VMIVME-3230
Intelligent 8-Channel Thermocouple Board

- Eight isolated, differential input channels
- On-board 16-bit microcomputer
- Linearization and cold junction compensation for thermocouple types J, K, T, E, R, S, B, N, W-Re
- Accepts multiple thermocouple types simultaneously
- High CMV isolation: 1,000 V
- Dual port registers for minimum host overhead
- High common-mode rejection: 120 dB at 60 Hz
- Local or remote cold junction compensation
- Program-selected measurement units, resolution, and data format
- Nonvolatile storage of calibration parameters, eliminates channel adjustment potentiometers
- A/D converter, 12 bits plus sign
- Inputs filtered and normal mode protected to 130 VRMS
- Optional high-level inputs available with provision for current loop termination
- Built-in-Test (BIT)
- GE Fanuc 90-70 series approval

APPLICATIONS

- Temperature measurement
- Industrial control systems
- Machinery instrumentation
- Current loop receiver

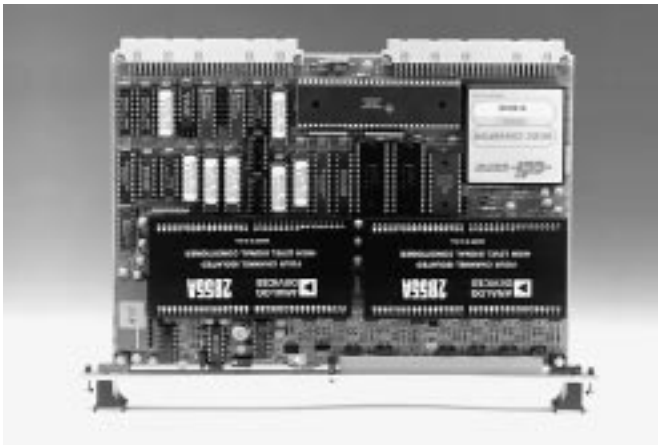
INTRODUCTION — The VMIVME-3230 is an 8-channel low-level input board, specifically designed for use with thermocouple inputs. The board performs reference (cold) junction temperature compensation and provides linearization for a variety of thermocouple types. All inputs are filtered and isolated, and are protected against normal-mode overvoltage. An optional configuration offers high-level inputs. The major VMIVME-3230 functional blocks are illustrated in Figure 1.

Thermocouple connections are made at a screw terminal block which connects directly to the front panel P3 connector. Provisions are also included for remotely locating the thermocouple connections and cold junction sensor.

FUNCTIONAL CHARACTERISTICS

Compliance: This product complies with the VMEbus specification Rev. C. 1 with the following mnemonics:
A16: D16: D08 (EO) Slave: 29, 2D
Form Factor: 6U

Board Address Selection: The base address of the board is selected by 11 on-board jumpers. This board may be operated in any slot except slot one.



Addressing Scheme: This board is addressed as 16 contiguous, 16-bit registers, located on any 16-word boundary within the short supervisory or short nonprivileged I/O space.

VMEbus Address Modifier: Address modifier lines are decoded to support either I/O access stated above. A single jumper is provided to support this feature. It is factory configured for short supervisory access.

ORDERING INFORMATION

October 28, 1994 800-003230-000 F		A	B	C	–	D	E	F
VMIVME-3230	–		0	0	–			

A = Input Options*
0 = 8 Thermocouple Channels
1 = 8 High-Level Channels, No Termination Resistors
2 = 8 High-Level Channels, with Termination Resistors
3 = 4 Thermocouple Channels
4 = 4 High-Level Channels, No Termination Resistors
5 = 4 High-Level Channels, with Terminal Resistors Installed

BC = 00 (Options reserved for future use)

INPUT CONNECTOR DATA

Connecting Component	*P3 (Phoenix)*
Compatible Mating Connector	No. 17-57-19-0**
PC Board Header Connector 20-pin	No. 17-57-42-0**

NOTES

* Contact the factory for custom input voltage ranges between ±50 mV and ±5 V.
** Available from: Phoenix Terminal Blocks, Inc.
P.O. Box 4100
Harrisburg, PA 17111

For Ordering Information, Call:
1-800-322-3616 or 1-205-880-0444 • FAX (205) 882-0859

Specifications subject to change without notice.

Board Identification: A Board Identification Register (BIR) contains a 16-bit VMIVME-3230 identification code.

