DELTA TAU DATA SYSTEMS, INC.

POWER PMAC UMAC CPU BOARD

HARDWARE REFERENCE

DOCUMENT # 3A0-604020-360

PRELIMINARY

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Table of Contents

Introduction

The Power PMAC UMAC CPU board (part number 604020-10x) provides a powerful computing engine for UMAC (Universal Motion and Automation Controller) rack-mounted systems. This 3U-format Eurocard (100 mm x 160 mm) can communicate with multiple accessory boards over the UBUS backplane. These accessory boards provide interfaces to the various machine elements for both motion and non-motion I/O, digital and analog.

The Power PMAC UMAC CPU board can communicate with all of the accessory boards that the older Turbo PMAC2 UMAC CPU board (603766-10x) could use. In addition, it can communicate with a new generation of "PMAC3" UMAC accessory boards for motion, MACRO ring, and I/O that employ a new generation ASIC and a 32-bit data bus on the backplane.

The Power PMAC UMAC CPU board acts as both a dedicated controller and a general-purpose embedded computer. It uses the Linux operating system with a hard-real-time kernel that guarantees determinacy of tasks such as servo loop closure.

Video Card
Vision System Card
Fieldbus Cards, etc...

Disk Drive

SATA | PCIe (x1) | PCIe (x4)

*Can be used as SATA or PCIe (x1)

Ethernet → Ethercat, Powerlink, Modbus, etc...

Ethernet → PC Comm i.e. -Web, TCP Sockets

RS232

UBUS

Lattice CPLD UBUS I/F

Power PMAC CPU 800Mhz - 1.0Ghz

USB 2.0

USB Hub/Card Reader

SD/MMC Expansion Slot (User Expansion)

Up to 8GB SD Memory Card (User Programs)

Soldered Down NAND Flash 512MB / 1G

Contains Complete Operating System Files plus Add on products ie. IEC1131, EPICS NC Application, Ethercat, etc ... User Interface Software

AMD NOR Boot Flash 64MB

Contains everything necessary to boot **Linux RTOS Kernel**

DDR2 512MB/1GB/2GB RAM w/ ECC Removable SOCDIMM
16M Motion Prog Buffer (adjustable)
8M PPmac Memory Map (Fixed)
1M User Shared Memory (adjustable)

Keyboard, Mouse, RS232, Hard Drive, Memory Stick etc...

USB 2.0 **Host** Expansion Port (User Expansion)

USB

USB 2.0 Device

USB

Laptop or PC

Configuration

The base version of the Power PMAC UMAC CPU board provides a 1-slot 3U-format (100mm x 160mm) Eurocard board with the following features:

- 800 MHz 32/64-bit Power PMAC CPU with built-in hardware floating-point math capabilities

- 1 GByte DDR2 active memory with error correction

- 64 MByte NOR boot flash memory

- 512 MByte built-in NAND flash memory for user application storage

- 2x 1000-Base-T (1 Gbit/sec) Ethernet communications ports

- USB 2.0 Host port

- USB 2.0 Device port

- 2x RS-232 communications ports

- Port for SD-format flash memory cards

- 32-bit UBUS backplane port to UMAC accessory boards

Optional Features

The following features are optionally present on the Power PMAC UMAC CPU board:

- 1.0 GHz 32/64-bit Power PMAC CPU with built-in hardware floating-point math capabilities

- 2 GByte DDR2 active memory with error correction

- 1 GByte built-in NAND flash memory for user application storage

- PCI Express "x1" expansion port

- PCI Express "x4" expansion port

- SATA port

Hardware Setup

There is virtually no hardware setup required before installation of the Power PMAC UMAC CPU board in the system.

E-Point Jumpers

The E-point jumpers on the board are intended for factory use. Their functionality is listed here primarily for reference.

E0: The two pins of E0 at the bottom edge of the board must not be shorted together in normal operation. Shorting the two pins together with a shunt locks the board in a reset state.

E1: The two pins of E1 at the bottom edge of the board must not be shorted together in normal operation. Shorting the two pins together with a shunt disables the watchdog timer circuit. This is necessary to load "bootstrap" firmware at the factory.

