USER MANUAL

Accessory 18

Thumbwheel Multiplexer

3Ax-602178-xUxx

October 1, 2003

DELTA TAU
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INTRODUCTION

The Thumbwheel Multiplexer, Accessory 18 (ACC-18), is a printed circuit board which provides the required circuitry for reading 16 thumbwheels or 64 DIP switches by PMAC. The connector JTHW (J3) on PMAC's main board is specifically provided for interface with ACC-18. Up to 32 ACC-18s can be daisy-chained to permit the reading of 512 thumbwheels (or 2048 binary TTL level inputs) by PMAC. The exact number of thumbwheel and/or DIP switches ordered with each ACC-18 is user selectable. The user must select how many thumbwheel digits (switches) are needed. A maximum of 16 switches may be installed on each ACC-18. The locations of the thumbwheel switches on the board should also be specified. In addition, if DIP switches are required on the same ACC-18, care should be taken to avoid multiplex memory map conflict with the selected thumbwheels (see sections on thumbwheel and DIP switch installation below). To facilitate the selection process, an Order Form is provided for ACC-18 (A sample of this Form is at the end of this Manual). ACC-18 comes with the following options:

ACC-18 Option 1: (DB37 Pin Connector)

Daisy-chain Expansion Connector - This is a DB37 connector (J2), which allows for the connection of more than one ACC-18 to one PMAC through its JTHW connector. Each ACC-18 board has an address selector 5-position DIP switch (SW9). The 5-bit address setting for each ACC-18 determines its specific address along the daisy chain. For each ACC-18 connected to PMAC, the switch must be set according to the addressing numbers shown in table 1. A 6" cable is provided with this option for the connection between any two adjoining ACC-18s (J2 of ACC-18 closer to PMAC should be connected to J1 of the next ACC-18).

ACC-18 Option 2: (Dip Switches)

Dip Switches, 8 Position, P/N 76SB08S or 76SB08 by Grayhill- This option is useful for the application of the multiplexer board to read individual binary bits. The provided DIP switches can serve as general purpose (program dependent) input switches to PMAC via ACC-18. Each DIP switch pack comes in 8 bits. A total of eight DIP switch packs may be installed on one ACC-18 board (assuming no thumbwheel switches are installed on the same ACC-18). This gives 64 individual bits configurable in groupings of 1 to 32 bits. For a direct parallel read of these switches by PMAC, use the command **TWB** (see PMAC's Manual). A DIP switch pack may not be installed at a position, which shares the same PMAC address with an installed thumbwheel switch (e.g., TS1/TS2 and SW1 should not be installed on the same ACC-18).

ACC-18 Option 3

N/A to PMAC

ACC-18 Option 4: (Thumbwheels)

This option provides the actual thumbwheels and the sockets for installing the thumbwheels on ACC-18. Factory installation of the sockets and the thumbwheels is the standard procedure whenever one or more thumbwheels are ordered together with an ACC-18. Otherwise, sockets may be soldered by the customer at desired locations on the board (each location corresponds to a specific thumbwheel multiplex address for PMAC). The thumbwheels are then plugged into the sockets. Thumbwheels by Cherry or equivalent P/N T20-02A, Tie Rod P/N 012-0347, Fastner P/N 012-0744, End Caps P/N 009-1153. Thumbwheel sockets by Edac or equivalent P/N 307-006-501-104, alternative 306-006-521-101 .

ACC-18 Option 5: (External Power Connector)

External Power Connector- This option allows for the connection of an external +5V power supply to ACC-18. Without this option, J1 brings in PMAC's +5V power supply for the on-board logic through the supplied 6' flat cable. If a longer cable is used, there may be an unacceptable drop in the supply voltage. In such situations, Option 5 should be ordered. In general, Option 5 is recommended for applications in which ACC-18 is located too far (more than 20 feet) away from PMAC.

ACC-18 Option 6: (Molex Connectors)

Molex Connectors and Mates - This Option allows for the connection of remotely located thumbwheels (or any other binary switch input) to an ACC-18. Molex or equivalent 6 pin connectors, male and female, with male P/N 09-06-1061 in the multiplexer's TS1 to TS16 connector slots and the female, P/N 09-50-7061 with contact pins 08-50-0106 terminating the cable from the remote thumbwheels.

