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PAS 9422/AO ENGINEERING SPECIFICATION

16 CHANNEL HIGH POWER AMPLIFIER VME ANALOG OUTPUT CARD

Revision A (03/22/2001)

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16 Channel High Power Amplifier
VME Analog Output Card

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I. INTRODUCTION

GENERAL DESCRIPTION

The PAS 9422/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 and the PAS 9715/AO, 32 channel, 12-bit Analog Output card. By using the combination of analog output and amplifier cards, a VME based analog output system can be constructed that will supply up to +/- 210 Volts and up to 200 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. The front panel is 1.6 inches wide and occupies two VME card slots. This is because the high power operational amplifiers used on the card are too tall to fit in a single VME slot. Aluminum heat sinks are used to increase the power dissipation of the amplifiers, and four amplifiers share a common heat sink. Both of the front panel connectors have the same pin out as the PAS 9715/AO and PAS 9716/AO Analog Output cards.

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. Amplifiers can be configured for either inverting or non-inverting operation, with soldered in jumpers.

Card Features: PAS 9422/AO

Number of Channels	16 (max.)
Output Voltage	+/- 210 Volt (max.)
Output Current	+/- 200 mAmps (max.)
Input Voltage	+/- 10 Volts (typ.), +/- 35 Volts (max.)
Gain	User specified
External Power Supply	+/-50 VDC (min.), +/- 150 VDC (typ.), +/- 225 V (max.)
Slew Rate	20 Volts / uSec. (typ.)
Full Power Bandwidth	24 KHz (typ)
Status LED’s	2 front panel LED’s are driven by the PAS 9715 or PAS 9716 Digital Output signals
Size	6U format, 160 mm x 233 mm
Front Panel	Double wide, requires two VME card slots
Input / Output Connectors	2 ea. DB 37 female
Power Supply Connector	6 position shrouded header (Molex) Mating Connector Molex # 50-57-9406

II. SPECIFICATIONS

Electrical Specifications PAS 9422/AO-000

Number of Channels	16 (Ch.0 – Ch.15)
Amplifier Configuration	Inverting
Gain	-63.3
Input Voltage	+/- 3.3 Volts (typ.),
Output Voltage	+/- 210 Volts (typ.)
Output Current	+/- 10 mAmps (typ.)
Current Limit	12 mA
Output Resistance (No load)	200 Ohms

Electrical Specifications PAS 9422/AO-006

Number of Channels	6 (Ch.0 – Ch.5)
Amplifier Configuration	Non-inverting
Gain	+ 5.00
Input Voltage	+/- 10 Volts (typ.),
Output Voltage	+/- 50 Volts (typ.)
Output Current	+/- 100 mAmps (typ.)
Current Limit	120 mA
Output Resistance (No load)	55 Ohms

Electrical Specifications PAS 9422/AO-009

Number of Channels	9 (Ch.0 – Ch.8)
Amplifier Configuration	Non-inverting
Gain	+21.2
Input Voltage	+/- 10 Volts (typ.),
Output Voltage	+/- 212 Volts (typ.)
Output Current	+/- 5 mAmps (typ.)
Current Limit	10 mA
Output Resistance (No load)	110 Ohms

Electrical Specifications PAS 9422/AO-016

Number of Channels	16 (Ch.0 – Ch.15)
Amplifier Configuration	Non-inverting
Gain	+21.2
Input Voltage	+/- 10 Volts (typ.),
Output Voltage	+/- 212 Volts (typ.)
Output Current	+/- 5 mAmps (typ.)
Current Limit	10 mA
Output Resistance (No load)	110 Ohms

Electrical Specifications PAS 9422/AO-116

Number of Channels	16 (Ch.0 – Ch.15)
Amplifier Configuration	Non-inverting
Gain	+ 7.0
Input Voltage	+/- 5.0 Volts (typ.),
Output Voltage	+/- 35.0 Volts (typ.)
Output Current	+/- 200 mA (max.)
Current Limit	200 mA
Output Resistance (No load)	50 Ohms

Electrical Specifications Common to all Versions

Zero Error Referred to Input	+/- 2 mV (typ.), +/- 10 mV (max.)
Gain Error	+/- 0.5 % FS (typ.)
Slew Rate	20 V / uSec (typ.)
Full Power Bandwidth	24 KHz (typ.)
Output Voltage Swing	+/- Vs-15 Volts (min.), +/- Vs-10 Volts (typ) @ I out = 200 mAmps
Card Power Requirements (External Power Supplies)	 +/- 50 VDC to +/- 225 VDC
Quiescent Current per Amplifier	2.0 mA (typ), 3.0 mA (max)

