

KEITHLEY

KPCI-3130 Series PCI Analog Output Board

User's Manual

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KPCI-3130 Series PCI Analog Output Board User's Manual

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Manual Print History

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Revision C (Document Number KPCI3130-900-01)	July 2002

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.

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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1

Overview

Product overview

KPCI-3130 Series analog output boards are designed for the PCI bus. The boards work in a Windows 95/98/NT/2000 environment and take advantage of the 32 bit width and the requirements, including communicating with peripherals, operating relays, and reading switch inputs. All I/O lines are TTL compatible. The series includes: KPCI-3130—8 channel analog output board with 32-bit digital I/O and KPCI-3132—2 channel analog output board.

System requirements

System requirements for the KPCI-3130 Series and DriverLINX software are listed in [Table 1-1](#).

Table 1-1
System requirements

CPU Type	Pentium or higher processor on motherboard with PCI bus version 2.1
Operating system	Windows® 95 or higher
	Windows® NT version 4.0 or higher
Memory	16MB or greater RAM when running Windows® 95 or 98
	32MB or greater RAM when running Windows® NT or 2000
Hard disk space	4MB for minimum installation
	50MB for maximum installation
Other	CD ROM drive that supports 32 bit Windows filenames.
	A free PCI bus expansion slot
	Enough reserve computer power supply capacity to power the KPCI-3130 board, which draws 15W maximum at 5VDC.
	A VGA, or compatible, display (640 × 480 or higher, 256 colors recommended).

DriverLINX Drivers and Application Program Interface (API) software

The DriverLINX CD shipped with the KPCI-3130 Series includes hardware drivers and interface software.

NOTE *The DriverLINX drivers on the supplied CD must be installed, even if DriverLINX software is already installed on the system. Installing the supplied drivers insures that the latest updates and enhancements are available for KPCI-3130 operation.*

DriverLINX Application Program Interfaces (APIs) provide support for 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.

In addition to the DriverLINX software, users may choose to install a fully integrated data acquisition software package, such as TestPoint or LabVIEW.

TestPoint is a fully featured, integrated application package with a graphical drag-and-drop interface, which can be used to create data acquisition applications without programming. LabVIEW is a fully featured graphical programming language used to create virtual instrumentation. LabVIEW support is provided on the DriverLINX CD.

Refer to Section 2, “[Functional Description](#),” for more information about available interface software.

Available accessories

The following optional accessories are available for KPCI-3130 Series boards:

- STP-36 Screw Terminal accessory (Figure 1-1) interfaces the KPCI-3130 Series I/O connectors to screw terminals.

NOTE *STP-36 screw terminals are numbered identically to the pins.*

WARNING The STP-36 is not intended for use in circuits carrying voltages in excess of 30VRMS, 42.4V peak or 60VDC. Failure to comply may result in an insulation failure and a shock hazard.

Figure 1-1
STP-36 screw terminal accessory



Manual overview

This manual provides overview, installation, operation, and troubleshooting information for the KPCI-3130 Series analog output boards.

The intended audience of this manual includes data acquisition system designers, engineers, technicians, scientists, and other users responsible for installation, configuration, and wiring of the KPCI-3130 Series boards. The instructions provided assume that the reader is familiar with Windows operation, with basic data-acquisition principles, and with the intended application.

Organization

This manual is organized as follows:

- Section 1 is this overview.
- Section 2 provides a functional description of the KPCI-3130 Series boards.
- Section 3 provides hardware installation procedures.
- Section 4 provides information for making hardware connections.
- Section 5 provides calibration information.
- Section 6 provides basic troubleshooting information.
- Appendix A provides KPCI-3130 Series specifications.
- Appendix B provides advanced troubleshooting procedures that include systematic problem isolation procedures and hardware and software I/O tests.
- Appendix C is a glossary of terms used throughout this manual.
- An index follows Appendix C.

Conventions

The following conventions apply throughout this manual:

- **10 point Times Bold** font is used for:
 - All Windows 95/98/2000/NT user-interaction items: commands, screen messages, menu names, menu options, and dialog-box items.
 - **WARNING** and **CAUTION** statements.
- *10 point Times Italic* is used for:
 - Emphasis in general.
 - Cross-references to other documents, such as other manuals or books.
 - *NOTE* statements.
- 10 POINT TIMES UPPER CASE is used for:
 - Switches (e.g. ON and OFF).
 - Keyboard keys (e.g. ENTER).
- 10 point Courier is used for software code statements.
- “Double quote marks” are used for:
 - Cross references to other manual sections/chapters, (e.g. “Troubleshooting”).
 - References to label, connector, or other marked items (e.g. “5V” labels on I/O connectors).

