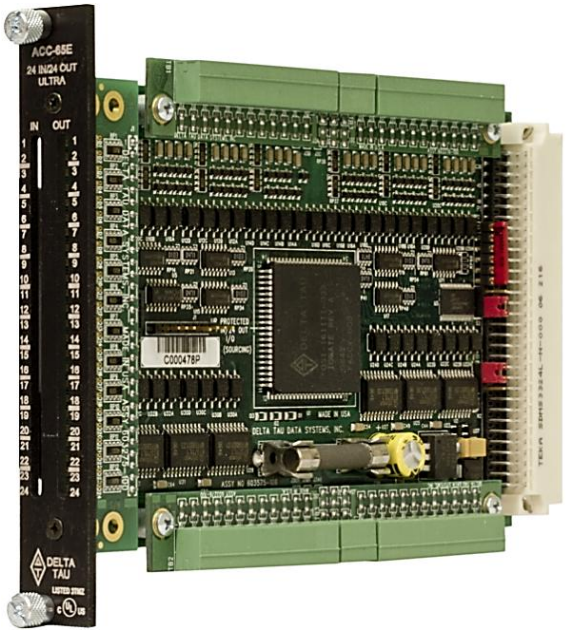
USER MANUAL

Accessory 65E



Digital I/O – Sinking Inputs, Sourcing Outputs

3Ax-603575-xUxx

February 14, 2015

CE cULus

DELTA TAU
Data Systems, Inc.

NEW IDEAS IN MOTION …

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Operating Conditions

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

WARNING

A Warning identifies hazards that could result in personal injury or death. It precedes the discussion of interest.

Caution

A Caution identifies hazards that could result in equipment damage. It precedes the discussion of interest.

Note

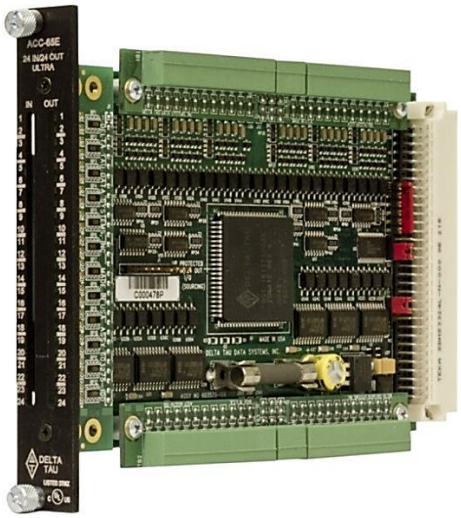
A Note identifies information critical to the understanding or use of the equipment. It follows the discussion of interest.

REVISION HISTORY				
REV.	**DESCRIPTION**	**DATE**	**CHG**	**APPVD**
1	Added CE Declaration	06/07/06	CP	SF
2	Revs. To J1, J2, Pins 8, 15	05/11/07	CP	AO
3	Reformatted Schematics	01/18/08	CP	SF
4	Updated Max Current Output	01/29/08	CP	SM
5	Added UL seal, updated agency approval	10/01/09	CP	SF
6	Added Power PMAC/MACRO Reformatted manual	02/24/14	RN	RN
7	Corrected DIP switch settings	02/03/15	RN	RN

Table of Contents

INTRODUCTION

The accessory 65E (ACC-65E) is a general purpose digital input and output card. It provides 24 inputs and 24 outputs of self-protected, optically isolated sinking inputs and sourcing outputs.



The ACC-65E is a 3U Euro style card intended to plug into the UMAC BUS backplane. It can be used with the:

- Turbo UMAC CPU
- Power UMAC CPU
- MACRO UMAC Station
  (MACRO16 CPU, PMAC2 or PMAC3 Style)

SPECIFICATIONS

Environmental Specifications

Description	Specification	Notes
Operating Temperature	0°C to 45°C	
Storage Temperature	-25°C to 70°C	
Humidity	10% to 95 %	Non-Condensing

Electrical Specifications

Power Requirements

Whether providing the ACC-65E with power from the 3U backplane bus or externally (standalone mode) through TB1, the power requirements (± 10%) are:

+5 V @ 0.38 A (Board Logic Input)
+24 V @ 0.60 A (Per Output Pin)
+24 V @ 8.00 A (Maximum current when using all outputs simultaneously)

Note

TB1 is a 2-pin 5V connector on the base board (used for standalone operation), not to be confused with the 12-pin TB1 connector on either of the I/O mezzanine boards.

Fuse

Manufacturer	Specification	Delta Tau Part Number	
Bussmann	125 V @ 20 A	MDA 20A	

Input Drivers

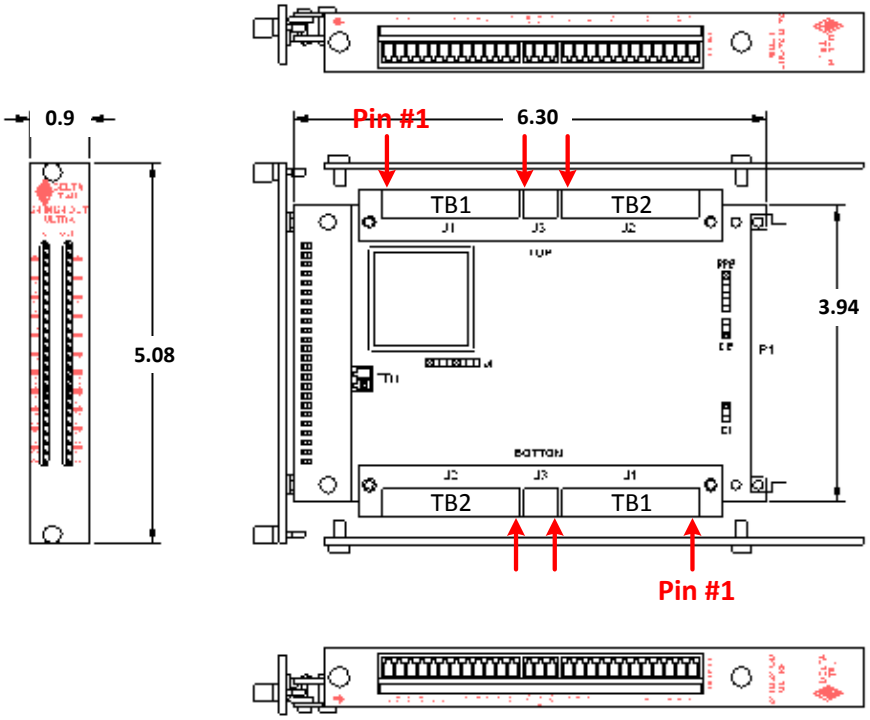
The inputs to the ACC-65E have an activation range from 12V to 24V. Due to the self-protecting circuitry, the inputs can only be configured as sinking.
Although self-protecting, no more than 33VDC should be applied to any I/O pin. This is a limitation of the protective circuitry which includes MMBZ33VALT1 Zener diodes.

Output Drivers

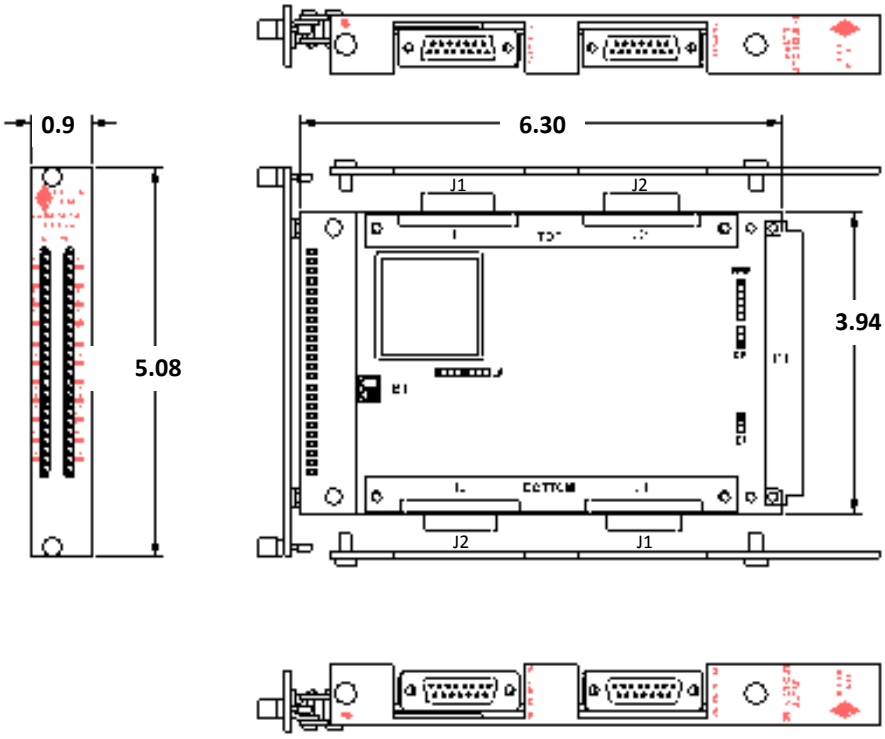
The output drivers use the Diodes Inc. Zetex ZXMS6006DG chip. The current drawn from each output line should be limited to 600 mA at voltage levels between 12 VDC and 24 VDC and no more than 8 Amps total for all outputs simultaneously.

Physical Specifications

Terminal Block Layout



D-Sub Layout



Description	Specification	Notes
Dimensions	Length: 16.256 cm (6.4 in.) Height: 10 cm (3.94 in.) Width: 2.03 cm (0.8 in.)	
Weight w/o Option 1A	180 g	Front Plate included
Terminal Block Connectors	FRONT-MC1,5/12-ST3,81 FRONT-MC1,5/5-ST3,81 FRONT-MC1,5/3-ST3,81	Terminal Blocks from Phoenix Contact. UL 94V-0
DB Option Connectors	DB15 Female	UL 94V-0

Note

The width is the width of the front plate. The length and height are the dimensions of the PCB. See Layout section for physical dimensions.

Agency Approval and Safety

Item	Description
CE Mark	Full Compliance
EMC	EN55011 Class A Group 1 EN61000-3-2 Class A EN61000-3-3 EN61000-4-2 EN61000-4-3 EN61000-4-4 EN61000-4-5 EN61000-4-6 EN61000-4-11
Safety	EN 61010-1
UL	UL 61010-1 File E314517
cUL	CAN/CSA C22.2 No. 1010.1-92 File E314517

Application of Council Directive: 89/336/EEC, 72/23/EEC

Manufacturers Name: Delta Tau Data Systems, Inc.

Manufacturers Address: 21314 Lassen Street
Chatsworth, CA 91311
USA

We, Delta Tau Data Systems, Inc. hereby declare that the product
Product Name: Accessory 65E
Model Number: 603575
And all of its options conforms to the following standards:

EN61326: 1997	Electrical equipment for measurement, control, and laboratory use- EMC requirements
EN55011: 1998	Limits and methods of measurements of radio disturbance characteristics of information technology equipment
EN61010-1	Electrical equipment for measurement, control, and laboratory use- Safety requirements
EN61000-3-2 :1995 A14:1998	Limits for harmonic current emissions. Criteria A
EN61000-3-3: 1995	Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 16A. Criteria B.
EN61000-4-2:1995 A1: 1998	Electro Static Discharge immunity test. Criteria B
EN61000-4-3: 1995 A1: 1998	Radiated, radio-frequency, electromagnetic field immunity test. Criteria A
EN61000-4-4: 1995	Electrical fast transients/burst immunity test. Criteria B
EN61000-4-5: 1995	Surge Test. Criteria B
EN61000-4-6: 1996	Conducted immunity test. Criteria A
EN61000-4-11: 1994	Voltage dips test. Criteria B and C

Date Issued: 11 May 2006
Place Issued: Chatsworth, California USA

Mark of Compliance

CE

ADDRESSING THE ACC-65E

Address Select DIP Switch SW1

The switch SW1 selects the starting address location for the first I/O gate on the ACC-65E. The following table shows the dip switch settings for the Turbo, Power, and MACRO Station settings:

Chip Select	Base Address				SW1 Positions					
	TURBO	MACRO	POWER		6	5	4	3	2	1
			I/O Base Offset	Index ACC-65E[n]						
CS10	Y:$78C00	Y:$8800	$A00000	0	ON	ON	ON	ON	ON	ON
	Y:$79C00	Y:$9800	$A08000	4	ON	ON	ON	**OFF**	ON	ON
	Y:$7AC00	Y:$A800	$A10000	8	ON	ON	**OFF**	ON	ON	ON
	Y:$7BC00	Y:$B800	$A18000	12	ON	ON	**OFF**	**OFF**	ON	ON
CS12	Y:$78D00	Y:$8840	$B00000	1	ON	ON	ON	ON	ON	**OFF**
	Y:$79D00	Y:$9840	$B08000	5	ON	ON	ON	**OFF**	ON	**OFF**
	Y:$7AD00	Y:$A840	$B10000	9	ON	ON	**OFF**	ON	ON	**OFF**
	Y:$7BD00	Y:$B840	$B18000	13	ON	ON	**OFF**	**OFF**	ON	**OFF**
CS14	Y:$78E00	Y:$8880	$C00000	2	ON	ON	ON	ON	**OFF**	ON
	Y:$79E00	Y:$9880	$C08000	6	ON	ON	ON	**OFF**	**OFF**	ON
	Y:$7AE00	Y:$A880	$C10000	10	ON	ON	**OFF**	ON	**OFF**	ON
	Y:$7BE00	Y:$B880	$C18000	14	ON	ON	**OFF**	**OFF**	**OFF**	ON
CS16	Y:$78F00	Y:$88C0	$D00000	3	ON	ON	ON	ON	**OFF**	**OFF**
	Y:$79F00	Y:$98C0	$D08000	7	ON	ON	ON	**OFF**	**OFF**	**OFF**
	Y:$7AF00	Y:$A8C0	$D10000	11	ON	ON	**OFF**	ON	**OFF**	**OFF**
	Y:$7BF00	Y:$B8C0	$D18000	15	ON	ON	**OFF**	**OFF**	**OFF**	**OFF**

Note

ON designates **Closed**. **OFF** designates **Open**. Factory default is all ON.

Legacy MACRO Dip Switch Settings

Chip Select	Base Address (Alternate)	SW1 Positions					
		6	5	4	3	2	1
10	Y:$B800 (Y:$FFE0)	ON (**OFF**)	ON (**OFF**)	**OFF**	**OFF**	ON	ON
12	Y:$B840 (Y:$FFE8)	ON (**OFF**)	ON (**OFF**)	**OFF**	**OFF**	ON	**OFF**
14	Y:$B880 (Y:$FFF0)	ON (**OFF**)	ON (**OFF**)	**OFF**	**OFF**	**OFF**	ON
16	Y:$B8C0 (Y:$FFF8)	ON (**OFF**)	ON (**OFF**)	ON	ON	**OFF**	**OFF**

Note

The Legacy Macro base addresses are double mapped. Set SW1 positions 5 & 6 to OFF if the alternate addressing is desired.

Hardware Address Limitations

Historically, two types of accessory cards have been designed for the UMAC 3U bus type rack: type A and type B cards. They can be sorted out as follows:

Name	Type	Category	Possible Number of Base Addresses	Maximum Number of cards in 1 rack
ACC-9E	A	General I/O	4	10
ACC-10E	A	General I/O	4	
ACC-11E	A	General I/O	4	
ACC-12E	A	General I/O	4	
ACC-53E	B	Feedback	12	12
ACC-57E	B	Feedback	12	
ACC-58E	B	Feedback	12	
ACC-59E	B	Analog I/O	12	
ACC-14E	B	General I/O	16	16
ACC-28E	B	Analog I/O	16	
ACC-36E	B	Analog I/O	16	
ACC-65E	B	General I/O	16	
ACC-66E	B	General I/O	16	
ACC-67E	B	General I/O	16	
ACC-68E	B	General I/O	16	
ACC-84E	B	Feedback	12	12

Addressing Type A and Type B accessory cards in a UMAC or MACRO station rack requires attention to the following set of rules:

Populating Rack with Type A Cards Only (no conflicts)

In this case, the card(s) can potentially use any available Address/Chip Select.

Note

The type A cards have only one base address per chip select (CS10, CS12, and CS14). Each card can be set up (jumper settings) to use the low, middle, or high byte of a specific base address. This makes it possible to populate a single rack with 9 (3 bases x 3 byte locations) Type A accessory cards. A fourth address is available at CS16 in which only the high byte can be used, thus making the maximum 10 Type A accessory cards.

Populating Rack with Type B Cards Only (no conflicts)

In this case, the card(s) can potentially use any available Address/Chip Select.

Populating Rack with Type A & Type B Cards (possible conflicts)

Typically, Type A and Type B cards should not share the same Chip Select. If this configuration is possible, then the following rules apply:

- **Type A and Type B Feedback Cards**
  Type A cards cannot share the same base address as Type B Feedback cards.

- **Type A and Type B General I/O Cards**
  Type A cards can share base addresses with Type B general I/O cards; however, in this case, Type B cards naturally use the lower byte (default), and Type A cards must be set to the middle/high byte of the selected base address.

- **Type A Cards and Type B Analog Cards**
  Type A cards can share base addresses with Type B analog I/O cards; however, in this case, Type B cards naturally use the middle/high bytes (default), so Type A cards should be set to the low byte of the selected base address.

Note

The above conflicts only occur with the first base address in each Chip Select of the Type B cards (i.e. $78C00, $78D00, $78E00, and $78F00). Conflicts can more simply be avoided by using only the second to fourth addresses of each Chip Select.

USING THE ACC-65E WITH POWER UMAC

Using the ACC-65E with Power UMAC requires:

- Knowing and configuring the index (address offset) of the card
- Declaring pointers, with user given names, to the appropriate I/O structure elements

Declaring Pointers to I/O Structure Elements

Mapping an ACC-65E at index 0, for example, with user configurable pointer names:

Inputs

```
PTR Input1->ACC65E[0].DataReg[0].0.1;
PTR Input2->ACC65E[0].DataReg[0].1.1;
PTR Input3->ACC65E[0].DataReg[0].2.1;
PTR Input4->ACC65E[0].DataReg[0].3.1;
PTR Input5->ACC65E[0].DataReg[0].4.1;
PTR Input6->ACC65E[0].DataReg[0].5.1;
PTR Input7->ACC65E[0].DataReg[0].6.1;
PTR Input8->ACC65E[0].DataReg[0].7.1;

PTR Input9->ACC65E[0].DataReg[1].0.1;
PTR Input10->ACC65E[0].DataReg[1].1.1;
PTR Input11->ACC65E[0].DataReg[1].2.1;
PTR Input12->ACC65E[0].DataReg[1].3.1;
PTR Input13->ACC65E[0].DataReg[1].4.1;
PTR Input14->ACC65E[0].DataReg[1].5.1;
PTR Input15->ACC65E[0].DataReg[1].6.1;
PTR Input16->ACC65E[0].DataReg[1].7.1;

PTR Input17->ACC65E[0].DataReg[2].0.1;
PTR Input18->ACC65E[0].DataReg[2].1.1;
PTR Input19->ACC65E[0].DataReg[2].2.1;
PTR Input20->ACC65E[0].DataReg[2].3.1;
PTR Input21->ACC65E[0].DataReg[2].4.1;
PTR Input22->ACC65E[0].DataReg[2].5.1;
PTR Input23->ACC65E[0].DataReg[2].6.1;
PTR Input24->ACC65E[0].DataReg[2].7.1;
```

Outputs

```
PTR Output1->ACC65E[0].DataReg[3].0.1;
PTR Output2->ACC65E[0].DataReg[3].1.1;
PTR Output3->ACC65E[0].DataReg[3].2.1;
PTR Output4->ACC65E[0].DataReg[3].3.1;
PTR Output5->ACC65E[0].DataReg[3].4.1;
PTR Output6->ACC65E[0].DataReg[3].5.1;
PTR Output7->ACC65E[0].DataReg[3].6.1;
PTR Output8->ACC65E[0].DataReg[3].7.1;

PTR Output9->ACC65E[0].DataReg[4].0.1;
PTR Output10->ACC65E[0].DataReg[4].1.1;
PTR Output11->ACC65E[0].DataReg[4].2.1;
PTR Output12->ACC65E[0].DataReg[4].3.1;
PTR Output13->ACC65E[0].DataReg[4].4.1;
PTR Output14->ACC65E[0].DataReg[4].5.1;
PTR Output15->ACC65E[0].DataReg[4].6.1;
PTR Output16->ACC65E[0].DataReg[4].7.1;

PTR Output17->ACC65E[0].DataReg[5].0.1;
PTR Output18->ACC65E[0].DataReg[5].1.1;
PTR Output19->ACC65E[0].DataReg[5].2.1;
PTR Output20->ACC65E[0].DataReg[5].3.1;
PTR Output21->ACC65E[0].DataReg[5].4.1;
PTR Output22->ACC65E[0].DataReg[5].5.1;
PTR Output23->ACC65E[0].DataReg[5].6.1;
PTR Output24->ACC65E[0].DataReg[5].7.1;
```

Typically, these pointers would be put in a “Global Includes” file.

