
**PAS 9710/AO
ENGINEERING SPECIFICATION**

**8 CHANNEL, 14 BIT, 2 uSEC
VME ANALOG OUTPUT CARD
Revision D (09/24/2003)**

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8 Channel 14 Bit 2 uSEC VME Analog Output Card

TABLE OF CONTENTS

Section	Title	Page
I	INTRODUCTION	5
	General Description	5
	Card Features	5
II	SPECIFICATIONS	6
	Electrical Specifications	6
	Environmental Specifications	6
	Physical Specifications	6
	Jumpers and Indicators	7
	Connector Definitions	10
III	PROGRAMMING INFORMATION	11
	Control and Status Register	12
	8 Digital to Analog Converters	13
	Board Identifier PROM	13
IV	CALIBRATION PROCEDURE	14
	Offset Adjustment	14
	Gain Adjustment	14

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LIST OF TABLES

Table	Title	Page
1	Pluggable Jumper Definitions	8
2	DB25 Connectors	10
3	Memory Map	11
4	Control & Status Register	12
5	Offset & Gain Adjustment Locations	14

I. INTRODUCTION

GENERAL DESCRIPTION

The PAS 9710 Analog Output card provides eight channels of fourteen bit analog voltage outputs. This card can be used in VME systems with A16, A24, or A32 addressing, and data writes of 16 and 32 bits are supported. Pluggable jumpers are used to configure the width of the address bus. The instruction type defines the width of the data bus. High speed voltage output DACs; with 2 uSec typical settling times are used on this card. The DAC output signals are available on a 25 pin D connector mounted through the front panel. A board identifier PROM and control & status register are also provided.

Card Features: PAS 9710/AO

- 8 channels, +/- 10 Volt, 14 bit outputs
- VME 6U form factor; 233 mm x 160 mm card size
- VME access: D32, D16; A32, A24, A16
- Right justified, two's complement, 14 bit integer data
- Digital output looks like contiguous memory
- Channel 0 digital output on 64 bit boundary
- Optional VME SYSFAIL assert on power up, SYSFAIL LED and Board Access LED on front panel
- 500 nSec response to new data, (plus settling time). 2 uSec typical settling time
- Programmable simultaneous update
- No VME interrupts
- Board identifier PROM – ID Code is VMEID PAS9710AO**
(** is the revision level)
- 25 pin D-type connector, sockets (female)

PAS 9710/AO DAC Features

Resolution	14 bits
Output Range	+/- 10 Volts
Output Current	+/- 5 mAmps
Settling Time	2 uSec (typ), 4 uSec (max.) pos. FS 2.5 uSec (typ), 4 uSec (max.) neg. FS
Cross-talk	80 dB (typ)

II. SPECIFICATIONS

Electrical Specifications

Number of Channels	8
Resolution	14 bits
Output Voltage	+/- 10.000 Volts
LSB bit weight	1.22 mVolt
Output Current	+/- 5 mAmps
Settling Time (+ FS change)	2 uSec (typ), 4 uSec (max.)
Settling Time (- FS change)	2.5 uSec (typ), 4 uSec (max.)
Integral Nonlinearity	+/- 1 LSB (max.)
Differential Nonlinearity	+/- .9 LSB (max.) Guaranteed Monotonic
Zero Error	+/- 2 LSB (adjustable to zero)
Gain Error	+/- 0.01 % FS (adjustable to zero)
Reference TC	60 ppm/C (max.)
Card Power Requirements	5 Volts @ 1 Amp, (typ) 12 Volts @ 120 mA, -12 Volts @ 50 mA

Output Filter Specifications (- 001)

Filter Type	Low Pass Single Pole RC
3dB Corner Frequency	75 KHz
RC Time Constant	2.1 Microseconds

Environmental Specifications

Operating Temperature Range	0 to 60 degrees C.
Storage Temperature Range	-20 to 85 degrees C.
Relative Humidity Range	20% to 80%, non-condensing

Physical Specifications

Dimensions	Form factor: 6U (160 mm x 233 mm)
Weight	12 oz. (typ)
Connectors	2 ea. 96 position DIN (VME bus connectors) 1 ea. DB25 female, (Analog Output connector)

Ordering Information (Dash Numbers)

-000	No Output Filter
-001	75 KHz Low Pass Output Filter

Jumpers and Indicators

The 9710/AO card contains 28 pluggable jumpers and two LED indicators. Twenty-four of the jumpers are used to set the board's VME base address, and are defined in table 1 on the following page.

