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USER MANUAL

Accessory 24V

PMAC VME Axis Expansion Card

3Ax-602226-xUxx

October 15, 2003

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INTRODUCTION

PMAC's Accessory 24, the Axis Expansion board, provides four or eight additional channels of quadrature encoder inputs, analog outputs, data lines for analog inputs, and motor related flags (Limits, Home Flags, Amplifier Enables, Amplifier Faults, and position Compare-Equal signals). This Accessory is intended for those applications which require more than the basic eight channels of the above signals provided on the PMAC base board (when used with its Option 1). In particular, PMAC's dual feedback servo capability or its motor commutation feature for more than four position loops requires Acc-24. This is because, in the above applications, either two channels of encoder feedback signals, or two analog output channels are required for each motor. In applications which require some extra Master / Handwheel encoder inputs Acc-24 may also be required.

Acc-24 comes in two forms: Acc-24P for PMAC PC and Acc-24V for PMAC VME. The STD BUS version of PMAC is not supported with this accessory. This Manual deals with Acc-24V, WHICH is to be used in conjunction with PMAC VME. For the PC bus version of this accessory, a separate Manual is provided.

Acc-24V Options

Acc-24V fits in the next open bus slot and communicates to PMAC VME via a provided 50-pin flat cable. The basic form of this Accessory contains one PMAC DSPGATE. It, therefore, can support four extra channels of encoder inputs and analog outputs. Acc-24V OPT-1 provides another DSPGATE, which extends its capabilities to eight channels. This Option comes as piggyback board for the main Acc-24V card. It communicates to Acc-24V via the connector P3 located on the main card.

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CONNECTORS

Refer to the schematic layout diagram of Acc-24V for connector locations on the board. Also refer to the pin definition listings at the end of this manual.

P1

This connector provides structural support as well as the digital power supply (+5V) for Acc-24V. It can also bring in the +12V and the -12V supplies from the bus provided jumpers E85, E87, and E88 are installed (the installation of these jumpers voids the opto-isolation feature of Acc-24V)

J1

This connector provides the link between Acc-24V and PMAC VME via the J2 (JEXP) connector on the CPU board. A 50-pin flat cable is provided for this task (see also the connection diagram). J1 must be connected to the PMAC CPU board's J2 **(**JEXP**).**

J2

This connector provides the signals provided on the J1 connector in a buffered form. If one Acc-14V (the I/O expansion board) is used in conjunction with a PMAC-VME and an ACC-24V, then this connector should be used for the connection to the Acc-14V's J10 connector. For more than one Acc-14V, a daisychain connector is needed. (See the relevant connection diagram).

J3

This is an iSBX connector, which provides only +5V, GND, +12V, and -12V power supplies for an iSBX module such as Acc-28 (analog-to-digital converter board).

J4

This is another iSBX connector with identical pin description as J3.

J5

This connector contains miscellaneous I/O signals related to the second DSPGATE on Acc-24V Option 1. Typically, it is used for direct connection to Acc-28 (the analog-to-digital converter board).

J6

This connector brings in the required DSPGATE clock signals from PMAC's J6 (JXIO) connector. A 4-pin flat cable is provided for this purpose. For proper operation of Acc-24V J6 must be connected to PMAC's J6 (JXIO).

J7

This connector brings out the eight Compare-Equal signals generated from the DSPGATES on Acc-24V and its OPT-1. Jumpers E93 and E94 determine the signals' polarities.

J8

This connector contains miscellaneous I/O signals related to the first DSPGATE on Acc-24V. Typically, it is used for direct connection to ACC-28 (the analog-to-digital converter board).

J9

This connector's pins are hardwired (pin-to-pin) to the connector J5.

P2A (JMACH4)

This connector contains the signals for motor/encoder channels 13 to 16. Typically, this connector is linked to Acc-8D, the Terminal Block board, via a 64-pin flat cable supplied with Acc-8D Option V. This connector is on Acc-24V Option 1, the piggyback board.

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P2 (JMACH3)

This connector contains the signals for motor/encoder channels 9 to 12. Typically, this connector is linked to Acc-8D, the Terminal Block board, via a 64-pin flat cable supplied with Acc-8D Option V.

TB1

This is a 4-pin terminal block, which provides an alternative digital power supply (+5V) input to Acc-24V. Typically, it is used for applications, which require this accessory's operation outside a VME rack. In addition, TB1 can also bring in +12V and -12V power supply inputs. For this purpose, jumpers E85, E87, and E88 must be installed. Note that this configuration voids the opto isolation feature of the board.

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ACC-24V CONNECTIONS

In order to use ACC-24V in conjunction with PMAC VME and other related accessories several connections are required. In this section, the most critical connections are explained (also, see the connection diagrams within this Manual).

Power Connection

Acc-24V is designed to fit into VME slot, but it only uses the bus for structural support and power supply. When inserted into the bus, Acc-24V always uses the +5V bus power supply for its digital circuitry. It can also pass this supply to encoders through its JMACH connectors. Outside a VME rack, the terminal block TB1 may be used for Acc-24V's digital (circuitry) power supply. The power for the board's analog circuitry should come from a separate supply through the JMACH connectors. This is helpful especially if large motors are being controlled. However, it is possible to bring in the +12V and -12V from the bus (or through the terminal block) for the purpose of powering the analog circuitry on Acc-24V. In this case, jumpers E85, E87, and E88 should be installed (this configuration defeats the opto isolation feature of the board).

Basic PMAC-VME Connection

A 4" long (supplied) 50-pin flat cable should be used to connect PMAC's JEXP (J2 on the CPU board) to ACC-24V's J1. In addition, a (supplied) 4-pin flat cable should be used between PMAC's JXIO (J6 on PMAC's main board) and ACC-24V's J6.

