ARTISAN®
TECHNOLOGY GROUP

Your **definitive** source for quality pre-owned equipment.

Artisan Technology Group
(217) 352-9330 | sales@artisantg.com | artisantg.com

Full-service, independent repair center
with experienced engineers and technicians on staff.

We buy your excess, underutilized, and idle equipment
along with credit for buybacks and trade-ins.

Custom engineering
so your equipment works exactly as you specify.

- Critical and expedited services
- In stock / Ready-to-ship
- Leasing / Rentals / Demos
- ITAR-certified secure asset solutions

Expert team | Trust guarantee | 100% satisfaction

All trademarks, brand names, and brands appearing herein are the property of their respective owners.

Find the *Precision Analog Systems PAS 9715/A0* at our website: *Click HERE*

Document PAS007
DOC Revision B (7/11/11)

PAS 9715/AO
ENGINEERING SPECIFICATION

32 CHANNEL, 12 BIT
VME ANALOG OUTPUT CARD
PCB REVISION B (04/12/1999)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Additional copies of this manual or other Precision Analog Systems (PAS) literature may be obtained from:

Precision Analog Systems Co.
1021 SW 75th Avenue
Plantation, Florida 33317
Phone: (954) 587-0668
E-mail: inquiry@precisionanalog.com

The information in this document is subject to change without notice.

PAS makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Although extensive editing and reviews are performed before release, PAS assumes no responsibility for any errors that may exist in this document. No commitment is made to update or keep current the information contained in this document.

PAS does not assume any liability arising out of the application or use of any product or circuit described herein, nor is any license conveyed under any patent rights or any rights of others.

PAS assumes no responsibility resulting from omissions or errors in this manual, or from the use of information contained herein.

PAS reserves the right to make any changes, without notice, to this product to improve reliability, performance, function or design.

All rights reserved.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

32 Channel 12 Bit
VME Analog Output Card

TABLE OF CONTENTS

Section	Title	Page
I	**INTRODUCTION**	5
	General Description	5
	Card Features	5
II	**SPECIFICATIONS**	7
	Electrical Specifications	7
	Environmental Specifications	7
	Physical Specifications	7
	Jumpers and Indicators	8
	Connector Definitions	10
III	**PROGRAMMING INFORMATION**	12
	Control and Status Register	13
	Digital Output Register	14
	Software Sync Register	15
	Software Reset Register	15
	Board Identifier PROM	15
	32 Digital to Analog Converters	16
IV	**CALIBRATION PROCEDURE**	17

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

32 Channel 12 Bit
VME Analog Output Card

LIST OF TABLES

Table	Title	Page
1	Pluggable Jumper Definitions	9
2	6 Position Shrouded Header, P6	10
3	DB37 Connectors	11
4	Memory Map	12
5	DAC Update Mode	13
6	Output Voltage Range	13
7	CSR Word Format	14
8	Digital Output Register	14

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

I. INTRODUCTION

GENERAL DESCRIPTION

The PAS 9715/AO provides thirty-two, twelve bit analog voltage output channels on a 6U VMEbus card. VME systems with A16, A24, or A32 addressing are supported, and data writes of 16 or 32 bits can be used. Pluggable jumpers are used to configure the width of the address bus and the data bus width is specified by the instruction type.

Eight, quad high speed voltage output DACs, with 6 uSec settling times are used to provide a total of thirty two analog output channels. The voltage output signals are available on a pair of 37 pin D connectors mounted through the front panel. These connectors also terminate four digital output signals. All of the analog outputs can be disconnected from the field wiring through on board, low impedance FET switches.

Six analog output ranges are available, under program control, which allows the card's output voltage to be tailored to your application. Bipolar ranges from +/- 10 volts to +/- 2.5 volts and unipolar ranges from 0 to 10 volts to 0 to 2.5 volts are supported. All output ranges provide a minimum of 5 milliamps of output current.

External synchronization signals and the card's voltage reference are available in a separate six-position connector at the front panel. Additional features include a board identifier PROM, control and status register, and DAC loop back registers.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Card Features: PAS 9715/AO

