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USER MANUAL

Accessory 24PCI2

Axis Expansion Board

xAx-603903-xUxx

January 6, 2006



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INTRODUCTION

Overview

The Acc-24PCI2 Axis Expansion Board provides four or eight channels of PMAC2-style servo interface circuitry for Turbo PMAC controllers. Up to four Acc-24PCI2 boards can be connected to one Turbo PMAC board, providing up to 32 additional channels of servo interface circuitry.

The Acc-24PCI2 is a 2/3-sized PC expansion card. It has PCI bus connectors, so it can be mounted in a PCI expansion slot. The Acc-24PCI2 does not communicate over the bus; the bus connectors are just a convenience for mounting the board near the Turbo PMAC when it is in the bus.

The Acc-24PCI2 board contains no processor; it has 1 or 2 highly integrated 4-channel PMAC2-style Servo ICs with the buffering circuitry and connectors around them.

Features

The Acc-24PCI2 board can be used with any Turbo PMAC or Turbo PMAC2 board, interfacing through the Expansion port. It is electrically and software compatible with Turbo PMAC VME and Turbo PMAC2 VME, but special mounting would be required. Note that even if the Turbo PMAC itself is a PMAC with the PMAC-style Servo ICs and interface circuitry, the Acc-24PCI2 with its PMAC2-style Servo ICs and interface circuitry can be connected to it.

The Acc-24PCI2 supports a wide variety of servo and stepper interfaces:

- Analog +/-10V velocity commands (requires Acc-8E or equivalent)
- Analog +/-10V torque commands (requires Acc-8E or equivalent)
- Sinusoidal analog +/-10V phase current commands (requires Acc-8E or equivalent)
- Direct digital pulse-width modulated (PWM) phase voltage commands (requires Acc-8F or equivalent)
- Pulse-and-direction commands (requires Acc-8S or equivalent)

A single Acc-24PCI2 can be used with a regular (non-Turbo) PMAC2 board, but there is no I-variable support in the regular PMAC2 for the configuration of the Servo ICs on the Acc-24PCI2. (I-variables I900 – I989 support the setup of the eight channels of the two Servo ICs on board the PMAC2 itself; there is nothing comparable for the eight channels on an Acc-24PCI2).

Use of an Acc-24PCI2 with a regular PMAC2 board requires the assignment of M-variables to the registers that would be I-variables, and execution of a power-on PLC to set the proper values in these registers.

Board Configuration

An Acc-24PCI2 comes standard with one Servo IC providing four servo interface channels, which are brought out on two 100-pin high-density connectors to an Acc-8 family breakout board or equivalent.

Each channel of servo interface circuitry includes the following:

- Three output command signal sets, configurable as either:
  - Two serial data streams to external DACs, 1 pulse-and-direction
  - Three PWM top-and-bottom pairs
- 3-channel differential/single-ended encoder input
- Nine input flags, two output flags
- Interface to two external serial ADCs, 8 to 18 bits

Option 1: If Option 1 is ordered, a second Servo IC with four additional servo interface channels is provided, for a total of eight interface channels on the board, brought out on four 100-pin high-density connectors.

HARDWARE SETUP

Position Compare Port Driver IC

The position compare output port J8 (JEQU) has a socketed driver IC in a 20-pin DIP socket at component U5. Three types of ICs can be placed in this socket: a fast CMOS driver, a high-current sinking driver, and a high-current sourcing driver.

The following table lists the properties of each driver IC:

Part	# of Pins	Max Voltage and Current	Output Type	Max Frequency	E11, E12 Setting
74ACT563 (default)	20	5V, 10 mA	Totem-Pole (CMOS)	5 MHz	1-2
ULN2803A	18	24V, 100 mA	Sinking (Open-Collector)	100 kHz	1-2
UDN2981	18	24V, 100 mA	Sourcing (Open-Emitter)	100 kHz	2-3

When the 18-pin ICs are placed in the 20-pin socket, pin 1 of the IC should be placed in pin 2 of the socket. This puts the IC at the right end of the socket when the board is the orientation where the text on the board reads properly.

Switch Configuration

Address DIP Switch S1

S1 is a 4-point DIP switch that sets up the address of the Acc-24PCI2 in Turbo PMAC's memory and I/O map. The setting of these DIP switches must match the addresses used by Turbo PMAC. No two Acc-24PCI2 boards connected to the same Turbo PMAC may have the same DIP switch address setting, or there will be an addressing conflict.

Switch S1-3 must be ON on an Acc-24PCI2 to enable addressing of the board by a Turbo PMAC. It must be OFF to enable addressing of the board by a non-Turbo PMAC2 board. In this case, the settings of S1-1 and S1-2 do not matter.

Switch S1-4 controls whether loss-of-encoder fault can be read by the Turbo PMAC or not. If E20 is ON, these encoder faults can be read at the following addresses:

- First Acc-24PCI2: Y:$078F00 bits 16-23
- Second Acc-24PCI2: Y:$079F00 bits 16-23
- Third Acc-24PCI2: Y:$07AF00 bits 16-23
- Fourth Acc-24PCI2: Y:$07BF00 bits 16-23

The settings of switches S1-1 and S1-2 define the address of the board in Turbo PMAC's address space. This in turn defines the number of the Servo ICs on the board, and the I-variable numbers in the Turbo PMAC that configures the ICs. The following table lists the possible settings:

S1-1	S1-2	Board No.	1ST IC No.	2ND IC No.	1ST IC I-Var. Range	2ND IC I- Var. Range	1ST IC Base Address	2ND IC Base Address
ON	ON	1ST	2	3	I7200-I7299	I7300-I7399	$078200	$078300
OFF	ON	2ND	4	5	I7400-I7499	I7500-I7599	$079200	$079300
ON	OFF	3RD	6	7	I7600-I7699	I7700-I7799	$07A200	$07A300
OFF	OFF	4TH	8	9	I7800-I7899	I7900-I7999	$07B200	$07B300

It is suggested, but not required, that the boards be assigned in order. That is, if there are two Acc-24PCI2 boards in the system, set up the one closest to the Turbo PMAC as the first board, and the next one as the second board.

Jumper Configuration

Position Compare Output Configuration Jumpers

CAUTION:

An incorrect setting of either of these jumpers can permanently damage the driver IC.

Jumpers E11 and E12 configure the hardware of the outputs on the JEQU (J8) Position Compare port. They must be set properly for the port's socketed driver IC in U5.

Normally, the Acc-24PCI2 is shipped with a 74ACT563 (or equivalent) CMOS driver IC. For this IC, jumpers E11 and E12 must both connect pins 1 and 2.

If the standard output driver is replaced with a ULN2803A (or equivalent) sinking output driver IC, jumpers E11 and E12 must both connect pins 1 and 2.

If the standard output driver is replaced with a UDN2981A (or equivalent) sourcing output driver IC, jumpers E11 and E12 must both be moved to connect pins 2 and 3.

Encoder Sample Clock Source Jumpers

Jumpers E13 and E14 control the source of the SCLK encoder sampling clock for each servo IC. The default setting of no jumper installed means that the SCLK signal comes from the servo IC and is output on the JMACH connectors. This setting is suitable for all but a few very special applications.

Serial ADC Source Jumpers

Jumpers E23, E24, E25, and E26 determine the source of serial ADC signals for each pair of channels on the Acc-24PCI2.

If the jumper is OFF (default), the serial ADC signals for the two channels come in through the 100-pin JMACH servo interface connector. This setting is used for digital current feedback when using direct-PWM power block amplifiers. It is also used for inputs from an Acc-28B ADC board when connected to the Acc-24PCI2 board through an Acc-8T board.

If the jumper is ON, the serial ADC signals for the two channels come in through the 16-pin JSx header on the board. This setting is used for the Acc-28B board when connected directly to the Acc-24PCI2 board's JSx connector.

The following table lists the connectors used for each jumper:

Jumper	Source when OFF	Source when ON
E23	J9 (JMACH1)	JS1
E24	J10 (JMACH2)	JS2
E25	J11 (JMACH3)	JS3
E26	J12 (JMACH4)	JS4

Output Disable State Jumpers

Jumpers E111 through E118 control the hardware state of the digital command output signals for each channel when the amplifier enable signal for that channel is in the disable state (false). Jumper E11n (n = 1 to 8) controls the output signals for Channel 'n' on the board.

If E11n is OFF (default), the command output signals for Channel n are still active when the amplifier enable signal is in the disable state. The Turbo PMAC software should be commanding a net zero command to be output on these signals, and the amplifier enable signal should be used by the amplifier so that no command output will cause action if it is receiving a disable signal. This OFF setting must be used when DAC output format is selected for the channel.

If E11n is ON, the command output signals for Channel 'n' are tri-stated when the amplifier enable signal is in the disable state. Typically, this setting is used only with direct-PWM power-block amplifiers that do not use amplifier enable to gate the PWM signals, and in which the zero-command format of 50% top on-time, and 50% bottom on-time cannot be tolerated in the disable state.

Resistor Pack Configuration

Termination Resistors

The Acc-24PCI2 provides sockets for termination resistors on differential input pairs coming into the board. As shipped, there are no resistor packs in these sockets. If these signals are brought long distances into the Acc-24PCI2 board and ringing at signal transitions is a problem, SIP resistor packs may be mounted in these sockets to reduce or eliminate the ringing.

All termination resistor packs are the types that have independent resistors (no common connection) with each resistor using two adjacent pins. The following table shows which packs are used to terminate each input device:

Input	Pack	Pack Size	Input	Pack	Pack Size
Encoder 1	RP79	6-pin	ADC 1 and 2	RP81	8-pin
Encoder 2	RP80	6-pin	ADC 3 and 4	RP90	8-pin
Encoder 3	RP92	6-pin	ADC 5 and 6	RP144	8-pin
Encoder 4	RP91	6-pin	ADC 7 and 8	RP154	8-pin
Encoder 5	RP137	6-pin	Fault 1 and 2	RP82	6-pin
Encoder 6	RP138	6-pin	Fault 3 and 4	RP89	6-pin
Encoder 7	RP148	6-pin	Fault 5 and 6	RP145	6-pin
Encoder 8	RP149	6-pin	Fault 7 and 8	RP155	6-pin
SCLK 12 and 34	RP97	6-pin	SCLK 56 and 78	RP157	6-pin

Pull-Up/Pull-Down Resistors

The differential input signal pairs to the Acc-24PCI2 have user-configurable pull-up/pull-down resistor networks to permit the acceptance of either single-ended or differential signals in one setting, or the detection of lost differential signals in another setting.

The '+' inputs of each differential pair each have a hard-wired 1k pull-up resistor to +5V. This cannot be changed.

The '-' inputs of each differential pair each have a hard-wired 2.2k resistor to +5V; each also has another 2.2k resistor as part of a socketed resistor pack that can be configured as a pull-up resistor to +5V, or a pull-down resistor to GND.

If this socketed resistor is configured as a pull-down resistor (the default configuration), the combination of pull-up and pull-down resistors on this line acts as a voltage divider, holding the line at +2.5V in the absence of an external signal. This configuration is required for single-ended inputs using the '+' lines alone; it is desirable for unconnected inputs to prevent the pick-up of spurious noise; it is permissible for differential line-driver inputs.

If this socketed resistor is configured as a pull-up resistor (by reversing the SIP pack in the socket), the two parallel 2.2k resistors act as a single 1.1k pull-up resistor, holding the line at +5V in the absence of an external signal. This configuration is required if encoder-loss detection is desired; it is required if complementary open-collector drivers are used; it is permissible for differential line-driver inputs even without encoder loss detection.

If Pin 1 of the resistor pack, marked by a dot on the pack, matches Pin 1 of the socket, marked by a wide white line on the front side of the board, and a square solder pin on the back side of the board, then the pack is configured as a bank of pull-down resistors. If the pack is reversed in the socket, it is configured as a bank of pull-up resistors.

