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Model V210

16-Channel, 12-bit A/D Converter

INSTRUCTION MANUAL

March, 1998

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Warranty

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16-channel,12-bit ADC with Filter

V210

GENERAL DESCRIPTION

The V210 is a single width, C-size, register-based, VXIbus module that converts 16 analog voltages into their equivalent digital values. The resulting digital data can be read over the VXIbus. The inputs are continuously scanned and converted, and the results are stored in the module's 16-word memory. The memory is arranged in a dual-port configuration, and read cycles are asynchronous with the conversion process, eliminating the overhead associated with testing for "converter busy." The analog voltages are converted using a sample-and-hold amplifier and a successive approximation converter.

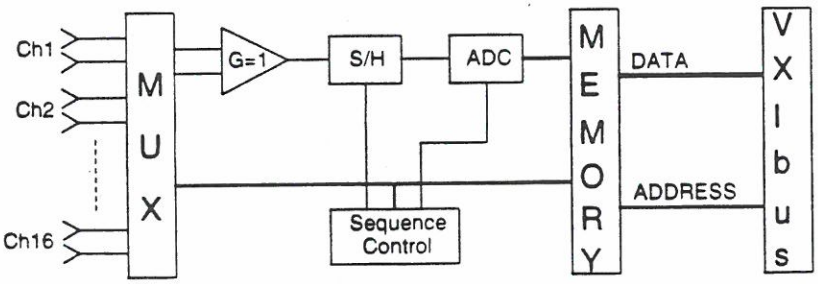
Versions of the V210 are available with input ranges of 0 to +5 V, 0 to +10 V, ±2.5 V, ±5 V, and ±10 V dc. For monitoring 4-20 mA current loop signals, it is common practice to mount a precision 250 Ω resistor external to the module (i.e., at a terminal strip) and use the 0 to +5 V input range. This allows the input to the V210 to be disconnected without disrupting the current loop. The loop must not exceed the maximum common-mode voltage rating of the V210.

All versions include a low-pass, RC filter on the input lines. The filter provides an attenuation slope of -6 dB/octave, and the cutoff frequency is set for 10 Hz.

The V210 supports both static and dynamic configuration. Access to the converted data is through memory locations indicated by the Offset Register within the VXIbus Configuration Register set, using A24/A16, D16 data transfers.

FEATURES

- **16-channel capability**
- **Differential inputs**
- **Self-scanning operation**
- **Dual-ported buffer memory**
- **Input lines protected for 300 V transients**



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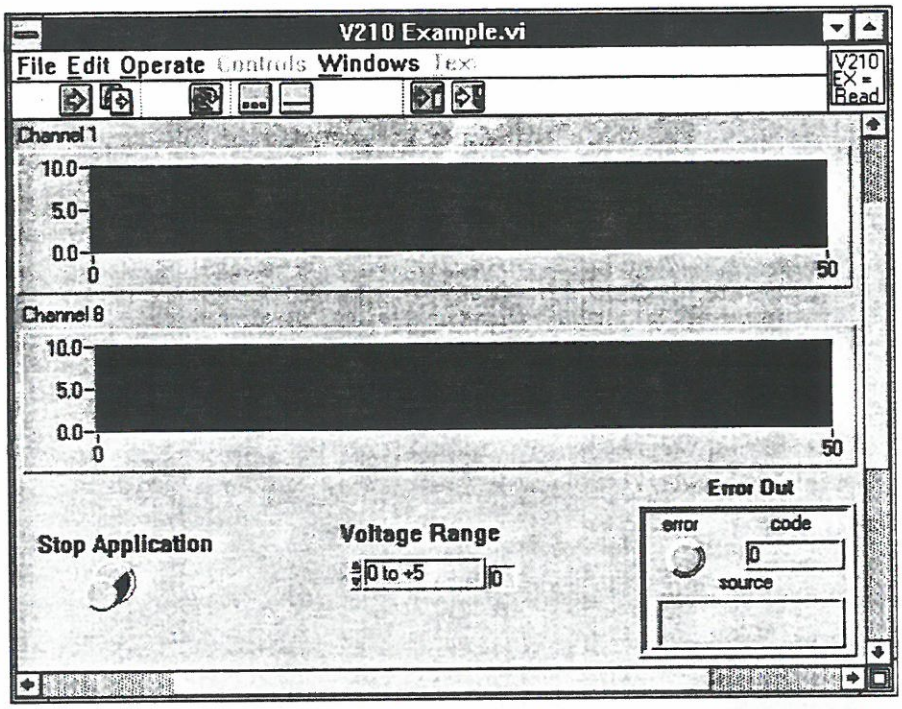
V210 (continued)

