VMIVME-3116
High Resolution Analog-to-Digital Converter Board

- 16-bit Resolution (Jumper Selectable to 15- or 14-bit Resolution)
- Autocalibration Option Controls Error to 1 LSB
- Up to 32 Single-Ended (Pseudo-Differential) or 16 Differential Front Panel Inputs
- 17 µs Conversion Time at 16 bits (10 µs Conversion Time with High-Speed Option)
- 15 µs Conversion Time at 14 bits (8.75 µs Conversion Time with High-Speed Option)
- 26 µs Analog Settling/Acquisition Time (15 µs with High-Speed Option)
- Short Cycle Feature Reduces Conversion Time by Converting Only 15 or 14 bits
- Provision for Interleaved Settling and Conversion Results in Maximum Throughout
- Overvoltage Protected Inputs
- Fail Safe with Power Off
- Full Scale Input Ranges: 0 to +5 V, 0 to +10 V, ±2.5 V, ±5 V, ±10 V
- Expandable to 1,056 Channels Utilizing VMIC Multiplexer Expansion Boards
- Supports Complete Product Line of VMIC Multiplexer Expansion Boards
- Compatible with VMIC's Analog Backplane (AMXbus™) for Multiplexer Expansion
- External Trigger Input Option
- On-Board Built-in-Test Logic Option and Precision Voltage References for Fault Detection
- Dedicated Multiplexer Input for Testing Analog Output Boards
- Front Panel Fail LED

SPECIFICATIONS

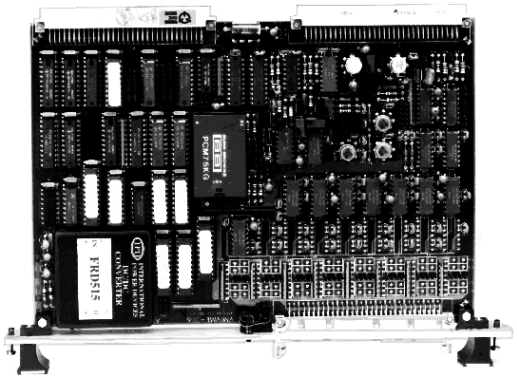
FUNCTIONAL CHARACTERISTICS

COMPLIANCE — This product complies with the VMEbus specification Rev. C. 1 with the following mnemonics: A16:D16, D08 (EO): 29, 2D: Slave 6U form factor.

BOARD ADDRESS — The address for the board is determined by board jumpers. This board can be plugged into any available slot (except slot 1) in the backplane.

CHANNEL SELECTION — Control and Status Register (CSR) bits D00 through D04 are used to select which of the 32 channels on the front panel connector is to be sampled in the normal mode. In the test mode, these same bits select which of several test voltages are to be sampled. In the external multiplexer sampling mode, the channel being sampled is determined by control data previously transmitted to an expansion multiplexer board (VMIVME-32XX Series or VMIVME-4500A). The five CSR bits have no effect in this mode.

When utilizing the external multiplexer mode, the ADC and up to 16 multiplexer boards share an Analog Multiplexer Bus (AMXbus™). The AMXbus™ backplane utilizes the user I/O pins on the P2 expansion bus and it is available in a variety of slot widths.



VMEbus ACCESS — Address modifier bits are decoded to support short nonprivileged I/O and/or short supervisory I/O access (jumper-selectable). The board is factory configured for short supervisory I/O access.

ORDERING INFORMATION

May 27, 1993 800-003116-000 E		A	B	C	-	D	E	F
VMIVME-3116	-				-			

A = Operational Options (1)
1 = Self-Test Standard and Autocalibration
3 = High-Speed Option, Self-Test Standard, and Autocalibration (2)

B = Filter Options
0 = No filter
1 = 6 Hz filter
2 = 9 Hz filter
3 = 36 Hz filter
4 = 300 Hz filter

C = Number of Channels
2 = 32 SE Channels (16 Differential Channels)

CONNECTOR DATA

Compatible Cable Connector	**Panduit No. 120-964-435E**
Strain Relief	**Panduit No. 100-000-032**
PC Board Header Connector	**Panduit No. 120-964-033A**

NOTES

Input voltage ranges are jumper-selectable (0 to +5, 0 to +10, ±2.5, ±5, or ±10 V); however, manual recalibration may be necessary unless autocalibration is used.
1. Autocalibration DACs (two 12-bit DACs) must be initialized under software control. Jumpers are provided to disable autocalibration and/or manual calibration.
2. The autocalibration feature of Option 3 works slightly different than the autocalibration feature of the other options; therefore, Option 3 boards may not be software compatible with the other options if the autocalibration feature is used.

