

PIO-96
ISA Bus Digital I/O Board
Instruction Manual

KEITHLEY

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PIO-96
ISA Bus Digital I/O Board
User's Manual

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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 the operating information carefully before using the product.

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, 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.

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.**

Users of this product must be protected from electric shock at all times. The responsible body must ensure that users are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product users 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.**

As described in the International Electrotechnical Commission (IEC) Standard IEC 664, digital multimeter measuring circuits (e.g., Keithley Models 175A, 199, 2000, 2001, 2002, and 2010) are Installation Category II. All other instruments' signal terminals are Installation Category I and must not be connected to mains.

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.

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 a  screw 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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1 General Description

The board

The PIO-96 board is a 96-line parallel digital I/O interface board. The combined board and supplied software installs and runs in any IBM PC-compatible computer that runs the Microsoft Windows® 95/98/NT operating system (Pentium®-series processor recommended).

The PIO-96 board is built around four industry-standard Intel 8255, 24-bit, programmable peripheral interface (PPI) adapter chips. Each 8255 includes the three TTL/CMOS-compatible digital I/O ports PA, PB, and PC. The PA and PB ports are byte-wide (8 bits) and configurable as inputs or outputs. The PC port is also byte-wide but can be divided into two separate 4-bit ports: PC lower and PC upper (each of which can be set up as either inputs or outputs). The PIO-96 supports the full set of operating configurations of the 8255 PPI as set by its Control Register. On power-up, or whenever the computer's hardware-reset line is asserted, all ports are cleared and set in a digital-input mode.

The PIO-96 uses 16 consecutive I/O addresses within the computer I/O address space (four addresses for each 8255 chip). The base address of the PIO-96 board is set by a base address switch. More than one PIO-96 may be installed in a single computer. However, each installed PIO-96 uses 16 I/O addresses (base address +0 through base address +15), and no two boards can use the same address.

The PIO-96 also includes a wait-state generator that insures a 300ns I/O cycle time, minimum, as required by the 8255. If your computer does not require the wait-state generator, it can be disabled by setting the wait-state jumper to the OFF position.

The computer power supplies provide +5V power through the I/O connectors for use in external applications, such as the addition of pull-up resistors. The +5V supply may also be used to power external accessories, as long as you observe the total-available-power limits of your computer and ensure that each connector pin current is limited to less than 1A.

NOTE *Do not connect the +5V outputs to an external +5V supply.*

I/O connections for each 8255 port use a 50-pin, 0.1-inch header connector. This configuration assures maximum shielding and minimum cross-talk by placing a ground wire in the cable between each I/O conductor. The mating connector socket is the 3M 3425-6050 (one required for each 24-bit port), or you may purchase a ready made 24-inch cable with connectors on both ends as Keithley part number CACC-2000. Longer cables are available by specifying Part # CACC-20NN, where NN is the number of feet added to the standard two-foot cable. Wiring accessories are also available.

General areas of application for the PIO-96 include all parallel-digital I/O requirements, such as communicating with peripherals, operating relays, reading switch inputs, etc.

Supporting software

DriverLINX software is supplied by Keithley with the PIO-96 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

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



2 Installation

This section contains the following procedures, in the order in which they are to be performed:

- Inventorying installation resources
- Installing the DriverLINX software needed to operate your PIO-96 board
- Configuring the installation in software
- Unpacking and inspecting the board, setting the base address of the board, and installing the board in your computer
- Checking the installation
- Wiring to your external circuits

NOTE *Install the DriverLINX software before installing the PIO-96 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-96 board's configuration settings.
2. Determine the resources your PIO-96 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-96 board.
5. Determine whether your PIO-96 board can use your computer's free resources.
6. Continue with the next section, "Installing DriverLINX software and documentation."

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.*

Installing DriverLINX software and documentation

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**.

