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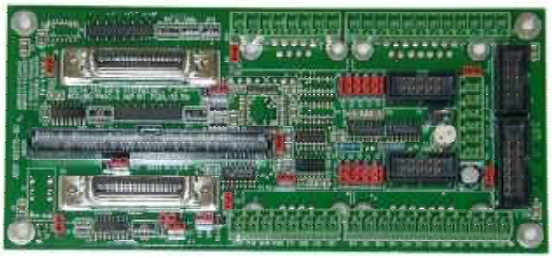
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ACC-8F, Full Digital PWM Interface Board



The ACC-8F digital interface board for the PMAC2 family of controllers provides signals for two channels with digital-input amplifiers. The amplifier inputs are direct PWM commands. The ACC-8F board has one flat-cable connection to the PMAC2. The connection to each digital amplifier is through a separate Mini-D connector. Encoder inputs can be brought in either through DB15 connectors, IDC Headers, or removable modular terminal blocks. Main flag inputs are brought in through DB9 connectors or removable modular terminal blocks. Supplementary flag inputs can be interfaced via the DB15 connectors, removable modular terminal blocks, or an IDC header.

Part Number ACC-8F: 602775

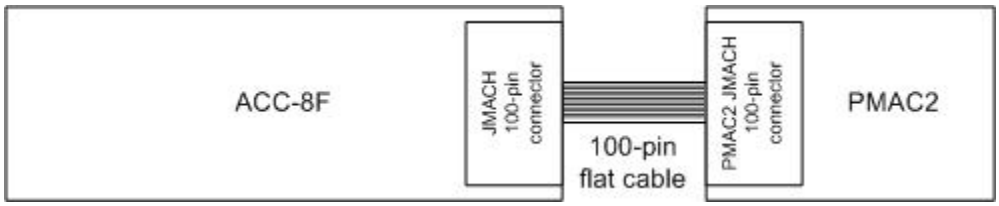
Options

- Option-1: Terminal Block interface for encoder inputs
- Option-2: DB15 connector interface for encoder inputs
- Option-3: DB Type connects for CE-Mark compliance
- Option-4: Rail mount
- Option-5: PWM input cable connector to ACC-8F (36") (two required per ACC-8F)
- Option-6: Incremental encoder interface

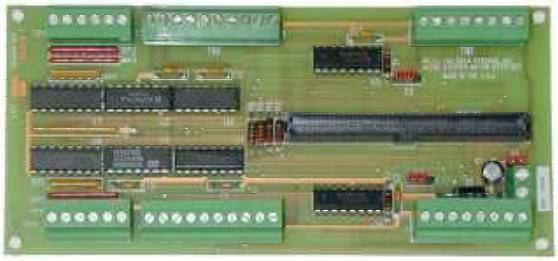
Characteristics

The ACC-8F is used to interface to direct PWM amplifiers that have A/D converters for the phase current values, providing serial digital current data. It has the following features:

- Mini-D 36-pin connector to direct-PWM drive per axis
- Differential 3-channel encoder plus Hall-track input per axis
- Four optically isolated sinking/sourcing 12-24V flag inputs per axis



ACC-8S, Stepper Interface Board



PMAC2's ACC-8S is a 2-axis output board designed for easy connection to stepper drivers. The step and direction outputs are RS422 compatible and are capable of being connected in either differential mode or single ended configurations for 5V input drivers.

Flag input terminals are provided to allow connection of 12V-24V sensors or limit switches. The PMAC2 can use a folded back signal from the ACC-8S to simulate the closure of a motor's position loop. Jumpers are provided to allow the use of an external encoder for true closed-loop control. Being a two-axis accessory, velocity loop encoder input may be used only if one drive output is used. ACC-8S is one of a series of I/O accessories for PMAC2. The interface to the PMAC2 is made using the JMACH connector cable. This cable is supplied with the board and is 24 inches long. When used with the ACC-8S, the PMAC2 outputs a pulse train of variable frequency and constant pulse width. This scheme is known as Pulse Frequency Modulation (PFM).

Part Number ACC-8S: 602644

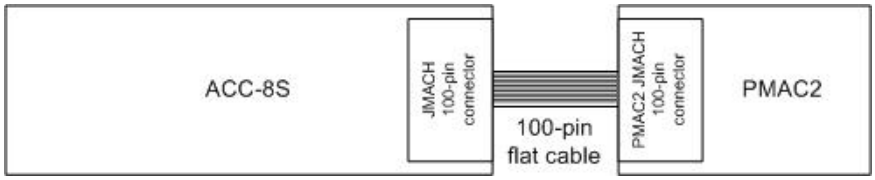
Options

- Option-1: Terminal Block encoder interface
- Option-2: Rail mount

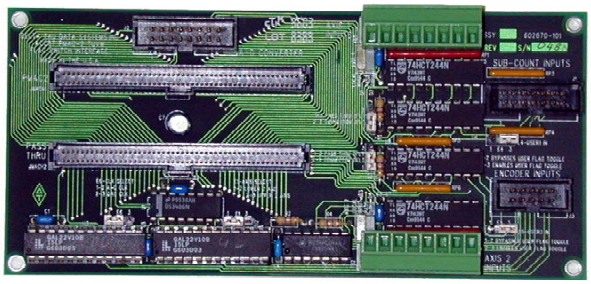
Characteristics

The ACC-8S provides a simple and low-cost interface to pulse-and-direction stepper and stepper-replacement servo drives. It has the following features:

- Differential pulse and direction output pairs per axis
- Differential amplifier-enable output per axis
- Differential amplifier-fault input per axis
- On-board pulse-swallower for slow stepper drives
- Optional differential 3-channel encoder interface per axis
- Four optically isolated sinking/sourcing 12-24V flag inputs per axis



ACC-8T, Supplemental Signal Multiplexer Board



The ACC-8T provides the means to multiplex the supplemental input flags T, U, V, W, and USER into PMAC2. It is useful if multiple uses of the same flag are desired at different times, such as hall-effect for power-up commutation signals and sub-count data from an analog encoder interpolator during operation. It is placed in between PMAC2 and the main ACC-8 board.

Part Number ACC-8T: 602670

Options

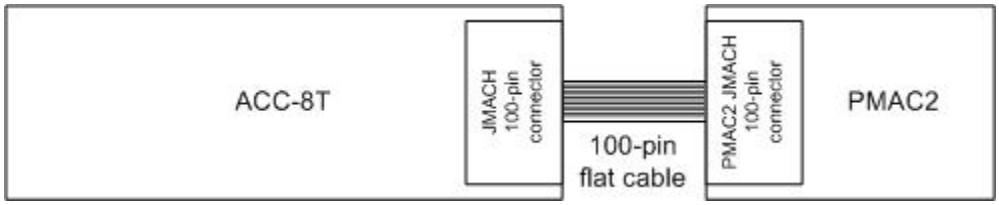
Option-1: Rail mount

Characteristics

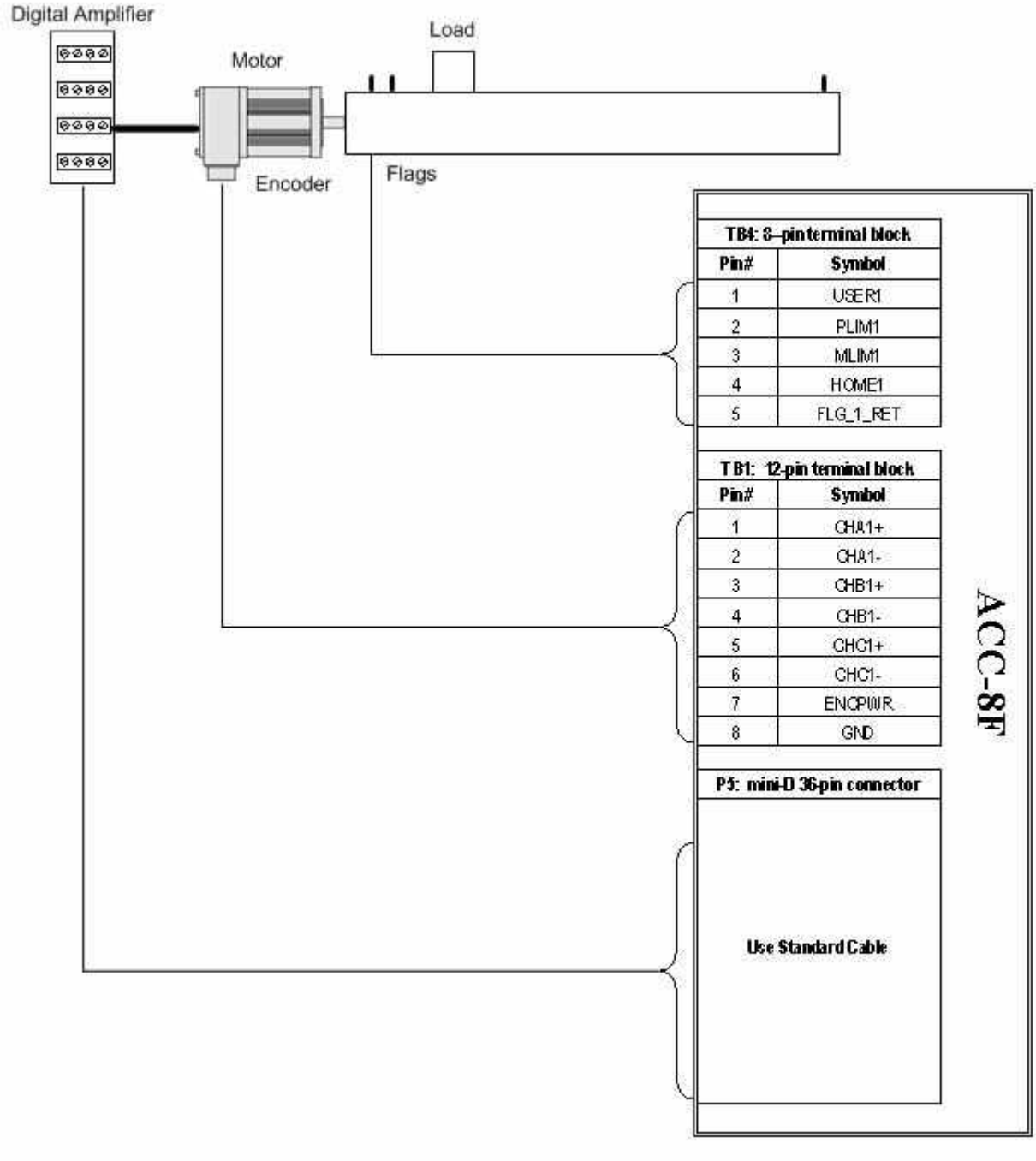
- Pass-thru for ACC-8x signals
- On-board header and terminal-block per axis for supplemental flags
- Multiplexer selection circuitry per axis for supplemental flags
- On-board header for two quadrature encoder inputs
- On-board header for interface to ACC-28B board

Note:

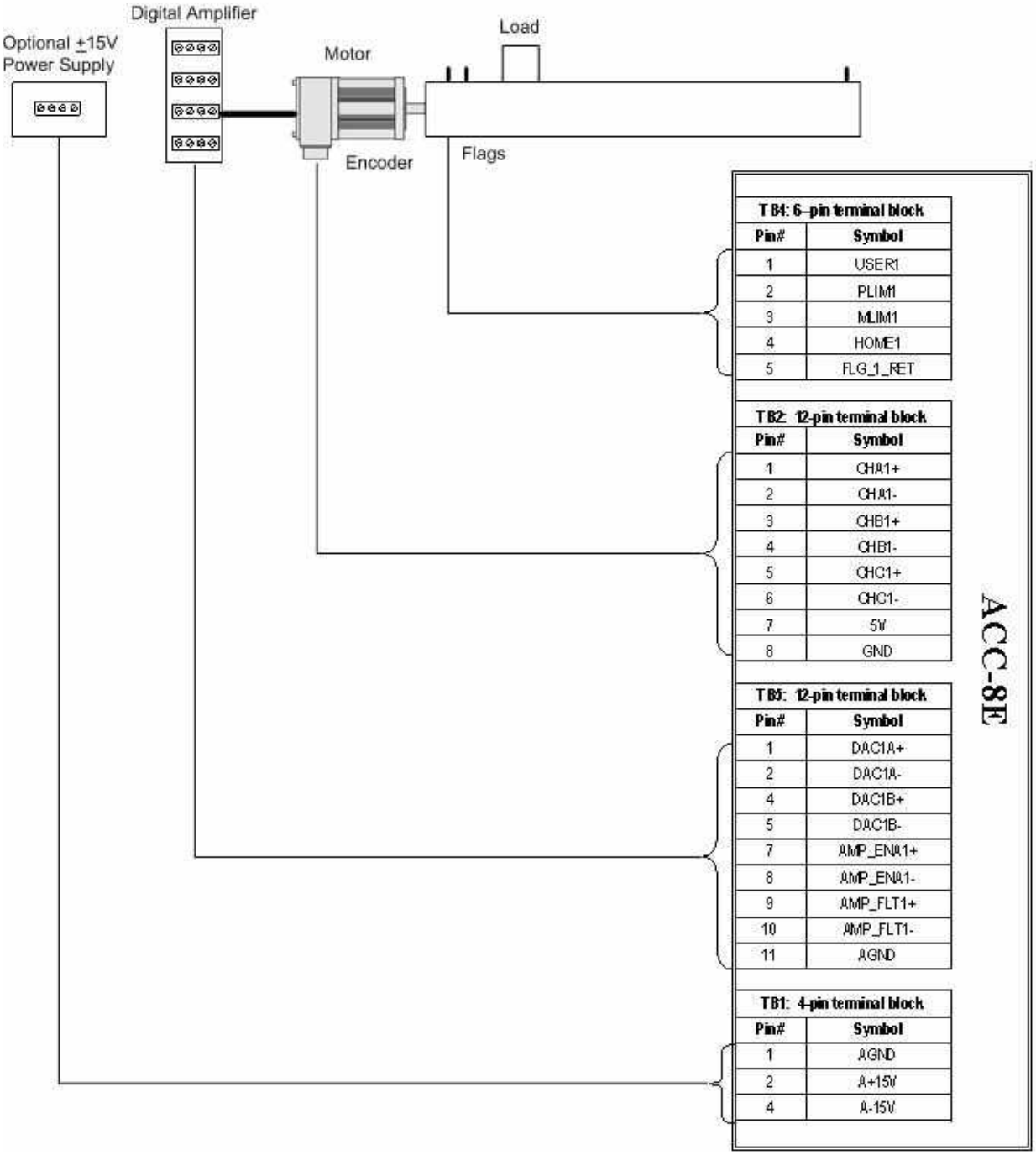
The ACC-8T is required for connections between the PMAC2 and the ACC-28B analog to digital converter board.