Connection to ACC-14V

If one Acc-14V (the I/O expansion board) is used in conjunction with a PMAC VME and an Acc-24V, then the connector J2 should be used for the connection to the Acc-14V's J10 connector. For more than one Acc-14V, a daisy chain connector is needed. (See the connection diagram.)

Connection ACC-28

Up to two Acc-28s may be connected via J8 and J9 to one Acc-24V. The first Acc-28's J1 connects to J8; the second Acc-28's J1 connects to J9 (note that the second connection is only possible when Option 1 is installed). If Acc-28s have the mating iSBX connectors, they may be directly plugged into Acc-24V's connectors J3 and J4 for structural support.

Connection to ACC-8D (or ACC-8P)

Each JMACH connector (J7 and J8) may be connected to one Terminal Block board (Acc-8D). The Terminal Blocks should be ordered with Option V so that the 64-pin socket and flat cable are provided for the connection to Acc-2V.

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DSPGATE CONSIDERATIONS

The maximum number of DSPGATEs used with each PMAC is four. The DSPGATES are used for PMAC's specific motor/ amplifier/ encoder interface functions. Each DSPGATE handles these functions for four channels. Thus, the basic 4-axes PMAC talks to one on-board DSPGATE. A PMAC with Option 1 talks to two on-board DSPGATEs, which provides these functions for eight channels. A PMAC with Option 1 and an Acc-24V will talk to three DSPGATES. A PMAC with Option 1, connected to an Acc-24V with its Option1, talks to four DSPGATEs. As a result, whenever an Acc-24V is used, other accessories with on-board DSPGATEs should not be used. Otherwise, PMAC's channels 9 to 16 will not function properly. Currently, for PMAC VME, the only accessory with this conflict is the Acc-29, the MDLT transducer interface board.

Using Acc-24 Data

PMAC's main manual provides the details of the memory map for Acc-24V's DSPGATEs (this will not be repeated here). These DSPGATE registers may be directly or indirectly read, written to, or inspected via some specific I-variables, M-variables, and the on-line read/write commands. M-variables may be used to directly access these registers within the user programs. Alternatively, it is possible to use PMAC's on-line Memory Read and Memory Write commands (R, RH, and W) to access these registers. In this section, the pertinent I-variables, which should be set in order to use the DSPGATEs within Acc-24V, will be mentioned. This will be followed by a brief note on the use of M-variables for reading and writing to various DSPGATE registers. Refer to the PMAC main manual for more details of I-variables and M-variables definitions and assignments.

I-Variable Assignment

The key I-variables which may require assignment (or re-assignment) are Ix02, Ix03, Ix04, Ix05, Ix25, and Ix83.

Ix02 tells PMAC where (what address) to put the output command for motor x. If a DAC register within Acc-24V's DSPGATEs is to be used for command output, then this parameter should be modified.

Example: To use the first DAC on the third DSPGATE (first DSPGATE on Acc-24V) for motor 5, I502= $C023. For PMAC commutated motors, Ix02 must point to the lower address of a pair of adjacent DACs that are being used to command the phases of the motor (DACs 9 and 10, or 11 and 12, or 13 and 14, or 15 and 16 on Acc-24V and its Opt. 1).

Ix03 through Ix05 tell PMAC where to look for position feedback / master handwheel information via the Encoder Conversion Table. This table should be extended using PMAC's memory write (WY) command, or through a special window in the PMAC executive program, to include the appropriate registers within Acc-24V's DSPGATES. Instead of the memory, write command the special window in the PMAC's Executive software may also be used. In addition, Ix03 through Ix05 should be modified accordingly to addresses of theses new conversion table entries. For example, to extend the default version of PMAC's Encoder conversion table by one entry, we may use WY:$72A,$00C020,$00 (see the Encoder Conversion Table section in the PMAC User Manual). Here, $C020 is the address of the first encoder counter on Acc-24V (ENC 9). This address is written in the last entry within the default conversion table at $72A. In addition, Ix03 is modified to be: Ix03= $72A.

Note

For a dual feedback application, Ix03 and Ix04 must be assigned to different addresses within the table. The instruction for setting Ix05, Motor x Master (handwheel) position address is identical to those for Ix03, except that extended bits (bits 16 to 23) of the data mean different things (see the I-variable Specification section within the PMAC User Manual).

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Ix25 parameter tells PMAC what set of input it will look to for motor x's limit switches, home flag, and Amplifier Fault flag. Typically, these are the inputs associated with an encoder input, specifically, those of the position feedback encoder for the motor. The default values of Ix25s point to addresses within the first two DSPGATEs on board the PMAC main board. To re-assign a particular Ix25 to an appropriate address within the DSPGATEs on board Acc-24V the following table should be used:

Flag Registers within Acc-24V DSPGATEs

lim9, hmfl9, ...	$C020
lim10, hmfl10, ...	$C024
lim11, hmfl11, ...	$C028
lim12, hmfl12, ...	$C02C
lim13, hmfl13, ...	$C030
lim14, hmfl14, ...	$C034
lim15, hmfl15, ...	$C038
lim16, hmfl16, ...	$C03C

Ix83 is the parameter, which tells PMAC which register to get its commutation (phasing) information from for motor x on an ongoing basis. This parameter which applies only to PMAC commutated motors, has default values pointing to the phase position encoder registers within the DSPGATEs. The default addresses for motors 1 to 4 are on the PMAC's DSPGATEs; for motors 5 to 8, they are on Acc-24V's DSPGATEs (see the PMAC User Manual I-variable Specification section). If the default values are not appropriate for a particular application, they may be easily modified using I-variable assignment statements.

