ARTISAN®
TECHNOLOGY GROUP

Your **definitive** source for quality pre-owned equipment.

Artisan Technology Group
(217) 352-9330 | sales@artisantg.com | artisantg.com

Full-service, independent repair center
with experienced engineers and technicians on staff.

We buy your excess, underutilized, and idle equipment
along with credit for buybacks and trade-ins.

Custom engineering
so your equipment works exactly as you specify.

- Critical and expedited services
- In stock / Ready-to-ship
- Leasing / Rentals / Demos
- ITAR-certified secure asset solutions

Expert team | Trust guarantee | 100% satisfaction

All trademarks, brand names, and brands appearing herein are the property of their respective owners.

Find the *Keithley / MetraByte PIO-12* at our website: *Click HERE*

PIO-12 User's Guide

Revision D - April 1994
Part Number: 64190

The information contained in this manual is believed to be accurate and reliable. However, Keithley Instruments, Inc., assumes no responsibility for its use or for any infringements of patents or other rights of third parties that may result from its use. No license is granted by implication or otherwise under any patent rights of Keithley Instruments, Inc.

KEITHLEY INSTRUMENTS, INC., SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES RELATED TO THE USE OF THIS PRODUCT. THIS PRODUCT IS NOT DESIGNED WITH COMPONENTS OF A LEVEL OF RELIABILITY SUITABLE FOR USE IN LIFE SUPPORT OR CRITICAL APPLICATIONS.

Refer to your Keithley Instruments license agreement and Conditions of Sale document for specific warranty and liability information.

MetraByte is a trademark of Keithley Instruments, Inc. All other brand and product names are trademarks or registered trademarks of their respective companies.

© Copyright Keithley Instruments, Inc., 1991, 1993, 1994.

All rights reserved. Reproduction or adaptation of any part of this documentation beyond that permitted by Section 117 of the 1976 United States Copyright Act without permission of the Copyright owner is unlawful.

Keithley MetraByte Division

Keithley Instruments, Inc.

440 Myles Standish Blvd. Taunton, MA 02780

Telephone: (508) 880-3000 • FAX: (508) 880-0179

Table of Contents

Preface

1 Overview

General Description 1-1
Features and Operating Characteristics 1-2
Accessories 1-2

2 Installation

Unpacking and Inspecting 2-1
Setting the Switches and Jumpers 2-2
Setting the Base Address. 2-3
Setting the J8 Slot/Wait State Switch 2-4
Configuring the Interrupt Level 2-4
Installing the Board 2-5
Using Power from the PIO-12 2-6

3 Cabling and Wiring

Attaching Accessories 3-2
Attaching an STC-37 Accessory 3-3

4 Programming

Port Configuration 4-2
Programming Examples. 4-5
Writing the Control Register. 4-5
Basic I/O Operations. 4-5
Reading BCD Data 4-5
Bit Operations 4-5
Programming Notes 4-6
Interpreted Basic 4-6
I/O Commands 4-6
PIO-12 Interrupt Channel 4-7
Assembly Language 4-7

5 Troubleshooting
Problem Isolation 5-1
Identifying Symptoms and Possible Causes 5-1
Testing the Board and Host Computer 5-3
Testing the Accessory Slot and I/O Connections 5-4
Technical Support 5-5

A Specifications

B Connector Pin Assignments

Index

List of Figures

Figure 1-1. Block Diagram of the PIO-12 1-1
Figure 2-1. Switch and Jumper Locations 2-2
Figure 3-1. Pin Assignments for the Main I/O Connector 3-1
Figure 3-2. Attaching Accessories through a C-1800 or S-1800 Cable 3-2
Figure 3-3. Layout of STC-37 Screw Terminal Connector Panel 3-3
Figure 3-4. Attaching an STC-37 Accessory 3-4
Figure B-1. Main I/O Connector Pin Assignments B-1

List of Tables

Table 2-1. Values of Base Address Switch Positions 2-3
Table 2-2. Standard Address Assignments 2-3
Table 2-3. Standard Interrupt Usage 2-5
Table 4-1. 8255 PPI Address Map 4-2
Table 4-2. Derivation of Port Configuration from Control Word 4-3
Table 4-3. PIO Control Word 4-4
Table 5-1. Troubleshooting Information 5-2
Table A-1 Input and Output Specifications A-1
Table A-2 Environmental Specifications A-2

Preface

The *PIO-12 User's Guide* describes how to set up, install, and program the PIO-12 digital I/O interface board.

This guide serves data acquisition system designers, engineers, programmers, and other users responsible for setting up, cabling and wiring signals to PIO-12 boards in an IBM® PC/XT™, PC AT®, or compatible computer. Users are assumed to be familiar with data acquisition principles, with their application, and with the programming language used with the PIO-12.

The *PIO-12 User's Guide* is organized as follows:

- Chapter 1 provides an overview of the hardware, a block diagram, and a description of PIO-12 features.
- Chapter 2 describes how to inspect, set up, and install the board.
- Chapter 3 describes how to connect accessories and wire applications to the board.
- Chapter 4 describes programming requirements of the board.
- Chapter 5 describes common problems and solutions, troubleshooting procedures, and how to obtain technical support.
- Appendix A contains PIO-12 specifications.
- Appendix B contains pin assignments for the main connector of the PIO-12 board.