Shorting the two pins of E1 together during an actual application disables an important safety feature and can be very dangerous!

E2: The two pins of E2 at the bottom edge of the board must not be shorted together in normal operation. Shorting the two pins together locks the board in "bootstrap" mode for the loading of new bootstrap firmware.

E3: The state of the two pins of E3 determines whether the PCI Express "x1" port or the SATA port is selected for a common internal port. If the two pins are not connected, the PCIe "x1" port is selected. If the two pins are shorted together with a shunt, the SATA port is connected. Since in the standard configurations of this board, at most one of these ports will be present, this jumper is typically set at the factory for the particular board configuration.

Connections

Board Front Side Connectors and Jumpers
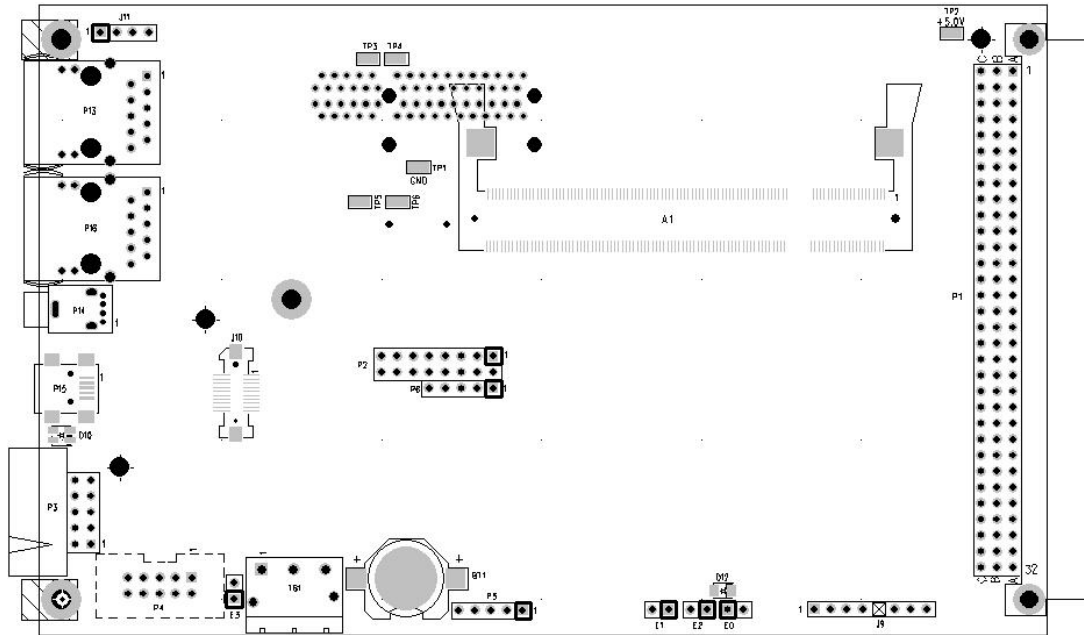
Board Back Side Connectors and Jumpers
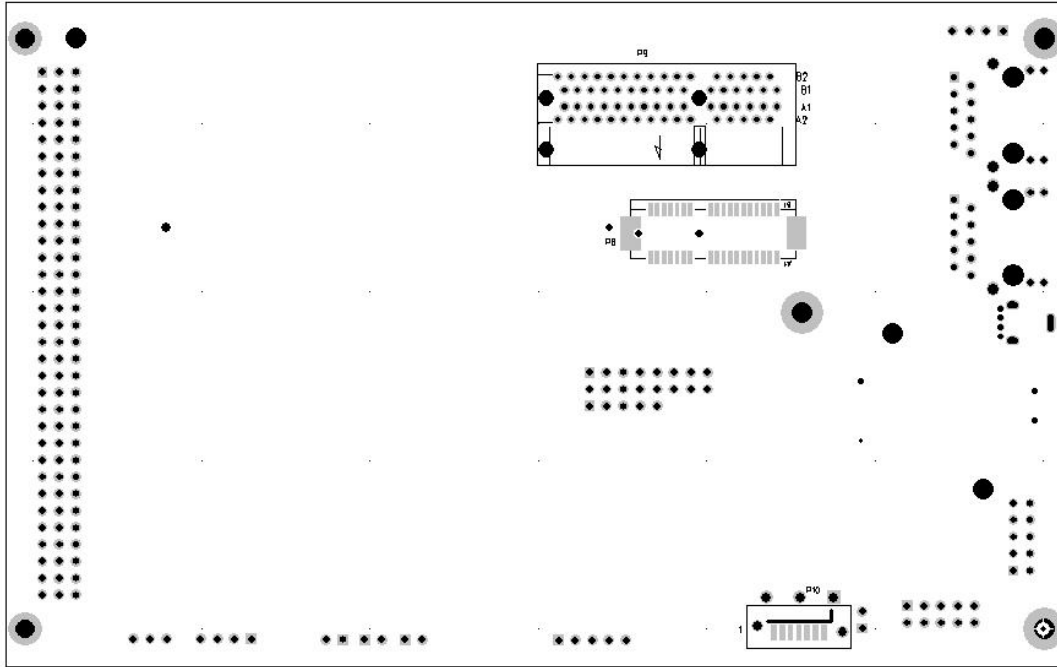
Backplane (UBUS) Connection

