Automation Products

OPTO 22

HARNESSING THE POWER OF THE PC FOR INDUSTRIAL AUTOMATION

PAMUX B4
Digital Brain Board
for use with
G4PB32H and PB32HQ
I/O Mounting Racks

Form 127.7

This technical document describes the features, specifications, and operations of the product.

The information in this manual has been carefully checked and is believed to be accurate; however, no responsibility is assumed for possible inaccuracies or omissions. Specifications are subject to change without notice.

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This warranty is limited to the original cost of the unit only and does not cover installation labor or any other contingent costs.

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Introduction

PAMUX is a high speed, high density, distributed I/O system. Connection to a host computer parallel port is via a 50-conductor, flat-ribbon cable. The cable can be up to 500 feet in length. Up to 512 I/O points can be daisy-chained from one ribbon cable.

Speed

The host computer can read or write eight I/O points to the PAMUX bus in under three microseconds. All 512 points of I/O can be accessed in under 200 microseconds.

Density

Each B4 Brain Board accommodates eight Quad Pak modules, giving you 32 points of I/O on a board 6.5 inches by 11.5 inches.

Distributed

The PAMUX bus is a distributed system. Using a 50-conductor ribbon cable, PAMUX Brain Boards may be located up to 500 feet from the host computer.

Environmental Specifications

Temperature:	0° to 60° C
Relative Humidity:	0 to 95%, non-condensing

System Configuration

The high cost of electrical wiring makes it desirable to place the control or monitoring point as close to the controlled device as possible.

As long as the total cable length is less than 500 feet, the PAMUX bus can be installed anywhere along the 50-conductor ribbon cable. This provides you with total flexibility in laying out your system. Figures 1, 2, and 3 below and on the next page illustrate several possible system configurations.

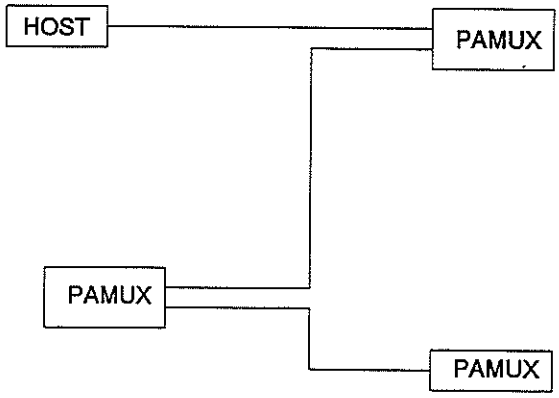


Figure 1
PAMUX Distributed System

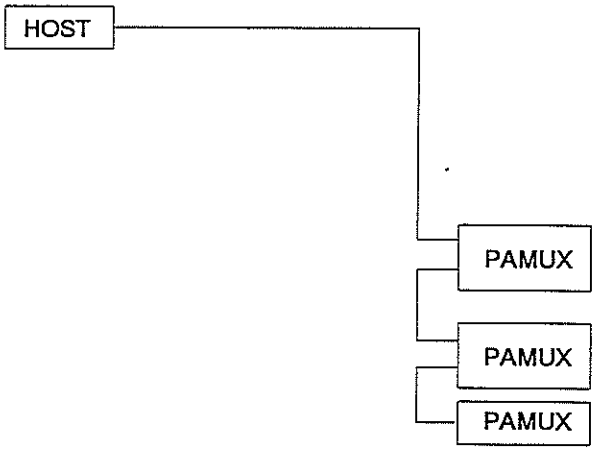


Figure 2
PAMUX Cluster System

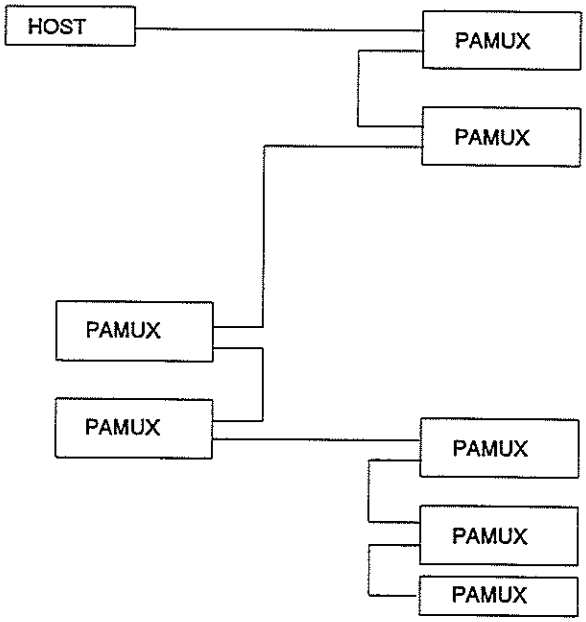


Figure 3
PAMUX Distributed Cluster System

PAMUX Boards

A PAMUX station is composed of two boards (three, if the terminator is installed): a brain board, part number B4, and a digital I/O mounting rack, part numbers G4PB32H or PB32HQ. If the PAMUX is the last board on the PAMUX bus, the terminator board, part number TERM1, must also be installed.