1

Overview

General Description

The PIO-12 is a 24-line, parallel, digital I/O interface board for IBM PC/XT, PC AT, and compatible computers. This board provides a flexible interface for a variety of parallel I/O devices, including instruments, displays and user-assembled systems. Figure 1-1 shows a block diagram of the PIO-12.

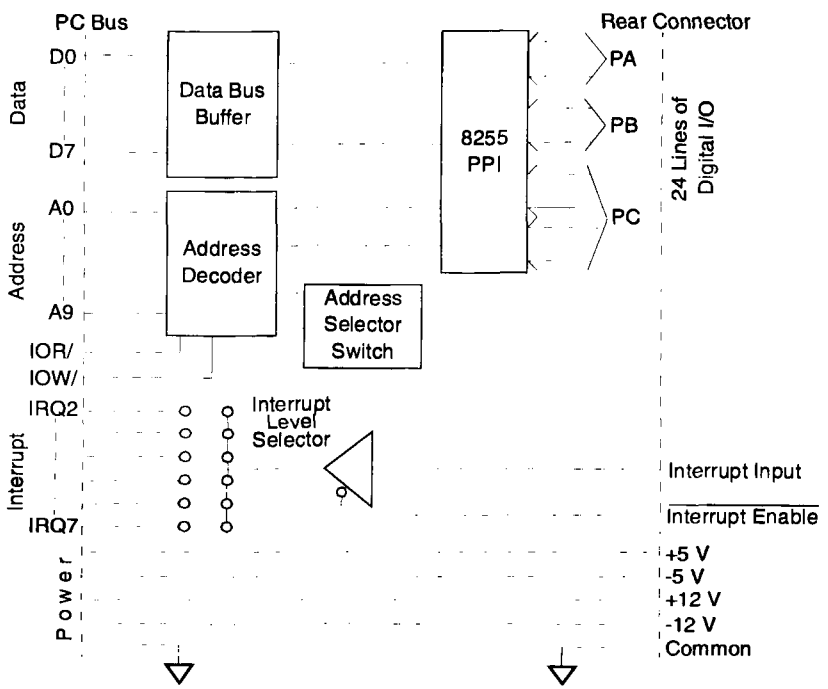


Figure 1-1. Block Diagram of the PIO-12

Features and Operating Characteristics

PIO-12 features and operating characteristics are described as follows:

- The PIO-12 has three TTL/CMOS-compatible, digital I/O ports: port A, port B, and port C. Ports A and B are both byte-wide (8-bits) and can be inputs or outputs. Port C is also byte-wide but is configurable as two separate 4-bit ports (port C Lower and port C Upper), each of which can be an input or output.

- The PIO-12 has an interrupt input channel with a corresponding interrupt-enable line. A PIO-12 interrupt can be directed to any of six interrupt levels available on the PC bus.

- The PIO-12 features its own enable line, which can be tri-stated (interrupt enable - active low). The 8259 Interrupt Controller of the computer handles interrupts and is set by the computer BIOS to respond to positive-edge-triggered (low-high) inputs. You must program the 8259 to respond to your application's requirements by setting up the corresponding interrupt handlers.

- The PIO-12 performs 10-bit I/O address decodes and communicates with the PC Bus as an 8-bit peripheral. The address map uses four consecutive I/O addresses. Multiple PIO-12 boards can be installed in a computer at different base addresses.

- Power levels of +5 V, -5 V, +12 V, and -12 V from the computer are available through the main I/O connector of the PIO-12. If you plan to use power from the PC, you should consider the power draw of all system devices and observe current-capacity limits of the computer.

Accessories

The following accessories are available for use with PIO-12 boards.

- **STA-U** - screw terminal accessory. This accessory connects to the main I/O connector of the PIO-12 through a C-1800 cable to make all I/O signals accessible through labeled screw terminals.

- **STC-37** - screw terminal connector panel. This accessory connects directly the the main I/O connector of the PIO-12 to provide general-purpose screw-terminal connections in a compact form factor.

- **SSIO-24** - 24-channel mounting panel for up to 24 solid-state, miniature I/O modules with functions of DC input, DC output, AC input, and AC output. The SSIO-24 connects to the main I/O connector of the PIO-12 through a C-1800 cable.

- **SRA-01** - 8-channel mounting panel for up to eight solid-state, miniature I/O modules. The SRA-01 connects to the main I/O connector of the PIO-12 through a C-1800 cable.

- **ERB-24** - electrical relay board. This accessory provides 24 electromechanical double-pole, double-throw relays for controlling and switching up to 3 A at 120 V_{rms}. The ERB-24 connects to the main I/O connector of the PIO-24 through a C-1800 cable.

- **ERA-01** - electrical relay accessory containing eight single-pole, double-throw relays that can switch up to 3 A at 120 V_{rms}.

- **C-1800** - cable. The C-1800 is an 18-inch ribbon cable terminated at both ends with 37-pin D-type connectors.

- **S-1800** - cable. The S-1800 is a shielded version of the C-1800.

Refer to Chapter 4 for cable connections for these accessories.

2

Installation

This chapter contains instructions for installing the PIO-12 board. The installation task includes three basic steps: unpacking and inspecting the board, setting the configuration switches and jumpers, and installing the board in the computer. These steps are described in the sections that follow.

Unpacking and Inspecting

Caution: A discharge of static electricity from your hands can seriously damage certain electrical components on any circuit board. Before handling any board, discharge static electricity from yourself by touching a grounded conductor such as your computer chassis (your computer must be turned off). Whenever you handle a board, hold it by the edges and avoid touching any board components.