To connect the Power PMAC UMAC CPU board to the UBUS backplane, simply slide the board into any slot of a UMAC that has a bus connection socket of a UBUS backplane board. It does not matter which socket on the backplane board is used, although customarily the CPU board is installed in the leftmost slot.

Getting the P1 backplane connector on the CPU board to mate firmly with the socket on the backplane requires some force, but can easily be done by hand. In a standard UMAC rack, getting the front plate flush with the front of the rack and turning the front screws firmly will ensure a good connection with the backplane.

The Power PMAC UMAC CPU board gets its electrical power through the UBUS backplane board, whether the power comes from a Delta Tau power supply or an external user-provided supply.

Ethernet Connections

The Power PMAC UMAC CPU board provides two Ethernet ports on the front panel: ETH 0 and ETH 1. Both ports can accept standard CAT-5 Ethernet cables with RJ-45 connectors. Both Ethernet ports provide transformer isolation to prevent ground-loop problems.

ETH 0 Ethernet Port (P13)

The "ETH 0" port is the top connector on the front panel. It is the primary port for communicating with the CPU board from a host computer, as when using the Integrated Development Environment (IDE) program running on a Windows^{TM} PC for developing your application.

Note that multiple computers on a single network can independently communicate to the Power PMAC CPU board through this single hardware port.

ETH 1 Ethernet Port (P16)

The "ETH 1" port is the second-to-top-connector on the front panel. It is the auxiliary Ethernet port and not intended for primary host communications.

USB Connections

The Power PMAC UMAC CPU board provides two USB ports on the front panel, one host port and one device port. Both provide USB 2.0 protocol communications.

Caution: USB ports are not electrically isolated, so care must be taken in the grounding scheme when any separately powered device is connected to one of these ports. Poor-quality communications and even permanent component damage is possible when ground loop issues or significant differences in ground potential exist.

USB 1 Host Port (P14)

The USB "host" port is labeled "USB 1" on the front panel. It is a "Standard-A" format connector located just below the Ethernet ports and has a horizontal orientation. With this port, the Power PMAC CPU acts as the host computer, and various peripheral devices can be connected through this port.

Probably the most common peripheral device used on this port is the "USB stick" flash drive. The Power PMAC CPU board will automatically recognize standardly formatted flash drives connected to this port. It is even possible to boot the CPU from this drive if the proper boot files are present on the drive.

It is also possible to use USB peripheral devices such as true disk drives and keyboards.

USB 2 Device Port (P15)

The USB "device" port is labeled "USB 2" on the front panel. It is a "Micro-B" format connector located just below the USB host port. With this port, the Power PMAC CPU board acts as a peripheral device.