I/O Mounting Racks

Two I/O mounting racks are availible for the PAMUX B4 Brain Board. The first, G4PB32H, utilizes our single point G4 I/O modules. This rack offers a dense footprint per point ratio and also provides I/O configuration on a point-by-point basis. The second I/O board is the PB32HQ which provides the same basic footprint as the G4PB32H but uses our Quad Pak I/O modules. Quad Paks contain four discrete modules in one package and so are configurable on four point increments.

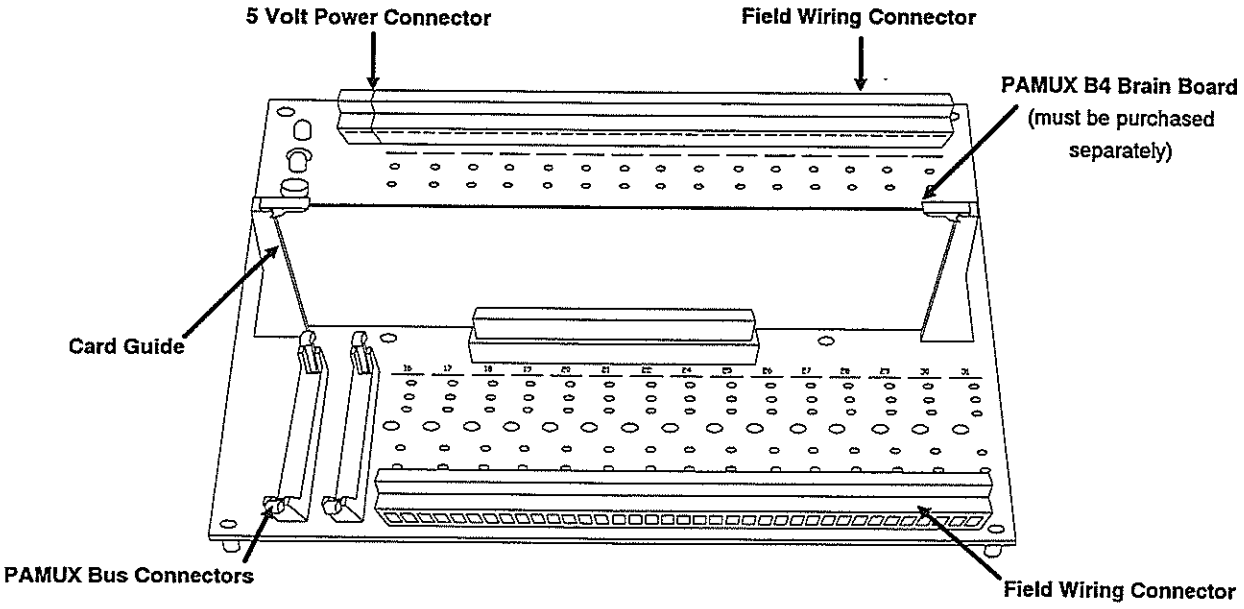


Figure 4
G4PB32H I/O Mounting Rack

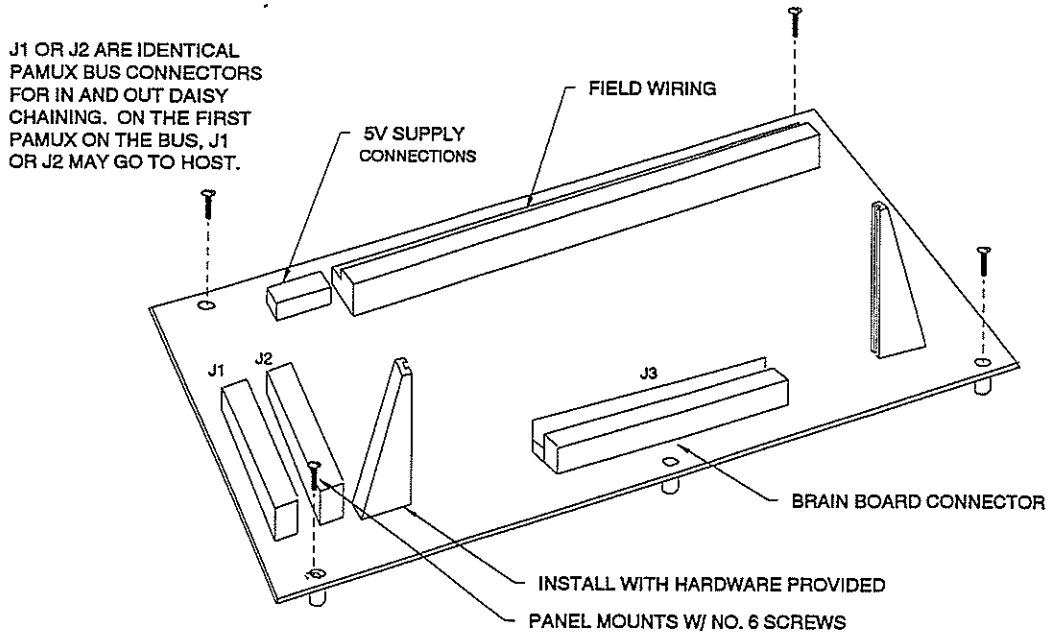


Figure 5
PB32HQ I/O Mounting Rack

PAMUX Brain Board

The PAMUX Brain Board (B4, Figure 6) is a 9.25 by 2.9 inch board. There is a 70-pin header connector on the bottom edge of the brain board used for connecting to the digital I/O mounting rack. When mounted, the component side of the brain board should be facing away from the Quad Pak I/O modules, Figure 7.

