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HARDWARE REFERENCE MANUAL

3U Turbo CPU Board
(3U Turbo PMAC2)

HRM for UMAC Turbo & Turbo Stack

3xx-603382-xHxx

January 29, 2003

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INTRODUCTION

Delta Tau's 3U-format Turbo PMAC systems combine the power of the Turbo PMAC family with an integrated packaging strategy that gives the user revolutionary flexibility and ease of use. The heart of these systems is the 3U Turbo PMAC CPU board, described in this manual. It can either be assembled with piggyback accessory boards to form a "Turbo Stack," or connected through a backplane to rack-mounted accessories to form a UMAC (Universal Motion and Automation Controller) Turbo system. UMAC systems provide integrated connectivity as well as ease of assembly, diagnostics, and repair.

UMAC CPU Boards

The UMAC is available with either of two CPU boards – Turbo PMAC2 or MACRO Station.

The Turbo PMAC2 CPU board creates a "UMAC Turbo," a full PMAC controller completely capable of standalone operation.

The MACRO Station CPU board creates a "UMAC MACRO." It is a remote slave node on a MACRO ring, requiring a PMAC2 controller to command it over the ring.

This manual describes the hardware for the UMAC Turbo CPU board; for the UMAC MACRO CPU board, consult the hardware reference manual for that product.

Associated Manuals

This document is the Hardware Reference Manual for the 3U Turbo CPU board for a UMAC Turbo system. It describes the hardware features and provides setup instructions.

You will need other manuals as well to use your UMAC Turbo system. Each accessory to the 3U Turbo CPU board has its own manual, describing its operation and any required software setup of the Turbo CPU.

You will also need the Software Reference Manual for the Turbo PMAC family, and the User's Guide for the PMAC or Turbo PMAC families.

3U Board Configurations

The 3U boards can be configured in either of two fundamental assemblies – "UMAC " and "Stack."

- **UMAC** – In the UMAC configuration (once called "Pack") the 3U-format boards are put together to communicate through a backplane bus called the UBUS, with all boards installed in a Euro-card rack. In this configuration, all 3U-format boards or modules can be installed or withdrawn from the pack individually, providing ease of installation, debugging, and repair.

  The photo at right shows two boards connected through a backplane in the UMAC configuration. They are not connected directly to each other.

- **Stack** – In the Stack configuration the 3U-format boards are put together as a stack of piggyback boards, (right, below). This configuration is ideal for compact, cost-sensitive embedded applications.



Two boards in UMAC Configuration

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Note:

The Stack boards and related breakout boards can be installed in a Euro-card rack, creating a hybrid "stack/pack" configuration. Because the Stack boards were developed first, this originally was the only way of creating a "pack" configuration, and pulling boards for service was an awkward chore. This configuration should now be used for existing "legacy" systems only.

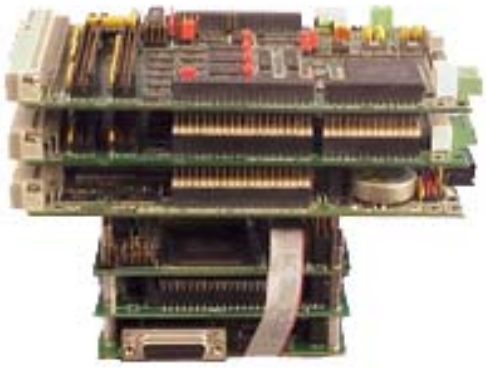


Two Boards in Stack Configuration

The following two photos show typical UMAC and Stack configurations. They are intended only to show what a completed system may look like, not to be instructions on how to put a particular system together.



Sample UMAC Configuration:
Turbo PMAC2 CPU & PC/104, ACC-24E2 4-Axis Interface, ACC-10E 48 Out, ACC-9E 48 In, ACC-11E 24 In/24 Out Low Power, Accessory E Power Supply



Sample "Stack" Configuration
PC/104 Computer, Turbo PMAC2 CPU, 2 ACC-2E 4-Axis Interface Boards

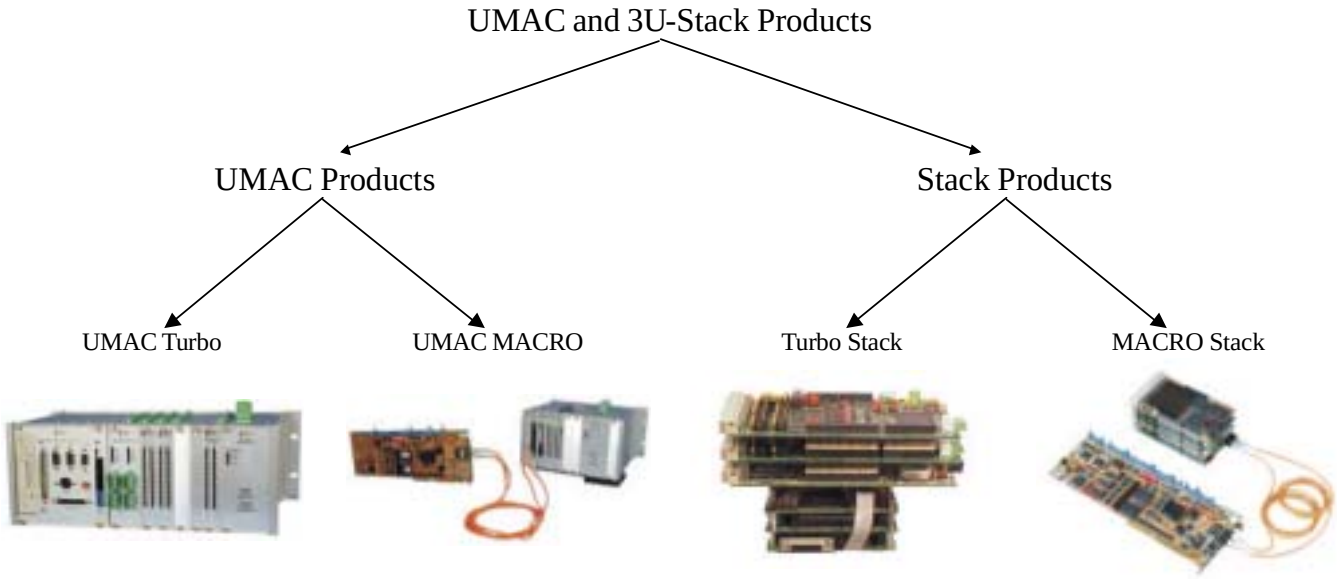
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3U Product Configurations (General Description)