CONNECTORS

Refer to the schematic layout diagram of ACC-18 for all connectors and their locations on the board. A listing for each connector's pin definition begins on page 13 of this manual.

J1

This DB37 connector provides the link between PMAC'S JTHW (J3) and ACC-18 through the supplied flat cable. For multiple ACC-18s, J1 provides the connection to J2 of the ACC-18 daisy-chained closer to PMAC (see connection diagram).

J2

This DB37 connector comes with Option 1. J2 provides the link between two adjoining ACC-18s (see connection diagram).

TB1

This is a 6-pin screw-down terminal block, which comes with ACC-18's Option 5 for the connection of external power. This connector also brings in an external PMAC reset input.

TB2

N/A to PMAC.

J3

N/A to PMAC.

THUMBWHEEL INSTALLATION

The thumbwheel sockets (or the Molex connectors for remote connections) may be installed at any of the 16 "TS" locations on an ACC-18. Each thumbwheel switch installed on a TS location represents one BCD digit. Starting from an odd number, any two adjoining TS locations form a unique multiplexed JTHW PMAC address for an 8-bit number. For each ACC-18 the TS1/TS2 pair has the lowest address on PMAC's JTHW memory map. The TS15/TS16 pair has the highest address (odd numbered switches form the low nibbles).

Example: On an ACC-18, which is DIP switch selected as the board #1 (see the first entry in table 1), the address of the socket location TS1 is that of the low nibble (0) of the first 8-bit number. On a second ACC-18, which is selected as the board #2, the address of socket location TS8 is that of the high nibble of the 12th (8+4) 8-bit number (see Table #1).

PMAC's specific BCD thumbwheel read command, TWD, can read multiple-digit BCD numbers (the maximum number of BCD digits read by one TWD command is 12).

When using the TWD read format for multiple digit numbers, the thumbwheel switches should be located in contiguous TS locations with the most significant BCD thumbwheel switch installed in either the low or the high nibble of the lowest addressed location. The TWD read command automatically switches the data between the low and the high nibbles of each 8-bit addressed number such that the most significant decimal digit is always read from the thumbwheel to the far left of others forming the multiple digit number. In addition, DIP switches should not be installed in locations with the same multiplex addresses (see Table 2 for the shared addresses between the thumbwheel and the DIP switches on each ACC-18 board).

Example: If an 8 digit number is to be read through 8 BCD thumbwheel switches on one ACC-18, the *most significant* digit's thumbwheel may be located in TS1, or TS2,. . ., or TS8. The corresponding *next most significant* digit should be located in TS2, or TS3,..., or TS9 respectively. Also, the corresponding *least significant* digit for this number should be installed in TS8, or TS9, or TS16 respectively. In addition, no DIP switches should be installed in any location with an address conflict with the selected TS locations.

Note

Whenever an ACC-18 is ordered with one or more Option 4s, the switches and the sockets will be factory installed according to the Order Form specifications by the customer.

DIP SWITCH INSTALLATION

The DIP switch sockets may be installed in any of the eight byte-wide "SW" locations (SW1 to SW8) on each ACC-18 board. Each 8-bit DIP switch pack installed on a SW location can represent 8 bits of an integer number, or eight 1-bit binary numbers, or any combination in between. Each switch has a unique multiplexed JTHW PMAC address with respect to other DIP switches. For each ACC-18 SW1 has the lowest address on the PMAC's JTHW memory map (corresponding to TS1/TS2 address). SW8 has the highest address (corresponding to TS15/TS16 address). Thus, care should be taken to avoid addressing conflicts whenever both DIP switches and thumbwheel switches are used on the same ACC-18 board (i.e. thumbwheels on TS1/TS2 should not be installed if DIP switches on SW1 are installed). PMAC's specific binary thumbwheel read command, TWB, can read multiple DIP switches as fixed-point (integer) numbers. The maximum number of binary bits read by one TWB command is 32. For multiple digit numbers the DIP switch packs should be located in contiguous SW locations, with the most significant 8-bit DIP switch installed at the highest address.

Note

The most significant data line is connected to the DIP switch number 8 within each DIP switch pack.

