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VMIVME-4101

16-CHANNEL 12-BIT D/A CONVERTER BOARD WITH 10 mA OUTPUTS

INSTRUCTION MANUAL

DOCUMENT NO. 500-004101-000

Revised June 18, 1992

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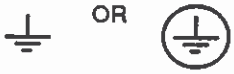
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Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts are so marked).



Protective conductor terminal. For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal which must be connected to ground before operating equipment.



Low-noise or noiseless, clean ground (earth) terminal. Used for a signal common, as well as providing protection against electrical shock in case of a fault. Before operating the equipment, terminal marked with this symbol must be connected to ground in the manner described in the installation (operation) manual.



Frame or chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.



Alternating current (power line).



Direct current (power line).



Alternating or direct current (power line).

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The NOTE sign denotes important information. It calls attention to procedure, practice, condition or the like, which is essential to highlight.

VMIVME-4101
16-CHANNEL 12-BIT D/A CONVERTER BOARD

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SECTION 1

VMIVME-4101
16-CHANNEL 12-BIT D/A CONVERTER BOARD

1.1 INTRODUCTION

The VMIVME-4101 is a 16-Channel 12-Bit D/A Converter Board, hereinafter referred to as the DAC Board. It can deliver up to 10 mA @ ±10 V per output. The board uses positive true offset binary data. The DAC Board provides double buffered data latches, buffered voltage outputs, and selectable external or internal update control strobes. The DAC Board is shown in Figure 1.1-1.

This document will primarily describe the operation of the DAC Board, but some details of the VMIVME-3100 (12-Bit A/D Converter Board) and the VMIVME-3200 (32-Channel Multiplexer Board) will be included for clarity. It is also intended to give the user a better understanding of the test capabilities of a data acquisition system using the DAC Board in conjunction with the VMIC Multiplexer Expander Board, (VMIVME-3200) and the A/D Converter Board, (VMIVME-3100).

For a thorough understanding of loopback test capabilities, the reader should have access to the following documents:

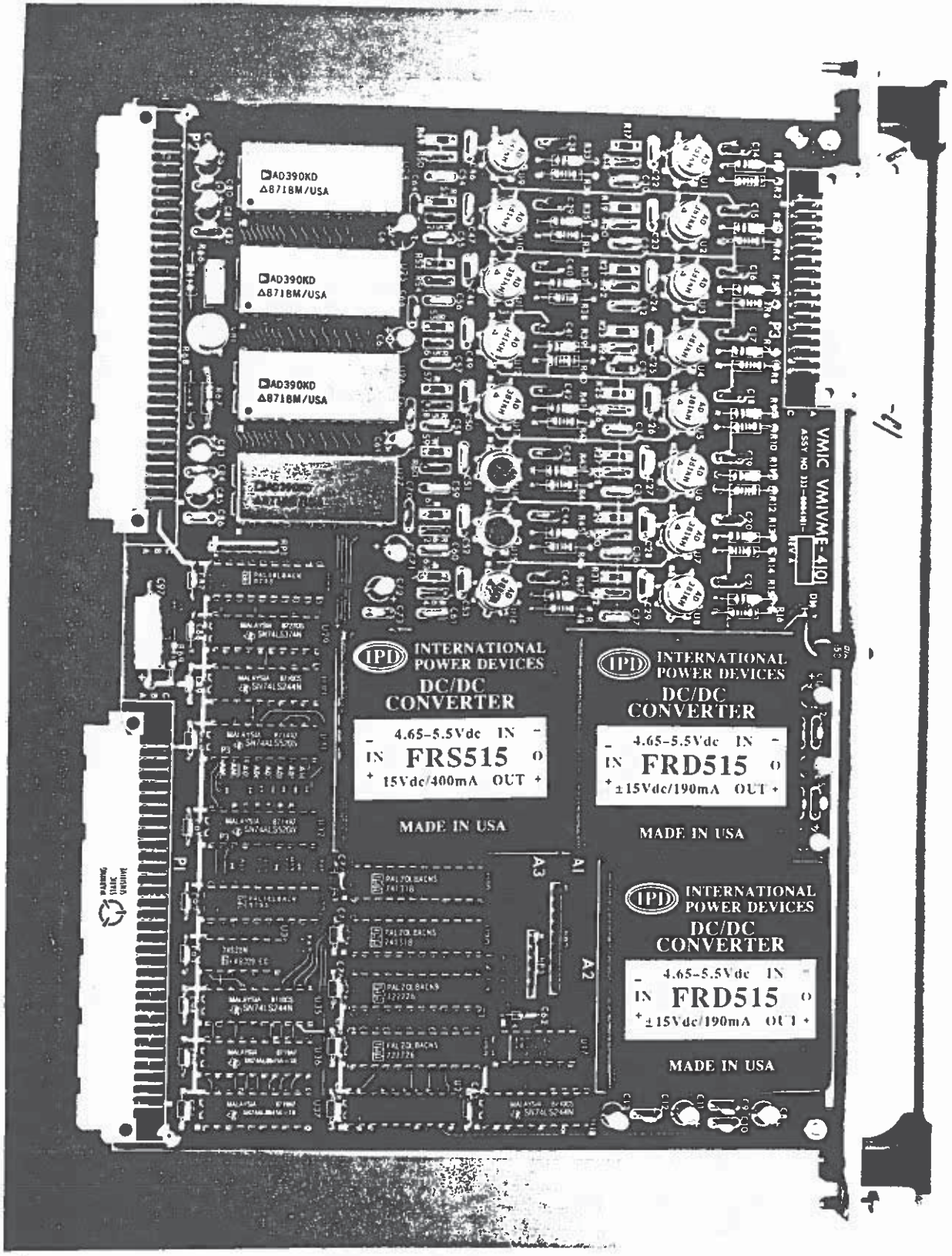
a. VMIVME-3200 32-Channel Analog
   Input Instruction Manual
   Document No. 500-003200-000

b. VMIVME-3100 12-Bit A/D Converter
   Board Instruction Manual
   Document No. 500-003100-000

1.2 VMIVME-4101 12-BIT D/A CONVERTER BOARD BRIEF OVERVIEW

The primary features of the VMIVME-4101 DAC Board are as follows:

a. Buffered voltage outputs
b. Double buffered data latches
c. 16 channels per board
d. 12-bit DACs
e. High reliability DIN type 96-pin I/O connectors
f. Individually keyed VME connector design
g. Double height Eurocard (6U) form factor
h. 12-bit positive true offset binary data



M4101/F1.1-1

Figure 1.1-1. 16-Channel D/A Converter Board

i. All 16 DAC outputs can be updated by one of the following three user-selectable methods:

   (1) Each DAC can be immediately updated when new data is written to the DAC's address.

   (2) Any DAC may be loaded with new data and converted at a later time by the user, under program control.

   (3) Any DAC that has been previously loaded with new data may be updated by an external TTL compatible device.

j. 10 mA output drive current
k. 4101-16-option: jumper-selectable for ±5 or ±10 V output
l. 4101-17-option: jumper-selectable for 0 to +5 V or 0 to +10 V output
m. Single +5 V supply operation
n. Factory trimmed gain and offset requires no calibration

1.3 REFERENCE MATERIAL

The reader should refer to "The VMEbus Specification" for a detailed explanation of the VMEbus. "The VMEbus Specification" is available from the following source:

VITA
VMEbus International Trade Association
10229 N. Scottsdale Road
Scottsdale, AZ 85253
(602) 951-8866

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.
Digital Input Board Application Guide	825-000000-000
Low Level Analog I/O Configuration Guide	825-000000-001
Change-of-State Application Guide	825-000000-002
Digital I/O (with Built-in-Test) Product Line Description	825-000000-003
Synchro/Resolver (Built-in-Test) Subsystem Configuration Guide	825-000000-004
Analog I/O Products (with Built-in-Test) Configuration Guide	825-000000-005
Connector and I/O Cable Application Guide	825-000000-006

SECTION 2

PHYSICAL DESCRIPTION AND SPECIFICATIONS

REFER TO 800-004101-000 SPECIFICATION

SECTION 3

THEORY OF OPERATION

3.1 INTRODUCTION

The DAC Board performs digital-to-analog conversions on 12-bit positive true offset binary coded input data words. It has a maximum analog output range of -10 to +10 V. This provides a resolution of 4.88 mV for each digital input of 1 LSB change. The buffered output voltage settles to within 1/2 LSB in 10 µs (maximum). Each output is capable of driving 10 mA.

The VMIVME-4101 offers high channel density by using four quad 12-bit D/A converters. 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 D/A board block diagram is shown in Figure 3.1-1, and the four quad DACs are represented in Figure 3.1-2.

Each of the 16 DACs is preceded by double buffered data latches. The data latches allow versatility in the way that DAC analog outputs 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 the control register. This register must be loaded by the user. The control register contents are described in Section 4, Tables 4.2.1-2 and 4.4-1.

3.2 IMMEDIATE DAC UPDATE MODE

The processor unit sends the 12-bit word to be converted to the first register of the selected DAC. If that DAC channel has previously been jumpered to do so, it will automatically pass the contents of the first DAC register into the second register and update the analog output. There are four jumpers that enables or disables update modes. Each jumper controls four DAC channels, and selects either the immediate or the delayed update mode, as described below. The jumper definitions and locations are described in Section 5.7.

3.3 DELAYED DAC UPDATE MODE

In the delayed DAC update mode, the processor sends the 12-bit word to be converted to the first DAC register of the selected DAC. The data is stored there and transferred to the second DAC register in one of two possible methods as described in Sections 3.3.1 and 3.3.2.

