz version; f_{in} < 1kHz on 6kHz version.
gain = 10	–	–	-60	dB	For f_{in} < 200Hz on 300Hz version; f_{in} < 1kHz on 6kHz version.
Analog filter					Analog filter is Butterworth.
High pass filter					
poles	–	–	2	–	
filter cutoff -3dB	–	0.5	–	Hz	
Low pass filter					
poles	–	–	6	–	
filter cutoff -3dB	–	300	–	Hz	For 300Hz version.
	–	6	–	kHz	For 6kHz version.
Anti aliasing filter					
poles	–	–	2	–	
filter cutoff -3dB	–	1.5	–	kHz	For 300Hz version.
	–	24	–	kHz	For 6kHz version.
Digital filter					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 6kHz (f_s : sampling frequency).
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-72	dB	
aliasing to f_c	–	–	-72	dB	
Filter delay					See “Understanding filter delays” on page 424.
300Hz	–	22.2	–	ms	Where f_{in} = f_c = 100Hz for 300Hz version.
6kHz	–	2.08	–	ms	Where f_{in} = f_c = 1kHz for 6kHz version.
Input resistance					
each input to GND	140	–	–	kΩ	Module powered off.
each input to GND	5	–	–	MΩ	Module powered on.

Setting up the KAM/CDC/101

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

The following treeview provides an overview of setup configurations available for this module:

Treeview icons legend	
DAU: Data Acquisition Unit	Indicator: Indicates the firing of an event based on specific conditions
PC: Personal Computer	Parser slot: Area of memory reserved for storing parsed data
Instrument: Any component or module used in a data acquisition system	Snarfer: Captures all data transmitted on a bus and selectively stores it
DataLink: Connection for transmitting or receiving (defines both the data link and the physical layer)	Bridge: Electrical circuit usually used for measuring purposes
Package: Used to describe how data is transmitted or stored	PCMCIA card: Peripheral interface device usually for use in laptop computers
Parameter: Any register that can be read from an instrument	Multiplexer: Selects one of many input signals and outputs that signal on a signal line
Algorithm: Defines processing to be performed on data	Channels: Defines settings for input or output channels on an instrument
InterConnect: Represents a physical connection on an instrument	
PCI card: Circuit board that plugs into the PCI bus on a PC	

NOTE: Ordering options
The PartReference settings are specific to each module variant. Only one variant is shown below.



Setting up the module

The following table lists the setup configurations available for the KAM/CDC/101/300.

SETUP DATA	CHOICE	DEFAULT/EXAMPLE	NOTES
Manufacturer			-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer
PartReference	KAM/CDC/101/300	KAM/CDC/101/300	ACRA CONTROL part number
SerialNumber			Unique name for each module
Settings	-	-	-
Module-Analog-In-1.2			-
Channel Channel(3:0)			Settings for this channel.
FilterCutoff	0.25, 0.5, 1, 2, 4, 8, 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.

Setting up parameters

Parameter definitions

The following table lists all parameters that are available for the KAM/CDC/101/300.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Channel(3:0) Charge signal data	Coulomb	OffsetBinary	16:4	R[15:0] 0000:FFFF (hex)

Programmable elements

Channel(3:0)

SETUP DATA	CHOICE	DEFAULT/EXAMPLE	NOTES
SizeInBits	16:4	16	R[15:0] 0000:FFFF (hex)
RangeMaximum	-10e-9 to 10e-9	10e-9	-
RangeMinimum	-10e-9 to 10e-9	-10e-9	-

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAM/CDC/101

It is important to use the shielded coaxial cable type as recommended by the sensor manufacturer. For an introduction to piezoelectric sensors, see *TEC/NOT/012 - Introducing force and pressure measurement using piezoelectric devices*.

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate will always be sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. The following figure shows a delay for an 8th order filter where f_c = 1kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1kHz / f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1kHz / f_c). For example, an 8th order Butterworth filter with an f_c of 1kHz delays a 1kHz signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

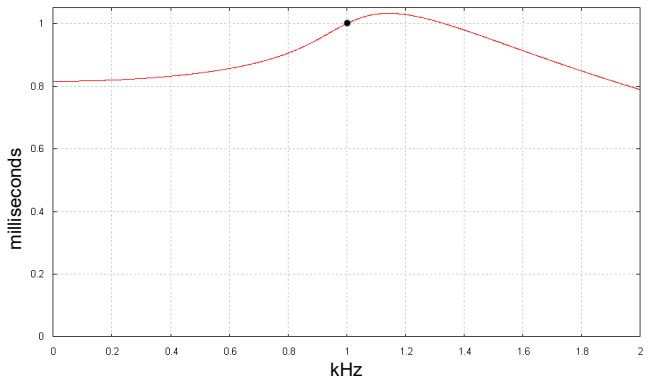


Figure 2: Filter delay for 8th order Butterworth filter where f_c = 1kHz

The filter delay for the KAM/CDC/101 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_A (analog filter delay) ≈ 2200µs for KAM/CDC/101/300

T_A (analog filter delay) ≈ 80µs for KAM/CDC/101/6k

f_c is the filter cutoff frequency.

Accuracy

Accuracy is quoted as 3% FSR from all sources over the operating temperature range. This value includes potential gain error of a module (lower than ±2%) and the high pass and low pass analog filter roll-off characteristics within the specified bandwidth. In addition, the potential gain variations caused by limited component accuracies were included in the accuracy specification.

The following figure and Figure 4 on page 425 show possible gain characteristics (expressed in a gain error sense) of analog filters used on KAM/CDC/101/300 and KAM/CDC/101/6K modules. They contain multiple plots, each simulated with varied component values within tolerance (a Monte Carlo analysis of the circuit). They can be used to approximate potential gain error for input signals from outside the specified bandwidth.

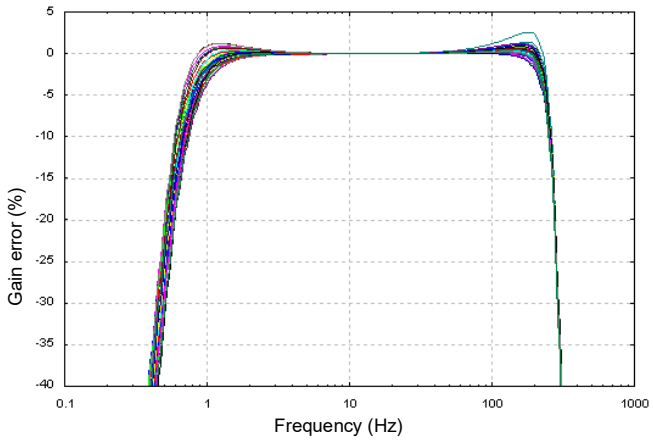


Figure 3: Analog filters on KAM/CDC/101/300 - magnitude variations chart

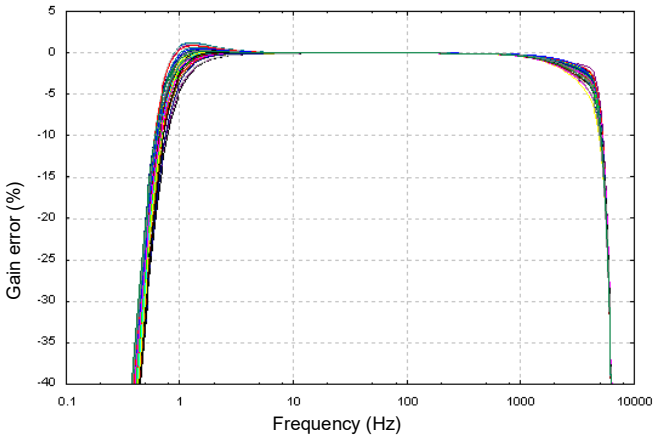


Figure 4: Analog filters on KAM/CDC/101/6k - magnitude variations chart

Calibration of the module gain within the pass band is possible, where required to achieve higher accuracy for certain applications. Contact Curtiss-Wright support (acra-support@curtisswright.com) for details.

Connector pinout of the KAM/CDC/101

There are four SMC (10-32) connectors, one for each channel labeled 0 to 3

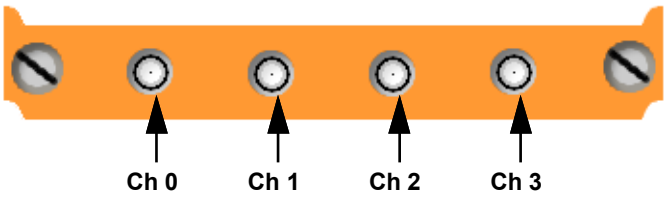


Figure 5: SMC connectors

Ordering information

PART NUMBER	DESCRIPTION
KAM/CDC/101/6k	Charge-to-digital converter (piezoelectric sensors, 6kHz b/w) - 4ch at 24ksps
KAM/CDC/101/300	Charge-to-digital converter (piezoelectric sensors, 300Hz b/w) - 4ch at 24ksps

The standard mating connector, ACC/CON/016, must be ordered separately.

Revision history

REVISION	DIFFERENCES	STATUS
KAM/CDC/101	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

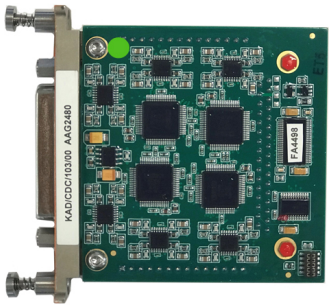
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/012	Piezoelectric effect and charge amplifiers
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/CDC/103

Differential ended current-to-digital converter (voltage excitation, 3 kHz b/w) - 24ch at 12 ksps

CURTISSWRIGHTDS.COM



Key Features

- 24 current input channels
- Input range ±22.2 mA
- Accuracy (0.042% FSR typical for input range of ±22.2 mA)
- 16-bit simultaneous sampling on each channel
- Voltage excitation (open-circuit voltage of 12V) for powering the sensor

Applications

- For use with 4 - 20 mA transmitters
- Current measurement

Overview

The KAD/CDC/103 is used to condition and digitize up to 24 differential ended current channels.

At the heart of the KAD/CDC/103 is a hard-wired state-machine that over-samples all channels at a rate between 48 ksps and 96 ksps and digitally filters any noise above the user-programmable cutoff frequency.

This is achieved using cascaded, half-band, finite-impulse-response (FIR) filters followed by an 8th order Butterworth IIR filter with a default cutoff point set at one quarter of the sampling frequency (fc = fs / 4). All signals are sampled simultaneously. Thus, when several channels are sampled at different sampling rates, at the start of an acquisition cycle all channels are aligned.

Voltage excitation is also applied to the sensor.

A maximum of three KAD/CDC/103 modules can be put in a chassis.

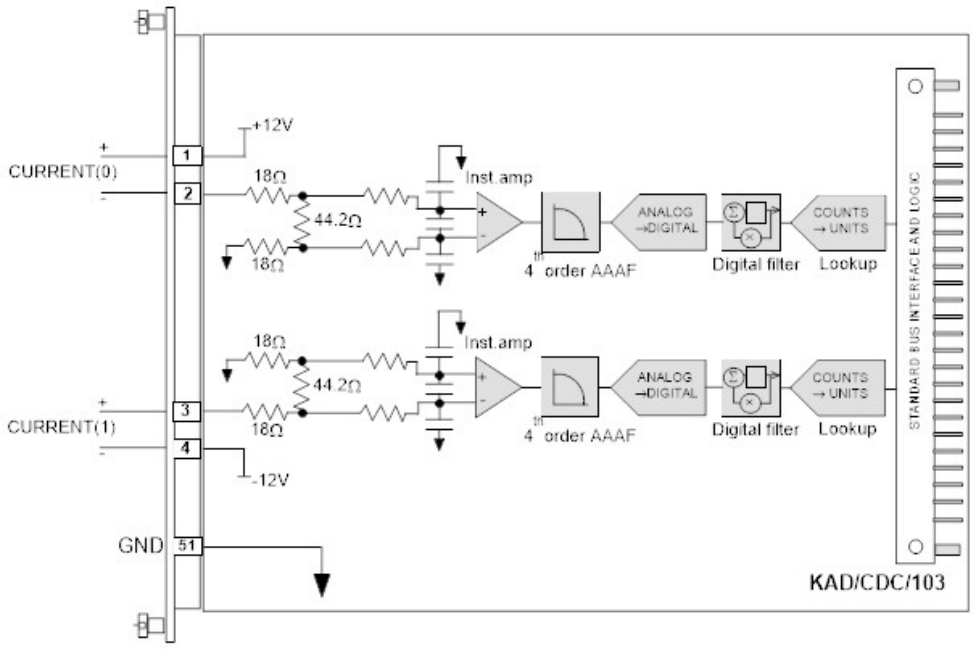


Figure 1: Channels 0 and 1 on the KAD/CDC/103

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under "Environmental ratings" in the "General specifications" table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination. A maximum of three KAD/CDC/103 modules can be put in a chassis.
Mass					
	–	90	–	g	
	–	3.17	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	–	168	180	mA	
±7V	–	0	0	mA	
+12V	–	72	80	mA	Not including excitation, which can be as much as 20 mA × 12.
-12V	–	63	70	mA	Not including excitation, which can be as much as 20 mA × 12.
total power	–	2.46	2.7	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

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TABLE 2	Differential ended analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	24	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
CURRENT[23:0]	1	–	12,000	sps	
Input current					
operating range	-22.2	–	22.2	mA	
absolute maximum	-30	–	30	mA	Currents outside of this range can damage input. Note: Do not short Current+ and Current- inputs as the absolute maximum ±30 mA input current limitation is applied. Due to low resistance of the inputs there is no ±40V overvoltage protection implemented.
DC error					
	–	0.042	0.06	%FSR	For input current range of ±22.2 mA.
	–	0.1	0.12	%FSR	For input current range of 4 mA to 20 mA.
Effective number of bits	10.5	11.5	–	bits	
Crosstalk	–	-95	–	dB	
Common mode					
voltage range	-3.5	–	5	V	Operational voltage range. This figure applies to the KAD/CDC/103/NE ordering option only.
rejection ratio	55	65	–	dB	Applies within the above common mode voltage range, $0 \leq f \leq f_c$. (f_c : filter cutoff frequency)
Analog filter					Analog filter is Butterworth.
poles	–	–	4	–	
filter cutoff -3dB	5.7	6	6.3	kHz	
Digital filter					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 3 kHz
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-72	dB	
aliasing to f_c	–	–	-74	dB	
Filter delay	–	0.66	–	ms	Measured for $f_{in} = f_c = 3$ Hz (f_{in} : input signal frequency). See “Understanding filter delays” on page 431.
Input resistance					KAD/CDC/103
between inputs	260	270	–	kΩ	Module powered off.
Input resistance					KAD/CDC/103/NE
between inputs	-	156.2	–	Ω	Module powered off.
between inputs	-	156.2	–	Ω	Module powered on.
each input to GND	-	13	–	kΩ	Module powered off.
each input to GND	-	12	–	MΩ	Module powered on.

Setting up the KAD/CDC/103

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/CDC/103	KAD/CDC/103	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
Current(23:0) Analog Input	-	-	Settings for this channel.
Settings	-	-	-
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Current(23:0) Parameters				
Current Current signal data.	Ampere	OffsetBinary	16	R[15:0]

Configurable parameters

Current(23:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-0.0222 to 0.0222	0.02	Range maximum for input channel
Range Minimum	-0.0222 to 0.0222	0.004	Range minimum for input channel

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/CDC/103

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate will always be sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. The following figure shows a delay for an 8^{th} order filter where f_c = 1 kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1 kHz / f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1 kHz / f_c). For example, an 8^{th} order Butterworth filter with an f_c of 1 kHz delays a 1 kHz signal by 1 ms; a filter with an f_c of 10 Hz delays a 10 Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

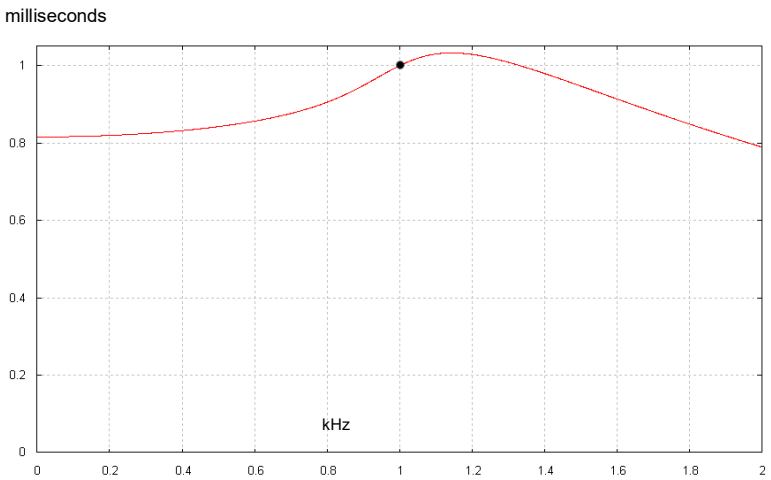


Figure 2: Filter delay for 8^{th} order Butterworth filter where f_c = 1 kHz

The filter delay for the KAD/CDC/103 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_D is the filter delay

T_A (analog filter delay) ≈ 0

Transducer excitation

The standard version of the module, KAD/CDC/103, provides 12V transducer excitation. The transducer must be connected to the module as shown in the following figure.

NOTE: All even channels of the card are powered from a +12V rail (as per the channel 0 depiction) and all odd channels are powered from a -12V rail (as per channel 1). This is done to maximize the number of cards that can be placed into one chassis and also to ensure even loading and stability of the chassis power supply.

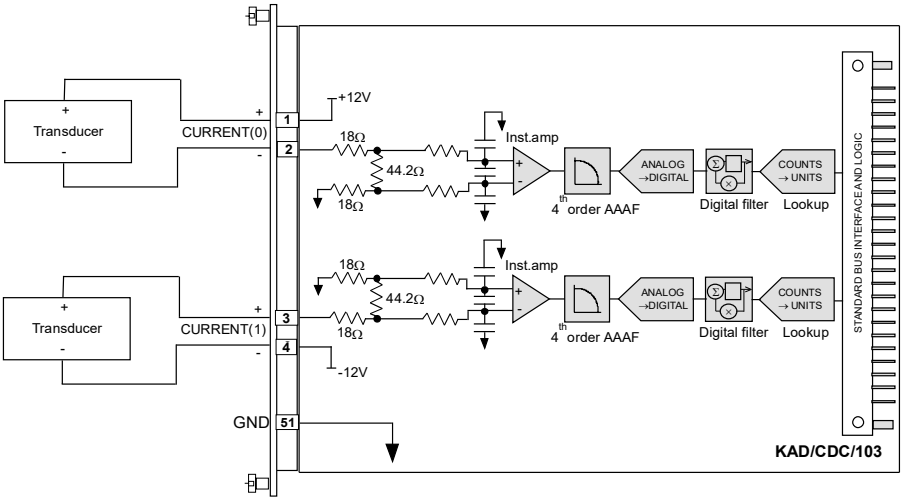


Figure 3: KAD/CDC/103 with transducers connected to channels 0 and 1

The KAD/CDC/103/NE variant does not provide excitation. Transducers must be connected to the module as shown in the following figure. The KAD/CDC/103/NE variant is compatible with the KAD/CDC/002 legacy module.

NOTE: All channels are of the same topology, so only channel 0 is shown.

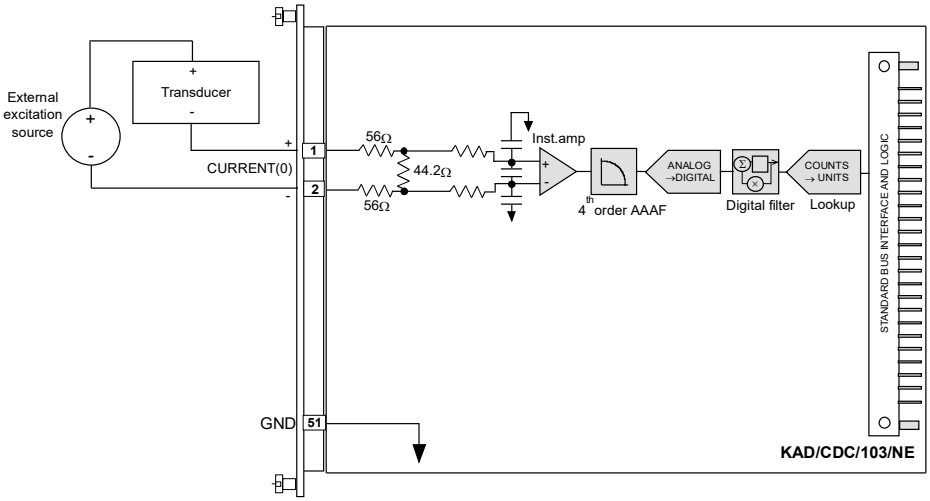


Figure 4: KAD/CDC/103/NE with a transducer powered by an external excitation source connected to channel 0

Connector pinout of the KAD/CDC/103

PIN	NAME	DESCRIPTION	COMMENT
1	CURRENT(0)+	Differential ended analog inputs	Analog input
2	CURRENT(0)-	Differential ended analog inputs	Analog input
3	CURRENT(1)+	Differential ended analog inputs	Analog input
4	CURRENT(1)-	Differential ended analog inputs	Analog input
5	CURRENT(2)+	Differential ended analog inputs	Analog input
6	CURRENT(2)-	Differential ended analog inputs	Analog input
7	CURRENT(3)+	Differential ended analog inputs	Analog input
8	CURRENT(3)-	Differential ended analog inputs	Analog input
9	CURRENT(4)+	Differential ended analog inputs	Analog input
10	CURRENT(4)-	Differential ended analog inputs	Analog input
11	CURRENT(5)+	Differential ended analog inputs	Analog input
12	CURRENT(5)-	Differential ended analog inputs	Analog input
13	CURRENT(6)+	Differential ended analog inputs	Analog input
14	CURRENT(6)-	Differential ended analog inputs	Analog input
15	CURRENT(7)+	Differential ended analog inputs	Analog input
16	CURRENT(7)-	Differential ended analog inputs	Analog input
17	CURRENT(8)+	Differential ended analog inputs	Analog input
18	CURRENT(8)-	Differential ended analog inputs	Analog input
19	CURRENT(9)+	Differential ended analog inputs	Analog input
20	CURRENT(9)-	Differential ended analog inputs	Analog input
21	CURRENT(10)+	Differential ended analog inputs	Analog input
22	CURRENT(10)-	Differential ended analog inputs	Analog input
23	CURRENT(11)+	Differential ended analog inputs	Analog input
24	CURRENT(11)-	Differential ended analog inputs	Analog input
25	CURRENT(12)+	Differential ended analog inputs	Analog input
26	CURRENT(12)-	Differential ended analog inputs	Analog input
27	CURRENT(13)+	Differential ended analog inputs	Analog input
28	CURRENT(13)-	Differential ended analog inputs	Analog input
29	CURRENT(14)+	Differential ended analog inputs	Analog input
30	CURRENT(14)-	Differential ended analog inputs	Analog input
31	CURRENT(15)+	Differential ended analog inputs	Analog input
32	CURRENT(15)-	Differential ended analog inputs	Analog input
33	CURRENT(16)+	Differential ended analog inputs	Analog input
34	CURRENT(16)-	Differential ended analog inputs	Analog input
35	CURRENT(17)+	Differential ended analog inputs	Analog input
36	CURRENT(17)-	Differential ended analog inputs	Analog input
37	CURRENT(18)+	Differential ended analog inputs	Analog input
38	CURRENT(18)-	Differential ended analog inputs	Analog input
39	CURRENT(19)+	Differential ended analog inputs	Analog input
40	CURRENT(19)-	Differential ended analog inputs	Analog input
41	CURRENT(20)+	Differential ended analog inputs	Analog input
42	CURRENT(20)-	Differential ended analog inputs	Analog input
43	CURRENT(21)+	Differential ended analog inputs	Analog input
44	CURRENT(21)-	Differential ended analog inputs	Analog input
45	CURRENT(22)+	Differential ended analog inputs	Analog input
46	CURRENT(22)-	Differential ended analog inputs	Analog input
47	CURRENT(23)+	Differential ended analog inputs	Analog input
48	CURRENT(23)-	Differential ended analog inputs	Analog input
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/CDC/103	Differential ended current-to-digital converter (voltage excitation, 3 kHz b/w) - 24ch at 12 ksps
KAD/CDC/103/NE	Differential ended current-to-digital converter (3 kHz b/w) - 24ch at 12 ksps (without excitation)

By default, the standard mating connector (CON/KAD/002/CP), is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/CDC/103	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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This document was reviewed on 4/12/2020 and does not contain technical data.

KAD/EXC/101

Power module providing sensor excitation

CURTISSWRIGHTDS.com



Key Features

- 10 single ended excitation outputs with programmable output voltage and current limit per channel
- Total current drawn from all channels up to 300mA
- One channel with a current limit up to 300mA at 24V (fold-back characteristics)
- One channel with a current limit up to 50mA
- Eight channels each with a current limit up to 15mA

Applications

- Power source for external sensors

Overview

Each of the KAD/EXC/101's 10 single ended excitation outputs has a programmable output voltage within the range of 0 to 24V.

There are three types of output available on the KAD/EXC/101: one output with a current limit up to 300mA (at 24V); one output with a current limit up to 50mA (at any output voltage); and the other eight outputs each with a current limit up to 15mA (at any output voltage). The current limit on each output type is programmable.

In addition to a programmable current limit, the first output type has a fixed, fold-back current limiter. This prevents the dissipating of too much power on the internal regulating element in case an output voltage is set lower than 24V.

Once a channel is overloaded (that is, the programmed current limit or the channel 0 fold-back limit is exceeded), the channel trips (automatically switches off).

The KAD/EXC/101 provides status of individual channels: information which channel has reached current limit and which has tripped. Additionally status of main internal power supply is provided.

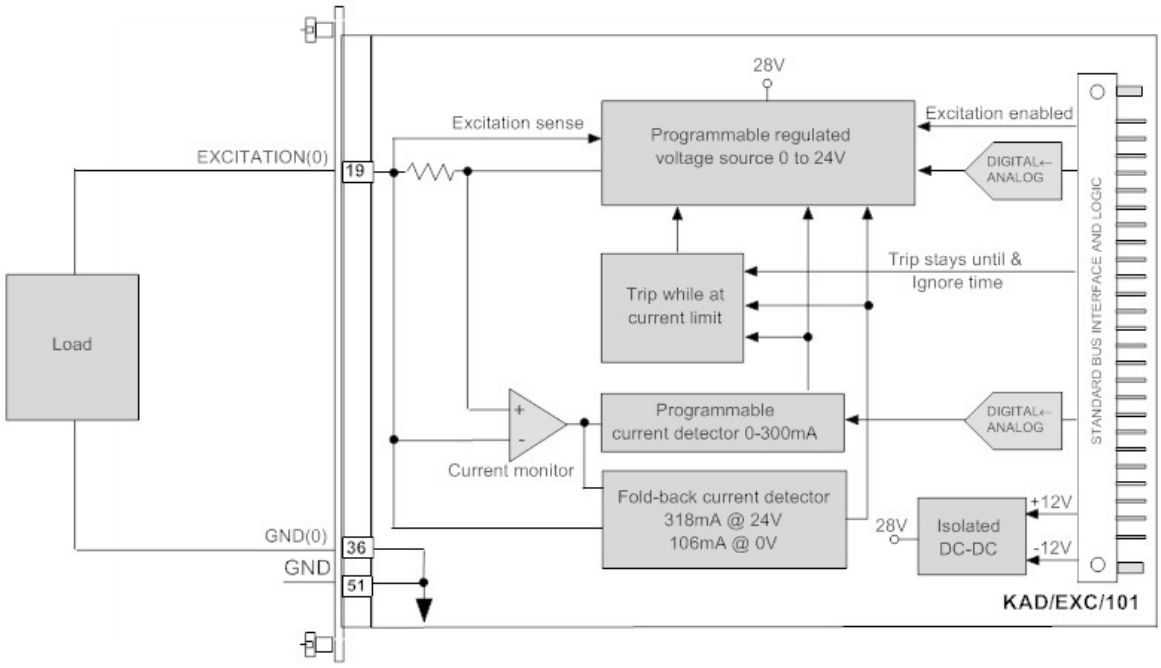


Figure 1: First of 10 output channels (the only channel which is capable up to 300mA output and includes a fold-back current limiter)

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	100	–	g	
	–	3.52	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	35	45	50	mA	
±7V	0	–	0	mA	
±12V	60	65	75	mA	Excludes current used by excitation. As a DC/DC converter is used, multiply the excitation current by 1.35 to calculate the current for both power lines.
total power	1.62	1.79	2.05	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

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TABLE 2	Single ended DC voltage excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs for EXCITATION(0)	–	–	1	–	
Outputs for EXCITATION(1)	–	–	1	–	
Outputs for EXCITATION[9:2]	–	–	8	–	
Output voltage					
operating range	0	–	24	V	
resolution	–	7.55	–	mV	
compliance for EXCITATION(0)	0	–	300	mA	For excitation output voltage of 24V. For voltages lower than 24V, the value is limited by a fixed fold-back current limiter, and linearly decreases to 106mA for 0V. The total current available for all excitation outputs is 300mA.
compliance for EXCITATION(1)	0	–	50	mA	For any excitation output voltage. The total current available for all excitation outputs is 300mA.
compliance for EXCITATION[9:2]	0	–	15	mA	
short circuit duration	∞	–	–	s	To GND. Outputs cannot be shorted to a voltage potential that is negative with respect to module GND as this may damage the output.
DC error					
error for EXCITATION(0)	–	0.2	0.4	%FSR	With a constant load of 270mA.
error for EXCITATION(1)	–	0.2	0.4	%FSR	With a constant load of 45mA.
error for EXCITATION[9:2]	–	0.2	0.4	%FSR	With a constant load of 13.5mA.
noise	–	1	5	mV_{rms}	
Programmable current limiter					
operating range for EXCITATION(0)	45	–	300	mA	
operating range for EXCITATION(1)	7.5	–	50	mA	
operating range for EXCITATION(9:2)	2.25	–	15	mA	
resolution for EXCITATION(0)	–	81.4	–	µA	
resolution for EXCITATION(1)	–	13.3	–	µA	
resolution for EXCITATION[9:2]	–	4	–	µA	
error for EXCITATION(0)	–	1	3	%FSR	

TABLE 2	Single ended DC voltage excitation outputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
error for EXCITATION(1)	–	1	3	%FSR	
error for EXCITATION[9:2]	–	2	4.5	%FSR	
Output resistance for EXCITATION(0)	–	0.05	0.1	Ω	
Output resistance for EXCITATION(1)	–	0.1	0.2	Ω	
Output resistance for EXCITATION[9:2]	–	0.2	0.6	Ω	
Capacitive load for EXCITATION(0)	0	–	50	µF	
Capacitive load for EXCITATION(1)	0	–	30	µF	
Capacitive load for EXCITATION[9:2]	0	–	10	µF	Each channel.

Setting up the KAD/EXC/101

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/EXC/101	KAD/EXC/101	The instrument part reference.
SerialNumber	AAA1234	AAA1234	Unique name for each module.
Settings	-	-	-
Trip Stays Until	Power-on Mode change	Power-on	Defines whether a channel remains tripped until next power-on, or if it is to be re-enabled at mode change as well.
Excitation Enabling Ignore Time	0 to 1	0.5	Defines the length of time (in s [seconds]) for which overcurrent conditions are ignored. Applies only to time during excitation enabling (at power-on or mode change), where surges caused by external sensors are possible.
Increment Only For Trip Time Counting	Yes No	Yes	Defines whether internal trip time counter only increments or also decrements based on if current limit was exceeded or not. Increments and decrements are executed based on 1ms internal period. Any even momentary current limit exceeded conditions are remembered for a specific period, causing an increment of the trip time counter.
Channels	-	-	-
Excitation(0) Excitation Output	-	-	-
Settings	-	-	-
Excitation Enabled	Yes No	Yes	Defines whether the output is enabled.
Excitation Voltage Level	0 to 24	0	Defines the excitation (in V) for the excitation output.
Excitation Current Limit	0.045 to 0.3	0.045	Defines the current limit (in A) for the excitation output.
Excitation(1) Excitation Output	-	-	-
Settings	-	-	-
Excitation Enabled	Yes No	Yes	Defines whether the output is enabled.
Excitation Voltage Level	0 to 24	0	Defines the excitation (in V) for the excitation output.
Excitation Current Limit	0.0075 to 0.05	0.0075	Defines the current limit (in A) for the excitation output.
Excitation(9:2) Excitation Output	-	-	-
Settings	-	-	-
Excitation Enabled	Yes No	Yes	Defines whether the output is enabled.
Excitation Voltage Level	0 to 24	0	Defines the excitation (in V) for the excitation output.
Excitation Current Limit	0.00225 to 0.015	0.00225	Defines the current limit (in A) for the excitation output.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
CurrentLimitStatus Indicates whether the current limits have been reached for specific channels since last read.	BitVector	BitVector	16	R[15:0]
Power-offStatus Indicates whether specific channels were disabled or tripped.	BitVector	BitVector	16	R[15:0]
TripStatus Indicates whether specific channels tripped.	BitVector	BitVector	16	R[15:0]
PowerSupplyStatus Provides information about status of internal 28V DC-DC converter.	BitVector	BitVector	16	R[15:0] R(0) PowerSupplyEnabled - Indicates whether the internal DC-DC supply is enabled. 0: Power supply is disabled. 1: Power supply is enabled. R(1) PowerSupplyVoltageLimitError - Indicates whether the internal DC-DC supply was disabled by fail-safe mechanism as a result of DC-DC output voltage limit reached. 0: No power supply output voltage error. 1: Power supply output over-voltage error indication (voltage exceeded 30V and fail-safe mechanism disabled power supply). R(2) PowerSupplyCurrentLimitError - Indicates whether the internal DC-DC supply was disabled by fail-safe mechanism as a result of DC-DC current limit reached (preventing possible overheating). 0: No power supply output current error. 1: Power supply output current error indication (current was exceeded and fail-safe mechanism disabled power supply). R[15:3] Reserved - Reserved for future use

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/EXC/101

Current limiter circuits

Every KAD/EXC/101 channel has a built-in current limiter circuit which is used to avoid excessive current being drawn during times of unexpected overload, external load failure, or short circuiting. Depending on the channel, different limits are allowed.

Every channel has a fast current limiter circuit, with a fixed maximum current limit set from around 50% to 100% above the maximum setting allowed for Excitation Current Limit. The role of this crude, fixed current limiter is to apply a limit (which for a short time—that is, <100ms—is safe for internal circuits) in a continuous manner and without any delay.

In addition to this fixed current limiter circuit, there is a precision programmable current detection circuit, which is used to precisely detect overcurrent conditions (as set in Excitation Current Limit). This precision current detection circuit works with a few microseconds delay, and when the limit is exceeded, the overcurrent condition is detected and causes the channel to trip (switch off).

Re-enabling of the channel is possible after power-cycling or programming the module, or if the module's Trip Stays Until setting is set to Mode change (and when the chassis mode is changed).

To ensure headroom for noise and errors of current detection circuit, it is recommended to set programmed Excitation Current Limit to leave 15% of FSR or more above the nominal current drawn. This means that the supported maximum nominal load on specific channels is lower, and is 255mA for channel 0, 42.5mA for channel 1, and 12.75mA for channels 2-9.

Channel types

Channel 0

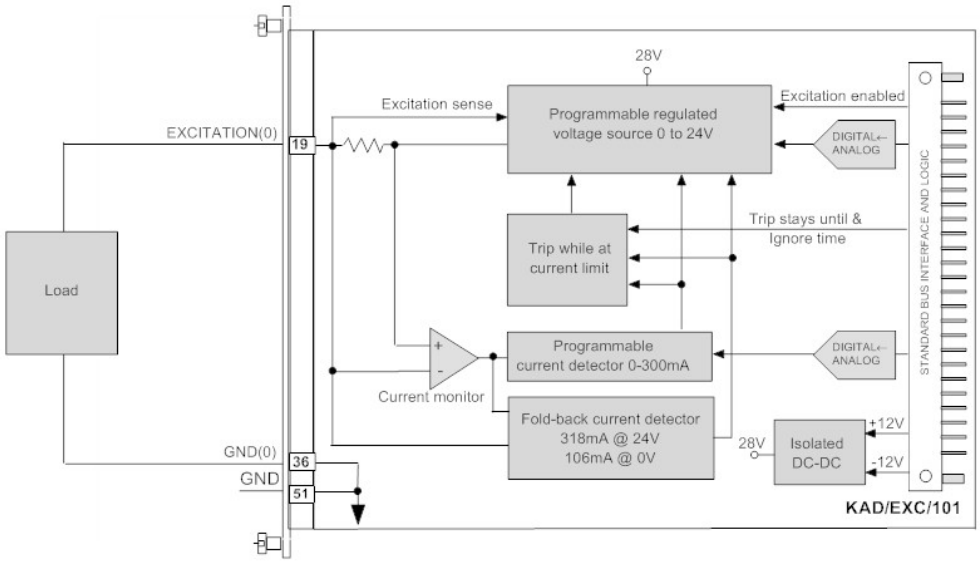


Figure 2: First output type (capable up to 300mA output and includes a fold-back current limiter)

You can set Excitation Current Limit, for channel 0, up to 300mA. Because of high currents possible, a fixed fold-back current detector is added into this channel. Fold-back detector prevents dissipating of too much power on the internal regulating element in the event of overloading the channel once an output voltage is lower than 24V. Fold-back circuit is configured in the way that it allows output of 318mA (typical) at 24V but only 106mA (typical) at 0V, and is linear for output voltages between 0V and 24V (see the following figure). Fold-back current detector also works with a few microseconds delay, and limits current in the same way as precision programmable Excitation Current Limit. Excitation Current Limit setting restricts current on top of what fold-back limiter allows. The following figure shows an example of voltage vs. current characteristics with Excitation Current Limit set to 200mA.

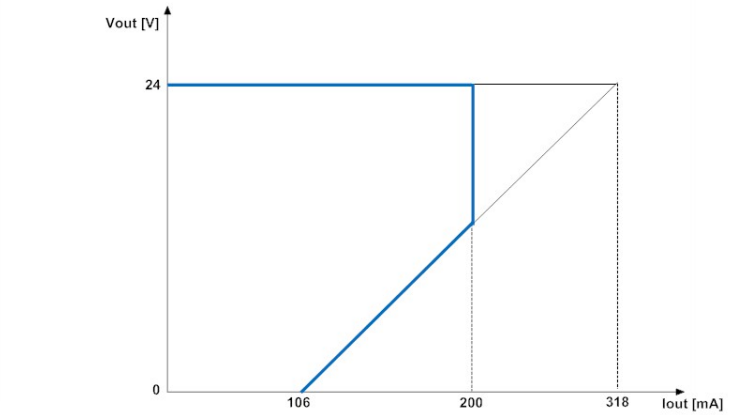


Figure 3: Channel 0 current limiter characteristics shown for 24V output, with current limit set to 200mA, and limitation of built-in fold-back circuit

Channel 1

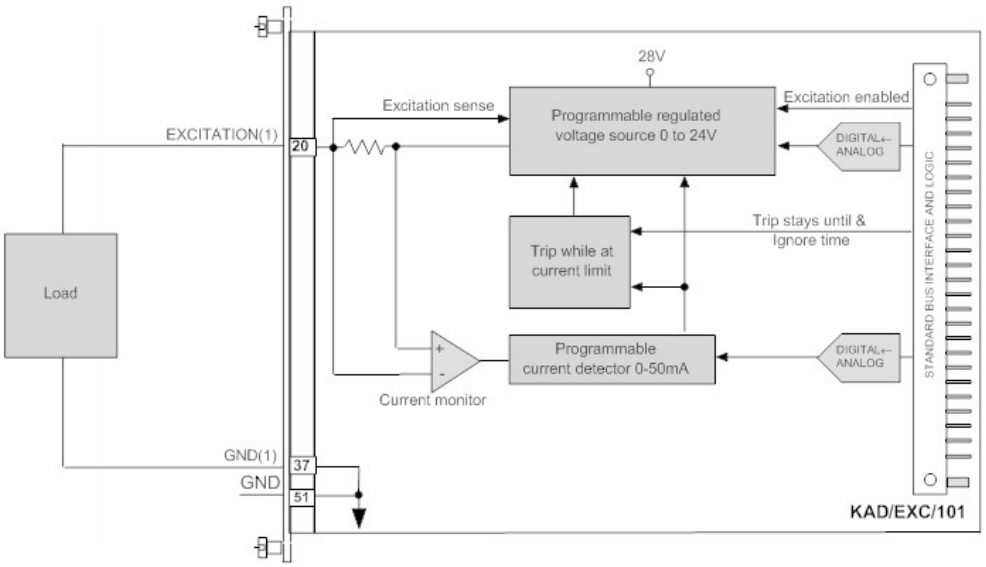


Figure 4: Second output type (capable of 50mA)

Channel 1 (see the figure above) has programmable Excitation Current Limit up to 50mA. There is no fold-back circuit on this channel.

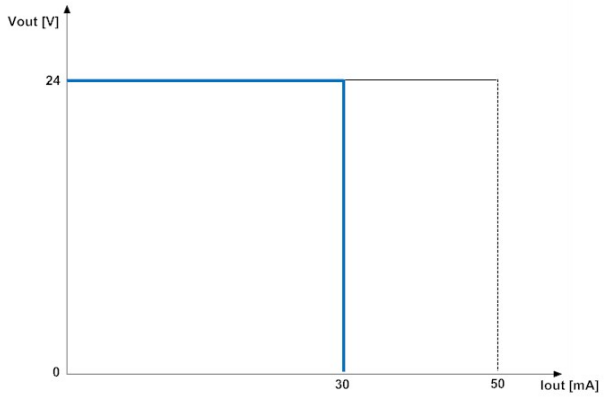


Figure 5: Channel 1 current limiter characteristics shown for 24V output, with current limit set to 30mA

Channel 2 to channel 9

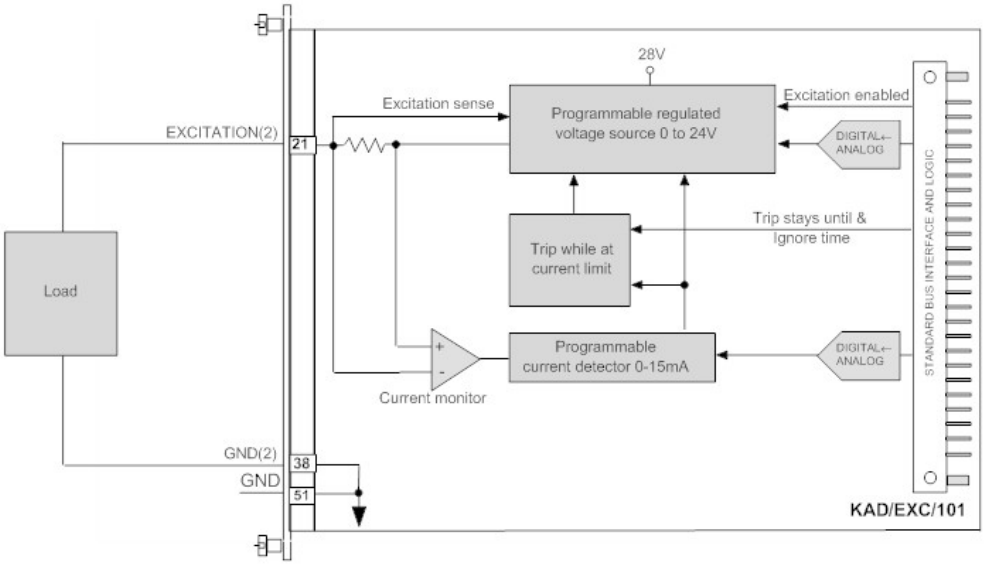


Figure 6: Third output type (capable of up to 15mA)

Channels 2 to 9 have programmable Excitation Current Limit up to 15mA. There is no fold-back circuit on these channels.

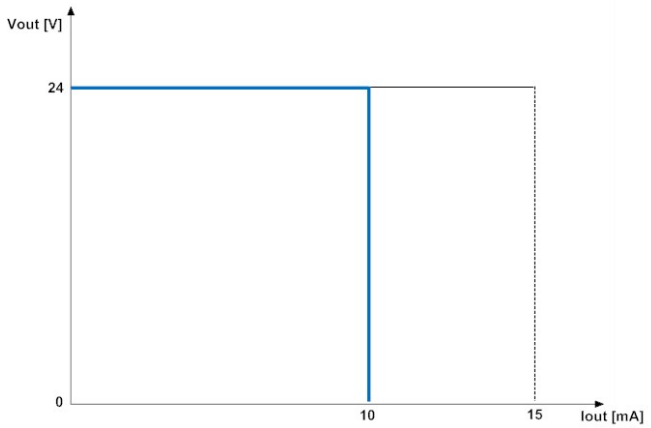


Figure 7: Channels 2 to 9 current limiter characteristics shown for 24V output, with current limit set to 10mA

Notes on KAD/EXC/101 operation

The KAD/EXC/101 allows up to a 300mA load to be used across all channels in total.

The sum of Excitation Current Limit settings across all enabled channels (where Excitation Enabled is set to Yes) can be maximum 370.5mA. The total value is limited by software, and checked during configuration verification or programming. It allows use of a total nominal load of up to 300mA across all channels with 15% FSR headroom on each channel.

NOTE: Headroom should not be used during normal operation; it is there to prevent false trips of channels due to noise, cross-talk, and errors of current limit detection circuits.

There is global overcurrent detection at the internal supply rail, which detects when more than 420mA (typical) is drawn by all channels combined. If this overcurrent detection continues for 100ms, built-in logic disables internal power supply for all channels, thereby effectively disabling all channels (as indicated by the PowerSupplyStatus register). This is to prevent stressing the internal supply with too much heat dissipation, as well as drawing too much current from internal chassis supply rails. Re-enabling is only possible after power cycling the KAD/EXC/101. This condition is not checked during excitation enabling phase for Excitation Enabling Ignore Time, as in that time short overcurrent conditions are expected to happen (load surge currents). Also, during excitation enabling phase, channels do not trip (time is not counted for tripping purposes during that phase).

Connector pinout of the KAD/EXC/101

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DNC		Do not connect
2	DNC		Do not connect
3	DNC		Do not connect
4	DNC		Do not connect
5	DNC		Do not connect
6	DNC		Do not connect
7	DNC		Do not connect
8	DNC		Do not connect
9	DNC		Do not connect
10	DNC		Do not connect
11	DNC		Do not connect
12	DNC		Do not connect
13	DNC		Do not connect
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	EXCITATION(0)	Single ended DC voltage excitation outputs	
20	EXCITATION(1)	Single ended DC voltage excitation outputs	
21	EXCITATION(2)	Single ended DC voltage excitation outputs	
22	EXCITATION(3)	Single ended DC voltage excitation outputs	
23	EXCITATION(4)	Single ended DC voltage excitation outputs	
24	EXCITATION(5)	Single ended DC voltage excitation outputs	
25	EXCITATION(6)	Single ended DC voltage excitation outputs	
26	EXCITATION(7)	Single ended DC voltage excitation outputs	
27	EXCITATION(8)	Single ended DC voltage excitation outputs	
28	EXCITATION(9)	Single ended DC voltage excitation outputs	
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	GND(0)		Ground for specific channel
37	GND(1)		Ground for specific channel
38	GND(2)		Ground for specific channel
39	GND(3)		Ground for specific channel
40	GND(4)		Ground for specific channel
41	GND(5)		Ground for specific channel
42	GND(6)		Ground for specific channel
43	GND(7)		Ground for specific channel
44	GND(8)		Ground for specific channel
45	GND(9)		Ground for specific channel
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/EXC/101	Power module providing sensor excitation

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/EXC/101	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment

Related documentation

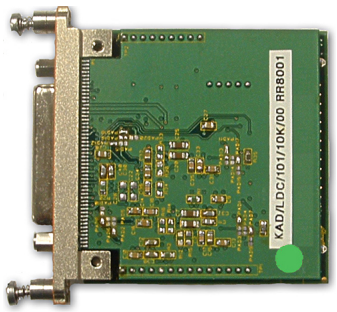
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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This document was reviewed on 25/10/2023 and does not contain technical data.

KAD/LDC/101

LVDT/RVDT-to-digital converter (voltage excitation, 6 kHz b/w) - 4ch at 24 ksps

CURTISSWRIGHTDS.COM



Key Features

- Four independent LVDT/RDVT input channels
- Four independent excitation channels (400 Hz x 4, 2.5 KHz x 4, 5 Khz x 4,or 10 Khz x 4 @ 3.5 Vrms)
- Accuracy 1.25%
- Supports ratiometric values from 0.2 to 0.8 for which conversion compensates for variations in excitation
- Short on any channel does not affect others
- 16-bit simultaneous sampling on each channel

Applications

- LVDT/RVDT sensors
- Compatible with LVDT sensors from Schaevitz

Overview

The KAD/LDC/101 is used for signal conditioning and digitized data acquisition from four Linear Variable Differential Transformer (LVDT) or Rotational Variable Differential Transformer (RVDT) devices. In addition to the measurement channels, the KAD/LDC/101 provides independent excitation for four channels. Each signal has independent signal conditioning and filtering.

The KAD/LDC/101 can be used with external excitation sources (400 Hz to 20 kHz), or with the independent onboard excitation outputs, which are capable of driving up to 25 mA_{rms} each.

At the heart of the KAD/LDC/101 is a hard-wired state-machine that over-samples all channels at a rate between 96 ksps and 192 ksps and digitally filters any noise above the user programmable cutoff frequency. This is achieved using cascaded, half-band, decimate by 2, 15 tap, finite-impulse-response (FIR) filters with 32-bit coefficients followed by an 8th order Butterworth IIR filter with a default cutoff point set at 25% of the sampling frequency.

All signals are sampled simultaneously. This means that even when several channels are sampled at different sampling rates, the sample at the start of the acquisition is always synchronized. Care must be taken when monitoring aircraft control signals due to the low input impedance when powered off.

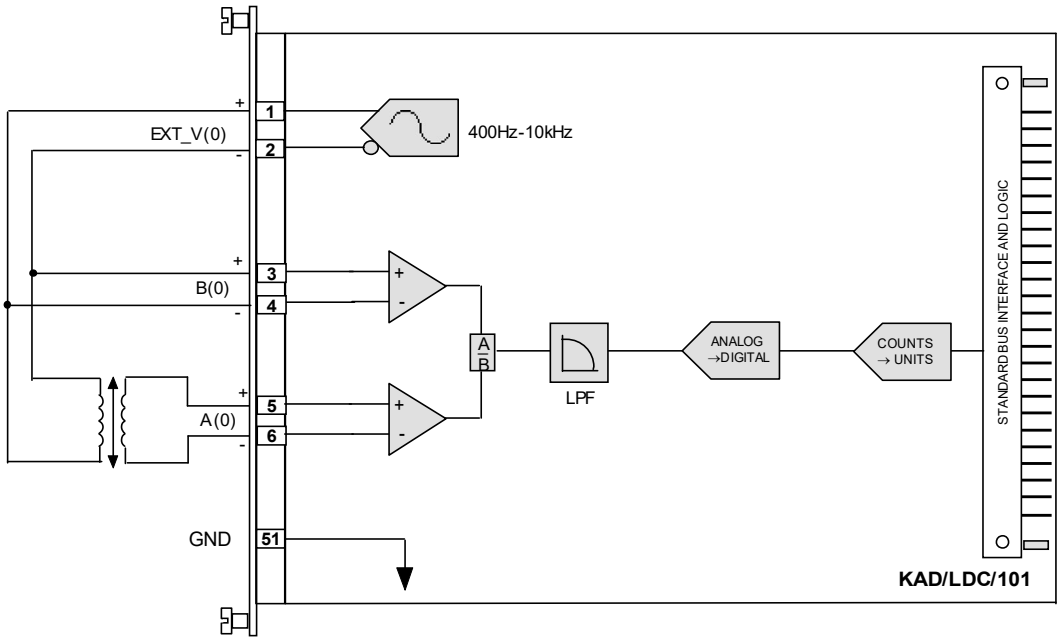


Figure 1: First of four channels on the KAD/LDC/101

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	100	–	g	
	–	3.53	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	75	–	120	mA	
±7V	–	–	–	mA	
+12V	70	–	85	mA	Excluding current used by excitation of LVDTs, the KAD/LDC/101 consumes 85 mA on the ±12V supply. If more than one KAD/LDC/101 is used with low impedance LVDTs, it is possible to exceed the 1.3A limit from the ±12V supply of the chassis. Therefore, the number and choice of modules that can reside within the same chassis as the KAD/LDC/101 may be limited.
-12V	62	–	75	mA	
total power	1.94	–	2.52	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Linear Variable Differential Transformer (LVDT) inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	4	–	Pairs of units A/B.
Sampling rate					While the sampling rate can be set individually, each input must have a power of two times any other (¼, ½,...2, 4).
Channel [3:0]	0.002	–	24	ksps	
Input voltage					
operating range	1	–	3.5	V_{rms}	
frequency range	2	–	20	kHz	
A/B ratio	0.2	–	0.8	–	Usable full scale range.
mechanical frequency (KAD/LDC/101/10K)	–	–	1	kHz	Maximum recommended mechanical frequency.

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TABLE 2	Linear Variable Differential Transformer (LVDT) inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
mechanical frequency (KAD/LDC/101/5K)	–	–	500	Hz	Maximum recommended mechanical frequency.
mechanical frequency (KAD/LDC/101/2.5K)	–	–	250	Hz	Maximum recommended mechanical frequency.
mechanical frequency (KAD/LDC/101/400)	–	–	40	Hz	Maximum recommended mechanical frequency.
overvoltage protection	-10	–	10	V	Voltages outside this range can damage input.
Total error (at phase)					When operating in series opposed mode, where phase shift between the primary winding and the secondary winding degrade the performance. Ratiometric calculation accuracy at room temperature, with an A/B ratio of 0.8.
±0°	-0.5	–	0.5	%FSR	
±5°	-0.6	–	0.6	%FSR	
±7°	-0.8	–	0.8	%FSR	
±10°	-1.25	–	1.25	%FSR	
Effective number of bits	8	10	–	bits	For sampling rates up to 1 Ksps.
Crosstalk	-60	–	–	dB	
Common mode					
voltage range	-10	–	10	V	Operational voltage range.
rejection ratio	50	–	–	dB	Applies within the above common mode voltage range, $0 \leq f \leq f_c$. (f_c : filter cutoff frequency).
Low-pass analog filter					
poles	–	–	4	–	
filter cutoff -3 dB	10.6	12.5	14.4	kHz	
Digital filter					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3 dB	0.25	–	16	f_s	The maximum value is limited to 6 kHz (f_s: sampling frequency).
0.1 dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1 dB bandwidth	–	–	-72	dB	
aliasing to f_c	–	–	-74	dB	
Filter delay	–	0.33	–	ms	Where $f_{in} = f_c = 6$ kHz (f_{in} : input signal frequency). See “Getting the most from the KAD/LDC/101” on page 452.
Input resistance					
between inputs	–	2	–	kΩ	Module powered off.
between inputs	–	200	–	kΩ	Module powered on.
each input to GND	–	1	–	kΩ	Module powered off.
each input to GND	–	200	–	kΩ	Module powered on.

TABLE 3	Bipolar AC voltage excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	4	–	Applied per channel.
Output voltage					
amplitude	–	3.5	–	V_{rms}	
frequency (KAD/LDC/101/10K)	–	10	–	kHz	Frequency is set depending on ordering option and is the same for all channels.
frequency (KAD/LDC/101/5K)	–	5	–	kHz	
frequency (KAD/LDC/101/2.5K)	–	2.5	–	kHz	
frequency (KAD/LDC/101/400)	–	400	–	Hz	
AC error					The measurement accuracy of the module is not affected by excitation errors within the min/max range shown here. Sensors may be affected by frequency errors. For details of errors introduced in sensors, see the manufacturer's data sheet for the sensor in use.
amplitude	-10	–	10	%	
frequency (KAD/LDC/101/10K)	-7.5	–	7.5	%	
frequency (KAD/LDC/101/5K)	-7.5	–	7.5	%	
frequency (KAD/LDC/101/2.5K)	-10	–	10	%	
frequency (KAD/LDC/101/400)	-15	–	15	%	
compliance	–	–	25	mA_{rms}	Per channel.
short circuit current	–	–	60	mA_{rms}	
short circuit duration	∞	–	–	s	To GND.
Output resistance	–	0.1	–	Ω	

Setting up the KAD/LDC/101

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/LDC/101/10k	KAD/LDC/101/10k	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
AnalogIn(3:0) Analog Input	-	-	-
Settings	-	-	-
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
AnalogIn(3:0) Parameters				
AnalogIn Analog signal data.	Volt	OffsetBinary	16	R[15:0]

Configurable parameters

AnalogIn(3:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-10 to 10	10	Range maximum for analog channel
Range Minimum	-10 to 10	-10	Range minimum for analog channel

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/LDC/101

For the four-wire configuration, it is important to use the zero-phase frequency as specified by the LVDT/RVDT manufacturer. Phase errors up to ±15° and ratio variations can cause gain/offset errors, so for different sensor types it is recommended that gain and offset corrections be calculated by calibrating one of each sensor type. For half-bridge configuration, the phase shift is not important.

If the signals to A and B are greater than 3.5 V_{rms}, they should be attenuated using an external resistor divider. If possible, both signals should be attenuated by the same amount (because the KAD/LDC/101 calculates the ratio between them).

When choosing the excitation frequency, the system bandwidth and the cutoff frequency should be a maximum of 1/10 the excitation frequency. For example, if the deflection being measured has a bandwidth of Fm = 200 Hz, the excitation frequency should be at least 2 kHz and the sampling rate should be approximately:

F_s = (Fm / 0.66) × 4 = 1212 Hz

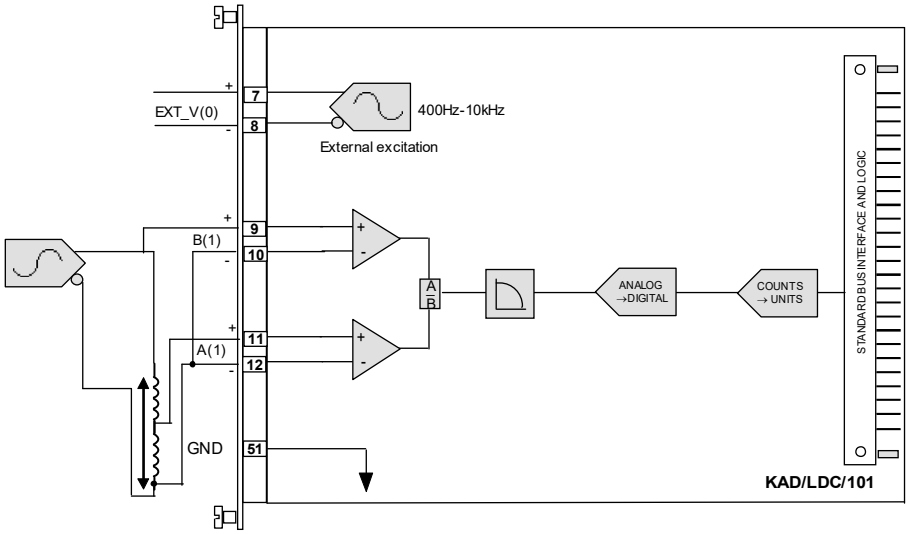


Figure 2: Second of four independent LVDT channels with external reference used (½-bridge configuration)

When operating in half bridge mode, the movement of the core changes the inductance of the secondary coils changing the voltage across each of them, acting as a potential divider.

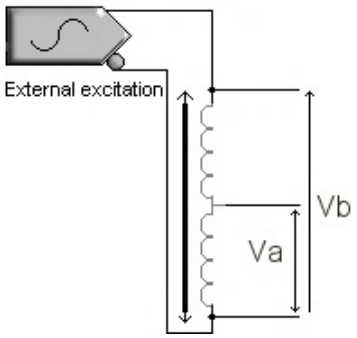


Figure 3: Voltage seen by the KAD/LDC/101

The voltage seen by the KAD/LDC/101 is:
Va / Vb × 12.5

When the bridge is balanced, the voltage seen is 6.25V. The LVDT's sensitivity determines the range about this balance point; this can be less than ±1V. For example ±1.36V with a Schaevitz MHR250; this is 4.7 times less output than series opposed mode.

When using the KAD/LDC/101 in half-bridge mode, this reduction in the useful range should be considered.

The gain can be set via the maximum and minimum range values. If S V/V/mil is the LVDT sensitivity and ±d is the maximum deflection, the gain required is:

$$G = \frac{10}{d \bullet S \bullet 12.5}$$

So for d = 0.1 inc, s = 2.4 mV/V/mil and gain = 3.33

Offset can be used to shift the null voltage point of the LVDT/RVDT.

NOTE: Overall measurement accuracy depends on the LVDT device used. For example, Schaevitz E100 has ±1% FSR with Fexc = 5 kHz.

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate are always sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. The following figure shows a delay for an 8th order filter where f_c = 1 kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1 kHz/ f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1 kHz/ f_c). For example, an 8th order Butterworth filter with an f_c of 1 kHz delays a 1 kHz signal by 1ms; a filter with an f_c of 10 Hz delays a 10 Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

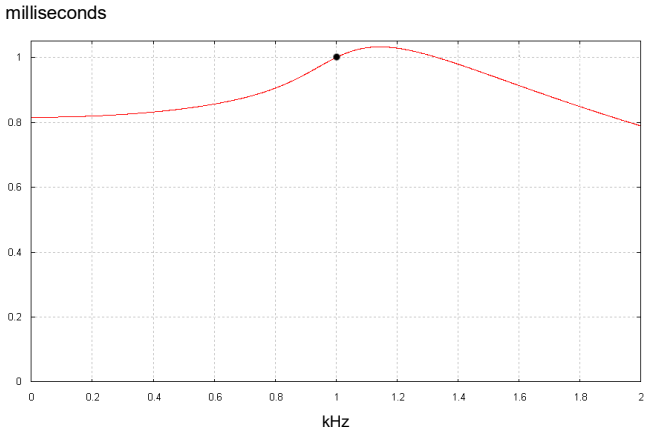


Figure 4: Filter delay for 8th order Butterworth filter where f_c = 1 kHz

The filter delay for the KAD/LDC/101 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_D is the filter delay

T_A (analog filter delay) ≈ 0

f_c is the filter cutoff frequency.

Amplitude profile

The KAD/LDC/101 has a typical 0.1dB point at $0.8f_c$, with the 0.2 dB occurring at approximately $0.83f_c$. Figure 5, Figure 6, Figure 7 and Figure 8 illustrate the amplitude profile at different frequencies.

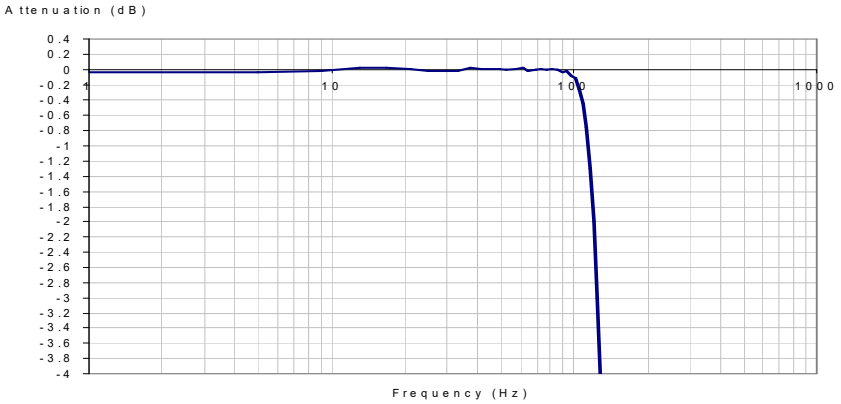


Figure 5: Amplitude profile when A\B frequency is 10 kHz and sampling rate is 500 Hz

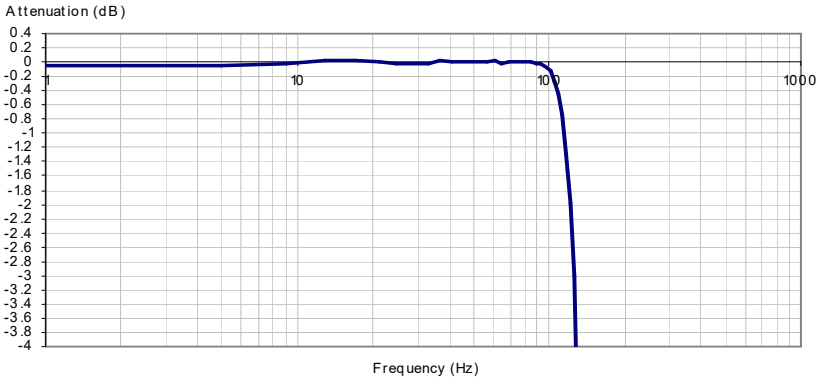


Figure 6: Amplitude profile when A\B frequency is 5 kHz and sampling rate is 500 Hz.

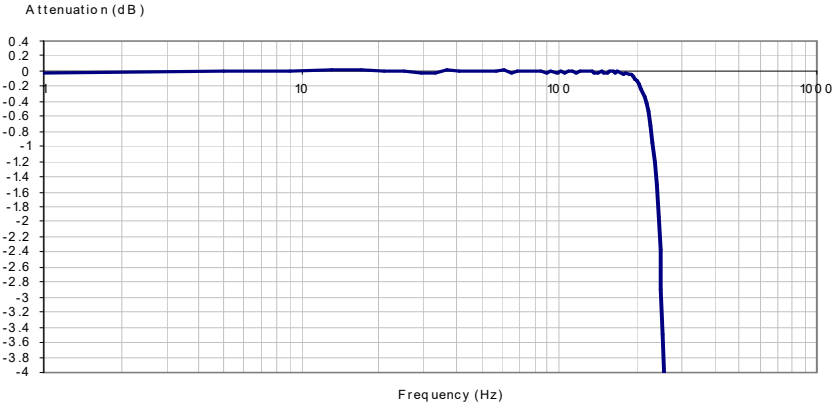


Figure 7: Amplitude profile when A\B frequency is 10 kHz and sampling rate is 1000 Hz.

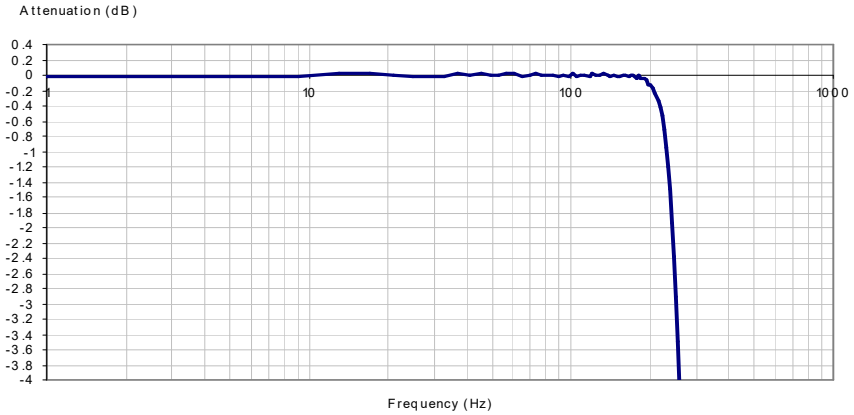


Figure 8: Amplitude profile when A\B frequency is 5 kHz and sampling rate is 1,000 Hz.

Connector pinout of the KAD/LDC/101

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	EXT_V(0)+	Bipolar AC voltage excitation outputs	LVDT excitation output; 1st channel
2	EXT_V(0)-	Bipolar AC voltage excitation outputs	LVDT excitation output; 1st channel
3	B(0)+	Linear Variable Differential Transformer (LVDT) inputs	LVDT reference input; 1st channel
4	B(0)-	Linear Variable Differential Transformer (LVDT) inputs	LVDT reference input; 1st channel
5	A(0)+	Linear Variable Differential Transformer (LVDT) inputs	LVDT input; 1st channel
6	A(0)-	Linear Variable Differential Transformer (LVDT) inputs	LVDT input; 1st channel
7	EXT_V(1)+	Bipolar AC voltage excitation outputs	LVDT excitation output; 2nd channel
8	EXT_V(1)-	Bipolar AC voltage excitation outputs	LVDT excitation output; 2nd channel
9	B(1)+	Linear Variable Differential Transformer (LVDT) inputs	LVDT reference input; 2nd channel
10	B(1)-	Linear Variable Differential Transformer (LVDT) inputs	LVDT reference input; 2nd channel
11	A(1)+	Linear Variable Differential Transformer (LVDT) inputs	LVDT input; 2nd channel
12	A(1)-	Linear Variable Differential Transformer (LVDT) inputs	LVDT input; 2nd channel
13	GND	Internal ground	
14	GND	Internal ground	
15	EXT_V(2)+	Bipolar AC voltage excitation outputs	LVDT excitation output; 3rd channel
16	EXT_V(2)-	Bipolar AC voltage excitation outputs	LVDT excitation output; 3rd channel
17	B(2)+	Linear Variable Differential Transformer (LVDT) inputs	LVDT reference input; 3rd channel
18	B(2)-	Linear Variable Differential Transformer (LVDT) inputs	LVDT reference input; 3rd channel
19	A(2)+	Linear Variable Differential Transformer (LVDT) inputs	LVDT input; 3rd channel
20	A(2)-	Linear Variable Differential Transformer (LVDT) inputs	LVDT input; 3rd channel
21	EXT_V(3)+	Bipolar AC voltage excitation outputs	LVDT excitation output; 4th channel
22	EXT_V(3)-	Bipolar AC voltage excitation outputs	LVDT excitation output; 4th channel
23	B(3)+	Linear Variable Differential Transformer (LVDT) inputs	LVDT reference input; 4th channel
24	B(3)-	Linear Variable Differential Transformer (LVDT) inputs	LVDT reference input; 4th channel
25	A(3)+	Linear Variable Differential Transformer (LVDT) inputs	LVDT input; 4th channel
26	A(3)-	Linear Variable Differential Transformer (LVDT) inputs	LVDT input; 4th channel
27	GND	Internal ground	
28	GND	Internal ground	
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/LDC/101/400	LVDT/RVDT-to-digital converter (400 Hz voltage excitation, 6 kHz b/w) - 4ch at 24ksps (with 52-way double-density connector)
KAD/LDC/101/10K	LVDT/RVDT-to-digital converter (10 kHz voltage excitation, 6 kHz b/w) - 4ch at 24ksps (with 52-way double-density connector)
KAD/LDC/101/5K	LVDT/RVDT-to-digital converter (5 kHz voltage excitation, 6 kHz b/w) - 4ch at 24ksps (with 52-way double-density connector)
KAD/LDC/101/2.5K	LVDT/RVDT-to-digital converter (2.5 kHz voltage excitation, 6 kHz b/w) - 4ch at 24ksps (with 52-way double-density connector)
KAM/LDC/101/10K	LVDT/RVDT-to-digital converter (10 kHz voltage excitation, 6 kHz b/w) - 4ch at 24ksps (with 51-way micro-miniature connector)
KAM/LDC/101/5K	LVDT/RVDT-to-digital converter (5 kHz voltage excitation, 6 kHz b/w) - 4ch at 24ksps (with 51-way micro-miniature connector)
KAM/LDC/101/2.5K	LVDT/RVDT-to-digital converter (2.5 kHz voltage excitation, 6 kHz b/w) - 4ch at 24ksps (with 51-way micro-miniature connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; or ACC/CON/008/04 for KAM modules), is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/LDC/101 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/LDC/101	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/014	Linear variable differential transformers
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

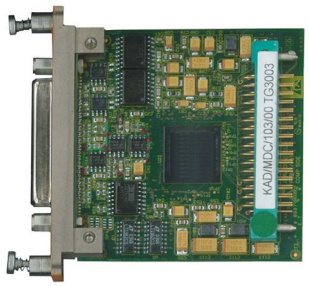
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/MDC/103

Multiplexing ADC (programmable analog gain, pressure scanner, polynomial temp. compensation) - 2ch at 20ksps

CURTISSWRIGHTDS.COM



Key Features

- Two differential ended temperature channels and two differential ended pressure channels
- Support for two 64-channel external multiplexers with 5V or 12V logic
- Programmable range on input channels
- Provides fourth order polynomial correction of scanner output voltage
- ±12V power and calibrated +5V excitation with sense lines
- 16-bit simultaneous sampling on each channel

Applications

- Interfacing to single temperature sense option pressure scanners from Esterline Pressure systems (example ESP-16HD, ESP-48SL)

Overview

The KAD/MDC/103 interfaces to multiplexed analog signals such as those from analog pressure scanners like the ESP-16HD, ESP-32HD, ESP-48SL or ESP-64HD with single-temperature sense option from Esterline.

The KAD/MDC/103 has two analog inputs for differential voltages and for external temperature measurements. In addition to measurement channels, the KAD/MDC/103 provides a 6-bit address for the external multiplexer.

The KAD/MDC/103 sequentially addresses up to 64 channels from an external multiplexer and measures the voltage on the outputs of pressure scanner multiplexers. The interval within which all external pressure channels are addressed is automatically set from the range 3.2ms to 512ms. For sample cycles longer than 512ms, the addressing cycle stays at the maximum value.

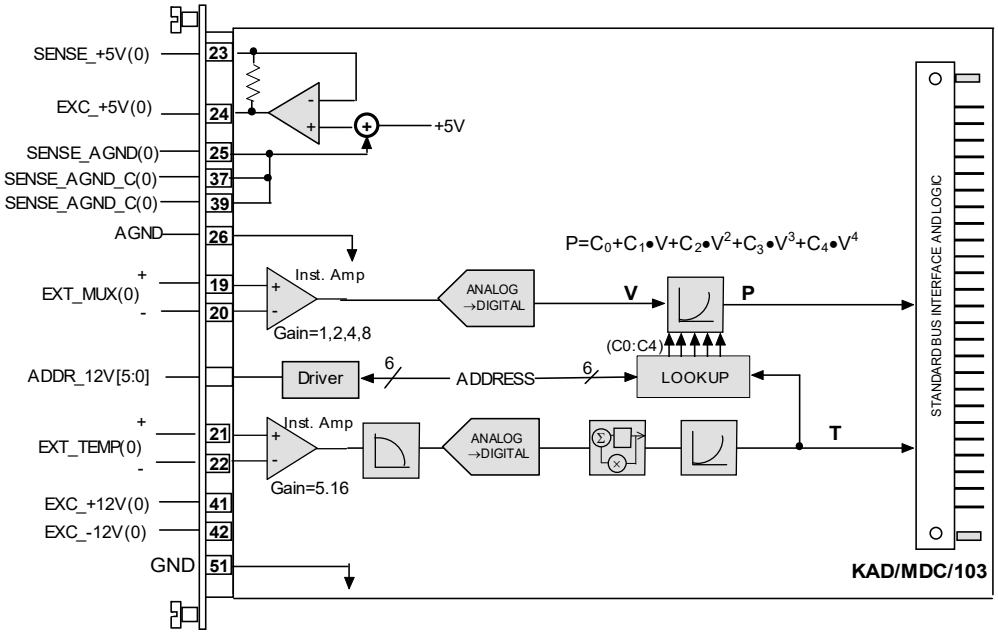


Figure 1: First pair of analog and temperature inputs with the multiplexer address bus

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	75	–	g	
	–	2.64	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	40	–	50	mA	
+7V	50	–	60	mA	Excludes current used by excitation.
-7V	40	–	50	mA	
+12V	90	–	130	mA	Excludes current used by excitation.
-12V	50	–	80	mA	Excludes current used by excitation.
total power	2.51	–	3.54	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Multiplexed analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	2	–	
Sampling rate					
EXT_MUX[1:0]±	–	–	20	ksps	
Input voltage					
primary gain = 1	-10	–	10	V	
primary gain = 2	-5	–	5	V	
primary gain = 4	-2.5	–	2.5	V	
primary gain = 8	-1.25	–	1.25	V	
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.

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TABLE 2	Multiplexed analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
DC error					DC signal averaged over 200 samples without excitation. Includes pressure linearization and interpolation for scanner's temperatures between manufacturer calibration points.
gain = 1, 2, 4, 8	–	–	0.25	%FSR	
Effective number of bits					
gain = 1, 2, 4, 8	13	–	–	bits	$f_{in} < f_s / 4$ where $f_s = 312.5$Hz (f_{in} : input signal frequency; f_s : sampling frequency).
Crosstalk					
gain = 1, 2, 4, 8	–	–	-80	dB	$f_{in} < f_s / 4$ where $f_s = 20$kHz.
Common mode					
voltage range	-10	–	10	V	Operational voltage range.
rejection ratio	80	–	–	dB	$f_{in} < 500$Hz where $f_s = 20$kHz.
Input resistance					
between inputs	22	–	–	kΩ	Module powered off.
between inputs	10	–	–	MΩ	Module powered on.
each input to GND	13	–	–	kΩ	Module powered off.
each input to GND	10	–	–	MΩ	Module powered on.

TABLE 3	Temperature inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	2	–	
Sampling rate					
EXT_TEMP[1:0]±	–	–	312.5	sps	
Input temperature					
full scale range	-40	–	85	°C	
DC error	-0.25	–	0.25	%FSR	Temperature averaged over 200 samples. Does not include sensor accuracy.
Effective number of bits	12	–	–	bits	$0 \le f < f_c$ (f_c : filter cutoff frequency).
Crosstalk	–	–	-60	dB	Between channels on the same module.
Ripple ratio					
$0 \le f < f_c$	–	–	0.5	dB	Operational voltage range.
Analog filter					Analog filter is Butterworth.
poles	–	2	–	–	
filter cutoff -3dB	–	500	–	Hz	
filter delay	–	450	–	µs	
Input resistance					
between inputs	100	–	–	kΩ	Module powered off.
between inputs	10	–	–	MΩ	Module powered on.
each input to GND	35	–	–	kΩ	Module powered off.
each input to GND	10	–	–	MΩ	Module powered on.

TABLE 4	Single ended DC voltage excitation outputs +5V				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs					
EXC_+5V[1:0]	–	–	2	–	
Output voltage					
operating range	–	5	–	V	
compliance	–	–	80	mA	Per channel.
short circuit current	–	–	150	mA	
short circuit duration	∞	–	–	s	To GND.
DC error					
error	-10	–	10	mV	Considered only with SENSE_5V and SENSE_AGND lines used across the load.
noise	–	–	-84	dB	
Output resistance	–	0.1	–	Ω	Considered only with SENSE_5V and SENSE_AGND lines used across the load.

TABLE 5	Single ended DC voltage excitation outputs +12V				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs					
EXC_+12V[1:0]	–	–	2	–	
Output voltage					
operating range	–	12	–	V	
compliance	–	–	120	mA	
short circuit current	–	–	–	mA	There is no short circuit protection on this output. Care must be taken not to short this output, otherwise damage may be caused to the module, as well as temporary disturbance to the operation of any other module(s) using the -12V line.
short circuit duration	–	–	0	s	
DC error					
error	-200	–	200	mV	
noise	–	–	-90	dB	
Output resistance	–	0.1	–	Ω	

TABLE 6	Single ended DC voltage excitation outputs -12V				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs					
EXC_-12V[1:0]	–	–	2	–	
Output voltage					
operating range	–	-12	–	V	
compliance	–	–	120	mA	
short circuit current	–	–	–	mA	There is no short circuit protection on this output. Care must be taken not to short this output, otherwise damage may be caused to the module, as well as temporary disturbance to the operation of any other module(s) using the -12V line.
short circuit duration	–	–	0	s	
DC error					
error	-200	–	200	mV	
noise	–	–	-90	dB	
Output resistance	–	0.1	–	Ω	

TABLE 7	Multiplexer address outputs 12V				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	6	–	
Signaling rate					
ADDR_12V(0)	–	–	10	kHz	
ADDR_12V(1)	–	–	5	kHz	
ADDR_12V(2)	–	–	2.5	kHz	
ADDR_12V(3)	–	–	1.25	kHz	
ADDR_12V(4)	–	–	0.625	kHz	
ADDR_12V(5)	–	–	0.3125	kHz	
Output voltage					
logic 0	–	–	0.5	V	Sinking 1mA.
logic 1	10	–	–	V	Sourcing 1mA.
short circuit current	–	–	25	mA	
short circuit duration	∞	–	–	s	To GND.
Output resistance	–	470	–	Ω	

TABLE 8	Multiplexer address outputs 5V				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	6	–	
Signaling rate					
ADDR_5V(0)	–	–	10	kHz	
ADDR_5V(1)	–	–	5	kHz	
ADDR_5V(2)	–	–	2.5	kHz	
ADDR_5V(3)	–	–	1.25	kHz	
ADDR_5V(4)	–	–	0.625	kHz	
ADDR_5V(5)	–	–	0.3125	kHz	
Output voltage					
logic 0	–	–	0.4	V	Sinking 1mA.
logic 1	3	–	–	V	Sourcing 1mA.
short circuit current	–	–	50	mA	
short circuit duration	∞	–	–	s	To GND.
Output resistance	–	150	–	Ω	

Setting up the KAD/MDC/103

Setting up parameters

For 2x64 parameters from EXT_MUX(0) and EXT_MUX(1)

SET-UP DATA	CHOICE	DEFAULT	NOTES
Name	No limit to characters	MyPressure	
Base unit	Pascal	Pascal	
maximum	No limits	82737.09	Defaults are set for ±12PSI scanner FSR.
minimum	No limits	-82737.09	Defaults are set for ±12PSI scanner FSR.
Data format	Offset binary	Offset binary	
Size in bits	4 to 16	16	
Offset	No limits	0	Re-zero offset. See “Getting the most from the KAD/MDC/103” on page 466.

For parameters from MUX_TEMP(0) and MUX_TEMP(1)

SET-UP DATA	CHOICE	DEFAULT	NOTES
Name	No limit to characters	MyTemperature	
Base unit	Celsius	Volt	
maximum	-40 to 85	85	
minimum	-40 to 85	-40	
Data format	Offset binary	Offset binary	
Size in bits	4 to 16	16	

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Setting up instrumentation

This module uses the X-Module-ExternalMultiplexer-Controller XidML schema. (See http://www.xidml.org).

For 2 x 64 parameters from EXT_MUX(0) and EXT_MUX(1)

SET-UP DATA	CHOICE	DEFAULT	NOTES
Manufacturer			
name	ACRA CONTROL	ACRA CONTROL	
part reference	KAD/MDC/103	KAD/MDC/103	ACRA CONTROL part number.
serial number	Fixed 6 characters	FE1234	Unique number for each module.

Setting up algorithms

This module uses the X-Module-ExternalMultiplexer-Controller XidML schema. (See http://www.xidml.org).

For 2 x 64 parameters from EXT_MUX(0) and EXT_MUX(1)

SET-UP DATA	CHOICE	DEFAULT	NOTES
AlgorithmSet			
input	No limitations	Calibration.txt	URL of calibration file for each pressure scanner. The URL of each calibration file must be specified.
output	No limitations	Rezero.txt	URL of rezero file. If not specified re-zero offset calibration won't be applied.

Getting the most from the KAD/MDC/103

In typical operation, the multiplexer's address is set to 000000_2 at the start of an acquisition cycle. If for example, 80µs later, the multiplexer output is sampled, the address increments to 000001_2 and the output is sampled again. After 5.12ms the address reads 111111_2 and all 64 channels have been sampled. Because sampling is sequential, all channels are sampled at the same rate.

Voltage input is provided to monitor the temperature output of the external multiplexer. The external temperature channel is sampled with the first pressure channel and then digitally filtered. The temperature read from the pressure scanner determines the selection of a fourth order polynomial for each of 64 external channels; this is used to linearize pressure according to a calibration file provided by the manufacturer of the pressure scanner.

Wiring

The 5V voltage excitation (EXC_+5V(x)) for the scanner bridges and temperature sensor is provided individually for each channel. EXC_+5V(x) has a SENSE_+5V(x) line to correct for voltage drops across the excitation line. A SENSE_+5V(x) line must be connected to the $+V_{S\ SENSE}$ output of the scanner. EXC_+5V(x) also contains correction for voltage drop across the AGND connection between the module and pressure scanner. To compensate for this drop, connect the SENSE_AGND(x) line to the GND_{SENSE} output of the scanner.

The ESP-16HD, ESP-32HD, ESP-48SL and ESP-64HD pressure scanners must be used with the address lines ADDR_12V(x). They are to be shared if two pressure scanners are connected.

For the ESP family of scanners, positive input of the pressure channel must be connected with V_o output of the scanner and negative input with GND_{SENSE} output.

For the temperature channel, positive input must be connected to V_T and negative to GND_{SENSE}. To minimize the wiring between the pressure scanner and the module, connect the GND_SENSE_COPY(x) pins to EXT_MUX(x)- and EXT_TEMP(x)- (if the scanner output voltage is referenced to GND, such as for the ESP family of scanners).

The following figure shows a wiring example for connecting an ESP pressure scanner to the KAD/MDC/103. Note, $V_{S\ RTN}$ (pin 9) of the pressure scanner must not be connected for correct operation of the scanner with the KAD/MDC/103.

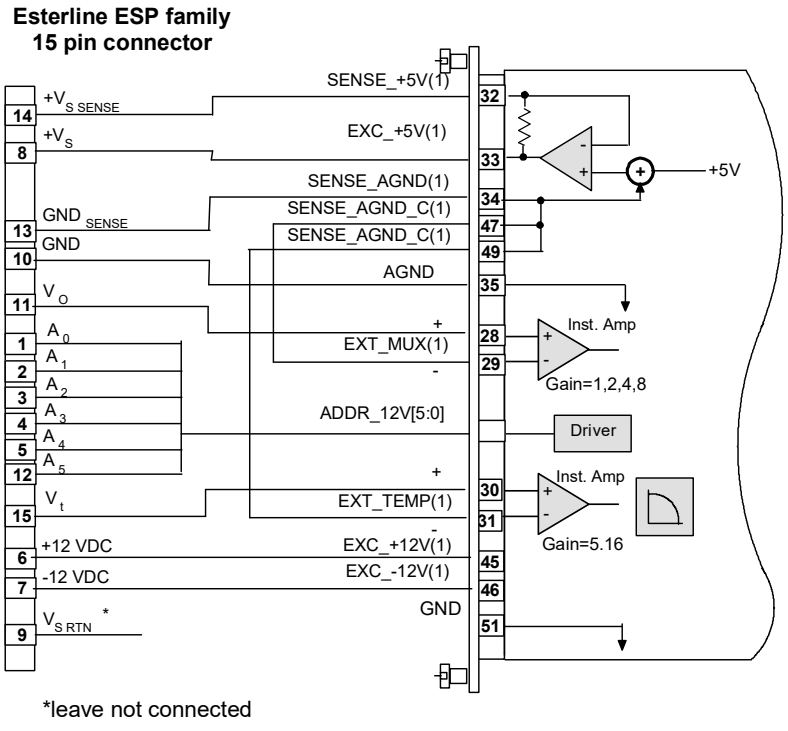


Figure 2: Wiring the ESP pressure scanner to the second channel of the KAD/MDC/103

Pressure scanners guarantee the best accuracy only when regular re-zero calibration of aging offset is carried out. In order to compensate for this, the system can be programmed without re-zero files specified and readings from each multiplexed channel treated as new re-zero offsets. Then the module can be programmed with those new values, and any aging error will be excluded from measurement. The re-zero file syntax is a multiple line file with a single floating point re-zero offset value per line. There are up to 64 values to be entered. The first line is related with multiplexed address 0, the following lines contain re-zero offsets for consecutive addresses. Offsets are to be entered in Pascals.

To prevent degraded system performance, use individual shielded cables for analog signals, excitations, and address lines.

Power consumption

In cases where high-current pressure scanners are used (such as the ESP-64HDs), current consumption from the KAD/MDC/103 excitation lines exceeds the value normally assigned to the +12V, -12V and +7V (used for EXC_+5V(x)) lines of the occupied slot. This is acceptable as long as the total current drawn from all occupied slots does not exceed that of the Acra KAM-500 chassis power supply.

If the maximum current of the Acra KAM-500 chassis power supply is exceeded, use an external ±12V and +5V power supply. The GND of an external power supply must be connected with the GND of the chassis. To prevent degradation of system accuracy, it is crucial to have a stable and accurate +5V supply.

Contact Curtiss-Wright support (acra-support@curtisswright.com) if an external power supply is to be used.

Connector pinout of the KAD/MDC/103

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	ADDR_12V(0)	Multiplexer address outputs 12V	LSB of address to pressure scanner; CMOS 0 to 12 volt logic levels
2	ADDR_12V(1)	Multiplexer address outputs 12V	
3	ADDR_12V(2)	Multiplexer address outputs 12V	
4	ADDR_12V(3)	Multiplexer address outputs 12V	
5	ADDR_12V(4)	Multiplexer address outputs 12V	
6	ADDR_12V(5)	Multiplexer address outputs 12V	MSB of address to pressure scanner. CMOS 0 to 12 volt logic levels.
7	DNC		Do not connect
8	DNC		Do not connect
9	GND	Digital ground	
10	ADDR_5V(0)	Multiplexer address outputs 5V	LSB of address to pressure scanner. TTL 0 to 5 volt logic levels.
11	ADDR_5V(1)	Multiplexer address outputs 5V	
12	ADDR_5V(2)	Multiplexer address outputs 5V	
13	ADDR_5V(3)	Multiplexer address outputs 5V	
14	ADDR_5V(4)	Multiplexer address outputs 5V	
15	ADDR_5V(5)	Multiplexer address outputs 5V	MSB of address to pressure scanner. TTL 0 to 5 volt logic levels.
16	DNC		Do not connect
17	GND	Digital ground	
18	DNC		Do not connect
19	EXT_MUX(0)+	Multiplexed analog inputs	From scanner pressure Mux output
20	EXT_MUX(0)-		
21	EXT_TEMP(0)+	Temperature inputs	From scanner temperature output
22	EXT_TEMP(0)-		
23	SENSE_+5V(0)		See “Getting the most from the KAD/MDC/103”
24	EXC_ +5V(0)	Single ended DC voltage excitation outputs +5V	See “Getting the most from the KAD/MDC/103”
25	SENSE_AGND(0)		See “Getting the most from the KAD/MDC/103”
26	AGND		
27	DNC		Do not connect
28	EXT_MUX(1)+	Multiplexed analog inputs	From scanner pressure output
29	EXT_MUX(1)-		
30	EXT_TEMP(1)+	Temperature inputs	From scanner temperature output
31	EXT_TEMP(1)-		
32	SENSE_+5V(1)		See “Getting the most from the KAD/MDC/103”
33	EXC_ +5V(1)	Single ended DC voltage excitation outputs +5V	See “Getting the most from the KAD/MDC/103”
34	SENSE_AGND(1)		See “Getting the most from the KAD/MDC/103”
35	AGND	Analog ground	
36	DNC		Do not connect
37	SENSE_AGND_C(0)		See “Getting the most from the KAD/MDC/103”
38	DNC		Do not connect
39	SENSE_AGND_C(0)		See “Getting the most from the KAD/MDC/103”
40	AGND		Do not connect
41	EXC_+12V(0)	Single ended DC voltage excitation outputs +12V	See “Getting the most from the KAD/MDC/103”
42	EXC_-12V(0)	Single ended DC voltage excitation outputs -12V	See “Getting the most from the KAD/MDC/103”
43	DNC		Do not connect
44	AGND	Analog ground	
45	EXC_+12V(1)	Single ended DC voltage excitation outputs +12V	See “Getting the most from the KAD/MDC/103”
46	EXC_-12V(1)	Single ended DC voltage excitation outputs -12V	See “Getting the most from the KAD/MDC/103”
47	SENSE_AGND_C(1)		See “Getting the most from the KAD/MDC/103”
48	DNC		Do not connect
49	SENSE_AGND_C(1)		See “Getting the most from the KAD/MDC/103”
50	DNC		Do not connect
51	GND	Digital ground	
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/MDC/103	Multiplexing ADC (programmable analog gain, pressure scanner, polynomial temp. compensation) - 2ch at 20ksps (with 52-way connector)
KAM/MDC/103	Multiplexing ADC (programmable analog gain, pressure scanner, polynomial temp. compensation) - 2ch at 20ksps (with 51-way connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; or ACC/CON/008/04 for KAM modules), is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

The KAD/MDC/103 uses power from the ±7V for excitation and therefore cannot be used with the KAM/CHS/04L, KAM/CHS/05F, KAM/CHS/03F, or KAM/CHS/02F chassis. In this data sheet, KAD/MDC/103 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/MDC/103	First release	Recommended for new programs

Supporting software

MODULE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

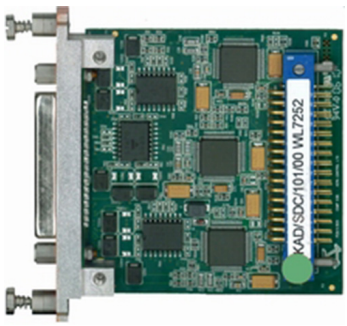
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/SDC/101

3-channel synchro-to-digital converter with programmable excitation

CURTISSWRIGHTDS.COM



Overview

The KAD/SDC/101 is a three-channel synchro-to-digital converter module.

A dedicated synchro-to-digital chip is used for each channel. The synchro excitation outputs and the reference inputs are separated to allow onboard or external excitation to be used.

The three parameters available from the KAD/SDC/101 each represent an angle.

Key Features

- Three independent synchro input channels (11.8V_{rms} nominal amplitude)
- 16-bit simultaneous sampling on all channels
- Best accuracy: ±6 arc minutes
- Programmable synchro excitation output amplitude and frequency (up to 11.8V_{rms}, 400 to 5,000 Hz)

Applications

- Angle measurement

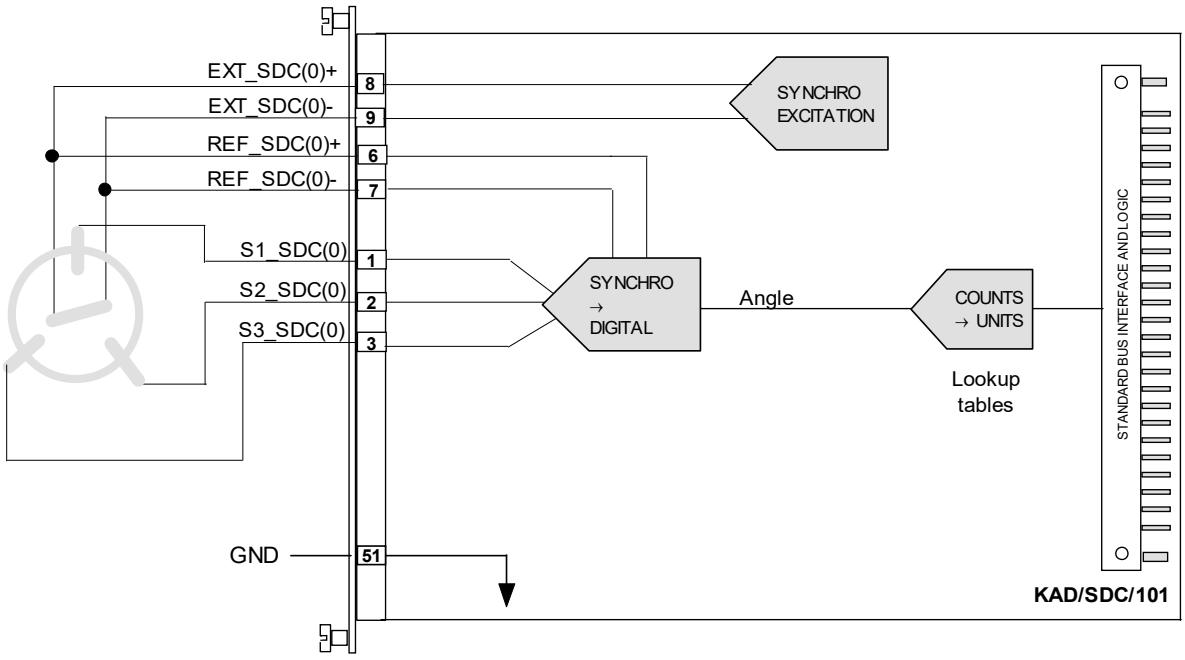


Figure 1: First of three channels on the KAD/SDC/101

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	70	–	g	
	–	2.47	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	120	–	160	mA	
±7V	–	–	–	mA	
±12V	40	–	65	mA	Excludes current used by excitation.
total power	1.56	–	2.36	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualifications Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

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TABLE 2	Synchro inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	3	–	
Sampling rate					
S1/S2/S3_SDC[2:0]	1	–	1,024	sps	
Input voltage					
operating range	6	11.8	13.5	V_{rms}	$11.8V_{rms}$ is nominal amplitude for input signals.
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input. Transient higher voltage pulses in the input signal are attenuated by bidirectional Transient Voltage Suppressors (TVS) installed on each input pair. TVS breakdown voltage is typically 58V and can handle pulses with power up to 600W (for 10 ms maximum).
Input angle					
angle	-180	–	180	°	Angle in degrees.
Accuracy					
	-6	–	6	‘	Angular error in arc minutes when input signal is $11.8V_{rms}$. Slow mode.
	-12	–	12	‘	Angular error in arc minutes when input signal is $6V_{rms}$. Slow mode.
Input resistance					
each input to GND	–	35	–	kΩ	Module powered off/on.

TABLE 3	Synchro reference inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	3	–	
Input frequency					
operating range	320	–	5,000	Hz	
Input voltage					
operating range	9	26	30	V_{rms}	$26V_{rms}$ is nominal amplitude for input signals.
overvoltage protection	-50	–	50	V	With respect to chassis ground. Voltages outside this range can damage input. Transient higher voltage pulses in the input signal are attenuated by bidirectional Transient Voltage Suppressors (TVS) installed on the input pair. TVS breakdown voltage is typically 128V and can handle pulses with power up to 600W (for 10 ms maximum).
Input resistance					
between inputs	–	155	–	kΩ	Module powered on or off.
each input to GND	–	77.5	–	kΩ	Module powered on or off.

TABLE 4	Differential ended excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	3	–	Amplitude and frequency settings are common for all channels.
Signaling rate	400	–	5,000	Hz	±2%. The exact generated frequency is a result of selecting the closest possible frequency for generation by a direct digital synthesis (DDS) circuit. Periods are rounded to 4 µs resolution.
Output voltage					
operating range	0	–	11.8	V_{rms}	The values specified here apply for an operating range of $6V_{rms}$ to $11.8V_{rms}$. A value of $0V_{rms}$ can be set in order to disable the output excitation voltage.
AC gain error	–	0.1	2	%FSR	Typical specified with no load; maximum specified at $20mA_{rms}$.
operating current	–	–	20	mA_{rms}	
DC offset	–	–	50	mV	
short circuit current	–	–	50	mA	
short circuit duration	∞	–	–	s	
Output resistance	–	0.5	–	Ω	

Setting up the KAD/SDC/101

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/SDC/101	KAD/SDC/101	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Settings	-	-	-
Mode	Slow Fast	Slow	Mode of operation. Slow mode offers better noise performance and resolution; fast mode offers better tracking range and wider bandwidth.
Excitation Amplitude	0 to 11.8	0.0	Excitation voltage (in Vrms) for differential ended excitation output.
Excitation Frequency	400 to 5000	2500	Excitation frequency (in Hz) for differential ended excitation output.
Channels	-	-	-
Angle(2:0) Analog Input	-	-	Settings for this channel.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Angle(2:0) Parameters				
Angle Angle signal data	Radian	OffsetBinary	16	R[15:0]

Configurable parameters

Angle(2:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-180 to 180	180	Range maximum for synchro channels
Range Minimum	-180 to 180	-180	Range minimum for synchro channels

---

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/SDC/101

Setting the operation mode

There are two operation modes; slow and fast.

Slow mode

Slow mode sets the tracking rate at up to 5 rps (revolutions per second), 50 Hz bandwidth and 16-bit resolution at a range of -180 to 180°. This mode offers optimal noise performance and is recommended for most applications. In slow mode the frequency of the reference signal (and therefore other input signals) can be any value between 400 and 5000 Hz.

Fast mode

If a faster tracking rate is needed, then fast mode can be selected. Fast mode sets the tracking rate at up to 80 rps, and 200 Hz bandwidth. However, when fast mode is selected, the primary resolution at a range of -180 to 180° is only 12 bits. Fast mode can only be selected when the minimum frequency of the reference signal (and therefore other input signals) is more than 800 Hz.

Wiring and polarity

The standard used in this document for the synchro voltages is shown in the following figure.

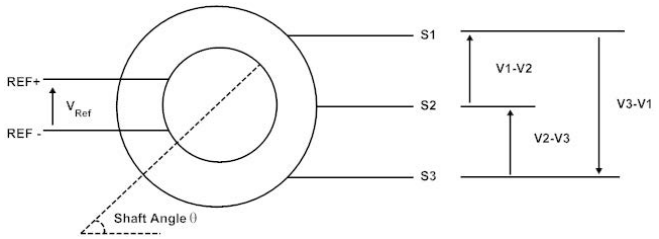


Figure 2: Synchro voltages standard

NOTE: Together with moving the switching point, the range maximum and range minimum are effectively moved by the same angle.

For the previous figure, the following applies:

- REF+ and REF- are the inputs to the rotor.
- S1, S2 and S3 are the stator outputs.
- V1-V2 is the voltage on synchro output S1 with respect to the voltage on output S2.

The peak amplitudes of the output voltages versus the rotor angle are shown in the following figure.

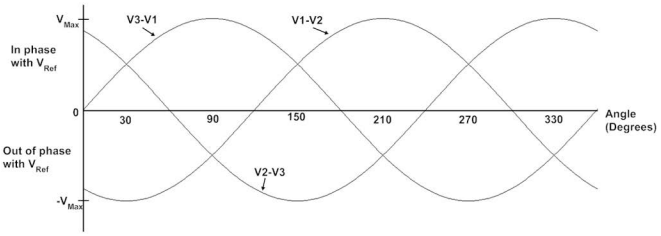


Figure 3: Peak amplitudes

Wiring of the synchro, results in an angle reading of 0° when the voltage of S1 with reference to S2 (V1-V2) and the voltage of S2 with reference to S3 (V2-V3) is the same amplitude but of opposite phase; the voltage V2-V3 is in phase with the REF_SDC(x) input signal.

By default, the output count of the module is zero at -180° and maximum at +180°. Hence there is a full scale change when the angle goes through the +180/-180 point. If this is undesirable, then the angle at which the output changes from zero to full scale can be changed. This can be done by swapping the two REF_SDC(x) inputs, which effectively moves the switching point by 180 degrees. Alternatively, if any two of the S1, S2, and S3 inputs are swapped, then the switching point is moved by either +120° or -120°.

Grounding the input signals

Optionally, pin 51 (GND) may be connected to any one of the inputs S1_SDC(x), S2_SDC(x), or S3_SDC(x). Note that it must not be connected to more than one of these inputs.

Connector pinout of the KAD/SDC/101

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	S1_SDC(0)	Synchro inputs	Synchro input S1; first channel
2	S2_SDC(0)	Synchro inputs	Synchro input S2; first channel
3	S3_SDC(0)	Synchro inputs	Synchro input S3; first channel
4	DNC		Do not connect
5	DNC		Do not connect
6	REF_SDC(0)+	Synchro reference inputs	Synchro reference; first channel
7	REF_SDC(0)-	Synchro reference inputs	Synchro reference; first channel
8	EXT_SDC(0)+	Differential ended excitation outputs	Synchro excitation; first channel
9	EXT_SDC(0)-	Differential ended excitation outputs	Synchro excitation; first channel
10	S1_SDC(1)	Synchro inputs	Synchro input S1; second channel
11	S2_SDC(1)	Synchro inputs	Synchro input S2; second channel
12	S3_SDC(1)	Synchro inputs	Synchro input S3; second channel
13	DNC		Do not connect
14	DNC		Do not connect
15	REF_SDC(1)+	Synchro reference inputs	Synchro reference; second channel
16	REF_SDC(1)-	Synchro reference inputs	Synchro reference; second channel
17	EXT_SDC(1)+	Differential ended excitation outputs	Synchro excitation; second channel
18	EXT_SDC(1)-	Differential ended excitation outputs	Synchro excitation; second channel
19	S1_SDC(2)	Synchro inputs	Synchro input S1; third channel
20	S2_SDC(2)	Synchro inputs	Synchro input S2; third channel
21	S3_SDC(2)	Synchro inputs	Synchro input S3; third channel
22	DNC		Do not connect
23	DNC		Do not connect
24	REF_SDC(2)+	Synchro reference inputs	Synchro reference; third channel
25	REF_SDC(2)-	Synchro reference inputs	Synchro reference; third channel
26	EXT_SDC(2)+	Differential ended excitation outputs	Synchro excitation; third channel
27	EXT_SDC(2)-	Differential ended excitation outputs	Synchro excitation; third channel
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/SDC/101	3-channel synchro-to-digital converter with programmable excitation

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/SDC/101	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment

Related documentation

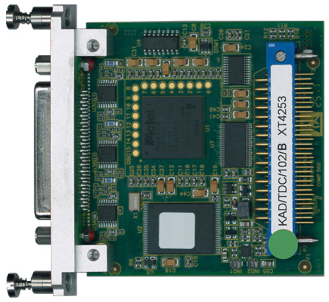
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/011	Synchros
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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This document was reviewed on 03/06/2022 and does not contain technical data.

KAD/TDC/102

Thermocouple ADC (reference compensation, 250Hz b/w) - 15ch at 1ksps

CURTISSWRIGHTDS.com



Key Features

- 15 grounded or isolated thermocouple input channels and compensation block (may use third party block) measurement
- Supports multiple thermocouple types with digital reference junction compensation and programmable thermocouple type per module
- Accuracy (0.5°C typical for K-type and XK_L-type in -50 to 150°C range, 1°C typical outside this range)
- Short on any channel does not affect others
- 16-bit simultaneous sampling on each channel

Applications

- Thermocouple temperature measurements

Overview

The KAD/TDC/102 is used to condition and digitize up to fifteen thermocouple channels and three channels of module junction temperature.

Together, the KAD/TDC/102 and the CON/KAD/010 connector use the preconfigured module junction temperature channels 0 and 2, to perform linearization and cold junction compensation for each thermocouple channel.

At the heart of the KAD/TDC/102 is a hard-wired state-machine that oversamples all channels at a rate up to 50ksps and digitally filters any noise above the user-programmable cutoff frequency.

This is achieved using cascaded, half-band, Finite-Impulse-Response (FIR) filters followed by an 8^{th} order Butterworth Infinite-Impulse-Response (IIR) filter with a default cutoff point set at one quarter of the sampling frequency ($f_c = f_s / 4$).

All signals are sampled simultaneously. When several channels are sampled at different sampling rates, at the start of an acquisition cycle, all channels are aligned.

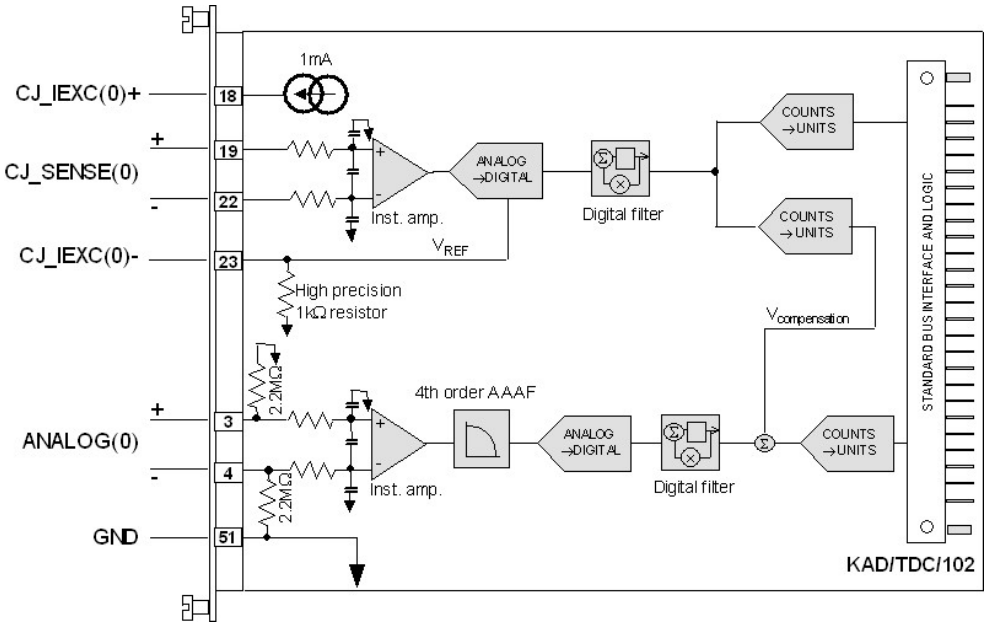


Figure 1: First of three reference junction channels plus first of 15 thermocouple channels

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	65	–	g	
	–	2.29	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *ACD/BAC/002/B* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	100	–	140	mA	
±7V	–	–	–	mA	
±12V	30	–	45	mA	
total power	1.22	–	1.78	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Cold junction				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	3	–	From PT100 sensors provided within the CON/KAD/010 connector. Resistive PT100 sensors are supplied from 1mA current source (typical value). The resistance measurement is ratiometric, compared with the embedded, high precision 1kΩ resistor.
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
JunctionTemperature[2:0]	0.5	–	1,000	sps	
Input temperature					

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TABLE 2	Cold junction (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
full scale range	-50	–	120	°C	
Input voltage					
operating range	0	–	250	mV	The measurement is a ratiometric resistance measurement performed with 1mA (typical) excitation current, Therefore, 0 to 250mV range is stated as the input voltage range.
overvoltage protection	-10	–	10	V	Voltages outside of this range can damage input.
DC error	–	0.04	0.2	%FSR	Temperature averaged over 200 samples. This includes any CON/KAD/010 error.
Effective number of bits	–	13.5	–	bits	$0 < f_{in} < 4Hz$ (f_{in} : input signal frequency)
Crosstalk	–	-98	-80	dB	$0 < f_{in} < 4Hz$
Analog filter					Analog filter is Butterworth.
poles	–	–	1	–	
filter cutoff -3dB	31.5	35	38.5	kHz	
Digital filter					Digital filter is embedded in the A/D converter. See “Signal filtering on reference junction channels” on page 487.
filter cutoff -3dB	–	4	–	Hz	
0.1dB bandwidth	–	0.1	–	f_c	(f_c : filter cutoff frequency)

TABLE 3	Thermocouple inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	15	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
Temperature[14:0]	0.5	–	1,000	sps	
Input temperature					The input temperature range is limited by the input voltage range of ±100mV and depends on the specific thermocouple type and the required cold junction temperature range. Refers to thermocouple type and maximum programmable range only (see “Accuracy” on page 486).
full scale range K-type thermocouple	-270	–	1,372	°C	For accuracy figures within a -200˚C and 1372˚C range, refer to the DC error parameter rows in this table.
full scale range B-type thermocouple	0	–	1,820	°C	
full scale range J-type thermocouple	-210	–	1,200	°C	
full scale range E-type thermocouple	-270	–	1,000	°C	
full scale range N-type thermocouple	-270	–	1,300	°C	
full scale range R-type thermocouple	-50	–	1,767	°C	
full scale range S-type thermocouple	-50	–	1,767	°C	
full scale range T-type thermocouple	-270	–	400	°C	

TABLE 3	Thermocouple inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
full scale range T99-type thermocouple	-59	–	229	°C	
full scale range XK_L-type thermocouple	-200	–	800	°C	For accuracy figures within a -200˚C and 800˚C range, refer to the DC error parameter rows in this table.
full scale range C-type thermocouple	0	–	2,315	°C	
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.
Input voltage					
operating range	-100	–	100	mV	
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.
DC error	–	0.5	1.5	°C	Temperature averaged over 200 samples for a grounded or isolated K-type and XK_L-type thermocouple when measured temperature (input signal) is within -50°C to 150°C. This error includes the cold junction measurement error, and is met for an ambient temperature change rate of up to 1°C per minute using an ACD/CJB/003.
DC error	–	1.0	2.5	°C	Temperature averaged over 200 samples for a grounded or isolated K-type and XK_L-type thermocouple when measured temperature (input signal) is outside -50°C to 150°C and greater than -200°C. This error includes the cold junction measurement error, and is met for an ambient temperature change rate of up to 1°C per minute using an ACD/CJB/003.
Effective number of bits	–	13.5	–	bits	$0 < f_{in} < 250Hz$ (f_{in} : input signal frequency)
Crosstalk	–	-90	-78	dB	$0 < f_{in} < 250Hz$
Common mode					
voltage range	-10	–	10	V	Operational voltage range (see “Common mode voltage effects” on page 486).
rejection ratio	90	110	–	dB	Applies within the above common mode voltage range, $0 \leq f_{in} < 250Hz$.

TABLE 3	Thermocouple inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Analog filter					Analog filter is Butterworth.
poles	–	–	4	–	
filter cutoff -3dB	2.95	3	3.15	kHz	
Digital filter					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 250Hz (f_s: sampling frequency).
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-72	dB	
aliasing to f_c	–	–	-74	dB	
Filter delay	–	20	–	ms	Where $f_{in} = f_c = 100Hz$ (f_{in} : input signal frequency). See “Understanding filter delays” on page 486.
Input resistance					
between inputs	700	800	–	kΩ	Module powered off. Within ±100mV input range.
between inputs	10	–	–	MΩ	Module powered on. Within ±100mV input range.
each input to GND	2.1	2.2	–	MΩ	Module powered off. Within ±100mV input range.
each input to GND	10	–	–	MΩ	Module powered on. Within ±100mV input range.

Setting up the KAD/TDC/102

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/TDC/102/B	KAD/TDC/102/B	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
Temperature(14:0) Analog Input.	-	-	Temperature input channels.
Settings	-	-	-
Thermocouple Type	UTF-8 String	.\LookupFiles\Thermocouple\TYPE K.LU	Specifies a URL where a specific thermocouple type lookup file can be found.
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.
JunctionTemperature(2:0) Junction Temperature Input.	-	-	Reference junction temperature channels.
Settings	-	-	-

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Temperature(14:0) Parameters				
Temperature Temperature signal data.	Celsius	OffsetBinary	16	R[15:0]
JunctionTemperature(2:0) Parameters				
JunctionTemperature Reference junction temperature signal data.	Celsius	OffsetBinary	16	R[15:0]

Configurable parameters

Temperature(14:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-270 to 1820	1372	Range maximum for thermocouple channels.
Range Minimum	-270 to 1820	-270	Range minimum for thermocouple channels.

JunctionTemperature(2:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-55 to 125	125	Range maximum for reference junction channels.
Range Minimum	-55 to 125	-55	Range minimum for reference junction channels.

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/TDC/102

Bias current return path

The KAD/TDC/102 does not require external bias returns, and provides the return for bias currents internally via a 2.2MΩ resistor from each input to ground.

Accuracy

The accuracy of the KAD/TDC/102 is specified for K-type thermocouples over the range specified in the DC error parameter rows in Table 3 on page 481. It is also met for J, XK_L, and E-type thermocouples that have a similar sensitivity. For thermocouples with a lower sensitivity (R, S, and T-type), the accuracy figure can be estimated by scaling the accuracy claimed for a K-type thermocouple by the ratio of its sensitivity (K-type thermocouple), to the sensitivity of the considered thermocouple.

Common mode voltage effects

The KAD/TDC/102 has a high Common-Mode Rejection Ratio (CMRR). However, in some configurations CMRR performance can be degraded by external circuitry. An example of this is when a thermocouple or external calibrator connected to a KAD/TDC/102 input is not isolated and additionally pulled elsewhere than the module's GND. This doesn't happen with isolated or grounded thermocouples but could happen if using certain calibrator configurations during testing.

For example, a thermocouple simulator is connected to a PC via a USB port (so they have a common GND) and the chassis GND is connected to the PC GND (the PCM link is from a KAD/BCU/101/C so there is no isolation between the internal grounds of each device). The thermocouple simulator generates approximately 1.6V common mode voltage on its output terminals (via roughly 25kΩ internal resistance). This causes approximately 0.7µA of current to flow to each of the module inputs.

There is approximately 15Ω difference in resistance between the K-type thermocouple leads (which interconnect the KAD/TDC/102 and the simulator) which is responsible for the presence of 11µV DC differential error voltage at inputs of the module. This is equivalent to approximately 0.28°C error in measurement with a K-type thermocouple within most of the thermocouple temperature range.

Isolating the calibrator from the module, or grounding one of its terminals, removes the unwanted effect which could be otherwise experienced with some types of simulators and some test circuits.

Mating connector

Because the compensation sensors are in the CON/KAD/010 mating connector (that ships with the module as part of the ACD/CJB/003), we recommend that only this mating connector is used (see "Ordering information" on page 490).

The CON/KAD/010 connector has three built-in PT100, high accuracy (1/3 of class B, DIN/IEC 60751 specification) sensors. The following table indicates which PT100 sensor is associated with which KAD/TDC/102 channel.

TABLE 4	CON/KAD/010 built-in PT100 sensor for each KAD/TDC/102 channel
KAD/TDC/102 channel (Temperature(x))	CON/KAD/010 built-in PT100 sensor (JunctionTemperature(x))
0	0
1	0
2	0
3	2
4	2
5	2
6	0
7	0
8	0
9	2
10	2
11	2
12	0
13	2
14	0

NOTE: The CON/KAD/010 built-in PT100 JunctionTemperature(1) is not assigned. Testing showed that JunctionTemperature(1) does not provide improved accuracy.

The CON/KAD/010 connector provides a compact accurate solution for the cold junction block and with the ACD/BAC/002/B, part of the ACD/CJB/003, guarantees the specified accuracy for an ambient temperature change rate of up to 1°C per minute.

For complete mechanical and electrical specifications, refer to the ACD/CJB/003, ACD/BAC/002/B, and CON/KAD/010 data sheets.

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter.

Signals sampled at the same sample rate will always be sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. The following figure shows a delay for an 8^{th} order filter where f_c = 1kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1kHz / f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1kHz / f_c). For example, an 8^{th} order Butterworth filter with an f_c of 1kHz delays a 1kHz signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

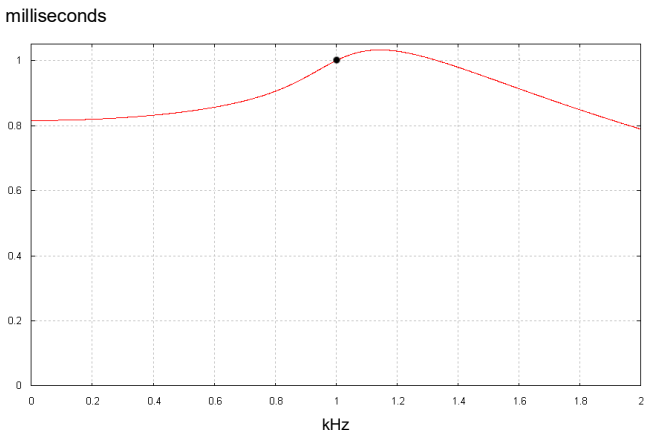


Figure 2: Filter delay for 8^{th} order Butterworth filter where f_c = 1kHz

The filter delay for the KAD/TDC/102 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_D is the filter delay

T_A (analog filter delay) ≈ 0

Signal filtering on reference junction channels

As well as an RF filter on the cold junction channels, the KAD/TDC/102 provides a digital filter, which is built into the analog-to-digital converter. This means—unlike other Curtiss-Wright analog modules—the filter characteristics of the KAD/TDC/102 reference junction channels are fixed. The cutoff frequency (-3dB) point is approximately at 4Hz and is not dependent on the sampling rate that is used.

The built-in digital filter has 50Hz and 60Hz attenuation (>65dB), and similar attenuation for frequencies above 90Hz. The following figure shows the magnitude characteristic of the filter.

(Image used with permission of Analog Devices, Inc.)

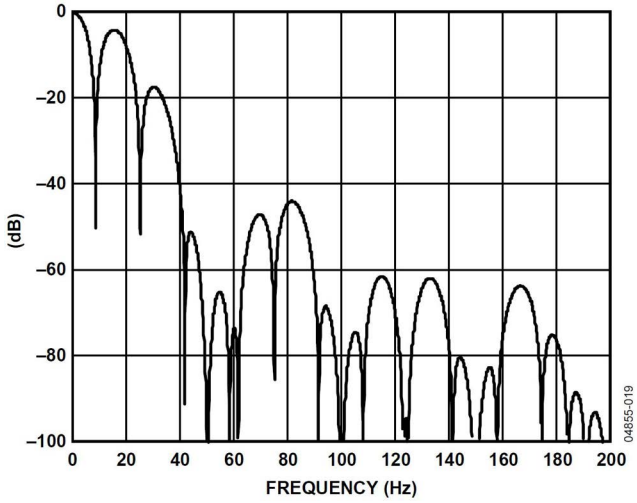


Figure 3: Magnitude characteristic of built-in A/D digital filter

Connector pinout of the KAD/TDC/102

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	ANALOG(12)+	Thermocouple inputs	
2	ANALOG(12)-	Thermocouple inputs	
3	ANALOG(0)+	Thermocouple inputs	
4	ANALOG(0)-	Thermocouple inputs	
5	ANALOG(1)+	Thermocouple inputs	
6	ANALOG(1)-	Thermocouple inputs	
7	ANALOG(2)+	Thermocouple inputs	
8	ANALOG(2)-	Thermocouple inputs	
9	ANALOG(3)+	Thermocouple inputs	
10	ANALOG(3)-	Thermocouple inputs	
11	ANALOG(4)+	Thermocouple inputs	
12	ANALOG(4)-	Thermocouple inputs	
13	ANALOG(5)+	Thermocouple inputs	
14	ANALOG(5)-	Thermocouple inputs	
15	ANALOG(13)+	Thermocouple inputs	
16	ANALOG(13)-	Thermocouple inputs	
17	DNC		Do not connect
18	CJ_IEXC(0)+	Cold junction	Excitation current to cold junction channel 0
19	CJ_SENSE(0)+	Cold junction	Sense line for cold junction channel 0
20	DNC		Do not connect
21	DNC		Do not connect
22	CJ_SENSE(0)-	Cold junction	Sense line for cold junction channel 0
23	CJ_IEXC(0)-	Cold junction	Excitation current from cold junction channel 0
24	CJ_IEXC(1)+	Cold junction	Excitation current to cold junction channel 1
25	CJ_SENSE(1)+	Cold junction	Sense line for cold junction channel 1
26	DNC		Do not connect
27	DNC		Do not connect
28	CJ_SENSE(1)-	Cold junction	Sense line for cold junction channel 1
29	CJ_IEXC(1)-	Cold junction	Excitation current from cold junction channel 1
30	CJ_IEXC(2)+	Cold junction	Excitation current to cold junction channel 2
31	CJ_SENSE(2)+	Cold junction	Sense line for cold junction channel 2
32	DNC		Do not connect
33	DNC		Do not connect
34	CJ_SENSE(2)-	Cold junction	Sense line for cold junction channel 2
35	CJ_IEXC(2)-	Cold junction	Excitation current from cold junction channel 2
36	ANALOG(14)+	Thermocouple inputs	
37	ANALOG(14)-	Thermocouple inputs	
38	ANALOG(6)+	Thermocouple inputs	
39	ANALOG(6)-	Thermocouple inputs	
40	ANALOG(7)+	Thermocouple inputs	
41	ANALOG(7)-	Thermocouple inputs	
42	ANALOG(8)+	Thermocouple inputs	
43	ANALOG(8)-	Thermocouple inputs	
44	ANALOG(9)+	Thermocouple inputs	
45	ANALOG(9)-	Thermocouple inputs	
46	ANALOG(10)+	Thermocouple inputs	
47	ANALOG(10)-	Thermocouple inputs	
48	ANALOG(11)+	Thermocouple inputs	
49	ANALOG(11)-	Thermocouple inputs	
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/TDC/102/B	Thermocouple ADC (reference compensation, 250Hz b/w) - 15ch at 1ksps

By default, an ACD/CJB/003 (which includes an ACD/BAC/002/B and a CON/KAD/010) is included with each module in the shipment.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/TDC/102/B	A/D converters are reset to default configuration after every read - this fixes problem with possible corruption of A/D configuration registers	Recommended for new programs
KAD/TDC/102	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/010	Thermocouples
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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This document was reviewed on 14/10/2020 and does not contain technical data.

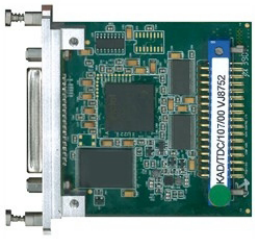
KAD/TDC/107

Thermocouple ADC (reference compensation, high accuracy, 4Hz b/w) - 12ch at 8sps

CURTISSWRIGHTDS.COM



ACD/CJB/002



Key Features

- 15 isolated thermocouple input channels and compensation block (ADC/CJB/002) measurement
- Ordering input range (±100mV) with digital reference junction compensation and programmable thermocouple type per module, includes cold junction block (ADC/CJB/002)
- Accuracy (0.55°C typical for K-type in -50 to 150°C range; 1.1°C typical outside this range)
- Short on any channel does not affect others
- 16-bit simultaneous sampling on each channel

Applications

- Thermocouple temperature measurements

Overview

Together the KAD/TDC/107 and the ACD/CJB/002 are used to digitize up to 12 thermocouple channels and 3 channels of module junction temperature.

The module junction temperature is a signal indicating the temperature of the ACD/CJB/002; the temperature is measured by PT100 sensors, which are built into the ACD/CJB/002.

Each compensation block signal is digitized and put to 2 x 65536 point linearization tables. One table is used to produce a compensation value to add to the other 12 channels (this table is thermocouple type specific) and the other table is used to scale the compensation block temperature between -55°C and 125°C.

Thermocouple channels are sampled and then scaled to the voltage range, which covers the selected temperature range for the chosen thermocouple type. The junction offset is removed from each of the thermocouple channels. Finally, each thermocouple channel voltage is linearized to engineering units using a 65536 point linearization table specific to the thermocouple type and range selected.

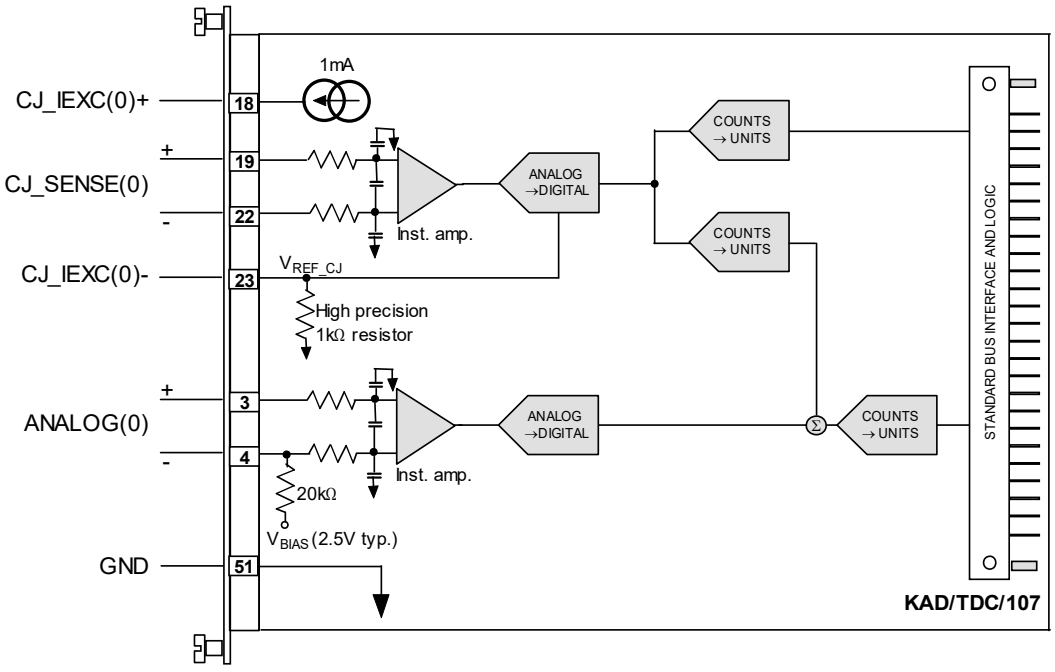


Figure 1: First of 3 reference junction channels plus first of 12 thermocouple channels

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	70	–	g	
	–	2.47	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *ACD/BAC/005* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	50	–	80	mA	
±7V	0	–	0	mA	
+12V	5	–	20	mA	
-12V	0	–	0	mA	
total power	0.31	–	0.64	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Cold junction				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	3	–	From PT100 sensors provided within the CON/KAD/010 connector. Resistive PT100 sensors are supplied from 1mA current source (typical value). The resistance measurement is ratiometric, compared with the embedded, high precision 1kΩ resistor.
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
JUNCTION[2:0]	1	–	8	sps	If the sampling rate is set faster, then the module outputs the same sample a number of times; therefore, the real output rate is a maximum of 8sps.
Input temperature					

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TABLE 2	Cold junction (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
full scale range	-55	–	125	°C	
Input voltage					
operating range	0	–	250	mV	
overvoltage protection	-10	–	10	V	Voltages outside of this range can damage input.
DC error	–	–	0.2	%FSR	Temperature averaged over 200 samples.
Effective number of bits	–	13	–	bits	$0 < f_{in} < 4Hz$ (f_{in} : input signal frequency).
Crosstalk	–	–	-80	dB	$0 < f_{in} < 4Hz$.
Analog filter					Analog filter is Butterworth.
poles	–	–	1	–	
filter cutoff -3dB	–	70	–	kHz	±5% error.
Digital filter					Digital filter is embedded in the A/D converter. See “Signal filtering” on page 499.
filter cutoff -3dB	–	4	–	Hz	
0.1dB bandwidth	–	0.1	–	f_c	(f_c : filter cutoff frequency).
Filter delay	–	63	–	ms	Where f_s = 8sps (f_s : sampling frequency). See “Understanding filter delays” on page 498.

TABLE 3	Thermocouple inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	12	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG[11:0]	1	–	8	sps	If the sampling rate is set faster, then the module outputs the same sample a number of times; therefore, the real output rate is a maximum of 8sps.
Input temperature					The input temperature range is limited by the input voltage range of ±78.125mV and depends on the specific thermocouple type and the required cold junction temperature range.
full scale range K-type thermocouple	-270	–	1372	°C	
full scale range B-type thermocouple	0	–	1820	°C	
full scale range J-type thermocouple	-210	–	1200	°C	
full scale range E-type thermocouple	-270	–	980	°C	
full scale range R-type thermocouple	-50	–	1767	°C	
full scale range S-type thermocouple	-50	–	1767	°C	
full scale range T-type thermocouple	-270	–	400	°C	

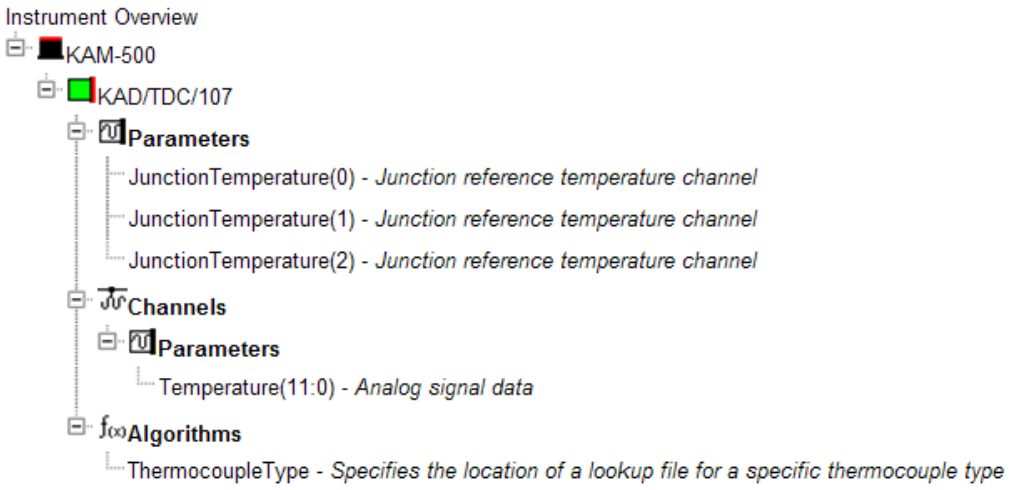
TABLE 3	Thermocouple inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
full scale range T99-type thermocouple	-59	–	229	°C	
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.
Input voltage					
operating range	-78.12	–	78.12	mV	
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.
DC error	–	–	0.55	°C	Temperature averaged over 200 samples for thermocouple K-type measured for FSR of -50°C to 150°C. This error includes the cold junction measurement error, and is met for an ambient temperature change rate of up to 4°C per minute using an ACD/CJB/002.
DC error	–	–	1.1	°C	Temperature averaged over 200 samples for thermocouple K-type measured outside -50°C to 150°C temperature range. This error includes the cold junction measurement error, and is met for an ambient temperature change rate of up to 4°C per minute using an ACD/CJB/002.
Effective number of bits	–	13	–	bits	$0 < f_{in} < 4Hz$ (f_{in} : input signal frequency).
Crosstalk	–	–	-100	dB	$0 < f_{in} < 4Hz$.
Common mode					
voltage range	0.5	–	4	V	Operational voltage range.
rejection ratio	80	–	–	dB	Applies within the above common mode voltage range, $0 \leq f_{in} < 4Hz$.
Analog filter					Analog filter is Butterworth.
poles	–	–	1	–	
filter cutoff -3dB	–	130	–	kHz	±5% error.
Digital filter					Digital filter is embedded in the A/D converter. See “Signal filtering” on page 499.
filter cutoff -3dB	–	4	–	Hz	
0.1dB bandwidth	–	0.1	–	f_c	
Filter delay	–	63	–	ms	Where f_s = 8sps (f_s: sampling frequency). See “Understanding filter delays” on page 498.
Input resistance					
between inputs (off)	1	–	–	MΩ	Module powered off. Within ±78.125mV input range.
between inputs (on)	1	–	–	MΩ	Module powered on. Within ±78.125mV input range.

Setting up the KAD/TDC/107

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

The following treeview provides an overview of setup configurations available for this module:

Treeview icons legend	
DAU: Data Acquisition Unit	Indicator: Indicates the firing of an event based on specific conditions
PC: Personal Computer	Parser slot: Area of memory reserved for storing parsed data
Instrument: Any component or module used in a data acquisition system	Snarfer: Captures all data transmitted on a bus and selectively stores it
DataLink: Connection for transmitting or receiving (defines both the data link and the physical layer)	Bridge: Electrical circuit usually used for measuring purposes
Package: Used to describe how data is transmitted or stored	PCMCIA card: Peripheral interface device usually for use in laptop computers
Parameter: Any register that can be read from an instrument	Multiplexer: Selects one of many input signals and outputs that signal on a signal line
Algorithm: Defines processing to be performed on data	Channels: Defines settings for input or output channels on an instrument
InterConnect: Represents a physical connection on an instrument	
PCI card: Circuit board that plugs into the PCI bus on a PC	



Setting up the module

The following table lists the setup configurations available for the KAD/TDC/107.

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/TDC/107	KAD/TDC/107	ACRA CONTROL part number.
SerialNumber	-	-	Unique name for each module.
Settings	-	-	-
Module-Analog-In-1.2	-	-	-
Channel Temperature(11:0)	-	-	Settings for this channel.
Linearization	No character limit	Not Specified	Specifies a URL where a specific thermocouple type lookup file can be found.

Setting up parameters

Parameter definitions

The following table lists all parameters that are available for the KAD/TDC/107.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
JunctionTemperature(0) Junction reference temperature channel	Celsius	OffsetBinary	16:4	R[15:0] 0000:FFFF (hex)
JunctionTemperature(1) Junction reference temperature channel	Celsius	OffsetBinary	16:4	R[15:0] 0000:FFFF (hex)
JunctionTemperature(2) Junction reference temperature channel	Celsius	OffsetBinary	16:4	R[15:0] 0000:FFFF (hex)
Temperature(11:0) Analog signal data	Celsius	OffsetBinary	16:4	R[15:0] 0000:FFFF (hex)

Programmable elements

JunctionTemperature(0)

SETUP DATA	CHOICE	DEFAULT	NOTES
RangeMaximum	-55 to 125	125	-
RangeMinimum	-55 to 125	-55	-
SizeInBits	16:4	16	R[15:0] 0000:FFFF (hex)

JunctionTemperature(1)

SETUP DATA	CHOICE	DEFAULT	NOTES
RangeMaximum	-55 to 125	125	-
RangeMinimum	-55 to 125	-55	-
SizeInBits	16:4	16	R[15:0] 0000:FFFF (hex)

JunctionTemperature(2)

SETUP DATA	CHOICE	DEFAULT	NOTES
RangeMaximum	-55 to 125	125	-
RangeMinimum	-55 to 125	-55	-
SizeInBits	16:4	16	R[15:0] 0000:FFFF (hex)

Temperature(11:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
RangeMaximum	-270 to 1820	1372	-
RangeMinimum	-270 to 1820	-270	-
SizeInBits	16:4	16	R[15:0] 0000:FFFF (hex)

Setting up algorithms

An algorithm describes how data should be processed. The following are algorithms supported by the KAD/TDC/107.

ThermocoupleType

Specifies the location of a lookup file for a specific thermocouple type

SETUP DATA	CHOICE	DEFAULT	NOTES
URL	TYPEB.LU TYPEE.LU TYPEJ.LU TYPEK.LU TYPER.LU TYPES.LU TYPET99.LU TYPET.LU	Not Specified	-

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/TDC/107

Bias current return path

The KAD/TDC/107 should not be used with external bias returns. It provides the return for bias currents internally via 20kΩ to 2.5V bias voltage. As a result, both input terminals are shifted to the middle of the operational voltage range supported by input stage circuits (0.5 to 4V).

NOTE: The KAD/TDC/107 is not a suitable module to support grounded thermocouples, as such connections force input terminals to operate outside of supported voltage range.

Accuracy

The accuracy of the KAD/TDC/107 is specified for K-type thermocouples. It is also met for J and E-type thermocouples. For thermocouples with a lower sensitivity (R, S, and T type), the accuracy figure is lower. Accuracy in that case, can be estimated by scaling the accuracy claimed for K-type thermocouple by the ratio of its sensitivity (K-type thermocouple), to the sensitivity of the considered thermocouple.

Mating connector

Because the compensation sensors are in the CON/KAD/010 mating connector (that ships with the module as part of the ACD/CJB/002), we recommend that only this mating connector is used (see “Specifications” on page 492).

The CON/KAD/010 connector has three built-in PT100, high accuracy (1/3 of class B, DIN/IEC 60751 specification) sensors. This connector provides a compact accurate solution for the cold junction block, and with the ACD/BAC/005 (also part of the ACD/CJB/002) guarantees the specified accuracy for an ambient temperature change rate of up to 4°C per minute.

The following table indicates which PT100 sensor is associated with which KAD/TDC/107 channel.

TABLE 4 CON/KAD/010 built-in PT100 sensor for each KAD/TDC/107 channel

KAD/TDC/107 CHANNEL (TEMPERATURE(X))	CON/KAD/010 BUILT-IN PT100 SENSOR (JUNCTIONTEMPERATURE(X))
0	0
1	0
2	0
3	2
4	2
5	2
6	0
7	0
8	0
9	2
10	2
11	2

For complete mechanical and electrical specifications, refer to the *ACD/CJB/002, ACD/BAC/005,* and *CON/KAD/010* data sheets.

If an external cold junction block other than the ACD/CJB/002 is required, contact Curtiss-Wright support (acra-support@curtisswright.com).

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate will always be sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias.

The filter delay for the KAD/TDC/107 is approximately:

$T_D \approx 1 / f_p - 0.062$; where $4Hz < f_p \leq 8Hz$; $f_p = 2^N \times f_s$

N is integer number

The f_p value is always bigger than 4Hz and lower or equal to 8Hz. The relationship between any channel f_s and f_p is to the power of 2. For example, if f_s = 1sps, f_p = 8Hz.

Sample rates higher than 8sps

For cases when f_s > 8sps, f_p is the greatest value within the range of 4sps to 8sps, which is the result of dividing f_s by the power of 2. Input signals are sampled at a rate of f_p only, so when f_s > 8sps, the output stream contains repeated samples

(specific power of 2 times each). For example, if f_s is 40sps then the actual sampling frequency f_p is 5sps, and each sample is repeated eight times. This functionality is implemented in order to avoid limitations to the acquisition cycle maximum frequency.

Signal filtering

As well as an RF filter on the thermocouple inputs and cold junction channels, the KAD/TDC/107 provides a digital filter, which is built into the analog-to-digital converter. This means—unlike other Curtiss-Wright analog modules—the filter characteristics of the KAD/TDC/107 are fixed. The cutoff frequency (-3dB) point is approximately at 4Hz and is not dependant on the sampling rate that is used.

The built-in digital filter has 50Hz and 60Hz attenuation (> 65dB) and similar attenuation for frequencies above 90Hz.

The following figure shows the magnitude characteristic of the filter.

(Image used with permission of Analog Devices, Inc.)

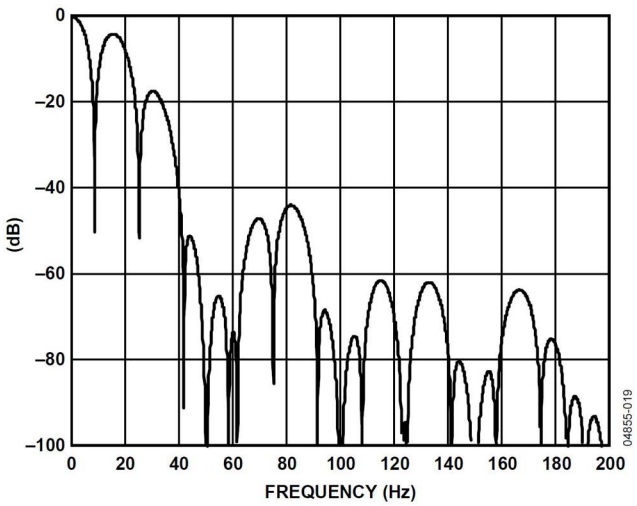


Figure 2: Magnitude characteristic of built-in A/D digital filter

NOTE: If a different type of digital filtering or higher sample rates are required, contact Curtiss-Wright support (acra-support@curtisswright.com).

Connector pinout of the KAD/TDC/107

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DNC		Do not connect
2	DNC		Do not connect
3	ANALOG(0)+	Thermocouple inputs	
4	ANALOG(0)-	Thermocouple inputs	
5	ANALOG(1)+	Thermocouple inputs	
6	ANALOG(1)-	Thermocouple inputs	
7	ANALOG(2)+	Thermocouple inputs	
8	ANALOG(2)-	Thermocouple inputs	
9	ANALOG(3)+	Thermocouple inputs	
10	ANALOG(3)-	Thermocouple inputs	
11	ANALOG(4)+	Thermocouple inputs	
12	ANALOG(4)-	Thermocouple inputs	
13	ANALOG(5)+	Thermocouple inputs	
14	ANALOG(5)-	Thermocouple inputs	
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	CJ_IEXC(0)+	Cold junction	Excitation current to cold junction channel 0
19	CJ_SENSE(0)+	Cold junction	Sense line for cold junction channel 0
20	DNC		Do not connect
21	DNC		Do not connect
22	CJ_SENSE(0)-	Cold junction	Sense line for cold junction channel 0
23	CJ_IEXC(0)-	Cold junction	Excitation current from cold junction channel 0
24	CJ_IEXC(1)+	Cold junction	Excitation current to cold junction channel 1
25	CJ_SENSE(1)+	Cold junction	Sense line for cold junction channel 1
26	DNC		Do not connect
27	DNC		Do not connect
28	CJ_SENSE(1)-	Cold junction	Sense line for cold junction channel 1
29	CJ_IEXC(1)-	Cold junction	Excitation current from cold junction channel 1
30	CJ_IEXC(2)+	Cold junction	Excitation current to cold junction channel 2
31	CJ_SENSE(2)+	Cold junction	Sense line for cold junction channel 2
32	DNC		Do not connect
33	DNC		Do not connect
34	CJ_SENSE(2)-	Cold junction	Sense line for cold junction channel 2
35	CJ_IEXC(2)-	Cold junction	Excitation current from cold junction channel 2
36	DNC		Do not connect
37	DNC		Do not connect
38	ANALOG(6)+	Thermocouple inputs	
39	ANALOG(6)-	Thermocouple inputs	
40	ANALOG(7)+	Thermocouple inputs	
41	ANALOG(7)-	Thermocouple inputs	
42	ANALOG(8)+	Thermocouple inputs	
43	ANALOG(8)-	Thermocouple inputs	
44	ANALOG(9)+	Thermocouple inputs	
45	ANALOG(9)-	Thermocouple inputs	
46	ANALOG(10)+	Thermocouple inputs	
47	ANALOG(10)-	Thermocouple inputs	
48	ANALOG(11)+	Thermocouple inputs	
49	ANALOG(11)-	Thermocouple inputs	
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/TDC/107	Thermocouple ADC (reference compensation, high accuracy, 4Hz b/w) - 12ch at 8sps
ACD/CJB/002	Cold junction block for KAD/TDC/107 (built in sensors, straight-through heavy thermal mass backshell) - 12ch

By default, an ACD/CJB/002 (which includes an ACD/BAC/005 and a CON/KAD/010) is included with each module in the shipment.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/TDC/107	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
TEC/NOT/010	Thermocouples
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
TEC/NOT/059	Cable assembly using ACD/CJB/002 reference junction block

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KAD/VDC/001

Differential ended voice-to-digital converter (CVSD) - 2ch at 64kbps

CURTISSWRIGHTDS.COM



Key Features

- Two differential ended audio input channels
- Input range (-30dB – 8dB)
- Fully IRIG-106 chapter 5 compatible
- Programmable sampling rates (8kbps to 64kbps) and word length (example 16bits @ 32kbps = 2k words per second)
- 500Hz tone output for link verification

Applications

- Cockpit voice monitoring

Overview

The KAD/VDC/001 is a dual audio-to-digital converter module.

At the core of the module is a delta-modulator where the delta size depends on the rate of change. This is referred to as Continuously Variable Slope Delta (CVSD) modulation. This delta-modulator outputs a serial stream to a serial-to-parallel converter, the output of which is regularly read over the backplane. For a detailed description of this type of audio encoding, refer to the IRIG-106 standard, Chapter 5.

A tone output is also available that can be connected to a channel, for link indication or calibration/verification.

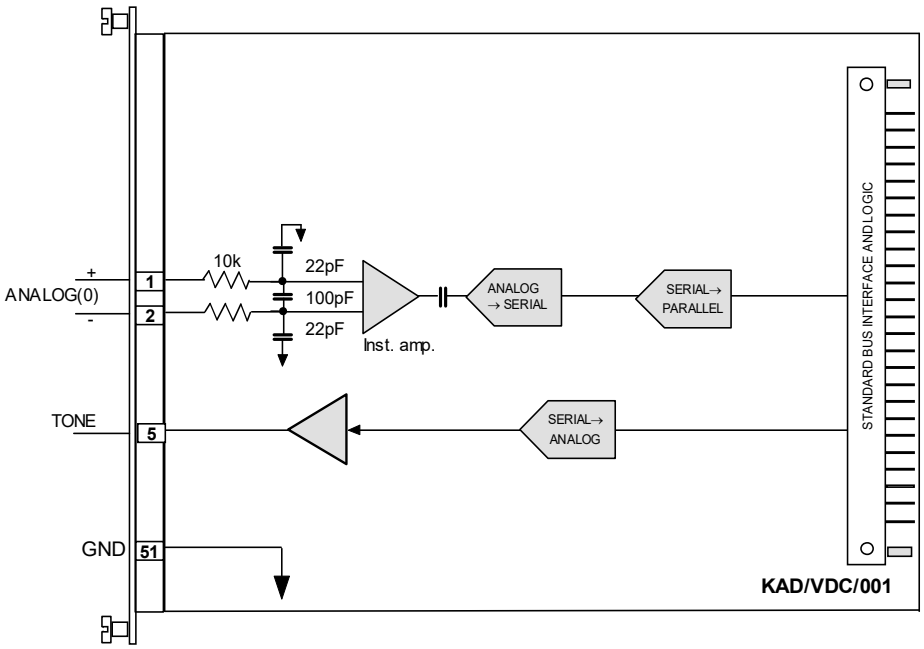


Figure 1: First of two independent audio channels and the tone output

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under "Environmental ratings" in the "General specifications" table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	65	–	g	
	–	2.29	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	500	ksps	Maximum combined access rate for read and write.
Power consumption					
+5V	80	–	140	mA	
±7V	0	–	0	mA	
+12V	15	–	30	mA	Excludes current used by tone outputs.
-12V	10	–	20	mA	Excludes current used by tone outputs.
total power	0.7	–	1.3	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Differential ended audio inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	2	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½ ...2, 4).
ANALOG[1:0]	8	–	64	kbps	
Input voltage					
operating range (G_p = 1)	-30	–	8	dB	Primary gain = 1; 0dB = 489mV. -30dB = 0.015Vrms; 8dB = 1.23 Vrms.
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.
Analog filter					
passband	300		3400	Hz	
Input resistance					
between inputs	–	20	–	kΩ	Module powered off.
between inputs	–	10	–	MΩ	Module powered on.
each input to GND	–	10	–	kΩ	Module powered off.
each input to GND	–	10	–	MΩ	Module powered on.

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TABLE 3	Tone outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	1	–	
Signaling rate					
TONE_O	495	–	505	Hz	
Output voltage					
operating range	1.27	1.41	1.55	V_{p-p}	
short circuit current	–	–	0	mA	Tone out is capacitively coupled to the output pin.
short circuit duration	∞	–	–	s	To GND.
Output impedance	–	320	–	Ω	Coupling capacitor impedance specified for 500Hz.

Setting up the KAD/VDC/001

Setting up parameters

For channels Analog(0) to Analog(1)

SET-UP DATA	CHOICE	DEFAULT	NOTES
Name	No limit to characters	MySignal	Serial output of CVSD modulator in parallel form. This is converted from serial to parallel at the start of an acquisition cycle and at equal intervals of time thereafter.
Base Unit	Unitless	Unitless	
gain	1	1	
Data Format	Offset binary	Offset binary	
Size In Bits	8 to 16	16	The rate at which data is clocked from the modulator depends on the bits per word and the words per acquisition cycle. The KAD/VDC/001 places the CVSD data in the most significant bits of the 16-bit KAD/VDC/001 parameter. The least significant bits are set to zero. For example, if a 12-bit CVSD is selected, bit 15 to bit 4 of the KAD/VDC/001 parameter contains the audio data, where bit 15 is the oldest bit; and bits 3 to 0 contain zeros.

Setting up instrumentation

This module uses the X-Module-Analog-In XidML schema. (See http://www.xidml.org).

For channels Analog(0) to Analog(7)

SET-UP DATA	CHOICES	DEFAULT	NOTES
Manufacturer			
name	ACRA CONTROL	ACRA CONTROL	
part reference	KAD/VDC/001	KAD/VDC/001	ACRA CONTROL part number.
serial number	Fixed 6 characters	FE1234	Unique number for each module.
Sub location	1 to 80 characters	MyDAU	Name of DAU.
slot	3 to N	3	The DAU slot the module fits into. First user-module goes into slot 3, where N is the number of user-slots + 2 in the DAU.

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/VDC/001

Audio quality can be improved by increasing the sampling rate. If the data is to be embedded in a PCM stream, it is recommended that the words be evenly commutated as this simplifies ground station demodulator design. For more information concerning ground station demodulator design, contact Curtiss-Wright support (acra-support@curtisswright.com).

The rate at which the card must be read depends on the word length and the sampling rate of the modulator. Some popular choices are shown in the following table.

CVSD MODULATOR BIT-RATE	AUDIO QUALITY	WORD RATE (ksps)			
		8 BITS	10 BITS	12 BITS	16 BITS
32kbps	Very good	4.0	3.2	≈2.7	2.0
16kbps	Good	2.0	1.6	≈1.3	1.0
8kbps	Public address system	1.0	0.8	≈0.7	0.5

NOTE: A KAD/VDC/001 channel can be transmitted into different sinks but it must be transmitted at the same rate. This is due to the audio encoding scheme.

Connector pinout of the KAD/VDC/001

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	ANALOG(0)+	Differential ended audio inputs	Voice channel
2	ANALOG(0)-	Differential ended audio inputs	Voice channel
3	ANALOG(1)+	Differential ended audio inputs	Voice channel
4	ANALOG(1)-	Differential ended audio inputs	Voice channel
5	TONE	Tone outputs	500Hz sine wave; 500mV$_{rms}$ typical
6	GND	Internal ground	
7	DNC		Do not connect
8	GND	Internal ground	
9	DNC		Do not connect
10	DNC		Do not connect
11	DNC		Do not connect
12	DNC		Do not connect
13	DNC		Do not connect
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/VDC/001	Differential ended voice-to-digital converter (CVSD) - 2ch at 64kbps (with 52-way connector)
KAM/VDC/001	Differential ended voice-to-digital converter (CVSD) - 2ch at 64kbps (with 51-way connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; or ACC/CON/008/04 for KAM modules), is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/VDC/001 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/VDC/001	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/015	CVSD Modulation of Audio Signals
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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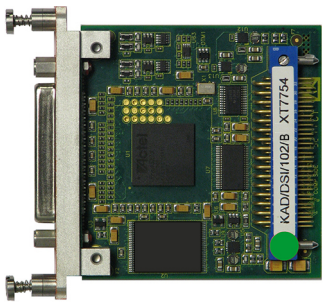
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KAD/DSI/102

Discrete input (programmable counters, time tagging) - 24ch

CURTISSWRIGHTDS.com



Key Features

- 24 differential ended, discrete, bi-level input channels
- 24 independent, 32-bit counters with ten different operating modes
- 40ns internal resolution
- FIFO based time tagging
- Resettable counters
- Detection of 0.5µs wide input signal pulses

Applications

- Engine speed measurement
- Data capture from a parallel bus
- Timestamping of events

Overview

The KAD/DSI/102 monitors the status (high/low) of up to 24 differential ended discrete input channels. Each of these has an assigned programmable 32-bit counter. Additionally each of the inputs can be used to trigger time tagged events.

Each counter can be programmed to operate in one of the following modes: Period, Pulse Width, Duty Cycle, Frequency, Events Since Sample, Events Since Power Up, Events Since Reset, Samples Since Power Up, Samples Since Reset, or Time Since Event. The range of each counter is programmable, as is the threshold (within ±28V), hysteresis (0.8 to 20V) and sensitivity to the rising/falling edge.

All the channels control the time tagging to the 1K word deep FIFO (80 bits wide each word). For each input, time tagging can be triggered by a rising edge, falling edge, both edges, or neither (when the channel is disabled). Every time a trigger occurs, an 80-bit word is written to the FIFO consisting of the 24 inputs (configurable to be either input state after the change or value representing the bits which triggered the event) and the 48-bit binary coded decimal IRIG time that the event happened. There are also three FIFO flags which indicate that the FIFO is empty, that a message has been skipped, or that a message is stale.

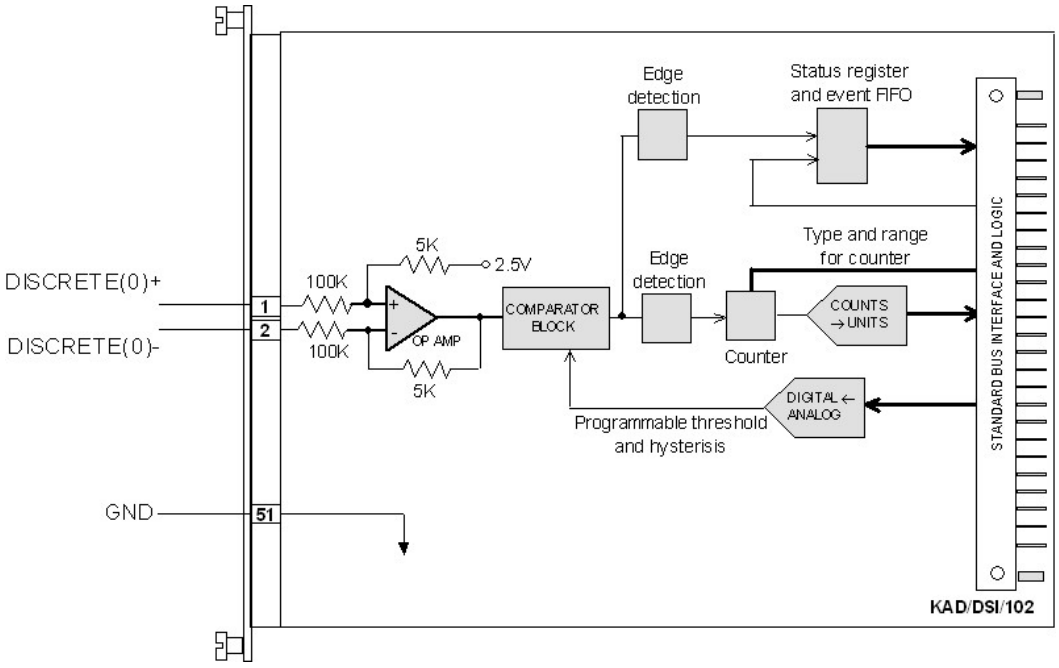


Figure 1: First of 24 discrete inputs; first counter and event FIFO

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under "Environmental ratings" in the "General specifications" table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	80	–	g	
	–	2.82	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	80	–	120	mA	
±7V	0	–	0	mA	
+12V	0	–	10	mA	
-12V	0	–	0	mA	
total power	0.4	–	0.72	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Differential ended digital inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	24	–	
Input voltage					
operating range	-30	–	30	V	
overvoltage protection	-50	–	50	V	Voltages outside of this range can damage input.
Input signal					
frequency range	0	–	1	MHz	High and low pulses of input signal detected as a result of threshold settings; each pulse must be at least 0.5µs wide (the shortest supported pulse width to be measured). All time and duty cycle measurements are taken based on a 40ns internal resolution and then scaled to output range.
threshold	-28	–	28	V	
threshold step	–	25	–	mV	
hysteresis	0.8	–	20	V	We recommend that hysteresis is set as wide as possible, usually in the order of 2 to 10 times lower than the step between logic levels.
hysteresis step	–	50	–	mV	

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TABLE 2	Differential ended digital inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Threshold accuracy					The error can be determined separately for Threshold Voltage High and Threshold Voltage Low as a summation of the offset error and the gain error. Gain error should be calculated as a percentage of Threshold Voltage High or Low.
offset error	–	0.1	0.4	V	
gain error	–	0.1	0.4	%	
Time accuracy					
internal resolution	–	40	–	ns	Applies to Period, Pulse Width, Duty Cycle, Frequency, and Time Since Event counter operation modes and edge detection.
reference clock precision	–	1	5	ppm	Applies to Period, Pulse Width, Duty Cycle, Frequency and Time Since Event measurements. It is determined by the stability of the Temperature Compensated Crystal Oscillator (TCXO). Maximum value stated is inclusive of aging.
Delay of edge detection	300	500	700	ns	This includes the delay introduced by analog circuits (filter and comparators) and digital logic (noise filtering, reference clock, and system clock resolution). This value is to be understood as offset for Time Since Event measurements. For the Event FIFO time tag error it is below time tag of 1µs resolution, and can therefore be treated as negligible.
Analog filter					
poles	–	1	–	–	
filter cutoff	–	30	–	MHz	
Event FIFO					
FIFO depth	–	–	1,024	msg	msg = messages.
FIFO message width	–	–	80	bits	
time tag resolution	–	1	–	µs	
Input resistance					
between inputs	–	210	–	kΩ	Module powered off.
between inputs	–	210	–	kΩ	Module powered on.
each input to GND	–	105	–	kΩ	Module powered off.
each input to GND	–	105	–	kΩ	Module powered on.
Input impedance					Measured at 100kHz.
between inputs	–	100	–	kΩ	Module powered off.
between inputs	–	100	–	kΩ	Module powered on.
each input to GND	–	50	–	kΩ	Module powered off.
each input to GND	–	50	–	kΩ	Module powered on.

Setting up the KAD/DSI/102

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/DSI/102/B	KAD/DSI/102/B	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Settings	-	-	-
On FIFO Empty	Flag Only All High	Flag Only	Configures the Event FIFO operation regarding EventIrigTimeTag. When there are no new messages either the time tag is repeated (Flag Only) or all EventIrigTimeTag bits are set high (All High).
On Event Record	Status After Event Trigger Delta	Status After Event	Configures Event Status subparameter to be either status of discrete inputs after triggering (Status After Event) or to indicate which of discrete inputs have triggered message to be written into the Event FIFO (Trigger Delta).
On FIFO Full Overflow	No Yes	Yes	Configures Event FIFO to overflow (reset) when FIFO gets full and new event message can't be written.
Duty Cycle Mode Timeout	0.1 to 150	1.0	Defines timeout (in seconds) for counters operating in Duty Cycle mode.
Pulse Width Mode Timeout	0.1 to 150	1.0	Defines timeout (in seconds) for counters operating in Pulse Width mode. The value can't be lower than Range Maximum for such counters.
Frequency Mode Reference Period	0.1 to 150	1.0	Sets reference period (in seconds) for Frequency mode of counter in step size of 0.05.
Channels	-	-	-
Discrete(23:0) Discrete Input	-	-	Represents a discrete input channel on an instrument.
Settings	-	-	-
Trigger Edge	None Rising Falling Both	None	Used on discrete channels to specify which edge causes the writing of an event message to the Event FIFO.
Threshold Voltage Level	-28 to 28	2	Specifies the threshold voltage level of the input signal to be recognized as either logic 1 or logic 0 state.
Threshold Voltage Hysteresis	0.8 to 20	1.0	Specifies the hysteresis width. The hysteresis is centered around the Threshold Voltage Level.
Counter(23:0) Counter Input	-	-	Represents counter related to each discrete input.
Settings	-	-	-

SETUP DATA	CHOICE	DEFAULT	NOTES
Trigger Edge	None Rising Falling Both	Rising	Used on counter channels to specify which signal edge causes related counter incrementation or is used as reference edge.
Counter Type	Period Pulse Width Duty Cycle Frequency Events Since Sample Events Since Power Up Events Since Reset Time Since Event Samples Since Power Up Samples Since Event	Events Since Power Up	Specifies how the counter operates.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Discrete Current state of discrete inputs.	BitVector	BitVector	32	R[31:0] R[31:24] Reserved - Reserved for future use. R[23:0] Status - The value representing the current state of 24 discrete inputs.
DiscreteHigh Current state of discrete inputs 23 down to 16. Padded with 8 0s at MSB side.	BitVector 16	BitVector		R[15:8] Reserved - Reserved for future use. R[7:0] Status_23_16 - The value representing the current state of 8 discrete inputs, from 23 to 16.
DiscreteLow Current state of discrete inputs 15 down to 0.	BitVector	BitVector	16	R[15:0] Status_15_0 - The value representing the current state of 15 discrete inputs, from15 to 0.
Discrete_23_8 Current state of 16 discrete inputs, 23 to 8.	BitVector	BitVector	16	R[15:0] R[15:0] Status_23_8 - The value representing the current state of 16 discrete inputs, from 23 to 8.
Discrete_11_0 Current state of 12 discrete inputs, 11 to 0. Padded with 4 0s on LSB side.	BitVector	BitVector	16	R[15:0] R[15:4] Status_11_0 - The value representing the current state of 12 discrete inputs, from 11 to 0. R[3:0] Reserved - Reserved for future use.
Counter(23:0) Parameters				
Counter 32-bit register. Depending on the Counter Type setting, it expresses counts, ratio, frequency, or time.	Count Second Second Second Ratio Hertz Count	OffsetBinary OffsetBinary OffsetBinary OffsetBinary OffsetBinary OffsetBinary OffsetBinary	32	R[31:0] Default condition Counter Type = Period Counter Type = Pulse Width Counter Type = Time Since Event Counter Type = Duty Cycle Counter Type = Frequency Other
Parser parameters				

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Event 80-bit wide event message.	BitVector	BitVector	80	R[79:0] R[79:32] EventIrigTimeTag - BCD IRIG time at the start of the event. When the FIFO data are stale (were already read and no new messages are in the FIFO since then), the last values are repeated (On FIFO Empty set to Flag Only). Otherwise all bits are 1 (On FIFO Empty set to All High). R(31) EventEmptyFlag - This bit is active when the Event FIFO is empty after power-up or reprogramming the system, and no message has been written since. R(30) EventStaleFlag - This bit is active when Event FIFO has been emptied and the same data is read more than once (no new messages). R(29) EventSkippedFlag - This bit is active when Event FIFO becomes full and one or more event messages could not be written, therefore were skipped. For On FIFO Full Overflow set to Yes, FIFO is reset additionally. R[28:24] Reserved - Reserved for future use. R[23:0] EventStatus - The value representing state of the 24 discrete inputs after an event or which input has caused triggering (On Event Record set to Status After Event or Trigger Delta respectively). When the FIFO was emptied or no new messages are in the FIFO, the last values are repeated.

Configurable parameters

Counter23:0

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	4294967295 0 to 150 0 to 150 0 to 1e6 1 0 to 1e6 4294967295	4294967295	The maximum range. Default condition Counter Type = Period Counter Type = Pulse Width Counter Type = Time Since Event Counter Type = Duty Cycle Counter Type = Frequency Other
Range Minimum	0	0	The minimum range.

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/DSI/102

Wiring the inputs

For single ended signals with 28V/0V or 28V/open modes (see the following figure), connect the signal to the positive input for each channel. The negative input can be left floating but we recommend that it is tied to ground (GND) as it is then less prone to picking up noise or cross-talk.

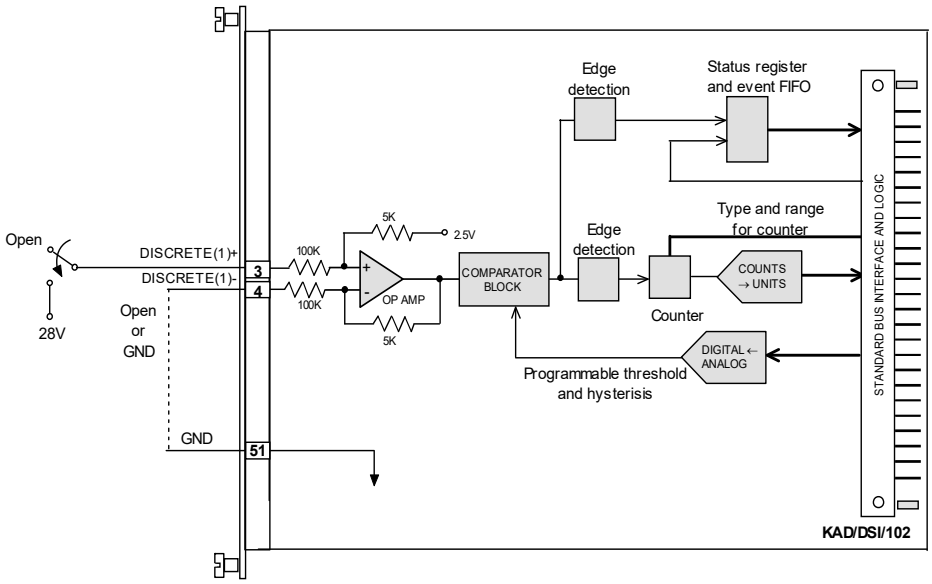


Figure 2: Second channel wired for operation in 28V/open mode

To configure the input to operate correctly with 0V/open mode, an external pull-up resistor is recommended to increase the voltage step seen by the KAD/DSI/102 module input. An example is shown in the following figure.

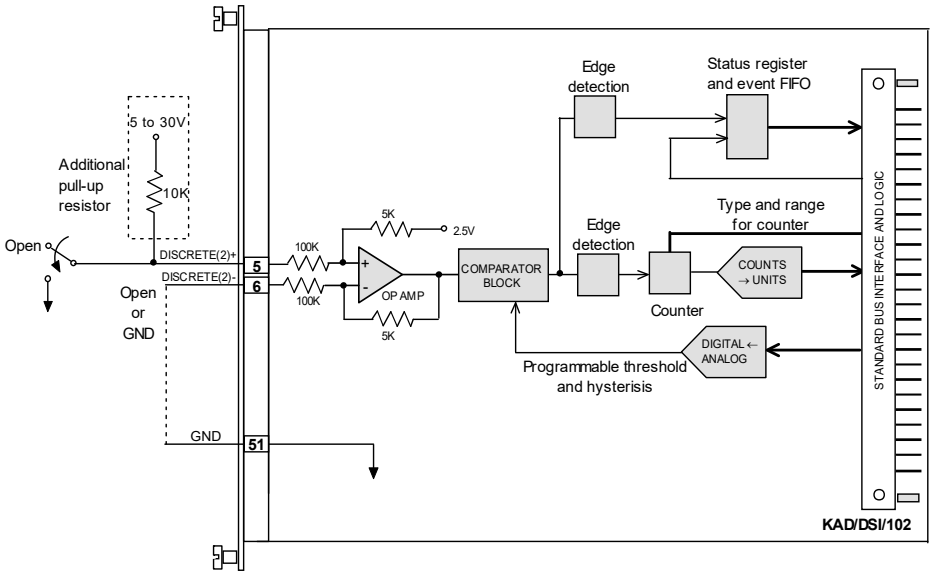


Figure 3: Third channel wired for operation in 0V/open mode using an external pull-up resistor

Setting threshold and hysteresis

The following figure shows an example of input signals, threshold levels, and hysteresis as well as points at which the KAD/DSI/102 detects valid edges.

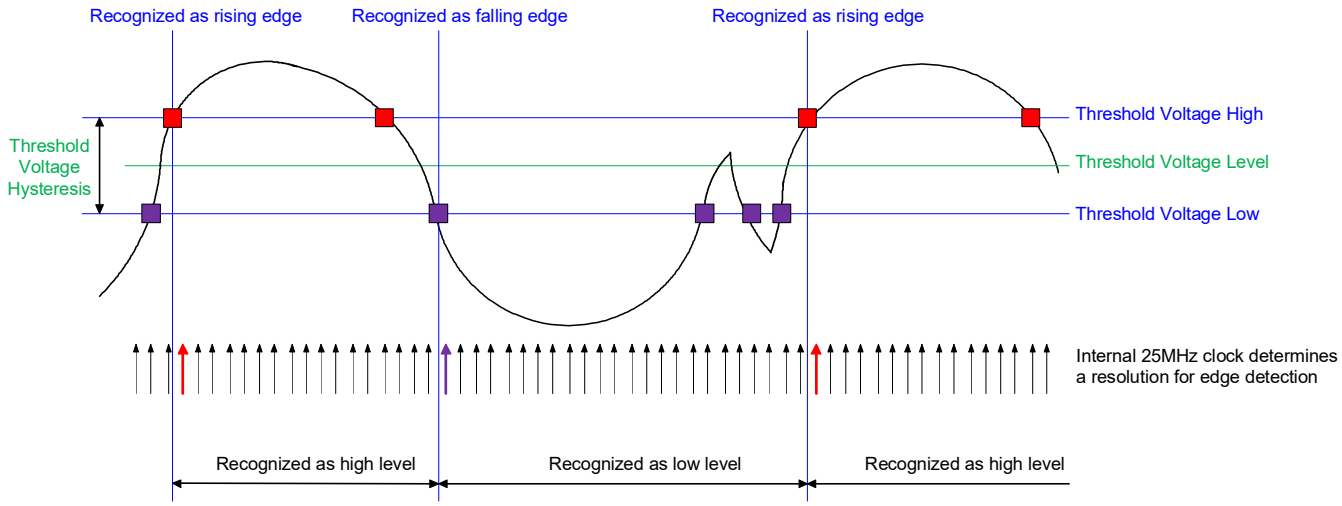


Figure 4: Edge and level detection

NOTE: Transition is considered a rising edge only after a full transition from the signal level below Threshold Voltage Low to above Threshold Voltage High takes place and vice versa for a falling edge. This has an impact for time when the module recognizes high and low pulses and also when Event messages are timestamped.

Normally the Threshold Voltage Level is set to a voltage midway between input signal logic states, while the Threshold Voltage Hysteresis is set to a value around 2 to 10 times lower than the distance between input signal logic states. A large hysteresis value is required if the incoming signal contains a lot of noise (including common mode voltage noise) or its edge is not sharp (such as with a slowly changing signal). Setting a wider hysteresis moves the edge detection voltage levels by (±0.5 × Threshold Voltage Hysteresis) from the Threshold Voltage Level. Therefore the value must not be too high as this may cause the effective edge detection voltage level to move outside the input signal range. Also, setting the Threshold Voltage Hysteresis value high may have an impact on the exact time the edge is detected, causing the EventIrigTimeTag to be further delayed by the time difference between the input signal crossing Threshold Voltage Level and the effective edge detection point caused by Threshold Voltage Hysteresis. The appropriate values must be considered for a specific application, signal change rate, and noise expected on signal lines.

For 28V/0V and 28V/open modes, when the signal is connected to the DISCRETE(x)+ input, and the DISCRETE(x)- input is left floating (or connected to GND), the recommended value of the Threshold Voltage Level is around 14V with the recommended Threshold Voltage Hysteresis being between 3V to 15V, depending on noise, input signal change rate, and allowed time tag error.

For 0V/open mode, we recommend using an external pull-up resistor and connecting DISCRETE(x)- to GND. This increases the voltage step and reduces the influence of unwanted noise in external cabling (open/floating inputs have high impedance so noise is easily picked up). Threshold Voltage Level and Threshold Voltage Hysteresis depend on the pull-up resistor value, the pull-up voltage, and whether DISCRETE(x)- is connected to GND, or left floating. If an external pull-up resistor is not used, ensure the noise level in the external cables do not cause unwanted edges being detected by the module. For 0V/open mode, when the signal is connected to the DISCRETE(x)+ input, and the DISCRETE(x)- input is left floating, the Threshold Voltage Level should be around -1.2V and Threshold Voltage Hysteresis around 1V. For a similar case, but with DISCRETE(x)- input connected to GND, values are 1.25V and 1V respectively.

Event FIFO

When time tagging events, make sure unused inputs or inputs that are not of interest are masked such that transitions on these inputs are ignored (Trigger Edge for Discrete[23:0] set to None). This helps ensure that the FIFO does not fill up due to too many events.

EventIrigTimeTag is 48 bits describing TimeHi, TimeLo, and TimeMicro.

TimeHi:

R[15:13] Reserved - Reserved for future use

R[12:7] Hours - BCD Hours 0 to 23

R[6:0] Minutes - BCD Minutes 0 to 59

TimeLo:

R(15) Reserved - Reserved for future use

R[14:8] Seconds - BCD Seconds 0 to 59

R[7:0] Centiseconds - BCD Centiseconds 0 to 99

TimeMicro:

R[15:0] Microseconds - BCD Microseconds 0 to 9999

To guarantee that the event FIFO is never completely filled, ensure that events are read more quickly than they occur. The event messages (80-bit wide word Event[79:0]) are written into FIFO, which can store up to 1,024 events.

For example, a square-wave input with a frequency of 500Hz with both edges set to trigger a write to FIFO, generates events with a frequency of 1,000Hz. The minimum frequency of reading events to avoid filling up FIFO and skipping some events must be greater than 1,000Hz.

If a burst of 1,000 events occurs every 250 seconds, then a minimum reading frequency of 4Hz must be used to safeguard that the FIFO is empty before the next burst arrives.

By default Event[23:0] bits contain the status of inputs after the event (On Event Record set to Status After Event), but can be configured to indicate which input(s) trigger a write to FIFO (Trigger Delta).

Event(31) indicates that the FIFO is empty and that nothing was written since last power-up or programming. Event(30) indicates that the message in the FIFO was read before (stale). By default (when On FIFO Empty is set to Flag Only), when the FIFO is empty, or when a message is stale, the other Event[79:0] bits keep their previous value. An alternative operation can be set to indicate an empty or stale FIFO by setting all bits of time tag (Event[79:32]) to 1 (All High setting), which is an invalid value for a time tag, that is, it’s not a BCD number.

Event(29) indicates that a message (or messages) was skipped. This happens if the FIFO is full and a new triggered message can't be written into the FIFO and is therefore skipped (when the On Event Record setting is Flag Only). In such a case, if the On FIFO Full Overflow setting is set to Yes, the FIFO is also reset (cleared).

An example of how the FIFO acts if the On Event Record is set to Status After Event can be seen in Figure 5 on page 522.

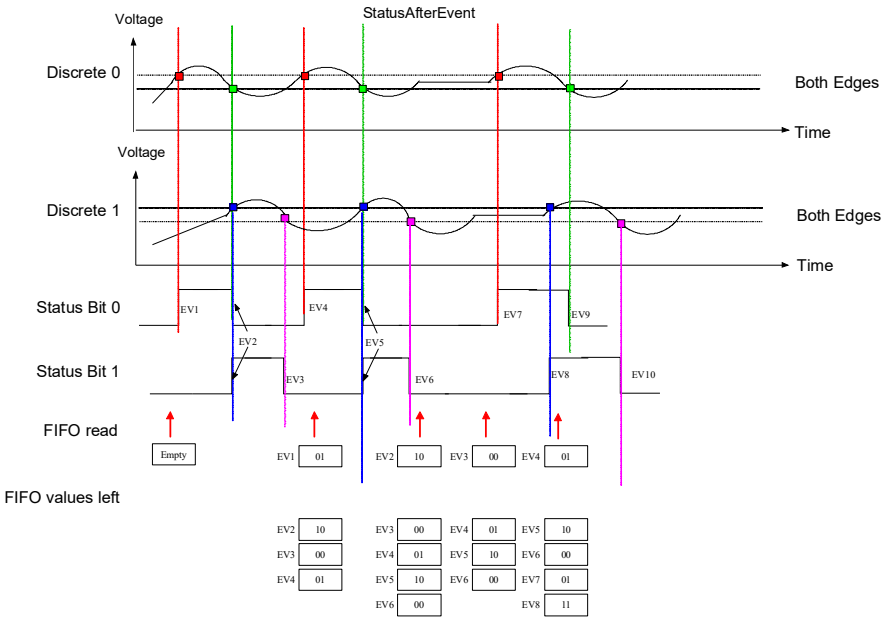


Figure 5: Event FIFO example with On Event Record set to Status After Event

Counter modes

Each counter can be set to any bit length (4 to 32 bits), counting values from 0 to ($2^{\text{Size In Bits}}$ - 1). Each counter event is configured independently from the Event FIFO triggering edge (threshold and hysteresis is common for counter and FIFO within one input channel). For some modes (Counter Type selection), previous counter input events can reset the next counter. This feature can be used when counting external or internal events and enables resetting based on another event. Note that the next counter/input for channel 23 (last channel) is channel 0 counter/input (first channel), and that the previous counter/input for channel 0 is channel 23 counter/input. The details of counter operation depends on the mode. There are 10 possible modes of operation and they are described below.

Period mode

The Period mode configures the counter to measure the time between events. Internally the counter increments every 40ns. The raw counter value is scaled to user-programmed Range Maximum and Size In Bits for a specific counter, railed, and then output from the module. A simplified example of counter operation in Period mode (without scaling to reach Range Maximum) is presented in the following figure.

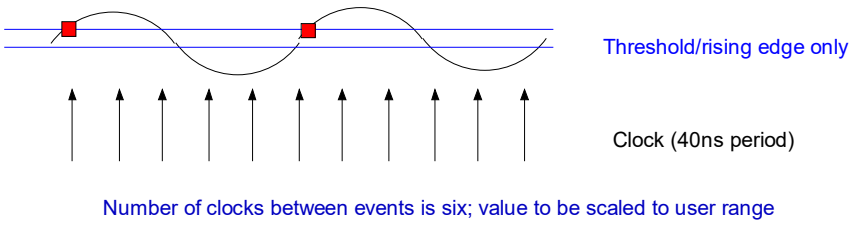


Figure 6: Example of counter operation in Period mode

When setting the counter Trigger Edge to Rising, a period is measured between consecutive rising edges. When setting it to Falling, a period is measured between falling edges.

Consider the following example where the counter Range Maximum is set to 1s and the counter Size In Bits is set to 24. For an input signal period of 0.25 seconds, the reading from the counter register is 0x0040 0000. Any signal with a period more than or equal to the Range Maximum rails at the maximum value defined by Size In Bits, that is, 0x00FF FFFF.

The equation for the Period mode is:

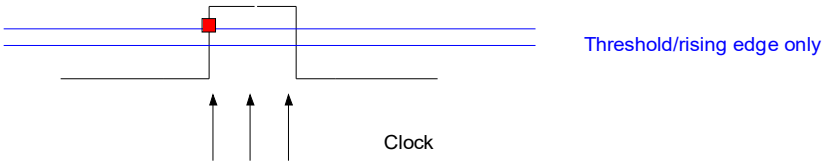
$$Period[counts] = Input\ Signal\ Period[s] \times \frac{2^{Size\ In\ Bits}}{Range\ Maximum[s]}$$

The error on this mode is determined by a 40ns internal time measurement resolution, 5ppm (1ppm typical) reference clock precision, and one-LSB resolution of the counter. The maximum error is 0.1% or the result of the following equation, whichever is the larger.

$$Error[s] = \pm\left(40 \times 10^{-9}[s] + 5 \times 10^{-6} \times Period[s] + \frac{Range\ Maximum[s]}{2^{Size\ In\ Bits}}\right)$$

Pulse Width mode

The Pulse Width mode configures the counter to measure the time of a high or low pulse. Internally, the counter increments every 40ns. The raw counter value is scaled to user-programmed Range Maximum and Size In Bits for a specific counter, railed, and then output from the module. It is possible to set the counter to measure a low or high pulse width by changing the Trigger Edge setting; a Rising setting means that the width of a high pulse is measured (see the following figure).



In this example, the number of clocks within high pulse is three

Figure 7: Example of counter operation in Pulse Width mode

The equation for the Pulse Width mode is:

$$Pulse\ Width[counts] = Input\ Signal\ Pulse\ Width[s] \times \frac{2^{Size\ In\ Bits}}{Range\ Maximum[s]}$$

The error on this mode is determined by a 40ns internal time measurement resolution, 5ppm (1ppm typical) reference clock precision, and one-LSB resolution of the counter.

$$Error[s] = \pm\left(40 \times 10^{-9}[s] + 5 \times 10^{-6} \times Pulse\ Width[s] + \frac{Range\ Maximum[s]}{2^{Size\ In\ Bits}}\right)$$

NOTE: In Pulse Width mode, the counter Trigger Edge set to Both, results in the measurement of either high or low pulse width. The value read from the output buffer is the previous value which was propagated through scaling, railing blocks before a new sample window started. Such a setup can be useful where a signal source indicates some event by toggling its current output level, rather than generating a defined edge or pulse.

Duty Cycle mode

The Duty Cycle mode calculates the ratio between the selected pulse width and the period of input signal. It then represents it over an offset binary range of 0 to 1 across the selected counter Size In Bits. The counter's Trigger Edge defines the edge at which the ratio value is recalculated, and which pulse width is used for the ratio calculation. A simple example of counter operation in Duty Cycle mode with Trigger Edge set to Rising is presented in Figure 8 on page 524.

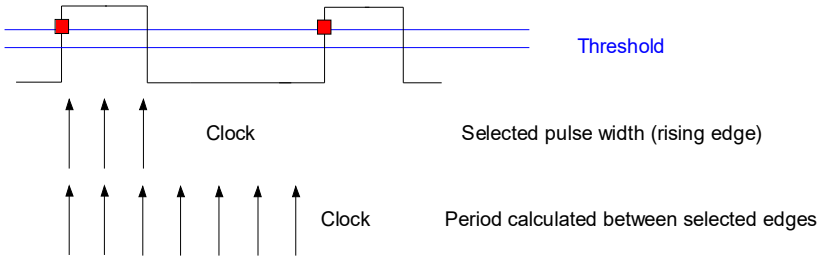


Figure 8: Example of counter operation in Duty Cycle mode

Setting the counter Trigger Edge to Rising means that the ratio between the high pulse and the period is calculated. Setting it to Falling means that the ratio between the low pulse and the period is calculated.

Consider the following example where an input signal of 12.5% duty cycle is connected to the input, the counter Trigger Edge is set to Rising, and Size in Bits is set to 16. In this scenario, the reading from the counter register is be 0x0000 2000 (meaning 0.125 in 16-bit size offset binary value representation).

NOTE: We recommend not using the Both setting in this mode.

The equation for Duty Cycle mode is:

$$Duty\ Cycle[counts] = Input\ Signal\ Duty\ Cycle[unitless] \times 2^{Size\ In\ Bits}$$

The error on this mode is determined by a 40ns internal time measurement resolution for both pulse width and period measurements, and one-LSB resolution of the counter. A worst case scenario (input signal duty cycle being close to one) would be covered by the following formula:

$$Error[unitless] = \pm\left(\frac{2 \times 40 \times 10^{-9}[s]}{Period[s]} + \frac{1}{2^{Size\ In\ Bits}}\right)$$

Frequency mode

The Frequency mode configures the counter to count events over a fixed time, which is defined by the Frequency Mode Reference Period setting, so the roles of incrementing and windowing signals versus Period mode are opposite. A simple example of counter operation in Frequency mode is presented in the following figure.

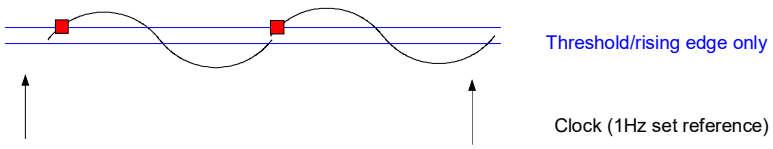


Figure 9: Example of counter operation in Frequency mode

NOTE: The internal counter value shown in the figure above is only for the purpose of illustrating the basics of operation when in Frequency mode; this value is scaled by user-defined values for Range Maximum and Size in Bits.

In Frequency mode, the counter Trigger Edge set to Both, results in the values counted being doubled. The Both setting may be desirable when increasing the resolution of the frequency measurement by a factor of two (which is possible if the duty cycle is around 50%).

Setting the counter Trigger Edge to Rising means that the internal counter increments on every rising edge of the input signal. Setting it to Falling means that it increments on every falling edge.

Consider the following example where the counter Range Maximum is set to 1,000,000 (Hz), the counter Size In Bits is set to 32 and the Frequency Mode Reference Period is set to any value. For a 500,000Hz input signal, the reading from the counter register is 0x8000 0000. Any signal with a frequency more than or equal to the Range Maximum rails at the maximum value defined by Size in Bits, that is, 0xFFFF FFFF.

Low input signal frequency example

Applying a 2.9Hz signal to an input configured as Frequency counter set with Rising Edge, Size In Bits = 16 bits, Range Maximum = 10Hz, and the Frequency Mode Reference Period is set to 1 second, outputs nine samples of 3Hz value 0x4CCC (19660 decimal) and one sample of 2Hz 0x3333 (13107 decimal). The average of (9 × 3Hz + 1 × 2Hz) / 10 = 2.9Hz gives the result expected. However a single measurement is determined by counting an integer number of edges over 1 second (Frequency Mode Reference Period), as this is the method used by the module for Frequency mode of counter operation. This is clearly visible (biggest relative error of measurement) if the frequency applied to the input is low (input frequency < 10 kHz when Frequency Mode Reference Period is set to 0.1 or input frequency < 1 kHhz when Frequency Mode Reference Period is set to 1). Accuracy can be improved by increasing Frequency Mode Reference Period, though the effect cannot be completely eliminated, and it is at a cost of the refresh rate of the Frequency measurement.

NOTE: The number of counted edges over ones is scaled (multiplied) to represent it as a user-defined Range Maximum, and this causes up to one LSB of the counter rounding error. For that reason the exact readings in the example above are not exactly 2Hz and 3Hz, but 1.999969482 and 2.99987793 respectively.

The equation for Frequency mode is:

$$Frequency[counts] = Input\ Signal\ Frequency[Hz] \times \frac{2^{Size\ In\ Bits}}{Range\ Maximum[Hz]}$$

The error on this mode is determined by one counted edge of input signal resolution, 5ppm (1ppm typical) reference clock precision, and one-LSB resolution of counter.

$$Error[Hz] = \pm\left(\frac{1}{Frequency\ Mode\ Reference\ Period\ [s]} + 5 \times 10^{-6} \times Frequency[Hz] + \frac{Range\ Maximum[Hz]}{2^{Size\ In\ Bits}}\right)$$

NOTE: For measuring low frequency signals, where a resolution of better than 1Hz is required, the more accurate method would be to use Period mode instead, and post-processing the reading to frequency by inverting it.

Events Since Sample mode[1]

In the Events Since Sample mode, the counter increments on events from related input (independently configured from Event FIFO triggering), and resets at the start of every sample window. The sample windows are synchronized to the start of the acquisition cycle, and are repeated every sample period. The Output buffer value is updated at the end of each sampling window value. A simple example of counter operation in Events Since Sample mode is presented in the following figure.

1. In previous Curtiss-Wright products, this mode was called EVENTS_SINCE.

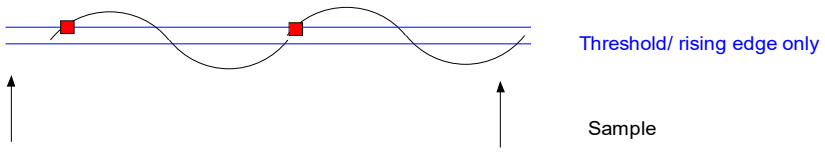


Figure 10: Example of counter operation in Events Since Sample mode

NOTE: In Events Since Sample mode, the counter Trigger Edge set to Both, results in the values counted being doubled. The Both setting may be desirable in scenarios where the signal source toggles to indicate an event.

Events Since Power Up mode[2]

The Events Since Power Up mode configures the counter to count events since system power-up or programming. A simple example of counter operation in Events Since Power Up mode is presented in the following figure.

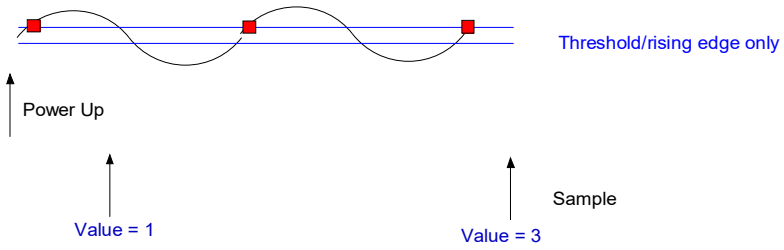


Figure 11: Example of counter operation in Events Since Power Up mode

NOTE: In Events Since Power Up mode, the counter Trigger Edge set to Both, results in the values counted being doubled. The Both setting may be desirable in scenarios where the signal source toggles to indicate an event.

Events Since Reset mode[3]

The Events Since Reset mode uses two adjacent inputs. This counter works in a mode similar to Events Since Sample mode, but the difference is that an event on the previous counter causes the counter to reset. The previous counter can be configured to any mode at the same time. This mode is useful if an external reset of counted events is required. A simple example of counter operation in Events Since Reset mode is presented in the following figure.

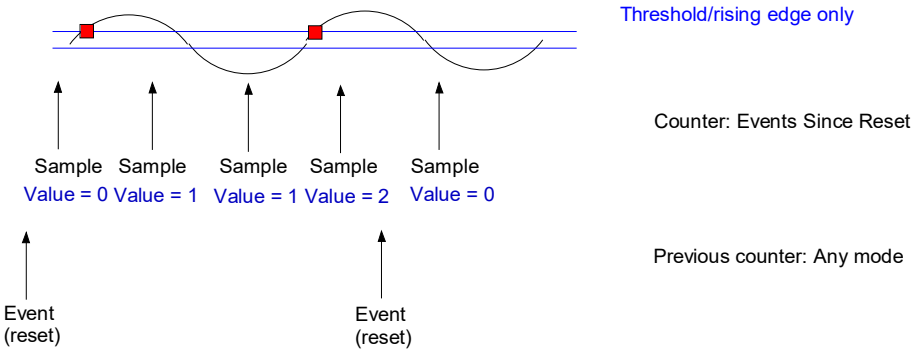


Figure 12: Example of counter operation in Events Since Reset mode

2. In previous Curtiss-Wright products, this mode was called EVENTS.
3. In previous Curtiss-Wright products, this mode was called RESET.

NOTE: In Events Since Reset mode, the counter Trigger Edge set to Both, results in the values counted being double in size. The Both setting may be desirable in scenarios where the signal source toggles to indicate an event.

Samples Since Power Up mode[4]

The Samples Since Power Up mode configures the counter to increment every time it is read. For example, if the counter Length is configured to 32 bits and it is read once per 1ms major frame, then it can act as a major frame counter that reaches its maximum value after approximately 49.7 days. This is the only mode where the counter returns to 0 after having reached the maximum value. After power-up or programming, the counter starts from 0. A simple example of counter operation in Samples Since Power Up mode is presented in Figure 13 on page 527.

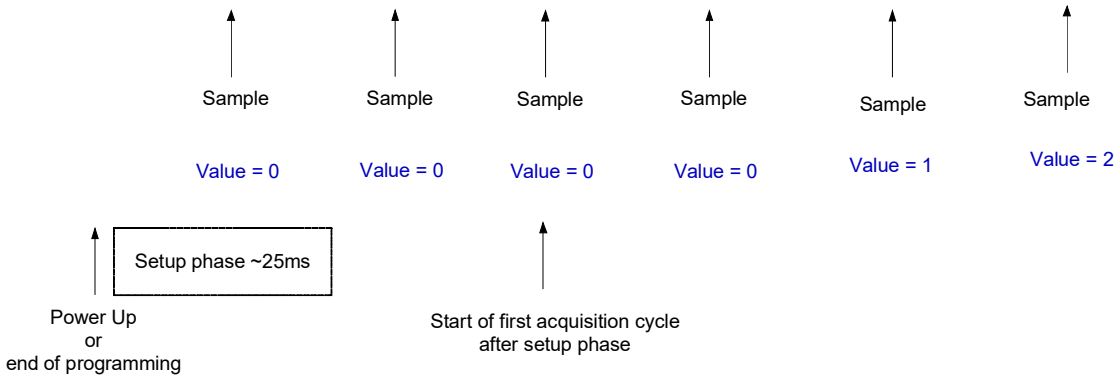


Figure 13: Example of counter operation in Samples Since Power Up mode

Samples Since Event mode[5]

The Samples Since Event mode configures the counter to work in a mode similar to the Samples Since Power Up mode, but the difference is that an event on the input causes the counter to reset to a value of 0, as power-up does. A simple example of counter operation in Samples Since Event mode is presented in the following figure.

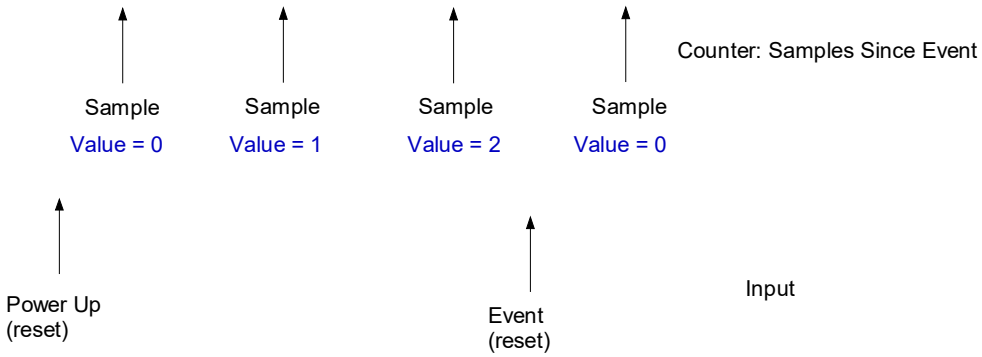


Figure 14: Example of counter operation in Samples Since Event mode

Time Since Event mode[6]

The Time Since Event mode configures the counter to reset on, and count time since, the last event. Output value is an offset binary representation of a user-defined Range Maximum over Size In Bits of counter. A simple example of counter operation in Time Since Event mode is presented in Figure 15 on page 528.

4. In previous Curtiss-Wright products, this mode was called READ.
5. In previous Curtiss-Wright products, this mode was called EVENT.
6. In KAD/DSI/002, this mode was called TIMER and in KAD/DSI/003 it was called ELAPSED.

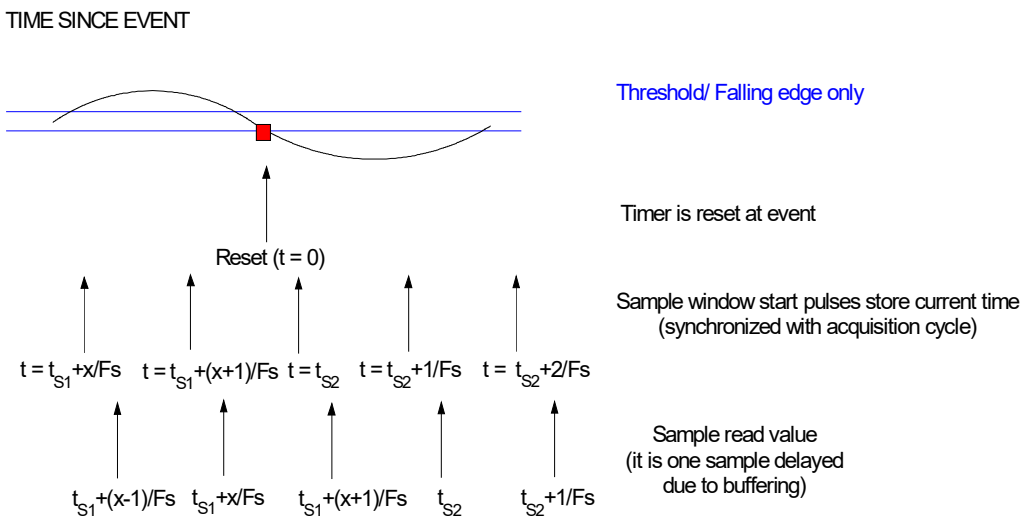


Figure 15: Example of counter operation in Time Since Event mode

The equation for the Time Since Event mode is:

$$Time\ Since\ Event[s] = Input\ Signal\ Time\ Since\ Event[s] \times \frac{2^{Size\ In\ Bits}}{Range\ Maximum[s]}$$

NOTE: Time value is sampled at the start of the sample window. The sample window is aligned with start of acquisition cycle and evenly spaced thereafter (with 1/Fs distance). The value read is one sample delayed due to the processing required (scaling to user-range), and so the buffered value is released for the next sample window. In this mode, the counter is also reset at power-up, and starts counting once the module setup phase is finished.

The error on this mode is determined by 40ns internal time measurement resolution, 5ppm (1ppm typical) reference clock precision, one-LSB resolution of the counter, and the delay of the analog input circuit and the digital edge detection block (which is 500ns ± 200ns).

$$Error[Hz] = \pm\left(40 \times 10^{-9}[s] + 5 \times 10^{-6} \times Time\ Since\ Event[s] + \frac{Range\ Maximum[s]}{2^{Size\ In\ Bits}}\right) + (500 \pm 200) \times 10^{-9}[s]$$

Timeout

If there are periods of measured signals which are longer than expected, it is desirable for the module to timeout and output a rail value. For example, with the KAD/DSI/102 the timeout feature applies to Period, Pulse Width and Duty Cycle modes. Such operation protects against a possible situation where the signal source gets disconnected (connection broken) and avoids displaying the last properly measured value of period.

In Period mode, the timeout is set automatically by software, based on the RangeMaximum set for a specific channel. If the RangeMaximum is exceeded, then a timeout occurs, and the counter value is propagated towards output buffer block (as the value must exceed RangeMaximum, then output value, after scaling and railing must be at the top rail).

In Pulse Width mode, there is a Pulse Width Mode Timeout setting available which defines the timeout value for all counters. In this mode, the output value could be 0, in the scenario where there is no new pulse ending edge since the last measurement taken (or since power-up/programming). Alternatively, if a timeout occurred after a new pulse trigger edge (beginning of pulse width measurement), then the output value is railed at the high rail of the range, for example 0xFFFFFFFF for 32-bit size counter.

In Duty Cycle mode, there is a Duty Cycle Mode Timeout setting available, which defines the maximum period of input signal on which the duty cycle ratio can be calculated. If timeout happens in this mode, the output value depends on the phase of the input signal during which timeout occurred. In the scenario that the last edge is the trigger edge, the output value is high rail (for example, 0x00FF FFFF where the Size in Bits for a specific channel is set to 24), otherwise the value is 0 (low rail). Low rail is also

the default output value after power-up.

The KAD/DSI/102 generates an internal timeout reference signal pulse every 50ms. This pulse is divided (individually per channel) by individual integer dividers (however, Pulse Width Mode Timeout and Duty Cycle Mode Timeout are set up for all channels by a single setting). As the reference signal is asynchronous versus input signals, KSM-500 and DAS Studio 3 software always rounds up the required timeout value divider and adds it to 1. This is to avoid the situation where timeout interrupts the measurement of a signal for which period is close (<50ms) to the required timeout. For example, if Pulse Width Timeout is set to 1s, then the value programmed is equivalent to 1.05 seconds.

Power-up

The 0 value from each counter, regardless of mode, is read until all blocks and channels are set up as per EEPROM configuration.

NOTE: In line with our policy for reading EEPROM setup, the EEPROM configuration is read and programmed in a loop.

After power-up or programming, at least one full setup pass (through all channels) needs to finish, before counter increments are allowed. This ensures all channels are already fully set up. This phase takes approximately 25ms, but for inter-channel synchronization purposes, finishes at the first acquisition cycle after all channels have been set up. Until this phase finishes, all samples read from counter registers are 0.