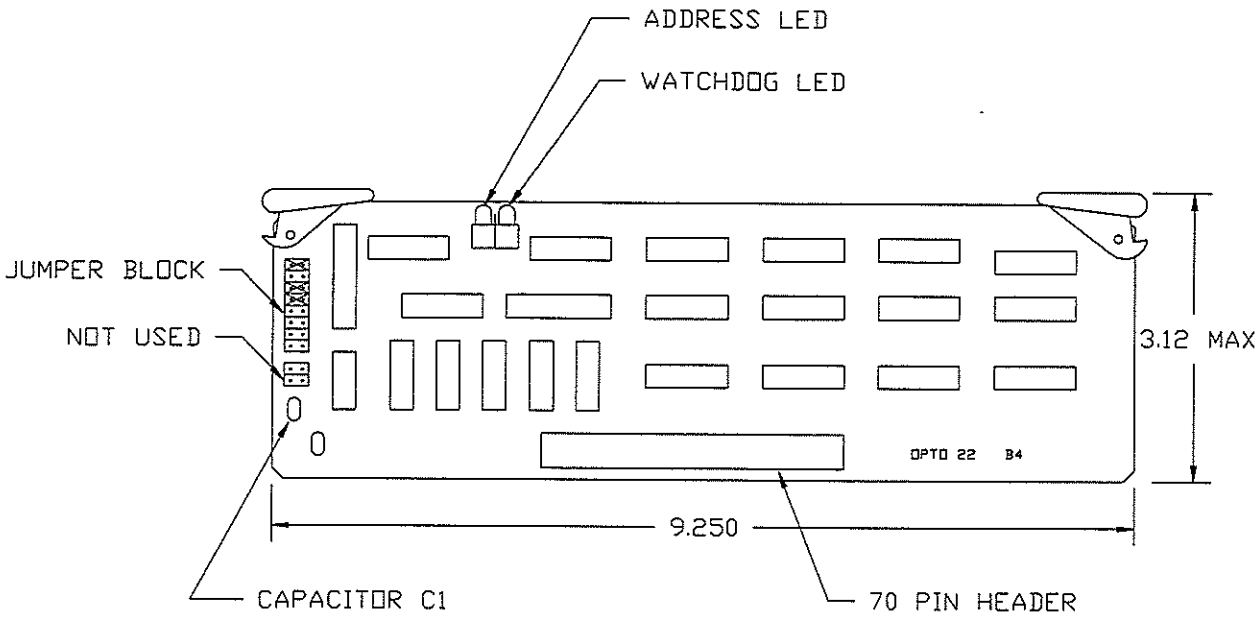


Figure 6
B4 PAMUX Brain Board

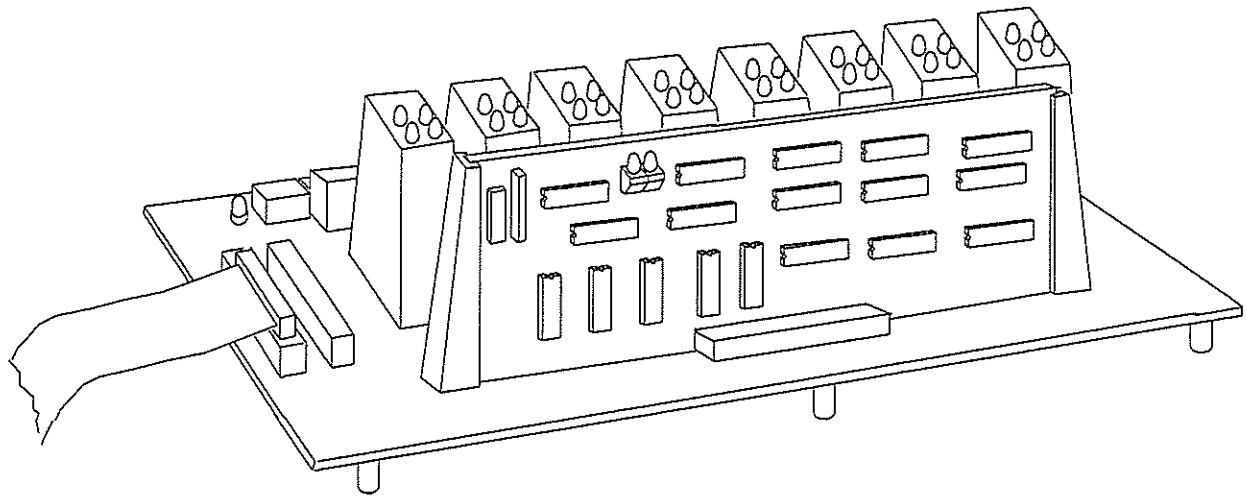


Figure 7
B4 Installed on a PB32HQ I/O Mounting Rack

Addressing

The PAMUX data bus is 8-bits wide, while the PAMUX station contains 32 points of I/O. Therefore, to access all 32 points, the B4/PB32HQ is composed of four consecutive banks of eight I/O channels. Each bank has its own address. When selecting the jumpers for a PAMUX address, you are actually selecting a base address for the banks on the PAMUX station. Examine the table below for address jumpering of the PAMUX bus.

Base Address of PAMUX	Jumper Positions 4	3	2	1
0	O	O	O	O
4	O	O	O	X
8	O	O	X	O
12	O	O	X	X
16	O	X	O	O
20	O	X	O	X
24	O	X	X	O
28	O	X	X	X
32	X	O	O	O
36	X	O	O	X
40	X	O	X	O
44	X	O	X	X
48	X	X	O	O
52	X	X	O	X
56	X	X	X	O
60	X	X	X	X

Note: X means that a jumper is present, O means that no jumper is present.

The four banks on the PAMUX have contiguous addresses. The bank 0 address is the same as the base address of the PAMUX, bank 1 address is the base address plus 1, bank 2 address is the base address plus 2, and the bank 3 address is the the base address plus 3. Figure 8 below shows the bank address layout for the PB32HQ I/O mounting rack.