The following table lists the pull-up/pull-down resistor pack for each input device:

Device	Resistor Pack	Device	Resistor Pack
Encoder 1	RP74	ADC/Fault 1 and 2	RP76
Encoder 2	RP75	ADC/FAULT 3 and 4	RP87
Encoder 3	RP85	ADC/Fault 5 and 6	RP143
Encoder 4	RP86	ADC/Fault 7 and 8	RP65
Encoder 5	RP139	SCLK 12 and 34	RP98
Encoder 6	RP140	SCLK 56 and 78	RP156
Encoder 7	RP150		
Encoder 8	RP151		

Loss of Encoder Circuit

The encoder-loss detection circuitry works for differential incremental encoders only. In proper operation, the digital states of the complementary inputs for a channel (e.g. A and A/) always should be opposite: when one is high, the other is low. If for some reason, such as a cable connection coming undone, one or more of the signal lines is no longer driven, pull-up resistors on the input line pull and hold the signal high. The encoder-loss detection circuitry uses exclusive-or (XOR) gates on each complementary pair to detect whether the signals are in the same or opposite states. These results are combined to produce a single encoder-loss status bit that the processor can read.

This technique requires that both signal lines of the pair have pull-up resistors. Note that this is not the default configuration of a PMAC as it is shipped. The complementary lines (A/ and B/) are pulled to 2.5V in a voltage-divider configuration as shipped to be able to accept both single-ended and normal differential inputs. This must be changed to a pull-up configuration which involves reversing a socketed resistor pack on the Acc-24PCI2. Encoder faults can be read at:

First Acc-24PCI2	Y:$078F00 bits 16-23
Second Acc-24PCI2	Y:$079F00 bits 16-23
Third Acc-24PCI2	Y:$07AF00 bits 16-23
Fourth Acc-24PCI2	Y:$07BF00 bits 16-23

So for each Acc-24PCI2 :

Channel #	Resistor Pack	Status Bit Address	Status Bit "Name"	Bit Error State
1	RP74	Y:$07xF00,0	QL_1-	0
2	RP75	Y:$07xF00,1	QL_2-	0
3	RP85	Y:$07xF00,2	QL_3-	0
4	RP86	Y:$07xF00,3	QL_4-	0
5	RP139	Y:$07xF00,4	QL_5-	0
6	RP140	Y:$07xF00,5	QL_6-	0
7	RP150	Y:$07xF00,6	QL_7-	0
8	RP151	Y:$07xF00,7	QL_8-	0

The "x" digit in this hex address matches the value (8, 9, A, or B) in the fourth digit from the right in the board's own base address (e.g. $079200).

Connections

Mounting

The Acc-24PCI2 can be mounted in one of three ways: in the PCI bus, or using standoffs.

- **PCI bus:** To mount in the PCI bus, simply insert the P1 card-edge connector into the PCI socket. If there is a standard PC-style housing, a bracket at the end of the Acc-24PCI2 board can be used to screw into the housing to hold the board down firmly.
- **Standoffs:** At each of the four corners of the Acc-24PCI2 board, there are mounting holes that can be used to mount the board on standoffs.

> ***Note:***
>
> The Acc-24PCI2 board does not do any communication through the bus connector; the connector is used simply for mounting, and, if the bus connector is electrically active, for power supply. Even in standalone applications, passive backplane boards can be very useful for mounting and power supply.

Power Supply Connection

The Acc-24PCI2 requires only 5V power: 1A in a 4-channel configuration, 2A in an 8-channel configuration (with Option 1). This power can be provided in several ways:

- **Bus connector:** If the Acc-24PCI2 is mounted in an electrically active PCI bus slot, it draws its 5V power from the bus automatically.
- **Terminal block:** The TB1 2-point terminal block can be used to bring in 5V power, especially in standalone applications. Point 1 is GND; Point 2 is +5V.
- **JMACH connectors:** Up to 1A may be brought in through each 100-pin JMACH connector from an Acc-8 board or its equivalent, provided the cable is 500 mm (20 in) or less in length.

Connection to Turbo PMAC

The Acc-24PCI2 connects to the Turbo PMAC through the 50-pin J1 header on the Acc-24PCI2. A short flat cable connects this to the JEXP header on the Turbo PMAC. If multiple Acc-24 boards are connected to a single Turbo PMAC board, they must be connected on a single daisy-chain cable. Total length of this cable should not exceed 300mm (12 in).

Machine Port Connections

Acc-24PCI2 has a 100-pin high-density header for each pair of servo interface channels. Through this connector, pass all of the digital signals to and from the amplifier, encoder, and flags for the two channels. Typically, this header is connected with a matching Delta Tau Acc-8 family 2-channel breakout board or equivalent through a provided 100-pin flat cable.

The machine port connectors are:

- J9 (JMACH1) Board Channels 1 and 2
- J10 (JMACH2) Board Channels 3 and 4
- J11 (JMACH3) Board Channels 5 and 6 (Option 1 required)
- J12 (JMACH4) Board Channels 7 and 8 (Option 1 required)

Alternate Port Connections

Acc-24PCI2 has a 16-pin header that provides alternate pinout for several signals associated with each pair of servo interface channels. These signals include the ADC clock, strobe, and data; the amplifier enable outputs, and the position compare outputs.

The main use of the alternate port connector is to provide a direct interface to an Acc-28B 2-channel or 4-channel A/D converter board. The Acc-28B can be connected directly to the alternate port connector on the Acc-24PCI2 through a 16-pin flat cable provided with the Acc-28B.

In order to use ADC inputs on the alternate connector, a jumper for the connector must be installed. If the jumper is OFF, the Acc-24PCI2 will take its ADC inputs from the matching 100-pin machine port connector.

The alternate port connectors and their control jumpers are:

- JS1 Board Channels 1 and 2 Jumper E23
- JS2 Board Channels 3 and 4 Jumper E24
- JS3 Board Channels 5 and 6 Jumper E25 (Option 1 required)
- JS4 Board Channels 7 and 8 Jumper E26 (Option 1 required)

SOFTWARE SETUP FOR TURBO PMAC

Use of the Acc-24PCI2 requires the proper setup of several I-variables on the Turbo PMAC. These settings are discussed in this section. Detailed descriptions of these variables are given in the Turbo PMAC Software Reference.

System Configuration I-Variables

External Servo IC Enable

Turbo PMAC variable I65 tells the controller which external devices containing Servo ICs, such as the Acc-24PCI2, are present in the system. I65 is a 4-bit value, with each bit representing one of the four possible devices that can be connected to a Turbo PMAC. The bit must be set to 1 to tell the Turbo PMAC software that the device is present.

- Bit 0, with a value of 1, specifies whether the first device is present
- Bit 1, with a value of 2, specifies whether the second device is present
- Bit 2, with a value of 4, specifies whether the third device is present
- Bit 3, with a value of 8, specifies whether the fourth device is present

An Acc-24PCI2 can be the first, second, third, or fourth device, depending on the setting of DIP switches S1-1 and S1-2.

Normally these external devices are added in order, so I65 takes one of four values:

- First external device alone: I65=1
- First and second external devices: I65=3
- First, second, and third external devices: I65=7
- First, second, third, and fourth external devices: I65=15

External Servo IC Type

Turbo PMAC variable I66 tells the controller which type of IC is present on a given external device. I66 is a 4-bit value, with each bit representing one of the four possible devices that can be connected to a Turbo PMAC. The bit is set to 0 if the device contains Type 0 PMAC-style DSPGATE Servo ICs; it is set to 1 if the device contains Type 1 PMAC2-style DSPGATE1 Servo ICs.

The Acc-24PCI2 contains the Type 1 PMAC2-style Servo ICs, so the bit of I66 for the Acc-24PCI2 must be set to 1 for proper operation.

- Bit 0, with a value of 1, is set to 1 if the first Acc-24PCI2 is present
- Bit 1, with a value of 2, is set to 1 if the second Acc-24PCI2 is present
- Bit 2, with a value of 4, is set to 1 if the third Acc-24PCI2 is present
- Bit 3, with a value of 8, is set to 1 if the fourth Acc-24PCI2 is present

Servo IC Configuration I-Variables

Turbo PMAC I-variables in the range I7000 – I7999 control the configuration of the Servo ICs. The hundred's digit represents the number of the Servo IC (0 to 9) in the system. Servo ICs 0 and 1 are (or can be) on board the Turbo PMAC board itself. Servo ICs 2 through 9 are (or can be) on external devices such as the Acc-24PCI2.

Servo IC Numbering

The number m of the Servo IC on the Acc-24PCI2 board is dependent on the addressing of the board with DIP switches S1-1 and S1-2, which place the board as the first, second, third, or fourth external device:

- First Acc-24PCI2: Servo IC 2 (Standard); Servo IC 3 (Option 1)
- Second Acc-24PCI2: Servo IC 4 (Standard); Servo IC 5 (Option 1)
- Third Acc-24PCI2: Servo IC 6 (Standard); Servo IC 7 (Option 1)
- Fourth Acc-24PCI2: Servo IC 8 (Standard); Servo IC 9 (Option 1)

The standard Servo IC on an Acc-24PCI2 occupies Channels 1 – 4 on the board, using connectors JMACH1, JMACH2, JS1, and JS2. The Option 1 Servo IC on an Acc-24PCI2 occupies Channels 5 – 8 on the board, using connectors JMACH3, JMACH4, JS3, and JS4.

For example, the standard Servo IC on the first Acc-24PCI2 is Servo IC 2 to Turbo PMAC and is configured by variables I7200 – I7299.

Servo Channel Numbering

Each Servo IC has four channels of servo interface circuitry. The ten's digit n of the I-variable configuring the IC represents the channel number on the IC (n = 1 to 4). For example, Channel 1 of the "Standard" Servo IC on the first Acc-24PCI2 is configured by variables I7210 – I7219. These channel-specific I-variables are represented generically as I7mn0 – I7mn9, where m represents the Servo IC number (0 – 9) and n represents the IC channel number (1 – 4).

The Channels 1 – 4 on the standard Servo IC of an Acc-24PCI2 correspond to Channels 1 – 4, respectively, on the Acc-24PCI2 board itself. The Channels 1 – 4 on the Option 1 Servo IC on an Acc-24PCI2 correspond to Channels 5 – 8, respectively, on the Acc-24PCI2 board.

I-variables in the I7000s for which the ten's digit is 0 (Channel 0) affect all 4 channels of the PMAC2-style Servo IC on the Acc-24PCI2. These multi-channel I-variables are represented generically as I7m00 – I7m09.

Multi-Channel I-Variables

Several multi-channel I-variables must be set up properly for proper operation of the Acc-24PCI2 in a Turbo PMAC system. The most important are:

- **I7m07: Servo IC m Phase/Servo Clock Direction:** This variable should be set to 3 for any Servo IC on an Acc-24PCI2 so it inputs its phase and servo clocks from signals generated on the Turbo PMAC itself.
- **I7m00: Servo IC m MaxPhase/PWM Frequency Control:** Typically, this will be set to the same value as the variable that controls the system clocks: I7000 on a non-Ultralite Turbo PMAC2, or I6800 on a Turbo PMAC2 Ultralite. If a different PWM frequency is desired, or the Acc-24PCI2 is used with a Turbo PMAC in which the system clock frequencies are set by jumpers, then the following constraint should be observed in setting this variable:

$$\frac{2 * PWMFreq(kHz)}{PhaseFreq} = \{Integer\}$$

- **I7m01: Servo IC m Phase Clock Frequency Control:** Even though the IC is receiving an external phase clock (see I7m07, above), usually it is best to create the same internal phase clock frequency in the Servo IC. This yields the following constraint:

$$I7m00 * (I7m01 + 1) = I7000 * (I7001 + 1) \quad \{\text{non-Ultralite Turbo PMAC2}\}$$

$$I7m00 * (I7m01 + 1) = I6800 * (I6801 + 1) \quad \{\text{Turbo PMAC2 Ultralite}\}$$

Solving for I7m01, we get

$$I7m01 = \frac{I7000 * (I7001 + 1)}{I7m00} - 1 \quad \{\text{non Ultralite PMAC2}\}$$

$$I7m01 = \frac{I6800 * (I6801 + 1)}{I7m00} - 1 \quad \{\text{Turbo PMAC2 Ultralite}\}$$

If I7m00 is the same as I7000 or I6800, I7m01 will be the same as I7001 or I6801. If the Acc-24PCI2 is interfaced to a Turbo PMAC board, it should be set by calculation to obtain the same phase clock frequency as that set by the jumpers on the Turbo PMAC.