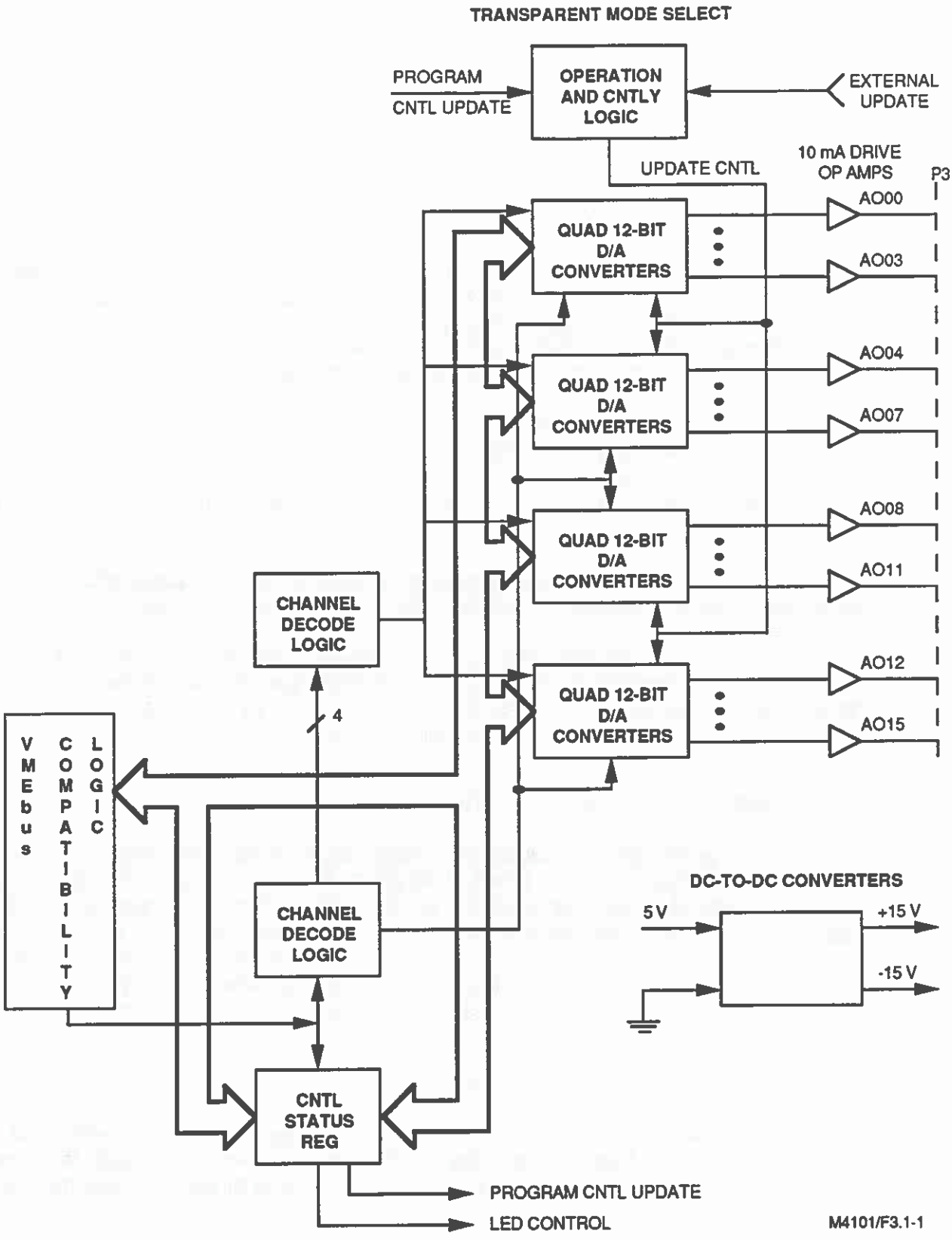


Figure 3.1-1. VMIVME-4101 Board

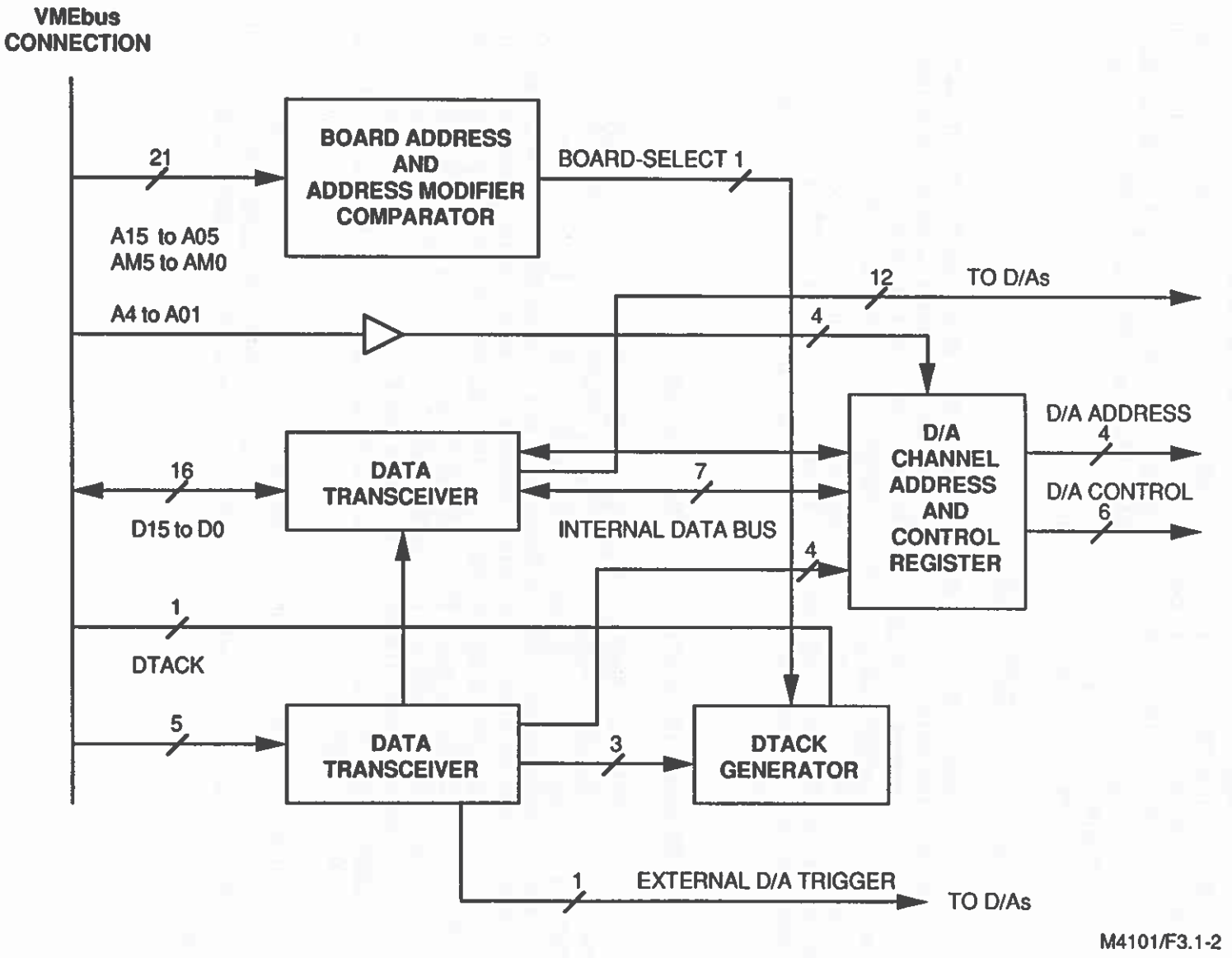


Figure 3.1-2. VMEbus Interface Logic and Interface Signals

3.3.1 Program Control Update

One way for a delayed transfer to occur is by writing a specified control bit to the control register. When the data is transferred to the second register, digital-to-analog conversion begins and the analog output settles to within 1/2 LSB in 8 µs. This method of updating the analog output under program control is useful when more than one DAC channel output is desired to change at a precise time. All 16 DAC outputs could be synchronized to change at certain periodic intervals under software control.

3.3.2 External Trigger Update

The second method of delayed transfers is to update the second storage register, and therefore the DAC output, by an external TTL compatible trigger. This trigger must first be enabled by the external trigger circuitry. This is done by installing an on-board jumper, as described in Section 5.8. When the external trigger is received (an active LOW signal for a minimum of 150 ns) the value stored in the first DAC register will be transferred to the second DAC register which begins a conversion. This way, all conversions can be synchronized to an external device.

3.4 VMEbus INTERFACE DESCRIPTION

The VMEbus interface (Figure 3.1-2) contains the necessary logic to interface the board (VMIVME-4101) to the VMEbus. The VMIVME-4101 is memory mapped in the VMEbus short I/O address space. During a write cycle to the board, address bits A05 through A15 are compared with the previously selected board address. The board address is selected by jumpers. If the addresses match, then a board-select signal is issued. This signal, along with the VMEbus control signals guide the data (D0 through D15) to a selected DAC or to the CSR on the VMIVME-4101. Address bits A01 through A04 select one of the 16 DAC channels when D15 is a LOW. Data bits D0 through D11 are latched into the selected DAC register. When D15 is a HIGH, data bits D08 through D14 are latched into the CSR.

The VMIVME-4101 circuitry requires +5, +15, and -15 V. The +5 V is supplied to the board via the P1 and P2 connectors. An on-board DC-to-DC converter generates the +15 and -15 V for the analog circuitry as shown in Figure 3.4-1.

