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USER MANUAL

Accessory 24P

Axis Expansion Board

3Ax-602192-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 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 require Acc-24. This is because, in both of the above applications, two channels of encoder feedback signals, or two analog output channels, respectively, are required for each motor. In addition, 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-24P which is to be used in conjunction with PMAC PC. For the VME bus version of this Accessory a separate manual is provided.

Acc-24P Options

Acc-24P fits in the next open bus slot and communicates to PMAC-PC via a provided 50-pin flat cable. The basic form of this accessory contains one PMAC DSPGATE. Therefore, it can support four extra channels of encoder inputs and analog outputs.

Acc-24P OPT1 provides another DSPGATE which extends its capabilities to eight channels.

Acc-24P OPT2 is a special cable (8" long) for the daisy-chain connection of Acc-24P and Acc-14D (or PMAC Opt-2 dual-ported RAM) to PMAC's JEXP connector.

Connectors

Refer to the schematic layout diagram of Acc-24P 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-24P. It can also bring in +12V and -12V if jumpers E85, E87, and E88 are installed. (This configuration defeats the opto-isolation features of the board).

J1

This connector provides the link between acc-24p and PMAC-PC 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's CPU board**, J**2 (JEXP)**.**

JS1

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

JS2

This connector contains miscellaneous I/O signals related to the second DSPGATE on Acc-24P. It is typically used for direct connection to Acc-28 (analog-to-digital converter board).

J5

This connector brings in the required DSPGATE clock signals from PMAC's J6 (JXIO) connector. In addition, two (jumper selectable) Compare-Equal signals are sent back for PMAC's use (possibly for host interrupts). A 10-pin flat cable is provided for this purpose. For proper operation of Acc-24p**,** J5 must be connected to PMAC's J6 (JXIO).

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J6
This connector brings in two channels of converted resolver inputs from Acc-14D.

J7 (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 60-pin flat cable supplied with Acc-8D Option P. It is only provided if Option 1 for Acc-24P is ordered.

J8 (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 60-pin flat cable supplied with Acc-8D Option P.

Acc-24P Connections
In order to use Acc-24P in conjunction with PMAC PC 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-24P is designed to fit into an expansion slot of a PC-XT or PC-AT bus computer. It does not use the bus for anything except power supply and structural support. When inserted into the bus, Acc-24P always uses the +5V bus power supply for its digital circuitry, and can pass the +5V out to the encoders through its JMACH connectors. We recommend the power for the board's analog circuitry come from a separate supply through the JMACH connector, particularly when driving large motors. However, it is possible, using jumpers E85, E87 and E88 to bring the ±12V supply from the bus to power the analog circuitry. This defeats the board's optical isolation between the analog and digital circuitry. When the board is used stand-alone, the board should be mounted using standoffs through the provided holes.

Basic PMAC-PC Connection
A 4" long (supplied) 50-pin flat cable should be used to connect PMAC'S JEXP (J2 on the CPU board) to Acc-24P's J1. In addition, a (supplied) 10-pin flat cable should be used between PMAC'S JXIO (J6 on PMAC's main board) and Acc-24P's J5.

Connection to Acc-14D
If one or more Acc-14D (I/O Expansion Boards) is to be used in conjunction with the Axes Expansion board, then Acc-24P Opt. 2 is required. This daisy-chain cable connects PMAC'S JEXP to Acc-24P's J1 and the first Acc-14D's J8. For the second, and the subsequent Acc-14D's, J10 of the board closer to PMAC should be connected to J9 of the board further away using the supplied flat cable with each Acc-14D.

Connection to Acc-28A (Analog Feedback).
If your application calls for analog feedback (Acc-28A), up to two Acc-28As may be connected via JS1 and JS2 to one Acc-24P. The first Acc-28A J1 connects to JS1, the second Acc-28A's J1 connects to JS2.

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 Opt.P so that the 60-pin socket and flat cable are provided for the connection to Acc-24P.

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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 Opt. 1 talks to two on-board DSPGATEs which provides these functions for eight channels. A PMAC with Opt. 1 and an Acc-24P will talk to three DSPGATEs. A PMAC with Opt. 1, connected to an Acc-24P with its Opt.1, talks to four DSPGATEs. As a result, whenever an Acc-24P is used, other accessories with on-board DSP gates should not be used. Otherwise PMAC 's channels 9 to 16 will not function properly. Currently these accessories are: Acc-29 the MDLT Transducer Interface Board, and any Acc-23P (obsolete A/D) option which contains on board DSP gates.

