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PAS 9418/AO
ENGINEERING SPECIFICATION

16 CHANNEL
HIGH POWER AMPLIFIER
VME ANALOG OUTPUT CARD
Revision A (04/18/1998)

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16 Channel
High Power Amplifier
VME Analog Output Card

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I. INTRODUCTION

GENERAL DESCRIPTION

The PAS 9418/AO provides sixteen high power amplifier circuits on a 6U format card. This amplifier is pin compatible with the PAS 9716/AO, 16 channel, 16-bit Analog Output card. By using the combination of these two cards, a VME based analog output system can be constructed that will supply up to +/- 160 volts and up to 50 mAmps of output current.

External power supplies are required to power the amplifiers, and a front panel connector is provided for wiring to these supplies. The front panel also provides two DB37 connectors. One terminates the input signals and the other provides the amplified output signals. Both of these connectors have the same pin out as the PAS 9716 Analog Output card.

The maximum current and voltage that can be delivered by the amplifiers is primarily determined by the amplifier's power dissipation. This is dependent on supply voltage and load impedance. Custom versions of this board can be provided with gain and output drive tailored to the application.

Card Features: PAS 9418/AO

Number of Channels	16
Output Voltage	+/- 60 Volts (typ.), +/- 85 Volts (max.) +/- 160 Volt Outputs available with component changes
Output Current	+/- 50 mAmps (typ.)
Input Voltage	+/- 10 Volts (typ.), +/- 35 Volts (max.)
Gain	3 or 6, jumper selectable
External Power Supply	+/-50 VDC (min.), +/- 75 VDC (typ.), +/- 100 VDC (max.) +/- 175 VDC available with component changes
Slew Rate	10 Volts / uSec. (typ.)
Full Power Bandwidth	25 KHz (typ) @ V out 120 V pk-pk
Status LEDs	2 front panel LEDs are driven by the PAS 9716 Digital Outs
Size	6U format, 160 mm x 233 mm
Input / Output Connectors	2 ea. DB 37 female
Power Supply Connector	6 position shrouded header (Molex)

II. SPECIFICATIONS

Electrical Specifications

Number of Channels	16 Analog Outputs
Output Voltage	+/- 60 Volts (typ.) +/- 85 Volts (max.) +/- 160 Volt outputs with component change
Output Current	+/- 40 mAmps (min.), +/- 50 mAmps (typ.)
Input Voltage	+/- 10 Volts (typ.), +/- 35 Volts (max.)
Gain	3 or 6, jumper selectable
Zero Error	+/- 5 mV, (adjustable to zero)
Gain Error	+/- 0.1 % FS, (adjustable to zero)
Slew Rate	10 V / uSec (typ.)
Full Power Bandwidth	25 KHz (typ.) V out = 120 V pk-pk, 1.5 K ohm load
Output Voltage Swing	+/- Vs-12 Volts (min.), +/- Vs-10 Volts (typ) @ I out = 40 mAmps
Card Power Requirements (VME Bus)	+/- 12 Volts @ 30 mAmps (typ.)
(External Power Supplies)	+/- 50 VDC to +/- 100 VDC +/- 175VDC with component changes @ +/- 65 mAmp (No Load) @ +/- 900 mAmp (Full Load)

Environmental Specifications

Operating Temperature Range	0 to 55 degrees C.
Storage Temperature Range	-20 to 85 degrees C.
Junction Temperature	150 degrees C. (max.)
Thermal Resistance (junction to air)	55 degrees C. / Watt (typ.)
Relative Humidity Range	20% to 80%, non-condensing

Physical Specifications

Dimensions	Form factor: Double (160 mm x 233 mm)
Weight	12 oz. (typ)
Connectors	2 ea. DB37 female, (Analog Input and Output connectors) 1 ea. 6 pin shrouded header (External power connector) Mating connector, Molex P/N 50-57-9406

Jumpers and Indicators

The 9418/AO card contains 16 Pluggable jumpers and two LED indicators. All of the jumpers have three pins, and provide two possible jumper locations. Pin 1 of each jumper strip is defined with a square pad in the PC board layout.

These 16 jumpers are used to set each channels gain to either three or six. Gain of three is selected by installing the jumpers from pin 1 to 2. This is the left position for the jumpers.
Gain of six is selected by installing the jumpers from pin 2 to 3. This is the right position for the jumpers.

TABLE 1

PLUGGABLE JUMPER DEFINITIONS

Jumper #	Function
J1	Gain CH 0
J2	Gain CH 1
J3	Gain CH 2
J4	Gain CH 3
J5	Gain CH 4
J6	Gain CH 5
J7	Gain CH 6
J8	Gain CH 7
J9	Gain CH 8
J10	Gain CH 9
J11	Gain CH 10
J12	Gain CH 11
J13	Gain CH 12
J14	Gain CH 13
J15	Gain CH 14
J16	Gain CH 15

Two LEDs are provided at the front panel to indicate the board's status. These LEDs are steered by the DO1 and DO2 signals from the 9716 Analog Output card. If the amplifier is not wired directly to the AO card, then the LEDs will be driven by the signals that are wired to pins 1 and 2 of P3.

