^1 HARDWARE REFERENCE MANUAL

Turbo PMAC2-PC Ultralite

Programmable Multi-Axis Controller

4Ax-603182-xHxx

June 16, 2003

DELTA TAU
Data Systems, Inc.
NEW IDEAS IN MOTION ...

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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 exposed to hazardous or conductive materials and/or environments, we cannot guarantee their operation.

TABLE OF CONTENTS

INTRODUCTION

OVERVIEW

The Turbo PMAC2-PC Ultralite is a member of the Turbo PMAC family of boards optimized for interface to the system through the MACRO ring. It contains no full channels of on-board axis interface circuitry (which is what makes it "Ultralite"). It can command up to 32 axes through the MACRO ring. It can also support up to 32 channels of off-board axis interface circuitry through its expansion port, connected to ACC-24P or ACC-24P2 boards.

The Turbo PMAC2-PC Ultralite is a full-sized ISA-bus expansion card. While it is capable of ISA bus communications, with or without the optional dual-ported RAM, it does not need to be inserted into an ISA expansion slot. Communications can be done through an RS-232 or RS-422 serial port; standalone operation is possible.

BOARD CONFIGURATION

Base Version

The base version of the Turbo PMAC2-PC Ultralite provides

- 80 MHz DSP56303 CPU (120 MHz PMAC equivalent)
- 128k x 24 SRAM compiled/assembled program memory (5C0)
- 128k x 24 SRAM user data memory (5C0)
- 1M x 8 flash memory for user backup & firmware (5C0)
- Latest released firmware version
- RS-232/422 serial interface, ISA (PC) bus interface
- 1 16-node MACRO interface IC
- MACRO ring circuitry (without connectors; see Opts. A & C)
- (No on-board axis interface circuitry)
- 2 channels supplemental interface circuitry, each including:
  - 2-channel differential/single-ended encoder input
  - 1 output command signal set, configurable as pulse-&-direction or PWM top-and-bottom pair
- Display, MACRO, muxed I/O, direct I/O interface ports
- PID/notch/feedforward servo algorithms
- Extended "pole-placement" servo algorithms
- 1-year warranty from date of shipment
- One manual per set of 1 to 4 PMACs in shipment
- (Cables, mounting plates, mating connectors not included)

MACRO Ring Connector Options

If a MACRO interface is desired (which is the usual reason for use of the board), at least one of the MACRO connector options must be selected. Both may be selected.

- Option A provides the MACRO-ring fiber optic SC-style interface connector. The key component on the board is U35.
- Option C provides the MACRO-ring RJ-45 electrical interface connectors. The key components on the board are J14 and J17.

Option 1: Additional MACRO Interface ICs

- Option 1A provides the first additional MACRO interface IC (2 total) for 16 additional MACRO nodes, 8 additional servo nodes and 8 additional I/O nodes (32 nodes total, 16 servo and 16 I/O). The key component on the board is U54.
- Option 1B provides the second additional MACRO interface IC (3 total) for 16 additional MACRO nodes, 8 additional servo nodes and 8 additional I/O nodes (48 nodes total, 24 servo and 24 I/O). The key component on the board is U55. Option 1A is a pre-requisite.
- Option 1C provides the third additional MACRO interface IC (4 total) for 16 additional MACRO nodes, 8 additional servo nodes and 8 additional I/O nodes (64 nodes total, 32 servo and 32 I/O). The key component on the board is U56. Options 1A and 1B are pre-requisites.

Option 2: Dual Ported RAM

Dual-ported RAM provides a very high-speed communications path for bus communications with the host computer through a bank of shared memory. DPRAM is advised if more than about 100 data items per second are to be passed between the controller and the host computer in either direction.

- Option 2 provides an 8k x 16 bank of dual-ported RAM. The key component on the board is U28. It is not compatible with Option 2B.
- Option 2B provides a 32k x 16 bank of dual-ported RAM. The key component on the board is U28A. It is not compatible with Option 2.

Option 5: CPU & Memory Configurations

The various versions of Option 5 provide different CPU speeds and main memory sizes. 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 device (with computational power equivalent to a 120 MHz non-Turbo PMAC), but higher speed versions will be available shortly.

The compiled/assembled-program 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 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.

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.

Option 7: Plate Mounting

- Option 7 provides a mounting plate connected to the PMAC with standoffs. It is used to install the PMAC in standalone applications.

