VMIVME-3419
32-Channel Signal Conditioning Board with Selectable Gain and Built-In-Test

Product Manual

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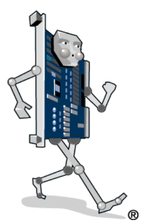

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Introduction

Features

The VMIVME-3419 is a 32 channel signal conditioning board. This VMIC product supports our extensive family of analog input/output products for the VMEbus. Low-level, differential inputs are accepted from temperature and pressure transducers, or from any other low-level analog signal source. Although the VMIVME-3419 board can be used with any high-level analog multiplexer and digitizer, it is specifically designed to be a companion to VMIC's scanning A/D Converter boards.

Individual channel voltage gain is decade selectable from x1 to x1000 and, when used with VMIC's analog input boards, provides full-scale ranges from ±10 mV to ±10 V. Excitation for RTDs and strain gages is provided from 2.5, 5, or 10 VDC, with total load current up to 250 mA. Three-pole, active, low-pass Butterworth filters are available in frequency ranges of 4 Hz, 40 Hz, 400 Hz, or 4 kHz. Filters are pluggable and affect eight channels per module. Open thermocouple inputs are detected by forcing the open channel offscale in either a positive or negative direction (jumper selectable for positive, negative, or disabled). The open sensor detection is intended to be used with gains of x10 to x1,000.

Built-in-Test (BIT) is supported by forcing the inputs from an externally supplied reference voltage from the P2 connector. BIT is controlled by a TTL signal at P2. The VMIVME-4125A System Test and Calibration (TESTCAL™) Board provides the control signals and a precision reference voltage. The VMIVME-4125A can produce a reference voltage of either positive or negative voltage that approaches full scale for most ADC applications.

The broad range of system applications includes factory automation, process control, data acquisition systems, training systems, and laboratory instrumentation.

A brief overview of the board's principal features illustrates the flexibility and performance offered by the VMIVME-3419 board:

- 32 differential analog input channels
- Each input channel provides:
  - — Optional 3-pole active low pass filters from 4 Hz, 40 Hz, 400 Hz or 4 kHz
  - — Gain selection of x1, x10, x100, or x1000
  - — Configuration for RTDs, strain gage bridges, or direct analog inputs
  - — Half-bridge completion for strain gage bridges
  - — Optional current loop termination resistors
- Buffered high-level analog outputs
- Isolation from the VMEbus; 500 VDC
- Full-scale input ranges from 10 mV to 10 V
- Strain gage excitation; 2.5, 5.0, or 10 V, at 250 mA total load
- Output cable matches input connectors for VMIC's family of scanning A/D boards
- Discrete wire or insulation displacement (IDC) input connectors
- Open Sensor detection for gains of x10 to x1,000 selectable as positive, negative, or disabled with a jumper

Functional Description

The VMIVME-3419 board (Figure 1 on page 14) is a 32-channel, differential, low-level, analog input signal conditioner for the VMEbus. Channel voltage gain is individually selectable as x1, x10, x100, or x1,000, and produces full-scale input ranges from ±10 mV to ±10 V. The output from each channel is a single-ended voltage source with a maximum full-scale range of ±10 V.

RTD and strain gage excitation outputs are provided for all channels. RTD excitation is selectable individually for each channel with a user-installed series resistor. Strain gage excitation is jumper selectable as 2.5 V, 5 V, or 10 VDC with remote sensing provided for both the positive and return connections. Total excitation output loading can be up to 250 mA for strain gages and RTDs.

Three-pole low pass filters are supplied in one of four optional ranges, 4 Hz, 40 Hz, 400 Hz, or 4 kHz. A no filter option is also available, see the ordering information. Filter modules control eight channel groups and are pluggable. Analog inputs are accepted through two front panel connectors, P3 and P4, which can be supplied to mate with either discrete wire or insulation displacement ribbon (IDC) 64-pin DIN connectors. The 64 pin connectors are stacked and referred to as a 128 pin ’CONDO’ header. The analog outputs are connected to the system through a 64-pin DIN connector, P5, which is also located on the front panel. Electrical power is obtained from the +5 VDC bus through the P1 connector. The VMIVME-3419 board uses the backplane only for electrical power, and BIT functions when used with the VMIVME-4125, and has no VMEbus control functions.

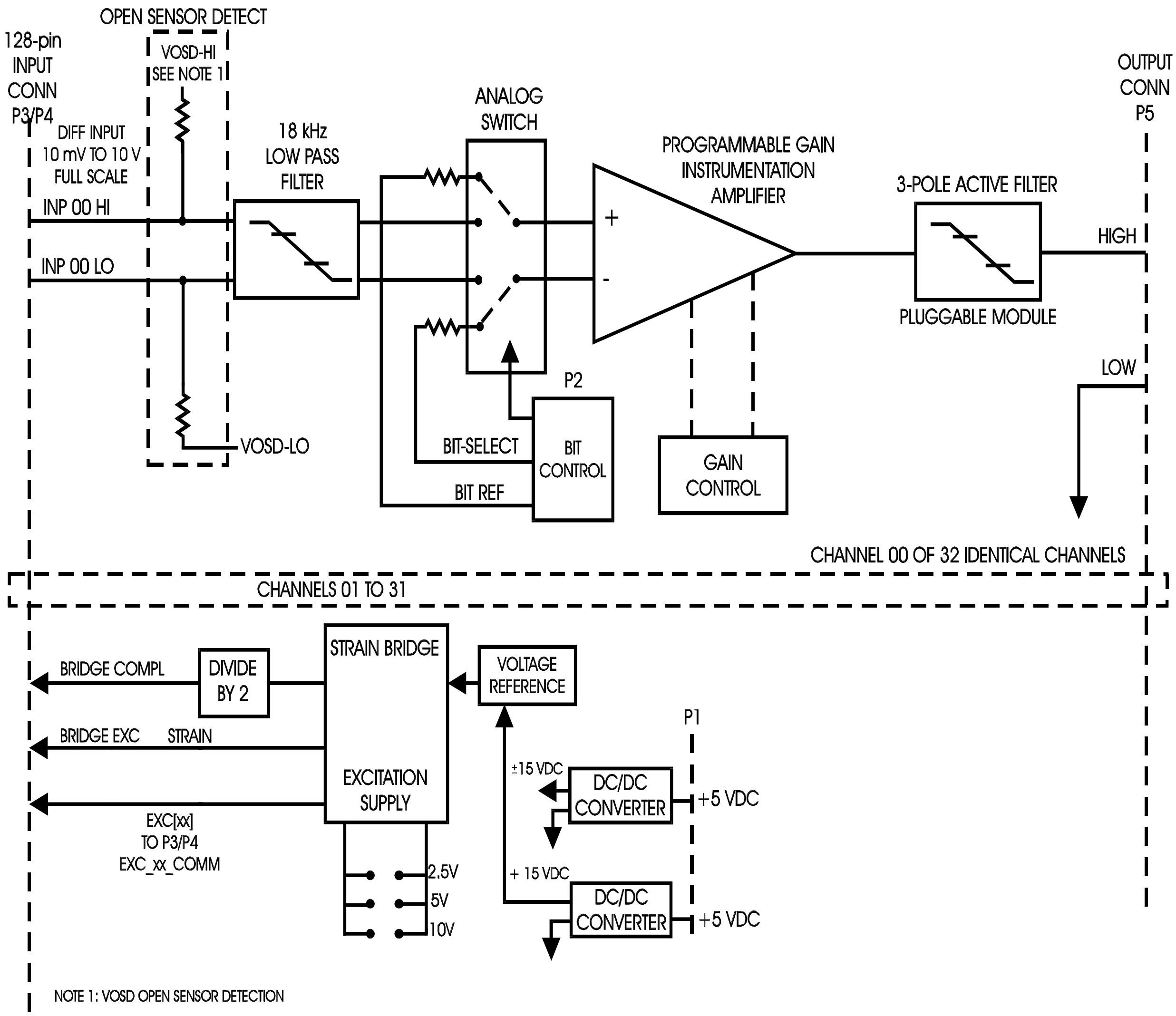

Figure 1 VMIVME-3419 Functional Block Diagram

Reference Material List

For a detailed explanation of the VMEbus and its characteristics, refer to "The VMEbus Specification" available from:

VITA

VMEbus International Trade Association

7825 East Gelding Drive, No. 104

Scottsdale, Arizona 85260

(602) 951-8866

FAX: (602) 951-0720

www.vita.com

Physical Description and Specifications: Refer to Product Specification, 800-003128-000 available from:

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Safety Summary

The following general safety precautions must be observed during all phases of the operation, service and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture and intended use of this product.

VMIC assumes no liability for the customer's failure to comply with these requirements.

Ground the System

To minimize shock hazard, the chassis and system cabinet must be connected to an electrical ground. A three-conductor AC power cable should be used. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet.

Do Not Operate in an Explosive Atmosphere

Do not operate the system in the presence of flammable gases or fumes. Operation of any electrical system in such an environment constitutes a definite safety hazard.

Keep Away from Live Circuits

Operating personnel must not remove product covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

Do Not Service or Adjust Alone

Do not attempt internal service or adjustment unless another person capable of rendering first aid and resuscitation is present.

Do Not Substitute Parts or Modify System

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the product. Return the product to VMIC for service and repair to ensure that safety features are maintained.

Dangerous Procedure Warnings

Warnings, such as the example below, precede only potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

WARNING: Dangerous voltages, capable of causing death, are present in this system. Use extreme caution when handling, testing and adjusting.

Warnings, Cautions and Notes

STOP informs the operator that a practice or procedure should not be performed. Actions could result in injury or death to personnel, or could result in damage to or destruction of part or all of the system.

WARNING denotes a hazard. It calls attention to a procedure, practice or condition, which, if not correctly performed or adhered to, could result in injury or death to personnel.

CAUTION denotes a hazard. It calls attention to an operating procedure, practice or condition, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the system.

NOTE denotes important information. It calls attention to a procedure, practice or condition which is essential to highlight.

CHAPTER

1

Theory of Operation

Contents

Operational Overview

This section describes the internal organization of the VMIVME-3419 board, and reviews the general principles of operation. Section summarizes the major board functions, each of which is described in detail in a subsequent section.

Functional Organization

The VMIVME-3419 board contains the following principal hardware functions, as shown in Figure 1 on page 14:

- Low pass input filter
- Active, low-pass Butterworth filters
- Open sensor detection
- Instrumentation amplifiers
- Excitation power supply
- RTD excitation
- Strain gage excitation and bridge completion
- Built-in-Test capability

General

Analog inputs are routed to the P3 and P4 connectors on the front panel using either flat-ribbon cables or discrete-wire cables. The inputs are filtered using a low pass input filter which is used for anti-aliasing at a cutoff frequency of 18 kHz. The inputs are then routed through an analog switch used to switch a known reference voltage into the system for board checkout and auto calibration.