Connector pinout of the KAD/DSI/102

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DISCRETE(0)+	Differential ended digital inputs	Discrete input
2	DISCRETE(0)-	Differential ended digital inputs	Discrete input
3	DISCRETE(1)+	Differential ended digital inputs	Discrete input
4	DISCRETE(1)-	Differential ended digital inputs	Discrete input
5	DISCRETE(2)+	Differential ended digital inputs	Discrete input
6	DISCRETE(2)-	Differential ended digital inputs	Discrete input
7	DISCRETE(3)+	Differential ended digital inputs	Discrete input
8	DISCRETE(3)-	Differential ended digital inputs	Discrete input
9	DISCRETE(4)+	Differential ended digital inputs	Discrete input
10	DISCRETE(4)-	Differential ended digital inputs	Discrete input
11	DISCRETE(5)+	Differential ended digital inputs	Discrete input
12	DISCRETE(5)-	Differential ended digital inputs	Discrete input
13	DISCRETE(6)+	Differential ended digital inputs	Discrete input
14	DISCRETE(6)-	Differential ended digital inputs	Discrete input
15	DISCRETE(7)+	Differential ended digital inputs	Discrete input
16	DISCRETE(7)-	Differential ended digital inputs	Discrete input
17	DISCRETE(8)+	Differential ended digital inputs	Discrete input
18	DISCRETE(8)-	Differential ended digital inputs	Discrete input
19	DISCRETE(9)+	Differential ended digital inputs	Discrete input
20	DISCRETE(9)-	Differential ended digital inputs	Discrete input
21	DISCRETE(10)+	Differential ended digital inputs	Discrete input
22	DISCRETE(10)-	Differential ended digital inputs	Discrete input
23	DISCRETE(11)+	Differential ended digital inputs	Discrete input
24	DISCRETE(11)-	Differential ended digital inputs	Discrete input
25	DISCRETE(12)+	Differential ended digital inputs	Discrete input
26	DISCRETE(12)-	Differential ended digital inputs	Discrete input
27	DISCRETE(13)+	Differential ended digital inputs	Discrete input
28	DISCRETE(13)-	Differential ended digital inputs	Discrete input
29	DISCRETE(14)+	Differential ended digital inputs	Discrete input
30	DISCRETE(14)-	Differential ended digital inputs	Discrete input
31	DISCRETE(15)+	Differential ended digital inputs	Discrete input
32	DISCRETE(15)-	Differential ended digital inputs	Discrete input
33	DISCRETE(16)+	Differential ended digital inputs	Discrete input
34	DISCRETE(16)-	Differential ended digital inputs	Discrete input
35	DISCRETE(17)+	Differential ended digital inputs	Discrete input
36	DISCRETE(17)-	Differential ended digital inputs	Discrete input
37	DISCRETE(18)+	Differential ended digital inputs	Discrete input
38	DISCRETE(18)-	Differential ended digital inputs	Discrete input
39	DISCRETE(19)+	Differential ended digital inputs	Discrete input
40	DISCRETE(19)-	Differential ended digital inputs	Discrete input
41	DISCRETE(20)+	Differential ended digital inputs	Discrete input
42	DISCRETE(20)-	Differential ended digital inputs	Discrete input
43	DISCRETE(21)+	Differential ended digital inputs	Discrete input
44	DISCRETE(21)-	Differential ended digital inputs	Discrete input
45	DISCRETE(22)+	Differential ended digital inputs	Discrete input
46	DISCRETE(22)-	Differential ended digital inputs	Discrete input
47	DISCRETE(23)+	Differential ended digital inputs	Discrete input
48	DISCRETE(23)-	Differential ended digital inputs	Discrete input
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/DSI/102/B	Discrete input (programmable counters, time tagging) - 24ch (with 52-way double-density connector)
KAM/DSI/102/B	Discrete input (programmable counters, time tagging) - 24ch (with 51-way micro-miniature connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; or ACC/CON/008/04 for KAM modules), is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/DSI/102 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/DSI/102/B	Added Time Since Event mode; improved threshold voltage hysteresis on channels (12) and (19)	Recommended for new programs
KAD/DSI/102	First release	Not recommended for new programs

Supporting software

MODULE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

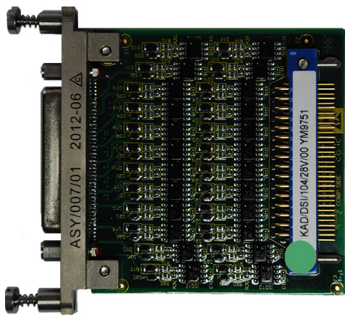
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/DSI/104

Optoisolated isolated input (counters, time tagging) - 24ch

CURTISSWRIGHTDS.COM



Key Features

- 24 differential ended optically isolated bi-level input channels
- 24 independent, 32-bit counters with ten different operating modes
- 40 ns internal resolution
- FIFO based time tagging
- Resettable counters
- Detection of 0.5 µs wide input signal pulses

Applications

- Engine speed measurement
- Data capture from a parallel bus
- Time stamping of events

Overview

The KAD/DSI/104 monitors the status (high/low) of up to 24 differential ended optically isolated input channels. Each of these has an assigned programmable 32-bit counter. Additionally each of the channels can be used to trigger time tagged events.

Each counter can be programmed to operate in one of the following modes: Period, Pulse Width, Duty Cycle, Frequency, Events Since Sample, Events Since Power Up, Events Since Reset, Time Since Event, Samples Since Power Up or Samples Since Reset. The range of each counter is programmable as is the sensitivity to the rising/falling edge. If the counter uses more than 16 bits, they are treated as two words.

All channels control time tagging to the 1K word deep FIFO (80 bits wide each word). For each input, time tagging can be triggered by a rising edge, falling edge, both edges or neither (when the channel is disabled). Every time a trigger occurs, a 80-bit word is written to the FIFO consisting of the 24 inputs (configurable to be either input state after the change or the value representing the bits which triggered the event), the 48-bit binary coded decimal IRIG time that the event happened, and FIFO flags (empty and skipped).

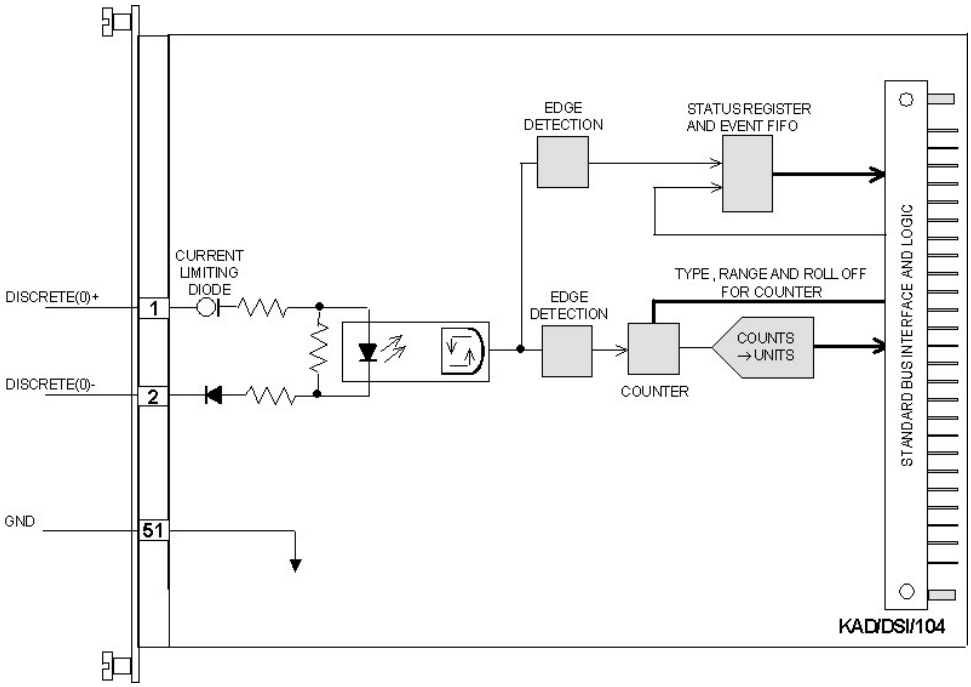


Figure 1: First of 24 optically isolated inputs as given for the TTL/discrete ordering option; first counter and event FIFO

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under "Environmental ratings" in the "General specifications" table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	70	–	g	
	–	2.47	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	110	–	140	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	0.55	–	0.7	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Optoisolated inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	24	–	
Input voltage					
operating range	0	–	40	V	
logic 0	6.0	–	7.9	V	The transition from 1 to 0 can occur at any point between these two values depending on ambient temperature and component tolerances/differences.
logic 1	17.9	–	21.4	V	The transition from 0 to 1 can occur at any point between these two values depending on ambient temperature and component tolerances/differences.
overvoltage protection	-80	–	80	V	Voltages outside of this range can damage input. The voltage between any two module terminals cannot fall outside this range.
Time accuracy					
internal resolution	–	40	–	ns	Applies to Period, Pulse Width, Duty Cycle, Frequency, and Time Since Event counter operation modes and edge detection.

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TABLE 2	Optoisolated inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
reference clock precision	–	1	5	ppm	Applies to Period, Pulse Width, Duty Cycle, Frequency and Time Since Event measurements. It is determined by the stability of the Temperature Compensated Crystal Oscillator. Maximum value stated is inclusive of aging.
Delay of edge detection	300	500	700	ns	This includes the delay introduced by analog circuits (filter and comparators) and digital logic (noise filtering, reference clock, and system clock resolution). This value is to be understood as offset for Time Since Event measurements. For the Event FIFO time tag error it is below time tag of one-microsecond resolution, and can therefore be treated as negligible.
Event FIFO					
FIFO depth	–	–	1,024	msg	msg = messages.
FIFO message width	–	–	80	bits	
time tag resolution	–	1	–	µs	
Input signal					
frequency range	–	–	1	MHz	High and low pulses of input signal detected as a result of threshold settings must be at least 0.5 µs each (the shortest supported pulse width to be measured). All time and duty cycle measurements are taken based on 40 ns internal resolution and then scaled to output range.
Input resistance					Measured at 28V.
between inputs	–	7.2	–	kΩ	Module powered on or off.[1]
each input to GND	10	–	–	MΩ	Module powered on or off.

1. Within each channel input loop, there is current limiter which imposes a limit of 5.7mA; impedance increases when this limit is exceeded.

Setting up the KAD/DSI/104

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/DSI/104	KAD/DSI/104	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Settings	-	-	-
On FIFO Empty	Flag Only All High	Flag Only	Configures the Event FIFO operation regarding EventIrigTimeTag. When there are no new messages either the time tag is repeated (Flag Only) or all EventIrigTimeTag bits are set high (All High).
On Event Record	Status After Event Trigger Delta	Status After Event	Configures Event Status subparameter to be either status of discrete inputs after triggering (Status After Event) or to indicate which of discrete inputs have triggered message to be written into the Event FIFO (Trigger Delta).
On FIFO Full Overflow	No Yes	Yes	Configures Event FIFO to overflow (reset) when FIFO gets full and new event message can't be written.
Duty Cycle Mode Timeout	0.1 to 150	1.0	Defines timeout (in seconds) for counters operating in Duty Cycle mode.
Pulse Width Mode Timeout	0.1 to 150	1.0	Defines timeout (in seconds) for counters operating in Pulse Width mode. The value can't be lower than Range Maximum for such counters.
Frequency Mode Reference Period	0.1 to 150	1.0	Sets reference period (in seconds) for Frequency mode of counter in step size of 0.05.
Channels	-	-	-
Discrete(23:0) Discrete Input	-	-	Represents a discrete input channel on an instrument.
Settings	-	-	-
Trigger Edge	None Rising Falling Both	None	Used on discrete channels to specify which edge causes the writing of an event message to the Event FIFO.
Counter(23:0) Counter Input	-	-	Represents counter related to each discrete input.
Settings	-	-	-
Trigger Edge	None Rising Falling Both	Rising	Used on counter channels to specify which signal edge causes related counter incrementation or is used as reference edge.

SETUP DATA	CHOICE	DEFAULT	NOTES
Counter Type	Period Pulse Width Duty Cycle Frequency Events Since Sample Events Since Power Up Events Since Reset Time Since Event Samples Since Power Up Samples Since Event	Events Since Power Up	Specifies how the counter operates.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Discrete Current state of discrete inputs.	BitVector	BitVector	32	R[31:0] R[31:24] Reserved - Reserved for future use. R[23:0] Status - The value representing current state of 24 discrete inputs.
DiscreteHigh Current state of discrete inputs 23 down to 16. Padded with 8 0s at MSB side.	BitVector	BitVector	16	R[15:8] Reserved - Reserved for future use. R[7:0] Status_23_16 - The value representing current state of 8 discrete inputs 23 down to 16.
DiscreteLow Current state of discrete inputs 15 down to 0.	BitVector	BitVector	16	R[15:0] Status_15_0 - The value representing the current state of 15 discrete inputs, from 15 down to 0.
Discrete_23_8 Current state of 16 discrete inputs, 23 to 8.	BitVector	BitVector	16	R[15:0] R[15:0] Status_23_8 - The value representing the current state of 16 discrete inputs, from 23 to 8.
Discrete_11_0 Current state of 12 discrete inputs, 11 to 0. Padded with 4 0s on LSB side.	BitVector	BitVector	16	R[15:0] R[15:4] Status_11_0 - The value representing the current state of 12 discrete inputs, from 11 to 0. R[3:0] Reserved - Reserved for future use.
Counter(23:0) Parameters				
Counter 32-bit register. Depending on the Counter Type setting, it expresses counts, ratio, frequency or time.	Count Second Second Second Ratio Hertz Count	OffsetBinary OffsetBinary OffsetBinary OffsetBinary OffsetBinary OffsetBinary OffsetBinary	32	R[31:0] Default condition Counter Type = Period Counter Type = Pulse Width Counter Type = Time Since Event Counter Type = Duty Cycle Counter Type = Frequency Other

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Parser parameters				
Event 80-bit wide event message.	BitVector	BitVector	80	R[79:0] R[79:32] EventIrigTimeTag - BCD IRIG time at the start of the event. When the FIFO data is stale (already read and no new messages are in the FIFO since then), the last values are repeated (On FIFO Empty set to Flag Only). Otherwise all bits are 1 (On FIFO Empty set to All High). R(31) EventEmptyFlag - This bit is active when the Event FIFO is empty after power-up or reprogramming the system, and no message has been written since. R(30) EventStaleFlag - This bit is active when Event FIFO has been emptied and the same data is read more than once (no new messages). R(29) EventSkippedFlag - This bit is active when Event FIFO becomes full and one or more event messages could not be written, therefore were skipped. For On FIFO Full Overflow set to Yes FIFO is reset additionally. R[28:24] Reserved - Reserved for future use. R[23:0] EventStatus - The value representing the state of the 24 discrete inputs after an event or which input has caused triggering (On Event Record set to Status After Event or Trigger Delta respectively). When the FIFO was emptied or no new messages are in the FIFO, the last values are repeated.

Configurable parameters

Counter23:0

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	4294967295 0 to 150 0 to 150 0 to 1e6 1 0 to 1e6 4294967295	4294967295	The maximum range. Default condition Counter Type = Period Counter Type = Pulse Width Counter Type = Time Since Event Counter Type = Duty Cycle Counter Type = Frequency Other
Range Minimum	0	0	The minimum range.

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/DSI/104

Event FIFO

When time tagging events, make sure unused inputs or inputs that are not of interest are masked such that transitions on these inputs are ignored (Trigger Edge for Discrete[23:0] set to None). This helps ensure that the FIFO does not fill up due to too many events.

EventIrigTimeTag is 48 bits describing TimeHi,TimeLo, and TimeMicro.

TimeHi:

R[15:13] Reserved - Reserved for future use

R[12:7] Hours - BCD Hours 0 to 23

R[6:0] Minutes - BCD Minutes 0 to 59

TimeLo:

R(15) Reserved - Reserved for future use

R[14:8] Seconds - BCD Seconds 0 to 59

R[7:0] Centiseconds - BCD Centiseconds 0 to 99

TimeMicro:

R[15:0] Microseconds - BCD Microseconds 0 to 9999

To guarantee that the event FIFO is never completely filled, ensure that events are read more quickly than they occur. The event messages (80-bit wide word Event[79:0]) are written into FIFO, which can store up to 1,024 events.

For example, a square-wave input with a frequency of 500 Hz with both edges set to trigger write to FIFO, generates events with a frequency of 1,000 Hz. The minimum frequency of reading events to avoid filling up FIFO and skipping some events must be greater than 1,000 Hz.

If a burst of 1,000 events occurs every 250 seconds, then a minimum reading frequency of 4 Hz must be used to safeguard that the FIFO is empty before the next burst arrives.

By default Event[23:0] bits contain the status of inputs after the event (On Event Record set to Status After Event), but can be configured to indicate which input(s) trigger a write to FIFO (Trigger Delta).

Event(31) indicates that the FIFO is empty and that nothing was written since last power-up or programming. Event(30) indicates that the message in the FIFO was read before (stale). By default (when On FIFO Empty is set to Flag Only), when the FIFO is empty, or when a message is stale, the other Event[79:0] bits keep their previous value. An alternative operation can be set to indicate an empty or stale FIFO by setting all bits of time tag (Event[79:32]) to 1 (All High setting), which is an invalid value for a time tag, that is, it’s not a BCD number.

Event(29) indicates that a message (or messages) was skipped. This happens if the FIFO is full and a new triggered message can't be written into the FIFO and is therefore skipped (when the On Event Record setting is Flag Only). In such a case, if the On FIFO Full Overflow setting is set to Yes, the FIFO is also reset (cleared).

An example of how the FIFO acts if the On Event Record is set to Status After Event can be seen in the following figure.

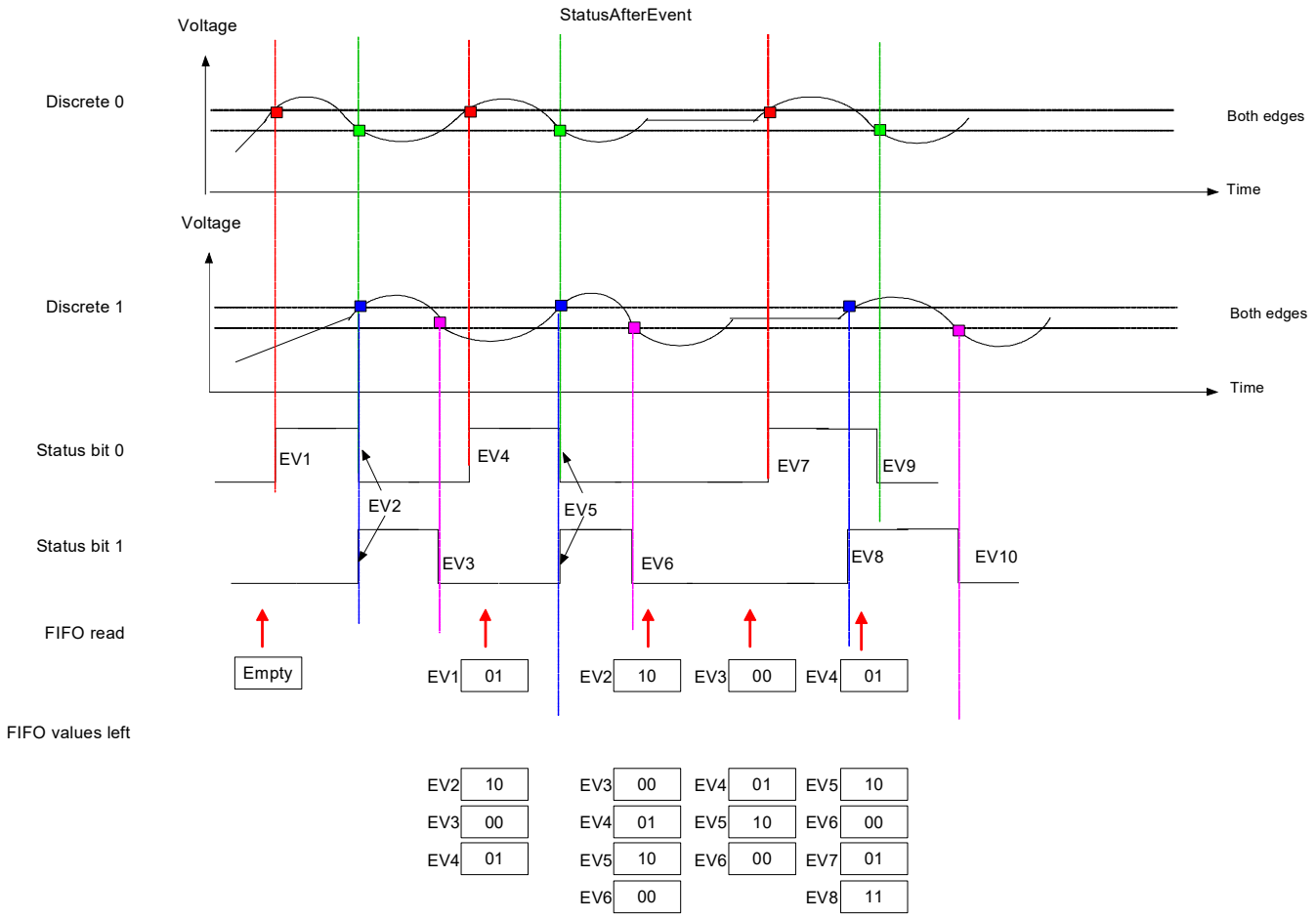


Figure 2: Event FIFO example with On Event Record set to Status After Event

Counter modes

Each counter can be set to any bit length (4 to 32 bits), counting values from 0 to ($2^{\text{Size In Bits}}$ - 1). Each counter event is configured independently from the Event FIFO triggering edge (threshold and hysteresis is common for counter and FIFO within one input channel). For some modes (Counter Type selection), previous counter input events can reset the next counter. This feature can be used when counting external or internal events and enables resetting based on another event. Note that the next counter/input for channel 23 (last channel) is channel 0 counter/input (first channel), and that the previous counter/input for channel 0 is channel 23 counter/input. The details of counter operation depends on the mode. There are ten possible modes of operation and they are described below.

Period mode

The Period mode configures the counter to measure the time between events. Internally the counter increments every 40 ns. The raw counter value is scaled to user-programmed Range Maximum and Size In Bits for a specific counter, railed, and then output from the module. A simplified example of counter operation in Period mode (without scaling to reach Range Maximum) is presented in the following figure.

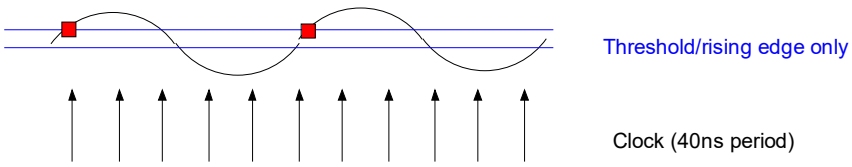


Figure 3: Example of counter operation in Period mode

When setting the counter Trigger Edge to Rising, a period is measured between consecutive rising edges. When setting it to Falling, a period is measured between falling edges.

Consider the following example where the counter Range Maximum is set to 1s and the counter Size In Bits is set to 24. For an input signal period of 0.25 seconds, the reading from the counter register is 0x0040 0000. Any signal with a period more than or equal to the Range Maximum rails at the maximum value defined by Size In Bits, that is, 0x00FF FFFF.

The equation for the Period mode is:

$$Period[counts] = Input\ signal\ period\ [seconds] \times \frac{2^{Size\ In\ Bits}}{Range\ Maximum[seconds]}$$

The error on this mode is determined by a 40 ns internal time measurement resolution, 5 ppm (1 ppm typical) reference clock precision, and one-LSB resolution of the counter.

$$Error[s] = \pm\left(40 \times 10^{-9}[s] + 5 \times 10^{-6} \times Period[s] + \frac{Range\ Maximum[s]}{2^{Size\ In\ Bits}}\right)$$

Pulse Width mode

The Pulse Width mode configures the counter to measure the time of a high or low pulse. Internally, the counter increments every 40 ns. The raw counter value is scaled to user-programmed Range Maximum and Size In Bits for a specific counter, railed, and then output from the module. It is possible to set the counter to measure a low or high pulse width by changing the Trigger Edge setting; a Rising setting means that the width of a high pulse is measured (see the following figure).

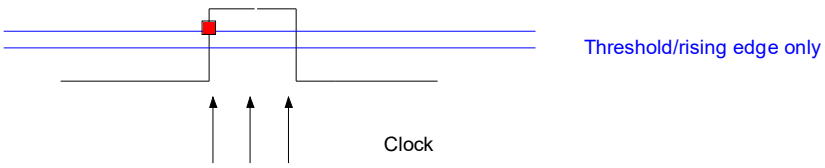


Figure 4: Example of counter operation in Pulse Width mode

The equation for the Pulse Width mode is:

$$Pulse\ Width[counts] = Input\ signal\ pulse\ width\ [seconds] \times \frac{2^{Size\ In\ Bits}}{Range\ Maximum[seconds]}$$

The error on this mode is determined by a 40 ns internal time measurement resolution, 5 ppm (1 ppm typical) reference clock precision, and one-LSB resolution of the counter.

$$Error[s] = \pm\left(40 \times 10^{-9}[s] + 5 \times 10^{-6} \times Pulse\ Width[s] + \frac{Range\ Maximum[s]}{2^{Size\ In\ Bits}}\right)$$

NOTE: In Pulse Width mode, the counter Trigger Edge set to Both results in the measurement of either high or low pulse width. The value read from the output buffer is the previous value which was propagated through scaling, railing blocks before a new sample window started. Such a setup can be useful where a signal source indicates some event by toggling its current output level, rather than generating a defined edge or pulse.

Duty Cycle mode

The Duty Cycle mode calculates the ratio between the selected pulse width and the period of input signal. It then represents it over an offset binary range of 0 to 1 across the selected counter Size In Bits. The counter's Trigger Edge defines the edge at which the ratio value is recalculated, and which pulse width is used for the ratio calculation. A simple example of counter operation in Duty Cycle mode with Trigger Edge set to Rising is presented in the following figure.

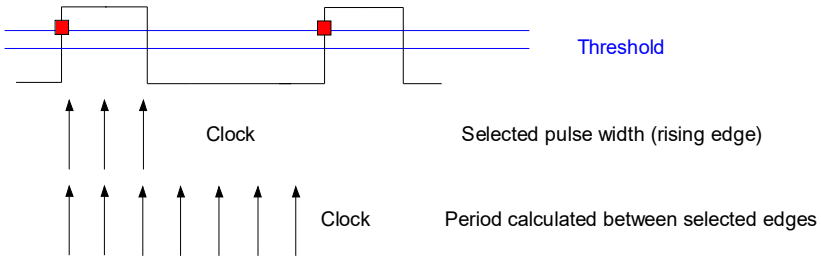


Figure 5: Example of counter operation in Duty Cycle mode

Setting the counter Trigger Edge to Rising means that the ratio between the high pulse and the period is calculated. Setting it to Falling means that the ratio between the low pulse and the period is calculated.

Consider the following example where an input signal of 12.5% duty cycle is connected to the input, the counter Trigger Edge is set to Rising, and Size in Bits is set to 16. In this scenario, the reading from the counter register is be 0x0000 2000 (meaning 0.125 in 16-bit size offset binary value representation).

NOTE: We recommend not using the Both setting in this mode.

The equation for Duty Cycle mode is:

$$Duty\ Cycle[counts] = Input\ signal\ duty\ cycle\ [unitless] \times 2^{Size\ In\ Bits}$$

The error on this mode is determined by a 40-ns internal time measurement resolution for both pulse width and period measurements, and one-LSB resolution of the counter. A worst case scenario (input signal duty cycle being close to one) would be covered by the following formula:

$$Error[unitless] = \pm\left(\frac{2 \times 40 \times 10^{-9}[s]}{Period\,[s]} + \frac{1}{2^{Size\ In\ Bits}}\right)$$

Frequency mode

The Frequency mode configures the counter to count events over a fixed time, which is defined by the Frequency Mode Reference Period setting, so the roles of incrementing and windowing signals versus Period mode are opposite. A simple example of counter operation in Frequency mode is presented in the following figure.

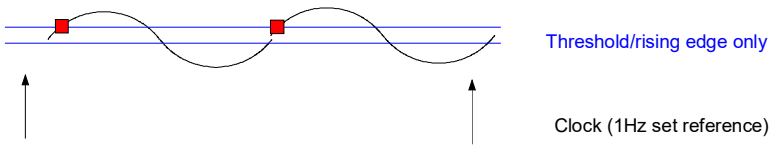


Figure 6: Example of counter operation in Frequency mode

NOTE: The internal counter value shown in the previous figure is only for the purpose of illustrating the basics of operation when in Frequency mode; this value is scaled by user-defined values for Range Maximum and Size in Bits.

In Frequency mode, the counter Trigger Edge set to Both results in the values counted being doubled. The Both setting may be desirable when increasing the resolution of the frequency measurement by a factor of two (which is possible if the duty cycle is around 50%).

Setting the counter Trigger Edge to Rising means that the internal counter increments on every rising edge of the input signal. Setting it to Falling means that it increments on every falling edge.

Consider the following example where the counter Range Maximum is set to 1000000 (Hz), the counter Size In Bits is set to 32 and the Frequency Mode Reference Period is set to any value. For a 500,000 Hz input signal, the reading from the counter register is 0x8000 0000. Any signal with a frequency more than or equal to the Range Maximum rails at the maximum value defined by Size in Bits, that is, 0xFFFF FFFF.

Low input signal frequency example

Applying a 2.9 Hz signal to an input configured as Frequency counter set with Rising Edge, Size In Bits = 16 bits, Range Maximum = 10 Hz, and the Frequency Mode Reference Period is set to 1 second, outputs nine samples of 3 Hz value 0x4CCC (19660 decimal) and one sample of 2 Hz 0x3333 (13107 decimal). The average of (9 × 3 Hz + 1 × 2 Hz) / 10 = 2.9 Hz gives the result expected. However a single measurement is determined by counting an integer number of edges over one second (Frequency Mode Reference Period), as this is the method used by the module for Frequency mode of counter operation. This is clearly visible (biggest relative error of measurement) if the frequency applied to the input is low (for example, below 100 Hz could be considered low). Accuracy can be improved by increasing Frequency Mode Reference Period, though the effect cannot be completely eliminated, and it is at a cost of the refresh rate of the Frequency measurement.

NOTE: The number of counted edges over ones is scaled (multiplied) to represent it as a user-defined Range Maximum, and this causes up to one LSB of the counter rounding error. For that reason the exact readings in the example above are not exactly 2 Hz and 3 Hz, but 1.999969482 and 2.99987793 respectively.

The equation for Frequency mode is:

$$Error[Hz] = \pm\left(\frac{1}{Frequency\ Mode\ Reference\ Period\ [s]} + 5 \times 10^{-6} \times Frequency[Hz] + \frac{Range\ Maximum[Hz]}{2^{Size\ In\ Bits}}\right)$$

The error on this mode is determined by one counted edge of input signal resolution, 5 ppm (1 ppm typical) reference clock precision, and one-LSB resolution of counter.

$$Error[Hz] = \pm\left(1[Hz] + 5 \times 10^{-6} \times Frequency[Hz] + \frac{Range\ Maximum[Hz]}{2^{Size\ In\ Bits}}\right)$$

NOTE: For measuring low frequency signals, where a resolution of better than 1 Hz is required, the more accurate method would be to use Period mode instead, and post-processing the reading to frequency by inverting it.

Events Since Sample mode[1]

In the Events Since Sample mode, the counter increments on events from related input (independently configured from Event FIFO triggering), and resets at the start of every sample window. The sample windows are synchronized to the start of the acquisition cycle, and are repeated every sample period. The Output buffer value is updated at the end of each sampling window value. A simple example of counter operation in Events Since Sample mode is presented in the following figure.

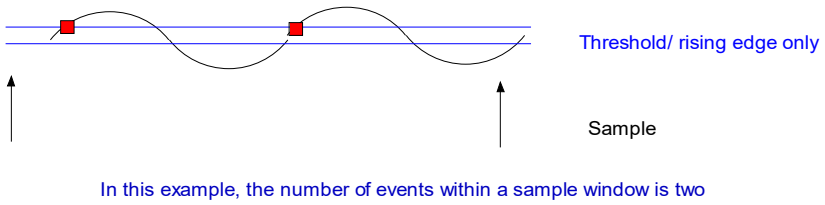


Figure 7: Example of counter operation in Events Since Sample mode

NOTE: In Events Since Sample mode, the counter Trigger Edge set to Both results in the values counted being doubled. The Both setting may be desirable in scenarios where the signal source toggles to indicate an event.

Events Since Power Up mode[2]

The Events Since Power Up mode configures the counter to count events since system power-up or programming. A simple example of counter operation in Events Since Power Up mode is presented in the following figure.

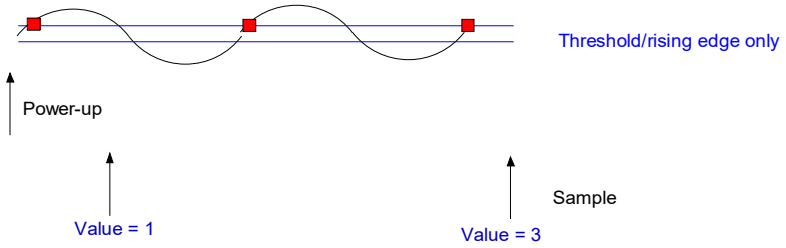


Figure 8: Example of counter operation in Events Since Power Up mode

NOTE: In Events Since Power Up mode, the counter Trigger Edge set to Both results in the values counted being doubled. The Both setting may be desirable in scenarios where the signal source toggles to indicate an event.

Events Since Reset mode[3]

The Events Since Reset mode uses two adjacent inputs. This counter works in a mode similar to Events Since Sample mode, but the difference is that an event on the previous counter causes the counter to reset. The previous counter can be configured to any mode at the same time. This mode is useful if an external reset of counted events is required. A simple example of counter operation in Events Since Reset mode is presented in the following figure.

1. In previous Curtiss-Wright products, this mode was called EVENTS_SINCE.
2. In previous Curtiss-Wright products, this mode was called EVENTS.
3. In previous Curtiss-Wright products, this mode was called RESET.

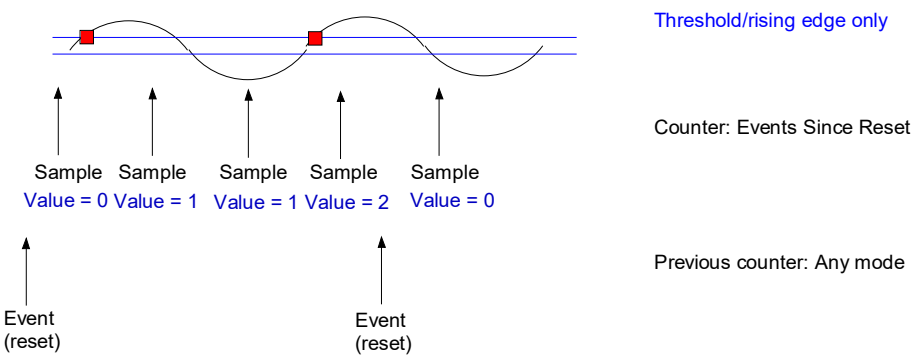


Figure 9: Example of counter operation in Events Since Reset mode

NOTE: In Events Since Reset mode, the counter Trigger Edge set to Both results in the values counted being double in size. The Both setting may be desirable in scenarios where the signal source toggles to indicate an event.

Samples Since Power Up mode[4]

The Samples Since Power Up mode configures the counter to increment every time it is read. For example, if the counter Length is configured to 32 bits and it is read once per 1 ms major frame, then it can act as a major frame counter that reaches its maximum value after approximately 49.7 days. This is the only mode where the counter returns to 0 after having reached the maximum value. After power-up or programming, the counter starts from 0. A simple example of counter operation in Samples Since Power Up mode is presented in the following figure.

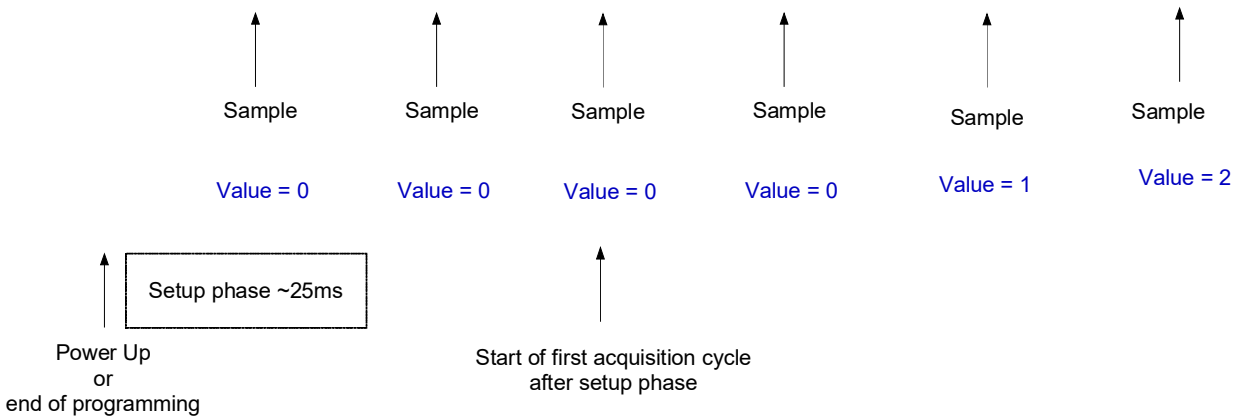


Figure 10: Example of counter operation in Samples Since Power Up mode

Samples Since Event mode[5]

The Samples Since Event mode configures the counter to work in a mode similar to the Samples Since Power Up mode, but the difference is that an event on the input causes the counter to reset to value of 0, as power up does. A simple example of counter operation in Samples Since Event mode is presented in the following figure.

4. In previous Curtiss-Wright products, this mode was called READ.
5. In previous Curtiss-Wright products, this mode was called EVENT.

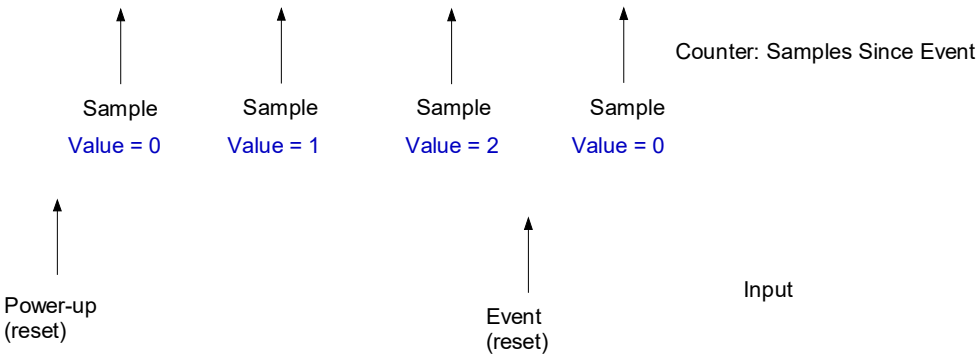


Figure 11: Example of counter operation in Samples Since Event mode

Time Since Event mode[6]

The Time Since Event mode configures the counter to reset on, and count time since, the last event. Output value is an offset binary representation of a user-defined Range Maximum over Size In Bits of counter. A simple example of counter operation in Time Since Event mode is presented in the following figure.

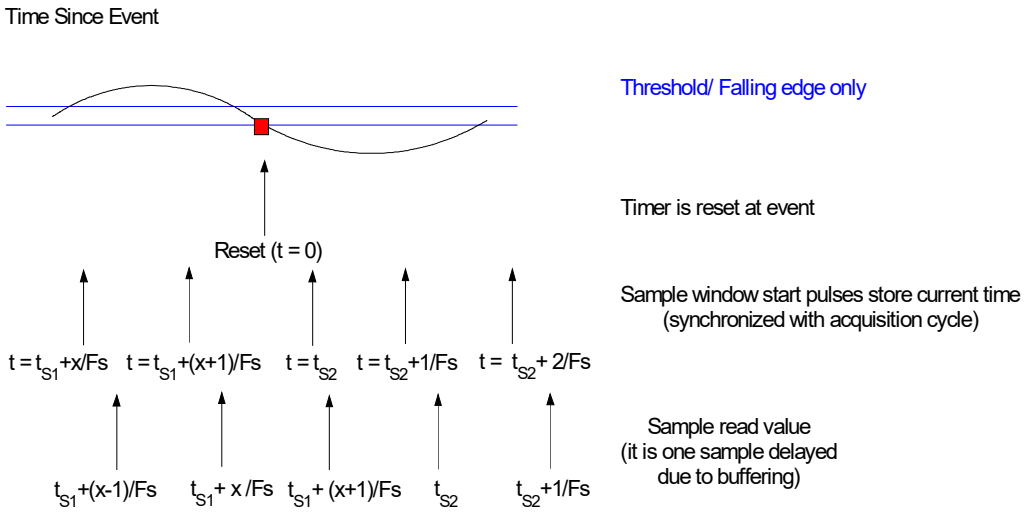


Figure 12: Example of counter operation in Time Since Event mode

The equation for the Time Since Event mode is:

$$Time\ Since\ Event\,[counts] = Input\ signal\ time\ since\ event\ [seconds] \times \frac{2^{Size\ In\ Bits}}{Range\ Maximum\,[seconds]}$$

NOTE: The Time value is sampled at the start of sample window. Sample window is aligned with start of acquisition cycle and evenly spaced thereafter (with $1/F_s$ distance). The value read is one sample delayed due to the processing required (scaling to user-range), and so the buffered value is released for the next sample window. In this mode, the counter is also reset at power-up, and starts counting once the module setup phase is finished.

6. In KAD/DSI/002 and KAD/DSI/004, this mode was called TIMER and in KAD/DSI/003 it was called ELAPSED.

The error on this mode is determined by 40 ns internal time measurement resolution, 5 ppm (1 ppm typical) reference clock precision, one-LSB resolution of the counter, and the delay of the analog input circuit and the digital edge detection block (which is 500 ns ± 200 ns).

$$Error[Hz] = \pm\left(40 \times 10^{-9}[s] + 5 \times 10^{-6} \times Time\ Since\ Event[s] + \frac{Range\ Maximum[s]}{2^{Size\ In\ Bits}}\right) + (500 \pm 200) \times 10^{-9}[s]$$

Timeout

If there are periods of measured signals which are longer than expected, it is desirable for the module to timeout and output a rail value. For example, with the KAD/DSI/104 the timeout feature applies to Period, Pulse Width and Duty Cycle modes. Such operation protects against a possible situation where the signal source gets disconnected (connection broken) and avoids displaying the last properly measured value of period.

In Period mode, the timeout is set automatically by software, based on the RangeMaximum set for a specific channel. If the RangeMaximum is exceeded, then a timeout occurs, and the counter value is propagated towards output buffer block (as the value must exceed RangeMaximum, then output value, after scaling and railing must be at the top rail).

In Pulse Width mode, there is a Pulse Width Mode Timeout setting available which defines the timeout value for all counters. In this mode, the output value could be 0, in the scenario where there is no new pulse ending edge since the last measurement taken (or since power-up/programming). Alternatively, if a timeout occurred after new pulse trigger edge (beginning of pulse width measurement), then the output value is railed at the high rail of the range, for example 0xFFFFFFFF for 32-bit size counter.

In Duty Cycle mode, there is a Duty Cycle Mode Timeout setting available, which defines the maximum period of input signal on which duty cycle ratio can be calculated. If timeout happens in this mode, the output value depends on the phase of the input signal during which timeout occurred. In the scenario that the last edge is the trigger edge, the output value is high rail (for example, 0x00FF FFFF where the Size in Bits for a specific channel is set to 24), otherwise the value is 0 (low rail). Low rail is also the default output value after power-up.

The KAD/DSI/104 generates an internal timeout reference signal pulse every 50 ms. This pulse is divided (individually per channel) by individual integer dividers (however, Pulse Width Mode Timeout and Duty Cycle Mode Timeout are set up for all channels by a single setting). As the reference signal is asynchronous versus input signals, KSM-500 and DAS Studio 3 software always rounds up the required timeout value divider and adds it to 1. This is in order to avoid the situation where timeout interrupts the measurement of a signal for which period is close (<50 ms) to the required timeout. For example, if Pulse Width Timeout is set to 1s, then the value programmed is equivalent to 1.05 seconds.

Power-up

The 0 value from each counter, regardless of mode, is read until all blocks and channels are set up as per EPROM configuration.

NOTE: In line with our policy for reading EPROM setup, the EPROM configuration is read and programmed in a loop.

After power-up or programming, at least one full setup pass (through all channels) needs to finish, before counter increments are allowed. This ensures all channels are already fully set up. This phase takes approximately 25 ms, but for inter-channel synchronization purposes, finishes at the first acquisition cycle after all channels have been set up. Until this phase finishes, all samples read from counter registers are 0.

Connector pinout of the KAD/DSI/104

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DISCRETE(0)+	Optoisolated inputs	Discrete input
2	DISCRETE(0)-	Optoisolated inputs	Discrete input
3	DISCRETE(1)+	Optoisolated inputs	Discrete input
4	DISCRETE(1)-	Optoisolated inputs	Discrete input
5	DISCRETE(2)+	Optoisolated inputs	Discrete input
6	DISCRETE(2)-	Optoisolated inputs	Discrete input
7	DISCRETE(3)+	Optoisolated inputs	Discrete input
8	DISCRETE(3)-	Optoisolated inputs	Discrete input
9	DISCRETE(4)+	Optoisolated inputs	Discrete input
10	DISCRETE(4)-	Optoisolated inputs	Discrete input
11	DISCRETE(5)+	Optoisolated inputs	Discrete input
12	DISCRETE(5)-	Optoisolated inputs	Discrete input
13	DISCRETE(6)+	Optoisolated inputs	Discrete input
14	DISCRETE(6)-	Optoisolated inputs	Discrete input
15	DISCRETE(7)+	Optoisolated inputs	Discrete input
16	DISCRETE(7)-	Optoisolated inputs	Discrete input
17	DISCRETE(8)+	Optoisolated inputs	Discrete input
18	DISCRETE(8)-	Optoisolated inputs	Discrete input
19	DISCRETE(9)+	Optoisolated inputs	Discrete input
20	DISCRETE(9)-	Optoisolated inputs	Discrete input
21	DISCRETE(10)+	Optoisolated inputs	Discrete input
22	DISCRETE(10)-	Optoisolated inputs	Discrete input
23	DISCRETE(11)+	Optoisolated inputs	Discrete input
24	DISCRETE(11)-	Optoisolated inputs	Discrete input
25	DISCRETE(12)+	Optoisolated inputs	Discrete input
26	DISCRETE(12)-	Optoisolated inputs	Discrete input
27	DISCRETE(13)+	Optoisolated inputs	Discrete input
28	DISCRETE(13)-	Optoisolated inputs	Discrete input
29	DISCRETE(14)+	Optoisolated inputs	Discrete input
30	DISCRETE(14)-	Optoisolated inputs	Discrete input
31	DISCRETE(15)+	Optoisolated inputs	Discrete input
32	DISCRETE(15)-	Optoisolated inputs	Discrete input
33	DISCRETE(16)+	Optoisolated inputs	Discrete input
34	DISCRETE(16)-	Optoisolated inputs	Discrete input
35	DISCRETE(17)+	Optoisolated inputs	Discrete input
36	DISCRETE(17)-	Optoisolated inputs	Discrete input
37	DISCRETE(18)+	Optoisolated inputs	Discrete input
38	DISCRETE(18)-	Optoisolated inputs	Discrete input
39	DISCRETE(19)+	Optoisolated inputs	Discrete input
40	DISCRETE(19)-	Optoisolated inputs	Discrete input
41	DISCRETE(20)+	Optoisolated inputs	Discrete input
42	DISCRETE(20)-	Optoisolated inputs	Discrete input
43	DISCRETE(21)+	Optoisolated inputs	Discrete input
44	DISCRETE(21)-	Optoisolated inputs	Discrete input
45	DISCRETE(22)+	Optoisolated inputs	Discrete input
46	DISCRETE(22)-	Optoisolated inputs	Discrete input
47	DISCRETE(23)+	Optoisolated inputs	Discrete input
48	DISCRETE(23)-	Optoisolated inputs	Discrete input
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/DSI/104/28V	Optoisolated isolated input (counters, time tagging) - 24ch (28V)

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/DSI/104	First release	Recommended for new programs

Supporting software

MODULE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

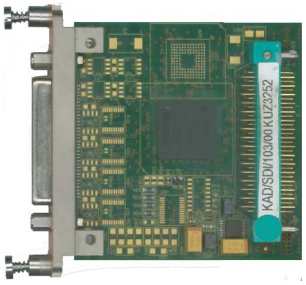
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/SDI/103

Serial data bus parser - 1ch



Overview

The KAD/SDI/103 is used to read data serially from external devices and store the data in a coherent frame buffer.

Synchronization is done via a Data clock, a Word clock and a Frame clock.

Key Features

- Frame data is time-tagged using standard 3 × 16 timer to 1µs resolution
- Decommutates one serial stream in RS-422 format
- Accepts NRZ-L, Bit clock, Word clock and Frame clock
- 100kbps, 200kbps, 300kbps, 500kbps, 800kbps, 1Mbps baud rates supported
- Supports 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096 words per frame
- Programmable word length (12 or 16-bit)
- No supercommutation
- All inputs have option for termination
- NRZ-L and Bit clock can be triggered on rising or falling edge

Applications

- Data acquisition systems
- General purpose serial data read from external devices

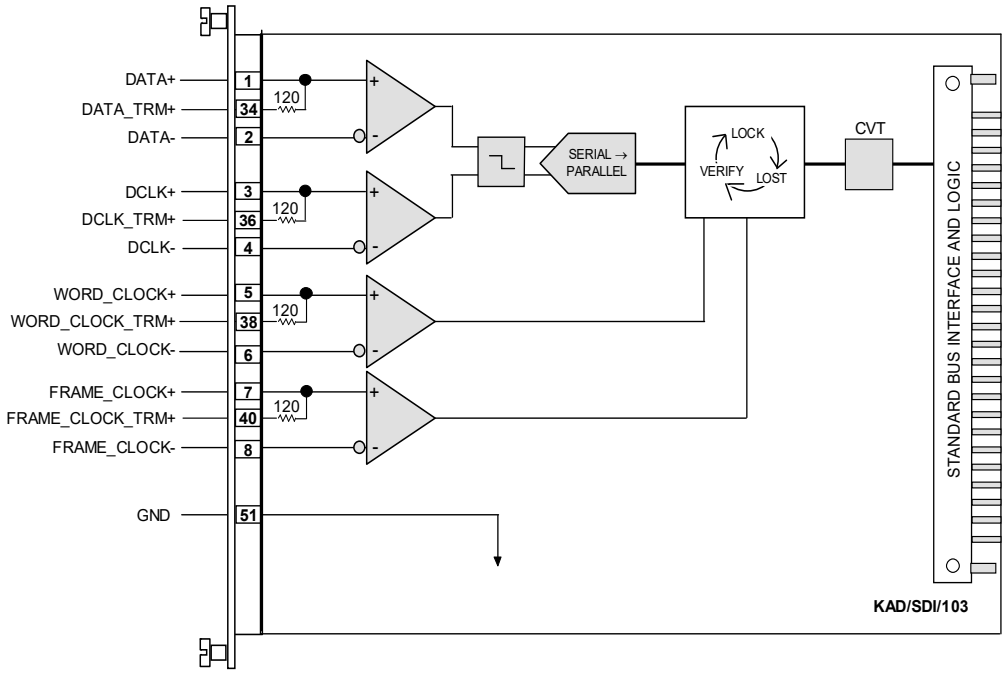


Figure 1: KAD/SDI/103 block diagram

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	64	–	g	
	–	2.25	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	80	–	105	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	0.40	–	0.53	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

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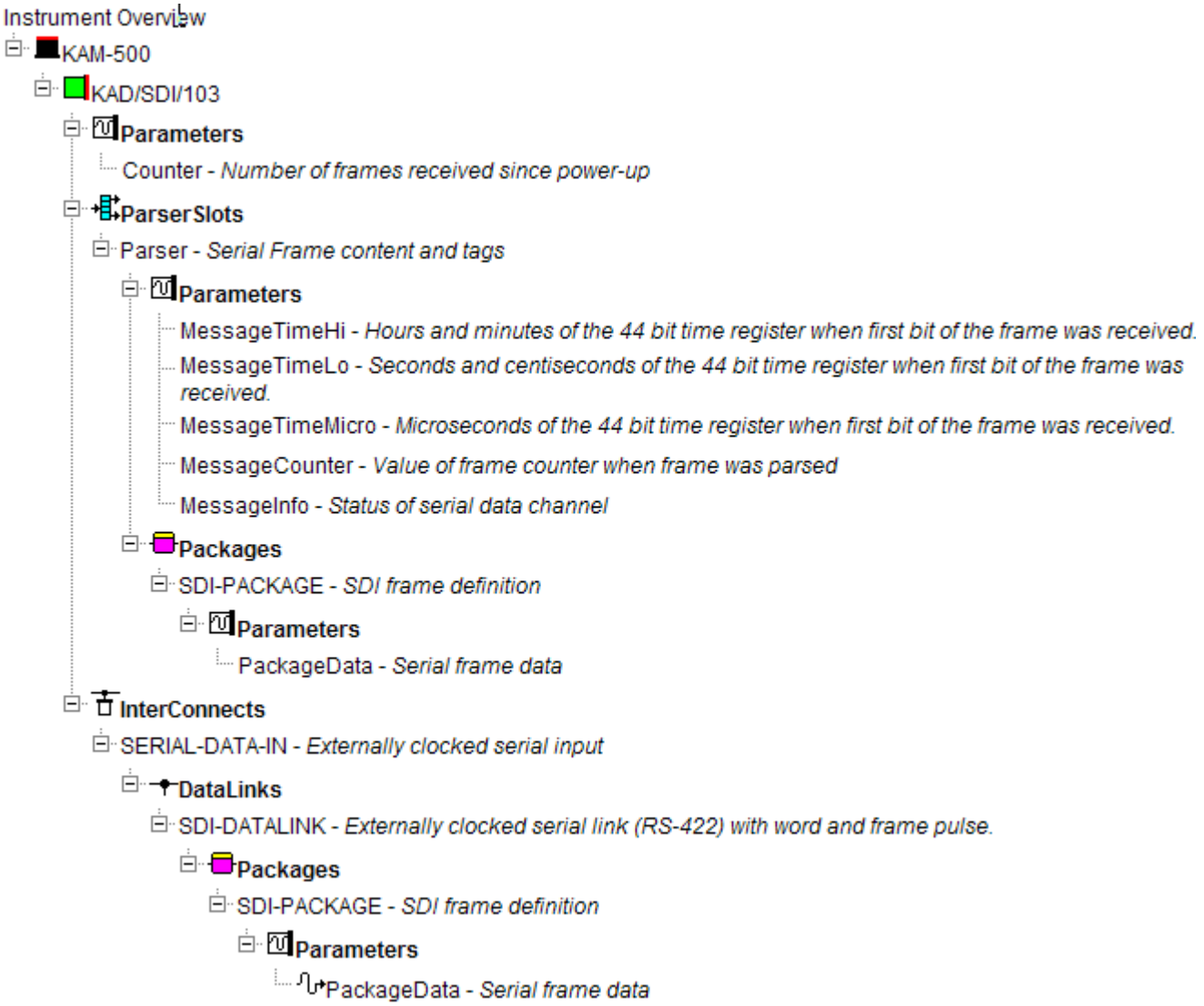
TABLE 2	RS-422 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	4	–	
Signaling rate					
DATA	–	–	1	Mbps	
Input voltage					
operating range	-7	–	12	V	Do not exceed operating range.
logic 0	–	–	0.2	V	V_{IN+} - V_{IN-}.
logic 1	0.2	–	–	V	V_{IN+} - V_{IN-}.
common mode voltage	-7	–	12	V	
overvoltage protection	-7.5	–	12.5	V	Voltages outside of this range can damage input.
ESD protection	8	–	–	kV	Human Body Model.
Input resistance					
between inputs	12	–	–	kΩ	Module powered on.
between inputs	12	–	–	kΩ	Module powered off.
between inputs	–	120	–	Ω	Module powered on and inputs terminated.
between inputs	–	120	–	Ω	Module powered off and inputs terminated.
each input to GND	6	–	–	kΩ	Module powered on.
each input to GND	6	–	–	kΩ	Module powered off.

Setting up the KAD/SDI/103

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

The following treeview provides an overview of setup configurations available for this module:

Treeview icons legend	
DAU: Data Acquisition Unit	Indicator: Indicates the firing of an event based on specific conditions
PC: Personal Computer	Parser slot: Area of memory reserved for storing parsed data
Instrument: Any component or module used in a data acquisition system	Snarfer: Captures all data transmitted on a bus and selectively stores it
DataLink: Connection for transmitting or receiving (defines both the data link and the physical layer)	Bridge: Electrical circuit usually used for measuring purposes
Package: Used to describe how data is transmitted or stored	PCMCIA card: Peripheral interface device usually for use in laptop computers
Parameter: Any register that can be read from an instrument	Multiplexer: Selects one of many input signals and outputs that signal on a signal line
Algorithm: Defines processing to be performed on data	Channels: Defines settings for input or output channels on an instrument
InterConnect: Represents a physical connection on an instrument	
PCI card: Circuit board that plugs into the PCI bus on a PC	



Setting up the module

The following table lists the setup configurations available for the KAD/SDI/103.

SETUP DATA	CHOICE	DEFAULT/EXAMPLE	NOTES
Manufacturer			
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/SDI/103	KAD/SDI/103	ACRA CONTROL part number.
SerialNumber	–	–	Unique number for each module.
InterConnects SERIAL-DATA-IN	No character limit	Not Specified	Externally clocked serial input.
Settings	–	–	–
Module-Parser-1.0	–	–	–
PackageBuffers	–	–	–
PackageBuffer Parser	–	–	Serial frame content and tags.
PackageReference	No character limit	MySDIFrame	–

Setting up parameters

Parameter definitions

The following table lists all parameters that are available for the KAD/SDI/103.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageTimeHi Hours and minutes of the 44-bit time register when first bit of the frame was received.	Unitless	BitVector	16	R[15:13] Reserved for future use. R[12:7] Time[43:38] BCD Hours 0 to 23. R[6:0] Time[37:31] BCD Minutes 0 to 59.
MessageTimeLo Seconds and centiseconds of the 44-bit time register when first bit of the frame was received.	Second	BCD	16	R(15) Reserved for future use. R[14:8] Time[30:24] Seconds 0 to 59. R[7:0] Time[23:16] Centiseconds 0 to 99.
MessageTimeMicro Microseconds of the 44-bit time register when first bit of the frame was received.	Second	BCD	16	R[15:0] Time[15:0] Microseconds 0 to 9999.
Counter Number of frames received since power-up	Count	OffsetBinary	16	R[15:0] 0000:FFFF.
MessageCounter Value of frame counter when frame was parsed	Count	OffsetBinary	16	R[15:0] 0000:FFFF.
MessageInfo Status of serial data channel	–	BitVector	16	R(15) Error received on the bus since last read. R[14:11] Reserved for future use. R(11) Buffer is empty. R(10) Data has been read before. R(9) Data has been overwritten. R[8:3] Reserved for future use. R(2) Frame clock error. R(1) Word clock error. R(0) Bit clock error.
PackageData Serial frame data	–	BitVector	12 16	12 R[11:0] is data, with R[15:12] = 0. 16 R[15:0].

Programmable elements

PackageData

SETUP DATA	CHOICE	DEFAULT/EXAMPLE	NOTES
SizeInBits	12 16	Not Specified	R[15:0].
ParameterTypeReference	–	–	–

Setting up data links

A data link is a connection for transmitting and receiving data. It defines both the data link and physical layers of the link. The following are data links supported by the KAD/SDI/103.

SERIAL-DATA-IN

Externally clocked serial link (RS-422) with word and frame pulse.

SETUP DATA	CHOICE	DEFAULT/EXAMPLE	NOTES
ProtocolProperties			
BitRate	1,000,000 800,000 500,000 300,000 200,000 100,000	Not Specified	–

Setting up packages

A package is a logical description of how data is transmitted or stored.

SDI-PACKAGE

SDI frame definition.

SETUP DATA	CHOICE	DEFAULT/EXAMPLE	NOTES
ReferencedToAbsoluteTime	No	No	Data can only be received asynchronously.
DataLinkReference	No character limit	Not Specified	–
Properties	–	–	–
MajorFrameProperties	–	–	–
BitsPerMinorFrame	65536:48	512	65536 when using a 16-bit word size and 4K words per frame.
MinorFramesPerMajorFrame	1	1	–
DefaultDataBitsPerWord	12 16	16	Bit per word.
DefaultMostSignificantBit	First	First	–
FillPattern	–	–	–
DefaultParity	None	None	–
SynchronizationStrategy			
SyncWord	–	–	–
SubframeSynchronizationStrategy	–	–	–
Modulation			
PCMCode	–	–	–
DclkPhase	0 180	0	–
PCMPolarity	True False	True	–
Content	–	–	–

SETUP DATA	CHOICE	DEFAULT/EXAMPLE	NOTES
Parameter	–	–	
NumberOfDataBits	12 16	Not Specified	–
MostSignificantBit	First	First	–
Location			
MinorFrameNumber	1	1	There can only ever be 1 minor frame per package.
Offset_Words	4096:1	1	–
Offset_Bits	65520:12	16	–
Occurrences	4096:1	1	Number of occurrences of this parameter per frame.

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/SDI/103

Serial lines waveform

The following diagram illustrates serial data timing. Word identification is done via a Data clock (DCLK) and a Word clock. The Frame clock occurrence can be identified by a unique flag or by a time word in the PCM frame. This is identified and checked against the expected frame sync. location as defined by the programmed baud rate, word length and frame length.

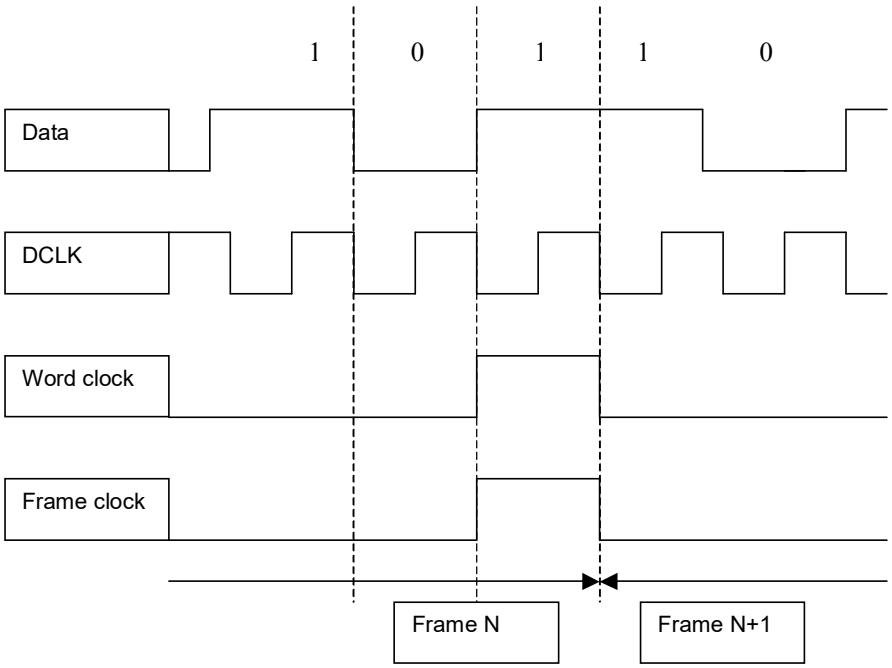


Figure 2: Serial data timing

Interpreting MessageInfo words

The MessageInfo word D(15) indicates when a new error is received. Although D(15) clears after it has been read, the lower three bits do not clear on read; these three bits toggle whenever a new error of that type is detected.

To determine which error was detected, compare the current MessageInfo word—which will have D(15) set—with the previous MessageInfo word.

The toggles of the lower MessageInfo bits indicate the error type.

Loss of frame sync

Data is assembled into frames using the Frame clock, and stored in a triple buffer. The frames can be read in received order. If data is read again before a new frame arrives, the stale flag is set; if data arrives and no buffer is available, the skipped flag is set.

Connector pinout of the KAD/SDI/103

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DATA+	RS-422 inputs	Data input; not internally terminated
2	DATA-	RS-422 inputs	Data input; not internally terminated
3	DCLK+	RS-422 inputs	Data clock input; not internally terminated
4	DCLK-	RS-422 inputs	Data clock input; not internally terminated
5	WORD_CLOCK+	RS-422 inputs	Word pulse input; not internally terminated
6	WORD_CLOCK-	RS-422 inputs	Word pulse input; not internally terminated
7	FRAME_CLOCK+	RS-422 inputs	Frame pulse input; not internally terminated
8	FRAME_CLOCK-	RS-422 inputs	Frame pulse input; not internally terminated
9	DNC		Do not connect
10	DNC		Do not connect
11	GND	Internal ground	
12	GND	Internal ground	
13	GND	Internal ground	
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DATA_TRM+	RS-422 inputs	
35	DNC		Do not connect
36	DCLK_TRM+	RS-422 inputs	
37	DNC		Do not connect
38	WORD_CLOCK_TRM+	RS-422 inputs	
39	DNC		Do not connect
40	FRAME_CLOCK_TR+	RS-422 inputs	
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/SDI/103	Serial data bus parser - 1ch

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/SDI/103	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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This document was reviewed on 14/10/2020 and does not contain technical data.

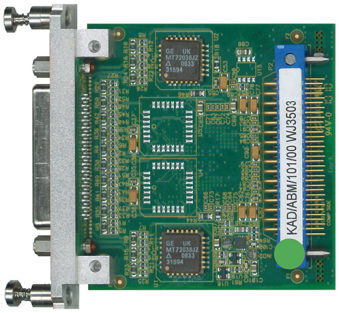
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KAD/ABM/101

ARINC-429 bus monitor parser/snarfer - 8ch

CURTISSWRIGHTDS.com



Key Features

- Monitors up to eight ARINC-429 busses
- Coherently parses traffic and tags for up to 4095 messages
- 64K deep selective FIFO for traffic and tags (snarfer)
- Detects six types of errors
- Word counter for each bus

Applications

- ARINC-429 monitoring and recording

Overview

The KAD/ABM/101 is an ARINC-429 bus monitor, which combines the capabilities of a coherent message parser with the flexibility of an all-pass/selected-pass snarfer FIFO and an error-detection function, on a single module.

The parser parses up to 4,095 words and their associated time and status tags. Each message has a stale bit (word read before) and a skipped bit (buffer overwritten). Messages can be parsed based on their bus number, label, SDI, and/or SSM fields.

The snarfer stores selected traffic and tags in a FIFO, 64K words deep. Each word has 16 bits for traffic tag information and 7 bits for FIFO content identification. Data selection and content identification is based on the Bus (0 to 7), ARINC traffic, tag type (time high/low/micro and message count) and how full the FIFO is. For more information see “Getting the most from the KAD/ABM/101” on page 571.

The word count increments on receipt of a valid word. The report word has bits indicating the type of error caught and the bus it occurred on.

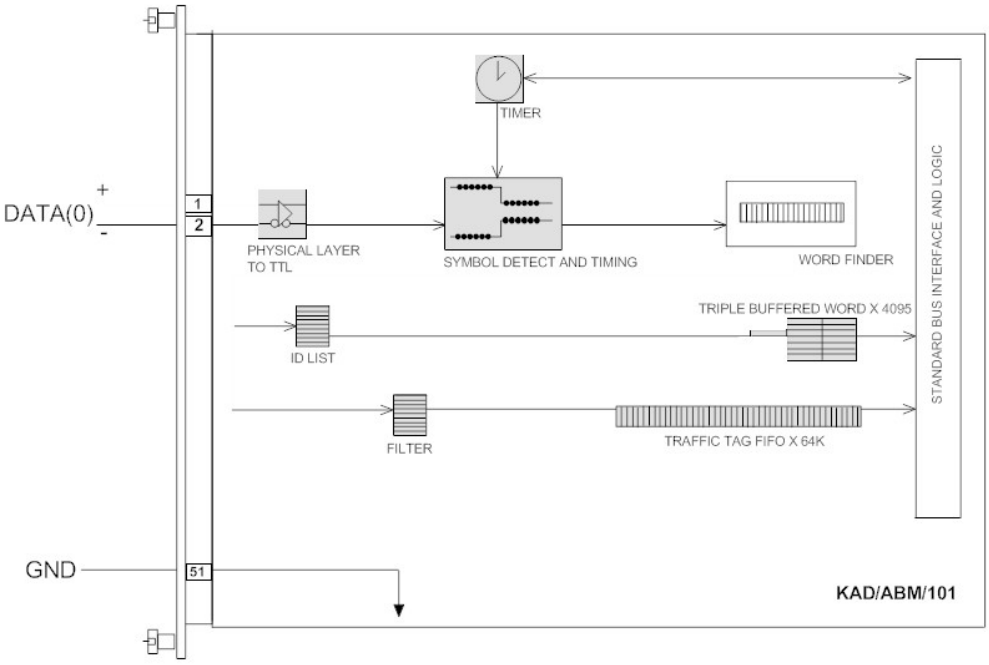


Figure 1: First of eight busses on the KAD/ABM/101

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	70	–	g	
	–	2.47	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	75	–	95	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	0.375	–	0.475	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	ARINC-429 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	8	–	ARINC-429 compatible.
Signaling rate					
DATA	12.5	–	100	kbps	Signaling rate is either 12.5, 50 or 100 kbps.
Operating range					
Logic 0	-2.5	–	2.5	V	
Logic L	-13	–	-6.5	V	
Logic H	6.5	–	13	V	

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Setting up the KAD/ABM/101

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ABM/101	KAD/ABM/101	The instrument part reference.
SerialNumber	FA1234	FA1234	Unique name for each module.
Settings SnarferFilter	-	-	Specifies content written to the snarfer FIFO as it fills, depending on the % fill level.
Fifo Level-25	Traffic, Message-Count, IrigTime, Error Traffic, IrigTime, Error Traffic, IrigTime Traffic, Error Error None	Traffic, Message-Count, IrigTime, Error	Specifies the type of data that should be stored when the FIFO is less than or equal to 25% full.
Fifo Level-50	Traffic, Message-Count, IrigTime, Error Traffic, IrigTime, Error Traffic, IrigTime Traffic, Error Error None	Traffic, Message-Count, IrigTime, Error	Specifies the type of data that should be stored when the FIFO is less than or equal to 50% full.
Fifo Level-75	Traffic, Message-Count, IrigTime, Error Traffic, IrigTime, Error Traffic, IrigTime Traffic, Error Error None	Traffic, Message-Count, IrigTime, Error	Specifies the type of data that should be stored when the FIFO is less than or equal to 75% full.
Fifo Level-100	Traffic, Message-Count, IrigTime, Error Traffic, IrigTime, Error Traffic, IrigTime Traffic, Error Error None	Traffic, Message-Count, IrigTime, Error	Specifies the type of data that should be stored when the FIFO is less than or equal to 100% full.
Processes	-	-	-
Parser(4094:0)	-	-	Parser definitions.
Catchall-Parser	-	-	Parser definitions.
Channels	-	-	-
ARINC-429-In(7:0) ARINC-429 Input	-	-	Represents a typical ARINC-429 bus monitor channel configuration.
Settings	-	-	-
Check For Parity	True False	False	Indicates whether parity should be checked.

SETUP DATA	CHOICE	DEFAULT	NOTES
Bit Rate	100e3 50e3 12.5e3	12.5e3	Specifies the number of bits transmitted per second.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Snarfer Message data, time tags, MessageCounts and errors are written to the snarfer, the content can be filtered depending on the fill level of the snarfer FIFO.	BitVector	BitVector	32	R[31:0] R[31:29] Bus - The bus the message was received on. R(28) Reserved R[27:24] ContentIdentifier - Identifies the content of snarfer[15:0]. 0000: Error. 0001: SnarferFull. 0010: MessageCount. 0011: SSM[1:0], Data[18:5]. 0100: Data[4:0], SDI[1:0], Label[0:7], Reserved. 0101: IrigMessageTimeMicro. 0110: IrigMessageTimeLo. 0111: IrigMessageTimeHi. 1000: SnarferEmpty. R[23:16] Reserved R[15:0] Content - The meaning of these bits depends on ContentIdentifier.
Report Reports the status of the module.	BitVector	BitVector	16	R[15:0] R(15) FreshError - An error occurred since last read. R[14:7] Reserved R[6:4] Bus - Indicates the bus the error occurred on. R[3:0] ErrorCode - Indicates the error that occurred last. 0000: BadBit. 0001: NotEnoughBits. 0010: TooManyBits. 0011: Reserved for future use. 0100: ParityError. 0101: Invalid Label, SSM or SDI. 1000: Reset occurred since last read.
Parser(4094:0) Parameters				
MessageCount A copy of WordCount when message was received.	Count	OffsetBinary	16	R[15:0]
MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes time midway through first transmitted bit.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageTimeLo Seconds and Centiseconds time midway through first transmitted bit.	BitVector	BitVector	16	R[31:16] R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.
MessageTimeMicro Microsecond time midway through first transmitted bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - BCD Microseconds 0 to 9999.
Catchall-Parser Parameters				
MessageCount A copy of WordCount when message was received.	Count	OffsetBinary	16	R[15:0]
MessageDataStyleA SSM, data, SDI, parity and message information.	BitVector	BitVector	32	R[31:0] R[31:30] SSM - Sign/Status Matrix. R[29:11] Data - Data word. R[10:9] SDI - Source Destination Identifier. R(8) Empty - This parser slot has not been written to yet. R(7) Stale - This parser slot has been read before. R(6) Skipped - This parser slot has been overwritten. R[5:3] Bus - The bus the message was received on. R[2:1] Reserved R(0) Parity - The parity bit received.
MessageDataStyleB Parity, SSM, data, bus, SDI and message information.	BitVector	BitVector	32	R[31:0] R(31) Parity R[30:29] SSM - Sign/Status Matrix. R[28:20] Data[18:10] - Bits 18 to 10 of the data word. R[19:17] Bus - The bus the message was received on. R(16) Reserved R[15:6] Data[9:0] - Bits 9 to 0 of the data word. R[5:4] SDI - Source Destination Identifier. R(3) Empty - This parser slot has not been written to yet. R(2) Stale - This parser slot has been read before. R(1) Skipped - This parser slot has been overwritten. R(0) Reserved
MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes time midway through first transmitted bit.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
MessageTimeLo Seconds and Centiseconds time midway through first transmitted bit.	BitVector	BitVector	16	R[31:16] R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.
MessageTimeMicro Microsecond time midway through first transmitted bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - BCD Microseconds 0 to 9999.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
ARINC-429-In(7:0) Parameters				
WordCount A count of valid ARINC-429 messages received on the bus.	Count	OffsetBinary	16	R[15:0]

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ABM/101

The KAD/ABM/101 contains a 64K deep by 32-bit wide snarfer FIFO, which is shared between all eight busses. All ARINC-429 traffic received by the KAD/ABM/101 is tagged with the reception time (IrigTime) and word count, and is then written into the snarfer FIFO according to a set of filter rules.

The 32 bits of the snarfer word are broken down as shown in the following figure.

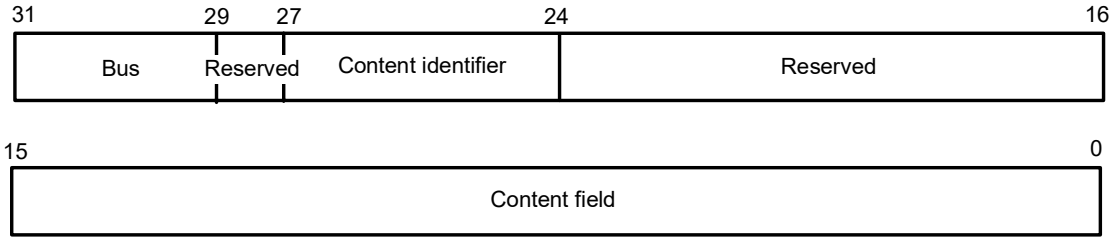


Figure 2: Snarfer word structure

- Bits 31 to 29 are used to identify the bus that the current traffic associates with.
- Bits 27 to 24 contain the content identifier for the content field (bits 15 to 0) of the snarfer word. These are as follows:
  - 0000 - Error
  - 0001 - Snarfer Full
  - 0010 - Word Count
  - 0011 - SSM[1:0], Data[18:5]
  - 0100 - Data[4:0], SDI[1:0], Label[0:7], Reserved
  - 0101 - Time Hi
  - 0110 - Time Lo
  - 0111 - Time Micro
  - 1000 - Snarfer Empty
- Bit 28 and bits 23 to 16 are reserved for future use.
- Bits 15 to 0 (content field) contain either the ARINC-429 traffic or additional tags. These additional tags generate extra data; snarfer filtering can be employed to reduce the amount of data written into the snarfer FIFO.

Snarfer filtering rules can be applied depending on how full the FIFO is (0-25%, 25-50%, 50-75%, 75-100% full). At each level you can apply a rule where the following is captured:

Traffic,	MessageCount,	IrigTime,	Error
Traffic,	IrigTime,		Error
Traffic,			IrigTime
Traffic,			Error
Error			
None			

The snarfer sample rate must be set based on the combined bus bit rates, bus utilization, and the amount of additional tag information.

When the FIFO is full, additional data is lost and the content identifier indicating Snarfer Full is set; then the content field is set to 0xAAAA. When the snarfer is empty, the content identifier field is set to Snarfer Empty and the content field is set to 0x5555.

Even if the snarfer is not required for traffic and tags, consider setting the snarfer filter to Error Only. This ensures all errors can be logged and timestamped when they occur.

Connector pinout of the KAD/ABM/101

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DATA(0)+	ARINC-429 inputs	ARINC-429 bus
2	DATA(0)-	ARINC-429 inputs	ARINC-429 bus
3	DATA(1)+	ARINC-429 inputs	ARINC-429 bus
4	DATA(1)-	ARINC-429 inputs	ARINC-429 bus
5	DATA(2)+	ARINC-429 inputs	ARINC-429 bus
6	DATA(2)-	ARINC-429 inputs	ARINC-429 bus
7	DATA(3)+	ARINC-429 inputs	ARINC-429 bus
8	DATA(3)-	ARINC-429 inputs	ARINC-429 bus
9	DATA(4)+	ARINC-429 inputs	ARINC-429 bus
10	DATA(4)-	ARINC-429 inputs	ARINC-429 bus
11	DATA(5)+	ARINC-429 inputs	ARINC-429 bus
12	DATA(5)-	ARINC-429 inputs	ARINC-429 bus
13	DATA(6)+	ARINC-429 inputs	ARINC-429 bus
14	DATA(6)-	ARINC-429 inputs	ARINC-429 bus
15	DATA(7)+	ARINC-429 inputs	ARINC-429 bus
16	DATA(7)-	ARINC-429 inputs	ARINC-429 bus
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	GND	Internal ground	
34	GND	Internal ground	
35	GND	Internal ground	
36	GND	Internal ground	
37	GND	Internal ground	
38	GND	Internal ground	
39	GND	Internal ground	
40	GND	Internal ground	
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/ABM/101	ARINC-429 bus monitor parser/snarfer - 8ch (with 52-way double-density connector)
KAM/ABM/101	ARINC-429 bus monitor parser/snarfer - 8ch (with 51-way micro-miniature connector)

By default, the standard mating connector, (CON/KAD/002/CP for KAD modules; or ACC/CON/008/04 for KAM modules), is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/ABM/101 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ABM/101	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/006	ARINC-429
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

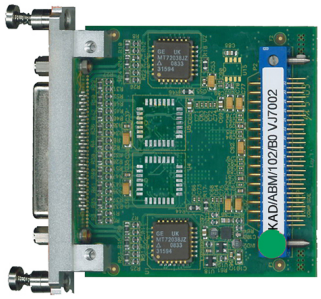
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ABM/102

ARINC-429 bus monitor parser/packetizer - 8ch

CURTISSWRIGHTDS.COM



Key Features

- Monitors up to eight ARINC-429 busses
- Coherently parses traffic and tags for up to 4095 messages
- Aperiodic transmission of packetized ARINC-429 messages including tags as iNET-X parser-aligned payload structures
- Detects five types of errors
- Word counter for each bus

Applications

- ARINC-429 monitoring and recording

Overview

The KAD/ABM/102 is an ARINC-429 bus monitor which combines the capabilities of a coherent message parser with the flexibility of an iNET-X packetizer and an error-detection function, on a single module.

The parser parses up to 4,095 words and their associated time and status tags. Each message has a stale bit (word read before) and a skipped bit (buffer overwritten). Messages can be parsed based on their bus number, label, SDI and/or SSM fields.

Every ARINC-429 message received from each of the eight busses is captured and packetized, along with time tags and a bus tag, with other received messages in a packetizer buffer. The packetizer contents can be assembled into Ethernet frames by an iNET-X controller or transmitter, for example a KAD/BCU/140, for transmission over Ethernet. The module can generate a single packet per input bus or packetize messages from all the active busses into a single packet stream.

To ensure efficient use of bandwidth, packets are only generated once a threshold amount has been stored (a maximum of 84 received messages are stored in each packet). Additionally, a programmable timeout ensures that smaller packets are generated even during periods of low activity on the bus, thereby allowing real-time analysis and processing of acquired messages. When there is no traffic, no packets are generated.

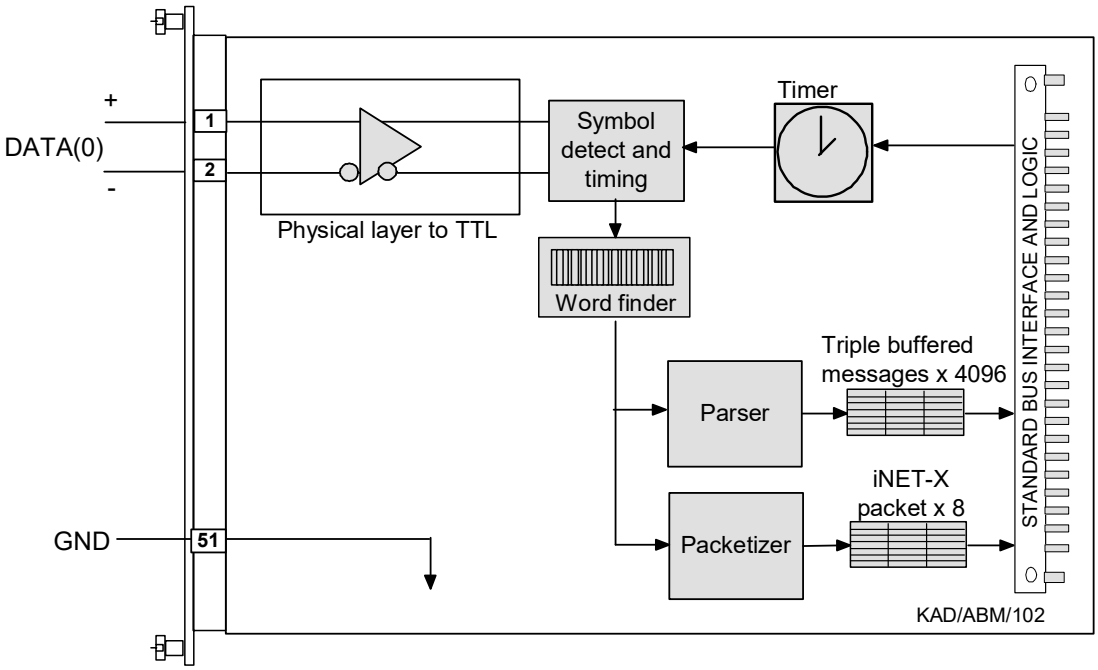


Figure 1: Primary bus monitor on the KAD/ABM/102

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	70	–	g	
	–	2.47	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	80	–	100	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	0.4	–	0.5	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	ARINC-429 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	8	–	ARINC-429 part 1 receiver compatible.
Signaling rate					
DATA	12.5	–	100	kbps	Signalling rate is either 12.5, 50 or 100kbps.

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Setting up the KAD/ABM/102

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ABM/102/B	KAD/ABM/102/B	The instrument part reference.
SerialNumber	FA1234	FA1234	Unique name for each module.
Settings	-	-	-
Packetization	Individual Combined	Individual	Packetization is set per channel or per instrument.
Processes	-	-	-
Parser(4094:0)	-	-	Parser definitions.
Catchall-Parser	-	-	Parser definitions.
Channels	-	-	-
ARINC-429-In(7:0) ARINC-429 Input	-	-	Represents a typical ARINC-429 bus monitor channel configuration.
Settings	-	-	-
Check For Parity	True False	False	Indicates whether parity should be checked.
Bit Rate	100e3 50e3 12.5e3	12.5e3	Specifies the number of bits transmitted per second.
Settings Packetizer	-	-	-
Stream Id	00 to FFFFFFFF	FFFFFFFF	iNET-X stream ID for selected channel if a packet is generated via the assertion of Packetization Enabled. This setting is only supported in DAS Studio 3.
Packetization Enabled	True False	False	Enables the transmission of an iNET-X packet containing the contents of this channel if an iNET-X transmitter is present in the chassis. This setting is only supported in DAS Studio 3.
Packet Size	200 to 511	511	Size of packet buffer in words.
Packet Timeout	10 to 1500	50	Generates a packet when the oldest data recorded is this old (ms).
ARINC-429-In-Combined ARINC-429 Input	-	-	Represents all eight ARINC-429 channels combined into one iNET-X packetizer.
Settings	-	-	-
Settings Packetizer	-	-	-
Stream Id	00 to FFFFFFFF	FFFFFFFF	iNET-X stream ID for selected channel if a packet is generated via the assertion of Packetization Enabled. This setting is only supported in DAS Studio 3.

SETUP DATA	CHOICE	DEFAULT	NOTES
Packetization Enabled	True False	False	Enables the transmission of an iNET-X packet containing the contents of this channel if an iNET-X transmitter is present in the chassis. This setting is only supported in DAS Studio 3.
Packet Size	200 to 511	511	Size of packet buffer in words.
Packet Timeout	10 to 1500	50	Generates a packet when the oldest data recorded is this old (ms).

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Report Reports the status of the module.	BitVector	BitVector	16	R[15:0] R(15) FreshError - An error occurred since last read. R[14:7] Reserved R[6:4] Bus - Indicates the bus the error occurred on. R[3:0] ErrorCode - Indicates the error that occurred last. 0000: BadBit. 0001: NotEnoughBits. 0010: TooManyBits. 0011: Reserved for future use. 0100: ParityError. 0101: Invalid Label, SSM or SDI. 1000: Reset occurred since last read.
Parser(4094:0) Parameters				
MessageCount A copy of WordCount when message was received.	Count	OffsetBinary	16	R[15:0] R[15:0] MessageCount
MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes time midway through first transmitted bit.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
MessageTimeLo Seconds and centiseconds time midway through first transmitted bit.	BitVector	BitVector	16	R[31:16] R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.
MessageTimeMicro Microsecond time midway through first transmitted bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - BCD Microseconds 0 to 9999.
Catchall-Parser Parameters				
MessageCount A copy of WordCount when message was received.	Count	OffsetBinary	16	R[15:0]

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageDataStyleA SSM, Data, SDI, Parity and message info.	BitVector	BitVector	32	R[31:0] R[31:30] SSM - Sign/Status Matrix. R[29:11] Data - Data Word. R[10:9] SDI - Source Destination Identifier. R(8) Empty - This parser slot has not been written to yet. R(7) Stale - This parser slot has been read before. R(6) Skipped - This parser slot has been overwritten. R[5:3] Bus - The bus the message was received on. R[2:1] Reserved R(0) Parity - The parity bit received.
MessageDataStyleB Parity, SSM, Data, Bus, SDI and message info.	BitVector	BitVector	32	R[31:0] R(31) Parity R[30:29] SSM - Sign/Status Matrix. R[28:20] Data[18:10] - Bits 18 to 10 of the Data Word. R[19:17] Bus - The bus the message was received on. R(16) Reserved R[15:6] Data[9:0] - Bits 9 to 0 of the Data Word. R[5:4] SDI - Source Destination Identifier. R(3) Empty - This parser slot has not been written to yet. R(2) Stale - This parser slot has been read before. R(1) Skipped - This parser slot has been over written. R(0) Reserved
MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes time midway through first transmitted bit.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
MessageTimeLo Seconds and centiseconds time midway through first transmitted bit.	BitVector	BitVector	16	R[31:16] R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.
MessageTimeMicro Microsecond time midway through first transmitted bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - BCD Microseconds 0 to 9999.
ARINC-429-In(7:0) Parameters				
WordCount A count of valid ARINC-429 messages received on the bus.	Count	OffsetBinary	16	R[15:0]

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ABM/102

For a detailed description on iNET-X packets, see *TEC/NOT/067 - IENA and iNET-X packet payload formats*.

KAD/ABM/102 packet formats

The KAD/ABM/102 can output packet payloads formatted for insertion into iNET-X systems.

iNET-X parser-aligned packet format

There is a diverse range of avionic bus technologies for which traffic may be captured, for example, MIL-STD-1553 or ARINC-429. The generalized iNET-X payload structure for parser-aligned packets is shown in the following figure.

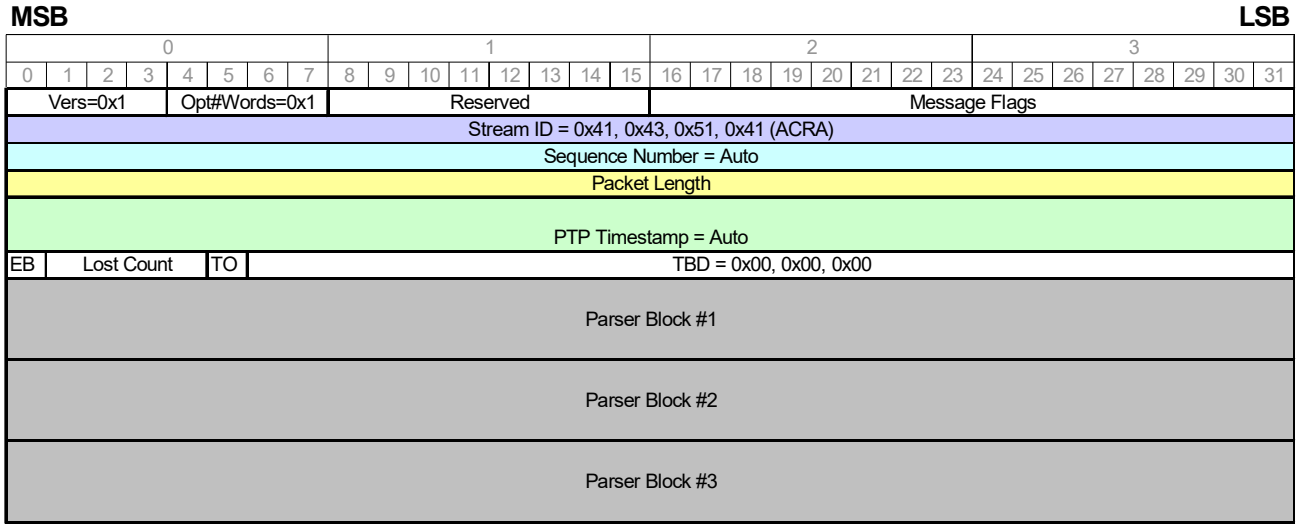


Figure 2: Generalized parser-aligned iNET-X packet

As messages are captured on the bus, they are formatted in a parser block. Each parser block begins with a 4-byte parser info word, followed by a 4-byte elapsed time tag and the message data shown in the following figure.

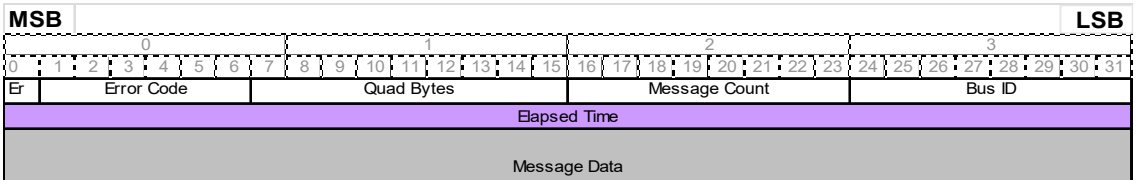


Figure 3: iNET-X parser block

A parser block consists of the following fields:

- Parser info word (4 bytes): metadata providing information about the health and status of the message.
  - Bit (0): indicates that an error occurred
  - Bits [1:6]: error codes
  - Bits [7:15]: number of quad bytes. This relates to the length of the parser info word, elapsed time tag, and the message data and padding (N x 4 bytes). For example, a 4-byte message captured from a given bus has a quad-byte value of 3, that is 12 bytes that includes 4 bytes parser info word, 4 bytes elapsed time, and 4 bytes bus message data.
  - Bits [16:23]: message counter. This is a message counter that relates to the messages contained in the payload. The message counter increments for each message contained in the packet payload and continues to increment across consecutive packets. The message counter resets and wraps around to 0 once it has reached the maximum message count of 0xFF.
  - Bits [24:31]: Bus ID corresponds to the physical bus number on the module, that is from 0 to 7.

- Elapsed time tag (4 bytes): time tag as an unsigned offset in nanoseconds that is added to the base PTP timestamp in the iNET-X header.
- Message (N x 4 bytes): captured bus traffic, padded if necessary to end on 4-byte boundary.

Example iNET-X parser-aligned packet format for ARINC-429

The KAD/ABM/102 is an eight-channel ARINC-429 bus monitor. Traffic captured on each of the ARINC-429 busses is placed in an iNET-X parser-aligned packet (see the following figure) where each bus has its own unique Stream ID. When Combined Packetization is selected, messages from all busses are placed in a single stream of packets, with a single Stream ID. The bus ID field identifies on which bus a message was received.

As ARINC messages arrive, they are tagged with a 4-byte parser info word and a 4-byte elapsed time word, followed by the 4-byte ARINC message. The parser info word identifies properties of the ARINC-429 message (such as the message counter and the ID of the bus on which the message was received) and marks the health of the message using an error bit and an error code.

The PTP timestamp in the iNET-X packet header is fixed when a packet is opened for writing and is used as the base timestamp for the whole packet. The PTP timestamp for each ARINC message in the packet can be calculated by adding the elapsed time to this base timestamp. Directly following the elapsed time field is the ARINC-429 message.

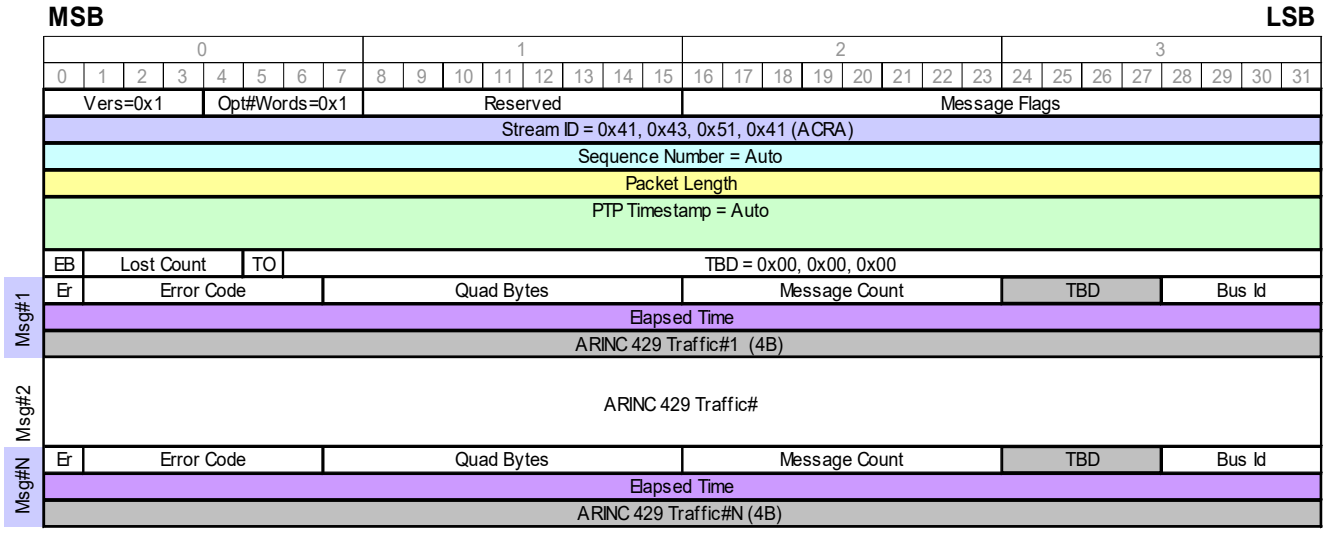


Figure 4: ARINC-429 iNET-X parser-aligned packet

For example, to facilitate real-time processing, the minimum payload size of an ARINC-429 packet is given as 1,008 bytes for a given default high-speed bus bit-rate of 100kbps, allowing for 84 ARINC 12-byte blocks to be carried in a single packet. This results in a maximum packet rate of 34 packets per second since the traffic on the bus may be asynchronous. The transmission properties for a 100kbps ARINC bus are summarized in the the following table.

TABLE 3	MyARINC packet transmission properties
TRANSMISSION PROPERTY	VALUE
ARINC-429 packet payload size (bytes)	1,008 bytes (84 ARINC message blocks of 12 bytes per ARINC block)
Total Ethernet frame length (bytes)	1,082 bytes MAC header 14 bytes + IP 20 bytes + UDP 8 bytes + iNET-X 28 bytes + ARINC-429 data + MAC frame check sequence 4 bytes
Packet rate (packets per second)	34
Total number of ARINC messages per packet	84 ARINC blocks
Total bit-rate (kbps)	294.3

Packetizer error codes for the KAD/ABM/102

An error in the incoming traffic is recorded by replacing the message data in the parser-aligned message with null data (32 zero bits) and setting the error bit and code in the iNET-X headers of the packet and the message. The error bit in the iNET-X packet header indicates that at least one of the parser blocks contains an error. The Most Significant Bit (MSB)—Er bit—of the errored parser block's header is set, and can be used during post-processing, to filter/drop these error messages.

The following table lists the error codes that can occur in the Error Code field in the parser info word in the parser block.

TABLE 4	Error codes
CODE[1]	DESCRIPTION
0x0	Bad bit
0x1	Not enough bits in word
0x2	Too many bits in word
0x3	Reserved for future use
0x4	Parity error (if enabled)
0x5	Invalid label, SSM or SDI
0x6 to 0x3F	Reserved for future use

1. Error codes are in hexadecimal.

Packetizer message counter

Each parser-aligned block contains a message counter. On the KAD/ABM/102, the counter starts from zero at the beginning of every packet, while on the KAD/ABM/102/B it starts from zero at power-up. That is, it does not reset to zero at the start of each packet.

The first parser-aligned block contains a counter, one count higher than the count in the last parser-aligned block of the last iNET-X packet.

Connector pinout of the KAD/ABM/102

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DATA(0)+	ARINC-429 inputs	ARINC-429 bus
2	DATA(0)-	ARINC-429 inputs	ARINC-429 bus
3	DATA(1)+	ARINC-429 inputs	ARINC-429 bus
4	DATA(1)-	ARINC-429 inputs	ARINC-429 bus
5	DATA(2)+	ARINC-429 inputs	ARINC-429 bus
6	DATA(2)-	ARINC-429 inputs	ARINC-429 bus
7	DATA(3)+	ARINC-429 inputs	ARINC-429 bus
8	DATA(3)-	ARINC-429 inputs	ARINC-429 bus
9	DATA(4)+	ARINC-429 inputs	ARINC-429 bus
10	DATA(4)-	ARINC-429 inputs	ARINC-429 bus
11	DATA(5)+	ARINC-429 inputs	ARINC-429 bus
12	DATA(5)-	ARINC-429 inputs	ARINC-429 bus
13	DATA(6)+	ARINC-429 inputs	ARINC-429 bus
14	DATA(6)-	ARINC-429 inputs	ARINC-429 bus
15	DATA(7)+	ARINC-429 inputs	ARINC-429 bus
16	DATA(7)-	ARINC-429 inputs	ARINC-429 bus
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	GND	Internal ground	
34	GND	Internal ground	
35	GND	Internal ground	
36	GND	Internal ground	
37	GND	Internal ground	
38	GND	Internal ground	
39	GND	Internal ground	
40	GND	Internal ground	
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/ABM/102/B	ARINC-429 bus monitor parser/packetizer - 8ch

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ABM/102/B	Upgraded ARINC-429 bus monitor with parser and packetizer	Recommended for new programs
KAD/ABM/102	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment

Related documentation

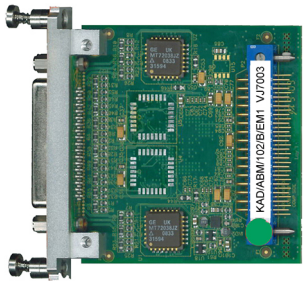
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/006	ARINC-429
TEC/NOT/051	Ethernet frames, Wireshark® and FAT32
TEC/NOT/067	IENA and iNET-X packet payload formats

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ABM/102/EM1

ARINC-429 bus monitor parser/packetizer/accumulator - 8ch

CURTISSWRIGHTDS.COM



Key Features

- Monitors up to eight ARINC-429 busses
- Coherently parses traffic and tags for up to 4095 messages
- Aperiodic transmission of packetized ARINC-429 messages including tags as iNET-X parser-aligned payload structures
- Detects five types of errors
- Word counter for each bus
- 48-bit accumulator of binary data from user-defined label

Applications

- ARINC-429 monitoring and recording

Overview

The KAD/ABM/102 is an ARINC-429 bus monitor which combines the capabilities of a coherent message parser with the flexibility of an iNET-X packetizer and an error-detection function, on a single module.

The parser parses up to 4,095 words and their associated time and status tags. Each message has a stale bit (word read before) and a skipped bit (buffer overwritten). Messages can be parsed based on their bus number, label, SDI and/or SSM fields.

Every ARINC-429 message received from each of the eight busses is captured and packetized, along with time tags and a bus tag, with other received messages in a packetizer buffer. The packetizer contents can be assembled into Ethernet frames by an iNET-X controller or transmitter, for example a KAD/BCU/140, for transmission over Ethernet. The module can generate a single packet per input bus or packetize messages from all the active busses into a single packet stream.

To ensure efficient use of bandwidth, packets are only generated once a threshold amount has been stored (a maximum of 84 received messages are stored in each packet). Additionally, a programmable timeout ensures that smaller packets are generated even during periods of low activity on the bus, thereby allowing real-time analysis and processing of acquired messages. When there is no traffic, no packets are generated.

The KAD/ABM/102/EM1 extends the functionality of the KAD/ABM/102 by adding a 48-bit accumulation, which accumulates binary data from a user-defined ARINC-429 label (see “EM1 accumulator” on page 593).

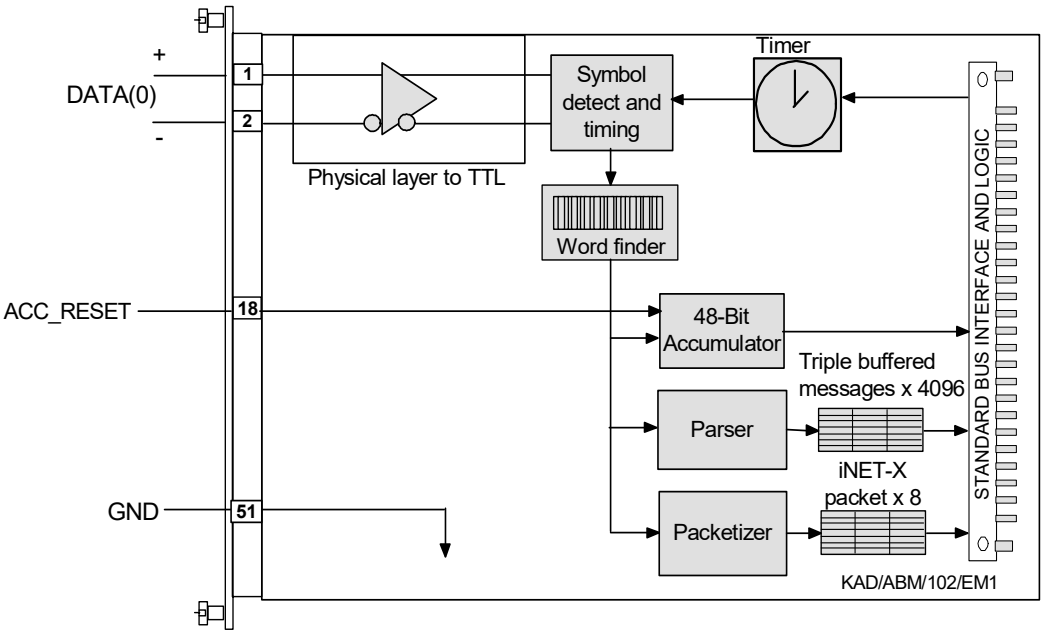


Figure 1: First bus monitor on the KAD/ABM/102/EM1

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under "Environmental ratings" in the "General specifications" table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	70	–	g	
	–	2.47	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	80	–	100	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	0.4	–	0.5	W	
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	ARINC-429 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	8	–	ARINC-429 compatible.
Signaling rate					
DATA	12.5	–	100	kbps	Signaling rate is either 12.5, 50 or 100kbps.
Operating range					
Logic 0	-2.5	–	2.5	V	
Logic L	-13	–	-6.5	V	
Logic H	6.5	–	13	V	

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TABLE 3	BTTL inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	1	–	Internally pulled to logic 0.
Signaling rate					
ACC RESET	32	–	–	µs	
Input voltage					
operating range	0	–	5.5	V	
logic 0	–	–	0.8	V	
logic 1	2	–	–	V	
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.
Input resistance					
each input to GND	88	–	–	kΩ	Module powered on.
each input to GND	12	–	–	kΩ	Module powered off.

Setting up the KAD/ABM/102/EM1

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ABM/102/B/EM1	KAD/ABM/102/B/EM1	The instrument part reference.
SerialNumber	FA1234	FA1234	Unique name for each module.
Settings	-	-	-
Packetization	Individual Combined	Individual	Packetization is set per channel or per instrument.
Settings Accumulator	-	-	-
Label	UTF-8 String Min size in bytes: 1 Max size in bytes: 3	247	ARINC-429 Label in Octal.
SDI	Any 00 01 10 11	Any	ARINC-429 Source Destination Indicator
DeltaTime	0 to 1	0.051282	Time delta between messages
Processes	-	-	-
Parser(4094:0)	-	-	Parser definitions.
Catchall-Parser	-	-	Parser definitions.
Channels	-	-	-
ARINC-429-In(7:0) ARINC-429 Input	-	-	Represents a typical ARINC-429 bus monitor channel configuration.
Settings	-	-	-
Check For Parity	True False	False	Indicates whether parity should be checked.
Bit Rate	100e3 50e3 12.5e3	12.5e3	Specifies the number of bits transmitted per second.
Accumlator Enabled	True False	False	Adds this channel to the accumulator.
Settings Packetizer	-	-	-
Stream Id	00 to FFFFFFFF	FFFFFFFF	iNET-X stream ID for selected channel if a packet is generated via the assertion of Packetization Enabled. This setting is only supported in DAS Studio 3.
Packetization Enabled	False	False	Enables the transmission of an iNET-X packet containing the contents of this channel if an iNET-X transmitter is present in the chassis. This setting is only supported in DAS Studio 3.
Packet Size	200 to 511	511	Size of packet buffer in words.
Packet Timeout	10 to 999	50	Generates a packet when the oldest data recorded is this old (ms).
ARINC-429-In-Combined ARINC-429 Input	-	-	Represents all eight ARINC-429 channels combined into one iNET-X packetizer.
Settings	-	-	-

SETUP DATA	CHOICE	DEFAULT	NOTES
Settings Packetizer	-	-	-
Stream Id	00 to FFFFFFFF	FFFFFFFF	iNET-X stream ID for selected channel if a packet is generated via the assertion of Packetization Enabled. This setting is only supported in DAS Studio 3.
Packetization Enabled	True False	False	Enables the transmission of an iNET-X packet containing the contents of this channel if an iNET-X transmitter is present in the chassis. This setting is only supported in DAS Studio 3.
Packet Size	200 to 511	511	Size of packet buffer in words.
Packet Timeout	10 to 999	50	Generates a packet when the oldest data recorded is this old (ms).

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Report Reports the status of the module	BitVector	BitVector	16	R[15:0] R(15) FreshError - An error occurred since last read. R[14:10] Reserved R(9) AccFull - The accumulator has reached all 1's R(8) AccCleared - The accumulator was cleared to 0 since last read R(7) Reserved R[6:4] Bus - Indicates the bus the error occurred on. R[3:0] ErrorCode - Indicates the error that occurred last. 0000: BadBit. 0001: NotEnoughBits. 0010: TooManyBits. 0011: Reserved for future use. 0100: ParityError. 0101: Invalid Label, SSM or SDI. 1000: Reset occurred since last read.
Accumulator Output of the accumulator locked at the start of the acquisition cycle.	Kilogram	OffsetBinary	48	R[47:0] R[47:0] Accumulator
Parser(4094:0) Parameters				
MessageCount A copy of WordCount when message was received.	Count	OffsetBinary	16	R[15:0] R[15:0] MessageCount
MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes time midway through first transmitted bit.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
MessageTimeLo Seconds and centiseconds time midway through first transmitted bit.	BitVector	BitVector	16	R[31:16] R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageTimeMicro Microsecond time midway through first transmitted bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - BCD Microseconds 0 to 9999.
Catchall-Parser Parameters				
MessageCount A copy of WordCount when message was received.	Count	OffsetBinary	16	R[15:0] R[15:0] MessageCount
MessageDataStyleA SSM, Data, SDI, Parity and message info.	BitVector	BitVector	32	R[31:0] R[31:30] SSM - Sign/Status Matrix. R[29:11] Data - Data Word. R[10:9] SDI - Source Destination Identifier. R(8) Empty - This parser slot has not been written to yet. R(7) Stale - This parser slot has been read before. R(6) Skipped - This parser slot has been overwritten. R[5:3] Bus - The bus the message was received on. R[2:1] Reserved R(0) Parity - The parity bit received.
MessageDataStyleB Parity, SSM, Data, Bus, SDI and message info.	BitVector	BitVector	32	R[31:0] R(31) Parity R[30:29] SSM - Sign/Status Matrix. R[28:20] Data[18:10] - Bits 18 to 10 of the Data Word. R[19:17] Bus - The bus the message was received on. R(16) Reserved R[15:6] Data[9:0] - Bits 9 to 0 of the Data Word. R[5:4] SDI - Source Destination Identifier. R(3) Empty - This parser slot has not been written to yet. R(2) Stale - This parser slot has been read before. R(1) Skipped - This parser slot has been over written. R(0) Reserved
MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes time midway through first transmitted bit.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
MessageTimeLo Seconds and centiseconds time midway through first transmitted bit.	BitVector	BitVector	16	R[31:16] R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.
MessageTimeMicro Microsecond time midway through first transmitted bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - BCD Microseconds 0 to 9999.
ARINC-429-In(7:0) Parameters				
WordCount A count of valid ARINC-429 messages received on the bus	Count	OffsetBinary	16	R[15:0]

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ABM/102/EM1

For a detailed description on iNET-X packets, see *TEC/NOT/067 - IENA and iNET-X packet payload formats*.

KAD/ABM/102/EM1 packet formats

The KAD/ABM/102/EM1 can output packet payloads formatted for insertion into iNET-X systems.

iNET-X parser-aligned packet format

There is a diverse range of avionic bus technologies for which traffic may be captured, for example, MIL-STD-1553 or ARINC-429. The generalized iNET-X payload structure for parser-aligned packets is shown in the following figure.

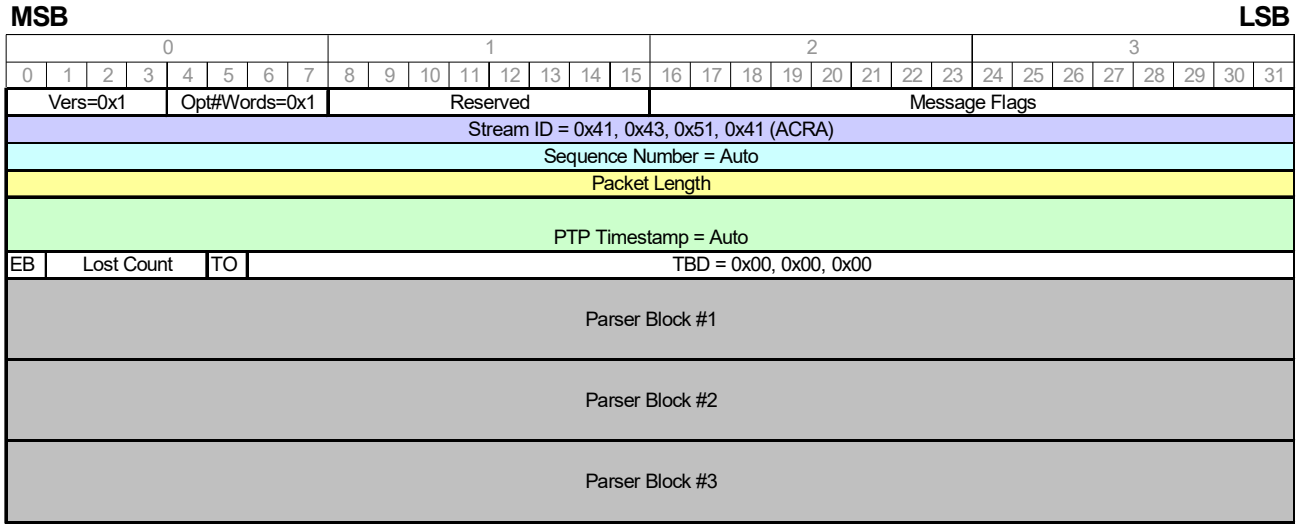


Figure 2: Generalized parser-aligned iNET-X packet

As messages are captured on the bus, they are formatted in a parser block. Each parser block begins with a 4-byte parser Info word, followed by a 4-byte elapsed time tag and the message data shown in the following figure.

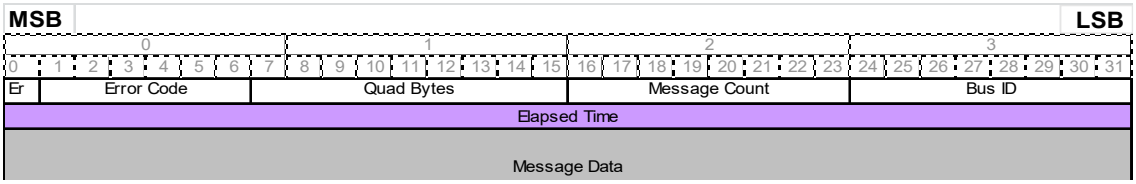


Figure 3: iNET-X parser block

A parser block consists of the following fields:

- Parser Info word (4 bytes): metadata providing information about the health and status of the message.
  - Bit (0): indicates that an error occurred
  - Bits [1:6]: error codes
  - Bits [7:15]: number of quad bytes. This relates to the length of the Parser Info word, Elapsed Time Tag, and the Message Data and padding (N x 4 bytes). For example, a 4-byte message captured from a given bus has a quad-byte value of 3, that is 12 bytes that includes 4 bytes Parser Info word, 4 bytes Elapsed time, and 4 bytes bus message data.
  - Bits [16:23]: message counter. This is a message counter that relates to the messages contained in the payload.
  - Bits [24:31]: Bus ID corresponds to the physical bus number on the module, that is from 0 to 7.
- Elapsed Time tag (4 bytes): time tag as an unsigned offset in nanoseconds that is added to the base PTP timestamp in the iNET-X header.
- Message (N x 4 bytes): captured bus traffic, padded if necessary to end on 4-byte boundary.

Example iNET-X parser-aligned packet format for ARINC-429

The KAD/ABM/102/EM1 is an 8-channel ARINC-429 bus monitor. Traffic captured on each of the ARINC-429 busses is placed in an iNET-X parser-aligned packet (see Figure 4 on page 592) where each bus has its own unique Stream ID. When Combined Packetization is selected, messages from all busses are placed in a single stream of packets, with a single stream ID. The bus ID field identifies on which bus a message was received.

As ARINC messages arrive, they are tagged with a 4-byte Parser Info word and a 4-byte Elapsed Time word, followed by the 4-byte ARINC message. The Parser Info word identifies properties of the ARINC-429 message (such as the message counter and the ID of the bus on which the message was received) and marks the health of the message using an error bit and an error code.

The PTP Timestamp in the iNET-X packet header is fixed when a packet is opened for writing and is used as the base timestamp for the whole packet. The PTP timestamp for each ARINC message in the packet can be calculated by adding the elapsed time to this base timestamp. Directly following the Elapsed Time field is the ARINC-429 message.

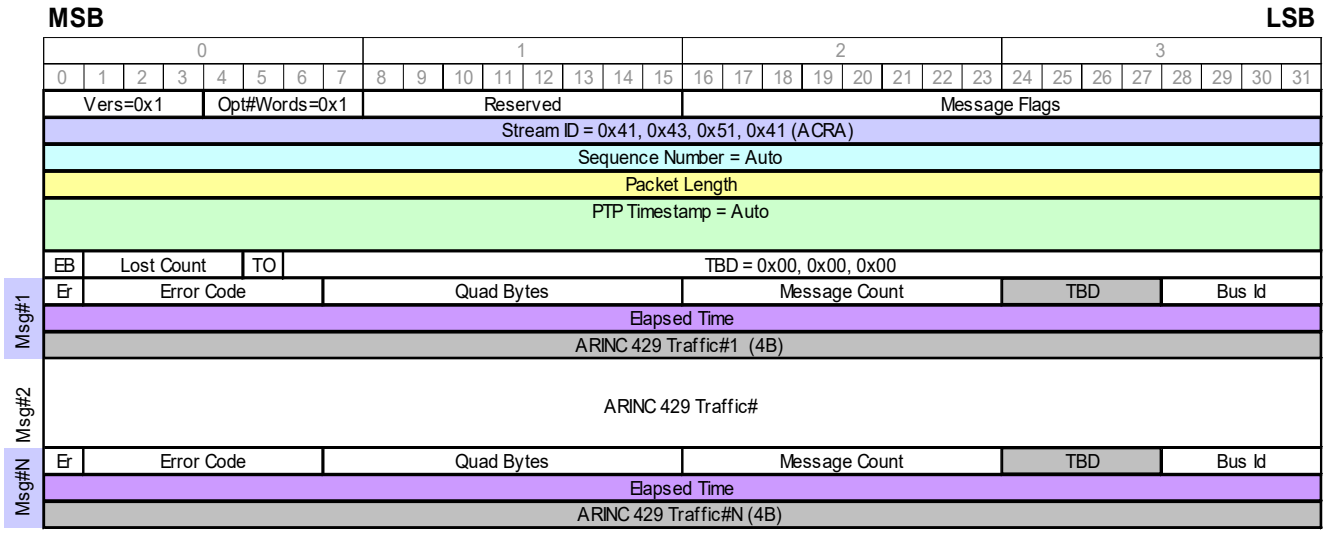


Figure 4: ARINC-429 iNET-X parser-aligned packet

For example, to facilitate real-time processing, the minimum payload size of an ARINC-429 packet is given as 1,008 bytes for a given default high-speed bus bit-rate of 100kbps, allowing for 84 ARINC 12-byte blocks to be carried in a single packet. This results in a maximum packet rate of 34 packets per second since the traffic on the bus may be asynchronous. The transmission properties for a 100kbps ARINC bus are summarized in the following table.

TABLE 4	MyARINC packet transmission properties
TRANSMISSION PROPERTY	VALUE
ARINC-429 packet payload size (bytes)	1,008 bytes (84 ARINC message blocks of 12 bytes per ARINC block)
Total Ethernet frame length (bytes)	1,082 bytes MAC header 14 bytes + IP 20 bytes + UDP 8 bytes + iNET-X 28 bytes + ARINC-429 data + MAC FCS 4 bytes
Packet rate (packets per second)	34
Total number of ARINC messages per packet	84 ARINC blocks
Total bit-rate (kbps)	294.3

Packetizer error codes for the KAD/ABM/102/EM1

An error in the incoming traffic is recorded by replacing the message data in the parser-aligned message with null data (32 zero bits) and setting the error bit and code in the iNET-X headers of the packet and the message. The error bit in the iNET-X packet header indicates that at least one of the parser blocks contains an error. The Most Significant Bit (MSB)—Er bit—of the errored

parser block's header is set, and can be used during post-processing, to filter/drop these error messages.

The following table lists the error codes that can occur in the Error Code field in the Parser Info word in the parser block.

TABLE 5	Error codes
CODE[1]	DESCRIPTION
0x0	Bad bit
0x1	Not enough bits in word
0x2	Too many bits in word
0x3	Reserved for future use
0x4	Parity error (if enabled)
0x5	Invalid label, SSM or SDI
0x6 to 0x3F	Reserved for future use

1. Error codes are in hexadecimal.

EM1 accumulator

The KAD/ABM/102/EM1 has the same functionality as the KAD/ABM/102/B, with the addition of a 48-bit accumulator. The accumulator is configured to measure fuel consumption. It does this by tracking a user-defined ARINC-429 message. The sixteen MSBs of the data from that message are looked up in an EEPROM table, which converts the fuel flow in pounds per hour to the amount of fuel used in kilograms. This is then added to the accumulator. The equation used is as follows:

Fuel consumed(n) = fuel consumed(n-1) + (fuel flow × (delta time/3600)).

Any of the eight ARINC 429 inputs can be included or excluded from the accumulator. However, if more than one bus is active all fuel flow messages must be at the same rate.

The accumulator is cleared to zero at power-up or if the ACC_RESET input is driven high (5V).

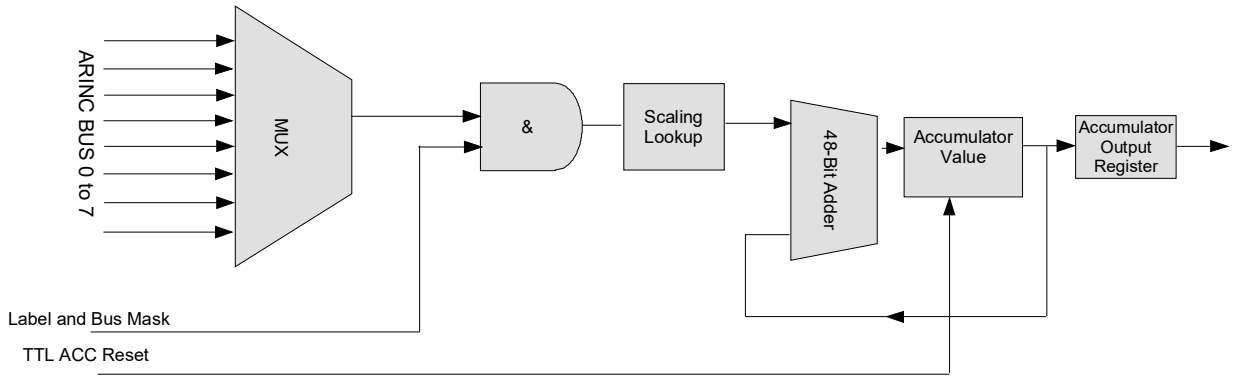


Figure 5: KAD/ABM/102/EM1 accumulator overview

Connector pinout of the KAD/ABM/102/EM1

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DATA(0)+	ARINC-429 inputs	ARINC-429 bus
2	DATA(0)-	ARINC-429 inputs	ARINC-429 bus
3	DATA(1)+	ARINC-429 inputs	ARINC-429 bus
4	DATA(1)-	ARINC-429 inputs	ARINC-429 bus
5	DATA(2)+	ARINC-429 inputs	ARINC-429 bus
6	DATA(2)-	ARINC-429 inputs	ARINC-429 bus
7	DATA(3)+	ARINC-429 inputs	ARINC-429 bus
8	DATA(3)-	ARINC-429 inputs	ARINC-429 bus
9	DATA(4)+	ARINC-429 inputs	ARINC-429 bus
10	DATA(4)-	ARINC-429 inputs	ARINC-429 bus
11	DATA(5)+	ARINC-429 inputs	ARINC-429 bus
12	DATA(5)-	ARINC-429 inputs	ARINC-429 bus
13	DATA(6)+	ARINC-429 inputs	ARINC-429 bus
14	DATA(6)-	ARINC-429 inputs	ARINC-429 bus
15	DATA(7)+	ARINC-429 inputs	ARINC-429 bus
16	DATA(7)-	ARINC-429 inputs	ARINC-429 bus
17	DNC		Do not connect
18	ACC_RESET	BTTL inputs	Internally pulled to low; resets the accumulator when pulled to BVDD
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	GND	Internal ground	
34	GND	Internal ground	
35	GND	Internal ground	
36	GND	Internal ground	
37	GND	Internal ground	
38	GND	Internal ground	
39	GND	Internal ground	
40	GND	Internal ground	
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/ABM/102/B/EM1	ARINC-429 bus monitor parser/packetizer/accumulator - 8ch

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ABM/102/B/EM1	First release	Recommended for new programs

Supporting software

MODULE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/006	ARINC-429
TEC/NOT/051	Ethernet frames, Wireshark® and FAT32
TEC/NOT/067	IENA and iNET-X packet payload formats

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ABM/103

ARINC-429 bus monitor parser/packetizer - 24ch

CURTISSWRIGHTDS.COM



Key Features

- Monitors up to 24 ARINC-429 busses
- Coherently parses traffic and tags for up to 8,191 messages
- Aperiodic transmission of packetized ARINC-429 messages including tags as iNET-X parser-aligned, IENA D Type, or IENA N Type payload structures per channel or per instrument
- Detects six types of errors
- Word counter for each bus

Applications

- ARINC-429 monitoring and recording

Overview

The KAD/ABM/103 is an ARINC-429 bus monitor which combines the capabilities of a coherent message parser with the flexibility of an iNET-X packetizer and an error-detection function, on a single module.

The parser parses up to 8,191 words and their associated time and status tags. Each message has a stale bit (word read before) and a skipped bit (buffer overwritten). Messages can be parsed based on their bus number, label, SDI and/or SSM fields.

Every ARINC-429 message received from each of the 24 busses is captured and packetized, along with time tags and a bus tag, with other received messages in a packetizer buffer. The packetizer contents can be assembled into Ethernet frames by an iNET-X controller or transmitter, for example a KAD/BCU/140, for transmission over Ethernet. The module can generate a single packet per input bus or packetize messages from all the active busses into a single packet stream.

To ensure efficient use of bandwidth, packets are only generated once a threshold amount has been stored (a maximum of 84 received messages are stored in each packet). Additionally, a programmable timeout ensures that smaller packets are generated even during periods of low activity on the bus, thereby allowing real-time analysis and processing of acquired messages. When there is no traffic, no packets are generated.

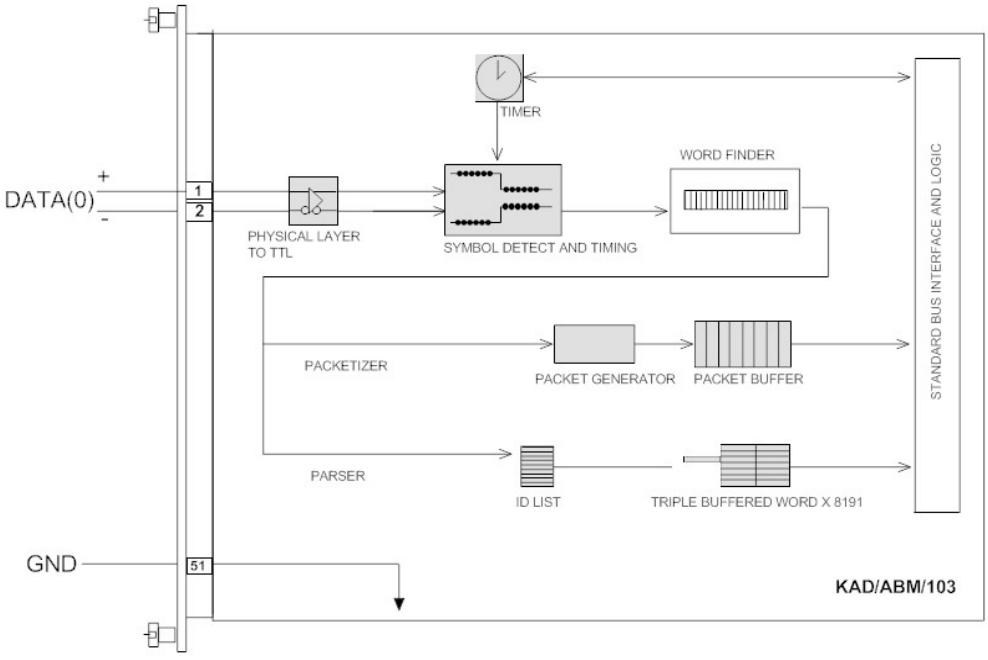


Figure 1: First of 24 parser/packetizers on the KAD/ABM/103

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	75	–	g	
	–	2.64	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	79	–	108	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	0.395	–	0.540	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	ARINC-429 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	24	–	
Signaling rate					
DATA	12.5	–	100	kbps	Signalling rate is either 12.5, 50 or 100kbps.
Operating range	-25	–	20	V	
logic ‘0’	-2.5	0	2.5	V	
logic ‘L’	-13	-10	-6.5	V	
logic ‘H’	6.5	10	13	V	

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Setting up the KAD/ABM/103

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ABM/103	KAD/ABM/103	The instrument part reference.
SerialNumber	AAA1234	AAA1234	Unique name for each module.
Settings	-	-	-
Packetization	Individual Combined	Individual	Packetization is set per channel or per instrument.
Settings *Setup*	-	-	-
Message Data Style	Style A Style B	Style A	Style B is the setup to transmit MessageDataStyleB. Style B is typically used when you want to transmit the ARINC parameter to a 12-bit fixed PCM.
Processes	-	-	-
Parser(8190:0)	-	-	Parser definitions.
Catchall-Parser	-	-	Parser definitions.
Channels	-	-	-
ARINC-429-In(23:0) *ARINC-429 Input*	-	-	ARINC-429 bus monitor channel configuration.
Settings *ARINC-429*	-	-	-
Rate Control	Auto-detect User specified Off	Auto-detect	Auto-detect: module detects bus speed automatically. User specified: restricts reception to specific bus rate. Off: no messages will be parsed or packetized from channel.
Bit Rate	100000 50000 12500	100000	Input bus bit rate. (Auto-detected bit rate sets to maximum to reserve backplane capacity for maximum rate.)
Parity Check	Odd Even Not checked	Not checked	Parity bit usage.
Settings *Packetizer*	-	-	-
Packetizer Format	iNET-X IENA IENA iNET-X Hybrid	iNET-X	Selects the packetizer header format for all channels.
Stream Id	00 to FFFFFFFF	FFFFFFFF	iNET-X stream identifier for selected channel if a packet is generated via the assertion of Packetization Enabled. This is a conditional setting and is only active when the Packetizer Format is set to iNET-X.
IENA Type	D N	N/A	Describes the IENA parameter type of the packet payload. This is a conditional setting and is active when the Packetizer Format is not set to IENA.
IENA Key	0 to FFFF	0	IENA Key for selected channel if a packet is generated via the assertion of Packetization Enabled. This is a conditional setting and is active when the Packetizer Format is not set to iNET-X.

SETUP DATA	CHOICE	DEFAULT	NOTES
Packetization Enabled	False	False	Enables the transmission of a packetizer packet containing the contents of this channel if a packetizer transmitter or memory module is present in the chassis.
Packet Size	200 to 511	511	Size of packet buffer in words.
Packet Timeout	10 to 999	50	Generates a packet when the oldest data recorded is this old (ms).
Utilization	0.00 to 1.00	1.00	The default of 1.0 should be used as it provides sufficient packets to carry all messages even when the bus is 100% active. Reducing Utilization schedules less packets for this bus, releasing backplane capacity for reading other modules. It should only be used when incoming message rates on the bus are known to be less than the maximum possible rate.
Packetization Sink	All Controller Only Slot 1 Slot 2 Slot 3 Slot 4 Slot 5 Slot 6 Slot 7 Slot 8 Slot 9 Slot 10 Slot 11 Slot 12 Slot 13 Slot 14 Slot 15	All	Selects which modules the packetizer package will be sent to for transmission or storage.
ARINC-429-In-Combined *ARINC-429 Input*	-	-	Single packetizer stream including all 24 ARINC-429 channels. Bus ID on each message identifies source bus.
Settings	-	-	-
Settings *Packetizer*	-	-	-
Packetizer Format	iNET-X IENA IENA iNET-X Hybrid	iNET-X	Selects the packetizer header format.
Stream Id	00 to FFFFFFFF	FFFFFFFF	iNET-X stream identifier for selected channel if a packet is generated via the assertion of Packetization Enabled. This is a conditional setting and is only active when the Packetizer Format is set to iNET-X.
IENA Type	D N	N/A	Describes the IENA parameter type of the packet payload. This is a conditional setting and is active when the Packetizer Format is not set to IENA.
IENA Key	0 to FFFF	0	IENA Key for selected channel if a packet is generated via the assertion of Packetization Enabled. This is a conditional setting and is active when the Packetizer Format is not set to iNET-X.

SETUP DATA	CHOICE	DEFAULT	NOTES
Packetization Enabled	True False	False	Enables the transmission of a packetizer packet containing the contents of this channel if a packetizer transmitter or memory module is present in the chassis.
Packet Size	200 to 511	511	Size of packet buffer in words.
Packet Timeout	10 to 999	50	Generates a packet when the oldest data recorded is this old (ms).
Utilization	0.00 to 1.00	1.00	Can be used to schedule less packets when incoming message rates are known to be less than maximum.
Packetization Sink	All Controller Only Slot 1 Slot 2 Slot 3 Slot 4 Slot 5 Slot 6 Slot 7 Slot 8 Slot 9 Slot 10 Slot 11 Slot 12 Slot 13 Slot 14 Slot 15	All	Selects the packetizer header format for all channels.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Report Reports the status of the module.	BitVector	BitVector	16	**R[15:0]** R(15) FreshError - An error occurred since last read. R[14:9] Reserved R[8:4] Bus - Indicates the bus the error occurred on. R[3:0] ErrorCode - Indicates the error that occurred last. When any error is detected, the corresponding message is not parsed (that is, error is flagged and message is lost). 0000: BadBit. 0001: NotEnoughBits. 0010: TooManyBits. 0011: BadGap. 0100: ParityError. 0101: Undefined Label, SSM or SDI (not supported in DAS Studio as all unparsed messages are passed to Catchall slot). 1000: Reset occurred since last read. (Report register initializes to 0008 after backplane reset or power on and stays at that value until changing to the new error code on the next valid error (with FreshError=1).)

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
ModuleWordCount Count of valid ARINC-429 messages received across all active channels. MessageCount in each parser slot stores the value of this counter as each message is stored.	BitVector	BitVector	16	R[15:0]
BusSpeedAll ARINC-429 bus speed for all 24 busses.	BitVector	BitVector	32	R[31:0]
BusSpeedHigh ARINC-429 bus speed for bus [23:26].	BitVector	BitVector	16	**R[31:16]** R[31:24] Reserved - Reserved. R(23) BusSpeed(23) - Bus Speed of Bus 23. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz) R(22) BusSpeed(22) - Bus Speed of Bus 22. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz) R(21) BusSpeed(21) - Bus Speed of Bus 21. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz) R(20) BusSpeed(20) - Bus Speed of Bus 20. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz) R(19) BusSpeed(19) - Bus Speed of Bus 19. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz) R(18) BusSpeed(18) - Bus Speed of Bus 18. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz) R(17) BusSpeed(17) - Bus Speed of Bus 17. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz) R(16) BusSpeed(16) - Bus Speed of Bus 16. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz)

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
BusSpeedLow ARINC-429 bus speed for bus [15:0].	BitVector	BitVector	16	**R[15:0]** R(15) BusSpeed(15) - Bus Speed of Bus 15. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz) R(14) BusSpeed(14) - Bus Speed of Bus 14. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz) R(13) BusSpeed(13) - Bus Speed of Bus 13. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz) R(12) BusSpeed(12) - Bus Speed of Bus 12. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz) R(11) BusSpeed(11) - Bus Speed of Bus 11. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz) R(10) BusSpeed(10) - Bus Speed of Bus 10. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz) R(9) BusSpeed(9) - Bus Speed of Bus 9. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz) R(8) BusSpeed(8) - Bus Speed of Bus 8. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz) R(7) BusSpeed(7) - Bus Speed of Bus 7. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz) R(6) BusSpeed(6) - Bus Speed of Bus 6. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz) R(5) BusSpeed(5) - Bus Speed of Bus 5. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz) R(4) BusSpeed(4) - Bus Speed of Bus 4. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz) R(3) BusSpeed(3) - Bus Speed of Bus 3. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz) R(2) BusSpeed(2) - Bus Speed of Bus 2. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz) R(1) BusSpeed(1) - Bus Speed of Bus 1. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz) R(0) BusSpeed(0) - Bus Speed of Bus 0. 0: High Speed Arinc-429 bus (100kHz) 1: Low Speed Arinc-429 bus (12.5kHz)

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
BusActiveAll ARINC-429 bus activity for all 24 busses.	BitVector	BitVector	32	R[31:0]
BusActiveHigh ARINC-429 bus activity of bus [23:16]. Logic 1 = message received in last second. 0 = no traffic in last second.	BitVector	BitVector	16	**R[31:16]** R[31:24] Reserved - Reserved. R[23:16] BusActivityHighBits -
BusActiveLow ARINC-429 bus activity of bus [15:0]. Logic 1 = message received in last second. 0 = no traffic in last second.	BitVector	BitVector	16	R[15:0]
TypeNumber Type number of the module	BitVector	BitVector	16	R[15:0]
Parser(8190:0) Parameters				
MessageCount A copy of WordCount when message was received.	Count	OffsetBinary	16	**R[15:0]** R[15:0] MessageCount
MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes time midway through first transmitted bit.	BitVector	BitVector	16	**R[47:32]** R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
MessageTimeLo Seconds and centiseconds time midway through first transmitted bit.	BitVector	BitVector	16	**R[31:16]** R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.
MessageTimeMicro Microsecond time midway through first transmitted bit.	Second	BCD	16	**R[15:0]** R[15:0] Microseconds - BCD Microseconds 0 to 9999.
Catchall-Parser Parameters				
MessageCount A copy of WordCount when message was received.	Count	OffsetBinary	16	R[15:0]
MessageDataStyleA SSM, Data, SDI, Parity and message info. Data style A is the default data format.	BitVector	BitVector	32	**R[31:0]** R[31:30] SSM - Sign/Status Matrix. R[29:11] Data - Data Word. R[10:9] SDI - Source Destination Identifier. R(8) Empty - This parser slot has not been written to yet. R(7) Stale - This parser slot has been read before. R(6) Skipped - This parser slot has been overwritten without being read. R[5:1] Bus - The bus the message was received on. R(0) Parity - The parity bit received.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageDataStyleB Parity, SSM, Data, Bus, SDI and message info.	BitVector	BitVector	32	**R[31:0]** R(31) Parity - The parity bit received. R[30:29] SSM - Sign/Status Matrix. R[28:20] Data[18:10] - Bits 18 to 10 of the Data Word. R[19:17] Bus - The bus the message was received on (3 least significant bits only). R(16) Reserved R[15:6] Data[9:0] - Bits 9 to 0 of the Data Word. R[5:4] SDI - Source Destination Identifier. R(3) Empty - This parser slot has not been written to yet. R(2) Stale - This parser slot has been read before. R(1) Skipped - This parser slot has been overwritten without being read. R(0) Reserved
MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes time midway through first transmitted bit.	BitVector	BitVector	16	**R[47:32]** R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
MessageTimeLo Seconds and centiseconds time midway through first transmitted bit.	BitVector	BitVector	16	**R[31:16]** R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.
MessageTimeMicro Microsecond time midway through first transmitted bit.	Second	BCD	16	**R[15:0]** R[15:0] Microseconds - BCD Microseconds 0 to 9999.
ARINC-429-In(23:0)Parameters				
WordCount Count of valid ARINC-429 messages received on the bus. Increases by 1 for each message received on the channel.	Count	OffsetBinary	16	R[15:0]

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ABM/103

For a detailed description on iNET-X packets, see *TEC/NOT/067 - IENA and iNET-X packet payload formats*.

Auto-detect rate

The KAD/ABM/103 automatically detects the bit rate used. The bit rate setting is only used by software to read the required number of packets from the packetizers.

KAD/ABM/103 Packet Formats

The KAD/ABM/103 can output packet payloads formatted for insertion into iNET-X or IENA systems.

iNET-X parser-aligned packet format

There is a diverse range of avionic bus technologies for which traffic may be captured, for example, MIL-STD-1553 or ARINC-429. The generalized iNET-X payload structure for parser-aligned packets is shown in the following figure.

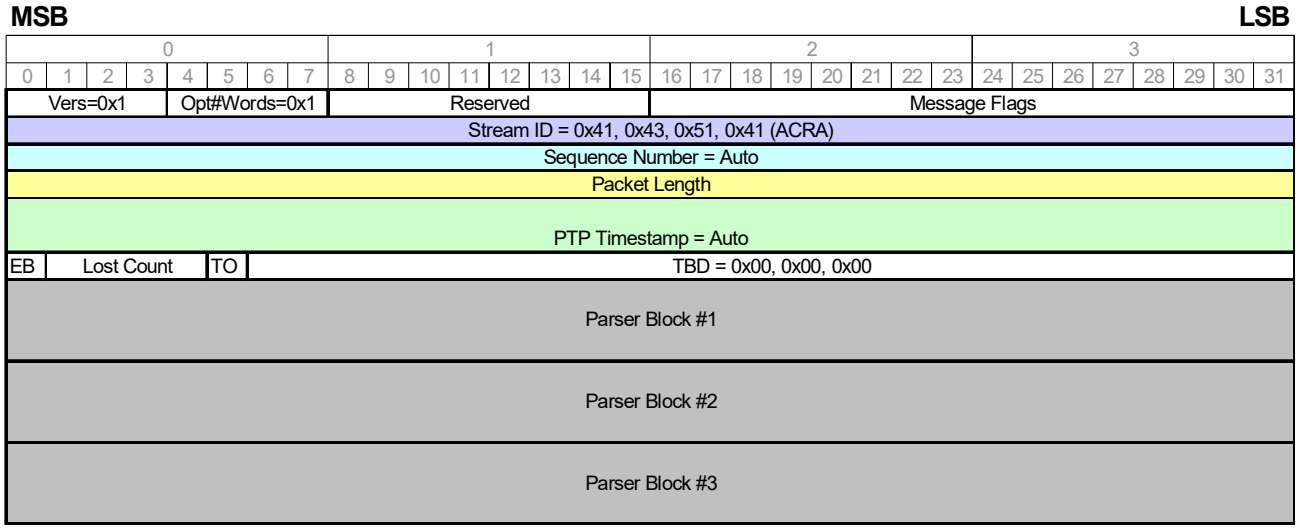


Figure 2: Generalized parser-aligned iNET-X packet

As messages are captured on the bus, they are formatted in a parser block. Each parser block begins with a 4-byte parser info word, followed by a 4-byte elapsed time tag and the message data shown in the following figure.

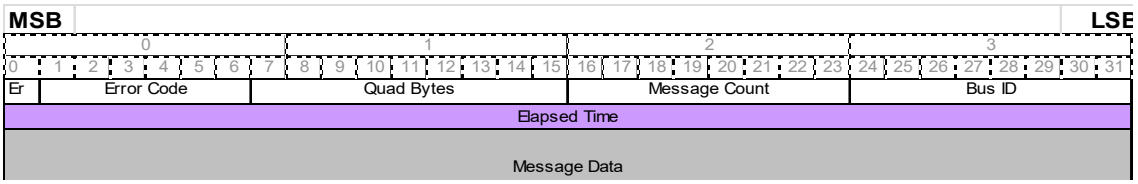


Figure 3: iNET-X parser block

A parser block consists of the following fields:

- Parser info word (4 bytes): metadata providing information about the health and status of the message.
  - Bit (0): indicates that an error occurred
  - Bits [1:6]: error codes
  - Bits [7:15]: number of quad bytes. This relates to the length of the parser info word, elapsed time tag, and the message data and padding (N x 4 bytes). For example, a 4-byte message captured from a given bus has a quad-byte value of 3, that is 12 bytes that includes 4 bytes parser information word, 4 bytes elapsed time, and 4 bytes bus message data.
  - Bits [16:23]: message counter. This is a message counter that relates to the messages contained in the payload. The message counter increments for each message contained in the packet payload and continues to increment across

consecutive packets. The message counter resets and wraps around to 0 once it has reached the maximum message count of 0xFF.

+ Bits [24:31]: Bus ID corresponds to the physical bus number on the module, that is from 0 to 23.

- Elapsed Time tag (4 bytes): time tag as an unsigned offset in nanoseconds that is added to the base PTP timestamp in the iNET-X header.
- Message (N x 4 bytes): captured bus traffic, padded if necessary to end on 4-byte boundary.

Example iNET-X parser-aligned packet format for ARINC-429 packetizer

The KAD/ABM/103 is a 24-channel ARINC-429 bus monitor. Traffic captured on each of the ARINC-429 busses is placed in an iNET-X parser-aligned packet (see Figure 4 on page 607) where each bus has its own unique stream ID.

When Combined Packetization is selected, messages from all busses are placed in a single stream of packets, with a single stream ID. The bus ID field identifies on which bus a message was received.

As ARINC messages arrive, they are tagged with a 4-byte parser information word and a 4-byte elapsed time word, followed by the 4-byte ARINC message. The parser information word identifies properties of the ARINC-429 message (such as the message counter and the ID of the bus on which the message was received) and marks the health of the message using an error bit and an error code.

The PTP timestamp in the iNET-X packet header is fixed when a packet is opened for writing and is used as the base timestamp for the whole packet. The PTP timestamp for each ARINC message in the packet can be calculated by adding the elapsed time to this base timestamp. Directly following the elapsed time field is the ARINC-429 message.

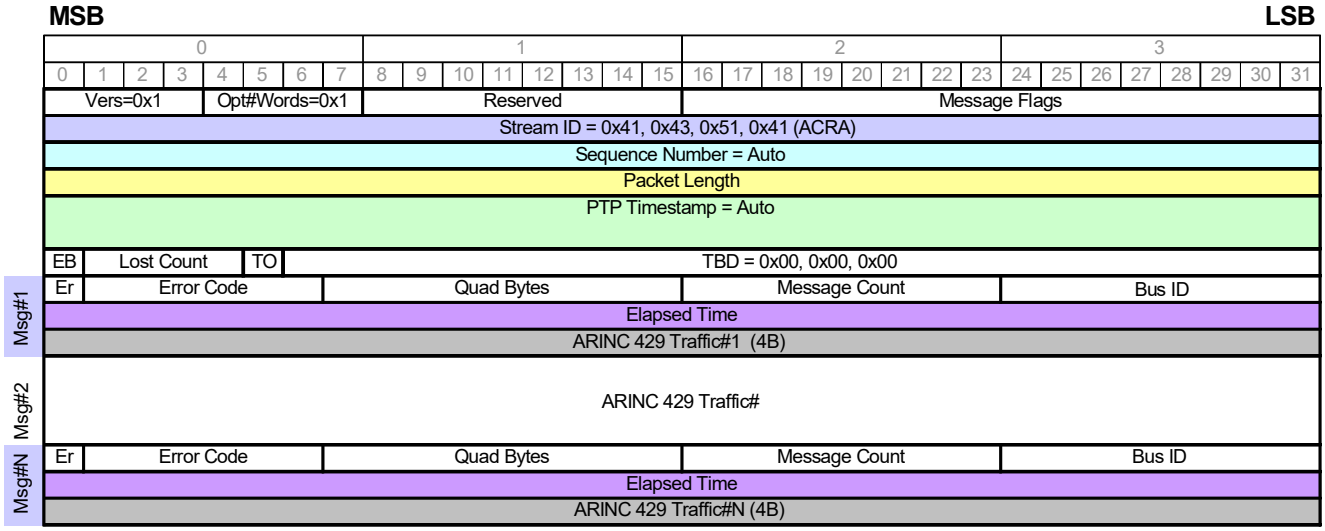


Figure 4: ARINC-429 iNET-X parser-aligned packet

For example, to facilitate real-time processing, the minimum payload size of an ARINC-429 packet is given as 1,008 bytes for a given default high-speed bus bit-rate of 100kbps, allowing for 84 ARINC 12-byte blocks to be carried in a single packet. This results in a maximum packet rate of 34 packets per second since the traffic on the bus may be asynchronous. The transmission properties for a 100kbps ARINC bus are summarized in the following table.

TABLE 3	MyARINC packet transmission properties
TRANSMISSION PROPERTY	VALUE
ARINC-429 packet payload size (bytes)	1,008 bytes (84 ARINC message blocks of 12 bytes per ARINC block)
Total Ethernet frame length (bytes)	1,082 bytes MAC header (14 bytes) + IP header (20 bytes) + UDP header (8 bytes) + iNET-X header (28 bytes) + ARINC-429 data (1008 bytes) + MAC Frame Check Sequence (FCS) (4 bytes)
Packet rate (packets per second)	34
Total number of ARINC messages per packet	84 ARINC blocks
Total bit-rate (kbps)	294.3

Packetizer error codes for the KAD/ABM/103

An error in the incoming traffic is recorded by replacing the message data in the parser-aligned message with null data (32 zero bits) and setting the error bit and code in the iNET-X headers of the packet and the message. The error bit in the iNET-X packet header indicates that at least one of the parser blocks contains an error. The Most Significant Bit (MSB)—Er bit—of the errored parser block's header is set, and can be used during post-processing, to filter/drop these error messages.

The following table lists the error codes that can occur in the error code field in the parser information word in the iNET-X parser block. The error codes reported match the codes that are also available in the module's Report Word.

TABLE 4	Error codes	
CODE[1]	REGISTER NAME	DESCRIPTION
0x0	BadBit	The gap between bits within the message is too short, too long, or an illegal bit is received (for example, simultaneous activity on both the True and False bit lines is an illegal condition).
0x1	NotEnoughBits	There is a gap large enough to be an inter-message gap before 32 valid data bits are seen.
0x2	TooManyBits	The inter-message gap is too small (for example, two messages run together so a 33rd bit is seen before a large enough gap) or spurious bit-like transitions occur on the line during a message, making it look like that is the case.
0x3	BadGap	The gap between messages is too short.
0x4	ParityError	Parity error (if enabled).
0x5 to 0x3F	Reserved for future use	

1. Error codes are in hexadecimal.

IENA

An IENA packet contains a standard IENA layer header and footer. Between these, the data field contains one or more parameters of a specified type. For the KAD/ABM/103 each ARINC-429 message can be formatted as either a D Type or N Type IENA parameter. In both cases, the 16-bit parameter ID for each parameter is composed by combining the bus ID (for channels 0 to 23) with the label and SDI fields from the received message. As shown in the following figure, these fields appear in the message from MSB to LSB in the order SDI[1:0], bus ID[4:0], and label[7:0]. The MSB is always equal to 0.

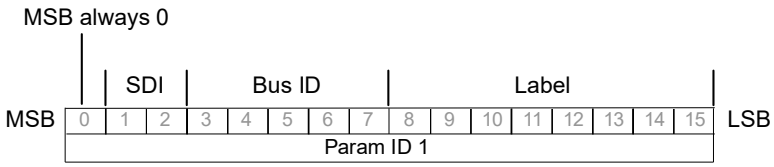


Figure 5: Parameter ID from received message

As shown in the following figure, D Type parameters consist of a 16-bit parameter ID, a 16-bit delay field, and the 32-bit ARINC-429 message. The delay field indicates the difference in microseconds between the timestamp in the IENA packet's header and the received timestamp for the specific message contained in the parameter. ARINC-429 messages use 8 bytes per N Type parameter.

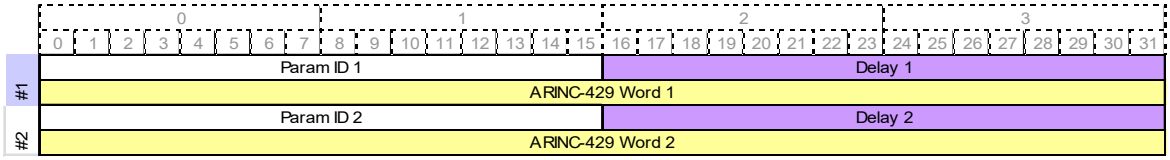


Figure 6: D Type IENA parameter for ARINC-429

As shown in the following figure, N Type parameters include the 16-bit parameter ID and the 32-bit message, but the delay field is omitted and the only timestamp is that of the packet, which relates to the first packetizer message. ARINC-429 messages use 6 bytes per N Type parameter.

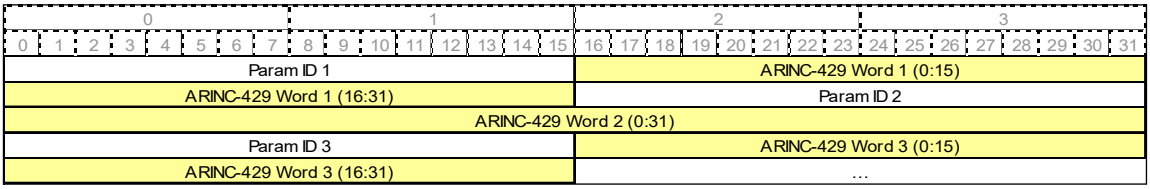


Figure 7: N Type IENA parameter for ARINC-429

MessageDataStyleB

For information on using MessageDataStyleB, contact Curtiss-Wright support (acra-support@curtisswright.com).

Connector pinout of the KAD/ABM/103

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DATA(0)+	ARINC-429 inputs	ARINC-429 bus
2	DATA(0)-	ARINC-429 inputs	ARINC-429 bus
3	DATA(1)+	ARINC-429 inputs	ARINC-429 bus
4	DATA(1)-	ARINC-429 inputs	ARINC-429 bus
5	DATA(2)+	ARINC-429 inputs	ARINC-429 bus
6	DATA(2)-	ARINC-429 inputs	ARINC-429 bus
7	DATA(3)+	ARINC-429 inputs	ARINC-429 bus
8	DATA(3)-	ARINC-429 inputs	ARINC-429 bus
9	DATA(4)+	ARINC-429 inputs	ARINC-429 bus
10	DATA(4)-	ARINC-429 inputs	ARINC-429 bus
11	DATA(5)+	ARINC-429 inputs	ARINC-429 bus
12	DATA(5)-	ARINC-429 inputs	ARINC-429 bus
13	DATA(6)+	ARINC-429 inputs	ARINC-429 bus
14	DATA(6)-	ARINC-429 inputs	ARINC-429 bus
15	DATA(7)+	ARINC-429 inputs	ARINC-429 bus
16	DATA(7)-	ARINC-429 inputs	ARINC-429 bus
17	DNC		Do not connect
18	DATA(8)+	ARINC-429 inputs	ARINC-429 bus
19	DATA(8)-	ARINC-429 inputs	ARINC-429 bus
20	DATA(9)+	ARINC-429 inputs	ARINC-429 bus
21	DATA(9)-	ARINC-429 inputs	ARINC-429 bus
22	DATA(10)+	ARINC-429 inputs	ARINC-429 bus
23	DATA(10)-	ARINC-429 inputs	ARINC-429 bus
24	DATA(11)+	ARINC-429 inputs	ARINC-429 bus
25	DATA(11)-	ARINC-429 inputs	ARINC-429 bus
26	DATA(12)+	ARINC-429 inputs	ARINC-429 bus
27	DATA(12-	ARINC-429 inputs	ARINC-429 bus
28	DATA(13)+	ARINC-429 inputs	ARINC-429 bus
29	DATA(13)-	ARINC-429 inputs	ARINC-429 bus
30	DATA(14)+	ARINC-429 inputs	ARINC-429 bus
31	DATA(14)-	ARINC-429 inputs	ARINC-429 bus
32	DATA(15)+	ARINC-429 inputs	ARINC-429 bus
33	DATA(15)-	ARINC-429 inputs	ARINC-429 bus
34	DATA(16)+	ARINC-429 inputs	ARINC-429 bus
35	DATA(16)-	ARINC-429 inputs	ARINC-429 bus
36	DNC		Do not connect
37	DATA(17)+	ARINC-429 inputs	ARINC-429 bus
38	DATA(17)-	ARINC-429 inputs	ARINC-429 bus
39	DATA(18)+	ARINC-429 inputs	ARINC-429 bus
40	DATA(18)-	ARINC-429 inputs	ARINC-429 bus
41	DATA(19)+	ARINC-429 inputs	ARINC-429 bus
42	DATA(19)-	ARINC-429 inputs	ARINC-429 bus
43	DATA(20)+	ARINC-429 inputs	ARINC-429 bus
44	DATA(20)-	ARINC-429 inputs	ARINC-429 bus
45	DATA(21)+	ARINC-429 inputs	ARINC-429 bus
46	DATA(21)-	ARINC-429 inputs	ARINC-429 bus
47	DATA(22)+	ARINC-429 inputs	ARINC-429 bus
48	DATA(22)-	ARINC-429 inputs	ARINC-429 bus
49	DATA(23)+	ARINC-429 inputs	ARINC-429 bus
50	DATA(23)-	ARINC-429 inputs	ARINC-429 bus
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/ABM/103	ARINC-429 bus monitor parser/packetizer - 24ch

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ABM/103	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/006	ARINC-429
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
TEC/NOT/051	TEC/NOT/051
TEC/NOT/067	IENA and iNET-X packet payload formats
TEC/NOT/086	Using the KAD/ABM/103

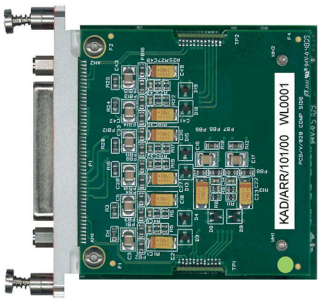
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ARR/101

ARINC 664 Part 7 (A664P7) redundancy remover - 1ch

CURTISSWRIGHTDS.COM



Key Features

- Single dual redundant A664P7 compatible interface using two IEEE 802.3u (100BaseTX) standard compatible Ethernet interfaces
- Supports up to 512 virtual links
- Filters redundant frames received within a 5ms window on the two A664P7 links; outputs exact copies of the non-redundant frames on the two output Ethernet interfaces
- Valid frame counters, error frame counters and discarded redundant frame counters
- Fixed latency through module

Applications

- Filtering of dually redundant A664P7 Ethernet network traffic

Overview

The KAD/ARR/101 is designed with two Ethernet network interfaces, which monitor network traffic on dually redundant A664P7 Ethernet links. The A664P7 redundancy remover captures frames on the two A664P7 links and performs error checking, such as Ethernet frame check sequence and the IP header checksum, on the received frames. Valid frames are buffered to facilitate filtering of redundant frames captured on the two A664P7 links.

Each A664P7 frame has a Virtual Link IDentifier (VLID) in the destination field and a sequence number, which increments by one with each frame. The first A664P7 frame on a virtual link received after reset/startup is sent to the redundancy remover. That VLID and Sequence Number (SN) are stored and any subsequent frame on that virtual link, with a sequence number equal to SN+1 or SN+2, is passed to the redundancy remover, and the new sequence number is stored. For any frames received on that virtual link with a sequence number not equal to SN+1 or SN+2, the new sequence number is stored but the frame is discarded.

Redundant copies are identified by having the same VLID and SN. The first A664P7 frame with a unique VLID and SN is sent directly to the output Ethernet interfaces. If another A664P7 frame with the same VLID and SN is received less than 5ms later, it is considered redundant and is not output. Should a redundant copy arrive in this time frame it is removed. The filtered frames are then output unchanged on two Ethernet network interfaces after a fixed latency.

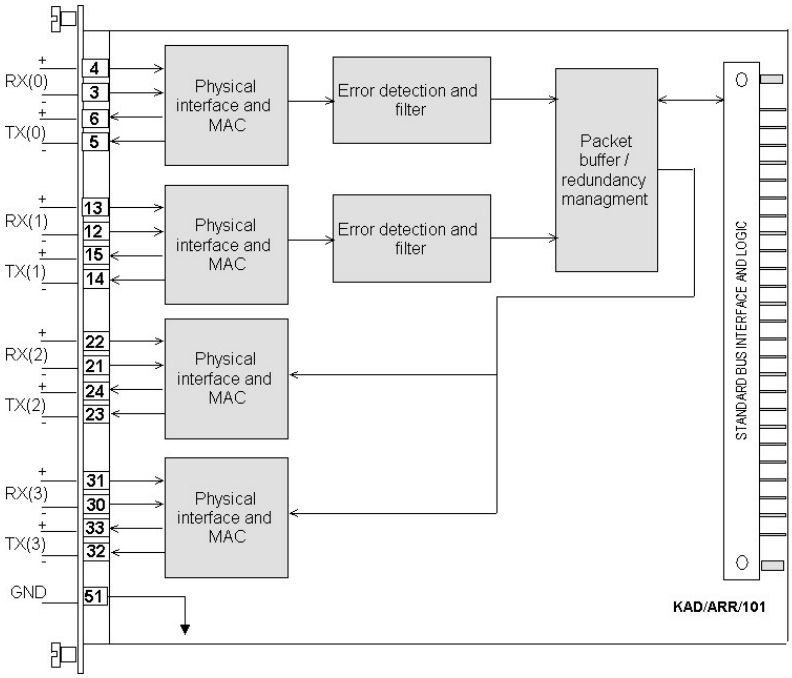


Figure 1: A664P7 redundancy remover

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under "Environmental ratings" in the "General specifications" table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	75	–	g	
	–	2.65	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the CON/KAD/002/CP data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	149	–	323	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	0.74	–	1.62	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Ethernet interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs/outputs	–	–	2	–	IEEE 802.3 compatible.

TABLE 3	A664P7 interface[1]				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs/outputs	–	–	1	–	Dual redundant A664P7 compatible.

1. The physical layer is two IEEE 802.3 redundant ports.

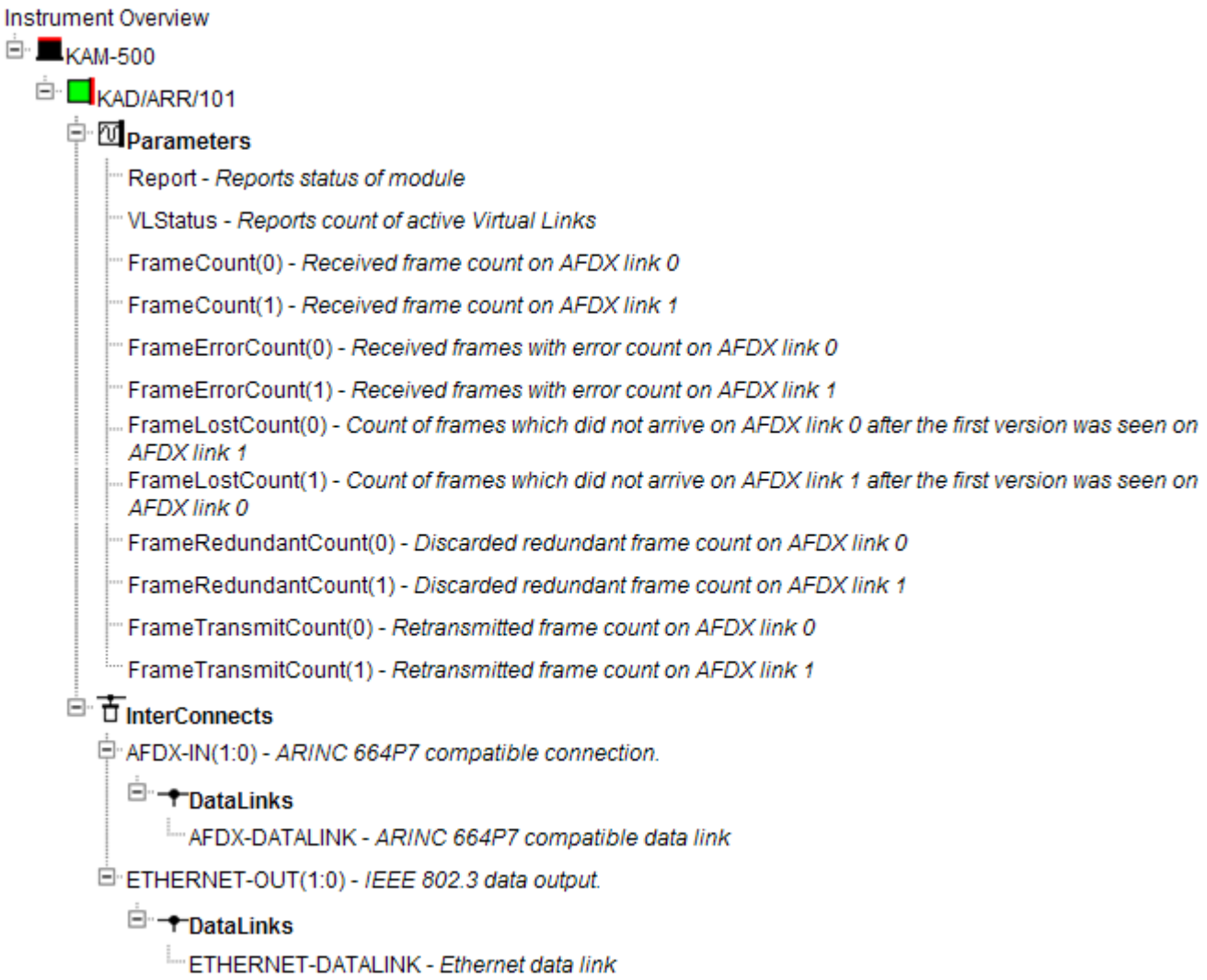
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Setting up the KAD/ARR/101

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

The following treeview provides an overview of setup configurations available for this module:

Treeview icons legend	
DAU: Data Acquisition Unit	Indicator: Indicates the firing of an event based on specific conditions
PC: Personal Computer	Parser slot: Area of memory reserved for storing parsed data
Instrument: Any component or module used in a data acquisition system	Snarfer: Captures all data transmitted on a bus and selectively stores it
DataLink: Connection for transmitting or receiving (defines both the data link and the physical layer)	Bridge: Electrical circuit usually used for measuring purposes
Package: Used to describe how data is transmitted or stored	PCMCIA card: Peripheral interface device usually for use in laptop computers
Parameter: Any register that can be read from an instrument	Multiplexer: Selects one of many input signals and outputs that signal on a signal line
Algorithm: Defines processing to be performed on data	Channels: Defines settings for input or output channels on an instrument
InterConnect: Represents a physical connection on an instrument	
PCI card: Circuit board that plugs into the PCI bus on a PC	



Setting up the module

The following table lists the setup configurations available for the KAD/ARR/101.

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ARR/101	KAD/ARR/101	ACRA CONTROL part number.
SerialNumber	-	-	Unique name for each module.
InterConnects			
AFDX-IN(1:0)	No character limit	Not Specified	A664P7 compatible connection.
ETHERNET-OUT(1:0)	No character limit	Not Specified	IEEE 802.3 data output.

Setting up parameters

Parameter definitions

The following table lists all parameters that are available for the KAD/ARR/101.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Report Reports status of module.	Unitless	BitVector	16	R[15:2] Reserved for future use. R(1) Error Code: 0 = no frames received on link 1 1 = no error R(0) Error Code: 0 = no frames received on link 0 1 = no error
VLStatus Reports count of active virtual links.	Unitless	BitVector	16	R(15) VL overflow: 0 = Normal operation, (count is valid) 1 = more than 512 unique virtual link IDs found since tracking started; redundancy removal not operational on additional virtual links. R[14:10] Reserved for future use. R[9:0] Count of virtual links being tracked (range 0-512 inclusive).
FrameCount(0) Received frame count on AFDX link 0.	Count	OffsetBinary	16	R[15:0] 0000:FFFF (hex)
FrameCount(1) Received frame count on AFDX link 1.	Count	OffsetBinary	16	R[15:0] 0000:FFFF (hex)
FrameErrorCount(0) Received frames with error count on AFDX link 0.	Count	OffsetBinary	16	R[15:0] 0000:FFFF (hex)
FrameErrorCount(1) Received frames with error count on AFDX link 1.	Count	OffsetBinary	16	R[15:0] 0000:FFFF (hex)
FrameLostCount(0) Count of frames which did not arrive on AFDX link 0 after the first version was seen on AFDX link 1.	Count	OffsetBinary	16	R[15:0] 0000:FFFF (hex)
FrameLostCount(1) Count of frames which did not arrive on AFDX link 1 after the first version was seen on AFDX link 0.	Count	OffsetBinary	16	R[15:0] 0000:FFFF (hex)
FrameRedundantCount(0) Discarded redundant frame count on AFDX link 0.	Count	OffsetBinary	16	R[15:0] 0000:FFFF (hex)
FrameRedundantCount(1) Discarded redundant frame count on AFDX link 1.	Count	OffsetBinary	16	R[15:0] 0000:FFFF (hex)
FrameTransmitCount(0) Retransmitted frame count on AFDX link 0.	Count	OffsetBinary	16	R[15:0] 0000:FFFF (hex)
FrameTransmitCount(1) Retransmitted frame count on AFDX link 1.	Count	OffsetBinary	16	R[15:0] 0000:FFFF (hex)

Setting up data links

A data link is a connection for transmitting and receiving data. It defines both the data link and physical layers of the link. The following are data links supported by the KAD/ARR/101.

Non-programmable data links

NAME	DESCRIPTION
AFDX-IN(1:0)	A664P7 compatible data link
ETHERNET-OUT(1:0)	Ethernet data link

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ARR/101

100BaseTX physical layer medium is defined as 100Ω Category 5 UTP cable.

Monitoring network traffic as an end system

The KAD/ARR/101 monitors true full-duplex traffic per link, in real-time. It receives only data sent from the A664P7 switches.

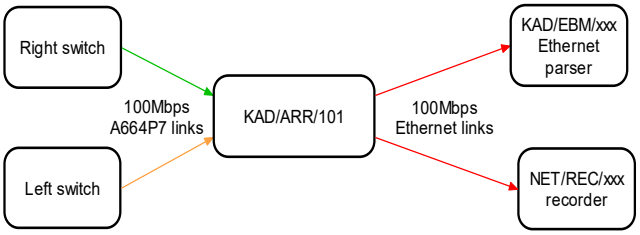


Figure 2: Ethernet monitoring as an end system

Monitoring network traffic via a hub

The KAD/ARR/101 can monitor traffic through a hub installed in one (or both) A664P7 links.

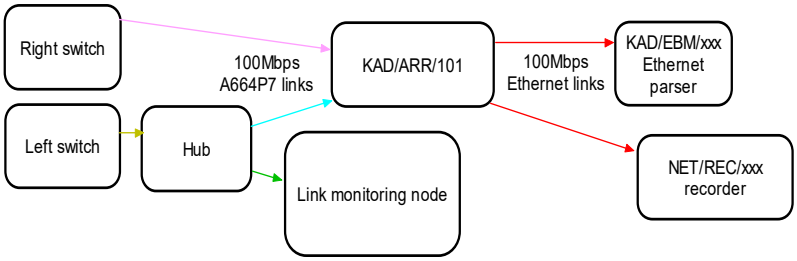


Figure 3: Ethernet monitoring via hub

KAD/ARR/101 limitations

The following is a summary of the KAD/ARR/101 module limitations:

- The module does not respond to Address Resolution Protocol (ARP) or PING on the two A664P7 links.
- The module does not respond to ARP or PING on the two Ethernet links.
- The two output Ethernet links should be connected directly to a KAD/EBM/xxx module and/or a NET/REC/xxx recorder. If a switch is used, it must be a NET/SWI/xxx or a KAD/SWI/xxx, and be configured for fixed 100Mbps operation. The module removes redundancy from the first 512 virtual links it detects. All frames from virtual links detected after the 512th virtual link are passed through. No redundancy removal is performed on frames from virtual links detected after the 512th virtual link.
- A combination of high data rate, a time skew between the input A664P7 links, and frame loss may cause non fixed latency through the module. In particular, where frames that should both be transmitted are received simultaneously on both input links, the first arriving packet is delayed by the fixed latency and the later packet is output immediately afterwards, respecting the inter-frame gap period.

Connector pinout of the KAD/ARR/101

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DNC		Do not connect
2	DNC		Do not connect
3	RX(0)-	A664P7 interface	Connection to A664P7 Network A
4	RX(0)+	A664P7 interface	Connection to A664P7 Network A
5	TX(0)-	A664P7 interface	Connection to A664P7 Network A
6	TX(0)+	A664P7 interface	Connection to A664P7 Network A
7	DNC		Do not connect
8	DNC		Do not connect
9	CHASSIS	Chassis	
10	DNC		Do not connect
11	DNC		Do not connect
12	RX(1)-	A664P7 interface	Connection to A664P7 Network B
13	RX(1)+	A664P7 interface	Connection to A664P7 Network B
14	TX(1)-	A664P7 interface	Connection to A664P7 Network B
15	TX(1)+	A664P7 interface	Connection to A664P7 Network B
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	RX(2)-	Ethernet interface	Ethernet output 1
22	RX(2)+	Ethernet interface	Ethernet output 1
23	TX(2)-	Ethernet interface	Ethernet output 1
24	TX(2)+	Ethernet interface	Ethernet output 1
25	DNC		Do not connect
26	DNC		Do not connect
27	CHASSIS	Chassis	
28	DNC		Do not connect
29	DNC		Do not connect
30	RX(3)-	Ethernet interface	Duplicate of Ethernet output 1
31	RX(3)+	Ethernet interface	Duplicate of Ethernet output 1
32	TX(3)-	Ethernet interface	Duplicate of Ethernet output 1
33	TX(3)+	Ethernet interface	Duplicate of Ethernet output 1
34	DNC		Do not connect
35	DNC		Do not connect
36	CHASSIS	Chassis	
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Not connected
48	DNC		Do not connect
49	DNC		Do not connect
50	CHASSIS	Chassis	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/ARR/101	ARINC 664 Part 7 (A664P7) redundancy remover - 1ch

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the Cables data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ARR/101	First release	Recommended for new programs

Supporting software

REVISION	DIFFERENCES
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

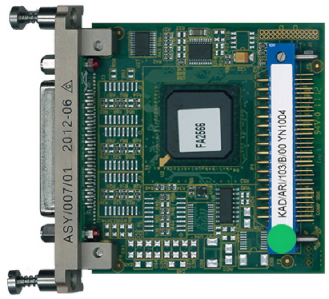
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KAD/ARI/103

ARINC-573/717 bus monitor parser - 1ch

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Key Features

- Monitors one ARINC-717 or ARINC-573 bus
- Coherently parses traffic and tags for up to 4096 12-bit words
- Detects sync and bits error
- Frame counter

Applications

- ARINC-717 and ARINC-573 DFDR bus monitoring

Overview

The KAD/ARI/103 is an ARINC-717 bus monitor that supports parsing of an ARINC-717 (DFDR) bus on a major frame level, with built in error detection on a single module. ARINC-717 is backwards compatible with ARINC-573, therefore ARINC-573 is also supported.

In the discussion below, traffic refers to words on the bus and tag refers to associated information such as info words.

The parser triple buffers up to 4096 12-bit words (4 sub-frames) and their associated tags as a frame. The status word that is buffered with each major frame indicates whether the frame has been read before (stale) or whether the message was overwritten before it was read (skipped), or whether the message has never been received (empty).

A valid frame is detected when all four sub frame sync words are received, each followed by 63, 127, 255, 511, or 1023 data words.

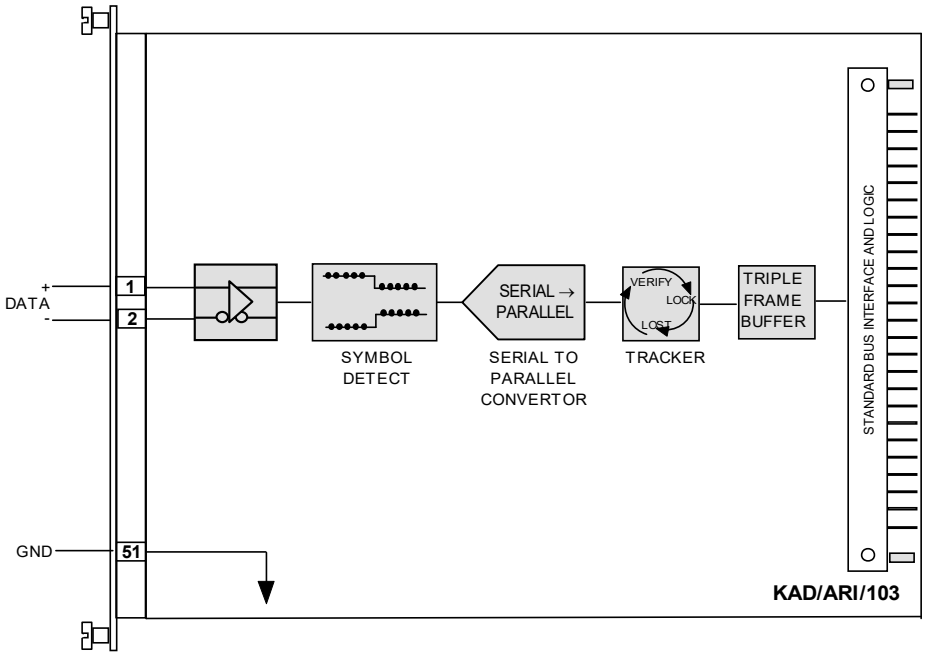


Figure 1: Internal block diagram for KAD/ARI/103 module

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	70	–	g	
	–	2.47	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	50	–	70	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	0.25	–	0.35	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	ARINC-717 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	1	–	ARINC-717 and ARINC-573 compatible.
Signaling rate					
DATA	768	–	12,288	bps	
Physical layer					
ARINC-573 and ARINC-717 compatible	–	–	–	–	

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TABLE 2	ARINC-717 inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Input voltage					
operating range	-25	–	25	V	Do not exceed operating range.
logic 0	–	–	0.2	V	(130mV hysteresis) V_{IN+} - V_{IN-}.
logic 1	0.2	–	–	V	(130mV hysteresis) V_{IN+} - V_{IN-}.
common mode voltage	-20	–	25	V	
overvoltage protection	-27	–	27	V	Voltage in excess of these values can damage input.
ESD protection	–	16	–	kV	Human Body Model.
Input resistance					
between inputs	24	–	–	kΩ	Module powered on.
between inputs	24	–	–	kΩ	Module powered off.
between inputs	–	120	–	Ω	Module powered on and inputs terminated.
between inputs	–	120	–	Ω	Module powered off and inputs terminated.
each input to GND	12	–	–	kΩ	Module powered on.
each input to GND	12	–	–	kΩ	Module powered off.

Setting up the KAD/ARI/103

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ARI/103/B	KAD/ARI/103/B	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Processes	-	-	-
Parser	-	-	-
Channels	-	-	-
ARINC-717-In ARINC-717 Input	-	-	Represents a typical ARINC-717 bus monitor channel configuration.
Settings	-	-	-
Major Frame Size	256 512 1024 2048 4096	256	The number of 12-bit words in each major frame, where there are 4 minor frames.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Parser Parameters				
FrameCount The count of valid ARINC-573/717 frames received when the frame is parsed.	Count	OffsetBinary	16	R[15:0] R[15:0] FrameCount
FrameData(4095:0) ARINC 573/717 frame data.	BitVector	BitVector	16	R[15:0] R[15:4] Data - ARINC 573/717 Data[11:0]. R[3:0] Reserved - Reserved for future use.
FrameInfo Stale/skipped indication for this received frame.	BitVector	BitVector	16	R[15:0] R(15) Empty - 1 indicates this parser slot is empty. R(14) Stale - 1 indicates this frame was read before. R(13) Skipped - 1 indicates this frame overwrote another. R[12:0] Reserved - Reserved for future use.
FrameIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
FrameTimeHi Hours and minutes time midway through first transmitted bit.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
FrameTimeLo Seconds and centiseconds time midway through first transmitted bit.	Second	BCD	16	R[31:16] R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.
FrameTimeMicro Microsecond time midway through first transmitted bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - BCD Microseconds 0 to 9999.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
ARINC-717-In Parameters				
Report Status of decommutator channel.	BitVector	BitVector	16	R[15:0] R(15) ErrorOnBus - Error received on the bus since last read. Note: In certain scenarios this bit can be set incorrectly. However, when this bit is set incorrectly, no data is lost. R(14) SyncWordReceived - Sync word received since last read. R(13) BusInLock - The bus is in lock. R[12:11] Reserved - Reserved for future use. R(10) NoSignal - No valid bits being received. R[9:8] ErrorCodes - Error codes. 00: Default - No errors 01: Bad bit 10: Sync word error 11: Reserved for future use R[7:5] Reserved - Reserved for future use. R[4:0] Reserved - Reserved for future use.

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ARI/103

If parameters are super-commutated, or samples of the same parameter appear in different sub-frames, they appear in different data registers.

Bit error detection in the KAD/ARI/103

The error detection circuit in the KAD/ARI/103 is sensitive to spurious electrical pulses, which may cause an illegal transition in an ARINC-717/573 bit, although the occurrence of these electrical pulses and illegal transitions is very rare. The bit is normally resolved to the correct state, however it is indicated in the module's report register as a bad bit. The KAD/ARI/103 drops only the major frame if an error occurs in one of the four minor frame sync words.

Connector pinout of the KAD/ARI/103

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DATA+	ARINC-717 inputs	ARINC-717 (DFDR) bus
2	DATA-	ARINC-717 inputs	ARINC-717 (DFDR) bus
3	DNC		Do not connect
4	DNC		Do not connect
5	DNC		Do not connect
6	DNC		Do not connect
7	DNC		Do not connect
8	DNC		Do not connect
9	DNC		Do not connect
10	DNC		Do not connect
11	DNC		Do not connect
12	DNC		Do not connect
13	DNC		Do not connect
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
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23	DNC		Do not connect
24	DNC		Do not connect
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29	DNC		Do not connect
30	DNC		Do not connect
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39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/ARI/103/B	ARINC-573/717 bus monitor parser - 1ch

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ARI/103/B	Added support for 1024 word minor frames (ARINC-717-15)	Recommended for new programs
KAD/ARI/103	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

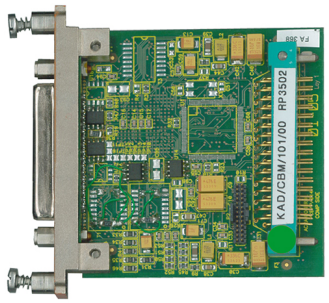
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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This document was reviewed on 21/1/2021 and does not contain technical data.

KAD/CBM/101

CCDL bus monitor parser - 4ch

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Key Features

- Parses 4 x 2.5MHz CCDL busses
- Coherently stores 32 traffic words per bus
- Adds stale, skipped and empty tags per message
- Adds message count and time tags per message
- Detects bit errors, and message length errors
- Features message counters on all four busses

Applications

- CCDL bus monitoring

Overview

The KAD/CBM/101 is a coherent CCDL bus monitor. It separately parses (triple buffers) data from four independent buses.

Each channel consists of a bit finder followed by a serial to parallel converter. After a valid preamble, 32 16-bit words with no bit errors, and a valid postamble the message is considered valid. Each valid message is then stored, along with the time the first bit of the preamble appeared and the message count for that channel. The message parser then waits for the next message.

Errors reported include bad bit after preamble and postamble not correct. In the event of an error message the parser will immediately start looking for the next preamble.

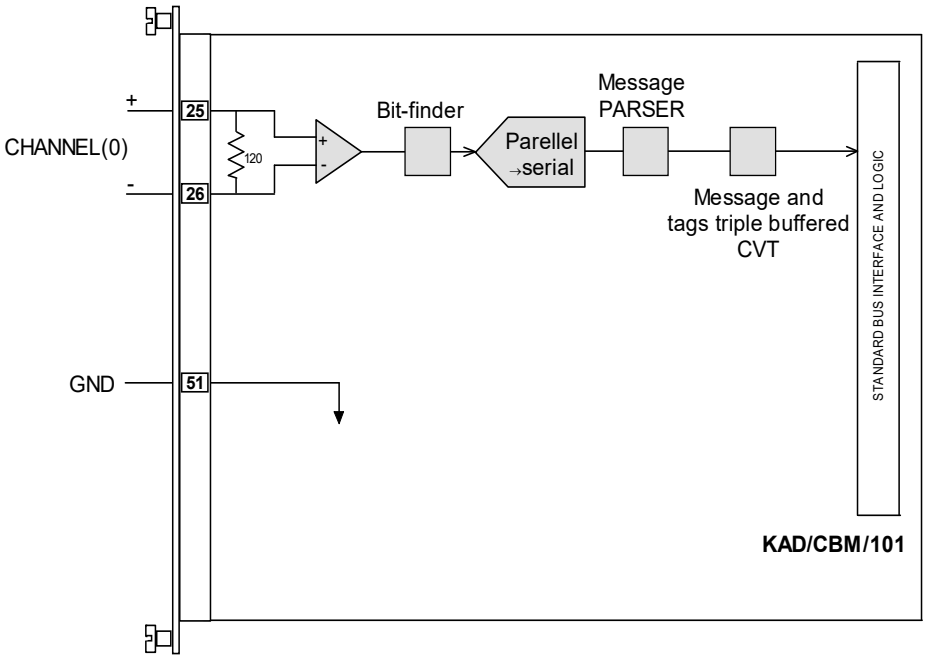


Figure 1: First of four independent CCDL parsers

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

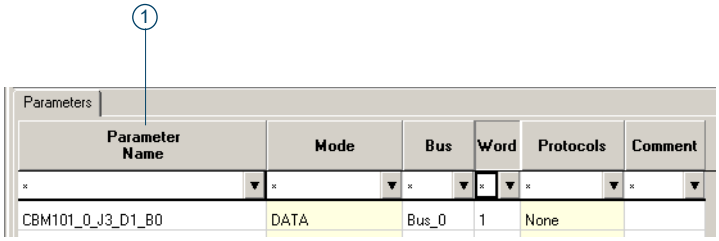
TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	70	–	g	
	–	2.47	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	71	–	73.3	mA	
+7V	0.8	–	0.8	mA	
-7V	3.21	–	3.28	mA	
+12V	2.6	–	2.68	mA	
-12V	3.7	–	3.92	mA	
total power	0.458	–	0.474	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

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TABLE 2	RS-422 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	4	–	
Signaling rate					
DATA	–	–	2.5	Mbps	
Input voltage					
operating range	-7	–	12	V	Do not exceed operating range.
logic 0	–	–	0.2	V	V_{IN+} - V_{IN-}
logic 1	0.2	–	–	V	V_{IN+} - V_{IN-}
common mode voltage	-7	–	12	V	
overvoltage protection	-7.5	–	12.5	V	Voltages outside of this range can damage input.
ESD protection	8	–	–	kV	Human Body Model.
Input resistance					
between inputs	–	120	–	Ω	Module powered on and inputs terminated.
between inputs	–	120	–	Ω	Module powered off and inputs terminated.
each input to GND	–	71	–	kΩ	Module powered on.
each input to GND	–	50	–	kΩ	Module powered off.

