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KEITHLEY

PIO-32 Series

User's Guide



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PIO-32 Series
User's Guide

Revision E - April, 2001
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Safety Precautions

The following safety precautions should be observed before using this product and any associated instrumentation. Although some instruments and accessories would normally be used with non-hazardous voltages, there are situations where hazardous conditions may be present.

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read and follow all installation, operation, and maintenance information carefully before using the product. Refer to the manual for complete product specifications.

If the product is used in a manner not specified, the protection provided by the product may be impaired.

The types of product users are:

Responsible body is the individual or group responsible for the use and maintenance of equipment, for ensuring that the equipment is operated within its specifications and operating limits, and for ensuring that operators are adequately trained.

Operators use the product for its intended function. They must be trained in electrical safety procedures and proper use of the instrument. They must be protected from electric shock and contact with hazardous live circuits.

Maintenance personnel perform routine procedures on the product to keep it operating properly, for example, setting the line voltage or replacing consumable materials. Maintenance procedures are described in the manual. The procedures explicitly state if the operator may perform them. Otherwise, they should be performed only by service personnel.

Service personnel are trained to work on live circuits, and perform safe installations and repairs of products. Only properly trained service personnel may perform installation and service procedures.

Keithley products are designed for use with electrical signals that are rated Installation Category I and Installation Category II, as described in the International Electrotechnical Commission (IEC) Standard IEC 60664. Most measurement, control, and data I/O signals are Installation Category I and must not be directly connected to mains voltage or to voltage sources with high transient over-voltages. Installation Category II connections require protection for high transient over-voltages often associated with local AC mains connections. Assume all measurement, control, and data I/O connections are for connection to Category I sources unless otherwise marked or described in the Manual.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak, or 60VDC are present. **A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.**

Operators of this product must be protected from electric shock at all times. The responsible body must ensure that operators are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product operators in these circumstances must be trained to protect themselves from the risk of electric shock. If the circuit is capable of operating at or above 1000 volts, **no conductive part of the circuit may be exposed.**

Do not connect switching cards directly to unlimited power circuits. They are intended to be used with impedance limited sources. NEVER connect switching cards directly to AC mains. When connecting sources to switching cards, install protective devices to limit fault current and voltage to the card.

Before operating an instrument, make sure the line cord is connected to a properly grounded power receptacle. Inspect the connecting cables, test leads, and jumpers for possible wear, cracks, or breaks before each use.

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When installing equipment where access to the main power cord is restricted, such as rack mounting, a separate main input power disconnect device must be provided, in close proximity to the equipment and within easy reach of the operator.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before: connecting or disconnecting cables or jumpers, installing or removing switching cards, or making internal changes, such as installing or removing jumpers.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.

The instrument and accessories must be used in accordance with its specifications and operating instructions or the safety of the equipment may be impaired.

Do not exceed the maximum signal levels of the instruments and accessories, as defined in the specifications and operating information, and as shown on the instrument or test fixture panels, or switching card.

When fuses are used in a product, replace with same type and rating for continued protection against fire hazard.

Chassis connections must only be used as shield connections for measuring circuits, NOT as safety earth ground connections.

If you are using a test fixture, keep the lid closed while power is applied to the device under test. Safe operation requires the use of a lid interlock.

If  or  is present, connect it to safety earth ground using the wire recommended in the user documentation.

The  symbol on an instrument indicates that the user should refer to the operating instructions located in the manual.

The  symbol on an instrument shows that it can source or measure 1000 volts or more, including the combined effect of normal and common mode voltages. Use standard safety precautions to avoid personal contact with these voltages.

The **WARNING** heading in a manual explains dangers that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading in a manual explains hazards that could damage the instrument. Such damage may invalidate the warranty.

Instrumentation and accessories shall not be connected to humans.

Before performing any maintenance, disconnect the line cord and all test cables.

To maintain protection from electric shock and fire, replacement components in mains circuits, including the power transformer, test leads, and input jacks, must be purchased from Keithley Instruments. Standard fuses, with applicable national safety approvals, may be used if the rating and type are the same. Other components that are not safety related may be purchased from other suppliers as long as they are equivalent to the original component. (Note that selected parts should be purchased only through Keithley Instruments to maintain accuracy and functionality of the product.) If you are unsure about the applicability of a replacement component, call a Keithley Instruments office for information.

To clean an instrument, use a damp cloth or mild, water based cleaner. Clean the exterior of the instrument only. Do not apply cleaner directly to the instrument or allow liquids to enter or spill on the instrument. Products that consist of a circuit board with no case or chassis (e.g., data acquisition board for installation into a computer) should never require cleaning if handled according to instructions. If the board becomes contaminated and operation is affected, the board should be returned to the factory for proper cleaning/servicing.

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Preface

The *PIO-32 Series User's Guide* explains how to install, cable, wire, program, and use the PIO-32 Series isolated, digital input and output (I/O) boards. This guide serves data acquisition system designers, engineers, technicians, programmers, scientists, and other users responsible for setting up, cabling, wiring, and programming the PIO-32 Series boards. This guide assumes that you are familiar with data acquisition and programming principles and with your particular application.

The *PIO-32 Series User's Guide* is organized as follows:

- Section 1 briefly describes the features of the PIO-32 Series boards, including descriptions of the supported software and accessories.
- Section 2 describes in more detail the input and output circuitry.
- Section 3 describes how to install the DriverLINX software and documentation, how to unpack, set up, and install the board, and how to configure and check the installation.
- Section 4 describes how to attach screw terminal panel accessories and how to wire signals to the PIO-32 Series boards.
- Section 5 briefly describes the need to program through the DriverLINX interface—provided with your board—and tells how to access the extensive DriverLINX documentation.
- Section 6 explains how to troubleshoot problems that may arise with the PIO-32 Series boards. It also explains how to obtain technical assistance and repairs for the boards.
- Appendix A lists the specifications for the PIO-32 Series boards.

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- Appendix B lists the connector pin assignments.
- Appendix C provides a register map, for background reference only (you program the PIO-32 Series boards through the DriverLINX interface, not at the register-level).

An index completes this guide.

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1

Overview

The PIO-32 Series boards are part of a family of digital input and output (I/O) boards designed for IBM® PC series computers and compatibles. The software currently supplied with these boards requires the Windows® 95/98/NT operating system and a compatible microprocessor (preferably a Pentium microprocessor).

These boards provide a flexible interface for a variety of parallel I/O devices, including instruments, displays, and control systems. The members of the PIO-32 Series are as follows:

- PIO-32I/O, which provides 16 digital inputs and 16 digital outputs
- PIO-32IN, which provides 32 digital inputs
- PIO-32OUT, which provides 32 digital outputs

The major features of all PIO-32 Series boards include the following:

- Input level (if included) of 3.5VDC to 28VDC
- Output relay contacts (if included), Form A, 0.75A at 30V RMS, 42.4V peak, 60VDC
- Connections through on-board ribbon headers
- High-density channel count
- Only one slot required for the board

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Important Safety Instructions

Each PIO-32 Series board bears a warning symbol that corresponds to the information in this section. Follow these steps when preparing to install your PIO-32 board:

1. Read the warnings in this section.

2. When installing, cabling, and wiring your board, heed the warnings marked on the board and described in this section, and follow the instructions in Sections 3 and 4.

3. When using the board, do not exceed the ratings specified in Appendix A.



Warning: Do not connect voltages greater than 30V RMS, 42.4V peak, or 60VDC to any input or output on this board.

Live voltages can still be present on the board even when the computer is turned off. To protect you and the circuit, covers are provided with the PIO-32 Series boards. Though you can remove the covers to service the PIO-32 Series boards, **do not use these boards with the covers removed!** In addition, disconnect all cables when servicing these boards.

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Supporting Software

DriverLINX software is supplied by Keithley with the PIO-32 Series board. DriverLINX provides convenient interfaces to configure and set I/O bits without register-level programming.

Most importantly, however, DriverLINX supports those programmers who wish to create custom applications using Visual C/C++, Visual Basic, or Delphi. DriverLINX accomplishes foreground and background tasks to perform data acquisition. The software includes memory and data buffer management, event triggering, extensive error checking, and context sensitive online help.

More specifically, DriverLINX provides application developers a standardized interface to over 100 services for creating foreground and background tasks for the following:

- Analog input and output
- Digital input and output
- Time and frequency measurement
- Event counting
- Pulse output
- Period measurement

In addition to basic I/O support, DriverLINX also provides:

- Built-in capabilities to handle memory and data buffer management
- A selection of starting and stopping trigger events, including pre-triggering, mid-point triggering and post-triggering protocols
- Extensive error checking
- Context-sensitive on-line help system

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DriverLINX is essentially hardware independent, because its portable APIs work across various operating systems. This capability eliminates unnecessary programming when changing operating system platforms.

Accessories

The optional accessories for the PIO-32 Series boards include screw terminal panels (STPs) and cables (C-3200/C-32NN) that convert from the ribbon headers on the board to the 37-D male cable connectors. The C-3200 cables are 30 inches long; longer cables are available, C-32NN, where NN is the number of feet added to the standard cable.

You can use STPs and cables to connect applications to the PIO-32 Series boards. An STP-37/FC accessory is available that combines a 37-D female receptacle, which directly mates to the 37-D male connector on the optional C-3200 cable for the PIO-32 Series boards, and 37 screw terminals in a protective case for desktop use.



Warning: Do not use the STP-37/FC and C-3200/C-32NN accessories or other STPs at voltages above 30V RMS, 42.4V peak, or 60VDC. These accessories are rated for 30V RMS, 42.4V peak, or 60VDC maximum. Use at higher voltages may result in shock hazard.

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2

Functional Description

This section describes the general layout of the PIO-32 Series boards and provides schematics of the typical input and output circuits.

The PIO-32 Series boards are channel-to-channel isolated and handle digital voltages in a broader range than standard TTL levels. Optional accessories for the board include screw terminal panels (STPs) and the C-3200 cables. The C-3200 cables are 30-inches long; they let you route the signals from 40-pin headers on the board through a slot in the rear panel bracket to 37-D male connectors. You connect the 37-D connectors to the optional STPs.