Option 8: High-Accuracy Clock Crystal

The Turbo PMAC2-PC Ultralite 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: Auxiliary Serial Port

The Turbo PMAC2-PC Ultralite comes standard with a single serial port, configurable as RS-232 or RS-422. Optionally a second serial port can be added.

- Option 9T adds an auxiliary RS-232 port in the CPU section.

Option 10: Firmware Version Specification

Normally the Turbo PMAC2-PC Ultralite is provided with the newest released firmware version. A label on the U10 flash memory IC shows the firmware version loaded at the factory.

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

Option 12: Analog-to-Digital Converters

Option 12 permits the installation of 8 or 16 channels of on-board multiplexed analog-to-digital converters. 1 or 2 of these converters are read every phase interrupt. The analog inputs are not optically isolated, and each can have a 0 – 5V input range, or a +/-2.5V input range, individually selectable.

- Option 12 provides an 8-channel 12-bit A/D converter. The key components on the board are U24 and connector J1.
- Option 12A provides an additional 8-channel 12-bit A/D converter. The key component on the board is U25.

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.

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

Option 18 provides a module at location U5 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 real-time clock and calendar. The year representation in the calendar is a 4-digit value, so there are no "Year 2000" problems.

TURBO PMAC2-PC ULTRALITE JUMPER DESCRIPTION

E0: Reset Lock Enable

E Point & Physical Layout	Location	Description	Default
E0 		Remove jumper for normal operation. Jump pins 1 to 2 to force the card to stay in the "reset" state.	No jumper installed

E1: Card 0 (Clock Direction) Select

E Point & Physical Layout	Location	Description	Default
E1 		Remove jumper to specify that this PMAC is Card 0, which generates its own phase and servo clock (default). Jump pins 1 to 2 to specify that this PMAC is not Card 0, but Card 1 to F (15), which requires external phase and servo clock signals from the serial port to operate.	No jumper installed

E2: (Reserved For Future Use)

E3: Re-Initialization On Reset Control

E Point & Physical Layout	Location	Description	Default
E3 		Remove jumper for normal reset mode (default). Jump pins 1 to 2 for re-initialization on reset.	No jumper installed

E4-E6: (Reserved For Future Use)

E7 – E10: IRQ PC Interrupt Select

E Point & Physical Layout	Location	Description	Default
E7 		Jump E7 pin 1 to 2 to permit PMAC2-PC Ultralite to interrupt PC on ISA bus interrupt line IRQ10. Remove E7 jumper to inhibit interrupt capability on this line.	No jumper installed
E8 		Jump E8 pin 1 to 2 to permit PMAC2-PC Ultralite to interrupt PC on ISA bus interrupt line IRQ11. Remove E8 jumper to inhibit interrupt capability on this line.	No jumper installed
E9 		Jump E9 pin 1 to 2 to permit PMAC2-PC Ultralite to interrupt PC on ISA bus interrupt line IRQ12. Remove E9 jumper to inhibit interrupt capability on this line.	No jumper installed
E10 		Jump E10 pin 1 to 2 to permit PMAC2-PC Ultralite to interrupt PC on ISA bus interrupt line IRQ15. Remove E10 jumper to inhibit interrupt capability on this line.	No jumper installed

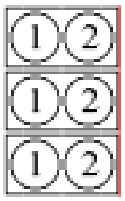
E17 – E18: Serial Port Select

E Point & Physical Layout	Location	Description	Default
E17 		Jump E17 pin 1 to 2 to select RS-232 serial data input from J5. Jump E17 pin 2 to 3 to select RS-422 serial data input from J5A.	Pins 1 – 2 jumpered
E18 		Jump E18 pin 1 to 2 to select RS-232 serial handshake input from J5. Jump E17 pin 2 to 3 to select RS-422 serial handshake input from J5A.	Pins 1 – 2 jumpered

E19: Watchdog Disable Jumper

E Point & Physical Layout	Location	Description	Default
E19  		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  **E22**		Remove jumper E20; jump E21 pin 1 to 2; jump E22 pin 2 to 3; to read flash IC on power-up/reset. 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
E23  		Jump pin 1 to 2 to reload firmware through serial or bus port. Remove jumper for normal operation.	No jumper installed