- 32 channels of analog voltage outputs, with a 12 bit D/A Converter per channel
- Software selectable +/- 10 V, +/- 5V, +/- 2.5 V, 0-10V, 0 to 5V, 0 to 2.5V ranges @ 5 mAmp output current per channel
- All DACs are calibrated with a precision on board voltage reference
- Offset binary or two's complement data format software selectable
- DAC's reset to bipolar zero during power up reset
- Outputs can be disconnected from field wiring through low impedance FET switches
- Output impedance of 0.6 ohm
- Output slew rate of 2.2 Volts per uSec, Settling time of 6 uSec to 0.01%
- DACs have digital readback registers
- Two DACs can be updated with a single VME long word write
- Double buffered DACs can be updated simultaneously with software or external sync
- VME 6U form factor; 233 mm x 160 mm card size
- VME access: D32, D16; A32, A24, A16 Slave
- No VME Interrupts
- Optional VME SYSFAIL assert on power up, jumper selectable
- SYSFAIL LED and board access LED on front panel
- Board Identifier PROM (Board ID is VMEID PAS9715/AO A0)
- Analog output signals are in a pair of DB37 connectors at the front panel.
- External synchronization input, output, and voltage reference signals in a separate six-position connector at the front panel.
- DACs are powered by +/- 15 Volts from an on board DC-to-DC converter
- Operating temperature range 0 to 60 deg C.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

II. SPECIFICATIONS

Electrical Specifications

Number of Channels	32 Analog Outputs, 4 Digital Outputs
Resolution	12 bits
Output Voltage	+/- 10 Volts, +/- 5 Volts, +/- 2.5 Volts 0 to 10 Volts, 0 to 5 Volts, 0 to 2.5 Volts
Output Current	+/- 5 mAmps
Settling Time	6 uSec (typ) to 0.01%
Integral Nonlinearity	+/- 1 LSB (max.)
Differential Nonlinearity	+/- 1 LSB (max.)
In Scale Error	+/- 2 LSB
Full Scale Error	+/- 2 LSB
Digital Outputs	4 Outputs, 74ALS14 Output Drivers
Low Level Output Voltage	0.35 V (typ), 0.50 V (max.) @ I out = 8mA
High Level Output Voltage	3.5 V (typ), 2.7 V (min.) @ I out + -0.4mA
Card Power Requirements	5 Volts @ TBD Amp, (typ)

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: Double (160 mm x 233 mm)
Weight	12 oz. (typ)
Connectors	2 ea. 96 position, (VME bus connectors) 2 ea. DB37 female, (Analog Output connectors) 1ea. 6 pin shrouded header (external sync. input, output & voltage ref.) Mating connector, Molex P/N 50-57-9406

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Jumpers and Indicators

The 9715/AO card contains 28 pluggable jumpers and two LED indicators. The first 24 jumpers are used to set the board's VME base address, and are defined in the table 1 on page 9. 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 on page 9.

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.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

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 X	A16 Addressing
J27 (1-2)	LED2 indicates board passed
J27 (2-3)	LED2 indicates board accessed
J28 IN	SYSFAIL controlled by control register

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Two LEDs are provided at the front panel to indicate the board's status. The upper LED is the 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 that bit. The SYSFAIL line will also be driven when the FAIL LED is on, if J28 is installed.

The lower LED is the PASS/ACCESS LED, and its function is selected with J27. 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. This LED can be used to indicate the board has passed some initial power up tests when it is configured for the pass function. When configured for the access function, the 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 pair of DB37 female connectors is installed through the board's front panel to provide access to the thirty-two analog output channels and the four digital outputs. A six position shrouded header is provided between the DB37 connectors to provide access to the external synchronization input and output signals and the positive voltage reference. The pin out of these connectors is defined below and on the following page.

TABLE 2

6 Position Shrouded Header, P6

Pin #	Signal Name
1	Reference Voltage High
2	Analog Ground
3	External Sync Out
4	Ground
5	External Sync In
6	Ground

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

TABLE 3

DB37 CONNECTORS

			(P4)	(P3)
		19	AGND	AGND
AGND	37			
		18	CH15H	CH31H
AGND	36			
		17	CH14H	CH30H
AGND	35			
		16	CH13H	CH29H
AGND	34			
		15	CH12H	CH28H
AGND	33			
		14	CH11H	CH27H
AGND	32			
		13	CH10H	CH26H
AGND	31			
		12	CH9H	CH25H
AGND	30			
		11	CH8H	CH24H
AGND	29			
		10	CH7H	CH23H
AGND	28			
		9	CH6H	CH22H
AGND	27			
		8	CH5H	CH21H
AGND	26			
		7	CH4H	CH20H
AGND	25			
		6	CH3H	CH19H
AGND	24			
		5	CH2H	CH18H
AGND	23			
		4	CH1H	CH17H
AGND	22			
		3	CH0H	CH16H
AGND	21			
		2	DO1	DO2
AGND	20			
		1	DO3	DO4

A Screw Termination Panel (STP) is available for terminating field signals and cabling them to the Analog Output card. The model # for the STP is 9400, and the I/O cable is # CBLF-D37A-0010.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

III. PROGRAMMING INFORMATION

The 9715/AO card responds to word and longword writes to the thirty-two Digital to Analog Converters (DACs). The card also supports word writes and reads to the control and status register, digital output, SW sync and SW reset registers, and word reads of the board identifier PROM. The card's memory map is shown below.