- **I7m02: Servo IC m Servo Clock Frequency Control:** Even though the IC is receiving an external servo clock (see I7m07, above), usually it is best to create the same internal servo clock frequency in the Servo IC. This means that I7m02 for the IC should be set the same as I7002 on a non-Ultralite Turbo PMAC2, or the same as I6802 on a Turbo PMAC2 Ultralite. When connected to a Turbo PMAC, I7m02 should create the same division from the phase clock as jumpers E3 – E6 do on the Turbo PMAC.
- **I7m03: Servo IC m Hardware Clock Frequency Control:** The hardware clock frequencies for the Servo IC should be set according to the devices attached to it. There is no reason that these frequencies have to be the same between ICs. There is seldom a reason to change this value from the default.

Single-Channel I-Variables

The single-channel setup I-variables for Channel n of Servo IC m work the same on an Acc-24PCI2 as they do on a Turbo PMAC2 itself. Each Servo IC has four channels n, numbered 1 to 4. For the first (standard) Servo IC on the Acc-24PCI2, the channel numbers 1 – 4 on the Servo IC are the same as the channel numbers 1 – 4 on the board. For the second (optional) Servo IC on the Acc-24PCI2, the channel numbers 1 – 4 on the Servo IC correspond to board channel numbers 5 – 8. The most important variables are:

- **I7mn0: Servo IC m Channel n Encoder Decode Control:** Typically, I7mn0 is set to 3 or 7 for x4 quadrature decode, depending on which way is up. If the channel is used for open-loop stepper drive, I7mn0 is set to 8 to accept internal pulse-and-direction, or to 0 to accept external pulse-and-direction (e.g. from an Acc-8S). It is set to 12 if the channel is used for MLDT feedback.
- **I7mn2: Servo IC m Channel n Capture Control:** I7mn2 determines whether the encoder index channel, an input flag, or both, are used for the capture of the encoder position.
- **I7mn3: Servo IC m Channel n Capture Flag Select:** I7mn3 determines which input flag is used for encoder capture, if one is used.
- **I7mn6: Servo IC m Channel n Output Mode Select:** I7mn6 determines whether the A and B outputs are DAC or PWM, and whether the C output is PFM (pulse-and-direction) or PWM. It is typically set either to 0, for 3-phase PWM, or to 3 for DACs and PFM.

Encoder Conversion Table I-Variables

To use feedback or master position data from an Acc-24PCI2, entries must be added to the encoder conversion table (ECT) using I-variables I8000 – I8191 to address and process this data. The default conversion table in the Turbo PMAC does not contain these entries; it only contains entries for the eight channels on board the Turbo PMAC.

Usually, the position data obtained through an Acc-24PCI2 board is an incremental encoder feedback, and occasionally an A/D converter feedback from an Acc-28B board connected through the Acc-24PCI2.

The ECT entries for Acc-24PCI2 incremental encoder channels are shown in the following table:

Encoder Channel #	1st Acc-24PCI2	2nd Acc-24PCI2	3rd Acc-24PCI2	4th Acc-24PCI2
Channel 1	$mF8200	$mF9200	$mFA200	$mFB200
Channel 2	$mF8208	$mF9208	$mFA208	$mFB208
Channel 3	$mF8210	$mF9210	$mFA210	$mFB210
Channel 4	$mF8218	$mF9218	$mFA218	$mFB218
Channel 5	$mF8300	$mF9300	$mFA300	$mFB300
Channel 6	$mF8308	$mF9308	$mFA308	$mFB308
Channel 7	$mF8310	$mF9310	$mFA310	$mFB310
Channel 8	$mF8318	$mF9318	$mFA318	$mFB318

The first hexadecimal digit in the entry, represented by 'm' in the table, is a 0 for the most common 1/T timer-based extension of digital incremental encoders; it is an 8 for the parallel-data extension of analog incremental encoders; it is a C for no extension of an incremental encoder.

The ECT entries for Acc-28B A/D converters read through an Acc-24PCI2 are shown in the following table:

Register	1st Acc-24PCI2	2nd Acc-24PCI2	3rd Acc-24PCI2	4th Acc-24PCI2
ADC 1A	$mF8205	$mF9205	$mFA205	$mFB205
ADC 1B	$mF8206	$mF9206	$mFA206	$mFB206
ADC 2A	$mF820D	$mF920D	$mFA20D	$mFB20D
ADC 2B	$mF820E	$mF920E	$mFA20E	$mFB20E
ADC 3A	$mF8215	$mF9215	$mFA215	$mFB215
ADC 3B	$mF8216	$mF9216	$mFA216	$mFB216
ADC 4A	$mF821D	$mF921D	$mFA21D	$mFB21D
ADC 4B	$mF821E	$mF921E	$mFA21E	$mFB21E
ADC 5A	$mF8305	$mF9305	$mFA305	$mFB305
ADC 5B	$mF8306	$mF9306	$mFA306	$mFB306
ADC 6A	$mF830D	$mF930D	$mFA30D	$mFB30D
ADC 6B	$mF830E	$mF930E	$mFA30E	$mFB30E
ADC 7A	$mF8315	$mF9315	$mFA315	$mFB315
ADC 7B	$mF8316	$mF9316	$mFA316	$mFB316
ADC 8A	$mF831D	$mF931D	$mFA31D	$mFB31D
ADC 8B	$mF831E	$mF931E	$mFA31E	$mFB31E

The first hexadecimal digit of the entry, represented by m in the above table, is a 1 if the ADC data is processed directly, without integration; it is a 5 if the data is integrated in the conversion. If the entry integrates the data, there is a second line in the entry – another I-variable – that specifies the bias of the A/D converter.

Motor Addressing I-Variables

For a Turbo PMAC motor to use the servo interface circuitry of the Acc-24PCI2, several of the addressing I-variables for the motor must contain the addresses of registers in the Acc-24PCI2 or the addresses of encoder conversion table registers containing data processed from the Acc-24PCI2. These I-variables can include:

- **Ixx02: Motor xx Command Output Address:** Ixx02 tells Turbo PMAC where to write its command outputs for Motor xx. If Acc-24PCI2 is to create the command signals, Ixx02 must contain the address of the register. The following table shows the address of the A output register for each channel of each Acc-24PCI2. These addresses can be used for single analog outputs, double analog outputs, or direct PWM outputs.

Acc-24PCI2 Register: Board No. & Channel	Address/ Ixx02 Value	PMAC2 Default for:	Acc-24PCI2 Register: Board No. & Channel	Address/ Ixx02 Value	PMAC2 Default for:
1st Acc-24P/V2 DAC/PWM1A	$078202	I902	3rd Acc-24P/V2 DAC/PWM1A	$07A202	I2502
1st Acc-24P/V2 DAC/PWM2A	$07820A	I1002	3rd Acc-24P/V2 DAC/PWM2A	$07A20A	I2602
1st Acc-24P/V2 DAC/PWM3A	$078212	I1102	3rd Acc-24P/V2 DAC/PWM3A	$07A212	I2702
1st Acc-24P/V2 DAC/PWM4A	$07821A	I1202	3rd Acc-24P/V2 DAC/PWM4A	$07A21A	I2802
1st Acc-24P/V2 DAC/PWM5A	$078302	I1302	3rd Acc-24P/V2 DAC/PWM5A	$07A302	I2902
1st Acc-24P/V2 DAC/PWM6A	$07830A	I1402	3rd Acc-24P/V2 DAC/PWM6A	$07A30A	I3002
1st Acc-24P/V2 DAC/PWM7A	$078312	I1502	3rd Acc-24P/V2 DAC/PWM7A	$07A312	I3102
1st Acc-24P/V2 DAC/PWM8A	$07831A	I1602	3rd Acc-24P/V2 DAC/PWM8A	$07A31A	I3202
2nd Acc-24P/V2 DAC/PWM1A	$079202	I1702	4th Acc-24P/V2 DAC/PWM1A	$07B202	--
2nd Acc-24P/V2 DAC/PWM2A	$07920A	I1802	4th Acc-24P/V2 DAC/PWM2A	$07B20A	--
2nd Acc-24P/V2 DAC/PWM3A	$079212	I1902	4th Acc-24P/V2 DAC/PWM3A	$07B212	--
2nd Acc-24P/V2 DAC/PWM4A	$07921A	I2002	4th Acc-24P/V2 DAC/PWM4A	$07B21A	--

2nd Acc-24P/V2 DAC/PWM5A	$079302	I2102	4th Acc-24P/V2 DAC/PWM5A	$07B302	--
2nd Acc-24P/V2 DAC/PWM6A	$07930A	I2202	4th Acc-24P/V2 DAC/PWM6A	$07B30A	--
2nd Acc-24P/V2 DAC/PWM7A	$079312	I2302	4th Acc-24P/V2 DAC/PWM7A	$07B312	--
2nd Acc-24P/V2 DAC/PWM8A	$07931A	I2402	4th Acc-24P/V2 DAC/PWM8A	$07B31A	--

If the C output register for a given Acc-24PCI2 and channel is used (primarily for pulse and direction output), simply add 2 to the address shown in the above table. For example, on the first Acc-24PCI2, output register 1C is at address $078204.

- **Ixx03: Motor xx Position-Loop Feedback Address**
- **Ixx04: Motor xx Velocity-Loop Feedback Address**
- **Ixx05: Motor xx Master Position Address**

  The Ixx03, Ixx04, and usually Ixx05 variables contain the address of a processed position value in the encoder conversion table, even when the raw data comes from the Acc-24PCI2. The first line of the encoder conversion table is at address $003501; the last line is at address $0035C0.

- **Ixx10: Motor xx Power-On Position Address:** Ixx10 tells the Turbo PMAC where to read absolute power-on position, if any. Typically, the only times Ixx10 will contain the address of an Acc-24PCI2 register is when the position is obtained from an A/D converter on an Acc-28B connected through the Acc-24PCI2, or when it is obtained from an MLDT (e.g. Temposonics™) sensor excited directly from an Acc-24PCI2.

  The following table shows the possible values of Ixx10 for Acc-28B A/D converters:

Ixx10 Values for Acc-24PCI2 ADC Registers (Ixx95=$B10000 for Acc-28B)

Register	1st Acc-24PCI2	2nd Acc-24PCI2	3rd Acc-24PCI2	4th Acc-24PCI2
ADC 1A	$078205	$079205	$07A205	$07B205
ADC 1B	$078206	$079206	$07A206	$07B206
ADC 2A	$07820D	$07920D	$07A20D	$07B20D
ADC 2B	$07820E	$07920E	$07A20E	$07B20E
ADC 3A	$078215	$079215	$07A215	$07B215
ADC 3B	$078216	$079216	$07A216	$07B216
ADC 4A	$07821D	$07921D	$07A21D	$07B21D
ADC 4B	$07821E	$07921E	$07A21E	$07B21E
ADC 5A	$078305	$079305	$07A305	$07B305
ADC 5B	$078306	$079306	$07A306	$07B306
ADC 6A	$07830D	$07930D	$07A30D	$07B30D
ADC 6B	$07830E	$07930E	$07A30E	$07B30E
ADC 7A	$078315	$079315	$07A315	$07B315
ADC 7B	$078316	$079316	$07A316	$07B316
ADC 8A	$07831D	$07931D	$07A31D	$07B31D
ADC 8B	$07831E	$07931E	$07A31E	$07B31E

The following table shows the possible values of Ixx10 for MLDT timer registers:

Ixx10 for Acc-24PCI2 MLDT Timer Registers (Ixx95=$170000)

MLDT Timer Channel #	1st Acc-24PCI2	2nd Acc-24PCI2	3rd Acc-24PCI2	4th Acc-24PCI2
Channel 1	$078200	$079200	$07A200	$07B200
Channel 2	$078208	$079208	$07A208	$07B208
Channel 3	$078210	$079210	$07A210	$07B210
Channel 4	$078218	$079218	$07A218	$07B218
Channel 5	$078300	$079300	$07A300	$07B300
Channel 6	$078308	$079308	$07A308	$07B308
Channel 7	$078310	$079310	$07A310	$07B310
Channel 8	$078318	$079318	$07A318	$07B318

- **Ixx24: Motor xx Flag Mode.** Ixx24 how to read and use the flags for Motor xx that are in the register specified by Ixx25. Ixx24 is a set of independent control bits. There are two bits that must be set correctly to use a flag set on an Acc-24PCI2.