The differential signal is then seen at the instrumentation amplifier. Programmable-gain instrumentation amplifiers (each amplifier is gain selectable) provide 32 channels of signal conditioning for direct transducer analog inputs. After the instrumentation amplifier, the input is converted to a single-ended output that passes through an optional three-pole active Butterworth filter. Active, low-pass Butterworth filters are optional with cut off frequencies of 4 Hz, 40 Hz, 400 Hz, and 4 kHz. The filters are configured as plug-in modules.

Dual DC-to-DC converters provide isolated 15 VDC for the board. A 5 W DC-to-DC converter supplies 250 mA for the excitation supply and a 12 W converter supplies ±15 VDC for the remainder of the board.

The output connector P5 is designed to cable directly to the 32-channel input connector of a VMIC scanning multiplexer / digitizer board through a standard 64-wire ribbon cable. A single 64-channel scanning multiplexer board, such as the VMIVME-3122, accommodates the outputs from two VMIVME-3419 boards.

Low Pass Input Filters

Each channel input HIGH / LOW pair passes through an anti-aliasing, differential, low-pass filter before appearing at the input of an Instrumentation Amplifier (See Figure 1-2 on page 23). The filter is a single-pole ladder which provides -3 dB cutoff frequency at 18 kHz.

Low Pass Output Filters

Factory options provide four filter ranges with -3 dB cutoff frequencies of 4 Hz, 40 Hz, 400 Hz, and 4 kHz. A fifth filter option eliminates the filters and routes the input signal from the instrumentation amplifier directly to the output connector. The output filters are in a Sallen-Key configuration and are designed with 3-pole Butterworth characteristics. Filters are pluggable modules and are configured in eight-channel groups.

Open Sensor Detection

An Open Sensor Detection (OSD) System is provided for all inputs. This network is used for determining if an open has occurred at the input and driving the output to full-scale within 5 seconds. OSD is accomplished by providing a +10 V or -10 V potential across the inputs through a high impedance resistor. A jumper is provided to select either positive output, negative output, or disabled (See Figure 1-1 below). OSD is intended to be used with gains of x10 to x1,000. OSD is nonfunctional during Built-in-Test (BIT) operation.

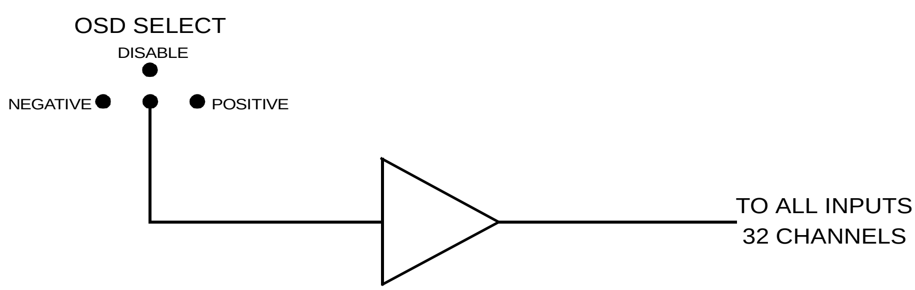


Figure 1-1 OSD Selection

Configuration with Current Loop Terminators

A current loop terminator factory option includes a 250 Ω, 0.01 percent, 1 / 4 W precision resistor. Only the voltage drop across the precision resistor and the 18 kHz low pass filter appears at the input of the instrumentation amplifier.

Configuration for Bridge Completion

Two-arm (half-bridge) strain gages generally require a passive two-arm bridge to complete the standard four-arm configuration. The passive bridge provides a reference voltage that equals the nominal ’zero’ output of the active half-bridge, and for symmetric gages equals one-half of the excitation voltage. The VMIVME-3419 board simulates the passive half-bridge with the bridge completion bus shown in Figure 1-3 on page 25. The bridge completion bus voltage equals one-half of the selected strain gage excitation voltage.

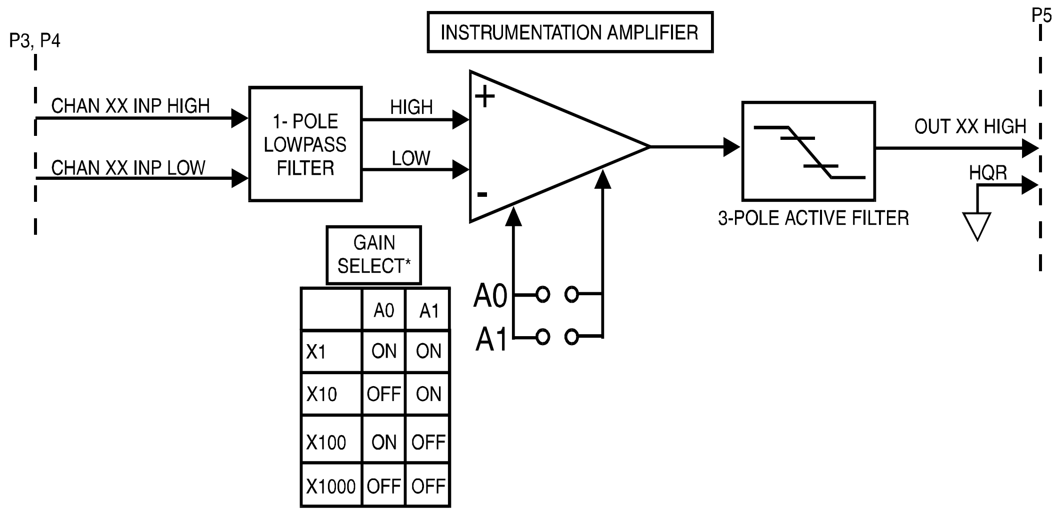
Connecting the BRIDGE-COMP (P4) pin to the low input establishes a simulated two-arm input at the respective channel. The output of the active bridge is connected to the (HIGH) input.

The bridge completion voltage is generated by a precision 2:1 attenuator across the excitation supply, and can be connected to the inverting input of any channel requiring bridge completion compensation.

Instrumentation Amplifiers

Gain Control

The instrumentation amplifier in each channel is a high impedance, differential amplifier with jumper-selectable gain and a single-ended output (See Figure 1-2 below). Each amplifier is programmable individually for a voltage gain of x1, x10, x100, or x1,000. For example, if a gain of 100 is needed then only jumper A0 will be installed.



	A0	A1
X1	ON	ON
X10	OFF	ON
X100	ON	OFF
X1000	OFF	OFF

Figure 1-2 Filter and Amplifier

Outputs

The single-ended output from the amplifier passes through a three-pole, active, Butterworth filter. This filter provides -3 dB cutoff frequencies at 4 Hz, 40 Hz, 400 Hz, and 4 kHz. The board may also be ordered without filters. The output section of each filter has a 47.5 Ω series resistor and a 1000 pF capacitor connected to AGND. This resistor/capacitor network ensures that the output will remain stable if high capacitive loading is present at the output. The output is routed to the P5 connector.

Excitation Power Supply

Excitation for RTDs and strain gages is generated by the power amplifier shown in Figure 1-3 on page 25. RTD excitation for all channels is derived from the excitation bus. The excitation power bus for strain gages consists of the STRN EXC HI and STRN EXC LO lines, and supplies a maximum load current of 250 mA. The STRN EXC HI line is routed to all channels as an excitation output. Excitation current is returned to the STRN EXC LO line through the INP_XX_COMM pins, where XX corresponds to the channel number. The strain gage excitation voltage is jumper-selected as +2.5, +5.0, or +10 VDC.

Remote Sensing

Remote sensing compensates for the voltage drop encountered in long excitation lines and ensures that the selected excitation voltage is delivered to the load. The POS SENSE and NEG SENSE lines from the P4 connector provide remote sensing of the excitation voltage delivered at a remotely located strain gage. The sense connections must be connected for proper operation.

Excitation Outputs

Resistive Thermal Device (RTD) and strain gage excitation are controlled with the adapters and jumper blocks shown in Figure 1-4 on page 27. All adapters are configured at the factory with jumpers (bus wire) in the R-EXC positions.