Setting up the KAD/CBM/101

Setting up Parameters

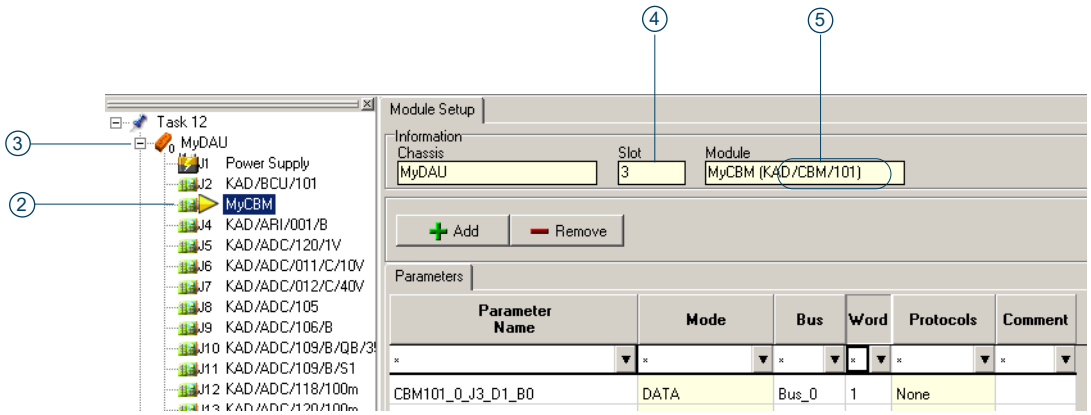



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       <RangeMaximum>500</RangeMaximum>
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 </ParameterTypeSet>
 <ParameterSet>
    <Parameter Name="LeftWingTemperature">
       <ParameterProperties>
          <ParameterTypeReference>MyTemperatureType</ParameterTypeReference>
       </ParameterProperties>
       <Source>
          <Package>
             <InstrumentReference>MyCCDLModule</InstrumentReference>
             <PackageReference>MyCCDLPackage</PackageReference>
1            <ParameterMap>CBM101_0_J3_D1_B0</ParameterMap>
          </Package>
       </Source>
       :
    </Parameter>
 </ParameterSet>
</Parameters>
:
```

	NAME	TYPE	RANGE	DEFAULT	MANDATORY	APPLIES TO	DESCRIPTION
1	ParameterMap	Name	N/A	N/A	No	Each module	The ParameterMap element can be used to specify a location in a package.

For brevity, some code has been removed from the above example, code not shown is indicated by ":"

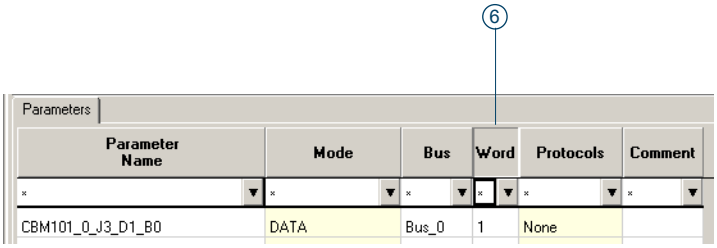
Setting up Instrumentation




```
:
<Instrumentation>
 <InstrumentSet>
    :
    <X-DAU-1.0 Name="MyDAU">
       <Manufacturer>
          <Name>ACRA CONTROL</Name>
          <PartReference>KAM/CHS/13U</PartReference>
       </Manufacturer>
    </X-DAU-1.0>
    :
(2) <X-Module-CCDL-1.0 Name="MyCBM">
       <Manufacturer>
          <Name>ACRA CONTROL</Name>
(5)       <PartReference>KAD/CBM/101</PartReference>
       </Manufacturer>
(3)    <Location>MyDAU</Location>
(4)    <SubLocation>3</SubLocation>
       <Interconnect>MyCCDLPackage</Interconnect>
    </X-Module-CCDL-1.0>
    :
 </InstrumentSet>
</Instrumentation>
:
```

	NAME	TYPE	RANGE	DEFAULT	MANDATORY	APPLIES TO	DESCRIPTION
(2)	InstrumentReference	Name	N/A	N/A	Yes	Each module	Name of module.
(3)	Location	Name	N/A	N/A	No	Each DAU	Name of DAU.
(4)	SubLocation	Number	N/A	N/A	No	Each module	The slot the module fits into. First user-module goes into slot 3.
(5)	PartReference	Selection	N/A	N/A	No	Each module	ACRA CONTROL part number.

Setting up Packages




