Delta Tau ACC-8DCE

PMAC I/O Interface Board

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CATALOG

PMAC Catalog

PMAC Catalog of Products

3A0-DTPMAC-xCxx

November 1, 2004

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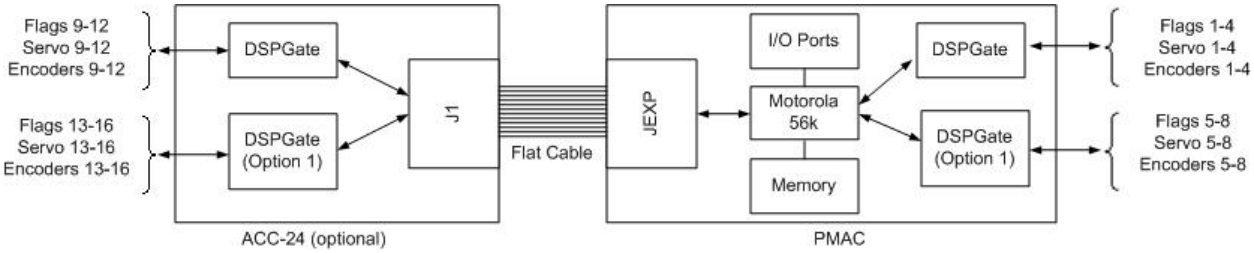
All Delta Tau Data Systems, Inc. motion controller products, accessories, and amplifiers contain static sensitive components that can be damaged by incorrect handling. When installing or handling Delta Tau Data Systems, Inc. products, avoid contact with highly insulated materials. Only qualified personnel should be allowed to handle this equipment.

In the case of industrial applications, we expect our products to be protected from hazardous or conductive materials and/or environments that could cause harm to the controller by damaging components or causing electrical shorts. When our products are used in an industrial environment, install them into an industrial electrical cabinet or industrial PC to protect them from excessive or corrosive moisture, abnormal ambient temperatures, and conductive materials. If Delta Tau Data Systems, Inc. products are directly exposed to hazardous or conductive materials and/or environments, we cannot guarantee their operation.

Table of Contents

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.

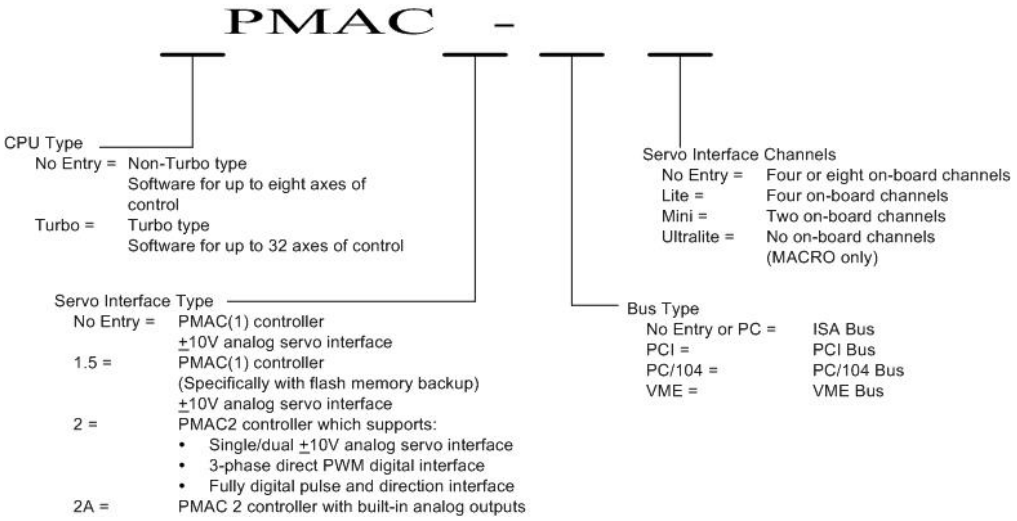
PMAC2 Ultralite

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.