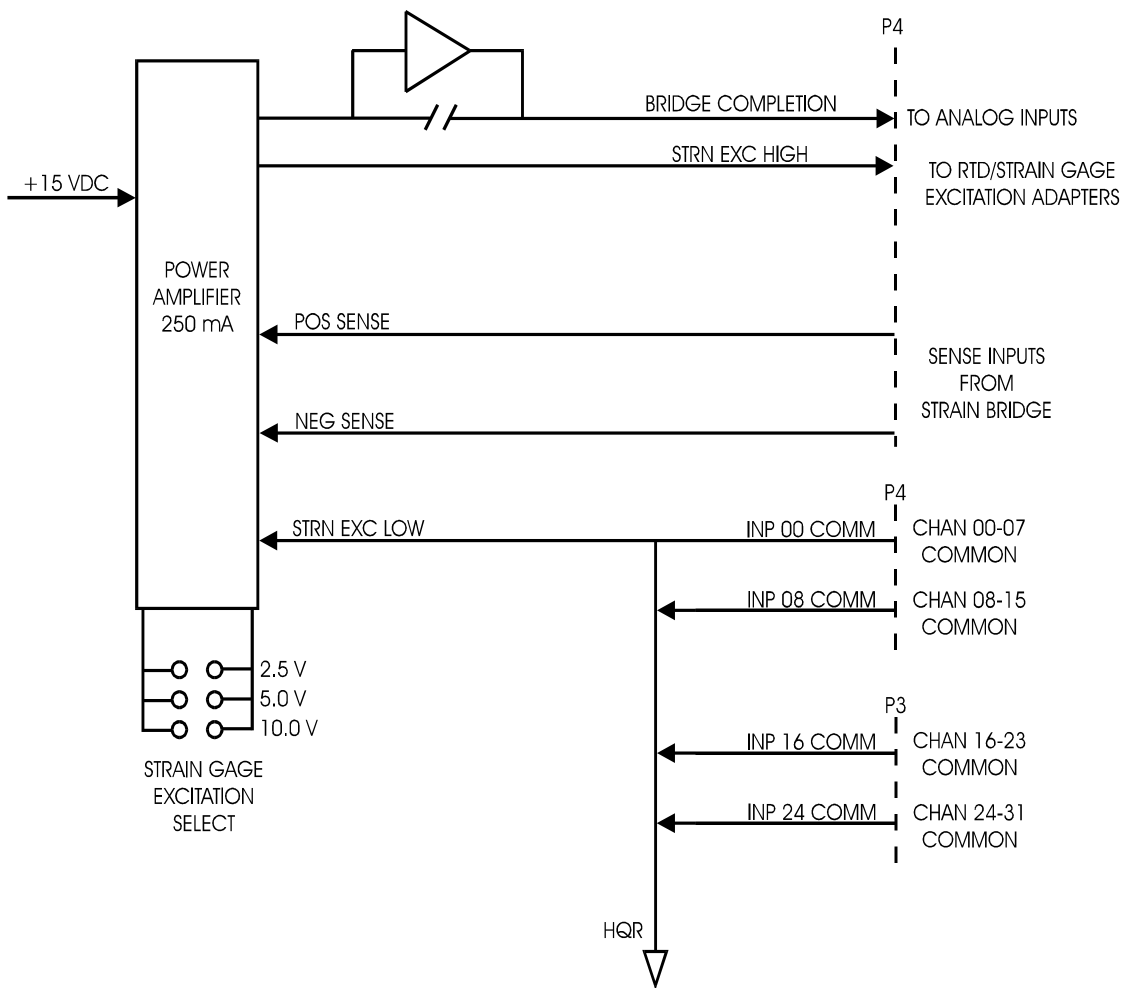


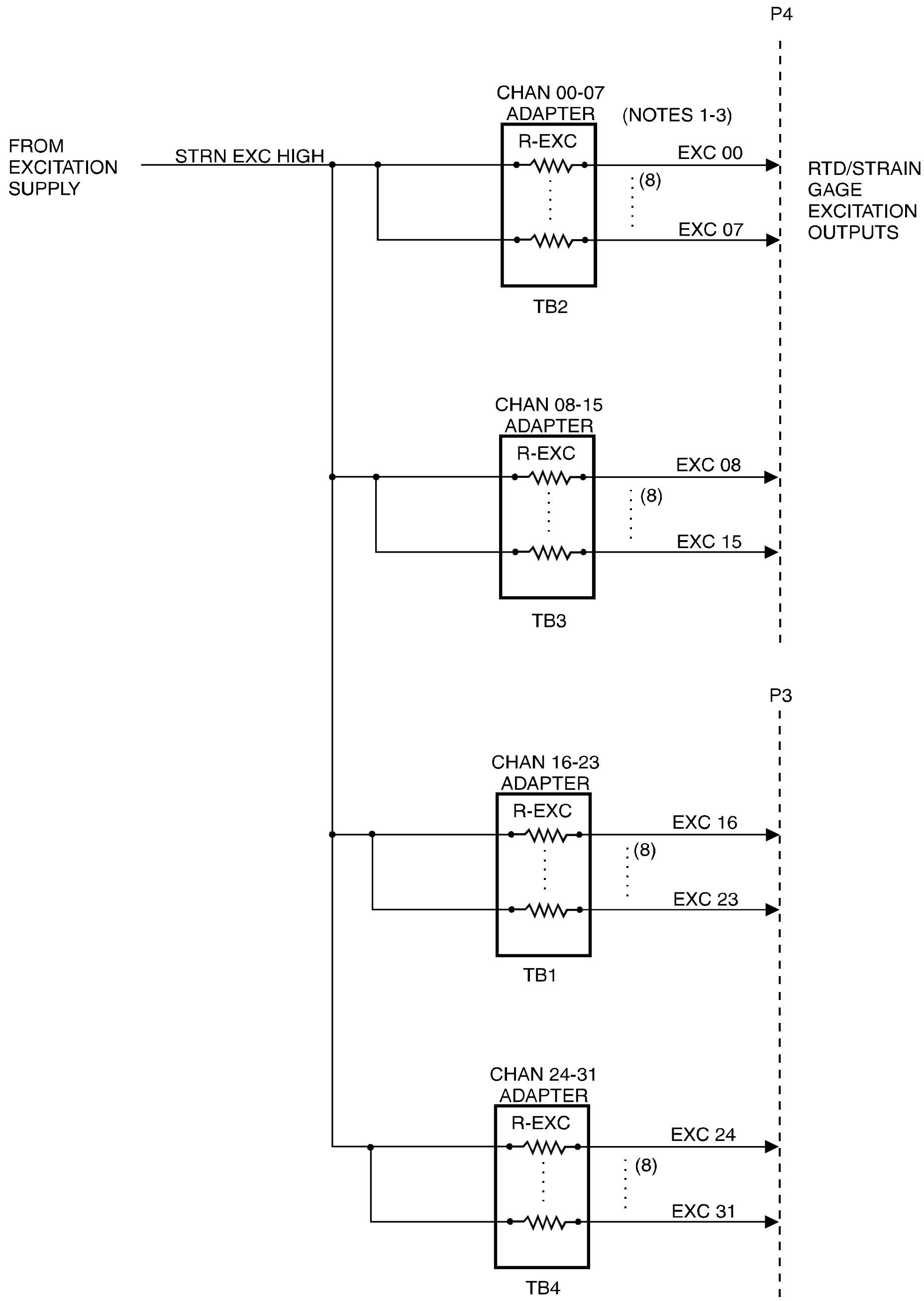
Figure 1-3 Excitation Power Supply

RTD Excitation

The excitation current for RTDs is determined by user-installed resistors on the excitation adapters shown in Figure 1-4 on page 27. RTD configurations and calculation of the R-EXC adapter resistor values are described in Chapter 2. The VMIVME-3419 can supply up to 250 mA of excitation current.

Strain Gage Excitation

Strain gages are usually voltage driven, and require jumpers instead of resistors on the R-EXC adapters. The adapters are configured at the factory with jumpers in all R-EXC positions.



NOTES:
1. Each adapter contains locations for eight R-EXC excitation resistors.
2. R-EXC is zero (jumpered) for strain gage operation.
3. Adapters are factory-configured for strain gage operation (R-EXC = jumper).

Figure 1-4 RTD and Strain Gage Excitation

Power Converter

Electrical power for the VMIVME-3419 board is supplied by two DC-to-DC Converters which convert the 5 V logic power input from the P1 connector into isolated ±15 VDC at 400 mA for board operation and a additional +15 VDC at 250 mA for the Strain Excitation Supply.

Built-In-Test (BIT)

To support system calibration requirements, an external calibration voltage (BIT REF) from P2 can be substituted for the normal channel signal. BIT voltages are routed directly into the input of the Instrumentation Amplifiers. The “CAL SPAN A” or “CAL ZERO” is an optically-isolated control signal shown in Figure 1-5 that controls the state of the Analog BIT switch, which selects either the channel signal or the BIT REF signal as the input voltage for the Instrumentation Amplifiers. A jumper is also used to isolate the BIT return signal from the VMIVME-3419.

A TTL HIGH (high) level or open input on either the CAL SPAN A or CAL ZERO lines establishes normal operation, where all channel signals from the P3/P4 inputs pass directly through the BIT switches to the respective Instrumentation Amplifier. A TTL LOW (zero) level allows the BIT REF voltage to be routed to the inputs of all Instrumentation Amplifiers. This provides a method for system Calibration and an overall system integrity check.

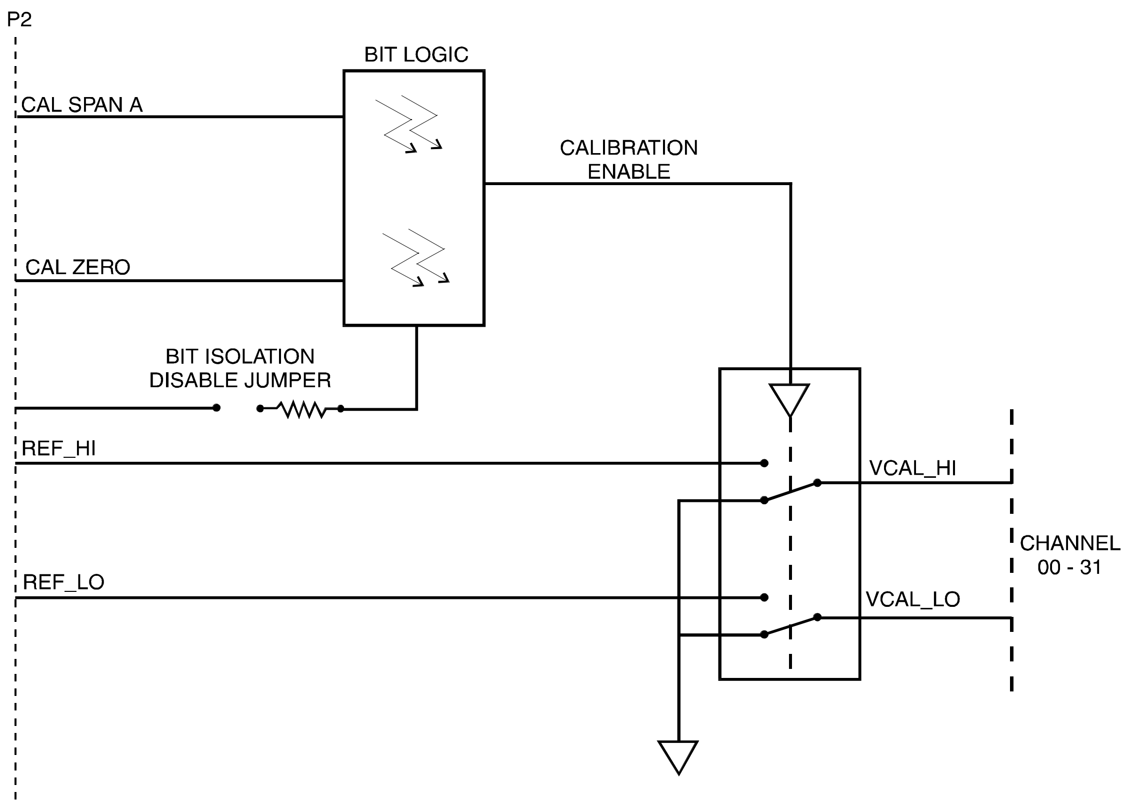


Figure 1-5 Built-in-Test

CHAPTER 2

Configuration and Installation

Contents

Introduction

This chapter describes the installation and configuration of the board. Cable configuration, jumper/switch configuration and board layout are illustrated in this chapter.

Unpacking Procedures

CAUTION: Some of the components assembled on VMIC's products may be sensitive to electrostatic discharge and damage may occur on boards that are subjected to a high-energy electrostatic field. When the board is placed on a bench for configuring, etc., it is suggested that conductive material should be inserted under the board to provide a conductive shunt. Unused boards should be stored in the same protective boxes in which they were shipped.

Upon receipt, any precautions found in the shipping container should be observed. All items should be carefully unpacked and thoroughly inspected for damage that might have occurred during shipment. The board(s) should be checked for broken components, damaged printed circuit board(s), heat damage, and other visible contamination. All claims arising from shipping damage should be filed with the carrier and a complete report sent to VMIC together with a request for advice concerning the disposition of the damaged item(s).

Physical Installation

CAUTION: Do not install or remove the boards while power is applied.

De-energize the equipment and insert the board into an appropriate slot of the chassis. While ensuring that the board is properly aligned and oriented in the supporting card guides, slide the board smoothly forward against the mating connector until firmly seated.

Before Applying Power: Checklist

Before applying power to the VMEbus chassis in which the board is installed, execute the following checklist to ensure that the board has been prepared correctly for operation.