```
:
<Packages>
 <PackageSet>
 :
    <X-CCDL-1.0 Name="MyCCDLPackage">
       <Synchronous>Yes</Synchronous>
       <PackagesPerAcquisitionCycle>2</PackagesPerAcquisitionCycle>
       <Content>
          <Parameter Name="P1">
             <Location>
                <Offset_Bits>0</Offset_Bits>
             </Location>
          </Parameter>
          :
       </Content>
    </X-CCDL-1.0>
    :
 </PackageSet>
</Packages>
:
```

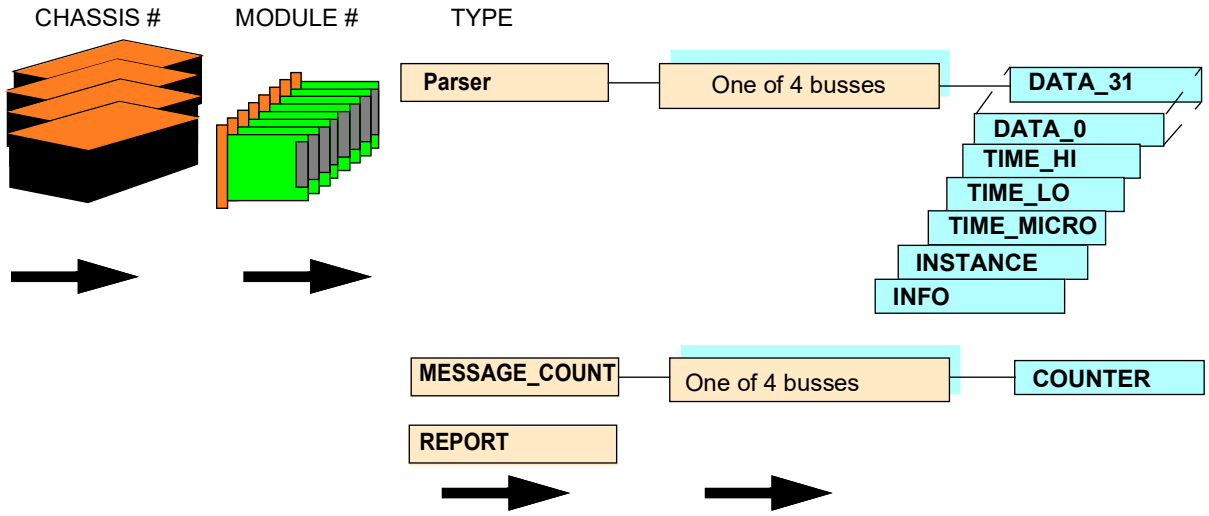
(6)

	NAME	TYPE	RANGE	DEFAULT	MANDATORY	APPLIES TO	DESCRIPTION	NOTES
(6)	Off-set_Bits	Integer	N/A	N/A	Yes	Each package	The location of a parameter in the package in terms of bits from beginning of the data stream	In the GUI this is set in units of 16-bit words, in XidML it is set in bits.

The field definition table explains the extracts shown opposite for the kSetup GUI and corresponding XidML task file for one channel of the KAD/CBM/101.

Output registers

The diagram shows the 153 registers that can be read from the KAD/CBM/101



REGISTER	BITS	DESCRIPTION	MSB
DATA_		Data word stored in parser; DATA_0 is first 16-bits, DATA_31 is last 16 bits	
	R[15:0]	Bits received (less preamble and post-amble bits), R(15) is FBR	R(15)
TIME_MICRO		Microsecond time at the time the start of message was detected	
	R[15:0]	BCD 0000-9999 microseconds	R(15)
TIME_LO		Seconds and centiseconds at the time the start of message was detected	
	R[15:0]	BCD 00.00-59.99 sec.	R(15)
TIME_HI		Hours and minutes at the time the start of message was detected	
	R[15:13]	Reserved for future use	
	R[12:7]	BCD 00-23 hours	R(12)
	R[6:0]	BCD 00-59 minutes	R(6)
INSTANCE		The message count when message is received	
INFO		Stale/skipped indication for this PARSED message	
	R(15)	1 indicates that this parser slot is empty	R(15)
	R(14)	1 indicates this message was read before	R(14)
	R(13)	1 indicates this message overwrote another	R(13)
	R[12:0]	Reserved for future use	
REPORT	R(15)	Error on Bus 3	R(15)
	R(14)	Reserved for future use	R(14)
	R[13:12]	See Error codes	R(13)
	R(11)	Error on Bus 2	R(11)
	R(10)	Reserved for future use	R(10)

REGISTER	BITS	DESCRIPTION	MSB
	R[9:8]	See Error codes	R(9)
	R(7)	Error on Bus 1	R(7)
	R(6)	Reserved for future use	R(6)
	R[5:4]	See Error codes	R(5)
	R(3)	Error on Bus 0	R(3)
	R(2)	Reserved for future use	R(2)
	R[1:0]	See Error codes	R(1)
COUNTER	R[15:0]	Message counter on one of the 4 busses	R(15)

FBR = First Bit Received
MSB = Most Significant Bit

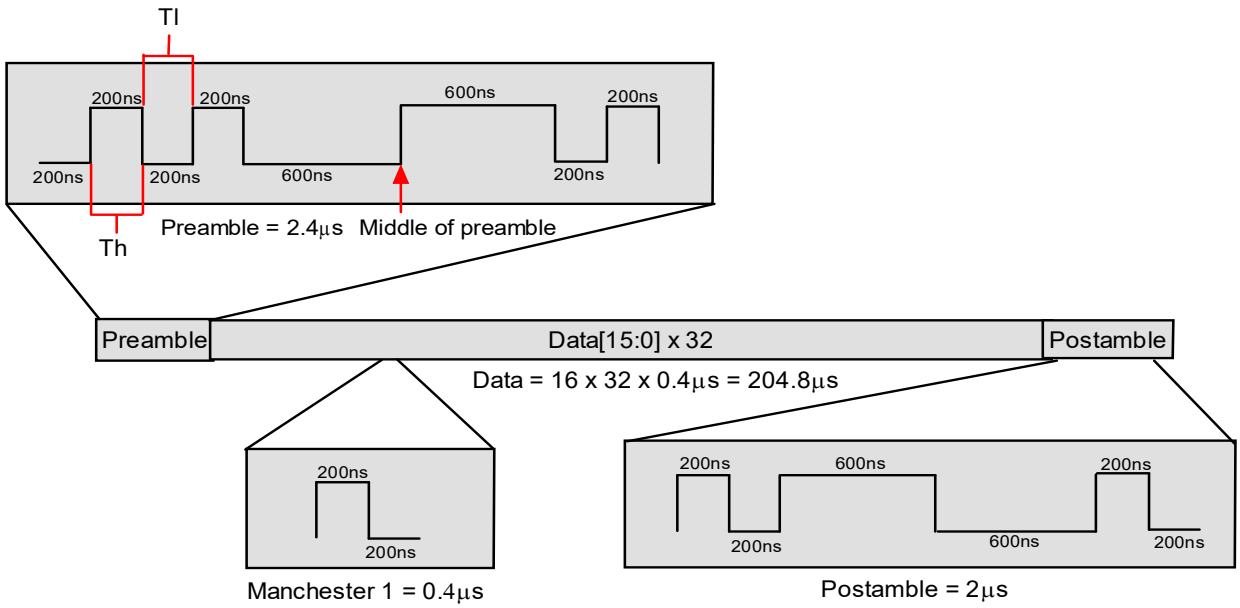
Error codes for the KAD/CBM/101

CODE[1]	DESCRIPTION	CODE	DESCRIPTION
00	Default value after power-up	10	Postamble not correct or message too long
01	Bad-bit after preamble	11	Reserved for future use

1. Error codes are in binary.

Getting the most from the KAD/CBM/101

Typically the report and counter words are only used for debug.



Th, Tl ≥180ns
Inter-message gap can be one of the following:
(a) Manchester encoded 1s or 0s
(b) High always, or low always, or tri-state

Figure 2: CCDL frame structure

Connector pinout of the KAD/CBM/101

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DNC		Do not connect
2	DNC		Do not connect
3	DNC		Do not connect
4	DNC		Do not connect
5	DNC		Do not connect
6	DNC		Do not connect
7	DNC		Do not connect
8	DNC		Do not connect
9	DNC		Do not connect
10	DNC		Do not connect
11	DNC		Do not connect
12	DNC		Do not connect
13	DNC		Do not connect
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	Channel(0)+	RS-422 inputs	D/E input, internally terminated with 120Ω
26	Channel(0)-	RS-422 inputs	D/E input, internally terminated with 120Ω
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	Channel(1)+	RS-422 inputs	D/E input, internally terminated with 120Ω
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	Channel(1)-	RS-422 inputs	D/E input, internally terminated with 120Ω
40	DNC		Do not connect
41	DNC		Do not connect
42	Channel(2)+	RS-422 inputs	D/E input, internally terminated with 120Ω
43	Channel(2)-	RS-422 inputs	D/E input, internally terminated with 120Ω
44	Channel(3)+	RS-422 inputs	D/E input, internally terminated with 120Ω
45	Channel(3)-	RS-422 inputs	D/E input, internally terminated with 120Ω
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	CHASSIS	KAM-500 chassis	
51	GND	KAM-500 internal ground	
52	CHASSIS	KAM-500 chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/CBM/101	CCDL bus monitor parser - 4ch (with 52-way double-density connector)
KAM/CBM/101	CCDL bus monitor parser - 4ch (with 51-way micro-miniature connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; ACC/CON/008/04 for KAM modules) is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/CBM/101 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/CBM/101	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

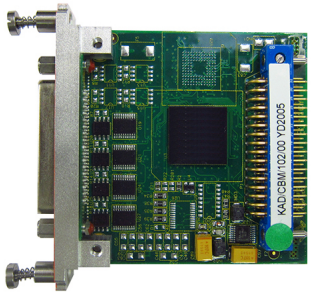
DOCUMENT	DETAILS
DOC/DBK/001	KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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KAD/CBM/102

CAN bus monitor parser - 4ch



Key Features

- Monitors up to four CAN2.0 A/B busses compliant with support for CAN aerospace message header
- Coherently parses traffic and tags for up to 126 messages per bus
- Programmable bit-rate per bus
- Data, remote, error and overload frame support
- Silent (monitors only, does not transmit or acknowledge)

Applications

- CAN bus monitor

Overview

The KAD/CBM/102 is a Controller Area Network (CAN) bus monitor which parses CAN bus traffic and tags each message for up to four CAN bus 2.0 A/B busses.

It combines a coherent message parser, message counter and error detection functions in a single module. In the following discussion, traffic refers to words on the bus (data, error and remote) and tags refer to associated information: microsecond time of start of frame bit transition, message count and errors.

The parser buffers up to 126 complete messages per bus and their associated tags in triple buffers. The Info tag associated with each message has a stale bit (message read before) a skipped bit (buffer overwritten) and an empty bit (no message received since power-up). MsgCnt increments on receipt of a valid message. The Report word has bits indicating that an error occurred and on which bus it occurred.

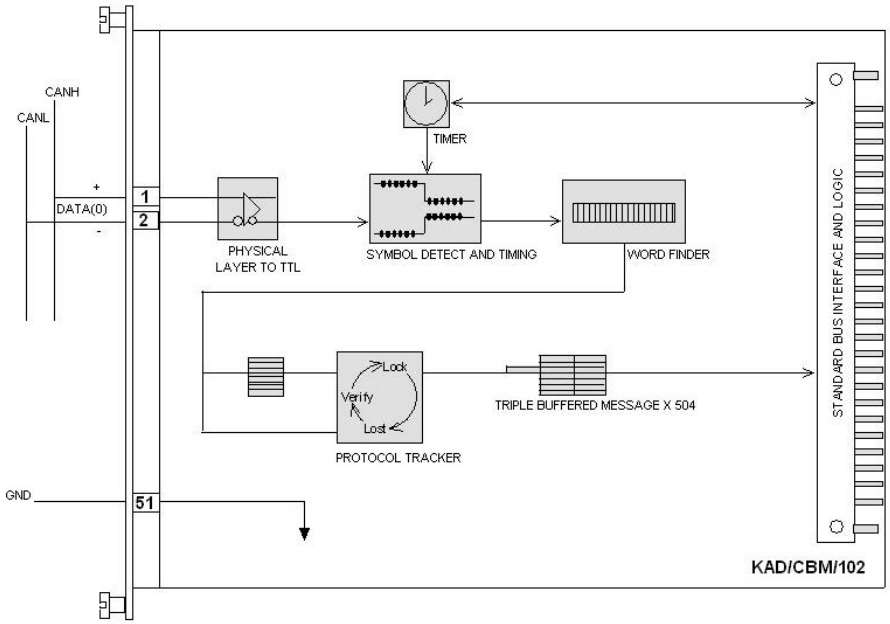


Figure 1: First of four independent busses

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
	–	66	–	g	
	–	2.33	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	75	–	105	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	0.38	–	0.53	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	CAN bus interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	4	–	CAN bus 2.0 A/B compatible.
Sampling rate					
DATA[3:0]±	–	–	1,000	kbps	
Physical layer					
CAN bus 2.0	0.02	–	1,000	kbps	
Supported baud rates	20	–	1,000	kbps	20, 50, 100, 125, 250, 500, 1,000

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Setting up the KAD/CBM/102

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/CBM/102	KAD/CBM/102	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Settings	-	-	-
Fill Value	0000 to FFFF	AAAA	Specifies a value that should be stored when the bus monitor is not receiving data.
Channels	-	-	-
CAN-In(3:0) CAN-Bus Input	-	-	-
Settings	-	-	-
Baud Rate	20000 50000 100000 125000 250000 500000 1000000	1000000	Specifies the number of symbols transmitted per second
Processes	-	-	-
Parser(125:0)	-	-	Parser slots on the module.
Catchall-Parser	-	-	All data not classified for parsing is captured in this parser slot

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Report Reports the status of the module	BitVector	BitVector	16	R[15:0] R(15) FreshError - Indicates fresh error R[14:4] Reserved - Reserved for future use R[3:0] Bus - Indicates the bus the error occurred on
Parser(125:0) Parameters				
MessageCount The current value of the message count for each parser slot since last reset/power-up.	Count	OffsetBinary	16	R[15:0]
MessageExtIdHi The Most Significant Bits (MSBs) of the extended identifier	BitVector	BitVector	16	R[15:0] R[15:0] EID[17:2]
MessageExtIdLo The Least Significant Bits (LSBs) of the extended identifier	BitVector	BitVector	16	R[15:0] R[15:14] EID[1:0] R[13:0] reserved
MessageInfo Stale/skipped indication for this PARSED message	BitVector	BitVector	16	R[15:0] R(15) Empty - ID is empty (no message received). R(14) Stale - 1 indicates this message was read before. R(13) Skipped - 1 indicates this message overwrote another R[12:0] Reserved - Reserved for future use.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageStdId The standard identifier.	BitVector	BitVector	16	R[15:0] R[15:5] STD ID - ID [10:0] R(4) SRR - SRR Standard frame remote transmit request bit R(3) IDE - IDE Extended identifier flag R[2:0] Reserved
MessageDLC Data Length Code for received message	BitVector	BitVector	16	R[15:0] R[15:12] DLC - Data length code. R[11:0] Reserved
MessageIrigTime48 48 bit wide IRIG time word	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes of the last bit in the message	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use R[12:7] Hours - BCD Hours 0 to 23 R[6:0] Minutes - BCD Minutes 0 to 59
MessageTimeLo Seconds and centiseconds of the last bit in the message	Second	BCD	16	R[31:16] R(15) Reserved - Reserved for future use R[14:8] Seconds - Seconds 0 to 59 R[7:0] Centiseconds - Centiseconds 0 to 99
MessageTimeMicro Microseconds of the last bit in the message	Second	BCD	16	R[15:0] R[15:0] Microseconds - Microseconds 0 to 9999
Catchall-Parser Parameters				
MessageCount The current value of the message count for each parser slot since last reset/power-up.	Count	OffsetBinary	16	R[15:0]
MessageExtIdHi The Most Significant Bits (MSBs) of the extended identifier	BitVector	BitVector	16	R[15:0] R[15:0] EID[17:2]
MessageExtIdLo The Least Significant Bits (LSBs) of the extended identifier	BitVector	BitVector	16	R[15:0] R[15:14] EID[1:0] R[12:0] reserved
MessageInfo Stale/skipped indication for this PARSED message	BitVector	BitVector	16	R[15:0] R(15) Empty - ID is empty (no message received). R(14) Stale - 1 indicates this message was read before. R(13) Skipped - 1 indicates this message overwrote another R[12:0] Reserved - Reserved for future use.
MessageStdId The standard identifier.	BitVector	BitVector	16	R[15:0] R[15:5] STD ID - ID [10:0] R(4) SRR - SRR Standard frame remote transmit request bit R(3) IDE - IDE Extended identifier flag R[2:0] Reserved
MessageDLC Data Length Code for received message	BitVector	BitVector	16	R[15:0] R[15:12] DLC - Data length code. R[11:0] Reserved
MessageIrigTime48 48 bit wide IRIG time word	BitVector	BitVector	48	R[47:0]

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageTimeHi Hours and minutes of the last bit in message	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use R[12:7] Hours - BCD Hours 0 to 23 R[6:0] Minutes - BCD Minutes 0 to 59
MessageTimeLo Seconds and centiseconds of the last bit in message	Second	BCD	16	R[31:16] R(15) Reserved - Reserved for future use R[14:8] Seconds - Seconds 0 to 59 R[7:0] Centiseconds - Centiseconds 0 to 99
MessageTimeMicro Microseconds of the last bit in message	Second	BCD	16	R[15:0] R[15:0] Microseconds - Microseconds 0 to 9999
MessagePayload(3:0) CAN message payload	BitVector	BitVector	16	R[15:0]

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following f i ve cha- acters "/><\.

Connector pinout of the KAD/CBM/102

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DATA(0)+	CAN bus interface	High level CAN bus (receive only)
2	DATA(0)-	CAN bus interface	Low level CAN bus (receive only)
3	DATA(1)+	CAN bus interface	High level CAN bus (receive only)
4	DATA(1)-	CAN bus interface	Low level CAN bus (receive only)
5	DATA(2)+	CAN bus interface	High level CAN bus (receive only)
6	DATA(2)-	CAN bus interface	Low level CAN bus (receive only)
7	DATA(3)+	CAN bus interface	High level CAN bus (receive only)
8	DATA(3)-	CAN bus interface	Low level CAN bus (receive only)
9	CHASSIS	Chassis	
10	CHASSIS	Chassis	
11	GND	Internal ground	
12	GND	Internal ground	
13	GND	Internal ground	
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	GND	Internal ground	
28	GND	Internal ground	
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/CBM/102	CAN bus monitor parser - 4ch (with 52-way double-density module top connector)
KAM/CBM/102	CAN bus monitor parser - 4ch (with 51-way micro-miniature module top connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; or ACC/CON/008/04 for KAM modules) is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet KAD/CBM/102 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/CBM/102	First release	Recommended for new programs

Supporting software

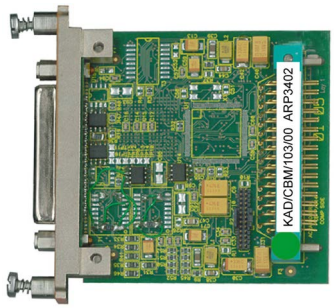
SOFTWARE	DIFFERENCES
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
TEC/NOT/056	Using the KAD/CBM/102

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This document was reviewed on 14/10/2020 and does not contain technical data.



Key Features

- Monitors up to four CCDL/MCDL busses
- Coherently parses traffic and tags for up to 127 messages per bus and one catchall buffer per bus
- Up to 65 bytes per message
- 16-bit content identifier covering header

Applications

- CCDL/MCDL bus monitors

Overview

The KAD/CBM/103 extracts valid CCDL/MCDL messages from incoming serial streams. It coherently extracts certain words from these messages and saves them to specified locations in the telemetry frames (parser). The KAD/CBM/103 parses CCDL/MCDL bus traffic and tags each message for up to four CCDL/MCDL busses. It combines a coherent message parser and a message counter with error detection functions in a single module.

In this data sheet, traffic refers to bytes on the bus and tags refer to associated information such as microsecond time of the last byte in the message, message count, and errors.

The parser triple buffers up to 127 unique complete messages per bus and their associated tags. The Info tag associated with each message has a stale bit (message read before) a skipped bit (buffer overwritten) and an empty bit (message was never received). MsgCnt increments on receipt of a valid message. The Report word contains bits which indicate an error has occurred, and on which bus it has occurred.

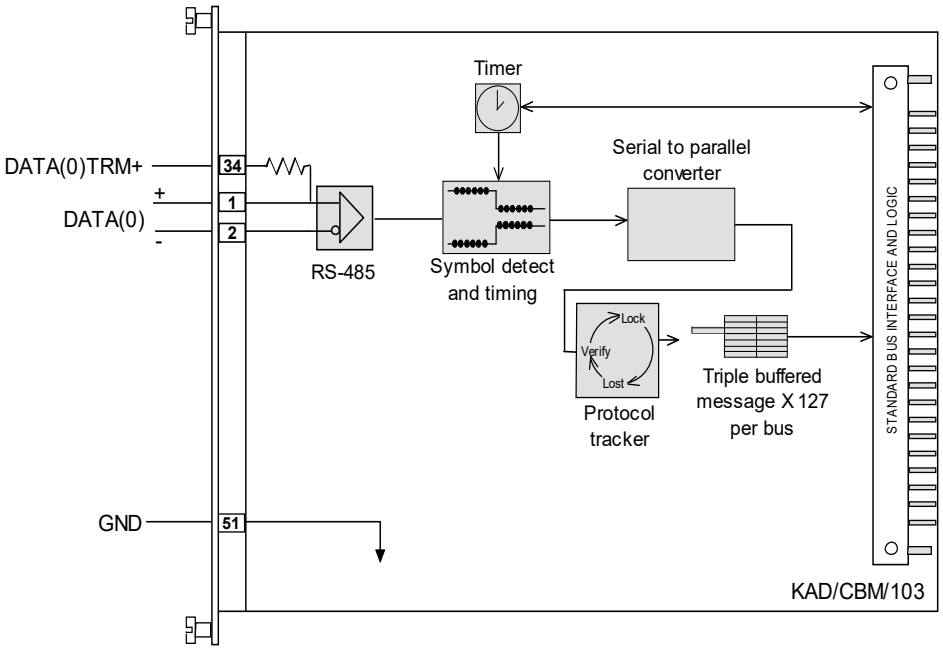


Figure 1: First of four independent CCDL parsers

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	66	–	g	
	–	2.32	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	100	–	165	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	0.5	–	0.83	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	CCDL/MCDL inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	4	–	
Signaling rate					
DATA[3:0]±	19.2	–	921.6	kbps	Four choices only: 19.2, 115.2, 460.8 and 921.6.
Input voltage					

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TABLE 2	CCDL/MCDL inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
operating range	-7	–	12	V	Do not exceed operating range.
logic 0	–	–	0.2	V	(130mV hysteresis) V_{IN+} - V_{IN-}.
logic 1	0.2	–	–	V	(130mV hysteresis) V_{IN+} - V_{IN-}.
common mode voltage	-7	–	12	V	
overvoltage protection	-60	–	60	V	Voltages outside of this range can damage input.
ESD protection	15			kV	Human Body Model.
Input resistance					
between inputs	24	–	–	kΩ	Module powered on.
between inputs	24	–	–	kΩ	Module powered off.
between inputs	–	124	–	Ω	Module powered on and inputs terminated.
between inputs	–	124	–	Ω	Module powered off and inputs terminated.
each input to GND	12	–	–	kΩ	Module powered on.
each input to GND	12	–	–	kΩ	Module powered off.

Setting up the KAD/CBM/103

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

The following treeview provides an overview of setup configurations available for this module:

Treeview icons legend	
DAU: Data Acquisition Unit	Indicator: Indicates the firing of an event based on specific conditions
PC: Personal Computer	Parser slot: Area of memory reserved for storing parsed data
Instrument: Any component or module used in a data acquisition system	Snarfer: Captures all data transmitted on a bus and selectively stores it
DataLink: Connection for transmitting or receiving (defines both the data link and the physical layer)	Bridge: Electrical circuit usually used for measuring purposes
Package: Used to describe how data is transmitted or stored	PCMCIA card: Peripheral interface device usually for use in laptop computers
Parameter: Any register that can be read from an instrument	Multiplexer: Selects one of many input signals and outputs that signal on a signal line
Algorithm: Defines processing to be performed on data	Channels: Defines settings for input or output channels on an instrument
InterConnect: Represents a physical connection on an instrument	
PCI card: Circuit board that plugs into the PCI bus on a PC	

Instrument Overview

- KAM-500
  - KAD/CBM/103
    - **Parameters**
      - ReadCounter - *Increments on each read.*
      - Report - *Indicates the status of the monitor.*
    - **ParserSlots**
      - Parser(126:0) - *CCDL/MCDL message PARSER, parses up to 127 unique messages per bus.*
        - **Parameters**
          - MessageTimeHi - *Hours and minutes time of the last byte in the message.*
          - MessageTimeLo - *Seconds and centiseconds time of the start of the last byte in the message.*
          - MessageTimeMicro - *Microsecond time of the start of the last character in the message.*
          - MessageCounter - *The current value of the frame count for each bus.*
          - MessageSize - *The number of bytes in the message, including header and checksum.*
          - MessageInfo - *Stale/skipped indication for this parsed message.*
        - **Packages**
          - ClassifiedNetworkPackages - *CCDL/MCDL package containing acquisition data to be received.*
            - **Parameters**
              - MessageData - *Received data N.*
      - Catchall-Parser(3:0) - *CCDL/MCDL catchall message PARSERs.*
        - **Parameters**
          - MessageTimeHi - *Hours and minutes time of the last byte in the message.*
          - MessageTimeLo - *Seconds and centiseconds time of the start of the last byte in the message.*
          - MessageTimeMicro - *Microsecond time of the start of the last character in the message.*
          - MessageCounter - *The current value of the frame count for each bus.*
          - MessageSize - *The number of bytes in the message, including header and checksum.*
          - MessageInfo - *Stale/skipped indication for this parsed message.*
        - **Packages**
          - CatchAllPackage - *CCDL/MCDL catchall package definition.*
            - **Parameters**
              - MessageData - *Received data N.*
    - **InterConnects**
      - Channel(3:0) - *Connection between the module channel and the CCDL data bus.*
        - **DataLinks**
          - ChannelDataLink - *CCDL/MCDL data link.*
            - **Packages**
              - ClassifiedNetworkPackages - *CCDL/MCDL package containing acquisition data to be received.*
                - **Parameters**
                  - MessageData - *Received data N.*
              - CatchAllPackage - *CCDL/MCDL catchall package definition.*
                - **Parameters**
                  - MessageData - *Received data N.*

Setting up the module

The following table lists the setup configurations available for the KAD/CBM/103.

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/CBM/103	KAD/CBM/103	ACRA CONTROL part number.
SerialNumber	-	-	Unique name for each module.
InterConnects Channel(3:0)	No character limit	Not Specified	Connection between the module channel and the CCDL data bus.
Settings	-	-	-
Module-Parser-1.0	-	-	-
PackageBuffers	-	-	-
PackageBuffer Parser(126:0)	-	-	CCDL/MCDL message parser, parses up to 127 unique messages per bus.
PackageReference	No character limit	Not Specified	-
PackageBuffer Catchall-Parser(3:0)	-	-	CCDL/MCDL catchall message parsers.
PackageReference	No character limit	Not Specified	-
Other	-	-	-

Setting up parameters

Parameter definitions

The following table lists all parameters that are available for the KAD/CBM/103.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
ReadCounter Increments on each read.	Unitless	OffsetBinary	16	R[15:0] Increments on each read.
Report Indicates the status of the monitor.	Unitless	BitVector	16	R(15) 1 indicates an error occurred since last read. R[14:8] Reserved for future use. R[7:4] Indicates the bus the error occurred on. R[3:0] Error code. 0 - No error. 1 - Bit error. 3 - Length error.
MessageTimeHi Hours and minutes time of the start of the last byte in the message.	Unitless	BitVector	16	R[15:13] Reserved for future use. R[12:7] BCD 00-23 hours. R[6:0] BCD 00-59 minutes.
MessageTimeLo Seconds and centiseconds time of the start of the last byte in the message.	Second	BCD	16	R[15:0] BCD 00.00-59.99 seconds.
MessageTimeMicro Microsecond time of the start of the last character in the message.	Second	BCD	16	R[15:0] BCD 0000-9999 microseconds.
MessageCounter The current value of the frame count for each bus.	Count	OffsetBinary	16	R[15:0] 0000-FFFF.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageSize The number of bytes in the message, including header and checksum.	Unitless	OffsetBinary	16	R[15:7] Reserved for future use. R[6:0] The number of bytes in the message. 0x0000 not allowed. 0x0003 three bytes (minimum). 0x0041 65 bytes (maximum).
MessageInfo Stale/skipped indication for this parsed message.	Unitless	BitVector	16	R(15) ID is empty (no message received). R(14) 1 indicates STALE (this message was read before). R(13) 1 indicates SKIPPED (this message overwrote another). R[12:0] Reserved for future use.
MessageData Received data N.	Unitless	OffsetBinary	16	R[15:8] The eight bits of byte 2*N+1 in serial stream. R[7:0] The eight bits of byte 2*N in serial stream. Where N is message word index (zero-based)

Setting up data links

A data link is a connection for transmitting and receiving data. It defines both the data link and physical layers of the link.
The following are data links supported by the KAD/CBM/103.

Non-programmable data links

NAME	DESCRIPTION
Channel(3:0)	CCDL/MCDL data link.

Setting up packages

A package is a logical description of how data is transmitted or stored.

ClassifiedNetworkPackages

CCDL/MCDL package containing acquisition data to be received.

SETUP DATA	CHOICE	DEFAULT	NOTES
ReferencedToAbsoluteTime	-	-	-
PackageRate	-	-	-
DataLinkReference	No character limit	Not Specified	-
Properties	-	-	-
HashBinary	-	-	HashBinary is used to specify values to be found at the classification offset.
Value	-	-	This is a 16-bit binary value used for packet classification. Its context is defined by its sibling OffsetIndex_Bytes.
OffsetIndex_Bytes	0:0	Not Specified	This element sets the context for packet classification.
Content	-	-	-
Parameter	-	-	-
Location	-	-	-
Offset_Bytes	66:0	Not Specified	-

CatchAllPackage

CCDL/MCDL catchall package definition.

SETUP DATA	CHOICE	DEFAULT	NOTES
ReferencedToAbsoluteTime	-	-	-
PackageRate	-	-	-
DataLinkReference	No character limit	Not Specified	-
Properties	-	-	-
HashBinary	-	-	HashBinary is used to specify values to be found at the classification offset. However, as this is a catchall package definition the hash binary value will be fixed.
Value	********	********	This wildcard value is fixed for the catchall package definition.
OffsetIndex_Bytes	0:0	Not Specified	This element sets the context for packet classification.
Content	-	-	-
Parameter	-	-	-
Location	-	-	-
Offset_Bytes	66:0	Not Specified	-

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/CBM/103

Parser

The KAD/CBM/103 can parse up to 127 messages per bus into individual slots.

The CCDL/MCDL message structure is shown in the following figure. Messages are separated by gaps (minimum 11 null bits); bytes within messages are transmitted without gaps.

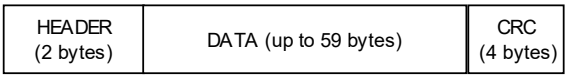


Figure 2: Message structure

The header shown in the previous figure is described in the following table.

TABLE 3	Message structure header description		
BITS 15-11 (MSB)	BIT 10	BITS 9-6	BITS 5-0 (LSB)
Master ID (5 bits)	Master/Slave (1 bit)	Message Freshness (4 bits)	Number of Data Bytes (6 bits)

The byte structure is shown in the following figure. It is the same as the byte definition used in the RS-232 communication protocol.

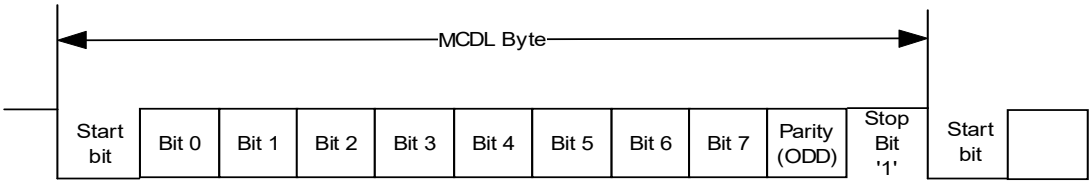


Figure 3: Byte structure

NOTE: Currently, four baud rates are supported: 921.6kbps; 460.8kbps; 115.2kbps; and 19.2kbps. For more information, contact Curtiss-Wright support (acra-support@curtisswright.com).

The KAD/CBM/103 also has four catchall slots reserved for each bus. In order to keep coherency, each slot is triple buffered. If messages arrive faster than the backplane controller (BCU) can read them, a skipped bit indicates that a message has been missed. If messages arrive slower than the rate at which the BCU is reading, a stale bit indicates that the same message has been read before. Each message is individually timestamped and counted.

Messages are individually identified by a 16-bit Content Identifier (CI), which covers the first two bytes of each message.

Connector pinout of the KAD/CBM/103

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DATA(0)+	CCDL/MCDL inputs	High level CCDL/MCDL bus (receive only)
2	DATA(0)-	CCDL/MCDL inputs	Low level CCDL/MCDL bus (receive only)
3	DATA(1)+	CCDL/MCDL inputs	High level CCDL/MCDL bus (receive only)
4	DATA(1)-	CCDL/MCDL inputs	Low level CCDL/MCDL bus (receive only)
5	DATA(2)+	CCDL/MCDL inputs	High level CCDL/MCDL bus (receive only)
6	DATA(2)-	CCDL/MCDL inputs	Low level CCDL/MCDL bus (receive only)
7	DATA(3)+	CCDL/MCDL inputs	High level CCDL/MCDL bus (receive only)
8	DATA(3)-	CCDL/MCDL inputs	Low level CCDL/MCDL bus (receive only)
9	CHASSIS	Chassis	
10	CHASSIS	Chassis	
11	GND	Internal ground	
12	GND	Internal ground	
13	GND	Internal ground	
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	GND	Internal ground	
28	GND	Internal ground	
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DATA(0)_TRM+		CCDL/MCDL bus interface; with internal 124Ω resistor
35	DNC		Do not connect
36	DATA(1)_TRM+		CCDL/MCDL bus interface; with internal 124Ω resistor
37	DNC		Do not connect
38	DATA(2)_TRM+		CCDL/MCDL bus interface; with internal 124Ω resistor
39	DNC		Do not connect
40	DATA(3)_TRM+		CCDL/MCDL bus interface; with internal 124Ω resistor
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/CBM/103	4-bus CCDL/MCDL monitor

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/CBM/103	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
DOC/HBK/002	Environmental Qualification Handbook
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
TEC/NOT/074	Using DAS Studio 3 to configure the KAD/CBM/103

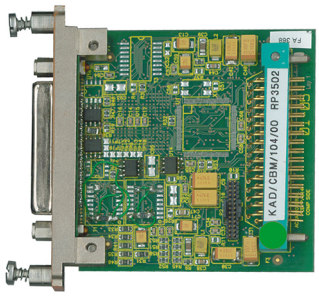
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/CBM/104

4-bus CSDB monitor

CURTISSWRIGHTDS.com



Key Features

- Four Commercial Standard Data Bus (CSDB) busses
- 16-bit Content Identifier (CI) covering address byte and status or first data byte
- Parsing of up to 127 complete messages and one catchall buffer per bus
- Tagging of messages with time and message count
- Up to 32 bytes per message

Applications

- CSDB bus monitors

Overview

The KAD/CBM/104 extracts valid CSDB messages from incoming serial streams. It coherently extracts certain words from these messages and saves them to specified locations in the telemetry frames (parser). The KAD/CBM/104 parses CSDB bus traffic and tags each message for up to four CSDB busses. It combines a message first in first out, a coherent message parser, and a message counter with error detection functions in a single module.

In this document, traffic refers to bytes on the bus and tags refer to associated information such as microsecond time of last byte of the message, message count, and errors.

The parser triple buffers up to 127 unique complete messages per bus and their associated tags. The MessageInfo tag associated with each message has a stale bit (message read before), a skipped bit (buffer overwritten), and an empty bit (no message received since power-on). The MsgCnt tag increments on receipt of a valid message. The Report word contains bits which indicate when an error has occurred, and on which bus it has occurred.

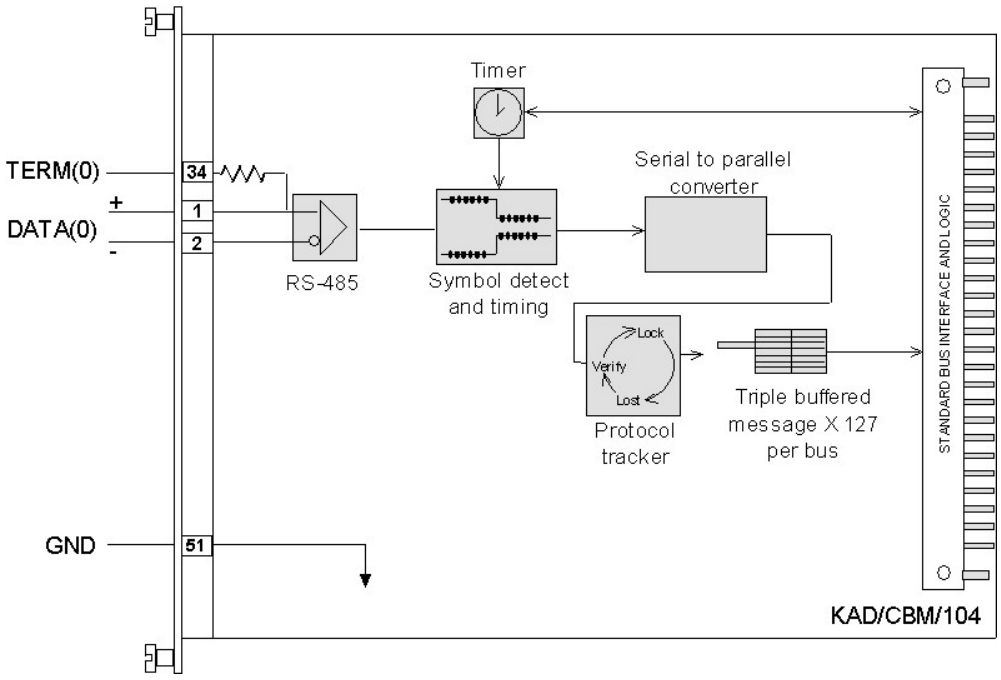


Figure 1: First of four independent busses

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	66	–	g	
	–	2.33	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	60	–	140	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	0.30	–	0.70	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

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TABLE 2	CSDB bus interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	4	–	RS-422 compatible.
Signalling rate					
Data[3:0]±	12.5		50	kbps	
Input voltage					
operating range	-7	–	12	V	Do not exceed operating range.
logic '0'	–	–	-0.2	V	V_{IN+} - V_{IN-}.
logic '1'	0.2	–	–	V	V_{IN+} - V_{IN-}.
overvoltage protection	-60	–	60	V	Voltage in excess of these values can damage input.
ESD protection	–	15	–	kV	Human Body Model.
Input resistance					
between inputs	–	150	–	kΩ	Module powered on.
between inputs	–	60	–	kΩ	Module powered off.
between inputs	–	124	–	Ω	Module powered on and inputs terminated.
between inputs	–	124	–	Ω	Module powered off and inputs terminated.
each input to GND	–	30	–	kΩ	Module powered on.
each input to GND	–	50	–	kΩ	Module powered off.

Setting up the KAD/CBM/104

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

The following treeview provides an overview of setup configurations available for this module:

Treeview icons legend	
DAU: Data Acquisition Unit	Indicator: Indicates the firing of an event based on specific conditions
PC: Personal Computer	Parser slot: Area of memory reserved for storing parsed data
Instrument: Any component or module used in a data acquisition system	Snarfer: Captures all data transmitted on a bus and selectively stores it
DataLink: Connection for transmitting or receiving (defines both the data link and the physical layer)	Bridge: Electrical circuit usually used for measuring purposes
Package: Used to describe how data is transmitted or stored	PCMCIA card: Peripheral interface device usually for use in laptop computers
Parameter: Any register that can be read from an instrument	Multiplexer: Selects one of many input signals and outputs that signal on a signal line
Algorithm: Defines processing to be performed on data	Channels: Defines settings for input or output channels on an instrument
InterConnect: Represents a physical connection on an instrument	
PCI card: Circuit board that plugs into the PCI bus on a PC	

Instrument Overview

- KAM-500
  - KAD/CBM/104
    - **Parameters**
      - ReadCounter - *Increments on each read.*
      - Report - *Indicates the status of the monitor.*
    - **ParserSlots**
      - Parser(126:0) - *CSDB message PARSER, parses up to 127 unique messages.*
        - **Parameters**
          - MessageTimeHi - *Hours and minutes time of the last byte in the message.*
          - MessageTimeLo - *Seconds and centiseconds time of the start of the last byte in the message.*
          - MessageTimeMicro - *Microsecond time of the start of the last character in message.*
          - MessageCounter - *The current value of the frame count for each bus.*
          - MessageSize - *The number of bytes in the message.*
          - MessageInfo - *Stale/skipped indication for this parsed message.*
        - **Packages**
          - ClassifiedNetworkPackages - *CSDB package containing acquisition data to be received.*
            - **Parameters**
              - MessageData - *Received data N.*
      - Catchall-Parser(0:0) - *CSDB catchall message PARSER.*
        - **Parameters**
          - MessageTimeHi - *Hours and minutes time of the last byte in the message.*
          - MessageTimeLo - *Seconds and centiseconds time of the start of the last byte in the message.*
          - MessageTimeMicro - *Microsecond time of the start of the last character in message.*
          - MessageCounter - *The current value of the frame count for each bus.*
          - MessageSize - *The number of bytes in the message.*
          - MessageInfo - *Stale/skipped indication for this parsed message.*
        - **Packages**
          - CatchAllPackage - *CSDB catchall package definition.*
            - **Parameters**
              - MessageData - *Received data N.*
    - **InterConnects**
      - Channel(3:0) - *Connection between the module channel and the CSDB data bus.*
        - **DataLinks**
          - ChannelDataLink - *CSDB data link.*
            - **Packages**
              - ClassifiedNetworkPackages - *CSDB package containing acquisition data to be received.*
                - **Parameters**
                  - MessageData - *Received data N.*
              - CatchAllPackage - *CSDB catchall package definition.*
                - **Parameters**
                  - MessageData - *Received data N.*

Setting up the module

The following table lists the setup configurations available for the KAD/CBM/104.

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/CBM/104	KAD/CBM/104	Acra part number.
SerialNumber	-	-	Unique name for each module.
InterConnects Channel(3:0)	No character limit	Not Specified	Connection between the module channel and the CSDB data bus.
Settings	-	-	-
Module-Parser-1.0	-	-	-
PackageBuffers	-	-	-
PackageBuffer Parser(126:0)	-	-	CSDB message parser, parses up to 127 unique messages.
PackageReference	No character limit	Not Specified	-
PackageBuffer Catchall-Parser(0:0)	-	-	CSDB catchall message parser.
PackageReference	No character limit	Not Specified	-
Other	-	-	-

Setting up parameters

Parameter definitions

The following table lists all parameters that are available for the KAD/CBM/104.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
ReadCounter Increments on each read.	Unitless	OffsetBinary	16	R[15:0] Increments on each read.
Report Indicates the status of the monitor.	Unitless	BitVector	16	R(15) 1 indicates an error occurred since last read. R[14:8] Reserved for future use. R[7:4] Indicates the bus the error occurred on. R[1:0] Error code. 0 - No error. 1 - Bit error.
MessageTimeHi Hours and minutes time of the last byte in the message.	Unitless	BitVector	16	R[15:13] Reserved for future use. R[12:7] BCD 00-23 hours. R[6:0] BCD 00-59 minutes.
MessageTimeLo Seconds and centiseconds time of the start of the last byte in the message.	Second	BCD	16	R[15:0] BCD 00.00-59.99 seconds.
MessageTimeMicro Microsecond time of the start of the last character in message.	Second	BCD	16	R[15:0] BCD 0000-9999 microseconds.
MessageCounter The current value of the frame count for each bus.	Count	OffsetBinary	16	R[15:0] 0000-FFFF.
MessageSize The number of bytes in the message.	Unitless	OffsetBinary	16	R[15:4] Reserved for future use. R[3:0] The number of bytes in the message. 0x0000 not allowed. 0x0003 three bytes (minimum). 0x000F 16 bytes (maximum).

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageInfo Stale/skipped indication for this parsed message.	Unitless	BitVector	16	R(15) 1 indicates ID is empty (no message received). R(14) 1 indicates stale (this message was read before). R(13) 1 indicates skipped (this message overwrote another). R[12:0] Reserved for future use.
MessageData Received data N.	Unitless	OffsetBinary	16	R[15:8] The eight bits of byte 2 x N + 1 in serial stream. R[7:0] The eight bits of byte 2 x N in serial stream. Where N is data word index (zero-based).

Setting up data links

A data link is a connection for transmitting and receiving data. It defines both the data link and physical layers of the link. The following are data links supported by the KAD/CBM/104.

Non-programmable data links

NAME	DESCRIPTION
Channel(3:0)	CSDB data link.

Setting up packages

A package is a logical description of how data is transmitted or stored.

ClassifiedNetworkPackages

CSDB package containing acquisition data to be received.

SETUP DATA	CHOICE	DEFAULT	NOTES
ReferencedToAbsoluteTime	-	-	-
PackageRate	-	-	-
DataLinkReference	No character limit	Not Specified	-
Properties	-	-	-
HashBinary	-	-	HashBinary is used to specify values to be found at the classification offset.
Value	-	-	This is a 16-bit binary value used for packet classification. Its context is defined by its sibling OffsetIndex_Bytes.
OffsetIndex_Bytes	0:0	Not Specified	This element sets the context for packet classification.
Content	-	-	-
Parameter	-	-	-
Location	-	-	-
Offset_Bytes	16:0	Not Specified	-

CatchAllPackage

CSDB catchall package definition.

SETUP DATA	CHOICE	DEFAULT	NOTES
ReferencedToAbsoluteTime	-	-	-
PackageRate	-	-	-
DataLinkReference	No character limit	Not Specified	-
Properties	-	-	-
HashBinary	-	-	HashBinary is used to specify values to be found at the classification offset. However, as this is a catchall package definition the hash binary value will be fixed.
Value	********	********	This wildcard value is fixed for the catchall package definition.
OffsetIndex_Bytes	0:0	Not Specified	This element sets the context for packet classification.
Content	-	-	-
Parameter	-	-	-
Location	-	-	-
Offset_Bytes	16:0	Not Specified	-

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/CBM/104

Parser

The KAD/CBM/104 can parse up to 127 messages into individual slots and has one catchall slot reserved for each bus. The CSDB frame structure is shown in the following figure. Idle time is a minimum of 11 bits, Interblock time has no restrictions, and the sync block consists of a predefined number of A5h characters.

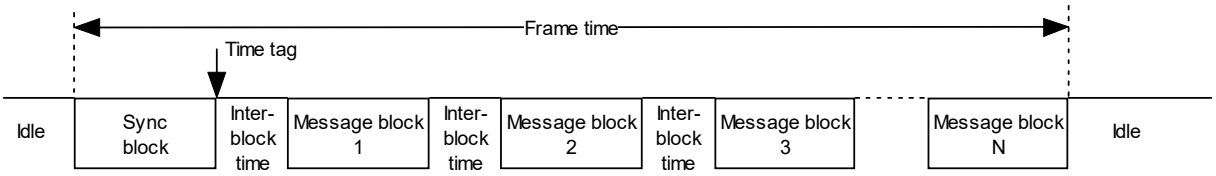


Figure 2: Frame structure

The message block structure is shown in the following figure.

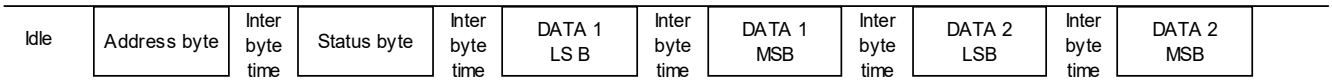


Figure 3: Message block structure

The byte structure is shown in the following figure. It is the same as the byte definition used in the RS-232 communication protocol.

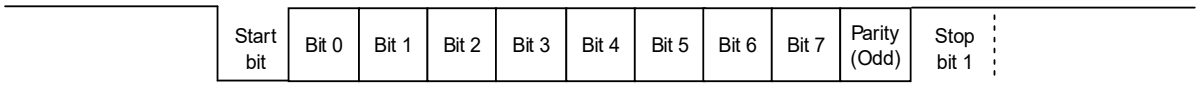


Figure 4: Byte structure

In order to keep coherency, each slot is triple buffered. If messages arrive faster than the backplane controller module (KAD/BCU/xxx) can read them, a skipped bit indicates that a message has been missed. If messages arrive slower than the rate at which the KAD/BCU/xxx is reading, a stale bit indicates that the same message has been read before. Each message is individually time stamped and counted.

Messages are individually identified by a 16-bit CI, which covers the first two bytes of each message.

NOTE: To avoid reporting of errors from unused busses, ensure that busses are correctly terminated.

Connector pinout of the KAD/CBM/104

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DATA(0)+	CSDB bus interface	High level CSDB bus (receive only)
2	DATA(0)-	CSDB bus interface	Low level CSDB bus (receive only)
3	DATA(1)+	CSDB bus interface	High level CSDB bus (receive only)
4	DATA(1)-	CSDB bus interface	Low level CSDB bus (receive only)
5	DATA(2)+	CSDB bus interface	High level CSDB bus (receive only)
6	DATA(2)-	CSDB bus interface	Low level CSDB bus (receive only)
7	DATA(3)+	CSDB bus interface	High level CSDB bus (receive only)
8	DATA(3)-	CSDB bus interface	Low level CSDB bus (receive only)
9	CHASSIS	Chassis	
10	CHASSIS	Chassis	
11	GND	Internal ground	
12	GND	Internal ground	
13	GND	Internal ground	
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	GND	Internal ground	
28	GND	Internal ground	
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DATA(0)_TRM+	CSDB bus interface	CSDB bus interface; with internal 124Ω resistor
35	DNC		Do not connect
36	DATA(1)_TRM+	CSDB bus interface	CSDB bus interface; with internal 124Ω resistor
37	DNC		Do not connect
38	DATA(2)_TRM+	CSDB bus interface	CSDB bus interface; with internal 124Ω resistor
39	DNC		Do not connect
40	DATA(3)_TRM+	CSDB bus interface	CSDB bus interface; with internal 124Ω resistor
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/CBM/104	4-bus CSDB monitor

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/CBM/104	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

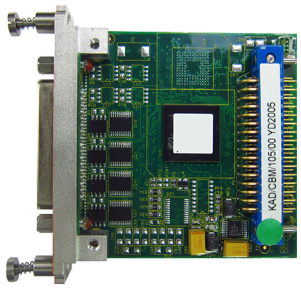
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/CBM/105

CAN bus packetizer - 4ch

CURTISSWRIGHTDS.COM



Key Features

- Monitors up to four CAN2.0 A/B busses
- Aperiodic transmission of packetized CAN messages including tags as iNET-X parser-aligned payload structures per channel or per instrument
- Programmable bit-rate per bus
- Data, remote, error, and overload frame support
- Silent (monitors only; does not transmit or acknowledge)

Applications

- CAN bus monitor

Overview

The KAD/CBM/105 is a four-channel CAN bus packetizer. It can capture four independent CAN bus streams. All data appearing on the bus is packetized and PARSER-aligned.

The KAD/CBM/105 captures and packetizes data until a packet of a pre-defined size, or a pre-defined timeout is exceeded.

The KAD/CBM/105 uses PARSER-aligned packet format. It supports two modes of packetization. In one mode, messages from each channel can be written into their own PARSER-aligned packet stream. In the other mode, all channels are combined into one packet stream with each message tagged with a bus identifier. Only one mode can be active at any time.

The report word has bits indicating that an error occurred and on which bus it occurred.

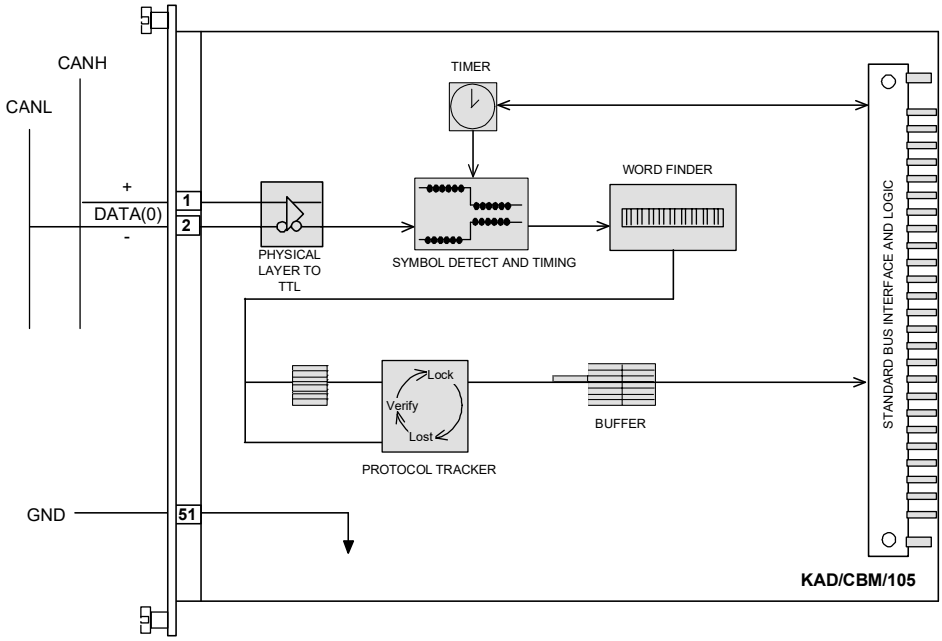


Figure 1: First of four independent busses

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	70	–	g	
	–	2.47	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	90	–	175	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	0.45	–	0.88	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	CAN bus interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	4	–	CAN bus 2.0 A/B compatible.
Sampling rate					
DATA[3:0]±	–	–	1,000	kbps	
Physical layer					
CAN bus 2.0	0.05	–	1,000	kbps	
Supported baud rates	20	–	1,000	kbps	20, 100, 125, 250, 500, 1,000

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TABLE 3	CAN Transceivers				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Channels	–	–	4	–	
Signalling rate					
Data	–	–	1,000	kbps	
Receiver input voltage					
operating range	-7	–	12	V	Do not exceed operating range.
logic 0	–	–	0.5	V	(400mV hysteresis) V_{IT+} - V_{IT-}
logic 1	0.9	–	–	V	(400mV hysteresis) V_{IT+} - V_{IT-}
common mode voltage	-7	–	12	V	
overvoltage protection	-40	–	40	V	Voltage in excess of these values can damage input.
ESD protection	–	16	–	kV	Human Body Model.
Input resistance					
between inputs	40	–	–	kΩ	Module powered on.
between inputs	40	–	–	kΩ	Module powered off.
each input to GND	20	–	–	kΩ	Module powered on.
each input to GND	20	–	–	kΩ	Module powered off.

Setting up the KAD/CBM/105

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/CBM/105	KAD/CBM/105	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Settings	-	-	-
Packetization	Individual Combined	Individual	Selects per channel or per instrument packetization.
Channels	-	-	-
CAN-In(3:0) CAN-Bus Input	-	-	-
Settings	-	-	-
Bit Rate	20000 100000 125000 250000 500000 1000000	1000000	Specifies the number of symbols transmitted per second
Settings Packetizer	-	-	-
Stream Id	00000000 to FFFFFFFF	FFFFFFFF	iNET-X stream ID for selected channel if a packet is generated via the assertion of Packetization Enabled. This setting is only supported in DAS Studio 3.
Packetization Enabled	True False	False	Enables the transmission of an iNET-X packet containing the contents of this channel if an iNET-X transmitter is present in the chassis. This setting is only supported in DAS Studio 3.
Packet Size	13 to 511	511	Maximum size of packet buffer in words.
Packet Timeout	10 to 999	50	Generate a packet when the oldest data recorded is this old (ms).
Can-In-Combined CAN-Bus Input	-	-	-
Settings	-	-	-
Settings Packetizer	-	-	-
Stream Id	00000000 to FFFFFFFF	FFFFFFFF	iNET-X stream ID for selected channel if a packet is generated via the assertion of Packetization Enabled. This setting is only supported in DAS Studio 3.
Packetization Enabled	True False	False	Enables the transmission of an iNET-X packet containing the contents of this channel if an iNET-X transmitter is present in the chassis. This setting is only supported in DAS Studio 3.
Packet Size	13 to 511	511	Maximum size of packet buffer in words.
Packet Timeout	10 to 999	50	Generate a packet when the oldest data recorded is this old (ms).

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Report Reports the status of the module	BitVector	BitVector	16	R[15:0] R(15) FreshError - Indicates a fresh error. This bit is cleared when read again, leaving all other bits at their previous value. R[14:4] Reserved - Reserved for future use. R[3:0] Bus - Indicates the bus on which the error occurred.
CAN-In(3:0) Parameters				
BusMessageCount Count of messages detected on the bus	Count	OffsetBinary	16	R[15:0]

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/CBM/105

For a detailed description on iNET-X packets, see *TEC/NOT/067 - IENA and iNET-X packet payload formats*.

iNET-X PARSER-aligned packet format

There is a diverse range of avionic bus technologies for which traffic may be captured, for example, MIL-STD-1553, PCM, or ARINC-429. The generalized iNET-X payload structure for parser-aligned packets is shown in the following figure.

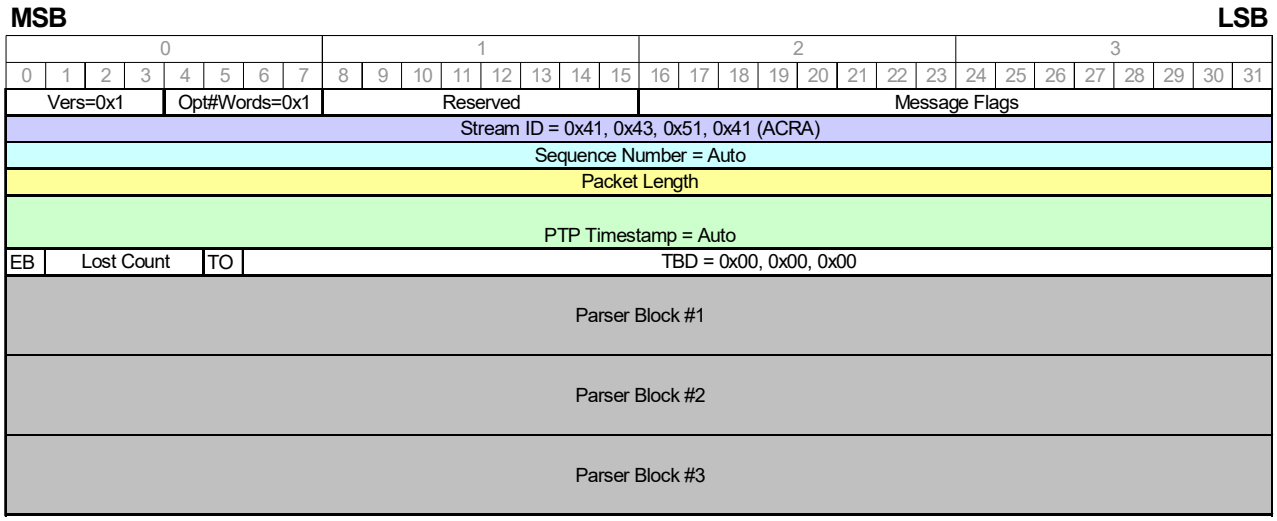


Figure 2: Generalized parser-aligned iNET-X packet

As messages are captured on the bus, they are formatted in a parser block. Each parser block begins with a 4-byte parser information word, followed by a 4-byte elapsed time tag and the message data shown in the following figure.

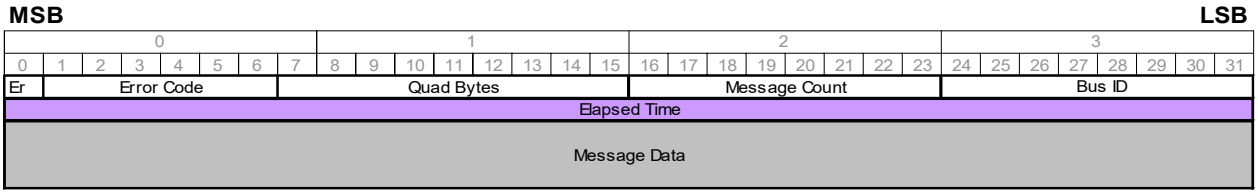


Figure 3: iNET-X parser block

A parser block consists of the following fields:

- Parser information word (4 bytes): metadata providing information about the health and status of the message.
  - Er (Bit 0): indicates that an error occurred. (Note that this field is not used and always reads zero.)
  - Bits [1:6]: Error code. (No error codes are defined; this field always reads zero.)
  - Quad bytes (Bits [7:15]): number of quad bytes. This relates to the length of the parser information word, elapsed time tag, and the message data and padding (N x 4 bytes). For example, a 4-byte message captured from a given bus has a quad-byte value of 3, that is 12 bytes that includes 4 bytes parser information word, 4 bytes elapsed time, and 4 bytes bus message data.
  - Message count (Bits [16:23]): message counter. This is a message counter that relates to the messages contained in the payload. The message counter increments for each message contained in the packet payload and continues to increment across consecutive packets. The message counter resets and wraps around to 0 once it has reached the maximum message count of 0xFF.
  - Bus ID (Bits [24:31]): bus number.
- Elapsed time (4 bytes): time tag as an unsigned offset in nanoseconds that is added to the base PTP timestamp in the iNET-X

header.

- Message data (N x 4 bytes): captured bus traffic, padded if necessary to end on 4-byte boundary.

Example iNET-X PARSER-aligned packet format for CAN bus KAD/CBM/105

The KAD/CBM/105 is a four-channel CAN bus 2.0A/B compliant parser and packetizer. In packetizer mode, the received CAN bus messages from all busses are encapsulated in parser-aligned iNET-X packet structures.

The generalized structure of an KAD/CBM/105 parser block is illustrated in the following figure. In the figure you can see that the iNET-X payload contains three CAN bus messages. Common to all parser block structures, the first word of the message is the parser information word which contains the Bus ID field which allows the bus on which this message was received to be identified. Following the parser information word is the elapsed time in nanoseconds which is added to the earliest reference timestamp contained in the iNET-X packet header. This is then followed immediately by the CAN bus message.

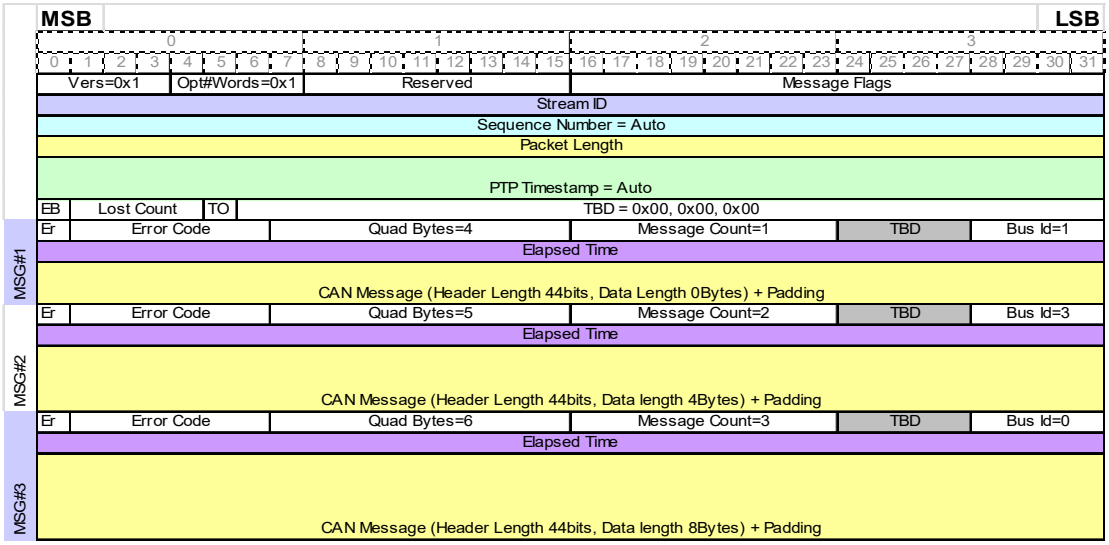


Figure 4: Generalized iNET-X parser block for multiple CAN bus messages

As the CAN bus messages arrive, the KAD/CBM/105 buffers them. A CAN bus message comprises a CAN bus header and data field which may contain 0 to 8 bytes of data. There are two formats of CAN bus header using an 11-bit Standard ID (SID) as received on a CAN 2.0A bus or a 29-bit Extended ID (EID) as received on CAN 2.0B bus. To facilitate processing a decommutation of the encapsulated CAN bus messages, a CAN bus status word immediately precedes the message. As with other bus packetizer modules, such as the KAD/PBM/104 and the KAD/MBM/101, the definition of the status word is bus-specific.

CAN bus message status word

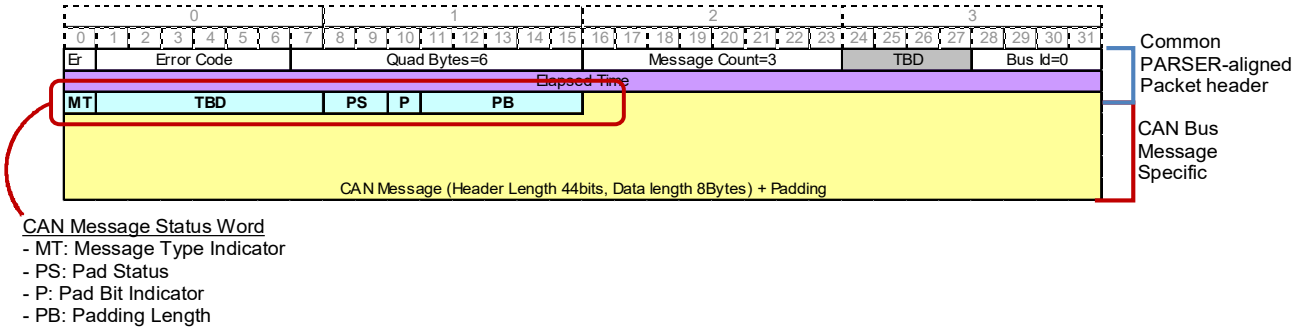


Figure 5: CAN bus message status word

- Bit(0) CAN Message Type Indicator: MT indicates that the CAN message uses either a SID or an EID.

MT=0 indicates that it is an 11-bit, CAN 2.0A SID message.

MT=1 indicates that it is a 29-bit, CAN 2.0B EID message.

- Bits [1:7] Reserved
- Bits [8:9] Pad Status:PS: indicates the conditions under which the CAN message has been padded.
- Bit(10) Pad:P indicates whether the message has been padded.
  - 00: Correct length
  - 01: Too few bits
  - 10: Too many bits
  - 11: Reserved
- Bits [11:15] Pad Bits:PB: indicates the number of bits that have been added to the end of the padded CAN message in order to achieve 32-bit alignment. 5 bits are used as it is possible that up to 31 bits may be required to pad the message to the 32-bit alignment boundary length.

iNET-X CAN bus parser-aligned packet structure padding

The following figure illustrates the format of a CAN bus message.

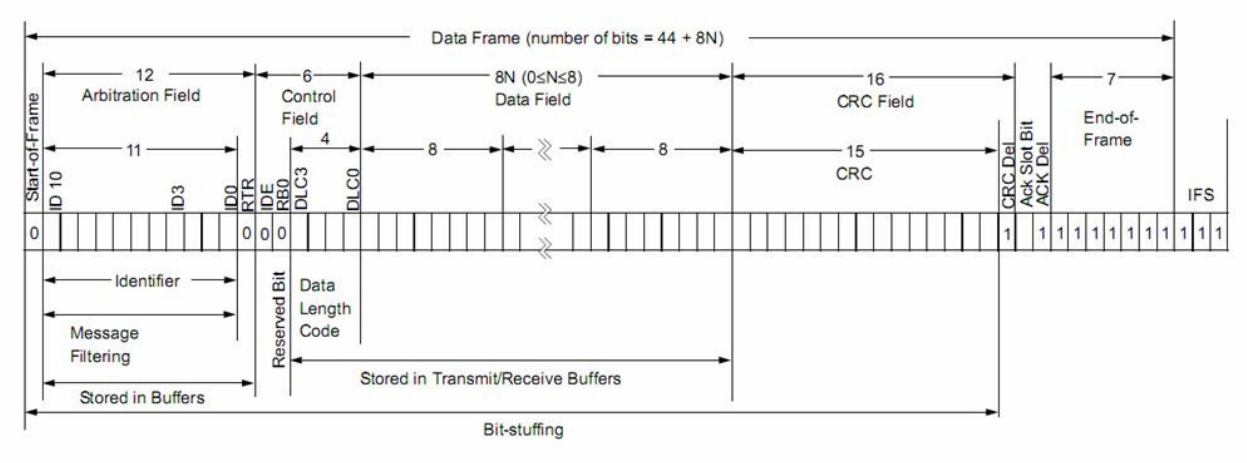


Figure 6: CAN bus message format

Since this format is not naturally network-order byte-aligned, the complete CAN message is treated as two distinct elements; a CAN message header word and the CAN message data (see the following figure). These are placed in the parser-aligned message block so that the first data byte of the CAN message is in the same location, regardless of whether it is a SID or EID message.

The KAD/CBM/105 does not store the Start-of-Frame field, CRC fields, ACK fields, or the End-of-Frame field.

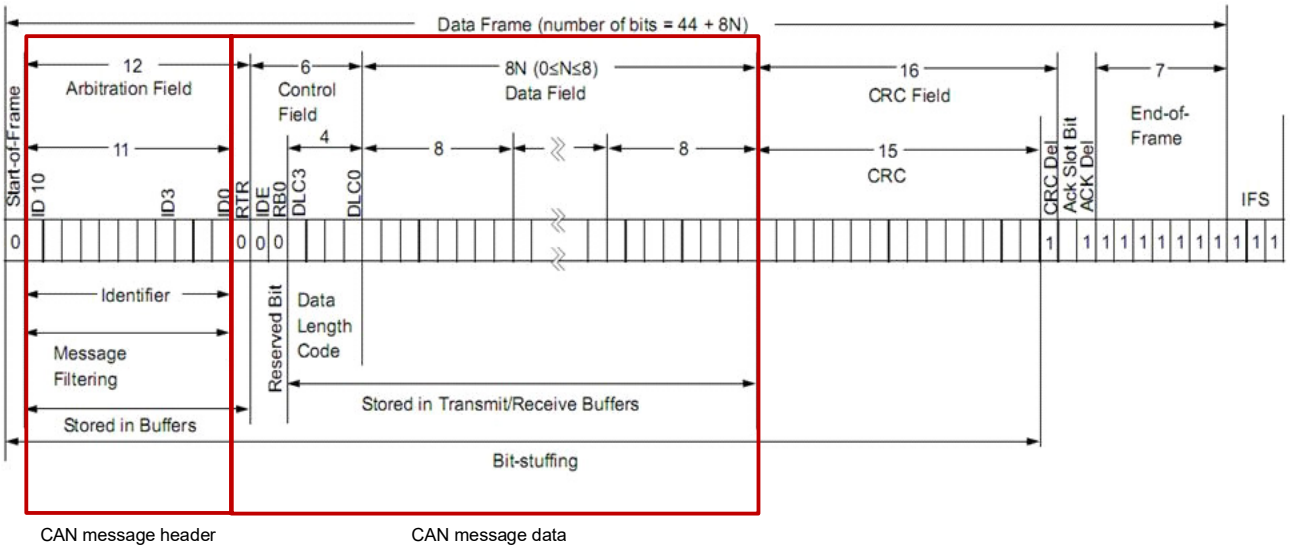
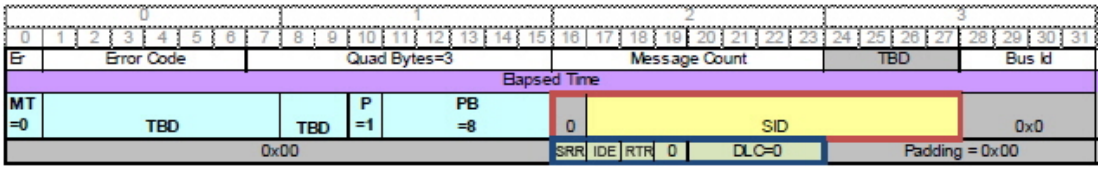


Figure 7: CAN message header word and CAN message data

The following table provides examples of SID and EID CAN bus messages in an iNET-X parser block structure.

Sample SID and EID CAN bus messages

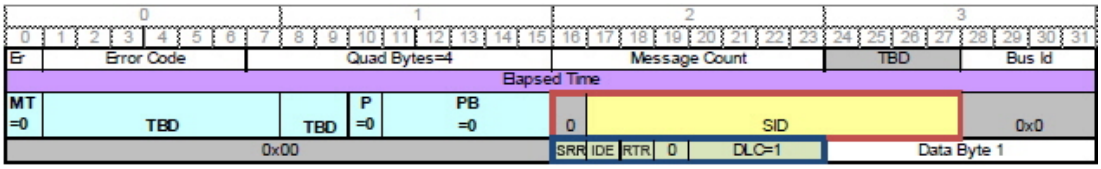
SID message with no data - padded



- MT=0: SID.
- P=1: Message is padded.
- PB=8: eight bits of padding appended to the end of the message.

DLC=0 No data bytes.

SID message with one byte of data - not padded

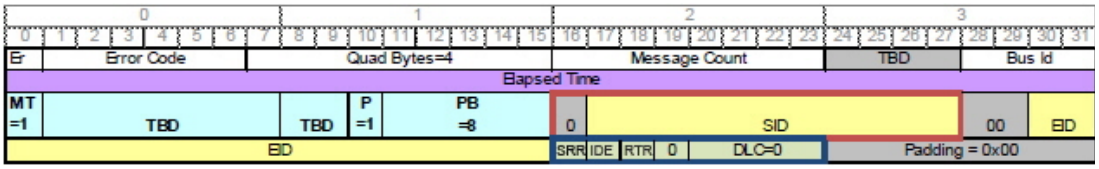


- MT=0: SID.
- P=0: Message is not padded.
- PB=0: No pad words appended to the message.

DLC=1 one byte of data.

Sample SID and EID CAN bus messages (continued)

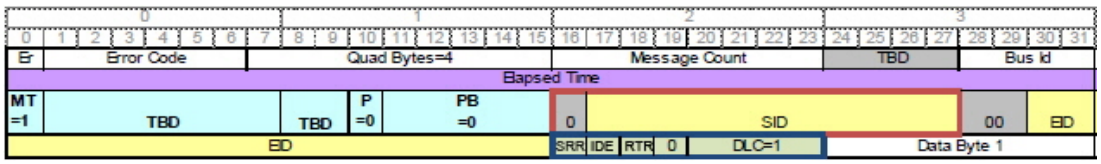
EID message with no data - padded



- MT=1: EID.
- P=1: Message is padded.
- PB=8: 8 bits of padding appended to the end of the message.

DLC=0.

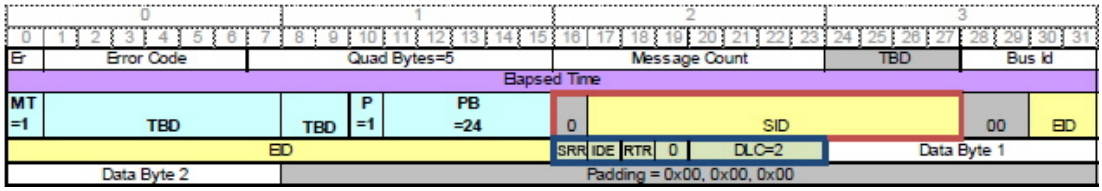
EID message with one byte of data - not padded



- MT=1: EID.
- P=0: Message is not padded.
- PB=0: No padding appended to the end of the message.

DLC=1: one byte of data.

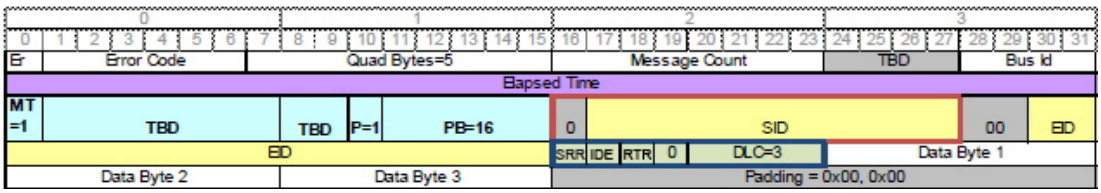
EID message with two bytes of data - padded



- MT=1: EID.
- P=1: Message is padded.
- PB=24: 24 bits of padding appended to the end of the message.

DLC=2: two bytes of data.

EID message with three bytes of data - padded

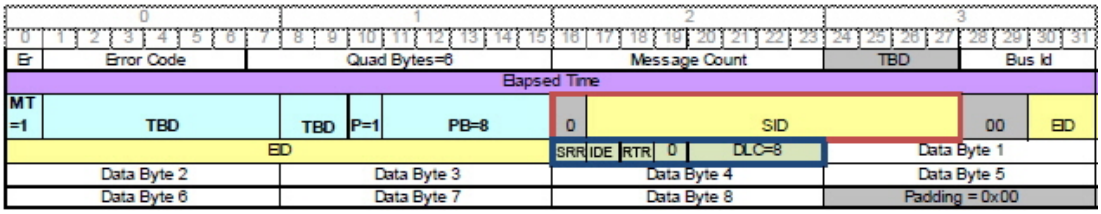


- MT=1: EID.
- P=1: Message is padded.
- PB=16: 16 bits of padding appended to the end of the message.

DLC=3: three bytes of data.

Sample SID and EID CAN bus messages (continued)

EID message with eight bytes of data - padded



- MT=1: EID.
- P=1: Message is padded.
- PB=8: eight bits of padding appended to the end of the message.

DLC=8: eight bytes of data.

Handling bit stuffing

The KAD/CBM/105 handles bit stuffing and any bit stuff error condition in compliance with CAN 2.0 B specifications. Where bit stuffing has been applied to the incoming data, according to the specifications, de-stuffing the affected bits is handled transparently by the front-end transceiver. If messages are deliberately lost on the bus due to a bit stuff error, the KAD/CBM/105 doesn't receive or report the messages. The KAD/CBM/105 is not capable of transmission, so it cannot cause a bit stuff error itself.

Connector pinout of the KAD/CBM/105

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DATA(0)+	CAN bus interface	High level CAN bus (receive only)
2	DATA(0)-	CAN bus interface	Low level CAN bus (receive only)
3	DATA(1)+	CAN bus interface	High level CAN bus (receive only)
4	DATA(1)-	CAN bus interface	Low level CAN bus (receive only)
5	DATA(2)+	CAN bus interface	High level CAN bus (receive only)
6	DATA(2)-	CAN bus interface	Low level CAN bus (receive only)
7	DATA(3)+	CAN bus interface	High level CAN bus (receive only)
8	DATA(3)-	CAN bus interface	Low level CAN bus (receive only)
9	CHASSIS	Chassis	
10	CHASSIS	Chassis	
11	GND	Internal ground	
12	GND	Internal ground	
13	GND	Internal ground	
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	GND	Internal ground	
28	GND	Internal ground	
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/CBM/105	CAN bus packetizer - 4ch

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/CBM/105	First release	Recommended for new programs

Supporting software

MODULE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
TEC/NOT/051	Ethernet frames, Wireshark® and FAT32
TEC/NOT/058	Overview of SNMP and using third party SNMP tools
TEC/NOT/067	IENA and iNET-X packet payload formats

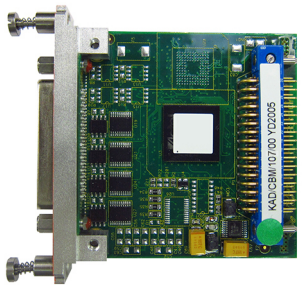
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/CBM/107

CAN bus monitor parser/packetizer - 4ch

CURTISSWRIGHTDS.COM



Key Features

- Four Controller Area Network (CAN) bus interfaces
- CAN bus 2.0 A/B compatible
- Data, remote, error and overload frame support
- Up to 126 complete messages per bus can be parsed
- Silent (monitors only, does not transmit or acknowledge)
- Programmable bit-rate per bus
- Individual channel or instrument-wide packetization

Applications

- CAN bus parser/packetizer

Overview

The KAD/CBM/107 is a four-channel CAN bus monitor, which combines the capabilities of a coherent message parser with the flexibility of an iNET-X packetizer on a single module.

The parser coherently parses up to 126 messages per bus and their associated time and status tags. As a message is read, a parser information word indicates the status of the data—a stale bit indicates that the message was read before and a skipped bit indicates the buffer was overwritten prior to being read. The timestamp records the microsecond time of start-of-frame bit indication. Message counters count how many messages are received on each bus and of each parsed type. Every field from each received CAN message can be captured and packetized with other messages in a packetizer buffer. The packetizer contents can be assembled into Ethernet frames by an iNET-X controller or transmitter, for example a KAD/BCU/140, or for transmission over Ethernet.

The KAD/CBM/107 can generate either a single packet stream per input bus or packetize messages from all the active busses into a single packet stream. In either case, a programmable timeout ensures that smaller packets are generated even during periods of low activity on the bus, thereby allowing real-time analysis and processing of acquired messages. When there is no traffic, no packets are generated.

The report word has bits indicating that an error occurred and on which bus it occurred.

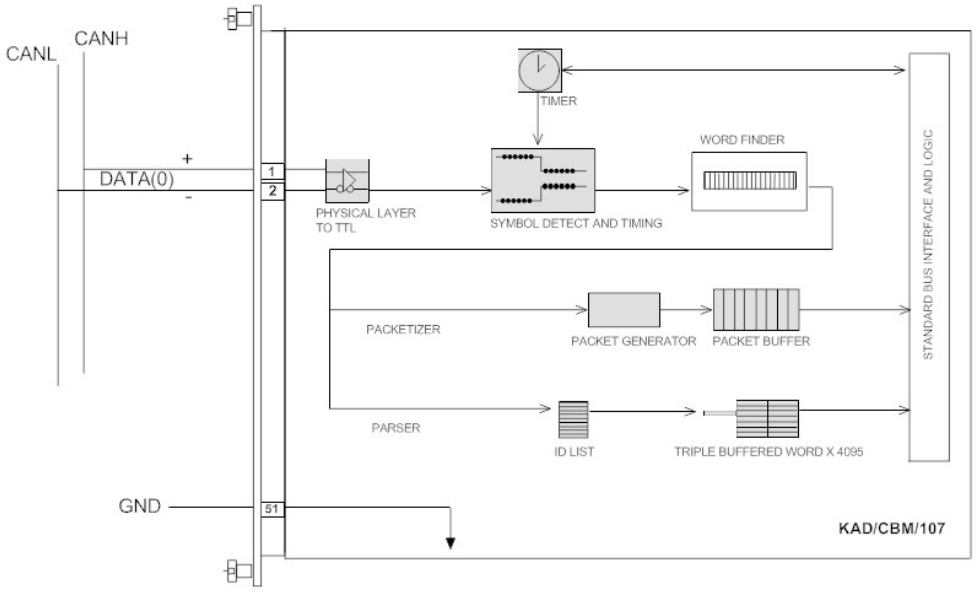


Figure 1: First of four independent busses

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	70	–	g	
	–	2.47	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	90	–	175	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	0.45	–	0.88	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	CAN bus interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	4	–	CAN bus 2.0 A/B compatible.
Sampling rate					
DATA[3:0]±	–	–	1,000	kbps	
Physical layer					
CAN bus 2.0	0.05	–	1,000	kbps	
Supported baud rates	20	–	1,000	kbps	20, 100, 125, 250, 500, 1,000.

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TABLE 3	CAN Transceivers				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Channels	–	–	4	–	
Signalling rate					
Data	–	–	1,000	kbps	
Receiver input voltage					
operating range	-7	–	12	V	Do not exceed operating range.
logic 0	–	–	0.5	V	(400mV hysteresis) V_{IT+} - V_{IT-}.
logic 1	0.9	–	–	V	(400mV hysteresis) V_{IT+} - V_{IT-}.
common mode voltage	-7	–	12	V	
overvoltage protection	-40	–	40	V	Voltage in excess of these values can damage input.
ESD protection	–	16	–	kV	Human Body Model.
Input resistance					
between inputs	40	–	–	kΩ	Module powered on.
between inputs	40	–	–	kΩ	Module powered off.
each input to GND	20	–	–	kΩ	Module powered on.
each input to GND	20	–	–	kΩ	Module powered off.

Setting up the KAD/CBM/107

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/CBM/107	KAD/CBM/107	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Settings	-	-	-
Fill Value	0000 to FFFF	AAAA	Specifies a value that should be stored when the bus monitor is not receiving data.
Packetization	Individual Combined	Individual	Selects per channel or per instrument packetization.
Channels	-	-	-
CAN-In(3:0) CAN-Bus Input	-	-	-
Settings	-	-	-
Bit Rate	20000 100000 125000 250000 500000 1000000	1000000	Specifies the number of symbols transmitted per second.
Settings Packetizer	-	-	-
Stream Id	00000000 to FFFFFFFF	FFFFFFFF	iNET-X stream ID for selected channel if a packet is generated via the assertion of Packetization Enabled. This setting is only supported in DAS Studio 3.
Packetization Enabled	True False	False	Enables the transmission of an iNET-X packet containing the contents of this channel if an iNET-X transmitter is present in the chassis. This setting is only supported in DAS Studio 3.
Packet Size	13 to 511	511	Maximum size of packet buffer in words.
Packet Timeout	10 to 999	50	Generate a packet when the oldest data recorded is this old (ms).
Processes	-	-	-
Parser(125:0)	-	-	Parser slots on the module.
Catchall-Parser	-	-	All data not classified for parsing is captured in this parser slot.
Can-In-Combined CAN-Bus Input	-	-	-
Settings	-	-	-
Settings Packetizer	-	-	-
Stream Id	00000000 to FFFFFFFF	FFFFFFFF	iNET-X stream ID for selected channel if a packet is generated via the assertion of Packetization Enabled. This setting is only supported in DAS Studio 3.
Packetization Enabled	True False	False	Enables the transmission of an iNET-X packet containing the contents of this channel if an iNET-X transmitter is present in the chassis. This setting is only supported in DAS Studio 3.

SETUP DATA	CHOICE	DEFAULT	NOTES
Packet Size	13 to 511	511	Maximum size of packet buffer in words.
Packet Timeout	10 to 999	50	Generate a packet when the oldest data recorded is this old (ms).

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Report Reports the status of the module.	BitVector	BitVector	16	R[15:0] R(15) FreshError - Indicates a fresh error. This bit is cleared when read again, leaving all other bits at their previous value. R[14:4] Reserved - Reserved for future use. R[3:0] Bus - Indicates the bus on which the error occurred.
CAN-In(3:0) Parameters				
BusMessageCount Count of messages detected on the bus.	Count	OffsetBinary	16	R[15:0]
Parser(125:0) Parameters				
MessageCount Value of BusMessageCount for this bus when the message in the slot was received.	Count	OffsetBinary	16	R[15:0]
MessageExtIdHi The Most Significant Bits (MSBs) of the extended identifier.	BitVector	BitVector	16	R[15:0] R[15:0] EID[17:2]
MessageExtIdLo The Least Significant Bits (LSBs) of the extended identifier.	BitVector	BitVector	16	R[15:0] R[15:14] EID[1:0] R[13:0] reserved
MessageInfo Stale/skipped indication for this parsed message.	BitVector	BitVector	16	R[15:0] R(15) Empty - ID is empty (no message received). R(14) Stale - 1 indicates this message was read before. R(13) Skipped - 1 indicates this message overwrote another. R[12:0] Reserved - Reserved for future use.
MessageStdId The standard identifier.	BitVector	BitVector	16	R[15:0] R[15:5] STD ID - ID [10:0] R(4) SRR - SRR Standard frame remote transmit request bit R(3) IDE - IDE Extended identifier flag. R[2:0] Reserved
MessageDLC Data Length Code for received message.	BitVector	BitVector	16	R[15:0] R[15:12] DLC - Data length code. R[11:0] Reserved
MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes of the last bit in the message	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use R[12:7] Hours - BCD Hours 0 to 23 R[6:0] Minutes - BCD Minutes 0 to 59

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageTimeLo Seconds and centiseconds of the last bit in the message	Second	BCD	16	R[31:16] R(15) Reserved - Reserved for future use R[14:8] Seconds - Seconds 0 to 59 R[7:0] Centiseconds - Centiseconds 0 to 99
MessageTimeMicro Microseconds of the last bit in the message	Second	BCD	16	R[15:0] R[15:0] Microseconds - Microseconds 0 to 9999
MessageCountPerSlot Count of messages parsed to this slot since last reset/power-up.	Count	OffsetBinary	16	R[15:0]
Catchall-Parser Parameters				
MessageCount Value of BusMessageCount for this bus when the message in the slot was received.	Count	OffsetBinary	16	R[15:0]
MessageExtIdHi The Most Significant Bits (MSBs) of the extended identifier.	BitVector	BitVector	16	R[15:0] R[15:0] EID[17:2]
MessageExtIdLo The Least Significant Bits (LSBs) of the extended identifier.	BitVector	BitVector	16	R[15:0] R[15:14] EID[1:0] R[12:0] Reserved
MessageInfo Stale/skipped indication for this parsed message.	BitVector	BitVector	16	R[15:0] R(15) Empty - ID is empty (no message received). R(14) Stale - 1 indicates this message was read before. R(13) Skipped - 1 indicates this message overwrote another. R[12:0] Reserved - Reserved for future use.
MessageStdId The standard identifier.	BitVector	BitVector	16	R[15:0] R[15:5] STD ID - ID [10:0] R(4) SRR - SRR Standard frame remote transmit request bit. R(3) IDE - IDE Extended identifier flag. R[2:0] Reserved
MessageDLC Data Length Code for received message.	BitVector	BitVector	16	R[15:0] R[15:12] DLC - Data length code. R[11:0] Reserved
MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes of the last bit in message.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use R[12:7] Hours - BCD Hours 0 to 23 R[6:0] Minutes - BCD Minutes 0 to 59
MessageTimeLo Seconds and centiseconds of the last bit in message.	Second	BCD	16	R[31:16] R(15) Reserved - Reserved for future use R[14:8] Seconds - Seconds 0 to 59 R[7:0] Centiseconds - Centiseconds 0 to 99
MessageTimeMicro Microseconds of the last bit in message.	Second	BCD	16	R[15:0] R[15:0] Microseconds - Microseconds 0 to 9999

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessagePayload(3:0) CAN message payload.	BitVector	BitVector	16	R[15:0]
MessageCountPerSlot Count of messages parsed to the catchall slot since last reset/power-up.	Count	OffsetBinary	16	R[15:0]

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/CBM/107

For a detailed description on iNET-X packets, see *TEC/NOT/067 - IENA and iNET-X packet payload formats*.

iNET-X parser-aligned packet format

There is a diverse range of avionic bus technologies for which traffic may be captured, for example, MIL-STD-1553, PCM, or ARINC-429. The generalized iNET-X payload structure for parser-aligned packets is shown in the following figure.

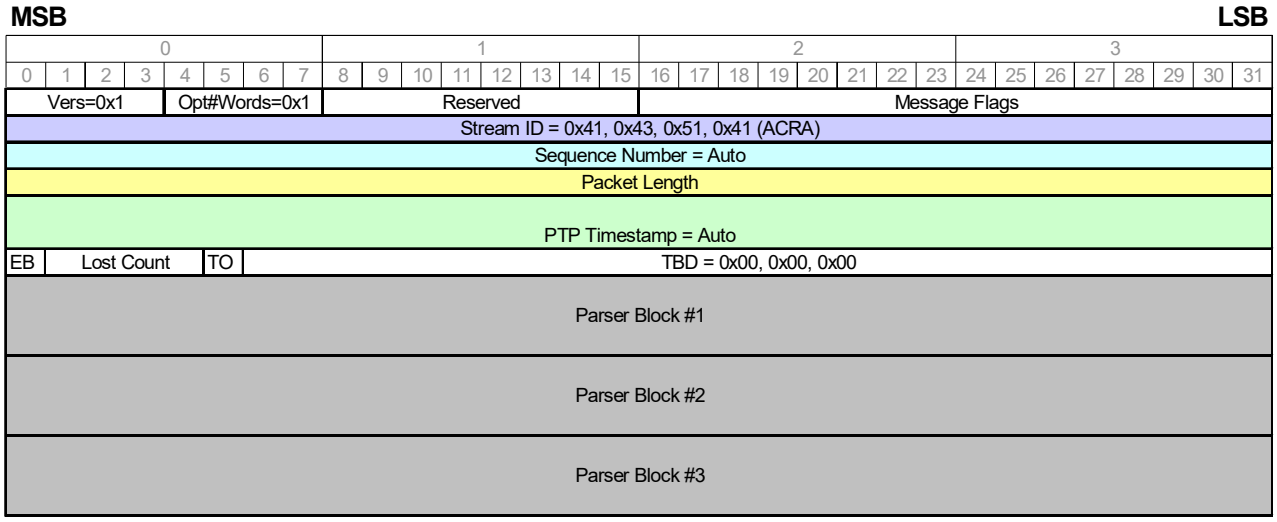


Figure 2: Generalized parser-aligned iNET-X packet

As messages are captured on the bus, they are formatted in a parser block. Each parser block begins with a 4-byte parser information word, followed by a 4-byte elapsed time tag and the message data shown in the following figure.

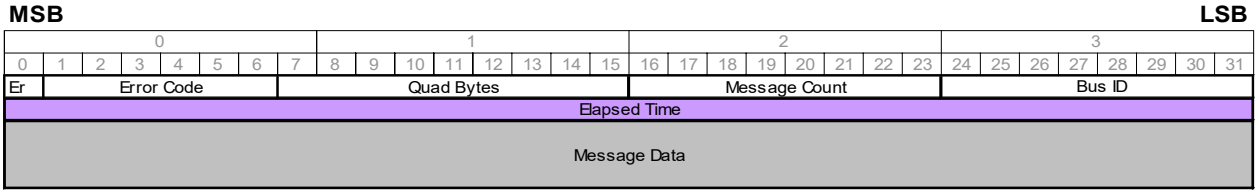


Figure 3: iNET-X parser block

A parser block consists of the following fields:

- Parser information word (4 bytes): metadata providing information about the health and status of the message.

- Er (Bit 0): indicates that an error occurred. (Note that this field is not used and always reads zero.)
- Bits [1:6]: Error code. (No error codes are defined; this field always reads zero.)
- Quad bytes (Bits [7:15]): number of quad bytes. This relates to the length of the parser information word, elapsed time tag, and the message data and padding (N x 4 bytes). For example, a 4-byte message captured from a given bus has a quad-byte value of 3, that is 12 bytes that includes 4 bytes parser information word, 4 bytes elapsed time, and 4 bytes bus message data.
- Message count (Bits [16:23]): message counter. This is a message counter that relates to the messages contained in the payload. The message counter increments for each message contained in the packet payload and continues to increment across consecutive packets. The message counter resets and wraps around to 0 once it has reached the maximum message count of 0xFF.
- Bus ID (Bits [24:31]): bus number.

- Elapsed time (4 bytes): time tag as an unsigned offset in nanoseconds that is added to the base PTP timestamp in the iNET-X header.
- Message data (N x 4 bytes): captured bus traffic, padded if necessary to end on 4-byte boundary.

Example iNET-X parser-aligned packet format for CAN bus KAD/CBM/107

The KAD/CBM/107 is a four-channel CAN bus 2.0 A/B compliant parser and packetizer. In packetizer mode, the received CAN bus messages from all busses are encapsulated in parser-aligned iNET-X packet structures.

The generalized structure of a KAD/CBM/107 parser block is illustrated in the following figure. In the figure you can see that the iNET-X payload contains three CAN bus messages. Common to all parser block structures, the first word of the message is the parser information word which contains the Bus ID field which allows the bus on which this message was received to be identified. Following the parser information word is the elapsed time in nanoseconds, which is added to the earliest reference timestamp contained in the iNET-X packet header. This is then followed immediately by the CAN bus message.

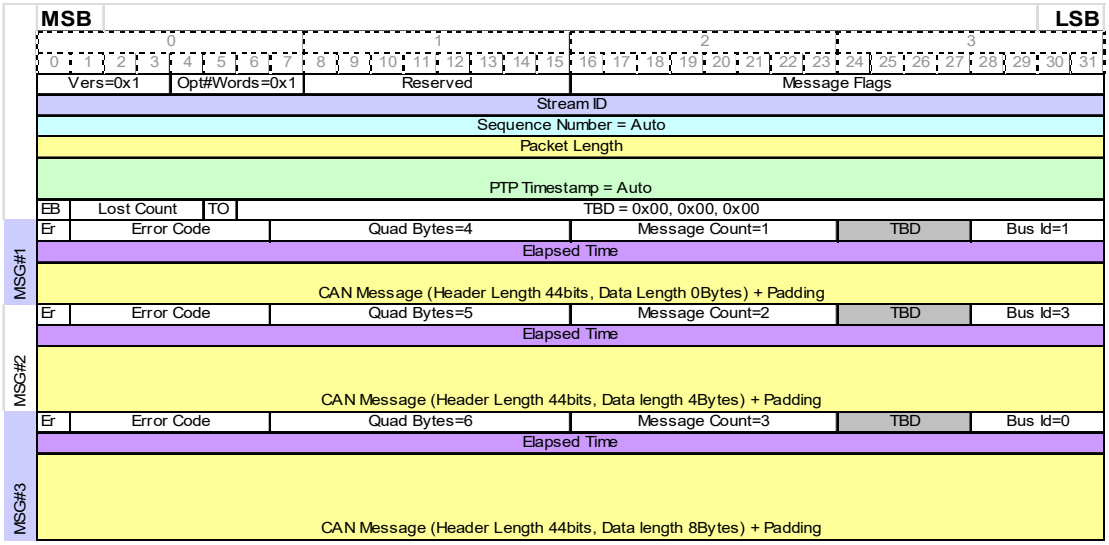


Figure 4: Generalized iNET-X parser block for multiple CAN bus messages

As the CAN bus messages arrive, the KAD/CBM/107 buffers them. A CAN bus message comprises a CAN bus header and data field which may contain 0 to 8 bytes of data. There are two formats of CAN bus header—an 11-bit Standard ID (SID) as received on a CAN 2.0 A bus, or a 29-bit Extended ID (EID) as received on a CAN 2.0 B bus. To facilitate processing a decommutation of the encapsulated CAN bus messages, a CAN bus status word immediately precedes the message. As with other bus packetizer modules, such as the KAD/PBM/104 and the KAD/MBM/101, the definition of the status word is bus-specific.

CAN bus message status word

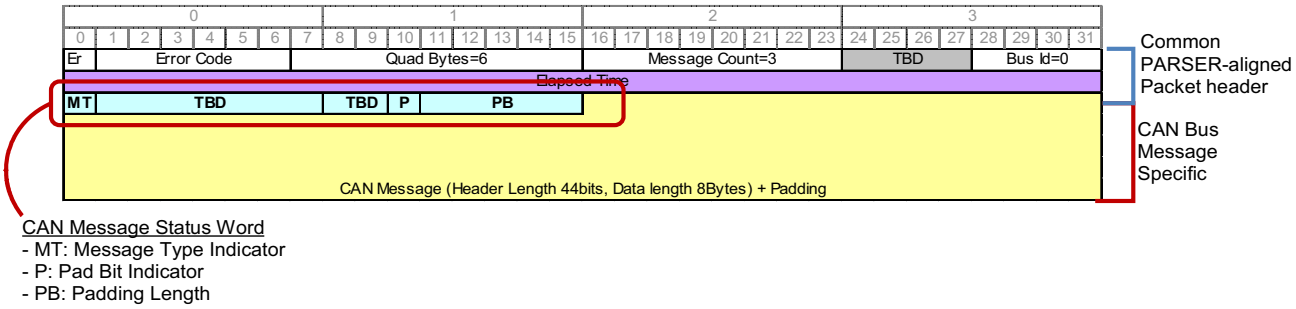


Figure 5: CAN bus message status word

- Bit(0) CAN Message Type indicator: MT indicates that the CAN message uses either an SID or an EID.
- MT=0 indicates that it is an 11-bit, CAN 2.0 A SID message.
- MT=1 indicates that it is a 29-bit, CAN 2.0 B EID message.
- Bits [1:9] Reserved
- Bit(10) Pad: P indicates whether the message has been padded.
- Bits [11:15] Pad Bits: PB indicates the number of bits that have been added to the end of the padded CAN message in order to achieve 32-bit alignment. 5 bits are used as it is possible that up to 31 bits may be required to pad the message to the 32-bit alignment boundary length.

iNET-X CAN bus parser-aligned packet structure padding

The following figure illustrates the format of a CAN bus message.

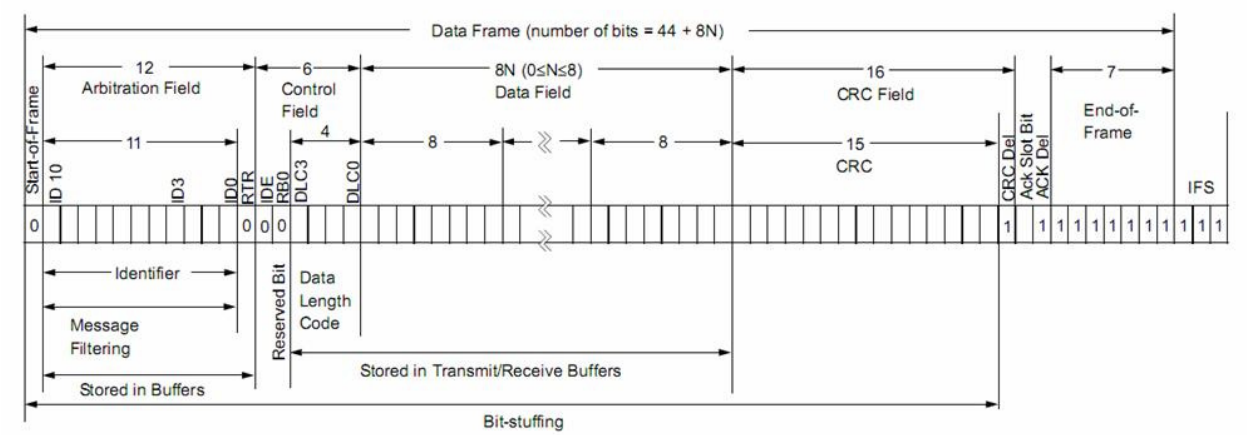


Figure 6: CAN bus message format

Since this format is not naturally network-order byte-aligned, the complete CAN message is treated as two distinct elements—a CAN message header word and the CAN message data (see the following figure). These are placed in the parser-aligned message block so that the first data byte of the CAN message is in the same location, regardless of whether it is an SID or EID message.

The KAD/CBM/107 does not store the Start-of-Frame field, Cyclical Redundancy Checking (CRC) fields, ACKnowledgement (ACK) fields, or the End-of-Frame field.

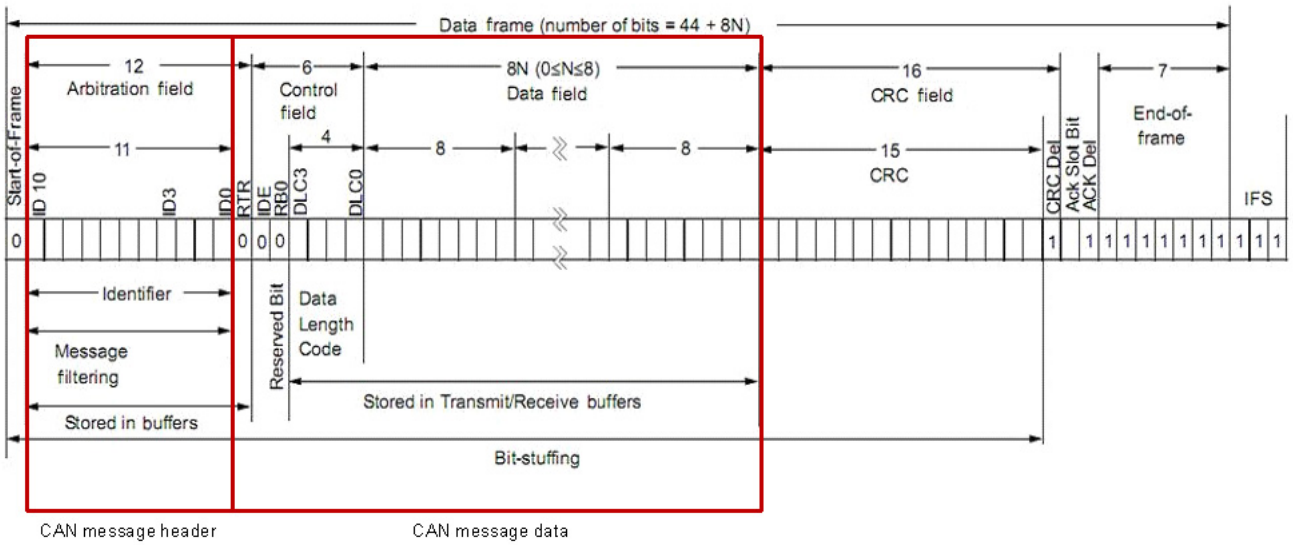
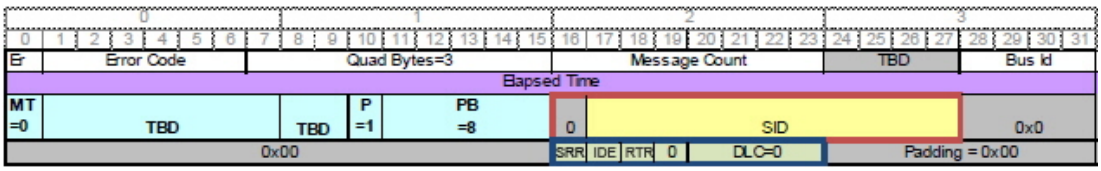


Figure 7: CAN message header word and CAN message data

The following table provides examples of SID and EID CAN bus messages in an iNET-X parser block structure.

Sample SID and EID CAN bus messages

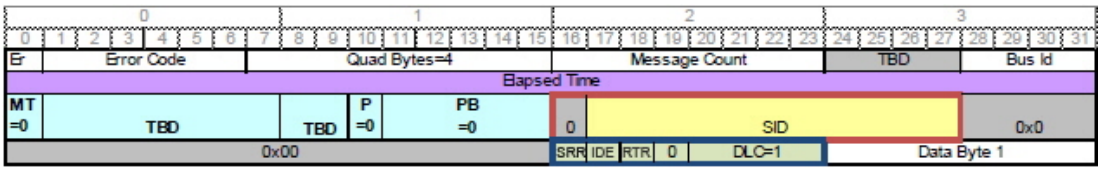
SID message with no data - padded



- MT=0: SID.
- P=1: Message is padded.
- PB=8: eight bits of padding appended to the end of the message.

DLC=0 No data bytes.

SID message with one byte of data - not padded

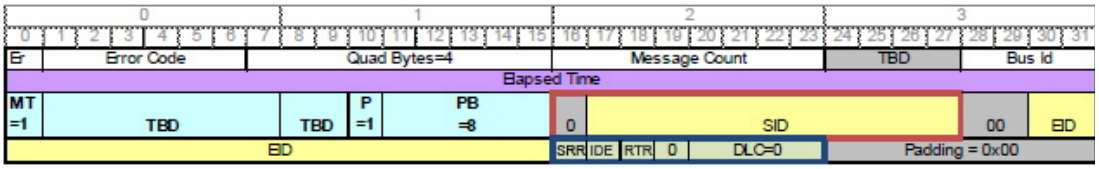


- MT=0: SID.
- P=0: Message is not padded.
- PB=0: No pad words appended to the message.

DLC=1 one byte of data.

Sample SID and EID CAN bus messages (continued)

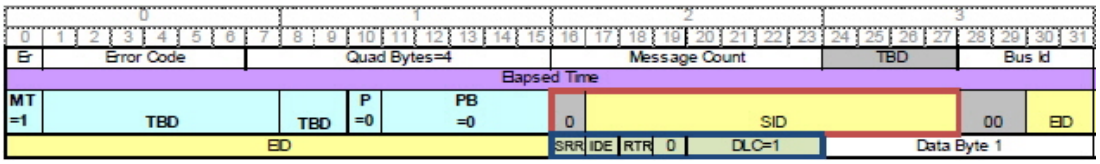
EID message with no data - padded



- MT=1: EID.
- P=1: Message is padded.
- PB=8: 8 bits of padding appended to the end of the message.

DLC=0.

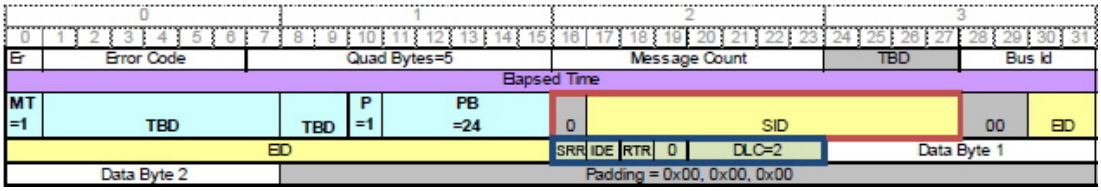
EID message with one byte of data - not padded



- MT=1: EID.
- P=0: Message is not padded.
- PB=0: No padding appended to the end of the message.

DLC=1: one byte of data.

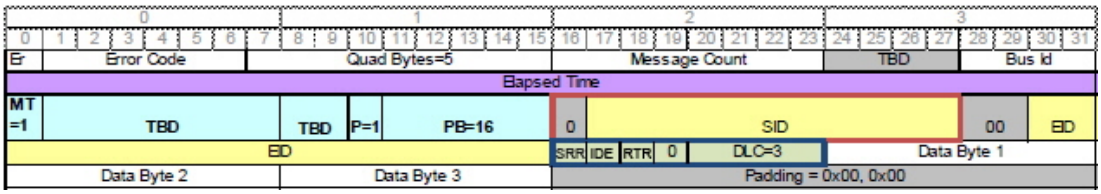
EID message with two bytes of data - padded



- MT=1: EID.
- P=1: Message is padded.
- PB=24: 24 bits of padding appended to the end of the message.

DLC=2: two bytes of data.

EID message with three bytes of data - padded

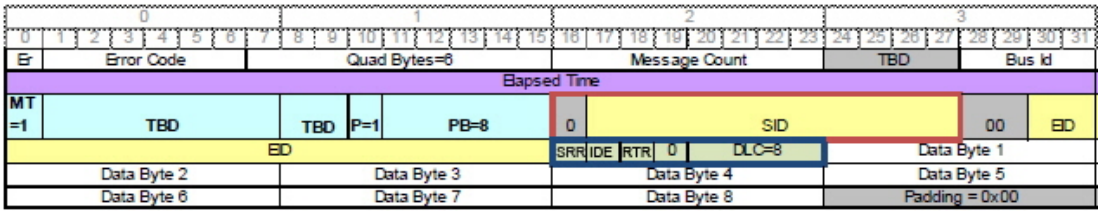


- MT=1: EID.
- P=1: Message is padded.
- PB=16: 16 bits of padding appended to the end of the message.

DLC=3: three bytes of data.

Sample SID and EID CAN bus messages (continued)

EID message with eight bytes of data - padded



- MT=1: EID.
- P=1: Message is padded.
- PB=8: eight bits of padding appended to the end of the message.

DLC=8: eight bytes of data.

Handling bit stuffing

The KAD/CBM/107 handles bit stuffing and any bit stuff error condition in compliance with CAN 2.0 B specifications. Where bit stuffing has been applied to the incoming data, according to the specifications, de-stuffing the affected bits is handled transparently by the front-end transceiver. If messages are deliberately lost on the bus due to a bit stuff error, the KAD/CBM/107 doesn't receive or report the messages. The KAD/CBM/107 is not capable of transmission, so it cannot cause a bit stuff error itself.

Connector pinout of the KAD/CBM/107

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DATA(0)+	CAN bus interface	High level CAN bus (receive only)
2	DATA(0)-	CAN bus interface	Low level CAN bus (receive only)
3	DATA(1)+	CAN bus interface	High level CAN bus (receive only)
4	DATA(1)-	CAN bus interface	Low level CAN bus (receive only)
5	DATA(2)+	CAN bus interface	High level CAN bus (receive only)
6	DATA(2)-	CAN bus interface	Low level CAN bus (receive only)
7	DATA(3)+	CAN bus interface	High level CAN bus (receive only)
8	DATA(3)-	CAN bus interface	Low level CAN bus (receive only)
9	CHASSIS	Chassis	
10	CHASSIS	Chassis	
11	GND	Internal ground	
12	GND	Internal ground	
13	GND	Internal ground	
14	DNC		Not connected
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	GND	Internal ground	
28	GND	Internal ground	
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/CBM/107	CAN bus monitor parser/packetizer - 4ch

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/CBM/107	First release	Recommended for new programs

Supporting software

MODULE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment

Related documentation

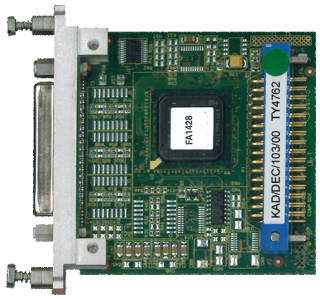
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
TEC/NOT/051	Ethernet frames, Wireshark® and FAT32
TEC/NOT/058	Overview of SNMP and using third party SNMP tools
TEC/NOT/067	IENA and iNET-X packet payload formats

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/DEC/103

IRIG-106 PCM decoder/merger - 2ch

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Key Features

- Decommutates up to two IRIG-106 PCM streams in NRZ-L (up to 20Mbps) or BIØ-L codes (up to 8Mbps)
- Up to 4k words per minor frame (16-bit) with programmable word length (4-16 bits), parity (odd/even/none) and word orientation per word
- Operates in synchronous mode with other Acra KAM-500s or in asynchronous mode with third-party PCM encoders

Applications

- Distributed data acquisition systems
- PCM decoders/mergers

Overview

The KAD/DEC/103 is a dual PCM decommutator that can accept two independent PCM streams. Data from each stream is individually parsed into a minor frame buffer from which it can be read coherently over the backplane.

The KAD/DEC/103 is ideally suited to merge two PCM streams in a distributed acquisition system with a star configuration.

In a typical distributed acquisition system where each Acra KAM-500 is operated synchronously, the KAD/DEC/103 runs in synchronous mode. Data is decommutated by the decoder before it is read over the backplane. In this mode there is no need for stale or skipped indication.

When decommutating data from an encoder running asynchronously, data is parsed into a coherent buffer. All parameters read are guaranteed to be from the same minor frame. If data is read slower than it is received, minor frames are skipped occasionally. If data is read faster than it is received, minor frames are repeated (stale) occasionally. In asynchronous mode it is recommended that the stale and skipped indication be read.

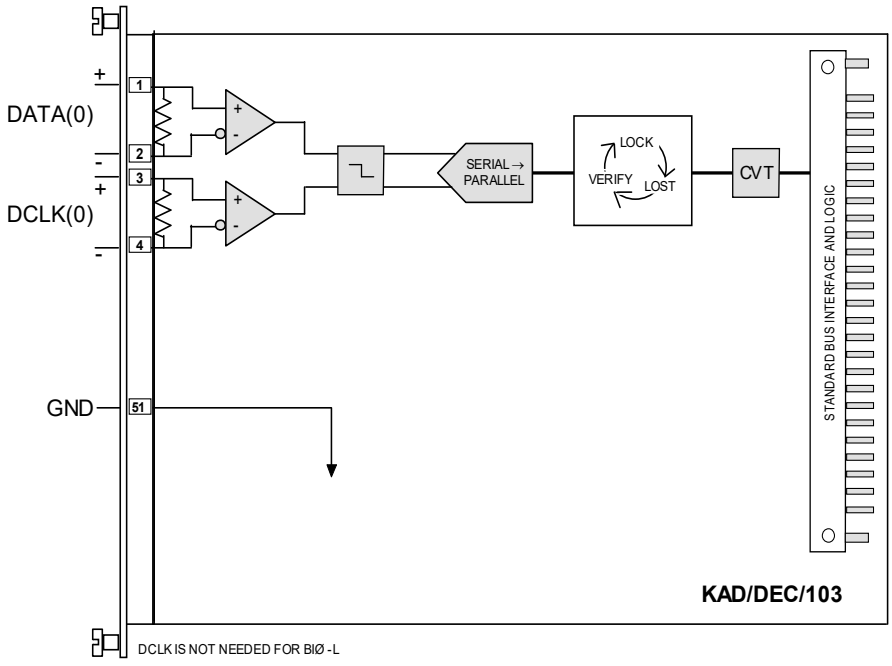


Figure 1: First of two independent PCM decommutators

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	66	–	g	
	–	2.23	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	190	–	260	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	0.95	–	1.3	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

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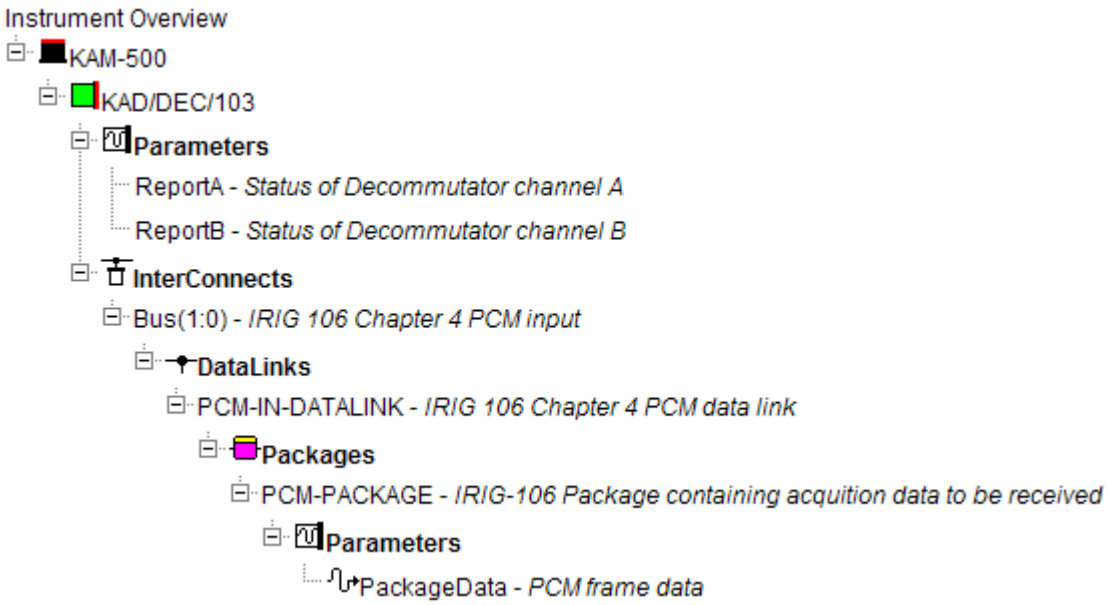
TABLE 2	RS-422 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	4	–	
Signalling rate					
Data	–	–	20	Mbps	NRZ-L (8Mbps for BIØ-L).
Input voltage					
operating range	-25	–	25	V	Do not exceed operating range.
logic 0	–	–	0.2	V	(130mV hysteresis) V_{IN+} - V_{IN-}.
logic 1	0.2	–	–	V	(130mV hysteresis) V_{IN+} - V_{IN-}.
common mode voltage	-20	–	25	V	
overvoltage protection	-27	–	27	V	Voltage in excess of these values can damage input.
ESD protection	–	16	–	kV	Human Body Model.
Input resistance					
between inputs	24	–	–	kΩ	Module powered on.
between inputs	24	–	–	kΩ	Module powered off.
between inputs	–	120	–	Ω	Module powered on and inputs terminated.
between inputs	–	120	–	Ω	Module powered off and inputs terminated.
each input to GND	12	–	–	kΩ	Module powered on.
each input to GND	12	–	–	kΩ	Module powered off.

Setting up the KAD/DEC/103

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

The following treeview provides an overview of setup configurations available for this module:

Treeview icons legend	
DAU: Data Acquisition Unit	Indicator: Indicates the firing of an event based on specific conditions
PC: Personal Computer	Parser slot: Area of memory reserved for storing parsed data
Instrument: Any component or module used in a data acquisition system	Snarfer: Captures all data transmitted on a bus and selectively stores it
DataLink: Connection for transmitting or receiving (defines both the data link and the physical layer)	Bridge: Electrical circuit usually used for measuring purposes
Package: Used to describe how data is transmitted or stored	PCMCIA card: Peripheral interface device usually for use in laptop computers
Parameter: Any register that can be read from an instrument	Multiplexer: Selects one of many input signals and outputs that signal on a signal line
Algorithm: Defines processing to be performed on data	Channels: Defines settings for input or output channels on an instrument
InterConnect: Represents a physical connection on an instrument	
PCI card: Circuit board that plugs into the PCI bus on a PC	



Setting up the module

The following table lists the setup configurations available for the KAD/DEC/103.

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/DEC/103	KAD/DEC/103	ACRA CONTROL part number.
SerialNumber	-	-	Unique name for each module.
InterConnects Bus(1:0)	No character limit	Not Specified	IRIG 106 Chapter 4 PCM input.
Settings	-	-	-
Module-PCM-In-1.2	-	-	-
Bus Bus(1:0)	-	-	-
SyncWordMask	FFFFFFFF:00000000	Not Specified	-

Setting up parameters

Parameter definitions

The following table lists all parameters that are available for the KAD/DEC/103.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
ReportA Status of decommutator channel A	Unitless	BitVector	16	R(15) Error received on the bus since last read. R(14) Sync word since last read. R(13)The bus is in lock. R[12:10] Reserved for future use. R[9:8] Error code. R(7) Stale, this frame has been read before. R(6) Skipped, one or more frames has been skipped. R(5) Empty, no frames have been received. R[4:0] Reserved for future use.
ReportB Status of decommutator channel B	Unitless	BitVector	16	R(15) Error received on the bus since last read. R(14) Sync word since last read. R(13)The bus is in lock. R[12:10] Reserved for future use. R[9:8] Error code. R(7) Stale, this frame has been read before. R(6) Skipped, one or more frames has been skipped. R(5) Empty, no frames have been received. R[4:0] Reserved for future use.
PackageData PCM frame data	-	-	16	R[15:0].

Setting up data links

A data link is a connection for transmitting and receiving data. It defines both the data link and physical layers of the link. The following are data links supported by the KAD/DEC/103.

Non-programmable data links

NAME	DESCRIPTION
Bus(1:0)	IRIG 106 Chapter 4 PCM data link

Setting up packages

A package is a logical description of how data is transmitted or stored.

PCM-PACKAGE

IRIG-106 Package containing acquisition data to be received.

SETUP DATA	CHOICE	DEFAULT	NOTES
ReferencedToAbsoluteTime	Yes No	Yes	-
PackageRate	-	-	-
DataLinkReference	No character limit	Not Specified	-
Properties	-	-	-
MajorFrameProperties	-	-	-
BitsPerMinorFrame	16384:48	48	16-bit words must be used when setting the maximum BitsPerMinorFrame to ensure buffer does not exceed 4096 words.
MinorFramesPerMajorFrame	1	1	-
DefaultDataBitsPerWord	16:4	16	-
DefaultMostSignificantBit	First Last	First	-
FillPattern	-		-
DefaultParity	None Odd Even	None	-
SynchronizationStrategy	-	-	-
SubframeSynchronizationStrategy	-	-	-
SFID	-	-	-
MinorFrameOffset_Bits	-	-	-
MinorFrameOffset_Words	-	-	-
StartValue	-	-	-
Increment	-	-	-
MostSignificantBit	-	-	-
Justification	-	-	-
SyncWord	-	-	-
Modulation	-	-	-
PCMCode	NRZ-L Bi-Phase-L	NRZ-L	-
DclkPhase	0 180	0	-
PCMPolarity	False True	True	-
Content	-	-	-
Parameter	-	-	-
NumberOfDataBits	-	-	-
MostSignificantBit	-	-	-

SETUP DATA	CHOICE	DEFAULT	NOTES
Location	-	-	-
MinorFrameNumber	1:1	Not Specified	-
Offset_Words	4095:3	3	-
Offset_Bits	-	-	-
Occurrences	-	-	-

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/DEC/103

Frame lock and loss

The number of necessary synchronization words to consider frame lock, and errors to cause a frame loss, is fixed, and therefore cannot be reprogrammed.

The KAD/DEC/103 is considered to be locked when two consecutive synchronization words are received correctly at the expected location and no other bit errors have been detected.

The KAD/DEC/103 immediately misses a frame after detecting a bit error (illegal bit), a parity error or a syncword error.

In summary, two synchronization words cause a frame lock and more than one bit error causes a frame loss.

Asynchronous mode

In asynchronous mode, if the data is read slightly faster (for example, 1% faster) than it is being received, data is never missed. However, it is sometimes repeated (1 in 100 frames in such cases). In asynchronous mode, to ensure PCM is in lock, check the Report/Status bits corresponding to The bus is in lock (bit 13) and the Sync word since last read (bit 14) making sure that both are set to logic 1. Any of these two bits set to zero implies possible loss of PCM lock. Additionally *stale, skip* and *empty* bits are relevant in asynchronous operation as the KAD/DEC/103 operates as a PCM bus monitor.

Frame structure

The KAD/DEC/103 is a minor-frame decoder only and therefore the default number of minor frames per major frame is one.

Error codes for the KAD/DEC/103

CODE	DESCRIPTION
0	Illegal BIØ-L bit[1]
1	Parity error
10	Sync word error
11	Reserved for future use

1. Available only in BIØ-L operation.

Synchronous operation: maximum inter-chassis bit rate

For synchronous operation in a distributed Acra KAM-500 chassis, the maximum inter-chassis bit-rate for the KAD/DEC/103 is 8Mbps, using NRZ-L PCM code.

Connector pinout of the KAD/DEC/103

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DATA(0)+	RS-422 inputs	PCM data; first bus
2	DATA(0)-	RS-422 inputs	PCM data; first bus
3	DCLK(0)+	RS-422 inputs	PCM data clock; first bus
4	DCLK(0)-	RS-422 inputs	PCM data clock; first bus
5	DATA(1)+	RS-422 inputs	PCM data
6	DATA(1)-	RS-422 inputs	PCM data
7	DCLK(1)+	RS-422 inputs	PCM data clock
8	DCLK(1)-	RS-422 inputs	PCM data clock
9	DNC		Do not connect
10	DNC		Do not connect
11	GND	Internal ground	
12	GND	Internal ground	
13	DNC		Do not connect
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/DEC/103	IRIG-106 PCM decoder/merger - 2ch (with 52-way double-density connector)
KAM/DEC/103	IRIG-106 PCM decoder/merger - 2ch (with 51-way micro-miniature connector)

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/DEC/103 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/DEC/103	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

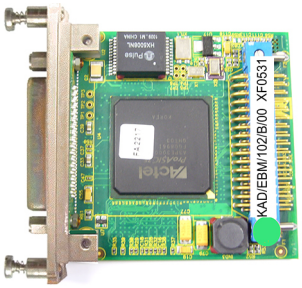
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
TEC/NOT/066	Using the KAD/DEC/103

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/EBM/102

Gigabit Ethernet bus monitor parser - 1ch

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Key Features

- Monitors a single 1000BaseT, IEEE 802.3 standard compatible, Gigabit Ethernet interface over copper cabling
- Coherently parses and classifies IPv4 packets up to 1,500 bytes and tags for up to 254 different flows and one catchall flow
- Supports flow identification on selected frame fields (8 × 16-bit fields) such as Ethernet MAC addresses, IP addresses, Layer 3 (UDP/TCP) fields, and Layer 4 application layer fields such as stream identifiers

Applications

- Monitoring, recording, diagnosis and troubleshooting of Ethernet network traffic

Overview

The KAD/EBM/102 can operate on 10BaseT, 100BaseTX and Gigabit Ethernet (1000BaseT) links and parse Ethernet frames. This allows the data within the parsed Ethernet frames to be distributed to other Acra KAM-500 modules.

The KAD/EBM/102 can classify traffic using 8 × 16-bit frame fields such as MAC addresses, IP addresses, IP length, protocol type (UDP/TCP), UDP or TCP port numbers. Up to 254 unique flows can be identified, where a flow represents a stream of Ethernet frames from a specific source to a specific destination. Flows are tagged with time stamps and packet count. The identification is based on the classification parameters with optional masking. All other traffic, excluding network management traffic such as ARP and ICMP-PING, is optionally discarded or else monitored via the catchall parser slot-ID 254. The KAD/EBM/102 replies to ARP requests and ICMP-PING requests.

The KAD/EBM/102 can optionally operate in a promiscuous mode, which allows it to observe all traffic on the link, not only packets that are addressed to it. The KAD/EBM/102 also features valid and error frame counters and error detection on Ethernet and IP layers.

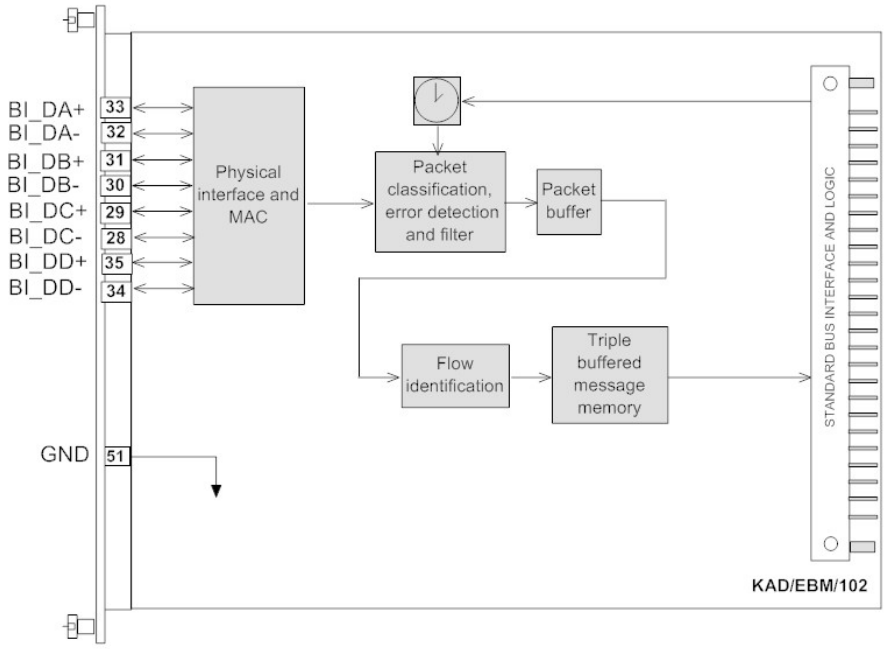


Figure 1: Single Ethernet link frame parser

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	75	–	g	
	–	2.65	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	–	–	465	mA	Monitoring a 1,000Mbps link.
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	–	–	2.3	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualifications Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Ethernet interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs/outputs	–	–	1	–	IEEE 802.3 compatible.

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Setting up the KAD/EBM/102

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/EBM/102/B	KAD/EBM/102/B	The instrument part reference.
SerialNumber	AAA1234	AAA1234	Unique name for each module.
Settings	-	-	-
Traffic Type	IENA Generic iNET-X All	iNET-X	Choose which set or sets of parser settings to use. All combines each set while processing is controlled by the Traffic Priority setting.
Traffic Priority	iNET-X then IENA then Generic iNET-X then Generic then IENA IENA then iNET-X then Generic IENA then Generic then iNET-X Generic then iNET-X then IENA Generic then IENA then iNET-X	iNET-X	Processing priority for package types when filtering rules overlap.
Operating Mode	Promiscuous Non-promiscuous	Non-promiscuous	Promiscuous mode allows monitoring of all network traffic. Non-promiscuous mode filters out traffic other than that addressed to the module's MAC address including broadcast traffic. The allowed values are Promiscuous and Non-Promiscuous.
Network Mode	Static	Static	-
Network Management Discard	True False	False	Disabling allows processing of received Broadcast-ARP-/PING- Requests and generation of appropriate Response packets. Also all Broadcast-ARP-/PING- Requests are rooted to parser slot 254. If set to Enabled all Broadcast-ARP-/PING- Requests are discarded.
IP Address	0.0.0.0 to 255.255.255.255	192.168.28.1	IP address of module, required to generate Broadcast-ARP/PING-Response, that is, if Network Management Discard is Disabled.
MAC Address	00-00-00-00-00-00 to FF-FF-FF-FF-FF-FF	00-00-00-00-00-00	Ethernet address of module, required to generate Broadcast-ARP/PING-Response, that is, if Network Management Discard is Disabled. Also required if Operating Mode is Non-promiscuous.
Route Unclassified Packets	True False	True	If set to True, all unclassified traffic is routed to the Catchall-Parser slot.
Bit Rate	1000 100 10 Auto-negotiate	1000	Interface bit rate in Mbps.
VLAN Support	True False	False	Enabling allows parser slot to skip over VLAN packet headers, if present, to classify traffic on basis of IP and UDP/TCP packet header fields.
Fill Value	0000 to FFFF	AAAA	Specifies the value that should be read from empty parser slots.

SETUP DATA	CHOICE	DEFAULT	NOTES
Settings Generic Parsing	-	-	Select packet offset locations for generic parsing.
Classifier Offset(0)	UTF-8 String Regular Expression: ^(?:75[0-8]|7[0-4][0-9]|[0-6]?[0-9][0-9]?|Not Used)$	Not Used	Word offset into Ethernet frame to use as classifier.
Classifier Offset(1)	UTF-8 String Regular Expression: ^(?:75[0-8]|7[0-4][0-9]|[0-6]?[0-9][0-9]?|Not Used)$	Not Used	Word offset into Ethernet frame to use as classifier.
Classifier Offset(2)	UTF-8 String Regular Expression: ^(?:75[0-8]|7[0-4][0-9]|[0-6]?[0-9][0-9]?|Not Used)$	Not Used	Word offset into Ethernet frame to use as classifier.
Classifier Offset(3)	UTF-8 String Regular Expression: ^(?:75[0-8]|7[0-4][0-9]|[0-6]?[0-9][0-9]?|Not Used)$	Not Used	Word offset into Ethernet frame to use as classifier.
Classifier Offset(4)	UTF-8 String Regular Expression: ^(?:75[0-8]|7[0-4][0-9]|[0-6]?[0-9][0-9]?|Not Used)$	Not Used	Word offset into Ethernet frame to use as classifier.
Classifier Offset(5)	UTF-8 String Regular Expression: ^(?:75[0-8]|7[0-4][0-9]|[0-6]?[0-9][0-9]?|Not Used)$	Not Used	Word offset into Ethernet frame to use as classifier.
Classifier Offset(6)	UTF-8 String Regular Expression: ^(?:75[0-8]|7[0-4][0-9]|[0-6]?[0-9][0-9]?|Not Used)$	Not Used	Word offset into Ethernet frame to use as classifier.
Classifier Offset(7)	UTF-8 String Regular Expression: ^(?:75[0-8]|7[0-4][0-9]|[0-6]?[0-9][0-9]?|Not Used)$	Not Used	Word offset into Ethernet frame to use as classifier.
Settings IENA Parsing	-	-	Select header fields to be used for parsing IENA traffic.
Source IP Address (IENA)	True False	False	Parse on Source IP Address (note: uses 2 classifications).
Source UDP Port (IENA)	True False	False	Parse on Source UDP Port Number.
Source MAC Address (IENA)	True False	False	Parse on Source MAC Address (note: uses 3 classifications).
Destination IP Address (IENA)	True False	False	Parse on Destination IP Address (note: uses 2 classifications).
Destination UDP Port (IENA)	True False	False	Parse on Destination UDP Port Number.
Destination MAC Address (IENA)	True False	False	Parse on Destination MAC Address (note: uses 3 classifications).
Key (IENA)	True False	False	Parse on IENA Key
Settings iNET-X Parsing	-	-	Select header fields to be used for parsing iNET-X traffic.

SETUP DATA	CHOICE	DEFAULT	NOTES
Source IP Address (iNet-X)	True False	False	Parse on Source IP Address (note: uses 2 classifications).
Source UDP Port (iNet-X)	True False	False	Parse on Source UDP Port Number.
Source MAC Address (iNet-X)	True False	False	Parse on Source MAC Address (note: uses 3 classifications).
Destination IP Address (iNet-X)	True False	False	Parse on Destination IP Address (note: uses 2 classifications).
Destination UDP Port (iNet-X)	True False	False	Parse on Destination UDP Port Number.
Destination MAC Address (iNet-X)	True False	False	Parse on Destination MAC Address (note: uses 3 classifications).
Stream ID (iNet-X)	True False	False	Parse on iNET-X Stream ID.
Channels	-	-	-
Ethernet Ethernet Input	-	-	-
Processes	-	-	-
Parser(253:0)	-	-	Parser slots for classified packages.
Catchall-Parser	-	-	Parser slot for unclassified packages (excluding network management traffic).
Packet-Filter(1023:0)	-	-	Specifies packet filtering rules.
Settings	-	-	-
Destination IP Address	0.0.0.0 to 255.255.255.255	192.168.2.1	Specifies the destination IP address the incoming packets should be filtered on.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Report Reports the status of the module	BitVector	BitVector	16	R[15:0] R[15:1] Reserved - Reserved for future use. R(0) Error Code - Ethernet link status. 0: Error, link is not connected. 1: No error.
FrameCount Frame count on the network link.	Count	OffsetBinary	16	R[15:0]
Parser(253:0) Parameters				
MessageCount Received frame count in the parser slot.	Count	OffsetBinary	16	R[15:0]
MessageSize Received frame size in bytes.	Unitless	OffsetBinary	16	R[15:0]

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageStatus Status of IP packets parsed.	BitVector	BitVector	16	R[15:0] R[15:3] Reserved R(2) IP Header Checksum - IP Header Checksum Status 0: Good IP Header Checksum 1: Bad IP Header Checksum R(1) IP Version - IP version check 0: IP version is IPv4 1: IP version is not IPv4 R(0) Reserved
MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes at the start of first received bit.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use R[12:7] Hours - BCD Hours 0 to 23 R[6:0] Minutes - BCD Minutes 0 to 59
MessageTimeLo Seconds and centiseconds at the start of first received bit.	Second	BCD	16	R[31:16] R(15) Reserved - Reserved for future use R[14:8] Seconds - Seconds 0 to 59 R[7:0] Centiseconds - Centiseconds 0 to 99
MessageTimeMicro Microseconds at the start of first received bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - Microseconds 0 to 9999
MessageInfo Information about parsed message.	BitVector	BitVector	16	R[15:0] R(15) Empty 1: This parser slot has not been written to yet. R(14) Stale 1: The message in this parser slot has been read before. R(13) Skipped 1: The message in this parser slot overwrote another message that had not been read. R[12:0] Reserved
Catchall-Parser Parameters				
MessageCount Received frame count in the parser slot.	Count	OffsetBinary	16	R[15:0]
MessageSize Received frame size in bytes.	Unitless	OffsetBinary	16	R[15:0]
MessageStatus Status of IP packets parsed.	BitVector	BitVector	16	R[15:0] R[15:3] Reserved R(2) IP Header Checksum - IP Header Checksum Status 0: Good IP Header Checksum 1: Bad IP Header Checksum R(1) IP Version - IP version check 0: IP version is IPv4 1: IP version is not IPv4 R(0) Reserved
MessageIrigTime48 48 bit wide IRIG time word	BitVector	BitVector	48	R[47:0]

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageTimeHi Hours and minutes at the start of first received bit.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use R[12:7] Hours - BCD Hours 0 to 23 R[6:0] Minutes - BCD Minutes 0 to 59
MessageTimeLo Seconds and centiseconds at the start of first received bit.	Second	BCD	16	R[31:16] R(15) Reserved - Reserved for future use R[14:8] Seconds - Seconds 0 to 59 R[7:0] Centiseconds - Centiseconds 0 to 99
MessageTimeMicro Microseconds at the start of first received bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - Microseconds 0 to 9999
MessageData(757:0) Data captured from Ethernet frames.	BitVector	BitVector	16	R[15:0]
MessageInfo Information about parsed message.	BitVector	BitVector	16	R[15:0] R(15) Empty 1: This parser slot has not been written to yet. R(14) Stale 1: The message in this parser slot has been read before. R(13) Skipped 1: The message in this parser slot overwrote another message that had not been read. R[12:0] Reserved
Packet-Filter(1023:0) Parameters				

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/EBM/102

The KAD/EBM/102 can be used to parse and classify IPv4 or VLAN encapsulated IPv4 packets, which are transported over an Ethernet network link. No other packet types are supported, that is, IPv6, IEEE 1588, MAC control etc. Ethernet traffic rates up to 1,000Mbps bandwidth are supported. Link auto-negotiation can be configured to establish a connection to 10/100/1000Mbps networks.

1000BaseT physical layer medium is defined as 100Ω CAT5 UTP cable. CAT5e or CAT6 UTP cable can also be used.

Monitoring network traffic via a passive network tap

The KAD/EBM/102 monitors true full-duplex traffic per link in real-time.

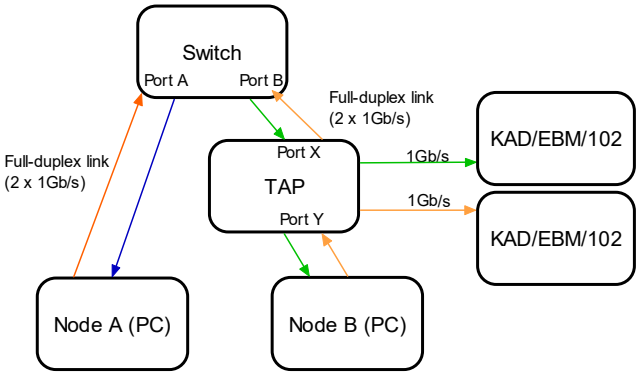


Figure 2: Ethernet monitoring via tap

Monitoring network traffic via a switch

The KAD/EBM/102 can monitor filtered traffic as managed by the switch. Ethernet packets can be delayed, reordered, or even lost in the switch.

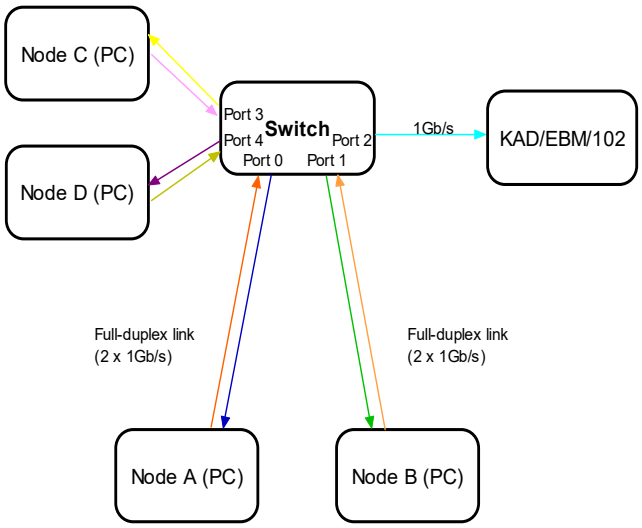


Figure 3: Ethernet monitoring via switch

A managed switch can be used to filter traffic to the switch port connecting to the KAD/EBM/102.

Unmanaged switches may require the switch port connecting to the KAD/EBM/102 to be stimulated via PING request/reply packets to prevent the switch port from dropping an inactive link. Unmanaged switches may not forward all traffic to the switch port connecting to the KAD/EBM/102.

Monitoring unfiltered traffic via a hub

The KAD/EBM/102 monitors unfiltered traffic at the common star point established by the hub. Ethernet packets cannot be delayed or filtered in the hub. However, hubs should not be used to monitor full-duplex Ethernet links, as operation is restricted to half-duplex mode only, thus making hubs susceptible to collisions which results in frames with errors. Half-duplex operation is not possible on Gigabit Ethernet networks so a hub cannot be used for monitoring.

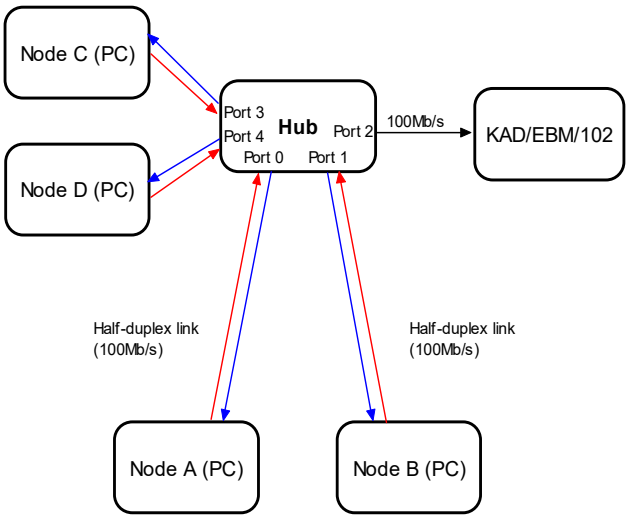


Figure 4: Ethernet monitoring via hub

KAD/EBM/102 limitations

ARP and PING packets addressed to the KAD/EBM/102 are replied to only if the KAD/EBM/102 is connected to the network via a switch or hub, but not via a tap.

Packet classification example

IP Packets can be classified into any of 254 unique parser slots on the basis of frame/packet header field values and/or data. Eight fields may be specified within the Ethernet frame, where each field has 16-bit size and granularity.

- The KAD/EBM/102 is being used to monitor packets using a switch, where the switch has been setup to forward all IP packets received on ports A/B/C/D to the KAD/EBM/102 via port L, but not traffic received on ports E/F/G. Thus the switch is performing a very coarse filtering of data.
- The traffic to be monitored is dialog involving Node A (connected to port A) and the other nodes connected to ports B/C/D.
- TCP and UDP traffic are monitored.
- The network is configured with static IP addresses, that is the IP address is predetermined and known (as opposed to dynamic IP addressing where a server allocates addresses to the network nodes using Dynamic Host Configuration Protocol [DHCP]). The IP address of Node A is 192.168.1.55 (on a Windows PC the IP address can be determined from DOS shell using the command ipconfig /all).
- It is not essential to know the Ethernet MAC address (or physical address) of Node A or any of the nodes with which it is communicating, as the IP address is a unique identifier for the node on the network.

NOTE: Up to eight classifiers can be specified when configuring the KAD/EBM/102. These classifiers can be located anywhere in the packet. Unexpected results can occur when classifiers are located within the body of a packet and packets which are shorter than the classifier location are received. Under these circumstances the shorter packet can be filtered to a parser slot unexpectedly.

In this example the KAD/EBM/102 is setup to filter packets sent by Node A, and packets destined to Node A.

- For packets sent by Node A, the IP Source address field displays a value of 192.168.1.55.
- For packets destined for Node A, the IP Destination address field displays a value of 192.168.1.55.
- 192.168.1.55 is a 32-bit number represented in hex notation as $C0A80137_{16}$.
- The IP Source address field is located within an Ethernet frame in 16-bit fields 13 and 14.
- The IP Destination address field is located within an Ethernet frame in 16-bit fields 15 and 16.
- TCP traffic can be identified when 06_{16} is displayed in the 8-bit IP Protocol Field.
- UDP traffic can be identified when 11_{16} is displayed in the 8-bit IP Protocol Field.
- The IP Protocol field is located within an Ethernet frame in the lower byte of 16-bit field 11.

Thus the KAD/EBM/102 may be configured as follows:

- UDP traffic sent from Node A is routed to parser slot 0.
- UDP traffic sent to Node A is routed to parser slot 1.
- TCP traffic sent from Node A is routed to parser slot 2.
- TCP traffic sent to Node A is routed to parser slot 3.

In this case, five Ethernet frame fields (fields 11/13/14/15/16) are classified as follows:

- xx11/C0A8/0137/xxxx/xxxx => route to parser slot 0
- xx11/xxxx/xxxx/C0A8/0137 => route to parser slot 1
- xx06/C0A8/0137/xxxx/xxxx => route to parser slot 2
- xx06/xxxx/xxxx/C0A8/0137 => route to parser slot 3

Or, alternatively, the KAD/EBM/102 may be configured as follows:

- UDP traffic sent to or from Node A is routed to parser slot 0.
- TCP traffic sent to or from Node A is routed to parser slot 1.

In this case, five Ethernet frame fields (fields 11/13/14/15/16) are classified as follows:

- xx11/C0A8/0137/xxxx/xxxx => route to parser slot 0
- xx11/xxxx/xxxx/C0A8/0137 => route to parser slot 0
- xx06/C0A8/0137/xxxx/xxxx => route to parser slot 1
- xx06/xxxx/xxxx/C0A8/0137 => route to parser slot 1

This is a simple example classifying data packets using only five of the eight available fields. More complicated classification is possible, using, for example, the Ethernet MAC addresses in the case where IP addresses are not predetermined (in a network where a server allocates IP addresses using the DHCP protocol), or using fields to distinguish between higher-layer protocol packets such as HTTP (web browser traffic) or FTP (file transfer).

TABLE 3	Values of OffsetIndex_Words	
FIELD NAME	OFFSET IF VLAN DISABLED	OFFSET IF VLAN ENABLED
Destination MAC address, word 0	0	0
Destination MAC address, word 1	1	1
Destination MAC address, word 2	2	2
Source MAC address, word 0	3	3
Source MAC address, word 1	4	4
Source MAC address, word 2	5	5
Frame type	6	8
VLAN priority/ID	N/A	7
IP version/IHL/ToS	7	9
IP packet size	8	10
IP ID	9	11
IP flags and fragment offset	10	12
IP TTL and protocol	11	13
IP header checksum	12	14
Source IP address, word 0	13	15
Source IP address, word 1	14	16
Destination IP address, word 0	15	17
Destination IP address, word 1	16	18
Source port no.	17	19
Destination port no.	18	20
UDP Length; TCP seq word 0	19	21
UDP CSum; TCP seq word 1	20	22
IENA key; TCP Ack word 0	21	23
IENA size; TCP Ack word 1	22	24
iNET-X Stream ID word 0, IENA date 0; TCP offset/flags	23	25
iNET-X Stream ID word 1, IENA date 1; TCP window	24	26
IENA date 2; TCP Csum	25	27
IENA status; TCP urgent Ptr	26	28
IENA Seq;TCP Options (or TCP Data 0)	27	29

ARINC 664 Part 7 (A664P7) monitoring

A664P7 defines the use of a deterministic Ethernet network as an avionic data bus. Since the KAD/EBM/102 can operate at 100BaseTX and is an Ethernet packet parser, it can monitor A664P7 traffic, however care must be taken using the

KAD/EBM/102 as an A664P7 destination end-system. A KAD/ARR/101 may be used to check the sequencing and remove the redundancy between the two source networks.

Setting the parser sample rate

The KAD/EBM/102 parser is triple buffered. If there is a burst of more than two messages between parser sampling intervals, the triple buffer can become saturated. The skipped bit in the MessageInfo parameter can be used to detect saturation as it indicates that a message was overwritten without being read. At all times, only complete and coherent messages are transferred.

If it is necessary for all messages in bursty traffic to be captured, the parser data must be sampled at a greater rate than the burst rate.

Connector pinout of the KAD/EBM/102

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DNC		Do not connect
2	DNC		Do not connect
3	DNC		Do not connect
4	DNC		Do not connect
5	DNC		Do not connect
6	DNC		Do not connect
7	DNC		Do not connect
8	DNC		Do not connect
9	CHASSIS	Chassis	
10	DNC		Do not connect
11	DNC		Do not connect
12	DNC		Do not connect
13	DNC		Do not connect
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	CHASSIS	Chassis	
28	DC-	Ethernet interface	Ethernet interface (pair C)
29	DC+	Ethernet interface	Ethernet interface (pair C)
30	DB-	Ethernet interface	Ethernet interface (pair B); Receive- for 100Mbps
31	DB+	Ethernet interface	Ethernet interface (pair B); Receive+ for 100Mbps
32	DA-	Ethernet interface	Ethernet interface (pair A); Transmit- for 100Mbps
33	DA+	Ethernet interface	Ethernet interface (pair A); Transmit+ for 100Mbps
34	DD-	Ethernet interface	Ethernet interface (pair D)
35	DD+	Ethernet interface	Ethernet interface (pair D)
36	CHASSIS	Chassis	
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	CHASSIS	Chassis	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/EBM/102/B	Gigabit Ethernet bus monitor parser - 1ch

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/EBM/102/B	Gigabit Ethernet interoperability with NET/SWI/101	Recommended for new programs
KAD/EBM/102	First release	Not recommended for new programs

Supporting software

SOFTWARE	DIFFERENCES
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related products

MODULE	DETAILS
NET/CON/001	1.5m female micro-miniature, circular to KAD Ethernet cable for KAD/BCU/140
NET/CON/009	KAD/BCU/140 programming cable 52-way DD to RJ45
NET/CON/011	1.5m female micro-miniature, circular to KAD flexible Ethernet cable for KAD/BCU/140

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
TEC/NOT/075	Using DAS Studio 3 to configure the KAD/EBM/102

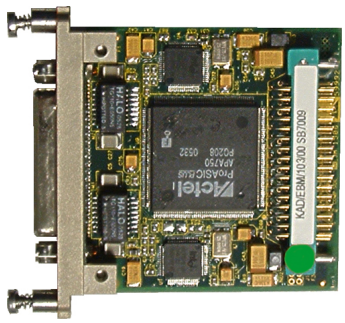
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/EBM/103

Parser for ARINC-429 on an ARINC 664 Part 7 (ARINC-664P7) network

CURTISSWRIGHTDS.COM



Features

- Monitors a single 100BaseTx IEEE 802.3 standard compatible Ethernet interface
- Coherently parses up to 1024 Rockwell Collins NDO within the ARINC-664P7 payload
- Stores ARINC-429 messages corresponding to matched ARINC-NDO headers in a Current Value Table (CVT)
- Features valid and error frame counters

Applications

- Monitoring and recording of ARINC-429 traffic transmitted over Rockwell Collins Pro Line Fusion Avionics System LAN (ASL)

Description

The KAD/EBM/103 is designed to accept 100BaseTX Ethernet traffic, then parse it and distribute it to other Acra KAM-500 modules.

The KAD/EBM/103 parses ARINC-664P7 traffic on the Rockwell Collins Pro Line Fusion ASL. This traffic consists of Ethernet packets, wrapping a variable number of ARINC-429 Network Data Objects (NDO), each associated with a 32-bit NDO-header identifier value consisting of a 24-bit NDO-ID and an 8-bit NDO-Source. The module specifically captures ARINC-NDO wrapping ARINC-429 format 32-bit messages.

The KAD/EBM/103 filters traffic using the ARINC-664P7 frame headers to select frames that contain ARINC-NDO messages. Up to 1,024 unique ARINC-NDO headers can then be identified within the ARINC-NDO payload based on the related NDO-header identifiers. The corresponding messages are stored in a CVT and tagged with time stamps.

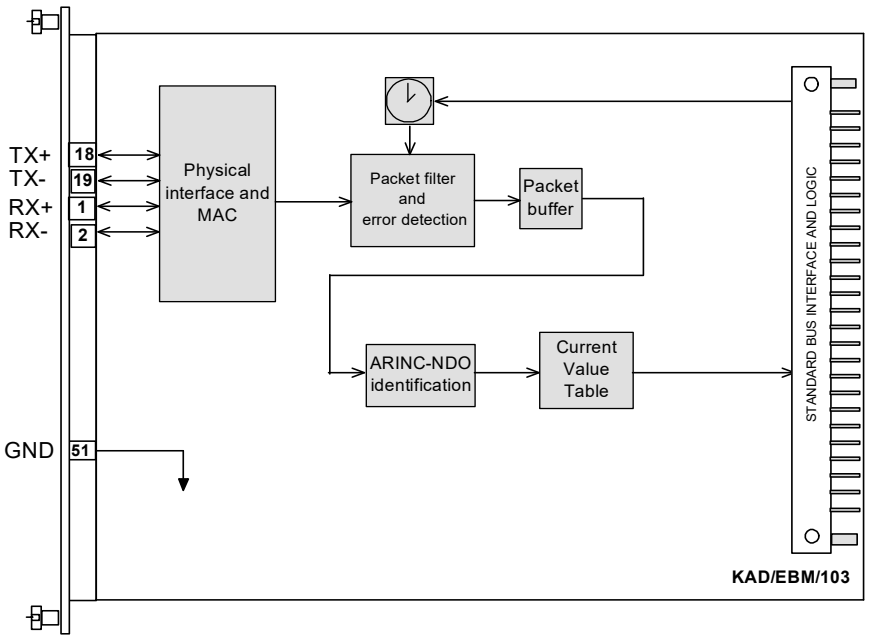


Figure 1: ARINC-NDO parser

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	75	–	g	
	–	2.65	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	260	–	480	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	1.3	–	2.4	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Ethernet interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs/outputs	–	–	1	–	IEEE 802.3 compatible.

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Setting up the KAD/EBM/103

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/EBM/103	KAD/EBM/103	The instrument part reference.
SerialNumber	FA1234	FA1234	Unique name for each module.
Channels	-	-	-
AFDX-In AFDX Input	-	-	ARINC-NDO traffic on an ARINC-664P7 channel.
Parsers	-	-	-
Parser (1024)	-	-	Parser slots for classified packages.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
AFDX-In Parameters				
FrameCount Count of frames received.	Count	OffsetBinary	48	R[47:0]
FrameErrorCount Count of frames dropped due to frame errors.	Count	OffsetBinary	48	R[47:0]
FrameDropCount Count of frames dropped due to receive FIFO overload.	Count	OffsetBinary	48	R[47:0]
FrameDiscardCount Count of frames discarded because frame headers indicate they do not contain NDO messages that would be parsed.	Count	OffsetBinary	48	R[47:0]
NdoMessageCount Count of ARINC NDO messages parsed from the traffic and written to Current Value Table.	Count	OffsetBinary	48	R[47:0]
NdoDiscardCount Count of NDOs examined but not parsed to parser slots. Does not include NDOs from frames that are discarded based on frame header fields.	Count	OffsetBinary	48	R[47:0]
MessageCount Message count across all slots	Count	OffsetBinary	16	R[15:0]

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageInfo Information about parsed message.	BitVector	BitVector	16	R[15:0] R(15) Empty 1: This parser slot has not been written to yet. R(14) Stale 1: The message in this parser slot has been read before. R(13) Skipped 1: The message in this parser slot overwrote another message that had not been read. R[12:0] Reserved
MessageIrigTime48 48-bit wide IRIG time word	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes at the start of first received bit.	BitVector	BitVector	16	R[47:32] R[6:0] Minutes - BCD Minutes 0 to 59 R[12:7] Hours - BCD Hours 0 to 23 R[15:13] Reserved - Reserved for future use
MessageTimeLo Seconds and centiseconds at the start of first received bit.	Second	BCD	16	R[31:16] R[7:0] Centiseconds - Centiseconds 0 to 99 R[14:8] Seconds - Seconds 0 to 59 R(15) Reserved - Reserved for future use
MessageTimeMicro Microseconds at the start of first received bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - Microseconds 0 to 9999
MessageData Data captured from Ethernet frames.	BitVector	BitVector	32	R[31:0]

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/EBM/103

Each ARINC-NDO message parsed is individually time stamped with the time the frame was received. The count tag, which can be read with each parsed message, increments (across all the parser slots) when each message is parsed and indicates the order the messages are received.

Before the first valid message is parsed into a particular slot, an empty bit is set. If the empty bit is set, the data is invalid and should not be used.

Multiple messages that are received in the same ARINC-664P7 frame are parsed into different parser slots depending on the NDO-header identifier.

If messages arrive slower than the rate at which the Ethernet Acra KAM-500 backplane controller is reading, a stale bit indicates that the same message has been read before. If messages arrive faster than the Ethernet Acra KAM-500 backplane controller can read them, a skipped bit indicates that a message has been missed. This may happen if multiple messages with the same identifier arrive in the same ARINC-664P7 frame, as the slot contains only the last available parsed message.

Connector pinout of the KAD/EBM/103

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	RX+	Ethernet interface	
2	RX-	Ethernet interface	
3	DNC		Do not connect
4	DNC		Do not connect
5	DNC		Do not connect
6	DNC		Do not connect
7	DNC		Do not connect
8	DNC		Do not connect
9	DNC		Do not connect
10	DNC		Do not connect
11	DNC		Do not connect
12	DNC		Do not connect
13	DNC		Do not connect
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	TX+	Ethernet interface	
19	TX-	Ethernet interface	
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/EBM/103	Parser for ARINC-429 on an ARINC 664 Part 7 (ARINC-664P7) network

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/EBM/103	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio User 3 Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/EBM/104

GE Aviation ARINC-664P7 bus monitor parser

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Key Features

- Monitors a dual redundant ARINC-664P7 compatible interface with redundancy removal
- Supports 512 virtual links
- Coherently parsers 256 different flows for parametric ARINC-664P7
- Coherently parsers 8192 different flows for ARINC 429 over ARINC-664P7
- Two 100BaseTX Ethernet interfaces streaming non redundant traffic to network recorders

Applications

- Monitoring of messages transmitted over GE Aviation ARINC-664P7 bus and streaming to networked recorder

Overview

The KAD/EBM/104 receives ARINC-664P7 traffic on a dual redundant interface; redundant messages are removed before the stream is sent to a classifier, which it then splits into two groups: parametric messages containing known placed data, which are parsed and made available across the Acra KAM-500 backplane, and non parametric messages containing ARINC-429 words where their content and placement is unknown, requiring further parsing before they are made available.

All parser slots are triple buffered; there are 256 parser slots for parametric messages and 8192 slots for ARINC 429 words/messages.

The KAD/EBM/104 has two additional 100BaseT (relay) ports that forward a mirror copy of all frames received after redundancy removal for transmission to packet recorders.

Fragmentation of ARINC-664P7 messages is not fully supported by the parser; the parser captures the first fragment only, while discarding the remaining fragments. The relay output forwards all fragmented messages.

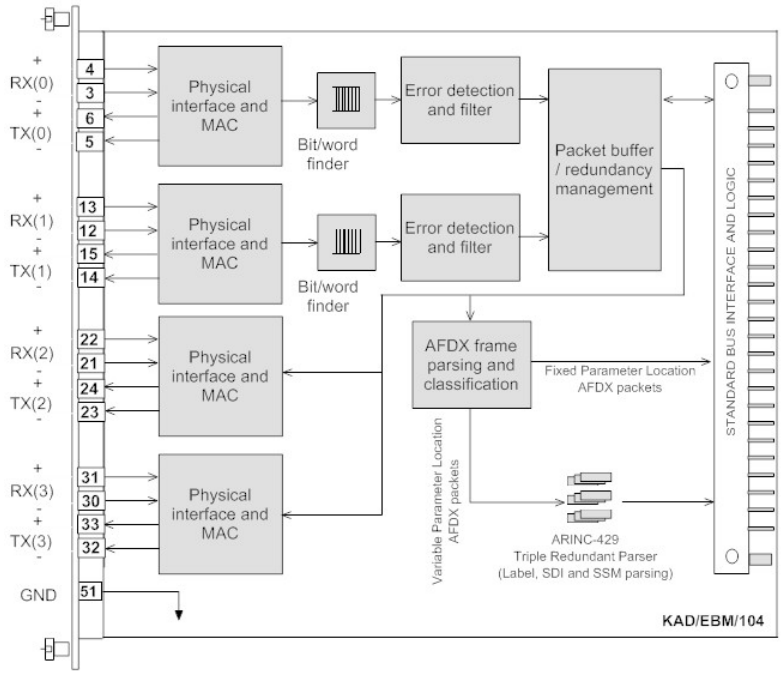


Figure 1: Inputs and outputs of the KAD/EBM/104 parser module

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	90	–	g	
	–	3.17	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	360	–	440	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	1800	–	2200	mW	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	ARINC-664P7				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs/outputs	–	–	2	–	IEEE 802.3 compatible.

TABLE 3	Ethernet interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs/outputs	–	–	4	–	IEEE 802.3 compatible.

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Setting up the KAD/EBM/104

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CON-TROL	Name of manufacturer.
PartReference	KAD/EBM/104	KAD/EBM/104	The instrument part reference.
SerialNumber	FA1234	FA1234	Unique name for each module.
Settings	-	-	-
Fill Value	0000 to FFFF	AAAA	Specifies the value that should be stored when the bus monitor is not receiving data.
Settings Importer Settings	-	-	-
ICD CSV File	UTF-8 String		Location and filename of a CSV file containing ICD (Interface Control Document) description of bus.
Receiving LRU	HF_FTI_AFT HF_FTI_FWD HF_FTI_L HF_FTI_R None	None	
Channels	-	-	-
ARINC_664_Part_7 ARINC 664 Part 7 Input	-	-	-
Processes	-	-	-
Parser(254:0)	-	-	ARINC-664P7 parser slots for parametric messages.
Catchall-Parser	-	-	All ARINC-664P7 parametric data not classified for parsing is captured in this parser slot.
Embedded_ARINC_429 ARINC 429 over ARINC 664 Part 7 Input	-	-	-
Processes	-	-	-
Parser(8190:0)	-	-	ARINC 429 over ARINC-664P7 parser slots.
Catchall-Parser	-	-	All ARINC 429 not classified for parsing is captured in this parser slot.
Ethernet-Out(1:0) Ethernet Output	-	-	Outputs a copy of all packets received on ARINC-664P7 In link.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Report Reports the status of the module; the MSB indicates that a new error has occurred since last read. All other bits are persistent and once set to 1 remain set until the module is reset by cycling the power or a new error occurs.	BitVector	BitVector	16	R[15:0] R(15) ErrorSinceLastRead - 1 indicates error occurred since last read. R(14) Reserved R(13) Non-Parametric Message size too big - 1 indicates that a non-parametric message containing ARINC 429 traffic was received with a size greater than 128. This may be due to misconfigured MIW/EDE setting. This bit is persistent and will cause Report(15) to be set to 1. R(12) Non-Parametric Message size zero - 1 indicates that a non-parametric message containing ARINC 429 traffic was received with a size of zero messages. This may be due to misconfigured MIW/EDE setting, or it could be normal behaviour where the end system is sending a frame with no ARINC 429 messages but making use of allocated bandwidth. Treat this as a warning; it will not cause Report(15) to be set to 1. R(11) Network B Sequence Number Error - The ARINC-664P7 Sequence number was different from the expected value; this bit is persistent and will cause Report(15) to be set to 1. R(10) Network B Ethernet Frame Bad CRC - 1 indicates that the CRC on network B failed, this bit is persistent and will cause Report(15) to be set to 1 R(9) Network B Bad Bit - 1 indicates that a bad bit occurred on network B, this bit is persistent and will cause Report(15) to be set to 1 R(8) Network B Link Inactive - 1 indicates that the link on network B is not active, this bit is driven by the phys activity bit and will not cause Report(15) to be set to 1 R[7:4] Reserved R(3) Network A Sequence Number Error - The ARINC-664P7 Sequence number was different from expected value, this bit is persistent and will cause Report(15) to be set to 1 R(2) Network A Ethernet Frame Bad CRC - 1 indicates that the CRC on network A failed; this bit is persistent and will cause Report(15) to be set to 1. R(1) Network A Bad Bit - 1 indicates that a bad bit occurred on network A; this bit is persistent and will cause Report(15) to be set to 1. R(0) Network A Link Inactive - 1 indicates that the link on network A is not active.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
RxValidCount(1:0) Number of packets received before redundancy removal block.	BitVector	BitVector	16	R[15:0]
RxErrorCount(1:0) Count of errors on ARINC-664P7 channel before redundancy removal block.	BitVector	BitVector	16	R[15:0]
RxDiscardCount(1:0) Number of packets removed by redundancy removal block.	BitVector	BitVector	16	R[15:0]
RxIcFailCount(1:0) Number of packets which failed integrity check and were dropped.	BitVector	BitVector	16	R[15:0]
TxRelayCount Number of ARINC-664P7 packets transmitted on the relay ports.	BitVector	BitVector	16	R[15:0]
Parser(254:0) Parameters				
A664P7MessageCount Received frame count in the parser slot.	Count	OffsetBinary	16	R[15:0]
A664P7MessageSize Received frame size in bytes.	Unitless	OffsetBinary	16	R[15:0]
A664P7MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
A664P7MessageTimeHi Hours and minutes at the start of first received bit.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use R[12:7] Hours - BCD Hours 0 to 23 R[6:0] Minutes - BCD Minutes 0 to 59
A664P7MessageTimeLo Seconds and centiseconds at the start of first received bit.	Second	BCD	16	R[31:16] R(15) Reserved - Reserved for future use R[14:8] Seconds - Seconds 0 to 59 R[7:0] Centiseconds - Centiseconds 0 to 99
A664P7MessageTimeMicro Microseconds at the start of first received bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - Microseconds 0 to 9999
A664P7MessageInfo Information about parsed message.	BitVector	BitVector	16	R[15:0] R(15) Empty 1: This parser slot has not been written to yet. R(14) Stale 1: The message in this parser slot has been read before. R(13) Skipped 1: The message in this parser slot overwrote another message that had not been read. R[12:0] Reserved
Catchall-Parser Parameters				
A664P7MessageCount Received frame count in the parser slot.	Count	OffsetBinary	16	R[15:0]

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
A664P7MessageSize Received frame size in bytes.	Unitless	OffsetBinary	16	R[15:0]
A664P7MessageIrigTime48 48-bit wide IRIG time word	BitVector	BitVector	48	R[47:0]
A664P7MessageTimeHi Hours and minutes at the start of first received bit.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use R[12:7] Hours - BCD Hours 0 to 23 R[6:0] Minutes - BCD Minutes 0 to 59
A664P7MessageTimeLo Seconds and centiseconds at the start of first received bit.	Second	BCD	16	R[31:16] R(15) Reserved - Reserved for future use R[14:8] Seconds - Seconds 0 to 59 R[7:0] Centiseconds - Centiseconds 0 to 99
A664P7MessageTimeMicro Microseconds at the start of first received bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - Microseconds 0 to 9999
A664P7MessageData(757:0) Data captured from Ethernet frames.	BitVector	BitVector	16	R[15:0]
A664P7MessageInfo Information about parsed message.	BitVector	BitVector	16	R[15:0] R(15) Empty 1: This parser slot has not been written to yet. R(14) Stale 1: The message in this parser slot has been read before. R(13) Skipped 1: The message in this parser slot overwrote another message that had not been read. R[12:0] Reserved
Parser(8190:0) Parameters				
A429MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
A429MessageTimeHi Hours and minutes of the last bit in the message	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use R[12:7] Hours - BCD Hours 0 to 23 R[6:0] Minutes - BCD Minutes 0 to 59
A429MessageTimeLo Seconds and centiseconds of the last bit in the message.	Second	BCD	16	R[31:16] R(15) Reserved - Reserved for future use R[14:8] Seconds - Seconds 0 to 59 R[7:0] Centiseconds - Centiseconds 0 to 99
A429MessageTimeMicro Microseconds of the last bit in the message.	Second	BCD	16	R[15:0] R[15:0] Microseconds - Microseconds 0 to 9999
A429MessageCount A copy of the number of the ARINC 664P7 received frame count which contained the ARINC 429 messages.	Count	OffsetBinary	16	R[15:0]

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
A429MessageInfo Information about parsed message.	BitVector	BitVector	16	R[15:0] R(15) Empty 1: This parser slot has not been written to yet. R(14) Stale 1: The message in this parser slot has been read before. R(13) Skipped 1: The message in this parser slot overwrote another message that had not been read. R[12:0] Reserved
Catchall-Parser Parameters				
A429MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
A429MessageTimeHi Hours and minutes time midway through first transmitted bit.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
A429MessageTimeLo Seconds and centiseconds time midway through first transmitted bit.	BitVector	BitVector	16	R[31:16] R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.
A429MessageTimeMicro Microsecond time midway through first transmitted bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - BCD Microseconds 0 to 9999.
A429MessageCount A copy of number of the ARINC 664P7 received frame count which contained the ARINC 429 messages.	Count	OffsetBinary	16	R[15:0]
A429MessageData The ARINC 429 data as it was received, Parity, SSM, Data, SDI and Label	BitVector	BitVector	32	R[31:0] R(31) Parity - The parity bit received. R[30:29] SSM - SSM(1:0): Sign/Status Matrix. R[28:10] Data - Data(18:0) : ARINC 429 Data field. R[9:8] SDI - SDI(1:0) Source Destination Identifier. R[7:0] Label - Label(0:7) : The ARINC 429 Label in the order it was received.
A429MessageInfo Information about parsed message.	BitVector	BitVector	16	R[15:0] R(15) Empty 1: This parser slot has not been written to yet. R(14) Stale 1: The message in this parser slot has been read before. R(13) Skipped 1: The message in this parser slot overwrote another message that had not been read. R[12:0] Reserved

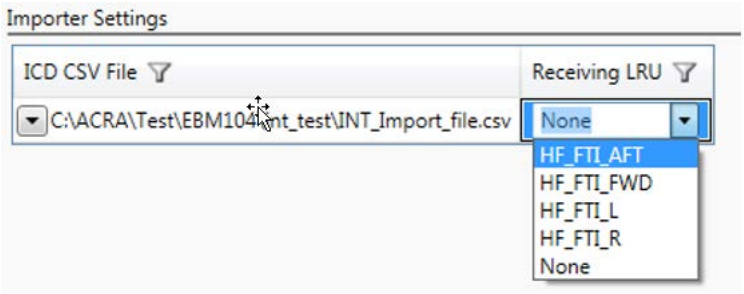
NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/EBM/104

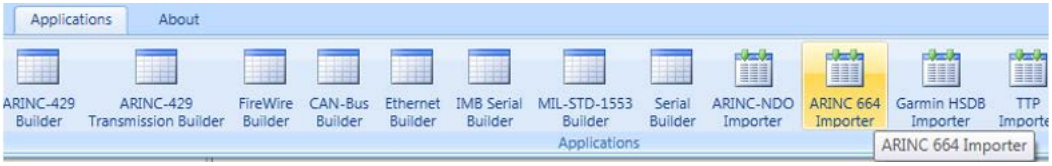
Importing ARINC-664P7 message definitions into DAS Studio 3

For this example, four KAD/EBM/104 modules are used. Each KAD/EBM/104 is configured to parse ARINC-664P7 traffic from one of four ARINC-664P7 busses. The message definitions for each bus are contained in a CSV file provided by the user.

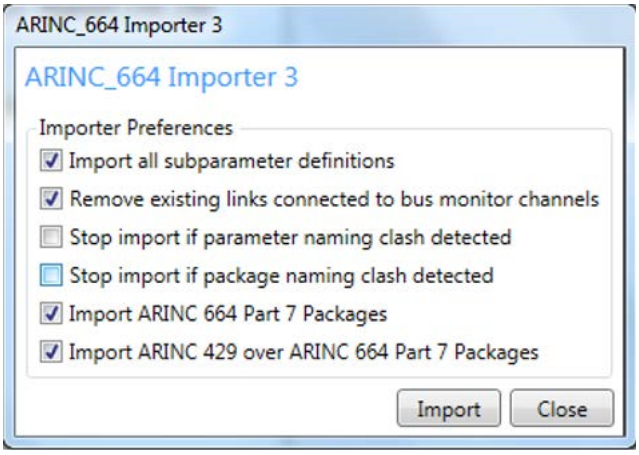
1. On the KAD/EBM/104 **Settings** tab, go to **Importer Settings**.
2. Click the **ICD CSV File** drop-down arrow and then browse to the CSV file to import.



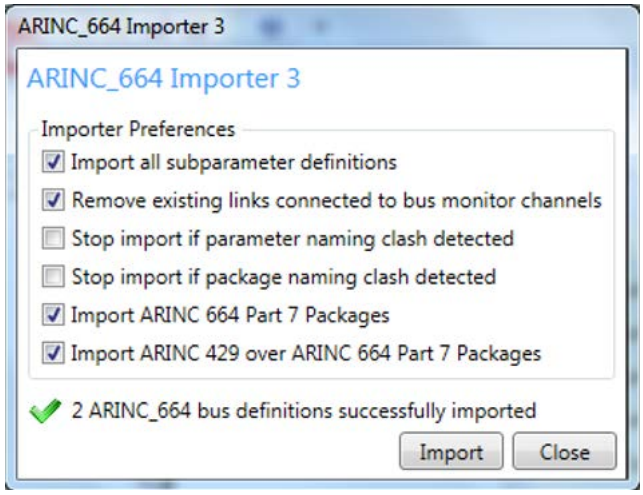
3. In the **Receiving LRU** field, select which bus from the ICD file this module must parse.
4. Repeat the above steps to set up each KAD/EBM/104 module in the task file.
5. On the **Applications** menu click **ARINC 664 Importer**.



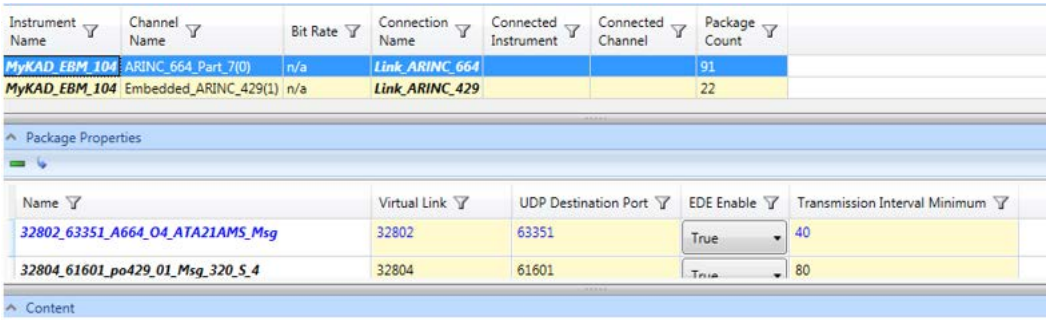
The **ARINC 664 Importer 3** dialog box opens. It is recommended to use the default settings as shown.



6. Clicks **Import**.
   After import, the following dialog box opens.



The message definitions imported for both **A664 Parametric** and **A664 A429** block message can be seen on the **Packages** tab in DAS Studio 3.



The parameters from these message definitions can now be placed in PCM or Ethernet as required.

Fragmentation

When a UDP message is fragmented over several IP packets, the UDP port numbers are contained in the first fragment only. As the destination port number is used to assign a parser ID, only the first fragment can be parsed, and only parameters within that fragment are available over the backplane. You must ensure that the way in which packets are fragmented does not change if data from a first fragment is to be captured, otherwise you may get unexpected results.

Closed network

ARINC-664P7 is intended for operation in a closed network; the KAD/EBM/104 is not intended to be used on an open network such as a Windows or a Linux domain. If a KAD/EBM/104 is used on an open network for commissioning or test purposes, then network management traffic will be sent. Some of this traffic will pass the ARINC-664P7 integrity check and redundancy management rules and then be transmitted by the relay ports. However, not all network management traffic will pass these rules and will instead be dropped from the system.

Power-on error report

The error output bits from the Ethernet PHY IC are brought into the modules report word. Occasionally, at power-on the PHY indicates an error before the interface is live. By monitoring the fresh error bit in the report word these errors can be filtered out.

Connector pinout of the KAD/EBM/104

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DNC		Do not connect
2	DNC		Do not connect
3	RX(0)-	ARINC-664P7	Connect to ARINC 664 network A
4	RX(0)+	ARINC-664P7	Connect to ARINC 664 network A
5	TX(0)-	ARINC-664P7	Connect to ARINC 664 network A
6	TX(0)+	ARINC-664P7	Connect to ARINC 664 network A
7	DNC		Do not connect
8	DNC		Do not connect
9	CHASSIS	Chassis	
10	DNC		Do not connect
11	DNC		Do not connect
12	RX(1)-	ARINC-664P7	Connect to ARINC 664 network B
13	RX(1)+	ARINC-664P7	Connect to ARINC 664 network B
14	TX(1)-	ARINC-664P7	Connect to ARINC 664 network B
15	TX(1)+	ARINC-664P7	Connect to ARINC 664 network B
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	RX(2)-	Ethernet interface	Mirror output Ethernet connection
22	RX(2)+	Ethernet interface	Mirror output Ethernet connection
23	TX(2)-	Ethernet interface	Mirror output Ethernet connection
24	TX(2)+	Ethernet interface	Mirror output Ethernet connection
25	DNC		Do not connect
26	DNC		Do not connect
27	CHASSIS	Chassis	
28	DNC		Do not connect
29	DNC		Do not connect
30	RX(3)-	Ethernet interface	Mirror output Ethernet connection
31	RX(3)+	Ethernet interface	Mirror output Ethernet connection
32	TX(3)-	Ethernet interface	Mirror output Ethernet connection
33	TX(3)+	Ethernet interface	Mirror output Ethernet connection
34	DNC		Do not connect
35	DNC		Do not connect
36	CHASSIS	Chassis	
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	CHASSIS	Chassis	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/EBM/104	GE Aviation ARINC-664P7 bus monitor parser

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/EBM/104	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

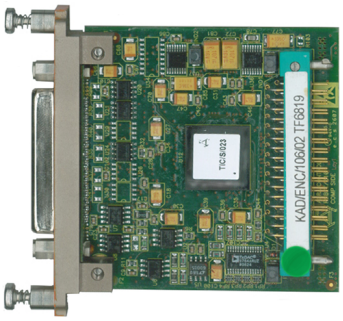
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ENC/106

IRIG-106 PCM encoder (PMF output)

CURTISSWRIGHTDS.COM



Key Features

- Sixth order linear phase (Bessel) PMF with programmable cutoff from 175kHz to 6MHz and output voltage from ±0.5Vp to ±5Vp
- Up to 10 PCM codes at up to 20Mbps
- 2 to 250K words per major frame and 4 to 8K words per minor frame
- 5 to 64 bits and parity (odd/even/none) programmable word by word
- Supports any sync word and sub-frame strategy

Applications

- RF transmission of PCM IRIG-106 Ch.4 streams

Overview

The KAD/ENC/106 is used to encode data from any KAM-500 module in an IRIG-106 Ch.4 PCM stream.

Multiple KAD/ENC/106 modules can be included in a KAM-500 system and parameters can be sent to some or all encoders. In particular, a system can have four encoders at different codes, data rates, word lengths and frame lengths. The only restriction is that an integral number of major frames be transmitted per acquisition cycle.

Parameters to be transmitted are stored in predefined locations in RAM. Each parameter has a word definition which includes the location in RAM, bits per word, MSB sent first/last and parity. This definition controls the RAM reader and the parallel-to-serial converter.

The KAD/ENC/106 has differential ended RS-422 outputs for data and clock along with buffered TTL outputs for NRZ-L, DATA, DCLK, word, minor-frame and major-frame pulses.

The KAD/ENC/106 also has a programmable premodulation filtered analog output which is suitable for use with a linear FM transmitter for telemetry. The cutoff frequency and amplitude can be changed to suit the bit-rate and transmitters deviation sensitivity.

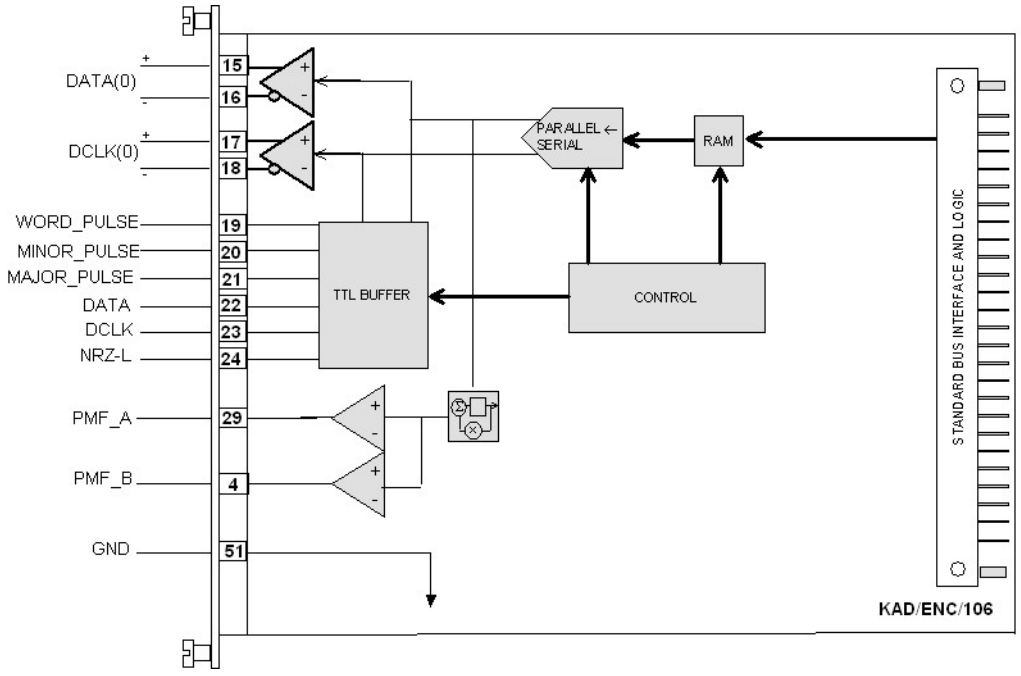


Figure 1: KAD/ENC/106 block diagram

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	70	–	g	
	–	2.47	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	231	–	284	mA	
±7V	0	–	0	mA	
+12V	53	–	54	mA	
-12V	49	–	49	mA	
total power	2.38	–	2.67	W	
Environmental ratings					See *Environmental Qualifications Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	RS-422 outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	8	–	
Signalling rate					
DATA[1:0]	–	–	20	Mbps	RZ, NRZ-L/M/S, RNRZ-L 15
DATA[1:0]	–	–	8	Mbps	BiØ-L/M/S, DM-M/S.
DCLK[1:0]	–	–	20	MHz	
Output voltage					
operating range	-20	–	25	V	
logic 0	–	–	-2	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
logic 1	2	–	–	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
short circuit current	–	–	100	mA	
short circuit duration	∞	–	–	s	Only one output may be shorted at a time.
ESD protection	–	–	5	kV	Human Body Model.
Output resistance	–	33	–	Ω	

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TABLE 3	BTTL outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	6	–	
Signalling rate					
DATA	–	–	16	Mbps	
DCLK	–	–	16	MHz	
NRZ_L	–	–	16	Mbps	
WORD	–	–	16	MHz	High for last bit of any word.
MINOR	–	–	4	MHz	High for last word of minor frame.
MAJOR	–	–	4	MHz	High for last word of major frame.
Output voltage					
logic 0	–	–	0.44	V	Sinking 24mA.
logic 1	3.76	–	–	V	Sourcing 24mA.
short circuit protection	–	–	50	mA	Indefinite to GND.
Output resistance	–	100	–	Ω	100Ω in series with standard TTL.

TABLE 4	Premodulation filter outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Amplitude					
PMF_A	±0.5	–	±2	V_p	PMF_A will drive a 50Ω load; setting the output voltage to $2V_p$ will result in $1V_p$ as the output impedance is 50Ω.
PMF_B	±2	–	±5	V_p	PMF_B is not designed to drive loads lower than 1KΩ; connecting a 50Ω load to it will result in excessive power dissipation.
Filter cutoff	175	–	6000	kHz	The filter cutoff is defaulted to 0.7 times the bit-rate for non return to zero codes and to 1.4 times for bi-phase codes. This is in accordance with the IRIG Telemetry Application Handbook recommendations.
Signalling rate					
RNRZ-L 15, NRZ-L/M/S	250	–	8000	kbps	
BiØ-L/M/S	125	–	4000	kbps	
Total harmonic distortion					
PMF_A	–	40	–	dBc	
PMF_B	–	40	–	dBc	
Current output					
short circuit protection PMF_A	–	40	–	mA	Indefinite to GND.
short circuit protection PMF_B	–	100	–	mA	Indefinite to GND.
Output resistance	–	50	–	Ω	50Ω in series with the output driver.
Filter type	–	–	–	–	Bessel (linear phase).
Restrictions	–	–	–	–	PCM code must be the same as the PCM digital output.

Setting up the KAD/ENC/106

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ENC/106	KAD/ENC/106	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
PCM-Out(1:0) PCM Output	-	-	IRIG 106 Chapter 4 PCM output.
Settings	-	-	-
Pcm Code	NRZ-L NRZ-M NRZ-S DM-M DM-S Bi-Phase-L Bi-Phase-M Bi-Phase-S RNRZ-L-15 RZ	NRZ-L	Specifies the PCM encoding used
Clock Phase	0 180	0	Indicates the phase of the data clock in degrees
Polarity	True False	True	Specifies the polarity used to transmit, where True means that data will be not inverted.
DCLK Enable	True False	False	-
PCM Enable	True False	False	-
Bit Rate	500 to 20000000	1000000	Specifies the number of bits transmitted per second
Packetizer Format	iNET-X	iNET-X	Selects the packetizer header format for all channels.
Stream Id	00 to FFFFFFFF	FFFFFFFF	iNET-X stream ID for selected channel if a packet is generated via the assertion of Packetization Enabled. This setting is only supported in DAS Studio 3.
Packetization Enabled	True False	False	Enables the transmission via an iNET-X transmitter module (for example KAD/ETH/102) of an iNET-X packet containing the contents of this channel. This setting is only supported in DAS Studio 3.
PMF-Out Analog Output	-	-	Programmable premodulation filtered analog output which is suitable for use with a linear FM transmitter for telemetry.
Settings	-	-	-
Amplitude	0 to 4	4	This value is the pk-pk amplitude that is, if you specify 10 you are setting the amplitude to +/- 5V or if you specify 1 you are setting the amplitude to +/-0.5V.
Enabled	True False	False	PMF Enable
Output	A B	A	PMF Output

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ENC/106

The KAD/ENC/106 has a transmission buffer of 32K registers in synchronous mode. The transmission buffer is 16 bits wide. The encoder can concatenate multiple registers to form words up to 64 bits long. If a register is transmitted, at least four bits from that register must be sent. Because data transmission is synchronous with backplane operation, a single register can be used for multiple parameters or multiple instances of a parameter when operating in synchronous mode.

The origin of each word in the PCM stream must be specified; fill data is used for unspecified locations. The location of the parameter in the buffer is transparent.

When transmitting PCM data over an RF link using bi-phase codes there are two dominant frequencies in the data signal; at the bit-rate and at half the bit-rate. When using non-return to zero codes, the highest frequency is at half the-bit rate but long chains of 1s or 0's can introduce frequencies down to DC. Using random codes such as RNRZ-L/15 makes good use of the available bandwidth whilst breaking up long chains of constant bits.

PCM encoder outputs

The KAD/ENC/106 has the following PCM encoder outputs:

DATA[1:0]±

Differential ended RS-422 output. Differential PCM coded data output.

DCLK[1:0]±

Differential ended RS-422 output. Differential data clock, consists of a transition at the start and centre of each bit transmitted.

DATA

Single ended BTTL output with 100Ω resistor in series.

DCLK

Single ended BTTL clock output with 100Ω resistor in series.

WORD_PULSE

Single ended BTTL output with 100Ω resistor in series. High for the last bit of each word. Its falling edge is aligned to the end of the last bit of each word.

MINOR_PULSE

Single ended BTTL output with 100Ω resistor in series. High for the last word of each minor frame. Its falling edge is aligned to the end of the last bit of each minor frame.

MAJOR_PULSE

Single ended BTTL output with 100Ω resistor in series. High for the last word of each major frame. Its falling edge is aligned to the end of the last bit of each major frame.

Timing, bit-rates and commutation

The following figure shows examples of timing for NRZL and Bi-Phase L (BIØ-L). For maximum bit-rates and supported PCM transmission see “Specifications” on page 746.

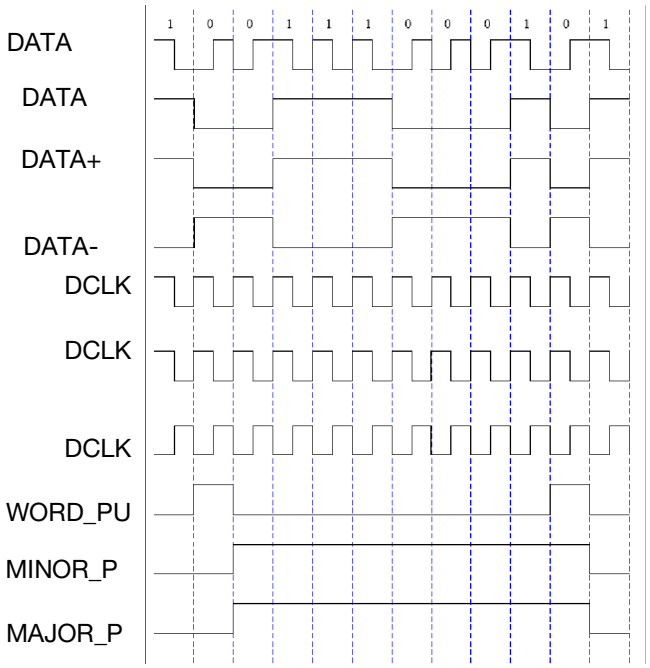


Figure 2: Timing for outputs

The KAD/ENC/106 allows variable word lengths and non-standard commutation (that is, samples of a specific parameter not evenly spaced in the PCM frame). However, we recommend using a default word length (for example, 16 bits) and evenly spaced commutation.

PMF outputs

The KAD/ENC/106 has two PMF outputs (PMF_A, pin 29 and PMF_B, pin 4) for interfacing to FM transmitters. The filter is a programmable sixth order Bessel (linear phase) which is generated digitally and reconstructed using a communications DAC.

The filter cutoff is set at 0.7 times the bit-rate for non-return to zero codes and to 1.4 times the bit-rate for bi-phase code.

The amplitude is user-defined, and should be set to allow for the FM transmitter's deviation sensitivity.

In order to give the widest possible output voltage range to match as many transmitters as possible, while keeping quantization steps in the DAC from having a negative effect on the outputs, there are two outputs:

- PMF_A covers ±0.5V to ±2V.
- PMF_B follows PMF_A and has an analog gain of 2.5, making it ideal for driving transmitters requiring between ±2V to ±5V.

Minimum word transmit time

The minimum word transmit time is 375ns for the KAD/ENC/106. Therefore at 8Mbps the minimum word size is 3 bits (8Mbps x 375ns = 3 bits). For example, a 16-bit parameter fragmented into two 12-bit subframes, the 4-bit least significant bit has also to be considered in the minimum word transmit time.

NOTE: Word size cannot go above 16 bits, therefore any sync word which is more than 16 bits is split into two words.

CRC generation

The KAD/ENC/106 supports insertion of CRC at the end of every minor frame (CRC generation is supported in KSM-500 only).

The KAD/ENC/106 only supports CRC insertion when using a CRC-CCITT (Comité Consultatif International de Télégraphique et Téléphonique) polynomial with the following specifications:

- Width = 16 bits
- Truncated polynomial = 0x1021
- Initial value = 0xFFFF
- Input data is not reflected
- Output CRC is not reflected
- No XOR (eXclusive OR) is performed on the output CRC

Connector pinout of the KAD/ENC/106

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DNC		Do not connect
2	DNC		Do not connect
3	GND	Internal ground	
4	PMF_B	Premodulation filter outputs	
5	DNC		Do not connect
6	DNC		Do not connect
7	DNC		Do not connect
8	DNC		Do not connect
9	DNC		Do not connect
10	DNC		Do not connect
11	GND	Internal ground	
12	GND	Internal ground	
13	GND	Internal ground	
14	DNC		Do not connect
15	DATA(0)+	RS-422 outputs	PCM output 0; not internally terminated
16	DATA(0)-	RS-422 outputs	PCM output 0; not internally terminated
17	DCLK(0)+	RS-422 outputs	Bit clock for PCM output 0; not internally terminated
18	DCLK(0)-	RS-422 outputs	Bit clock for PCM output 0; not internally terminated
19	WORD_PULSE	BTTL outputs	High for last bit of word
20	MINOR_PULSE	BTTL outputs	High for last word of minor frame
21	MAJOR_PULSE	BTTL outputs	High for last word of major frame
22	DATA	BTTL outputs	PCM output
23	DCLK	BTTL outputs	Bit clock for PCM; internally terminated with 100Ω
24	NRZ_L	BTTL outputs	Uncoded PCM output
25	DNC		Do not connect
26	DNC		Do not connect
27	GND	Internal ground	
28	GND	Internal ground	
29	PMF_A	Premodulation filter outputs	
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DATA(1)+	RS-422 outputs	PCM output 1; not internally terminated
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DATA(1)-	RS-422 outputs	PCM output 1; not internally terminated
40	DCLK(1)+	RS-422 outputs	Bit clock for PCM output 1; not internally terminated
41	DCLK(1)-	RS-422 outputs	Bit clock for PCM output 1; not internally terminated
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/ENC/106	IRIG-106 PCM encoder (PMF output) (with 52-way double-density connector)
KAM/ENC/106	IRIG-106 PCM encoder (PMF output) (with 51-way micro-miniature connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; or ACC/CON/008/04 for KAM modules), is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/ENC/106 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ENC/106	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

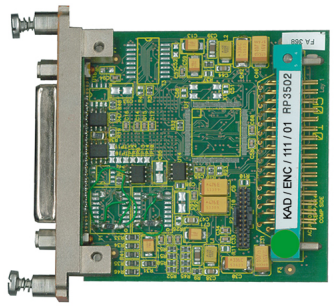
DOCUMENT	DETAILS
DOC/DBK/001	KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/024	Evolution of Pulse Code Modulation
TEC/NOT/027	IRIG 106-96 Chapter 4
TEC/NOT/035	Rules for PCM Placement

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KAD/ENC/111

CCSDS encoder (Ethernet interface, internal 64MB memory buffer)

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Key Features

- Receives data over Ethernet and generates CCSDS frames
- Filters packets using stream ID
- 64MB memory buffer
- Four RS-422/485 outputs
- Programmable bit-rate from 250kbps to 4Mbps
- CCSDS frames of fixed length of 1,279 bytes
- Reed Solomon (255,223) and Randomizer according to ECSS-E-ST-50-01C

Applications

- RF data links

Overview

The KAD/ENC/111 is a CCSDS encoder with an Ethernet interface and a 64MB internal memory buffer. It is used to wrap UDP packets received over Ethernet into CCSDS frames of fixed length of 1,279 bytes.

The KAD/ENC/111 has two modes of operation, which can be controlled from the Acra KAM-500 backplane. In the first mode, the module interleaves real-time data received over Ethernet with idle data generated by the module. In the second mode, the module interleaves real-time data received over Ethernet with data read from the internal memory buffer.

There are two ways to switch the KAD/ENC/111 between modes, either by the internal timer (default) or by command from another Acra KAM-500 module through the backplane. The module has four RS-422/485 outputs which are buffered copies of the single CCSDS channel.

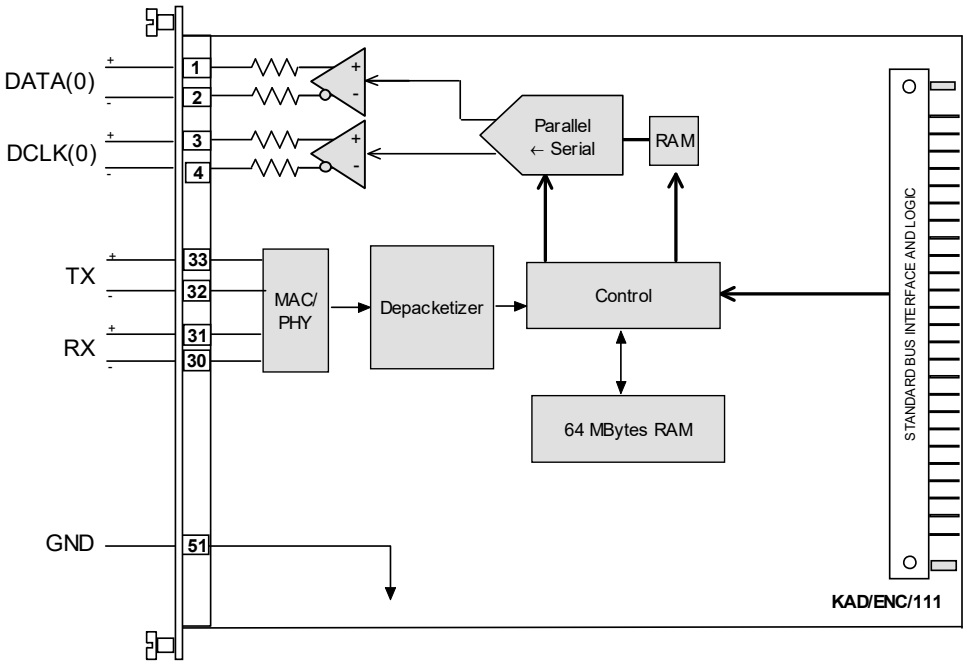


Figure 1: Ethernet interface and first of four CCSDS outputs

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under "Environmental ratings" in the "General specifications" table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	73	–	g	
	–	2.57	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	353	–	418	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	1.77	–	2.09	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	RS-422 outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	8	–	
Signaling rate					
DATA[3:0]	0.25	–	4	Mbps	NRZ-L.
DCLK[3:0]	0.25	–	4	MHz	
Output voltage					
operating range	-15	–	20	V	
logic 0	–	–	-2	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
logic 1	2	–	–	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
short circuit current	–	–	250	mA	
short circuit duration	90	–	–	s	Only one output may be shorted at a time.
overvoltage protection	-27	–	27	V	
ESD protection	-5	–	5	kV	Human Body Model.
Output resistance	–	65	–	Ω	R_{LOAD} = 100Ω.

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TABLE 3	Ethernet interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs/outputs	–	–	1	–	IEEE 802.3 compatible; 100BaseTX only.

Setting up the KAD/ENC/111

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ENC/111	KAD/ENC/111	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Settings	-	-	-
Version Number	0 to 3	0	CCSDS transfer frame version number field.
Spacecraft ID	0 to 3FF	24A	Spacecraft ID.
Real Time VCID	0 to 7	3	Virtual channel ID for real time data.
Stored VCID	0 to 7	4	Virtual channel ID for stored data.
Idle VCID	0 to 7	7	Virtual channel ID for idle data.
Bit Rate	250000 to 4000000	1000000	This is the bit rate of the CCSDS output.
Frame Data Field Status	0000 to FFFF	1800	CCSDS frame data field status bits. Least significant 11 bits are not user settable and are filled by the First Header Pointer.
Start Storing Command Value	0000 to FFFF	1111	Value of the CmdRegister to start storing data.
Stop Storing Command Value	0000 to FFFF	2222	Value of the CmdRegister to stop storing data.
Start Reading Command Value	0000 to FFFF	3333	Value of the CmdRegister to start reading data.
Stop Reading Command Value	0000 to FFFF	4444	Value of the CmdRegister to stop reading data.
Reset Pointer Command Value	0000 to FFFF	5555	Value of the CmdRegister to reset buffer pointer.
Settings CCSDS Operational Control Field	-	-	CCSDS Operation control field settings.
OCF enable	True False	False	CCSDS transfer frame operational control flag.
OCF value	0 to FFFFFFFF	10	CCSDS transfer frame operational control field.
Settings Read/Record Time	-	-	-
Start Recording Time	0 to FFFFFFFFFFFFFFFF	0000000000000000	Time in PTP format to start recording.
Stop Recording Time	0 to FFFFFFFFFFFFFFFF	0000000000000000	Time in PTP format to stop recording.

SETUP DATA	CHOICE	DEFAULT	NOTES
Start Reading Time	0 to FFFFFFFFFFFFFFFF	0000000000000000	Time in PTP format to start reading from buffer.
Stop Reading Time	0 to FFFFFFFFFFFFFFFF	0000000000000000	Time in PTP format to stop reading from buffer.
Processes	-	-	-
Command	-	-	-
Channels	-	-	-
CCSDS-OUT(3:0) PCM Output	-	-	IRIG 106 Chapter 4 PCM output.
Settings	-	-	-
Clock Phase	0 180	0	Specifies the phase of the data clock in degrees.
Polarity	True False	True	Specifies the polarity of the data.
CCSDS Enable	True False	True	Enables transmission of CCSDS on this channel.
Ethernet-In Ethernet Input	-	-	Represents a typical Ethernet channel on a networked device.
Settings	-	-	-
IP Address	0.0.0.0 to 255.255.255.255	192.168.2.1	Specifies the IP Address of the instrument.
Stream Id Filter	00000000000000000000000000000000 00 to 11111111111111111111111111111111 11	11111111111111111111111111111111 11	Mask for value of iNET-X IDs to be included into CCSDS stream.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Status Register with status of the module. This register can be read through the Acra KAM-500 backplane.	BitVector	BitVector	16	R[15:0] R(0) StoreMode - Indicates that the module is operating in store mode. 1: Module is storing data to buffer. R(1) ReadMode - Indicates that the module is operating in read mode. 1: Module is reading data from buffer. R(2) BufferFull - Indicates that either or both of the iNetX packet buffer pointer table and the buffer itself is full. R(3) PointerTableFull - Indicates that the iNetX packet buffer pointer table is full. R(4) PointerError - Indicates that an iNetX packet buffer pointer table error has occurred since the previous read of Status. R(5) PointerReset - Indicates that an iNetX packet buffer pointer reset has occurred since the previous read of Status. R[15:6] Reserved - Reserved

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
BufferReadPointer Current value of read pointer. It is 25 bits in length. The upper 7 bits are reserved and hence undefined.	BitVector	BitVector	32	R[31:0] R[31:25] Reserved - Reserved R[24:0] BufferReadPointer - Current value of read pointer.
BufferWritePointer Current value of write pointer. It is 25 bits in length. The upper 7 bits are reserved and hence undefined.	BitVector	BitVector	32	R[31:0] R[31:25] Reserved - Reserved R[24:0] BufferWritePointer - Current value of write pointer.
Command Read the CommandRegister value	BitVector	BitVector	16	R[15:0]
Command Parameters				
CommandRegister Register to start/stop storing data, start/stop reading data and resetting memory buffer pointers. Please refer to the Command values in the Instrument settings.	BitVector	BitVector	16	R[15:0]

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following f i ve cha- acters "/><\.

Getting the most from the KAD/ENC/111

The CCSDS frame structure is shown in the following figure.

<table>
<tr><td rowspan="6">Sync Word</td><td colspan="12">Transfer frame</td><td></td><td></td></tr>
<tr><td colspan="12">Header</td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Frame identification</td><td>Master Channel Frame Count</td><td>Virtual Channel Frame Count</td><td colspan="5">Frame data field status</td><td></td><td>Operational Control Field</td><td>Reed Solomon Check Symbol</td></tr>
<tr><td>Version number</td><td>SC ID</td><td>Virtual Channel ID</td><td>Oper. Control Field Flag</td><td></td><td></td><td>Sec Header Flag</td><td>Synch Flag</td><td>Packet Order Flag</td><td>Segment Length Flag</td><td>First Header Pointer</td><td>iNET-X Packets</td><td></td><td></td></tr>
<tr><td>2 bits</td><td>10 bits</td><td>3 bits</td><td>1 bit</td><td></td><td></td><td>1 bit</td><td>1 bit</td><td>1 bit</td><td>2 bits</td><td>11 bits</td><td></td><td></td><td></td></tr>
<tr><td colspan="4">2 bytes</td><td>1 byte</td><td>1 byte</td><td colspan="5">2 bytes</td><td></td><td></td><td></td></tr>
<tr><td>4 bytes</td><td colspan="11">6 bytes</td><td>1105 bytes</td><td>4 bytes</td><td>160 bytes</td></tr>
</table>

Figure 2: CCSDS frame structure

All fields, except Master Channel Frame Count, Virtual Channel Frame Count, First Header Pointer, and Reed Solomon Check Symbol are static and can be programmed from the Graphical User Interface (GUI).

Connector pinout of the KAD/ENC/111

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DATA(0)+	RS-422 outputs	CCSDS output 0; internally terminated
2	DATA(0)-	RS-422 outputs	CCSDS output 0; internally terminated
3	DCLK(0)+	RS-422 outputs	Bit clock for CCSDS output 0; internally terminated
4	DCLK(0)-	RS-422 outputs	Bit clock for CCSDS output 0; internally terminated
5	DATA(1)+	RS-422 outputs	CCSDS output 1; internally terminated
6	DATA(1)-	RS-422 outputs	CCSDS output 1; internally terminated
7	DNC		Do not connect
8	DNC		Do not connect
9	DNC		Do not connect
10	DNC		Do not connect
11	GND	Internal ground	
12	GND	Internal ground	
13	GND	Internal ground	
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	DCLK(1)+	RS-422 outputs	Bit clock for CCSDS output 1; internally terminated
19	DCLK(1)-	RS-422 outputs	Bit clock for CCSDS output 1; internally terminated
20	DATA(2)+	RS-422 outputs	CCSDS output 2; internally terminated
21	DATA(2)-	RS-422 outputs	CCSDS output 2; internally terminated
22	DCLK(2)+	RS-422 outputs	Bit clock for CCSDS output 2; internally terminated
23	DCLK(2)-	RS-422 outputs	Bit clock for CCSDS output 2; internally terminated
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	GND	Internal ground	
28	GND	Internal ground	
29	DNC		Do not connect
30	RX-	Ethernet interface	
31	RX+	Ethernet interface	
32	TX-	Ethernet interface	
33	TX+	Ethernet interface	
34	DNC		Do not connect
35	DNC		Do not connect
36	DATA(3)+	RS-422 outputs	CCSDS output 3; internally terminated
37	DATA(3)-	RS-422 outputs	CCSDS output 3; internally terminated
38	DCLK(3)+	RS-422 outputs	Bit clock for CCSDS output 3; internally terminated
39	DCLK(3)-	RS-422 outputs	Bit clock for CCSDS output 3; internally terminated
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/ENC/111	CCSDS encoder (Ethernet interface, internal 64MB memory buffer)

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ENC/111	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

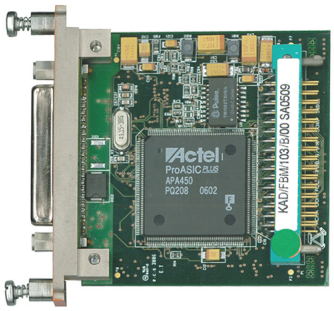
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/FBM/103

FireWire S200b bus monitor parser - 1ch

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Key Features

- Monitors up to a single IEEE 1394b compatible bus at a signal rate of 200Mbps (S200b) using a transformer coupled interface
- Coherently parses isochronous and asynchronous stream packets and tags for up to 65 messages using the Channel ID/Message ID
- Maximum payload size of 2KB per packet
- Discards other asynchronous, bus configuration and PHY packets (except traffic with transaction code 0xA)

Applications

- FireWire beta mode bus monitoring

Overview

The KAD/FBM/103 monitors FireWire (IEEE 1394b) traffic. It acts as a leaf in the FireWire bus topology and to all other nodes on the bus, the link layer and transaction layer appear to be deactivated.

The KAD/FBM/103 parses isochronous or asynchronous stream packets. All other traffic is ignored (configuration traffic, PHY packets and asynchronous transactions). Selected packets and associated tag information are stored in one of 65 triple-buffered parser slots. Each parser slot contains up to 1036 16-bit words: 1,030 words of packet content; three words of timestamp information; one word containing the transaction number; one word containing the packet size; and one word containing buffer information.

FireWire packets are parsed in two stages. First, packets are filtered to accept only isochronous and asynchronous stream packets (traffic with transaction code A_{16}). Then the channel ID and message ID (third quadlet in the FireWire packet) are used to classify the packet and determine which of the 65 parser slots the packet is written to. Unique channel ID and message ID combinations can be targeted to any of the 64 available parser slots.

Parser slot 0 may be configured to operate as a catchall slot where any channel and message IDs not mapped to specific parser slots are routed.

The KAD/FBM/103 also provides transaction counters and error detection.

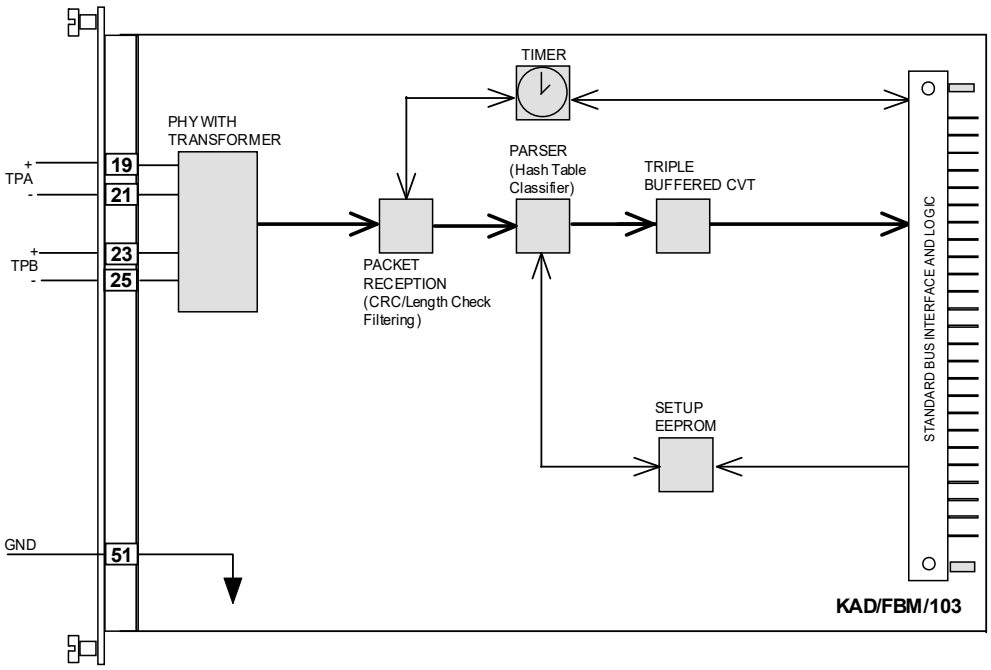


Figure 1: Filtering and parsing in the KAD/FBM/103

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	74	–	g	
	–	2.61	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	195	–	324	mA	
total power	0.972	–	1.62	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation*, *TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualifications Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	FireWire bus interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	1	–	IEEE 1394b compatible.
Sampling rate					
TPA	–	–	2	Msps	
TPB	–	–	2	Msps	
Voltage	200	–	800	mV	1394b differential input voltage.
Data rate	–	–	200	Mbps	The KAD/FBM/103 operates at a fixed speed only (FireWire S200B); it cannot autonegotiate to other data rates.

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Setting up the KAD/FBM/103

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Setting up parameters

For parameter Report

SET-UP DATA	CHOICE	DEFAULT	NOTES
Name	Report	FBM103_Report	Received transactions error report.
Base Unit	Unitless	Unitless	R(15) Error occurred since last read. R[14:4] Reserved for future use. R[3:0] Error code.
maximum	8008_{16}	8001_{16}	CRC error occurred since last read.
minimum	0001_{16}	$000F_{16}$	
Data Format	BitVector	BitVector	
Size In Bits	1 to 16	16	

For parameter Sts1394

SET-UP DATA	CHOICE	DEFAULT	NOTES
Name	Sts1394	FBM103_Sts_1394	IEEE 1394b port status.
Base Unit	Unitless	Unitless	R[15:8] Reserved for future use. R[7:2] PHY_ID. R(1) Reserved for future use. R(0) Link is connected.
maximum	$00FD_{16}$	0001_{16}	Link is connected. Node has an ID of 0.
minimum	0	0	Nothing is connected to the port.
Data Format	BitVector	BitVector	
Size In Bits	1 to 16	16	

For parameter TotalTrnCnt

SET-UP DATA	CHOICE	DEFAULT	NOTES
Name	TrnCnt	FBM103_Trns_Cnt	Transaction counter, counts all fully parsed transactions, counter can overflow.
Base Unit	Unitless	Unitless	
maximum	$FFFF_{16}$	0002_{16}	2 packets were parsed.
minimum	0	0	0 packets were parsed.
Data Format	Offset binary	Offset binary	
Size In Bits	1 to 16	16	

For parameter PackageData

SET-UP DATA	CHOICE	DEFAULT	NOTES
Name	PackageData	FBM103_TrnData	IEEE 1394b packet. Pkt_Data_0 is first word received. The first word received is the packet header. 16 MSB bits.
Base Unit	Unitless	Unitless	
maximum	$FFFF_{16}$	0002_{16}	

For parameter PackageData

SET-UP DATA	CHOICE	DEFAULT	NOTES
minimum	0	0	
Data Format	Offset binary	Offset binary	
Size In Bits	1 to 16	16	

For parameter TrnInfo

SET-UP DATA	CHOICE	DEFAULT	NOTES
Name	TrnInfo	FBM103_TrnInfo	Information tag for this parsed transaction. This is a non-zero value.
Base Unit	Unitless	Unitless	R(15) 1 indicates that there is no message stored (empty) R(14) 1 indicates this message was read before (stale) R(13) 1 indicates this message overwrote another (skipped) R[12:0] Reserved for future use, may be non-zero value.
maximum	8000_{16}	8000_{16}	Parser slot empty, nothing parsed since power-up.
minimum	0	0	New message parsed, no messages skipped.
Data Format	BitVector	BitVector	
Size In Bits	1 to 16	16	

For parameter TrnTimeHi

SET-UP DATA	CHOICE	DEFAULT	NOTES
Name	TrnTimeHi	FBM103_TrnTimeHi	Hours and minutes time of start of transaction.
Base Unit	Unitless	Unitless	[12:11] Tens of Hours D[10:7] Hours D[6:4] Tens of Minutes D[3:0] Minutes
maximum	$11D9_{16}$	0002_{16}	Message was received when TimeHi was 0 hours, 2 minutes.
minimum	0	0	
Data Format	BitVector	BitVector	
Size In Bits	1 to 16	16	

For parameter TrnTimeLo

SET-UP DATA	CHOICE	DEFAULT	NOTES
Name	TrnTimeLo	FBM103_TrnTimeLo	Seconds and centiseconds time of the start of transaction.
Base Unit	Second	Second	R[14:12] Tens of seconds R[11:8] Ones of seconds R[7:4] Tenths of seconds R[3:0] Hundredths of seconds
maximum	5999_{16}	0002_{16}	Message was received when TimeLo was 0.02 seconds.
minimum	0	0	
Data Format	BinaryCodedDecimal	BinaryCodedDecimal	
Size In Bits	1 to 16	16	

For parameter TrnTimeMicro

SET-UP DATA	CHOICE	DEFAULT	NOTES
Name	TrnMicroTime	FBM103_TrnMicroTime	Microsecond time of the start of the acquisition cycle.
Base Unit	Second	Second	
maximum	9999_{16}	0002_{16}	Message was received when TimeMicro was 2µs.
minimum	0	0	
Data Format	BinaryCodedDecimal	BinaryCodedDecimal	
Size In Bits	1 to 16	16	

For parameter TrnCnt

SET-UP DATA	CHOICE	DEFAULT	NOTES
Name	TrnCnt	FBM103_TrnCnt	Transaction number.
Base Unit	Unitless	Unitless	
maximum	$FFFF_{16}$	0002_{16}	Message was the 2nd parsed packet.
minimum	0	0	
Data Format	Offset binary	Offset binary	
Size In Bits	1 to 16	16	

For parameter TrnSize

SET-UP DATA	CHOICE	DEFAULT	NOTES
Name	TrnSize	FBM103_TrnSize	Packet size in quadlets, with header, header CRC, data, and data CRC.
Base Unit	Unitless	Unitless	
maximum	0203_{16}	0103_{16}	Message has a 1024B data payload (total packet size is 1036B).
minimum	4	4	Message has a 4B data payload (total packet size us 16B).
Data Format	Offset binary	Offset binary	
Size In Bits	1 to 16	16	

Setting up instrumentation

This module uses the X-Module-Firewire-Monitor-1.1 XidML schema. (See http://www.xidml.org).

For messages

SET-UP DATA	CHOICES	DEFAULT	NOTES
Manufacturer			
name	ACRA CONTROL	ACRA CONTROL	
part reference	KAD/FBM/103	KAD/FBM/103	ACRA CONTROL part number.
serial number	Fixed 6 characters	FE1234	Unique number for each module.
Settings			
MessageBuffer	Parser(0) to Parser (64)	Parser(0)	This element is used to store the name of messages that are buffered together.
Name	Message Name	Msg_0_J5_0	This element is used to store the name of a message.

For messages

SET-UP DATA	CHOICES	DEFAULT	NOTES
fill value	0 to $FFFF_{16}$	1023	Value used to fill empty parser slots. This is the default value for all parameters beginning with Trn, except TrnInfo which is 8000_{16} when nothing is parsed. Also all PackageData are filled with this value when nothing is parsed.

Setting up packages

This module uses the X-Firewire-1.1 XidML schema. (See http://www.xidml.org).

For transaction channels

SET-UP DATA	CHOICES	DEFAULT	NOTES
Synchronous	No	No	
Packages per acquisition cycle	1	1	
Properties			
number of words	0 to 1029	4	
HashBinaryValue	1,0,X Up to 32 bits	1,00000000000000000000000000000000	The channel, Message High and Message Low ID are stored in a hashbinary. If the OffsetIndex_Bits is 8, the value contains the channel. If the OffsetIndex_Bits is 64, the value is the Message High and Message Low ID's.
OffsetIndex_Bits		8, 64	Specifies the offset in bits of the location containing the specified value.
Content			
parameter	no character limit	P1	
offset words	0 to 1029	0	

NOTE: It is recommended that names are less than 20 characters, have no white space, bold or italic characters or contain any of the following five characters "/><\.

Getting the most from the KAD/FBM/103/B

Triple buffering

Triple buffering supports concurrent access to the packet being read, packet being received, and an interim packet. The transaction information (TrnInfo) word associated with each packet is used to indicate whether the packet is stale (buffer has been read before) or skipped (buffer has been overwritten).

Packet classification

FireWire isochronous (or asynchronous stream) packets can be stored in one of 65 parser slots or dropped (not stored). The decision on which parser slot to store the packet or to drop the packet is based on three fields of information from each packet: the 6-bit Channel ID; the upper 16 bits of the Message ID; and the lower 16 bits of the Message ID (Message ID is the third quadlet in the packet). An explicit data value or a special wildcard value ALL can be specified for each of these fields. The combination of these three fields plus a destination parser slot is defined as a rule. Up to 255 rules can be specified. Rules can allow for multiple packets to be stored in a single parser slot. And rules may overlap. The compiler sorts and processes rules in a deterministic order.

The following table is an example set of rules that can be defined. Rules may be entered in any order. The compiler sorts the rules as shown in this table. Rules for a channel are grouped together and then within this group explicit rules are processed first, followed by wildcard rules.

TABLE 3 Example classification names

Rule	Parser Slot	Channel ID	Message Hi ID	Message Lo ID	Order Rules Processed	Description
0	1	1	ALL	ALL	1	All packets with a Channel ID of 1 are routed to parser slot 1.
1	2	2	ALL	CAFE	2	All packets with a Channel ID of 2 and the Message Lo ID of CAFE are routed to parser slot 2.
2	3	3	0	0	3	Packets with a Channel ID of 3, a Message Hi ID of 0 and a Message Lo ID of 0 are routed to parser slot 3.
3	4	3	0	ALL	4	Packets that match this pattern, excluding packets that match rule 2, are routed to parser slot 4.
4	5	3	ALL	0	5	Packets that match this pattern, excluding packets that match rule 2 and 3, are routed to parser slot 5.
5	6	3	ALL	ALL	6	Packets that match this pattern, excluding packets that match rule 2, 3, and 4, are routed to parser slot 6.
6	62	ALL	DEAD	DEAD	7	Packets that match this pattern are routed to parser slot 62. For Channel ID 1, this rule has no effect. For Channel ID 2, this rule affects all packets not covered by rule 1. For Channel ID 3, this rule has no effect. The reason is that rules 3-6 have higher priority than this rule.

TABLE 3	Example classification names (continued)					
Rule	Parser Slot	Channel ID	Message Hi ID	Message Lo ID	Order Rules Processed	Description
7	63	ALL	BODE	ALL	8	Packets that match this pattern are routed to parser slot 63. Rules 0 to 6 have higher priority than this rule.
8	64	ALL	ALL	ABBA	9	Packets that match this pattern are routed to parser slot 64. This rule has the lowest priority.

Error codes for the KAD/FBM/103

Code[1]	Description
0_{16}	Reserved for future use.
1_{16}	CRC error in header or payload was detected.
2_{16}	FIFO overflow. This indicates that the amount of incoming traffic that needs to be parsed exceeds the processing capability of the module. Filtering must be tightened.
3_{16}	Reserved for future use.
4_{16}	Length mismatch. The length defined in the header does not match the actual received amount of data.
5_{16}-7_{16}	Reserved for future use.
8_{16}	Packet too big. A packet was received that exceeds the maximum payload of 2048 bytes.
9_{16}-D_{16}	Reserved for future use.
E_{16}	Reserved for future use.
F_{16}	Default value after power up.

1. Error codes are in hexadecimal.

Connector pinout of the KAD/FBM/103

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DNC		Do not connect
2	DNC		Do not connect
3	DNC		Do not connect
4	DNC		Do not connect
5	DNC		Do not connect
6	DNC		Do not connect
7	DNC		Do not connect
8	DNC		Do not connect
9	DNC		Do not connect
10	DNC		Do not connect
11	DNC		Do not connect
12	DNC		Do not connect
13	DNC		Do not connect
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	TPA+	FireWire bus interface	Receive Data+ (IEEE convention uses TPA)
20	DNC		Do not connect
21	TPA-	FireWire bus interface	Receive Data- (IEEE convention uses TPA*)
22	DNC		Do not connect
23	TPB+	FireWire bus interface	Transmit Data+ (IEEE convention uses TPB)
24	DNC		Do not connect
25	TPB-	FireWire bus interface	Transmit Data- (IEEE convention uses TPB*)
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/FBM/103/B	FireWire S200b bus monitor parser - 1ch

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/FBM/103/B	Transformer coupled FireWire bus monitor with enhanced parsing	Recommended for new programs
KAD/FBM/103	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

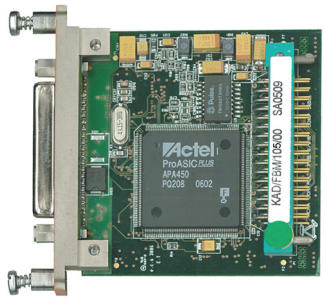
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualifications Handbook
DOC/MAN/018	KSM-500 Databook
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/FBM/105

Multi-rate FireWire bus monitor parser - 1ch

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Key Features

- Monitors an IEEE 1394b S100b, S200b, S400b bus
- Coherently parses traffic and tags
- Supports 511 (1k), 256 (2k) or 128 (4k) messages (including one catchall slot)
- Parser discards bus configuration, PHY packets and other asynchronous packets (except traffic with transaction code 0xA)
- Provides transaction counters and error detection

Applications

- FireWire beta mode bus monitoring

Overview

The KAD/FBM/105 acts as a leaf in the FireWire bus topology. To all other nodes on the bus, the link layer and transaction layer appear deactivated.

The KAD/FBM/105 parses isochronous or asynchronous stream packets; all other traffic (configuration traffic, PHY packets, and asynchronous transactions) is ignored. Selected packets and associated tag information are stored in triple buffered parser slots. The size of the parser buffer, and consequently the number of parser buffers, can be adapted to each application, depending on the rate and the maximum size of the data payload. If the maximum data payload is up to 1,024 bytes, 511 parser slots are available; if it is 2,048 bytes, 256 parser slots are available; and if it is 4,096 bytes, up to 128 parser slots are available.

FireWire packets are parsed in two stages. First, packets are filtered to accept only isochronous and asynchronous stream packets (traffic with transaction code 0xA). Then the isochronous packet header quadlet, and five quadlets of the FireWire packet data payload, are used to classify the packet and determine which of the parser slots the packet is written to. All packets, excluding STOF packets, must be at least 14 quadlets long, otherwise they are dropped. The minimum packet interval is 13 µs. Packets including STOF packets with a packet interval smaller than 13 µs may be dropped. (An STOF packet is 13 quadlets long and has a 0X00281FA0 header. The packet interval is the time interval between the first bit of each of two consecutive packets.)

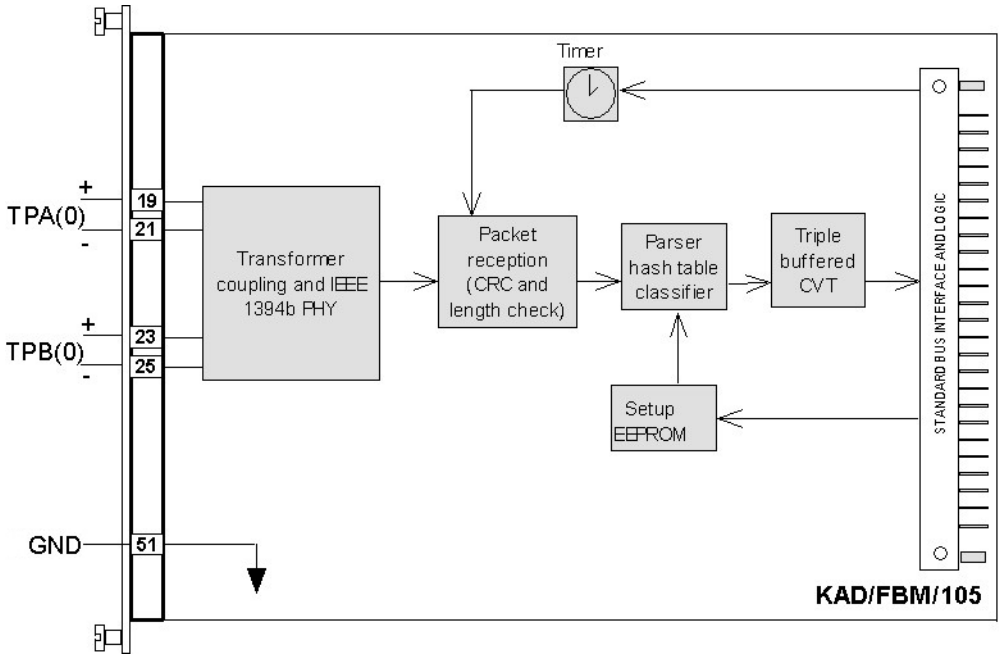


Figure 1: Parsing in the KAD/FBM/105

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	75	–	g	
	–	2.64	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	4	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	200	–	250	mA	
total power	1.00	–	1.25	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	FireWire bus interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	1	–	IEEE 1394b, S400b compatible.
Voltage	200	–	800	mV	1394b differential input voltage.
Data rate	100	–	400	Mbps	Auto-negotiate FireWire 100 Mbps, 200 Mbps and 400 Mbps.

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Setting up the KAD/FBM/105

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/FBM/105/B	KAD/FBM/105/B	The instrument part reference.
SerialNumber	AAA1234	AAA1234	Unique name for each module.
Settings	-	-	-
Parser Slot Number	128 slots (4k size) 256 slots (2k size) 511 slots (1k size)	511 slots (1k size)	Number of parser slots (including one catchall parser slot). 128 slots with 4KB buffer, 256 slots with 2KB buffer, 511 slots with 1KB buffer
Fill Value	0000 to FFFF	AAAA	Value used to fill empty parser slots.
Parser Err Message Enable	True False	False	Parsing of packets with errors enabled (packets with errors not dropped).
Processes	-	-	-
Parser(509:0)	-	-	Parser slots on the module.
Catchall-Parser	-	-	All data not classified for parsing is captured in this parser slot.
Channels	-	-	-
FireWire-In FireWire-Bus Input	-	-	-

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Report Reports the status of the module.	BitVector	BitVector	16	R[15:0] R(15) FreshError - Indicates error occurred since last read. R[14:4] Reserved - Reserved for future use. R[3:0] Error code - Error code.
Status1394B IEEE 1394b port status.	BitVector	BitVector	16	R[15:0] R[15:11] Reserved - Reserved for future use. R(10) ShortPacketDroped - Short packet dropped. (Clears on read.) R[9:8] DataRate - Data Rate of last received package 00: 100Mbps 01: 200Mbps 10: 400Mbps 11: Reserved for future use. R[7:2] PHY_ID - FireWire PHY Identifier. R(1) Reserved - Reserved for future use. R(0) Link - Link connection status.
BusMessageCountOthers Transaction counter, counts all fully parsed packets that do not have STOF header. This counter can overflow.	BitVector	BitVector	16	R[15:0]

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
BusMessageCountHdrDef Transaction counter, counts all fully parsed packets with STOF header (0X00281FA0). This counter can overflow.	BitVector	BitVector	16	R[15:0]
Message100ShortCount Count of 100Mbps messages that are dropped as they are smaller than minimum packet size allowed for 100Mbps packages. This counter can overflow.	BitVector	BitVector	16	R[15:0]
Message200ShortCount Count of 200Mbps messages that are dropped as they are smaller than minimum packet size allowed for 200Mbps packages and are not STOF messages. This counter can overflow.	BitVector	BitVector	16	R[15:0]
Message400ShortCount Count of 400Mbps messages that are dropped as they are smaller than minimum packet size allowed for 400Mbps packages and are not STOF messages. This counter can overflow.	BitVector	BitVector	16	R[15:0]
Parser(509:0) Parameters				
MessageCount Received message count.	Count	OffsetBinary	16	R[15:0]
MessageSize The number of bytes in the message.	Count	OffsetBinary	16	R[15:0]
MessageInfoBuffer Information tag for this parsed transaction. This is a non-zero value.	BitVector	BitVector	16	R[15:0] R(15) Empty - 1 indicates that there is no message stored. R(14) Stale - 1 indicates this message was read before. R(13) Skipped - 1 indicates this message overwrote another. R[12:0] Reserved - Reserved for future use.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageInfoPacket Information tag for this parsed transaction.	BitVector	BitVector	16	R[15:0] R(15) ErrorInMessage - 1 indicates that there is an error associated with this message, R(14) BusMessageCount - 1 indicates that BusMessageCountHdrDef was used. R[13:4] Reserved - Reserved for future use. R(3) HdrCrcError - 1 indicates CRC error in header of this message was detected. R(2) PayloadCrcError - 1 indicates CRC error in payload of this message was detected. R(1) LengthMismatch - 1 indicates length mismatch. The length defined in the header does not match the actual received amount of data. R(0) Message2Big - 1 indicates that message is too big. A message was received that exceeds the maximum payload defined.
MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes time midway through first transmitted bit.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
MessageTimeLo Seconds and centiseconds time midway through first transmitted bit.	BitVector	BitVector	16	R[31:16] R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.
MessageTimeMicro Microsecond time midway through first transmitted bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - BCD Microseconds 0 to 9999.
Catchall-Parser Parameters				
MessageCount Received message count.	Count	OffsetBinary	16	R[15:0]
MessageSize The number of bytes in the message.	Count	OffsetBinary	16	R[15:0]
MessageData(2053:0) Message Data. Buffer size is 1k (511 parser slots), 2k (256 parser slots) or 4k (128 parser slots)	BitVector	BitVector	16	R[15:0]
MessageInfoBuffer Information tag for this parsed transaction. This is a non-zero value.	BitVector	BitVector	16	R[15:0] R(15) Empty - 1 indicates that there is no message stored. R(14) Stale - 1 indicates this message was read before. R(13) Skipped - 1 indicates this message overwrote another. R[12:0] Reserved - Reserved for future use.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageInfoPacket Information tag for this parsed transaction.	BitVector	BitVector	16	R[15:0] R(15) ErrorInMessage - 1 indicates that there is an error associated with this message. R(14) BusMessageCount - 1 indicates that BusMessageCountHdrDef was used. R[13:4] Reserved - Reserved for future use. R(3) HdrCrcError - 1 indicates CRC error in header of this message was detected. R(2) PayloadCrcError - 1 indicates CRC error in payload of this message was detected. R(1) LengthMismatch - 1 indicates length mismatch. The length defined in the header does not match the actual received amount of data. R(0) Message2Big - 1 indicates that message is too big. A message was received that exceeds the maximum payload defined.
MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes time midway through first transmitted bit.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
MessageTimeLo Seconds and centiseconds time midway through first transmitted bit.	BitVector	BitVector	16	R[31:16] R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.
MessageTimeMicro Microsecond time midway through first transmitted bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - BCD Microseconds 0 to 9999.

NOTE: it is recommended that names are less than 20 characters, have no white space, bold or italic characters or contain any of the following five characters "/><\.

Getting the most from the KAD/FBM/105

Error codes for the KAD/FBM/105

Code[1]	DESCRIPTION
0_{16}	Reserved for future use.
1_{16}	Cyclical Redundancy Checking (CRC) error in header was detected.
2_{16}	Reserved for future use.
3_{16}	CRC error in payload was detected.
4_{16}	Length mismatch. The length defined in the header does not match the actual received amount of data.
5_{16}-7_{16}	Reserved for future use.
8_{16}	Packet too big. Received packet exceeds the maximum payload allowed for its data rate or exceeds selected buffer size.[2]
9_{16}-D_{16}	Reserved for future use.
E_{16}	Reserved for future use.
F_{16}	Default value after power-on.

1. Error codes are in hexadecimal.
2. Buffer size is determined by the Parser Slot Number setting (see “Instrument settings” on page 773).

Shielded Twisted Pair (STP) cable length

The maximum length of the STP cable is 15 meters for S100b, S200b, and S400b.

Triple buffering

Triple buffering supports concurrent access to the packet being read, the packet being received, and an interim packet. The transaction information word (MessageInfo) associated with each packet is used to indicate whether the packet is stale (buffer has been read before) or skipped (buffer has been overwritten).

Packet classification

Isochronous and asynchronous stream packets can be stored in one of the parser slots or dropped (not stored). The decision on which parser slot to store the packet or the decision to drop a packet is based on information from each packet, that is, information in the isochronous packet header quadlet (quadlet 0, which includes, for example, the channel ID) and five quadlets of the FireWire packet data payload (Quadlets 2, 4, 10, 11, and 13 of the Firewire package). DAS Studio 3 names Quadlet 0 as Quadlet A, Quadlet 2 as Quadlet B, Quadlet 4 as Quadlet C, Quadlet 10 as Quadlet D, Quadlet 11 as Quadlet E, and Quadlet 13 as Quadlet F. An explicit data value or a special wildcard value can be specified for each of these fields.

Up to 510 rules can be specified. A rule is defined by a combination of the packet header quadlet, the five quadlets of the FireWire packet data payload and the wildcard mask. Rules can allow for multiple packets to be stored in a single parser slot. Rules may overlap. The compiler sorts and processes rules in a deterministic order.

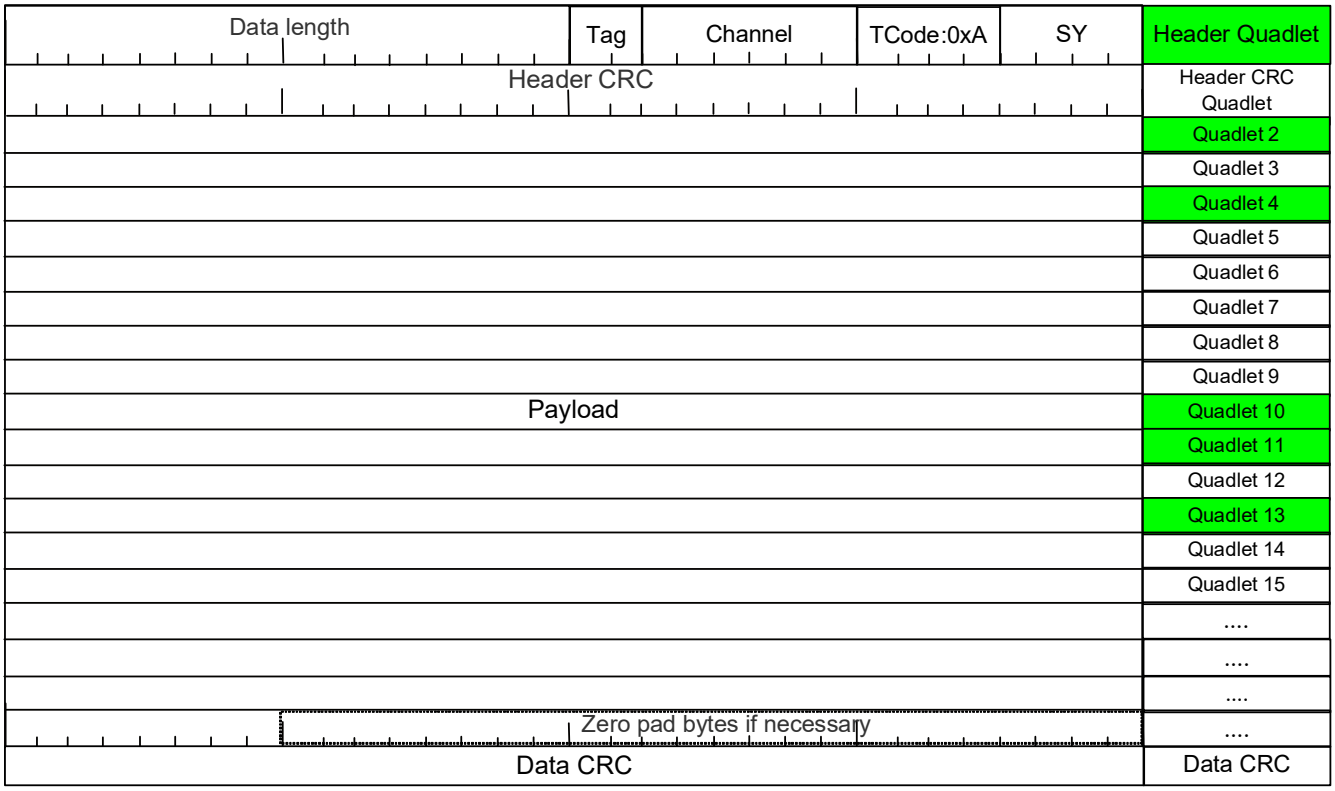


Figure 2: Six quadlets of the FireWire packet which the module parses

Connector pinout of the KAD/FBM/105

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DNC		Do not connect
2	DNC		Do not connect
3	DNC		Do not connect
4	DNC		Do not connect
5	DNC		Do not connect
6	DNC		Do not connect
7	DNC		Do not connect
8	DNC		Do not connect
9	DNC		Do not connect
10	DNC		Do not connect
11	DNC		Do not connect
12	DNC		Do not connect
13	DNC		Do not connect
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	TPA+	FireWire bus interface	Receive Data+ (IEEE convention uses TPA)
20	DNC		Do not connect
21	TPA-	FireWire bus interface	Receive Data- (IEEE convention uses TPA*)
22	DNC		Do not connect
23	TPB+	FireWire bus interface	Transmit Data+ (IEEE convention uses TPB)
24	DNC		Do not connect
25	TPB-	FireWire bus interface	Transmit Data- (IEEE convention uses TPB*)
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/FBM/105/B	Multi-rate FireWire bus monitor parser - 1ch (with 52-way double-density connector)
KAM/FBM/105/B	Multi-rate FireWire bus monitor parser - 1ch (with 51-way micro-miniature connector)

By default, the standard mating connector, (CON/KAD/002/CP for KAD modules; or ACC/CON/008/04 for KAM modules), is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/FBM/105 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/FBM/105/B	Added support for IEEE 1394b S200b, S400b bus; supports 511 (1k), 256 (2k) or 128 (4k) messages	Recommended for new programs
KAD/FBM/105	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

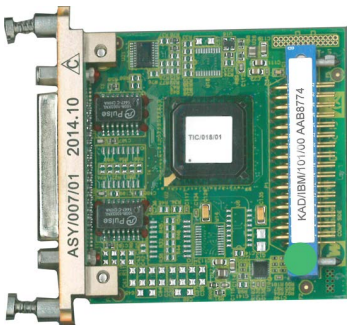
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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This document was reviewed on 12/01/2023 and does not contain technical data.

KAD/IBM/101

IMB serial bus monitor parser/packetizer - 2ch

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Key Features

- Monitors up to two IMB busses
- Coherently parses traffic (up to 65 words) and tags for up to 1024 messages (including one catchall slot) per bus
- Aperiodic transmission of packetized IBM messages including tags as iNET-X parser aligned payload structure per channel
- Message counter per bus
- Pass-through output per bus

Applications

- IMB bus monitoring and recording

Overview

The KAD/IBM/101 is a two-channel serial bus monitor which combines the capabilities of a coherent message parser with the flexibility of an iNET-X packetizer on a single module.

The parser parses up to 1024 messages per channel and their associated time and status tags. Each message has a stale bit (word read before), skipped bit (buffer overwritten), and empty bit (no message received since power-on). Intermodule Data Bus (IMB) messages can be parsed based on the 16-bit Label field in each IMB message. Each parser slot can hold a message of up to 65, 16-bit words long.

Every message received from each of the two busses is captured and packetized—along with the time tags and a bus tag—with other received messages in a packetized buffer. The packetizer contents can be assembled into Ethernet frames by an iNET-X controller or transmitter, for example the KAD/BCU/140, for transmission over Ethernet.

To ensure efficient use of the bandwidth, iNET-X packets are only generated once a payload threshold has been reached. Additionally, a programmable timeout ensures that smaller packets are generated even during periods of low activity on the bus, thereby allowing real-time analysis and processing of the acquired messages. When there is no traffic, no packets are generated.

Both channels have outputs and therefore are not end terminating nodes. All IMB messages received at each channel are re-transmitted in a pass-through fashion.

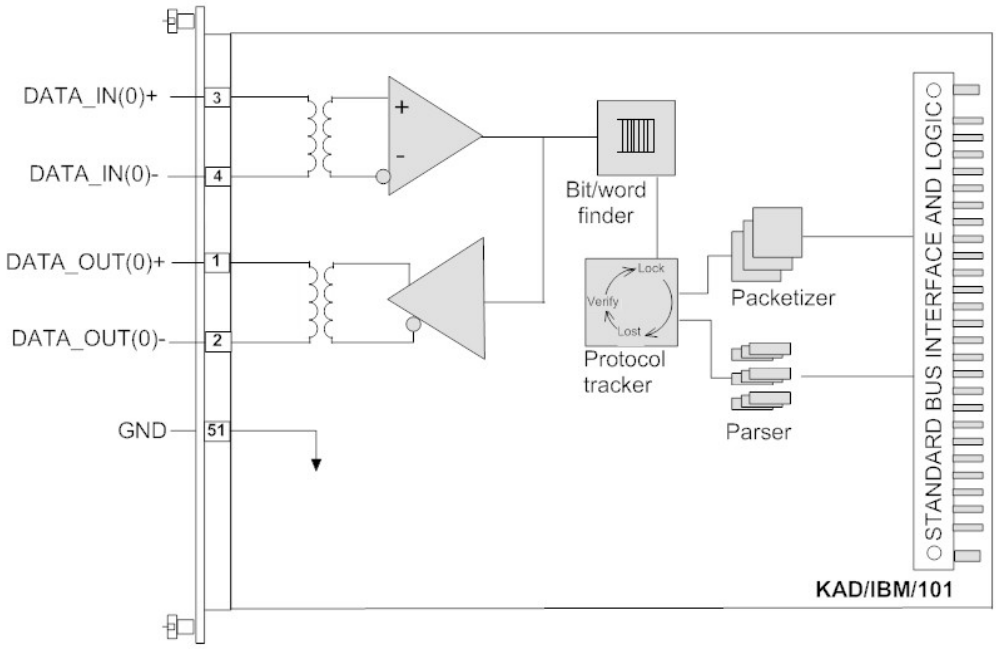


Figure 1: First of two channels of the KAD/IBM/101

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	70	–	g	
	–	2.47	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	120	–	420	mA	
+7V	–	0	–	mA	
-7V	–	0	–	mA	
+12V	–	0	–	mA	
-12V	–	0	–	mA	
total power	0.6	–	2.1	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	IMB inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	2	–	IMB bus compliant.

TABLE 3	IMB outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	2	–	IMB bus compliant.

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Setting up the KAD/IBM/101

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/IBM/101	KAD/IBM/101	The instrument part reference.
SerialNumber	AAA1234	AAA1234	Unique name for each module.
Settings	-	-	-
Fill Value	0000 to FFFF	AAAA	Value used to fill empty parser slots.
Channels	-	-	-
Serial-In(1:0) Serial Input	-	-	Represents an IMB serial channel.
Settings	-	-	-
Channel Enable	True False	True	True = Channel Enabled; False = Channel Disabled, no traffic will be recorded
Settings Packetizer	-	-	-
Stream Id	00000000 to FFFFFFFF	FFFFFFFF	iNET-X stream ID for selected channel if a packet is generated via the assertion of Packetization Enabled.
Packetization Enabled	True False	False	Enables the transmission of an iNET-X packet containing the contents of this channel if an iNET-X transmitter is present in the chassis.
Packet Size	200 to 729	729	Size of packet buffer in words.
Packet Timeout	10 to 999	50	Generates a packet when the oldest data recorded is this old (ms).
Processes	-	-	-
Parser(1022:0)	-	-	-
Catchall-Parser	-	-	-

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Report Indicates the status of the monitor.	BitVector	BitVector	16	R[15:0] R[15:2] Reserved - Reserved for future use. R(1) Bus1Active - 1 indicates that at least one message was received by Bus1 in last acquisition cycle R(0) Bus0Active - 1 indicates that at least one message was received by Bus0 in last acquisition cycle
ModuleMessageCount Count of messages parsed by the module.	Count	OffsetBinary	16	R[15:0]
Serial-In(1:0) Parameters				
ChannelMessageCount Count of messages parsed by the Channel.	Count	OffsetBinary	16	R[15:0]
Parser(1022:0) Parameters				

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageSize Number of received bytes in the message. (Includes message header and data.)	Count	OffsetBinary	16	R[15:0]
MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes time of the first character in message.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
MessageTimeLo Seconds and centiseconds time of the first character in message.	BitVector	BitVector	16	R[31:16] R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.
MessageTimeMicro Microseconds time of the first character in message.	Second	BCD	16	R[15:0] R[15:0] Microseconds - BCD Microseconds 0 to 9999.
MessageCount Received message count.	Count	OffsetBinary	16	R[15:0]
MessageInfo Information tag for this parsed transaction. This is a non-zero value.	BitVector	BitVector	16	R[15:0] R(15) Empty - 1 indicates that there is no message stored. R(14) Stale - 1 indicates this message was read before. R(13) Skipped - 1 indicates this message overwrote another. R[12:0] Reserved - Reserved for future use.
Catchall-Parser Parameters				
MessageSize Number of received bytes in the message. (Includes message header and data.)	Count	OffsetBinary	16	R[15:0]
MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes time of the first character in message.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
MessageTimeLo Seconds and centiseconds time of the first character in message.	BitVector	BitVector	16	R[31:16] R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.
MessageTimeMicro Microseconds time of the first character in message.	Second	BCD	16	R[15:0] R[15:0] Microseconds - BCD Microseconds 0 to 9999.
MessageData(64:0) IMB message data.	BitVector	BitVector	16	R[15:0]
MessageCount Received message count.	Count	OffsetBinary	16	R[15:0]

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageInfo Information tag for this parsed transaction. This is a non-zero value.	BitVector	BitVector	16	R[15:0] R(15) Empty - 1 indicates that there is no message stored. R(14) Stale - 1 indicates this message was read before. R(13) Skipped - 1 indicates this message overwrote another. R[12:0] Reserved - Reserved for future use.

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/IBM/101

For a detailed description on iNET-X packets, see *TEC/NOT/067 - IENA and iNET-X packet payload formats*.

KAD/IBM/101 packet formats

The KAD/IBM/101 can output packet payloads formatted for insertion into iNET-X systems.

iNET-X parser-aligned packet format

The generalized iNET-X payload structure for a parser-aligned packet is shown in the following figure.

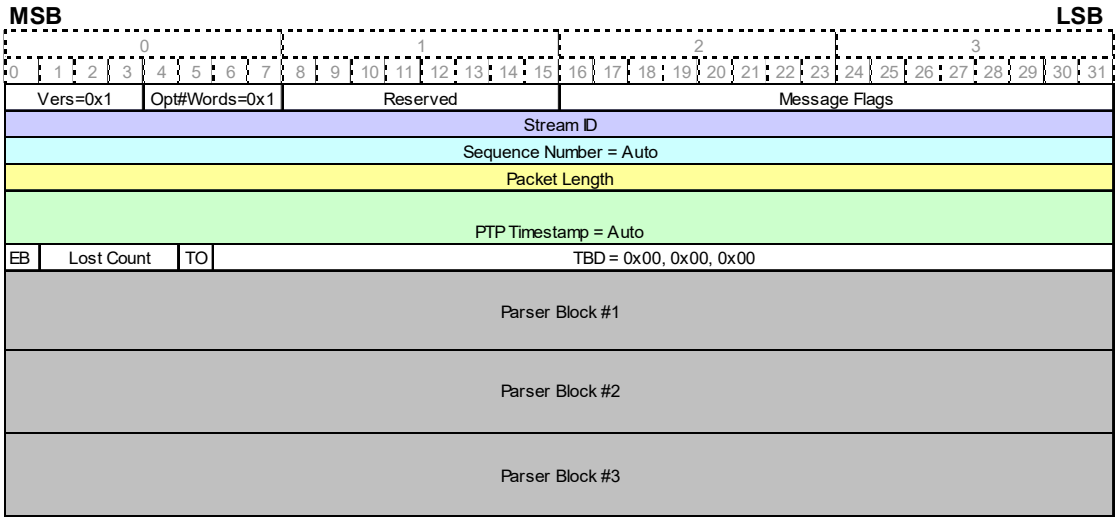


Figure 2: Generalized parser-aligned iNET-X packet

As messages are captured on the bus, they are formatted into a parser block. Each parser block begins with a 4-byte parser info word, followed by a 4-byte elapsed time tag, followed by a 2-byte protocol specific header and the message data (label, length, payload, and CRC) shown in the following figure.

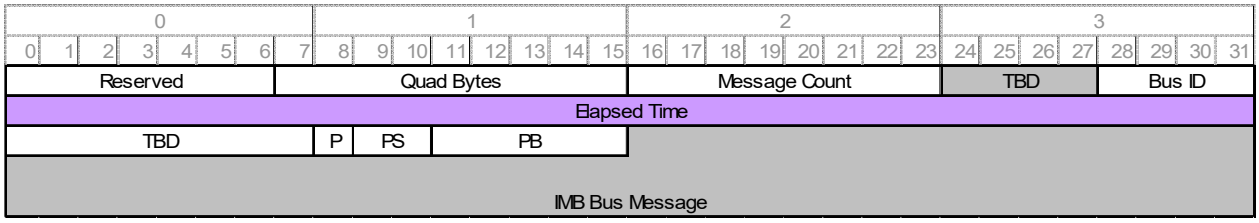


Figure 3: iNET-X parser block for IMB messages

A parser block consists of the following fields:

- Parser info word (4 bytes): metadata providing information about the status of the message.
  - Bits [0:6]: Reserved.
  - Bits [7:15]: number of quad bytes. This relates to the length of the parser info word, elapsed time tag, and the message data and padding (N x 4 bytes). For example, a 4-byte message captured from a given bus has a quad-byte value of 3, that is 12 bytes, which includes 4 bytes parser info word, 4 bytes elapsed time, and 4 bytes bus message data.
  - Bits [16:23]: message counter. This is a counter that relates to the messages contained in the payload.
  - Bits [24:31]: bus ID corresponds to the physical bus number on the module that is from 0 to 7.
- Elapsed time tag (4 bytes): time tag as an unsigned offset in nanoseconds that is added to the base Precision Time Protocol (PTP) timestamp in the iNET-X header.

- Padding information (1 bit)
  - Bit (0): Pad(P): indicates whether the message has been padded with 16 bits.
- Message (N x 4 bytes): captured bus traffic, padded if necessary to end on a 4-byte boundary.

Example iNET-X parser-aligned packet format for the IMB bus

The KAD/IBM/101 is a 2-channel IMB bus monitor. Traffic captured on each of the channels is placed in an iNET-X parser-aligned packet as shown in the following figure, where each bus has its own unique stream ID. The bus ID identifies on which bus a message was received.

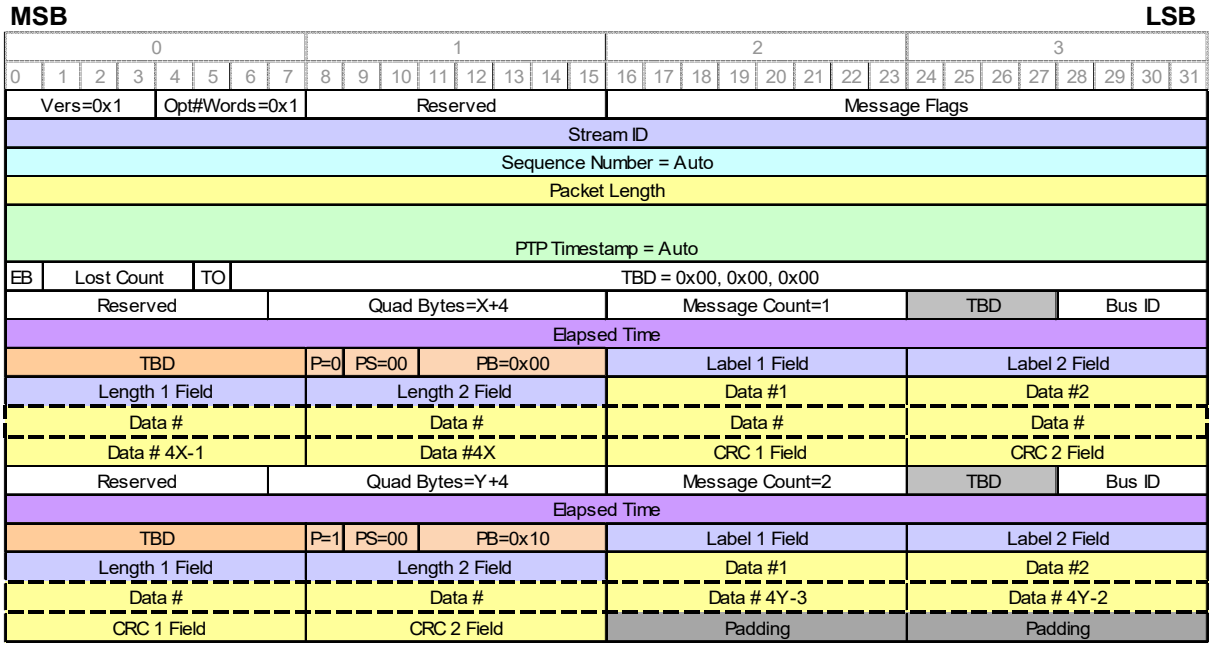


Figure 4: IMB bus iNET-X parser-aligned packet

As IMB messages arrive, they are tagged with a 4-byte parser info word and a 4-byte elapsed time word, followed by 1 bit of padding information. The parser info word identifies properties of the IMB message (such as the message counter and the ID of the bus on which the message was received).

The PTP timestamp in the iNET-X packet header is fixed when a packet is opened for writing and is used as the base timestamp for the whole packet. The PTP timestamp for each message in the packet can be calculated by adding the elapsed time to this base timestamp.