Digital Amplifier with Incremental Encoder



Analog Amplifier with Incremental Encoder



TB4: 6-pin terminal block

Pin#	Symbol
1	USER1
2	PLIM1
3	MLIM1
4	HOME1
5	FLG_1_RET

TB2: 12-pin terminal block

Pin#	Symbol
1	CHA1+
2	CHA1-
3	CHB1+
4	CHB1-
5	CHC1+
6	CHC1-
7	5V
8	GND

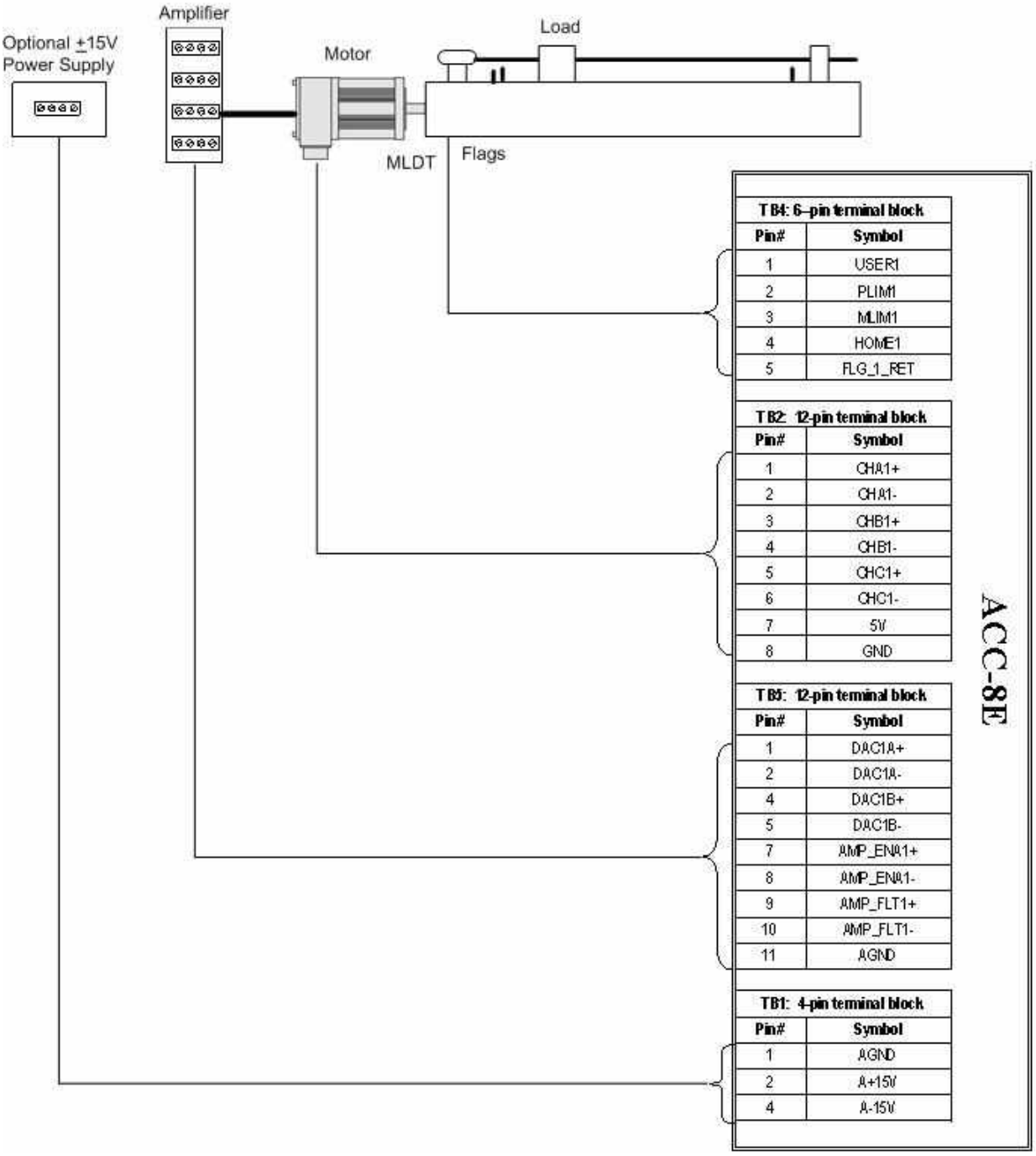
TB3: 12-pin terminal block

Pin#	Symbol
1	DAC1A+
2	DAC1A-
4	DAC1B+
5	DAC1B-
7	AMP_ENA1+
8	AMP_ENA1-
9	AMP_FLT1+
10	AMP_FLT1-
11	AGND

TB1: 4-pin terminal block

Pin#	Symbol
1	AGND
2	A+15V
4	A-15V

Analog Amplifier with MLDT Feedback



TB4: 6-pin terminal block

Pin#	Symbol
1	USER1
2	PLIM1
3	MLIM1
4	HOME1
5	FLG_1_RET

TB2: 12-pin terminal block

Pin#	Symbol
1	CHA1+
2	CHA1-
3	CHB1+
4	CHB1-
5	CHC1+
6	CHC1-
7	5V
8	GND

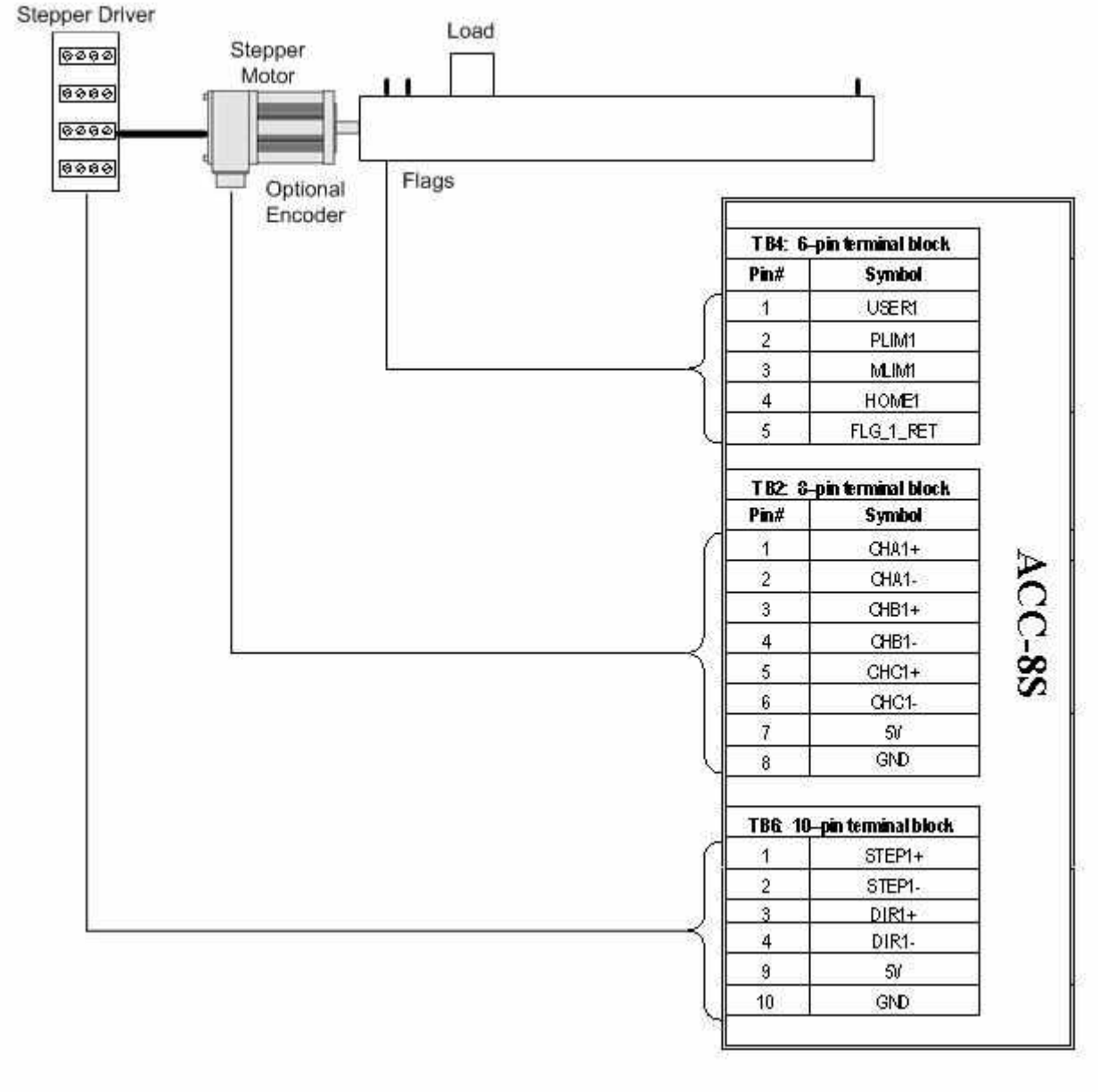
TB3: 12-pin terminal block

Pin#	Symbol
1	DAC1A+
2	DAC1A-
4	DAC1B+
5	DAC1B-
7	AMP_ENA1+
8	AMP_ENA1-
9	AMP_FLT1+
10	AMP_FLT1-
11	AGND

TB1: 4-pin terminal block

Pin#	Symbol
1	AGND
2	A+15V
4	A-15V

Stepper Driver with Incremental Encoder



DIGITAL INPUTS/OUTPUTS EXPANSION BOARDS

On-Board PMAC(1) Digital I/Os

PMAC's JOPTO port (J5 on PMAC PC, Lite, and VME) provides eight general-purpose digital inputs and eight general-purpose digital outputs. Each input and each output has its own corresponding ground pin in the opposite row. The 34-pin connector was designed for easy interface to OPTO-22 or equivalent optically isolated I/O modules. Delta Tau's ACC-21F is a six-foot cable used for this purpose.

On-Board PMAC2 Digital I/Os

The PMAC2 JIO port provides 32 digital I/O lines at 5V CMOS levels. It is intended for general purpose I/O interfaced through buffers such as Opto-22™ or Grayhill. ACC-21A provides a convenient method for connection of this port to Opto-22™ or Grayhill type boards. This port is configurable in sets of eight bits, or one byte, as either inputs or outputs.

PMAC(1) and PMAC2 I/O Expansion Boards

- ACC-14D and ACC-14V: Typically are used for interfacing PMAC with parallel feedback devices like laser interferometers and absolute parallel sensors. ACC-14 can be configured also for other general-purpose I/O connections. It has parallel (fast) communications in comparison to serial (slow) communications of the ACC-34 series. It can plug in the PC bus (14D) or the VME bus (14V) but cannot be rail mounted.
- ACC-27: Typically used when only eight extra general purpose inputs and outputs are necessary in addition to the ones provided in the JOPTO or JIO ports. ACC-27 disables the JTHW multiplexing port for any other purpose.

ACC-34 Family of I/O Expansion Boards

PMAC's family of accessories 34 is a series of general-purpose discrete input/output (I/O) boards. These boards provide 32 lines of optically isolated inputs and 32 lines of optically isolated outputs. The actual I/O reads and writes are carried out using a special form of M-Variables. Boards of the ACC-34 family are one of a series of I/O accessories for PMAC that uses the JTHW connector. All these accessories use the JTHW multiplex address scheme, and several of them may be daisy-chained to a single PMAC. Up to 32 ACC-34s may be connected to a single PMAC, which gives a possible 1024 input and 1024 output lines in addition to those available on the PMAC board and on the parallel I/O expansion board(s) (ACC-14). ACC-34 communicates to PMAC via its JTHW connector through the supplied flat cable.

Board	Mounting	Voltage Rating	Output Current	Individual Isolation	Input RC filter	Serial Parity
ACC-34AA	DIN – Rail	24 V	100 mA	Yes	Yes	Yes
ACC-34B	DIN – Rail	5 V	20 mA	No	No	No
ACC-34D	Panel	5 V	20 mA	No	No	Yes

ACC-11P: Isolated 24-Input/24-Output Expansion Board

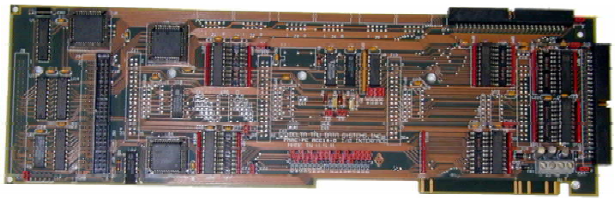
The ACC-11P is a PCI-format with 24 or 48 isolated digital inputs at 12V to 24V levels and 24 or 48 isolated digital outputs at 12V to 24V levels, 100 mA per output point. This accessory board connects to the PMAC board through the JEXP expansion port. The baseboard is provided with 24 inputs and 24 outputs. When Option-1 is ordered, an extra set of 24 inputs and 24 outputs is provided. In both cases the sinking and sourcing outputs must be selected by ordering the appropriate options.

- Option-A: sinking output drivers for 24 outputs
- Option-B: sourcing output drivers for 24 outputs
- Option-1: additional 24 inputs and 24 outputs
- Option-1A: sinking output drivers for additional 24 outputs
- Option-1B: sourcing output drivers for additional 24 outputs

Example:
To order an ACC-11P with 48 inputs and 48 sinking outputs, order ACC-11P with Option-A, Option-1 and Option-1A.

ACC-14D/ACC-14P, 48 I/O Expansion Board

PMAC's ACC-14D provides expanded and flexible digital I/O capabilities for the controller. It may be configured for a wide variety of different uses by selecting different voltage levels, sinking/sourcing, and latched/non-latched I/O to serve many diverse applications. Up to six ACC-14Ds may be connected to a single PMAC at the same time. This extends PMAC's on-board I/O capabilities with a maximum of 288 additional external I/O. The ACC-14D can be installed in the ISA PC-bus, and the ACC-14P can be installed in the PCI PC-bus. Even if the ACC-14D or ACC-14P does not use the PC-bus other than for mechanical support and 5V power supply, it is a convenient method for installing it close to PMAC.



ACC-14D

Part Number 602193

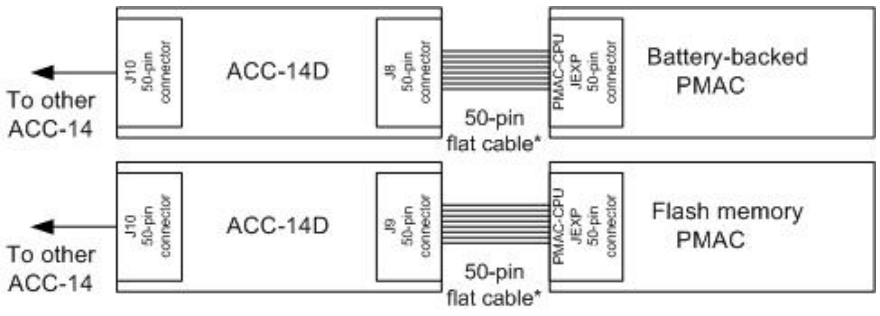
Options

ACC-14D requires an Option-1, 2 or 4:

- Option-1: 24 inputs and 24 outputs, TTL levels (0 - 5V), low true
- Option-2: 24 inputs and 24 outputs, 0 – 24V, low true
- Option-4: Custom configuration to be specified by the user. (Fill out specification sheet)
- Option-7: 20 cm (8") 50-pin 3-drop connector cable (For use with Acc-14D when PMAC Option-2, ACC-24P or ACC-36P are also used.)

Characteristics

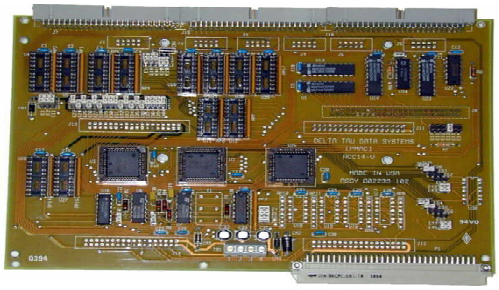
- 48 I/O points per board; up to six boards per PMAC. 100 mA per channel, up to 24V
- Hardware selectable between sinking and sourcing (and totem-pole) in groups of eight; defaults are 5V totem-pole (Option-1; not meant for direct drive – intended for Opto-22 or similar connection) or 24V sinking (Option-2)
- Hardware selectable between inputs and outputs in groups of eight; default is 24 inputs and 24 outputs
- Not opto-isolated; designed for easy connection to Opto-22 (PB24) and similar boards with ACC-21G cable
- Parallel (fast) communications to PMAC through the JEXP port



* If more than one accessory other than the ACC-14 is connected to the PMAC JEXP port, use the 3-connector cable ACC-14.

ACC-14V, 48 I/O Expansion Board

PMAC's ACC-14V provides expanded and flexible digital I/O capabilities for the controller. It may be configured for a wide variety of different uses by selecting different voltage levels, sinking/ sourcing, and latched/non-latched I/O to serve many diverse applications. Up to six ACC-14Vs may be connected to a single PMAC at the same time. This extends PMAC's on-board I/O capabilities with a maximum of 288 additional external I/O. The ACC-14V could be installed in the VME bus. Even if the ACC-14V does not use the VME bus other than for mechanical support and 5V power supply, it is a convenient method for installing it close to PMAC.



ACC-14V

Part Number 602239

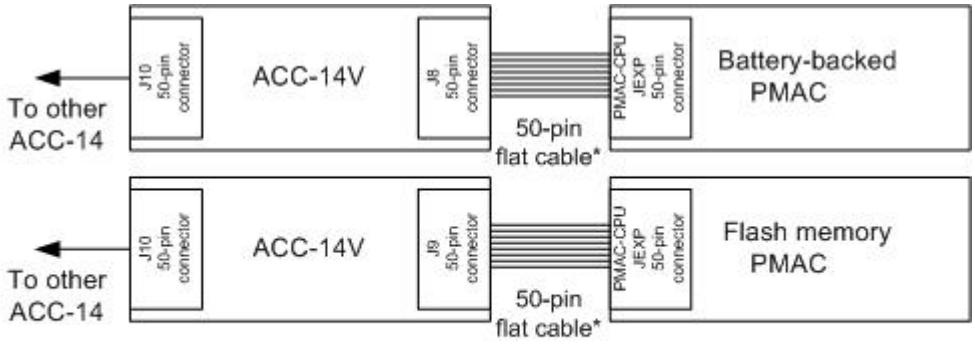
Options

ACC-14V requires an Option-1, 2 or 4

- Option-1: 24 inputs and 24 outputs, TTL levels (0 - 5V), low true
- Option-2: 24 inputs and 24 outputs, 0 - 24V, low true
- Option-4: Custom configuration to be specified by the user. (Fill out specification sheet.)
- Option-7: 20 cm (8") 50-Pin 3-drop connector cable (For use with ACC-14V when ACC-24V or ACC-36V are also used.)

Characteristics

- 48 I/O points per board; up to six boards per PMAC. 100 mA per channel, up to 24V
- Hardware selectable between sinking and sourcing (and totem-pole) in groups of eight; defaults are 5V totem-pole (Option-1; not meant for direct drive – intended for Opto-22 or similar connection) or 24V sinking (Option-2)
- Hardware selectable between inputs and outputs in groups of eight; default is 24 inputs and 24 outputs
- Not opto-isolated; designed for easy connection to Opto-22 (PB24) and similar boards with ACC-21G cable
- Parallel (fast) communications to PMAC through the JEXP port



* If more than one accessory other than the ACC-14 is connected to the PMAC JEXP port, use the 3-connector cable ACC-14 OPT-7.

ACC-21A, JIO Adapter for OPTO-22® Style Boards

The ACC-21A was created to use PMAC2's JIO port with OPTO 22 or Grayhill style I/O module racks. The ACC-21A can be used with the 8, 16, 24, or 32 module boards from these manufacturers. The PMAC2 JIO port has 32 bits of inputs and outputs that can be software configured as inputs or outputs on a byte-by-byte basis (eight bits). The following table lists the possible input/out schemes possible with the PMAC2 JOPTO port.

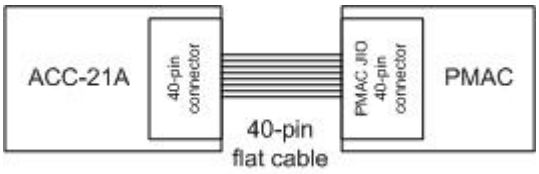


Inputs	Outputs
32	0
24	8
16	16
8	24
0	0

Note:

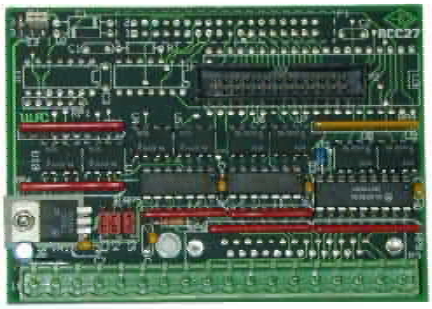
This accessory is not compatible with the PMAC(1) type boards.

Part Number 603375



ACC-27, Thumbwheel Port Opto-Isolation Board

The Thumbwheel Multiplexer Port, or Multiplexer Port, on the JTHW (J3) connector has eight input lines and eight output lines. The output lines can be used to multiplex large numbers of inputs and outputs on the port, and Delta Tau provides accessory boards and software structures (special M-Variable definitions) to capitalize on this feature. However, if no more than eight extra inputs and outputs are required, the ACC-27 permits using the multiplexing I/O lines as discrete optically isolated I/O lines. In addition to the standard discrete I/O provided on the PMAC through its JOPT(J5) connector and those provided with the main I/O expansion board (Accessory 14), this accessory may be used. ACC-27's Option-2 allows direct interface to the PMAC through its JTHW (J3) connector. The external (isolated) voltage supply to this board for the eight inputs and outputs can range from 12 to 24V. ACC-27 disables the JTHW multiplexing port for any other purpose.



ACC-27

Part Number 602237

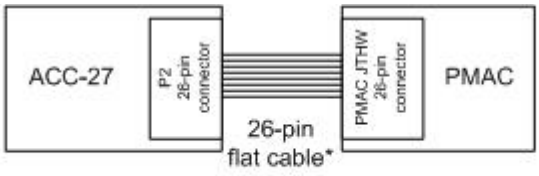
Options

- Option-2A: DB-25 input connection
- Option-2B: 18-pin input terminal block (default)

Characteristics

- 16 I/O points per board
- One board only per PMAC; no other accessories on thumbwheel port
- 100 mA per channel, up to 24V

- Hardware selectable between sinking and sourcing in groups of eight; default is all sinking (inputs can be changed simply by moving a jumper; sourcing outputs must be special-ordered or field-configured)
- Eight inputs, eight outputs only; no changes
- Opto-isolated
- Parallel (fast) communications to PMAC through the thumbwheel port



*No other PMAC accessory that communicates to PMAC through its thumbwheel port (JTHW) may be used in conjunction with this accessory.