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-96 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.
8. On the System Settings Changed dialog box, click **No**. (The system will be rebooted and configured later under "Configuring your installation" on page 2-4.) 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:\Drvlinx4Docs\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.*

10. Continue with “Configuring your installation.”

Configuring your installation

Configure your installation as follows:

1. Locate and briefly review the DriverLINX 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:\Drvlinx4Help\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 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 as a non-Plug and Play operating system, using BIOS setup, and then 2) individually assign the interrupt to the ISA bus.*

4. Continue with “Preparing and installing your board.”

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 and inspecting the board

After you unpack the board from its outer shipping material, do the following:

1. Remove the item from its packing material while keeping one hand firmly on a metal portion of the system chassis. This prevents any damage to the board components from static-electric build-up.
2. After allowing a moment for static electricity discharge, carefully unwrap the board from its anti-static material.
3. Inspect the board for any possible damage. Report any sign of damage to the shipper and the manufacturer.

Confirm that each item on the packing list has been shipped. It is a good idea to retain the packing material in the event that the board must be returned to the factory for repair.

Continue with the next procedure, "Setting the base address switch."

Setting the base address switch

The PIO-96 contains a DIP switch that must be set prior to installing the board in the computer. This switch selects the board's base address from the computer's available I/O addresses. The PIO-96 uses a block of 16 non-overlapping I/O addresses, and the base address switch selects where in the computer's I/O space the board resides. Base addresses must be assigned within the range of 100h to 3FFh (512 to 1023 decimal).

The default base address setting is 300h. If 300h was also assigned to the board when you ran the DriverLINUX Plug and Play Wizard, you do not need to reset the address switch. Otherwise, reset the base address switch to conform to the base address assigned when you ran the Wizard.

The base-address 6-position DIP switch is located in the lower right-hand corner of the board. To make a base address setting, use a pen-tip to move the individual switches to their ON or OFF position.

NOTE *When setting the base address switch, use the switch numbers that have been silk-screened on the board, and ignore any numbers that may be on the switch itself.*

For example, to set a base address of 300h (768 decimal), move switches 9 and 8 into the OFF position while leaving all other switches in the ON position. Figure 2-1 shows the PIO-96 base address switch and the address values corresponding to each of the seven poles. Figure 2-2 shows the board location of the base address switch.

Set the base address now. When you have finished setting the base address, continue with "Setting the wait-state jumper."

Figure 2-1
Base address switch values

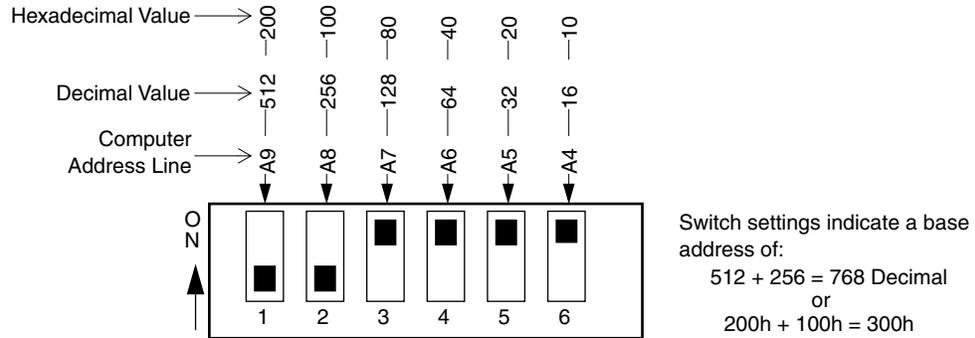
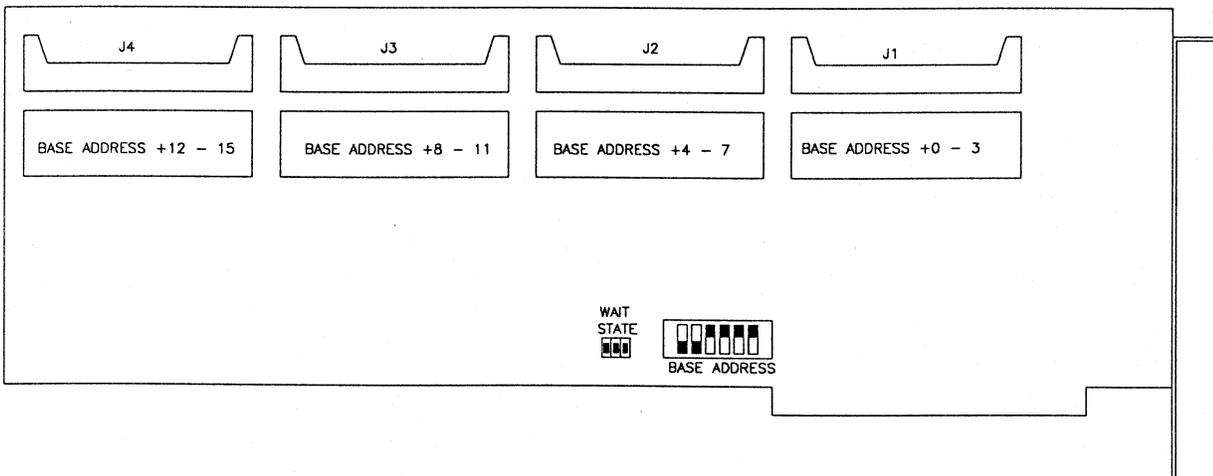


