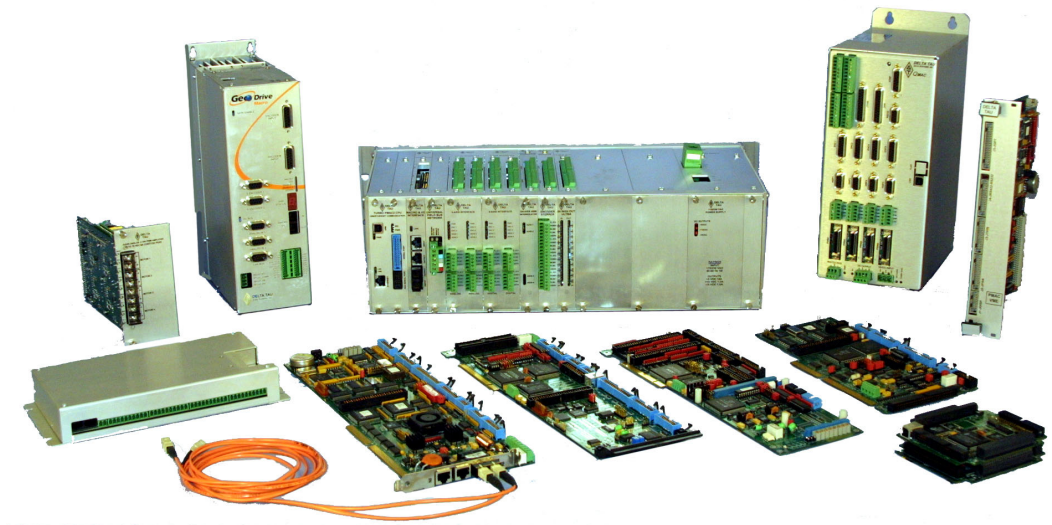
CATALOG

PMAC Catalog



PMAC Catalog of Products

3A0-DTPMAC-xCxx

November 1, 2004

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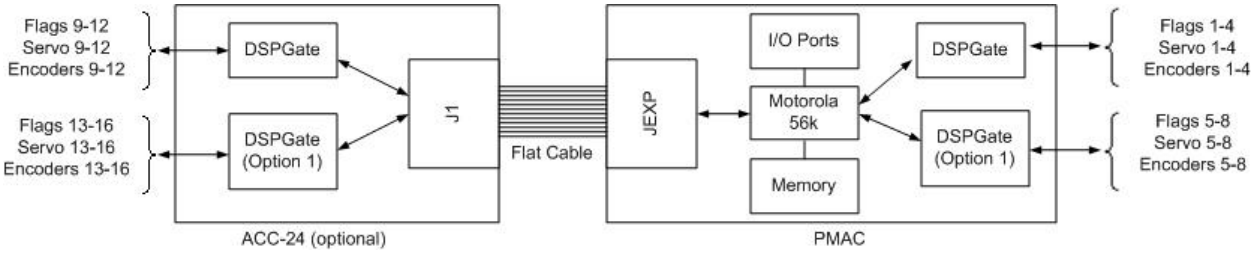
INTRODUCTION

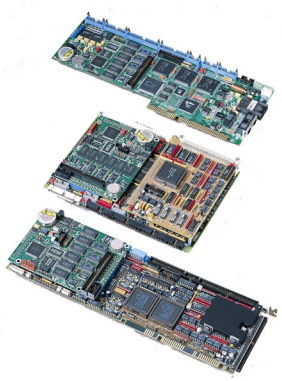
PMAC, pronounced *Pe'-MAC* stands for Programmable Multi-Axis Controller. It is a family of high-performance servo motion controllers capable of commanding up to 32 axes of motion simultaneously with a high level of sophistication.



- The PMAC is available in different hardware versions. These cards differ from each other in form factor, the nature of the bus interface, and in the availability of certain I/O ports.
- The main component in PMAC is its CPU: the Motorola Digital Signal Processor (DSP) DSP56k. The power of the DSP56k and the brilliant Delta Tau firmware design is what makes PMAC such an excellent controller. PMAC is provided with several CPU types, speeds and memory options.
- PMAC's CPU communicates with the axes through specially designed custom gate array ICs, referred to as DSPGATES. Each DSPGATE contains four consecutively numbered channels. There are two types of DSPGATES: the PMAC(1) type and the PMAC2 type. The main difference between these two types is the kind of motor command signals that they can provide. The PMAC(1) type can only output a ±10V (DAC) command signal per channel whereas the PMAC2 type can output either a digital PWM set of outputs, a pulse and direction (stepper) set of outputs or two ±10V (DAC) outputs per channel.
- Each PMAC channel provided by a PMAC(1) type DSPGATE has one DAC output, one encoder input and four dedicated flag inputs: two end-of-travel limits, one home input and one amplifier fault input. Most applications require a single PMAC channel per motor. Two PMAC channels per motor are necessary, for example, for dual-feedback applications (two encoders per motor) or analog sinusoidal commutation (two analog DAC outputs per motor).
- Each PMAC2 channel provided by a PMAC2 type DSPGATE has a set of servo command signals, one encoder input, five supplemental input flags and four dedicated flag inputs: two end-of-travel limits, one home input and one amplifier fault input. Most applications require a single PMAC2 channel per motor. Two PMAC2 channels per motor are necessary, for example, for dual-feedback applications requiring two encoders per motor.
- Any non-Turbo PMAC can control up to eight motors or axis as long as enough channels are provided. Every PMAC contains one DSPGATE, which has channels 1 through 4 (PMAC-Mini has only two channels). If Option-1 is ordered (not available on PMAC-Lite or PMAC-Mini), a second DSPGATE is provided, which has channels 5 through 8. If ACC 24 is ordered, a third DSPGATE is provided, which has channels 9 through 12. If ACC-24 Option-1 is ordered as well, a fourth DSPGATE is provided, which has channels 13 through 16.
- A Turbo PMAC can control up to 32 axes. When ordered with Option-1, the main Turbo PMAC board will contain two DSPGATE chips for a total of eight channels. Up to four ACC-24 with eight channels each can be added to the Turbo PMAC for a total of 40 channels. The ACC-24 connects to the main PMAC board through a flat cable to its JEXP port.
- PMAC has its own on-board memory. This allows PMAC to keep its configuration parameters, programs and variables for a given application. Therefore, any version of PMAC may run as a standalone controller or commanded by a host computer either over a serial port or over a bus port.

- Any PMAC has on board general-purpose digital inputs and outputs. This, in combination with the available PLC programming method, makes PMAC not only a motion controller but a multi-purpose PLC device as well.
- Several other I/O ports are available in most PMACs for the expansion of I/O lines, the connection of optional analog to digital converters and the addition of either vacuum fluorescent or LCD display devices.

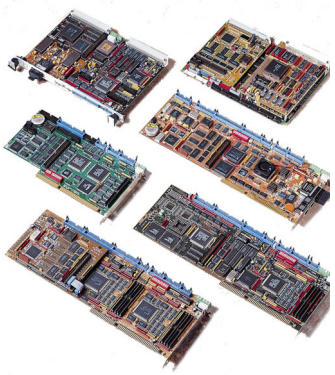
Turbo PMAC



The Turbo PMAC family should be selected based on the following features:

- Up to 32 axis of motion control in up to 16 different coordinate systems (motor groups) using up to 40 channels. The Turbo PMAC can be either PMAC(1) or PMAC2 type.
- Advanced lookahead (tighter acceleration and velocity control) and inverse kinematics (robotics) built-in features.
- Improved overall firmware features including better data array programming, more efficient analog inputs multiplexing, both regular and extended servo algorithms on the standard firmware, completely independent communication ports and optional second serial port.

PMAC2



The PMAC2 family should be selected based on the following features:

- PMAC2 is the only option to control digital amplifiers requiring direct PWM digital control signals. Also, the PMAC2 is more efficient for drives that require pulse and direction signals such as stepper motor drives.
- PMAC2 has two DAC (analog ±10V) outputs per channel. This makes PMAC2 more efficient for the control of amplifiers through analog sinusoidal commutation requiring two DAC signals per motor.
- PMAC2 can directly interface with MLDT position feedback devices.
- The highly improved capture and compare features of PMAC2 in comparison to the PMAC(1) type allow the high precision synchronization of position feedback devices (encoders) with especially dedicated digital inputs and outputs.
- Through its handwheel port, two extra full encoder inputs are standard in any PMAC2. Also, a single parallel feedback device can be interfaced to any standard PMAC2 board.
- The PMAC2 Ultralite does not have any on-board DSPGATE chips. Usually the DSPGATE chips are connected at long distances from the PMAC2 Ultralite to a UMAC MACRO system through either a fiber optic or twisted pair link. This not only allows a long distance connection (from 10 feet to 2 miles with glass fiber) to motors, amplifiers and I/O devices but also reduces wiring complexity and electromagnetic noise.

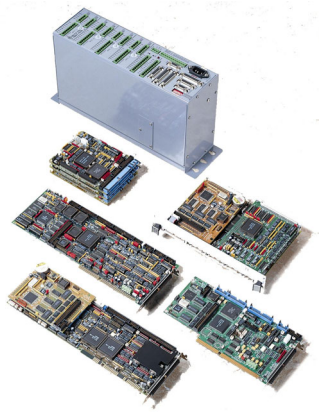
The PMAC2 style DSPGATES have the following features that can control virtually any kind of motor or amplifier:

- Three top-and-bottom PWM output signal pairs (when the digital side is used)
- Two 18-bit serial DAC output lines with clock and strobe (when the analog side is used)
- One pulse-and-direction output signal pair (when the stepper side is used)
- One 3-channel (A, B and C) quadrature differential encoder input with hardware capture and compare
- Four capture-capable input flags (HOME, +LIMIT, -LIMIT and Amplifier FAULT)
- Five supplemental input flags, for hall commutation, sub-count data or error code

PMAC(1)

The PMAC(1) type, the first developed member of the PMAC family, should be selected based on the following features:

- Cost efficient when controlling amplifiers that require a single analog ±10V control signal.
- On-board 5 to 24V range general-purpose digital I/O port (PMAC2 is limited to 5V operation.)
- Dedicated control panel with automatic functions supported in PMAC's firmware (not available in PMAC-Mini)



PMAC Lite

The PMAC Lite is recommended for applications with three or four channel requirements in either a PC based or stand alone environment. The term Lite stands for the limitation to only one DSPGATE Gate-Array IC on board, thus limiting the number of axis of control to four. The PMAC Lite is available in PMAC(1) or PMAC2 format, as a Turbo or non-Turbo type and with PCI bus form factor. The number of channels can always be expanded from 4 to 12 through the use of either an ACC-24P or ACC-24P2 for PMAC(1) or PMAC2 type respectively.

PMAC Mini

The PMAC Mini is recommended for applications with one or two channel requirements in either a PC based or stand alone environment. The term Mini stands for the limitation to one half DSPGATE Gate-Array IC on board, thus limiting the number of axis of control to two. The PMAC Mini is available in PMAC(1) or PMAC2 format with PCI bus form factor. The number of channels can always be expanded from 2 to 10 through the use of either an ACC-24P or ACC-24P2 for PMAC(1) or PMAC2 type respectively.

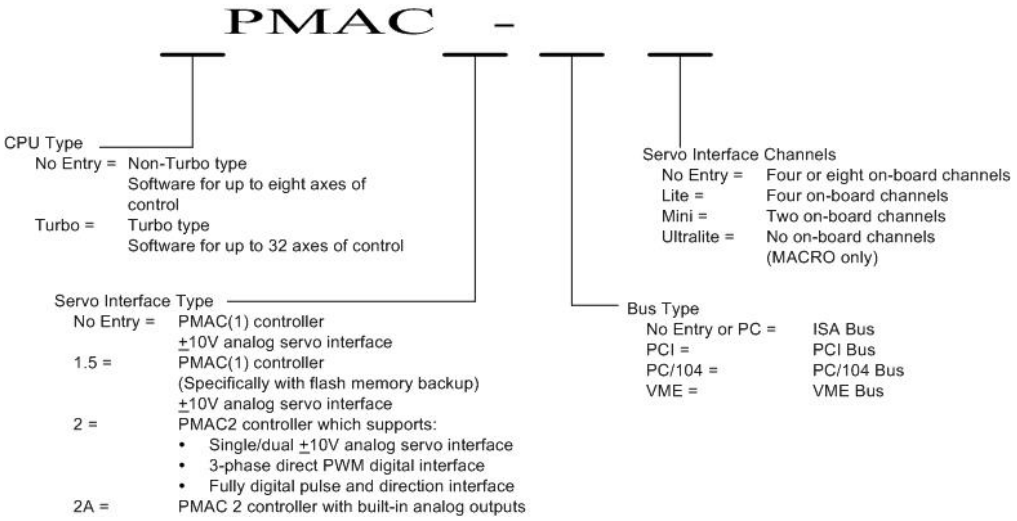
PMAC2 Ultralite

The term UltraLite stands for no DSPGATE Gate-Array ICs on board this kind of PMAC2. The ASICs are located in a different set of boards, usually remotely located from PMAC2, referred as UMAC MACRO systems. In fact, the PMAC2 UltraLite in combination with the UMAC MACRO system can be seen as a PMAC2 divided in two halves: the central processing portion that contains the DSP processor and the distributed circuitry that connects to motors, amplifiers and different I/O points.

The PMAC2 Ultralite and the UMAC MACRO (Motion and Control Ring Optical) systems are linked with a fiber optic or twisted pair connection. This clever distribution of components brings many benefits:

- Drastic reduction of wiring complexity
- Elimination of interference by electromagnetic noise long distance connections (3000 m, ~2 miles with glass fiber)

PMAC Motion Controller Nomenclature



Example:

Turbo PMAC2 – PCI Ultralite

PMAC with 32 axes firmware for the PCI bus with MACRO fiber optics interface and no on-board axes outputs

PMAC2A – PC/104

PMAC with eight axes firmware for the PC/104 Bus with ±10V analog outputs and PMAC2 type firmware.

PMAC Motion Controllers Chart

Board Name	PCI	PC-104	VME	USB	MACRO	RS-232 / 422	1-2 Axes	1-4 Axes	1-8 Axes	1-32 Axes	Analog ± 10 V Commands	Digital PWM Commands	Stepper Commands
PMAC-Mini PCI	•					•	•				•		
PMAC-Lite PCI	•			•		•	•	•			•		
PMAC-PCI	•			•		•	•	•	•		•		
PMAC2-Lite PCI	•			•		•	•	•			•	•	•
PMAC2-PCI	•			•		•	•	•	•		•	•	•
PMAC2-PCI Ultralite	•				•	•	•	•	•		•	•	•
Turbo PMAC-Lite PCI	•			•		•	•	•			•		
Turbo PMAC-PCI	•			•		•	•	•	•	•	•		
Turbo PMAC2-Lite PCI	•			•		•	•	•			•	•	•
Turbo PMAC2-PCI	•			•		•	•	•	•	•	•	•	•
Turbo PMAC2-PCI Ultralite	•				•	•	•	•	•	•	•	•	•
PMAC2A-PC/104		•		•		•	•	•	•		•	•	•
PMAC-VME			•	•		•	•	•	•		•		
Turbo PMAC-VME			•	•		•	•	•	•	•	•		
PMAC2-VME Ultralite			•	•	•	•	•	•	•		•	•	•
PMAC2-VME			•	•		•	•	•	•		•	•	•
Turbo PMAC2-VME			•	•		•	•	•	•	•	•	•	•

PMAC Connectors and Indicators

Display Port Outputs (JDISP Port)

The JDISP connector (J1) allows connection of the ACC-12A liquid crystal displays, or of the ACC-12C vacuum fluorescent display. Both text and variable values may be shown on these displays through the use of the **DISPLAY** command, executing in either motion or PLC programs.

Control-Panel Port I/O (JPAN Port)

The JPAN connector (J2 on PMAC-PC, -Lite, -VME) is a 26-pin connector with dedicated control inputs, dedicated indicator outputs, a quadrature encoder input, and an analog input (requires PMAC OPT-15). The control inputs are low true with internal pull-up resistors. They have predefined functions unless the control-panel-disable I-Variable (I2) has been set to 1. If this is the case, they may be used as general-purpose inputs by assigning M-Variables to their corresponding memory-map locations (bits of Y address $FFC0). This port is not present on the PMAC-Mini board.

Thumbwheel Multiplexer Port I/O (JTHW Port)

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. Up to 32 of the multiplexed I/O boards may be daisy-chained on the port, in any combination.

Serial Port Connection

For serial communications, use a serial cable to connect your PC's COM port to the PMAC's serial port connector (J4 on PMAC PC, Lite, and VME; J1). Delta Tau provides cables for this purpose: accessory 3D connects PMAC PC or VME to a DB-25 connector; ACC-3L connects PMAC Lite to a DB-9 connector. Standard DB-9-to-DB-25 or DB-25-to-DB-9 adapters may be needed for your particular setup.

General-Purpose Digital Inputs and Outputs (JOPTO Port)

PMAC's JOPTO connector (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 Accessory 21F is a six-foot cable for this purpose.

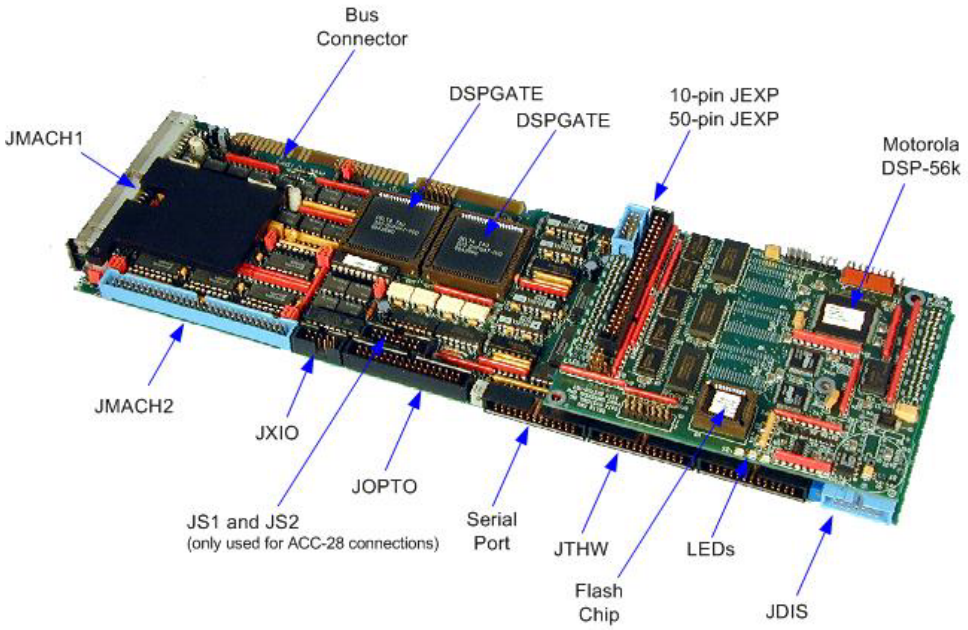
Machine Connectors

The primary machine interface connector is JMACH1 (J8 on PMAC-PC, J11 on PMAC Lite, P2 on PMAC-VME). It contains the pins for four channels of machine I/O: analog outputs, incremental encoder inputs, and associated input and output flags, plus power-supply connections. The next machine interface connector is JMACH2 (J7 on PMAC-PC, P2A on PMAC VME, not available on a PMAC Lite). It is essentially identical to the JMACH1 connector for one to four more axes. It is only present if the PMAC card has been fully populated to handle eight axes (Option-1), because it interfaces the optional extra components.

LED Indicators

PMACs with the Option CPU have three LED indicators: red, yellow, and green. The red and green LEDs have the same meaning as with the standard CPU: when the green LED is lit, this indicates that power is applied to the +5V input; when the red LED is lit, this indicates that the watchdog timer has tripped and shut down the PMAC.

The new yellow LED located beside the red and green LEDs, when lit, indicates that the phase-locked loop that multiplies the CPU clock frequency from the crystal frequency on the Option CPU is operational and stable. This indicator is for diagnostic purposes only; it may not be present on some boards.



Note:

1. The yellow LED is not present on a battery-backed PMAC. It is only present on Option CPUs with flash memory.
2. JMACH2 connector and second DSPGATE chip is present only on a PMAC with Option-1 (8-axis PMAC).

PMAC System Configuration Incompatibilities

In general, PMAC, its options, and its accessories can be mixed and matched at will. However, there are some combinations that are not permissible. These combinations are listed below.

JEXP Expansion Port Accessories

The non-Turbo PMAC can interface with two off-board DSPGATEs, whereas the Turbo PMAC can interface with eight off-board DSPGATEs. The ACC-24P/V can have either only one DSPGATE or a second DSPGATE when ACC-24P/V Option-1 is ordered. The ACC-51P can have one only DSPGATE.

Due to bus drive limitations, a limit of four with an absolute maximum of six expansion port (JEXP) accessories is recommended on any PMAC. In addition, the address spaces for ACC-14D/V and ACC-36P/V boards on the JEXP expansion port are limited to six. One ACC-14D/V occupies a full address space; four ACC-36P/V boards occupy one address space.

JTHW Thumbwheel Multiplexer Port Accessories

A total of 32 boards can be plugged into the thumbwheel multiplexer port (JTHW).

The ACC-27 Opto-Isolated I/O board cannot be used with any other accessory that connects through the thumbwheel multiplexer port (JTHW): the ACC-8D OPT-7 R/D converter (if absolute power-on position is desired); the ACC-8D OPT-9 Yaskawa Encoder Interface, or any of the ACC-34 family of serial I/O boards. This is because the ACC-27 uses the port in non-multiplexed fashion.

There is a limit of 256 addresses for multiplexed accessories on the JTHW thumbwheel multiplexer port: the ACC-8D OPT-7 R/D converter (if absolute power-on position is desired); the ACC-8D OPT-9 Yaskawa Encoder Interface, or any of the ACC-34 family of serial I/O boards.

- An ACC-8D OPT-7 board occupies one address.
- An ACC-8D OPT-9 board occupies one address.
- An ACC-34 type board occupies eight consecutive addresses, starting with an address divisible by eight.

There are no known cases of anyone using all of these address spaces.

JDISP Display Port Accessories

Only one display can be connected to the JDISP display port. This includes any of the ACC-12 family of displays.

JSx Port Accessories

Each ACC-28B A/D converter board must interface to a separate DSPGATE gate array IC on PMAC2 or ACC-24P2 through its JSx connector. Therefore, the limitations on numbers of ACC-28s for a PMAC2 system are as follows:

PMAC2, no Opt 1; no ACC-24P2	1 ACC-28	PMAC2 with Opt 1; ACC-24P2, no Opt 1	3 ACC-28s
PMAC2 with Opt 1; no ACC-24P2	2 ACC-28s	PMAC2, no Opt 1; ACC-24P2 with Opt 1	3 ACC-28s
PMAC2, no Opt 1; ACC-24P2, no Opt 1	2 ACC-28s	PMAC2 with Opt 1; ACC-24P2 with Opt 1	4 ACC-28s

The Turbo PMAC2 is capable of addressing a total of ten DSPGATEs (40 channels) for a total of ten ACC-28s. The interface of ten ACC-28s for a total of 40 analog inputs is accomplished with a PMAC2 with Option-1 and four ACC-24P2 each with Option-1.

Turbo PMAC Open Servo

Turbo PMAC's Open Servo software feature permits users to write custom algorithm in a high-level language that will execute on Turbo PMAC's high-priority servo interrupt. This algorithm can be used either for actual servo control functions, or for other tasks that must execute at a very high priority, such as very high-frequency I/O, special pre-processing of feedback data, or special post-processing of servo commands.

Open Servo algorithms are written in a text editor and downloaded with the PEWIN32PRO PMAC Executive program. The algorithm is compiled into DSP machine code in the host computer before being downloaded into Turbo PMAC's active memory. This process is identical to writing PMAC compiled PLCC programs.

Open Servo algorithms may be retained in Turbo PMAC's non-volatile flash memory using the **SAVE** command. When executed, they replace only the standard servo-loop algorithm for the motor. All other tasks, including trajectory generation, motion and PLC program executions, and safety checking, are still executed by the Turbo PMAC's built-in firmware.

The Open Servo feature is a second method for creating user-written servo algorithms in Turbo PMAC. Previously, this could be done only by writing the algorithm in assembly language for the DSP56300 family using Motorola's cross-assembler, and downloading the assembled code to the Turbo PMAC. The Open Servo feature permits these algorithms to be written without the need to understand and use assembly language.

The compiled Open Servo program is similar to the compiled PLC programs, but there are two key differences:

- Open Servo algorithms run on the servo interrupt, with guaranteed execution every cycle (or the Turbo PMAC will watchdog); compiled PLC programs either run on the real-time interrupt (PLCC 0) with possible pre-emption by motion program calculations, or in background (PLCC 1 – 31) with no deterministic execution rate.
- Open Servo algorithms have specific access mechanisms to special registers used for servo functions.

Requirements

The Open Servo requires a Turbo PMAC controller (Turbo PMAC(1), Turbo PMAC2, UMAC, or QMAC) with version 1.938 or newer firmware to execute the algorithm. It requires a PC running PEWIN32PRO version 3.2 or newer PMAC Executive program.

Proportional Control Programming Example

The following algorithm shows one of the simplest possible Open Servo algorithms, implementing a simple proportional control law using the motor's Ixx30 parameter as the proportional gain.

```
OPEN SERVO                                  ; Following lines to be compiled
CLEAR                                       ; Not necessary, but acceptable
COPYREG P30                                 ; Copy following error into P30
P35=P30*I(ITOF(MTRNUM*100+30))/65536        ; Multiply by gain, scale
RETURN(FTOI(P35))                           ; Make an integer and output
CLOSE
```

Operators

+	Addition
-	Subtraction
*	Multiplication
/	Division
%	Modulo, remainder
&	bit-by-bit **AND**
|	bit-by-bit **OR**
^	bit-by-bit **XOR**

Comparators

=	Equal to
>	Greater than
<	Less than
~	Approximately equal to [within 0.5]
!=	Not equal to
!>	Not greater than, less than or equal to
!<	Not less than, greater than or equal to
!~	Not approximately equal to [not within 0.5]

Functions

SIN	Trigonometric sine
COS	Trigonometric cosine
TAN	Trigonometric tangent
ASIN	Trigonometric arc sine
ACOS	Trigonometric arc cosine
ATAN	Trigonometric arc tangent
ATAN2	Special 2-argument, 4-quadrant arc tangent
ABS	Absolute value
INT	Greatest integer within
EXP	Exponentiation
LN	Natural logarithm
SQRT	Square root

Special Built-in Functions

FLIMIT	saturation-check function
MTRNUM	returns executing motor number
COPYREG	copies important motor registers into P-Variables

Logical Control

IF / **[ELSE]** / **ENDIF**	branching constructs
WHILE / **ENDWHILE**	looping constructs

TURBO PMAC BOARDS

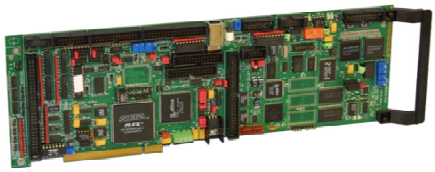
The Turbo PMAC family should be selected based on the following features:

- Up to 32 axis of motion control in up to 16 different coordinate systems (motor groups) using up to 40 channels. The Turbo PMAC can be either PMAC(1) or PMAC2 type.
- Advanced lookahead (tighter acceleration and velocity control) and inverse kinematics (robotics) built-in features.
- Improved overall firmware features including better data array programming, more efficient analog inputs multiplexing, both regular and extended servo algorithms on the standard firmware, completely independent communication ports and optional second serial port.