ACC-34AA, Optically Isolated I/O Board

ACC-34AA output drivers are organized in a set of four 8-bit groups. These outputs may be ordered with either current sourcing drivers or with current sinking drivers by selecting the appropriate ordering option. The sourcing configuration of this accessory board uses UDN2981 current sourcing drivers for the four 8-bit output groups. With this configuration, the current drawn from each output line should be limited to 100 mA at voltage levels between 12 and 24V. Option-1 is available for current sinking applications. In current sinking configurations, one ULN2803 driver is used for each 8-bit output group. Each open collector output line can sink up to 100 mA when pulled up to a voltage level between 12 to 24V (external pull-up resistors are not supplied). ACC-34AA input buffers are also organized in a set of four 8-bit groups. Each group (each byte) uses one ULN2802 driver as the input buffer. The appropriate setting of the pertinent jumpers and diode groups accommodates both current sourcing and sinking inputs. The default setting is for current sourcing configurations on all inputs. ACC-34AA also supports a local watchdog timer feature independent of PMACs.

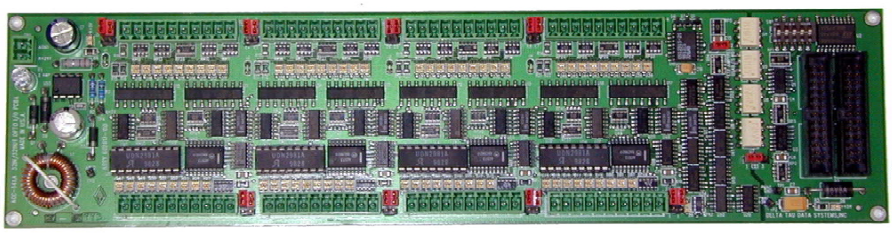
Part Number 602817

Options

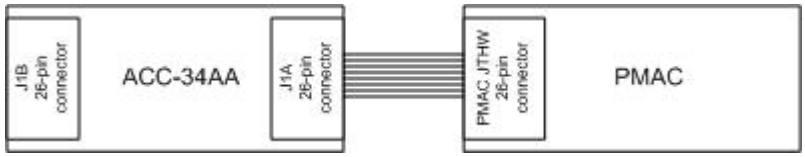
- Option-1: sinking configuration
- Option-2: sourcing configuration
- Option-3: rail mount

Characteristics

- 64 I/O points per board
- Up to 32 boards per PMAC
- 100 mA per channel, up to 24V
- Hardware selectable between sinking and sourcing in groups of eight; default is all sourcing
- Opto-isolated
- Serial (slow) communications to PMAC through the thumbwheel port
- Requires PMAC firmware version 1.13 or higher (for TWS M-variable form)
- Individual optical isolation of all I/O points
- RC filter with 1 msec time constant on all inputs
- Parity checking on serial communications with PMAC
- Two multiplexer port headers for easier daisy-chaining



ACC-34AA



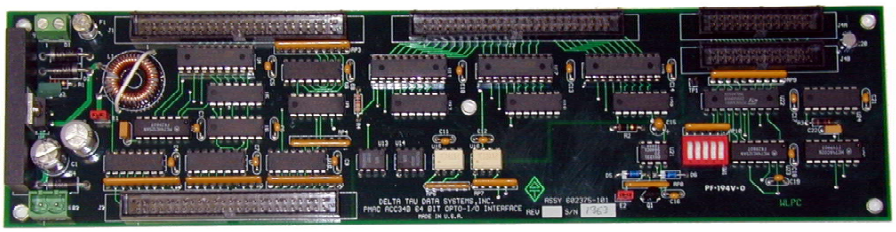
ACC-34B, Optically Isolated I/O Board OPTO-22 Compatible

PMAC's ACC-34B is a discrete input/output (I/O) board designed for easy connection to Opto-22 and compatible mounting racks. The board interfaces with several third party opto modules (e.g. Opto-22 Models G4PB24 and G4PB16H) via standard 50-pin flat cables (see ACC-21 cables). ACC-34B provides 32 lines of optically isolated inputs and 32 lines of optically isolated outputs. Both the inputs and the outputs are TTL compatible negative logic (low true) types. The actual I/O reads and writes are carried out using a special form of M-Variables.

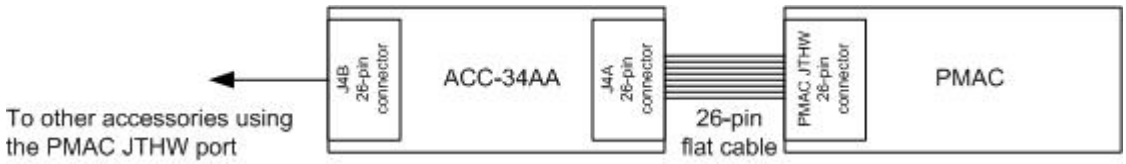
Part Number 602375

Options

Option-1: DIN rail mount



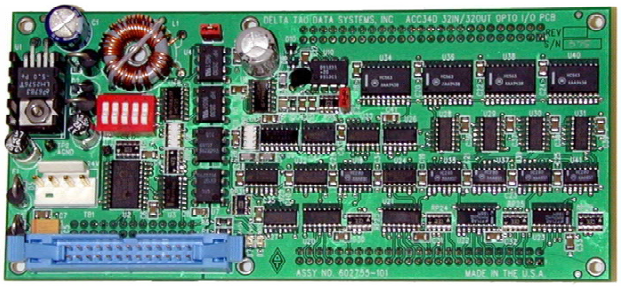
ACC-34B



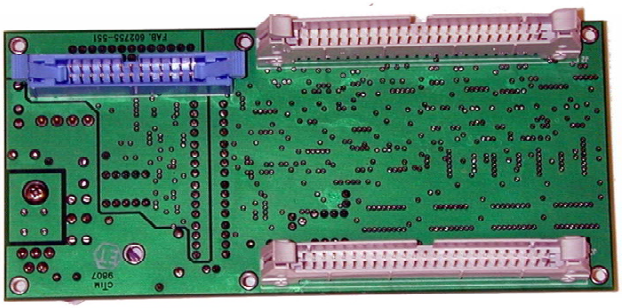
ACC-34D, Optically Isolated I/O Board OPTO-22 Compatible

PMAC's ACC-34D is a discrete input/output (I/O) board designed for easy connection to Opto-22 and compatible mounting racks. The board interfaces with several third party opto modules (e.g. Opto-22 Models G4PB32, 70GRQ432 and all PB8, 16, and 24 boards) via standard 50-pin flat cables (see ACC-21 cables). ACC-34D provides 32 lines of optically isolated inputs and 32 lines of optically isolated outputs. Both the inputs and the outputs are TTL compatible negative logic (low true) types. The actual I/O reads and writes are carried out using a special form of M-Variables. This accessory is meant to be panel mounted. It cannot be DIN rail mounted.

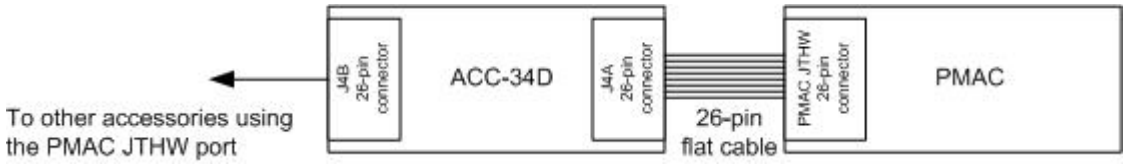
Part Number 602755



ACC-34D

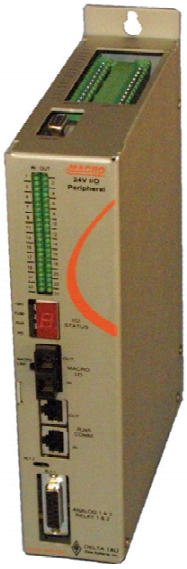


ACC-34D Back View



ACC-65M: Sourcing 24-Inputs/24-Outputs MACRO Device

The ACC-65M is a boxed accessory with 24 isolated self-protected digital inputs and 24 isolated self-protected digital outputs. The inputs and outputs are controlled through a MACRO link either with fiber optic or copper and RJ-45 connector. The inputs are either sinking or sourcing (by user wiring) at 12V to 24V levels. The outputs are sourcing, each at up to 24VDC with 600mA continuous and 1.2A peak for up to two seconds. An optional set of analog inputs, analog outputs and relay contacts can be installed to control, for example, one or two inverter drives through the MACRO link.



Note:

This accessory works only with a Turbo PMAC2 system, either in Ultralite or UMAC versions.

Part Number 3x0-603740-10x

Options

- OPT-A (30A-603740-OPT): Fiber Optic MACRO connectors
- OPT-C (30C-603740-OPT): RJ45 MACRO connectors
- OPT-1 (301-603740-OPT): This option includes:
  - Two relay contact outputs
  - Two 12-bit DAC outputs with 0-10V voltage range
  - Two 12-bit ADC inputs with 0-10V voltage range

ACC-68M: Sinking 24-Inputs/24-Outputs MACRO Device

The ACC-68M is a boxed accessory with 24 isolated self-protected digital inputs and 24 isolated self-protected digital outputs. The inputs and outputs are controlled through a MACRO link either with fiber optic or copper and RJ-45 connector. The inputs are either sinking or sourcing (by user wiring) at 12V to 24V levels. The outputs are sinking, each at up to 24VDC with 600mA continuous and 1.2A peak for up to two seconds. An optional set of analog inputs, analog outputs and relay contacts can be installed to control, for example, one or two inverter drives through the MACRO link.

Note:

This accessory works only with a Turbo PMAC2 system, either in Ultralite or UMAC versions.

Part Number 3x0-603747-10x

Options

- OPT-A (30A-603747-OPT): Fiber Optic MACRO connectors
- OPT-C (30C-603747-OPT): RJ45 MACRO connectors
- OPT-1 (301-603747-OPT): This option includes:
  - Two relay contact outputs
  - Two 12-bit DAC outputs with 0-10V voltage range
  - Two 12-bit ADC inputs with 0-10V voltage range

ACC–73: PMAC Fieldbus Gateway in ISA Bus Format

This accessory allows the PMAC motion controller to communicate with other external devices using a field bus communication protocol like DeviceNet, Profibus, and CanOpen as required. Up to six ACC-73s may be connected to a single PMAC at the same time. The ACC-73 can be installed in the ISA PC-bus. Even if the ACC-73 does not use the ISA bus other than for mechanical support and 5V power supply, it is a convenient method for installing it close to PMAC. This board can act as a master or a slave in the field bus connections. The specific option must be ordered to specify the type of field bus communications required.

Part Number 603776

Options

- ACC-73 OPT-1: Profibus Master (Part Number: 3A1-603776-10X)
- ACC-73 OPT-2: Profibus Slave (Part Number: 3A2-603776-10X)
- ACC-73 OPT-3: DeviceNet Master (Part Number: 3A3-603776-10X)
- ACC-73 OPT-4: DeviceNet Slave (Part Number: 3A4-603776-10X)
- ACC-73 OPT-5: CanOpen Master (Part Number: 3A5-603776-10X)
- ACC-73 OPT-6: CanOpen Slave (Part Number: 3A6-603776-10X)

ACC–74: PMAC Fieldbus Gateway in PCI Bus Format

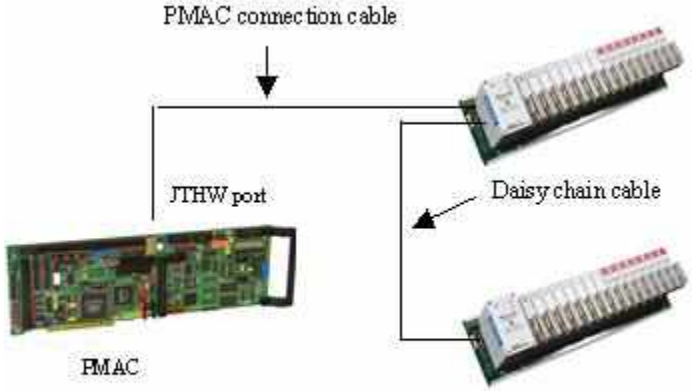
This accessory allows the PMAC motion controller to communicate with other external devices using a field bus communication protocol like DeviceNet, Profibus, ControlNet and CanOpen as required. Up to six ACC-74s may be connected to a single PMAC at the same time. The ACC-74 can be installed in the PCI PC-bus. Even if the ACC-74 does not use the PCI bus other than for mechanical support and 5V power supply, it is a convenient method for installing it close to PMAC. This board can act as a master or a slave in the field bus connections. The specific option must be ordered to specify the type of field bus communications required.

Part Number 603784

Options

- ACC-74 OPT-1: Profibus Master (part number: 3A1-603784-10X)
- ACC-74 OPT-2: Profibus Slave (part number: 3A2-603784-10X)
- ACC-74 OPT-3: DeviceNet Master (part number: 3A3-603784-10X)
- ACC-74 OPT-4: DeviceNet Slave w/ front panel (part number: 3A4-603784-10X)
- ACC-74 OPT-5: CanOpen Master w/ front Panel (part number: 3A5-603784-10X)
- ACC-74 OPT-6: CanOpen Slave w/ front panel (part number: 3A6-603784-10X)
- ACC-74 OPT-7: ControlNet Slave w/ front panel (part number: 3A7-603784-10X)

OPTO-22® Snap I/O Compatible Solutions for PMAC JTHW I/O



Up to 32 ACC-7x modules can be daisy-chained on a single PMAC using the daisy chain cables.

ACC-76: Thumbwheel Interface for OPTO 22 Snap I/O

ACC-76 provides 32in/32out digital I/O fixed per interface module. One ACC-76 is required for each rack. Up to 32 ACC-76s may be daisy chained to a single PMAC, which gives a possible 1,024 input and 1,024 output points. Shielded cables connect ACC-76 with either PMAC, QMAC, or another ACC-76/77 and the cable is selected from the following options:

- A PMAC connection cable with a 26-pin IDC connector and a DB-25 connector for connecting to the PMAC JTHW connector.
- A daisy chain cable with DB-25 connectors on both sides for connecting ACC-76 to another ACC-76 or an ACC-77 module. This cable also is the PMAC connection cable to a QMAC system.

Part Number: 603773

ACC-77: Thumbwheel Interface for OPTO 22 Snap Input Modules

ACC-77 has the same features as ACC-76 but it provides 64 inputs instead of 32 inputs and 32 outputs. A shielded cable connects ACC-77 with either PMAC, QMAC, or another ACC-76/77, and it can be selected from the following options:

- A PMAC connection cable with a 26-pin IDC connector and a DB-25 connector for connecting to the PMAC JTHW connector.
- A daisy chain cable with DB-25 connectors on both sides for connecting ACC-77 to another ACC-76 or an ACC-77 module. This cable also is the PMAC connection cable to a QMAC system.

Part Number: 603774

Cables: Daisy Chain

- 30cm (12in) shielded cable for interconnecting between multiple ACC-76 or ACC-77 (Part number: 200-603773-0120)
- 60cm (24in) shielded cable for interconnecting between multiple ACC-76 or ACC-77 (Part number: 200-603773-0240)

- 90cm (36in) shielded cable for interconnecting between multiple ACC-76 or ACC-77 (Part number: 200-603773-0360)
- 180cm (72in) shielded cable for interconnecting between multiple ACC-76 or ACC-77 (Part number: 200-603773-0720)

Cables: PMAC Connection

- 90cm (36in) flat ribbon cable for connecting ACC-76 or ACC-77 to PMAC (Part number: 2C1-603130-0360)

For connection to QMAC, use the daisy chain cable above.

SNAP Digital Input Modules

These modules are provided by OPTO 22 and are not by Delta Tau Data Systems Inc.

AC Input:
SNAP-IAC5 4-channel, 90–140 VAC input, 5VDC logic Form 773
SNAP-IAC5A 4-channel, 180–280 VAC input, 5VDC logic Form 773
SNAP-IAC5MA 4-channel, 90–140 VAC/VDC input, 5VDC logic, manual/auto switches Form 773
SNAP-IAC5FM* 4-channel, 90–140 VAC/VDC input, 5VDC logic Form 773
SNAP-IAC5AFM* 4-channel, 180–280 VAC input, 5VDC logic Form 773

DC Input:
SNAP-IDC5 4-channel, 10–32 VDC input, 5VDC logic Form 773
SNAP-IDC5D 4-channel, 2.5–28 VDC input, 5VDC logic Form 773
SNAP-IDC5-FAST 4-channel, high-speed, 2.5–16VDC input, 5VDC logic Form 773
SNAP-IDC5-FAST-A 4-channel, high-speed, 18–32VDC input, 5VDC logic Form 773
SNAP-IDC5G 4-channel, 35–75 VAC/VDC input, 5VDC logic Form 773
SNAP-IDC5-HT 4-channel, leakage-tolerant 15–32VDC input, 5VDC logic Form 773
SNAP-IDC5MA 4-channel, isolated, high-speed, 10–32VAC/VDC input, 5VDC logic, manual/auto switches Form 773
SNAP-IDC5Q Two-axis quadrature position input Form 1053
SNAP-IDC5-SW 4-channel switch status input, normally open Form 773
SNAP-IDC5-SW-NC 4-channel switch status input, normally closed Form 773
SNAP-IDC5FM* 4-channel 10–32VDC input, 5VDC logic Form 773
SNAP-IDC5DFM* 4-channel 2.5–28VDC input, 5VDC logic Form 773

SNAP Digital Output Modules

AC Output:
SNAP-OAC5 4-channel, 12–250VAC input, 5VDC logic Form 1144
SNAP-OAC5FM* 4-channel, 12–250VAC input, 5VDC logic Form 1144
SNAP-OAC5MA 4-channel, isolated, 12–250VAC output, 5VDC logic, manual/auto switches Form 1144
SNAP-OAC5-i 4-channel, isolated, 12–250VAC output, 5VDC logic Form 1144
SNAP-OAC5-iFM* 4-channel, isolated, 12–250VAC output, 5VDC logic Form 1144

DC Output:
SNAP-ODC5SRC 4-channel, 5–60VDC output, 5VDC logic, source Form 1144
SNAP-ODC5SRCFM* 4-channel, 5–60VDC output, 5VDC logic, source Form 1144
SNAP-ODC5SNK 4-channel, 5–60VDC output, 5VDC logic, sink Form 1144
SNAP-ODC5SNKFM* 4-channel, 5–60VDC output, 5VDC logic, sink Form 1144
SNAP-ODC5ASNK 4-channel, 5–200VDC output, 5VDC logic, sink Form 1144
SNAP-ODC5R 4-channel, dry contact output, normally open Form 1144
SNAP-ODC5RFM* 4-channel, dry contact output, normally open Form 1144
SNAP-ODC5R5 4-channel, dry contact output, normally closed Form 1144
SNAP-ODC5R5FM* 4-channel, dry contact output, normally closed Form 1144
SNAP-ODC5MA 4-channel, isolated, 5–60VDC output, 5VDC logic, manual/auto switches Form 1144

SNAP-ODC5-i 4-channel, isolated, 5–60VDC output, 5VDC logic Form 1144
SNAP-ODC5-iFM* 4-channel, isolated, 5–60VDC output, 5VDC logic Form 1144
SNAP-ODC5A-i 4-channel, isolated, 5–200VDC output, 5VDC logic Form 1144
SNAP-ODC5A-iFM* 4-channel, isolated, 5–200VDC output, 5VDC logic Form 1144

ACC-78: JOPT and JTHW Interface for OPTO 22 Snap I/O

ACC-78 provides an interface between both the JOPT and JTHW PMAC ports to OPTO 22 type snap modules. Since the JOPT and JTHW have eight inputs and eight outputs each, ACC-78 provides 16 inputs and 16 outputs of OPTO 22 style connections. ACC-78 is compatible with OPTO 22 SNAP-B8M and SNAP-B4M backplanes and all SNAP digital I/O modules, and it is supplied with a 24 inch IDC cable.