Note

To switch/add definitions to a different card, change the ACC65E[0] to ACC65E[**n**], where **n** is the card index set by the dip switch settings.

Note

With Power PMAC, the control word is set up automatically by the firmware with **ACC65E[n].CtrlReg** = 7.

USING THE ACC-65E WITH TURBO UMAC

Using the ACC-65E with Turbo UMAC requires:

- Knowing (configuring) the base address of the card
- Pointing M-Variables to the appropriate I/O memory locations
- Configuring the control word

Assigning M-Variables to I/O Memory Locations

Mapping an ACC-65E at $78C00, for example, with user configurable M-Variable numbers and name substitutions:

Inputs

```
#define Input1  M7001  Input1->Y:$078C00,0,1
#define Input2  M7002  Input2->Y:$078C00,1,1
#define Input3  M7003  Input3->Y:$078C00,2,1
#define Input4  M7004  Input4->Y:$078C00,3,1
#define Input5  M7005  Input5->Y:$078C00,4,1
#define Input6  M7006  Input6->Y:$078C00,5,1
#define Input7  M7007  Input7->Y:$078C00,6,1
#define Input8  M7008  Input8->Y:$078C00,7,1

#define Input9  M7009  Input9->Y:$078C01,0,1
#define Input10 M7010  Input10->Y:$078C01,1,1
#define Input11 M7011  Input11->Y:$078C01,2,1
#define Input12 M7012  Input12->Y:$078C01,3,1
#define Input13 M7013  Input13->Y:$078C01,4,1
#define Input14 M7014  Input14->Y:$078C01,5,1
#define Input15 M7015  Input15->Y:$078C01,6,1
#define Input16 M7016  Input16->Y:$078C01,7,1

#define Input17 M7017  Input17->Y:$078C02,0,1
#define Input18 M7018  Input18->Y:$078C02,1,1
#define Input19 M7019  Input19->Y:$078C02,2,1
#define Input20 M7020  Input20->Y:$078C02,3,1
#define Input21 M7021  Input21->Y:$078C02,4,1
#define Input22 M7022  Input22->Y:$078C02,5,1
#define Input23 M7023  Input23->Y:$078C02,6,1
#define Input24 M7024  Input24->Y:$078C02,7,1
```

Outputs

```
#define Output1  M7025  Output1->Y:$078C03,0,1
#define Output2  M7026  Output2->Y:$078C03,1,1
#define Output3  M7027  Output3->Y:$078C03,2,1
#define Output4  M7028  Output4->Y:$078C03,3,1
#define Output5  M7029  Output5->Y:$078C03,4,1
#define Output6  M7030  Output6->Y:$078C03,5,1
#define Output7  M7031  Output7->Y:$078C03,6,1
#define Output8  M7032  Output8->Y:$078C03,7,1

#define Output9  M7033  Output9->Y:$078C04,0,1
#define Output10 M7034  Output10->Y:$078C04,1,1
#define Output11 M7035  Output11->Y:$078C04,2,1
#define Output12 M7036  Output12->Y:$078C04,3,1
#define Output13 M7037  Output13->Y:$078C04,4,1
#define Output14 M7038  Output14->Y:$078C04,5,1
#define Output15 M7039  Output15->Y:$078C04,6,1
#define Output16 M7040  Output16->Y:$078C04,7,1

#define Output17 M7041  Output17->Y:$078C05,0,1
#define Output18 M7042  Output18->Y:$078C05,1,1
#define Output19 M7043  Output19->Y:$078C05,2,1
#define Output20 M7044  Output20->Y:$078C05,3,1
#define Output21 M7045  Output21->Y:$078C05,4,1
#define Output22 M7046  Output22->Y:$078C05,5,1
#define Output23 M7047  Output23->Y:$078C05,6,1
#define Output24 M7048  Output24->Y:$078C05,7,1
```

Note

To address a different card, replace the **xx** digits in the address locations $07**xx**00 to $07**xx**05 to correspond to the base address configured by the dip switch settings.

Configuring the Control Word

With Turbo PMAC, the control word must be set to 7. This is done by writing (once on power-up) to the control register which is at base address + 7, bits [7:0].

```
M7000->Y:$078C07,0,8   // For base address $78C00

Open PLC 1 Clear
M7000 = 7
Disable PLC 1
Close
```

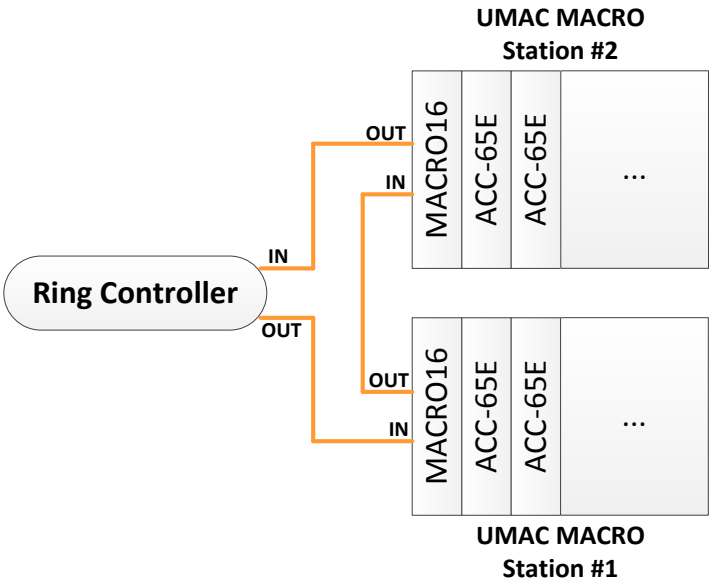
USING THE ACC-65E WITH MACRO

In a MACRO configuration, the ACC-65E resides typically in a UMAC MACRO Station with a MACRO8 (legacy) or MACRO16 CPU.

The ring controller can be either a Turbo or a Power PMAC.

- Turbo PMAC ring controllers:
  Turbo Brick family
  Turbo UMAC with ACC-5E
  Turbo UltraLite

- Power PMAC ring controllers:
  Power Brick family
  Power UMAC with ACC-5E
  Power UMAC with ACC-5E3
  Power EtherLite



Generally, the user's goal is to transfer the ACC-65E I/O data (48 bits per card) from/to the ring controller by reading the 24-bits of inputs and writing to the 24-bits of outputs.

This I/O data transfer is accomplished using I/O nodes; therefore, it is essential to know:

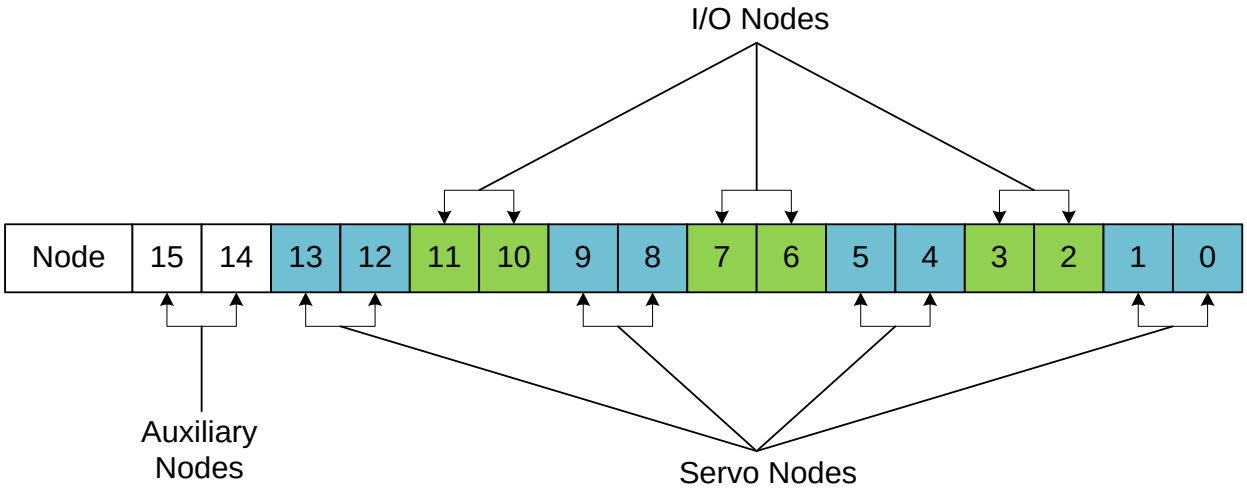
- Which I/O nodes are used
- Which MACRO station I/O node addresses correspond to which Ring Controller I/O node addresses

MACRO16 I/O Node Addressing

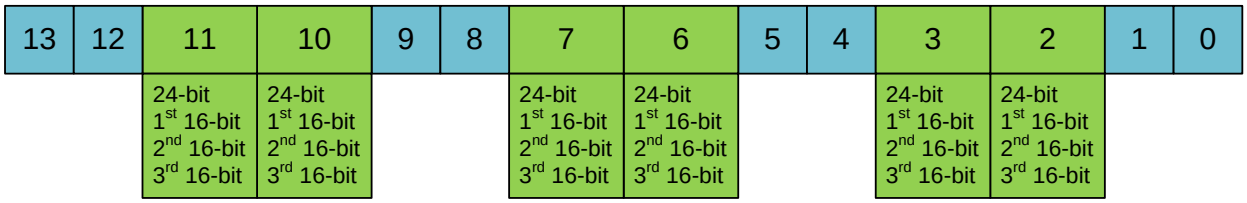
A MACRO IC consists of a number of auxiliary, servo, and I/O nodes:

- Auxiliary nodes are Master/Control registers and are for internal firmware use.
- Servo nodes carry information such as feedback, commands, and flags for motor control.
- I/O nodes are by default unoccupied and are configurable for transferring miscellaneous data.

The MACRO16 CPU is populated with two PMAC2 style MACRO ICs, each consisting of 16 nodes: 2 auxiliary, 8 servo, and 6 I/O nodes (the legacy MACRO8 has only one IC).



Each I/O node consists of one 24-bit and three 16-bit (upper) data registers:



Note

The MACRO8 CPU is populated with only 1 PMAC2 Style MACRO IC (IC# 0).

The I/O node data register addresses ($C0XX) for the two MACRO ICs on a station are:

	MACRO Station IC #0					
Node	**2**	**3**	**6**	**7**	**10**	**11**
24-bit	X:$C0A0	X:$C0A4	X:$C0A8	X:$C0AC	X:$C0B0	X:$C0B4
16-bit	X:$C0A1	X:$C0A5	X:$C0A9	X:$C0AD	X:$C0B1	X:$C0B5
16-bit	X:$C0A2	X:$C0A6	X:$C0AA	X:$C0AE	X:$C0B2	X:$C0B6
16-bit	X:$C0A3	X:$C0A7	X:$C0AB	X:$C0AF	X:$C0B3	X:$C0B7

	MACRO Station IC #1					
Node	**2**	**3**	**6**	**7**	**10**	**11**
24-bit	X:$C0E0	X:$C0E4	X:$C0E8	X:$C0EC	X:$C0F0	X:$C0F4
16-bit	X:$C0E1	X:$C0E5	X:$C0E9	X:$C0ED	X:$C0F1	X:$C0F5
16-bit	X:$C0E2	X:$C0E6	X:$C0EA	X:$C0EE	X:$C0F2	X:$C0F6
16-bit	X:$C0E3	X:$C0E7	X:$C0EB	X:$C0EF	X:$C0F3	X:$C0F7

Note

I/O nodes which will be chosen to transfer the ACC-65E(s) data are configurable and chosen by the user depending on availability and I/O node management in the MACRO station.

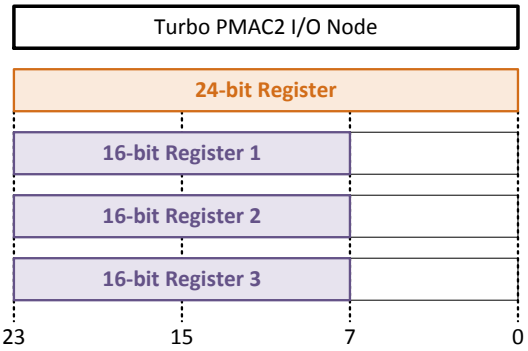
Note

Non-Turbo PMAC2 Ultralite (legacy) I/O node addresses are the same as MACRO Station IC# 0 node registers. For instance, addresses on the ring controller start at $C0A0, instead of at $78420 as seen in the following section.

Ring Controller I/O Node Addressing

Turbo PMAC2 I/O Node Addressing

Turbo ring controllers interface with PMAC2 Style MACRO ICs. The data resides in the bit fields illustrated on the right:



Turbo ring controllers can be populated with up to 4 PMAC2 style MACRO ICs (reported by **I4902**). Below are the I/O node addresses ($7XXXX) for each of the PMAC2 Style MACRO ICs:

	Turbo Ring Controller MACRO IC #0 Node Registers					
Station I/O Node#	**2**	**3**	**6**	**7**	**10**	**11**
Ring Controller I/O Node#	**2**	**3**	**6**	**7**	**10**	**11**
24-bit	X:$78420	X:$78424	X:$78428	X:$7842C	X:$78430	X:$78434
16-bit	X:$78421	X:$78425	X:$78429	X:$7842D	X:$78431	X:$78435
16-bit	X:$78422	X:$78426	X:$7842A	X:$7842E	X:$78432	X:$78436
16-bit	X:$78423	X:$78427	X:$7842B	X:$7842F	X:$78433	X:$78437

	Turbo Ring Controller MACRO IC #1 Node Registers					
Station I/O Node#	**2**	**3**	**6**	**7**	**10**	**11**
Ring Controller I/O Node#	**18**	**19**	**22**	**23**	**26**	**27**
24-bit	X:$79420	X:$79424	X:$79428	X:$7942C	X:$79430	X:$79434
16-bit	X:$79421	X:$79425	X:$79429	X:$7942D	X:$79431	X:$79435
16-bit	X:$79422	X:$79426	X:$7942A	X:$7942E	X:$79432	X:$79436
16-bit	X:$79423	X:$79427	X:$7942B	X:$7942F	X:$79433	X:$79437

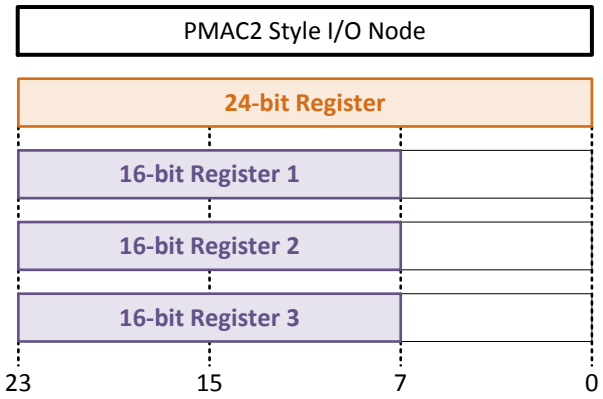
	Turbo Ring Controller MACRO IC #2 Node Registers					
Station I/O Node#	**2**	**3**	**6**	**7**	**10**	**11**
Ring Controller I/O Node#	**34**	**35**	**38**	**39**	**42**	**43**
24-bit	X:$7A420	X:$7A424	X:$7A428	X:$7A42C	X:$7A430	X:$7A434
16-bit	X:$7A421	X:$7A425	X:$7A429	X:$7A42D	X:$7A431	X:$7A435
16-bit	X:$7A422	X:$7A426	X:$7A42A	X:$7A42E	X:$7A432	X:$7A436
16-bit	X:$7A423	X:$7A427	X:$7A42B	X:$7A42F	X:$7A433	X:$7A437

	Turbo Ring Controller MACRO IC #3 Node Registers					
Station I/O Node#	**2**	**3**	**6**	**7**	**10**	**11**
Ring Controller I/O Node#	**50**	**51**	**54**	**55**	**58**	**59**
24-bit	X:$7B420	X:$7B424	X:$7B428	X:$7B42C	X:$7B430	X:$7B434
16-bit	X:$7B421	X:$7B425	X:$7B429	X:$7B42D	X:$7B431	X:$7B435
16-bit	X:$7B422	X:$7B426	X:$7B42A	X:$7B42E	X:$7B432	X:$7B436
16-bit	X:$7B423	X:$7B427	X:$7B42B	X:$7B42F	X:$7B433	X:$7B437

Power PMAC2 I/O Node Addressing

The Power PMAC can interface with the ACC-5E which carries PMAC2 Style MACRO ICs.

The PMAC2 Style MACRO IC I/O node data registers reside in the bit fields illustrated on the right:



And the corresponding structure elements:

Structure Element	Data Register
Gate2[*i*].Macro[*j*][0]	24 bits
Gate2[*i*].Macro[j][1]	16 bits
Gate2[*i*].Macro[*j*][2]	16 bits
Gate2[*i*].Macro[*j*][3]	16 bits

Where:

- ***i*** is the PMAC2 Style MACRO IC index
- ***j*** is the I/O node number.

Note

Bitwise mapping, into the PMAC2 Style MACRO structure elements requires Power PMAC firmware version **1.5.8.215** or newer.