Jumpers J1 and J2 are used to select the board's operating environment; either A16, A24 or A32. The configuration of these jumpers is defined in table 1.

Jumper J3 is used to set the function of the pass / access LED. When it is in position 1-2, the LED is controlled by bit 1 in the control register. When it is in position 2-3 the LED indicates the board is being accessed.

Jumper J4 allows the SYSFAIL line to be driven with bit 0 of the control register when it is installed.

TABLE 1
PLUGGABLE JUMPER DEFINITIONS

<u>Jumper #</u>	<u>Function</u>
J1 IN, J2 IN	A32 Addressing
J1 IN, J2 OUT	A24 Addressing
J1 OUT, J2 X	A16 Addressing
J3 (1-2)	LED2 indicates board passed
J3 (2-3)	LED2 indicates board accessed
J4 IN	SYSFAIL controlled by control register
J8	A8
J9	A9
J10	A10
J11	A11
J12	A12
J13	A13
J14	A14
J15	A15
J16	A16
J17	A17
J18	A18
J19	A19
J20	A20
J21	A21
J22	A22
J23	A23
J24	A24
J25	A25
J26	A26
J27	A27
J28	A28
J29	A29
J30	A30
J31	A31

Jumper Installation

When an address jumper is installed, the corresponding address bit must be a zero to compare. When the jumper is removed, the corresponding address bit must be a one. The board is shipped with address jumpers J8 through J27 installed, which sets the base address to F0000000.

Jumpers J1 and J2 are used to set the board's address space. The board can be set to respond to A16, A24 or A32 space, and the jumper configurations are defined in the table above. The board is shipped configured for the extended 32 bit address space, with J1 and J2 installed.

Jumper J3 is used to configure the function of the lower LED. When the jumper is installed in position 1-2 (away from the front panel), the LED will be driven by bit 1 of the control register. When J3 is installed in position 2-3 (close to the front panel), the LED will come on any time the board is accessed. This is the position the jumper is shipped in.

Jumper J4 is used to allow bit one of the control register to drive the SYSFAIL line, if it is installed. The board is shipped with J4 installed, and the SYSFAIL line will be driven any time the board is reset.

Two LEDs are provided at the front panel to indicate the board's status. The upper LED is the red FAIL LED, and powers up on. This LED is controlled with bit 0 of the control register, and can be turned off by writing a one to bit 0. The SYSFAIL line will also be driven when the FAIL LED is on, if J4 is installed.

The lower LED is the green PASS / Access LED. When configured for the PASS function, it is controlled by bit 1 of the control register. This LED can be turned on by writing a one to bit 1, and it will power up turned off. When configured for the access function, this LED will turn on any time the board is accessed. A one-shot is used to drive this LED, so it will be visible on single cycle accesses.

Connector Definitions

Two 96 position DIN connectors are installed on the backplane end of the board to make the standard VME bus connection. A DB25 female connector is installed through the board's front panel to provide access to the eight analog output channels. The pin out of this connector is defined in Table 2.

TABLE 2
DB25 CONNECTOR

AGND	25	13	SIMUPIN
AGND	24	12	CH1H
AGND	23	11	AGND
AGND	22	10	CH3H
AGND	21	9	CH5H
AGND	20	8	AGND
AGND	19	7	CH7H
AGND	18	6	CH0H
AGND	17	5	AGND
AGND	16	4	CH2H
AGND	15	3	CH4H
AGND	14	2	AGND
		1	CH6H

III. PROGRAMMING INFORMATION

The PAS 9710/AO card responds to word and longword writes to the eight Digital to Analog Converters (DACs). Using longword writes allows two DACs to be updated with one transfer, and reduces the time to update the board by half. Word writes to the control register and word reads of the board identifier PROM are also supported. The card's memory map is shown below.