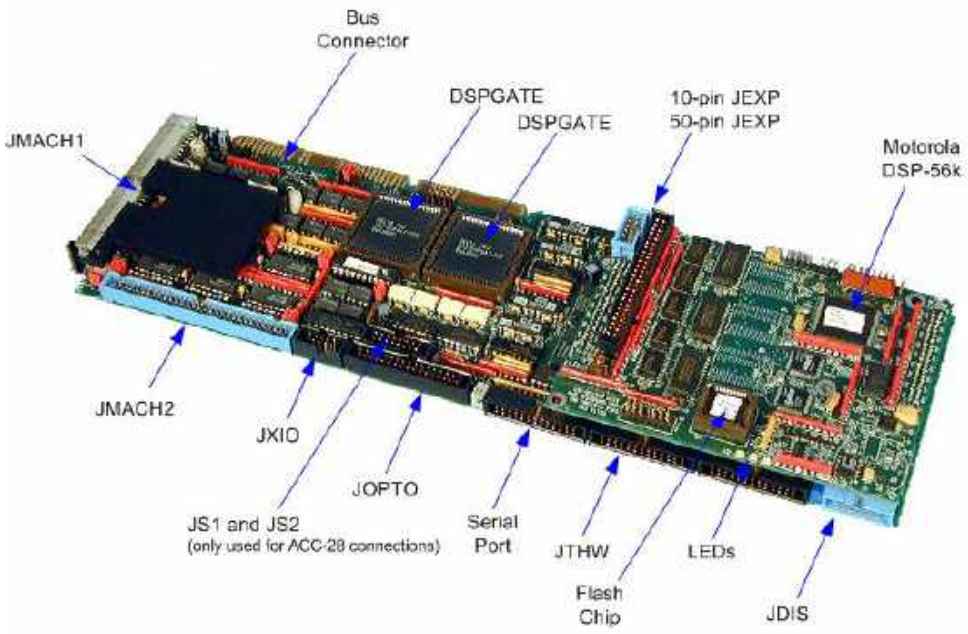
Machine Connectors

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

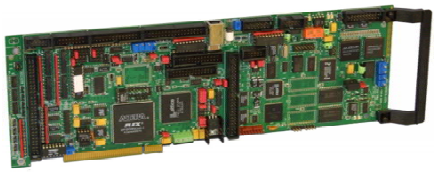
The Turbo PMAC family should be selected based on the following features:

- 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.

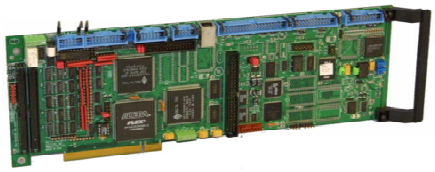
- Multiplexer Port providing eight input lines and eight output lines at TTL levels. When using the PMAC ACC-34x type boards, these lines allow multiplexing up to 1024 I/O lines on the port.
- Control panel port with dedicated control inputs, dedicated indicator outputs, a quadrature encoder input, and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

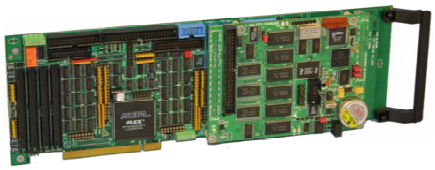
- Display port for the connection to a vacuum fluorescent or liquid crystal display
- I/O port providing 32 digital I/O lines at 5V CMOS levels configurable by byte for inputs or outputs. ACC-21A provides a convenient method for connection of this port to Opto-22™ or Grayhill type boards.
- Multiplexer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

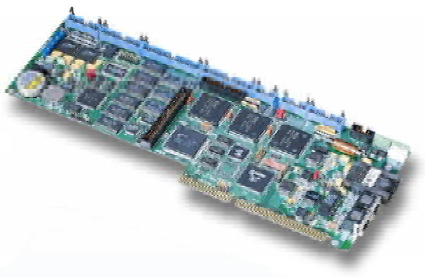
- Display port for the connection to a vacuum fluorescent or liquid crystal display
- I/O port providing 32 digital I/O lines at 5V CMOS levels configurable by byte for inputs or outputs. ACC-21A provides a convenient method for connection of this port to Opto-22™ or Grayhill type boards.
- Multiplexer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