M-Variable Assignment

A detailed description of M-variable assignments and use to access PMAC's memory and I/O space is given in the PMAC User Manual (under PMAC Computation Features). The user may assign M-variables to any of the registers within the DSPGATEs (see the PMAC DSP-GATE Features in section the User Manual). These registers may be subsequently read or written to using these (previously defined) M-variables.

Example: To read ADC register 16 (on the second DSPGATE within Acc-24V), the definition:

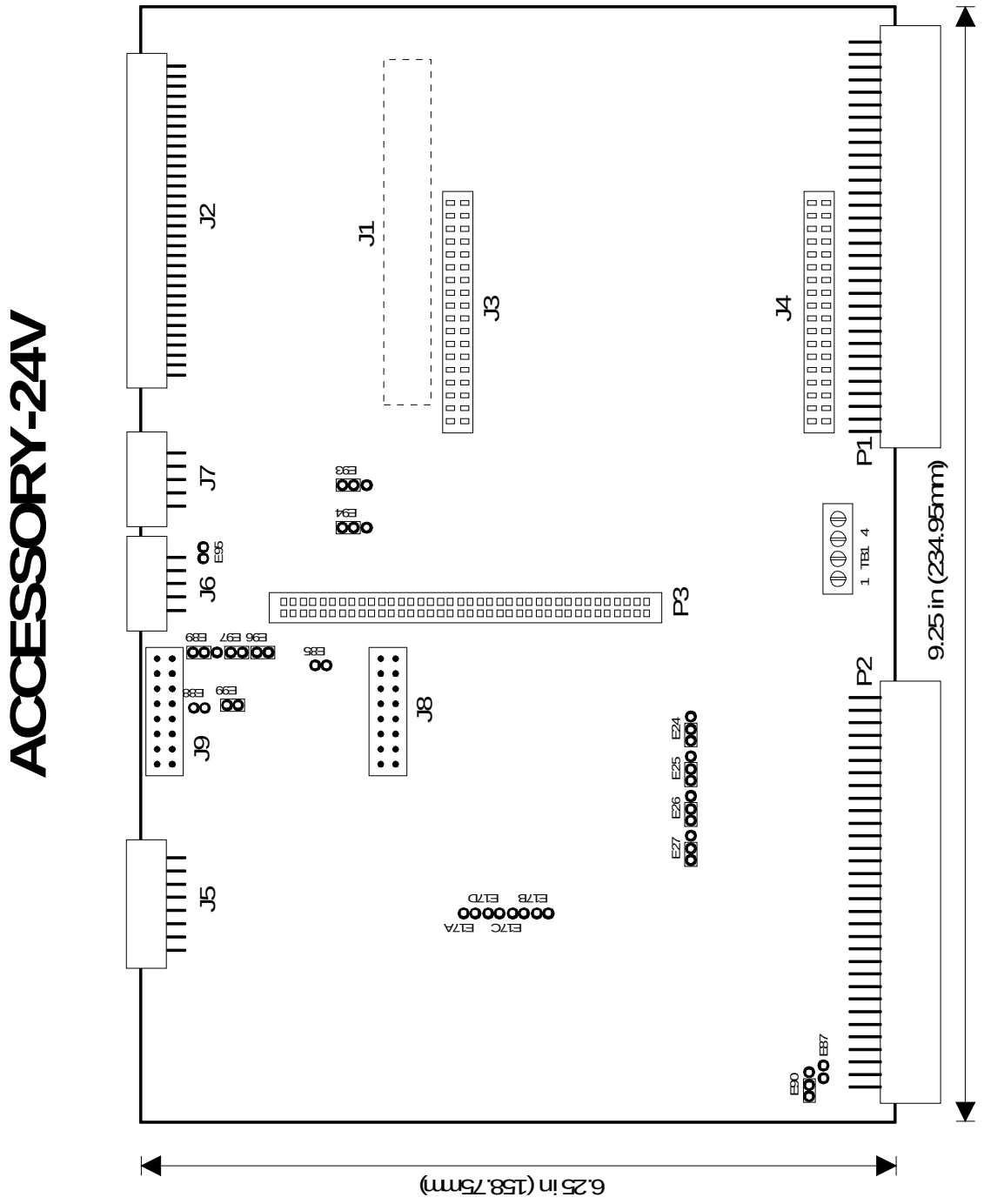
```
M216->Y:$C03F,8,16,S    (ADC16:  8-bit offset,16-bits wide)
```

assigns M variable 216 to ADC16. Subsequently, M216 may be used within a user program. For example:

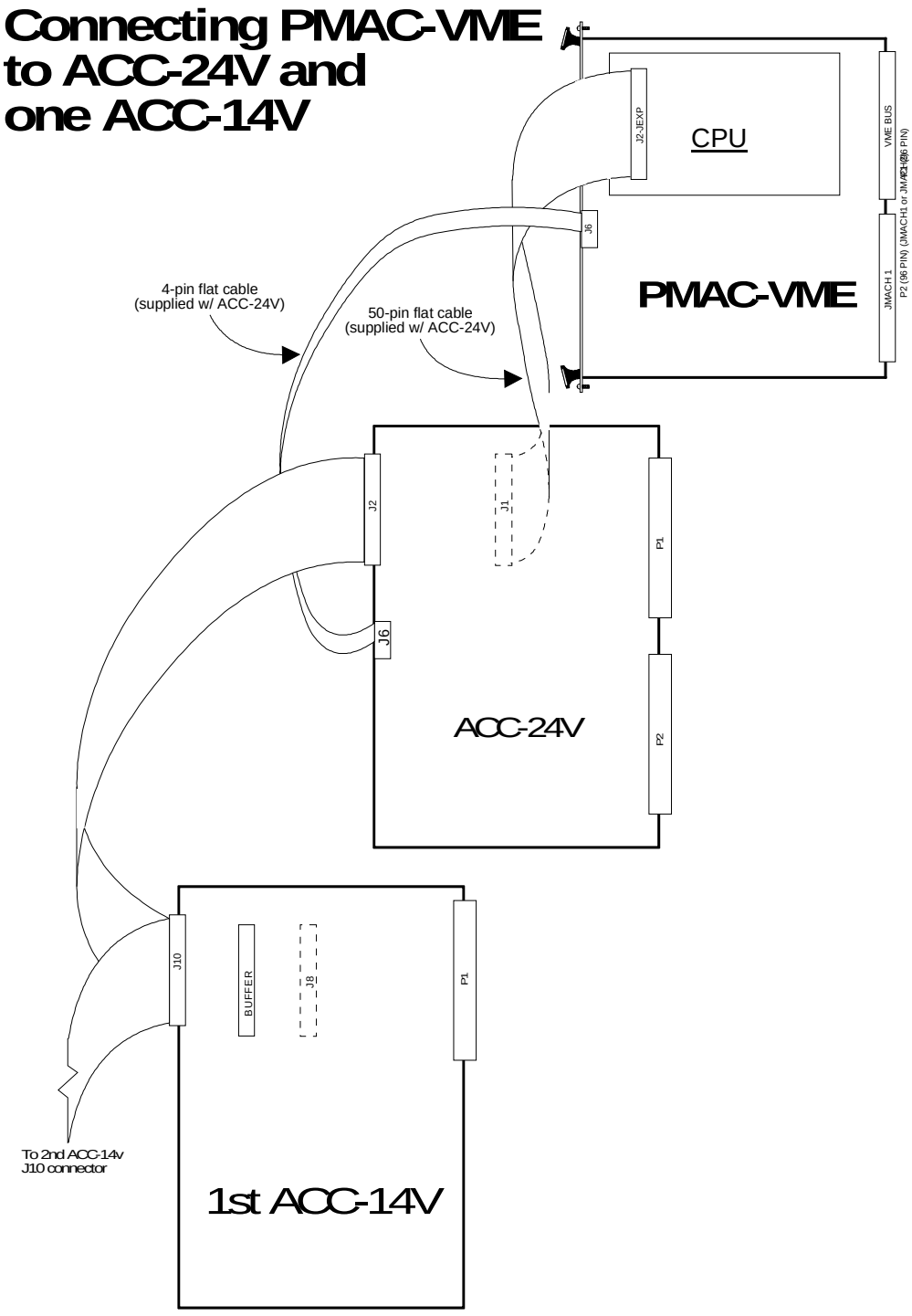
```
X(M216*3)        (Move x-axis proportional the value of ADC16)
```

However, care should be taken to distinguish between the input and the output registers within each DSPGATE (see the Memory Map Section in the PMAC User Manual). In addition, it should be noted that most of these registers are updated (written into) by PMAC when latching external devices during servo loop closure interrupts (e.g. ADC registers, Servo Position (encoder) registers, etc.). Others, such as the DAC registers, are updated automatically by PMAC's firmware during the servo loop (or phasing) interrupts.

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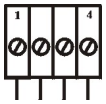
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CONNECTOR PINOUTS

TB1* 4-Pin Terminal Block

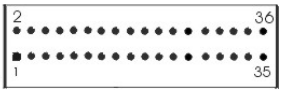


Top View

Pin #	Symbol	Function	Description
1	GRD	Input	Digital Ground
2	+ 5V	Input	+5V Supply
3	+12V	Input	+12V Supply
4	-12V	Input	-12V Supply

*TBI may be used as an alternative power supply connection if Acc-24V is not used with a VME rack. **Note:** for +12V and -12V input through TB1 jumpers E85, E87, and E88 must be installed. This does, however, defeat the opto-isolation feature of the board.

J3 and J4 (36-Pin Header)



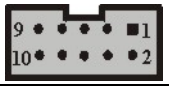
Top View

Pin #	Symbol	Function	Description
1	+12V	Output	Positive Analog Supply
2	-12V	Output	Negative Analog Supply
3	GND	Common	Ground
4	+5V	Output	Digital Supply
5-23	NC		
24			
25	NC		
26	NC		
27	NC		
28			
29	NC		
30	NC		
31	NC		
32			
33	NC		
34	NC		
35	GND	Common	Ground
36	+5V	Output	Digital Supply

Typically, J3 and J4 are iSBX connectors which are used for Acc-28's (analog-to-digital converter boards) power supply.

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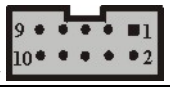
J6 (10-Pin Connector)

Top View 

Pin #	Symbol	Function	Description	Notes
1	NC			
2	NC			
3	NC			
4	NC			
5	NC			
6	NC			
7	NC			
8	NC			
9	SCLK	Output	System Clock	
10	DCLK	Output	Servo-Encoder Clock D to A, A to D Clock	Servo-Encoder Timing Clock DAC and ADC Clock for Channels 9 to 16

This connector brings in SCLK and DCLK signals from PMAC-VME. This connector must be connected to J6 of PMAC-VME's J6 connector via the 4-pin flat cable supplied with Acc-24V.