Assemblies of 3U-format boards can be made with either of two CPU processor boards – a 3U MACRO-CPU board, or a 3U Turbo PMAC2 CPU board. Most other 3U-format boards, labeled “Accessory” boards, can be used with either CPU board.

- When the 3U MACRO-CPU board is used, the resulting assemblies are called “UMAC MACRO” or "3U MACRO Stack."
- When the 3U Turbo PMAC2 CPU board is used, the resulting assemblies are called “UMAC Turbo” or "Turbo Stack."

Refer to the "UMAC & 3U Stack Products Selection Guide" for more detailed descriptions of how the rack and stack products are integrated.



The UMAC Turbo is composed of a 3U-format Turbo PMAC2 CPU board and a set of accessory boards in 3U-format, all plugged in a common UBUS backplane and installed inside a 3U format rack. A PC/104 computer and several optional communication accessories (including all of the major FieldBuses, MACRO and Ethernet) can be installed inside the UMAC system providing convenient flexibility and virtually unlimited expandability.

The UMAC MACRO is composed of a MACRO Interface/CPU board and a set of accessory boards in 3U-format, all plugged in a common UBUS backplane and installed inside a 3U format rack. The UMAC MACRO must receive commands from an external MACRO compatible device like a PMAC2 Ultralite or a UMAC Turbo system. The UMAC MACRO does not support a PC/104 or communication accessories and it is preferred for distributed control over a MACRO ring connection.

The Turbo stack is composed of a 3U-format Turbo PMAC2 CPU board and a set of accessory boards in 3U-format plugged to it in a stack configuration. The Turbo stack configuration is less expensive than the UMAC Turbo system but it is limited to eight axes of motion control versus 32 axes on a UMAC Turbo system. The Turbo Stack is selected over a UMAC Turbo system because is more compact, allowing its installation inside already existing cabinets with some space limitations.

The MACRO stack is composed of a MACRO Interface/CPU board and a set of accessory boards in 3U-format plugged to it in a stack configuration. The UMAC MACRO must receive commands from an external MACRO compatible device like a PMAC2 Ultralite or a UMAC Turbo system. The MACRO Stack is selected over a UMAC MACRO system because it is more compact, allowing its installation inside already existing cabinets with some space limitations.

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UMAC CPU Basic Specifications

Physical Specifications

Size: 33.5cm x 9.9cm x 3.8cm (13.2" x 3.9" x 1.4")

Weight: ¼ lb.

Temperature

Operating: 0°C to 60°C (32°)F to 140°F)

Storage: 12°C to 82°C (10°F to 180°F)

Humidity: 10% to 95%, noncondensing

Electrical Specifications

Power: 1A @ +5V (±5%)

Battery: 3.0V Lithium Cell, 1200mAh, 2/3A-size, no tabs; or 3.6V Lithium Cell, 1000 mAh, 1.00" can

Expected battery life: 10 years (standard), 6-9 months (Opt. 5).

Recommended replacement: 24 months (standard), 3-6 months (Opt. 5)

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3U TURBO CPU BOARD CONFIGURATION

The base version of the 3U Turbo PMAC2 CPU board provides a 1-slot 3U-format Eurocard board with:

- 80 MHz DSP56303 CPU (120 MHz PMAC equivalent)
- 128k x 24 SRAM compiled/assembled program memory (Opt. 5C0)
- 128k x 24 SRAM user data memory (Opt. 5C0)
- 1M x 8 flash memory for user backup & firmware (Opt. 5C0)
- Latest released firmware version
- RS-232/422 serial interface
- Inter-board "stack" connectors for piggyback servo and I/O accessory boards
- Backplane UBUS expansion connector for "pack" servo and I/O accessory boards

If the "3A0" part prefix for the CPU board is ordered, the board comes with a standard Eurocard front plate with top and bottom installation screws. (Top and bottom plates are provided with the ACC-Px pack frame.

Option 2: Bus Interfaces

The 3U Turbo PMAC2 CPU board comes standard only with a serial interface. Option 2 provides a faster bus interface for high-speed communications. The interface is PC/104 bus compatible (mechanical, electrical, and software), so it is software-compatible with the ISA bus. However, the board is not PC/104 form-factor compliant, and it can only be placed on top of a PC/104 stack.

- Option 2: PC/104 interface. Stacking connectors from solder side of CPU board.
- Option 2B: 32k x 16 bank of on-board dual-ported RAM (requires Option 2)

Option 4: CPU Type

The Turbo PMAC2-3U CPU board comes standard with a DSP56303 CPU IC as component U1. This CPU has enough internal memory to process the servo and commutation for the first 15 motors entirely from internal memory; these algorithms for the last 17 motors must be processed from slower external memory. The optional DSP56309 CPU has additional internal memory, so the processing of these motors is significantly improved. The processor type in the board is reported on receipt of the **CPU** command.

- Option 4C: 80 MHz DSP56309 CPU IC. Recommended for control of more than 16 axes, especially with PMAC-based commutation. Not compatible with any Option 5Dx.
- Option 4D: 100 MHz DSP56309 CPU IC. Recommended for control of more than 16 axes, especially with PMAC-based commutation. Not compatible with any option 5Cx

Option 5: CPU & Memory Configurations

The various versions of Option 5 provide different CPU speeds and main memory sizes on the piggyback CPU board. Only one Option 5xx may be selected for the board.

