# USER MANUAL

## Accessory 24V

PMAC VME Axis Expansion Card

3Ax-602226-xUxx

October 15, 2003

DELTA TAU
Data Systems, Inc.
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# Table of Contents

# 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, Amp. Enables, Amp. 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 4 extra channels of encoder inputs and analog outputs. ACC-24V OPT-1 provides another DSPGATE, which extends its capabilities to 8 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.

# 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 OPT. 1. It is typically 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. It is typically 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 Opt. 1, the piggyback board.

## 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. It is typically 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.

# 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 connector(s). Outside a VME rack, the terminal block tb1 may be used for ACC-24V's digital (circuitry) power supply. We recommend that the power for the board's analog circuitry come from a separate supply through the JMACH connector(s). This is especially helpful 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 Opt.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.

# 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 FOUR 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 Opt.1, 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 Accessory 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 section on "Encoder Conversion Table in the PMAC's Main 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 *Dual Feedback* application Ix03 and Ix04 will have to 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's Main Manual).

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 Main 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

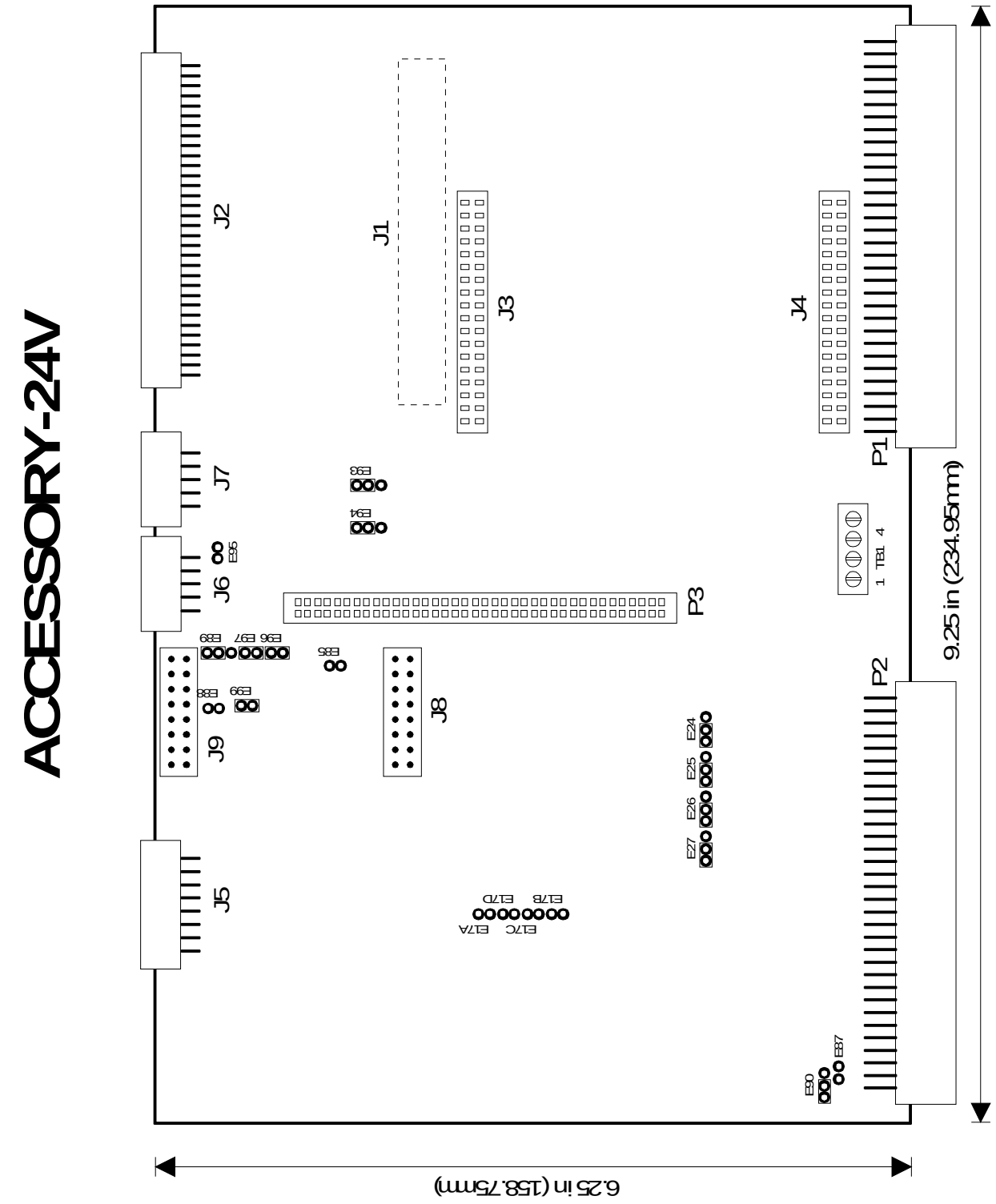
A detailed description of M-variable assignment and use to access PMAC's memory and I/O space is given in the PMAC's Main Manual (under PMAC Computation Features). The user may assign M-variables to any of the registers within the DSPGATEs (see the section on "PMAC DSP-GATE Features" in the Main Manual). 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's Main 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.