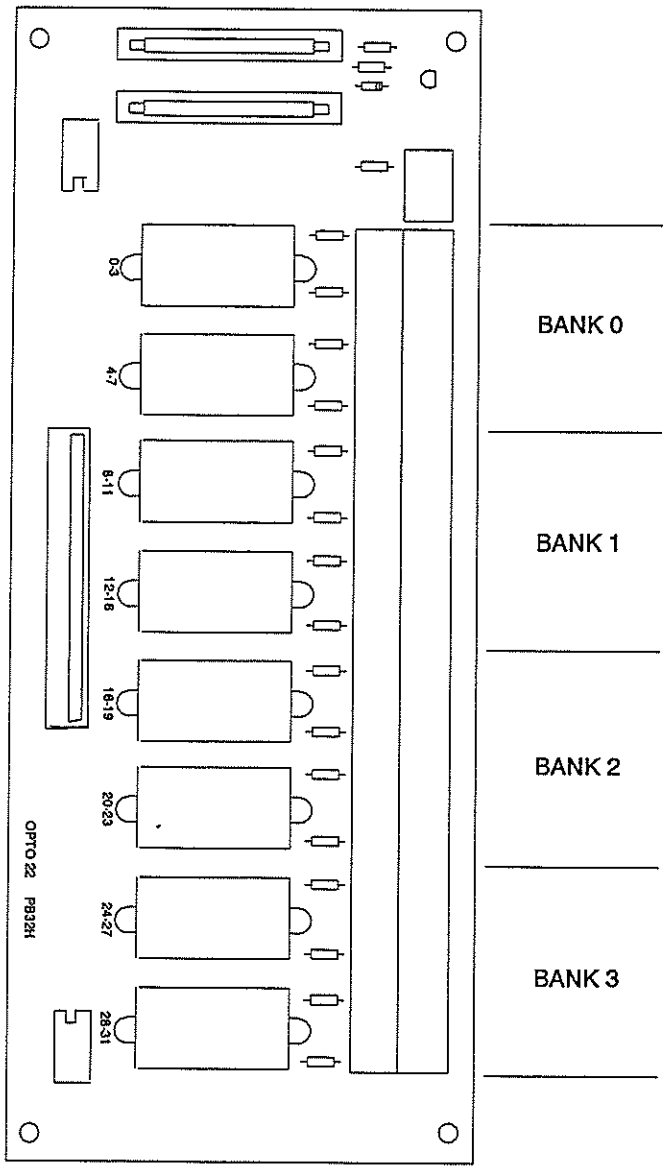


Figure 8
PB32HQ Bank Addess Layout

Watchdog

A "watchdog timer" is a method of shutting down your process when your host computer goes off-line. The "watchdog timer" on the PAMUX depends on a periodic read or write strobe from the host computer. The individual PAMUX need not be addressed. The absence of a strobe for a specified time will activate the "watchdog" function. There are four possible actions that can be taken on a time-out. The following table shows the jumpering for all possible watchdog functions.

Watchdog Functions	Jumper Positions 6	5
No action.	X	X
Activate relay Channel 0.	X	O
Deactivate all relay channels.	O	X
Activate relay Channel 0 and deactivate relay Channels 1 through 31.	O	O

Note: X means that a jumper is present, O means that no jumper is present.

The factory setting for the watchdog time interval is 500 milliseconds. This time can be varied from one (1) millisecond to 11.7 seconds by using different values of capacitor C1 in the 0.001 to 22 microfarad range. The following table shows typical capacitor values that may be used for various "watchdog" time-out values.

C1 (Microfarads)	Time-out (Seconds)
1.0	0.5
2.2	1.2
4.7	2.5
10.0	5.3
22.0	11.7

Reset

One of the control lines on the PAMUX bus is called "RESET." The "RESET" line is used for turning off the relays on all the PAMUX stations on the bus. Two jumpers control the way that the "RESET" line affects the PAMUX bus. Jumper 7 is for the selection of the polarity of the reset (active high or active low).