TABLE 4

PAS 9715/AO MEMORY MAP

BASE + 00	Reserved	Reserved	BASE + 01
02	Reserved	Con/Stat Register	03
04	Reserved	Reserved	05
06	Reserved	Digital Out Register	07
08	Reserved	Reserved	09
0A	Reserved	SW Sync	0B
0C	Reserved	Reserved	0D
0E	Reserved	SW Reset	0F
10	Reserved	Reserved	11
1E	Reserved	Reserved	1F
20	FF	V (56)	21
22	FF	M (4D)	23
24	FF	E (45)	25
26	FF	I (49)	27
28	FF	D (44)	29
2A	FF	P (50)	2B
2C	FF	A (41)	2D
2E	FF	S (53)	2F
30	FF	9 (39)	31
32	FF	7 (37)	33
34	FF	1 (31)	35
36	FF	5 (35)	37
38	FF	A (41)	39
3A	FF	O (4F)	3B
3C	FF	A (41)	3D
3E	FF	0 (30)	3F
40	CH 0	CH 0	41
42	CH 1	CH 1	43
	Thru	Thru	
7C	CH 30	CH 30	7D
7E	CH 31	CH 31	7F

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Control and Status Register

The Control and Status Register (CSR) is located at the cards base address plus 2. Writes to the CSR are used to determine what conditions will update the DACs, select the data format and output voltage range, and enable or disable the outputs.

Bits 1 and 2 of the CSR determine when the DAC's output registers will be updated, and the states of these bits are defined in the table below.

TABLE 5

DAC Update Mode

Bit 2	Bit 1	DAC update mode
0	0	DACs update when they are written
0	1	DACs update on the negative edge of the external sync signal
1	0	DACs update on the positive edge of the external sync signal
1	1	DACs update with a software sync.

Bit 3 of the CSR determines the data format. When it is a 0 the card uses 2's complement data and when it is a 1 the card uses offset binary data format. When the card is configured for bipolar outputs, 2's complement data should be selected, and unipolar output configurations should select offset binary data. Refer to the section on the Digital-to-Analog Converters for more information on the data formats.

Bit 4, 5 and 6 of the CSR determine the card's output voltage range and if the output range is unipolar or bipolar. Bits 4 and 5 select the range, and bit 6 selects unipolar or bipolar. The states of these bits are defined in the following table.

TABLE 6

Output Voltage Range

Bit 6	Bit 5	Bit 4	Output Voltage Range
0	0	0	+/- 10 Volts
0	0	1	+/- 5.0 Volts
0	1	0	+/-2.5 Volts
0	1	1	+/- 2.5 Volts
1	0	0	0 to 10 Volts
1	0	1	0 to 5.0 Volts
1	1	0	0 to 2.5 Volts
1	1	1	0 to 2.5 Volts

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Bit 7 of the CSR is used to enable the analog outputs. The outputs are disabled when the board is reset or when a zero is written to bit 7. This puts the outputs in a high impedance state. Writing a 1 to bit 7 connects the outputs of the DACs to the output connectors through low impedance FET switches.

TABLE 7

CSR WORD FORMAT

15-8	7	6	5	4	3	2	1	0
Not Used	Out Enbl HT	Uni Biplr HT	Out Range HT	Out Range HT	Data Form HT	Updat Mode HT	Updat Mode HT	Sync Status HT

LT = Low True
HT = High True

The status of the CSR is read at the card's base address plus 2. The Status Register returns the state of the control bits 1 through 7, and also indicates the status of the DAC synchronization signal with bit 0.

Bit 0 in the Status Register is the synchronization status bit, and returns a 1 when the condition that causes the DACs to be updated has occurred. The sync status bit resets after the CSR is read. When the card is configured to update whenever a DAC is written, this bit will always return a zero, since the update event is not required. If the card is configured to update the DACs with an external or software sync signal, then this bit will return a 1 when the trigger event occurs, and will reset to 0, after the CSR is read.

The power up or reset condition of the Control and Status Register is FF00, and indicates the outputs are disabled, the +/- 10 Volt output range is selected with 2's compliment data format, and the DACs will update when they are written.

Digital Output Register

The Digital Output Register (DOR) is located at the card's base address plus six, and is used to control the LEDs, external sync output and the digital output signals. The format of this register is shown below.