Example: To read a 16-bit binary number via two 8-bit DIP switch packs, the most significant 8-bit pack may be installed in locations SW2, or SW4, or SW8. The least significant 8-bit pack should be installed in locations SW1, or SW3, or SW7 respectively. In addition, no thumbwheel switches should be installed in sockets with address conflicts with the selected DIP switch locations.

Note

Whenever an ACC-18 is ordered with one or more Option 2s, the switches and the sockets will be factory installed according to the Order Form specification by the customer.

MULTIPLEX ADDRESS MAP

Each ACC-18 occupies 8 bytes of address space on the PMAC's JTHW multiplex memory space. This memory space is 8-bit wide, providing the ability to daisy-chain 32 (256/8) ACC-18s together. The 5-bit DIP switch, SW9, determines the address of each ACC-18 board on the allocated memory space. Table 1 shows how SW9 should be set for one or more ACC-18 boards connected to the same PMAC. Table 2 shows the addresses of the thumbwheel and the DIP switch sockets within each ACC-18 board.

Table 1 (Address Relationship)

Board #	Byte		SW9 DIP SWITCH SETTING				
	Low Nibble	High Nibble	1	2	3	4	5
#1	0-3	4-7	ON	ON	ON	ON	ON
#2	8-11	12-15	ON	ON	ON	ON	OFF
#3	16-19	20-23	ON	ON	ON	OFF	ON
#4	24-27	28-31	ON	ON	ON	OFF	OFF
#5	32-35	36-39	ON	ON	OFF	ON	ON
#6	40-43	44-47	ON	ON	OFF	ON	OFF
#7	48-51	52-55	ON	ON	OFF	OFF	ON
#8	56-59	60-63	ON	ON	OFF	OFF	OFF
#9	64-67	68-71	ON	OFF	ON	ON	ON
#10	72-75	76-79	ON	OFF	ON	ON	OFF
#11	80-83	84-87	ON	OFF	ON	OFF	ON
#12	88-91	92-95	ON	OFF	ON	OFF	OFF
#13	96-99	100-103	ON	OFF	OFF	ON	ON
#14	104-107	108-111	ON	OFF	OFF	ON	OFF
#15	112-115	116-119	ON	OFF	OFF	OFF	ON
#16	120-123	124-127	ON	OFF	OFF	OFF	OFF
#17	128-131	132-135	OFF	ON	ON	ON	ON
#18	136-139	140-143	OFF	ON	ON	ON	OFF
#19	144-147	148-151	OFF	ON	ON	OFF	ON
#20	152-155	156-159	OFF	ON	ON	OFF	OFF
#21	160-163	164-167	OFF	ON	OFF	ON	ON
#22	168-171	172-175	OFF	ON	OFF	ON	OFF
#23	176-179	180-183	OFF	ON	OFF	OFF	ON
#24	184-187	188-191	OFF	ON	OFF	OFF	OFF
#25	192-195	196-199	OFF	OFF	ON	ON	ON
#26	200-203	204-207	OFF	OFF	ON	ON	OFF
#27	208-211	212-215	OFF	OFF	ON	OFF	ON
#28	216-219	220-223	OFF	OFF	ON	OFF	OFF
#29	224-227	228-231	OFF	OFF	OFF	ON	ON
#30	232-235	236-239	OFF	OFF	OFF	ON	OFF
#31	240-243	244-247	OFF	OFF	OFF	OFF	ON
#32	248-251	252-255	OFF	OFF	OFF	OFF	OFF

The daisy-chain board address relationship with respect to the 5-bit (SW9) DIP position setting.

Note: ON=CLOSED, OFF=OPEN. To turn "off" a switch, push down on the "open" side. To turn "on" a switch, push down on the "numbered" side.

Table 2 (Multiplex Memory Map)

ACC-18 Multiplex Address	Corresponding Thumbwheel Switch Number		Corresponding DIP Switch Number
	MS Nibble	**LS Nibble**	
Byte #1	TS2	TS1	SW1
Byte #2	TS4	TS3	SW2
Byte #3	TS6	TS5	SW3
Byte #4	TS8	TS7	SW4
Byte #5	TS10	TS9	SW5
Byte #6	TS12	TS11	SW6
Byte #7	TS14	TS13	SW7
Byte #8	TS16	TS15	SW8

The multiplex memory map for each ACC-18.
Note: The address of DIP switches in a given row conflict with those for the thumbwheel switches in the same row. Therefore, for a given byte address, *either* DIP switches *or* thumbwheels switches may be installed.