Part Number 603768

ACC-79: JIO Interface for OPTO 22 Snap I/O

ACC-79 provides an interface between the PMAC2 JIO port and OPTO 22 type snap modules. The PMAC2 JIO port has 32 I/O lines programmable as inputs or outputs in groups of eight. Therefore, the OPTO 22 modules must be selected as either inputs or outputs according to the programmable settings of the PMAC2 JIO port. ACC-79 is compatible with OPTO 22 SNAP-B8M and SNAP-B4M backplanes and all SNAP digital I/O modules, and it is supplied with a 24 inch IDC cable.

Part Number 603770

ANALOG FEEDBACK INTERFACES

PMAC(1) Optional Analog Inputs

PMAC has three accessories that it can use to read analog signals. These interface boards may be used for either servo loop feedback or for data acquisition. ACC-28B is Delta Tau's most accurate analog to digital converter, which features separate A/D's per channel. Both ACC-36 and ACC-28A have multiplexed A/D's on board. ACC-28A is an externally mounted board with a 16-bit resolution and a higher conversion rate than ACC-36 (12 bit). ACC-36 must be located immediately adjacent to PMAC while ACC-28A or ACC-28B may be placed up to two feet away from PMAC. The three A/D boards are summarized below:

Type	# of Channels	Resolution (bits)	Repeatability (bits)	Voltage Range	Mounting	Optical Isolation?
ACC-28A	4	15	12	± 10V	DIN Rail	Yes
ACC-28B	2 or 4	16	15	± 10V	DIN Rail	Yes
ACC-36P	16	12	11	0-10 V, ± 5V	ISA Bus	No
ACC-36V	16	12	11	0-10 V, ± 5V	VME Bus	No
Option-12	8 or16	12	11	0-5 V, ± 2.5V	On-board option	No
Option-15	1 (2 on Mini)	11	10	0-10 V, ± 10V on Lite and Mini	On-board option	No, Yes on Mini

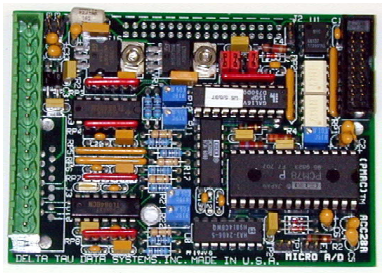
PMAC2 Optional Analog Inputs

PMAC has two accessories that it can use to read analog signals. These entire interface boards may be used for either servo loop feedback or for data acquisition. ACC-28B is Delta Tau's most accurate analog to digital converter, which features separates A/D's per channel. ACC-36 has multiplexed A/D's on board and must be located immediately adjacent to PMAC while the ACC-28B may be placed up to two feet away from PMAC. The two A/D boards are summarized below:

Type	# of Channels	Resolution (bits)	Repeatability (bits)	Voltage Range	Mounting	Optical Isolation?
ACC-28B	2 or 4	16	15	± 10V	DIN Rail	Yes
ACC-36P	16	12	11	0-10 V, ± 5V	ISA Bus	No
ACC-36V	16	12	11	0-10 V, ± 5V	VME Bus	No
Option-12	8 or16	12	11	0-5 V, ± 2.5V	On-board Option	No

ACC-28A, 4-Channel Analog Converter Board

PMAC's ACC-28A Analog-to-Digital Conversion board provides four channels of high-speed high-resolution analog input capability to the PMAC controller. The input voltages, in the range of ±10V, are converted to 16-bit signed values, at an 18 KHz rate (55 µsec conversion). This input can be used for servo position feedback, as from an LVDT or potentiometer, or for general-purpose usage that allows, for instance, monitoring process variables, to allow analog speed control, or to monitor motor currents. The resolution of the A/D conversion can now be selected via jumpers. In addition, the ACC-28A benefits from a design improvement aimed at substantially reducing the noise signals and the cross-talk signals between the four analog input channels. It achieves this by trading off resolution to gain substantially improved cross-talk elimination. Also an improved sample-and-hold circuit design reduces noise and enhances the accuracy of the analog-to-digital conversion process. This accessory is not compatible with the PMAC2 board; use the ACC-28B instead.

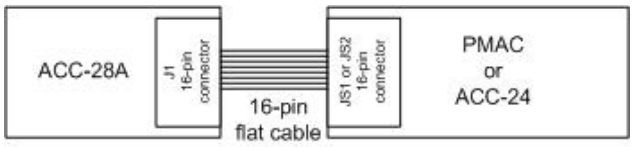


ACC-28A

Part Number 602236

Options

- Option-2A: DB-15 input connector
- Option-2B: 12-pin input terminal block (default)
- Option-3: Rail mount



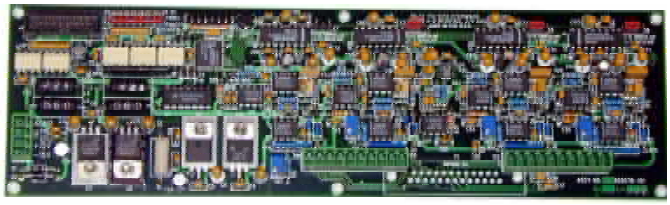
ACC-28B, 2-Channel, 16-Bit Analog to Digital Converter Board

Delta Tau's ACC-28B is a 2 or 4-channel analog to digital converter interface board (Option-1) designed to provide a means for precision voltage measurement as an input to the PMAC. This accessory uses four 16-bit analog-to-digital converters that provide voltage measurements that are accurate to ±2 bits. Jumpers will allow each A-D converter to be selected for Bipolar or Unipolar converting modes. When selected for bipolar mode, differential inputs input voltages to ±10V (20V p-p) can be applied. When selected for unipolar mode, input voltages from 0V to +10V are applied. In unipolar mode, negative input voltages will not damage the A-D converters. Opto-couplers are used to isolate the ACC-28B's circuitry from the PMAC. When used with PMAC1 or ACC-24P, each ACC-28B occupies four channels using the PMAC's JS1 or JS2 interface connector. ACC-28B requires ±15VDC. The PMAC2 board requires the ACC-8T to connect the ACC-28B board. A PMAC2 channel controlling a digital amplifier with current feedback cannot use the ACC-28B board.

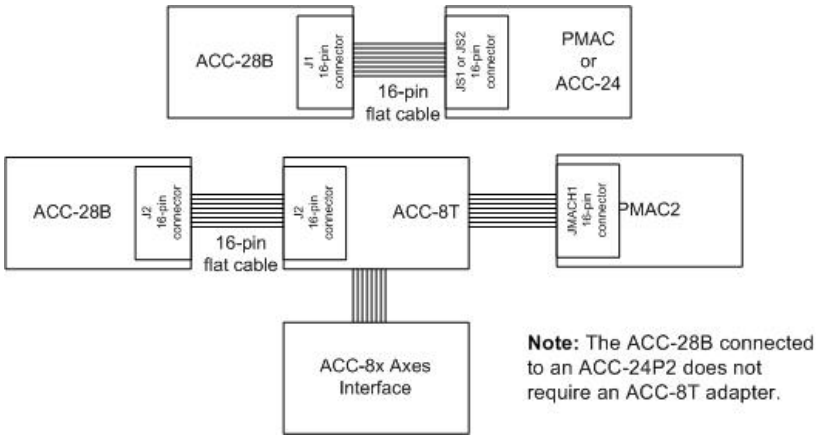
Part Number 602678

Options

- Option-1: Additional on board 2-channels A/D converter
- Option-2A: Analog input connector DB25
- Option-2B: Analog input connector, terminal block
- Option-4: Rail mount



ACC-28B



ACC-36P, 16-Channel, 12-Bit Analog to Digital Converter Board

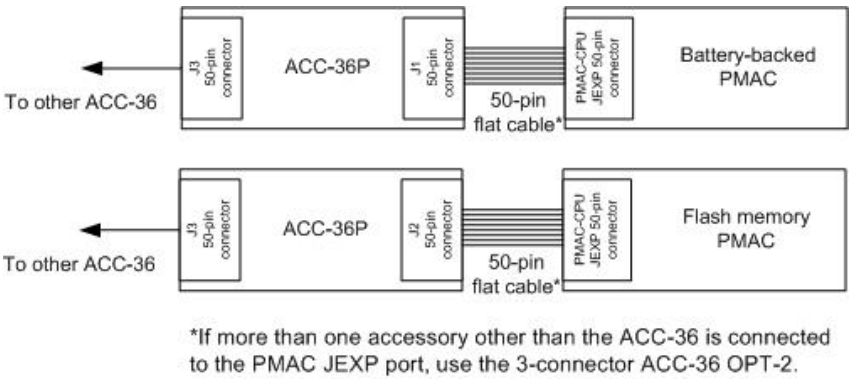
PMAC's ACC-36P is an analog data acquisition board capable of converting 16 analog input signals. The analog inputs can be read in a bipolar fashion with input ranges of ±5V single-ended or ±2.5V differential. If the analog inputs are read in a unipolar fashion, the input ranges are 0 to 10V single-ended or 0 to 5V differential. The basic ACC-36P board is populated for sixteen (16) channels of analog input. ACC-36P's design features make it an ideal analog data-acquisition board for monitoring and collection of signals from a variety of sensors and transducers. Up to 24 ACC-36Ps may be connected to PMAC providing up to 384 possible analog input channels. By using simple M-Variable assignments, the converted data may be used in PLC programs for monitoring and data collection purposes.

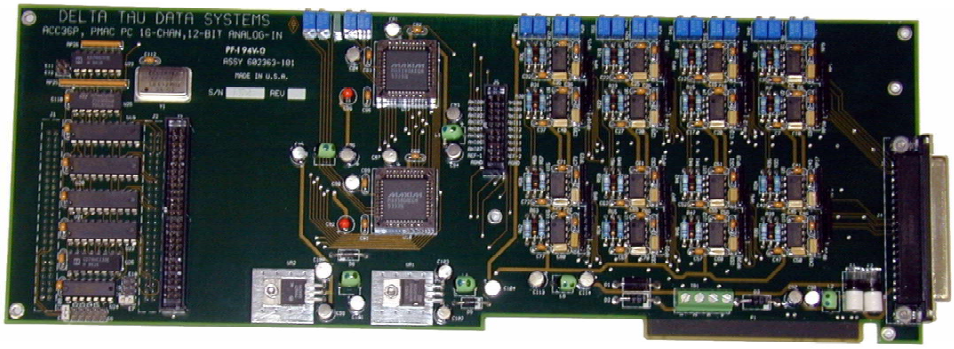
For PMAC firmware V1.15 and above, 16 channels may be read to specified PMAC memory locations automatically. These registers can be monitored using M-Variables or read into PMAC's encoder conversion table for servo feedback control. Only one ACC-36 may be used in this fashion per PMAC. To use this automatic feature, all channels on the card must be read in this manner. The Turbo PMAC firmware has a more efficient method for reading multiplexed analog inputs through the ACC-36P board. In the Turbo PMAC, an automatic conversion table can be set through I-Variables, making the analog inputs reading process more powerful and simple. The ACC-36P can be installed in the ISA PC-bus. Even if the ACC-36P does not use the ISA bus other than for mechanical support and 5V power supply, it is a convenient method for installing it close to PMAC.

Part Number 602363

Options

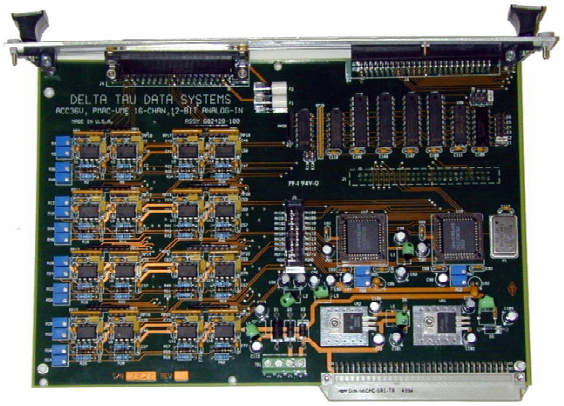
Option-2: 20-cm (8") 50-pin 3-connector cable when ACC-36P is used with PMAC Option-2, ACC-14D or ACC-24P





ACC-36P

ACC-36V, 16-Channel, 12-Bit Analog to Digital Converter Board



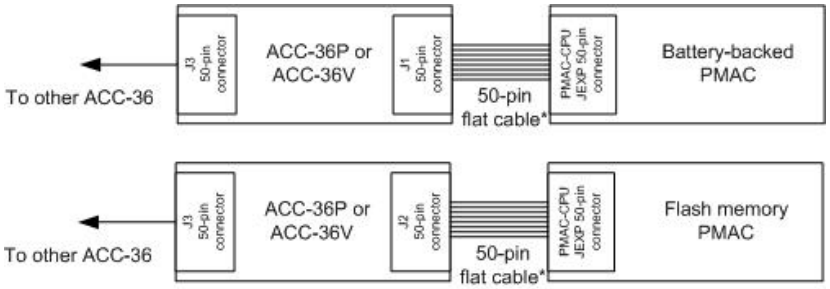
PMAC's ACC-36V is an analog data acquisition board capable of converting 16 analog input signals. The analog inputs can be read in a bipolar fashion with input ranges of ±5V single-ended or ±2. 5V differential. If the analog inputs are read in a unipolar fashion, the input ranges are 0 to 10V single-ended or 0 to 5V differential. The basic ACC-36V board is populated for sixteen channels of analog input. The ACC-36V's design features make it an ideal analog data-acquisition board for monitoring and collecting signals from a variety of sensors and transducers. Up to 24 ACC-36Vs may be connected to PMAC providing up to 384 possible analog input channels. By using simple M-Variable assignments, the converted data may be used in PLC programs for monitoring and data collection purposes.

For PMAC firmware V1.15 and above, 16 channels may be read to specified PMAC memory locations automatically. These registers can be monitored using M-Variables or read into PMAC's encoder conversion table for servo feedback control. Only one ACC-36 may be used in this fashion per PMAC. To use this automatic feature, all channels on the card must be read in this manner. The Turbo PMAC firmware has a more efficient method for reading multiplexed analog inputs through the ACC-36P board. In the Turbo PMAC, an automatic conversion table can be set through I-Variables making the analog inputs reading process more powerful and simple. The ACC-36V can be installed in the VME bus. Even if the ACC-36V does not use the VME bus other than for mechanical support and 5V power supply, it is a convenient method for installing it close to PMAC.

Part Number 602428

Options

Option-2: 20-cm (8") 50-pin 3-connector cable when ACC-36V is used with ACC-24V, or ACC-14V



*If more than one accessory other than the ACC-36 is connected to the PMAC JEXP port, use the 3-connector ACC-36 OPT-2.

OPT-12, On-Board Analog to Digital Converters

The JANA port is present only if the PMAC Option-12 is ordered and this option is available for most PMACs. Option-12 provides eight 12-bit analog inputs (ANAI00-ANAI07). Option-12A provides eight additional 12-bit analog inputs (ANA08-ANAI15) for a total of 16 inputs. The analog inputs can be used as unipolar inputs in the 0V to +5V range, or bi-polar inputs in the -2.5V to +2.5V range.

OPT-15, Onboard Voltage to Frequency Converter

The Wiper analog input (0 to +10V on PMAC PC, VME; -10V to +10V on PMAC Lite, referenced to digital ground) provides an input to a voltage-to-frequency converter (V/F) with a gain of 25 kHz/V, providing a range of 0-250 kHz. The output of the V/F can be connected to the Encoder 4 counter using jumpers E72 and E73. If these jumpers are on, nothing else should be connected to the Encoder 4 inputs. Make sure that the Encoder 4 jumper E24 is set for single-ended signals, connecting pins 1 and 2.

The Wiper analog input information is processed in PMAC through the encoder conversion table resulting in a number proportional to the analog input value. In this fashion, it results on a single low-resolution analog to digital converter. This option is not available for the PMAC2 board.

SERVO INTERFACES

The standard position feedback device that PMAC can read without any options is one incremental quadrature encoder per motor. Several optional accessories are provided for a variety of position feedback devices including absolute sensors, laser interferometers and analog feedback devices.

The axis expansion boards provide more channel circuitry than those present on the PMAC base board. This is important particularly when using Turbo PMAC type boards. Up to four ACC-24s with eight channels each can be added to the Turbo PMAC for controlling up to 32 axes.

ACC-8D-OPT-6, Encoder Opto-Isolator Board

ACC-8D Option-6 is a separate board designed to sit alongside the main ACC-8D board although is compatible with any PMAC with incremental encoder inputs. ACC-8D Option-6 provides the capability to optically isolate four incremental encoders from PMAC's digital circuitry. This can be important for signal integrity in noisy environments. (Usually, differential signals and cable shielding are tried first.) Because the encoders are isolated from PMAC, a separate 5V-power supply is required for the encoders. The encoder signals and the power (5V and GND) for the encoder side of the board are brought in through Terminal Block 1. The encoder signals are passed on to PMAC either through (provided) 10-line flat cables that connect JENC1 through JENC4 on Option-6 to J1A through J4A (see diagram) on the main ACC-8D board, or through discrete wiring that connects Terminal Block 2 (TB2) on Option-6 to the Terminal Block on ACC-8D or ACC-8P. For ACC-8P, this is the only connection choice since J1A through J4A connectors are not available. For ACC-8D either discrete wiring (through TB2) or cable wiring (through JENC1 to JENC4) should be used. The power for the PMAC half of the board comes through this connection as well.

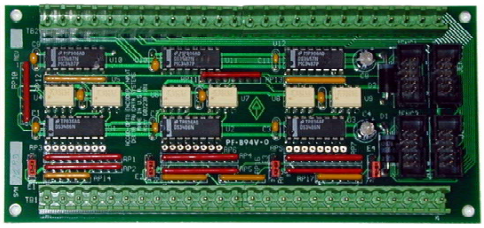
Note:

The flat cables provide only a single-ended third-channel signal to the ACC-8D. Because of the short distance, any difference in noise immunity should be minimal. In this case, tie the complementary third-channel signal(s) on the main ACC-8D board to 2.1V with the appropriate jumpers.