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

DATA CONVERSION — Conversion is initiated under program control or upon receipt of an externally generated trigger pulse. Mode selection control is available to enable or disable the external trigger feature. A channel can be selected and conversion can be initiated by writing a single word.

MODE SELECTION — The operating modes of the board are selectable under program control. They are:

Select channel or test voltages
Enable on-board multiplexers
Initiate A/D conversion
Select single-ended or differential inputs via on-board multiplexers
Enable external start conversion trigger
Select board self-test
Controls Fail LED
Short settling/tracking time (typically 18 µs)
Board reset

TEST MODE — The board is designed with eight precision voltages which may be used for fault detection and isolation. Furthermore, each front panel input is monitored by an unbuffered self-test multiplexer. The self-test multiplexer provides a means of testing all inputs, and enables buffer amplifier offsets to be eliminated in software.

It also supports off-line and real-time fault detection and isolation of a wide variety of other VMIC products. For a thorough understanding of possible subsystem configurations, the reader should refer to the VMIC Analog I/O (AIO) Configuration Guide (Document No. 825-000000-005).

BOARD FAILURE — The front panel Fail LED is illuminated at power-up and is extinguished under program control after successful execution of user diagnostics.

DIGITAL DATA FORMAT — The 16-bit digital data format is jumper selectable as offset binary, straight binary, or two's complement, and can represent either a unipolar or bipolar range.

CHANNELS — Thirty-two single-ended input channels or 16 differential input channels are available as front panel inputs to this board. This board also supports VMIC's full line of external multiplexer boards which require the use of VMIC's Analog Multiplexer Bus (AMXbus™). The AMXbus™ backplane is installed in the same physical location as the P2 expansion bus.

SHORT CYCLE FEATURE — Jumpers are provided to set the conversion data width to 14, 15, or 16 bits. Conversions of 14 bits reduce the conversion time to 15 µs; 14-bit resolution conversion time is 8.75 µs with the high-speed option.

ELECTRICAL CHARACTERISTICS(1)

Resolution: 16-bit (jumper selectable to 14 or 15 bits)

Analog Input Ranges (Jumper Selected): 0 to +5 V, 0 to +10 V ±2.5 V, ±5 V, ±10 V

Conversion Time: 17 µs (10 µs with high-speed option)

Analog Acquisition Time: 26 µs (15 µs with high-speed option)

Monotonicity: Monotonic over full operating temperature range

Common-Mode Range: ±11 V (maximum)

Common-Mode Rejection: 70 dB

Accuracy: 0.007 percent ±0.5 mV of FSR(2) with input filters installed.
0.007 percent of FSR(2) with no input filters installed.
0.005 percent with autocalibration over full temperature range.

Input Impedance: 10 MΩ (minimum)

Input Offset Voltage: 2 mV (maximum - before manual or autocalibration)
4 mV with autocalibration

Differential Nonlinearity: No missing codes at 14 bits, over full temperature range

Precision Test Voltages: 0.0000 V, ±9.9929 V, ±4.9964 V, ±2.4982 V

Temperature Coefficient for Positive Test Voltages (+2.4982, +4.9964, +7.9929): 1.5 PPM/° C

Temperature Coefficient for Negative Test Voltages (-2.4982, -4.9964, -9.9929): 2.5 PPM/° C

Input Overvoltage Protection: ±40 V (maximum) (Note 4)

Optional Single Pole Analog Input Filter(3): -3 dB @ 6 Hz, 9 Hz, or 36 Hz

Power Requirements: +5 V @ 2 A (maximum)

PHYSICAL/ENVIRONMENTAL SPECIFICATIONS

Dimensions: Standard VME double width board (160 mm x 233.5 mm)

VMEbus Connector: Two 96-pin DIN connectors. VMIC utilizes the user I/O pins on the P2 connector to support an AMXbus™. A variety of AMXbus™ backplanes are available from VMIC.