READING DATA FROM ACC-18

There are two special format M-variables for reading the data from an ACC-18: TWD and TWB. These special PMAC M-variables along with the general M-variable definition formats are described in the main PMAC Manual. Also, included are the details for the use of the M-variables in user programs. The reader should refer to the main PMAC Manual for examples of motion and PLC programs using M-variables. In this section, a brief description of the two special thumbwheel board M-variable definitions is given.

TWD Definition (BCD Thumbwheel-Multiplexer Definition)

This command causes PMAC to define the specified M-Variable or range of variables to point to a set of binary-coded-decimal digits multiplexed on the thumbwheel port with accessory 18 or compatible hardware.

M{constant}->TWD:{m-plex address},{offset},{size}[.{dp}],{format}

{m-plex address} is an integer constant in the range 0 to 255 corresponding to the byte within the 256-byte wide JTHW address space containing the most significant digit (nibble) of thumbwheel data;

{offset} is either 0 or 4. The Offset is 0 when the most significant digit is in the low address nibble (odd numbered TS switches). The Offset is 4 when the most significant digit is in the high address nibble (even numbered TS switches).

{size} is the number of digits. The minimum number of digits is 1. The maximum number of digits is 12;

{dp} is the number of thumbwheel digits taken as being to the right of the decimal point (0 to 8 ; default is 0);

{format} is either U for unsigned, or S for signed. If it is signed, the least significant bit of the most significant digit is taken as the sign bit (the rest of the most significant digit is ignored).

Example: To define (assign to) the M-variable 123, the value of multiple thumbwheels via the TWD command may be written:

```
M123->TWD:4,0,8.3,U
```

This PMAC M- variable definition means that the most significant digit is at multiplex address 4, low nibble (left digit); there are 8 digits, 3 of which are fractional; and it is always interpreted as a positive value. This corresponds to eight thumbwheel digits along the bottom row of the lowest-addressed thumbwheel board, with the decimal point 3 digits from the right.

TWB Definition (Binary Thumbwheel-Multiplexer Definition)

This is a special (integer) format read-only M-variable definition for PMAC's read of one or more switches via the multiplex board. The command format is:

M{constant}->TWB:{m-plex address}, {offset}, {size},{format}

{m-plex address} is an integer constant in the range 0 to 255 corresponding to the byte address of the least significant bit of the M-variable;

{offset} is an integer constant from 0 through 7 that defines which bit of this byte is the least significant bit of the M-variable;

{size} is the bit-width of the M-variable in the range of 1 to 32;

{format} is either U for unsigned, or S for signed (two's complement);

Example: To define (assign to) the M-variable 204 the value of multiple switches via the TWB command we may write:

```
M204->TWB:2,0,16,S
```

This PMAC M-variable definition means that the least significant bit of the multiple switches is at multiplex address 2 (SW2), with the least significant bit located at bit zero of the byte (e.g. DIP switch 1 on SW2). The integer number is 16 bit, with the most significant bit read as the sign bit. This corresponds to two DIP switch packs at locations SW3 and SW2 on the lowest addressed thumbwheel board.

Note

The most significant byte of the 16-bit number is read from SW3 with the sign bit read from DIP switch 8 (right most DIP switch).

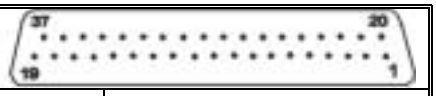
JUMPERS AND LEDS

There are three LEDs on the top left hand corner of the multiplexer board. IPOS is connected to PMAC's In-Position output. BUFU is connected to PMAC's Buffer Request signal for your convenience. The third LED (ERROR) is not connected to PMAC. In addition, the position of Jumper E1, (the only jumper on the board) does not play any role for the use of ACC-18 with PMAC.

