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PAS 9732/AI ENGINEERING SPECIFICATION

8 CHANNEL, 14 BIT, 3 MHz per CHANNEL
VME ANALOG INPUT CARD
Revision A (11/18/2000)

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8 Channel 14 Bit 3 MHz per Channel
VME Analog Input Card

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I. INTRODUCTION

GENERAL DESCRIPTION

The PAS 9732/AI is a VME based, eight channel, 14 bit, 3 MHz per channel, Analog Input Card. This card can be used in VME systems with A16, A24, or A32 addressing, and data bus widths of 16 and 32 bits are supported. Jumper plugs are used to configure the width of the address and data buses. Eight high speed Analog to Digital Converters (ADCs) with 3 MHz conversion rates continuously scan the analog input signals, which are connected to a 25 pin D connector mounted through the front panel. A board identifier PROM, test registers, and a control register are also provided.

Card Features: PAS 9732/AI

- 8 channel, 14 bit Analog Input Card
- 0 to 10 Volt and +/- 10 Volt versions available
- 3 MHz per channel continuous sampling on all channels
- VME 6U form factor; 233 mm x 160 mm card size
- VME access: D32, D16; A32, A24, A16
- Right justified sixteen bit integer data
- Digital input looks like contiguous memory
- Channel zero input data on 64 bit boundary
- Optional VME SYSFAIL assert on power up, SYSFAIL LED and Board Access LED on front panel
- 500 nSec VME response time, (plus conversion time). 333 nSec conversion time
- No VME interrupts
- Board identifier PROM; ID code is VMEID PAS9732AI **. (** Is revision level)
- 25 pin D-type connector, sockets (female). Matches pin out of PAS 9710/AO and PAS 9731/AI cards
- Operating temperature range 0 to 60 deg. Celsius, with forced air cooling

II. SPECIFICATIONS

Electrical Specifications

Number of Channels	8
Resolution	14 bits
Input Voltage Ranges	0 to +10 Volts or +/- 10 Volt
LSB bit weight	610 uV (0 to 10 Volt version) 1.22 mV (+/- 10 Volt version)
Conversion Time	333 nSec, continuous on all channels
Integral Nonlinearity	+/- 2.5 LSB (typ)
Differential Nonlinearity	+/- 0.6 LSB (typ)
Zero Error	+/- 2 LSB (adjustable to zero)
Gain Error	+/- 0.01% FSR (adjustable to zero)
Gain TC	50 ppm/C (typ)
Common Mode Rejection Ratio	80 dB (typ) DC to 60 Hz
Card Power Requirements	5 Volts @ 2 Amps (typ), 3 Amps (max.)

Environmental Specifications

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

Physical Specifications

Dimensions	Form factor: Double (160 mm x 233 mm)
Weight	12 oz. (typ)
Connectors	2 ea. 96 pos. DIN (VME bus) 1 ea. DB25 female (Analog Input)

Jumpers and Indicators

The 9732/AI card contains 28 jumper plugs and two LED indicators. The first 24 jumpers set the board's VME base address, and are defined in the following table. When a jumper is installed, the corresponding address bit must be low to select the card's address, and when a jumper is removed the corresponding address bit must be high. The card is shipped configured for address F0000000, so that 20 of the possible 24 address jumpers are installed.

Jumpers J25 and J26 are used to select the boards operating environment, either A16, A24 or A32, and the installation of these jumpers is defined in table 1.

Jumper J27 is used to set the function of the Pass/Access LED. When it is installed in position 1-2, the LED is controlled by bit 1 in the control register. When J27 is in position 2-3 the LED indicates the board is being accessed.

Jumper J28 allows the SYSFAIL line to be driven with bit 0 of the control register when it is installed.

Ordering Information

Two versions of the PAS 9732/AI card are available as options specified by the three-digit dash number. The ordering information for the two versions is specified below:

- PAS 9732/AI-000 = 0 to 10 Volt Input Range
- PAS 9732/AI-001 = +/- 10 Volt Input Range

TABLE 1

PLUGGABLE JUMPER DEFINITIONS

Jumper #	Function
J1	A8
J2	A9
J3	A10
J4	A11
J5	A12
J6	A13
J7	A14
J8	A15
J9	A16
J10	A17
J11	A18
J12	A19
J13	A20
J14	A21
J15	A22
J16	A23
J17	A24
J18	A25
J19	A26
J20	A27
J21	A28
J22	A29
J23	A30
J24	A31
J25 IN, J26 IN	A32 Addressing
J25 IN, J26 OUT	A24 Addressing
J25 OUT, J26 OUT	A16 Addressing
J27 (1-2)	LED2 indicates board passed
J27 (2-3)	LED2 indicates board accessed
J28 IN	SYSFAIL controlled by CSR

Two LED’s indicate the board's status and are visible at the front panel. The upper red LED is the Fail indicator and powers up on. This LED is controlled with bit zero of the control register, and can be turned off by writing a one to bit zero. The SYSFAIL line is driven when the Fail LED is on, if J28 is installed.