The tables below show I/O Node numbers of the 4 PMAC2 Style MACRO ICs:

	Gate2[**0**]					
Station I/O Node#	2	3	6	7	10	11
Ring Controller I/O Node [*j*]	**2**	**3**	**6**	**7**	**10**	**11**

	Gate2[**1**]					
Station I/O Node#	2	3	6	7	11	12
Ring Controller I/O Node [*j*]	**18**	**19**	**22**	**23**	**26**	**27**

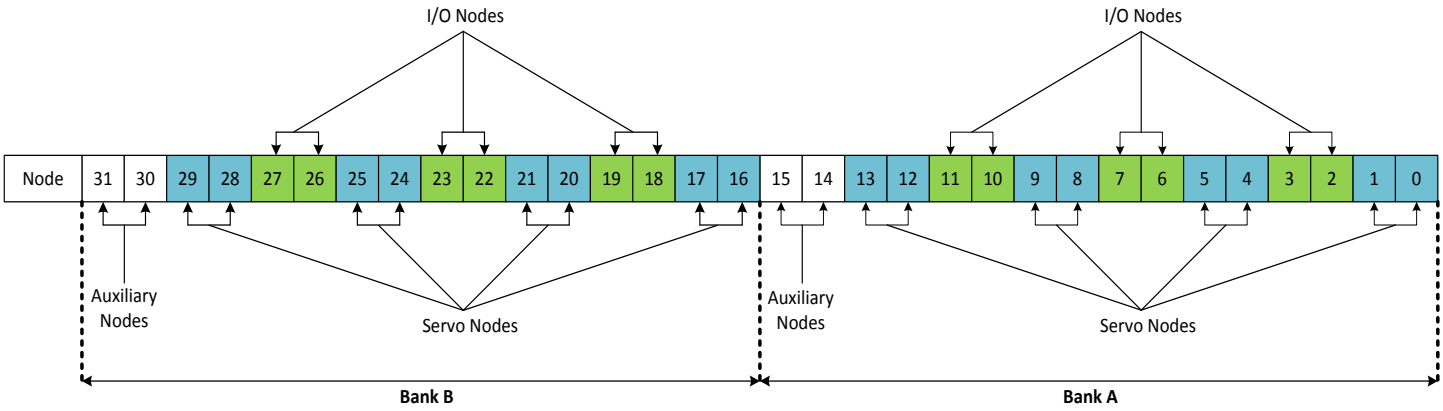
	Gate2[**2**]					
Station I/O Node#	2	3	6	7	10	11
Ring Controller I/O Node [*j*]	**34**	**35**	**38**	**39**	**42**	**43**

	Gate2[**3**]					
Station I/O Node#	2	3	6	7	11	12
Ring Controller I/O Node [*j*]	**50**	**51**	**54**	**55**	**58**	**59**

Power PMAC3 I/O Node Addressing

A PMAC3 style MACRO IC consists of 32 nodes: 4 auxiliary, 16 servo, and 12 I/O nodes. One or more of these ICs can be found in the following hardware:

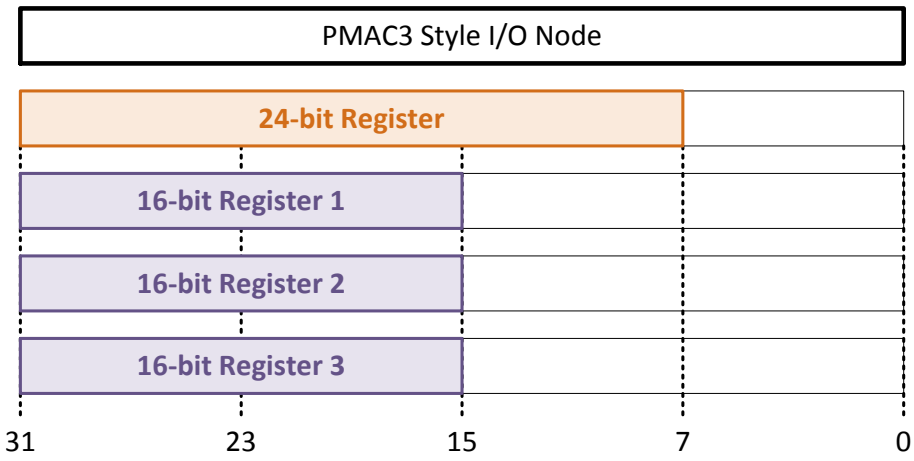
- Power Brick Family
- Power UMAC with ACC-5E3
- Power EtherLite



Note

The Power PMAC can have up to 16 PMAC3 Style MACRO ICs. ICs present are reported by the variable **Macro.IC3s**.

A PMAC3 Style MACRO IC I/O node consists of 4 data registers: 1 x 24-bit and 3 x 16-bit residing in the following bit fields:



With the PMAC3 Style MACRO ICs, the I/O node data registers are typically accessed using structure elements, which can be inputs or outputs for either bank:

Bank B		Bank A		Data Register
Inputs	**Outputs**	**Inputs**	**Outputs**	
Gate3[*i*].MacroInB[*j*][0]	Gate3[*i*].MacroOutB[*j*][0]	Gate3[*i*].MacroInA[*j*][0]	Gate3[*i*].MacroOutA[*j*][0]	24-bit
Gate3[*i*].MacroInB[*j*][1]	Gate3[*i*].MacroOutB[*j*][1]	Gate3[*i*].MacroInA[*j*][1]	Gate3[*i*].MacroOutA[*j*][1]	1st 16-bit
Gate3[*i*].MacroInB[*j*][2]	Gate3[*i*].MacroOutB[*j*][2]	Gate3[*i*].MacroInA[*j*][2]	Gate3[*i*].MacroOutA[*j*][2]	2nd 16-bit
Gate3[*i*].MacroInB[*j*][3]	Gate3[*i*].MacroOutB[*j*][3]	Gate3[*i*].MacroInA[*j*][3]	Gate3[*i*].MacroOutA[*j*][3]	3rd 16-bit

Where:
- ***i*** is the PMAC3 Style MACRO IC index
- ***j*** is the I/O node number.

Note

Bitwise mapping into the PMAC3 Style MACRO structure elements requires Power PMAC firmware version **1.5.8.215** or newer.

Below are example tables showing I/O Node numbers of the first 4 PMAC3 Style MACRO ICs:

	Gate3[0]											
	Bank A						Bank B					
Station Node#	2	3	6	7	10	11	2	3	6	7	11	12
Ring Controller I/O Node **[*j*]**	**2**	**3**	**6**	**7**	**10**	**11**	**18**	**19**	**22**	**23**	**26**	**27**

	Gate3[1]											
	Bank A						Bank B					
Station Node#	2	3	6	7	10	11	2	3	6	7	11	12
Ring Controller I/O Node **[*j*]**	**34**	**35**	**38**	**39**	**42**	**43**	**50**	**51**	**54**	**55**	**58**	**59**

	Gate3[2]											
	Bank A						Bank B					
Station Node#	2	3	6	7	10	11	2	3	6	7	11	12
Ring Controller I/O Node **[*j*]**	**66**	**67**	**70**	**71**	**74**	**75**	**82**	**83**	**86**	**87**	**90**	**91**

	Gate3[3]											
	Bank A						Bank B					
Station Node#	2	3	6	7	10	11	2	3	6	7	11	12
Ring Controller I/O Node **[*j*]**	**98**	**99**	**102**	**103**	**106**	**107**	**114**	**115**	**118**	**119**	**122**	**123**

Configuring MACRO I/O Transfers

Having set up the following:

- Ring Controller MACRO communication for ASCII and MS commands
  I6840 with Turbo PMAC2
  Gate2[i].MacroMode with Power PMAC2
  Gate3[i].MacroModeA and **Gate3[i].MacroModeB** with Power PMAC3

- MACRO Station MACRO communication for ASCII and MS commands
  MI996

- Enabled the chosen I/O nodes on the ring controller
  I6841 with Turbo PMAC2
  Gate2[i].MacroEnable with Power PMAC2
  Gate3[i].MacroEnableA and **Gate3[i].MacroEnableB** with Power PMAC3

- Enabled the corresponding I/O nodes on the MACRO station IC
  MS{anynode},MI975
  Typically, masked with the enabled I/O node(s) E.g. MS2,MI975=$4 enables transfers using I/O node number 2.

- Set up the I/O Data Transfer Period
  MS{anynode},MI19
  Typically = 4

The ACC-65E(s) I/O data should now be available to transfer to/from the ring controller.

Each ACC-65E possesses 48 bits (24 in/24 out) of data to be transferred. Depending on the number of cards in the MACRO station and I/O nodes available, one or more of the following methods can be used, stated in the order of simplicity:

- **MS{anynode},MI160**
  48-bit transfer into a 1 x 24-bit data register (uses 1 x I/O node)

- **MS{anynode},MI71**
  48-bit transfer into 2 x 24-bit data registers (uses 2 x I/O nodes)

- **MS{anynode},MI69/MI70**
  48-bit transfer into 3 x 16-bit data registers (uses 1 x I/O nodes)

Note

{anynode} refers to any activated node on a particular MACRO IC.

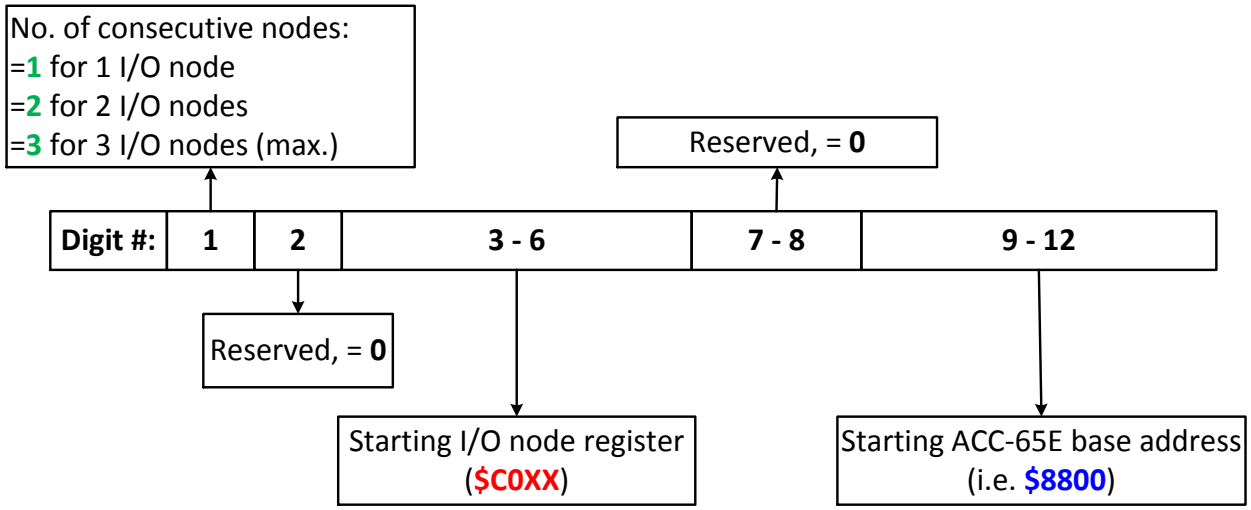
Note

MS{anynode},MI160 requires MACRO16 CPU firmware 1.204 or newer.

MS{anynode},MI160

MI160 transfers all 48 bits (24 in, 24 out) of an ACC-65E into a single read/write 24-bit data register. It handles up to 3 x ACC-65Es at consecutive base addresses (e.g. Y:$8800, Y:$9800, Y:$A800) and places the data in 3 x consecutive 24-bit data registers.

MI160 is a 48-bit variable represented as 12 hexadecimal digits which are set up as follows (digit #1 is leftmost when constructing the word):



Note

MI160 requires MACRO16 CPU firmware ~1.204 or higher.

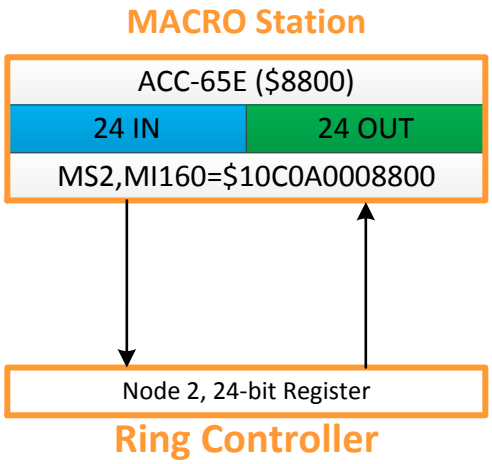
Note

For multiple ACC-65E transfers with MI160, consecutive cards must be under the same chip select.

MI160 example 1

Transferring I/O data for one ACC-65E at address $8800 over node 2 of MACRO IC 0:

```
MS2,MI19=4                      // Data transfer period [msec]
MS2,MI160=$10C0A0008800         // MI160 transfer
MS2,MI975=$4                    // Enable Mask I/O node 2
```



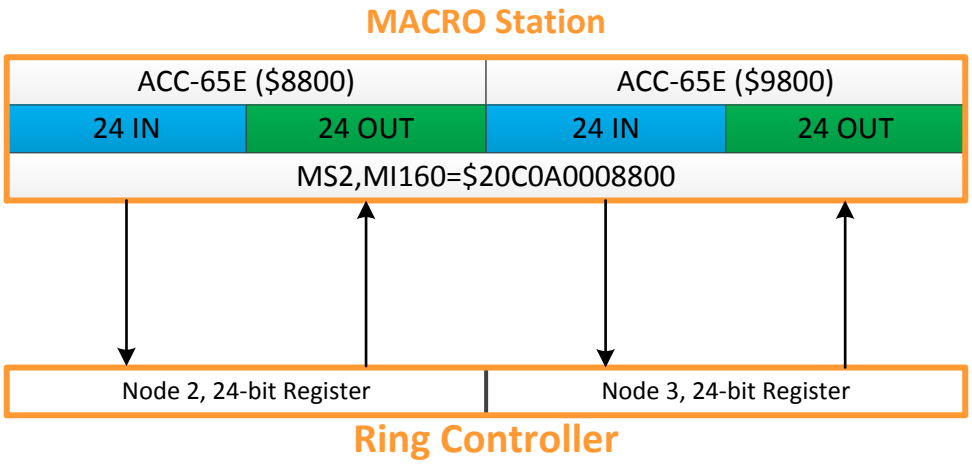
Having downloaded the above settings into the MACRO16 station, the inputs can be read and outputs can be transferred from the ring controller side (I/O node 2) in the following bit fields:

	Turbo		**Power**			
	I/O Node Address	Data Bits	Structure Element (PMAC2)	Data Bits	Structure Element (PMAC3)	Data Bits
Inputs	X:$78420	**23:00**	Gate2[0].Macro[2][0]	**23:00**	Gate3[0].MacroInA[2][0]	**31:08**
Outputs					Gate3[0].MacroOutA[2][0]	

MI160 example 2

Transferring I/O data for two ACC-65Es at consecutive base addresses $8800 and $9800 over nodes 2 and 3 of MACRO IC 0:

```
MS2,MI19=4
MS2,MI160=$20C0A0008800
MS2,MI975=$C
```



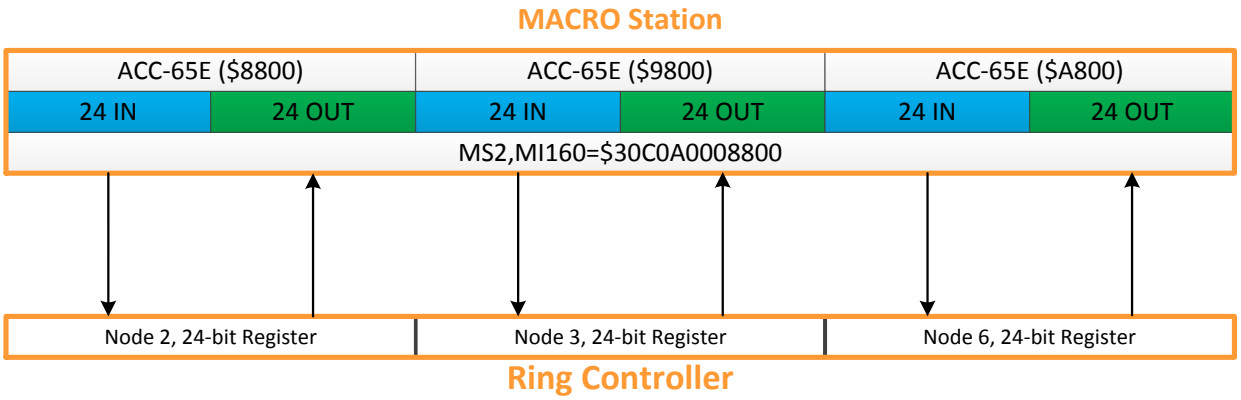
Having downloaded the above settings into the MACRO16 station, the inputs can be read and outputs can be transferred from the ring controller side (I/O nodes 2 and 3) in the following bit fields:

		Turbo		**Power**			
		I/O Node Address	Data Bits	Structure Element (PMAC2)	Data Bits	Structure Element (PMAC3)	Data Bits
1st ACC-65E	**Inputs**	X:$78420	**23:00**	Gate2[0].Macro[2][0]	**23:00**	Gate3[0].MacroInA[2][0]	**31:08**
	Outputs					Gate3[0].MacroOutA[2][0]	
2nd ACC-65E	**Inputs**	X:$78424	**23:00**	Gate2[0].Macro[3][0]	**23:00**	Gate3[0].MacroInA[3][0]	**31:08**
	Outputs					Gate3[0].MacroOutA[3][0]	

MI160 example 3

Transferring I/O data for three ACC-65Es at consecutive base addresses $8800, $9800, and $A800 over nodes 2, 3, and 6:

```
MS2,MI19=4
MS2,MI160=$30C0A0008800
MS2,MI975=$4C
```



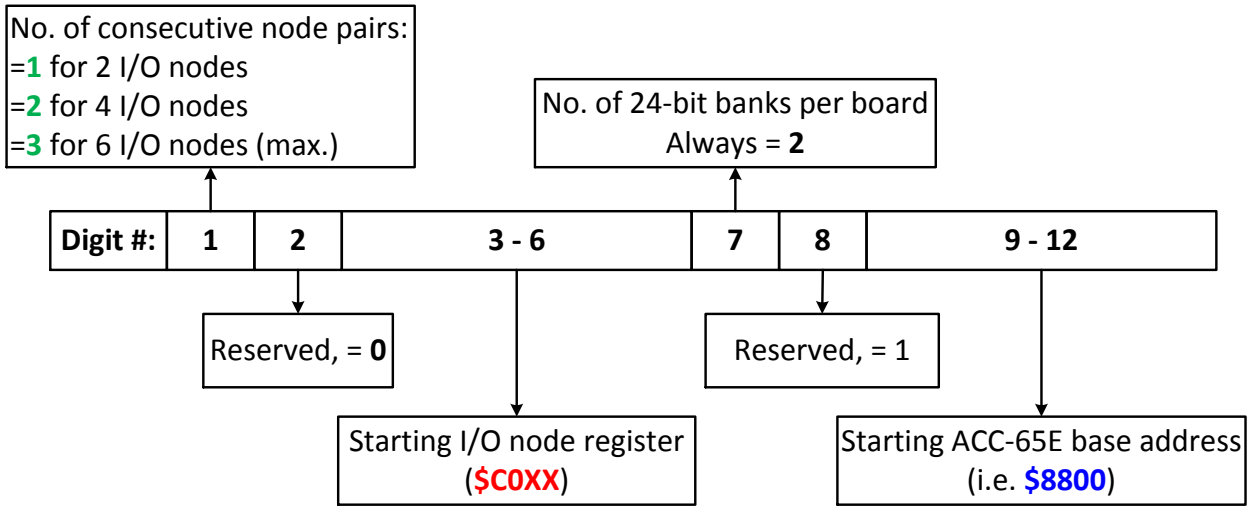
Having downloaded the above settings into the MACRO16 station, the inputs can be read and outputs can be transferred from the ring controller side (I/O nodes 2, 3, and 6) in the following bit fields:

		Turbo		**Power**			
		I/O Node Address	Data Bits	Structure Element (PMAC2)	Data Bits	Structure Element (PMAC3)	Data Bits
1st ACC-65E	**Inputs**	X:$78420	**23:00**	Gate2[0].Macro[2][0]	**23:00**	Gate3[0].MacroInA[2][0]	**31:08**
	Outputs					Gate3[0].MacroOutA[2][0]	
2nd ACC-65E	**Inputs**	X:$78424	**23:00**	Gate2[0].Macro[3][0]	**23:00**	Gate3[0].MacroInA[3][0]	**31:08**
	Outputs					Gate3[0].MacroOutA[3][0]	
3rd ACC-65E	**Inputs**	X:$78428	**23:00**	Gate2[0].Macro[6][0]	**23:00**	Gate3[0].MacroInA[6][0]	**31:08**
	Outputs					Gate3[0].MacroOutA[6][0]	

MS{anynode},MI71

MI71 transfers all 48 bits (24 in, 24 out) of an ACC-65E into 2 x consecutive I/O node 24-bit data registers. It handles up to 3 x ACC-65Es at consecutive base addresses (e.g. Y:$8800, Y:$8900, Y:$8A00), and places the data in 6 x consecutive 24-bit I/O node data registers.