E40: Electrical/Optical Macro Input Select

E Point & Physical Layout	Location	Description	Default
E40  		Jump E40 pin 1 to 2 to select MACRO input from fiber optic receiver. Remove E40 jumper to select MACRO input from electrical RJ45 receiver.	Jumper installed (Option A) No jumper installed (Option C)

E41, E42, E43: Macro Signal Test Points (For Factory Use)

JP3: MACRO (Wired) Loopback Enable

E Point & Physical Layout	Location	Description	Default
JP3 		Jump JP3 pin 1 to 2 to disable internal loopback MACRO communications and permit true electrical MACRO communications. Remove JP3 jumper to select internal loopback MACRO communications (for test purposes only).	Jumper installed

JP4-JP6: For Factory Use Only

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 set the base address of the PMAC2 on the PC 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.

Switch #	Bit Value	Default	Default Value	Your Value
1 (S1A-1)	16 (10h)	ON (x1)	16 (10h)	
2 (S1A-2)	32 (20h)	OFF (x0)	0	
3 (S1A-3)	64 (40h)	OFF (x0)	0	
4 (S1A-4)	128 (80h)	OFF (x0)	0	
5 (S1A-5)	256 (100h)	OFF (x0)	0	
6 (S1A-6)	512 (200h)	ON (x1)	512 (200h)	
7 (S1A-7)	1024 (400h)	OFF (x0)	0	
8 (S1A-8)	2048 (800h)	OFF (x0)	0	
9 (S1B-1)	4096 (1000h)	OFF (x0)	0	
10 (S1B-2)	8192 (2000h)	OFF (x0)	0	
11 (S1B-3)	16384 (4000h)	OFF (x0)	0	
12 (S1B-4)	32768 (8000h)	OFF (x0)	0	
Total	--	--	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 9 through 12. All of these should be ON to set their bits to 0. The '3' corresponds to switches 5 through 8. 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'.

Switch #	12	11	10	9	8	7	6	5	4	3	2	1	-	-	-	-
Hex				0				3				E				0
Binary	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0
Setting	on	on	on	on	on	on	off	off	off	off	off	on	-	-	-	-

TURBO PMAC2-PC ULTRALITE MATING CONNECTORS

J1 (JANA)/Analog (Option 12)

1. 14-pin female flat cable connector Delta Tau P/N 014-R00F14-0K0
   Qty. 2 - T&B Ansley P/N 609-1441
2. 171-14 T&B Ansley stan. flat cable stranded 14-wire
3. Phoenix varioface modules type FLKM14 (male pins) P/N 22 81 02 1

J2 (JTHW)/Multiplexer Port

1. 26-pin female flat cable connector Delta Tau P/N 014-R00F26-0K0 qty. 2 - T&B Ansley P/N 609-2641
2. 171-26 T&B Ansley stan. flat cable stranded 26-wire
3. Phoenix varioface module type FLKM 26 (male pins) P/N 22 81 05 0

J3 (JIO)/Digital I/O

1. 40-pin female flat cable connector Delta Tau P/N 014-R00F40-0K0 qty. 2 - T&B Ansley P/N 609-4041
2. 171-40 T&B Ansley stan. flat cable stranded 40-wire
3. Phoenix varioface module type FLKM 40 (male pins)

J4 (JMACRO)/Macro Digital Data

1. 26-pin female flat cable connector Delta Tau P/N 014-R00F26-0K0 qty. 2 - T&B Ansley P/N 609-2641
2. 171-26 T&B Ansley stan. flat cable stranded 26-wire
3. Phoenix varioface module type FLKM 26 (male pins) P/N 22 81 05 0

J5 (JRS232)/RS-232 Serial Communications

1. 10-pin female flat cable connector Delta Tau P/N 014-ROOF10-0K0 qty. 2 - T&B Ansley P/N 609-1041
2. 171-10 T&B Ansley stan. flat cable stranded 10-wire
3. Phoenix varioface module type FLKM 10 (male pins) P/N 22 81 01 8

J5A (JRS422)/RS-422 Serial Communications

1. 26-pin female flat cable connector Delta Tau P/N 014-R00F26-0K0 qty. 2 - T&B Ansley P/N 609-2641
2. 171-26 T&B Ansley stan. flat cable stranded 26-wire
3. Phoenix varioface module type FLKM 26 (male pins) P/N 22 81 05 0