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USING ACCESSORY 24

PMAC's Main Manual provides the details of the memory map for Acc-24P's DSPGATEs. 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-24P 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-24P's DSPGATEs is to be used for command output, then this parameter should be modified. For example, to use the first DAC on the third DSPGATE (first DSPGATE on Acc-24P) 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-24P and its Opt. 1).

Ix02 Values for Commutating Eight Motors via ACC 24P

Since it takes two PMAC DACs to commutate one motor, an 8-axis PMAC-PC may only commutate 4 motors. Commutating eight motors with PMAC is possible with PMAC's Acc-24P. The Ix02 definitions for commutating motors are listed below.

Ix02 Table

Ix02	Hex	Decimal	DAC Pair
I102	$C002	49154	DAC1 & DAC2
I202	$C00A	49162	DAC3 & DAC4
I302	$C012	49170	DAC5 & DAC6
I402	$C01A	49178	DAC7 & DAC8
I502	$C022	49186	DAC9 & DAC10
I602	$C02A	49194	DAC11 & DAC12
I702	$C032	49202	DAC13 & DAC14
I802	$C03A	49210	DAC15 & DAC16

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Comparison of Ix02 Values for Commutated and Non-Commutated Motors

DAC#	DAC Address	Ix02 Commutated	*Ix02 Non-Commutated	PMAC Lite w/ Acc-24
DAC 1	$C003		I102	I102
DAC 2	$C002	I102	I202	I202
DAC 3	$C00B		I302	I302
DAC 4	$C00A	I202	I402	I402
DAC 5	$C013		I502	
DAC 6	$C012	I302	I602	
DAC 7	$C01B		I702	
DAC 8	$C01A	I402	I802	
DAC 9	$C023			I502
DAC 10	$C022	I502		I602
DAC 11	$C02B			I702
DAC 12	$C02A	I602		I802
DAC 13	$C033			
DAC 14	$C032	I702		
DAC 15	$C03B			
DAC 16	$C03A	I802		
* Factory defaults				

Ix03, **Ix04**, and **Ix05** tell PMAC where to look for position feedback, velocity feedback and master handwheel information via the Encoder Conversion Table. This table should be extended using PMAC's memory write (WY) command or through the special window in the PMAC executive program to include the appropriate registers within acc-24p's dspgates. In addition, Ix03, Ix04 and Ix05 should be modified accordingly. 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 the Encoder Conversion Table in PMAC's Main Manual). The instruction for setting

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Here $C020 is the address of the first encoder counter on acc-24p (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. 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 PMAC's Main Manual).

For Dual Feedback systems, there are position sensors on both motor and the load. A sensor on the load provides a more accurate measure of position than a sensor on the motor because its accuracy is not affected by imperfections in the motor coupling. However, it can also make the axis less stable because these coupling imperfections (typically compliance and backlash) are now inside the loop. A sensor on the motor, while less accurate provides better stability because these imperfections are not inside the loop.

In many cases, it is possible to get both accuracy and stability by using sensors on both the motor and the load. In a PMAC system, simply use the load encoder to close the position loop for accuracy (Ix03) and use the motor encoder to close the velocity loop for stability (Ix04).

If the velocity loop feedback is the same device as is used for commutation (if PMAC is doing the commutation), then both Ix04 and Ix83 (commutation feedback address) must reference the same device.

Encoder Conversion Table Example

The encoder conversion table will need to be expanded with the addition of Acc-24P. The starting address for then Acc-24P encoder channels will be dependent on the type of conversion the table is performing for the current feedback devices. The default encoder conversion table and encoder conversion type using an Acc-24P expansion board are shown on the following page.