Use the following procedure to unwrap and inspect a PIO-12 board.

1. Factory packaging of the PIO-12 board includes a final wrap of protective, anti-static material. Remove the board from its anti-static wrapping material. You may wish to store the wrapping material for possible future use.

2. Inspect the board for signs of damage. If damage is apparent, arrange to return the board to the factory (see "Technical Support" on page 5-5).

3. Check the remaining contents of your package against the packing list to be sure your order is complete. Report any missing items, immediately.

4. When you are satisfied with the inspection, proceed with the software and hardware setup instructions.

Setting the Switches and Jumpers

The base address, interrupt level, and J8 slot/wait state option are all specified through switch or jumper settings. Although the factory default settings are appropriate for most installations, check each of these settings against the needs of your application and make any necessary changes. The locations and factory default settings of these switches and jumpers are shown in Figure 2-1.

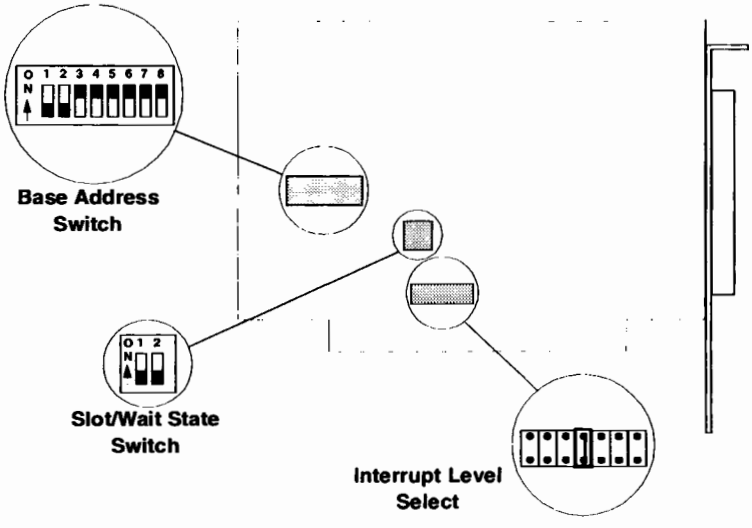


Figure 2-1. Switch and Jumper Locations

Setting the Base Address

The base address switch is preset at the factory for 300h (see Figure 2-1). If this address is already assigned to some other device in your computer, you must set this switch for a different address.

The address you specify must be within the range of 200 to 3FCh (512 to 1020 decimal) and on a 4-byte boundary. Table 2-1 lists the base address switch settings. Use these tables as a guide when selecting a base address.

Table 2-1. Values of Base Address Switch Positions

Switch Position	Address Line	Value When Switch Is OFF	
		Decimal	Hexadecimal
1	A9	512	200
2	A8	256	100
3	A7	128	80
4	A6	64	40
5	A5	32	20
6	A4	16	10
7	A3	8	8
8	A2	4	4

When selecting a base address, do not select an address that conflicts with those already in use. Table 2-2 lists standard address assignments and their corresponding devices.

Table 2-2. Standard Address Assignments

Address	Device	Address	Device
000 - 0FF	Internal I/O	378 - 37F	Printer
100 - 1FF	Undecoded	380 - 389*	Binary comm. 2
200 - 20F	Joy stick Port	380 - 38C*	SDLC comm.

Table 2-2. Standard Address Assignments (cont.)

Address	Device	Address	Device
210 - 217	Expansion unit	390 - 39F	Available
218 - 21F	Available	3A0 - 3A9*	Binary comm.
220 - 24F	Reserved	3AA - 3AF	Available
250 - 277	Available	3B0 - 3BF	Mono disp./printer
278 - 27F	Reserved	3C0 - 3CF	Reserved
280 - 2EF	Available	3D0 - 3DF	Color/graphics
2F0 - 2F7	Reserved	3E0 - 3E7	Reserved
2F8 - 2FF	Com2:	3E8 - 3EF	Available
300 - 31F	Available	3F0 - 3F7	Floppy disk
320 - 32F	Fixed disk	3F8 - 3FF	Com1:
330 - 377	Available		

Setting the J8 Slot/Wait State Switch

This switch block consists of two switches: the J8 Slot switch (switch 1) and the Wait State switch (switch 2). Setting the J8 Slot switch to ON enables the board to occupy the J8 slot of an IBM PC/XT (the J8 slot is right-most on the PC/XT motherboard); setting switch 1 to OFF (the default position) disables the slot option.

Setting the Wait State switch to ON enables a 500 ns wait state, which may be required in PCs having 8 MHz system clocks. Setting switch 2 to OFF (the default position) disables the wait state.

Configuring the Interrupt Level

Interrupt levels are specified through jumper settings on the Interrupt Level jumper block. Jumper positions 2 to 7 on the jumper block correspond to IRQ2 to IRQ7, respectively. Position X (the default position) disables the interrupt levels.

Table 2-3 lists the industry-standard usage for interrupts 2 to 7; use this table as a guide when selecting an interrupt level.

Table 2-3. Standard Interrupt Usage

Interrupt (IRQ) Level	Usage (if device exists)
2	Reserved (XT), IRQ 8 to 15 (15)
3	COM2 or SDLC
4	COM1 or SDLC
5	Hard disk (XT), LPT (AT)
6	Floppy disk
7	LPT

Installing the Board

Caution: Installing or removing a board while power is on can damage your computer.