Board Name	PCI	PC-104	VME	USB	MACRO	RS-232 / 422	1-2 Axes	1-4 Axes	1-8 Axes	1-32 Axes	Analog ± 10 V Commands	Digital PWM Commands	Stepper Commands
Turbo PMAC-Lite PCI	●			●		●	●	●			●		
Turbo PMAC-PCI	●			●		●	●	●	●	●	●		
Turbo PMAC2-Lite PCI	●			●		●	●	●			●	●	●
Turbo PMAC2-PCI	●			●		●	●	●	●	●	●	●	●
Turbo PMAC2-PCI Ultralite	●				●	●	●	●	●	●	●	●	●
Turbo PMAC-VME			●	●		●	●	●	●	●	●		
Turbo PMAC2-VME			●	●		●	●	●	●	●	●	●	●

Turbo PMAC PCI Lite, 4-Axis with ±10V Servo Outputs PCI Board

Recommended for applications with three or four ±10V channel requirements in either a PCI-PC based or stand alone environment. The term Lite stands for the limitation of only one DSPGATE Gate-Array IC on board. In comparison with the non-Turbo version, this board provides better velocity and acceleration control algorithms (lookahead) and an overall improved firmware. The number of channels can always be expanded, from 4 to 12, through the use of an ACC-24P.



Part Number 400-603657-TRx

Number of Channels

The Turbo PMAC PCI Lite can have only one on-board DSPGATE that provides four channels axis interface circuitry, each including:

- 16-bit ±10V differential analog output
- Differential/single-ended encoder input with A, B quadrature channels and C index channel
- Four input flags, two output flags
- Interface to external 16-bit serial ADC

CPU and Memory

The Turbo PMAC PCI Lite is provided with an 80 MHz DSP56303 CPU (120 MHz PMAC equivalent) and flash memory. Any variable change in a flash type memory must be saved manually in Turbo PMAC for it to be retained on a power-up\reset cycle. Therefore, if machine parameters like parts counters or state variables are required, the Option-16A battery-backed parameter RAM is suggested.

- Option-5C0: This is the standard CPU and memory configuration. It is provided automatically if no Option-5xx is specified. It provides an 80 MHz DSP56303 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.
- Option-5C3: It provides an 80 MHz DSP56303 CPU (120 MHz PMAC equivalent) with 8k x 24 of internal memory, 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.
- Option-5D0: It provides a 100 MHz DSP56309 CPU (150 MHz PMAC equivalent) with 34k x 24 of internal memory, 128k x 24 of compiled/assembled program memory, 128k x 24 of user data memory; and a 1M x 8 flash memory.
- Option-5D3: It provides a 100 MHz DSP56309 CPU (150 MHz PMAC equivalent) with 34k x 24 of internal memory, 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.
- Option-5E0: It provides a 160 MHz DSP56311 CPU (240 MHz PMAC equivalent) with 128k x 24 of internal memory, 128k x 24 of compiled/assembled program memory, 128k x 24 of user data memory; and a 1M x 8 flash memory.
- Option-5E3: It provides a 160 MHz DSP56311 CPU (240 MHz PMAC equivalent) with 128k x 24 of internal memory, 512k x 24 of compiled/assembled program memory, 512k x 24 of user data memory; and a 4M x 8 flash memory.
- Option-16A: 32Kx24 SRAM battery-backed parameter memory

Communications

The Turbo PMAC PCI Lite can communicate either through the PCI bus or through the RS-422 serial interface using the optional ACC-3D flat cable. All communication ports in a Turbo PMAC are independent of each other allowing multiple devices communicating with it at any given time.

- Option-2: The 8Kx16 dual-ported RAM provides a method of sharing memory between PMAC and the host computer for very fast interchange of data. The Option-2 is installed on-board the PMAC.
- Option-9T: Auxiliary RS-232 serial port. This option is installed in the CPU piggyback board and connects to the computer through the optional ACC-3L flat cable.

Firmware Version

PMAC is provided with the latest firmware revision with the regular servo algorithm.

Option-10: Through this option, an older than the latest firmware released version can be ordered on-board. When possible, use the same firmware revision for similar machines. This is important in cases where the new PMAC is a replacement in an already existing machine or a new machine using existing programs is developed.

Miscellaneous

The following ports are provided standard in any PMAC:

- Display port for the connection to a vacuum fluorescent or liquid crystal display
- JOPTO Port: This port provides eight general-purpose digital inputs and eight general-purpose digital outputs at 5 to 24VDC levels and a maximum of 100 mA per output. This 34-pin connector was designed for easy interface to OPTO-22 or equivalent optically isolated I/O modules when different voltage levels or opto-isolation to the PMAC board is necessary.
- Multiplexer Port providing 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.

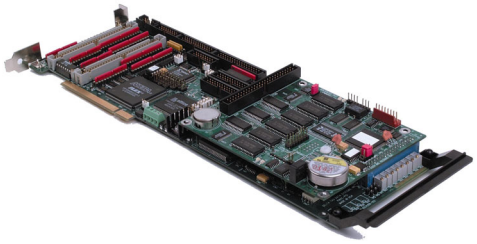
- Control panel port with dedicated control inputs, dedicated indicator outputs, a quadrature encoder input, and an analog input (requires PMAC OPT-15)

Most options to the PMAC board are possible only to install in the factory, whereas most accessories for PMAC can be ordered and installed at a later stage. Therefore, it is important to order all the necessary options at the time when PMAC is ordered.

- Option-7: Plate mounting for standalone applications. PMAC is mounted in an aluminum plate allowing its installation as a stand-alone controller.
- Option-8A: The standard clock crystal in PMAC has ±100 ppm accuracy. Through 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.
- Option-12: 8-channel on-board 12-bit A/D converter. With this option, extra components are added on the PMAC board for eight analog-to-digital converters with 12-bits resolution and 0-5 or ±2.5V range. Typically, this option is used for analog sensors reading but not used regularly for analog sensors feedback devices.
- Option-12A: Extra 8-channel on-board 12-bit A/D converter. This option requires Option-12 and provides a total of 16 analog-to-digital converters with 12-bits resolution and 0-5 or ±2.5V range.
- Option-15: Voltage to frequency (V-to-F) converter to use control panel port analog input. This feature uses one of the encoder channels in PMAC to provide a low-resolution method of a single analog input interface.
- Option-18A: Electronic board identification number module. This option can be used to let a host computer program identify the Turbo PMAC board connected to the machine.

Turbo PMAC PCI, up to 32-Axis with ±10V Servo Outputs PCI Board

Recommended for applications that require more than eight ±10V channels in either a PCI PC based or stand alone environments. The base Turbo PMAC PCI board can control up to eight axes. The necessary channels to control up to 32 axes are provided by optional ACC-24P boards. A Turbo PMAC PCI board with four ACC-24P boards will have 40 channels for controlling up to 32 axes in 16 different coordinate systems or groups of motors.



Part Number 400-603588-TRx

Number of Channels

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

- 16-bit ±10V differential analog output
- Differential/single-ended encoder input with A, B quadrature channels and C index channel
- Four input flags, two output flags
- Interface to external 16-bit serial ADC

Option-1: Provides a second on-board DSPGATE chip with four additional channels axis interface circuitry. Since this option consists of extra ICs added on the baseboard, it must be installed in factory.

CPU and Memory

The Turbo PMAC is provided with an 80 MHz DSP56303 CPU (120 MHz PMAC equivalent) and flash memory. Any variable change in a flash type memory must be saved manually in Turbo PMAC for it to be retained on a power-up\reset cycle. Therefore, if machine parameters like parts counters or state variables are required, the Option-16A battery-backed parameter RAM is suggested.

- Option-5C0: This is the standard CPU and memory configuration. It is provided automatically if no Option-5xx is specified. It provides an 80 MHz DSP56303 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.
- Option-5C3: It provides an 80 MHz DSP56303 CPU (120 MHz PMAC equivalent) with 8k x 24 of internal memory, 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.
- Option-5D0: It provides a 100 MHz DSP56309 CPU (150 MHz PMAC equivalent) with 34k x 24 of internal memory, 128k x 24 of compiled/assembled program memory, 128k x 24 of user data memory; and a 1M x 8 flash memory.
- Option-5D3: It provides a 100 MHz DSP56309 CPU (150 MHz PMAC equivalent) with 34k x 24 of internal memory, 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.
- Option-5E0: It provides a 160 MHz DSP56311 CPU (240 MHz PMAC equivalent) with 128k x 24 of internal memory, 128k x 24 of compiled/assembled program memory, 128k x 24 of user data memory; and a 1M x 8 flash memory.
- Option-5E3: It provides a 160 MHz DSP56311 CPU (240 MHz PMAC equivalent) with 128k x 24 of internal memory, 512k x 24 of compiled/assembled program memory, 512k x 24 of user data memory; and a 4M x 8 flash memory.
- Option-16A: 32Kx24 SRAM battery-backed parameter memory

Communications

The Turbo PMAC PCI can communicate either through the PCI bus or through the RS-422 serial interface using the optional ACC-3D flat cable. All communication ports in a Turbo PMAC are independent of each other allowing multiple devices communicating with it at any given time.

- Option-2: The 8Kx16 dual-ported RAM provides a method of sharing memory between PMAC and the host computer for very fast interchange of data. The Option-2 is installed on-board the PMAC.
- Option-9T: Auxiliary RS-232 serial port. This option is installed in the CPU piggyback board and connects to the computer through the optional ACC-3L flat cable.

Firmware Version

PMAC is provided with the latest firmware revision with the regular servo algorithm.

Option-10: Through this option, an older than the latest firmware released version can be ordered on-board. When possible, use the same firmware revision for similar machines. This is important in cases where the new PMAC is a replacement in an already existing machine or a new machine using existing programs is developed.

Miscellaneous

The following ports are provided standard in any PMAC:

- Display port for the connection to a vacuum fluorescent or liquid crystal display
- JOPTO Port: This port provides eight general-purpose digital inputs and eight general-purpose digital outputs at 5 to 24VDC levels and a maximum of 100 mA per output. This 34-pin connector was designed for easy interface to OPTO-22 or equivalent optically isolated I/O modules when different voltage levels or opto-isolation to the PMAC board is necessary.

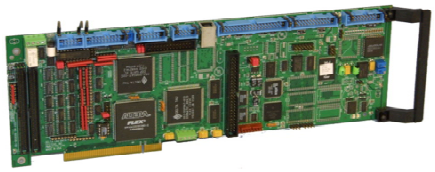
- Multiplexer Port providing eight input lines and eight output lines at TTL levels. When using the PMAC ACC-34x type boards, these lines allow multiplexing up to 1024 I/O lines on the port.
- Control panel port with dedicated control inputs, dedicated indicator outputs, a quadrature encoder input, and an analog input (requires PMAC OPT-15)

Most options to the PMAC board are possible only to install in the factory, whereas most accessories for PMAC can be ordered and installed at a later stage. Therefore, it is important to order all the necessary options at the time when PMAC is ordered.

- Option-7: Plate mounting for standalone applications. PMAC is mounted in an aluminum plate allowing its installation as a stand-alone controller.
- Option-8A: The standard clock crystal in PMAC has ±100 ppm accuracy. Through 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.
- Option-12: 8-channel on-board 12-bit A/D converter. With this option, extra components are added on the PMAC board for eight analog-to-digital converters with 12-bits resolution and 0-5 or ±2.5V range. Typically, this option is used for analog sensors reading but not used regularly for analog sensors feedback devices.
- Option-12A: Extra 8-channel on-board 12-bit A/D converter. This option requires Option-12 and provides a total of 16 analog-to-digital converters with 12-bits resolution and 0-5 or ±2.5V range.
- Option-15: Voltage to frequency (V-to-F) converter to use control panel port analog input. This feature uses one of the encoder channels in PMAC to provide a low-resolution method of a single analog input interface.
- Option-18A: Electronic board identification number module. This option can be used to let a host computer program identify the Turbo PMAC board connected to the machine.

Turbo PMAC2 PCI Lite, 4-Axis with Digital Servo Outputs PCI Board

This board can be used installed in a PCI bus host computer or used as a stand-alone motion controller. When combined with the appropriate accessory ACC-8x, it provides from 4 to 32 axes of digital direct PWM, analog or pulse and direction amplifier command signals. The base Turbo PMAC2-PC board can control up to four axes. The necessary channels to control up to 32 axes are provided by optional ACC-24P2 boards. A Turbo PMAC2-PC board with four ACC-24P2 boards will have 36 channels for controlling up to 32 axes in 16 different coordinate systems or groups of motors.



Part Number 400-603658-TRx

Number of Channels

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

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

The base version without options also provides two channels of supplemental interface circuitry, each including:

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

Option-1: Provides a second on-board DSPGATE chip with four additional channels axis interface circuitry. This option must be installed in the factory. Additional channels can be obtained from up to four ACC-24P2 boards.

CPU and Memory

The Turbo PMAC2 is provided with an 80 MHz DSP56303 CPU (120 MHz PMAC equivalent) and flash memory. Any variable change in a flash type memory must be saved manually in Turbo PMAC for it to be retained on a power-up\reset cycle. Therefore, if machine parameters like parts counters or state variables are required, the Option-16A battery-backed parameter RAM is suggested.

- Option-5C0: This is the standard CPU and memory configuration. It is provided automatically if no Option-5xx is specified. It provides an 80 MHz DSP56303 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.
- Option-5C3: It provides an 80 MHz DSP56303 CPU (120 MHz PMAC equivalent) with 8k x 24 of internal memory, 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.
- Option-5D0: It provides a 100 MHz DSP56309 CPU (150 MHz PMAC equivalent) with 34k x 24 of internal memory, 128k x 24 of compiled/assembled program memory, 128k x 24 of user data memory; and a 1M x 8 flash memory.
- Option-5D3: It provides a 100 MHz DSP56309 CPU (150 MHz PMAC equivalent) with 34k x 24 of internal memory, 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.
- Option-5E0: It provides a 160 MHz DSP56311 CPU (240 MHz PMAC equivalent) with 128k x 24 of internal memory, 128k x 24 of compiled/assembled program memory, 128k x 24 of user data memory; and a 1M x 8 flash memory.
- Option-5E3: It provides a 160 MHz DSP56311 CPU (240 MHz PMAC equivalent) with 128k x 24 of internal memory, 512k x 24 of compiled/assembled program memory, 512k x 24 of user data memory; and a 4M x 8 flash memory.
- Option-16A: 32Kx24 SRAM battery-backed parameter memory

Communications

The Turbo PMAC2 PCI can communicate either through the PCI bus or through the RS-232 serial interface using the optional ACC-3L flat cable. All communication ports in a Turbo PMAC are independent of each other allowing multiple devices to communicate with it at any given time.

- Option-2: The 8Kx16 dual-ported RAM provides a method of sharing memory between PMAC and the host computer for very fast interchange of data.
- Option-3: 12 Mbit/sec USB1.1 communications port. When this option is used, the PCI port is disabled.
- Option-9T: Auxiliary RS-232 serial port. This option is installed in the CPU piggyback board and connects to the computer through the optional ACC-3L flat cable.

Firmware Version

Turbo PMAC is provided with the latest firmware revision with both the regular and the extended servo algorithm. Variables in the Turbo PMAC allow the selection per motor of either the regular or extended servo algorithms.

Option-10: Through this option, an older than the latest firmware released version can be ordered on-board. When possible, use the same firmware revision for similar machines. This is important in cases where the new PMAC is a replacement in an already existing machine or a new machine using existing programs is developed.

Miscellaneous

The following ports are provided standard in any PMAC2:

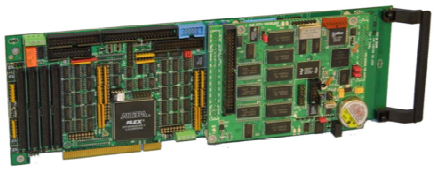
- Display port for the connection to a vacuum fluorescent or liquid crystal display
- I/O port providing 32 digital I/O lines at 5V CMOS levels configurable by byte for inputs or outputs. ACC-21A provides a convenient method for connection of this port to Opto-22™ or Grayhill type boards.
- Multiplexer port providing eight input lines and eight output lines at TTL levels. When using the PMAC ACC-34x type boards, these lines allow multiplexing large numbers of inputs and outputs on the port. Up to 32 of the multiplexed I/O boards may be daisy-chained on the port, in any combination.

Most options to the Turbo PMAC2 board are possible only to install in the factory, whereas most accessories for Turbo PMAC2 can be ordered and installed at a later stage. Therefore, it is important to order all the necessary options at the time when PMAC is ordered.

- Option-7: Plate mounting for standalone applications. Turbo PMAC2 is mounted in an aluminum plate allowing its installation as a stand-alone controller.
- Option-8A: The standard clock crystal in PMAC has ±100 ppm accuracy. Through 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.
- Option-12: 8-channel on-board 12-bit A/D converter. With this option, extra components are added on the PMAC board for eight analog-to-digital converters with 12-bits resolution and 0-5 or ±2.5V range. Typically, this option is used for analog sensors reading but not used regularly for analog sensors feedback devices.
- Option-12A: Extra 8-channel on-board 12-bit A/D converter. This option requires Option-12 and provides a total of 16 analog-to-digital converters with 12-bits resolution and 0-5 or ±2.5V range.
- Option-18A: Electronic board identification number module. This option can be used to let a host computer program identify the Turbo PMAC board connected to the machine.

Turbo PMAC2 PCI, up to 32-Axis with Digital Servo Outputs PCI Board

This board can be used installed in a PCI bus host computer or used as a stand-alone motion controller. When combined with the appropriate accessory ACC-8x, it provides up to 32 axes of digital, analog or pulse and direction amplifier command signals. The base Turbo PMAC2 PCI board can control up to eight axes. The necessary channels to control up to 32 axes are provided by optional ACC-24P2 boards. A Turbo PMAC2 PCI board with four ACC-24P2 boards will have 40 channels for controlling up to 32 axes in 16 different coordinate systems or groups of motors.



Part Number 400-603367-TRx

Number of Channels

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

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

The base version without options also provides two channels of supplemental interface circuitry, each including:

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

Option-1: Provides a second on-board DSPGATE chip with four additional channels axis interface circuitry. This option must be installed in the factory. Additional channels can be obtained from up to four ACC-24V2 boards.

CPU and Memory

The Turbo PMAC is provided with an 80 MHz DSP56303 CPU (120 MHz PMAC equivalent) and flash memory. Any variable change in a flash type memory must be saved manually in Turbo PMAC for it to be retained on a power-up\reset cycle. Therefore, if machine parameters like parts counters or state variables are required, the Option-16A battery-backed parameter RAM is suggested.

- Option-5C0: This is the standard CPU and memory configuration. It is provided automatically if no Option-5xx is specified. It provides an 80 MHz DSP56303 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.
- Option-5C3: It provides an 80 MHz DSP56303 CPU (120 MHz PMAC equivalent) with 8k x 24 of internal memory, 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.
- Option-5D0: It provides a 100 MHz DSP56309 CPU (150 MHz PMAC equivalent) with 34k x 24 of internal memory, 128k x 24 of compiled/assembled program memory, 128k x 24 of user data memory; and a 1M x 8 flash memory.
- Option-5D3: It provides a 100 MHz DSP56309 CPU (150 MHz PMAC equivalent) with 34k x 24 of internal memory, 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.
- Option-5E0: It provides a 160 MHz DSP56311 CPU (240 MHz PMAC equivalent) with 128k x 24 of internal memory, 128k x 24 of compiled/assembled program memory, 128k x 24 of user data memory; and a 1M x 8 flash memory.
- Option-5E3: It provides a 160 MHz DSP56311 CPU (240 MHz PMAC equivalent) with 128k x 24 of internal memory, 512k x 24 of compiled/assembled program memory, 512k x 24 of user data memory; and a 4M x 8 flash memory.
- Option-16A: 32Kx24 SRAM battery-backed parameter memory

Communications

The Turbo PMAC2 PCI can communicate either through the PCI bus or through the RS-232 serial interface using the optional ACC-3L flat cable. All communication ports in a Turbo PMAC are independent of each other allowing multiple devices to communicate with it at any given time.

- Option-2: The 8Kx16 dual-ported RAM provides a method of sharing memory between PMAC and the host computer for very fast interchange of data. The Option-2 is installed on-board of the PMAC2, and no extra PCI slot is required for it.
- Option-9T: Auxiliary RS-232 serial port. This option is installed in the CPU piggyback board and connects to the computer through the optional ACC-3L flat cable.

Firmware Version

Turbo PMAC is provided with the latest firmware revision with both the regular and the extended servo algorithm. Variables in the Turbo PMAC allow the selection per motor of either the regular or extended servo algorithms.

Option-10: Through this option, an older than the latest firmware released version can be ordered on-board. When possible, use the same firmware revision for similar machines. This is important in cases where the new PMAC is a replacement in an already existing machine or a new machine using existing programs is developed.

Miscellaneous

The following ports are provided standard in any PMAC2:

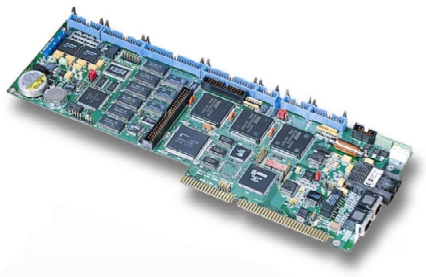
- Display port for the connection to a vacuum fluorescent or liquid crystal display
- I/O port providing 32 digital I/O lines at 5V CMOS levels configurable by byte for inputs or outputs. ACC-21A provides a convenient method for connection of this port to Opto-22™ or Grayhill type boards.
- Multiplexer port providing eight input lines and eight output lines at TTL levels. When using the PMAC ACC-34x type boards, these lines allow multiplexing large numbers of inputs and outputs on the port. Up to 32 of the multiplexed I/O boards may be daisy-chained on the port, in any combination.

Most options to the Turbo PMAC2 board are possible only to install in the factory, whereas most accessories for Turbo PMAC2 can be ordered and installed at a later stage. Therefore, it is important to order all the necessary options at the time when PMAC is ordered.

- Option-7: Plate mounting for standalone applications. Turbo PMAC2 is mounted in an aluminum plate allowing its installation as a stand-alone controller.
- Option-8A: The standard clock crystal in PMAC has ±100 ppm accuracy. Through 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.
- Option-12: 8-channel on-board 12-bit A/D converter. With this option, extra components are added on the PMAC board for eight analog-to-digital converters with 12-bits resolution and 0-5 or ±2.5V range. Typically, this option is used for analog sensors reading but not used regularly for analog sensors feedback devices.
- Option-12A: Extra 8-channel on-board 12-bit A/D converter. This option requires Option-12 and provides a total of 16 analog-to-digital converters with 12-bits resolution and 0-5 or ±2.5V range.
- Option-18A: Electronic board identification number module. This option can be used to let a host computer program identify the Turbo PMAC board connected to the machine.

Turbo PMAC2 PCI Ultralite, up to 32-Axis with MACRO PCI Board

This board can be used installed in a PCI bus host computer or used as a stand-alone motion controller. This board must be complemented with MACRO components allowing distributed motion control over a fiber optic link or a twisted pair connection. The term Ultralite stands for no DSPGATE Gate-Array ICs on board of this kind of PMAC2. The ASICs are located in a different set of boards, usually remotely located from PMAC2, referred as UMAC MACRO systems. A Turbo PMAC2-Ultralite board can control up to 32 axes. A single UMAC MACRO can connect up to 16 axes. Therefore, two UMAC MACRO systems can be tied together in a single ring for a convenient motion control distribution.



Part Number 400-603726-100

Number of Channels

The Turbo PMAC2 Ultralite board does not have any on-board channels for controlling amplifiers and motors. A UMAC MACRO System is required providing the necessary channel circuitry.

CPU and Memory

The Turbo PMAC is provided with an 80 MHz DSP56303 CPU (120 MHz PMAC equivalent) and flash memory. Any variable change in a flash type memory must be saved manually in Turbo PMAC for it to be retained on a power-up\reset cycle. Therefore, if machine parameters like parts counters or state variables are required, the Option-16A battery-backed parameter RAM is suggested.

- Option-5C0: This is the standard CPU and memory configuration. It is provided automatically if no Option-5xx is specified. It provides an 80 MHz DSP56303 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.
- Option-5C3: It provides an 80 MHz DSP56303 CPU (120 MHz PMAC equivalent) with 8k x 24 of internal memory, 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.
- Option-5D0: It provides a 100 MHz DSP56309 CPU (150 MHz PMAC equivalent) with 34k x 24 of internal memory, 128k x 24 of compiled/assembled program memory, 128k x 24 of user data memory; and a 1M x 8 flash memory.
- Option-5D3: It provides a 100 MHz DSP56309 CPU (150 MHz PMAC equivalent) with 34k x 24 of internal memory, 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.
- Option-5E0: It provides a 160 MHz DSP56311 CPU (240 MHz PMAC equivalent) with 128k x 24 of internal memory, 128k x 24 of compiled/assembled program memory, 128k x 24 of user data memory; and a 1M x 8 flash memory.
- Option-5E3: It provides a 160 MHz DSP56311 CPU (240 MHz PMAC equivalent) with 128k x 24 of internal memory, 512k x 24 of compiled/assembled program memory, 512k x 24 of user data memory; and a 4M x 8 flash memory.
- Option-16A: 32Kx24 SRAM battery-backed parameter memory

Communications

The Turbo PMAC2 Ultralite board can communicate either through the PCI bus, through RS-422 serial interface using the optional ACC-3D flat cable or through RS-232 serial interface using the optional ACC-3L flat cable. All communication ports in a Turbo PMAC are independent of each other allowing multiple devices to communicate with it at any given time.