Default Table

Encoder Channel	Source Address	DSPGATE Address	Conversion Type
1	$720	$00C000	1/T incremental
2	$721	$00C004	1/T incremental
3	$722	$00C008	1/T incremental
4	$723	$00C00C	1/T incremental
5	$724	$00C010	1/T incremental
6	$725	$00C014	1/T incremental
7	$726	$00C018	1/T incremental
8	$727	$00C01C	1/T incremental
	$728	$400723	Time-base for converted Enc. 4
	$72A	$00000*	Signifies end of table

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Table with Acc-24P

Encoder Channel	Source Address	DSPGATE Address	Conversion Type
1	$720	$00C000	1/T incremental
2	$721	$00C004	1/T incremental
3	$722	$00C008	1/T incremental
4	$723	$00C00C	1/T incremental
5	$724	$00C010	1/T incremental
6	$725	$00C014	1/T incremental
7	$726	$00C018	1/T incremental
8	$727	$00C01C	1/T incremental
	$728	$400723	Time-base for converted Enc. 4
9	$72A	$00C020	1/T incremental
10	$72B	$00C024	1/T incremental
11	$72C	$00C028	1/T incremental
12	$72D	$00C02C	1/T incremental
13	$72E	$00C030	1/T incremental
14	$72F	$00C034	1/T incremental
15	$730	$00C038	1/T incremental
16	$731	$00C03C	1/T incremental
	$732	$000000	End of Table

Adding to Encoders 5-8

To add dual feedback to encoders 5 through 8, we could define encoders 9 through 12 on to Acc-24P with the following write statement or through the PMAC Executive dialog boxes.

```
WY:$72A, $00C020, $00C024, $00C028, $00C002C
```

Since we have a dual feedback system, we must change I-variables Ix03 and Ix04. For simplicity, the encoders connected to Acc-24P (Channels 10 through 12) are connected to the load. Encoders 5 through 8 are coupled to the motor shaft. With the above setup, the I-variables would have the following definitions.

```
I503=$72A                    I703=$72C
I504=$724                    I704=$726
I603=$72B                    I803=$72D
I604=$725                    I804=$727
```

Replacing Encoders 5-8

If using a PMAC Lite or 4-axis PMAC PC, then encoder channels 5-8 may be defined using Acc-24P.

Encoder Channel	Source Y:Address	DSPGATE Address	Converted Data X: Address	No. of Rows
1	$720	$00C000	$720	1
2	$721	$00C004	$721	1
3	$722	$00C008	$722	1
4	$723	$00C00C	$723	1
5	$724	$00C020	$724	1
6	$725	$00C028	$725	1
7	$726	$00C02C	$726	1
8	$727	$00C030	$727	1
	$728	$400723	$729	2

Ix25 parameter tells PMAC what inputs 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 reassign a particular Ix25 to an appropriate address within the DSPGATEs on board Acc-24P the following table should be used:

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Flag Registers within Acc-24 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**

For example, if encoder 9 was connected to the load and Encoder 1 was coupled to the motor, Ix25 should be pointing to the DSPGATE associated with Acc-24P. Therefore, set Ix25 equal to xx$C020 where xx stands for the extended addressing for that variable (See Ix25 definition in PMAC I-Variable Specifications in the User Manual).

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, use Acc-24P's DSPGATE for phase position addressing (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.

The default values for each motor x use the phase position register for encoder 2x-1.

Ix83 Table

Ix83	Hex	Decimal	Encoder
I183	$C001	49153	Encoder 1
I283	$C009	49161	Encoder 2
I383	$C011	49179	Encoder 3
I483	$C019	49177	Encoder 4
I583	$C021	49185	Encoder 5
I683	$C029	49193	Encoder 6
I783	$C031	49201	Encoder 7
I883	$C039	49209	Encoder 8

M-Variable Assignment to PMAC's DSPGATES

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 PMAC DSPGATE Features section in the Main Manual). These registers may be subsequently read or written to using these (previously defined) M-variables. As an example, to read ADC register 16 (on the second DSPGATE within Acc-24P), the definition:

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

assigns M variable 216 to ADC16. (For PMAC A/D conversion, the analog signal is converted to a signed 16 bit number (±10V = ±32768)). Subsequently, M216 may be used within a user program. For example:

```
X(M216*3)
```
(Move x-axis proportional (3×) to 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.).

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Others, such as the DAC registers, are updated automatically by PMAC's firmware during the servo loop (or phasing) interrupts.