Viewing the manual online

The *DriverLINX Manuals* and this manual have been provided in electronic form (in PDF file format) on the DriverLINX CD-ROM. The manuals can be viewed with Rev 3.01 or later of Adobe Acrobat Reader (provided on the DriverLINX CD-ROM).

NOTE *DriverLINX's primary documentation is Windows On-Line Help. The appropriate help hardware and software help files are automatically installed with the DriverLINX driver and interface (API) installers. The PDF files are provided for users preferring book, rather than hypertext, format for viewing or printing.*

Following are a few techniques that may be used for viewing the PDF version of the manual with Adobe Acrobat Reader:

- Click on the manual title to open the manual.
- Click on a heading from the table of contents on the left side of the document to jump to a specific section of the document.
- Within the document, click on the text shown in blue to jump to the appropriate reference (the pointer changes from a hand to an index finger).
- To go back to the page from which the jump was made, click the right mouse button and **Go Back**, or from the main menu, click **View**, then **Go Back**.
- To print the document, from the main menu, click **File**, then **Print**.
- To increase or decrease the size of the displayed document, from the main menu, click **View**, then **Zoom**.
- To turn smoothing off, click **File**, then **Preferences/General**, and uncheck **Smooth Text and Monochrome Images**.

NOTE *By default, text and monochrome images are smoothed in Acrobat Reader, resulting in blurry images.*

2

Functional Description

Overview

The KPCI-3130 Series analog output boards are designed for the PCI bus. The KPCI-3130 Series boards work in a Windows 95/98/NT/2000 environment and take advantage of the 32 bit width and the requirements, including communicating with peripherals, operating relays, and reading switch inputs. All I/O lines are TTL compatible. The KPCI-3130 board also provides Digital I/O.

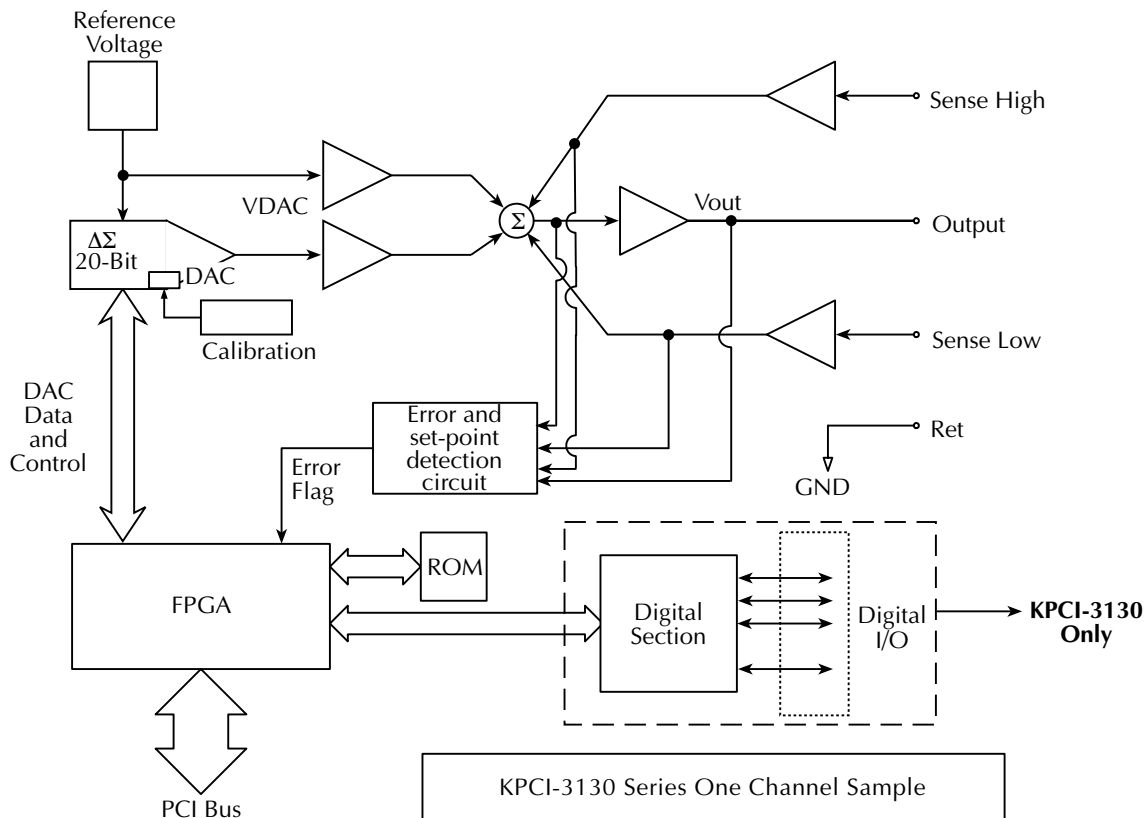
This section provides an overview of the KPCI-3130 Series hardware and interface software.