- Option-2: This option is not compatible with Option-2B. This option provides 8Kx16 dual-ported RAM circuitry on board of the Turbo PMAC2 Ultralite. It provides a method of sharing memory between Turbo PMAC and the host computer for very fast interchange of data.
- Option-9T: Auxiliary RS-232 serial port. With this option a second serial port circuitry with a 10-pin connector is installed in the Turbo PMAC2 Ultralite. The optional ACC-3L is recommended for this serial port connection.

Firmware Version

Turbo PMAC is provided with the latest firmware revision with both the regular and the extended servo algorithms. Parameters in the Turbo PMAC allow the selection per motor of either the regular or extended servo algorithms.

Option-10: Through this option, an older than the latest firmware released version can be ordered on-board. When possible, use the same firmware revision for similar machines. This is important in cases where the new PMAC is a replacement in an already existing machine or a new machine using existing programs is developed.

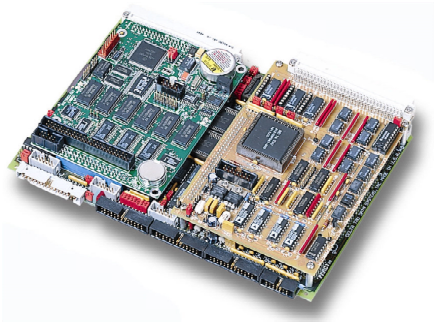
Miscellaneous

Most options to the Turbo PMAC board are possible only to install in the factory, whereas most accessories for Turbo PMAC can be ordered and installed at a later stage. Therefore, it is important to order all the necessary options at the time when PMAC is ordered.

- Option-A: MACRO-ring fiber optic interface connector. This option must match the option ordered on the MACRO CPU\Interface of the UMAC MACRO System.
- Option-C: MACRO-ring fiber RJ-45 electrical interface connector. This option must match the option ordered on the MACRO CPU\Interface of the UMAC MACRO System.
- Option-1U1: First additional MACRO Interface IC (2 Total) for 16 additional MACRO Nodes (32 Total).
- Option-1U2: Second additional MACRO Interface IC (3 Total) for 16 additional MACRO Nodes (48 Total). This option requires Option-1U1.
- Option-1U3: Third additional MACRO Interface IC (4 Total) for 16 additional MACRO Nodes (64 Total). This option requires Option-1U1 and Option-1U2.
- Option-7: Plate mounting for standalone applications. Turbo PMAC2-Ultralite is mounted in an aluminum plate allowing its installation as a stand-alone controller.
- Option-8A: The standard clock crystal in PMAC has ±100 ppm accuracy. Through 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.
- Option-12: 8-channel on-board 12-bit A/D converter. With this option, extra components are added on the PMAC board for eight analog-to-digital converters with 12-bits resolution and 0-5 or ±2.5V range. Typically, this option is used for analog sensors reading but not used regularly for analog sensors feedback devices.
- Option-12A: Extra 8-channel on-board 12-bit A/D converter. This option requires Option-12 and provides a total of 16 analog-to-digital converters with 12-bits resolution and 0-5 or ±2.5V range.
- Option-18A: Electronic board identification number module. This option can be used to let a host computer program identify the Turbo PMAC board connected to the machine.

Turbo PMAC VME, up to 32-Axis with ±10V Outputs VME Board

Recommended for applications that require more than eight ±10V channels in either a VME based or stand alone environment.



Part Number 400-602203-TRx\602200 \ 602199

Number of Channels

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

- 16-bit ±10V differential analog output
- Differential/single-ended encoder input with A, B quadrature channels and C index channel
- Four input flags, two output flags
- Interface to external 16-bit serial ADC

Option-1V: Provides a board that has a second DSPGATE chip with four additional channels axis interface circuitry.

CPU and Memory

The Turbo PMAC is provided with an 80 MHz DSP56303 CPU (120 MHz PMAC equivalent) and flash memory. Any variable change in a flash type memory must be saved manually in Turbo PMAC for it to be retained on a power-up\reset cycle. Therefore, if machine parameters such as parts counters or state variables are required, the Option-16A battery-backed parameter RAM is suggested.

- Option-5C0: This is the standard CPU and memory configuration. It is provided automatically if no Option-5xx is specified. It provides an 80 MHz DSP56303 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.
- Option-5C3: It provides an 80 MHz DSP56303 CPU (120 MHz PMAC equivalent) with 8k x 24 of internal memory, 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.
- Option-5D0: It provides a 100 MHz DSP56309 CPU (150 MHz PMAC equivalent) with 34k x 24 of internal memory, 128k x 24 of compiled/assembled program memory, 128k x 24 of user data memory; and a 1M x 8 flash memory.
- Option-5D3: It provides a 100 MHz DSP56309 CPU (150 MHz PMAC equivalent) with 34k x 24 of internal memory, 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.
- Option-5E0: It provides a 160 MHz DSP56311 CPU (240 MHz PMAC equivalent) with 128k x 24 of internal memory, 128k x 24 of compiled/assembled program memory, 128k x 24 of user data memory; and a 1M x 8 flash memory.
- Option-5E3: It provides a 160 MHz DSP56311 CPU (240 MHz PMAC equivalent) with 128k x 24 of internal memory, 512k x 24 of compiled/assembled program memory, 512k x 24 of user data memory; and a 4M x 8 flash memory.
- Option-16A: 32Kx24 SRAM battery-backed parameter memory

Communications

The Turbo PMAC VME can communicate either through the VME bus or through the RS-422 serial interface using the optional ACC-3D flat cable. All communication ports in a Turbo PMAC are independent of each other allowing multiple devices to communicate with it at any given time. Usually, Turbo PMAC VME users select the Option-2 for a faster and easier method of communication with other VME devices on the rack.

- Option-2V: The 8Kx16 dual-ported RAM provides a method of sharing memory between Turbo PMAC and the host computer for very fast interchange of data. The Option-2V is installed on-board of the Turbo PMAC VME.
- Option-9T: Auxiliary RS-232 serial port. This option is installed in the CPU piggyback board and connects to the computer through the optional ACC-3L flat cable.

Firmware Version

Turbo PMAC is provided with the latest firmware revision with both the regular and the extended servo algorithm. Variables in the Turbo PMAC allow the selection per motor of either the regular or extended servo algorithms.

Option-10: Through this option, an older than the latest firmware released version can be ordered on-board. When possible, use the same firmware revision for similar machines. This is important in cases where the new PMAC is a replacement in an already existing machine or a new machine using existing programs is developed.

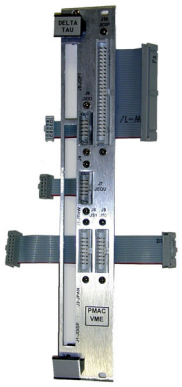
Miscellaneous

The following ports are provided standard in any PMAC:

- Display port for the connection to a vacuum fluorescent or liquid crystal display
- JOPTO port: This port provides eight general-purpose digital inputs and eight general-purpose digital outputs at 5 to 24VDC levels. This 34-pin connector was designed for easy interface to OPTO-22 or equivalent optically isolated I/O modules when different voltage levels or opto-isolation to the PMAC board is necessary.
- Multiplexer port providing eight input lines and eight output lines at TTL levels. When using the PMAC ACC-34x type boards, these lines allow multiplexing large numbers of inputs and outputs on the port. Up to 32 of the multiplexed I/O boards may be daisy-chained on the port, in any combination.
- Control panel port with dedicated control inputs, dedicated indicator outputs, a quadrature encoder input, and an analog input (requires PMAC OPT-15).

Most options to the Turbo PMAC board are possible only to install in the factory whereas most accessories for Turbo PMAC can be ordered and installed at a later stage. Therefore, it is important to order all the necessary options at the time when PMAC is ordered.

- Option-0: Removal of VME interface. Reduces cost for standalone applications by removing the special interface chip used to communicate with the VME bus.
- Option-3V: Extended VME front plate for additional five connectors mounted on front of panel
- Option-3VG: Enclosed plastic PLC style front plate
- Option-7V: Plate mounting for standalone applications. Turbo PMAC VME is mounted in an aluminum plate allowing its installation as a stand-alone controller.
- Option-8A: The standard clock crystal in PMAC has ±100 ppm accuracy. Through 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.
- Option-14: Replacement of flag opto isolators with socketed shunts. This is necessary when a very fast position capture procedure is performed, or 5V-level flag inputs from Opto-22 or equivalent modules are used.
- Option-15: Voltage to frequency (V-to-F) converter to use control panel port analog input. This feature uses one of the encoder channels in PMAC to provide a low-resolution method of a single analog input interface.
- Option-18A: Electronic board identification number module. This option can be used to let a host computer program identify the Turbo PMAC board connected to the machine.



Turbo PMAC2 VME up to 32-Axis with Digital Outputs VME Board

This board can be used installed in a VME bus system or used as a stand-alone motion controller. When combined with the appropriate accessory ACC-8x, it provides up to 32 axes of stepper, digital PWM or analog ±10V amplifier command signals.

Part Numbers 400-602413-TRx \ 602413 \ 602200

Number of Channels

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

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

The base version without options also provides two channels of supplemental interface circuitry, each including:

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

Option-1: Provides a second on-board DSPGATE chip with four additional channels axis interface circuitry. This option must be installed in the factory.

CPU and Memory

The Turbo PMAC is provided with an 80 MHz DSP56303 CPU (120 MHz PMAC equivalent) and flash memory. Any variable change in a flash type memory must be saved manually in Turbo PMAC for it to be retained on a power-up\reset cycle. Therefore, if machine parameters like parts counters or state variables are required, the Option-16A battery-backed parameter RAM is suggested.

- Option-5C0: This is the standard CPU and memory configuration. It is provided automatically if no Option-5xx is specified. It provides an 80 MHz DSP56303 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.
- Option-5C3: It provides an 80 MHz DSP56303 CPU (120 MHz PMAC equivalent) with 8k x 24 of internal memory, 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.
- Option-5D0: It provides a 100 MHz DSP56309 CPU (150 MHz PMAC equivalent) with 34k x 24 of internal memory, 128k x 24 of compiled/assembled program memory, 128k x 24 of user data memory; and a 1M x 8 flash memory.
- Option-5D3: It provides a 100 MHz DSP56309 CPU (150 MHz PMAC equivalent) with 34k x 24 of internal memory, 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.

- Option-5E0: It provides a 160 MHz DSP56311 CPU (240 MHz PMAC equivalent) with 128k x 24 of internal memory, 128k x 24 of compiled/assembled program memory, 128k x 24 of user data memory; and a 1M x 8 flash memory.
- Option-5E3: It provides a 160 MHz DSP56311 CPU (240 MHz PMAC equivalent) with 128k x 24 of internal memory, 512k x 24 of compiled/assembled program memory, 512k x 24 of user data memory; and a 4M x 8 flash memory.
- Option-16A: 32Kx24 SRAM battery-backed parameter memory

Communications

The Turbo PMAC2 VME can communicate either through the VME bus, through the RS-422 serial interface using the optional ACC-3D flat cable or through the RS-232 serial interface using the optional ACC-3L flat cable. All communication ports in a Turbo PMAC are independent of each other allowing multiple devices communicating with it at any given time. Almost all Turbo PMAC VME users select the Option-2 for a faster and easier method of communication with other VME devices on the rack.

- Option-2V: The 8Kx16 dual-ported RAM provides a method of sharing memory between Turbo PMAC and the host computer for fast interchange of data. The Option-2V is installed on-board of the Turbo PMAC2 VME.
- Option-9T: Auxiliary RS-232 serial port. This option is installed in the CPU piggyback board and connects to the computer through the optional ACC-3L flat cable.

Firmware Version

Turbo PMAC is provided with the latest firmware revision with both the regular and the extended servo algorithm. Variables in the Turbo PMAC allow the selection per motor of either the regular or extended servo algorithms.

Option-10: Through this option, an older than the latest firmware released version can be ordered on-board. When possible, use the same firmware revision for similar machines, and this is important in cases where the new PMAC is a replacement in an already existing machine or a new machine using the same existing programs is developed.

Miscellaneous

The following ports are provided standard in any PMAC2:

- Display port for the connection to a vacuum fluorescent or liquid crystal display
- I/O port providing 32 digital I/O lines at 5V CMOS levels configurable by byte for inputs or outputs. ACC-21A provides a convenient method for connection of this port to Opto-22™ or Grayhill type boards.
- Multiplexer port providing eight input lines and eight output lines at TTL levels. When using the PMAC ACC-34x type boards these lines allow multiplexing large numbers of inputs and outputs on the port. Up to 32 of the multiplexed I/O boards may be daisy-chained on the port, in any combination.

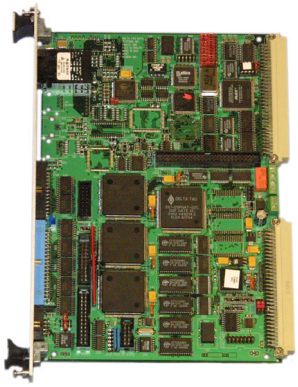
Most options to the Turbo PMAC2 board are possible to install only in the factory, whereas most accessories for Turbo PMAC2 can be ordered and installed at a later stage. Therefore, it is important to order all the necessary options at the time when PMAC is ordered.

- Option-0: Removal of VME interface. Reduces cost for standalone applications by removing the special interface chip used to communicate with the VME bus.
- Option-7V: Plate mounting for standalone applications. Turbo PMAC2 VME is mounted in an aluminum plate allowing its installation as a stand-alone controller.
- Option-8A: The standard clock crystal in PMAC has ±100 ppm accuracy. Through 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.

- Option-12: 8-channel on-board 12-bit A/D converter. With this option, extra components are added on the PMAC board for eight analog-to-digital converters with 12-bits resolution and 0-5 or ±2.5V range. Typically, this option is used for analog sensors reading but not used regularly for analog sensors feedback devices.
- Option-12A: Extra 8-channel on-board 12-bit A/D converter. This option requires Option-12 and provides a total of 16 analog-to-digital converters with 12-bits resolution and 0-5 or ±2.5V range.
- Option-18A: Electronic board identification number module. This option can be used to let a host computer program identify the Turbo PMAC board connected to the machine.

PMAC2 VME Turbo Ultralite 32-Axis with MACRO Link VME

This board can be used installed in a PCI bus host computer or used as a stand-alone motion controller. This board must be complemented with MACRO components allowing distributed motion control over a fiber optic link or a twisted pair connection. The term Ultralite stands for no DSPGATE Gate-Array ICs on board of this kind of PMAC2. The ASICs are located in a different set of boards, usually remotely located from PMAC2, referred as UMAC MACRO systems. A Turbo PMAC2 Ultralite board can control up to 32 axes. A single UMAC MACRO can connect up to 16 axes. Therefore, two UMAC MACRO systems can be tied together in a single ring for a convenient motion control distribution.



Part Number 400-603616-100

Number of Channels

The Turbo PMAC2 Ultralite board does not have on-board channels for controlling amplifiers and motors. A UMAC MACRO System is required providing the necessary channel circuitry.

CPU and Memory

The Turbo PMAC with the 5AS Processor Option (default) is provided with an 80 MHz DSP56303 CPU (120 MHz PMAC equivalent) and flash memory. Any variable change in a flash type memory must be saved manually in Turbo PMAC for it to be retained on a power-up\reset cycle. Therefore, if machine parameters such as parts counters or state variables are required, the Option-16A battery-backed parameter RAM is suggested.

- Option-5C0: This is the standard CPU and memory configuration. It is provided automatically if no Option 5xx is specified. It provides an 80 MHz DSP56303 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.
- Option-5C3: It provides an 80 MHz DSP56303 CPU (120 MHz PMAC equivalent) with 8k x 24 of internal memory, 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.
- Option-5D0: It provides a 100 MHz DSP56309 CPU (150 MHz PMAC equivalent) with 34k x 24 of internal memory, 128k x 24 of compiled/assembled program memory, 128k x 24 of user data memory; and a 1M x 8 flash memory.

- Option-5D3: It provides a 100 MHz DSP56309 CPU (150 MHz PMAC equivalent) with 34k x 24 of internal memory, 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.
- Option-5E0: It provides a 160 MHz DSP56311 CPU (240 MHz PMAC equivalent) with 128k x 24 of internal memory, 128k x 24 of compiled/assembled program memory, 128k x 24 of user data memory; and a 1M x 8 flash memory.
- Option-5E3: It provides a 160 MHz DSP56311 CPU (240 MHz PMAC equivalent) with 128k x 24 of internal memory, 512k x 24 of compiled/assembled program memory, 512k x 24 of user data memory; and a 4M x 8 flash memory.
- Option-16A: 32Kx24 SRAM battery-backed parameter memory

Communications

The Turbo PMAC2 Ultralite board can communicate either through the VME bus, through RS-422 serial interface using the optional ACC-3D flat cable or through RS-232 serial interface using the optional ACC-3L flat cable. All communication ports in a Turbo PMAC are independent of each other allowing multiple devices communicating with it at any given time.

- Option-2A: This option is not compatible with Option-2B. This option provides a 8Kx16 dual-ported RAM circuitry on board of the Turbo PMAC2 Ultralite. It provides a method of sharing memory between Turbo PMAC and the host computer for fast interchange of data.
- Option-2B: This option is not compatible with Option-2A. This option provides a 32Kx16 dual-ported RAM circuitry on board of the Turbo PMAC2 Ultralite. It provides a method of sharing memory between Turbo PMAC and the host computer for fast interchange of data.
- Option-9T: Auxiliary RS-232 serial port. With this option, a second serial port circuitry with a 10-pin connector is installed in the Turbo PMAC2-Ultralite. The optional ACC-3L is recommended for this serial port connection.

Firmware Version

Turbo PMAC2 is provided with the latest firmware revision with the regular servo algorithm.

Option-10: Through this option, an older than the latest firmware released version can be ordered on-board. This is important in cases where the new PMAC is a replacement in an already existing machine or a new machine using existing programs is developed. When possible, use the same firmware revision for similar machines.

Miscellaneous

Most options to the Turbo PMAC board can be installed only in the factory, whereas most accessories for Turbo PMAC can be ordered and installed at a later stage. Therefore, it is important to order all the necessary options at the time when PMAC is ordered.

- Option-A: MACRO-ring fiber optic interface connector. This option must match the option ordered on the MACRO CPU Interface of the UMAC MACRO System.
- Option-C: MACRO-ring fiber RJ-45 electrical interface connector. This option must match the option ordered on the MACRO CPU Interface of the UMAC MACRO System.
- Option-1U1: First additional MACRO Interface IC (2 Total) for 16 additional MACRO Nodes (32 Total).
- Option-1U2: Second additional MACRO Interface IC (3 Total) for 16 additional MACRO Nodes (48 Total). This option requires Option-1U1.
- Option-1U3: Third additional MACRO Interface IC (4 Total) for 16 additional MACRO Nodes (64 Total). This option requires Option-1U1 and Option-1U2.
- Option-7V: Plate mounting for standalone applications. Turbo PMAC2 Ultralite is mounted in an aluminum plate allowing its installation as a stand-alone controller.

- Option-8A: The standard clock crystal in Turbo PMAC has ±100 ppm accuracy. Through this option, a high-accuracy clock crystal (+/-15ppm) 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.
- Option-9T: Auxiliary RS-232 Serial Port. With this option, a second serial port circuitry with a 10-pin connector is installed in the Turbo PMAC2 VME Ultralite. The optional ACC-3L is recommended for this serial port connector.
- Option-0VA: Removal of VME interface. Reduces cost for standalone applications by removing the special interface chip used to communicate with the VME bus.

NON-TURBO PMAC BOARDS

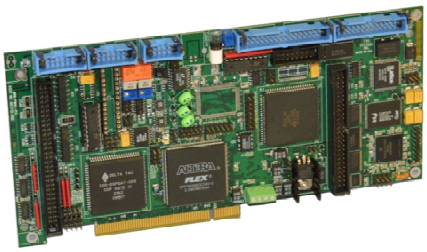
The Non-Turbo PMAC family should be selected based on the following features:

- Application is limited to eight axes or less. The non-Turbo PMAC can be either PMAC(1) or PMAC2 type.
- No advanced lookahead (tighter acceleration and velocity control) or inverse kinematics (robotics) built-in features is required.
- None of the following features of the Turbo PMAC family of motion controllers is required: improved overall firmware features including better data array programming, more efficient analog inputs multiplexing, both regular and extended servo algorithms on the standard firmware, completely independent communication ports and optional second serial port.

Board Name	PCI	PC-104	VME	USB	MACRO	RS-232 / 422	1-2 Axes	1-4 Axes	1-8 Axes	1-32 Axes	Analog ± 10 V Commands	Digital PWM Commands	Stepper Commands
PMAC-Mini PCI	●					●	●				●		
PMAC-Lite PCI	●			●		●	●	●			●		
PMAC-PCI	●			●		●	●	●	●		●		
PMAC2-Lite PCI	●			●		●	●	●			●	●	●
PMAC2-PCI	●			●		●	●	●	●		●	●	●
PMAC2-PCI Ultralite	●				●	●	●	●	●		●	●	●
PMAC2A-PC/104		●		●		●	●	●	●		●	●	●
PMAC-VME			●	●		●	●	●	●		●		
PMAC2-VME Ultralite			●	●	●	●	●	●	●		●	●	●
PMAC2-VME			●	●		●	●	●	●		●	●	●

PMAC PCI Mini, 2-Axis with ±10V Servo Outputs PCI Board

Recommended for applications with one or two ±10V channel requirements in either a PCI PC based or stand-alone environment. The term Mini stands for the limitation of one half DSPGATE Gate Array IC on board. Two extra full encoder channels (for a total of four on-board) can be used for dual feedback applications or, with the two optional voltage-to-frequency (V/F) converters, for stepper drivers or hybrid amplifiers control. There is no control panel port or bus interrupt in the PMAC Mini board. The number of channels can be expanded, from two to ten, through the use of an ACC-24P.



Part Number 400-603712-10x

Number of Channels

The PMAC Mini can have only one on-board DSPGATE. Two of the four channels in the DSPGATE chip are used partially by only using its encoder inputs. The remaining two channels are used fully providing two channels of axis interface circuitry, each including:

- 16-bit ±10V differential analog output
- Differential/single-ended encoder input with A, B quadrature channels and C index channel
- Four input flags, two output flags
- Interface to external 16-bit serial ADC

CPU and Memory

The base version without options has a 40 MHz DSP563xx CPU with flash memory.

- Option-5CF: 80 MHz CPU with internal zero-wait-state triple-bus SRAM, flash backup, no battery (600% speed increase).
- Option-5EF: 160 MHz CPU with internal zero-wait-state triple-bus SRAM, flash backup, no battery (1200% speed increase).

Communications

The PMAC Mini can communicate through the PCI bus or through the RS-232 serial interface using the optional ACC-3L flat cable. Only one method of communication is allowed at a time.

- Option-2: The 8Kx16 dual-ported RAM provides a method of sharing memory between PMAC and the host computer for very fast interchange of data.
- Option-3: 12 Mbit/sec USB1.1 communications port. When this option is used, the PCI port is disabled.

Firmware Version

PMAC is provided with the latest firmware revision with the regular servo algorithm.

- Option-6: This option provides an Extended (Pole-Placement) Servo Algorithm firmware instead of the regular servo algorithm firmware. This is required only in difficult-to-control systems (resonances, backlash, friction, disturbances, changing dynamics).
- Option-6L: This option provides a multi-block lookahead firmware for tighter trajectory and acceleration control.
- Option-10: Through this option, an older than the latest firmware released version can be ordered on-board. When possible, use the same firmware revision for similar machines. This is important in cases where the new PMAC is a replacement in an already existing machine or a new machine using existing programs is developed.

Miscellaneous

The following ports are provided standard in any PMAC:

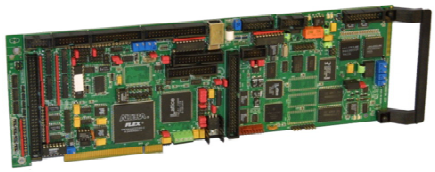
- Display port for the connection to a vacuum fluorescent or liquid crystal display
- JOPTO port: This port provides eight general-purpose digital inputs and eight general-purpose digital outputs at 5 to 24VDC levels and a maximum of 100 mA per output. This 34-pin connector was designed for easy interface to OPTO-22 or equivalent optically isolated I/O modules when different voltage levels or opto-isolation to the PMAC board is necessary.
- Multiplexer port providing 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.

Most options to the PMAC board are possible to install only in the factory, whereas most accessories for PMAC can be ordered and installed at a later stage. Therefore, it is important to order all the necessary options at the time when PMAC is ordered.

- Option-7: Plate mounting for standalone applications. The PMAC Mini is mounted in an aluminum plate allowing its installation as a stand-alone controller.
- Option-8A: The standard clock crystal in PMAC has ±100 ppm accuracy. Through 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.
- Option-15: Two voltage-to-frequency converter chips are installed on-board. This feature allows two axis of pulse and direction (stepper) control or a low-resolution method for two analog inputs interface. This feature uses the two on-board extra encoder channels 3 and 4.

PMAC PCI Lite, 4-Axis with ±10V Servo Outputs PCI Board

Recommended for applications with three or four ±10V channel requirements in either a PCI PC based or stand alone environment. The term Lite stands for the limitation of only one DSPGATE Gate-Array IC on board. The number of channels can always be expanded, from 4 to 12, through the use of an ACC-24P.



Part Number 400-603657-10x

Number of Channels

The PMAC PCI Lite can have only one on-board DSPGATE that provides four channels axis interface circuitry, each including:

- 16-bit ±10V differential analog output
- Differential/single-ended encoder input with A, B quadrature channels and C index channel
- Four input flags, two output flags
- Interface to external 16-bit serial ADC

CPU and Memory

The base version without options has a 40 MHz DSP563xx CPU with flash memory. Any variable change in a flash type memory must be saved manually in PMAC for it to be retained on a power-up\reset cycle. Therefore, if machine parameters like parts counters or state variables are required, the Option-16 battery-backed parameter RAM is suggested.

- Option-5CF: 80 MHz CPU with internal zero-wait-state triple-bus SRAM, flash backup, no battery (600% speed increase). Requires V1.17 or newer firmware.
- Option-5EF: 160 MHz CPU with internal zero-wait-state triple-bus SRAM, flash backup, no battery (1200% speed increase). Requires V1.17 or newer firmware.
- Option-16: 16K x 24 battery-backed parameter RAM

Communications

The PMAC PCI Lite can communicate through the PCI bus, through the RS-422 serial interface using the optional ACC-3D flat cable or through the RS-232 serial interface using the optional ACC-3L flat cable. Only one method of communication is allowed at a time.

- Option-2: The 8Kx16 dual-ported RAM provides a method of sharing memory between PMAC and the host computer for very fast interchange of data.
- Option-3: 12 Mbit/sec USB1.1 communications port. When this option is used, the PCI port is disabled.

Firmware Version

PMAC is provided with the latest firmware revision with the regular servo algorithm.