Input Organization: User inputs to this board are organized as eight differential, low-level, input signal pairs.

ELECTRICAL SPECIFICATIONS AT 25 °C

Number of Input Channels: Eight thermocouple channels plus reference sensor, or (optionally) eight high-level channels

Analog Input Range Options: Full-scale ranges of ±30 mV, ±60 mV, and ±90 mV, high-level input ranges of ±50 mV and ±5 V

Processing Accuracy: (See Table 1 for processing characteristics)

Bandwidth: -3 dB at 2-5 Hz.

Channel Scan Rate: 250 channel/sec minimum (8 channels enabled)

Open Input Detection (Thermocouple Inputs): Negative full-scale reading on open channel

Channel Selection Settling Time: 4.0 msec to 0.01 percent

Gain Error: ±0.15 percent maximum (±40 PPM per degree -C)

Gain Nonlinearity: ±0.10 percent maximum

Input Offset: ±20 µV ±0.025 percent FSR maximum (± 2 µV per °C)

Isolation Voltage: ±1,000 Vpk (750 Vrms) maximum, 0 to 60 Hz

Common-Mode Rejection: 20 dB minimum; Rs≤100 Ω, F≥50 Hz

Normal-Mode Protection: 130 Vrms continuous (7 Vrms for resistor-terminated high-level inputs).

Normal-Mode Rejection: 25 dB minimum, 60 Hz

Input Resistance: 100 MΩ minimum with power applied, 35 kΩ with power removed, 100 Ω if current loop terminators are installed

Input Bias Current: 8 nA maximum

Input Noise: 2 Converter LSB pk-pk

Calibration Provisions: Analog-to-Digital Converter (ADC) is calibrated automatically to an on-board standard. Inputs are field calibrated to "zero" and full-scale input conditions; calibration parameters are stored in nonvolatile memory.

BOARD CONTROL AND STATUS REGISTER (CSR)

Mode Control: CSR bits 3, 2, and 1 establish the VMIVME-3230 operating modes as:

- Continuous channel scanning
- Single scan
- Channel offset calibration
- Channel range calibration
- Reference (cold) junction calibration

Sequence Initiation: Scan and calibration sequences are initiated by setting CSR bit 0 to "one", or by an external TTL trigger at P3 if CSR bit 4 is set to "one". Bit 0 is cleared automatically at the end of each sequence.

Software Reset: The on-board processor is forced to the reset state while CSR bit 5 is set to "one".

Fail Indicator: Front panel indicator is OFF if CSR bit 7 is "one", and is ON if bit 7 is "zero".

Built-in-Test (BIT): On-board BIT sequence is executed directly after a reset operation occurs. CSR bit 6 is set to "one" if the test fails, and is cleared to "zero" if the BIT is successful. VMIVME-3230 BIT verifies the correct operation of the:

- Analog multiplexer
- ADC
- Processor and memory
- Internal control and status ports

CHANNEL CONTROL REGISTER (CCR)

Channel Mask: CCR bits 7 through 0 constitute an 8-bit channel enable mask, with each bit controlling the corresponding channel number. A channel is enabled if the control bit is a "one", and disabled (not processed) if the control bit is a "zero". Default is FF HEX (all channels enabled). CCR bits 13 through 8 control processed data resolution (LSB weight) and measurement units.

Data Coding: Coding of processed data is controlled by CCR bits D15 and D14 as:

D15	D14	Data Coding
0	0	Offset Binary
0	1	Two's complement
1	0	Complement of offset binary
1	1	Complement of two's complement

Data is right-justified, and the sign is extended through the MSB (bit 15). Default value is "01" (Two's complement).

DATA REGISTERS

Processed Data: A 16-bit Data Register is provided for each of the eight input channels and for the cold junction compensation sensor channel.

Channel Calibration: In the calibration modes, the on-board processor adjusts the appropriate parameter (offset or gain) to produce the correct output. The final value of the calibration parameter is stored in nonvolatile memory.

To prevent accidental alteration of calibration parameters, an on-board jumper must be in the CAL-ENABLE position in order for the calibration sequence to be executed.

Open Thermocouple Detection: Thermocouples which are exposed for long periods to vibration, high temperature, or corrosive atmospheres, are subject to failure in the open-circuit mode. Open-circuit conditions also can occur due to loose connections or broken thermocouple wires. The resulting floating-sensor input will produce erroneous readings which may, or may not, be in the expected range of measurement.