The lower green LED is the Pass / Access indicator, and its function is selected with J27. When configured for the Pass function, bit 1 of the control register drives this indicator. The Pass LED can be turned on by writing a one to bit one, 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 the LED, so that 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 installed through the board's front panel to provide access to the eight analog input channels. The pin out of this connector is defined in Table 2 on the following page.

TABLE 2

DB25 CONNECTOR

		13	AGND
CH1L	25	12	CH1H
AGND	24	11	AGND
CH3L	23	10	CH3H
CH5L	22	9	CH5H
AGND	21	8	AGND
CH7L	20	7	CH7H
CH0L	19	6	CH0H
AGND	18	5	AGND
CH2L	17	4	CH2H
CH4L	16	3	CH4H
AGND	15	2	AGND
CH6L	14	1	CH6H

III. PROGRAMMING INFORMATION

The 9732/AI card responds to word and longword transfers to the eight Analog to Digital Converters (ADCs), and the four-byte test register. 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 9732/AI MEMORY MAP

BASE + 00		Control Register	BASE + 01
02	Reserved	Reserved	03
04	Test Register	Test Register	05
06	Test Register	Test Register	07
08	Reserved	Reserved	0F
10	CH0	CH0	11
12	CH1	CH1	13
14	CH2	CH2	15
16	CH3	CH3	17
18	CH4	CH4	19
1A	CH5	CH5	1B
1C	CH6	CH6	1D
1E	CH7	CH7	1F
20	Reserved	Reserved	21
3E	Reserved	Reserved	3F
40	ID PROM	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		3 (33)	55
56		2 (32)	57
58		A (41)	59
5A		I (49)	5B
5C		A (41)	5D
5E		0 (30)	5F
60	ID PROM	Reserved	7F
80	SECOND	COPY	FF

Control and Status Register

The Control and Status Register, (CSR), is used to set the states of the LED's and SYSFAIL line. This register is located at the card's base address.

Bit 0 of the CSR steers the Fail LED and SYSFAIL line on the backplane. When the card is reset the Fail LED will come on, and the SYSFAIL line will be driven true. Writing a one to bit zero will turn off the Fail LED and the SYSFAIL line.

Bit 1 of the CSR controls the Pass LED if this function is selected with J27. This LED is turned off when the board is reset or when a zero is written to bit one. Writing a one to bit one will turn on the LED. Reading the CSR returns the value that was last written to it.

Bit 2 – 7 of the CSR will return the value that was last written to them and they have no other function.

32 Bit Test Register

The 32-bit test register is located at an offset of four from the base address. This register can be written to with either words or longwords, and read back with either words or longwords. When the register is read it will return the last value that was written to it, and is useful for testing the card's internal data busses, and VME bus interface.

Analog to Digital Converters

The ADCs can be read starting at the card's base address plus 10(hex) with either word or longword transfers. When the ADCs are read with longwords, two channels are read with the same transfer. This effectively doubles the data rate when compared with using word transfers. Refer to the card's memory map for the location of each ADC. The data returned by the ADC's is right justified, and on 0 to 10 volt cards the two MSB's always return zeros. On the +/- 10 volt cards the data is 2's compliment and sign extended. If an ADC address is written, the card will handshake with the VME bus, but will not write any data.

Board Identifier PROM

The board identifier PROM is located at an offset of 40(hex) from the base address, and can be read with word reads only. Only the least significant byte of the word 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.

A second copy of the board's registers is contained at offsets 80 through FF.

IV. CALIBRATION PROCEDURE (0 to 10 Volt version)

In order to calibrate this card the following equipment is required:

1) A VME test system with a CPU and test program to scan the card and display the data,
2) A precision voltage standard and an optional precision volt meter to verify the standard,
3) A function generator to provide the AC common mode voltage,
4) A test connector to apply voltage to the channels under test. This connector should use shielded cable to make the connection between the card and the voltage standard.

Install the card to be calibrated in the test chassis, apply power, and allow the card to stabilize for five minutes.

ZERO ADJUSTMENT

Connect the high side of each channel to the high side of the voltage standard. Connect the low side of each channel and analog ground to the low side of the voltage standard. Use a test connector described above to make these connections. Apply 610 micro Volts to the cards inputs and adjust the zero potentiometers (R13, R27, R41, R55, R69, R83, R97, R111) for a reading of one count using the data display in the test system.

GAIN ADJUSTMENT

Connect the high side of each channel and the card's analog ground to the low side of the voltage standard. Connect the low side of each channel to the high side of the voltage standard. This configures the input amplifier to invert the voltage from the voltage standard, and puts the positive input of the common mode resolver at ground. Input negative 9.9988 Volts from the voltage standard and adjust the gain potentiometers (R18, R32, R46, R60, R74, R88, R102, R116) for a reading of 3FFE by using the data display in the test system.

COMMON MODE ADJUSTMENT

Connect the low side of each channel and the card's analog ground to the low side of the voltage standard. Connect the high side of each channel to the high side of the voltage standard. Input 9.9988 Volts from the voltage standard, and adjust the common mode potentiometers, (R16, R30, R44, R58, R72, R86, R100, R114), for a reading of 3FFE.