J6 (JDISP)/Display

1. 14-pin female flat cable connector Delta Tau P/N 014-R00F14-0K0

   Qty. 2 - T&B Ansley P/N 609-1441
2. 171-14 T&B Ansley stan. flat cable stranded 14-wire
3. Phoenix varioface modules type FLKM14 (male pins) P/N 22 81 02 1

J7 (JHW)/Auxiliary Channel

1. 20-pin female flat cable connector Delta Tau P/N 014-R00F20-0K0
   Qty. 2 - T&B Ansley P/N 609-2041
2. 171-20 T&B Ansley stan. flat cable stranded 20-wire
3. Phoenix varioface modules type FLKM20 (male pins)

J11 (JEXP)/Expansion

1. 50-pin female flat cable connector Delta Tau P/N 014-R00F50-0K0 qty. 2 - T&B Ansley P/N 609-5041
2. 171-50 T&B Ansley stan. flat cable stranded 50-wire
3. Phoenix varioface module type FLKM 50 (male pins) P/N 22 81 08 9

J14: MACRO Electrical Input Connector: 8-pin RJ-45 Socket

J17: MACRO Electrical Output Connector: 8-pin RJ-45 Socket

J18: JTAG/OnCE (for factory use only): 10-pin IDC Header

J19: JSIO (for factory use only): 8-pin SIP Connector

J20: JISP (for factory use only): 8-pin SIP Connector

P1: ISA Bus Connector: 64-pin card-edge Connector

P2: ISA Bus Connector: 36-pin card-edge Connector

TB1: JPWR Power Supply Connector: 4-point Terminal Block

TB2: WD Watchdog Output Connector: 4-point Terminal Block

U35: MACRO Fiber Optic Transceiver: Double SC Fiber-Optic Socket

TURBO PMAC2-PC ULTRALITE CONNECTOR PINOUTS

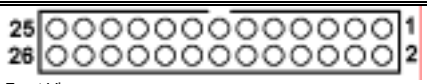
J1 (JANA) Analog Input Port Connector

J1/JANA (20-Pin Header) (Present Only If Option 12 Ordered)				
Pin #	**Symbol**	**Function**	**Description**	**Notes**
1	ANAI00	INPUT	Analog Input 0	0-5V OR +/-2.5V range
2	ANAI01	INPUT	Analog Input 1	0-5V OR +/-2.5V range
3	ANAI02	INPUT	Analog Input 2	0-5V OR +/-2.5V range
4	ANAI03	INPUT	Analog Input 3	0-5V OR +/-2.5V range
5	ANAI04	INPUT	Analog Input 4	0-5V OR +/-2.5V range
6	ANAI05	INPUT	Analog Input 5	0-5V OR +/-2.5V range
7	ANAI06	INPUT	Analog Input 6	0-5V OR +/-2.5V range
8	ANAI07	INPUT	Analog Input 7	0-5V OR +/-2.5V range
9	ANAI08	INPUT	Analog Input 8	0-5V OR +/-2.5V range
10	ANAI09	INPUT	Analog Input 9	0-5V OR +/-2.5V range
11	ANAI10	INPUT	Analog Input 10	0-5V OR +/-2.5V range
12	ANAI11	INPUT	Analog Input 11	0-5V OR +/-2.5V range
13	ANAI12	INPUT	Analog Input 12	0-5V OR +/-2.5V range
14	ANAI13	INPUT	Analog Input 13	0-5V OR +/-2.5V range
15	ANAI14	INPUT	Analog Input 14	0-5V OR +/-2.5V range
16	ANAI15	INPUT	Analog Input 15	0-5V OR +/-2.5V range
17	GND	COMMON	PMAC Common	Not isolated from digital
18	+12V	OUTPUT	Pos. Supply Volt.	To power ext. Circuitry
19	GND	COMMON	PMAC Common	Not isolated from digital
20	-12V	OUTPUT	NEG. Supply Volt.	To power ext circuitry

The JANA connector provides the inputs for the 8 or 16 optional analog inputs on the Turbo PMAC2-PC Ultralite.

