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DDC on Board™

DD-42988P1-300
ARINC 429 ISA INTERFACE CARD



DESCRIPTION

The DD-42988P1-300 card is a full-size ISA bus card which provides a high performance communication link between a PC host and up to 16 ARINC 429 Data Buses. This card's multiprocessor architecture provides reliable, high integrity ARINC 429 reception and transmission. Designed for high-performance applications, the DD-42988P1-300 card is capable of off-loading tasks from the host computer that could not previously be performed by a single interface card.

The DD-42988P1-300 card conforms with the Mark 33 Digital Information Transfer System 429-17 specification, and is also capable of parametric testing that deviates from the standard specification. This is useful during test and validation phases of Line Replacement Unit (LRU) development, and at repair depots for margin testing to detect "phantom" errors and failures.

The card supports eight "configurable" parametric channels that can be set as either receivers or transmitters. In addition to the eight configurable channels, the card also provides eight low-speed receiver channels, for a total of up to 16 independent ARINC 429 channels. The card can also perform engineering unit conversions.

The DD-42988P1-300 works with DDC's advanced, easy-to-use, DD-42999S0 Commercial Avionics Utilities Software Suite. This optional application software includes an ARINC 429 Data Bus Analyzer, ARINC 615 Data Loader, and an ARINC 739 MCDU Simulator.

FEATURES

- Eight Programmable Parametric Channels:
  - Rx/Tx
  - High/Low/Variable Speed
  - Variable Voltage
  - Variable Bit Gap
  - Variable Word Size
- Eight Additional Low-Speed Receivers
- FIFO and Scheduled Transmission Methods
- Label/SDI Receive Data Filtering
- 10 µs Time Stamping Resolution
- On-Board Engineering Unit Conversion
- 256 KiloBytes of Dual-Port RAM for Real-Time Data
- RS232/422 Port
- Four On-Board Channel Processors Each Operating at 20 MHz
- One Additional Board Processor Operating at 25 MHz
- Supports DOS, Windows® 3.X/95/98/NT/2000 and LabVIEW™
- Optional Application Software Available

DDC® Data Device Corporation

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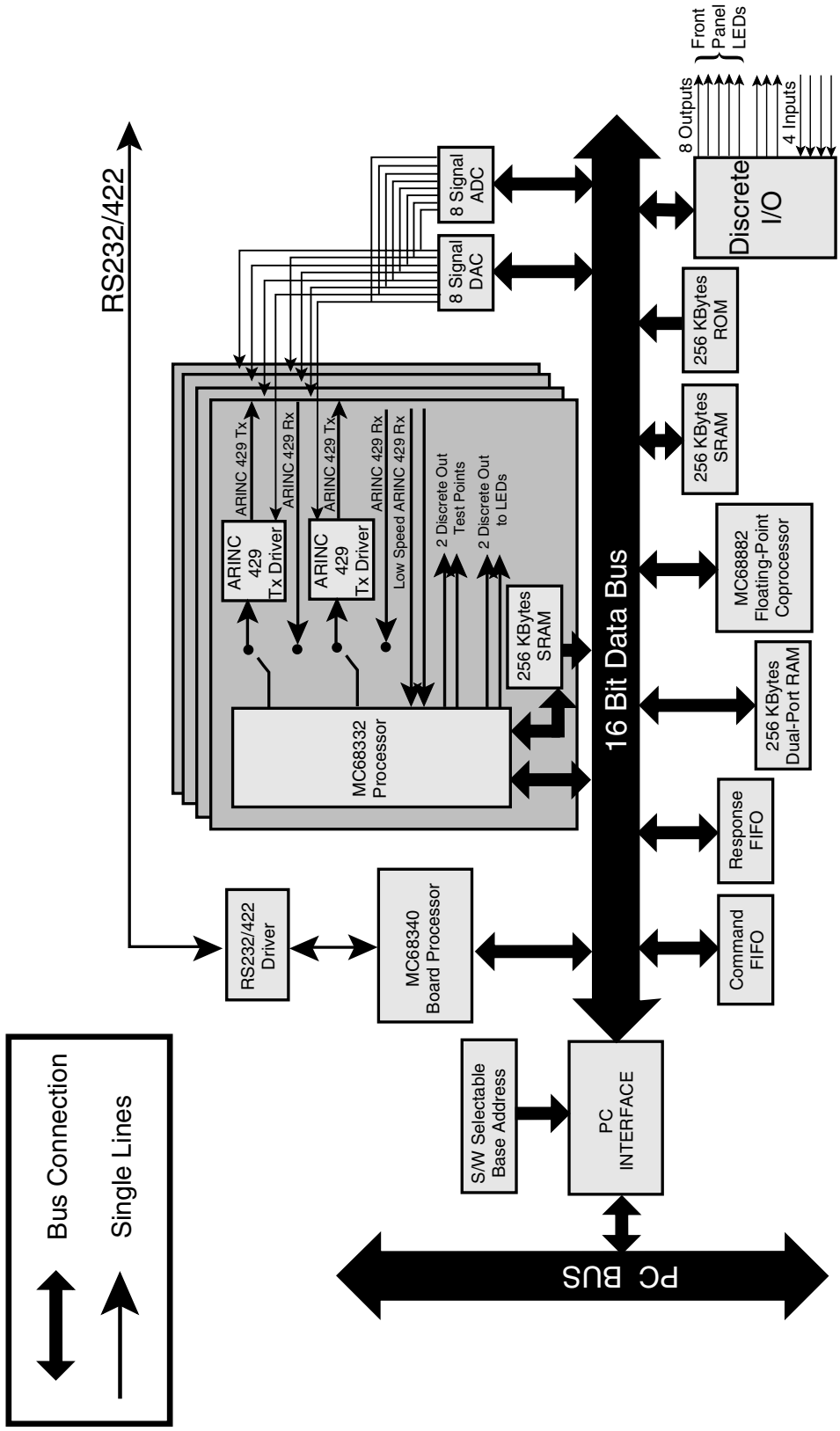