Figure 2-2
Board component locations



Setting the wait-state jumper

The wait-state PIO-96 generator insures a 300ns I/O cycle time, minimum, as required by the 8255. If your computer does not require the wait-state generator, it can be disabled by setting the board's wait-state jumper to the OFF position.

The PIO-96 is shipped with the wait-state generator disabled (jumper block set on the two pins farthest from the base address switch). To enable the wait-state generator, place the jumper on the two pins closest to the base address switch.

Continue with the next procedure, "Connecting cables to the board."

Connecting cables to the board

NOTE *Do not yet connect the cables to any external circuits. Wiring to external circuits should be done after the procedures under “Checking your installation.”*

Each 24-bit port on the PIO-96 uses a 50-pin connector as an interface to data acquisition signals. This connector is compatible with the manufacturer's CACC-2000 series of cables. However, please note that the standard CACC-2000 cable is only 18 inches long. Since the connector, and up to 14 inches of the I/O cable (worst case) will be inside the computer, the standard CACC-2000 cable may be inadequate. However, longer cables are available. Simply order a CACC-20NN, where NN is the additional number of feet (beyond the standard 18 inches) that you desire.

Alternatively, you can make custom cables for specific purposes. The mating connector is 3M type 3425-6050. One is required for each 24-bit port.

Before installing the board and before connecting any external circuits, install all cables that you intend to use, as follows:

1. Make sure that your wrist strap is on and grounded. (You should use a grounded wrist strap. However, if you don't have a wrist strap, touch any metallic part of the computer cabinet with one hand before holding the board in the other hand. This will safely discharge any static electricity that has built-up in your body.)
2. Connect all the CACC-2000 Series cables needed to interface to your external circuits to connectors J1 through J4 on the board. See Figure 2-2 for locations of these connectors.
3. Continue with the next procedure, “Installing the board.”

Installing the board

This section provides general instructions for installing the PIO-96 board. For additional information on installing peripheral boards, consult the documentation provided with your computer.

CAUTION **Do not attempt to insert or remove any adapter board with the computer power ON. This could cause damage to your computer.**

To install the PIO-96 board, do the following:

1. Turn OFF power to the computer and all attached options.
2. Unplug the power cords of all attached options from the electrical outlets. Make a note of where all the cables and cords are attached to the rear of the system unit and disconnect. Failure to disconnect all external cables from the computer can result in a hazardous condition, since dangerous voltage levels may be present on externally connected cables, even though the computer is turned OFF.
3. Remove the cover of the computer.
4. Choose an available option slot. Make sure that there is an *additional empty slot* to its right. Loosen and remove the screw at the top of the blank adapter plate. Then slide the plate up and out to remove.
5. Make sure that your wrist strap is on and grounded. (You should use a grounded wrist strap. However, if you don't have a wrist strap, touch any metallic part of the computer cabinet with one hand before holding the board in the other hand. This will safely discharge any static electricity that has built-up in your body.)
6. Check that you have set the desired base address.

7. Feed the cables through the rear of the computer at the slot where the PIO-96 will be installed.
8. Align the gold edge connector with the edge socket and the back adapter plate with the adapter plate screw. Gently press the board downward into the socket. Reinstall the adapter plate screw.
9. Replace the computer cover.
10. Continue with the procedures in “Checking your installation.”

