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USER MANUAL

Accessory 10E

Opto 48-Bit Output Board

3xx-603299-xUxx

September 24, 2003

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INTRODUCTION

The PMAC Accessory 10E is a general-purpose output board to the UMAC-Turbo or UMAC-MACRO systems. ACC-10E provides 48 lines of optically isolated outputs. The actual I/O writes are carried out using a special form of M-variables, which will be described later. ACC-10E is one of the series of 3U rack I/O accessories designed to transfer data through the UMAC BUS (UBUS). The other boards in the family of MACRO I/O Accessory products include the following:

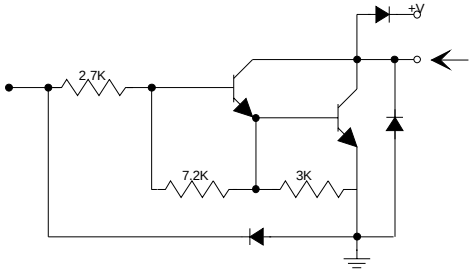
ACC-9E	48 optically isolated inputs
ACC-10E	48 optically isolated outputs, low power
ACC-11E	24 inputs and 24 outputs, low power, all optically isolated
ACC-12E	24 inputs and 24 outputs, high power, all optically isolated
ACC-14E	48-bits TTL level I/O

Output Drivers

The output drivers are organized in a set of six 8-bit groups. Each group (each byte) may be ordered with either current sourcing drivers (default) or with current sinking drivers. The default configuration of this accessory board uses UDN2981 current sourcing drivers for the six 8-bit output groups. With this configuration, the current drawn from each output line should be limited to 100 mA at voltage levels between 12 and 24 volts. Custom configurations are available for current sinking applications. In current sinking configurations one ULN2803 driver is used per each 8-bit output group. Each open collector output line can sink up to 100 mA when pulled up to a voltage level between 12 and 24 volts (external pull-up resistors are not supplied).

Sinking Outputs:

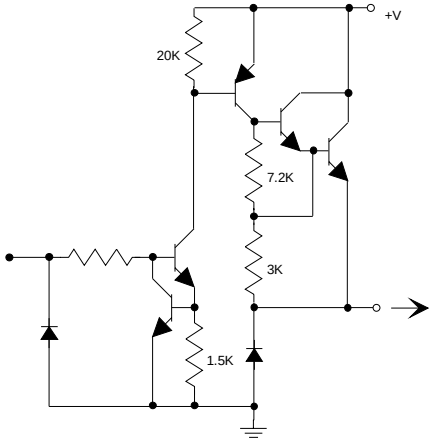
OUTPUT CHIP EQUIVALENT
CIRCUIT ULN2803 FOR SINKING



INVERTING, OPEN COLLECTOR, SINKING, 12-24V

Sourcing Outputs:

OUTPUT CHIP EQUIVALENT
CIRCUIT UDN2981 FOR SOURCING



NON-INVERTING, SOURCING, 12-24V

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HARDWARE SETUP

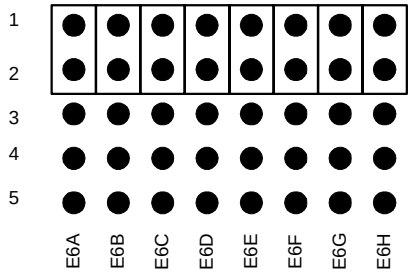
The Accessory 10E must have several jumpers configured to work properly with other I/O cards in the ring. The jumpers used on this board will select the starting I/O Gate Array transfer address and the MACRO Station I/O Node to be transferred to.

E1-E4: I/O Gate Transfer Jumpers

Jumper	UMAC MACRO	UMAC Turbo
E1	$8800 or $FFE0	$078C00 (default)
E2	$8840 or $FFE8	$078D00
E3	$8880 or $FFF0	$078E00
E4	$88C0	$078F00

E5: I/O Gate Data Clock Select

Jumper	Function
E5	Servo Clock 2-3 Phase Clock (default)



E6A – E6H Layout Diagram

E6A-E6H: Node Select Jumpers

Jumper	Setting	UMAC MACRO	UMAC Turbo
E6A-E6H	1-2 (default*)	1st I/O node set by MI69 and MI70 1st and 2nd node by MI71	Uses Bits 0 – 7 for six consecutive memory locations (48-bits)
E6A-E6H	2-3 or 3-4	2nd I/O node set by MI69 and MI70 3rd and 4th node by MI71	Uses Bits 8 – 15 for six consecutive memory locations (48-bits)
E6A-E6H	4-5	3rd I/O node set byMI69 and MI70 5th and 6th node by MI71	Uses Bits 16 – 23 for six consecutive memory locations (48-bits)
*Could be different if Delta Tau built and tested the UMAC at the factory. **Example:** If the UMAC MACRO Rack specified two ACC-9E's, one board would have E6A-E6H jumpered 1-2 and the next board would be jumpered 2-3, etc.			

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E10-E21*Sinking or Sourcing Output Select

Jumpers	Description
E10 & E11	1-2 Sinking inputs with the ULN2803A IC for outputs 1through 8 2-3 Sourcing outputs with the UDN2981A IC for outputs 1 through 8
E12 & E13	1-2 Sinking inputs with the ULN2803A IC for outputs 9 through 16 2-3 Sourcing outputs with the UDN2981A IC for outputs 9 through 16
E14 & E15	1-2 Sinking inputs with the ULN2803A IC for outputs 17 through 24 2-3 Sourcing outputs with the UDN2981A IC for outputs 17 through 24
E16 & E17	1-2 Sinking inputs with the ULN2803A IC for outputs 25 through 32 2-3 Sourcing outputs with the UDN2981A IC for outputs 25 through 32
E18 & E19	1-3 Sinking inputs with the ULN2803A IC for outputs 33 through 40 2-3 Sourcing outputs with the UDN2981A IC for outputs 33 through 40
E20 & E21	1-4 Sinking inputs with the ULN2803A IC for outputs 41 through 48 2-3 Sourcing outputs with the UDN2981A IC for outputs 41 through 48

Hardware Address Limitations

The ACC-10E has a hardware address limitation relative to the newer series of UMAC high-speed IO cards. The new IO cards have four addresses per chip select (CS10, CS12, CS14, and CS16). This enables these cards to have up to 16 different addresses. The ACC-9E, ACC-10E, ACC-11E, and ACC-12E all have one address per chip select but also have the low-byte, middle-byte, and high-byte type of addressing scheme and allows for a maximum of twelve of these IO cards.

UMAC Card Types

UMAC Card	Number of Addresses	Category	Maximum # of cards	Card Type
ACC-9E, ACC-10E ACC-11E, ACC-12E	4	General IO	12	**A**
ACC-65E, ACC-66E ACC-67E, ACC-68E ACC-14E	16	General IO	16	**B**
ACC-28E, ACC-36E ACC-59E	16	ADC and DAC	16	**B**
ACC-53E, ACC-57E ACC-58E	16	Feedback Devices	16	**B**

Chip Select Addresses

Chip Select	UMAC Turbo Type A Card	MACRO Type A Card	UMAC Turbo Type B Card	MACRO Type B Card
10	$078C00	$FFE0 or $8800	$078C00, $079C00 $07AC00, $07BC00	$8800,$9800 $A800,$B800
12	$078D00	$FFE8 or $8840	$078D00, $079D00 $07AD00, $07BD00	$8840,$9840 $A840,$B840
14	$078E00	$FFF0 or $8880	$078E00, $079E00 $07AE00, $07EC00	$8880,$9880 $A880,$B880
16	$078F00	$88C0	$078F00, $079F00 $07AF00, $07BF00	$88C0,$98C0 $A8C0,$B8C0

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Addressing Conflicts

When just using only the type A UMAC cards or using only the type B UMAC cards in an application, the user does not have to worry about potential addressing conflicts other than making sure the individual cards are set to the addresses as specified in the manual.

If the user has both type A and type B UMAC cards in their rack they should be aware of the possible addressing conflicts. If the customer is using the Type A card on a particular Chip Select (CS10, CS12, CS14, or CS16) then they cannot use a Type B card with the same Chip Select address unless the Type B card is a general IO type. If the Type B card is a general IO type, then the Type B card will be the low-byte card at the Chip Select address and the Type A card(s) will be setup at as the middle-byte and high-byte addresses.

Type A and Type B Example 1: ACC-10E and ACC-36E

If the user has an ACC-10E and ACC-36E the user cannot allow both cards to use the same Chip Select because the data from both cards will be overwritten by the other card.

The solution to this problem is to make sure you do not address both cards to the same chip select.

Type A and Type B Example 2: ACC-10E and ACC-65E

For this example the user could allow the two cards to share the same chip select because the ACC-65E is a general purpose IO Type B card. The only restriction in doing so is that the ACC-65E must be considered the low-byte addressed card and the ACC-10E must be jumpered to either the middle or high bytes (jumper E6A-E6H).

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USING ACC-10E WITH UMAC TURBO

For the UMAC-Turbo, the ACC-10E can be used for general outputs only. The registers used for the outputs are 8-bit registers and the user defines three 8-bit registers for each 24-bit I/O port.

UMAC-Turbo Memory Mapping for ACC-10E

The Delta Tau I/O Gate used on the ACC-10E is an 8-bit processor; therefore, the memory mapping to the I/O bits is processed as 8-bit words at the Turbo UMAC. Using this simple scheme you could process up to 576 (144×4) bits of data for general purpose I/O.