  Bit 0 of Ixx24 must be set to 1 to tell the Turbo PMAC that this flag set is in a "Type 1" PMAC2-style Servo IC. Bit 18 of Ixx24 must be set to 0 to tell the Turbo PMAC that this flag set is *not* transmitted over a MACRO ring. Other bits of Ixx24 may be set as desired for a particular application.

- **Ixx25: Motor xx Flag Address.** Ixx25 tells Turbo PMAC where to access its flag data for Motor xx. If Acc-24PCI2 is interface to the flags, Ixx25 must contain the address of the flag register in Acc-24PCI2. The following table shows the address of the flag register for each channel of each Acc-24PCI2.

Acc-24PCI2 Register: Board No. & Channel	Address/ Ixx25 Value	PMAC2 Default for:	Acc-24PCI2 Register: Board No. & Channel	Address / Ixx25 Value	PMAC2 Default for:
1st Acc-24P/V2 Flag Set 1	$078200	I925	3rd Acc-24P/V2 Flag Set 1	$07A200	I2525
1st Acc-24P/V2 Flag Set 2	$078208	I1025	3rd Acc-24P/V2 Flag Set 2	$07A208	I2625
1st Acc-24P/V2 Flag Set 3	$078210	I1125	3rd Acc-24P/V2 Flag Set 3	$07A210	I2725
1st Acc-24P/V2 Flag Set 4	$078218	I1225	3rd Acc-24P/V2 Flag Set 4	$07A218	I2825
1st Acc-24P/V2 Flag Set 5	$078300	I1325	3rd Acc-24P/V2 Flag Set 5	$07A300	I2925
1st Acc-24P/V2 Flag Set 6	$078308	I1425	3rd Acc-24P/V2 Flag Set 6	$07A308	I3025
1st Acc-24P/V2 Flag Set 7	$078310	I1525	3rd Acc-24P/V2 Flag Set 7	$07A310	I3125
1st Acc-24P/V2 Flag Set 8	$078318	I1625	3rd Acc-24P/V2 Flag Set 8	$07A318	I3225
2nd Acc-24P/V2 Flag Set 1	$079200	I1725	4th Acc-24P/V2 Flag Set 1	$07B200	--
2nd Acc-24P/V2 Flag Set 2	$079208	I1825	4th Acc-24P/V2 Flag Set 2	$07B208	--
2nd Acc-24P/V2 Flag Set 3	$079210	I1925	4th Acc-24P/V2 Flag Set 3	$07B210	--
2nd Acc-24P/V2 Flag Set 4	$079218	I2025	4th Acc-24P/V2 Flag Set 4	$07B218	--
2nd Acc-24P/V2 Flag Set 5	$079300	I2125	4th Acc-24P/V2 Flag Set 5	$07B300	--
2nd Acc-24P/V2 Flag Set 6	$079308	I2225	4th Acc-24P/V2 Flag Set 6	$07B308	--
2nd Acc-24P/V2 Flag Set 7	$079310	I2325	4th Acc-24P/V2 Flag Set 7	$07B310	--
2nd Acc-24P/V2 Flag Set 8	$079318	I2425	4th Acc-24P/V2 Flag Set 8	$07B318	--

- **Ixx81: Motor xx Power-On Phase Position Address.** Ixx81 tells Turbo PMAC2 where to read absolute power-on position for motor phase commutation if any. Typically, it will contain the address of an Acc-24PCI2 register for only two types of absolute phasing sensors. The hall-effect commutation sensors (or their optical equivalents) connected to the U, V, and W input flags on an Acc-24PCI2 channel, or the encoder counter filled by simulated quadrature from a Yaskawa absolute encoder connected to the Acc-24PCI2 through an Acc-8D Option 9 board.

  The following table contains the possible settings of Ixx81 for hall sensor absolute position with an Acc-24PCI2:

Turbo PMAC Ixx81 Acc-24PCI2 Hall Phasing Settings (Ix91=$800000 - $FF0000)

Hall Flag Channel #	1st Acc-24PCI2	2nd Acc-24PCI2	3rd Acc-24PCI2	4th Acc-24PCI2
Channel 1	$078200	$079200	$07A200	$07B200
Channel 2	$078208	$079208	$07A208	$07B208
Channel 3	$078210	$079210	$07A210	$07B210
Channel 4	$078218	$079218	$07A218	$07B218
Channel 5	$078300	$079300	$07A300	$07B300
Channel 6	$078308	$079308	$07A308	$07B308
Channel 7	$078310	$079310	$07A310	$07B310
Channel 8	$078318	$079318	$07A318	$07B318

The following table contains the possible settings of Ixx81 to read the encoder counters for Yaskawa absolute encoders:

Turbo PMAC Ixx81 Acc-24PCI2 Encoder Register Settings (Ix91=$480000 - $580000)

Encoder Register Channel #	1st Acc-24PCI2	2nd Acc-24PCI2	3rd Acc-24PCI2	4th Acc-24PCI2
Channel 1	$078201	$079201	$07A201	$07B201
Channel 2	$078209	$079209	$07A209	$07B209
Channel 3	$078211	$079211	$07A211	$07B211
Channel 4	$078219	$079219	$07A219	$07B219
Channel 5	$078301	$079301	$07A301	$07B301
Channel 6	$078309	$079309	$07A309	$07B309
Channel 7	$078311	$079311	$07A311	$07B311
Channel 8	$078319	$079319	$07A319	$07B319

- **Ixx82: Motor xx Current Feedback Address.** Ixx82 tells Turbo PMAC where to get its current-loop feedback every phase update cycle. If Ixx82 is set to 0, Turbo PMAC does not perform current-loop calculations for Motor xx.

  The following table shows the possible values of Ixx82 for Acc-24PCI2 ADC register pairs:

  Turbo PMAC Ixx82 Acc-24PCI2 ADC Register Settings

ADC Register Channel #	1st Acc-24PCI2	2nd Acc-24PCI2	3rd Acc-24PCI2	4th Acc-24PCI2
Channel 1	$078206	$079206	$07A206	$07B206
Channel 2	$07820E	$07920E	$07A20E	$07B20E
Channel 3	$078216	$079216	$07A216	$07B216
Channel 4	$07821E	$07921E	$07A21E	$07B21E
Channel 5	$078306	$079306	$07A306	$07B306
Channel 6	$07830E	$07930E	$07A30E	$07B30E
Channel 7	$078316	$079316	$07A316	$07B316
Channel 8	$07831E	$07931E	$07A31E	$07B31E

- **Ixx83: Motor xx Phase Position Address.** Ixx83 tells Turbo PMAC where to get its commutation position feedback every phase update cycle. This almost always contains the address of an encoder phase position register.

  The following table shows the possible values of Ixx83 for Acc-24PCI2 encoder phase position registers:

  Turbo PMAC Ixx83 Acc-24PCI2 Encoder Register Settings

Encoder Register Channel #	1st Acc-24PCI2	2nd Acc-24PCI2	3rd Acc-24PCI2	4th Acc-24PCI2
Channel 1	$078201	$079201	$07A201	$07B201
Channel 2	$078209	$079209	$07A209	$07B209
Channel 3	$078211	$079211	$07A211	$07B211
Channel 4	$078219	$079219	$07A219	$07B219
Channel 5	$078301	$079301	$07A301	$07B301
Channel 6	$078309	$079309	$07A309	$07B309
Channel 7	$078311	$079311	$07A311	$07B311
Channel 8	$078319	$079319	$07A319	$07B319

JUMPER AND SWITCH DESCRIPTIONS

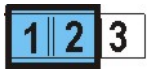
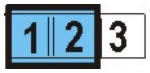
S1: Board Addressing DIP-Switch Bank

Switch	Location	Description	Default
S1-1	B-1	Board Expansion Port Address Select: Use S1-1 and S1-2 to select Acc-24PCI2 address on Turbo PMAC's exp. port according to following table.	ON
S1-2	B-1	Board Expansion Port Address Select: Use S1-1 and S1-2 to select Acc-24PCI2 address on Turbo PMAC's exp. port according to following table	ON
S1-3	B-1	Board Expansion Port Address Enable: Set S1-3 to ON position when connecting to Turbo PMAC/PMAC2; enables addressing of multiple Acc-24 boards with S1-1 and S1-2. Set S1-3 to OFF position when connecting to regular (non-Turbo) PMAC2.	ON
S1-4	B-1	Encoder Fault Read Enable: Set S1-4 ON to enable Turbo PMAC read of encoder fault at CS16 select line. Set S1-4 OFF to disable Turbo PMAC read of encoder fault, permitting other types of boards (i.e. Acc-14P, Acc-36P) at the addresses found in the loss of encoder section.	OFF

Addressing of Acc-24 Boards for Turbo PMAC

S1-1	S1-2	S1-3	Board No.	1st IC No.	2nd IC No.	1st IC Base Address	2nd IC Base Address
ON	ON	ON	1ST	2	3	$078200	$078300
OFF	ON	ON	2ND	4	5	$079200	$079300
ON	OFF	ON	3RD	6	7	$07A200	$07A300
OFF	OFF	ON	4TH	8	9	$07B200	$07B300

E11, E12: Output Driver IC Configuration

E-Point	Location	Description	Default
E11 	A-3	**JEQU Port Configuration:** ***CAUTION*** Incorrect setting may damage driver IC. Jump pins 1 to 2 for CMOS (74ACT563) OR sinking (ULN2803A) driver on Port (default configuration). Jump pins 2 to 3 for sourcing driver (udn2981a) on port (alternate configuration).	1-2 jumpered
E12 	A-3	**JEQU Port Configuration:** ***CAUTION*** Incorrect setting may damage driver IC. Jump pins 1 to 2 for CMOS (74ACT563) OR sinking (ULN2803A) driver on Port (default configuration). Jump pins 2 to 3 for sourcing driver (UDN2981A) on port (alternate configuration)	1-2 jumpered

E13, E14: Encoder Sample Clock Direction

E-Point	Location	Description	Default
E13 	A-5	**Encoder sample clock direction:** Remove jumper to output SCLK generated in first Servo IC on SCLK_12 and SCLK_34, or to control direction by software. Jump pins 1 to 2 to input SCLK signal for first Servo IC on SCLK_34 and output this signal on SCLK_12. Jump pins 2 to 3 to input SCLK signal for first Servo IC on SCLK_12 and output this signal on SCLK_34.	No jumper
E14 	A-2	**Encoder sample clock direction:** Remove jumper to output SCLK generated in second Servo IC on SCLK_56 and SCLK_78, or to control direction by software. Jump pins 1 to 2 to input SCLK signal for second Servo IC on SCLK_78 and output this signal on SCLK_56. Jump pins 2 to 3 to input SCLK signal for second Servo IC on SCLK_56 and output this signal on SCLK_78.	No jumper