Figure 2-1 shows the general layout of PIO-32 Series boards. Note the ribbon headers, labeled J1 and/or J2, on your board; these ribbon headers provide 16 digital input or output channels each. The orientation of the headers differs among the boards, as shown in Figure 2-1.

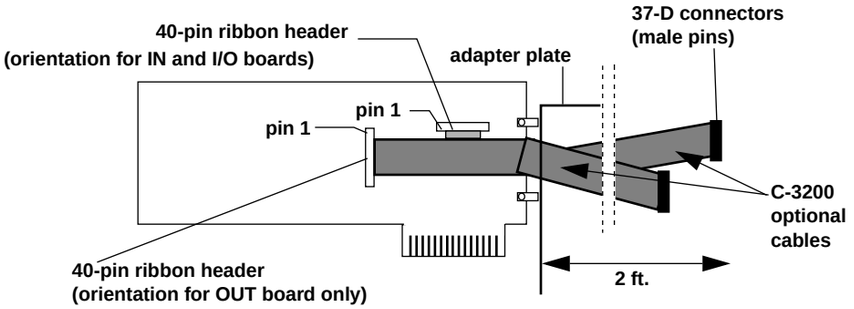


Figure 2-1. General Layout of PIO-32 Series Boards

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Input Circuitry

The PIO-32I/O has 16 digital input channels and uses the J1 ribbon header (channels 0 to 15). The PIO-32IN has 32 digital input channels and uses the J1 and J2 ribbon headers (channels 0 to 31). Figure 2-2 shows each input channel schematically. You must limit the input voltage to 28VDC and the input current to 15mA maximum. The positive input signals are labeled P*n*P (where *n* is the bit number, 0 to 31); the negative input signals are labeled P*n*N (where *n* is the bit number, 0 to 31).

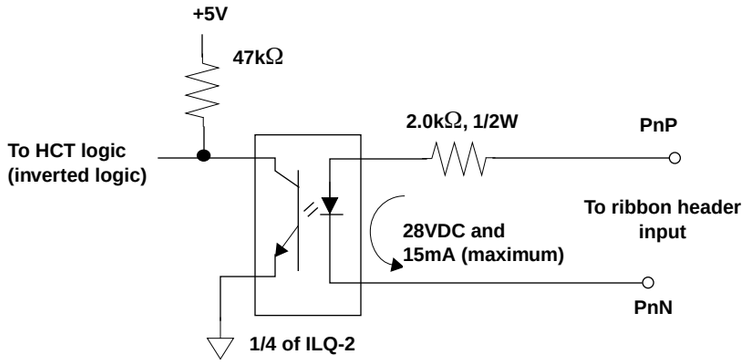


Figure 2-2. Typical Input Circuit

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Output Circuitry

The PIO-32I/O has 16 digital output channels and uses the J2 ribbon header (channels 16 to 31). The PIO-32OUT has 32 digital output channels and uses the J1 and J2 ribbon headers (channels 0 to 31). Figure 2-3 shows the output channels schematically. The output channels are reed relays (form A) rated to 10W at 0.75A or 30V RMS, 42.4V peak, or 60VDC maximum (resistive). The relay connections are not polarized (positive or negative equivalent) and are labeled P*n*P and P*n*N (where *n* is the bit number, 0 to 15).

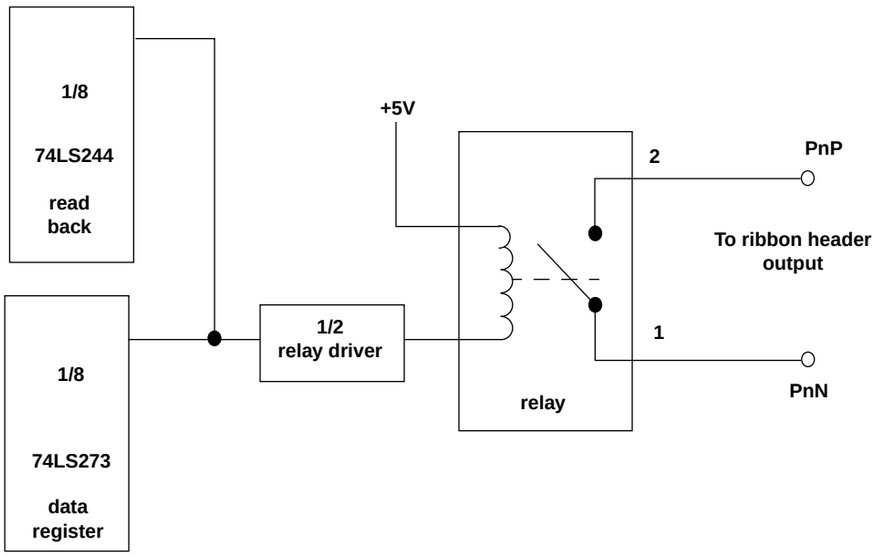


Figure 2-3. Typical Output Circuit

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3

Setup and Installation



Warning: The procedures in this section are intended for qualified service personnel. Do not perform these procedures unless you are qualified to do so.

Overview

This section describes the following:

- Inventorying installation resources.
- Installing the DriverLINX software needed to operate your PIO-32 board.
- Configuring the installation in software.
- Unpacking and inspecting the board, setting the base address of the board, and then installing the board in your computer.
- Checking the installation.

If you encounter any problems with the board after installation, refer to Section 6 for troubleshooting information.

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Note: Install the DriverLINX software before installing the PIO-32 board. Otherwise, the device drivers will be more difficult to install.

Inventorying Required Installation Resources

Before installing DriverLINX and the board, do the following:

1. Inventory your PIO-32 board's configuration settings.
2. Determine the resources your PIO-32 board requires.
3. Inventory your computer's resources already allocated to other installed devices.
4. Determine whether your computer has sufficient resources for your PIO-32 board.
5. Determine whether your PIO-32 board can use your computer's free resources.

Note: *The DriverLINX Installation and Configuration Guide*, Section 1, amplifies the inventory process in checklist items 1-5. (Ignore the rest of the checklist items for now.) To display this manual from your DriverLINX PIO Series CD-ROM, open the Windows Explorer, then double click on **X:\Drvlinx4\Docs\Instconf.pdf**, where **X** = the letter of the CD-ROM drive. Acrobat Reader must already be installed on the other system. If necessary, you can first install Acrobat Reader directly from the CD-ROM by double clicking **X:\Acrobat\setup.exe**.

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Installing DriverLINX Software and Documentation

Note: Even if DriverLINX versions other than the PIO Series version are already installed on your system, you must also install the PIO Series DriverLINX version. In the process, some DriverLINX capabilities shared by all boards may be upgraded (test utilities, for example).

This section discusses installation of drivers, interfaces, and documentation. The component installation options provided by the DriverLINX setup program are as follows:

- **Install Drivers** — This required component installs only the files you need for configuring your hardware and running third-party data-acquisition applications that require DriverLINX.
- **Install Interfaces** — This optional component installs the files and example programs that you will need to develop custom applications for DriverLINX using C/C++, Visual Basic, and Delphi.
- **Install Documentation** — This optional component installs electronic documentation for DriverLINX that you can read, search, and print using the Adobe Acrobat Reader.
- **Install Acrobat** — This optional component installs the Adobe Acrobat Reader for the DriverLINX electronic documentation.

Install the DriverLINX software and board as follows:

1. Place the DriverLINX PIO Series CD-ROM in your drive and wait a few seconds. On most systems, setup starts automatically. If not, run the setup.exe file, found in the root directory of the CD-ROM.

   A DriverLINX Browser Introduction screen appears. Thereafter, the DriverLINX CD Navigator screen appears automatically after waiting a few seconds or after clicking **Next**.

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Note: On the DriverLINX CD Navigator and other DriverLINX Browser screens, place the cursor over a menu item to see an explanation. A star next to a menu item means that it was selected previously.

Before continuing with this installation, Keithley suggests clicking **Read Me First** on the DriverLINX CD Navigator and reviewing the brief information that appears.

2. On the DriverLINX CD Navigator screen, click **Install DriverLINX**. An Install These DriverLINX Components screen appears.

3. Click **Install Drivers**, and then follow the series of on-screen instructions. When done, the Install These DriverLINX Components screen reappears.

4. If you do not plan to develop custom application software for your PIO-32 Series board, then skip to Step 5. If you do plan to develop custom application software, you must install DriverLINX interfaces before writing the software. Install them now by clicking **Install Interfaces** and following the series of on-screen instructions. When done, the Install These DriverLINX Components screen reappears.

5. Click **Install Documentation** and follow the series of on-screen instructions. This step installs the manuals. When done, the Install These DriverLINX Components screen reappears.

6. If Acrobat Reader is not already installed on your system, install it now. You need Acrobat Reader to read the manuals, a section of which you must access in step 9. Click on **Install Acrobat** and follow the series of on-screen instructions. When done, the Install These DriverLINX Components screen reappears.

7. Click **Exit.** Then, on the screen that appears saying "Thank you for using DriverLINX," click **Done**. The System Settings Changed dialog box appears.

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8. On the System Settings Changed dialog box, click **No**. (The system will be rebooted and configured later under "Configuring Your Installation.") The screen returns to the Windows desktop.

9. Print out one section of a DriverLINX manual that you will briefly review later during system configuration. Proceed as follows:

   a. In the **Start** menu under **Programs → DriverLINX,** click **On-line Manuals.** A menu document appears

   b. In the menu document, scroll until you find the major category **Configuration**.

   c. Under **Configuration** click **Hardware References**. A list of documents appears.

   d. In the list of documents, click **Keithley PIO Series**. Acrobat Reader opens and the manual entitled *Using DriverLINX with Your Hardware—Keithley PIO Series* appears.

   e. Print the following section from the *Using DriverLINX with Your Hardware—Keithley PIO Series* manual: "Configuring the PIO Series."