Analog Input Connector (32 SE/16 D Analog Inputs): Board connector (P3) - Panduit male connector type 120-964-455E
Input cable connector female type 120-964-053A

Temperature: 0 to +55 °C, operating
-20 to +85 °C, storage

Humidity: 20 to 80 percent relative, noncondensing

1 At 25 °C, unless specified otherwise.

2 FSR means Full Scale Range and is equal to 20 V for a ±10 V range.

3 Contact VMIC for special filter requirements.

4 Power applied.

APPLICATION AND CONFIGURATION GUIDES — The following Application and Configuration Guides are available from VMIC to assist the user in the selection, specification, and implementation of systems based on VMIC's products.

Title	Document No.
Analog I/O Products (with Built-in-Test) Configuration Guide	825-000000-005
Connector and I/O Cable Application Guide	825-000000-006

FUNCTIONAL DESCRIPTION

INTRODUCTION — The VMIVME-3116 Board is a 32-channel, high resolution, Analog-to-Digital Converter (ADC) board that is designed with the unique features of Built-in-Test (BIT) and autocalibration (refer to Figure 1). The Built-in-Test hardware is designed with on-board precision voltages (refer to Figure 2) which may be read for fault detection and isolation. A front panel Fail LED is provided that is automatically illuminated at power-up or upon system reset, and may be extinguished upon successful completion of board level diagnostics. The BIT concept supports off-line and real-time fault detection and isolation.

Each front panel input is monitored by an unbuffered self-test multiplexer. The self-test multiplexer provides a means of testing all inputs, and enables buffer amplifier offsets to be eliminated in software.

Additional Built-in-Test features are provided to support fault detection and isolation of other VMIC products. The reader should refer to VMIC's Document No. 800-000000-005 for additional information on analog Built-in-Test subsystem configurations.

The autocalibration feature compensates for zero and gain errors. This feature allows the user at any time to read zero and gain errors and null them under software control.

This product may be manufactured with a variety of options as selected by the user. Options are shown in the Ordering Information. A wide variety of filter options are available and the board may be ordered with 16 single-ended/8 differential channels at a reduced cost. The board is designed to support up to 32 single-ended/16 differential input channels at full scale range of 0 to +5 V, 0 to +10 V, ±2.5 V, ±5 V, and ±10 V by user-selectable jumper options.

Acquisition and conversion time combined (excluding expansion multiplexers) is approximately 43 µs maximum, giving a maximum throughput rate of approximately 23 kHz with noninterleaved operation. A maximum throughput rate of 50 kHz can be achieved by utilizing the interleaved settling/conversion and short settling features. Output coding is straight binary, offset binary, or two's complement.

This product also supports VMIC's expansion multiplexer product line which is based on an AMXbus™. The AMXbus™ backplane is installed in the same physical location as the P2 VME expansion backplane. Several subsystem configurations using the AMXbus™ analog multiplexers, and/or analog output boards are shown in Figures 3, 4, and 5.

SYSTEM THROUGHPUT USING MULTIPLEXER EXPANSION BOARDS — The VMIVME-3116 supports a wide variety of multiplexer expansion boards which affect the total system throughput. The total system throughput (Fs) may be calculated using the formula shown below:

$$Fs = \frac{1}{N\,(T_1 + T_2 + T_3)}$$ Samples per second, where

N is the number of channels.
T_1 is the remote multiplexer settling time.
T_2 is the 3116 amplifier settling time.
T_3 is the 3116 A/D conversion time.

T_1 is a variable that is provided on each multiplexer expansion board data sheet. The VMIVME-3116 also supports interleaved (pipelined) measurement, in which T_2 is reduced to produce maximum throughput.

A wide variety of multiplexer expansion boards are supported by the VMIVME-3116 ADC Board. An AMXbus™ is available as a standard product to support the low cost expansion concept. A list of multiplexer expansion products is provided in Table 1.