The CPU is a DSP5630x IC as component U1. It is currently available only as an 80 MHz or 100 MHz device (with computational power equivalent to a 120 MHz or 150 MHz non-Turbo PMAC, respectively), but higher speed versions will be available shortly.

The compiled/assembled-program "P"memory SRAM ICs are located in U14, U15, and U16. These ICs form the active memory for the firmware, compiled PLCs, and user-written phase/servo algorithms. These can be 128k x 8 ICs (for a 128k x 24 bank), fitting in the smaller footprint, or they can be the larger 512k x 8 ICs (for a 512k x 24 bank), fitting in the full footprint.

The user-data memory ("x/y") SRAM ICs are located in U11, U12, and U13. These ICs form the active memory for user motion programs, uncompiled PLC programs, and user tables and buffers. These can be 128k x 8 ICs (for a 128k x 24 bank), fitting in the smaller footprint, or they can be the larger 512k x 8 ICs (for a 512k x 24 bank), fitting in the full footprint.

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The flash memory IC is located in U10. This IC forms the non-volatile memory for the board's firmware, the user setup variables, and for user programs, tables, and buffers. It can be 1M x 8, 2M x 8, or 4M x 8 in capacity.

- Option 5C0 is the standard CPU and memory configuration. It is provided automatically if no Option 5xx is specified. It provides an 80 MHz CPU (120 MHz PMAC equivalent), 128k x24 of compiled/assembled program memory, 128k x 24 of user data memory; and a 1M x 8 flash memory.
- Option 5C1 provides an 80 MHz CPU (120 MHz PMAC equivalent), 128k x 24 of compiled/assembled program memory, an expanded 512k x 24 of user data memory, and a 2M x 8 flash memory.
- Option 5C2 provides an 80 MHz CPU (120 MHz PMAC equivalent), an expanded 512k x 24 of compiled/assembled program memory, 128k x 24 of user data memory, and a 2M x 8 flash memory.
- Option 5C3 provides an 80 MHz CPU (120 MHz PMAC equivalent), 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. Check factory for availability of this option.
- Option 5D0 provides a 100 MHz CPU (150 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 5D1 provides a 100 MHz CPU (150 MHz PMAC equivalent), 128k x 24 of compiled/assembled program memory, an expanded 512k x 24 of user data memory, and a 2M x 8 flash memory.
- Option 5D2 provides a 100 MHz CPU (150 MHz PMAC equivalent), an expanded 512k x 24 of compiled/assembled program memory, 128k x 24 of user data memory, and a 2M x 8 flash memory.
- Option 5D3 provides a 100 MHz CPU (150 MHz PMAC equivalent), 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. Check factory for availability of this option.

Option 8: High-Accuracy Clock Crystal

The 3U Turbo CPU board has a clock crystal (component Y1) of nominal frequency 19.6608 MHz (~20 MHz). The standard crystal's accuracy specification is +/-100 ppm.

- Option 8A provides a nominal 19.6608 MHz crystal with a +/-15 ppm accuracy specification.

Option 9: Serial Port Configuration

The 3U Turbo CPU board comes standard with a single RS-232/422 serial port, a second serial port can be added.

- Option 9T adds an auxiliary RS-232 port on the CPU board. The key components added are IC U22 and connector J8 on the CPU board.

Option 10: Firmware Revision Specification

Normally the 3U Turbo CPU board is provided with the newest released firmware revision. Some users may wish to "freeze" their designs on an older revision. A label on the U10 flash memory IC shows the firmware revision loaded at the factory. The **VERSION** command can be used to report what firmware revision is currently installed.

- Option 10 provides for a user-specified firmware version.

Option 16: Battery-Backed Parameter Memory

The contents of the standard memory are not retained through a power-down or reset unless they have been saved to flash memory first. Option 16 provides supplemental battery-backed RAM for real-time parameter storage that is ideal for holding machine state parameters in case of an unexpected power-down. The battery is located at component BT1.

- Option 16A provides a 32k x 24 bank of battery-backed parameter RAM in components U17, U18, and U19, fitting in the smaller footprint for those locations.
- Option 16B provides a 128k x 24 bank of battery-backed parameter RAM in components U17, U18, and U19, filling the full footprint for those locations.

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Option 18: Identification Number & Real Time Clock/Calendar Module

Option 18 provides a module at location U5 on the CPU board that contains an electronic identification number, and possibly a real-time clock/calendar.

- Option 18A provides an electronic identification-number module.
- Option 18B provides an electronic identification-number module with a battery-backed real-time clock and calendar. The year representation in the calendar is a 4-digit value, so there are no "Y2K" problems.

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HARDWARE SETUP

Clock Source Jumpers

In order to operate, the Turbo CPU board must receive servo and phase clock signals from a source external to the board. These clock signals can be brought into the board from one of three possible ports: the stack connector, the UBUS backplane connector, or the front-side main serial-port connector. Jumpers E1A and E1B must be configured properly for the clock source you use.

To receive the clock signals over the UBUS backplane, usually from an ACC-24E2x axis-interface board or an ACC-5E MACRO-interface board, E1A must connect pins 1 and 2, and E1B must connect pins 2 and 3. This configuration is typical for a UMAC Turbo "pack" system. The clock signals are output on the main serial port.

To receive the clock signals through the stack connectors, usually from an ACC-2E axis-interface board, E1A must connect pins 1 and 2, and the E1B jumper must be removed. This configuration is typical for a Turbo Stack system. The clock signals are output on the main serial port.