Note: If your data acquisition system is not connected to a printer, you can display and print the *Using DriverLINX with Your Hardware—Keithley PIO Series* manual sections from another system, directly from the CD-ROM (without installing anything). To display the manual, open the Windows Explorer, then double click on X:\Drvlinx4\Docs\Notes\kmbpio.pdf, where X = the letter of the CD-ROM drive. Acrobat Reader must already be installed on the other system. If necessary, you can first install Acrobat Reader directly from the CD-ROM by double clicking X:\Acrobat\setup.exe.

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10. Continue with the next section, "Configuring Your Installation."

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1. Locate and briefly review the manual section, “Configuring the PIO Series,” that you printed earlier during step 9 of “Installing DriverLINX Software and Documentation.” Reviewing this section will help prepare you to input information and select options when configuring your installation.

Note: Be sure to note and follow all configuration differences between installations for Windows NT and Windows 95/98.

---

2. Reboot your computer. The DriverLINX Plug and Play Wizard appears on your screen automatically at the end of the boot cycle.

Note: If you do not run the DriverLINX Plug and Play Wizard now, it will not reappear during the current computer session, although it may appear after a subsequent reboot. If you wish to configure your board sometime later, you can start the Plug and Play Wizard manually from a batch file. In the Windows Explorer, double click X:\Drvlinx4\Help\kmbpio.bat, where X is the letter of the drive on which DriverLINX is installed.

---

3. On the Plug and Play Wizard, click **Wizard** and follow the series of on-screen instructions that appear. The wizard will first lead you through the steps of installing your hardware—from a software viewpoint—and configuring it.

Note: If your operating system is Windows NT, use Windows NT Diagnostics to find the free resources that the Plug and Play Wizard asks you to assign. However, if your board requires an interrupt, to reliably find a free ISA interrupt you may need to: 1) configure your computer as having a non-Plug and Play operating system, using BIOS setup, and then 2) individually assign the interrupt to the ISA bus.

---

4. Continue with the next section, “Preparing and Installing Your Board.”

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Preparing and Installing Your Board

Caution: Ensure that the computer is turned OFF before installing or removing a board. Installing or removing a board while power is ON can damage your computer, the board, or both.

Handle the board in a static-controlled workstation; wear a grounded wrist strap. Discharge static voltage differences between the wrapped board and the handling environment before removing the board from its protective wrapper. Failure to discharge static electricity before and during handling may damage semiconductor circuits on the board.

Handle the board using the mounting bracket. Do not touch the circuit traces or connector contacts when handling the board.

Unpacking the Board

To prevent any damage to your PIO-32 Series board, perform the following steps when unpacking the board:

1. Remove the wrapped PIO-32 Series board from its outer shipping carton.

2. Making sure your computer is turned OFF but grounded, hold the wrapped board in one hand while placing your other hand firmly on the metal portion of the computer chassis; this discharges any static electricity.

3. Carefully remove the board from its anti-static wrapping material. You may store the wrapping material for future use.

4. Inspect the board for signs of damage. If any damage is apparent, arrange to return the board to the factory; refer to Section 6 for more information.

5. Check the remaining contents of your package against the packing list to ensure that your order is complete. Immediately report any missing items to the factory.

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6. Once you have determined that the board is acceptable, set the base address. The next section explains how to set the base address.

Setting the Base Address

Note: Before setting the base address switches, check the different requirements for Windows 95/98 and Windows NT. Refer to "Configuring the PIO Series" in *Using DriverLINX with Your Hardware—Keithley PIO Series* manual, which you printed in step 9 of "Installing the DriverLINX Software."

The base address is the only item you need to set on the PIO-32 Series boards. The PIO-32 Series boards normally use a block of eight I/O addresses. The factory default base address is 300h. If 300h was assigned to the board when you ran the DriverLINX Plug and Play Wizard, you do not need to set the address switch. Otherwise, reconfigure the base address switch (labeled BASE ADDRESS on the board) to conform to the base address assigned when you ran the Wizard.

The base address switch block contains eight switches, labeled 1 through 8. Switch 1 corresponds to the most significant bit (MSB) of the base address (A9); switch 7 corresponds to the least significant bit (LSB) of the base address (A3). Switch 8 is reserved.

You place a switch in the ON position (logic 0) by sliding the switch toward the top (numbered side) of the switch block. You place a switch in the OFF position (logic 1) by sliding the switch toward the bottom (unnumbered side) of the switch block. Figure 3-1 illustrates the setting for a base address of 300h; switches 1 and 2 are in the OFF position and switches 3, 4, 5, 6, 7, and 8 are in the ON position (A9 and A8 are logic 1, A7 through A3 are logic 0).

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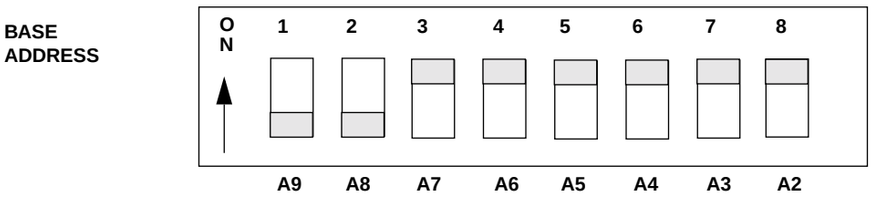


Figure 3-1. Setting the Base Address

Write down the base address for each board; you will need the base address when you program the board. See Section 5 for information on register level programming.

Proceed next to “Installing the Board.”

Installing the Board

Before installing the PIO-32 Series board in the host computer, ensure that the base address switches are set appropriately.



Warning: Do not connect voltages greater than 30V RMS, 42.4V peak, or 60VDC to any input or output on this board.

Live voltages can still be present on the board even when the computer is turned off. To protect you and the circuit, Keithley provides covers with the PIO-32 Series boards. Though you can remove the covers to service the PIO-32 Series boards, **do not use these boards with the covers removed!** In addition, disconnect all cables when servicing these boards.

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

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To install the board, perform the following steps:

1. Turn power to the computer and all attached equipment OFF.
2. Remove the computer chassis cover.
3. Select an available slot appropriate to the length of the board.
4. Loosen and remove the screw at the top of the blank adapter plate, and then slide the plate up and out to remove.
5. If you are installing your own cables or the optional C-3200/C-32NN ribbon cables, decide how to run the cables. Note that the strain relief on the C-3200/C-32NN 40-pin connector may need to be removed for clearance or to allow the cable to run in the correct direction. Decide on the folds and orientation of the cables but do not install them yet.
6. Insert and secure the board connector in the selected slot.
7. Route your cables or the C-3200/C-32NN cables from the outside of the chassis through the slot in the adapter plate and connect them to the appropriate 40-pin header. Fold the ribbon cable so that it does not interfere with other boards in the chassis.
8. Replace the computer chassis cover.
9. Plug in all cords and cables not already connected.
10. Continue with the next section, “Checking Your Installation.”

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Checking Your Installation

The ability to start the DriverLINX AIO Panel utility, which is available after you install DriverLINX, verifies that DriverLINX and the board are installed and configured satisfactorily.

You can also test the functions of the PIO-32 board, without needing to write an application program, by connecting appropriate digital signals and observing the responses with the DriverLINX AIO Panel.

After you configure and check your installation, you can attach accessories as needed and wire the appropriate signals to the board. Refer to Section 4 for instructions.

I/O Bit Tests

General Information

1. Start the AIO Panel as follows:

   a. In the **Start** menu, click **Programs**.

   b. Find the **DriverLINX ▸ Test Panels** folder, under which you should find the **AIO Panel** entry.

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c. Click on the **AIO Panel** entry. The **Analog I/O Panel** should appear, similar to the example in Figure 3-2. (If you have other DriverLINX devices installed in addition to the digital input/output card you are testing, they will also be listed. In that case, select the desired digital I/O card and the proper device number before proceeding.)

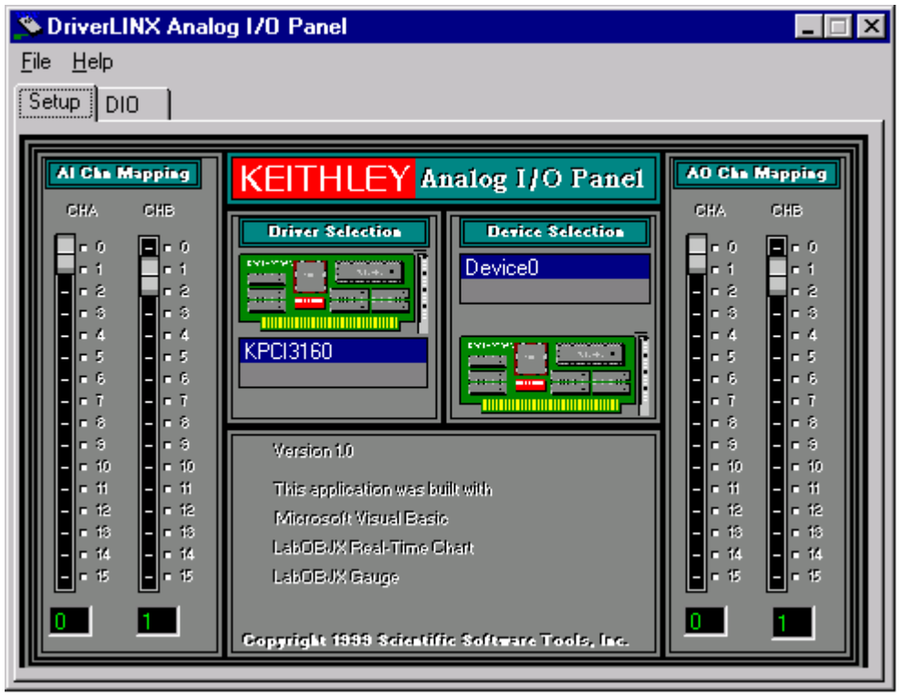


Figure 3-2. An AIO Panel example

Note: The “Driver Selection” column will show the actual DriverLINX driver(s) you have installed.

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2. On the **AIO Control Panel**, click the **DIO** tab.