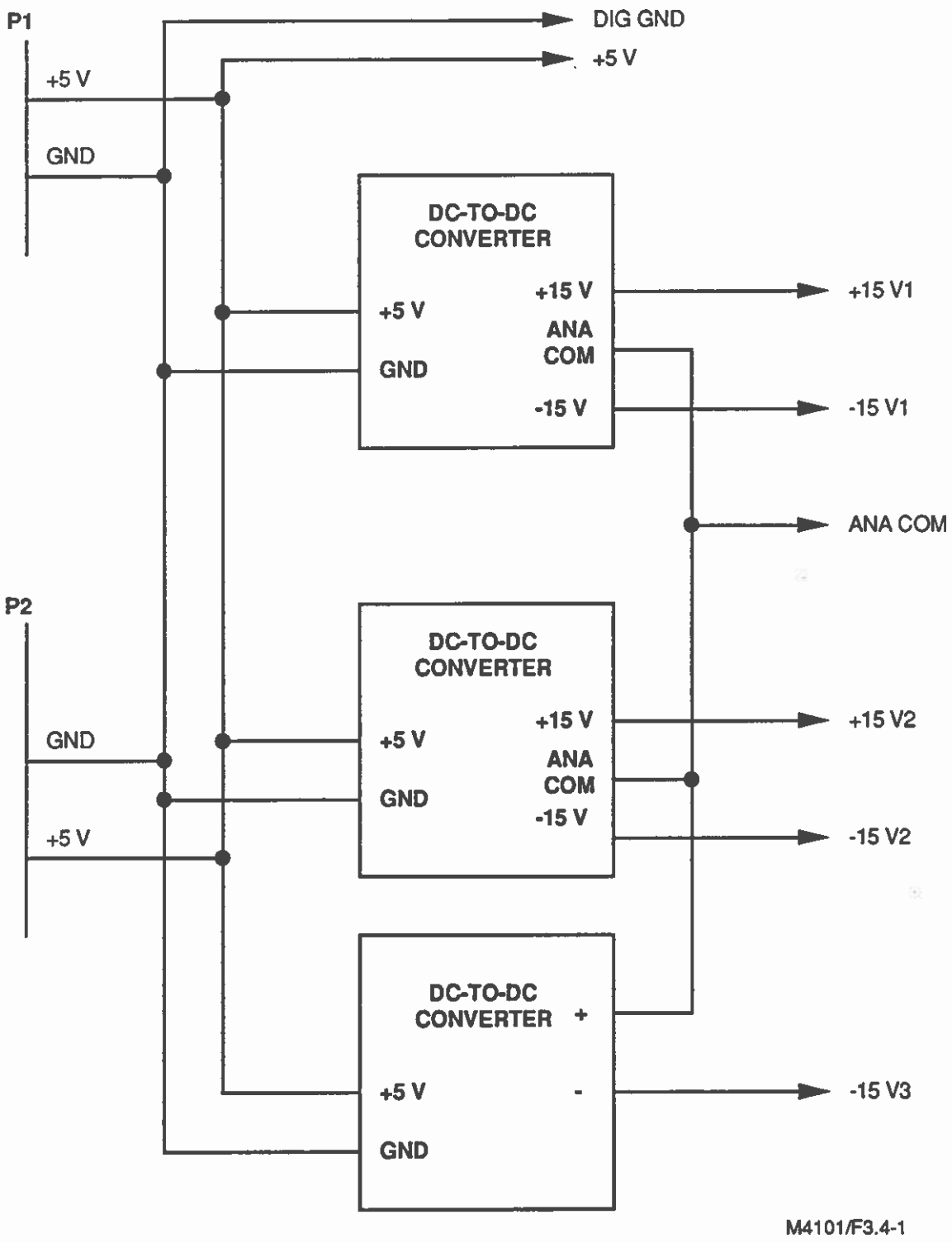


Figure 3.4-1. D/A Converter Board Power

SECTION 4.

PROGRAMMING

4.1 INTRODUCTION

The DAC Board is memory mapped in the short I/O address space. The board occupies 16 successive word locations in the VME short I/O address space of 65,535 bytes. The short I/O space is located from XXXX0000 HEX to XXXXFFFF HEX. The address bits A31 to A16 are CPU dependent. Each write or read cycle must be a word transfer to an even address, due to the DAC output resolution of 12 bits. The board base address (XXXX0000 HEX) may be selected by DIP switches, as shown in Section 5.5. Figure 4.1-1 represents the VMIVME-4101 address map, assuming the factory set base address of XXXX0000 HEX. Note that the Control and Status Register (CSR) can be written to and read from any of the 16-word locations that the board occupies. When the board is written to, the destination of the data is controlled by data bit 15. If data bit 15 is a "one", the word is written to the control register; whereas, when data bit 15 is a "zero", the data is written to the DAC which is addressed. Reading any address on the board will return the status of the board.

4.2 DAC BOARD PROGRAMMING OPTIONS

There are two types of registers that must be written to for proper operation of the DAC Board. One is the CSR, the other are the D/A Converters. The order in which they are written to may differ, depending on the desired mode of operation for DAC channel start convert.

4.2.1 Immediate DAC Update Mode

The immediate DAC update mode is described in Section 3.1.1 and must be enabled by the jumper configuration described in Section 5.7. Once this has been set up, a 12-bit word can be written to any DAC channel where it will begin immediate analog conversion.

By the operation of the CSR and its control of the analog isolation switches between the DAC outputs and the P3 (user) connector, all 16 DAC channels can be initiated to the proper value as described in the preceding paragraph. After powering-up the board, load the DAC channels with the initial 12-bit word required (positive true offset binary coding, see Table 4.2.1-1). Immediately after being written to, the analog output is updated to the new value. The CSR register definitions are shown in Table 4.2.1-2. A programming example of the Immediate DAC Update Mode is detailed in Section 4.4.

CONTROL AND STATUS REGISTER (READ/WRITE) ADDRESS

	(MSB) D15	D14		D8	D7	(LSB) D0
XXXX0000 XXXX0002 • • XXXX001E	1		CONTROL AND STATUS BITS			NOT USED

DAC CHANNELS (0 TO15) ADDRESS (WRITE ONLY)

ADDRESS	(MSB) D15	D14	D13	D12	D11	(LSB) D0
XXXX0000	0	NOT USED			DAC OUT 0	
XXXX0002	0	"			DAC OUT 1	
XXXX0004	0	"			DAC OUT 2	
XXXX0006	0	"			DAC OUT 3	
XXXX0008	0	"			DAC OUT 4	
XXXX000A	0	"			DAC OUT 5	
XXXX000C	0	"			DAC OUT 6	
XXXX000E	0	"			DAC OUT 7	
XXXX0010	0	"			DAC OUT 8	
XXXX0012	0	"			DAC OUT 9	
XXXX0014	0	"			DAC OUT 10	
XXXX0016	0	"			DAC OUT 11	
XXXX0018	0	"			DAC OUT 12	
XXXX001A	0	"			DAC OUT 13	
XXXX001C	0	"			DAC OUT 14	
XXXX001E	0	"			DAC OUT 15	

M4101/F4.1-1

Figure 4.1-1. Control and Status Register and DAC Channels Address Map

OFFSET BINARY

Table 4.2.1-1. Data Format Analog Output vs Digital Input (±10 V Scale)

DIGITAL INPUT CODE (MSB) D15	D14	D13	D12	D11	(LSB) D0	ANALOG OUTPUT VOLTAGE	
0	X	X	X	0000 0000 0000		- 10.000 V	-FULL SCALE
0	X	X	X	0100 0000 0000		- 5.000 V	-1/2 SCALE
0	X	X	X	1000 0000 0000		0.000 V	ZERO
0	X	X	X	1000 0000 0001		+ 4.88 mV	+1LSB
0	X	X	X	1100 0000 0000		+ 5.000 V	+1/2 SCALE
0	X	X	X	1111 1111 1111		+ 9.9951 V	+FULL SCALE-1LSB

M4101/T4.2.1-1

The Analog Output may be calculated by the input code written by the processor to the selected DAC channel as follows:

$$\text{Analog Output} = -10\ \text{V} + (\text{Digital Input Code in decimal}) \times \frac{20}{4096}$$

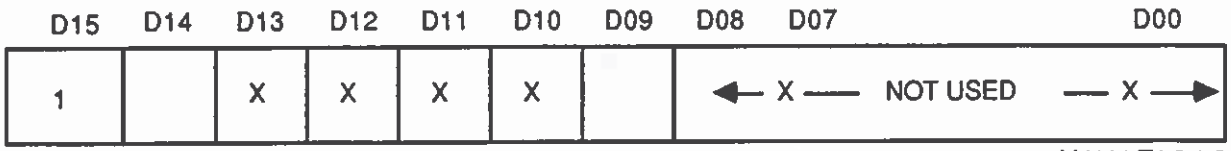
Example: The Analog Output for a digital input of A00H would be:

(1) A00H decimal equivalent is 2560

(2) $\text{Analog Out} = -10\ \text{V} + (2560)\ \frac{20}{4096}$

$= 2.5\ \text{V}$

Table 4.2.1-2. Control and Status Register Data Format and Definitions



M4101/T4.2.1-2

a. D00 through D08, D10, D11, D12, and D13 are not used.

b. D09 Program Control Start Convert. When input HIGH, generates a signal that transfers contents of previously loaded DACs to the second rank register and updates the analog ouput.

c. D14 A LOW state turns ON the Fail LED. A HIGH state turns it OFF. At power-up, this control bit is LOW.

d. D15 This bit is used as a register-select bit to determine which type of device is to be selected during a write cycle. D15 must be HIGH when writing to the control register. Otherwise, D15 must be LOW when writing to the D/A channels.

4.3 DELAYED DAC UPDATE MODE

The Delayed DAC Update Mode operation is described in Section 3.2. This mode must have previously been enabled by the jumper configuration in Section 5.7. There are two ways for a DAC channel to be updated after the 12-bit word is loaded into the DAC's first register. First, is under program control when data bit D9 is written HIGH to the CSR. Data bit D15 must always be HIGH when writing to the CSR Also, a previously loaded DAC may be updated by an external trigger input from another device. The external trigger must not be enabled until after the desired DAC channel(s) are loaded. A programming example of the delayed DAC update mode is detailed in Section 4.5.

4.4 MC68000 ASSEMBLY LANGUAGE PROGRAMMING OF THE VMIVME-4101 DAC BOARD

Only a few assembly language statements are necessary to properly control and utilize the DAC board. It will be assumed that the base address of the board in this example is FF0060H. The board address can be determined by Section 4.1 and Section 5.5.

The first example will be the loading of all the 16 digital-to-analog converters with a full scale value of FFFH, giving an analog output over the P3 connector of 9.9951 V. After being written to, the D/A output value will be updated immediately. This is the immediate DAC update mode explained in Section 4.1.2. The following program is intended as an instructional example only and may not be useful in the user's application. To enable the DAC immediate update mode, the jumper configuration in Section 5.7 must be employed. A flowchart of this example is shown in Figure 4.4-1, and the assembly language program is shown in Table 4.4-1.