MI71 is a 48-bit variable represented as 12 hexadecimal digits which are set up as follows (digit #1 is leftmost when constructing the word):



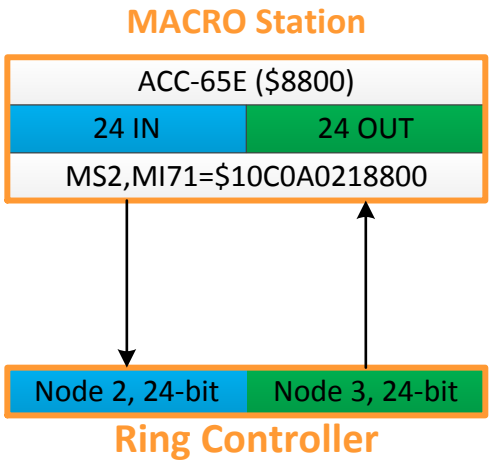
Note

For multiple ACC-65E transfers with MI71, consecutive cards must be under the same chip select.

MI71 example 1

Transferring I/O data for one ACC-65E at address $8800 over nodes 2 and 3 of MACRO IC 0:

```
MS2,MI19=4
MS2,MI71=$10C0A0218800
MS2,MI975=$C
```



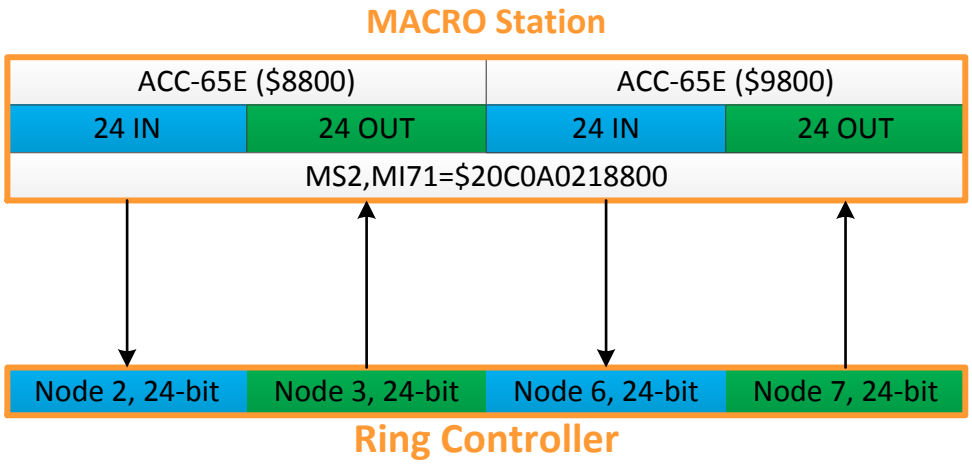
Having downloaded the above settings into the MACRO16 station, the inputs and outputs are now available to access from the ring controller side (e.g. I/O nodes 2, 3) in the following bit fields:

	Turbo		**Power**			
	I/O Node Address	Data Bits	Structure Element (PMAC2)	Data Bits	Structure Element (PMAC3)	Data Bits
Inputs	X:$78420	**23:00**	Gate2[0].Macro[2][0]	**23:00**	Gate3[0].MacroInA[2][0]	**31:08**
Outputs	X:$78424	**23:00**	Gate2[0].Macro[3][0]	**23:00**	Gate3[0].MacroOutA[3][0]	**31:08**

MI71 example 2

Transferring I/O data for two ACC-65Es at consecutive base addresses $8800 and $8900 over nodes 2, 3, 6, and 7 of MACRO IC 0:

```
MS2,MI19=4
MS2,MI71=$20C0A0218800
MS2,MI975=$CC
```



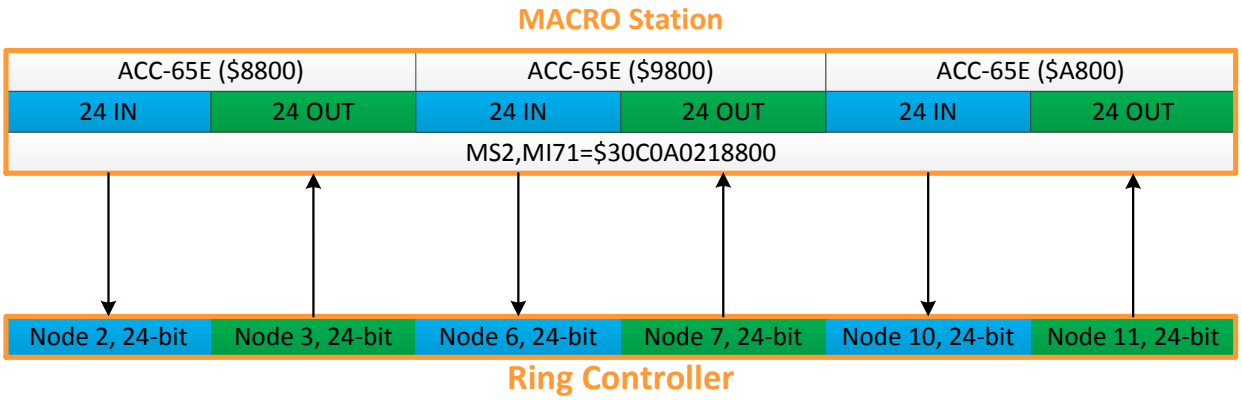
Having downloaded the above settings into the MACRO16 station, the inputs and outputs are now available to access from the ring controller side (e.g. I/O nodes 2, 3, 6, and 7) in the following bit fields:

		Turbo		**Power**			
		I/O Node Address	Data Bits	Structure Element (PMAC2)	Data Bits	Structure Element (PMAC3)	Data Bits
1st ACC-65E	**Inputs**	X:$78420	**23:00**	Gate2[0].Macro[2][0]	**23:00**	Gate3[0].MacroInA[2][0]	**31:08**
	Outputs	X:$78424	**23:00**	Gate2[0].Macro[3][0]	**23:00**	Gate3[0].MacroOutA[3][0]	**31:08**
2nd ACC-65E	**Inputs**	X:$78428	**23:00**	Gate2[0].Macro[6][0]	**23:00**	Gate3[0].MacroInA[6][0]	**31:08**
	Outputs	X:$7842C	**23:00**	Gate2[0].Macro[7][0]	**23:00**	Gate3[0].MacroOutA[7][0]	**31:08**

MI71 example 3

Transferring I/O data for three ACC-65Es at consecutive base addresses $8800, $9800, and $A800 over nodes 2, 3, 6, 7, 10, and 11:

```
MS2,MI19=4
MS2,MI71=$30C0A0218800
MS2,MI975=$CCC
```



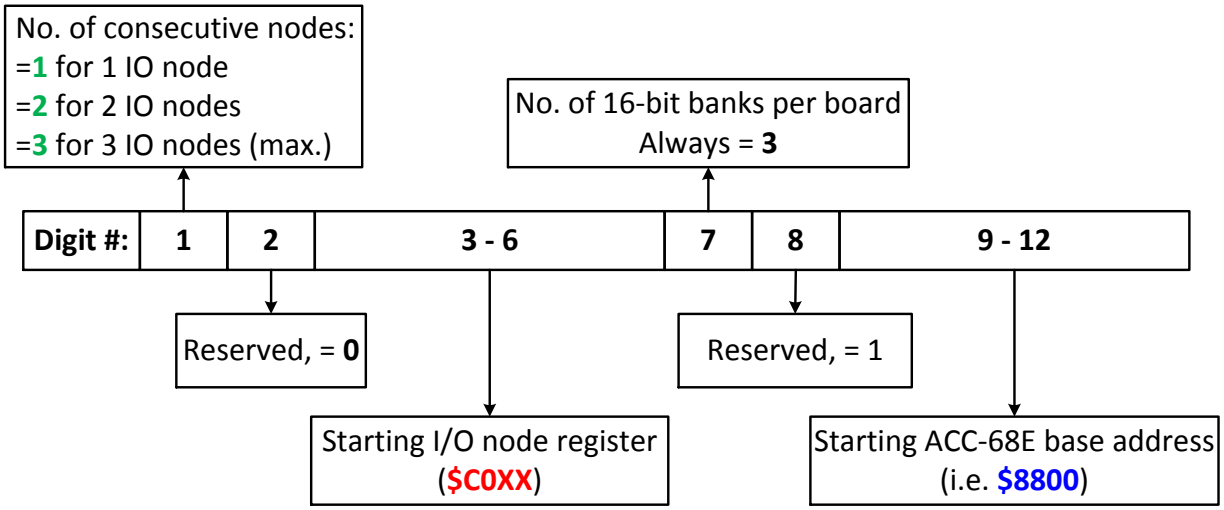
Having downloaded the above settings into the MACRO16 station, the inputs and outputs are now available to access on the ring controller side (I/O nodes 2, 3, 6, 7, 10, and 11) in the following bit fields:

		Turbo		**Power**			
		I/O Node Address	Data Bits	Structure Element (PMAC2)	Data Bits	Structure Element (PMAC3)	Data Bits
1st ACC-65E	**Inputs**	X:$78420	**23:00**	Gate2[0].Macro[2][0]	**23:00**	Gate3[0].MacroInA[2][0]	**31:08**
	Outputs	X:$78424	**23:00**	Gate2[0].Macro[3][0]	**23:00**	Gate3[0].MacroOutA[3][0]	**31:08**
2nd ACC-65E	**Inputs**	X:$78428	**23:00**	Gate2[0].Macro[6][0]	**23:00**	Gate3[0].MacroInA[6][0]	**31:08**
	Outputs	X:$7842C	**23:00**	Gate2[0].Macro[7][0]	**23:00**	Gate3[0].MacroOutA[7][0]	**31:08**
3rd ACC-65E	**Inputs**	X:$78430	**23:00**	Gate2[0].Macro[10][0]	**23:00**	Gate3[0].MacroInA[10][0]	**31:08**
	Outputs	X:$78434	**23:00**	Gate2[0].Macro[11][0]	**23:00**	Gate3[0].MacroOutA[11][0]	**31:08**

MS{anynode},MI69/MI70

MI69/MI70 transfers all 48 bits (24 in, 24 out) of an ACC-65E into 3 x I/O node 16-bit data registers. It handles up to 3 x ACC-65Es at consecutive base addresses (e.g. Y:$8800, Y:$8900, Y:$8A00), and places the data in 9 x consecutive 16-bit I/O node data registers.

MI69/70 are 48-bit variables represented as 12 hexadecimal digits which are set up as follows (digit #1 is leftmost when constructing the word):



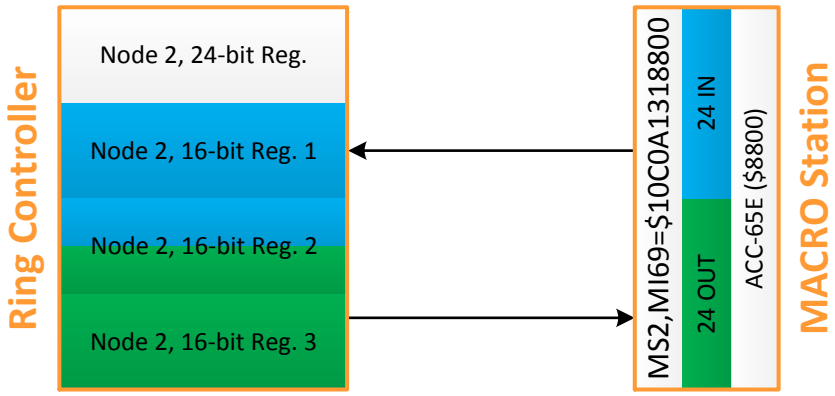
Note

For multiple ACC-65E transfers with MI69/MI70, consecutive cards must be under the same chip select.

MI69/70 example 1

Transferring I/O data for one ACC-65E at address $8800 over node 2 of MACRO IC 0:

```
MS2,MI19=4
MS2,MI69=$10C0A1318800
MS2,MI975=$4
```



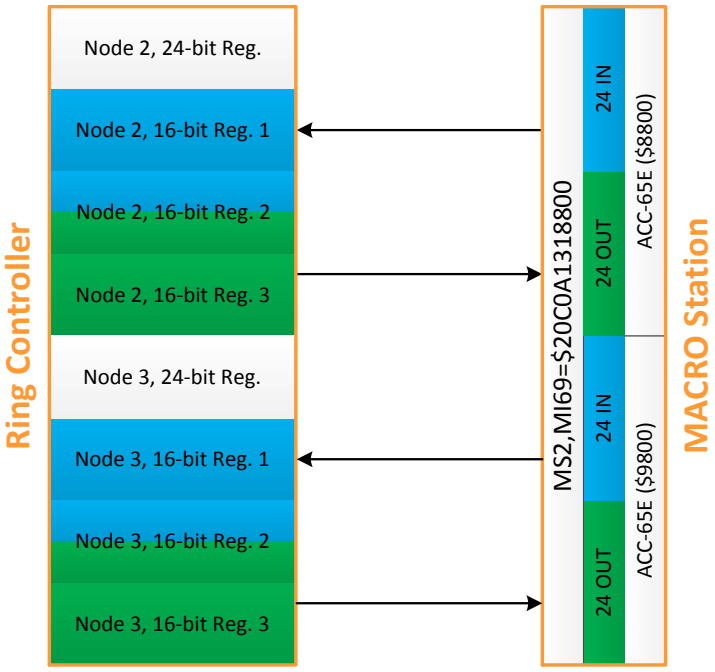
Having downloaded the above settings into the MACRO16 station, the inputs and outputs are now available to access on the ring controller side (I/O node 2) in the following bit fields:

	Turbo		**Power**			
	I/O Node Address	Data Bits	Structure Element (PMAC2)	Data Bits	Structure Element (PMAC3)	Data Bits
Inputs	X:$78421	**23:08**	Gate2[0].Macro[2][1]	**23:08**	Gate3[0].MacroInA[2][1]	**31:16**
	X:$78422	**15:08**	Gate2[0].Macro[2][2]	**15:08**	Gate3[0].MacroInA[2][2]	**23:16**
Outputs	X:$78422	**23:16**	Gate2[0].Macro[2][2]	**23:16**	Gate3[0].MacroOutA[2][2]	**31:24**
	X:$78423	**23:08**	Gate2[0].Macro[2][3]	**23:08**	Gate3[0].MacroOutA[2][3]	**31:16**

MI69/70 example 2

Transferring I/O data for two ACC-65Es at consecutive base addresses $8800 and $9800 over nodes 2 and 3 of MACRO IC 0:

```
MS2,MI19=4
MS2,MI69=$20C0A1318800
MS2,MI975=$C
```



Having downloaded the above settings into the MACRO16 station, the inputs and outputs are now available to access on the ring controller side (I/O nodes 2 and 3) in the following bit fields:

		Turbo		Power			
		I/O Node Address	Data Bits	Structure Element (PMAC2)	Data Bits	Structure Element (PMAC3)	Data Bits
1st ACC-65E	Inputs	X:$78421	23:08	Gate2[0].Macro[2][1]	23:08	Gate3[0].MacroInA[2][1]	31:16
		X:$78422	16:08	Gate2[0].Macro[2][2]	16:08	Gate3[0].MacroInA[2][2]	23:16
	Outputs	X:$78422	23:16	Gate2[0].Macro[2][2]	23:16	Gate3[0].MacroOutA[2][2]	31:24
		X:$78423	23:08	Gate2[0].Macro[2][3]	23:08	Gate3[0].MacroOutA[2][3]	31:16
2nd ACC-65E	Inputs	X:$78425	23:08	Gate2[0].Macro[3][1]	23:08	Gate3[0].MacroInA[3][1]	31:16
		X:$78426	15:08	Gate2[0].Macro[3][2]	15:08	Gate3[0].MacroInA[3][2]	23:16
	Outputs	X:$78426	23:16	Gate2[0].Macro[3][2]	23:16	Gate3[0].MacroOutA[3][2]	31:24
		X:$78427	23:08	Gate2[0].Macro[3][3]	23:08	Gate3[0].MacroOutA[3][3]	31:16

Accessing the Transferred Data

Having transferred the ACC-65E I/O data to and from the MACRO station and into the ring controller's registers mentioned above, bitwise mapping is the final step.

- With the PMAC2 style MACRO IC:
  The inputs can be bitwise mapped and read.
  The output state is not reported, and writing to two separate bits simultaneously (without using the full word) is not possible, thus an image word is required.

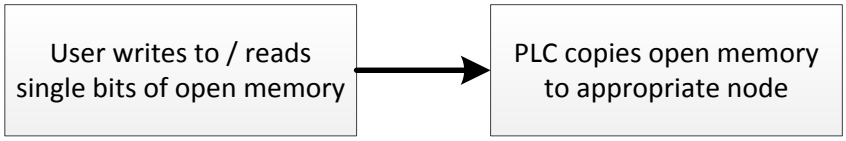
- With the PMAC3 style MACRO IC:
  The inputs can be bitwise mapped and read.
  The outputs can be directly bitwise mapped, written to, and reported.

Outputs Mirror Image Concept

A mirror image is a memory location on the ring controller, typically open or scratch memory that mimics the state of the ACC-65E outputs (residing in the MACRO station). This can be done in a PLC program. The following are recommended memory registers to use:

- Turbo PMAC Open Memory Registers (24 bits) **$10F0-$10FF** (X and Y)

- Power PMAC Open Memory Registers (32 bits), unsigned **Sys.Udata[*i*]**
  Use Sys.Udata[1], Sys.Udata[2], Sys.Udata[3]…



Bitwise mapping to user memory structure elements in Power PMAC is not allowed. Explicit syntax with offset address must be used. The offset address is found by multiplying the element structure index by 4. To the right is an example of the first 4 unsigned open memory structure elements and their corresponding address offsets:

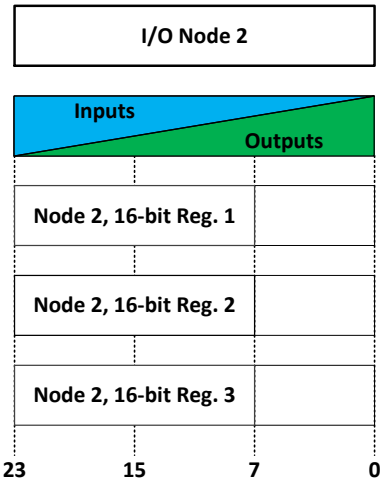
Structure Element	Address Offset
Sys.Udata[1]	U.USER:4
Sys.Udata[2]	U.USER: 8
Sys.Udata[3]	U.USER:12
Sys.Udata[4]	U.USER:16

Note

A large number of self-addressed (default **Sys.pushm**) pointers in Power PMAC use **Sys.Udata[0]**; therefore, it is highly advised NOT to use it as a general purpose user memory.