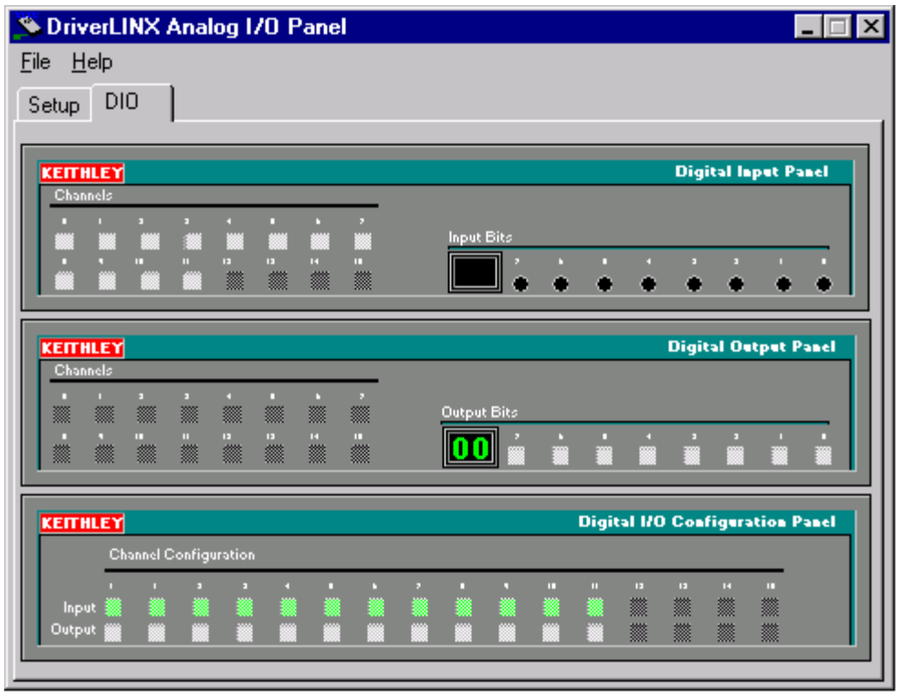


Figure 3-3. DIO channel tab example

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Note: The on-screen digital I/O controller works as follows:

- Channels 0 to 15 refer to the 8-bit general-purpose registers of your digital input-output card. (Depending on which card is used, the number of valid 8-bit registers will vary.) Bits displayed on the **Digital Input Panel** and the **Digital Output Panel** are numbered 0-7 for every channel. Refer elsewhere in this manual for a description of the available ports and their direction.
- Invalid channels and settings appear as dark gray squares. For example:
  - Non-existent channels always appear as dark gray squares.
  - Channels configured as inputs will appear as dark gray squares on the output panel.
- Valid channels and settings appear as white squares when OFF and green squares when ON. (When the manual is printed in black and white, valid channels and settings appear as white squares when OFF and as light gray squares when ON.)
- The two-digit numeric displays under **Input Bits** and **Output Bits** show the hexadecimal values of the adjacent bit patterns.
- To configure a valid channel either for input or output, use the **Digital Channel Configuration Panel**. Click on either the **Input** or **Output** square below the channel number. Note: this selection will be disabled for channels which are fixed as input or output by hardware design.
- To turn ON output-channel bits, use the **Digital Output Panel**. First select the channel number of the bits to be turned on by clicking on the appropriate square under **Channels**. Then, turn ON a bit by clicking the appropriate square under **Output Bits**. Turn OFF a bit in the same way.
- To read an input-channel bit, use the **Digital Input Panel**. First select the channel number to be checked by clicking the appropriate square under **Channels**. Then, read the numbered bit under **Input Bits**. OFF input bits appear as black dots and ON input bits appear as green dots. (When the manual is printed in black and white, OFF input bits appear as black dots and ON input bits appear as light gray dots.)

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3. Under **Digital I/O Configuration Panel**, configure channels as shown in Figure 3-4. (Actual channels available will vary according to your hardware.)

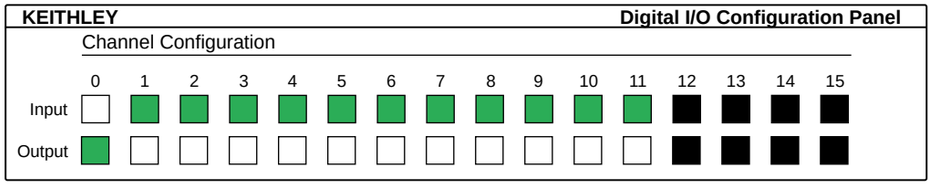


Figure 3-4. Configuring the digital I/O channels as inputs and outputs

Note: For clarity when the manual is printed in black and white, the control colors in Figure 3-4 and subsequent drawings will be shown as follows:

Illustration	Color on Actual Panel	Function
BLACK	DARK GRAY	Invalid
WHITE	LIGHT GRAY	OFF
GRAY	GREEN	ON

4. In the **Digital Output Panel** under **Channels**, click on a channel (here, channel **0**) as shown in Figure 3-5.

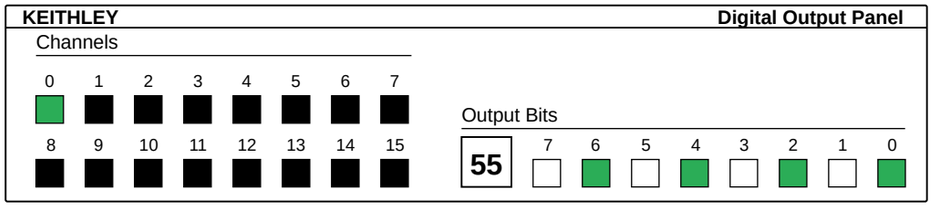


Figure 3-5. Configuring channel 0 for output bit pattern A

5. In the **Digital Output Panel** under **Output Bits**, set the bits of the channel as desired as shown in Figure 3-5. (Click on each bit position to turn it ON or OFF.)

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6. In the **Digital Input Panel** under **Channels**, click on a channel to select it and display the logical state of its input lines.

Output Set Test

The output set test checks whether logic levels measured at all output pins agree with output bit patterns set by software, using a DriverLINX graphical interface (AIO Panel).

Note: This test is performed without user circuits being connected to the outputs.

Perform the output set test as follows:

1. Ready the following equipment:
   - A digital voltmeter (DVM) or a digital multimeter (DMM) set to measure voltages, or a logic probe capable of reading TTL logic levels.
   - A suitable accessory and cable for the board being tested.
2. Turn OFF the host computer.
3. Connect the cable and accessory to your board.
4. Turn ON the host computer and boot Windows 95/98/NT.
5. Click the Windows 95/98/NT **Start** tab.

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6. Start the AIO Panel as follows:

   a. In the **Start** menu, click **Programs**.

   b. Find the **DriverLINX ▸ Test Panels** folder, under which you should find the **AIO Panel** entry.

   c. Click on the **AIO Panel** entry. The **Analog I/O Panel** should appear, similar to the example in Figure 3-6. (If you have other DriverLINX devices installed in addition to the digital input/output card you are testing, they will also be listed. In that case, select the desired digital I/O card and the proper device number before proceeding.)

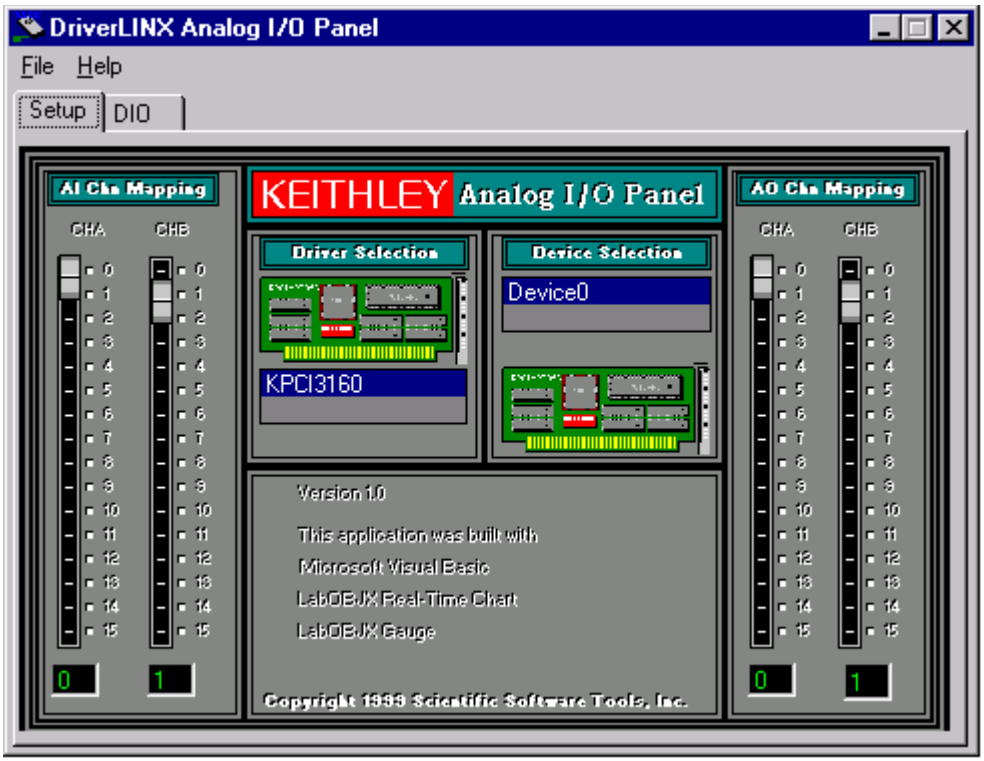


Figure 3-6. An AIO Panel example

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7. On the **AIO Panel**, click the **DIO** tab.

Note: To read an input-channel bit, use the **Digital Input Panel**. First, select the channel number to be checked by clicking the appropriate square under **Channels**. Then, read the numbered bit under **Input Bits**. OFF input bits appear as black dots and ON input bits appear as green dots. (When the manual is printed in black and white, OFF input bits appear as black dots and ON input bits appear as light gray dots.) Further information about this panel, how to make changes, and how to interpret displays, is given in "I/O Bit Tests" of this section.

---

8. Under **Digital I/O Configuration Panel**, configure the output channels to be tested as shown in Figure 3-7. (Actual output channels will vary according to your hardware.)