Reset Level	Jumper 7
Active high.	X
Active low.	O

Note: X means that a jumper is present, O means that no jumper is present.

Jumper 8 is for the selection of how the "RESET" line affects the "watchdog timer" circuitry. If jumper 8 is installed and the "RESET" line is made active, the "watchdog timer" circuitry will be disabled. If a time-out occurs after the reset line is made active, no "watchdog" action will occur. If a time-out occurs before the the reset line is made active, the reset will deactivate all modules except for module zero. If module zero was on, it will still be on (it can be cleared by doing a read or write on the PAMUX bus).

Terminator Board

For the PAMUX stations to operate correctly, both ends of the bus MUST be terminated. The host computer and the last PAMUX on the bus are the only devices that should have termination resistors installed. If you are using Opto 22's PAMUX adapter cards, their have the termination resistors designed into the adapter cards.

The PAMUX bus terminator board (TERM1) is a 1.25 by 2.65 inch board with a four inch, red wire. The TERM1 board plugs into the J1 or J2 connector on the PB32HQ I/O mounting rack. The component side of the terminator board will be facing away from the Quad Pak modules when installed and the red wire connects to the + 5 VDC terminal. Figure 9 illustrates the proper installations of the terminator board.

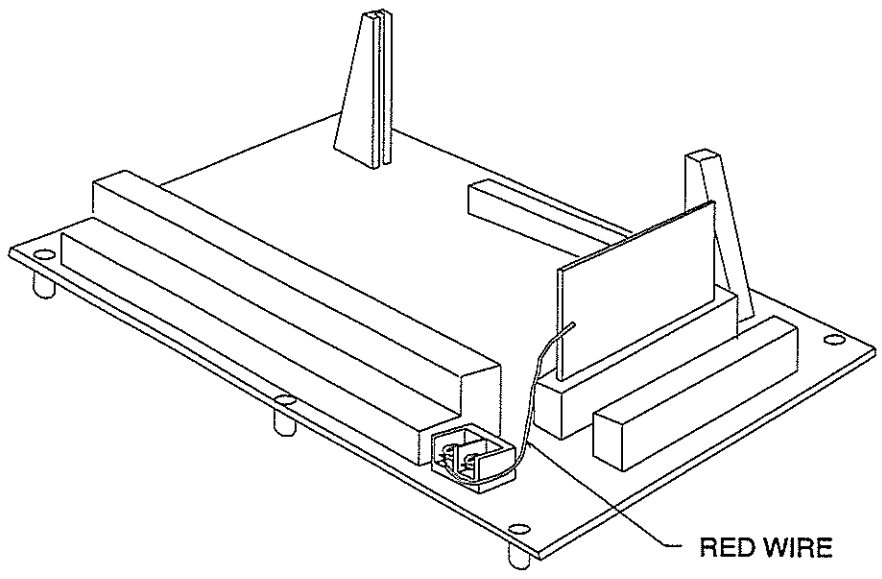


Figure 9
TERM1 Installed on a PB32HQ I/O Mounting Rack

Note: The red wire attaches to the +5 VDC terminal.