PMAC's JEXP Limitation

JEXP (expansion) is the 50-pin cable connector located on PMAC's CPU board. There are limitations to the amount of unbuffered boards connected to one PMAC. These limitations vary with the type of PMAC ordered. Currently PMAC has several options which can be ordered to enhance PMAC's processing speed:

Standard	20 Mhz CPU, One-Wait State RAM	
Option 4A	20 Mhz CPU, Zero-Wait State RAM, Flash backup	25 % increase
Option 5	30 Mhz CPU, Zero-Wait State RAM	75% increase
Option 5A	40 Mhz CPU, Zero-Wait State RAM, Flash Backup	125 % increase
Option 5B	60 Mhz CPU, Zero-Wait State RAM, Flash Backup	250 % increase

The amount of unbuffered accessory boards which can be used with one standard PMAC, PMAC Option 5, and PMAC Option 4A, 5A, and 5B is listed below:

PMAC with Flash CPU vs PMAC with Battery backed CPU	
Standard PMAC (20 MHz)	2 unbuffered boards
Option 5 (30 Mhz)	1 unbuffered board
Option 4A, 5A, 5B	No limit (buffers are included on PMAC)

Unbuffered Accessory Boards	
Option 2	Dual Ported RAM
Acc-24	Axis Expansion Board
Acc-29	MLDT Interface Board

Buffered Accessory Boards	
Acc-14	Digital I/O boards
Acc-36	A/D Conversion Boards

If PMAC has flash memory, the on board buffers on the accessory board are bypassed. However, for PMACs with battery backed CPUs, the accessory board which is connected to PMAC's JEXP connector uses its on board buffers.

* The maximum length of the cable between boards is 6 in. (150 mm).

Power Requirements

5V	**15V**	**-15V**	**Other 24V etc.**
200mA	250mA	250mA	N/A

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Connector Pinouts

JS1 (16-Pin Header)

Pin #	Symbol	Function	Description	Notes
1	DCLK	Output	D to A, A to D Clock	DAC and ADC clock for channels 9, 10, 11, 12
2	BDATA1	Output	D to A Data	DAC data for channels 9, 10, 11, 12
3	ASELO/	Output	Channel Select Bit 0	Select for channels 9, 10, 11, 12
4	ASEL1/	Output	Channel Select Bit 2	Select for channels 9, 10, 11, 12
5	CONVERT 01	Output	A to D Convert	ADC convert signal channels 9, 10, 11, 12
6	ADCIN1	Input	A to D Data	ADC data for channels 9, 10, 11, 12
7	OUT1/	Output	Amp Enable/Dir	AMP Enable/Direction for channel 9
8	OUT2/	Output	Amp Enable/Dir	AMP Enable/Direction for channel 10
9	OUT3/	Output	Amp Enable/Dir	AMP Enable/Direction for channel 11
10	OUT4/	Output	Amp Enable/Dir	AMP Enable/Direction for channel 12
11	HF41	Input	Amp Fault	Amp Fault input for channel 9
12	HF42	Input	Amp Fault	Amp Fault input for channel 10
13	HF43	Input	Amp Fault	Amp Fault input for channel 11
14	HF44	Input	Amp Fault	Amp Fault input for channel 12
15	+5V	Output	+5V Supply	Power supply out
16	GND	Common	PMAC Common	
Miscellaneous I/0 – Typically, this connector is used for direct connection to Acc-23 or Acc-28 (the analog-to-digital converter boards)				

JS2 (16-Pin Header)

Pin #	Symbol	Function	Description	Notes
1	DCLK	Output	D to A, A to D Clock	DAC and ADC clock for channels 13, 14, 15, 16
2	BDATA2	Output	D to A Data	DAC data for channels 13,14,15,16
3	ASEL2/	Output	Channel Select Bit 2	Select for channels 13,14,15,16
4	ASEL3/	Output	Channel Select Bit 3	Select for channels 13,14,15,16
5	CONVERT 23	Output	A to D Convert	ADC convert signal channels 13,14,15,16
6	ADCIN2	Input	A to D Data	ADC data for channels 13,14,15,16
7	OUT5/	Output	Amp Enable/Dir	Amp Enable/Direction for channel 13
8	OUT6/	Output	Amp Enable/Dir	Amp Enable/Direction for channel 14
9	OUT7/	Output	Amp Enable/Dir	Amp Enable/Direction for channel 15
10	OUT8/	Output	Amp Enable/Dir	Amp Enable/Direction for channel 16
11	HF45	Input	Amp Fault	Amp Fault input for channel 13
12	HF46	Input	Amp Fault	Amp Fault input for channel 14
13	HF47	Input	Amp Fault	Amp Fault input for channel 15
14	HF48	Input	Amp Fault	Amp Fault input for channel 16
15	+5V	Output	+5V Supply	Power supply out
16	GND	Common	PMAC Common	
Miscellaneous I/O. Typically, this connector is used for direct connection to Acc-23 or Acc-28 (the analog-to-digital converter boards).				