To receive the clock signals through the main serial port, usually from another PMAC system or a reference signal generator, E1A must connect pins 2 and 3, and E1B must connect pins 1 and 2. This configuration is rarely used, but permits complete synchronization to the system that is generating the clock signals.

Watchdog Timer Jumper

Jumper E19 should be OFF for normal operation, leaving the watchdog timer circuit active and prepared to shut down the card in case of a severe problem. Putting jumper E19 ON disables the watchdog timer circuit. This should only be used for test purposes, in trying to track down the source of watchdog timer trips. Normal operation of a system with this jumper ON should never be attempted, as an important safety feature is disabled.

Operation Mode Jumpers

Jumpers E20, E21, and E22 control the operational mode of the 3U Turbo CPU. For normal operation, E20 must be OFF, E21 must be ON, and E22 must be ON. Other settings of these jumpers are for factory use only.

Firmware Reload Jumper

Jumper E23 should be OFF for normal operation. If you want to load new firmware into the flash-memory IC on the CPU, E23 should be ON when the card is powered up. This puts the card in "bootstrap mode", ready to accept new firmware. If you then try to establish communications to the card with the Executive program, either over the main serial port or the PC/104 bus port, the Executive program will automatically recognize that the card is in bootstrap mode, and prompt you for the firmware file to download.

Re-Initialization Jumper

Jumper E3 should be OFF for normal operation, where the last saved I-variable values are loaded from flash memory into active memory at power-up/reset. If E3 is ON during power-up/reset, the factory default I-variable values are instead loaded into active memory at power-up/reset. The last saved values are not lost when this happens. This jumper is typically only used when the system's set up has a problem severe enough that communications does not work – otherwise, a **$$$***** command can be used for re-initialization.

Reference Voltage Connect Jumper

Jumper E12 permits the reference voltage for the analog and digital circuits in the 3U Turbo PMAC2 system to be tied together. If you are not isolating the analog circuits from the digital circuits, this jumper should be ON. (Note that in a Turbo Stack system, you *cannot* isolate these circuits from each other.) If you are isolating the analog circuits from the digital circuits, using separate isolated supplies for the two circuits, this jumper should be OFF.

Interrupt Select Jumpers

If the Option 2 PC/104-bus interface is installed, the 3U Turbo CPU can interrupt the PC/104 host computer over one of four interrupt lines as selected by jumpers E7 – E10. At most one of these jumpers should be ON in any configuration.

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- E7 ON selects interrupt line IRQ10
- E8 ON selects interrupt line IRQ11
- E9 ON selects interrupt line IRQ12
- E10 ON selects interrupt line IRQ15

Serial-Port Level Select Jumpers

The standard J7 serial port can be used for either RS-232 or RS-422 serial communications. To use RS-232, jumpers E17 and E18 should connect pins 1 and 2; to use RS-422, jumpers E17 and E18 should connect pins 2 and 3.

Re-Initialization Jumper

If jumper E3 is installed when the board is powered-up or reset, the board firmware will go through a re-initialization process, returning most I-variables to factory default values. It will also go through an system auto-detection process, selecting which of the Servo ICs and MACRO ICs that it finds will be the source of the servo and phase clock signals for the system.

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CONNECTIONS

Stack Connections

If the 3U Turbo CPU board is used in a "Turbo Stack" configuration, the stack accessory boards (ACC-2E, 3E, 4E, and 6E) are mounted on top (component side) of the CPU board. The solder-side prong connectors of these stack boards insert into the mating component-side sockets of the board below it. All four corners of these boards provide mounting holes for standoff connections between boards. The stacking connectors provide for the Eurocard "4T" standard of 20mm (0.8") spacing between boards, so standoff lengths must be chosen accordingly. If Delta Tau assembles the stack, it will install the proper standoffs.

Backplane (UMAC) Connections

To connect the 3U Turbo CPU board to the UBUS backplane, simply insert the P1 connector into one of the sockets on an ACC-Ux UBUS backplane board. It does not matter which socket on the UBUS backplane board is used, although customarily, the CPU board is installed in the leftmost slot. Typically the backplane board will already have been installed in a Eurorack frame (ACC-Px or equivalent), so the CPU board is simply slid into one of the slot guides in the frame until mates with the backplane board; then the front-plate screws are tightened for a firm connection to the rack and backplane.

If a power supply has been connected to the UBUS backplane board, this power will automatically be supplied to the Turbo CPU board. The UBUS backplane board is capable of supplying isolated analog and digital supplies, but the 3U-format power supplies (ACC-Ex, ACC-F) provided by Delta Tau do not keep these two supplies isolated from each other.

PC/104 Connections

If the Option 2 PC/104 connector is installed, the 3U Turbo CPU board may be mounted on the top of a PC/104 stack. Because it does not pass the connector through, it may only be mounted on the top of such a stack. The 3U Turbo CPU board has four mounting holes in the standard PC/104 locations for standoff connections to the PC/104 stack. Note that the PC/104 connector used on the 3U Turbo CPU board provides for the Eurocard "4T" standard of 20mm (0.8") spacing between boards, not the PC/104 standard of 15mm (0.6"), so standoff lengths must be chosen accordingly.

Serial Port Connections

The standard J7 serial-port connector on the front edge of the 3U Turbo CPU board is an IDC 26-pin header. The connector is designed so a standard flat-cable connection (such as a Delta Tau ACC-3D cable) to a DB-25 connector can be used. From there, a standard DB25-to-DB9 adapter can be used if necessary. The servo and phase clock signals can either be input or output on this connector, depending on the setting of jumpers E1A and E1B.

The auxiliary J8 serial-port connector that comes with Option 9T is an IDC 10-pin header. The connector is designed so a standard flat-cable connection (such as a Delta Tau ACC-3L cable) to a DB-9 connector can be used. From there, a standard DB9-to-DB25 adapter can be used if necessary.

