VMIVME-4116
8-Channel 16-bit Resolution
Analog Output Board

- 8 channels
- 16-bit DACs
- Fast settling: 10 µs maximum to ±0.003 percent of FSR
- Buffered voltage output (±10 V at 5 mA)
- Multiplexed programmable outputs on P2 connector for testing analog outputs
- Double-buffered data latches
- Jumper-selectable synchronized update control
- Selectable external update control input or software-controlled strobe provides single update strobe for all DAC outputs
- Front panel fail LED
- High reliability DIN-type output connector
- Outputs set to 0.0 V on power up
  — Outputs are automatically disconnected from the field at power up
- Double Eurocard form factor
- Supports VMIC’s analog expansion and Built-in-Test bus (AMXbus™) that interconnects the P2 connectors of various VMIC ADC and DAC boards and expansion multiplexer boards
- Multiplexed programmable outputs for testing analog input multiplexer boards
  — Requires VMIC ADC board and AMXbus for Built-In-Test

INTRODUCTION — The VMIVME-4116 Digital-to-Analog Converter (DAC) Board performs digital-to-analog conversion on 16-bit positive true offset binary or two’s complement coded words, with an analog output range of -10 to +10 V. This provides for a resolution of 305 µV for each digital input of 1 LSB change. The buffered output voltage settles to within 1/2 LSB in 10 µs.

The DAC offers a Digital-to-Analog Integrated Circuit (IC) per channel. A Control and Status Register (CSR) is loaded by the processor and this register controls the functioning of the board. The CSR can be read by the processor at any time. The VMIVME-4116 board functional block diagram is shown in Figure 1. Each of the eight DACs is preceded by double-buffered data latches. The data latches allow versatility in the way the DAC analog output may be updated.

There are three methods by which new data can be converted by a DAC. Each method is enabled/disabled by on-board jumpers and is further controlled by a CSR that must be loaded by the user.

FUNCTIONAL CHARACTERISTICS

Compatibility: The VMIVME-4116 Analog Output Board is a standard, double height, printed circuit board which is compatible with the VMEbus specification.

Board Address: The physical address for the board is selected by 12 DIP switches. VMIC bus address lines A05 through A15 are decoded for board selection.
**Mode Selection:** The operational modes of the board are selected by setting the following control bits during a write cycle to the Control and Status Register (CSR). The CSR may be read at any time to verify the current operating mode. The function of each bit in the CSR is defined as follows.

- **D08** — Enables DAC outputs to the P3 connector
- **D09** — Initiates digital-to-analog conversion
- **D10** — Not used
- **D11 to D13** — Test mode control bits
- **D14** — Operates Fail LED
- **D15** — Not used

**Test Mode:** The DAC board may be used in conjunction with other VMIC boards and VMIC’s AMXbus backplane for extensive fault detection and isolation. There are two dedicated analog signal lines that are used by the DAC board. Loopback tests may be executed primarily for testing the Analog-to-Digital Converter (ADC) board by utilizing any one of the eight DAC outputs.

While in a test mode, the eight DAC outputs may be isolated from the P3 output connector so that user-connected devices are not affected by testing. Also, the testing may be performed in conjunction with real-time control of the user-connected devices, providing real-time fault detection capabilities.

**Analog Input Test Mode:** Any one of the eight analog outputs may be multiplexed to an analog test bus (Test Bus 1). This analog bus is used to verify the operation of the analog input multiplexer expansion board that supports Built-in-Test. VMIC’s AMXbus supports the analog Built-in-Test concepts.

**Analog Output Testing:** Any one of the eight analog outputs may be switched to the analog output test bus (Test Bus 2). This bus is routed over the P2 AMXbus analog backplane to a VMIC ADC which verifies the analog output of each of the eight DACs on the VMIVME-4116 board.

**System Reset:** Application of the system reset signal via the VMEbus initializes the board into a state with all analog outputs disconnected from the P3 connector if either the JFET switch or output isolation relay options are installed. If no output isolation switches or relays are installed (see the Ordering Options), then system reset initializes all analog outputs to the P3 connector to 0.0 V. The analog test bus outputs are disconnected from the P2 connector upon system reset.