NOTE Detailed KPCI-3130 Series specifications are provided in Appendix A, "Specifications." Specific I/O connections are identified in Section 4.

Hardware

The KPCI-3130 Series boards include an analog output section. The KPCI-3130 board also includes a digital I/O section. A functional block diagram is provided in Figure 2-1.

Figure 2-1
KPCI-3130 Series block diagram



Interface software

DriverLINX interface software provides convenient interfaces for configuring and setting I/O bits without register-level programming. DriverLINX also allows the user to run a custom program in Visual C/C++, Visual Basic, or Delphi.

TestPoint and LabVIEW are full-featured graphical data acquisition software packages that work well with KPCI-3130 Series boards.

A summary of the pros and cons of using integrated packages (such as TestPoint or LabVIEW) rather than writing custom programs (using DriverLINX) is provided in the Keithley Full Line Catalog.

The KPCI-3130 Series has fully functional driver support for use under Windows 95/98/NT/2000.

NOTE *DriverLINX drivers must be installed to run any applications for the board, whether they are custom-programmed applications or integrated software packages, such as TestPoint or LabVIEW.*

DriverLINX for Windows 95/98/NT/2000

DriverLINX Application Program Interface (API) software is supplied by Keithley with the KPCI-3130 Series board. DriverLINX is essentially hardware independent. Its portable APIs work across various operating systems, eliminating the need for additional programming when changing operating system platforms.

In addition, DriverLINX supports 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.

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 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.

Refer to the DriverLINX documentation to determine which services are supported by the KPCI-3130 Series boards.

TestPoint

TestPoint is a fully featured, integrated application package that incorporates many commonly used math, analysis, report generation, and graphics functions. TestPoint's graphical drag-and-drop interface can be used to create data acquisition applications, without programming, for IEEE-488 instruments, data acquisition boards, and RS232/RS485 instruments and devices.

TestPoint includes features for controlling external devices, responding to events, processing data, creating report files, and exchanging information with other Windows programs. It provides libraries for controlling most popular GPIB instruments. OCX and ActiveX controls plug directly into TestPoint, allowing additional features from third party suppliers.

LabVIEW

LabVIEW is a fully featured graphical programming language used to create virtual instrumentation. It consists of an interactive user interface, complete with knobs, slides, switches, graphs, strip charts, and other instrument panel controls. Its data driven environment uses function blocks that are virtually wired together and pass data to each other. The function blocks, which are selected from palette menus, range from arithmetic functions to advanced acquisition, control, and analysis routines. Also included are debugging tools, help windows, execution highlighting, single stepping, probes, and breakpoints to trace and monitor the data flow execution. LabVIEW can be used to create professional applications with minimal programming.

Virtual instruments (VIs) compatible with LabVIEW are available for the KPCI-3130 Series boards.

3

Installation

Overview

This section provides instructions for the following procedures:

- Installing the software (DriverLINX drivers and interface software).
- Installing KPCI-3130 Series boards into the system.
- Configuring the installed software and board.

NOTE *The KPCI-3130 hardware is designed to be installed after the device drivers are installed. Be sure to install the DriverLINX software before installing the KPCI-3130 board.*

Installing DriverLINX

Refer to the *Read this first* document that accompanies your board for installation instructions.