J2 (JTHW) Multiplexer Port Connector

J2/JTHW (26-Pin Header)



Front View

Pin #	Symbol	Function	Description	Notes
1	GND	COMMON	PMAC Common	
2	GND	COMMON	PMAC Common	
3	DAT0	INPUT	DATA-0 Input	Data input from MUX port accessories
4	SEL0	OUTPUT	SELECT-0 Output	Address/data output for MUX port accessories
5	DAT1	INPUT	DATA-1 Input	Data input from MUX port accessories
6	SEL1	OUTPUT	SELECT-1 Output	Address/data output for MUX port accessories
7	DAT2	INPUT	DATA-2 Input	Data input from MUX port accessories
8	SEL2	OUTPUT	SELECT-2 Output	Address/data output for MUX port accessories
9	DAT3	INPUT	DATA-3 Input	Data input from MUX port accessories
10	SEL3	OUTPUT	SELECT-3 Output	Address/data output for MUX port accessories
11	DAT4	INPUT	DATA-4 Input	Data input from MUX port accessories
12	SEL4	OUTPUT	SELECT-4 Output	Address/data output for MUX port accessories
13	DAT5	INPUT	DATA-5 Input	Data input from MUX port accessories
14	SEL5	OUTPUT	SELECT-5 Output	Address/data output for MUX port accessories
15	DAT6	INPUT	DATA-6 Input	Data input from MUX port accessories
16	SEL6	OUTPUT	SELECT-6 Output	Address/data output for MUX port accessories
17	DAT7	INPUT	DATA-7 Input	Data input from MUX port accessories
18	SEL7	OUTPUT	SELECT-7 Output	Address/data output for MUX port accessories
19	N.C.	N.C.	No Connection	
20	GND	COMMON	PMAC Common	
21	BRLD/	OUTPUT	Buffer Request	Low is "buffer req."
22	GND	COMMON	PMAC Common	
23	IPLD/	OUTPUT	In Position	Low is "in position"
24	GND	COMMON	PMAC Common	
25	+5V	OUTPUT	+5VDC Supply	Power supply out
26	INIT/	INPUT	PMAC Reset	Low is "reset"

The JTHW multiplexer port connector provides 8 inputs and 8 outputs at TTL levels; these are typically used to create multiplexed I/O with accessory boards such as ACC-18 (Thumbwheel) and ACC-34 (Discrete I/O). The port I/O may also be used directly, as non-multiplexed I/O.

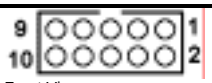
J3 (JI/O) General Input/Output Connector

J3/JIO (40-Pin Header)				
Pin #	**Symbol**	**Function**	**Description**	**Notes**
1	I/O00	IN/OUT	Digital I/O 0	Software direction ctrl.
2	I/O01	IN/OUT	Digital I/O 1	Software direction ctrl.
3	I/O02	IN/OUT	Digital I/O 2	Software direction ctrl.
4	I/O03	IN/OUT	Digital I/O 3	Software direction ctrl.
5	I/O04	IN/OUT	Digital I/O 4	Software direction ctrl.
6	I/O05	IN/OUT	Digital I/O 5	Software direction ctrl.
7	I/O06	IN/OUT	Digital I/O 6	Software direction ctrl.
8	I/O07	IN/OUT	Digital I/O 7	Software direction ctrl.
9	I/O08	IN/OUT	Digital I/O 8	Software direction ctrl.
10	I/O09	IN/OUT	Digital I/O 9	Software direction ctrl.
11	I/O10	IN/OUT	Digital I/O 10	Software direction ctrl.
12	I/O11	IN/OUT	Digital I/O 11	Software direction ctrl.
13	I/O12	IN/OUT	Digital I/O 12	Software direction ctrl.
14	I/O13	IN/OUT	Digital I/O 13	Software direction ctrl.
15	I/O14	IN/OUT	Digital I/O 14	Software direction ctrl.
16	I/O15	IN/OUT	Digital I/O 15	Software direction ctrl.
17	I/O16	IN/OUT	Digital I/O 16	Software direction ctrl.
18	I/O17	IN/OUT	Digital I/O 17	Software direction ctrl.
19	I/O18	IN/OUT	Digital I/O 18	Software direction ctrl.
20	I/O19	IN/OUT	Digital I/O 19	Software direction ctrl.
21	I/O20	IN/OUT	Digital I/O 20	Software direction ctrl.
22	I/O21	IN/OUT	Digital I/O 21	Software direction ctrl.
23	I/O22	IN/OUT	Digital I/O 22	Software direction ctrl.
24	I/O23	IN/OUT	Digital I/O 23	Software direction ctrl.
25	I/O24	IN/OUT	Digital I/O 24	Software direction ctrl.
26	I/O25	IN/OUT	Digital I/O 25	Software direction ctrl.
27	I/O26	IN/OUT	Digital I/O 26	Software direction ctrl.
28	I/O27	IN/OUT	Digital I/O 27	Software direction ctrl.
29	I/O28	IN/OUT	Digital I/O 28	Software direction ctrl.
30	I/O29	IN/OUT	Digital I/O 29	Software direction ctrl.
31	I/O30	IN/OUT	Digital I/O 30	Software direction ctrl.
32	I/O31	IN/OUT	Digital I/O 31	Software direction ctrl.
33	GND	COMMON	Ref. Voltage	
34	GND	COMMON	Ref. Voltage	
35	PHASE/	OUTPUT	Phase Clock	For latching data
36	SERVO/	OUTPUT	Servo Clock	For latching data
37	GND	COMMON	Ref. Voltage	
38	GND	COMMON	Ref. Voltage	
39	+5V	OUTPUT	Supply Voltage	To power ext. Circuitry
40	+5V	OUTPUT	Supply Voltage	To power ext. Circuitry