E23 – E26: Serial ADC Source Select

E-Point	Location	Description	Default
E23 	A-4	**Serial ADC source select:** Remove jumper to read serial ADC data from JMACH1 (J9) port: for digital current feedback or Acc-28B connected thru Acc-8T. Jump pins 1 and 2 to read serial ADC data from JS1: for Acc-28B connected directly to JS1.	Jumper removed
E24 	A-4	**Serial ADC source select:** Remove jumper to read serial ADC data from JMACH2 (J10) port: for digital current feedback or Acc-28B connected thru Acc-8T. Jump pins 1 and 2 to read serial ADC data from JS2: for Acc-28B connected directly to JS2.	Jumper removed
E25 	A-1	**Serial ADC source select:** Remove jumper to read serial ADC data from JMACH3 (J11) port: for digital current feedback or Acc-28B connected thru Acc-8T. Jump pins 1 and 2 to read serial ADC data from JS3: for Acc-28B connected directly to JS3.	Jumper removed
E26 	A-1	**Serial ADC source select:** Remove jumper to read serial ADC data from JMACH4 (J12) port: for digital current feedback or Acc-28B connected thru Acc-8T. Jump pins 1 and 2 to read serial ADC data from JS4: for Acc-28B connected directly to JS4.	Jumper removed

E111 – E118: Digital Command Output Disable State

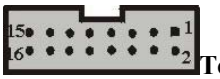
E-Point	Location	Description	Default
E111 	A-4	**Digital command output disable state select:** Jump pins 1 to 2 to tri-state channel 1 digital command output signals when amplifier enable signal is false (this setting used only for PWM outputs if balanced 50% output is not desired in disable mode). Remove jumper to keep channel 1 digital command signals enabled (driving) when amplifier enable signal is false.	No jumper
E112 	A-4	**Digital command output disable state select:** Jump pins 1 to 2 to tri-state channel 2 digital command output signals when amplifier enable signal is false (this setting only used for PWM outputs if balanced 50% output is not desired in disable mode). Remove jumper to keep channel 2 digital command signals enabled (driving) when amplifier enable signal is false.	No jumper
E113 	A-5	**Digital command output disable state select:** Jump pins 1 to 2 to tri-state channel 3 digital command output signals when amplifier enable signal is false (this setting only used for PWM outputs if balanced 50% output is not desired in disable mode). Remove jumper to keep channel 3 digital command signals enabled (driving) when amplifier enable signal is false.	No jumper
E114 	A-5	**Digital command output disable state select:** Jump pins 1 to 2 to tri-state channel 4 digital command output signals when amplifier enable signal is false (this setting only used for PWM outputs if balanced 50% output is not desired in disable mode). Remove jumper to keep channel 4 digital command signals enabled (driving) when amplifier enable signal is false.	No jumper
E115 	A-2	**Digital command output disable state select:** Jump pins 1 to 2 to tri-state channel 5 digital command output signals when amplifier enable signal is false (this setting only used for PWM outputs if balanced 50% output is not desired in disable mode). Remove jumper to keep channel 5 digital command signals enabled (driving) when amplifier enable signal is false.	No jumper
E116 	A-2	**Digital command output disable state select:** Jump pins 1 to 2 to tri-state channel 6 digital command output signals when amplifier enable signal is false (this setting only used for PWM outputs if balanced 50% output is not desired in disable mode). Remove jumper to keep channel 6 digital command signals enabled (driving) when amplifier enable signal is false.	No jumper

E117 	A-2	**Digital command output disable state select:** Jump pins 1 to 2 to tri-state channel 7 digital command output signals when amplifier enable signal is false (this setting only used for PWM outputs if balanced 50% output is not desired in disable mode). Remove jumper to keep channel 7 digital command signals enabled (driving) when amplifier enable signal is false.	No jumper
E118 	A-2	**Digital command output disable state select:** Jump pins 1 to 2 to tri-state channel 8 digital command output signals when amplifier enable signal is false (this setting only used for PWM outputs if balanced 50% output is not desired in disable mode). Remove jumper to keep channel 8 digital command signals enabled (driving) when amplifier enable signal is false.	No jumper

CONNECTOR DESCRIPTIONS

JS1: ADC Channel 1 and 2 Connector

JS1 (16-Pin Connector)



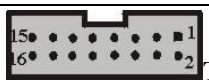
Top View

Pin #	Symbol	Function	Description	Notes
1	ADC_CLK1-	Output	Converter clock	Software set frequency
2	N.C.		No Connect	
3	SCLK12+	Output	Encoder Clock	Software set frequency
4	SCLK12-	Output	Encoder Clock	Software set frequency
5	ADC_STB1-	Output	Converter Strobe	Software set signal
6	N.C.		No Connect	
7	AENA1+	Output	Amplifier Enable	5V high true
8	AENA2+	Output	Amplifier Enable	5V high true
9	EQU1+	Output	Amplifier enable	5V high true
10	EQU2+	Output	Amplifier Enable	5V high true
11	ADC_DAA1+	Input	ADC Input Data	Serial data stream
12	ADC_DAB1+	Input	ADC Input Data	Serial data stream
13	ADC_DAA2+	Input	ADC Input Data	Serial data stream
14	ADC_DAB2+	Input	ADC Input Data	Serial data stream
15	+5V	Output	+5Vdc Supply	Power supply out
16	GND	Common	PMAC Common	Not isolated from digital

The JS1 connector provides alternate connections for several signals associated with servo interface channels 1 and 2 on the Acc-24PCI2. These signals are also present on JMACH1 and JEQU. JS1 can be used to connect directly to an Acc-28B. Jumper E23 must be removed to use the inputs on JS1.

JS2: ADC Channel 3 and 4 Connector

JS2 (16-Pin Connector)



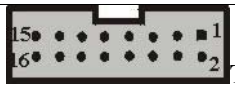
Top View

Pin #	Symbol	Function	Description	Notes
1	ADC_CLK3-	Output	Converter Clock	Software set frequency
2	N.C.		No Connect	
3	SCLK34+	Output	Encoder Clock	Software set frequency
4	SCLK34-	Output	Encoder Clock	Software set frequency
5	ADC_STB3-	Output	Converter Strobe	Software Set Signal
6	N.C.		No Connect	
7	AENA3+	Output	Amplifier Enable	5V high true
8	AENA4+	Output	Amplifier Enable	5V high true
9	EQU3+	Output	Amplifier Enable	5V high true
10	EQU4+	Output	Amplifier Enable	5V high true
11	ADC_DAA3+	Input	ADC Input Data	Serial data stream
12	ADC_DAB3+	Input	ADC Input Data	Serial data stream
13	ADC_DAA4+	Input	ADC Input Data	Serial data stream
14	ADC_DAB4+	Input	ADC Input Data	Serial data stream
15	+5V	Output	+5Vdc Supply	Power supply out
16	GND	Common	PMAC Common	Not isolated from digital

The JS2 connector provides alternate connections for several signals associated with servo interface channels 1 and 2 on the Acc-24PCI2. These signals are also present on JMACH2 and JEQU. JS2 can be used to connect directly to an Acc-28B. Jumper E24 must be removed to use the inputs on JS2.

JS3: ADC Channel 5 6 Connector

JS3 (16-Pin Connector)
(Present only if Option 1 is ordered)

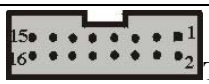


Top View

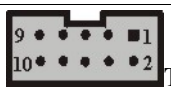
Pin #	Symbol	Function	Description	Notes
1	ADC_CLK5-	Output	Converter Clock	Software Set Frequency
2	N.C.		No Connect	
3	SCLK56+	Output	Encoder Clock	Software Set Frequency
4	SCLK56-	Output	Encoder Clock	Software Set Frequency
5	ADC_STB5-	Output	Converter Strobe	Software Set Signal
6	N.C.		No Connect	
7	AENA5+	Output	Amplifier Enable	5v high true
8	AENA6+	Output	Amplifier Enable	5v high true
9	EQU5+	Output	Amplifier Enable	5v high true
10	EQU6+	Output	Amplifier Enable	5v high true
11	ADC_DAA5+	Input	ADC input data	Serial data stream
12	ADC_DAB5+	Input	ADC input data	Serial data stream
13	ADC_DAA6+	Input	ADC input data	Serial data stream
14	ADC_DAB6+	Input	ADC input data	Serial data stream
15	+5V	Output	+5Vdc Supply	Power supply out
16	GND	Common	PMAC Common	Not isolated from digital

The JS3 connector provides alternate connections for several signals associated with servo interface channels 5 and 6 on the Acc-24PCI2. These signals are also present on JMACH3 and JEQU. JS3 can be used to connect directly to an Acc-28B. Jumper E25 must be removed to use the inputs on JS3.

JS4: ADC Channel 7 and 8 Connector

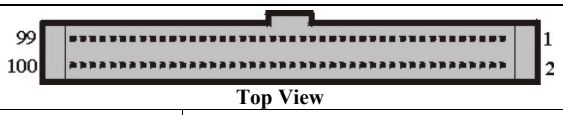
JS4 (16-Pin Connector) (Present only if Option 1 is ordered)			**Top View**	
Pin #	**Symbol**	**Function**	**Description**	**Notes**
1	ADC_CLK7-	Output	Converter Clock	Software set frequency
2	N.C.		No Connect	
3	SCLK78+	Output	Encoder Clock	Software set frequency
4	SCLK78-	Output	Encoder Clock	Software set frequency
5	ADC_STB7-	Output	Converter Strobe	Software set signal
6	N.C.		No Connect	
7	AENA7+	Output	Amplifier Enable	5v high true
8	AENA8+	Output	Amplifier Enable	5v high true
9	EQU7+	Output	Amplifier Enable	5v high true
10	EQU8+	Output	Amplifier Enable	5v high true
11	ADC_DAA7+	Input	ADC input data	Serial data stream
12	ADC_DAB7+	Input	ADC input data	Serial data stream
13	ADC_DAA8+	Input	ADC input data	Serial data stream
14	ADC_DAB8+	Input	ADC input data	Serial data stream
15	+5V	Output	+5Vdc Supply	Power supply out
16	GND	Common	PMAC Common	Not isolated from digital
The JS4 connector provides alternate connections for several signals associated with servo interface channels 7 and 8 on the Acc-24PCI2. These signals are also present on JMACH4 and JEQU. JS4 can be used to connect directly to an Acc-28B. Jumper E26 must be removed to use the inputs on JS4.				

J8 (JEQU): Position Compare Output Connector

J8 JEQU (10-Pin Connector)			**Top View**	
Pin #	**Symbol**	**Function**	**Description**	**Notes**
1	EQU1/	Output	Enc. 1 COMP-EQ	Low is TRUE
2	EQU2/	Output	Enc. 2 COMP-EQ	Low is TRUE
3	EQU3/	Output	Enc. 3 COMP-EQ	Low is TRUE
4	EQU4/	Output	Enc. 4 COMP-EQ	Low is TRUE
5	EQU5/	Output	Enc. 5 COMP-EQ	Low is TRUE
6	EQU6/	Output	Enc. 6 COMP-EQ	Low is TRUE
7	EQU7/	Output	Enc. 7 COMP-EQ	Low is TRUE
8	EQU8/	Output	Enc. 8 COMP-EQ	Low is TRUE
9	+V	Supply	Positive Supply	+5V to +24V
10	GND	Common	Digital Ground	
This connector provides the position-compare outputs for the eight encoder channels.				