Power Supply Connections

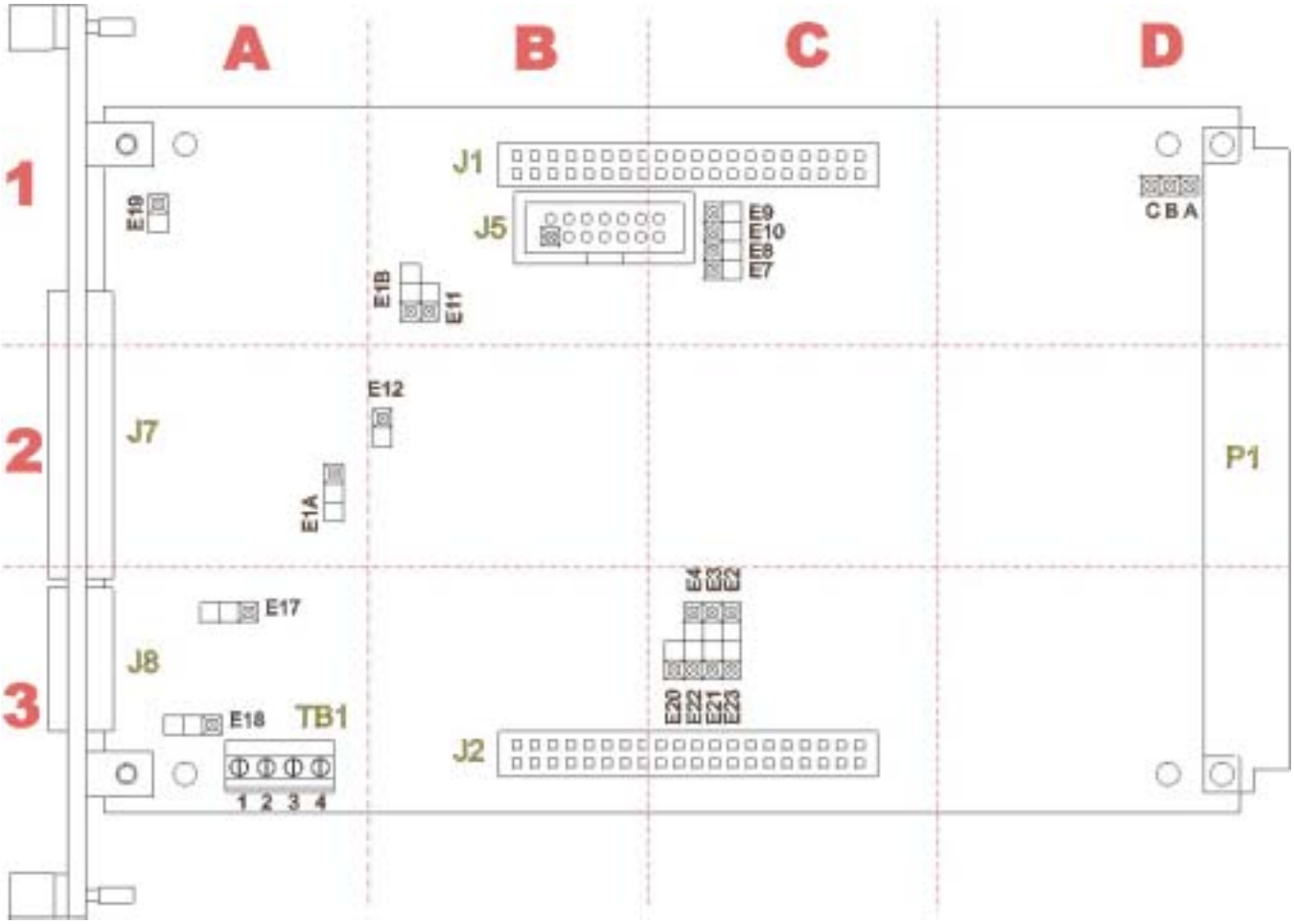
The TB1 4-point terminal block on the Turbo CPU board can be used to bring in +5V and +/-15V power to the system, particularly in a stack configuration. (In a "UMAC" backplane configuration, the power is almost always brought in through the UBUS backplane board instead.) Note that with a single reference voltage on this connector, there can be no isolation between the supplies (stack configurations have no provisions for isolating analog and digital supplies anyway).

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TURBO CPU BOARD JUMPERS AND PINOUTS

The "Location" columns of the following tables refer to the mapped locations shown in the drawing below:



CPU Card Layout

Note:

Pin 1 of an E-point is masked by an "X" in white ink on the composite side, and by a square solder pad on the solder side.

E0: Factory Use Only

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E1A: Servo and Phase Clock Direction Control

E Point & Physical Layout	Location	Description	Default
	**A-2**	Jump pins 1 and 2 or remove jumper for the UMAC Turbo system to use its internally generated servo and phase clock signals and to output these signals on the J7 serial port connector on the Turbo CPU board. E1B should connect pins 2 and 3 or be removed. Jump pins 2 and 3 for the UMAC Turbo system to expect to receive its servo and phase clock signals on the J7 serial port connector on the Turbo CPU board. E1B should also connect pins 1 and 2.	Pins 1-2 jumpered

E1B: Servo/Phase Clock Source Control

E Point & Physical Layout	Location	Description	Default
	**B-1**	Jump pin 1 to 2 to get phase and servo clocks from J7 RS422 connector (from an external source such as another PMAC). Jump pin 2 to 3 to get phase and servo clocks from P1 backplane connector (from an ACC-24E2x, or equivalent board). Remove jumper to get phase and servo clocks from J2 Stack connector (from an ACC-2E or equivalent board).	OFF – default for Stack configuration 2-3 – default for Pack configuration

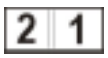
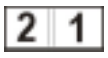
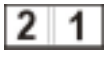
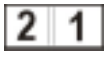
E2: Reserved for future use