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J5 (10-Pin Connector)

Pin #	Symbol	Function	Description	Notes
1	CHA1	N.C.		
2	CHB1	N.C.		
3	CHC1	N.C.		
4	CHA3	N.C.		
5	CHB3	N.C.		
6	CHC3	N.C.		
7	IR5	Output[1]	Interrupt IR5	Interrupt from expansion board (See E point listing (E54 to E65)
8	IR6	Output[2]	Interrupt IR6	Interrupt from expansion board (See E point Listing (E54 to E65)
9	SCLK	Input	System Clock	Servo-encoder timing
10	DCLK	Input	D to A, A to D Clock	

1 Jumper selector to EQU 9, or EQU 11, or EQU 13, OR EQU 15

2 Jumper selector to EQU 10, or EQU 12, or EQU 14, or EQU 16

This connector must be connected to PMAC's JxIO (J6) via the supplied cable

J6 (10-Pin Connector)

Pin #	Symbol	Function	Description	Notes
1	CHA9	Input	Encoder 9 Channel A	Resolver Input
2	CHB9	Input	Encoder 9 Channel B	Resolver Input
3	CHC9	Input	Encoder 9 Channel C	Resolver Input
4	CHA11	Input	Encoder 11 Channel A	Resolver Input
5	CHB11	Input	Encoder 11 Channel B	Resolver Input
6	CHC11	Input	Encoder 11 Channel C	Resolver Input
7	IR5	Output[1]	Interrupt IR5	Interrupt from expansion board (See E point listing (E54 to E65)
8	IR6	Output[2]	Interrupt IR6	Interrupt from expansion board (See E point listing E54 to E65)
9	SCLK	Output	System Clock	Servo-encoder timing
10	DCLK	Output	D to A, A to D Clock	

1 Jumper selector to EQU 9, or EQU 11, or EQU 13, OR EQU 15

2 Jumper selector to EQU 10, or EQU 12, or EQU 14, or EQU 16

This connector is typically used for connection to Acc-14D in order to bring in two channels of resolver inputs via the iSBX connectors on Acc-14D

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J7 (JMACH 4) (60-Pin Header)

Pin #	Symbol	Function	Description	Notes
1	+5V	Output	+5V Power	For encoders
2	+5V	Output	+5V Power	For encoders
3	GND	Common	PMAC Common	
4	GND	Common	PMAC Common	
5	CHC15	Input	Encoder C Channel Positive	Channel #15
6	CHC16	Input	Encoder C Channel Positive	Channel #16
7	CHC15/	Input	Encoder C Channel Negative	Channel #15 (Do not GND if not used)
8	CHC16/	Input	Encoder C Channel Negative	Channel #16 (Do not GND if not used)
9	CHB15	Input	Encoder B Channel Positive	Channel #15
10	CHB16	Input	Encoder B Channel Positive	Channel #16
11	CHB15/	Input	Encoder B Channel Negative	Channel #15 (Do not GND if not used)
12	CHB16/	Input	Encoder B Channel Negative	Channel #16 (Do not GND if not used)
13	CHA15	Input	Encoder A Channel Positive	Channel #15
14	CHA16	Input	Encoder A Channel Positive	Channel #16
15	CHA15/	Input	Encoder A Channel Negative	Channel #15 (Do not GND if not used)
16	CHA16/	Input	Encoder A Channel Negative	Channel #16 (Do not GND if not used)
17	CHC13/	Input	Encoder C Channel Positive	Channel #13
18	CHC14	Input	Encoder C Channel Positive	Channel #14
19	CHC13/	Input	Encoder C Channel Negative	Channel #13 (Do not GND if not used)
20	CHC14/	Input	Encoder C Channel Negative	Channel #14 (Do not GND if not used)
21	CHB13	Input	Encoder B Channel Positive	Channel #13
22	CHB14	Input	Encoder B Channel Positive	CHAN #14
23	CHB13/	Input	Encoder B Channel Negative	Channel #13 (Do not GND if not used)
24	CHB14/	Input	Encoder B Channel Negative	Channel #14 (Do not GND if not used)
25	CHA13	Input	Encoder A Channel Positive	Channel #13
26	CHA14	Input	Encoder A Channel Positive	Channel #14
27	CHA13/	Input	Encoder A Channel Negative	Channel #13 (Do not GND if not used)
28	CHA14/	Input	Encoder A Channel Negative	Channel #14 (Do not GND if not used)
29	DAC15	Output	Analog Out Positive 15	+/- 10V to AGND
30	DAC16	Output	Analog Out Positive 16	+/- 10V to AGND
31	DAC15/	Output	Analog Out Negative 15	+/- 10V to AGND
32	DAC16/	Output	Analog Out Negative 16	+/- 10V to AGND
33	AENA15/ DIR15	Output	Amp-Ena/Dir 15	Jumperable polarity
34	ANA16/ DIR16	Output	Amp-Ena/Dir 16	Jumperable polarity
35	FAULT15	Input	Amp-Fault 15	High true