	Jumper E1	Jumper E2	Jumper E3	Jumper E4	Description
E6A-E6H 1-2	Y:$078C00,0,8	Y:$078D00,0,8	Y:$078E00,0,8	Y:$078F00,0,8	I/O bits 0-7
	Y:$078C01,0,8	Y:$078D01,0,8	Y:$078E01,0,8	Y:$078F01,0,8	I/O bits 8-15
	Y:$078C02,0,8	Y:$078D02,0,8	Y:$078E02,0,8	Y:$078F02,0,8	I/O bits 16-23
	Y:$078C03,0,8	Y:$078D03,0,8	Y:$078E03,0,8	Y:$078F03,0,8	I/O bits 24-31
	Y:$078C04,0,8	Y:$078D04,0,8	Y:$078E04,0,8	Y:$078F04,0,8	I/O bits 32-39
	Y:$078C05,0,8	Y:$078D05,0,8	Y:$078E05,0,8	Y:$078F05,0,8	I/O bits 40-47
	Y:$078C07,0,8	Y:$078D07,0,8	Y:$078E07,0,8	Y:$078F07,0,8	Control Word
E6A-E6H 2-3 or 3-4	Y:$078C00,8,8	Y:$078D00,8,8	Y:$078E00,8,8	Y:$078F00,8,8	I/O bits 0-7
	Y:$078C01,8,8	Y:$078D01,8,8	Y:$078E01,8,8	Y:$078F01,8,8	I/O bits 8-15
	Y:$078C02,8,8	Y:$078D02,8,8	Y:$078E02,8,8	Y:$078F02,8,8	I/O bits 16-23
	Y:$078C03,8,8	Y:$078D03,8,8	Y:$078E03,8,8	Y:$078F03,8,8	I/O bits 24-31
	Y:$078C04,8,8	Y:$078D04,8,8	Y:$078E04,8,8	Y:$078F04,8,8	I/O bits 32-39
	Y:$078C05,8,8	Y:$078D05,8,8	Y:$078E05,8,8	Y:$078F05,8,8	I/O bits 40-47
	Y:$078C07,8,8	Y:$078D07,8,8	Y:$078E07,8,8	Y:$078F07,8,8	Control Word
E6A-E6H 4-5	Y:$078C00,16,8	Y:$078D00,16,8	Y:$078E00,16,8	Y:$078F00,16,8	I/O bits 0-7
	Y:$078C01,16,8	Y:$078D01,16,8	Y:$078E01,16,8	Y:$078F01,16,8	I/O bits 8-15
	Y:$078C02,16,8	Y:$078D02,16,8	Y:$078E02,16,8	Y:$078F02,16,8	I/O bits 16-23
	Y:$078C03,16,8	Y:$078D03,16,8	Y:$078E03,16,8	Y:$078F03,16,8	I/O bits 24-31
	Y:$078C04,16,8	Y:$078D04,16,8	Y:$078E04,16,8	Y:$078F04,16,8	I/O bits 32-39
	Y:$078C05,16,8	Y:$078D05,16,8	Y:$078E05,16,8	Y:$078F05,16,8	I/O bits 40-47
	Y:$078C07,16,8	Y:$078D07,16,8	Y:$078E07,16,8	Y:$078F07,16,8	Control Word

Data processing at these I/O Gate Arrays is extremely fast. If you were to map the machine I/O to the ACC-10E memory locations, you could do read or write bit wise or using 8-bit words.

Control Register

The control register at address {Base + 7} permits the configuration of the IOGATE IC to a variety of applications. The control register consists of 8 write/read-back bits – Bits 0 - 7. The control register consists of two sections: Direction Control and Register Select.

The direction control allows setting input bytes to be read only. One of the advantages of the IOGATE IC is that we give the user the ability to define the bits as inputs or outputs. This "control" mechanism allows the user to ensure the inputs will always be read properly. Our traditional I/O accessories always define the inputs and outputs by hardware.

The register select bits allow you to define the input or output bytes inversion control or the latching input features.

Since the ACC-10E does not have any input circuitry, the control word for the ACC-67E should only be modified for direction control only.

Direction Control Bits

Bits 0 to 5 of the control register simply control the direction of the I/O for the matching numbered data register. That is, Bit *n* controls the direction of the I/O at {Base + *n*}. A value of 0 in the control bit (the default) permits a write operation to the data register, enabling the output

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function for each line in the register. Enabling the output function does not prevent the use of any or all of the lines as inputs, as long as the outputs are off (non-conducting). A value of 1 in the control bit does not permit a write operation to the data register, disabling the output, reserving the register for inputs.

For example, a value of 1 in Bit 3 disables the write function into the data register at address {Base + 3}, ensuring that lines IO24 - IO31 can always be used as inputs.

Register Select Control Bits

Bits 6 and 7 of the control register together select which of 4 possible registers can be accessed at each of the addresses {Base + 0} through {Base + 5}. They also select which of 2 possible registers can be selected at {Base + 6}.

The following table explains how these bits select registers:

Bit 7	Bit 6	Combined Value	{Base + 0} to {Base + 5} Register Selected	{Base + 6} Register Selected
0	0	0	Data Register	Data Register
0	1	1	Setup Register 1	Setup Register
1	0	2	Setup Register 2	n. a.
1	1	3	Setup Register 3	n. a.

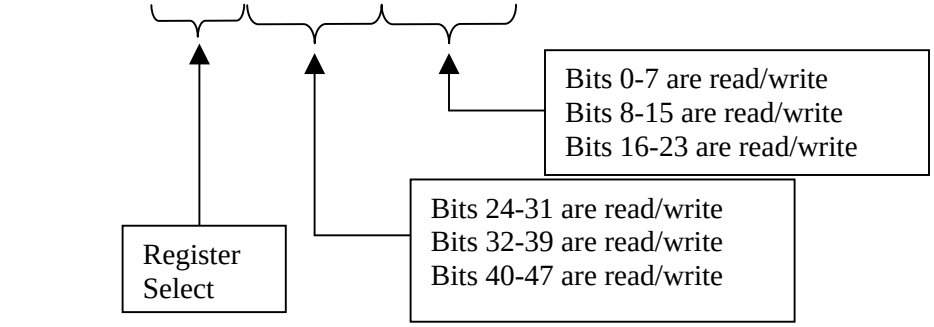
In a typical application, non-zero combined values of Bits 6 and 7 are only used for initial configuration of the IC. These values are used to access the setup registers at the other addresses. After the configuration is finished, zeros are written to both Bits 6 and 7, so the data registers at the other registers can be accessed.

Control Word Setup Example

You need to set up the control words for the IO card at power up. To accomplish this task, a simple plc could be written to set up the control word properly. For this example, we will be setting up one ACC-11E (IC0 –24in/24out), one ACC9E (IC1 - 48 inputs), and one ACC-10E (IC2 - 48 outputs).

Control Word for ACC-10E (`M2007->Y:$078C07,0,8`)

Hex ($)	0				0			
Binary	0	0	0	0	0	0	0	0
Bit	7	6	5	4	3	2	1	0



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```
M2000->Y:$078C00,0,8          ;I/O bits 0-7 (port A IC0)
M2001->Y:$078C01,0,8          ;I/O bits 8-15 (port A IC0)
M2002->Y:$078C02,0,8          ;I/O bits 16-23 (port A IC0)
M2003->Y:$078C03,0,8          ;I/O bits 0-7 (port B IC0)
M2004->Y:$078C04,0,8          ;I/O bits 8-15 (port B IC0)
M2005->Y:$078C05,0,8          ;I/O bits 16-23 (port B IC0)
M2006->Y:$078C06,0,8          ;register selected
M2007->Y:$078C07,0,8          ;control register

M2008->Y:$078C00,8,8          ;I/O bits 0-7 (port A IC1)
M2009->Y:$078C01,8,8          ;I/O bits 8-15 (port A IC1)
M2010->Y:$078C02,8,8          ;I/O bits 16-23 (port A IC1)
M2011->Y:$078C03,8,8          ;I/O bits 0-7 (port B IC1)
M2012->Y:$078C04,8,8          ;I/O bits 8-15 (port B IC1)
M2013->Y:$078C05,8,8          ;I/O bits 16-23 (port B IC1)
M2014->Y:$078C06,8,8          ;register selected
M2015->Y:$078C07,8,8          ;control register

M2016->Y:$078C00,16,8         ;I/O bits 0-7 (port A IC2)
M2017->Y:$078C01,16,8         ;I/O bits 8-15 (port A IC2)
M2018->Y:$078C02,16,8         ;I/O bits 16-23 (port A IC2)
M2019->Y:$078C03,16,8         ;I/O bits 0-7 (port B IC2)
M2020->Y:$078C04,16,8         ;I/O bits 8-15 (port B IC2)
M2021->Y:$078C05,16,8         ;I/O bits 16-23 (port B IC2)
M2022->Y:$078C06,16,8         ;register selected
M2023->Y:$078C07,16,8         ;control register

M2007->Y:078C07,0,8           ;control word for $78C00,0,8 - $78C05,0,8
M2015->Y:078C07,8,8           ;control word for $78C00,8,8 - $78C05,8,8
M2023->Y:078C07,16,8          ;control word for $78C00,16,8 -$78C05,16,8

;**** PLC to initialize read/write I/O bits ****
OPEN PLC 1 CLEAR
M2007=$07               ;define bits 0-23 as inputs and bits 24-47 as
                        ;outputs (ACC-11E)
M2015=$3F               ;define bits 0-23 and 24-47 as inputs (ACC-9E)
M2023=$00               ;define bits 0-23 and 24-47 as outputs (ACC-10E)
DIS PLC1
CLOSE
```

Accessory 10E I/O M-Variables for UMAC Turbo

The following is a list of suggested M-variables for the default jumper settings is provided. You may assign any M-variables to these addresses. The user may make these M-variable definitions and use them as general purpose I/O for their PLC's or motion programs.

```
M8000->Y:$078C00,0,1   Output 0      M8024->Y:$078C03,0,1   Output 24
M8001->Y:$078C00,1,1   Output 1      M8025->Y:$078C03,1,1   Output 25
M8002->Y:$078C00,2,1   Output 2      M8026->Y:$078C03,2,1   Output 26
M8003->Y:$078C00,3,1   Output 3      M8027->Y:$078C03,3,1   Output 27
M8004->Y:$078C00,4,1   Output 4      M8028->Y:$078C03,4,1   Output 28
M8005->Y:$078C00,5,1   Output 5      M8029->Y:$078C03,5,1   Output 29
M8006->Y:$078C00,6,1   Output 6      M8030->Y:$078C03,6,1   Output 30
M8007->Y:$078C00,7,1   Output 7      M8031->Y:$078C03,7,1   Output 31
M8008->Y:$078C01,0,1   Output 8      M8032->Y:$078C04,0,1   Output 32
M8009->Y:$078C01,1,1   Output 9      M8033->Y:$078C04,1,1   Output 33
M8010->Y:$078C01,2,1   Output 10     M8034->Y:$078C04,2,1   Output 34
M8011->Y:$078C01,3,1   Output 11     M8035->Y:$078C04,3,1   Output 35
M8012->Y:$078C01,4,1   Output 12     M8036->Y:$078C04,4,1   Output 36
M8013->Y:$078C01,5,1   Output 13     M8037->Y:$078C04,5,1   Output 37
```


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```
M8014->Y:$078C01,6,1   Output 14     M8038->Y:$078C04,6,1   Output 38
M8015->Y:$078C01,7,1   Output 15     M8039->Y:$078C04,7,1   Output 39
M8016->Y:$078C02,0,1   Output 16     M8040->Y:$078C05,0,1   Output 40
M8017->Y:$078C02,1,1   Output 17     M8041->Y:$078C05,1,1   Output 41
M8018->Y:$078C02,2,1   Output 18     M8042->Y:$078C05,2,1   Output 42
M8019->Y:$078C02,3,1   Output 19     M8043->Y:$078C05,3,1   Output 43
M8020->Y:$078C02,4,1   Output 20     M8044->Y:$078C05,4,1   Output 44
M8021->Y:$078C02,5,1   Output 21     M8045->Y:$078C05,5,1   Output 45
M8022->Y:$078C02,6,1   Output 22     M8046->Y:$078C05,6,1   Output 46
M8023->Y:$078C02,7,1   Output 23     M8047->Y:$078C05,7,1   Output 47
```