RS-232 Connection

The Power PMAC UMAC CPU board provides two RS-232 ports on the front panel, at the bottom left. The connector is an IDC 10-pin connector, with the pinout arranged such that a flat cable crimped to an IDC 10-pin header at this end and a 9-pin D-sub connector at the other end will provide a standard RS-232 connection. The Delta Tau ACC-3L cable provides this connectivity.

RS-232 Port 0 (P3)

The connector for the first RS-232 port is on the front panel, at the bottom left corner.

RS-232 Port 1 (P4)

The connector for the second RS-232 port is just inside the bottom of the front panel. It is mainly intended for factory use in loading embedded firmware into the card. While it can be used in actual applications, it is not directly accessible when the card is fully installed in the rack.

SD Card Connection

The Power PMAC UMAC CPU board provides a socket for SD card insertion at the bottom right corner of the front panel. This permits the use of standard "camera card" flash memory for many uses. It is even possible to boot the CPU from an SD card if the proper boot files are present on the card.

Watchdog Timer Connection (TB1)

The Power PMAC UMAC CPU board provides a dedicated connector for the output of the on-board watchdog timer. This 3-point removable terminal block is on the bottom edge of the board, near the front end. The solid-state relay output on this connector can be used for fail-safe shutdown of power circuitry in case of timer trip or loss of controller power.

Note that prototype and pilot-run versions of this board do not have this connector.

Optional PCI Express Connections

The Power PMAC UMAC CPU board optionally provides one or two PCI Express connectors on the "back side" of the board (the left side when looking at the rack from the front). These permit the installation of PCI Express expansion cards inside the rack provided there is space available in the rack to the left of the CPU board.

These connectors permit the use of accessories such as video cards, vision systems, and additional Ethernet ports in the Power PMAC system.

PCIe (x1) Connector (P8)

The P8 connector near the middle of the back side of the CPU board provides a "times 1" (x1 – single serial channel) PCI Express connection. It is considered Port 0/Slot 0 by the CPU. PCI Express "x1" accessories can be installed in this connector.

This connector is offered in "vertical" format only, so the PCIe accessory board will be at right angles to the UMAC CPU board. In this configuration, the assembly occupies 5 slots in the UMAC rack. This connector cannot be present if the PCIe "x4" connector is present in the right-angle configuration.

Note that this connector shares an internal port with the SATA port, so both cannot be used at once.

PCIe (x4) Connector (P9)

The P9 connector near the top of the back side of the CPU board provides a "times 4" (x4 – four serial channels) PCI Express connection. It is considered Port 1/Slot 1 by the CPU. PCI Express "x1" and "x4" accessories can be installed in this connector.

This connector can be present in either "vertical" or "right-angle" configurations. In the vertical configuration the PCIe accessory board will be at right angles to the UMAC CPU board, and the assembly will occupy 5 slots in the UMAC rack. In the right-angle configuration, the PCIe accessory board will be parallel to the CPU board, and the assembly will occupy 2 or 3 slots in the UMAC rack. If the right-angle configuration of this connector is present, no PCIe "x1" connector can be present.

Optional SATA Port Connection (P10)

The P10 connector on the bottom of the back side of the CPU board provides a SATA port for high-speed connection to devices such as external disk drives.

Note that this connector shares an internal port with the PCIe "x1" port, so both cannot be used at the same time.