- Option-6: This option provides an Extended (Pole-Placement) Servo Algorithm firmware instead of the regular servo algorithm firmware. This is required only in difficult-to-control systems (resonances, backlash, friction, disturbances, changing dynamics).
- Option-6L: This option provides a multi-block lookahead firmware for tighter trajectory and acceleration control.
- Option-10: Through this option, an older than the latest firmware released version can be ordered on-board. When possible, use the same firmware revision for similar machines. This is important in cases where the new PMAC is a replacement in an already existing machine or a new machine using existing programs is developed.

Miscellaneous

The following ports are provided standard in any PMAC:

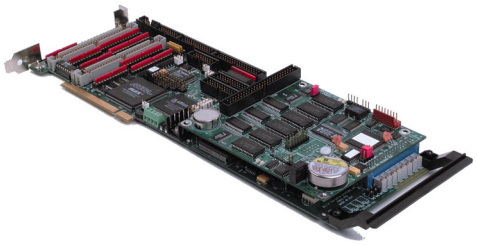
- Display port for the connection to a vacuum fluorescent or liquid crystal display
- JOPTO port: This port provides eight general-purpose digital inputs and eight general-purpose digital outputs at 5 to 24VDC levels and a maximum of 100 mA per output. This 34-pin connector was designed for easy interface to OPTO-22 or equivalent optically isolated I/O modules when different voltage levels or opto-isolation to the PMAC board is necessary.
- Multiplexer port providing 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.
- Control panel port with dedicated control inputs, dedicated indicator outputs, a quadrature encoder input, and an analog input (requires PMAC OPT-15)

Most options to the PMAC board are possible to install only in the factory, whereas most accessories for PMAC can be ordered and installed at a later stage. Therefore, it is important to order all the necessary options at the time when PMAC is ordered.

- Option-7: Plate mounting for standalone applications. PMAC is mounted in an aluminum plate allowing its installation as a stand-alone controller.
- Option-8A: The standard clock crystal in PMAC has ±100 ppm accuracy. Through 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.
- Option-12: 8-channel on-board 12-bit A/D converter. With this option, extra components are added on the PMAC board for eight analog-to-digital converters with 12-bits resolution and 0-5 or ±2.5V range. Typically, this option is used for analog sensors reading but not used regularly for analog sensors feedback devices.
- Option-12A: Extra 8-channel on-board 12-bit A/D converter. This option requires Option-12 and provides a total of 16 analog-to-digital converters with 12-bits resolution and 0-5 or ±2.5V range.
- Option-15: Voltage to frequency (V-to-F) converter to use control panel port analog input. This feature uses one of the encoder channels in PMAC to provide a low-resolution method of a single analog input interface.

PMAC PCI, 8-Axis with ±10V Servo Outputs PCI Board

Recommended for applications that require four to eight ±10V channels in either a PCI PC based or stand alone environment.



Part Number 400-603588-10x

Number of Channels

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

- 16-bit ±10V differential analog output
- Differential/single-ended encoder input with A, B quadrature channels and C index channel
- Four input flags, two output flags
- Interface to external 16-bit serial ADC

Option-1: Provides a second on-board DSPGATE chip with four additional channels axis interface circuitry. Since this option consists of extra ICs added on the baseboard, it must be installed in the factory.

CPU and Memory

The base version without options has a 40 MHz DSP563xx CPU with flash memory. Any variable change in a flash type memory must be saved manually in PMAC for it to be retained on a power-up\reset cycle. Therefore, if machine parameters like parts counters or state variables are required, the Option-16 battery-backed parameter RAM is suggested.

- Option-5CF: 80 MHz CPU with internal zero-wait-state triple-bus SRAM, flash backup, no battery (600% speed increase). Requires V1.17 or newer firmware.
- Option-5EF: 160 MHz CPU with internal zero-wait-state triple-bus SRAM, flash backup, no battery (1200% speed increase). Requires V1.17 or newer firmware.
- Option-16: 16K x 24 battery-backed parameter RAM

Communications

The PMAC PCI can communicate either through the PCI bus or through the RS-422 serial interface using the optional ACC-3D flat cable. Only one method of communication is allowed at a time.

- Option-2: The 8Kx16 dual-ported RAM provides a method of sharing memory between PMAC and the host computer for very fast interchange of data.
- Option-3: 12 Mbit/sec USB1.1 communications port. When this option is used, the PCI port is disabled.

Firmware Version

PMAC is provided with the latest firmware revision with the regular servo algorithm.

- Option-6: This option provides an Extended (Pole-Placement) Servo Algorithm firmware instead of the regular servo algorithm firmware. This is required only in difficult-to-control systems (resonances, backlash, friction, disturbances, changing dynamics).
- Option-6L: This option provides a multi-block lookahead firmware for tighter trajectory and acceleration control.

- Option-10: Through this option, an older than the latest firmware released version can be ordered on-board. When possible, use the same firmware revision for similar machines. This is important in cases where the new PMAC is a replacement in an already existing machine or a new machine using existing programs is developed.

Miscellaneous

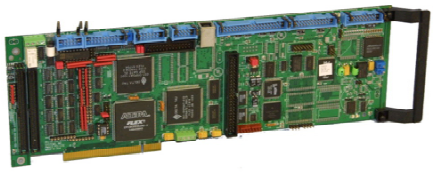
The following ports are provided standard in any PMAC:

- Display port for the connection to a vacuum fluorescent or liquid crystal display
- JOPTO port: This port provides eight general-purpose digital inputs and eight general-purpose digital outputs at 5 to 24VDC levels and a maximum of 100 mA per output. This 34-pin connector was designed for easy interface to OPTO-22 or equivalent optically isolated I/O modules when different voltage levels or opto-isolation to the PMAC board is necessary.
- Multiplexer port providing 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.
- Control panel port with dedicated control inputs, dedicated indicator outputs, a quadrature encoder input, and an analog input (requires PMAC OPT-15)

Most options to the PMAC board are possible to install only in the factory, whereas most accessories for PMAC can be ordered and installed at a later stage. Therefore, it is important to order all the necessary options at the time when PMAC is ordered.

- Option-7: Plate mounting for standalone applications. PMAC is mounted in an aluminum plate allowing its installation as a stand-alone controller.
- Option-8A: The standard clock crystal in PMAC has ±100 ppm accuracy. Through 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.
- Option-12: 8-channel on-board 12-bit A/D converter. With this option, extra components are added on the PMAC board for eight analog-to-digital converters with 12-bits resolution and 0-5 or ±2.5V range. Typically, this option is used for analog sensors reading but not used regularly for analog sensors feedback devices.
- Option-12A: Extra 8-channel on-board 12-bit A/D converter. This option requires Option-12 and provides a total of 16 analog-to-digital converters with 12-bits resolution and 0-5 or ±2.5V range.
- Option-15: Voltage to frequency (V-to-F) converter to use control panel port analog input. This feature uses one of the encoder channels in PMAC to provide a low-resolution method of a single analog input interface.

PMAC2 PCI Lite, 4-axis with Digital Servo Outputs PCI Board



This board can be used installed in a PCI bus host computer or used as a stand-alone motion controller. When combined with the appropriate accessory ACC-8x, it provides four axes of analog ±10V, digital direct PWM, or pulse and direction amplifier command signals. The term Lite stands for the limitation of only one DSPGATE Gate-Array IC on board. The number of channels can be expanded, from 4 to 12, through the use of an ACC-24P2.

Part Number 400-603658-10x

Number of Channels

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

- Three output command signal sets, configurable as either:
  - Two serial data streams to external DACs, one pulse-&-direction
  - Three PWM top-and-bottom pairs

- 3-channel differential/single-ended encoder input
- Nine input flags, two output flags
- Interface to two external serial ADCs, 8 to 18 bits

The base version without options also provides two channels of supplemental interface circuitry, each including:

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

CPU and Memory

The PMAC is provided with a 40 MHz DSP563xx CPU and flash memory. Any variable change in a flash type memory must be saved manually in PMAC for it to be retained on a power-up\reset cycle. Therefore, if machine parameters like parts counters or state variables are required, the Option-16A battery-backed parameter RAM is suggested.

- Option-5CF: 80 MHz CPU with internal zero-wait-state triple-bus SRAM, flash backup, no battery (600% speed increase)
- Option-5EF: 160 MHz CPU with internal zero-wait-state triple-bus SRAM, flash backup, no battery (1200% speed increase)
- Option-16: 16K x 24 battery-backed parameter RAM

Communications

The PMAC2 PCI Lite can communicate through the PCI bus, through the RS-422 serial interface using the optional ACC-3D flat cable or through the RS-232 serial interface using the optional ACC-3L flat cable. Only one method of communication is allowed at a time.

- Option-2: The 8Kx16 dual-ported RAM provides a method of sharing memory between PMAC and the host computer for very fast interchange of data. The Option-2 is installed on-board of the PMAC2 Lite.
- Option-3: 12 Mbit/sec USB1.1 communications port. When this option is used, the PCI port is disabled.

Firmware Version

PMAC is provided with the latest firmware revision with the regular servo algorithm.

- Option-6: This option provides an Extended (Pole-Placement) Servo Algorithm firmware instead of the regular servo algorithm firmware. This is required only in difficult-to-control systems (resonances, backlash, friction, disturbances, changing dynamics).
- Option-6L: This option provides a multi-block lookahead firmware for tighter trajectory and acceleration control.
- Option-10: Through this option, an older than the latest firmware released version can be ordered on-board. When possible, use the same firmware revision for similar machines. This is important in cases where the new PMAC is a replacement in an already existing machine or a new machine using existing programs is developed.

Miscellaneous

The following ports are provided standard in any PMAC2:

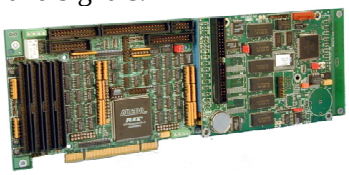
- Display port for the connection to a vacuum fluorescent or liquid crystal display
- I/O port providing 32 digital I/O lines at 5V CMOS levels configurable by byte for inputs or outputs. ACC-21A provides a convenient method for connection of this port to Opto-22™ or Grayhill type boards.
- Multiplexer port providing 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.

Most options to the PMAC board are possible to install only in the factory, whereas most accessories for PMAC can be ordered and installed at a later stage. Therefore, it is important to order all the necessary options at the time when PMAC is ordered.

- Option-7: Plate mounting for standalone applications. The PMAC is mounted in an aluminum plate allowing its installation as a stand-alone controller.
- Option-8A: The standard clock crystal in PMAC has ±100 ppm accuracy. Through 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.
- Option-12: 8-channel on-board 12-bit A/D converter. With this option, extra components are added on the PMAC board for eight analog-to-digital converters with 12-bits resolution and 0-5 or ±2.5V range. Typically, this option is used for analog sensors reading but not used regularly for analog sensors feedback devices.
- Option-12A: Extra 8-channel on-board 12-bit A/D converter. This option requires Option-12 and provides a total of 16 analog-to-digital converters with 12-bits resolution and 0-5 or ±2.5V range.

PMAC2 PCI, 8-Axis with Digital Servo Outputs PCI Board

This board can be used installed in a PCI bus host computer or used as a stand-alone motion controller. When combined with the appropriate accessory ACC-8x, it provides up to eight axes of stepper, digital PWM or analog ±10V amplifier command signals.



Part Number 400-603367-10x

Number of Channels

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

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

The base version without options also provides two channels of supplemental interface circuitry, each including:

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

Option-1: Provides a second on-board DSPGATE chip with four additional channels axis interface circuitry. Since this option consists of extra ICs added on the baseboard, it must be installed in the factory.

CPU and Memory

The base version without options has a 40 MHz DSP563xx CPU with flash memory. Any variable change in a flash type memory must be saved manually in PMAC for it to be retained on a power-up\reset cycle. Therefore, if machine parameters like parts counters or state variables are required, the Option-16 battery-backed parameter RAM is suggested.

- Option-5CF: 80 MHz CPU with internal zero-wait-state triple-bus SRAM, flash backup, no battery (600% speed increase). Requires V1.17 or newer firmware.
- Option-5EF: 160 MHz CPU with internal zero-wait-state triple-bus SRAM, flash backup, no battery (1200% speed increase). Requires V1.17 or newer firmware.
- Option-16: 16K x 24 battery-backed parameter RAM

Communications

The PMAC2 can communicate through the PCI bus or through the RS-232 serial interface using the optional ACC-3L flat cable. Only one method of communication is allowed at a time.

- Option-2: The 8Kx16 dual-ported RAM provides a method of sharing memory between PMAC and the host computer for very fast interchange of data. The Option-2 is installed on-board of the PMAC2.
- Option-9L: This option is a piggyback board that replaces the RS-232 interface with an RS-422 interface.

Firmware Version

PMAC is provided with the latest firmware revision with the regular servo algorithm.

- Option-6: This option provides an Extended (Pole-Placement) Servo Algorithm firmware instead of the regular servo algorithm firmware. This is required only in difficult-to-control systems (resonances, backlash, friction, disturbances, changing dynamics).
- Option-6L: This option provides a multi-block lookahead firmware for tighter trajectory and acceleration control.
- Option-10: Through this option, an older than the latest firmware released version can be ordered on-board. When possible, use the same firmware revision for similar machines. This is important in cases where the new PMAC is a replacement in an already existing machine or a new machine using existing programs is developed.

Miscellaneous

The following ports are provided standard in any PMAC2:

- Display port for the connection to a vacuum fluorescent or liquid crystal display
- I/O port providing 32 digital I/O lines at 5V CMOS levels configurable by byte for inputs or outputs. ACC-21A provides a convenient method for connection of this port to Opto-22™ or Grayhill type boards.
- Multiplexer port providing eight input lines and eight output lines at TTL levels. When using the PMAC ACC-34x type boards, these lines allow multiplexing large numbers of inputs and outputs on the port. Up to 32 of the multiplexed I/O boards may be daisy-chained on the port, in any combination.

Most options to the PMAC board can be installed only in the factory, whereas most accessories for PMAC can be ordered and installed at a later stage. Therefore, it is important to order all the necessary options at the time when PMAC is ordered.

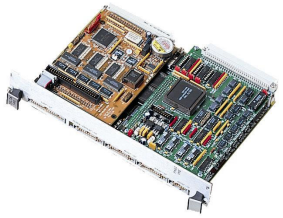
- Option-7: Plate mounting for standalone applications. The PMAC is mounted in an aluminum plate allowing its installation as a stand-alone controller.
- Option-8A: The standard clock crystal in PMAC has ±100 ppm accuracy. Through this option, a high-accuracy clock crystal (±15 ppm) is installed instead. 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.
- Option-12: 8-channel on-board 12-bit A/D converter. With this option, extra components are added on the PMAC board for eight analog-to-digital converters with 12-bits resolution and 0-5 or ±2.5V range. Typically, this option is used for analog sensors reading but not used regularly for analog sensors feedback devices.
- Option-12A: Extra 8-channel on-board 12-bit A/D converter. This option requires Option-12 and provides a total of 16 analog-to-digital converters with 12-bits resolution and 0-5 or ±2.5V range.

PMAC VME, 8-Axis with ±10V Outputs VME Board

Recommended for applications that require up to eight ±10V channels in either a VME based or stand alone environment.

Part Numbers 400-602203-10x \ 602200 \ 602199

Number of Channels



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

- 16-bit ±10V differential analog output
- Differential/single-ended encoder input with A, B quadrature channels and C index channel
- Four input flags, two output flags
- Interface to external 16-bit serial ADC

Option-1V: Provides a board that has a second DSPGATE chip with four additional channels axis interface circuitry.

CPU and Memory

The base version without options has a 20 MHz DSP56002 CPU with one wait-state battery-backed RAM. The memory on the CPU options is flash type with zero-wait state allowing faster access from the CPU and therefore providing a significant speed increase. However, any variable change in a flash type memory must be saved manually in PMAC for it to be retained on a power-up\reset cycle. Therefore, if machine parameters like parts counters or state variables are required, the Option-16 battery-backed parameter RAM is suggested as a complement to the faster CPU options.

- Option-4A: 20 MHz CPU, zero-wait RAM, flash backup, no battery, (~25% speed increase)
- Option-5A: 40 MHz CPU, zero-wait RAM, flash backup, no battery, (~125% speed increase)
- Option-5B: 60 MHz CPU, zero-wait RAM, flash backup, no battery, (~250% speed increase)
- Option-5CF: 80 MHz CPU with internal zero-wait-state triple-bus SRAM, flash backup, no battery (600% speed increase). Requires V1.17 or newer firmware.
- Option-5EF: 160 MHz CPU with internal zero-wait-state triple-bus SRAM, flash backup, no battery (1200% speed increase). Requires V1.17 or newer firmware.
- Option-16: 16K x 24 battery-backed parameter RAM (Requires OPT-4A, 5A, 5B or 5CF or 5EF)

Communications

The PMAC VME can communicate either through the VME bus or through the RS-422 serial interface using the optional ACC-3D flat cable. Only one method of communication is allowed at a time. However, most PMAC-VME users select Option-2 for a faster and easier method of communication with other VME devices on the rack.

Option-2V: The 8Kx16 dual-ported RAM provides a method of sharing memory between PMAC and the host computer for very fast interchange of data. The Option-2V is installed on-board of the PMAC VME.

Firmware Version

PMAC is provided with the latest firmware revision with the regular servo algorithm.

- Option-6: This option provides an Extended (Pole-Placement) Servo Algorithm firmware instead of the regular servo algorithm firmware. This is required only in difficult-to-control systems (resonances, backlash, friction, disturbances, changing dynamics).
- Option-6L: This option provides a multi-block lookahead firmware for tighter trajectory and acceleration control.
- Option-10: Through this option, an older than the latest firmware released version can be ordered on-board. When possible, use the same firmware revision for similar machines. This is important in cases where the new PMAC is a replacement in an already existing machine or a new machine using existing programs is developed.

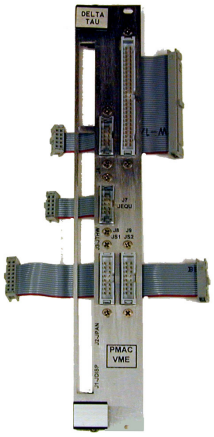
Miscellaneous

The following ports are provided standard in any PMAC:

- Display port for the connection to a vacuum fluorescent or liquid crystal display
- JOPTO port: This port provides eight general-purpose digital inputs and eight general-purpose digital outputs at 5 to 24VDC levels. This 34-pin connector was designed for easy interface to OPTO-22 or equivalent optically isolated I/O modules when different voltage levels or opto-isolation to the PMAC board is necessary.
- 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 large numbers of inputs and outputs on the port. Up to 32 of the multiplexed I/O boards may be daisy-chained on the port, in any combination.
- Control panel port with dedicated control inputs, dedicated indicator outputs, a quadrature encoder input, and an analog input (requires PMAC OPT-15).

Most options to the PMAC board are possible to install only in the factory, whereas most accessories for PMAC can be ordered and installed at a later stage. Therefore, it is important to order all the necessary options at the time when PMAC is ordered.

- Option-0: Removal of VME interface. Reduces cost for standalone applications by removing the special interface chip used to communicate with the VME bus.
- Option-3V: Extended VME front plate for additional five connectors mounted on front of panel
- Option-3VG: Enclosed plastic PLC style front plate
- Option-7V: Plate mounting for standalone applications. PMAC is mounted in an aluminum plate allowing its installation as a stand-alone controller.
- Option-8A: The standard clock crystal in PMAC has ±100 ppm accuracy. Through 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.
- Option-14: Replacement of flag opto isolators with socketed shunts. This is necessary when a fast position capture procedure is performed, or 5V-level flag inputs from Opto-22 or equivalent modules are used.
- Option-15: Voltage to frequency (V-to-F) converter to use control panel port analog input. This feature uses one of the encoder channels in PMAC to provide a low-resolution method of a single analog input interface.



PMAC2 VME, 8-Axis with Digital Outputs VME Board

This board can be used installed in a VME bus system or used as a stand-alone motion controller. When combined with ACC-8x, it provides up to eight axes of stepper, digital PWM or analog ±10V amplifier command signals.

Part Numbers 400-602413-10x \ 602413 \ 602414

Number of Channels

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

- Three output command signal sets, configurable as either:
  - Two serial data streams to external DACs, one pulse-&-direction
  - Three PWM top-and-bottom pairs
- 3-channel differential/single-ended encoder input

- Nine input flags, two output flags
- Interface to two external serial ADCs, 8 to 18 bits

In addition, the base version without options provides two channels of supplemental interface circuitry, each including:

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

Option-1V: Provides a board that has a second DSPGATE chip with four additional channels axis interface circuitry.

CPU and Memory

The PMAC is provided with a 40 MHz DSP56002 CPU and flash memory. Any variable change in a flash type memory must be saved manually in PMAC for it to be retained on a power-up\reset cycle. Therefore, if machine parameters like parts counters or state variables are required, the Option-16A battery-backed parameter RAM is suggested.

- Option-5B: 60 MHz CPU, zero-wait state SRAM, (50% speed increase)
- Option-5CF: 80 MHz CPU with internal zero-wait-state triple-bus SRAM, flash backup, no battery (250% speed increase). Requires V1.17 or newer firmware.
- Option-5EF: 160 MHz CPU with internal zero-wait-state triple-bus SRAM, flash backup, no battery (500% speed increase). Requires V1.17 or newer firmware.

Communications

The PMAC2 can communicate through the VME bus, the RS-422 serial interface using the optional ACC-3D flat cable or the RS-232 serial interface using the optional ACC-3L flat cable. Only one method of communication is allowed at a time. However, most PMAC VME users select Option-2 for a faster and easier method of communication with other VME devices on the rack.

Option-2: The 8Kx16 dual-ported RAM provides a method of sharing memory between PMAC and the host computer for very fast interchange of data. The Option-2V is installed on-board of the PMAC VME.

Firmware Version

PMAC is provided with the latest firmware revision with the regular servo algorithm.

- Option-6: This option provides an Extended (Pole-Placement) Servo Algorithm firmware instead of the regular servo algorithm firmware. This is required only in difficult-to-control systems (resonances, backlash, friction, disturbances, changing dynamics).
- Option-6L: This option provides a multi-block lookahead firmware for tighter trajectory and acceleration control.
- Option-10: Through this option, an older than the latest firmware released version can be ordered on-board. When possible, use the same firmware revision for similar machines. This is important in cases where the new PMAC is a replacement in an already existing machine or a new machine using existing programs is developed.

Miscellaneous

The following ports are provided standard in any PMAC2:

- Display port for the connection to a vacuum fluorescent or liquid crystal display
- I/O port provides 32 digital I/O lines at 5V CMOS levels configurable by byte for inputs or outputs. ACC-21A provides a convenient method for connection of this port to Opto-22™ or Grayhill type boards.
- 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 large numbers of inputs and outputs on the port. Up to 32 of the multiplexed I/O boards may be daisy-chained on the port, in any combination.

Most options to the PMAC board are possible to install only in the factory, whereas most accessories for PMAC can be ordered and installed at a later stage. Therefore, it is important to order all the necessary options at the time when PMAC is ordered.

- Option-0: Removal of VME interface. Reduces cost for standalone applications by removing the special interface chip used to communicate with the VMEbus.
- Option-7V: Plate mounting for standalone applications. The PMAC is mounted in an aluminum plate allowing its installation as a stand-alone controller.
- Option-8A: The standard clock crystal in PMAC has ±100 ppm accuracy. Through 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.
- Option-12: 8-channel on-board 12-bit A/D converter. With this option, extra components are added on the PMAC board for eight analog-to-digital converters with 12-bits resolution and 0-5 or ±2.5V range. Typically, this option is used for analog sensors reading but not used regularly for analog sensors feedback devices.
- Option-12A: Extra 8-channel on-board 12-bit A/D converter. This option requires Option-12 and provides a total of 16 analog-to-digital converters with 12-bits resolution and 0-5 or ±2.5V range.

PMAC2A-PC/104, 8-Axis with Digital Servo Outputs PC/104 Board

The PMAC2A-PC104 motion controller is a compact, cost-effective version of the Delta Tau's PMAC2 family of controllers. It can be composed of up to three boards in a stack configuration, allowing to control up to eight axes with analog ±10V, digital PWM, or pulse and direction amplifier command signals. This motion controller can be used stand-alone or commanded by a host computer with its RS-232 serial port or the optional PC/104 bus interface, USB or Ethernet communication methods.

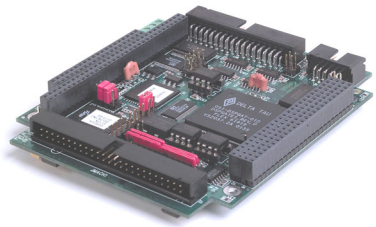
4-Axis Base Board

Part Number 400-603670-10x

Number and Type of Servo Channels

The base version without options is a 90mm x 95mm board and it provides a 4-channel axis interface circuitry, each including:

- Single 12-bit ±10V differential analog output (DAC) or pulse-&-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
- Two output flags: amplifier enable signal at 5-24 VDC levels and encoder compare EQU line at TTL levels



PMAC2A-PC/104 Base Board

General-Purpose I/O

Either the user flags or other not assigned axes flag on the base board can be used as general-purpose I/O for up to 20 inputs and four outputs at 5-24VDC levels. Additional general-purpose I/O lines can be added by ordering the appropriate options on the ACC-1P axes expansion board or the ACC-2P communications board.

OPT-12: Provides two channels of 12-bit A/D converters on board of the PMAC2A-PC/104 base board.

CPU and Memory

The PMAC2A-PC/102 is provided with a 40 MHz DSP563xx CPU (80 MHz 560xx equivalent), 512k x 8 flash memory for user backup and firmware and 128k x 24 internal zero-wait-state SRAM.

- OPT-5CF: This provides a faster 80 MHz DSP563xx CPU (160 MHz 560xx equivalent)
- OPT-5EF: This provides a faster 160 MHz DSP563xx CPU (320 MHz 560xx equivalent)

Communications

Without any options, the PMAC2A-PC/104 communicates through the RS-232 serial interface using the optional ACC-3L flat cable, part number 200-602321-10x. Additional methods of communication can be added by ordering the appropriate options on the ACC-2P communications board. Only one method of communication is allowed at a time.

OPT-2A: it provides the PC/104 bus interface allowing bus communications between a PC/104 type computer and the PMAC2A-PC/104 motion controller.

Firmware Version

PMAC is provided with the latest firmware revision with the regular PID/notch/feedforward servo algorithm.

- Option-6: This option provides an extended (Pole-Placement) servo algorithm firmware. This is required only in difficult-to-control systems (resonances, backlash, friction, disturbances, changing dynamics).
- Option-6L: This option provides a multi-block lookahead firmware for tighter trajectory and acceleration control.
- Option-10: Through this option an older than the latest firmware released version could be ordered on-board. When possible, use the same firmware revision for similar machines, and this is important in cases where the new PMAC is a replacement in an already existing machine or a new machine using same existing programs is developed.