Connector Definitions

Two 96 position DIN connectors are installed on the back plane end of the board and connect to the VME bus to bring in +/- 12 Volts. This voltage is used for the offset adjustment of the amplifier circuits. The board also jumpers through the bus grant and interrupt acknowledge signals using these connectors.

Two DB37 female connectors are installed through the board's front panel to provide access to the sixteen analog output channels and the two digital outputs. The pin out of these connectors is defined on the following page.

A six-position Molex header is provided at the front panel, and located between the two DB37 connectors. This connector is used to bring in external power to the amplifiers. The mating connector to this header is Molex P/N 50-57-9406, and the crimp on pin P/Ns are 16-02-1114 or 16-02-1125.

The pin out of this connector is defined below.

TABLE 2

6 Position Molex Header

1	Positive Power Supply
2	Power Supply Ground
3	Negative Power Supply
4	N/C
5	N/C
6	N/C

TABLE 3

DB37 Connectors (P3 and P4)

		19	AGND
AGND	37		
		18	CH1H
AGND	36		
		17	CH3H
AGND	35		
		16	CH5H
AGND	34		
		15	CH7H
AGND	33		
		14	CH9H
AGND	32		
		13	CH11H
AGND	31		
		12	CH13H
AGND	30		
		11	CH15H
AGND	29		
		10	CH0H
AGND	28		
		9	CH2H
AGND	27		
		8	CH4H
AGND	26		
		7	CH6H
AGND	25		
		6	CH8H
AGND	24		
		5	CH10H
AGND	23		
		4	CH12H
AGND	22		
		3	CH14H
AGND	21		
		2	DO1
AGND	20		
		1	DO2

P3 is the input connector, P4 is the output connector. The same signal names are used in the input and output connectors. Example; CH0H input is P3 pin 10, and CH0H output is P4 pin 10.

III. CIRCUIT DESCRIPTION

The PAS 9418/AO card contains 16 high power amplifier circuits. Cards can be configured to either provide a gain of three or gain of six. In either case, the output current and voltage range will be increased significantly when compared with a standard analog output card.

All of the amplifier circuits have gain and offset adjustments. A calibration procedure is provided on the following page, and describes how to make these adjustments.

The amplifiers used on this card are high voltage monolithic MOSFET operational amplifiers. They deliver performance features previously only found in hybrid designs, while increasing reliability. The amplifier part number is PA42, and they are built by Apex Microtechnology Corporation.

The PA42 is packaged in Apex's hermetic SIP10 package. This package has a typical thermal resistance of 55 deg, C per Watt from junction to air, and the device has a maximum junction temperature of 150 deg. C.
Based on these parameters, the amplifier will dissipate a maximum of 1.7 Watts, and should typically be operated at 1.25 Watts or less.

When the amplifier card is configured to drive 60 Volts at 50 mAmps into a resistive load with +/- 75 Volt power supplies, the maximum power in the amplifier will be 1.17 Watts. In this example, the load resistance is 1.2 K ohms, and the maximum power dissipation in the amplifier occurs at half of the power supply voltage. As the output voltage increases from this point, the voltage across the amplifier decreases, and as the output voltage decreases, the current through the amplifier and the load decreases. When the amplifier is driving this load to 60 volts, it is delivering 3 Watts of power to the load, and the amplifier is dissipating 750 mWatts.

VI. CALIBRATION PROCEDURE

Configure all sixteen jumpers on the PAS 9418/AO card to position 2 to 3. This configures all channels on the card for the gain of 6. Install the card in a VME chassis, and connect the external power supplies. Allow the card to stabilize for approximately 15 minutes.

Offset Adjustment

Connect all of the input signals to ground, either using a shorting connector or by connecting the card to a PAS 9716/AO card and driving the outputs to zero Volts. Observe the individual output channels with a Voltmeter and adjust the zero pot on each channel for zero Volts. The offset adjustment pots are defined in the table below.

Gain Adjustment

Drive all of the input signals to 10.00 Volts, and adjust all of the gain pots so that all of the outputs are at 60.00 Volts. The gain adjustment pots are defined in the table below.

TABLE 4

Gain and Offset Potentiometers

CH #	Offset Pot	Gain Pot
0	R4	R10
1	R16	R22
2	R28	R34
3	R40	R46
4	R52	R58
5	R64	R70
6	R76	R82
7	R88	R94
8	R100	R106
9	R112	R118
10	R124	R130
11	R136	R142
12	R148	R154
13	R160	R166
14	R172	R178
15	R184	R190