The VMIVME-3230 Board addresses this potential system problem by injecting a small negative bias current (4 nA) into all thermocouple channel inputs. An open thermocouple input responds to the bias current by slewing to negative full-scale in approximately 10 seconds.

PHYSICAL/ENVIRONMENTAL

Temperature:
0 to +55 °C (Standard VME Slot), operating
0 to 60 °C (1.6-in slot)
-40 to +85 °, storage

Humidity: 5 to 95 percent, relative noncondensing

Altitude: Operation to 10,000 ft

Cooling: Forced-air convection (Standard VME Slot)
Convection (1.6-in slot)

Dimensions: Double Height Eurocard (6U), 160 mm x 233.35 mm

Vibration: 1 in; 5 to 10 Hz
1.0 g; 10 to 200 Hz

Input Connector (P3): 20-pin terminal connector (refer to input connector data table in the Ordering Information)

Power Requirements: 2.0 A (typical) at +5.0 VDC (+0.25/-0.125 VDC) 2.5 A (maximum)

RELATED PRODUCTS AND APPLICATIONS — VMIC offers a broad range of Analog Input/Output (AIO) products for VME systems, and supports these products with comprehensive applications information. Contact VMIC for a description of current products and a list of application guides.

GE-Fanuc 90-70 SERIES APPROVAL — VMIC has received approval for the VMIVME-3230 to be used with the GE-Fanuc 90-70 family of products. An Installation and Integration Guide for the VMIVME-3230 is available from VMIC. This guide details the Integration of the VMIVME-3230 into the GE-Fanuc 90-70 family.

SPECIFYING FACTORY OPTIONS — To accommodate the variety of thermocouple requirements encountered in VME applications, the VMIVME-3230 Board can be supplied with the following options:

Eight isolated high-level inputs (substituted for thermocouple inputs), with provision for current loop termination resistors.
Current loop termination resistors (100 Ω, 0.02 percent)

installed (available only with high-level inputs option). Four input channels instead of eight channels.

The full part number is described under the Ordering Information.