4.5 PROGRAM EXAMPLE (DELAYED DAC UPDATE MODE)

In the programming example in Section 4.4, all 16 D/A converters were loaded with a full scale value of FFFH in the immediate update mode. For illustration purposes, the same result will be obtained by this programming example by using the delayed DAC update mode. The delayed DAC mode is jumper-selectable, as described in Section 5.7.

Figure 4.5-1 shows the programming sequence in a flowchart. Table 4.5-1 is the example program listing and comments. A base address of FF0060H is assumed.

In the following program example, all 16 DAC channels are loaded with new data then updated under program control. Alternatively, if previously enabled, an external trigger input could have initiated the D/A conversion process.

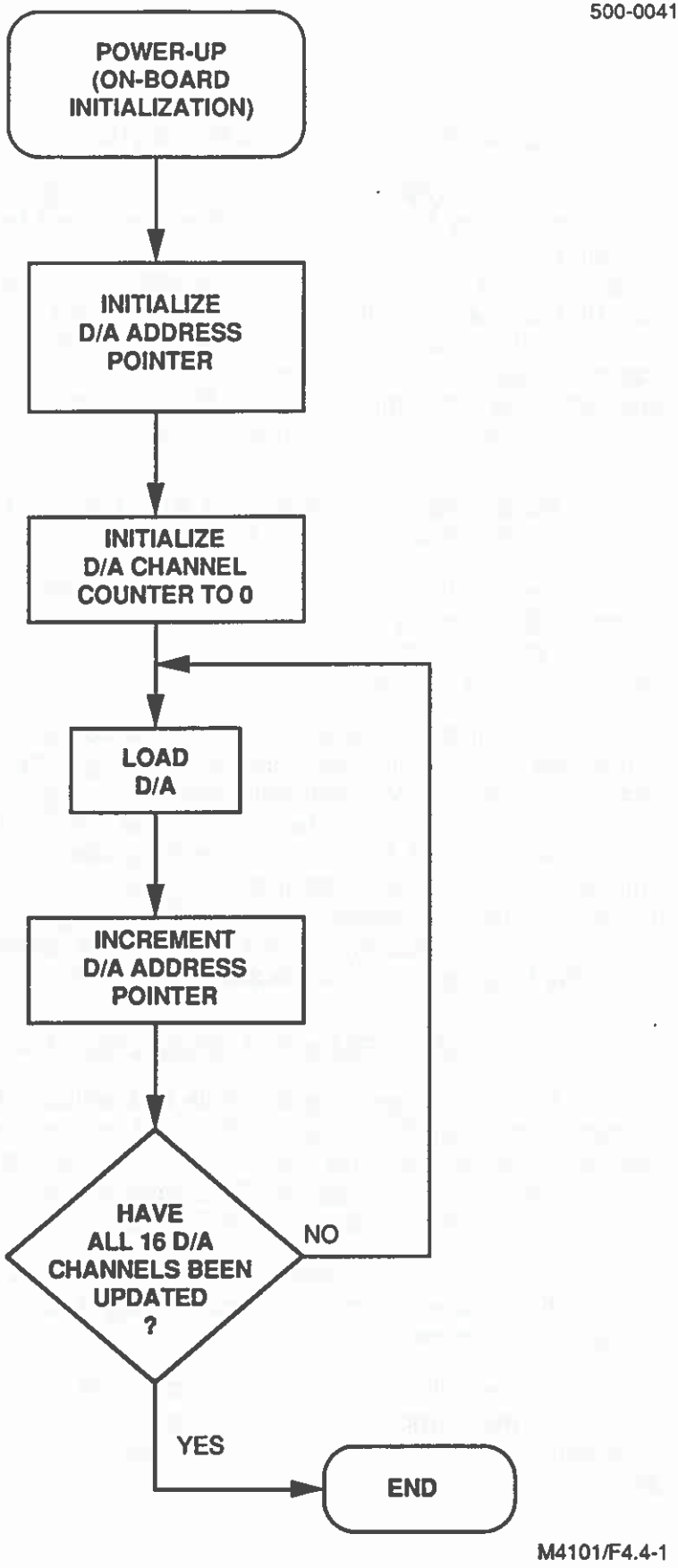


Figure 4.4-1. D/A Programming Sequence (Immediate D/A Start Convert Mode)

Table 4.4-1. Program Example (Immediate DAC Update Mode)

			COMMENT
	MOVE.W	#$ 0, D0	1
	LEA	$ FF0060, A0	2
LOAD NEXT D/A	MOVE.W	#$ 0FFF, (A0)+	3
	ADD.W	#1, D0	4
	CMP.W	#$ 0010, D0	5
	BNE	LOAD NEXT D/A	6
	STOP		7

M4101/T4.4-1

COMMENTS:

1. Initialize register D0 (used as a counter) to "zero"
2. Load address of DAC Channel #1 into address register A0
3. Load DAC channel with maximum value. Address pointer is automatically incremented to next DAC channel
4. Increment counter stored in D0
5. If all 16 DAC channels have not been loaded, then (7)
6. Load next DAC channel
7. STOP

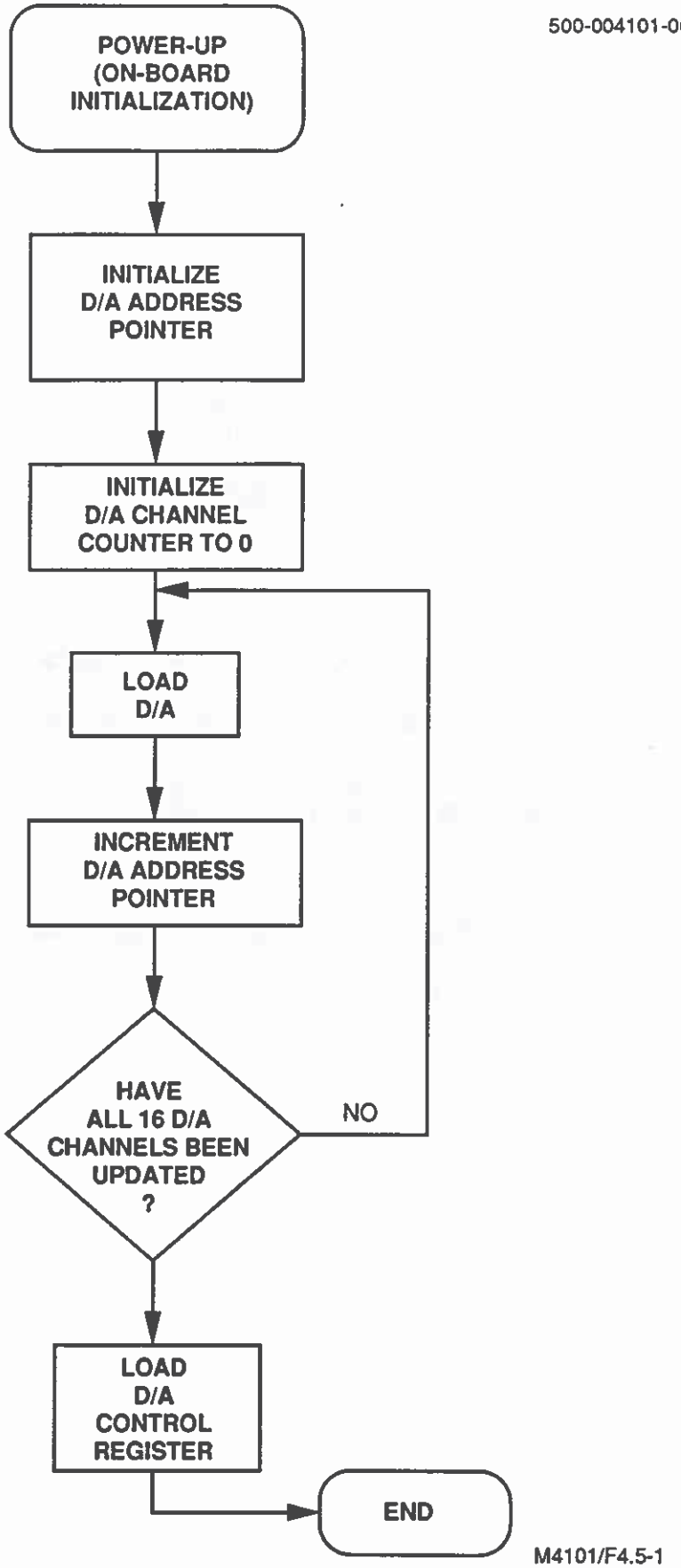


Figure 4.5-1. D/A Programming Sequence (Delayed DAC Update Mode)

Table 4.5-1. Program Example (Delayed DAC Update Mode)

			COMMENT
	MOVE.W	#$ 0, D0	1
	LEA	$ FF0060, A0	2
LOAD NEXT D/A	MOVE.W	#$ 0FFF, (A0)+	3
	ADD.W	#1, D0	4
	CMP.W	#$ 0010, D0	5
	BNE	LOAD NEXT D/A	6
	MOVE.W	#$ C200, $FF0060	7
	STOP		8

M4101/T4.5-1

COMMENTS:

1. Initialize register D0 (used as a counter) to "zero"
2. Load address of DAC Channel #1 into address register A0
3. Load DAC channel with maximum value. Address pointer is automatically incremented to next DAC Channel.
4. Increment counter stored in D0
5. If all 16 DAC channels have not been loaded, then (6)
6. Load next DAC channel
7. Load control register to start digital-to-analog conversion of all 16 DAC channels. Analog outputs routed out P3 connector.
8. STOP

SECTION 5

CONFIGURATION AND INSTALLATION

5.1 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. UNUSED BOARDS SHOULD BE STORED IN THE SAME PROTECTIVE BOXES AS SHIPPED. WHEN THE BOARD IS TO BE LAID ON A BENCH FOR CONFIGURING, ETC., IT IS SUGGESTED THAT CONDUCTIVE MATERIAL BE INSERTED UNDER THE BOARD TO PROVIDE A CONDUCTIVE SHUNT.