Use the following steps to install a PIO-12 board in an accessory slot of your computer:

1. Turn off power to the computer and all attached equipment.
2. Remove the computer chassis cover.
3. Select an unoccupied accessory slot, and remove the corresponding blank plate from the I/O connector panel.
4. Insert and secure the board in the selected slot.
5. Replace the computer cover.
6. Turn on power to the computer.

Using Power from the PIO-12

Power from the computer supply is available on the main I/O connector of the PIO-12. In situations where the PIO-12 is used with a dedicated peripheral (for example, a switch pad) and the cabling and design loads are fixed, you may find it more appropriate to use the PIO-12 power outputs. In most other cases, however, you are advised to power external devices from their own supplies.

In general, you are advised **not** to use computer power unless you can safely avoid the following conditions:

- Short circuits, overloads, or the application of other external voltages. All of these conditions may damage the PC system board and result in costly repairs. The PC power supply is designed to shutdown on a short circuit, but you should not rely on this characteristic to protect your system.

- A power draw that exceeds the capacity of the computer power supply and its internal loads (see the technical reference manual for your computer). Because of computer board connector and trace width limitations, we recommend that you limit power draw to 1 A from the +5 V and +12 V supplies (if available). The -12 V and -5 V supplies are limited to much lower loads.

3

Cabling and Wiring

This chapter describes the cabling and wiring required for attaching accessories and I/O lines to the main I/O connector of your PIO-12 boards. The main I/O connector of the PIO-12 is a 37-pin D-type. Pin assignments for this connector are shown in Figure 3-1.

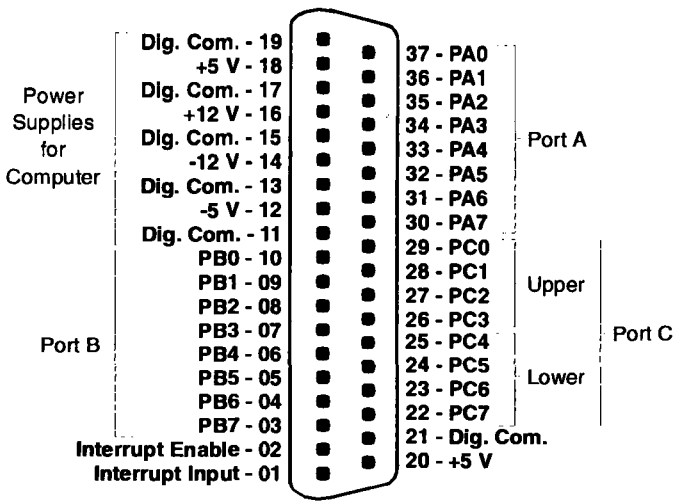


Figure 3-1. Pin Assignments for the Main I/O Connector

Caution: To avoid electrical damage, turn off power to the computer and any attached accessories before making connections to PIO-12 boards.

Attaching Accessories

The following accessories attach to the PIO-12 through a C-1800 or S-1800 cable, as shown in Figure 3-2:

- STA-U screw terminal accessory.
- SSIO-24 12-channel mounting panel for I/O modules.
- SRA-01 8-channel mounting panel for I/O modules.
- ERB-24 electrical relay board.
- ERA-01 electrical relay accessory.

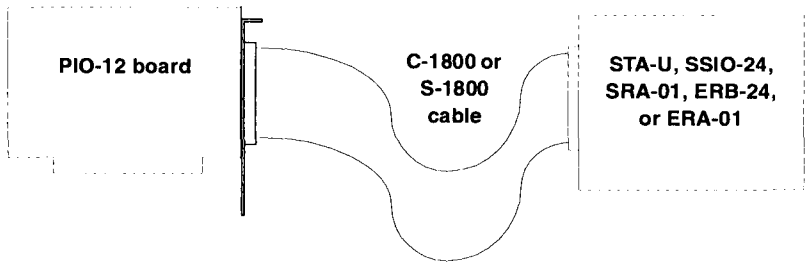


Figure 3-2. Attaching Accessories through a C-1800 or S-1800 Cable

Attaching an STC-37 Accessory

The STC-37 is a screw terminal panel that appears as shown in Figure 3-3.

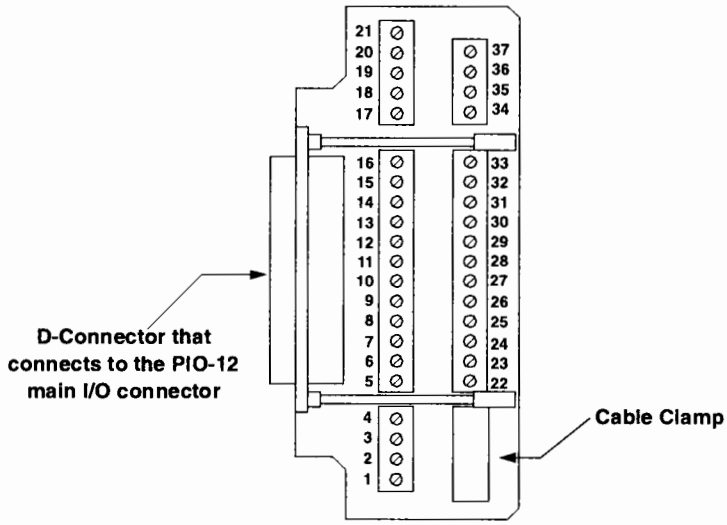


Figure 3-3. Layout of STC-37 Screw Terminal Connector Panel

The STC-37 connects to the PIO-12 main I/O connector as shown in Figure 3-4. The screw terminal numbers of the STC-37 correspond to the pin numbers of the main I/O connector.