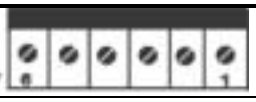
CONNECTOR PINOUTS

DB and Terminal Block Connectors

J1 and J2 (DB 37-Pin Connectors)

Top View 

Pin #	Symbol	Function	Description	Notes
1	STRB/	Input	Strobe	N/A to PMAC
2	DATA 0	Output	Data Bit 0	Input to PMAC
3	DATA 1	Output	Data Bit 1	Input to PMAC
4	DATA 2	Output	Data Bit 2	Input to PMAC
5	DATA 3	Output	Data Bit 3	Input to PMAC
6	DATA 4	Output	Data Bit 4	Input to PMAC
7	DATA 5	Output	Data Bit 5	Input to PMAC
8	DATA 6	Output	Data Bit 6	Input to PMAC
9	DATA 7	Output	Data Bit 7	Input to PMAC
10	N/C			
11	N/C			
12	IPOS	Input	In-Position	Output from PMAC
13	+5V	Input	+5V Supply	
14	GRD	Common	PMAC Common	
15	N/C			
16	GRD	Common	PMAC Common	
17	N/C			
18	BUFU	Input	Buffer-full	Not Connected for PMAC
19	N/C			
20	GRD	Common	PMAC Common	
21	SEL0	Input	Address Line 0	Output from PMAC
22	SEL1	Input	Address Line 1	Output from PMAC
23	SEL2	Input	Address Line 2	Output from PMAC
24	SEL3	Input	Address Line 3	Output from PMAC
25	SEL4	Input	Address Line 4	Output from PMAC
26	SEL5	Input	Address Line 5	Output from PMAC
27	SEL6	Input	Address Line 6	Output from PMAC
28	SEL7	Input	Address Line 7	Output from PMAC
29	GRD	Common	PMAC Common	Output from PMAC
30	GRD	Common	PMAC Common	Output from PMAC
31	GRD	Common	PMAC Common	Output from PMAC
32	INIT/	Output	PMAC Reset	Brought through TB1
33	EROR/	Input	Error Signal	N/A to PMAC
34	N/C			
35	N/C			
36	N/C			
37	N/C			

TB1 (External Power Supply Connector)				Top View 
Pin #	**Symbol**	**Function**	**Description**	**Notes**
1	STRB/	Input	Strobe	PMAC Common
2	GRD	Input	Common	
3	INIT/	Input	PMAC Reset	External Reset
4	GRD	Input	PMAC Common	
5	+5V	Input	External Supply	
6	GND	Input	PMAC Common	
TB1 is installed on ACC-18 only if Option 5 is ordered.				

J3

This connector is not used with PMAC

TB2

This connector is not used with PMAC.

SUMMARY

Accessory 18 is a device capable of reading 8 bytes of data and each byte is broken into 2 nibbles. Therefore, ACC-18 is capable of having 16 individual thumbwheels or eight 8-dip switches. If thumbwheels are used, each thumbwheel is inserted into one slot and represents 1 nibble of data. If DIP switches are used, then each switch represents 1 byte of data.

Power Requirements

5V	15V	-15V	Other 24V etc.
60 mA			

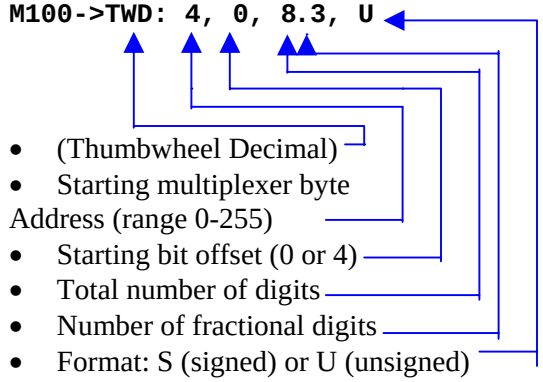
PMAC THUMBWHEEL USE

Using thumbwheels on the ACC-18 thumbwheel multiplexer board is a simple, two-step process with PMAC.

Step 1: Define an M-Variable to the group of digits.