Item	Specifications
Inputs	
Number of input channels	16 differential inputs
Input signal ranges	0-5 V, 0-10 V, ±5 V, or ±10 V dc (by order option)
Input Protection	±35 V continuous; ±300 V for 100 µs
Common-mode input voltage	±12 V dc, maximum
Common-mode rejection	-80 dB, min; -88 dB, typical; dc to 60 Hz
Input impedance	$10^9\ \Omega$
Drift	±25 µV/°C, typical
Filtering	
Input filter	Single-pole, low-pass, RC type
-3 dB cutoff frequency (f_c)	10 Hz
A/D Converter	
Resolution	12 bits (one part in 4096)
Linearity error	±0.012% of Full Scale Range
Differential linearity error	±½ LSB, typical
Total accuracy error	±34 ppm/°C, maximum
Quantization error	±½ LSB, typical
Conversion time	1 ms per channel
On-board Memory	Sixteen 12-bit words
Input Connector Type	50P "D"
Power Requirements	
+5 V	1.8 A, typical
+24 V	65 mA, typical
-24 V	30 mA, typical
Environmental and Mechanical	
Temperature range	
Operational	0°C to + 50°C
Storage	-25°C to +75°C
Relative humidity	0 to 85%, non-condensing to +40°C
Cooling requirements	10 CFM
Dimensions	340 mm x 233.35 mm x 30.48 mm (C-size)
Front panel potential	Chassis ground

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SOFTWARE SUPPORT

Includes the KineticSystems library of "C" routines, LabVIEW driver, and LabWindows for DOS driver. *For the latest information on additional software products please contact the factory.*



Sample V210 LabVIEW Screen

ORDERING INFORMATION

Model V210-EA11	16-channel, 12-bit ADC with Filter; 0 to +5 V input
Model V210-EB11	16-channel, 12-bit ADC with Filter; 0 to +10 V input
Model V210-EC11	16-channel, 12-bit ADC with Filter; ±2.5 V input
Model V210-ED11	16-channel, 12-bit ADC with Filter; ±5 V input
Model V210-EE11	16-channel, 12-bit ADC with Filter; ±10 V input

ACCESSORIES

Model 5851-Bxyz	Cable—50S "D" to Unterminated
Model 5851-Dxyz	Cable—50S "D" to 50S "D"
Model 5851-Exyz	Cable—50P "D" to 50S "D"
Model 5934-Z1A	Connector—50S "D"

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UNPACKING AND INSTALLATION

The Model V210 is shipped in an anti-static bag within a styrofoam packing container. Carefully remove the module from its static-proof bag and prepare to set the various options to conform to the desired operating environment.

Logical Address Switches

The V210 represents one of the 255 devices permitted in a VXIbus system. (Logical Address 0 is reserved for the Slot 0 device). The module is shipped from the factory with its address set for Logical Address 255. This address can be shared by multiple devices in a system that supports dynamic configuration. If the V210 is to be used in a system that does not support dynamic configuration, or in a system where static configuration of the module is desired, the Logical Address must be manually established. This is accomplished by manipulating eight rocker switches located under the access hole in the modules right-side ground shield. Refer to FIGURE 1 below.