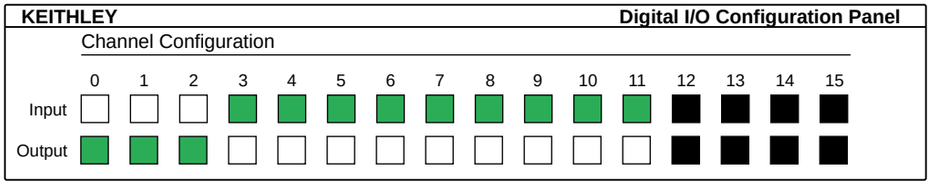


Figure 3-7. Configuring the digital I/O channels as inputs and outputs

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Note: In Figure 3-7 and subsequent drawings of digital I/O controller panels, the squares below invalid channels are colored black instead of dark gray—for clarity when the manual is printed in black and white.

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9. In the **Digital Output Panel** under **Channels**, click on an output channel (channel **0** in this example) as shown in Figure 3-8.

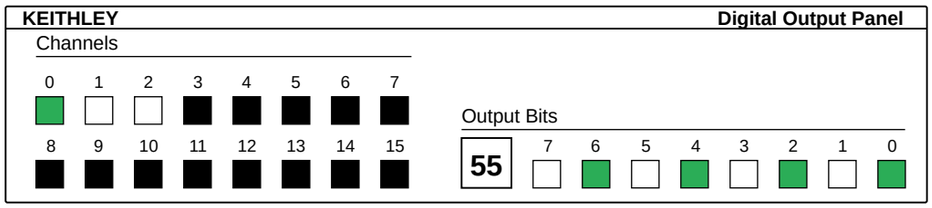


Figure 3-8. Configuring channel 0 for output bit pattern A

10. In the **Digital Output Panel** under **Output Bits**, set the bits of channel **0** for bit pattern A as shown in Figure 3-8.

11. Measure the voltage between signal ground and each bit of the output port with a DMM or DVM. Make measurements at the cabled mating connector of your accessory.

12. Each bit set to ON in the **AIO Panel** should output a logic-high signal at the corresponding I/O terminal, reading typically about 4 volts (minimum of 2.2 volts) at a DMM/DVM. Each bit set to OFF in the **AIO Panel** should output a logic-low signal at the corresponding I/O terminal, reading typically about 0 volts (maximum of 0.8 volts) at a DMM/DVM. Do one of the following:

Note: The typical values shown are valid for boards with TTL compatible outputs. For boards with relay outputs (REL-16, PDISO-8, and PIO-32) the output will be a relay contact closure. For boards with open collector outputs (PIO-HV) use a pull up resistor to an appropriate voltage to detect output state. Refer to the hardware description in this user's guide for more details on the output's electrical specification.

- If the bit patterns set on the **AIO Panel** do not agree with the logic levels measured at the I/O terminals, the board is not functioning properly. Stop here, and determine why.
- If the bit patterns set on the **AIO Panel** agree with the logic levels measured at the I/O terminals, then repeat steps 9, 10, and 11 for remaining output channels.

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13. In the **Digital Output Panel** under **Channels**, click on the output channel to test (channel **0** in this example) as shown in Figure 3-9.

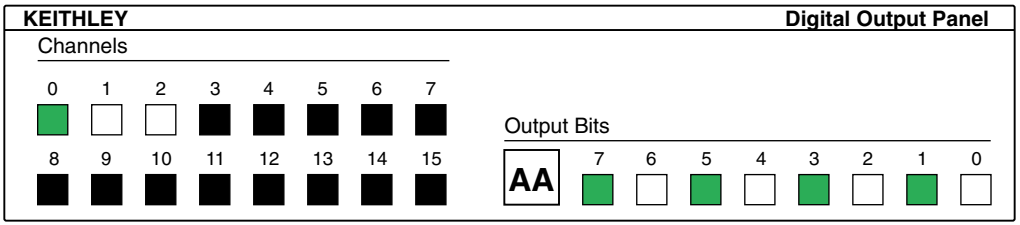


Figure 3-9. Configuring channel 0 for output bit pattern B

14. In the **Digital Output Panel** under **Output Bits**, set the bits of channel **0** for bit pattern B as shown in Figure 3-9.

15. Measure the voltage between signal ground and each bit of the output port with a DMM or DVM. Make measurements at the STA-50 terminals or the cabled mating connector that is connected to the selected CONN-3160-D1 50-pin connector.

16. Again, each bit set to ON in the **AIO Panel** should output a logic-high signal at the corresponding I/O terminal, reading typically about 4 volts (minimum of 2.2 volts) at a DMM/DVM. Each bit set to OFF in the **AIO Panel** should output a logic-low signal at the corresponding I/O terminal, reading typically about 0 volts (maximum of 0.8 volts) at a DMM/DVM.

Note: The typical values shown are valid for boards with TTL compatible outputs. For boards with relay outputs (REL-16, PDISO-8, and PIO-32) the output will be a relay contact closure. For boards with open collector outputs (PIO-HV) use a pull up resistor to an appropriate voltage to detect output state. Refer to the hardware description in this user's guide for more details on the output's electrical specification.

- If the bit patterns set on the **AIO Panel** do not agree with the logic levels measured at the I/O terminals, the board is not functioning properly. Stop here, and determine why.

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- If the bit patterns set on the **AIO Panel** do agree with the logic levels measured at the I/O terminals, and you have performed an output set test for all ports, the board is functioning properly.

17. Repeat steps 13, 14, and 15 for additional output channels.

Input Read Test

A similar test of input circuitry can be performed by applying an input signal of suitable type to each input line and verifying that the appropriate input indicator changes state. Refer to the hardware description in this user's guide for more details on the input's electrical specifications.

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4

Cabling and Wiring



Warning: The procedures in this section are intended for qualified service personnel. Do not perform these procedures unless you are qualified to do so.

After installing your PIO-32 Series boards, you can attach accessories and wire the appropriate signals to the board. This section includes the following information about cabling and wiring the PIO-32 Series boards:

- Description and illustration of the optional C-3200/C-32NN cables for the PIO-32 Series boards
- Description and illustration of cabling the boards to an STP-37/FC screw terminal panel
- Examples of typical digital I/O wiring
- Connector pin assignments

Caution: Before you make any connections to a PIO-32 Series board, make sure that power to your computer and any accessories attached to the PIO-32 Series board are OFF.

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Optional Cables

Warning: Do not use the C-3200/C-32NN cables at voltages above 30V RMS, 42.4V peak, or 60VDC. These cables are rated for 30V RMS, 42.4V peak, or 60VDC maximum. Use at higher voltages may result in insulation breakdown and shock hazard.

To connect the PIO-32 Series boards to screw terminal panel accessories or other equipment, you need additional cables. You have the option of providing your own cables or purchasing two C-3200/C-32NN cables. The C-3200/C-32NN cables have a 40-pin ribbon connector at one end and a 37-pin, D-type male connector at the other end. Use the 40-pin connectors to bring the cables through the board's rear adapter plate slot to the headers on the board. You use the 37-D connector to attach equipment or to wire a screw terminal panel. Figure 4-1 shows the C-3200 and C-32NN cables. Note that the C-3200 cable is 30-inches long while the C-32NN cable has NN extra feet of cable (NN being the number of feet added to the standard cable).

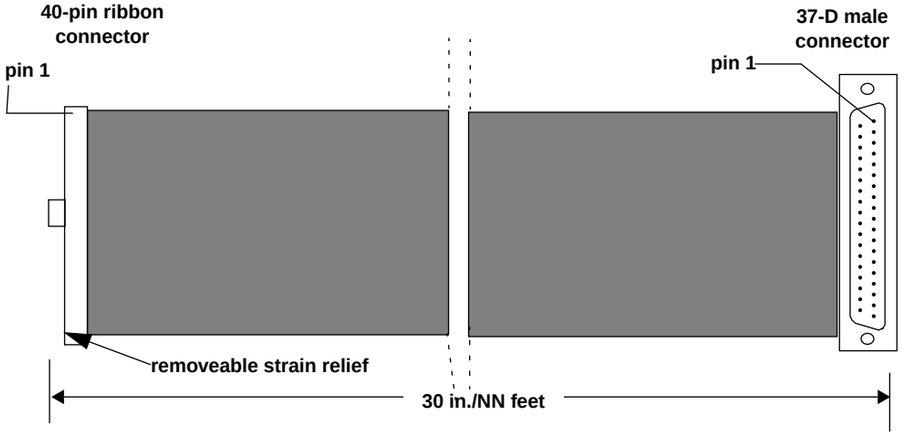


Figure 4-1. C-3200/C-32NN Optional Cables

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STP-37/FC Screw Terminal Panel

Warning: Do not use the STP-37/FC and C-3200/C-32NN accessories or other screw terminal panels at voltages above 30V RMS, 42.4V peak, or 60VDC. These accessories are rated for 30V RMS, 42.4V peak, or 60VDC maximum. Use at higher voltages may result in shock hazard.

Using the screw terminals on the STP-37/FC, you can easily connect your applications to the PIO-32 Series boards with your own cables or with the optional C-3200/C-32NN cables. Figure 4-2 shows the PIO-32 Series board cabled to two STP-37/FC screw terminal panels. Labeled from 1 to 37, the screw terminals correspond directly to the numbers of the pins on the C-3200/C-32NN cable 37-D connectors (not the 40-pin ribbon header).

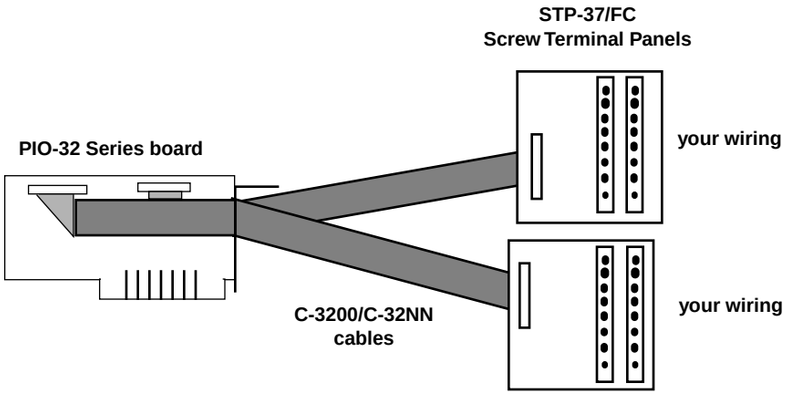


Figure 4-2. PIO-32 Series Board Cabled to Screw Terminal Panels

Caution: Keithley recommends that you always use the STP-37/FC with a case and cover. Figure 4-3 shows the mounting holes for the STP-37/FC without the case.