Example:

```
M100->TWD: 4, 0, 8.3, U
```



- (Thumbwheel Decimal)
- Starting multiplexer byte

Address (range 0-255)

- Starting bit offset (0 or 4)
- Total number of digits
- Number of fractional digits
- Format: S (signed) or U (unsigned)

Step 2: Use the M-Variable in your program

Example:

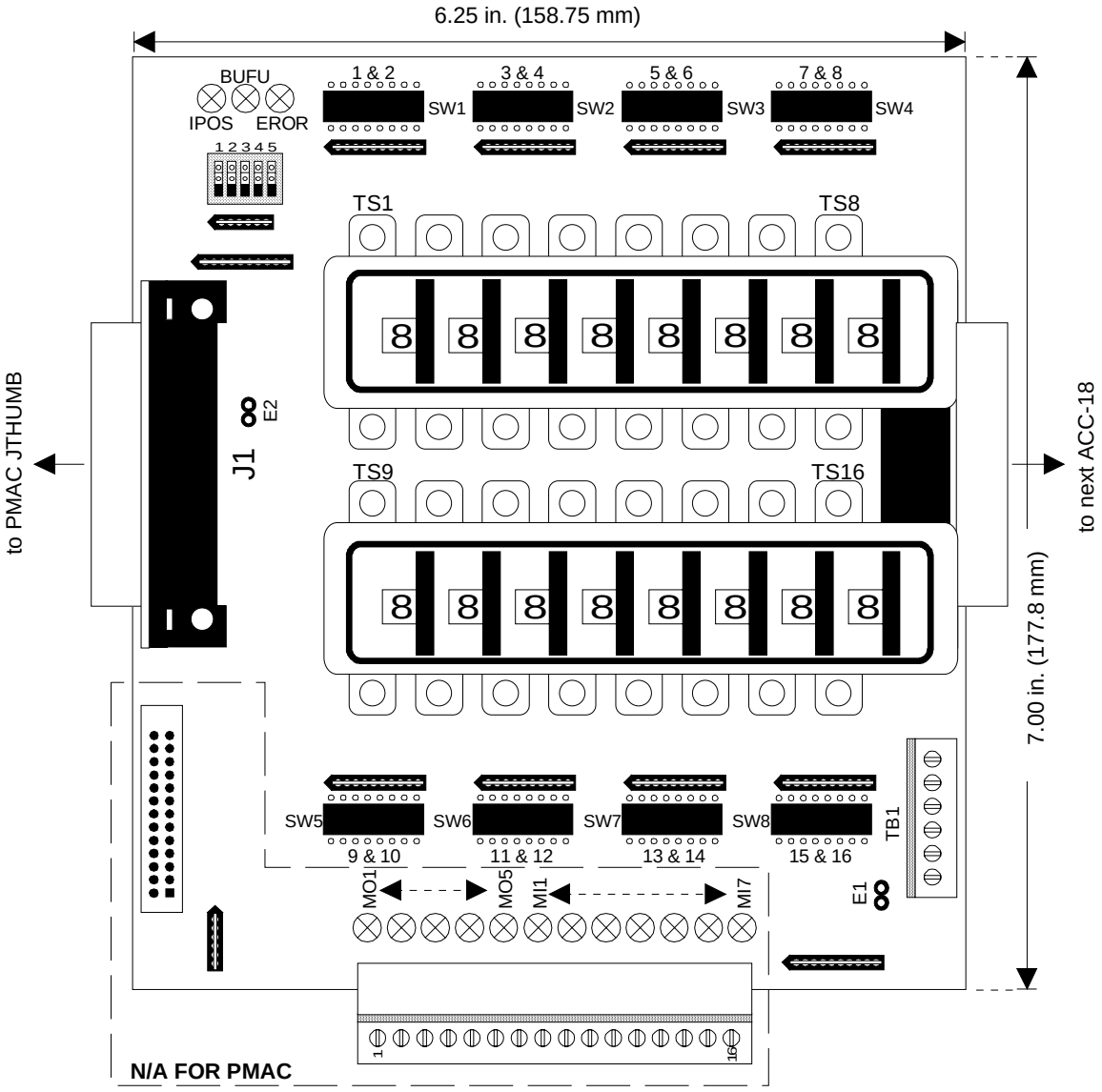
F(M100)

X(M100)