NOTE *Always install DriverLINX before installing the board or LabVIEW support. Both TestPoint and LabVIEW support require DriverLINX to access the board's hardware resources.*

Installing application software and drivers

Installing the TestPoint support

It is anticipated that, in the future, TestPoint will implicitly support the KPCI-3130 Series boards without installing additional drivers. Check with the following concerning current availability of TestPoint support for the KPCI-3130 Series:

- The TestPoint technical support page of the Keithley web site (www.keithley.com).
- The TestPoint manufacturer, Capital Equipment Corporation (CEC).

Installing the LabVIEW software and driver

If you plan to use only run-time LabVIEW applications with your KPCI-3130 Series board, you need not install a special driver. LabVIEW run-time support is automatically installed when you install and configure DriverLINX.

However, if you plan to develop custom applications using the LabVIEW Integrated Development Environment, you must install the DriverLINX Virtual Instruments (VIs). These VIs are provided on your DriverLINX CD-ROM but do not install automatically when you install DriverLINX and your board. You must first install the LabVIEW application program and DriverLINX, then install the DriverLINX VIs.

If you do not install the VIs during the same session in which you install DriverLINX (refer to your *Read this first* document), you may install them later as follows:

1. Start `setup.exe` on the DriverLINX CD-Rom. The DriverLINX Browser introduction screen appears.
2. Click **Next** on the DriverLINX Browser introduction screen (or wait a few seconds). The DriverLINX CD Navigator screen appears.
3. On the DriverLINX CD Navigator screen, click **Install DriverLINX**. An Install These DriverLINX Components screen appears.
4. On the Install These DriverLINX Components screen, click **LabVIEW™ Support**.
5. Follow the series of on-screen instructions that appear.

Installing the KPCI-3130 Series boards

This subsection helps you to do the following:

- Prepare the board installation.
- Physically install the 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 the 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.

Checking resources for the board

Ensure that your computer has sufficient resources, particularly power resources, to run your KPCI-3130 Series board. Check the capacity of the computer power supply and the power requirements of your computer and presently installed boards. Then check the additional power requirements for this board. Refer to Appendix A, “[Specifications](#).” If necessary, free resources by uninstalling other boards.

Unwrapping and inspecting the board

NOTE *Install the DriverLINX software before installing a KPCI-3130 Series board. Otherwise, the device drivers will be more difficult to install.*

After you remove the wrapped board from its outer shipping carton, unwrap it and inspect it as follows:

1. Your board is packaged at the factory in an anti-static wrapper. Do not remove the anti-static wrapper until you have discharged any static electricity voltage differences between the wrapped board and the environment. Wear a wrist strap. A grounded wrist strap discharges static electricity from the wrapped board as soon as you hold it. Keep the wrist strap on until you have finished installing the board.
2. Remove the board from its anti-static wrapping material. (Store the wrapping material for future use.)
3. Inspect the board for damage. If damage is apparent, arrange to return the board to the factory. Refer to Appendix B, “[Technical support](#).”
4. Check the remaining contents of the package against the packing list and report any missing items immediately.
5. If the inspection is satisfactory, proceed to “[Installing the board](#).”

Installing the board

Install the KPCI-3130 Series board in a PCI expansion slot on your computer as follows:

1. Turn power OFF to the computer and to any external circuits attached to the board.
2. Remove the computer chassis cover.
3. Select an unoccupied PCI expansion slot in the rear panel, and remove the corresponding dummy mounting plate.
4. Insert the PCI connector of the board into the selected PCI slot of the computer. Take care not to interfere with neighboring boards. Ensure that the board is properly seated in the slot.
5. Secure the mounting bracket of the board to the chassis, using the retaining screw that you removed when you removed the dummy mounting bracket.
6. Continue with the next subsection, “[Configuring the software and board.](#)”

Configuring the software and board

1. Turn ON and reboot the system. Once windows has started, the DriverLINX Plug and Play Wizard screen will appear automatically.

NOTE *If the Wizard does not automatically start, or if it gets cancelled, manually start it as follows:*

- Open the Windows Explorer.
- Double click on *X:\DrvLINX4\Help\kpci3130.bat*, where *X* = the letter of the drive where DriverLINX is installed. The Wizard opens.