1. The configuration instructions in *Configuration and Installation* have been reviewed and applied to system requirements._____
2. All I/O cables are properly terminated for the input/output connectors. Refer to *Connector Description* on page 50 for connector descriptions._____
3. Installation has been completed as described in *Physical Installation* on page 33. _____
4. All system cable connections are correct._____

Operational Configuration

Factory-Installed Jumpers

Each VMIVME-3419 board is configured at the factory with the specific jumper arrangement shown in Table 2-1 on page 36. The factory configuration establishes the following functional baseline for the VMIVME-3419 board, and ensures that all essential jumpers are installed.

- Channel configuration
  - — Voltage gain is x100 (x1 for current-loop inputs)
- Strain Gauge excitation
  - — +2.5 VDC output
  - — Remote sensing disabled
- Open Sensor Detection
  - — Disabled
- High Quality Return
  - — All jumpers installed

Grounding for all channels is provided through individual high-quality return paths. Jumper block E7 is used to connect each group of eight channels to the high-quality return. This set of jumpers should always be installed. Also, jumpers E39 and E40, when installed, are used to disable the 500 VDC isolation and are installed from the factory.

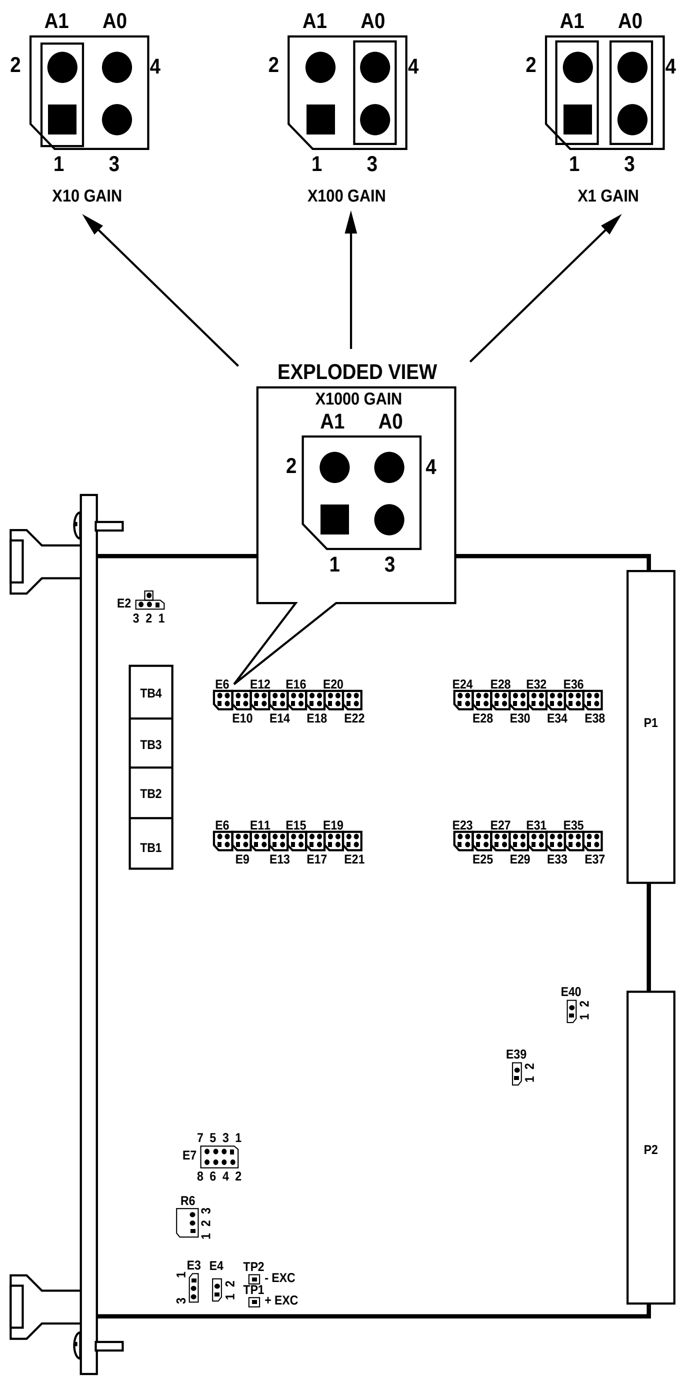


Figure 2-1 VMIVME-3419 Jumper Locations

Table 2-1 Channel Configuration Jumpers

Factory Configuration: x100 Gain					
Channel	**Jumper**	**Factory Configuration**	**Channel**	**Jumper**	**Factory Configuration**
CHN0	E23	3-4 Installed (A0) 1-2 Omitted (A1)	CHN16	E5	3-4 Installed (A0) 1-2 Omitted (A1)
CHN1	E25	3-4 Installed (A0) 1-2 Omitted (A1)	CHN17	E9	3-4 Installed (A0) 1-2 Omitted (A1)
CHN2	E27	3-4 Installed (A0) 1-2 Omitted (A1)	CHN18	E11	3-4 Installed (A0) 1-2 Omitted (A1)
CHN3	E29	3-4 Installed (A0) 1-2 Omitted (A1)	CHN19	E13	3-4 Installed (A0) 1-2 Omitted (A1)
CHN4	E31	3-4 Installed (A0) 1-2 Omitted (A1)	CHN20	E15	3-4 Installed (A0) 1-2 Omitted (A1)
CHN5	E33	3-4 Installed (A0) 1-2 Omitted (A1)	CHN21	E17	3-4 Installed (A0) 1-2 Omitted (A1)
CHN6	E35	3-4 Installed (A0) 1-2 Omitted (A1)	CHN22	E19	3-4 Installed (A0) 1-2 Omitted (A1)
CHN7	E37	3-4 Installed (A0) 1-2 Omitted (A1)	CHN23	E21	3-4 Installed (A0) 1-2 Omitted (A1)
CHN8	E24	3-4 Installed (A0) 1-2 Omitted (A1)	CHN24	E6	3-4 Installed (A0) 1-2 Omitted (A1)
CHN9	E26	3-4 Installed (A0) 1-2 Omitted (A1)	CHN25	E10	3-4 Installed (A0) 1-2 Omitted (A1)
CHN10	E28	3-4 Installed (A0) 1-2 Omitted (A1)	CHN26	E12	3-4 Installed (A0) 1-2 Omitted (A1)
CHN11	E30	3-4 Installed (A0) 1-2 Omitted (A1)	CHN27	E14	3-4 Installed (A0) 1-2 Omitted (A1)
CHN12	E32	3-4 Installed (A0) 1-2 Omitted (A1)	CHN28	E16	3-4 Installed (A0) 1-2 Omitted (A1)
CHN13	E34	3-4 Installed (A0) 1-2 Omitted (A1)	CHN29	E18	3-4 Installed (A0) 1-2 Omitted (A1)
CHN14	E36	3-4 Installed (A0) 1-2 Omitted (A1)	CHN30	E20	3-4 Installed (A0) 1-2 Omitted (A1)
CHN15	E38	3-4 Installed (A0) 1-2 Omitted (A1)	CHN31	E22	3-4 Installed (A0) 1-2 Omitted (A1)

Input Gain and Voltage Range

The input voltage gain of each channel is jumper-selectable individually as x1, x10, x100, or x1000 as shown in Table 2-2. Maximum gain (x1000) is selected by removing both gain selection jumpers completely. The factory configuration provides a gain of x100 for all channels.

When used with a multiplexing A/D board such as the VMIVME-3122, the effective full-scale voltage range is the range of the A/D board divided by the gain of the VMIVME-3419 board:

EFFECTIVE INPUT RANGE = A/D BOARD RANGE ÷ VMIVME-3419 GAIN.

For example, a voltage gain of x100 produces an effective input voltage range of ±100 mV with an A/D board range of ±10 V.

Table 2-2 Gain Selection

	A0	A1
x1	Installed	Installed
x10	Omitted	Installed
x100	Installed	Omitted
x1000	Omitted	Omitted

Open Sensor Detection

The open sensor detection network is provided to alert the user if any input field wiring becomes open. This is done by forcing the output of the VMIVME-3419 offscale within five seconds. The open sensor detection circuit is polarity selectable using a single jumper to select positive, negative, or disabled, see Table 2-3. However, VMIC recommends that if a channel is not being used, the inputs should be terminated, INPUT_XX_HI, and INPUT_XX_LO shorted and connected to INPUT_XX_COMM. The open sensor detection is intended to be used with gains of x10 to x1000.

Table 2-3 Open Sensor Detection (OSD) Functions

Reference Designator	Function	Factory Configuration
E2 1-2	Negative OSD	Omitted
E2 2-3	Positive OSD	Omitted
E2 2-4	Disable OSD	Installed

Three-Pole Active Filters

The Butterworth filters, if ordered, are configured for specified frequencies from the factory. The filter modules are pluggable and control eight-channel blocks. Filter modules may be used or removed. No additional strapping or connections are required for proper channel operation. Modules are interchangeable to accommodate different cutoff frequencies. Cutoff frequencies may be modified by changing the associated SIP (Single In-Line Package) resistor. The SIPs are mounted in sockets and require caution while removing them. To change the filter cutoff frequency, follow the proceeding guidelines listed below. SIPs are of isolated resistor type. If SIPs are bussed or terminating type, they will cause improper operation of the board.

1. Determine the desired -3 dB cutoff frequency. Note if the frequency desired is less than 190 Hz, the filter module 332-000217 (Figure 2-2 on page 39), is best suited. Likewise, use the filter module 332-000228 (Figure 2-3 on page 39), for frequencies between 190 Hz and 18 kHz. Resistance (R) should remain within 500 Ω < R < 100 kΩ to prevent any problems with offset voltages and bias currents.
2. To modify the -3 dB frequency for the 0217 module, use the following formula to compute the new SIP resistor value:

$$R = \frac{188,000}{F}$$

   Where:

   R = New SIP Resistor Value

   F = New -3 dB Cutoff Frequency

3. To modify the -3 dB cutoff frequency for the 0228 module, use the following formula to compute the new resistance value:

$$R = \frac{18,800,000}{F}$$

4. After the new SIP value has been computed, acquire the number of SIPs required (one per channel).
5. Remove the filter module from the main board. The module is pressed into the socket, therefore care should be exercised to prevent damage to the pins and the filter module during removal. After the module has been removed, carefully remove the SIP and replace with the new computed value SIP (Table 2-4 on page 41). Reinstall the module by exerting equal pressure on both sides of the pins.