Cables and Connectors

The PAMUX bus is connected to a host computer via a 50-conductor, flat ribbon cable. Opto 22 provides a number of pre-assembled cables. Examine the table below for the Opto 22 cables:

Length (Feet)	Part Number
1.5	HH1.5
2	HH2
4	HH4
6	HH6
8	HH8
10	HH10

The maximum allowable length of the PAMUX bus is 500 feet. If the cables offered by Opto 22 do not meet your needs, the table below lists several cable types available.

Cable Type	3m Part Number	Alpha Part Number
REGULAR	3365/50	3580/50 or 3583/50
GROUND PLANED	3353/50 or 3469/50 or 3476/50	3584/50
JACKETED	3603/50	3589/50
JACKETED AND GROUND PLANED	3517/50	3590/50

The following connectors will work with any of the ribbon cables on the previous page:

Manufacturer	Connector Part Number
3M	3425-7000
Circuit Assembly	CA-50IDSB

Modules

The table below lists the various Opto 22 Quad Pak I/O modules available for the PB32HQ I/O mounting rack.

Input Modules	
4 - 16 VDC (fast response)	IDC5BQ
10 - 32 VDC	IDC5Q
15 - 32 VDC	IDC5Q
90 - 140 VAC/VDC	IAC5Q
180 - 280 VAC/VDC	IAC5AQ

Output Modules	
5 - 60 VDC	ODC5Q
12 - 280 VAC	OAC5Q

Power Supply

Each PAMUX station requires a power supply of + 5 VDC at 0.5 amps. The PAMUX station, which has a terminator board installed, will required an additional 1.0 amps (the total for a terminated PAMUX station is 1.5 amps). To assure proper operation, the voltage at each PAMUX station should be between 5.0 and 5.1 VDC. The following is a list of some power supply manufacturers:

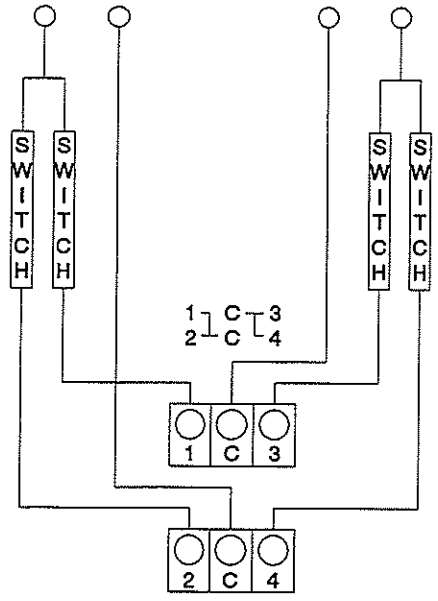
ACOPIAN CORP.
P.O. Box 638
Easton, PA 18044
215-258-5441

POWER-ONE LINEAR PRODUCTS
740 Calle Plano
Camarillo, CA 93010-8583
Outside California: 800-235-5943
From California: 800-421-3439

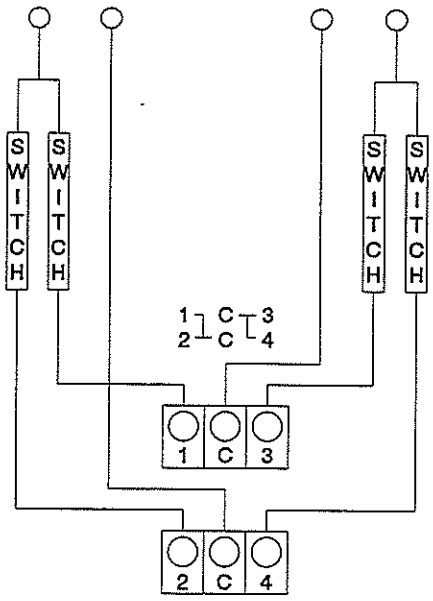
PACKAGED POWER
2981 Gateway Drive
Pompano Beach, FL 33069
305-974-2442

Wiring Diagrams

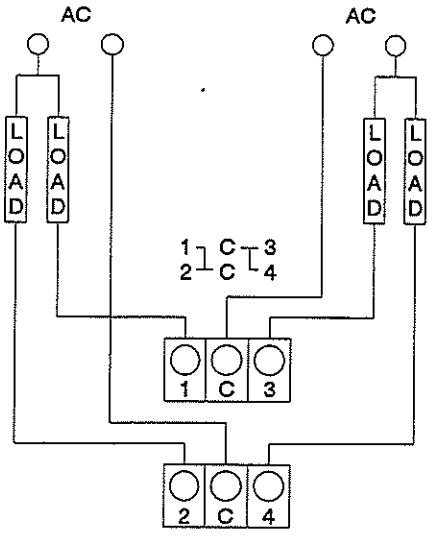
Two circuits in each Quad Pak module share a common fuse. In each module, channels 1 and 2 share the common connection on the upper row barrier strip, channels 3 and 4 share the common connection on the lower row barrier strip. Figure 10 below, illustrates the proper wiring of field devices to the Quad Pak I/O modules.