Directly following the elapsed time field is the 1 bit of padding information (indicating that padding was added) and 15 bits of TBD field. If the message does not finish on a 32-bit boundary, padding bits are added.

Parser

MessageData(0) is the IMB label while MessageData(1) is the IMB message length; IMB data starts at MessageData(2).

Connector pinout of the KAD/IBM/101

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DNC		Do not connect
2	DNC		Do not connect
3	DATA_IN(0)+	IMB inputs	Data in
4	DATA_IN(0)-	IMB inputs	Data in
5	DNC		Do not connect
6	DNC		Do not connect
7	DNC		Do not connect
8	DNC		Do not connect
9	CHASSIS	Chassis	
10	CHASSIS	Chassis	
11	GND	Internal ground	
12	GND	Internal ground	
13	GND	Internal ground	
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DATA_IN(1)+	IMB inputs	Data in
18	DATA_IN(1)-	IMB inputs	Data in
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	GND	Internal ground	
28	GND	Internal ground	
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DATA_OUT(0)-	IMB outputs	Data out (buffered copy of DATA_IN(0))
34	DATA_OUT(0)+	IMB outputs	Data out (buffered copy of DATA_IN(0))
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DATA_OUT(1)-	IMB outputs	Data out (buffered copy of DATA_IN(1))
42	DATA_OUT(1)+	IMB outputs	Data out (buffered copy of DATA_IN(1))
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/IBM/101	IMB serial bus monitor parser/packetizer - 2ch

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/IBM/101	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
TEC/NOT/051	Ethernet frames, Wireshark® and FAT32
TEC/NOT/067	IENA and iNET-X packet payload formats

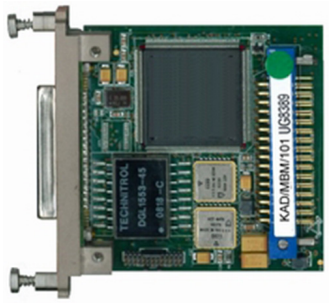
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/MBM/101

Dual redundant MIL-STD-1553 bus monitor with parser-packetizer

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Key Features

- Monitors one dual redundant MIL-STD-1553 bus using Direct or Transformer coupled operation
- Coherently parses traffic and tags for up to 1,024 parser ID; parser ID based on 16-bit commands; RT-RT messages treated as one parser ID
- Aperiodic transmission of packetized MIL-STD-1553 messages including tags as iNET-X payload structure per channel

Optional recording of messages with time-out status reply

Applications

- MIL-STD-1553 traffic monitoring and recording

Overview

The KAD/MBM/101 is a MIL-STD-1553 dual redundant bus monitor which combines the capabilities of a coherent message parser, with the flexibility of a iNET-X packetizer. It also provides message counting, and extensive error detection functions on a single module.

The KAD/MBM/101's parser, triple buffers up to 1,024 messages (including one catchall), and their associated tags, in buffers up to 43 words wide. The Info tag associated with each message has a stale bit (message read before), a skipped bit (buffer overwritten) and an empty bit (no message received since power-up)—all of which can be included as discrete parameters for transmission or logging.

Moreover, all MIL-STD-1553 messages are encapsulated as iNET-X parser-aligned payload structures. These parser-aligned packets may be transmitted aperiodically to optimize network bandwidth utilization and memory usage when recording the MIL-STD-1553 bus. Aperiodic packet transmission ensures that no messages are lost, since the Acra KAM-500 controller oversamples the KAD/MBM/101 and generates only a packet for transmission when the buffer is not empty, that is, when at least one new message has been captured from the bus.

Two message counters increment on receipt of a valid message. The REPORT word has a fresh error flag with a 6-bit error code to indicate the type of error caught and the bus on which it occurred. Errors are also time stamped and recorded in the iNET-X packet.

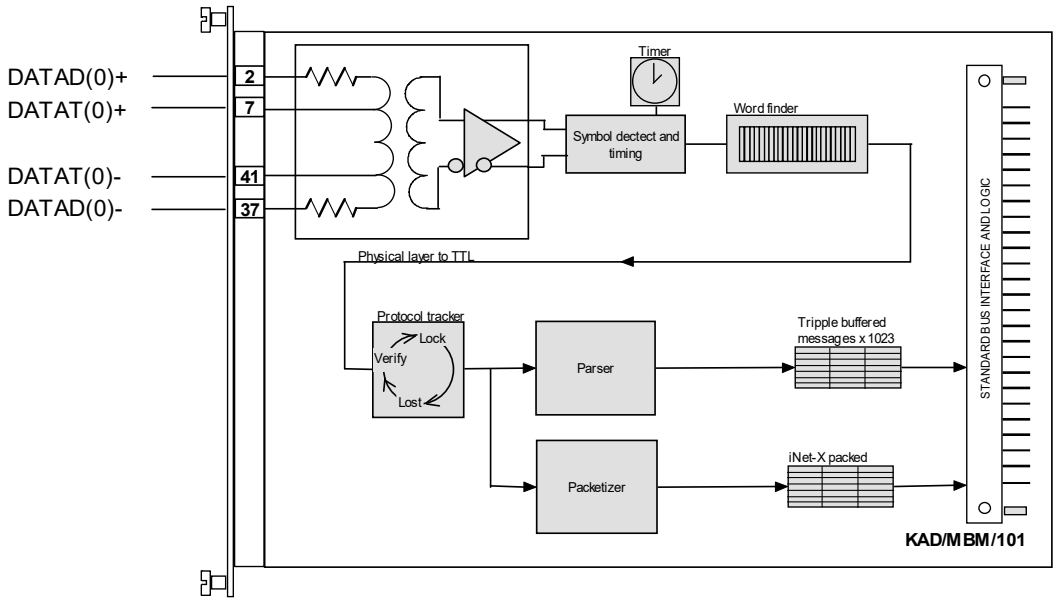


Figure 1: Primary bus packetizer on the KAD/MBM/101

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under "Environmental ratings" in the "General specifications" table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass		2.82			
	–	80	–	g	
	–	2.82	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	111	–	122	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	0.56	–	0.61	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	MIL-STD-1553				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	1	–	Dual redundant. MIL-STD-1553-B compatible.
Sampling rate	–	–	2	Msps	Maximum data rate of MIL-STD-1553 is 36kwps (72ksps).
Input voltage					
operating range	1.3	–	20	V_{p-p}	Applies to both transformer and direct coupled connection methods.
Connection methods					
transformer coupled	–	–	–	–	
direct coupled	–	–	–	–	

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Setting up the KAD/MBM/101

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/MBM/101	KAD/MBM/101	The instrument part reference.
SerialNumber	FA2342	FA2342	Unique name for each module.
Settings	-	-	-
Fill Value	0000 to FFFF	AAAA	Specifies the value that should be stored when the bus monitor is not receiving data.
Processes	-	-	-
Parser(1022:0)	-	-	One of 1023 selective parser slots.
Catchall-Parser	-	-	Any message that is not parsed goes to this final parser slot.
Channels	-	-	-
MIL-STD-1553-In-Primary MIL-STD-1553 Input	-	-	Represents a typical MIL-STD-1553 bus monitor channels configuration.
Settings	-	-	-
Maximum Response Time	1 to 31	12	Maximum permitted response time for RT in micro seconds.
Accept Rx Message With No Status	True False	False	Receive messages with no status response are stored when set to True.
Accept Tx Message With No Status	True False	False	Transmit messages with no status response are stored when set to True.
Settings Mode Code 17	-	-	Mode Code 17 messages are used to extend the Sub Address range for RT by providing a Sub-sub Addressing.
Load Map From	SSA Cycle	SSA	This element is used to specify which bits from the data word of the Mode Code 17 message are used for the map index. The allowed values are "SSA" and "Cycle".
Time Bit First	True False	False	This element is used to specify if the Time Bit in a mode code 17 message is the least significant bit (True) or the most significant bit (False).
Ignore Fresh Bit	False True	False	This element is used to control updating of the map index depending on the fresh bit value in the mode code 17 data word. A value of "True" means the fresh bit is ignored and a value of "False" means it is not ignored.
Ignore Time Bit	True False	False	This element is used to control updating of the map index depending on the time bit value in the mode code 17 data word. A value of "True" means the time bit is ignored and a value of "False" means it is not ignored.
Default Map On Power Up	00 to 7F	00	This element can be used to specify the default extended sub-address mapping when the bus monitor first powers up. The value expected is a hexadecimal value.
Settings Packetizer	-	-	-

SETUP DATA	CHOICE	DEFAULT	NOTES
Stream Id	00 to FFFFFFFF	FFFFFFFF	iNET-X stream ID for selected channel if a packet is generated via the assertion of Packetization Enabled. This setting is only supported in DAS Studio 3.
Packetization Enabled	True False	False	Enables the transmission of an iNET-X packet containing the contents of this channel if an iNET-X transmitter is present in the chassis. This setting is only supported in DAS Studio 3.
Packet Size	200 to 722	722	Size of packet buffer in words.
Packet Timeout	10 to 1500	50	Generate a packet when the oldest data recorded is this old (ms).
MIL-STD-1553-In-Secondary MIL-STD-1553 Input	-	-	Represents a typical MIL-STD-1553 bus monitor channels configuration.
Settings Packetizer	-	-	-
Stream Id	00 to FFFFFFFF	FFFFFFFF	iNET-X stream ID for selected channel if a packet is generated via the assertion of Packetization Enabled. This setting is only supported in DAS Studio 3.
Packetization Enabled	True False	False	Enables the transmission of an iNET-X packet containing the contents of this channel if an iNET-X transmitter is present in the chassis. This setting is only supported in DAS Studio 3.
Packet Size	200 to 722	722	Size of packet buffer in words.
Packet Timeout	10 to 1500	50	Generate a packet when the oldest data recorded is this old (ms).

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Report Reports the status of the module	BitVector	BitVector	16	R[15:0] R(15) ErrorSinceLastRead - 1 indicates error occurred since last read. R(14) ErrorOnSecondaryBus - 1 indicates the last error occurred on secondary bus. R[13:6] Reserved - Reserved for future use. R[5:0] ErrorCodes - Indicates the error that occurred last (See “Error codes” in Getting the most from).
ErrorCount A count of errors detected on both busses	BitVector	BitVector	16	R[15:0] R[15:0] ErrorCount - A count of errors detected on both busses.
Parser(1022:0) Parameters				
MessageCount Message counter value when the word was received.	Count	OffsetBinary	16	R[15:0] R[15:0] MessageCount
MessageCommand1 First command word in message.	BitVector	BitVector	16	R[15:0] R[15:0] MessageCommand1
MessageStatus1 First status word stored in message.	BitVector	BitVector	16	R[15:0] R[15:0] MessageStatus1

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageResponseTime1 First status word's response time in microseconds.	Second	OffsetBinary	16	R[15:0] R[15:0] MessageResponseTime1
MessageCommand2 Second command word of an RT-RT message.	BitVector	BitVector	16	R[15:0] R[15:0] MessageCommand2
MessageStatus2 Second status word of an RT-RT message.	BitVector	BitVector	16	R[15:0] R[15:0] MessageStatus2
MessageResponseTime2 Second status word's response time in microseconds of an RT-RT message.	Second	OffsetBinary	16	R[15:0] R[15:0] MessageResponseTime2
MessageInfo Stale/skipped indication for this parsed message.	BitVector	BitVector	16	R[15:0] R(15) Empty - 1 indicates this parser slot is empty. R(14) Stale - 1 indicates this message was read before. R(13) Skipped - 1 indicates this message overwrote another. R[12:0] Reserved - Reserved for future use.
MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes time midway through first transmitted bit.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
MessageTimeLo Seconds and centiseconds time midway through first transmitted bit.	Second	BCD	16	R[31:16] R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.
MessageTimeMicro Microsecond time midway through first transmitted bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - BCD Microseconds 0 to 9999.
Catchall-Parser Parameters				
MessageCount Message counter value when the word was received.	Count	OffsetBinary	16	R[15:0] R[15:0] MessageCount
MessageCommand1 First command word in mes-sage.	BitVector	BitVector	16	R[15:0] R[15:0] MessageCommand1
MessageStatus1 First status word stored in mes-sage.	BitVector	BitVector	16	R[15:0] R[15:0] MessageStatus1
MessageResponseTime1 First status word's response time in microseconds.	Second	OffsetBinary	16	R[15:0] R[15:0] MessageResponseTime1
MessageData(31:0) MIL-1553 message data	BitVector	BitVector	16	R[15:0] R[15:0] MessageData
MessageCommand2 Second command word of an RT-RT message.	BitVector	BitVector	16	R[15:0] R[15:0] MessageCommand2

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageStatus2 Second status word of an RT-RT message.	BitVector	BitVector	16	R[15:0] R[15:0] MessageStatus2
MessageResponseTime2 Second status word's response time in microseconds of an RT-RT message.	Second	OffsetBinary	16	R[15:0] R[15:0] MessageResponseTime2
MessageInfo Stale/skipped indication for this parsed message.	BitVector	BitVector	16	R[15:0] R(15) Empty - 1 indicates this parser slot is empty. R(14) Stale - 1 indicates this message was read before. R(13) Skipped - 1 indicates this message overwrote another. R[12:0] Reserved - Reserved for future use.
MessageIrigTime48 48-bit wide IRIG time word	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes time midway through first transmitted bit.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
MessageTimeLo Seconds and centiseconds time midway through first transmitted bit.	Second	BCD	16	R[31:16] R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.
MessageTimeMicro Microsecond time midway through first transmitted bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - BCD Microseconds 0 to 9999.
MIL-STD-1553-In-Primary Parameters				
MessageCountPrimary Count of all good messages on the bus.	Count	OffsetBinary	16	R[15:0] R[15:0] MessageCountPrimary
MIL-STD-1553-In-Secondary Parameters				
MessageCountSecondary Count of all good messages on the bus.	Count	OffsetBinary	16	R[15:0] R[15:0] MessageCountSecondary

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/MBM/101

For a detailed description on iNET-X packets, see *TEC/NOT/067 - IENA and iNET-X packet payload formats*.

iNET-X parser-aligned packet format

There is a diverse range of avionic bus technologies for which traffic may be captured, for example, MIL-STD-1553, PCM, or ARINC-429. The generalized iNET-X payload structure for parser-aligned packets is shown in the following figure.

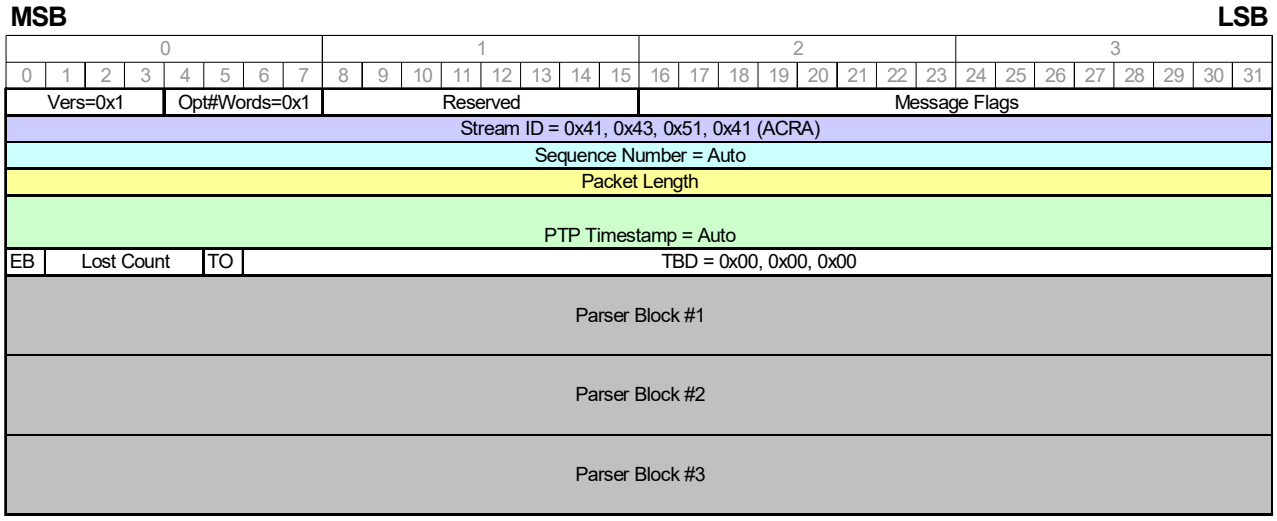


Figure 2: Generalized parser-aligned iNET-X packet

As messages are captured on the bus, they are formatted in a parser block. Each parser block begins with a 4-byte parser information word, followed by a 4-byte elapsed time tag and the message data shown in the following figure.

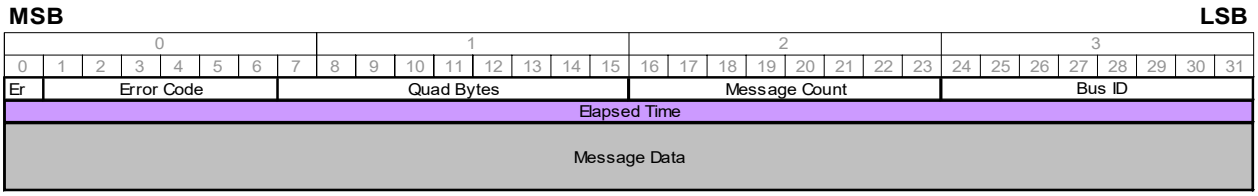


Figure 3: iNET-X parser block

A parser block consists of the following fields:

- Parser information word (4 bytes): metadata providing information about the health and status of the message.
  - Er (Bit 0): indicates that an error occurred.
  - Bits [1:6]: Reserved.
  - Quad bytes (Bits [7:15]): number of quad bytes. This relates to the length of the parser information word, elapsed time tag, and the message data and padding (N x 4 bytes). For example, a 4-byte message captured from a given bus has a quad-byte value of 3, that is 12 bytes that includes 4 bytes parser information word, 4 bytes elapsed time, and 4 bytes bus message data.
  - Message count (Bits [16:23]): message counter. This is a message counter that relates to the messages contained in the payload. The message counter increments for each message contained in the packet payload and continues to increment across consecutive packets. The message counter resets and wraps around to 0 once it has reached the maximum message count of 0xFF.
  - Bus ID (Bits [24:31]): bus number.
- Elapsed time (4 bytes): time tag as an unsigned offset in nanoseconds that is added to the base PTP timestamp in the iNET-X

header.

- Message data (N x 4 bytes): captured bus traffic, padded if necessary to end on 4-byte boundary.

iNET-X parser-aligned packet structure for MIL-STD-1553 bus monitoring

As MIL-STD-1553 messages arrive, the MIL-STD-1553 protocol tracker logic identifies them and maps them to corresponding transaction identifier codes, as in the following table. The KAD/MBM/101 module creates an independent packet stream for each of the primary and secondary buses. Bus ID is fixed to 0 for Bus A packets and 1 for Bus B packets.

TABLE 3	Transaction identifier codes	
MESSAGE TYPE	MNEMONIC	TRANSACTION ID
Bus Controller to Remote Terminal	BC -> RT	0x00
Remote Terminal to Bus Controller	RT -> BC	0x01
Remote Terminal to Remote Terminal	RT -> RT	0x02
Mode Code without Data	M -> S	0x03
Mode Code with Data (R)	MD -> S	0x04
Mode Code with Data (T)	M -> SD	0x05
BROADCAST		
Bus Controller to Remote Terminals	BC -> RTS	0x06
Remote Terminal to Remote Terminals	RT -> RTS	0x07
Mode Code without Data	M	0x08
Mode Code with Data (R)	MD	0x09
MESSAGES WITHOUT STATUS REPLY		
Bus Controller to Remote Terminal	BC -> RT	0x10
Remote Terminal to Bus Controller	RT -> BC	0x11
Remote Terminal to Remote Terminal	RT -> RT	0x12
Mode Code without Data	M -> S	0x13
Mode Code with Data (R)	MD -> S	0x14
Mode Code with Data (T)	M -> SD	0x15
Remote Terminal to Remote Terminal	RT -> RTS	0x17

Only valid MIL-STD-1553 transactions are stored in the packet (see the following figure). If an error occurs, only the parser information word and elapsed time tag are written to the iNET-X packet; the message is then dumped. The error bit and error code (see the previous table), which are set in the parser information word, indicate the cause of the error.

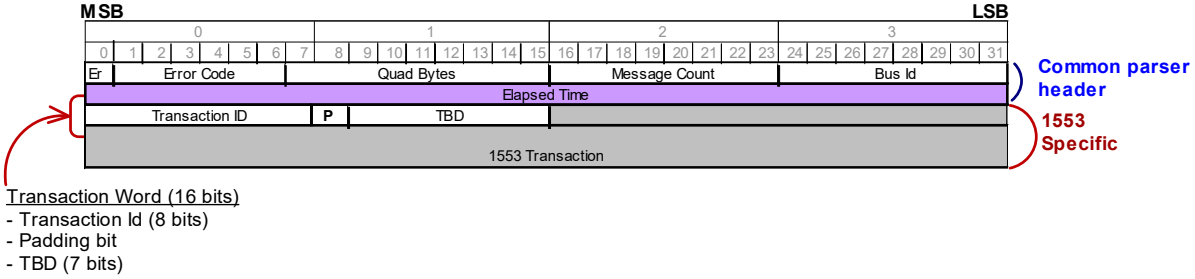


Figure 4: MIL-STD-1553 transaction iNET-X parser-aligned packet

In the case where a remote terminal is off-line but it is still desirable to capture data sent to it, you can set options to include Accept Rx Message With No Status and Accept Tx Message With No Status. In such a scenario, the parser information word

indicates an error but the 1553 traffic is still captured.

The transaction identifier may be used to indicate when response times are carried in the iNET-X parser-aligned block. The MIL-STD-1553 standard specifies a minimum response time of 4µs and a maximum response time of 12µs. However, the bus controller waits up to 20µs before determining a timeout has occurred. The granularity of response time on the 8MHz bus can be measured to a resolution of 125ns. When a timeout occurs, the response time is set to 0xFF.

In order to facilitate the decoding and decommutation of the MIL-STD-1553 parser-aligned iNET-X packets, the first word of a MIL-STD-1553 transaction is the transaction word where:

- Transaction word (2 bytes): metadata providing protocol tracking information, health, and status of the message.
  - Transaction ID (Bits [0:7]): see Table 3 on page 798
  - P (Bit 8): bit to indicate if the parser message has been padded to fall on a 4-byte boundary
  - TBD (Bits [9:15]): TBD

Where a MIL-STD-1553 transaction does not fall on a 32-bit boundary, the MIL-STD-1553 parser-aligned message is padded. In MIL-STD-1553 the maximum number of padding words (16-bit) possible in a single transaction is one. Therefore a single bit is sufficient to indicate if a transaction message has been padded. Figure 5 on page 799 and Figure 6 on page 799 illustrate individual MIL-STD-1553 BC -> RT transactions, with and without padding.

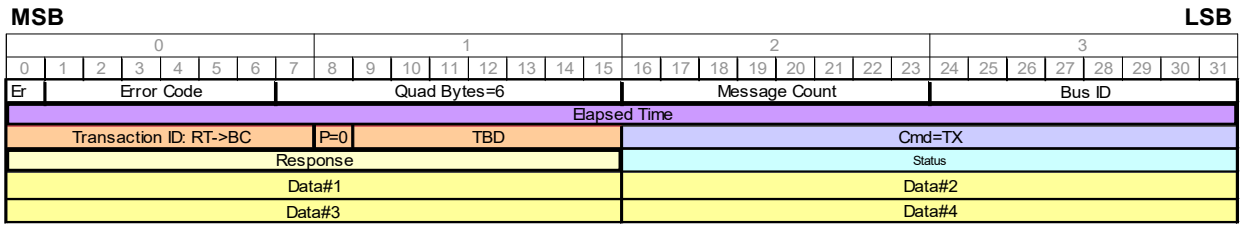


Figure 5: MIL-STD-1553 transaction iNET-X parser-aligned message without padding

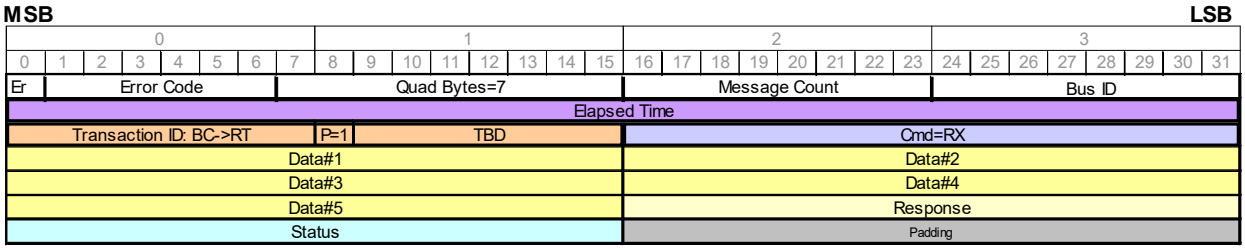


Figure 6: MIL-STD-1553 transaction iNET-X parser-aligned message with padding

Figure 7 on page 800 demonstrates the iNET-X parser-aligned payload structure for MIL-STD-1553 with the following three parsed MIL-STD-1553 transactions in the payload:

- BC -> RT: With four data words transferred.
- RT -> RT: With five data words transferred.
- RT -> BC: With four data words transferred.

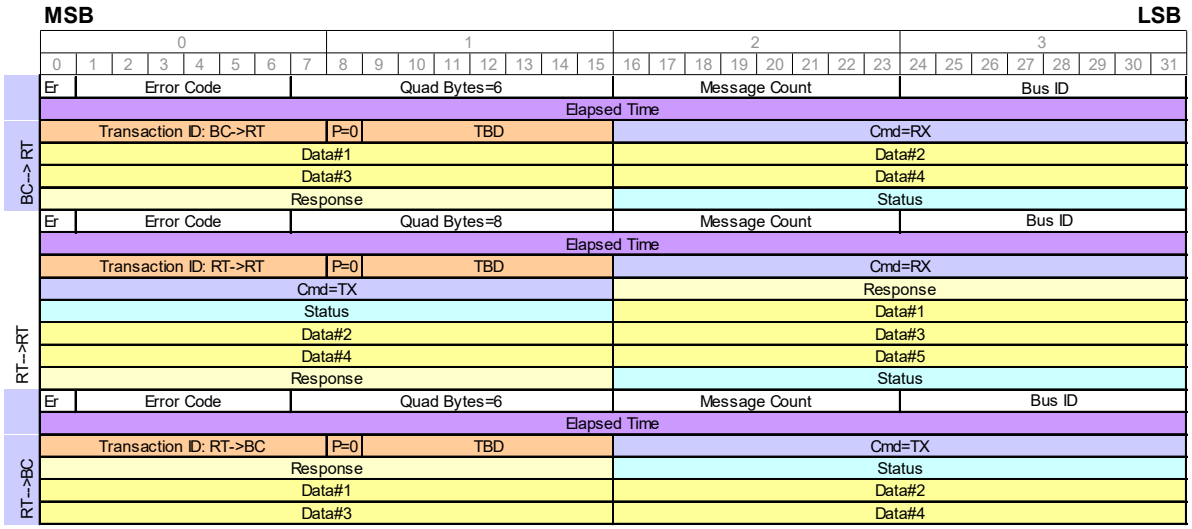


Figure 7: iNET-X parser-aligned payload for multiple MIL-STD-1553 transactions

For example, the MIL-STD-1553 bus has a peak bit-rate of 1Mbps. However, the messages and transactions transmitted are variable in length and asynchronous. If it is assumed that the mean MIL-STD-1553 transaction is 14 bytes long (comprising of a command, response, data words, and a status word), the iNET-X parser block structure encapsulating this transaction is therefore 24 bytes (including the MIL-STD-1553 transaction ID, parser information word and the elapsed time). In this case, each iNET-X parser-aligned packet may contain up to 60 parser blocks in the payload (that is, 60 parser blocks x 24 bytes per block which results in 1440 bytes of payload, or 840 bytes of MIL-STD-1553 bus data). To ensure that no data is lost on the bus, packets are generated at a rate of 150 packets per second.

The transmission properties for a 1Mbps MIL-STD-1553 bus are summarized in the following table.

TABLE 4	MyMIL-STD-1553 packet transmission properties
TRANSMISSION PROPERTY	**VALUE**
MIL-STD-1553 packet payload size (bytes)	1440 bytes (60 MIL-STD-1553 parser blocks of 24 bytes per block where each block contains 14 bytes of MIL-STD-1553 bus data)
Total Ethernet frame length (bytes)	1514 bytes (MAC header 14 bytes + IP 20 bytes + UDP 8 bytes + iNET-X 28 bytes + MIL-STD-1553 data + MAC FCS 4 bytes)
Packet rate (packets per second)	150
Total number of MIL-STD-1553 transactions per packet	60 transactions assuming 14 bytes per transaction
Total bit-rate (kbps)	1816.8

TABLE 5	Error codes		
ERROR CODE	**DESCRIPTION**	**ERROR CODE**	**DESCRIPTION**
0_{16}	Reserved for future use.	20_{16}	Expected STS was a data word.
1_{16}	Data word did not have enough bits.	21_{16}	Expected STS was invalid.
2_{16}	Data word had bit error.	22_{16}	Expected STS had incorrect RT.
3_{16}	Data word had parity error.	23_{16}	Expected STS had contiguous traffic.
4_{16}	Non-data word did not have enough bits.	24_{16}	Expected STS timed out.
5_{16}	Non-data word had bit error.	25_{16}	Expected STS had no contiguous data word.
6_{16}	Non-data word had parity error.	26_{16}	Reserved for future use.

TABLE 5	Error codes		
ERROR CODE	DESCRIPTION	ERROR CODE	DESCRIPTION
7_{16}	Reserved for future use.	27_{16}	Reserved for future use.
8_{16}	Expected data word was non-data word.	28_{16}	Reserved for future use.
9_{16}	Expected data word did not have contiguous word.	29_{16}	Reserved for future use.
A_{16}	Expected last data word was not last.	$2A_{16}$	Reserved for future use.
B_{16}	Expected mode data word was non-data word.	$2B_{16}$	Expected Tx CMD of RT to RT(s) had different number of words than Rx CMD.
C_{16}	Expected mode data word has contiguous traffic.	$2C_{16}$	Expected Tx CMD of RT to RT(s) had same RT as Rx CMD.
D_{16}	Reserved for future use.	$2D_{16}$	Expected Tx CMD of RT to RT(s) had contiguous traffic.
E_{16}	Reserved for future use.	$2E_{16}$	Second CMD in RT-RT was not a TX.
F_{16}	Reserved for future use.	$2F_{16}$	Reserved for future use.
10_{16}	Expected first CMD was a data word.	30_{16}	Reserved for future use.
11_{16}	Reserved for future use.	31_{16}	Reserved for future use.
12_{16}	Reserved for future use.	32_{16}	Reserved for future use.
13_{16}	Reserved for future use.	33_{16}	Reserved for future use.
14_{16}	Reserved for future use.	34_{16}	Reserved for future use.
15_{16}	Expected first CMD had contiguous traffic.	35_{16}	Reserved for future use.
16_{16}	Expected first CMD was Rx with no contiguous data word.	36_{16}	Reserved for future use.
17_{16}	Expected first CMD was Mode with no contiguous data.	37_{16}	Reserved for future use.
18_{16}	Expected second STS of RT to RT was data word.	38_{16}	Reserved for future use.
19_{16}	Expected second STS of RT to RT had incorrect RT.	39_{16}	Reserved for future use.
$1A_{16}$	Expected second STS of RT to RT had contiguous traffic.	$3A_{16}$	Reserved for future use.
$1B_{16}$	Expected second STS of RT to RT timed out.	$3B_{16}$	Reserved for future use.
$1C_{16}$	Reserved for future use.	$3C_{16}$	Reserved for future use.
$1D_{16}$	Reserved for future use.	$3D_{16}$	Reserved for future use.
$1E_{16}$	Reserved for future use.	$3E_{16}$	Reserved for future use.
$1F_{16}$	Reserved for future use.	$3F_{16}$	Reset occurred since last read.

Tx = transmit; STS = status; CMD = command.

Detecting messages when a remote terminal is off-line

When a MIL-STD-1553 remote terminal is off-line, it does not respond (with a STATUS word) to bus controller Rx commands. When a MIL-STD-1553 remote terminal is off-line, it does not respond (with a STATUS word followed by data) to bus controller Tx commands.

To acquire data from MIL-STD-1553 messages, which have been sent from the bus controller to off-line remote terminals, see “Message capture settings” on page 802. To determine, via telemetry, if a remote terminal is off-line, see “Detecting when a Tx remote terminal is off-line” on page 802.

Message capture settings

The following settings can be used to capture messages when the remote terminal is off-line:

- AcceptRxMessageWithNoStatus
- AcceptTxMessageWithNoStatus

NOTE: The message counter on the KAD/MBM/101 counts all messages that go into the parser (two dedicated counters for bus primary/secondary), which are defined by either AcceptRxMessageWithNoStatus or AcceptTxMessageWithNoStatus.

AcceptRxMessageWithNoStatus

If any remote terminals monitoring the MIL-STD-1553 bus are likely to be off-line, set AcceptRxMessageWithNoStatus to YES. When AcceptRxMessageWithNoStatus is set to YES, the KAD/MBM/101 captures data from Rx command messages, where the remote terminal does not respond with a STATUS word. In this scenario, the STATUS word in the parser is hex FFFF.

If AcceptRxMessageWithNoStatus is set to NO, then only complete messages, where a remote terminal responds, are captured.

AcceptTxMessageWithNoStatus

When AcceptTxMessageWithNoStatus is set to YES, the KAD/MBM/101 accepts Tx command messages where the remote terminal does not respond. In this scenario, only the Tx command appears on the MIL-STD-1553 bus, the KAD/MBM/101 parser data is invalid, the STATUS word in the parser is hex FFFF and time stamps record any occurrence of the COMMAND word.

The AcceptTxMessageWithNoStatus setting enables the capture of messages when the remote terminal is off-line. However, for this setting to have an effect, AcceptRxMessageWithNoStatus must be set to YES.

When AcceptTxMessageWithNoStatus is set to NO, the KAD/MBM/101 rejects Tx command messages where the remote terminal does not respond. The effect on the parser is that the last valid message with the last valid data and time stamps remain.

Detecting when a Tx remote terminal is off-line

To detect when a Tx remote terminal is off-line, set AcceptTxMessageWithNoStatus to YES. The parser STATUS word must be sent to detect this and then be processed in the ground station. If the STATUS word is hex FFFF, the ground station must deal with the invalid data in the parser. Otherwise, the data shows FFFFh.

Response time

One feature of the KAD/MBM/101 is the ability to program the response timeout. This value should reflect the actual response timeout on the MIL-STD-1553 bus. Under normal circumstances a remote terminal responds within 4 to 12 microseconds. However a remote terminal should wait a minimum of 14 microseconds before considering that the remote terminal has timed out. Some implementations of MIL-STD-1553 have deviated from the standard and have their own response times. For this reason, the expected response time is configurable on the KAD/MBM/101.

It is important that the KAD/MBM/101 has response time configured correctly because there may be confusion over which MIL-STD-1553 messages certain control words belong to. In MIL-STD-1553, the COMMAND word and STATUS word have the same signature. For example, if the response time is set too high, and if there is no response from a particular RT, the next COMMAND word may belong to that message as a STATUS word. This may cause issues parsing the next message. If the response time is set too low, then the KAD/MBM/101 may consider that a valid message has timed out due to no response. The status of this message appears as the next command. This may cause issues parsing the next message and so on.

Parser sample rate

The KAD/MBM/101 parser is triple buffered. If there is a burst of more than three messages between parser sampling intervals, the triple buffer can be saturated. Therefore, if it is necessary that all messages get captured, the parser data must be sampled at the speed of the burst if this is above the aggregate rate.

Variable sized messages

By default, the KAD/MBM/101 is configured to parse any number of data words for a particular message. It is also possible to parse messages of particular sizes.

In cases where there are variable sized messages and when word count is set to All, care must be taken when processing the data. The parser only updates the data words that appear on the MIL-STD-1553 bus. The other words are not valid. This means that the ground station or post processing must use the number of data words indicated in the command word to identify which data words are valid. The other option is to parse particular message sizes individually.

Connector pinout of the KAD/MBM/101

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DNC		Do not connect
2	DATAD(0)+	MIL-STD-1553	Direct coupled primary bus
3	DNC		Do not connect
4	DNC		Do not connect
5	DNC		Do not connect
6	DNC		Do not connect
7	DATAT(0)+	MIL-STD-1553	Transformer coupled primary bus
8	DNC		Do not connect
9	DNC		Do not connect
10	DNC		Do not connect
11	DNC		Do not connect
12	DATAT(1)+	MIL-STD-1553	Transformer coupled secondary bus
13	DNC		Do not connect
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DATAD(1)+	MIL-STD-1553	Direct coupled secondary bus
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	GND	Internal ground	
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	GND	Internal ground	
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DATAD(0)-	MIL-STD-1553	Direct coupled primary bus
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DATAT(0)-	MIL-STD-1553	Transformer coupled primary bus
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DATAT(1)-	MIL-STD-1553	Transformer coupled secondary bus
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DATAD(1)-	MIL-STD-1553	Direct coupled secondary bus
51	DNC		Do not connect
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/MBM/101	Dual redundant MIL-STD-1553 bus monitor with parser-packetizer

When ordering, specify which connector (ASD/MSB/001/TC for transformer coupled; or ASD/MSB/001/DC for direct coupled) is preferred. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). For details of the version of this module with Mode Code 17 support, contact Curtiss-Wright support (acra-support@curtisswright.com). Additional items must be ordered separately; refer to Related products for options.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/MBM/101	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment

Related products

SOFTWARE	DETAILS
ASD/MSB/001/TCC	KAM MIL-STD-1553 interface cable (45cm long) terminated with two Twinax TRB connectors for applications with transformer coupling (shield connected to chassis)
ASD/MSB/001/DCC	KAM MIL-STD-1553 interface cable (45cm long) terminated with two Twinax TRB connectors for applications with direct coupling (shield connected to chassis)

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/004	MIL-STD-1553
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
TEC/NOT/051	Ethernet frames, Wireshark® and FAT32
TEC/NOT/067	IENA and iNET-X packet payload formats

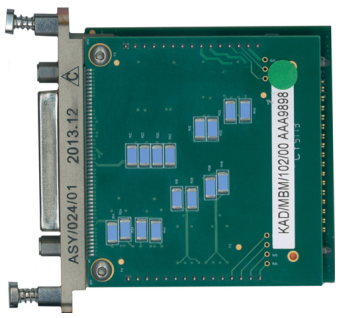
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/MBM/102

MIL-STD-1553 bus monitor parser/packetizer - 4ch dual redundant

CURTISSWRIGHTDS.COM



Key Features

- Monitors up to four dual redundant MIL-STD-1553 busses using Direct or Transformer coupled operation
- Coherently parses traffic and tags for up to 4,092 parser ID; parser ID based on 16-bit commands; RT-RT messages treated as one parser ID
- Aperiodic transmission of packetized MIL-STD-1553 messages including tags as iNET-X payload structure per channel
- Optional recording of messages with time-out status reply

Applications

- MIL-STD-1553 traffic monitoring and recording

Overview

The KAD/MBM/102 is a MIL-STD-1553 bus monitor, which can monitor up to four dual redundant busses. It combines the capabilities of a coherent message parser, with the flexibility of an iNET-X packetizer. It also provides message counting and extensive error detection functions, on a single module.

The KAD/MBM/102's parser, triple buffers up to 4,092 complete messages and their associated tags in buffers up to 43 words wide. The INFO tag associated with each message has a stale bit (message read before), a skipped bit (buffer overwritten) and an empty bit (no message received since power-on). These tags can be included as discrete parameters in Ethernet or PCM transmissions.

All messages are transparently added to an iNET-X parser-aligned packet and are sent aperiodically. This is achieved by oversampling the packet buffers with the Acra KAM-500 controller and silently dropping packets, which have already been sent saving bandwidth and media storage. iNET-X messages are optimized for Ethernet transmission and simultaneous storage in Wireshark® Packet CAPture (PCAP) format.

All messages are protocol tracked by the KAD/MBM/102. It handles all mode codes (including those that are user-defined).

The MessageCount increments on receipt of a valid message. The error word has bits (in the form of a 6-bit code) which indicate the type of error caught and the bus on which it occurred. Errors are also time stamped and recorded in the iNET-X packet.

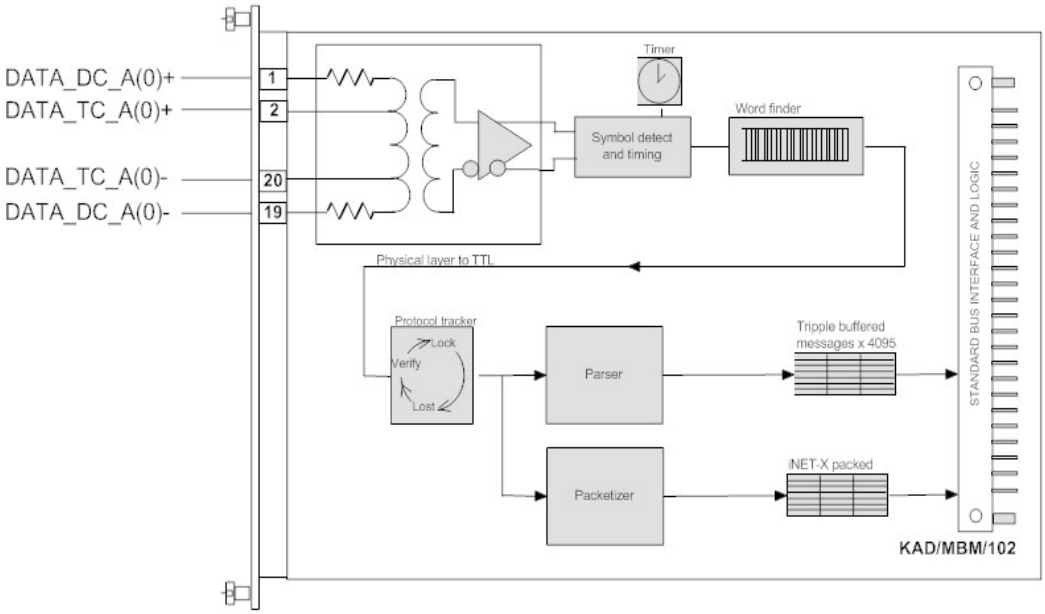


Figure 1: First of four bus parser/packetizers on the KAD/MBM/102

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under "Environmental ratings" in the "General specifications" table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	90	–	g	
	–	3.17	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	200	–	220	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	1	–	1.1	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	MIL-STD-1553				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	4	–	Dual redundant. MIL-STD-1553-B compatible.
Sampling rate	–	–	2	Msps	Maximum data rate of MIL-STD-1553 is 36kwps (72ksps).
Input voltage					
operating range	1.36	–	20	V_{p-p}	Direct coupled.
operating range	1.01	–	20	V_{p-p}	Transformer coupled.
Connection methods					
transformer coupled	–	–	–	–	
direct coupled	–	–	–	–	

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Setting up the KAD/MBM/102

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/MBM/102	KAD/MBM/102	The instrument part reference.
SerialNumber	AAA/1234	AAA/1234	Unique name for each module.
Settings	-	-	-
Fill Value	0000 to FFFF	AAAA	Specifies the value that should be stored when the bus monitor is not receiving data.
Packetization	Dual Redundant Individual	Individual	Selects packetization on a pair of busses or an individual bus.
Processes	-	-	-
Catchall-Parser	-	-	Any message that is not parsed goes to this final parser slot.
Channels	-	-	-
MIL-STD-1553-In-A(3:0) MIL-STD-1553 Input	-	-	Represents a typical MIL-STD-1553 bus monitor channel configuration.
Settings	-	-	-
Maximum Response Time	8 to 31	12	Maximum permitted response time for RT in micro seconds.
Accept Rx Message With No Status	True False	False	Received messages with no status response are stored, when set to True.
Accept Tx Message With No Status	True False	False	Transmitted messages with no status response are stored, when set to True.
Settings Mode Code 17	-	-	Mode Code 17 messages are used to extend the Sub Address range for an RT by providing a Sub-sub Addressing.
Settings Packetizer	-	-	-
Stream Id	00 to FFFFFFFF	FFFFFFFF	iNET-X stream ID for selected channel if a packet is generated via the assertion of Packetization Enabled. This setting is only supported in DAS Studio 3.
Packetization Enabled	True False	False	Enables the transmission of an iNET-X packet containing the contents of this channel if an iNET-X transmitter is present in the chassis. This setting is only supported in DAS Studio 3.
Packet Size	200 to 722	722	Size of packet buffer in words.
Packet Timeout	10 to 999	50	Generates a packet when the oldest data recorded is this old (ms).
Processes	-	-	-
Parser(1022:0)	-	-	One of 1023 selective parser slots available per channel.
MIL-STD-1553-In-B(3:0) MIL-STD-1553 Input	-	-	Represents a typical MIL-STD-1553 bus monitor channel configuration.
Settings Packetizer	-	-	-
Stream Id	00 to FFFFFFFF	FFFFFFFF	iNET-X stream ID for selected channel if a packet is generated via the assertion of Packetization Enabled. This setting is only supported in DAS Studio 3.

SETUP DATA	CHOICE	DEFAULT	NOTES
Packetization Enabled	True False	False	Enables the transmission of an iNET-X packet containing the contents of this channel if an iNET-X transmitter is present in the chassis. This setting is only supported in DAS Studio 3.
Packet Size	200 to 722	722	Size of packet buffer in words.
Packet Timeout	10 to 999	50	Generates a packet when the oldest data recorded is this old (ms).

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Report Reports the status of the module	BitVector	BitVector	16	R[15:0] R(15) ErrorSinceLastRead - 1 indicates error occurred since last read. R[14:13] MIL-STD-1553-In - Indicates which channel the error occurred on. R(12) ErrorOnSecondaryBus - 1 indicates the last error occurred on secondary bus. R[11:6] Reserved - Reserved for future use. R[5:0] ErrorCodes - Indicates the error that occurred last (see “Error codes” in Getting the most from).
BusActive The eight LSBs indicate if a valid message was received on a bus since last read.	BitVector	BitVector	16	R[15:0] R[15:8] Reserved - Reserved for future use. R[15:0] BusActive - A 1 indicates that a valid message was received on a bus in the last second.
Catchall-Parser Parameters				
MessageCount Message counter value when the word was received.	Count	OffsetBinary	16	R[15:0] R[15:0] MessageCount
MessageCommand1 First command word in message.	BitVector	BitVector	16	R[15:0] R[15:0] MessageCommand1
MessageStatus1 First status word stored in message.	BitVector	BitVector	16	R[15:0] R[15:0] MessageStatus1
MessageResponseTime1 First status word's response time in microseconds.	Second	OffsetBinary	16	R[15:0] R[15:0] MessageResponseTime1
MessageData(31:0) MIL-1553 message data	BitVector	BitVector	16	R[15:0] R[15:0] MessageData
MessageCommand2 Second command word of an RT-RT message.	BitVector	BitVector	16	R[15:0] R[15:0] MessageCommand2
MessageStatus2 Second status word of an RT-RT message.	BitVector	BitVector	16	R[15:0] R[15:0] MessageStatus2
MessageResponseTime2 Second status word's response time in microseconds of an RT-RT message.	Second	OffsetBinary	16	R[15:0] R[15:0] MessageResponseTime2

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageInfo Stale/skipped indication for this parsed message.	BitVector	BitVector	16	R[15:0] R(15) Empty - 1 indicates this parser slot is empty. R(14) Stale - 1 indicates this message was read before. R(13) Skipped - 1 indicates this message overwrote another. R[12:11] MIL-STD-1553-In - Indicates which channel the message was received on. R(10) MessageOnSecondaryBus - 1 indicates that the message was on the secondary bus. R[9:0] Reserved - Reserved for future use.
MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes time midway through first transmitted bit.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
MessageTimeLo Seconds and centiseconds time midway through first transmitted bit.	Second	BCD	16	R[31:16] R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.
MessageTimeMicro Microsecond time midway through first transmitted bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - BCD Microseconds 0 to 9999.
MIL-STD-1553-In-A(3:0) Parameters				
MessageCountA Count of all good messages on the primary bus.	Count	OffsetBinary	16	R[15:0] R[15:0] MessageCountPrimary
ErrorCountA A count of errors detected on the primary bus.	BitVector	BitVector	16	R[15:0] R[15:0] ErrorCount - A count of errors detected on both busses.
WordsPerSecondA The number of MIL-STS-1553 words received on the primary bus in the last second.	BitVector	OffsetBinary	16	R[15:0] R[15:0] WordsPerSecondA
Parser(1022:0) Parameters				
MessageCount Message counter value when the word was received.	Count	OffsetBinary	16	R[15:0] R[15:0] MessageCount
MessageCommand1 First command word in message.	BitVector	BitVector	16	R[15:0] R[15:0] MessageCommand1
MessageStatus1 First status word stored in message.	BitVector	BitVector	16	R[15:0] R[15:0] MessageStatus1
MessageResponseTime1 First status word's response time in microseconds.	Second	OffsetBinary	16	R[15:0] R[15:0] MessageResponseTime1
MessageCommand2 Second command word of an RT-RT message.	BitVector	BitVector	16	R[15:0] R[15:0] MessageCommand2

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageStatus2 Second status word of an RT-RT message.	BitVector	BitVector	16	R[15:0] R[15:0] MessageStatus2
MessageResponseTime2 Second status word's response time in microseconds of an RT-RT message.	Second	OffsetBinary	16	R[15:0] R[15:0] MessageResponseTime2
MessageInfo Stale/skipped indication for this parsed message.	BitVector	BitVector	16	R[15:0] R(15) Empty - 1 indicates this parser slot is empty. R(14) Stale - 1 indicates this message was read before. R(13) Skipped - 1 indicates this message overwrote another. R[12:11] MIL-STD-1553-In - Indicates which channel the message was received on. R(10) MessageOnSecondaryBus - 1 indicates that the message was on the secondary bus. R[9:0] Reserved - Reserved for future use.
MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes time midway through first transmitted bit.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
MessageTimeLo Seconds and centiseconds time midway through first transmitted bit.	Second	BCD	16	R[31:16] R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.
MessageTimeMicro Microsecond time midway through first transmitted bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - BCD Microseconds 0 to 9999.
MIL-STD-1553-In-B(3:0) Parameters				
MessageCountB Count of all good messages on the secondary bus.	Count	OffsetBinary	16	R[15:0] R[15:0] MessageCountSecondary
ErrorCountB A count of errors detected on the secondary bus.	BitVector	BitVector	16	R[15:0] R[15:0] ErrorCount - A count of errors detected on both busses.
WordsPerSecondB The number of MIL-STS-1553 words received on the secondary bus in the last second.	BitVector	OffsetBinary	16	R[15:0] R[15:0] WordsPerSecondB

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/MBM/102

For a detailed description on iNET-X packets, see *TEC/NOT/067 - IENA and iNET-X packet payload formats*.

iNET-X parser-aligned packet format

There is a diverse range of avionic bus technologies for which traffic may be captured, for example, MIL-STD-1553, PCM, or ARINC-429. The generalized iNET-X payload structure for parser-aligned packets is shown in the following figure.

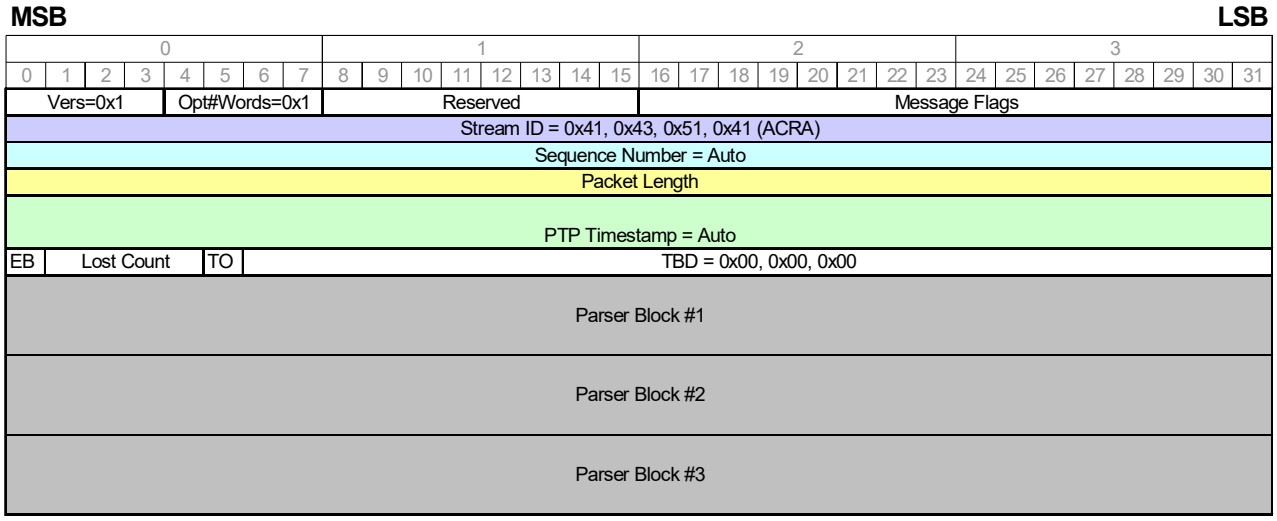


Figure 2: Generalized parser-aligned iNET-X packet

As messages are captured on the bus, they are formatted in a parser block. Each parser block begins with a 4-byte parser information word, followed by a 4-byte elapsed time tag and the message data shown in the following figure.

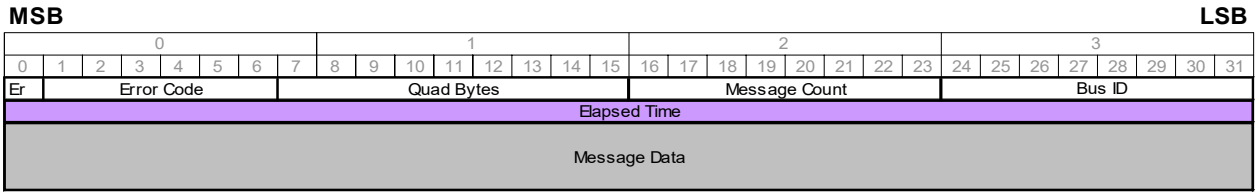


Figure 3: iNET-X parser block

A parser block consists of the following fields:

- Parser information word (4 bytes): metadata providing information about the health and status of the message.
  - Er (Bit 0): indicates that an error occurred.
  - Bits [1:6]: Reserved.
  - Quad bytes (Bits [7:15]): number of quad bytes. This relates to the length of the parser information word, elapsed time tag, and the message data and padding (N x 4 bytes). For example, a 4-byte message captured from a given bus has a quad-byte value of 3, that is 12 bytes that includes 4 bytes parser information word, 4 bytes elapsed time, and 4 bytes bus message data.
  - Message count (Bits [16:23]): message counter. This is a message counter that relates to the messages contained in the payload. The message counter increments for each message contained in the packet payload and continues to increment across consecutive packets. The message counter resets and wraps around to 0 once it has reached the maximum message count of 0xFF.
  - Bus ID (Bits [24:31]): bus number.
- Elapsed time (4 bytes): time tag as an unsigned offset in nanoseconds that is added to the base PTP timestamp in the iNET-X

header.

- Message data (N x 4 bytes): captured bus traffic, padded if necessary to end on 4-byte boundary.

iNET-X parser-aligned packet structure for MIL-STD-1553 bus monitoring

As MIL-STD-1553 messages arrive, the MIL-STD-1553 protocol tracker logic identifies them and maps them to corresponding transaction identifier codes, as in the following table.

TABLE 3	Transaction identifier codes	
MESSAGE TYPE	MNEMONIC	TRANSACTION ID
Bus Controller to Remote Terminal	BC -> RT	0x00
Remote Terminal to Bus Controller	RT -> BC	0x01
Remote Terminal to Remote Terminal	RT -> RT	0x02
Mode Code without Data	M -> S	0x03
Mode Code with Data (R)	MD -> S	0x04
Mode Code with Data (T)	M -> SD	0x05
BROADCAST		
Bus Controller to Remote Terminals	BC -> RTS	0x06
Remote Terminal to Remote Terminals	RT -> RTS	0x07
Mode Code without Data	M	0x08
Mode Code with Data (R)	MD	0x09
MESSAGES WITHOUT STATUS REPLY		
Bus Controller to Remote Terminal	BC -> RT	0x10
Remote Terminal to Bus Controller	RT -> BC	0x11
Remote Terminal to Remote Terminal	RT -> RT	0x12
Mode Code without Data	M -> S	0x13
Mode Code with Data (R)	MD -> S	0x14
Mode Code with Data (T)	M -> SD	0x15
Remote Terminal to Remote Terminal	RT -> RTS	0x17

Only valid MIL-STD-1553 transactions are stored in the packet (see the following figure). If an error occurs, only the parser information word and elapsed time tag are written to the iNET-X packet; the message is then dumped. The error bit and error code (see the previous table), which are set in the parser information word, indicate the cause of the error.

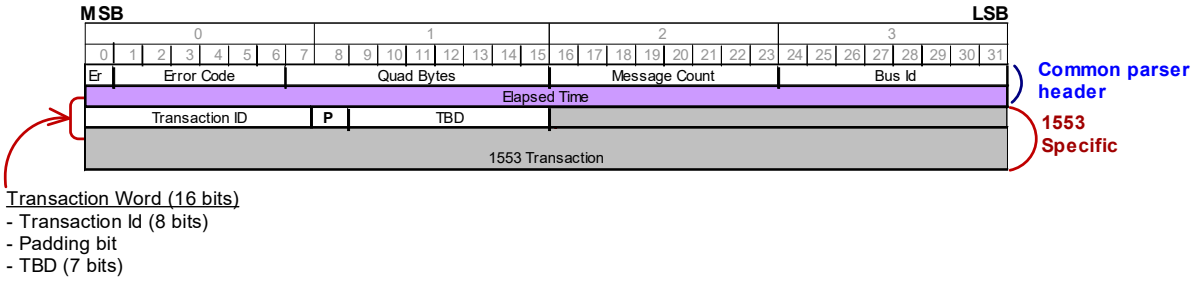


Figure 4: MIL-STD-1553 transaction iNET-X parser-aligned packet

In the case where a remote terminal is off-line but it is still desirable to capture data sent to it, you can set options to include Accept Rx Message With No Status and Accept Tx Message With No Status. In such a scenario, the parser information word indicates an error but the 1553 traffic is still captured.

The transaction identifier may be used to indicate when response times are carried in the iNET-X parser-aligned block. The MIL-STD-1553 standard specifies a minimum response time of 4µs and a maximum response time of 12µs. However, the bus controller waits up to 20µs before determining a timeout has occurred. The granularity of response time on the 8MHz bus can be measured to a resolution of 125ns. When a timeout occurs, the response time is set to 0xFF.

In order to facilitate the decoding and decommutation of the MIL-STD-1553 parser-aligned iNET-X packets, the first word of a MIL-STD-1553 transaction is the transaction word where:

- Transaction word (2 bytes): metadata providing protocol tracking information, health, and status of the message.
  - Transaction ID (Bits [0:7]): see Table 3 on page 814
  - P (Bit 8): bit to indicate if the parser message has been padded to fall on a 4-byte boundary
  - TBD (Bits [9:15]): TBD

Where a MIL-STD-1553 transaction does not fall on a 32-bit boundary, the MIL-STD-1553 parser-aligned message is padded. In MIL-STD-1553 the maximum number of padding words (16-bit) possible in a single transaction is one. Therefore a single bit is sufficient to indicate if a transaction message has been padded. Figure 5 on page 815 and Figure 6 on page 815 illustrate individual MIL-STD-1553 BC -> RT transactions, with and without padding.

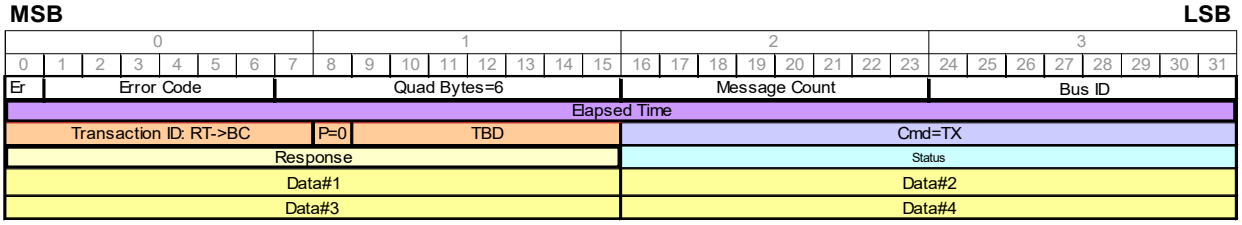


Figure 5: MIL-STD-1553 transaction iNET-X parser-aligned message without padding

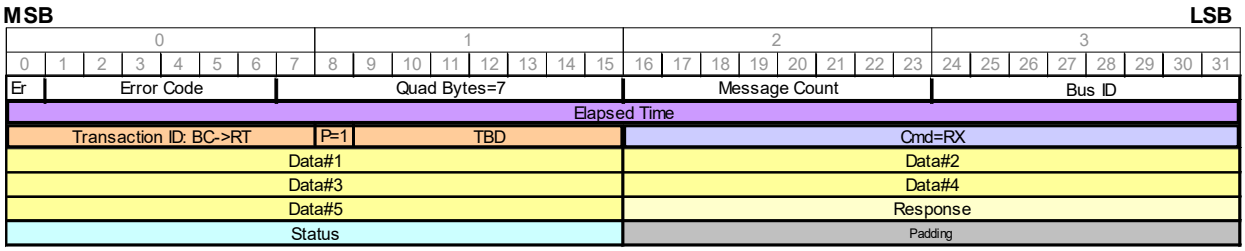


Figure 6: MIL-STD-1553 transaction iNET-X parser-aligned message with padding

Figure 7 on page 816 demonstrates the iNET-X parser-aligned payload structure for MIL-STD-1553 with the following three parsed MIL-STD-1553 transactions in the payload:

- BC -> RT: With four data words transferred.
- RT -> RT: With five data words transferred.
- RT -> BC: With four data words transferred.

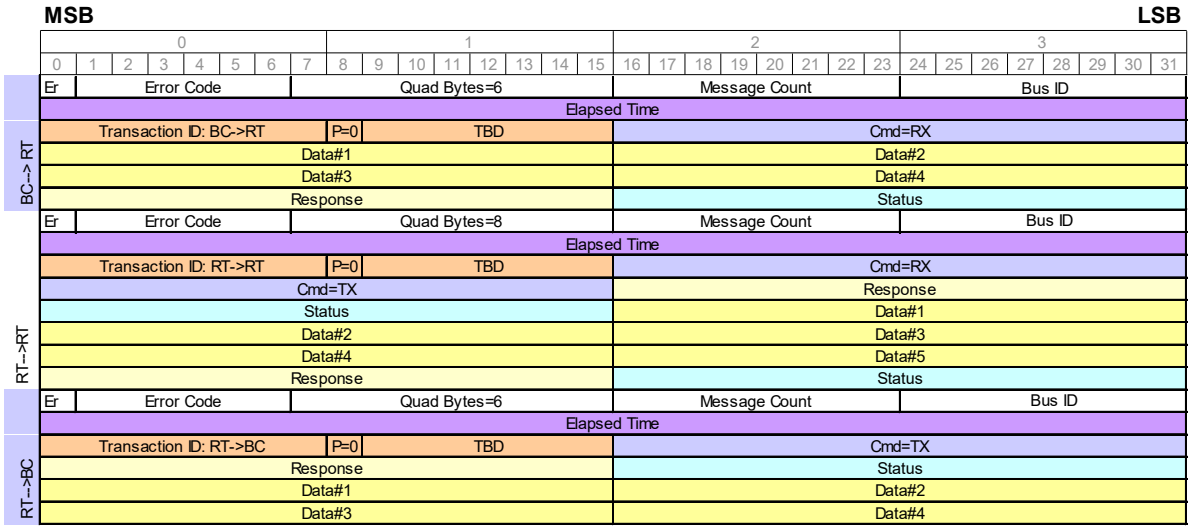


Figure 7: iNET-X parser-aligned payload for multiple MIL-STD-1553 transactions

For example, the MIL-STD-1553 bus has a peak bit-rate of 1Mbps. However, the messages and transactions transmitted are variable in length and asynchronous. If it is assumed that the mean MIL-STD-1553 transaction is 14 bytes long (comprising of a command, response, data words, and a status word), the iNET-X parser block structure encapsulating this transaction is therefore 24 bytes (including the MIL-STD-1553 transaction ID, parser information word and the elapsed time). In this case, each iNET-X parser-aligned packet may contain up to 60 parser blocks in the payload (that is, 60 parser blocks x 24 bytes per block which results in 1440 bytes of payload, or 840 bytes of MIL-STD-1553 bus data). To ensure that no data is lost on the bus, packets are generated at a rate of 150 packets per second.

The transmission properties for a 1Mbps MIL-STD-1553 bus are summarized in the following table.

TABLE 4	MyMIL-STD-1553 packet transmission properties
TRANSMISSION PROPERTY	VALUE
MIL-STD-1553 packet payload size (bytes)	1440 bytes (60 MIL-STD-1553 parser blocks of 24 bytes per block where each block contains 14 bytes of MIL-STD-1553 bus data)
Total Ethernet frame length (bytes)	1514 bytes (MAC header 14 bytes + IP 20 bytes + UDP 8 bytes + iNET-X 28 bytes + MIL-STD-1553 data + MAC FCS 4 bytes)
Packet rate (packets per second)	150
Total number of MIL-STD-1553 transactions per packet	60 transactions assuming 14 bytes per transaction
Total bit-rate (kbps)	1816.8

TABLE 5	Error codes		
ERROR CODE	DESCRIPTION	ERROR CODE	DESCRIPTION
0_{16}	Reserved for future use.	20_{16}	Expected STS was a data word.
1_{16}	Data word did not have enough bits.	21_{16}	Expected STS was invalid.
2_{16}	Data word had bit error.	22_{16}	Expected STS had incorrect RT.
3_{16}	Data word had parity error.	23_{16}	Expected STS had contiguous traffic.
4_{16}	Non-data word did not have enough bits.	24_{16}	Expected STS timed out.
5_{16}	Non-data word had bit error.	25_{16}	Expected STS had no contiguous data word.
6_{16}	Non-data word had parity error.	26_{16}	Reserved for future use.

TABLE 5	Error codes (continued)		
ERROR CODE	DESCRIPTION	ERROR CODE	DESCRIPTION
7_{16}	Reserved for future use.	27_{16}	Reserved for future use.
8_{16}	Expected data word was non-data word.	28_{16}	Reserved for future use.
9_{16}	Expected data word did not have contiguous word.	29_{16}	Reserved for future use.
A_{16}	Expected last data word was not last.	$2A_{16}$	Reserved for future use.
B_{16}	Expected mode data word was non-data word.	$2B_{16}$	Expected Tx CMD of RT to RT(s) had different number of words than Rx CMD.
C_{16}	Expected mode data word has contiguous traffic.	$2C_{16}$	Expected Tx CMD of RT to RT(s) had same RT as Rx CMD.
D_{16}	Reserved for future use.	$2D_{16}$	Expected Tx CMD of RT to RT(s) had contiguous traffic.
E_{16}	Reserved for future use.	$2E_{16}$	Second CMD in RT-RT was not a TX.
F_{16}	Reserved for future use.	$2F_{16}$	Reserved for future use.
10_{16}	Expected first CMD was a data word.	30_{16}	Reserved for future use.
11_{16}	Reserved for future use.	31_{16}	Reserved for future use.
12_{16}	Reserved for future use.	32_{16}	Reserved for future use.
13_{16}	Reserved for future use.	33_{16}	Reserved for future use.
14_{16}	Reserved for future use.	34_{16}	Reserved for future use.
15_{16}	Expected first CMD had contiguous traffic.	35_{16}	Reserved for future use.
16_{16}	Expected first CMD was Rx with no contiguous data word.	36_{16}	Reserved for future use.
17_{16}	Expected first CMD was Mode with no contiguous data.	37_{16}	Reserved for future use.
18_{16}	Expected second STS of RT to RT was data word.	38_{16}	Reserved for future use.
19_{16}	Expected second STS of RT to RT had incorrect RT.	39_{16}	Reserved for future use.
$1A_{16}$	Expected second STS of RT to RT had contiguous traffic.	$3A_{16}$	Reserved for future use.
$1B_{16}$	Expected second STS of RT to RT timed out.	$3B_{16}$	Reserved for future use.
$1C_{16}$	Reserved for future use.	$3C_{16}$	Reserved for future use.
$1D_{16}$	Reserved for future use.	$3D_{16}$	Reserved for future use.
$1E_{16}$	Reserved for future use.	$3E_{16}$	Reserved for future use.
$1F_{16}$	Reserved for future use.	$3F_{16}$	Reset occurred since last read.

Tx = transmit; STS = status; CMD = command.

Detecting messages when a remote terminal is off-line

When a MIL-STD-1553 remote terminal is off-line, it does not respond (with a status word) to bus controller Rx commands or it does not respond (with a status word followed by data) to bus controller Tx commands.

To acquire data from MIL-STD-1553 messages, which have been sent from the bus controller to off-line remote terminals, see “Message capture settings” on page 818. To determine, via telemetry, if a remote terminal is off-line, see “Detecting when a Tx remote terminal is off-line” on page 818.

Message capture settings

The following settings can be used to capture messages when the remote terminal is off-line:

- AcceptRxMessageWithNoStatus
- AcceptTxMessageWithNoStatus

NOTE: The message counter on the KAD/MBM/102 counts all messages that go into the parser (two dedicated counters for bus primary/secondary), which are defined by either AcceptRxMessageWithNoStatus or AcceptTxMessageWithNoStatus.

AcceptRxMessageWithNoStatus

If any remote terminals monitoring the MIL-STD-1553 bus are likely to be off-line, set AcceptRxMessageWithNoStatus to Yes. When AcceptRxMessageWithNoStatus is set to Yes, the KAD/MBM/102 captures data from Rx command messages, where the remote terminal does not respond with a status word. In this scenario, the status word in the parser is hex FFFF.

If AcceptRxMessageWithNoStatus is set to No, then only complete messages, where a remote terminal responds, are captured.

AcceptTxMessageWithNoStatus

When AcceptTxMessageWithNoStatus is set to Yes, the KAD/MBM/102 accepts Tx command messages where the remote terminal does not respond. In this scenario, only the Tx command appears on the MIL-STD-1553 bus, the KAD/MBM/102 parser data is invalid, the status word in the parser is hex FFFF, and time stamps record any occurrence of the command word.

The AcceptTxMessageWithNoStatus setting enables the capture of messages when the remote terminal is off-line. However, for this setting to have an effect, AcceptRxMessageWithNoStatus must be set to Yes.

When AcceptTxMessageWithNoStatus is set to No, the KAD/MBM/102 rejects Tx command messages where the remote terminal does not respond. The effect on the parser is that the last valid message with the last valid data and time stamps remain.

Detecting when a Tx remote terminal is off-line

To detect when a Tx remote terminal is off-line, set AcceptTxMessageWithNoStatus to Yes. The parser status word must be sent to detect this and then be processed in the ground station. If the status word is hex FFFF, the ground station must deal with the invalid data in the parser. Otherwise, the data shows spikes.

Response time

One feature of the KAD/MBM/102 is the ability to program the response timeout. This value should reflect the actual response timeout on the MIL-STD-1553 bus. Under normal circumstances, a remote terminal responds within 4 to 12ms. However a remote terminal should wait a minimum of 14ms before considering that the remote terminal has timed out. Some implementations of MIL-STD-1553 have deviated from the standard and have their own response times. For this reason, the expected response time is configurable on the KAD/MBM/102.

It is important that the KAD/MBM/102 has response time configured correctly because there may be confusion over which MIL-STD-1553 messages certain control words belong to. In MIL-STD-1553, the command word and status word have the same signature. For example, if the response time is set too high, and if there is no response from a particular RT, the next command word may belong to that message as a status word. This may cause issues parsing the next message. If the response time is set too low, then the KAD/MBM/102 may consider that a valid message has timed out due to no response. The status of this message appears as the next command. This may cause issues parsing the next message and so on.

Parser sample rate

The KAD/MBM/102 parser is triple buffered. If there is a burst of more than three messages between parser sampling intervals, the triple buffer can be saturated. Therefore, if it is necessary that all messages get captured, the parser data must be sampled at the speed of the burst if this is above the aggregate rate.

Variable sized messages

By default, the KAD/MBM/102 is configured to parse any number of data words for a particular message. It is also possible to parse messages of particular sizes.

In cases where there are variable sized messages and when

word count is set to All, care must be taken when processing the data. The parser only updates the data words that appear on the MIL-STD-1553 bus. The other words are not valid. This means that the ground station or post processing must use the number of data words indicated in the command word to identify which data words are valid. The other option is to parse particular message sizes individually.

Connector pinout of the KAD/MBM/102

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DATA_DC_A(0)+	MIL-STD-1553	Direct coupled primary input of bus(0)
2	DATA_TC_A(0)+	MIL-STD-1553	Transformer coupled primary input of bus(0)
3	DATA_DC_B(0)+	MIL-STD-1553	Direct coupled secondary input of bus(0)
4	DATA_TC_B(0)+	MIL-STD-1553	Transformer coupled secondary input of bus(0)
5	DATA_DC_A(1)+	MIL-STD-1553	Direct coupled primary input of bus(1)
6	DATA_TC_A(1)+	MIL-STD-1553	Transformer coupled primary input of bus(1)
7	DATA_DC_B(1)+	MIL-STD-1553	Direct coupled secondary input of bus(1)
8	DATA_TC_B(1)+	MIL-STD-1553	Transformer coupled secondary input of bus(1)
9	DATA_DC_A(2)+	MIL-STD-1553	Direct coupled primary input of bus(2)
10	DATA_TC_A(2)+	MIL-STD-1553	Transformer coupled primary input of bus(2)
11	DATA_DC_B(2)+	MIL-STD-1553	Direct coupled secondary input of bus(2)
12	DATA_TC_B(2)+	MIL-STD-1553	Transformer coupled secondary input of bus(2)
13	DATA_DC_A(3)+	MIL-STD-1553	Direct coupled primary input of bus(3)
14	DATA_TC_A(3)+	MIL-STD-1553	Transformer coupled primary input of bus(3)
15	DATA_DC_B(3)+	MIL-STD-1553	Direct coupled secondary input of bus(3)
16	DATA_TC_B(3)+	MIL-STD-1553	Transformer coupled secondary input of bus(3)
17	DNC		Do not connect
18	DNC		Do not connect
19	DATA_DC_A(0)-	MIL-STD-1553	Direct coupled primary input of bus(0)
20	DATA_TC_A(0)-	MIL-STD-1553	Transformer coupled primary input of bus(0)
21	DATA_DC_B(0)-	MIL-STD-1553	Direct coupled secondary input of bus(0)
22	DATA_TC_B(0)-	MIL-STD-1553	Transformer coupled secondary input of bus(0)
23	DATA_DC_A(1)-	MIL-STD-1553	Direct coupled primary input of bus(1)
24	DATA_TC_A(1)-	MIL-STD-1553	Transformer coupled primary input of bus(1)
25	DATA_DC_B(1)-	MIL-STD-1553	Direct coupled secondary input of bus(1)
26	DATA_TC_B(1)-	MIL-STD-1553	Transformer coupled secondary input of bus(1)
27	DATA_DC_A(2)-	MIL-STD-1553	Direct coupled primary input of bus(2)
28	DATA_TC_A(2)-	MIL-STD-1553	Transformer coupled primary input of bus(2)
29	DATA_DC_B(2)-	MIL-STD-1553	Direct coupled secondary input of bus(2)
30	DATA_TC_B(2)-	MIL-STD-1553	Transformer coupled secondary input of bus(2)
31	DATA_DC_A(3)-	MIL-STD-1553	Direct coupled primary input of bus(3)
32	DATA_TC_A(3)-	MIL-STD-1553	Transformer coupled primary input of bus(3)
33	DATA_DC_B(3)-	MIL-STD-1553	Direct coupled secondary input of bus(3)
34	DATA_TC_B(3)-	MIL-STD-1553	Transformer coupled secondary input of bus(3)
35	DNC		Do not connect
36	CHASSIS	Chassis	
37	GND	Internal ground	
38	CHASSIS	Chassis	
39	GND	Internal ground	
40	CHASSIS	Chassis	
41	GND	Internal ground	
42	CHASSIS	Chassis	
43	GND	Internal ground	
44	CHASSIS	Chassis	
45	GND	Internal ground	
46	CHASSIS	Chassis	
47	GND	Internal ground	
48	CHASSIS		
49	GND	Internal ground	
50	CHASSIS	Chassis	
51	GND	Internal ground	
52	CHASSIS	Chassis	

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Ordering information

PART NUMBER	DESCRIPTION
KAD/MBM/102	MIL-STD-1553 bus monitor parser/packetizer - 4ch dual redundant (transformer coupled/direct coupled)

When ordering, specify which connector (ASD/MBM/102/TCC for transformer coupled; or ASD/MBM/102/DCC for direct coupled) is preferred. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/MBM/102	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment

Related products

MODULE	DETAILS
ASD/MBM/102/TCC	MIL-STD-1553 transformer coupled interface cable (45cm) with eight Twinax TRB connectors (shield connected to chassis)
ASD/MBM/102/DCC	MIL-STD-1553 direct coupled interface cable (45cm) with eight Twinax TRB connectors (shield connected to chassis)

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio User Manual
TEC/NOT/004	MIL-STD-1553
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
TEC/NOT/051	Ethernet frames, Wireshark® and FAT32
TEC/NOT/067	IENA and iNET-X packet payload formats

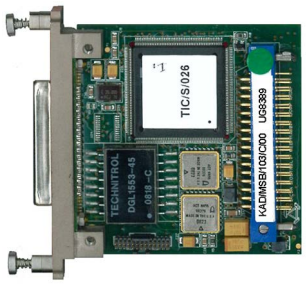
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KAD/MSB/103

MIL-STD-1553 bus monitor parser - 1ch dual redundant

CURTISSWRIGHTDS.COM



Key Features

- Monitors a single direct coupled or transformer coupled dual redundant MIL-STD-1553 bus
- Coherently parses traffic and tags for up to 1,024 messages (including one catchall)
- 3K word deep selective FIFO for traffic and tags (snarfer) formatted with IRIG-106 Ch.8
- Handles all mode codes (including user defined)
- Protocol tracker does not rely on instrumentation bit
- ID based on all 16 bits of command

Applications

- MIL-STD-1553 traffic monitor

Overview

The KAD/MSB/103 is a MIL-STD-1553 dual redundant bus monitor which combines the capabilities of a snarfer, coherent message parser, message counter, and error detection functions on a single module. Traffic refers to words on the bus (command, status, and data) and tags refer to associated information (microsecond time of sync. bit transition, message count, response time, and errors). When used in parser mode, the KAD/MSB/103 triple buffers up to 1,023 complete messages and their associated tags in buffers up to 43 words wide. The INFO tag associated with each message has a stale bit (message read before), a skipped bit (buffer overwritten) and an empty bit (message was never received), as well as an indication on which bus the message was received. The MESSAGE count increments on receipt of a valid message. The ERROR word has bits indicating the type of error caught in the form of a 6-bit (up to 38 different errors) code and the bus on which it occurred.

The KAD/MSB/103 records Mode Code 17 for which the ID is based on the last Mode Code 17 sub-address map number received for the involved remote terminals. With that it can monitor the full expanded sub-address space for up to 31 remote terminals. It also has an optional recording of messages with time out status reply. The snarfer stores selected traffic and tags in a FIFO 3K words deep. Each snarfer word has 16 bits for traffic/tag information and 8 bits for FIFO content identification. Data selection and content identification is based on the bus (primary/secondary), traffic type (command, status, data), tag type (high/low/micro/response time, message count) and how full the FIFO is.

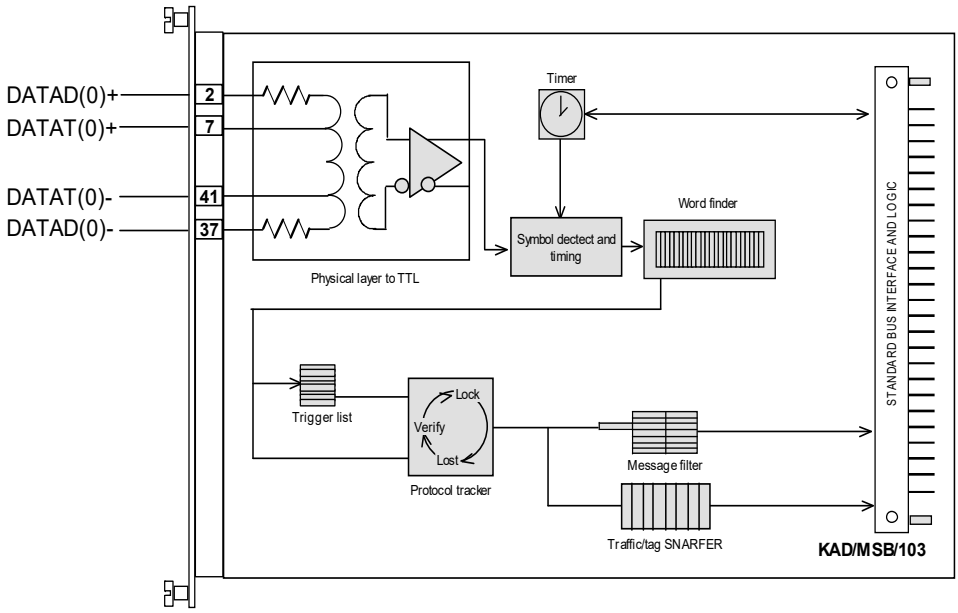


Figure 1: Primary bus monitor on the KAD/MSB/103

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	80	–	g	
	–	2.82	–	oz	Design metric is grams.
Height above chassis					
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	106	–	147	mA	
+7V	0	–	0	mA	
-7V	0	–	0	mA	
+12V	0	–	0	mA	
-12V	0	–	0	mA	
total power	0.530	–	0.735	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	MIL-STD-1553				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	1	–	Dual redundant. MIL-STD-1553-B compatible.
Sampling rate					
	–	–	2	Msps	Maximum data rate of MIL-STD-1553 is 36kwps.
Operating range					
transformer coupled	1.3	–	20	V_{p-p}	
direct coupled	1.8	–	20	V_{p-p}	

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Setting up the KAD/MSB/103

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/MSB/103/C	KAD/MSB/103/C	The instrument part reference.
SerialNumber	FA2342	FA2342	Unique name for each module.
Settings	-	-	-
Fill Value	0000 to FFFF	AAAA	Specifies the value that should be stored when the bus monitor is not receiving data.
Settings Snarfer Filtering	-	-	-
Fifo Level-25	All TrafficOnly HeaderOnly ErrorOnly	All	Specifies the type of data that should be stored when the FIFO is 25% or less full.
Fifo Level-50	All TrafficOnly HeaderOnly ErrorOnly	TrafficOnly	Specifies the type of data that should be stored when the FIFO is 50% or less full.
Fifo Level-75	All TrafficOnly HeaderOnly ErrorOnly	HeaderOnly	Specifies the type of data that should be stored when the FIFO is 75% or less full.
Fifo Level-100	All TrafficOnly HeaderOnly ErrorOnly	ErrorOnly	Specifies the type of data that should be stored when the FIFO is 100% or less full.
Bus ID	0 1 2 3 4 5 6 7	0	-
Processes	-	-	-
Parser(1022:0)	-	-	One of 1023 selective parser slots.
Catchall-Parser	-	-	Any message that is not parsed goes to this final parser slot.
Channels	-	-	-
MIL-STD-1553-In MIL-STD-1553 Input	-	-	Represents a typical MIL-STD-1553 bus monitor channels configuration.
Settings	-	-	-
Maximum Response Time	1 to 31	12	Maximum permitted response time for RT in micro seconds.
Accept Rx Message With No Status	True False	False	Receive messages with no status response is stored, when set to true.
Accept Tx Message With No Status	True False	False	Transmit messages with no status response is stored, when set to true.

SETUP DATA	CHOICE	DEFAULT	NOTES
Settings Mode Code 17	-	-	Mode Code 17 messages are used to extend the Sub Address range for a RT by providing a Sub-sub Addressing
Load Map From	SSA Cycle	SSA	This element is used to specify which bits from the data word of the mode code 17 message are used for the map index. The allowed values are "SSA" and "Cycle"
Time Bit First	True False	False	This element is used to specify if the Time Bit in a mode code 17 message is the least significant bit (true) or the most significant bit (false).
Ignore Fresh Bit	False True	False	This element is used to control updating of the map index depending on the fresh bit value in the mode code 17 data word. A value of "true" means the fresh bit is ignored and a value of "false" means it is not ignored.
Ignore Time Bit	True False	False	This element is used to control updating of the map index depending on the time bit value in the mode code 17 data word. A value of "true" means the time bit is ignored and a value of "false" means it is not ignored.
Default Map On Power Up	00 to 7F	00	This element can be used to specify the default extended sub-address mapping when the bus monitor first powers up. The value expected is a hexadecimal value.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Report Reports the status of the module	BitVector	BitVector	16	R[15:0] R(15) ErrorSinceLastRead - 1 indicates error occurred since last read. R(14) ErrorOnSecondaryBus - 1 indicates the last error occurred on secondary bus. R[13:6] Reserved - Reserved for future use. R[5:0] ErrorCodes - Indicates the error that occurred last (See “Error codes for the KAD/MSB/103”).
Snarfer Content Identifier and Content of 1553 Traffic captured on the MIL-STD-1553 bus.	BitVector	BitVector	32	R[31:0]
SnarferHi Snarfer contents as indicated by content identifier. This and SnarferHi are read from the Snarfer24 FIFO.	BitVector	BitVector	16	R[31:16] R[30:15] Parity - 1 Indicates an even number of ones in the bus identifier, content identifier and content. R[14:12] Bus ID - Bus identifier as defined in setup. R[11:8] Content identifier - (See “Content IDs for KAD/MSB/103 snarfer FIFO”) R[7:0] Reserved for future use

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
SnarferLo Bus number and content identifier. This together with SnarferLo is read from the Snarfer24 FIFO.	BitVector	BitVector	16	R[15:0] R[15:0] Content - The contents of the snarfer according to the content identifier COMMAND, STATUS, DATA, TIME_HI, TIME_LO, TIME_MICRO. The contents for snarfer empty are AAAA(hex). The contents for snarfer full are 5555(hex). The contents for NON-DATA are the command/status bits if not enough information is available to distinguish between them (this can only happen when recovering from an error condition). When ERROR: R[15:7] are reserved. R(6) = 1 indicates the error was on the secondary bus. R[5:0] Indicates the error that occurred. (See “Error codes for the KAD/MSB/103”).
Snarfer24 The parameter is made up from the 16 bits of SnarferLo and the eight bits of data in SnarferHi.	BitVector	BitVector	24	R[23:0] R[23:0] Snarfer24 - The parameter is made up from the 16 bits of SnarferLo and the 8 bits of data in SnarferHi
Parser(1022:0) Parameters				
MessageCount Message counter value when the word was received.	Count	OffsetBinary	16	R[15:0] R[15:0] MessageCount
MessageCommand1 First command word in message.	BitVector	BitVector	16	R[15:0] R[15:0] MessageCommand1
MessageStatus1 First status word stored in message.	BitVector	BitVector	16	R[15:0] R[15:0] MessageStatus1
MessageResponseTime1 First status word's response time in microseconds.	Second	OffsetBinary	16	R[15:0] R[15:0] MessageResponseTime1
MessageCommand2 Second command word of an RT-RT message.	BitVector	BitVector	16	R[15:0] R[15:0] MessageCommand2
MessageStatus2 Second status word of an RT-RT message.	BitVector	BitVector	16	R[15:0] R[15:0] MessageStatus2
MessageResponseTime2 Second status word's response time in microseconds of an RT-RT message.	Second	OffsetBinary	16	R[15:0] R[15:0] MessageResponseTime2
MessageInfo Stale/skipped indication for this parsed message.	BitVector	BitVector	16	R[15:0] R(15) Empty - 1 indicates this parser slot is empty. R(14) Stale - 1 indicates this message was read before. R(13) Skipped - 1 indicates this message overwrote another. R[12:0] Reserved - Reserved for future use.
MessageIrigTime48 48 bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageTimeHi Hours and minutes time midway through first transmitted bit.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
MessageTimeLo Seconds and centiseconds time midway through first transmitted bit.	Second	BCD	16	R[31:16] R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.
MessageTimeMicro Microsecond time midway through first transmitted bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - BCD Microseconds 0 to 9999.
Catchall-Parser Parameters				
MessageCount Message counter value when the word was received.	Count	OffsetBinary	16	R[15:0] R[15:0] MessageCount
MessageCommand1 First command word in message.	BitVector	BitVector	16	R[15:0] R[15:0] MessageCommand1
MessageStatus1 First status word stored in message.	BitVector	BitVector	16	R[15:0] R[15:0] MessageStatus1
MessageResponseTime1 First status word's response time in microseconds.	Second	OffsetBinary	16	R[15:0] R[15:0] MessageResponseTime1
MessageData(31:0) MIL-1553 message data	BitVector	BitVector	16	R[15:0] R[15:0] MessageData
MessageCommand2 Second command word of an RT-RT message.	BitVector	BitVector	16	R[15:0] R[15:0] MessageCommand2
MessageStatus2 Second status word of an RT-RT message.	BitVector	BitVector	16	R[15:0] R[15:0] MessageStatus2
MessageResponseTime2 Second status word's response time in microseconds of an RT-RT message.	Second	OffsetBinary	16	R[15:0] R[15:0] MessageResponseTime2
MessageInfo Stale/skipped indication for this parsed message.	BitVector	BitVector	16	R[15:0] R(15) Empty - 1 indicates this parser slot is empty. R(14) Stale - 1 indicates this message was read before. R(13) Skipped - 1 indicates this message overwrote another. R[12:0] Reserved - Reserved for future use.
MessageIrigTime48 48 bit wide IRIG time word	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes time midway through first transmitted bit.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageTimeLo Seconds and centiseconds time midway through first transmitted bit.	Second	BCD	16	R[31:16] R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.
MessageTimeMicro Microsecond time midway through first transmitted bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - BCD Microseconds 0 to 9999.
MIL-STD-1553-In Parameters				
MessageCountPrimary Count of all valid messages on the bus.	Count	OffsetBinary	16	R[15:0] R[15:0] MessageCountPrimary
MessageCountSecondary Count of all valid messages on the bus.	Count	OffsetBinary	16	R[15:0] R[15:0] MessageCountSecondary

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following f i ve cha- acters "/><\.

Content IDs for KAD/MSB/103 snarfer FIFO

CONTENT ID	DESCRIPTION
0_{16}	Buffer overflow
1_{16}	Fill word (content ID is 1 when the FIFO is empty)
2_{16}	Non-data secondary (in case of error event)
3_{16}	Non-data primary (in case of error event)
4_{16}	Time - Response
5_{16}	Time - Microsecond
6_{16}	Time - Low
7_{16}	Time - High
8_{16}	Error secondary
9_{16}	Data secondary
A_{16}	Status secondary
B_{16}	Command secondary
C_{16}	Error primary
D_{16}	Data primary
E_{16}	Status primary
F_{16}	Command primary

Error codes for the KAD/MSB/103

ERROR CODE	DESCRIPTION
0_{16}	Reserved for future use.
1_{16}	Data word did not have enough bits.
2_{16}	Data word had bit error.
3_{16}	Data word had parity error.
4_{16}	Non-data word did not have enough bits.
5_{16}	Non-data word had bit error.
6_{16}	Non-data word had parity error.
7_{16}	Reserved for future use.
8_{16}	Expected data word was non-data word.
9_{16}	Expected data word did not have contiguous word.
A_{16}	Expected last data word was not last.
B_{16}	Expected mode data word was non-data word.
C_{16}	Expected mode data word has contiguous traffic.
D_{16}	Reserved for future use.
E_{16}	Reserved for future use.
F_{16}	Reserved for future use.
10_{16}	Expected first cmd. was data word.
11_{16}	Expected first cmd. had invalid RT.
12_{16}	Expected first cmd. had invalid SA.
13_{16}	Expected first cmd. had invalid number of words.
14_{16}	Expected first cmd. was invalid mode.
15_{16}	Expected first cmd. had contiguous traffic.
16_{16}	Expected first cmd. was Rx with no contiguous data word.
17_{16}	Expected first cmd. was Mode with no contiguous data.
18_{16}	Expected second sts. of RT to RT was data word.
19_{16}	Expected second sts. of RT to RT had incorrect RT.
$1A_{16}$	Expected second sts. of RT to RT had contiguous traffic.
$1B_{16}$	Expected second sts. of RT to RT timed out.
$1C_{16}$	Received invalid 2nd status in RT to RT.
$1D_{16}$	Reserved for future use.
$1E_{16}$	Reserved for future use.
$1F_{16}$	Reserved for future use.
20_{16}	Expected sts. was data word.
21_{16}	Expected sts. was invalid.

ERROR CODE	DESCRIPTION
22_{16}	Expected sts. had incorrect RT.
23_{16}	Expected sts. had contiguous traffic.
24_{16}	Expected sts. timed out.
25_{16}	Expected sts. had no contiguous data word.
26_{16}	Reserved for future use.
27_{16}	Reserved for future use.
28_{16}	Expected Tx cmd. of RT to RT(s) had invalid RT.
29_{16}	Expected Tx cmd. of RT to RT(s) had invalid SA.
$2A_{16}$	Expected Tx cmd. of RT to RT(s) had invalid number of words.
$2B_{16}$	Expected Tx cmd. of RT to RT(s) had different number of words than Rx cmd.
$2C_{16}$	Expected Tx cmd. of RT to RT(s) had same RT as Rx cmd.
$2D_{16}$	Expected Tx cmd. of RT to RT(s) had contiguous traffic.
$2E_{16}$	Expected Tx cmd. of RT to RT(s) was not a Tx cmd.
$2F_{16}$	Reserved for future use.
30_{16}	Reserved for future use.
31_{16}	Reserved for future use.
32_{16}	Reserved for future use.
33_{16}	Reserved for future use.
34_{16}	Reserved for future use.
35_{16}	Reserved for future use.
36_{16}	Reserved for future use.
37_{16}	Reserved for future use.
38_{16}	Reserved for future use.
39_{16}	Reserved for future use.
$3A_{16}$	Reserved for future use.
$3B_{16}$	Reserved for future use.
$3C_{16}$	Reserved for future use.
$3D_{16}$	Reserved for future use.
$3E_{16}$	Reserved for future use.
$3F_{16}$	Reset occurred since last read.

Tx = Transmit; sts = status; cmd = command.

Getting the most from the KAD/MSB/103

The following section describes how to configure the KAD/MSB/103 for specific data acquisition requirements.

Detecting messages when a remote terminal is off-line

When a MIL-STD-1553 remote terminal is off-line, it does not respond (with a STATUS word) to bus controller Rx commands. When a MIL-STD-1553 remote terminal is off-line, it does not respond (with a STATUS word followed by data) to bus controller Tx commands.

To acquire data from MIL-STD-1553 messages which have been sent from the bus controller to off-line remote terminals, see “Message capture settings” on page 832. To determine, via telemetry, if a remote terminal is off-line, see “Detecting when a Tx remote terminal is off-line” on page 832.

Message capture settings

The following settings can be used to capture messages when the remote terminal is off-line:

- AcceptRxMessageWithNoStatus
- AcceptTxMessageWithNoStatus

NOTE: The message counter on the KAD/MSB/103 counts all messages that go into the parser (two dedicated counters for bus primary/secondary), which are defined by either AcceptRxMessageWithNoStatus or AcceptTxMessageWithNoStatus.

AcceptRxMessageWithNoStatus

If any remote terminals monitoring the MIL-STD-1553 bus are likely to be off-line, set AcceptRxMessageWithNoStatus to YES. When AcceptRxMessageWithNoStatus is set to YES, the KAD/MSB/103 captures data from Rx command messages, where the remote terminal does not respond with a STATUS word. In this scenario, the STATUS word in the parser is hex FFFF.

If AcceptRxMessageWithNoStatus is set to NO, then only complete messages, where a remote terminal responds, are captured.

AcceptTxMessageWithNoStatus

When AcceptTxMessageWithNoStatus is set to YES, the KAD/MSB/103 accepts Tx command messages where the remote terminal does not respond. In this scenario, only the Tx command appears on the MIL-STD-1553 bus, the KAD/MSB/103 parser data is invalid, the STATUS word in the parser is hex FFFF and time stamps record any occurrence of the COMMAND word.

The AcceptTxMessageWithNoStatus setting enables the capture of messages when the remote terminal is off-line. However, for this setting to have an effect, AcceptRxMessageWithNoStatus must be set to YES.

When AcceptTxMessageWithNoStatus is set to NO, the KAD/MSB/103 rejects Tx command messages where the remote terminal does not respond. The effect on the parser is that the last valid message with the last valid data and time stamps remain.

Detecting when a Tx remote terminal is off-line

To detect when a Tx remote terminal is off-line, set AcceptTxMessageWithNoStatus to YES. The parser STATUS word must be sent to detect this and then be processed in the ground station. If the STATUS word is hex FFFF, the ground station must deal with the invalid data in the parser. Otherwise, the data shows spikes.

Response time

One feature of the KAD/MSB/103 is the ability to program the response timeout. This value should reflect the actual response timeout on the MIL-STD-1553 bus. Under normal circumstances a remote terminal responds within 4 to 12 microseconds. However a remote terminal should wait a minimum of 14 microseconds before considering that the remote terminal has timed out. Some implementations of MIL-STD-1553 have deviated from the standard and have their own response times. For this reason, the expected response time is configurable on the KAD/MSB/103.

It is important that the KAD/MSB/103 has response time configured correctly because there may be confusion over which MIL-STD-1553 messages certain control words belong to. In MIL-STD-1553, the COMMAND word and STATUS word have the

same signature. For example, if the response time is set too high, and if there is no response from a particular RT, the next COMMAND word may belong to that message as a STATUS word. This may cause issues parsing the next message. If the response time is set too low, then the KAD/MSB/103 may consider that a valid message has timed out due to no response. The status of this message appears as the next command. This may cause issues parsing the next message and so on.

Parser sample rate

The KAD/MSB/103 parser is triple buffered. If there is a burst of more than three messages between parser sampling intervals, the triple buffer can be saturated. Therefore, if it is necessary that all messages get captured, the parser data must be sampled at the speed of the burst if this is above the aggregate rate.

Variable sized messages

By default, the KAD/MSB/103 is configured to parse any number of data words for a particular message. It is also possible to parse messages of particular sizes.

In cases where there are variable sized messages and when word count is set to “all”, care must be taken when processing the data. The parser only updates the data words that appear on the MIL-STD-1553 bus. The other words are not valid. This means that the ground station or post processing must use the number of data words indicated in the command word to identify which data words are valid. The other option is to parse particular message sizes individually.

Snarfer sampling rate

The snarfer sample rate should be set according to the expected aggregate bus traffic. A 100% utilized bus has MIL-STD-1553 traffic appearing at 50kHz. This can be used as a guideline for configuring the snarfer sample rate. For 100% utilization, sample at 50kHz; for 50% utilization, sample at 25kHz and so on. If the FIFO overflows, MIL-STD-1553 traffic is lost. Therefore, it is important to set the snarfer filter settings appropriately.

Snarfer filtering options

SETTING	DESCRIPTION
All	Traffic + three time tags of command and status + response time
ErrorOnly	Error tags only
TrafficOnly	Traffic as it appears on the bus with any errors flagged and time tagged
HeaderOnly	Command, status, and time tagged errors

Connector pinout of the KAD/MSB/103

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DNC		Do not connect
2	DATAD(0)+	MIL-STD-1553	Direct coupled primary bus
3	DNC		Do not connect
4	DNC		Do not connect
5	DNC		Do not connect
6	DNC		Do not connect
7	DATAT(0)+	MIL-STD-1553	Transformer coupled primary bus
8	DNC		Do not connect
9	DNC		Do not connect
10	DNC		Do not connect
11	DNC		Do not connect
12	DATAT(1)+	MIL-STD-1553	Transformer coupled secondary bus
13	DNC		Do not connect
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DATAD(1)+	MIL-STD-1553	Direct coupled secondary bus
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	GND	KAM-500 internal ground	
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	GND	KAM-500 internal ground	
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DATAD(0)-	MIL-STD-1553	Direct coupled primary bus
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DATAT(0)-	MIL-STD-1553	Transformer coupled primary bus
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DATAT(1)-	MIL-STD-1553	Transformer coupled secondary bus
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DATAD(1)-	MIL-STD-1553	Direct coupled secondary bus
51	DNC		Do not connect
52	CHASSIS	KAM-500 chassis	Double-density connector only

Ordering Information

PART NUMBER	DESCRIPTION
KAD/MSB/103/C	52-way double-density mating connector (transformer coupled/direct coupled)
KAM/MSB/103/C	51-way micro-miniature mating connector (transformer coupled/direct coupled)

When ordering, specify which connector (for KAD orders, ASD/MSB/001/TC for transformer coupled or ASD/MSB/001/DC for direct coupled; for KAM orders, ACC/CON/029 for transformer coupled, or ACC/CON/009 for direct coupled) is preferred. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the Cables data sheet). For details of the version of this module with Mode Code 17 support, contact Curtiss-Wright support (acra-support@curtisswright.com).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/MSB/103/C	Message capturing changed to allow storing of traffic when either a RxRT or TxRT fails to respond	Recommended for new programs
KAD/MSB/103/B	Dual redundant MIL-STD-1553 bus monitor with Mode Code 17 support and 3K deep selective FIFO for traffic and tags (snarfer)	Not recommended for new programs
KAD/MSB/103	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related products

SOFTWARE	DETAILS
ASD/MSB/001/TCC	KAM MIL-STD-1553 interface cable (45cm long) terminated with two Twinax TRB connectors for applications with transformer coupling (shield connected to chassis)
ASD/MSB/001/DCC	KAM MIL-STD-1553 interface cable (45cm long) terminated with two Twinax TRB connectors for applications with direct coupling (shield connected to chassis)

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/004	MIL-STD-1553
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

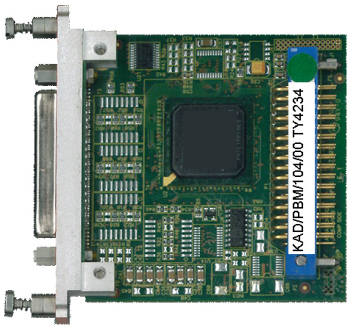
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/PBM/104

4-channel IRIG-106 PCM bus packetizer

CURTISSWRIGHTDS.com



Overview

The KAD/PBM/104 is a four-channel PCM bus monitor. It can capture four independent PCM streams for storage in Wireshark® Packet CAPture (PCAP) format and for simultaneous transmission via Ethernet.

There is no major frame decommutation.

Key Features

- Monitors four IRIG-106 PCM streams (16-bit words)
- Accepts NRZ-L code with Data clock
- Aggregate data rate of 20Mbps
- Time tags first bit of packet to one µs (microsecond)
- Aperiodic transmission
- Up to 717 words per minor frame (16-bit words)

Applications

- Airborne solid-state recorders

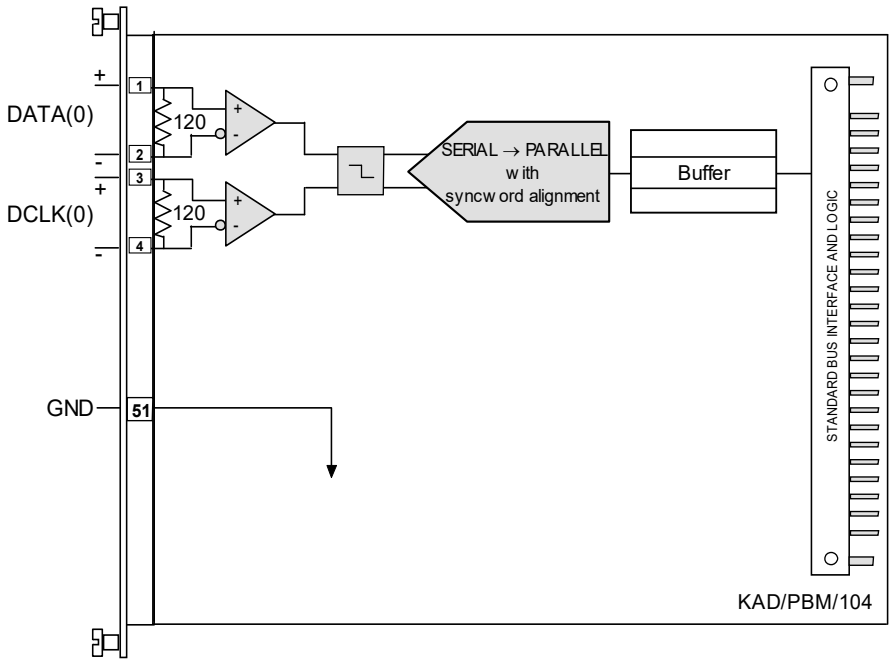


Figure 1: First of four independent PCM bus monitors

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	70	–	g	
	–	2.47	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements, see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined read rate.
Power consumption					
+5V	–	–	268	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	–	–	1.34	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	RS-422 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	4	–	
Signalling rate					
DATA[3:0]±	0.1	–	20	Mbps	
DCLK[3:0]±	0.1	–	20	MHz	
Input voltage					
operating range	-25	–	25	V	Do not exceed operating range.
logic 0	–	–	-0.2	V	(130mV hysteresis) V_{IN+} - V_{IN-}.
logic 1	0.2	–	–	V	(130mV hysteresis) V_{IN+} - V_{IN-}.
common mode voltage	-20	–	25	V	
overvoltage protection	-27	–	27	V	Voltage in excess of these values can damage input.
ESD protection	–	16	–	kV	Human Body Model.
Input resistance					
between inputs	–	120	–	Ω	

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Setting up the KAD/PBM/104

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/PBM/104	KAD/PBM/104	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
PCM-In(3:0) PCM Input	-	-	IRIG-106 PCM input channel.
Settings	-	-	-
Pcm Code	NRZ-L	NRZ-L	Specifies the PCM encoding used.
Clock Phase	0 180	180	Indicates the phase of the data clock in degrees.
Polarity	True False	True	Specifies the polarity used to transmit.
Bit Rate	1000 to 20000000	1000000	Bit rate of input channel.
Packet Size	17 to 729	720	Size of packet buffer in words.
Stream Id	00 to FFFFFFFF	FFFFFFFF	iNET-X stream ID for selected channel.
Packetization Enabled	True False	False	Enables packetization on selected channel.
Sync Word	00 to FFFFFFFF	FE6B2840	Indicates 32-bit sync word pattern.
Sync Word Mask	00 to FFFFFFFF	FFFFFFFF	Indicates which bits are deemed significant in the sync word and therefore should be matched.
Frame Length	64 to 11472	3200	Indicates minimum number of bits within minor frame.

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/PBM/104

For a detailed description on iNET-X packets, see *TEC/NOT/067 - IENA and iNET-X packet payload formats*.

iNET-X parser-aligned packet structure for PCM bus monitoring in the KAD/PBM/104

The KAD/PBM/104 packetizes parsed minor frames in parser-aligned iNET-X packet structures. As the PCM data stream arrives, the KAD/PBM/104 tracks the incoming bit-stream to identify the minor frame sync word. The complete minor frame is buffered and packetized in an iNET-X parser block structure. The generalized structure of a single PCM parser block is illustrated in the following figure.

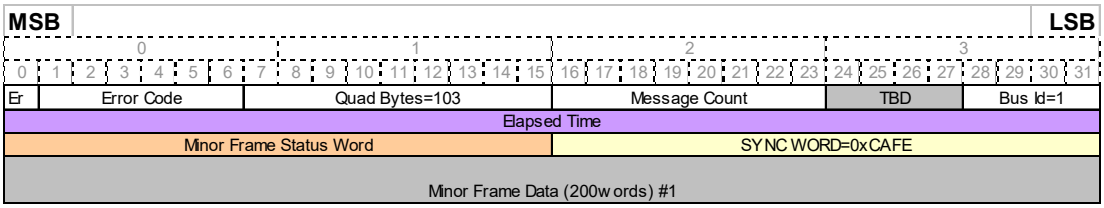


Figure 2: Generalized iNET-X parser block for a PCM minor frame

Common to all parser block structures, the first word is the parser Information Word and is followed by the Elapsed Time tags. This is immediately followed by the minor frame status word and the minor frame data that has been buffered by the KAD/PBM/104.

Minor frame status word

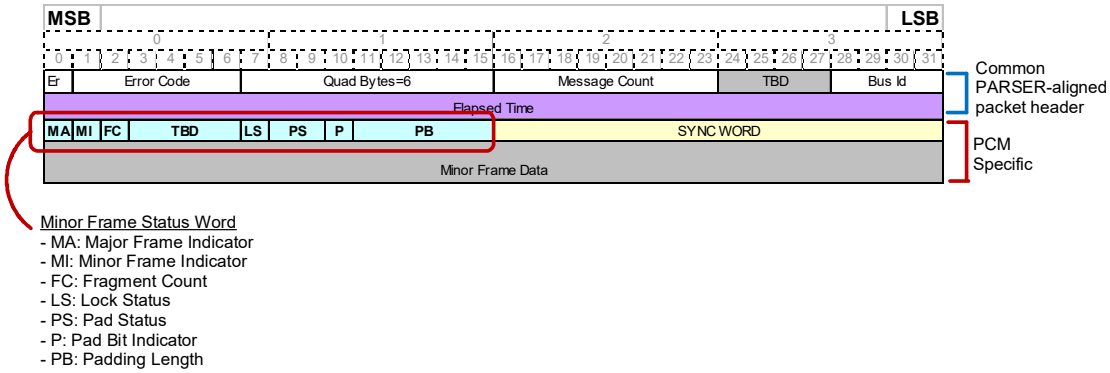


Figure 3: iNET-X parser-aligned PCM minor frame status word

- MA (Bit 0): Major Frame Indicator: indicates that the minor frame contained in this parser block is the first minor frame in the major frame. This feature is not currently supported in the KAD/PBM/104.
- MI (Bit 1): Minor Frame Indicator: indicates that the data contained in this parser block is a complete minor frame in the major frame.
  - MI=0 implies that the minor frame is fragmented.
  - MI=1 implies that the parser block contains a complete minor frame. As fragmentation is not currently supported in KAD/PBM/104, MI always read 1.
- FC (Bit 2): Minor Frame Fragment Count: indicates the minor frame fragment. This allows tracking of the minor frame fragments for reassembly. According to the IRIG-106 Chapter 4 standard the maximum sized minor frame (class II) is 2,048 bytes. Therefore no more than two packets are required to carry the maximum allowable sized minor frame of 2,048 bytes. When a minor frame is fragmented across consecutive fragments:
  - MI=0 indicates that the packet does NOT contain a complete fragment.
  - FC=0 indicates that the packet contains the first fragment
  - FC=1 indicates that the packet contains the second fragment. Fragmentation is not currently supported in the KAD/PBM/104.

Thus the first packet would have: MI=0; FC=0 and the second packet has MI=0; FC=1.

- TBD (Bits [3:6]): TBD
- LS (Bit 7): LockStatus: indicates that this is the first minor frame packetized after coming back into lock.
- P (Bit 8): Pad: indicates whether the message has been padded.
- PS (Bits [9:10]): Pad Status: indicates the conditions under which this PCM minor frame has been padded.
  + 00: Correct length
  + 01: Too few bits
  + 10: Too many bits
  + 11: TBD
- PB (Bits [11:15]): Pad Bits: indicates the number of bits that have been added to the end of the padded minor frame in order to achieve 32-bit alignment. Five bits are used as it is possible that up to 31 bits may be required to pad the message to the 32-bit alignment boundary length.

iNET-X PCM parser-aligned packet structure padding conditions

Without padding

When a minor frame falls on a 32-bit alignment boundary, it need not be padded.

- P=0, PS=00 : where the parsed minor frame is the correct length and naturally falls on a 32-bit alignment boundary and as such no padding is required.
- P=0, PS=01 : where the parsed minor frame has too few bits but naturally falls on a 32-bit alignment boundary and as such no padding is required.
- P=0, PS=10 : where the parsed minor frame has too many bits but naturally falls on a 32-bit alignment boundary and as such no padding is required.

With padding

- P=1, PS=00 : where the parsed minor frame is the correct length but the minor frame is an odd number of words long and therefore requires one word of padding in order to fall on a 32-bit alignment boundary.

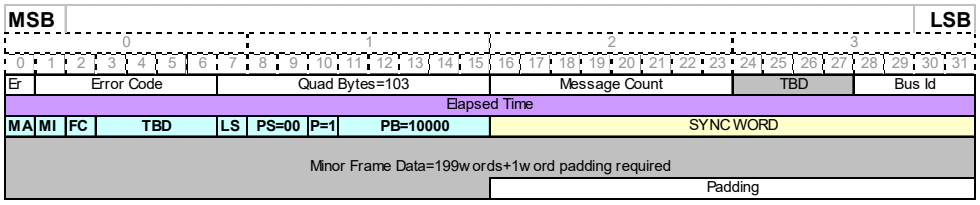


Figure 4: iNET-X parser-aligned PCM minor frame: correct length, requires padding

- P=1, PS=01 : where the parsed minor frame has too few bits (i.e. less than 31 bits) and requires padding at the end of the minor frame to end on a 32-bit alignment boundary.

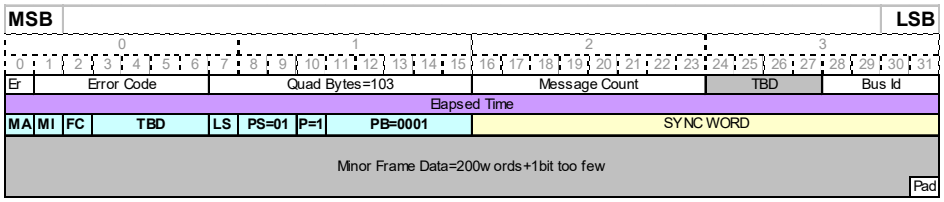


Figure 5: iNET-X parser-aligned PCM minor frame: incorrect length (too few bits), requires padding

- P=1, PS=10 : where the parsed minor frame has too many bits (i.e. up to 31 bits) and requires padding at the end of the minor frame to end on a 32-bit alignment boundary.

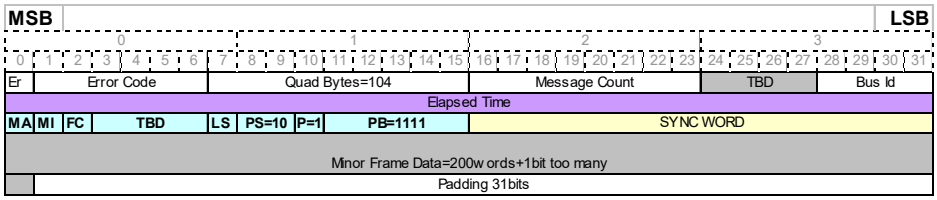


Figure 6: iNET-X parser-aligned PCM minor frame: incorrect length (too many bits), requires padding

iNET-X PCM parser-aligned packet structure with multiple minor frames

Consider a minor frame comprising 200 words plus the sync word. The total amount of data for a single minor frame packed in a parser block structure is 412 bytes where:

- Parser block header = 4 bytes
- Elapsed Time = 4 bytes
- Minor frame status word = 2 bytes
- Sync word = 2 bytes
- Minor frame data = 400 bytes

Since this falls on a 32-bit alignment boundary there is no padding required. The parser block of quad bytes is 103 bytes long as this length includes the length of the parsed data, padding and parser block header. In this example, the iNET-X parser-aligned packet payload may contain three complete minor frame parser blocks.

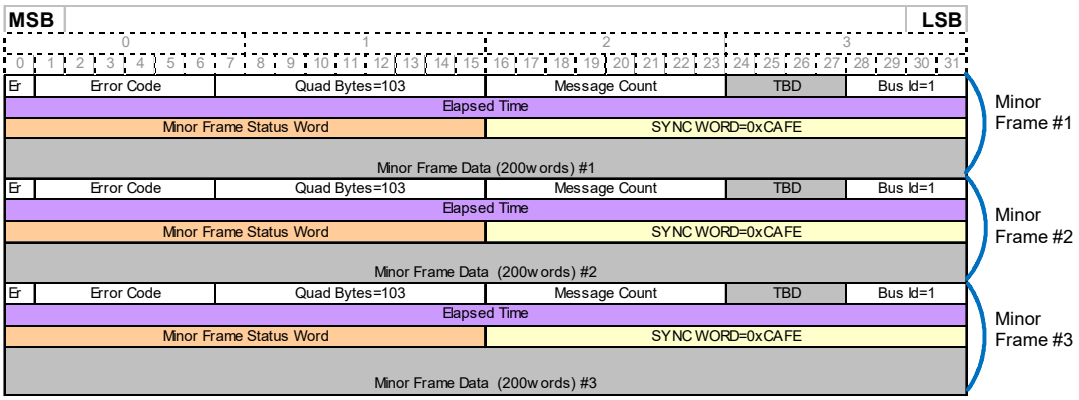


Figure 7: iNET-X parser-aligned packet with multiple PCM minor frames

Connector pinout of the KAD/PBM/104

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DATA(0)+	RS-422 inputs	PCM data; first bus
2	DATA(0)-	RS-422 inputs	PCM data; first bus
3	DCLK(0)+	RS-422 inputs	PCM Data clock; first bus
4	DCLK(0)-	RS-422 inputs	PCM Data clock; first bus
5	DATA(1)+	RS-422 inputs	PCM data
6	DATA(1)-	RS-422 inputs	PCM data
7	DCLK(1)+	RS-422 inputs	PCM Data clock
8	DCLK(1)-	RS-422 inputs	PCM Data clock
9	CHASSIS	Chassis	
10	CHASSIS	Chassis	
11	GND	Internal ground	
12	GND	Internal ground	
13	GND	Internal ground	
14	DNC		Do not connect
15	DATA(2)+	RS-422 inputs	PCM data
16	DATA(2)-	RS-422 inputs	PCM data
17	DCLK(2)+	RS-422 inputs	PCM Data clock
18	DCLK(2)-	RS-422 inputs	PCM Data clock
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DATA(3)+	RS-422 inputs	PCM data
26	DATA(3)-	RS-422 inputs	PCM data
27	GND	Internal ground	
28	GND	Internal ground	
29	DCLK(3)+	RS-422 inputs	PCM Data clock
30	DCLK(3)-	RS-422 inputs	PCM Data clock
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/PBM/104	4-channel IRIG-106 PCM bus packetizer

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/PBM/104	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

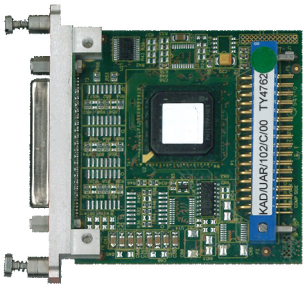
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
TEC/NOT/051	Ethernet frames, Wireshark® and FAT32
TEC/NOT/067	IENA and iNET-X packet payload formats

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KAD/UAR/102

RS-232/RS-422/RS-485 universal asynchronous parser and snarfer - 4ch

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Key Features

- Monitors up to four RS-422/485/232 busses
- Coherently parses traffic and tags for up to 125 messages from 4 to 512 bytes
- 2K words deep per channel (snarfer)
- Bit-rates from 300bps to 1,000,000bps
- 7/8 bits per word with odd, even or no parity
- Programmable start sequence (1 to 8 bytes), stop sequence (1 byte or by fixed length) and idle time

Applications

- Interfacing with serial data links

Overview

The KAD/UAR/102 is used to parse (coherently extract specific bytes) and snarf (send all data to a FIFO) up to four RS-232/422/485 channels. The module is able to parse and snarf each channel at the same time.

The signal type (RS-232/422/485), bits per word and parity are programmable on a channel-by-channel basis. The bit-rates must be binary multiples of each other.

In the parser, a total of up to 125 complete messages are triple buffered so that the stale indication is message-wide. Each message can be up to 512 characters (bytes) long (including start and stop characters). Each message is tagged to 0.1ms resolution; a message is considered found when a start sequence of between 4 and 8 specific bytes is received.

The end of message byte is determined by a user-defined stop character or specific number of words. A message is not updated if any sequence is incorrect.

The snarfer stores all data from each bus in a separate FIFO 2K words deep.

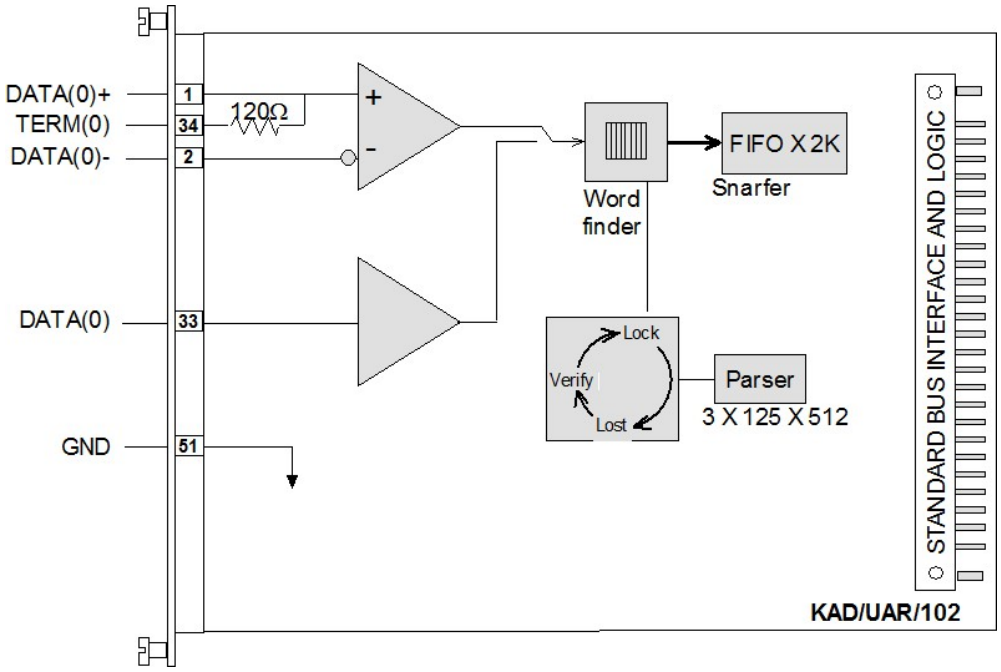


Figure 1: First of four channels of the KAD/UAR/102

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under "Environmental ratings" in the "General specifications" table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	70	–	g	
	–	2.49	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	–	85	94	mA	
±7V	–	0	0	mA	
±12V	–	0	0	mA	
total power	–	0.425	0.470	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	RS-422 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	4	–	
Signalling rate					
DATA	0.0003	–	1	Mbps	NRZ-L (8Mbps for BIØ-L).
Input voltage					
operating range	-25	–	25	V	Do not exceed operating range.
logic '0'	–	–	0.2	V	(130mV hysteresis) V_{IN+} - V_{IN-}.
logic '1'	0.2	–	–	V	(130mV hysteresis) V_{IN+} - V_{IN-}.
common mode voltage	-20	–	25	V	
overvoltage protection	-27	–	27	V	Voltage in excess of these values can damage input.
ESD protection	–	16	–	kV	Human Body Model.
Input resistance					
between inputs	24	–	–	kΩ	Module powered on/off.
between inputs	–	120	–	Ω	Module powered on/off and inputs terminated.
each input to GND	12	–	–	kΩ	Module powered on/off.

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TABLE 3	RS-232 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	4	–	
Signaling rate					
DATA[3:0]	0.0003	–	1	Mbps	
Input voltage					
operating range	-25	–	25	V	Do not exceed operating range.
logic ‘0’	–	–	0.6	V	
logic ‘1’	2.4	–	–	V	
overvoltage protection	-25	–	25	V	Voltages outside of this range can damage input.
ESD protection	-15	–	15	kV	Human Body Model.
Input resistance					
each input to GND (on)	–	4.8	–	MΩ	Module powered on.
each input to GND (off)	–	4.7	–	kΩ	Module powered off.

Setting up the KAD/UAR/102

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/UAR/102/C	KAD/UAR/102/C	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Processes	-	-	-
Parser(124:0)	-	-	-
Channels	-	-	-
Serial-In(3:0) Serial Input	-	-	Connection between the module channel and RS232/422/485 data bus.
Settings	-	-	-
Signal Type	RS-422 RS-485 RS-232	RS-422	Type of data stream.
Baud Rate	300 600 1200 2400 4800 9600 14400 19200 38400 57600 62500 76800 115200 208300 230400 250000 312500 345600 352500 360000 460800 625000 694444 781250 892857 921600 500000 1000000 1041666	9600	Specifies the number of symbols transmitted per second.
Data Bits Per Word	7 8	8	Bits per word.

SETUP DATA	CHOICE	DEFAULT	NOTES
Parity	None Odd Even	None	Parity of word.
Idle Time Sync Interval	0 to 63	0	Time in ms between consecutive characters required before starting new message (Note: Must be in range 2-63 ms or 0 ms. Setting to 1 ms is invalid).

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Report Indicates the status of the monitor.	BitVector	BitVector	16	R[15:0] R(15) ErrorIndicator - 1 indicates an error occurred since last read. R[14:13] BusNumber - The bus the error occurred on. R[12:4] Reserved - Reserved for future use R[3:0] ErrorCodes 0001: Parity error 0010: Bad stop bit 0100: Too many data words. Other: Reserved for future use
Parser(124:0) Parameters				
MessageSize Number of received bytes (including start bytes) example 1+3 = 4 bytes in a message. Minimum length of message is 4 bytes (3 bytes of start sequence plus 1 stop byte or at least 1 byte in case of fixed length message).	Count	OffsetBinary	16	R[15:0]
MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes time of the last character in message.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use R[12:7] Hours - BCD Hours 0 to 23 R[6:0] Minutes - BCD Minutes 0 to 59
MessageTimeLo Seconds and centiseconds time of the start of the last character in message.	Second	BCD	16	R[31:16] R(15) Reserved - Reserved for future use R[14:8] Seconds - Seconds 0 to 59 R[7:0] Centiseconds - Centiseconds 0 to 99
MessageTimeMicro Microsecond time of the start of the last character in message.	Second	BCD	16	R[15:0] R[15:0] Microseconds - Microseconds 0 to 9999

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageInfo Indicates status of message.	BitVector	BitVector	16	R[15:0] R(15) Empty - This slot is empty. R(14) Stale - Contents of this slot have already been read. R(13) Skipped - Contents of this slot have been over-written. R[12:0] Reserved - Reserved for future use.
MessageCount Count of messages detected on the bus.	Count	OffsetBinary	16	R[15:0]
Serial-In(3:0) Parameters				
Snarfer Snarfer Register	BitVector	BitVector	16	R[15:0] R[15:8] FifoData - The 8/7 bits received. R(15) is the First Bit Transmitted R(7) FifoIsEmpty - 1 indicates the FIFO is empty R(6) FifoWasFull - 1 indicates the FIFO was full R[5:0] Reserved - Reserved for future use

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/UAR/102

It is important to ground (GND) each source of RS-232, RS-422 or RS-485. The following figure shows how to optionally terminate the RS-422 and RS-485 receivers by using the internal termination resistor provided on the module (TERM pin). Star grounding provides optimal noise rejection. For details on grounding, see *TEC/NOT/063 - Grounding and shielding of the Acra KAM-500*.

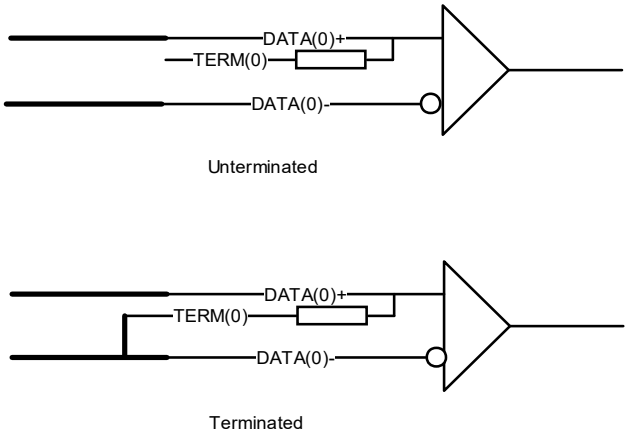


Figure 2: Optional RS-422/RS-485 third pin termination

Maximum message length

The maximum message length is 512 bytes. This length includes the bytes used for the start pattern and the end byte (if an end byte is used).

Interval between messages

The interval between the start patterns of messages must be at least 8 bytes in order for the KAD/UAR/102 to parse the message.

For example, if a message 6 bytes in length is parsed, then a following message whose start sequence includes either of the next 2 bytes will not be detected or parsed.

Error codes for the KAD/UAR/102

TABLE 4	Error codes
CODE[1]	DESCRIPTION
1_{16}	Parity error.
2_{16}	Bad stop bit.
4_{16}	Last character not found in 512 characters.
0_{16}, 3_{16}, 5_{16}, 6_{16}, 7_{16}	Reserved for future use.

1. Error codes are in hexadecimal.

Parser data word definition

Consider a hexadecimal stream with 0x40, 0x41, 0x42, 0x43, 0x44, and 0x45:

Data position 0: DW0 is 0x4041

Data position 1: DW1 is 0x4140

Data position 2: DW2 is 0x4243

Data position 3: DW3 is 0x4342

Data position 4: DW4 is 0x4445

Data position 5: DW5 is 0x4544 (and so on)

Connector pinout of the KAD/UAR/102

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DATA(0)+	RS-422 inputs	Data in; differential ended alternative to Pin 33
2	DATA(0)-	RS-422 inputs	Data in; connect to pin 34 for 120Ω termination
3	DATA(1)+	RS-422 inputs	Data in; differential ended alternative to Pin 35
4	DATA(1)-	RS-422 inputs	Data in; connect to pin 36 for 120Ω termination
5	DATA(2)+	RS-422 inputs	Data in; differential ended alternative to Pin 37
6	DATA(2)-	RS-422 inputs	Data in; connect to pin 38 for 120Ω termination
7	DATA(3)+	RS-422 inputs	Data in; differential ended alternative to Pin 39
8	DATA(3)-	RS-422 inputs	Data in; connect to pin 40 for 120Ω termination
9	DNC		Do not connect
10	DNC		Do not connect
11	DNC		Do not connect
12	DNC		Do not connect
13	DNC		Do not connect
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DATA(0)	RS-232 inputs	Data in; single ended alternative to pin 1
34	TERM(0)	RS-422 inputs	Connect to pin 2 for 120Ω termination
35	DATA(1)	RS-232 inputs	Data in; single ended alternative to pin 3
36	TERM(1)	RS-422 inputs	Connect to pin 4 for 120Ω termination
37	DATA(2)	RS-232 inputs	Data in; single ended alternative to pin 5
38	TERM(2)	RS-422 inputs	Connect to pin 6 for 120Ω termination
39	DATA(3)	RS-232 inputs	Data in; single ended alternative to pin 7
40	TERM(3)	RS-422 inputs	Connect to pin 8 for 120Ω termination
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	GND	Internal ground	
51	GND	Internal ground	
52	CHASSIS	KAM-500 chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/UAR/102/C	RS-232/RS-422/RS-485 universal asynchronous parser and snarfer - 4ch (with 52-way double-density connector)
KAM/UAR/102/C	RS-232/RS-422/RS-485 universal asynchronous parser and snarfer - 4ch (with 51-way micro-miniature connector)

By default, the standard mating connector, (CON/KAD/002/CP for KAD modules; or ACC/CON/008/04 for KAM modules), is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/UAR/102 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/UAR/102/C	Minimum message length reduced to 4 bytes instead of 9	Recommended for new programs
KAD/UAR/102/B	Optimized to allow DAS Studio 3 more flexibility in parameter placement	Not recommended for new programs
KAD/UAR/102	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
DOC/HBK/002	Environmental Qualification Handbook
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
TEC/NOT/062	Using the KAD/UAR/102
TEC/NOT/063	Grounding and shielding of the Acra KAM-500

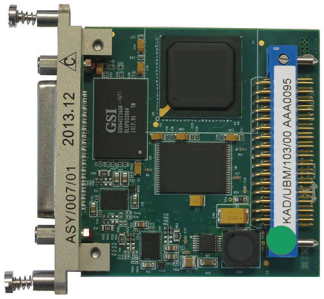
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KAD/UBM/103

RS-232, RS-422 or RS-485 serial bus parser/packetizer - 16ch

CURTISSWRIGHTDS.COM



Key Features

- Monitors up to 16 RS-422/485/232 busses
- Coherently parses traffic and tags for up to 511 messages from 4 to1024 bytes
- Aperiodic transmission of packetized serial messages including tags as iNET-X parser-aligned payload structure
- Bit-rates from 300bps to 1,000,000bps
- 7/8 bits per word with odd, even or no parity
- Programmable start sequence (1 to 8 bytes), stop sequence (1 byte or by fixed length) and idle time

Applications

- Interfacing with serial data links

Overview

The KAD/UBM/103 is used to monitor up to 16 RS-232/422/485 channels. The module can parse (coherently extract specific bytes) and/or packetize (insert messages in packets for Ethernet transmission) each channel at the same time.

The signal type (RS-232/422/485), bits per word, and parity are programmable on a channel-by-channel basis.

In the parser, a total of up to 511 complete messages are triple buffered so that the stale indication is message-wide. Each message can be up to 1,024 characters (bytes) long (including start and stop characters). Each message is tagged to 0.1ms resolution; a message is considered found when a start sequence of up to eight specific bytes is received. The end-of-message delimiter is determined by a user-defined stop character or after a specific number of words are received. A message is not updated if any sequence is incorrect.

Independently of the parser, an iNET-X packet stream is generated for each channel. All received bytes are encapsulated in an iNET-X parser-aligned payload structure. A programmable gap time allows the module to split the incoming bytes into shorter timestamped sequences. A block header attached to each sequence stores the channel index, length, and the time of reception of each message. These parser-aligned packets may be transmitted aperiodically to optimize network bandwidth utilization and memory usage when recording serial traffic.

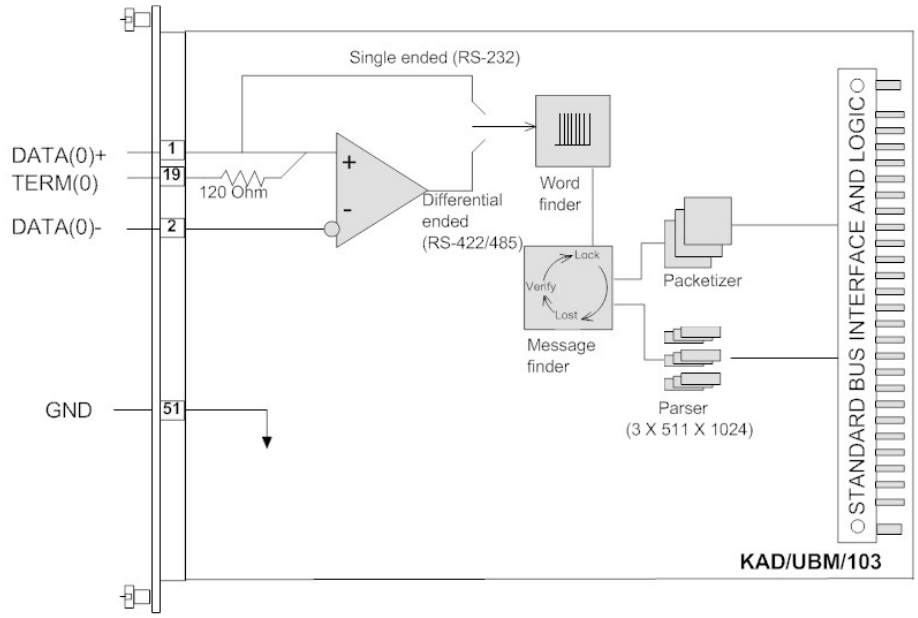


Figure 1: First of 16 channels of the KAD/UBM/103

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	75	–	g	
	–	2.64	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	275	–	300	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	1.375	–	1.50	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

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TABLE 2	RS-422/RS-485 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	16	–	
Signalling rate					
DATA	0.0003	–	1	Mbps	NRZ-L.
Input voltage					
operating range	-15	–	15	V	Do not exceed operating range.
logic 0	–	–	0.2	V	(190mV hysteresis) V_{IN+} - V_{IN-}.
logic 1	0.2	–	–	V	(190mV hysteresis) V_{IN+} - V_{IN-}.
common mode voltage	-7	–	12	V	
overvoltage protection	-15	–	15	V	Voltage in excess of these values can damage input.
ESD protection	–	16	–	kV	Human Body Model.
Input resistance					
between inputs	–	250	–	kΩ	Module powered up and no input termination.
between inputs	–	260	–	kΩ	Module powered down and no input termination.
between inputs	–	120	–	Ω	Module powered up and inputs terminated with external or internal termination resistor.
between inputs	–	120	–	Ω	Module powered down and inputs terminated with external termination resistor.

TABLE 3	RS-232 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	16	–	
Signaling rate					
DATA[15:0]	0.0003	–	1	Mbps	
Input voltage					
operating range	-15	–	15	V	Do not exceed operating range.
logic 0	2.5	–		V	
logic 1		–	0.6	V	
overvoltage protection	-15	–	15	V	Voltages outside of this range can damage input.
ESD protection	16	–	16	kV	Human Body Model.
Input resistance					
each input to GND	–	5	–	kΩ	Module powered up.
each input to GND	–	130	–	kΩ	Module powered down.

Setting up the KAD/UBM/103

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/UBM/103	KAD/UBM/103	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Settings	-	-	-
Parser Data Endianness	First byte at low end of word First byte at high end of word One word per byte	First byte at low end of word	Select byte order in data field of parser slot. If one word per byte is selected, the lower byte of each word is padded with zero.
Fill Value	0000 to FFFF	AAAA	The value returned by Parser Parameters (excluding MessageInfo) when MessageInfo indicates the parser is empty.
Processes	-	-	-
Parser(510:0)	-	-	-
Channels	-	-	-
Serial-In(15:0) *Serial Input*	-	-	Connection between the module channel and RS-232/422/485 data bus.
Settings *Serial Interface*	-	-	-
Signal Type	RS-232 RS-422 RS-485	RS-232	Type of data stream.
Baud Rate	300 to 1000000	9600	Specifies the number of symbols transmitted per second.
Data Bits Per Word	7 8	8	Bits per incoming data word. Two incoming words are packed into a single 16-bit output word.
Parity	No Parity Even Parity Odd Parity	No Parity	Configure whether parity bit is present in incoming data.
Parity Check	Not checked Report failure Report failure and offset	Not checked	Configure whether and how parity failures are reported. Note: failure offset is only available in packetizer output.
Gap Between Messages	0 to 10000	10	Time gap between consecutive characters required before starting new message. Value expressed in unit of character periods at configured bit rate. Set to 0 to ignore all gaps.
Programmable Termination	Disabled Enabled	Disabled	Enable internal 120-ohm termination resistance. (Note: not active when power is disabled. Use wiring selectable termination instead if termination is required at all times.)
Settings *Packetizer*	-	-	-
Packetizer Format	iNET-X IENA iNET-X Hybrid	iNET-X	Selects the packetizer header format for all channels.

SETUP DATA	CHOICE	DEFAULT	NOTES
Stream Id	00 to FFFFFFFF	FFFFFFFF	iNET-X stream identifier for selected channel if a packet is generated via the assertion of Packetization Enabled. This is a conditional setting and is only active when the Packetizer Format is set to iNET-X.
Packetization Enabled	True False	False	Enables the transmission of a packetizer packet containing the contents of this channel if a packetizer transmitter or memory module is present in the chassis.
Packet Size	200 to 511	511	Size of packet buffer in words.
Packet Timeout	10 to 999	50	Generate a packet when the oldest data recorded is this old (ms).
Utilization	0.01 to 1.00	1.00	Can be used to schedule less packets when incoming message rates are known to be less than maximum. Expressed as a decimal that is, 1.00 = 100% utilization.
IENA Key	0 to FFFF	0	IENA Key for selected channel if a packet is generated via the assertion of Packetization Enabled. This is a conditional setting and is active when the Packetizer Format is not set to iNET-X.
One Message Per Packet	True False	False	Set to True to limit packets to one parserblock. After each gap, the next message starts a new packet. Only use this setting if the number of packets scheduled exceeds the number of messages expected and the maximum size message is less than the Packet Size.
Packetization Sink	All Controller Only Slot 1 Slot 2 Slot 3 Slot 4 Slot 5 Slot 6 Slot 7 Slot 8 Slot 9 Slot 10 Slot 11 Slot 12 Slot 13 Slot 14 Slot 15	All	Selects which modules the packetizer package is sent to for transmission or storage.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Report Indicates the status of the monitor.	BitVector	BitVector	16	**R[15:0]** R(15) ErrorIndicator - 1 indicates an error occurred since last read. R[14:11] BusNumber - The bus the error occurred on. R[10:4] Reserved - Reserved for future use. R[3:0] ErrorCodes - Each bit set indicates that particular error occurred since report word last read. After the report word has been read, further reads will return the last non-zero error code with the ErrorIndicator bit not set. 0001: Parity error. 0010: Bad stop bit. 0100: Too many data words. Stop character not found in 1024 characters. Other: Reserved for future use.
ModuleMessageCount Count of messages received (all channels). Increments by one each time the parser logic detects a complete message. Reads as 0 before first message received.	BitVector	BitVector	16	R[15:0]
Parser(510:0) Parameters				
MessageSize Number of received bytes (including start bytes. For example, 1+8 = 9 bytes in a message). Minimum length of message is 2 bytes (1 byte of start sequence plus one stop byte or at least one byte in case of fixed length message).	Count	OffsetBinary	16	R[15:0]
MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes time midway through first transmitted bit.	BitVector	BitVector	16	**R[47:32]** R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
MessageTimeLo Seconds and centiseconds time midway through first transmitted bit.	BitVector	BitVector	16	**R[31:16]** R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.
MessageTimeMicro Microsecond time midway through first transmitted bit.	Second	BCD	16	**R[15:0]** R[15:0] Microseconds - BCD Microseconds 0 to 9999.
MessageCount Received message count.	Count	OffsetBinary	16	R[15:0]

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageInfo Stale/skipped indication for this parsed message.	BitVector	BitVector	16	**R[15:0]** R(15) Empty - ID is empty (no message received). R(14) Stale - 1 indicates this message was read before. R(13) Skipped - 1 indicates this message overwrote another. R[12:0] Reserved - Reserved for future use.
Serial-In(15:0) Parameters				
ChannelMessageCount Index of received message. First message received is given value 0. Increments by 1 each time the parser logic detects a valid message on this channel. Reads as Fill Value before first message received.	BitVector	BitVector	16	R[15:0]
ChannelByteCount Count of bytes received on this bus.	Count	OffsetBinary	16	R[15:0]
ChannelErrCount Count of errors detected on this bus.	BitVector	BitVector	16	R[15:0]

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/UBM/103

Each of the 16 bus connections can be independently selected as RS-232, RS-422 or RS-485. For RS-232 (single ended), use a DATA(x)+ pin and leave the corresponding DATA(x)- pin unconnected. Both data pins are required when a differential mode is selected (RS-422 or RS-485).

The following figure shows how to optionally terminate the RS-422 and RS-485 receivers by using the internal termination resistor provided on the module (TERM[x] pin). It is important to ground each source of RS-232, RS-422 or RS-485. Star grounding provides optimal noise rejection. For details on grounding, see *TEC/NOT/063 - Grounding and shielding of the Axon and Acra KAM-500*.

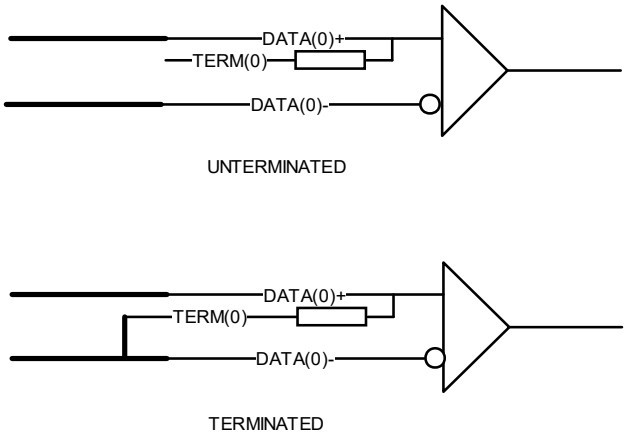


Figure 2: Optional RS-422/RS-485 third pin termination

Maximum message length

The maximum message length is 1,024 bytes. This length includes the bytes used for the start pattern and the end byte (if an end byte is used).

Timestamps for parser/packetizer and idle time for parser

For information on using timestamps for parser/packetizer and idle time (gap between messages) for parser, contact Curtiss-Wright support (acra-support@curtisswright.com).

Parser Data Endianness example

With ABCD characters being transmitted, setting Parser Data Endianness to:

First byte at low end of word: the module outputs DW0=AB and DW1=CD

First byte at high end of word: the module outputs DW0=BA and DW1=DC

One word per byte: the module outputs DW0=A0, DW1=B0, DW2=C0 and DW3=D0

Error codes

Code[1]	DESCRIPTION
1_{16}	Parity error.
2_{16}	Bad stop bit.
4_{16}	Last character not found in 1.024 characters (in report word only; not in packetizer error code).
0_{16}, 3_{16}, 5_{16}, 6_{16}, 7_{16}	Reserved for future use.

1. Error codes are in hexadecimal.

Packetizer format

The KAD/UBM/103 recognizes bytes as having a start bit, data bits (seven or eight, programmable), a parity bit (optional), and a stop bit. The KAD/UBM/103 gathers groups of bytes into standard iNET-X parser-aligned blocks. Each output packet can contain multiple blocks. If configured to receive 7-bit bytes, each byte is padded to 8 bits using a zero at the most significant bit before saving.The generalized iNET-X payload structure for parser-aligned packets is shown in Figure 3 on page 863 and examples of parser block formats are shown in Figure 4 on page 864.

A parser block is created for each logical message, based on the gaps between sequences of bytes. A new parser block is created at the start of each iNET-X packet and also when the time gap between successive bytes exceeds a programmable threshold.

The gap time threshold is programmed in characters. By setting the threshold value to just under the minimum gap time allowable between messages (under the protocol being used), it is possible to correctly split the bytes of the incoming stream into individual messages, as required. If multiple messages are received back-to-back, in a burst with no such gap, they are packetized as a single message. Conversely, if a single message continues past the end of one packet with no gap, the succeeding bytes are packetized in a new parser block in the next packet. A bit in the header of the first parser block, in the following packet, is set to indicate that this block is a continuation of the message in the final block of the previous packet. The location of this continuation bit is marked Cn in the example parser blocks in Figure 4 on page 864.

If a 0µs threshold is set, gaps are not detected, and in the absence of errors, each iNET-X packet contains a single parser block whose length is controlled by the packet timeout and size settings selected.

The Error Code field for the parser block indicates whether any error was detected.

If parity error detection is enabled, the parity bit for each byte is checked but not recorded. If error reporting is enabled, the error code is reported in the parser block header, and optionally, an extra quadbyte can be suffixed to the parser block indicating the byte offset of the first error. There may be additional errors at locations past this offset.

NOTE: Additional packetized messages that contain one zero value byte can occur when there is noise on the incoming signal lines. These may be marked as errors, depending on the parity and error detection settings.

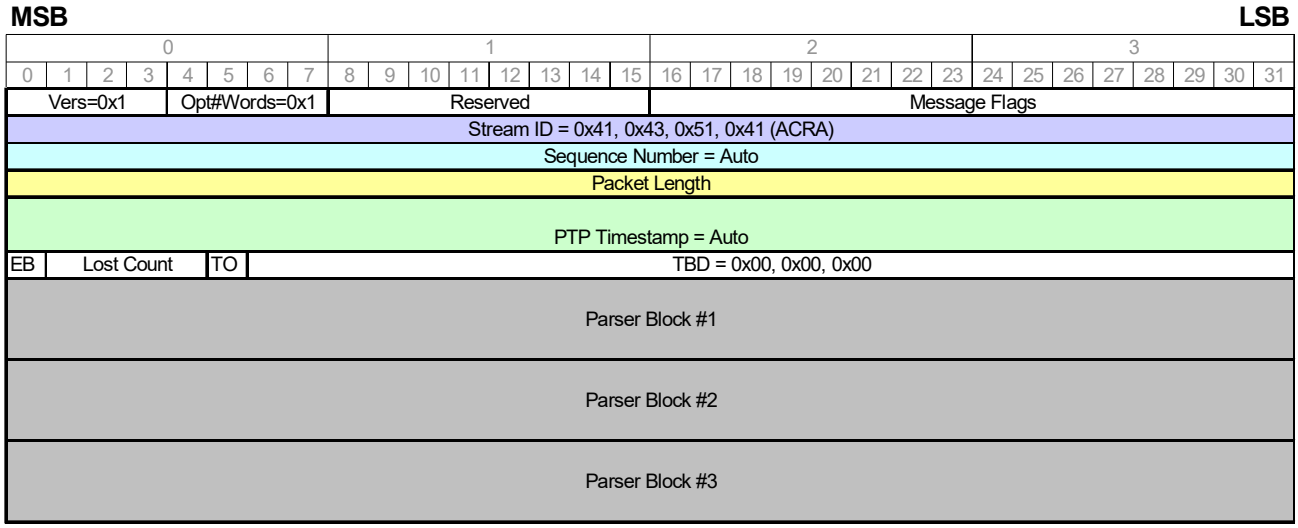
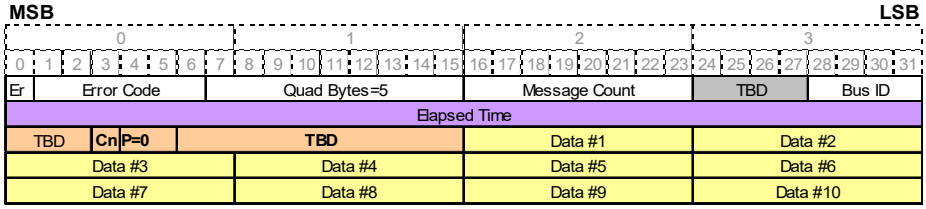


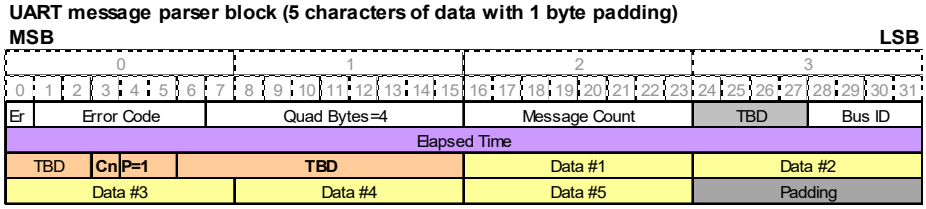
Figure 3: Generalized parser-aligned iNET-X packet

Parser blocks example

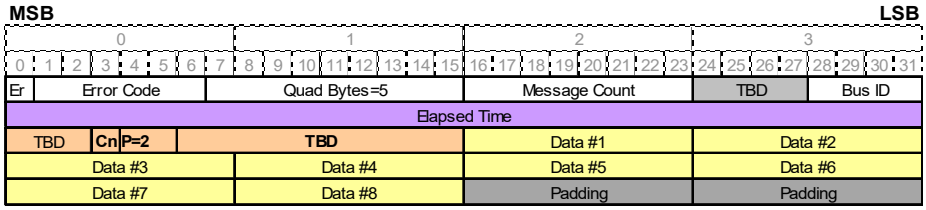
UART message parser block (10 characters of data)



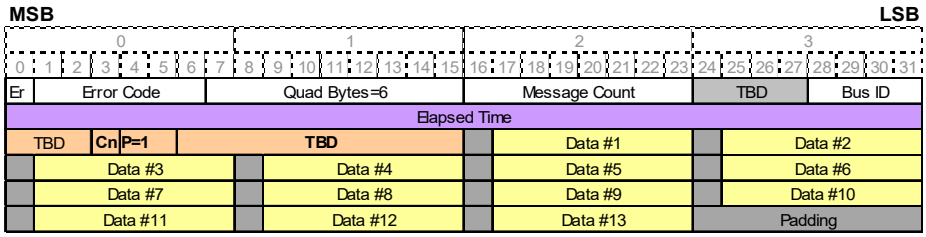
UART message parser block (5 characters of data with 1 byte padding)



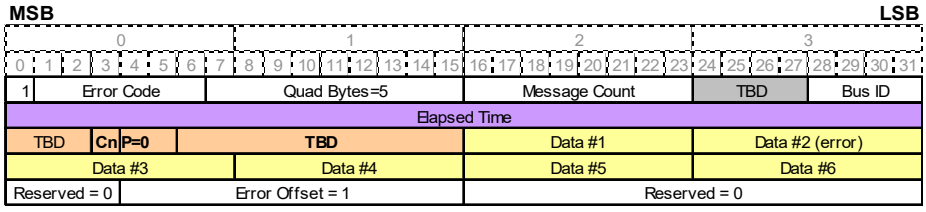
UART Message Parser Block (8 characters of data with 2 bytes padding)



UART Message Parser Block (13 characters of data (7 bits per character), 1 byte padding)



UART message parser block (6 characters of data, parity error in second byte; location reported by adding extra quadword)



P = Number of padding bytes added to complete final quadbyte to 32 bits
Cn = Continuation Indicator (1 = this block continues the block that ended the previous packet.)

Figure 4: Parser block formats used in packetizer

UART = Universal Asynchronous Receiver Transmitter)

Connector pinout of the KAD/UBM/103

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DATA(0)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
2	DATA(0)-	RS-422/RS-485 inputs	Data in; connect to pin 19 for 120Ω termination
3	DATA(1)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
4	DATA(1)-	RS-422/RS-485 inputs	Data in; connect to pin 21 for 120Ω termination
5	DATA(2)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
6	DATA(2)-	RS-422/RS-485 inputs	Data in; connect to pin 23 for 120Ω termination
7	DATA(3)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
8	DATA(3)-	RS-422/RS-485 inputs	Data in; connect to pin 25 for 120Ω termination
9	DATA(4)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
10	DATA(4)-	RS-422/RS-485 inputs	Data in; connect to pin 27 for 120Ω termination
11	DATA(5)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
12	DATA(5)-	RS-422/RS-485 inputs	Data in; connect to pin 29 for 120Ω termination
13	DATA(6)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
14	DATA(6)-	RS-422/RS-485 inputs	Data in; connect to pin 31 for 120Ω termination
15	TERM(7)	RS-422/RS-485 inputs	Connect to pin 16 for 120Ω termination
16	DATA(7)-	RS-422/RS-485 inputs	Data in; connect to pin 15 for 120Ω termination
17	DATA(8)-	RS-422/RS-485 inputs	Data in; connect to pin 34 for 120Ω termination
18	GND	Internal ground	
19	TERM(0)	RS-422/RS-485 inputs	Connect to pin 2 for 120Ω termination
20	TERM(9)	RS-422/RS-485 inputs	Connect to pin 38 for 120Ω termination
21	TERM(1)	RS-422/RS-485 inputs	Connect to pin 4 for 120Ω termination
22	TERM(10)	RS-422/RS-485 inputs	Connect to pin 40 for 120Ω termination
23	TERM(2)	RS-422/RS-485 inputs	Connect to pin 6 for 120Ω termination
24	TERM(11)	RS-422/RS-485 inputs	Connect to pin 42 for 120Ω termination
25	TERM(3)	RS-422/RS-485 inputs	Connect to pin 8 for 120Ω termination
26	TERM(12)	RS-422/RS-485 inputs	Connect to pin 44 for 120Ω termination
27	TERM(4)	RS-422/RS-485 inputs	Connect to pin 10 for 120Ω termination
28	TERM(13)	RS-422/RS-485 inputs	Connect to pin 46 for 120Ω termination
29	TERM(5)	RS-422/RS-485 inputs	Connect to pin 12 for 120Ω termination
30	TERM(14)	RS-422/RS-485 inputs	Connect to pin 48 for 120Ω termination
31	TERM(6)	RS-422/RS-485 inputs	Connect to pin 14 for 120Ω termination
32	TERM(15)	RS-422/RS-485 inputs	Connect to pin 50 for 120Ω termination
33	DATA(7)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
34	TERM(8)	RS-422/RS-485 inputs	Connect to pin 17 for 120Ω termination
35	DATA(8)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
36	GND	Internal ground	
37	DATA(9)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
38	DATA(9)-	RS-422/RS-485 inputs	Connect to pin 20 for 120Ω termination
39	DATA(10)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
40	DATA(10)-	RS-422/RS-485 inputs	Connect to pin 22 for 120Ω termination
41	DATA(11)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
42	DATA(11)-	RS-422/RS-485 inputs	Connect to pin 24 for 120Ω termination
43	DATA(12)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
44	DATA(12)-	RS-422/RS-485 inputs	Connect to pin 26 for 120Ω termination
45	DATA(13)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
46	DATA(13)-	RS-422/RS-485 inputs	Connect to pin 28 for 120Ω termination
47	DATA(14)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
48	DATA(14)-	RS-422/RS-485 inputs	Connect to pin 30 for 120Ω termination
49	DATA(15)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
50	DATA(15)-	RS-422/RS-485 inputs	Connect to pin 32 for 120Ω termination
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/UBM/103	RS-232, RS-422 or RS-485 serial bus parser/packetizer - 16ch

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/UBM/103	First release	Recommended for new programs

Supporting software

SOFTWARE	DIFFERENCES
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

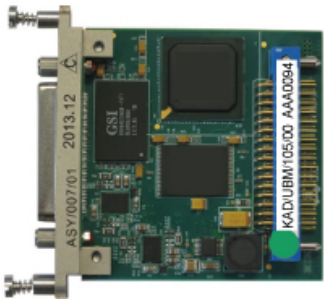
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
TEC/NOT/063	Grounding and shielding of the Axon and Acra KAM-500
TEC/NOT/079	Using the KAD/UBM/103

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/UBM/105

RS-232, RS-422, or RS-485 high data rate up to 5 Mbps serial bus parser/packetizer -12ch

CURTISSWRIGHTDS.COM



Key Features

- Monitors up to 12 RS-422/485/232 busses
- Coherently parses traffic and tags for up to 511 messages from 4 to1024 bytes
- Aperiodic transmission of packetized serial messages including tags as iNET-X parser-aligned payload structure
- Bit-rates from 300 bps to 5,000,000 bps
- 7/8 bits per word with odd, even or no parity
- Programmable start sequence (1 to 8 bytes) and stop sequence (1 byte or by fixed length)

Applications

- Interfacing with serial data links

Overview

The KAD/UBM/105 is used to monitor up to 12 RS-232/422/485 channels. The module can parse (coherently extract specific bytes) and/or packetize (insert messages in packets for Ethernet transmission) each channel at the same time.

The signal type (RS-232/422/485), bits per word, and parity are programmable on a channel-by-channel basis.

In the parser, a total of up to 511 complete messages are triple buffered so that the stale indication is message-wide. Each message can be up to 1,024 characters (bytes) long (including start and stop characters). Each message is tagged to 0.1ms resolution; a message is considered found when a start sequence of up to eight specific bytes is received. The end-of-message delimiter is determined by a user-defined stop character or after a specific number of words are received. A message is not updated if any sequence is incorrect.

Independently of the parser, an iNET-X packet stream is generated for each channel. All received bytes are encapsulated in an iNET-X parser-aligned payload structure. A programmable gap time allows the module to split the incoming bytes into shorter timestamped sequences. A block header attached to each sequence stores the channel index, length, and the time of reception of each message. These parser-aligned packets may be transmitted aperiodically to optimize network bandwidth utilization and memory usage when recording serial traffic.

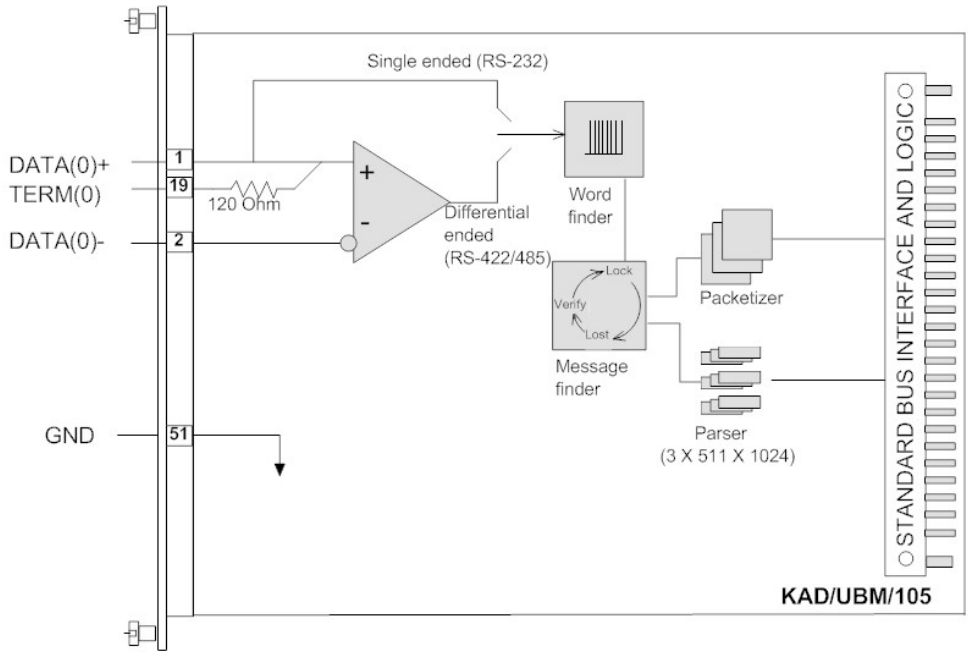


Figure 1: First of 12 channels of the KAD/UBM/105

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	75	–	g	
	–	2.64	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	200	–	233	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	1.00	–	1.17	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

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TABLE 2	RS-422/RS-485 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	12	–	
Signalling rate					
DATA	0.0003	–	5	Mbps	NRZ-L.
Input voltage					
operating range	-15	–	15	V	Do not exceed operating range.
logic 0	–	–	0.2	V	(190mV hysteresis) V_{IN+} - V_{IN-}.
logic 1	0.2	–	–	V	(190mV hysteresis) V_{IN+} - V_{IN-}.
common mode voltage	-7	–	12	V	
overvoltage protection	-15	–	15	V	Voltage in excess of these values can damage input.
ESD protection	–	16	–	kV	Human Body Model.
Input resistance					
between inputs	–	250	–	kΩ	Module powered up and no input termination.
between inputs	–	260	–	kΩ	Module powered down and no input termination.
between inputs	–	120	–	Ω	Module powered up and inputs terminated with external or internal termination resistor.
between inputs	–	120	–	Ω	Module powered down and inputs terminated with external termination resistor.

TABLE 3	RS-232 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	12	–	
Signaling rate					
DATA[15:0]	0.0003	–	0.5	Mbps	
Input voltage					
operating range	-15	–	15	V	Do not exceed operating range.
logic 0	2.5	–		V	
logic 1		–	0.6	V	
overvoltage protection	-15	–	15	V	Voltages outside of this range can damage input.
ESD protection	16	–	16	kV	Human Body Model.
Input resistance					
each input to GND	–	5	–	kΩ	Module powered on.
each input to GND	–	130	–	kΩ	Module powered off.

Setting up the KAD/UBM/105

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/UBM/105	KAD/UBM/105	The instrument part reference.
SerialNumber	AAA1234	AAA1234	Unique name for each module.
Settings	-	-	-
Parser Data Endianness	First byte at low end of word First byte at high end of word	First byte at low end of word	Select byte order in data field of parser slot.
Fill Value	0000 to FFFF	AAAA	Value used to fill empty parser slots.
Processes	-	-	-
Parser(510:0)	-	-	-
Channels	-	-	-
Serial-In(11:0) Serial Input	-	-	Connection between the module channel and RS-232/422/485 data bus.
Settings Serial Interface	-	-	-
Signal Type	RS-232 RS-422 RS-485	RS-422	Type of data stream.
Baud Rate	300 to 5000000	9600	Specifies the number of symbols transmitted per second.
Data Bits Per Word	7 8	8	Bits per incoming data word. Two incoming words are packed into a single 16-bit output word.
Parity	No Parity Even Parity Odd Parity	No Parity	Configure whether parity bit is present in incoming data.
Parity Check	Report failure Report failure and off-set	Report failure	Configure how parity failures are reported. Note: fail-ure offset is only available in packetizer output.
Gap Between Messages	0 to 10000	10	Time gap between consecutive characters required before starting new message. Value expressed in unit of character periods at configured bit rate. Set to 0 to ignore all gaps.
Programmable Termination	Disabled Enabled	Disabled	Enable internal 120-ohm termination resistance. (Note: not active when power is disabled. Use wiring selectable termination instead if termination is required at all times.)
Settings Packetizer	-	-	-
Stream Id	00000000 to FFFFFFFF	FFFFFFFF	iNET-X stream ID for selected channel if a packet is generated via the assertion of Packetization Enabled. This setting is only supported in DAS Studio 3.
Packetization Enabled	True False	False	Enables the transmission of an iNET-X packet con-taining the contents of this channel if an iNET-X transmitter is present in the chassis. This setting is only supported in DAS Studio 3.

SETUP DATA	CHOICE	DEFAULT	NOTES
Packet Size	200 to 511	511	Size of packet buffer in words.
Packet Timeout	10 to 999	50	Generate a packet when the oldest data recorded is this old (ms).
Utilization	0.01 to 1.00	1.00	Can be used to schedule less packets when incoming message rates are known to be less than maximum. Expressed as a decimal, that is, 1.00 = 100% utilization.
One Message Per Packet	True False	False	Set to True to limit packets to one parser block. After each gap, the next message starts a new packet. Only use this setting if the number of packets scheduled exceeds the number of messages expected and the maximum size message is less than the Packet Size.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Report Indicates the status of the monitor.	BitVector	BitVector	16	R[15:0] R(15) ErrorIndicator - 1 indicates an error occurred since last read. R[14:11] BusNumber - The bus the error occurred on. R[10:4] Reserved - Reserved for future use. R[3:0] ErrorCodes - Each bit set indicates that a particular error occurred since report word last read. After the report word has been read, further reads return the last non-zero error code with the ErrorIndicator bit not set. 0001: Parity error. 0010: Bad stop bit. 0100: Too many data words. Stop character not found in 1024 characters. Other: Reserved for future use.
ModuleMessageCount Increments by one each time the parser logic detects a complete message.	BitVector	BitVector	16	R[15:0]
Parser(510:0) Parameters				
MessageSize Number of received bytes (including start bytes, for example, 1 + 8 = 9 bytes in a message). Minimum length of message is 2 bytes (1 byte of start sequence plus 1 stop byte or at least 1 byte in case of fixed length message).	Count	OffsetBinary	16	R[15:0]
MessageIrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageTimeHi Hours and minutes time midway through first transmitted bit.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
MessageTimeLo Seconds and centiseconds time midway through first transmitted bit.	BitVector	BitVector	16	R[31:16] R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.
MessageTimeMicro Microsecond time midway through first transmitted bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - BCD Microseconds 0 to 9999.
MessageCount Received message count.	Count	OffsetBinary	16	R[15:0]
MessageInfo Stale/skipped indication for this parsed message.	BitVector	BitVector	16	R[15:0] R(15) Empty - ID is empty (no message received). R(14) Stale - 1 indicates this message was read before. R(13) Skipped - 1 indicates this message overwrote another. R[12:0] Reserved - Reserved for future use.
Serial-In(11:0) Parameters				
ChannelMessageCount Increments by one each time the parser logic detects a complete message.	BitVector	BitVector	16	R[15:0]
ChannelByteCount Count of bytes received on this bus.	Count	OffsetBinary	16	R[15:0]
ChannelErrCount Count of errors detected on this bus.	BitVector	BitVector	16	R[15:0]

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/UBM/105

Each of the 12 bus connections can be independently selected as RS-232, RS-422 or RS-485. For RS-232 (single ended), use a DATA(x)+ pin and leave the corresponding DATA(x)- pin unconnected. Both data pins are required when a differential mode is selected (RS-422 or RS-485).

The following figure shows how to optionally terminate the RS-422 and RS-485 receivers by using the internal termination resistor provided on the module (TERM[x] pin). It is important to ground each source of RS-232, RS-422 or RS-485. Star grounding provides optimal noise rejection. For details on grounding, see *TEC/NOT/063 - Grounding and shielding of the Axon and Acra KAM-500*.

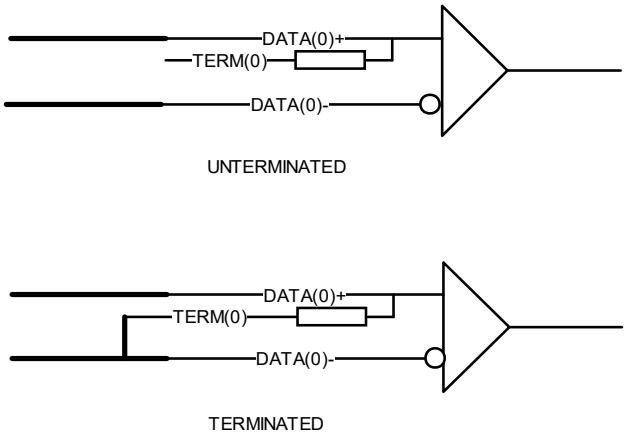


Figure 2: Optional RS-422/RS-485 third pin termination

Maximum message length

The maximum message length is 1,024 bytes. This length includes the bytes used for the start pattern and the end byte (if an end byte is used).

Parser Data Endianness example

With ABCD characters being transmitted, setting Parser Data Endianness to:

First byte at low end of word - module outputs DW0 = AB and DW1 = CD

First byte at high end of word - module outputs DW0 = BA and DW1 = DC

Error codes

CODE[1]	DESCRIPTION
1_{16}	Parity error.
2_{16}	Bad stop bit.
4_{16}	Last character not found in 1.024 characters (in report word only; not in packetizer error code).
0_{16}, 3_{16}, 5_{16}, 6_{16}, 7_{16}	Reserved for future use.

1. Error codes are in hexadecimal.

Parser slot count

If any channel is configured with a rate higher than 1 MHz, the total number of parser slots that can be set up is reduced as shown in the following table.

MAXIMUM BIT-RATE CONFIGURED	AVAILABLE PARSER SLOT COUNT
<1 Mbps	511
1-2 Mbps	440
2-4 Mbps	160
4-5 Mbps	96

Packetizer format

The KAD/UBM/105 recognizes bytes as having a start bit, data bits (seven or eight, programmable), a parity bit (optional), and a stop bit. The KAD/UBM/105 gathers groups of bytes into standard iNET-X parser-aligned blocks. Each output packet can contain multiple blocks. If configured to receive 7-bit bytes, each byte is padded to 8 bits using a zero at the most significant bit before saving. The generalized iNET-X payload structure for parser-aligned packets is shown in Figure 3 on page 874 and examples of parser block formats are shown in Figure 4 on page 875.

A parser block is created for each logical message, based on the gaps between sequences of bytes. A new parser block is created at the start of each iNET-X packet and also when the time gap between successive bytes exceeds a programmable threshold.

The gap time threshold is programmed in characters. By setting the threshold value to just under the minimum gap time allowable between messages (under the protocol being used), it is possible to correctly split the bytes of the incoming stream into individual messages, as required. If multiple messages are received back-to-back, in a burst with no such gap, they are packetized as a single message. Conversely, if a single message continues past the end of one packet with no

gap, the succeeding bytes are packetized in a new parser block in the next packet. A bit in the header of the first parser block, in the following packet, is set to indicate that this block is a continuation of the message in the final block of the previous packet. The location of this continuation bit is marked Cn in the example parser blocks in Figure 4 on page 875.

If a 0 µs threshold is set, gaps are not detected, and in the absence of errors, each iNET-X packet contains a single parser block whose length is controlled by the packet timeout and size settings selected.

The Error Code field for the parser block indicates whether any error was detected.

If parity error detection is enabled, the parity bit for each byte is checked but not recorded. If error reporting is enabled, the error code is reported in the parser block header, and optionally, an extra quadbyte can be suffixed to the parser block indicating the byte offset of the first error. There may be additional errors at locations past this offset.

NOTE: Additional packetized messages that contain one zero value byte can occur when there is noise on the incoming signal lines. These may be marked as errors, depending on the parity and error detection settings.

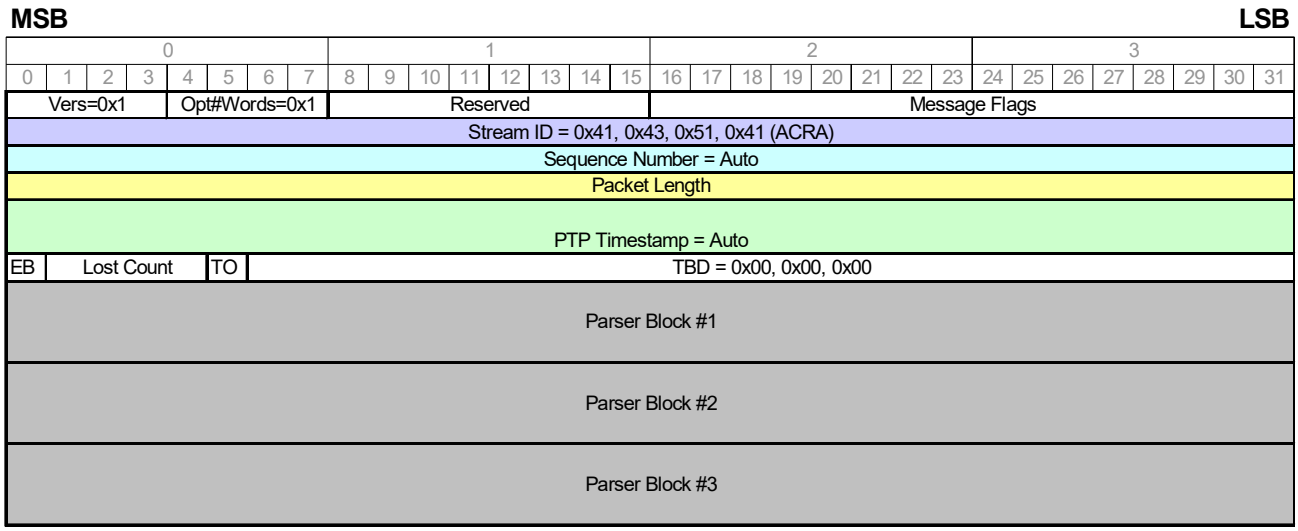
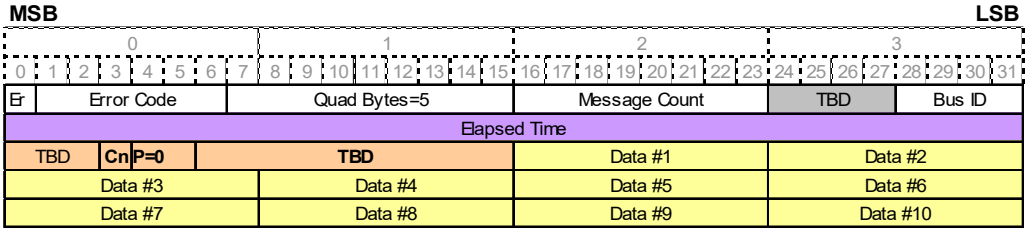


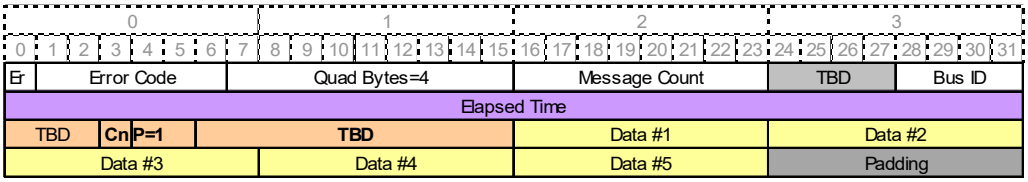
Figure 3: Generalized parser-aligned iNET-X packet

Parser blocks example

UART message parser block (10 characters of data)

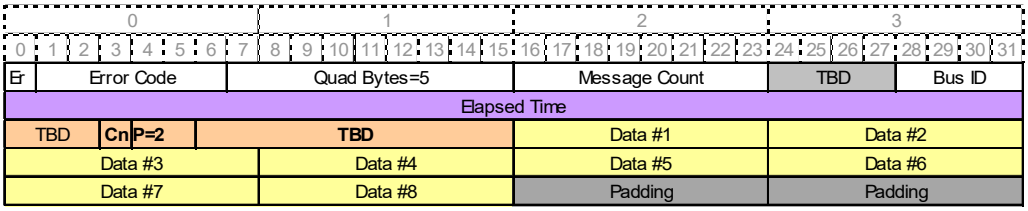


UART message parser block (5 characters of data with 1 byte padding)

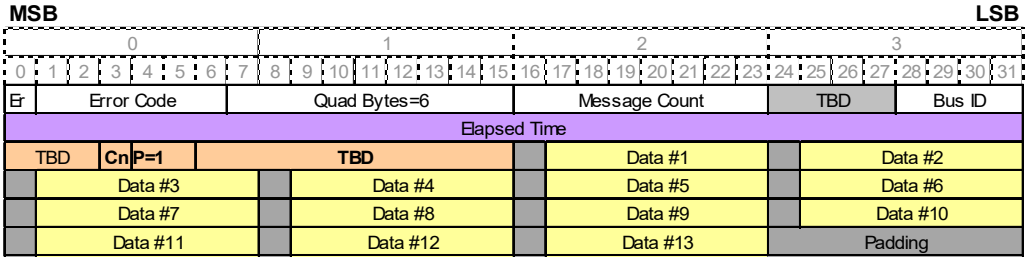


UART = Universal Asynchronous Receiver Transmitter)

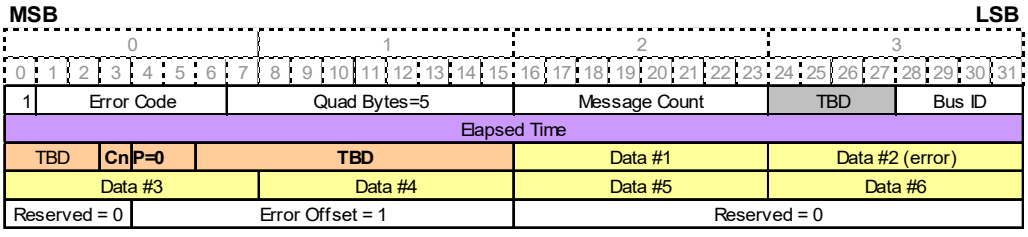
UART Message Parser Block (8 characters of data with 2 bytes padding)



UART Message Parser Block (13 characters of data (7 bits per character), 1 byte padding)



UART message parser block (6 characters of data, parity error in second byte; location reported by adding extra quadword)



P = Number of padding bytes added to complete final quadbyte to 32 bits
Cn = Continuation Indicator (1 = this block continues the block that ended the previous packet.)

Figure 4: Parser block formats used in packetizer

Connector pinout of the KAD/UBM/105

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DATA(0)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
2	DATA(0)-	RS-422/RS-485 inputs	Data in; connect to pin 19 for 120Ω termination
3	DATA(1)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
4	DATA(1)-	RS-422/RS-485 inputs	Data in; connect to pin 21 for 120Ω termination
5	DATA(2)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
6	DATA(2)-	RS-422/RS-485 inputs	Data in; connect to pin 23 for 120Ω termination
7	DATA(3)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
8	DATA(3)-	RS-422/RS-485 inputs	Data in; connect to pin 25 for 120Ω termination
9	DNC		Do not connect
10	DNC		Do not connect
11	DNC		Do not connect
12	DNC		Do not connect
13	DATA(6)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
14	DATA(6)-	RS-422/RS-485 inputs	Data in; connect to pin 31 for 120Ω termination
15	TERM(7)	RS-422/RS-485 inputs	Connect to pin 16 for 120Ω termination
16	DATA(7)-	RS-422/RS-485 inputs	Data in; connect to pin 15 for 120Ω termination
17	DNC		Do not connect
18	GND	Internal ground	
19	TERM(0)	RS-422/RS-485 inputs	Connect to pin 2 for 120Ω termination
20	DNC		Do not connect
21	TERM(1)	RS-422/RS-485 inputs	Connect to pin 4 for 120Ω termination
22	TERM(10)	RS-422/RS-485 inputs	Connect to pin 40 for 120Ω termination
23	TERM(2)	RS-422/RS-485 inputs	Connect to pin 6 for 120Ω termination
24	TERM(11)	RS-422/RS-485 inputs	Connect to pin 42 for 120Ω termination
25	TERM(3)	RS-422/RS-485 inputs	Connect to pin 8 for 120Ω termination
26	TERM(4)	RS-422/RS-485 inputs	Connect to pin 44 for 120Ω termination
27	DNC		Do not connect
28	TERM(5)	RS-422/RS-485 inputs	Connect to pin 46 for 120Ω termination
29	DNC		Do not connect
30	TERM(8)	RS-422/RS-485 inputs	Connect to pin 48 for 120Ω termination
31	TERM(6)	RS-422/RS-485 inputs	Connect to pin 14 for 120Ω termination
32	TERM(9)	RS-422/RS-485 inputs	Connect to pin 50 for 120Ω termination
33	DATA(7)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
34	DNC		Do not connect
35	DNC		Do not connect
36	GND	Internal ground	
37	DNC		Do not connect
38	DNC		Do not connect
39	DATA(10)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
40	DATA(10)-	RS-422/RS-485 inputs	Connect to pin 22 for 120Ω termination
41	DATA(11)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
42	DATA(11)-	RS-422/RS-485 inputs	Connect to pin 24 for 120Ω termination
43	DATA(4)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
44	DATA(4)-	RS-422/RS-485 inputs	Connect to pin 26 for 120Ω termination
45	DATA(5)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
46	DATA(5)-	RS-422/RS-485 inputs	Connect to pin 28 for 120Ω termination
47	DATA(8)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
48	DATA(8)-	RS-422/RS-485 inputs	Connect to pin 30 for 120Ω termination
49	DATA(9)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
50	DATA(9)-	RS-422/RS-485 inputs	Connect to pin 32 for 120Ω termination
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/UBM/105	RS-232, RS-422, or RS-485 high data rate up to 5 Mbps serial bus parser/packetizer -12ch

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/UBM/105	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
TEC/NOT/063	Grounding and shielding of the Axon and Acra KAM-500
TEC/NOT/079	Using the KAD/UBM/103

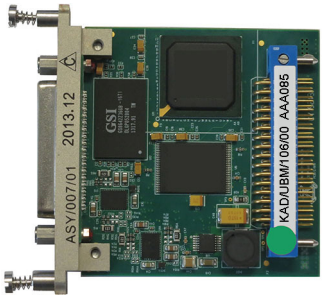
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/UBM/106

RS-232, RS-422 or RS-485 serial bus snarfer - 16ch

CURTISSWRIGHTDS.COM



Key Features

- Monitors up to 16 RS-422/485/232 busses
- 1 KB buffer per channel (snarfer)
- Bit-rates from 300 bps to 1,000,000 bps
- 7/8 bits per word with odd, even or no parity

Applications

- Interfacing with serial data links

Overview

The KAD/UBM/106 is used to monitor up to 16 RS-232/422/485 channels. The module can snarf (send all data to a FIFO) up to 16 RS-232/422/485 channels. The module is able to snarf each channel at the same time.

The signal type (RS-232/422/485), bits per word, and parity are programmable on a channel-by-channel basis.

The snarfer stores all data from each bus in a separate FIFO 1 KB deep. The FIFO is read via the Acra KAM-500 backplane. Each received data byte can be read once from the FIFO. If the FIFO contains data, a fresh data flag is set in the 16-bit word read from the snarfer. If the FIFO is empty, then the fresh data flag is cleared and the data bits are filled with zeros.

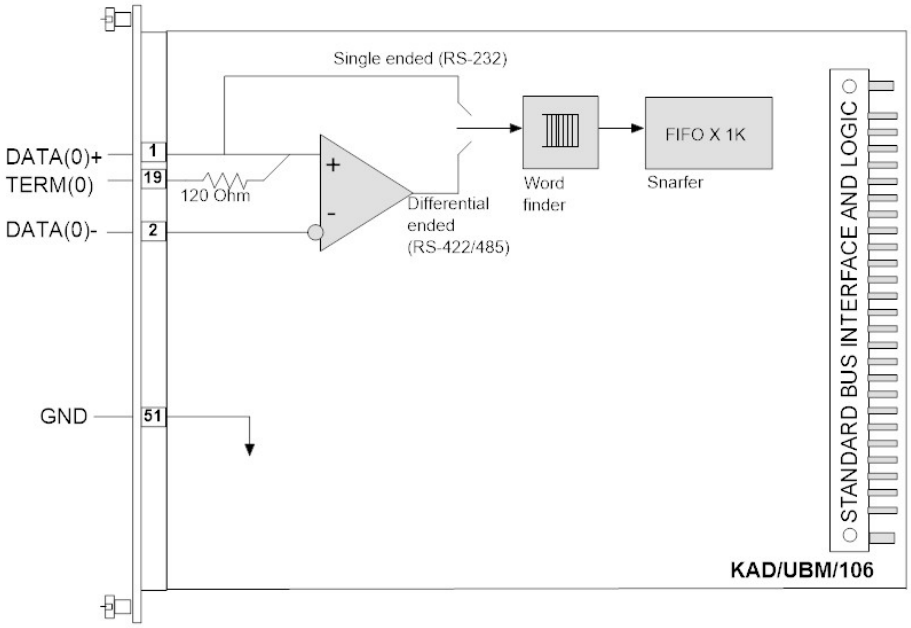


Figure 1: First of 16 channels of the KAD/UBM/106

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	75	–	g	
	–	2.64	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	–	230	260	mA	
±7V	–	0	0	mA	
±12V	–	0	0	mA	
total power	–	1.15	1.30	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

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TABLE 2	RS-422/RS-485 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	16	–	
Signalling rate					
DATA	0.0003	–	1	Mbps	NRZ-L.
Input voltage					
operating range	-15	–	15	V	Do not exceed operating range.
logic 0	–	–	0.2	V	(190mV hysteresis) V_{IN+} - V_{IN-}.
logic 1	0.2	–	–	V	(190mV hysteresis) V_{IN+} - V_{IN-}.
common mode voltage	-7	–	12	V	
overvoltage protection	-15	–	15	V	Voltage in excess of these values can damage input.
ESD protection	–	16	–	kV	Human Body Model.
Input resistance					
between inputs	–	250	–	kΩ	Module powered up and no input termination.
between inputs	–	260	–	kΩ	Module powered down and no input termination.
between inputs	–	120	–	Ω	Module powered up and inputs terminated with external or internal termination resistor.
between inputs	–	120	–	Ω	Module powered down and inputs terminated with external termination resistor.

TABLE 3	RS-232 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	16	–	
Signaling rate					
DATA[15:0]	0.0003	–	1	Mbps	
Input voltage					
operating range	-15	–	15	V	Do not exceed operating range.
logic 0	–	–	0.6	V	
logic 1	2.5	–	–	V	
overvoltage protection	-15	–	15	V	Voltages outside of this range can damage input.
ESD protection	16	–	16	kV	Human Body Model.
Input resistance					
each input to GND	–	5	–	kΩ	Module powered up.
each input to GND	–	130	–	kΩ	Module powered down.

Setting up the KAD/UBM/106

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/UBM/106	KAD/UBM/106	The instrument part reference.
SerialNumber	AAE1234	AAE1234	Unique name for each module.
Settings	-	-	-
Fill Value	0000 to FFFF	0000	Value used to fill empty snarfer data (8 least significant bits of Fill Value only).
Channels	-	-	-
Serial-In(15:0) *Serial Input*	-	-	Connection between the module channel and RS-232/422/485 data bus.
Settings *Serial Interface*	-	-	-
Signal Type	RS-232 RS-422 RS-485	RS-422	Type of data stream.
Baud Rate	300 to 1000000	9600	Specifies the number of symbols transmitted per second.
Data Bits Per Word	7 8	8	Bits per incoming data word. Two incoming words are packed into a single 16-bit output word.
Parity	No Parity Even Parity Odd Parity	No Parity	Configure whether parity bit is present in incoming data.
Programmable Termination	Disabled Enabled	Disabled	Enable internal 120-ohm termination resistance. (Note: not active when power is disabled. Use wiring selectable termination instead if termination is required at all times.)
MSB First	True False	False	LSB of each character is usually transmitted first. Enable this setting if the MSB is transmitted first.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Report Indicates the status of the monitor.	BitVector	BitVector	16	R[15:0] R(15) ErrorIndicator - 1 indicates an error occurred since last read. R[14:11] BusNumber - The bus the error occurred on. R[10:4] Reserved - Reserved for future use. R[3:0] ErrorCodes - Each bit set indicates that a particular error occurred since report word last read. After the report word has been read, further reads return the last non-zero error code with the ErrorIndicator bit not set. 0001: Parity error. 0010: Bad stop bit. Other: Reserved for future use.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Serial-In(15:0) Parameters				
ChannelByteCount Count of bytes received on this bus.	Count	OffsetBinary	16	R[15:0]
ChannelErrCount Count of errors detected on this bus.	BitVector	BitVector	16	R[15:0]
Snarfer Snarfer Register	BitVector	BitVector	16	R[15:0] R[15:8] FifoData - The 8/7 bits received. R(15) is the First Bit Transmitted if MSB First setting is true, R(8) is the First Bit Transmitted if MSB First setting is false. R(7) FifoFresh - 1 indicates the FIFO data is a new value R(6) FifoWasFull - 1 indicates the FIFO was full R[5:0] Reserved - Reserved for future use

NOTE: It is recommended that names do not contain any of the following five characters "/><\.

Getting the most from the KAD/UBM/106

Each of the 16 bus connections can be independently selected as RS-232, RS-422 or RS-485. For RS-232 (single ended), use a DATA(x)+ pin and leave the corresponding DATA(x)- pin unconnected. Both data pins are required when a differential mode is selected (RS-422 or RS-485).

The following figure shows how to optionally terminate the RS-422 and RS-485 receivers by using the internal termination resistor provided on the module (TERM[x] pin). It is important to ground each source of RS-232, RS-422 or RS-485. Star grounding provides optimal noise rejection. For details on grounding, see *TEC/NOT/063 - Grounding and shielding of the Axon and Acra KAM-500*.

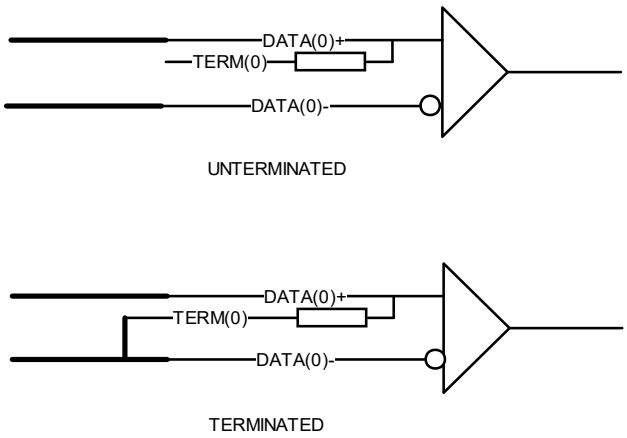


Figure 2: Optional RS-422/RS-485 third pin termination

Snarfer example

The KAD/UBM/106 snarfer is implemented in a 1 KB FIFO. The following example shows how data is set.

Settings are as follows:

- Transmitter 8 data bits with value 0xCB (1100 1011)
- MSB first set to False
- EVEN parity
- 1 stop bit

The following output on consecutive 10-bit PCM words from the relevant channel of the KAD/UBM/106.

>…| 0000 0000 00 | 1100 1011 10 | 0000 0000 00 | …

>…| Before sample | byte sampled | After sample | …

- Bits 15:8 – the byte on the serial line or 0x00 fill data if FIFO Fresh flag is cleared (this means the FIFO is empty)
- Bit 7 – FIFO Fresh bit flag indicator (high if byte is fresh – low if byte is a fill word due to empty FIFO)
- Bit 6 – FIFO Was Full bit flag (high if FIFO data is first fresh word after overflow)
- Bits 5:0 – don't care

Sampling requirements

In order to snarf 100% of the traffic in the serial bus and avoid a buffer overflow, a sampling frequency higher than the maximum incoming traffic is required. In order to calculate this rate, the incoming serial bit-rate, maximum expected burst of data (if known), buffer size (1 KB) and additional bits (parity/stop bits) need to be taken into account.

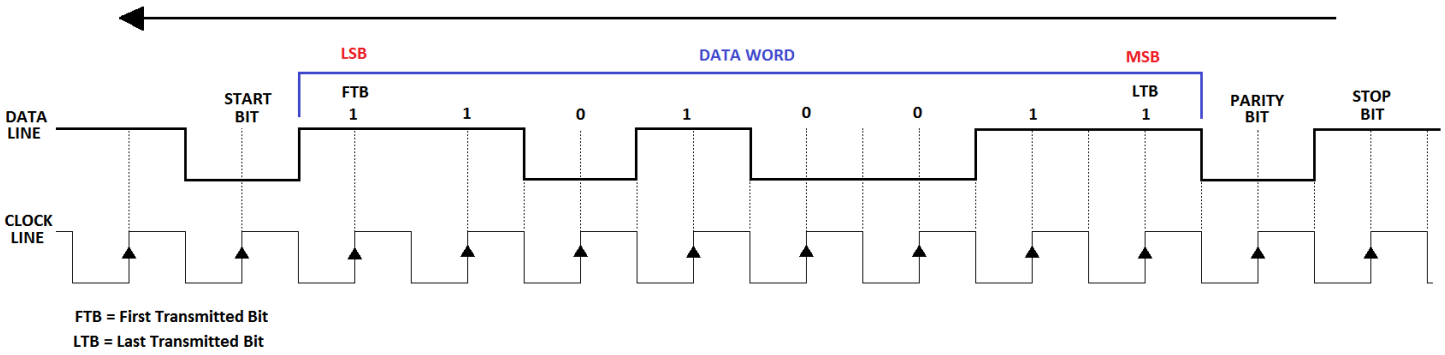


Figure 3: Example: sending 0xCB as 8-bit payload

Error codes

Code[1]	DESCRIPTION
1_{16}	Parity error.
2_{16}	Bad stop bit.
0_{16}, 3_{16}, 4_{16} 5_{16}, 6_{16}, 7_{16}	Reserved for future use.

1. Error codes are in hexadecimal.

Connector pinout of the KAD/UBM/106

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DATA(0)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
2	DATA(0)-	RS-422/RS-485 inputs	Data in; connect to pin 19 for 120Ω termination
3	DATA(1)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
4	DATA(1)-	RS-422/RS-485 inputs	Data in; connect to pin 21 for 120Ω termination
5	DATA(2)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
6	DATA(2)-	RS-422/RS-485 inputs	Data in; connect to pin 23 for 120Ω termination
7	DATA(3)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
8	DATA(3)-	RS-422/RS-485 inputs	Data in; connect to pin 25 for 120Ω termination
9	DATA(4)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
10	DATA(4)-	RS-422/RS-485 inputs	Data in; connect to pin 27 for 120Ω termination
11	DATA(5)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
12	DATA(5)-	RS-422/RS-485 inputs	Data in; connect to pin 29 for 120Ω termination
13	DATA(6)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
14	DATA(6)-	RS-422/RS-485 inputs	Data in; connect to pin 31 for 120Ω termination
15	TERM(7)	RS-422/RS-485 inputs	Connect to pin 16 for 120Ω termination
16	DATA(7)-	RS-422/RS-485 inputs	Data in; connect to pin 15 for 120Ω termination
17	DATA(8)-	RS-422/RS-485 inputs	Data in; connect to pin 34 for 120Ω termination
18	GND	Internal ground	
19	TERM(0)	RS-422/RS-485 inputs	Connect to pin 2 for 120Ω termination
20	TERM(9)	RS-422/RS-485 inputs	Connect to pin 38 for 120Ω termination
21	TERM(1)	RS-422/RS-485 inputs	Connect to pin 4 for 120Ω termination
22	TERM(10)	RS-422/RS-485 inputs	Connect to pin 40 for 120Ω termination
23	TERM(2)	RS-422/RS-485 inputs	Connect to pin 6 for 120Ω termination
24	TERM(11)	RS-422/RS-485 inputs	Connect to pin 42 for 120Ω termination
25	TERM(3)	RS-422/RS-485 inputs	Connect to pin 8 for 120Ω termination
26	TERM(12)	RS-422/RS-485 inputs	Connect to pin 44 for 120Ω termination
27	TERM(4)	RS-422/RS-485 inputs	Connect to pin 10 for 120Ω termination
28	TERM(13)	RS-422/RS-485 inputs	Connect to pin 46 for 120Ω termination
29	TERM(5)	RS-422/RS-485 inputs	Connect to pin 12 for 120Ω termination
30	TERM(14)	RS-422/RS-485 inputs	Connect to pin 48 for 120Ω termination
31	TERM(6)	RS-422/RS-485 inputs	Connect to pin 14 for 120Ω termination
32	TERM(15)	RS-422/RS-485 inputs	Connect to pin 50 for 120Ω termination
33	DATA(7)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
34	TERM(8)	RS-422/RS-485 inputs	Connect to pin 17 for 120Ω termination
35	DATA(8)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
36	GND	Internal ground	
37	DATA(9)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
38	DATA(9)-	RS-422/RS-485 inputs	Connect to pin 20 for 120Ω termination
39	DATA(10)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
40	DATA(10)-	RS-422/RS-485 inputs	Connect to pin 22 for 120Ω termination
41	DATA(11)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
42	DATA(11)-	RS-422/RS-485 inputs	Connect to pin 24 for 120Ω termination
43	DATA(12)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
44	DATA(12)-	RS-422/RS-485 inputs	Connect to pin 26 for 120Ω termination
45	DATA(13)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
46	DATA(13)-	RS-422/RS-485 inputs	Connect to pin 28 for 120Ω termination
47	DATA(14)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
48	DATA(14)-	RS-422/RS-485 inputs	Connect to pin 30 for 120Ω termination
49	DATA(15)+	RS-422/RS-485 inputs, RS-232 inputs	Data in
50	DATA(15)-	RS-422/RS-485 inputs	Connect to pin 32 for 120Ω termination
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/UBM/106	RS-232, RS-422 or RS-485 serial bus snarfer - 16ch

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/UBM/106	First release	Recommended for new programs

Supporting software

SOFTWARE	DIFFERENCES
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
TEC/NOT/063	Grounding and shielding of the Axon and Acra KAM-500

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This document was reviewed on 14/10/2020 and does not contain technical data.

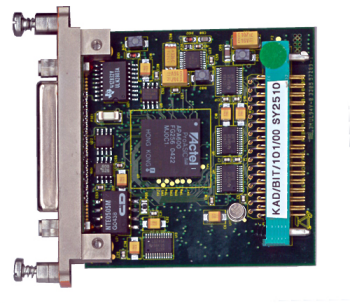
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KAD/BIT/101

Built-in self test module

CURTISSWRIGHTDS.COM



Key Features

- Provide up to 120 window functions (limit checking); up to 32 parameters can be sent to each window function
- Monitors voltage, temperature, format running and address checksum
- Counts number of power-ons and total time powered on
- 4 x 3 types of status output (TTL, LED and doll's eyes)
- Selected errors transmitted in First In First Out (FIFO) with optional time tagging and via RS-422

Applications

- System monitoring

Overview

The KAD/BIT/101 is a Continuous Built-In Test module (CBIT) which checks the Acra KAM-500 backplane to verify correct system operation.

The KAD/BIT/101 measures the precise value of the ±12V, ±7V, and +5V power lines to ensure they are within specifications. Temperature sensors are located at the top block and the center of the module to allow the measurement of both the chassis top block temperature and the chassis internal temperature.

The KAD/BIT/101 checks that the current acquisition cycle is a valid format, measures the duration of each acquisition cycle, and performs a checksum of all addresses transferred on the backplane to ensure the correct operation of the current format.

The KAD/BIT/101 can be used to check both analog signal conditioning modules and bus monitor modules in a chassis. Channels on analog signal conditioning modules are checked to confirm that the signal stays within a minimum and maximum value. The KAD/BIT/101 can check the status register from each bus monitor module in the chassis to indicate when an error occurs.

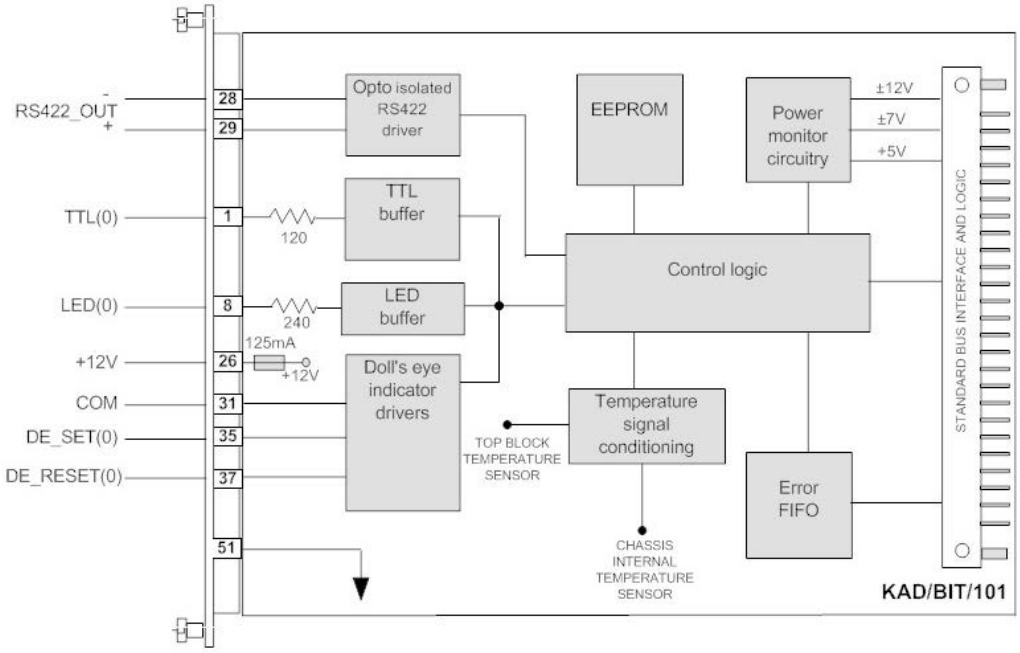


Figure 1: First of each of the four status outputs for KAD/BIT/101

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					Design metric is grams.
	–	70	–	g	
	–	2.47	–	oz	
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	Design metric is millimeters.
bare connector	–	–	0.43	in.	
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	85	–	140	mA	Excludes current used by TTL, LED and RS-422 outputs.
±7V	0	–	0	mA	
+12V	5	–	20	mA	Excludes current sourced from +12V excitation for doll’s eye indicators.
-12V	5	–	10	mA	
total power	0.55	–	1.06	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	BTTL outputs (TTL)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	4	–	
Signaling rate					
TTL[3:0]	–	–	5	Hz	
Output voltage					
logic 0	–	–	0.1	V	Sinking 0.1mA.
logic 1	4.4	–	–	V	Sourcing 0.1mA.
short circuit current	–	–	50	mA	Only one output may be shorted at a time.
short circuit duration	∞	–	–	s	To GND.
Output resistance	–	140	–	Ω	

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TABLE 3	BTTL outputs (LED)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	4	–	
Signaling rate					
LED[3:0]	–	–	5	Hz	
Output voltage					
logic 0	–	–	0.1	V	Sinking 0.1mA.
logic 1	4.4	–	–	V	Sourcing 0.1mA.
short circuit current	–	–	50	mA	Only one output may be shorted at a time.
short circuit duration	∞	–	–	s	To GND.
Output resistance	–	260	–	Ω	

TABLE 4	RS-422 outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	1	–	
Signaling rate					
RS-422 OUT	9,600	–	115,200	bps	
Output voltage					
absolute operating range	-5	–	5	V	Absolute voltage of the operating signal must stay within this range.
logic 0	–	–	-3	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
logic 1	3	–	–	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
common mode voltage	2.2	–	3.3	V	
short circuit current	–	–	250	mA	
short circuit duration	–	–	1	s	
ESD protection	16	–	–	kV	Human Body Model.
Output resistance	–	20	–	Ω	

TABLE 5	Open collector outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	4	–	Four pairs of DE_SET(x) and DE_RESET(x).
Signaling rate					
DE_SET[3:0]	–	–	2	Hz	
DE_RESET[3:0]	–	–	2	Hz	
Output voltage					
logic 0	–	0.9	–	V	Sinking 100mA.
logic 1	–	–	–	V	High impedance (open collector).
Output resistance	–	2	–	Ω	Equivalent dynamic resistance when sinking 100mA.

TABLE 6	Single ended DC voltage excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	1	–	
Output voltage					
operating range	11.6	12	12.2	V	Connected via 125mA fast-acting fuse from internal +12V supply rail.
compliance	–	–	125	mA	
short circuit current	–	–	1,000	mA	Drawing this current causes the fuse to blow within 1ms.
short circuit duration	–	–	0	s	Short of this output causes protection fuse to blow. As the fuse is soldered on the PCB, the module must be returned to Curtiss-Wright support (acra-support@curtisswright.com) for fuse replacement.
Output resistance	–	2	–	Ω	

Setting up the KAD/BIT/101

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/BIT/101	KAD/BIT/101	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Settings	-	-	-
Baud Rate	9600 115200	9600	Baud rate of RS-422 data stream.
FIFO Select	None Micro Only High Low Micro	High Low Micro	Format of time tag stored in FIFO with ERROR_CODE
Settings Dolls Eye Polarity	-	-	Active position of Dolls Eye.
Dolls Eye 0	Active Set Active Reset	Active Set	Active position of Dolls Eye 0.
Dolls Eye 1	Active Set Active Reset	Active Set	Active position of Dolls Eye 1.
Dolls Eye 2	Active Set Active Reset	Active Set	Active position of Dolls Eye 2.
Dolls Eye 3	Active Set Active Reset	Active Set	Active position of Dolls Eye 3.
Settings LED Polarity	-	-	Active level of LED outputs.
LED 0	Active Low Active High	Active High	Active level of LED output 0.
LED 1	Active Low Active High	Active High	Active level of LED output 1.
LED 2	Active Low Active High	Active High	Active level of LED output 2.
LED 3	Active Low Active High	Active High	Active level of LED output 3.
Settings TTL Polarity	-	-	Active level of TTL outputs.
TTL 0	Active Low Active High	Active High	Active level of TTL output 0.
TTL 1	Active Low Active High	Active High	Active level of TTL output 1.
TTL 2	Active Low Active High	Active High	Active level of TTL output 2.
TTL 3	Active Low Active High	Active High	Active level of TTL output 3.
Processes	-	-	-
Event(127:0)	-	-	Configuration for each event generator.

SETUP DATA	CHOICE	DEFAULT	NOTES
Settings Event Settings	-	-	Event algorithm settings.
Trigger Condition	Algorithm Reference Alarm Boolean-Simple	MyTriggerCondition	A reference to an algorithm that defines the valid conditions for this event. Parameter values that do not satisfy this condition trigger the outputs.
Output 0	Off On	Off	Activate bit 0 of output when Trigger Condition value is false.
Output 1	Off On	Off	Activate bit 1 of output when Trigger Condition value is false.
Output 2	Off On	Off	Activate bit 2 of output when Trigger Condition value is false.
Output 3	Off On	Off	Activate bit 3 of output when Trigger Condition value is false. This setting also enables writing error events to the FIFO.
Sample Rate	1 to 100000	1	Number of times per second (Hz) the event is checked.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
+12V 16-bit value of +12V power line on chassis backplane. Calculate voltage using formula in "Getting the most from" section of data sheet.	Volt	OffsetBinary	16	R[15:0]
-12V 16-bit value of -12V power line on chassis backplane. Calculate voltage using formula in "Getting the most from" section of data sheet.	Volt	OffsetBinary	16	R[15:0]
+7V 16-bit value of +7V power line on chassis backplane. Calculate voltage using formula in "Getting the most from" section of data sheet.	Volt	OffsetBinary	16	R[15:0]
-7V 16-bit value of -7V power line on chassis backplane. Calculate voltage using formula in "Getting the most from" section of data sheet.	Volt	OffsetBinary	16	R[15:0]

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
5V 16-bit value of +5V power line on chassis backplane. Calculate voltage using formula in "Getting the most from" section of data sheet.	Volt	OffsetBinary	16	R[15:0]
InternalTemperature Internal chassis temperature BCD ratio. Calculate temperature using formula in "Getting the most from" section of data sheet.	Celsius	BCD	16	R[15:0]
ChassisTemperature Chassis temperature BCD ratio, measured at top block. Calculate temperature using formula in "Getting the most from" section of data sheet.	Celsius	BCD	16	R[15:0]
BackplaneTicks Count of 8MHz clock ticks in the previous backplane acquisition cycle. Counts from 0.	Count	OffsetBinary	32	R[31:0] R[31:16] Ticks_Hi R[15:0] Ticks_Lo
CurrentFormat Current backplane format. Note: This parameter is internal to the module only. It can be applied to an algorithm Trigger Condition but its value cannot be read or placed.	BitVector	BitVector	16	R[15:0]
Status Status output changes since last read.	BitVector	BitVector	16	R[15:0] R[15:12] Reserved R(11) EepromAccessError R[10:4] Reserved R[3:0] STS - Current value of 4 status bits, with all changes OR'd in.
FifoError Error Code	BitVector	BitVector	16	R[15:0] R[15:14] Reserved R(13) FifoFull R(12) FifoEmpty R[11:7] ParameterID R[6:0] FunctionID
FifoTime 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
FifoTimeHi Hours and minutes time midway through first transmitted bit.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
FifoTimeLo Seconds and centiseconds time midway through first transmitted bit.	Second	BCD	16	R[31:16] R(15) Reserved - Reserved for future use. R[14:8] Seconds - Seconds 0 to 59. R[7:0] Centiseconds - Centiseconds 0 to 99.
FifoTimeMicro Microseconds time midway through first transmitted bit.	Second	BCD	16	R[15:0] R[15:0] Microseconds - Microseconds 0 to 9999.
ErrorCounter Count of error messages generated.	Count	OffsetBinary	16	R[15:0]
PowerUpCount Number of times the module has been powered on. The value is non-volatile.	Count	OffsetBinary	32	R[31:0] R[31:16] PowerUpCount_Hi R[15:0] PowerUpCount_Lo
TimeOn Increments by one each time the module is powered on and at every 5 minute interval thereafter. The value is non-volatile.	Count	OffsetBinary	32	R[31:0] R[31:16] TimeOn_Hi R[15:0] TimeOn_Lo

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/BIT/101

The KAD/BIT/101 is a CBIT module that monitors an Acra KAM-500 system, using window functions to ensure that it is operating correctly. A window function is a table with an entry for every possible value of a parameter with a corresponding output entry. Up to 120 window functions can be configured. Each window function can check up to 32 parameter inputs with a 4-bit output. The outputs of all of the window functions are OR'd together to produce a 4-bit result.

The KAD/BIT/101 has six methods to indicate the results of the window functions, shown in the following figure. Each output bit activates the related LED, TTL output, and doll's eye output (for example, output 0 activates LED 0, TTL 0, and Dolls Eye 0). The RS-422 output is activated by output 3 only.

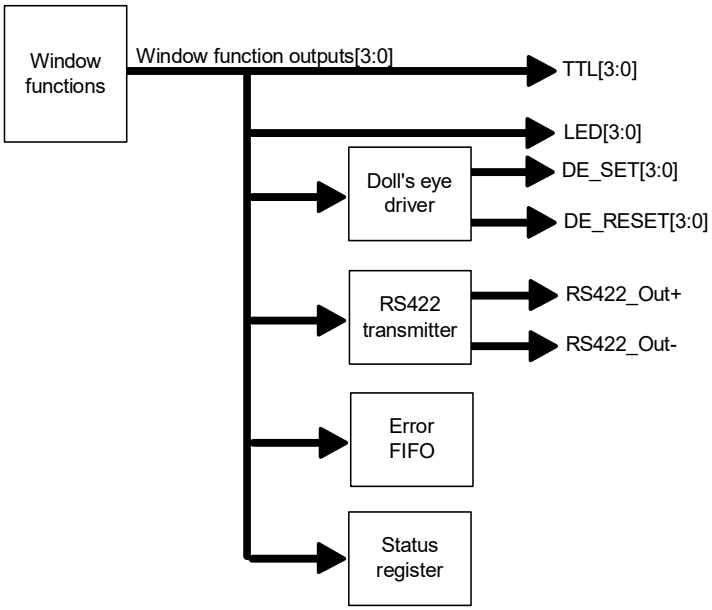


Figure 2: Six methods to indicate window functions

The KAD/BIT/101 accepts internal parameters and parameters from other modules present in the same chassis (or backplane) as inputs for window functions. There are window functions that can be configured to monitor the KAD/BIT/101 internal parameters to check power, temperature, and Acra KAM-500 backplane operation. Other window functions can be configured to monitor parameters from other modules to ensure they are operating correctly.

An example of two window functions is shown in the following figure. Window function 1 is used to check one of the internal power parameters of the KAD/BIT/101. The output of window function 1 is 0001, because the value of the input parameter is not above 2. Window function 120 is used to check a parameter from another module. The output of window function 120 is 0010, because the value of the input parameter is less than 65535.

NOTE: The 10ms gap ensures that SET and RESET are never active at the same time. This is required due to the latched nature of the doll's eye indicator.

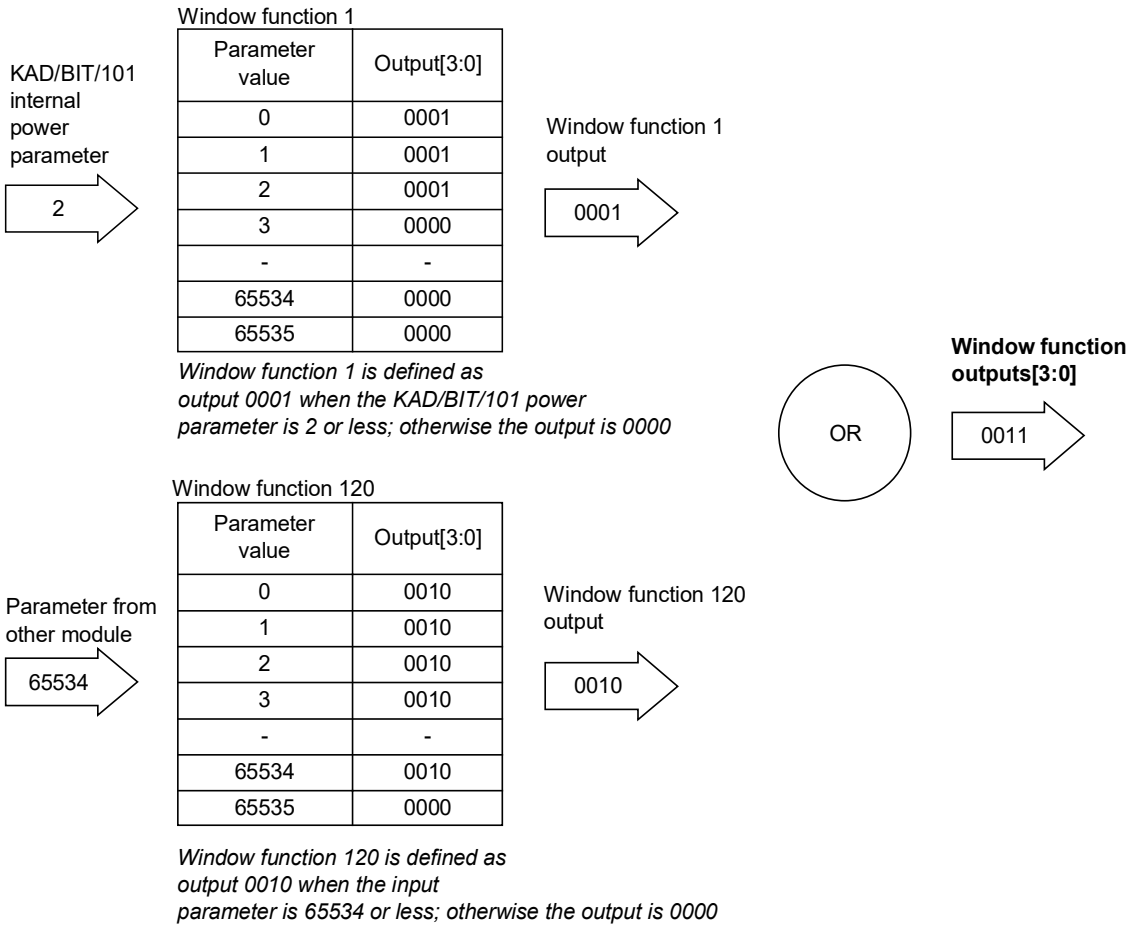


Figure 3: Example of two window functions

The PowerUpCount and TimeOn counters are stored in an EEPROM, which has an approximate life of ten years. The status register contains a bit which indicates when the module must be returned to Curtiss-Wright support (acra-support@curtisswright.com) for a replacement EEPROM.

The TimeOn counter takes up to 250ms to be updated and can be updated asynchronously from the acquisition cycle.

The LED and TTL outputs are updated for 200ms or the length of the acquisition cycle, whichever is longer. If the acquisition cycle is longer than 200ms, the LED and TTL outputs are updated at the start of the cycle and remain the same for the cycle. If the acquisition cycle is shorter than 200ms the LED and TTL outputs have an output period of 200ms. If the error condition is met again during an output active period, then the period is extended.

The KAD/BIT/101 powers up to four dual-coil doll's eye indicators. The KAD/BIT/101 set and reset outputs are energized with a 40ms pulse to select the display state of the doll's eye indicator. The outputs that drive the doll's eyes are updated every 500ms, asynchronously from the acquisition cycle. To reduce the power requirement, the update pulses are staggered in time to ensure that only one output pulse can be activated at any instant (that is, one from the eight outputs for set or reset for each of the four doll's eyes). Each pulse is 40ms wide with a minimum gap of 10ms between pulses. If an error is asserted and deasserted quickly, the shortest time the doll's eye is active is 500ms. The KAD/BIT/101 outputs a +12V supply, which can be used to power the doll's eye indicators, or an external +12V source can be used. It is required that the KAD/BIT/101 COM input is connected to the power supply that is used to power the indicators (as shown in the following figure). Only +12V operation is supported.

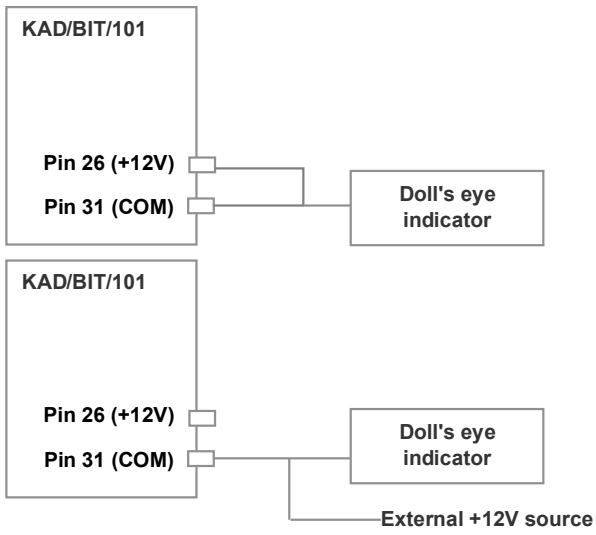


Figure 4: Doll's eye indicator and COM input power source

The COM input is connected to the doll's eye driver within the KAD/BIT/101 and protects drivers against damage when switching doll's eye indicators. It is not recommended that the doll's eye indicator is used when monitoring the supply rails as the current drawn by the indicators themselves is sufficient to cause a voltage spike on the supply rail that can be detected by the monitoring circuit causing continuous switching of the output.

The circuitry for voltage monitoring on all of the supply rails is measured using the +12V supply. Any changes on the +12V supply affects all the voltages that are measured. In other words an error on the +12V supply may cause the other channels to incorrectly show an error.

The error counter parameter counts the number of times a test condition has been met. For example, if six parameters are tested using a window and all meet the condition, then the error counter increments by six when next read.

When the format of the current acquisition cycle is changed, then the error counter and FIFO in the KAD/BIT/101 are reset.

The KAD/BIT/101 contains two non-volatile counters. The first counter increments each time the chassis containing the module has been powered on, the second counter increments when the module is powered on and every five minutes thereafter.

The KAD/BIT/101 has four status bits (corresponding to outputs 0 to 3), which indicate when an error occurs; these can be configured for each error condition. The status bits drive four TTL outputs, four LED outputs, and four doll's eye indicators on the top block of the module. The fourth status bit (output 3) is also used to specify that an error code (ERROR_CODE) corresponding to the error is written to the Error FIFO and transmitted via the RS-422 output stream. The error code is stored in the Error FIFO with optional time-tags.The Error FIFO can store a maximum of 4,096 errors or tags. If the FifoTimeMicro tag is also stored, then the FIFO can hold 2,048 errors or tags, and with all three time tags stored, then the FIFO can hold 1,024 errors or tags.

If using the KAD/BIT/101 in a KAM/CHS/13U, KAM/CHS/13U/B, or KAM/CHS/13U/C, two KAD/BIT/101 modules are required to monitor the +12V supply of all slots. The +12V supply is split between two supply rails; the first rail supplies the first four module slots while the second rail supplies the last nine slots.

The following figure shows an example of the operation of the window function outputs when the acquisition cycle is less than 200ms.

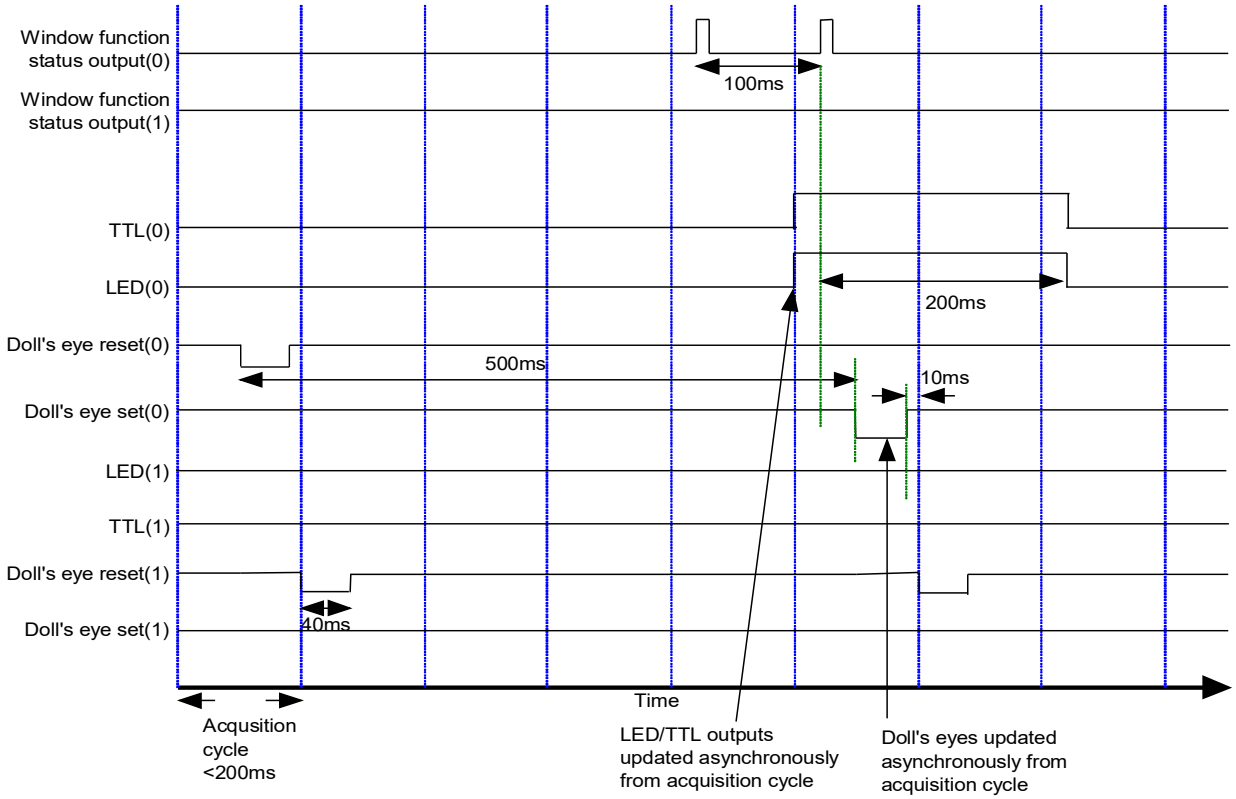


Figure 5: Example of the operation of window function outputs when the acquisition cycle is less than 200ms

KSM-500 fixed window functions

KSM-500 has fixed window functions compared to DAS Studio 3, which include the following:

Power line voltage levels

The KAD/BIT/101 measures the precise value of the +12V, -12V, +7V, -7V, and +5V power lines at greater than 1% accuracy.

Chassis temperature

The KAD/BIT/101 measures chassis and chassis internal temperatures at greater than ±6°C accuracy.

Acra KAM-500 operation

The KAD/BIT/101 ensures the operation of the acquisition cycle by checking the selected formats address checksum and the number of clock cycles.

Errors transmitted via RS-422

The KAD/BIT/101 transmits selected error codes in a 20-character message over an RS-422 output stream when the fourth status bit is set. (This bit also controls whether messages are recorded via the FIFO.) This message also contains the error number and an overflow indicator. The transmission bit-rate can be either 9.6kbps or 115.2kbps. When the module is power-cycled, there may be an extra character transmitted on the RS-422 serial output.

The total message length is 20 ASCII characters (including $E and commas).

The message format is:

$E<ERR_COUNT>, <PARAMETER-ID>, <WINDOW_FCT-ID>, <STS_OUT>, <SKIPPED> <CR><LF>

where:

<ERR_COUNT>: BCD count which increments every error (five characters).

<PARAMETER-ID>: BCD ID number of parameter (two characters).

<WINDOW_FCT-ID>: BCD ID number of window function (three characters).

<STS_OUT>: Error status output (one character).

<SKIPPED>: ASCII O when an overflow occurred; otherwise N (one character).

<CR>: ASCII carriage return (one character) 0x0D.

<LF>: ASCII line feed (one character) 0x0A.

Checking status registers

The KAD/BIT/101 can check whether individual bits are set or cleared in another module's status register. For example, the KAD/BIT/101 checks the status of the KAM/MEM/003 and KAD/MEM/004 modules to determine whether the following is true:

- CompactFlash® card in the module is empty
- CompactFlash card in the module has stored data over a specified threshold
- CompactFlash card in the module is full

In kSetup, you can mask a bit window function by using 1 to check whether a bit is set, and 0 to check whether a bit is cleared. Use X as a wildcard to ignore all other bits. For example, use XXXX.XXXX.1XXX.XXXX to check if bit 7 is set.

NOTE: The same parameter cannot be sent to multiple window functions. This means that a parameter can generate only one output function based on its content.

Status sampling rate

The value returned by the status register depends on the sampling rate of the status register and the rate at which parameters to be monitored are sunk into the KAD/BIT/101. If this sink rate is less than the sampling rate of the status register, the register returns zeros for some samples. It is important to sample the status register at least as fast as the parameter that is sunk fastest into the KAD/BIT/101, otherwise some status updates may not be read.

Measuring the temperature of the chassis

The KAD/BIT/101 has two temperature sensors that measure the chassis top block and internal temperature. The temperatures measured can be inputs to window functions and/or can be read as parameters. The temperature parameter is a four-digit BCD value with a range from 0000_{10} to 9999_{10}.

To calculate the temperature measured, use the following formula:

$$\text{Temperature } °C = -200 \times (0.85 - (\text{ratio}_{10} / 10000_{10}))^3 + (425 \times (\text{ratio}_{10} / 10000_{10})) - 273$$

If the temperature is more than 50°C, then the formula above can be approximated using the following formula:

$$\text{Temperature } °C = (425 \times (\text{ratio}_{10} / 10000_{10})) - 273$$

NOTE: Ratio_{10} is the parameter that is read from the module. When viewing this parameter, care must be taken to treat it as BCD and not as hex or offset binary.

Reading power supply voltage parameters

The KAD/BIT/101 measures the voltage on each of the backplane power supply rails and presents each value as a parameter that can be checked for out of range values or read as a placeable parameter. Use the following formulas to calculate the actual voltage from the value that is read.

For ±12V power supplies:

Voltage in volts = (parameter x 20 / 65536 - 10) x 2

For ±7V and +5V power supplies:

Voltage in volts = (parameter x 20 / 65536 - 10)

Error checking latency

For the first 62 acquisition cycles after power-up, the KAD/BIT/101 does not check for errors. Thereafter, it checks for errors every acquisition cycle.

Connector pinout of the KAD/BIT/101

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	TTL(0)	BTTL outputs (TTL)	Status TTL output
2	TTL(1)	BTTL outputs (TTL)	Status TTL output
3	TTL(2)	BTTL outputs (TTL)	Status TTL output
4	TTL GND		Ground for TTL outputs
5	TTL(3)	BTTL outputs (TTL)	Status TTL output
6	DNC		Do not connect
7	DNC		Do not connect
8	LED(0)	BTTL outputs (LED)	Status LED output
9	LED GND		Ground for LED outputs
10	LED(1)	BTTL outputs (LED)	Status LED output
11	LED GND		Ground for LED outputs
12	LED(2)	BTTL outputs (LED)	Status LED output
13	LED GND		Ground for LED outputs
14	LED(3)	BTTL outputs (LED)	Status LED output
15	LED GND		Ground for LED outputs
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	+12V	Out	+12V to doll's eye indicators
27	DNC		Do not connect
28	RS-422_OUT-	RS-422 outputs	
29	RS-422_OUT+	RS-422 outputs	
30	DNC		Do not connect
31	COM		Doll's eye driver; supply voltage
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DE_SET(0)	Open collector outputs	Doll's eye indicator set
36	DNC		Do not connect
37	DE_RESET(0)	Open collector outputs	Doll's eye indicator reset
38	DNC		Do not connect
39	DE_SET(1)	Open collector outputs	Doll's eye indicator set
40	DNC		Do not connect
41	DE_RESET(1)	Open collector outputs	Doll's eye indicator reset
42	DNC		Do not connect
43	DE_SET(2)	Open collector outputs	Doll's eye indicator set
44	DNC		Do not connect
45	DE_RESET(2)	Open collector outputs	Doll's eye indicator reset
46	DNC		Do not connect
47	DE_SET(3)	Open collector outputs	Doll's eye indicator set
48	DNC		Do not connect
49	DE_RESET(3)	Open collector outputs	Doll's eye indicator reset
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/BIT/101	Built-in self test module (with 52-way double-density connector)
KAM/BIT/101	Built-in self test module (with 51-way micro-miniature connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; or ACC/CON/008/04 for KAM modules), is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/BIT/101 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/BIT/101	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/045	Using the KAD/BIT/101
TEC/NOT/049	Power estimation

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This document was reviewed on 14/4/2022 and does not contain technical data.

KAD/DAC/001

8-channel analog outputs with 16-channel discrete outputs

CURTISSWRIGHTDS.COM



Key Features

- Eight single ended analog output channels
- Input range of ±10V
- Lookup tables to map input parameter to analog output
- 16 single ended discrete output channels
- Combinatorial logic to map multiple parameters to a single discrete output

Applications

- Provide discrete outputs based on backplane parameters, for example memory status; or output a voltage waveform, for example for a strip recorder

Overview

The KAD/DAC/001 can be used to output up to eight single ended waveforms, and provide up to sixteen discrete output indications. Outputs are short circuit protected (indefinite to ground).

The module is able to take any parameter from the backplane and, using a user-defined lookup table, map that parameter to the output voltage range of the analog output channel. A different map can be used for each of the eight analog channels.

Each of the discrete outputs can be set to a logic high or low based on a combination of input words. The input words are passed through a user-defined mapping function, which produces a single bit output. A typical example would be a max-min. window function to determine if a parameter lies in a defined range.

The outputs from the mapping functions can be either logically ANDed or ORed together, and inverted if required, in order to control the discrete output.

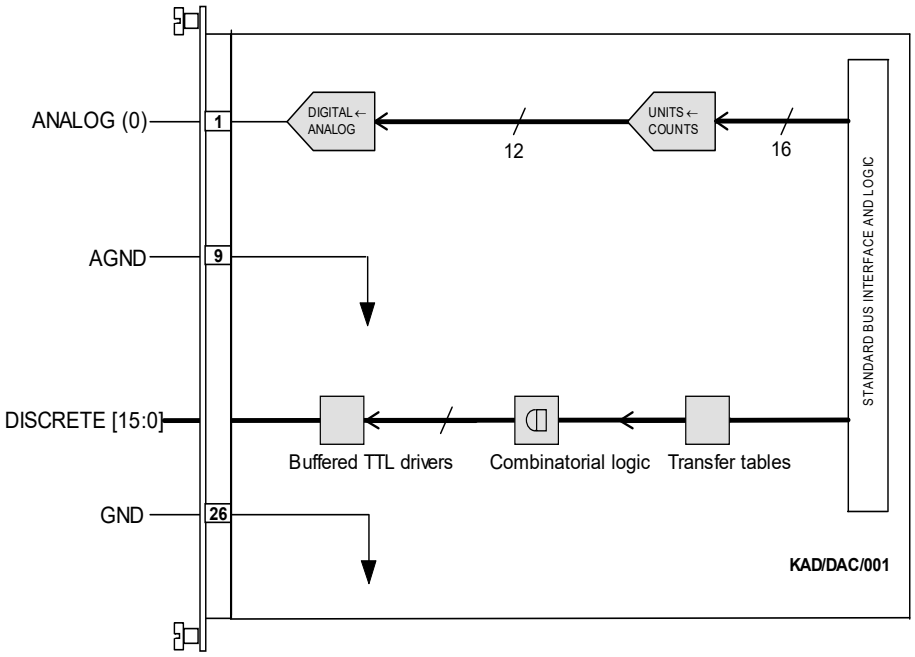


Figure 1: First of eight analog channels and the 16 discrete channels of the KAD/DAC/001

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	70	–	g	
	–	2.47	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	108	–	115	mA	
±7V	0	–	0	mA	
±12V	10	–	12	mA	
total power	0.78	–	0.86	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualifications Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Single ended DC voltage outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	8	–	
Update rate					
ANALOG	–	–	40	kbps	
Output voltage					
operating range	-10	–	10	V	
resolution	–	–	4.8	mV	
short circuit current	–	–	50	mA	
short circuit duration	∞	–	–	s	To GND.
DC error	-40	–	40	mV	
Output resistance	–	–	200	Ω	

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TABLE 3	BTTL outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	16	–	
Update rate					
DIGITAL	–	–	40	kbps	
Output voltage					
logic 0	–	–	0.2	V	Sinking 0.1mA.
logic 1	4.8	–	–	V	Sourcing 0.1mA.
short circuit current	–	–	30	mA	
short circuit duration	∞	–	–	s	To GND.
Output resistance	100	–	–	Ω	

Setting up the KAD/DAC/001

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

The following treeview provides an overview of setup configurations available for this module:

Treeview icons legend	
DAU: Data Acquisition Unit	Indicator: Indicates the firing of an event based on specific conditions
PC: Personal Computer	Parser slot: Area of memory reserved for storing parsed data
Instrument: Any component or module used in a data acquisition system	Snarfer: Captures all data transmitted on a bus and selectively stores it
DataLink: Connection for transmitting or receiving (defines both the data link and the physical layer)	Bridge: Electrical circuit usually used for measuring purposes
Package: Used to describe how data is transmitted or stored	PCMCIA card: Peripheral interface device usually for use in laptop computers
Parameter: Any register that can be read from an instrument	Multiplexer: Selects one of many input signals and outputs that signal on a signal line
Algorithm: Defines processing to be performed on data	Channels: Defines settings for input or output channels on an instrument
InterConnect: Represents a physical connection on an instrument	
PCI card: Circuit board that plugs into the PCI bus on a PC	

Instrument Overview
- KAM-500
  - KAD/DAC/001/B
    - **Channels**
      - **Parameters**
        - DigitalIn(7:0) - *Any parameter from the backplane may be sunk to the module for conversion to an analog signal*
    - **InterConnects**
      - AnalogOut(7:0) - *The output voltage from the D/A which is updated at the start of each acquisition cycle*
        - **DataLinks**
          - Analog-Signal-Out - *Analog signal link*
      - DiscreteOut(15:0) - *16 discrete output bits derived from backplane parameters*
        - **DataLinks**
          - Discrete-Signal-Out - *Digital signal link*
    - **Algorithms**
      - TableAlgorithm - *User-defined lookup table that maps a parameter from the backplane to the output voltage range of the analog output channel*

Setting up the module

The following table lists the setup configurations available for the KAD/DAC/001/B.

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	-
PartReference	KAD/DAC/001/B	KAD/DAC/001/B	-
SerialNumber	-	-	-
InterConnects AnalogOut(7:0)	No character limit	MyAnalogSignal	The output voltage from the D/A which is updated at the start of each acquisition cycle.
DiscreteOut(15:0)	No character limit	MyDiscreteSignal	16 discrete output bits derived from backplane parameters.
Settings	-	-	-
Module-Analog-Out-1.2	-	-	-
Channel DigitalIn(7:0)	-	-	-
Linearization	No character limit	MyTableLookupAlgorithm	Reference to a user-defined lookup table; a different map can be used for each of the eight analog channels.

Setting up parameters

Parameter definitions

The following table lists all parameters that are available for the KAD/DAC/001/B.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
DigitalIn(7:0) Any parameter from the backplane may be sunk to the module for conversion to an analog signal	-	-	16	R[15:0] 0000:FFFF (hex)

Setting up data links

A data link is a connection for transmitting and receiving data. It defines both the data link and physical layers of the link. The following are data links supported by the KAD/DAC/001/B.

Non-programmable data links

NAME	DESCRIPTION
AnalogOut(7:0)	Analog signal link
DiscreteOut(15:0)	Digital signal link

Setting up algorithms

An algorithm describes how data should be processed. The following are algorithms supported by the KAD/DAC/001/B.

TableAlgorithm

User-defined lookup table that maps a parameter from the backplane to the output voltage range of the analog output channel.

SETUP DATA	CHOICE	DEFAULT	NOTES
ParameterTypeReference	-	-	-
Output	-	-	-
Entry		-	-
Input	65535:0	Not Specified	-
Output	10:-10	Not Specified	-

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/DAC/001

Each of the outputs is single ended. AGND and GND are connected internally on the module. However, it is recommended to use AGND for the analog output returns and GND for the discrete output returns.

The following table provides an example of how discrete outputs are defined when the appropriate modules are present:

TABLE 4	An example of discrete output definitions
D(15)[1]	Power-down glitch during last fastest output period
D(14)	EEPROM memory is full
D(13)	EEPROM memory is empty
D(12)	EEPROM memory is logging
D(11)	IRIG-B time is connected with no receive errors this acquisition cycle
D(10)	There have been no errors on any bus being monitored this acquisition cycle
D(9)	Parameter A is within the defined window
D(8)	Parameter B is within the defined window
D[7:0]	TBD

1. D(15) cannot be pre-configured.

The KAD/DAC/001 GUI does not support discrete output setup. However, settings can be configured via low level file management from the command line. To request instructions for configuring discrete output - TSR_U_029, contact Curtiss-Wright support (acra-support@curtisswright.com).

Connector pinout of the KAD/DAC/001

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	ANALOG(0)	Single ended DC voltage outputs	Analog output
2	ANALOG(1)	Single ended DC voltage outputs	Analog output
3	ANALOG(2)	Single ended DC voltage outputs	Analog output
4	ANALOG(3)	Single ended DC voltage outputs	Analog output
5	ANALOG(4)	Single ended DC voltage outputs	Analog output
6	ANALOG(5)	Single ended DC voltage outputs	Analog output
7	ANALOG(6)	Single ended DC voltage outputs	Analog output
8	ANALOG(7)	Single ended DC voltage outputs	Analog output
9	AGND	Internal ground	
10	DISCRETE(0)	BTTL outputs	Discrete output
11	DISCRETE(1)	BTTL outputs	Discrete output
12	DISCRETE(2)	BTTL outputs	Discrete output
13	DISCRETE(3)	BTTL outputs	Discrete output
14	DISCRETE(4)	BTTL outputs	Discrete output
15	DISCRETE(5)	BTTL outputs	Discrete output
16	DISCRETE(6)	BTTL outputs	Discrete output
17	DISCRETE(7)	BTTL outputs	Discrete output
18	DISCRETE(8)	BTTL outputs	Discrete output
19	DISCRETE(9)	BTTL outputs	Discrete output
20	DISCRETE(10)	BTTL outputs	Discrete output
21	DISCRETE(11)	BTTL outputs	Discrete output
22	DISCRETE(12)	BTTL outputs	Discrete output
23	DISCRETE(13)	BTTL outputs	Discrete output
24	DISCRETE(14)	BTTL outputs	Discrete output
25	DISCRETE(15)	BTTL outputs	Discrete output; MSB, indicates power-down glitch during fastest rate period
26	GND	Internal ground	
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	DNC		Do not connect
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/DAC/001/B	8-channel analog outputs with 16-channel discrete outputs