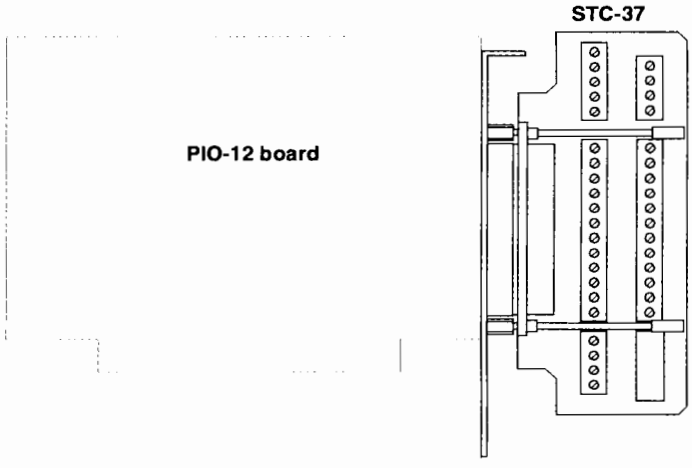


Figure 3-4. Attaching an STC-37 Accessory

4

Programming

PIO-12 programmability is provided through the board's 8255 Programmable Peripheral Interface (PPI) integrated circuit. The 8255 PPI provides 24 digital I/O lines, which make up the following three ports:

- PORT A (abbreviated PA) consists of one 8-bit data output latch/buffer and one 8-bit data input latch.
- PORT B (PB) consists of one 8-bit data output latch/buffer and one 8-bit data input buffer.
- PORT C (PC) consists of one 8-bit data output latch/buffer and one 8-bit data input buffer. This port can also be used as two 4-bit ports: PC Upper (PC4 to PC7) and PC Lower (PC0 to PC3).

Programming the PIO-12 involves two fundamental tasks: setting the port configuration and reading/writing data from/to the ports. These tasks are discussed in the sections that follow.

Note: If you need more detailed information on the 8255 PPI, please contact an Intel representative for a complete data sheet on the 8255 PPI.

Port Configuration

Each port or half-port is configured as an input or an output according to the value of the control word in the PPI control register. The control word is 1-byte word programmed at Base Address +3. Refer to Table 4-1 for the complete 8255 PPI address map.

Table 4-1. 8255 PPI Address Map

Address	Function	Type
Base Address +0	Port A (PA)	Read/Write
Base Address +1	Port B (PB)	Read/Write
Base Address +2	Port C (PC)	Read/Write
Base Address +3	Control Word	Write only

The control word also specifies one of the following three operating modes (for a complete description of the PPI operating modes, refer to the Intel 8255-5 data sheet):

- **Mode 0** - Basic I/O; all ports are I/O ports.
- **Mode 1** - Strobed I/O; part of Port C controls data transfer.
- **Mode 2** - Bidirectional I/O on Port A only; part of Port C controls data transfer.

A power-up or reset automatically configures all ports as inputs. This configuration remains intact until changed by a write to the control register. The initialization section of your program should set the port

configuration. Table 4-2 illustrates how the port configuration is derived from the control word.

Table 4-2. Derivation of Port Configuration from Control Word

Bit #	Bit Setting	Configuration
7	0	Bit set/reset mode for PC0 to PC7
	1	Mode set active for PC0 to PC7
6 and 5	00	Mode 0 for PA4 to PA7 and PC4 to PC7
	01	Mode 1 for PA4 to PA7 and PC4 to PC7
	10	Mode 2 for PA4 to PA7 and PC4 to PC7
	1X	Mode 2 for PA4 to PA7 and PC4 to PC7
4	0	PA output
	1	PA input
3	0	PC4 to PC7 output
	1	PC4 to PC7 input
2	0	PB0 to PB3 and PC0 to PC3 output
	1	PB0 to PB3 and PC0 to PC3 input
1	0	PB output
	1	PB input
0	0	PC0 to PC3 output
	1	PC0 to PC3 input

To simplify your selection of a control word to match your choice of port directions, use Table 4-3. This atble summarizes information from the Intel peripheral data book on control words and their port directions for mode 0.

Table 4-3. PIO Control Word

Control Word	Port A	Port B	Port C Lower 0 to 3	Port C Upper 4 tp 7
80h	Out	Out	Out	Out
81h	Out	Out	In	Out
82h	Out	In	Out	Out
83h	Out	In	In	Out
88h	Out	Out	Out	In
89h	Out	Out	In	In
8Ah	Out	In	Out	In
8Bh	Out	In	In	In
90h	In	Out	Out	Out
91h	In	Out	In	Out
92h	In	In	Out	Out
93h	In	In	In	Out
98h	In	Out	Out	In
99h	In	Out	In	In
9Ah	In	In	Out	In
9Bh	In	In	In	In

A noteworthy characteristic of the 8255 PPI is that all port registers are cleared by a write to the control register. Consequently, if your program intends to repeatedly change the port configuration, you may need to make provisions for restoring data to cleared ports.