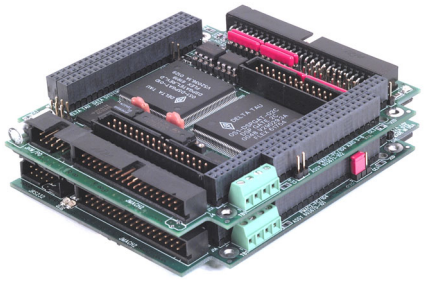
ACC-1P: Axes 5 to 8 Expansion Board with Digital I/O Ports

Part Number 300-603671-10x

Number and Type of Servo Channels

ACC-1P provides a second board, stacked to the baseboard that has a second DSPGATE chip with four additional channels axis interface circuitry. This board expands the number of channels from four to a total of eight on the PMAC2A-PC/104 board. Each additional channel includes:

- Single 12-bit ±10V differential analog output (DAC) or pulse-&-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
- Two output flags: amplifier enable signal at 5-24VDC levels and encoder compare EQU line at TTL levels



PMAC2A-PC/104 Base Board shown stacked with the ACC-1P axes board

General-Purpose I/O

ACC-1P-OPT-1: This provides the following ports on the ACC-1P axes expansion board for digital I/O connections:

- Multiplexer port: This connector provides eight input lines and eight output lines at TTL levels. When using the PMAC ACC-34x type boards, these lines allow multiplexing large numbers of inputs and outputs on the port. Up to 32 of the multiplexed I/O boards may be daisy-chained on the port, in any combination.
- I/O port: This port provides eight general-purpose digital inputs and eight general-purpose digital outputs at 5 to 24VDC levels. This 34-pin connector was designed for easy interface to OPTO-22 or equivalent optically isolated I/O modules when different voltage levels or opto-isolation to the PMAC2A-PC/104 is necessary.
- Handwheel port: This port provides two extra channels, each jumper selectable between encoder input or pulse output.

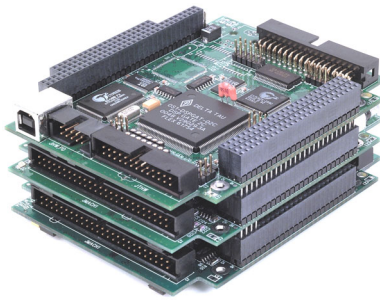
ACC-1P-OPT-2: This provides two channels of 12-bit A/D converters on board of the ACC-1P axes expansion board.

ACC-2P: Communications Board with Digital I/O Ports

Part Number 300-603672-10x

Communications

- ACC-2P-OPT-1A: This provides a 12 Mbit/sec USB interface allowing USB communications with the PMAC2A-PC/104 motion controller
- ACC-2P-OPT-1B: This provides a 10 Mbit/sec Ethernet interface allowing Ethernet communications with the PMAC2A-PC/104 motion controller.
- ACC-2P-OPT-2: This provides an 8K x 16 dual-ported RAM for USB, Ethernet or PC/104 ports on board of the ACC-2P communications board. If using this for USB or Ethernet communications, ACC-2P-OPT-1A or ACC-2P-OPT-1B must be ordered. If it is used for PC/104-bus communications, PMAC2A-PC/104-OPT-2A must be ordered.

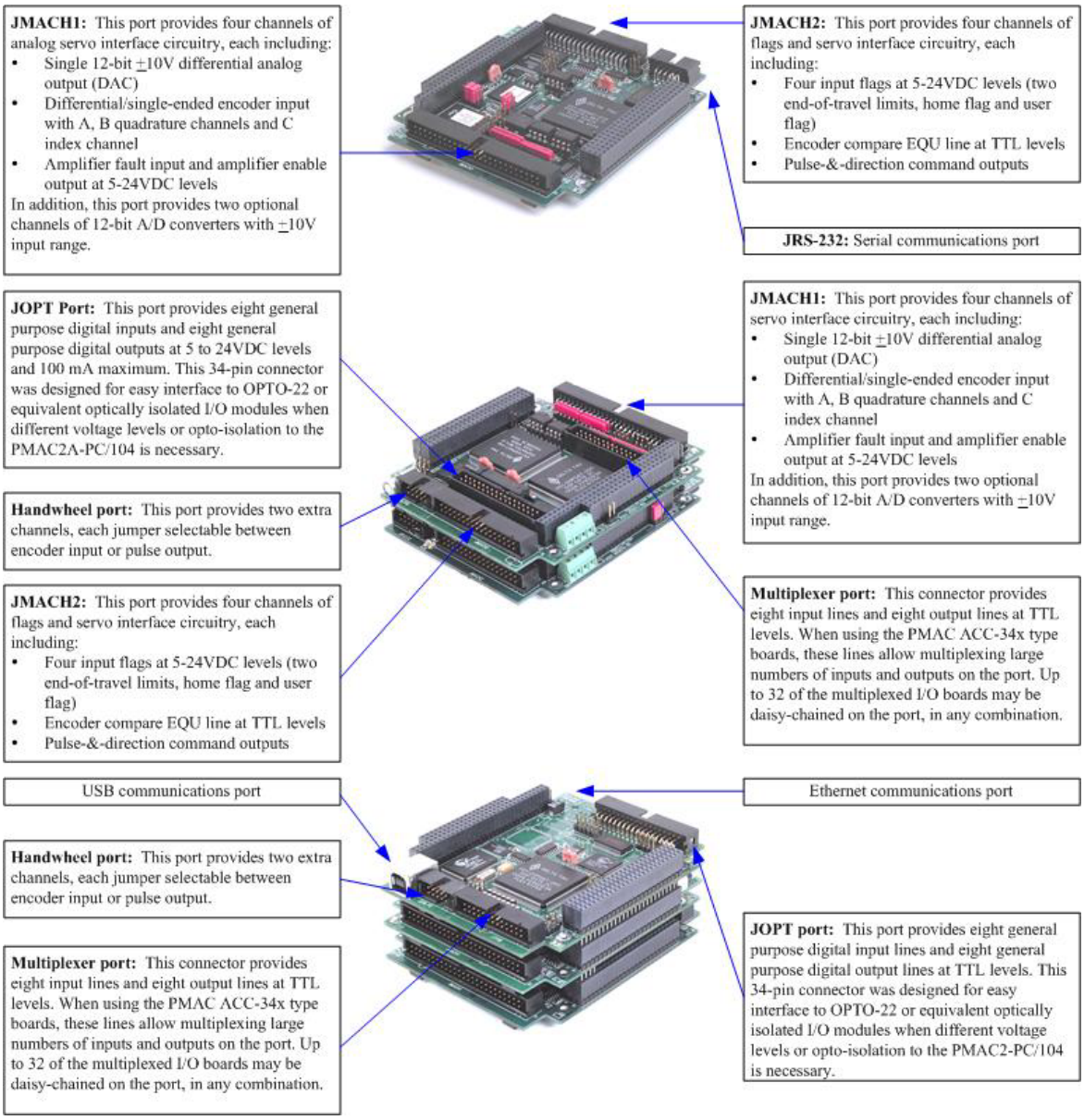


PMAC2A-PC/104 Baseboard shown stacked with the Option-1P and Option-2P boards

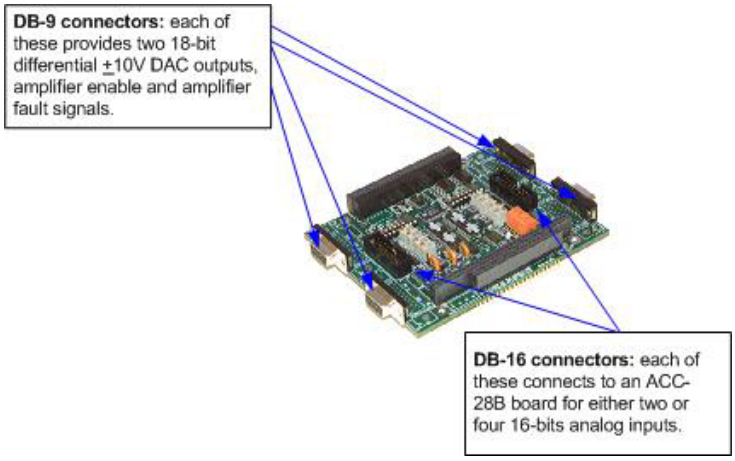
General-Purpose I/O

ACC-2P-OPT-3: This provides the following ports on the ACC-2P communication board for digital I/O connections:

- Multiplexer port: This connector provides eight input lines and eight output lines at TTL levels. When using the PMAC ACC-34x type boards, these lines allow multiplexing large numbers of inputs and outputs on the port. Up to 32 of the multiplexed I/O boards may be daisy-chained on the port, in any combination.
- I/O port: This port provides eight general-purpose digital inputs and eight general-purpose digital outputs at TTL levels. This 34-pin connector was designed for easy interface to OPTO-22 or equivalent optically isolated I/O modules when different voltage levels or opto-isolation to the PMAC2A-PC/104 is necessary.
- Handwheel port: This port provides two extra channels, each jumper selectable between encoder input or pulse output.

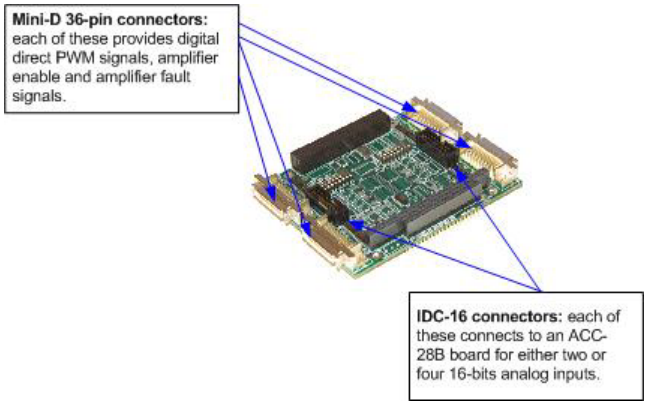


ACC-8ES: Four Channel Dual-DAC Analog Stack Board



ACC-8ES provides four channels of 18-bit dual DAC with four DB-9 connectors. This accessory stacks to the PMAC2A-PC/104 board and it is used mostly with amplifiers that require two ±10V command signals for sinusoidal commutation. This accessory can also be selected when 18-bit DAC resolution is required instead of the standard 12-bit DAC resolution. In addition, the ACC-8ES board can be used to connect an ACC-28B to the PMAC2A-PC/104 board. Two ACC-8ES can be stacked to the PMAC2A-PC/104 board for a total of eight dual DAC channels.

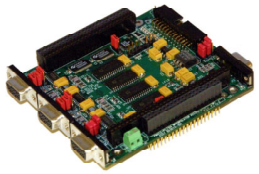
ACC-8FS: Four Channel Direct PWM Stack Breakout Board



ACC-8FS is a 4-channel direct PWM stack breakout board for PMAC2A-PC/104 with four standard 36-pin connectors. This is used to control digital amplifiers that require direct PWM control signals. When a digital amplifier with current feedback is used, the analog inputs provided by the OPT-12 of the PMAC2A-PC/104, the OPT-2 of the ACC-1P or the ACC-28B cannot be used. Two ACC-8FS can be stacked to the PMAC2A-PC/104 board for a total of eight direct PWM digital channels.

ACC-51S: 4096x Sinusoidal Interpolator Board Stack Board

ACC-51S is sine wave input interpolator stack board for the PMAC2A-PC/104. This accessory can be ordered with either two or four channels of sine wave interpolator inputs. The Interpolator accepts inputs from sinusoidal or quasi-sinusoidal encoders and provides encoder position data to the PMAC. This interpolator creates 4,096 steps per sine-wave cycle.



ACC-8TS: Breakout Board for ACC-28B Connections

ACC-8TS is a stack interface board to connect either one or two ACC-28B A/D converter boards. When a digital amplifier with current feedback is used, the analog inputs provided by the ACC-28B cannot be used.

PMAC(1) AXES BREAKOUT BOARDS

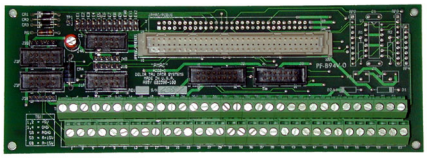
Typically, on a PMAC(1) type board, the connections are actually made to a terminal block that is attached to the JMACH connector by a flat cable. The pinout numbers on the terminal block are the same as those on the JMACH connector for PMAC PC. While the numbering scheme for the pins on machine connectors on PMAC VME is different from that for PMAC PC, the physical arrangement is the same.

Board	Mounting	Breakout Style	Breakout Connector	Notes
ACC-8P	DIN – Rail	Monolithic	Terminal Block	Simple Phoenix contact board
ACC-8D	DIN – Rail	Monolithic	Terminal Block	Headers for connection to option boards
ACC-8DCE	DIN – Rail	Modular	D-sub connector	Fully shielded for easy CE mark compliance

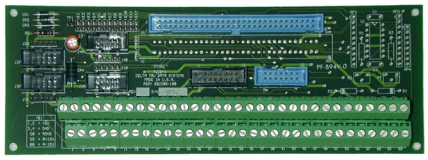
ACC-8D or ACC-8P Terminal Block/Breakout Boards

PMAC Accessory 8D (ACC-8D) (P/N 602205-100) provides a convenient means for routing PMAC's JMACH connector signals and power supply lines to a terminal block. In addition, ACC-8D provides the ability to connect several specific input/output options to PMAC conveniently through flat cables. These options include resolver interfaces, stepper motors converters and encoder isolator boards. If these options are not needed, use the ACC-8P terminal block board, which provides only the connection terminals. One of the following two options for the ACC-8D must be selected:

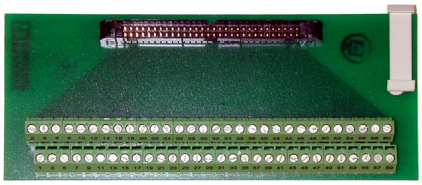
- ACC 8D Option-P: 60-pin socket and flat cable to PMAC PC
- ACC 8D Option-V: 96-pin socket and 64 line flat cable to PMAC VME



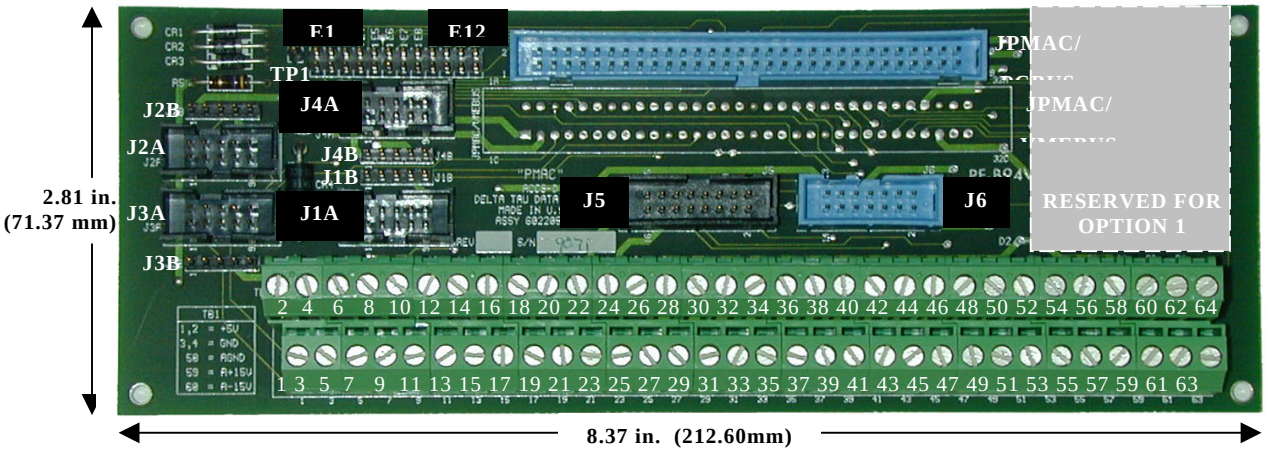
ACC-8D with OPT-P



ACC-8D with OPT-V



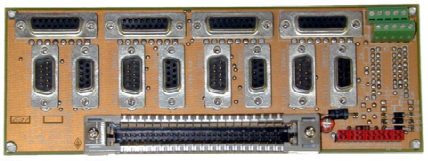
ACC-8P with OPT-P



One ACC-8D provides all of the pinouts from a single JMACH connector on PMAC, which consists of four I/O channels (analog outputs, encoder feedback, and associated flags). The base version of PMAC has only one JMACH connector; therefore, it only needs one ACC-8D. A PMAC with Option-1 (additional four channels) has two JMACH connectors; therefore, it requires two ACC-8Ds. If a 4-channel ACC-24 (axis expansion board) is also used, there is one more JMACH connector; therefore, three ACC-8Ds are required. An 8-channel ACC-24 has two JMACH connectors; therefore, a total of four ACC-8Ds would be required. The ACC-8D OPT-5 provides the rail mount support for the ACC-8D.

ACC-8DCE

PMAC's ACC-8DCE (ACC-8DCE) (P/N 3A0-602654-10X) is a CE-Certified printed circuit for routing PMAC's JMACH connector signals and power supply lines to terminal block or D-Sub connectors. This accessory facilitates PMAC's connection to amplifiers and feedback signals, and provides a convenient means to connect several input/output options to PMAC. The ACC-8DCE design takes EMI considerations into account. The product optimizes performance by providing easy, efficient and cost-effective interface connections between the PMAC and amplifier connectors. The printed circuit board itself is layered by ground and power plains, with higher frequency lines imbedded in the middle layers. One of the following two options for the ACC-8DCE must be selected:



ACC-8DCE Front View

- Option-PCE: PMAC PC to ACC-8DCE Cable
- Option-1: PMAC PC Input Terminal Block 301-AC8DCE-OPT
- Option-2: D-Sub Input for PMAC PC 302-AC8DCE-OPT
- Option-5: 3rd Phase Generator 305-AC8DCE-OPT
- Option-6: Rail Mount 306-AC8DCE-OPT

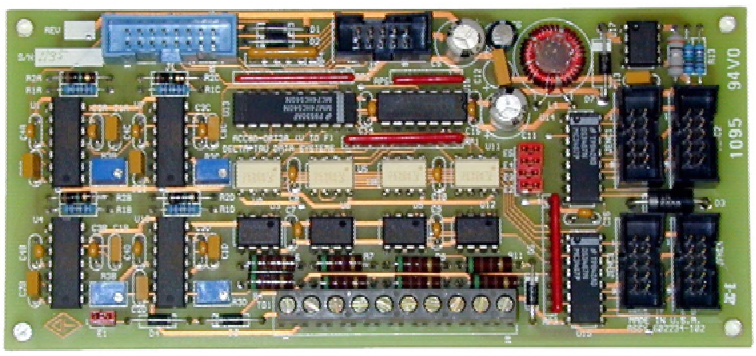
ACC-8D-OPT-2, Voltage to Frequency Converter Board

Accessory 8D (ACC-8D) Option-2 is a standalone printed circuit board that is connected to PMAC via ACC-8D, the Terminal Block board. Option-2 provides four Voltage-to-Frequency converters (V-to-F) that allow PMAC to drive four standard stepper motor drives. The output of Option-2 is a set of four pulse and direction signals at TTL levels. The input is a set of four analog magnitude commands coupled with digital direction bits. PMAC supplies the input to the Option-2 board via ACC-8D (J5 connector) that should be connected to ACC-8D Option-2 board (J1 connector) via the supplied 16-pin flat cable. The pulses to the stepper driver can represent full steps, half steps or microsteps. This is dependent on the driver itself, not on PMAC or this option. The stepper-motor systems can be operated either open loop or closed-loop, individually selectable. If operating the axis open loop, feed the pulse and direction signals back into a PMAC encoder port through a provided cable to fool the PMAC into thinking it has feedback. If operating it closed-loop, connect the actual encoder lines to the PMAC encoder port, as with a regular servomotor. The output frequency range must be selected at the time of ordering this option board. This accessory is dedicated for PMAC(1) type boards only. The Option-15 in the PMAC Mini is equivalent to this accessory. For controlling stepper motors, the PMAC2 board is recommended instead.

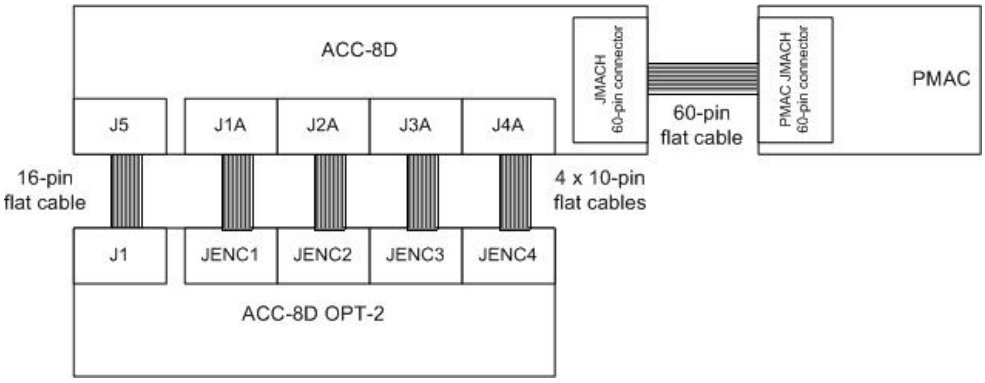
Part Number 602234

Options

- Option-A: V to F converter 10 KHz max, 20 u sec pulse width (for existing customers only)
- Option-B: V to F converter 50 KHz max, 4 u sec pulse width (for existing customers only)
- Option-C: V to F converter 100 KHz max, 2 u sec pulse width
- Option-D: V to F converter 500 KHz max, 400 nsec pulse width
- Option-E: V to F converter 1 KHz max, 200 nsec pulse width
- Option-F: V to F converter 2 KHz max, 100 nsec pulse width
- Option-G: Rail mount for OPT-2

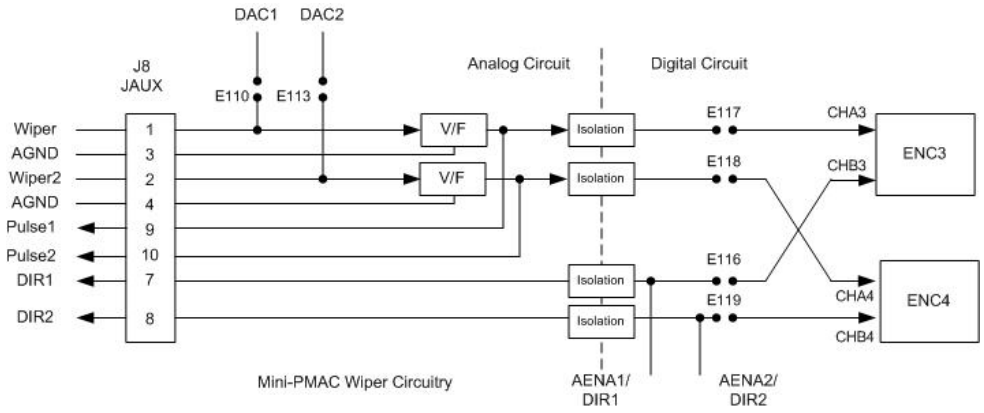


ACC-8D-Option-2

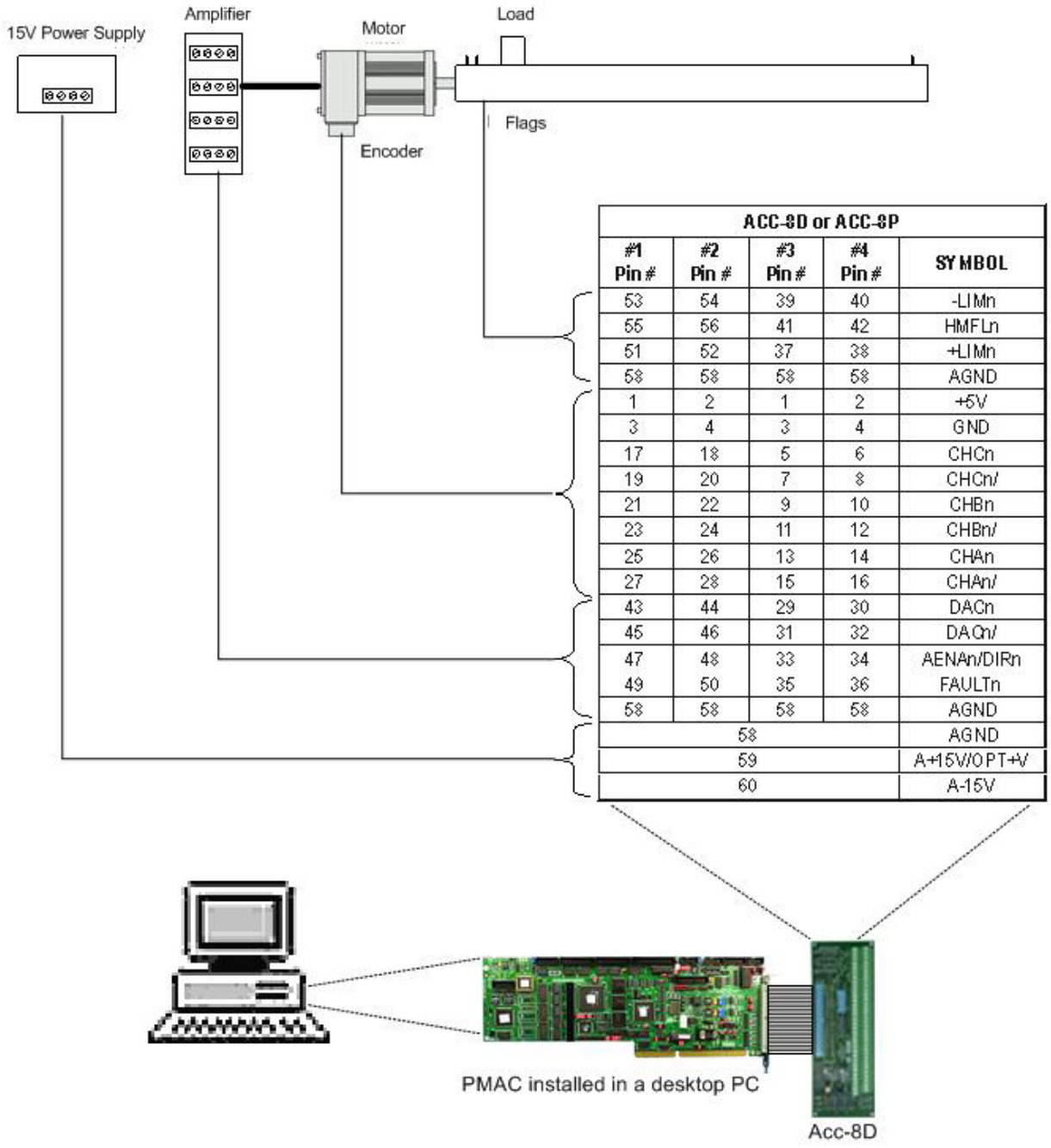


OPT-15, On-Board Voltage to Frequency Converter

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/Volt, 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. On PMAC Lite, the pulse and direction signals may be output on the CHA4 and CHB4 pins, respectively, of the JMACH1 connector. These can be used to command a stepper-motor driver. The DAC4 output can be wired into the Wiper input, which provides both the feedback that the servo loop requires, and the command signals to the driver. This permits the PMAC Lite to drive one stepper motor without a special accessory board. Other PMACs can still use the wiper circuitry to control a single stepper drive but the AENA / DIR line must be set as direction line disabling the amplifier enable function. This option is not available for the PMAC2 board. The OPT-15 circuitry in the PMAC Mini board is opto-isolated and has two WIPER inputs allowing to control up to two pulse and direction drives:



Machine Connections Example



ACC-8D or ACC-8P				
#1 Pin #	#2 Pin #	#3 Pin #	#4 Pin #	SYMBOL
53	54	39	40	-LIMn
55	56	41	42	HMFLn
51	52	37	38	+LIMn
58	58	58	58	AGND
1	2	1	2	+5V
3	4	3	4	GND
17	18	5	6	CHCn
19	20	7	8	CHCn/
21	22	9	10	CHBn
23	24	11	12	CHBn/
25	26	13	14	CHAn
27	28	15	16	CHAn/
43	44	29	30	DACn
45	46	31	32	DACn/
47	48	33	34	AENAn/DIRn
49	50	35	36	FAULTn
58	58	58	58	AGND
58				AGND
59				A+15V/OPT+V
60				A-15V

PMAC2 AXES INTERFACE BOARDS

The JMACHn machine interface ports on PMAC2 are seldom interfaced directly to a machine. Usually, an interface board is used. Because of the flexibility of PMAC2's capabilities, different interfaces are wanted for different types of applications: servo and stepper; analog and digital. Delta Tau has developed a family of interface boards for different types of applications; some users will wish to design their own. All of the Delta Tau interface boards are 2-axis boards, providing breakout for one JMACHn port. The boards currently available are listed below:

Board	Drive Interface Signals	Breakout Style	Breakout Connector	Notes
ACC-8A	Analog	DIN-Rail	DB-15 connectors	- One or two 16-bit DACs per axis - Relays for amp enable - Optional Interpolator circuit
ACC-8E	Analog	DIN-Rail	12-point terminal block	- Two 18-bit DACs per axis - Relays for amp enable
ACC-8F	Direct PWM and digital current	DIN-Rail	Mini-D 36-pin	- Loss of encoder circuit - Optional Yaskawa Hall decode
ACC-8S	Pulse and direction	DIN-Rail	10-point terminal block	- Optional encoder interface - Pulse swallower for slow drivers

ACC-8A, Analog Servo Interface with Optional Feedback Interpolator

PMAC2's ACC-8A is a 2-channel interface board designed to interface to analog amplifiers, quadrature encoders, sinusoidal encoders, hall-effect sensors, position limits, and home flags. The ACC-8A may be ordered with either one analog (DAC) output per channel or, through the Option-1, with two analog (DAC) outputs per channel for a total of four on-board DACs. Two DACs per channel may be required, for example, for controlling motors through sinusoidal commutation. This board has an optional interface for sinusoidal encoders, allowing the use of our sub-count interpolation process.