FIGURE 1. DD-42988P1-300 INTERFACE CARD BLOCK DIAGRAM

TABLE 1. DD-42988P1-300 SPECIFICATIONS	
PARAMETER	
PHYSICAL	
Height	3.9” (9.91 cm)
Width	13.3” (33.78 cm)
WEIGHT	
Net	12 oz. (0.34 kg)
Shipping	28 oz. (0.79 kg)
HOST INTERFACE ADDRESS SPACE	
16 kBytes of System Memory Space (Paging Window)	
8 Consecutive I/O Addresses	
ENVIRONMENT	
Operating Temperature:	0 to 50°C at ≤ 90% relative humidity, non-condensing.
Storage Temperature:	-40 to 70°C at ≤ 90% relative humidity, non-condensing.
DOCUMENTATION	
Detailed installation instructions and user documentation is provided with all products.	

TECHNICAL INFORMATION

The DD-42988P1-300 card has five processors. One processor, called the board processor, maintains host communications, processes raw data, and transfers it to the four channel processors. The channel processors manage and control the 429 communication. Each channel processor handles two configurable receive or transmit channels (high or low speed), and two low-speed receive channels.

Since each channel processor can filter received data and schedule transmit data, the performance of the board processor is not dependent on bus loading, but only on the amount of received data being transferred to the host and the amount of transmit data the host generates.

The receivers cannot unknowingly lose data since each of the channel processors can buffer fully loaded buses.

CARD OVERVIEW

The DD-42988P1-300 card contains eight configurable parametric channels that can be configured to be transmitters or receivers. When programmed as transmitters, these channels can be further programmed to output a voltage signal from 0 to 12 volts. Transmitters or receivers can be programmed for variable word sizes (2-32 bits), appropriate parity level (even, odd, or none), variable frequency (100Hz - 120KHz), and variable inter-word gap time.

In addition to the eight configurable channels, the card also contains eight low-speed receive channels. This provides the user with a total of 16 fully independent channels. The card can filter received data based on the label/SDI parameter. The card is capable of transmitting data in both FIFO and scheduled modes. The card also contains a floating-point co-processor used to reliably convert data to and from engineering units. This allows the host to directly communicate data to the card in standard engineering units.

RECEPTION

Each receiver channel independently time-stamps and buffers the incoming data. The data is then converted to engineering units (if desired), and sent to the PC host. Received words are automatically checked for parity.

A built-in error counter indicates the number of errors that have occurred during data reception. The card can also filter received words, thereby off-loading the host processors by only collecting data of interest.

The card has a flash programmable EEPROM that contains firmware, allowing programmers access to the following card features in a simple, easy to understand format:

Receiving

- "Mailbox" type reception from any channel
- Queued reception from any channel
- Filtering of received label/SDI combinations
- Time stamping of received data

The card is capable of receiving data in two modes: FIFO and mailbox. When FIFO mode is selected through the DefineRxChannel API library routine, a First-In-First-Out queue is created in Dual-Port RAM, from which the host can read the received ARINC 429 data and time stamps in the exact order in which the words were received. The time stamp has a 10 µs resolution. The size of the FIFO is selectable and can be anywhere from 16 to 32,768 32-bit words.