J7 JEQU (10-Pin Connector)

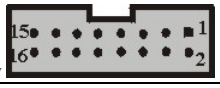
Top View 

Pin #	Symbol	Function	Description	Notes
1	EQU 9/	Output	Enc. 9 Comp-Eq	Low True
2	EQU10/	Output	Enc. 10 Comp-Eq	Low True
3	EQU11/	Output	Enc. 11 Comp-Eq	Low True
4	EQU12	Output	Enc. 12 Comp-Eq	Low True
5	EQU13/	Output	Enc. 13 Comp-Eq	Low True
6	EQU14/	Output	Enc. 14 Comp-Eq	Low True
7	EQU15/	Output	Enc. 15 Comp-Eq	Low True
8	EQU16/	Output	Enc. 16 Comp-Eq	Low True
9	+V	Supply	Positive Supply	Low True
10	GND	Common	Ground	+5 to +24V

This connector brings out the eight compare equal signals generated from the DSPGATES on Acc-24V and its Option 1.
Refer to Jumpers E93 and E94 for proper configuration of this output (for sourcing or sinking type outputs).

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J8 (JS3) (16-Pin Header)

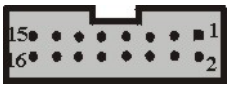
Top View 

Pin #	Symbol	Function	Description	Notes
1	DCLK	Output	D to A, A to D Clock	DAC and ADC Clock for Ch. 9, 10, 11, 12
2	BDATA3	Output	D to A Data	DAC Data for Ch. 9, 10, 11, 12
3	ASEL4/	Output	Axis Select Bit 0	Select for Ch. 9, 10, 11, 12
4	ASEL5/	Output	Axis Select Bit 2	Select for Ch. 9, 10, 11, 12
5	CONVERT 45	Output	A to D Convert	ADC Convert Signal Ch. 9, 10, 11, 12
6	ADCIN3	Input	A to D Data	ADC Data for Ch. 9, 10, 11, 12
7	OUT 9/	Output	Amp Enable /Dir.	Amp Enable/Direction for Ch. 9
8	OUT 10/	Output	Amp Enable /Dir.	Amp Enable/Direction for Ch. 10
9	OUT11/	Output	Amp Enable /Dir.	Amp Enable/Direction for Ch. 11
10	OUT12/	Output	Amp Enable /Dir.	Amp Enable/Direction for Ch. 12
11	HF 9	Input	Amp Fault	AMP Fault Input for Ch. 9
12	HF 410	Input	Amp Fault	AMP Fault Input for Ch. 10
13	HF 411	Input	Amp Fault	AMP Fault Input for Ch. 11
14	HG 412	Input	Amp Fault	AMP Fault Input for Ch. 12
15	+5V	Output	+5V Supply	Power Supply Out
16	GND	Common	PMAC Common	

Typically, miscellaneous I/O is used to interface with Acc-28 (the analog-to-digital converter board).

J5 and J9 (JS4) (16-Pin Header)

(Labeled J1 on OPT-1 board)

Top View 

Pin #	Symbol	Function	Description	Notes
1	DCLK	Output	D to A, A to D Clock	DAC and ADC Clock for Ch. 13, 14, 15, 16
2	BDATA4	Output	D to A Data	DAC Data for Ch. 13, 14, 15, 16
3	ASEL6/	Output	Axis Select Bit 0	Select for Ch. 13, 14, 15, 16
4	ASEL7/	Output	Axis Select Bit 2	Select for Ch. 13, 14, 15, 15
5	CONVERT 67	Output	A to D Convert	ADC Convert Signal Ch. 13, 14, 15, 16
6	ADCIN4	Input	A to D Data	ADC Data for Ch. 13, 14, 15, 16
7	OUT 13/	Output	Amp Enable /Dir	Amp Enable/Direction for Ch. 13
8	OUT 14/	Output	Amp Enable /Dir	Amp Enable/Direction for Ch. 14
9	OUT15/	Output	Amp Enable /Dir	Amp Enable/Direction for Ch. 15
10	OUT16/	Output	Amp Enable /Dir	Amp Enable/Direction for Ch. 16
11	HF 413	Input	Amp Fault	Amp Fault Input for Ch. 13
12	HF 414	Input	Amp Fault	Amp Fault Input for Ch. 14
13	HF 415	Input	Amp Fault	Amp Fault Input for Ch. 15
14	HG 416	Input	Amp Fault	Amp Fault Input for Ch. 16
15	+5V	Output	+5V Supply	Power Supply Out
16	GND	Common	PMAC Common	

Typically, miscellaneous I/O is used to interface with Acc-28 (the analog-to-digital converter board).