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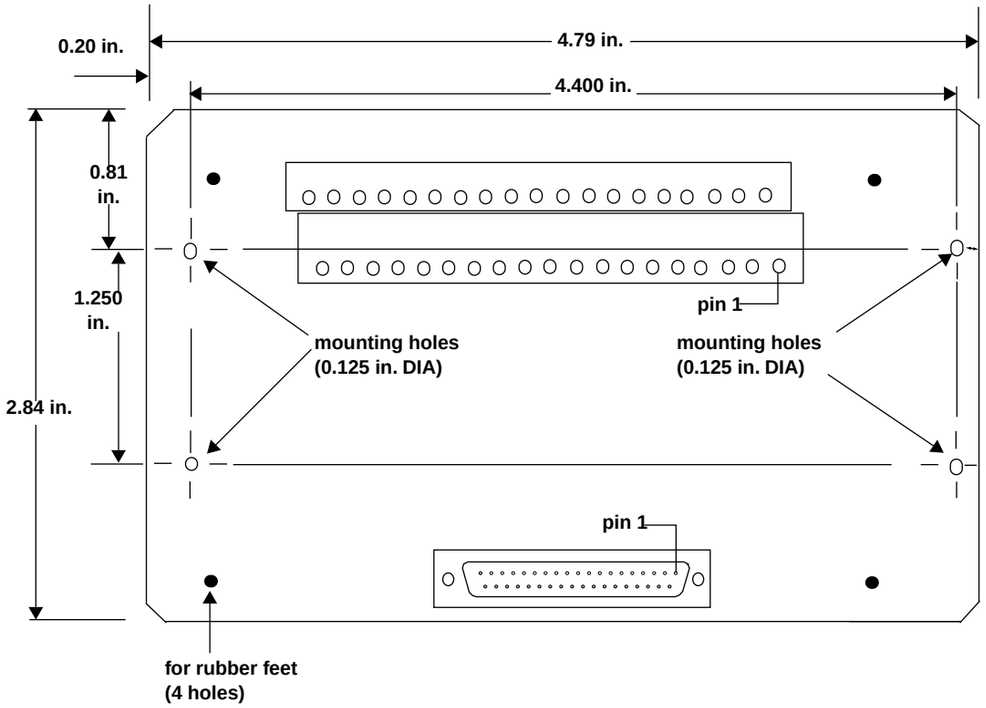


Figure 4-3. STP-37/FC Mounting Holes

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Typical Digital I/O Wiring

This section provides a typical non-TTL digital input wiring example for the PIO-32IN board and a typical digital output control wiring example for the PIO-32OUT board.

In the digital input example shown in Figure 4-4, the PIO-32IN board monitors the presence of non-TTL signals. If no signal is present, the input value is 0; if a non-TTL signal is present, the input value is 1. The polarity matters for a digital input.

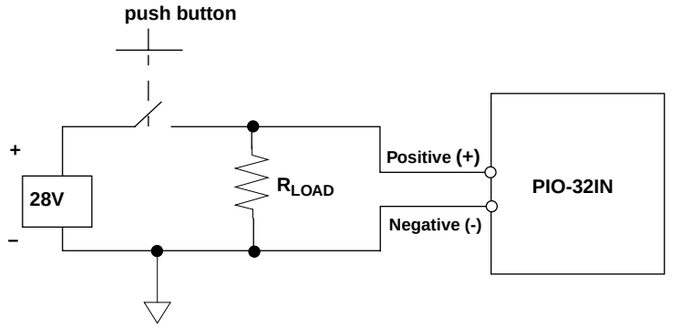


Figure 4-4. Typical Non-TTL Digital Input Wiring Example

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In the digital output example shown in Figure 4-5, the PIO-32OUT board is used to control the on and off state of a device. The polarity does not matter in this example.

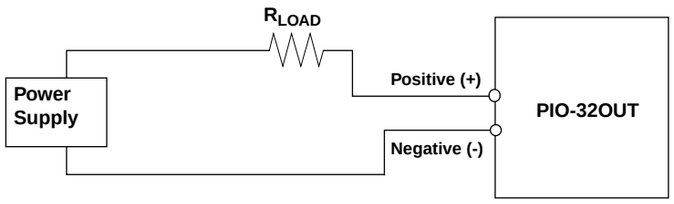


Figure 4-5. Typical Digital Output Control Wiring Example

Connector Pin Assignments

If you are using the C-3200/C-32NN cables, note that the pin assignments for the 37-D connector and the 40-pin ribbon header are numbered differently. Figure 4-6 on page 4-7 shows the 37-D cable connector and its pin assignments for the J1 signals; Figure 4-7 on page 4-8 shows this connector and its pin assignments for the J2 signals. Figure 4-8 on page 4-9 shows the 40-pin ribbon header and its pin assignments for the J1 signals; Figure 4-9 on page 4-10 shows the ribbon header and its pin assignments for the J2 signals. Refer to Appendix B for more information on these pin assignments.

Note: The positive input signals are labeled P*n*P (where *n* is the bit number, 0 to 31); the negative input signals are labeled P*n*N (where *n* is the bit number, 0 to 31).

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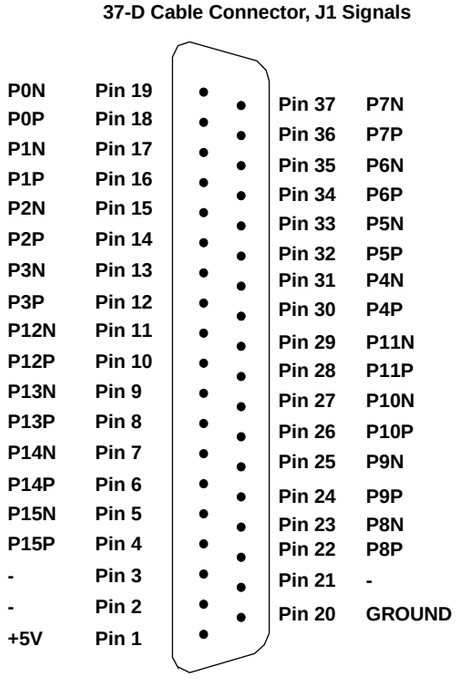


Figure 4-6. Pin Assignments for the C-3200 Cable 37-D Connector, J1 Signals

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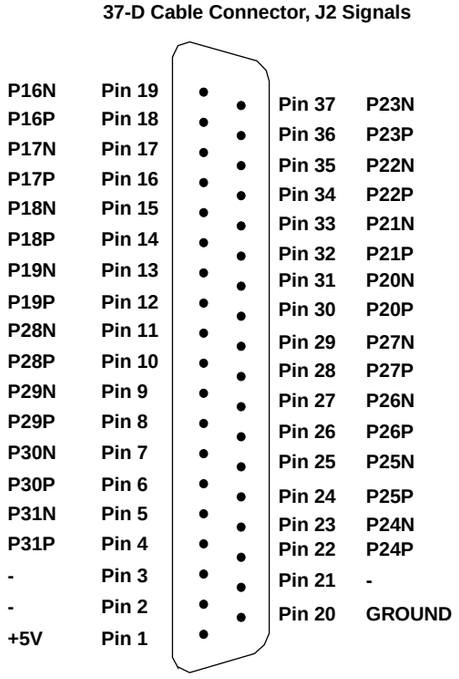


Figure 4-7. Pin Assignments for the C-3200 Cable 37-D Connector, J2 Signals

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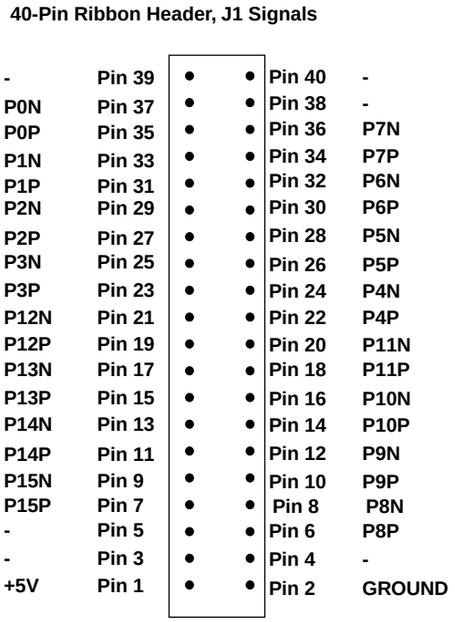


Figure 4-8. Pin Assignments for 40-Pin Ribbon Header, J1 Signals

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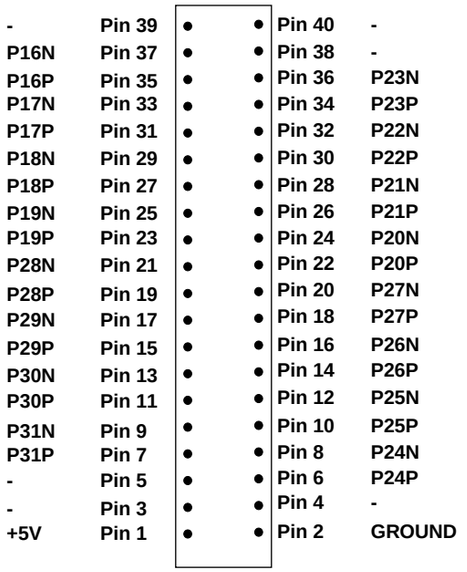


Figure 4-9. Pin Assignments for the 40-Pin Ribbon Header, J2 Signals

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5

Programming

You do not program the registers of your PIO-32 Series board directly through Windows 95/98/NT. Instead, you program register changes through the application programming interface (API) of DriverLINX. DriverLINX is provided on the CD-ROM that comes with your board and should now be installed on your system. (Refer to Section 3.) Using DriverLINX, you can program the board in Visual C/C++, Visual Basic, and Delphi.