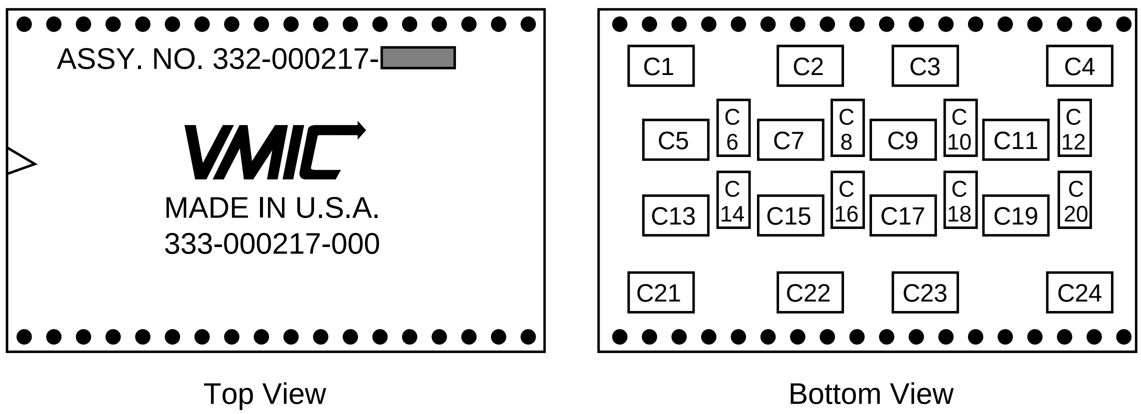


Figure 2-2 Assembly Drawing of the 0217 Filter Board

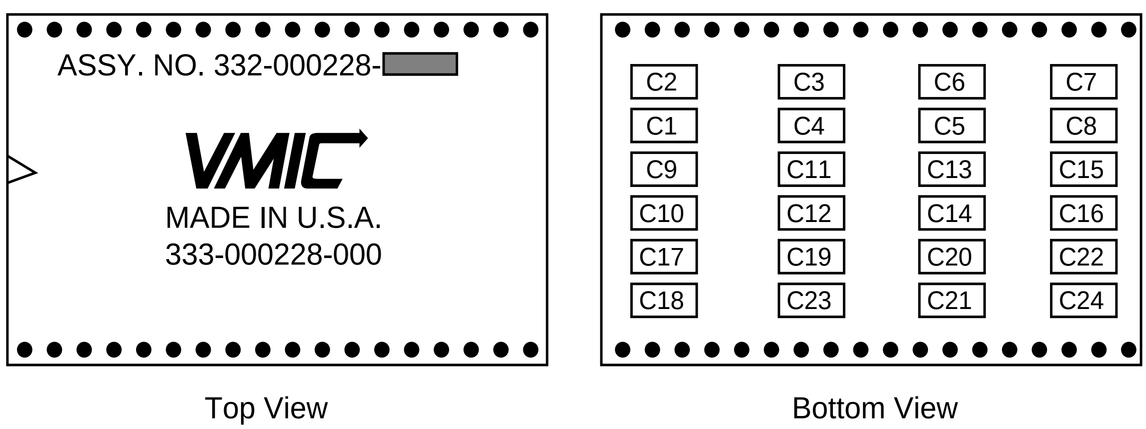


Figure 2-3 Assembly Drawing of the 0228 Filter Board

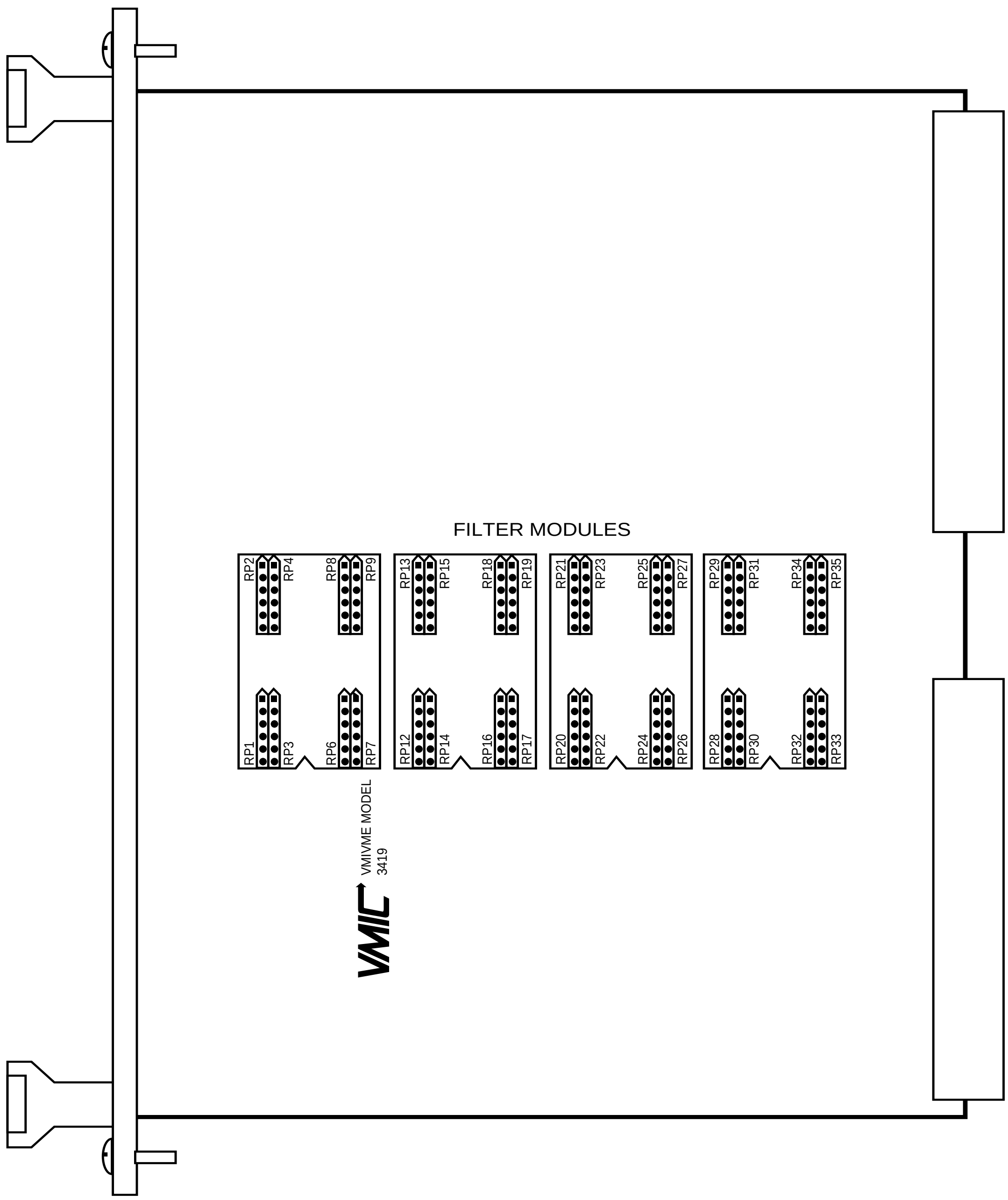


Figure 2-4 Location of the Filter Modules on the VMIVME-3419 Board

Table 2-4 SIP Table

CHANNEL	SIP NO.	CHANNEL	SIP NO.
CH0	RP20	CH16	RP1
CH1	RP22	CH17	RP3
CH2	RP21	CH18	RP2
CH3	RP23	CH19	RP4
CH4	RP24	CH20	RP6
CH5	RP26	CH21	RP7
CH6	RP25	CH22	RP8
CH7	RP27	CH23	RP9
CH8	RP28	CH24	RP12
CH9	RP30	CH25	RP14
CH10	RP29	CH26	RP13
CH11	RP31	CH27	RP15
CH12	RP32	CH28	RP16
CH13	RP33	CH29	RP17
CH14	RP34	CH30	RP18
CH15	RP35	CH31	RP19

Strain Bridge Excitation

The internal excitation supply can provide up to 250 mA of excitation for strain gauges (or for RTDs) at 2.5, 5.0, or 10.0 VDC. Jumpers are installed in the REXC excitation resistor positions for channels which use strain gauge excitation. Remote sensing permits strain gauges to be "clustered" remotely without introducing errors due to line losses. Positive and negative sensing connections are provided through the POS_SENSE and NEG_SENSE pins in the P4 connector, as shown in Figure 2-6 on page 45 and Table 2-10 on page 54.

Conventional strain gauges can vary in resistance from a few ohms to several kohms, but more common values are 120, 240, 350, and 700 Ω. The internal excitation supply has a load capacity of 250 mA, and is not intended to provide excitation for strain gauges on all channels. This would require several amperes of excitation current. High current strain gauge excitation should be provided by an external precision power supply.

Table 2-5 Excitation Jumper Functions

Function (Installed)	Jumper Identification		Factory Configuration
	E3	E4	
2.5 VDC Bridge Excitation	2-3	Omitted	Installed
5 VDC Bridge Excitation	2-3	1-2	Omitted
10 VDC Bridge Excitation	1-2	1-2	Omitted

RTD Inputs

Excitation for Resistance Temperature Detectors (RTDs) is implemented by connecting the RTD as shown in Figure 2-5 on page 43, and by:

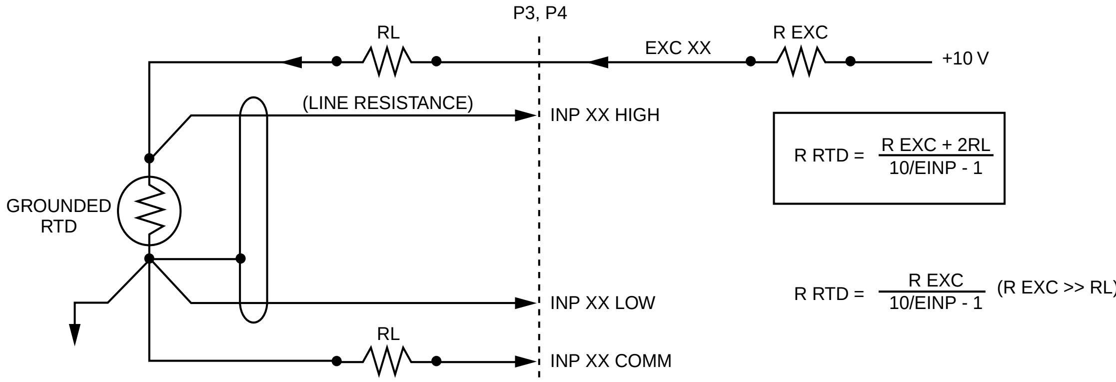
- Installing the correct value of REXC excitation resistor, as shown in Figure 2-5 on page 43.
- For example, if a 100Ω platinum RTD is assigned as the input device for Channel 05, and requires an excitation current of 0.400 mA:
  - — Connect the RTD to the Channel 05 inputs as shown in Figure 2-5 on page 43.
  - — Select a desired excitation voltage as shown in Table 2-5 above.
  - — Calculate the excitation resistor REXC (assume zero line resistance): For example, if a 100Ω platinum RTD is assigned as the input device for Channel 05, and requires an excitation current of 0.400 mA:

$$REXC = (10.0\ V \div 0.0004\ A) - 100\Omega = 24.9\ k\Omega$$

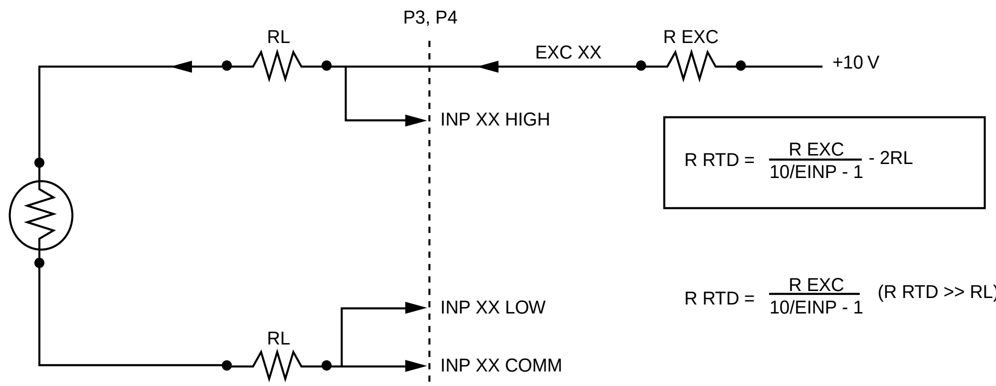
  - — Carefully remove the Bifurcated Terminal Block Adapter from TB2 socket. Remove existing bus wire from pins 6 and 11, installed from the factory. Install REXC between pins 6 and 11 of TB2, reinstall adapter, noting polarity.
  - — Select the channel gain that produces the highest channel output without exceeding full scale over the expected measurement temperature range. (A 100Ω platinum RTD with 0.4 mA excitation current will have a sensitivity of approximately 154 µV/°C at 0 °C, and a total output of over 120 mV at 600 °C.) Therefore, if a gain of 100 is selected, the VMIVME-3419 output will be forced offscale at the higher limits of this particular RTD.

Very large resistance ranges or very long lines may require additional compensation for these effects in order to achieve maximum accuracy. For precise measurement of the RTD resistance (RTD), use the appropriate equations in Figure 2-5 on page 43.

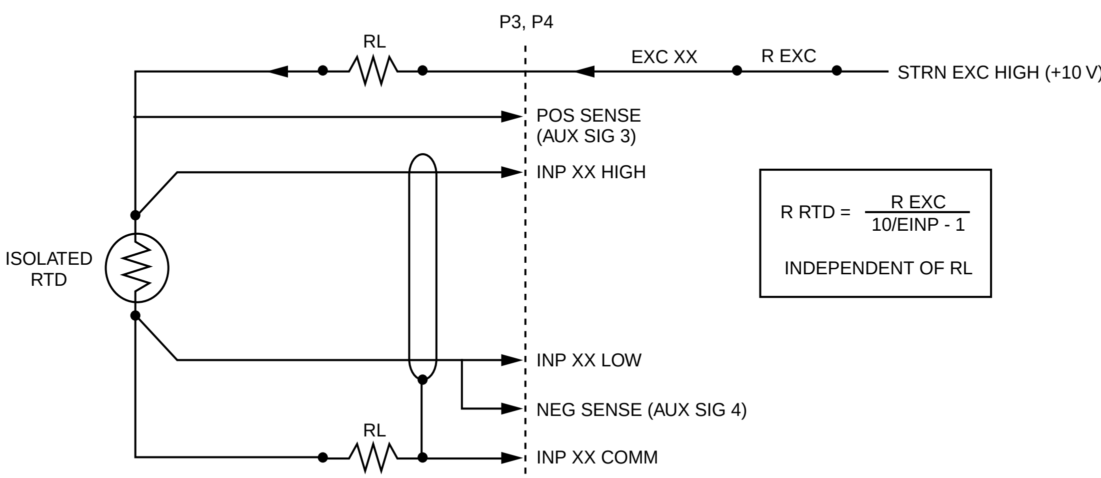
RTDs normally use low excitation currents of less than 1 mA, to avoid self-heating errors. Current up to 250 mA can be supplied from the strain gauge excitation bus as shown in Figure 2-5 on page 43 (C).



a. Four-Wire RTD Connection (Preferred Approach)



b. Two-Wire RTD Connection



c. Four-Wire RTD Connection with Remote Excitation Resistor

Figure 2-5 RTD Configurations

Strain Gauge Characteristics

Strain gauges respond accurately and repeatedly to very small changes in surface dimensions, and consequently are used extensively in sensors which produce these changes, such as transducers for force, pressure, and torque. The response of a strain gauge is affected by a number of external factors, including orientation, temperature, and the relative expansion coefficients of the gauge and the surface to which it is attached. However, for a properly installed strain gauge, these effects are minimal and the response (EG) is equal to:

EG = EEXC x STRAIN x GAUGE FACTOR x NUMBER OF ACTIVE ARMS ÷ 2

where:EEXC = Excitation Voltage

STRAIN = Elongation Factor (Elongation ÷ Length)

GAUGE FACTOR = Geometric Factor, Usually 2.0

NUMBER OF ACTIVE ARMS = 1, 2, 3, or 4

Commercially available strain gauges generally are specified more simply by combining the gauge factor and number of active arms into a single “gauge sensitivity” parameter:

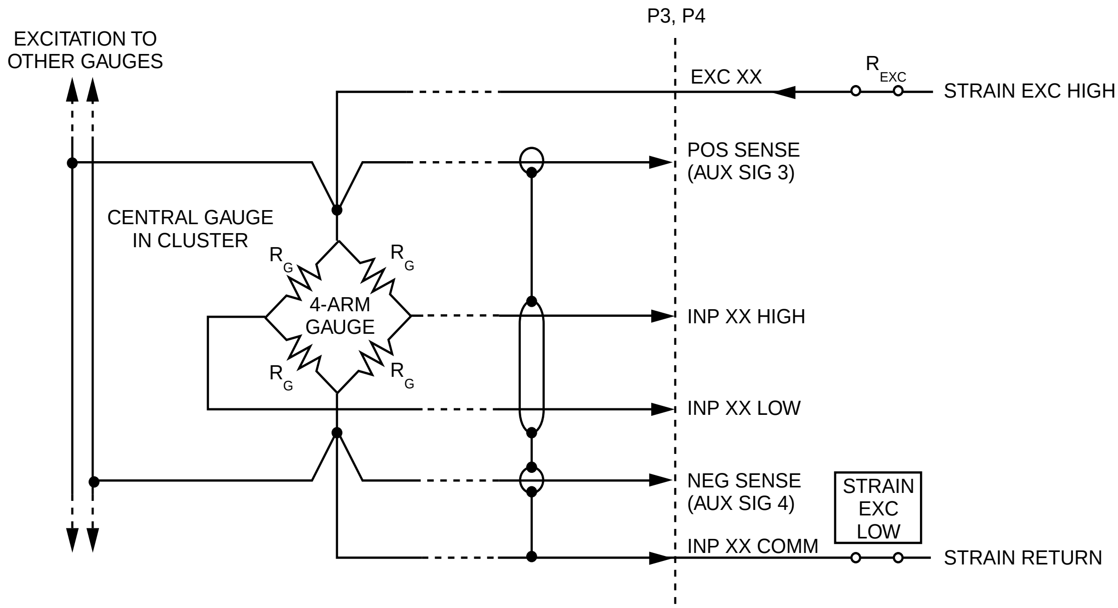
EG = EEXC x STRAIN x GAUGE SENSITIVITY

Typical full-scale values for strain vary from 0.001 to 0.002 (1,000 to 2,000 microstrain), while gauge sensitivity usually is between 1 and 4 for conventional gauges. So the full scale output level is typically between 0.001 and 0.008 times the excitation voltage, or from 10 to 80 mV with 10 VDC excitation. High output semiconductor gauges can produce greater output voltages, but generally are considered to be less accurate and less reliable than conventional gauges.

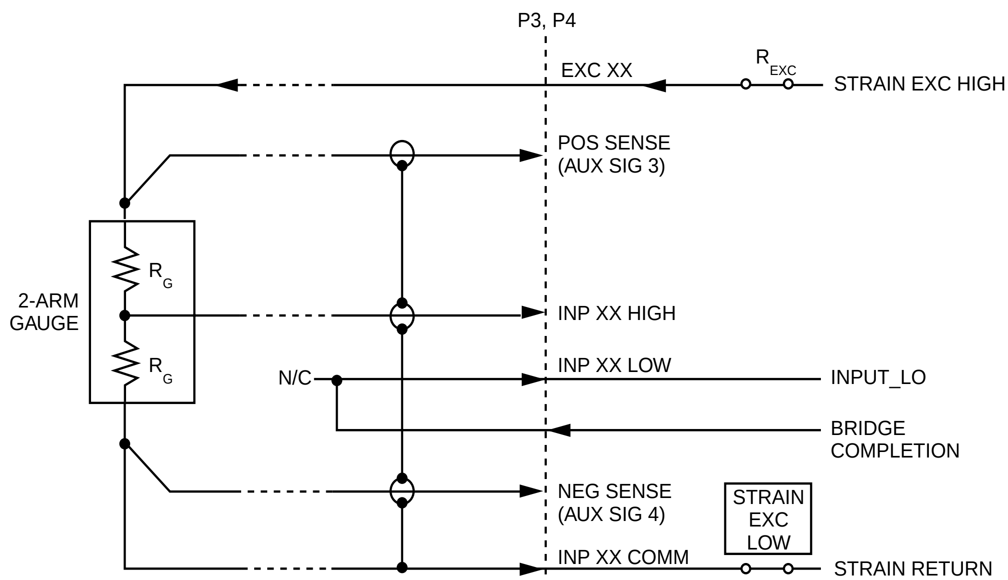
Strain Channel Inputs

Strain gauge channels are typically operated with a voltage gain of x100 to produce a full-scale output range from ±1 to ±10 V. The output of a four-arm gauge can be connected directly to the differential input of a channel, as shown in Figure 2-6 on page 45 (a). Two-arm (half bridge) gauges, however, have only a single output and the full bridge must be “completed” with another half bridge.

A half bridge is simulated on the VMIVME-3419 board by dividing the excitation voltage precisely in half and by providing an output pin to connect this “bridge completion” bus to the inverting input of any or all channels (Figure 2-6 on page 45). Bridge Completion is connected externally (i.e., terminal bus strip).



a. Four-Arm Strain Gauge Bridge with Remote Excitation Sensing



b. Two-Arm Strain Gauge Bridge with Remote Excitation Sensing

Figure 2-6 Strain Gauge Configurations

Channel Output Polarity

Signal polarity is maintained between the VMIVME-3419 inputs and outputs. A positive input level produces a positive output level.