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P2 JMACH3 (96-Pin Header)				
Pin #	**Symbol**	**Function**	**Description**	**Notes**
A01	+5V	Output*	+5V Power	For Encoders
A02	GND	Common	PMAC Common	
A03	CHC12	Input	Encoder C Ch. Positive	Axis #12
A04	CHC12/	Input	Encoder C Ch. Negative	Axis #12 (Do not GND if not used)
A05	CHB12	Input	Encoder B Ch. Positive	Axis #12
A06	CHB12/	Input	Encoder B Ch. Negative	Axis #12 (Do not GND if not used)
A07	CHA12	Input	Encoder A Ch. Positive	Axis #12
A08	CHA12/	Input	Encoder A Ch. Negative	Axis #12 (Do not GND if not used)
A09	CHC10	Input	Encoder C Ch. Positive	Axis #10
A10	CHC10/	Input	Encoder C Ch. Negative	Axis #10 (Do not GND if not used)
A11	CHB10	Input	Encoder B Ch. Positive	Axis #10
A12	CHB10/	Input	Encoder B Ch. Negative	Axis #10 (Do not GND if not used)
A13	CHA10	Input	Encoder A Ch. Positive	Axis #10
A14	CHA10/	Input	Encoder A Ch. Negative	Axis #10 (Do not GND if not used)
A15	DAC12	Output	Ana. Out Positive 12	+/-10V to agnd
A16	DAC12	Output	Ana. Out Negative 12	+/-10V to agnd
A17	AENA 12/DIR12	Output	Amp-Ena/Dir.12	Jumperable Polarity
A18	FAULT12	Input	Amp-Fault 12	High True
A19	+LIM12 **	Input	Positive Limit 12	Failsafe High True
A20	-LIM12 **	Input	Negative Limit 12	Failsafe
A21	HMFL12	Input	Home-Flag 12	Programmable Polarity
A22	DAC10	Output	Ana. Out Positive 10	+/-10V to agnd
A23	DAC10/	Output	Ana. Out Negative 10	+/-10V to agnd
A24	AENA10/DIR10	Output	Amp-Enable/Dir. 10	Jumperable Polarity
A25	FAULT10	Input	Amp-Fault 10	High True
A26	+LIM10 **	Input	Positive Limit 10	Failsafe High True
A27	-LIM10 **	Input	Negative Limit 10	Failsafe High True
A28	HMFL10	Input	Home-Flag 10	Programmable Polarity Analog Common
A29	AGND	Input		Analog Common
A30	A-15V	Input		Analog -15V Supply
A31	GND	Common	PMAC Common	
A32	+5V	Output*	+5V Power	For Encoders
Note: In stand-alone applications, these can be used as +5V power supply inputs to power PMAC's digital circuitry.				

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P2 JMACH3 (96-Pin Header) Continued				
Pin #	**Symbol**	**Function**	**Description**	**Notes**
CO1	+5V	Output*	+5V Power	For Encoders
CO2	GND	Common	PMAC Common	
CO3	CHC11	Input	Encoder C Ch. Positive	Axis #11
CO4	CHC11/	Input	Encoder C Ch. Negative	Axis #11 (Do not GND if not used)
CO5	CHB11	Input	Encoder B Ch. Positive	Axis #11
CO6	CHB11/	Input	Encoder B Ch. Negative	Axis #11 (Do not GND if not used)
CO7	CHA11	Input	Encoder A Ch. Positive	Axis #11
CO8	CHA11/	Input	Encoder A Ch. Negative	Axis #11 (Do not GND if not used)
CO9	CHC9	Input	Encoder C Ch. Positive	Axis #9
C10	CHC 9/	Input	Encoder C Ch. Negative	Axis # 9 (Do not GND if not used)
C11	CHB 9	Input	Encoder B Ch. Positive	Axis #9
C12	CHB9/	Input	Encoder B Ch. Negative	Axis #9 (Do not GND if not used)
C13	CHA9	Input	Encoder A Ch. Positive	Axis #9
C14	CHA9/	Input	Encoder A Ch. Negative	Axis #9 (Do not GND if not used)
C15	DAC11	Output	Ana. Out Positive 11	+/-10V to AGND
C16	DAC11	Output	Ana. Out Negative 11	+/-10V to AGND
C17	AENA 11/DIR11	Output	Amp-Enable/Dir. 11	Jumperable Polarity
C18	FAULT11	Input	Amp-Fault 11	High True
C19	+LIM11 **	Output	Positive Limit 11	Failsafe High True
C20	-LIM11 **	Input	Negative Limit 11	Failsafe
C21	HMFL11	Input	Home-Flag 11	Programmable Polarity
C22	DAC9	Output	Ana. Out Positive 9	+/-10V to AGND
C23	DAC9 /	Output	Ana. Out Negative 9	+/-10V to AGND
C24	AENA9 /DIR9	Output	Amp-Enable/Dir. 9	Jumperable Polarity
C25	FAULT9	Input	Amp-Fault 9	High True
C26	+LIM9 **	Input	Positive Limit 9	Failsafe High True
C27	-LIM9 **	Input	Negative Limit 9	Failsafe High True
C28	HMFL9	Input	Home-Flag 9	Programmable Polarity
C29	ORST/	Output		Following Error Out
C30	A+15V	Input		Analog +15V Supply
C31	GND	Common	PMAC Common	
C32	+5V	Output*	+5V Power	For Encoders

The P2 connector is use to connect Acc-24V to the third four channels (Channels 9, 10, 11, and 12) of servo amps and motors.

** **Note:** Pins marked -LIMn should be connected to switches at the positive end of travel; pins marked +LIMn should be connected to switches at the negative end of travel.