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J7 (JMACH 4) (60-Pin Header) (Continued)

Pin #	Symbol	Function	Description	Notes
36	FAULT16	Input	Amp-Fault 16	High true
37	+LIM15	Input	Positive Limit 15	Failsafe high true
38	+LIM16	Input	Positive Limit 16	Failsafe high true
39	-LIM15	Input	Negative Limit 15	Failsafe high true
40	-LIM16	Input	Negative Limit 16	Failsafe high true
41	HMFL15	Input	Home-Flag 15	Programmable Polarity
42	HMFL16	Input	Home-Flag 16	Programmable Polarity
43	DAC13	Output	Analog Out Positive 13	+/- 10V to AGND
44	DAC14	Output	Analog Out Positive 14	+/- 10V to AGND
45	DAC13/	Output	Analog Out Negative 13	+/- 10V to AGND
46	DAC14/	Output	Analog Out Negative 14	+/- 10V to AGND
47	AENA13/ DIR13	Output	Amp-Ena/Dir 13	Jumperable polarity
48	AENA14/ DIR14	Output	Amp-Ena/Dir 14	Jumperable polarity
49	FAULT13	Input	Amp-Fault 13	High true
50	FAULT14	Input	Amp-Fault 14	High true
51	+LIM13	Input	Positive Limit 13	Failsafe high true
52	+LIM14	Input	Positive Limit 14	Failsafe high true
53	-LIM13	Input	Negative Limit 13	Failsafe high true
54	-LIM14	Input	Negative Limit 14	Failsafe high true
55	HMFL13	Input	Home-Flag 13	Programmable Polarity
56	HMFL14	Input	Home-Flag 14	Programmable Polarity
57	ORST/	Output	Optically Isolated Reset	PMAC reset
58	AGND	Input		Analog common
59	A+15V/ OPT+V	Input	A+15V or OPTO +V	Analog +15V supply
60	A-15V	Input		Analog -15 V supply
The J7 connector is used to connect Acc-24P + OPT1 to the last four channels of encoder/motor/amplifier input/outputs.				

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J8 (JMACH 3) (60-Pin Header)