J9 (JMACH1): Servo Channel 1 and 2 Connector

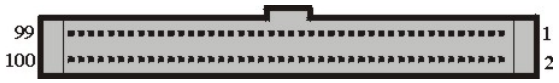
J9 JMACH1 (100-Pin Connector)



Top View

Pin #	Symbol	Function	Description	Notes
1	+5V	Output/Input	+5V Power	For external circuit or from external supply
2	+5V	Output/Input	+5V Power	For external circuit or from external supply
3	GND	Common	Reference Voltage	
4	GND	Common	Reference Voltage	
5	CHA1+	Input	Enc 1 Positive A Channel	Also pulse input
6	CHA1-	Input	Enc 1 Negative A Channel	Also pulse input
7	CHB1+	Input	Enc 1 Positive B Channel	Also direction input
8	CHB1-	Input	Enc 1 Negative B Channel	Also direction input
9	CHC1+	Input	Enc 1 Positive C Channel	Index channel
10	CHC1-	Input	Enc 1 Negative C Channel	Index channel
11	CHU1	Input	Channel 1 U Flag	Hall Effect, Fault Code, or sub-count
12	CHV1	Input	Channel 1 V Flag	Hall Effect, Fault Code, or sub-count
13	CHW1	Input	Channel 1 W Flag	Hall Effect, Fault Code, or sub-count
14	CHT1	Input	Channel 1 T Flag	Fault Code, or sub-count
15	USER1	Input	General Purpose User Flag	Hardware capture flag, or sub-count
16	PLIM1	Input	Positive Overtravel Limit	Hardware capture flag
17	MLIM1	Input	Negative Overtravel Limit	Hardware capture flag
18	HOME1	Input	Home Switch Input	Hardware capture flag
19	ACCFLT1	Input	Accessory Fault Flag	For loss of acc supply voltage
20	WD0/	Output	Watchdog Output	Low is PMAC watchdog fault
21	SCLK12+	Input/Output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
22	SCLK12-	Input/Output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
23	ADC_CLK1+	Output	A/D Converter Clock	Programmable frequency
24	ADC_CLK1-	Output	A/D Converter Clock	Programmable frequency
25	ADC_STB1+	Output	A/D Converter Strobe	Programmable sequence
26	ADC_STB1-	Output	A/D Converter Strobe	Programmable sequence
27	ADC_DAA1+	Input	Channel A ADC Serial Data	MSB first
28	ADC_DAA1-	Input	Channel A ADC Serial Data	MSB first
29	ADC_DAB1+	Input	Channel B ADC Serial Data	MSB first
30	ADC_DAB1-	Input	Channel B ADC Serial Data	MSB first
31	AENA1+	Output	Amplifier Enable	High is enable
32	AENA1-	Output	Amplifier Enable	Low is enable
33	FAULT1+	Input	Amplifier Fault	Programmable polarity

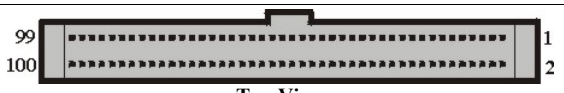
J9 JMACH1 (100-Pin Connector) (Continued)



Top View

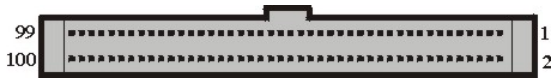
Pin #	Symbol	Function	Description	Notes
34	FAULT1-	Input	Amplifier Fault	Programmable polarity
35	PWMATOP1+ DAC_CLK1+	Output	Phase A Top CMD or DAC Clock	Programmable function control
36	PWMATOP1- DAC_CLK1-	Output	Phase A Top CMD or DAC Clock	Programmable function control
37	PWMABOT1+ DAC1A+	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
38	PWMABOT1- DAC1A-	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
39	PWMBTOP1+ DAC_STB1+	Output	Phase B Top CMD or DAC Strobe	Programmable function control
40	PWMBTOP1- DAC_STB1-	Output	Phase B Top CMD or DAC Strobe	Programmable function control
41	PWMBBOT1+ DAC1B+	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control
42	PWMBBOT1- DAC1B-	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control
43	PWMCTOP1+ DIR1+	Output	Phase B Top CMD or PFM Direction	Programmable function control
44	PWMCTOP1- DIR1-	Output	Phase B Top CMD or PFM Direction	Programmable function control
45	PWMCBOT1+ PULSE1+	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
46	PWMCBOT1- PULSE1-	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
47	GND	Common	Reference Voltage	
48	GND	Common	Reference Voltage	
49	+5V	Output/Input	+5V Power	For external circuit or from external supply
50	+5V	Output/Input	+5V Power	For external circuit or from external supply
51	+5V	Output/Input	+5V Power	For external circuit or from external supply
52	+5V	Output/Input	+5V Power	For external circuit or from external supply
53	GND	Common	Reference Voltage	
54	GND	Common	Reference Voltage	
55	CHA2+	Input	Enc 2 Positive A Channel	Also Pulse input
56	CHA2-	Input	Enc 2 Negative A Channel	Also Pulse input
57	CHB2+	Input	Enc 2 Positive B Channel	Also direction input
58	CHB2-	Input	Enc 2 Negative B Channel	Also direction input
59	CHC2+	Input	Enc 2 Positive C Channel	Index channel
60	CHC2-	Input	Enc 2 Negative C Channel	Index channel
61	CHU2	Input	Channel 2 U Flag	Hall effect, Fault Code, or sub-count

J9 JMACH1 (100-Pin Connector) (Continued)

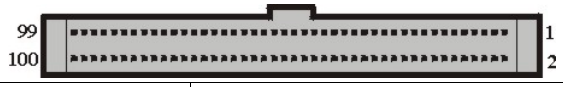


Top View

Pin #	Symbol	Function	Description	Notes
62	CHV2	Input	Channel 2 V Flag	Hall effect, Fault Code, or sub-count
63	CHW2	Input	Channel 2 W Flag	Hall effect, Fault Code, or sub-count
64	CHT2	Input	Channel 2 T Flag	Fault Code, or sub-count
65	USER2	Input	General Purpose User Flag	Hardware capture flag, or sub-count
66	PLIM2	Input	Positive Overtravel Limit	Hardware capture flag
67	MLIM2	Input	Negative Overtravel Limit	Hardware capture flag
68	HOME2	Input	Home Switch Input	Hardware capture flag
69	ACCFLT2	Input	Accessory Fault Flag	For loss of acc supply voltage
70	WD0/	Output	Watchdog Output	Low is PMAC watchdog fault
71	SCLK12+	Input/Output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
72	SCLK12-	Input/Output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
73	ADC_CLK2+	Output	A/D Converter Clock	Programmable frequency
74	ADC_CLK2-	Output	A/D Converter Clock	Programmable frequency
75	ADC_STB2+	Output	A/D Converter Strobe	Programmable sequence
76	ADC_STB2-	Output	A/D Converter Strobe	Programmable sequence
77	ADC_DAA2+	Input	Channel A ADC Serial Data	MSB first
78	ADC_DAA2-	Input	Channel A ADC Serial Data	MSB first
79	ADC_DAB2+	Input	Channel B ADC Serial Data	MSB first
80	ADC_DAB2-	Input	Channel B ADC Serial Data	MSB first
81	AENA2+	Output	Amplifier Enable	High is enable
82	AENA2-	Output	Amplifier Enable	Low is enable
83	FAULT2+	Input	Amplifier Fault	Programmable polarity
84	FAULT2-	Input	Amplifier Fault	Programmable polarity
85	PWMATOP2+ DAC_CLK2+	Output	Phase A Top CMD or DAC Clock	Programmable function control
86	PWMATOP2- DAC_CLK2-	Output	Phase A Top CMD or DAC Clock	Programmable function control
87	PWMABOT2+ DAC2A+	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
88	PWMABOT2- DAC2A-	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
89	PWMBTOP2+ DAC_STB2+	Output	Phase B Top CMD or DAC Strobe	Programmable function control
90	PWMBTOP2- DAC_STB2-	Output	Phase B Top CMD or DAC Strobe	Programmable function control
91	PWMBBOT2+ DAC2B+	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control
92	PWMBBOT2- DAC2B-	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control
93	PWMCTOP2+ DIR2+	Output	Phase B Top CMD or PFM Direction	Programmable function control

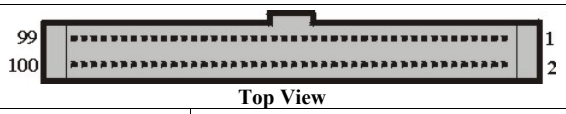
J9 JMACH1 (100-Pin Connector) (Continued)			 **Top View**	
Pin #	**Symbol**	**Function**	**Description**	**Notes**
94	PWMCTOP2- DIR2-	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control
95	PWMCBOT2+ PULSE2+	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
96	PWMCBOT2- PULSE2-	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
97	GND	Common	Reference Voltage	
98	GND	Common	Reference Voltage	
99	+5V	Output/Input	+5V Power	For external circuit or from external supply
100	+5V	Output/Input	+5V Power	For external circuit or from external supply
The JMACH1 connector provides the interface pins for channels 1 and 2. Usually, it is connected to a breakout board, such as one of the Acc-8x family of boards, or an application-specific interface board. **Connector:** 100-pin male box header with center key, 0050" pitch. AMP part # 1-04068-7 Delta Tau part # 014-00010-FPB.				

J10 (JMACH2): Servo Channel 3 and 4 Connector

J10 JMACH2 (100-Pin Connector) **Top View**				
Pin #	**Symbol**	**Function**	**Description**	**Notes**
1	+5V	Output/Input	+5V Power	For external circuit or from external supply
2	+5V	Output/Input	+5V Power	For external circuit or from external supply
3	GND	Common	Reference Voltage	
4	GND	Common	Reference Voltage	
5	CHA3+	Input	Enc 3 Positive A Channel	Also pulse input
6	CHA3-	Input	Enc 3 Negative A Channel	Also pulse input
7	CHB3+	Input	Enc 3 Positive B Channel	Also direction input
8	CHB3-	Input	Enc 3 Negative B Channel	Also direction input
9	CHC3+	Input	Enc 3 Positive C Channel	Index Channel
10	CHC3-	Input	Enc 3 Negative C Channel	Index Channel
11	CHU3	Input	Channel 3 U Flag	Hall Effect, Fault Code, or sub-count
12	CHV3	Input	Channel 3 V Flag	Hall Effect, Fault Code, or sub-count
13	CHW3	Input	Channel 3 W Flag	Hall Effect, Fault Code, or sub-count
14	CHT3	Input	Channel 3 T Flag	Fault Code, or sub-count
15	USER3	Input	General Purpose User Flag	Hardware capture flag, or sub-count
16	PLIM3	Input	Positive Overtravel Limit	Hardware capture flag
17	MLIM3	Input	Negative Overtravel Limit	Hardware capture flag
18	HOME3	Input	Home Switch Input	Hardware capture flag
19	ACCFLT3	Input	Accessory Fault Flag	For loss of ACC supply voltage
20	WD0/	Output	Watchdog Output	Low is PMAC watchdog fault
21	SCLK34+	Input / output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
22	SCLK34-	Input / output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
23	ADC_CLK3+	Output	A/D Converter Clock	Programmable frequency
24	ADC_CLK3-	Output	A/D Converter Clock	Programmable frequency
25	ADC_STB3+	Output	A/D Converter Strobe	Programmable sequence

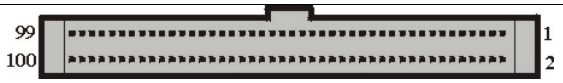
26	ADC_STB3-	Output	A/D Converter Strobe	Programmable sequence
27	ADC_DAA3+	Input	Channel A ADC Serial Data	MSB first
28	ADC_DAA3-	Input	Channel A ADC Serial Data	MSB first
29	ADC_DAB3+	Input	Channel B ADC Serial Data	MSB first
30	ADC_DAB3-	Input	Channel B ADC Serial Data	MSB first
31	AENA3+	Output	Amplifier Enable	High is enable
32	AENA3-	Output	Amplifier Enable	Low is enable
33	FAULT3+	Input	Amplifier Fault	Programmable polarity
34	FAULT3-	Input	Amplifier Fault	Programmable polarity
35	PWMATOP3+ DAC_CLK3+	Output	Phase A Top CMD or DAC Clock	Programmable function control
36	PWMATOP3- DAC_CLK3-	Output	Phase A Top CMD or DAC Clock	Programmable function control
37	PWMABOT3+ DAC3A+	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
38	PWMABOT3- DAC3A-	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
39	PWMBTOP3+ DAC_STB3+	Output	Phase B Top CMD or DAC Strobe	Programmable function control
40	PWMBTOP3- DAC_STB3-	Output	Phase B Top CMD or DAC Strobe	Programmable function control
41	PWMBBOT3+ DAC3B+	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control
42	PWMBBOT3- DAC3B-	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control
43	PWMCTOP3+ DIR3+	Output	Phase B Top CMD or PFM Direction	Programmable function control
44	PWMCTOP3- DIR3-	Output	Phase B Top CMD or PFM Direction	Programmable function control
45	PWMCBOT3+ PULSE3+	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
46	PWMCBOT3- PULSE3-	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
47	GND	Common	Reference Voltage	
48	GND	Common	Reference Voltage	
49	+5V	Output/Input	+5V Power	For external circuit or from external supply
50	+5V	Output/Input	+5V Power	For external circuit or from external supply
51	+5V	Output/Input	+5V Power	For external circuit or from external supply
52	+5V	Output/Input	+5V Power	For external circuit or from external supply
53	GND	Common	Reference Voltage	
54	GND	Common	Reference Voltage	
55	CHA4+	Input	Enc 4 Pos. A Chan.	Also pulse input