Checking your installation

The ability to start the DriverLINX PIO Control 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-96 board, without needing to write an application program, by connecting appropriate digital signals and observing the responses with the DriverLINX PIO Control Panel. Before connecting signals, first read the following wiring information.

To access the PIO Control Panel, do the following:

1. Click the Windows 95/98/NT **Start** tab.
2. In the **Start** menu, click **Programs**.
3. Find the **DriverLINX** → **Test Panels** entry, under which you should find the **PIO Panel** entry.
4. Click on the **PIO Panel** entry. The **PIO Control Panel** should appear.
5. After you configure and check your installation, continue with the next section, “Wiring to external circuits.”

NOTE Refer also to the *DriverLINX Installation and Configuration Guide* and *Using DriverLINX with Your Hardware—Keithley PIO Series manuals*.

Wiring to external circuits

CAUTION Make sure power both to the board and to all external circuits is turned OFF before connecting cables and external wiring to your board. Making connections while the board and/or external circuits are powered can damage the board, the external circuits, the computer, or all three.

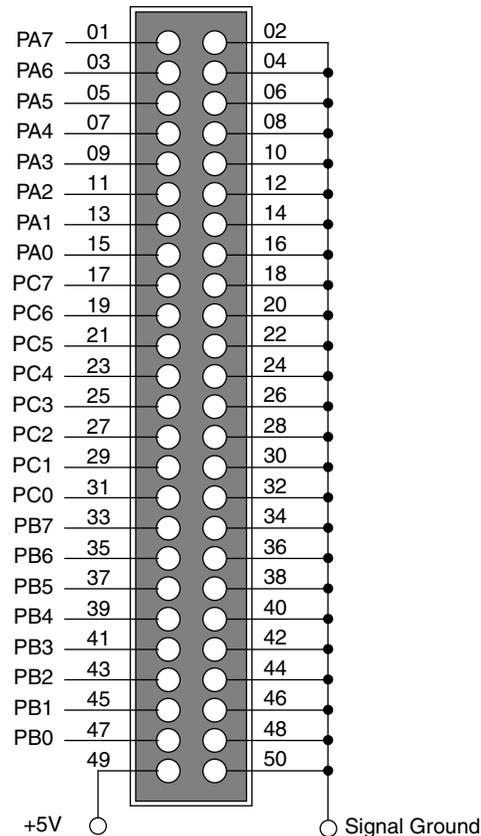
Each 24-bit port on the PIO-96 uses a 50-pin connector as an interface to user circuits. This connector is compatible with the Keithley CACC-2000 Series cables (or with custom cables made using a 3M 3425-6050 mating connector) One or more of these should be connected to the board at this point in your installation. The following subsections describe using a screw terminal wiring accessory, identifying I/O connector pin numbers, and using board power for external circuits.

Identifying I/O connector pin numbers

All connections to the PIO-96 are made through four identical 50-pin plugs located along the top edge of the board. Before wiring cables and/or screw terminal accessories to external circuits, review the pin assignments of the I/O connectors, as shown in Figure 2-3.

Figure 2-3

Pin assignments for a PIO-96 I/O connector and corresponding terminal assignments for a connected STA-50 accessory



Mating connector is part number 3M 3425-6050

Using a screw terminal accessory

An STA-50 screw terminal accessory directly connects a screw terminal to each pin of a PIO-96 I/O connector, via a CACC-200 Series cable. (Therefore the numbers of an STA-50 screw terminal accessory match the pin numbers of a PIO-96 I/O 50-pin connector. See Figure 2-3 above.) It also provides a circuit breadboarding area and a second connector that is wired pin-to-pin to the first connector.

If you require screw terminals, rather than simple cable connections, connect an STA-50 screw terminal accessory to the free end of each CACC-2000 Series cable that you connected to the board in "Connecting cables to the board." (Each port on the PIO-96 requires a separate STA-50.)

Wiring PIO-96 power to external circuits

External power from the computer's internal supply is available on the PIO-96 connector. This power is convenient to use for common board applications. However, Keithley recommends that you do not use the computer power unless you are confident that you can safely meet the following conditions.