Pin #	Symbol	Function	Description	Notes
1	+5V	Output *	+5V Power	For encoders
2	+5V	Output *	+5V Power	For encoders
3	GND	Common	PMAC Common	
4	GND	Common	PMAC Common	
5	CHC11	Input	Encoder C Channel Positive	Channel #11
6	CHC12	Input	Encoder C Channel Positive	Channel #12
7	CHC11/	Input	Encoder C Channel Negative	Channel #11 (Do not GND if not used)
8	CHC12/	Input	Encoder C Channel Negative	Channel #2 (Do not GND if not used)
9	CHB11	Input	Encoder B Channel Positive	Channel #11
10	CHB12	Input	Encoder B Channel Positive	Channel #2
11	CHB11/	Input	Encoder B Channel Negative	Channel #11 (Do not GND if not used)
12	CHB12/	Input	Encoder B Channel Negative	Channel #12 (Do not GND if not used)
13	CHA11	Input	Encoder A Channel Positive	Channel #11
14	CHA12	Input	Encoder A Channel Positive	Channel #12
15	CHA11/	Input	Encoder A Channel Negative	Channel #11 (Do not GND if not used)
16	CHA12/	Input	Encoder A Channel Negative	Channel #2 (Do not GND if not used)
17	CHC 9	Input	Encoder C Channel Positive	Channel #9
18	CHC10	Input	Encoder C Channel Positive	Channel #10
19	CHC9/	Input	Encoder C Channel Negative	Channel #9 (Do not GND if not used)
20	CHC10	Input	Encoder C Channel Negative	Channel #10 (Do not GND if not used)
21	CHB9	Input	Encoder B Channel Positive	Channel #9
22	CHB10	Input	Encoder B Channel Positive	Channel #10
23	CHB9/	Input	Encoder B Channel Negative	Channel #9 (Do not GND if not used)
24	CHB10/	Input	Encoder B Channel Negative	Channel #10 (Do not GND if not used)
25	CHA9	Input	Encoder A Channel Positive	Channel #9
26	CHA10	Input	Encoder A Channel Positive	Channel #10
27	CHA9/	Input	Encoder A Channel Negative	Channel #9 (Do not GND if not used)
28	CHA10/	Input	Encoder A Channel Negative	Channel #10 (Do not GND if not used)
29	DAC11	Output	Analog Out Positive 11	+/- 10V to AGND
30	DAC12	Output	Analog Out Positive 12	+/- 10V to AGND
31	DAC11/	Output	Analog Out Negative 11	+/- 10V to AGND
32	DAC12/	Output	Analog Out Negative 12	+/- 10V to AGND
33	AENA11/ DIR11	Output	Amp-Ena/Direction 11	Jumperable polarity

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J8 (JMACH 3) (60-Pin Header) (Continued)

Pin #	Symbol	Function	Description	Notes
34	ANA12/ DIR12	Output	Amp-Ena/Direction 12	Jumperable polarity
35	FAULT11	Input	Amp-Fault 11	High true
36	FAULT12	Input	Amp-Fault 12	High true
37	+LIM11	Input	Positive Limit 11	Failsafe high true
38	+LIM12	Input	Positive Limit 12	Failsafe high true
39	-LIM11	Input	Negative Limit 11	Failsafe high true
40	-LIM12	Input	Negative Limit 12	Failsafe high true
41	HMFL11	Input	Home Flag 11	Programmable polarity
42	HMFL12	Input	Home Flag 12	Programmable polarity
43	DAC9	Output	Analog Out Positive 9	+/- 10V to AGND
44	DAC10	Output	Analog Out Positive 10	+/- 10V to AGND
45	DAC9/	Output	Analog Out Negative 9	+/- 10V to AGND
46	DAC10/	Output	Analog Out Negative 10	+/- 10V to AGND
47	AENA9/ DIR9	Output	Amp-Ena/Direction 9	Jumperable polarity
48	AENA10/ DIR10	Output	Amp-Ena/Direction 10	Jumperable polarity
49	FAULT9	Input	Amp-Fault 9	High true
50	FAULT10	Input	Amp-Fault 10	High true
51	+LIM9	Input	Positive Limit 9	Failsafe high true
52	+LIM10	Input	Positive Limit 10	Failsafe high true
53	-LIM9	Input	Negative Limit 9	Failsafe high true
54	-LIM10	Input	Negative Limit 10	Failsafe high true
55	HMFL0	Input	Home Flag 9	Programmable polarity
56	HMFL10	Input	Home Flag 10	Programmable polarity
57	ORST/	Output	Optically Isolated Reset	PMAC reset
58	AGND	Input		Analog common
59	A+15V	Input		Analog +15V supply
60	A-15V	Input		Analog -15 V supply
J8 connector is used to connect Acc-24P to channels 9, 10, 11, and 12 of encoders/amplifiers/motors, input/output signals * In standalone applications, these can be used as +5V power supply inputs to power Acc-24P's digital circuitry.				