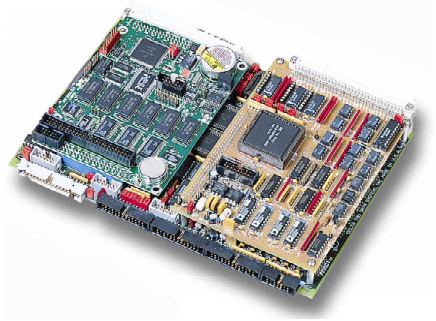
Miscellaneous

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

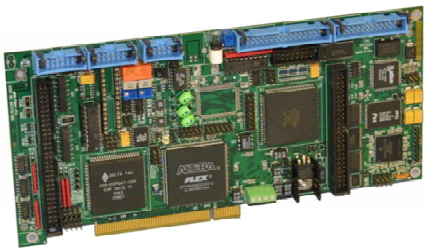
The Non-Turbo PMAC family should be selected based on the following features:

- 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:

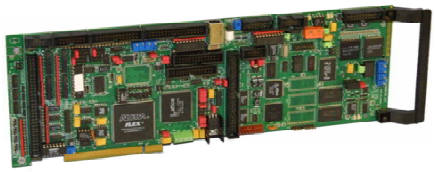
- Display port for the connection to a vacuum fluorescent or liquid crystal display
- JOPTO port: This port provides eight general-purpose digital inputs and eight general-purpose digital outputs at 5 to 24VDC levels and a maximum of 100 mA per output. This 34-pin connector was designed for easy interface 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

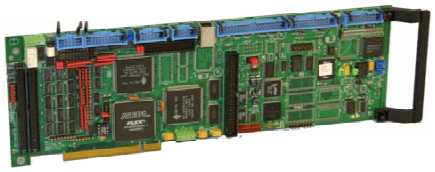
The following ports are provided standard in any PMAC:

- 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:

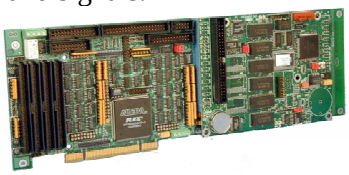
- Display port for the connection to a vacuum fluorescent or liquid crystal display
- I/O port providing 32 digital I/O lines at 5V CMOS levels configurable by byte for inputs or outputs. ACC-21A provides a convenient method for connection of this port to Opto-22™ or Grayhill type boards.
- Multiplexer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