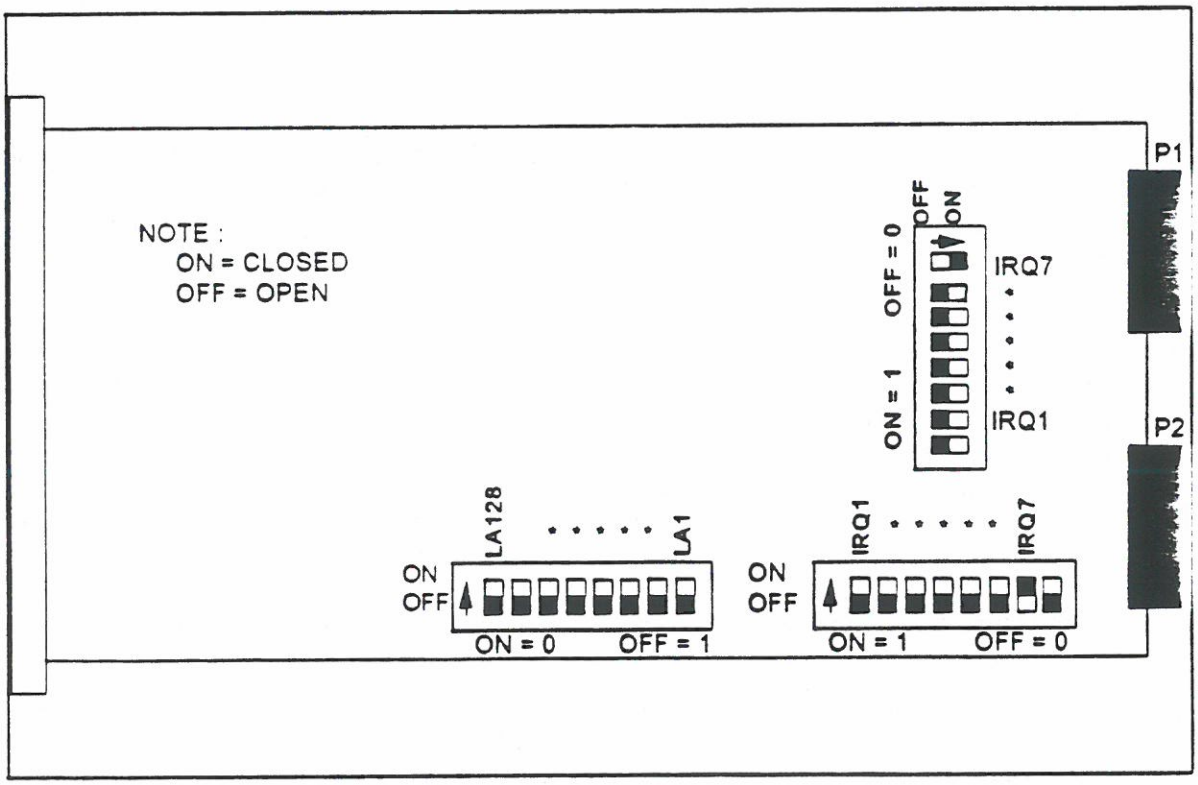


FIGURE 1 - V210 SWITCH LOCATIONS

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The eight switches represent a binary combination of numbers that range from zero to 255. Use a scribe or other appropriate instrument to set the Logical Address to the desired value. The bit pattern for the base address is shown below:

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00	
1	1	LA128	LA64	LA32	LA16	LA8	LA4	LA2	LA1	0	0	0	0	0	0	R

Bits 15 and 14 are set to "1" (VXI defined).

Bits 13 through 6 are user-selectable via the address switches LA128-LA1.

Bits 5 through 0 are set to "0" to indicate a block of 64 bytes.

Interrupt Switches

The V210 does not generate interrupts. No switches are provided for setting the Interrupt Request level.

Module Insertion

The V210 is a C-sized, single width VXIbus module. It requires 1800 milliamperes of +5 volt power, 65 milliamperes of +24 volt power, 30 milliamperes of -24 volt power, and 10 cubic feet per minute of air flow to maintain stability. Except for Slot 0, it can be mounted in any unoccupied slot in a C-size VXIbus main frame.

CAUTION: TURN MAINFRAME POWER OFF WHEN INSERTING OR REMOVING MODULE

WARNING: REMEMBER TO REMOVE INTERRUPT ACKNOWLEDGE DAISY-CHAIN JUMPERS PRIOR TO INSERTING THIS MODULE IN THE BACKPLANE

To insure proper interrupt acknowledge cycles from the V210 module, the daisy-chain Interrupt Acknowledge jumper must be removed before the module is installed in a slot. Conversely, daisy-chain jumpers must be installed in any empty slot between the V210 and the Slot 0 Controller.