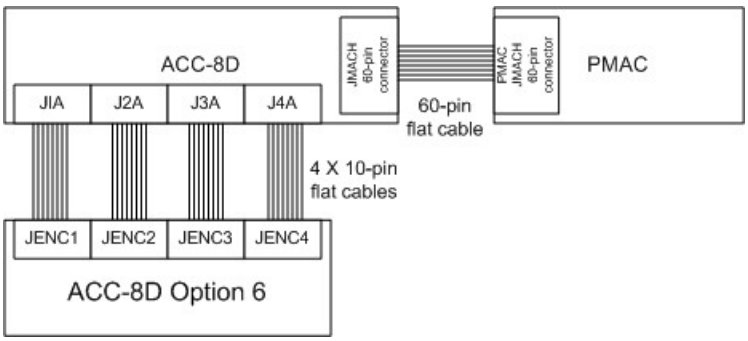
Part Number 602238

Options

Option-A: Rail mount for OPT-6



ACC-8D Option-6



ACC-8D-OPT-7, the Resolver to Digital Converter Board

PMAC's ACC-8D Option-7 (P/N 307-0ACC8D-OPT) is a printed circuit board for resolver-to-digital conversion. This board provides up to four channels of resolver inputs to the PMAC controller. The inputs may be used as feedback or master reference signals for the PMAC servo loops. The basic configuration of the board contains two 12-bit fixed resolution tracking resolver-to-digital (R-to-D) converters. Option-A adds another two converters and Option-B provides a rail mount stand. ACC-8D Option-7 can interface to most industry standard resolvers. Typical resolvers requiring 5 to 10 kHz excitation frequencies with voltages ranging from 5 to 10V peak-to-peak are compatible with this PMAC accessory. Provisions are made for three on-board generated excitation signals (2.44, 4.88 and 9.76 kHz). In addition, the user may choose to bring into the board an external excitation input. Adjustment pots are provided so that, depending on a particular resolver's rotor to stator winding ratio, the sine and the cosine signals' magnitude are optimized for R-to-D conversion (5V peak-to-peak). For the standard single stage resolvers, up to four R-to-D converters (one ACC-8D Option-7 with Option-A) may be interfaced to the basic 4-axis PMAC controller. All versions of PMAC with Option-1 can handle eight R-to-D converters (two ACC-8D Option-7 with Option-A). For PMAC VME and PMAC PC, using the Axis Expansion accessory (ACC-24), eight additional channels (16 in total) of R-to-D converters may be interfaced to a single PMAC (up to four ACC-8D Option-7s with Option-A). For geared resolvers, up to three R-to-D converters may be used for each feedback channel of PMAC. This means that up to 48 R-to-D converters (3*16) can be connected to a single 8-axis PMAC supported by an eight-channel Axis Expansion board (ACC-24 with Option-1). The optional JTHW connection provides PMAC with absolute information on power-up that is often obtained from geared resolver devices. If the absolute reading is not needed, the ACC-8D Option-7 simply provides an incremental quadrature encoder feedback information.

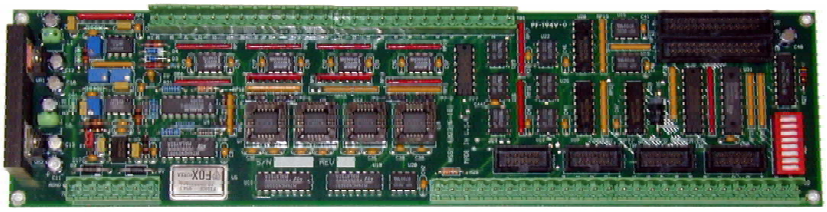
Note:

3-phase synchros are not compatible with this accessory.

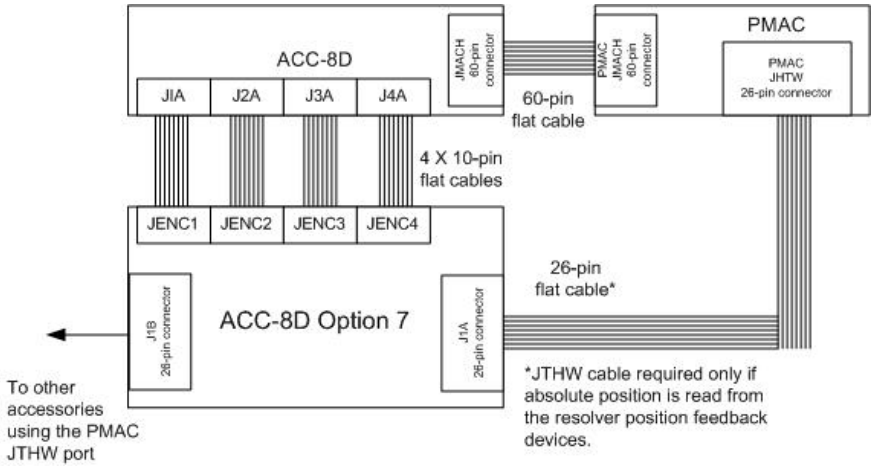
Part Number 602326

Options

- Option-A: Two additional channels (4 total) with 2 10-pin, 40-cm (16") cables
- Option-B: Rail mount



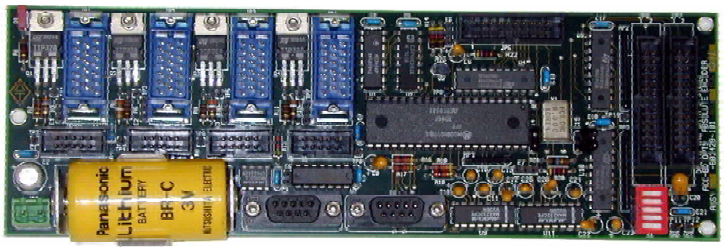
ACC-8D Option-7



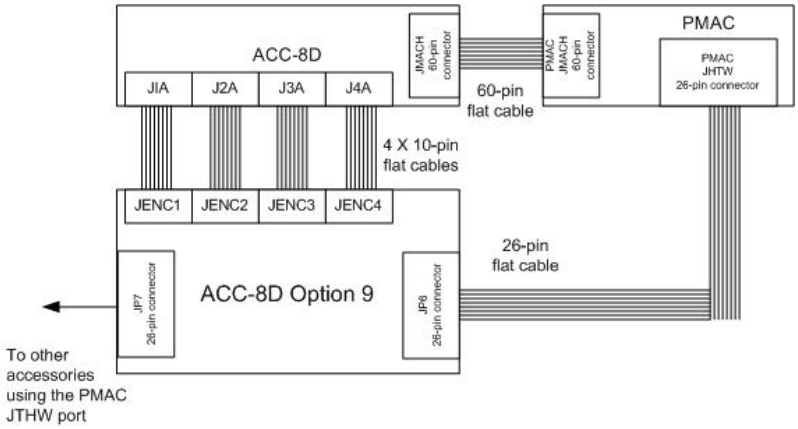
ACC-8D-OPT-9, Yaskawa Absolute Encoder Converter Board

PMAC's ACC-8D Option-9 (P/N 309-0ACC8D-OPT9) allows a PMAC interface to the Yaskawa absolute encoder. This board provides up to four channels of absolute encoder inputs to the PMAC controller with both A/B quadrature incremental encoder signal feedback, as well as absolute position data. To prevent data from being lost in the case of power loss or power off conditions, a 3V battery is included on the board with a monitor circuit to provide an indication of any drop in excess of 5%. In addition, there are four jumpers on the board to allow the customer to reset the absolute position value. The encoder has internal counters and memory that count and retain the incremental counts. Upon power up, it sends RS232 data to PMAC representing the absolute position. Operation is then switched automatically to incremental.

Part Number 602429

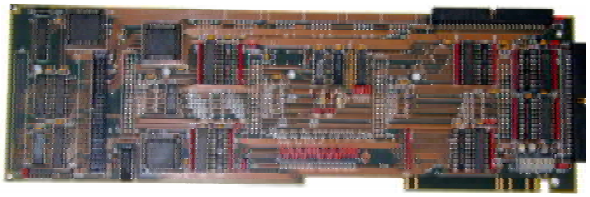


ACC-8D Option-8



ACC-14D/ACC-14P, 48 I/O Expansion Board

PMAC's ACC-14D provides expanded and flexible digital I/O capabilities for the controller. It may be configured for a wide variety of different uses by selecting different voltage levels, sinking/sourcing, and latched/nonlatched I/O to serve many diverse applications. Up to six ACC-14Ds may be connected to a single PMAC at the same time. This extends PMAC's onboard I/O capabilities with a maximum of 288 additional external I/O. The ACC-14D can be installed in the ISA PC bus, and the ACC-14P can be installed in the PCI PC bus. Even if the ACC-14D or ACC-14P does not use the PC bus other than for mechanical support and 5V power supply, it is a convenient method for installing it close to PMAC.



ACC-14D

Part Number 602193

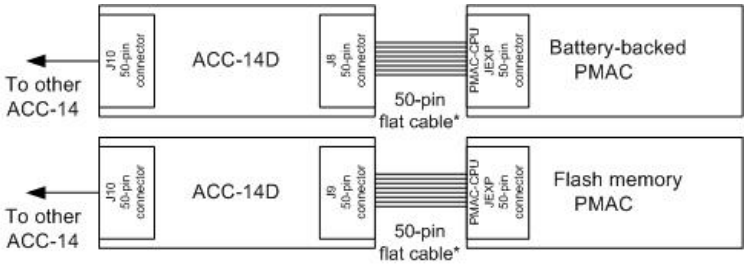
Options

ACC-14D requires an Option-1, 2 or 4

- Option-1: 24 inputs and 24 outputs, TTL levels (0 - 5V), low true
- Option-2: 24 inputs and 24 outputs, 0 - 24V, low true
- Option-4: Custom configuration to be specified by the user. Fill out specification sheet
- Option-7: 20 cm (8") 50-Pin 3-drop connector cable (For use with Acc-14D when PMAC Option-2, ACC-24P or ACC-36P is also used.)

Characteristics

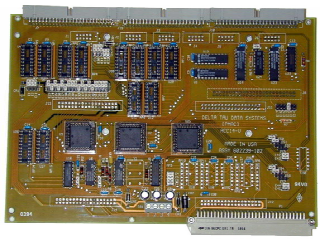
- 48 I/O points per board; up to six boards per PMAC. 100 mA per channel, up to 24V
- Hardware selectable between sinking and sourcing (and totem-pole) in groups of eight; defaults are 5V totem-pole (Option-1; not meant for direct drive – intended for Opto-22 or similar connection) or 24V sinking (Option-2)
- Hardware selectable between inputs and outputs in groups of eight; default is 24 inputs and 24 outputs
- Not opto-isolated; designed for easy connection to Opto-22 (PB24) and similar boards with ACC-21G cable
- Parallel (fast) communications to PMAC through the JEXP port



* If more than one accessory other than the ACC-14 is connected to the PMAC JEXP port, use the 3-connector cable ACC-14 OPT-7.

ACC-14V, 48 I/O Expansion Board

PMAC's ACC-14V is commonly used for parallel feedback (absolute encoders, laser interferometers, and resolvers). Up to six ACC-14Vs may be connected to a single PMAC at the same time, providing up to 12 24-bits parallel feedback inputs. The ACC-14V can be installed in the VME bus. Even if the ACC-14V does not use the VME bus other than for mechanical support and 5V power supply, it is a convenient method for installing it close to PMAC.



ACC-14V

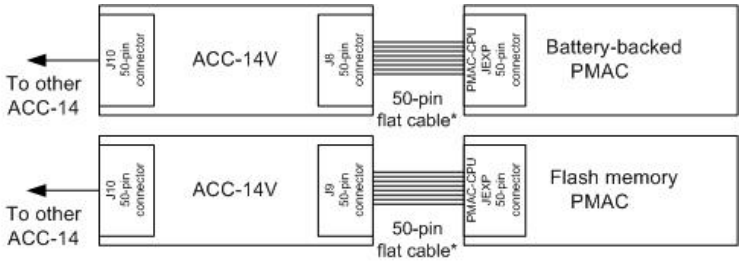
Part Number 602239

Options

- Option-3: 48 inputs, TTL levels (0 - 5V), latching for parallel binary feedback
- Option-6: Dual parallel to quadrature converter (Required if PMAC is to commutate a motor using a parallel feedback device.)
- Option-7: 20cm (8") 50-Pin 3-drop connector cable (For use with Acc-14D/V when PMAC Option-2, ACC-24P or ACC-36P is also used.)

Note:

Each ACC-14V board has 48 bits of input so it may be connected to two parallel feedback devices of up to 24 bits each, or one of over 24 bits.



* If more than one accessory other than the ACC-14 is connected to the PMAC JEXP port, use the 3-connector cable ACC-14 OPT-7.

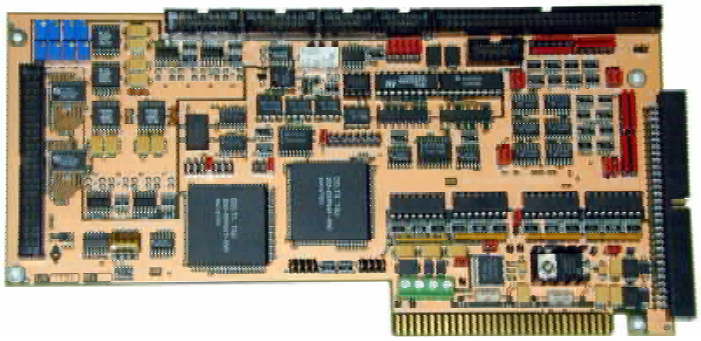
ACC-24P, Axis-Expansion Board

PMAC's ACC-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 Enable, Amplifier Fault, and position Compare-Equal signals). This accessory is intended for those applications that require more than the basic eight channels of the above signals provided on the PMAC baseboard (when used with its Option-1). In particular, PMAC's dual feedback servo capability, or its motor commutation feature for more than four position loops, requires ACC-24. This is because, in 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. This accessory provides the base Turbo PMAC board with extra channels. In a Turbo PMAC board, four ACC-24P boards could be daisy-chained to provide up to 40 channels and be able to control up to 32 motors.

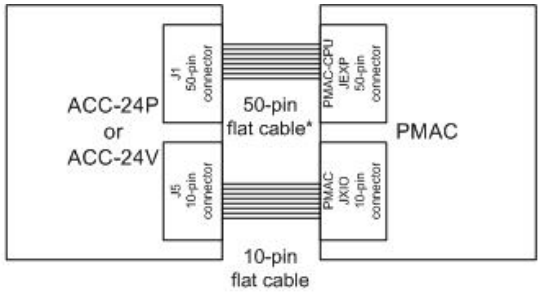
Part Number 602192

Options

- Option-1: Four additional channels
- Option-2: 20-cm (8") 50-Pin 3-drop connector cable. For use with ACC-24P when PMAC Option-2, ACC-14D or ACC-36P are also used.



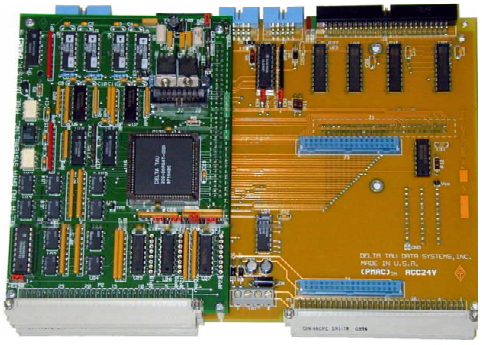
ACC-24P



*If more than one accessory is connected to the PMAC JEXP port, use the 3-connector cable ACC-24 OPT-2.

ACC-24V, Axis-Expansion Board

PMAC's ACC-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 Enable, Amplifier Fault, and position Compare-Equal signals). This accessory is intended for those applications that require more than the basic eight channels of the above signals provided on the PMAC baseboard (when used with its Option-1). In particular, PMAC's dual feedback servo capability, or its motor commutation feature for more than four position loops, requires ACC-24. This is because, in 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. This accessory provides the base Turbo PMAC board with extra channels. In a Turbo PMAC board, four ACC-24V boards could be daisy-chained to provide up to 40 channels and be able to control up to 32 motors.

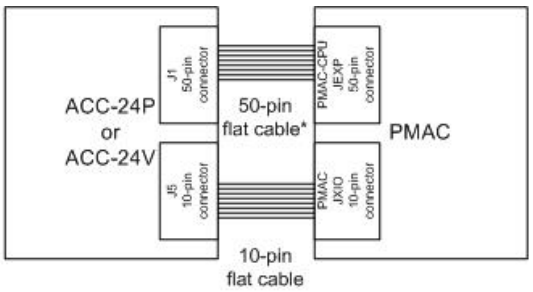


ACC-24V

Part Number 602226

Options

- Option-1: Four additional channels
- Option-2: 20-cm (8") 50-pin 3-connector cable when ACC-36V is used with ACC-24V, or ACC-14V



*If more than one accessory is connected to the PMAC JEXP port, use the 3-connector cable ACC-24 OPT-2.

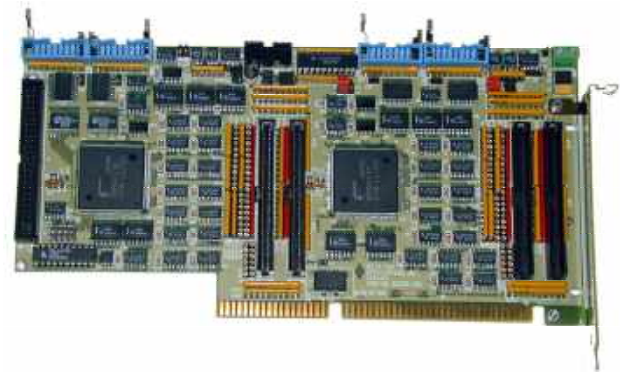
ACC-24P2, Axis-Expansion Board

PMAC's ACC-24P2, the Axis Expansion board provides four or eight additional channels of quadrature encoder inputs, servo command outputs, data lines for analog inputs, and motor related flags (Limits, Home Flags, Amplifier Enable, Amplifier Fault, and position Compare-Equal signals). This accessory is intended for those applications that require more than the basic eight channels of the above signals provided on the PMAC2 baseboard (when used with its Option-1). In particular, PMAC's dual feedback servo capability requires ACC-24. This is because, in the above application, two channels of encoder feedback signals are required for each motor. In a Turbo PMAC board, four ACC-24P2 boards could be daisy-chained to provide up to 40 channels and be able to control up to 32 motors.

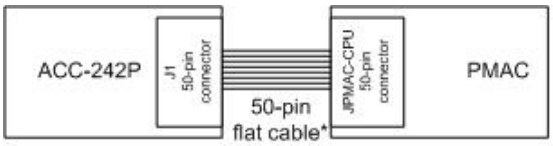
Part Number 603135

Options

- Option-1: Four additional channels
- Option-2: 20-cm (8") 50-Pin 3-drop connector cable. For use with Acc-14D/V when PMAC Option-2, ACC-24P, or ACC-36P is also used.



ACC-24P2



* If more than one accessory is connected to the PMAC JEXP port, use the 3-connector cable ACC-24 OPT-2.