E3: Re-Initialization on Reset Control

E Point & Physical Layout	Location	Description	Default
	**C-3**	Remove jumper for normal reset mode (default). Jump pins 1 to 2 for re-initialization on reset.	No jumper installed

E4: Reserved for future use

E7 – E10: IRQ PC Interrupt Select

E Point & Physical Layout	Location	Description	Default
E7: 	**C-1**	Jump E7 pin 1 to 2 to permit UMAC to interrupt PC on PC/104 bus interrupt line IRQ10. Remove E7 jumper to inhibit interrupt capability on this line.	No jumper installed
E8: 	**C-1**	Jump E8 pin 1 to 2 to permit UMAC to interrupt PC on PC/104 bus interrupt line IRQ11. Remove E8 jumper to inhibit interrupt capability on this line.	No jumper installed
E9: 	**C-1**	Jump E9 pin 1 to 2 to permit UMAC to interrupt PC on PC/104 bus interrupt line IRQ12. Remove E9 jumper to inhibit interrupt capability on this line.	No jumper installed
E10: 	**C-1**	Jump E10 pin 1 to 2 to permit UMAC to interrupt PC on PC/104 bus interrupt line IRQ15. Remove E10 jumper to inhibit interrupt capability on this line.	No jumper installed

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E12: Digital/Analog Reference Connect

E Point & Physical Layout	Location	Description	Default
	B-2	Jump pin 1 to 2 to tie digital GND reference to analog AGND reference when using joint supply (e.g. from TB1 or PC/104). Remove jumper to maintain separate GND and AGND reference voltages to keep isolation when using separate supplies.	Pins 1-2 jumpered

E17 – E18: Serial Port Select

E Point & Physical Layout	Location	Description	Default
E17: 	A-3	Jump E17 pin 1 to 2 to select RS-232 serial data input from J7. Jump E17 pin 2 to 3 to select RS-422 serial data input from J8.	Pins 1-2 jumpered
E18: 	A-3	Jump E18 pin 1 to 2 to select RS-232 serial handshake input from J7. Jump E18 pin 2 to 3 to select RS-422 serial handshake input from J8.	Pins 1-2 jumpered

E19: Watchdog Disable Jumper

E Point & Physical Layout	Location	Description	Default
	A-1	Jump pin 1 to 2 to disable Watchdog timer (for test purposes only!!). Remove jumper to enable Watchdog timer.	No jumper installed

E20 – E22: Power-Up/Reset Load Source

E Point & Physical Layout	Location	Description	Default
E20: 	C-3	To load active memory from flash IC on power-up/reset, Remove jumper E20; Jump E21 pin 1 to 2 Jump E22 pin 1 to 2. Other combinations are for factory use only; the board will not operate in any other configuration.	No E20 jumper installed E21 and E22 jump pin 1 to 2

E23: Firmware Reload Enable

E Point & Physical Layout	Location	Description	Default
	C-3	Jump pin 1 to reload firmware through serial or bus port. Remove jumper for normal operations.	No jumper installed

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DIP Switch Block S1: PC Bus Base Address

S1B				S1A							
4	**3**	**2**	**1**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
⇑	⇑	⇑	⇑	⇑	⇑	⇑	⇑	⇑	⇑	⇑	⇑
⇓	⇓	⇓	⇓	⇓	⇓	⇓	⇓	⇓	⇓	⇓	⇓
ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON

The 12 DIP switches on block S1 (location B-3) set the base address of the Turbo PMAC2-3U on the PC/104 bus. Together they form a binary number. Each switch, if in the ON (closed) position, sets its bit to 0; if in the OFF (open) position, sets its bit to 1. The possible base addresses are all multiples of 16, so switch 1 sets a bit value of 16, switch 2 sets a bit value of 32, and so on.

S1A Switch #	Bit Value	Default	Default Value	Your Value
1	16 (10h)	OFF (x1)	16 (10h)	
2	32 (20h)	ON (x0)	0	
3	64 (40h)	ON (x0)	0	
4	128 (80h)	ON (x0)	0	
5	256 (100h)	ON (x0)	0	
6	512 (200h)	OFF (x1)	512 (200h)	
7	1024 (400h)	ON (x0)	0	
8	2048 (800h)	ON (x0)	0	
S1B Switch #				
1	4096 (1000h)	ON (x0)	0	
2	8192 (2000h)	ON (x0)	0	
3	16384 (4000h)	ON (x0)	0	
4	32768 (8000h)	ON (x0)	0	
		Total Value:	528 (210h)	

If you wish to set the board to a different bus address, it is best to specify that address in hexadecimal form, because each hex digit corresponds to 4 switches. The last hex digit of the base address is always zero.
For example, you wish to set the base address on the PC bus to 992 decimal, or 03E0 hex. The first "0" corresponds to switches 1 through 4 of S1B. All of these should be ON to set their bits to 0. The "3" corresponds to switches 5 through 8 of S1A. Switches 8 and 7 should be ON, and switches 6 and 5 should be OFF to define the "3." The "E" corresponds to switches 1 through 4. Switches 4, 3, and 2 should be OFF, and switch 1 should be ON to define the E."