ACCESSORY-24V
J1
J2
J3
J4
J5
J6
J7
J8
J9
P1
P2
P3
E1
TB1
4
E2
E3
E4
E5
E6
E7
E8
E9
E10
E11
E12
E13
E14
E15
E16
E17
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E24
E25
E26
E27
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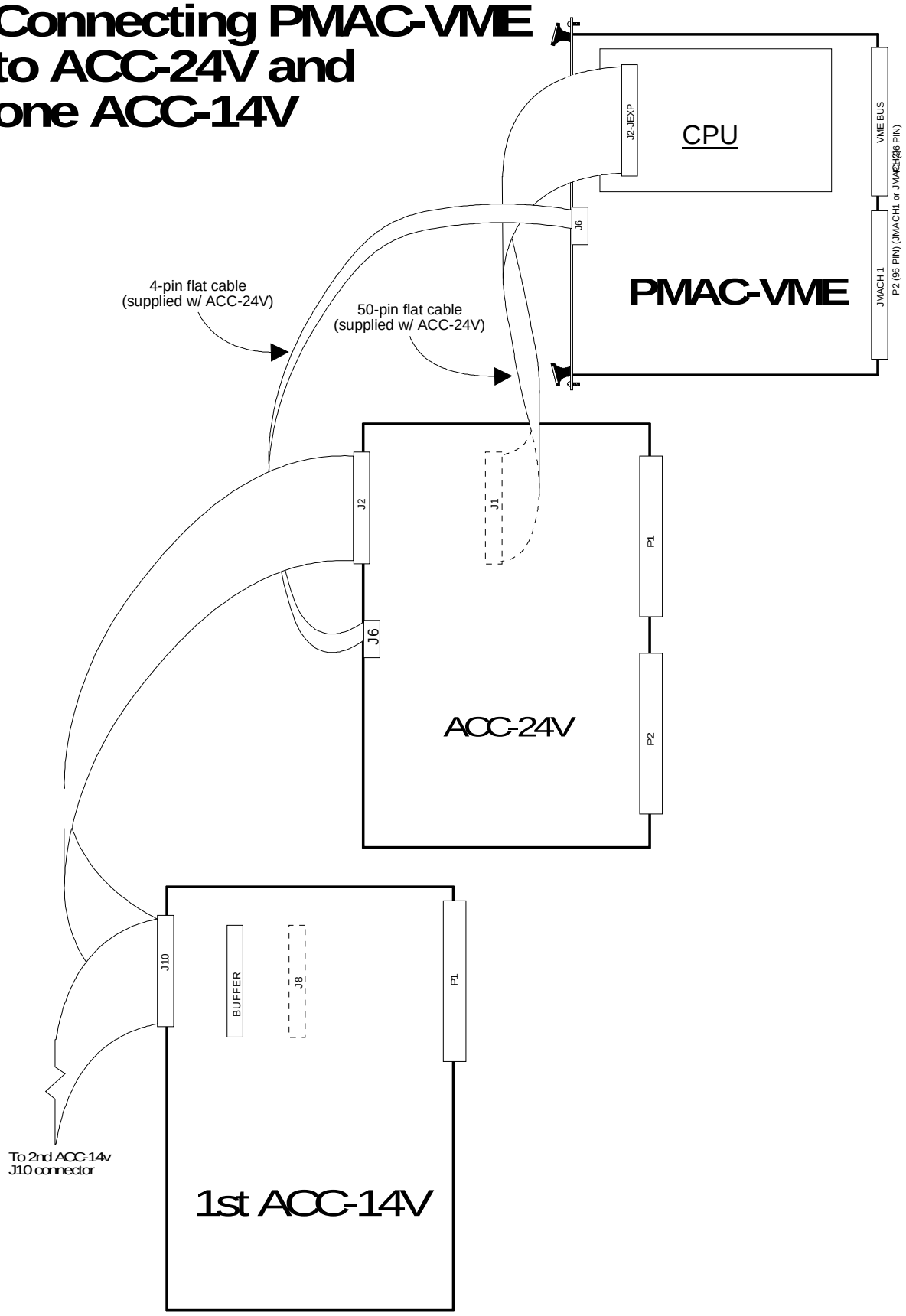
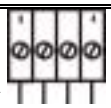
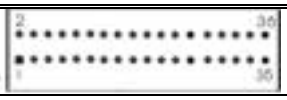
E29
E30
E31
E32
E33
E34
E35
E36
E37
9.25 in (234.95mm)
6.25 in (158.75mm)