FRONT PANEL INFORMATION

LEDs

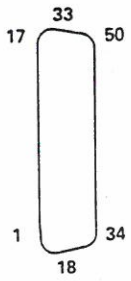
ADD_REC — This LED turns on when the Operational Registers are being accessed.

ACTIVE — This LED turns on to indicate scanning is active.

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CONNECTORS

The Input Connector on the front-panel allows access to 16 ADC inputs. This connector is a 50-contact "D" connector and will mate to KineticSystems' Model 5934-Z1A connector. A layout of this connector is shown below:



FACE VIEW

Pin/Wire List

50 PIN 'D'

PIN NO.		PIN NO.		PIN NO.	
17	Channel 8 RETURN	33	Channel 16 RETURN	50	GROUND
16	Channel 8 SIGNAL	32	Channel 16 SIGNAL	49	
15	Channel 7 RETURN	31	Channel 15 RETURN	48	
14	Channel 7 SIGNAL	30	Channel 15 SIGNAL	47	
13	Channel 6 RETURN	29	Channel 14 RETURN	46	
12	Channel 6 SIGNAL	28	Channel 14 SIGNAL	45	
11	Channel 5 RETURN	27	Channel 13 RETURN	44	
10	Channel 5 SIGNAL	26	Channel 13 SIGNAL	43	
9	Channel 4 RETURN	25	Channel 12 RETURN	42	
8	Channel 4 SIGNAL	24	Channel 12 SIGNAL	41	
7	Channel 3 RETURN	23	Channel 11 RETURN	40	
6	Channel 3 SIGNAL	22	Channel 11 SIGNAL	39	
5	Channel 2 RETURN	21	Channel 10 RETURN	38	
4	Channel 2 SIGNAL	20	Channel 10 SIGNAL	37	
3	Channel 1 RETURN	19	Channel 9 RETURN	36	
2	Channel 1 SIGNAL	18	Channel 9 SIGNAL	35	
1	GROUND			34	

FIGURE 2 - V210 FRONT-PANEL CONNECTOR

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PROGRAMMING INFORMATION

VMEbus/VXIbus Addressing

Of the defined VXIbus Configuration Registers, the V210 implements those required for register-based devices. The V210 also contains a set of Operational Registers to monitor and control the functional aspects of the devices. Both register sets are described in this section.

Access to the Configuration Registers for all VXIbus modules is available through the VMEbus short address space. The Register Addresses are located in the upper 16 kilobytes of the A16 address range ($C000_{16}$ to $FFFF_{16}$). The setting of the Logical Address Switch, or the contents of the Logical Address Register (see below) are mapped into Address lines A6 through A13, thereby establishing a base address for the module somewhere in the range of $C000_{16}$ to $FFFF_{16}$.

VXIbus Configuration Registers

Configuration Registers are required by the VXIbus specification so that the appropriate levels of system configuration can be accomplished. The Configuration Registers in the V210 are offset from the base address. **Note: the V210 only responds to these addresses if the Short Nonprivileged Access (29_{16}) or Short Supervisory Access ($2D_{16}$) Address Modifier Codes are set for the backplane bus cycle.** Table 1 shows the applicable Configuration Registers present in the V210, their offset from the base (Logical) address, and their Read/Write capabilities.

TABLE 1
CONFIGURATION REGISTERS - SHORT I/O ADDRESS SPACE

OFFSET (HEX)	WRITE/READ MODE	REGISTER NAME
00_{16}	Write/Read	ID/Logical Address Register
02_{16}	Read	Device Type Register
04_{16}	Write/Read	Status/Control Register
06_{16}	Write/Read	Offset Register
08_{16}	Read	Attribute Register
$1E_{16}$	Read	Subclass Register

ID/Logical Address Register

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00	
	0	1	0	0	1	1	1	1	0	0	1	0	1	0	0	1	R
00_{16}	DON'T CARE								LOGICAL ADDRESS REGISTER								W

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READ

Bit(s)	Mnemonic	Meaning
15, 14	Device Class	This is a Register-Based device.
13, 12	Address Space Needs	This module requires the use of A16/A24 address space.
11 - 00	Manufacturer's ID	3881 ($F29_{16}$) for KineticSystems.