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P2A JMACH4 (96-Pin Header on Option 1)				
Pin #	**Symbol**	**Function**	**Description**	**Notes**
A01	+5V	Output*	+5V Power	For encoders
A02	GND	Common	PMAC Common	
A03	CHC16	Input	Encoder C Ch. Positive	Axis #16
A04	CHC16/	Input	Encoder C Ch. Negative	Axis #16 (Do not GND if not used)
A05	CHB16	Input	Encoder B Ch. Positive	Axis #16
A06	CHB16/	Input	Encoder B Ch. Negative	Axis #16 (Do not GND if not used)
A07	CHA16	Input	Encoder A Ch. Positive	Axis #16
A08	CHA16/	Input	Encoder A Ch. Negative	Axis #16 (Do not GND if not used)
A09	CHC14	Input	Encoder C Ch. Positive	Axis #14
A10	CHC14/	Input	Encoder C Ch. Negative	Axis #14 (Do not GND if not used)
A11	CHB14	Input	Encoder B Ch. Positive	Axis #14
A12	CHB14/	Input	Encoder B Ch. Negative	Axis #14 (Do not GND if not used)
A13	CHA14	Input	Encoder A Ch. Positive	Axis #14
A14	CHA14/	Input	Encoder A Ch. Negative	Axis #14 (Do not GND if not used)
A15	DAC16	Output	Ana. Out Positive 16	+/-10V to AGND
A16	DAC16	Output	Ana. Out Negative 16	+/-10V to AGND
A17	AENA 16/DIR16	Output	Amp-Ena/Dir.16	Jumperable Polarity
A18	FAULT16	Input	Amp-Fault 16	High True
A19	+LIM16 **	Input	Positive Limit 16	Failsafe High True
A20	- LIM16 **	Input	Negative Limit 16	Failsafe
A21	HMFL16	Input	Home-Flag 16	Programmable Polarity
A22	DAC14	Output	Ana. Out Positive 14	+/-10V to AGND
A23	DAC14/	Output	Ana. Out Negative 14	+/-10V to AGND
A24	AENA14/DIR14	Output	Amp-Enable/Dir. 14	Jumperable Polarity
A25	FAULT14	Input	Amp-Fault 14	High True
A26	+LIM14 **	Input	Positive Limit 14	Failsafe High True
A27	-LIM14 **	Input	Negative Limit 14	Failsafe High True
A28	HMFL14	Input	Home-Flag 14	Programmable Polarity Ana. Common
A29	AGND	Input		Analog Common
A30	A-15V	Input		Analog -15V Supply
A31	GND	Common	PMAC Common	
A32	+5V	Output*	+5V Power	For Encoders

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P2A JMACH4 (96-Pin Header on Option 1) Continued				
Pin #	**Symbol**	**Function**	**Description**	**Notes**
CO1	+5V	Output*	+5V Power	For encoders
CO2	GND	Common	PMAC Common	
CO3	CHC15	Input	Encoder C Ch. Positive	Axis #15
CO4	CHC15/	Input	Encoder C Ch. Negative	Axis #15 (Do not GND if not used)
CO5	CHB15	Input	Encoder B Ch. Positive	Axis #15
CO6	CHB15/	Input	Encoder B Ch. Negative	Axis #15 (Do not GND if not used)
CO7	CHA15	Input	Encoder A Ch. Positive	Axis #15
CO8	CHA15/	Input	Encoder A Ch. Negative	Axis #15 (Do not GND if not used)
CO9	CHC13	Input	Encoder C Ch. Positive	Axis #13
C10	CHC 13/	Input	Encoder C Ch. Negative	Axis # 13 (Do not GND if not used)
C11	CHB 13	Input	Encoder B Ch. Positive	Axis #13
C12	CHB13/	Input	Encoder B Ch. Negative	Axis #9 (Do not GND if not used)
C13	CHA13	Input	Encoder A Ch. Positive	Axis #913
C14	CHA13/	Input	Encoder A Ch. Negative	Axis #13 (Do not GND if not used)
C15	DAC15	Output	Ana. Out Positive 15	+/-10V to AGND
C16	DAC15	Output	Ana. Out Negative 15	+/-10V to AGND
C17	AENA 15/DIR15	Output	Amp-Ena/Dir.15	Jumperable Polarity
C18	FAULT15	Input	Amp-Fault 15	High True
C19	+LIM15 **	Input	Positive Limit 15	Failsafe High True
C20	-LIM15 **	Input	Negative Limit 15	Failsafe
C21	HMFL15	Input	Home-Flag 15	Programmable Polarity
C22	DAC13	Output	Ana. Out Positive 13	+/-10V to AGND
C23	DAC13/	Output	Ana. Out Negative 13	+/-10V to AGND
C24	AENA13 /DIR13	Output	Amp-Ena/Dir.13	Jumperable Polarity
C25	FAULT13	Input	Amp-Fault 13	High True
C26	+LIM13 **	Input	Positive Limit 13	Failsafe High True
C27	-LIM13 **	Input	Negative Limit 13	Failsafe High True
C28	HMFL13	Input	Home-Flag 13	Programmable Polarity
C29	ORST/	Output		Following Err. Out
C30	A+15V	Input		Analog +15V Supply
C31	GND	Common	PMAC Common	
C32	+5V	Output*	+5V Power	For Encoders

The P2A connector is used to connect Acc-24V to fourth 4-channels (Channels 13, 14, 15 and 16) of servo amp and motors.

** **Note**: Pins marked -LIMn should be connected to switches at the positive end of travel; pins marked +LIMn should be connected to switches at the negative end of travel.