- There must be no short circuits, overloads, or application of external voltages. All of these conditions may damage the computer system board and result in costly repairs. The computer power supply is designed to shutdown on a short circuit, but you should not rely on this characteristic.
- The amount of power drawn must be consistent with the capacity of the computer power supply and its internal loads (see your computer's technical reference manual). Due to computer board connector and trace-width limitations, the manufacturer recommends that you limit power draw to 1 ampere regardless of power supply capabilities.

In situations where the PIO-96 is used with a dedicated peripheral (for example, a switch pad) and the cabling and design loads are fixed, it may make economic sense to use the PIO-96 power outputs. In most other cases, it is advisable to power external devices from their own supplies.

3 Programming

You do not program the registers of your PIO-96 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 "Installation" on page 2-1.) Using DriverLINX, you can program the board in Visual C/C++, Visual Basic, and Delphi.

DriverLINX features are summarized under "Supporting software" on page 1-3. 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** entry, under which you will find the **On-line Manuals** entry.
4. Click on the **On-line Manuals** entry. The DriverLINX 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.
6. Click on the desired 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 DriverLINX Printable Documentation table of contents opens via Acrobat Reader.
2. Scroll through the DriverLINX Printable Documentation table of contents and find the document or document category that you want.
3. Click on the desired 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.

A **Specifications**

Logic inputs and outputs

	Min.	Max.
Input logic low voltage	-0.5	+0.8V
Input logic high voltage	2.0	5.0V
Input load current PA, PB, & PC ports ($0 < V_{in} < 5v$)	-10	+10 μ A
Input low current interrupt inputs	-	-0.4mA
Input high current interrupt inputs	-	20 μ A
Output low voltage PA, PB & PC ports ($I_{sink} = 1.7mA$)	-	0.45V
Output high voltage PA, PB & PC ports	2.4V	-
Output source current PB & PC ports only ($V_{out} = 1.5V$, 8 outputs max.)	-1.0	-4.0mA

Power consumption

+5V	1.6 Amp max. plus any external load
+12V	Not used
-12V	Not used

Mechanical and environmental

Operating Temperature Range	0 to 50°C
Storage Temperature Range	-20 to +70°C
Humidity	0-90% noncondensing
Weight	7oz (210gm)

B **I/O Address Map**

Address offsets 0-3, 4-7, 8-11, and 12-15 correspond to the four 8255 PPI chips, each of which has four ports: three I/O ports and one control port. Each of the 8255 chips acts identically and independently. (For a full description of the many capabilities of the 8255 chip, refer to the data sheet of Intel or other 8255 chip manufacturer.)

All the operating modes of the 8255 are supported identically on the PIO-96. However, the majority of users are likely to operate the 8255 in the simple basic input/output mode (also called Mode 0 operation). Therefore, only Mode 0 is emphasized here. If you wish to operate the 8255 in Mode 1 (strobed input/output) or Mode 2 (bidirectional bus) configurations, refer to the 8255 data sheet.

NOTE *On power up or whenever the computer RESET line is asserted, all I/O ports of the 8255 are initially set as inputs.*

Also, a write to the control register at base address +3 (or +7, +11, or +15) clears all output ports.

The 16 locations in I/O address space are allocated as shown in Table B-1.

Table B-1
I/O address map

Bits	Location	Function	Type
0-23	Base address +0	8255 PA Port	Read/Write
	Base address +1	8255 PB Port	Read/Write
	Base address +2	8255 PC Port	Read/Write
	Base address +3	8255 Control	Write Only
24-47	Base address +4	8255 PA Port	Read/Write
	Base address +5	8255 PB Port	Read/Write
	Base address +6	8255 PC Port	Read/Write
	Base address +7	8255 Control	Write Only
48-71	Base address +8	8255 PA Port	Read/Write
	Base address +9	8255 PB Port	Read/Write
	Base address +10	8255 PC Port	Read/Write
	Base address +11	8255 Control	Write Only
72-95	Base address +12	8255 PA Port	Read/Write
	Base address +13	8255 PB Port	Read/Write
	Base address +14	8255 PC Port	Read/Write
	Base address +15	8255 Control	Write Only

Note that the PIO-96 requires a full block of sixteen I/O addresses. For correct operation, other adapters must not conflict with any I/O address within this range, even if the upper ports of your PIO-96 will not be used.