Connector Pinouts

P1 UBUS32 Backplane Connector Pinout

Pin #	Row A	Row B	Row C
1	+5V	+5V	+5V
2	GND	GND	GND
3	BD09 (*BD01*)	BD00 (*rsvrd.*)	BD08 (*BD00*)
4	BD11 (*BD03*)	BD01 (*rsvrd.*)	BD10 (*BD02*)
5	BD13 (*BD05*)	BD02 (*rsvrd.*)	BD12 (*BD04*)
6	BD15 (*BD07*)	BD03 (*rsvrd.*)	BD14 (*BD06*)
7	BD17 (*BD09*)	BD04 (*rsvrd.*)	BD16 (*BD08*)
8	BD19 (*BD11*)	BD05 (*rsvrd.*)	BD18 (*BD10*)
9	BD21 (*BD13*)	BD06 (*rsvrd.*)	BD20 (*BD12*)
10	BD23 (*BD15*)	BD07 (*rsvrd.*)	BD22 (*BD14*)
11	BD25 (*BD17*)	rsrvd	BD24 (*BD16*)
12	BD27 (*BD19*)	rsrvd	BD26 (*BD18*)
13	BD29 (*BD21*)	rsrvd	BD28 (*BD20*)
14	BD31 (*BD23*)	BCSDIR(*rsvrd.*)	BD30 (*BD22*)
15	rsrvd	BCS0-(*rsvrd.*)*	rsrvd
16	BA01	BCS1-(*rsvrd.*)*	BA00
17	BA04 (*BA03*)	BCS5-(*rsvrd.*)*	BA02
18	BA03 (*BX/Y*)	BA15 (*BA14*)	BA05 (*BA04*)
19	BCS3-	BA07 (*BA06*)	BCS2-
20	BA06 (*BA05*)	BA08 (*BA07*)	BCS4-
21	BCS12-	BA09 (*BA08*)	BCS10-
22	BCS16-	BA10 (*BA09*)	BCS14-
23	BA14 (*BA13*)	BA11 (*BA10*)	BA13 (*BA12*)
24	BRD-	BA12 (*BA11*)	BWR-
25	rsrvd	DPRCS1-	rsrvd
26	WAIT-	VMECS1-	BRESET
27	PHASE+	UMAC_INT-	SERVO+
28	PHASE-	INT1- (*EQU1-*)	SERVO-
29	AGND	INT2- (*EQU2-*)	AGND
30	A-15V	PWM_ENA	A+15V
31	GND	GND	GND
32	+5V	+5V	+5V

Notes:
1. These signals are provided primarily for reference, as this is typically an "internal" connector inside the system without direct user access.
2. Names in italics refer to the naming of this pin for the older UBUS24 24-bit backplane. Accessory boards designed for the Turbo PMAC UMAC CPU use these signal designations.
3. "rsrvd" means "reserved for future use"
4. "B" as the first letter means "buffered"

P3 MAIN RS232 (10-PIN CONNECTOR)

9 ⭕⭕⭕⭕⭕ 1
10 ⭕⭕⭕⭕⭕ 2
Front View
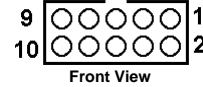
PIN #	SYMBOL	FUNCTION	DESCRIPTION	NOTES
1	N.C.	--	NO CONNECT	
2	DTR	BIDIRECT	DATA TERM RDY	TIED TO "DSR"
3	TXD/	INPUT	RECEIVE DATA	HOST TRANSMIT DATA
4	CTS	INPUT	CLEAR TO SEND	HOST READY BIT
5	RXD/	OUTPUT	SEND DATA	HOST RECIEVE DATA
6	RTS	OUTPUT	REQ. TO SEND	PMAC READY BIT
7	DSR	BIDIRECT	DATA SET READY	TIED TO "DTR"
8	N.C.	--	NO CONNECT	
9	GND	COMMON	PMAC COMMON	
10	RESET_SW/	INPUT	SYSTEM RESET	RESET LOW, RELEASE HI

P4 AUX RS232 (10-PIN CONNECTOR)

9 ⭕⭕⭕⭕⭕ 1
10 ⭕⭕⭕⭕⭕ 2
Front View
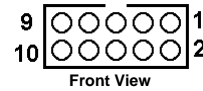
PIN #	SYMBOL	FUNCTION	DESCRIPTION	NOTES
1	N.C.	--	NO CONNECT	
2	AUXDTR	BIDIRECT	DATA TERM RDY	TIED TO "DSR"
3	AUXTXD/	INPUT	RECEIVE DATA	HOST TRANSMIT DATA
4	AUXCTS	INPUT	CLEAR TO SEND	HOST READY BIT
5	AUXRXD/	OUTPUT	SEND DATA	HOST RECIEVE DATA
6	AUXRTS	OUTPUT	REQ. TO SEND	PMAC READY BIT
7	AUXDSR	BIDIRECT	DATA SET READY	TIED TO "DTR"
8	N.C.	--	NO CONNECT	
9	GND	COMMON	PMAC COMMON	
10	+5V	OUTPUT	+5VDC SUPPLY	POWER SUPPLY OUTPUT