NOTE *The wizard can be started directly from the CD-ROM by double clicking on *Y:\DrvLINX4\Help\kpci3130.bat*, where *Y* = the drive letter of the CD-ROM drive.*

2. Click **Continue** and follow the on-screen instructions to configure the combined board and DriverLINX installations.
3. Test the installation as follows:
 - a. Click the Windows **Start** tab.
 - b. Locate the **Programs** → **DriverLINX** → **Test Panels** submenu.
 - c. Select **AIO Panel**. The starting screen for the AIO test panel should appear.

NOTE *The ability to start the AIO Control Panel utility, which is available after DriverLINX is installed, verifies that DriverLINX and the board are installed and configured satisfactorily and are working together. If the test panel does not start, go to Appendix B, “[Problem isolation Scheme B: installation](#)” to troubleshoot the Installation.*

- d. Close the control panel.

Using the analog I/O panel

The analog I/O panel is used to test the board and software installation and the functionality of the inputs/outputs. Specific test procedures are provided in [Appendix B](#).

DriverLINX calibration utility

The DriverLINX Calibration Utility automates many of the operations required to calibrate the analog output of the board. The KPCI-3130 Series boards do not have calibration potentiometers. On-screen instructions are provided as required.

Specific calibration procedures are provided in Section 5, “[Calibration](#).”

4

Connecting the Hardware

This section steps through the following:

- Identifying I/O connector pin assignments for KPCI-3130 Series.
- Connecting interface accessories.
- Wiring I/O to external circuits.

WARNING This product is SELV (Secondary Extra Low Voltage) and must be double insulated from any hazardous voltages internal to the PC or any external circuits.

The maximum voltage is $\pm 15\text{VDC}$. Exceeding this value will result in an electric shock hazard.

Identifying I/O connector pin assignments for KPCI-3130 Series

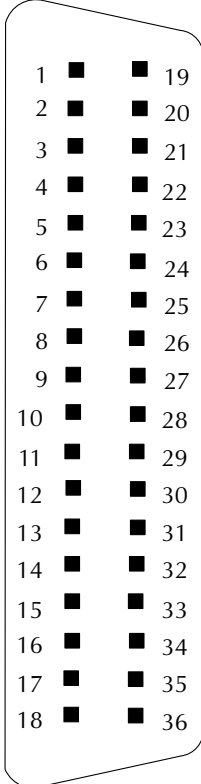
Analog connector

External signals are connected to the KPCI-3130 Series boards through two IEEE-1284 36-pin mini-D connectors, located at the rear of the board.

- Refer to Figure 4-1 and Table 4-1 for pin assignments and signal descriptions for the upper I/O connector.

NOTE *Identical pin assignments apply to the terminals of the STP-36 screw-terminal accessory when connected to the I/O connector.*

Figure 4-1
Pin assignments for KPCI-3130 Series upper "Analog" I/O connector



OUT0	1	■	■	19	GND
S0H	2	■	■	20	S0L
OUT1	3	■	■	21	GND
S1H	4	■	■	22	S1L
OUT2	5	■	■	23	GND
S2H	6	■	■	24	S2L
OUT3	7	■	■	25	GND
S3H	8	■	■	26	S3L
OUT4	9	■	■	27	GND
S4H	10	■	■	28	S4L
OUT5	11	■	■	29	GND
S5H	12	■	■	30	S5L
OUT6	13	■	■	31	GND
S6H	14	■	■	32	S6L
OUT7	15	■	■	33	GND
S7H	16	■	■	34	S7L
	17	■	■	35	
	18	■	■	36	

Table 4-1
Signal descriptions for "Analog" I/O connector pins and screw-terminals

Pin or terminal	Assignment	Description
1 2 19 20	OUT0 S0H GND S0L	Channel 0 signals: <ul style="list-style-type: none"> • Output • Sense High • Ground • Sense Low
3 4 21 22	OUT1 S1H GND S1L	Channel 1 signals: <ul style="list-style-type: none"> • Output • Sense High • Ground • Sense Low
5 6 23 24	OUT2 S2H GND S2L	Channel 2 signals: <ul style="list-style-type: none"> • Output • Sense High • Ground • Sense Low
7 8 25 26	OUT3 S3H GND S3L	Channel 3 signals: <ul style="list-style-type: none"> • Output • Sense High • Ground • Sense Low
9 10 27 28	OUT4 S4H GND S4L	Channel 4 signals: <ul style="list-style-type: none"> • Output • Sense High • Ground • Sense Low
11 12 29 30	OUT5 S5H GND S5L	Channel 5 signals: <ul style="list-style-type: none"> • Output • Sense High • Ground • Sense Low
13 14 31 32	OUT6 S6H GND S6L	Channel 6 signals: <ul style="list-style-type: none"> • Output • Sense High • Ground • Sense Low
15 16 33 34	OUT7 S7H GND S7L	Channel 7 signals: <ul style="list-style-type: none"> • Output • Sense High • Ground • Sense Low
17 18 35 36		Not Used