Ground Connections

Digital return (BIT RTN) for the BIT control input at P2 is connected to the internal digital return through jumper E40. VMEbus digital return and the internal analog ground are connected together if jumper E39 is installed, or are isolated if the jumper is omitted. Both E39 and E40 jumpers are normally installed, and should be installed if a P2 bit interface is used.

Calibration

Before delivery from the factory, the VMIVME-3419 is fully calibrated and conforms to all applicable specifications. Should recalibration be required, refer to the paragraphs in this section and perform the calibration procedures in the order shown. The locations of all adjustments are shown in Figure 2-1 on page 35. All calibration adjustments are sealed against accidental movement. The seals are easily broken for recalibration, and should be resealed with a suitable fast-curing sealing compound after recalibration has been completed.

Equipment Required

1. Digital Voltmeter (DVM) 100 mVDC to 10.000 VDC ranges; 5 or more digits; ±0.004 percent of reading measurement accuracy; 10 MΩ minimum input impedance.
2. Digital Voltage Source 100 mVDC to 10.000 VDC ranges; ±0.004 percent setting resolution and accuracy. 10Ω maximum source resistance.
3. Chassis VMEbus backplane or equivalent, with J1 connector, +5 ±0.1 VDC, 5 A power supply. One slot allocated for testing the VMIVME-3419 board.
4. Extender Board, VMEbus extender board; test leads.

WARNING: Do not install or remove this board with power applied to the system.

Excitation Supply Calibration

The sense lines must be connected prior to this calibration. The POS SENSE line must be connected to any excitation output line. The NEG SENSE line must be connected to any input COMM pin. See Table 2-10 on page 54 or if field is connected, proceed to step 1.

1. Install jumpers for desired excitation voltage, see Figure 2-1 on page 35 and Table 2-5 on page 42.
2. Connect the DVM between TP1 (+) and TP2 (-). Adjust R6 for a DVM indication of selected voltage ±0.03%.

Channel Verification

1. Although there are no mechanical offset or gain adjustments for the VMIVME-3419 channels, the integrity may be checked against specification. Install all program jumpers to conform to the application required. If the application configuration has not been defined or is not available, restore all program jumpers to the factory configuration, as shown in Table 2-1 on page 36.
2. Apply power to the chassis backplane. Allow a minimum warm-up interval of ten minutes before proceeding.

3. Connect all input INP_XX_HIGH, INP_XX_LOW, and INP_XX_COMM pins together at P3 and P4. Refer to Figure Table 2-10 on page 54 or the pin assignments for these inputs.
4. Connect the digital voltmeter between the Channel 00 outputs pins at P5-A1(+) and P5-C1(-). The output should be within values listed in Table 2-6 below and Table 2-7 below.
5. All offset voltages should remain within the tolerances shown in Table 2-6 below.
6. Remove connections made in step 3.

Table 2-6 Offset Voltage Tolerances

Offset Voltage	
Gain	**Voltage**
x1000	±250 µV
x100	±300 µV
x10	±600 µV
x1	±3.5 mV

7. Apply a differential input voltage of 95% of Full-Scale Value (depending on selected gain) to the channel inputs. Connect the source positive (+) lead to the channel input high and the source negative (-) lead to the channel input low, see Table 2-10 on page 54 for pin assignments. Measure output, correct offset, and output value should be within maximum tolerance listed in Table 2-7 below.

Table 2-7 Maximum Gain Error

Gain Error	
Selected Gain	**Maximum Gain Error**
x1000	0.1%
x100	0.06%
x10	0.06%
x1	0.06%

8. Repeat Steps 5 and 6 for the remaining 31 channels. Refer to Table 2-10 on page 54 for the associated output pins.

BIT Verification

1. Connect the voltage source between pins A7 (+) and C7 (-) of the P2 connector. See Table 2-8 below and Figure 2-8 on page 51.
2. Connect pins A3 and A1 of P2 together.
3. Adjust the voltage source to +4.00000 VDC.
4. Connect the voltmeter positive test lead to the Channel 00 output pin at the P5 connector. Verify that the voltmeter indicates +4.000 ±0.001 mVDC.
5. Repeat step 4 for the remaining 31 channels.
6. Calibration is completed. Remove power from the board. Remove all test connections. Restore the calibrated board to the required operational configuration.

Table 2-8 P2 Connector User Pin Assignments

Pin Function	P2 Pin Number
CAL SPAN A	A3
CAL ZERO	A2
BIT RTN	A1
REF HIGH	A7
REF LOW	C7

Connector Description

Electrical connections to the VMIVME-3419 board are made through four DIN connectors P1, P2, P3 / P4, and P5, which have the pin configurations shown in Figure 2-8 on page 51. Connector ordering information is shown in Table 2-9 on page 52. P1 and P2 are 96-pin connectors which supply +5 VDC power to the board from the VMEbus backplane, and which provide mechanical support for the rear of the board. No other VMEbus backplane functions are implemented, with the exception of Built-in-Test functions of the P2 connector.