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)	30 degrees C. / Watt (typ.) (Without heatsink)
Relative Humidity Range	20% to 80%, non-condensing

Physical Specifications

Dimensions	Form factor: Double (160 mm x 233 mm)
Front Panel	Double Wide, requires two VME card slots
Weight	16 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 PAS 9422/AO card contains 16 sets of soldered in jumpers and two LED indicators.
These 16 jumpers are used to configure each amplifier to be either inverting or non-inverting, and are factory installed.

Two LED's are provided at the front panel to indicate the board's status. These LED's are steered by the DO1 and DO2 signals from the PAS 9715 or PAS 9716 Analog Output cards. If the amplifier is not connected directly to the AO card, then the LED's will be driven by the signals that are connected to pins 1 and 2 of P3.

Connector Definitions

Two 96 position DIN connectors are installed on the backplane end of the board and jumper through the VME bus grant and interrupt acknowledge signals.

Two DB37 female connectors are installed through the board's front panel to provide access to the sixteen amplifier circuits and the LED drive signals. The pin out of these connectors is defined on the following page.

A six-position Molex header is provided at the front panel, 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 1

6 Position Molex Header

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

TABLE 2

DB37 Connectors (P3 and P4)

AGND	37	19	AGND
AGND	36	18	CH0
AGND	35	17	CH1
AGND	34	16	CH2
AGND	33	15	CH3
AGND	32	14	CH4
AGND	31	13	CH5
AGND	30	12	CH6
AGND	29	11	CH7
AGND	28	10	CH8
AGND	27	9	CH9
AGND	26	8	CH10
AGND	25	7	CH11
AGND	24	6	CH12
AGND	23	5	CH13
AGND	22	4	CH14
AGND	21	3	CH15
AGND	20	2	LED1
		1	LED2

P3 is the input connector, P4 is the output connector. The same signal names are used in the input and output connectors. Example; CH0 input is P3 pin 18, and CH0 output is P4 pin 18.

III. AMPLIFIER CIRCUIT DESCRIPTION

The PAS 9422/AO card contains 16 high power amplifier circuits. Cards can be configured for either inverting or non-inverting operation. Custom configurations of gain and the number of channels populated are available as options.

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 PA15, and they are built by Apex Microtechnology Corporation.

The PA15 is packaged in Apex's hermetic SIP02 package. This package has a typical thermal resistance of 30 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 3.0 Watts. The PAS 9422/AO provides additional heat sinking for the parts to lower the junction temperature.

When the amplifier 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.

Under these conditions, the power in the amplifier is calculated to be,
(37.5 Volts x 37.5 Volts) / 1.2 K Ohms = 1.17 Watts

As the output voltage increases from this point, the voltage across the amplifier and the power dissipated by the amplifier decreases. As the output voltage decreases from this point, 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.

When the amplifier is configured to drive 40 Volts at 100 mAmps into a resistive load with +/- 55 Volt power supplies, the maximum power in the amplifier will be 1.89 Watts. In this example, the load resistance is 400 Ohms, and the maximum power dissipation in the amplifier occurs at half of the power supply voltage.

Under these conditions, the power in the amplifier is calculated to be,
(27.5 Volts x 27.5 Volts) / 400 Ohms = 1.89 Watts

When the amplifier is configured to drive 212 Volts at 10 mAmps into a resistive load with +/- 225 Volt power supplies, the maximum power in the amplifier will be 596 mWatts. In this example, the load resistance is 21.2 K Ohms, and the maximum power dissipation in the amplifier occurs at half of the power supply voltage.

Under these conditions, the power in the amplifier is calculated to be,
(112.5 Volts x 112.5 Volts) / 21.2 K Ohms = 596 mWatts
Other factors to consider when using these cards are that the amplifiers require a minimum of +/- 50 Volt power supplies and the power supply voltages must be 12 Volts greater than the output voltage swing. This voltage is required to properly bias the current sources in the amplifiers, so that they will meet their published specifications. In applications where the amplifier always has a positive output voltage and delivers the load current from the positive supply, a negative power supply with a low output current can be used. The low current negative supply is always required to properly bias the internal current sources.