For WRITE transactions, bits 15 through eight are not used, and setting them has no effect on the V210. In Dynamically configured systems (i.e., the Logical Address switches were set to a value of 255), bits seven through zero are written with the new Logical Address value.

Device Type

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00	
02_{16}	1	1	1	1	0	0	1	0	0	0	0	1	0	0	0	0	R

On READ transactions:

Bit(s)	Mnemonic	Meaning
15 - 12	Required Memory	The V210 requires 256 bytes of additional memory space.
11 - 00	Model Code	Identifies this device as Model V210 (210_{16}).

Status/Control Register

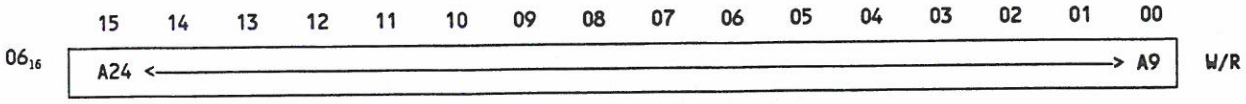
	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00	
04_{16}	A24 ACT	MODID	S	1	ZEROS								RDY	PASS	0	RST	W/R
	A24 ENA	N/U	N/U	1	NOT USED											RST	

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Bit	Mnemonics	Description
15	A24	Writing a "1" will enable A24 addressing and allow access to the Operational Registers. Reading a "1" indicates A24 is active. This bit is reset to a "0" on power-up or the assertion of SYSRESET*.
14	MODID	This Read-Only bit is set to a "1" if the module is not selected with the MODID line on VXIbus connector P2. A "0" will indicate that the device is selected by a high state on the P2 MODID line.
13	Status	This Read-Only bit indicates the status of the last operational transaction to the V210. A "1" indicates the transaction completed successfully.
12	1	This Read/Write bit is included for compatibility with other KineticSystems' VXIbus modules. It should always be written with a "1".
11-4	N/U	Not used. Read as a "0".
3	RDY	READY. The V210 is always ready. Read as a "1".
2	PASS	PASS. The V210 will always pass self tests. Read as a "1".
1	N/U	NOT USED. Read as a "0".
0	RST	RESET. This Read/Write bit controls the Soft Reset condition within the V210. While the Soft Reset condition is enabled (by writing a "1" to this bit position), any further access to the Operational Register (see below) except the Diagnostic and Interrupt Status registers, is inhibited. This bit can be reset by writing a "0", on power-up or the assertion of SYSRESET*.

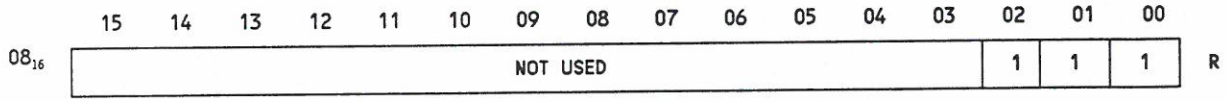
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Offset Register



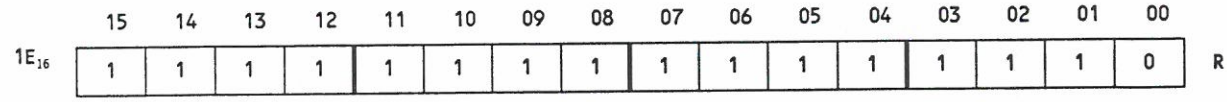
This 16-bit read/write register defines the base address for the A24 Operational Register set. The register is reset to an all "0" condition on power-up or the assertion of SYSRESET*, and is written with the appropriate value under program control.

Attribute Register



Bit(s)	Mnemonic	Meaning
15 - 03	Not Used	These bits are not used by the V210, and are read as a "0".
02	Intr Control	The V210 does not have any Interrupt Control capabilities.
01	Intr Handler	The V210 does not have Interrupt Handler capabilities.
00	Intr Status	The V210 does not have an Interrupt Status register.