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JUMPER/E-POINT DESCRIPTIONS

E- Point	Physical Layout	Description	Default
E17A} E17B} E17C} E17D}		AENA (1-4 respectively) Jump 1-2 for High True Remove jumper for low true AENA (1-4 respectively)	No jumper installed
[E24 - E27: Encoder single-ended/differential control]			
E24 E25 E26 E27		Jump pin 2 to 3 to obtain differential encoder input mode; Jump pin 1 to 2 to obtain non-differential encoder input mode; This will bias encoder negative inputs to 1/2 VCC = 2.5V	1-2 Jumper installed (Non-Diff.)
[E85: Host supplied analog power source enable]			
E85		Jump pin 1 to pin 2 to allow A +14V to come from P1 (Ties amplifier and Acc-24V power supply together Defeats opto coupling). Note that if E85 is changed, E88 and E87 must also be changed; also see E90.	No jumper installed
[E87 - E88: Host supplied analog power source enable]			
E87		Jump pin 1 to pin 2 to allow analog GND to come from P1 (Ties amplifier and Acc-24V GND together. Defeats opto isolation). Note that if E87 is changed, E85 and E88 must also be changed; also see E90.	No jumper installed
E88		Jump pin 1 to pin 2 to allow A-14V to come from P1 (ties amplifier and Acc-24V power supply together. Defeats opto isolation). Note that if E88 is changed, E87 and E85 must also be changed; also see E90.	No jumper installed
[E89: Amplifier-supplied switch pull-up enable]			
E89		Jump pin 1 to pin 2 to supply optically isolated flags from A+15V input “A+15V" on P2 (JMACH3) pin C30. E90 must have jump pins 1 to 2. Jump pins 2 to 3 to supply optically isolated flags from A+V input on the piggyback board (P2A pin C30). E90 must have jump pins 1 to 2.	1 to 2 jumper installed
[E 90: Host-Supplied switch pull-up enable]			
E90		Jump pin 1 to pin 2 to allow A=15V/OPT=V on P2A (JMACH4) pin C30, (also installed see E89) to power Opto switch sensor inputs (including limits). Jump pin 2 to 3 to allow +12V from bus connector to power Opto switch sensor inputs (including limits). Optical isolation is then lost. See also E85, E87, E88 and PMAC Opto Isolation Diagram.	1 to 2 jumper installed

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E- Point	Physical Layout	Description	Default
[E93 - E95: Compare-Equal output voltage configure]			
E93		Jump pin 1 to pin 2 to apply +V (+5V to 24V) to pin 11 of U28 (should be ULN2803A for sink output configuration). Jump pin 2 to 3 to apply GND to pin 11 of U28 (S/B UDN2981A for source output configuration).	1 to 2 jumper installed
E94		Jump pin 1 to 2 to apply GND to pin 10 of U28 (S/B ULN2803A for sink output configuration). Jump pin 2 to 3 to apply +V (+5V to 24V) to pin 10 of U28 (S/B UDN2981A for source output configuration).	1 to 2 jumper installed
E95		For future use.	No jumper installed
[E96-E97: Analog source isolate from Option 1]			
E96		Jump 1-2 to connect A+15V on Acc-24V to A+15V on Option 1 piggyback board. Remove 1-2 to keep A+15V isolated between Option 1 board and main board.	Jumper installed
E97		Jump 1-2 to connect A-15V on Acc-24V board to A-15V on Option 1 piggyback board. Remove 1-2 to keep A-15V isolated between Option 1.	Jumper installed
[E99: Analog source isolate from Option 1]			
E99		Jump 1-2 to connect AGND on main Acc-24V to AGND on Option 1 piggyback board. Remove 1-2 to keep AGND isolated between Option 1 board and main board.	Jumper installed
[E17E - E17H: Amplifier - Enable polarity control]			
E17E} E17F} E17G} E17H}		AENA (13-16 respectively) Jump 1-2 for high true. Remove jumper for low true AENA (13-16 respectively)	No jumper installed
[E18 - E21: Encoder single-ended/differential control]			
E18 E19 E20		Jump pin 2 to 3 to obtain differential encoder input mode; Jump pin 1 to 2 to obtain non-differential encoder input mode; this will bias encoder negative inputs to 1/2Vcc=2.5V.	1-2 Jumper Installed (Non-diff.)
[E185, E187, E188: Host-supplied analog power source enable]			
E185		Jump pin 1 to pin 2 to allow A+14V to come from P1 (ties amplifier and PMAC PC power supply together; defeats opto isolation). Note that if E185 is changed, E188 and E187 must also be changed; also see E190.	No jumper installed

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E- Point	Physical Layout	Description	Default
E187		Jump pin 1 to pin 2 to allow analog GND to come from P1 (ties amplifier and PMAC-PC GND together. Defeats opto isolation). Note that if E187 is changed, E185 and E188 must also be changed; also see E190.	No jumper installed
E188		Jump pin 1 to pin 2 to allow A-14V to come from P1 (ties amplifier and Acc-24V power supply together defeats opto (coupling). Note that if E188 is changed, E187 and E185 must also be changed. Also see E190.	No jumper installed
[E189: Amplifier-supplied switch pull-up enable]			
E189		Jump pin 1 to 2 to allow A+15V/+V on P2A (JMACH4) pin 59, to tie to A+15V on P2 (JMACH3) pin C30. This jumper must be installed to allow A+15V to power the Opto switch sensor inputs (including limits) from the same opto-power supply that powers the amplifier output stage. Also see E190.	1 to 2 jumper installed
[E190: Host-supplied switch pull-up enable]			
E190		Jump pin 1 to 2 to allow A+15V/OPT+V on P2A (JMACH3) pin C30, (also see E189) to power Opto switch sensor inputs (including limits). Jump pin 2 to 3 to allow +12V from bus connector to power Opto switch sensor inputs (including limits). Optical isolation is then lost. See also E185, E187, E188 and figure on PMAC opto isolation.	1 to 2 jumper installed
[E196-E197, E199: Analog source isolate from main board]			
E196		Jump 1-2 to connect A+15V on option 1 piggyback board to main Acc-24V board Remove 1-2 to keep A+15V isolated between main board and piggyback board	No jumper installed
E197		Jump 1-2 to connect A-15V on Option 1 piggyback board to main Acc-24V board Remove 1-2 to keep A-15V isolated between main board and piggyback board.	No jumper installed
E199		Jump 1 to 2 to connect AGND on Option 1 piggyback board to main Acc-24V board Remove 1-2 to keep AGND isolated between main board and piggyback board.	No jumper installed

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