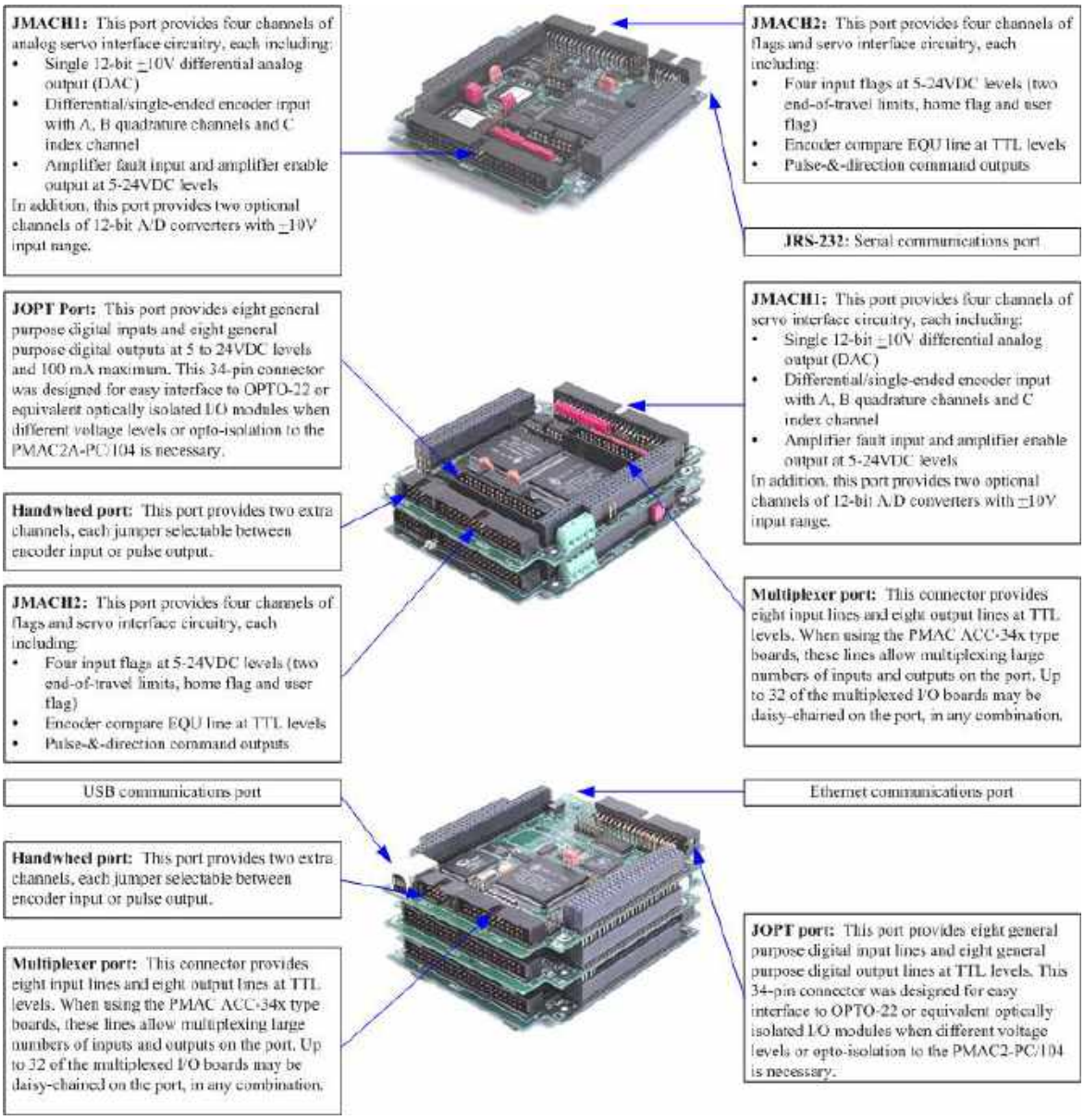
- ACC-2P-OPT-1A: This provides a 12 Mbit/sec USB interface allowing USB communications with the PMAC2A-PC/104 motion controller
- ACC-2P-OPT-1B: This provides a 10 Mbit/sec Ethernet interface allowing Ethernet communications with the PMAC2A-PC/104 motion controller.
- ACC-2P-OPT-2: This provides an 8K 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

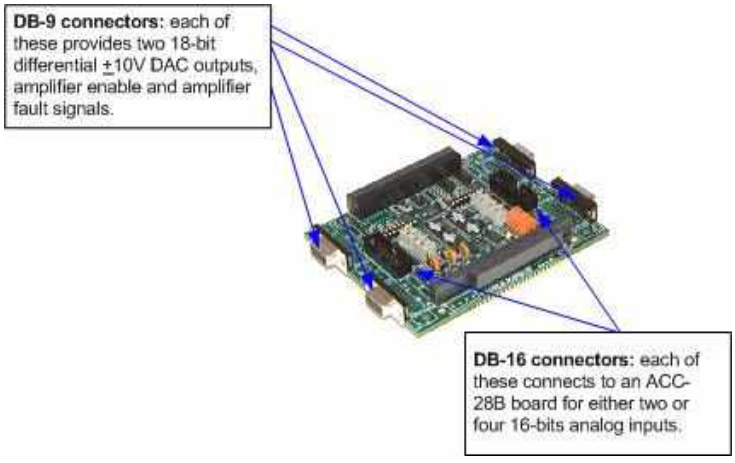
General-Purpose I/O

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.