Subclass Register



Bit(s)	Mnemonic	Meaning
15	Extended Device	"1" indicates this to be a VXIbus defined Extended Device.
14-00	Register-Based	$7FFE_{16}$ indicates this to be an Extended register-based Device.

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OPERATIONAL REGISTERS

The Operational Registers are the mechanism used to access the functional registers of the V210. For compatibility with other KineticSystems' VXIbus modules in this series, these registers are positioned in the VMEbus Standard Address (A24) space. The base address for these registers is defined by the contents of the Offset Register within the Configuration Register set.

Prior to gaining access to the Operational Registers, the A24 Enable bit (bit 15) must be set in the Status/Control Register. **Note: The V210 will only respond to these addresses if the Standard Nonprivileged Data Access (39_{16}), Standard Nonprivileged Program Access ($3A_{16}$), Standard Supervisory Data Access ($3D_{16}$), or Standard Supervisory Program Access ($3E_{16}$) Address Modifier Codes are set for the bus cycle(s).**

Of the 256 bytes requested by the setting of the Device Type register in the Configuration Register set, only 62 bytes are used. (256 is the minimum number of bytes that can be requested through the Device Type register.) Table 2 shows the applicable Operational Registers present in the V210, their offset from the base A24 address, and their Read/Write capabilities.

TABLE 2
V210 OPERATIONAL REGISTERS - STANDARD ADDRESS SPACE

A24 OFFSET	WRITE/READ MODE	REGISTER NAME
00_{16}	Write/Read	Diagnostic Register
12_{16}	Read	Channel #1
16_{16}	Read	Channel #2
$1A_{16}$	Read	Channel #3
$1E_{16}$	Read	Channel #4
22_{16}	Read	Channel #5
26_{16}	Read	Channel #6
$2A_{16}$	Read	Channel #7
$2E_{16}$	Read	Channel #8
32_{16}	Read	Channel #9
36_{16}	Read	Channel #10
$3A_{16}$	Read	Channel #11
$3E_{16}$	Read	Channel #12
42_{16}	Read	Channel #13
46_{16}	Read	Channel #14
$4A_{16}$	Read	Channel #15
$4E_{16}$	Read	Channel #16

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Diagnostic Register (Offset 00_{16})

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00	
00_{16}	Don't Care								D	S	0	0	0	0	0	0	R
00_{16}	Don't Care								0	0	0	0	0	0	0	INIT	W

Bit	Mnemonic	Description
15-8	Don't Care	Not used. Read as "0s" and ignored on write cycles.
7	Diagnostic	When this bit is set to a "1", the last register access to the Operational Registers (offsets 12_{16} through $4E_{16}$) was valid.
6	Status	When this bit is set to a "1", the last register access to the Operational Registers (offsets 12_{16} through $4E_{16}$) was accepted.
5,1	N/U	Not Used.
0	INIT	Setting this bit to a "1" will only reset the Operational Registers (offsets 12_{16} through $4E_{16}$). The Configuration Registers and the Diagnostic Register are unaffected.

Channel Registers

These registers are used to read the A/D value of each input channel. Each channel is updated every 16 milliseconds. To read a given channel refer to Table 2 for the appropriate channel register.

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00	
R16	R15	R14	R13	R12	R11	R10	R9	R8	R7	R6	R5	R4	R3	R2	R1	R

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APPENDIX A

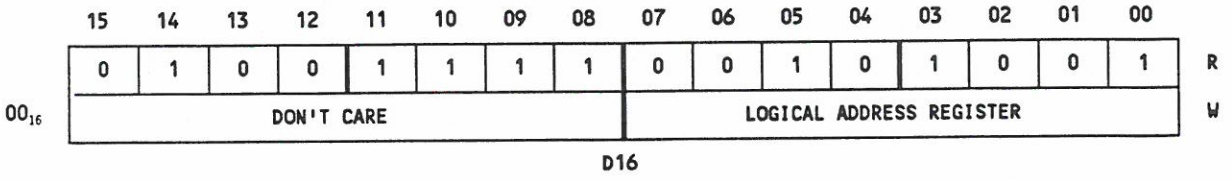
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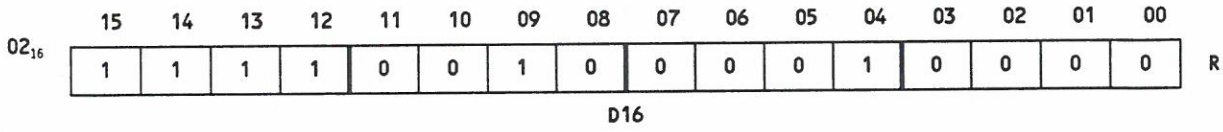
V210 REGISTER LAYOUT