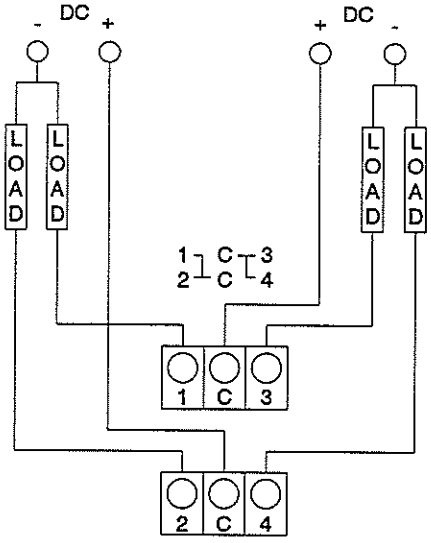
AC INPUT MODULE



DC INPUT MODULE



AC OUTPUT MODULE



DC OUTPUT MODULE

Figure10
Quad Pak I/O Module Field Wiring

Accessories

AC28

The AC28 is an IBM PC/XT/AT adapter card to the PAMUX bus. The AC28 will also work in an IBM PS/2 Model 30 and Model 30 286 computer. Up to four of these cards may be used in your IBM, giving you control of up to 2048 points of I/O.

AC36

The AC36 provides a PAMUX bus interface for a TTL parallel port. Compatible products include parallel port devices for MULTIBUS, STD, and VME bus products.

UCA4

The UCA4 is a universal interface card to the PAMUX bus. This card will allow you to interface a general purpose parallel port to the PAMUX bus.

Bus Layout

To implement the PAMUX bus, a UCA4 or AC36 adapter card and a 17-line, parallel port is required. The port is configured as 8 data lines, 6 address lines, a read strobe line, a write strobe line, and a reset line. The Opto 22 pinout for the header connector is as follows:

Pin Number	Signal Function
1	Address line 0
3	Address line 1
5	Address line 2
7	Address line 3
9	Address line 4
11	Address line 5
13	Write strobe line
15	Read strobe line
33	Data line 7
35	Data line 6
37	Data line 5
39	Data line 4
41	Data line 3
43	Data line 2
45	Data line 1
47	Data line 0
49	Reset line

Used to select the group of 8 points
0 - 63

0 = off = false
1 = on = true

Note: All even numbered pins on the connector are connected to logic ground.

Bus Timing

Write Timing

The PAMUX write timing is very simple to generate. The first thing to do is to apply the PAMUX address and data signals on the bus, wait at least 100 nanoseconds, then activate the write strobe for at least 2000 nanoseconds. When you deactivate the write strobe, the data will be latched on the addressed PAMUX station. The address lines must be held stable for a minimum of 100 nanoseconds after the write strobe is brought low. Figure 11 shows the minimum bus timing for a PAMUX bus write cycle.

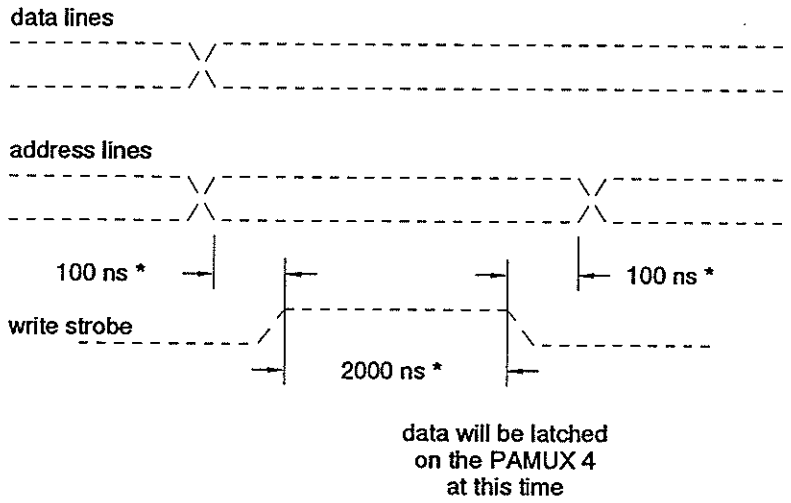


Figure 11
PAMUX Timing for a Write Cycle

Read Timing

To generate the PAMUX bus read cycle, apply the PAMUX address to the bus, wait at least 100 nanoseconds, activate the read strobe and after 2000 nanoseconds the data will be available. Read the data and deactivate the read strobe. Figure 12 shows the minimum bus timing for a PAMUX bus read cycle.