Data ports

The PA and PB ports of the 8255 chip are byte-wide, and the direction of all lines within a port is set by the control register. The PC Port of the 8255 chip may also be used as a byte-wide port or split into two ports of four bits (nibble-wide). The PC0 to PC3 lines are known as the PC-lower port and the PC4 to PC7 lines are known as the PC-upper port. The directions of the PC-upper and PC-lower ports are independently programmable. In modes 1 and 2 of PPI operation, the PC port assumes the role of a control or “handshaking” port and many of its lines assume fixed functions. However, in Mode 0 (basic input/output), the PC lines behave exactly as the PA and PB ports so that you have three independent 8 bit ports for a total of 24 digital I/O lines.

There are slight electrical differences between the ports. Although all three ports are TTL/CMOS-compatible, the PB and PC Ports are designed also to source current as high as 1mA at 1.5V for driving resistive loads or Darlington type power transistors, etc. The PA port does not have this capability. For dissipation reasons, no more than eight outputs total should be used in current sourcing applications. The port descriptions for each 8255 chip are as follows:

- Port A - Consists of one 8 bit data output latch/buffer and one 8 bit data input latch.
- Port B - Consists of one 8-bit data input/output latch/buffer and one 8-bit data input buffer.
- Port C - Consists of one 8-bit data output latch/buffer and one 8-bit data input buffer (no latch for input). This port can be divided into two 4 bit ports under the mode control. Each 4 bit port contains a 4 bit latch and it can be used for the control signal outputs and status signal inputs in conjunction with ports A & B (modes 1 & 2).]

Control port

The control port bits on each 8255 chip are used as shown in Table B-2.

Table B-2

Control register bit functions for each 8255 chip

Control group	Bit number	Function	I/O status for this bit ¹	
			When bit value = 0	When bit value = 1
	Bit 7	Mode set flag	Inactive	Active
A	Bit 6	Mode selections for the PA and the PC-upper ports	When bit 6 = 0 AND bit 5 = 0: Mode 0 When bit 6 = 0 AND bit 5 = 1: Mode 1 When bit 6 = 1 AND bit 5 = 0: Mode 2 When bit 6 = 1 AND bit 5 = 1: Mode 2	
	Bit 5			
	Bit 4	I/O direction for the PA port	Outputs, all bits of this port.	Inputs, all bits of this port.
	Bit 3	I/O direction to the PC-upper port	Outputs, all bits of this port.	Inputs, all bits of this port.
B	Bit 2	Mode selections for the PB and the PC-lower ports	Mode 0	Mode 1
	Bit 1	I/O direction for PB port	Outputs, all bits of this port.	Inputs, all bits of this port.
	Bit 0	I/O direction for the PC-lower port	Outputs, all bits of this port.	Inputs, all bits of this port.

¹For safety, the values of bits 0, 1, 3, and 4 default to “1” upon computer power-up or reset, so that all ports start out as inputs.

Table B-3 shows example control-byte codes for Mode 0.

Table B-3

Example control bytes for mode 0

Control byte (hexadecimal)	Configuration
80	PA, PB & PC all outputs
81	PA, PB, PC-upper outputs, PC-lower input
82	PA & PC outputs, PB input
8B	PA output, PB & PC inputs
9B	PA, PB & PC all inputs
Etc.... (there are 15 combinations in Mode 0)	

When a port is configured as an output, the data that the port outputs can be returned by reading the same location. However, this may not reflect the actual state of the output lines if one or more is shorted. The state of the output *latch* is being read, not the buffered output lines.

C **User-Serviceable Parts**

The four 8255 PPI components are in sockets. If any of the digital I/O chips are damaged by external shorts or transients, replacing the appropriate chip may correct the problem. The 8255 chips on the PIO-96 board should be replaced with an Intel P8255A-5 chip or equivalent part from another manufacturer. Nothing more than a screwdriver is needed to make these repairs.

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