10 JMACH2 (100-Pin Connector) (Continued)

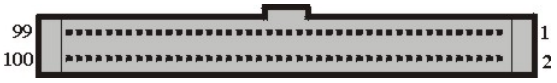


Top View

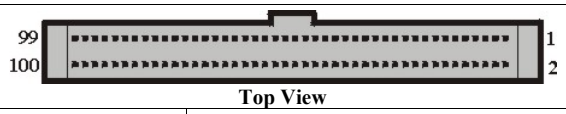
Pin #	Symbol	Function	Description	Notes
56	CHA4-	Input	Enc 4 Neg. A Chan.	Also pulse input
57	CHB4+	Input	Enc 4 Pos. B Chan.	Also direction input
58	CHB4-	Input	Enc 4 Neg. B Chan.	Also direction input
59	CHC4+	Input	Enc 4 Pos. C Chan.	Index channel
60	CHC4-	Input	Enc 4 Neg. C Chan.	Index channel
61	CHU4	Input	Chan 4 U Flag	Hall Effect, Fault Code, or sub-count
62	CHV4	Input	Chan 4 V Flag	Hall Effect, Fault Code, or sub-count
63	CHW4	Input	Channel 4 W Flag	Hall Effect, Fault Code, or sub-count
64	CHT4	Input	Channel 4 T Flag	Fault Code, or sub-count
65	USER4	Input	General Purpose User Flag	Hardware capture flag, or sub-count
66	PLIM4	Input	Positive Overtravel Limit	Hardware capture flag
67	MLIM4	Input	Negative Overtravel Limit	Hardware capture flag
68	HOME4	Input	Home Switch Input	Hardware capture flag
69	ACCFLT4	Input	Accessory Fault Flag	For loss of ACC supply voltage
70	WD0/	Output	Watchdog Output	Low is PMAC watchdog fault
71	SCLK34+	Input/Output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
72	SCLK34-	Input/Output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
73	ADC_CLK4+	Output	A/D Converter Clock	Programmable frequency
74	ADC_CLK4-	Output	A/D Converter Clock	Programmable frequency
75	ADC_STB4+	Output	A/D Converter Strobe	Programmable sequence
76	ADC_STB4-	Output	A/D Converter Strobe	Programmable sequence
77	ADC_DAA4+	Input	Channel A ADC Serial Data	MSB first
78	ADC_DAA4-	Input	Channel A ADC Serial Data	MSB first
79	ADC_DAB4+	Input	Channel B ADC Serial Data	MSB first
80	ADC_DAB4-	Input	Channel B ADC Serial Data	MSB first
81	AENA4+	Output	Amplifier Enable	High is enable
82	AENA4-	Output	Amplifier Enable	Low is enable
83	FAULT4+	Input	Amplifier Fault	Programmable polarity
84	FAULT4-	Input	Amplifier Fault	Programmable polarity
85	PWMATOP4+ DAC_CLK4+	Output	Phase A Top CMD or DAC Clock	Programmable function control
86	PWMATOP4- DAC_CLK4-	Output	Phase A Top CMD or DAC Clock	Programmable function control
87	PWMABOT4+ DAC4A+	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
88	PWMABOT4- DAC4A-	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
89	PWMBTOP4+ DAC_STB4+	Output	Phase B Top CMD or DAC Strobe	Programmable function control
90	PWMBTOP4- DAC_STB4-	Output	Phase B Top CMD or DAC Strobe	Programmable function control
91	PWMBBOT4+ DAC4B+	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control
92	PWMBBOT4- DAC4B-	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control
93	PWMCTOP4+ DIR4+	Output	Phase B Top CMD or PFM Direction	Programmable function control

J10 JMACH2 (100-Pin Connector) (Continued)			 Top View	
Pin #	**Symbol**	**Function**	**Description**	**Notes**
94	PWMCTOP4- DIR4-	Output	Phase B Top CMD or PFM Direction	Programmable function control
95	PWMCBOT4+ PULSE4+	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
96	PWMCBOT4- PULSE4-	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
97	GND	Common	Reference Voltage	
98	GND	Common	Reference Voltage	
99	+5V	Output/Input	+5V Power	For external circuit or from external supply
100	+5V	Output/Input	+5V Power	For external circuit or from external supply
The JMACH2 connector provides the interface pins for channels 3 and 4. Usually, it is connected to a breakout board, such as one of the Acc-8x family of boards, or an application-specific interface board. **Connector:** 100-pin male box header with center key, 0050" pitch. AMP part # 1-04068-7 Delta Tau part # 014-00010-FPB.				

J11 (JMACH3): Servo Channel 5 and 6 Connector

J11 JMACH3 (100-Pin Connector) (Present only if Option 1 ordered)			 Top View	
Pin #	**Symbol**	**Function**	**Description**	**Notes**
1	+5V	Output/Input	+5V Power	For external circuit or from external supply
2	+5V	Output/Input	+5V Power	For external circuit or from external supply
3	GND	Common	Reference Voltage	
4	GND	Common	Reference Voltage	
5	CHA5+	Input	Enc 5 Positive A Channel	Also pulse input
6	CHA5-	Input	Enc 5 Negative A Channel	Also pulse input
7	CHB5+	Input	Enc 5 Positive B Channel	Also direction input
8	CHB5-	Input	Enc 5 Negative B Channel	Also direction input
9	CHC5+	Input	Enc 5 Positive C Channel	Index channel
10	CHC5-	Input	Enc 5 Negative C Channel	Index channel
11	CHU5	Input	Channel 5 U Flag	Hall Effect, Fault Code, or sub-count
12	CHV5	Input	Channel 5 V Flag	Hall Effect, Fault Code, or sub-count
13	CHW5	Input	Channel 5 W Flag	Hall Effect, Fault Code, or sub-count
14	CHT5	Input	Channel 5 T Flag	Fault Code, or sub-count
15	USER5	Input	General Purpose User Flag	Hardware capture flag, or sub-count
16	PLIM5	Input	Positive Overtravel Limit	Hardware capture flag
17	MLIM5	Input	Negative Overtravel Limit	Hardware capture flag
18	HOME5	Input	Home Switch Input	Hardware capture flag
19	ACCFLT5	Input	Accessory Fault Flag	For loss of ACC supply voltage
20	WD0/	Output	Watchdog Output	Low is PMAC watchdog fault
21	SCLK56+	input / output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
22	SCLK56-	input / output	Encoder Sample Clock	Direction controlled by PMAC2 jumper

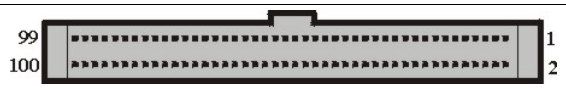
J11 JMACH3 (100-Pin Connector) (Continued)



Top View

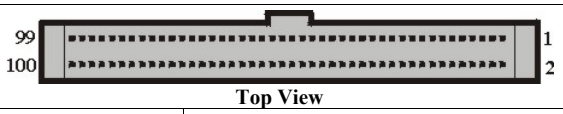
Pin #	Symbol	Function	Description	Notes
23	ADC_CLK5+	Output	A/D Converter Clock	Programmable frequency
24	ADC_CLK5-	Output	A/D Converter Clock	Programmable frequency
25	ADC_STB5+	Output	A/D converter Strobe	Programmable frequency
26	ADC_STB5-	Output	A/D converter Strobe	Programmable frequency
27	ADC_DAA5+	Input	Chan A ADC Serial Data	MSB first
28	ADC_DAA5-	Input	Chan A ADC Serial Data	MSB first
29	ADC_DAB5+	Input	Chan B ADC Serial Data	MSB first
30	ADC_DAB5-	Input	Chan B ADC Serial Data	MSB first
31	AENA5+	Output	Amplifier Enable	High is enable
32	AENA5-	Output	Amplifier Enable	Low is enable
33	FAULT5+	Input	Amplifier Fault	Programmable polarity
34	FAULT5-	Input	Amplifier Fault	Programmable polarity
35	PWMATOP5+ DAC_CLK5+	Output	Phase A Top CMD or DAC Clock	Programmable function control
36	PWMATOP5- DAC_CLK5-	Output	Phase A Top CMD or DAC Clock	Programmable function control
37	PWMABOT5+ DAC5A+	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
38	PWMABOT5- DAC5A-	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
39	PWMBTOP5+ DAC_STB5+	Output	Phase B Top CMD or DAC Strobe	Programmable function control
40	PWMBTOP5- DAC_STB5-	Output	Phase B Top CMD or DAC Strobe	Programmable function control
41	PWMBBOT5+ DAC5B+	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control
42	PWMBBOT5- DAC5B-	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control
43	PWMCTOP5+ DIR5+	Output	Phase B Top CMD or PFM Direction	Programmable function control
44	PWMCTOP5- DIR5-	Output	Phase B Top CMD or PFM Direction	Programmable function control
45	PWMCBOT5+ PULSE5+	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
46	PWMCBOT5- PULSE5-	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
47	GND	Common	Reference Voltage	
48	GND	Common	Reference Voltage	
49	+5V	Output/Input	+5V Power	For external circuit or from external supply
50	+5V	Output/Input	+5V Power	For external circuit or from external supply
51	+5V	Output/Input	+5V Power	For external circuit or from external supply
52	+5V	Output/Input	+5V Power	For external circuit or from external supply
53	GND	Common	Reference Voltage	
54	GND	Common	Reference Voltage	
55	CHA6+	Input	Enc 6 Positive A Channel	Also pulse input

J11 JMACH3 (100-Pin Connector) (Continued)

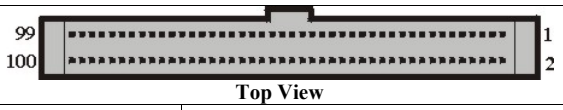


Top View

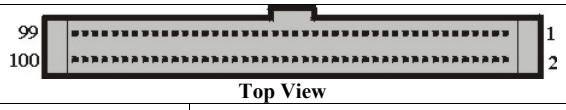
Pin #	Symbol	Function	Description	Notes
56	CHA6-	Input	Enc 6 Negative A Channel	Also pulse input
57	CHB6+	Input	Enc 6 Positive B Channel	Also direction input
58	CHB6-	Input	Enc 6 Negative B Channel	Also direction input
59	CHC6+	Input	Enc 6 Positive C Channel	Index channel
60	CHC6-	Input	Enc 6 Negative C Channel	Index channel
61	CHU6	Input	Channel 6 U Flag	Hall Effect, Fault Code, or sub-count
62	CHV6	Input	Channel 6 V Flag	Hall Effect, Fault Code, or sub-count
63	CHW6	Input	Channel 6 W Flag	Hall Effect, Fault Code, or sub-count
64	CHT6	Input	Channel 6 T Flag	Fault Code, or sub-count
65	USER6	Input	General Purpose User Flag	Hardware capture flag, or sub-count
66	PLIM6	Input	Positive Overtravel Limit	Hardware capture flag
67	MLIM6	Input	Negative Overtravel Limit	Hardware capture flag
68	HOME6	Input	Home Switch Input	Hardware capture flag
69	ACCFLT6	Input	Accessory Fault Flag	For loss of ACC supply voltage
70	WD0/	Output	Watchdog Output	Low is PMAC watchdog fault
71	SCLK56+	Input/Output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
72	SCLK56-	Input/Output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
73	ADC_CLK6+	Output	A/D Converter Clock	Programmable frequency
74	ADC_CLK6-	Output	A/D Converter Clock	Programmable frequency
75	ADC_STB6+	Output	A/D Converter Strobe	Programmable sequence
76	ADC_STB6-	Output	A/D Converter Strobe	Programmable sequence
77	ADC_DAA6+	Input	Channel A ADC Serial Data	MSB first
78	ADC_DAA6-	Input	Channel A ADC Serial Data	MSB first
79	ADC_DAB6+	Input	Channel B ADC Serial Data	MSB first
80	ADC_DAB6-	Input	Channel B ADC Serial Data	MSB first
81	AENA6+	Output	Amplifier Enable	High is enable
82	AENA6-	Output	Amplifier Enable	Low is enable
83	FAULT6+	Input	Amplifier Fault	Programmable polarity
84	FAULT6-	Input	Amplifier Fault	Programmable polarity
85	PWMATOP6+ DAC_CLK6+	Output	Phase A Top CMD or DAC Clock	Programmable function control
86	PWMATOP6- DAC_CLK6-	Output	Phase A Top CMD or DAC Clock	Programmable function control
87	PWMABOT6+ DAC6A+	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
88	PWMABOT6- DAC6A-	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
89	PWMBTOP6+ DAC_STB6+	Output	Phase B Top CMD or DAC Strobe	Programmable function control
90	PWMBTOP6- DAC_STB6-	Output	Phase B Top CMD or DAC Strobe	Programmable function control
91	PWMBBOT6+ DAC6B+	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control
92	PWMBBOT6- DAC6B-	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control