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E-Point Descriptions

E-Point	Physical Layout	Description	Default
E17	*1 *2	Jump 1-2 for low true AENA (9-16)	1-2 jumper installed
E18	*1 *2 *3	(ENC 13) Jump pin 2 to 3 to obtain differential (non-diff) encoder input mode	1-2 jumper installed
Encoder Single Ended/Differential			
E19		(ENC14) Jump pin 1 to 2 to obtain non-differential encoder input mode. This will bias encoder negative inputs to1/2 VCC=2.5V	
E20	"	(ENC15) 1/2 VCC = 2.5V	
E21	"	(ENC16)	
E24	*1 *2 *3	(ENC12) Jump pin 2 to 3 to obtain differential encoder input mode.	1-2 jumper installed (non-diff)
E25	"	(ENC11) Jump pin 1 to 2 to obtain non-differential encoder input mode.	
E26	"	(ENC10) This will bias encoder negative inputs to ½ VCC=2.5V	
E27	"	(ENC9)	
[E54 - E65: Host Interrupt Signal Select]			
E54	*2 *1	Jump pin 1 to 2 to allow EQU16 to interrupt host-PC at PMAC interrupt level IR6	No jumper installed
E55	*2 *1	Jump pin 1 to 2 to allow EQU12 to interrupt host-PC at PMAC Interrupt level IR6	No jumper installed
E56	*2 *1	Jump Pin 1 to 2 to allow EQU15 to interrupt host-PC at PMAC Interrupt level IR5	No jumper installed
E57	*2 *1	Jump pin 1 to 2 to allow EQU11 to interrupt host-PC at PMAC Interrupt level IR5	No jumper installed
E60	*2 *1	Jump pin 1 to 2 to allow EQU14 to interrupt host-PC at PMAC Interrupt level IR6	No jumper installed
E61	*2 *1	Jump pin 1 to 2 to allow EQU10 to interrupt host-PC at PMAC Interrupt level IR6	No jumper installed

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E64	*2 *1	Jump pin 1 to 2 to allow EQU13 to interrupt host-PC at PMAC Interrupt level IR5	No jumper installed
E65	*2 *1	Jump pin 1 to 2 to allow EQU9 to interrupt host-PC at PMAC Interrupt level IR5	No jumper installed
Note: Acc-24 generated IR5 to be active, jumper E63 must be installed on PMAC's main board. Acc-24 generated IR6 to be active, jumper E59 must be installed on PMAC's main board.			
[E85: Host Supplied Analog Power Source Enable]			
E85	1 2 * *	Jump pin 1 to pin 2 to allow A+14V to come from P1 (ties amplifier and Acc-24P power supply together. Defeats opto coupling).	No jumper installed
Note: If E85 is changed, E88 and E87 must also be changed; also see E90.			
E87	1 2 * *	Jump pin 1 to pin 2 to allow analog GND to come from P1 (Ties amplifier and Acc-24P GND together. Defeats opto coupling).	No jumper installed
Note: If E87 is changed, E85 and E88 must also be changed; also SEE E90.			
E88	1 2 * *	Jump pin 1 to pin 2 to allow A-14V to come from P1 (Acc-24P power supply together). Ties amplifier and defeats opto coupling).	No jumper installed
Note: If E88 is changed; E87 and E85 must also be changed, also see E90.			

[E89: Amplifier-Supplied Switch Pull-Up Enable]			
E89	* * 1 2	Jump pin 1 to 2 to allow A+15V/+V on J7 (JMACH4) pin 59, to tie to A+15Von J8 (JMACH3) pin 59. 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 E 90.	1 to 2 jumpers installed
[E90: Host-Supplied Switch Pull-Up Enable]			
E90	*1 *2 *3	Jump pin 1 TO 2 to allow A+15V/ OPT+V on J7 (JMACH 4) pin 59, (also see E89) to power opto switch sensor inputs (including limits). Jump pin 2 to 3 to allow +12V from DC bus connector P1-pin B09 to power opto switch sensor inputs (including limits). optical isolation is then lost.	1 to 2 jumpers installed

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Variable	Value	Units	Definition
Ix02	$C00A	Ext. Legal PMAC Y addresses	Motor x Command Output (DAC) Address
Ix03			
Ix04			
Ix05			
Ix25	$2C008	Extended Legal PMAC X addresses	Motor x Limit/Home Flag/Amp Address
I383	$C009	Legal PMAC X addresses	Motor x Ongoing Phasing Position Address

Encoder Converter Table for Acc 24P

Encoder Channel	Address	Y-Word (DSPGATE)
1	$720	$00C000
2	$721	$00C004
3	$722	$00C008
4	$723	$00C00C
5	$724	$00C010
6	$725	$00C014
7	$726	$00C018
8	$727	$00C01C
9	$72A	$00C020
10	$72B	$00C024
11	$72C	$00C028
12	$72D	$00C02C
13	$72E	$00C030
14	$72F	$00C034
15	$730	$00C038
16	$731	$00C03C
EOT*	$732	$000000
* End of Table		

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