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/DAC/001/B	Improved output impedance	Recommended for new programs
KAD/DAC/001	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

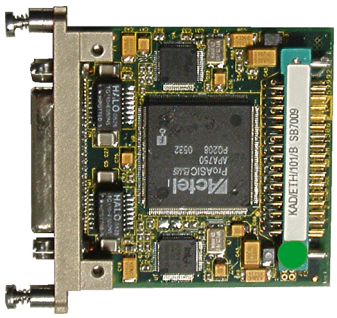
DOCUMENT	DETAILS
DOC/DBK/001	KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/ETH/101

Ethernet transmission and programming interface module (IENA compatible)

CURTISSWRIGHTDS.COM



Key Features

- Bi-directional, full-duplex, fast Ethernet (100BaseTx) connection
- Fixed user-assigned Internet Protocol (IP) address
- Two separately buffered Ethernet outputs
- UDP support for packets up to 64kbyte (32ksamples) via IP fragmentation
- Current Value Table (CVT) of up to 1Msample
- IP version 4 (IPv4) and IENA protocols supported

Applications

- Ethernet based data acquisition systems

Overview

The KAD/ETH/101 is a full-duplex, fast Ethernet (100Mbps) module that can be used to program an Acra KAM-500 system or transmit data from an Acra KAM-500 system.

In acquisition mode, some or all acquired data is transferred from the backplane to the onboard CVT. Onboard it is packetized into a user-defined structure. Once full, the packet is transmitted via UDP.

Any number of user-defined packet structures can be handled simultaneously. Different packet identifiers, packet sizes and destination IP addresses can be individually programmed for each packet type. Destination IP addresses can be unicast, multicast or broadcast.

Upon reception of a programming packet, the module immediately exits acquisition mode and switches to program/verify mode. In program/verify mode it can read or write data blocks to or from any module in any chassis within a distributed Acra KAM-500 system.

The KAD/ETH/101 supports IPv4 networks with fixed IP address allocation, including user-assignment of the module's own IP address. The module is factory-programmed with a unique Ethernet MAC address.

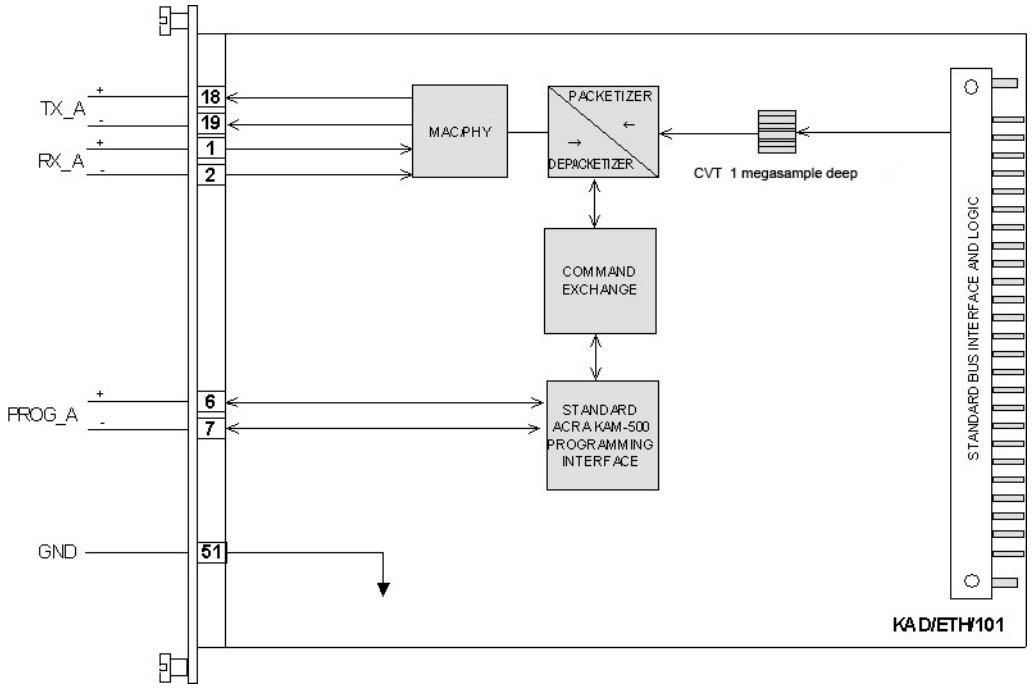


Figure 1: One of two Ethernet links and programming links

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under "Environmental ratings" in the "General specifications" table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	75	–	g	
	–	2.65	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	288	–	438	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	1.44	–	2.19	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Ethernet interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs/outputs	–	–	1	–	IEEE 802.3 compatible.

TABLE 3	RS-485				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Channels	–	–	2	–	
Signaling rate					
PROG_A	–	–	1	Mbps	
PROG_B	–	–	1	Mbps	
Input voltage					
operating range	-7	–	12	V	
logic 0	–	–	-0.2	V	V_{IN+} - V_{IN-}.
logic 1	0.2	–	–	V	V_{IN+} - V_{IN-}.
overvoltage protection	-60	–	60	V	
ESD protection	-15	–	15	kV	Human Body Model.

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TABLE 3	RS-485 (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Output voltage					
operating range	-7	–	12	V	
logic 0	–	–	-2	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
logic 1	2	–	–	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
short circuit current	–	–	25	mA	
short circuit duration	∞	–	–	s	Only one output may be shorted at a time.
Input resistance					
between inputs	–	150	–	MΩ	Module powered on.
between inputs	–	60	–	kΩ	Module powered off.
between inputs	–	120	–	Ω	Module powered on and inputs terminated.
between inputs	–	120	–	Ω	Module powered off and inputs terminated.
each input to GND	–	30	–	MΩ	Module powered on.
each input to GND	–	30	–	kΩ	Module powered off.
Output resistance	–	25	–	Ω	

Setting up the KAD/ETH/101

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ETH/101/B	KAD/ETH/101/B	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Settings	-	-	-
IP Address	0.0.0.0 to 255.255.255.255	0.0.0.0	User-assigned IP address of module.
Port	0 to 65535	1023	UDP private port number used for programming.
Channels	-	-	-
Ethernet(1:0) Ethernet Bidirectional	-	-	Connection between the module channel and IEEE 802.3 data bus. Ethernet(1) is an electrical copy of Ethernet(0).

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Report Reports the status of the module.	BitVector	BitVector	16	R[15:0] R[3:0] Error Code - Supported error codes. 0000: Primary network link not established. 0001: Secondary network link not established when enabled. 0010: Secondary network link transmit frame contained errors. 0011: Primary network link receive frame contained errors. 0100: Reserved for future use. 0101: Module is in configuration mode. 0110: Housekeeping not successfully loaded from serial EEPROM and Flash. 0111: Module reset. 1000: SRAM access contention. 1001: Reserved for future use. 1010: Framing-engine TxOffset configuration setting is greater than actual acquisition cycle. 1011: Primary network link receive frame dropped from FIFO. Other: Reserved for future use. R[14:4] Reserved - Reserved for future use.

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ETH/101

NOTE: It is recommended that Category 5 UTP, or better, Ethernet cables as specified in the Ethernet cabling standard (TIA/EIA-568-B) are used for 100BaseTX connections.

Differences between Ethernet link A and Ethernet link B

Although packet transmission on Ethernet link B is a copy of Ethernet link A, and performs in a similar manner to that illustrated in Figure 2 on page 919, packet reception is not supported on Ethernet link B. Also, ARP and ping requests are implemented via Ethernet link A only.

KAD/ETH/101 and programming

As indicated in the following figure, incoming programming packets from the programming PC are processed by the KAD/ETH/101 and translated into a programming sequence that is transmitted out over Curtiss-Wright's proprietary programming link (PROG_A, PROG_B). Similarly, acknowledgments and data replies that are received on one of these programming links are packetized and forwarded to the PC via the Ethernet link A.

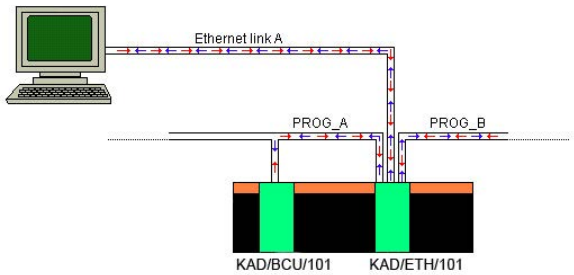


Figure 2: Programming over Ethernet

User-assignment of KAD/ETH/101 IP address

Unlike its KAD/ETH/001 predecessor, the KAD/ETH/101 does not have a 32-bit top-block pin-out, which allowed the module's IP address to be hard-wired. Instead, the KSM-500 software is used to configure the module with a user-assigned IP address. The mechanism works as follows:

The KAD/ETH/101 is placed into IP Address Configuration mode by connecting the top-block pin (pin 39 = IP_ASSIGN) to GND (such as pin 51 of the module). When in this mode, the module assumes a default hard-wired IP address. The IP address 224.0.0.3 is used, as it is an unassigned IP multicast address (defined by IETF RFC 3171), within the local network control block of addresses.

An IP address configuration packet is transmitted to the module for the purpose of configuring the module with a user-assigned IP address. The user-assigned IP address is stored in serial EEPROM on the module for subsequent reference.

The KAD/ETH/101 is released from IP Address Configuration Mode by disconnecting the GND connection from top-block pin 39.

NOTE: Only one module on the network must be set to IP Address Configuration mode at a time. This prevents other KAD/ETH/101 modules from simultaneously processing the configuration packets and thus mistakenly acquiring the same user-assigned IP address.

Packet fragmentation

Ethernet packet sizes range between 64 bytes and 1518 bytes. Ideally, application data packets are designed to fit, with their headers, in 1518-byte Ethernet packets. Packets larger than this can be transmitted over Ethernet by high level protocols such as IP, but they get fragmented (split into smaller pieces). Fragmented packets must then be reassembled by the receiving device to recreate the original IP packet. Packet fragmentation is undesirable for the following reasons:

- Fragments may arrive out of order and complicate reassembly of the data.
- Fragments may be lost, rendering all other fragments of the frame useless.
- The process of fragmenting and reassembling the data is time-consuming.

NOTE: Switches and routers which support IEEE 802.1Q VLAN tagging support Ethernet packets of up to 1522 bytes, including the 4-byte IEEE 802.1Q VLAN tag.

Multi-format and the KAD/ETH/101

The KAD/ETH/101 supports only format select 0.

Connector pinout for the KAD/ETH/101

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	RX_A+	Ethernet interface	Ethernet interface A
2	RX_A-	Ethernet interface	Ethernet interface A
3	DNC		Do not connect
4	DNC		Do not connect
5	CHASSIS	Chassis	
6	PROG_A+	RS-485	Internally terminated with 120Ω
7	PROG_A-	RS-485	Internally terminated with 120Ω
8	PROG_B+	RS-485	Internally terminated with 120Ω
9	PROG_B-	RS-485	Internally terminated with 120Ω
10	CHASSIS	Chassis	
11	DNC		Do not connect
12	DNC		Do not connect
13	DNC		Do not connect
14	DNC		Do not connect
15	DNC		Do not connect
16	RX_B+	Ethernet interface	Ethernet interface B
17	RX_B-	Ethernet interface	Ethernet interface B
18	TX_A+	Ethernet interface	Ethernet interface A
19	TX_A-	Ethernet interface	Ethernet interface A
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	TX_B+	Ethernet interface	Electrical copy of pin 18
34	TX_B-	Ethernet interface	Electrical copy of pin 19
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	IP_ASSIGN		User-assigned IP address; internally pulled to 1 if open
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/ETH/101/B	Ethernet transmission and programming interface module (IENA compatible)

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ETH/101/B	Issue with programming certain multi-chassis configurations rectified	Recommended for new programs
KAD/ETH/101	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/032	Using Ethernet for data transmission
TEC/NOT/049	Power estimation
TEC/NOT/054	Using the KAD/ETH/101

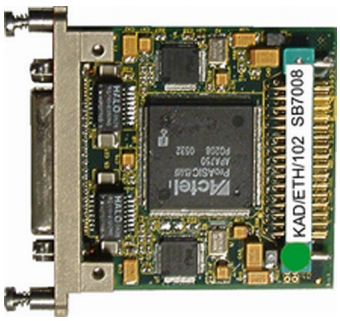
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KAD/ETH/102

Ethernet transmission and programming interface module (iNET-X compatible)

CURTISSWRIGHTDS.COM



Key Features

- Bi-directional, full-duplex, Fast Ethernet (100BaseTX) connection
- Fixed user-assigned Internet Protocol (IP) address
- Two separately buffered Ethernet outputs
- User Datagram Protocol (UDP) support for packets up to 64 kbyte (32 ksamples) via IP fragmentation
- Current Value Table (CVT) of up to 1 Msample
- IP version 4 (IPv4) and iNET-X protocols supported

Applications

- Ethernet based data acquisition systems

Overview

The KAD/ETH/102 is a full-duplex, Fast Ethernet (100 Mbps) module that can be used to program an Acra KAM-500 system or transmit data from an Acra KAM-500 system.

In acquisition mode, some or all acquired data is transferred from the backplane to the onboard CVT. Onboard it is packetized into a user-defined structure. Once full, the packet is transmitted via UDP.

Any number of user-defined packet structures can be handled simultaneously. Different packet identifiers, packet sizes and destination IP addresses can be individually programmed for each packet type. Destination IP addresses can be unicast, multicast, or broadcast.

Upon reception of a programming packet, the module immediately exits acquisition mode and switches to program/verify mode. In program/verify mode it can read or write data blocks to or from any module in any chassis within a distributed Acra KAM-500 system.

The KAD/ETH/102 supports IPv4 networks with fixed IP address allocation, including user-assignment of the module's own IP address. The module is factory-programmed with a unique Ethernet MAC address.

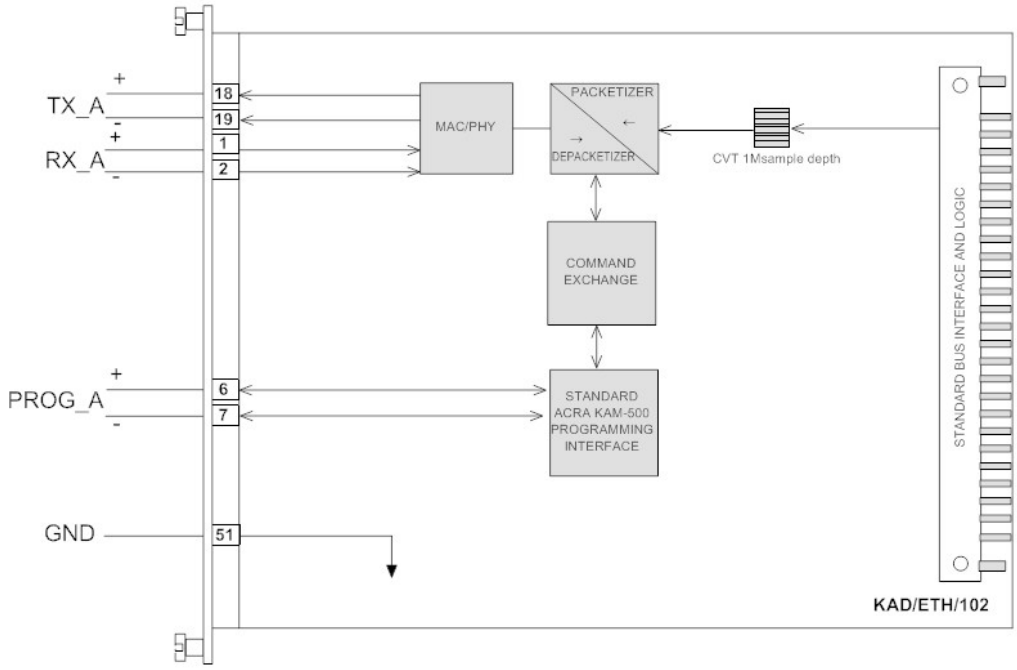


Figure 1: One of two Ethernet links and programming links

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	75	–	g	
	–	2.65	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2.5	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	351	–	429	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	1.76	–	2.14	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Ethernet interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs/outputs	–	–	1	–	IEEE 802.3 compatible. 100BaseTX only.

TABLE 3	RS-485				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Channels	–	–	2	–	
Signaling rate					
PROG_A	–	–	1	Mbps	
PROG_B	–	–	1	Mbps	
Input voltage					
operating range	-7	–	12	V	
logic 0	–	–	-0.2	V	V_{IN+} - V_{IN-}.
logic 1	0.2	–	–	V	V_{IN+} - V_{IN-}.
overvoltage protection	-60	–	60	V	
ESD protection	-15	–	15	kV	Human Body Model.

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TABLE 3	RS-485 (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Output voltage					
operating range	-7	–	12	V	
logic 0	–	–	-2	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
logic 1	2	–	–	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
short circuit current	–	–	25	mA	
short circuit duration	∞	–	–	s	Only one output may be shorted at a time.
Input resistance					
between inputs	–	150	–	MΩ	Module powered on.
between inputs	–	60	–	kΩ	Module powered off.
between inputs	–	120	–	Ω	Module powered on and inputs terminated.
between inputs	–	120	–	Ω	Module powered off and inputs terminated.
each input to GND	–	30	–	MΩ	Module powered on.
each input to GND	–	30	–	kΩ	Module powered off.
Output resistance	–	25	–	Ω	

Setting up the KAD/ETH/102

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ETH/102	KAD/ETH/102	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Settings	-	-	-
PTP Leap Seconds	0 to 256	34	Number of leap seconds since the 1st January 1970.
IP Address	0.0.0.0 to 255.255.255.255	0.0.0.0	User-assigned IP address of module.
Port	0 to 65535	1023	UDP private port number used for programming.
Is Leap Year	False True	False	Specifies if the current year is a leap year.
Channels	-	-	-
Ethernet(1:0) Ethernet Output	-	-	Connection between the module channel and IEEE 802.3 data bus. Ethernet(1) is an electrical copy of Ethernet(0).
PROG-Out RS-422 Output	-	-	Outputs Acra's programming protocol.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Report Reports the status of the module.	BitVector	BitVector	16	R[15:0] R(15) Event - Event occurred since last read. R[14:4] Reserved - Reserved for future use. R[3:0] Error Code - Supported error codes. This register is only valid if an event is flagged. 0000: Primary network link not established. 0001: Secondary network link not established when enabled. 0010: Secondary network link transmit frame contained errors. 0011: Primary network link receive frame contained errors. 0100: Reserved for future use. 0101: Module is in configuration mode. 0110: Housekeeping not successfully loaded from serial EEPROM and Flash. 0111: Module reset. 1000: SRAM access contention. 1001: Reserved for future use. 1010: Framing-engine TxOffset configuration setting is greater than actual acquisition cycle. 1011: Primary network link receive frame dropped from FIFO. Other: Reserved for future use.

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ETH/102

NOTE: It is recommended that Category 5 UTP, or better, Ethernet cables as specified in the Ethernet cabling standard (TIA/EIA-568-B) are used for 100BaseTX connections.

Differences between Ethernet link A and Ethernet link B

Although packet transmission on Ethernet link B is a copy of Ethernet link A, and performs in a similar manner to that illustrated in the following figure, packet reception is not supported on Ethernet link B. Also, ARP and PING are implemented via Ethernet link A only.

Multi-format and the KAD/ETH/102

The KAD/ETH/102 supports only format select 0.

KAD/ETH/102 and programming

As indicated in the following figure, incoming programming packets from the programming PC are processed by the KAD/ETH/102 and translated into a programming sequence that is transmitted out over Curtiss-Wright's proprietary programming link (PROG_A, PROG_B). Similarly, acknowledgements and data replies that are received on one of these programming links are packetized and forwarded to the PC via the Ethernet link A. PROG_A is for all chassis whose chassis ID is 31 or less. PROG_B is for all chassis whose chassis ID is 32 or greater.

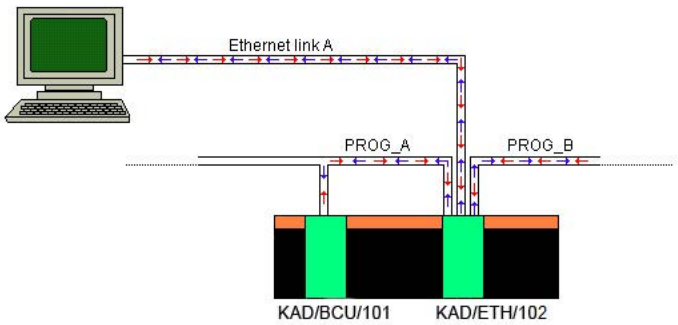


Figure 2: Programming over Ethernet

User-assignment of KAD/ETH/102 IP address

Similar to the KAD/ETH/101, KSM-500 software is used to configure the module with a user-assigned IP address. The mechanism works as follows:

The KAD/ETH/102 is placed into IP Address Configuration mode by connecting the top-block pin (pin 39 = IP_ASSIGN) to GND (such as pin 51 of the module). When in this mode, the module assumes a default hard-wired IP address. The IP address 224.0.0.3 is used, as it is an unassigned IP multicast address (defined by IETF RFC 3171), within the local network control block of addresses.

An IP address configuration packet is transmitted to the module for the purpose of configuring the module with a user-assigned IP address. The user-assigned IP address is stored in serial EEPROM on the module for subsequent reference.

The KAD/ETH/102 is released from IP Address Configuration Mode by disconnecting the GND connection from top-block pin 39.

WARNING: Only one module on the network must be set to IP Address Configuration Mode at a time. This prevents other KAD/ETH/102 modules from simultaneously processing the configuration packets and thus mistakenly acquiring the same user-assigned IP address.

Packet fragmentation

Ethernet packet sizes range between 64 bytes and 1518 bytes. Ideally, application data packets are designed to fit, with their headers, in 1518-byte Ethernet packets. Packets larger than this can be transmitted over Ethernet by high level protocols such as IP, but they get fragmented (split into smaller pieces). Fragmented packets must then be reassembled by the receiving device to recreate the original IP packet. Packet fragmentation is undesirable for the following reasons:

- Fragments may arrive out of order and complicate reassembly of the data.
- Fragments may be lost, rendering all other fragments of the frame useless.
- The process of fragmenting and reassembling the data is time-consuming.

NOTE: Switches and routers which support IEEE 802.1Q VLAN tagging support Ethernet packets of up to 1522 bytes, including the 4-byte IEEE 802.1Q VLAN tag.

iNET-X timestamps

The KAD/ETH/102 generates iNET-X packets, which have a Precision Time Protocol (PTP) timestamp. The source of the timestamp is either from a KAM/TCG/XXX time code generator module or a KAD/BCU/XXX controller module. If the source of the timestamp is a PCM controller, such as the KAD/BCU/101/E, or a legacy time code generator module, such as the KAM/TCG/102, then the day of epoch information is missing from the timestamp and the timestamps reset every

24 hours. However, if the KAD/ETH/102 is connected to a network containing PTP traffic, it can search the PTP messages and extract the day of epoch information to create complete timestamps.

NOTE: The KAD/ETH/102 does not support IENA.

DAS Studio 3 notes

If there is a KAD/BCU/101 with a defined stream ID and Packetization Enabled set to True, then the Multi Chassis Scheduler (MCS) creates a parser-aligned iNET-X package with that stream ID. The Single Chassis Scheduler (SCS) then fills and transmits a package for each minor frame in the PCM stream. The payload is an exact copy of the minor frame contents, including the sync word.

Connector pinout of the KAD/ETH/102

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	RX_A+	Ethernet interface	
2	RX_A-	Ethernet interface	
3	DNC		Do not connect
4	DNC		Do not connect
5	CHASSIS	Acra KAM-500 chassis	
6	PROG_A+	RS-485	Internally terminated with 120Ω
7	PROG_A-	RS-485	Internally terminated with 120Ω
8	PROG_B+	RS-485	Internally terminated with 120Ω
9	PROG_B-	RS-485	Internally terminated with 120Ω
10	CHASSIS	Chassis	
11	DNC		Do not connect
12	DNC		Do not connect
13	DNC		Do not connect
14	DNC		Do not connect
15	DNC		Do not connect
16	RX_B+	Ethernet interface	Ethernet interface B
17	RX_B-	Ethernet interface	Ethernet interface B
18	TX_A+	Ethernet interface	Ethernet interface A
19	TX_A-	Ethernet interface	Ethernet interface A
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	TX_B+	Ethernet interface	Electrical copy of pin 18
34	TX_B-	Ethernet interface	Electrical copy of pin 19
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	IP_ASSIGN		User-assigned IP address; internally pulled to 1 if open
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/ETH/102	Ethernet transmission and programming interface module (iNET-X compatible)

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ETH/102	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/032	Using Ethernet for data acquisition
TEC/NOT/034	Ethernet data acquisition networking
TEC/NOT/049	Power estimation

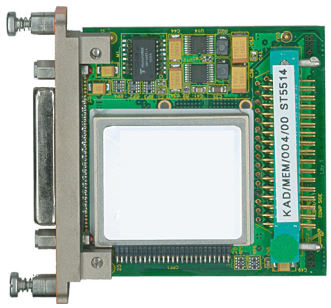
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAD/MEM/004

CompactFlash® memory module (data extraction via Fast Ethernet)

CURTISSWRIGHTDS.COM



Key Features

- Supports logging of data into solid-state memory
- High data transfer rate
- Data extraction via Fast Ethernet (100BaseTX)
- Programmable event sizes and data triggers

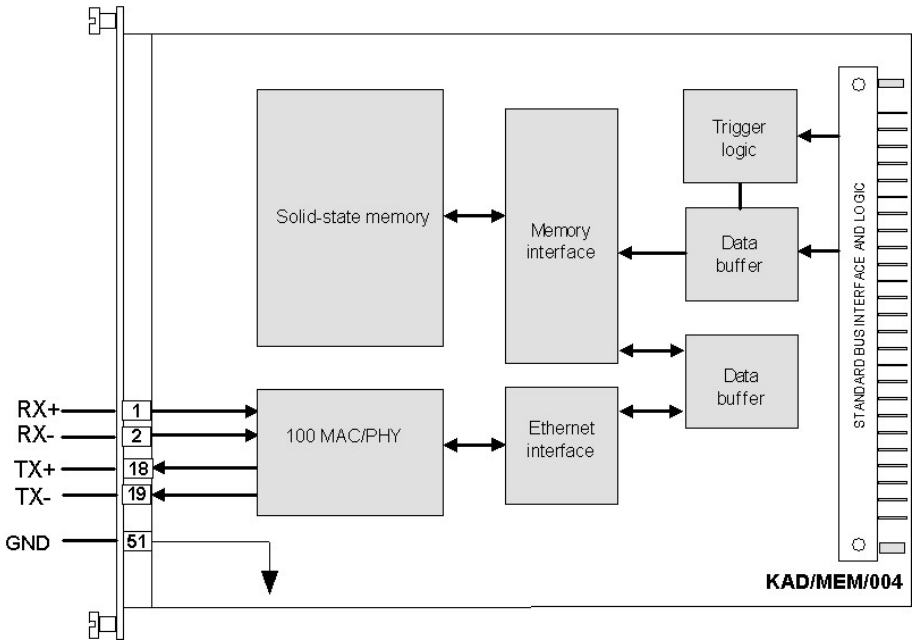
Applications

- Stand-alone data logging
- Restricted unit access

Overview

The KAD/MEM/004 is a memory module which supports logging of Acra KAM-500 data to solid-state memory. The data can be sourced from any module within a distributed Acra KAM-500 system. Logged data can then be extracted via a Fast Ethernet interface.

The KAD/MEM/004 is designed for applications where stand-alone logging of data is required, without the need for a separate data recorder, and where access to the unit is restricted. If removal of the CompactFlash card is preferred, the KAM/MEM/103 is recommended.



Inputs and outputs on the KAD/MEM/004

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under "Environmental ratings" in the "General specifications" table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Only one KAD/MEM/004 module is allowed per Acra KAM-500 system; it must be in the master chassis.
Mass					
	–	90	–	g	
	–	3.17	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	350	–	440	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	1.75	–	2.2	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Ethernet interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs/outputs	–	–	1	–	IEEE 802.3 compatible; 100BaseTX only.

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Setting up the KAD/MEM/004

All module setup can be defined in XML using XidML® schemas (see www.xidml.org).

The following treeview provides an overview of setup configurations available for this module:

XidML Legend

DAU: Data Acquisition Unit (PC: Personal Computer)

Instrument: Any component or module used in a data acquisition system

DataLink: Connection for transmitting or receiving (defines both the data link and the physical layer)

Package: Used to describe how data is transmitted or stored

Parameter: Any register that can be read from an instrument

Algorithm: Defines processing to be performed on data

NOTE: The PartReference settings are specific to each module variant. Only one variant is shown below.

Instrument Overview

- KAM-500
  - KAD/MEM/004/B/32G
    - **Parameters**
      - Report - *Status of CompactFlash Card*
    - **InterConnects**
      - LOGGED-DATA - *Connection for writes to CompactFlash*
        - **DataLinks**
          - MEMDATALINK - *CompactFlash card interface*
            - **Packages**
              - MEMORY-PACKAGE - *User defined data package*
      - ETHERNET-DATA - *Data can be extracted from the CompactFlash over Fast Ethernet*
        - **DataLinks**
          - ETHERNETDATALINK - *IEEE 802.3 compatible data link*
    - **Algorithms**
      - TRIGGER-ALARM-ALGORITHM - *This algorithm is used to define trigger conditions when the required trigger condition is a counter/bit vector value or range of values*
      - TRIGGER-BOOLEAN-ALGORITHM - *This algorithm is used to define trigger conditions when the required trigger condition is a bit or combination of bit values. The bit value combinations can be logically ANDed or ORed together to create complex triggering scenarios*

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/MEM/004/B/32G	KAD/MEM/004/B/32G	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
FlashCard FlashCard Output	-	-	Represents a typical flash card channel on an instrument.
Settings	-	-	-
Settings Trigger	-	-	-
Log Condition	Always Log Never Log	Always Log	-
Processes	-	-	-
Logging	-	-	-
Ethernet-Out Ethernet Output	-	-	Represents a typical Ethernet channel on a networked device.
Settings	-	-	-
IP Address	0.0.0.0 to 255.255.255.255	192.168.2.1	Specifies the IP Address of the instrument.
MAC Address	00-0C-4D-00-00-00 to 00-0C-4D-FF-FF-FF	00-0C-4D-11-22-33	Indicates the MAC address of the module. The standard hexadecimal notation must be used and the first three bytes must correspond to 00-0C-4D. The last three bytes can be set to any value as long as the resulting MAC addresses are unique in the system.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
FlashCard Parameters				
Status Status of CompactFlash card	BitVector	BitVector	16	R[15:0] R[15:9] CompactFlashLevel - Binary 0 - 7F hex shows how full the CompactFlash card is. R(8) CardFullIndicator - 1 when card is full. R(7) LoggingIndicator - 1 while logging. R(6) DataLoggedIndicator - 1 if logging or logged at least once. R[5:0] ErrorCodes 000000: Log mode + ok 00010: Card is being initialized or data is being extracted 000011: Logging too fast 000100: CompactFlash memory card fault or no CompactFlash card present 111111: CompactFlash card detected and initialization complete. Other: Reserved for future use

Setting up data links

A data link is a connection for transmitting and receiving data. It defines both the data link and physical layers of the link. The following are data links supported by the KAD/MEM/004/B/32G.

Non-programmable data links

NAME	DESCRIPTION
LOGGED-DATA	CompactFlash card interface
ETHERNET-DATA	IEEE 802.3 compatible data link

Setting up packages

A package is a logical description of how data is transmitted or stored.

MEMORY-PACKAGE

User defined data package

SETUP DATA	CHOICE	DEFAULT	NOTES
ReferencedToAbsoluteTime	Yes	Yes	-
PackageRate	0	1	-
DataLinkReference	No character limit	Not Specified	-
Properties			-
InitializationPattern	0000 FFFF	0000	-
Header	-	-	-
Value	FFFF:0000	0000	-
Content	-	-	-
Parameter	-	-	-
Location			-
Occurrences	-	-	-
Offset_Address	-	-	-

Setting up algorithms

An algorithm describes how data should be processed. The following are algorithms supported by the KAD/MEM/004/B/32G.

TRIGGER-ALARM-ALGORITHM

This algorithm is used to define trigger conditions when the required trigger condition is a counter/bit vector value or range of values.

SETUP DATA	CHOICE	DEFAULT	NOTES
Window			-
OKMaximum	0 to 65535	Not Specified	-
OKMinimum	0 to 65535	Not Specified	-

TRIGGER-BOOLEAN-ALGORITHM

This algorithm is used to define trigger conditions when the required trigger condition is a bit or combination of bit values. The bit value combinations can be logically ANDed or ORed together to create complex triggering scenarios.

SETUP DATA	CHOICE	DEFAULT	NOTES
OR	-	-	-
Input			-

SETUP DATA	CHOICE	DEFAULT	NOTES
BitIndex	15:0	Not Specified	-
Invert	Yes No	No	-
AND	-	-	-
Input			-
BitIndex	15:0	Not Specified	-
Invert	Yes No	No	-

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Error codes for the KAD/MEM/004

CODE[1]	DESCRIPTION
0_{16}	Log mode + ok
1_{16}	Reserved for future use
2_{16}	Card is being initialized or data is being extracted
3_{16}	Too fast data logging
4_{16}	CompactFlash memory card fault or no CompactFlash card present
5_{16}-$3E_{16}$	Reserved for future use
$3F_{16}$	CompactFlash card detected and initialization complete

1. Error codes are in hexadecimal.

Getting the most from the KAD/MEM/004

Logging data

When recording to the KAD/MEM/004, data is organized into individual events. Each event is a continuous stream of data recorded to the memory card. This continuous data stream is written to the media from onboard RAM buffers in the form of individual blocks, each of which is 32 kilosamples in length. The package rate limit of the KAD/MEM/004 is 16 kilosamples per cycle.

When the KAD/MEM/004 is configured to use a trigger as a start condition, there are several options for defining a stop condition. The first option is to log for a user-configurable number of 32-kilosample blocks, from two up to 65536 blocks. In this scenario, when the trigger condition is True, an event is started and data is recorded to the card for the user-specified number of 32-kilosample blocks. When the specified number of data blocks has been written to the card, one of two things happens. If, by this time, the trigger condition has become False, data logging is stopped and the event is ended. However, if the trigger condition is still True after the specified number of blocks has been written, data continues to be logged to the card until the trigger condition becomes False or the card is completely filled. In this way the card can be filled by one single event.

When configured to continuously log (Always Log), blocks of data are written to the memory card whenever the system is powered on. The number of events created on a card is determined by the number of times that system power is cycled.

When logging data from analog modules with digital filtering (such as the KAD/ADC/109), the digital filters must be given time to settle, after power-on, before good data is recorded to the card. If using one of these analog parameters as a trigger, it is recommended that a second trigger be used, with either time or discrete data as the start condition. This prevents erroneous events from being created on the card due to any analog data spikes that may occur as the digital filters settle. In a multi-chassis system, the KAD/MEM/004 must be placed in the master chassis and not in any slave chassis.

NOTE: While media is not removable, the CompactFlash card can be upgraded by Curtiss-Wright support.

Recording delay increases as memory card fills

At power up, memory needs to find the first empty block to start recording. This delay before recording starts is dependent on how full the card is. At 2 seconds per 1 GB of card used a 32 GB card which is 1/4 full will take 16 seconds to find the first empty block and start recording.

Stop/restart with Always Log setting

When a KAD/MEM/004 is queried, for example, its data is extracted using kFlashCardXID, recording stops. Due to the Always Log setting, recording restarts automatically.

Each time recording stops/restarts in this way, a new event is created.

CompactFlash card initialization

The CompactFlash card cannot be initialized at the same time as it is being programmed, as during programming KAD/MEM/004 access to the CompactFlash card is disabled. We recommend that initialization of the KAD/MEM/004 does not take place at ambient temperatures of greater than 70°C.

KAD/MEM/004 and X-SYNC

We recommend that the KAD/MEM/004 is not used in conjunction with X-SYNC.

Network protocol support

When connected to an Ethernet network the KAD/MEM/004 appears as a network node. It supports the Address Resolution Protocol and ping protocols for network address resolution and network debug.

IP and MAC addresses

The Internet Protocol (IP) and Media Access Control (MAC) of the KAD/MEM/004 are stored in EPROM and must be configured before the KAD/MEM/004 can be detected over an Ethernet network. After reprogramming the IP or MAC address, power cycle the KAD/MEM/004.

Recording rate limitations

The KAD/MEM/004 can record data at up to 1 Msps. This maximum sampling rate is not individually tested on each shipped module. At a logging rate of 128 ksps, tests did not show any loss of data. However, tests above 128 ksps indicated a loss of data up to 0.02% of capacity, equivalent to a data loss of less than 8 blocks. 1 block being 32 KB.

The drops were not identified as occurring in any specific location on the card itself or at any particular instance during the recording time.

This loss of data is due to the internal architecture of the CompactFlash card.

Format select restrictions

The KAD/MEM/004 supports format select 0 only.

Connector pinout of the KAD/MEM/004

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	RX+	Ethernet interface	Ethernet in
2	RX–	Ethernet interface	Ethernet in
3	DNC		Do not connect
4	DNC		Do not connect
5	DNC		Do not connect
6	DNC		Do not connect
7	DNC		Do not connect
8	DNC		Do not connect
9	DNC		Do not connect
10	DNC		Do not connect
11	DNC		Do not connect
12	DNC		Do not connect
13	DNC		Do not connect
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	TX+	Ethernet interface	Ethernet out
19	TX–	Ethernet interface	Ethernet out
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
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40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	Double-density connector only

Ordering information

PART NUMBER	DESCRIPTION
KAD/MEM/004/B/32G	CompactFlash® memory module (data extraction via Fast Ethernet) (with 52-way double-density module top connector)
KAM/MEM/004/B/32G	CompactFlash® memory module (data extraction via Fast Ethernet) (with 51-way micro-miniature module top connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; ACC/CON/008/04 for KAM modules), is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/MEM/004 refers to both the KAD and KAM version of the module. Only one KAD/MEM/004 can be installed in an Acra KAM-500 chassis.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/MEM/004/B/xG	Corrects problems with capacity reporting at power-on and initialization at high temperature	Recommended for new programs
KAD/MEM/004/xG	Memory module with a xGB CompactFlash card	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools
kFlashCardXID 1.9	Initializes CompactFlash cards and extracts logged data

Related documentation

MODULE	DETAILS
DST/Z/007	kFlashcardXID 1.8 data sheet
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/039	Using the KAM/MEM/003/B
TEC/NOT/049	Power estimation

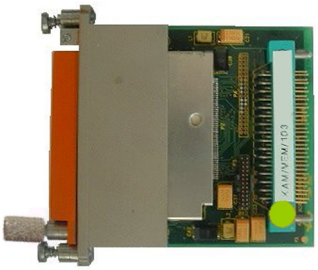
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAM/MEM/103

CompactFlash memory module

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Key Features

- Supports removable solid-state memory cards
- Removable CompactFlash® media (supports Type I and II)
- CompactFlash media: can be read with USB card-reader or PCMCIA adapter
- Programmable event size
- Designed to support high-speed CompactFlash cards
- Logs data at up to 2 Msps

Applications

- Stand-alone data logging

Overview

The KAM/MEM/103 is a memory card interface which supports logging to CompactFlash removable memory cards.

The KAM/MEM/103 is designed to be used with a wide range of CompactFlash cards. As higher density CompactFlash cards become available, they are approved by Curtiss-Wright for use with this module.

The KAM/MEM/103 can store data on a CompactFlash Card from any combination of data sources in an Acra KAM-500 system. Data storage can be triggered by a combination of discrete bits and analog signal levels. To read or erase the data, remove the card and read it using a standard off-the-shelf CompactFlash card reader. Software tools are available from Curtiss-Wright and third party vendors to read recorded data.

The KAM/MEM/103 is designed for applications where stand-alone logging of data is required, that is, without the need for a separate data recorder. A Status register is available to be transmitted via an output module, to monitor errors, logging conditions and capacity remaining. This can be useful as a pre-test checkout capability.

The KAM/MEM/103 has a knurled head captive screw for fastening/unfastening the data acquisition unit lid by hand or with tools.

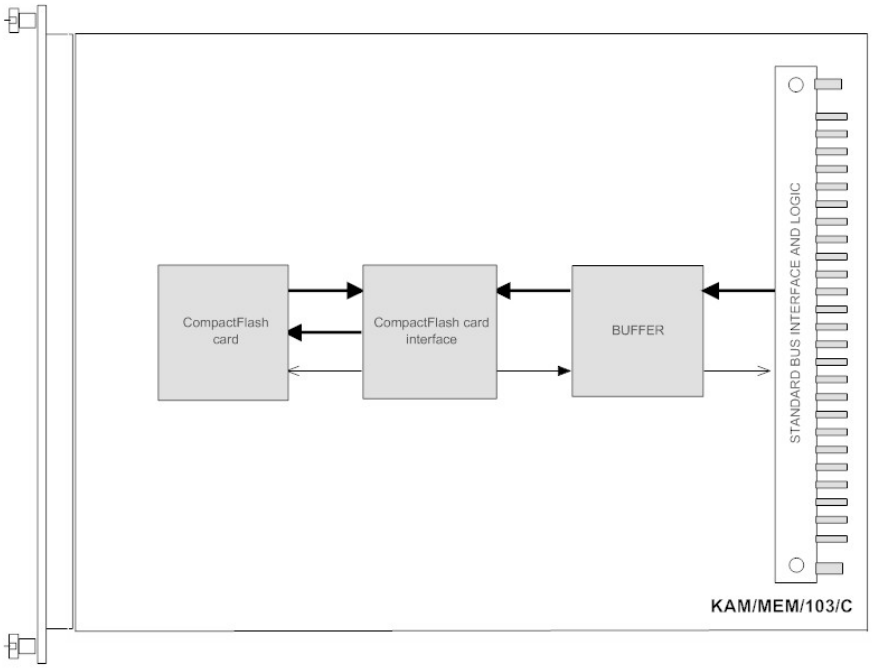


Figure 1: KAM/MEM/103 functional diagram

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Software supports only one KAM/MEM/103 card per chassis. Can be placed in any user-slot in any combination.
Mass					
	–	90	–	g	
	–	3.17	–	oz	Design metric is grams.
Height above chassis					For clearance requirements for the hinged lid, see measurements in Figure 2 on page 950.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	70	–	135	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	0.35	–	0.675	W	CompactFlash card fitted. Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

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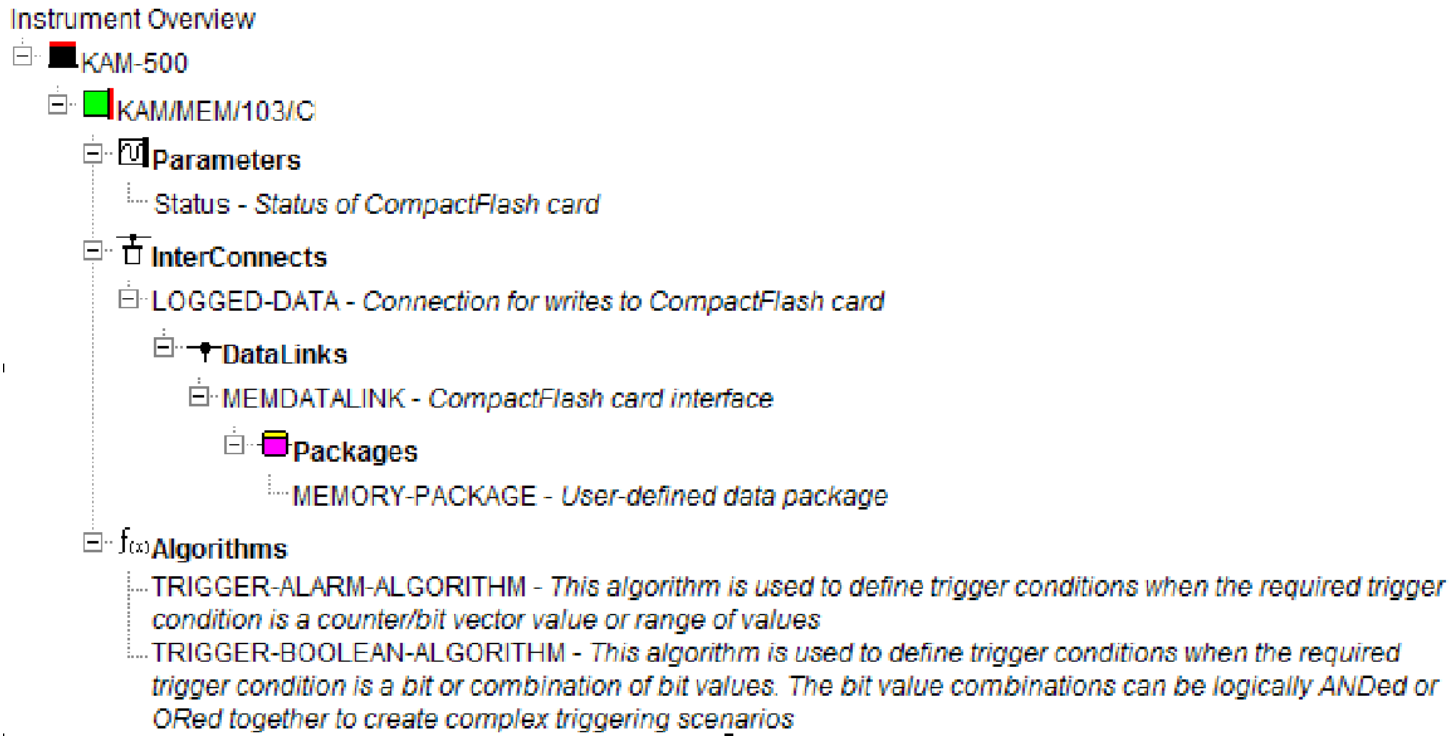
TABLE 2	CompactFlash interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Memory size	–	–	32	GB	Correct operation can only be guaranteed with CompactFlash cards validated and approved for use with the KAM/MEM/103. For details of approved CompactFlash cards, see the *CompactFlash cards* data sheet. The KAM/MEM/103 has been designed to work with CompactFlash cards up to 128 GB in size; at the time of writing, the KAM/MEM/103 is compatible with CompactFlash cards of up to 32 GB in size.
Recording rate	–	–	2	Msps	The maximum sampling rate is not supported by all CompactFlash cards (see the *CompactFlash cards* data sheet).
EventLogSize					
1 Msps and above	8	–	16,384	32K blocks	Use eight or multiples of eight.
less than 1 Msps	2	–	16,384	32K blocks	
Format select restrictions	–	–	–	–	The KAM/MEM/103 supports format select 0 only.
Tightening torque	–	–	–	–	0.6 Nm for all captive screws on the product.

Setting up the KAM/MEM/103

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

The following treeview provides an overview of setup configurations available for this module:

Treeview icons legend	
DAU: Data Acquisition Unit	Indicator: Indicates the firing of an event based on specific conditions
PC: Personal Computer	Parser slot: Area of memory reserved for storing parsed data
Instrument: Any component or module used in a data acquisition system	Snarfer: Captures all data transmitted on a bus and selectively stores it
DataLink: Connection for transmitting or receiving (defines both the data link and the physical layer)	Bridge: Electrical circuit usually used for measuring purposes
Package: Used to describe how data is transmitted or stored	PCMCIA card: Peripheral interface device usually for use in laptop computers
Parameter: Any register that can be read from an instrument	Multiplexer: Selects one of many input signals and outputs that signal on a signal line
Algorithm: Defines processing to be performed on data	Channels: Defines settings for input or output channels on an instrument
InterConnect: Represents a physical connection on an instrument	
PCI card: Circuit board that plugs into the PCI bus on a PC	



Setting up the module

The following table lists the setup configurations available for the KAM/MEM/103/C.

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAM/MEM/103/C	KAM/MEM/103/C	ACRA CONTROL part number.
SerialNumber	-	-	Unique name for each module.
InterConnects LOGGED-DATA	No character limit	Not Specified	Connection for writes to CompactFlash card.
Settings	-	-	-
Module-Recorder-1.3	-	-	-
EventLogSize_Bytes	4294967296:131072	131072	The number of bytes that must be logged when a logging event is triggered. This must be a minimum of 131072 and an integer multiple of 65536 bytes.
Triggers Trigger(1:0)	-	-	-
TriggerAlgorithmReference	No character limit	Not Specified	-
Addendum	-	-	-
StrategyFile	-	-	-
URL	-	strategy.txt	StrategyFile defines the order in which samples are recorded on the CompactFlash card and is used by the KSM-500 suite of tools to extract data from the CompactFlash card.
AlwaysOverwrite	Yes No	No	Indicates if the strategy file should be overwritten each time.

Setting up parameters

Parameter definitions

The following table lists all parameters that are available for the KAM/MEM/103/C.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Status Status of CompactFlash card.	Unitless	BitVector	16	R[15:9] Binary 0 - 7F hex shows how full the CompactFlash card is. R(8) 1 when card is full. R(7) 1 while logging. R(6) 1 if logging or logged at least once. R[5:0] Error code.

Setting up data links

A data link is a connection for transmitting and receiving data. It defines both the data link and physical layers of the link. The following are data links supported by the KAM/MEM/103/C.

Non-programmable data links

NAME	DESCRIPTION
LOGGED-DATA	CompactFlash card interface.

Setting up packages

A package is a logical description of how data is transmitted or stored.

MEMORY-PACKAGE

User defined data package

SETUP DATA	CHOICE	DEFAULT	NOTES
ReferencedToAbsoluteTime	Yes	Yes	-
PackageRate	-	1	-
DataLinkReference	No character limit	Not Specified	-
Properties	-	-	-
InitializationPattern	0000 FFFF	0000	-
Header	-	-	-
Value	0000 to FFFF	0000	-
Content	-	-	-
Parameter	-	-	-
Location	-	-	-
Occurrences	-	-	-
Offset_Address	-	-	-

Setting up algorithms

An algorithm describes how data should be processed. The following are algorithms supported by the KAM/MEM/103/C.

TRIGGER-ALARM-ALGORITHM

This algorithm is used to define trigger conditions when the required trigger condition is a counter/bit vector value or range of values.

SETUP DATA	CHOICE	DEFAULT	NOTES
Window		-	-
OKMaximum	0 to 65535	Not Specified	-
OKMinimum	0 to 65535	Not Specified	-

TRIGGER-BOOLEAN-ALGORITHM

This algorithm is used to define trigger conditions when the required trigger condition is a bit or combination of bit values. The bit value combinations can be logically ANDed or ORed together to create complex triggering scenarios.

SETUP DATA	CHOICE	DEFAULT	NOTES
OR	-	-	-
Input		-	-
BitIndex	15:0	Not Specified	-
Invert	Yes No	No	-
AND	-	-	-
Input		-	-
BitIndex	15:0	Not Specified	-
Invert	Yes No	No	-

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Error codes for the KAM/MEM/103

CODE[1]	DESCRIPTION
00_{16}	Log mode + ok
01_{16}	Reserved for future use
02_{16}	Reserved for future use
03_{16}	Logging too fast
04_{16}	CompactFlash memory card fault or no CompactFlash card present
05_{16}	Reserved for future use
06_{16}-3E 16	Reserved for future use
$3F_{16}$	CompactFlash card detected and initialization complete

1. Error codes are hexadecimal.

Getting the most from the KAM/MEM/103

Logging



Any subset of the parameters available over the backplane can be stored in the KAM/MEM/103. Up to two parameters can be used to specify the start (trigger) conditions. For example, an analog signal is within a certain window and certain discrete bits in another parameter can be set.

Event sizes are specified ultimately in terms of acquisition cycles, but they are presented via the graphical user interface in terms of seconds.

The Status register can indicate overflow, that is, logging too fast (for more information, see “Error codes for the KAM/MEM/103” on page 949). Overflow occurs when the CompactFlash card fitted/installed cannot log continuously at the configured sampling rate. This status information is also recorded with the logged data.

When logging at low sample rates (1,000 sps) it can take several minutes for the data to be written to the CompactFlash card. Successful writing of the first samples to the CompactFlash card is indicated by the Status register error code changing from $3F_{16}$ to 00_{16}. When a full CompactFlash card is fitted in a KAM/MEM/103, this information is indicated by R(8) of the Status register being set to 1. R[15:9] indicates 0016. R(8) has precedence over R[15:9].

Triggers

The minimum number of blocks to be logged for a given trigger condition can be configured. This is the minimum number of blocks that are recorded for an event where the trigger conditions are met for a single sample. This condition can be met when both trigger (A trigger and B trigger) conditions have been met, even if one is valid for a single sample. The maximum number of blocks that can be recorded from this type of event is 65,536 blocks, the minimum is two blocks. If the trigger is maintained for more than the specified minimum number of blocks to log, data is logged until the trigger condition is removed, so if the trigger is maintained valid for a sufficient number of acquisition cycles the CompactFlash card can be filled with data from a single event.

When logging data from analog modules with digital filtering (for example, KAD/ADC/014) after power-on, digital filtering must be given time to settle before data is logged to the KAM/MEM/103. In this scenario, we recommend using time or discrete data as the B trigger input, and the selected analog parameter value range as the A trigger input.

EventLogSize

The KAM/MEM/103 logs data at a sustained rate of 2 Msps, however CompactFlash cards of varying capacity may not be fast enough to work at this rate.

Tests prove that when logging above 1 Msps and using event-driven triggers, best results are obtained when the minimum EventLogSize is set to eight or a multiple of eight 32K blocks. When logging below 1 Msps, a minimum EventLogSize setting is not critical.

Samples per acquisition cycle

The KAM/MEM103 is limited to 16,376 samples per acquisition cycle. The KAM/MEM/103 requires at least two acquisition cycles stored in one block, that is, the number of samples per acquisition cycle to be stored is limited to 16384 (32,768 / 2). Eight words of header are equal to 16,376 samples per acquisition cycle. If kSetup or DAS Studio 3 displays an error stating that you cannot store more than 16,376 words per acquisition cycle, you must increase the acquisition cycle rate.

Storage media

Use only those CompactFlash cards validated and approved for use with the KAM/MEM/103. For details of approved cards, see the *CompactFlash cards* data sheet.

Automatic recording

You can trigger automatic recording on a memory module such as the KAM/MEM/103 by using a parameter or, a combination of two parameter values, from the logged list. You can also trigger recording using a 5V signal from a pin on backplane controller (BCU) modules KAD/BCU/101 and KAD/BCU/105. For details on using triggers, see *TEC/NOT/064 - Using the KAM/MEM/103*.

This automatic recording stops only when the trigger conditions, as stated above, are removed and the “minimum number of blocks to be logged” are logged.

Removing the CompactFlash card

To eject the CompactFlash card from the KAM/MEM/103, unscrew the captive lid locking screw and hinge the lid away from the card (see the following figure). Press the eject button and remove the card. The hinged lid restrains the card while in use. The hinged lid opens out 95°, in an arc of radius 63 mm (2.5 inch).

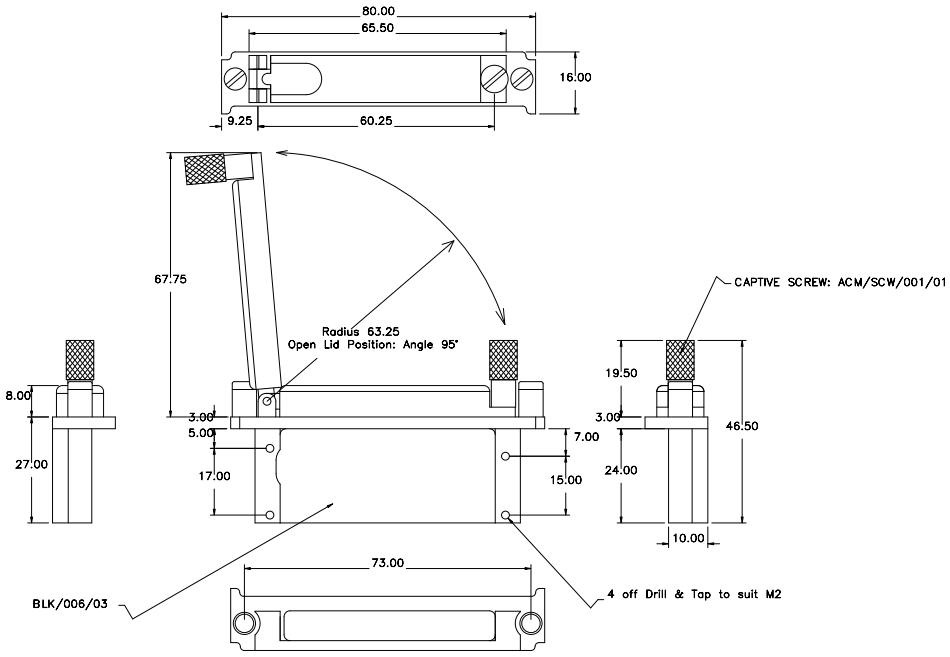


Figure 2: KAM/MEM/103 hinged lid

Connector pinout of the KAM/MEM/103

There is no connector pinout for the KAM/MEM/103.

Ordering information

PART NUMBER	DESCRIPTION
KAM/MEM/103/C	CompactFlash memory module

Only one KAM/MEM/103 can be installed in an Acra KAM-500 chassis.

Revision history

REVISION	DIFFERENCES	STATUS
KAM/MEM/103/C	Corrects an issue where the KAM/MEM/103 may fail to start logging correctly with a KAD/BCU/140/C (or previous revision)	Recommended for new programs
KAM/MEM/103/B	Corrects an issue where the KAM/MEM/103 fails to start logging correctly with a KAD/BCU/105 and fails in an X-SYNC slave chassis	Not recommended for new programs
KAM/MEM/103	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
kFlashcardXID	Initializes CompactFlash cards and extracts logged data
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DST/Y/032	CompactFlash cards data sheet
DST/Z/007	kFlashcardXID 1.8 data sheet
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
TEC/NOT/64	Using the KAM/MEM/103

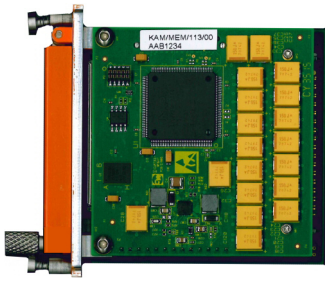
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This document was reviewed on 14/10/2020 and does not contain technical data.

KAM/MEM/113

CompactFlash memory module with PCAP format

CURTISSWRIGHTDS.COM



Key Features

- Supports removable solid-state memory cards
- Removable CompactFlash® media (supports Type I & II)
- Uses FAT32 file system
- Stores Ethernet frames in industry standard Packet CAPture (PCAP) files, viewable using Wireshark® or another third party application
- Always Log or log when triggered
- Logs data at up to 2.5 Msps
- Records IENA and/or iNET-X packets

Applications

- Stand-alone data logging

Overview

The KAM/MEM/113 is a memory card interface which supports logging to CompactFlash removable memory cards.

The KAM/MEM/113 is designed to be used with a wide range of CompactFlash cards. The KAM/MEM/113 can store data in a CompactFlash card from any combination of data sources in an Acra KAM-500 system. Data storage can be triggered by a combination of discrete bits and analog signal levels.

Recorded data is written directly to files. The recorded files are formatted according to the PCAP file format so that they are viewable with network analysis tools such as Wireshark. Recorded data can be read directly from the CompactFlash card on a PC with any off-the-shelf card reader.

The KAM/MEM/113 is designed for applications where stand-alone logging of data is required, that is, without the need for a separate data recorder. Status and Report registers are available for transmission via an output module, to monitor errors, logging conditions, and capacity remaining. This can be useful as a pre-test checkout capability.

For asynchronous bus data, the KAM/MEM/113 supports aperiodic transmission for efficient bandwidth use, whereby a packet is not generated if no fresh data has been acquired from a packetizer user-module.

The KAM/MEM/113 has a knurled head captive screw for fastening/unfastening the data acquisition unit lid by hand or with tools.

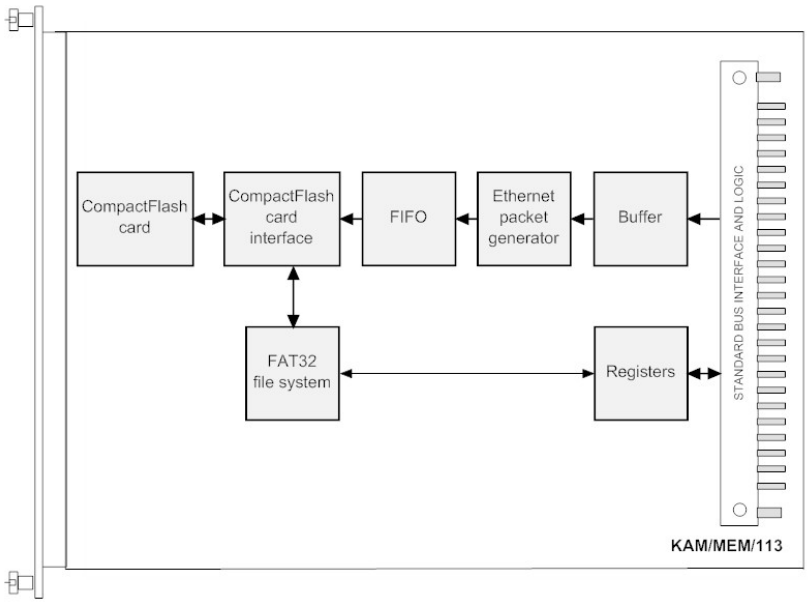


Figure 1: KAM/MEM/113 functional diagram

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under "Environmental ratings" in the "General specifications" table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	105	–	g	
	–	3.7	–	oz	Design metric is grams.
Height above chassis					For clearance requirements for the hinged lid, see measurements in Figure 5 on page 961.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	4	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	208	–	300	mA	
±7V	0	–	0	mA	
±12V	0	–	0	mA	
total power	1.04	–	1.5	W	CompactFlash card fitted. Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	CompactFlash interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Memory size	–	–	128	GB	Correct operation can only be guaranteed with CompactFlash cards validated and approved for use with the KAM/MEM/113. For details of approved CompactFlash cards, see the *CompactFlash cards* data sheet.
Recording rate	–	–	2.5	Msps	The KAM/MEM/113 supports sampling rates of up to 2.5 Msps. Refer to Table 3 in the *CompactFlash cards* data sheet for the precise recording rate for each CF card.
Format select restrictions	–	–	–	–	One format reserved for Idle Format; another format reserved for Erase Format. All formats except Erase Format and Idle Format can be used. Note, the data set recorded in each format is identical.
Tightening torque	–	–	–	–	0.6 Nm for all captive screws on the product.

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Setting up the KAM/MEM/113

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAM/MEM/113	KAM/MEM/113	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Settings Time	-	-	Settings relating to synchronization and time conversions.
PTP Leap Seconds	0 to 127	36	Current Leap Second count. Offset between PTP time and UTC time.
Current Year	2000 to 2100	2015	This Current Year value is used as the year in any timestamp values. However, if the unit synchronizes to a time source that specifies the year, this value is updated.
IENA Only	True False	False	When True, the module generates all time stamps using the DOY value and Current Year. When False, the module uses PTP time as the source.
Settings Recorder	-	-	Settings used by PCAP recorders.
Wrap Around	True False	False	Specifies whether logging stops when the CompactFlash card is full or whether logging wraps back around to the start of the CompactFlash card.
Log Condition	Triggered Always Log Triggered Until Full Never Log	Always Log	Specifies whether logging is Triggered, Triggered Until Full, Always On, or Off.
Trigger Truth Table	Trigger A Trigger B Trigger A or B Trigger A and B	Trigger A	Specifies how to form the trigger condition (if Log Condition is Triggered).
Settings Packet Generation	-	-	Defines packets logged to the CompactFlash card.
Dummy IP Address	0.0.0.0 to 255.255.255.255	192.168.28.1	IP address of module, required to generate Ethernet packets for logging on CompactFlash card. A dummy address is used as there is no external Ethernet interface.
Dummy MAC Address	00-00-00-00-00-00 to FF-FF-FF-FF-FF-FF	00-0C-4D-00-03-10	Ethernet address of module, required to generate Ethernet packets for logging on CompactFlash card. A dummy address is used as there is no external Ethernet interface.
Settings Factory	-	-	-
Allow Erase	True False	False	Allows the CF card to be erased when the chassis is switched to the Erase Format select.

SETUP DATA	CHOICE	DEFAULT	NOTES
Idle Format	0 to 14	4	FMT value of Idle Format. When the chassis is in this format, the card is in idle mode (no logging will be started; any active logging will be stopped).
Erase Format	0 to 14	8	FMT value of Erase Format. When the chassis is in this format, the File Table on the card is erased (if Allow Erase is set to True).
Channels	-	-	-
FlashCard FlashCard Output	-	-	Represents a typical CompactFlash card channel on an instrument.
Processes	-	-	-
TriggerA	-	-	An algorithm placed in this process is used to generate the Trigger A (via LookUp).
Settings	-	-	-
Trigger Condition	Algorithm Reference Boolean-Simple Window-Function-Alarm	MyTriggerCondition	A reference to an algorithm that defines the trigger condition.
Sample Rate	1 to 100000	1	Number of times to check the event per second (Hz)
TriggerB	-	-	An algorithm placed in this process is used to generate the Trigger B (via LookUp).
Settings	-	-	-
Trigger Condition	Algorithm Reference Boolean-Simple Window-Function-Alarm	MyTriggerCondition	A reference to an algorithm that defines the trigger condition.
Sample Rate	1 to 100000	1	Number of times to check the event per second (Hz)

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Status Status of CompactFlash card	BitVector	BitVector	16	R[15:0] R[15:8] CompactFlashLevel - 0 - 100 (64h) shows how full the CompactFlash card is as percentage (during formatting, shows percent completed). Set to x"FF" when not applicable. R[7:6] Reserved - Reserved R(5) CardValid - 1 when card available for use. R(4) CardPresent - 1 when card detected. R(3) Filled/Wrapped - 1 when CompactFlash card filled / wrapped-around since power-on. R(2) Formatting - 1 while formatting. R(1) DataLogged - 1 if data logged since power-on. R(0) DataLogging - 1 if logging active.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Report Report error conditions	BitVector	BitVector	16	R[15:0] R(15) ReportEvent - 1 if new event reported since last read. R(6) FMT Changed - 1 when FMT has been changed. R(5) Reserved - Reserved R(4) FE Reset - 1 when internal Framing Engine resets. R(3) PBIT Fault - 1 when Power On Self test reports a fault. R(2) SRAM Fault - 1 when SRAM is reporting a fault. R(1) FlashCardFault - 1 when CompactFlash card fault. R(0) LoggingError - 1 when FIFO overflow / logging too fast.
ErrorCount Increments each time an fresh error (as per Report) is detected.	BitVector	BitVector	16	R[15:0]

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAM/MEM/113

Any subset of the parameters available over the backplane can be stored in the KAM/MEM/113. Up to two parameters can be used to specify the start (trigger) conditions. For example, an analog signal is within a certain window and certain discrete bits in another parameter can be set.

The status word indicates overflow (logging too fast). Overflow occurs when the CompactFlash card cannot log continuously at the configured sampling rate.

When logging data from analog modules with digital filtering (for example, KAD/ADC/014) after power-on, the digital filtering must be given time to settle before data is logged to the KAM/MEM/113. In this case it is recommended to use time or discrete data as the B trigger input, with the A trigger as the selected analog parameter value range.

When logging at low sample rates (1000 sps) it can take several minutes for the data to be written into the CompactFlash card. Successful writing of the first samples to the CompactFlash card is indicated by the logged bit in the status word. The KAM/MEM/113 supports formatting of the CompactFlash card by switching to the dedicated Erase format; the Status word indicates formatting progress. To prevent unintended formatting of the card, this feature is disabled by default. Data is extracted using an off-the-shelf CompactFlash reader to view the file system under Windows®, and using the Wireshark tool to open the PCAP files.

When a full CompactFlash card is inserted in a KAM/MEM/113, this information is indicated by R[15:8] of the status word being set to 64_{16} (= 100%).

The KAM/MEM/113 stops recording when the media is full, however a wrap-around-when-full setting allows recording to continue after deleting the oldest file.

NOTE: The logging bit D(0) in the status word indicates if the CompactFlash card has triggered; this will remain set even when the CompactFlash card is full.

Idle Format

Idle Format is used to suspend logging while maintenance is being carried out on the system or to remove a CompactFlash card safely.

NOTE: If the CompactFlash card is ejected during logging without being stopped (by either removing a trigger or using Idle Format) data may be lost.

Ensuring data integrity during loss of power

The KAM/MEM/113 has a capacitor bank, which allows the module to save data that is currently being recorded during a loss of power by updating the directory. In the unlikely event that the directory is corrupted as a result of this loss of power, data can be retrieved by post processing the PCAP file.

Avoiding data loss

To avoid data loss or corruption of the most recent data file, we recommend setting Log Condition to either Triggered or Triggered Until Full.

If using the Log Condition setting Always Log, ensure the module is switched to the correct Idle Format value prior to ejecting the CompactFlash card. Switching to the Idle Format value ensures logging stops cleanly.

NOTE: If the chassis is being programmed and the module is triggered, it can result in some short session files being recorded during programming. After programming is finished, normal recording operation resumes.

File format

Ethernet packets are stored in a FAT32 volume using the Wireshark PCAP file format (on condition that the CompactFlash card is not full).

The following figure displays examples of PCAP files stored on the CompactFlash card.

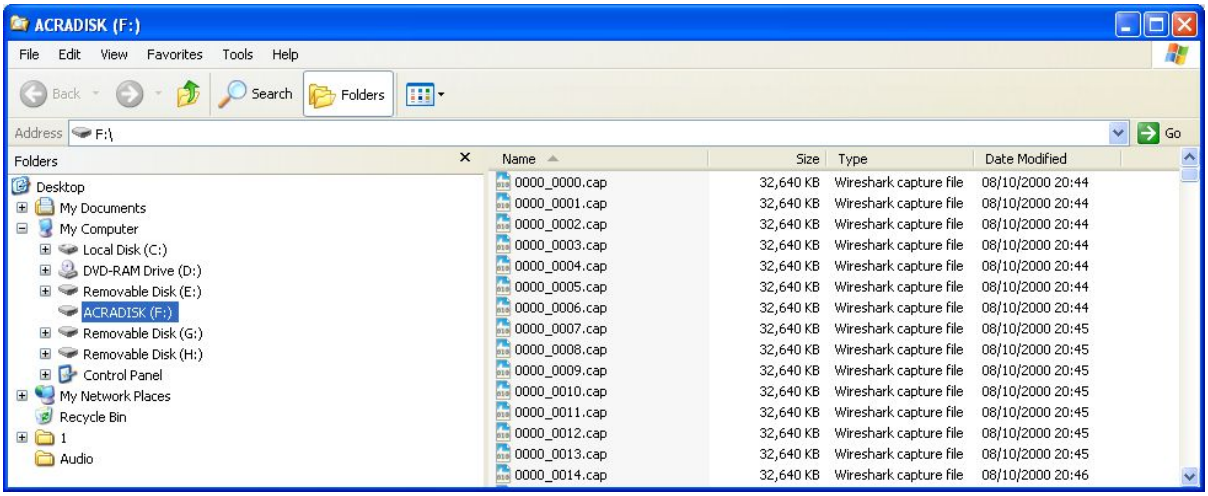


Figure 2: CompactFlash card content viewed in Windows Explorer

PCAP file size

The maximum PCAP file size is 32 MB regardless of the size of the CF card. This is hard-coded into the FPGA and is not configurable.

Storage media

Use only those CompactFlash cards validated and approved for use with the KAM/MEM/113. For details of approved cards, see the *CompactFlash cards* data sheet.

IP packets and how they are stored

PCAP files store packets contiguously (see the following figure).

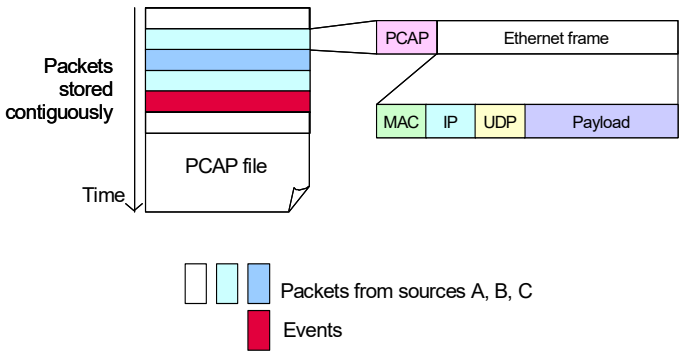


Figure 3: Files of packets

Automatic recording

You can trigger automatic recording on a memory module such as the KAM/MEM/113 by using a parameter or, a combination of two parameter values, from the logged list.

This automatic recording stops only when the trigger conditions, as stated above, are removed. Alternatively, the recording starts on a trigger (on the next acquisition cycle) and records until full. If the trigger condition is met, recording starts on a data

acquisition cycle boundary. Similarly, if the trigger is removed, recording stops on the next data acquisition cycle boundary.

The KAM/MEM/113 can also be configured to Always Log. The KAM/MEM/113 is configured to start recording after 10 acquisition cycles.

Formatting a CompactFlash card

Each CompactFlash card must first be formatted before it can be used in the KAM/MEM/113. One of the following methods can be used for formatting:

- Format a card using an SSR/CHS/001/B.
- Format a card using the erase format from the KAM/MEM/113.
- Format a card using a software utility to format the CompactFlash card on a PC. Note, this software utility can only be used if the card has already been formatted using one of the above two methods.

For more information on the software utilities used for formatting a card, contact Curtiss-Wright support (acra-support@curtisswright.com).

PTP Leap Seconds

When the chassis is synchronized through PTP, the time is already corrected for leap seconds by the BCU. In this situation the Leap Seconds setting on the KAM/MEM/113 is not used.

Difficulty inserting or removing KAM/MEM/113 module

It can sometimes prove difficult to insert and/or extract the KAM/MEM/113 module into a chassis when there is another module in the adjacent slot of the chassis. One of the components on the KAM/MEM/113/02 and /03 module is slightly taller and can potentially hinder the insertion of the KAM/MEM/113 module into the chassis. The KAM/MEM/113 module can still be inserted and extracted from the chassis successfully, however, sometimes, it may be necessary to firstly remove the module in the adjacent slot of the chassis. Then insert the KAM/MEM/113 module and reinsert the module in the adjacent slot.

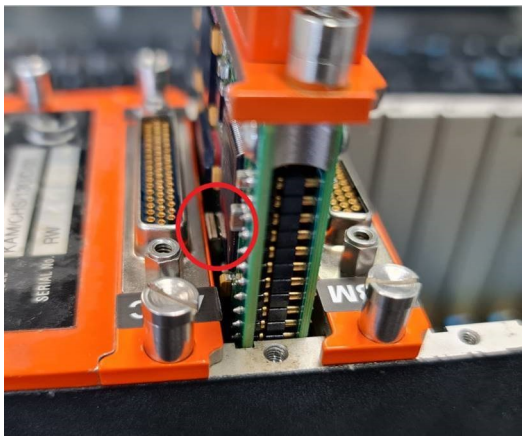


Figure 4: Inserting/extracting a KAM/MEM/113

It is recommended that care should be taken when attempting to insert/extract the KAM/MEM/113 module to/from the chassis slot.

If you do experience this issue and cannot place the module into the chassis safely, then contact support at acra-support@curtisswright.com.

Removing the CompactFlash card

To avoid data loss, ensure the chassis is powered off before removing the CompactFlash card.

To eject the CompactFlash card, unscrew the captive lid locking screw and hinge the lid away from the card (see the following figure). Press the eject button and remove the card. The hinged lid restrains the card while in use. The hinged lid opens out 95°, in an arc of radius 63 mm (2.5 inch).

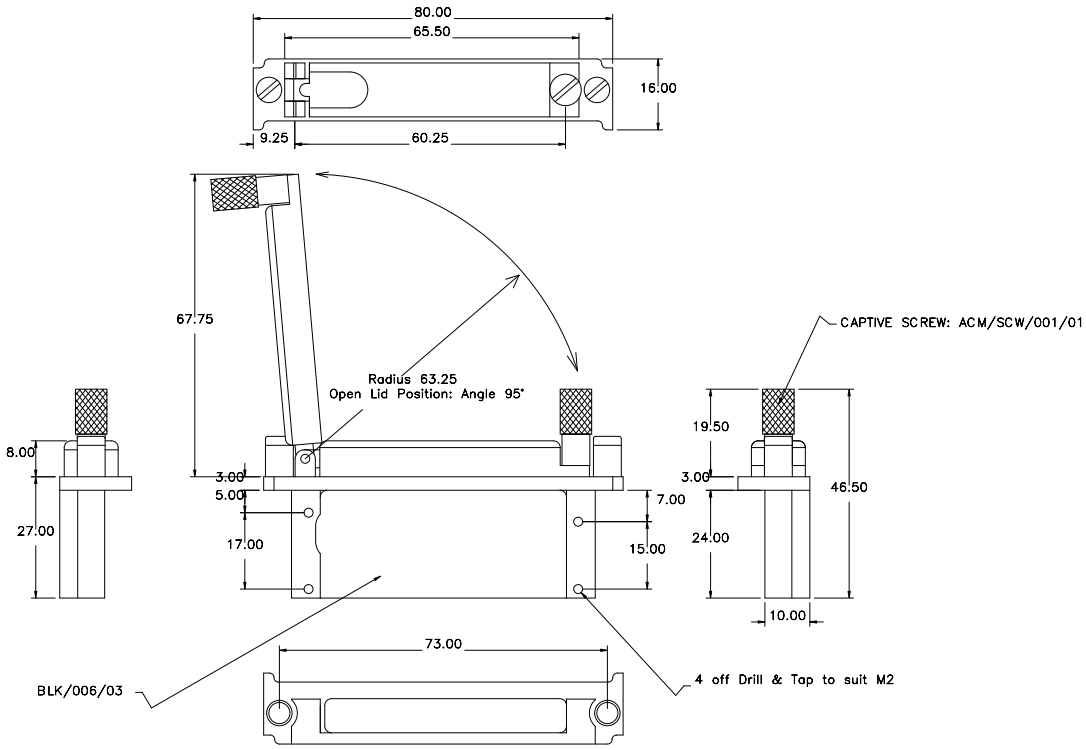


Figure 5: KAM/MEM/113 hinged lid

Connector pinout of the KAM/MEM/113

There is no connector pinout for the KAM/MEM/113.

Ordering information

PART NUMBER	DESCRIPTION
KAM/MEM/113	CompactFlash memory module with PCAP format

The KAM/MEM/113 does not require a connector. Additional items must be ordered separately; refer to Related products for options.

Revision history

REVISION	DIFFERENCES	STATUS
KAM/MEM/113	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

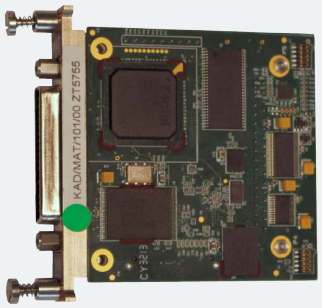
Related products

MODULE	DETAILS
CompactFlash cards	CompactFlash cards for use with Curtiss-Wright products
Data Exporter	Extracts parameter sample values from PCAP files

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
TEC/NOT/051	Ethernet frames, Wireshark® and FAT32
TEC/NOT/083	Using the KAM/MEM/113

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KAD/MAT/101

Microcontroller-based module

The KAD/MAT/101 allows you run your own programs based on a dual core C6000DSP+ARM9 microcontroller. It provides high performance DSP functions in a widely used architecture. You can develop C-based programs using a standard Integrated Development Environment (IDE).

The KAD/MAT/101 offers the functionality of a modern microcontroller and DSP and it facilitates access to the backplane so you can read parameters from and/or write results to other modules. These features allow you to perform a range of complex and computing intensive real-time operations (such as Fast Fourier Transforms [FFT]) to any of the parameters available on the backplane.

DSP programming is facilitated by the use of a C674x DSP library. This library includes C-callable, general-purpose signal-processing routines that are typically used in computationally intensive real-time applications. The Software Development Kit (SDK) comprises of a suite of tools used to develop and debug user applications and includes many other features such as a source code editor, compiler, debugger, and profiler.

When using the KAD/MAT/101, the user object code is developed using the Texas Instruments (TI) tool set on a Linux Virtual Machine (VM) running on a Windows operating system. The resulting binary file can be downloaded to the KAD/MAT/101 without the need for additional equipment or third party software.

Key Features

- Computing module using industry standard C674x Digital Signal Processor (DSP)
- User-programmable microcontroller with embedded DSP
- 256K, 16-bit parameter input and result samples per acquisition cycle
- Object code can be downloaded directly via standard Curtiss-Wright tools
- Coherent data at two or three calculation cycles latency

Applications

- Creation of bespoke flight test applications

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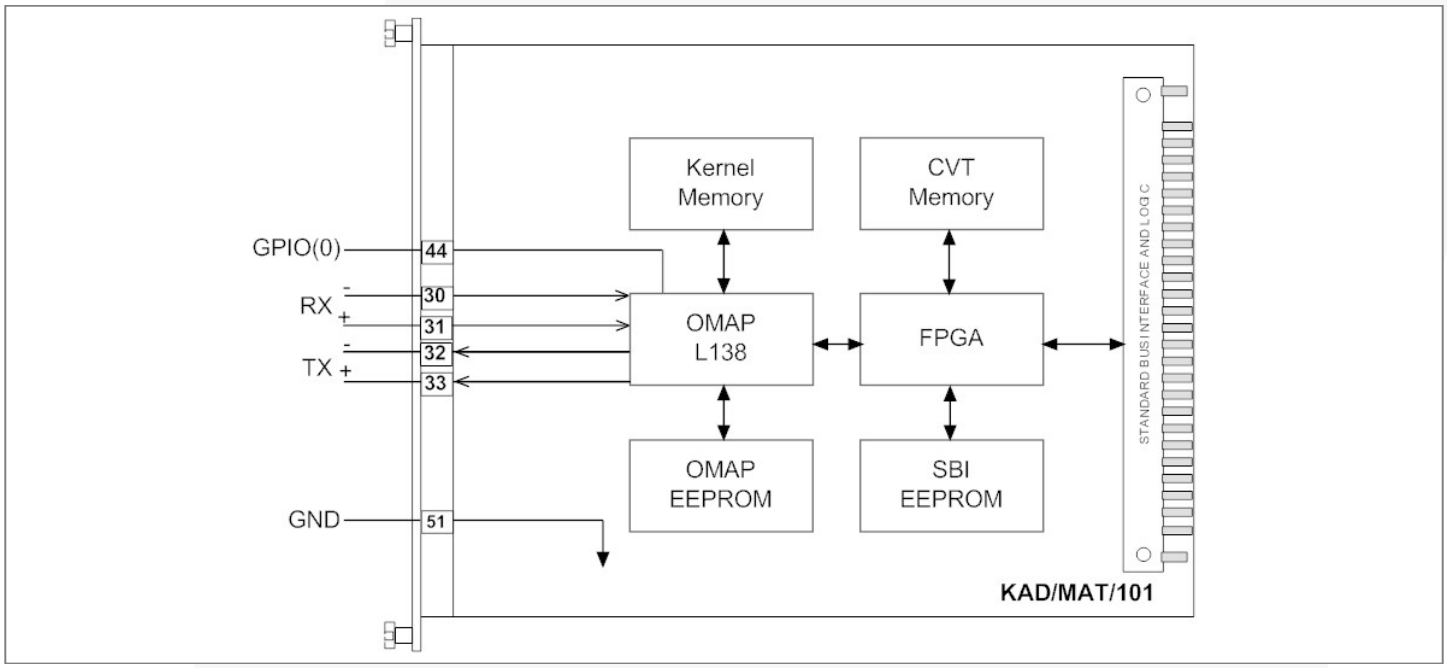


Figure 1: Module block diagram

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Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

Table 1 General specifications

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	90	–	g	
	–	3.17	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	87	–	321	mA	
+12V	79	–	135	mA	
total power	1.86	–	3.225	W	Running a 512 x 32-bit fixed point FFT every 100 ms. Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	70	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

Table 2 RS-232 inputs

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	2	–	
Signaling rate					
	300	–	115200	bps	
Input voltage					
operating range	-25	–	25	V	Do not exceed operating range.
logic 0	2.4	–	–	V	
logic 1	–	–	0.6	V	
overvoltage protection	-25	–	25	V	Voltages outside of this range can damage input.
ESD protection	15	–	–	kV	Human Body Model.
Input resistance					
each input to GND	3	5	–	kΩ	Module powered on.
each input to GND	–	4.4	–	kΩ	Module powered off.

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Table 3 RS-232 outputs

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	2	–	
Signalling rate					
DATA	300	–	115200	bps	
Output voltage					
absolute operating range	-13.2	–	13.2	V	To Ground.
logic 0	5	5.4	–	V	R_{LOAD} = 3 kΩ.
logic 1	–	-5.4	-5	V	R_{LOAD} = 3 kΩ.
short circuit current	-60	–	60	mA	
short circuit duration	–	–	∞	s	Only one output may be shorted at a time.
ESD protection	15	–	–	kV	Human Body Model.
Output resistance	–	10	–	MΩ	

Table 4 BTTL inputs

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	0	4	8	–	
Signaling rate					
	0.001	–	10,000	kHz	
Input voltage					
operating range	0	–	5.5	V	
logic 0	–	–	0.8	V	
logic 1	2	–	–	V	
overvoltage protection	0	–	5.5	V	Voltages outside of this range can damage input.
Input resistance					
each input to GND	–	31	–	MΩ	Module powered on.
each input to GND	–	44	–	kΩ	Module powered off.

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Table 5 BTTL outputs

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	0	4	8	–	
Signaling rate					
	0.001	–	10,000	kHz	
Output voltage					
logic 0	–	–	0.8	V	Sinking 50 mA.
logic 1	2	–	5	V	Sourcing 50 mA.
short circuit current	–	–	50	mA	
short circuit duration	∞	–	–	s	To GND.
Output resistance	50	–	–	Ω	100Ω in series with standard TTL.

Table 6 Ethernet interface

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs/outputs	–	–	1	–	IEEE 802.3 compatible; 10BaseT/100BaseTX full-duplex only. Can be used with both cross-over and straight-through cables.

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Setting up the KAD/MAT/101

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/MAT/101	KAD/MAT/101	The instrument part reference.
SerialNumber	AAA/1234	AAA/1234	Unique name for each module.
Settings	-	-	-
Latency	Fast Standard Custom	Fast	Choice of Fast (2 data acquisition cycles), Standard(3 data acquisition cycles) or Custom (user-defined) result latencies through the system.
ZIP File Path	UTF-8 String		The ZIP file path for the user code (which is down-loaded to the KAD/MAT/101).
Header File Path	UTF-8 String		The file path for the generated header file (which is used in the compilation of the user code).
Settings Advanced	-	-	-
Heart Beat Enable	Enabled Disabled	Enabled	Controls watch dog functionality. Do not disable unless debugging.
Processes	-	-	-
Calculation-Input(2047:0)	-	-	-
Settings	-	-	-
Algorithm Description	UTF-8 String Min size in bytes: 1 Max size in bytes: 1024	My FFT algorithm accord-ing to ref. 123	Description/notes of algorithm used.
Data Conversion	Native 2's Complement Q15 Q31 C15 C31 Native_Byte_Swap	Native	Data format expected on the OMAP-L138 for this calculation channel (see the KAD/MAT/101 User Guide for more information).
Sample Rate	0 to 1e6	1	-
Calculation-Output(2047:0)	-	-	-
Settings	-	-	-
Output Rate	0 to 1e6	1	Number of instances of the Result parameter (set by wizard).
Channels	-	-	-
Event(3:0) PacketiserEvent Input	-	-	If data occurs intermittently it can be sent as one of four packetizer streams
Settings	-	-	-
Packet Size	9 to 719	719	Size of packet buffer in words (including 7-word header).
Packetization Enabled	True False	False	-
Stream Id	0 to FFFFFFFF	FFFFFFFF	Stream ID of packets on this channel.

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SETUP DATA	CHOICE	DEFAULT	NOTES
Packet Rate	0 to 1e6	10	Sets the number of packets per second expected from the KAD/MAT/101.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
ErrorCount Number of errors detected sofar	BitVector	BitVector	16	R[15:0]
IrigTime48 48-bit wide IRIG time word. The time when this bank was written on the chassis.	BitVector	BitVector	48	R[47:0]
MessageTimeHi Hours and minutes time of bank switch.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use. R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
MessageTimeLo Seconds and centiseconds time of bank switch.	BitVector	BitVector	16	R[31:16] R(15) Reserved - Reserved for future use. R[14:8] Seconds - BCD Seconds 0 to 59. R[7:0] Centiseconds - BCD Centiseconds 0 to 99.
MessageTimeMicro Microsecond time of the first bit of bank switch.	Second	BCD	16	R[15:0] R[15:0] Microseconds - BCD Microseconds 0 to 9999.
Report Reports the status of the module.	BitVector	BitVector	16	R[15:0] R(15) Fresh Event - Indicates new event or error. R[14:6] Reserved - Reserved for future use. R(5) OMAP-L138 user event - OMAP-L128 toggled Event line - application event marker (not a Panic). R(4) OMAP-L138 Panic - OMAP-L128 asserted Panic line - serious application error on OMAP-L138 R(3) DMA Write Truncation - EDMA Write Truncated R(2) DMA Read Truncation - EDMA Read Truncated R(1) Read Fifo Underflow - EDMA READ FIFO underflow - x"dead" will be inserted R(0) Watch Dog Error - Watch dog fired - OMAP-L138 was reset.
Calculation-Input(2047:0) Parameters				
Input(127:0) 16-bit input parameter	BitVector	BitVector	16	R[15:0]
Calculation-Output(2047:0) Parameters				
Result(127:0) 16bit result parameter	BitVector	BitVector	16	R[15:0]

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

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Getting the most from the KAD/MAT/101

The processor used in the KAD/MAT/101 is a TI OMAP-L138 dual core processor. Refer to the Texas Instruments website at http://www.ti.com under the OMAP section for full technical details and documentation.

The software running on the OMAP-L138 processor can be written using the TI SDK which runs on Linux (Ubuntu 10.04). This Linux development environment can be run as a VM on a Windows operating system containing the SDK and extensions.

For ease of development, the object code can be transferred to the KAD/MAT/101 using DAS Studio 3. A serial link is available on the top connector for console messages. When updating the user application while the module is at an elevated temperature, a power cycle may be required to ensure correct loading of the user application.

NOTE: After power-up, the KAD/MAT/101 generates undefined result content and undefined BTTL outputs until the user process is running.

A training course can be given to aid development of user programs on the KAD/MAT/101. Attendees are expected to be familiar with embedded programming in C. The course focuses on backplane data transfer to and from the KAD/MAT/101 and on how to integrate with DAS Studio 3.

Due to the user-definable nature of KAD/MAT/101 modules, Curtiss-Wright cannot provide support for debugging customer-generated code. Instead, example code with instructions for use is provided (see the KAD/MAT/101 User Guide for details).

Support is provided in the form of confirming hardware functionality and to supporting the example_loopback , ug_led and ug_serial examples provided in the MAT user documentation.

Power consumption

The power consumption varies depending on the amount of processing performed by the card and may exceed the allowed 260 mA (on the 5V rail) and 96 mA (on the 12V rail) for a single slot.

Suggested applications

The KAD/MAT/101 allows you to develop bespoke applications for flight test applications in the following domains:

- Frequency analysis of analog signals
- Digital filtering of analog parameters
- Data transformation and concentration
- Engineering unit conversion
- Custom Built-In Test (BIT) reports
- Exceedance reporting
- NMEA message parsing
- Fuel level tracking
- SNMP monitoring

The Fast Fourier Transform (FFT) program

The KAD/MAT/101 module ships with example code for an FFT program. The following steps are required to create a turnkey application:

1. Decide on an input parameter set.
2. Decide on a return parameter set.
3. Produce a configuration file with these settings.

The resulting configuration file is then used in DAS Studio 3 to produce a C-language header file, which defines the indices of the input and return parameter instances in the kernel memory. The program is then written using the Texas Instruments DVSDK on Ubuntu 10.04 and a cross compiled image is produced as an .ELF file. This executable is cross-compiled using the GNU tool chain specifically for the ARM processor and only runs on the KAD/MAT/101 processor. The ELF executable and all related files (if any) are then compressed into a ZIP archive on Ubuntu and copied to the PC, where it is then referenced in the task configuration file. During subsequent programming, the .ELF file is transferred to the KAD/MAT/101 module and is run during data acquisition. Results produced by the program are written to memory, which is then accessible over the backplane for further use.

How buffering works

The KAD/MAT/101 module retrieves and stores data in banks of parameters. These banks are timestamped and all parameters in the banks are coherent. The module can receive up to 256K words (16 bits) of input instances during a calculation cycle. Available kernel memory on the microprocessor can be used to increase the amount of

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data which is buffered. This buffered data can then be used to increase the resolution of an FFT calculation, for example by using overlapped buffers.

Typically, the module is used for data reduction and it processes far more inputs than it produces results; however by selecting the result page, the entire 256K of result space can be accessed if required. The result data is coherent; however it lags by two or three calculation cycles depending on the latency setting.

File system storage

The standard file system is read-only. There is provision made for 512 KB of read/write file system if required for the turnkey application.

RAM and EEPROM space available for user code

The following space is available for user code:

- 80 MB of RAM
- 5.5 MB of EEPROM (maximum zip is 1 MB)

Additional I/Os

There are additional I/Os available on the top-block for end-user use.

- Dedicated console and user-application RS-232 links
- Eight BTTL I/O (subject to available current on BTTL)
- One full-duplex Ethernet I/O

The eight general purpose I/Os can be configured in two banks of four to be either inputs or outputs:

Bank A contains pins GPIO(0) to GPIO(3); and Bank B contains pins GPIO(4) to GPIO(7).

The banks can be independently configured as input only or output only.

NOTE: The direction of the GPIOs can be configured as a bank only. For instance, if GPIO(0) is selected to be an input, then all GPIOs in bank A will be inputs; they cannot be individually configured within the bank.

The Ethernet, RS-232, and eight TTL I/Os are not used during standard operation and require additional software development. We recommend that only advanced users (preferably with experience in the development of firmware for embedded systems) program these I/Os when used for acquisition purposes.

Instead of using inputs via the top-block, we recommend using backplane data as the input for standard operation. Following this recommendation, dedicated KAD modules can be used to parse other buses (such as Ethernet and RS-232) and pass the data to the KAD/MAT/101 over the backplane.

NOTE: There is no internal pull-up or pull-down resistors on the BTLL I/O. If required, these can be placed externally.

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Connector pinout of the KAD/MAT/101

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	DNC		Do not connect
2	DNC		Do not connect
3	DNC		Do not connect
4	DNC		Do not connect
5	RS_IN(1)	RS-232 inputs	Serial line; available for end-user
6	RS_IN(0)	RS-232 inputs	Serial line (console)
7	RS_OUT(1)	RS-232 outputs	Serial line; available for end-user
8	DNC		Do not connect
9	CHASSIS	Chassis	
10	DNC		Do not connect
11	DNC		Do not connect
12	DNC		Do not connect
13	DNC		Do not connect
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	GPIO(7)	BTTL inputs/BTTL outputs	General end-user I/O (Bank B)
18	GND		For use with I/O
19	GND		For use with I/O
20	GND		For use with I/O
21	GND		For use with I/O
22	GND		For use with I/O
23	GND		For use with I/O
24	GND		For use with I/O
25	GND		For use with I/O
26	RS_OUT(0)	RS-232 outputs	Serial line (console)
27	CHASSIS	Chassis	
28	DNC		Do not connect
29	DNC		Do not connect
30	RX(-)	Ethernet interface	Ethernet interface
31	RX(+)	Ethernet interface	Ethernet interface
32	TX(-)	Ethernet interface	Ethernet interface
33	TX(+)	Ethernet interface	Ethernet interface
34	DNC		Do not connect
35	GPIO(6)	BTTL inputs/BTTL outputs	General end-user I/O (Bank B)
36	CHASSIS	Chassis	
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	GPIO(0)	BTTL inputs/BTTL outputs	General end-user I/O (Bank A)
45	GPIO(1)	BTTL inputs/BTTL outputs	General end-user I/O (Bank A)
46	GPIO(2)	BTTL inputs/BTTL outputs	General end-user I/O (Bank A)
47	GPIO(3)	BTTL inputs/BTTL outputs	General end-user I/O (Bank A)
48	DNC		Do not connect
49	GPIO(4)	BTTL inputs/BTTL outputs	General end-user I/O (Bank B)
50	GPIO(5)	BTTL inputs/BTTL outputs	General end-user I/O (Bank B)
51	GND	Internal ground	
52	CHASSIS	Chassis	

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Ordering information

PART NUMBER	DESCRIPTION
KAD/MAT/101	Microcontroller-based module

By default, one DEV/KIT/001 or DEV/KIT/001/CHN is included with each order, while a standard mating connector, CON/KAD/002/CP, is included with each module in the order. Their part numbers will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/MAT/101	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
Ubuntu 10.04 + TI DVSDK	A Linux cross-compilation environment is required to generate the user configurations (in C++ using the C6Accel framework from TI)
DEV/KIT/001	Development kit for KAD/MAT/101

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
DOC/USG/017	KAD/MAT/101 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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KAM/TCG/105

Time-code generator with GPS/IRIG input and battery backup

CURTISSWRIGHTDS.COM



Key Features

- Synchronizes with IRIG-B or GPS
- 1 µs time resolution
- Less than three parts per million drift when acting as a generator
- Time is maintained on an internal battery during power-off
- GPS navigation information is available
- Secondary time source input

Applications

- System synchronization
- Parameter time tagging
- Global positioning

Overview

The KAM/TCG/105 can accept time from an IRIG-B time source, from its onboard GPS receiver (external antenna required), or from an external GPS receiver outputting NMEA messages and a one PPS signal. The received time is written to an internal timer and to a Real-Time Clock (RTC) that maintains time during power-down. The time can be used for synchronization of a distributed Acra KAM-500 data acquisition system. The module generates IRIG-B outputs to allow external devices to synchronize with the Acra KAM-500 system.

The module comprises a GPS reader and an IRIG reader which decode incoming signals. The IRIG reader extracts control functions and straight binary seconds as well as time. The GPS reader parses NMEA messages as they are generated by the receiver. Extracted navigation data such as position, altitude, velocity, and heading are available as individual parameters. The module can also be synchronized via NMEA messages being sent over RS-232 from a third party GPS or PC with granularity of one second.

The timer block is a 4 x 16-bit Binary Coded Decimal (BCD) counter with microsecond resolution. For example, at 1 µs before midnight on January 1, the timer would read 0001 23:59 59.99 9999.

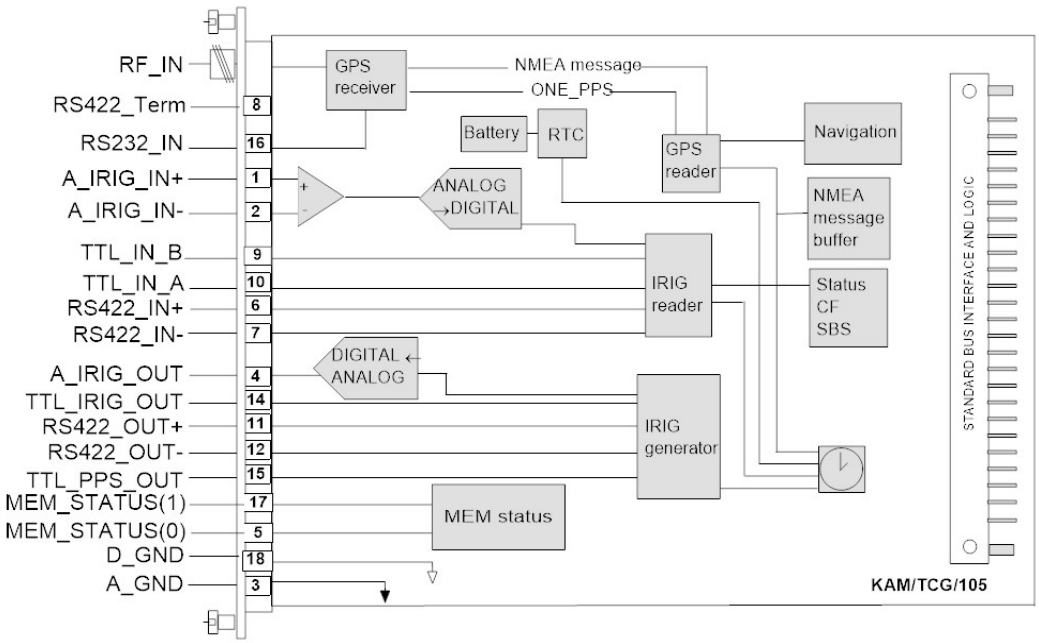


Figure 1: Inputs and outputs on the KAM/TCG/105

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	90	–	g	
	–	3.17	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/003/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	inch	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	–	–	230	mA	
±7V	–	–	0	mA	
+12V	–	–	32	mA	With no antenna connected.
-12V	–	–	28	mA	
total power	–	–	1.87	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	
Battery duration	–	–	4	years	To replace the battery, the unit must be returned to Curtiss-Wright. Contact Curtiss-Wright support (acra-support@curtisswright.com) for details.

TABLE 2	Active antenna inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	1	–	
Bias voltage	5.15	–	5.35	V	
Bias current	–	–	50	mA	
Signal strength	-138	–	–	dBm	
Antenna gain	10	26	50	dB	See “GPS antenna” on page 988.
Antenna noise	–	–	1.5	dB	See “GPS antenna” on page 988.
ESD protection	–	2	–	kV	Human body model

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TABLE 3	Onboard GPS receiver				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	1	–	
Time accuracy	–	–	1	µs	Relative to GPS time. See “GPS time” on page 988.
Position accuracy					See “Navigation data accuracy” on page 988.
2D fix	2.5	–	22	m	Circular Error Probable (CEP).
3D fix	2.5	–	22	m	Spherical Error Probable (SEP).
Satellite acquisition time					See “Acquisition” on page 988.
reacquisition	3.5	5	–	s	
warm power-up	–	40	–	s	
cold power-up	–	60	–	s	Test carried out with a minimum of four satellites in use.
GPS update rate	–	1	1	Hz	
Time format	–	–	–	–	Coordinated Universal Time (UTC).
Navigation datum	–	–	–	–	World Geodetic System-84 (WGS-84). See “Datum” on page 988.
Restrictions					Coordinating Committee for Multilateral Export Controls restrictions apply.
velocity	–	–	1,854	kph	
velocity	–	–	1,000	knots	
altitude	–	–	18,000	m	
altitude	–	–	60,000	ft	

TABLE 4	Analog IRIG time inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	1	–	
Sampling rate					
A_IRIG_IN	–	–	2	Msps	Operating as analog IRIG-B input, the following time codes are supported: IRIG-B 120, 121, 122, 123.
Input voltage					
voltage range	0.1	–	10	V_{p-p}	
overvoltage protection	-7	–	12	V	Voltages outside of this range can damage input.
Time error					
offset	–	–	4	µs	
Input resistance					
between inputs	–	1.1	–	MΩ	Module powered off.
between inputs	52	–	–	kΩ	Module powered on.
each input to GND	–	75	–	kΩ	Module powered off.
each input to GND	390	–	–	kΩ	Module powered on.

TABLE 5	BTTL inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	2	–	
Signalling rate					
TTL_IN	–	–	1	bps	Operating as ONE_PPS input.
TTL_IN	–	–	100	bps	Operating as IRIG-B input, the following time codes are supported: IRIG-B 000, 001, 002, 003.
Input voltage					
operating range	0	–	5.25	V	
logic 0	0	–	0.7	V	
logic 1	2	–	5.25	V	
overvoltage protection	-0.3	–	6	V	Voltage in excess of these values can damage input.
Signalling currents					
logic 0	–	-0.2	-0.5	mA	
logic 1	–	2	5	mA	
Input resistance					
each input to GND	–	27	–	MΩ	Module powered on.
each input to GND	–	53	–	kΩ	Module powered off.
Time error					
offset	–	–	2	µs	Over full operating temperature range. When configured as primary (TTL_IRIG) input range.

TABLE 6	RS-232 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	1	–	
Baud rate					
RS232_IN	4,800	–	115,200	bps	The following baud rates are supported: 4800, 9600, 19200, 115200.
Input voltage					
operating range	-25	–	25	V	Do not exceed operating range.
logic 0	–	–	0.6	V	V_{IN+} - V_{IN-}.
logic 1	2.4	–	–	V	V_{IN+} - V_{IN-}.
overvoltage protection	-25	–	25	V	Voltage in excess of these values can damage input.
ESD protection	-15	–	15	kV	Human Body Model.
Input resistance					
each input to GND	–	4.8	–	MΩ	Module powered on.
each input to GND	–	4.7	–	kΩ	Module powered off.

TABLE 7	RS-422 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	2	–	
Signalling rate					
RS422_IN	–	–	100	bps	Operating as IRIG-B input, the following time codes are supported: IRIG-B 000, 001, 002, 003.
RS422_IN	4,800	–	115,200	bps	Operating as NMEA data input, the following baud rates are supported: 4800, 9600, 19200, 115200.
Input voltage					
operating range	-7	–	12	V	Do not exceed operating range.
logic 0	–	–	-0.7	V	V_{IN+} - V_{IN-}.
logic 1	0.7	–	–	V	V_{IN+} - V_{IN-}.
overvoltage protection	-7	–	12	V	Voltage in excess of these values can damage input.
ESD protection	–	–	15	kV	Human Body Model.
Input resistance					
between inputs	–	117	–	MΩ	Module powered on.
between inputs	–	117	–	kΩ	Module powered off.
between inputs	–	121	–	Ω	Module powered on and inputs terminated.
between inputs	–	121	–	Ω	Module powered off and inputs terminated.
each input to GND	–	4.2	–	MΩ	Module powered on.
each input to GND	–	59	–	kΩ	Module powered off.

TABLE 8	Analog IRIG time outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	1	–	
Signaling rate					
A_IRIG_OUT	–	–	1	kHz	Operating as analog IRIG-B 123 output with a 1 kHz carrier frequency.
Output voltage					
mark amplitude	4	–	20	V_{p-p}	Range: 4, 8, 12, 16, 20.
mark to space ratio	–	3	–	–	Space amplitude = mark amplitude/3.
short circuit current	3	10	–	mA	
short circuit duration	∞	–	–	s	To GND.

TABLE 9	BTTL outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	2	–	
Signaling rate					Outputs are updated at the start of the acquisition cycle.
MEM_STATUS(0)	–	–	100	kbps	
MEM_STATUS(1)	–	–	100	kbps	
Output voltage					
logic 0	–	–	0.44	V	Sinking 24 mA.
logic 1	4.4	–	–	V	Sourcing 24 mA.
short circuit current	–	–	50	mA	
short circuit duration	∞	–	–	s	To GND.

TABLE 10	BTTL outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	2	–	
Signaling rate					
TTL_IRIG_OUT	–	–	100	bps	Operating as IRIG-B 003 digital output.
TTL_PPS_OUT	1	–	10	Hz	Operating as a selectable one or 10-PPS output. Rising edge of TTL_PPS_OUT indicates the start of a second.
Output voltage					
logic 0	–	–	0.2	V	Sinking 0.1 mA through 100Ω output resistance.
logic 1	4.8	–	–	V	Sourcing 0. 1mA through 100Ω output resistance.
short circuit current	–	–	50	mA	
short circuit duration	∞	–	–	s	To GND.

TABLE 11	RS-422 outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	1	–	
Signaling rate					
RS422_OUT	100	–	–	bps	When providing IRIG-B.
RS422_OUT	–	–	1	Mbps	When providing X-SYNC.
Output voltage					
operating voltage	-7	–	12	V	Absolute voltage of the operating signal must stay within this range.
logic 0	–	–	-2	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
logic 1	2	–	–	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
overvoltage protection	-7	–	12	V	
short circuit current	–	–	250	mA	
short circuit duration	∞	–	–	s	Only one output may be shorted at a time.
ESD protection	-15	–	15	kV	Human Body Model.

Setting up the KAM/TCG/105

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAM/TCG/105	KAM/TCG/105	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Settings	-	-	-
Time Server	Master FreeRunning Slave	Master	When Master, time is seeded from the KAM/TCG/105 into other slave modules. When Slave, time is seeded from a master module into the KAM/TCG/105. When FreeRunning, no time seeding takes place.
Primary Input	IRIG-B GPS RTC	IRIG-B	Specifies which input takes priority; when selecting RTC, seeded time is loaded from the RTC.
Allow Secondary	True False	True	When set to True allows the module to switch to either the primary or secondary time source (which-ever is in lock).
Control Function Source	IRIG-B Zeros Year	Zeros	Selects which bit-pattern is loaded on the Control Function field of the outgoing IRIG-B stream.
Settings *IRIG-B-In*	-	-	Settings on the IRIG-B input.
Current Year	2011 to 2098	2015	Indicates the current year.
IRIG Source	Analog RS-422 TTL_A	TTL_A	Selects the physical interface used for decoding the IRIG-B time code stream.
IRIG-B revision	IRIG-B-200-9x IRIG-B-200-04	IRIG-B-200-9x	When selected, module decodes the year from the CF bits (IRIG-B-200-04).
Processes	-	-	-
MemoryFilter	-	-	A parameter placed in this register is used to gener-ate the output of the MEM_STATUS (80% full and logging).
Parser(14:0)	-	-	One of 15 NMEA parser slots.
Catchall-Parser	-	-	Any NMEA message that is not parsed goes to this final parser slot.
Channels	-	-	-
GPS-In *GPS-In Input*	-	-	Time and navigation parameters are taken from the KAM/TCG/105's onboard GPS receiver.
Settings	-	-	-
GPS Source	OnBoardGPS RS-422 RS-232	OnBoardGPS	-
PPS Source	TTL_A RS-422	None	-
Maximum Dilution Of Precision	1 to 15	5	Specifies the maximum Dilution of Precision (DOP) allowed. DOP is an expression of the quality of the GPS solution; the lower the value, the more accurate it is.

SETUP DATA	CHOICE	DEFAULT	NOTES
Baud Rate	4800 9600 19200 38400 57600 115200	19200	Specifies the number of symbols received per second.
Settings *On Board GPS*	-	-	These settings are only applied to the onboard GPS receiver.
Dynamic	Stationary Pedestrian Automotive Sea Airborne with <1g Acceleration Airborne with <2g Acceleration Airborne with <4g Acceleration	Airborne with <2g Acceleration	Dynamic profile of onboard GPS receiver.
Leap Seconds	0 to 255	15	The number of seconds difference between UTC and GPS time; only applied to onboard GPS receiver.
PPS-Out *TTL Output*	-	-	One or ten Pulse Per Second output.
Settings	-	-	-
PPS Rate	1 10	1	-
RS-422-Out *RS-422 Output*	-	-	Outputting IRIG-B, NMEA or X-SYNC
Settings	-	-	-
Mode	IRIG-B X-SYNC NMEA	IRIG-B	Switches amongst outputting digital IRIG-B, X-SYNC out (which synchronizes legacy data acquisition systems) or NMEA (NMEA being the electrical copy of the NMEA source). If GPS onboard is used, the baud rate set internally for output NMEA messages is 115200 bps.
TTL-Out *TTL Output*	-	-	Outputting IRIG-B.
MEM_STATUS(1:0) *Digital Output*	-	-	MEM_STATUS(1:0) showing 80% full and logging function of the memory card.
Analog-IRIG-BOut *Analog Output*	-	-	Outputting an analog IRIG-B stream (1kHz amplitude modulated sine wave).
Settings	-	-	-
Amplitude	2 to 10	4	-
RS-422-In *RS-422 Input*	-	-	-
Settings	-	-	-
TTL-In *TTL Input*	-	-	-
Analog-IRIG-BIn *Analog Input*	-	-	-
Settings	-	-	-

SETUP DATA	CHOICE	DEFAULT	NOTES
PPS Source	TTL_A TTL_B RS-422 None	None	-
RS-232-In *RS-232 Input*	-	-	-

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
StatusIn IRIG-B and timer status register.	BitVector	BitVector	16	R[15:0] R(15) IRIG-BLock - When 1, the IRIG-B decoder is locked to a valid IRIG-B stream. R(14) StraightBinarySeconds(16) - Bit 16 (MSB) of the Straight Binary Seconds decoded from the IRIG-B stream (see StraightBinarySeconds for bits 15 to 0). R[13:3] Reserved R(2) SourcePrimary - When 1, the timer is locked to the primary timer source. R(1) TimerLock - When 1, the timer's PLL is in lock with the input TIME ONE_PPS source. R(0) Reserved
ControlFunction Control Function (CF) bits received from the IRIG-B input.	BitVector	BitVector	32	R[31:0] R[31:5] ControlFunction R[4:0] Reserved
StraightBinarySeconds Sixteen LSBs of the seventeen Straight Binary Seconds received in the IRIG-B stream.	Second	OffsetBinary	16	R[15:0]
IrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
TimeHi Time in hours and minutes at the start of the acquisition cycle.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
TimeLo Time in seconds and centiseconds at the start of the acquisition cycle.	BitVector	BitVector	16	R[31:16] R(15) Reserved - Reserved for future use R[14:8] Seconds - Seconds 0 to 59. R[7:0] Centiseconds - Centiseconds 0 to 99.
TimeMicro Time in microseconds at the start of the acquisition cycle.	Second	BCD	16	R[15:0] R[15:0] Microseconds - Microseconds 0 to 9999.
DayOfYear The day of the year from 1 to 366 at the start of the acquisition cycle.	BitVector	BitVector	16	R[15:0] R[15:10] Reserved R[9:0] DayOfYear
MemoryFilter Parameters				

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MemoryReportRegister Use the MEM module report register as input. This drives the MEM_STATUS(1:0) outputs.	BitVector	BitVector	16	R[15:0]
Parser(14:0) Parameters				
MessageInfo Indicates status of message (stale/skipped/empty)	BitVector	BitVector	16	R[15:0] R(15) Empty - This slot is empty. R(14) Stale - Contents of this slot have already been read. R(13) Skipped - Contents of this slot have been overwritten. R[12:0] Reserved - Reserved for future use.
Catchall-Parser Parameters				
MessageData(40:0) The 2x8 bits of a particular byte in serial NMEA messages (word aligned, 41 words maximum)	BitVector	BitVector	16	R[15:0]
MessageInfo Indicates status of message (stale/skipped/empty)	BitVector	BitVector	16	R[15:0] R(15) Empty - This slot is empty. R(14) Stale - Contents of this slot have already been read. R(13) Skipped - Contents of this slot have been overwritten. R[12:0] Reserved - Reserved for future use.
GPS-In Parameters				
Latitude Latitude received in the NMEA stream.	BitVector	BitVector	48	R[47:0]
LatitudeHi Degrees and minutes of latitude.	Unitless	BCD	16	R[47:32] R[15:8] Degrees - Degrees of latitude 0 to 89. R[7:0] Minutes - Minutes of latitude 0 to 59.
LatitudeLo Decimal minutes of latitude.	Unitless	BCD	16	R[31:16] R[31:16] DecimalMinutes - Decimal places of minutes of latitude 0.0000 to 0.9999.
LatitudeMicroMinutes Fifth decimal place of minutes of latitude.	BitVector	BitVector	16	R[15:0] R[15:4] Reserved R[3:0] DecimalMinutes - Fifth decimal place of minutes of latitude 0.00000 to 0.00009.
Longitude Longitude received in the NMEA stream.	BitVector	BitVector	48	R[47:0]
LongitudeHi Degrees of Longitude.	BitVector	BitVector	16	R[47:32] R[47:44] Reserved R[43:32] Degrees - Degrees of longitude 0 to 179.
LongitudeLo Minutes and decimal minutes of longitude.	Unitless	BCD	16	R[31:16] R[31:24] Minutes - Minutes of longitude 0 to 59. R[23:16] DecimalMinutes - Decimal places of minutes of longitude 0.00 to 0.99.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
LongitudeMicroMinutes Decimal minutes of longitude.	BitVector	BitVector	16	R[15:0] R[27:12] Reserved R[11:0] DecimalMinutes - Last three decimal places of minutes of longitude 0.00000 to 0.00999.
Altitude Altitude expressed as height above Mean Sea Level (MSL).	BitVector	BitVector	32	R[31:0]
AltitudeHi Tens of thousands of meters.	BitVector	BitVector	16	R[31:16] R(31) AltitudeIsNegative - When 1, the altitude is below mean sea level. R[30:20] Reserved R[19:16] Altitude - Tens of thousands of meters 0 to 9.
AltitudeLo Thousands of meters.	Meter	BCD	16	R[15:0] R[15:0] Altitude - Meters 0 to 9999.
VelocityInKph Velocity in kilometers per hour.	MetersPerSecond	BCD	16	R[15:0] R[15:0] VelocityInKph - KM 0 to 9999.
VelocityInKn Velocity in nautical miles per hour.	Unitless	BCD	16	R[15:0] R[15:0] VelocityInKn - KN 0 to 9999.
Heading True course over ground.	BitVector	BitVector	32	R[31:0]
HeadingHi Degrees of true course over ground.	Unitless	BCD	16	R[31:16] R[31:26] Reserved R[25:16] Degrees - Degrees 0 to 359.
HeadingLo Decimal degrees of true course over ground	Unitless	BCD	16	R[15:0] R[15:8] Reserved R[7:0] DecimalDegrees - Decimal degrees of true course over ground.
DilutionOfPrecision Dilution of precision. See “Dilution of Precision (DOP)” section.	BitVector	BitVector	16	R[15:0] R[15:12] Reserved R[11:8] PDOP - Positional DOP; if DOP > 15 then 15 is returned. R[7:4] HDOP - Horizontal DOP; if DOP > 15 then 15 is returned. R[3:0] VDOP - Vertical DOP; if DOP > 15 then 15 is returned.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
StatusGPS GPS status register.	BitVector	BitVector	16	R[15:0] R(15) GPSLock - When 1, the GPS decoder is locked to a valid NMEA stream. R(14) FixError - When 1, indicates that the Fix Flag was not set R(15)=0. R(13) CheckSumError - When 1, indicates that a checksum error was detected R(15)=0. R(12) TooFewSatellites - When 1, indicates that less than the minimum configured number of satellites are used, which can affect the quality of the received data. R(11) DOPTooHigh - When 1, indicates that one of the DOP (Dilution of Precision) figures is outside a specified range. R(10) North/South - When 0, the latitude read is in the northern hemisphere; when 1, the latitude read is in the southern hemisphere. R(9) East/West - When 0, the longitude read is east of the Greenwich Meridian; when 1, the longitude read is west of the Greenwich Meridian. R(8) LocationValid - This bit will be set when Latitude/Longitude information has been successfully parsed from the NMEA stream. R[7:4] SatellitesInView - Number of satellites in view. R[3:0] SatellitesInUse - Number of satellites used to calculate GPS solution.

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAM/TCG/105

The KAM/TCG/105 is a combined GPS and IRIG-B input module. It can accept inputs from a number of sources.

SMA torque setting

The recommended torque setting for the SMA connector is 0.45 Nm (0.33 foot pound-force).

PPS pulse input

There are three PPS inputs: TTL_IN_A, TTL_IN_B, and RS-422 (when selected).

TTL_IN_B is a dedicated PPS input. TTL_IN_A and RS-422 can also be used to take in IRIG-B digital or NMEA messages.

When used for PPS inputs, these can be used to synchronize to an external 1 PPS pulse.

NOTE: TTL_IN_B can only be used with analog IRIG-B.

Time seeding

On power-up of the Acra KAM-500, the KAM/TCG/105's timer is seeded with time from the RTC. The RTC receives time once the source (GPS or IRIG) is locked. Once powered down, the battery maintains time on the RTC. Then on subsequent power-ups, time is loaded from the RTC.

NOTE: Typically, it can take 2 seconds from power up for the module to get its time from the RTC, during which time it will free run.

Once a time source is locked, it updates the internal RTC time. If the module is in slave mode, the RTC time is updated with time from the master module.

Alternatively, the initial time can be set from the PC using either Time Seeder or kTimeseed.

It is not recommended to power on the module at less than -30°C if no external timing source is applied, as the RTC may not seed the correct time and the internal clock will indicate time since power on.

Primary and secondary inputs

The KAM/TCG/105 accepts time from either an IRIG-B stream or a GPS receiver via NMEA messages.

It is possible to use one time source as the primary input and optionally enable the other time source as the secondary input. If the primary time source becomes unavailable (missing or has errors), then after 10 seconds the KAM/TCG/105 switches to the secondary source. Later, if the primary source becomes available again then the KAM/TCG/105 switches back to the primary time source after 10 seconds.

This allows for synchronization with a secondary IRIG source when an aircraft is in the hangar where GPS is not available; then for GPS to be used when the aircraft is on the runway or in flight, without reprogramming the Acra KAM-500.

If the primary source is GPS then the secondary source must be IRIG and vice versa. For instance, you cannot use an external GPS receiver as the primary time input and use the onboard GPS receiver as the secondary time input. Also, because the digital pins are used for more than one function, there must be no pin clash between the primary and secondary input pins.

The following table shows available combinations of primary and secondary time inputs.

		IRIG		
		Analog	TTL_IN	RS422_IN
GPS	On Board	Y	Y	Y
	RS422_IN TTL_PPS	Y	N	N
	RS232_IN TTL_PPS	Y	N	Y

Control Function Source

The KAM/TCG/105 can set the control function bits of the outgoing IRIG-B stream as shown in the following table.

SETTING	DESCRIPTION
IRIG-B	CF bits are copied from the incoming IRIG-B stream
Zeros	CF bits are set to Zero
Year	CF bits are used to encode the current year as per IRIG Standard 200-04.

Clock synchronization

The KAM/TCG/105's timer uses a digital Phase Locked Loop (PLL) to synchronize its own clock with an external time source. Frequency and phase error are corrected every second. If the error is greater than 500 µs, the PLL jumps to the correct time immediately. After that it tracks the external time source. When the PLL is locked to the external time source, R(1) of the IRIG_STATUS register is set to one.

The timer in a KAD/BCU/101 can be seeded with time from

the KAM/TCG/105 at the start of the acquisition cycle, but over the course of the acquisition cycle, it can drift by up to 4 µs per second. This can be eliminated by physically connecting the KAM/TCG/105's X-SYNC OUT signal to the KAD/BCU/101 X-SYNC signal.

GPS antenna

A minimum antenna gain of 10dB is recommended to compensate for losses in the cable connecting the antenna to the KAM/TCG/105. A maximum antenna gain of 50 dB and a maximum antenna noise figure of 1.5 dB are recommended for the GPS receiver.

The GPS receiver calculates the carrier-to-noise ratio for the antenna at power-up. It is therefore important that the GPS antenna is connected to the module before it is powered up. Power to the active antenna is linearly regulated down from the modules 12V to a nominal 5.25V antenna supply. When estimating system power the max current drawn theoretically by the antenna should be added to the KAM/TCG/105 +12V current figure.

NOTE: The previously recommended antenna RFE/AEG/001 is no longer available for purchase. The S67-1575-132 antenna from Sensor System Inc. is now recommended.

GPS receiver

The KAM/TCG/105 uses a civilian-band (L1) GPS receiver. The United States Department of Defense (DoD) can turn on Selective Availability (SA) at any time without warning. This degrades the accuracy of the GPS data.

The KAM/TCG/105 can extract time and navigation information from an NMEA data stream. It is fitted with an onboard GPS receiver but can be interfaced to an external L1 or L2 GPS receiver via the 19-way connector.

The NMEA messages, GGA, and ZDA or RMC, are the minimum required for KAM/TCG/105 time synchronization. The VTG message is required to get velocity and true heading. If it is not provided then registers VELOCITY_KPH, VELOCITY_KN, HEADING are forced to an illegal state of all 1s.

NOTE: GPS is a broad subject and beyond the scope of this data sheet. There are many online guides and GPS dictionaries such as those found at the following links:
www.gps.oma.be/gb/dic_gb_ok_css.htm
www.colorado.edu/geography/gcraft/notes/gps/gps_f.html

Altitude representation

The GGA NMEA message contains altitude fields above mean sea level. When the altitude is 25 meters above sea level, it gives a reading of 00025; when the altitude is 25 meters below sea level, it gives a reading of 00D25. The D indicates that the reading is negative.

GPS time

The KAM/TCG/105 derives time from data received from a constellation of satellites. These satellites are in continuous moving orbit which affects the behavior of the KAM/TCG/105 as described in “Acquisition” on page 988.

The KAM/TCG/105 measures GPS time; the accuracy of the time is not absolute but relative to the GPS time. If an external GPS receiver is used, the KAM/TCG/105 locks to within ±1 µs without considering the external GPS receiver accuracy.

Acquisition

Along with time and navigation data, GPS satellites transmit GPS ephemeris data and GPS almanac data.

Ephemeris data tells the GPS receiver where each GPS satellite is at any time throughout the day. Each satellite transmits ephemeris data showing the orbital information for that satellite and for every other satellite in the system.

Almanac data is constantly transmitted by each satellite. It contains information about the status of the satellite, current date and time.

Cold power-up

When the GPS receiver is powered up for the first time or has no backup battery connected, the GPS receiver has no knowledge of its last position or approximate time, and has no ephemeris or almanac data. The GPS receiver starts to search for signals blindly. This is normal behavior. Cold power-up for GPS receivers can take several minutes.

Navigational data

The KAM/TCG/105 may be used to record navigation information. The information provided by the KAM/TCG/105 is referenced to a specific datum.

Datum

The onboard GPS receiver uses WGS-84, which is a geographic model obtained by referencing the earth's sea level surface area and applying theoretical mathematical calculations. The chart datum is usually defined in the legend of the chart.

Navigation data accuracy

Unlike GPS time the position information is subject to a

number of inaccuracies, due to the inherent behavior of the GPS system.

GPS status register

GPS lock is set to one when the KAM/TCG/105 receives a valid NMEA stream and accompanying PPS signal from either the onboard GPS receiver or an external GPS receiver connected to the KAM/TCG/105. It is cleared only on arrival of a PPS signal if the NMEA stream is not valid (for example the fix flag not set), or after two seconds without a PPS signal.

Any error in the GPS stream is indicated by the fix error bit which is set as soon as an error is received and can lead to the clearing of the GPS lock bit by up to two seconds, if the GPS receiver stops outputting a PPS pulse.

Dilution Of Precision (DOP)

DOP is a function expressing the mathematical uncertainty in a position fix, based on the relative positions of the satellites used to obtain that position fix. In standard GPS applications there are three types of DOP information available.

PDOP: Position (three coordinates)

HDOP: Horizontal (two horizontal coordinates)

VDOP: Vertical (height only)

DOP has a best case value of 1; higher numbers indicating a greater uncertainty in the precision of the position fix. A low DOP value (2) is considered good, a high number (>7) is considered poor.

Circular Error Probable (CEP)

CEP is the radius of a circle within which there is a 50% probability of the antenna being located.

Spherical Error Probable (SEP)

SEP is the three-dimensional analog of CEP, it is the radius of a sphere within which there is a 50% probability of being located.

Grounding the IRIG source

It is important to ground (GND) the source of the IRIG-B stream. If the time source is a single-ended analog signal, the GND must be connected to the negative IRIG-B input A_IRIG_IN- (see Figure 5 on page 990).

RS-422 output - X-SYNC operation

The KAM/TCG/105 can output an X-SYNC stream on pins 11 and 12 (for synchronization of backplane controller modules) instead of IRIG time on RS422_OUT. This allows the KAM/TCG/105 to be used to synchronize the acquisition cycle to the start of a second. When X-SYNC is in use, some restrictions must be placed on the acquisition cycle frequency; that is, only the following frequencies are supported: 0.5, 1, 2, 4, 5, 8 10, 16, 20, 25, 32, 40, 50, 64, 80, 100 Hz.

RS-422 output - NMEA messages

The KAM/TCG/105 can output NMEA messages on pins 11 and 12 (RS422_OUT).

When the NMEA option is enabled, the KAM/TCG/105 generates NMEA messages continuously, which are an electrical copy of the NMEA source. If GPS onboard is used, the baud rate set internally for output NMEA messages is 115200 bps.

Before GPS lock is achieved, the KAM/TCG/105 does not have sufficient information to populate the NMEA messages, and as a result, the message fields are set to null or default values.

Once the GPS lock has been achieved, the various NMEA output message fields are filled in correctly.

Looking into a GPSGGA message, before GPS lock has occurred, the location information is populated entirely with null and default values. The output message for this example would look like this:

$GPGGA,094902.00,,,,,0,00,99.99,,,,,,*60

Once GPS lock has been achieved, the location information is populated correctly and the GPSGGA message for this example now looks like this:

$GPGGA,094903.00,5318.75900,N,00614.26146,W,1,09,1.01, 35.6,M,52.9,M,,*7E

Battery drift when module powered off

When the Acra KAM-500 is switched off, the battery back-up time continues. This can drift, however only up to 3.5 ppm.

TTL status outputs

The KAM/TCG/105 monitors the performance of a KAM/MEM/003, KAM/MEM/103, or KAD/MEM/004 module in the same chassis and provides two status outputs showing whether the MEM is logging or not, and whether the memory is more than 80% full.

Possible configurations

The following diagrams illustrate the different configurations possible with the KAM/TCG/105. In each case the time input source is illustrated in the top half of the diagram, while the available outputs are shown in the bottom half.

NMEA format

All NMEA inputs/outputs on the KAM/TCG/105 use the NMEA 0183 standard.

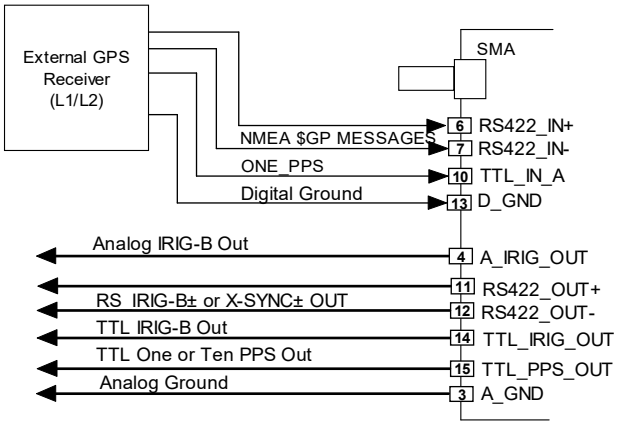


Figure 2: Connected to external GPS receiver using RS-422 and TTL

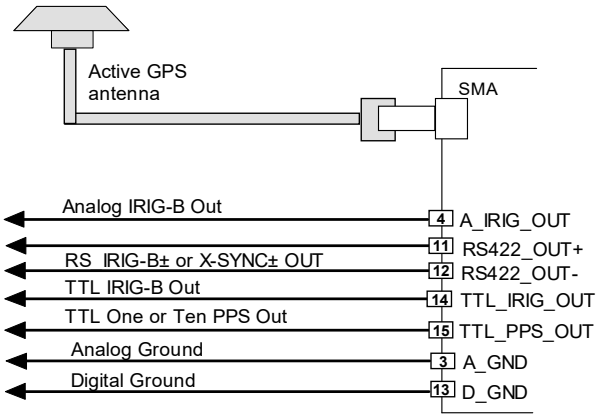


Figure 3: Connected to active GPS antenna

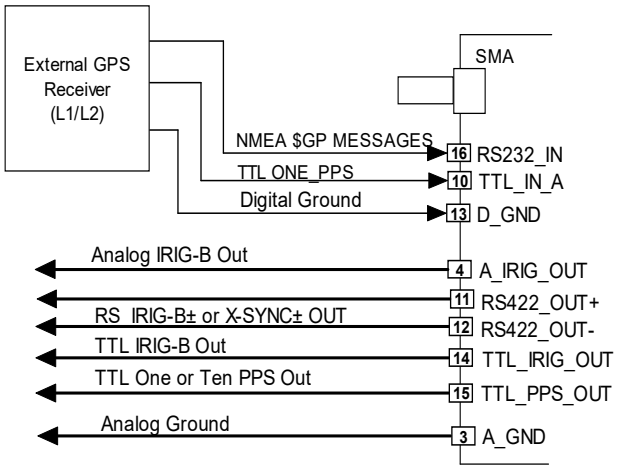


Figure 4: Connected to external GPS receiver using RS-232 and TTL

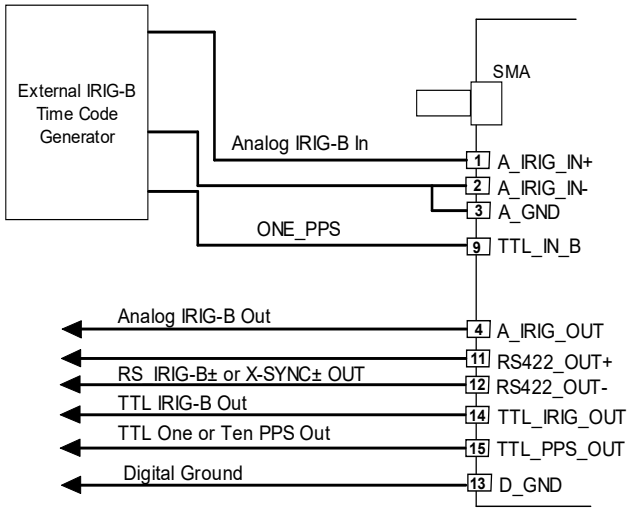


Figure 5: Receiving analog IRIG Time

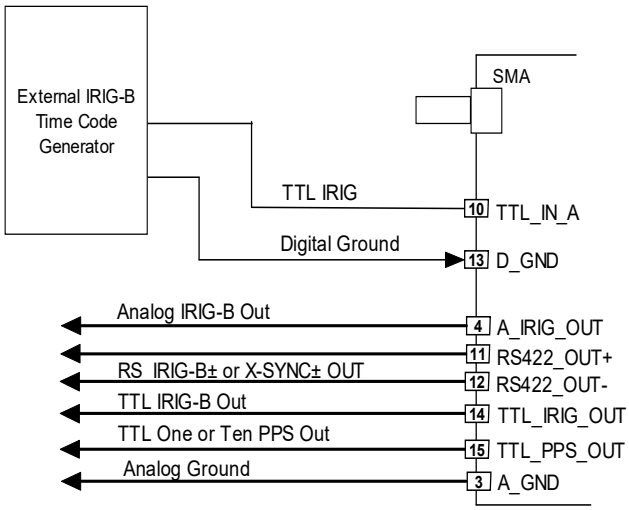


Figure 6: Connected to external IRIG source using TTL

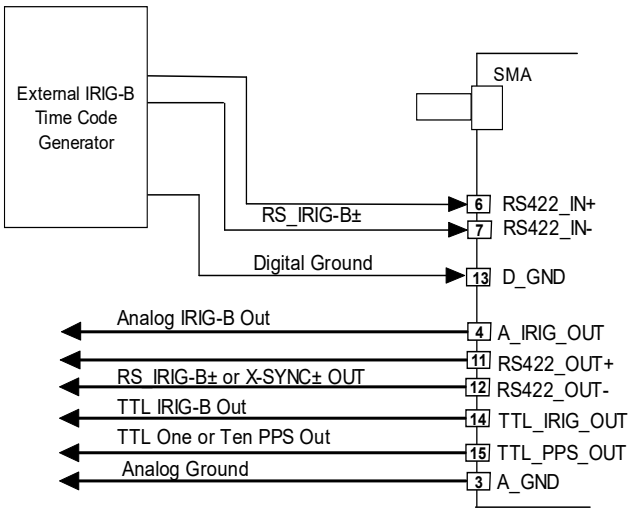


Figure 7: Connected to external IRIG Time source using RS422

Connector pinout of the KAM/TCG/105

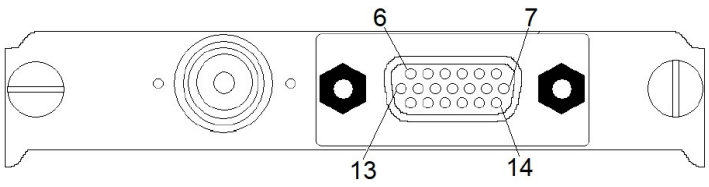


Figure 8: 19-way DD-type connector plus SMA connector

19-way Double-Density (DD) type connector

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	A_IRIG_IN+	Analog IRIG time inputs	Analog IRIG-B time in (AM/PWM); 1kHz carrier
2	A_IRIG_IN-	Analog IRIG time inputs	Analog IRIG-B time in (AM/PWM); 1kHz carrier
3	A_GND	Analog ground	
4	A_IRIG_OUT	Analog IRIG time outputs	Analog IRIG-B time out (AM/PWM); 1kHz carrier
5	MEM_STATUS(0)	BTTL outputs	Asserted when memory card is logging
6	RS422_IN+	RS-422 inputs	Either IRIG-B time (PWM) or NMEA data
7	RS422_IN-	RS-422 inputs	Either IRIG-B time (PWM) or NMEA data
8	RS_IRIG_TERM	Termination pin for RS-422	Connect to RS422_IN+ if needed
9	TTL_IN_B	BTTL inputs	
10	TTL_IN_A	BTTL inputs	Additional PPS input for use with analog IRIG-B input only. Either IRIG-B or ONE_PPS in from external GPS source
11	RS422_OUT+	RS-422 outputs	Either IRIG-B, X-SYNC, or NMEA out
12	RS422_OUT-	RS-422 outputs	Either IRIG-B, X-SYNC, or NMEA out
13	D_GND	Digital ground	
14	TTL_IRIG_OUT	BTTL outputs	IRIG-B time out (PWM)
15	TTL_PPS_OUT	BTTL outputs	One or ten pulses per second
16	RS232_IN	RS-232 inputs	NMEA stream in from external GPS receiver
17	MEM_STATUS(1)	BTTL outputs	Asserted when memory card is 80% (or more) full
18	D_GND	Digital ground	
19	CHASSIS	Chassis	Chassis connection

SMA connector[1]

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
Center	RF_IN	Active antenna inputs	Excitation output to active antenna and RF input to module (50Ω impedance)
Outer shell	RF_GND	Active antenna inputs	RF ground reference; isolated from chassis

1. For details of cables that connect to this interface, see the Related products table in this data sheet.

Ordering information

PART NUMBER	DESCRIPTION
KAM/TCG/105	Time-code generator with GPS/IRIG input and battery backup

By default, the standard mating connector CON/KAD/003/CP, and an ACD/BAC/004/B backshell, are included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). Additional items must be ordered separately; refer to Related products for options.

Revision history

REVISION	DIFFERENCES	STATUS
KAM/TCG/105	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related products

MODULE	DETAILS
ACC/GPS/001/05M	GPS antenna interface cable (5m long) terminated with Threaded Neill-Concelman (TNC) male (shield isolated)

Related documentation

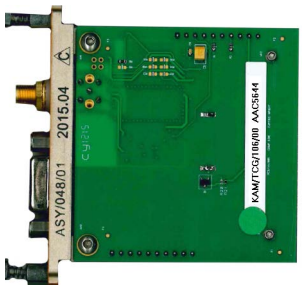
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/ 072	Time and leap seconds
TEC/NOT/ 085	Using the KAM/TCG/105 and KAM/TCG/106
XidML wall chart	Overview of key concepts and components in XidML

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This document was reviewed on 14/10/2020 and does not contain technical data.

KAM/TCG/106

Time-code generator with GPS/IRIG input and external battery backup

CURTISSWRIGHTDS.COM



Key Features

- Synchronizes with IRIG-B or GPS
- 1 µs time resolution
- Less than three parts per million drift when acting as a generator
- Time is maintained by using an external battery during power-off; only 3V batteries (±0.5V) supported
- GPS navigation information is available
- Secondary time source input

Applications

- System synchronization
- Parameter time tagging
- Global positioning

Overview

The KAM/TCG/106 can accept time from an IRIG-B time source, from its onboard GPS receiver (external antenna required), or from an external GPS receiver outputting NMEA messages and a one PPS signal. The received time is written to an internal timer and to a Real-Time Clock (RTC) that maintains time during power-down (when an external battery is connected). The time can be used for synchronization of a distributed Acra KAM-500 data acquisition system. The module generates IRIG-B outputs to allow external devices to synchronize with the Acra KAM-500 system.

The module comprises a GPS reader and an IRIG reader which decode incoming signals. The IRIG reader extracts control functions and straight binary seconds as well as time. The GPS reader parses NMEA messages as they are generated by the receiver. Extracted navigation data such as position, altitude, velocity, and heading are available as individual parameters. The module can also be synchronized via NMEA messages being sent over RS-232 from a third party GPS or PC with granularity of one second.

The timer block is a 4 x 16-bit Binary Coded Decimal (BCD) counter with microsecond resolution. For example, at 1 µs before midnight on January 1, the timer would read 0001 23:59 59.99 9999.

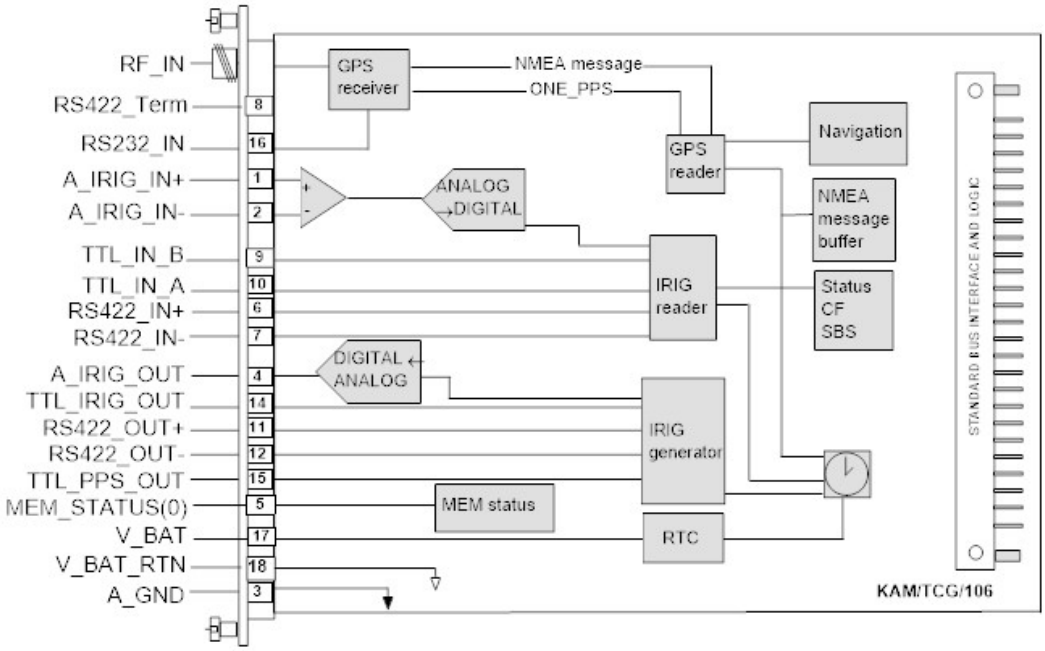


Figure 1: Inputs and outputs on the KAM/TCG/106

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	90	–	g	
	–	3.17	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/003/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	inch	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	–	–	230	mA	
±7V	–	–	0	mA	
+12V	–	–	32	mA	With no antenna connected.
-12V	–	–	28	mA	
total power	–	–	1.87	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Active antenna inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	1	–	
Bias voltage	5.15	–	5.35	V	
Bias current	–	–	50	mA	
Signal strength	-138	–	–	dBm	
Antenna gain	10	26	50	dB	See “GPS antenna” on page 1006.
Antenna noise	–	–	1.5	dB	See “GPS antenna” on page 1006.
ESD protection	–	2	–	kV	Human body model

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TABLE 3	Onboard GPS receiver				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	1	–	
Time accuracy	–	–	1	µs	Relative to GPS time. See “GPS time” on page 1006.
Position accuracy					See “Navigation data accuracy” on page 1006.
2D fix	2.5	–	22	m	Circular Error Probable (CEP).
3D fix	2.5	–	22	m	Spherical Error Probable (SEP).
Satellite acquisition time					See “Acquisition” on page 1006.
reacquisition	3.5	5	–	s	
warm power-up	–	40	–	s	
cold power-up	–	60	–	s	Test carried out with a minimum of four satellites in use.
GPS update rate	–	1	1	Hz	
Time format	–	–	–	–	Coordinated Universal Time (UTC).
Navigation datum	–	–	–	–	World Geodetic System-84 (WGS-84). See “Datum” on page 1006.
Restrictions					Coordinating Committee for Multilateral Export Controls restrictions apply.
velocity	–	–	1,854	kph	
velocity	–	–	1,000	knots	
altitude	–	–	18,000	m	
altitude	–	–	60,000	ft	

TABLE 4	Analog IRIG time inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	1	–	
Sampling rate					
A_IRIG_IN	–	–	2	Msps	Operating as analog IRIG-B input, the following time codes are supported: IRIG-B 120, 121, 122, 123.
Input voltage					
voltage range	0.1	–	10	V_{p-p}	
overvoltage protection	-7	–	12	V	Voltages outside of this range can damage input.
Time error					
offset	–	–	4	µs	
Input resistance					
between inputs	–	1.1	–	MΩ	Module powered off.
between inputs	52	–	–	kΩ	Module powered on.
each input to GND	–	75	–	kΩ	Module powered off.
each input to GND	390	–	–	kΩ	Module powered on.

TABLE 5	BTTL inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	2	–	
Signaling rate					
TTL_IN	–	–	1	bps	Operating as ONE_PPS input.
TTL_IN	–	–	100	bps	Operating as IRIG-B input, the following time codes are supported: IRIG-B 000, 001, 002, 003.
Input voltage					
operating range	0	–	5.25	V	
logic 0	0	–	0.7	V	
logic 1	2	–	5.25	V	
overvoltage protection	-0.3	–	6	V	Voltage in excess of these values can damage input.
Signaling currents					
logic 0	–	-0.2	-0.5	mA	
logic 1	–	2	5	mA	
Input resistance					
each input to GND	–	27	–	MΩ	Module powered on.
each input to GND	–	53	–	kΩ	Module powered off.
Time error					
offset	–	–	2	µs	Over full operating temperature range. When configured as primary (TTL_IRIG) input range.

TABLE 6	RS-232 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	1	–	
Baud rate					
RS232_IN	4,800	–	115,200	bps	The following baud rates are supported: 4800, 9600, 19200, 115200.
Input voltage					
operating range	-25	–	25	V	Do not exceed operating range.
logic 0	–	–	0.6	V	V_{IN+} - V_{IN-}.
logic 1	2.4	–	–	V	V_{IN+} - V_{IN-}.
overvoltage protection	-25	–	25	V	Voltage in excess of these values can damage input.
ESD protection	-15	–	15	kV	Human Body Model.
Input resistance					
each input to GND	–	4.8	–	MΩ	Module powered on.
each input to GND	–	4.7	–	kΩ	Module powered off.

TABLE 7	RS-422 inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	2	–	
Signaling rate					
RS422_IN	–	–	100	bps	Operating as IRIG-B input, the following time codes are supported: IRIG-B 000, 001, 002, 003.
RS422_IN	4,800	–	115,200	bps	Operating as NMEA data input, the following baud rates are supported: 4800, 9600, 19200, 115200.
Input voltage					
operating range	-7	–	12	V	Do not exceed operating range.
logic 0	–	–	-0.7	V	V_{IN+} - V_{IN-}.
logic 1	0.7	–	–	V	V_{IN+} - V_{IN-}.
overvoltage protection	-7	–	12	V	Voltage in excess of these values can damage input.
ESD protection	–	–	15	kV	Human Body Model.
Input resistance					
between inputs	–	117	–	MΩ	Module powered on.
between inputs	–	117	–	kΩ	Module powered off.
between inputs	–	121	–	Ω	Module powered on and inputs terminated.
between inputs	–	121	–	Ω	Module powered off and inputs terminated.
each input to GND	–	4.2	–	MΩ	Module powered on.
each input to GND	–	59	–	kΩ	Module powered off.

TABLE 8	Battery inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	1	–	
Input voltage					
operating range	2	3	3.8	V	
overvoltage	-3.8	–	3.8	V	Voltage in excess of these values can damage input.
Input current					
operating range	–	2.5	–	µA	

TABLE 9	Analog IRIG time outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	1	–	
Signaling rate					
A_IRIG_OUT	–	–	1	kHz	Operating as analog IRIG-B 123 output with a 1 kHz carrier frequency.
Output voltage					
mark amplitude	4	–	20	V_{p-p}	Range: 4, 8, 12, 16, 20.
mark to space ratio	–	3	–	–	Space amplitude = mark amplitude/3.
short circuit current	3	10	–	mA	
short circuit duration	∞	–	–	s	To GND.

TABLE 10	BTTL outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	3	–	
Signaling rate					
MEM_STATUS(0)	–	–	100	kbps	Output is updated at the start of the acquisition cycle.
TTL_IRIG_OUT	–	–	100	bps	Operating as IRIG-B 003 digital output.
TTL_PPS_OUT	1	–	10	Hz	Operating as a selectable one or 10-PPS output. Rising edge of TTL_PPS_OUT indicates the start of a second.
Output voltage					
logic 0	–	–	0.44	V	Sinking 24 mA.
logic 1	4.4	–	–	V	Sourcing 24 mA.
short circuit current	–	–	50	mA	
short circuit duration	∞	–	–	s	To GND.

TABLE 11	RS-422 outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	1	–	
Signaling rate					
RS422_OUT	100	–	–	bps	When providing IRIG-B.
RS422_OUT	–	–	1	Mbps	When providing X-SYNC.
Output voltage					
operating voltage	-7	–	12	V	Absolute voltage of the operating signal must stay within this range.
logic 0	–	–	-2	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
logic 1	2	–	–	V	V_{0+} - V_{0-} ; R_{LOAD} = 100Ω.
overvoltage protection	-7	–	12	V	
short circuit current	–	–	250	mA	
short circuit duration	∞	–	–	s	Only one output may be shorted at a time.
ESD protection	-15	–	15	kV	Human Body Model.

Setting up the KAM/TCG/106

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAM/TCG/106	KAM/TCG/106	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Settings	-	-	-
Time Server	Master FreeRunning Slave	Master	When Master, time is seeded from the KAM/TCG/106 into other slave modules. When Slave, time is seeded from a master module into the KAM/TCG/106. When FreeRunning, no time seeding takes place.
Primary Input	IRIG-B GPS RTC	IRIG-B	Specifies which input takes priority; when selecting RTC, seeded time is loaded from the RTC.
Allow Secondary	True False	True	When set to True allows the module to switch to either the primary or secondary time source (which-ever is in lock).
Control Function Source	IRIG-B Zeros Year	Zeros	Selects which bit-pattern is loaded on the Control Function field of the outgoing IRIG-B stream.
Settings *IRIG-B-In*	-	-	Settings on the IRIG-B input.
Current Year	2011 to 2098	2015	Indicates the current year.
IRIG Source	Analog RS-422 TTL_A	TTL_A	Selects the physical interface used for decoding the IRIG-B time code stream.
IRIG-B revision	IRIG-B-200-9x IRIG-B-200-04	IRIG-B-200-9x	When selected, module decodes the year from the CF bits (IRIG-B-200-04).
Processes	-	-	-
Parser(14:0)	-	-	One of 15 NMEA parser slots.
Catchall-Parser	-	-	Any NMEA message that is not parsed goes to this final parser slot.
Channels	-	-	-
GPS-In *GPS-In Input*	-	-	Time and navigation parameters are taken from the KAM/TCG/106's onboard GPS receiver.
Settings	-	-	-
GPS Source	OnBoardGPS RS-422 RS-232	OnBoardGPS	-
PPS Source	TTL_A RS-422	None	-
Maximum Dilution Of Precision	1 to 15	5	Specifies the maximum Dilution of Precision (DOP) allowed. DOP is an expression of the quality of the GPS solution; the lower the value, the more accurate it is.

SETUP DATA	CHOICE	DEFAULT	NOTES
Baud Rate	4800 9600 19200 38400 57600 115200	19200	Specifies the number of symbols received per second.
Settings *On Board GPS*	-	-	These settings are only applied to the onboard GPS receiver.
Dynamic	Stationary Pedestrian Automotive Sea Airborne with <1g Acceleration Airborne with <2g Acceleration Airborne with <4g Acceleration	Airborne with <2g Acceleration	Dynamic profile of onboard GPS receiver.
Leap Seconds	0 to 255	15	The number of seconds difference between UTC and GPS time; only applied to onboard GPS receiver.
PPS-Out *TTL Output*	-	-	One or ten Pulse Per Second output.
Settings	-	-	-
PPS Rate	1 10	1	-
RS-422-Out *RS-422 Output*	-	-	Outputting IRIG-B, NMEA or X-SYNC
Settings	-	-	-
Mode	IRIG-B X-SYNC NMEA	IRIG-B	Switches amongst outputting digital IRIG-B, X-SYNC out (which synchronizes legacy data acquisition systems) or NMEA (NMEA being the electrical copy of the NMEA source). If GPS onboard is used, the baud rate set internally for output NMEA messages is 115200 bps.
TTL-Out *TTL Output*	-	-	Outputting IRIG-B.
Analog-IRIG-BOut *Analog Output*	-	-	Outputting an analog IRIG-B stream (1kHz amplitude modulated sine wave).
Settings	-	-	-
Amplitude	2 to 10	4	-
RS-422-In *RS-422 Input*	-	-	-
Settings	-	-	-
TTL-In *TTL Input*	-	-	-
Analog-IRIG-BIn *Analog Input*	-	-	-
Settings	-	-	-
PPS Source	TTL_A TTL_B RS-422 None	None	-

SETUP DATA	CHOICE	DEFAULT	NOTES
RS-232-In *RS-232 Input*	-	-	-

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
StatusIn IRIG-B and timer status register.	BitVector	BitVector	16	R[15:0] R(15) IRIG-BLock - When 1, the IRIG-B decoder is locked to a valid IRIG-B stream. R(14) StraightBinarySeconds(16) - Bit 16 (MSB) of the Straight Binary Seconds decoded from the IRIG-B stream (see StraightBinarySeconds for bits 15 to 0). R[13:3] Reserved R(2) SourcePrimary - When 1, the timer is locked to the primary timer source. R(1) TimerLock - When 1, the timer's PLL is in lock with the input TIME ONE_PPS source. R(0) Reserved
ControlFunction Control Function (CF) bits received from the IRIG-B input.	BitVector	BitVector	32	R[31:0] R[31:5] ControlFunction R[4:0] Reserved
StraightBinarySeconds Sixteen LSBs of the seventeen Straight Binary Seconds received in the IRIG-B stream.	Second	OffsetBinary	16	R[15:0]
IrigTime48 48-bit wide IRIG time word.	BitVector	BitVector	48	R[47:0]
TimeHi Time in hours and minutes at the start of the acquisition cycle.	BitVector	BitVector	16	R[47:32] R[15:13] Reserved - Reserved for future use R[12:7] Hours - BCD Hours 0 to 23. R[6:0] Minutes - BCD Minutes 0 to 59.
TimeLo Time in seconds and centiseconds at the start of the acquisition cycle.	BitVector	BitVector	16	R[31:16] R(15) Reserved - Reserved for future use R[14:8] Seconds - Seconds 0 to 59. R[7:0] Centiseconds - Centiseconds 0 to 99.
TimeMicro Time in microseconds at the start of the acquisition cycle.	Second	BCD	16	R[15:0] R[15:0] Microseconds - Microseconds 0 to 9999.
DayOfYear The day of the year from 1 to 366 at the start of the acquisition cycle.	BitVector	BitVector	16	R[15:0] R[15:10] Reserved R[9:0] DayOfYear
Parser(14:0) Parameters				

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
MessageInfo Indicates status of message (stale/skipped/empty)	BitVector	BitVector	16	R[15:0] R(15) Empty - This slot is empty. R(14) Stale - Contents of this slot have already been read. R(13) Skipped - Contents of this slot have been overwritten. R[12:0] Reserved - Reserved for future use.
Catchall-Parser Parameters				
MessageData(40:0) The 2x8 bits of a particular byte in serial NMEA messages (word aligned, 41 words maximum)	BitVector	BitVector	16	R[15:0]
MessageInfo Indicates status of message (stale/skipped/empty)	BitVector	BitVector	16	R[15:0] R(15) Empty - This slot is empty. R(14) Stale - Contents of this slot have already been read. R(13) Skipped - Contents of this slot have been overwritten. R[12:0] Reserved - Reserved for future use.
GPS-In Parameters				
Latitude Latitude received in the NMEA stream.	BitVector	BitVector	48	R[47:0]
LatitudeHi Degrees and minutes of latitude.	Unitless	BCD	16	R[47:32] R[15:8] Degrees - Degrees of latitude 0 to 89. R[7:0] Minutes - Minutes of latitude 0 to 59.
LatitudeLo Decimal minutes of latitude.	Unitless	BCD	16	R[31:16] R[31:16] DecimalMinutes - Decimal places of minutes of latitude 0.0000 to 0.9999.
LatitudeMicroMinutes Fifth decimal place of minutes of latitude.	BitVector	BitVector	16	R[15:0] R[15:4] Reserved R[3:0] DecimalMinutes - Fifth decimal place of minutes of latitude 0.00000 to 0.00009.
Longitude Longitude received in the NMEA stream.	BitVector	BitVector	48	R[47:0]
LongitudeHi Degrees of Longitude.	BitVector	BitVector	16	R[47:32] R[47:44] Reserved R[43:32] Degrees - Degrees of longitude 0 to 179.
LongitudeLo Minutes and decimal minutes of longitude.	Unitless	BCD	16	R[31:16] R[31:24] Minutes - Minutes of longitude 0 to 59. R[23:16] DecimalMinutes - Decimal places of minutes of longitude 0.00 to 0.99.
LongitudeMicroMinutes Decimal minutes of longitude.	BitVector	BitVector	16	R[15:0] R[27:12] Reserved R[11:0] DecimalMinutes - Last three decimal places of minutes of longitude 0.00000 to 0.00999.
Altitude Altitude expressed as height above Mean Sea Level (MSL).	BitVector	BitVector	32	R[31:0]

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
AltitudeHi Tens of thousands of meters.	BitVector	BitVector	16	R[31:16] R(31) AltitudeIsNegative - When 1, the altitude is below mean sea level. R[30:20] Reserved R[19:16] Altitude - Tens of thousands of meters 0 to 9.
AltitudeLo Thousands of meters.	Meter	BCD	16	R[15:0] R[15:0] Altitude - Meters 0 to 9999.
VelocityInKph Velocity in kilometers per hour.	MetersPerSecond	BCD	16	R[15:0] R[15:0] VelocityInKph - KM 0 to 9999.
VelocityInKn Velocity in nautical miles per hour.	Unitless	BCD	16	R[15:0] R[15:0] VelocityInKn - KN 0 to 9999.
Heading True course over ground.	BitVector	BitVector	32	R[31:0]
HeadingHi Degrees of true course over ground.	Unitless	BCD	16	R[31:16] R[31:26] Reserved R[25:16] Degrees - Degrees 0 to 359.
HeadingLo Decimal degrees of true course over ground	Unitless	BCD	16	R[15:0] R[15:8] Reserved R[7:0] DecimalDegrees - Decimal degrees of true course over ground.
DilutionOfPrecision Dilution of precision. See “Dilution of Precision (DOP)” section.	BitVector	BitVector	16	R[15:0] R[15:12] Reserved R[11:8] PDOP - Positional DOP; if DOP > 15 then 15 is returned. R[7:4] HDOP - Horizontal DOP; if DOP > 15 then 15 is returned. R[3:0] VDOP - Vertical DOP; if DOP > 15 then 15 is returned.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
StatusGPS GPS status register.	BitVector	BitVector	16	R[15:0] R(15) GPSLock - When 1, the GPS decoder is locked to a valid NMEA stream. R(14) FixError - When 1, indicates that the Fix Flag was not set R(15)=0. R(13) CheckSumError - When 1, indicates that a checksum error was detected R(15)=0. R(12) TooFewSatellites - When 1, indicates that less than the minimum configured number of satellites are used, which can affect the quality of the received data. R(11) DOPTooHigh - When 1, indicates that one of the DOP (Dilution of Precision) figures is outside a specified range. R(10) North/South - When 0, the latitude read is in the northern hemisphere; when 1, the latitude read is in the southern hemisphere. R(9) East/West - When 0, the longitude read is east of the Greenwich Meridian; when 1, the longitude read is west of the Greenwich Meridian. R(8) LocationValid - This bit will be set when Latitude/Longitude information has been successfully parsed from the NMEA stream. R[7:4] SatellitesInView - Number of satellites in view. R[3:0] SatellitesInUse - Number of satellites used to calculate GPS solution.

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAM/TCG/106

The KAM/TCG/106 is a combined GPS and IRIG-B input module. It can accept inputs from a number of sources.

SMA torque setting

The recommended torque setting for the SMA connector is 0.45 Nm (0.33 foot pound-force).

PPS pulse input

There are three PPS inputs: TTL_IN_A, TTL_IN_B, and RS-422 (when selected).

TTL_IN_B is a dedicated PPS input. TTL_IN_A and RS-422 can also be used to take in IRIG-B digital or NMEA messages.

When used for PPS inputs, these can be used to synchronize to an external 1 PPS pulse.

NOTE: TTL_IN_B can only be used with analog IRIG-B.

Time seeding

On power-up of the Acra KAM-500, the KAM/TCG/106's timer is seeded with time from the RTC. The RTC receives time once the source (GPS or IRIG) is locked. Once powered down, the battery maintains time on the RTC. Then on subsequent power-ups, time is loaded from the RTC.

NOTE: Typically, it can take 2 seconds from power up for the module to get its time from the RTC, during which time it will free run.

Once a time source is locked, it updates the internal RTC time. If the module is in slave mode, the RTC time is updated with time from the master module.

Alternatively, the initial time can be set from the PC using either Time Seeder or kTimeseed.

It is not recommended to power on the module at less than -30°C if no external timing source is applied, as the RTC may not seed the correct time and the internal clock will indicate time since power on.

Primary and secondary inputs

The KAM/TCG/106 accepts time from either an IRIG-B stream or a GPS receiver via NMEA messages.

It is possible to use one time source as the primary input and optionally enable the other time source as the secondary input. If the primary time source becomes unavailable (missing or has errors), then after 10 seconds the KAM/TCG/106 switches to the secondary source. Later, if the primary source becomes available again then the KAM/TCG/106 switches back to the primary time source after 10 seconds.

This allows for synchronization with a secondary IRIG source when an aircraft is in the hangar where GPS is not available; then for GPS to be used when the aircraft is on the runway or in flight, without reprogramming the Acra KAM-500.

If the primary source is GPS then the secondary source must be IRIG and vice versa. For instance, you cannot use an external GPS receiver as the primary time input and use the onboard GPS receiver as the secondary time input. Also, because the digital pins are used for more than one function, there must be no pin clash between the primary and secondary input pins.

The following table shows available combinations of primary and secondary time inputs.

		IRIG		
		Analog	TTL_IN	RS422_IN
GPS	On Board	Y	Y	Y
	RS422_IN TTL_PPS	Y	N	N
	RS232_IN TTL_PPS	Y	N	Y

Control Function Source

The KAM/TCG/106 can set the control function bits of the outgoing IRIG-B stream as shown in the following table.

SETTING	DESCRIPTION
IRIG-B	CF bits are copied from the incoming IRIG-B stream
Zeros	CF bits are set to Zero
Year	CF bits are used to encode the current year as per IRIG Standard 200-04.

Clock synchronization

The KAM/TCG/106's timer uses a digital Phase Locked Loop (PLL) to synchronize its own clock with an external time source. Frequency and phase error are corrected every second. If the error is greater than 500 µs, the PLL jumps to the correct time immediately. After that it tracks the external time source. When the PLL is locked to the external time source, R(1) of the IRIG_STATUS register is set to one.

The timer in a KAD/BCU/101 can be seeded with time from

the KAM/TCG/106 at the start of the acquisition cycle, but over the course of the acquisition cycle, it can drift by up to 4 µs per second. This can be eliminated by physically connecting the KAM/TCG/106's X-SYNC OUT signal to the KAD/BCU/101 X-SYNC signal.

GPS antenna

A minimum antenna gain of 10dB is recommended to compensate for losses in the cable connecting the antenna to the KAM/TCG/106. A maximum antenna gain of 50 dB and a maximum antenna noise figure of 1.5 dB are recommended for the GPS receiver.

The GPS receiver calculates the carrier-to-noise ratio for the antenna at power-up. It is therefore important that the GPS antenna is connected to the module before it is powered up. Power to the active antenna is linearly regulated down from the modules 12V to a nominal 5.25V antenna supply. When estimating system power the max current drawn theoretically by the antenna should be added to the KAM/TCG/106 +12V current figure.

NOTE: The previously recommended antenna RFE/AEG/001 is no longer available for purchase. The S67-1575-132 antenna from Sensor System Inc. is now recommended.

GPS receiver

The KAM/TCG/106 uses a civilian-band (L1) GPS receiver. The United States Department of Defense (DoD) can turn on Selective Availability (SA) at any time without warning. This degrades the accuracy of the GPS data.

The KAM/TCG/106 can extract time and navigation information from an NMEA data stream. It is fitted with an onboard GPS receiver but can be interfaced to an external L1 or L2 GPS receiver via the 19-way connector.

The NMEA messages, GGA, and ZDA or RMC, are the minimum required for KAM/TCG/106 time synchronization. The VTG message is required to get velocity and true heading. If it is not provided then registers VELOCITY_KPH, VELOCITY_KN, HEADING are forced to an illegal state of all 1s.

NOTE: GPS is a broad subject and beyond the scope of this data sheet. There are many online guides and GPS dictionaries such as those found at the following links:
www.gps.oma.be/gb/dic_gb_ok_css.htm
www.colorado.edu/geography/gcraft/notes/gps/gps_f.html

Altitude representation

The GGA NMEA message contains altitude fields above mean sea level. When the altitude is 25 meters above sea level, it gives a reading of 00025; when the altitude is 25 meters below sea level, it gives a reading of 00D25. The D indicates that the reading is negative.

GPS time

The KAM/TCG/106 derives time from data received from a constellation of satellites. These satellites are in continuous moving orbit which affects the behavior of the KAM/TCG/106 as described in “Acquisition” on page 1006.

The KAM/TCG/106 measures GPS time; the accuracy of the time is not absolute but relative to the GPS time. If an external GPS receiver is used, the KAM/TCG/106 locks to within ±1 µs without considering the external GPS receiver accuracy.

Acquisition

Along with time and navigation data, GPS satellites transmit GPS ephemeris data and GPS almanac data.

Ephemeris data tells the GPS receiver where each GPS satellite is at any time throughout the day. Each satellite transmits ephemeris data showing the orbital information for that satellite and for every other satellite in the system.

Almanac data is constantly transmitted by each satellite. It contains information about the status of the satellite, current date and time.

Cold power-up

When the GPS receiver is powered up for the first time or has no backup battery connected, the GPS receiver has no knowledge of its last position or approximate time, and has no ephemeris or almanac data. The GPS receiver starts to search for signals blindly. This is normal behavior. Cold power-up for GPS receivers can take several minutes.

Navigational data

The KAM/TCG/106 may be used to record navigation information. The information provided by the KAM/TCG/106 is referenced to a specific datum.

Datum

The onboard GPS receiver uses WGS-84, which is a geographic model obtained by referencing the earth's sea level surface area and applying theoretical mathematical calculations. The chart datum is usually defined in the legend of the chart.

Navigation data accuracy

Unlike GPS time the position information is subject to a

number of inaccuracies, due to the inherent behavior of the GPS system.

GPS status register

GPS lock is set to one when the KAM/TCG/106 receives a valid NMEA stream and accompanying PPS signal from either the onboard GPS receiver or an external GPS receiver connected to the KAM/TCG/106. It is cleared only on arrival of a PPS signal if the NMEA stream is not valid (for example the fix flag not set), or after two seconds without a PPS signal.

Any error in the GPS stream is indicated by the fix error bit which is set as soon as an error is received and can lead to the clearing of the GPS lock bit by up to two seconds, if the GPS receiver stops outputting a PPS pulse.

Dilution Of Precision (DOP)

DOP is a function expressing the mathematical uncertainty in a position fix, based on the relative positions of the satellites used to obtain that position fix. In standard GPS applications there are three types of DOP information available.

PDOP: Position (three coordinates)

HDOP: Horizontal (two horizontal coordinates)

VDOP: Vertical (height only)

DOP has a best case value of 1; higher numbers indicating a greater uncertainty in the precision of the position fix. A low DOP value (2) is considered good, a high number (>7) is considered poor.

Circular Error Probable (CEP)

CEP is the radius of a circle within which there is a 50% probability of the antenna being located.

Spherical Error Probable (SEP)

SEP is the three-dimensional analog of CEP, it is the radius of a sphere within which there is a 50% probability of being located.

Grounding the IRIG source

It is important to ground (GND) the source of the IRIG-B stream. If the time source is a single-ended analog signal, the GND must be connected to the negative IRIG-B input A_IRIG_IN- (see Figure 5 on page 1008).

RS-422 output - X-SYNC operation

The KAM/TCG/106 can output an X-SYNC stream on pins 11 and 12 (for synchronization of backplane controller modules) instead of IRIG time on RS422_OUT. This allows the KAM/TCG/106 to be used to synchronize the acquisition cycle to the start of a second. When X-SYNC is in use, some restrictions must be placed on the acquisition cycle frequency; that is, only the following frequencies are supported: 0.5, 1, 2, 4, 5, 8 10, 16, 20, 25, 32, 40, 50, 64, 80, 100 Hz.

RS-422 output - NMEA messages

The KAM/TCG/106 can output NMEA messages on pins 11 and 12 (RS422_OUT).

When the NMEA option is enabled, the KAM/TCG/106 generates NMEA messages continuously, which are an electrical copy of the NMEA source. If GPS onboard is used, the baud rate set internally for output NMEA messages is 115200 bps.

Before GPS lock is achieved, the KAM/TCG/106 does not have sufficient information to populate the NMEA messages, and as a result, the message fields are set to null or default values.

Once the GPS lock has been achieved, the various NMEA output message fields are filled in correctly.

Looking into a GPSGGA message, before GPS lock has occurred, the location information is populated entirely with null and default values. The output message for this example would look like this:

$GPGGA,094902.00,,,,,0,00,99.99,,,,,,*60

Once GPS lock has been achieved, the location information is populated correctly and the GPSGGA message for this example now looks like this:

$GPGGA,094903.00,5318.75900,N,00614.26146,W,1,09,1.01, 35.6,M,52.9,M,,*7E

Battery drift when module powered off

When the Acra KAM-500 is switched off, the battery back-up time continues. This can drift, however only up to 3.5 ppm.

TTL status outputs

The KAM/TCG/106 monitors the performance of a KAM/MEM/003, KAM/MEM/103, or KAD/MEM/004 module in the same chassis and provides one status output showing whether the MEM is logging or not.

Possible configurations

The following diagrams illustrate the different configurations possible with the KAM/TCG/106. In each case the time input source is illustrated in the top half of the diagram, while the available outputs are shown in the bottom half.

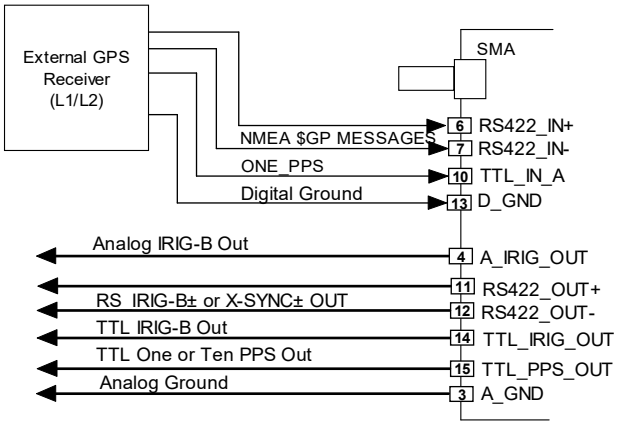


Figure 2: Connected to external GPS receiver using RS-422 and TTL

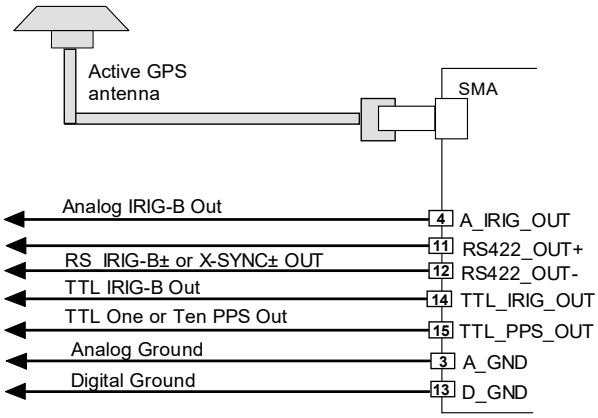


Figure 3: Connected to active GPS antenna

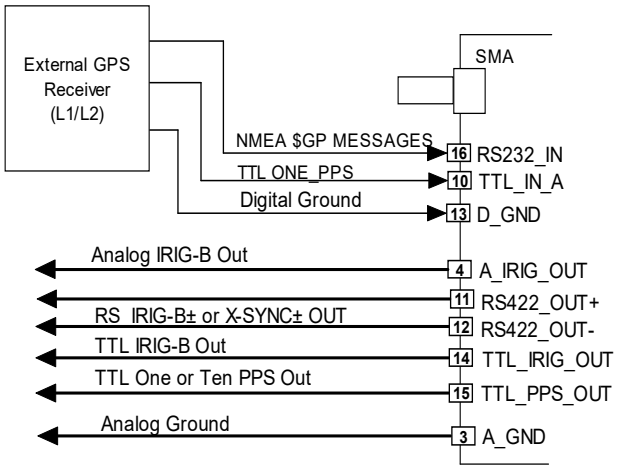


Figure 4: Connected to external GPS receiver using RS-232 and TTL

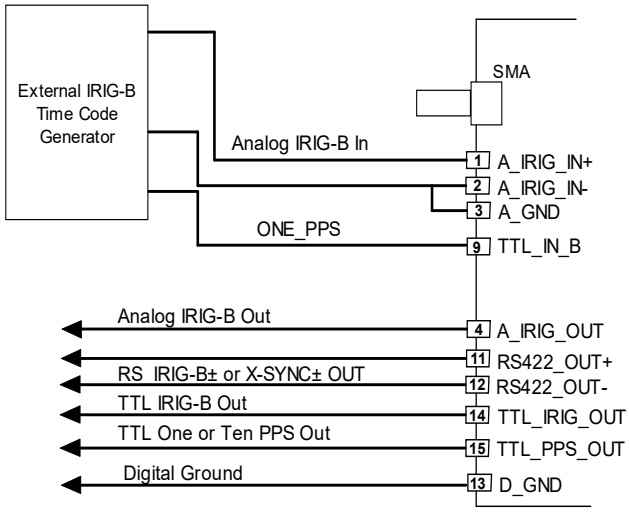


Figure 5: Receiving analog IRIG Time

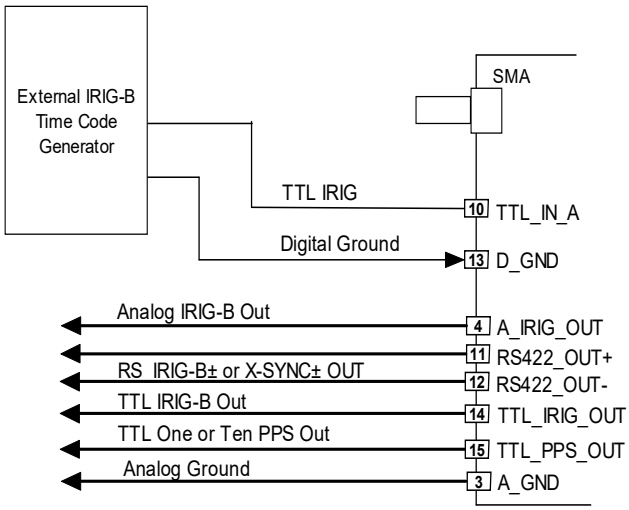


Figure 6: Connected to external IRIG source using TTL

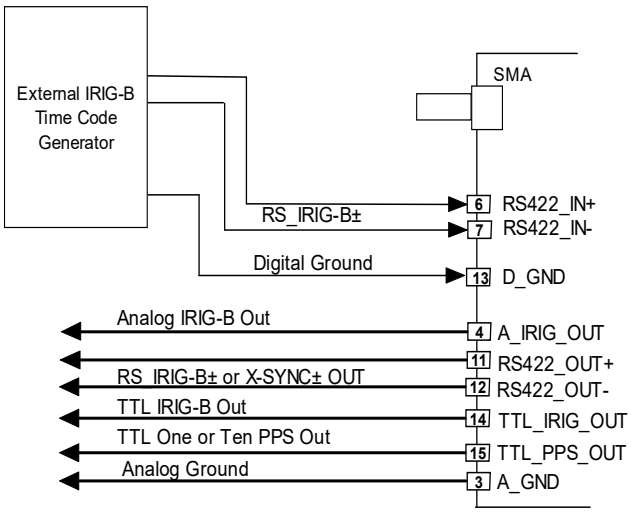


Figure 7: Connected to external IRIG Time source using RS422

Connector pinout of the KAM/TCG/106

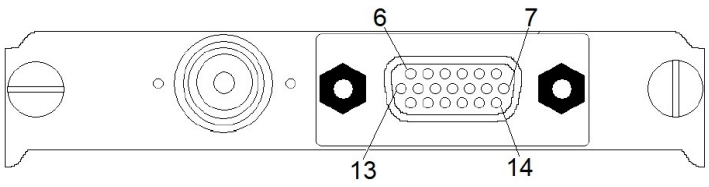


Figure 8: 19-way DD-type connector plus SMA connector

19-way Double-Density (DD) type connector

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	A_IRIG_IN+	Analog IRIG time inputs	Analog IRIG-B time in (AM/PWM); 1kHz carrier
2	A_IRIG_IN-	Analog IRIG time inputs	Analog IRIG-B time in (AM/PWM); 1kHz carrier
3	A_GND	Analog ground	
4	A_IRIG_OUT	Analog IRIG time outputs	Analog IRIG-B time out (AM/PWM); 1kHz carrier
5	MEM_STATUS(0)	BTTL outputs	Asserted when memory card is logging
6	RS422_IN+	RS-422 inputs	Either IRIG-B time (PWM) or NMEA data
7	RS422_IN-	RS-422 inputs	Either IRIG-B time (PWM) or NMEA data
8	RS_IRIG_TERM	Termination pin for RS-422	Connect to RS422_IN+ if needed
9	TTL_IN_B	BTTL inputs	
10	TTL_IN_A	BTTL inputs	Additional PPS input for use with analog IRIG-B input only. Either IRIG-B or ONE_PPS in from external GPS source
11	RS422_OUT+	RS-422 outputs	Either IRIG-B, X-SYNC, or NMEA out
12	RS422_OUT-	RS-422 outputs	Either IRIG-B, X-SYNC, or NMEA out
13	D_GND	Digital ground	
14	TTL_IRIG_OUT	BTTL outputs	IRIG-B time out (PWM)
15	TTL_PPS_OUT	BTTL outputs	One or ten pulses per second
16	RS232_IN	RS-232 inputs	NMEA-183 stream in from external GPS receiver
17	V_BAT	Battery inputs	Positive battery input
18	V_BAT_RTN	Internal ground	Ground return for battery
19	CHASSIS	Chassis	Chassis connection

SMA connector[1]

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
Center	RF_IN	Active antenna inputs	Excitation output to active antenna and RF input to module (50Ω impedance)
Outer shell	RF_GND	Active antenna inputs	RF ground reference; isolated from chassis

1. For details of cables that connect to this interface, see the Related products table in this data sheet.

Ordering information

PART NUMBER	DESCRIPTION
KAM/TCG/106	Time-code generator with GPS/IRIG input and external battery backup

By default, the standard mating connector CON/KAD/003/CP, and an ACD/BAC/004/B backshell, are included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). Additional items must be ordered separately; refer to Related products for options.

Revision history

REVISION	DIFFERENCES	STATUS
KAM/TCG/106	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related products

MODULE	DETAILS
ACC/GPS/001/05M	GPS antenna interface cable (5m long) terminated with Threaded Neill-Concelman (TNC) male (shield isolated)

Related documentation

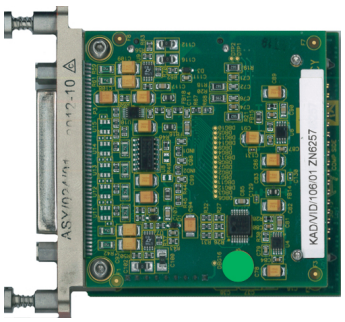
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/ 072	Time and leap seconds
TEC/NOT/ 085	Using the KAM/TCG/105 and KAM/TCG/106
XidML wall chart	Overview of key concepts and components in XidML

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This document was reviewed on 11/12/2020 and does not contain technical data.

KAD/VID/106

H.264 video encoder (analog video input) - 1ch

CURTISSWRIGHTDS.COM



Key Features

- H.264 compression of video input channels (NTSC or PAL)
- Supports digital video formats CIF, 2CIF, D1
- Configurable I-frame to P-frame ratio
- Programmable frame rates
- Advanced Audio Codec (AAC) audio encoding
- Constant compressed video bit-rate target can be set to between 250 kbps and 10 Mbps

Applications

- Video monitoring of cockpit and control surfaces
- Direct monitoring of video compatible head/up and head/down displays

Overview

The KAD/VID/106 is an H.264 video encoder card that converts one of three composite analog video inputs, or one Y/C analog video input to digital video and compresses it. Compressed video bit-rate is kept constant using multi-pass encoding and padding of the transport stream. Optional audio encoding produces a digital audio data stream. The left and right audio channels can be individually turned on or off: and the audio bit rate can be selected. An Audio Only mode (without video) can also be enabled. Selection of PAL or NTSC input format is a configurable setting.

The KAD/VID/106 latency is less than 80 ms. The latency measures the amount of time it takes to encode and transfer one video frame from the backplane interface of the module.

The KAD/VID/106 offers two generator lock outputs (CAM_2_GENLOCK_OUT and CAM_3_GENLOCK_OUT) to allow synchronization of all four video input signals.

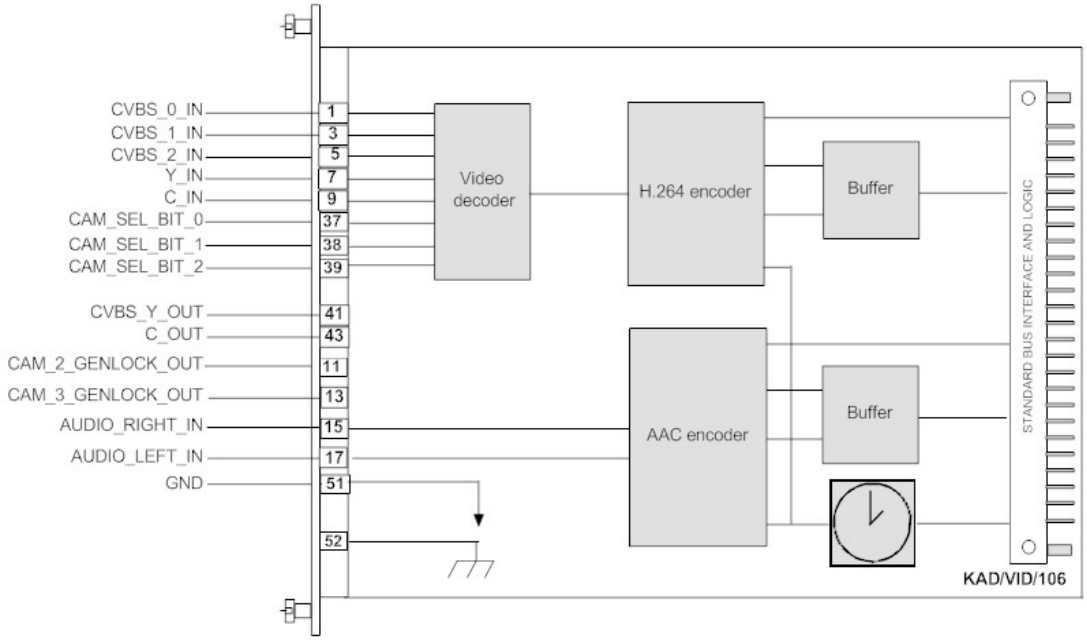


Figure 1: Audio and video interfaces of the KAD/VID/106

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	95	–	g	
	–	3.36	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	–	–	294.8	mA	
+12V	–	–	71.5	mA	
-12V	–	–	23.1	mA	
total power	–	–	2.61	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Video inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	4	–	
Encoded video rate					
CVBS_[2:0]_IN	0.250	–	10	Mbps	One of three possible composite video inputs.
Y_IN/C_IN	0.250	–	10	Mbps	Y_IN and C_IN must be used as a pair.
Video input format	–	NTSC/ PAL	–	–	
Input level	–	1	–	V_{pp}	
Input resistance					
each input to GND	–	75	–	Ω	Each input is terminated with a 75Ω impedance-matching resistor. When Y_IN/C_IN is not selected, the input impedance of the C_IN input is 120 kΩ. When Y_IN/C_IN is selected, the input impedance of C_IN is 75Ω.

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TABLE 3	BTTL inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	3	–	
Signaling rate					
CAM_SEL_BIT_[2:0]	–	–	1	Hz	See “Selecting a camera” on page 1017.
Input voltage					
operating range	0	3.3	–	V	Internally pulled high; can be brought low by connecting to GND. (see “Getting the most from the KAD/VID/106” on page 1017.)
logic 0	0	–	0.8	V	
logic 1	2	–	3.6	V	
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.
Input resistance					
each input to GND	10	–	–	MΩ	Module powered on.
each input to GND	10	–	–	kΩ	Module powered off.

TABLE 4	Audio inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	2	–	
Encoded audio rate					Each audio channel can optionally be encoded at 64 kbps.
AUDIO_LEFT_IN	0	–	64	kbps	
AUDIO_RIGHT_IN	0	–	64	kbps	
Input level	–	1	–	V_{rms}	
Input resistance					
each input to GND	–	11	–	kΩ	

TABLE 5	Video outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	2	–	Camera synchronization output derived from CVBS_0_IN.
Generator lock outputs					
CAM_2_GENLOCK_OUT	–	1	–	V_{pp}	AC coupled output with a 75Ω resistor in series for impedance matching.
CAM_3_GENLOCK_OUT	–	1	–	V_{pp}	AC coupled output with a 75Ω resistor in series for impedance matching.
Source copy outputs					
CVBS_Y_OUT	–	–	–	–	Composite video/component video luminance output.
C_OUT	–	–	–	–	Component video chrominance output.
Output level	–	1	–	V_{pp}	
Output resistance	–	75	–	Ω	AC coupled output with a 75Ω resistor in series for impedance matching.

Setting up the KAD/VID/106

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/VID/106/B	KAD/VID/106/B	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Settings	-	-	-
Encapsulation Mode	Packetizer FIFO	Packetizer	Switches between FIFO mode and Packetizer mode. Packetizer mode transmits iNET-X block-type payloads.
Audio Video Mode	Normal Audio Only	Normal	Switches between Normal (video and audio) and Audio Only mode.
Sample Width	16-bit 12-bit	16-bit	Controls the sample width; 16-bit or 12-bit samples.
Settings Video Input	-	-	-
Video Format	NTSC PAL	PAL	Used to select the video format.
Video Source	CVBS_IN(0) CVBS_IN(1) CVBS_IN(2) Test Y/C_IN CameraSelect(2:0) None	CVBS_IN(0)	Used to select between three composite input channels, one Y/C input channel or a test picture.
Settings Time Overlay	-	-	-
Video Timer On	True False	True	Specifies whether time overlay is present.
Text Color	Black White	Black	Specifies the color of the text.
Background Style	Solid None	Solid	Specifies the style of the text background.
Horizontal Placement	0 to 719	40	Specifies the left most Time Overlay horizontal placement in terms of pixel position where (0,0) represents the top-left corner of the image. When a value larger than 577 is used, the Time Overlay will start go off the screen.
Vertical Placement	0 to 575	40	Specifies the top most Time Overlay vertical placement in terms of pixel position. When a value larger than 542 (PAL) or 447 (NTSC) is used, the Time Overlay will start go off the screen.
Settings Compression	-	-	-
Video Resolution	CIF 2CIF D1	CIF	Used to specify the digital video resolution.

SETUP DATA	CHOICE	DEFAULT	NOTES
Video Bit Rate	250 kbps 512 kbps 750 kbps 900 kbps 1 Mbps 2 Mbps 5 Mbps 10 Mbps	1 Mbps	H.264 encoding produces a bit stream with an average bit-rate close to the value specified in this setting. When Encapsulation Mode is FIFO, 5 Mbps and 10 Mbps are not supported.
GOP Mode	All I 1:1 1:5 1:15 1:25 1:30 1:50 1:60	1:15	I-frame to P-frame ratio.
Frame Rate	1 5 8.33 12.5 25	25	Used to set the number of frames per second. This setting is context sensitive and depends on which video format is selected; NTSC or PAL. Settings shown here are for PAL. When NTSC is selected, available settings are: 1, 6, 10, 15, 30.
Audio Setting	Stereo Left Right None	Stereo	Describes the audio settings of the instrument. The allowed values are Mono, Stereo, Left, Right and None. None means that there is no audio.
Audio Channel Bit Rate	64 kbps 32 kbps	64 kbps	Audio encoding bit-rate per channel.
Channels	-	-	-
CVBS_IN(2:0) Video Input	-	-	Single ended composite video inputs.
Y/C_IN Video Input	-	-	S-video input made up of two physical channels. Y luminance and C chromance.
CameraGenLock(1:0) CameraGenLock Output	-	-	GenLock camera synchronization signal derived from CVSB_IN(0).
CameraSelect(2:0) CameraSelect Input	-	-	Physical pins used to select between three composite input channels, one component input channel or a test picture.
VideoCopyOut(1:0) VideoCopyOut Output	-	-	Buffered copy of the selected input video source.
MPEG2TSIn MPEG2 Transport Stream Input	-	-	iNET-X packetizer channel for audio and video MPEG-2 transport stream.
Settings	-	-	-
Stream Id	00 to FFFFFFFF	FFFFFFFF	iNET-X stream ID for selected channel if a packet is generated via the assertion of Packetization Enabled. This setting is only supported in DAS Studio 3.
Packetization Enabled	True False	False	Enables the transmission of an iNET-X packet containing the contents of this channel if an iNET-X transmitter is present in the chassis. This setting is only supported in DAS Studio 3.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
MPEG2TS MPEG2 transport stream of H.264 encoded video data and AAC encoded audio data.	BitVector	BitVector	16	R[15:0]

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Report Reports the status of the module.	BitVector	BitVector	16	R[15:0] R(15) Fresh Error - Indicates occurrence of a new error. Resets to 0 when read from the backplane. R[14:8] DSP Timeout Count - Helps detect problems in the DSP processor by giving the amount of time-outs detected. R[7:5] Error Code - 3-bit error code used to indicate the most recent error detected in the motherboard FPGA. 000: No error 101: Malformed audio packet length. Error code is generated when an AAC packet length of zero is detected. R(4) Audio FIFO Overflow - The internal audio FIFO of the MPEG2 transport stream frame overflowed at least once. R(3) Video FIFO Overflow - The internal video FIFO of the MPEG2 transport stream frame overflowed at least once. R(2) BIST Passed - Built in test passed and DSP processor is up and running. R(1) ACC Encoded Audio Present - ACC audio from DSP processor present. R(0) H.264 Encoded Video Present - H.264 video from DSP processor present.

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/VID/106

For a detailed description on iNET-X payloads, see *TEC/NOT/070 - iNET-X payload structures*.

KAD/VID/106 video decoder and encoder

The KAD/VID/106 video section consists of two units; an analog video decoder and an H.264 baseline profile encoder. The video decoder operates on one of the three composite or Y/C input signals and supports both NTSC and PAL. The H.264 encoder unit is highly configurable and can be tuned to suit various applications by setting the frame rate (fps), GOP mode, and output video resolution. The sample width can be set to 16 bits or 12 bits.

Enabling video and audio

The module can encapsulate via software, video only, audio only, or both video and audio into the MPEG2 transport stream.

Set Audio Video Mode to Normal for both video and audio; set to Audio Only for audio.

However, if you only want video, you need to set Audio Video Mode to Normal and then set Audio Setting to None.

WARNING: If Audio Video Mode is set to Audio Only, then Audio Setting must not be None. Otherwise, no MPEG transport stream is output as no audio or video have been requested.

Setting the I-frame to P-frame ratio

The GOP can be set via software to I-frame mode only (All I) or up to I-frame to 60 P-frames (1:60) to achieve a higher compression ratio. Reducing the P-frame to I-frame ratio improves real-time characteristics and loss recovery. Increasing the P-frame to I-frame ratio gives a higher compression ratio at the expense of loss recovery.

Setting the video output resolution

The digital video output resolutions can be set via software to D1, 2CIF, and CIF depending on picture detail required. Also, the number of fps can be reduced from full frame (30 fps NTSC, 25 fps PAL) down to 1 fps. Increasing the frame rate makes the appearance of movement more fluid, but can add significantly to the output data rate and is not always necessary with graphical displays. Optional AAC audio encoding produces a digital audio data stream at 32 kbps or 64 kbps per channel. The left and right channels can be individually turned on or off.

Synchronizing incoming video input signals

The KAD/VID/106 has two genlock outputs to allow synchronization of all four incoming video input signals. When multiple synchronized video signals are connected, the KAD/VID/106 can switch between the incoming channels via an external switch. The KAD/VID/106 also outputs a copy of the currently selected input source. This allows it to be relayed to a second KAD/VID/106 which can be set up with different encoding parameters. For example, to allow video to be recorded at a higher quality necessitating a higher bit-rate; while lower quality video is available for transmission at a lower bit-rate over a PCM or Ethernet link. Time can be optionally overlaid onto the picture. For link testing, a color bar test picture can be generated. If no input source is present, the module outputs a blue screen image.

Selecting a camera

Camera selection can be controlled via software or via the CAM_SEL_BIT_[2:0] input signals on the top connector. When the module is programmed for camera selection via the top connector input lines, then the behavior is determined as listed in the following table.

TABLE 6			Camera selection test sequence format
C_SEL_BIT_[2:0]			CABLING
0	0	0	Test screen
0	0	1	CVBS_0_IN
0	1	0	CVBS_1_IN
0	1	1	CVBS_2_IN
1	0	0	Y_IN/C_IN

Only one input can be selected at a time by connecting the CAM_SEL_BIT_[2:0] pin to GND on pin 40. These signals are internally pulled high. The amount of time it takes to switch from one video input to another via the top block CAM_SEL_BIT_[2:0] is 500ms or less.

Optimal configuration

The two optimal video settings tables below display the recommended H.264 bit-rate range for different resolution and frame rate settings.

NOTE: The optimal video settings tables represent a subset of the results gathered during tests. For more information on the optimal configuration for specific setups, contact Curtiss-Wright support (acra-support@curtiss-wright.com).

TABLE 7	KAD/VID/106 optimal PAL video settings		
BIT-RATE (MBPS)	RESOLUTION	FRAME RATE (FPS)	GOP
0.250	CIF	25	15
0.250	2CIF	12.5	5
0.250	D1	8	15
0.512	CIF	12.5	5
0.512	2CIF	25	15
0.512	D1	12.5	5
0.75	CIF	25	15
0.75	D1	25	5
0.9	CIF	25	5
0.9	D1	25	15
1	2CIF	25	15
1	D1	25	15
2	2CIF	25	5
2	D1	25	15
5	2CIF	25	5
5	D1	25	5
10	2CIF	25	5
10	D1	25	5

TABLE 8	KAD/VID/106 optimal NTSC video settings		
BIT-RATE (MBPS)	RESOLUTION	FRAME RATE (FPS)	GOP
0.250	CIF	15	5
0.250	2CIF	15	15
0.512	CIF	15	5
0.512	2CIF	15	15
0.75	CIF	30	5
0.75	2CIF	30	15
0.75	D1	1	5
0.9	CIF	30	5
0.9	2CIF	30	15
0.9	D1	1	5
0.9	D1	15	15
1	2CIF	30	5
1	D1	30	15
2	2CIF	30	5
2	D1	30	5
5	2CIF	30	5
5	D1	30	5
10	2CIF	30	5
10	D1	30	5

It is recommended to use high bit-rates if the video content contains fine details or fast moving scenes. If the application is constrained to low bit-rates, then either reduce the resolution of the encoded video (for example, use CIF instead of D1) or reduce the frame rate. Increasing the value of the GOP increases the number of predicted frames used thus effectively increasing the compression ratio. A higher compression ratio may help in reducing the bandwidth requirements of the encoded video.

NOTE: Set **Audio Setting** to **None** when 10 Mbps and 250 kbps video bit-rates are used.

Audio Only FIFO Mode sample rates

When **Audio Video Mode** is set to **Audio Only** and **Encapsulation Mode** is set to **Audio FIFO**, you must set the rate at which the MPEG2 Transport stream is sampled. The required sample rate is dependent on the **Audio Channel Bit Rate** setting and the dynamic range (amplitude) of the audio signal(s).

The following settings can be used as a guide and may need adjustment depending on the signals dynamic range.

TABLE 9 Audio bit rates and FIFO sample rate

AUDIO SETTING	AUDIO CHANNEL BIT RATE	FIFO SAMPLE RATE (BITS PER SECOND)
Stereo	64 kbps	200 kbps (12.5 ksps)
Left/Right	64 kbps	128kbps (8 ksps)
Stereo	32 kbps	128kbps (8 ksps)
Left/Right	32 kbps	100kbps (6.25 ksps)

Connector pinout of the KAD/VID/106

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	CVBS_0_IN	Video inputs	Composite video input channel 0
2	DNC		Do not connect
3	CVBS_1_IN	Video inputs	Composite video input channel 1
4	DNC		Do not connect
5	CVBS_2_IN	Video inputs	Composite video input channel 2
6	DNC		Do not connect
7	Y_IN	Video inputs	Component video input (luminance)
8	DNC		Do not connect
9	C_IN	Video inputs	Component video input (chrominance)
10	DNC		Do not connect
11	CAM_2_GENLOCK_OUT	Video outputs	Synchronization output
12	DNC		Do not connect
13	CAM_3_GENLOCK_OUT	Video outputs	Synchronization output
14	DNC		Do not connect
15	AUDIO_RIGHT_IN	Audio inputs	Analog audio input
16	DNC		Do not connect
17	AUDIO_LEFT_IN	Audio inputs	Analog audio input
18	GND	Internal ground	
19	DNC		Do not connect
20	GND	Internal ground	
21	DNC		Do not connect
22	GND	Internal ground	
23	DNC		Do not connect
24	GND	Internal ground	
25	DNC		Do not connect
26	GND	Internal ground	
27	DNC		Do not connect
28	GND	Internal ground	
29	DNC		Do not connect
30	GND	Internal ground	
31	DNC		Do not connect
32	GND	Internal ground	
33	DNC		Do not connect
34	GND	Internal ground	
35	DNC		Do not connect
36	GND	Internal ground	
37	CAM_SEL_BIT_0	BTTL inputs	Internally pulled high
38	CAM_SEL_BIT_1	BTTL inputs	Internally pulled high
39	CAM_SEL_BIT_2	BTTL inputs	Internally pulled high
40	GND	Internal ground	
41	CVBS_Y_OUT	Video outputs	Composite video/component video luminance output
42	GND	Internal ground	
43	C_OUT	Video outputs	Component video chrominance output
44	GND	Internal ground	
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/VID/106/B	H.264 video encoder (analog video input) - 1ch

By default, the standard mating connector, CON/KAD/002/CP, is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
KAD/VID/106/B	250kbps video bit-rate supported; audio bit-rate per channel can be 32kbps as well as 64kbps; Audio Only mode supported; 12-bit sampling mode implemented; format switching supported; audio video synchronization improved	Recommended for new programs
KAD/VID/106	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
TEC/NOT/050	Understanding how data is stored in Ethernet packets
TEC/NOT/051	Ethernet frames, Wireshark® and FAT32
TEC/NOT/067	IENA and iNET-X packet payload formats
TEC/NOT/073	Using the KAD/VID/106

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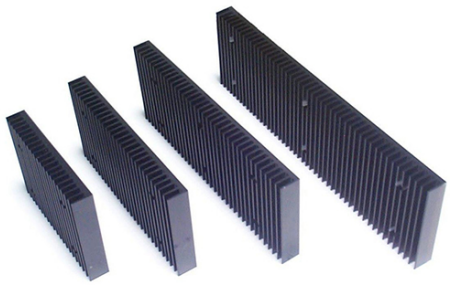
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ACC/HSK/001

Optional heat sinks for the Acra KAM-500 system

CURTISSWRIGHTDS.COM



Key Features

- Black fins for maximum radiation/convection
- Comes complete with mounting screws
- Compact

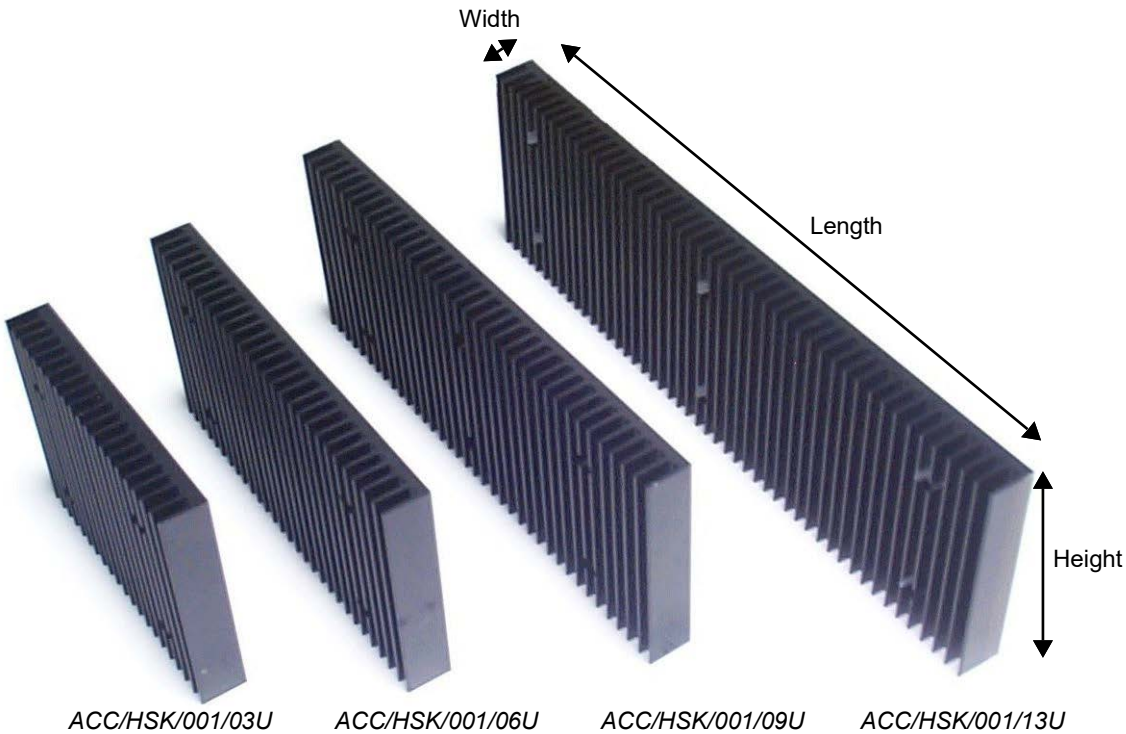
Applications

- Chassis heat sink

Overview

Although the Acra KAM-500 system is power efficient and is designed to operate at chassis temperatures of up to 85°C, heat sinks are recommended for all applications where space permits. One or two heat sinks can be attached to each chassis.

- ACC/HSK/001/03U is designed for the three user-slot chassis KAM/CHS/03U
- ACC/HSK/001/06U is designed for the six user-slot chassis KAM/CHS/06U
- ACC/HSK/001/09U is designed for the nine user-slot chassis KAM/CHS/09U
- ACC/HSK/001/13U is designed for the 13 user-slot chassis KAM/CHS/13U



Specifications

TABLE 1	ACC/HSK/001/03U mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Dimensions					
height	–	75	–	mm	
height	–	2.95	–	in.	Design metric is millimeters.
length	–	125	–	mm	
length	–	4.92	–	in.	
width	–	15	–	mm	
width	–	0.59	–	in.	
Mass					
	–	140	–	g	
	–	4.93	–	oz	Design metric is grams.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Finish	–	–	–	–	Black anodized.

TABLE 2	ACC/HSK/001/06U mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Dimensions					
height	–	75	–	mm	
height	–	2.95	–	in.	Design metric is millimeters.
length	–	167	–	mm	
length	–	6.57	–	in.	
width	–	15	–	mm	
width	–	0.59	–	in.	
Mass					
	–	195	–	g	
	–	6.87	–	oz	Design metric is grams.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Finish	–	–	–	–	Black anodized.

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TABLE 3	ACC/HSK/001/09U mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Dimensions					
height	–	75	–	mm	
height	–	2.95	–	in.	Design metric is millimeters.
length	–	209	–	mm	
length	–	8.22	–	in.	
width	–	15	–	mm	
width	–	0.59	–	in.	
Mass					
	–	250	–	g	
	–	8.81	–	oz	Design metric is grams.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Finish	–	–	–	–	Black anodized.

TABLE 4	ACC/HSK/001/13U mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Dimensions					
height	–	75	–	mm	
height	–	2.95	–	in.	Design metric is millimeters.
length	–	247.4	–	mm	
length	–	9.7	–	in.	
width	–	15	–	mm	
width	–	0.59	–	in.	
Mass					
	–	340	–	g	
	–	11.99	–	oz	Design metric is grams.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Finish	–	–	–	–	Black anodized.

NOTE: Mounting screws should all be initially tightened to 0.4Nm (0.295 foot pound-force) and then finally tightened to 0.6Nm (0.44 foot pound-force). Thread lock glue should be applied to each screw.

To maximize heat transfer efficiency, use a thermal conductive compound between the heat sink and the chassis.

Ordering information

PART NUMBER	DESCRIPTION
ACC/HSK/001/03U	One or two ACC/HSK/001/03U heat sinks are recommended with each KAM/CHS/03U. Four mounting screws, ACC/SCW/001, are supplied with each heat sink.
ACC/HSK/001/06U	One or two ACC/HSK/001/06U heat sinks are recommended with each KAM/CHS/06U. Four mounting screws, ACC/SCW/001, are supplied with each heat sink.
ACC/HSK/001/09U	One or two ACC/HSK/001/09U heat sinks are recommended with each KAM/CHS/09U. Six mounting screws, ACC/SCW/001, are supplied with each heat sink.
ACC/HSK/001/13U	One or two ACC/HSK/001/13U heat sinks are recommended with each KAM/CHS/13U. Six mounting screws, ACC/SCW/001, are supplied with each heat sink.

The heat sinks are recommended where space permits but must be ordered separately. Adding a heat sink does not affect the length or height of the KAM-500 chassis but does increase the width by 15mm (0.59in.). Adding two heat sinks (one on each side) increases the width by 30mm (1.18in.).

The mounting screws supplied with the heat sinks, ACC/SCW/001, are M3x6mm cap head allen set screws.

Revision history

REVISION	DIFFERENCES	STATUS
ACC/HSK/001/03U	First release	Recommended for new programs
ACC/HSK/001/06U	First release	Recommended for new programs
ACC/HSK/001/09U	First release	Recommended for new programs
ACC/HSK/001/13U	First release	Recommended for new programs

Related documentation

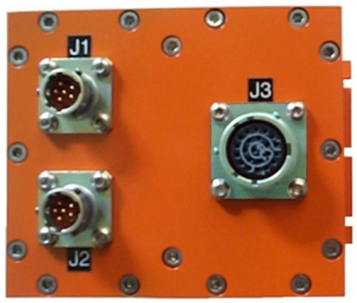
DOCUMENT	DETAILS
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/DBK/001	KAM-500 Databook

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ACC/TRF/002

Power transformer for variable frequency supplies from 200 Hz to 900 Hz - 6ch

CURTISSWRIGHTDS.COM



Overview

The unit is used to condition 115 VAC RMS, variable frequency (200 Hz to 900 Hz) aircraft supplies to a voltage level suitable for input to the Curtiss-Wright three-phase power monitor module, KAD/ADC/008.

The unit is capable of accepting and producing outputs for up to six channels.

Key Features

- Six transformer-coupled channels
- Rugged aluminum casing
- Designed for use with the KAD/ADC/008
- Designed for variable frequency supplies with a frequency range from 200 Hz to 900 Hz

Applications

- Monitoring aircraft power supplies

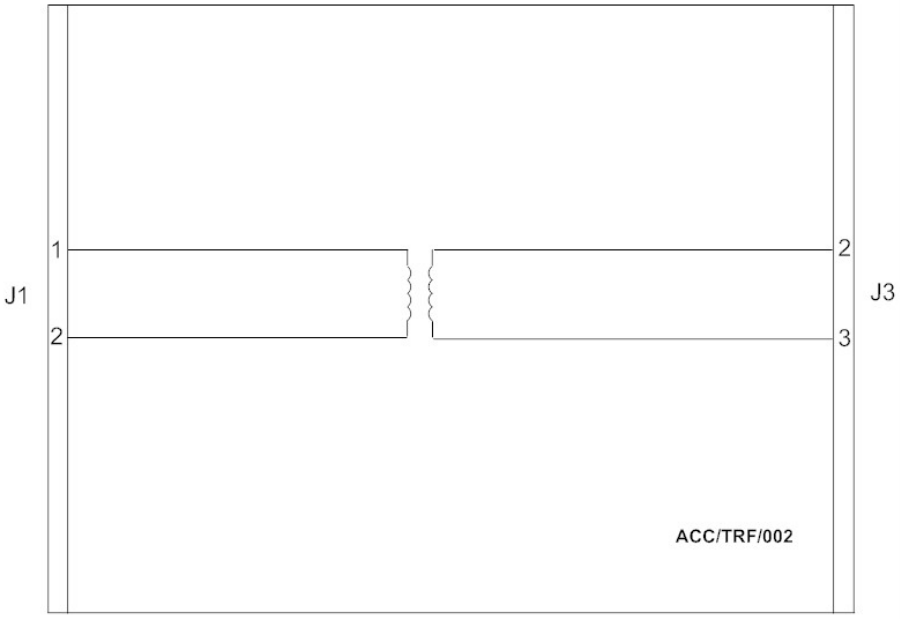


Figure 1: First of six independent transformer channels

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Channels	–	–	6	–	Transformer coupled.
Dimensions					Design metric is millimeters.
height	–	46.4	–	mm	Includes lid and base plate.
height	–	1.83	–	in.	Includes lid and base plate.
length	–	118	–	mm	Includes mounting lugs.
length	–	4.64	–	in.	Includes mounting lugs.
width	–	80	–	mm	
width	–	3.14	–	in.	
Height above chassis					
bare connector	9.8	10.0	10.2	mm	
bare connector	0.386	0.394	0.402	in.	Design metric is millimeters.
Mass					
no modules	–	0.62	–	kg	
no modules	–	1.37	–	lb	Design metric is kilograms.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Finish					Electroless nickel-plated.
top parts	–	–	–	–	Painted REINORANGE RAL2004.
base, side and end plates	–	–	–	–	Painted REINORANGE RAL2004.

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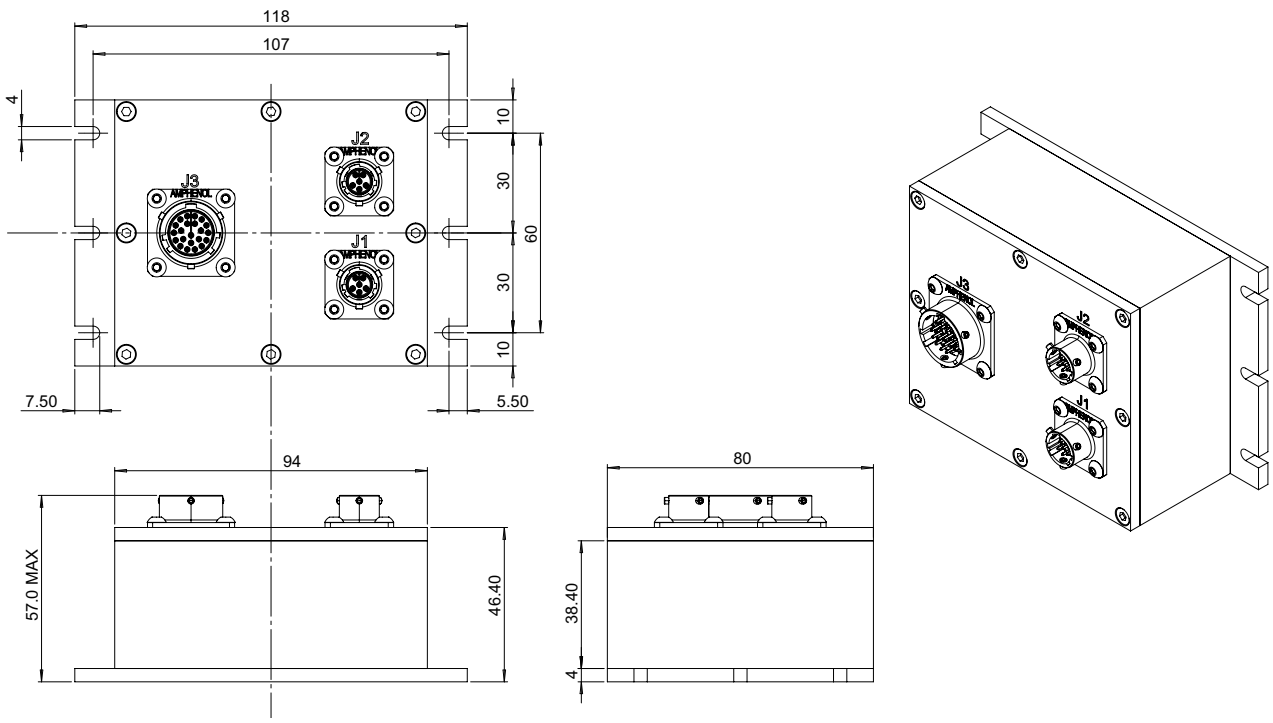


Figure 2: ACC/TRF/002 mechanical drawing

TABLE 2	Transformer inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	6	–	
Input signal voltage	–	115	–	VAC_{RMS}	
Input signal frequency	200	–	900	Hz	
Transformation ratio	20.3:1	20.9:1	21.5:1	–	$115V_{rms}$ input
Input protection	–	62	–	mA	Each input fused at primary current.

TABLE 3	Transformer outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	6	–	
Output signal voltage	–	5.50	–	VAC_{RMS}	
Output signal frequency	200	–	900	Hz	

Getting the most from the ACC/TRF/002

The ACC/TRF/002 has been designed to provide signal conditioning for input to a KAD/ADC/008 module, therefore each ACC/TRF/002 can be used with up to two KAD/ADC/008 modules when monitoring three-phase power lines.

The following figure displays how to connect the ACC/TRF/002 to a KAD/ADC/008.

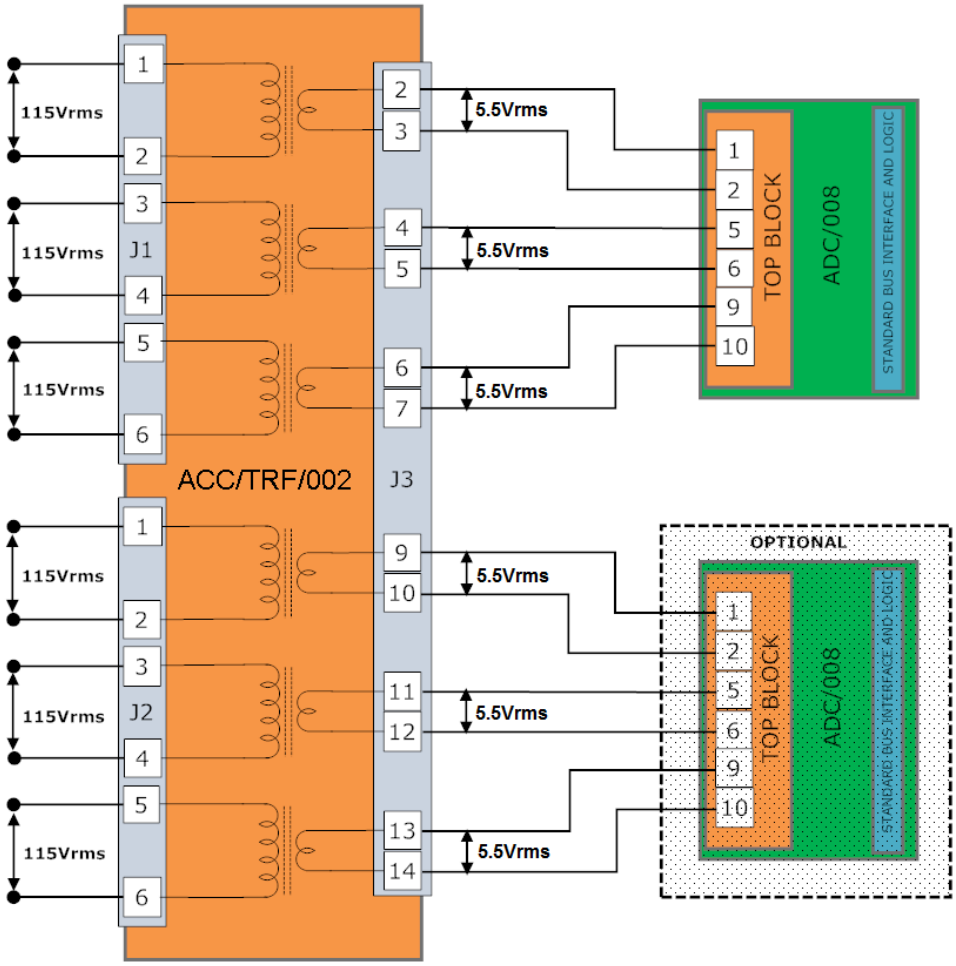


Figure 3: ACC/TRF/002 connected to KAD/ADC/008

NOTE: At least 80 mm (3.14 in.) clearance is required at the top of the unit for connectors and cables.

Because the mounting of the transformer in relation to the chassis is not known, a mating connector is not supplied with the ACC/TRF/002. However, recommended mating connectors are mentioned in “Related products” on page 1035.

For current measurements of each phase we recommend using a current transformer. For details, see *TEC/NOT/037 - Using the KAD/ADC/008*.

Connector pinout of ACC/TRF/002

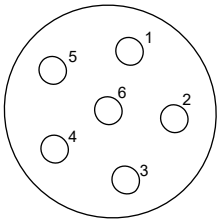


Figure 4: Pinout for J1 and J2

J1

PIN	NAME	DESCRIPTION	COMMENT
1	Phase 1	Input	Connected to J3 pin 2
2	Neutral	Input	Connected to J3 pin 3
3	Phase 2	Input	Connected to J3 pin 4
4	Neutral	Input	Connected to J3 pin 5
5	Phase 3	Input	Connected to J3 pin 6
6	Neutral	Input	Connected to J3 pin 7

J2

PIN	NAME	DESCRIPTION	COMMENT
1	Phase 4	Input	Connected to J3 pin 9
2	Neutral	Input	Connected to J3 pin 10
3	Phase 5	Input	Connected to J3 pin 11
4	Neutral	Input	Connected to J3 pin 12
5	Phase 6	Input	Connected to J3 pin 13
6	Neutral	Input	Connected to J3 pin 14

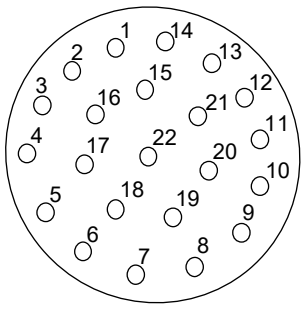


Figure 5: Pinout for J3

J3

PIN	NAME	DESCRIPTION	COMMENT
1	DNC		Do not connect
2	J1 VOLTAGE(0)	Output	Connected to VOLTAGE(0) on KAD/ADC/008
3	J1 GND	Output	Connected to GND (pin 2) on KAD/ADC/008
4	J1 VOLTAGE(1)	Output	Connected to VOLTAGE(1) on KAD/ADC/008
5	J1 GND	Output	Connected to GND (pin 6) on KAD/ADC/008
6	J1 VOLTAGE(2)	Output	Connected to VOLTAGE(2) on KAD/ADC/008
7	J1 GND	Output	Connected to GND (pin 10) on KAD/ADC/008
8	DNC		Do not connect
9	J2 VOLTAGE(0)	Output	Connected to VOLTAGE(0) on KAD/ADC/008
10	J2 GND	Output	Connected to GND (pin 2) on KAD/ADC/008
11	J2 VOLTAGE(1)	Output	Connected to VOLTAGE(1) on KAD/ADC/008
12	J2 GND	Output	Connected to GND (pin 6) on KAD/ADC/008
13	J2 VOLTAGE(2)	Output	Connected to VOLTAGE(2) on KAD/ADC/008
14	J2 GND	Output	Connected to GND (pin 10) on KAD/ADC/008
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect

Ordering information

PART NUMBER	DESCRIPTION
ACC/TRF/002	Power transformer for variable frequency supplies from 200 Hz to 900 Hz - 6ch

Revision history

REVISION	DIFFERENCES	STATUS
ACC/TRF/002	First release	Recommended for new programs

Related products

MODULE	DETAILS
KAD/ADC/008	Single ended ADC (programmable analog gain, three phase power monitor, 1kHz b/w) - 6ch at 20sps
ACC/CON/021	Mating connector for ACC/TRF/001/B, ACC/TRF/002 - J1, J2 connectors (6-way)
ACC/CON/010	Mating connector for ACC/TRF/001/B, ACC/TRF/002 - J3 connector (22-way)
ACC/BAC/008	Backshell for 22-way power connector

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
TEC/NOT/037	Using the KAD/ADC/008

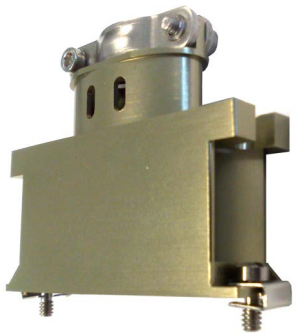
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ACD/BAC/002

Backshell for KAD connectors (straight-through)

CURTISSWRIGHTDS.com



Overview

The ACD/BAC/002 is an electroless nickel-plated, aluminum backshell for use with KAD module DD mating connectors.

The part is supplied with two 4-40 UNC, stainless steel mating screws, two stainless steel retaining clips, and clamp bars with Allen head screws.

Key Features

- For use with KAD - Double-Density (DD) - mating connectors

Applications

- Use with cables and mating connectors

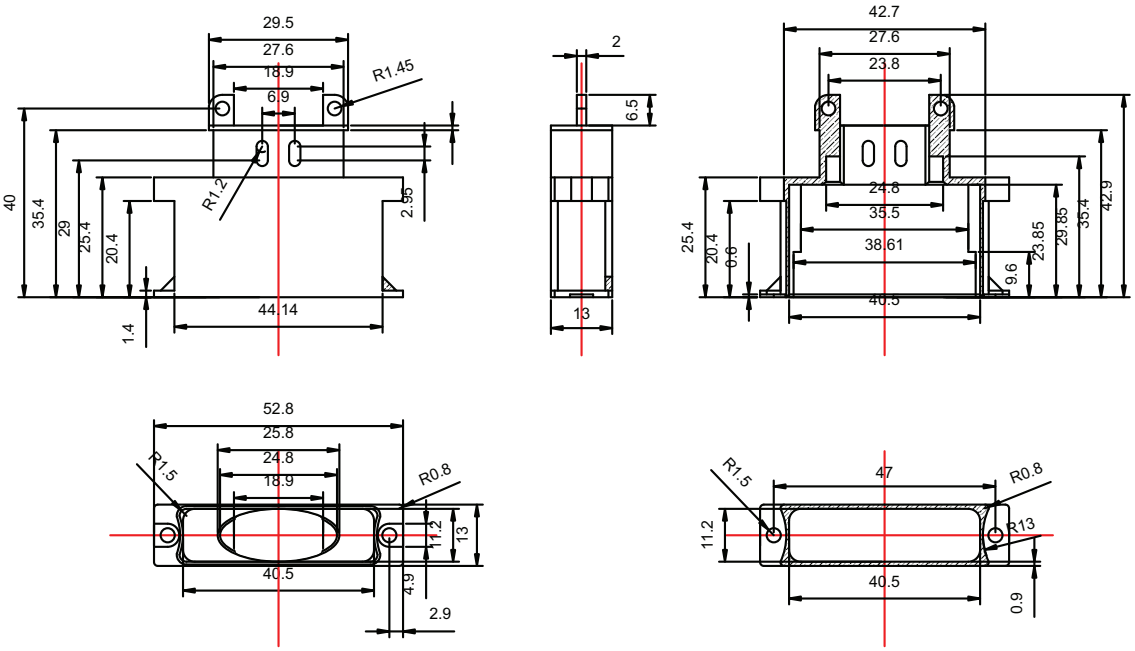


Figure 1: ACD/BAC/002 mechanical drawing

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
backshell, screw and clip	–	18	–	g	
backshell, screw and clip	–	0.63	–	oz	Design metric is grams.
Height above chassis					
	–	48.4	–	mm	For chassis clearance including bend radius, see Figure 2 on page 1040.
	–	1.9	–	in.	
Dimensions					
backshell height	–	42.88	–	mm	
backshell height	–	1.68	–	in.	Design metric is millimeters.
backshell length	–	52.85	–	mm	
backshell length	–	2.08	–	in.	
backshell width	–	12.8	–	mm	
backshell width	–	0.50	–	in.	
screw length	–	3.51	–	mm	Length of threaded insert.
screw length	–	0.13	–	in.	Length of threaded insert.
width of clip	–	6.35	–	mm	ACD/BAC/002/B/00
width of clip	–	0.24	–	in.	ACD/BAC/002/B/00
width of clip	–	6.50	–	mm	ACD/BAC/002/B/01
width of clip	–	0.26	–	in.	ACD/BAC/002/B/01
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Finish					
backshell	–	–	–	–	Electroless nickel-plated aluminium.
screw	–	–	–	–	Stainless steel.
clip	–	–	–	–	Stainless steel.

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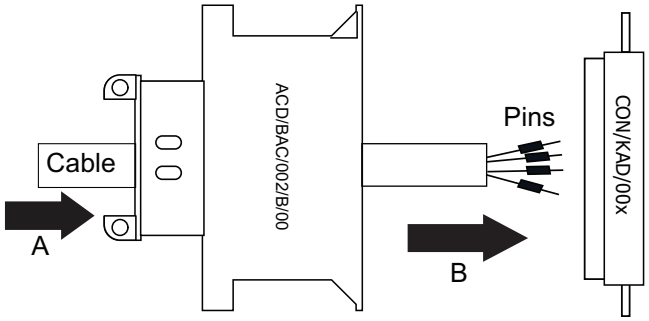
Getting the most from the ACD/BAC/002

The ACD/BAC/002 backshell is for use only with CON/KAD/00x mating connectors.

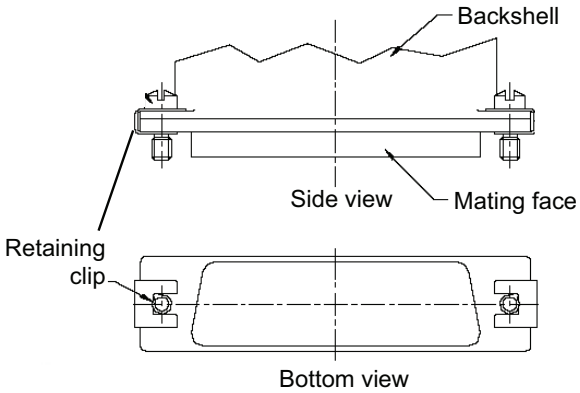
When fitting the ACD/BAC/002, the cable (wires and pins) must be inserted through the backshell before the pins are inserted into the mating connector.

Connector assembly (ACD/BAC/002/B/00)

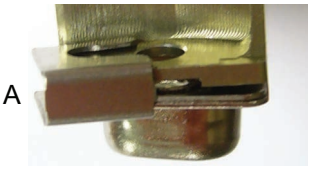
1. Remove the screws and retaining clips from the CON/KAD/00x connector to which the backshell is to be attached. (These can be discarded as the screws and clips provided with the backshell are used for the connector assembly.)
2. Insert the cable to be inserted into the CON/KAD/00x connector through the backshell (A).



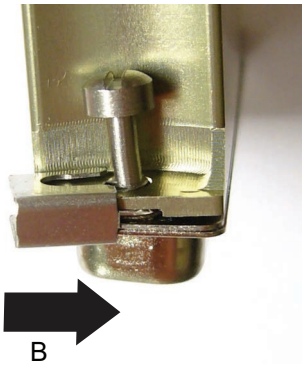
3. Insert the crimped pins into the CON/KAD/00x connector (B). (See the respective *CON/KAD/00x* and *KIT/001* data sheets in the *Acra KAM-500 Databook* for instructions on how to insert these pins.)
4. Join the backshell and the CON/KAD/00x connector.
5. To fit a retaining clip (ACD/CLP/003), ensure the correct side is located on the mating face side of the assembly as shown here.



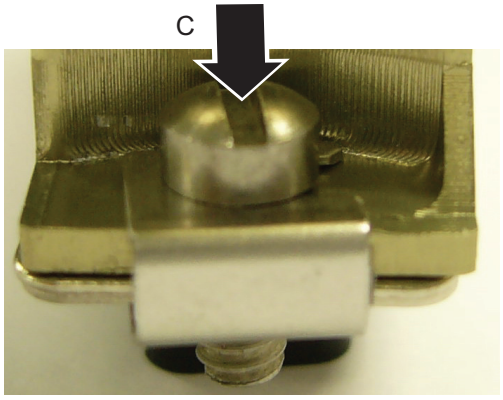
6. Position the retaining clip over the edge of the side flange (A).



7. Insert a screw (ACD/SCW/004) into the hole on the flange so that the threaded part of the screw is inside the hole and then slide the clip across so that it locks around the screw (B).



8. Now push the screw down so it is fully inserted into the retaining clip (C).
(When securing the connector assembly to a module, note the recommended tightening torque is 0.4Nm.)

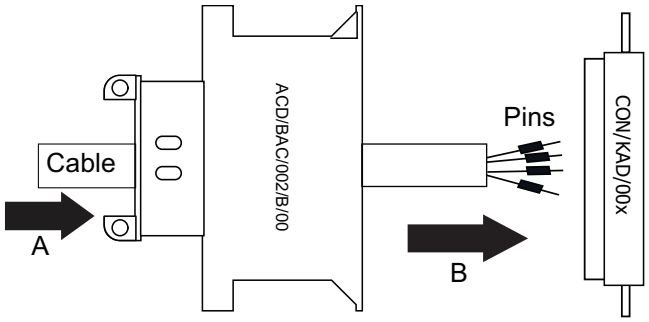


9. Repeat steps 5 to 8 for the other retaining clip.
10. Secure the cable with the clamp bar.
Note: Do not exceed tightening torque of 0.4Nm.

NOTE: We recommend always using a nut-locking solution on the clamp bar assembly screws.

Connector assembly (ACD/BAC/002/B/01)

1. Remove the screws and retaining clips from the CON/KAD/00x connector to which the backshell is to be attached. (These can be discarded as the screws and clips provided with the backshell are used for the connector assembly.)
2. Insert the cable to be inserted into the CON/KAD/00x connector through the backshell (A).



3. Insert the crimped pins into the CON/KAD/00x connector (B). (See the respective *CON/KAD/00x* and *KIT/001* data sheets in the *Acra KAM-500 Databook* for instructions on how to insert these pins.)
4. Join the backshell and the CON/KAD/00x connector.
5. Insert a screw (SCC/BAC/001) into a retaining clip (NUT/025/01) and turn the screw a quarter turn to hold it in place.



6. Position the retaining clip over the flange so that the holes and screw are aligned.



7. Turn the screw until it has dropped into place.



8. Repeat steps 5 to 7 for the other retaining clip. (When securing the connector assembly to a module, note the recommended tightening torque is 0.4Nm.)
9. Secure the cable with the clamp bar.
   Note: Do not exceed tightening torque of 0.4Nm.

NOTE: We recommend always using a nut-locking solution on the clamp bar assembly screws.

Bend radius

The following diagram shows an example of the clearance needed when using the ACD/BAC/002 with a CON/KAD/00x mating connector.

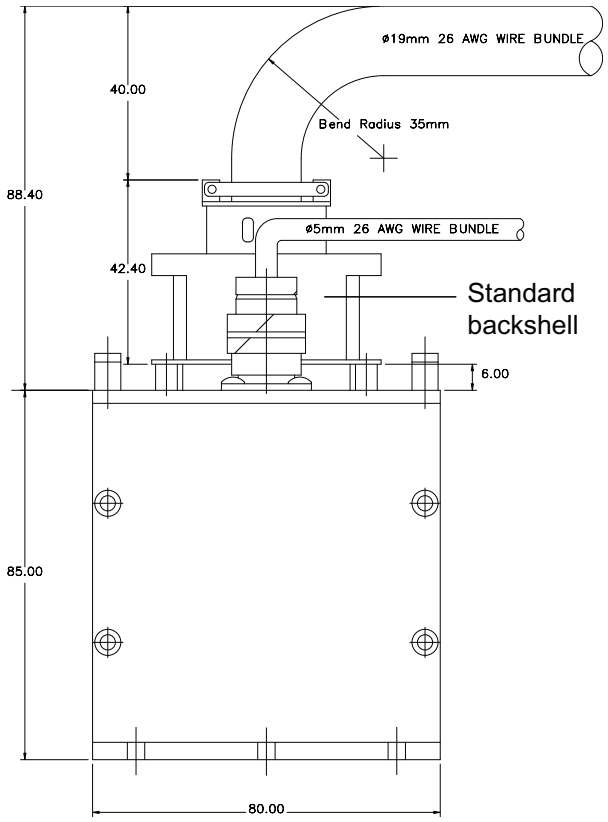


Figure 2: ACD/BAC/002 bend radius

Ordering information

PART NUMBER	DESCRIPTION
ACD/BAC/002/B	Backshell for KAD connectors (straight-through)

Revision history

REVISION	DIFFERENCES	STATUS
ACD/BAC/002/B	Reinforced mounting clips; Allen head clamp bar screws	Recommended for new programs
ACD/BAC/002	First release	Not recommended for new programs

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook

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ACD/BAC/003

Backshell for KAD connectors (20°)

CURTISSWRIGHTDS.com



Overview

The ACD/BAC/003 is an electroless nickel-plated, aluminum backshell for use with KAD module DD mating connectors.

The part is supplied with two 4-40 UNC, stainless steel mating screws (ACD/SCW/004), two stainless steel retaining clips (ACD/CLP/003), and clamp bars with Allen head screws.

Key Features

- For use with KAD - Double-Density (DD) - mating connectors

Applications

- Use with cables and mating connectors

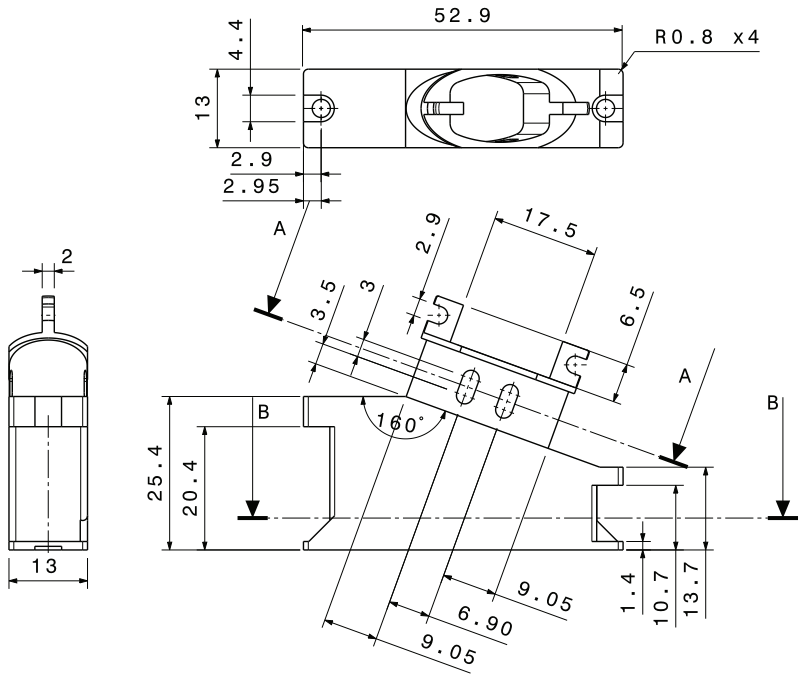


Figure 1: ACD/BAC/003 mechanical drawing (measurements in millimeters)

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
backshell, screw and clip	–	18	–	g	
backshell, screw and clip	–	0.63	–	oz	Design metric is grams.
Height above chassis					
	–	47	–	mm	For chassis clearance including bend radius, see Figure 2 on page 1046.
	–	1.85	–	in.	
Dimensions					
backshell height	–	42.02	–	mm	
backshell height	–	1.65	–	in.	Design metric is millimeters.
backshell length	–	52.9	–	mm	
backshell length	–	2.08	–	in.	
backshell width	–	13	–	mm	
backshell width	–	0.51	–	in.	
screw length	–	3.51	–	mm	Length of threaded insert.
screw length	–	0.13	–	in.	Length of threaded insert.
width of clip	–	6.35	–	mm	
width of clip	–	0.24	–	in.	
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Finish					
backshell	–	–	–	–	Electroless nickel-plated aluminium.
screw	–	–	–	–	Stainless steel.
clip	–	–	–	–	Stainless steel.

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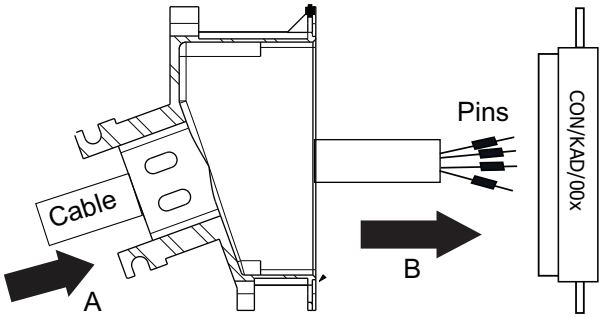
Getting the most from the ACD/BAC/003

The ACD/BAC/003 backshell is for use only with CON/KAD/00x mating connectors.

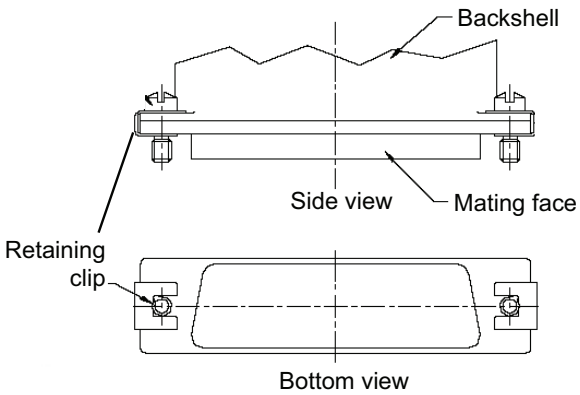
When fitting the ACD/BAC/003, the cable (wires and pins) must be inserted through the backshell before the pins are inserted into the mating connector.

Connector assembly

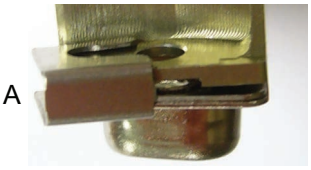
1. Remove the screws and retaining clips from the CON/KAD/00x connector to which the backshell is to be attached. (These can be discarded as the screws and clips provided with the backshell are used for the connector assembly.)
2. Insert the cable to be inserted into the CON/KAD/00x connector through the backshell (A).



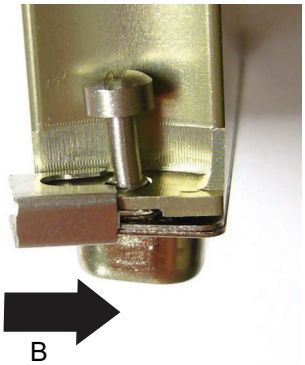
3. Insert the crimped pins into the CON/KAD/00x connector (B). (See the respective *CON/KAD/00x* and *KIT/001* data sheets in the *Acra KAM-500 Databook* for instructions on how to insert these pins.)
4. Join the backshell and the CON/KAD/00x connector.
5. To fit a retaining clip (ACD/CLP/003), ensure the correct side is located on the mating face side of the assembly as shown here.



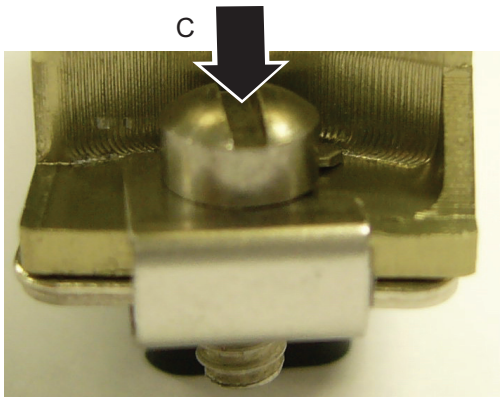
6. Position the retaining clip over the edge of the side flange (A).



7. Insert a screw (ACD/SCW/004) into the hole on the flange so that the threaded part of the screw is inside the hole and then slide the clip across so that it locks around the screw (B).



8. Now push the screw down so it is fully inserted into the retaining clip (C).
(When securing the connector assembly to a module, note the recommended tightening torque is 0.4Nm.)



9. Repeat steps 5 to 8 for the other retaining clip.
10. Secure the cable with the clamp bar.
Note: Do not exceed tightening torque of 0.4Nm.

NOTE: We recommend always using a nut-locking solution on the clamp bar assembly screws.

Bend radius

The following diagram shows an example of the clearance needed when using the ACD/BAC/003 with a CON/KAD/00x mating connector.

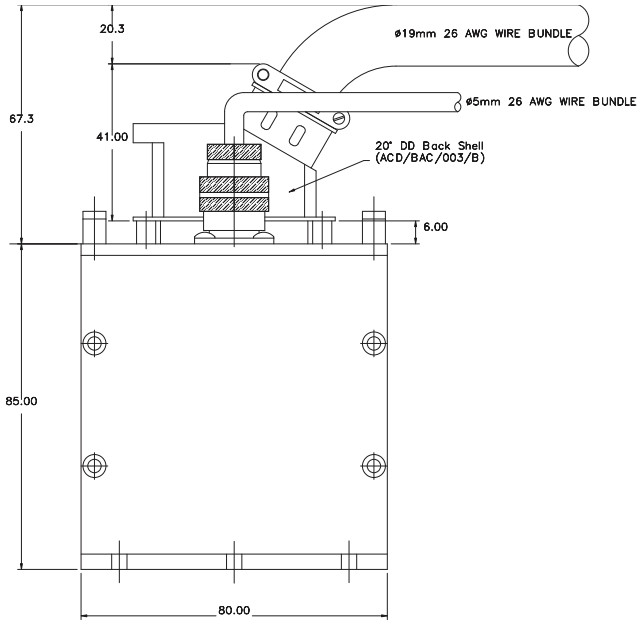


Figure 2: ACD/BAC/003 bend radius

Ordering information

PART NUMBER	DESCRIPTION
ACD/BAC/003/B	Backshell for KAD connectors (20°)

Revision history

REVISION	DIFFERENCES	STATUS
ACD/BAC/003/B	Reinforced mounting clips; Allen head clamp bar screws	Recommended for new programs
ACD/BAC/003	First release	Not recommended for new programs

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook

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ACD/BAC/004

Backshell for CON/KAD/003/CP

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Overview

The ACD/BAC/004 is an electroless nickel-plated, aluminum backshell for use with CON/KAD/003/CP mating connectors.

The part is supplied with two 4-40 UNC, stainless steel mating screws (ACD/SCW/004), two stainless steel retaining clips (ACD/CLP/003), and clamp bars with Allen head screws.

Key Features

- For use with CON/KAD/003/CP

Applications

- Use with CON/KAD/003/CP cables and mating connector

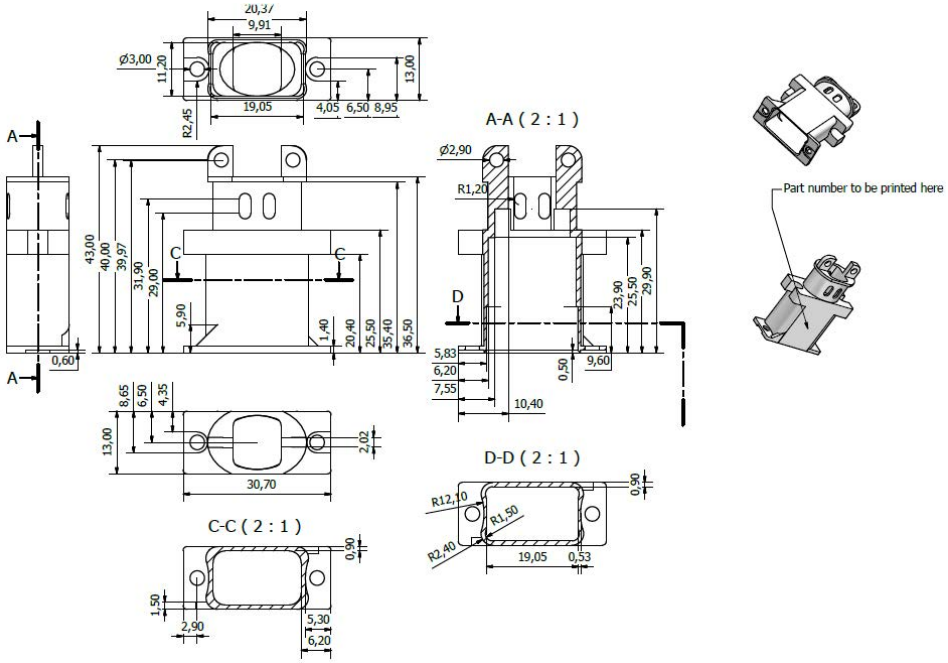


Figure 1: ACD/BAC/004 mechanical drawing (measurements in millimeters)

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
backshell, screw and clip	–	15	–	g	
backshell, screw and clip	–	0.52	–	oz	Design metric is grams.
Height above chassis					
	–	48.4	–	mm	For chassis clearance including bend radius, see Figure 2 on page 1052.
	–	1.9	–	in.	
Dimensions					Design metric is millimeters.
backshell height	–	43	–	mm	
backshell height	–	1.69	–	in.	
backshell length	–	30.7	–	mm	
backshell length	–	1.2	–	in.	
backshell width	–	13	–	mm	
backshell width	–	0.51	–	in.	
screw length	–	3.51	–	mm	Length of threaded insert.
screw length	–	0.13	–	in.	Length of threaded insert.
width of clip	–	6.35	–	mm	
width of clip	–	0.24	–	in.	
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Finish					
backshell	–	–	–	–	Electroless nickel-plated aluminium.
screw	–	–	–	–	Stainless steel.
clip	–	–	–	–	Stainless steel.

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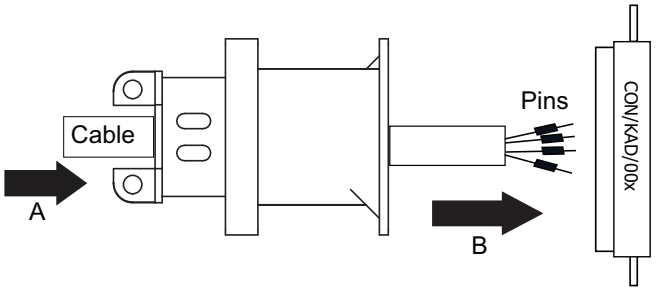
Getting the most from the ACD/BAC/004

The ACD/BAC/004 backshell is for use only with CON/KAD/003/CP mating connectors.

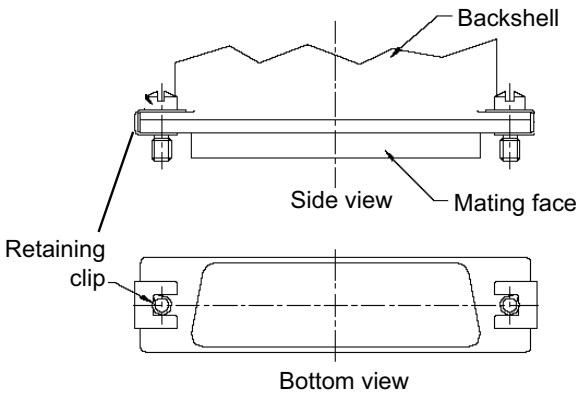
When fitting the ACD/BAC/004, the cable (wires and pins) must be inserted through the backshell before the pins are inserted into the mating connector.

Connector assembly

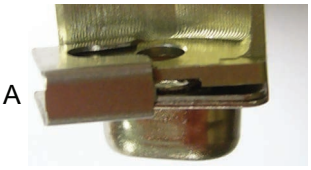
1. Remove the screws and retaining clips from the CON/KAD/003/CP connector to which the backshell is to be attached. (These can be discarded as the screws and clips provided with the backshell are used for the connector assembly.)
2. Insert the cable to be inserted into the CON/KAD/003/CP connector through the backshell (A).