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 disposition of the damaged item(s).

5.2 PHYSICAL INSTALLATION

CAUTION

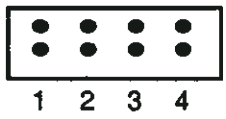
DO NOT INSTALL OR REMOVE BOARDS WHILE POWER IS APPLIED.

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.

5.3 INSTALLATION

This section describes the VMIVME-4101 DAC Board setup procedure and jumper configuration. The board-select base address and board jumper configuration are factory preset and shown in Table 5.3-1. The base address selection jumper fields are all shown in the factory configured position. This implies a base address for the board at XXXX0060H. The value for XXXX depends on the processor board used. Refer to your processor manual for the XXXX value required to access short I/O.

Table 5.3-1. VMIVME-4101 Factory Set Jumper Configuration

JUMPER	FUNCTION	FACTORY CONFIGURATION
A05 through A10, AM2, $\overline{AM2}$	Base address and address modifier selection jumpers	A10 ●—● A09 ●—● A08 ●—● A07 ●—● A06 ● ● A05 ● ● $\overline{AM2}$ ● ● AM2 ● ●
A11 to A15	Base address selection jumpers (All jumpers installed)	A15 ●—● A14 ●—● A13 ●—● A12 ●—● A11 ●—●
J1 to J4	Jumpers 1 through 4 determine DAC update mode. Factory preset to immediate DAC update mode (no jumpers installed)	
EXT	The external jumper enables/ disables the DAC external trigger factory preset to disable DAC external trigger. (no jumper installed)	EXT 
N0 to N15 Effective Rev B board	These 16 jumpers when not installed divide the output voltage range in half	N0 to N15 are installed
R17, R49, R19, R51, R21, R53, R23, R55, R25, R57, R27, R59, R29, R61, R31, R63 Effective Rev A board only	The 16 precision resistors when installed divide the output voltage range in half	The resistors are not installed

M4101/T5.3-1

5.4 BEFORE APPLYING POWER: CHECKLIST

Before installing the board in a VMEbus system, go through the following checklist to verify the board is ready for the intended operation:

a. Have the sections on Theory and Programming of the DAC board, Sections 3.0 and 4.0, been read and applied to system requirements? ___√___

b. Review Table 5.3-1 to verify the factory installed jumpers are set to the desired condition. _____

   (1) To change DAC board address jumpers see Section 5.5.
   (2) To change address modifier response jumper ($\overline{AM2}$, AM2), see Section 5.6.
   (3) To change DAC update mode jumpers 1 through 4, see Section 5.7.
   (4) To change enable/disable DAC external trigger jumper EXT, see Section 5.8.
   (5) To change the analog output voltage range, see Section 5.9.

c. To calibrate the +10 V precision reference, see Section 5.10. _____

d. Has the cable, with proper mating connector, been connected to the analog output connector (P3)? See Section 5.11. _____

5.4.1 DAC Board Installation

After steps 1 through 5 have been reviewed in Section 5.1, then the DAC board may be installed in a VMEbus system. (Do not install or remove the board with power ON). The DAC board may generally be installed in any slot position, except slot one which is usually reserved for the master processing unit.

5.5 BOARD ADDRESS SELECTION - JUMPERS

There are address-select jumpers at two locations on the VMIVME-4101 Board. The way in which each jumper corresponds to the address bits is shown in Figure 5.5-1, and jumper locations on the board are shown in Figure 5.5-2.

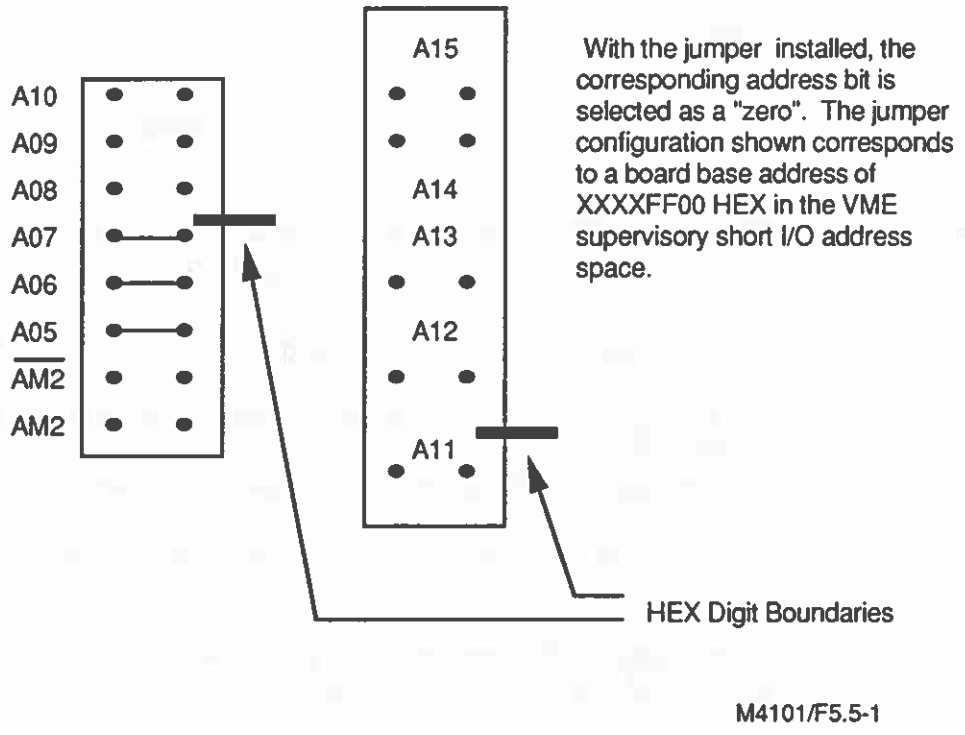


Figure 5.5-1. Base Address Jumper Setup

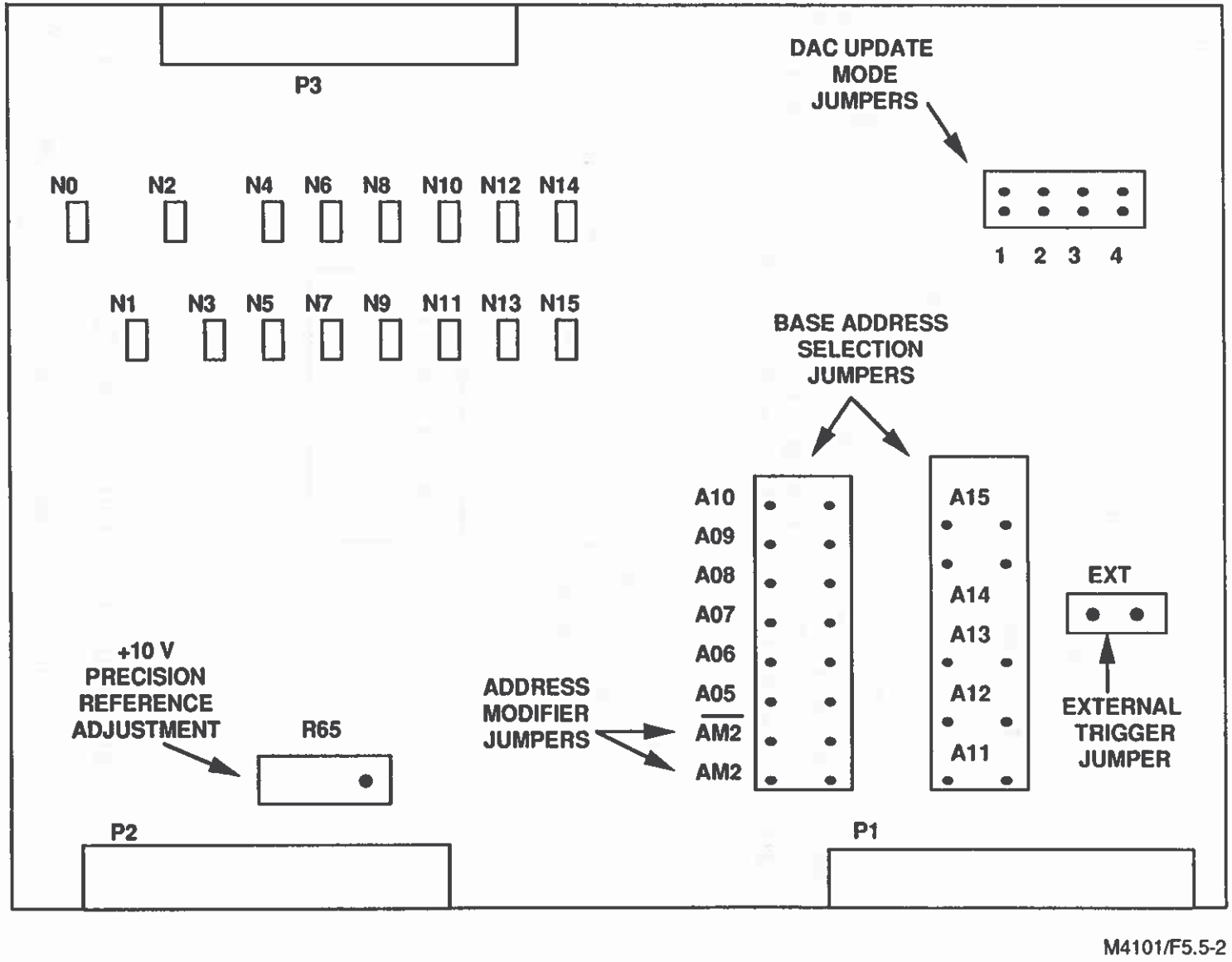


Figure 5.5-2. VMIVME-4101 Jumper Field Locations

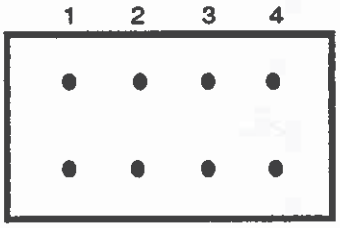
5.6 ADDRESS MODIFIER RESPONSE SELECTION

The DAC board is memory mapped in the short I/O address space, as described in Section 4.1. The DAC Board will respond to either or both address modifier codes that may be issued to the DAC board by a CPU board during a write or read cycle. The DAC board is factory set to respond to supervisory short I/O access (no jumper installed). To select nonprivileged short I/O access, install the jumper at location $\overline{\text{AM2}}$. To configure the board so it will respond to either supervisory or nonprivileged access, install the jumper at AM2. Refer to Figure 5.5-2 for the address modifier jumper locations.