Programming Examples

The examples presented below use the BASIC programming language to illustrate some of common programming tasks. Line numbers in these examples were arbitrarily selected; these examples will work with any valid line numbering scheme.

Writing the Control Register

The following code specifies 300h as the base address of the PIO-12, then configures all of the ports as outputs:

```
10  BADDR = &H300          'Specifies 300h as the
                           'PIO-12 base I/O address.
20  OUT BADDR +3, &H80     'Sets all ports to outputs.
```

Basic I/O Operations

The following code performs some basic I/O operations:

```
30  OUT BADDR, &H22        'Sends 22 Hex to Port A.
40  OUT BADDR +1, 99       'Sends 99 to Port B.
50  PRINT INP(BADDR +1)    'Reads and displays
                           'Port B data in decimal.
60  PRINT HEX$(INP(BADDR))'Reads and displays
                           'Port A data in Hex.
```

Reading BCD Data

The following code reads 2-digit BCD (Binary Coded Decimal) data:

```
30  BCD% = INP(BADDR)      'Read data.
                           'Convert to decimal.
40  BCD% = (BCD% AND &HF0)*10/16 + (BCD% AND &H0F)
```

Bit Operations

Bit operations can use the Boolean operators OR, AND, XOR, EQV, IMP, and NOT.

The following code sets Bit 3 on Port A to 1 without disturbing the other bits:

```
30  A% = INP(BADDR)          'Read port A.
40  OUT BADDR, (A% OR 2^3)'OR bit 3 and write to
                             'Port A.
```

The following code clears bit 7:

```
30  A% = INP(BADDR)          'Read port A.
                             'AND the inverse of bit 7,
                             'effectively masking it
                             'to an OFF state.
40  OUT BADDR, (A% AND NOT(2^7))
```

The following code illustrates the use of the BASIC *WAIT* command to wait for a particular condition on Port C:

```
30  WAIT BADDR +2, N%, J%
```

The result of an XOR on the data read at Port BADDR +2 (Port C in this example) and J% is ANDed with N%. If the result is zero, the program loops back and reads the port again; otherwise execution continues with the next line.

Programming Notes

The following subsections discuss some of the factors you should consider when programming the PIO-12.

Interpreted Basic

Programs written using Interpreted BASIC are relatively slow in executing I/O statements. Compiling these programs usually decreases the execution time dramatically.

I/O Commands

Most high-level languages include port I/O commands. Fortran, however, does not have built-in I/O commands. Fortran users will have to resort to

Assembly language library functions (external CALLs) for I/O operations.

PIO-12 Interrupt Channel

BASIC does not directly support writing interrupt routines except through the use of an assembly language CALL. If you are using the interrupt channel on the PIO-12, you probably have to program in Assembly or C to write an interrupt handler.

Assembly Language

Assembly language provides a direct programming method, as the following code illustrates:

```
MOV DX, BASE_ADDRESS     ;Load DX with port address.
IN AL,DX                 ;Read a port into AL.
OUT DX,AL                ;Write AL out to a port.
```

Note that the 80286/386 processors cannot reliably execute successive I/O instructions to the same port address. This is due to recovery time requirements on the I/O peripheral circuits and is not related to the PIO-12 design.

Because of this limitation, the use of code similar to the following is not recommended.

```
IN AL,DX                 ;Example of problematic
                         ;code.
INC AL
OUT DX,AL
```

The suggested work-around to this limitation is to program a short delay (using a JMP instruction) between successive I/O instructions. This technique is illustrated in the following code:

```
IN AL,DX                 ;Recommended method.
INC AL
JMP LABEL                ;JMP generates delay &
                         ;breaks instruction queue.
LABEL: OUT DX,AL
```

5

Troubleshooting

If your PIO-12 board is not operating properly, use the information in this chapter to isolate the problem. If the problem appears serious enough to warrant technical support, refer to for information on how to contact an applications engineer.

Problem Isolation

If you encounter a problem with a PIO-12 board, use the instructions in this section to isolate the cause of the problem before calling Keithley MetraByte Hardware Applications Engineering.

Identifying Symptoms and Possible Causes

Use the troubleshooting information in Table 5-1 to try to isolate the problem. Table 5-1 lists general symptoms and possible solutions for problems with PIO-12 boards.

Table 5-1. Troubleshooting Information

Symptom	Possible Cause	Possible Solution
Board does not respond	Base address is incorrect or not consistent with what the program is addressing.	Check the base-address-switch setting. If the base address is set correctly, make sure no other computer device is using any of the I/O locations beginning at the specified base address. If necessary, reconfigure the base address. Refer to for instructions on setting the base address.
	The interrupt level is incorrect or not consistent with what the program is addressing.	Make sure no other computer device is using the interrupt level specified in your program. If necessary, reset the interrupt level.
	The board configuration is incorrect.	Check the remaining settings.
	The board is incorrectly aligned in the accessory slot.	Check the board for proper seating.
	The board is damaged.	Contact the Keithley MetraByte Hardware Applications Engineering Department; see "Technical Support" on page 5-5.
Intermittent operation	The most common cause of this problem is that the I/O bus speed is in excess of 8 MHz.	Reduce I/O bus speed to a maximum of 8 MHz (to change the I/O bus speed, run BIOS setup). See your computer documentation for instructions on running BIOS setup.
	Vibrations or loose connections exist.	Cushion source of vibration and tighten connections.
	The board is overheating.	Check environmental and ambient temperature. See the documentation for your computer.
	Electrical noise exists.	Provide better shielding or reroute unshielded wiring.