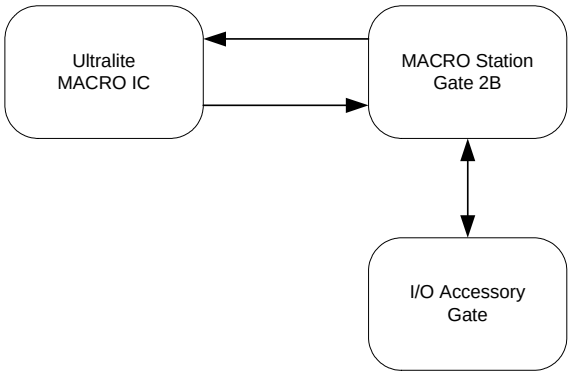
```
;****** Sample E-Stop PLC *****
; This PLC will abort all motion programs and kill the bus voltage to
; the motors when E-stop is depressed.  When E-Stop button in pulled out
; the motors will servo to actual position (<ctrl> A command) after
; allowing 5 seconds for proper bus voltage.
;     P7000 used as a Latch variable
;     M7000 used Emergency Stop Input (from ACC-9E)
;     M8000 used as Main Contact for main AC for Bus Voltage
;     I5111 used as count down timer
OPEN PLC 5 CLEAR
IF (M7000=1 and P7000=0)      ;emergency stop condition
    CMD^A                     ;global motion program abort
    I5111=500*8388608/I10     ;500 msec delay for deceleration
    WHILE (I5111>0) ENDWHILE
    CMD^K                     ;kill all axes
    M8000=0                   ;turn off BUS voltage
    P7000=1                   ;latch input
Endif
IF (M7000=0 and P7000=1)
    M8000=1                   ;enable BUS voltage
    I5111=5000*8388608/I10    ;5000 msec delay for bus voltage
    WHILE (I5111>0) ENDWHILE
    CMD^A                     ;close loop for all servos
    P7000=0                   ;latch input
Endif
Close
```


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MACRO-STATION I/O TRANSFER

A fundamental understanding of the MACRO Station I/O transfer is needed to set up the MACRO I/O family of accessories.

Typically, the MACRO station will have up to eight axis nodes (0, 1, 4, 5, 8, 9, 12, 13) and up to six I/O transfer nodes (2, 3, 6, 7, 10, 11). There are two types of I/O transfers allowed to send information to the Ultralite from the MACRO-Station: 48-bit transfer and 24-bit transfer. The PMAC2 Ultralite and the MACRO-Station enable you to transfer 72 bits per I/O node. For a multi Master system, 432 bits (6×72) of data may be transferred for each Master (Ultralite) in the ring. If only one Master is used in the ring, node 14 could be used for I/O transfer, which would give us 504 bits (7×72) of I/O transfer data.



For all MACRO-Station I/O accessories, the information is transferred to or from the accessory I/O Gate to the MACRO-Station CPU Gate 2B. Information from the MACRO-Station Gate 2B is then read or written directly to the MACRO IC on the Ultralite. Once the information is at the Ultralite, it can be used in your application motion programs or PLC programs.

Each I/O board has jumper and software settings to select the I/O transfer memory locations at both the I/O transfer Gate and the MACRO transfer addresses. These jumpers and software settings are discussed in this manual.

MACRO I/O Gate Locations

$8800, $8802, $8804
$8840, $8842, $8844
$8880, $8882, $8884
$88C0, $88C2, $88C4

MACRO Station I/O Node Transfer Addresses

Node(s)	Node 24-bit: Transfer Addresses	Node 16-bit (upper 16 bits): Transfer Addresses
2	X:$C0A0	X:$C0A1, X:$C0A2, X:$C0A3
3	X:$C0A4	X:$C0A5, X:$C0A6, X:$C0A7
6	X:$C0A8	X:$C0A9, X:$C0AA, X:$C0AB
7	X:$C0B0	X:$C0B1, X:$C0B2, X:$C0B3
10	X:$C0B4	X:$C0B5, X:$C0B6, X:$C0B7
11	X:$C0B8	X:$C0B9, X:$C0BA, X:$C0BB

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PMAC2 Ultralite I/O Node Addresses

Node	Node 24-bit: Transfer Addresses	Node 16-bit (upper 16 bits): Transfer Addresses
2	X:$C0A0	X:$C0A1, X:$C0A2, X:$C0A3
3	X:$C0A4	X:$C0A5, X:$C0A6, X:$C0A7
6	X:$C0A8	X:$C0A9, X:$C0AA, X:$C0AB
7	X:$C0B0	X:$C0B1, X:$C0B2, X:$C0B3
10	X:$C0B4	X:$C0B5, X:$C0B6, X:$C0B7
11	X:$C0B8	X:$C0B9, X:$C0BA, X:$C0BB

PMAC2 Turbo Ultralite I/O Node Addresses

MACRO IC Node	User Node	Node 24-bit Transfer Addresses	Node 16-bit (upper 16 bits) Transfer Addresses
(IC0) 2	2	X:$078420	X:$078421, X:$078422, X:$078423
(IC0) 3	3	X:$078424	X:$078425, X:$078426, X:$078427
(IC0) 6	6	X:$078428	X:$078429, X:$07842A, X:$07842B
(IC0) 7	7	X:$07842C	X:$07842D, X:$07842E, X:$07842F
(IC0) 10	10	X:$078430	X:$078431, X:$078432, X:$078433
(IC0) 11	11	X:$078434	X:$078435, X:$078436, X:$078437
(IC1) 2	18	X:$079420	X:$079421, X:$079422, X:$079423
(IC1) 3	19	X:$079424	X:$079425, X:$079426, X:$079427
(IC1) 6	22	X:$079428	X:$079429, X:$07942A, X:$07942B
(IC1) 7	23	X:$07942C	X:$07942D, X:$07942E, X:$07942F
(IC1) 10	26	X:$079430	X:$079431, X:$079432, X:$079433
(IC1) 11	27	X:$079434	X:$079435, X:$079436, X:$079437
(IC2) 2	34	X:$078420	X:$07A421, X:$07A422, X:$07A423
(IC2) 3	35	X:$07A424	X:$07A425, X:$07A426, X:$07A427
(IC2) 6	38	X:$07A428	X:$07A429, X:$07A42A, X:$07A42B
(IC2) 7	39	X:$07A42C	X:$07A42D, X:$07A42E, X:$07A42F
(IC2) 10	42	X:$07A430	X:$07A431, X:$07A432, X:$07A433
(IC2) 11	43	X:$07A434	X:$07A435, X:$07A436, X:$07A437
(IC3) 2	50	X:$07B420	X:$07B421, X:$07B422, X:$07B423
(IC3) 3	51	X:$07B424	X:$07B425, X:$07B426, X:$07B427
(IC3) 6	54	X:$07B428	X:$07B429, X:$07B42A, X:$07B42B
(IC3) 7	55	X:$07B42C	X:$07B42D, X:$07B42E, X:$07B42F
(IC3) 10	58	X:$07B430	X:$07B431, X:$07B432, X:$07B433
(IC3) 11	59	X:$07B434	X:$07B435, X:$07B436, X:$07B437

Example: If you wanted to read the inputs from the MACRO Station of the first 24-bit I/O node address of node 2 (X:$C0A0), then he/she could point an M-variable to the Ultralite or TURBO Ultralite I/O node registers to monitor the inputs.

```
M980->X:$C0A0,0,24          ;Ultralite node2 address
M1980->X:$078420,0,24       ;Turbo Ultralite MACRO IC0 node 2 address
```

These M-variable definitions (M980 or M1980) could then be used to monitor the inputs for either the Ultralite or Turbo Ultralite,

MACRO I/O Software Settings

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The MACRO-Station I/O can be configured as either an input or an output. The hardware connected to the MACRO I/O boards determines whether or not the addresses defined are inputs or outputs. Each I/O node has 72-bits of data to be transferred automatically to the Ultralite. As stated previously, there are three methods of transfer: 3×16-bit, 1×24-bit, or 72-bit transfer.

There are several variables at the MACRO-Station and PMAC2 Ultralite that enable the I/O data transfer. Once these variables are set to the appropriate values, you can then process the data like a normal PMAC or PMAC2. The variables to be modified at the MACRO-Station are MI19, MI69, MI70, MI71, MI169*, MI170*, MI171*, MI172*, MI173*, MI975, and MI996. The Ultralite must have I996 modified to enable the I/O nodes used.

* Can only be used with MACRO-Station firmware version 1.112 or greater

MI19 controls the data transfer period on a Compact MACRO Station between the MACRO node interface registers and the I/O registers, as specified by station MI-variables MI20 through MI71. If MI19 is set to 0, this data transfer is disabled. If MI19 is greater than 0, its value sets the period in Phase clock cycles (the same as MACRO communications cycles) at which the transfer is done.

MI975 permits the enabling of MACRO I/O nodes on the Compact MACRO Station. MI975 is a 16-bit value (bits 0 to 15) with bit *n* controlling the enabling of MACRO node *n*. If the bit is set to 0, the node is disabled; if the bit is set to 1, the node is enabled. The I/O nodes on the Compact MACRO Station are nodes 2, 3, 6, 7, 10, and 11, which can be enabled by MI975 bits of these numbers. Only bits 2, 3, 6, 7, 10, and 11 of MI975 should ever be set to 1.

MI975 is used at the power-on/reset of the Compact MACRO Station in combination with rotary switch SW1 and MI976 to determine which MACRO nodes are to be enabled. The net result can be read in Station variable MI996. To get a value of MI975 to take effect, the value must be saved (**MSSAVE{node}**) and the Station reset (**MS$$${node}**).