Turbo PMAC2 MI160 Mapping Example

MI160 is used to transfer ACC-65E data through MACRO IC 0 node 2 of the ring controller, which places the 24 bits of inputs and 24 bits of outputs in the same 24-bit data register:



The inputs are mapped into the 24-bit register of node 2

```
#define Input1  M7001    Input1->X:$78420,0,1
#define Input2  M7002    Input2->X:$78420,1,1
#define Input3  M7003    Input3->X:$78420,2,1
#define Input4  M7004    Input4->X:$78420,3,1
#define Input5  M7005    Input5->X:$78420,4,1
#define Input6  M7006    Input6->X:$78420,5,1
#define Input7  M7007    Input7->X:$78420,6,1
#define Input8  M7008    Input8->X:$78420,7,1
#define Input9  M7009    Input9->X:$78420,8,1
#define Input10 M7010    Input10->X:$78420,9,1
#define Input11 M7011    Input11->X:$78420,10,1
#define Input12 M7012    Input12->X:$78420,11,1
#define Input13 M7013    Input13->X:$78420,12,1
#define Input14 M7014    Input14->X:$78420,13,1
#define Input15 M7015    Input15->X:$78420,14,1
#define Input16 M7016    Input16->X:$78420,15,1
#define Input17 M7017    Input17->X:$78420,16,1
#define Input18 M7018    Input18->X:$78420,17,1
#define Input19 M7019    Input19->X:$78420,18,1
#define Input20 M7020    Input20->X:$78420,19,1
#define Input21 M7021    Input21->X:$78420,20,1
#define Input22 M7022    Input22->X:$78420,21,1
#define Input23 M7023    Input23->X:$78420,22,1
#define Input24 M7024    Input24->X:$78420,23,1
```

The outputs require an image word.
We will use **Y:$10FF** (24 bits) open memory register; therefore, the bitwise mapping of the outputs should point to the open memory.

```
#define Output1  M7025  Output1->Y:$10FF,0,1
#define Output2  M7026  Output2->Y:$10FF,1,1
#define Output3  M7027  Output3->Y:$10FF,2,1
#define Output4  M7028  Output4->Y:$10FF,3,1
#define Output5  M7029  Output5->Y:$10FF,4,1
#define Output6  M7030  Output6->Y:$10FF,5,1
#define Output7  M7031  Output7->Y:$10FF,6,1
#define Output8  M7032  Output8->Y:$10FF,7,1
#define Output9  M7033  Output9->Y:$10FF,8,1
#define Output10 M7034  Output10->Y:$10FF,9,1
#define Output11 M7035  Output11->Y:$10FF,10,1
#define Output12 M7036  Output12->Y:$10FF,11,1
#define Output13 M7037  Output13->Y:$10FF,12,1
#define Output14 M7038  Output14->Y:$10FF,13,1
#define Output15 M7039  Output15->Y:$10FF,14,1
#define Output16 M7040  Output16->Y:$10FF,15,1
#define Output17 M7041  Output17->Y:$10FF,16,1
#define Output18 M7042  Output18->Y:$10FF,17,1
#define Output19 M7043  Output19->Y:$10FF,18,1
#define Output20 M7044  Output20->Y:$10FF,19,1
#define Output21 M7045  Output21->Y:$10FF,20,1
#define Output22 M7046  Output22->Y:$10FF,21,1
#define Output23 M7047  Output23->Y:$10FF,22,1
#define Output24 M7048  Output24->Y:$10FF,23,1
```

The following mirror image PLC (which should be executing constantly) will copy the outputs into node 2:

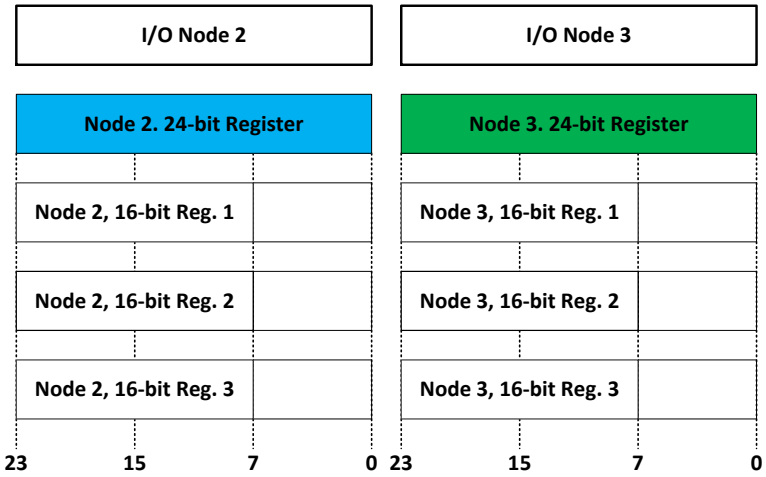
```
#define N2Twenty4      M7049   ; Node 2, 24-bit data register
#define OutMirror      M7050   ; Mirror word, open memory

N2Twenty4->Y:$78420,0,24       ; Node 2, 24-bit data register
OutMirror->Y:$10FF,0,24        ; Open memmory register
OutMirror = 0                  ; Save/Initialize to zero or desired state

Open PLC 1 Clear
N2Twenty4 = OutMirror          ; Update data register
Close
```

Note

The output states are now reported and can now be toggled individually using the bitwise assignments to the open memory register.

Turbo PMAC2 MI71 Mapping Example

MI71 is used to transfer ACC-65E data through MACRO IC 0 nodes 2 and 3 of the ring controller, which places the 24 bits of inputs in the 24-bit register of node 2 and the 24 bits of outputs in the 24-bit register of node 3:



The inputs are mapped into the 24-bit register of node 2

```
#define Input1  M7001   Input1->X:$78420,0,1
#define Input2  M7002   Input2->X:$78420,1,1
#define Input3  M7003   Input3->X:$78420,2,1
#define Input4  M7004   Input4->X:$78420,3,1
#define Input5  M7005   Input5->X:$78420,4,1
#define Input6  M7006   Input6->X:$78420,5,1
#define Input7  M7007   Input7->X:$78420,6,1
#define Input8  M7008   Input8->X:$78420,7,1
#define Input9  M7009   Input9->X:$78420,8,1
#define Input10 M7010   Input10->X:$78420,9,1
#define Input11 M7011   Input11->X:$78420,10,1
#define Input12 M7012   Input12->X:$78420,11,1
#define Input13 M7013   Input13->X:$78420,12,1
#define Input14 M7014   Input14->X:$78420,13,1
#define Input15 M7015   Input15->X:$78420,14,1
#define Input16 M7016   Input16->X:$78420,15,1
#define Input17 M7017   Input17->X:$78420,16,1
#define Input18 M7018   Input18->X:$78420,17,1
#define Input19 M7019   Input19->X:$78420,18,1
#define Input20 M7020   Input20->X:$78420,19,1
#define Input21 M7021   Input21->X:$78420,20,1
#define Input22 M7022   Input22->X:$78420,21,1
#define Input23 M7023   Input23->X:$78420,22,1
#define Input24 M7024   Input24->X:$78420,23,1
```

The outputs require an image word.
We will use **Y:$10FF** (24 bits) open memory register (to copy the 24 bits of node 3); therefore, the bitwise mapping of the outputs should point to the open memory.

```
#define Output1  M7025  Output1->Y:$10FF,0,1
#define Output2  M7026  Output2->Y:$10FF,1,1
#define Output3  M7027  Output3->Y:$10FF,2,1
#define Output4  M7028  Output4->Y:$10FF,3,1
#define Output5  M7029  Output5->Y:$10FF,4,1
#define Output6  M7030  Output6->Y:$10FF,5,1
#define Output7  M7031  Output7->Y:$10FF,6,1
#define Output8  M7032  Output8->Y:$10FF,7,1
#define Output9  M7033  Output9->Y:$10FF,8,1
#define Output10 M7034  Output10->Y:$10FF,9,1
#define Output11 M7035  Output11->Y:$10FF,10,1
#define Output12 M7036  Output12->Y:$10FF,11,1
#define Output13 M7037  Output13->Y:$10FF,12,1
#define Output14 M7038  Output14->Y:$10FF,13,1
#define Output15 M7039  Output15->Y:$10FF,14,1
#define Output16 M7040  Output16->Y:$10FF,15,1
#define Output17 M7041  Output17->Y:$10FF,16,1
#define Output18 M7042  Output18->Y:$10FF,17,1
#define Output19 M7043  Output19->Y:$10FF,18,1
#define Output20 M7044  Output20->Y:$10FF,19,1
#define Output21 M7045  Output21->Y:$10FF,20,1
#define Output22 M7046  Output22->Y:$10FF,21,1
#define Output23 M7047  Output23->Y:$10FF,22,1
#define Output24 M7048  Output24->Y:$10FF,23,1
```

The following mirror image PLC (which should be executing constantly) will copy the outputs into node 3:

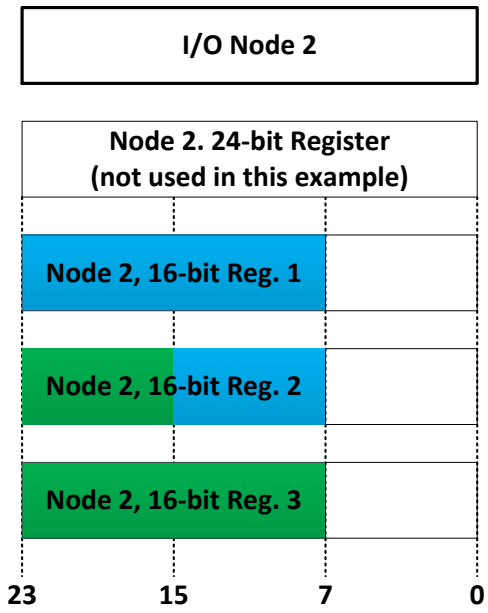
```
#define N3Twenty4      M7049          ; Node 3, 24-bit register
#define OutMirror      M7050          ; Mirror word, open memory

N3Twenty4->Y:$78424,0,24      ; 24-bit register, node 3
OutMirror->Y:$10FF,0,24               ; Open memmory register
OutMirror = 0                 ; Save/Initialize to zero or desired state

Open PLC 1 Clear
N3Twenty4 = OutMirror         ; Update data register
Close
```

Note

The output states are now reported and can be toggled individually using the bitwise assignments to the open memory register.

Turbo PMAC2 MI69/70 Mapping Example

MI69 / MI70 is used to transfer ACC-66E data through MACRO IC 0 node 2 of the ring controller, which places the data in registers as illustrated on the right:



The lower 16 bits of the 24 bits of inputs reside in the first 16-bit register, and the upper 8 bits of the 24 bits of inputs reside in the lower byte of the second 16-bit register.

The lower 8 bits of the 24 bits of outputs reside in the upper byte of the second 16-bit register, and the upper 16 bits of the 24 bits of outputs reside in the third 16-bit register.

The inputs are mapped into 16-bit registers of node 2:

```
#define Input1  M7001   Input1->X:$78421,8,1
#define Input2  M7002   Input2->X:$78421,9,1
#define Input3  M7003   Input3->X:$78421,10,1
#define Input4  M7004   Input4->X:$78421,11,1
#define Input5  M7005   Input5->X:$78421,12,1
#define Input6  M7006   Input6->X:$78421,13,1
#define Input7  M7007   Input7->X:$78421,14,1
#define Input8  M7008   Input8->X:$78421,15,1
#define Input9  M7009   Input9->X:$78421,16,1
#define Input10 M7010   Input10->X:$78421,17,1
#define Input11 M7011   Input11->X:$78421,18,1
#define Input12 M7012   Input12->X:$78421,19,1
#define Input13 M7013   Input13->X:$78421,20,1
#define Input14 M7014   Input14->X:$78421,21,1
#define Input15 M7015   Input15->X:$78421,22,1
#define Input16 M7016   Input16->X:$78421,23,1
#define Input17 M7017   Input17->X:$78422,8,1
#define Input18 M7018   Input18->X:$78422,9,1
#define Input19 M7019   Input19->X:$78422,10,1
#define Input20 M7020   Input20->X:$78422,11,1
#define Input21 M7021   Input21->X:$78422,12,1
#define Input22 M7022   Input22->X:$78422,13,1
#define Input23 M7023   Input23->X:$78422,14,1
#define Input24 M7024   Input24->X:$78422,15,1
```

The outputs require an image word
We will use **Y:$10FF** open memory register to create an image word; therefore, the bitwise mapping of the outputs should point to the open memory.

```
#define Output1  M7025  Output1->Y:$10FF,0,1
#define Output2  M7026  Output2->Y:$10FF,1,1
#define Output3  M7027  Output3->Y:$10FF,2,1
#define Output4  M7028  Output4->Y:$10FF,3,1
#define Output5  M7029  Output5->Y:$10FF,4,1
#define Output6  M7030  Output6->Y:$10FF,5,1
#define Output7  M7031  Output7->Y:$10FF,6,1
#define Output8  M7032  Output8->Y:$10FF,7,1
#define Output9  M7033  Output9->Y:$10FF,8,1
#define Output10 M7034  Output10->Y:$10FF,9,1
#define Output11 M7035  Output11->Y:$10FF,10,1
#define Output12 M7036  Output12->Y:$10FF,11,1
#define Output13 M7037  Output13->Y:$10FF,12,1
#define Output14 M7038  Output14->Y:$10FF,13,1
#define Output15 M7039  Output15->Y:$10FF,14,1
#define Output16 M7040  Output16->Y:$10FF,15,1
#define Output17 M7041  Output17->Y:$10FF,16,1
#define Output18 M7042  Output18->Y:$10FF,17,1
#define Output19 M7043  Output19->Y:$10FF,18,1
#define Output20 M7044  Output20->Y:$10FF,19,1
#define Output21 M7045  Output21->Y:$10FF,20,1
#define Output22 M7046  Output22->Y:$10FF,21,1
#define Output23 M7047  Output23->Y:$10FF,22,1
#define Output24 M7048  Output24->Y:$10FF,23,1
```

The following mirror image PLC (which should be executing constantly) will copy the outputs into node 2:

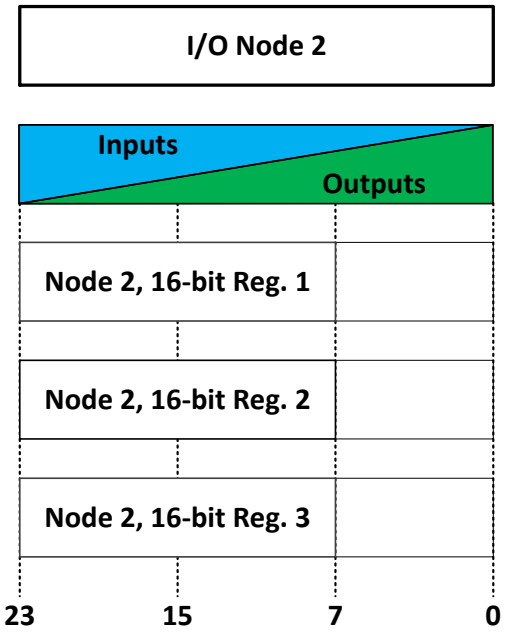
```
#define N2Second16     M7049          ; Node 2, second 16-bit register
#define N2Third16      M7050          ; Node 2, third 16-bit register
#define OutMirror      M7051          ; Mirror word, open memory

N2Second16->X:$78422,8,16             ; Second 16-bit register, node 2
N2Third16->X:$78423,8,16              ; Third 16-bit register, node 2
OutMirror->Y:$10FF,0,24               ; Open memory
OutMirror = 0                         ; Save/Initialize to zero or desired state

Open PLC 1 Clear
N2Second16 = OutMirror & $0000FF      ; Mask with lower 8 bits
N2Third16 = OutMirror & $FFFF00/$100  ; Mask OutMirror with upper 16 bits and shift to lower 16
Close
```

Note

The output states are now reported and can be toggled individually using the bitwise assignments to the open memory register.

Power PMAC2 MI160 Mapping Example

MI160 is used to transfer ACC-65E data through MACRO IC 0 node 2 of the ring controller, which places the 24 bits of inputs and 24 bits of outputs in the same 24-bit data register:



The inputs are mapped into the 24 bits of node 2:

```
PTR Input1->Gate2[0].Macro[2][0].0.1;
PTR Input2->Gate2[0].Macro[2][0].1.1;
PTR Input3->Gate2[0].Macro[2][0].2.1;
PTR Input4->Gate2[0].Macro[2][0].3.1;
PTR Input5->Gate2[0].Macro[2][0].4.1;
PTR Input6->Gate2[0].Macro[2][0].5.1;
PTR Input7->Gate2[0].Macro[2][0].6.1;
PTR Input8->Gate2[0].Macro[2][0].7.1;
PTR Input9->Gate2[0].Macro[2][0].8.1;
PTR Input10->Gate2[0].Macro[2][0].9.1;
PTR Input11->Gate2[0].Macro[2][0].10.1;
PTR Input12->Gate2[0].Macro[2][0].11.1;
PTR Input13->Gate2[0].Macro[2][0].12.1;
PTR Input14->Gate2[0].Macro[2][0].13.1;
PTR Input15->Gate2[0].Macro[2][0].14.1;
PTR Input16->Gate2[0].Macro[2][0].15.1;
PTR Input17->Gate2[0].Macro[2][0].16.1;
PTR Input18->Gate2[0].Macro[2][0].17.1;
PTR Input19->Gate2[0].Macro[2][0].18.1;
PTR Input20->Gate2[0].Macro[2][0].19.1;
PTR Input21->Gate2[0].Macro[2][0].20.1;
PTR Input22->Gate2[0].Macro[2][0].21.1;
PTR Input23->Gate2[0].Macro[2][0].22.1;
PTR Input24->Gate2[0].Macro[2][0].23.1;
```

Note

Bitwise mapping with PMAC2 style MACRO IC is supported starting with Power PMAC firmware version **1.5.8.215**.

The outputs require an image word.
We will use **Sys.Udata[1]** open memory register to create the image word; therefore, the bitwise mapping of the outputs:

```
PTR Output1->U.USER:4.0.1;
PTR Output2->U.USER:4.1.1;
PTR Output3->U.USER:4.2.1;
PTR Output4->U.USER:4.3.1;
PTR Output5->U.USER:4.4.1;
PTR Output6->U.USER:4.5.1;
PTR Output7->U.USER:4.6.1;
PTR Output8->U.USER:4.7.1;
PTR Output9->U.USER:4.8.1;
PTR Output10->U.USER:4.9.1;
PTR Output11->U.USER:4.10.1;
PTR Output12->U.USER:4.11.1;
PTR Output13->U.USER:4.12.1;
PTR Output14->U.USER:4.13.1;
PTR Output15->U.USER:4.14.1;
PTR Output16->U.USER:4.15.1;
PTR Output17->U.USER:4.16.1;
PTR Output18->U.USER:4.17.1;
PTR Output19->U.USER:4.18.1;
PTR Output20->U.USER:4.19.1;
PTR Output21->U.USER:4.20.1;
PTR Output22->U.USER:4.21.1;
PTR Output23->U.USER:4.22.1;
PTR Output24->U.USER:4.23.1;
```

Bitwise mapping to user memory structure elements is not allowed. Explicit syntax with offset address must be used. The offset address is found by multiplying the element structure index by 4. To the right is an example of the first 4 unsigned open memory structure elements and their corresponding address offsets:

Structure Element	Address Offset
Sys.Udata[1]	U.USER:4
Sys.Udata[2]	U.USER:8
Sys.Udata[3]	U.USER:12
Sys.Udata[4]	U.USER:16

Note

A large number of self-addressed (default **Sys.pushm**) pointers in Power PMAC use **Sys.Udata[0]**; therefore, it is highly advised NOT to use it as general purpose user memory.

The following mirror image PLC (which should be executing constantly) will copy the outputs into node 2:

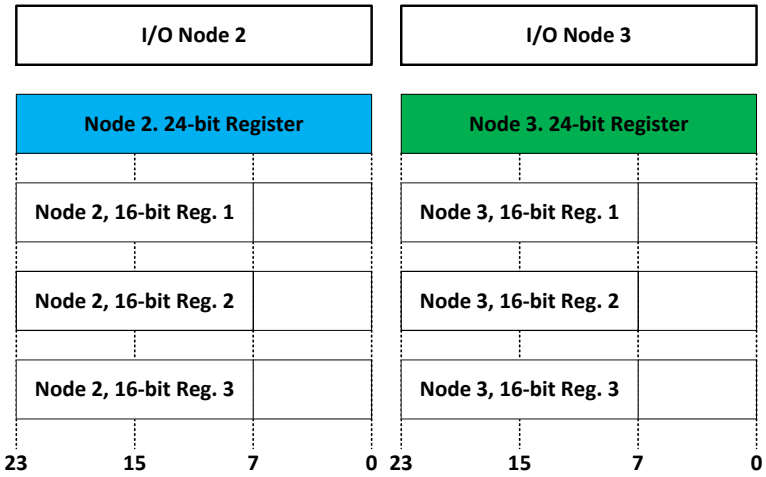
```
PTR N2Twenty4->Gate2[0].Macro[2][0];          // node 2 (shared with inputs)
PTR OutMirror->U.USER:4.0.24;                 // Mirror Word, shared user memmory
OutMirror = 0                                 // Save/initialize to zero or desired state

Open PLC 1
N2Twenty4 = OutMirror                         // Update data register
Close
```

Note

The output states are now reported and can be toggled individually using the bitwise assignments to the open memory register.