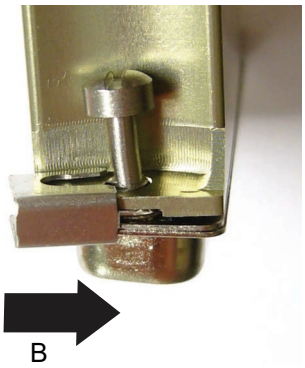
3. Insert the crimped pins into the CON/KAD/003/CP connector (B). (See the respective *CON/KAD/003/CP* and *KIT/001* data sheets in the *Acra KAM-500 Databook* for instructions on how to insert these pins.)
4. Join the backshell and the CON/KAD/003/CP connector.
5. To fit a retaining clip (ACD/CLP/003), ensure the correct side is located on the mating face side of the assembly as shown here.



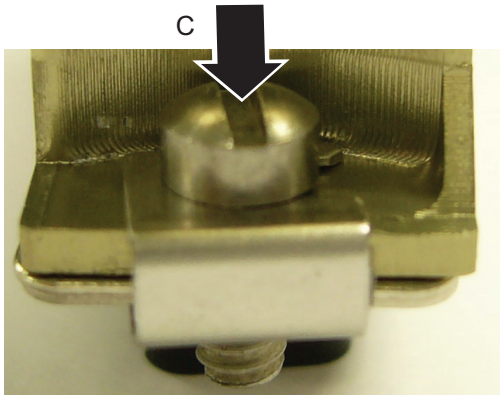
6. Position the retaining clip over the edge of the side flange (A).



7. Insert a screw (ACD/SCW/004) into the hole on the flange so that the threaded part of the screw is inside the hole and then slide the clip across so that it locks around the screw (B).



8. Now push the screw down so it is fully inserted into the retaining clip (C).
   (When securing the connector assembly to a module, note the recommended tightening torque is 0.4Nm.)



9. Repeat steps 5 to 8 for the other retaining clip.
10. Secure the cable with the clamp bar.
    Note: Do not exceed tightening torque of 0.4Nm.

NOTE: We recommend always using a nut-locking solution on the clamp bar assembly screws.

Bend radius

The following diagram shows an example of the clearance needed when using the ACD/BAC/004 with a CON/KAD/003/CP mating connector.

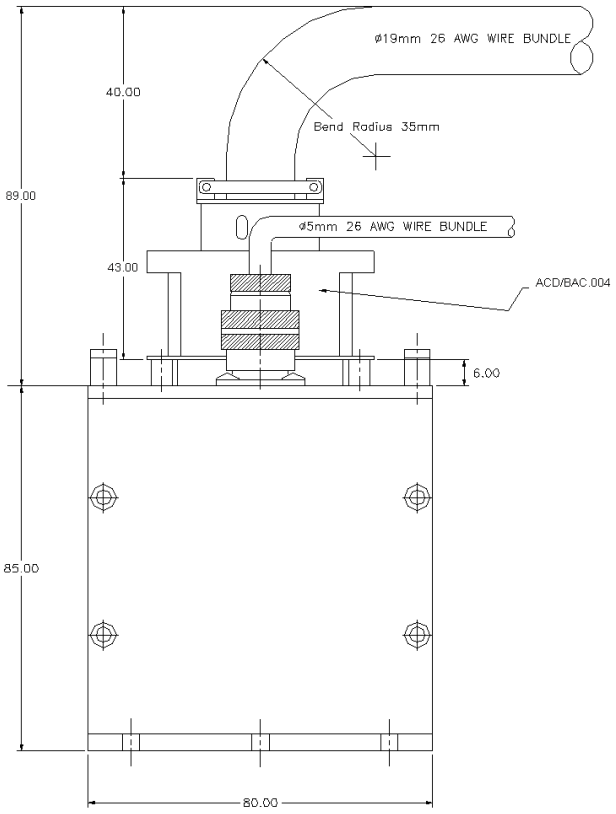


Figure 2: ACD/BAC/004 bend radius

Ordering information

PART NUMBER	DESCRIPTION
ACD/BAC/004/B	Backshell for CON/KAD/003/CP

Revision history

REVISION	DIFFERENCES	STATUS
ACD/BAC/004/B	Reinforced mounting clips; Allen head clamp bar screws	Recommended for new programs
ACD/BAC/004	First release	Not recommended for new programs

Related products

PRODUCT	DETAILS
CON/KAD/003/CP	Mating connector for KAM/TCG/102, KAM/TCG/103, and KAM/TCG/105 (DD, 19-way)

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook

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ACD/BAC/005

Backshell for KAD/TDC/107 (straight-through, heavy thermal mass)

CURTISSWRIGHTDS.com



Overview

The ACD/BAC/005 is an electroless, nickel-plated, aluminum backshell for use with CON/KAD/010 mating connectors.

The part is supplied with two pre-assembled, 4-40 UNC stainless steel mating screws (ACC/JAC/002) each held in place by the backshell itself.

Key Features

- Nickel-plated aluminium backshell

Applications

- Use with cables and CON/KAD/010 mating connector

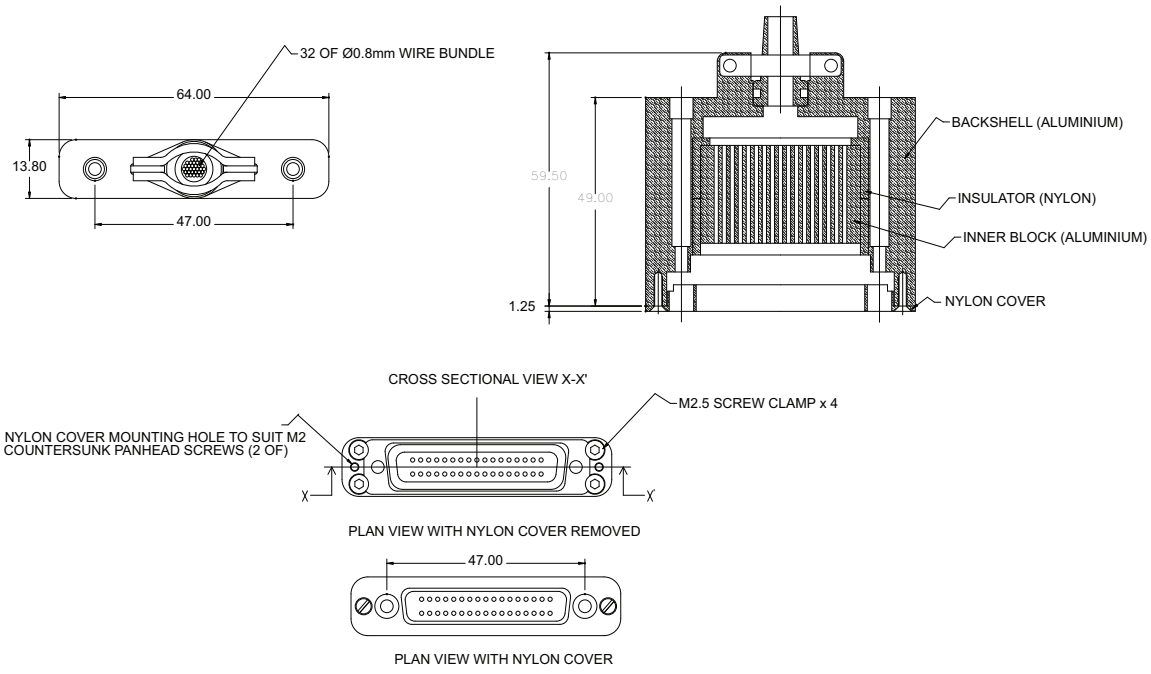


Figure 1: ACD/BAC/005 mechanical drawing

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
backshell, screw and clip	–	96	–	g	
backshell, screw and clip	–	3.39	–	oz	Design metric is grams.
Height above chassis					
bend radius	–	19	–	mm	6mm bundle, 26 AWG, 35mm bend radius.
bend radius	–	0.75	–	in.	0.24in. bundle, 26 AWG, 1.37in. bend radius.
Dimensions					
backshell height	–	60.75	–	mm	
backshell height	–	2.39	–	in.	Design metric is millimeters.
backshell length	–	64	–	mm	
backshell length	–	2.52	–	in.	
backshell width	–	13.8	–	mm	
backshell width	–	0.54	–	in.	
screw length	–	59	–	mm	Length of threaded insert.
screw length	–	2.32	–	in.	
Environmental ratings					See *Environmental Qualification Handbook.*
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Finish					
backshell	–	–	–	–	Electroless nickel-plated aluminium.
screw	–	–	–	–	Stainless steel.
cover	–	–	–	–	Nylon.
strain relief grommet	–	–	–	–	PVC.

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Getting the most from the ACD/BAC/005

For details of assembling instructions, see *TEC/NOT/059 - Cable assembly using ACD/CJB/002 reference junction block*. The typical bend radius to be expected from using the ACD/BAC/005 is shown in the following diagram.

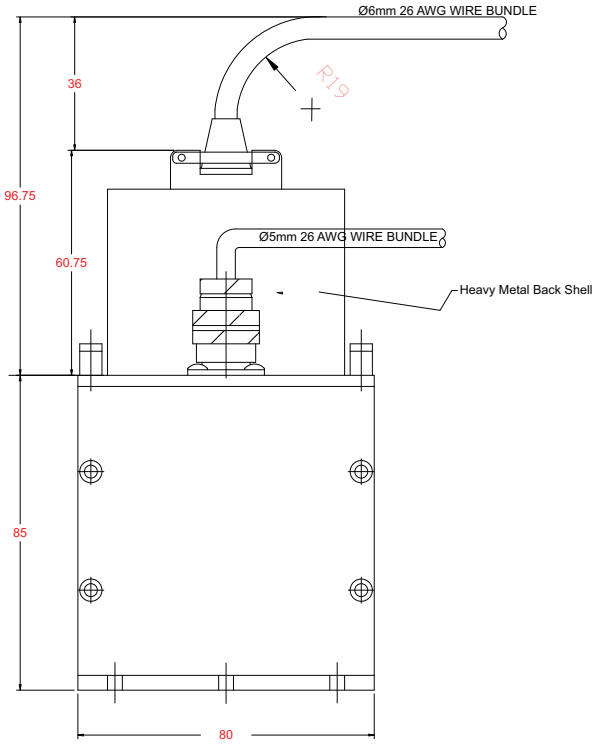


Figure 2: Bend radius

Ordering information

PART NUMBER	DESCRIPTION
ACD/BAC/005	Backshell for KAD/TDC/107 (straight-through, heavy thermal mass)

Revision history

REVISION	DIFFERENCES	STATUS
ACD/BAC/005	First release	Recommended for new programs

Related products

PRODUCT	DETAILS
ACD/CJB/002	Cold junction block for KAD/TDC/107 (built in sensors, straight-through heavy thermal mass backshell) - 12ch
CON/KAD/010	Mating connector for KAD/TDC/002 and KAD/TDC/007 (DD, 52-way, 3 built-in temperature sensors)
KAD/TDC/107	Thermocouple ADC (reference compensation, high accuracy, 4Hz b/w) - 12ch at 8sps

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
TEC/NOT/059	Cable assembly using ACD/CJB/002 reference junction block

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ACD/BAC/006

Backshell for KAD connectors (90°)

CURTISSWRIGHTDS.COM



Key Features

- For use with KAD (double-density) mating connectors
- 90 degree termination
- Rugged design which envelopes connector shell in housing
- Split assembly with captive bolts for improved cable installation and removal
- A-286 high strength alloy captive bolts with a 3/32 socket HEX

Applications

- Use with cables and standard issue mating connectors

Overview

The ACD/BAC/006 is an electroless nickel-plated, aluminum alloy backshell for use with KAD module double-density mating connectors.

The ACD/BAC/006 is supplied with the following: two captive 4-40 UNC socket head cap bolts, two plain washers, two bent strain relief clamps, one straight strain relief clamp, four captive M2 × 8 stainless steel socket head cap bolts, and two M2 × 6 stainless steel socket head cap bolts for the strain relief clamps. (For part numbers and descriptions, see figure and table on page 3.)

The ACD/BAC/006 is suitable for cables up to 11.5 mm in diameter.

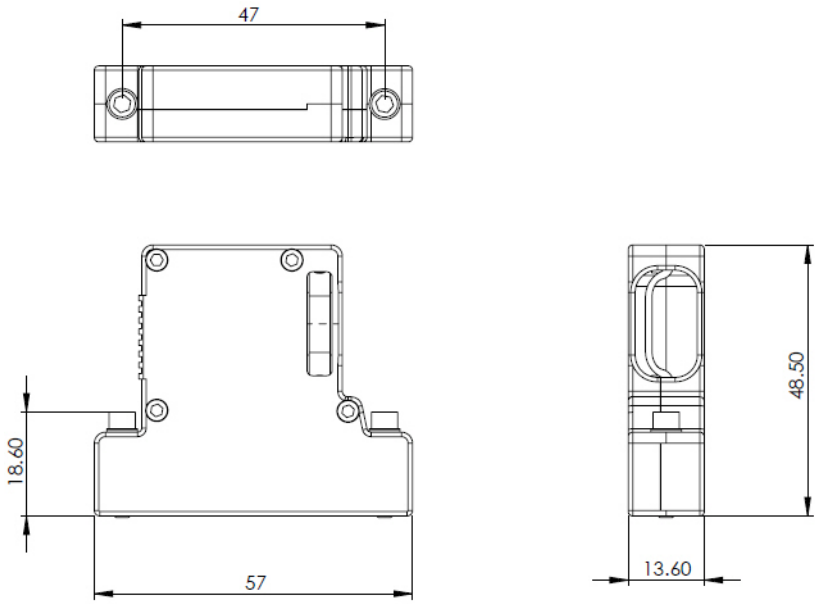


Figure 1: ACD/BAC/006 mechanical drawing (measurements in millimeters)

Specifications

	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
backshell, screw and clip	–	27	–	g	
backshell, screw and clip	–	0.952	–	oz	Design metric is grams.
Height above chassis					
	–	50.5	–	mm	
	–	1.98	–	in.	
Dimensions					
backshell height	–	48.5	–	mm	
backshell height	–	1.9	–	in.	Design metric is millimeters.
backshell length	–	57	–	mm	
backshell length	–	2.24	–	in.	
backshell width	–	13.6	–	mm	
backshell width	–	0.53	–	in.	
screw length	–	4.28	–	mm	Length of threaded insert.
screw length	–	0.16	–	in.	Length of threaded insert.
Environmental ratings					
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Materials					
shell	–	–	–	–	AA6082-T6.
4-40 UNC captive bolts	–	–	–	–	A-286.
M2 bolts	–	–	–	–	A2 stainless steel.
Finish					
backshell	–	–	–	–	Electroless nickel-plated aluminum (MIL-C-26074D Class 1, Grade A).
screw	–	–	–	–	
clip	–	–	–	–	

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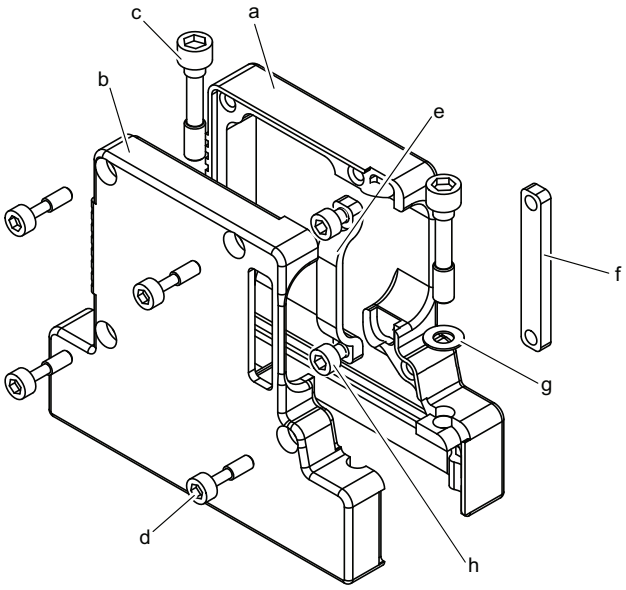
Getting the most from the ACD/BAC/006

The ACD/BAC/006 is for use with standard CON/KAD/0xx mating connectors only. When fastening the backshell to the chassis, apply a maximum torque of 0.8 Nm (0.59 ft/lbs) to the 4-40 UNC captive bolts when used with user modules with an /SEF part number. Apply a torque of 0.4 Nm (0.295 ft/lbs) in all other cases.

NOTE: The ACD/BAC/006 is not compatible with connectors which have a rear grommet.

Connector assembly

1. Remove the screws and retaining clips from the CON/KAD/0xx connector to which the backshell is to be attached. (These can be discarded as the screws and clips provided with the backshell are used for the connector assembly.)
2. Insert the crimped pins into the CON/KAD/0xx connector.
   (See the respective *CON/KAD/0xx* and *KIT/001* data sheets in the *Acra KAM-500 Databook* for instructions on how to insert these pins.)
3. Insert the cable assembly into one side of the backshell.
4. Install the strain relief clamp bar (M2 x 6 bolts).
   Depending on the thickness of wire being clamped, use a bent strain relief clamp (ACD/CMP/003) and the straight strain relief clamp (ACD/CMP/004) or use two bent strain relief clamps. The bent clamps can be rotated to close the opening if required.



Label	Part number	Description	Qty
a	ACD/BAC/006/00/S1	90 degree backshell side 1	1
b	ACD/BAC/006/00/S2	90 degree backshell side 2	1
c	SCC/061	4-40 UNC captive bolts	2
d	SCC/064/M2	M2 x 8 mm captive bolts	4
e	ACD/CMP/003	Bent strain relief clamp	2
f	ACD/CMP/004	Straight strain relief clamp	1
g	WAS/019	Washer	2
h	SCC/001/M2	M2 X 6 mm cap screws	2

5. Assemble the backshell sides (captive M2 x 8 bolts) and the CON/KAD/0xx connector.

   NOTE: We recommend that thread lock (Loctite® 222) is applied to the M2 bolts and they are torqued to 0.25 Nm (0.260.184 ft/lbs).
   When fastening the backshell to (and loosening from) a module, alternate between bolts when turning.

Ordering information

PART NUMBER	DESCRIPTION
ACD/BAC/006	Backshell for KAD connectors (90°)

Revision history

REVISION	DIFFERENCES	STATUS
ACD/BAC/006	First release	Recommended for new programs

Related products

MODULE	DETAILS
CON/KAD/002/CP	Mating connector (DD, 52-way)
CON/KAD/002/CP/SEC	Mating connector (DD, 52-way), without retaining screws and clips

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook

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ACD/BAC/007

Backshell for KAD connectors (180°)



Key Features

- For use with KAD (double-density) mating connectors
- 180 degree termination
- Rugged design which envelopes connector shell in housing
- Split assembly with captive bolts for improved cable installation and removal
- A-286 high strength alloy captive bolts with a 3/32 socket HEX

Applications

- Use with cables and standard issue mating connectors

Overview

The ACD/BAC/007 is an electroless nickel-plated, aluminum alloy backshell for use with KAD module double-density mating connectors.

The ACD/BAC/007 is supplied with two captive 4-40 UNC socket head cap bolts, two plain washers, two bent strain relief clamps (ACD/CMP/003/00), one straight strain relief clamp (ACD/CMP/004/00), four captive M2 x 8 stainless steel socket head cap bolts, and two M2 x 6 stainless steel socket head cap bolts for the strain relief clamps.

The ACD/BAC/007 is suitable for cables up to 11.5 mm in diameter.

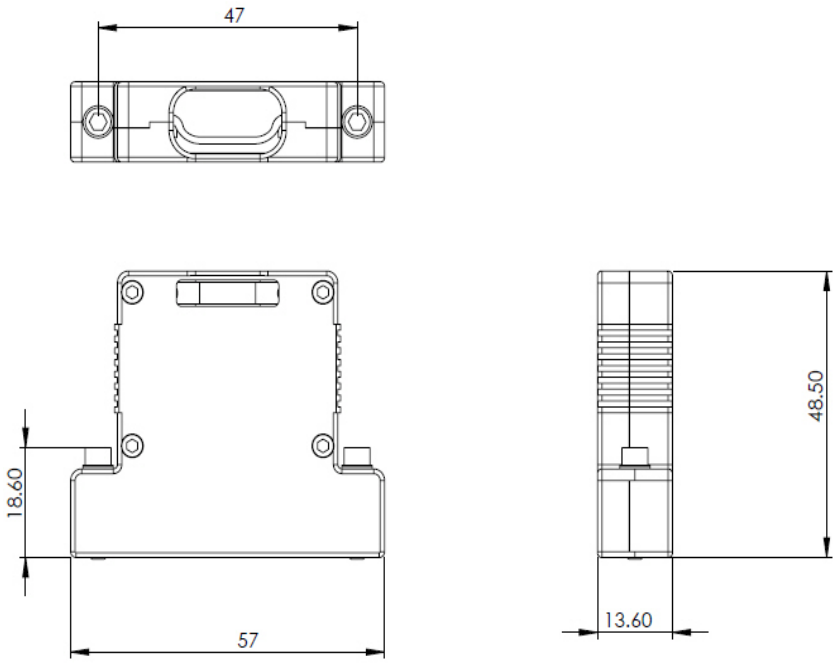


Figure 2: ACD/BAC/007 mechanical drawing (measurements in millimeters)

Specifications

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
backshell, screw and clip	–	27	–	g	
backshell, screw and clip	–	0.952	–	oz	Design metric is grams.
Height above chassis					
	–	50.5	–	mm	
	–	1.98	–	in.	
Dimensions					
backshell height	–	48.5	–	mm	
backshell height	–	1.9	–	in.	Design metric is millimeters.
backshell length	–	57	–	mm	
backshell length	–	2.24	–	in.	
backshell width	–	13.6	–	mm	
backshell width	–	0.53	–	in.	
screw length	–	4.28	–	mm	Length of threaded insert.
screw length	–	0.16	–	in.	Length of threaded insert.
Environmental ratings					
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Materials					
shell	–	–	–	–	AA6082-T6.
4-40 UNC captive bolts	–	–	–	–	A-286.
M2 bolts	–	–	–	–	A2 stainless steel.
Finish					
backshell	–	–	–	–	Electroless nickel-plated aluminium (MIL-C-26074D Class 1, Grade A).
screw	–	–	–	–	
clip	–	–	–	–	

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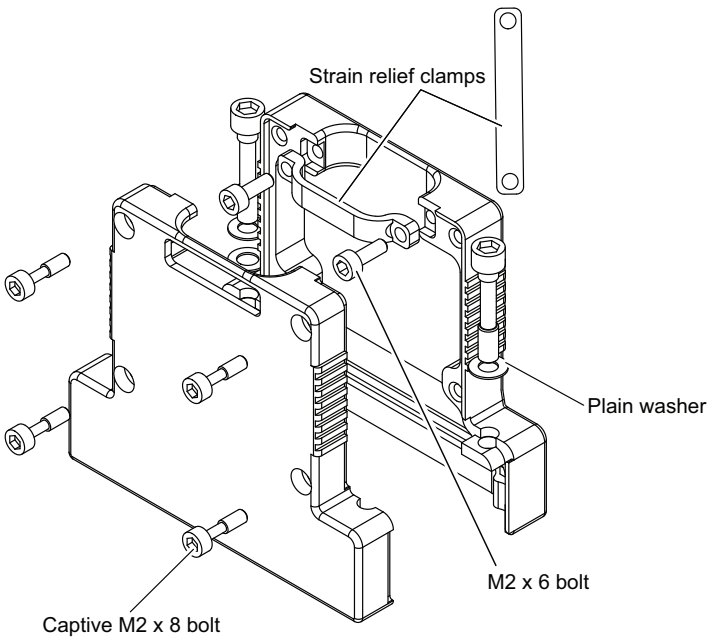
Getting the most from the ACD/BAC/007

The ACD/BAC/007 backshell is for use with standard CON/KAD/00x mating connectors only. When fastening the backshell to the chassis, apply a maximum torque of 0.8 Nm (0.59 ft/lbs) to the 4-40 UNC captive bolts when used with user modules with an /SEF part number. Apply a torque of 0.4 Nm (0.295 ft/lbs) in all other cases.

NOTE: The ACD/BAC/007 is not compatible with connectors that have a rear grommet.

Connector assembly

1. Remove the screws and retaining clips from the CON/KAD/00x connector to which the backshell is to be attached. (These can be discarded as the screws and clips provided with the backshell are used for the connector assembly.)
2. Insert the crimped pins into the CON/KAD/00x connector. (See the respective CON/KAD/00x and KIT/001 data sheets in the *Acra KAM-500 Databook* for instructions on how to insert these pins.)
3. Insert the cable assembly into one side of the backshell.
4. Install the strain relief clamp bar (M2 x 6 bolts).
   The full range of cable and wire diameters can be clamped by using the reverse of the bent strain relief clamp (ACD/CMP/003) and the straight strain relief clamp (ACD/CMP/004).



5. Assemble the backshell sides (captive M2 x 8 bolts) and the CON/KAD/00x connector.

NOTE: We recommend that thread lock (Loctite® 222) is applied to the M2 bolts and they are torqued to 0.25 Nm (0.184 ft/lbs).
When fastening the backshell to (and loosening from) a module, alternate between bolts when turning.

Ordering information

PART NUMBER	DESCRIPTION
ACD/BAC/007	Backshell for KAD connectors (180°)

Revision history

REVISION	DIFFERENCES	STATUS
ACD/BAC/007	First release	Recommended for new programs

Related products

MODULE	DETAILS
CON/KAD/002/CP	Mating connector (DD, 52-way)
CON/KAD/002/CP/SEC	Mating connector (DD, 52-way), without retaining screws and clips

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook

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ACD/BAC/011

Backshell for KAD connectors (straight-through)

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Overview

The ACD/BAC/011 is an electroless nickel-plated, aluminum backshell for use with KAD module DD mating cable connectors.

The part consists of a body and a lid. It is supplied with two 4-40 UNC stainless steel captive jackscrews, two stainless steel captive lid screws, and a cable clamp saddle bar with two slot head screws.

Key Features

- For use with KAD 52-way Double-Density (DD) connectors such as CON/KAD/002/CP
- Easier cable harness assembly with removable lid
- Captive thumbscrews for hand tightening or torque drivers
- Adjustable cable entry clamp up to 160 mm^2
- Internal shield wire termination
- Reduced height
- Aluminum alloy construction

Applications

- Use with cables and mating connectors on Acra KAM-500 and Axon modules

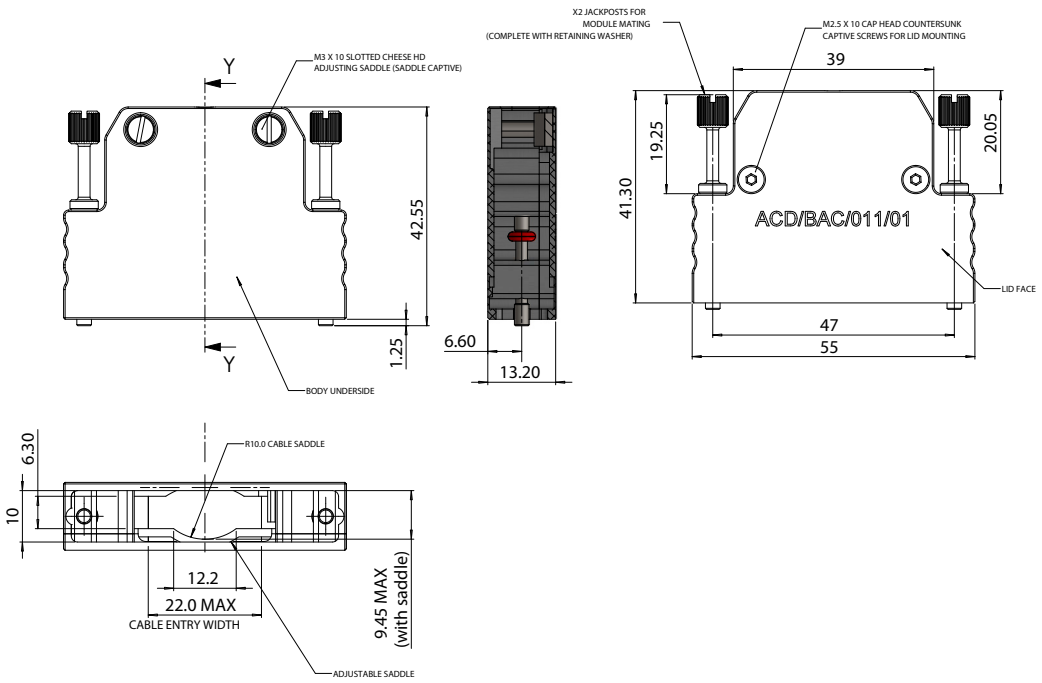
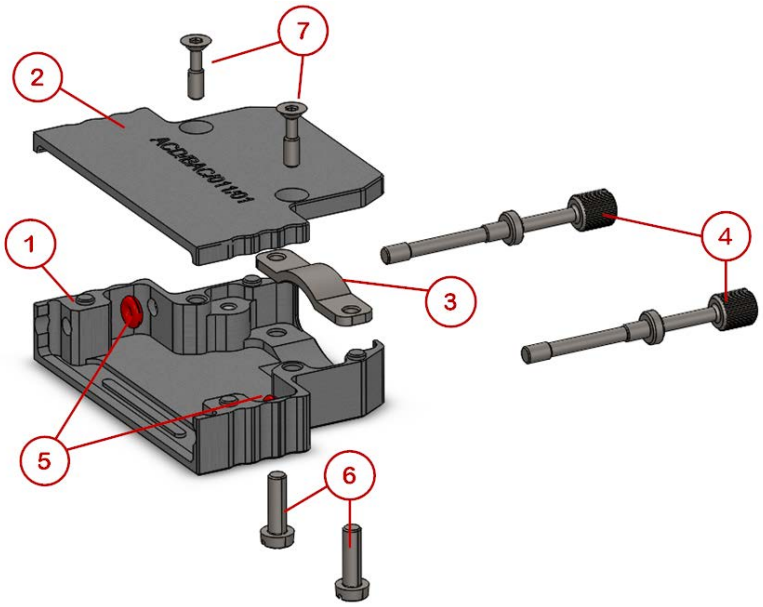


Figure 1: ACD/BAC/011 mechanical drawing

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
backshell, assembled	–	30	–	g	
backshell, assembled	–	1.06	–	oz	Design metric is grams.
backshell with CON/KAD/002	–	39	–	g	
backshell with CON/KAD/002	–	1.36	–	oz	
Height above chassis					
backshell only	–	41.30	–	mm	Does not include cable bend radius.
backshell only	–	1.63	–	in.	
Dimensions					
backshell height	–	41.30	–	mm	
backshell height	–	1.63	–	in.	Design metric is millimeters.
backshell length	–	55.00	–	mm	
backshell length	–	2.16	–	in.	
backshell width	–	13.20	–	mm	To suit Axon 14 mm (0.55 in.) module pitch.
backshell width	–	0.52	–	in.	
jackscrew, threaded section	–	4.30	–	mm	Length of threaded section. 4-40 UNC 2A thread gauge.
jackscrew, threaded section	–	0.17	–	in.	
jackscrew length	–	41.75	–	mm	Overall jackscrew length.
jackscrew length	–	1.64	–	in.	
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	150	°C	Limited at low temperature by nitrile rubber O-rings on jackscrews.
storage temperature	-55	–	150	°C	
Finish					
backshell	–	–	–	–	Electroless nickel-plated aluminum (6082T6).
screw	–	–	–	–	Stainless steel (A2 SS).
retaining O-rings	–	–	–	–	Nitrile rubber.

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INCLUDED PARTS

1. Backshell body
2. Backshell lid
3. Cable clamp saddle
4. 4-40 UNC jackscrews (× 2)
5. Retaining O-rings (× 2)
6. M3 × 10 mm cable clamp screws, slotted drive (× 2)
7. M2.5 × 10 mm countersunk lid screws, 2 mm hex socket (× 2)

Figure 2: Exploded-view showing parts included

Getting the most from the ACD/BAC/011

The ACD/BAC/011 backshell is for use only with CON/KAD/00x 52-way DD cable connectors, such as CON/KAD/002/CP and CON/KAD/005/CP.

NOTE: When mating to a KAM or Axon module, do not exceed the maximum torque of 0.6 Nm (5.2 in-ft) on the 4-40 UNC jackscrews.

The cable clamp at its widest extension can accept 16 cables of 3.3 mm (0.13 in.) diameter each.

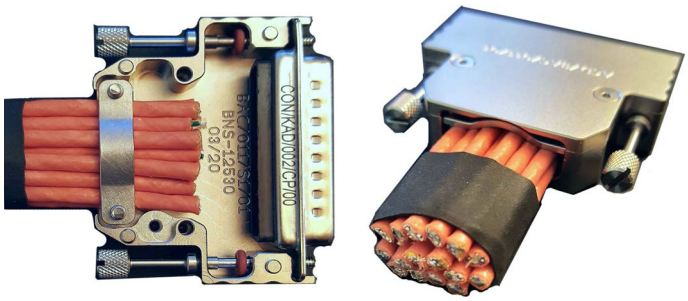


Figure 3: Multiple cable assembly

Connector and backshell assembly

The following figure identifies the parts used in assembling the connector and backshell.

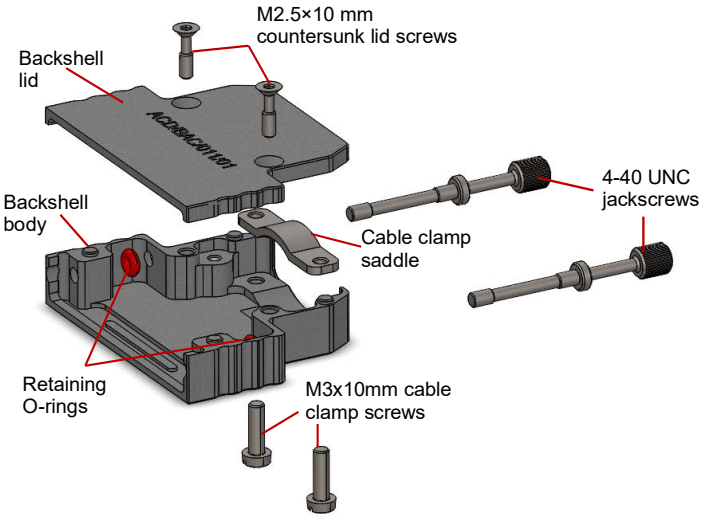
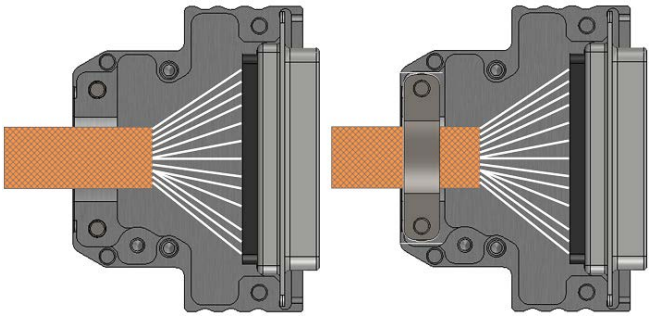
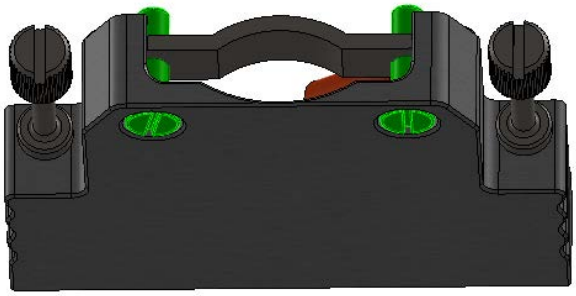


Figure 4: Assembly parts identification

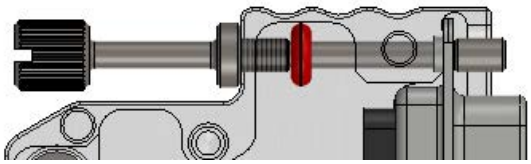
1. Remove the screws and retaining clips from the CON/KAD/00x connector to which the backshell is to be attached. (These can be discarded as the screws and clips provided with the backshell are used for the connector assembly.)
2. Crimp pins to the cable wiring. (See the *KIT/001* data sheet for instructions on crimping.)
3. Insert the crimped pins into the CON/KAD/00x connector. (See the respective *CON/KAD/00x* and *KIT/001* data sheets in the *Acra KAM-500 Databook* for instructions on how to insert these pins.)
4. Seat the CON/KAD/00x connector and cables into the backshell body and then position the cable clamp saddle over the cables.



5. Thread the two cable clamp screws through the bottom of the backshell and into the cable clamp saddle to secure the cable(s). Do not tighten fully at this stage.



6. Fit the jackscrews through the rear of the backshell (cable entry side), then through the red retaining O-rings, then through the front of the backshell and the CON/KAD/00x connector.



7. Form all connector wires to fit inside the backshell body. Press them down if necessary so they are not pinched or caught between the body and the lid.
8. Place the backshell lid on the backshell body.
The lid should sit on the alignment pegs and there should be no visible gaps or trapped wires in the seam. The CON/KAD/00x connector should sit in its groove on the lid.



9. Insert the M2.5 lid screws. Torque the lid screws to 0.4 Nm.



10. Tighten the cable clamp screws to secure the cable.

NOTE: Overtightening may damage the cables.

NOTE: Do not exceed max M3 screw torque of 0.6 Nm.

Shield termination

For best EMC performance, cables with braided shields should have the braid or metal ferrule make good electrical contact directly to the cable clamp and/or backshell. The backshell will be in electrical contact with the KAM-500 or Axon chassis through the connector frame and jackscrews.

As shown in the following figure, shield or drain wires can also be terminated with an M2.5 ring terminal and fastened to the inside of the shell with an M2.5 × 5 mm screw (not included).

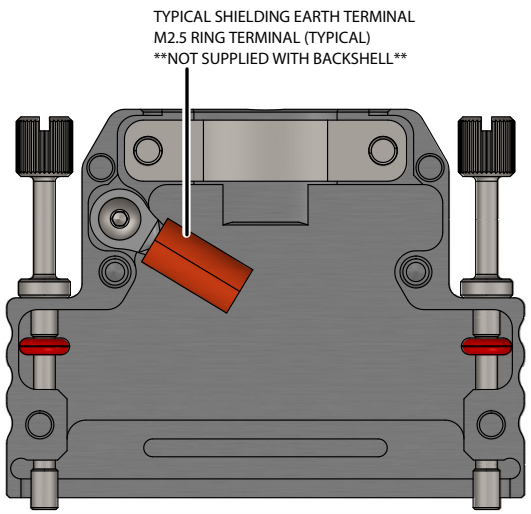


Figure 5: Internal shield termination

Ordering information

PART NUMBER	DESCRIPTION
ACD/BAC/011	Backshell for KAD connectors (straight-through)

By default, the backshell ships with slot-head drive jackscrews. Cross-head drive jackscrews (BAC/011/S5) are optional and must be ordered separately; refer to Related products for options.

Revision history

REVISION	DIFFERENCES	STATUS
ACD/BAC/011	First release	Recommended for new programs

Related products

MODULE	DETAILS
BAC/011/S5	Jackscrew for ACD/BAC/011 with cross-head drive (optional replacement)
CON/KAD/002/CP	Mating connector (DD, 52-way)
CON/KAD/005/CP	Mating connector (DD, 52-way, rear grommet)

Related documentation

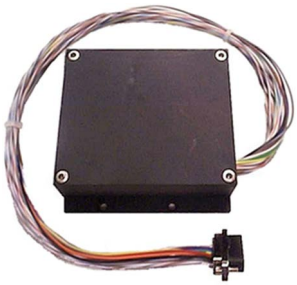
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook (Acra KAM-500)
DOC/HBK/008	Environmental Qualification Handbook for Axon Products.

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ACD/CJB/001

Cold junction block for thermocouples -15ch

CURTISSWRIGHTDS.com



Overview

The ACD/CJB/001 is designed to be used with the ADC/003 and is used to terminate up to 15 thermocouples at a measured temperature.

Each thermocouple has a dual terminal with screws in three rows of five. The block also includes a sensor with a 12mV/°K output which is used by the ADC/003 for reference junction compensation.

Key Features

- 15 screw junctions for thermocouple (T/C) leads
- Numbered terminals
- Built in temperature reference (12mV/°K)

Applications

- Use to terminate thermocouples

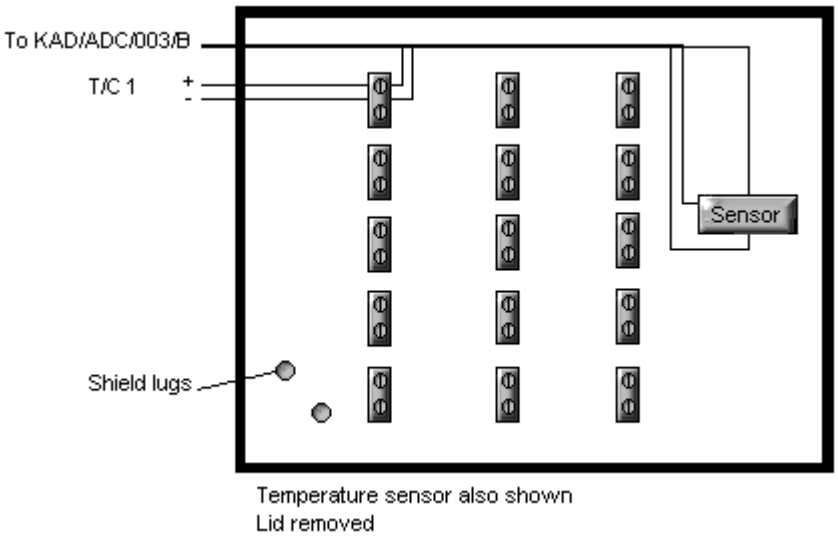


Figure 1: First of 15 TC inputs on the ACD/CJB/001

Specifications

Channels:	15 plus reference junction
Reference junction:	Supply 12V (from ADC/003) Output 12mV/°K (accuracy ±1.5°K)

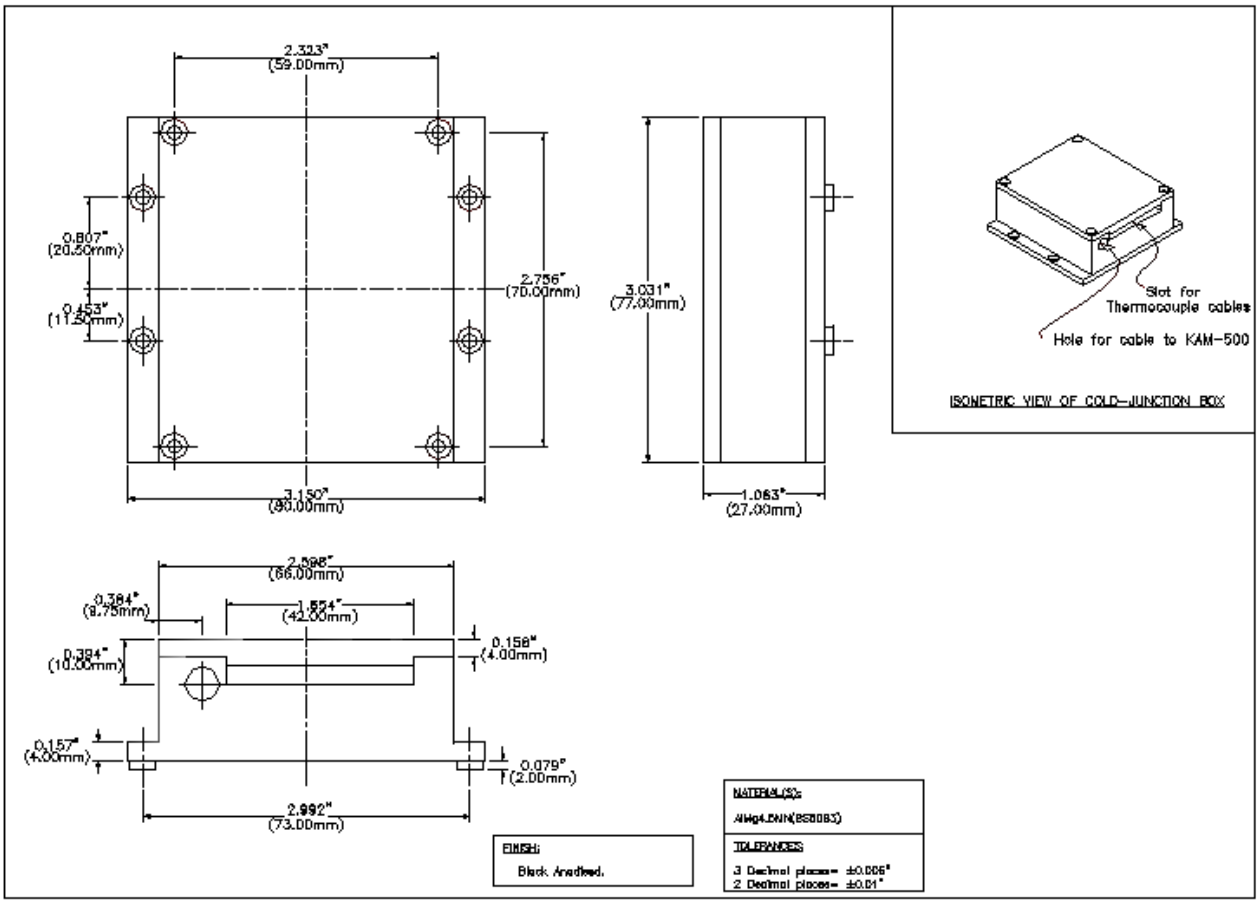


Figure 2: ACD/CJB/001 mechanical drawing

Getting the most from the ACD/CJB/001

An ACD/CJB/001 can be mounted at each end of an Acra KAM-500 chassis by removing four screws in the end plate.

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Ordering information

PART NUMBER	DESCRIPTION
ACD/CJB/001	Cold junction block for thermocouples -15ch (52-way double density mating connector)
ACM/CJB/001	Cold junction block for thermocouples -15ch (51-way micro-miniature mating connector)

Revision history

REVISION	DIFFERENCES	STATUS
ACD/CJB/001	First release	Recommended for new programs

Related products

PRODUCT	DETAILS
KAD/ADC/003	15 channel thermocouple A/D converter with reference compensation

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook

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ACD/CJB/002

Cold junction block for KAD/TDC/107 (built in sensors, straight-through heavy thermal mass backshell) - 12ch

CURTISSWRIGHTDS.COM



Key Features

- Supports 12 thermocouples
- Three built-in PT100 sensors (typical accuracy of ±0.1°C)

Applications

- Use to connect thermocouples to KAD/TDC/107 modules

Overview

The ACD/CJB/002 is designed to be used with the KAD/TDC/107 and is used to terminate up to 12 thermocouples at a measured temperature.

The block comprises a CON/KAD/010 and an ACD/BAC/005 and is delivered with every KAD/TDC/107.

The ACD/BAC/005 is an electroless, nickel-plated, aluminum backshell for use with CON/KAD/010 mating connectors. It provides heavy thermal mass and increases thermal isolation of the area around the thermocouple cold junction and built-in temperature sensors.

The CON/KAD/010 has three built-in PT100 temperature sensors for accurate measurement of thermocouple cold junction temperature, as close as possible to real junction. The sensors used are 1/3 of class B, DIN/IEC 60751 specification (±0.1 ± 0.00166×t) [°C]. In a typical operational range of -40 to 85°C these sensors are more accurate than ±0.24°C, with typical accuracy being around 0.1°C.

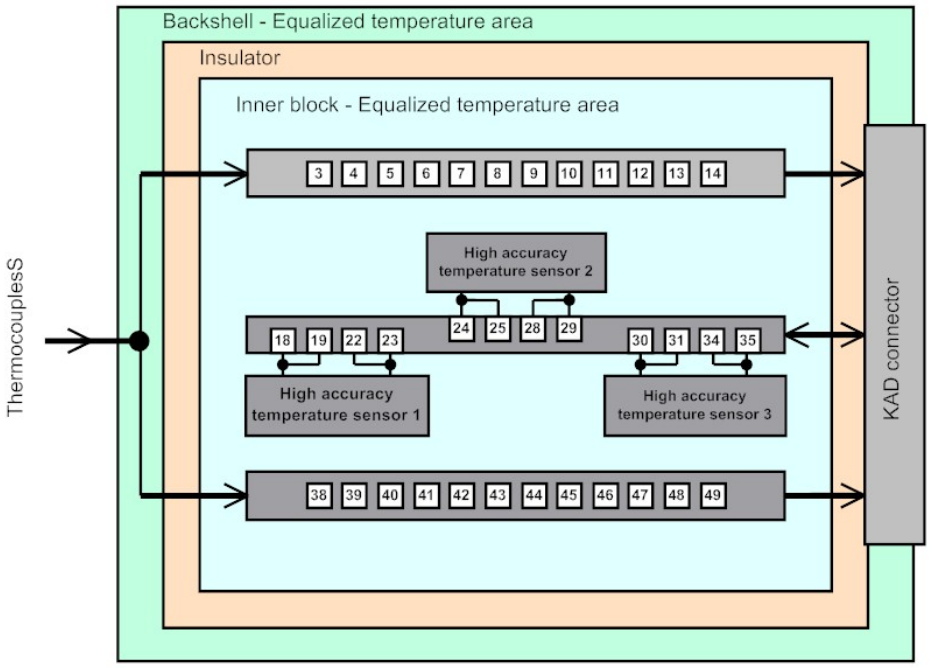


Figure 1: Block diagram of ACD/CJB/002

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
	–	105	–	g	
	–	3.7	–	oz	Design metric is grams.
Height above chassis					
bend radius	–	19	–	mm	6mm bundle, 26 AWG, 35mm bend radius.
bend radius	–	0.75	–	in.	0.24in. bundle, 26 AWG, 1.37in. bend radius.
Dimensions					
backshell height	–	60.75	–	mm	
backshell height	–	2.39	–	in.	Design metric is millimeters.
backshell length	–	64	–	mm	
backshell length	–	2.52	–	in.	
backshell width	–	13.8	–	mm	
backshell width	–	0.54	–	in.	
screw length	–	59	–	mm	Length of threaded insert.
screw length	–	2.32	–	in.	
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Finish					
backshell	–	–	–	–	Electroless nickel-plated aluminium.
screw	–	–	–	–	Stainless steel.
cover	–	–	–	–	Nylon.
strain relief grommet	–	–	–	–	PVC.
connector	–	–	–	–	Nickel-plated steel.
clip	–	–	–	–	Stainless steel.
integral isolator housing	–	–	–	–	Nylon.
pins	–	–	–	–	Copper alloy with 1.2µm gold plating.
retaining clips	–	–	–	–	Stainless steel.

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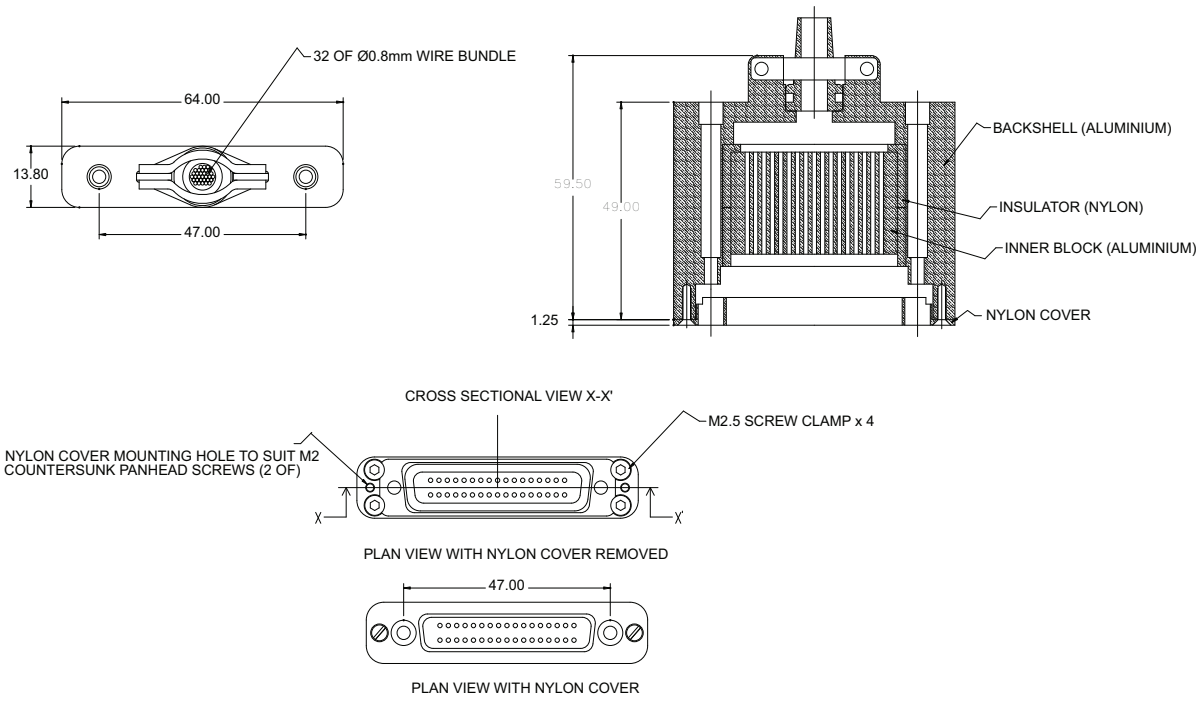


Figure 2: ACD/CJB/002 mechanical drawing

Getting the most from the ACD/CJB/002

The ACD/CJB/002 is mounted on the KAD/TDC/107 module. The ACD/CJB/002 provides heavy thermal mass and increases thermal isolation of the area around the thermocouple cold junction and built-in temperature sensors. This allows accurate cold junction measurements and improves the overall accuracy of a KAD/TDC/107 module when the junction is exposed to ambient temperature change.

Compared to using a CON/KAD/010 with a standard backshell, such as the ACD/BAC/002, any error occurring during transients of the ambient temperature is minimized by a factor of five (approximately).

Ordering information

PART NUMBER	DESCRIPTION
ACD/CJB/002	Cold junction block for KAD/TDC/107 (built in sensors, straight-through heavy thermal mass backshell) - 12ch

Revision history

REVISION	DIFFERENCES	STATUS
ACD/CJB/002	First release	Recommended for new programs

Related products

MODULE	DETAILS
ACD/BAC/005	Straight-through heavy thermal mass backshell kit for KAD/TDC/107
CON/KAD/010	DD mating connector with 3 built-in temperature sensors
KAD/TDC/107	12-ch. high accuracy (0.55°C), thermocouple ADC with cold junction compensation

Related documentation

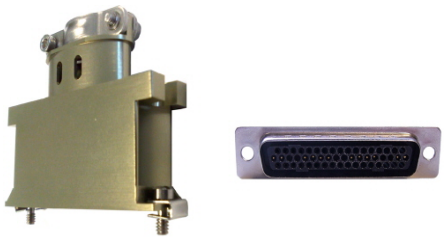
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
TEC/NOT/059	Cable assembly using ACD/CJB/002 reference junction block

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ACD/CJB/003

Cold junction block for KAD/TDC/102 (built in sensors, straight-through backshell) - 15ch

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Overview

The ACD/CJB/003 is designed to be used with the KAD/TDC/102 and is used to terminate up to 15 thermocouples at a measured temperature.

The block comprises a double-density connector, CON/KAD/010, and a straight-through backshell, ACD/BAC/002/B. An ACD/CJB/003 is delivered with every KAD/TDC/102, unless the alternative angled backshell, ACD/CJB/004, is specified in the order.

The CON/KAD/010 includes three PT100 sensors which are used by the KAD/TDC/102 for reference junction compensation.

Key Features

- Supports 15 thermocouples
- Three built-in PT100 sensors (typical accuracy of ±0.1°C)

Applications

- Use to connect thermocouples to KAD/TDC/102 modules

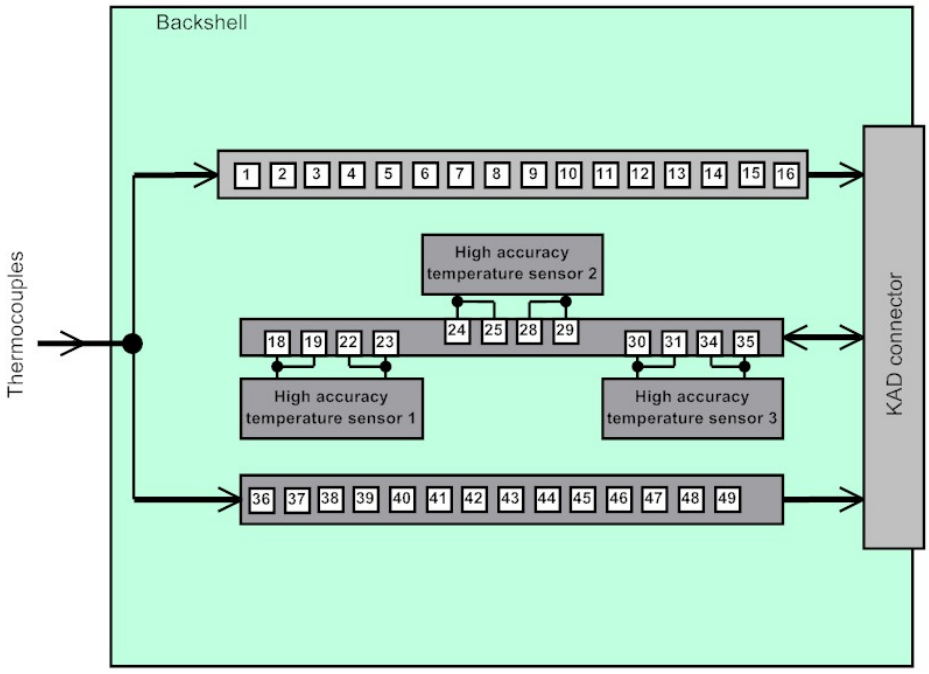


Figure 1: Block diagram of ACD/CJB/003

Specifications

TABLE 1	Mechanical specifications (ACD/BAC/002/B)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
backshell, screw and clip	–	18	–	g	
backshell, screw and clip	–	0.63	–	oz	Design metric is grams.
Height above chassis					
	–	48.4	–	mm	For chassis clearance including bend radius, see the *ACD/BAC/002/B* data sheet.
	–	1.9	–	in.	
Dimensions					
backshell height	–	42.88	–	mm	
backshell height	–	1.68	–	in.	Design metric is millimeters.
backshell length	–	52.85	–	mm	
backshell length	–	2.08	–	in.	
backshell width	–	12.8	–	mm	
backshell width	–	0.50	–	in.	
screw length	–	3.51	–	mm	Length of threaded insert.
screw length	–	0.13	–	in.	Length of threaded insert.
width of clip	–	6.35	–	mm	
width of clip	–	0.24	–	in.	
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Finish					
backshell	–	–	–	–	Electroless nickel-plated aluminium.
screw	–	–	–	–	Stainless steel.
clip	–	–	–	–	Stainless steel.

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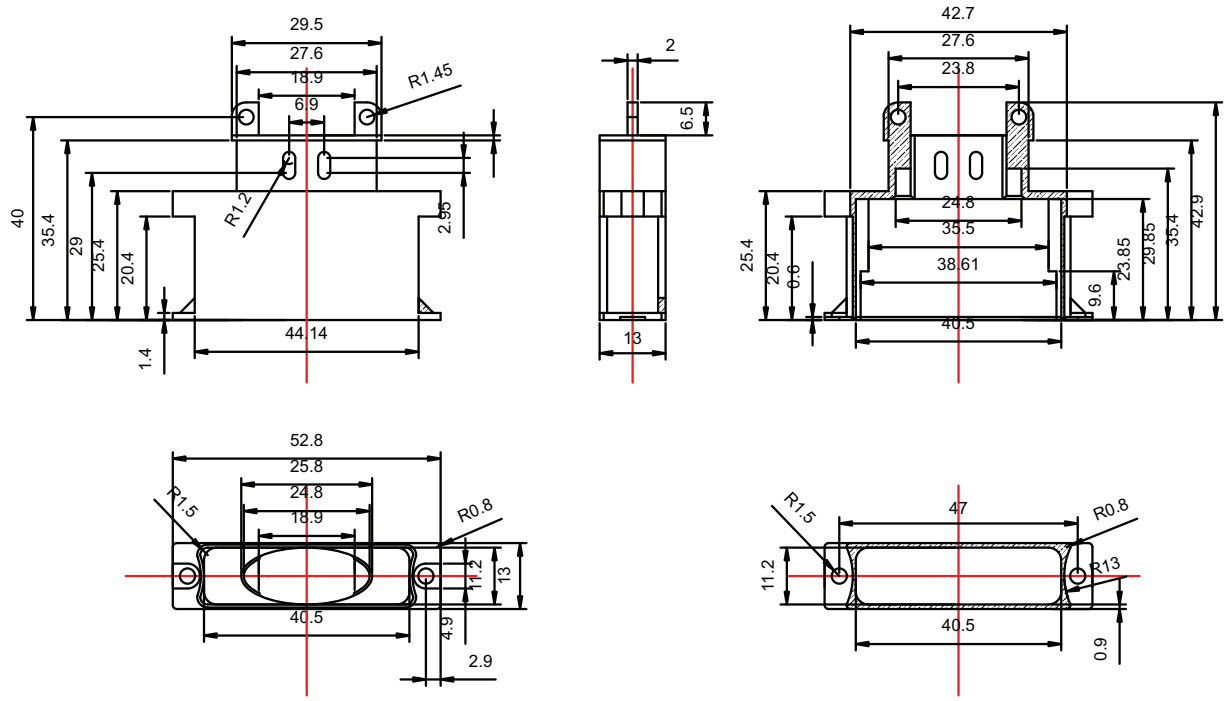


Figure 2: ACD/BAC/002/B mechanical drawing

Getting the most from the ACD/CJB/003

The ACD/CJB/003 reference junction block consists of a CON/KAD/010 connector and an ACD/BAC/002/B backshell. It has been designed for mounting on KAD/TDC/102 modules.

The CON/KAD/010 is supplied with 40 loose pin contacts. For instructions on how to insert these pins for the KAD/TDC/102, see the *KIT/001* data sheet in the *Acra KAM-500 Databook*.

When fitting the ACD/BAC/002/B, the cable (wires and pins) must be inserted through the backshell before the pins are inserted into the CON/KAD/010 connector, see the *ACD/BAC/002/B* data sheet for details.

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Ordering information

PART NUMBER	DESCRIPTION
ACD/CJB/003	Cold junction block for KAD/TDC/102 (built in sensors, straight-through backshell) - 15ch

Revision history

REVISION	DIFFERENCES	STATUS
ACD/CJB/003	First release	Recommended for new programs

Related products

MODULE	DETAILS
ACD/BAC/002/B	Nickel-plated aluminum straight-through backshell for KAD connectors
CON/KAD/010	DD mating connector with 3 built-in temperature sensors
KAD/TDC/102	15-channel thermocouple ADC with reference compensation

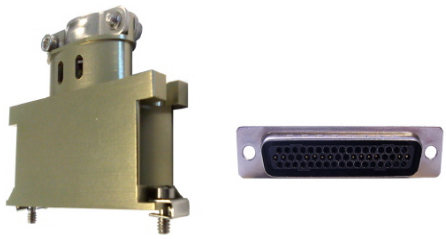
Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook

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ACD/CJB/005

Cold junction block for KAD/ADC/136 (built-in sensor, straight-through backshell) - 7ch



FEATURES

- Supports seven thermocouples
- One built-in PT100 sensor (typical accuracy of ±0.1°C)

APPLICATIONS

- Use to connect thermocouples to KAD/ADC/136 modules

DESCRIPTION

The ACD/CJB/005 cold junction block is an optional accessory for the KAD/ADC/136. Designed for mounting on a KAD/ADC/136, it is used to terminate up to seven thermocouples.

The ACD/CJB/005 comprises a Double-Density (DD) CON/KAD/012 connector and a straight-through ACD/BAC/002/B backshell.

The CON/KAD/012 includes one built-in PT100 sensor, which is used by the KAD/ADC/136 for reference junction compensation. This sensor connects to channel 0 of a KAD/ADC/136, allowing the other seven channels to be set to any mode (for example, thermocouple mode, full-bridge mode, or ICP mode).

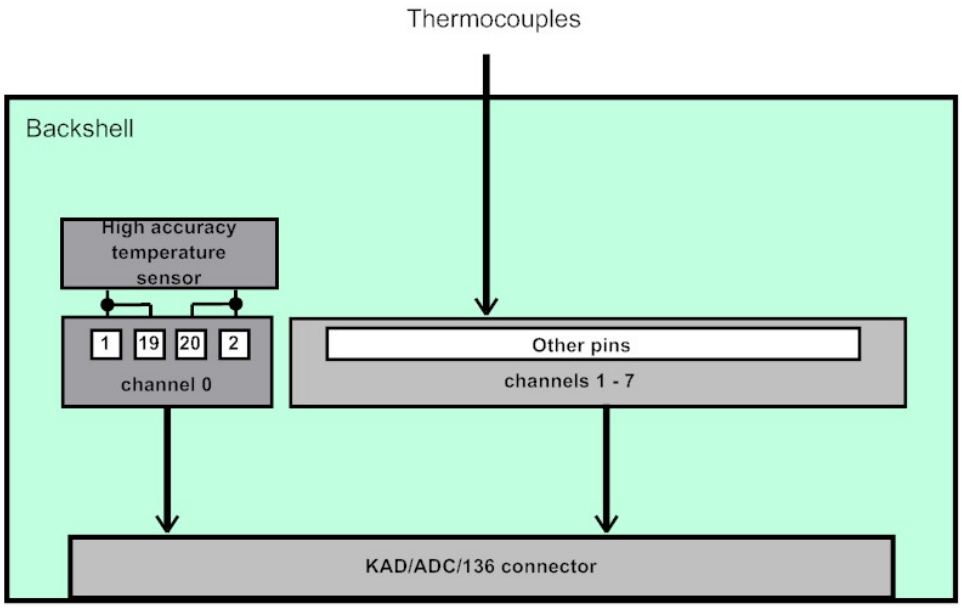


Figure 1: Block diagram of ACD/CJB/005

Specifications

TABLE 1	Mechanical specifications (ACD/BAC/002/B)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
backshell, screw and clip	–	18	–	g	
backshell, screw and clip	–	0.63	–	oz	Design metric is grams.
Height above chassis					
	–	48.4	–	mm	For chassis clearance including bend radius, see the *ACD/BAC/002/B* data sheet.
	–	1.9	–	in.	
Dimensions					
backshell height	–	42.88	–	mm	
backshell height	–	1.68	–	in.	Design metric is millimeters.
backshell length	–	52.85	–	mm	
backshell length	–	2.08	–	in.	
backshell width	–	12.8	–	mm	
backshell width	–	0.50	–	in.	
screw length	–	3.51	–	mm	Length of threaded insert.
screw length	–	0.13	–	in.	Length of threaded insert.
width of clip	–	6.35	–	mm	
width of clip	–	0.24	–	in.	
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Finish					
backshell	–	–	–	–	Electroless nickel-plated aluminum.
screw	–	–	–	–	Stainless steel.
clip	–	–	–	–	Stainless steel.

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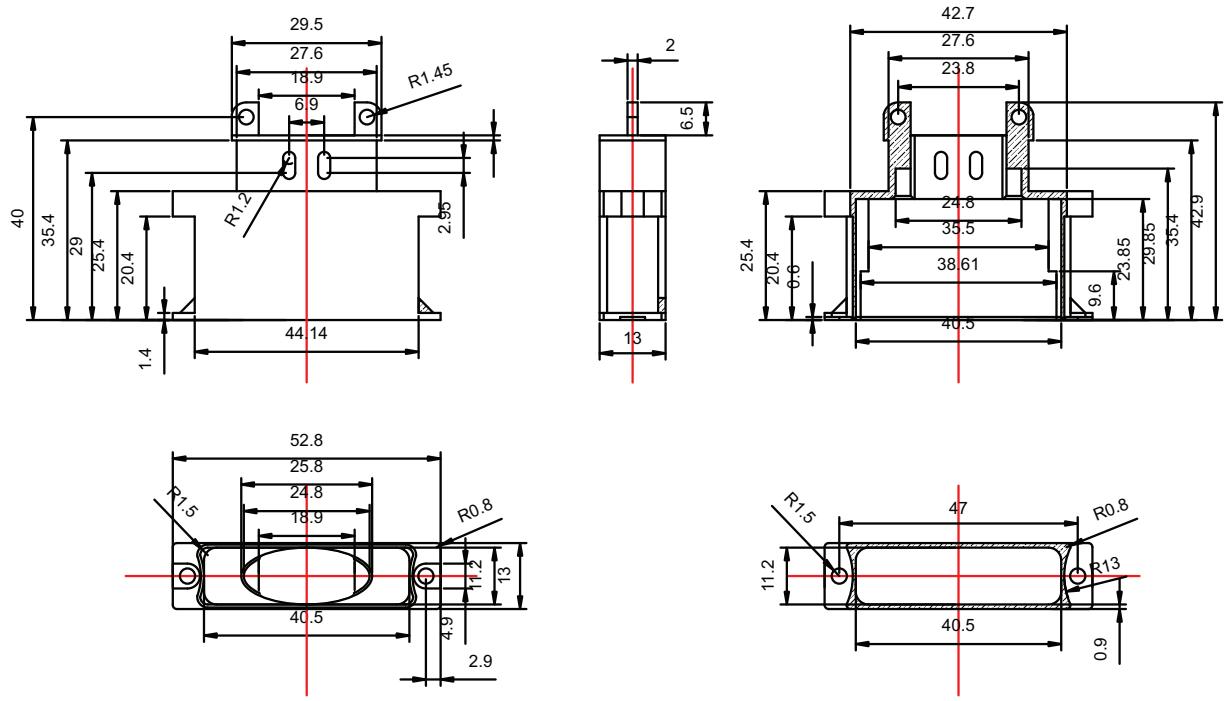


Figure 2: ACD/BAC/002/B mechanical drawing

Getting the most from the ACD/CJB/005

The ACD/CJB/005 reference junction block consists of a CON/KAD/012 connector and an ACD/BAC/002/B backshell. It has been designed for mounting on KAD/ADC/136 modules.

The CON/KAD/012 is supplied with 48 loose pin contacts. For instructions on how to insert these pins for the KAD/ADC/136, see the *KIT/001* data sheet in the *Acra KAM-500 Databook*.

When fitting the ACD/BAC/002/B, the cable (wires and pins) must be inserted through the backshell before the pins are inserted into the CON/KAD/012 connector; see the *ACD/BAC/002/B* data sheet for details.

Ordering information

PART NUMBER	DESCRIPTION
ACD/CJB/005	Cold junction block for KAD/ADC/136 (built-in sensor, straight-through backshell) - 7ch

Revision history

REVISION	DIFFERENCES	STATUS
ACD/CJB/005	First release	Recommended for new programs

Related products

MODULE	DETAILS
ACD/BAC/002/B	Nickel-plated aluminum straight-through backshell for KAD connectors
CON/KAD/012	Mating connector for KAD/ADC/136 in thermocouple mode (DD, 52-way, 1 built-in temperature sensor)
KAD/ADC/136	Flexible ADC (full/½-bridge, ICP, RTD thermocouple, FIR/IIR, 12.5kHz b/w) - 8ch at 50ksps

Related documentation

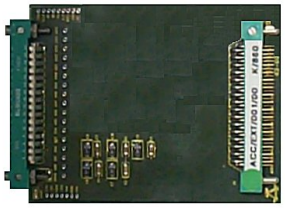
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook

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ACM/EXT/001

Extender board for the Acra KAM-500 system

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Key Features

- All backplane lines are extended
- LED-indicated power on

Applications

- Allows modules to operate above the chassis during bench testing

Overview

The ACM/EXT/001 is used to extend the Acra KAM-500 backplane so that user-modules can operate external to (above) the Acra KAM-500 chassis. This card is intended as a debug tool for customers developing their own Acra KAM-500 user-modules.

The ACM/EXT/001 is for bench testing use only, and can only be inserted in user-slots. It cannot be used in controller-slot J2.

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Dimensions					
height	–	95	–	mm	
height	–	3.74	–	in.	Design metric is millimeters.
length	–	69.85	–	mm	
length	–	2.75	–	in.	
width	1.4	1.5	1.6	mm	
width	0.05	0.05	0.06	in.	
Mass					
	–	38	–	g	
	–	1.34	–	oz	Design metric is grams.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	

Ordering information

PART NUMBER	DESCRIPTION
ACM/EXT/001/B	Extender board for the Acra KAM-500 system

Revision history

REVISION	DIFFERENCES	STATUS
ACM/EXT/001/B	First release	Recommended for new programs

Related documentation

DOCUMENT	DETAILS
DOC/MAN/018	KSM-500 Databook
DOC/DBK/001	Acra KAM-500 Databook

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BAC/PSU/007

Backshell for CON/PSU/007

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Overview

The BAC/PSU/007 is the recommended backshell for CON/PSU/007 standard power supply unit mating connectors. The backshell helps to prevent wires from becoming frayed or damaged, while a clamp bar provides strain relief.

The backshell is supplied with two clamp bars, two split lock washers and two screws.

Key Features

- Provides strain relief
- Helps prevent wires becoming frayed or damaged

Applications

- Used in cable assemblies with CON/PSU/007 connectors

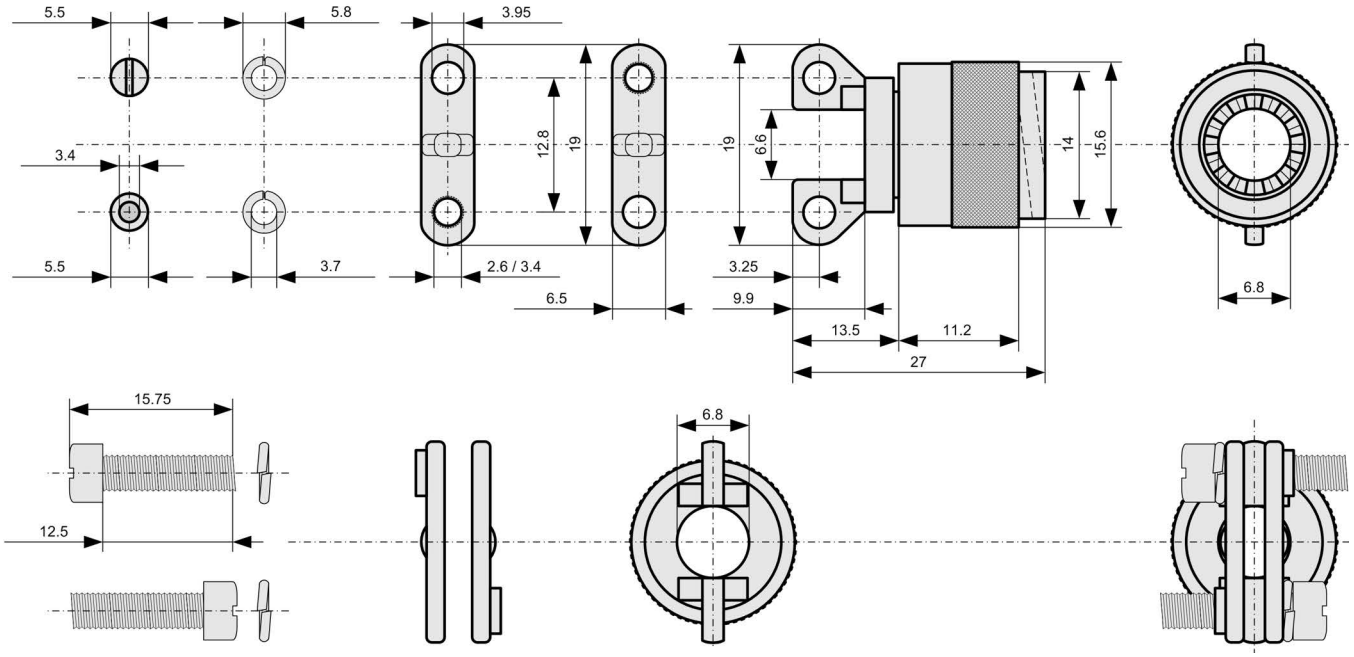


Figure 1: BAC/PSU/007 mechanical drawing

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					Design metric is grams.
backshell, clamp bars, screws and washers	–	8	–	g	
backshell, clamp bars, screws and washers	–	0.28	–	oz	
Dimensions					Design metric is millimeters.
backshell diameter	–	15.6	–	mm	
backshell diameter	–	0.62	–	in.	
backshell length	–	27	–	mm	
backshell length	–	1.06	–	in.	
screw diameter	–	3	–	mm	
screw diameter	–	0.12	–	in.	
screw length	–	12.5	–	mm	Length of threaded insert.
screw length	–	0.49	–	in.	
Chassis clearance					Design metric is millimeters. CON/PSU/007 with BAC/PSU/007 backshell.
connector height	–	40.5	–	mm	
connector height	–	1.59	–	in.	
bend radius height	–	49.8	–	mm	
bend radius height	–	1.96	–	in.	
Finish					
backshell body	–	–	–	–	Electroless nickel-plated aluminium.
clamp bars	–	–	–	–	Electroless nickel-plated aluminium.
screws	–	–	–	–	Stainless steel.
split lock washers	–	–	–	–	Stainless steel.

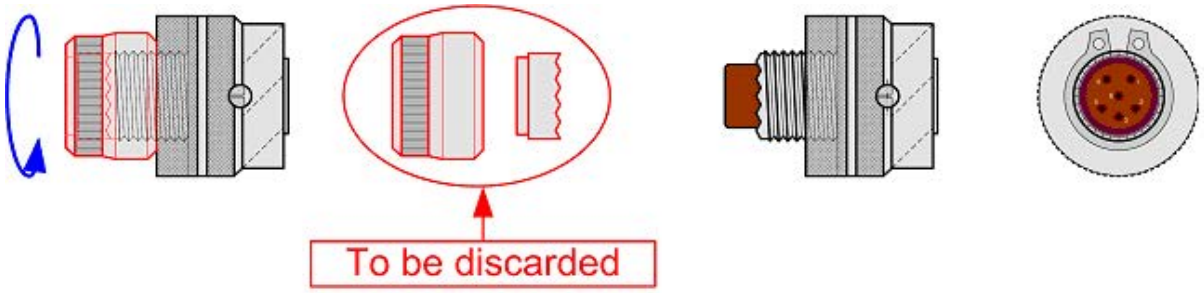
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Getting the most from the BAC/PSU/007

To prevent mechanical stress to wires and pins, always use a BAC/PSU/007 backshell with CON/PSU/007 connectors.

Connector assembly

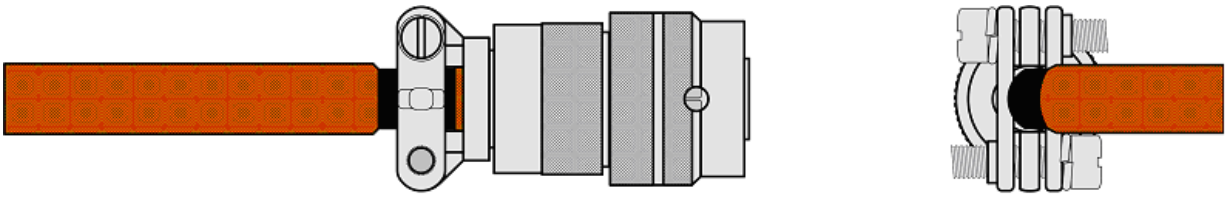
1. Remove the backshell and cover from the CON/PSU/007 connector. (These parts can be discarded.)



2. Remove the screws and clamp bars from the BAC/PSU/007 backshell.
3. Insert the cable and crimped wires to be inserted into the CON/PSU/007 connector through the BAC/PSU/007 backshell.



4. Insert the crimped contacts into the CON/PSU/007 connector.
5. Join the backshell and the CON/PSU/007 connector.
6. Secure the cable with the clamp bars, split lock washers and screws.



NOTE: We recommend always using a nut-locking solution on the clamp bar assembly screws.

Ordering information

PART NUMBER	DESCRIPTION
BAC/PSU/007	Backshell for CON/PSU/007

Revision history

REVISION	DIFFERENCES	STATUS
BAC/PSU/007	First release	Recommended for new programs

Related products

PRODUCT	DETAILS
CON/PSU/007	6-way nickel-plated bayonet standard PSU mating connector

Related documentation

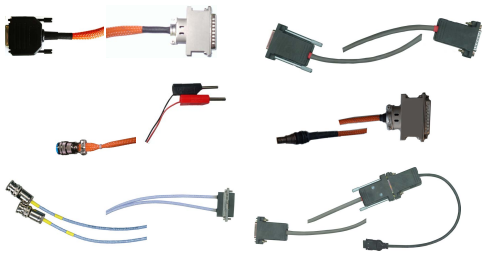
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook

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CABLES

Standard cables used for Acra KAM-500 and Axon system assembly

CURTISSWRIGHTDS.com



Key Features

- Connector for MIL-STD-1553 module
- Connector for PC card programmer/decoder
- Connector for power supply modules
- Connector for Axonite extender modules
- Single connector for all acquisition modules
- Multiple second sources for most connectors

Applications

- Assembling data acquisition systems

Overview

The connectors and cables are designed to mate with standard Acra KAM-500 and Axon modules.

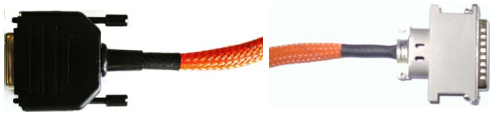
Depending on the cable ordered, internal wires may not be twisted or shielded. We strongly recommend that cables used are twisted or shielded. Contact Curtiss-Wright support (acra-support@curtisswright.com) for details. Use recommended tools (see the *KIT/001* data sheet) for working with either KAM or KAD connectors.

The use of third-party double-density mating connectors with KAD acquisition modules, apart from those approved, may result in damage to the mating connector and to the double-density connector on the KAD acquisition module. Such damage would incur out of warranty repair costs.

For specifications of the cables and connectors covered in this data sheet, see the respective tables starting on page 1096.

For Ethernet cables and connectors, see the *Network cables* data sheet. For ground station cables and connectors, see the *Ground station cables* data sheet.

IMPORTANT: Except where noted, the cables listed in this data sheet have not been qualified for flight test use.



ACC/ASY/022



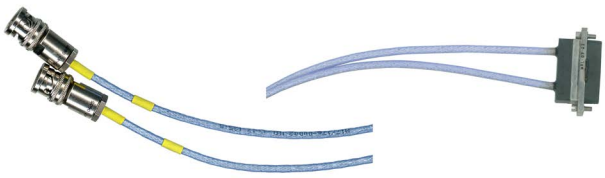
ACC/CON/012



CON/PSU/007/FL/100



AXN/CAB/001



ACC/CON/009



CON/DEC/001

Figure 1: Curtiss-Wright cables and connectors

Ordering information

Contact Curtiss-Wright support (acra-support@curtisswright.com) for details concerning special looms, non-standard lengths and terminating connectors.

Cables are grouped in the following tables.

Table 1 - Power supply cables on page 1096
Table 2 - KAM/BCU interface cables on page 1097
Table 3 - General purpose KAM module cables on page 1098
Table 4 - KAD/BCU interface cables on page 1098
Table 5 - Other modules cables on page 1099
Table 6 - MIL-STD-1553 cables on page 1099
Table 7 - SAM/DEC/007 and SAM/DEC/008 PCM interface cables on page 1102
Table 8 - Coaxial cables on page 1103
Table 9 - Axonite extension cables on page 1104

TABLE 1 Power supply cables

PART NUMBER	CONNECTOR 1	CONNECTOR 2	LENGTH[1]	OUTSIDE DIAMETER	MINIMUM BEND RADIUS	DESCRIPTION	NOTES
ACC/ASY/007/04	 [MD9] 9-way micro-miniature	 Banana plugs, pair	0.45m (18 in.*)	4.7 mm (0.19 in.)	47 mm (1.85 in.)	KAM/CHS with PSU/011 KAM/SYS cable (45 cm long) terminated with banana plugs (4 mm diameter). This cable is compatible with legacy KAM/SYS systems.	Compatible with KAM/PSU/01. Not compatible with Axon. MIL-STD-681 color coding, 26 AWG PTFE wire.
CON/PSU/007/FL/100	 CON/065/F[2]	 Banana plugs, pair	1.0m* (39 in.)	10 mm (0.39 in.)	50 mm (1.97 in.)	KAM/PSU/012 cable (1m long) terminated with banana plugs (4 mm diameter) Red = Power+ (28 VDC supply) Black = Power- (0 VDC return)	Compatible with KAM-500 and NET-500 products. Not compatible with Axon. 22 AWG, orange sleeving.
CON/PSU/007/FL/300	 CON/065/F[2]	 Banana plugs, pair	3.0m (118 in.)	10 mm (0.39 in.)	50 mm (1.97 in.)	KAM/PSU/012 cable (3m long) terminated with banana plugs (4 mm diameter) Red = Power+ (28 VDC supply), Black = Power- (0 VDC return)	Compatible with KAM-500, SSR-500, and NET-500 products. Not compatible with Axon. 22 AWG, orange sleeving.

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TABLE 1	Power supply cables (continued)						
PART NUMBER	CONNECTOR 1	CONNECTOR 2	LENGTH[1]	OUTSIDE DIAMETER	MINIMUM BEND RADIUS	DESCRIPTION	NOTES
CON/PSU/008/FL/100	 CON/261/F[2]	 Banana plugs, pair	1.0m (39 in.)	10 mm (0.39 in.)	50 mm (1.97 in.)	1m, 3-way bayonet PSU interface cable terminated with std. banana plugs (4 mm diameter), for Axon Red = Power (+) 28V supply Black = Power (-) 0V return	AXN PSU cable (1m) with 3-way connector Compatible with Axon. Not compatible with KAM-500. 20 AWG, orange sleeving.
CON/PSU/008/FLG/100	 CON/261/F[2]	 Banana plugs, three (red, black, green)	1.0m (39 in.)	10 mm (0.39 in.)	50 mm (1.97 in.)	1m, 3-way bayonet PSU interface cable terminated with std. banana plugs (4 mm diameter) and additional ground wire, for Axon Red = Power (+) 28V supply Black = Power (-) 0V return Green = Internal Ground	AXN PSU cable (1m) with 3-way connector Compatible with Axon. Not compatible with KAM-500. 20 AWG, orange sleeving.

1. Where marked * design length in inches; otherwise design length in metric.
2. The bayonet style PSU connectors CON/065/F (6-way) and CON/261/F (3-way) both use BAC/003/01 backshell with cable clamp. Power supply cables are unshielded wires with orange braided sleeving.

TABLE 2	KAM/BCU interface cables					
PART NUMBER	CONNECTOR 1	CONNECTOR 2	LENGTH[1]	OUTSIDE DIAMETER	MINIMUM BEND RADIUS	DESCRIPTION
ACC/ASY/021/04	KAM MD51		0.45m (18 in.*)	10 mm (0.39 in.)	50 mm (1.97 in.)	KAM (51-way) controller module interface cable (45 cm long), terminated with 15-way standard D type female connector. Suitable for KAM/BCU/x01.
ACC/ASY/021/10	KAM MD51		1.02m (40 in.*)	10 mm (0.39 in.)	50 mm (1.97 in.)	KAM (51-way) controller module interface cable (102 cm long), terminated with 15-way standard D type female connector. Suitable for KAM/BCU/x01.

TABLE 2	KAM/BCU interface cables (continued)					
PART NUMBER	CONNECTOR 1	CONNECTOR 2	LENGTH[1]	OUTSIDE DIAMETER	MINIMUM BEND RADIUS	DESCRIPTION
ACC/ASY/021/20	KAM MD51	D15F	2.03m (80 in.*)	10 mm (0.39 in.)	50 mm (1.97 in.)	KAM (51-way) controller module interface cable (203 cm long), terminated with 15-way standard D type female connector. Suitable for KAM/BCU/x01.
ACC/ASY/024	KAM MD51	RJ-F + IP toggle switch	0.50m (20 in.)	6.5 mm (0.26 in.)	65 mm (2.56 in.)	KAM/BCU/105 controller module interface crossover cable (50 cm long), terminated with female RJ45; On/Off switch on flying lead for IP address programming.

1. Where marked * design length in inches; otherwise design length in metric.

TABLE 3	General purpose KAM module cables					
PART NUMBER	CONNECTOR 1	CONNECTOR 2	LENGTH[1]	OUTSIDE DIAMETER	MINIMUM BEND RADIUS	DESCRIPTION
ACC/CON/008/04	KAM MD51[2]	Flying leads[3]	0.45m (18 in.*)	10 mm (0.39 in.)	50 mm (1.97 in.)	KAM module interface cable (45 cm long), 51-way, general purpose, not terminated.
ACC/CON/008/10	KAM MD51[2]	Flying leads[3]	1.0m (39 in.)	10 mm (0.39 in.)	50 mm (1.97 in.)	KAM mating connector (102 cm long), 51-way, not terminated.
ACC/CON/008/20	KAM MD51[2]	Flying leads[3]	2.0m (79 in.)	10 mm (0.39 in.)	50 mm (1.97 in.)	KAM mating connector (203 cm long), 51-way, not terminated.

1. Where marked * design length in inches; otherwise design length in metric.
2. *KAM MD51* 51-way micro-miniature DCDM is sold as ACC/CON/008 with various lengths of flying leads. Color coding on flying leads is MIL-STD-681.
3. Wire type on flying leads is 26 AWG PTFE multi-core wire.

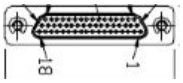


TABLE 4	KAD/BCU interface cables					
PART NUMBER	CONNECTOR 1	CONNECTOR 2	LENGTH[1]	OUTSIDE DIAMETER	MINIMUM BEND RADIUS	DESCRIPTION
ACC/ASY/022/C	52-way DD	D15F 2	0.45m (18 in.*)	10 mm (0.39 in.)	50 mm (1.97 in.)	KAD (52-way) controller module interface cable (45 cm long) terminated with 15-way commercial D type female connector. Suitable for KAM/BCU/x01.
ACC/ASY/023/C	52-way DD	RJ45 female socket (8P8C)[3] RJ-F	3.0m (118 in.)	6.5 mm (0.26 in.)	65 mm (2.6 in.)	KAD/BCU/105 controller module interface crossover cable (30 cm long) with straight backshell. On/Off switch on flying lead for IP address programming.

1. Where marked * design length in inches; otherwise design length in metric.

2. D15F  15-way female connector
3. See the *Network cables* data sheet for connecting to an Ethernet network system with controllers such as KAD/BCU/140/x and AXN/BCU/40x.

TABLE 5	Other modules cables					
PART NUMBER	CONNECTOR 1	CONNECTOR 2	LENGTH[1]	OUTSIDE DIAMETER	MINIMUM BEND RADIUS	DESCRIPTION
ACC/CON/031	52-way DD[2]	50-way D-type JIG/UNI/001	0.45m (18 in.*)	12 mm (0.47 in.)	60 mm (2.36 in.)	JIG/UNI/001 interface cable (45cm long) terminated with 50-way D type connector. Orange sleeving.
ACC/CON/053[3]	MD9 male 	Flying leads	1.0m (39 in.)	4.7 mm (0.19 in.)	47 mm (1.85 in.)	9-way micro-miniature male D connector with flying 26AWG, MIL-STD-681 color coding leads (1m long) for audio ports on SSR/CHS/001 voice interface.

1. Where marked * design length in inches; otherwise design length in metric.
2. The CON/KAD/002 52-way DD (Double Density) cable connector is shipped with compatible KAD modules and supplied with 52 crimpable pins. It is also the standard connector for Axon modules.



3. Curtiss-Wright does not manufacture or supply a backshell for this connector.

TABLE 6	MIL-STD-1553 cables						
PART NUMBER	CONNECTOR 1	CONNECTOR 2	LENGTH[1]	OUTSIDE DIAMETER	MINIMUM BEND RADIUS	DESCRIPTION	NOTES
ASD/MSB/001/DC	52-way DD	2 x TRB[2]	0.45m (18 in.*)	4.57 mm (0.18 in.)	22.9 mm (0.90 in.)	KAD MIL-STD-1553 interface cable (45cm long) terminated with two Twinax TRB connectors for applications with direct coupling (shield connected to digital ground).	Cables are 24AWG shielded twisted pair. The shield is connected to pin 22 for Bus 0 and pin 32 for Bus 1 (GND). Compatible with KAD/MSB/x and KAD/MBM/101 modules.

TABLE 6	MIL-STD-1553 cables (continued)						
PART NUMBER	CONNECTOR 1	CONNECTOR 2	LENGTH[1]	OUTSIDE DIAMETER	MINIMUM BEND RADIUS	DESCRIPTION	NOTES
ASD/MSB/001/DCC	52-way DD	2 x TRB 2	0.45m (18 in.*)	3.30 mm (0.13 in.)	16.51 mm (1.30 in.)	KAD MIL-STD-1553 interface cable (45cm long) terminated with two Twinax TRB connectors for applications with direct coupling (shield connected to chassis).	Cables are 24AWG shielded twisted pair. The shield is connected to pin 52 (chassis) for both Bus 0 and Bus 1. Compatible with KAD/MSB/x and KAD/MBM/101 modules.
ASD/MSB/001/TC	52-way DD	2 x TRB 2	0.45m (18 in.*)	3.30 mm (0.13 in.)	16.51 mm (1.30 in.)	KAD MIL-STD-1553 interface cable (45cm long) terminated with two Twinax TRB connectors for applications with transformer coupling (shield connected to digital ground).	Cables are 24AWG shielded twisted pair. The shield is connected to pin 22 for Bus 0 and pin 32 for Bus 1 (GND). Compatible with KAD/MSB/x and KAD/MBM/101 modules.
ASD/MSB/001/TCC	52-way DD	2 x TRB 2	0.45m (18 in.*)	3.30 mm (0.13 in.)	16.51 mm (1.30 in.)	KAD MIL-STD-1553 interface cable (45cm long) terminated with two Twinax TRB connectors for applications with transformer coupling (shield connected to chassis).	Cables are 24AWG shielded twisted pair. The shield is connected to pin 52 (chassis) for both Bus 0 and Bus 1. Compatible with KAD/MSB/x and KAD/MBM/101 modules.
ASD/MSB/001/TCC2M	52-way DD	2 x TRB 2	2.0m (79 in.)	3.30 mm (0.13 in.)	16.51 mm (1.30 in.)	KAD MIL-STD-1553 interface cable (2m long) terminated with two Twinax TRB connectors for applications with transformer coupling (shield connected to chassis).	Cables are 24AWG shielded twisted pair. The shield is connected to pin 52 (chassis) for both Bus 0 and Bus 1. Compatible with KAD/MSB/x and KAD/MBM/101 modules.

TABLE 6	MIL-STD-1553 cables (continued)						
PART NUMBER	CONNECTOR 1	CONNECTOR 2	LENGTH[1]	OUTSIDE DIAMETER	MINIMUM BEND RADIUS	DESCRIPTION	NOTES
ACC/CON/009	KAM MD51	2 x TRB 2	0.45m (18 in.*)	3.30 mm (0.13 in.)	16.51 mm (1.30 in.)	KAM MIL-STD-1553 interface cable (45 cm long) terminated with two Twinax TRB connectors for applications with direct coupling.	Each lead contains a 24 AWG twisted pair that is shielded (to GND); the shield is connected to pin 22 for Bus 0 and pin 32 for Bus 1 (GND). Compatible with KAM/MSB/xxx modules.
ACC/CON/029	KAM MD51	2 x TRB 2	0.45m (18 in.*)	3.30 mm (0.13 in.)	16.51 mm (1.30 in.)	KAM MIL-STD-1553 interface cable (45cm long) terminated with two Twinax TRB connectors for applications with transformer coupling (shield connected to digital ground).	Each lead contains a 24 AWG twisted pair that is shielded (to GND); the shield is connected to pin 22 for Bus 0 and pin 32 for Bus 1 (GND). Compatible with KAM/MSB/xxx modules.
ASD/MBM/102/DCC	52-way DD	8 x TRB 2	0.45m (18 in.*)	4.57 mm (0.18 in.)	22.90 mm (0.90 in.)	KAD MIL-STD-1553 interface cable (45 cm long) terminated with eight Twinax TRB connectors for applications with direct coupling (shield connected to chassis).	Compatible with KAD/MBM/102 and AXN/MBM/401. Supports four direct-coupled busses, with both primary (A) and secondary (B) connections.
ASD/MBM/102/TCC	52-way DD	8 x TRB 2	0.45m (18 in.*)	4.57 mm (0.18 in.)	22.90 mm (0.90 in.)	KAD MIL-STD-1553 interface cable (45 cm long) terminated with eight Twinax TRB connectors for applications with transformer coupling (shield connected to chassis).	Compatible with KAD/MBM/102 and AXN/MBM/401. Supports four transformer-coupled busses, with both primary (A) and secondary (B) connections.

TABLE 6	MIL-STD-1553 cables (continued)						
PART NUMBER	CONNECTOR 1	CONNECTOR 2	LENGTH[1]	OUTSIDE DIAMETER	MINIMUM BEND RADIUS	DESCRIPTION	NOTES
ASD/MBM/402/DCC	52-way DD	4 x TRB[2]	0.45m (18 in.*)	4.57 mm (0.18 in.)	22.90 mm (0.90 in.)	KAD MIL-STD-1553 interface cable (45 cm long) terminated with four Twinax TRB connectors for applications with direct coupling (shield connected to chassis).	Compatible with AXN/MBM/402 and DC bus 0 & 1 (only) of AXN/MBM/401. Supports two direct-coupled busses, with both primary (A) and secondary (B) connections.
ASD/MBM/402/TCC	52-way DD	4 x TRB[2]	0.45m (18 in.*)	4.57 mm (0.18 in.)	22.90 mm (0.90 in.)	KAD MIL-STD-1553 interface cable (45 cm long) terminated with four Twinax TRB connectors for applications with transformer coupling (shield connected to chassis).	Compatible with AXN/MBM/402 and TC bus 0 & 1 (only) of AXN/MBM/401. Supports two transformer-coupled busses, with both primary (A) and secondary (B) connections.

1. Where marked * design length in inches; otherwise design length in metric.

2. TRB  Twinax TRB MIL-STD-1553 Milestek

TABLE 7	SAM/DEC/007 and SAM/DEC/008 PCM interface cables					
PART NUMBER	CONNECTOR 1	CONNECTOR 2	LENGTH[1]	OUTSIDE DIAMETER	MINIMUM BEND RADIUS	DESCRIPTION
ACC/CON/020/B	D15 15-way D type male 	15-way PCMCIA LAN female connector	0.3m (11.8 in.)	4.5 mm (0.18 in.)	45 mm (1.78 in.)	15-way PCMCIA LAN to standard 15-way commercial D-type male plug connector cable (30 cm long) to interface to the SAM/DEC/007 module (shield connected to chassis).
ACC/CON/012	D15 male 	D15 female	3.0m (118 in.)	6.6 mm (0.26 in.)	66.7 mm (2.63 in.)	Acra KAM-500 RS-422 programming/data cable (3m long) with termination resistors on programming lines, TTL lines not connected. Compatible with SAM/DEC/007 and SAM/DEC/008, connects to ACC/ASY/022 for interface to a KAD/BCU/x01.

TABLE 7	SAM/DEC/007 and SAM/DEC/008 PCM interface cables (continued)					
PART NUMBER	CONNECTOR 1	CONNECTOR 2	LENGTH[1]	OUTSIDE DIAMETER	MINIMUM BEND RADIUS	DESCRIPTION
CON/DEC/001/B	D15 male 	15-way PCMCIA LAN female connector	3.3m (130 in.)	-	-	ACC/CON/012 combined with ACC/CON/020/B cable assemblies for SAM/DEC/007.
CON/USB/006	USB A male 	USB B male 	2.0m (79 in.)	4.0 mm (0.16 in.)	40 mm (1.58 in.)	USB A male to USB B male cable for PC connection to SAM/DEC/008.

1. Where marked * design length in inches; otherwise design length in metric.

TABLE 8	Coaxial cables						
PART NUMBER	CONNECTOR 1	CONNECTOR 2	LENGTH[1]	OUTSIDE DIAMETER	MINIMUM BEND RADIUS	DESCRIPTION	NOTES
ASM/TCG/102	 SMA	 TNC	1.82m (72 in.*)	5.0 mm (0.20 in.)	25 mm (0.98 in.)	GPS antenna interface cable (1.82m long) terminated with Threaded Neill-Concelman (TNC) male (shield isolated).	50Ω, RG142B/U coax, double shield 1.82 meters. Used with KAM/TCG/10x, NET/SWI/101 and SSR/CHS/xxx.
ACC/GPS/001/05M	 SMA	 TNC	5.0m (197 in.)	5.0 mm (0.20 in.)	25 mm (0.98 in.)	GPS antenna interface cable (5m long) terminated with Threaded Neill-Concelman (TNC) male (shield isolated).	50Ω, RG142B/U coax, double shield 5 meters. Used with KAM/TCG/10x, NET/SWI/101 and SSR/CHS/xxx.
ACC/CON/016	 10-32 UNF	10-32 UNF	3.05m (120 in.*)	2.34 mm (0.09 in.)	24.3 mm (0.95 in.)	KAM/CDC/101 low-noise, softline cable (305 cm long), terminated with 10-32 UNF connectors.	28 AWG S.P Copperweld® wire. Temperature range -73 to +260°C [-100 to +500 °F], Bend radius minimum 24.2 mm (0.950 in.), Shield S.P. Copper braid, silicone jacketed.

1. Where marked * design length in inches; otherwise design length in metric.

TABLE 9	Axonite extension cables						
PART NUMBER	CONNECTOR 1	CONNECTOR 2	LENGTH[1]	OUTSIDE DIAMETER	MINIMUM BEND RADIUS	DESCRIPTION	NOTES
AXN/CAB/001/01M	52-way DD	 Axonite locking circular connector	1.0m (39 in.)	4.6 mm (0.18 in.)	8.9 mm (0.35 in.)	Interface cable for AXN/ITE/001 from AXN/EXT/401 (1m long)	Cat6A F/UTP 28AWG 4-Pair, shielded backshell
AXN/CAB/001/02M	52-way DD	 Axonite locking circular connector	2.0m (79 in.)	4.6 mm (0.18 in.)	8.9 mm (0.35 in.)	Interface cable for AXN/ITE/001 from AXN/EXT/401 (2m long)	Cat6A F/UTP 28AWG 4-Pair, shielded backshell
AXN/CAB/001/05M	52-way DD	 Axonite locking circular connector	5.0m (197 in.)	4.6 mm (0.18 in.)	8.9 mm (0.35 in.)	Interface cable for AXN/ITE/001 from AXN/EXT/401 (5m long)	Cat6A F/UTP 28AWG 4-Pair, shielded backshell
AXN/CAB/001/10M	52-way DD	 Axonite locking circular connector	10.0m (394 in.)	4.6 mm (0.18 in.)	8.9 mm (0.35 in.)	Interface cable for AXN/ITE/001 from AXN/EXT/401 (10m long)	Cat6A F/UTP 28AWG 4-Pair, shielded backshell

1. Where marked * design length in inches; otherwise design length in metric.

Axonite cables have undergone environmental testing per the *Environmental Qualification Handbook for Axon Products*. Contact Curtiss-Wright support (acra-support@curtisswright.com) for connector and cable sourcing or environmental test details.

Getting the most from cables

The following figure displays connections possible when using some of the cables listed in this data sheet.

NOTE: For AXN/BCU/40x, KAD/BCU/140/x, NET/REC/xxx, SSR/CHS/xxx, and NET/SWI/xxx cables, refer to the *Network cables* data sheet.

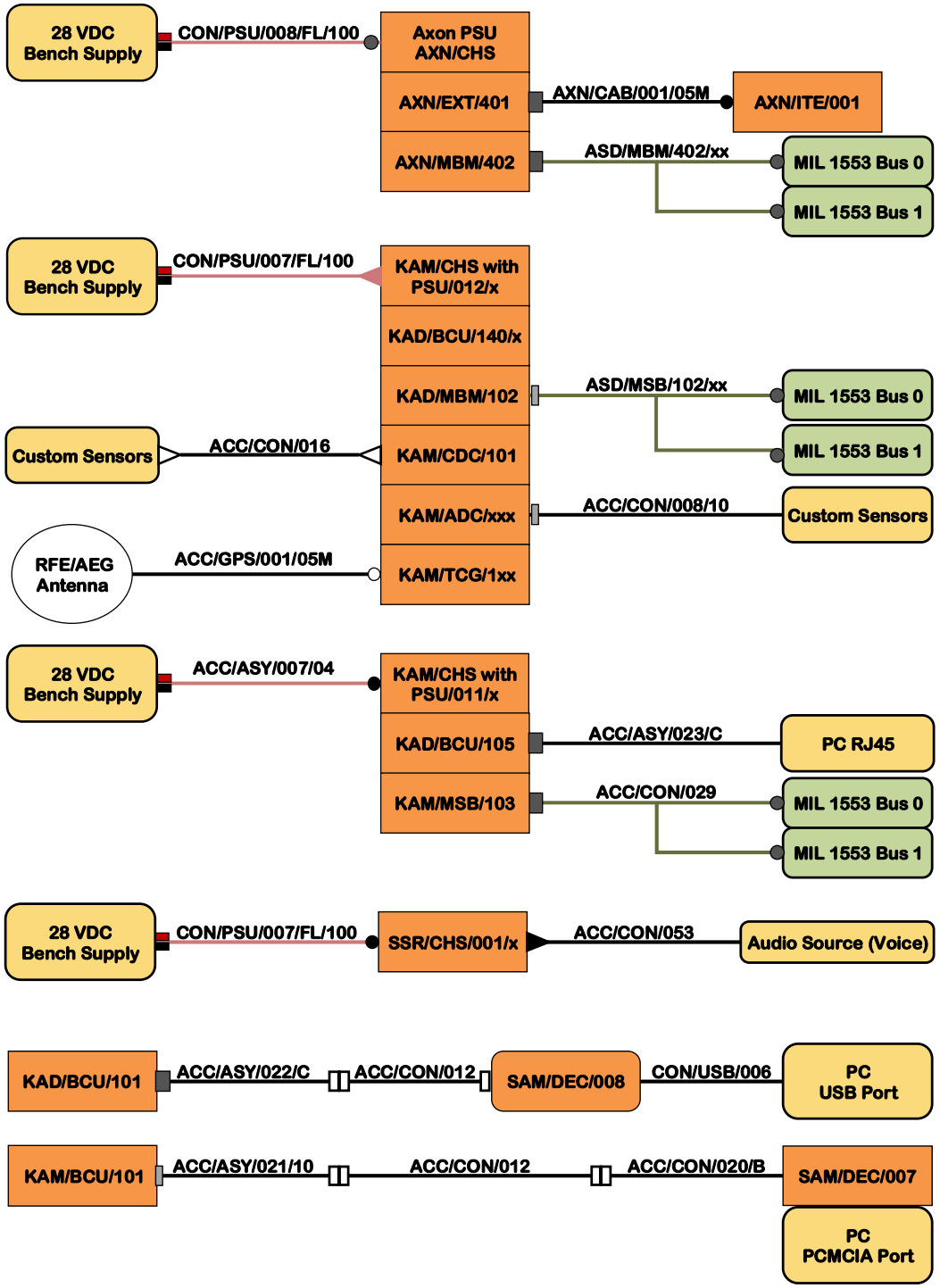


Figure 2: Sample connections for cables

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CON/KAD/002/CP

Mating connector (DD, 52-way)

CURTISSWRIGHTDS.COM



Key Features

- Mating connector for KAD modules
- Includes connector shell, crimp pins and mating screws

Applications

- Connecting modules

Overview

The CON/KAD/002/CP is a 52-way Double-Density (DD) connector for use with all Acra KAM-500 KAD modules (except the KAD/TDC/002).

The part is supplied as a connector shell (with integral insulator), and a bag of 52 crimp pins (size 22 AWG), which may be inserted into the connector shell. The connector is electroless nickel-plated.

The mating screws are stainless steel and are held in place on the connector shell by stainless steel retaining clips.

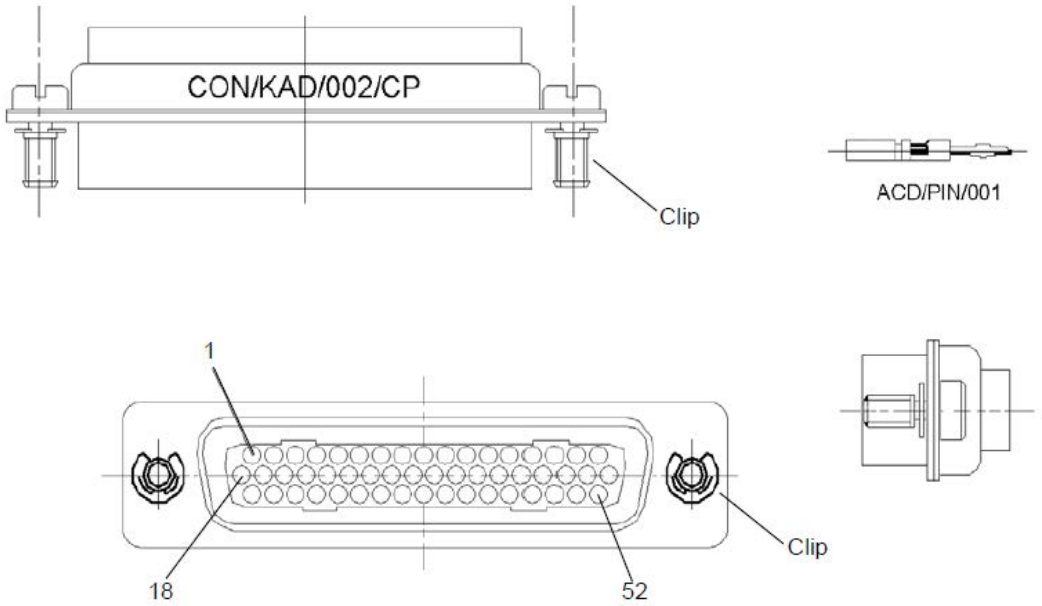


Figure 1: CON/KAD/002/CP plan, elevation and front view

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
connector, screw and clip	–	8.7	–	g	
connector, screw and clip	–	0.30	–	oz	Design metric is grams.
Dimensions					
connector height	–	14	–	mm	
connector height	–	0.5	–	in.	Design metric is millimeters.
connector length	–	53	–	mm	
connector length	–	2	–	in.	
connector width	–	12.8	–	mm	
connector width	–	0.5	–	in.	
screw length	–	3.5	–	mm	Length of threaded insert.
screw length	–	0.1	–	in.	Length of threaded insert.
width of clip	–	5.0	–	mm	
width of clip	–	0.2	–	in.	
Chassis clearance					
connector height	–	22	–	mm	
connector height	–	0.9	–	in.	
bend radius height	–	52	–	mm	Without ACD/BAC/002 or ACD/BAC/003 attached.
bend radius height	–	2	–	in.	
Finish					
connector	–	–	–	–	Nickel-plated SPCC-SD.
screw	–	–	–	–	Stainless steel.
clip	–	–	–	–	Stainless steel.
integral isolator housing	–	–	–	–	Nylon.
pins	–	–	–	–	Copper alloy with 1.2µm gold plating. Crimp pins accommodate cable size 22 - 26 AWG.
pins and retaining clips	–	–	–	–	Stainless steel.

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Getting the most from the CON/KAD/002/CP

This 52-way DD mating connector can be used with all Acra KAM-500 double-density modules except the KAD/TDC/002.

The CON/KAD/002/CP is supplied with 52 loose pin contacts. See the *KIT/001* data sheet in the *Acra KAM-500 Databook* for instructions on how to insert these pins.

When mating and un-mating double-density connectors, jackscrews should be screwed/unscrewed by half a turn alternately on each side until the connectors are fully mated/un-mated. Failure to mate/un-mate the connectors in this manner may result in deformation of the module top connector, which can reduce the reliability of the electrical contact of the connector/module with face.

WARNING: It is recommended that pins are only inserted once into each pin location of the connector. A reinsertion of any pin into a location where a pin has been removed may result in a loose pin.

Ordering information

PART NUMBER	DESCRIPTION
CON/KAD/002/CP	Mating connector (DD, 52-way)
CON/KAD/002/CP/SEC	Mating connector (DD, 52-way), without retaining screws and clips

Revision history

REVISION	DIFFERENCES	STATUS
CON/KAD/002/CP	First release	Recommended for new programs

Related products

MODULE	DETAILS
ACD/BAC/002/B	Nickel-plated aluminum straight-through backshell for KAD connectors
ACD/BAC/003/B	Nickel-plated aluminum 20° double-density backshell for KAD connectors
CON/KAD/004	Mating connector for CON/KAD/002/CP (female, DD, 52-way)

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook

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CON/KAD/002/SR

Mating connector for KAD/TDC/002 (DD, 52-way)

CURTISSWRIGHTDS.COM



Key Features

- Mating connector for KAD/TDC/002

Applications

- Connecting KAD/TDC/002 modules

Overview

The CON/KAD/002/SR is a modified 52-way Double-Density (DD) connector for use with the KAD/TDC/002.

The part is supplied as a connector shell (with integral insulator), and a bag of 42 crimp pins (size 22 AWG), which may be inserted into the connector shell. The connector is electroless nickel-plated.

The mating screws are stainless steel and are held in place on the connector shell by stainless steel retaining clips.

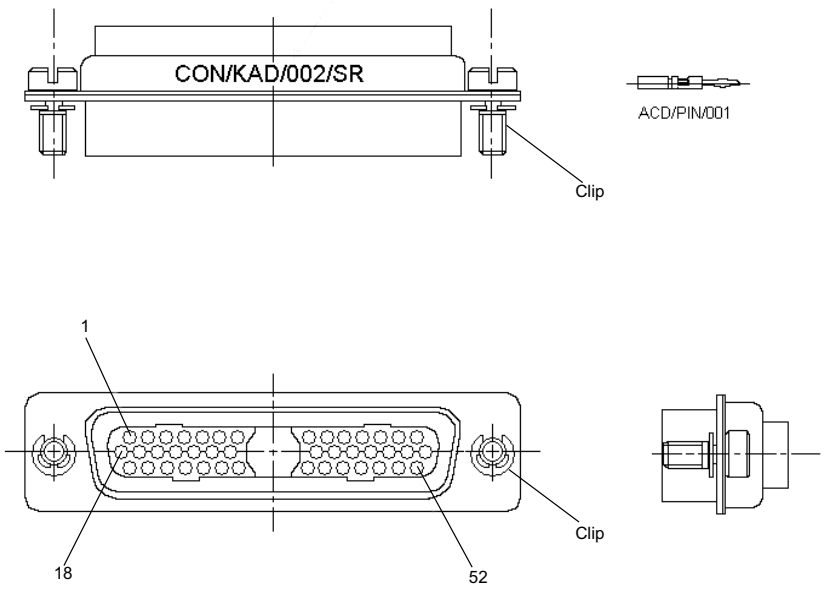


Figure 1: CON/KAD/002/SR plan, elevation and front view

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
connector, screw and clip	–	8.7	–	g	
connector, screw and clip	–	0.30	–	oz	Design metric is grams.
Dimensions					
connector height	–	14	–	mm	
connector height	–	0.5	–	in.	Design metric is millimeters.
connector length	–	53	–	mm	
connector length	–	2	–	in.	
connector width	–	12.8	–	mm	
connector width	–	0.5	–	in.	
screw length	–	3.5	–	mm	Length of threaded insert.
screw length	–	0.1	–	in.	Length of threaded insert.
width of clip	–	5.0	–	mm	
width of clip	–	0.2	–	in.	
Chassis clearance					
connector height	–	22	–	mm	
connector height	–	0.9	–	in.	
bend radius height	–	52	–	mm	Without ACD/BAC/002 or ACD/BAC/003 attached.
bend radius height	–	2	–	in.	
Finish					
connector	–	–	–	–	Electroless nickel-plated aluminum.
screw	–	–	–	–	Stainless steel.
clip	–	–	–	–	Stainless steel.
integral isolator housing	–	–	–	–	Nylon.
pins	–	–	–	–	Copper alloy with 1.2µm gold plating. Crimp pins accommodate cable size 22 - 26 AWG.
pins and retaining clips	–	–	–	–	Stainless steel.

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Getting the most from the CON/KAD/002/SR

The modified 52-way DD mating connector is only for use with the KAD/TDC/002.

The CON/KAD/002/SR is supplied with 42 loose pin contacts. See the *KIT/001* data sheet in the *Acra KAM-500 Databook* for instructions on how to insert these pins.

When mating and un-mating double-density connectors, jackscrews should be screwed/unscrewed by half a turn alternately on each side until the connectors are fully mated/un-mated. Failure to mate/un-mate the connectors in this manner may result in deformation of the module top connector, which can reduce the reliability of the electrical contact of the connector/module with face.

WARNING: It is recommended that pins are only inserted once into each pin location of the connector. A reinsertion of any pin into a location where a pin has been removed may result in a loose pin.

Ordering information

PART NUMBER	DESCRIPTION
CON/KAD/002/SR	Mating connector for KAD/TDC/002 (DD, 52-way)

Revision history

REVISION	DIFFERENCES	STATUS
CON/KAD/002/SR	First release	Recommended for new programs

Related products

MODULE	DETAILS
ACD/BAC/002/B	Nickel-plated aluminum straight-through backshell for KAD connectors
ACD/BAC/003/B	Nickel-plated aluminum 20° double-density backshell for KAD connectors

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook

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CON/KAD/003/CP

Mating connector for KAM/TCG/102, KAM/TCG/103, and KAM/TCG/105 (DD, 19-way)

CURTISSWRIGHTDS.COM



Key Features

- Mating connector for KAM/TCG/102, KAM/TCG/103, and KAM/TCG/105
- Includes connector shell, crimp pins, and mating screws

Applications

- Connecting to KAM/TCG/102, KAM/TCG/103, and KAM/TCG/105

Overview

The CON/KAD/003/CP is a 19-way double-density connector for use with the KAM/TCG/102, KAM/TCG/103, and KAM/TCG/105.

The part is supplied as a connector shell (with integral insulator), and a bag of 19 crimp pins (size 22 AWG), which may be inserted into the connector shell. The connector is electroless nickel-plated.

The mating screws are stainless steel and are held in place on the connector shell by stainless steel retaining clips.

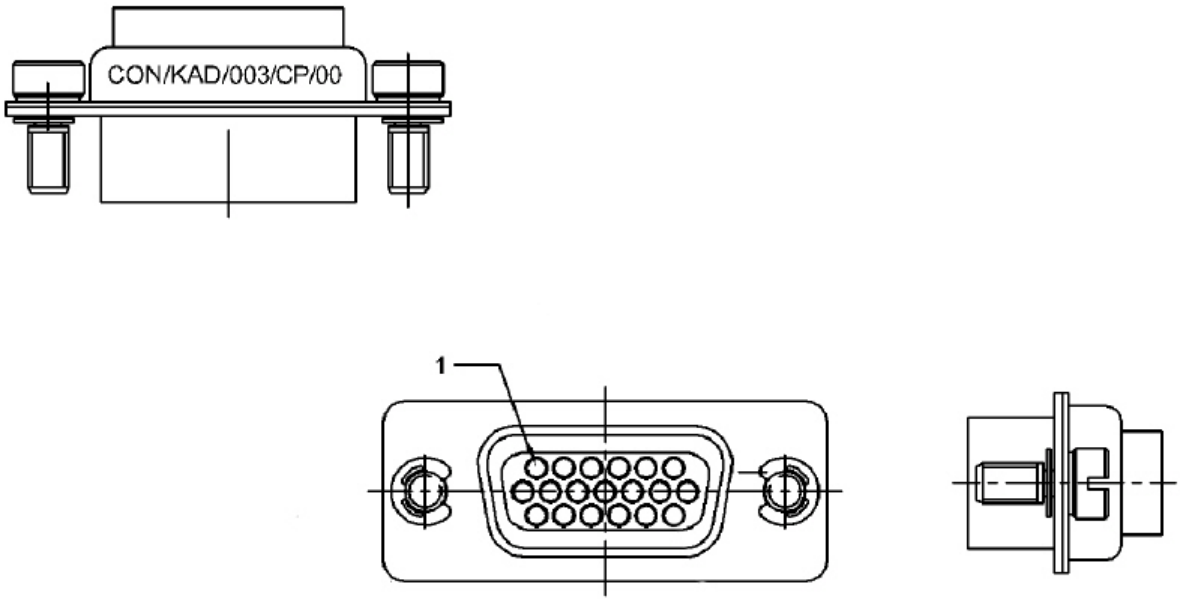


Figure 1: CON/KAD/003/CP plan, elevation and end-view

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
connector, screw and clip	–	8	–	g	
connector, screw and clip	–	0.3	–	oz	Design metric is grams.
Dimensions					
connector height	–	13.7	–	mm	
connector height	–	0.5	–	in	Design metric is millimeters.
connector length	–	31.2	–	mm	
connector length	–	1.2	–	in	
connector width	–	12.8	–	mm	
connector width	–	0.5	–	in	
screw length	–	3.5	–	mm	Length of threaded insert.
screw length	–	0.1	–	in	Length of threaded insert.
width of clip	–	5.0	–	mm	
width of clip	–	0.2	–	in	
Chassis clearance					
connector height	–	15.0	–	mm	
connector height	–	0.6	–	in	
bend radius height	–	35	–	mm	Without ACD/BAC/002 or ACD/BAC/003 attached.
bend radius height	–	1.4	–	in	
Finish					
connector	–	–	–	–	Electroless nickel-plated steel.
screw	–	–	–	–	Stainless steel.
clip	–	–	–	–	Stainless steel.
integral isolator housing	–	–	–	–	Nylon.
pins	–	–	–	–	Copper alloy with 1.2 µm gold plating. Crimp pins accommodate cable size 22 - 26 AWG.
pins and retaining clips	–	–	–	–	Stainless steel.

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Getting the most from the CON/KAD/003/CP

This 19-way double-density mating connector is used with the KAM/TCG/102, KAM/TCG/103, and KAM/TCG/105. The CON/KAD/003/CP is supplied with 19 loose pin contacts. See the Getting the most from section of the *KIT/001* data sheet for instructions on how to insert these pins.

When mating and un-mating double-density connectors, jackscrews should be screwed/unscrewed by half a turn alternately on each side until the connectors are fully mated/un-mated. Failure to mate/un-mate the connectors in this manner may result in deformation of the module top connector, which can reduce the reliability of the electrical contact of the connector/module with the contact face.

WARNING: It is recommended that pins are only inserted once into each pin location of the connector. A reinsertion of any pin into a location where a pin has been removed may result in a loose pin.

Ordering information

PART NUMBER	DESCRIPTION
CON/KAD/003/CP	Mating connector for KAM/TCG/102, KAM/TCG/103, and KAM/TCG/105 (DD, 19-way)

Revision history

REVISION	DIFFERENCES	STATUS
CON/KAD/003/CP	Issued first release of data sheet.	Recommended for new programs

Related products

MODULE	DETAILS
ACD/BAC/004	Backshell for CON/KAD/003/CP

Related documentation

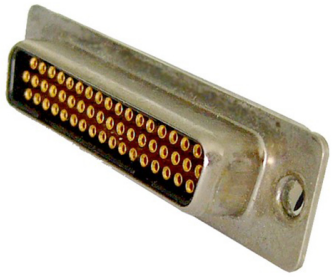
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook

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CON/KAD/004

Mating connector for CON/KAD/002/CP (female, DD, 52-way)

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Overview

The CON/KAD/004 is a 52-way Double-Density (DD) for use on jig assemblies as this connector mates with the CON/KAD/002/CP.

The part is supplied as a connector shell (with integral insulator) pre-populated with (52 x 22AWG) female socket contacts that have pigtail solder contacts at the rear of the connector.

Key Features

- KAD female connector as standard on KAD modules
- Includes connector shell and 52 x 22AWG socket contacts with pig tail contacts at rear
- Mating connector for CON/KAD/002/CP

Applications

- Jig assemblies

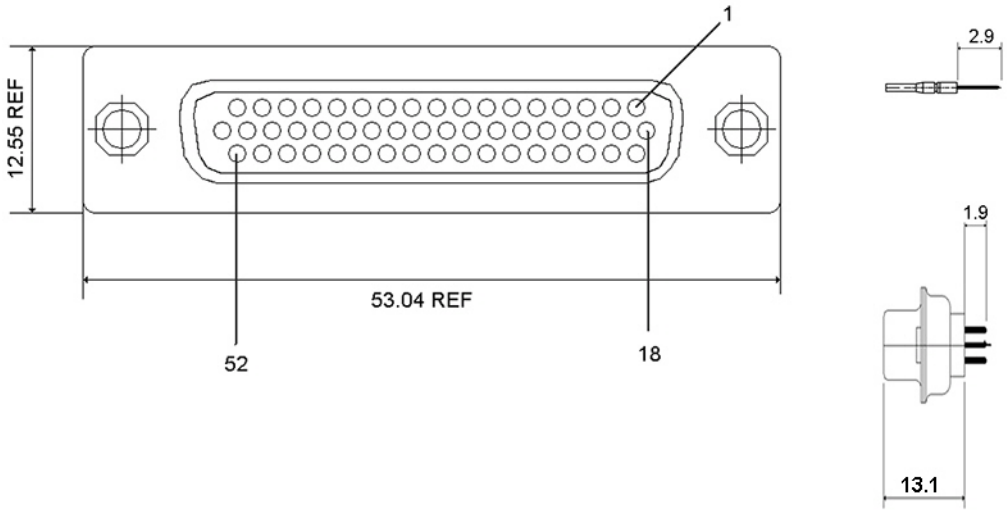


Figure 1: CON/KAD/004 front view

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
connector	–	12	–	g	
connector	–	0.42	–	oz	Design metric is grams.
Dimensions					
connector height	12.9	13	13.1	mm	
connector height	0.50	0.51	0.52	in.	Design metric is millimeters.
connector length	52.9	53	53.1	mm	
connector length	2.1	2.1	2.1	in.	
connector width	12.5	12.6	12.7	mm	
connector width	0.5	0.5	0.5	in.	
Finish					
connector	–	–	–	–	Nickel-plated.
socket contacts	–	–	–	–	Gold-plated copper alloy.
pigtail solder contacts	–	–	–	–	Gold-plated copper alloy.
integral isolator housing	–	–	–	–	Nylon.

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Getting the most from the CON/KAD/004

The 52-way female DD mating connector can be used to mate with the CON/KAD/002/CP on jig assemblies.

The CON/KAD/004 is pre-populated with 52 x 22AWG socket contacts that are also pre-fitted with 52 x pigtail solder contacts at the rear of the connector.

We recommend that 2 x 4-40 UNC jack posts be attached to the CON/KAD/004, so that the screws on the mating connector, CON/KAD/002/CP, can be inserted securely into it.

Ordering information

PART NUMBER	DESCRIPTION
CON/KAD/004	Mating connector for CON/KAD/002/CP (female, DD, 52-way)

Revision history

REVISION	DIFFERENCES	STATUS
CON/KAD/004	First release	Recommended for new programs

Related products

MODULE	DETAILS
CON/KAD/002/CP	Mating connector (DD, 52-way)

Related documentation

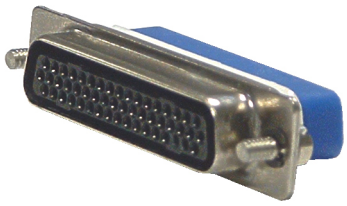
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualifications Handbook

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CON/KAD/005/CP

Mating connector (DD, 52-way, rear grommet)

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Key Features

- Mating connector for KAD modules
- Includes connector shell, crimp pins, mating screws and grommet at the rear

Applications

- Connecting modules

Overview

The CON/KAD/005/CP is a 52-way Double-Density (DD) connector for use with all Acra KAM-500 KAD modules (except the KAD/TDC/002).

The part is supplied as a connector shell (with integral insulator), and a bag of 52 crimp pins (size 22 AWG), which may be inserted into the connector shell. A grommet is attached at the rear. The connector is electroless nickel-plated.

The mating screws are stainless steel and are held in place on the connector shell by stainless steel retaining clips.

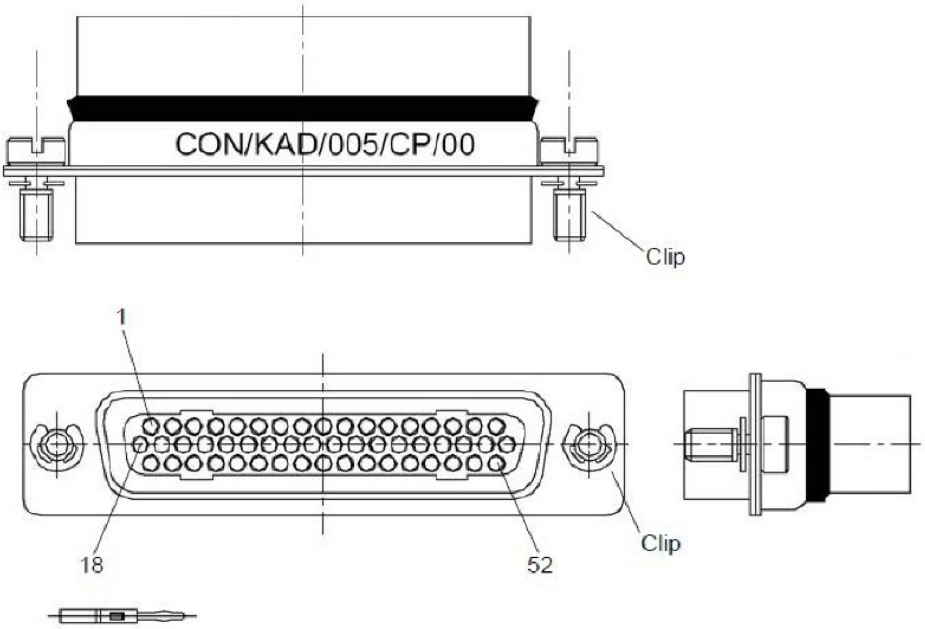


Figure 1: CON/KAD/005/CP plan, elevation and front view

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
connector, screw and clip	–	10	–	g	
connector, screw and clip	–	0.35	–	oz	Design metric is grams.
Dimensions					
connector height	–	19.9	–	mm	
connector height	–	0.78	–	in.	Design metric is millimeters.
connector length	–	53.4	–	mm	
connector length	–	2.1	–	in.	
connector width	–	12.8	–	mm	
connector width	–	0.5	–	in.	
screw length	–	3.5	–	mm	Length of threaded insert.
screw length	–	0.1	–	in.	Length of threaded insert.
width of clip	–	5.0	–	mm	
width of clip	–	0.2	–	in.	
Chassis clearance					
connector height	–	22	–	mm	
connector height	–	0.9	–	in.	
bend radius height	–	52	–	mm	Without ACD/BAC/002 or ACD/BAC/003 attached.
bend radius height	–	2	–	in.	
Finish					
connector	–	–	–	–	Electroless nickel plated aluminum.
screw	–	–	–	–	Stainless steel.
clip	–	–	–	–	Stainless steel.
integral isolator housing	–	–	–	–	Nylon.
pins	–	–	–	–	Copper alloy with 1.2µm gold plating. Crimp pins accommodate cable size 22 - 26 AWG.
pins and retaining clips	–	–	–	–	Stainless steel.
grommet	–	–	–	–	Fluoro silicon rubber.

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Getting the most from the CON/KAD/005/CP

This 52-way DD mating connector can be used with all Acra KAM-500 double-density modules except the KAD/TDC/002.

The CON/KAD/005/CP is supplied with 52 loose pin contacts. See the *KIT/001* data sheet in the *Acra KAM-500 Databook* for instructions on how to insert these pins.

When mating and un-mating double-density connectors, jackscrews should be screwed/unscrewed by half a turn alternately on each side until the connectors are fully mated/un-mated. Failure to mate/un-mate the connectors in this manner may result in deformation of the module top connector, which can reduce the reliability of the electrical contact of the connector/module with the contact face.

WARNING: It is recommended that pins are only inserted once into each pin location of the connector. A reinsertion of any pin into a location where a pin has been removed may result in a loose pin.

Ordering information

PART NUMBER	DESCRIPTION
CON/KAD/005/CP	Mating connector (DD, 52-way, rear grommet)

Revision history

REVISION	DIFFERENCES	STATUS
CON/KAD/005/CP	First release	Recommended for new programs

Related products

MODULE	DETAILS
ACD/BAC/002/B	Nickel-plated aluminum straight-through backshell for KAD connectors
ACD/BAC/003/B	Nickel-plated aluminum 20° double-density backshell for KAD connectors

Related documentation

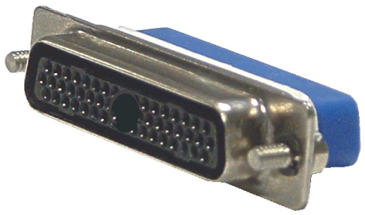
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualifications Handbook
DOC/MAN/018	KSM-500 Databook

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CON/KAD/005/SR

Mating connector for KAD/TDC/002 (DD, 52-way, rear grommet)

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Key Features

- Mating connector for the KAD/TDC/002
- Includes connector shell, crimp pins, mating screws and grommet at the rear

Applications

- Connecting KAD/TDC/002 modules

Overview

The CON/KAD/005/SR is a modified 52-way Double-Density (DD) connector for use with the KAD/TDC/002.

The part is supplied as a connector shell (with integral insulator), and a bag of 42 crimp pins (size 22 AWG), which may be inserted into the connector shell. A rubber grommet is attached at the rear. The connector is electroless nickel-plated.

The mating screws are stainless steel and are held in place on the connector shell by stainless steel retaining clips.

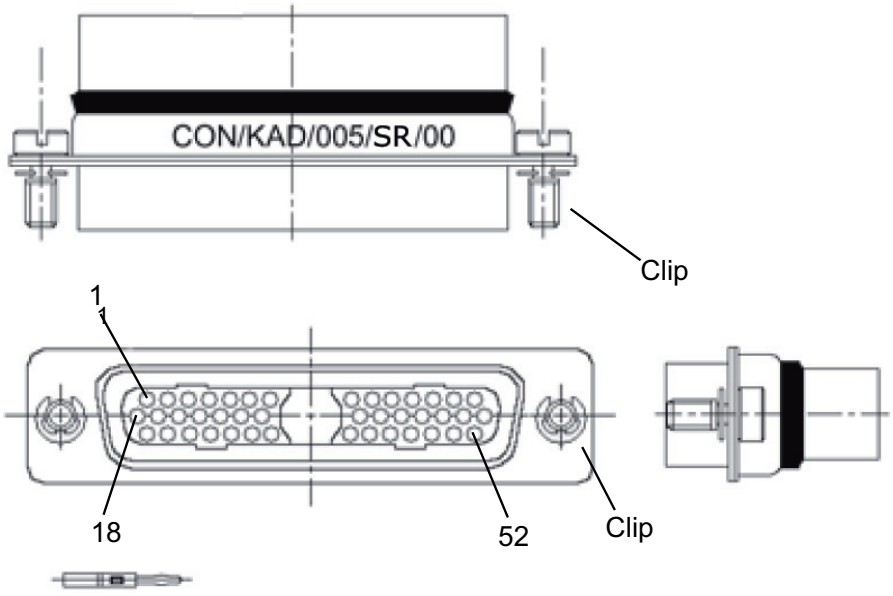


Figure 1: CON/KAD/005/SR plan, elevation and front view

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
connector, screw and clip	–	10	–	g	
connector, screw and clip	–	0.35	–	oz	Design metric is grams.
Dimensions					
connector height	–	19.9	–	mm	
connector height	–	0.78	–	in.	Design metric is millimeters.
connector length	–	53.4	–	mm	
connector length	–	2.1	–	in.	
connector width	–	12.8	–	mm	
connector width	–	0.5	–	in.	
screw length	–	3.5	–	mm	Length of threaded insert.
screw length	–	0.1	–	in.	Length of threaded insert.
width of clip	–	5.0	–	mm	
width of clip	–	0.2	–	in.	
Chassis clearance					
connector height	–	22	–	mm	
connector height	–	0.9	–	in.	
bend radius height	–	52	–	mm	Without ACD/BAC/002 or ACD/BAC/003 attached.
bend radius height	–	2	–	in.	
Finish					
connector	–	–	–	–	Electroless nickel plated.
screw	–	–	–	–	Stainless steel.
clip	–	–	–	–	Stainless steel.
integral isolator housing	–	–	–	–	Nylon.
pins	–	–	–	–	Copper alloy with 1.2µm gold plating. Crimp pins accommodate cable size 22 - 26 AWG.
pins and retaining clips	–	–	–	–	Stainless steel.
grommet	–	–	–	–	Fluoro silicon rubber.

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Getting the most from the CON/KAD/005/SR

This modified 52-way DD mating connector is to be used with the KAD/TDC/002.

The CON/KAD/005/SR is supplied with 42 loose pin contacts. See the *KIT/001* data sheet in the *Acra KAM-500 Databook* for instructions on how to insert these pins.

When mating and un-mating double-density connectors, jackscrews should be screwed/unscrewed by half a turn alternately on each side until the connectors are fully mated/un-mated. Failure to mate/un-mate the connectors in this manner may result in deformation of the module top connector, which can reduce the reliability of the electrical contact of the connector/module.

WARNING: It is recommended that pins are only inserted once into each pin location of the connector. A reinsertion of any pin into a location where a pin has been removed may result in a loose pin.

Ordering information

PART NUMBER	DESCRIPTION
CON/KAD/005/SR	Mating connector for KAD/TDC/002 (DD, 52-way, rear grommet)

Revision history

REVISION	DIFFERENCES	STATUS
CON/KAD/005/SR	First release	Recommended for new programs

Related products

MODULE	DETAILS
ACD/BAC/002/B	Nickel-plated aluminum straight-through backshell for KAD connectors
ACD/BAC/003/B	Nickel-plated aluminum 20° double-density backshell for KAD connectors

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualifications Handbook
DOC/MAN/018	KSM-500 Databook

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CON/KAD/008/CP

Mating connector (DD, 52-way, rear grommet, no mating screws)

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Overview

The CON/KAD/008/CP is a 52-way Double-Density (DD) connector for use with all Acra KAM-500 KAD modules (except the KAD/TDC/002).

The part is supplied as a connector shell (with integral insulator), and a bag of 52 crimp pins (size 22 AWG), which may be inserted into the connector shell. A rubber grommet is attached at the rear. The connector is electroless nickel-plated.

Key Features

- Mating connector for KAD modules
- Includes connector shell, crimp pins and rear grommet
- No mating screws attached

Applications

- Connecting KAD modules

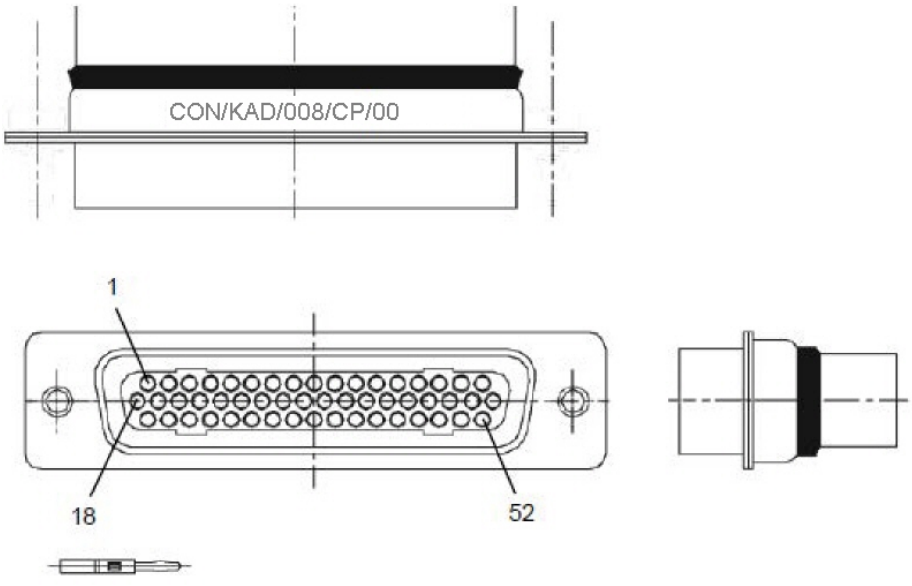


Figure 1: CON/KAD/008/CP plan, elevation and front view

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
connector and grommet	–	10	–	g	
connector and grommet	–	0.35	–	oz	Design metric is grams.
Dimensions					
height	–	19.9	–	mm	
height	–	0.78	–	in.	Design metric is millimeters.
length	–	53.42	–	mm	
length	–	2.10	–	in.	
width	–	12.8	–	mm	
width	–	0.5	–	in.	
Chassis clearance					
connector height	–	22	–	mm	
connector height	–	0.86	–	in.	
bend radius height	–	52	–	mm	Without ACD/BAC/002 or ACD/BAC/003 attached.
bend radius height	–	2.05	–	in.	
Finish					
connector	–	–	–	–	Electroless nickel-plated.
integral isolator housing	–	–	–	–	Nylon.
pins	–	–	–	–	Copper alloy with 1.2µm gold plating. Crimp pins accommodate cable size 22 - 26 AWG.
pins and retaining clips	–	–	–	–	Stainless steel.
grommet	–	–	–	–	Fluro silicone rubber.

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Getting the most from the CON/KAD/008/CP

This 52-way DD mating connector can be used with all Acra KAM-500 double-density modules except the KAD/TDC/002.

The CON/KAD/008/CP is supplied with 52 loose pin contacts. See the *KIT/001* data sheet in the *Acra KAM-500 Databook* for instructions on how to insert these pins.

When mating and un-mating double-density connectors, jackscrews should be screwed/unscrewed by half a turn alternately on each side until the connectors are fully mated/un-mated. Failure to mate/un-mate the connectors in this manner may result in deformation of the module top connector, which can reduce the reliability of the electrical contact of the connector/module.

WARNING: It is recommended that pins are only inserted once into each pin location of the connector. A reinsertion of any pin into a location where a pin has been removed may result in a loose pin.

Ordering information

PART NUMBER	DESCRIPTION
CON/KAD/008/CP	Mating connector (DD, 52-way, rear grommet, no mating screws)

Revision history

REVISION	DIFFERENCES	STATUS
CON/KAD/008/CP	First release	Recommended for new programs

Related products

MODULE	DETAILS
ACD/BAC/002/B	Nickel-plated aluminum straight-through backshell for KAD connectors
ACD/BAC/003/B	Nickel-plated aluminum 20° double-density backshell for KAD connectors

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook

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CON/KAD/008/SR

Mating connector for KAD/TDC/002 (DD, 52-way, rear grommet, no mating screws)



Key Features

- Mating connector for the KAD/TDC/002
- Includes connector shell, crimp pins and rear grommet
- No mating screws attached

Applications

- Connecting KAD/TDC/002 modules

Overview

The CON/KAD/008/SR is a modified 52-way Double-Density (DD) connector for use with the KAD/TDC/002.

The part is supplied as a connector shell (with integral insulator), and a bag of 42 crimp pins (size 22 AWG), which may be inserted into the connector shell. A rubber grommet is attached at the rear. The connector is electroless nickel-plated.

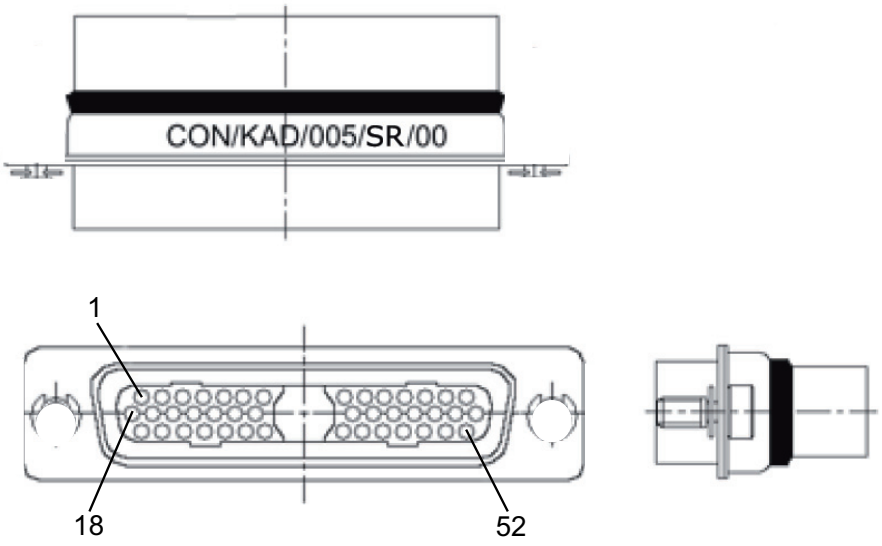


Figure 1: CON/KAD/008/SR elevation, plan and front view

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
connector and grommet	–	10	–	g	
connector and grommet	–	0.35	–	oz	Design metric is grams.
Dimensions					
connector height	–	19.9	–	mm	
connector height	–	0.78	–	in.	Design metric is millimeters.
connector length	–	53.42	–	mm	
connector length	–	2.10	–	in.	
connector width	–	12.8	–	mm	
connector width	–	0.5	–	in.	
Chassis clearance					
connector height	–	22	–	mm	
connector height	–	0.86	–	in.	
bend radius height	–	52	–	mm	Without ACD/BAC/002 or ACD/BAC/003 attached.
bend radius height	–	2.05	–	in.	
Finish					
connector	–	–	–	–	Electroless nickel-plated.
integral isolator housing	–	–	–	–	Nylon.
pins	–	–	–	–	Copper alloy with 1.2µm gold plating. Crimp pins accommodate cable size 22 - 26 AWG.
pins and retaining clips	–	–	–	–	Stainless steel.
grommet	–	–	–	–	Fluro silicone rubber.

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Getting the most from the CON/KAD/008/SR

This modified 52-way DD mating connector is to be used with the KAD/TDC/002.

The CON/KAD/008/SR is supplied with 42 loose pin contacts. See the *KIT/001* data sheet in the *Acra KAM-500 Databook* for instructions on how to insert these pins.

When mating and un-mating double-density connectors, jackscrews should be screwed/unscrewed by half a turn alternately on each side until the connectors are fully mated/un-mated. Failure to mate/un-mate the connectors in this manner may result in deformation of the module top connector, which can reduce the reliability of the electrical contact of the connector/module.

The CON/KAD/008/SR is supplied pre-stamped with text referring to the CON/KAD/005/SR. This is due to the rework to remove the mating screws from the CON/KAD/005/SR to make it into the CON/KAD/008/SR and is not an error.

WARNING: It is recommended that pins are only inserted once into each pin location of the connector. A reinsertion of any pin into a location where a pin has been removed may result in a loose pin.

Ordering information

PART NUMBER	DESCRIPTION
CON/KAD/008/SR	Mating connector for KAD/TDC/002 (DD, 52-way, rear grommet, no mating screws)

Revision history

REVISION	DIFFERENCES	STATUS
CON/KAD/008/SR	First release	Recommended for new programs

Related products

MODULE	DETAILS
ACD/BAC/002/B	Nickel-plated aluminum straight-through backshell for KAD connectors
ACD/BAC/003/B	Nickel-plated aluminum 20° double-density backshell for KAD connectors

Related documentation

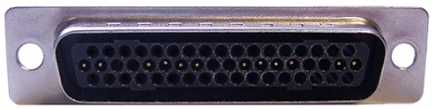
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook

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CON/KAD/010

Mating connector for KAD/TDC/102 and KAD/TDC/107 (DD, 52-way, 3 built-in temperature sensors)

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Key Features

- Nickel-plated connector shell
- Three built-in PT100 sensors (typical accuracy of ±0.1°C)
- Includes crimp pins and mating screws

Applications

- Cold junction reference for KAD/TDC/107 and KAD/TDC/102 modules

Overview

The CON/KAD/010 is a Double-Density (DD) connector for use with KAD/TDC/107 and KAD/TDC/102 modules.

The part is supplied as a connector shell (with integral insulator), and a bag containing a minimum of 33 crimp pins (size 22 AWG), which may be inserted into the connector shell. It is part of the ACD/CJB/002 kit which is delivered with KAD/TDC/107 modules and the ACD/CJB/003 kit which is delivered with KAD/TDC/102 modules. The CON/KAD/010 is also part of the ACD/CJB/004 kit, which is an alternative kit for the KAD/TDC/102.

The CON/KAD/010 has three built-in PT100 temperature sensors for accurate measurement of thermocouple cold junction temperature, as close as possible to real junction. The sensors used are 1/3 of class B, DIN/IEC 60751 specification (±0.1 ± 0.00166×t) [°C]. In a typical operational range of -40 to 85°C these sensors are more accurate than ±0.24°C, with typical accuracy being around 0.1°C.

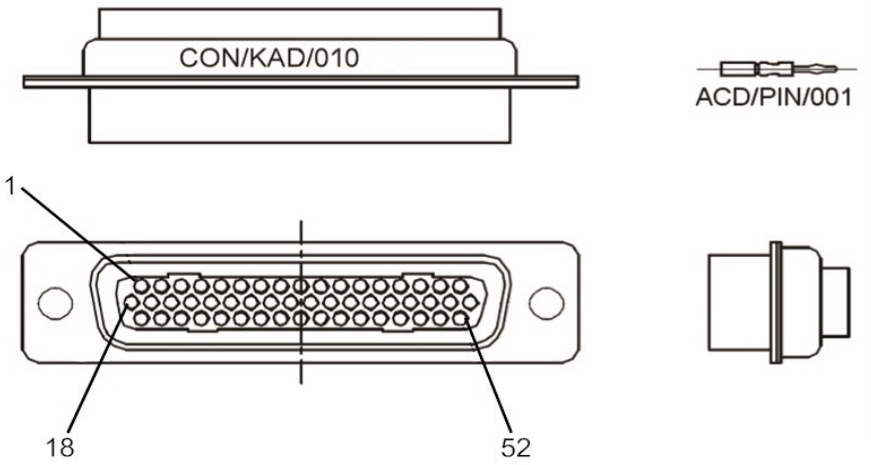


Figure 1: CON/KAD/010 plan, elevation and front view

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
connector, screw and clip	–	10	–	g	
connector, screw and clip	–	0.35	–	oz	Design metric is grams.
Dimensions					
connector height	–	14	–	mm	
connector height	–	0.5	–	inch	Design metric is grams.
connector length	–	53	–	mm	
connector length	–	2.1	–	inch	
connector width	–	12.8	–	mm	
connector width	–	0.5	–	inch	
screw length	–	3.5	–	mm	Length of threaded insert.
screw length	–	0.14	–	inch	Length of threaded insert.
width of clip	–	5.0	–	mm	
width of clip	–	0.2	–	inch	
Chassis clearance					
connector height	–	22	–	mm	
connector height	–	0.86	–	inch	
bend radius height	–	52	–	mm	Without backshell attached. If a backshell is attached, see the respective backshell data sheet for more information.
bend radius height	–	2.05	–	inch	
Finish					
connector	–	–	–	–	Nickel-plated steel.
screw	–	–	–	–	Stainless steel.
clip	–	–	–	–	Stainless steel.
integral isolator housing	–	–	–	–	Nylon.
pins	–	–	–	–	Copper alloy with 1.2 µm gold plating. Crimp pins accommodate cable size 22 - 26 AWG.
retaining clips	–	–	–	–	Stainless steel.

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Getting the most from the CON/KAD/010

This mating connector is only for use with the KAD/TDC/107 and KAD/TDC/102 modules. It is supplied with loose pin contacts. For instructions on how to insert these pins for the KAD/TDC/102, see the *KIT/001* data sheet in the *Acra KAM-500 Databook*. For KAD/TDC/107 assembly instructions, see the *Cable assembly using ACD/CJB/002 reference junction block* technical note.

When mating and un-mating DD connectors, jackscrews should be screwed/unscrewed by half a turn alternately on each side until the connectors are fully mated/un-mated. Failure to mate/un-mate the connectors in this manner may result in deformation of the module top connector, which can reduce the reliability of the electrical contact of the connector/module with face.

Built-in PT100 sensors are configured so they can operate in four-wire resistance measurement mode, with sensing of dropout voltage at the sensor, so any wire and contact resistances are compensated and do not introduce error. For KAD/TDC/107 and KAD/TDC/102 modules, each sensor operates with a constant current source of 1 mA (typically) in ratiometric mode. Current excitations are connected to pins 18, 24 and 30 and current returns are connected to pins 23, 29 and 35. Positive and negative sense lines are at pin positions 19, 22, and 25; and at 28, 31 and 34 respectively for each temperature sensor.

WARNING: It is recommended that pins are only inserted once into each pin location of the connector. A reinsertion of any pin into a location where a pin has been removed may result in a loose pin.

Ordering information

PART NUMBER	DESCRIPTION
CON/KAD/010	Mating connector for KAD/TDC/102 and KAD/TDC/107 (DD, 52-way, 3 built-in temperature sensors)

Revision history

REVISION	DIFFERENCES	STATUS
CON/KAD/010	First release	Recommended for new programs

Related products

MODULE	DETAILS
ACD/CJB/002	Cold junction block for KAD/TDC/107 (built in sensors, straight-through heavy thermal mass backshell) - 12ch
ACD/CJB/003	Cold junction block for KAD/TDC/102 (built in sensors, straight-through backshell) - 15ch
ACD/CJB/004	Reference junction block for the KAD/TDC/102 with a 20° backshell

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
TEC/NOT/059	Cable assembly using ACD/CJB/002 reference junction block

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CON/KAD/020/CP

Mating connector (DD, 52-way) supporting multiple pin insertion/removal cycles

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Overview

The CON/KAD/020/CP is a 52-way Double-Density (DD) connector for use with all Acra KAM-500 KAD modules (except the KAD/TDC/002).

The part is supplied as a connector shell (with integral insulator), and a bag of 52 crimp pins (size 22 AWG), which may be inserted into the connector shell. The connector is electroless nickel-plated.

The mating screws are stainless steel and are held in place on the connector shell by stainless steel retaining clips.

Key Features

- Mating connector for KAD modules
- Includes connector shell, crimp pins and mating screws

Applications

- Connecting modules

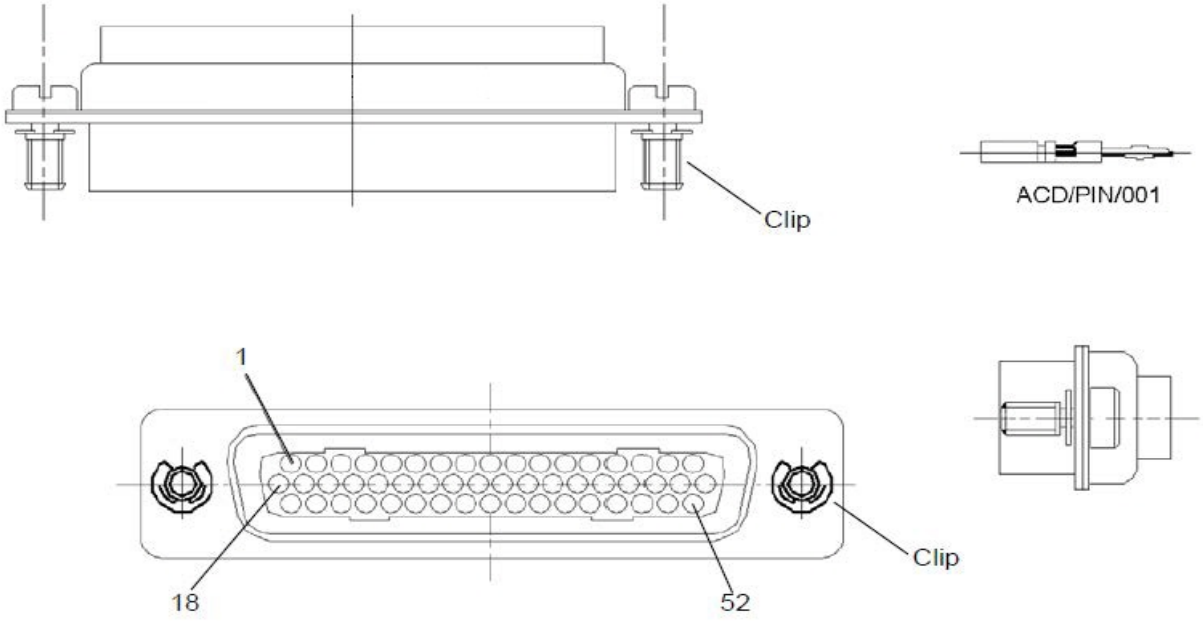


Figure 1: CON/KAD/020/CP plan, elevation and front view

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
connector, screw and clip	–	8.7	–	g	
connector, screw and clip	–	0.30	–	oz	Design metric is grams.
Dimensions					
connector height	–	14	–	mm	
connector height	–	0.5	–	in.	Design metric is millimeters.
connector length	–	53	–	mm	
connector length	–	2	–	in.	
connector width	–	12.8	–	mm	
connector width	–	0.5	–	in.	
screw length	–	3.5	–	mm	Length of threaded insert.
screw length	–	0.1	–	in.	Length of threaded insert.
width of clip	–	5.0	–	mm	
width of clip	–	0.2	–	in.	
Chassis clearance					
connector height	–	22	–	mm	
connector height	–	0.9	–	in.	
bend radius height	–	52	–	mm	Without ACD/BAC/002 or ACD/BAC/003 attached.
bend radius height	–	2	–	in.	
Finish					
connector	–	–	–	–	Nickel-plated SPCC-SD.
screw	–	–	–	–	Stainless steel.
clip	–	–	–	–	Stainless steel.
integral isolator housing	–	–	–	–	Nylon.
pins	–	–	–	–	Copper alloy with 1.2 µm gold plating. Crimp pins accommodate cable size 22 - 26 AWG.
pins and retaining clips	–	–	–	–	Stainless steel.

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Getting the most from the CON/KAD/020/CP

This 52-way DD mating connector can be used with all Acra KAM-500 double-density modules except the KAD/TDC/002.

The CON/KAD/020/CP is supplied with 52 loose pin contacts. See the *KIT/001* data sheet in the *Acra KAM-500 Databook* for instructions on how to insert these pins.

When mating and un-mating double-density connectors, jackscrews should be screwed/unscrewed by half a turn alternately on each side until the connectors are fully mated/un-mated. Failure to mate/un-mate the connectors in this manner may result in deformation of the module top connector, which can reduce the reliability of the electrical contact of the connector/module with face.

NOTE: Supplier data sheet states that after 10 pin insertion/extraction cycles are performed in the same pin location on the connector, the minimum axial load at that pin location will be 4 lb or 17.8N equivalent.

Ordering information

PART NUMBER	DESCRIPTION
CON/KAD/020/CP	Mating connector (DD, 52-way) supporting multiple pin insertion/removal cycles

Revision history

REVISION	DIFFERENCES	STATUS
CON/KAD/020/CP	First release	Recommended for new programs where multiple pin insertions/extractions are required; otherwise the CON/KAD/020 is recommended

Related products

MODULE	DETAILS
ACD/BAC/002/B	Nickel-plated aluminum straight-through backshell for KAD connectors
ACD/BAC/003/B	Nickel-plated aluminum 20° double-density backshell for KAD connectors
CON/KAD/004	Mating connector for CON/KAD/002/CP (female, DD, 52-way)

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook

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CON/KAD/030/CP

Mating connector for KAM/TCG/102, KAM/TCG/103, and KAM/TCG/105 (DD, 19-way) supporting multiple pin insertion/removal cycles



Key Features

- Mating connector for KAM/TCG/102, KAM/TCG/103, and KAM/TCG/105
- Includes connector shell, crimp pins, and mating screws

Applications

- Connecting to KAM/TCG/102, KAM/TCG/103, and KAM/TCG/105

Overview

The CON/KAD/030/CP is a 19-way double-density connector for use with the KAM/TCG/102, KAM/TCG/103, and KAM/TCG/105.

The part is supplied as a connector shell (with integral insulator), and a bag of 19 crimp pins (size 22 AWG), which may be inserted into the connector shell. The connector is electroless nickel-plated.

The mating screws are stainless steel and are held in place on the connector shell by stainless steel retaining clips.

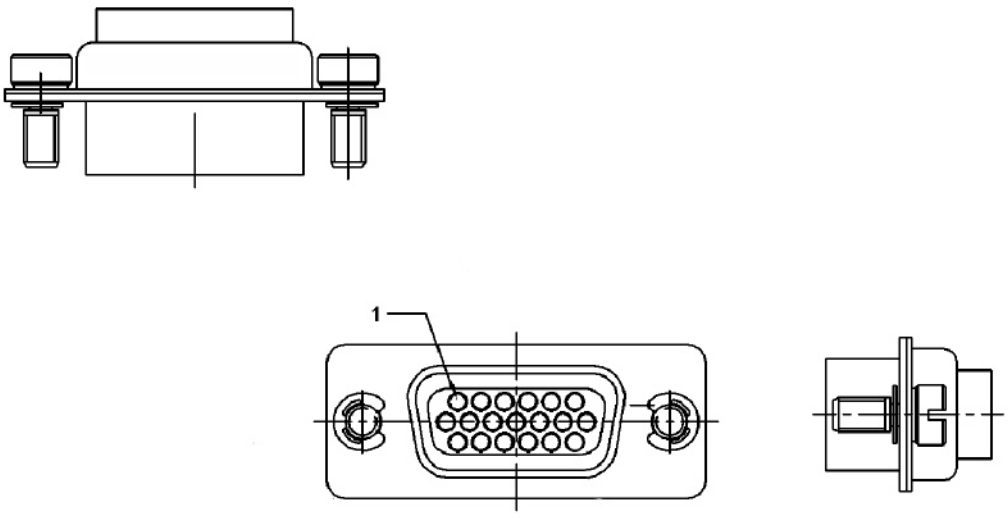


Figure 1: CON/KAD/030/CP plan, elevation and end-view

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
connector, screw and clip	–	8	–	g	
connector, screw and clip	–	0.3	–	oz	Design metric is grams.
Dimensions					
connector height	–	13.7	–	mm	
connector height	–	0.5	–	in	Design metric is millimeters.
connector length	–	31.2	–	mm	
connector length	–	1.2	–	in	
connector width	–	12.8	–	mm	
connector width	–	0.5	–	in	
screw length	–	3.5	–	mm	Length of threaded insert.
screw length	–	0.1	–	in	Length of threaded insert.
width of clip	–	5.0	–	mm	
width of clip	–	0.2	–	in	
Chassis clearance					
connector height	–	15.0	–	mm	
connector height	–	0.6	–	in	
bend radius height	–	35	–	mm	Without ACD/BAC/002 or ACD/BAC/003 attached.
bend radius height	–	1.4	–	in	
Finish					
connector	–	–	–	–	Electroless nickel-plated steel.
screw	–	–	–	–	Stainless steel.
clip	–	–	–	–	Stainless steel.
integral isolator housing	–	–	–	–	Nylon.
pins	–	–	–	–	Copper alloy with 1.2 µm gold plating. Crimp pins accommodate cable size 22 - 26 AWG.
pins and retaining clips	–	–	–	–	Stainless steel.

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Getting the most from the CON/KAD/030/CP

This 19-way double-density mating connector is used with the KAM/TCG/102, KAM/TCG/103, and KAM/TCG/105. The CON/KAD/030/CP is supplied with 19 loose pin contacts. See the Getting the most from section of the *KIT/001* data sheet for instructions on how to insert these pins.

When mating and un-mating double-density connectors, jackscrews should be screwed/unscrewed by half a turn alternately on each side until the connectors are fully mated/un-mated. Failure to mate/un-mate the connectors in this manner may result in deformation of the module top connector, which can reduce the reliability of the electrical contact of the connector/module with the contact face.

NOTE: Supplier data sheet states that after 10 pin insertion/extraction cycles are performed in the same pin location on the connector, the minimum axial load at that pin location will be 4 lb or 17.8N equivalent.

Ordering information

PART NUMBER	DESCRIPTION
CON/KAD/030/CP	Mating connector for KAM/TCG/102, KAM/TCG/103, and KAM/TCG/105 (DD, 19-way) supporting multiple pin insertion/removal cycles

Revision history

REVISION	DIFFERENCES	STATUS
CON/KAD/030/CP	Issued first release of data sheet.	Recommended for new programs where multiple pin insertions/extractions are required; otherwise the CON/KAD/030 is recommended

Related products

MODULE	DETAILS
ACD/BAC/004	Backshell for CON/KAD/003/CP

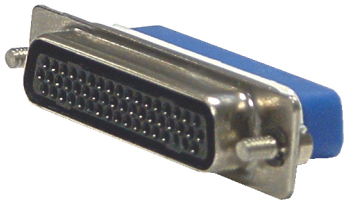
Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook

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CON/KAD/050/CP

Mating connector (DD, 52-way, rear grommet) supporting multiple pin insertion/removal cycles



Key Features

- Mating connector for KAD modules
- Includes connector shell, crimp pins, mating screws and grommet at the rear

Applications

- Connecting modules

Overview

The CON/KAD/050/CP is a 52-way Double-Density (DD) connector for use with all Acra KAM-500 KAD modules (except the KAD/TDC/002).

The part is supplied as a connector shell (with integral insulator), and a bag of 52 crimp pins (size 22 AWG), which may be inserted into the connector shell. A grommet is attached at the rear. The connector is electroless nickel-plated.

The mating screws are stainless steel and are held in place on the connector shell by stainless steel retaining clips.

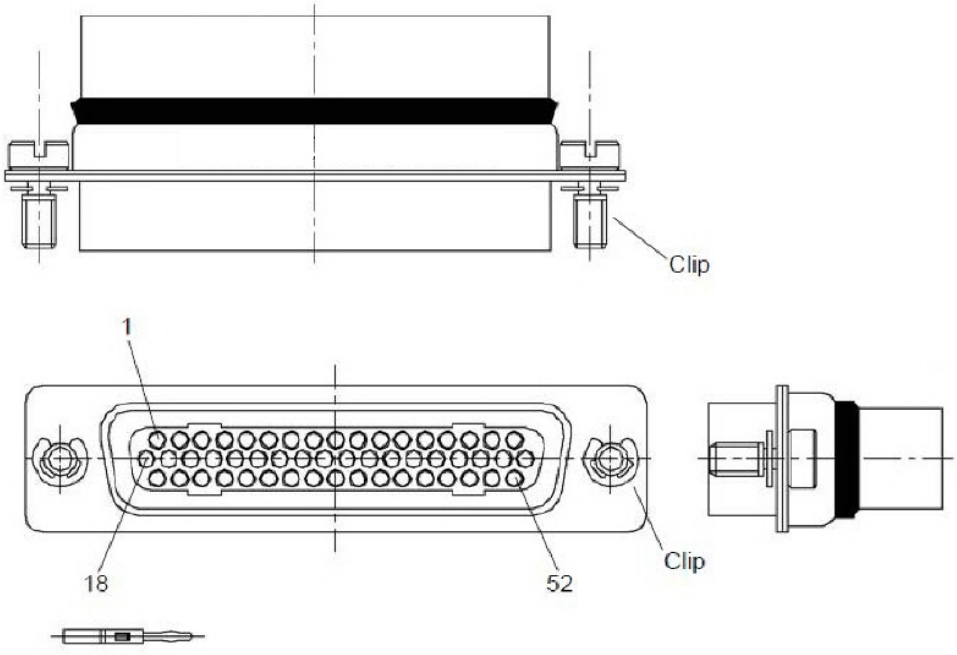


Figure 1: CON/KAD/050/CP plan, elevation and front view

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
connector, screw and clip	–	10	–	g	
connector, screw and clip	–	0.35	–	oz	Design metric is grams.
Dimensions					
connector height	–	19.9	–	mm	
connector height	–	0.78	–	in.	Design metric is millimeters.
connector length	–	53.4	–	mm	
connector length	–	2.1	–	in.	
connector width	–	12.8	–	mm	
connector width	–	0.5	–	in.	
screw length	–	3.5	–	mm	Length of threaded insert.
screw length	–	0.1	–	in.	Length of threaded insert.
width of clip	–	5.0	–	mm	
width of clip	–	0.2	–	in.	
Chassis clearance					
connector height	–	22	–	mm	
connector height	–	0.9	–	in.	
bend radius height	–	52	–	mm	Without ACD/BAC/002 or ACD/BAC/003 attached.
bend radius height	–	2	–	in.	
Finish					
connector	–	–	–	–	Electroless nickel plated aluminum.
screw	–	–	–	–	Stainless steel.
clip	–	–	–	–	Stainless steel.
integral isolator housing	–	–	–	–	Nylon.
pins	–	–	–	–	Copper alloy with 1.2µm gold plating. Crimp pins accommodate cable size 22 - 26 AWG.
pins and retaining clips	–	–	–	–	Stainless steel.
grommet	–	–	–	–	Fluoro silicon rubber.

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Getting the most from the CON/KAD/050/CP

This 52-way DD mating connector can be used with all Acra KAM-500 double-density modules except the KAD/TDC/002.

The CON/KAD/050/CP is supplied with 52 loose pin contacts. See the *KIT/001* data sheet in the *Acra KAM-500 Databook* for instructions on how to insert these pins.

When mating and un-mating double-density connectors, jackscrews should be screwed/unscrewed by half a turn alternately on each side until the connectors are fully mated/un-mated. Failure to mate/un-mate the connectors in this manner may result in deformation of the module top connector, which can reduce the reliability of the electrical contact of the connector/module with the contact face.

NOTE: Supplier data sheet states that after 10 pin insertion/extraction cycles are performed in the same pin location on the connector, the minimum axial load at that pin location will be 4 lb or 17.8N equivalent.

Ordering information

PART NUMBER	DESCRIPTION
CON/KAD/050/CP	Mating connector (DD, 52-way, rear grommet) supporting multiple pin insertion/removal cycles

Revision history

REVISION	DIFFERENCES	STATUS
CON/KAD/050/CP	First release	Recommended for new programs where multiple pin insertions/extractions are required; otherwise the CON/KAD/050 is recommended

Related products

MODULE	DETAILS
ACD/BAC/002/B	Nickel-plated aluminum straight-through backshell for KAD connectors
ACD/BAC/003/B	Nickel-plated aluminum 20° double-density backshell for KAD connectors

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualifications Handbook
DOC/MAN/018	KSM-500 Databook

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CON/KAD/080/CP

Mating connector (DD, 52-way, rear grommet, no mating screws) supporting multiple pin insertion/removal cycles

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Overview

The CON/KAD/080/CP is a 52-way Double-Density (DD) connector for use with all Acra KAM-500 KAD modules (except the KAD/TDC/002).

The part is supplied as a connector shell (with integral insulator), and a bag of 52 crimp pins (size 22 AWG), which may be inserted into the connector shell. A rubber grommet is attached at the rear. The connector is electroless nickel-plated.

Key Features

- Mating connector for KAD modules
- Includes connector shell, crimp pins and rear grommet
- No mating screws attached

Applications

- Connecting KAD modules

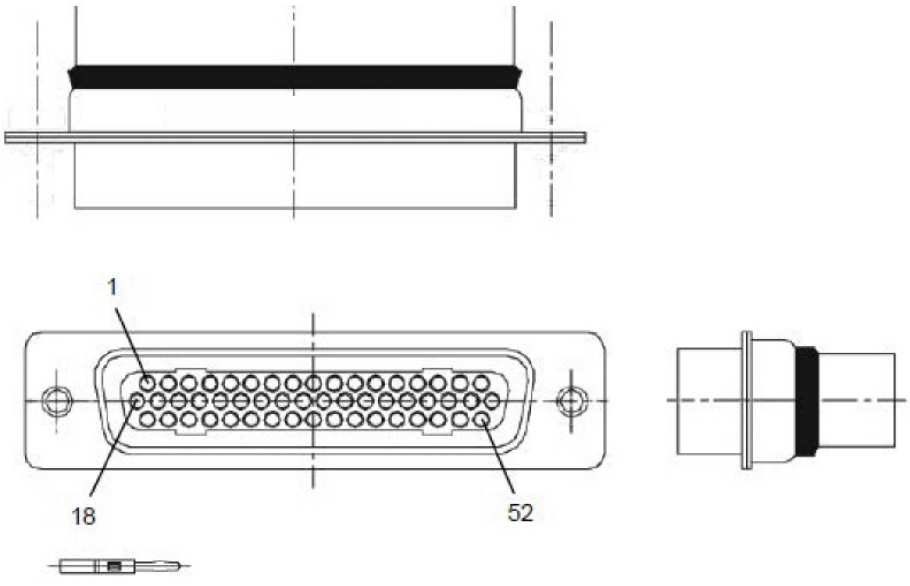


Figure 1: CON/KAD/080/CP plan, elevation and front view

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					
connector and grommet	–	10	–	g	
connector and grommet	–	0.35	–	oz	Design metric is grams.
Dimensions					
height	–	19.9	–	mm	
height	–	0.78	–	in.	Design metric is millimeters.
length	–	53.42	–	mm	
length	–	2.10	–	in.	
width	–	12.8	–	mm	
width	–	0.5	–	in.	
Chassis clearance					
connector height	–	22	–	mm	
connector height	–	0.86	–	in.	
bend radius height	–	52	–	mm	Without ACD/BAC/002 or ACD/BAC/003 attached.
bend radius height	–	2.05	–	in.	
Finish					
connector	–	–	–	–	Electroless nickel-plated.
integral isolator housing	–	–	–	–	Nylon.
pins	–	–	–	–	Copper alloy with 1.2µm gold plating. Crimp pins accommodate cable size 22 - 26 AWG.
pins and retaining clips	–	–	–	–	Stainless steel.
grommet	–	–	–	–	Fluro silicone rubber.

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Getting the most from the CON/KAD/080/CP

This 52-way DD mating connector can be used with all Acra KAM-500 double-density modules except the KAD/TDC/002.

The CON/KAD/080/CP is supplied with 52 loose pin contacts. See the *KIT/001* data sheet in the *Acra KAM-500 Databook* for instructions on how to insert these pins.

When mating and un-mating double-density connectors, jackscrews should be screwed/unscrewed by half a turn alternately on each side until the connectors are fully mated/un-mated. Failure to mate/un-mate the connectors in this manner may result in deformation of the module top connector, which can reduce the reliability of the electrical contact of the connector/module.

NOTE: Supplier data sheet states that after 10 pin insertion/extraction cycles are performed in the same pin location on the connector, the minimum axial load at that pin location will be 4 lb or 17.8N equivalent.

Ordering information

PART NUMBER	DESCRIPTION
CON/KAD/080/CP	Mating connector (DD, 52-way, rear grommet, no mating screws) supporting multiple pin insertion/removal cycles

Revision history

REVISION	DIFFERENCES	STATUS
CON/KAD/080/CP	First release	Recommended for new programs where multiple pin insertions/extractions are required; otherwise the CON/KAD/080 is recommended

Related products

MODULE	DETAILS
ACD/BAC/002/B	Nickel-plated aluminum straight-through backshell for KAD connectors
ACD/BAC/003/B	Nickel-plated aluminum 20° double-density backshell for KAD connectors

Related documentation

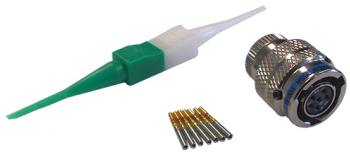
DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook

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CON/PSU/007

Mating connector for PSU (6-way)

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Key Features

- Lightweight, space saving design
- Contact protection - 100% scoop-proof LJT (Long Junior Tri-Lock) design prevents bent pins and short circuits during mating
- Quick positive coupling - 3-point bayonet lock system

Applications

- Standard power connector for all Acra products that use the 6-way bayonet receptacle

Overview

The CON/PSU/007 is a 6-way nickel-plated bayonet connector that mates with the power inlet on most Acra products using the appropriate receptacle.

The 3-point bayonet lock system allows the CON/PSU/007 to stay mated even when under high vibration.

The 100% scoop-proof LJT design prevents bent pins and short circuits during mating.

The connector is supplied with seven (one spare) crimp contact sockets, a standard backshell without strain relief, a mating face dust cup, and a plastic contact insertion/removal tool.

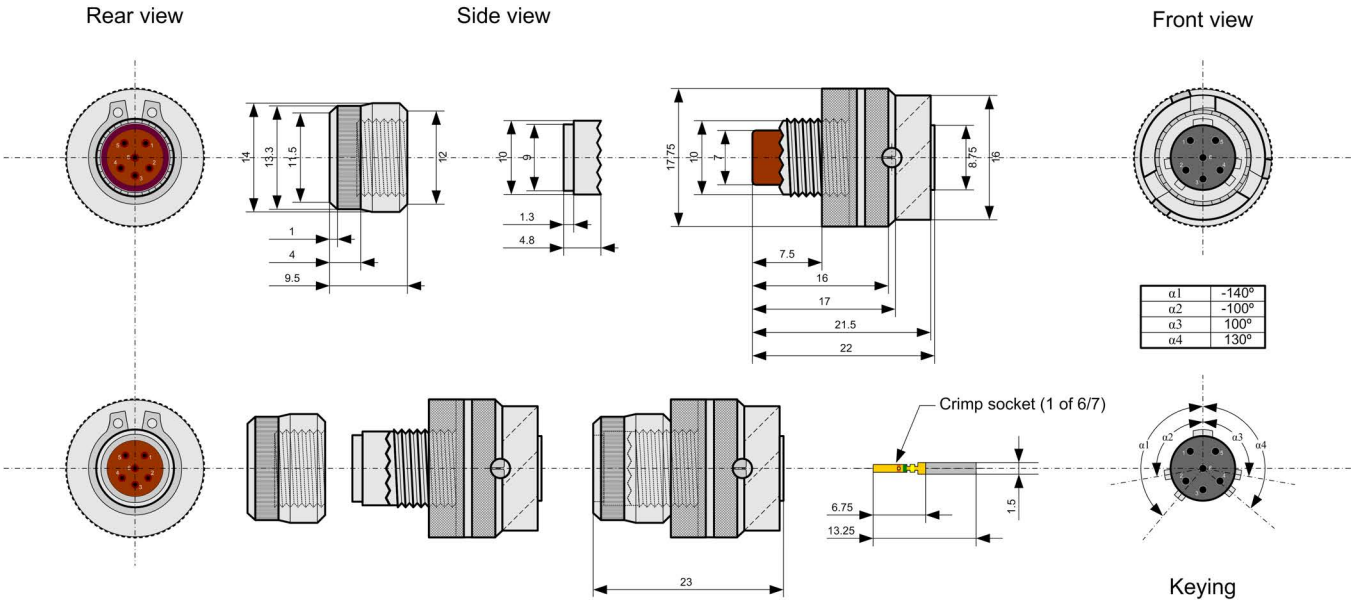


Figure 1: CON/PSU/007 mechanical drawing

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					Design metric is grams.
connector without backshell	–	6	–	g	
connector without backshell	–	0.21	–	oz	
connector with backshell	–	8	–	g	
connector with backshell	–	0.28	–	oz	
Dimensions					Design metric is millimeters.
connector diameter	–	17.75	–	mm	
connector diameter	–	0.69	–	in.	
connector length	–	23	–	mm	With supplied backshell populated.
connector length	–	0.91	–	in.	With supplied backshell populated.
contact socket diameter	–	1.5	–	mm	
contact socket diameter	–	0.06	–	in.	
contact socket length	–	13.25	–	mm	Length of threaded insert.
contact socket length	–	0.52	–	in.	
Chassis clearance					Design metric is millimeters.
connector height	–	23	–	mm	With supplied backshell populated.
connector height	–	0.91	–	in.	With supplied backshell populated.
bend radius height	–	20	–	mm	5mm bundle, AWG 26, 20mm bend radius.
bend radius height	–	0.8	–	in.	0.2in bundle, AWG 26, 0.8in bend radius.
Finish					
connector shell	–	–	–	–	Electroless nickel-plated aluminium.
insert	–	–	–	–	Rigid dielectric.
seals	–	–	–	–	Fluorinated silicone rubber, brown.
contact socket	–	–	–	–	Copper alloy with 1.2µm gold plating.

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Getting the most from the CON/PSU/007

To prevent mechanical stress to wires and pins, always use a BAC/PSU/007 backshell with CON/PSU/007 connectors.

Connector assembly

The crimping tool Daniels AFM8 is recommended to use for crimping the contact sockets onto the wires. Substitutions of crimping equipment may result in connector failure at the assembly operation.

The proper insertion tool (supplied with the connector) must be used to assure seating of the contact in the insulator in the proper position. This tool has been designed for use with this product. Do not use ACC/TOL/027 or ACC/TOL/028 tools (that are included in ACC/KIT/005) for inserting the crimped sockets into the CON/PSU/007 connector. These tools have been designed for the micro-miniature, circular connectors and are not compatible with the CON/PSU/007.

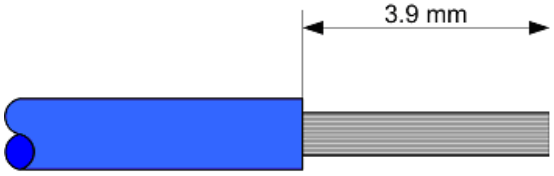
Any substitution of proper insertion tools may result in over or under insertion of the contact, which damages the retention system of the insulator.

The CON/PSU/007 mating connector has been designed with a controlled float to allow for ease of mating. To avoid reducing this float or causing a splaying of the contacts, any unnecessary strain by clamping too close to the rear of the connector should be avoided.

Use of recommended tools and proper assembly techniques pays dividends in reliability and reduced costs.

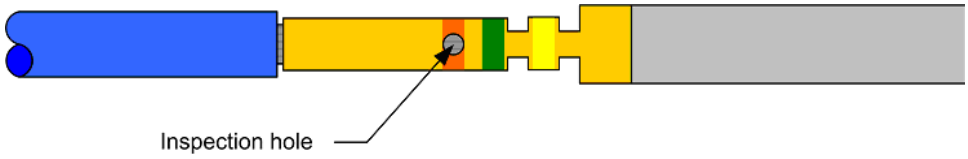
Wire stripping

Cut the wires to the length required and strip 0.153in. (3.9mm) of insulation from the end to be crimped. Check for cut or broken wires and frayed insulation.

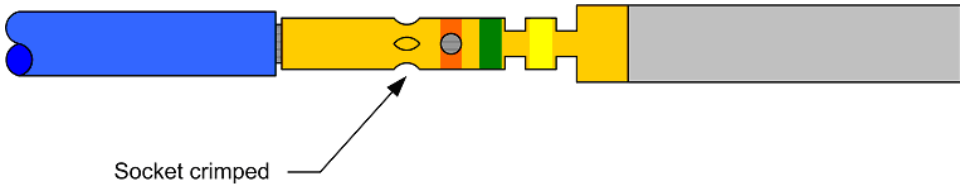


Contact crimping

1. Insert the wire into the contact until the wire is visible in the inspection hole.

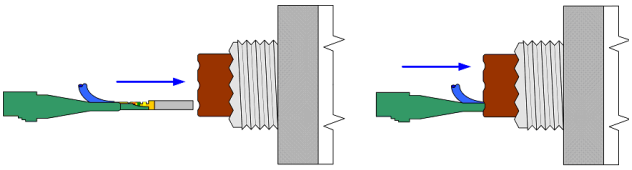


2. Insert the wire into the crimp tool (Daniels AFM8) and turn the adjustment wheel to the appropriate setting for the wire size.
3. Crimp the contact to the wire by squeezing the crimp tool handles firmly to ensure a proper crimp (the tool does not release if crimping is incomplete).



Contact insertion

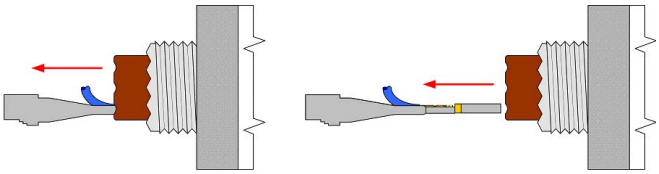
1. Using the green (insertion) side of the tool provided with the connector put the tip over the wire as shown. The tool tip butts against the crimp pot. The connector must be firmly supported during insertion operations.



2. Using a firm, steady pressure, push the contact into the cavity until the contact locks into place.
3. Repeat steps 1 and 2 for the other wires to be populated.

Contact extraction

1. Ensuring the wire is in the groove of the white (removal) side of the tool provided with the connector, insert the extraction tip into the contact cavity.



2. Pinch the wire between your finger and the white plastic grip and slide the tool and contact out of the connector.
3. Repeat steps 1 and 2 for the other wires to be removed.

Ordering information

PART NUMBER	DESCRIPTION
CON/PSU/007	Mating connector for PSU (6-way)

The corresponding backshell, BAC/PSU/007, must be ordered separately.

Revision history

REVISION	DIFFERENCES	STATUS
CON/PSU/007	First release	Recommended for new programs

Related products

MODULE	DETAILS
BAC/PSU/007	Backshell for CON/PSU/007

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook

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CON/PSU/007/CS1

Mating connector with backshell

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Key Features

- Includes connector shell, crimp/solder sockets and backshell
- Lightweight, space saving design
- Contact protection - 100% scoop-proof LJT (Long Junior Tri-Lock) design prevents bent pins and short circuits during mating
- Quick positive coupling - 3-point bayonet lock system

Applications

- Connecting power to KAM/PSU bayonet style modules
- Standard power connector for all Acra products that use the 6-way bayonet receptacle

Overview

The CON/PSU/007/CS1 is a 6-way bayonet connector (CON/PSU/007) and backshell (BAC/PSU/007) as used on the KAM-500 power cable (CON/PSU/007/FL/100), but without the pre-fitted wires and orange sleeving.

The CON/PSU/007/CS1 is a 6-way nickel-plated bayonet connector that mates with the power inlet on most Acra products using the appropriate receptacle.

The 3-point bayonet lock system allows the CON/PSU/007/CS1 to stay mated even when under high vibration.

The 100% scoop-proof LJT design prevents bent pins and short circuits during mating.

The connector is supplied with seven (one spare) crimp contact sockets, a standard backshell without strain relief, a mating face dust cup, and a plastic contact insertion/removal tool.

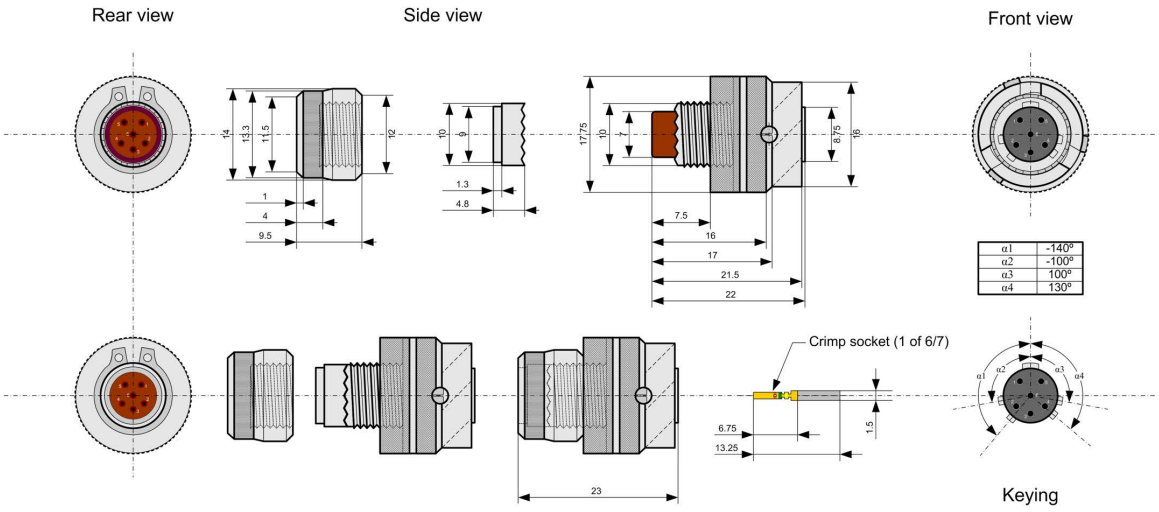


TABLE - A

AMPHENOL PART NUMBER DESIGNATOR	MIL PART NUMBER DESIGNATOR	CONNECTOR SHELL SIZE SIZE	A DIA.(MAX)		B DIA.(MAX)		C (MAX)		D (MAX)		E (MAX)		F (MAX)	
SHELL SIZE	DASH NO		INCH	MM	INCH	MM	INCH	MM	INCH	MM	INCH	MM	INCH	MM
08	08	8	0.62	15.67	0.89	22.48	0.63	16.00	0.73	18.54	1.32	33.53	0.77	19.61

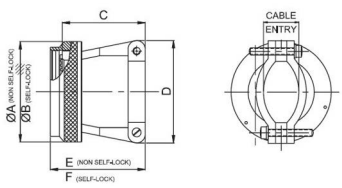


Figure 1: CON/PSU/007/CS1 mechanical drawing

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					Design metric is grams.
connector without backshell	–	6	–	g	
connector without backshell	–	0.21	–	oz	
connector with backshell	–	8	–	g	
connector with backshell	–	0.28	–	oz	
Dimensions					Design metric is millimeters.
connector diameter	–	17.75	–	mm	
connector diameter	–	0.69	–	in.	
connector length	–	23	–	mm	With supplied backshell populated.
connector length	–	0.91	–	in.	With supplied backshell populated.
contact socket diameter	–	1.5	–	mm	
contact socket diameter	–	0.06	–	in.	
contact socket length	–	13.25	–	mm	Length of threaded insert.
contact socket length	–	0.52	–	in.	
Chassis clearance					Design metric is millimeters.
connector height	–	23	–	mm	With supplied backshell populated.
connector height	–	0.91	–	in.	With supplied backshell populated.
bend radius height	–	20	–	mm	5mm bundle, AWG 26, 20mm bend radius.
bend radius height	–	0.8	–	in.	0.2in bundle, AWG 26, 0.8in bend radius.
Finish					
connector shell	–	–	–	–	Electroless nickel-plated aluminum.
insert	–	–	–	–	Rigid dielectric.
seals	–	–	–	–	Fluorinated silicone rubber, brown.
contact socket	–	–	–	–	Copper alloy with 1.2µm gold plating.

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Getting the most from the CON/PSU/007/CS1

When using the connector shell, ensure that you use the supplied backshell. The CON/PSU/007/CS1 is supplied with six loose socket contacts which can be crimped or soldered. The insertion and removal tool is included.

To prevent mechanical stress to wires and pins, always use a BAC/PSU/007 backshell with CON/PSU/007/CS1 connectors.

Connector assembly

The crimping tool Daniels AFM8 is recommended to use for crimping the contact sockets onto the wires. Substitutions of crimping equipment may result in connector failure at the assembly operation.

The proper insertion tool (supplied with the connector) must be used to assure seating of the contact in the insulator in the proper position. This tool has been designed for use with this product. Do not use ACC/TOL/027 or ACC/TOL/028 tools (that are included in ACC/KIT/005) for inserting the crimped sockets into the CON/PSU/007/CS1 connector. These tools have been designed for the micro-miniature, circular connectors and are not compatible with the CON/PSU/007/CS1.

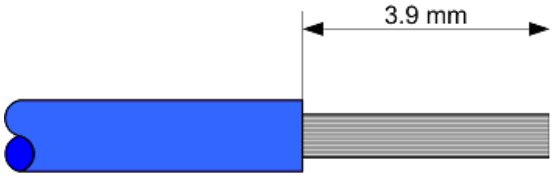
Any substitution of proper insertion tools may result in over or under insertion of the contact, which damages the retention system of the insulator.

The CON/PSU/007/CS1 mating connector has been designed with a controlled float to allow for ease of mating. To avoid reducing this float or causing a splaying of the contacts, any unnecessary strain by clamping too close to the rear of the connector should be avoided.

Use of recommended tools and proper assembly techniques pays dividends in reliability and reduced costs.

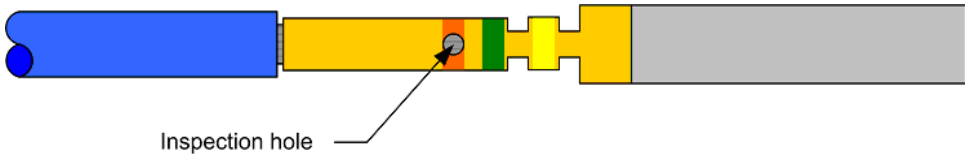
Wire stripping

Cut the wires to the length required and strip 0.153in. (3.9mm) of insulation from the end to be crimped. Check for cut or broken wires and frayed insulation.

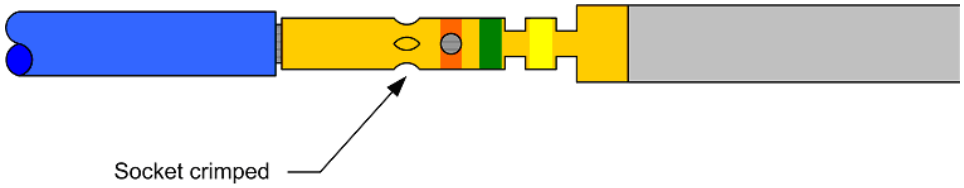


Contact crimping

1. Insert the wire into the contact until the wire is visible in the inspection hole.

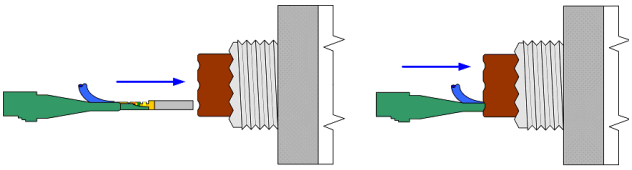


2. Insert the wire into the crimp tool (Daniels AFM8) and turn the adjustment wheel to the appropriate setting for the wire size.
3. Crimp the contact to the wire by squeezing the crimp tool handles firmly to ensure a proper crimp (the tool does not release if crimping is incomplete).



Contact insertion

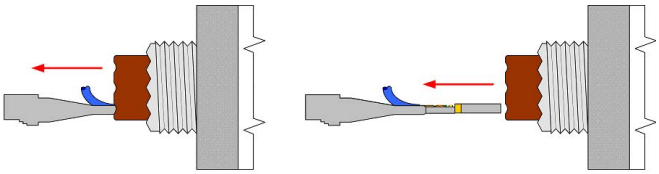
1. Using the green (insertion) side of the tool provided with the connector put the tip over the wire as shown. The tool tip butts against the crimp pot. The connector must be firmly supported during insertion operations.



2. Using a firm, steady pressure, push the contact into the cavity until the contact locks into place.
3. Repeat steps 1 and 2 for the other wires to be populated.

Contact extraction

1. Ensuring the wire is in the groove of the white (removal) side of the tool provided with the connector, insert the extraction tip into the contact cavity.



2. Pinch the wire between your finger and the white plastic grip and slide the tool and contact out of the connector.
3. Repeat steps 1 and 2 for the other wires to be removed.

Ordering information

PART NUMBER	DESCRIPTION
CON/PSU/007/CS1	Mating connector with backshell

Revision history

REVISION	DIFFERENCES	STATUS
CON/PSU/007/CS1	First release	Recommended for new programs

Related products

MODULE	DETAILS
BAC/PSU/007	Backshell for CON/PSU/007
CON/PSU/007	Mating connector for PSU (6-way)

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
Cables	Standard cables used for Acra KAM-500 and Axon system assembly

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CON/SAV/001

6-way bayonet-style connector saver

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Key Features

- MIL-DTL-38999 Series 2 specification
- Positive locking mechanism- 3-point bayonet lock system keyed to match bayonet power connector
- One-piece, non-removable pin/socket contacts for maximum reliability and minimum effect on circuit resistance

Applications

- Standard power connector for all products that use the 6-way bayonet receptacle

Overview

Connectors have a limited amount of mate/de-mate cycles before they begin to deteriorate. Connector savers are attached to a connector to reduce the repeated mating and de-mating cycles experienced.

The CON/SAV/001 is a 6-way power connector saver and preserves the integrity and performance on data acquisition, switching and recording products during the manufacturing, testing and check-out phases.

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					Design metric is grams.
connector saver	–	10	–	g	
connector saver	–	0.35	–	oz	
Dimensions					Design metric is millimeters.
connector saver height	–	30.5	–	mm	
connector saver height	–	1.2	–	in.	
connector saver height	–	33.3	–	mm	When connector saver is mated from ACRA KAM-500 chassis metalwork.
connector saver height	–	1.31	–	in.	When connector saver is mated from ACRA KAM-500 chassis metalwork.
connector diameter	–	19.1	–	mm	
connector diameter	–	0.75	–	in.	
Finish					
connector shell	–	–	–	–	Aluminum alloy 6061-T6 per ASTM-B 211, 221.
front and rear insulators	–	–	–	–	Glass-filled liquid crystal polymer in accordance with MIL-M-24519, Type GLP-30F.
contact retention clip	–	–	–	–	Beryllium copper, heat-treated, unplated.
grommet, peripheral seal and interfacial seal	–	–	–	–	Blended elastomer, 30% silicone per ZZ-R-765, 70% fluorosilicone per MIL-R-25988.
pin/socket contacts (environmental)	–	–	–	–	Copper alloy/gold plate.
socket contact hoods	–	–	–	–	Corrosion resistant steel IAW AISI303 passivate QQ-P-35.
wave spring (bayonet versions)	–	–	–	–	Stainless steel 17-7PH, condition C passivate QQ-P-35.
EMI ground springs	–	–	–	–	Beryllium copper, gold plate MIL-G-45204.
adhesives	–	–	–	–	Silicone and epoxy.
potting compound, PCB and solder cup versions	–	–	–	–	Hysol EE4215. Filter connectors: Stycast 2850FT/Catalyst 11 thermally conductive epoxy encapsulant.

Getting the most from the CON/SAV/001

We recommend using the CON/SAV/001 for up to 250 mate/de-mate cycles.

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Ordering information

PART NUMBER	DESCRIPTION
CON/SAV/001	6-way bayonet-style connector saver

Revision history

REVISION	DIFFERENCES	STATUS
CON/SAV/001	First release	Recommended for new programs

Related products

PRODUCT	DETAILS
CON/065/M	6-way bayonet connector
CON/PSU/007/FL100	6-Way Bayonet PSU Cable

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook

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CON/SAV/002

52-way D-SUB module connector saver



Key Features

- Aluminum metal casing with two captive 4-40 slot hex screws

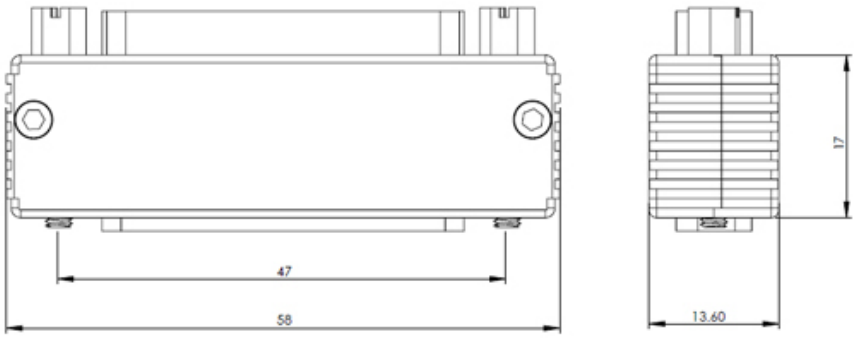
Applications

- To be used as connector saver for Acra KAM-500 KAD/xxx/xxx modules

Overview

Connectors have a limited amount of mate/de-mate cycles before they begin to deteriorate. Connector savers are attached to a connector to reduce the repeated mating/de-mating cycles experienced.

The CON/SAV/002 is a 52-way Double-Density (DD) connector saver for use with all Acra KAM-500 KAD modules (except the KAD/TDC/002). It preserves the integrity and performance on data acquisition, switching and recording products during the manufacturing, testing and check-out phases.



CON/SAV/002 mechanical drawing (measurements in millimeters)

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					Design metric is grams.
connector saver and jackposts	–	36	–	g	
connector saver and jackposts	–	1.27	–	oz	
Dimensions					Design metric is millimeters.
connector saver height	–	23	–	mm	
connector saver height	–	0.9	–	in.	
connector saver length	–	58	–	mm	
connector saver length	–	2.28	–	in.	
connector width	–	13.6	–	mm	
connector width	–	0.53	–	in.	
jackscrew length	–	4	–	mm	Length of threaded insert.
jackscrew length	–	0.157	–	in.	Length of threaded insert.
Chassis clearance					
connector height from metalwork	–	22	–	–	
connector height from metalwork	–	0.9	–	–	
Finish					
connector saver housing	–	–	–	–	Electroless nickel plated aluminum 6082-T6.
jackposts	–	–	–	–	A2 stainless steel.
jackscrew	–	–	–	–	A2 stainless steel.
integral isolator housing					Nylon.
pins					Copper alloy with 1.2µm gold plating.
connector shell	–	–	–	–	Stainless steel.

Getting the most from the CON/SAV/002

Torque jackposts to 0.9 Nm. However, when attaching bolts from backshells or connectors to the CON/SAV/002 jackposts, do not apply torque; instead tighten bolts such that they are seated only.

When mating and un-mating DD connector savers, jackscrews should be screwed/unscrewed by half a turn alternately on each side until the connectors are fully mated/un-mated. Failure to mate/de-mate the connectors in this manner may result in deformation of the module top connector, which can reduce the reliability of the electrical contact of the connector/module with the contact face. We recommend using the CON/SAV/002 for up to 250 mate/de-mate cycles.

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Ordering information

PART NUMBER	DESCRIPTION
CON/SAV/002	52-way D-SUB module connector saver

Revision history

REVISION	DIFFERENCES	STATUS
CON/SAV/002	First release	Recommended for new programs

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook

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CON/SAV/003

3-way bayonet-style connector saver



Key Features

- MIL-DTL-38999 Series 2 specification
- Positive locking mechanism- 3-point bayonet lock system keyed to match bayonet power connector
- One-piece, non-removable pin/socket contacts for maximum reliability and minimum effect on circuit resistance

Applications

- Standard power connector for all products that use the 3-way bayonet receptacle

Overview

Connectors have a limited amount of mate/de-mate cycles before they begin to deteriorate. Connector savers are attached to a connector to reduce the repeated mating and de-mating cycles experienced.

The CON/SAV/003 is a 3-way power connector saver and preserves the integrity and performance on data acquisition, switching and recording products during the manufacturing, testing and check-out phases.

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Mass					Design metric is grams.
connector saver	–	10	–	g	
connector saver	–	0.35	–	oz	
Dimensions					Design metric is millimeters.
connector saver height	–	30.5	–	mm	
connector saver height	–	1.2	–	in.	
connector saver height	–	33.3	–	mm	When connector saver is mated from ACRA KAM-500 chassis metalwork.
connector saver height	–	1.31	–	in.	When connector saver is mated from ACRA KAM-500 chassis metalwork.
connector diameter	–	19.1	–	mm	
connector diameter	–	0.75	–	in.	
Finish					
connector shell	–	–	–	–	Aluminum alloy 6061-T6 per ASTM-B 211, 221.
front and rear insulators	–	–	–	–	Glass-filled liquid crystal polymer in accordance with MIL-M-24519, Type GLP-30F.
contact retention clip	–	–	–	–	Beryllium copper, heat-treated, unplated.
grommet, peripheral seal and interfacial seal	–	–	–	–	Blended elastomer, 30% silicone per ZZ-R-765, 70% fluorosilicone per MIL-R-25988.
pin/socket contacts (environmental)	–	–	–	–	Copper alloy/gold plate.
socket contact hoods	–	–	–	–	Corrosion resistant steel IAW AISI303 passivate QQ-P-35.
wave spring (bayonet versions)	–	–	–	–	Stainless steel 17-7PH, condition C passivate QQ-P-35.
EMI ground springs	–	–	–	–	Beryllium copper, gold plate MIL-G-45204.
adhesives	–	–	–	–	Silicone and epoxy.
potting compound, PCB and solder cup versions	–	–	–	–	Hysol EE4215. Filter connectors: Stycast 2850FT/Catalyst 11 thermally conductive epoxy encapsulant.

Getting the most from the CON/SAV/003

We recommend using the CON/SAV/003 for up to 250 mate/de-mate cycles.

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Ordering information

PART NUMBER	DESCRIPTION
CON/SAV/003	3-way bayonet-style connector saver

Revision history

REVISION	DIFFERENCES	STATUS
CON/SAV/003	First release	Recommended for new programs

Related products

PRODUCT	DETAILS
CON/261/F	3-way bayonet connector (female)
CON/261/M	3-way bayonet connector (male)

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook

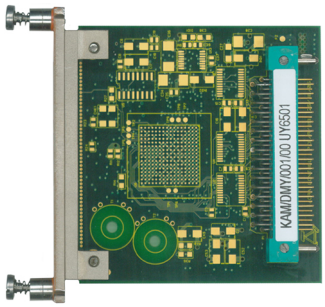
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KAM/DMY/001

Dummy module

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Key Features

- Dummy module for empty user-slot in chassis
- Includes blank top-block, lid and backplane connector

Applications

- Occupying empty user-slot in chassis where protection from moisture, salt fog, and sand ingress is required

Overview

The KAM/DMY/001 is a dummy module intended for occupying an empty user-slot in an Acra KAM-500 chassis.

Specifications

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	48	–	g	
	–	1.69	–	oz	Design metric is grams.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

Getting the most from the KAM/DMY/001

KAM/DMY/001 modules have undergone environmental testing to prove durability against moisture, salt fog, and sand ingress within an Acra KAM-500 chassis. For compliance with environmental testing, we recommend ordering a KAM/DMY/001 module for each unoccupied user-slot.

Ordering information

PART NUMBER	DESCRIPTION
KAM/DMY/001	Dummy module

Revision history

REVISION	DIFFERENCES	STATUS
KAM/DMY/001	First release	Recommended for new programs

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook

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JIG/UNI/001

Universal test jig for Acra KAM-500 modules

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Key Features

- External two-wire test signal bus connection by 3 × BNC or 4 × 4 mm banana connectors
- The 50 functional module pins each have a three-way switch to: isolated 2 mm banana connector; test signal bus and/or; test signal bus minus
- Switches negate the need for external jumper wires for connection to test signals or outputs
- Monitoring of test signal bus possible due to multiple access points
- PCB designed to minimize RF pickup

Applications

- Break-out box for insertion into existing wiring looms

Overview

The JIG/UNI/001 is a universal test jig for Acra KAM-500 modules. It is designed so that each of the 50 functional pins, plus ground are exposed. There is a three-way switch which can connect each of the 50 functional pins to an isolated 2 mm banana connection, the plus side of the test signal bus, or the minus side of the bus.

The test jig can be used as a break-out box for insertion into existing wiring looms.

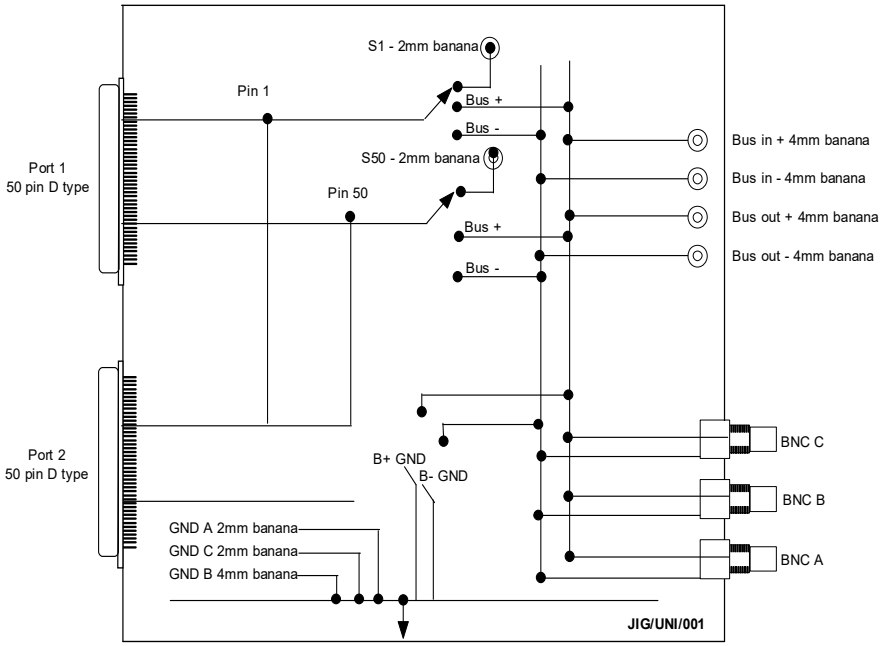


Figure 1: Ports 1 and 2 of the JIG/UNI/001

Specifications

Maximum current per pin:	100 mA
Switch life:	5000 operations

Getting the most from the JIG/UNI/001

The test signal bus can be used as an input or an output. If the negative side of the signal test bus is used as a ground, this may be connected to the JIG/UNI/001 ground via a switch on the JIG/UNI/001.

To ground all pins, switch the signal bus+ to ground, switch the signal bus- to ground, and switch each of the 50 pins to bus+ or bus-. We recommend taking care not to connect excitations to outputs when switching.

Ordering information

PART NUMBER	DESCRIPTION
JIG/UNI/001/D	Universal test jig for Acra KAM-500 modules

One ACC/CON/031 cable is supplied with the JIG/UNI/001. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the cables data sheet).

Revision history

REVISION	DIFFERENCES	STATUS
JIG/UNI/001/D	Three-way switches replaced with new switches as previous obsolete; no functional change from previous JIG/UNI/001/C	Recommended for new programs
JIG/UNI/001/C	First release	Not recommended for new programs

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook

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KIT/001

Standard tools used for Acra KAM-500 system assembly

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Key Features

- Tool kits for Acra KAM-500 chassis, modules and cable connectors

Applications

- Assembling Acra KAM-500 system

Overview

ACD/KIT/001 consists of:

- ACD/TOL/002 – 24 AWG special thin body insertion tool
- ACD/TOL/005 – Handle for use with ACD/TOL/002 and ACD/TOL/006
- ACD/TOL/006 – Extraction tool for use with ACD/TOL/005
- ACD/TOL/004 – K154 positioner

ACM/KIT/001 consists of:

- ACC/TOL/002 – 3 x 0.5mm slotted screwdriver
- ACC/TOL/004 – 2 mm Allen key
- ACC/TOL/005 – 2.5 mm T-bar Allen key
- ACC/TOL/038 – 4 x 0.8 mm slotted screwdriver



Figure 1: Standard tools used for Acra KAM-500 system assembly

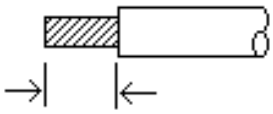
Getting the most from KIT/001 tools

Follow these instructions to assemble the CON/KAD connector variations.

- The proper crimp tool (Daniels AFM8) and positioner must be used. The KIT/001 tools have been designed for use with this product. Substitutions of crimping equipment may result in connector failure at the assembly operation.
- After crimping a contact to a lead it is vital that the proper tool be used to assure seating the contact in the insulator in the proper position. Any substitution of insertion tools may result in over or under insertion of the contact which will damage the retention system of the insulator.
- The female (socket) side of the connector has been designed with a controlled float to allow for ease of mating. To avoid reducing this float or causing a splaying of the contacts, any unnecessary strain by clamping too close to the rear of the connector should be avoided.
- Connectors should be supported in a vice (or otherwise firmly supported) during both insertion and extraction of contacts. Failure to do say may result in insertion/extraction tips being broken.

Use of recommended tools and proper assembly techniques will pay dividends in reliability and reduced costs.

Wire stripping



Cut the wires to the length required and strip 0.16 inch (4 mm) of insulation from the end to be crimped. Check for cut or broken strands and frayed insulation.

Contact crimping

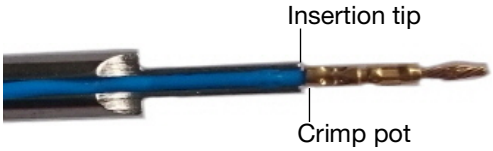
1. Attach the ACD/TOL/004 positioner to the crimp tool (Daniels AFM8) and turn the adjustment wheel to the appropriate setting for the wire size as indicated on the label of the positioner.
2. Insert the stripped end of the wire into the contact.



3. Insert the wire into the crimp tool, and crimp the contact to the wire by squeezing the handles firmly to insure a proper crimp (tool will not release if crimping is incomplete).

Contact insertion

1. Place the insertion tip (ACD/TOL/002) in the insertion/extraction handle (ACD/TOL/005).
2. Place the wire along the grove in the insertion tip so that the tip butts up against the crimp pot as shown below.



3. Place the connector in a vice and using a firm, steady pressure, while keeping the tool perpendicular, push the contact into the cavity until the contact locks into place. The shoulder of the tool tip bottoms against the rear of the insulator, preventing over-insertion.



4. Repeat these steps for other wires to be populated.

Contact extraction

When removing contacts, place the connector in the vice so that you are pushing the contacts from the opposite side they were inserted.

1. Place the extraction tip (ACD/TOL/006) in the insertion/extraction handle (ACD/TOL/005).
2. Insert the extraction tip into the socket until you feel the contact butt up against the shoulder of the pin contact.



3. While keeping the tool perpendicular, apply a firm steady pressure to push the contact and remove it from the connector.
4. Repeat these steps for other contacts to be removed.

WARNING: It is recommended that pins are only inserted once into each pin location of the connector. A reinsertion of any pin into a location where a pin has been removed may result in a loose pin.

Ordering information

PART NUMBER	DESCRIPTION
ACD/KIT/001	Tool kit for double-density connectors
ACM/KIT/001	Tool kit for Acra KAM-500 chassis heatsinks, module retention, cable connectors and backshells

By default an ACC/TOL/030 tool, which aids insertion/removal of modules, is included with each shipment. Additional items must be ordered separately; refer to Related products for options.

Revision history

REVISION	DIFFERENCES	STATUS
ACD/KIT/001	First release	Recommended for new programs
ACM/KIT/001	First release	Recommended for new programs

Related products

MODULE	DETAILS
AFM8 M22520/2-01	For Daniels crimp tool (M22520/2-01), see www.dmctools.com

Related documentation

DOCUMENT	DETAILS
DOC/HBK/002	Environmental Qualification Handbook
DOC/DBK/001	Acra KAM-500 Databook
Handling precautions	Handling procedures for installing hardware modules (see the *Acra KAM-500 Databook*)

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LID/001

Spare user-slot lids and spare screws for the Acra KAM-500 system

CURTISSWRIGHTDS.com



Key Features

- Spare screws for housing
- Spare lid for unused slots
- Screws are standard size (M3 × 6mm)

Applications

- Spare chassis parts
- Occupy empty user slots where protection from moisture, salt fog, and sand ingress is not a requirement

Overview

ACM/LID/001

ACC/LID/001 is a lid for empty user-slots. This lid (labelled SPARE) is recommended for unoccupied user-slots and is the same shape and color as the lids of user-modules. For compliance with salt fog, sand and moisture testing, we recommend ordering a KAM/DMY/001 module for each unoccupied user-slot. KAM/DMY/001 modules have undergone environmental testing to prove durability against moisture, salt fog, and sand ingress within an Acra KAM-500 chassis.

Lids are supplied in quantities of ten. ACM/LID/001 comprises a pack of ten ACC/LID/001s.

(ACC/LID/001 is an internal Curtiss-Wright part number.)

ACC/SCW/001

The ACC/SCW/001 is a pack of M3 × 6mm cap head screws. These spares are offered as a part number for completeness only. Screws are supplied in quantities of 500.



Figure 1: Single ACC/LID/001 from pack of ten ACM/LID/001

Specifications

TABLE 1	Mechanical specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Dimensions					
height	–	3	–	mm	
height	–	0.11	–	in.	Design metric is millimeters.
length	–	13.8	–	mm	
length	–	0.54	–	in.	
width	–	80	–	mm	
width	–	3.14	–	in.	
Mass					
	–	14	–	g	
	–	0.49	–	oz	Design metric is grams.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	125	°C	
Finish	–	–	–	–	Electroless nickel plated with top surface painted REINORANGE RAL2004.

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Ordering information

PART NUMBER	DESCRIPTION
ACM/LID/001	Spare user-slot lids for the Acra KAM-500 system
ACC/SCW/001	M3 × 6mm cap head screw pack

Additional items must be ordered separately; refer to Related Products for options.

Revision history

REVISION	DIFFERENCES	STATUS
ACM/LID/001	First release	Recommended for new programs

Related products

PRODUCT	DETAILS
KAM/DMY/001	Dummy module

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook

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To get the most out of Acra KAM-500 data sheets (and the Acra KAM-500 system) it is important to understand some of the key concepts and goals behind the Acra KAM-500 system. This section introduces the Acra KAM-500 and in particular some of the nomenclature and design goals associated with the Acra KAM-500 system.

Chassis components

The Acra KAM-500 is a modular data acquisition system designed for harsh aerospace applications where space is at a premium. The system is completely software programmable and contains no switches, potentiometers, bridges, relays or socketed ICs (such as programming EEPROM).

A wide range of user-modules is available for analog input/output, avionics bus monitoring, time tagging, non-volatile (EEPROM) storage and (PCM) transmission. Any user-module can go into any user-slot (up to 13) in any combination (there is 2.0A of current available for bridge excitation).

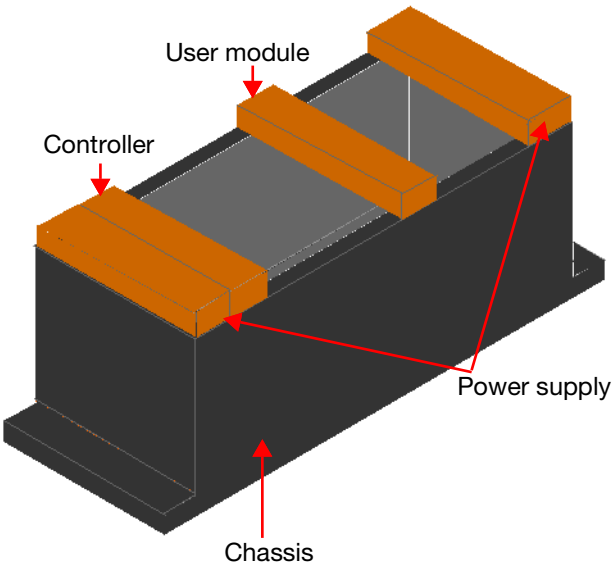


Figure 1: Isometric view of a single chassis

The chassis is black aluminum (the top is painted orange).

The isolated power supply comprises two sets of components, one at each end of the chassis, and is used to convert a nominal 28V to that used by the modules.

Each chassis has a backplane and controller. The controller synchronizes module operation and transfers data from one module to another. The controller also contains the programming interface and is polarized to prevent it being plugged into a user-slot. The controller/encoder also contains a complete IRIG-106 PCM generator. Additional/auxiliary encoders can be added in any user-slot.

For distributed systems a merger module is inserted in any user-slot for every additional pair of Acra KAM-500s. A single chassis can merge data from up to 26 PCM streams. Up to 64 chassis can be programmed via two twisted pairs, see “Distributed data acquisition” on page 1199.

A high level of parts commonality between modules and use of monolithic devices underpins the reliability of the Acra KAM-500. The Acra KAM-500 uses no microprocessors, which means there is no micro code for flight approval, and no power-up sequences or watch-dog circuitry. Hard-wired state machines and EEPROM-based setup ensure that when it works once, it works always.

Another feature of the Acra KAM-500 is that a parameter (for example, strain from channel 4 of the KAD/ADC/109 bridge module) can be sent to multiple modules. For example, a chassis can have multiple PCM streams of different codes, bit-rates, word lengths, words per minor frame and minor frames per major frame with some parameters going to all streams and some parameters going to one stream.

Dimensional tolerance

In mechanical drawings of chassis (and other Curtiss-Wright hardware), dimensional tolerance, unless otherwise stated is ±0.1mm (for dimensions marked --,00). The tolerance for angular dimensions is ±0.3 degrees unless otherwise stated.

Backplane operation

The backplane has a 16-bit bidirectional address/data bus and control lines which read parameters, write, latch the address and select the module (including broadcast). Backplane transfer is synchronized using an 8MHz system clock from which all module timing is derived.

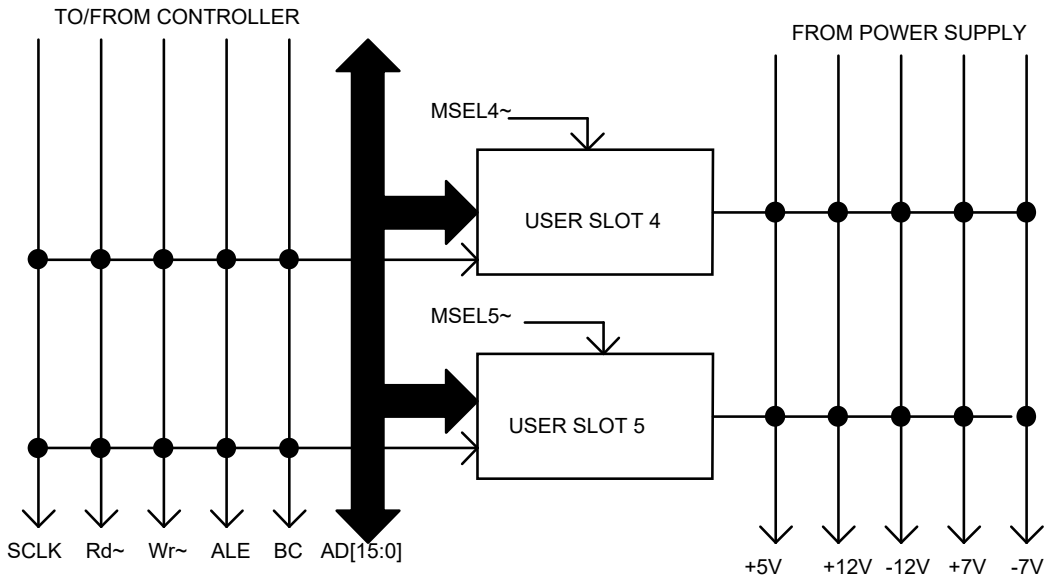


Figure 2: Backplane operation

All modules appear to the backplane as registers to be read or written. For example the KAD/ADC/109, which has 8 analog inputs has eight read registers.

Apart from data read and write registers, other registers are transparent to the user for module test, identification and synchronization. The following diagram shows an example of this type of data flow.

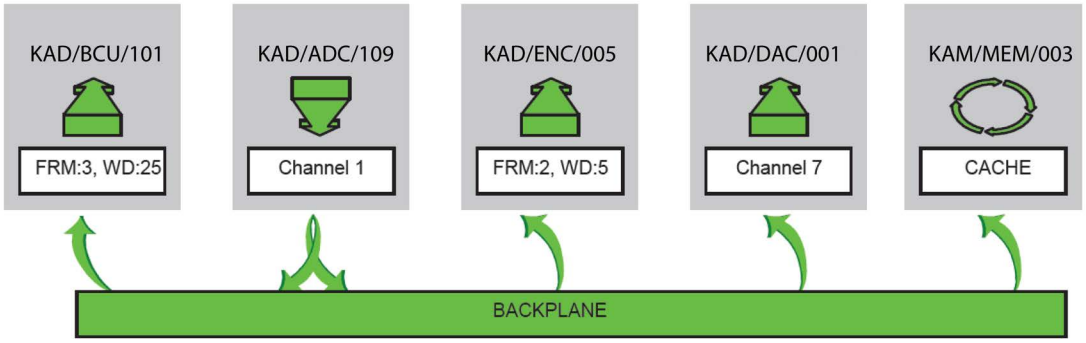


Figure 3: Data path from an KAD/ADC/109 to 4 modules

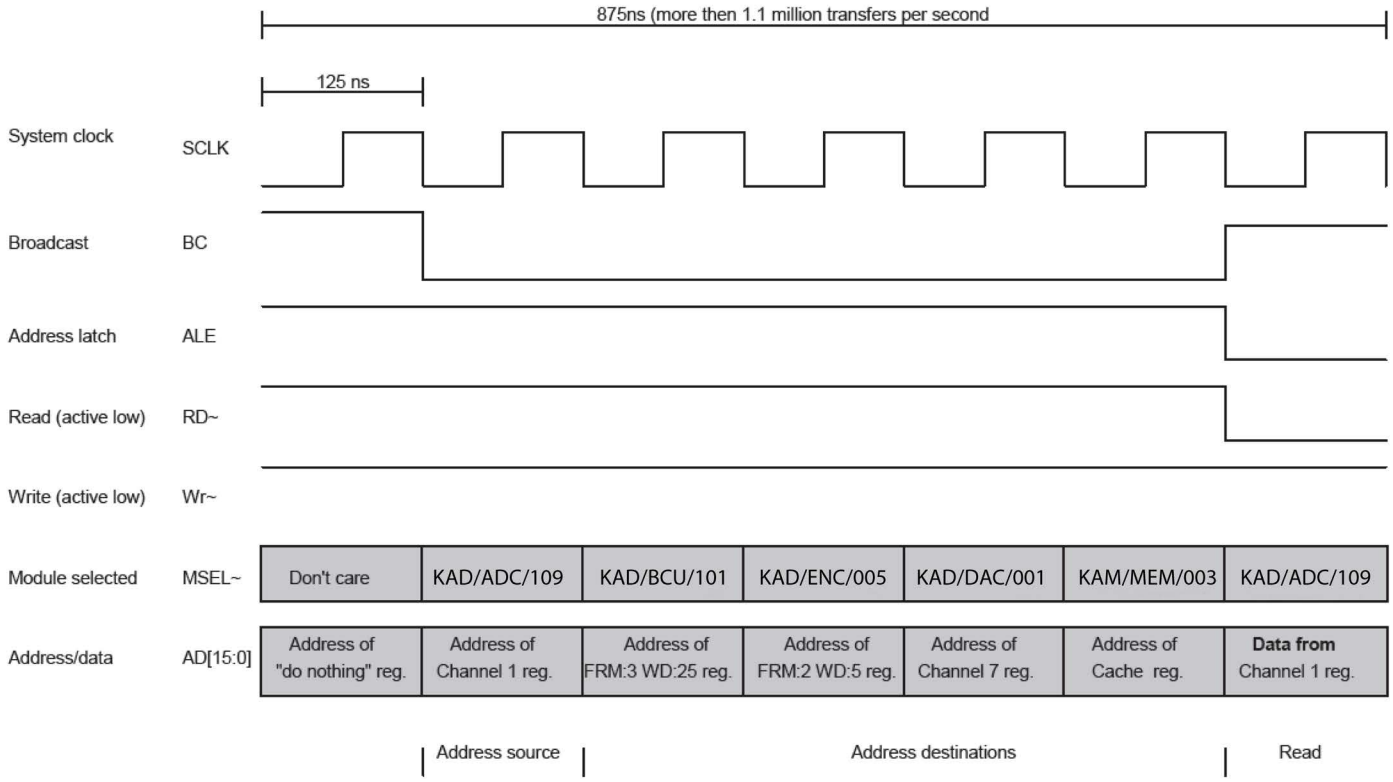


Figure 4: Timing diagram for parameter transfer

The diagram above shows an example of the timing associated with this type of data flow. In this example 875ns is required to transfer the parameter. Typical data transfer takes 4 clock cycles (500ns). The theoretical maximum is 16 clock cycles (2µs); for this reason each Acra KAM-500 in a system has an aggregate sampling rate specification of 500,000 samples per second (sps). The 100 series family of modules has sampling rates up to 2Msps.

Distributed data acquisition

To extend a distributed system, up to two additional Acra KAM-500s can be added at any time by inserting a KAD/DEC/103 merger module in any user-slot of any chassis. Any Acra KAM-500 system can be placed anywhere as illustrated in the following diagram.

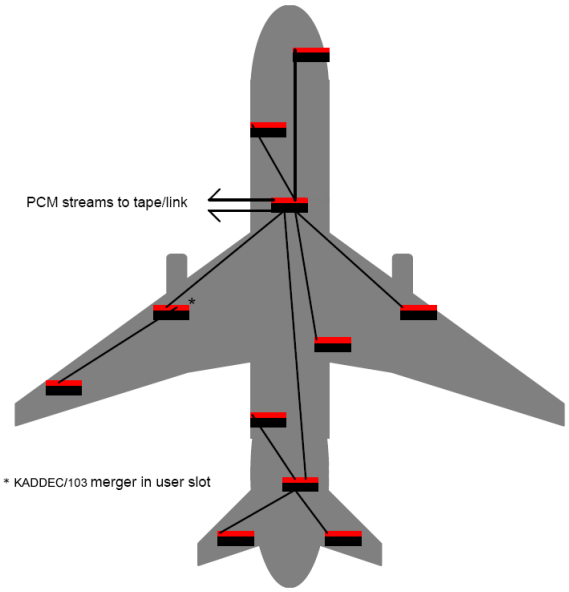


Figure 5: A distributed system

A PCM stream from the KAD/BCU/101 controller/encoder (or from an auxiliary encoder KAD/ENC/005 in any user-slot) in the source chassis (by convention called a SLAVE) is connected to the merger module in the destination chassis (by convention called a master). This data transfer requires two twisted pairs (for clock and data) and ground.

Up to 64 units can be programmed via a single multi-drop programming link. Each controller has six discrete digital inputs to set the programming address. This programming link requires an additional twisted pair (for clock and data) to be connected during programming.

It is recommended that all chassis operate synchronously. Therefore two more twisted pairs have to be added. One is a 1MHz clock connected to a digital PLL on each controller to generate the 8MHz system clock. The other is for acquisition cycle alignment (analogous to a major frame pulse). These signals are best taken from a single chassis controller. Any chassis can be made the master by setting the address select lines to zero.

If a chassis is used for time-tagging events, it runs synchronously with others about the distributed system but does not have the same absolute time unless seeded (for example using an IRIG time source).

For a more detailed discussion of how to connect a distributed system, see “Equipment interface” on page 1211.

NOTE: We do not support the use of a master/slave daisy-chain configuration.

Acquisition cycles and synchronous sampling

The controller cycles through a format stored in EEPROM. Any register, channel or parameter that must be read or written is accessed at least once during this acquisition cycle. For this reason any glitches are recovered within one of these acquisition cycles.

An acquisition cycle is the shortest possible time to do everything at least once. (It is analogous to a PCM major frame.) For example, if the slowest signals are sampled every 10ms and 11ms respectively, the acquisition cycle is 110ms (the lowest common multiple). If an Acra KAM-500 is generating two PCM frames with major frame lengths of 10ms and 11ms respectively, the acquisition cycle is 110ms.

In the past, data acquisition systems tended to multiplex multiple signals to a single A/D according to commutation sequences determined by the transmission protocol(s). This meant that to time correlate data, analysis engineers had to understand the data packet(s) used and add a different time offset for each signal. Also, multiplexing signals or holding them with sample and hold devices becomes more difficult with today’s 12, 14 and 16-bit systems.

NOTE: In the Acra KAM-500, at the start of every acquisition cycle a command is broadcast causing all signals to be sampled and the time latched in the timer module. After that samples are evenly spaced.

In Figure 6 on page 1201 a major frame consisting of two minor frames is drawn. By convention the minor frames are usually drawn underneath each other as shown. The diagram also shows the two minor frames with respect to time (one after the other) and underneath them the instances that each signal is sampled. If there is only a single PCM stream the acquisition cycle is the same length (of time) as the major frame.

All signals are sampled at the start of the acquisition cycle (major frame) and all signals with the same sample rate are always sampled at the same time.

In Figure 6 on page 1201, two channels are super-commutated at different rates. One is four times per acquisition cycle and the other six times.

With the Acra KAM-500 the sampling points are not a function of the data transmission/logging packet(s) but rather are a function of the sampling rates only. To time correlate all data, include the acquisition cycle start time (Ts) in the parameter list and make a note of the acquisition cycle time (Ta).

In the Acra KAM-500 this strategy holds even if the signals are in different chassis at opposite ends of the aircraft.

Format switching and test-and-type registers

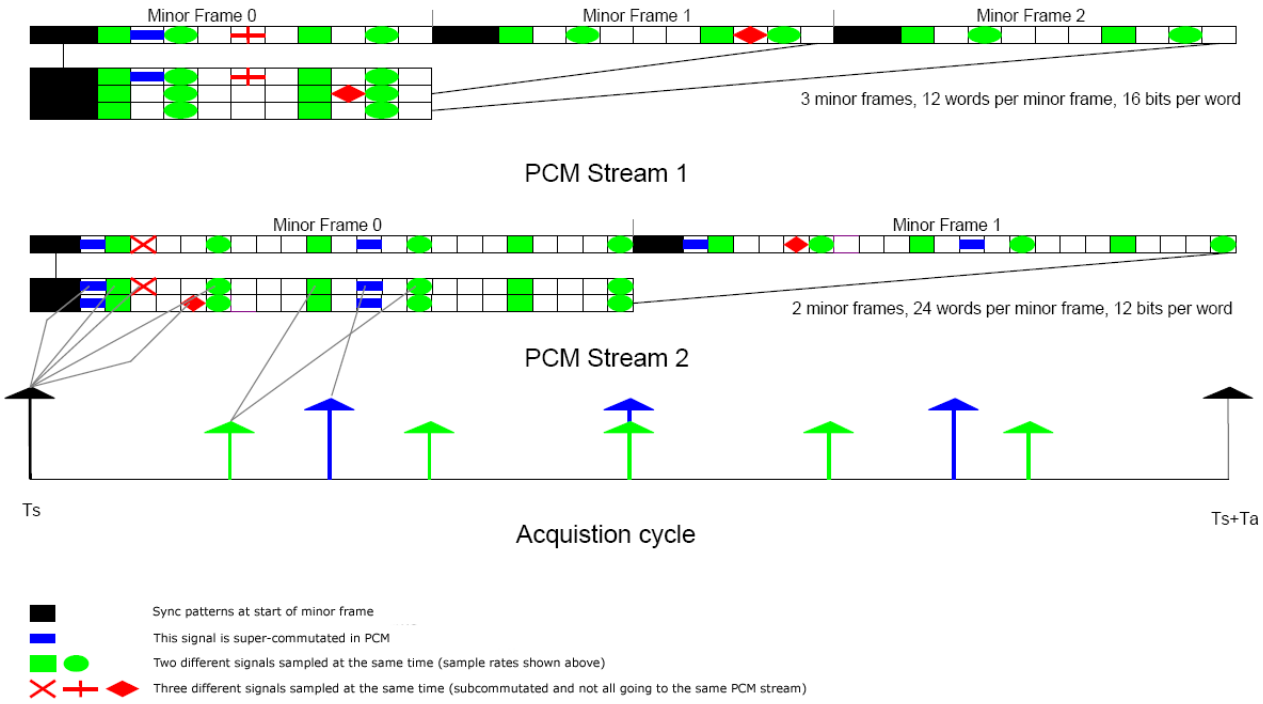


Figure 6: The relationship between acquisition cycle and major frame for a single stream

Format switching

Up to 15 formats can be stored in a controller, each corresponding to one acquisition cycle. Four digital lines are available to the user to select between formats. Examples:

- One format that samples gages on the undercarriage can be used while a plane is taking off and another format that does not sample these gages can be switched in when the undercarriage is retracted.
- Reserve a format containing only fixed data for troubleshooting data links, decommutation hardware and analysis software.

The Acra KAM-500 switches to a new format only at the end of an acquisition cycle. If PCM streams are being generated each can contain a format identifier so that lock is maintained even if word lengths, meanings, and commutations change.

Test and type registers

All modules have test registers so that programming utilities can check the backplane, RAM and EEPROM address/data lines. Each module has EEPROM for storing setup information, 128Kbytes of which are reserved for housekeeping information. Module type information is stored here, which allows a programming utility to identify the module in each slot.



Acra KAM-500 modules contain devices that require standard ESD precautions to be observed when handling components that are usually inside the chassis. Furthermore, in electrostatic environments it is strongly recommended that grounds be connected before connecting signals, especially high speed digital busses, such as RS-422, which are difficult to protect.

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Environmental specifications

Overview

The following table summarizes the main environmental specifications for the Acra KAM-500.

TABLE 1	General environmental specifications			
PARAMETER	MIN.	TYP.	MAX.	UNITS
Storage life and maintenance	–	–	5	Years
Temperature				
operational (case)	-40	–	85	°C
storage (case)	-55	–	105	°C
Altitude	–	75000	–	ft.
	–	22860	–	m
Shock				
100g for 11ms	In each of the three major axes. terminal peak sawtooth, 12 shocks.			
250g for 6ms	In each of the three major axes, half sine, 12 shocks.			
Water ingress (drip test) (45 min.)	–	280	–	l/m^2/hr.
Vibration	Sinusoidal: 10g peak			
	Endurance: Random, 0.83g^2/Hz peak, 10min/axis.			
	Functional: Random, 0.20g^2/Hz peak, 60min/axis.			
Acceleration	16.5g for 1 minute in each direction of three mutually perpendicular axes.			
EMI/EMC	As per MIL-STD-461E & BS3G100.			
Humidity	0	–	95	%
Contamination testing	70°C for 93 hours, Propan-2-OI, Ethylene Glycol (50% v/v in water), AVTUR F-34, Aeroshell Turbine Oil 308, Aeroshell Fluid 31, Aeroshell F31.			

For full details of the specifications and the design considerations taken by Curtiss-Wright, see the remainder of this chapter.

Where possible, devices are selected for designs that have already been tested on other modules. In particular the same connectors, backplane logic, EEPROMS, RAMS, gate arrays, and capacitors can be found on all acquisition modules.

The specifications in this chapter apply to all Acra KAM-500 modules except where stated in the data sheet. Some modules have been qualified by type. Unless otherwise stated, all specifications apply to a fully operating system.

Storage life and maintenance

The Acra KAM-500 is designed to be kept in storage for up to five years before installation. Special conditions such as altitude, temperature, humidity, pressure (including air transportation), and ventilation beyond those specified under operating conditions do not apply during storage.

Calibration interval for analog modules

Based on typical use, Acra KAM-500 analog-to-digital (A/D) converter modules are expected to remain in calibration for a period of 24 months from the date of delivery. It is recommended that analog modules are checked for accuracy at the end of the initial 24-month period, and at 12-month intervals thereafter.

It is the end user's responsibility to perform the verification of the calibration of the entire system in order to ensure correct results are obtained.

Most of the newer 100-series analog modules (such as the KAD/ADC/106) can be factory calibrated for gain/offset error using

special test jigs and software. This service is available from Curtiss-Wright for a standard RMA/calibration charge.

Some non-100-series analog modules can also be factory-calibrated for offset error, namely the KAD/ADC/005, KAD/ADC/009, KAD/ADC/013, and KAD/TDC/002 modules.

However, most older analog modules including the KAD/ADC/001, KAD/ADC/002, KAD/ADC/003, KAD/ADC/006, KAD/ADC/010, KAD/ADC/011, KAD/ADC/012, and KAD/ADC/014 do not support factory-calibration. If these modules are outside their intended accuracy due to age, factory-repair may be possible, or gain/offset error can be adjusted for either by changing the gain/offset settings using KSM-500 software or in post-processing. Note that repairs are handled as RMAs in the normal way.

Format switching and analog modules

If format switching is used, the user range and/or the linearization table must stay the same as for format 0. This is required to meet accuracy figures quoted in the specifications tables of each respective data sheet.

Design considerations

Every effort is made to use components with no particular performance degrading restrictions. In particular, components that may drift with age such as timers and A/D or D/A converters are specified over their lifetime.

It is recommended to always run the auto-configuration utility after system installation. This utility checks memory and backplane address/data lines, refreshes EEPROMs and detects from the date in EEPROM if the real-time clock battery (if present) needs to be changed.

Apart from changing the battery in the real-time clock module and for module malfunction, no part of the system requires removal from the aircraft. For this reason it is recommended that an external time source (such as an IRIG time stream) be used for systems requiring time tagging.

Physical dimensions, weight and mass

The Acra KAM-500 is cuboid with only mounting lugs, thumb screws, connectors, and optional heat sinks protruding. The Acra KAM-500 has two connector options for modules: a 51-way micro-miniature connector or a 52-way double density connector.

Physical dimensions, weight and mass: design considerations

The mass of each component or module is kept to a minimum and large mass components such as power supplies are placed as evenly as possible at each end of the chassis. User-modules can usually be arranged to keep the center of gravity close to the geometric center of the cuboid. Most of the weight (typically more than 75%) is in the chassis, not the modules.

The Acra KAM-500 is a modular system and information on a particular configuration's approximate mass and dimensions can be calculated by referencing the data sheets of the modules in the system.

Temperature

The Acra KAM-500 is designed to operate within specifications at temperature extremes. In particular it is designed to operate at case temperatures within the range of -40°C to 85°C and during rates of change in excess of 1°C/min.

The Acra KAM-500 has been tested and certified in accordance with MIL-STD-810 specifications, Methods 501.4 and 502.4.

TABLE 2	Temperature MIL-STD-810 specifications			
PARAMETER	MIN.	TYP.	MAX.	UNITS
Methods 501.4 and 502.4, procedure I[1]				
operational	-40	–	85	°C
non-operational	-55	–	105	°C

1. Sampled at least 4 hours after stabilization of specimen temperature.

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Temperature: design considerations

Power consumption is kept to a minimum, the main aluminum housing is a dull color (to aid thermal radiation) and heat sink fins are recommended where space permits. The Acra KAM-500 has no fans or coolants. However, it is recommended to bolt the chassis to a good heat conductor in an environment with good airflow away from heat sources.

The Acra KAM-500 is a modular system and information on a particular configuration's power consumption and heating may be provided on request.

Because convection is less effective at higher altitudes each module is designed so as to conduct heat to the chassis as quickly as possible (for example, each module has a ground plane).

Care is also taken when choosing components such as capacitors that they are specified for low temperature operation.

Altitude and rapid decompression

The Acra KAM-500 is designed to operate within specifications at high altitudes. The Acra KAM-500 has been tested and certified in accordance with MIL-STD-810F, Method 500.4.

TABLE 3	Altitude and rapid decompression MIL-STD-810F specifications			
PARAMETER	MIN.	TYP.	MAX.	UNITS
Method 500.4				
Procedure II	Carried out at maximum pressure of 115Kpa (1150mbar) and a minimum pressure of 3.6Kpa (36mbar).			
Procedure III	Carried out from room ambient to 3.6Kpa (36mbar) at a rate of 218Kpa/minute (2180mbar/min.).			
Method 500.4				
Procedure IV	Procedure II was carried out with the unit unpowered and a pressure change from 2,438m (8000ft) to 12,192m (40,000ft) was achieved in 78.4ms.			

Shock

The Acra KAM-500 has been tested and certified in accordance with MIL-STD-810F Method 516.5.

TABLE 4	Shock MIL-STD-810F specifications			
PARAMETER	MIN.	TYP.	MAX.	UNITS
Method 516.5 Procedure V - modified				
severity	100g, 11ms, terminal peak sawtooth			
No. of shocks	12 (2 in each direction of 3 mutually perpendicular axes)			

Shock: design considerations

The Acra KAM-500 is designed to endure severe shock environments while operating. In particular the following is observed:

1. Device mass is always kept to a minimum. The power supply DC/DC converters, the real-time clock battery, the KAD/ADC/109 and KAD/ADC/106 daughter boards, and the through-hole device on the synchro-to-digital converter are the largest devices. Special care was taken to harness/secure these devices.
2. Devices with moving parts or liquids are never used. The Acra KAM-500 has no IC sockets, relays, jumpers, switches, or potentiometers.
3. PCB freedom of movement is minimized. The backplane PCB is securely mounted to the chassis base-plate. Module PCBs are approximately 70mm x 70mm.

Water ingress (drip test)

The Acra KAM-500 has been tested and certified in accordance with the following.

TABLE 5	Water ingress MIL-STD-810F specifications			
PARAMETER	MIN.	TYP.	MAX.	UNITS
Method 506.4, Procedure III				
Precipitation rate		280		$l/m^2/hr.$
Duration	45 minutes, divided equally between 3 faces (one side, one end and one top)			

Water ingress: design considerations

All Acra KAM-500 modules are conformally coated.

The only gaps in the data acquisition system are the spaces between the module lids. There are no gaps on the bottom or sides of the Acra KAM-500 system.

Vibration

The Acra KAM-500 has been tested and certified in accordance with the following.

TABLE 6	Vibration MIL-STD-810F Sinusoidal frequency sweeps specifications			
PARAMETER	MIN.	TYP.	MAX.	UNITS
Method 514.5, Procedure I				
frequency range	10	–	2000	Hz
amplitude	$20mm_{p-p}$ from 10 to 16Hz			
	10g pk from 16 to 2000Hz			
Sweep rate	1 octave per minute			
Duration:	One upward sweep from 10 to 2000Hz and one downward sweep from 2000 to 10Hz			
	Note: Limitations on shaker displacement reduced the acceleration level to 5g at 10Hz rising to 10g at 14Hz			

TABLE 7	Vibration MIL-STD-810F random functional			
PARAMETER	MIN.	TYP.	MAX.	UNITS
Method 514.5, Procedure I; Figure 514.5C-8				
frequency range	15	–	2000	Hz
Spectrum	0.04 g2/Hz from 15 to 89.2Hz 4dB/octave from 89.2 to 300Hz			
	0.2 g2/Hz from 300 to 1000Hz			
	-6dB/octave from 1000 to 2000Hz			
Duration:	60 mins per axis			

TABLE 8	Vibration MIL-STD-810F random endurance specifications			
PARAMETER	MIN.	TYP.	MAX.	UNITS
Method 514.5, Procedure I				
frequency range	15	–	2000	Hz
Spectrum				
	0.04g^2/Hz from 15 to 30.7Hz			
	+4dB/octave from 30.7 to 300Hz			
	0.83g^2/Hz from 300 to 1000Hz			
	-6dB/octave from 1000 to 2000Hz			
Duration:	10 mins per axis			

Vibration: design considerations

The same design considerations apply as for shock. See “Shock: design considerations” on page 1205 for details. The Acra KAM-500 is a modular system and a particular configuration's resonant frequencies may be specified on request.

Acceleration

The Acra KAM-500 has been tested and certified in accordance with:

TABLE 9	Acceleration MIL-STD-810F specifications			
PARAMETER	MIN.	TYP.	MAX.	UNITS
Method 513.5, Procedure II				
acceleration	16.5g in each direction of three mutually perpendicular axes.			
duration	Minimum of 1 minute in each direction.			

Acceleration: design considerations

The same design considerations apply as for shock. See “Shock: design considerations” on page 1205 for details.

EMI/EMC

The Acra KAM-500 is designed to meet, and will be certified in accordance with the following:

EU directive 89/336/EEC; E50081-1 & E50082-1.

The Acra KAM-500 has been tested and certified in accordance with the following:

BS 3G100 Part 2 Section 2 (Magnetic Influence)

MIL-STD-461E: CE-101, CE-102, CS-101, CS-114, CS-115, CS-116, RE-102, RS-103.

For EMC compliance all cables should be shielded and all shields should be connected to the Acra KAM-500 chassis via the connector backshell.

Electromagnetic emissions and susceptibility: design considerations

A particular emphasis is placed on minimizing electromagnetic emissions and susceptibility. In particular the following is observed:

1. Where possible power switching devices are not used.

The power supply modules are the only ones that contain DC/DC converters. These devices are screened and were always present during the tests above.

2. Where possible high frequency oscillators are not used.

The controller has a screened 64MHz oscillator which is quickly divided to an 8MHz system clock from which modules take their timing. The MIL-STD-1553 and STANAG 3910 bus monitors have low-power oscillators for over-sampling the busses being monitored.

3. The chassis housing is metallic with no “line of sight”.

The chassis housing is 6mm (0.2in) aluminum with beveled joints that ensure no lateral or horizontal “lines of sight”. The modular nature of the system means that there are vertical lines of sight between modules. These lines were always present during the tests.

4. The Acra KAM-500 does not contain RF transmitters or receivers.
5. All PCBs have ground planes.

Electrostatic discharge and handling

Where appropriate the Acra KAM-500 inputs and outputs have been certified by design in accordance with the following.

TABLE 10	Electrostatic discharge and handling specifications			
PARAMETER	MIN.	TYP.	MAX.	UNITS
EIAJ IC121: (Machine model)	–	1	–	kV
MIL-STD 3015.7: (Human body model)	–	5	–	kV
IEC 1000-4-2:	Direct discharge Level 1.			

The Acra KAM-500 has been tested in accordance with the following.

TABLE 11	Electrostatic discharge and handling testing specifications			
PARAMETER	MIN.	TYP.	MAX.	UNITS
IEC 801-2:1991 (EN61000-4-2:1995): (Human body model)		15/8		kV

Acra KAM-500 modules contain devices that require standard ESD precautions to be observed when handling components that are normally inside the chassis. Also, in electrostatic environments it is strongly recommended that grounds be connected before connecting signals, especially high speed digital busses, such as RS-422, which are difficult to protect.

Electrostatic discharge and handling: design considerations

A particular emphasis is placed on minimizing ESD vulnerability. In particular the following is observed:

1. Digital CMOS devices are never connected directly to an I/O pin.
2. Where possible inputs have large resistors in series.
3. Slow low-current outputs have large resistors in series.
4. RS-422 and digital drivers/receivers are all specified to the above specifications.

Electrical bonding and insulation

The Acra KAM-500 has been tested and certified in accordance with the following:

Electrical bonding test; AC/KAM-500-II/SLTP/1.4, Paragraph 3.

Electrical Insulation Test, High Voltage Test; BS3G100, Part 4, Section 1, Subsection 1, Paragraph 5.1.

Electrical Insulation Test; BS3G100, Part 4, Section 1, Subsection 1, Paragraph 5.2. Insulation Resistance Test.

Electrical Insulation Test; BS3G100, Part 4, Section 1, Subsection 1, Paragraph 5.3 Leakage Current Measurements.

Humidity

The Acra KAM-500 has been tested and certified in accordance with the following.

TABLE 12	MIL-STD-810F, Method 507.4			
PARAMETER	MIN.	TYP.	MAX.	UNITS
Temperature	20	30	60	°C
Relative humidity	–	95	–	%
Relative humidity (during temperature reduction)	–	85	–	%
Dwell times (at each level)	–	4	–	hours
Cycle duration	–	24	–	hours
Number of cycles	–	5	–	

MIL-STD-810F, Method 507.4 (Modified)

Five cycles, each comprising:

1. +32°C, <15% rh, 10 hours
2. +38°C, <2% rh, 4 hours
3. +32°C, <15% rh, 10 hours
4. +27°C, 100% rh, 4 hours
5. +30°C, 95% rh, 20 hours

Humidity: design considerations

All Acra KAM-500 modules are conformally coated.

Fungus/mold growth: design considerations

All Acra KAM-500 modules are conformally coated.

Internal contamination

The Acra KAM-500 has been tested and certified in accordance with the following:

BS 3G 100, part 2, section 3, subsection 3.12 class A for occasional contamination.

Temperature: 70°C

Duration: 93 hours.

Fluids tested include:

- Propan-2-Ol
- Ethylene glycol (50% v/v in water)
- AVTUR F-34
- AeroShell Turbine Oil 308
- AeroShell Fluid 31
- AeroShell F31

Internal contamination: design considerations

The Acra KAM-500 does not contain any hydraulics, lubricants, coolants or battery fluids.

The battery used in the real-time clock module is sealed nickel-cadmium.

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Overview

This section should be read by any engineer responsible for wiring to or from the Acra KAM-500. After reading this the most common mistakes made during installation should be avoided. These include:

- Incorrect grounding between chassis
- Incorrect setting of the chassis address
- Noise due to poor shielding
- Lack of return paths from isolated sources

General guidelines

This section describes a number of good design practices not specific to the Acra KAM-500 regarding the following:

- Bus termination
- Twisting differential ended pairs
- Common-mode signal returns
- Connecting aircraft power, grounds, returns and shields

Bus termination

The Acra KAM-500 can be connected to a large variety of busses. Many of these busses are differential ended such as RS-422, while some are single ended such as RS-232. There are also optical and Ethernet variations to name a few.

The analysis of high speed busses with respect to propagation delay, power consumption, reflections, common-mode-pickup, and isolation requires some understanding of wave propagation theory, which is beyond the scope of this book. However, the physical layer specification of all busses specify the recommended impedances of cables, their terminations at each end, and the impedances of any device connected to it.

Any Acra KAM-500 device connected to a bus meets the physical layer specification for that bus.

Busses that allow multiple devices to be connected, such as RS-422 and MIL-STD-1553, usually require the cable terminations to be added externally. To simplify the wiring task for the Acra KAM-500, any device that is the only transmitter on an RS-422 bus has the cable termination internal to the module. When a bus is terminated internally, this is shown in the block diagram on the front page of the data sheet and is mentioned in the connector pinout section of the data sheet.

Twisting differential ended pairs

Most busses and some signals to the Acra KAM-500 are differential ended. Pin names for these type of lines have a plus (+) and minus (-) suffix. The difference between the lines is measured rather than the absolute value of each, so it is recommended to twist them about each other. After twisting, the next recommended step is shielding.

Twisted pairs tend to pick up the same electromagnetic interference so the difference between them stays the same. Analog lines are also more likely to stay at the same temperature, which may reduce thermal emf differences at connectors and effects due to temperature drifts.

Other pairs should also be twisted as illustrated in the following image:

- The supply and return for in-line charge amplifiers.
- The excitation and return for bridges (especially if the sense lines are not used).
- The sense lines for bridges.

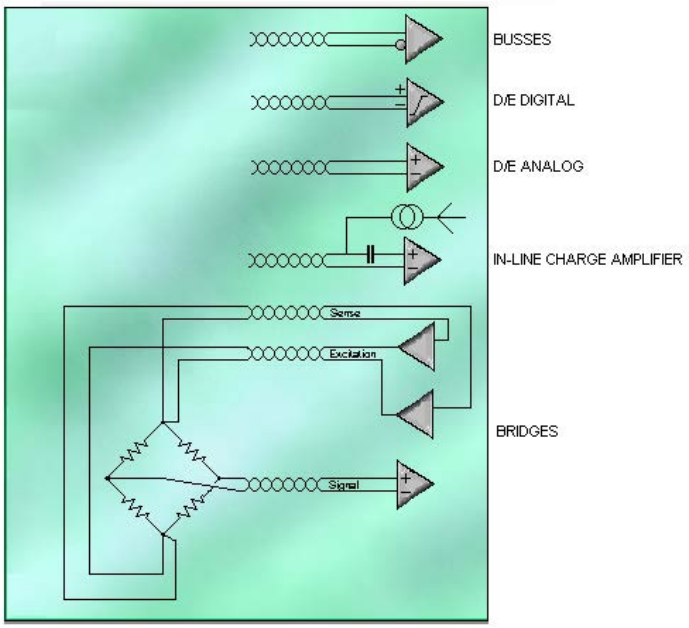


Figure 1: Twisting pairs

Common-mode signal returns

For a common mistake when connecting signals that float with respect to the Acra KAM-500, see the following figure.

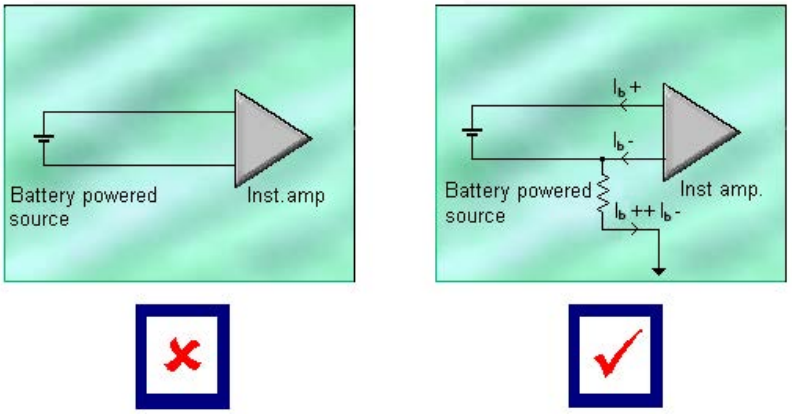


Figure 2: Common-mode signal returns

REASONS THE CIRCUIT ON THE LEFT IS INCORRECT:	SOME RECOMMENDATIONS:
There are no returns for any leakage/bias currents from the input circuit. These currents are typically in the order of nA and any voltage across the return resistor causes a common-mode voltage which can be ignored even for large values of resistance.	This is not an issue with single ended signals (for example analog signals such as on the KAD/ADC/001) as the return is always connected to ground.
The line on the circuit has a high (>>1MΩ) input impedance that makes it susceptible to electromagnetic interference pick-up. The smaller the return resistor the better (0Ω is ideal).	If the signal comes from circuitry powered by the Acra KAM-500 (for example a bridge) the return resistor is not needed.
In real-life applications two floating circuits are at different potentials due to inductive and capacitive couplings. The return resistor makes it easier to pull the floating source along.	If the source and destination circuits are grounded together (for example two devices communicating via RS-422) the return resistor is usually not needed.
	With thermocouple devices (for example KAD/TDC/002) a return resistor is already provided.
	The most common occurrence of this problem is when using battery powered devices (for example calibration sources).
	If in doubt use a return resistor.

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Connecting aircraft power, grounds, returns and shields

The following figure shows the grounding scheme used inside the Acra KAM-500.

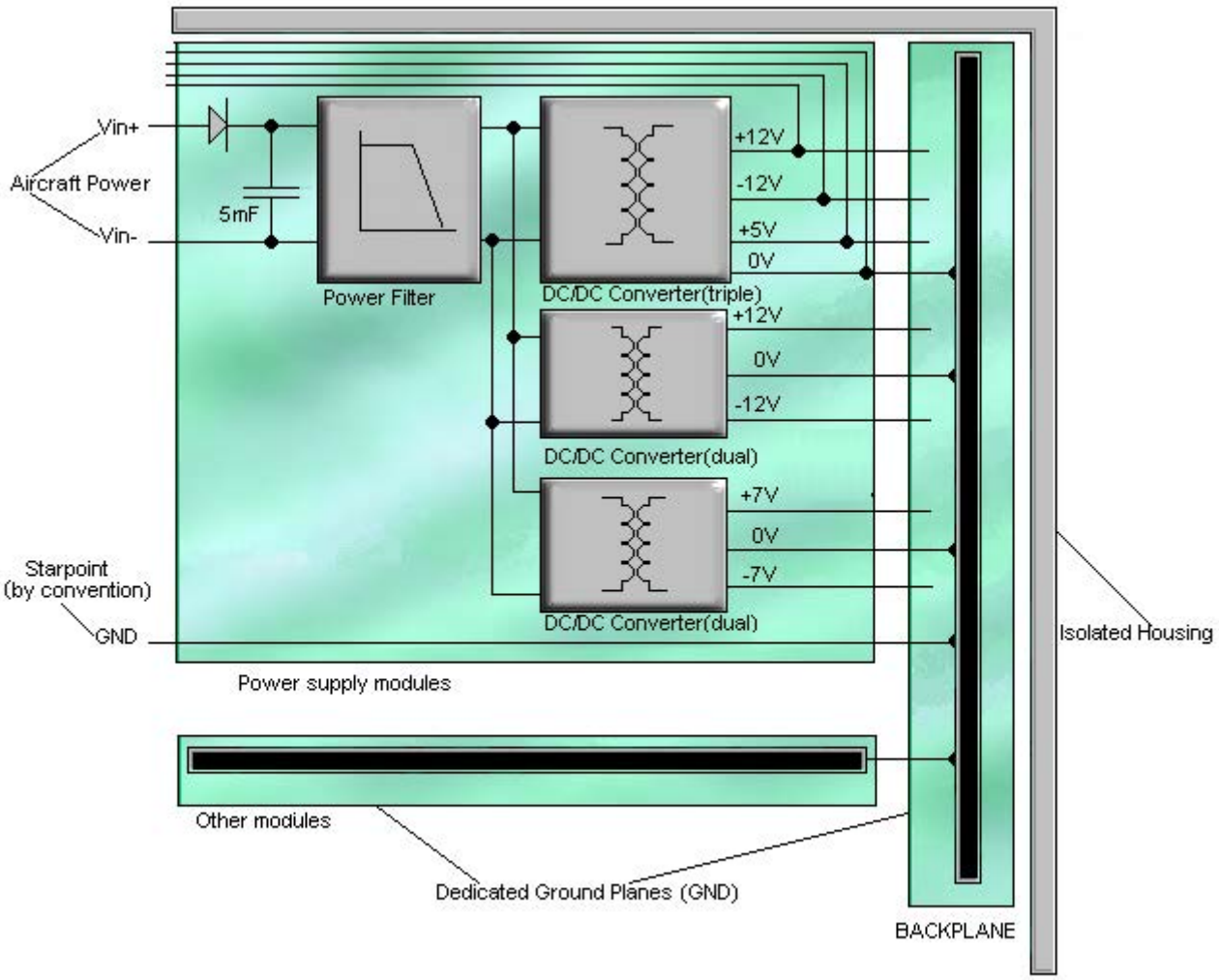


Figure 3: Acra KAM-500 grounding scheme

Acra KAM-500 design notes

- The aircraft power (POWER±) is connected only to the isolated DC/DC converters.
- The chassis is not galvanically connected to anywhere (except the I/O connector shells).
- One layer of the backplane Printed Circuit Board (PCB) is devoted entirely to a ground plane (GND) that is less than 2mΩ between any two points. This layer is the grounding star center. The ground pin (GND pin 4) on the KAM/PSU/012 goes directly to this node (and nowhere else).
- All modules have ground planes (GND) that are connected to the backplane via pins on the backplane connector.
- Occasionally modules have both analog and digital I/O on the same card (for example the KAD/DAC/001). In these cases the return for analog circuitry is designated AGND. AGND is connected to GND at the backplane.

Notes for the system installer

- Where possible it is recommended to designate the GND pin on the power supply unit of the star node for all non-current carrying references (for example when connecting multiple Acra KAM-500s, the programming PC, shields, and other systems about the plane).
- Where possible it is recommended to connect the chassis externally to GND using the pin on the KAM/PSU/012.
- It is recommended that the aircraft power return POWER- remains isolated because it is a current carrying line. However, if it must be tied to GND it is recommended that it be done using the pins POWER- and GND on the KAM/PSU/012 (on one chassis only).
- It is recommended that all shields be connected to the CHASSIS pin of the KAM/PSU/012 only. If the chassis has been grounded, shields need only be connected to the I/O connector back shells.
- Acra KAM-500 inputs tend to have high common mode input impedance so return currents are typically measured in mA or nA. The ground tracks and connector pins typically have mΩ resistances (the leads tend to be higher) so the voltages created, using the scheme displayed on the left of the following image, are in the order of mV for each channel. However where possible the scheme on the right is recommended for signals from external circuits.
- For EMC compliance, all cables should be shielded and all shields should be connected to the Acra KAM-500 chassis via the connector backshell.

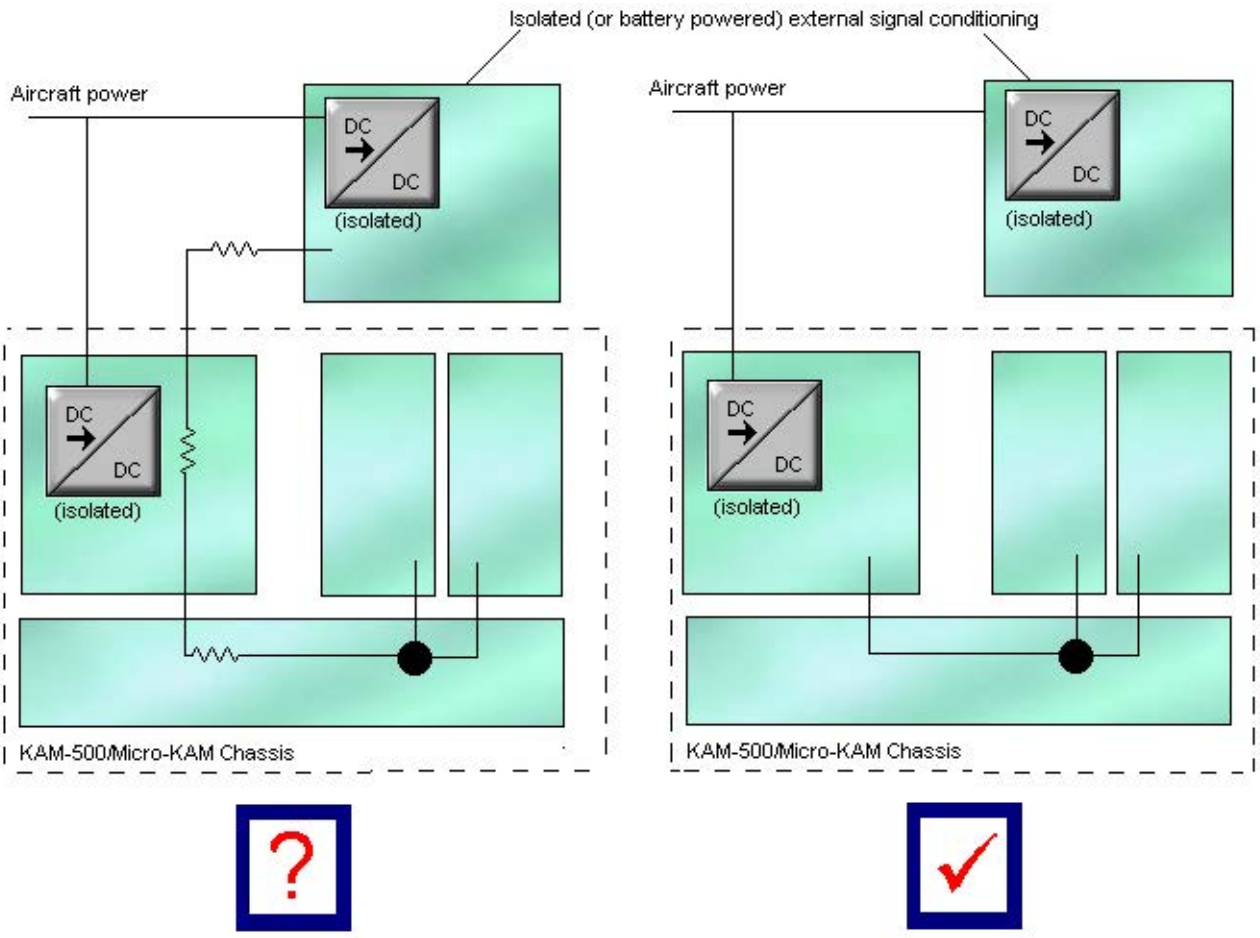


Figure 4: Schemes for external circuit signals

Chassis connections

Figure 5 on page 1216 shows the recommended wiring diagram to be used with a distributed Acra KAM-500 system. In this illustration each chassis housing remains isolated as does the aircraft power return. Figure 6 on page 1217 shows the recommended wiring diagram to be used with an Ethernet system and Figure 7 on page 1218 shows the recommended wiring diagram for a CAIS system.

Connecting aircraft power (POWER±)

These lines carry currents up to 3A.

POWER+ (aircraft 28V)	goes to pin 1 of the PSU only
POWER- (aircraft return)	goes to pin 2 of the PSU only

Programming lines (PROG_DCLK±, PROG_DATA±)

The programming lines consist of two twisted pairs.

MASTER-SLAVE SYSTEM			
PROG_DATA+	goes from SAM/DEC/007 pin 6	to KAD/BCU/101 pin 25	(of up to 32 Acra KAM-500s)
PROG_DATA-	goes from pin 8	to BCU/101 pin 26	(of up to 32 Acra KAM-500s)
ETHERNET SYSTEM			
PROG_DATA_A+	goes from KAD/ETH/001 pin 6	to KAD/BCU/101 pin 25	
PROG_DATA_A-	goes from KAD/ETH/001 pin 7	to KAD/BCU/101 pin 26	
PROG_DATA_B+	goes from KAD/ETH/001 pin 8	to KAD/BCU/101 pin 25	for PROG± CHASSIS_ID 32-63
PROG_DATA_B-	goes from KAD/ETH/001 pin 9	to KAD/BCU/101 pin 26	for PROG± CHASSIS_ID 32-63

Each pair must be terminated at the end with a 120Ωresistor. On the SAM/DEC/007 these lines are terminated internally as standard.

These pins are internally connected to other pins on the KAD/BCU/101 connector.

Synchronization Lines (X_SYNC±, X_CLK±)

These lines are used to synchronize the operation of each Acra KAM-500 chassis. One unit is designated master by setting the chassis address lines CHASSIS_ID[3:0] low (see “Setting the programming address select lines (CHASSIS_ID[3:0])” on page 1219). The master outputs a signal on two twisted pairs that are connected to all other Acra KAM-500s (if there are more than 16, or a star wiring configuration is used then some external buffering may be required). They consist of two twisted pairs.

X_SYNC+	goes from the master KAD/BCU/101 pin 32	to slave KAD/BCU/101 pin 13
X_SYNC-	goes from the master KAD/BCU/101 pin 33	to slave KAD/BCU/101 pin 14

Each pair must be terminated at the end of the loop with a 120Ω resistor.

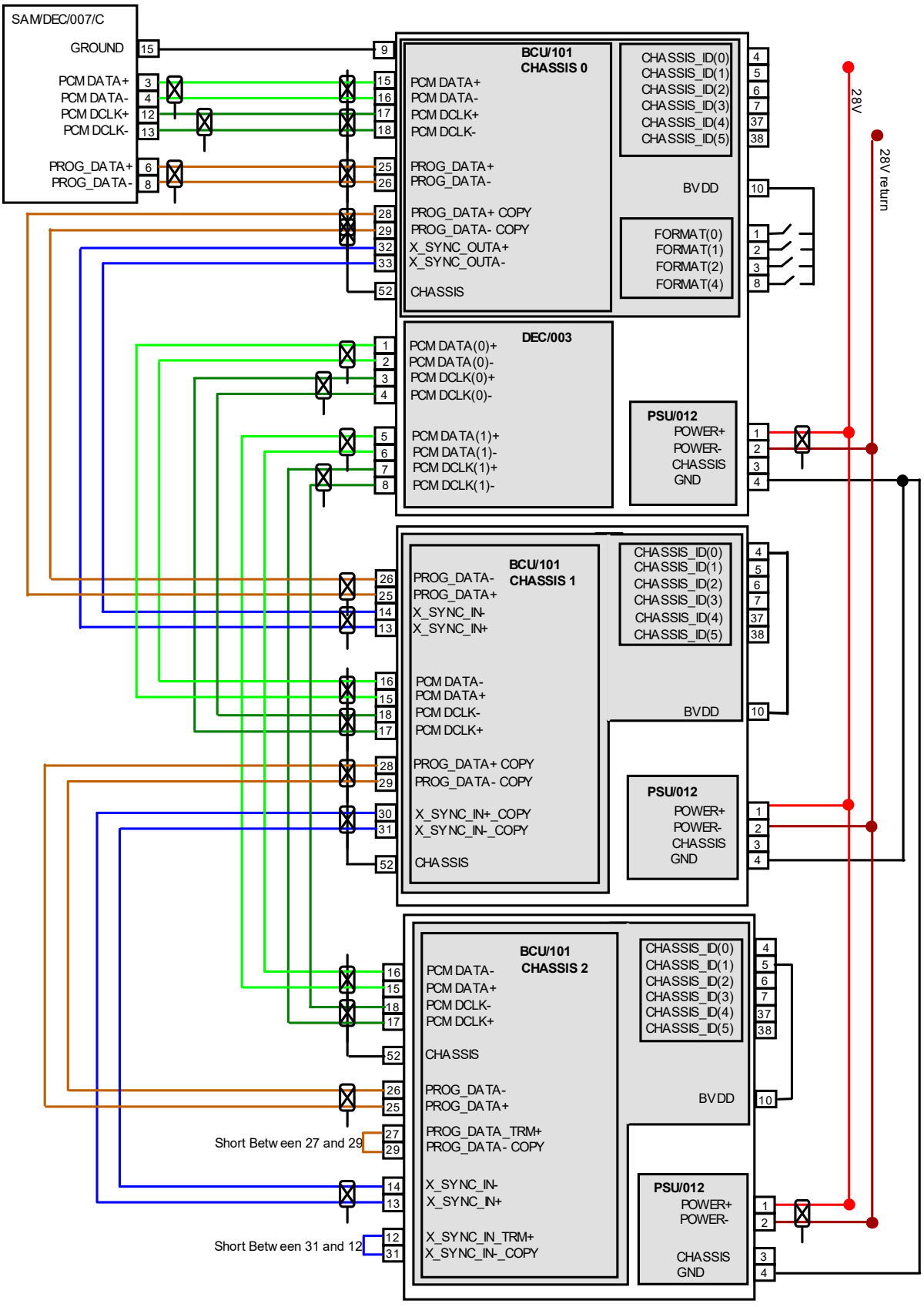


Figure 5: Recommended wiring diagram for the distributed Acra KAM-500 system

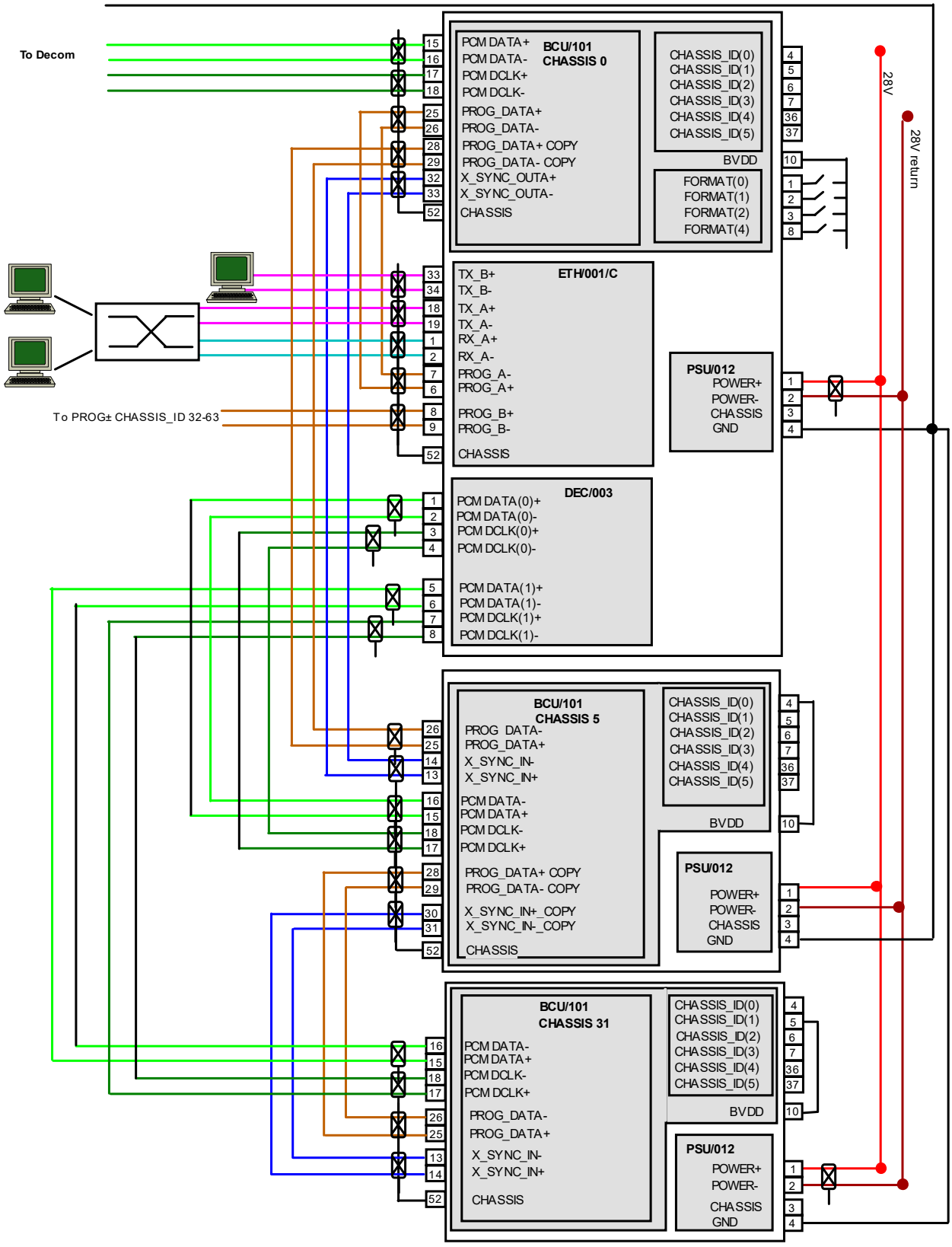


Figure 6: Recommended wiring diagram for the Ethernet system

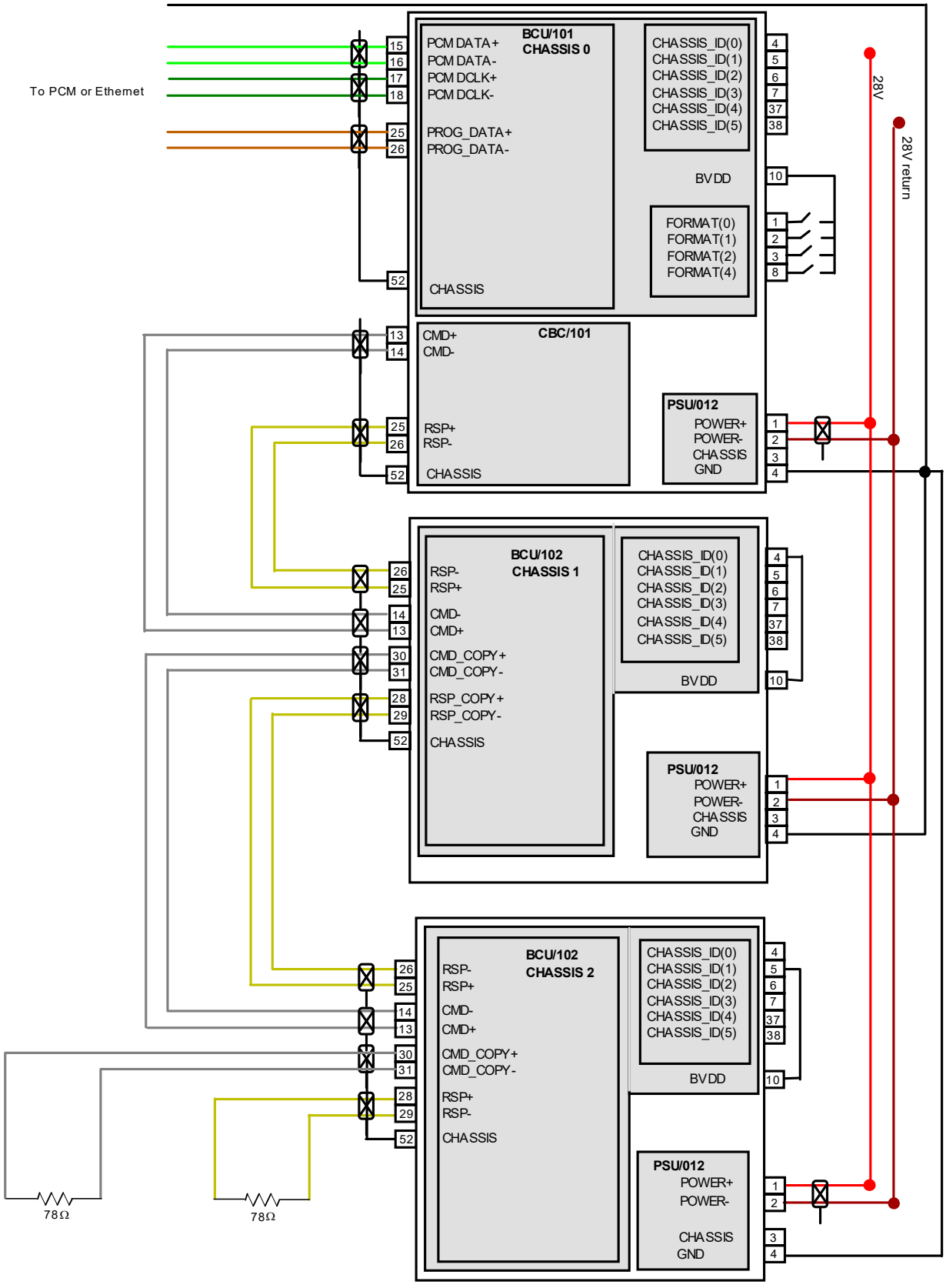


Figure 7: Recommended wiring diagram for the CAIS system

Data transfer lines to SAM/DEC/007 (DATA±, DCLK±)

These lines are used to transfer data from one chassis (usually the master) to the programing PC. They consist of two twisted pairs.

DCLK+	goes from KAD/BCU/101 pin 17	to SAM/DEC/007 pin 12
DCLK-	goes from KAD/BCU/101 pin 18	to SAM/DEC/007 pin 13
DATA+	goes from KAD/BCU/101 pin 15	to SAM/DEC/007 pin 3
DATA-	goes from KAD/BCU/101 pin 16	to SAM/DEC/007 pin 4

Data transfer lines between chassis (DATA±, DCLK±)

These lines are used to transfer data from one chassis to another. They consist of two twisted pairs.

Data can be sent from either the primary or auxiliary encoders to either channel of the dual decoder (KAD/DEC/003).

DCLK+	goes from KAD/BCU/101 pin 17	to KAD/DEC/003 pin 3	(7 for second channel)
DCLK-	goes from KAD/BCU/101 pin 18	to KAD/DEC/003 pin 4	(8 for second channel)
DATA+	goes from KAD/BCU/101 pin 15	to KAD/DEC/003 pin 1	(5 for second channel)
DATA-	goes from KAD/BCU/101 pin 16	to KAD/DEC/003 pin 2	(6 for second channel)

Setting the programming address select lines (CHASSIS_ID[3:0])

Up to 16 chassis can be connected to the programming lines. Each must be given a unique binary address from 0000 to 1111.

NOTE: 0000 is reserved for the master.

CHASSIS_ID(0)	Least Significant Bit (LSB)	is KAD/BCU/101 pin 4
CHASSIS_ID(1)		is KAD/BCU/101 pin 5
CHASSIS_ID(2)		is KAD/BCU/101 pin 6
CHASSIS_ID(3)	Most Significant Bit (MSB)	is KAD/BCU/101 pin 7

0 is set by connecting to GND or by leaving the pin open.

1 is set by connecting to BVDD (buffered 5V).

Setting the format select lines (FORMAT[3:0])

Up to 15 formats can be stored in the controller (KAD/BCU/101). Each has a binary address between 0000 to 1110 (1111 is reserved for housekeeping information in the controller).

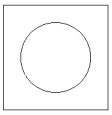
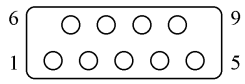
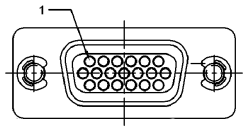
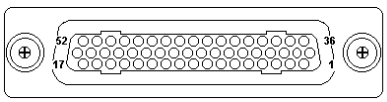
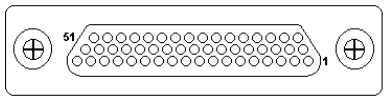
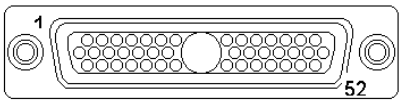
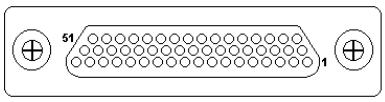
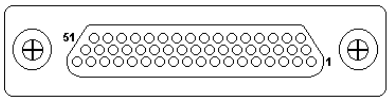
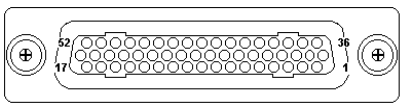
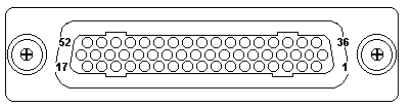
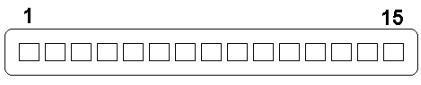
FORMAT(0)	(LSB)	is KAD/BCU/101 pin 1
FORMAT(1)		is KAD/BCU/101 pin 2
FORMAT(2)		is KAD/BCU/101 pin 3
FORMAT(3)	(MSB)	is KAD/BCU/101 pin 8

0 is set by connecting to GND or by leaving the pin open.

1 is set by connecting to BVDD (buffered 5V).

If multiple chassis and formats are used, the format select lines should be connected to all chassis.

Acra KAM-500 connectors

PINOUTS FOR SOCKET[1]	WHERE USED	VENDORS	PART NO.
	Bayonet connector for power supply	Townsend Coates Other source: ABACUS POLAR	MS27499-E-8-F-35PN
	9-way micro-miniature connector for power supply	Glenair International Other sources: CINCH	DCDM-9P-6E5-18-199/214/240
	19-way double-density connector for KAM/TCG/102 and KAM/TCG/103	Curtiss-Wright	CON/KAD/003/CP
	52-way double-density mating connector for KAD modules	Curtiss-Wright	CON/KAD/002/CP
	51-way micro-miniature mating connector for KAM modules	Glenair International Other source: ITT Cannon CINCH	DCDM-51P-6E5-18-199/214/240
	52-way double-density mating connector for KAD/TDC/002/D modified so as to accommodate the sensor on the module connector	Curtiss-Wright	CON/KAD/002/SR
	51-way micro-miniature connector for modules for MIL-STD-1553 monitoring applications (direct coupled)	Glenair International	MRM9422
	51-way micro-miniature connector for modules for MIL-STD-1553 monitoring applications (transformer coupled)	Glenair International	MRM11887
	52-way double-density connector for modules for MIL-STD-1553 monitoring applications (direct coupled)	Curtiss-Wright	ASD/MSB/001/DC or ASD/MSB/001/DCC
	52-way double-density connector for modules for MIL-STD-1553 monitoring applications (transformer coupled)	Curtiss-Wright	ASD/MSB/001/TC or ASD/MSB/001/TCC
	Connectors on SAM/DEC/007/C	Acal Other source: Connect Electronics	61512-011

PINOUTS FOR SOCKET[1]	WHERE USED	VENDORS	PART NO.
The charge-to-digital converter module KAM/CDC/101 contains four connectors (10-32 UNF thread jacks) for use with the low-noise coaxial connectors commonly used with piezoelectric charge devices. Often the cable and plug are part of the sensor.	Connectors on KAM/CDC/101/C	Microdot Connectors Inc.	

1. The connectors are viewed looking into the front face from above.

#	COLOR (BOXES)	COLOR (WORDS)	#	COLOR (BOXES)	COLOR (WORDS)
1		Black	27		Black + Grey
2		Brown	28		Brown + Red
3		Red	29		Brown + Orange
4		Orange	30		Brown + Yellow
5		Yellow	31		Brown + Green
6		Green	32		Brown + Blue
7		Blue	33		Brown + Purple
8		Purple	34		Brown + Grey
9		Grey	35		Red + Orange
10		White	36		Red + Yellow
11		White + Black	37		Red + Green
12		White + Brown	38		Red + Blue
13		White + Red	39		Red + Purple
14		White + Orange	40		Red + Grey
15		White + Yellow	41		Orange + Yellow
16		White + Green	42		Orange + Green
17		White + Blue	43		Orange + Blue
18		White + Purple	44		Orange + Purple
19		White + Grey	45		Orange + Grey
20		Black + Brown	46		Yellow + Green
21		Black + Red	47		Yellow + Blue
22		Black + Orange	48		Yellow + Purple
23		Black + Yellow	49		Yellow + Grey
24		Black + Green	50		Green + Blue

#	COLOR (BOXES)	COLOR (WORDS)	#	COLOR (BOXES)	COLOR (WORDS)
25		Black + Blue	51		Green + Purple
26		Black + Purple	52		Green + Grey

Some notes on common digital busses

In this section the physical layer (voltages, currents, impedances and so on) are discussed with respect to some digital signal types associated with the Acra KAM-500. This is intended to help installation engineers check cable lengths, cable impedances, termination impedances, and data rate limits for the various types of digital signal discussed.

Buffered TTL

TTL (or Transistor-Transistor-Logic) logic levels are generally used for communication between ICs (Integrated Circuits) on a PCB.

BTTL or buffered TTL is used on an Acra KAM-500 output connector when a digital signal is required that will not be transmitted far (say 30cm (1 ft.)) and does not require much current drive (< 5mA) (for example the 1pps output of a time code generator).

BTTL is essentially a single ended TTL driver/receiver with a 100Ω resistance in series.

TTL levels are typically 0 to 0.8V for a logic low and 2.0 to 5.0V for a logic high.

RS-232

RS-232 is generally used for slow (typically 9600bps) transmission of data to or from a computer close by (typically less than 10m). RS-232 is single ended.

RS-422/485

RS-422 was introduced as a high-speed differential ended version of RS-232. RS-485 is similar to RS-422 except that it is designed for more drivers and receivers.

Being differential ended, RS-422/485 is recommended in applications requiring long cables (>1m) or fast data rates (>50kbps). However the start and end of the cable must be terminated with a termination resistor (120Ω) and any stubs from the bus must be kept less than 25cm (10 inches).

	BTTL	RS-232	RS-422	RS-485
TYPE	SINGLE ENDED	SINGLE ENDED	DIFFERENTIAL ENDED	DIFFERENTIAL ENDED
Maximum cable length	1m	10m	1km	1km
Maximum data rate (bps)	750k	20k	10M	10M
Logic LOW (Tx)	0V	+5V +15V	-2V	-1.5V
Logic HIGH (Tx)	5V	-5V -15V	+2V	+1.5V
Logic LOW (Rx)	0.8V	+3V	+0.2V	+0.2V
Logic HIGH (Rx)	2.8V	-3V	-0.2V	-0.2V
Termination impedance	n/a	n/a	100Ωmin	60Ωmin

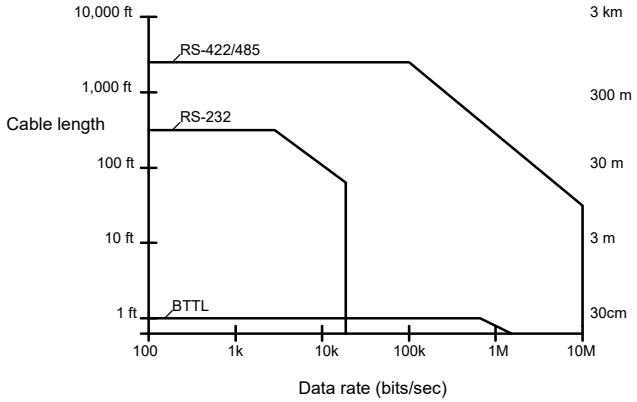


Figure 8: Cable length versus data rates

Torque settings for Acra KAM-500

The following are the recommended torque settings for Acra KAM-500 screws:

SCREW TYPE	RECOMMENDED TORQUE SETTING	LOCATION
Spring-mounted thumbscrews	0.6 Nm (0.44 foot pound-force)	On each Acra KAM-500 module.
M3 hex head stainless steel screw	0.6 Nm (0.44 foot pound-force)	Sides and base plate for chassis assembly.
4-40 UNC stainless steel screw	0.25 Nm (0.18 foot pound-force)	Mating connector on CON/KAD/002/CP and CON/KAD/002/SR.
SMA	0.45 Nm (0.33 foot pound-force)	GPS inputs
Grounding bolt, 10-24 UNC 2B	2.5 Nm (22 Lbfin)	On KAM/PSU/012 top block

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3D drawings of products sold by Curtiss-Wright are available in STEP (STandard for the Exchange of Product model data) format. The following image displays one such example.

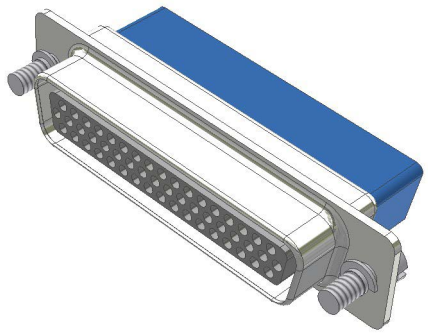


Figure 1: 3D drawing of CON/KAD/005/CP

Currently, 3D drawings are available for the following products:

- ACD/BAC/002/B
- ACD/BAC/003/B
- AXN/CHS/06U
- AXN/CHS/09U
- AXN/CHS/16U
- AXN/ITE/01U
- BAC/MMO/001/F10
- BAC/MMO/001/F19
- CON/KAD/002/CP
- CON/KAD/005/CP
- CON/MMO/001/F10A
- CON/MMO/001/F19A
- CON/PSU/007/CS1
- DRE/SSD/001
- KAM/CHS/03U/D
- KAM/CHS/06U/D
- KAM/CHS/09U/D
- KAM/CHS/12R/E
- KAM/CHS/13U/D
- NET/SWI/101/C
- SSR/CHS/001/B
- SSR/CHS/002
- SSR/REC/001

For a copy of one or more of the 3D drawings, contact Curtiss-Wright support (acra-support@curtisswright.com).

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This document was reviewed on 14/10/2020 and does not contain technical data.

Receiving, inspection & warranties

Receiving

Unpack the instrument and save the carton and packing material in case the instrument must be shipped to another site or returned to the factory for service.

Inspection

Inspect the exterior of the instrument for any visible signs of damage that may have occurred during transit. If damaged, contact ACRA CONTROL Customer Service

ACRA CONTROL system warranty

ACRA CONTROL warrants that each product we sell you is free from defects in labor and materials and shall conform to its product specifications as defined in the product user documentation. If the product does not function as warranted during the warranty period, we will repair or replace it without charge.

Warranty period

The warranty period for hardware products is 12 months. The warranty period begins on the date of invoice.

Limit of warranty

Misuse, accident, modification, unsuitable physical or operating environment, improper maintenance, or damage caused by a product for which we are not responsible will void the warranty.

Certain components may have separate warranty periods as stated in the product user documentation.

The MANUFACTURER does not warrant that its Manufacturer Products are fit for any particular purpose and shall have no liability in that respect except to the extent that the intended end user application of the Manufacturer Products has been expressly approved in writing by the MANUFACTURER in the relevant contract of sale.

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This is your sole remedy for product defects. In no event will ACRA CONTROL’s liability exceed the price paid for the software, regardless of the form of the claim.

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Warning and cautions

Mise en garde et précautions

Warnung und Sicherheitshinweise

This WARNING note below is required by the FCC and relates only to the interference potential of this equipment. This message is a direct quotation.

WARNING: The equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. As temporarily permitted by regulation, it has not been tested for compliance with the limits for Class A computing devices pursuant to Subpart B or Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

Mise en garde: La notice d'avertissement ci-dessous est exigée par la FCC et concerne uniquement le potentiel d'interférence de cet appareil. Ce message est une citation directe. Cet appareil dégage, utilise et peut produire une énergie suffisante pour perturber le réseau de communication s'il n'est pas utilisé selon les instructions données dans le manuel. Ayant obtenu une autorisation temporaire par la règlementation, il n'a pas été testé comformément aux limites de la Class A des dispositifs informatiques suivant le sous-alinéa B ou l'alinéa 15 des règles de la FCC, qui sont designées pour fournir une protection raisonnable contre de telles inrterférences. L'utilisation de cet appareil dans une zone résidentielle peut provoquer des interférences et seul l'utilisateur est tenu de prendre les précautions nécessaires pour corriger celles-ci.

Warnung: Die erste unten aufgeführte Warnung wird von der FCC gefordert und bezieht sich ausschließlich auf mögliche Störungen, durch dieses Gerät verursacht. Der Text ist ein direktes Zitat. Die in diesem Gerät erzeugten verwendeten und eventuell auch abgegebenen Radiowellen können, wenn das Gerät nicht entsprechend den Anweisungen im Bedienungshandbuch installiert und eingesetzt wird, Störungen im Funkverkehr verursachen. Entsprechend einer einstweiligen Erlaubnis durch entsprechende Bestimmungen, wurde das Gerät nicht auf die Einhaltung der Grenzwerte für Klasse A Computer-Einrichtungen gemäß Unterabschnitt B oder Teil 15 der FCC Bestimmungen getestet, die einen ausreichenden Schutz vor solchen Störungen gewährleisten sollen. Bei Betrieb dieses Gerätes in Wohngebiet ist eine solche Störung möglich. Der Anwender wird in diesem Fall aufgefordert, auf eigene Kosten die notigen Maßnahmen zu ergreifen, um diese Störungen zu beheben.

General hazard statement

The system shall only be installed and used by trained personnel, in accordance with local safety rules, in accordance with the environmental and operational limits indicated in the data sheets/manuals and in no way that may cause injury to persons or damage to property.

Materials

The Acra KAM-500 contains no material that could be considered hazardous to the operator during installation, operation, or disposal of the unit. Furthermore it does not contain any hydraulic fluid, lubricant, coolant or battery fluid.

Bus interfaces

Acra KAM-500 is flight test equipment and as such is not intended for direct connection to flight critical avionics control busses or flight critical instrumentation busses. Appropriate methods of isolation in the event of Acra KAM-500 failure must be employed by the end user. To minimize the risk of interference with avionics busses, modules that are avionics bus monitors use interfaces where the transmission portion of the interface is disabled using a hardwired method. For any modules that are connected to a data bus either as bus monitors or to transmit data on an instrumentation bus, it is the responsibility of the end-user to analyze potential failure

modes and their effect upon the system as a whole and to implement preventive measures as appropriate to ensure that any failure of the Acra KAM-500 system will not impact on the safety of the aircraft.

Sensor interfaces and ignition hazards

Acra KAM-500 contains no moving parts or high voltage components (greater than 50V dc.) that could cause a spark. However, it must be noted that certain Acra KAM-500 modules are designed to provide sensor excitation for several different sensor types, (e.g. strain gages, accelerometers, resistive temperature devices), taking the form of either voltage or current excitation as appropriate.

While these excitation outputs are designed with output limiting functionality, in some circumstances dedicated barrier or isolation devices may need to be inserted. It is the responsibility of the end-user to analyze potential failure modes of these external sensor interfaces and to implement preventative measures as appropriate to ensure that any failure of the Acra KAM-500 system will not impact on the safety of the aircraft.

Power supplies

The power supplies present in the Acra KAM-500 are designed to be fault tolerant, and incorporate current limiting in the event of short circuit developing on their outputs. An Acra KAM-500 system should always be provided with power from a dedicated, fused power bus, separate to other flight critical systems with appropriate circuit breakers to protect the power bus in the event of overload or the drawing of excessive transient or inrush current. It is the responsibility of the end-user to analyze potential failure modes of the power supply and to implement preventative measures as appropriate to ensure that any failure of the Acra KAM-500 system will not affect the safety of the aircraft.

Heating effects

Acra KAM-500 is designed to operate in the temperature range of -40ºC to 85ºC, where the quoted temperature is the temperature of the Acra KAM-500 chassis. The internal temperature during normal operation can be approximately 15ºC to 20ºC above chassis temperature depending on module configuration. To prevent overheating during normal operation, ensure the operating environment can dissipate the heat generated by Acra KAM-500. It is the responsibility of the Acra KAM-500 end-user to analyze potential failure modes due to overheating and to implement preventative measures as appropriate to ensure that any failure of the Acra KAM-500 system will not impact on the safety of the aircraft.

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Acronyms

This document lists common acronyms and terms used in telemetry. For more telemetry terminology, see *TEC/NOT/026, Dictionary of telemetry terms*.

AAAF

Analog Anti-Aliasing Filter. See AAF.

AAF

Anti-Aliasing Filter. A filter which reduces aliasing effects by restricting the bandwidth of the sampled signal to approximately satisfy the sampling theorem, that is, most of the signal energy is kept within a bandwidth of half of the sampling frequency.

ACK

ACKnowledgment code. The communications code sent from a receiving station to a transmitting station to indicate that it is ready to accept data. It is also used to acknowledge the error-free receipt of transmitted data.

Acra KAM-500

Acra's flagship modular data acquisition product.

A/D

Analog to Digital. Conversion of analog signals to digital.

AES

Advanced Encryption Standard. An NIST-standard cryptographic cipher that uses a block length of 128 bits and key lengths of 128, 192 or 256 bits. Officially replacing the Triple DES method in 2001, AES uses the Rijndael algorithm. AES can be encrypted in one pass instead of three, and its key size is greater than Triple DES's 168 bits.

AHeAD

Aircraft Health Analysis and Diagnosis. Embraer system for predictive maintenance.

AHUMS

Adaptive HUMS. See HUMS.

ARO

After Receipt (of) Order.

ARP

Address Resolution Protocol. A protocol used to obtain a node's physical hardware address.

ARTM

Advanced Range TeleMetry program. Tier 1 products use SOQPSK techniques to double the data rate in a given RF bandwidth; Tier II uses multi-h techniques to treble it. PCM/FM is sometimes referred to as Tier 0.

ATP

Acceptance Test Procedure. The final phase of design validation, which ensures that each component of a customer's system (hardware and software) work together.

BAG

Bandwidth Allocation Gap. Allocated data transmission interval in an ARINC 664 Part 7 network.

Bandwidth

The frequency range occupied or required by a signal. Pulse Code Modulation (PCM) signals contain harmonics that are usually removed by pre-modulation filtering to reduce the bandwidth needed for telemetry transmission or tape recording. However, insufficient bandwidth may result in the loss of essential information and prevent the recovery of PCM encoded data.

Barker codes