Digital I/O connector (KPCI-3130 board only)

Refer to Figure 4-2 and Table 4-2 for pin assignments and signal descriptions for the lower “Digital” I/O connector, through which 32 bits of general-purpose, high-current digital I/O are connected.

NOTE *Identical pin assignments apply to the terminals of the STP-36 screw-terminal accessory when connected to the I/O connector.*

Figure 4-2
Pin assignments for KPCI-3130 Series lower “Digital” I/O connector

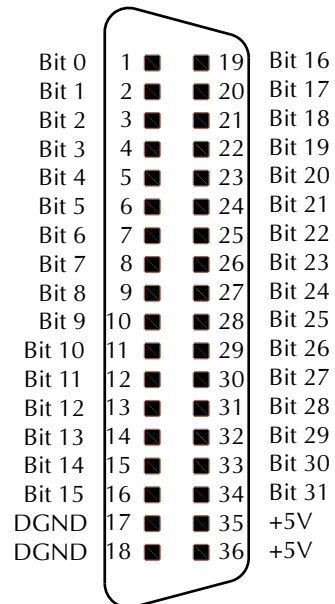


Table 4-2
Signal descriptions for "Digital" I/O connector pins and screw-terminals

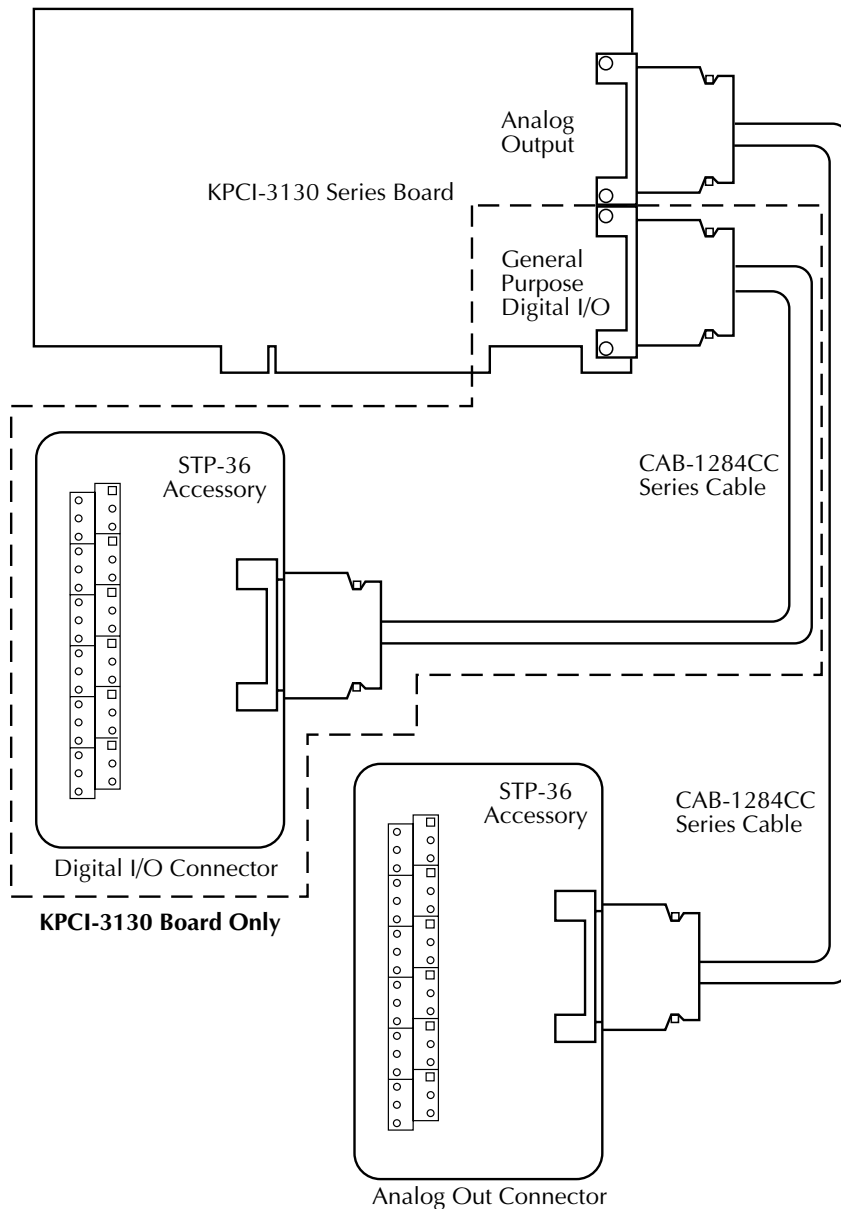
"Digital" connector pin or STP-36 terminal	Bit assignment	Description
1 2 3 : 8	Bit 0 Bit 1 Bit 2 : Bit 7	General-purpose digital I/O bits, channel 0. As a group, these 8 bits are user-configurable as either all inputs or all outputs. (The 8 bits comprise the register of a type 652 chip.)
9 10 11 : 16	Bit 8 Bit 9 Bit 10 : Bit 15	General-purpose digital I/O bits, channel 1. As a group, these 8 bits are user-configurable as either all inputs or all outputs. (The 8 bits comprise the register of a type 652 chip.)
17, 18	DGND	Digital grounds.
19 20 21 : 26	Bit 16 Bit 17 Bit 18 : Bit 23	General-purpose digital I/O bits, channel 2. As a group, these 8 bits are user-configurable as either all inputs or all outputs. (The 8 bits comprise the register of a type 652 chip.)
27 28 29 : 34	Bit 24 Bit 25 Bit 26 : Bit 31	General-purpose digital I/O bits, channel 3. As a group, these 8 bits are user-configurable as either all inputs or all outputs. (The 8 bits comprise the register of a type 652 chip.)
35, 36	+5V	+ 5VDC from computer bus.