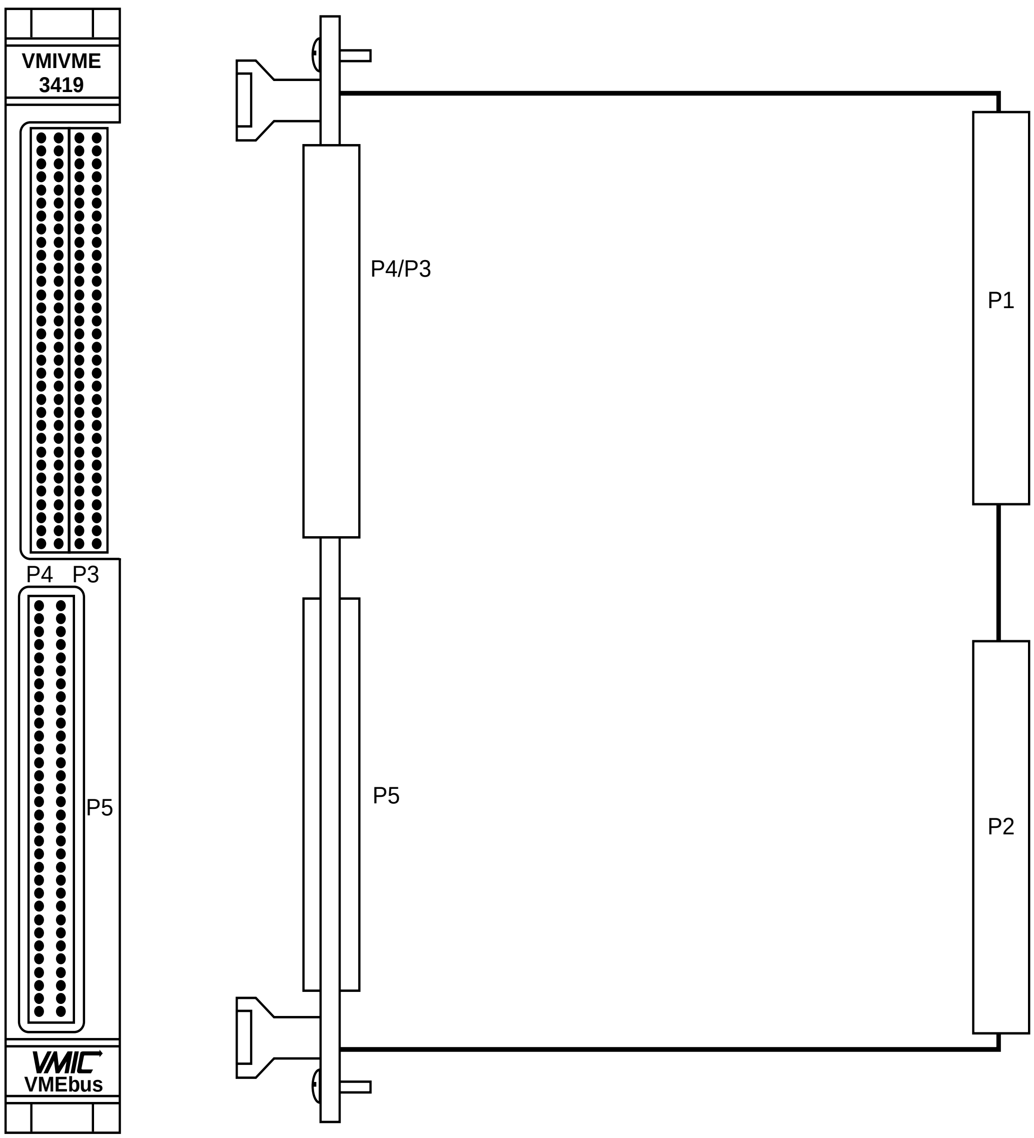


Figure 2-7 Connector Locations on the VMIVME-3419

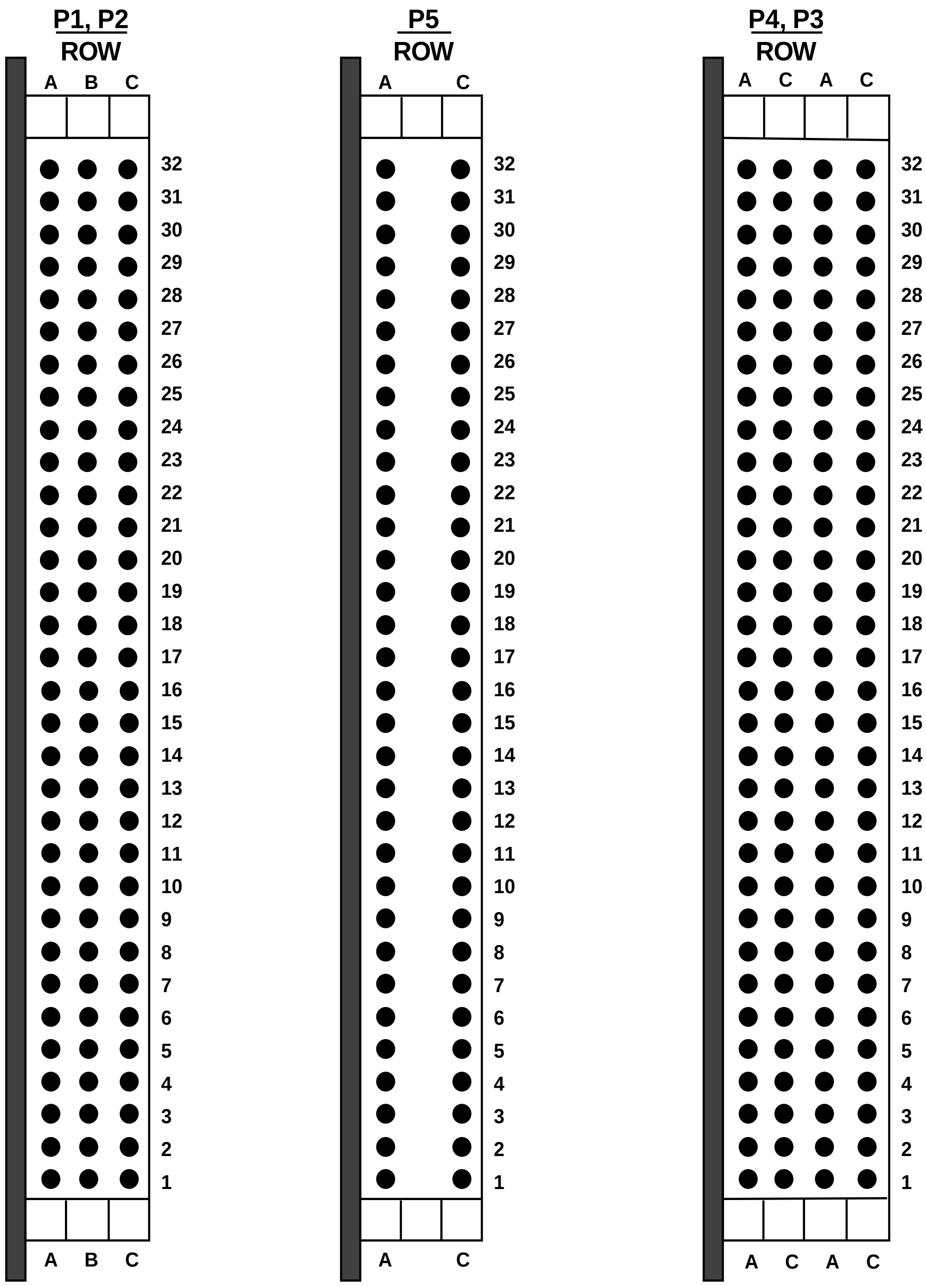


Figure 2-8 Connector Pin Configurations

Table 2-9 Connector Ordering Information

I/O Connector Data	Part Number	Recommended Manufacturer
P5		
PC Board Connector	120-964-1470	Panduit
Compatible Mating Connector	120-964-435	Panduit
Strain Relief Device	100-000-032	Panduit
P3/P4		
PC Board Connector with Strain Relief	3764-D302	3M
PC Board Connector without Strain Relief	3764-D202	3M
Compatible Mating Connector	7964-6500EC	3M
Strain Relief	3448-7964	3M

Analog Inputs

Analog inputs are connected to the board through front panel connectors P3 and P4. P4 contains the input pins for Channels 00 to 15, and P3 contains the input pins for Channels 16 to 31. Pin assignments for P3 and P4 are summarized in Table 2-10 on page 54. Refer to *Operational Configuration* on page 34 for the selection of input configurations.

P3 and P4 accept either mass-terminated, ribbon-cable connectors or discrete-wire cable connectors. If ribbon-cables are used, “varitwist” or equivalent twisted-pair cables are recommended to minimize crosstalk and induced noise. Discrete-wire cables should provide a twisted-shielded wire pair for each channel input.

Analog Outputs

P5 is a 64-pin connector which provides single-ended analog outputs for all 32 channels.

System Considerations

Applications with Scanning A/D Boards

A single 64-channel VMIVME-3113 or VMIVME-3122 scanning A/D board can accommodate the outputs from two VMIVME-3419 boards. In this configuration, each of the two 32-channel input connectors (P3, P4) on the A/D board is connected to the P5 output connector from one of the two VMIVME-3419 boards. The A/D board is operated in either the pseudo-differential mode or single-ended mode, and usually is configured for minimum (x1) gain. When filters are used, normally select the A/D board with a higher frequency filter than the VMIVME-3419 or none at all. The A/D board should also be jumpered for ±10 V input. It should also be noted, offset may be adjusted to zero with system calibration. Gain error is also adjustable to 0.01% with system calibration. Depending on system grounding requirements, A/D Converter inputs will be configured for either differential or pseudo-differential operation as discussed in the following sections.

Differential A/D Operation

Common-mode ground is established through the VMIVME-3419 board by installing the E39 jumper described in *Operational Configuration* on page 34. This configuration minimizes the effect of induced power-line interference in the interconnecting cable, but is susceptible to high-frequency digital noise in the backplane if the A/D and analog input boards are separated by a considerable distance or are located in different chassis.

Low-Level Applications

If inputs are obtained directly from low-level remote sources, the grounding scheme can have a major effect on system performance. Each system has its own unique interference considerations, but the following general guidelines will apply in most cases.

System Grounds:

Differential inputs are relatively immune to offset potentials between the various components of a system, but are only effective within a specific common mode range, usually ±11 V from their respective analog commons or grounds. If an input line exceeds this range, the corresponding channel will respond unpredictably.

Common mode problems can be avoided by providing a system ground which is connected to analog ground (AGND) at the chassis, and which interconnects all remote isolated grounds or commons. The system ground should not be used as a power return. A separate system ground connection is recommended for each VMIVME-3419 board.

Table 2-10 Input/Output Connector Pin Assignments

	P3, P4 Input Pins				P5 Output Pins	
CH No.	**INP High**	**INP Low**	**Excitation**	**INP COMM**	**Out High**	**Out Low**
00	P4-A1	P4-C1	P4-A2	P4-C2	P5-A1	P5-C1
01	P4-A3	P4-C3	P4-A4	P4-C4	P5-A2	P5-C2
02	P4-A5	P4-C5	P4-A6	P4-C6	P5-A3	P5-C3
03	P4-A7	P4-C7	P4-A8	P4-C8	P5-A4	P5-C4
04	P4-A9	P4-C9	P4-A10	P4-C10	P5-A5	P5-C5
05	P4-A11	P4-C11	P4-A12	P4-C12	P5-A6	P5-C6
06	P4-A13	P4-C13	P4-A14	P4-C14	P5-A7	P5-C7
07	P4-A15	P4-C15	P4-A16	P4-C16	P5-A8	P5-C8
08	P4-A17	P4-C17	P4-A18	P4-C18	P5-A9	P5-C9
09	P4-A19	P4-C19	P4-A20	P4-C20	P5-A10	P5-C10
10	P4-A21	P4-C21	P4-A22	P4-C22	P5-A11	P5-C11
11	P4-A23	P4-C23	P4-A24	See Note 4 P4-C24	P5-A12	P5-C12
12	P4-A25	P4-C25	P4-A26	See Note 1 P4-C26	P5-A13	P5-C13
13	P4-A27	P4-C27	P4-A28	See Note 1 P4-C28	P5-A14	P5-C14
14	P4-A29	P4-C29	P4-A30	See Note 2 P4-C30	P5-A15	P5-C15
15	P4-A31	P4-C31	P4-A32	See Note 3 P4-C32	P5-A16	P5-C16
16	P3-A1	P3-C1	P3-A2	P3-C2	P5-A17	P5-C17
17	P3-A3	P3-C3	P3-A4	P3-C4	P5-A18	P5-C18
18	P3-A5	P3-C5	P3-A6	P3-C6	P5-A19	P5-C19
19	P3-A7	P3-C7	P3-A8	P3-C8	P5-A20	P5-C20
20	P3-A9	P3-C9	P3-A10	P3-C10	P5-A21	P5-C21
21	P3-A11	P3-C11	P3-A12	P3-C12	P5-A22	P5-C22
22	P3-A13	P3-C13	P3-A14	P3-C14	P5-A23	P5-C23
23	P3-A15	P3-C15	P3-A16	P3-C16	P5-A24	P5-C24
24	P3-A17	P3-C17	P3-A18	P3-C18	P5-A25	P5-C25
25	P3-A19	P3-C19	P3-A20	P3-C20	P5-A26	P5-C26
26	P3-A21	P3-C21	P3-A22	P3-C22	P5-A27	P5-C27
27	P3-A23	P3-C23	P3-A24	P3-C24	P5-A28	P5-C28
28	P3-A25	P3-C25	P3-A26	P3-C26	P5-A29	P5-C29
29	P3-A27	P3-C27	P3-A28	P3-C28	P5-A30	P5-C30
30	P3-A29	P3-C29	P3-A30	P3-C30	P5-A31	P5-C31
31	P3-A31	P3-C31	P3-A32	P3-C32	P5-A32	P5-C32

NOTES:
1.Reserved.
2.Strain Gauge Excitation Positive Sense P4-C30.
3.Strain Gauge Excitation Negative Sense P4-C32.
4.Bridge Completion P4-C24.

Long Input Lines:

Long input lines (greater than 10 feet), or inputs from grounded sources (sources which are not floating), should be connected to differential inputs, and overall shields should be extended from the input sources to a point as close to the board as possible. Single-ended inputs are susceptible to ground loop errors, and should be used only with high-level floating sources.

Floating and Grounded Signal Sources:

The shield from a floating signal source (RTC, strain gauge, etc.) should be connected to the LOW (negative) terminal at the source. For low impedance sources (less than 10 Ω (+)) or for sources which are protected from interference fields, connect the board-end of the shield to analog return (AGND). For high impedance sources, connect all shield terminals of the sources together, and leave the shields disconnected at the board.

Outputs of grounded sources (sources which are not floating) must be referenced to a common ground which ensures that the input voltage will not exceed the active input voltage range of the board. Shields from grounded sources should be connected to the LOW terminal of the sources, and should be left disconnected at the board.

Source Impedance:

Use signal sources with the lowest available source impedances. Susceptibility to crosstalk and other interference increases as the source impedance increases.

Unused Inputs:

The grounding of unused inputs is not essential, but can assist in minimizing susceptibility to system noise, as well as preventing the instrumentation amplifiers from constantly being driven into saturation from the Open Sensor Detect circuit. Furthermore, it is recommended to use a gain of x1.

CHAPTER

3

Programming

Introduction

The VMIVME-3419 board has no control interface with the VMEbus, and does not require conventional programming. However, a Built-in-Test interface is provided at the P2 connector for direct interface to the VMIVME-4125 TESTCAL‰ System Calibration Board. The BIT interface includes two input control signals for selecting CAL_SPAN_A and CAL_ZERO, both of which have pull-up resistors for open-collector TTL inputs and a COMM signal BIT return. Two reference signals provide precision voltages: REF_HI and REF_LO. The Calibration Signal is used for verifying system integrity and system calibration / zeroing capability. The BIT section default is in direct input mode when power is applied.

Maintenance

Maintenance

This section provides information relative to the care and maintenance of VMIC's products. If the product malfunctions, verify the following:

- System power
- Software
- System configuration
- Electrical connections
- Jumper or configuration options
- Boards are fully inserted into their proper connector location
- Connector pins are clean and free from contamination
- No components of adjacent boards are disturbed when inserting or removing the board from the chassis
- Quality of cables and I/O connections

If products must be returned, contact VMIC for a Return Material Authorization (RMA) Number. **This RMA Number must be obtained prior to any return**.

Contact VMIC Customer Care at 1-800-240-7782, or
E-mail: customer.service@vmic.com

Maintenance Prints

User level repairs are not recommended. The drawings and tables in this manual are for reference purposes only.