ACC-39 PMAC Handwheel Encoder Interface Board

PMAC's ACC-39 is a small printed circuit board designed for the purpose of interfacing the PMAC controller with a hand wheel or a slow time base encoder. ACC-39 provides a cost effective solution for PMAC applications in which the four or the eight standard high speed encoder decode circuits on PMAC's DSPGATES are used already and yet there is an additional need for just one hand wheel encoder input. This accessory accepts one pair of A QUAD B encoder signals. The maximum rate is approximately 31 A/B square waves per servo cycle. With PMAC's default servo frequency of 2.262 KHz this translates to a maximum encoder line rate of 62.5 KHz. The x4 circuitry provides a maximum of 250,000 counts per second at this servo frequency. The x4 circuitry is fixed in hardware and cannot be changed. In addition, in contrast to the standard high-speed encoder circuits of PMAC, this accessory board does not allow software programmability for direction selection (to switch direction one must physically exchange the input from the encoder A signal with the input from encoder B signal). Moreover, the 1/T interpolation is not performed, so there may be more quantization noise from the encoder. The extra noise may not be noticeable for master hand wheel following. However, it may have a detectable adverse effect when using the encoder for the time base function. ACC-39 can be interfaced to both single-ended (A & B) and differential line driver encoder inputs (A, A/ & B, B/). In addition, it can also be interfaced to the less popular complementary open collector encoder signals that use A, B, A/ and B/. In this case, the resistor pack RP2 should mounted in the reverse direction from the factory supplied default setting.

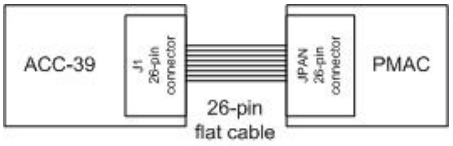
Note:

ACC-39 interfaces to PMAC through PMAC's front panel port (JPAN) via the supplied 26-pin flat cable. When this accessory is installed, then the normal PMAC panel functions cannot be used at the same time (I2 should be set to 1 or 3). In addition, when connecting this cable to PMAC, make sure that it is the JPAN (J2) header and not the JTHW (J3) header to which the cable is connected. Connecting the cable to JTHW will damage the cable. Since the PMAC Mini or the PMAC2 boards lack the JPAN connector, this accessory is not compatible with the PMAC Mini or the PMAC2 boards.

Part Number 602378



ACC-39



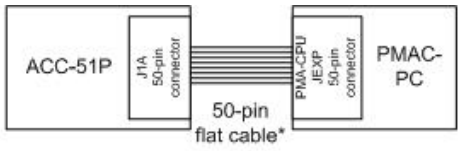
ACC-51P, Expansion Port Interpolator Accessory

Delta Tau's ACC-51P Expansion Port Interpolator is a sine wave input interpolator designed to interface analog quadrature encoders to the PMAC 40Mhz or faster. The ACC-51P is a PCI-style board so it may be mounted in a typical PCI expansion slot. The ACC-51P does not communicate through the PCI bus; the bus is only a convenience for mounting and power supply connections. The Interpolator accepts inputs from two (optionally four) sinusoidal or quasi-sinusoidal encoders and provides encoder position data to the PMAC. This interpolator creates 4,096 steps per sine-wave cycle. The Interpolator can accept either a current-source or a voltage-source signal from the encoder. A jumper selects between 25.3KW input impedance for current-based encoders or 120W input termination for voltage-based encoders. The maximum sine-cycle frequency input is approximately 1.4MHz. When used with a 1000 line sinusoidal rotary encoder, there will be 4,096,000 counts per revolution. The maximum calculated electrical speed of this encoder would be 1,400 RPS or 84,000 RPM, which exceeds the maximum physical speed of most encoders. On a 1000 line encoder that represents electrically up to approximately 5.734 billion steps per second maximum speed.

Part Number 603195



ACC-51P



*If more than one accessory is connected to the PMAC JEXP port, use the 3-connector cable ACC-24 OPT-2.

ACC-70P, Expansion Port Feedback Interface Accessory

Delta Tau's ACC-70P is an Expansion Port feedback interface for FA-CODER type absolute encoders. Data from the Tamagawa-Seiki FA-CODER absolute type encoders is serially transmitted to the ACC-70P board, which then translates it for PMAC position feedback use. The ACC-70P is a PCI-style board so it may be mounted in a typical PCI expansion slot. The ACC-70P does not communicate through the PCI bus; the bus is only a convenience for mounting and power supply connections.

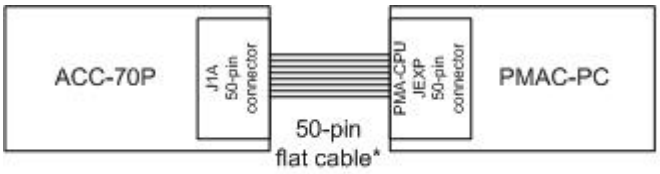
Part Number 3x0-603732-10x

TS5667N420 Encoder Features

- Full absolute signal output
- 17 bit/1 Turn, multi-turn 16-bit (at 6000 rpm max.)
- Two-way serial communication
- Small size
- Serial data transmission
- Fail-check operation
- Even during power outage, Multi-Turn data is backed up by external battery and built-in capacitor.



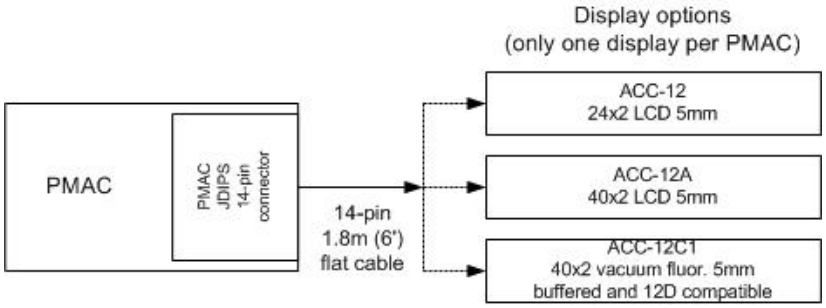
ACC-70P



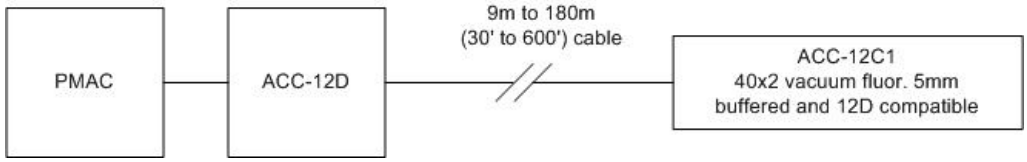
*If more than one accessory is connected to the PMAC JEXP port, use the 3-connector cable ACC-24 OPT-2.

DISPLAY ACCESSORIES

Display options when the distance between PMAC and the display is up to 1.8 m (6'):



Display options when the distance between PMAC and the display is up to 180 m (600'):



ACC-12A, Display 40x2 LCD Alphanumeric 5 mm High

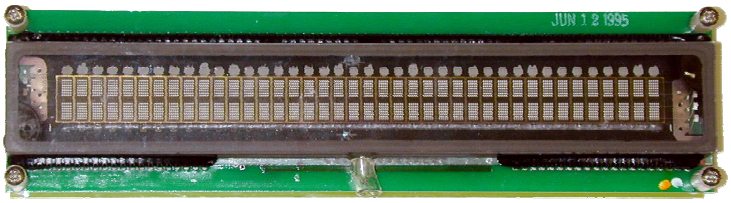


Part Number ACC-12A A59130

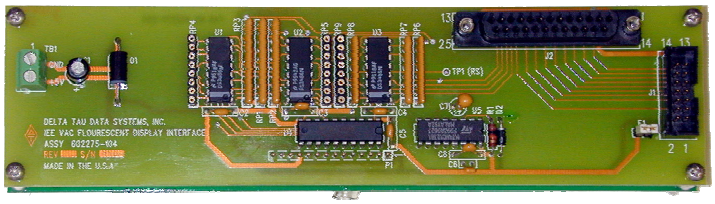
ACC-12C1, 40x2 Vacuum Fluorescent Display

PMAC's ACC-12C1 is a 2x40 character Vacuum Fluorescent Display unit which interfaces to all versions of PMAC via a 14-pin Display Connector J1 (JDISP). This accessory is assembled from two separate boards: the Vacuum Fluorescent board (manufactured by IEE Inc.) and the bottom adapter board (manufactured by Delta Tau, Inc.). The package includes a 6' long 14-pin flat cable for connection to PMAC's J1 connector and a bezel with a mounted glass filter. ACC-12C1 is compatible with ACC-12D, the long-distance display signal drive module.

Part Number ACC-12C1 602275



ACC-12C1



ACC-12C1 Back View

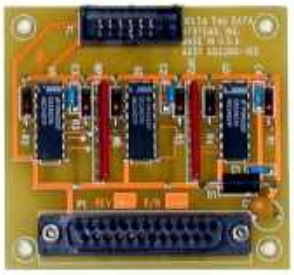
ACC-12D, Display Port Transmitter

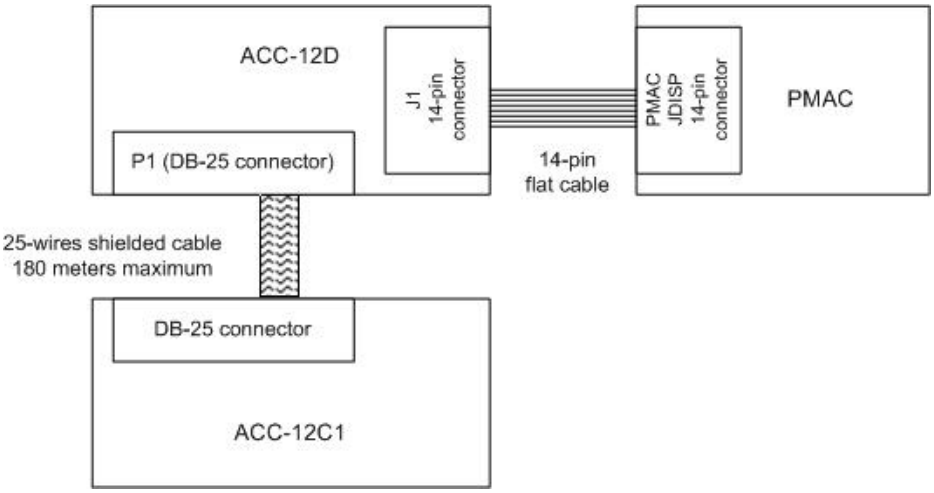
PMAC's ACC-12D is a small printed circuit board whose function is to buffer and transmit PMAC's JDISP signals differentially to the PMAC remote display ACC-12C1. ACC-12D should be used in conjunction with ACC-12C1 whenever they are physically situated a long distance (up to 600 feet) away from PMAC. For distances less than six feet, ACC-12D usually is not required. A 14-pin flat cable is provided for the connection of ACC-12D (via its J1 header) to PMAC's JDISP (J1). The buffered J1 signals are transmitted differentially via the DB-25 connector (P1) to the remote display. The cable for this connection is not provided and should be made using twisted pair shielded wires. Typically, the 5V power supply for the ACC-12D's onboard circuits is brought in through J1 from PMAC via its JDISP. If ordered with Option-1**,** ACC-12D is supplied on a DIN rail mount.

Part Number ACC-12D: 602395

Options

Option-1: DIN rail mount





MISCELLANEOUS ACCESSORIES

ACC-1, 5V Power Supplies and Batteries

These power supplies are needed only for stand-alone applications of the PMAC, when the cards are not getting their +5V supply from the bus. The version of this accessory is selected by capacity:

- ACC-1L is a replacement battery for the RAM on older PMAC PC or PMAC VME CPU boards. It is a 3V lithium battery, 1200 mAh, 2/3A-size, and no tabs.
- ACC-1LS is a replacement battery for the RAM on PMAC-Lite and newer PMAC PC and PMAC VME boards. It is a 3.6V lithium battery, 1000 mAh, 1.15" diameter can.

ACC-2, ±15V Power Supplies

These power supplies provide +/- 15V to the analog output stage of PMAC, which is optically isolated from the digital 5V circuitry. This accessory has the following versions:

- ACC-2A: +/-15V, +5V for 1 PMAC (16W rating)
- ACC-2B: +/-15V, +5V for 2 PMACs (40W rating)

ACC-3, Serial Communications Cable

These series of accessories are a three-meter (ten-foot) flat cable with either a DB-25 or DB-9 connector on one end (for connection to the host computer) and either an IDC 26-pin or an IDC 10-pin connector on the other end (for connection to PMAC's serial port). It is not to be purchased if ACC-26 serial-communications converter card is purchased. Multi-drop versions of the cable are available for daisy-chained PMAC systems:

- ACC-3D: Single-drop 3-meter DB-25 to IDC-26 flat cable (PC/VME)
- ACC-3E: One additional PMAC "drop" on ACC-3D
- ACC-3L: Single-drop 3-meter DB-9 to IDC-10 flat cable (Lite)
  - ACC-3L-Option-1: Adapter for 3L cable: male DB9 connector to female DB25 connector

ACC-6, Handwheel Encoder

This is a Hewlett-Packard HEDS-7501 rotary pulse generator or handwheel encoder with 256 lines per revolution. A six-foot flat cable is provided with the encoder. PMAC ACC-8D has matching sockets for this cable.

ACC-21, Cables from PMAC to OPTO-22 Type Boards

Accessory 21 is a family of cables for connection to the J5 (JOPT) connector on PMAC. Many will purchase OPTO-22 boards and connect it to PMAC with an ACC-21 cable from Delta Tau.

- ACC-21F: 180 cm (6') 50-pin card edge to 34-pin IDC header cable for connecting PMAC JOPTO connector to PB8/16/24 or equivalent boards
- ACC-21FH: 180 cm (6') 50-pin IDC header to 34-pin IDC header cable for connecting PMAC JOPTO connector to PB8/16/24H or equivalent boards
- ACC-21G: 180 cm (6') 50-pin card edge to 50-pin IDC header cable for connecting ACC-14D/V and ACC-34B to PB8/16/24 or equivalent boards
- ACC-21GH: 180 cm (6') 50-pin IDC header to 50-pin IDC header cable for connecting ACC-14D/V and ACC-34B to PB8/16/24H or equivalent boards

ACC-31, PMAC(1) Demobox

Accessory 31 is used to demonstrate PMAC's numerous motion control features. This accessory is a useful tool for PMAC-based program development and verifications by OEMs. Internally the unit consists of a ±15V and +5V DC power supply, four or eight DC motors with HP 500-line encoders, four or eight motor amplifiers, an optional PMAC board, and the necessary wiring to external connectors. It also includes a control front panel and switches in the form of PMAC's ACC-16D to allow for input and output display independent of a host computer.

This accessory is dedicated for PMAC(1) type boards only.

Miscellaneous Accessories and Cables

- ACC-22: Extended warranty to two years from data of purchase
- ACC-32: PMAC operating software upgrade/update kit includes EPROM or flash file, executive diskette and manuals
  - Option-1: Additional EPROM
- ACC-40: On-site field service/training; two day (16 hr) minimum, plus lodging, travel cost and time
- ACC-42PB: MACRO interface board for PC Bus and JEXP port (Requires Option-1 or 2 and A or C)
  - Option-A: Fiber optic interface
  - Option-C: RJ-45 cable interface
  - Option-1: PMAC JEXP connector for use with PMAC (1) board
  - Option-2: ISA Bus Interface (for direct PC use, no PMAC)
  - Option-3A: 1.5m (5ft) terminated glass optical fiber cable
  - Option-3B: 5m (15ft) terminated glass optical fiber cable
  - Option-3C: 8m (25ft) terminated glass optical fiber cable
  - Option-3D: Custom-length terminated glass optical fiber cable
- ACC-8D-OPT-P: 40 cm (16") cable with 60-pin IDC connector
- ACC-8D-OPT-V: 40 cm (16") cable with 96-pin DIN connector
- OPT-2-OPT-A: 50-pin 3 connector cable when more than one of these are used: OPT- 2, ACC-14, 24, 29 or 36
- JTHW Daisy-chain cable: 4 x 36-pin connectors spaced at 10” intervals (Order Number: 402-727-5010)

ACC-26A, Serial Communication Optical-Isolation/Adapter Board

PMAC’s ACC-26A is a serial communication optical isolation board for all versions of PMAC. The ACC-26A Option-1 can be used for optical isolation of the host computer’s RS-232 to PMAC's RS-422 connector J4 (this is suitable for the PMAC PC, PMAC VME, and PMAC LITE).

ACC-26A Option-2 is suitable for the Mini-PMAC. Option-2 simply acts as an optical isolation board between the host’s RS-232 and the PMAC’s RS-232 connectors.

ACC-26A Option-3 provides, through its J5 (JGEF) connector, optical isolation of the serial communication link between a host computer and the GE-FANUC series 90-70 PLC.

ACC-26A Option-4 may be used for Delta Tau’s other motion control cards (SMCC and MCC). T he board comes with a standard DIN-rail mounting system, or the four corner holes can be used to mount the board with standoffs. Both DB-9 and DB-25 connectors are provided for host connection.

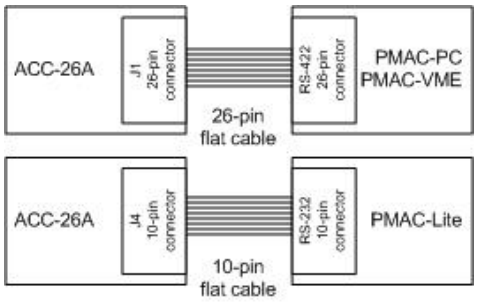
Part Number 602213

Options

- Option-1: Host RS-232 to PMAC RS-422, w/26-pin 60-cm (24") cable
- Option-2: RS232 to RS232 optical isolation w/10 pin 24" cable
- Option-3: RS232 to RS422, (GE Fanuc Series 90-70 PLC)



ACC-26A


ACC-26A
J1
26-pin
connector
RS-422
26-pin
connector
PMAC-PC
PMAC-VME
26-pin
flat cable
ACC-26A
J4
10-pin
connector
RS-232
10-pin
connector
PMAC-Lite
10-pin
flat cable

QMAC SYSTEM

The QMAC is a 4-axis Turbo PMAC2 motion controller conveniently packaged in a 100 mm wide by 250 mm high by 175 mm deep enclosure. It can control up to four axes with analog ±10V, digital PWM, or pulse and direction amplifier command signals. The QMAC can be used stand-alone or commanded by a host computer with its RS-232 serial port or the optional USB or Ethernet communication methods.



Part Number 500-603506-10x

Number of Channels

The base version without options provides four channels axis interface circuitry, each including:

- Differential pulse and direction command outputs
- Differential/single-ended encoder input with A, B quadrature channels and C index channel
- Five input flags at 5-24VDC levels: amplifier fault, two end-of-travel limits, home flag and user flag
- Four extra input flags when pulse and direction outputs are not used: T, U, V and W lines at TTL levels
- One amplifier enable output flag through a relay contact

The base version without options also provides an interface circuitry with DB-25 connector for two supplemental channels, each including:

- 2-channel differential/single-ended encoder input
- One output command signal set, configurable as either pulse-&-direction or PWM top-and-bottom pair

OPT-A (301-603506-OPT): Analog amplifier interface for channels 1 to 4. OPT-A provides the analog circuitry and connectors for each of the four QMAC channels. This option is necessary to control amplifiers that require a single ±10V DAC command signal.