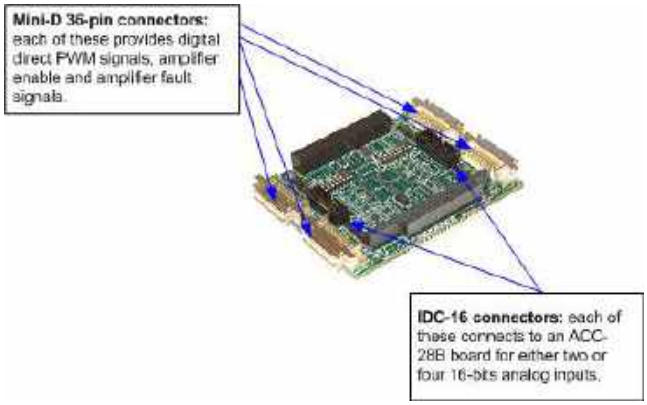


ACC-8ES: Four Channel Dual-DAC Analog Stack Board



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

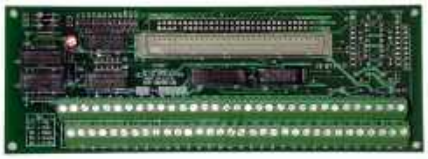
Typically, on a PMAC(1) type board, the connections are actually made to a terminal block that is attached to the JMACH connector by a flat cable. The pinout numbers on the terminal block are the same as those on the JMACH connector for PMAC PC. While the numbering scheme for the pins on machine connectors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

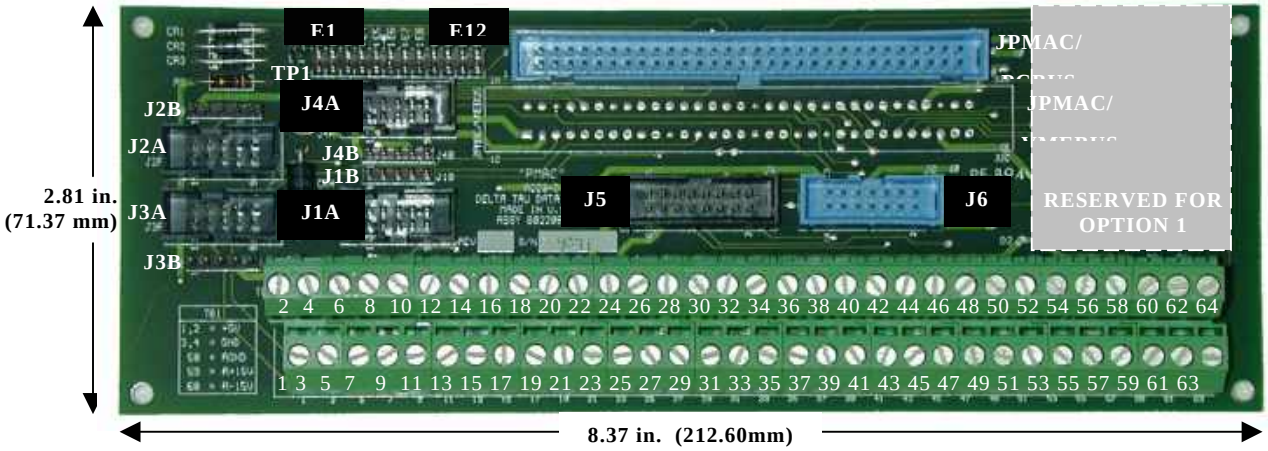
- ACC 8D Option-P: 60-pin socket and flat cable to PMAC PC
- ACC 8D Option-V: 96-pin socket and 64 line flat cable to PMAC VME



ACC-8D with OPT-P

ACC-8D with OPT-V

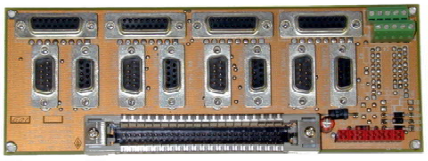
ACC-8P with OPT-P



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

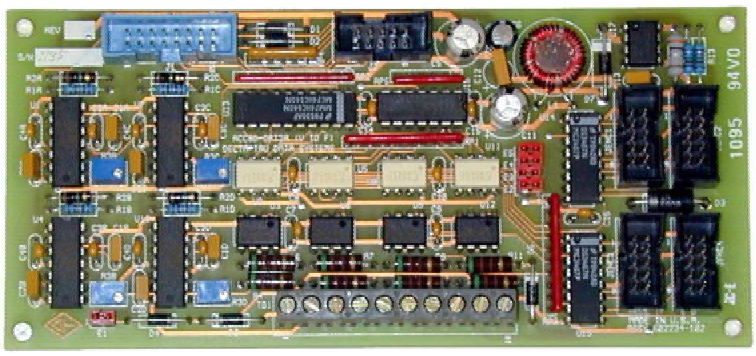
ACC-8D-OPT-2, Voltage to Frequency Converter Board

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.