For example, if using a 10,000 line sinusoidal encoder, PMAC2 essentially would read 2,560,000 increments per revolution. The main input flags (HOME, PLIM, MLIM, and USER) for both channels pass through AC Opto modules, which provide optical isolation with sinking or sourcing capability from 5 to 24V. Resistor sockets are provided for selecting the inputs range between 12 to 24V or 5V operation.

Part Number 603476

Options

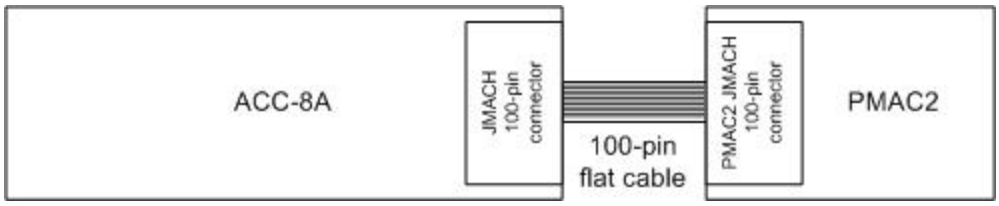
The standard configuration without options provides two channels, each with:

- One isolated 18-bit analog output with amplifier enable relay output and amplifier fault input
- 3-channel quadrature encoder feedback
- Set of isolated flag inputs
- T, U, V, and W Hall Effects inputs or pulse-and-direction outputs

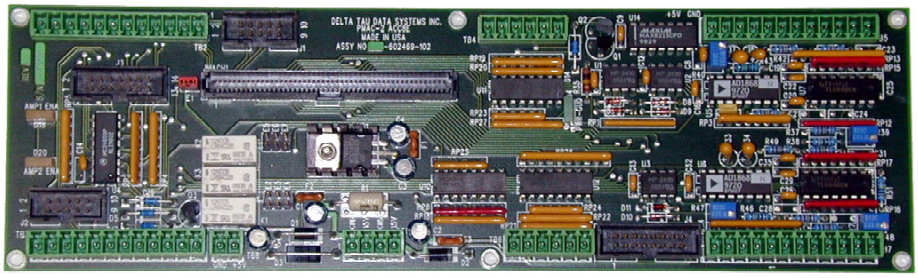
Option-1: This option adds a 256x sine wave encoder interpolator circuit for each channel (key components U11 and U12).

Option-2: This option adds a second isolated 18-bit analog output per channel (key components U27 and U28). This results on two DAC ±10V outputs per channel for a total of four on-board DACs.

Option-3: Rail mount



ACC-8E, Analog Servo Interface Board



The ACC-8E for the PMAC2 family of controllers provides the signals for two axes with analog-input amplifiers. The amplifiers can be velocity-mode, torque-mode, or sinusoidal input mode (two analog commands); or any mix of the above. The ACC-8E board has a single flat-cable connection to the PMAC2. All of the main signals to and from the machine can be wired through modular removable terminal blocks. Alternatively, many signals can be connected to the machine through flat cables via on-board IDC headers.

Part Number 602469

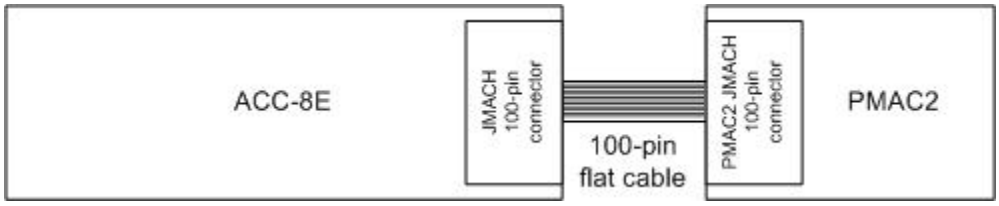
Options

Option-1: Rail mount

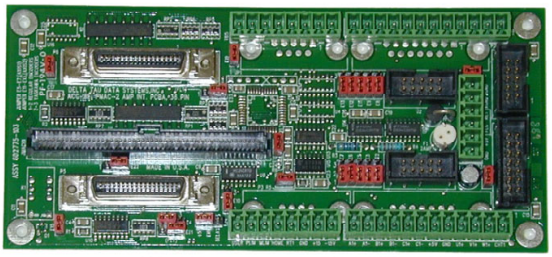
Characteristics

The ACC-8E is used for analog drive interfaces. It is a DIN-rail mountable board and has the following features:

- Two optically isolated 18-bit DACs per axis
- Dry-contact relay amplifier-enable output per axis
- Optically isolated amplifier fault input per axis
- Differential 3-channel encoder input per axis
- Four optically isolated sinking/sourcing 12-24V flag inputs per axis



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

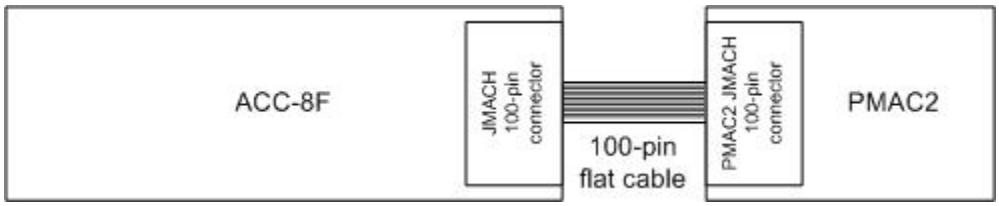
Options

- 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

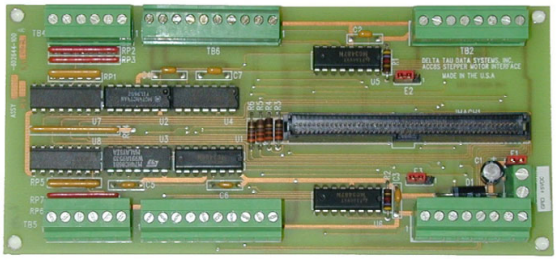
Characteristics

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

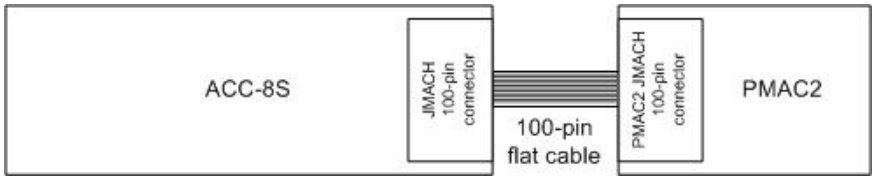
Options

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

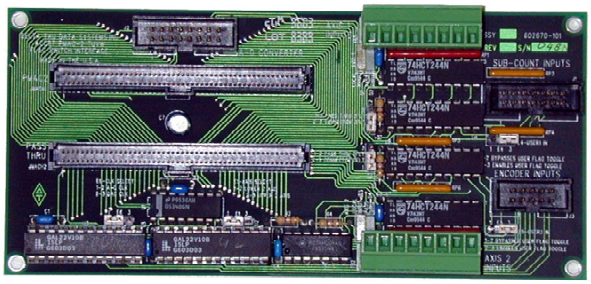
Characteristics

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

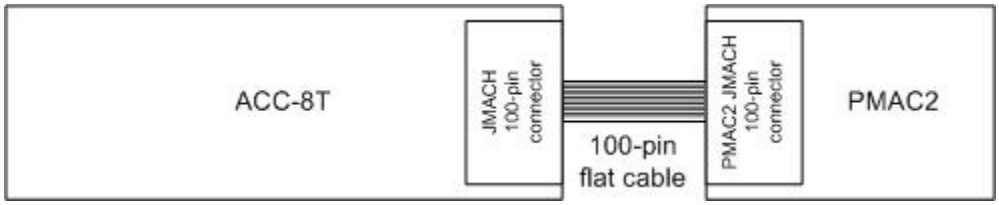
Option-1: Rail mount

Characteristics

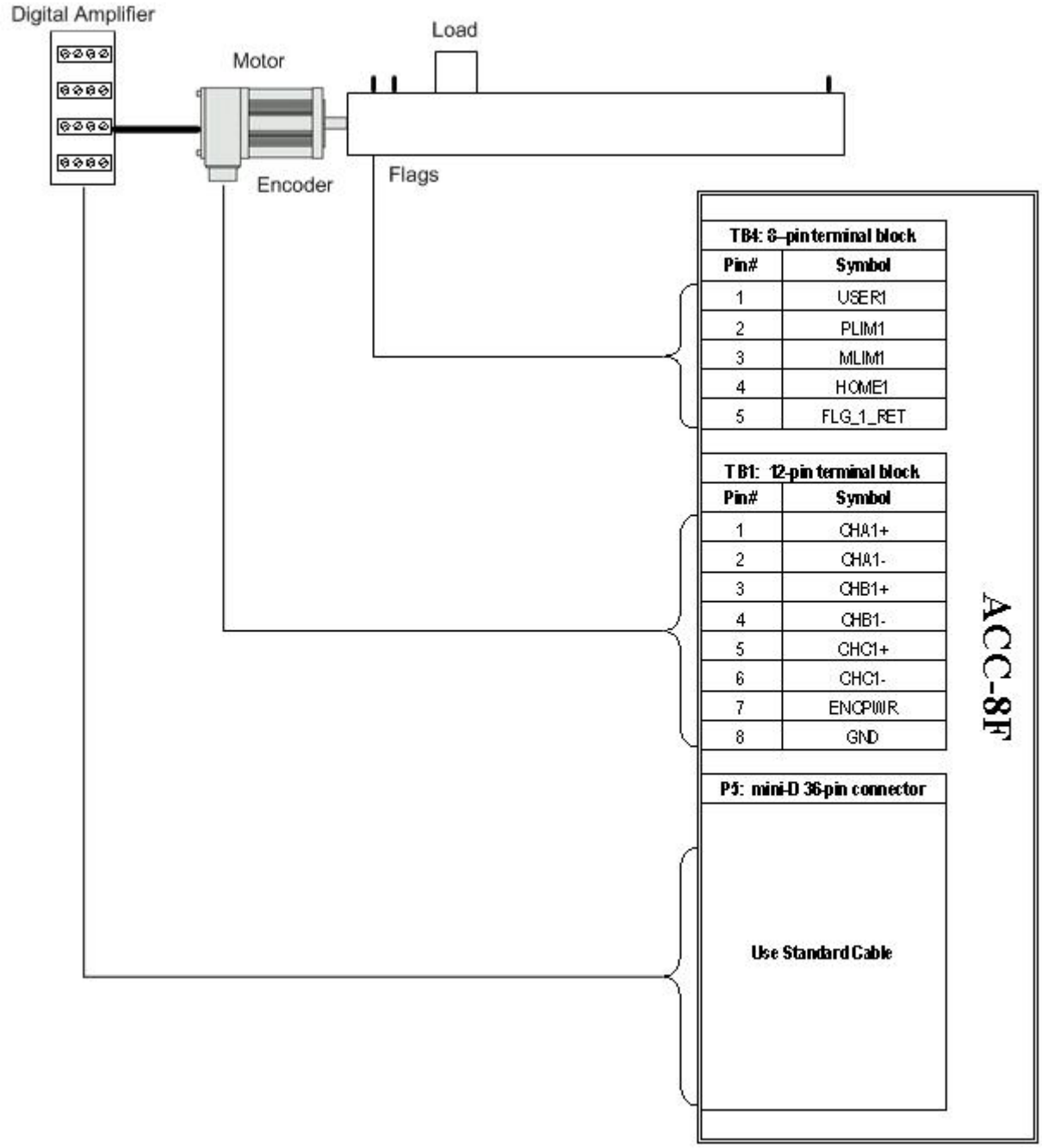
- Pass-thru for ACC-8x signals
- On-board header and terminal-block per axis for supplemental flags
- Multiplexer selection circuitry per axis for supplemental flags
- On-board header for two quadrature encoder inputs
- On-board header for interface to ACC-28B board

Note:

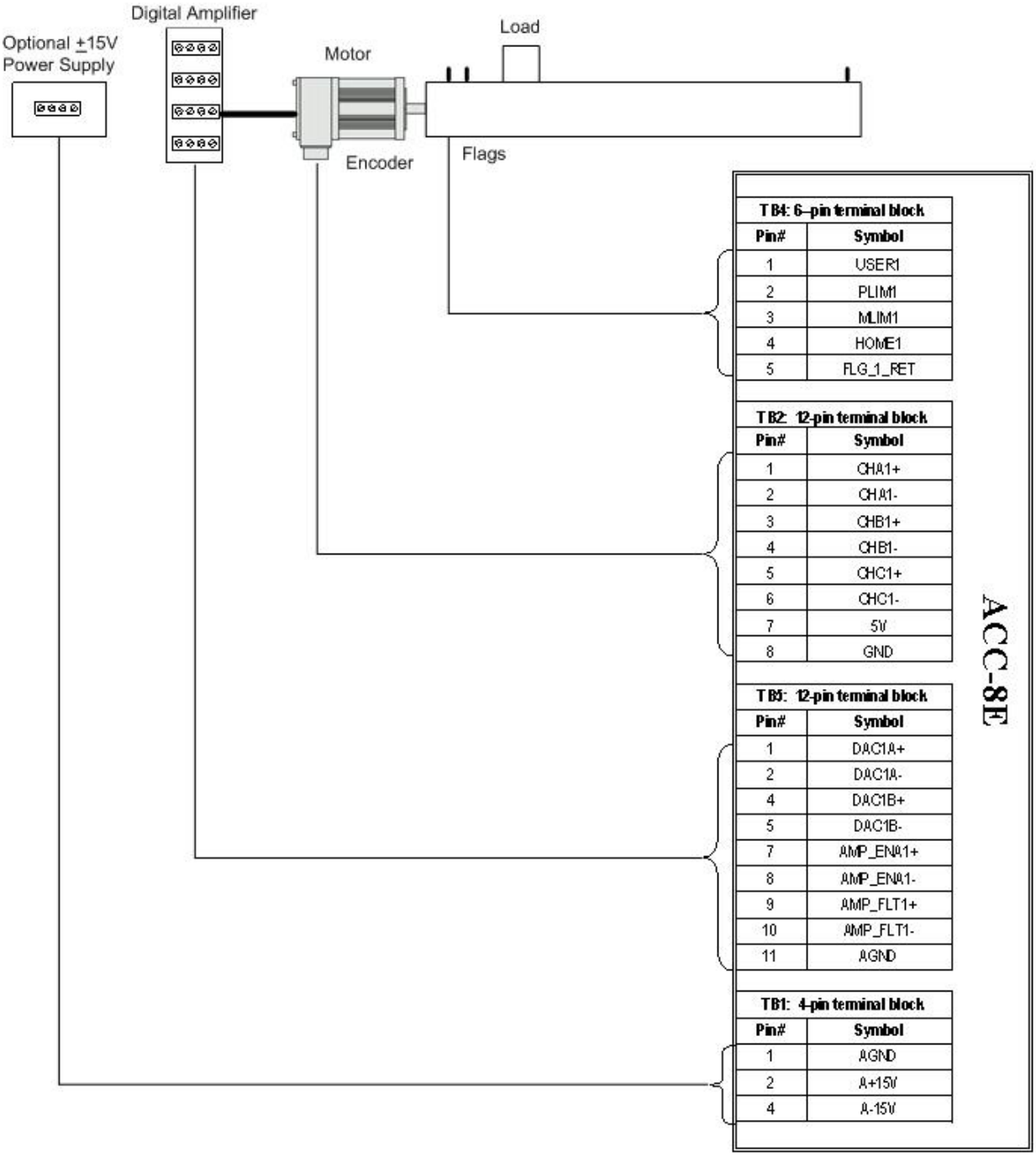
The ACC-8T is required for connections between the PMAC2 and the ACC-28B analog to digital converter board.



Digital Amplifier with Incremental Encoder



Analog Amplifier with Incremental Encoder



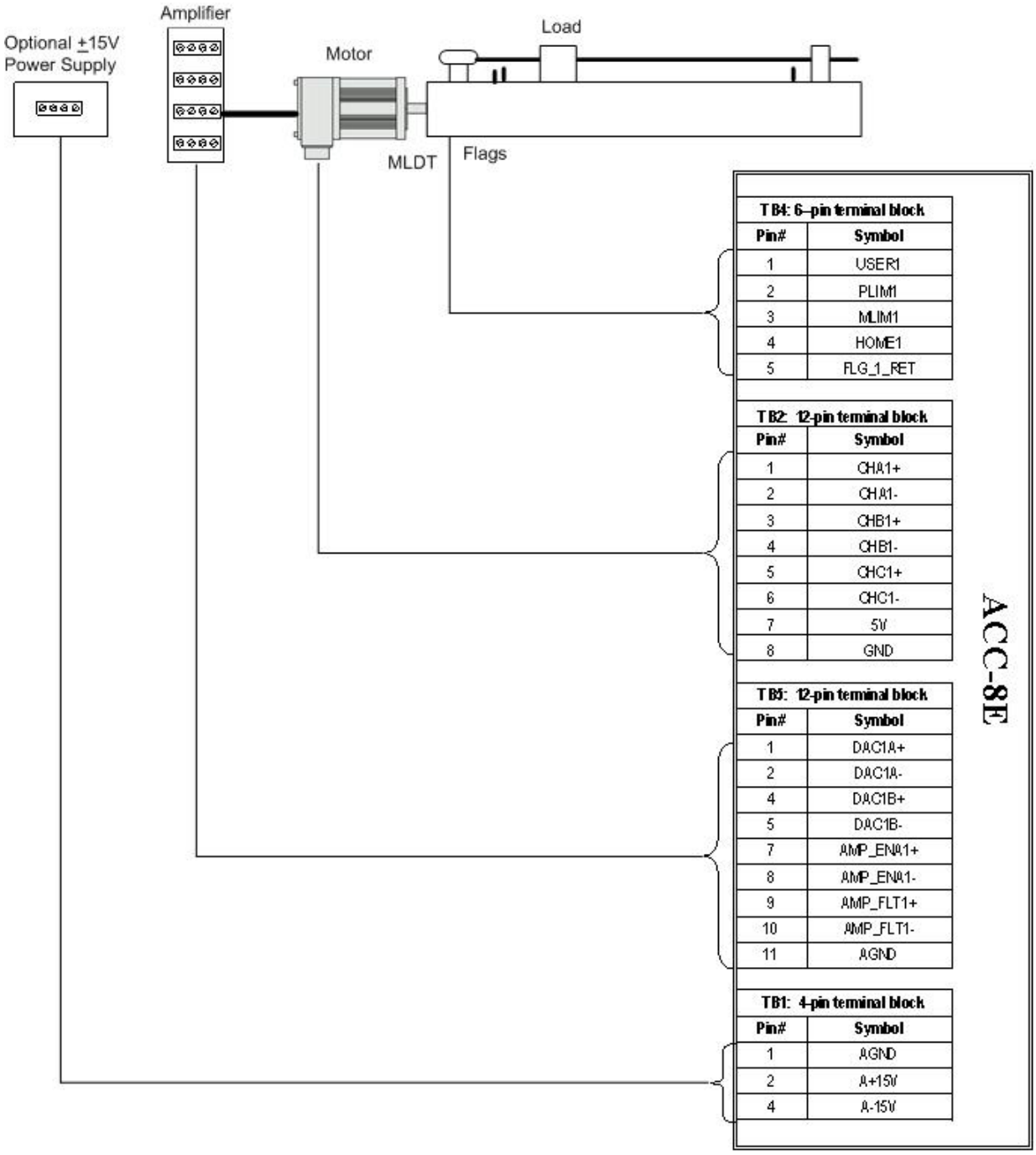
TB4: 6-pin terminal block	
Pin#	Symbol
1	USER1
2	PLIM1
3	MLIM1
4	HOME1
5	FLG_1_RET

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

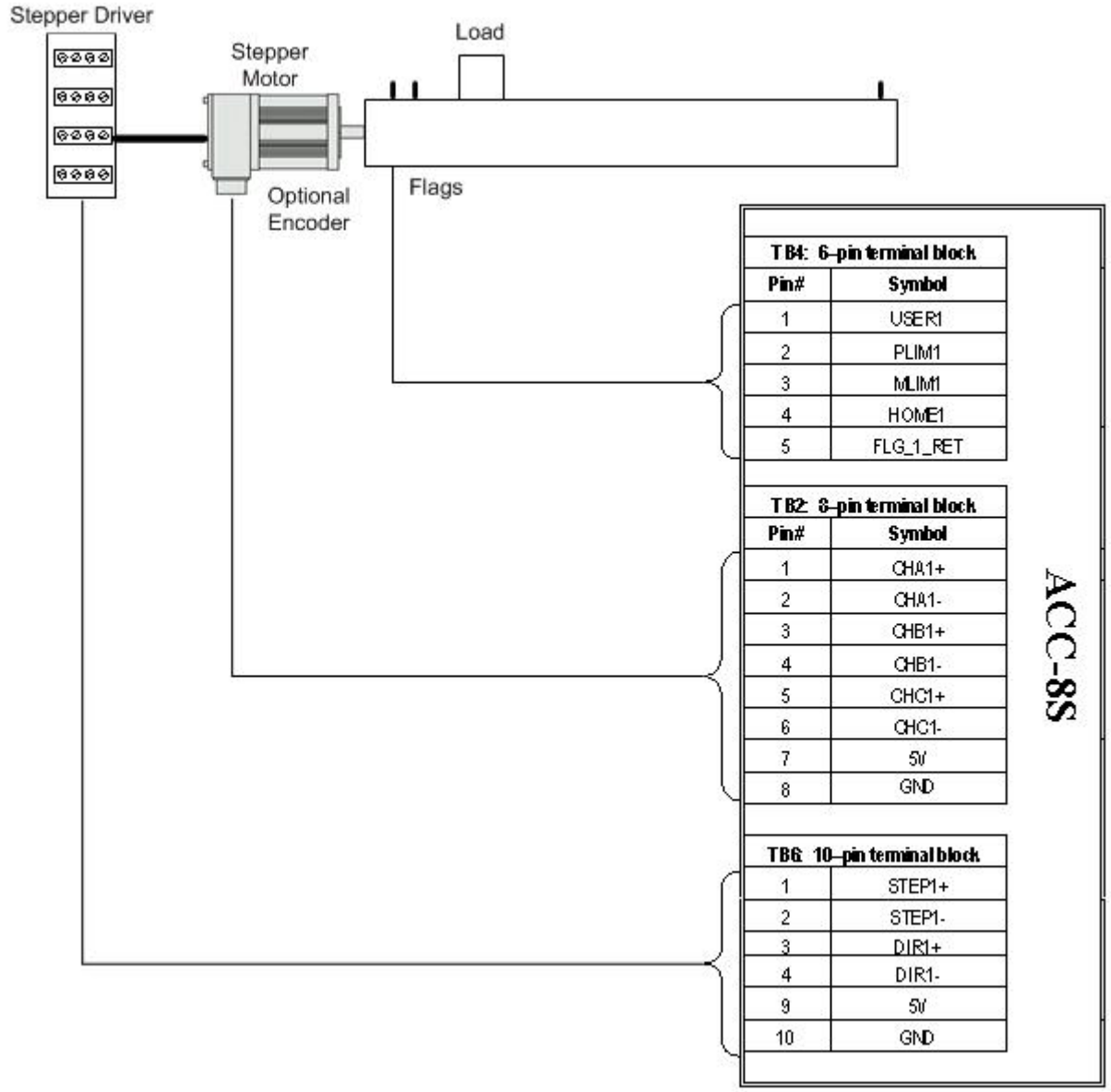
TB3: 12-pin terminal block

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

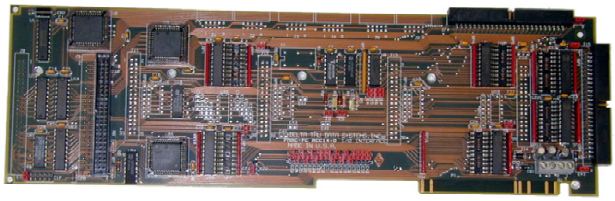
The ACC-11P is a PCI-format with 24 or 48 isolated digital inputs at 12V to 24V levels and 24 or 48 isolated digital outputs at 12V to 24V levels, 100 mA per output point. This accessory board connects to the PMAC board through the JEXP expansion port. The baseboard is provided with 24 inputs and 24 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