DriverLINX features are summarized in Section 1. For detailed information about DriverLINX in general and about programming with DriverLINX specifically, refer to your DriverLINX documentation.

Note: To access the DriverLINX documents on-line, Acrobat Reader (version 3.0 or greater) must be installed on your computer.

To access the DriverLINX documentation after you have installed it on your computer, do the following:

1. Click the Windows 95/98/NT **Start** tab.

2. In the **Start** menu, click **Programs**.

3. Find the **DriverLINX** folder, under which you should find the **On-line Manuals** entry.

4. Click on the **On-line Manuals** entry. The DriveLINX Printable Documentation table of contents opens via Acrobat reader.

5. Scroll through the DriverLINX Printable Documentation table of contents and find the document or document category that you want.

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6. Click on the wanted document or document category. Either the selected document appears or a list of documents that fit the selected category appears.

7. If a list appears, click on the title of the document that you want. The desired document appears.

To access the DriverLINX documentation from the CD-ROM that came with your board, do the following:

1. In Windows Explorer, double click on **X:\Drvlinx4\Docs\Toc.pdf**, where **X** is the drive letter of your CD-ROM drive. The DriveLINX Printable Documentation table of contents opens via Acrobat reader.

2. Scroll through the DriveLINX Printable Documentation table of contents and find the document or document category that you want.

3. Click on the wanted document or document category. Either the selected document appears or a list of documents that fit the selected category appears.

4. If a list appears, click on the title of the document that you want. The desired document appears.

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6

Troubleshooting



Warning: The procedures in this section are intended for qualified service personnel. Do not perform these procedures unless you are qualified to do so.

If your PIO-32 Series board is not operating properly, use the information in this section to help you isolate the problem. If the problem appears serious enough to require technical support, refer to page 6-6 for information on how to contact an applications engineer.

Problem Isolation

If you encounter a problem with a PIO-32 Series board, use the instructions in this section to isolate the cause of the problem before calling Keithley Technical Support.

Identifying Symptoms and Possible Causes

Use the troubleshooting information in Table 6-1 to try to isolate the problem. Table 6-1 lists general symptoms and possible solutions for problems with PIO-32 Series boards.

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Table 6-1. Troubleshooting Information

Symptom	Possible Cause	Possible Solution
Board does not respond	DriverLINX is not installed correctly or the combined DriverLINX/board installation is not properly configured.	Reinstall and/or reconfigure DriverLINX if necessary. Refer to page 3-3 and to "Configuring the PIO Series" in the manual *Using DriverLINX With Your Hardware—Keithley PIO Series*.
	Base address is incorrect.	Make sure that no other system resource is using the specified base address and that the board base address setting matches the software setting. Reconfigure the base address, if necessary. Refer to page 3-8 for instructions on setting the base address.
	The board is incorrectly aligned in the accessory slot.	Check installation.
	The board is damaged.	Contact the Keithley Applications Engineering Department; see page 6-6.
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 the documentation for your computer 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 for specifications.
	Electrical noise exists.	Provide better shielding or reroute wiring.

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Table 6-1. 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-32 Series board; refer to page 3-8 for more information. Check the I/O assignments of other system resources and reconfigure, if necessary.
	Polarity of input current reversed.	Check wiring for proper use of positive and negative connections.
	Outputs not indicating proper level.	Check that the circuit is complete (are both relay connections used?). You may need to apply pull-up resistors for the external source
Computer does not boot.	Board not seated properly.	Check that the board is properly installed.
	The base address setting of the PIO-32 board conflicts with that of another system resource.	Verify that the base address settings of your system resources are 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 6-1, continue with the next two sections to further isolate the problem.

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Testing the PIO-32 Series Board and Host Computer

To isolate the problem to the PIO-32 Series board or to the host computer, perform the following steps.



Warning: Do not connect voltages greater than 30V RMS, 42.4V peak, or 60VDC to any input or output on this board.

Live voltages can still be present on the board even when the computer is turned off. To protect you and the circuit, Keithley provides covers with the PIO-32 Series boards. Though you can remove the covers to service the PIO-32 Series boards, **do not use these boards with the covers removed!** In addition, disconnect all cables when servicing these boards.

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. Unplug the accessory connector(s) or cable(s) from the PIO-32 Series board(s), keeping the connections intact on the accessory board(s).

3. Remove the PIO-32 Series board(s) from the computer and visually check for damage. If a board is obviously damaged, refer to page 6-6 for information on returning the board.

4. With the PIO-32 Series board(s) 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-32 Series 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 page 6-6 before calling Keithley Applications Engineering.

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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-32 Series 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-32 Series board that you know is functional. Do not make any I/O connections.

2. Apply computer power and check operation with the functional PIO-32 Series board in place. This test checks the computer accessory slot. If you are using more than one PIO-32 Series board, check the other slots you are using.

3. If the accessory slots are functional, check the I/O connections. Connect the accessory boards, one at a time, and check operation.

4. If operation is normal, the problem is in the PIO-32 Series board(s) originally in the computer. Try the PIO-32 Series board(s) one at a time in the computer to determine which is faulty. Use the troubleshooting information in the next section to try to isolate the problem.

5. If you cannot isolate the problem, refer to the next section for instructions on getting technical support.

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Technical Support

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

1-888-KEITHLEY

Monday - Friday, 8:00 a.m. - 5:00 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 following information available before you call:

PIO-32 Series board	Model	I/O IN OUT
	Serial #	_____
	Revision code (4 digits)	_____
	Base address setting	_____
Computer	Manufacturer	_____
	CPU type	_____
	Clock speed (MHz)	_____
	Math coprocessor	Yes No
	Amount of RAM	_____
	Video system	_____
	BIOS type	_____
Operating system	DOS version	_____
	Windows version	_____
	Windows mode	_____
Software package	Name	_____
	Version	_____
	Invoice/order #	_____
Compiler (if applicable)	Language	_____
	Manufacturer	_____
	Version	_____

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Accessories	STP-37/FC	_____
	STA-U	_____
	C-3200/C-32NN cables	_____
	Other	_____
	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 Instruments, Inc.
28775 Aurora Road
Cleveland, Ohio 44139

Telephone 1-888-KEITHLEY
FAX (440) 248-6168

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

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

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A

Specifications

This appendix provides a table of the specifications for the PIO-32 Series boards. In Table A-1, the abbreviation N/A means not applicable.

Table A-1. PIO-32 Series Specifications

Feature	Attribute	PIO-32I/O	PIO-32IN	PIO-32OUT
Digital Output	Channels	16	0	32
	Contact Type	Rhodium plated (Form A, normally open contacts)	N/A	Rhodium plated (Form A, normally open contacts)
	Contact Rating	10W at 0.75A or 30V RMS, 42.4V peak, or 60VDC maximum (resistive)	N/A	10W at 0.75A or 30V RMS, 42.4V peak, or 60VDC maximum (resistive)
	Contact Resistance	100mΩ (maximum, initial)	N/A	100mΩ (maximum, initial)
	Contact Life	10^7 operations at rated load; 10^9 at low level	N/A	10^7 operations at rated load; 10^9 at low level
	Operation Time	1.0 ms	N/A	1.0 ms
	Release Time	1.0 ms	N/A	1.0 ms

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Table A-1. PIO-32 Series Specifications (cont.)

Feature	Attribute	PIO-32I/O	PIO-32IN	PIO-32OUT
Digital Input	Channels	16	32	0
	Type	Optoisolator	Optoisolator	N/A
	Input Resistor	2.0kΩ, 1/2W	2.0kΩ, 1/2W	N/A
	Input High (Min.)	3.5VDC, 1.25mA	3.5VDC, 1.25mA	N/A
	Input High (Max.)	28VDC, 15mA	28VDC, 15mA	N/A
	Input Low	0.8VDC or open	0.8VDC or open	N/A
	Response Frequency	<3.0kHz	<3.0kHz	N/A
Power Consumption	+5 VDC (typical)	0.8A + 22mA per active relay (max.)	0.5A	1.0A + 22mA per active relay (max.)
Environment	Operating Temperature	0° to 50°C	0° to 50°C	0° to 50°C
	Storage Temperature	-20° to 70°C	-20° to 70°C	-20° to 70°C
	Humidity	0 to 90% noncondensing	0 to 90% noncondensing	0 to 90% noncondensing
Mechanical	Length	13.3 in. (Full slot)	9.0 in.	13.3 in. (Full slot)
	Height	4.25 in.	4.25 in.	4.25 in.
	Depth	0.75 in.	0.75 in.	0.75 in.
	Weight	10 oz.	6 oz.	12 oz.
	Board Connector Type	2 x 40-pin ribbon 3M #2540-6002UG	2 x 40-pin ribbon 3M #2540-6002UG	2 x 40-pin ribbon 3M #2540-6002UG
	Board Connector Mate	2 x 40-pin ribbon 3M #3417-7000	2 x 40-pin ribbon 3M #3417-7000	2 x 40-pin ribbon 3M #3417-7000

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B

Connector Pin Assignments

This appendix provides a table of the connector pin assignments for the 37-D and 40-pin ribbon connectors and of the signals for the J1 and J2 connectors of the PIO-32 Series boards. In addition, this appendix contains the same pin assignment figures for these connectors as shown in Section 4. For instructions on cabling accessories and wiring signals to your PIO-32 Series board, see Section 4.

In Table B-1, note that input and output signals are paired as P*n*P and P*n*N (where *n* is the bit number, 0 to 15). The P suffix represents the positive side and the N suffix the negative side. Connector J1 is associated with signals for bits 0 to 15, and connector J2 is associated with signals for bits 16 to 31.