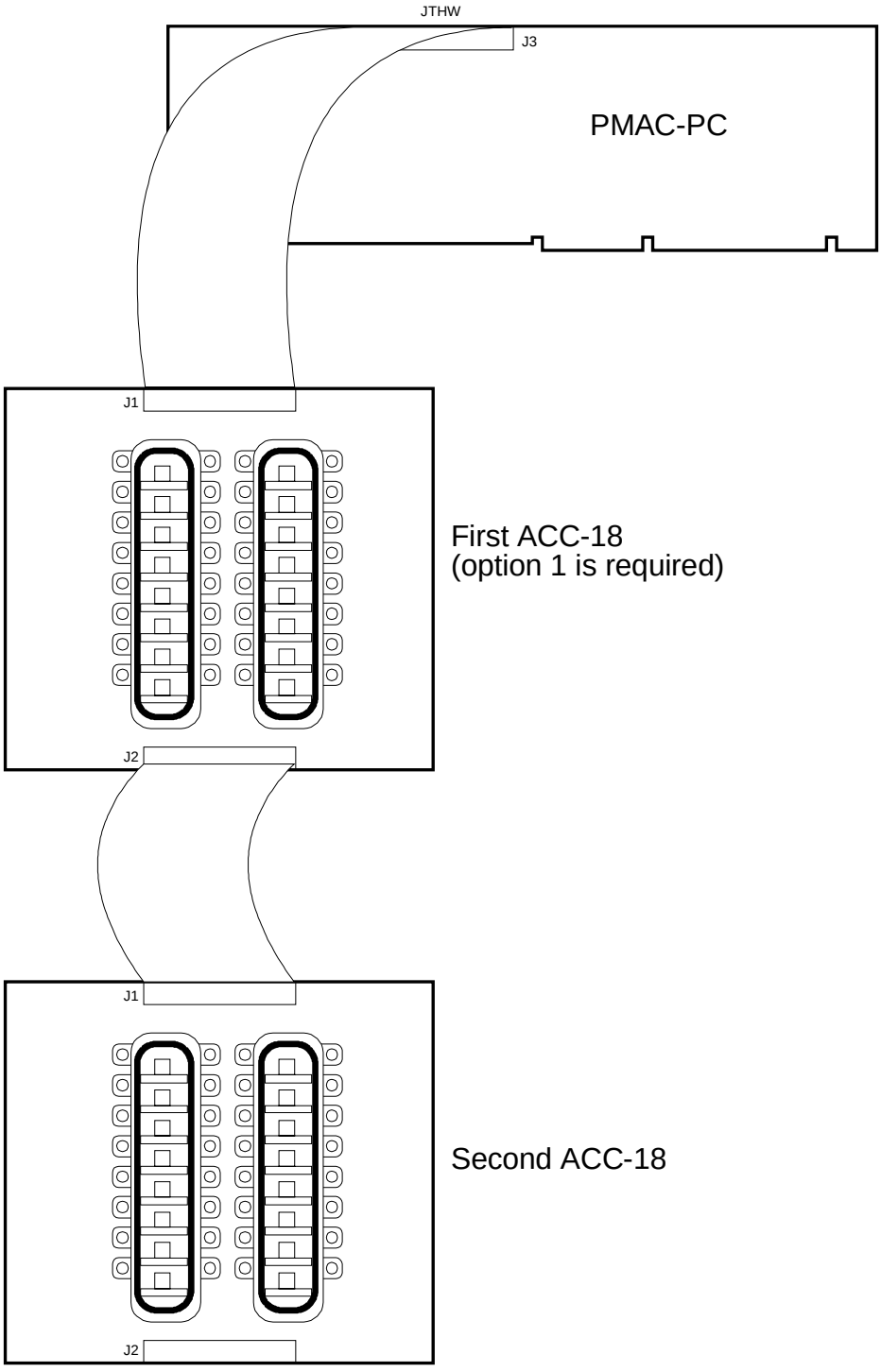
P1=SIN (M100)