When Mailbox mode is selected through the DefineRxChannel API library routine, a Dual-Port RAM "Mailbox" is created from which the host can read the most current data for a particular label/SDI combination. This mode of reception is extremely useful when the user is only concerned with the latest received data. Both FIFO and mailbox modes can be used simultaneously. The received data words can be filtered by label/SDI combinations or by just the label of the received data words.

TABLE 2. EXAMPLES OF STANDARD LIBRARY FUNCTIONS	
• ***Configuration*** *ConfigureSerialPort, SetInterruptConditions*	• ***Transmitting*** *DefineTxScheduleTable, ModifyTxChannel*
• ***Card Control*** *DequeueErrors, ResetClock, RunDiagnostic*	• ***Engineering Units*** *LoadEngineeringConversionTable*
• ***Channel Control*** *HaltChannel, StartChannel*	• ***Discrete Control*** *ReadInputDiscrete, WriteOutputDiscrete*
• ***Receiving*** *DefineRxFilterWords, ModifyRxChannel*	

TRANSMISSION

Each transmitter channel processes scheduled transmissions and transmits buffered sequential words. When the card gets a transmit word from the host, it is converted from engineering units to the ARINC 429 word and proper parity is automatically generated.

The card's firmware allows programmers access to the following methods of transmission:

- Queued FIFO transmission
- Scheduled major/minor frames transmission
- Scheduled label/SDI rate transmission

If scheduled data is to be transmitted, the user must select scheduled mode through the DefineTxChannel API library routine. There are two ways to schedule a transmission, by table or by rate. The DefineTxScheduleTable API library routine or the DefineTxScheduleRates API library routine is used, respectively, to configure scheduled transmissions.

The DefineTxScheduleTable API library routine allows the host to define a schedule that will continuously be transmitted by the card. The API library routine takes a scheduled table of data and organizes a user-defined number of "minor frames" into a "major frame." The card will transmit each minor frame in sequence until all the minor frames have been transmitted. This cycle of minor frames comprises one major frame. Once the major frame has been transmitted, the card will start over again with the first minor frame.

The DefineTxScheduleRates API library routine allows the host to define a schedule that will continuously be transmitted by the card. The user can assign a rate associated with each label/SDI combination. The word will get transmitted at the interval that the user has specified. If the user wishes to distinguish only by label and not by label and SDI then the SDI field is set to a "don't care" value.

This card is capable of transmitting data in both FIFO and scheduled modes. When both modes are being used the scheduled data will take priority over the FIFO data. The FIFO data will get transmitted in the gaps between scheduled data transmissions without altering the schedule.

TIME-STAMPING

The card is capable of time-stamping all received data words. For applications that use multiple cards, the timer on each card used to time-stamp received words can be synchronized by connecting all the cards via a header pin on the card. Time-stamping resolution is 10 µs.

INDICATOR LEDS

There is a fail light on the top edge of the card which indicates the pass/fail status of the card's built-in-tests. Four more LEDs are used to show detailed diagnostic information. All of these LEDs are connected to output discretes, and are therefore also available on a header on the card.

BUILT-IN TESTING

The card's firmware contains built-in tests which are performed on power-up. When these tests are passed, the card indicates to the host that it successfully completed power-up self testing. If any test fails, this information is passed on to the host. LEDs, including the main "FAIL" light on the top edge of the card, are lit to indicate a failure code.

The following tests are performed during power up: processor tests, memory tests, a ROM checksum test, and channel processor communication tests. In addition, the card contains an analog-to-digital converter (ADC) that allows testing of the digital-to-analog converter (DAC), controlling the variable voltage outputs of the transmitters.

The host PC has the ability to perform a complete system test when the user connects an "external loopback" connector to the card. This connects input discretes to output discretes, and transmitters to receivers. The host can then send data on the transmitter and verify that the data was received correctly by the receivers.

HOST COMMUNICATIONS

The cards communicate to the host via 256 KBytes of Dual-Port RAM, a Command FIFO, a Response FIFO, and optional interrupts. The Command and Response FIFOs reside in the PC's I/O address space and are used to communicate commands to the card from the host, and responses to those commands back to the host. The host accesses the dual-port RAM via a 16 KByte paged memory window.

DATA MEMORY

The card contains 256 Kilobytes of Dual-Port RAM memory used for data exchange between the host computer and the card. This memory allows for excellent reliability of data transfer between the card and the host computer. The Command and Response FIFO aids in this reliable transfer of data.

The card also contains 256 Kilobytes of SRAM for each channel processor to use directly. There is a total of 1.25 Megabytes of SRAM on the card. The co-processor contains 256 Kilobytes of Flash Boot ROM that performs a series of power-on-self-tests.