**Front Panel Fail LED:** If an error condition is detected during the diagnostics, a front panel Fail LED may be illuminated under software control for a visual failure indication. The LED is illuminated upon power up clear (system reset) and is extinguished upon successful diagnostic execution.

**Analog Output Channels:** Eight analog output channels

The analog output equation for offset binary bipolar operation:

\[-10 \text{ V to } +10 \text{ V} \text{ at } 5 \text{ mA}\]

\[ V_{\text{OUT}} = -10 \text{ V} + \frac{(\text{Digital Code } \times 20)}{65536} \]

**ELECTRICAL CHARACTERISTICS**

**Data Transfer:** A16/D8, D16

**Analog Output (Voltage output at } R_{\text{LOAD}} = 2 \text{ k}\Omega)\):**

- **Bipolar:** -10 to +10 V at 5 mA

**Output Impedance:**

- Standard model — 0.15 \Omega
- Optional output isolation switches (JFET switch) — 100 \Omega
- Optional output isolation relays — 0.2 \Omega

**D/A Input Code:**

- **Bipolar:** Offset binary, two’s complement binary

**Resolution:** 16 bits

**Accuracy (Typical at 25 °C)*:**

- **Gain Error:** Adjusted to ±1/2 LSB
- **Offset:**
  - **Bipolar:** Adjusted to ±1/2 LSB
- **Differential Linearity Error:** ±0.003 percent of FSR (Full-Scale Range)
- **Linearity Error:** ±0.0015 percent of FSR

**Drift (Typical Unless Otherwise Stated):**

- **Gain Drift:** ±10 PPM/°C
- **Zero Drift:** ±5 PPM of FSR/°C
Differential Linearity Over Temperature: +0.009 to -0.006 percent of FSR (maximum)

Linearity Error Over Temperature: ±0.006 percent of FSR (maximum)

**Settling Time:** 10 µs to ±1/2 LSB

**Monotonicity:** 14 bits monotonic over full temperature range

**Power Requirements:** 2.5 A (maximum) at +5 V

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### PHYSICAL/ENVIRONMENTAL

- **Temperature:** 0 to +50 °C, operating
  -20 to +85 °C, storage

- **Humidity:** 20 to 80 percent relative, noncondensing

- **Altitude:** Operation to 10,000 ft

- **Cooling:** Forced air convection

- **Dimensions:** Double height Eurocard (6U) 160 x 233.35 mm

- **VMEbus Connector:** Two 96-pin DIN connectors. VMIC utilizes the user I/O pins on the P2 connector to support an analog bus (AMXbus). A variety of AMXbus backplanes are available from VMIC as standard products.

- **Output Connector:** Board connector (P3) — Panduit male connector type 120-332-033A
  - Output cable connector — female type 120-332-435E
  - Output connector strain relief 100-000-042

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### TRADemarks

AMXbus is a trademark of and the VMIC logo is a registered trademark of VMIC. Other registered trademarks are the property of their respective owners.

*Accuracy stated without analog output isolation switches installed. The Built-in-Test hardware features analog output isolation switches for all eight channels that can be turned ON/OFF by software commands. These switches are in a series with the analog output and the user-connected device at the P3 connector. These switches have an ON resistance of approximately 100 Ω (maximum). If the user-connected load does not have a high impedance input, then a possible voltage division error is introduced. For example, if R(LOAD) is 10 kΩ, then a 1 percent error is introduced. R(LOAD) should be 10 MΩ or greater for an error of 0.001 percent or less.

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### 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 in VMIC’s products.

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The AMXbus backplane may be replaced with a standard P2 VME expansion bus and user-supplied jumper wires on the user I/O pins. The VMIC AMXbus backplane is available in printed circuit form in 5, 9, or 19 slots. The AMXbus backplane is designed to provide enhanced noise immunity and is recommended for most applications.

Figure 1. VMIVME-4116 Board Functional Block Diagram

Figure 2. Model 41xx Series Built-in-Test Configuration