CONFIGURATION REGISTERS

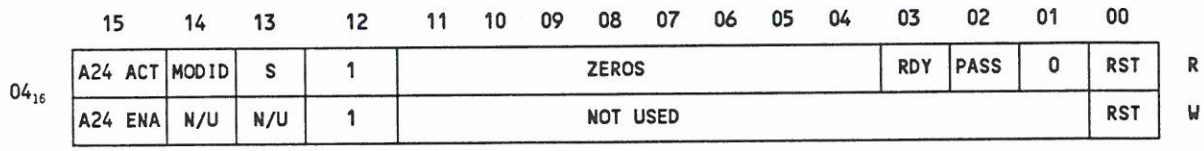
ID/Logical Address Register



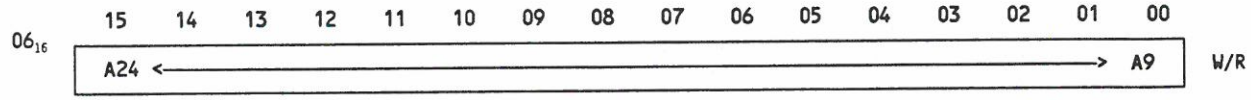
Device Type



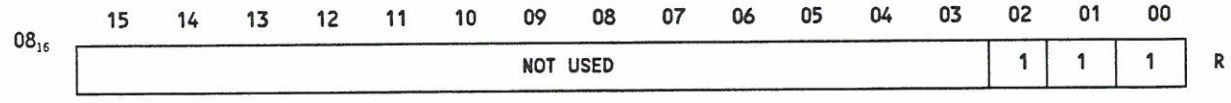
Status/Control Register



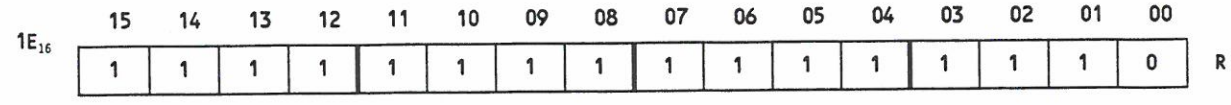
Offset Register



Attribute Register



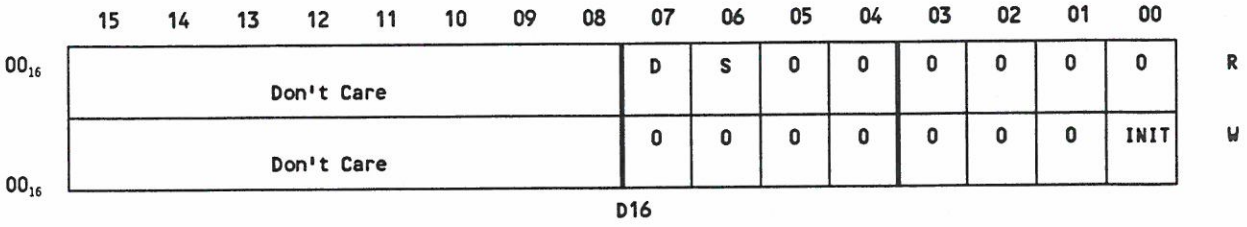
Subclass Register



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OPERATIONAL REGISTERS

Diagnostic Register

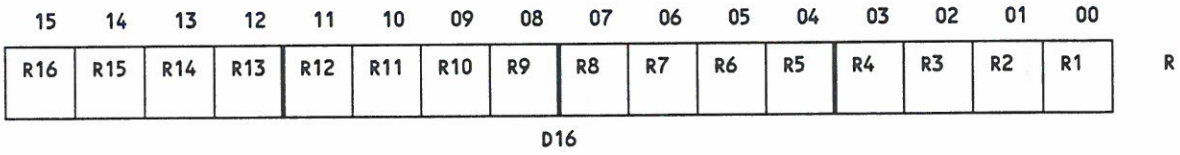


Channel 1 2 3 4 5 6 7 8

Channel Registers 12_{16}, 16_{16}, $1A_{16}$, $1E_{16}$, 22_{16}, 26_{16}, $2A_{16}$, $2E_{16}$