The JI/O connector provides 32 input/output pins at TTL levels. Direction can be controlled in byte-wide groups.

J5 (JRS232) Serial Port Connector

J5/JRS232 (10-Pin Header)



Front View

Pin #	Symbol	Function	Description	Notes
1	PHASE	IN/OUT	Phasing Clock	See Notes 1, 2
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 receive data
6	RTS	OUTPUT	Req. To Send	PMAC ready bit
7	DSR	BIDIRECT	Data Set Ready	Tied to "DTR"
8	SERVO	IN/OUT	Servo Clock	See note 2
9	GND	COMMON	PMAC Common	
10	+5V	OUTPUT	+5Vdc Supply	Power supply out

The JRS232 connector provides the PMAC2-PC with the ability to communicate serially with an RS232 port. This connector cannot be used for daisychain communication interconnection of multiple PMACs, although it can be used to share servo and phase clocks for synchronicity. The J5A RS-422 interface is required for daisychain communication.

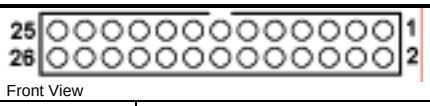
Jumpers E17 and E18 must connect pins 1 and 2 to use this port for serial communications.

Note 1: If communicating to PMAC2 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.

J5A: RS422 Serial Port Connector

J5A/JRS422 (26-Pin Header)



Front View

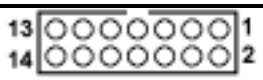
Pin #	Symbol	Function	Description	Notes
1	CHASSI	COMMON	PMAC Common	
2	S+5V	OUTPUT	+5Vdc Supply	Deactivated by "E8"
3	RD-	INPUT	Receive Data	Diff. I/O low true **
4	RD+	INPUT	Receive Data	Diff. I/O high true *
5	SD-	OUTPUT	Send Data	Diff. I/O low true **
6	SD+	OUTPUT	Send Data	Diff. I/O high true *
7	CS+	INPUT	Clear To Send	Diff. I/O low true **
8	CS-	INPUT	Clear To Send	Diff. I/O low true **
9	RS+	OUTPUT	Req. To Send	Diff. I/O high true **
10	RS-	OUTPUT	Req. To Send	Diff. I/O low true *
11	DTR	BIDIRECT	Data Term Read	Tied to "DSR"
12	INIT/	INPUT	PMAC Reset	Low is "reset"
13	GND	COMMON	PMAC Common	**
14	DSR	BIDIRECT	Data Set Ready	Tied 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	PMAC Common	
26	+5V	OUTPUT	+5Vdc Supply	Power supply out

The JRS422 connector provides the PMAC with the ability to communicate both in RS422 and RS232. In addition, this connector is used to daisychain interconnect multiple PMACs for synchronized operation.

Jumpers E17 and E18 must connect pins 2 and 3 to use this port for serial communications.