Example: Set MI975 to enable nodes 2 and 3.

```
MS0, I975   Set Number MACRO IO nodes to be enabled
```

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0

∴**MS0, i975=$000C**

MS0,MI975=$4	; Enable I/O Node 2 alone
MS0,MI975=$C	; Enable I/O Nodes 2 & 3
MS0,MI975=$4C	; Enable I/O Nodes 2, 3, & 6
MS0,MI975=$CC	; Enable I/O Nodes 2, 3, 6, & 7
MS0,MI975=$4CC	; Enable I/O Nodes 2, 3, 6, 7, & 10
MS0,MI975=$CCC	; Enable I/O Nodes 2, 3, 6, 7, 10, & 11
MS4,MI975=$40	; Enable I/O Node 6 alone
MS4,MI975=$C0	; Enable I/O Nodes 6 & 7
MS8,MI975=$400	; Enable I/O Node 10 alone
MS8,MI975=$C00	; Enable I/O Nodes 10 & 11

MI69 and MI70 specify the registers used in 16-bit I/O transfers between MACRO node interface registers and I/O registers on the MACRO Station I/O accessory board. They are used only if MI19 is greater than 0.

MI69 and MI70 are 48-bit variables represented as 12 hexadecimal digits. The first 6 digits specify the number and address of 48-bit (3 x 16) real-time MACRO-node register sets to be

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used. The second 6 digits specify the number and address of 16-bit I/O sets on the MACRO Station I/O accessory board to be used. The individual digits are specified as follows:

Digit #	Possible Values	Description
1	0, 1, 2, 3	Number of MACRO I/O nodes to use (0 disables); this should also match the number of 48-bit I/O sets you intend to use (see Digit 7)
2	0	(Reserved for future use)
3-6	$C0A1 (Node 2), $C0A5 (Node 3), $C0A9 (Node 6), $C0AD (Node 7), $C0B1 (Node 10), $C0B5 (Node 11)	MACRO Station X Address of MACRO I/O node first of three 16-bit registers
7	0, 1, 2, 3	Number of 16-bit I/O sets to use (1x16, 2x16, 3x16; 0 disables)
8	1	Set to 1 for ACC-14E, ACC-65E, ACC-66E, ACC-67E consecutive address read (Base, +$1000, +$2000)
9-12	$FFC0, $FFC8, $FFD0, $FFD8 $8800, $8840, $8880, $88C0 $FFE0*, $FFE8*, $FFF0*	MACRO Station Y Base Address of I/O Board as set by Board Jumper E1-E4 (ACC-3E board) or E15-E18 (ACC-4E board) MACRO Station Y Base Address of ACC-9E, ACC-10E, ACC-11E, ACC-12E and ACC-13E *for legacy systems

When this function is active, the MACRO Station will copy values from the MACRO command (input) node registers to the I/O board addresses; it will copy values from the I/O board addresses to the MACRO feedback (output) node registers. Writing a '0' to a bit of the I/O board enables it as an input, letting the output pull high. Writing a '1' to a bit of the I/O board enables it as an output and pulls the output low.

Example:

(1) 48 bit I/O transfer using node 2 with jumper E1 of ACC-11E selected

```
MS0, MI69=$10C0A130$8800
```

(2) 96 bit I/O transfer using nodes 2 & 3, jumper E1 of ACC-9E & ACC-11E (72 inputs, 24 outputs),

E6A-E6H set to 1-2 on 1st board and E6A-E6H set to 2-3 on 2nd board.

```
MS0, MI69=$20C0A130$8800
```

(3) 288 bit I/O transfer using nodes 2, 3, 6, 7, 10, and 11, using 3 ACC-9Es (144 inputs) and 3 ACC-10Es (144 outputs). Jumpers E1 on all ACC-9Es selected, and jumpers E2 on all ACC-10Es selected. Jumpers E6A-E6H selected 1-2, 2-3, 4-5 on ACC-9E Input Boards 1, 2, and 3, respectively. Jumpers E6A-E6H selected 1-2, 2-3, 4-5 on ACC-10E Output Boards 1, 2, and 3, respectively.

```
MS0, MI69=$30C0A130$8800
MS0, MI70=$30C0AD30$8840
```

MI71 specifies the registers used in 24-bit I/O transfers between MACRO I/O node interface registers and I/O registers on the MACRO Station I/O accessory board. It is used only if MI19 is greater than 0.

MI71 is a 48-bit variable represented as 12 hexadecimal digits. The first 6 digits specify the number and address of 48-bit real-time MACRO-node register sets to be used. The second 6 digits specify the number and address of 48-bit I/O sets on the MACRO Station I/O accessory board to be used.

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The individual digits are specified as follows:

Digit #	Possible Values	Description
1	0, 1, 2, 3	Number of MACRO I/O nodes to use times 2 (0 disables); this should also match the number of 48-bit I/O sets you intend to use (see Digit 7)
2	0	(Reserved for future use)
3-6	$C0A0 (Node 2), $C0A4 (Node 3), $C0A8 (Node 6), $C0AC (Node 7), $C0B0 (Node 10), $C0B4 (Node 11)	MACRO Station X Address of MACRO I/O node first of three 16-bit registers
7	0, 1, 2	Number of 24-bit I/O sets to use (1x24, 2x24; 0 disables)
8	1	Set to 1 for ACC-14E, ACC-65E, ACC-66E, ACC-67E consecutive address read (Base, +$1000, +$2000)
9-12	$FFC0, $FFC8, $FFD0, $FFD8 $8800, $8840, $8880, $88C0 $FFE0*, $FFE8*, $FFF0*	MACRO Station Y Base Address of I/O Board as set by Board Jumper E1-E4 (ACC-3E board) or E15-E18 (ACC-4E board) MACRO Station Y Base Address of ACC-9E, ACC-10E, ACC-11E, ACC-12E and ACC-13E *for legacy systems

When this function is active, the MACRO Station will copy values from the MACRO command (input) node registers to the I/O board addresses; it will copy values from the I/O board addresses to the MACRO feedback (output) node registers. Writing a '0' to a bit of the I/O board enables it as an input, letting the output pull high. Writing a '1' to a bit of the I/O board enables it as an output and pulls the output low.

Example:

(1) Two 24-bit I/O transfers using nodes 2 and 3 with jumper E1 of ACC-11E selected

```
MS0, MI71=$10C0A020$8800
```

(2) 96 bit I/O transfer using nodes 2, 3, 6, and 7, jumper E1 of ACC-9E & ACC-11E (72 inputs, 24 outputs), E6A-E6H set to 1-2 on 1st board and E6A-E6H set to 2-3 on 2nd board.

```
MS0, MI71=$20C0A020$8800
```

(3) 144 bit I/O transfer using nodes 2, 3, 6, 7, 10, and 11, using two ACC-9E (96 inputs) and one ACC-10E (48 outputs). Jumpers E1 on all ACC-9E selected, and jumpers E1 on all ACC-10Es selected. Jumpers E6A-E6H selected 1-2, 2-3, 4-5 on Boards 1, 2, and 3 respectively

```
MS0, MI71=$30C0A020$8840
```

MI169 and **MI170** specify the registers used in 72-bit I/O transfers between one MACRO node interface register and I/O registers on a MACRO station. They are used only if MI19 is greater than 0.

MI169 and MI170 are 48-bit variables represented as 12 hexadecimal digits. The first 6 digits specify the address of 72-bit (24 & 3 x 16-bit) real-time MACRO-node register to be used. The second 6 digits specify the address of the LOWER I/O Gate on an Option 3 or Option 4 board to be used.

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The individual digits are specified as follows:

Digit #	Possible Values	Description
1	0	(Reserved for future use)
2	0	(Reserved for future use)
3-6	$C0A0 (Node 2), $C0A4 (Node 3), $C0A8 (Node 6), $C0AC (Node 7), $C0B0(Node 10), $C0B4 (Node 11)	MACRO Station X Address of MACRO I/O node 24-bit registers.
7	0	(Reserved for future use)
8	0	(Reserved for future use)
9-12	$FFC0, $FFC8, $FFD0, $FFD8 $8800, $8840, $8880, $88C0 $FFE0*, $FFE8*, $FFF0*	MACRO Station Y Base Address of I/O Board as set by Board Jumper E1-E4 (ACC-3E board) or E15-E18 (ACC-4E board) MACRO Station Y Base Address of ACC-9E, ACC-10E, ACC-11E, ACC-12E and ACC-13E * for legacy systems

When this function is active, the MACRO Station will copy values from the MACRO command (input) node registers to the I/O board addresses; it will copy values from the I/O board addresses to the MACRO feedback (output) node registers. Writing a '0' to a bit of the I/O board enables it as an input, letting the output pull high. Writing a '1' to a bit of the I/O board enables it as an output and pulls the output low.

The following table shows the mapping of I/O points on the I/O piggyback boards to the MACRO node registers. I/O points move from the least significant bit to the most significant bit (I/O00 at Node bit 0).

I/O Point #s	Option 3 Part	Present on Option 4?	Matching MACRO X Register
I/O00 - I/O15	Sub-option A	Yes	Specified MACRO X Address + 1
I/O16 - I/O31	Sub-option A	Yes	Specified MACRO X Address + 2
I/O32 - I/O47	Sub-option A	Yes	Specified MACRO X Address + 3
I/O48 - I/O71	Sub-option B	No	Specified MACRO X Address + 0

Examples:

I169=$00C0A000$8800 transfers 72-bit I/O between an I/O board set at $8800 and MACRO Nodes 2 ($C0A0-$C0A3)

I169=$00C0B000$8840 transfers 72-bit I/O between an I/O board set at $8840 and MACRO Node 10 ($C0B0-$C0B3).

MI171, MI172 or MI173 specifies the registers used in 144-bit I/O transfers between MACRO I/O node interface registers and I/O registers on a MACRO station. It is used only if MI19 is greater than 0. The transfer utilizes two consecutive 72-bit X: memory I/O nodes. The three 48-bit I/O Gates must be the LOWER, MIDDLE and UPPER configuration.

MI171, MI172 or MI173 is a 48-bit variable represented as 12 hexadecimal digits. The first 6 digits specify the address of the first 72-bit real-time MACRO-node register sets to be used of the two. The second 6 digits specify the address of 48-bit I/O sets on an Option 3 or Option 4 board to be used.

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The individual digits are specified as follows:

Digit #	Possible Values	Description
1	0	(Reserved for future use)
2	0	(Reserved for future use)
3-6	$C0A0 (Nodes 2,3), $C0A4 (Nodes 3,6), $C0A8 (Nodes 6,7), $C0AC (Nodes 7,10), $C0B0 (Nodes 10,11), $C0B4 (Nodes 11,14)	MACRO Station X Address of MACRO I/O first 24-bit register of the two consecutive nodes
7	0	(Reserved for future use)
8	0	(Reserved for future use)
9-12	$FFC0, $FFC8, $FFD0, $FFD8 $8800, $8840, $8880, $88C0 $FFE0*, $FFE8*, $FFF0*	MACRO Station Y Base Address of I/O Board as set by Board Jumper E1-E4 (ACC-3E board) or E15-E18 (ACC-4E board) MACRO Station Y Base Address of ACC-9E, ACC-10E, ACC-11E, ACC-12E and ACC-13E * for legacy systems

When this function is active, the MACRO Station will copy values from the MACRO command (input) node registers to the I/O board addresses; it will copy values from the I/O board addresses to the MACRO feedback (output) node registers. Writing a '0' to a bit of the I/O board enables it as an input, letting the output pull high. Writing a '1' to a bit of the I/O board enables it as an output, pulling the output low.