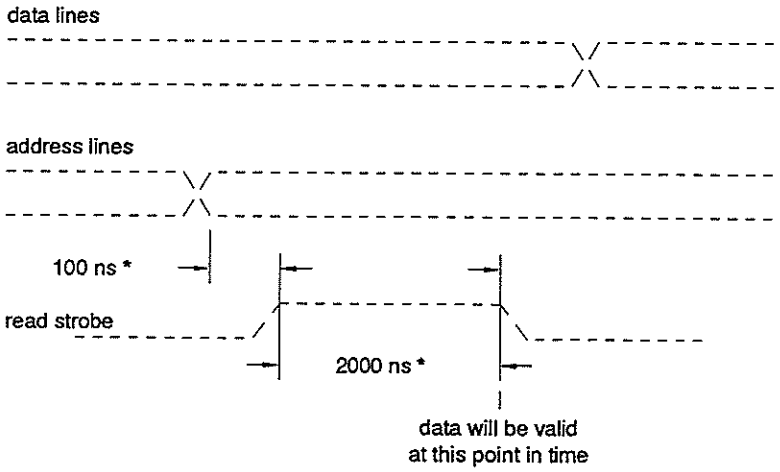


Figure 12
PAMUX Timing for a Read Cycle

Troubleshooting

Check the + 5 VDC supply at each PAMUX station (not at the power supply). The voltage should be between 5.0 and 5.1 VDC.

Install jumpers 5 and 6 to disable the watchdog timer while you are troubleshooting the system.

Verify that only the last PAMUX station on the bus has the terminator board (TERM1) installed.

Write a program to continually read one board. This will keep the ADDRESS LED on the B4 flashing. The example below was used on an IBM AT with an AC28 PAMUX adapter card.

```
110   '
120   '       This example is for an IBM PC/XT/AT and an
130   '       AC28 PAMUX adapter card.
140   '       The AC28 is addressed at 180 Hex and the
150   '       B4 Brain Board is addressed at 12.
160   '
170   '       Read Lower 8 Modules
180   '
190   '
200   BASE% = &H180                 'AC28 Address
210   BOARD% = 12                   'B4 Address
220   A% = INP(BASE% + BOARD%)      'Read B4 Brain Board
230   GOTO 220                      'Loop Back To Reading B4 Brain Board
```

While the program is running, does the correct board's ADDRESS LED light? If not, it may mean that the board is jumpered for the wrong reset level (jumper 7). Change the reset level and run the program again.

Does address LED light now? If not, please call Technical Support at 1-800-321-OPTO (6786) or 909-695-9299.

Programming

You must be careful when to the PAMUX units. When you are writing to a relay bank that has input and output modules, you MUST make sure to write zeros to input module positions. If you write a 1 to an input module, the module will read back as being active even if it is inactive.

The following BASIC example illustrates how to use a simple "ANDing" technique to maintain input integrity. Relay bank 1 on PAMUX unit 12 has four input channels and four output channels. The inputs are channels 0 - 3. Notice line 1120, the "AND &HFO" is done to guarantee that zeros will be written to the inputs.

```
1040    '
1050    '           read bank 1 on board addressed as 12
1060    '
1070    TEMP% = INP (AC28.BASE% + 12 + 1)
1080    '
1090    '
1100    '           set bit for module 6 to be turned on
1110    '
1120    TEMP% = (TEMP% or &H40) AND &HFO
1130    '
1140    '
1150    '           write new value to bank 1 on board 12
1160    '
1170    OUT AC28.BASE + 12 + 1, TEMP%
1180    '
```

Software Driver

The PAMUX Analog/Digital driver is an assembly language subroutine that provides an interface between a PAMUX network and applications programs written in high level languages.

The driver allows the programmer to talk to PAMUX by simply calling a subroutine.

The driver performs the following functions:

- Converts the data returned by PAMUX to a forms that is easily manipulated in a high level language.
- Carries out all the necessary handshaking with the PAMUX bus.
- Transparently handles input masking on writes
- Performs error checking and returns diagnostics codes.

This saves you time and effort that would be spent becoming familiar with the intricacies of the PAMUX bus structure.

To use the driver in your application program, you need to know the following:

- How to call an assembly language subroutine from the language you have chosen to wrote your application.
- How to tell the driver what PAMUX command to send by assigning values to parameters.
- How to interpret the data passed back by the driver.

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For more information call: 1-800-321-OPTO (1-800-321-6786) or (909)695-3000
For Technical Assistance call our 24 hour Hotline: 1-800-HLP-OPTO (1-800-457-6786)
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