J11 JMACH3 (100-Pin Connector) (Continued)			 Top View	
Pin #	**Symbol**	**Function**	**Description**	**Notes**
93	PWMCTOP6+ DIR6+	Output	Phase B Top CMD or PFM Direction	Programmable function control
94	PWMCTOP6- DIR6-	Output	Phase B Top CMD or PFM Direction	Programmable function control
95	PWMCBOT6+ PULSE6+	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
96	PWMCBOT6- PULSE6-	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
97	GND	Common	Reference Voltage	
98	GND	Common	Reference Voltage	
99	+5V	Output/Input	+5V Power	For external circuit or from external supply
100	+5V	Output/Input	+5V Power	For external circuit or from external supply
The JMACH3 connector provides the interface pins for channels 5 and 6. Usually, it is connected to a breakout board, such as one of the Acc-8x family of boards, or an application-specific interface board. Connector: 100-pin male box header with center key, 0050" pitch. AMP part # 1-04068-7 Delta Tau part # 014-00010-FPB.				

J12 (JMACH4): Servo Channel 7 and 8 Connector

J12 JMACH4 (100-Pin Connector) (Present only if Option 1 ordered)			 Top View	
Pin #	**Symbol**	**Function**	**Description**	**Notes**
1	+5V	Output/Input	+5V Power	For external circuit or from external supply
2	+5V	Output/Input	+5V Power	For external circuit or from external supply
3	GND	Common	Reference Voltage	
4	GND	Common	Reference Voltage	
5	CHA7+	Input	Enc 7 Positive A Channel	Also pulse input
6	CHA7-	Input	Enc 7 Negative A Channel	Also pulse input
7	CHB7+	Input	Enc 7 Positive B Channel	Also direction input
8	CHB7-	Input	Enc 7 Negative B Channel	Also direction input
9	CHC7+	Input	Enc 7 Positive C Channel	Index channel
10	CHC7-	Input	Enc 7 Negative C Channel	Index channel
11	CHU7	Input	Channel 7 U Flag	Hall Effect, Fault Code, or sub-count
12	CHV7	Input	Channel 7 V Flag	Hall Effect, Fault Code, or sub-count
13	CHW7	Input	Channel 7 W Flag	Hall Effect, Fault Code, or sub-count
14	CHT7	Input	Channel 7 T Flag	Fault Code, or sub-count
15	USER7	Input	General Purpose User Flag	Hardware capture flag, or sub-count
16	PLIM7	Input	Positive Overtravel Limit	Hardware capture flag
17	MLIM7	Input	Negative Overtravel Limit	Hardware capture flag
18	HOME7	Input	Home Switch Input	Hardware capture flag

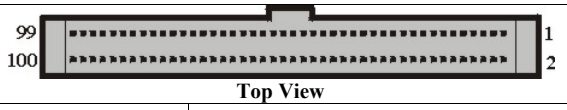
J12 JMACH4 (100-Pin Connector) (Continued)



Top View

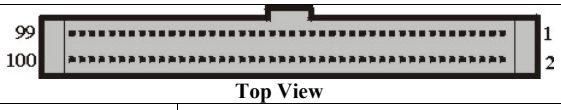
Pin #	Symbol	Function	Description	Notes
19	ACCFLT7	Input	Accessory Fault Flag	For loss of ACC supply voltage
20	WD0/	Output	Watchdog Output	Low is PMAC watchdog fault
21	SCLK78+	Input/Output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
22	SCLK78-	Input/Output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
23	ADC_CLK7+	Output	A/D Converter Clock	Programmable frequency
24	ADC_CLK7-	Output	A/D Converter Clock	Programmable frequency
25	ADC_STB7+	Output	A/D Converter Strobe	Programmable sequence
26	ADC_STB7-	Output	A/D Converter Strobe	Programmable sequence
27	ADC_DAA7+	Input	Chan A ADC Serial Data	MSB first
28	ADC_DAA7-	Input	Chan A ADC Serial Data	MSB first
29	ADC_DAB7+	Input	Chan B ADC Serial Data	MSB first
30	ADC_DAB7-	Input	Chan B ADC Serial Data	MSB first
31	AENA7+	Output	Amplifier Enable	High is enable
32	AENA7-	Output	Amplifier Enable	Low is enable
33	FAULT7+	Input	Amplifier Fault	Programmable polarity
34	FAULT7-	Input	Amplifier Fault	Programmable polarity
35	PWMATOP7+ DAC_CLK7+	Output	Phase A Top CMD or DAC Clock	Programmable function control
36	PWMATOP7- DAC_CLK7-	Output	Phase A Top CMD or DAC Clock	Programmable function control
37	PWMABOT7+ DAC7A+	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
38	PWMABOT7- DAC7A-	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
39	PWMBTOP7+ DAC_STB7+	Output	Phase B Top CMD or DAC Strobe	Programmable function control
40	PWMBTOP3- DAC_STB7-	Output	Phase B Top CMD or DAC Strobe	Programmable function control
41	PWMBBOT7+ DAC7B+	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control
42	PWMBBOT7- DAC7B-	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control
43	PWMCTOP7+ DIR7+	Output	Phase B Top CMD or PFM Direction	Programmable function control
44	PWMCTOP7- DIR7-	Output	Phase B Top CMD or PFM Direction	Programmable function control
45	PWMCBOT7+ PULSE7+	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
46	PWMCBOT7- PULSE7-	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
47	GND	Common	Reference Voltage	
48	GND	Common	Reference Voltage	
49	+5V	Output/Input	+5V Power	For external circuit or from ext. supply
50	+5V	Output/Input	+5V Power	For external circuit or from external supply

J12 JMACH4 (100-Pin Connector)
(Continued)



Pin #	Symbol	Function	Description	Notes
51	+5V	Output/Input	+5V Power	For external circuit or from external supply
52	+5V	Output/Input	+5V Power	For external circuit or from external supply
53	GND	Common	Reference Voltage	
54	GND	Common	Reference Voltage	
55	CHA8+	Input	Enc 8 Positive A Channel	Also pulse input
56	CHA8-	Input	Enc 8 Negative A Channel	Also pulse input
57	CHB8+	Input	Enc 8 Positive B Channel	Also direction input
58	CHB8-	Input	Enc 8 Negative B Channel	Also direction input
59	CHC8+	Input	Enc 8 Positive C Channel	Index channel
60	CHC8-	Input	Enc 8 Negative C Channel	Index channel
61	CHU8	Input	Channel 8 U Flag	Hall Effect, Fault Code, or sub-count
62	CHV8	Input	Channel 8 V Flag	Hall Effect, Fault Code, or sub-count
63	CHW8	Input	Channel 8 W Flag	Hall Effect, Fault Code, or sub-count
64	CHT8	Input	Channel 8 T Flag	Fault Code, or sub-count
65	USER8	Input	General Purpose User Flag	Hardware capture flag, or sub-count
66	PLIM8	Input	Positive Overtravel Limit	Hardware capture flag
67	MLIM8	Input	Negative Overtravel Limit	Hardware capture flag
68	HOME8	Input	Home Switch Input	Hardware capture flag
69	ACCFLT8	Input	Accessory Fault Flag	For loss of ACC supply voltage
70	WD0/	Output	Watchdog Output	Low is PMAC watchdog fault
71	SCLK78+	Input/Output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
72	SCLK78-	Input/Output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
73	ADC_CLK8+	Output	A/D Converter Clock	Programmable frequency
74	ADC_CLK8-	Output	A/D Converter Clock	Programmable frequency
75	ADC_STB8+	Output	A/D Converter Strobe	Programmable Sequence
76	ADC_STB8-	Output	A/D Converter Strobe	Programmable Sequence
77	ADC_DAA8+	Input	Channel A ADC Serial Data	MSB first
78	ADC_DAA8-	Input	Channel A ADC Serial Data	MSB first
79	ADC_DAB8+	Input	Channel B ADC Serial Data	MSB first
80	ADC_DAB8-	Input	Channel B ADC Serial Data	MSB first
81	AENA8+	Output	Amplifier Enable	High is enable
82	AENA8-	Output	Amplifier Enable	Low is enable
83	FAULT8+	Input	Amplifier Fault	Programmable polarity
84	FAULT8-	Input	Amplifier Fault	Programmable polarity
85	PWMATOP8+ DAC_CLK8+	Output	Phase A Top CMD or DAC Clock	Programmable function control
86	PWMATOP8- DAC_CLK8-	Output	Phase A Top CMD or DAC Clock	Programmable function control
87	PWMABOT8+ DAC8A+	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
88	PWMABOT8- DAC8A-	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
89	PWMBTOP8+ DAC_STB8+	Output	Phase B Top CMD or DAC Strobe	Programmable function control

J12 JMACH4 (100-Pin Connector)
(Continued)



Top View

Pin #	Symbol	Function	Description	Notes
90	PWMBTOP8- DAC_STB8-	Output	Phase B Top CMD or DAC Strobe	Programmable function control
91	PWMBBOT8+ DAC8B+	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control
92	PWMBBOT8- DAC8B-	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control
93	PWMCTOP8+ DIR8+	Output	Phase B Top CMD or PFM Direction	Programmable function control
94	PWMCTOP8- DIR8-	Output	Phase B Top CMD or PFM Direction	Programmable function control
95	PWMCBOT8+ PULSE8+	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
96	PWMCBOT8- PULSE8-	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
97	GND	Common	Reference Voltage	
98	GND	Common	Reference Voltage	
99	+5V	Output/Input	+5V Power	For external circuit or from external supply
100	+5V	Output/Input	+5V Power	For external circuit or from external supply

The JMACH4 connector provides the interface pins for channels 7 and 8. It is usually connected to a breakout board, such as one of the Acc-8x family of boards, or an application-specific interface board.

J1 (JEXP): Expansion Port Connector

J1 is a 50-pin IDC connector that connects to the matching JEXP expansion port connector on the Turbo PMAC/PMAC2 board with the provided 50-pin cable. Up to four Acc-24PCI2 boards may be connected to one Turbo PMAC/PMAC2 with a single daisy chain connector.

P1: PCI Bus Connector

P1 is the standard 62-tooth card-edge PCI connector. If the Acc-24PCI2 is plugged into an PCI socket using this connector, only the power and return pins are used.

TB1: Standalone Power Supply Terminal Block

This terminal block can be used to provide the input for the power supply for the circuits on the Acc-24PCI2 board when it is not in a bus configuration. When the Acc-24PCI2 is in a bus configuration, these supplies automatically come through the bus connector from the bus power supply; in this case, this terminal block should not be used.

Pin #	Symbol	Function	Description	Notes
1	GND	Common	Reference Voltage	
2	+5V	Input	Positive Supply Voltage	Supplies all PMAC digital circuits

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