Power PMAC2 MI71 Mapping Example

MI71 is used to transfer ACC-65E data to MACRO IC 0 nodes 2 and 3 of the ring controller, which places the 24 bits of inputs in the 24-bit register of node 2 and the 24 bits of outputs in the 24-bit register of node 3:



The inputs are mapped into the 24 bits of node 2:

```
PTR Input1->Gate2[0].Macro[2][0].0.1;
PTR Input2->Gate2[0].Macro[2][0].1.1;
PTR Input3->Gate2[0].Macro[2][0].2.1;
PTR Input4->Gate2[0].Macro[2][0].3.1;
PTR Input5->Gate2[0].Macro[2][0].4.1;
PTR Input6->Gate2[0].Macro[2][0].5.1;
PTR Input7->Gate2[0].Macro[2][0].6.1;
PTR Input8->Gate2[0].Macro[2][0].7.1;
PTR Input9->Gate2[0].Macro[2][0].8.1;
PTR Input10->Gate2[0].Macro[2][0].9.1;
PTR Input11->Gate2[0].Macro[2][0].10.1;
PTR Input12->Gate2[0].Macro[2][0].11.1;
PTR Input13->Gate2[0].Macro[2][0].12.1;
PTR Input14->Gate2[0].Macro[2][0].13.1;
PTR Input15->Gate2[0].Macro[2][0].14.1;
PTR Input16->Gate2[0].Macro[2][0].15.1;
PTR Input17->Gate2[0].Macro[2][0].16.1;
PTR Input18->Gate2[0].Macro[2][0].17.1;
PTR Input19->Gate2[0].Macro[2][0].18.1;
PTR Input20->Gate2[0].Macro[2][0].19.1;
PTR Input21->Gate2[0].Macro[2][0].20.1;
PTR Input22->Gate2[0].Macro[2][0].21.1;
PTR Input23->Gate2[0].Macro[2][0].22.1;
PTR Input24->Gate2[0].Macro[2][0].23.1;
```

Note

Bitwise mapping with PMAC2 style MACRO IC is supported starting with Power PMAC firmware version 1.5.8.215.

The outputs require an image word.
We will use **Sys.Udata[1]** open memory register (to copy the 24 bits of node 3) to create the image word.
Therefore, the bitwise mapping of the outputs:

```
PTR Output1->U.USER:4.0.1;
PTR Output2->U.USER:4.1.1;
PTR Output3->U.USER:4.2.1;
PTR Output4->U.USER:4.3.1;
PTR Output5->U.USER:4.4.1;
PTR Output6->U.USER:4.5.1;
PTR Output7->U.USER:4.6.1;
PTR Output8->U.USER:4.7.1;
PTR Output9->U.USER:4.8.1;
PTR Output10->U.USER:4.9.1;
PTR Output11->U.USER:4.10.1;
PTR Output12->U.USER:4.11.1;
PTR Output13->U.USER:4.12.1;
PTR Output14->U.USER:4.13.1;
PTR Output15->U.USER:4.14.1;
PTR Output16->U.USER:4.15.1;
PTR Output17->U.USER:4.16.1;
PTR Output18->U.USER:4.17.1;
PTR Output19->U.USER:4.18.1;
PTR Output20->U.USER:4.19.1;
PTR Output21->U.USER:4.20.1;
PTR Output22->U.USER:4.21.1;
PTR Output23->U.USER:4.22.1;
PTR Output24->U.USER:4.23.1;
```

Bitwise mapping to user memory structure elements is not allowed. Explicit syntax with offset address must be used. The offset address is found by multiplying the element structure index by 4. To the right is an example of the first 4 unsigned open memory structure elements and their corresponding address offsets:

Structure Element	Address Offset
Sys.Udata[1]	U.USER:4
Sys.Udata[2]	U.USER:8
Sys.Udata[3]	U.USER:12
Sys.Udata[4]	U.USER:16

Note

A large number of self-addressed (default **Sys.pushm**) pointers in Power PMAC use **Sys.Udata[0]**; therefore, it is highly advised NOT to use it as general purpose user memory.

The following PLC (which should be executing constantly) will copy the outputs into node 3:

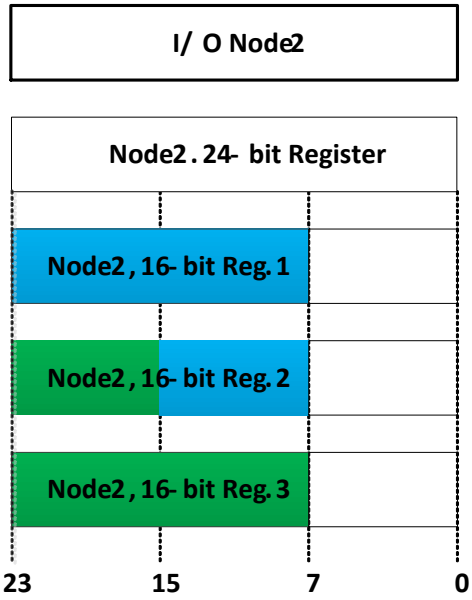
```
PTR N3Twenty4->Gate2[0].Macro[3][0];          // 24-bit register, node 3
PTR OutMirror->U.USER:4.0.24;                 // Mirror Word, shared user memory
OutMirror = 0                                 // Save/initialize to zero or desired state

Open PLC 1
N3Twenty4 = OutMirror                         // Update data register
Close
```

Note

The output states are now reported and can be toggled individually using the bitwise assignments to the open memory register.

Power PMAC2 MI69/70 Mapping Example

MI69 / MI70 is used to transfer ACC-65E data through MACRO IC 0 node 2 of the ring controller, which places the data as illustrated on the right:



The lower 16 bits of the 24 bits of inputs reside in the first 16-bit register, and the upper 8 bits of the 24 bits of inputs reside in the lower byte of the second 16-bit register.

The lower 8 bits of the 24 bits of outputs reside in the upper byte of the second 16-bit register, and the upper 16 bits of the 24 bits of outputs reside in the third 16-bit register.

The inputs are mapped into 16-bit registers of node 2:

```
PTR Input1->Gate2[0].Macro[2][1].8.1
PTR Input2->Gate2[0].Macro[2][1].9.1
PTR Input3->Gate2[0].Macro[2][1].10.1
PTR Input4->Gate2[0].Macro[2][1].11.1
PTR Input5->Gate2[0].Macro[2][1].12.1
PTR Input6->Gate2[0].Macro[2][1].13.1
PTR Input7->Gate2[0].Macro[2][1].14.1
PTR Input8->Gate2[0].Macro[2][1].15.1
PTR Input9->Gate2[0].Macro[2][1].16.1
PTR Input10->Gate2[0].Macro[2][1].17.1
PTR Input11->Gate2[0].Macro[2][1].18.1
PTR Input12->Gate2[0].Macro[2][1].19.1
PTR Input13->Gate2[0].Macro[2][1].20.1
PTR Input14->Gate2[0].Macro[2][1].21.1
PTR Input15->Gate2[0].Macro[2][1].22.1
PTR Input16->Gate2[0].Macro[2][1].23.1
PTR Input17->Gate2[0].Macro[2][2].8.1
PTR Input18->Gate2[0].Macro[2][2].9.1
PTR Input19->Gate2[0].Macro[2][2].10.1
PTR Input20->Gate2[0].Macro[2][2].11.1
PTR Input21->Gate2[0].Macro[2][2].12.1
PTR Input22->Gate2[0].Macro[2][2].13.1
PTR Input23->Gate2[0].Macro[2][2].14.1
PTR Input24->Gate2[0].Macro[2][2].15.1
```

Note

Bitwise mapping with PMAC2 style MACRO IC is supported starting with Power PMAC firmware version **1.5.8.215**.

The outputs require an image word. We will use **Sys.Udata[1]** open memory register to create the image word. Therefore, the bitwise mapping of the outputs:

```
PTR Output1->U.USER:4.0.1;
PTR Output2->U.USER:4.1.1;
PTR Output3->U.USER:4.2.1;
PTR Output4->U.USER:4.3.1;
PTR Output5->U.USER:4.4.1;
PTR Output6->U.USER:4.5.1;
PTR Output7->U.USER:4.6.1;
PTR Output8->U.USER:4.7.1;
PTR Output9->U.USER:4.8.1;
PTR Output10->U.USER:4.9.1;
PTR Output11->U.USER:4.10.1;
PTR Output12->U.USER:4.11.1;
PTR Output13->U.USER:4.12.1;
PTR Output14->U.USER:4.13.1;
PTR Output15->U.USER:4.14.1;
PTR Output16->U.USER:4.15.1;
PTR Output17->U.USER:4.16.1;
PTR Output18->U.USER:4.17.1;
PTR Output19->U.USER:4.18.1;
PTR Output20->U.USER:4.19.1;
PTR Output21->U.USER:4.20.1;
PTR Output22->U.USER:4.21.1;
PTR Output23->U.USER:4.22.1;
PTR Output24->U.USER:4.23.1;
```

Bitwise mapping to user memory structure elements is not allowed. Explicit syntax with offset address must be used. The offset address is found by multiplying the element structure index by 4. To the right is an example of the first 4 unsigned open memory structure elements and their corresponding address offsets:

Structure Element	Address Offset
Sys.Udata[1]	U.USER:4
Sys.Udata[2]	U.USER:8
Sys.Udata[3]	U.USER:12
Sys.Udata[4]	U.USER:16

Note

A large number of self-addressed (default **Sys.pushm**) pointers in Power PMAC use **Sys.Udata[0]**; therefore, it is highly advised NOT to use it as general purpose user memory.

The following mirror image PLC (which should be executing constantly) will copy the outputs into node 2:

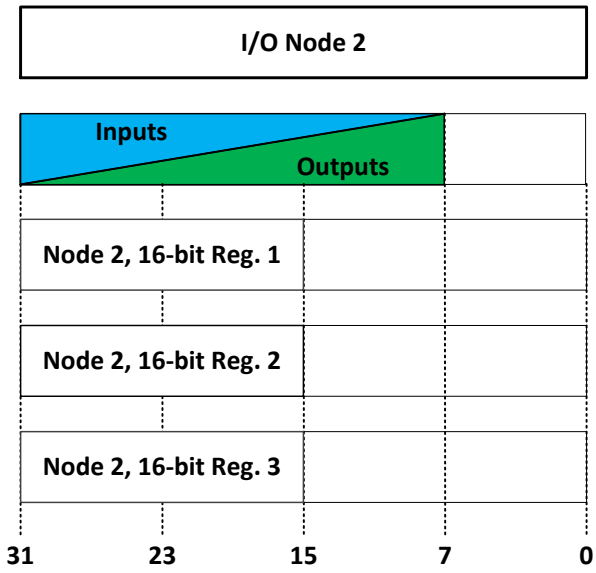
```
PTR N2Second16->Gate2[0].Macro[2][2];        // Node 2, Second 16-bit register (upper 8 bits)
PTR N2Third16->Gate2[0].Macro[2][3];         // Node 2, Third 16-bit register (upper 16 bits)
PTR OutMirror->U.USER:4.0.24;                // Mirror Word, shared user memory
OutMirror = 0                                // Save/initialize to zero or desired state

Open PLC 1
N2Second16 = OutMirror & $0000FF <<16        // Update 2nd 16-bit reg; shift to upper 16-bits
N2Third16 = OutMirror & $FFFF00              // Update node 2 third 16-bit register
Close
```

Note

The output states are now reported and can be toggled individually using the bitwise assignments to the open memory register.

Power PMAC3 MI160 Mapping Example

MI160 is used to transfer ACC-65E data through MACRO IC 0 Bank A node 2 of the ring controller, which places the 24 bits of inputs in the **IN** 24-bit data register of node 2, and the 24 bits of outputs in the **OUT** 24-bit data register of node 2:

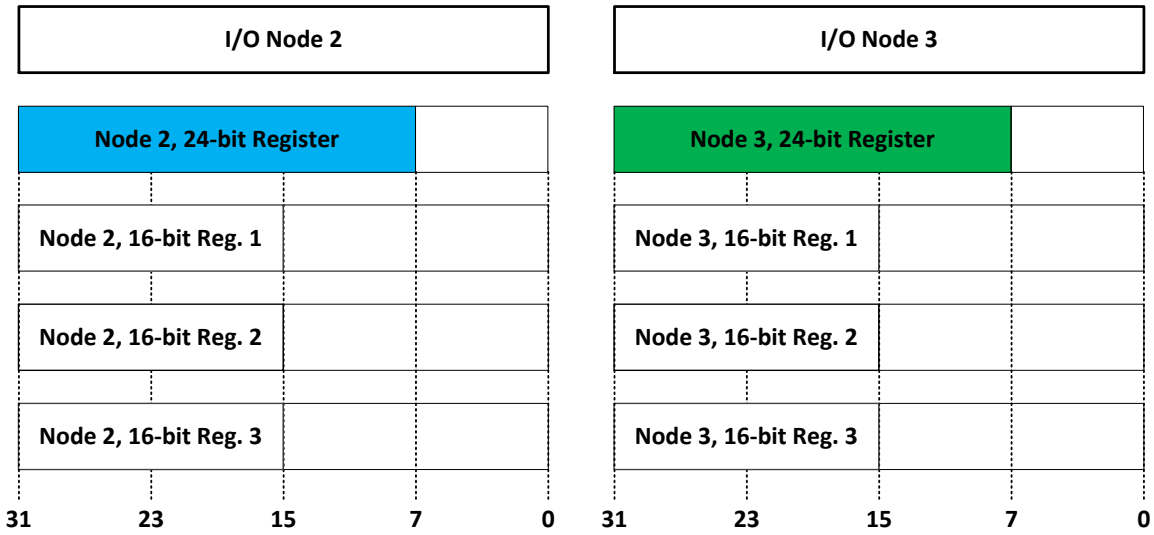


Inputs	Outputs
PTR Input1->Gate3[0].MacroInA[2][0].8.1;	PTR Output1->Gate3[0].MacroOutA[2][0].8.1;
PTR Input2->Gate3[0].MacroInA[2][0].9.1;	PTR Output2->Gate3[0].MacroOutA[2][0].9.1;
PTR Input3->Gate3[0].MacroInA[2][0].10.1;	PTR Output3->Gate3[0].MacroOutA[2][0].10.1;
PTR Input4->Gate3[0].MacroInA[2][0].11.1;	PTR Output4->Gate3[0].MacroOutA[2][0].11.1;
PTR Input5->Gate3[0].MacroInA[2][0].12.1;	PTR Output5->Gate3[0].MacroOutA[2][0].12.1;
PTR Input6->Gate3[0].MacroInA[2][0].13.1;	PTR Output6->Gate3[0].MacroOutA[2][0].13.1;
PTR Input7->Gate3[0].MacroInA[2][0].14.1;	PTR Output7->Gate3[0].MacroOutA[2][0].14.1;
PTR Input8->Gate3[0].MacroInA[2][0].15.1;	PTR Output8->Gate3[0].MacroOutA[2][0].15.1;
PTR Input9->Gate3[0].MacroInA[2][0].16.1;	PTR Output9->Gate3[0].MacroOutA[2][0].16.1;
PTR Input10->Gate3[0].MacroInA[2][0].17.1;	PTR Output10->Gate3[0].MacroOutA[2][0].17.1;
PTR Input11->Gate3[0].MacroInA[2][0].18.1;	PTR Output11->Gate3[0].MacroOutA[2][0].18.1;
PTR Input12->Gate3[0].MacroInA[2][0].19.1;	PTR Output12->Gate3[0].MacroOutA[2][0].19.1;
PTR Input13->Gate3[0].MacroInA[2][0].20.1;	PTR Output13->Gate3[0].MacroOutA[2][0].20.1;
PTR Input14->Gate3[0].MacroInA[2][0].21.1;	PTR Output14->Gate3[0].MacroOutA[2][0].21.1;
PTR Input15->Gate3[0].MacroInA[2][0].22.1;	PTR Output15->Gate3[0].MacroOutA[2][0].22.1;
PTR Input16->Gate3[0].MacroInA[2][0].23.1;	PTR Output16->Gate3[0].MacroOutA[2][0].23.1;
PTR Input17->Gate3[0].MacroInA[2][0].24.1;	PTR Output17->Gate3[0].MacroOutA[2][0].24.1;
PTR Input18->Gate3[0].MacroInA[2][0].25.1;	PTR Output18->Gate3[0].MacroOutA[2][0].25.1;
PTR Input19->Gate3[0].MacroInA[2][0].26.1;	PTR Output19->Gate3[0].MacroOutA[2][0].26.1;
PTR Input20->Gate3[0].MacroInA[2][0].27.1;	PTR Output20->Gate3[0].MacroOutA[2][0].27.1;
PTR Input21->Gate3[0].MacroInA[2][0].28.1;	PTR Output21->Gate3[0].MacroOutA[2][0].28.1;
PTR Input22->Gate3[0].MacroInA[2][0].29.1;	PTR Output22->Gate3[0].MacroOutA[2][0].29.1;
PTR Input23->Gate3[0].MacroInA[2][0].30.1;	PTR Output23->Gate3[0].MacroOutA[2][0].30.1;
PTR Input24->Gate3[0].MacroInA[2][0].31.1;	PTR Output24->Gate3[0].MacroOutA[2][0].31.1;

With Power PMAC3, the outputs can be directly bitwise mapped, written to, and reported. Mirror word is not required.

Power PMAC3 MI71 Mapping Example

MI71 is used to transfer ACC-65E data through MACRO IC 0 Bank A nodes 2 and 3 of the ring controller, which places the 24 bits of inputs in the **In** 24-bit data register of node 2 and the 24 bits of outputs in the **Out** 24-bit register of node 3:

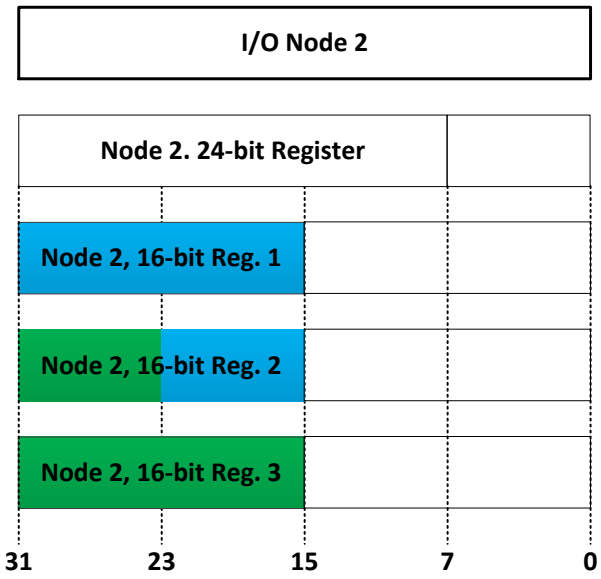


Inputs	Outputs
PTR Input1->Gate3[0].MacroInA[2][0].8.1;	PTR Output1->Gate3[0].MacroOutA[3][0].8.1;
PTR Input2->Gate3[0].MacroInA[2][0].9.1;	PTR Output2->Gate3[0].MacroOutA[3][0].9.1;
PTR Input3->Gate3[0].MacroInA[2][0].10.1;	PTR Output3->Gate3[0].MacroOutA[3][0].10.1;
PTR Input4->Gate3[0].MacroInA[2][0].11.1;	PTR Output4->Gate3[0].MacroOutA[3][0].11.1;
PTR Input5->Gate3[0].MacroInA[2][0].12.1;	PTR Output5->Gate3[0].MacroOutA[3][0].12.1;
PTR Input6->Gate3[0].MacroInA[2][0].13.1;	PTR Output6->Gate3[0].MacroOutA[3][0].13.1;
PTR Input7->Gate3[0].MacroInA[2][0].14.1;	PTR Output7->Gate3[0].MacroOutA[3][0].14.1;
PTR Input8->Gate3[0].MacroInA[2][0].15.1;	PTR Output8->Gate3[0].MacroOutA[3][0].15.1;
PTR Input9->Gate3[0].MacroInA[2][0].16.1;	PTR Output9->Gate3[0].MacroOutA[3][0].16.1;
PTR Input10->Gate3[0].MacroInA[2][0].17.1;	PTR Output10->Gate3[0].MacroOutA[3][0].17.1;
PTR Input11->Gate3[0].MacroInA[2][0].18.1;	PTR Output11->Gate3[0].MacroOutA[3][0].18.1;
PTR Input12->Gate3[0].MacroInA[2][0].19.1;	PTR Output12->Gate3[0].MacroOutA[3][0].19.1;
PTR Input13->Gate3[0].MacroInA[2][0].20.1;	PTR Output13->Gate3[0].MacroOutA[3][0].20.1;
PTR Input14->Gate3[0].MacroInA[2][0].21.1;	PTR Output14->Gate3[0].MacroOutA[3][0].21.1;
PTR Input15->Gate3[0].MacroInA[2][0].22.1;	PTR Output15->Gate3[0].MacroOutA[3][0].22.1;
PTR Input16->Gate3[0].MacroInA[2][0].23.1;	PTR Output16->Gate3[0].MacroOutA[3][0].23.1;
PTR Input17->Gate3[0].MacroInA[2][0].24.1;	PTR Output17->Gate3[0].MacroOutA[3][0].24.1;
PTR Input18->Gate3[0].MacroInA[2][0].25.1;	PTR Output18->Gate3[0].MacroOutA[3][0].25.1;
PTR Input19->Gate3[0].MacroInA[2][0].26.1;	PTR Output19->Gate3[0].MacroOutA[3][0].26.1;
PTR Input20->Gate3[0].MacroInA[2][0].27.1;	PTR Output20->Gate3[0].MacroOutA[3][0].27.1;
PTR Input21->Gate3[0].MacroInA[2][0].28.1;	PTR Output21->Gate3[0].MacroOutA[3][0].28.1;
PTR Input22->Gate3[0].MacroInA[2][0].29.1;	PTR Output22->Gate3[0].MacroOutA[3][0].29.1;
PTR Input23->Gate3[0].MacroInA[2][0].30.1;	PTR Output23->Gate3[0].MacroOutA[3][0].30.1;
PTR Input24->Gate3[0].MacroInA[2][0].31.1;	PTR Output24->Gate3[0].MacroOutA[3][0].31.1;

With Power PMAC3, the outputs can be directly bitwise mapped, written to, and reported. Mirror word is not required.