P13 ETH 0 ETHERNET (8-PIN CONNECTOR)

Front View

PIN #	SYMBOL	FUNCTION	DESCRIPTION	NOTES
1	P0MDI0+	BIDIR	LINE 0 POS	
2	P0MDI0-	BIDIR	LINE 0 NEG	
3	P0MDI1+	BIDIR	LINE 1 POS	
4	P0MDI1-	BIDIR	LINE 1 NEG	
5	P0MDI2+	BIDIR	LINE 2 POS	
6	P0MDI2-	BIDIR	LINE 2 NEG	
7	P0MDI3+	BIDIR	LINE 3 POS	
8	P0MDI3-	BIDIR	LINE 3 NEG	

This connector is used for Ethernet communications from the UMAC to a PC. The appropriate Category 5 100/1000-Base T network cable that mates to this connector can be purchased from any local computer store. The type of network cable to purchase depends on the configuration to the host PC.

P16 ETH 1 ETHERNET (8-PIN CONNECTOR)

Front View

PIN #	SYMBOL	FUNCTION	DESCRIPTION	NOTES
1	P1MDI0+	BIDIR	LINE 0 POS	
2	P1MDI0-	BIDIR	LINE 0 NEG	
3	P1MDI1+	BIDIR	LINE 1 POS	
4	P1MDI1-	BIDIR	LINE 1 NEG	
5	P1MDI2+	BIDIR	LINE 2 POS	
6	P1MDI2-	BIDIR	LINE 2 NEG	
7	P1MDI3+	BIDIR	LINE 3 POS	
8	P1MDI3-	BIDIR	LINE 3 NEG	

This connector is used for Ethernet communications over a fieldbus network. The appropriate Category 5 100/1000-Base T network cable that mates to this connector can be purchased from any local computer store. The type of network cable to purchase depends on the configuration to the network.

P14 USB 1 COMM (4-PIN CONNECTOR)

[**4 3 2 1**]
Front View

PIN #	SYMBOL	FUNCTION	DESCRIPTION	NOTES
1	VCC	OUTPUT	SUPPLY VOLTAGE	
2	D-	BIDIRECT.	DATA NEG.	
3	D+	BIDIRECT.	DATA POS.	
4	GND	COMMON	REF. VOLTAGE	

This connector provides a USB "host" interface on a Standard A connector. It is suitable for standard USB connectors to external devices

P15 USB 2 COMM (5-PIN CONNECTOR)

\ **5 4 3 2 1** /
Front View

PIN #	SYMBOL	FUNCTION	DESCRIPTION	NOTES
1	VCC	OUTPUT	SUPPLY VOLTAGE	
2	D-	BIDIRECT.	DATA NEG.	
3	D+	BIDIRECT.	DATA POS.	
4	ID	OUTPUT	BUS TYPE IDENT	
5	GND	COMMON	REF. VOLTAGE	

This connector provides a USB "host" interface on a Standard A connector. It is suitable for standard USB connectors to external devices

TB1 WATCHDOG OUT (3-PIN CONNECTOR)

[**1 2 3**]
Front View

PIN #	SYMBOL	FUNCTION	DESCRIPTION	NOTES
1	N.O.	OUTPUT	NORMALLY OPEN CONTACT	CLOSED UNDER PROPER OPERATION
2	COM	RETURN	COMMON	USED WITH N.O. OR N.C.
3	N.C.	OUTPUT	NORMALLY CLOSED CONTACT	OPEN UNDER PROPER OPERATION

The TB1 connector provides the output signals for the watchdog timer circuit. It is recommended that this output be used as part of the safety circuitry for the system, so if the Power PMAC CPU loses power or trips its watchdog timer, the system will go into a safe shutdown mode without the assistance of any software on the Power PMAC CPU.