INTERRUPT GENERATION

The robust interrupt generation capability of the DD-42988P1-300 card allows it to asynchronously signal the host when certain events occur. These events include receive and transmit events, error events, FIFO events, discrete I/O events and board processor interrupts.

Through program control, any of the interrupts can be selectively enabled or masked.

The SetInterruptConditions API library routine allows the host to determine under what conditions the card will generate an interrupt.

Eight additional LEDs on the top edge of the card indicate channel activity and channel built-in-test status.

DISCRETE I/O

There are two basic commands for handling the card's discrete inputs and outputs. The WriteOutputDiscrete API library routine is used for setting the value of all discrete outputs on the card, and the ReadInputDiscrete API library routine is used for reading the discrete inputs.

There are eight output discretes (TTL compatible) on the cards. These are used for a variety of purposes, including triggering events, indicating status, and general purpose use. These outputs can sink up to 10 mA of current.

There are four input discretes (TTL and CMOS compatible). Each input discrete accepts any input from 2.4 - 5 volts as a "true" voltage, and from 0 - 0.8 volts as "false." These discretes are available on header pins on the card.

INCLUDED SOFTWARE

CARD LIBRARY

The DD-42966S0 software package furnished with the card includes Windows 95/98/NT/2000 drivers, and a complete API (Application Programming Interface) software library. This software is used to configure the card for receiving and transmitting data on the bus. TABLE 2 lists some standard library functions. LabVIEW support is also provided.

The software is a runtime library that provides the user with a hardware abstraction layer for the card. The library includes routines that dramatically reduce software development time by providing a high-level software interface to the card. The library allows the user to program the card without detailed knowledge of the card's architecture.

When transmitting, the host can request that the card send data sequentially from a FIFO queue, or that the card automatically send scheduled data and allow the host to update the data asynchronously. If both FIFO and scheduled modes are selected, the scheduled data always takes priority over the FIFO data, with the FIFO data words “filling-in” the gaps between scheduled data.

When receiving, the host can get data sequentially from a FIFO or get the most recent data for any label/SDI combination from a “mailbox” slot. The data placed in the receive FIFO is time-stamped by the card. The FIFO words can be filtered by label/SDI combination.

The host can download an Engineering Unit Conversion Table to the card that enables conversion between raw ARINC 429 words and engineering units. The format for all ARINC 429 data placed in Dual-Port RAM is determined by this table. If no table has been defined, all words default to “raw” format.

DIAGNOSTIC SOFTWARE

The diagnostic software provided with each DD-42988P1-300 card verifies that the card is installed and operating properly. This is useful when a card is first installed in a PC to verify that the card and PC are communicating, i.e., that the card has been configured correctly for a particular PC.

The diagnostic software verifies the operation of the Command/Response FIFOs, the Dual-Port RAM, the input and output discretes, the PC interrupts, as well as all the circuitry tested by the firmware’s built-in-tests. With the loopback connector installed, the software will also test all the transmitter and receiver circuitry.

OPTIONAL APPLICATION SOFTWARE:

DD-42999S0 - Commercial Avionics Utilities Software Suite
Includes: ARINC 429 Data Bus Analyzer
ARINC 615 Data Loader
ARINC 739 MCDU Simulator

Contact factory for more information.

CUSTOMER SUPPORT

Data Device Corporation is committed to providing unsurpassed customer support. All hardware has a two-year limited warranty. All library and driver updates are available free of charge for the life of the product. This does not include application software.

ORDERING INFORMATION

DD-42988P1-300

ARINC 429 ISA Interface Card
8 Rx/Tx Channels
8 Rx Channels
8 Output/4 Input Discretes

Included Software:

DD-42998S0

API Software library and drivers for DOS and Windows 3.x

DD-42966S0

API Software library and drivers for Windows 95/98/NT/2000

DD-42968S0

LabVIEW library support

All of the software listed above is provided free of charge on our web site at www.ddc-web.com

OPTIONAL APPLICATION SOFTWARE

DD-42999S0

Commercial Avionics Utilities Software Suite
Includes: ARINC 429 Data Bus Analyzer
ARINC 615 Data Loader
ARINC 739 MCDU Simulator

These products contain tin-lead solder.

STANDARD DDC PROCESSING FOR DISCRETE MODULES/PC BOARD ASSEMBLIES		
TEST	**METHOD(S)**	**CONDITION(S)**
INSPECTION/WORKMANSHIP	IPC-A-610	Class 3
ELECTRICAL TEST	DDC ATP	—

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