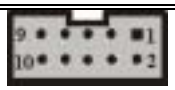
# Connecting PMAC-VME to ACC-24V and one ACC-14V

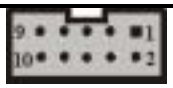


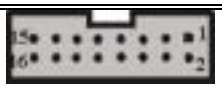
# CONNECTOR PINOUTS

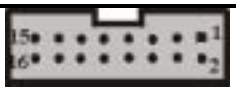
| TB1* 4-Pin Terminal Block | | | Top View  |
|---|---|---|---|
| **Pin #** | **Symbol** | **Function** | **Description** |
| 1 | GRD | Input | Digital Ground |
| 2 | + 5V | Input | +5V Supply |
| 3 | +12V | Input | +12V Supply |
| 4 | -12V | Input | -12V Supply |
| *TBI may be used as an alternative 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. | | | |

| **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 OPT 1.<br>Refer to Jumpers E93 and E94 for proper configuration of this output (for sourcing or sinking type outputs). | | | | |

| **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). | | | | |

| 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. | | | | |

| **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 4 channels (Channels 9, 10, 11, and 12) of servo amps and motors.<br>** **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. | | | | |

| **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 |

| **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.

# JUMPER/E-POINT DESCRIPTIONS

| E-Point | Physical Layout | Description | Default |
|---|---|---|---|
| E17A}<br>E17B}<br>E17C}<br>E17D} |  | AENA (1-4 respectively)<br>JUMP 1-2 for High True<br>Remove jumper for low true AENA (1-4 respectively) | No jumper installed |
| **[E24 - E27: Encoder single-ended/differential control]** | | | |
| E24<br>E25<br>E26<br>E27 |  | Jump pin 2 to 3 to obtain differential encoder input mode;<br>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).<br>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).<br>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).<br>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.<br>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).<br>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).<br>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 |

| 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).<br>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).<br>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.<br>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.<br>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.<br>Remove 1-2 to keep agnd isolated between Option 1 board and main board. | Jumper installed |
| **[E17E - E17H: Amplifier - Enable polarity control]** | | | |
| E17E}<br>E17F}<br>E17G}<br>E17H} |  | AENA (13-16 respectively) Jump 1-2 for high true.<br>Remove jumper for low true AENA (13-16 respectively) | No jumper installed |
| **[E18 - E21: Encoder single-ended/differential control]** | | | |
| E18<br>E19<br>E20 |  | Jump pin 2 to 3 to obtain differential encoder input mode;<br>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).<br>Note that if E185 is changed, E188 and E187 must also be changed; also see E190. | No jumper installed |

| 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).<br>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).<br>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 |