J6 (JDISP) Display Connector

J6/JDISP (14-Pin Header)



Front View

Pin #	Symbol	Function	Description	Notes
1	Vdd	OUTPUT	+5V Power	Power supply out
2	Vss	COMMON	PMAC Common	
3	Rs	OUTPUT	Read Strobe	TTL signal out
4	Vee	OUTPUT	Contrast Adjust. Vee	0 to +5Vdc *
5	E	OUTPUT	Display Enable	High is enable
6	R/W	OUTPUT	Read Or Write	TTL signal out
7	DB1	OUTPUT	Display Data1	
8	DB0	OUTPUT	Display Data0	
9	DB3	OUTPUT	Display Data3	
10	DB2	OUTPUT	Display Data2	
11	DB5	OUTPUT	Display Data5	
12	DB4	OUTPUT	Display Data4	
13	DB7	OUTPUT	Display Data7	
14	DB6	OUTPUT	Display Data6	

The JDISP connector is used to drive the 2 line x 24 character (Acc-12), 2 x 40 (Acc-12A) LCD, or the 2 x 40 vacuum fluorescent (Acc 12C) display unit. The DISPLAY command may be used to send messages and values to the display.

J7 (JHW) Handwheel Encoder Connector

J7/JHW (20-Pin Header)

PIN #	SYMBOL	FUNCTION	DESCRIPTION	NOTES
1	GND	COMMON	Ref. Voltage	
2	+5V	OUTPUT	Supply Voltage	To power ext. Circuitry
3	HWA1+	INPUT	Hw Pos A Chan.	Also pulse input
4	HWA1-	INPUT	Hw Neg A Chan.	Also pulse input
5	HWB1+	INPUT	Hw Pos B Chan.	Also direction input
6	HWB1-	INPUT	Hw Neg B Chan.	Also direction input
7	HWA2+	INPUT	Hw Pos A Chan.	Also pulse input
8	HWA2-	INPUT	Hw Neg A Chan.	Also pulse input
9	HWB2+	INPUT	Hw Pos B Chan.	Also direction input
10	HWB2-	INPUT	Hw Neg B Chan.	Also direction input
11	PUL1+	OUTPUT	PFM Pos Pulse	Also PWM output
12	PUL1-	OUTPUT	PFM Neg Pulse	Also PWM output
13	DIR1+	OUTPUT	PFM Pos Dir. Out	Also PWM output
14	DIR1-	OUTPUT	PFM Neg Dir Out	Also PWM output
15	PUL2+	OUTPUT	PFM Pos Pulse	Also PWM output
16	PUL2-	OUTPUT	PFM Neg Pulse	Also PWM output
17	DIR2+	OUTPUT	PFM Pos Dir. Out	Also PWM output
18	DIR2-	OUTPUT	PFM Neg Dir Out	Also PWM output
19	GND	COMMON	Ref. Voltage	
20	+5V	OUTPUT	Supply Voltage	To power ext. Circuitry

This connector provides the interface for 2 quadrature encoders, typically to be used as "handwheel" or time base master encoders. It also provides two channels of pulse-and-direction or PWM top-and-bottom pair outputs.

TB1 (2/4-Pin Terminal Block)

This terminal block can be used to provide the input for the power supply for the circuits on the PMAC2 board when it is not in a bus configuration. When the PMAC2 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.

Pin#	Symbol	Function	Description	Notes
1	GND	COMMON	Reference Voltage	
2	+5V	INPUT	Positive Supply Voltage	Supplies all PMAC digital circuits
3	+12V	INPUT	Positive Supply Voltage	+12V to +15V; not req'd 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
Note: Unless Option 12 (Analog-to-Digital Converters) is included on the board, only pins 1 and 2 will be provided on this terminal block.				

TB2 (4-Pin Terminal Block)

This terminal block provides the output for PMAC2's watchdog timer relay, both normally open and normally closed contacts.

Pin#	Symbol	Function	Description	Notes
1	WD_NC	OUTPUT	Watchdog Relay Out	Normally closed
2	COM	INPUT	Watchdog Return	+V or 0V
3	WD_NO	OUTPUT	Watchdog Relay Out	Normally open
4	COM	INPUT	Watchdog Return	+V or 0V

Note: The "normally-closed" relay contact is open while PMAC2 is operating properly -- it has power and the watchdog timer is not tripped -- and closed when the PMAC2 is not operating properly -- either it has lost power or the watchdog timer has tripped. The "normally-open" relay contact is closed while PMAC2 is operating properly, and open when PMAC2 is not operating properly.

MACRO Interface Connectors

Option A: Fiber Optic Transceiver

U35 Lower port: Transmit Optical Data
U35 Upper port: Receive Optical Data

Option C: RJ-45 "Phone Jack" Connectors

J14: Receive Data
J17: Transmit Data