5.7 DAC UPDATE MODE SELECT JUMPERS

There are four jumpers, and each jumper corresponds to a set of of four D/A channels. To enable a set of channels for the immediate DAC update mode, the corresponding jumper is removed (not installed). If a jumper is installed, as indicated in Figure 5.7-1, then that set of four channels will operate in the delayed DAC update mode. Jumper locations are shown in Figure 5.5-2.

- D/A Channels 1 to 4 — Install Jumper 1
- D/A Channels 5 to 8 — Install Jumper 2
- D/A Channels 9 to 12 — Install Jumper 3
- D/A Channels 13 to 16 — Install Jumper 4



M4101/F5.7-1

Figure 5.7-1. Jumper Configuration

5.8 EXTERNAL DAC UPDATE TRIGGER ENABLE/DISABLE

Install jumper EXT if external trigger operation is desired. Otherwise, remove jumper EXT. See Figure 5.5-2 for jumper location on board.

5.9 OUTPUT VOLTAGE RANGE SELECTION

The board may be ordered with either a 0 to +10 range or a -10 to +10 V range. With the proper jumper configuration each output voltage range may be divided in half to either a 0 to +5 V range or -5 to +5 V range. Refer to Table 5.9-1 for the desired jumper configuration. For Rev A board only refer to Table 5.9-2.

Table 5.9-1. Output Voltage Range Selection (Effective Rev. B Board)

OUTPUT VOLTAGE RANGE	JUMPERS N0 TO N15
-10 to +10 V	INSTALLED
-5 to +5 V	NOT INSTALLED
0 to +10 V	INSTALLED
0 to +5 V	NOT INSTALLED

M4101/T5.9-1

Table 5.9-2. Output Voltage Range Selection (Effective Rev. A Board)

OUTPUT VOLTAGE RANGE	RESISTORS - R17, R49, R19, R51, R21, R53, R23, R55, R25, R57, R27, R59, R29, R61, R31, R63
-10 to +10 V	NOT INSTALLED
-5 to +5 V	INSTALLED
0 to +10 V	NOT INSTALLED
0 to +5 V	INSTALLED

M4101/T5.9-2

5.10 CALIBRATING THE +10 V PRECISION REFERENCE

The +10 V precision reference has been adjusted at the factory and locktight has been applied to the potentiometer adjustment to ensure that no changes occur during shipping and handling. However, the lock-tight is easily broken away for user adjustment if necessary. Long term drift of the reference is very low (0.25 mV/1000 hrs). After 6000 hrs of operation or when the references output (P2 connector) is being used by other devices, the reference voltage should be checked with a 5-1/2 digit voltmeter. The procedure is as follows:

a. Remove any cable connected to the P3 connector.

b. Apply power to the board and let warm up 15 minutes.

c. Attach the negative lead of the voltmeter to the P3 connector pin C-1or P2 connector pin A18.

d. Attach the positive lead of the voltmeter to the wire jumper P2 connector pin A17 or U24 pin 17.

e. If voltage is not within 1.0 mV of +10 V, then recalibrate reference.

f. Recalibrate reference by adjusting potentiometer R65 (board location shown in Figure 5.5-2) to +10 V (± 0.5 mV).

5.11 CONNECTOR DESCRIPTIONS

Two connectors P1 and P2 connect the DAC board to the VMEbus backplane and provide the interface to other VMIC analog boards. The connectors are 96-pin DIN type. The primary connector, P1, contains the address data and control lines and all additional signals necessary to control data transfer and other bus functions. P2 connector carries the I/O lines necessary to join the DAC board with the optional VMIVME-3200 Mulitplexer Expander Board and the VMIVME-3100 12-Bit A/D Converter Board. The P2 connector connects the DAC board with the Analog P2 Backplane (AMXbus™). See Figure 5.11-1 and Table 5.11-1 for the P2 connector signal assignments.

If the test bus option is to be used in conjunction with other VMIC analog I/O boards, then the user must use a VMIC printed circuit Analog P2 Backplane (AMXbus™). These backplanes are available in different slot widths to accommodate almost any combination of boards.

The P3 connector is a Panduit 32-pin male connector type 120-332-033A. The matching Panduit connector for the input cable is a female connector type 120-332-435E. This connector handles the 16 analog outputs, each with an associated analog ground wire. See Figure 5.11-2 and Table 5.11-2 for the P3 connector signal assignments.

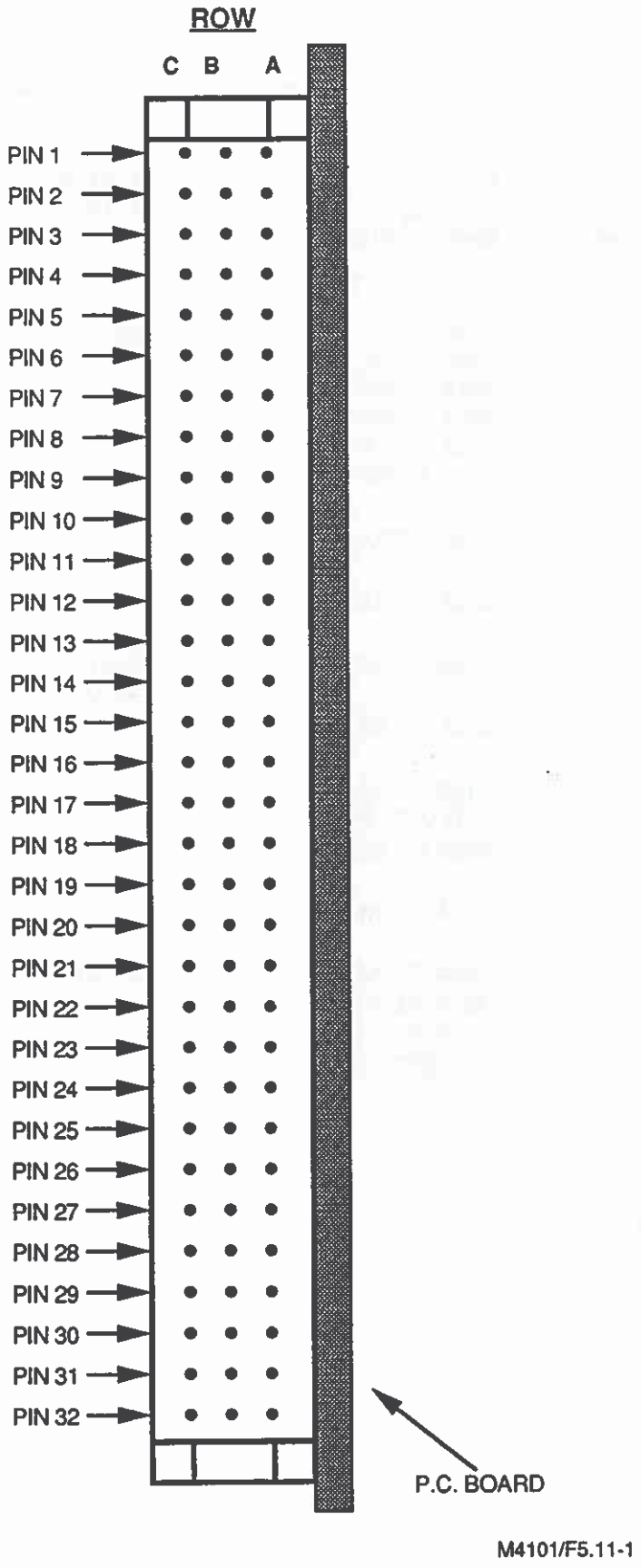


Figure 5.11-1. P2 Connector Pin Locations (Rear View of Board)

Table 5.11-1. P2 Connector Signal Assignments

PIN NUMBER	ROW A SIGNAL MNENOMIC	ROW B SIGNAL MNENOMIC	ROW C SIGNAL MNENOMIC
1	ANA COM	+5 V	
2	ANA COM	GND	
3	ANA COM		
4	ANA COM		
5	ANA COM		
6	ANA COM		
7			
8	ANA COM		
9			
10	ANA COM		
11			
12	ANA COM	GND	
13		+5 V	
14	ANA COM		
15			
16	ANA COM		
17	+10 V REF		
18	ANA COM		
19			
20	ANA COM		
21			
22	ANA COM	GND	
23	ANA COM		
24	ANA COM		
25	EXTSCL		
26	GND		
27			
28			
29			
30			
31		GND	
32		+5 V	