Power PMAC3 MI69/70 Mapping Example

MI69 / MI70 is used to transfer ACC-65E data through MACRO IC 0 Bank A node 2 of the ring controller, which places the data as illustrated on the right:



The lower 16 bits of the 24 bits of inputs reside in the first 16-bit register, and the upper 8 bits of the 24 bits of inputs reside in the lower byte of the second 16-bit register. All in **In** registers.

The lower 8 bits of the 24 bits of outputs reside in the upper byte of the second 16-bit register, and the upper 16 bits of the 24 bits of outputs reside in the third 16-bit register.
All in **Out** registers.

Inputs	Outputs
PTR Input1->Gate3[0].MacroInA[2][1].16.1;	PTR Output1->Gate3[0].MacroOutA[2][2].24.1;
PTR Input2->Gate3[0].MacroInA[2][1].17.1;	PTR Output2->Gate3[0].MacroOutA[2][2].25.1;
PTR Input3->Gate3[0].MacroInA[2][1].18.1;	PTR Output3->Gate3[0].MacroOutA[2][2].26.1;
PTR Input4->Gate3[0].MacroInA[2][1].19.1;	PTR Output4->Gate3[0].MacroOutA[2][2].27.1;
PTR Input5->Gate3[0].MacroInA[2][1].20.1;	PTR Output5->Gate3[0].MacroOutA[2][2].28.1;
PTR Input6->Gate3[0].MacroInA[2][1].21.1;	PTR Output6->Gate3[0].MacroOutA[2][2].29.1;
PTR Input7->Gate3[0].MacroInA[2][1].22.1;	PTR Output7->Gate3[0].MacroOutA[2][2].30.1;
PTR Input8->Gate3[0].MacroInA[2][1].23.1;	PTR Output8->Gate3[0].MacroOutA[2][2].31.1;
PTR Input9->Gate3[0].MacroInA[2][1].24.1;	PTR Output9->Gate3[0].MacroOutA[2][3].16.1;
PTR Input10->Gate3[0].MacroInA[2][1].25.1;	PTR Output10->Gate3[0].MacroOutA[2][3].17.1;
PTR Input11->Gate3[0].MacroInA[2][1].26.1;	PTR Output11->Gate3[0].MacroOutA[2][3].18.1;
PTR Input12->Gate3[0].MacroInA[2][1].27.1;	PTR Output12->Gate3[0].MacroOutA[2][3].19.1;
PTR Input13->Gate3[0].MacroInA[2][1].28.1;	PTR Output13->Gate3[0].MacroOutA[2][3].20.1;
PTR Input14->Gate3[0].MacroInA[2][1].29.1;	PTR Output14->Gate3[0].MacroOutA[2][3].21.1;
PTR Input15->Gate3[0].MacroInA[2][1].30.1;	PTR Output15->Gate3[0].MacroOutA[2][3].22.1;
PTR Input16->Gate3[0].MacroInA[2][1].31.1;	PTR Output16->Gate3[0].MacroOutA[2][3].23.1;
PTR Input17->Gate3[0].MacroInA[2][2].16.1;	PTR Output17->Gate3[0].MacroOutA[2][3].24.1;
PTR Input18->Gate3[0].MacroInA[2][2].17.1;	PTR Output18->Gate3[0].MacroOutA[2][3].25.1;
PTR Input19->Gate3[0].MacroInA[2][2].18.1;	PTR Output19->Gate3[0].MacroOutA[2][3].26.1;
PTR Input20->Gate3[0].MacroInA[2][2].19.1;	PTR Output20->Gate3[0].MacroOutA[2][3].27.1;
PTR Input21->Gate3[0].MacroInA[2][2].20.1;	PTR Output21->Gate3[0].MacroOutA[2][3].28.1;
PTR Input22->Gate3[0].MacroInA[2][2].21.1;	PTR Output22->Gate3[0].MacroOutA[2][3].29.1;
PTR Input23->Gate3[0].MacroInA[2][2].22.1;	PTR Output23->Gate3[0].MacroOutA[2][3].30.1;
PTR Input24->Gate3[0].MacroInA[2][2].23.1;	PTR Output24->Gate3[0].MacroOutA[2][3].31.1;

With Power PMAC3, the outputs can be directly bitwise mapped, written to, and reported. Mirror word is not required.

Configuring the Control Word for MACRO

The control word is configured automatically with MACRO16 CPU firmware version 1.204 and newer. The setup below is for older firmware versions.

The control word can be configured with MACRO using MI198 and MI199:

- Set MI198 to $40000 + {base address} + 7
- Set MI199 = 7

Configuring the Control Word must be done on every power-up/reset such as in the following example PLC which performs the configuration and then disables itself.

Example:

With ACC-65E at base addresses $8800, and using node 2 for MACRO Station communication.

Turbo PMAC ring controllers:

```
Open PLC 1 Clear
I5111 = 250 * 8388608 / I10 WHILE (I5111 > 0) EndW

CMD"MS2,MI198=$408807"        // Point to control word of Card 1 at address $8800
CMD"MS2,MI199=7"              // Write to control word
I5111 = 250 * 8388608 / I10 WHILE (I5111 > 0) EndW

Disable PLC 1
Close
```

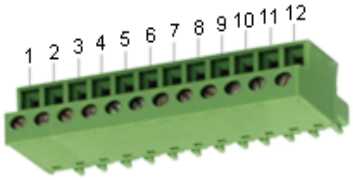
Power PMAC ring controllers:

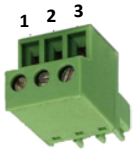
```
Open PLC 1
CALL Timer(0.250)                    // 250 msec delay. Requires loading the Timer subprogram.

CMD"MACROSTATION2,MI198=$408807"     // Point to control word of Card 1 at address $8800
CMD"MACROSTATION2,MI199=7"           // Write to control word
CALL Timer(0.250)

Disable PLC 1                        // Disable this PLC
Close
```

CONNECTOR PINOUTS AND WIRING

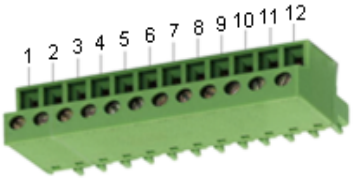
Terminal Block Connectors

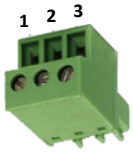
Top: Inputs

TB1 / TB2 Top (Inputs)		
Pin #	**Function**	**Description**
1	Input	Input #1 / 13
2	Input	Input #2 / 14
3	Input	Input #3 / 15
4	Input	Input #4 / 16
5	Input	Input #5 / 17
6	Input	Input #6 / 18
7	Input	Input #7 / 19
8	Input	Input #8 / 20
9	Input	Input #9 / 21
10	Input	Input #10 / 22
11	Input	Input #11 / 23
12	Input	Input #12 / 24

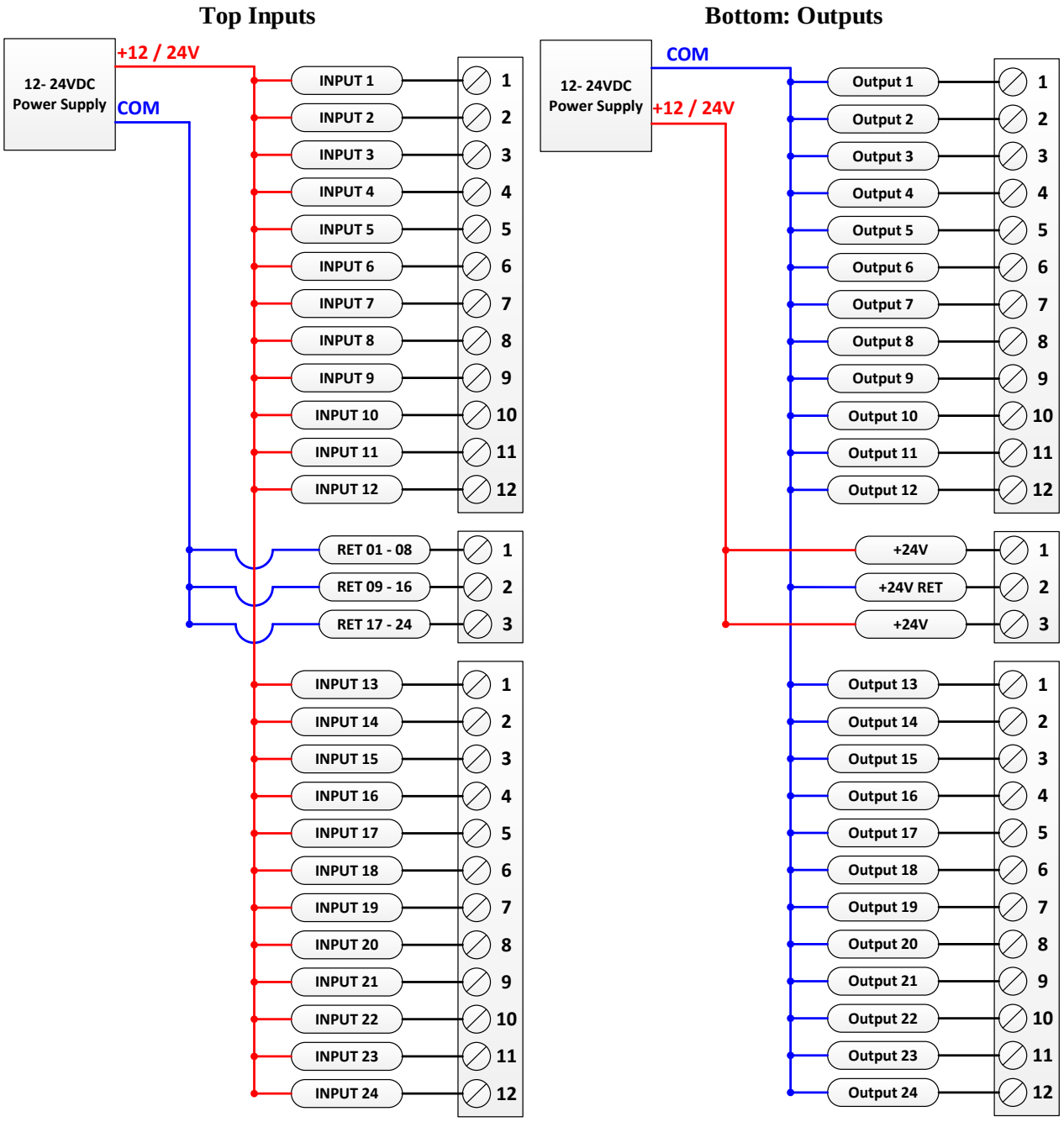
TB3 Top (Inputs Reference / Return)	
Pin #	**Function / Description**
1	Inputs Return 01 – 08
2	Inputs Return 09 – 16
3	Inputs Return 17 – 24

Bottom: Outputs

TB1 / TB2 Bottom (Outputs)		
Pin #	**Function**	**Description**
1	Output	Output #1 / 13
2	Output	Output #2 / 14
3	Output	Output #3 / 15
4	Output	Output #4 / 16
5	Output	Output #5 / 17
6	Output	Output #6 / 18
7	Output	Output #7 / 19
8	Output	Output #8 / 20
9	Output	Output #9 / 21
10	Output	Output #10 / 22
11	Output	Output #11 / 23
12	Output	Output #12 / 24

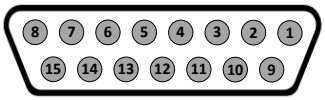
TB3 Bottom (Outputs Power)	
Pin #	**Function / Description**
1	+ 24V
2	+24V RETURN
3	+ 24V

TB Wiring Diagram

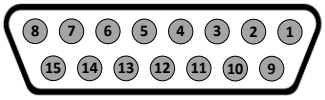


D-Sub Connectors

Top: Inputs

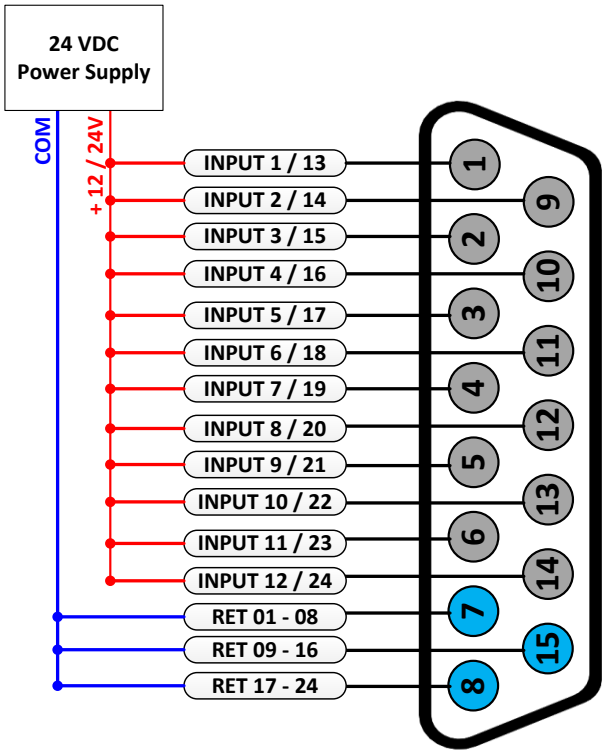
J1 / J2 Top: D-sub DA-15F Mating: D-sub DA-15M			
Pin #	**Function**	**J1**	**J2**
1	Input	Input #1	Input #13
2	Input	Input #3	Input #25
3	Input	Input #5	Input #17
4	Input	Input #7	Input #19
5	Input	Input #9	Input #21
6	Input	Input #11	Input #23
7	Return	Inputs Return 1–8	
8	Return	Inputs Return 17–24	
9	Input	Input #2	Input #14
10	Input	Input #4	Input #16
11	Input	Input #6	Input #18
12	Input	Input #8	Input #20
13	Input	Input #10	Input #22
14	Input	Input #12	Input #24
15	Return	Inputs Return 9–16	

Bottom: Outputs

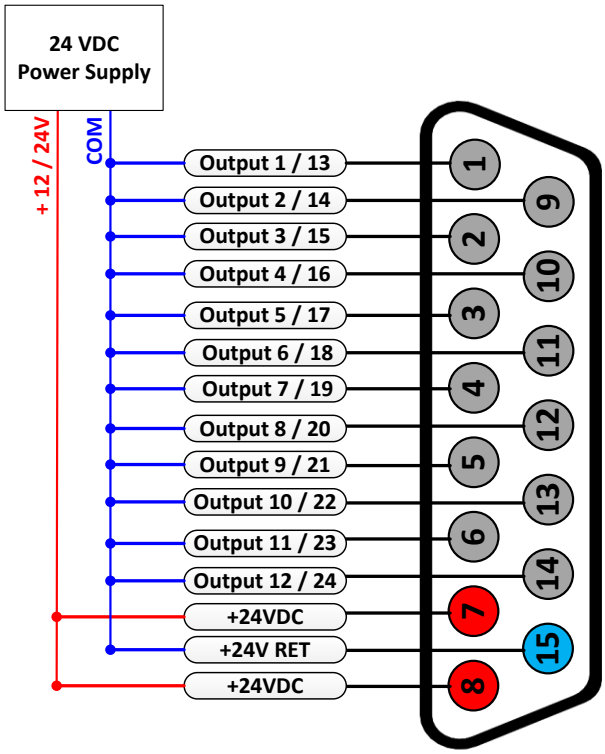
J1 / J2 Top: D-sub DA-15F Mating: D-sub DA-15M			
Pin #	**Function**	**J1**	**J2**
1	Output	Output #1	Output #13
2	Output	Output #3	Output #15
3	Output	Output #5	Output #17
4	Output	Output #7	Output #19
5	Output	Output #9	Output #21
6	Output	Output #11	Output #23
7	Input	+ 24V	
8	Input	+ 24V	
9	Output	Output #2	Output #14
10	Output	Output #4	Output #16
11	Output	Output #6	Output #18
12	Output	Output #8	Output #20
13	Output	Output #10	Output #22
14	Output	Output #12	Output #24
15	Return	+24V RETURN	

D-Sub Wiring diagram

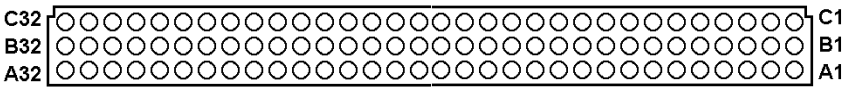
Top: Inputs



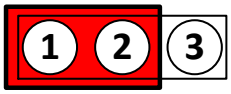
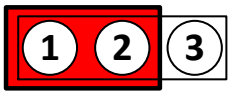
Bottom: Outputs