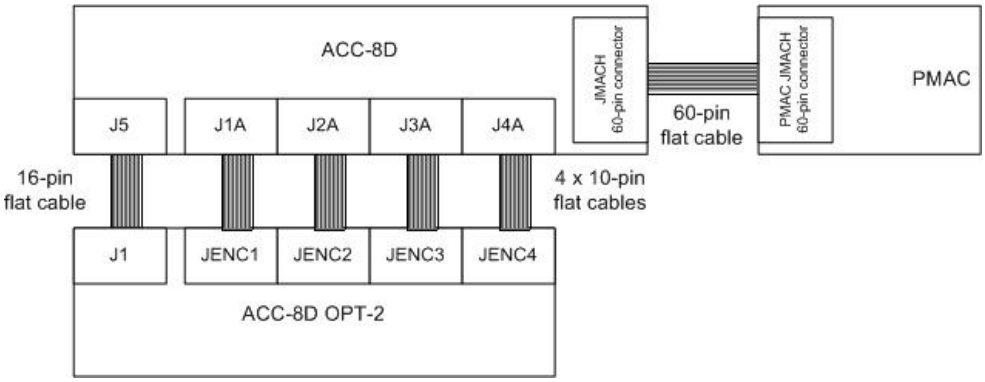
Part Number 602234

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

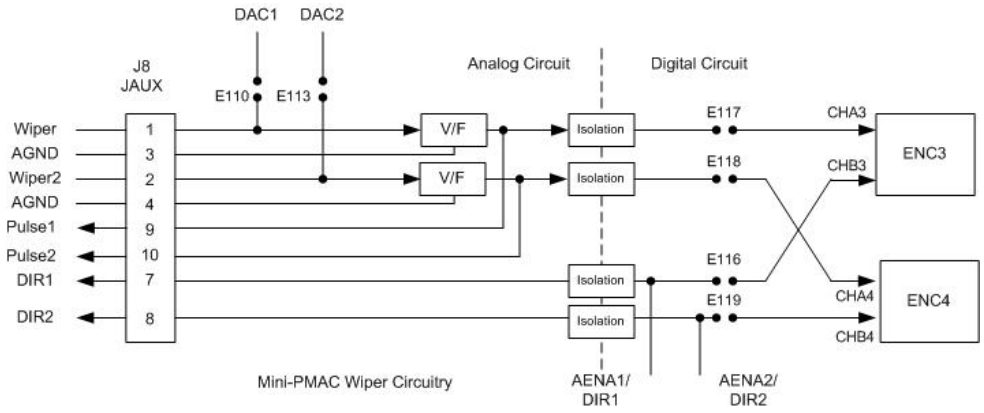


ACC-8D-Option-2

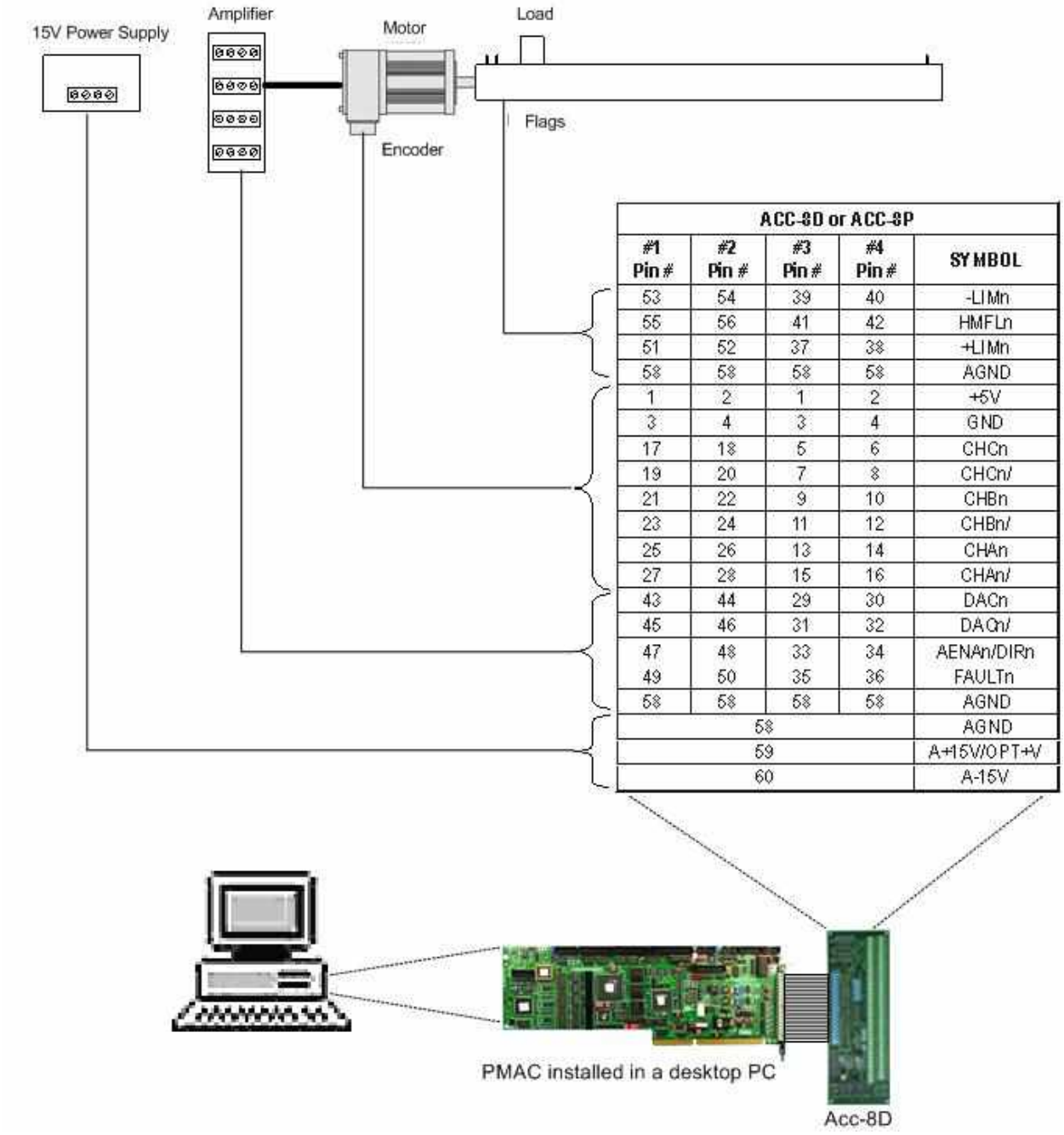


OPT-15, On-Board Voltage to Frequency Converter

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

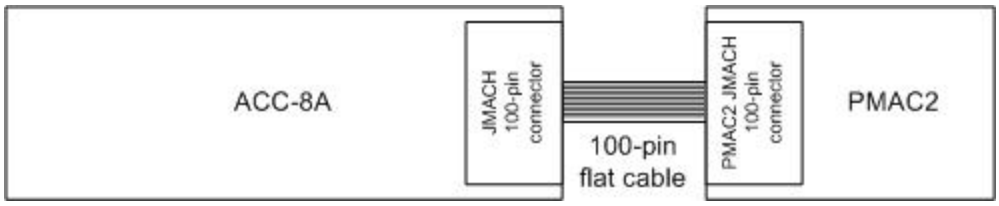
The standard configuration without options provides two channels, each with:

- 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

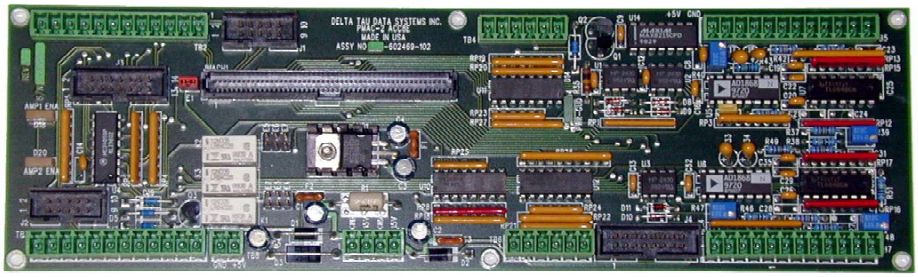
Option-1: This option adds a 256x sine wave encoder interpolator circuit for each channel (key components U11 and U12).

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