The following table shows the mapping of I/O points on the I/O piggyback boards to the MACRO node registers. I/O points move from the least significant bit to the most significant bit (I/O00 at Node bit 0).

I/O Point #s	Option 3 Part	Present on Option 4?	Matching MACRO X Register
I/O00 - I/O15	Sub-option A	Yes	Specified MACRO X Address + 1
I/O16 - I/O31	Sub-option A	Yes	Specified MACRO X Address + 2
I/O32 - I/O47	Sub-option A	Yes	Specified MACRO X Address + 3
I/O48 - I/O63	Sub-option B	No	Specified MACRO X Address + 5
I/O64 - I/O79	Sub-option B	No	Specified MACRO X Address + 6
I/O80 - I/O95	Sub-option B	No	Specified MACRO X Address + 7
I/O96 - I/O119	Sub-option C	No	Specified MACRO X Address + 0
I/O120 - I/O143	Sub-option C	No	Specified MACRO X Address + 4

Example:
(1) Transfer 72-bits I/O transfers using nodes 2 and 3

```
MS0, MI171=$00C0A00$8800
```


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Reading and Writing to Node Addresses

Delta Tau recommends that you read and write to the node address as complete words. If the node address is 24-bits wide or 16-bits wide, read or write to the M-Variable assigned to that address:

Example:

Ultralite	**Turbo Ultralite**
M970->X:$C0A0,0,24	M970->X:$78420,0,24
M980->X:$C0A1,8,16	M980->X:$78421,8,16
M981->X:$C0A2,8,16	M981->X:$78422,8,16
M982->X:$C0A3,8,16	M982->X:$78423,8,16
M1000->X:$0770,0,24	M1000->X:$0010F0,0,24 ;image word
M1001->X:$0771,8,16	M1001->X:$0010F0,8,16 ;image word
For Outputs:	
M970=$F00011	;sets bits 0,4,20,21,22,& 23
M980=$8101	;sets bits 0,8,& 23
M970=M1000	;sets M970 equal to M1000
M980=M1001	;sets M980 equal to M1001
For Inputs:	
M1000=M970	;sets M1000 equal to M970
M1001=M980	;sets M1001 equal to M980

If using the 48-bit read/write method, it would be ideal if the inputs and outputs were used in multiples of 16. Example: 48 inputs, 32 inputs, 16 outputs, 16 inputs 32 outputs, or 48 output (see **Example 1**). If the 16-bit word is to be split (8 in and 8 out), then we would read the word at the beginning of the PLC and write the word at the end of the PLC. However, instead of writing the value of the inputs to the output word, you must write zeros to all input bits of this "in/out" word (see **Example 3**). This is because writing a value of 1 to a MACRO-I/O register makes that I/O bit an *output only* bit.

Example Setup:

```
System Configuration:   8-axis PWM System w/ 96 bit I/0 (48 inputs & 48
                        outputs)
                        ACC-11E
```

PMAC Ultralite Setup

```
I996=$FB33F             ;activates nodes 1,2,3,4,5,8,9,12, and 13 at
                        ;Ultralite
```

TURBO PMAC Ultralite Setup

```
I6841=$FB33F            ;activates nodes 1,2,3,4,5,8,9,12, and 13 at
                        ;Turbo Ultralite
```

Macro Station Definitions

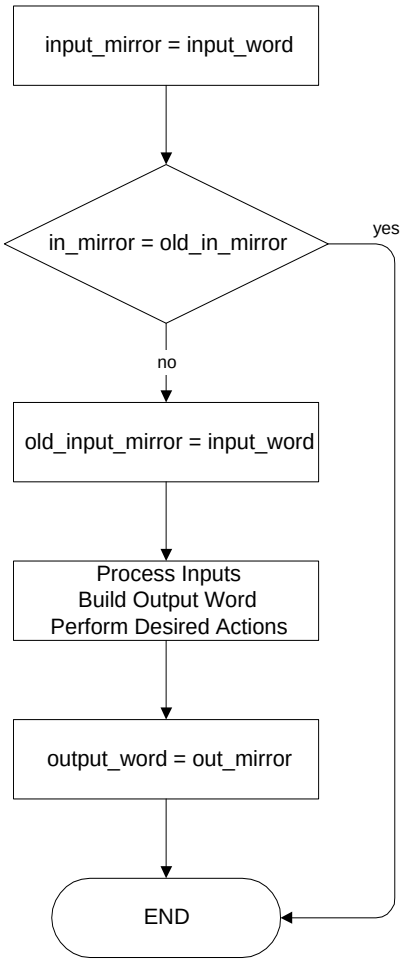
```
MS0,MI69=$20C0A130$8800 ;sets up macro to transfer data for ACC11E
MS0,MI975=$C            ;enable node 2 and 3 for I/O
MS0,MI19=4              ;sets interrupt period for data transfer
MSSAVE0                 ;save to macro station
MS$$$0                  ;reset macro station to enable
```


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Active Nodes for Compact MACRO I/O Station

Option	Node(s)	Gate Addresses	Node Transfer Addresses
48-Bit	2	$8800	$C0A1,$C0A2,$C0A3
96-Bit	2,3	$8800	$C0A1,$C0A2,$C0A3
		$8802	$C0A5,$C0A6,$C0A7
144-Bit	2,3,6	$8800	$C0A1,$C0A2,$C0A3
		$8802	$C0A5,$C0A6,$C0A7
		$8804	$C0A9,$C0AA,$C0AB

The data in this application will transfer 48-bits of data per node as specified by MI69. These memory locations could be utilized by pointing an M-variable to the node locations. In your PLC program, these M-variables would be considered the actual input words and actual output words or a combination of the two (8 inputs/8 outputs for 16-bit read/write). To efficiently read and write to these memory locations, Delta Tau suggests using image input words to read the actual input words and then write to the actual output word if the inputs have changed states. The following block diagram shows the typical logic for PMAC's inputs and outputs.



For this application, we are using six 16-bit data transfers and will use the following M-Variable definitions in our application.

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PMAC2 Ultralite Example M-Variable Definitions

```
M980->X:$C0A1,8,16          ;IO word #1, 1st 16 bit word node2
M981->X:$C0A2,8,16          ;IO word #2, 2nd 16 bit word node 2
M982->X:$C0A3,8,16          ;IO word #3, 3rd 16 bit word node 2
M983->X:$C0A5,8,16          ;IO word #1, 1st 16 bit word node 3
M984->X:$C0A6,8,16          ;IO word #2, 2nd 16 bit word node 3
M985->X:$C0A7,8,16          ;IO word #3, 3rd 16 bit word node 3

M1000->X:$0770,8,16         ;Input mirror word #1
M1001->Y:$0770,8,16         ;Input mirror word #2
M1002->X:$0771,8,16         ;Input mirror word #3
M1003->Y:$0771,8,16         ;Output mirror word #1
M1004->X:$0772,8,16         ;Output mirror word #2
M1005->Y:$0772,8,16         ;Output mirror word #3
M1010->X:$0773,8,16         ;Old Image mirror word #1
M1011->Y:$0773,8,16         ;Old Image mirror word #2
M1012->X:$0774,8,16         ;Old Image mirror word #3
```

IO word #1	IO Word #2	IO Word #3
M800->X:$770,8	M816->Y:$770,8	M832->X:$771,8
M801->X:$770,9	M817->Y:$770,9	M833->X:$771,9
M802->X:$770,10	M818->Y:$770,10	M834->X:$771,10
M803->X:$770,11	M819->Y:$770,11	M835->X:$771,11
M804->X:$770,12	M820->Y:$770,12	M836->X:$771,12
M805->X:$770,13	M829->Y:$770,13	M837->X:$771,13
M806->X:$770,14	M822->Y:$770,14	M838->X:$771,14
M807->X:$770,15	M823->Y:$770,15	M839->X:$771,15
M808->X:$770,16	M824->Y:$770,16	M840->X:$771,16
M809->X:$770,17	M825->Y:$770,17	M841->X:$771,17
M810->X:$770,18	M826->Y:$770,18	M842->X:$771,18
M811->X:$770,19	M827->Y:$770,19	M843->X:$771,19
M812->X:$770,20	M828->Y:$770,20	M844->X:$771,20
M813->X:$770,21	M829->Y:$770,21	M845->X:$771,21
M814->X:$770,22	M830->Y:$770,22	M846->X:$771,22
M815->X:$770,23	M831->Y:$770,23	M847->X:$771,23

IO word #4	IO Word #5	IO Word #6
M900->Y:$771,8	M916->X:$772,8	M932->Y:$772,8
M901->Y:$771,9	M917->X:$772,9	M933->Y:$772,9
M902->Y:$771,10	M918->X:$772,10	M934->Y:$772,10
M903->Y:$771,11	M919->X:$772,11	M935->Y:$772,11
M904->Y:$771,12	M920->X:$772,12	M936->Y:$772,12
M905->Y:$771,13	M129->X:$772,13	M937->Y:$772,13
M906->Y:$771,14	M922->X:$772,14	M938->Y:$772,14
M907->Y:$771,15	M923->X:$772,15	M939->Y:$772,15
M908->Y:$771,16	M924->X:$772,16	M940->Y:$772,16
M909->Y:$771,17	M925->X:$772,17	M941->Y:$772,17
M910->Y:$771,18	M926->X:$772,18	M942->Y:$772,18
M911->Y:$771,19	M927->X:$772,19	M943->Y:$772,19
M912->Y:$771,20	M928->X:$772,20	M944->Y:$772,20
M913->Y:$771,21	M129->X:$772,21	M945->Y:$772,21
M914->Y:$771,22	M930->X:$772,22	M946->Y:$772,22
M915->Y:$771,23	M931->X:$772,23	M947->Y:$772,23