TRADEMARKS

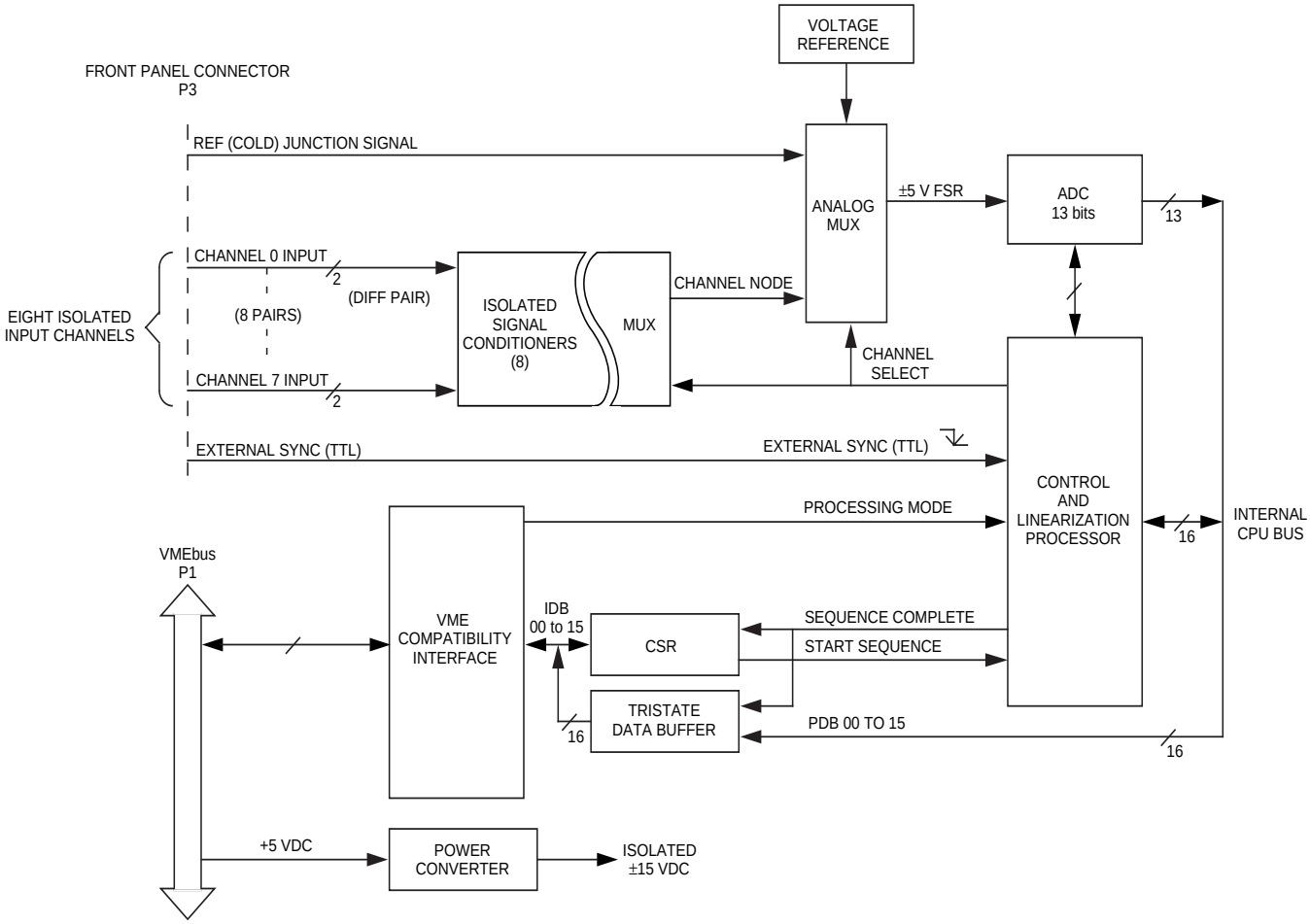


Figure 1. VMIVME-3230 Intelligent 8-Channel Thermocouple Board Block Diagram

Table 1. VMIVME-3230 Thermocouple Processing Characteristics

SELECT CODE (DECIMAL)	TC TYPE	ALLOY	FSR*	TEMP RANGE (°C)	RESOLUTION (°C)	ACCURACY (± °C)**
00	B	Pt-6%Rh vs. Pt-30%Rh (Platinum - Rhodium)	±30 mV	200 to 500 500 to 1,000 1,000 to 1,800	4.0 2.0 2.0	8 5 4
01	E	Chromel - Constantan	±90 mV	-250 to -200 -200 to -50 -50 to 500 500 to 1,000	2.0 1.0 0.5 6.5	10 3 2 5
02	J	Iron - Constantan	±60 mV	-250 to 750	0.3	2
03	K	Chromel - Alumenel	±60 mV	-250 to -200 -200 to -100 -100 to 1,300	0.9 0.8 0.5	2 2 2
04	N	Nicrosil - Nisil	±60 mV	-250 to -100 -100 to 0 0 to 1,300	2.0 1.0 0.5	10 2 2
05	R	Pt vs. Pt-13%Rh	±30 mV	0 to 50 50 to 1,000	1.0 1.0	4 3
06	S	Pt vs. Pt-10%Rh	±30 mV	0 to 50 50 to 1,000 1,000 to 1,800	1.0 0.7 0.7	4 3 2
07	T	Copper - Constantan	±30 mV	-250 to -200 -200 to 400	1.0 0.3	3 1
08	---	W vs. W-26%Re (Tungsten Rhenuim)	±60 mV	150 to 200 200 to 1,000 1,000 to 2,300	5.0 3.0 1.3	12 7 3
09	C	W-5%Re vs. W-26%Re	±60 mV	0 to 200 200 to 2,300	2.0 1.5	5 3
10	---	W-3%Re vs. W-25%Re	±60 mV	0 to 200 200 to 1,000 1,000 to 2,300	2.0 2.0 1.3	5 4 2
11	---	(Reserved)				
12	---	(Reserved)				
13	---	(Linear Conversion)	±30 mV			
14	---	(Linear Conversion)	±60 mV			
15	---	(Linear Conversion)	±90 mV			

* Jumper selected.

**Error band increases ±0.007 °C per degree - C deviation of the cold junction temperature from +25 °C. Local cold junction sensing (on-board sensor) can produce an additional uncertainty of 1.5 °C due to temperature differences between the sensor and the external mating connector. A remote sensor can reduce this uncertainty to 0.5 °C.