A selection of bits to be used as frame sync words so as to minimize the probability of false lock. For more information, see the Reference section of the *Applications Handbook*.

BDS

Best Data Selector. Diversity receiver method where the stream with the least data errors, such as sync word slips, and sync word bit errors, is used.

BER

Bit Error Rate. The average number of bits transmitted in error. Every data link has a theoretical minimum error rate depending on the noise present. A reasonable encoder/decoder system linked via copper would have a BER of 10-9. BERs are specified for encoders, data links (especially radio), bit syncs, and decoders.

BIO-L

Bi-phase Level. See PCM Codes.

BIO-M

Bi-phase Mark. See PCM Codes.

BIO-S

Bi-phase Space. See PCM Codes.

BOM file

File used to store original hardcopy BOMs (Bill of Materials).

bps

Bits Per Second. The measurement of the speed of data transfer in a communications system. Note that Bps is used to denote Bytes Per Second.

BSS

Best Source Selector. Diversity receiver method where the stream with the best signal-to-noise ratio is used.

CAIS

Common Airborne Instrumentation Systems. Developed by the U.S. Department of Defense to promote standardization commonality and interoperability among aircraft test instrumentation systems.

CAR

Corrective Action Report. A report into any defect in any product or procedure.

cBIT

Continuous Built-In-Test.

CBM

Condition-Based Maintenance. Used primarily to predict when to service the machine rather than to repair it, but no clear distinction. Originally used for industrial machines and generators, then for airplanes.

COFDM

Coded Orthogonal FDM. See FDM.

COMSEC

Compound word for COMmunications SECurity.

COO

Confirmation of Order. The document issued to customers that confirms terms and conditions, price, and quantities of the last revision of RFQ.

COTS

Commercial Off-The-Shelf. Refers to ready-made merchandise that is available for sale.

CSMA/CA

Carrier Sense Multiple Access/Collision Avoidance. A transmission protocol that attempts to avoid collisions that can occur when two nodes attempt to transmit at the same time on the bus rather than detect them, as in CSMA/CD.

CSMA/CD

Carrier Sense Multiple Access/Collision Detection. The Local Area Network (LAN) access method used in Ethernet. When a device wants to gain access to the network, it checks to see if the network is quiet (senses the carrier) before it begins transmitting its data. Collision Detection allows for the node to be aware if another node begins to transmit causing their frames to collide.

CSS

Correlated Source Selection. Diversity receiver method where two streams with roughly the same signal-to-noise ratio and data error rates are aligned (correlated) and voting or soft-bits are used to decide on a bit-by-bit basis.

D/A

Digital to Analog. Conversion of digital signals to analog.

DAS

Data Acquisition System.

DAS Studio 3

DAS Studio 3 uses a multi-threaded design, which utilizes multi-core processors to improve performance. DAS Studio 3 lets you configure Data Acquisition Units (DAUs), network switches, recorders and ground stations in an integrated environment.

DAU

Data Acquisition Unit.

dB

Decibel. A unit which indicates a ratio of power between two signals.

dBc

Decibels relative to carrier. A common measurement (in decibels) in Radio Frequency (RF) engineering to specify the power of a sideband in a modulated signal relative to the carrier.

DHCP

Dynamic Host Configuration Protocol. A protocol that automatically assigns IP addresses to client stations logging onto an IP network.

Diversity Combining

A method, based on signal power, of switching between diverse receivers.

Diversity receivers

Using two or more streams to reduce lost data. *Temporal diversity* - sending data twice in the one stream. *Frequency diversity* - using two frequencies. *Spatial diversity* - using two receivers at different physical locations. *Polar diversity* - using left and right hand (I/Q) receivers.

DM-M

Delay Modulation Mark. See PCM Codes.

DM-S

Delay Modulation Space. See PCM Codes.

DNS

Domain Name System. A system for converting host names and domain names into IP addresses on the Internet or on local networks that use the TCP/IP protocol.

DST

Data SheeT. Every product must have a data sheet outlining the features, applications specifications, and revision history as well as any other technical data required to use it. The front leaf of the data sheet is used by Sales as a short-form data sheet which they give to potential customers.

DV

Design Verification. The stage between handover after unit test and product release; it culminates in a Design Verification Report (DVR). DV is also an acronym for the Design Verification department.

DVP

Design Verification Plan.

DVR

Design Verification Report. Every active NRE culminates in a DVR. If written after a design verification phase, it documents all the tests done and the results. If written after the suspension of an NRE, it states the reason(s) for the suspension.

Eb/No

Bit Energy/Noise Spectral Density. A measure of the signal-to-noise ratio.

EEPROM

Electrically Erasable Programmable ROM. Re-writable memory that holds its content without power. EEPROMs have a lifespan of between 10k and 100k write cycles, which is considerably greater than the EPROMs that preceded them.

EHUMS

Engine HUMS. See HUMS.

ENOB

Effective Number Of Bits.

ES

End System. ARINC 664 Part 7 end-device that produces data to be transmitted over the ARINC 664 Part 7 network.

ESS

Environmental Stress Screening. Process of exposing products to stresses in order to force latent defects to manifest themselves by permanent or catastrophic failure during the screening process.

FAT32

An enhancement of the File Allocation Table file system that supports memory media with capacities up to 2 TB.

FAQ

Frequently Asked Questions. Questions asked by both customers and Curtiss-Wright employees.

FEC

Forward Error Correction. A means of adding extra bits to reduce bit error rates. Common methods are convolutional, reduced parity, and turbo coding.

FDM

Frequency Division Multiplexing. Transmitting multiple data signals simultaneously over a single wire by using multiple carriers, each having a unique center frequency. Each data stream, such as text, voice or video, is placed into a separate carrier that is modulated by various methods.

FDAU

Flight Data Acquisition Unit.

FIFO

First In First Out. A storage method that retrieves the item stored for the longest time.

FQPSK

Feher-patented QPSK. See QPSK.

FSK

Frequency Shift Keying. A simple digital modulation technique that uses two frequencies for 0 and 1. See QPSK.

FSR

Full Scale Range.

FTI

Flight Test Instrumentation. The instrumentation system, including mounting brackets, that is used on an aircraft for flight test purposes. It is usually orange in color in order to distinguish it from standard equipment.

FTP

File Transfer Protocol. File transfer protocol that runs over TCP/IP.

FUMS

Fleet Usage Monitoring System. HUMS for a particular fleet of aircraft (not very common).

GAHMM

Global Aircraft Health Monitoring and Management. Airbus system for predictive maintenance.

GHUMS

Generic HUMS. See HUMS.

GSX-500

Suite of ground-station software products. Some of these products are third-party.

GTS-500

Suite of ground-station hardware products. Some of these products are third-party.

Hamming code

A method by which extra bits can be added to a word so as to detect one (or more) bit errors (and possibly fix them).

hDefML

Hardware Definition Markup Language. A hardware definition schema, used by Acra software to program Acra hardware.

HUMS

Health and Usage Monitoring System. Mostly (and originally) for helicopters. Focused on rotating parts (gear box, shaft) with specific software for frequency analysis and cumulative databases. Variants include E-HUMS (engines), T-HUMS (Turbo prop shafts).

iBIT

Initiated Built-In-Test.

ICMP

Internet Control Management Protocol. An IP protocol used to send error and control messages. The most widely known ICMP function is the Ping command which echoes a message across the network which allows the communication path between end nodes to be tested.

IEEE

Institute of Electrical and Electronic Engineers. A membership organization that includes engineers, scientists, and students in electronics and allied fields.

iDefML

An XML file for each piece of hardware, which outlines the XidML schemas that apply and the constraints imposed for each setting and a pointer to the data sheet. For Acra KAM-500 modules, it also contains register definition and EEPROM generation sections.

IGMP

Internet Group Management Protocol. The protocol that governs the management of multicast groups in an IP network.

ISI

InterSymbol Interference. A form of distortion of a signal in which one symbol interferes with subsequent symbols. This is an unwanted phenomenon as the previous symbols have a similar effect as noise, thus making the communication less reliable.

IRIG

Inter-Range Instrumentation Group. The standards body of the Range Commanders Council (RCC).

IRIG time codes

The different time codes have alphabetic designations. A, B, D, E, G, and H are the standards currently defined. The main difference between codes is their rate, which varies between one pulse per minute and 10,000 pulses per second.

IRIG 106 (Ch.4 Ch.8 Ch.10)

Inter Range Instrumentation Group. IRIG-106 is the main standard in our industry, containing chapters on PCM (ch. 4), MIL-STD-1553 snarfing (ch. 8), solid state storage (Ch.10), and RF standards (appendices).

iNET

Integrated Network Enhanced Telemetry. A program, led by Southwest Research Institute that is developing a standard for next-generation data acquisition systems. A key objective of iNET is to adopt open standard network-based technologies to ensure reduced costs and equipment interoperability.

Since the iNET standard is not released as of 2012, iNET-X is an expedited implementation of the iNET standard that provides the core functionality, technologies, and standards that are outlined in the iNET standard and unlikely to change in the released version of the standard. For the end user, iNET-X provides a phased, safe, and gradual transition towards network based technologies.

IP

Internet Protocol. The network layer protocol OSI stack. The IP layer provides logical IP source and destination addresses for packets that are transmitted across the network.

IP address

The address of a device attached to an IP network. Every network node must have a unique IP address for each network connection. The format of an IP (version 4) address is a 32-bit numeric address, written in dotted quad format. Each number can be zero to 255. For example, 1.160.10.240 could be an IP address. Some IP addresses are reserved. For more information, see http://www.iana.org/numbers

IPC

Institute for Printed Circuits. Class 3 is the best standard for visual inspection of assembled Printed Circuit Boards (PCBs).

IP subnet addressing

Routers, or gateways, are used to separate networks. The router breaks the network into multiple subnets. This result may seem familiar as Class A, B, and C addresses have a self-encoded or default subnet mask built in; class A network address - 255.0.0.0: class B network address - 255.255.0.0: class C network address - 255.255.255.0.

ISO 9000

ISO 9000 is a family of standards for quality management systems. ISO 9000 is maintained by ISO, the International Organization for Standardization. Adhering to an ISO 9000 standard certifies that formalized business processes are being applied.

ISHM

Integrated Systems Health Management. Similar to L/ESS.

JIRA

Curtiss-Wright's internal issue-tracker software.

KAM chassis

Consists of housing, Power Supply Units (PSU), and backplane.

kbps

KiloBits Per Second. A unit of data transfer rate equal to one thousand bits per second.

ksps

KiloSamples Per Second. One thousand samples per second.

kHz

KiloHertz. One thousand cycles per second. It is used to measure the transmission frequency of electronic devices, including channels, buses, and the computer's internal clock.

KGV-69

A chip designed to be a 'bare bones' encryptor for use in very high risk applications. The KGV 69 encrypts and decrypts serial data at up to 50 Mbps.

KSM-500

The software tools used to support Acra KAM-500 hardware.

kV

KiloVolt. One thousand volts.

L/ESS

Loads and Environmental Spectra Survey. Mostly airframe strain gauges.

LNA

Low-Noise Amplifier. An amplifier used in communication systems to amplify very weak signals.

LXI

LAN eXtensions for Instrumentation. A standard developed by the LXI Consortium. The LXI standard defines devices using open-standard LAN (Ethernet) for system inter-device communication.

mA

MilliAmpere. One thousandth of an amp.

MAC

Medium Access Control. The MAC layer adds source and destination hardware address identification to MAC frames transmitted across the Ethernet. The MAC layer also defines the protocol governing the transmission of Ethernet frames over the medium. The MAC layer of wired IEEE 802.3 Ethernet is CSMA/CD whilst the MAC layer of wireless IEEE 802.11 is CSMA/CA.

MAC address

A hardware address which uniquely identifies each node of a network. In IEEE 802 networks, the Data Link Control (DCL) layer of the OSI reference model is divided into two sublayers—the Logical Link Control (LLC) layer and the Media Access Control (MAC) layer. The MAC layer interfaces directly with the network medium. Consequently, each different type of network medium requires a different MAC layer.

Matched filter

The optimum filter required to maximise the signal-to-noise ratio in receivers. The GTS/DEC/003 uses a fully programmable digital matched filter.

Matches to lock

The number of valid sync words (1-16) required after loss before the data is considered valid.

Max

Error, including drift over temperature. Contrast with Typical.

Mbps

MegaBits Per Second. One million bits per second. (If the B is upper case, it is MegaBytes per Second—one million bytes per second.)

MBps

MegaBytes Per Second. One million bytes per second. 1 MB = 1024 kB.

MHz

MegaHertz. One million cycles per second. It is used to measure the transmission speed of electronic devices, including channels, buses, and the computer's internal clock.

MIL-STD

Military Standard. A detailed technical specification for a product that is purchased by a U.S. military agency.

Misses to loss

The number of sync words (1-16) which fail the match tolerance before data is considered invalid.

ms

MilliSecond. One thousandth of a second.

Msps

MegaSamples Per Second. One thousand samples per second.

MTBF

Mean Time Between Failures. The mean (average) time between failures of a system.

MTU

Maximum Transmission Unit. Maximum packet size allowed to be carried on the network segment. Any packet that exceeds the MTU is fragmented by the intermediate router or switch or may be discarded. Typically the MTU of an Ethernet frame is 1522B on an IEEE 802.3 100BaseTX Ethernet network segment.

mV

MilliVolt. One thousandth of a volt.

NDA (IP)

Non-Disclosure Agreement (Intellectual Properties). A legal contract, between at least two parties, that outlines confidential materials or knowledge which the parties wish to share. As part of the contract, the parties agree not to disclose information covered by the agreement.

NRE

Non-Recurring Engineering. Any task to be carried out by product development becomes an active NRE. Every active NRE culminates in a DVR.

NRZ-L

Non-Return to Zero Level. See PCM Codes.

NRZ-M

Non-Return to Zero Mark. See PCM Codes.

NRZ-S

Non-Return to Zero Space. See PCM Codes.

ns

Nano Second. One billionth of a second (1E-9 seconds).

NTP

Network Time Protocol. Internet time synchronization protocol with millisecond accuracy.

OLM

Operational Loads Monitoring. Mostly airframe strain gauges.

OSI (model)

Open System Interconnection. An ISO standard for worldwide communications that defines a framework for implementing protocols in seven layers. Control is passed from one layer to the next, starting at the application layer in one station, proceeding to the bottom layer, over the channel to the next station and back up the hierarchy.

Package

An element of XidML that describes how data is transported. For example, when starting kExcel we have to select the package (PCM format) to be loaded in SAM/DEC/007.

PAM

Pulse Amplitude Modulation. Pulse modulation in which a voltage is sampled periodically, then transmitted as an analog signal whose amplitude is proportional to the sampled voltage. Because PAM is susceptible to transmission noise, it has been replaced by PCM in most telemetry applications. For more information, see *TEC/NOT/024, Evolution of Pulse Code modulation (PCM)*.

Parser

Primarily a Curtiss-Wright word for a bus monitor that stores whole packets in triple buffers (received, interim, and read) so that specific words from specific packets can be included coherently.

pBIT

Periodic Built-In-Test.

PCB

Printed Circuit Board. A rigid, flat board that holds chips and other electronic components. A PCB legend on a PCB indicates its part number and serial number.

PCM

Pulse Code Modulation. The primary way analog signals are converted into digital form by taking samples of the waveforms from 8 to 192 thousand times per second (8 to 192 kHz) and recording each sample as a digital number from 8 to 24 bits long.

PCM Codes

Any of several encoding schemes used to convert a parallel digital value into a serially transmitted sequence of binary code. For more information on PCM codes, see *TEC/NOT/027, IRIG 106-96 chapter 4*.

PHM

Prognostic Health Monitoring. Like CBM, originally used for wind turbines and generators.

PHUMS

Prognostic HUMS. See HUMS.

PING

Packet Inter-Network Groper (ICMP Echo Request). An Internet utility used to determine whether a particular IP address is reachable by sending out a packet and waiting for a response. PING is used to test and debug a network as well as see if a user or server is online.

PO

Purchase Order. Document issued by a buyer to a seller, indicating the type, quantities and agreed prices for products or services the seller will provide to the buyer.

Port

A number used, in conjunction with the IP address, to indicate one end of an Ethernet conversation. Some port numbers are reserved for particular services. The port number identifies what type of port it is. For example, a server listening for HTTP traffic listens on port 80. Port numbers range from 0 to 65536, but only port numbers 0 to 1024 are reserved for privileged services and designated as well known ports. For more information, see http://www.iana.org/numbers

PTP

Precision Time Protocol, IEEE 1588. GPS-triggered time synchronization protocol with sub-millisecond accuracy.

PPM

Parts Per Million.

Pps

Packets Per Second. The measurement of activity in a local area network.

QoS

Quality of Service. A measure of performance in a data communications system, which may comprise of one or more metrics. In networked-based systems typical QoS metrics include latency, jitter, throughput, and loss. QoS provisioning mechanisms

are used to ensure that the system's performance meets the target QoS goals as defined by the relevant QoS metrics.

QPSK

Quadrature Pulse Shift Keying. A digital modulation scheme that conveys data by changing, or modulating, the phase of a reference signal (the carrier wave). See FSK.

QRRC

Quaternary Root Raised Cosine. A base-band modulation that allows almost twice the data rate as PCM/FM in the same RF band.

RAM

Random Access Memory. Memory that is 'byte addressable' and provides direct access to any location on the chip. The contents of any byte can be read or written without regard to the bytes before or after it.

RARP

Reverse ARP. A protocol that retrieves the IP address associated with a given MAC address.

Ratiometric

In electronic or electromechanical systems, it refers to the output voltage as a ratio of the supply voltage. For example, if the input voltage is doubled, the output voltage is doubled.

RCC

Range Commanders Council. The RCC is part of the U.S. Government. See IRIG.

RDAU

Remote Data Acquisition Unit.

Return code

Represents the success condition of a tool. '1' means success; '0' means failure.

RFP

Request for Proposal. Invitation for suppliers, often through a bidding process or invitation to tender, to submit a proposal on specific commodity or service.

RFQ

Request for Quotation. A process where suppliers are invited to bid on specific products or services.

ROM

Rough Order (of) Magnitude estimate. An early cost estimate used to give a rough estimate of what the project will cost to complete.

ROM

Read Only Memory. Memory that permanently stores instructions and data. Its content is created in the last masking stage of the chip manufacturing process and cannot be changed. Although EPROMs, EEPROMs, and particularly flash memory, are the kinds of non-volatile storage one hears about more often, ROM technology is mature and inexpensive.

RMA

Return Merchandise Authorization. An RMA is the official authorization from Acra that it will accept product to be returned from a customer site. An RMA is typically granted by Acra when there is a problem with a product which necessitates its return to Acra for repair, rework, or replacement. RMAs are granted by the Applications Department at Acra.

RNRZ-L

Randomized Non-Return to Zero Level. See PCM Codes.

RTP

Real-time Transport Protocol. Transport protocol running over UDP/IP, used for real-time applications.

RTSP

Real-Time Streaming Protocol. An application level protocol for controlling the delivery of data with real-time properties. RTSP is known as the Internet remote control since it provides a mechanism for users to PLAY, PAUSE, and REWIND selected streams of data. The RTSP protocol only defines how to command real-time streams, it does not define how those streams are delivered across the network.

RX

Receive. A communications abbreviation for receive. Contrast with TX.

RZ

Return to Zero. See PCM Codes.

SDRS

Structural Data Recording System. Similar to SUMS.

SHM

Structural Health Monitoring. Used for civil engineering originally (bridges, buildings) and then airplanes.

SINAD

Signal to Noise And Distortion ratio.

Snarfer

Primarily a Curtiss-Wright word for a bus monitor that stores traffic and tags (such as time) in a FIFO. For example, as per IRIG-106 chapter 8.

SNMP

Simple Network Management Protocol. A widely used network monitoring and control protocol. Data is passed from SNMP agents, which are hardware and/or software processes, reporting activity in each network device, such as a hub, router or bridge, to the workstation console used to oversee the network.

SOQPSK

Shaped Offset Quadrature Phase-Shift Keying. See QPSK.

sps

Samples Per Second.

SRAM

Static RAM. A fast memory technology that requires power to hold its content. Static RAM (SRAM, S-RAM) is used for high-speed registers, caches, and relatively small memory banks such as a frame buffer on a display adapter.

SPHM

Structural Prognostic Health Monitoring. Similar to PHM.

SSS

Smart Source Selector. A Curtiss-Wright technology where elements of link power, signal-to-noise ratio, best bit selection, and best data selection are used in diversity combining.

STP

Shielded Twisted Pair. STP is used in noisy environments where the shield around each of the wire pairs, plus an overall shield, protects against excessive electromagnetic interference. Contrast with UTP.

SUMS

Structural Usage Monitoring System. Mostly used for aerostructures/wings on airplanes.

Switch

A device that can forward Ethernet frames to their destination.

Sync word match tolerance

The number of bits (0-63) that can be incorrect and the sync word is still considered a match.

TATEM

Technologies And Techniques for new Maintenance concepts. EU study with 60 companies under framework program.

TCP

Transmission Control Protocol. A reliable transport protocol, which ensures that all data arrive accurately and 100% intact at the other end by allowing for acknowledgments and retransmissions of lost packets.

TCP/IP

Transmission Control Protocol/Internet Protocol. This de facto Unix standard is the protocol of the Internet and the global standard for communications.

TDM

Time Division Multiplexing. A process by which there is a strictly defined schedule that controls when a node can transmit on the bus.

TDMA

Time Division Multiple Access. A process by which there is a strictly defined schedule that controls when a node can transmit on the bus. Multiple nodes may access the bus.

Telemetry

The science of gathering information at some remote location and transmitting the data to a convenient location to be examined and recorded.

TFTP

Trivial File Transfer Protocol. File transfer protocol that runs over UDP/IP.

THD

Total Harmonic Distortion. A measurement of the harmonic distortion present in a signal. It is defined as the ratio of the sum of the powers of all harmonic components, to the power of the fundamental frequency.

THUMS

Engine HUMS (T=Turbo fan/shaft/jet). See HUMS.

TMATS

TeleMetry Attributes Transfer Standard. ASCII file metadata format for PCM related metadata.

TX

Transmit. A communications abbreviation for transmit. Contrast with RX.

Typical

Error at 25°C. Contrast with Max.

UDP

User Datagram Protocol. An unreliable connection-less transport protocol which doesn't provide a guarantee that packets will arrive, or that they will arrive in the order in which they were sent. UDP is widely used for streaming audio and video, voice over IP (VoIP), and videoconferencing.

UTP

Unshielded Twisted Pair. A pair of wires that are twisted around each other to minimize interference. Contrast with STP.

VDC

Volts Direct Current. Electricity whose polarity is constantly the same polarity.

VHM

Integrated Vehicle Health Monitoring. Used for NASA space vehicles originally. Relies on extensive network of sensors built into the vehicle.

Viterbi Equalization

A method of taking advantage of known inter-symbol interference inherent in some modulation schemes such as PCM/FM to improve bit error rate.

VHUMS

Vehicle HUMS. See HUMS.

VL

A Virtual Link defines a preconfigured unidirectional connection from one end system to one or more destination end systems in an ARINC 664 Part 7 network.

VLAN

Virtual Local Area Network (Ethernet). A logical subgroup within a local area network that is created via software rather than manually moving cables in the wiring closet.

V_{rms}

Volts Root-Mean-Square. The root-mean-square (rms) voltage of a sinusoidal source of an electromotive force: V_{rms} is used to characterize the source. It is the square root of the time average of the voltage squared.

V_{p-p}

Volts Peak-to-Peak. The difference between the largest voltage in the signal and the lowest voltage in the signal.

WLAN

Wireless Local Area Network (IEEE 802.11). A local area network that transmits over the air typically in the 2.4GHz or 5GHz unlicensed frequency band.

XdefML

XidML Definition Markup Language. A published (on www.xidml.org) validation schema that can optionally be used in conjunction with XidML to allow vendors to specify constraints for their XidML instrument definitions.

Xid

eXtensible Instrumentation Definition. Old metadata standard, now replaced by XidML.

XidML

eXtensible Instrumentation Metadata exchange Mark-up Language. A published metadata schema for how telemetry systems are configured. XidML supersedes XID and Curtiss-Wright's XML. It includes hardware, packet, and processing setup information.

XHUMS

Experimental HUMS. See HUMS.

X-Tools

Versions of some of Curtiss-Wright's software tools, such as X-Setup, X-Report, X-Translate, and X-Validate; introduced in an attempt to popularize XidML.

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Controlled document revision histories

The following documents have been updated since the previous release of the Acra KAM-500 Databook:

- KAD/MAT/101

Documents which have updates are marked by a ●.

Documents are arranged by alpha-numeric order of their titles

DST/X/034		**3D DRAWINGS**
Date	**Action**	**Reason**
10 Oct. 2019	Added ACD/BAC/003/B to list of 3D drawings.	
28 May 2019	List of 3D drawings available updated to include AXN/CHS/06U, AXN/CHS/09U, AXN/CHS/16U, and AXN/ITE/01U.	
6 Dec. 2018	List of 3D drawings available updated to include NET/SWI/101/C.	
21 Jan. 2016	List of 3D drawings available updated to include KAM/CHS/12R/E.	
10 Apr. 2015	Applied Defense Solutions template features.	
23 Feb. 2015	Applied Defense Solutions template features.	
10 Nov. 2014	Applied Curtiss-Wright template features.	
20 Sep. 2012	Curtiss-Wright template applied.	
21 Jun. 2012	SSR/CHS/001/B added to list of products for which there is a 3D drawing.	
14 Jun. 2011	Issued first release.	
DST/V/064		**KAD/ABM/101 DATA SHEET**
Date	**Action**	**Reason**
2 Sep. 2021	In ARINC-429 inputs table, changed statement that ARINC-429 part 1 receiver is compliant to instead state that it is compatible; added Operating range to table.	
1 Feb. 2018	Added back to Databook	Classification changed to standard.
9 Feb. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
18 Oct. 2013	Rephrased some parts of the Description section. In Parameter definitions table, updated “Label[7:0]” to “Label[0:7]”. Updated Getting the most section.	
20 Sep. 2012	Curtiss-Wright template applied.	
28 Nov. 2011	Updated template, which included updates to Supporting Software and Related Documentation	
8 Jul. 2011	Issued first release of data sheet	
DST/X/055		**KAD/ABM/103 DATA SHEET**
Date	**Action**	**Reason**
14 Jun. 2022	In ARINC-429 inputs table, removed Input voltage and Input resistance parameters from table and added Operating range. Updated “Setting up the KAD/ABM/103” tables. Adding new “MessageDataStyleB” section. In the Related documentation table, added TEC/NOT/086 - Using the KAD/ABM/103.	

23 Feb. 2016	In the Parameter definitions table, Report parameter, removed definitions for R(3:0) ErrorCode. These definitions are now described in the Error codes table. In the iNET-X parser-aligned packet format section, revised the description for Bits [16:23]: message counter.	
20 Jan. 2016	Added back to Databook	Classification changed to standard.
18 Sep. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
15 Apr. 2015	Applied Defense Solutions template features (including a revision of the features listed on the first page).	
26 Feb. 2015	Applied Defense Solutions template features. In Figure 1, updated text for Triple Buffered Word to read x 8191. In Instrument settings tables, amended descriptions for Utilization, Report, and MessageDataStyleA. In the Packetizer error codes for the KAD/ABM/103 section, clarified the introduction to Table 4.	
14 Nov. 2014	In Getting the most from... section, added new Auto-detect rate section.	
22 Aug. 2014	Applied Curtiss-Wright template features.	First released as non standard product. Added to databook when status changed to standard.

DST/J/064 — **ACC/HSK/001 DATA SHEET**

Date	Action	Reason
9 Jun. 2016	In Table 4, corrected heatsink length from 265mm to 247mm. In the Note that follows Table 4, specified that screws should initially be tightened to 0.4Nm.	
16 Apr. 2015	Applied Defense Solutions template features.	
20 Sep. 2012	Curtiss-Wright template applied.	
31 May	Added details of the mounting screw to the ordering information	
23 May 2012	Added the following note: To maximize heat transfer efficiency we recommend using a thermal conductive compound between the heat sink and the chassis.	
1 May 2012	Added a note stating mounting screws should be tightened to 0.6Nm and thread lock glue should be applied to each screw.	
17 Apr. 2012	Removed reference to mounting screw part number.	Mounting screw now included in the heat sink part number.
28 Nov. 2011	Updated template, which included updates to Supporting Software and Related Documentation	
23 Jan. 2008	Updated table format.	
1 Dec. 2006	Updated specifications tables.	
18 Oct. 2006	Reformatted data sheet.	
14 Jul. 2006	Clarified ACC/SCW/001 ordering options.	
13 Apr. 2006	Updated ordering options to include ACC/SCW/001	
10 Feb. 2006	Reformatted data sheet	
3 Jul. 2003	Changed product number for heatsinks	Part numbers renamed IAW Acra's part numbering scheme.
1 May 2002	**Specifications:** Updated to show new widths and 009/QB3 of heat sinks	**Specification change.**
1 Nov. 2000	Issued preliminary data sheet	

DST/AC/020 — **ACC/TRF/002 DATA SHEET**

Date	Action	Reason
31 Oct. 2023	Inserted new "Figure 2: ACC/TRF/002 mechanical drawing".	

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2 Dec. 2022	Corrected module name in Figure 2 from “ACC/TRF/002/B” to “ACC/TRF/002”.	
17 Nov. 2017	Issued first release of data sheet	

DST/W/106		**ACD/BAC/002/B DATA SHEET**
DATE	ACTION	REASON
30 Nov. 2016	Added connector assembly instructions for the ACD/BAC/002/B/01 production revision.	To address differences between the /00 and /01 revisions.
9 Feb. 2015	Applied Defense Solutions template features.	
10 Nov. 2014	Applied Curtiss-Wright template features.	
28 Feb. 2013	Updated data sheet title description.	
20 Sep. 2012	Curtiss-Wright template applied.	
28 Nov. 2011	Updated template, which included updates to Supporting Software and Related Documentation	
6 Jan. 2011	Issued first release of data sheet	

DST/W/107		**ACD/BAC/003/B DATA SHEET**
Date	**Action**	**Reason**
9 Feb. 2015	Applied Defense Solutions template features.	
10 Nov. 2014	Applied Curtiss-Wright template features.	
28 Feb. 2013	Updated data sheet title description.	
20 Sep. 2012	Curtiss-Wright template applied.	
28 Nov. 2011	Updated template, which included updates to Supporting Software and Related Documentation	
6 Jan. 2011	Issued first release of data sheet	

DST/W/108		**ACD/BAC/004/B DATA SHEET**
Date	**Action**	**Reason**
9 Feb. 2015	Applied Defense Solutions template features.	
10 Nov. 2014	Applied Curtiss-Wright template features.	
28 Feb. 2013	Updated data sheet title description.	
20 Sep. 2012	Curtiss-Wright template applied.	
28 Nov. 2011	Updated template, which included updates to Supporting Software and Related Documentation	
6 Jul. 2011	Replaced the mechanical drawing, on the first page, with the most recent version.	
14 Jan. 2011	Issued first release of data sheet	

DST/W/017		**ACD/BAC/005 DATA SHEET**
Date	**Action**	**Reason**
9 Feb. 2015	Applied Defense Solutions template features.	
10 Nov. 2014	Applied Curtiss-Wright template features.	
28 Feb. 2013	Updated data sheet title description.	
20 Sep. 2012	Curtiss-Wright template applied.	

28 Nov. 2011	Updated template, which included updates to Supporting Software and Related Documentation	
17 Sep. 2010	Issued first release of data sheet	

DST/AB/003 **ACD/BAC/006 DATA SHEET**

Date	Action	Reason
20 Dec. 2023	In the Overview section, removed references to the two crinkle washers. In the Getting the most from the module section, specified that the maximum torque of 0.8 Nm (0.59 ft/lbs) to the 4-40 UNC captive bolts is for use with user modules with an /SEF part number while a torque of 0.4 Nm (0.295 ft/lbs) is used in all other cases; changed the recommended torque when using thread lock 0.25 Nm (0.184 ft/lbs). Added CON/KAD/002/CP/SEC to the Related products.	
25 Apr. 2023	Deleted references to National Aerospace Standard (NAS). In the Getting the most from the module section, changed the torque when fastening the backshell to the chassis from 1.4 Nm to 0.8 Nm.	
20 Jan. 2021	On page 1, clarified descriptions for parts that ship. In Getting the most from the ACD/BAC/006 first paragraph, clarified to which part the torque applies. In step 4 of the Connector assembly procedure, clarified usage of the strain relief clamps and added a table to show all parts in the drawing.	
17 Jul. 2017	In the Connector assembly procedure, added a drawing and made some text modifications to clarify assembly.	
7 Apr. 2016	In the Connector assembly procedure, clarified in the Note, that thread lock is used and bolts are torqued.	
3 Jun. 2015	Issued first release of data sheet	

DST/AG/007 **ACD/BAC/007 DATA SHEET**

Date	Action	Reason
20 Dec. 2023	In the Overview section, removed references to the two crinkle washers. In the Getting the most from the module section, specified that the maximum torque of 0.8 Nm (0.59 ft/lbs) to the 4-40 UNC captive bolts is for use with user modules with an /SEF part number while a torque of 0.4 Nm (0.295 ft/lbs) is used in all other cases; changed the recommended torque when using thread lock 0.25 Nm (0.184 ft/lbs). Added CON/KAD/002 and CON/KAD/002/CP/SEC to the Related products.	
25 Apr. 2023	Deleted references to National Aerospace Standard (NAS). In the Getting the most from the module section, changed the torque when fastening the backshell to the chassis from 1.4 Nm to 0.8 Nm.	
17 Jun. 2020	Issued first release of data sheet	

DST/AB/004 **ACD/BAC/011 DATA SHEET**

Date	Action	Reason
18 Jul. 2017	In the Connector assembly procedure, added a drawing and made some text modifications to clarify assembly.	
7 Apr. 2016	In the Connector assembly procedure, clarified in the Note, that thread lock is used and bolts are torqued.	
3 Jun. 2015	Issued first release of data sheet	

DST/P/014 **ACD/CJB/001 DATA SHEET**

Date	Action	Reason
23 Feb. 2015	Applied Defense Solutions template features.	
10 Nov. 2014	Applied Curtiss-Wright template features.	

27 Feb. 2013	Updated data sheet title description.	
20 Sep. 2012	Curtiss-Wright template applied.	
28 Nov. 2011	Updated template, which included updates to Supporting Software and Related Documentation	
23 Jan. 2008	Updated table format.	
18 Oct. 2006	Reformatted data sheet.	
13 Apr. 2006	Updated mechanical drawing for clarity	**Documentation error**
10 Feb. 2006	Reformatted data sheet	
7 Sep. 2005	Enlarged mechanical drawing.	**Customer feedback. Drawing was enlarged for clarity.**
4 May 2004	Issued first release of data sheet	

DST/W/018 — **ACD/CJB/002 DATA SHEET**

Date	Action	Reason
16 Apr. 2015	Applied Defense Solutions template features.	
25 Mar. 2013	Updated Description with additional information on the ACD/BAC/005 backshell and the CON/KAD/010 mating connector. Added Mechanical specification table and drawing.	
27 Feb. 2013	Updated data sheet title description.	
20 Sep. 2012	Curtiss-Wright template applied.	
17 Sep. 2012	Removed the line under Ordering Information which stated: “By default, the ACD/BAC/005 and CON/KAD/010 are included as part of the shipment.”	
28 Nov. 2011	Updated template, which included updates to Supporting Software and Related Documentation	
17 Sep. 2010	Issued first release of data sheet	

DST/W/018 — **ACD/CJB/003 DATA SHEET**

Date	Action	Reason
16 Apr. 2015	Applied Defense Solutions template features.	
13 Jun. 2013	Added mechanical specifications and mechanical drawing of ACD/BAC/002/B to data sheet.	
27 Feb. 2013	Updated data sheet title description.	
2 Oct. 2012	Issued first release of data sheet	

DST/AB/001 — **ACD/CJB/005 DATA SHEET**

Date	Action	Reason
5 Dec. 2016	Issued first release of data sheet	

DST/K/003 — **ACM/EXT/001/B DATA SHEET**

Date	Action	Reason
9 Feb. 2015	Applied Defense Solutions template features.	
10 Nov. 2014	Applied Curtiss-Wright template features.	
27 Feb. 2013	Updated data sheet title description.	
20 Sep. 2012	Curtiss-Wright template applied.	

28 Nov. 2011	Updated template, which included updates to Supporting Software and Related Documentation	
23 Jan. 2008	Updated table format.	
1 Dec. 2006	Updated specifications tables.	
18 Oct. 2006	Reformatted data sheet and updated features.	
10 Feb. 2006	Reformatted data sheet	
7 Sep. 2005	Replaced reference to ACM/EXT/001 with reference to ACM/EXT/001/B	**Specification change.** New extender board released.
4 Jan. 2005	Removed references to ACC/EXT/002	**Documentation error.**
1 Apr. 2004	Changed ACC/EXT/001 to ACM/EXT/001 IAW part numbering scheme	
1 Feb. 2002	**Title:** Changed title of data sheet from "ACC/EXT/001" to "Extender boards" Added details of ACC/EXT/002	**Specification change.** A second extender board was released. **Specification change.** A second extender board was released.
1 Apr. 2001	**Features**: Added photograph of ACC/EXT/001	
1 Nov. 2000	Issued preliminary data sheet	

DST/Y/008 — **KAD/ABM/102/B DATA SHEET**

Date	Action	Reason
18 May 2017	In ARINC-429 inputs table, changed statement that ARINC-429 part 1 receiver is compliant to instead state that it is compatible.	
15 Apr. 2015	Applied Defense Solutions template features (including a revision of the features listed on the first page).	
7 Aug. 2014	In Getting the most from section, added new Packetizer message counter section.	
3 Mar. 2014	Issued first release of data sheet.	First released as non standard product. Added to databook when status changed to standard.

DST/Y/051 — **KAD/ABM/102/B/EM1 DATA SHEET**

Date	Action	Reason
13 Aug. 2021	In ARINC-429 inputs table, changed statement that ARINC-429 part 1 receiver is compliant to instead state that it is compatible. Removed Input voltage and Input resistance parameters from table and added Operating range.	
15 Apr. 2015	Applied Defense Solutions template features (including a revision of the features listed on the first page).	
11 Mar. 2015	Applied Defense Solutions template features. In BTTL inputs table, changed Inputs condition to Internally pulled to logic 0.	
9 Jan. 2014	Issued first release of data sheet	

DST/N/053 — **KAD/ADC/008 DATA SHEET**

Date	Action	Reason
27 Sep. 2022	Issued first release of data sheet	

DST/R/046 — **KAD/ADC/010/C DATA SHEET**

Date	Action	Reason
17 Apr. 2015	Applied Defense Solutions template features (including a revision of Key Features and Applications on the first page).	
10 Nov. 2014	Applied Curtiss-Wright template features.	

19 Feb. 2013	Updated data sheet title description.	
20 Sep. 2012	Curtiss-Wright template applied.	
21 Dec. 2011	New template applied.	
23 Dec. 2010	Updated values for 0.1B bandwidth and filter cutoff -3dB in the Differential ended analog inputs table	
1 Dec. 2010	Applied template update (which included adding “KAD/” prefix to module name).	
10 Jun. 2008	Updated specifications and module setup.	
18 Oct. 2006	Updated Module setup, and reformatted data sheet.	
10 Feb. 2006	Reformatted data sheet	
1 Dec. 2005	Issued first release of data sheet.	

DST/R/044 **KAD/ADC/011/C DATA SHEET**

Date	Action	Reason
18 Mar. 2015	Applied Defense Solutions template features (including a revision of the features listed on the first page).	
10 Nov. 2014	Applied Curtiss-Wright template features.	
8 Feb. 2013	Updated data sheet title description. In Features, changed FSR as follows: for 10V module from “±0.3%” to “±0.6%”; for 40V module from “±0.55%” to “±1.2%”. Added “Up to 1.17kHz bandwidth (KAD/ADC/011/40V)” for 40V module. In Description, removed second paragraph “The signal conditioning...” Added block diagram for 40V module. In Single ended analog inputs table, updated values for DC error, Effective number of bits, Crosstalk, Analog filter, and Input resistance.	
20 Sep. 2012	Curtiss-Wright template applied.	
21 Dec. 2011	New template applied. Changed Pin 50 from Chassis to ground.	
23 Dec. 2010	Updated values for 0.1B bandwidth and filter cutoff -3dB in the Differential ended analog inputs table	
1 Dec. 2010	Applied template update (which included adding “KAD/” prefix to module name).	
11 Aug. 2008	Updated description for understanding filter delays.	
10 Jun. 2008	Updated specifications and module setup; corrected filter delay equation.	
6 Jul. 2007	Updated specifications.	
18 Oct. 2006	Updated Module setup, and reformatted data sheet.	
14 Jul. 2006	Corrected features	**Documentation error**
13 Apr. 2006	Corrected ordering options	**Documentation error**
10 Feb. 2006	Reformatted data sheet	
7 Sep. 2005	**Specifications:** Clarified description of delay between Ch0-Ch23 and Ch24-Ch47 Setup: Changed Settings for filter cutoff to 0.125Hz to 2.125Hz	**Documentation error.**

8 Aug. 2005	**Features:** Changed Programmable gain, offset and filter cutoff for each channel to Programmable digital gain offset and filter cutoff for each channel **Description:** Changed last paragraph to read: The signal conditioning on KAD/ADC/011/C consists of unity gain buffer with the optional attenuation resistor at the input stage such that the input options are ±10V or ±40V. Secondary gain and offset are achieved digitally according to requested range. **Specifications:** Changed Sampling restrictions: the maximum sampling rate per channel is 8500sps to Sampling restrictions: maximum sampling rate per channel: 8.5kHz Minimum sampling rate:0.5kHz Maximum aggregate sampling rate: 408kHz Updated sampling rates **Setup:** Changed Offset to Secondary offset Changed comment to read: For example if there is no attenuation, a range from 5V to 10V can be set at the second stage (gain = 4, offset = 7.5V). Removed references to linearization tables.	**Documentation error.** **Customer feedback.** **Customer feedback.** **Documentation error.** **Customer feedback.**
1 Jul. 2005	Issued first release of data sheet.	

DST/U/028 — KAD/ADC/105/B DATA SHEET

Date	Action	Reason
17 Jan. 2022	Removed “High accuracy...” point from Key Features. In Table 2, Effective number of bits setting, for primary gain = 1000 is changed to fc <= 1kHz.	
24 Apr. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR). In the Balance current outputs table, changed the maximum DC error from 0.5 to 0.6.	
8 Jan. 2016	Added back to Databook	Classification changed to standard.
9 Nov. 2015	Applied Defense Solutions template features (including a revision of Key Features on the first page). In Additional delay sources section, removed figures and changed second sentence to: That additional delay is 2µs for a gain of 10, 15µs for a gain of 100, and 150µs for a gain of 1,000. Added DAS Studio 3 support to Supporting software section.	
6 Jan. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
19 Feb. 2013	Updated data sheet title description.	
20 Sep. 2012	Curtiss-Wright template applied.	
21 Dec. 2011	New template applied.	
22 Feb. 2010	KAM/ADC/105/B module added as ordering option.	
2 Nov. 2009	Updated Treeview icons legend.	
1 Oct. 2009	Changed power consumption values; added new Power considerations section.	
18 Aug. 2008	Issued first release of data sheet.	

DST/U/033 — KAD/ADC/106/C DATA SHEET

Date	Action	Reason
15 Jun. 2023	Added new “Temperature drift” section.	
17 Jan. 2022	In Table 3, Effective number of bits setting, for primary gain = 1000 is changed to fc <= 1kHz.	
7 Nov. 2018	In Table 2, changed the Max DC error to 1.6.	
24 Apr. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR). In the Balance current outputs table, changed the maximum DC error from 0.5 to 0.6.	

7 Sep. 2015	Reclassified data sheet as a standard product and added it to the Acra KAM-500 Databook. Applied Defense Solutions template features (including a revision of Key Features on the first page). In the General specifications table: rounded up the mass values; for the ±12V line, changed the power consumption multiplier to 1.5. In Additional delay sources section, changed second sentence to: That additional delay is 2µs for a gain of 10, 15µs for a gain of 100, and 150µs for a gain of 1,000. Added DAS Studio 3 support to Supporting software section.	**Module made non-standard in Jan. 2015 and removed from the Acra KAM-500 Databook.**
25 Nov. 2013	In Ordering Information table, added KAM/ADC/106 variant. In the Additional delay sources section, deleted text and figures relating to amplitude error and delay error.	
7 May 2013	Updated input impedance values for AC analog inputs.	
6 Mar. 2013	Moved Common mode specification from AC analog inputs table to Differential ended analog inputs table.	**Erroneously added to AC analog inputs table in 27 Feb. 2013 review.**
27 Feb. 2013	Added Common mode specification to AC analog inputs table. Updated all Input resistance figures to 10MΩ. Removed duplicated Power considerations information from page 9.	
20 Sep. 2012	Curtiss-Wright template applied.	
21 Dec. 2011	New template applied.	
2 Nov. 2009	Updated Treeview icons legend.	
5 Oct. 2009	Updated Treeview icons legend; added reference to TEC/NOT/049 in Power considerations section.	
14 Jan. 2009	Issued first release of data sheet.	
22 Aug. 2008	Issued first release of data sheet.	

DST/T/097 — **KAD/ADC/109/C/S1 DATA SHEET**

Date	Action	Reason
19 May 2021	In Table 2, Effective number of bits setting, for primary gain = 1000 is changed to fc <= 1kHz. In the Instrument settings table, Excitation Amplitude setting, changed the default to 0. Added a new “Source load error caused by the balance adjust circuit” section. In Ordering information section, added KAM/CHS/02F to the chassis that are not supported.	
24 Apr. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR). In the Balance current outputs table, changed the maximum DC error from 0.5 to 0.6.	
8 Jan. 2016	Added back to Databook	Classification changed to standard.
6 Jan. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
27 Feb. 2013	Updated data sheet description. Updated ENOB gain=100 to 11. Updated all Input resistance figures to 10MΩ.	
20 Sep. 2012	Curtiss-Wright template applied.	
23 Mar. 2012	New template applied.	
25 Feb. 2010	KAM/ADC/109/C/S1 module added as ordering option. Applied new template.	
22 Aug. 2008	Issued first release of data sheet.	

DST/U/031 — **KAD/ADC/109/C/S2 DATA SHEET**

Date	Action	Reason
1 Jun. 2021	In Table 2, Effective number of bits setting, for primary gain = 1000 is changed to fc <= 1kHz. Added a new “Sense lines” section. In Ordering information section, added KAM/CHS/02F to the chassis that are not supported.	

24 Apr. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR). In the Balance current outputs table, changed the maximum DC error from 0.5 to 0.6.	
8 Jan. 2016	Added back to Databook	Classification changed to standard.
6 Jan. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
19 Nov. 2014	Applied Curtiss-Wright template features. From Features, removed High impedance per channel when powered off. In the General specifications table, rounded up mass values. In Bipolar DC voltage excitation outputs specification table, changed resolution of 1.8 from Max. to Typ. Changed title of Bridge adjust DC current outputs table to Balance current outputs; changed “adjust line” in footnote to “balance current output”. In Additional delay sources section, changed second sentence to: That additional delay is 2µs for a gain of 10, 15µs for a gain of 100, and 150µs for a gain of 1,000. In the same section, removed the last paragraph and the two figures.	
7 May 2013	Updated input resistance values for Differential ended analog inputs.	
27 Feb. 2013	Updated data sheet description. In Differential ended analog inputs table, updated ENOB gain=100 to 1 and added new row for Input resistance. Updated Output resistance value to 0.5.	
20 Sep. 2012	Curtiss-Wright template applied.	
14 Jun. 2012	Added section to GMTF section: “Source load error caused by the balance adjust circuit.”	
23 Mar. 2012	New template applied.	
1 Dec. 2010	Applied template update (which included adding “KAD/” prefix to module name).	
22 Aug. 2008	Issued first release of data sheet.	

DST/X/058 — **KAD/ADC/111 DATA SHEET**

Date	Action	Reason
20 Feb. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR).	
1 Jul. 2016	Under Ordering information, corrected duplicate KAM/ADC/111/40V ordering option; added mating connector for KAM modules.	
23 Feb. 2015	Applied Defense Solutions template features (including a revision of the Key Features and Overview on the first page).	
5 Aug. 2014	Issued first release of data sheet.	First released as non standard product. Added to databook when status changed to standard.

DST/V/080 — **KAD/ADC/112 DATA SHEET**

Date	Action	Reason
13 Apr. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR). In the Balance current outputs table, changed the maximum DC error from 0.5 to 0.6.	
10 Apr. 2017	Updated Ordering information to insert reference to the 10V KAM variant.	
22 Apr. 2016	Updated Ordering information to insert reference to the KAM variant.	
23 Feb. 2015	Applied Defense Solutions template features (including a revision of the Key Features and Overview on the first page).	

6 Mar. 2013	Corrected maximum value for Common mode voltage (for KAD/ADC/112/1V, KAD/ADC/112/10V, and KAD/ADC/112/100M variants).	
19 Feb. 2013	Updated data sheet title description.	
20 Sep. 2012	Curtiss-Wright template applied.	
23 Mar. 2012	New template applied.	
23 Dec. 2011	New template applied.	
12 Jul. 2011	Issued first release of data sheet.	

DST/V/059 **KAD/ADC/113/B DATA SHEET**

Date	Action	Reason
6 Jan. 2023	In Table 2. RTD inputs, for the Effective number of bits parameter, changed the Condition/Details to specify ≤ 250Hz.	
3 Feb. 2020	In the “Setting the range and excitation” section, removed the last two sentences about using 2mA excitation.	
24 Apr. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR). In the Balance current outputs table, changed the maximum DC error from 0.5 to 0.6.	
18 Mar. 2015	Applied Defense Solutions template features (including a revision of the features listed on the first page).	
21 Nov. 2014	Applied Curtiss-Wright template features. In the RTD inputs table, changed units for Filter delays from f_c to ms. In the Single ended DC current excitation outputs table, corrected Compliance values. Removed Additional delay sources section.	
5 Mar. 2013	Corrected Power consumption values. Removed the example given in Setting the range and excitation section.	
19 Feb. 2013	Updated data sheet title description.	
20 Sep. 2012	Curtiss-Wright template applied.	
22 Feb. 2012	New template applied.	
27 Apr. 2010	Features updated to include “(±0.87 between -50 and 200oC @ 2mA)” beside High accuracy. Text in circuit diagram changed from “Programmable current sink 1mA to 2.066mA” to “Programmable current sink 1mA to 2mA”. KAD/ADC/013 in Related products changed to KAD/ADC/113/B/1K.	
25 Feb. 2010	KAM/ADC/113/B module added as ordering option. Applied new template.	
8 Dec. 2009	Issued first release of data sheet	

DST/Y/031 **KAD/ADC/115 DATA SHEET**

Date	Action	Reason
9 Feb. 2022	In Ordering information section, added KAM/CHS/02F to the chassis that are not supported.	
13 Apr. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR). In the Balance current outputs table, changed the maximum DC error from 0.5 to 0.6.	
11 Apr. 2016	Issued first release of data sheet.	First released as non standard product. Added to databook when status changed to standard.

DST/AJ/021		KAD/ADC/115/DT DATA SHEET
Date	**Action**	**Reason**
8 Feb. 2024	Issued first release of data sheet.	
DST/AY/014		**KAD/ADC/115/NRTD DATA SHEET**
Date	**Action**	**Reason**
3 Oct. 2023	Issued first release of data sheet.	
DST/S/083		**KAD/ADC/116 DATA SHEET**
Date	**Action**	**Reason**
25 May 2023	Added new “Temperature drift” section.	
18 Jan. 2022	Clarified that the KAM/ADC/116/10VNE variant is *not* connected internally to analog inputs but provided on top connector as separate pin.	
24 Apr. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR). In the Balance current outputs table, changed the maximum DC error from 0.5 to 0.6.	
17 Jan. 2018	In the AC analog inputs table, specified under Condition/Details for all AC gain errors the following: fc < 2 kHz.	
14 Nov. 2016	Added back to Databook	Classification changed to standard.
6 Jan. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
5 Mar. 2013	In AC analog inputs specifications table, updated aliasing to 0.1dB band value, and updated Input impedance minimum values.	
21 Feb. 2013	Updated ±12V and total power consumption values and corrected Input impedance in the AC analog inputs table	
19 Feb. 2013	Updated data sheet title description.	
20 Sep. 2012	Curtiss-Wright template applied.	
22 Feb. 2012	New template applied.	
1 Dec. 2010	Applied template update (which included adding “KAD/” prefix to module name).	
21 Dec. 2009	Removed from the November Databook because precautionary STOP SHIP was in place; the reasons for this directive have since been resolved.	
10 Jun. 2008	Updated specifications and module setup.	
23 Oct. 2007	First release.	
DST/U/034		**KAD/ADC/117/B DATA SHEET**
Date	**Action**	**Reason**
17 Jan. 2022	In Table 2, Effective number of bits setting, for primary gain = 1000 is changed to fc <= 1kHz. In Ordering information section, added KAM/CHS/02F to the chassis that are not supported.	
24 Apr. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR). In the Balance current outputs table, changed the maximum DC error from 0.5 to 0.6.	
1 Sep. 2016	Added back to Databook	Classification changed to standard.

5 Aug. 2016	Applied Defense Solutions template features (including a revision of Key Features on the first page). In Additional delay sources section, removed figures and changed second sentence to: That additional delay is 2µs for a gain of 10, 15µs for a gain of 100, and 150µs for a gain of 1,000. In Related documentation, removed reference to obsolete TEC/NOT/002.	
6 Jan. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
19 Feb. 2013	Updated data sheet title description.	
20 Sep. 2012	Curtiss-Wright template applied.	
22 Feb. 2012	New template applied.	
1 Dec. 2010	Applied template update (which included adding “KAD/” prefix to module name).	
16 Nov. 2009	Removed from the November Databook because precautionary STOP SHIP was in place; the reasons for this directive have since been resolved.	
22 Aug. 2009	Issued first release of data sheet.	

DST/T/098 — **KAD/ADC/117/EC1 DATA SHEET**

Date	Action	Reason
20 Jun. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR).	
11 May 2017	In Additional delay sources (IIR filter mode) section, deleted text “(IIR filter mode)” as applies to both filter modes. In Ordering information section, added KAM/CHS/02F to the chassis that are not supported.	
14 Nov. 2016	Added back to Databook	Classification changed to standard.
6 Jan. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
19 Feb. 2013	Updated data sheet title description.	
22 Oct. 2012	Curtiss-Wright template applied.	
22 Feb. 2012	New template applied.	
1 Dec. 2010	Applied template update (which included adding “KAD/” prefix to module name).	
16 Nov. 2009	Removed from the November Databook because precautionary STOP SHIP was in place; the reasons for this directive have since been resolved.	
16 Jul. 2008	Issued first release of data sheet	

DST/P/065 — **KAD/ADC/118 DATA SHEET**

Date	Action	Reason
24 Apr. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR). In the Balance current outputs table, changed the maximum DC error from 0.5 to 0.6.	
11 Apr. 2016	Added back to Databook	Classification changed to standard.
6 Jan. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.

8 Dec. 2014	Updated circuit diagram with additional operating amp. circuit. In the Ordering Information section, corrected descriptions of KAM/ADC/118/1V and KAM/ADC/118/100M to include "...with 51-way micro-miniature connector". In the Differential ended analog inputs table, corrected maximum gain values for DC error. In the Compensation for lead resistance (Excitation Mode set to Voltage) section, removed "(Excitation Mode set to Voltage)" from the heading and replaced the content. In the Understanding filter delays section, added definition for T_D. Removed Additional delay sources section.	
3 May 2013	Updated input resistance values for Differential ended analog inputs. Removed reference to obsolete technical note (TEC/NOT/002) from Related Documentation.	
6 Mar. 2013	Corrected maximum value for Common mode voltage. Corrected maximum value for aliasing to 0.1dB band.	
19 Feb. 2013	Updated data sheet title description.	
31 Oct. 2012	Split crosstalk figures and rejection ratio into 3 lines for ADC/118/100M, ADC/118/1V and ADC/118/10V	
26 Oct. 2012	Curtiss-Wright template applied.	
22 Feb. 2012	New template applied.	
30 Sep. 2010	In "Differential ended analog inputs" table, clarified Condition/Details for DC error; added match pair resistors to half-bridge configuration in Figure 2; added "Excitation drift on potentiometer configurations" section.	
16 Nov. 2009	Removed from the November Databook because precautionary STOP SHIP was in place; the reasons for this directive have since been resolved.	
28 Jul. 2008	Updated specifications tables.	
10 Jun. 2008	Updated specifications and module setup.	
6 Jul. 2007	Updated specification tables.	
18 Oct. 2006	Updated Module setup, and reformatted data sheet.	
13 Apr. 2006	Corrected features & specifications for accuracy	**Documentation error.**
8 Mar. 2006	Issued first release of data sheet.	

DST/R/006 — **KAD/ADC/120 DATA SHEET**

Date	Action	Reason
24 Apr. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR). In the Balance current outputs table, changed the maximum DC error from 0.5 to 0.6.	
14 Dec. 2017	In Table 2, Effective number of bits setting for 10V and 1V variants, clarified that fc = 0.25fs.	
23 Nov. 2017	Issued first release of data sheet	

DST/V/060 — **KAD/ADC/126/B DATA SHEET**

Date	Action	Reason
13 Apr. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR). In the Balance current outputs table, changed the maximum DC error from 0.5 to 0.6.	
1 Sep. 2016	Added back to Databook	Classification changed to standard.
9 Jun. 2016	In AC analog inputs table, changed Primary gain, max. values for 3kHz and 10kHz.	

11 Nov. 2015	Applied Defense Solutions template features (including a revision of Key Features on the first page). In General specifications table, revised Mass and +/-12V multiplier. In AC analog inputs table, revised AC gain error. In Additional delay sources section, changed second sentence to: That additional delay is 2µs for a gain of 10, 15µs for a gain of 100, and 150µs for a gain of 1,000; and removed both figures.	
14 Apr. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
18 Mar. 2015	Applied Defense Solutions template features (including a revision of the features listed on the first page).	
19 Feb. 2013	Updated data sheet title description.	
20 Sep. 2012	Curtiss-Wright template applied.	
22 Feb. 2012	New template applied.	
11 Jan. 2011	Added a +/-7 row for Power consumption in the General specifications table and added a reference to Understanding filter delays in the Filter delay row in the AC analog inputs table. KAM/ADC/126/B variant added.	
1 Dec. 2010	Applied template update (which included adding “KAD/” prefix to module name).	
8 Dec. 2009	Issued first release of data sheet	

DST/S/085 — **KAD/ADC/129/S1 DATA SHEET**

Date	Action	Reason
8 May 2019	In Ordering information section, added KAM/CHS/02F to the chassis that are not supported.	
23 Jul. 2018	In the Differential ended analog inputs table, removed Typical values for AC gain error. Added new “Source load error caused by the balance adjust circuit” section.	
13 Apr. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR). In the Balance current outputs table, changed the maximum DC error from 0.5 to 0.6.	
14 May 2015	Mass values rounded up. In the Compensation for lead resistance section, changed excitation setting to 2.5. In Additional delay sources section, removed current paragraph and figures and replaced with two new paragraphs. Removed DAS Studio 3 from Supporting software and Related documentation tables.	
23 Feb. 2015	Applied Defense Solutions template features (including a revision of the Key Features and Overview on the first page).	
19 Feb. 2013	Updated data sheet title description.	
20 Sep. 2012	Curtiss-Wright template applied.	
11 Apr. 2012	Updated Ordering Information to insert reference to the KAM variant.	
22 Feb. 2012	New template applied.	
13 Jan. 2011	Issued first release of data sheet	

DST/V/081 — **KAD/ADC/129/S2 DATA SHEET**

Date	Action	Reason
1 Jun. 2021	Added a new “Sense lines” section. In Ordering information section, added KAM/CHS/02F to the chassis that are not supported.	
13 Apr. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR). In the Balance current outputs table, changed the maximum DC error from 0.5 to 0.6.	

4 Oct. 2016	In Key Features, deleted feature “High impedance per channel when powered off”. Applied Defense Solutions template features.	
11 Feb. 2015	Applied Defense Solutions template features (including a revision of the features listed on the first page). Mass values rounded up. DAS Studio 3 removed from Supporting software section.Removed the Additional delay sources section.	
7 May 2013	Updated input resistance values and input impedance condition/details for Differential ended analog inputs. Removed reference to obsolete technical note (TEC/NOT/002) from Related Documentation.	
19 Feb. 2013	Updated data sheet title description.	
20 Sep. 2012	Curtiss-Wright template applied.	
22 Feb. 2012	New template applied.	
13 Jan. 2011	Issued first release of data sheet	

DST/W/123 — **KAD/ADC/130 DATA SHEET**

Date	Action	Reason
13 Apr. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR). In the Balance current outputs table, changed the maximum DC error from 0.5 to 0.6.	
14 Nov. 2016	Issued first release of data sheet.	First released as non standard product. Added to databook when status changed to standard.

DST/AA/014 — **KAD/ADC/134/B DATA SHEET**

Date	Action	Reason
28 Feb. 2024	Added 1V variant to Specifications table and Ordering Information.	
20 May 2021	In Table 2, “Common mode” setting, replaced the “voltage range” row with two rows; one for /100m and one for /10V. For the “rejection ratio (KAD/ADC/134/10V)” setting modified the Min. and Typ. values.	
28 Nov. 2018	In Table 2, “AC gain error” replaced the 2 rows with 3 updated rows.	
5 Feb. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR). In the Balance current outputs table, changed the maximum DC error from 0.5 to 0.6.	
6 Jul. 2017	In the Instrument settings table, Excitation Amplitude setting, changed the choice from “0.2 to 5.1” to “0 to 5.1”.	
13 May 2016	Issued first release of data sheet	

DST/AA/017 — **KAD/ADC/135/B DATA SHEET**

Date	Action	Reason
21 May 2021	In Table 2, “AC gain error for 0 Hz < fin ≤ 2 kHz” added information in the Condition/Details column to say “For IIR setting of Filter Mode.” For the “Common mode” setting, modified the “voltage range” values and added information in the Condition/Details column regarding testing with a Full Scale Range. For the “rejection ratio (Gp = 1 to 128)” setting modified the Min. values.	
6 Feb. 2020	In the “Bridge adjust DC current outputs” table, changed the TYP/MAX DC error.	
13 Apr. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR). In the Balance current outputs table, changed the maximum DC error from 0.5 to 0.6.	

13 Nov. 2017	In Revision history table, added text “individually configurable analog gains”	
4 Apr. 2017	Issued first release of data sheet	

DST/AC/006 — **KAD/ADC/136/C DATA SHEET**

Date	Action	Reason
8 Nov. 2023	In Figures 1 to Figures 9, corrected the block “Fixed 3.6mA typ. ICP excitation” to “Fixed 3.5mA typ. ICP excitation”.	
2 Nov. 2023	In Table 1, General specifications, modified the Minimum power values for +5V and the corresponding total power. Removed the “drift vs. room temperature” rows from Tables 3 and 4. Made extensive changes to Table 5 including removing the “compliance”, “short circuit current”, and “error” rows.	
17 Dec. 2021	In Getting the most from the KAD/ADC/136, added two new sections: “Error when using digital/secondary gain (Gs)” and “Use of GND(x) pins”.	
10 May 2017	In Ordering information section, added KAM/CHS/02F to the chassis that are not supported.	
9 Sep. 2016	In Single ended DC current excitation outputs table, increased the error range for ICP outputs from 1.4 mA to 1.6 mA.	
31 Aug. 2016	In the Flexible analog inputs table, DC error when Input Mode set to Thermocouple parameter, specified the following: “This error includes the cold junction measurement error, and is met for an ambient temperature change rate of up to 1°C per minute using an ACD/CJB/005.”	
8 Jul. 2016	Issued first release of data sheet.	

DST/AC/014 — **KAD/ADC/141 DATA SHEET**

Date	Action	Reason
9 Feb. 2022	In Ordering information section, added KAM/CHS/02F to the chassis that are not supported.	
20 Mar. 2017	Issued first release of data sheet	

DST/R/018 — **KAD/ARR/101 DATA SHEET**

Date	Action	Reason
13 Apr. 2015	Applied Defense Solutions template features (including a revision of the features listed on the first page).	
7 Oct. 2014	Applied Curtiss-Wright template features. Replaced AFDX terminology with ARINC 664 Part 7 (A664P7). In the General specifications table, rounded up mass value.	
7 Mar. 2014	Inserted registered trademark symbol after first instance of AFDX. Rounded up mass value. Applied Curtiss-Wright template features. In the KAD/ARR/101 limitations section, updated "If a switch is used, it must be a NET/SWI/001 or KAD/SWI/004" to "If a switch is used, it must be a NET/SWI/xxx or a KAD/SWI/xxx, and be configured for fixed 100Mbps operation."	
16 Apr. 2013	Issued first release of data sheet.	First released as non standard product. Added to databook when status changed to standard.

DST/Y/044 — **KAD/ARI/103/B DATA SHEET**

Date	Action	Reason
23 Jan. 2023	In Key Features, removed point “64k deep selective FIFO for traffic and tags (snarfer)”. In the Instrument settings table, changed Major Frame Size corrected typo 1048 to 1024.	
21 Jan. 2021	Issued first release of data sheet.	First released as non standard product. Added to databook when status changed to standard.

DST/W/118		BAC/PSU/007 DATA SHEET
Date	**Action**	**Reason**
9 Feb. 2015	Applied Defense Solutions template features.	
10 Nov. 2014	Applied Curtiss-Wright template features.	
27 Feb. 2013	Updated data sheet title description.	
20 Sep. 2012	Curtiss-Wright template applied.	
28 Nov. 2011	Updated template, which included updates to Supporting Software and Related Documentation	
13 Jan. 2011	Issued first release of data sheet.	
DST/Y/029		**KAD/BCU/101/E DATA SHEET**
Date	**Action**	**Reason**
18 Apr. 2023	At the end of the “Master with two slaves scenario” section, added a note to clarify that X_SYNC_OUTB is an electronic copy of X_SYNC_OUTA.	
22 Sep. 2017	In the Synchronization specification table, added an instantaneous error row for KAD/BCU/101; removed the rundant Input voltage empty row. In the DATA[3:0]± section, clarified that DATA[3:1] can be disabled in software in order to reduce power consumption. In the DCLK[3:0]± section, clarified that DCLK[3:1] can be disabled in software in order to reduce power consumption.	
7 Jan. 2016	Added back to Databook	Classification changed to standard.
3 Nov. 2015	Applied Defense Solutions template features (including a revision of Key Features on the first page).	
6 Jan. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
31 Jul. 2014	In Ordering Information section replaced ACC/ASY/022/B with ACC/ASY/022/C. In General specifications table, rounded up mass value.	
14 Mar. 2014	Issued first release of data sheet.	
DST/Y/034		**KAD/BCU/105/E DATA SHEET**
Date	**Action**	**Reason**
27 Jan. 2016	Added back to Databook	Classification changed to standard.
26 Feb. 2015	Applied Curtiss-Wright template features. In the PTP restrictions section, added a paragraph to explain what happens when time on a KAD/BCU/105 changes by more than 500µs.	
6 Jan. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
14 Oct. 2014	Applied Curtiss-Wright template features. In the Related Products section data sheet, reworded the description of the micro-miniature connector. In the Mechanical specifications table, rounded up mass value.	
29 Mar. 2013	Issued first release of data sheet.	
DST/AA/037		**KAD/BCU/140/D DATA SHEET**
Date	**Action**	**Reason**
18 Jan. 2022	In “Getting the most from the KAD/BCU/140 section, added a new “PTP time error update” section.	

1 Apr. 2021	In Table 2, Synchronization specification, in the CONDITION/DETAILS column for the “Time to synchronize IEEE Std 1588-2008 (PTPv2)” parameter, clarified that the PTPv2 Delay Req protocol is also known as End-to-end delay request-response mechanism. In the Instrument settings table, under the PTP Protocol setting, added a footnote for PTPv2 Delay P2P1: The PTPv2 Delay P2P protocol is not tested on the KAD/BCU/140 and is reserved for future use. In the Revision history table for KAD/BCU/140/D, revised the Differences text to “Addition of PTPv1 Grandmaster and PTPv2 slave; addition of Mirrored Ethernet output; addition of PTPTimeError parameter; the Status is now Recommended for new programs with out condition and the KAD/BCU/140/C is now Not recommended for new programs.	
19 Mar. 2019	In Redundant Ethernet output section, corrected typo.	
5 Feb. 2018	In Setting up the KAD/BCU/140, added “Settings IENA” to Instrument settings table. In Parameter definitions table, clarified that PTPTimeError setting is measured in nanoseconds. In Getting the most from the KAD/BCU/140, PTP support section, clarified that the KAD/BCU/140 accepts a maximum PTPv2 Announce Interval of 2 seconds. Added KSM-500 to Supporting software and Related documentation.	
13 Oct. 2016	In “Ethernet interface” table, added note that the module uses auto-negotiation to set the transmission speed. In “Setting up the KAD/BCU/140” section, added new TypeNumber parameter. In “Getting the most from the KAD/BCU/140” section, added new “Leap seconds” section.	
30 Jul. 2015	Issued first release of data sheet.	

DST/R/015 **KAD/BIT/101 DATA SHEET**

Date	Action	Reason
14 Apr. 2022	Added back to Databook	Classification changed to standard.
20 Nov. 2017	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
1 Sep. 2016	Added back to Databook	Classification changed to standard.
3 Nov. 2015	Applied Defense Solutions template features (including a revision of Key Features on the first page).	
11 Feb. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
25 Jul. 2014	In General specifications table, updated mass. In Single ended DC voltage excitation outputs table, updated values for operating range. In Instrument settings table, moved notes for Baud Rate to Getting the most from. In Getting the most from, expanded introduction paragraph to Figure 2. Added Note before Figure 3. Expanded two introduction paragraphs before Figure 4 and the two paragraphs that follow. Added new KSM-500 fixed window functions and Errors transmitted via RS-422 sections. Applied Curtiss-Wright template features.	
20 Sep. 2012	Curtiss-Wright template applied.	
29 Aug. 2012	Updated xdefml and added TEC/NOT/045 to related documentation.	
28 Nov. 2011	Updated template, which included updates to Supporting Software and Related Documentation	
20 Jun. 2011	Updated Setting up KAD/BIT/101 to correct details for power line voltage levels. Updated ‘Getting the most...’ to add Checking status registers and Status sampling rate. Applied new template.	
30 Sep. 2008	Updated specifications tables.	
26 May 2008	Corrected formula condition for “Measuring the temperature of the chassis” section, from “...less than 50°C...” to “...more than 50°C...”	**Documentation error.**

18 Oct. 2006	Updated circuit diagram and reformatted data sheet.	
14 Jul. 2006	Updated Getting the Most from section.	
26 May 2006	Moved Chassis temperature equation to 'Getting the Most from BIT/101'.	
13 Apr. 2006	Corrected Register definition.	**Documentation error.**
8 Mar. 2006	Reformatted data sheet.	

DST/AB/029 — **KAM/MEM/103/C DATA SHEET**

Date	Action	Reason
19 Oct. 2023	Under Key Features, modified the bullet point "Designed to support high-speed CompactFlash cards up to 128 GB" to read "Designed to support high-speed CompactFlash cards"	
3 Dec. 2018	In Table 2, Recording rate, in Condition/Details changed cross-reference to "see the *CompactFlash cards* data sheet". Added a new "Storage media" section; removed the "Using the DRE/CFM/002/32GB with KAM/MEM/103 modules" section.	Specific CF card information is now moved to the *CompactFlash cards* data sheet.
21 Aug. 2017	Issued first release of data sheet.	First released as non standard product. Added to databook when status changed to standard.

DST/X/067 — **KAM/MEM/113 DATA SHEET**

Date	Action	Reason
26 Oct. 2022	In Table 2, CompactFlash interface, changed the maximum Recording rate to 2.5 Msps; in the Details column added a reference to the CompactFlash data sheet. At the end of the "Automatic recording" section, specified that the module is configured to start recording after 10 acquisition cycles. In the Related products table, added Data Exporter.	
14 Sep. 2021	Added a new "Difficulty inserting or removing KAM/MEM/113 module" section.	Advise users of potential difficulty fitting the KAM/MEM/113 module.
27 Jan. 2021	In Table 2 CompactFlash interface, under the Format select restrictions parameter, clarified that All formats except Erase Format and Idle Format can be used.	
30 May 2019	Added new PTP Leap Seconds section.	
3 Dec. 2018	In the Parameter definitions table, changed the Report register R(5) to Reserved. Added a new "Storage media" section; removed the "Supported CF cards" section.	Specific CF card information is now moved to the *CompactFlash cards* data sheet.
22 Feb. 2018	Updated the module photo on page 1. Added a new Supported CF cards section. In the Related documentation table, added reference to TEC/NOT/083.	
19 Oct. 2017	Added PCAP file section to clarify that the maximum PCAP file size is 32 MB,	
7 Feb. 2017	Issued first release of data sheet.	

DST/J/062 — **CABLES DATA SHEET**

Date	Action	Reason
11 Feb. 2022	Added two additional columns to specify outside cable diameter and minimum bend radius to all cable tables.	
28 Sep. 2021	In Table 4, ACC/ASY/023/C cable, Description column, clarified that the On/Off switch on flying lead is for IP address programming. Removed design revision /C from JIG/UNI/001/C and ACC/CON/031/C.	
26 Jun. 2020	Added the following cables: ACC/CON/053, ASD/MBM/402/DCC, ASD/MBM/402/TCC, AXN/CAB/001/01M, AXN/CAB/001/02M, AXN/CAB/001/05M, AXN/CAB/001/10M, CON/PSU/008/FLG/100. Grouped cables by type and reorganized cable specifications into a tabular format.	

24 Mar. 2016	Added CON/PSU/008/FL/100 cable.	
26 Nov. 2015	Added CON/USB/006 cable.	
14 May 2015	Added ASD/MBM/102/DCC cable. Corrected typo (ASD/MSB/001/B/DC/~~B~~) in the following table titles: ASD/MSB/001/B/DC; ASD/MSB/001/B/DCC; ASD/MSB/001/B/TC; ASD/MSB/001/B/TCC; ASD/MSB/001/B/TCC2M	
25 Feb. 2015	Added ASD/MBM/102/TCC cable. Corrected typo (ASD/MSB/001/B/DC/~~B~~) in the following cables: ASD/MSB/001/B/DC; ASD/MSB/001/B/DCC; ASD/MSB/001/B/TC; ASD/MSB/001/B/TCC; ASD/MSB/001/B/TCC2M	
30 Oct. 2014	Updated ASD/MSB/001/xxx part numbers to revision B. In specification tables, Chassis clearance, Condition/Details column, changed referenced data sheet from CON/KAD/002/CP to ACD/BAC/002.	
21 May 2014	Replaced ACC/ASY/022/B cable with ACC/ASY/022/C revision in drawing on first page and in Ordering Information. In Specifications updated ACC/ASY/022/C: removed reference to flying leads; removed reference to MIL-STD-681; changed wire type to 24 AWG PVC. Applied Curtiss-Wright template features.	
26 Nov. 2013	Added ASM/TCG/102 cable.	
20 Sep. 2012	Curtiss-Wright template applied.	
23 Aug. 2012	Removed ASM/MSB/001/DCC and ASM/MSB/001/TCC.	Suspended notification received.
31 May 2012	Added ACC/CON/016.	
20 Mar. 2012	Added ASD/MSB/001/TCC2M. Added AWG reference to the ASD/MSB/001/DC, DCC,TC, TCC, TCC2M ASM/MSB/001/TCC and DCC, ACC/CON/009 and ACC/CON/029.	
29 Nov. 2011	Added new cable, ACC/ASY/024/00 Ethernet Programming Cable with switch for KAM/BCU/105	
8 Aug. 2011	Updated Ordering Information to edit the description of ACC/ASY/023/C.	
19 Jul. 2011	Inserted references to 'Twinax TRB connectors' for the following products: ACC/CON/009; ACC/CON/029; ASD/MSB/001/DC; ASD/MSB/001/DCC; ASD/MSB/001/TC; ASD/MSB/001/TCC; ASM/MSB/001/DCC; and ASM/MSB/001/TCC.	
17 May 2011	Added ASD/MSB/001/DCC, ASD/MSB/001/TCC, ASM/MSB/001/DCC and ASM/MSB/001/TCC cables. Updated related products to include all connectors. Updated cables description to include details of shield connection. Removed color coding on flying leads for CON/PSU/007/FL/100 and CON/PSU/007/FL/300.	
28 Mar. 2011	Added cross references to the Ground station cables data sheet and the Network cables data sheet.	
14 Jan. 2011	Added ACC/GPS/001/05M. Updated cable descriptions in Ordering Information to include cable lengths.	
5 Nov. 2010	Added the ACC/ASY/022/B which replaces ACC/ASY/022, added the ACC/ASY/023/C which replaces ACC/ASY/023/B, and added the ACC/CON/031/C which replaces ACC/CON/031/B.	
31 Aug. 2010	Removed four cables (NET/CON/001. NET/CON/002, NET/CON/003, NET/CON/004).	**These cables migrated to the NET Cables data sheet**
25 Feb. 2010	Added four cables (NET/CON/001. NET/CON/002, NET/CON/003, NET/CON/004); corrected inconsistencies for metric conversions.	
26 Aug. 2009	Added the ACC/ASY/023/B (crossover cable with straight backshell), which replaces ACC/ASY/023 (crossover cable with angled backshell).	
25 Feb. 2009	Updated the description of ACC/ASY/023 in Ordering Information and replaced images of ACC/ASY/007/04 and ACC/ASY/008/04 with images of CON/PSU/007/FL/100 and ACC/ASY/022.	

16 Jan. 2009	Updated Ordering Information and added a specification table for ACC/ASY/023.	
9 Oct. 2008	Updated Ordering Information and added a specification table for ACC/CON/031/B.	**ACC/CON/031/B was released.**
23 Jan. 2008	Updated table format.	
12 Sep. 2007	Added CON/PSU/007/FL/300.	
1 May 2007	Added new cables, and removed redundant cables. Added Specifications tables.	
18 Oct. 2006	Reformatted data sheet.	
14 Jul. 2006	Added cables & photos.	**Documentation error.**
26 May 2006	Updated list of cables.	
13 Apr. 2006	Added Cables	
10 Feb. 2006	Reformatted data sheet.	
7 Sep. 2005	Removed references to CON/DEC/001 as it is no longer recommended for new programs. Added Selection guide for CON/DEC/001/B.	**Customer feedback.**
8 Aug. 2005	Added CON/DEC/001/B cable	**Specification Change.**
1 Aug. 2004	Description: Updated to show that the 15-way LAN open to standard 15-way commercial D-type plug connector cable is called the CON/DEC/001	**Documentation error.**
1 Jun. 2004	Added description of CON/KAD/002/CP.	**Specification Change.**
1 Mar. 2004	Added description of ACD/PIN/001.	**Customer feedback.**
3 Nov. 2003	Corrected error in Description table.	Documentation error.
1 Sep. 2003	Updated ordering information to show new part number for connector.	Part number renamed IAW Acra's part numbering scheme.
3 Jul. 2003	Added descriptions of new double-density connectors.	
1 Apr. 2003	**Description:** Added description of CON/051/M and CON/055/M.	**Specification change.** These double density connectors are now standard.
4 Mar. 2003	**Description:** Added description of ACC/CON/029.	**Specification change.**
3 Dec. 2002	**Description:** Added the following text to the description of the ACC/CON/009 "The shield is connected to pin 22 for Bus 0 and pin 32 for Bus 1 (GND)."	**Customer feedback**.
1 May 2002	**Description:** Added description of ACC/CON/020.	**Specification change.** The ACC/CON/020 was released.
1 Feb. 2002	**Description:** Added description of ACC/CON/016.	**Specification change.** The ACC/CON/016 was released.
1 Jun. 2001	**Description**: ACC/CON/012, Added the text "The TTL lines are not connected"	**Customer feedback**.
1 Apr. 2001	**Ordering information**: Changed to show that cables no longer come as standard with each system but must now be ordered separately **Description**: Changed to show that the following part numbers have changed: ACC/CON/006 changed to ACC/CON/013 ACC/CAB/004 changed to ACC/CON/012 ACC/CON/007 changed to ACC/CON/007/04 ACC/CON/008 changed to ACC/CON/008/04	**Customer feedback**. Mating connectors required vary according to application. **Style consistency**.
1 Nov. 2000	Issued preliminary data sheet	

DST/P/064		**KAD/CBM/101 DATA SHEET**
Date	**Action**	**Reason**
1 Sep. 2016	Added back to Databook	Classification changed to standard.

10 Nov. 2015	Applied Defense Solutions template features. Mass values rounded up. Removed DAS Studio 3 from Supporting software and Related documentation tables.	
6 Jan. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
19 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
28 Nov. 2011	Updated template, which included updates to Supporting Software and Related Documentation	
1 Jul. 2011	Updated to the latest template, which included adding a “KAD/” or “KAM/” prefix where applicable. No specifications were changed.	
25 Feb. 2010	Updated pinout table so that channel 2 is located on pins 42 and 43, channel 3 is located on pins 44 and 45. Applied new template.	
5 Sep. 2008	Updated specifications.	
18 Oct. 2006	Reformatted data sheet.	
7 Sep. 2005	**Error codes:** Reformatted table and added footnote.	**Customer feedback.**
8 Aug. 2005	Issued first release of data sheet.	

DST/L/043 — **KAD/CBM/102 DATA SHEET**

Date	Action	Reason
12 Jan. 2023	In Table 2, CAN bus interface, changed the Min value for CAN bus 2.0 to 0.02; changed the Min value for Supported baud rates to 20. In the Instrument settings table, added 50000 as a Choice for Baud Rate.	
13 Apr. 2015	Applied Defense Solutions template features (including a revision of the features listed on the first page).	
10 Nov. 2014	Applied Curtiss-Wright template features.	
19 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
7 Jun. 2012	XdefML inserted to more accurately define the MessageCount and MsgExtIdLo registers. Pinout updated to accurately represent GND and NC pins.	
9 Mar. 2012	XdefML inserted to more accurately define the MessageCount and MsgExtIdLo registers.	
28 Nov. 2011	Updated template, which included updates to Supporting Software and Related Documentation	
6 Jul. 2011	Updated CAN bus interface table to state that supported baud rates include 50kbps. Updated Setting up parameters section to correct message counter definition.	
7 May 2010	Converted total power values, in General specifications table, to watts. Applied new template.	
13 Jul. 2009	Text “response time” removed from the Description section on page 1.	
10 Apr. 2009	Updated the CAN bus interface table.	Editing of baud rates supported and updating of units from Mbps to kbps.
1 May 2008	Issued first release of data sheet.	

DST/V/071 — **KAD/CBM/103 DATA SHEET**

Date	Action	Reason
25 Oct. 2022	Added TEC/NOT/074 to the Related documentation table.	
15 Apr. 2015	Applied Defense Solutions template features (including a revision of the features listed on the first page).	

16 Apr. 2013	Issued first release of data sheet.	First released as non standard product. Added to databook when status changed to standard.

DST/V/072 — **KAD/CBM/104 DATA SHEET**

Date	Action	Reason
11 Jun. 2020	In the Connector pinout table, for pins 3, 4, 7, 8, removed the word “clock” from the Description column.	
1 Jul. 2016	Removed KSM-500 from supported software and documentation.	
9 Feb. 2015	Applied Defense Solutions template features.	
7 Apr. 2014	Updated Supporting Software and Related Documentation sections to include reference to DAS Studio 3. Updated pinout table to insert all cross references to CSDB bus interface specification table. Applied style changes.	
19 Mar. 2014	Issued first release of data sheet.	First released as non standard product. Added to databook when status changed to standard.

DST/Y/038 — **KAD/CBM/105 DATA SHEET**

Date	Action	Reason
1 Sep. 2016	Added back to Databook	Classification changed to standard.
10 Aug. 2016	In iNET-X PARSER-aligned packet format, modified notes for Er (Bit 0) and Bits [1:6].	
2 Aug. 2016	In Overview, added paragraph to clarify report word bits. In Setting up the KAD/CBM/105, change Packet Timeout choice to 10 to 999; changed Register definition for Report parameter. In iNET-X PARSER-aligned packet format, added notes for Er (Bit 0) and Bits [1:6]. Added new Handling bit stuffing section.	
4 Feb. 2016	In the Mechanical specifications table, rounded up mass value. Changed all SSR/ references to KAD/. Added support for KSM-500 to Supporting software and Related documentation tables.	
1 Sep. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
15 Apr. 2015	Applied Defense Solutions template features (including a revision of the features listed on the first page).	
16 Apr. 2013	Issued first release of data sheet.	First released as non standard product. Added to databook when status changed to standard.

DST/Z/016 — **KAD/CBM/107 DATA SHEET**

Date	Action	Reason
30 Jan. 2019	In CAN bus message status word section, revised descriptions for Bits [1:10].	
10 Aug. 2016	In General specifications table, updated power consumption values. In iNET-X PARSER-aligned packet format, modified notes for Er (Bit 0) and Bits [1:6].	
19 Feb. 2016	Issued first release of data sheet.	

DST/AG/006 — **KAD/CDC/103 DATA SHEET**

Date	Action	Reason
14 Apr. 2022	Issued first release of data sheet.	First released as non standard product. Added to databook when status changed to standard.

DST/X/033 — **KAM/CHS/02F DATA SHEET**

Date	Action	Reason
21 Feb. 2020	Under “Ordering information”, added clarified that spare lids (ACM/LID/001) must be ordered separately.	

14 Apr. 2016	In Getting the most from the KAM/CHS/02F, added Ground mounting bolt section.	
9 Feb. 2015	Applied Defense Solutions template features.	
10 Nov. 2014	Applied Curtiss-Wright template features.	
20 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
29 Jun. 2012	Issued first release of data sheet	

DST/P/062 **KAM/CHS/03F DATA SHEET**

Date	Action	Reason
21 Feb. 2020	Clarified that the PSU to be used must be the /B revision. Under “Ordering information”, clarified that spare lids (ACM/LID/001) must be ordered separately. Added ACM/LID/001 to Related products table.	
9 Feb. 2015	Applied Defense Solutions template features.	
10 Nov. 2014	Applied Curtiss-Wright template features.	
20 Feb. 2013	Updated data sheet title description.	
21 Sep. 2012	Curtiss-Wright template applied. Updated pinout table for the PSU for the KAM/CHS/03F; ground pins now labeled GND (instead of AGND).	
21 Feb. 2012	New template applied.	
1 Dec. 2010	Applied template update (which included adding “KAM/” prefix to module name).	
15 Apr. 2008	Corrected dimensions/width of module.	
28 Jan. 2008	Updated table format.	
1 Dec. 2006	Updated specifications tables.	
18 Oct. 2006	Reformatted data sheet.	
10 Feb. 2006	Reformatted data sheet.	
17 Nov. 2005	Added Weight of chassis	Documentation error
17 Nov. 2005	Issued first release of data sheet.	

DST/W/042 **KAM/CHS/03U/E DATA SHEET**

Date	Action	Reason
21 Feb. 2020	Clarified that the PSU to be used must be the /B revision. Under “Ordering information”, clarified that spare lids (ACM/LID/001) must be ordered separately.	
21 Feb. 2020	Clarified that the PSU to be used must be the /B revision. Under “Ordering information”, clarified that spare lids (ACM/LID/001) must be ordered separately.	
16 Apr. 2015	Applied Defense Solutions template features.	
12 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
20 Oct. 2011	Issued first release of data sheet	

DST/N/043 **KAM/CHS/04L/B DATA SHEET**

Date	Action	Reason
16 Apr. 2015	Applied Defense Solutions template features.	

30 Apr. 2013	Updated module photo to show Curtiss-Wright Controls logo.	
20 Feb. 2013	Updated data sheet title description.	
21 Sep. 2012	Curtiss-Wright template applied. Updated pinout table for the PSU for the KAM/CHS/03F; ground pins now labeled GND (instead of AGND).	
4 May 2012	In Figure 2, changed “Mounting Holes bore dimension” from “x1?” to “x1¾”.	
21 Feb. 2012	New template applied.	
1 Dec. 2010	Applied template update (which included adding “KAM/” prefix to module name).	
26 May 2008	Updated description.	
28 Jan. 2008	Updated table format.	
1 Dec. 2006	Updated specifications tables.	
18 Oct. 2006	Reformatted data sheet.	
15 Sep. 2006	Updated chassis schematic.	
10 Feb. 2006	Reformatted data sheet.	
7 Sep. 2005	Enlarged mechanical drawing.	**Customer feedback.** Drawing was enlarged for clarity.
1 Jul. 2005	Issued first release of data sheet	

DST/S/004 — **KAM/CHS/05F/SC DATA SHEET**

Date	Action	Reason
18 Jan. 2022	Added a new “User module required in chassis” section.	
16 Apr. 2015	Applied Defense Solutions template features.	
30 Apr. 2013	Updated module photo to show Curtiss-Wright Controls logo.	
20 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
21 Feb. 2012	New template applied.	
1 Dec. 2010	Applied template update (which included adding “KAM/” prefix to module name).	
24 Aug. 2009	Updated specifications table format.	
3 Apr. 2009	Issued first release of data sheet	

DST/W/052 — **KAM/CHS/06U/E DATA SHEET**

Date	Action	Reason
21 Feb. 2020	Clarified that the PSU to be used must be the /B revision. Under “Ordering information”, clarified that spare lids (ACM/LID/001) must be ordered separately.	
21 Feb. 2020	Clarified that the PSU to be used must be the /B revision. Under “Ordering information”, clarified that spare lids (ACM/LID/001) must be ordered separately.	
19 Jun. 2018	In Table 1, General specifications, added row for Chassis material. Under Ordering information, added note that ACM/LID/001 ships with each chassis ordered.	
20 Nov. 2017	Updated Figure 2: KAM/CHS/06U mechanical drawing.	
16 Apr. 2015	Applied Defense Solutions template features.	

24 Jun. 2013	Updated mechanical drawing on p. 3. Applied minor template change.	
20 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
20 Oct. 2011	Issued first release of data sheet.	

DST/W/057		**KAM/CHS/09U/E DATA SHEET**
Date	**Action**	**Reason**
21 Feb. 2020	Clarified that the PSU to be used must be the /B revision. Under “Ordering information”, clarified that spare lids (ACM/LID/001) must be ordered separately.	
21 Feb. 2020	Clarified that the PSU to be used must be the /B revision. Under “Ordering information”, clarified that spare lids (ACM/LID/001) must be ordered separately.	
19 Jun. 2018	In Table 1, General specifications, added row for Chassis material. Updated Figure 2: KAM/CHS/13U mechanical drawing: changed mounting holes to 4.0 mm; changed ground bolt torque to 2.5Nm. Under Ordering information, added note that ACM/LID/001 ships with each chassis ordered.	
16 Apr. 2015	Applied Defense Solutions template features.	
24 Jun. 2013	Updated mechanical drawing on p. 3. Applied minor template change.	
20 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
20 Oct. 2011	Issued first release of data sheet.	

DST/AB/027		**KAM/CHS/12R/E DATA SHEET**
Date	**Action**	**Reason**
12 Jan. 2016	Issued first release of data sheet.	

DST/W/065		**KAM/CHS/13U/E DATA SHEET**
Date	**Action**	**Reason**
21 Feb. 2020	Clarified that the PSU to be used must be the /B revision. Under “Ordering information”, clarified that spare lids (ACM/LID/001) must be ordered separately.	
21 Feb. 2020	Clarified that the PSU to be used must be the /B revision. Under “Ordering information”, clarified that spare lids (ACM/LID/001) must be ordered separately.	
8 May 2019	Updated Figure 2 to include screw size and torque for the ground mounting bolt.	
16 Apr. 2015	Applied Defense Solutions template features.	
24 Jun. 2013	Updated mechanical drawing on p. 3. Applied minor template change.	
20 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
20 Oct. 2011	Issued first release of data sheet.	

DST/R/008		CON/KAD/002/CP DATA SHEET
Date	**Action**	**Reason**
8 Mar. 2022	In Table 1, Mechanical specifications, changed the finish for connector to Nickel-plated SPCC-SD. Added the CON/KAD/002/CP/SEC to Ordering information.	
23 Jun. 2021	In the “Contact extraction” section, added a Warning that pins should only be inserted once into each pin location of the connector.	
8 Jun. 2016	In Overview, clarified number and size of supplied crimp pins. Moved text “crimp pins accommodate cable size 22 - 26 AWG” from Overview to Mechanical specification table.	
16 Apr. 2015	Applied Defense Solutions template features.	
9 Oct. 2014	Clarified that the crimp pins accommodate cable size 22 - 26 AWG. Added CON/KAD/004 to Related Products. Applied Curtiss-Wright template features.	
27 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
20 Dec. 2011	New template applied.	
7 Jul. 2010	Updated mechanical drawing to add clip labels and edited associated caption to specify front view.	
19 May 2010	Shortened data sheet description and related product descriptions - DD replaces double density. Applied new template. Pins 1, 18 and 52 labelled on mechanical drawing.	
23 Jan. 2008	Updated table format.	
11 Sep. 2007	Corrected selection path.	
18 Oct. 2006	Reformatted data sheet.	
10 Feb. 2006	Removed mechanical drawing of screw	**Documentation error**
7 Sep. 2005	Enlarged mechanical drawing.	**Customer feedback.** Drawing was enlarged for clarity.
1 Jun. 2005	Issued first release of data sheet	

DST/R/009		CON/KAD/002/SR DATA SHEET
Date	**Action**	**Reason**
23 Jun. 2021	In the “Contact extraction” section, added a Warning that pins should only be inserted once into each pin location of the connector.	
8 Jun. 2016	In Overview, clarified number and size of supplied crimp pins. Moved text “crimp pins accommodate cable size 22 - 26 AWG” from Overview to Mechanical specification table.	
16 Apr. 2015	Applied Defense Solutions template features.	
28 Aug. 2014	Clarified that the CON/KAD/002/SR is a modified 52-way Double-Density connector. Clarified that the crimp pins accommodate cable size 26 - 22 AWG. Applied Curtiss-Wright template features.	
27 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
20 Dec. 2011	New template applied.	
7 Jul. 2010	Updated mechanical drawing to add clip labels and edited associated caption to specify front view.	
19 May 2010	Shortened data sheet description and related product descriptions - DD replaces double density. Pins 1, 18 and 52 labelled on mechanical drawing.	

30 Mar. 2010	Changed data sheet summary, replacing '2-way double-density connector' with '52-way double-density connector'. Applied new template.	**Typographical error.**
23 Jan. 2008	Updated table format.	
11 Sep. 2007	Corrected selection path.	
18 Oct. 2006	Reformatted data sheet.	
10 Feb. 2006	Removed mechanical drawing of screw and corrected number of pins supplied with CON/KAD/002/SR	**Documentation error**
7 Sep. 2005	Enlarged mechanical drawing.	**Customer feedback.** Drawing was enlarged for clarity.
1 Jun. 2005	Issued first release of data sheet.	

DST/S/042 — **CON/KAD/003/CP DATA SHEET**

Date	Action	Reason
23 Jun. 2021	In the "Contact extraction" section, added a Warning that pins should only be inserted once into each pin location of the connector.	
5 Feb. 2018	Added KAM/TCG/105 in all places where supported modules are mentioned.	
8 Jun. 2016	In Overview, clarified number and size of supplied crimp pins. Moved text "crimp pins accommodate cable size 22 - 26 AWG" from Overview to Mechanical specification table.	
16 Apr. 2015	Applied Defense Solutions template features.	
9 Oct. 2014	Clarified that the crimp pins accommodate cable size 22 - 22 AWG. Applied Curtiss-Wright template features.	
27 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
20 Dec. 2011	New template applied.	
17 May 2011	Updated to include reference to KAM/TCG/103.	
31 Aug. 2010	Applied new template.	
22 Jun. 2010	Reclassified data sheet as a standard product and added it to the KAM-500 Databook.	**Module reclassified on 22 Jun. 2010 from being a non-standard to a standard product**

DST/S/040 — **CON/KAD/004 DATA SHEET**

Date	Action	Reason
16 Apr. 2015	Applied Defense Solutions template features.	
27 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
4 May 2012	Added missing connector height of "13.1" to Figure 1; corrected same in Mechanical specifications table.	
16 Apr. 2012	Added a note under "Ordering Information" to say corresponding backshell is required but not included in order.	
13 Jan. 2011	Issued first release of data sheet	

DST/S/041 — **CON/KAD/005/CP DATA SHEET**

Date	Action	Reason
23 Jun. 2021	In the "Contact extraction" section, added a Warning that pins should only be inserted once into each pin location of the connector.	

8 Jun. 2016	In Overview, clarified number and size of supplied crimp pins. Moved text “crimp pins accommodate cable size 22 - 26 AWG” from Overview to Mechanical specification table.	
16 Apr. 2015	Applied Defense Solutions template features.	
9 Oct. 2014	Clarified that the crimp pins accommodate cable size 22 - 26 AWG. Applied Curtiss-Wright template features.	
27 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
20 Dec. 2011	New template applied.	
7 Jul. 2010	Updated mechanical drawing to add clip labels and edited associated caption to specify front view.	
19 May 2010	Shortened data sheet description and related product descriptions - DD replaces double density. Applied new template. Pins 1, 18 and 52 labelled on mechanical drawing.	
23 Jan. 2008	Updated table format.	
30 Oct. 2007	Corrected module short description.	
11 Sep. 2007	Issued first release of data sheet.	

DST/T/095 — **CON/KAD/005/SR DATA SHEET**

Date	Action	Reason
23 Jun. 2021	In the “Contact extraction” section, added a Warning that pins should only be inserted once into each pin location of the connector.	
8 Jun. 2016	In Overview, clarified number and size of supplied crimp pins. Moved text “crimp pins accommodate cable size 22 - 26 AWG” from Overview to Mechanical specification table.	
16 Apr. 2015	Applied Defense Solutions template features.	
9 Oct. 2014	Clarified that the CON/KAD/005/SR is a modified 52-way Double-Density connector. Clarified that the crimp pins accommodate cable size 22 - 26 AWG. Applied Curtiss-Wright template features.	
27 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
20 Dec. 2011	New template applied.	
7 Jul. 2010	Updated mechanical drawing to add clip labels and edited associated caption to specify front view.	
19 May 2010	Shortened data sheet description and related product descriptions - DD replaces double density. Applied new template. Pins 1, 18 and 52 labelled on mechanical drawing.	
23 Jan. 2008	Updated table format.	
30 Oct. 2007	Issued first release of data sheet.	

DST/T/066 — **CON/KAD/008/CP DATA SHEET**

Date	Action	Reason
2 Feb. 2022	Updated Figure 1 to show the correct label on the connector. In Getting the most from the CON/KAD/008/CP deleted the paragraph that referred to the connector being supplied pre-stamped as the CON/KAD/005/CP.	
23 Jun. 2021	In the “Contact extraction” section, added a Warning that pins should only be inserted once into each pin location of the connector.	

8 Jun. 2016	In Overview, clarified number and size of supplied crimp pins. Moved text “crimp pins accommodate cable size 22 - 26 AWG” from Overview to Mechanical specification table.	
16 Apr. 2015	Applied Defense Solutions template features.	
9 Oct. 2014	Clarified that the crimp pins accommodate cable size 22 - 26 AWG. Applied Curtiss-Wright template features.	
27 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
20 Dec. 2011	New template applied.	
7 Jul. 2010	Updated mechanical drawing caption to specify front view.	
19 May 2010	Shortened data sheet description and related product descriptions - DD replaces double density. Pins 1, 18 and 52 labelled on mechanical drawing.	
30 Mar. 2010	Updated photo to reflect true image of the CON/KAD/008/CP. Applied new template.	
20 Apr. 2009	Issued first release of data sheet	

DST/T/067 — **CON/KAD/008/SR DATA SHEET**

Date	Action	Reason
23 Jun. 2021	In the “Contact extraction” section, added a Warning that pins should only be inserted once into each pin location of the connector.	
8 Jun. 2016	In Overview, clarified number and size of supplied crimp pins. Moved text “crimp pins accommodate cable size 22 - 26 AWG” from Overview to Mechanical specification table.	
16 Apr. 2015	Applied Defense Solutions template features.	
9 Oct. 2014	Clarified that the CON/KAD/008/SR is a modified 52-way Double-Density connector. Clarified that the crimp pins accommodate cable size 22 - 26 AWG. Applied Curtiss-Wright template features.	
27 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
20 Dec. 2011	New template applied.	
8 Jul. 2010	Updated mechanical drawing to add clip labels and edited associated caption to specify front view.	
19 May 2010	Shortened data sheet description and related product descriptions - DD replaces double density. Pins 1, 18 and 52 labelled on mechanical drawing.	
30 Mar. 2010	Updated photo to reflect true image of the CON/KAD/008/SR. Applied new template.	
20 Apr. 2009	Issued first release of data sheet	

DST/W/016 — **CON/KAD/010 DATA SHEET**

Date	Action	Reason
23 Jun. 2021	In the “Contact extraction” section, added a Warning that pins should only be inserted once into each pin location of the connector.	
15 Feb. 2018	In Overview, clarified that a minimum of 33 crimp pins are supplied.	**Customer feedback.**
8 Jun. 2016	In Overview, clarified number and size of supplied crimp pins.	

12 May 2016	Corrected part numbers from KAD/TDC/002 and KAD/TDC/007 to KAD/TDC/102 and KAD/TDC/107 respectively. Updated Figure 1 to correct part number to show CON/KAD/010. In Mechanical specification table, clarified that the crimp pins accommodate cable size 22 - 26 AWG.	
8 May 2015	Updated Figure 1 to indicate pin 1 location.	
16 Apr. 2015	Applied Defense Solutions template features.	
15 Mar. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
17 Sep. 2012	Added ACD/CJB/003 and ACD/CJB/004 to related products.	
21 Jun. 2012	Updated references to TCD/108 with correct references to TDC/102.	
20 Dec. 2011	New template applied.	
14 Sep. 2010	Issued first release of data sheet	

DST/AJ/027 — **CON/KAD/020/CP DATA SHEET**

Date	Action	Reason
5 Jan. 2024	Issued first release of data sheet	

DST/AJ/028 — **CON/KAD/030/CP DATA SHEET**

Date	Action	Reason
5 Jan. 2024	Issued first release of data sheet	

DST/AJ/029 — **CON/KAD/050/CP DATA SHEET**

Date	Action	Reason
5 Jan. 2024	Issued first release of data sheet	

DST/AJ/030 — **CON/KAD/080/CP DATA SHEET**

Date	Action	Reason
5 Jan. 2024	Issued first release of data sheet	

DST/W/115 — **CON/PSU/007 DATA SHEET**

Date	Action	Reason
17 Apr. 2015	Applied Defense Solutions template features.	
14 Oct. 2014	Applied Curtiss-Wright template features. Throughout data sheet, reworded the description of the micro-miniature connector.	
27 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
16 Apr. 2012	Added a note under “Ordering Information” to say corresponding backshell is required but not included in order.	
13 Jan. 2011	Issued first release of data sheet	

DST/AJ/039 — **CON/PSU/007/CS1 DATA SHEET**

Date	Action	Reason
13 Sep. 2023	Issued first release of data sheet	First released as non standard product. Added to databook when status changed to standard.

DST/AB/005		CON/SAV/001 DATA SHEET
Date	**Action**	**Reason**
17 Apr. 2015	Issued first release of data sheet	
DST/AB/006		**CON/SAV/002 DATA SHEET**
Date	**Action**	**Reason**
7 Apr. 2016	In Getting the most from section, added introductory paragraph to clarify when to use torque and when not to.	
17 Apr. 2015	Issued first release of data sheet	
DST/AB/008		**CON/SAV/003 DATA SHEET**
Date	**Action**	**Reason**
17 Apr. 2015	Issued first release of data sheet	
DST/S/050		**KAD/DAC/001/B DATA SHEET**
Date	**Action**	**Reason**
9 Nov. 2016	Added back to Databook	Classification changed to standard.
6 Jan. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
27 Sep. 2012	Curtiss-Wright template applied.	
28 Nov. 2011	Updated template, which included updates to Supporting Software and Related Documentation	
1 Jul. 2011	Updated to the latest template, which included adding a “KAD/” or “KAM/” prefix where applicable. No specifications were changed.	
8 Dec. 2009	Issued first release of data sheet	
DST/V/074		**KAD/DEC/103 DATA SHEET**
Date	**Action**	**Reason**
16 Sep. 2021	In the “PCM-PACKAGE” table, “BitsPerMinorFrame” setting, changed “16384:48” to “65536:48” and added clarification in the Notes column.	
25 Nov. 2015	Revised Asynchronous mode section. In Error codes for the KAD/DEC/003 table, specified that 0 - Bit error is an illegal BIØ-L bit.	
15 Apr. 2015	Applied Defense Solutions template features (including a revision of the features listed on the first page).	
19 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
11 Apr. 2012	Updated Ordering Information to insert reference to the KAM variant.	
28 Nov. 2011	Updated template, which included updates to Supporting Software and Related Documentation	
17 Sep. 2010	Issued first release of data sheet.	
DST/U/002		**KAM/DMY/001 DATA SHEET**
Date	**Action**	**Reason**
9 Feb. 2015	Applied Defense Solutions template features.	
10 Nov. 2014	Applied Curtiss-Wright template features.	

15 Jul. 2013	Updated Features section to reference protection from moisture, salt fog, and sand ingress. Inserted Getting the most from... section	
27 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
1 Jul. 2011	Updated to the latest template, which included adding a “KAD/” or “KAM/” prefix where applicable. No specifications were changed.	
11 Nov. 2011	Updated template, which included updates to Supporting Software and Related Documentation	
23 Jan. 2008	Reformatted data sheet.	

DST/Y/009		**KAD/DSI/102/B DATA SHEET**
Date	**Action**	**Reason**
15 Nov. 2023	In the “Low input signal frequency example” changed the sentence “if the frequency applied to the input is low (for example, below 100 Hz could be considered low” to “if the frequency applied to the input is low (input frequency < 10 Khz when Frequency Mode Reference Period is set to 0.1, or input frequency < 1 Khz when Frequency Mode Reference Period is set to 1)”.	
13 Jul. 2020	In the equation for the Period mode section, added following condition: “The maximum error is 0.1% or the result of the following equation, whichever is the larger.”	
25 May 2018	In Overview on page 1, removed the last paragraph, which referred to a narrower input voltage range and hysteresis.	
15 Feb. 2017	Updated data sheet to add “Frequency Mode Reference Period” setting.	
16 Feb. 2015	Applied Defense Solutions template features (including a revision of the features listed on the first page). In the Parameter definitions table, added DiscreteHigh and DiscreteLow settings.	
11 Dec. 2014	Issued first release of data sheet	

DST/W/091		**KAD/DSI/104 DATA SHEET**
Date	**Action**	**Reason**
15 Nov. 2023	In the “Optoisolated inputs” table, modified Min/Max values for the logic 0/logic 1 rows; added Condition/Details for both rows. Removed the hysteresis row.	
16 Feb. 2017	Updated Getting the most from section to address recent addition of Frequency Mode Reference Period setting.	
17 Oct. 2016	Issued first release of data sheet.	First released as non standard product. Added to databook when status changed to standard.

DST/AB/026		**KAD/EBM/102/B DATA SHEET**
Date	**Action**	**Reason**
17 Jun. 2021	In Table 3, Values of OffsetIndex_Words, added two missing rows at top for Destination MAC address, word 0/1	17 Jun. 2021
7 Dec. 2018	Added Related products table containing three NET/CON/0XX cables.	
10 Oct. 2016	Added back to Databook	Classification changed to standard.
1 Oct. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
2 Sep. 2015	In Getting the most from section, added new Linking to a NET/SWI/101 section.	
13 Apr. 2015	Applied Defense Solutions template features (including a revision of the features listed on the first page).	

9 Sep. 2014	Applied Curtiss-Wright template features. In the RTD inputs table, changed units for Filter delays from f_c to ms. In the Single ended DC current excitation outputs table, corrected Compliance values. Removed Additional delay sources section. In the General specifications table, rounded up mass value.	
19 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
20 Apr. 2012	Issued first release of data sheet.	

DST/W/086 — **KAD/EBM/103 DATA SHEET**

Date	Action	Reason
9 Nov. 2016	Added back to Databook Applied Defense Solutions template features (including a revision of Key Features on the first page).	Classification changed to standard.
6 Jan. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
7 Oct. 2014	Applied Curtiss-Wright template features. In the General specifications table, rounded up mass value. Replaced AFDX terminology with ARINC 664 Part 7 (A664P7).	
16 Apr. 2013	Issued first release of data sheet.	First released as non standard product. Added to databook when status changed to standard.

DST/AB/020 — **KAD/EBM/104 DATA SHEET**

Date	Action	Reason
6 Oct. 2016	Issued first release of data sheet.	

DST/S/092 — **KAD/ENC/106 DATA SHEET**

Date	Action	Reason
29 May 2020	In the “Setting up the KAD/ENC/106” section, under the Polarity setting, added “where True means that data will be not inverted” to the description. In the “Minimum word transmit time” section, modified the equation from 8Mbps x 625ns = 5 bits to 8Mbps x 375ns = 3 bits.	
17 Apr. 2015	Applied Defense Solutions template features (including a revision of Key Features and Applications on the first page).	
7 Aug. 2014	Updated ‘Getting the most...’ section to include content for CRC generation. Applied Curtiss-Wright template features.	
19 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
26 Jun. 2012	Updated template. Added Minimum word transmit time section to GTMF. Updated xdefml.	
28 Nov. 2011	Updated template, which included updates to Supporting Software and Related Documentation	
25 May 2009	Updated ‘Getting the most from...’ section.	In Premodulation filter outputs, the filter cutoff was updated from 0.35 to 0.7 times the bit-rate for non-return to zero codes.
10 Nov. 2008	Corrected typo.	**Documentation error.**
3 Sep. 2008	Updated specifications and “Getting the most from...” section.	
7 Jan. 2008	Updated module photo.	
5 Oct. 2007	Issued first release of data sheet.	

DST/W/078		KAD/ENC/111 DATA SHEET
Date	**Action**	**Reason**
1 Sep. 2016	Added back to Databook	Classification changed to standard.
3 Nov. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
15 Apr. 2015	Applied Defense Solutions template features (including a revision of the features listed on the first page).	
19 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
13 Jun. 2012	Issued first release of data sheet.	
DST/W/128		**KAD/ETH/101/B DATA SHEET**
Date	**Action**	**Reason**
1 Sep. 2016	Added back to Databook	Classification changed to standard.
15 Aug. 2016	Applied Defense Solutions template features (including a revision of Key Features on the first page).	
6 Feb. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
10 Nov. 2014	Applied Curtiss-Wright template features. Removed reference to obsolete TEC/NOT/034.	
7 Feb. 2014	Updated data sheet description. Applied additional Curtiss-Wright Controls template features. Added TEC/NOT/054 to Related Documentation. In the Getting the most from the KADETH/101/B section: updated text for Category 5 cables to include reference to 100BaseTX connections (also applied a note style to this text); reworded the User-assignment of KAD/ETH/101 IP address section; and corrected typos (KAD/ETH/001 had been stated in wording relating to multi-format). Clarified wording in Packet fragmentation section by removing reference to 'should be designed'	
28 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
24 Aug. 2011	Clarified that only format select 0 is supported; revised min/max power consumption figures.	
28 Nov. 2011	Updated template, which included updates to Supporting Software and Related Documentation	
9 May 2011	Issued first release of data sheet.	
DST/V/073		**KAD/ETH/102 DATA SHEET**
Date	**Action**	**Reason**
30 Jun. 2017	Issued first release of data sheet.	First released as non standard product. Added to databook when status changed to standard.
DST/AA/016		**KAD/EXC/101 DATA SHEET**
Date	**Action**	**Reason**
25 Oct. 2023	Issued first release of data sheet.	First released as non standard product. Added to databook when status changed to standard.
DST/T/085		**KAD/FBM/103/B DATA SHEET**
Date	**Action**	**Reason**
31 Jul. 2017	In FireWire bus interface table, removed S100B from Data rate row; clarified that S200 is the only supported speed.	

1 Sep. 2016	Added back to Databook	Classification changed to standard.
6 Nov. 2015	Applied Defense Solutions template features (including a revision of the Key Features and Overview on the first page).	
6 Jan. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
10 Nov. 2014	Applied Curtiss-Wright template features.	
19 Feb. 2013	Updated data sheet title description.	
27 Sep. 2012	Curtiss-Wright template applied.	
28 Nov. 2011	Updated template, which included updates to Supporting Software and Related Documentation	
1 Jul. 2011	Updated to the latest template, which included adding a “KAD/” or “KAM/” prefix where applicable. No specifications were changed.	
5 Feb. 2008	Issued first release of data sheet.	

DST/AA/004 — **KAD/FBM/105/B DATA SHEET**

Date	Action	Reason
21 Dec. 2022	Issued first release of data sheet.	First released as non standard product. Added to databook when status changed to standard.

DST/U/055 — **HANDLING PRECAUTIONS**

Date	Action	Reason
11 May 2016	In Electrostatic considerations section, clarified to include text “and top block connector pins” are at risk. Changed the recommended torque settings for 4-40 UNC screws from 0.25Nm to 0.4N.	
16 Apr. 2015	Applied Defense Solutions template features.	
20 May 2013	Added torque settings for the 2-56 UNC stainless steel screws.	
22 Oct. 2012	Curtiss-Wright template applied.	
24 Sep. 2012	Updated text and graphics to include SSR-500 chassis.	
3 Feb. 2012	Changed torque setting for captive screw from 0.25Nm to 0.6Nm.	
30 May 2011	Added details of using ACC/TOL/030 to aid the insertion and removal of modules in a system.	
5 May 2010	“Removing a module” step 5, added clarification to avoid exerting lateral force on screws; “Inserting a module” step 2, added clarifications to loosen adjacent screws.	
3 Mar. 2009	Issued first release of data sheet.	

DST/AA/005 — **KAD/IBM/101 DATA SHEET**

Date	Action	Reason
2 Feb. 2021	In Figure 3 and the text that follows it, changed bits 0 to 6 to be Reserved. In Figure 4, changed bits 0 to 6 to be Reserved. Added a new section “Parser”.	
23 Mar. 2016	Issued first release of data sheet.	

DST/AE/019 — **JIG/UNI/001/D DATA SHEET**

Date	Action	Reason
28 Sep. 2021	Removed design revision /C from ACC/CON/031/C.	
26 Nov. 2019	Issued first release of data sheet.	

DST/J/063		KIT/001 DATA SHEET
Date	**Action**	**Reason**
22 Jun. 2021	Removed references to ACD/TOL/011. In the “Contact extraction” section, added a Warning that pins should only be inserted once into each pin location of the connector.	
28 May 2019	In the Getting the most from section, revised all illustrations and text for clarity. In the Related products table, added the AFM8 M22520/2-01 part.	
16 Apr. 2015	Applied Defense Solutions template features.	
15 Feb. 2012	Updated Features. Added ACC/TOL/038 to ACM/KIT/001. Changed the ACC/TOL/002 description to 3 x 0.5mm slotted screwdriver. Updated ACM/KIT/001 photo. Updated ordering information descriptions. Created Related Products section and added in ACD/TOL/011. Added ACC/TOL/030 under Ordering Information.	
16 Oct. 2012	Curtiss-Wright template applied.	
20 Dec. 2011	New template applied.	
29 Apr. 2011	Updated data sheet to include ACC/TOL/030, which is not part of the kit but is a recommended tool to aid insertion/removal of modules.	
18 Nov. 2010	Updated data sheet to include ACD/TOL/011, which is not part of the kit but is a recommended screwdriver.	
26 Apr. 2010	Changed measurement for wire stripping from 0.004” to 0.12”. Applied new template.	
26 Mar. 2009	Updated images of ACD/KIT tools.	
21 Mar. 2008	Corrected length of wire to be stripped.	**Customer feedback.**
1 Dec. 2006	Updated specifications tables.	
18 Oct. 2006	Reformatted data sheet and renamed data sheet.	
10 Feb. 2006	Reformatted data sheet.	
4 May 2004	Updated description of ACD/TOL/002	**Customer feedback.**
1 Oct. 2003	Corrected figure caption from cm to mm	**Documentation error**
1 Sep. 2003	Removed reference to ACD/TOL/004.	**Customer feedback.**
1 Aug. 2003	Added “Getting The Most From ACx/TOL/00x” section	**Customer feedback.**
3 Jul. 2003	Added descriptions of new tools	
1 Feb. 2002	**Ordering information:** Corrected Ordering information	
1 Apr. 2001	**Features**: Changed to show that one set of tools is supplied with each order and not with each system. **Description**: Replaced tools ACC/TOL/001, ACC/TOL/002, ACC/TOL/003 with tools ACC/TOL/002, ACC/TOL/004, ACC/TOL/005	**Customer feedback**. Customers ordering multiple systems only wanted one set of tools. **Customer feedback**.
1 Nov. 2000	Issued preliminary data sheet	

DST/J/061		LID/001 DATA SHEET
Date	**Action**	**Reason**
9 Feb. 2015	Applied Defense Solutions template features.	
10 Nov. 2014	Applied Curtiss-Wright template features.	
15 Jul. 2013	Updated Features section to reference protection from moisture, salt fog, and sand ingress. Updated Description to include reference to KAM/DMY/001 modules.	

6 Nov. 2012	Description updated to correctly refer to ACC/LID/001 as the part number for individual lids. Description also updated to state that related screws are supplied in quantities of 500.	
16 Oct. 2012	Curtiss-Wright template applied.	
20 Dec. 2011	New template applied.	
23 Jan. 2008	Updated table format.	
1 Dec. 2006	Updated specifications tables.	**Renamed as LID/001, was Chassis Accessories**
18 Oct. 2006	Reformatted data sheet.	
10 Feb. 2006	Reformatted data sheet	
1 Mar. 2004	Updated description of chassis accessories.	**Customer feedback.**
3 Jul. 2003	Added description of ACD/PIN/001.	**Specification change.** New pins for double-density connectors.
1 Jul. 2002	**Photograph:** Added photograph of placeholder lid	
1 Feb. 2002	**Description:** Added description of new lid ACC/LID/002	**Specification change.** A new lid was released.
1 Apr. 2001	**Ordering information:** Changed to show that spare user-slot lids and spare screws are no longer delivered as standard with each system but must be ordered separately	**Customer feedback.** A set for each chassis delivered was excessive. One per program is generally preferable.
1 Nov. 2000	Issued preliminary data sheet	

DST/P/048 — KAD/LDC/101 DATA SHEET

Date	Action	Reason
19 Oct. 2021	Updated Figure 1 to show pin 1 as positive and pin 2 as negative.	
9 Aug. 2021	Updated Figure 1 to show pin 1 connected to pin 3 and pin 2 connected to pin 4. In Table 2, Input resistance, corrected the inputs to show two of them as powered on; previously the four inputs were incorrectly shown as powered off.	
24 Apr. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR). In the Balance current outputs table, changed the maximum DC error from 0.5 to 0.6.	
9 Nov. 2016	Added back to Databook.	Classification changed to standard.
6 Jan. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
20 Feb. 2013	Updated data sheet title description.	
8 Jan. 2013	Added 400Hz x 4 excitation channel to Features list	
9 Nov. 2012	Added KAD/LDC/101/400k variant. Updated figure 1, figure 2 and power values.	
16 Oct. 2012	Curtiss-Wright template applied.	
29 Aug. 2012	Updated xdefml and added details of DAS Studio	
22 Dec. 2011	New template applied.	
31 Jan. 2011	Updated LVDT inputs spec table to include mechanical frequency rates for 10K, 5K and 2.5K. Added amplitude profile with graphs to the GTMF section.	
29 Sep. 2010	Added 2.5k version; clarified Condition/Details for AC error in “Bipolar AC voltage excitation outputs” table to state that the measurement accuracy of the module is not affected by excitation errors within the min/max range shown, however, sensors may be affected by frequency errors.	
26 Feb. 2010	Removed KAD/LDC/101/5K and KAM/LDC/101/5K ordering options; changed feature on page 1 from “3Vrms” to “3.5Vrms”.	
18 Dec. 2008	Reformatted specifications tables and ‘Getting the most...’ section.	

18 Oct. 2006	Added new Module Setup section and reformatted data sheet.	
26 May 2006	Reformatted Specifications table & updated selection path	
13 Apr. 2006	Updated ordering options	
10 Feb. 2006	Reformatted data sheet	
8 Aug. 2005	Issued first release of data sheet.	

DST/Y/047 — **KAD/MAT/101 DATA SHEET**

Date	Action	Reason
5 Apr. 2024	In the RS-232 inputs specifications table, under Input voltage, reversed Min/Max 0 values for logic 0 and logic 1. In the RS-232 outputs specifications table, for absolute operating range changed Condition/Details to “To Ground”. Under Output voltage, revised Min/Max 0 values for logic 0 and logic 1; revised Condition/Details to RLoad = 3 kohms.	
7 Dec. 2021	In the Connector pinout of the KAD/MAT/101 table, corrected pins GPIO(0) to GPIO(3) to “BTTL Inputs”; and pins GPIO(4) to GPIO(7) “BTTL Outputs”.	
25 Jul. 2016	Added back to Databook.	Classification changed to standard.
29 Sep. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
16 Apr. 2015	Applied Defense Solutions template features (including a revision of the Key Features and Overview on the first page).	
12 Dec. 2014	Issued first release of data sheet.	

DST/X/012 — **KAD/MBM/101 DATA SHEET**

Date	Action	Reason
18 Jun. 2021	In the Note in section “Message capture settings”, clarified that message counters are two dedicated counters for bus primary/secondary.	
4 Oct. 2016	In “Detecting when a Tx remote terminal is off-line” section, clarified that data shows FFFFh and not spikes.	
11 Jan. 2016	Added back to Databook. Applied Defense Solutions template features (including a revision of the Key Features and Overview on the first page). In the Mechanical specifications table, rounded up mass value. In the iNET-X parser-aligned packet structure for MIL-STD-1553 bus monitoring section, added text in opening paragraph on how independent packet streams are created. Removed references to obsolete TEC/NOT/050.	Classification changed to standard.
6 Jan. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
16 Apr. 2013	Issued first release of data sheet.	First released as non standard product. Added to databook when status changed to standard.

DST/X/054 — **KAD/MBM/102 DATA SHEET**

Date	Action	Reason
18 Jun. 2021	In the Note in section “Message capture settings”, clarified that message counters are two dedicated counters for bus primary/secondary. In the “Connector pinout of the KAD/MBM/102”, corrected pins 21 and 22, whose descriptions were reversed.	
20 Jan. 2016	Issued first release of data sheet.	First released as non standard product. Added to databook when status changed to standard.

DST/S/052		KAD/MDC/103 DATA SHEET
Date	**Action**	**Reason**
17 Jun. 2021	In the “Overview” section, removed the reference to the ESP-DTC scanner. In the “Ordering information” section, clarified which chassis types the module cannot be used with due to using power from the ±7V for excitation.	
24 Apr. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR). In the Balance current outputs table, changed the maximum DC error from 0.5 to 0.6.	
29 Jan. 2016	Added back to Databook. Applied Defense Solutions template features (including a revision of the features listed on the first page). In the Mechanical specifications table, rounded up mass value. Added DAS Studio 3 as supporting software and related documentation.	Classification changed to standard.
6 Jan. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
10 Nov. 2014	Applied Curtiss-Wright template features.	
22 May 2013	Updated condition/details for rejection ratio in Multiplexed analog inputs.	
15 Mar. 2013	Updated data sheet title description.	
16 Oct. 2012	Curtiss-Wright template applied.	
22 Dec. 2011	New template applied.	
1 Dec. 2010	Applied template update (which included adding “KAD/” prefix to module name).	
12 May 2009	Updated Features, Description and specification tables.	Features and Description updated to provide clarification on types of scanners supported. Specification tables updated to add notes on short circuit protection and change signalling rate units for multiplexer address outputs.
3 Sep. 2008	Updated specifications and data sheet summary.	
7 Aug. 2007	Issued first release of data sheet.	

DST/T/054		KAD/MEM/004/B DATA SHEET
Date	**Action**	**Reason**
17 Jun. 2021	Added new section “Recording delay increases as memory card fills”.	
24 Jun. 2019	Added back to Databook.	Classification changed to Released/standard.
19 Jul. 2018	Removed data sheet from Acra KAM-500 Databook.	Classification changed to Not recommended.
30 Nov. 2016	Issued first release of data sheet.	

DST/V/006		KAD/MSB/103/C DATA SHEET
Date	**Action**	**Reason**
8 Jun. 2021	In the Note in the “Message capture settings” section, messages that go into the parser are two dedicated counters for bus primary/secondary. Added a new Related products table that includes ASD/MSB/001/TCC and ASD/MSB/001/DC cables.	
25 Jan. 2016	Added back to Databook. Applied Defense Solutions template features (including a revision of the Key Features and Overview on the first page). Revised the second paragraph of the Description. In Getting the most from, added Snarfer filtering options table. On the last page, removed the Related products table.	Classification changed to standard.
6 Jan. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.

19 Feb. 2013	Updated data sheet title description.	
16 Oct. 2012	Curtiss-Wright template applied.	
14 Jun. 2012	KAM version of module added. xDefML updated. Pin 51 marked as DNC. Details of the new connectors available added to the related products section.	
7 Jul. 2011	Updated Features and Content IDs for KAD/MSB/103 SNARFER FIFO to include reference to primary and secondary (busses). Features also updated to include reference to 1024 messages.	
1 Jul. 2011	Updated to the latest template, which included adding a “KAD/” or “KAM/” prefix where applicable. No specifications were changed.	
28 Jan. 2010	Updated the MIL-STD-1553 spec table to amend operating range values. Also updated the Content ID table to confirm that content ID is 1 when the FIFO is empty.	
24 Nov. 2009	Issued first release of data sheet.	

DST/AC/013 — **KAD/PBM/104 DATA SHEET**

Date	Action	Reason
15 Nov. 2023	In Key Features, added point to clarify limitation up to 717 words per minor frame.	
30 Sep. 2016	Issued first release of data sheet.	

DST/S/032 — **KAM/CDC/101 DATA SHEET**

Date	Action	Reason
24 Apr. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR). In the Balance current outputs table, changed the maximum DC error from 0.5 to 0.6.	
11 Apr. 2016	Added back to Databook.	Classification changed to standard.
6 Jan. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
20 Feb. 2013	Updated data sheet title description.	
17 Jan. 2013	Issued first release of data sheet.	

DST/Z/021 — **KAM/PSU/011/B DATA SHEET**

Date	Action	Reason
19 Oct. 2023	Added new “±12V connector limitation” section.	
16 Apr. 2015	Applied Defense Solutions template features.	
28 Aug. 2013	Issued first release of data sheet	

DST/W/043 — **KAM/PSU/012/B DATA SHEET**

Date	Action	Reason
9 Jan. 2023	Added a note after Table 1, Specifications regarding MIL-STD-704D and MIL-STD-704F compliance. In Getting the most from the KAM/PSU/012, added a new “+12V connector limitation” section.	
12 Nov. 2015	In Figure 1, moved location of the 5mF capacitor. In “Electrical specifications” table, added condition for Input range; added Inrush current row. In “Getting the most from” section, removed references to MIL-STD-704E standard. Corrected typo by changing KAM/PSU/012/DNC to KAM/PSU/012/NC.	
16 Apr. 2015	Applied Defense Solutions template features.	
16 Oct. 2012	Curtiss-Wright template applied.	
1 Dec. 2011	Updated details in the input range of Electrical Specs table.	

14 Oct. 2011	Issued first release of data sheet	

DST/Y/024 — **KAM/PSU/014 DATA SHEET**

Date	Action	Reason
16 Apr. 2015	Applied Defense Solutions template features.	
20 Feb. 2013	Updated data sheet title description.	
16 Oct. 2012	Curtiss-Wright template applied.	
5 Jul. 2012	Changed condition column in input range line of Electrical spec table to 15W max. output	
29 Jun. 2012	Issued first release of data sheet	

DST/Z/010 — **SAM/DEC/008 DATA SHEET**

Date	Action	Reason
19 Apr. 2016	Issued first release of data sheet.	First released as non standard product. Added to databook when status changed to standard.

DST/Z/025 — **KAM/TCG/105 DATA SHEET**

Date	Action	Reason
14 Jul. 2023	Corrected Figures 1 and 4 to show TTL_IN as TTL_IN_A. In the General specifications table, removed the “-12V” row from Power consumption; revised the total power accordingly. Removed the “Output resistance” row from Tables 8, 9, 10, and 11. In the “GPS antenna” section, removed reference to the RFE/AEG/001 antenna and noted the antenna that is currently recommended; clarified that when estimating system power the max current drawn theoretically by the antenna should be added to the KAM/TCG/105 +12V current figure. Removed the “Warm power-up” and “Reacquisition” section. Removed RFE/AEG/001 from the Related products table.	
20 Oct. 2022	In the “GPS receiver” section, corrected the required NMEA messages to be “GGA, and ZDA or RMC”. Added TEC/NOT/072 and TEC/NOT/085 to the Related documentation table.	
16 Jun. 2020	In the Instrument settings table, Mode setting, added a description. Changed the name of “X-SYNC operation” section to “RS-422 output - X-SYNC operation”. Added a new “RS-422 output - NMEA messages” section. Modified “Figure 8: 19-way DD-type connector plus SMA connector” to clarify pin labeling order.	
6 Nov. 2018	In the “Time seeding” section, added a Note to clarify time it takes for module to get time from RTC.	
21 Feb. 2018	In the BTTL outputs table, TTL_PPS_OUT Condition/Details column, indicated that the Rising edge of TTL_PPS_OUT indicates the start of a second.	
23 Mar. 2017	In Time seeding section, added a paragraph regarding powering up the module at less than -30C if no external timing sources is applied.	
14 Oct. 2016	In Setting up the KAM/TCG/105 section, under Settings/Mode, added clarification for NMEA setting. In 19-way Double-Density (DD) type connector table, added NMEA to comment column for pins 11 and 12.	
6 Apr. 2016	Change register definition for HeadingLo parameter from R[7:0] Reserved to R[15:8] Reserved. In TTL status outputs section, added KAM/MEM/103 as a module to be monitored.	
5 Oct. 2015	Changed the recommended torque setting for the SMA connector from 0.68Nm to 0.45Nm.	
17 Sep. 2015	Issued first release of data sheet.	

DST/AG/014		KAM/TCG/106 DATA SHEET
Date	**Action**	**Reason**
18 Jul. 2023	Corrected Figures 1 and 4 to show TTL_IN as TTL_IN_A. Removed the “Output resistance” row from Tables 9, 10, and 11. Removed the “Output resistance” row from Tables 8, 9, 10, and 11. In the “GPS antenna” section, removed reference to the RFE/AEG/001 antenna and noted the antenna that is currently recommended; clarified that when estimating system power the max current drawn theoretically by the antenna should be added to the KAM/TCG/105 +12V current figure. Removed the “Warm power-up” section. Removed RFE/AEG/001 from the Related products table.	
20 Oct. 2022	In the “GPS receiver” section, corrected the required NMEA messages to be “GGA, and ZDA or RMC”. Added TEC/NOT/072 and TEC/NOT/085 to the Related documentation table.	
17 Dec. 2020	Issued first release of data sheet.	

DST/W/033		KAD/SDC/101 DATA SHEET
Date	**Action**	**Reason**
3 Jun. 2022	Issued first release of data sheet.	First released as non standard product. Added to databook when status changed to standard.

DST/U/015		KAD/SDI/103 DATA SHEET
Date	**Action**	**Reason**
22 May 2015	Applied Defense Solutions template features.	
10 Nov. 2014	Applied Curtiss-Wright template features.	
20 Feb. 2013	Updated data sheet title description.	
16 Oct. 2012	Curtiss-Wright template applied.	
28 Nov. 2011	Updated template, which included updates to Supporting Software and Related Documentation	
1 Jul. 2011	Updated to the latest template, which included adding a “KAD/” or “KAM/” prefix where applicable. No specifications were changed.	
2 Nov. 2009	Updated Treeview icons legend.	
5 Oct. 2009	Updated Treeview icons legend; added reference to TEC/NOT/049 in Power considerations section.	
20 Jan. 2009	Issued first release of data sheet.	

DST/W/009		KAD/SWI/101 DATA SHEET
Date	**Action**	**Reason**
16 Apr. 2015	Applied Defense Solutions template features.	
11 Jun. 2013	In Connector pinout of the KAD/SWI/101, changed comment for pins 3/4/5/6 to “DAU port 0; changed comment for pins 21/22/23/24 to “DAU port 2.	
20 Feb. 2013	Updated data sheet title description.	
16 Oct. 2012	Curtiss-Wright template applied.	
23 Apr. 2012	Reworded last line on first page to read “For example, typically better than ±100ns error, when connecting with Acra’s KAD/BCU/105KAD/BCU/105 and KAD/BCU/140 (Ethernet backplane controller) “ Added TEC/NOT/065 to the related documentation section. Added NET/CON/004 to related products. Updated diagram on first page to add a NET/SWI/ 004 between the KAD/SWI/101 and the NET/REC/001.	

7 Oct. 2011	Issued first release of data sheet.	

DST/V/065 **KAD/SWI/102 DATA SHEET**

Date	Action	Reason
21 Jan. 2021	In the Supporting software table, made a correction to state the module is only supported by using KC.exe with low level XID files.	
26 May 2015	Applied Defense Solutions template features (including a revision of Key Features on the first page). Removed DAS Studio 3 from Supporting software and Related documentation tables.	
6 Oct. 2014	Applied Curtiss-Wright template features. In the Description section, reworded final paragraph for clarity. In the Ordering Information section, replaced reference to the Cables data sheet with reference to the Network Cables data sheet. In the General specifications table, rounded up mass value.	
16 Apr. 2013	Issued first release of data sheet.	First released as non standard product. Added to databook when status changed to standard.

DST/Y/025 **KAD/SWI/107 DATA SHEET**

Date	Action	Reason
16 Apr. 2015	Applied Defense Solutions template features (including a revision of the Key Features and Overview on the first page).	
31 Oct. 2014	Applied Curtiss-Wright template features. In Description, clarified that the KAD/SWI/107 provides an active non-intrusive mechanism. In Ordering Information, changed reference from *Cables* data sheet to *Network Cables* data sheet.	
6 Feb. 2014	Reworded description. In Features, clarified use of the term “paired tap ports” and removed recommendation to not have any data on the aggregator/monitors ports. In Description, added a paragraph to explain the concept of a tap port pair. From Related Products, removed NET/CON/004 cable; added NET/CON/018 cable. In General specifications table, rounded up mass value. In Port allocations table, updated the description for ports 3/4 to state “Monitor port that aggregates and transmits Ethernet frames from the tap ports”. Applied Curtiss-Wright template features.	
7 Nov. 2012	Issued first release of data sheet.	

DST/Y/045 **KAD/SWI/108 DATA SHEET**

Date	Action	Reason
18 Jan. 2022	In the “Inter-connecting KAD/SWI/108 modules” section, added a Note stating that up to four KAD/SWI/108 modules can be cascaded.	
8 Jun. 2021	In Table 1, General Specification, under Throughput parameter - 100BaseTX/10BaseTX, added a throughput value for 100Mbps for each defined aggregator port in the Condition/Details column. Added NET/CON/002 to the Related products table.	
14 Jun. 2018	In the Parameters definitions table, Report parameter; reworded the descriptions in the Register/Definition column; no technical content was changed. Added new Inter-connecting KAD/SWI/108 modules section.	
21 Feb. 2018	In General specifications table, changed total power units to Watt and updated power values accordingly. Added a new PTP packets section.	
25 Apr. 2016	In Setting up the KAD/SWI/108 section, expanded the descriptions for RxDropCnt and TxDropCnt. In Getting the most from, added RxDropCnt and TxDropCnt definitions section.	
16 Apr. 2015	Applied Defense Solutions template features (including a revision of the Key Features and Overview on the first page).	

7 Oct. 2014	Applied Curtiss-Wright template features. In Ordering Information, changed reference from *Cables* data sheet to *Network Cables* data sheet. In Getting the most from... specified that Auto MDI/MDIX only operates with Port Mode set to Auto-negotiate.	
10 Feb. 2014	Added descriptions on filtering capabilities to Features, Description and Getting the most from sections. From Related Products, removed NET/CON/004 cable; added NET/CON/018 cable. In General specifications table, rounded up mass value.	
13 Dec. 2013	Issued first release of data sheet.	

DST/Y/012 — **KAD/TDC/102/B DATA SHEET**

Date	Action	Reason
28 Feb. 2022	In Table 3, Thermocouple inputs: in the description for “full scale range K-type thermocouple” parameter changed the accuracy figures upper range to 1372˚C. Clarified the descriptions for both DC error parameters.	
3 Dec. 2020	In the Overview, deleted the following sentence from the first paragraph: “Each thermocouple channel can be configured separately for use with a wide range of thermocouple types.”	
13 Apr. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR). In the Balance current outputs table, changed the maximum DC error from 0.5 to 0.6.	
25 Jul. 2017	In Thermocouple inputs table, on the Input temperature row, Condition/Details column, added a reference to the new Accuracy section. Added details to the full scale range K-type thermocouple and full scale range XK_L-type thermocouple rows. Added a new Accuracy section.	
28 Jul. 2016	In Thermocouple inputs table, updated values for full scale range K-type thermocouple; in Condition/details for DC error, added text “and within a -200°C to 1100°C temperature range.”	
21 Apr. 2016	Added back to Databook	Classification changed to standard.
17 Jul. 2015	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
24 Mar. 2015	Applied Defense Solutions template features (including a revision of the Key Features and Overview on the first page).	
23 Apr. 2014	Reworded the Description section. In the Input temperature section of the Thermocouple inputs table, added C-type thermocouple. Removed the Additional delay sources section. Reworded the Common mode voltage effects section. Applied Curtiss-Wright template features.	
28 Aug. 2013	In Description on page 1, revised values for scaling junction block temperature. In Cold junction table, revised Input temperature values. In Thermocouple inputs table, revised Input temperature values for full scale range K-type T/C.	
23 Aug. 2013	In Thermocouple inputs table, corrected Input resistance values; for “each input to GND (off/on)” rows, added “Within ±100mV input range” in Condition/Details column.	
20 Feb. 2013	Updated data sheet title description. Removed Related Products section. Added the “CON/KAD/010 built-in PT100 sensor for each KAD/TDC/102 channel” table to GTMF.	
16 Dec. 2012	Issued first release of data sheet.	

DST/V/032 — **KAD/TDC/107 DATA SHEET**

Date	Action	Reason
13 Apr. 2018	In the introductory paragraph of the Specifications section, added the following: Module specifications are met for up to 97% of Full Scale Range (FSR). In the Balance current outputs table, changed the maximum DC error from 0.5 to 0.6.	

16 Apr. 2015	Applied Defense Solutions template features (including a revision of the features listed on the first page).	
8 Sep. 2014	In caption on page 1, changed “First of 3 compensation...” to “First of 3 reference junction...”. In General specifications table, rounded up mass value. Added “CON/KAD/010 built-in PT100 sensor for each KAD/TDC/107 channel” table to “Mating connector” section. Applied Curtiss-Wright template features.	
20 Feb. 2013	Updated data sheet title description.	
16 Oct. 2012	Curtiss-Wright template applied.	
22 Dec. 2011	New template applied.	
9 May 2011	GTMF section updated to note that the KAD/TDC/107 is not a suitable module to support grounded thermocouples.	
17 Sep. 2010	Issued first release of data sheet	

DST/X/084 — **KAD/UAR/102/C DATA SHEET**

Date	Action	Reason
23 Jan. 2023	Removed “Rules for baud rate availability” section. Added section title “Error codes for the KAD/UAR/102” before Table 4, Error codes.	
8 Mar. 2022	In the General specifications table, provided the maximum Power consumption values.	
20 Jul. 2021	In the “Instrument settings” table, corrected the Baud Rate choices available to 29. In “Rules for baud rate availability”, corrected the Baud Rate choices available to 29. Added a new “Parser data word definition” section.	
1 Feb. 2018	In Ordering information, added KAM/UAR/102/C variant.	
15 Feb. 2017	Added new “Interval between messages” section.	
26 Apr. 2016	Issued first release of data sheet.	

DST/Y/060 — **KAD/UBM/103 DATA SHEET**

Date	Action	Reason
27 Sep. 2022	In the Parameter definitions table, updated the descriptions for ChannelMessageCount and ModuleMessageCount.	
19 Oct. 2021	In the RS-232 inputs specifications table, under Input voltage, reversed Min/Max 0 values for logic 0 and logic 1.	
16 Sep. 2021	In the RS-232 inputs specifications table, under Input voltage, changed the logic 0 value to 2.5; and changed the logic 1 value to 0.6. Added a new “Timestamps for parser/packetizer and idle time for parser” section.	
1 Dec. 2020	In Setting up the KAD/UBM/103, updated the description for the Fill Value parameter to read “The value returned by Parser Parameters (excluding MessageInfo) when MessageInfo indicates the parser is empty.”	
22 Mar. 2018	In Figure 1, corrected "3 x 254 x 1024" to "3 x 511 x 1024. Added new Parser Data Endianness example section.	
13 Apr. 2015	Applied Defense Solutions template features (including a revision of the features listed on the first page).	
10 Nov. 2014	Issued first release of data sheet.	

DST/AB/014 — **KAD/UBM/105 DATA SHEET**

Date	Action	Reason
25 Oct. 2022	Added TEC/NOT/079 to the Related documentation table.	

19 Oct. 2021	In the RS-232 inputs specifications table, under Input voltage, reversed Min/Max 0 values for logic 0 and logic 1.	
17 Jun. 2021	Removed “idle time” from the last bullet point in Key Features. In the RS-232 inputs specifications table, under Input voltage, changed the logic 0 value to 2.5; and changed the logic 1 value to 0.6.	
21 Sep. 2018	Issued first release of data sheet.	First released as non standard product. Added to databook when status changed to standard.

DST/AF/038 — **KAD/UBM/106 DATA SHEET**

Date	Action	Reason
26 Feb. 2020	Issued first release of data sheet.	

DST/N/065 — **KAD/VDC/001 DATA SHEET**

Date	Action	Reason
19 Jan. 2021	On page 1, updated the Features. In Table 2, Differential ended audio inputs, added the following in the Condition/Details column, “-30dB = 0.015Vrms ; 8Db = 1.23 Vrms”. In Getting the most from the KAD/VDC/001 added a Note to clarify transmission into different sinks.	
4 May 2018	Added back to Databook	Classification changed to standard.
14 Mar. 2018	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
10 Mar. 2015	Applied Defense Solutions template features. Added DAS Studio 3 as supporting software and related documentation.	
6 Oct. 2014	Applied Curtiss-Wright template features. Changed data sheet title description from “...2ch at 64ksps” to “...2ch at 64kbps”. In General specifications table, rounded up mass value. In Differential ended audio inputs table, changed Units for Sampling rate to kbps and changed Units for Analog filter to Hz.	
20 Feb. 2013	Updated data sheet title description.	
16 Oct. 2012	Curtiss-Wright template applied.	
22 Dec. 2011	New template applied.	
1 Dec. 2010	Applied template update (which included adding “KAD/” prefix to module name).	
25 Sep. 2008	Updated specification tables and pinout table.	
18 Oct. 2006	Added Module Setup section and reformatted data sheet.	
10 Feb. 2006	Reformatted data sheet.	
15 Sep. 2006	Added new Module setup format.	
1 Mar. 2005	**Setup:** Added the following text: The KAD/VDC/001 places the CVSD data in the most significant bits of the 16-bit KAD/VDC/001 parameter. The least significant bits are set to zero. For example, if a 12-bit CVSD is selected, bit 15 to bit 4 of the KAD/VDC/001 parameter will contain the audio data, where bit 15 is the oldest bit; and bits 3 to 0 will contain zeros.	**Customer feedback.**
1 Sep. 2004	**Setup:** Updated to show that Bits per Word can be set from 8 to 16	**Documentation error.**
1 Aug. 2004	Clarified description of sampling rates	**Customer feedback.**
1 Jun. 2004	Updated Ordering Information to show that CON/KAD/002/CP is the default mating connector.	**Specification change.**
3 Jul. 2003	Updated ordering information to show new part number for connector.	Part number renamed IAW Acra’s part numbering scheme.
1 Apr. 2003	Issued first release of data sheet.	KAD version (KAM version was DST/J/054).

DST/AB/032		KAD/VID/106/B DATA SHEET
Date	**Action**	**Reason**
12 Oct. 2023	Added a new “Audio Only FIFO Mode sample rates” section.	
4 May 2018	Added back to Databook	Classification changed to standard.
3 Apr. 2018	Removed data sheet from Acra KAM-500 Databook.	Classification changed to non-standard.
31 Jan. 2017	Issued first release of data sheet.	
DST/AC/011		**WIRELESS DATA ACQUISITION EVALUATION KIT**
Date	**Action**	**Reason**
19 Aug. 2021	Issued first release of data sheet.	
HW/BK/0002		**ACRA KAM-500 DATABOOK (FRONT/BACK MATTER)**
Date	**Action**	**Reason**
4 Feb. 2020	Added definition for “CAIS” to the Acronyms section.	
5 Mar. 2018	Added definitions for “Max” and “Typical” to the Acronyms section.	
2 Jan. 2018	Moved the “Acronyms” section from the Appendix to its own section titled “Acronyms” Appendix B.	
1 Jul. 2016	In Appendices, applied updates to acronyms and terms.	
1 Dec. 2015	Applied Defense Solutions template features to the Introducing data sheets section. In the Revision histories chapter, removed the List of controlled drawings.	
HW/SPF/0005		**INTRODUCING THE ACRA KAM-500**
Date	**Action**	**Reason**
10 Apr. 2015	Applied Defense Solutions template features.	
12 Nov. 2014	Applied Curtiss-Wright template features.Added a section on Dimensional tolerance. In the Distributed data acquisition section, replace reference to KAD/DAC/003 with reference to KAD/DEC/103 and updated the note on daisy-chain configuration to confirm “We do not support the use of a master/slave daisy-chain configuration”.	
30 Oct. 2012	Curtiss-Wright template applied.	
QD/HW/SPF/L/0001		**ENVIRONMENTAL SPECIFICATIONS**
Date	**Action**	**Reason**
4 Feb. 2020	In the “Physical dimensions, weight and mass” section, clarified how information on a particular configuration's approximate mass and dimensions can be provided.	
27 Feb. 2018	In Table 1, updated description for Vibration parameter. In Table 7, updated Parameters and description to match *Environmental Qualification Handbook.*	**Customer feedback**
20 Dec. 2017	In the “Calibration interval for analog modules” section, added the following paragraph: *It is the end user's responsibility to perform the verification of the calibration of the entire system in order to ensure correct results are obtained.* Added a new section “Format switching and analog modules”.	**Customer feedback**
19 Nov. 2015	Applied Defense Solutions template.	
9 Nov. 2012	Updated storage life to 5 years, as stated in the Environmental Qualifications Handbook.	

16 Oct. 2012	Curtiss-Wright template applied.	
30 May 2008	Removed redundant cross-reference to “Power consumption” and “Masses & dimensions” chapters.	**“Power consumption” and “Masses & dimensions” chapters were removed from Databook.**
11 Sep. 2007	Added calibration interval for analog modules.	
1 Dec. 2006	Added explosive decompression test.	
18 Oct. 2006	Reformatted data sheet.	
10 Feb. 2006	Reformatted data sheet.	
2 May 2005	Rewritten for clarity.	**Customer feedback.**
4 Jan. 2005	**3.1 Overview:** Updated description of altitude to show that the KAM-500 is operational at 75,000 feet (22,860 meters)	**Documentation error.**
4 Oct. 2004	**3.10 Electromagnetic emissions and susceptibility** Corrected to show that RS-103 measures radiated susceptibility between 400MHz and 18GHz	**Documentation error.**
4 May 2004	**3.10 Electromagnetic emissions and susceptibility** Added the following text: For EMC compliance all cables should be shielded and all shields should be connected to the KAM-500 chassis via the connector backshell.	**Customer feedback.**
1 Apr. 2004	**3.4 Temperature:** Corrected error in text.	**Documentation error.**
1 Mar. 2004	Updated Environmental Specifications to include details of new certifications obtained	**Specification change.**
1 Apr. 2003	**3.6 Shock, Design considerations** Changed to reference the KAD/ADC/006 and KAD/ADC/009	**Specification change.** The KAD/ADC/006 and KAD/ADC/009 have replaced “KAM” modules as standard.
1 Oct. 2002	**3.6 Shock, Design considerations** Changed reference to resolver to synchro	**Documentation error.**
1 Aug. 2002	**Overview:** Updated to show that MIL-STD-810F Method 514.1 Procedure I certification has been obtained	**Specification change.**
4 Jun. 2002	Updated Environmental Specifications to include details of new certifications obtained, i.e. MIL-STD-810F Method 514.1 Procedure I Electrical Bonding Test AC/KAM-500-II/SLTP/1.4, Paragraph 3 Electrical Insulation Test, High Voltage Test BS3G100, Part 4, Section 1, Subsection 1, Paragraph 5.1 Electrical Insulation Test, Insulation Resistance Test BS3G100, Part 4, Section 1, Subsection 1, Paragraph 5.2 Electrical Insulation Test, Leakage Current Measurements BS3G100, Part 4, Section 1, Subsection 1, Paragraph 5.3	**Specification change.**
1 May 2002	Updated Environmental Specifications to include details of new certifications obtained, i.e. MIL-STD-810F Method 516.5 Procedure V - modified MIL-STD-810F Method 506.4, Procedure III	**Specification change.**
1 Mar. 2002	Updated Environmental Specifications to include details of new certifications obtained, i.e. BS 3G100 Part 2 Section 2 CS101 EN61000-4-2:1995 GAMME-EG-13 IEC 801-2:1991 (ESD) MIL-STD-810F Methods 500.4 Procedure II and III MIL-STD-810F Methods 501.4 and 502.4 Procedure I MIL-STD-810F Method 507.4	**Specification change.**
1 Aug. 2001	**3.8 Electromagnetic emissions and susceptibility**: Changed text to “The KAM-500 is designed to meet, and will be certified in accordance with” from “The KAM-500 has been certified in accordance with”	**Documentation error**.

1 Apr. 2001	**3.7 Vibration**: In the random vibration; functional, the spectrum changed from 0.4g2/Hz from 15 to 89.2Hz +4dB/octave from 89.2 to 300Hz to 0.04g2/Hz from 15 to 89.2Hz +4dB/octave from 89.2 to 300Hz. In the random vibration: endurance, the spectrum changed from 0.4g2/Hz from 15 to 30.7Hz +4dB/octave from 30.7 to 300Hz to 0.04g2/Hz from 15 to 30.7Hz +4dB/octave from 30.7 to 300Hz	**Documentation error**. The earlier document had a typographical error.
1 Jan. 2001	Issued preliminary data sheet	

QD/HW/SPF/L/0002 EQUIPMENT INTERFACE

Date	Action	Reason
4 Feb. 2020	In the “Torque settings for Acra KAM-500” section, corrected the grounding bolt torque setting from 4.5 Nm to 2.5 Nm.	
27 Feb. 2018	In the Torque settings for Acra KAM-500 table, added a row for Grounding bolt.	
15 Jun. 2017	In Acra KAM-500 connectors table, corrected the pinout drawings and “Where used” descriptions for CON/KAD/003/CP (row 3) and DCDM-51P-6E5-18-199/214/240 (row 4).	Drawings were of module and shoud have shown mating connector.
19 Nov. 2015	In the Torque settings section, corrected the torque for the SMA connector.	
10 Apr. 2015	Applied Defense Solutions template features.	
15 Nov. 2013	Updated Connectors on KAM-500 section to insert references to KAD/TDC/002/D and KAM/CDC/101. Updated Figure 5 to correct pin numbers for PCM DCLK+ and PCM DCLK-. Updated Figure 7 to correct descriptions for pin 30 and pin 31.	
30 Oct. 2012	Curtiss-Wright template applied. Reworded “Bus termination” section to include RS-422 and RS-232 busses. Updated vendors and part numbers in “Connectors on KAM-500” table.	
11 Mar. 2011	Updated the Torque settings section to include settings for the SMA connector.	
18 Oct. 2006	Reformatted data sheet.	
14 Jul. 2006	**Corrected 'Recommended wiring diagram for the distributed KAM-500 system'.**	**Documentation error.**
13 Apr. 2006	Updated to include new PSU modules	
10 Feb. 2006	Reformatted data sheet	
7 Sep. 2005	**4.3 Chassis Connections:** Corrected error in Figure 1.5	**Documentation error.**
1 Apr. 2005	**4.4.1 Connectors on KAM-500:** Corrected error in part number for Bayonet connector for power supply.	**Documentation error.** Typographical error.
1 Mar. 2005	**Figure 1.5:** Corrected error on wiring diagram for distributed KAM-500 system.	**Documentation error.**
1 Dec. 2004	**4.4.1 Connectors on KAM-500:** added footnote: “The connectors are viewed looking into the front face from above.” Added section 4.6 Torque Settings	**Customer feedback.**
1 Aug. 2004	**4.4.1 Connectors on KAM-500:** Added description of the CON/KAD/001/SR	**Specification change.**
4 May 2004	Added the following text: For EMC compliance all cables should be shielded and all shields should be connected to the KAM-500 chassis via the connector backshell. Replaced references to KAM/PSU/003 and KAM/PSU/005 with KAM/PSU/007	**Customer feedback.** KAM/PSU/007 is standard power supply offered to customers.
1 Aug. 2003	**4.3.2 Programming Lines (PROG_DCLK±, PROG_DATA±)** Updated description to show that the SAM/DEC/007 is Acra’s standard decoder card.	

1 Apr. 2003	Updated to include wiring diagram for the KAD/ENC/004 and to describe new double-density connectors.	**Specification change.**
1 Oct. 2001	**Programming lines**: Added the text "On the SAM/DEC/005 these lines are terminated internally as standard."	**Style consistency.** Changed to make termination clearer.
1 Apr. 2001	**Note**, Removed the text: In 2001, ACRA CONTROL will offer a controller with less inter-chassis wires. In particular FORMAT[3:0], X_CLK±, PROG_CLK± and IRIG time connections to multiple chassis will be combined into the X_SYNC± pair. Please contact ACRA CONTROL for details. Notes for the System Installer: Replaced "KAM/PSU/003" by "KAM/PSU/003 or KAM/PSU/005" **Connectors on** KAM/CDC/001: Added the following: CONNECTORS ON KAM/CDC/001 The charge to digital converter module KAM/CDC/001 contains 4 connectors (10-32 UNF thread jacks) for use with the low-noise co-axial connectors commonly used with piezoelectric charge devices. Often the cable and plug are part of the sensor. One source of mating connector is Microdot Connectors Inc.	**Specification change.** **Specification change**. **Specification change**.
1 Jan. 2001	**4.5.1 Buffered TTL**: Added: TTL levels are typically 0 to 0.8V for a logic low and 2.0 to 5.0V for a logic high.	**Specification change**.

HW/SPF/0006 — WARRANTY AND SAFETY

Date	Action	Reason
6 Dec. 2017	Changed title section to "Warranty and safety" (Appendix A); moved the "Acrnoyms" section to a new section titled "Acronyms" (Appendix B) In the "Limit of warranty" section, added the following paragraph: *The MANUFACTURER does not warrant that its Manufacturer Products are fit for any particular purpose and shall have no liability in that respect except to the extent that the intended end user application of the Manufacturer Products has been expressly approved in writing by the MANUFACTURER in the relevant contract of sale.* In the "General hazard statement" section, added the following paragraph: *The system shall only be installed and used by trained personnel, in accordance with local safety rules, in accordance with the environmental and operational limits indicated in the data sheets/manuals and in no way that may cause injury to persons or damage to property.*	**Customer feedback**
14 Jun. 2017	Added the following definitions: Ratiometric; STP; UTP.	
8 Apr. 2015	Applied Defense Solutions template features. Replaced reference to AFDX with reference to ARINC 664 Part 7.	
30 Oct. 2012	Curtiss-Wright template applied.	

Other data sheets available

Data sheets are available for the following legacy products which are not recommended for new programs.

REF.	DESCRIPTION (LEGACY)
ACC/TRF/001	6-channel power transformer
ACC/TRF/001/B	Power transformer - 6ch
ACD/BAC/002	Electroless nickel-plated aluminum straight-through backshell for KAD connectors
ACD/BAC/003	Electroless nickel-plated aluminum 30° double-density backshell for KAD connectors
ACD/BAC/004	Electroless nickel-plated aluminum double-density backshell for CON/KAD/003/CP
JIG/UNI/001/C	Universal test jig for Acra KAM-500 modules
KAD/ABM/102	ARINC-429 bus monitor packetizer - 8ch
KAD/ADC/001	32-ch. S/E analog to digital (A/D) converter
KAD/ADC/002/B	2-ch. D/E analog to digital converter at 100ksps
KAD/ADC/002/C	Differential ended ADC (piezoresitive pressure, 12.5kHz b/w) - 2ch at 100ksps
KAD/ADC/003	15-ch. thermocouple A/D converter with reference compensation
KAD/ADC/003/B	15-channel thermocouple A/D converter module with reference compensation
KAD/ADC/005	8-ch. D/E analog to digital converter with signal conditioning
KAD/ADC/006	6-ch. S/E accelerometer (ICP) A/D converter with signal conditioning
KAD/ADC/008	Single ended ADC (programmable analog gain, three phase power monitor, 1kHz b/w) - 6ch at 20sps
KAD/ADC/009/S1	8-ch. bridge A/D conv. with excitation and signal conditioning
KAD/ADC/009/S2	8-ch. bridge A/D conv. with excitation, sense and signal conditioning
KAD/ADC/009/QB/120	8-channel A/D conv. module, with exc. and sig. cond. for ¼-bridge 120Ohm strain gages
KAD/ADC/010	2-ch. D/E analog to digital converter. 14-bits at 100ksps
KAD/ADC/010/B	2-ch. D/E analog to digital converter. 14-bits at 100ksps
KAD/ADC/011	48-channel S/E analog to digital converter
KAD/ADC/011/B	48-channel S/E analog to digital converter
KAD/ADC/012	24-channel D/E analog to digital converter
KAD/ADC/012/B	24-channel D/E analog to digital converter
KAD/ADC/012/C	24-channel D/E analog to digital converter
KAD/ADC/013	16-ch. ¼-bridge A/D conv. with excitation and sig. con for PT100s
KAD/ADC/013/B	16-ch. ¼-bridge A/D conv. with excitation and sig. con for PT100s
KAD/ADC/013/C	16-channel ¼-bridge A/D converter with excitation and signal conditioning for PT100
KAD/ADC/013/D	16-channel ¼-bridge A/D converter with excitation and signal conditioning for PT100
KAD/ADC/013/E	16-channel ¼-bridge A/D converter with excitation and signal conditioning for PT100
KAD/ADC/014	16-channel bridge A/D converter with voltage excitation and signal conditioning
KAD/ADC/014/B	16-channel bridge A/D converter with voltage excitation and signal conditioning
KAD/ADC/014/C	16-channel bridge A/D converter with voltage excitation and signal conditioning
KAD/ADC/014/D	16-channel bridge A/D converter with voltage excitation and signal conditioning
KAD/ADC/018	12-ch. bridge A/D conv. with excitation, balancing and signal conditioning

REF.	DESCRIPTION (LEGACY)
KAD/ADC/020	12-ch. bridge A/D conv. with excitation, balancing and signal conditioning
KAD/ADC/021	16-channel multiplexing D/E analog-to-digital converter
KAD/ADC/105	8-channel D/E analog-to-digital converter with signal conditioning
KAD/ADC/106	6-ch. S/E accelerometer (ICP) A/D converter with signal conditioning
KAD/ADC/106/B	6-channel S/E accelerometer (ICP) analog-to-digital converter with sig. conditioning
KAD/ADC/109/B/QB120	8-ch. A/D converter, with current exc. and sig. cond. for ¼-bridge 120Ω strain gages
KAD/ADC/109/B/QB350	8-ch. A/D converter, with current exc. and sig. cond. for ¼-bridge 350Ω strain gages
KAD/ADC/109/B/S1	8-ch. bridge A/D converter module, with voltage excitation and signal conditioning
KAD/ADC/109/B/S2	8-ch. bridge A/D converter with voltage excitation, sense lines and signal conditioning
KAD/ADC/113	16-channel ¼-bridge A/D converter with excitation and signal conditioning for PT100
KAD/ADC/115	¼-bridge ADC (current excitation, PT1000 temp. sensors, 6.25kHz b/w) - 16ch at 25ksps
KAD/ADC/117	8-channel A/D converter with bridge signal conditioning & constant current excitation
KAD/ADC/126	4-channel wideband S/E accelerometer (ICP) analog-to-digital converter with sig. conditioning
KAD/ADC/134	Full/½-bridge ADC (voltage excitation, strain gages, shunt resistor, 6.25kHz b/w) - 16ch at 25ksps
KAD/ADC/135	Full/½-bridge ADC (voltage/current excitation, programmable analog gain, FIR/IIR, 6.25kHz b/w) - 12ch at 25ksps
KAD/ADC/136	Flexible ADC (full/½-bridge, ICP, PT100, thermocouple, FIR/IIR, 12.5kHz b/w) - 8ch at 50ksps (uses ±7V)
KAD/ADC/136/B	Flexible ADC (full/½-bridge, ICP, RTD, thermocouple, FIR/IIR, 12.5kHz b/w) - 8ch at 50ksps
KAD/ADC/141/PT100	¼-bridge ADC (current excitation, PT100 temp. sensors, 3.125kHz b/w) - 16ch at 12.5ksps
KAD/ARI/001	8-channel ARINC-429 Bus Monitor
KAD/ARI/001/B	8-channel ARINC-429 bus monitor with parity option
KAD/BCU/001	KAM-500 backplane controller with IRIG-106 PCM encoder
KAD/BCU/001/B	KAM-500 backplane controller with IRIG-106 PCM encoder
KAD/BCU/002	A CAIS compliant backplane controller for any KAM-500 chassis
KAD/BCU/003/ET	KAM-500 controller with IRIG-106 PCM encoder
KAD/BCU/101/C	KAM-500 backplane controller with IRIG-106 PCM encoder
KAD/BCU/101/D	IRIG-106 backplane controller and encoder
KAD/BCU/102	A CAIS backplane controller for any KAM-500 chassis
KAD/BCU/105	Single-port Fast Ethernet KAM-500 backplane controller and packet generator
KAD/BCU/105/B	Fast Ethernet KAM-500 backplane controller and packet generator
KAD/BCU/105/C	Fast Ethernet KAM-500 backplane controller and packet generator
KAD/BCU/105/C/AB1/ET	Extended temp. Fast Ethernet KAM-500 backplane controller and packet generator
KAD/BCU/105/D	Ethernet backplane controller - IENA compatible
KAD/BCU/105/D/AB1/ET	Extended temp. Fast Ethernet KAM-500 backplane controller and packet generator
KAD/BCU/140	Ethernet backplane controller - IENA/iNET-X compatible
KAD/BCU/140/C	Ethernet backplane controller - IENA/iNET-X compatible with TFTP programming
KAD/BCU/140/F	Ethernet backplane controller - full format support MEM Trigger, IENA/iNET-X compatible, PTPv1/PTPv2 client or Grandmaster, dual Ethernet output
KAD/BCU/145	Ethernet backplane controller - IENA/iNET-X compatible, PTPv1 client and Grandmaster, PTPv2 client, dual Ethernet output

REF.	DESCRIPTION (LEGACY)
KAD/BCU/140/DEM	Ethernet backplane controller - DEM compatible, PTPv1 client or Grandmaster, PTPv2 client, single Ethernet output
KAD/CDC/002	Differential ended current-to-digital converter (1.1kHz b/w) - 24ch at 17.5ksps
KAD/DAC/001	8-channel analog outputs, with 16-channel discrete outputs
KAD/DAC/002	8 analog output channels, with 16 discrete output channels
KAD/DEC/003	IRIG-106 PCM decoder/merger - 2ch
KAD/DPI/002	Data input (RAM reader) - dual-port
KAD/DSI/003	24-channel bi-level input module with counters and time tagging
KAD/DSI/004	Optoisolated input (counters, time tagging) - 24ch
KAD/EBM/101	Ethernet bus monitor
KAD/EBM/101/B	Ethernet bus monitor parser - 1ch
KAD/ENC/004	KAM-500 controller with IRIG-106 PCM encoder
KAD/ENC/006	IRIG-106 PCM Encoder with Pre-modulation Filter (PMF) output
KAD/ENC/006/HA	IRIG-106 PCM encoder with pre-modulation filter (PMF) output
KAD/ETH/101	2.5Msample/sec data acquisition and programming over Ethernet
KAD/FBM/102	FireWire bus monitor parser - 1ch
KAD/FBM/103	S200 beta mode FireWire bus monitor
KAD/MBI/102	A MIL-STD-1553 remote terminal
KAD/MDC/001	8 x 64-ch. external multiplexing A/D converter
KAD/MEM/004	A CompactFlash® memory module with data extraction via Fast Ethernet
KAM/MEM/103	KAM-500 series 100 CompactFlash® memory module
KAM/MEM/103/B	CompactFlash memory module
MKM/BCU/101	KAM-500 backplane controller with IRIG-106 PCM encoder for MicroKam
KAD/MSB/001/B	Dual redundant MIL-STD-1553 bus monitor with D/C and T/C inputs
KAD/MSB/003	Dual redundant MIL-STD-1553 bus monitor with Mode Code 17 support
KAD/MSB/003/B	Dual redundant MIL-STD-1553 bus monitor with Mode Code 17 support
KAD/MSB/103	Dual redundant MIL-STD-1553 bus monitor with Mode Code 17 support
KAD/MSB/103/B	Dual redundant MIL-STD-1553 bus monitor with Mode Code 17 support
KAD/RTC/002	Real-time clock generator for KAM-500 systems
KAD/RTC/003	RTC generator (memory status outputs)
SAM/VAD/001	Video compression replay unit
SAM/DEC/007/P	KAM-500 programming interface
KAD/PBM/001	Panavia bus monitor parser - 8ch
KAD/PBM/002	MC/ENMC bus monitor snarfer/parser - 1ch
KAD/TCG/001	IRIG-B time code reader and generator with external battery
KAD/TCG/001/B	IRIG-B time code reader and generator
KAD/TCG/001/C	IRIG-B time code reader and generator with external battery
KAD/TDC/001	16-ch. A/D converter with excitation & sig. conditioning for 2K2 & 10K thermistors

REF.	DESCRIPTION (LEGACY)
KAD/TDC/002/B	15-ch. thermocouple A/D converter with reference compensation
KAD/TDC/002/B/ET	15-ch. thermocouple A/D converter with reference compensation
KAD/TDC/002/C	15-ch. thermocouple A/D converter with reference compensation
KAD/TDC/002/C/ET	15-ch. thermocouple A/D converter with reference compensation
KAD/TDC/002/D	Thermocouple ADC (reference compensation, 40Hz b/w) - 15ch at 512sps
KAD/TDC/002/D/10m	Thermocouple ADC (reference compensation, 10mV input range, 40Hz b/w) - 15ch at 512sps
KAD/TDC/005	15-ch. thermocouple A/D converter with external temperature sensor
KAD/TDC/006	15-channel thermocouple analog-to-digital converter with reference channel
KAD/TDC/102	15-channel thermocouple ADC with reference compensation
KAD/UAR/001	8-channel RS-232 or RS-422/485 universal asynchronous receiver
KAD/UAR/102	4-channel RS-232, RS-422 or RS-485 universal asynchronous PARSER and SNARFER
KAD/UAR/102/B	RS-232/422/485 bus monitor snarfer/parser - 4ch
KAD/UAR/002/B	4-ch. RS-232 or RS-422/485 universal async. PARSER
KAD/UAR/002/C	RS-232/422/485 bus monitor parser - 4ch
KAD/UAR/003	RS-422 bus monitor parser - 2ch
KAD/VID/001	Single-channel video interface to external video encoder
KAD/VID/103	Single-channel MPEG-4 encoder
KAD/VID/106	H.264 video encoder (analog video input) - 1ch
KAM/ADC/005/5KHZ	8-ch D/E analog to digital converter with signal conditioning
KAM/ADC/009/S1/5KHZ	8-ch. bridge A/D conv. with excitation and signal conditioning
KAM/ADC/009/S4	8-ch. bridge A/D conv. with excitation and signal conditioning
KAM/ADC/009/S5	8-ch. bridge A/D conv. with excitation, sense and signal conditioning
KAM/CBC/001	CAIS bus controller
KAM/CDC/001	4-ch. charge-to-digital converter for piezoelectric devices
KAM/CHS/03U/B	KAM-500 chassis with 3 user-slots
KAM/CHS/03U/C	KAM-500 chassis with 3 user-slots
KAM/CHS/03U/D	KAM-500 chassis with 3 user-slots
KAM/CHS/06U/B	KAM-500 chassis with 6 user-slots
KAM/CHS/06U/C	KAM-500 chassis with 6 user-slots
KAM/CHS/06U/D	KAM-500 chassis with 6 user-slots
KAM/CHS/09U/B	KAM-500 chassis with 9 user-slots
KAM/CHS/09U/C	KAM-500 chassis with 9 user-slots
KAM/CHS/09U/D	KAM-500 chassis with 9 user-slots
KAM/CHS/12R/B	KAM-500 circular form chassis with 12 user slots
KAM/CHS/12R/C	KAM-500 circular form chassis with 12 user-slots
KAM/CHS/13U/B	KAM-500 chassis with 13 user-slots
KAM/CHS/13U/C	KAM-500 chassis with 13 user-slots

REF.	DESCRIPTION (LEGACY)
KAM/CHS/13U/D	KAM-500 chassis with 13 user-slots
KAM/CHS/13U/E/VG1	Acra KAM-500 chassis - 13 user-slots
KAM/ISO/001	4-ch. D/E input signal isolated 4-ch. S/E output
KAM/MBC/001	A MIL-STD-1553 bus controller for FTI applications
KAM/MEM/001	8M parameter EEPROM memory module
KAM/MEM/003	CompactFlash® memory module
KAM/MEM/003/B	KAM-500 CompactFlash® memory module
KAM/MEM/003/C	KAM-500 high speed CompactFlash® memory module
KAM/MEM/003/D	KAM-500 high speed CompactFlash® memory module
KAM/MEM/003/E	KAM-500 high speed CompactFlash® memory module
KAM/MSB/002/B	Dual redundant MIL-STD-1553 bus monitor with mode code 17 support
KAM/PSU/007	5V, ±7V, and ±12V power supply unit for KAM-500 chassis
KAM/PSU/008	Power supply unit for KAM/CHS/03F chassis
KAM/PSU/009	5V, ±7V, and ±12V power supply unit for KAM-500 chassis
KAM/PSU/010	5V, ±7V and ±12V power supply unit for KAM-500 chassis
KAM/PSU/011	Power supply unit for Acra KAM-500 chassis (+5V, ±7V and ±12V) - 9-way connector
KAM/PSU/012	+5V, ±7V and ±12V power supply unit for KAM-500 chassis with 6-way connector
KAM/RCV/101	GNSS receiver module for the Vega C program
KAM/TCG/002	IRIG-A, B, G time code reader and generator
KAM/TCG/004	GPS Time code translator and IRIG-B generator
KAM/TCG/102/B	Combined GPS and IRIG input module
KAM/TCG/102/C	Combined GPS and IRIG input module
KAM/UAR/004	RS-422/485/232 universal async. parser
KAM/WSI/104/C	LORD wireless sensor network interface module
OBE/LRU/001	Thermocouple concentrator, 180ch
SAM/DEC/007/C	Acra KAM-500 programming interface with IRIG-106 PCM decoder

Data sheets are available for the following non-standard products.

REF.	DESCRIPTION (NON-STANDARD)
CON/KAD/012	Mating connector for KAD/ADC/136 when used with thermocouple sensors (DD, 52-way, 1 built-in temperature sensor)
CON/PSU/010/SEC	PSU connector with backshell for KAM/CSB/12U/B
KAD/ADC/001	32-ch. S/E analog to digital (A/D) converter
KAD/ADC/005/5KHZ	8-ch D/E analog to digital converter with signal conditioning
KAD/ADC/005/C1	32-ch. S/E analog to digital (A/D) converter
KAD/ADC/009/QB/100	8-ch. ¼-bridge A/D conv. with excitation and sig. con for PT100s
KAD/ADC/009/QB/350	8-ch. ¼-bridge A/D conv. with excitation and sig. con for ¼-bridge 350W strain gages
KAM/ADC/009/S1/5KHZ	8-ch. bridge A/D conv. with excitation and signal conditioning

REF.	DESCRIPTION (NON-STANDARD)
ADC/009/S1/NF	8-ch. bridge A/D conv. with excitation and signal conditioning
KAD/ADC/009/S2	8-ch. bridge A/D conv. with excitation, sense and signal conditioning
KAD/ADC/009/S2/ET	8-ch. bridge A/D conv. with excitation, sense and signal conditioning
KAD/ADC/009/S4	8-ch. bridge A/D conv. with excitation and signal conditioning
KAD/ADC/009/S5	8-ch. bridge A/D conv. with excitation, sense and signal conditioning
KAD/ADC/011/X1	48-channel S/E analog to digital converter with X1 option
KAD/ADC/011/X1	48-channel S/E analog to digital converter with X1 option
KAD/ADC/014/R2	12-ch. ¼-bridge 350-ohm A/D converter with current excitation and 4-ch. 32 volt D/E
KAD/ADC/016	12-ch. S/E accelerometer (ICP) A/D converter with signal conditioning
KAD/ADC/017	8-ch. bridge A/D conv. with constant excitation current and signal conditioning
KAD/ADC/021	16-channel multiplexing D/E analog-to-digital converter
KAD/ADC/017/AB1/ET	8-ch. bridge A/D conv. with constant excitation current and signal conditioning
KAD/ADC/019/100	8-ch. ¼-bridge A/D conv. with excitation and sig. con for PT100s
KAD/ADC/105	Differential ended ADC (programmable analog gain, 6kHz b/w) - 8ch at 24ksps
KAD/ADC/106	Accelerometer ADC (current excitation, programmable analog gain, 6kHz b/w) - 6ch ICP and 2ch D/E at 24ksps
KAD/ADC/109/QB120	¼-bridge 120Ω ADC (current excitation, programmable analog gain, 6kHz b/w) – 8ch at 24ksps
KAD/ADC/109/C/QB120	¼-bridge 120Ω ADC (current excitation, programmable analog gain, 6kHz b/w) – 8ch at 24ksps
KAD/ADC/109/QB350	¼-bridge 350Ω ADC (current excitation, programmable analog gain, 6kHz b/w) - 8ch at 24ksps
KAD/ADC/109/S1	Full-bridge ADC (voltage excitation, programmable analog gain, 6kHz b/w) - 8ch at 24ksps
KAD/ADC/109/S2	Full-bridge ADC (voltage excitation, programmable analog gain, sense lines, 6kHz b/w) - 8ch at 24ksps
KAD/ADC/111/10V/ET	Single ended ADC (extended temp., 1kHz b/w, ±10V) - 48ch at 4ksps
KAD/ADC/113/ET	¼-bridge ADC (current excitation, PT100 temp. sensors, extended temp., 3kHz b/w) - 16ch at 12ksps
KAD/ADC/114	Full-bridge ADC (voltage excitation, strain gages, 3kHz b/w) - 16ch at 12ksps
KAD/ADC/117	Full-bridge ADC (current excitation, programmable analog gain, 6kHz b/w) - 8ch at 24ksps
KAD/ADC/120	Full-bridge ADC (voltage excitation, 3kHz b/w) - 12ch at 12ksps
KAD/ADC/118/100M/ET	Full-bridge ADC (voltage excitation, 3kHz b/w, ±100mV, extended temperature) - 12ch at 12ksps
KAD/ADC/132	24-channel ±200V common mode voltage ladder analog-to-digital converter
KAD/ADC/136/E12	Flexible ADC (full/½-bridge, ICP, PT100, thermocouple, FIR/IIR, 12.5kHz b/w) - 8ch at 50ksps (uses ±12V)
KAD/ADC/141	¼-bridge ADC (current excitation, RTD temp. sensors, 3.125kHz b/w) - 16ch at 12.5ksps
KAD/ARI/001	8-channel ARINC-429 bus monitor with parity option
KAD/ARI/002	ARINC-429 transmitter - 1ch
KAD/ARI/103	ARINC-573 bus monitor parser - 1ch
KAD/BCU/001	A CAIS compliant backplane controller for any KAM-500 chassis
KAD/BCU/001	KAM-500 backplane controller with IRIG-106 PCM encoder
KAD/BCU/001/CX	KAM-500 Backplane Controller With IRIG-106 PCM Encoder
KAD/BCU/003	KAM-500 backplane controller with T-BUS Interface
KAD/BCU/003/3SB	KAM-500 backplane controller with Tbus interface (3 bits)

REF.	DESCRIPTION (NON-STANDARD)
KAD/BCU/101	KAM-500 backplane controller with IRIG-106 PCM encoder
KAD/BCU/101/X1	Acra KAM-500 backplane controller with IRIG-106 PCM encoder
KAD/BCU/102	A CAIS backplane controller for any KAM-500 chassis
KAD/BCU/105	Fast Ethernet KAM-500 backplane controller and packet generator
KAD/BCU/105/AB1/ET	Ethernet backplane controller - IENA compatabile, extended temperature
KAD/BCU/140	Ethernet backplane controller - IENA/iNET-X compatible
KAD/BCU/140/X1	Ethernet backplane controller - IENA/iNET-X compatible
KAD/BCU/142/B	Ethernet backplane controller - IENA/iNET-X compatible, PTPv1 client or Grandmaster, PTPv2 client
KAD/BCU/142/ET	Ethernet backplane controller - IENA/iNET-X compatible, PTPv1 client and Grandmaster, PTPv2 client, extended temperature
KAD/BCU/143/B	Ethernet backplane controller - IENA/iNET-X compatible, PTP support
KAD/CBC/001	CAIS bus controller
KAD/CBC/101	CAIS (Common Airborne Instrumentation Systems) bus controller
KAD/CDC/001	4-channel charge-to-digital converter for piezoelectric devices
KAD/CDI/101	Interface module for the cockpit display unit (OBE/CDU/001)
KAD/DAC/001	8-channel analog outputs with 16-channel discrete outputs
KAD/DEC/002	2-ch. IRIG-106 PCM decoder/merger
KAD/DPI/001	8K x 64-bit external dual port RAM reader
KAD/DSI/002	Discrete input (counters, time tagging) - 24ch
KAD/EBM/101	Ethernet bus monitor parser - 1ch
KAD/ENC/002	IRIG-106 PCM encoder
KAD/ENC/003	KAM-500 controller with IRIG-106 PCM encoder
KAD/ENC/004	KAM-500 controller with IRIG-106 PCM encoder
KAD/ENC/004/ET	KAM-500 controller with IRIG-106 PCM encoder
KAD/ENC/005	IRIG-106 PCM encoder
KAD/ENC/005/B	IRIG-106 PCM encoder - 1ch
KAD/ENC/007	KAM-500 controller with IRIG-106 PCM encoder
KAD/ENC/112	Ethernet to CCSDS
KAD/ENC/113	Ethernet to CCSDS
KAD/ETH/001	A 100 base Tx ethernet interface for programming and data acquisition
KAD/EXC/101	Power module providing sensor excitation
KAD/FBM/001	A single EF-2000 FCS bus monitor module
KAD/FBM/103	FireWire S200b bus monitor parser - 1ch
KAD/HBM/102	G1000 HSDB bus monitor parser - 1ch
JAM/ADC/009/QB/100R	Test jig for calibrating quarter bridges
JAM/ADC/009/QB/250R	Test jig for calibrating quarter bridges
JAM/ADC/009/S1	Test jig for balancing (offset nulling) KAM/ADC/009/S1
KAD/LDC/001	2-ch. LVDT/RVDT to digital converter

REF.	DESCRIPTION (NON-STANDARD)
KAD/MAT/001	An SAF-C167-CR-LM Microcontroller-based module for FTI applications
KAD/MBC/001	Command-only MIL-STD-1553 bus controller
KAD/MBI/001	A MIL-STD-1553 remote terminal
KAD/MBI/101	Dual redundant MIL-STD-1553 bus monitor with parser-packetizer
KAD/MBI/103	MIL-STD-1553 remote terminal with Rx/Tx support and programmable address
KAD/MDC/002	Multiplexing ADC (programmable analog gain, pressure scanner, external temp. compensation) - 2ch at 12.5ksps
KAD/MEM/103	CompactFlash memory module
KAD/MSB/103	MIL-STD-1553 bus monitor parser - 1ch dual redundant
KAD/PBM/002/BA1	A Parser for the MC (and ENMC) Link with BA1 options
KAD/PDC/001	14-channel pressure acquisition module with temperature compensation
KAD/PDC/001/ET	14-channel pressure acquisition module with temperature compensation
KAD/RDC/101	3-channel resolver-to-digital converter with programmable excitation
KAD/RTC/003	RTC generator (memory status outputs)
SAM/DEC/005	IRIG-106 PCM decoder card with KAM-500 programming interface
SAM/DEC/007/UT	KAM-500 programming interface with IRIG-106 PCM decoder
SAM/DEC/007	KAM-500 programming interface with IRIG-106 PCM decoder
SAM/DEC/007/P	KAM-500 programming interface
KAD/SBC/101	4-channel I^2C bus controller
KAD/SBM/102	HDLC bus monitor
KAD/SDC/001	Synchro-to-digital converter - 2ch at 24ksps
KAD/SDI/001	8-channel serial data input module (clock out/data in)
KAD/SDI/002	A cross channel data link (CCDL) receiver
KAD/SIG/101	Versatile signal generator controlled via RS-232/RS-422 link
KAD/SWI/103	4-port Ethernet switch module with a dedicated programming port
KAD/TBM/101	TTP bus monitor
KAM/TCG/102	Combined GPS and IRIG input
KAM/TCG/103	Combined GPS, IRIG and ARINC-429 input module
KAD/TDC/001	16-ch. A/D converter with excitation & sig. conditioning for 2K2 & 10K thermistors
KAD/TDC/002/MB1	15-ch. thermocouple A/D converter with reference compensation
KAD/TDC/004	12-ch. A/D conv. with excitation and sig. con for PT100s
KAD/TDC/004/ET	12-ch. A/D conv. with excitation and sig. con for PT100s
KAD/TDC/101	Thermistor ADC (voltage excitation, 6.25kHz b/w) - 16ch at 25ksps
KAD/TDC/109	16-channel A/D converter with excitation for use with AD590 sensors
KAD/UAR/102	RS-232/RS-422/RS-485 universal asynchronous parser and snarfer - 4ch
KAD/UAT/101	RS-232/422 asynchronous transmitter - 4ch
KAD/UBM/101	8-channel RS-422 or RS-485 serial bus packetizer
KAD/UTL/102	Format select line sequencing module

REF.	DESCRIPTION (NON-STANDARD)
KAD/UTL/106	Battery usage and health monitor
KAD/VDC/001	Differential ended voice-to-digital converter (CVSD) - 2ch at 64kbps
KAD/VID/103/B	MPEG-4 video encoder (analog video input) - 1ch
KAD/VID/106/B	H.264 video encoder (analog video input) - 1ch
KAM/BIT/102	Network built-in self test module with event packetizer
KAM/CHS/03F/MB1	KAM-500 chassis with 3 non-standard user-slots
KAM/CHS/03U/CR1	KAM-500 chassis with power glitch reservoir capacitors removed, -12V on bayonet connector
KAM/CHS/03U/NC	KAM-500 chassis with 3 user-slots, power glitch reservoir capacitors removed from power supply
KAM/CHS/03U/SML	KAM-500 chassis with 3 user-slots
KAM/CHS/04L/AB1/ET	KAM-500 chassis with 4 user-slots
KAM/CHS/04L/ET	KAM-500 chassis with 4 user-slots
KAM/CHS/06U/AB1	KAM-500 chassis with 6 user-slots with AB1 option
KAM/CHS/06U/AB2	KAM-500 chassis with 6 user-slots with AB2 option
KAM/CHS/06U/AW1	KAM-500 chassis with 6 user-slots and enhanced EMC performance
KAM/CHS/06U/NC	KAM-500 chassis with 6 user-slots, power glitch reservoir capacitors removed from power supply
KAM/CHS/06U/E/SB	Acra KAM-500 chassis - 6 user-slots
KAM/CHS/09U/MB2	KAM-500 chassis with 9 user-slots and MB2 option
KAM/CHS/09U/AW1	KAM-500 chassis with 9 user-slots and enhanced EMC performance
KAM/CHS/09U/MB2	KAM-500 chassis with 9 user-slots and MB2 option
KAM/CHS/09U/MB1	KAM-500 chassis with 9 user-slots
KAM/CHS/12R/AG2	KAM-500 system with 12 user-slots
KAM/CHS/13U/CA1	KAM-500 chassis with 13 user-slots
KAM/CHS/13U/AG2	KAM-500 chassis with 13 user-slots with AG2 option
KAM/FBM/001/B	FCS bus monitor - 1ch
KAM/LRU/001/MB3	Meteor ALD DAU for use in EIM-F location
KAM/MAT/001	An SAF-C165-LM Microcontroller-based module for FTI applications
KAM/MEM/103/C	CompactFlash memory module
KAM/MSB/001/TC	Dual redundant MIL-STD-1553 bus monitor
KAM/MSB/002	Dual redundant MIL-STD-1553 bus monitor with mode code 17 support
KAM/MSB/002/TC	Dual redundant MIL-STD-1553 bus monitor with mode code 17 support
KAM/PSU/003	Power supply unit for KAM-500 systems
KAM/PSU/005	Power supply unit for 3-user-slot KAM-500 system
KAM/PSU/006	Power supply unit for KAM-500 chassis
KAM/PSU/006/ET	Power supply unit for KAM-500 chassis
KAM/PSU/007/AG2	Power supply unit for KAM-500 chassis
KAM/PSU/007/NC	+5V, ±7V and ±12V power supply unit for KAM-500 chassis with NC option
KAM/PSU/008	Power supply unit for KAM/CHS/03F chassis

REF.	DESCRIPTION (NON-STANDARD)
KAM/PSU/012	+5V, ±7V and ±12V power supply unit for KAM-500 chassis with 6-way connector
KAM/PSU/012/AW1	Power supply unit for KAM-500 chassis with 6-way connector and improved EMC performance
KAM/PSU/013/PR	5V and ±12V power supply unit for ASD/PRG/001
KAM/PSU/013/SC	+5V and ±12V power supply unit for KAM-500 chassis
KAM/SBM/001	STANAG 3910 bus monitor parser - 1ch dual redundant
KAM/SBM/101	EFAbus Express/STANAG 3910 bus monitor parser - 1ch dual redundant
KAM/TCG/104	Time-code generator with IRIG input
KAM/WSI/101	Wireless sensor network interface module
MKM/ADC/014/R1	16 channel multi analog input module with excitation
MKM/ADC/014/R2	12-ch. ¼-bridge 350-ohm A/D converter with current excitation and 4-ch. 32 volt D/E
MKM/ADC/014/R3	16-Ch. analog module with ICP, PT100, pressure and D/E channels
MKM/BCU/101	KAM-500 backplane controller with IRIG-106 PCM encoder for MicroKam
MKM/CHS/02U	MicroKAM chassis with two user-slots
MKM/PSU/001	Power supply unit for MKM/CHS/02U with 9-way connector

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