Verify the previous adjustments and re-adjust as required.

The Common Mode potentiometers can also be adjusted with an AC signal generator. Connect the high and low side of each channel together and to the output of the function generator. Connect the analog ground from the card to the low side of the function generator. Adjust the function generator to output a 60 Hz, 10 Volt peak sine wave. Adjust the common mode potentiometers (R16, R30, R44, R58, R72, R86, R100, R114) for the minimum peak to peak counts using the data display on the test system. Verify the previous adjustments, and re-adjust as required.

TABLE 4

VOLTAGES AND CODES

(0 to 10 Volts)

Voltage	Code (hex)
+9.9994	3FFF
+9.9988	3FFE
+5.0000	2000
+2.5000	1000
+1.2500	0800
+625 mV	0400
+312.5 mV	0200
+156.2 mV	0100
+78.1 mV	0080
+39.0 mV	0040
+19.5 mV	0020
+9.76 mV	0010
+4.88 mV	0008
+2.44 mV	0004
+1.22 mV	0002
0.610 mV	0001

TABLE 5

BIT WEIGHT

(0 to 10 Volts)

Bit number	Value
15	Zero
14	Zero
13	5.0000 V
12	2.5000 V
11	1.2500 V
10	625 mV
9	312.5 mV
8	156.2 mV
7	78.1 mV
6	39.0 mV
5	19.5 mV
4	9.76 mV
3	4.88 mV
2	2.44 mV
1	1.22 mV
0	0.610 mV

IV. CALIBRATION PROCEDURE (+/- 10 Volt version)

In order to calibrate this card the following equipment is required:

5) A VME test system with a CPU and test program to scan the card and display the data,
6) A precision voltage standard and an optional precision volt meter to verify the standard,
7) A function generator to provide the AC common mode voltage,
8) A test connector to apply voltage to the channels under test. This connector should use shielded cable to make the connection between the card and the voltage standard.

Install the card to be calibrated in the test chassis, apply power, and allow the card to stabilize for five minutes.

VOLTAGE REFERENCE ADJUSTMENT

Monitor the output of the voltage reference with the voltmeter, and adjust R125 for a reading of 2.5000 Volts.

ZERO ADJUSTMENT

Connect the high and low side of each channel to the high side of the voltage standard. Connect the card's analog ground to the low side of the voltage standard. Use a test connector described above to make these connections. Apply 2.5000 Volts from the voltage standard, and adjust the zero potentiometers, (R13, R27, R41, R55, R69, R83, R97, R111) for a reading of zero counts using the data display in the test system.

COMMON MODE ADJUSTMENT

Connect the low side of each channel and the card's analog ground to the low side of the voltage standard. Connect the high side of each channel to the high side of the voltage standard. Input negative 9.9988 Volts from the voltage standard, and adjust the common mode potentiometers, (R16, R30, R44, R58, R72, R86, R100, R114), for a reading of E001.

GAIN ADJUSTMENT

Connect the high side of each channel and the card's analog ground to the low side of the voltage standard. Connect the low side of each channel to the high side of the voltage standard. This configures the input amplifier to invert the voltage from the voltage standard, and puts the summing junction of the common mode resolver at 2.000 Volts. Input negative 9.9988 Volts from the voltage standard, and adjust the gain potentiometers (R18, R32, R46, R60, R74, R88, R102, R116) for a reading of 1FFF by using the data display in the test system.

Verify the previous adjustments and re-adjust as required.

The Common Mode potentiometers can also be adjusted with an AC signal generator. Connect the high and low side of each channel together and to the output of the function generator. Connect the analog ground from the card to the low side of the function generator. Adjust the function generator to output a 60 Hz, +/- 10 Volt peak sine wave. Adjust the common mode potentiometers (R16, R30, R44, R58, R72, R86, R100, R114) for the minimum peak to peak counts using the data display on the test system. Verify the previous adjustments, and re-adjust as required.

TABLE 6

VOLTAGES AND CODES

(+/- 10 Volts)

Voltage	Code (hex)
-10.000 V	E000
-9.9988 V	E001
+9.9988 V	1FFF
+5.0000 V	1000
+2.5000 V	0800
+1.2500 V	0400
+625 mV	0200
+312.5 mV	0100
+156.2 mV	0080
+78.1 mV	0040
+39.0 mV	0020
+19.5 mV	0010
+9.76 mV	0008
+4.88 mV	0004
+2.44 mV	0002
+1.22 mV	0001

TABLE 7

BIT WEIGHT

(+/- 10 Volts)

Bit number	Value
15	Sign
14	Sign
13	Sign
12	5.0000 V
11	2.5000 V
10	1.2500 V
9	625 mV
8	312.5 mV
7	156.2 mV
6	78.1 mV
5	39.0 mV
4	19.5 mV
3	9.76 mV
2	4.88 mV
1	2.44 mV
0	1.22 mV