Table 1. Multiplexer Expansion Products

Model No. (VMIVME-)	Description	Availability
3200A	32SE/16 D MUX with Built-in-Test	Now
3210	64 SE/32 D MUX with Current Sense Option	Now
3232	32-Channel LVDT Demodulator/Multiplexer Board	Now
4500A	16 SE MUX with 16 Analog Outputs	Now
A05	5-Slot P2 Analog Backplane	Now
A09	9-Slot P2 Analog Backplane	Now
A19	19-Slot P2 Analog Backplane	Now

BUILT-IN-TEST — The VMIVME-3116 Board supports a wide variety of VMIC's analog I/O products that are designed to support fault detection and isolation to the board level. The VMIVME-3116 employs an internal precision voltage generator (self-test standards) to support testing the VMIVME-3116 as a stand-alone board. The VMIVME-3116 also contains a dedicated input test multiplexer that supports loopback testing of a variety of VMIC's analog output boards. A summary of VMIC's analog output boards with this feature is shown in Table 2.

In addition, the VMIVME-3116 supports the Built-in-Test concept of the VMIVME-3200A multiplexer. The reader should refer to VMIC's Analog I/O Products (with Built-in-Test) Configuration Guide (Document No. 800-000000-005) for a thorough understanding of possible subsystem configurations using VMIC's Built-in-Test concepts.

Table 2. Analog Output Products with Built-in-Test

Model No. (VMIVME-)	Description	Availability
4100	16-Channel, 12-bit D/A	Now
4116	8-Channel, 16-bit D/A	Now
4105	8-Channel, 12-bit Multiplying	Now
4500A	12-bit D/A, Dual Port Memory, 16 S&H Outputs and 16 SE Multiplexer Analog Inputs	Now

INTERFACING TO VMIC's 3V/5V SERIES SIGNAL CONDITIONERS — The 3V/5V Series modular signal conditioners convert a wide variety of low-level voltages, thermocouples, RTDs, etc., to high-level voltages. In addition, many of the modules provide up to ±1500 Vrms continuous isolation. Up to 16 of these modules may be installed in a signal conditioning backplane with an optional 19-inch rack mount kit. The high-level outputs are routed to a 26-pin connector, from which a ribbon-cable connects the signal conditioning backplane to the front panel of the VMIVME-3116 ADC Board.

The 3V/5V Series signal conditioning subsystem, in conjunction with the VMIVME-3116 ADC Board, provides a complete solution enabling almost any type of sensor data to be available to the VMEbus. The following input modules are available: low-level (mV), AC, thermocouple, RTD, current, frequency, strain gage, LVDT, and high-level (V) inputs.

TRADEMARKS

AMXbus is a trademark of VME Microsystems International Corporation. The VMIC logo is a registered trademark of VME Microsystems International Corporation. Other registered trademarks are the property of their respective owners.