OPT-A1 (3A1-603506-OPT): Second Analog output for channels 1 to 4. OPT-A1 provides a second ±10V DAC output per each of the analog channels that are ordered through the OPT-A. This option is necessary for those amplifiers that require two analog ±10V DAC command signals or that require sinusoidal commutation. This option requires OPT-A.

OPT-B (30B-603505-OPT): Direct PWM for channels 1 to 4. OPT-B provides the circuitry and connectors for digital amplifiers that require direct PWM digital command signals. OPT-B can still be ordered if OPT-A is ordered, which allows controlling both digital and analog amplifiers with the same QMAC system.

CPU and Memory

The QMAC is provided with an 80 MHz DSP56303 CPU (120 MHz PMAC equivalent) and the following memory types:

- 128k x 24 SRAM compiled/assembled program memory
- 128k x 24 SRAM user data memory
- 1M x 8 flash memory for user backup and firmware

OPT-5C0 (5C0-0TURBO-OPT): This is the standard CPU and memory configuration. It is provided automatically if no option-5xx is specified. It provides an 80 MHz CPU (120 MHz PMAC equivalent), 128k x24 of compiled/assembled program memory, 128k x 24 of user data memory and a 1M x 8 flash memory.

OPT-5C3 (5C3-0TURBO-OPT): This option provides an 80 MHz CPU with an expanded 512k x 24 of compiled/assembled program memory, an expanded 512k x 24 of user data memory, and a 4M x 8 flash memory.

Communications

The QMAC can communicate through the RS-232 serial interface using the optional ACC-3L flat cable. All communication ports in a QMAC are independent of each other allowing multiple devices communicating with it at any given time.

OPT-2 (302-603506-OPT): This option provides the high-speed USB communications interface, which is a faster method of communication than the standard RS-232 QMAC communications port. The USB is the QMAC bus format much like the PCI is the bus format for the PMAC-PCI board. This option is not compatible with OPT-2A.

OPT-2A (3A2-603506-OPT): This option provides the high-speed Ethernet communications interface, which is a faster method of communication than the standard RS-232 QMAC communications port. This option is not compatible with OPT-2.

OPT-2B (3B2-603506-OPT): Dual-Ported RAM for USB or Ethernet Interface. The dual-ported RAM provides a method of sharing memory between QMAC and the host computer for fast interchange of data. This option requires OPT-2 or OPT-2A.

Firmware Version

QMAC is provided with the newest released firmware version.

OPT-10 (310-0PMAC2-OPT): With this option, an older version of on-board firmware can be ordered. This is important in cases where the new QMAC is a replacement in an already existing machine or is installed in a new machine using the existing programs. When possible, use the same firmware revision for similar machines.

Miscellaneous

The following ports are provided standard in any QMAC:

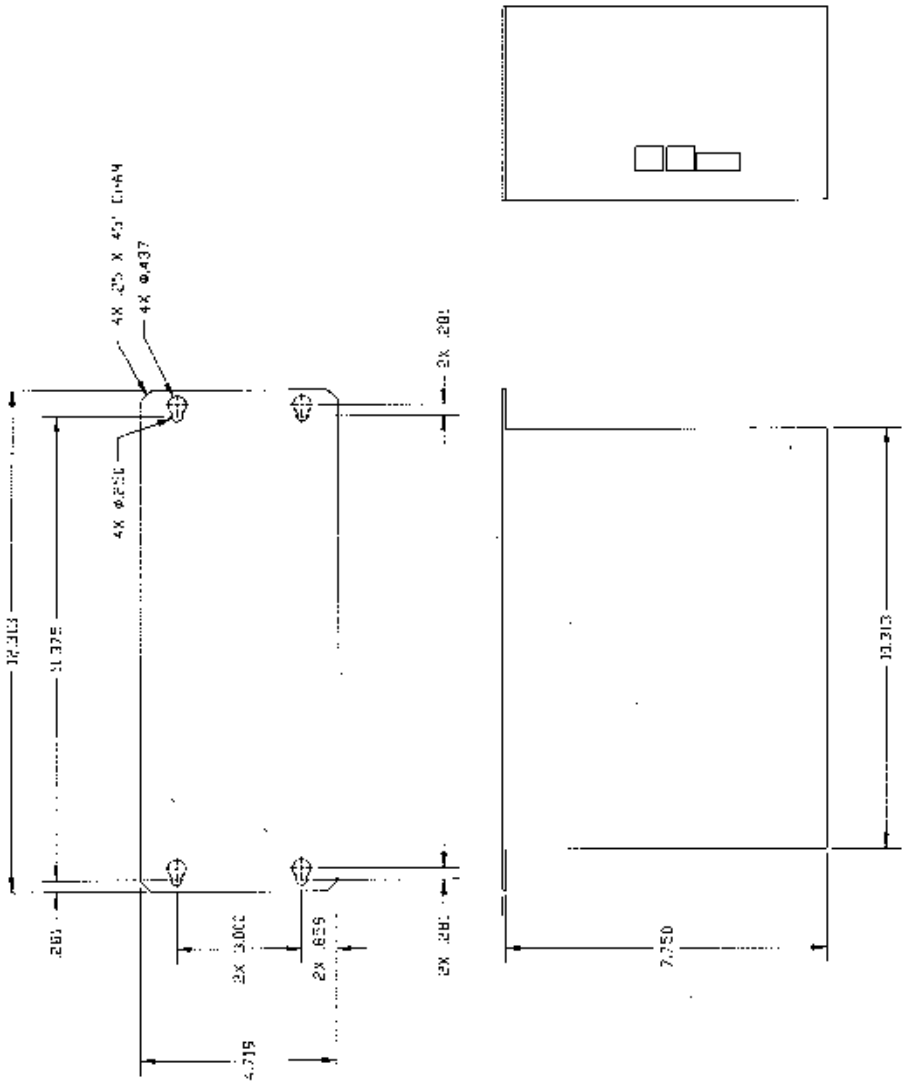
- Display port for the connection to a vacuum fluorescent or liquid crystal display
- I/O port: This port provides sixteen general-purpose 5 to 24V sinking or sourcing digital inputs and eight general-purpose sourcing digital outputs at 5 to 24VDC levels and a maximum of 250 mA per output.
- Multiplexer port provides eight input lines and eight output lines at TTL levels. When using the PMAC ACC-34x type boards, these lines allow multiplexing up to 1024 I/O lines on the port.

All options to the QMAC system must be installed in the factory. Therefore, it is important to order all the necessary options at the time when QMAC system is ordered.

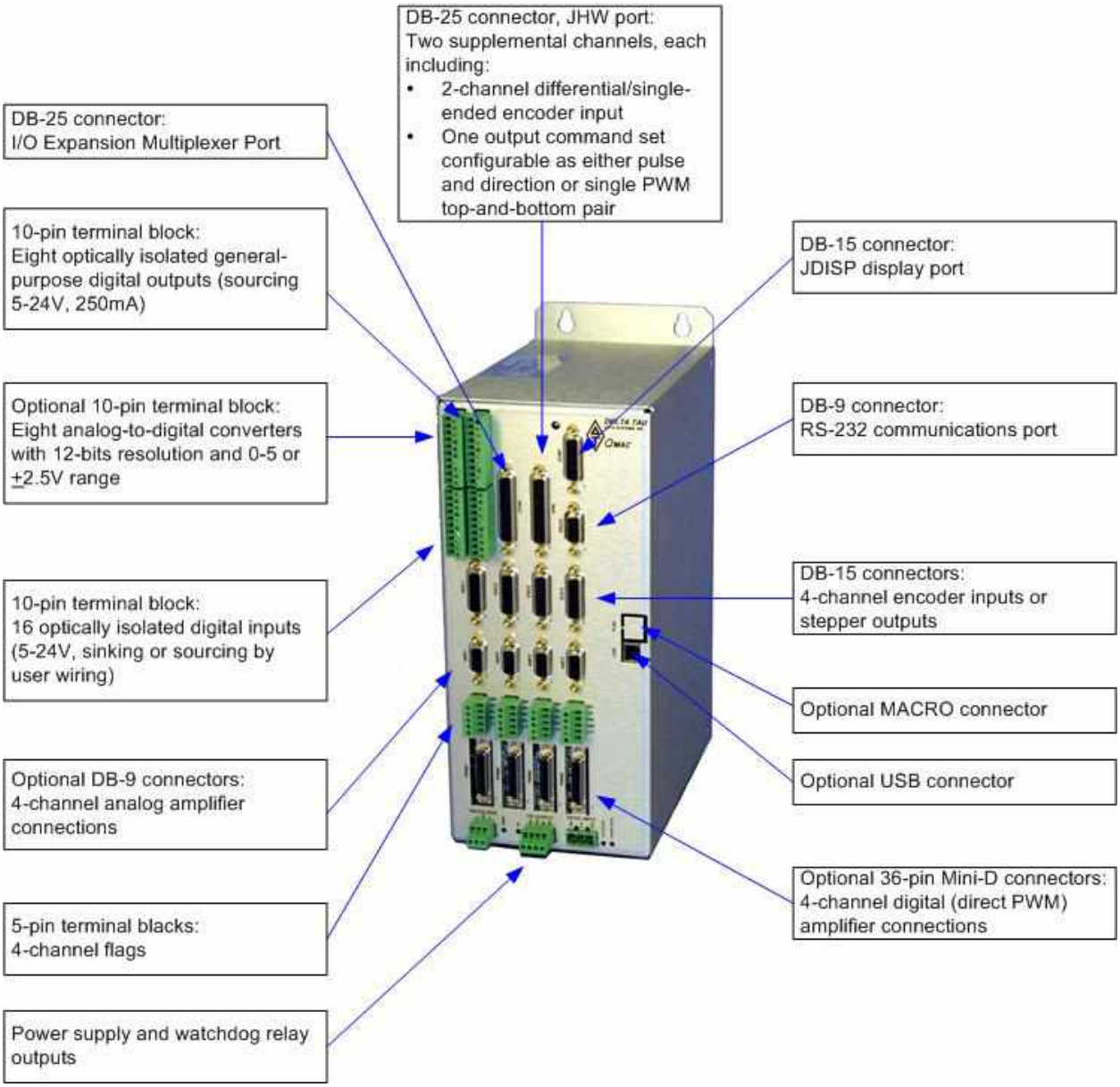
- OPT-3A (30A-603506-OPT): This option provides the MACRO ring interface with RJ-45 type connectors. This option allows QMAC to interface with any MACRO compatible device for servo axes or I/O expansion.
- OPT-3B (30B-603506-OPT): This option provides the MACRO ring interface with both fiber optics and RJ-45 type connectors. This option allows QMAC to interface with any MACRO compatible device for servo axes or I/O expansion.
- OPT-3C (30C-603506-OPT): This option provides the MACRO ring interface with fiber optics type connectors. This option allows QMAC to interface with any MACRO compatible device for servo axes or I/O expansion.
- OPT-7 (30C-603506-OPT): This option provides the Field Bus interface for the QMAC. If this option is ordered, one of the following options must be ordered as well: OPT-7A1, OPT-7A2, OPT-7B1 or OPT-7B2.
- OPT-7A1 (10M-DEVICE-NET): This option provides the DeviceNet Master interface for the QMAC.

- OPT-7A2 (10S-DEVICE-NET): This option provides the DeviceNet Slave interface for the QMAC.
- OPT-7B1 (10M-PROFIB-000): This option provides the Profibus Master interface for the QMAC.
- OPT-7B2 (10S-PROFIB-000): This option provides the Profibus Slave interface for the QMAC.
- OPT-8A (3A8-603506-OPT): The standard clock crystal in QMAC has ± 100 ppm accuracy. With this option, a high-accuracy clock crystal (± 15 ppm) is installed instead. This option is required only for an accurate synchronization and velocity accuracy for long-term applications. Generally, this will be noticeable only if a continuous move sequence lasts more than ten minutes.
- OPT-12 (312-603506-OPT): With this option, extra components are added in the QMAC system to provide eight analog-to-digital converters with 12-bits resolution and 0-5 or ±2. 5V range. Typically, this option is used for reading analog sensors but usually it is not used for implementing servo axes with analog feedback devices.
- OPT-16A (316-A03506-OPT): 32Kx24 SRAM battery-backed parameter memory. This option is necessary when machine parameters like parts counters or state variables are required to keep their values automatically during a power-up\reset cycle.
- OPT-18A (318-603506-OPT): This option provides an electronic board identification number module, allowing a host computer program to identify the QMAC system that is communicating with.

QMAC Dimensions



QMAC Connectors Layout



EXAMPLE PROGRAMS

This section illustrates the software capabilities of the non-Turbo PMAC(1) family of motion controllers. Most of the software features illustrated in these examples can be ported to other PMAC type families. Other PMAC families include non-Turbo PMAC2, Turbo PMAC(1) and Turbo PMAC2.

Example 1: A Simple Move

This example shows how to program a simple move on the PMAC. First, the program specifies how to do the move, and then commands the move.

Set-up and Definitions

```
&1                      ; Coordinate System 1
CLOSE                   ; Make sure all buffers are closed
#1->X                   ; Assign motor 1 to the X-axis - 1 program unit
                        ; of X is 1 encoder count of motor #1
```

Motion Program Text

```
OPEN PROG 1             ; Open buffer for program entry, Program #1
CLEAR                   ; Erase existing contents of buffer
LINEAR                  ; Blended linear interpolation move mode
ABS                     ; Absolute mode - moves specified by position
TA500                   ; Set 1/2 sec (500 msec) acceleration time
TS0                     ; Set no S-curve acceleration time
F5000                   ; Set feedrate (speed) of 5000 units (cts)/sec
X10000                  ; Move X-axis to position 10000
DWELL500                ; Stay in position for 1/2 sec (500 msec)
X0                      ; Move X-axis to position 0
CLOSE                   ; Close buffer - end of program
```

To run this program:

```
&1 B1 R                 ; Coordinate System 1, point to Beginning of
                        ; Program 1, Run
```

Example 2: A Complex Move

This example introduces incremental and time-specification of moves, looping logic, using variables, scaling of axes, and simple arithmetic. Note that logical and mathematical operations do not delay moves.

Set-up and Definitions

```
&2                      ; Coordinate system 2
                        ; NOTE: No motor can be simultaneously defined
                        ; in more than one coordinate system
CLOSE                   ; Make sure all buffers are closed
#5->1000X               ; 1 unit (cm) of X is 1000 counts of motor 5
```

Motion Program Text

```
OPEN PROG 2             ; Open buffer for entry, Program #2
CLEAR                   ; Erase existing contents of buffer
LINEAR                  ; Blended linear interpolation move mode
INC                     ; Incremental mode - moves specified by distance
TA500                   ; 1/2 sec (500 msec) acceleration time
TS250                   ; 1/4 sec in each half of S-curve
P1=0                    ; Initialize a loop counter variable
WHILE (P1<10)           ; Loop until condition is false (10 times)
  X10                   ; Move X-axis 10 cm (=10,000 cts) positive
  DWELL500              ; Hold position for 1/2 sec
  X-10                  ; Move X-axis back 10 cm negative
  DWELL500              ; Hold position for 1/2 sec
  P1=P1+1               ; Increment loop counter
ENDWHILE                ; End of loop
```

```
CLOSE                    ; Close buffer - end of program
```

To run this program:

```
&2 B2 R                  ; Coordinate System 2, point to Beginning of
                         ; Program 2, Run
```

Example 3: Conditional Branching

This program introduces conditional branching, calculated move distances, home finding, and I/O addressing.

Set-up and Definitions

```
CLOSE                    ; Make sure all buffers are closed
&1                       ; Coordinate System 1
#2->27.77777778A         ; A-axis is programmed in degrees
                         ; 10,000 (cts/rev) / 360 (deg/rev)
M1->Y:$FFC2,8,1          ; Variable M1 assigned to Machine Output 1
M11->Y:$FFC2,0,1         ; Variable M11 assigned to Machine Input 1
I190=60000               ; Feedrate (speed) units are per minute
                         ; (1 min=60000 msec)
```

Motion Program Text

```
OPEN PROG 3 CLEAR        ; Prepare buffer for entry
HOME2                    ; Find home position for motor
LINEAR                   ; Blended linear interpolation move mode
F20                      ; Speed of 20 degrees per minute
Q50=0                    ; Initialize a loop counter variable
WHILE (Q50<36)           ; Loop until condition is false (36 times)
  IF (M11=1)             ; Machine Input 1 on?
    A((Q50+1)*10)        ; Positive move to calculated position
  ELSE                   ; Do the following branch for false IF
    A(-(Q50+1)*10)       ; Negative move to calculated position
  ENDIF
  DWELL20                ; Hold position for 20 msec
  M1=1 M1=0              ; Pulse output on and off quickly
  DWELL20                ; Hold position for 20 msec
  A0                     ; Return to home position
  Q50=Q50+1              ; Increment loop counter
ENDWHILE                 ; End of loop
CLOSE                    ; Close buffer - end of program
```

To run this program:

```
&1 B3 R                  ; Coordinate System 1, point to Beginning of
                         ; Program 3, Run
```

Example 4: Linear and Circular Interpolation

This example introduces linear and circular interpolation in a Cartesian X-Y application

Set-up and Definitions

```
CLOSE                    ; Make sure all buffers are closed
&1                       ; Coordinate System 1
#3->10000X               ; Use motor 3 for X-axis
#4->10000Y               ; Use motor 4 for Y-axis
```

Motion Program Text for Rotary Axis

```
OPEN PROG 4 CLEAR        ; Prepare buffer for entry
RAPID X1 Y4              ; Fast move to starting point
F500                     ; Speed for linear and circular moves
LINEAR Y13               ; Straight move
CIRCLE1 X2 Y14 I1 J0     ; CW arc
LINEAR X3                ; Straight move
CIRCLE1 X4 Y13 I0 J-1    ; CW arc
```

```
LINEAR Y7                    ; Straight move
CIRCLE1 X7 Y4 I3 J0          ; CCW arc
LINEAR X13                   ; Straight move
CIRCLE1 X14 Y3 I0 J-1        ; CW arc
LINEAR Y2                    ; Straight move
CIRCLE1 X13 Y1 I-1 J0        ; CW arc
LINEAR X4                    ; Straight move
CIRCLE1 X1 Y4 I0 J3          ; CW arc
DWELL100                     ; Hold 100 ms
RAPID X0 Y0                  ; Return home
CLOSE
```

To run this program:

```
&1 B4 R                      ; Coordinate System 1, point to Beginning of
                             ; Program 4, Run
```

Example 5: G-Code Program

This is a simple example of a PMAC G-Code program. `Gxx` is interpreted as a call to label `Nxx000` of `PROG 1000` (below). Mxx is interpreted as a call to label `Nxx000` of `PROG 1001` (bottom). Far more extensive codes are possible; standard forms of the common codes are provided on diskette.