Table 5-1. Troubleshooting Information (cont.)

Symptom	Possible Cause	Possible Solution
Data appears to be invalid	The most common cause of this problem is that the I/O bus speed is in excess of 8 MHz.	Reduce I/O bus speed to a maximum of 8 MHz (to change the I/O bus speed, run BIOS setup). See the documentation for your computer for instructions on running BIOS setup.
	An open connection exists.	Check wiring to screw terminal.
	Another system resource is using the specified base address.	Reconfigure the base address of the PIO-12 board; refer to for more information. Check the I/O assignments of other system resources and reconfigure, if necessary.
Computer does not boot.	Board not seated properly.	Check the installation of the board.
	The base address setting of the PIO-12 board conflicts with that of another system resource.	Check the base address settings of your system resources; each address must be unique.
	The power supply of the host computer is too small to handle all the system resources.	Check the needs of all system resources and obtain a larger power supply.

If your board is not operating properly after using the information in Table 5-1, continue with the next two sections to further isolate the problem.

Testing the Board and Host Computer

To isolate the problem to the PIO-12 board or to the host computer, use the following steps:

1. Turn the power to the host computer OFF, and remove power connections to the computer.

Caution: Removing a board with the power ON can cause damage to your board and/or computer.

2. While keeping connections to accessory board intact, unplug the accessory connector or cable from the PIO-12 board.

3. Remove the PIO-12 board from the computer and visually check for damage. If a board is obviously damaged, refer to "Technical Support" on page 5-5 for information on returning the board.

4. With the PIO-12 board out of the computer, check the computer for proper operation. Power up the computer and perform any necessary diagnostics.

At this point, if you have another PIO-12 board that you know is functional, you can test the slot and I/O connections using the instructions in the next section. If you do not have another board, refer to the instructions on "Technical Support" on page 5-5 before calling Keithley Technical Support.

Testing the Accessory Slot and I/O Connections

When you are sure that the computer is operating properly, test the computer accessory slot and I/O connections using another PIO-12 board that you know is functional. To test the computer accessory slot and the I/O connections, follow these steps:

1. Remove computer power again, and install a PIO-12 board that you know is functional. Do not make any I/O connections.

2. Turn computer power ON and check operation with the functional board in place. This test checks the computer accessory slot. If you were using more than one PIO-12 board when the problem occurred, use the functional board to test the other slot, as well.

3. If the accessory slots are functional, use the functional board to check the I/O connections. Reconnect and check the operation of the I/O connections, one at a time.

4. If operation fails for an I/O connection, check the individual inputs one at a time for shorts and opens.

5. If operation remains normal to this point, the problem is in the PIO-12 board(s) originally in the computer. If you were using more than one

board, try each board one at a time in the computer to determine which is faulty.

6. If you cannot isolate the problem, refer to the next section for instructions on obtaining assistance.

Technical Support

Before returning any equipment for repair, call the Keithley MetraByte Hardware Applications Engineering Department at:

(508) 880-3000

Monday - Friday, 8:00 A.M. - 6:00 P.M., Eastern Time

An applications engineer will help you diagnose and resolve your problem over the telephone. Please make sure that you have the information page available before you call:

PIO-12 Board Configuration	Model	_____
	Serial #	_____
	Revision code	_____
	Base address setting	_____
	Interrupt level setting	_____
Computer	Manufacturer	_____
	CPU type	_____
	Clock speed (MHz)	_____
	KB of RAM	_____
	Video system	_____
	BIOS type	_____
Operating System	DOS version	_____
	Windows version	_____
	Windows mode	_____
Software package	Name	_____
	Serial #	_____
	Version	_____
	Invoice/Order #	_____
Compiler (if applicable)	Language	_____
	Manufacturer	_____
	Version	_____
Accessories	Type	_____
	Type	_____
	Type	_____

If a telephone resolution is not possible, the applications engineer will issue you a Return Material Authorization (RMA) number and ask you to return the equipment. Include the RMA number with any documentation regarding the equipment.

When returning equipment for repair, include the following information:

- Your name, address, and telephone number.
- The invoice or order number and date of equipment purchase.
- A description of the problem or its symptoms.
- The RMA number on the **outside** of the package.

Repackage the equipment, using the original anti-static wrapping, if possible, and handling it with ground protection. Ship the equipment to:

ATTN: RMA #_____
Repair Department
Keithley MetraByte
440 Myles Standish Boulevard
Taunton, Massachusetts 02780

Telephone (508) 880-3000
Telex 503989
FAX (508) 880-0179

Notes: If you are submitting your equipment for repair under warranty, you must include the invoice number and date of purchase.

To enable Keithley Metrabyte to respond as quickly as possible, you must include the RMA number on the outside of the package.

A

Specifications

Inputs and outputs of the PIO-12 are TTL/DTL-compatible. Outputs can drive one standard TTL (74 series) load or four LSTTL (74LS) loads. CMOS compatibility can be achieved by connecting a 10 kΩ pullup resistor from the PI)-12 output to +5 V. Table A-1 and Table A-2 list PIO-12 specifications.