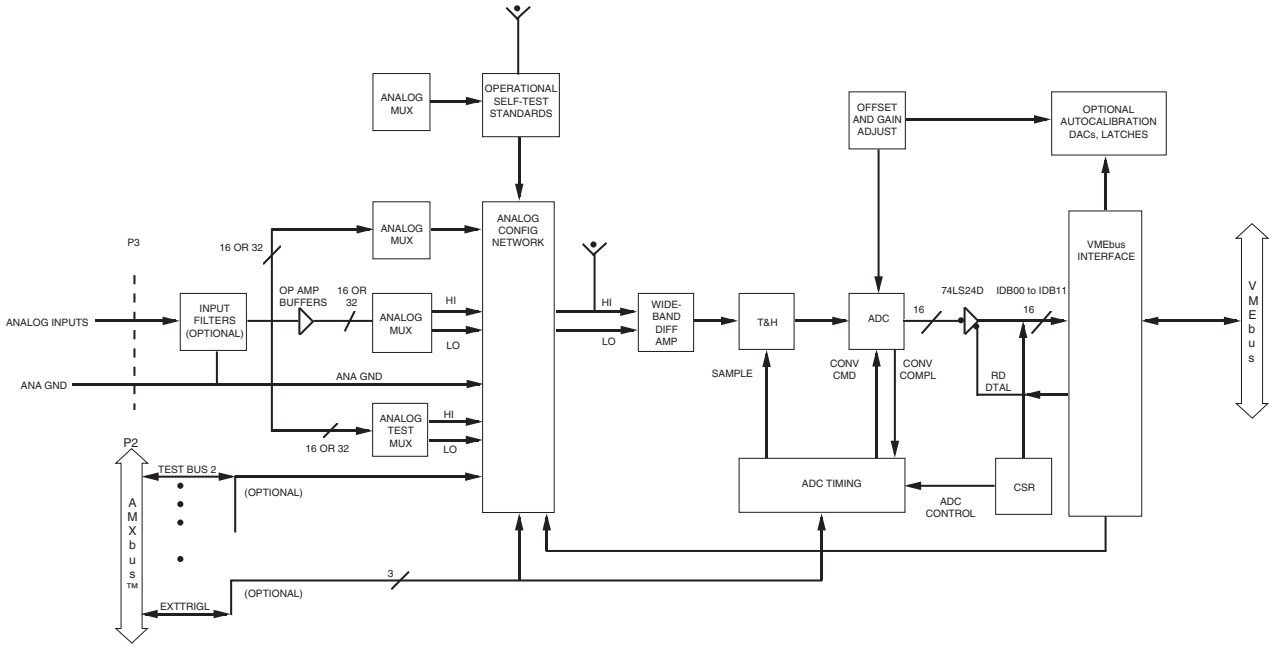


Figure 1. VMIVME-3116 Functional Block Diagram

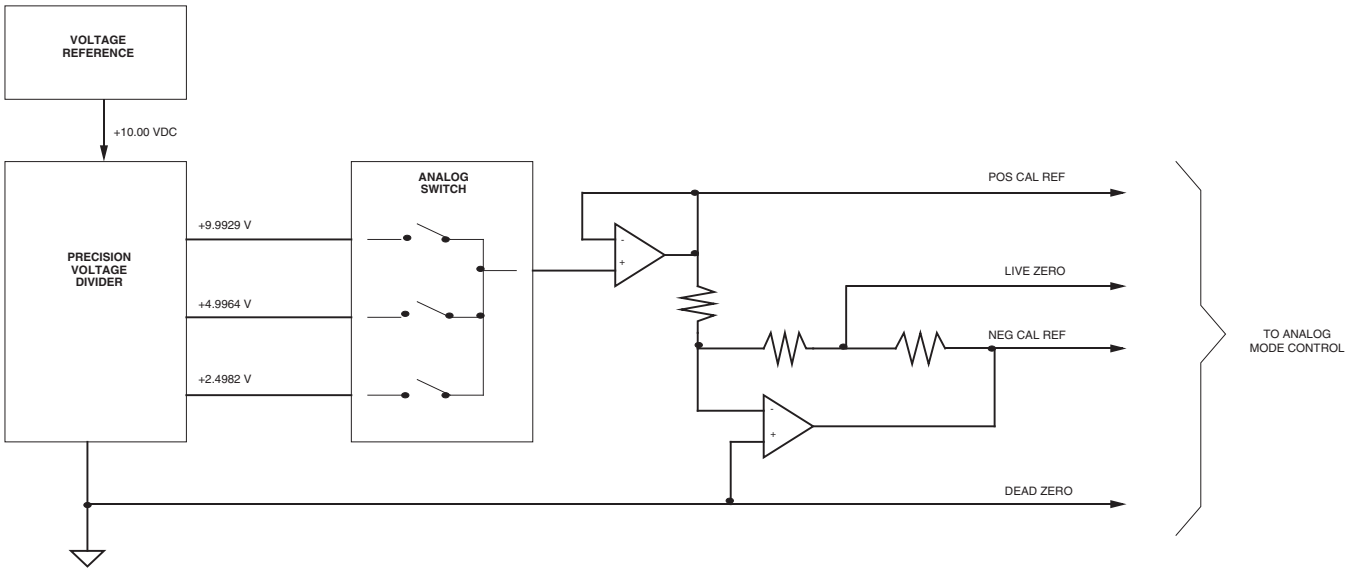