Part Program Text

Note:

The part program does not need to know how the G-codes and M-codes are executed.

```
OPEN PROG 5 CLEAR            ; Prepare motion program 5 for entry
G17 G90                      ; XY plane, absolute move spec
G97 S1800                    ; Set spindle speed of 1800 rpm
F500                         ; Cutting speed 500 mm/min
G00 X10.00 Y5.00             ; Rapid move to (10, 5)
M03                          ; Start spindle
G04 P2.0 ; Wait 2 seconds
G01 Z0                       ; Lower cutter
X30.25 Y5.00                 ; Linear XY move
G03 X35.25 Y10.00 J5         ; CCW arc move
G01 X35.25 Y50.10            ; Linear move
G03 X30.25 Y55.10 I-5        ; CCW arc move
G01 X10.00 Y55.10            ; Linear move
G03 X5.00 Y50.10 J-5         ; CCW arc move
G01 X5.00 Y10.00             ; Linear move
G03 X10.00 Y5.00 I5          ; CCW arc move
G01 Z5 M05                   ; Cutter up, stop
G00 X0 Y0                    ; Back to home
CLOSE
```

Note:

Motion program 1000 contains the G-Code subroutines.

```
OPEN PROG 1000 CLEAR         ; Prepare buffer 1000 for entry
RAPID RETURN                 ; G00 Rapid mode (N0 is implied)
N01000 LINEAR RETURN         ; G01 Linear interpolation mode
N02000 CIRCLE1 RETURN        ; G02 Clockwise circle mode
N03000 CIRCLE2 RETURN        ; G03 Counterclockwise circle mode
N04000 READ(P)               ; G04 Dwell for P seconds
IF (Q100 & 32768 > 0)        ; P parameter specified?
  DWELL (Q116*1000)          ; PMAC specifies dwell time in msec
```

```
ENDIF
RETURN
N17000 NORMAL K-1 RET          ; G17 Specify XY plane
N18000 NORMAL J-1 RET          ; G18 Specify ZX plane
N19000 NORMAL I-1 RET          ; G19 Specify YZ plane
N90000 ABS RET                 ; G90 Absolute mode
N91000 INC RET                 ; G91 Incremental mode
N97000 READ(S)                 ; G97 Spindle speed set
IF (Q100 & 262144 > 0)         ; S parameter specified?
  I422=Q119/30                 ; #4 jog speed in cts/msec
ENDIF
RETURN
CLOSE
```

Note:

Motion program 1001 contains the M-Code subroutines.

```
OPEN PROG 1001 CLEAR           ; Prepare buffer 1001 for entry
N03000 CMD "#4J+" RET          ; Start spindle clockwise (closed loop)
N04000 CMD "#4J-" RET          ; Start spindle counterclockwise (ditto)
N05000 CMD "#4J/" RET          ; Stop spindle
CLOSE
```

To run this program:

```
&1 B5 R                 ;Coordinate System 1, point to Beginning of
                        ;Program 5, Run
```

Example 6: PLC I/O

These examples show how to use PLC programs with PMAC's general-purpose I/O.

Definitions and Setup

```
CLOSE                          ; To ensure these are on-line
M1->Y:$FFC2,8,1                ; Machine Output 1
M2->Y:$FFC2,9,1                ; Machine Output 2
M3->Y:$FFC2,10,1               ; Machine Output 3
M4->Y:$FFC2,11,1               ; Machine Output 4
M11->Y:$FFC2,0,1               ; Machine Input 1
M12->Y:$FFC2,1,1               ; Machine Input 2
M13->Y:$FFC2,2,1               ; Machine Input 3
M14->Y:$FFC2,3,1               ; Machine Input 4
M20..39->*                     ; Self-referenced flag variables
```

PLC Program

```
CLOSE                          ; Make sure other buffers closed
OPEN PLC 5                     ; Open buffer for editing
CLEAR                          ; Erase existing contents
```

This first branch sets a variable based on the state of Machine Input 1. This variable could be a destination, speed, time, etc.

```
IF (M11=1)                     ; Machine Input 1 true?
   P1000=5000                  ; If so, set to this value
ELSE
   P1000=500                   ; If not set to this value
ENDIF
```

This next branch increments a counter every time Machine Input 2 goes true (edge triggered)

```
IF (M12=1)                     ; Machine Input 2 true?
   IF (M22=0)                  ; Not true last time thru?
      P8=P8+1                  ; Have rise edge, so increment
      M22=1                    ; Note as true for next time thru
```

```
   ENDIF
ELSE                          ; MI2 is not true
   M22=0                      ; Note as not true for next time thru
ENDIF
```

This next branch sets an output only if all four of a set of flag variables are true

```
IF (M23=1 AND M24=1)          ; First two flags true?
AND (M25=1 AND M26=1)         ; Second two flags true?
   M1=1                       ; Then set output
ELSE
   M1=0                       ; Otherwise clear output
ENDIF
CLOSE                         ; Close the buffer
ENABLE PLC 5                  ; Enable operation of program
```

Example 7: Jogging Motors from A PLC Program

This program shows how to use the thumbwheel input lines to create jog switches that are dedicated to a particular motor. Note in particular the use of latching flags so that commands are given only on a change of state of the input line, making them edge-triggered.

Setup and Definitions

```
CLOSE
M50->Y:$FFC1,0                ; Thumbwheel port input bit 0
M51->Y:$FFC1,1                ; Thumbwheel port input bit 1
M52->Y:$FFC1,2                ; Thumbwheel port input bit 2
M53->Y:$FFC1,3                ; Thumbwheel port input bit 3
M60->*                        ; Latching bit for M50
M61->*                        ; Latching bit for M51
M62->*                        ; Latching bit for M52
M63->*                        ; Latching bit for M53
```

PLC Program to Implement Function

```
OPEN PLC 16
CLEAR
IF (M50=1)                    ; Motor 1 jog plus switch on
   IF (M60=0)                 ; But not on last time
      COMMAND"#1J+"           ; Issue command
      M60=1                   ; Set latching flag
   ENDIF
ELSE                          ; Motor 1 jog plus switch off
   IF (M60=1)                 ; But not off last time
      COMMAND"#1J/"           ; Issue stop command
      M60=0                   ; Set latching flag
   ENDIF
ENDIF

IF (M51=1)                    ; Motor 1 jog minus switch on
   IF (M61=0)                 ; But not on last time
      COMMAND"#1J-"           ; Issue command
      M61=1                   ; Set latching flag
   ENDIF
ELSE                          ; Motor 1 jog minus switch off
   IF (M61=1)                 ; But not off last time
      COMMAND"#1J/"           ; Issue stop command
      M61=0                   ; Set latching flag
   ENDIF
ENDIF
```

```
IF (M52=1)                    ; Motor 2 jog plus switch on
   IF (M62=0)                 ; But not on last time
      COMMAND"#2J+"           ; Issue command
      M62=1                   ; Set latching flag
   ENDIF
ELSE                          ; Motor 2 jog plus switch off
   IF (M62=1)                 ; But not off last time
      COMMAND"#2J/"           ; Issue stop command
      M62=0                   ; Set latching flag
   ENDIF
ENDIF

IF (M53=1)                    ; Motor 2 jog minus switch on
   IF (M63=0)                 ; But not on last time
      COMMAND"#2J-"           ; Issue command
      M63=1                   ; Set latching flag
   ENDIF
ELSE                          ; Motor 2 jog minus switch off
   IF (M63=1)                 ; But not off last time
      COMMAND"#2J/"           ; Issue stop command
      M63=0                   ; Set latching flag
   ENDIF
ENDIF
```

GENERAL WIRING GUIDELINES

Proper wiring, grounding and shielding are essential to prevent unwanted electrical noise and to assure proper servo operation and performance. The most common symptoms resulting from improper wiring are inaccurate positioning, poor servo control and, in the worst case, damage parts of the controller's hardware. These are some known noise sources:

- Switches operating inductive loads such as relays, solenoids
- Solid state relays or PWM servo amplifiers
- Arc welding and plasma torch machines
- Heavy current carrying wires
- Fluorescent Lights
- Neon lights

The following sections illustrate the most common wiring problems and methods for reducing electromagnetic noise.

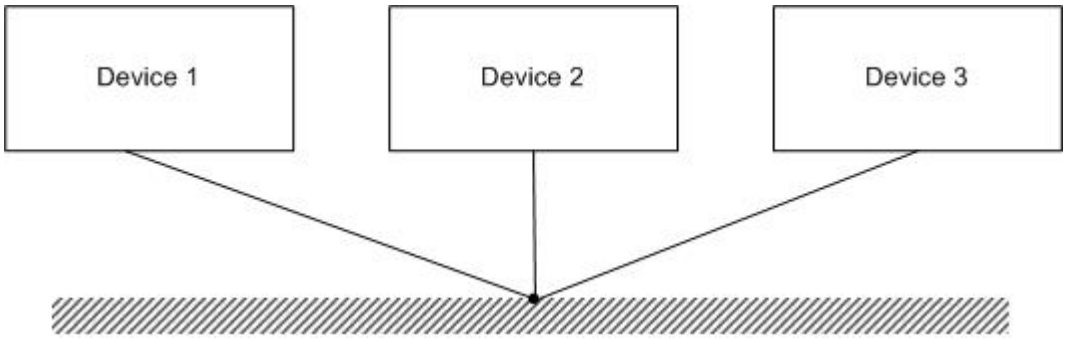
Ground Loops

Ground is an equipotential circuit reference point. A ground loop can be defined as electrical grounds that are not at the same electrical potential, namely zero volts AC and DC. As a result, a ground loop generates a potential difference along the ground line connecting two electrical devices. This originates the following important consequences:

- An electrical current will circulate along the ground wire, dissipating power and generating heat. Wire insulators will be degraded and eventually damaged.
- The ground electric potential will change resulting in a wrong signal reference. Some electrical signals in PMAC will change state above 0.7V against ground. If the ground reference rises above 1V, an evident unreliable behavior will result.
- In some cases, the ground line is used as a safety mechanism against electric shocks. Therefore, the ground line must be kept as a zero volts reference point.

Star Ground Connection

All component chassis ground points and signal ground or common points should be tied together at a single point (star connection). This point should then be tied with a single conductor to an earth ground point. This form of grounding prevents ground loops and insures that all components are properly grounded against shock hazard.

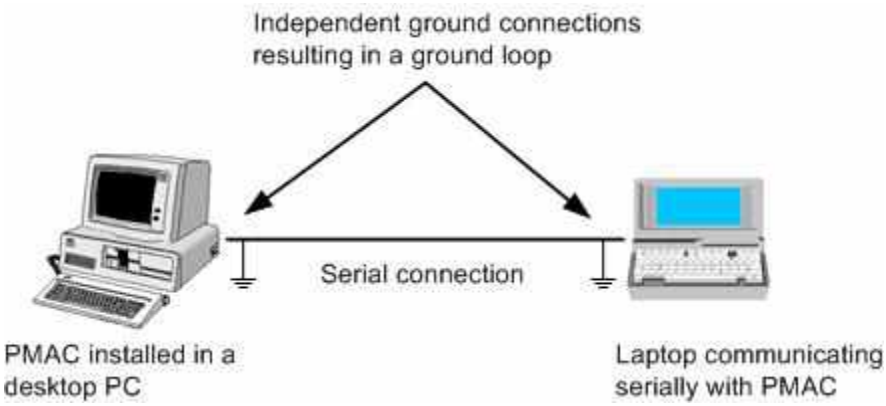


This configuration applies only for common ground connections and not for devices with opto-isolation circuits. Do not tie the PMAC analog and digital grounds together if PMAC is powered with separate analog and digital power supplies (the recommended method).

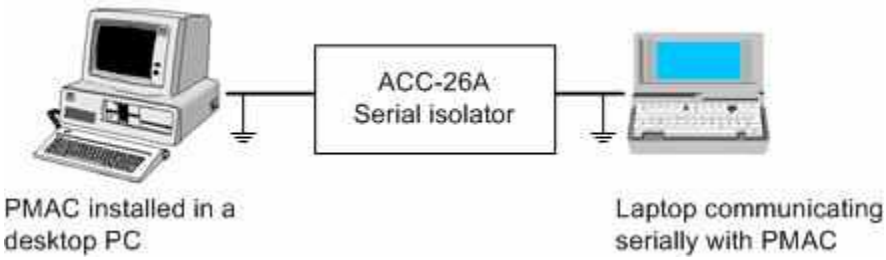
Opto-Isolation Circuits

Delta Tau provides several opto-isolating boards allowing separate ground circuits. Opto-isolating accessories for encoder signals, serial communications and digital inputs and outputs are available.

Example:



Solution:



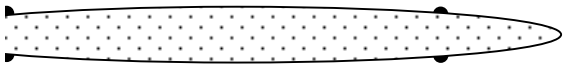
In this case, a serial communications isolator board will keep the laptop and desktop grounds separated avoiding a ground loop.

EMI, Electromagnetic Interference

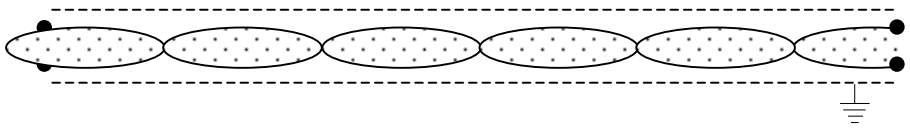
Electromagnetic interference (EMI) is an electrical noise that creates a disturbance or undesired response in one or more circuits, equipments, or systems. EMI is usually due to magnetic fields originated by nearby high current cables or transformers. Other sources of EMI include high voltage spikes generated by nearby solenoids, relays and arc welding machines.

Twisted Wires

In order to reduce electromagnetic interference, twisting of the power wires is highly recommended. Two wires carrying high current originates an inductive loop that is proportional to the area in between them:

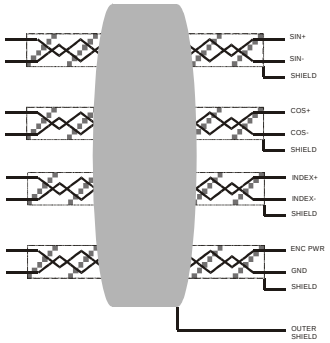


In a twisted cable, each adjacent pair of areas eliminates the inductive effect:



Shielded Cable

In general, it is a good practice to shield all wires carrying low-level signals. This is especially important if the signal level wires are run near power level wiring such as motor wires or relays wires. When shielding wires connect only one end of the shield, preferably the source end, connecting both ends of a shield will result in ground loops. It is recommended that the unconnected end of the shield will be insulated to prevent accidental connection. The best cabling to use for interpolated sinusoidal encoder outputs is a double-shielded twisted pair cable. Typically, there are four pairs used in a differential encoder's wiring. The picture below shows how the wiring may be implemented for a typical differential encoder using double shielded twisted pair cable.



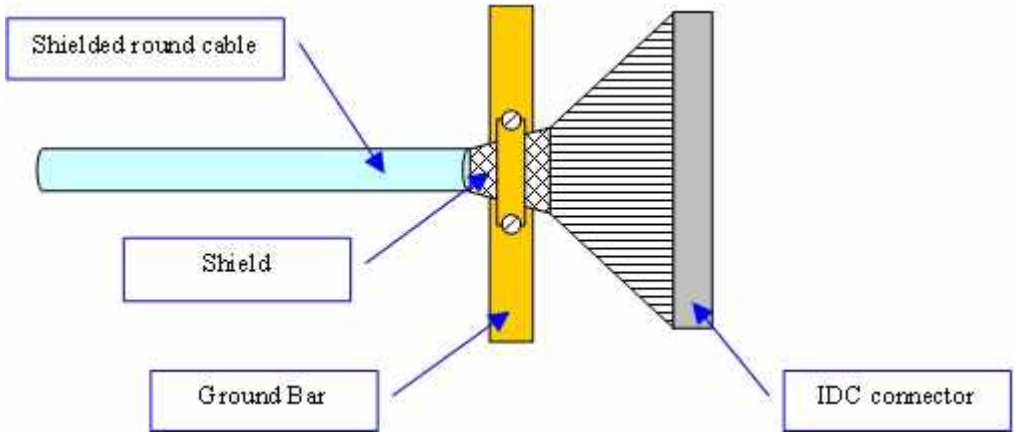
EXAMPLE OF DOUBLE SHIELDED
4 TWISTED PAIR CABLE

Wires Separation and Length

Since the electromagnetic interference drastically decreases with distance, the best method to prevent EMI is to separate the power cables from the signal cables. Also, since the capacitance and inductive characteristics of a cable increases with the distance, delicate signal cables must be kept short. PMAC's JMACH cable should not exceed the 36 inches in length whereas PMAC's JEXP cable should not exceed the 6 inches in length.

Flat Cable Shielding

When using shielded flat cables it is convenient to select a rounded cable with IDC connectors in both sides. With the addition of ground bars this configuration makes a good reliable shielded connection.

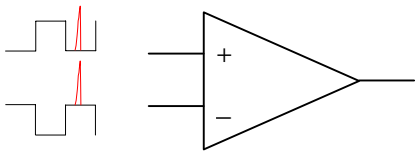


Basic Rules for Proper Wiring

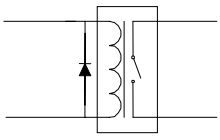
1. Take the time to sketch the system out before installing. This graphic representation of the installation will help avoid introducing ground loops and will serve as a road map for eliminating noise if it is present.
2. Do not introduce ground loops. Ground loops are created whenever a ground reference is established at more than one location.
3. Never run signal wires alongside power cables. This is true especially in installations where high-powered amplifiers are used. Large amplifiers are capable of drawing large currents. These currents vary the electromagnetic field surrounding the power cable. The more current that flows through the wire, the bigger this field becomes. If signal cables are located in close proximity to this fluctuating electromagnetic field, noise could be induced into the system.

   Do not route signal and power wiring through common junctions. Consider using double-shielded cables if there is no way to separate the wires.
4. Use a shielded signal cable connecting only one end of the shield, preferably the source end (the point where the signal is generated). This will insure maximum protection against induced noises by power cables and other sources of electromagnetic interference.
5. Twist pairs of power wires from DC power supplies, DC brush motors and other high current cables.
6. Cable intersections should always occur at right angles to minimize magnetic coupling.
7. Keep signal cables short. PMAC's JMACH cable should not exceed 36 inches in length whereas PMAC's JEXP cable should not exceed 6 inches in length.
8. Use a separate analog and digital power supply. This will eliminate noise entering the digital circuits from the machine connections.
9. When possible, use differential instead of single-ended signals. Differential signals will have common mode rejection for noise spikes. If a single-ended signal is used, do not ground the remaining associated signal and leave it floating.

Noise spike will be suppressed by the common rejection mode of the differential input.



10. Use opto-isolation circuits when possible. Delta Tau provides a variety of opto-isolation boards for different signals.
11. A diode must be connected across a relay or solenoid coils in order to reduce inductive voltage.



In some cases, when the electromagnetic noise affecting an input signal cannot be minimized otherwise, use an RC filter. The values of the RC filter must be carefully selected in order to not interfere with the safe operation of the input signal to filter.

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