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Table B-1. 37-D and 40-Pin Signals for Connectors J1 and J2

37-D Pins	Ribbon Pins	PIO-32 J1 Signals	PIO-32 J2 Signals	37-D Pins	Ribbon Pins	PIO-32 J1 Signals	PIO-32 J2 Signals
1	1	+5V	+5V	20	2	GROUND	GROUND
2	3	-	-	21	4	-	-
3	5	-	-	22	6	P8P	P24P
4	7	P15P	P31P	23	8	P8N	P24N
5	9	P15N	P31N	24	10	P9P	P25P
6	11	P14P	P30P	25	12	P9N	P25N
7	13	P14N	P30N	26	14	P10P	P26P
8	15	P13P	P29P	27	16	P10N	P26N
9	17	P13N	P29N	28	18	P11P	P27P
10	19	P12P	P28P	29	20	P11N	P27N
11	21	P12N	P28N	30	22	P4P	P20P
12	23	P3P	P19P	31	24	P4N	P20N
13	25	P3N	P19N	32	26	P5P	P21P
14	27	P2P	P18P	33	28	P5N	P21N
15	29	P2N	P18N	34	30	P6P	P22P
16	31	P1P	P17P	35	32	P6N	P22N
17	33	P1N	P17N	36	34	P7P	P23P
18	35	P0P	P16P	37	36	P7N	P23N
19	37	P0N	P16N	-	38	-	-
				-	39	-	-
				-	40	-	-

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Figure B-1 shows the pin assignments for the 37-D cable connector, J1 signals. Figure B-2 on page B-4 shows the pin assignments for the 37-D cable connector, J2 signals. Figure B-3 on page B-5 shows the pin assignments for the 40-in ribbon header, J1 signals. Figure B-4 on page B-6 shows the pin assignments for the 40-pin ribbon header, J2 signals.

Note: The positive input signals are labeled P*n*P (where *n* is the bit number, 0 to 31); the negative input signals are labeled P*n*N (where *n* is the bit number, 0 to 31).

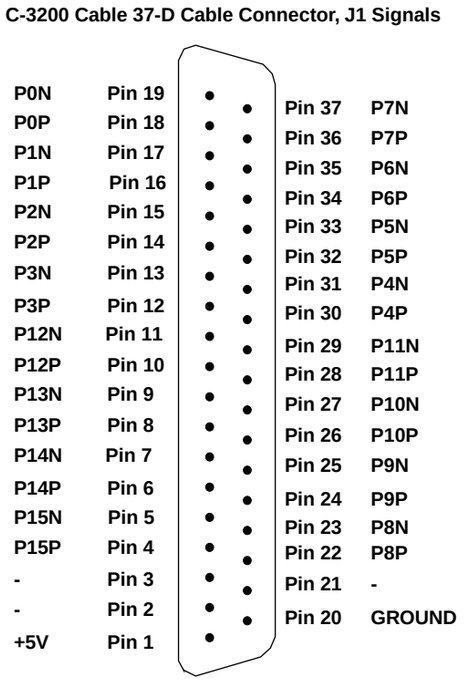


Figure B-1. Pin Assignments for the C-3200 Cable 37-D Connector, J1 Signals

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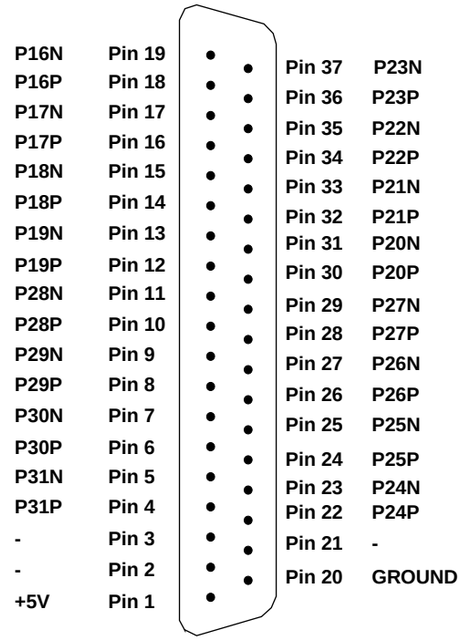


Figure B-2. Pin Assignments for the C-3200 Cable 37-D Connector, J2 Signals

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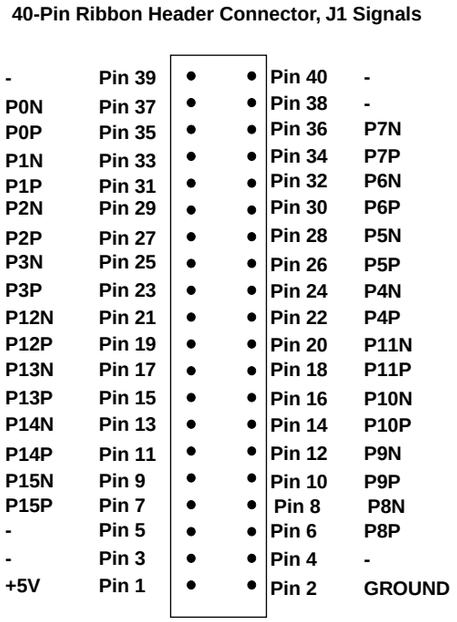


Figure B-3. Pin Assignments for 40-Pin Ribbon Header Connector, J1 Signals

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40-Pin Ribbon Header Connector, J2 Signals

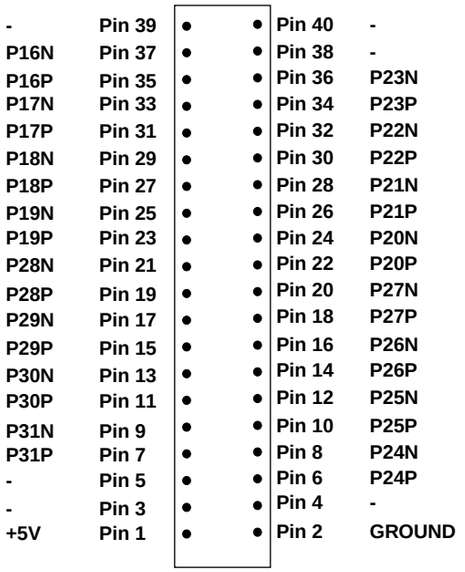


Figure B-4. Pin Assignments for 40-Pin Ribbon Header Connector, J2 Signals

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C

Register Maps

Note: Address maps are provided here only for background reference purposes. You do not program registers directly in Windows 95/98/NT. Instead, you program register changes through the application programming interface (API) of DriverLINX, which is provided on the CD-ROM that comes with your board. Refer to the DriverLINX documentation that is installed on your system. (If it is not yet installed, you can find it on the CD-ROM in the X:\DrvLINX4\Docs and X:\DrvLINX4\Docs\Notes folders, where X is the drive letter of the CD-ROM drive.)

The PIO-32 Series boards contain four 8-bit registers. To maintain compatibility with the PIO-12 products, which use an 8255 Programmable Peripheral Interface integrated circuit, the four registers are at base addresses +0h, +1h, +4h, and +5h. Base addresses +2h, +3h, +6, and +7h are not used. Reads or writes to these locations are ignored; the ports are not software configurable.

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Table C-1 summarizes the PIO-32 Series register maps.

Table C-1. PIO-32 Series Register Map Summary

Base	8255 Port	PIO-32IN	PIO-32OUT	PIO-32I/O
+0h	Port A	Read	Readback/Write	Read
+1h	Port B	Read	Readback/Write	Read
+2h	Port C (not used)	N/A	N/A	N/A
+3h	Control Register (fixed)	N/A	N/A	N/A
+4h	Port A	Read	Readback/Write	Readback/Write
+5h	Port B	Read	Readback/Write	Readback/Write
+6h	Port C (not used)	N/A	N/A	N/A
+7h	Control Register (fixed)	N/A	N/A	N/A

Table C-2 lists the register map for the PIO-32I/O board; Table C-3 lists the register map for the PIO-32IN board; and Table C-4 lists the register map for the PIO-32OUT board.

Notes: In each table, the abbreviation BA is for the Base Address.

For input port bits: 0 = no current through optoisolator,
1 = current > 1.25mA (voltage > 3.5V)
For output port bits: 0 = relay is not activated (open)
1 = relay is activated (closed

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Table C-2. PIO-32I/O Register Map

BA	Write Bits								Read Bits							
	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
	Not Used								Input Port							
+0h	-	-	-	-	-	-	-	-	P7	P6	P5	P4	P3	P2	P1	P0
	Not Used								Input Port							
+1h	-	-	-	-	-	-	-	-	P15	P14	P13	P12	P11	P10	P9	P8
	Output Port								Readback Port							
+4h	P23	P22	P21	P20	P19	P18	P17	P16	P23	P22	P21	P20	P19	P18	P17	P16
	Output Port								Readback Port							
+5h	P31	P30	P29	P28	P27	P26	P25	P24	P31	P30	P29	P28	P27	P26	P25	P24

Table C-3. PIO-32IN Register Map

BA	Write Bits								Read Bits							
	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
	Not Used								Input Port							
+0h	-	-	-	-	-	-	-	-	P7	P6	P5	P4	P3	P2	P1	P0
	Not Used								Input Port							
+1h	-	-	-	-	-	-	-	-	P15	P14	P13	P12	P11	P10	P9	P8
	Not Used								Input Port							
+4h	-	-	-	-	-	-	-	-	P23	P22	P21	P20	P19	P18	P17	P16
	Not Used								Input Port							
+5h	-	-	-	-	-	-	-	-	P31	P30	P29	P28	P27	P26	P25	P24

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Table C-4. PIO-32OUT Register Map

BA	Write Bits								Read Bits							
	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
	Output Port								Readback Port							
+0h	P7	P6	P5	P4	P3	P2	P1	P0	P7	P6	P5	P4	P3	P2	P1	P0
	Output Port								Readback Port							
+1h	P15	P14	P13	P12	P11	P10	P9	P8	P15	P14	P13	P12	P11	P10	P9	P8
	Output Port								Readback Port							
+4h	P23	P22	P21	P20	P19	P18	P17	P16	P23	P22	P21	P20	P19	P18	P17	P16
	Output Port								Readback Port							
+5h	P31	P30	P29	P28	P27	P26	P25	P24	P31	P30	P29	P28	P27	P26	P25	P24

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