TABLE 3
PAS 9710/AO MEMORY MAP

BASE + 00	Reserved	Reserved	BASE + 01
02	Control Register	Control Register	03
04	Reserved	Reserved	0F
10	CH 0	CH 0	11
12	CH 1	CH 1	13
14	CH 2	CH 2	15
16	CH 3	CH 3	17
18	CH 4	CH 4	19
1A	CH 5	CH 5	1B
1C	CH 6	CH 6	1D
1E	CH 7	CH 7	1F
20	Reserved	Reserved	21
3E	Reserved	Reserved	3F
40		V (56)	41
42		M (4D)	43
44		E (45)	45
46		I (49)	47
48		D (44)	49
4A		P (50)	4B
4C		A (41)	4D
4E		S (53)	4F
50		9 (39)	51
52		7 (37)	53
54		1 (31)	55
56		0 (30)	57
58		A (41)	59
5A		O (4F)	5B
5C		D (44)	5D
5E		0 (30)	5F

Control and Status Register (Base + 02 hex)

The Control and Status Register (CSR) is located at the board's base address plus 2 (hex) and can be written and read with word transfers. The CSR is used to steer the SYSFAIL line, control the front panel LED's, and enable the DAC's to be updated. The word format for the CSR is shown below in Table 4.

TABLE 4
Control & Status Register

7	6	5	4	3	2	1	0
Loop Back	Loop Back	Loop Back	Loop Back	Loop Back	Sim Update	Pass LED	Fail LED

Bit 7 – 3 (Loop Back) These bits will return the value that was last written to them.

Bit 2 of the CSR is used to update the D-to-A Converters. The DAC's have an input register and a DAC register. When bit 2 is cleared to a zero, the DAC register will track the input register, and the DAC output voltage will change whenever a new value is written to the DAC. When bit 2 is set to a one, new values written to the DAC will not change the output voltage. This allows all of the DAC input registers to be updated with a series of write transfers. The outputs of all the DAC's will be updated simultaneously by writing a zero to bit 2 of the control register. An alternate way to simultaneously update the DAC's is to leave bit 2 of the control register set to a one, and drive the simultaneous update input signal low. This signal is located on P3 pin 13.

Bit 1 This bit controls the Pass LED. Reading this bit returns the value that was last written to it.

1 = Turn on the Pass LED
0 = Turn off the Pass LED

Bit 0 This bit controls the Fail LED. The SYSFAIL line will also be asserted when the Fail LED is on if J4 is installed. Reading this bit returns the value that was last written to it.

1 = Turn off the Fail LED
0 = Turn on the Fail LED

Eight D-to-A Converters (Base Address + 10H thru 1EH) Write Only

The eight Digital-to-Analog Converters (DAC's) are written starting at the board's base address plus 10 (hex). Two's complement data is used when writing to the DAC's. Only the fourteen least significant bits are used, with the most significant of these being the sign bit. A digital output word of 1FFF produces positive full scale. Zero volts are produced with a digital word of 0000 and negative full scale occurs at 2000 (hex).

The D-to-A Converters can be written to individually using word transfers, or in pairs using long word transfers.

Board Identifier PROM (Base Address + 41H to 5FH) Read Only

The Board Identifier PROM is located starting at the board's base address plus 41 and continues to the base address plus 5F.

Byte and word reads to the Identifier PROM are supported. Only the least significant byte of a word read will contain valid data, and the most significant byte will contain FF. The ID PROM contains 16 ASCII characters that specify the board's model number and revision level. A write to the ID PROM location will handshake, but not transfer any data.

IV. CALIBRATION PROCEDURE

Install the PAS 9710/AO card in a VME chassis, and allow the card to stabilize for approximately five minutes. A meter with five digits of resolution and accuracy is required to perform these adjustments.

Offset Adjustment

The offset adjustment should be performed before the gain adjustment to avoid interaction of adjustments. Write the hex value 0000 to the channel to be adjusted, and adjust the zero potentiometer for a value of 0.000 volts. The location of the zero adjustment pots are defined in table 5 below.

Gain Adjustment

Write a hex value of 1FFF to the channel to be adjusted, and adjust the gain potentiometer for a value of +9.9988 Volts. The locations of the gain adjustment pots are defined in table 5 below.

Repeat the offset adjustment to verify it is correct.

TABLE 5

Offset & Gain Adjustment Locations

Channel	Offset	Gain
0	38	34
1	14	10
2	44	40
3	20	16
4	50	46
5	26	22
6	56	52
7	32	28