M4101/T5.11-1

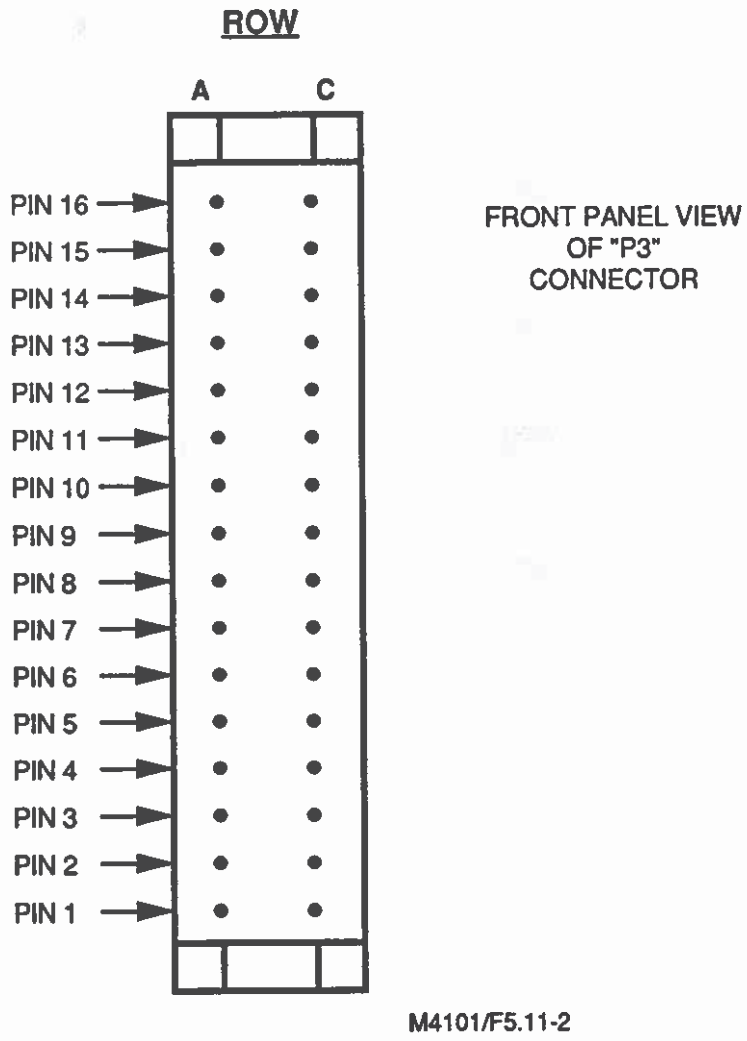


Figure 5.11-2. P3 Connector Pin Locations

Table 5.11-2. P3 Connector Signal Assignments

PIN NUMBER	ROW A	ROW B	ROW C
1	AN00		ANA COM
2	AN01		ANA COM
3	AN02		ANA COM
4	AN03		ANA COM
5	AN04		ANA COM
6	AN05		ANA COM
7	AN06		ANA COM
8	AN07		ANA COM
9	AN08		ANA COM
10	AN09		ANA COM
11	AN10		ANA COM
12	AN11		ANA COM
13	AN12		ANA COM
14	AN13		ANA COM
15	AN14		ANA COM
16	AN15		ANA COM

M4101/T5.11-2

SECTION 6

MAINTENANCE AND WARRANTY

6.1 MAINTENANCE

This section of the technical manual provides information relative to the care and maintenance of VMIC's products. Should the products malfunction, the user should verify the following:

a. Software
b. System configuration
c. Electrical connections
d. Jumper or configuration options
e. Boards fully inserted into their proper connector location
f. Connector pins are clean and free from contamination
g. No components of adjacent boards are disturbed when inserting or removing the board from the VMEbus card cage
h. Quality of cables and I/O connections

User level repairs are not recommended. Contact VMIC for a Return Material Authorization (RMA) Number. This RMA Number must be obtained prior to any return.

6.2 MAINTENANCE PRINTS

The appendix(ices) to this manual contain(s) drawings and diagrams for reference purposes.

6.3 WARRANTY

VMIC's Standard Products are warranted to be free from defects in material and workmanship for a period of two years (24 months) from the date of shipment. In discharge of this warranty, VMIC, at its option, agrees to either repair or replace, at VMIC's facility and at VMIC's discretion, any part, component, subassembly accessory, or any hardware, software, or system product, which under proper and normal use proves defective in material and workmanship.

The customer shall provide notice to VMIC of each such defect within a reasonable time after the customer's discovery of such defect.

In order to return the defective product(s) or part(s), the customer must contact VMIC's Customer Service Department to obtain a Call Ticket Number. The

defective product(s) or part(s) must also be properly boxed and weighed. After a VMIC Call Ticket Number and RMA Number have been obtained, the defective product(s) or part(s) may be returned (transportation collect for surface UPS) to VMIC. Any replaced or repaired product(s) or part(s) will be shipped back to the customer's at the expense of VMIC (also UPS surface).

The customer should be aware that the above process can sometimes take up to eight (8) days for the shipment to reach VMIC. The customer has the option to ship the defective product(s) or part(s) at the customer's own expense if the customer cannot afford this possible delay.

There shall be no warranty or liability on any VMIC product(s) or part(s) that is (are) damaged or subjected to accident(s), perils of nature, negligence, overtemperature, overvoltage, misapplication of electrical power, insertion or removal of boards from backplanes and/or I/O connectors with power applied by the customer(s), appointee(s), or any other person(s) without the expressed approval of VMIC.

Final determination of warranty eligibility shall be made by VMIC, and if a warranty claim is considered invalid for any reason, the customer will be charged for services performed and expenses incurred by VMIC in repair, handling and shipping the returned product or part. Determination as to whether the item is within warranty, coverage shall not be unreasonably withheld.

The warranty period of the replacement or repaired product(s) or part(s) shall terminate with the termination of the warranty period with respect to the original product(s) or part(s) for all replacement parts supplied or repairs made during the original warranty period.

THE FOREGOING WARRANTY AND REMEDY ARE EXCLUSIVE AND VMIC SHALL HAVE NO OTHER OR ADDITIONAL LIABILITY TO BUYER OR TO ANYONE CLAIMING UNDER BUYER (THIRD PARTY) UNDER ANY OTHER AGREEMENT OR WARRANTY, EXPRESS OR IMPLIED EITHER IN FACT OR BY OPERATION OF THE LAW, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS, STATUTORY, OR OTHERWISE. VMIC SHALL HAVE NO LIABILITY FOR SPECIAL OR CONSEQUENTIAL DAMAGES OF ANY KIND OR FROM ANY CAUSE ARISING OUT OF THE INSTALLATION OR USE OF ANY PRODUCT FURNISHED HEREUNDER.

6.4 OUT-OF-WARRANTY REPAIR POLICY

The following sections describe VMIC's policy on repairs and warranties on repaired products.

6.4.1 Repair Category

VMIC's repair policy of standard products is divided into two categories, depending on the item to be repaired. These categories are:

a. Product Exchange
b. Fixed Price Repair

Category 1 (product exchange) represents the fastest turn around of the two categories. In this case, the customer sends the malfunctioning product to VMIC. VMIC will return an operational product to the customer within 72 hours of receipt provided VMIC has the product in stock.

Provided that the returned product is repairable customers should contact VMIC prior to returning products for repair to determine stocking status.

Category 2 (Fixed Price Repair) applies to products returned to VMIC for repair and subsequent return to the customer.

Return authorizations are required on all product repairs, and all purchase orders should refer to VMIC's RMA Number which is assigned by VMIC's Customer Service Department.

6.4.2 Repair Pricing

Contact your factory representative for repair pricing. Current pricing can be found in the Repair and Replacement Policy in the most current Standard Conditions of Sales Document (F0109-91). Refer to exclusions (Section 6.4.7).

6.4.3 Payment

Payment is due upon delivery or at VMIC's option, net thirty (30) days from the date of delivery. Payment should be made to:

VME Microsystems International Corporation
12090 South Memorial Parkway
Huntsville, Alabama 35803-3308
Attention: Accounts Receivable

VMIC allows a one (1) percent discount for payment made within ten (10) days of invoice date or a two (2) percent discount on payment made prior to shipment of order. This payment discount, however, does not apply to freight.

6.4.4 Shipping Charges

Shipping charges are the customer's responsibility, with the exception of warranty repairs, whereby VMIC will pay the return to customer shipping charges.

6.4.5 Shipping Instructions

The type of packaging used to ship the product depends on whether the product is shipped singly, in a chassis, or packaged with other boards. The shipper should carefully pack the product(s), using the same precautions listed in the "unpacking procedures". The user should utilize the same (or equivalent) protective packaging container for re-shipment as provided by VMIC. Approved ESD procedures are recommended when handling VMIC's products.

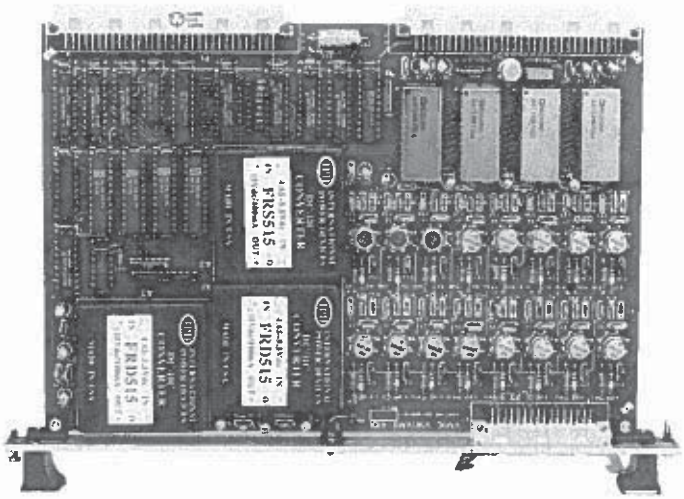
6.4.6 Warranty on Repairs

Products repaired by VMIC are warranted against defects in workmanship and material for a period of ninety (90) days from date of shipment to the customer for all products that were repaired out of warranty. See Standard Conditions of Sale for products repaired within the warranty.

6.4.7 Exclusions

Repair rates may not apply to products which have received unusual physical or electrical damage. In such cases, VMIC will provide an estimated price for product repair or replacement. The customer may then choose to have the product repaired at the estimated price, returned unrepaired at no charge, or replaced at VMIC's current list price.