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TURBO PMAC2 3U CPU BOARD CONNECTOR SUMMARY

J1:		Stack Connector
J2:		Stack Connector
J1A, B:		PC/104 Main Connector, 64-pin prong connector (Option 2 required)
J2C, D:		PC/104 AT Connector, 40-pin prong connector (Option 2 required)
J5:		JTAG/OnCE (for factory use only): 10-pin IDC connector
J6:		JISP (for factory use only): 8-pin SIP connector
J7:	*	RS-232/RS-422 Serial Port Connector
J8:	*	Auxiliary RS-232 Serial Port (Option 9T required)
J21:		JISP_B (for factory use only) (SIP 8 connector)
P1:		UBUS Expansion Port (96-pin DIN connector)
TB1:	*	JPWR Power Supply Connector: 4-point terminal block

***** Pinouts shown in next section. Connectors not flagged with an asterisk are for internal use or factory setup.

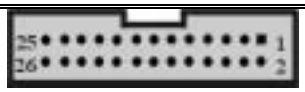
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TURBO PMAC2 3U CPU BOARD CONNECTOR PINOUTS

J7: RS-232/422 Serial Port Connector

(26-pin Header at Location A-2)



Front View

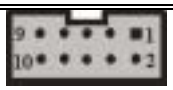
Pin #	Symbol	Function	Description	Notes
1	CHASSI	Common	Turbo PMAC2-3U Common	
2	S+5V	Output	+5VDC Supply	Deactivated by "ES"
3	RD- / RXD-	Input	Receive Data	Diff. low TRUE / low TRUE
4	RD+	Input	Receive Data	Diff. high TRUE
5	SD- / TXD-	Output	Send Data	Diff. low TRUE / low TRUE
6	SD+	Output	Send Data	Diff. high TRUE
7	CS+ / CTS	Input	Clear to Send	Diff. high TRUE / high TRUE
8	CS-	Input	Clear to Send	Diff. low TRUE
9	RS+ / RTS	Output	Request to Send	Diff. high TRUE / high TRUE
10	RS-	Output	Request to Send	Diff. low TRUE
11	DTR	Bidirect	Data Terminal Ready	Shorted to DSR
12	INIT/	Input	Turbo PMAC2-3U Reset	Low is "RESET"
13	GND	Common	Turbo PMAC2-3U Common	
14	DSR	Bidirect	Data Set Ready	Shorted to DTR
15	SDIO-	Bidirect	Special Data	Diff. I/O low TRUE
16	SDIO+	Bidirect	Special Data	Diff. I/O high TRUE
17	SCIO-	Bidirect	Special CTRL.	Diff. I/O low TRUE
18	SCIO+	Bidirect	Special CTRL.	Diff. I/O high TRUE
19	SCK-	Bidirect	Special Clock	Diff. I/O low TRUE
20	SCK+	Bidirect	Special Clock	Diff. I/O high TRUE
21	SERVO-	Bidirect	Servo Clock	Diff. I/O low TRUE
22	SERVO+	Bidirect	Servo Clock	Diff. I/O high TRUE
23	PHASE-	Bidirect	Phase Clock	Diff. I/O low TRUE
24	PHASE+	Bidirect	Phase Clock	Diff. I/O high TRUE
25	GND	Common	Turbo PMAC2-3U Common	
26	+5V	Output	+5VDC Supply	Power Supply Out

The RS-232 / 422 connector provides the Turbo PMAC2-3U with the ability to communicate both in RS422 and RS232. In addition, this connector is used to daisy chain interconnect multiple Turbo PMAC2-3Us for synchronized operation.
The connector is arranged so a flat cable can connect directly to a DB-25 serial connector on the other end.
Jumpers E17 and E18 should connect pins 1 and 2 to use this port for RS-232 communications; they should connect pins 2 and 3 to use this port for RS-422 communications.

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J8: Auxiliary Serial Port Connector (RS232)

(10-pin Header at Location A-3)



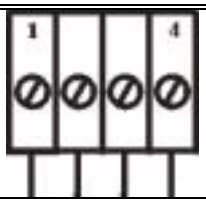
Front View

Pin #	Symbol	Function	Description	Notes
1	PHASE	In/Out	Phasing Clock	
2	DTR	Bidirect	Data Terminal Ready	Shorted to DSR.
3	TXD/	Input	Receive Data	Low TRUE
4	CTS	Input	Clear to Send	High TRUE
5	RXD/	Output	Send Data	Low TRUE
6	RTS	Output	Request to Send	High TRUE
7	DSR	Bidirect	Data Set Ready	Shorted to DTR.
8	SERVO	In/Out	Servo Clock	
9	GND	Common	Turbo PMAC2-3U Common	
10	+5V	Output	+5VDC Supply	

Note 1: If communicating to Turbo PMAC2-3U over this connector with a modem-style terminal emulator such as Microsoft Windows Terminal, line 1 should not be connected.
Note 2: SERVO and PHASE are outputs if jumper E1 is OFF; they are inputs if Jumper E1 is ON.
The J8 connector provides an auxiliary RS-232 serial port, independent of the main serial port at J7. It is provided if Option 9T is ordered.

TB1: 4-Pin Terminal Block

(Location A-3)



Pin #	Symbol	Function	Description	Notes
1	GND	Common	Reference Voltage	
2	+5V	Input	Positive Supply Voltage	Supplies all Turbo PMAC2-3U digital circuits
3	+12V	Input	Positive Supply Voltage	+12V to +15V; Not required on-board; used on J1 to supply analog inputs
4	-12V	Input	Negative Supply Voltage	-12V to +15V; Required for Opt-12 ADCs; used on J1 to supply analog inputs

This terminal block can be used to provide the input for the power supply for the circuits on the Turbo PMAC2-3U board when it is not in a bus configuration. When the Turbo PMAC2-3U is in a bus configuration, these supplies automatically come through the bus connector from the bus power supply; in this case, this terminal block should not be used.

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ACCESSORIES

Both the Turbo and the MACRO CPU boards can support either the Stack or the UMAC configuration. The systems are configured modularly with the selection of a series of accessory boards, some appropriate for the Stack, and some appropriate for the UMAC. These accessories are listed here; they are described briefly in the *Configuration* section following. Each has its own manual for detailed description.