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PMAC2 Turbo Ultralite Example M-Variable Definitions

```
M980->X:$78421,8,16          ;IO word #1, 1st 16 bit word node2
M981->X:$78422,8,16          ;IO word #2, 2nd 16 bit word node 2
M982->X:$78423,8,16          ;IO word #3, 3rd 16 bit word node 2
M983->X:$78425,8,16          ;IO word #1, 1st 16 bit word node 3
M984->X:$78426,8,16          ;IO word #2, 2nd 16 bit word node 3
M985->X:$78427,8,16          ;IO word #3, 3rd 16 bit word node 3

M1000->X:$0010F0,8,16        ;Input mirror word #1
M1001->Y:$0010F0,8,16        ;Input mirror word #2
M1002->X:$0010F1,8,16        ;Input mirror word #3
M1003->Y:$0010F1,8,16        ;Output mirror word #1
M1004->X:$0010F2,8,16        ;Output mirror word #2
M1005->Y:$0010F2,8,16        ;Output mirror word #3
M1010->X:$0010F3,8,16        ;Old Image mirror word #1
M1011->Y:$0010F3,8,16        ;Old Image mirror word #2
M1012->X:$0010F4,8,16        ;Old Image mirror word #3
```

IO word #1	IO Word #2	IO Word #3
M800->X:$0010F0,8	M816->Y:$0010F0,8	M832->X:$0010F1,8
M801->X:$0010F0,9	M817->Y:$0010F0,9	M833->X:$0010F1,9
M802->X:$0010F0,10	M818->Y:$0010F0,10	M834->X:$0010F1,10
M803->X:$0010F0,11	M819->Y:$0010F0,11	M835->X:$0010F1,11
M804->X:$0010F0,12	M820->Y:$0010F0,12	M836->X:$0010F1,12
M805->X:$0010F0,13	M829->Y:$0010F0,13	M837->X:$0010F1,13
M806->X:$0010F0,14	M822->Y:$0010F0,14	M838->X:$0010F1,14
M807->X:$0010F0,15	M823->Y:$0010F0,15	M839->X:$0010F1,15
M808->X:$0010F0,16	M824->Y:$0010F0,16	M840->X:$0010F1,16
M809->X:$0010F0,17	M825->Y:$0010F0,17	M841->X:$0010F1,17
M810->X:$0010F0,18	M826->Y:$0010F0,18	M842->X:$0010F1,18
M811->X:$0010F0,19	M827->Y:$0010F0,19	M843->X:$0010F1,19
M812->X:$0010F0,20	M828->Y:$0010F0,20	M844->X:$0010F1,20
M813->X:$0010F0,21	M829->Y:$0010F0,21	M845->X:$0010F1,21
M814->X:$0010F0,22	M830->Y:$0010F0,22	M846->X:$0010F1,22
M815->X:$0010F0,23	M831->Y:$0010F0,23	M847->X:$0010F1,23

IO word #4	IO Word #5	IO Word #6
M900->Y:$0010F1,8	M916->X:$0010F2,8	M932->Y:$0010F2,8
M901->Y:$0010F1,9	M917->X:$0010F2,9	M933->Y:$0010F2,9
M902->Y:$0010F1,10	M918->X:$0010F2,10	M934->Y:$0010F2,10
M903->Y:$0010F1,11	M919->X:$0010F2,11	M935->Y:$0010F2,11
M904->Y:$0010F1,12	M920->X:$0010F2,12	M936->Y:$0010F2,12
M905->Y:$0010F1,13	M129->X:$0010F2,13	M937->Y:$0010F2,13
M906->Y:$0010F1,14	M922->X:$0010F2,14	M938->Y:$0010F2,14
M907->Y:$0010F1,15	M923->X:$0010F2,15	M939->Y:$0010F2,15
M908->Y:$0010F1,16	M924->X:$0010F2,16	M940->Y:$0010F2,16
M909->Y:$0010F1,17	M925->X:$0010F2,17	M941->Y:$0010F2,17
M910->Y:$0010F1,18	M926->X:$0010F2,18	M942->Y:$0010F2,18
M911->Y:$0010F1,19	M927->X:$0010F2,19	M943->Y:$0010F2,19
M912->Y:$0010F1,20	M928->X:$0010F2,20	M944->Y:$0010F2,20
M913->Y:$0010F1,21	M129->X:$0010F2,21	M945->Y:$0010F2,21
M914->Y:$0010F1,22	M930->X:$0010F2,22	M946->Y:$0010F2,22
M915->Y:$0010F1,23	M931->X:$0010F2,23	M947->Y:$0010F2,23

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Example 1: 48 Inputs 48 Outputs Using 3X16-Bit Transfers

For this example, the inputs and outputs are not sharing the same Node Transfer Addresses ($C0A1, $C0A2, $C0A3, $C0A5, $C0A6, and $C0A7). Each of the node transfer address can be defined as 16-bit addresses.

Ultralite (8 Axis)	Turbo Ultralite (8 Axis)	Description
I996=$0FB33F	I6841=$0FB33F	Enable nodes 0,1,2,3,4,5,8,9,12, & 13 at PMAC Ultralite
M980->X:$C0A1,8,16	M980->X:$78421,8,16	IO word #1, 1st 16 bit word node2
M981->X:$C0A2,8,16	M981->X:$78422,8,16	IO word #2, 2nd 16 bit word node 2
M982->X:$C0A3,8,16	M982->X:$78423,8,16	IO word #3, 3rd 16 bit word node 2
M983->X:$C0A5,8,16	M983->X:$78425,8,16	IO word #1, 1st 16 bit word node 3
M984->X:$C0A6,8,16	M984->X:$78426,8,16	IO word #2, 2nd 16 bit word node 3
M985->X:$C0A7,8,16	M985->X:$78427,8,16	IO word #3, 3rd 16 bit word node 3
M1000->X:$0770,8,16	M1000->X:$0010F0,8,16	Input mirror word #1
M1001->Y:$0770,8,16	M1001->Y:$0010F0,8,16	Input mirror word #2
M1002->X:$0771,8,16	M1002->X:$0010F1,8,16	Input mirror word #3
M1003->Y:$0771,8,16	M1003->Y:$0010F1,8,16	Output mirror word #1
M1004->X:$0772,8,16	M1004->X:$0010F2,8,16	Output mirror word #2
M1005->Y:$0772,8,16	M1005->Y:$0010F2,8,16	Output mirror word #3
M1010->X:$0773,8,16	M1010->X:$0010F3,8,16	Old Image mirror word #1
M1011->Y:$0773,8,16	M1011->Y:$0010F3,8,16	Old Image mirror word #2
M1012->X:$0774,8,16	M1012->X:$0010F4,8,16	Old Image mirror word #3

```
MS0,MI69=$20C0A130$8800    sets up macro to transfer data for ACC-9E and 10E
MS0,MI975=$C               enable node 2 and 3 for I/O
MS0,MI19=4                 sets interrupt period for data transfer
MSSAVE0                    ;save to macro station
MS$$$0                     ;reset macro station to enable

OPEN PLC1 CLEAR

M1000=M980                          new input mirror equal to actual input
wordM1001=M981                      new input mirror equal to actual input word
M1002=M982                          new input mirror equal to actual input word

IF (M1000 != M1010) OR (M1001 != M1011)  if inputs change, process outputs

       M1010 = M1000              old input mirror equal to new input mirror
       M1011 = M1001              old input mirror equal to new input mirror
       .
       .
       .              {     Set outputs based on inputs or program logic
       .
       .
       M983 = M1003                        Output word equals Output Mirror Word
       M984 = M1004                        Output word equals Output Mirror Word
       M985 = M1005                        Output word equals Output Mirror Word
ENDIF
CLOSE
```


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Example 2: 48 Inputs 48 Outputs Using 1X24-Bit Transfers

For this example, the inputs and outputs are not sharing the same Node Transfer Address ($C0A0, $C0A4, $C0A8, $C0B0). Each of the node transfer addresses can be defined as 24-bit addresses.

Ultralite (8 Axis)	Turbo Ultralite (8 Axis)	Description
I996=$0FB3FF	I6841=$0FB3FF	Enable nodes 0,1,2,3,4,5,6,7,8,9,12, & 13 at PMAC Ultralite
M970->X:$C0A0,0,24	M970->X:$78420,0,24	IO word #1, 24 bit word node2
M971->X:$C0A4,0,24	M971->X:$78424,0,24	IO word #2, 24 bit word node 3
M972->X:$C0A8,0,24	M972->X:$78428,0,24	IO word #3, 24 bit word node 6
M973->X:$C0B0,0,24	M973->X:$7842C,0,24	IO word #1, 24 bit word node 7
M1000->X:$0770,0,24	M1000->X:$0010F0,0,24	Input mirror word #1
M1001->Y:$0770,0,24	M1001->Y:$0010F0,0,24	Input mirror word #2
M1002->X:$0771,0,24	M1002->X:$0010F1,0,24	Output mirror word #1
M1003->Y:$0771,0,24	M1003->Y:$0010F1,0,24	Output mirror word #2
M1010->X:$0772,0,24	M1010->X:$0010F2,0,24	Old Input mirror word #2
M1011->Y:$0772,0,24	M1011->Y:$0010F2,0,24	Old Input mirror word #3

```
MS0,MI71=$20C0A020$8800    sets up macro to transfer data for ACC-9E and 10E
MS0,MI975=$CC              enable node 2, 3, 6, and 7 for I/O at MACRO Station
MS0,MI19=4                 sets interrupt period for data transfer
MSSAVE0                    ;save to macro station
MS$$$0                     ;reset macro station to enable

OPEN PLC1 CLEAR

M1000=M970                          new input mirror equal to actual input word
M1001=M971                          new input mirror equal to actual input word

IF (M1000 != M1010) OR (M1001 != M1011)  if inputs change, process outputs

       M1010 = M1000              old input mirror equal to new input mirror
       M1011 = M1001              old input mirror equal to new input mirror
       .
       .
       .
       .              {     Set outputs based on inputs or program logic
       .
       .
       M973 = M1002               Output word equals Output Mirror Word
       M974 = M1003               Output word equals Output Mirror Word

ENDIF
CLOSE
```


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Example 3: 36 Inputs 36 Outputs Using 1X72-Bit Transfers

The 72-bit transfer is unique because it allows you to transfer both the 3×16-bit and 1×24-bit transfer in one read/write transfer. This method can only be used with MACRO firmware version 1.112 or higher. Using this method, we only need to activate one node. In this case, we will use node 2.

For this example, the inputs and outputs are sharing the same Node Transfer Address. You will notice address X:$C0A1 has 12-bits of inputs and 4 bits of outputs. To properly write to the 4 output bits, Delta Tau recommends that you write the outputs to the entire word.