VMIVME-4101
16-CHANNEL ANALOG OUTPUT (10 mA) BOARD



FEATURES

- BUFFERED VOLTAGE OUTPUT (±10 V @ 10 mA)
- OUTPUT VOLTAGE RANGE OPTIONS (0 to +5 V, 0 to +10 V, ± 5 V, OR ±10 V)
- JUMPER-SELECTABLE VOLTAGE DIVIDED BY TWO
- FAST SETTLING: 10 µsec MAXIMUM TO ±1/2 LSB
- 16 CHANNELS PER BOARD
- 12-bit DAC PER CHANNEL
- HIGH RELIABILITY DIN TYPE OUTPUT CONNECTOR
- DOUBLE-BUFFERED DATA LATCHES
- DOUBLE EUROCARD FORM FACTOR
- SELECTABLE EXTERNAL UPDATE CONTROL INPUT PROVIDES SINGLE UPDATE STROBE FOR ALL DAC OUTPUTS
- HIGH ACCURACY REFERENCE (20 ppm/°C)
- FACTORY TRIMMED GAIN AND OFFSET - REQUIRES NO CALIBRATION

VME MICROSYSTEMS INTERNATIONAL CORPORATION
12090 South Memorial Parkway
Huntsville, Alabama 35803-3308
(205) 880-0444 FAX No.: (205) 882-0859
1-800-322-3616

Revised 22 June 1992
Specifications subject to change without notice.
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VMIVME-4101
16-CHANNEL ANALOG OUTPUT (10 mA) BOARD

SPECIFICATIONS

FUNCTIONAL CHARACTERISTICS

COMPLIANCE:

VMEbus A16:D16
The VMIC 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 determined by the setting of an 11-bit DIP switch. VMEbus address lines A05 through A15 are decoded for board selection.

VMEbus ACCESS:

Address modifier bits are decoded to support nonprivileged short I/O and/or supervisory short I/O access. Two jumpers are provided to support these options. The board is factory configured for supervisory short I/O access.

DATA TRANSFER:

Data is transferred to one of the 16 Digital-to-Analog Converters (DACs) whenever data line D15 is low and the proper board address and channel address appear on the address lines. Digital data to the DAC is contained in data bits D00 through D11. With longword transfers the upper 16 bits are ignored.

MODE SELECTION:

When a write operation is performed, the destination of the data is controlled by data bit 15. If data bit 15 is a "one", the word is written to the Control Register; whereas, when data bit 15 is a "zero", the data is written to the DAC which is addressed. Performing a read operation to any valid board address will allow the user to read the contents of the Board Control Register (BCR). The control bit functions are as follows:

D09 - Initiates digital-to-analog conversion
D14 - Operates software-controlled LED
D15 - Routes data to the Control Register or to a selected DAC channel

SYNCHRONIZATION:

Jumpers are available on the board to allow the user to synchronize changing of the analog outputs. In normal operation, each output channel changes immediately upon receipt of a new digital input. By reconfiguring the jumpers, it is possible to cause the analog outputs to change upon application of an external trigger(1) or upon receipt of a command via the (VMEbus). This provides the user with the capability of updating all 16 channels simultaneously.

FRONT PANEL LED:

The front panel LED is software controlled via the on-board Control Register. The LED is illuminated upon power-up reset.

SYSTEM RESET:

Application of the system reset signal via the VMEbus initializes the Control Register outputs to logic "zero"

CHANNELS:

Sixteen analog output channels

+10 V REFERENCE:

All 16 DAC channels share a high precision, low drift reference that is available for external use at the P2 connector

1. The user must ensure that the external trigger is not generated while writing data to DAC Registers.

ELECTRICAL SPECIFICATIONS

ANALOG OUTPUT:	VMIVME-4101-160 option: jumper-selectable for ±5 or ±10 V output VMIVME-4101-170 option: jumper-selectable for 0 to +5 V or 0 to +10 V output
OUTPUT PROTECTION:	Outputs are short circuit protected to GND
DAC INPUT CODE:	Positive true offset binary
RESOLUTION:	12 bits

ACCURACY (@ 25°C)

GAIN ERROR:	±0.05 percent of FSR(2)(typical)
OFFSET:	±0.025 percent of FSR (typical)
LINEARITY ERROR:	±1/4 LSB (typical)
DIFFERENTIAL LINEARITY ERROR:	±1/2 LSB (typical)
TEMPERATURE DRIFT:	
ZERO:	±10 ppm/°C
GAIN:	±10 ppm/°C
REFERENCE OUTPUT:	
VOLTAGE OUTPUT:	10 V (±0.5 mV)
TEMPERATURE COEFFICIENT:	5 ppm/°C
LONG-TERM STABILITY:	25 ppm/1,000 hrs
CURRENT AVAILABLE FOR EXTERNAL USE:	9 mA
VOLTAGE OUTPUT SETTLING TIME:	10 µsec (maximum) to ±1/2 LSB
MONOTONICITY:	Monotonic over full temperature range

POWER REQUIREMENTS

+5 V @ 4.6 A (maximum)
3.6 A (typical)

PHYSICAL/ENVIRONMENTAL SPECIFICATIONS

DIMENSIONS:	Standard VME double width board 160 mm x 233.5 mm
OUTPUT CONNECTOR:	Board connector (P3) - Panduit male connector type 120-332-033A Input cable connector - female connector type 120-332-435E
TEMPERATURE:	0 to +55°C, operating -20 to +85°C, storage
HUMIDITY:	20 to 80 percent relative, noncondensing

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

APPLICATION AND CONFIGURATION GUIDES

TITLE	DOCUMENT NO.
Digital Input Board Application Guide	825-000000-000
Change-of-State Application Guide	825-000000-002
Digital I/O (with Built-in-Test) Product Line Description	825-000000-003
Synchro/Resolver (Built-in-Test) Subsystem Configuration Guide	825-000000-004
Analog I/O Products (with Built-in-Test) Configuration Guide	825-000000-005
Connector and I/O Cable Application Guide	825-000000-006

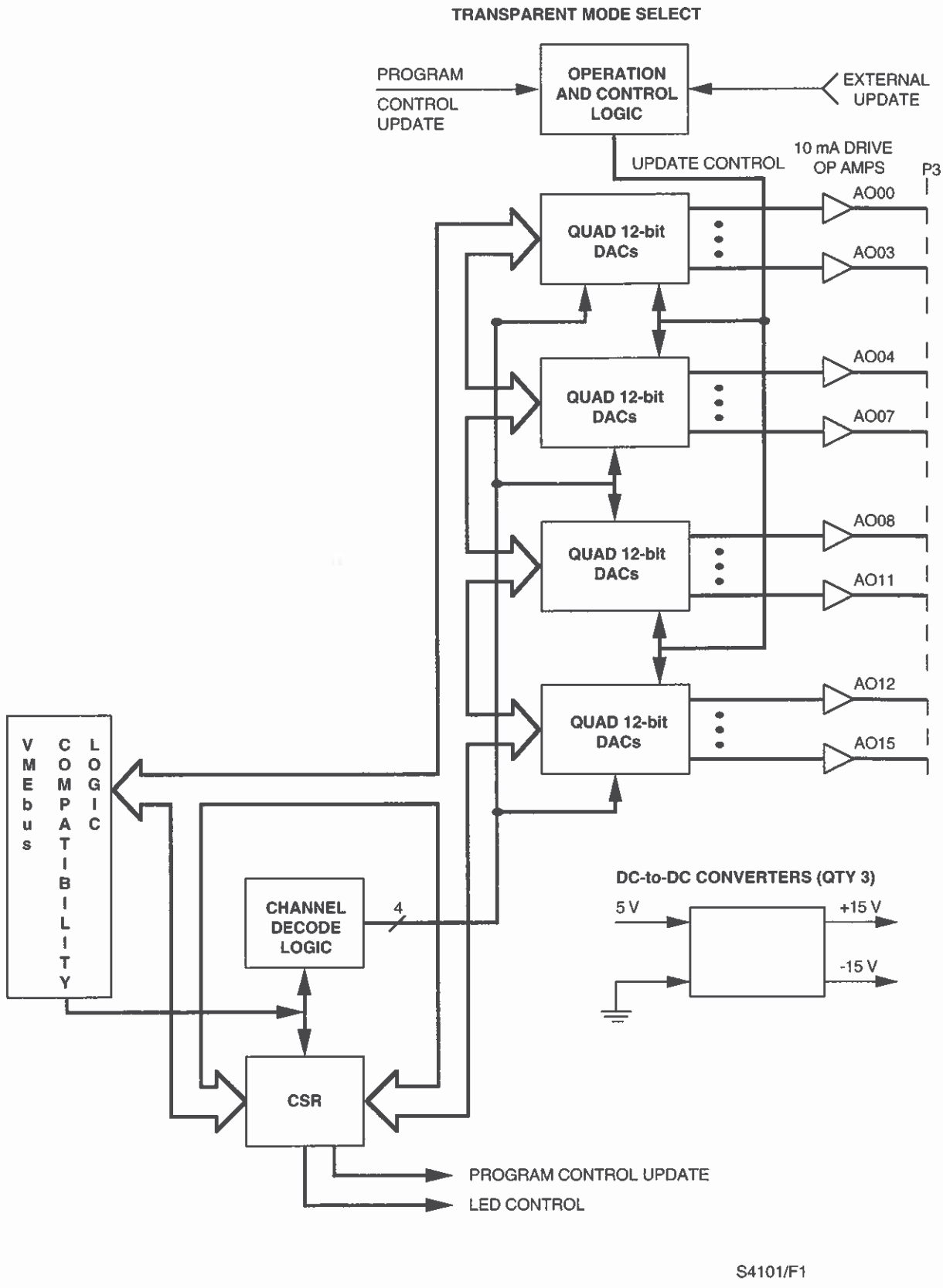


Figure 1. VMIVME-4101 Block Diagram

VMIVME-4101
16-CHANNEL ANALOG OUTPUT (10 mA) BOARD

ORDERING INFORMATION

DESCRIPTION	MODEL NUMBER VMIVME-
VOLTAGE OUTPUT - JUMPER-SELECTABLE BETWEEN ±10 V AND ±5 V	4101-160
VOLTAGE OUTPUT - JUMPER-SELECTABLE BETWEEN 0 to +10 V and 0 to +5 V	4101-170

CONNECTOR DATA

COMPATIBLE CABLE CONNECTOR	PANDUIT NO. 120-332-435E
STRAIN RELIEF	PANDUIT NO. 100-000-042
P.C. BOARD HEADER CONNECTOR	PANDUIT NO. 120-332-033A

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