Connecting interface accessories

CAUTION The two I/O connectors of the KPCI-3130 board, labeled “Analog” and “Digital”, are mechanically identical. Ensure that you connect interface accessories, and, indirectly, external circuits to the correct I/O connector. Connecting interface accessories or external circuits to the wrong connector may result in damage to the KPCI-3130 board, the host computer, your external circuits, or all three.

The STP-36 accessory provides basic screw terminal wiring to the I/O connector of a KPCI-3130 Series board. All of the screw terminals are connected to the same-numbered pins of a KPCI-3130 “Analog” or “Digital” I/O connector. Figure 4-3 shows how the accessory connects to the KPCI-3130 or KPCI-3132.

Figure 4-3
Connecting STP-36 screw terminal accessory



Wiring I/O to external circuits

Wiring analog output signals

This section provides a few guidelines for wiring the analog outputs from the DACs (digital-to-analog converters) that are available on the KPCI-3130 Series boards. Each DAC can be configured to output a range of $\pm 10\text{V}$. Performance characteristics and drive capabilities for these DACs are listed in Appendix A. Eight DACs are available on the KPCI-3130 while two DACs are available on the KPCI-3132.

WARNING Do NOT intersperse data acquisition connections with AC line connections. Keep data acquisition cables and connections away from any AC line connections. Interconnections or shorting between data and power lines can result in personal injury or death or extensive damage to your computer. To prevent this problem, ensure that all connections are tight and sound, so that signal wires are unlikely to come loose and short to hazardous voltages.

Ensure that there is not a short circuit at the output for any length of time; maintaining a short circuit at the output causes the board to become very hot and may result in personal injury.

CAUTION Ensure that both the computer and external circuits are turned OFF before making any connections. Making connections while the computer and external circuits are powered can damage the computer, the board, and the external circuit.

NOTE *Avoid large capacitive loads at the analog outputs. Capacitive loads higher than $100\mu\text{F}$ destabilize the analog outputs and make them susceptible to ringing (transient oscillations).*

KPCI-3130 Series boards contain separate ground connections for analog and digital signals. Use the analog ground (GND) for analog signals and analog power; use the digital ground (DGND) for digital signals and other power supply returns. Do this to avoid interference from digital switching noise currents on sensitive analog signals. However, be aware that both analog and digital grounds are tied together at the board PCI connector and are ultimately connected to the building system ground via the mains.