Ultralite (8 Axis)	Turbo Ultralite (8 Axis)	Description
I996=$0FB337	I6841=$0FB337	Enable nodes 0,1,2,4,5,8,9,12, & 13 at PMAC Ultralite
M970->X:$C0A0,0,24	M970->X:$78420,0,24	IO word #1, 24 bit word node2
M980->X:$C0A1,8,16	M971->X:$78421,8,16	IO word #1, 1st 16 bit word node2
M981->X:$C0A2,8,16	M972->X:$78422,8,16	IO word #2, 2nd 16 bit word node 2
M982->X:$C0A3,8,16	M973->X:$78423,8,16	IO word #3, 3rd 16 bit word node 2
M1000->X:$0770,0,24	M1000->X:$0010F0,0,24	Input mirror word #1
M1001->Y:$0770,8,12	M1001->Y:$0010F0,8,12	I/O mirror word #2 (12 bits inputs only!)
M1002->Y:$0770,8,16	M1002->Y:$0010F0,8,16	Output mirror word #1 (12 bits inputs & 4 bits outputs)
M1003->X:$0771,8,16	M1003->X:$0010F1,8,16	Output mirror word #2
M1004->Y:$0771,8,16	M1004->Y:$0010F1,8,16	Output mirror word #3
M1010->X:$0771,0,24	M1010->X:$0010F2,0,24	Old Input mirror word #1
M1011->Y:$0771,8,12	M1011->Y:$0010F2,8,12	Old Input mirror word #2

```
MS0,MI169=$00C0A000$8800   sets up macro to transfer data for ACC-11E
MS0,MI975=$4        enable node 2 for I/O
MS0,MI19=4                 sets interrupt period for data transfer
MSSAVE0                    ;save to macro station
MS$$$0              ;reset macro station to enable

OPEN PLC1 CLEAR

M1000=M970                          new input mirror equal to actual input word
M1001=M981&$0FFF                    use only lower 12 bits

IF (M1000 != M1010) OR (M1001 != M1011)  if inputs change, process outputs
       M1010 = M1000              old input mirror equal to new input mirror
       M1011 = M1001              old input mirror equal to new input mirror
       .
       .
       .
       .              {     Set outputs based on inputs or program logic
       .
       .
       M983 = M1001&F000          Output word equals Output Mirror Word Use Only
                                  Upper 4-Bits
       M984 = M1002               Output word equals Output Mirror Word
       M985 = M1003               Output word equals Output Mirror Word
ENDIF
CLOSE
```


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Setting up Control Word for MACRO IO

The Delta Tau IO gate array used on the UMAC IO accessories has the ability to allow any of the 48-bits be used as an input (read) or an output (write). To protect the inputs to be read only the user can define the individual bits as read only on a byte-by-byte basis. This accomplished by writing to the control word of the IO gate.

Each IO gate has eight 8-bit words:
IO word 0 - IO bits 0-7
IO word 1 - IO bits 8-15
IO word 2 - IO bits 16-23
IO word 3 - IO bits 24-31
IO word 4 - IO bits 32-39
IO word 5 - IO bits 40-47
IO word 6 - Data Word
IO word 7 - **Control Word**

IO words 0 through 5 contain the actual IO data. IO word 7 is the control word that allows us to turn any of the IO words into read only bits. The lower 6 bits of the Control Word are used to tell the IO gate whether or not the data in the six IO word bytes are read only or read/write registers. For example, if the user wanted to make IO word 0, IO word 1, and IO word 2 (bits 0-23) read only they would have to set the IO control word equal to 7 (binary 000111).

As of MACRO firmware release 1.16 there are no MI-variables to support direct access to the IO control words. An easy method can be used to write directly to the control word of the IO gate using MI198 and MI199 (place the register you want to read or write to into MI198 and the read or write to that value using MI199). This will usually be done in a one time read PLC at power up.

Base Address from E2 Setting	**Control Word Location**	**MI198 Setting**	**Description**
Y:$8800 ($FFE0*)	Y:$8807,0,8	MI198=$40$8807	Low word – CS10
	Y:$8807,8,8	MI198=$48$8807	Middle word – CS10
	Y:$8807,16,8	MI198=$50$8807	High word – CS10
Y:$8840 ($FFE8*)	Y:$8847,0,8	MI198=$40$8847	Low word – CS12
	Y:$8847,8,8	MI198=$48$8847	Middle word – CS12
	Y:$8847,16,8	MI198=$50$8847	High word – CS12
Y:$8880 ($FFF0*)	Y:$8887,0,8	MI198=$40$8887	Low word – CS14
	Y:$8887,8,8	MI198=$48$8887	Middle word – CS14
	Y:$8887,16,8	MI198=$50$8887	High word – CS14
Y:$88C0	Y:$88C7,0,8	MI198=$40$88C7	Low word – CS16
	Y:$88C7,8,8	MI198=$48$88C7	Middle word – CS16
	Y:$88C7,16,8	MI198=$50$88C7	High word – CS16
* for legacy systems			

Once we have the control word defined to MI198, we can write to the individual bytes associated with the IO gate and make them either read only or read/write (default).

Byte 0	Byte 1	Byte 2	Byte 3	Byte4	Byte 5
Y:$8800,0,8	Y:$8801,0,8	Y:$8802,0,8	Y:$8803,0,8	Y:$8804,0,8	Y:$8805,0,8
Y:$8800,8,8	Y:$8801,8,8	Y:$8802,8,8	Y:$8803,8,8	Y:$8804,8,8	Y:$8805,8,8

Example: MACRO Station has ACC-10E (48 out) and ACC-11E(24in/24out) set to base addresses $8800,0,8 and $8800,8,8 respectively.

```
#define Timer1  I5111      ;plc countdown timer for Turbo Ultralite
;#define Timer1 M70        ;plc countdown timer for Ultralite
```


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```
;M70->X:$0700,0,24,s        ;countdown timer for non-turbo PMAC

Open PLC 10 Clear
Timer1=2000*8388608/I10     ;2 second delay to ensure MACRO
While (Timer1>0)Endwhile    ;Station is powered up properly

CMD"MS0,MI198=$40$8807"     ;set control word for ACC-10E
CMD"MS0,MI199=$00"          ;write $00 into Y:$8807,0,8 (control word)
Timer1=50*8388608/I10       ;50 msec delay
While (Timer1>0) Endwhile

CMD"MS0,MI198=$48$8807"     ;set control word for ACC-11E
CMD"MS0,MI199=$07"          ;write $07 into Y:$8807,8,8 (control word)
Timer1=50*8388608/I10       ;50 msec delay
While (Timer1>0) Endwhile