TABLE 8

DIGITAL OUTPUT REGISTER

15-8	7	6	5	4	3	2	1	0
Not Used	Not Used	Not Used	Not Used	Not Used	DO4	DO3	DO2 Pass LED	DO1 Fail LED

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Bit 0 in the DOR controls DO1 and drives the fail LED. When the card powers up or is reset, this bit is turned on. The fail LED is the upper most LED on the front panel. It can be turned off by writing a 1 to bit zero. When the fail LED is on, the SYSFAIL signal will be driven on the VME backplane if J28 is installed. The state of DO1 is also driven out on pin 2 of P3 and P4.

Bit 1 in the DO register controls DO2, and drives the external sync output. It can be used to drive the Pass LED, if J27 is installed from pin 1 to 2.

Bits 2 and 3 of the DO register control DO3 and DO4 respectively. DO3 is the output signal connected to pin 1 of P4, and DO4 is connected to pin 1 of P3.

Bits 4 through 15 of the DO register are not used, and when the DO register is read they will return values of one. The power up or reset state of the DO register is FFF0.

Software Sync Register

The Software Sync Register is located at the boards base address plus A. Writing to this location causes the DAC output registers to be updated, if the software sync mode was selected with the CSR. Reading the software sync register will return a value of FFFF.

Software Reset Register

The Software Reset Register is located at the boards base address plus E. Writing to this location will reset the board to its power up reset condition. Reading this register will return the value FFFF.

Board Identifier PROM

The board IDentifier PROM is located at an offset of 20 (hex) from the base address, and can be read with word reads 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 will handshake, but not transfer any data.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

32 Digital to Analog Converters

The thirty-two D-to-A Converters (DACs) can be written to starting at the board's base address plus 40 (hex). Binary Two's Complement or Offset Binary data can be written to the DACs depending on the state of bit three in the Control and Status Register. Two's complement data should be used with bipolar outputs, so that the code required to produce a negative voltage can be determined by taking the 2's complement of the code that produces a positive voltage of the same magnitude. For the bipolar Analog Output configuration of this card, using Two's Complement data a digital word of 7FF gives positive full scale output, 800 hex gives negative full scale output, and 000 hex gives bipolar zero output. All of the negative voltage codes have the MSB set to a one, so it represents the sign bit. The magnitude of positive full scale is always 1 LSB less than the magnitude of negative full scale, because of the one code required for zero.

Offset binary data should be used with unipolar outputs, since the sign of the data is always positive. A digital output word of FFF provides positive full scale in this configuration. Zero volts are produced with a digital word of 000, and half scale occurs at 800 hex.

Dual rank registers are used in the DAC's and data is always written into the DAC's input register. If the simultaneous update feature is disabled, the DAC register will also be updated during this write. If the DAC's are to be updated simultaneously, then the following sequence should be performed;

1) Bits 1 and 2 in the Control Register are set to select the condition that will update the DAC registers
2) all of the DACs are written to,
3) when the synchronization pulse occurs, all of the DACs will be updated.
4) The state of the update signal can be monitored by reading bit zero in the status register.

The Digital to Analog Converters can be written to individually using word transfers, or in pairs using longword transfers. During a power up reset, all of the DAC outputs will be disabled, and the output voltage of all of the DACs will set to mid scale. This is 0.000 Volts, since the card resets to the +/- 10 Volt range. The software controlling the board should configure the board to the proper output range, and write the initial values to all the DACs before enabling the outputs.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

IV. CALIBRATION PROCEDURE

1) Install the 9715/AO card in a VME chassis, and allow the card to stabilize for approximately 15 minutes.

2) All of the DACs on this card are connected to a common voltage reference, and only two adjustments are required to adjust the entire card.

3) Positive reference voltage adjustment.
   Monitor the positive reference voltage at P6 pin 1 and adjust R 24 for a value of 10.000 Volts.

4) Negative reference voltage adjustment.
   Monitor the negative reference voltage and adjust for a value of -10.000 Volts.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Artisan Technology Group is an independent supplier of quality pre-owned equipment

Gold-standard solutions

Extend the life of your critical industrial, commercial, and military systems with our superior service and support.

We buy equipment

Planning to upgrade your current equipment? Have surplus equipment taking up shelf space? We'll give it a new home.

Learn more!

Visit us at **artisantg.com** for more info on price quotes, drivers, technical specifications, manuals, and documentation.

Artisan Scientific Corporation dba Artisan Technology Group is not an affiliate, representative, or authorized distributor for any manufacturer listed herein.

We're here to make your life easier. How can we help you today?

(217) 352-9330 | sales@artisantg.com | artisantg.com

ARTISAN® TECHNOLOGY GROUP