Figure 2. VMIVME-3116 Self-Test Standards Network

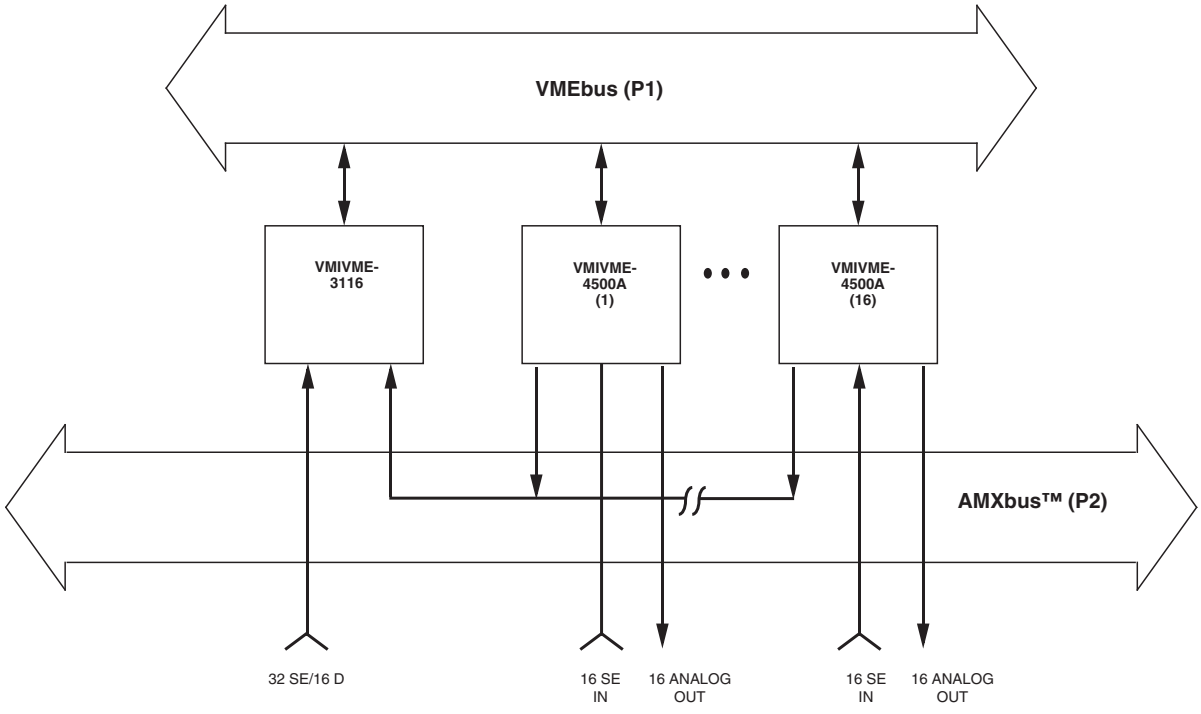
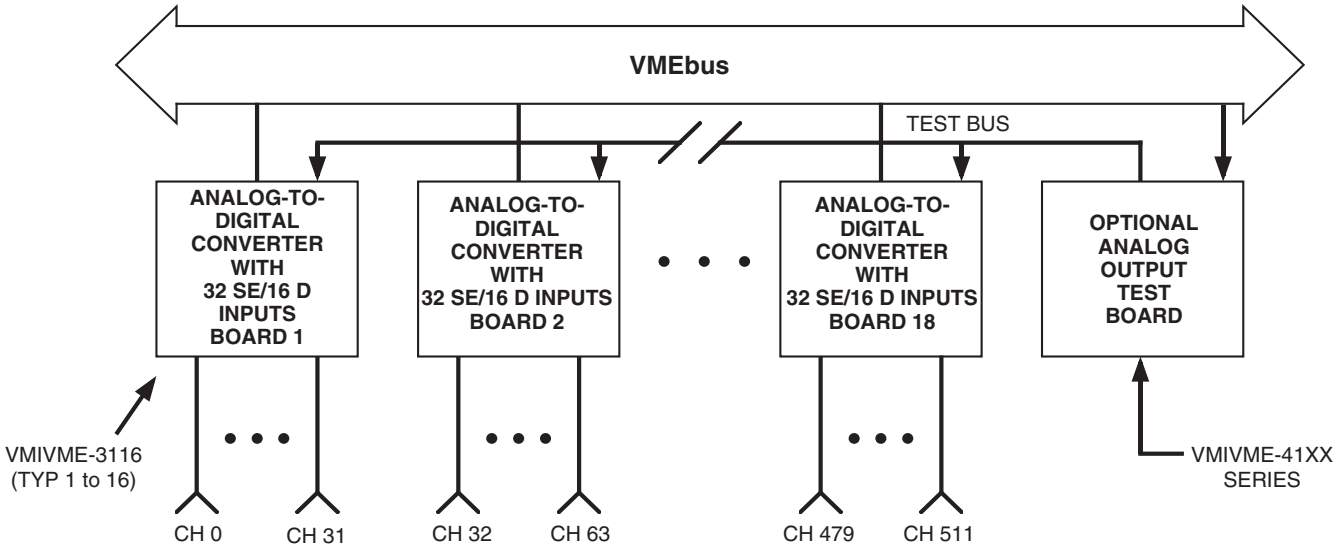