The following table shows 3U products by function:

Turbo PMAC2-3U CPU Board Options	Option 2 Family: Bus Interface (Stack Configuration Only)	Option 4 Family: CPU Type	Option 5 Family: CPU Speed and Memory Configurations
	Option 8 Family: High-Accuracy Clock Crystal	Option 10: Firmware Revision Specification	Option 16 Family: Battery-Backed Parameter Memory
	Option 18 Family: Identification Number & Real Time Clock/Calendar Module		
"Stack" Piggyback Accessory Boards	ACC-1E: 2-Axis Interface Stack Board, 300-602810-10x (UMAC MACRO only)	ACC-2E: 4-Axis Interface Stack Board, 300-602805-10x	ACC-3E: 48/96/144 TTL I/O Stack Board, 300-602811-10x
	ACC-4E: Isolated 24-In/24-Out Stack Board, 300-602872-10x	ACC-6E: 8/16-Channel 12-Bit ADC Stack Board, 300-602810-10x	ACC-13 Family: Terminal Block Boards for ACC-8DE and ACC-8FE
	ACC-15E: Isolated 12-In/12-Out Driver & Breakout Board, 300-603488-10x		
	PC/104 Assembly, 3R0-0PC104-10x	CPU Module, 100-CMM686-10x	IDE Controller & Hard Drive, 100-CMT107-000
		Floppy Drive, 100-FLOPPY-DRV	Front Panel Interface Assembly, 3F5-603382-100
		Keyboard, 100-RT6255-101	Mouse, 100-OMSSER-MSE
		Monitor, 100-OC706T-017	Ethernet Utility Module, 300-603467-10x
UMAC Backplane-Mountable Accessory Boards – Axis	ACC-24E2, 2-Axis Digital PWM, 300-603397-10x	ACC-24E2 Option 1D, Additional 2-Axis Digital PWM, 3D1-603397-10x	ACC-24E2A, 2-Axis Analog, 300-603398-10x
	ACC-24E2A Option 1A, Additional 2-Axis Analog, 3A1-603398-10x	ACC-24E2S, 4-Axis Stepper, 300-603441-10x	
UMAC Backplane-Mountable Accessory Boards – I/O	ACC-3E1, 48/96/144 I/O, 300-603359-10x	ACC-9E, 48 In, 300-603283-10x	ACC-10E, Isolated 48-Output Board, 300-603299-10x
	ACC-11E, Isolated 24-In/24-Out Board, 300-603307-10x	ACC-12E, Isolated 24-In/24-Hi-Power-Out Board, 3A0-603277-10x	ACC-14E, 48 I/O, 300-603472-10x
	ACC-15E, 12 In / 12 Out, Opto22, 300-603488-10x		
UMAC Backplane-Mountable Accessory Boards – Communication	ACC-5E, Macro & I/O Interface, 300-603437-10x	ACC-54E, USB/Ethernet TCP/IP Communication, 300-603467-10x	ACC-55E, (UNET) Universal Field Bus Adapter Network Card, 300-603485-10x

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UMAC Backplane-Mountable Accessory Boards – Miscellaneous	ACC-28E, 2/4 Channel 16-Bit A/D Converter, 300-603404-10x	ACC-36E, 16-Channel 12-Bit A/D Converter, 300-603483-10x	ACC-51E, x4096 Interpolator, 300-603438-10x
	ACC-53E, SSI, 300-603360-10x	ACC-56E, Extender Card, 300-603401-10x	ACC-57E, Yaskawa or Mitsubishi ABS, Encoder Unit, 300-603484-10x
	ACC-58E, R/D Converter, 16 Bit, 300-603482-10x		
UBUS (UMAC's Backplane Boards)	ACC-U4, UBUS 4-Slot Backplane, 300-603462-10x	ACC-U6, UBUS 6-Slot Backplane, 300-603403-10x	ACC-U8, UBUS 8-Slot Backplane, 300-603463-10x
	ACC-U10, UBUS 10-Slot Backplane, 300-603464-10x	ACC-U12, UBUS 12-Slot Backplane, 300-603465-10x	ACC-U14, UBUS 14-Slot Backplane, 300-603466-10x
	ACC-U16, UBUS 16-Slot Backplane, 300-603471-10x	ACC-U18, UBUS 18-Slot Backplane, 300-603491-10x	
Amplifiers – Analog ±10VDC Input (Brush Motors)	4-Axis Analog ± 10V Input Linear Amplifier, 24VDC, 0.5/1A, 300-603489-10x	4-Axis Analog ± 10V Input PWM Amplifier, 48VDC, 2/4A, 300-603443-10x	4-Axis Analog ± 10V Input PWM Amplifier, 70VDC, 8/12A, 300-603486-10x
	Backplane, Double Analog Amplifier, 300-603470-10x	Backplane, Single Analog Amplifier, 300-603490-10x	
Amplifiers – Digital PWM Input (brushless)	2-Axis Digital PWM Amplifier, 360VDC, 4/8A, 400-603391-10x	2-Axis Digital PWM/Macro Amplifier, 360VDC, 8/16A, 400-603392-10x	Single Axis Digital PWM/Macro Amplifier, 360VDC, 8/16A, 401-603391-10x
	Single-Axis Digital PWM Amplifier, 360VDC, 8/16A, 401-603492-10x	Power Supply for 3U Digital PWM Amplifiers, 400-603428-10x	Backplane, Digital PWM, 300-603435-10x
Power Supplies – DC Input	ACC-F, 3U DC to DC Converter,10A, 30F-603216-OPT		
Power Supplies – AC Input	ACC-E, 3U AC Power Supply, 8A, 30E-603269-OPT	ACC-E1, 3U AC Power Supply, 14A, 31E-603269-OPT	ACC-E2, AC Power Supply, 20A, 32E-603468-OPT
UMAC Chassis Assemblies (Rack)	3U Rack, 10-1/2 Slot (42T) 542-602932-10x	3U Rack, 15-3/4 Slot (63T) 563-602932-10x	3U Rack, 21 Slot (84T) 584-602932-10x
	3U Rack, Variable Width per Customer Requirements (custom design), 500-602932-10x		

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