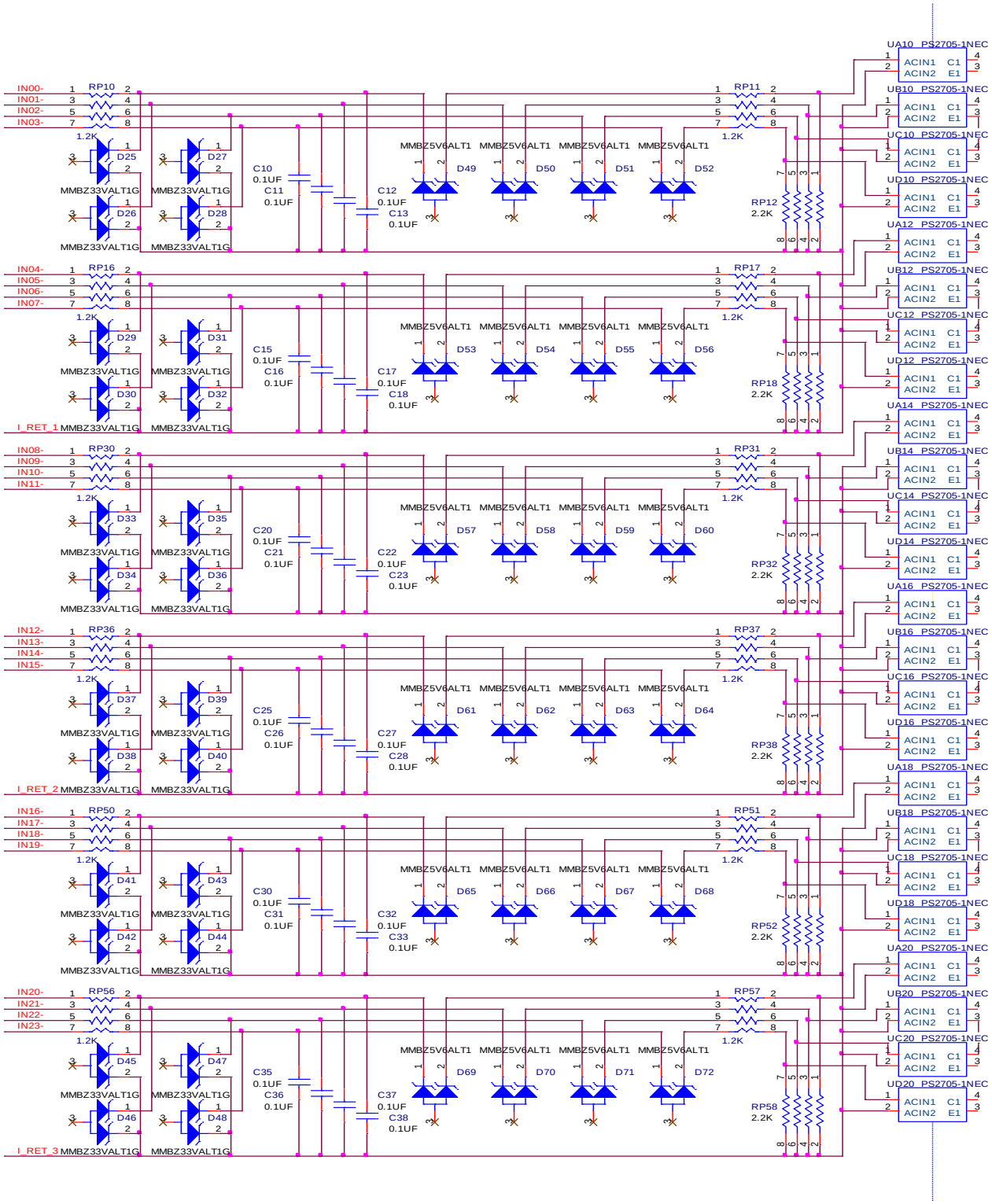
P1: UMAC Bus (UBUS) Connector

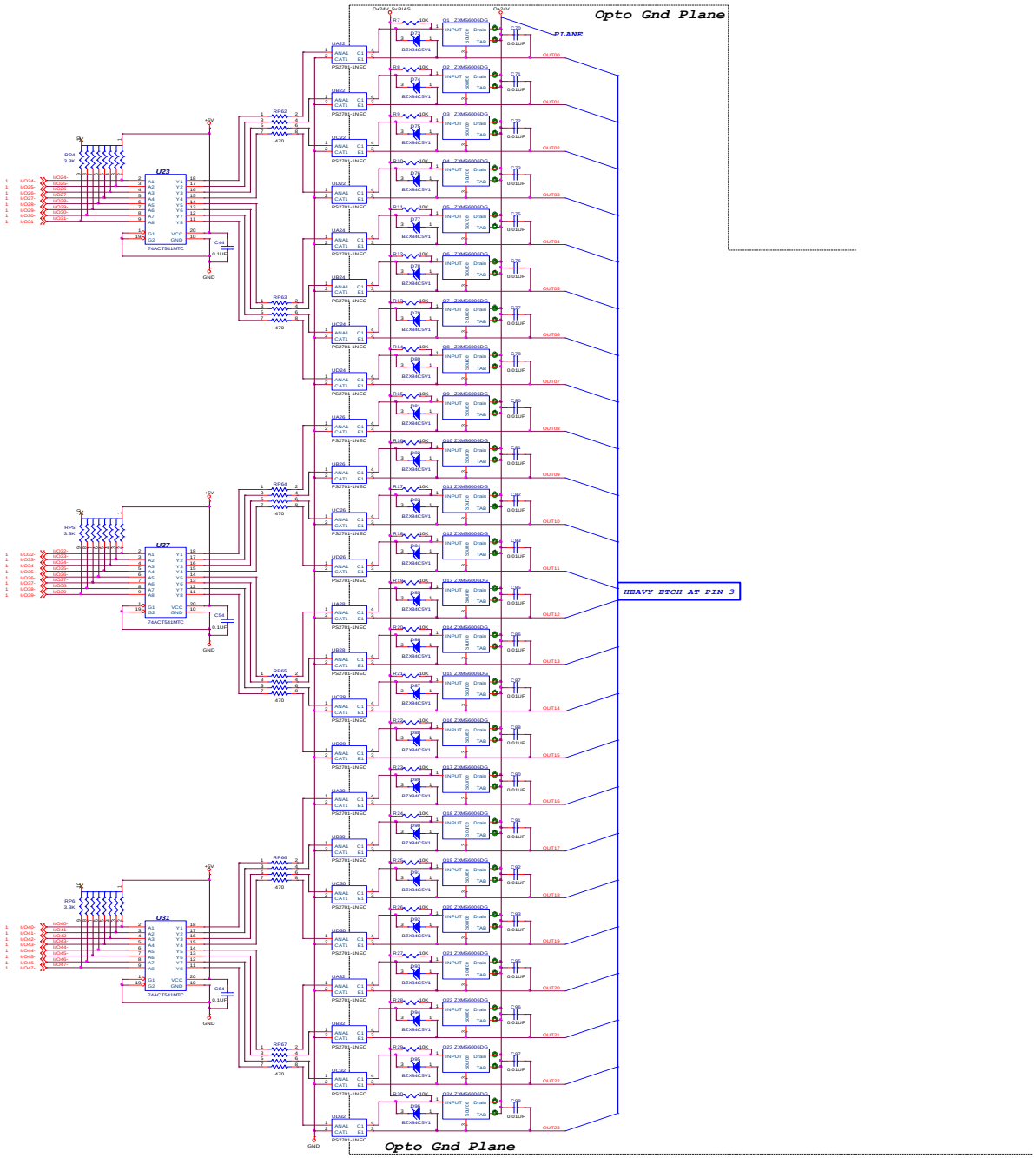
P1 UBUS (96-Pin Header)			
Pin #	**Row A**	**Row B**	**Row C**
1	+5 Vdc	+5 Vdc	+5 Vdc
2	GND	GND	GND
3	BD01	DAT0	BD00
4	BD03	SEL0	BD02
5	BD05	DAT1	BD04
6	BD07	SEL1	BD06
7	BD09	DAT2	BD08
8	BD11	SEL2	BD10
9	BD13	DAT3	BD12
10	BD15	SEL3	BD14
11	BD17	DAT4	BD16
12	BD19	SEL4	BD18
13	BD21	DAT5	BD20
14	BD23	SEL5	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	-15 Vdc	PWRGND	+15 Vdc
31	GND	GND	GND
32	+5 Vdc	+5 Vdc	+5 Vdc

APPENDIX A: E-POINT JUMPERS

Jumper	Configuration	Default
E1: 	➢ 1 to 2 Turbo/Power/MACRO CPUs Revision 104 or newer ➢ 2 to 3 for Legacy MACRO CPUs Rev. 103 or older	Factory Set
E2: 	➢ 1 to 2 to sample at Servo Rate ➢ 2 to 3 to sample at Phase Rate	1 – 2

APPENDIX B: SCHEMATICS




Opto Gnd Plane
PLANE
HEAVY ETCH AT PIN 3
Opto Gnd Plane
U23
U27
U31
74ACT541MTC
PS2701-1NEC
BZX84C5V1
ZXM66003DG
OUT00
OUT01
OUT02
OUT03
OUT04
OUT05
OUT06
OUT07
OUT08
OUT09
OUT10
OUT11
OUT12
OUT13
OUT14
OUT15
OUT16
OUT17
OUT18
OUT19
OUT20
OUT21
OUT22
OUT23

APPENDIX C: USING THE ACC-65E IN C

This section shows how the ACC-65E can be programmed and used via the C programming language in Power PMAC.

ACC-65E C Library

Include the following header file (*acc65e.h*) into the Project:

```
#include <gplib.h>
#include <RtGpShm.h>   // Global Rt/Gp Shared memory pointers
//-----------------------------------------------------------------
// The following is a projpp created file from the User defines
//-----------------------------------------------------------------
#include "../../Include/pp_proj.h"

#define ON                    1       // Assumes that (logic high)=true
#define OFF                   0       // Assumes that (logic low)=false

void ACC65E_SetControlWord(unsigned int CardNumber);
unsigned int ACC65E_GetInputState(unsigned int CardNumber, unsigned int InputNumber);
unsigned int ACC65E_GetOutputState(unsigned int CardNumber, unsigned int OutputNumber);
void ACC65E_SetOutputState(unsigned int CardNumber, unsigned int OutputNumber, unsigned int
State);
```

Then put the following source code file (*acc65e.c*) into the same folder as the header above:

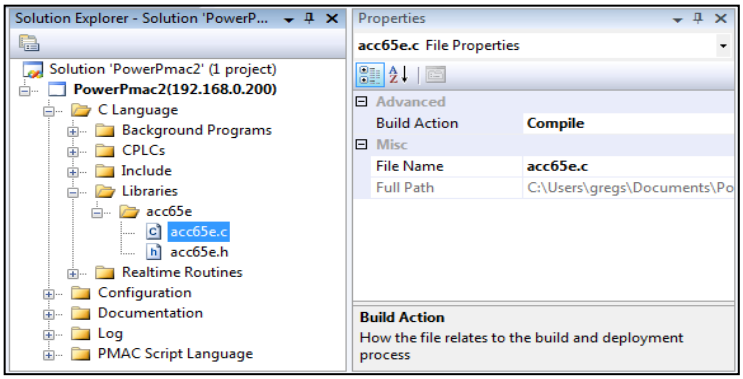
```
#include <gplib.h>
#include <RtGpShm.h>   // Global Rt/Gp Shared memory pointers
//-----------------------------------------------------------------
// The following is a projpp created file from the User defines
//-----------------------------------------------------------------
#include "../../Include/pp_proj.h"
#include "acc65e.h"

void ACC65E_SetControlWord(unsigned int CardNumber)
{
// CardNumber: Power PMAC I/O Card Index of this card (0-15)
        volatile unsigned int *ioptr;
        ioptr = piom + pshm->OffsetCardIO[CardNumber]/4 + 7;
        *ioptr = 7 << 8; // Shift 7 up 8 and write the value
        return;
}

unsigned int ACC65E_GetInputState(unsigned int CardNumber, unsigned int InputNumber)
{
// CardNumber: Power PMAC I/O Card Index of this card (0-15)
// InputNumber: Input Pin Number (1-24)
        volatile unsigned int *ioptr;
        InputNumber--;
        ioptr = piom + pshm->OffsetCardIO[CardNumber]/4;
        ioptr += InputNumber/8;
        // Shift all bits above the desired bit out
        // Then shift down to bit 0 and return
        return (unsigned int)((*ioptr << (31 - (InputNumber%8 + 8))) >> 31);
}

unsigned int ACC65E_GetOutputState(unsigned int CardNumber, unsigned int OutputNumber)
{
// CardNumber: Power PMAC I/O Card Index of this card (0-15)
// OutputNumber: Input Pin Number (1-24)
        volatile unsigned int *ioptr;
        OutputNumber--;
        ioptr = piom + pshm->OffsetCardIO[CardNumber]/4;
```

```
        ioptr += OutputNumber/8 + 3;
        // Shift all bits above the desired bit out
        // Then shift down to bit 0 and return
        return (unsigned int)((*ioptr << (31 - (OutputNumber%8 + 8))) >> 31);
}
void ACC65E_SetOutputState(unsigned int CardNumber, unsigned int OutputNumber, unsigned int
State)
{
// CardNumber: Power PMAC I/O Card Index of this card (0-15)
// OutputNumber: Input Pin Number (1-24)
// State: 1=ON, 0=OFF
        volatile unsigned int *ioptr;
        unsigned int HighBitInCorrectLocation;
        OutputNumber--;
        HighBitInCorrectLocation  = 1 << ((OutputNumber % 8) + 8);
        ioptr = piom + pshm->OffsetCardIO[CardNumber]/4;
        ioptr += OutputNumber/8 + 3;
        if(State == 1) // If the user wants the pin to be ON (high true)
        // Logical OR with the bit the user desires to activate
                *ioptr |= HighBitInCorrectLocation;
        else
        // Logical AND the register with a 0 in the desired location to bring the pin's state low
        // right shift to push out garbage in lowest 8 bits, then shift back up 8 bits to have
        // data in the proper location
                *ioptr &= (((~0)^HighBitInCorrectLocation) >> 8) << 8;
        return;
}
```

Locations for the C Files

Background C Programs

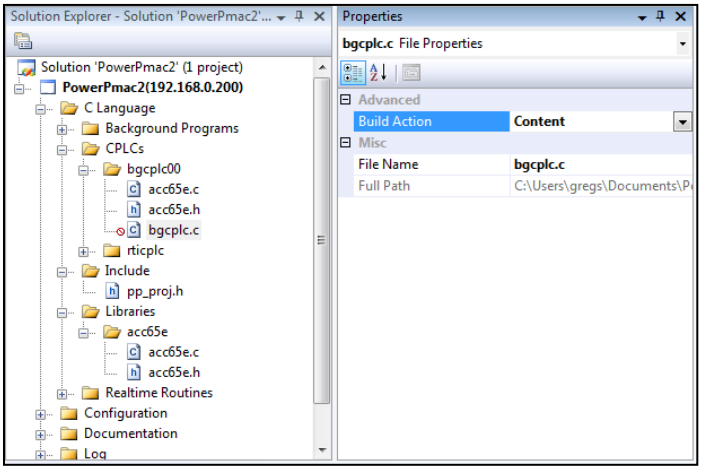
To use the above ACC-65E code in a Background C Program, make a new folder called “acc65e” in the C Language→Libraries folder under the Solution Explorer in the Power PMAC IDE. Then, put the code into this folder and make sure that the Build Action for acc65e.c under Properties is set to “Compile”. The Solution Explorer should then look something like the screenshot to the right.



Then, in the Background Program, include the header file with the following preprocessor directive:

```
#include "../../Libraries/acc65e/acc65e.h"
```

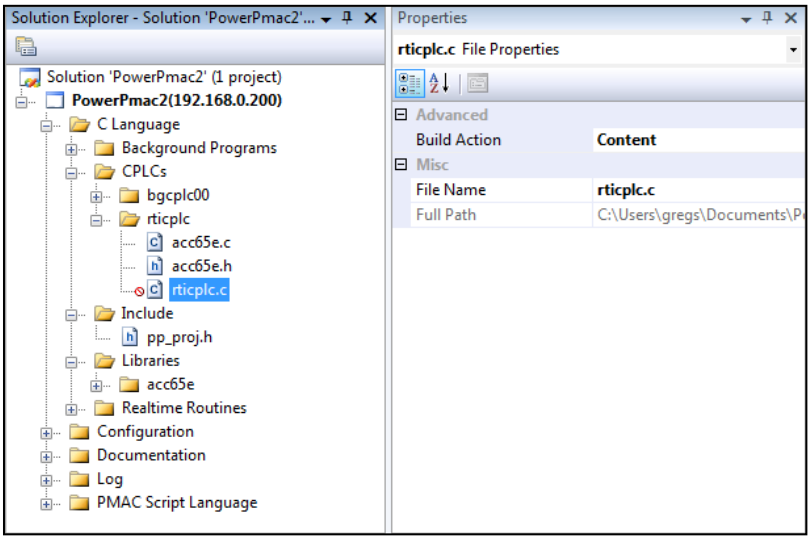
Background CPLCs (BGCPLCs) and Real-Time CPLCs (RTICPLCs)
To use the above code in a Background CPLC (BGCPLC), put *acc65e.h* and *acc65e.c* into the same folder as the BGCPLC. For example, when using BGCPLC00, Solution Explorer might look like the following:



Then, include the header file with the following preprocessor directive:

```
#include "acc65e.h"
```

The same is true for RTICPLCs:



Function Descriptions

ACC65E_SetControlWord()
Description
This function sets the control word of ACC-65E.

Input Arguments
CardNumber: The Power PMAC I/O Card Index of this card, given in the table in the Addressing ACC-65E section of this manual, corresponding to this card's I/O base address offset. Range: 0–15.

Return Value
None; returns void.

ACC65E_GetInputState()
Description
This function returns the state of the input pin specified.

Input Arguments
CardNumber: The Power PMAC I/O Card Index of this card, given in the table in the Addressing ACC-65E section of this manual, corresponding to this card's I/O base address offset. Range: 0–15.

InputNumber: The pin number of the input pin whose state the user desires to read. Inputs on ACC-65E are numbered 1–24, which is the range for this argument.

Return Value
Returns the state of the input pin:
0 = False/Low/Off
1 = True/High/On

ACC65E_GetOutputState()
Description
This function returns the state of the output pin specified.

Input Arguments
CardNumber: The Power PMAC I/O Card Index of this card, given in the table in the Addressing ACC-65E section of this manual, corresponding to this card's I/O base address offset. Range: 0–15.

OutputNumber: The pin number of the output pin whose state the user desires to read. Outputs on ACC-65E are numbered 1–24, which is the range for this argument.

Return Value
Returns the state of the input pin:
0 = False/Low/Off
1 = True/High/On

ACC65E_SetOutputState()
Description
This function sets the state of the output pin specified.

Input Arguments
CardNumber: The Power PMAC I/O Card Index of this card, given in the table in the Addressing ACC-65E section of this manual, corresponding to this card's I/O base address offset. Range: 0–15.

OutputNumber: The pin number of the output pin whose state the user desires to set. Outputs on ACC-65E are numbered 1–24, which is the range for this argument.

Return Value
None; returns void.

Example

Getting Inputs and Setting Outputs in a BGCPLC
For a single ACC-65E at I/O base offset $B00000, this BGCPLC reads inputs 1–24, storing the values in P100–P123, respectively, and writes to outputs 1–24 using values stored in P200–P223, respectively. The states of output pins 1-24 are read and then stored in P300–P323, respectively, for sake of comparison or demonstration purposes.

```
#include <gplib.h>
#include <stdio.h>
#include <dlfcn.h>

#include "../../Include/pp_proj.h"
#include "acc65e.h"

#define ACC65E_CardNumber     1 // for base offset of $B00000

void user_plcc()
{
        unsigned int ChannelNumber, ArrayIndex;
        for(ChannelNumber = 1; ChannelNumber < 25; ChannelNumber++)
        { // Cycle through all 24 channels
                ArrayIndex = ChannelNumber - 1; // Convert channel number to array index
                // Get the states of input pins 1-24 and store the states in P100-P123
                pshm->P[100 +
ArrayIndex]=(double)ACC65E_GetInputState(ACC65E_CardNumber,ChannelNumber);
                // Set the states of output pins 1-24 to the values stored in P200-P223
                ACC65E_SetOutputState(ACC65E_CardNumber,ChannelNumber,(unsigned int)pshm->P[200 +
ArrayIndex]);
                // Get the states of output pins 1-24 and store the states in P300-P323
                pshm->P[300 +
ArrayIndex]=(double)ACC65E_GetOutputState(ACC65E_CardNumber,ChannelNumber);
        }
        return;
}
```