Figure 3. Typical Low Cost AIO Subsystems with Built-in-Test



NOTE: Utilizing an ADC per 32 SE channels provides up to 450,000 samples/s and 512 analog input channels. The high conversion rate is obtained by starting conversion on all 18 boards sequentially, followed by reading converted data sequentially (CH 0 Bd No. 1, CH 32 Bd No. 2, etc.)

Figure 4. VMIVME-3116 High Performance Analog-to-Digital Subsystem with Built-in-Test

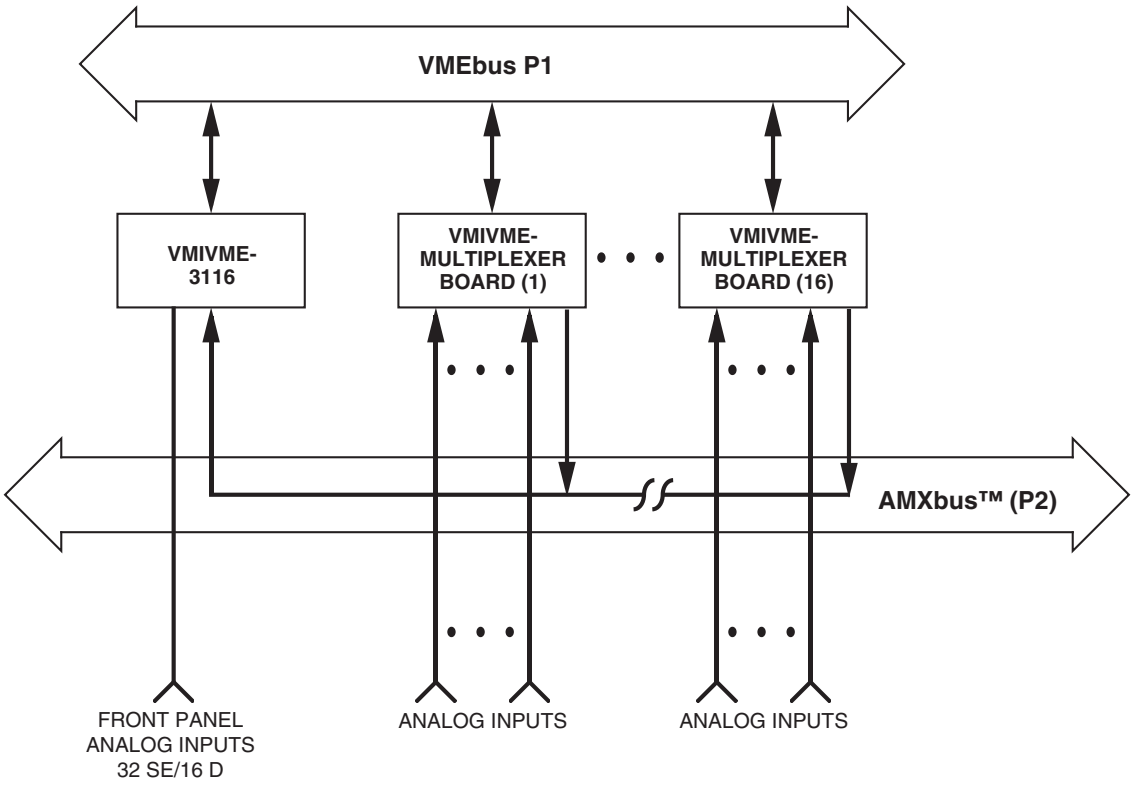


Figure 5. VMIVME-3116 Typical Configuration with Multiplexer Expansion