DIAGRAMS

ACC-18
THUMBWHEEL INPUT



CONNECTING TWO ACC-18s TO PMAC



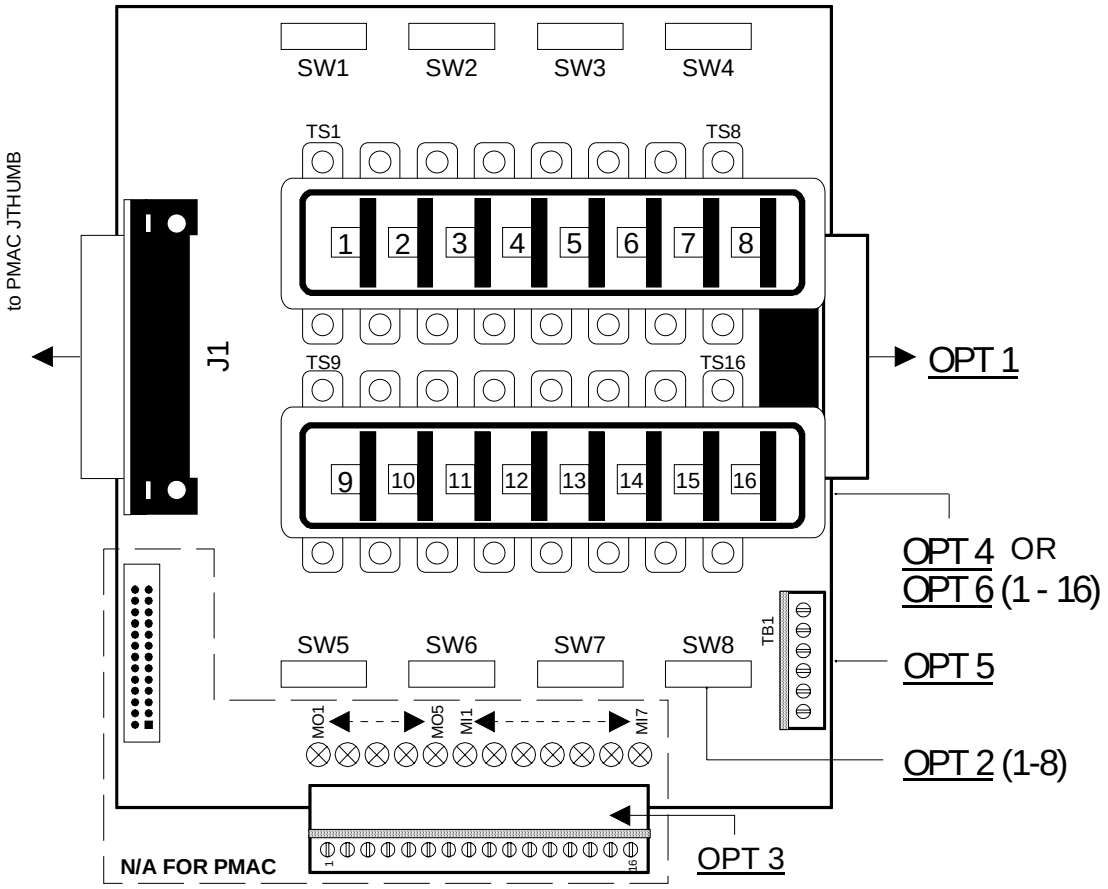
ACC-18 ORDER FORM

IN TERMINAL USE ONLY
CUSTOMER :
JOB # :
CONTACT :
PHONE # :
DATE :
COMMENTS :

COMPANY : _____ DATE : _____
NAME : _____ TITLE : _____
PHONE #: _____ FAX : _____
PO #: _____
AUTHORIZATION SIGNATURE : _____

PLEASE MARK OPTIONS AS NEEDED: (please see example)

_____ OPT 1 - EXPANSION CONN.
_____ OPT 2 - DIP SWITCH (SPECIFY WHICH 1-8) _____
_____ OPT 3 - OPTO I/O CONN., LEDs
_____ OPT 4 - THUMBWHEELS (SPECIFY WHICH 1-6)1 _____
_____ OPT 5 - EXTERNAL POWER CONN.
_____ OPT 6 - MOLEX CONN. & MATES (SPECIFY WHICH 1-16) _____
COMMENT / SPECIAL INSTRUCTIONS: _____
_____



ACC-18 ORDER FORM
Example

(Note: if the following options are ordered, the ACC-18 would look as below)

PLEASE MARK OPTIONS AS NEEDED:

__X__ OPT 1 - EXPANSION CONN.
__X__ OPT 2 - DIP SWITCH (SPECIFY WHICH 1-8) **3 and 4**
_____ OPT 3 - OPTO I/O CONN., LEDs
__X__ OPT 4 - THUMBWHEELS (SPECIFY WHICH 1-16) **1 to 4, 9 to 12**
__X__ OPT 5 - EXTERNAL POWER CONN.
_____ OPT 6 - MOLEX CONN. & MATES (SPECIFY WHICH 1-16) _____
COMMENT / SPECIAL INSTRUCTIONS: _____
_____