Table A-1. Input and Output Specifications

Logic Inputs and Outputs	Minimum	Maximum
Input logic low voltage	-0.5 V	0.8 V
Input logic high voltage	2.0 V	5.0 V
Input load current for the PA, PB, and PC ports ($0 < V_{in} < 5$ V)	-10 µA	10 µA
Input low current interrupt inputs	—	-0.4 mA
Input high current interrupt inputs	—	20 µA
Output low voltage for PA, PB, and PC ports (I_{sink} = 1.7 mA)	—	-0.45 V
Output high voltage for PA, PB, and PC ports (I_{source} = 200 µA)	2.4 V	—

Table A-2. Environmental Specifications

Feature	Specification
Bus-loading power consumption	170 mA
Operating temperature range	0 to 50° C
Stoarge temperature range	-40 to 100° C
Humidity	0 to 90% noncondensing
Dimensions	5 inches L x 4.25 inches H x 0.75 inches (12.7 cm x 10.8 cm x 1.9 cm)
Weight	4 oz. (113 g)

B

Connector Pin Assignments

The connection between an external I/O device and the PIO-12 is made at the main I/O connector, which is a standard 37-pin, D-type male connector. The mating connector is a 37-pin, D-type female connector (part# SFC-37). Figure B-1 illustrates pin assignments of the PIO-12 main I/O connector.

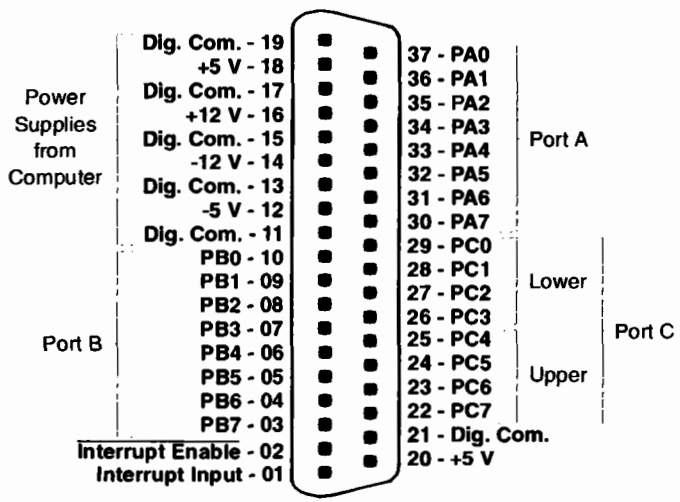


Figure B-1. Main I/O Connector Pin Assignments

Index

A

accessories, attaching 3-2
accessory
    ERA-01 1-3
    ERB-24 1-3
    SRA-01 1-3
    SSIO-24 1-3
    STA-U 1-2
    STC-37 1-3
anti-static wrapping material 2-1
assembly language 4-7
attaching
    accessories 3-2
    the STC-37 accessory 3-3

B

base address switch 2-3
basic I/O operations 4-5
bit operations 4-5
block diagram 1-1

C

C-1800 cable 1-3
cable
    C-1800 1-3
    S-1800 1-3
cabling and wiring 3-1
connector, main I/O 1-2
control byte 4-2

D

data input latch 4-1
digital I/O ports 1-2

E

ERA-01 accessory 1-3
ERB-24 accessory 1-3
examples, programming 4-5

F

factory-default settings 2-2
features and operating characteristics 1-2

G

general description 1-1

I

I/O commands 4-6
installing a PIO-12 board 2-5
Interpreted BASIC 4-6
interrupt
    controller, 8259 1-2
    enable line 1-2
    input channel 1-2
interrupt levels 2-4
interrupts 2 to 7 2-5

J

J8
    Slot switch 2-4
    Wait State switch 2-4
jumper block 2-4

L

latch/buffer 4-1

M

main I/O connector 1-2, B-1

O

operating modes 4-2
output latch/buffer 4-1

P

parallel I/O devices 1-1
pin assignments B-1
port configuration 4-2, 4-3
power levels 1-2
PPI address map 4-2
PPI, 8255 4-1
problem isolation 5-1
programming examples 4-5
programming notes 4-6
programming the PIO-12 4-1

R

reading BCD data 4-5
RMA number 5-6

S

S-1800 cable 1-3
setting
    a base address 2-3
    the J8 Slot/Wait State switch 2-4
specifications A-1
SRA-01 accessory 1-3
SSIO-24 accessory 1-3
static electricity 2-1
STA-U accessory 1-2
switch and jumper locations 2-2
symptoms and possible solutions 5-1

T

technical support 5-5
TTL/CMOS-compatible 1-2

U

unpacking and inspecting 2-1
using power from the PIO-12 2-6
using the interrupt channel 4-7

W

writing the control register 4-5

Artisan Technology Group is an independent supplier of quality pre-owned equipment

Gold-standard solutions

Extend the life of your critical industrial, commercial, and military systems with our superior service and support.

We buy equipment

Planning to upgrade your current equipment? Have surplus equipment taking up shelf space? We'll give it a new home.

Learn more!

Visit us at **artisantg.com** for more info on price quotes, drivers, technical specifications, manuals, and documentation.

Artisan Scientific Corporation dba Artisan Technology Group is not an affiliate, representative, or authorized distributor for any manufacturer listed herein.

We're here to make your life easier. How can we help you today?

(217) 352-9330 | sales@artisantg.com | artisantg.com

ARTISAN® TECHNOLOGY GROUP