Disable PLC10

Close
```

APPENDIX – MACRO Legacy Systems

The legacy systems are defined as MACRO CPU with the following part numbers:

- 602804-100
- 602804-101
- 602804-102
- 602804-103
- 602804-104

These systems do not have the extended addressing of the newer model MACRO CPU's (602804-105 through 602804-10A). The addressing scheme for the legacy MACRO systems is listed below.

For Legacy MACRO systems the ACC-9E, ACC-10E, ACC-11E, and ACC-12E will have the following base addess table:

E1-E4: I/O Gate Transfer Jumpers

Jumper	UMAC MACRO
E1	$FFE0
E2	$$FFE8
E3	$FFF0
E4	Not Available

The ACC-65E, ACC-66E, and ACC-67E are not direct replacements for ACC-9E, ACC-10E, and ACC-11E I/O cards. The reason the self-protected I/O is not a direct replacement is because of the addressing scheme. The older I/O cards used the LOW, MIDDLE, and HIGH bytes of a base address and the MACRO I-variables would read consecutive I/O cards in this manner. The self-protected I/O cards are addressed from the LOW bytes only. Because of this, the MACRO I-variables (MI69, MI70, and MI71) were modified to read up to three consecutive base address cards in MACRO firmware version 1.16.

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Chip Select	MACRO Address	Dip Switch SW1 Position					
		6	**5**	**4**	**3**	**2**	**1**
CS 10	$FFE0	OPEN	OPEN	OPEN	OPEN	CLOSE	CLOSE
CS 12	$FFE8	OPEN	OPEN	OPEN	OPEN	CLOSE	OPEN
CS 14	$FFF0	OPEN	OPEN	OPEN	OPEN	OPEN	CLOSE
CS 16	Cannot Use	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN

To use the new IO cards with the older firmware systems, the user can use each of the IO transfer variables (MI69, MI70, MI71) to transfer 48-bits each. The main problem is that the older systems did not have the new extended addressing and the user can only use **three** IO cards per MACRO station.

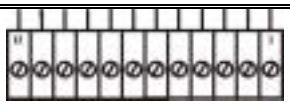
- For systems with only one IO card the user will not have to change anything
- If any of these New IO cards are used with the ACC-9E, ACC-10E, ACC-11E, or ACC-12E, then the user should address the New IO card as the first card (LOW byte) in addressing scheme.

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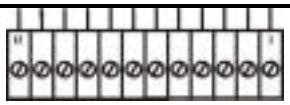
I/O TERMINALS

TB1 Top (12-Pin Terminal Block)

Top View 

Pin #	Symbol	Function	Description	Notes
1	OUT00	Output	Output #1	Sinking/Sourcing*
2	OUT01	Output	Output #2	Sinking/Sourcing*
3	OUT02	Output	Output #3	Sinking/Sourcing*
4	OUT03	Output	Output #4	Sinking/Sourcing*
5	OUT04	Output	Output #5	Sinking/Sourcing*
6	OUT05	Output	Output #6	Sinking/Sourcing*
7	OUT06	Output	Output #7	Sinking/Sourcing*
8	OUT07	Output	Output #8	Sinking/Sourcing*
9	OUT08	Output	Output #9	Sinking/Sourcing*
10	OUT09	Output	Output #10	Sinking/Sourcing*
11	OUT10	Output	Output #11	Sinking/Sourcing*
12	OUT11	Output	Output #12	Sinking/Sourcing*
This terminal block provide the inputs 1-12 for the ACC-9E Input Card				

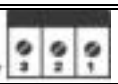
TB2 Top (12-Pin Terminal Block)

Top View 

Pin #	Symbol	Function	Description	Notes
1	OUT12	Output	Output #13	Sinking/Sourcing*
2	OUT13	Output	Output #14	Sinking/Sourcing*
3	OUT14	Output	Output #15	Sinking/Sourcing*
4	OUT15	Output	Output #16	Sinking/Sourcing*
5	OUT16	Output	Output #17	Sinking/Sourcing*
6	OUT17	Output	Output #18	Sinking/Sourcing*
7	OUT18	Output	Output #19	Sinking/Sourcing*
8	OUT19	Output	Output #20	Sinking/Sourcing*
9	OUT20	Output	Output #21	Sinking/Sourcing*
10	OUT21	Output	Output #22	Sinking/Sourcing*
11	OUT22	Output	Output #23	Sinking/Sourcing*
12	OUT23	Output	Output #24	Sinking/Sourcing*
This terminal block provide the inputs 13-24 for the ACC-10E Input Card				

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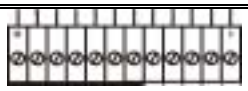
TB3 Top (3-Pin Terminal Block)

Top View 

Pin #	Symbol	Function	Description	Notes
1	GND1	Reference	Reference voltage	
2	V1	Voltage	12-24V	
3	GND1	Reference	Reference voltage	

This terminal block can be used to provide the input reference for the ACC-10E for the first 24 outputs.

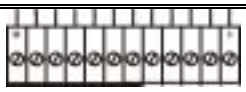
TB1 Bottom (12-Pin Terminal Block)

Top View 

Pin #	Symbol	Function	Description	Notes
1	OUT24	Output	Output #25	Sinking/Sourcing*
2	OUT25	Output	Output #26	Sinking/Sourcing*
3	OUT26	Output	Output #27	Sinking/Sourcing*
4	OUT27	Output	Output #28	Sinking/Sourcing*
5	OUT28	Output	Output #29	Sinking/Sourcing*
6	OUT29	Output	Output #30	Sinking/Sourcing*
7	OUT30	Output	Output #31	Sinking/Sourcing*
8	OUT31	Output	Output #32	Sinking/Sourcing*
9	OUT32	Output	Output #33	Sinking/Sourcing*
10	OUT33	Output	Output #34	Sinking/Sourcing*
11	OUT34	Output	Output #35	Sinking/Sourcing*
12	OUT35	Output	Output #36	Sinking/Sourcing*

This terminal block provide the inputs 25-36 for the ACC-10E Input Card

TB2 Bottom (12-Pin Terminal Block)

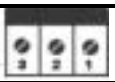
Top View 

Pin #	Symbol	Function	Description	Notes
1	OUT36	Output	Output #37	Sinking/Sourcing*
2	OUT37	Output	Output #38	Sinking/Sourcing*
3	OUT38	Output	Output #39	Sinking/Sourcing*
4	OUT39	Output	Output #40	Sinking/Sourcing*
5	OUT40	Output	Output #41	Sinking/Sourcing*
6	OUT41	Output	Output #42	Sinking/Sourcing*
7	OUT42	Output	Output #43	Sinking/Sourcing*
8	OUT43	Output	Output #44	Sinking/Sourcing*
9	OUT44	Output	Output #45	Sinking/Sourcing*
10	OUT45	Output	Output #46	Sinking/Sourcing*
11	OUT46	Output	Output #47	Sinking/Sourcing*
12	OUT47	Output	Output #48	Sinking/Sourcing*

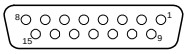
This terminal block provide the inputs 37-48 for the ACC-10E Input Card

*****For sinking outputs use ULN2803A and jumper E10, E11, E12, E13, E14, E15, E16, E17, E18, E19, E20, E21 from 1-2. For sourcing outputs use UDN2981A and jumper E10, E11, E12, E13, E14, E15, E16, E17, E18, E19, E20, E21 from 2-3.

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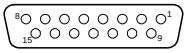
TB3 Bottom (3-Pin Terminal Block)			Top View 	
Pin #	**Symbol**	**Function**	**Description**	**Notes**
1	GND2	Reference	Reference voltage	
2	V2	Voltage	12-24V	
3	GND2	Reference	Reference voltage	
This terminal block can be used to provide the input reference for the ACC-10E for the second 24 outputs				

DB15 Style Connector J1 Top – Outputs 1 through 12

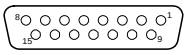
J1 Top Connector			Front View 	
Pin #	**Symbol**	**Function**	**Description**	**Notes**
1	OUT00	Output	Output #1	Sinking/Sourcing*
2	OUT02	Output	Output #3	Sinking/Sourcing*
3	OUT04	Output	Output #5	Sinking/Sourcing*
4	OUT06	Output	Output #7	Sinking/Sourcing*
5	OUT08	Output	Output #9	Sinking/Sourcing*
6	OUT10	Output	Output #11	Sinking/Sourcing*
7	GND1	Reference	Reference voltage	
8	GND1	Reference	Reference voltage	
9	OUT01	Output	Output #2	Sinking/Sourcing*
10	OUT03	Output	Output #4	Sinking/Sourcing*
11	OUT05	Output	Output #6	Sinking/Sourcing*
12	OUT07	Output	Output #8	Sinking/Sourcing*
13	OUT09	Output	Output #10	Sinking/Sourcing*
14	OUT11	Output	Output #12	Sinking/Sourcing*
15	V1	Voltage	12-24V	
*****For sinking outputs use ULN2803A and jumper E10, E11, E12, E13, E14, E15, E16, E17, E18, E19, E20, E21 from 1-2. For sourcing outputs use UDN2981A and jumper E10, E11, E12, E13, E14, E15, E16, E17, E18, E19, E20, E21 from 2-3.				

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DB15 Style Connector J2 Top – Outputs 12 through 24

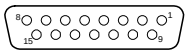
J2 Top Connector			Front View 	
Pin #	**Symbol**	**Function**	**Description**	**Notes**
1	OUT12	Output	Output #13	Sinking/Sourcing*
2	OUT14	Output	Output #15	Sinking/Sourcing*
3	OUT16	Output	Output #17	Sinking/Sourcing*
4	OUT18	Output	Output #19	Sinking/Sourcing*
5	OUT20	Output	Output #21	Sinking/Sourcing*
6	OUT22	Output	Output #23	Sinking/Sourcing*
7	GND1	Reference	Reference voltage	
8	GND1	Reference	Reference voltage	
9	OUT13	Output	Output #14	Sinking/Sourcing*
10	OUT15	Output	Output #16	Sinking/Sourcing*
11	OUT17	Output	Output #18	Sinking/Sourcing*
12	OUT19	Output	Output #20	Sinking/Sourcing*
13	OUT21	Output	Output #22	Sinking/Sourcing*
14	OUT23	Output	Output #24	Sinking/Sourcing*
15	V1	Voltage	12-24V	
*****For sinking outputs use ULN2803A and jumper E10, E11, E12, E13, E14, E15, E16, E17, E18, E19, E20, E21 from 1-2. For sourcing outputs use UDN2981A and jumper E10, E11, E12, E13, E14, E15, E16, E17, E18, E19, E20, E21 from 2-3.				

DB15 Style Connector J1 Bottom – Outputs 25 through 36

J1 Bottom Connector			Front View 	
Pin #	**Symbol**	**Function**	**Description**	**Notes**
1	OUT24	Output	Output #25	Sinking/Sourcing*
2	OUT26	Output	Output #27	Sinking/Sourcing*
3	OUT28	Output	Output #29	Sinking/Sourcing*
4	OUT30	Output	Output #31	Sinking/Sourcing*
5	OUT32	Output	Output #33	Sinking/Sourcing*
6	OUT34	Output	Output #35	Sinking/Sourcing*
7	GND1	Reference	Reference voltage	
8	GND1	Reference	Reference voltage	
9	OUT25	Output	Output #26	Sinking/Sourcing*
10	OUT27	Output	Output #28	Sinking/Sourcing*
11	OUT29	Output	Output #30	Sinking/Sourcing*
12	OUT31	Output	Output #32	Sinking/Sourcing*
13	OUT33	Output	Output #34	Sinking/Sourcing*
14	OUT35	Output	Output #36	Sinking/Sourcing*
15	V1	Voltage	12-24V	
*****For sinking outputs use ULN2803A and jumper E10, E11, E12, E13, E14, E15, E16, E17, E18, E19, E20, E21 from 1-2. For sourcing outputs use UDN2981A and jumper E10, E11, E12, E13, E14, E15, E16, E17, E18, E19, E20, E21 from 2-3.				

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DB15 Style Connector J2 Bottom – Outputs 37 through 48

J2 Bottom Connector			Front View 	
Pin #	**Symbol**	**Function**	**Description**	**Notes**
1	OUT36	Output	Output #37	Sinking/Sourcing*
2	OUT38	Output	Output #39	Sinking/Sourcing*
3	OUT40	Output	Output #41	Sinking/Sourcing*
4	OUT42	Output	Output #43	Sinking/Sourcing*
5	OUT44	Output	Output #45	Sinking/Sourcing*
6	OUT46	Output	Output #47	Sinking/Sourcing*
7	GND	Reference	Reference voltage	
8	GND1	Reference	Reference voltage	
9	OUT37	Output	Output #38	Sinking/Sourcing*
10	OUT39	Output	Output #40	Sinking/Sourcing*
11	OUT41	Output	Output #42	Sinking/Sourcing*
12	OUT43	Output	Output #44	Sinking/Sourcing*
13	OUT45	Output	Output #46	Sinking/Sourcing*
14	OUT47	Output	Output #48	Sinking/Sourcing*
15	V1	Voltage	12-24V	

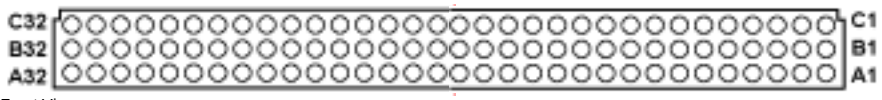
*****For sinking outputs use ULN2803A and jumper E10, E11, E12, E13, E14, E15, E16, E17, E18, E19, E20, E21 from 1-2. For sourcing outputs use UDN2981A and jumper E10, E11, E12, E13, E14, E15, E16, E17, E18, E19, E20, E21 from 2-3.

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UBUS PINOUTS

P1 UBUS (96-Pin Header)



Front View

Pin #	Row A	Row B	Row C
1	+5Vdc	+5Vdc	+5Vdc
2	GND	GND	GND
3	BD01	DAT0	BD00
4	BD03	SEL0	BD02
5	BD05	DAT1	BD04
6	BD07	SEL1	BD06
7	BD09	DAT2	BD08
8	BD11	SEL2	BD10
9	BD13	DAT3	BD12
10	BD15	SEL3	BD14
11	BD17	DAT4	BD16
12	BD19	SEL4	BD18
13	BD21	DAT5	BD20
14	BD23	SEL5	BD22
15	BS1	DAT6	BS0
16	BA01	SEL6	BA00
17	BA03	DAT7	BA02
18	BX/Y	SEL7	BA04
19	CS3-	BA06	CS2-
20	BA05	BA07	CS4-
21	CS12-	BA08	CS10-
22	CS16-	BA09	CS14-
23	BA13	BA10	BA12
24	BRD-	BA11	BWR-
25	BS3	MEMCS0-	BS2
26	WAIT-	MEMCS1-	RESET
27	PHASE+	IREQ1-	SERVO+
28	PHASE-	IREQ2-	SERVO-
29	ANALOG	GND IREQ3-	ANALOG GND
30	-15Vdc	PWRGND	+15Vdc
31	GND	GND	GND
32	+5Vdc	+5Vdc	+5Vdc

For more details about the JEXP, see the UBUS Specification Document.

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