Channel 9 10 11 12 13 14 15 16

Channel Registers 32_{16}, 36_{16}, $3A_{16}$, $3E_{16}$, 42_{16}, 46_{16}, $4A_{16}$, $4E_{16}$



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APPENDIX B

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To determine the expected data bit pattern for a given channel, one must first calculate the Least Significant Bit (LSB) for the option that is being used. The following formula is used to calculate the LSB.

$$\text{One LSB} = \frac{\text{Volts FSR}}{2^n}$$

- Where Volts FSR (Full Scale Range) equals the input range of the module.
- ' n ' equals the number of bits for the ADC, in this case ' n ' equals 12.

Using the above equation the LSB can be calculated for each option.

Example V210-ED11 $\quad$ One LSB = $\frac{10V}{4096}$ = 2.441 mV

Module Option	One LSB
V210-EA11 0 to +5V (CSB)	1.221mV
V210-EB11 0 to +10V (CSB)	2.441 mV
V210-EC11 ± 2.5V (CTC)	1.221 mV
V210-ED11 ± 5V (CTC)	2.441 mV
V210-EE11 ± 10V (CTC)	4.883 mV

By dividing the input voltage for a given channel by the LSB one may determine the expected digital output for that channel.

Example: A V210-EC11 is calibrated for ± 5V input , complimentary two's complement (CTC). If + 2.5000V is applied to channel 1, then the expected output data would be $\frac{2.5000V}{2.441mV} = 1024_{10} = 400_{16}$

The following two tables show examples of the expected digital output

V210-EA11 calibrated for 0 to +5V input (CSB) $\quad$ 1 bit = 1.22 mV

Digital Output				Voltage In
0	F	F	F	+4.9988V
0	8	0	0	+2.5000V
0	0	0	1	+.0012V
0	0	0	0	0.0000V

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V210-EB11 calibrated for 0 to +10V input (CSB) 1 bit = 2.44 mV

Digital Output				Voltage In
0	F	F	F	+9.9976V
0	8	0	0	+5.0000V
0	0	0	1	+.0024V
0	0	0	0	0.0000V

V210-EC11 calibrated for ± 2.5V input (CTC) 1 bit = 1.22 mV

Digital Output				Voltage in
0	7	F	F	+2.4988V
0	4	0	0	+1.2500V
0	0	0	1	+.00012V
0	0	0	0	0.0000V
F	F	F	F	-0.0012V
F	C	0	0	-1.2500V
F	8	0	1	-2.4988V
F	8	0	0	-2.5000V

V210-ED11 calibrated for ± 5V input (CTC) 1 bit = 2.44 mV

Digital Output				Voltage in
0	7	F	F	+4.9976V
0	4	0	0	+2.5000V
0	0	0	1	+.00024V
0	0	0	0	0.0000V
F	F	F	F	-0.0024V
F	C	0	0	-2.5000V
F	8	0	1	-4.9976V
F	8	0	0	-5.000V

V210-EE11 calibrated for ± 10V input (CTC) 1 bit = 4.88 mV

Digital Output				Voltage in
0	7	F	F	+9.9952V
0	4	0	0	+5.0000V
0	0	0	1	+.00048V
0	0	0	0	0.0000V
F	F	F	F	-0.0048V
F	C	0	0	-5.0000V
F	8	0	1	-9.9952V
F	8	0	0	-10.000V

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2. Obtain a Return Authorization (RA) Number.
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4. Include a description of the problem and your technical contact person with the product.
5. Ship the product prepaid with the RA Number marked on the outside of the package to:

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KineticSystems Company, LLC
Repair Service Center
900 North State Street
Lockport, IL 60441

Telephone: (815) 838-0005
Facsimile: (815) 838-4424

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