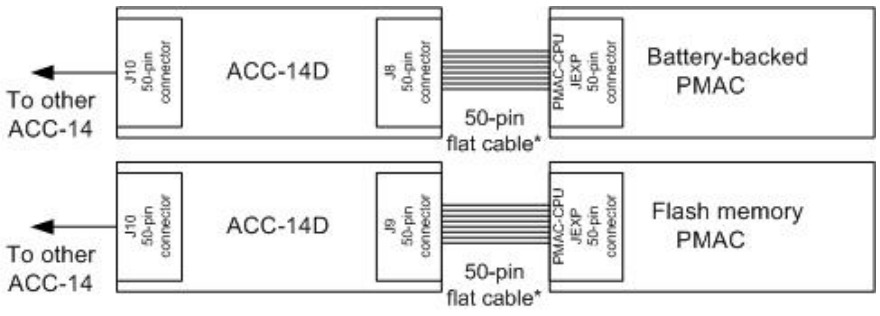
Options

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

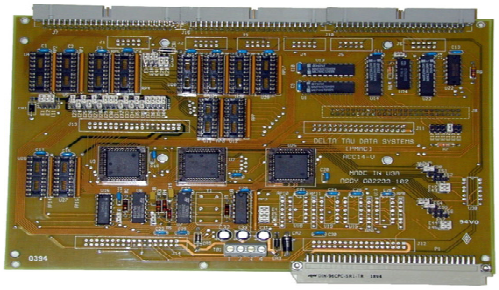
- 48 I/O points per board; up to six boards per PMAC. 100 mA per channel, up to 24V
- Hardware selectable between sinking and sourcing (and totem-pole) in groups of eight; defaults are 5V totem-pole (Option-1; not meant for direct drive – intended for Opto-22 or similar connection) or 24V sinking (Option-2)
- 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

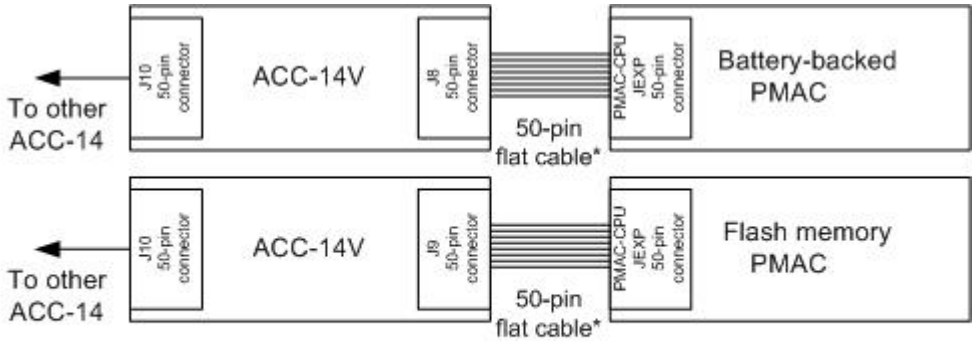
Options

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

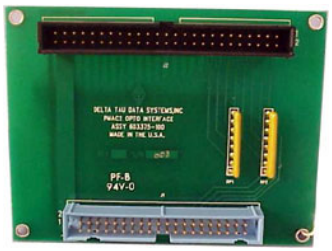
- 48 I/O points per board; up to six boards per PMAC. 100 mA per channel, up to 24V
- Hardware selectable between sinking and sourcing (and totem-pole) in groups of eight; defaults are 5V totem-pole (Option-1; not meant for direct drive – intended for Opto-22 or similar connection) or 24V sinking (Option-2)
- 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.

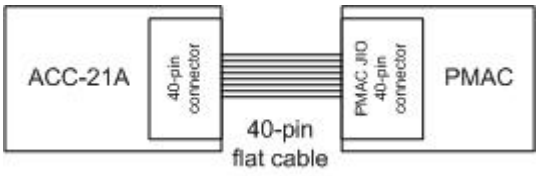


Inputs	Outputs
32	0
24	8
16	16
8	24
0	0

Note:

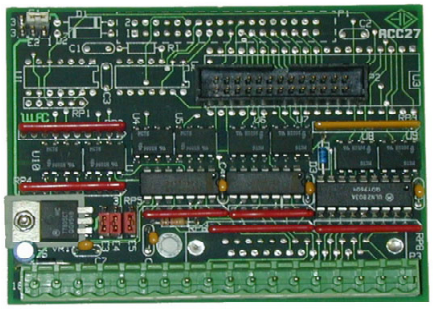
This accessory is not compatible with the PMAC(1) type boards.

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

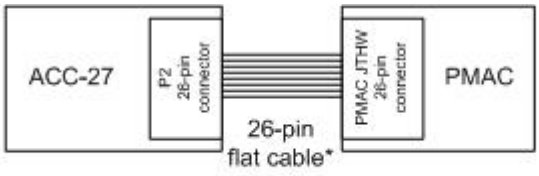
Options

- 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.

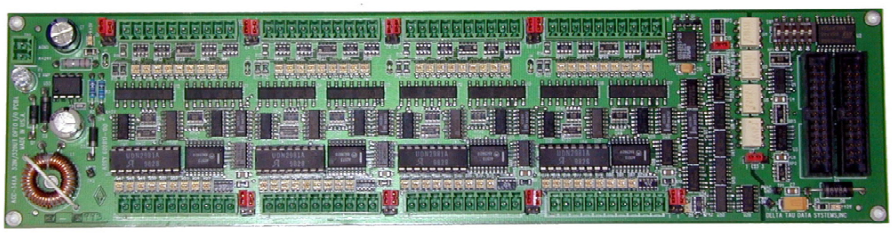
Part Number 602817

Options

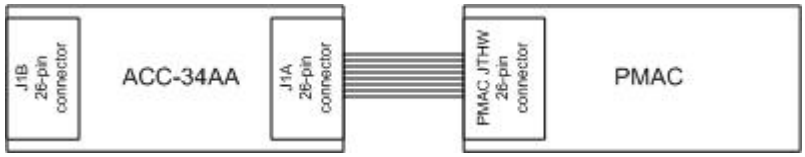
- Option-1: sinking configuration
- Option-2: sourcing configuration
- Option-3: rail mount

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



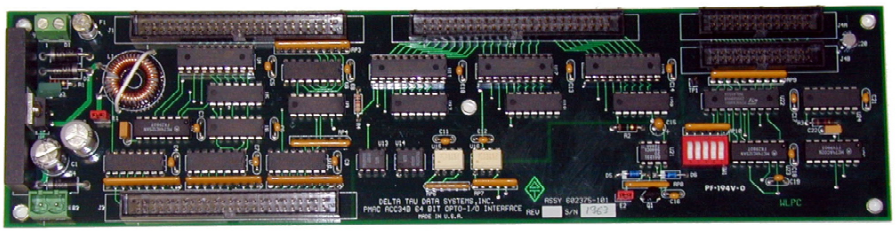
ACC-34B, Optically Isolated I/O Board OPTO-22 Compatible

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.

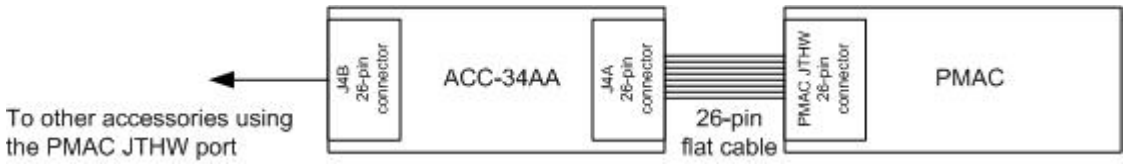
Part Number 602375

Options

Option-1: DIN rail mount



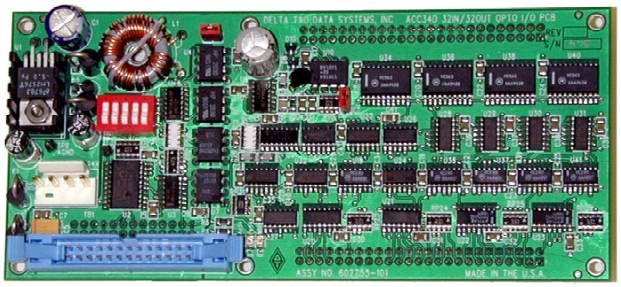
ACC-34B



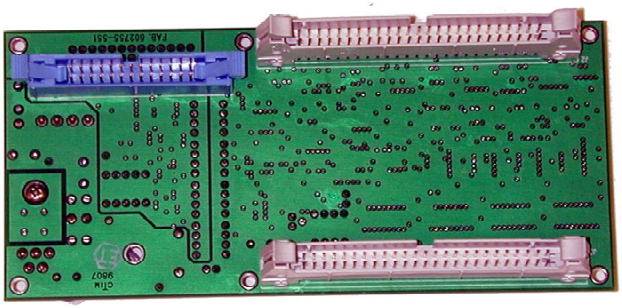
ACC-34D, Optically Isolated I/O Board OPTO-22 Compatible

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.

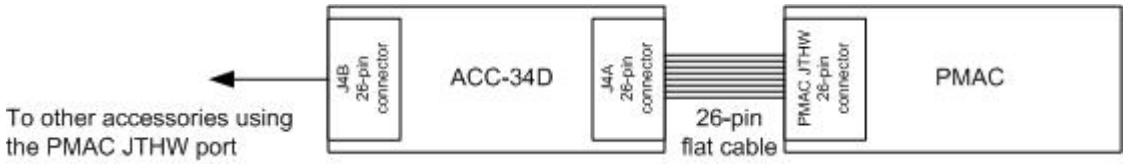
Part Number 602755



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

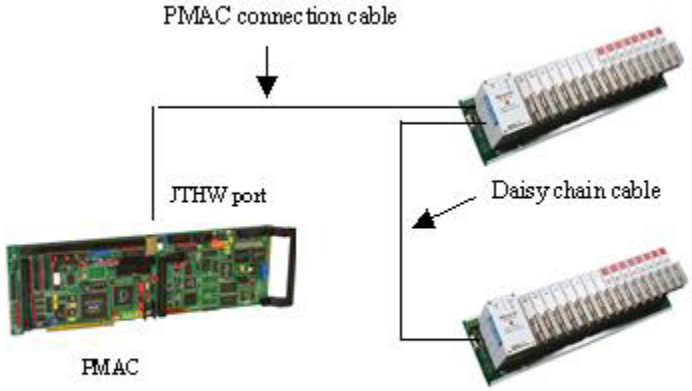
This accessory allows the PMAC motion controller to communicate with other external devices using a field bus communication protocol like DeviceNet, Profibus, ControlNet and CanOpen as required. Up to six ACC-74s may be connected to a single PMAC at the same time. The ACC-74 can be installed in the PCI 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

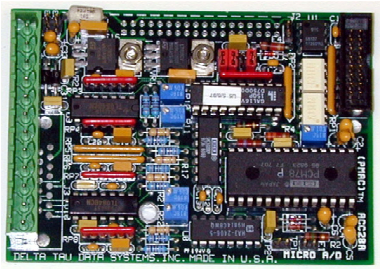
PMAC2 Optional Analog Inputs

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.

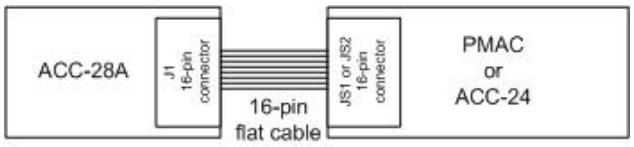


ACC-28A

Part Number 602236

Options

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



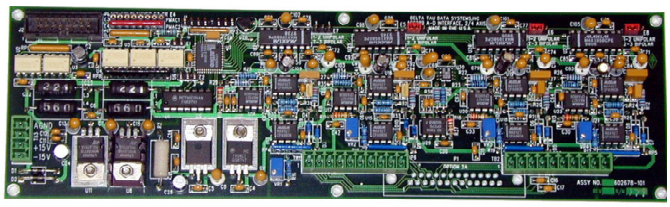
ACC-28B, 2-Channel, 16-Bit Analog to Digital Converter Board

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.

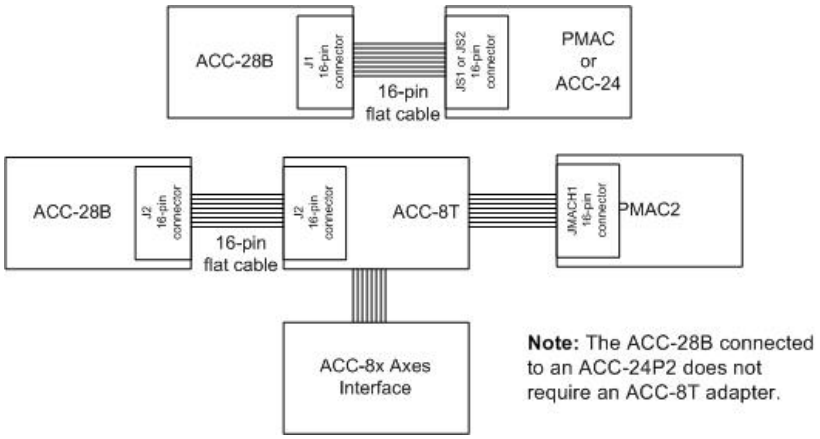
Part Number 602678

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

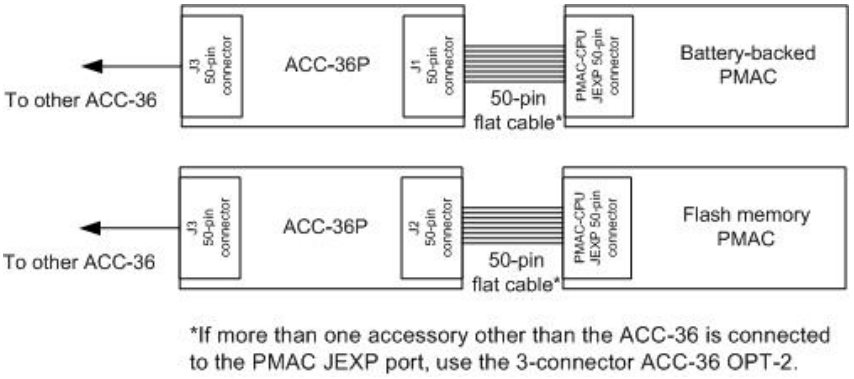
PMAC's ACC-36P is an analog data acquisition board capable of converting 16 analog input signals. The analog inputs can be read in a bipolar fashion with input ranges of ±5V single-ended or ±2.5V differential. If the analog inputs are read in a unipolar fashion, the input ranges are 0 to 10V single-ended 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.

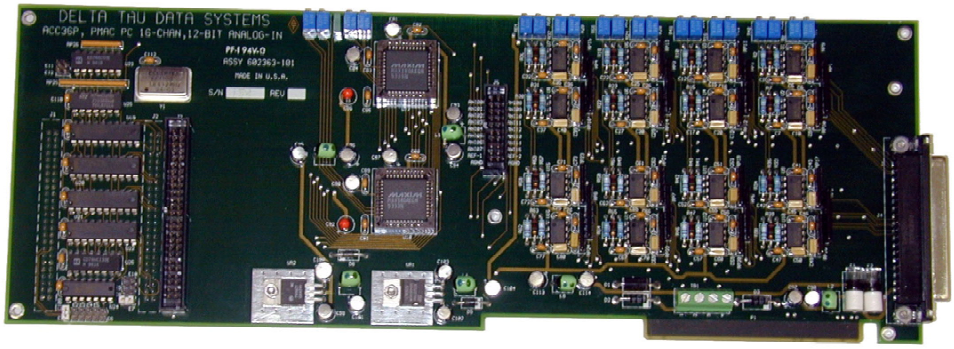
For PMAC firmware V1.15 and above, 16 channels may be read to specified PMAC memory locations automatically. These registers can be monitored using M-Variables or read into PMAC's encoder conversion table for servo feedback control. Only one ACC-36 may be used in this fashion per PMAC. To use this automatic 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

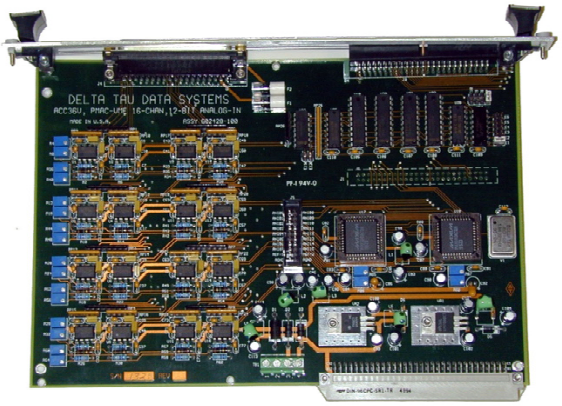
Option-2: 20-cm (8") 50-pin 3-connector cable when ACC-36P is used with PMAC Option-2, ACC-14D or ACC-24P





ACC-36P

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



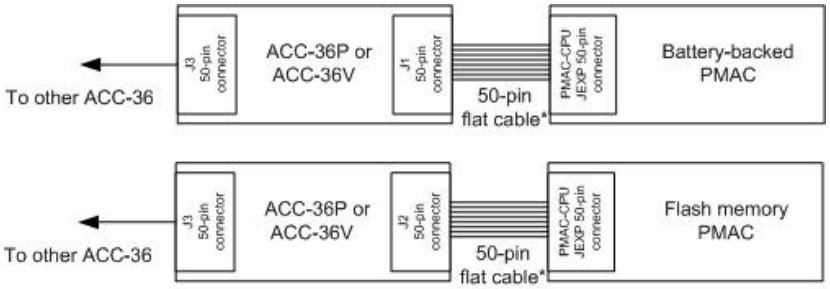
PMAC's ACC-36V is an analog data acquisition board capable of converting 16 analog input signals. The analog inputs can be read in a bipolar fashion with input ranges of ±5V single-ended or ±2. 5V differential. If the analog inputs are read in a unipolar fashion, the input ranges are 0 to 10V single-ended 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.

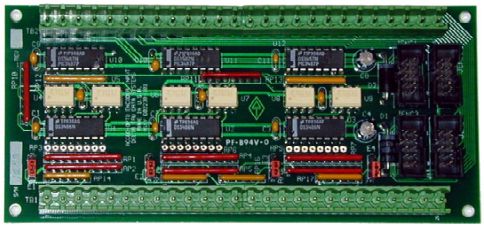
Note:

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.

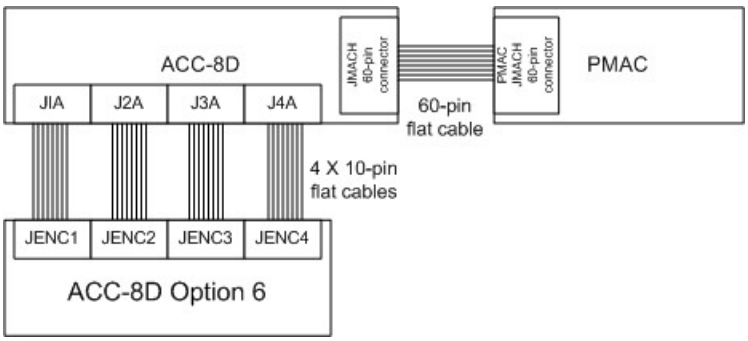
Part Number 602238

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.

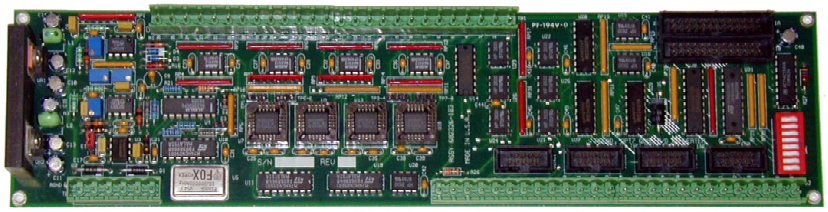
Note:

3-phase synchros are not compatible with this accessory.

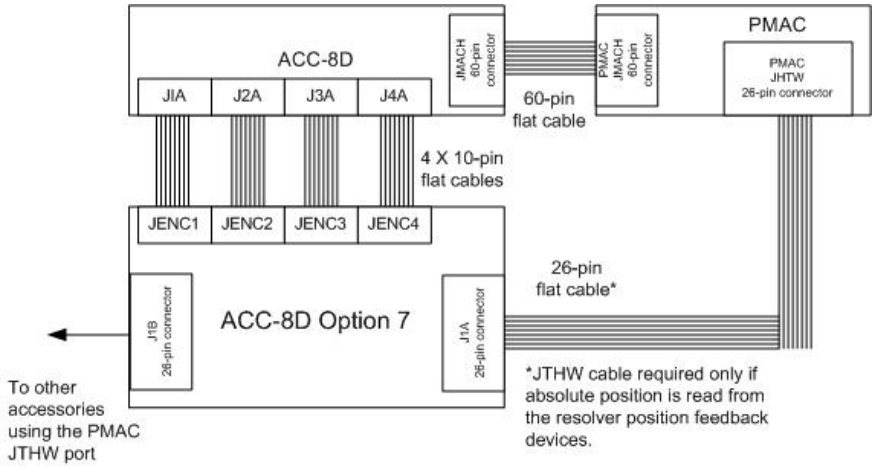
Part Number 602326

Options

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



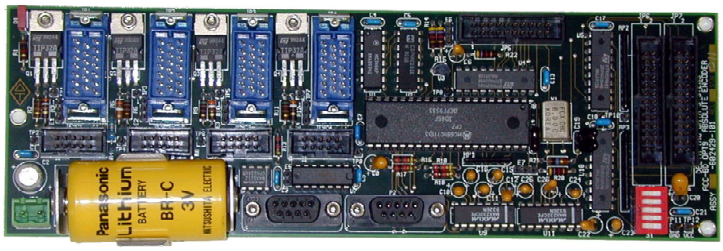
ACC-8D Option-7



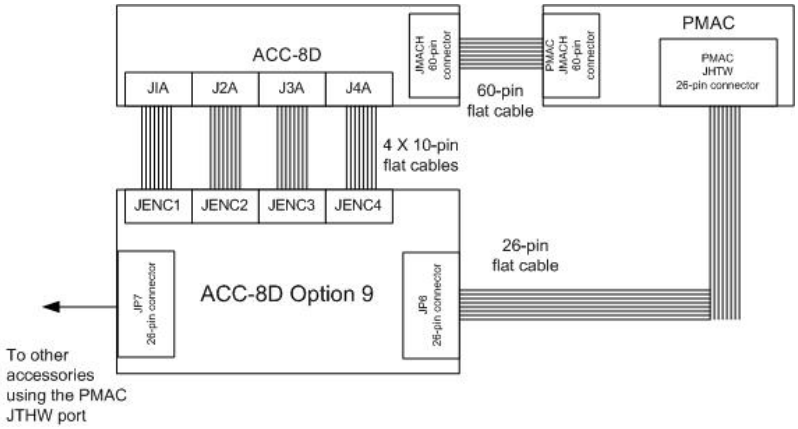
ACC-8D-OPT-9, Yaskawa Absolute Encoder Converter Board

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

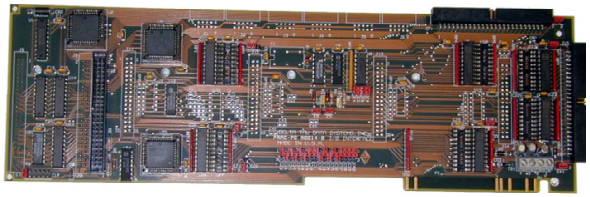


ACC-8D Option-8



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

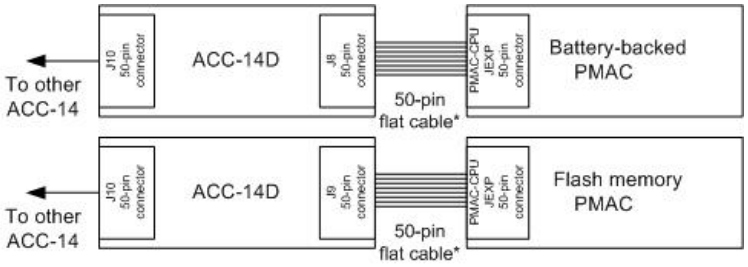
Options

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

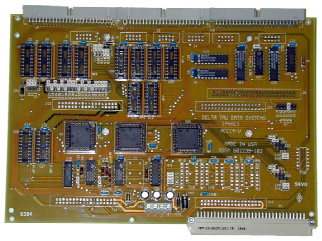
- 48 I/O points per board; up to six boards per PMAC. 100 mA per channel, up to 24V
- Hardware selectable between sinking and sourcing (and totem-pole) in groups of eight; defaults are 5V totem-pole (Option-1; not meant for direct drive – intended for Opto-22 or similar connection) or 24V sinking (Option-2)
- 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

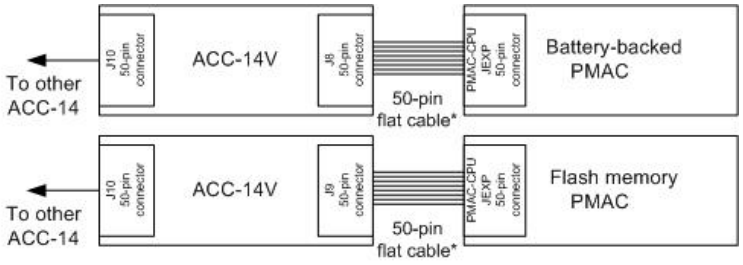
Part Number 602239

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.

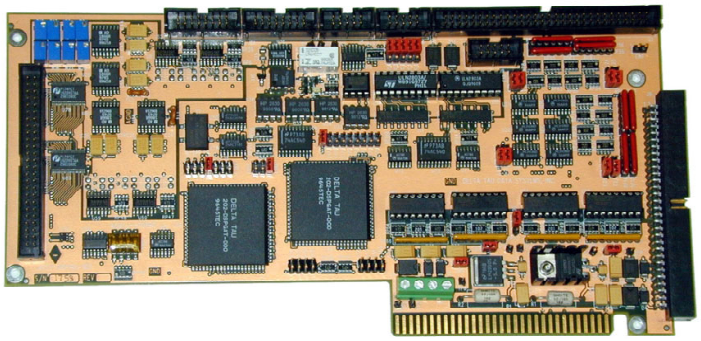
ACC-24P, Axis-Expansion Board

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.

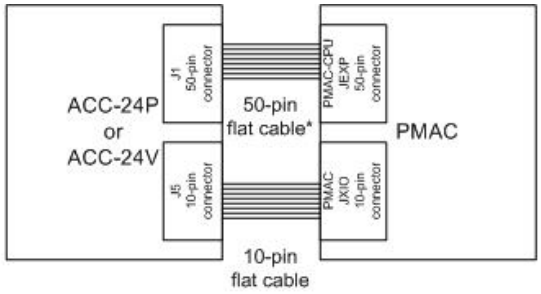
Part Number 602192

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.



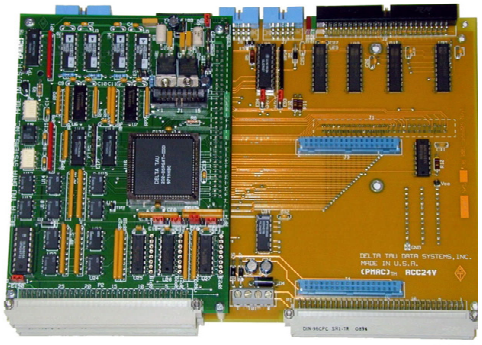
ACC-24P



*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.

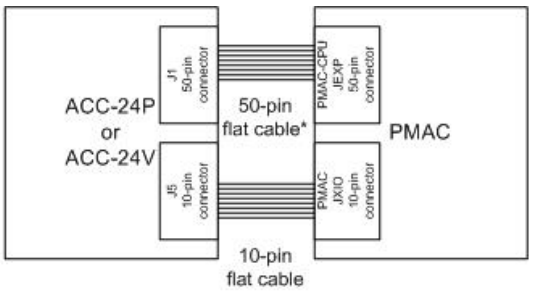


ACC-24V

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.

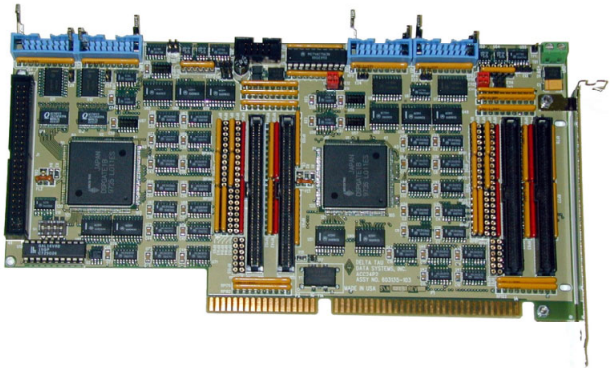
ACC-24P2, Axis-Expansion Board

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.

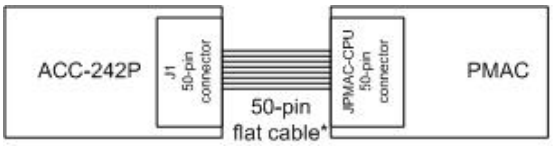
Part Number 603135

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.

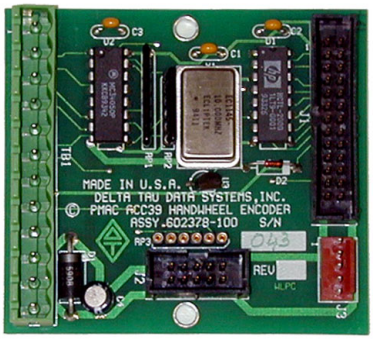
ACC-39 PMAC Handwheel Encoder Interface Board

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.

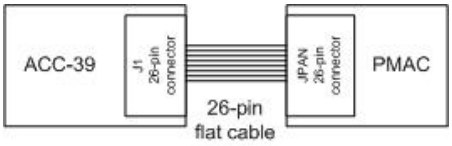
Note:

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

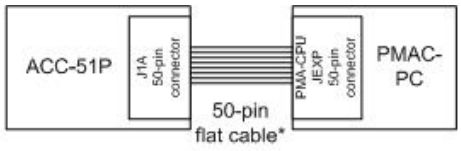


ACC-51P, Expansion Port Interpolator Accessory

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

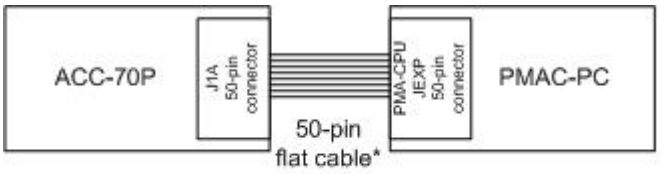
Delta Tau's ACC-70P is an Expansion Port feedback interface for FA-CODER type absolute encoders. Data from the Tamagawa-Seiki FA-CODER absolute type encoders is serially transmitted to the ACC-70P board, which then translates it for PMAC position feedback use. The ACC-70P is a PCI-style board so it may 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.

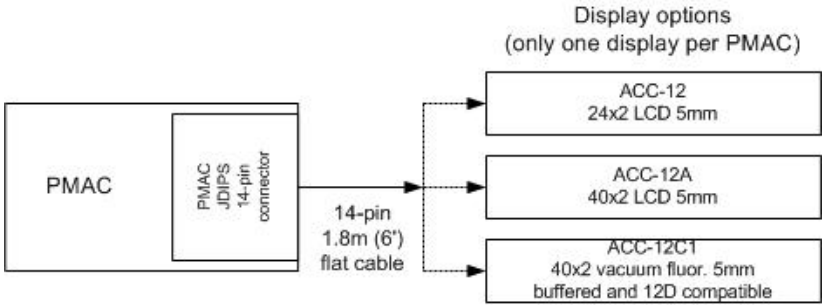
ACC-70P



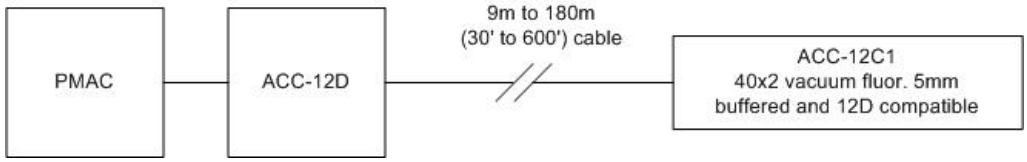
*If more than one accessory is connected to the PMAC JEXP port, use the 3-connector cable ACC-24 OPT-2.

DISPLAY ACCESSORIES

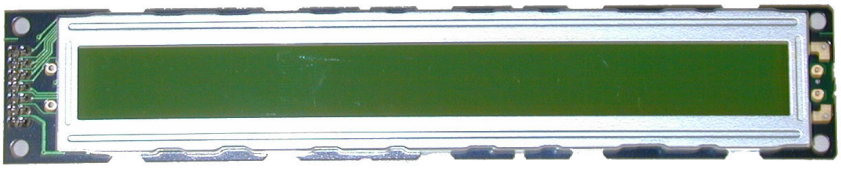
Display options when the distance between PMAC and the display is up to 1.8 m (6'):



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

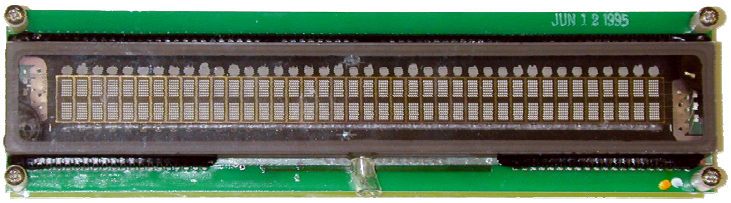


Part Number ACC-12A A59130

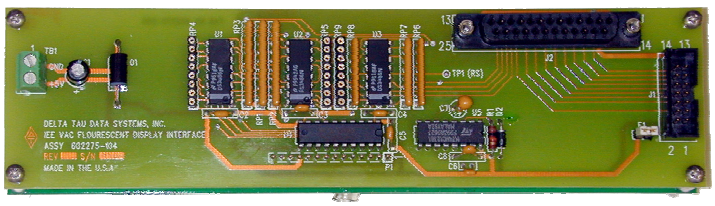
ACC-12C1, 40x2 Vacuum Fluorescent Display

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

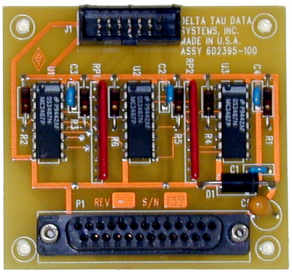
ACC-12D, Display Port Transmitter

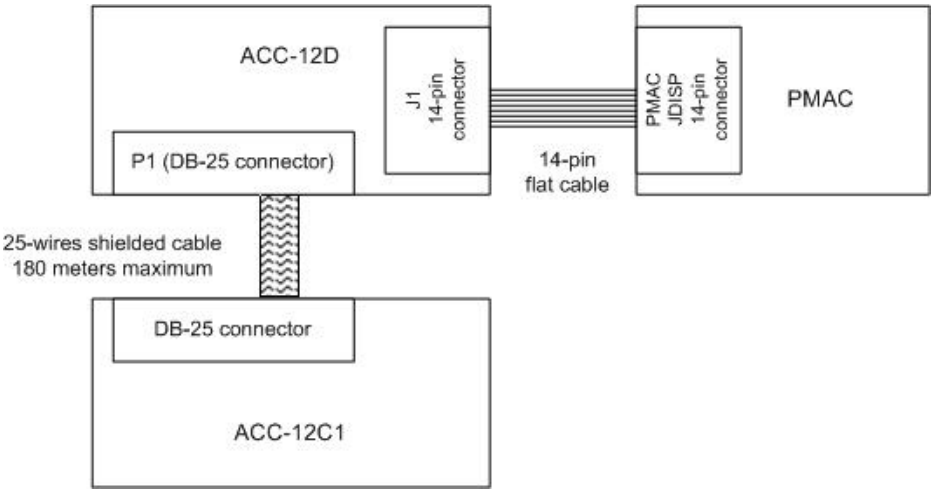
PMAC's ACC-12D is a small printed circuit board whose function is to buffer and transmit PMAC's JDISP signals differentially to the PMAC remote display ACC-12C1. ACC-12D should be used in conjunction with ACC-12C1 whenever they are physically situated a long distance (up to 600 feet) away from PMAC. 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.

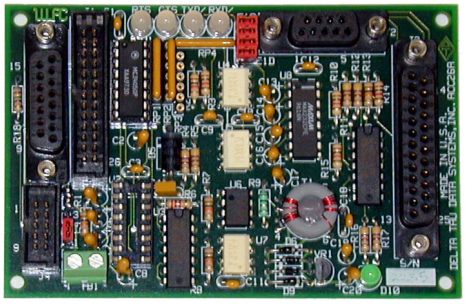
ACC-26A Option-3 provides, through its J5 (JGEF) connector, optical isolation of the serial communication link between a host computer and the GE-FANUC series 90-70 PLC.

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.

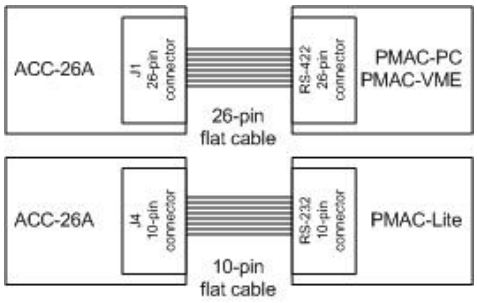
Part Number 602213

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)

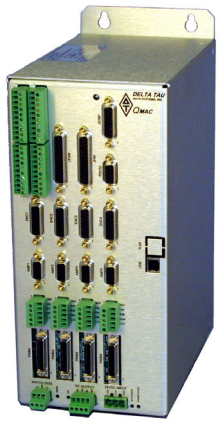


ACC-26A


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:

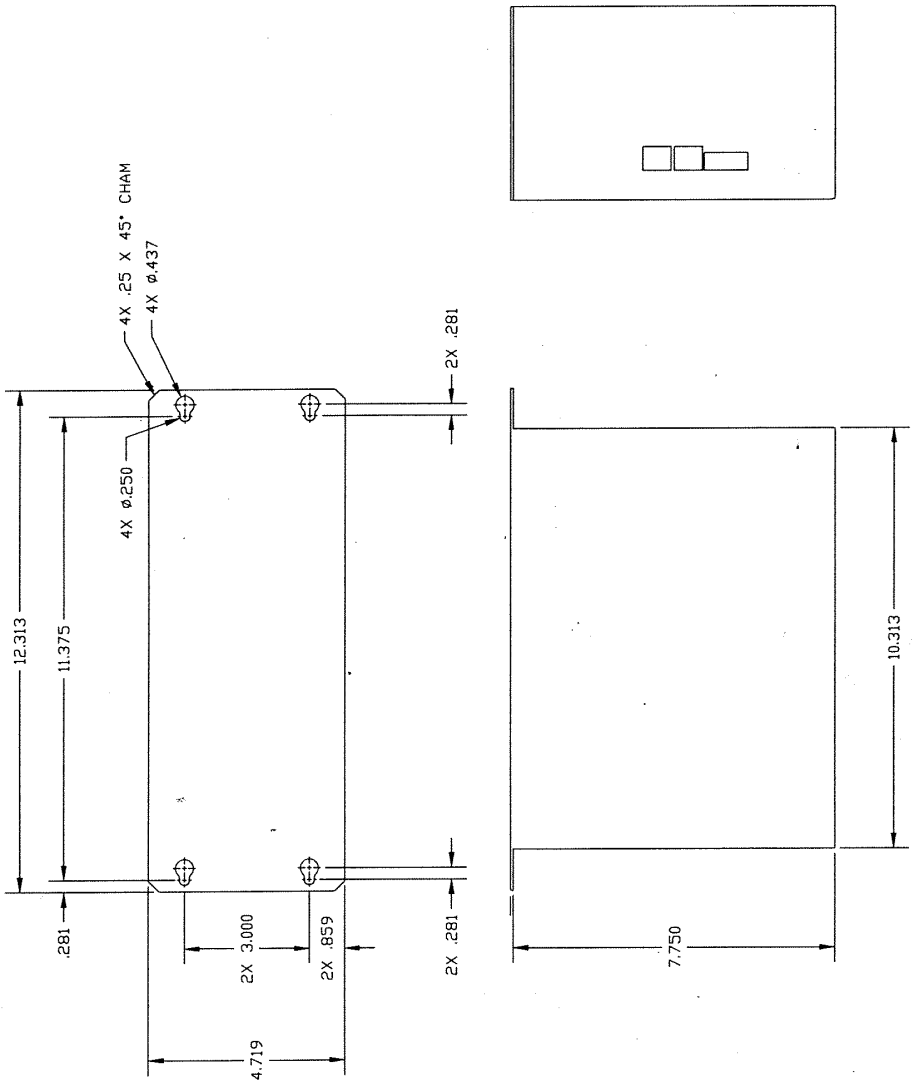
- Display port for the connection to a vacuum fluorescent or liquid crystal display
- I/O port: This port provides sixteen general-purpose 5 to 24V sinking or sourcing digital inputs and eight general-purpose sourcing digital outputs at 5 to 24VDC levels and a maximum of 250 mA per output.
- Multiplexer 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.

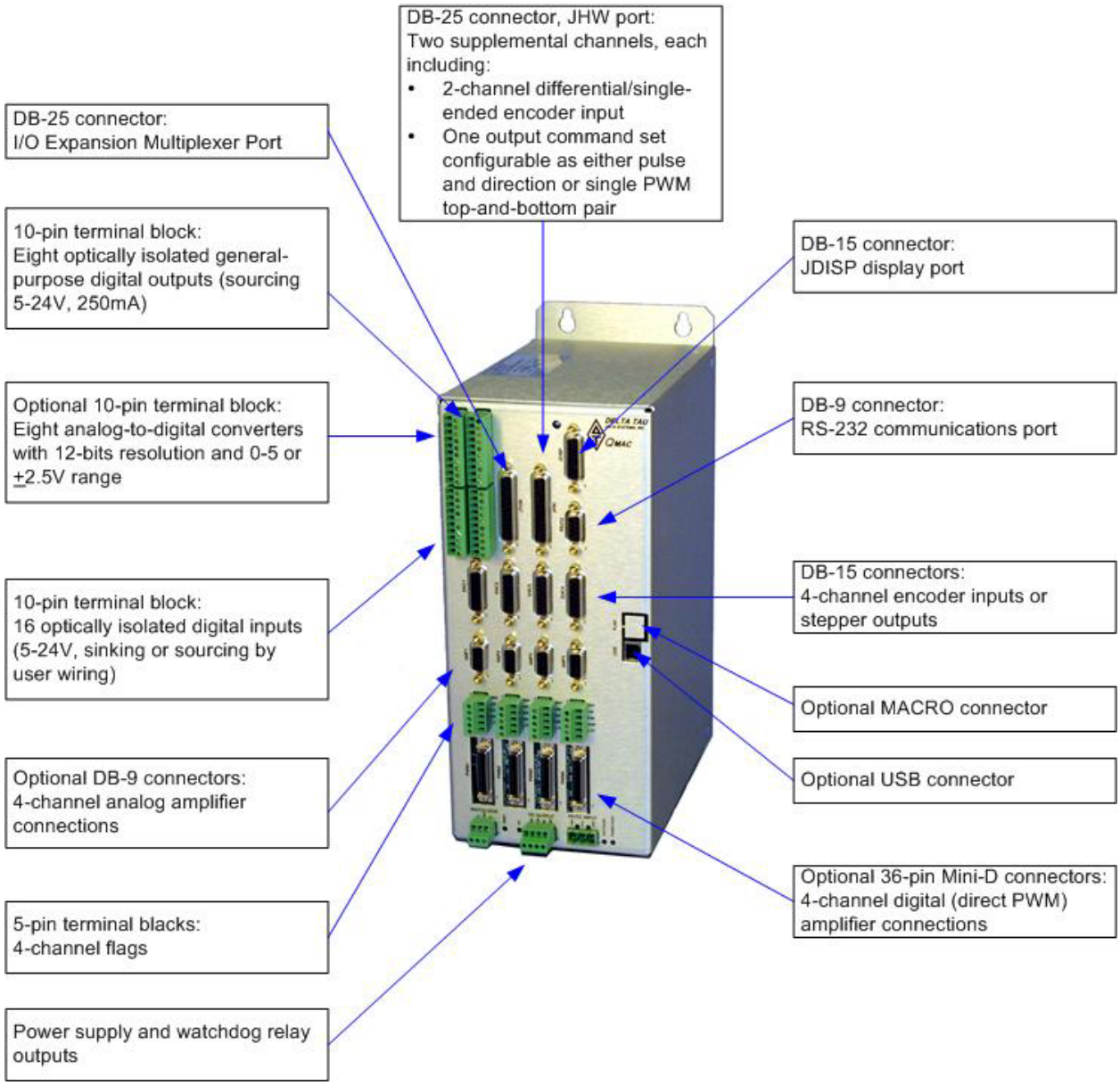
- OPT-3A (30A-603506-OPT): This option provides the MACRO ring interface with RJ-45 type connectors. This option allows QMAC to interface with any MACRO compatible device for servo axes or I/O expansion.
- OPT-3B (30B-603506-OPT): This option provides the MACRO ring interface with both fiber optics and 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.

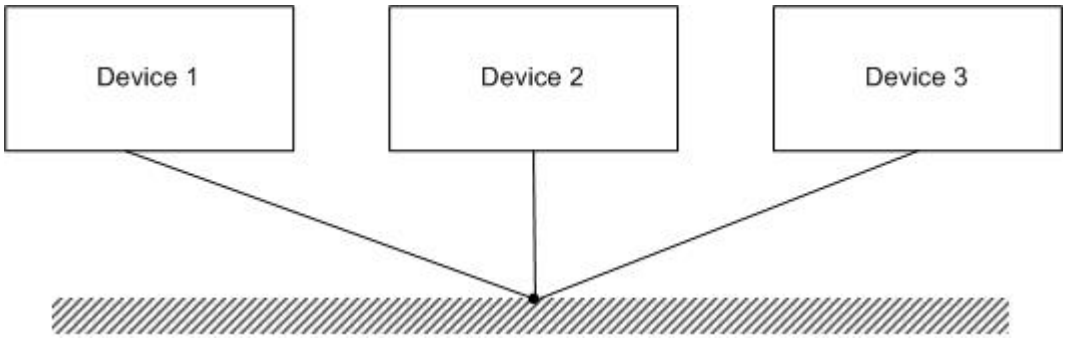
Ground Loops

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.

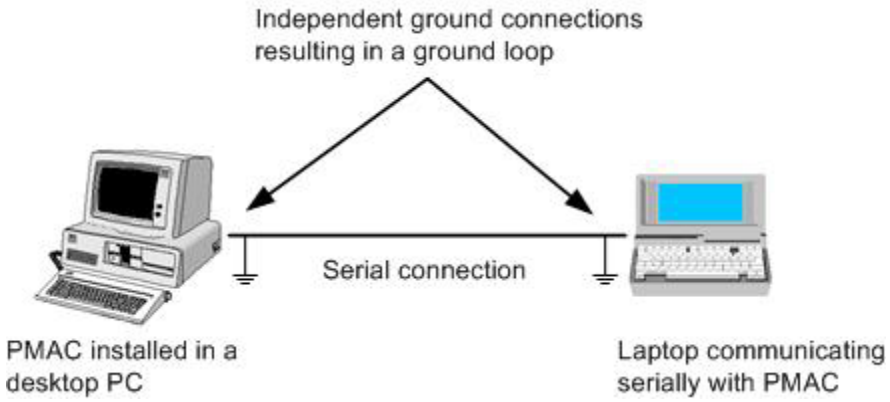


This configuration applies only for common ground connections and not for devices with opto-isolation circuits. Do not tie the PMAC analog and digital grounds together if PMAC is powered with separate analog and digital power supplies (the recommended method).

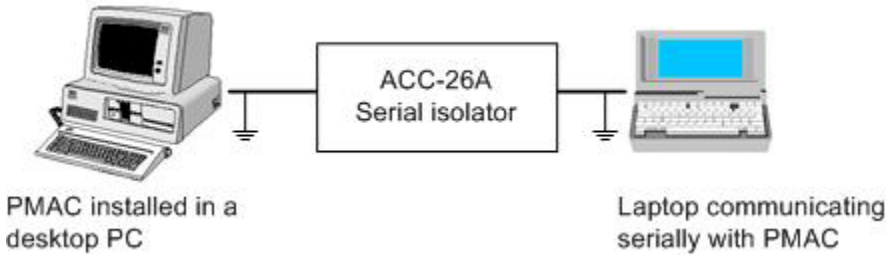
Opto-Isolation Circuits

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:



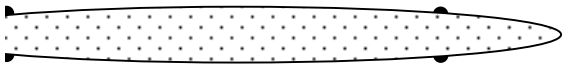
In this case, a serial communications isolator board will keep the laptop and desktop grounds separated avoiding a ground loop.

EMI, Electromagnetic Interference

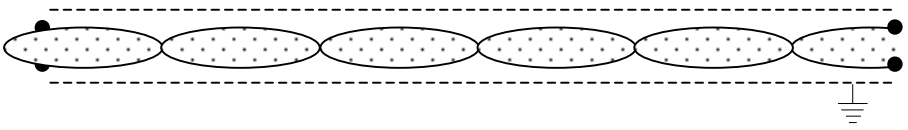
Electromagnetic interference (EMI) is an electrical noise that creates a disturbance or undesired response in one or more circuits, equipments, or systems. EMI is usually due to magnetic fields originated by nearby high current cables or transformers. Other sources of EMI include high voltage spikes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

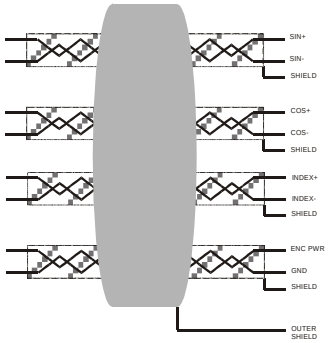


In a twisted cable, each adjacent pair of areas eliminates the inductive effect:



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.



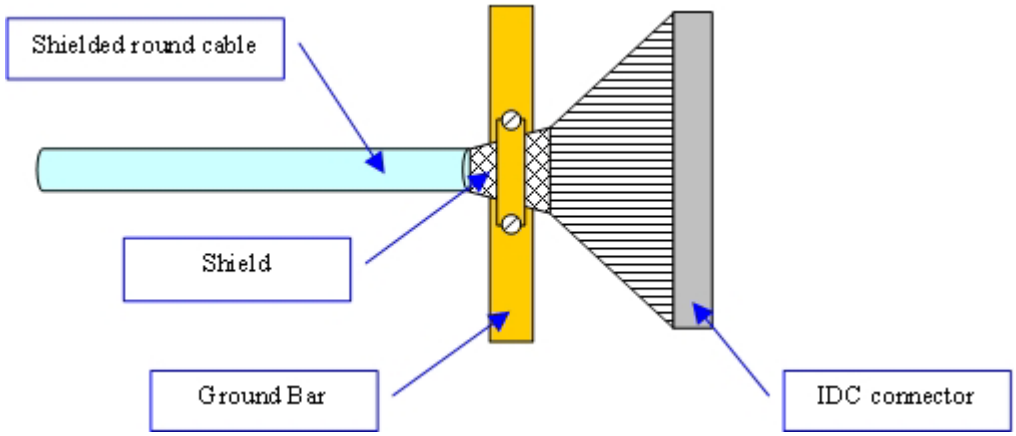
EXAMPLE OF DOUBLE SHIELDED
4 TWISTED PAIR CABLE

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.

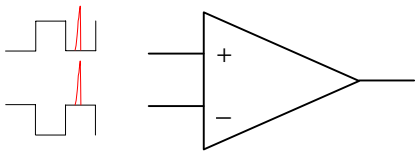


Basic Rules for Proper Wiring

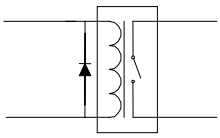
1. Take the time to sketch the system out before installing. This graphic representation of the installation will help avoid introducing ground loops and will serve as a road map for eliminating noise if it is present.
2. Do not introduce ground loops. Ground loops are created whenever a ground reference 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.