Make all analog output connections to the “Analog” I/O connector of the board through the screw terminals of an STP-36 screw terminal accessory. To connect an STP-36 accessory to your board, refer to “Connecting interface accessories” earlier in this section. The appropriate STP-36 screw terminals are identified in Figure 4-1.

Making two-wire and four-wire mode connections

The KPCI-3130 Series can be configured for two-wire (local sense) or four-wire (remote sense) mode connections. The selected mode determines whether the KPCI-3130 Series eliminates voltage drops due to the lead wire resistance between the STP-36 and the load terminals.

NOTE *The STP-36 Screw Terminal accessory interfaces the KPCI-3130 Series analog connector to screw terminals that are numbered identically to the pins.*

Two-wire mode (local sense)

For two-wire mode connections, the KPCI-3130 Series boards sense at the channel output and the channel ground at the terminals of the STP-36.

Two jumpers are required for connections in the two-wire mode. As shown in Figure 4-4, one jumper is placed between Sense High and Channel Output. Another jumper is placed between Sense Low and Channel Ground. Failure to install both of these jumpers for each channel will result in an alarm flag for the specific channel and an overvoltage on the channel's output if the channel is enabled. See Figure 4-5 for an example schematic.

For example, to configure CH0 for two-wire mode:

1. Install a jumper between pins 1 and 2 of the STP-36.
2. Install a jumper between pins 19 and 20 of the STP-36.
3. Connect the load between pins 1 and 19 or pins 2 and 20 of the STP-36.

NOTE *Terminate all unused channel sense lines (Sense HI to Output and Sense LO to GND/return).*

Figure 4-4
Two-wire mode connections

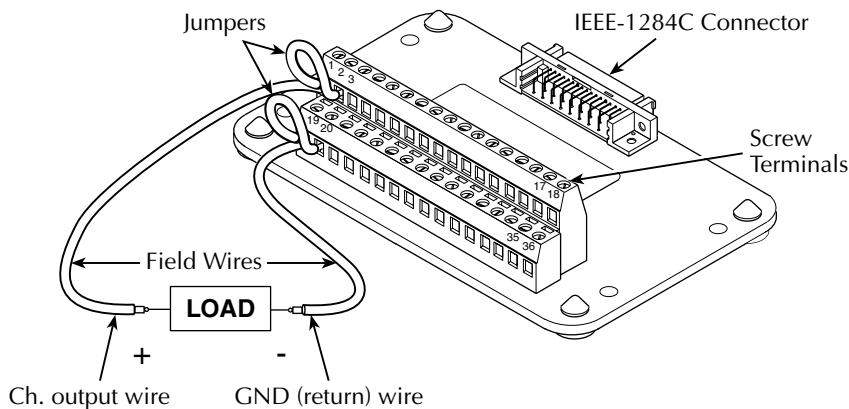
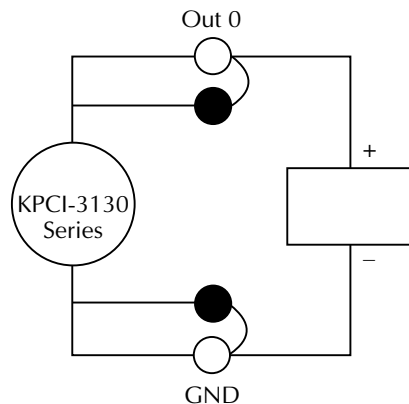


Figure 4-5
Example of a two-wire mode connection



Four-wire mode (remote sense)

For four-wire mode connections, the Sense High and Sense Low wires are connected between the STP-36 and the load terminal, eliminating voltage drops due to lead (wire) resistance. The desired output voltage appears at the load terminals. See Figure 4-6 and Figure 4-7.

Note that for four-wire mode connections, there should not be any jumpers installed at the STP-36 terminals.

For example, to configure CH0 for four-wire mode:

1. Connect the load between pins 1 and 19 of the STP-36.
2. Connect Sense High (pin 2 of the STP-36) to the (+) terminal of the load.
3. Connect Sense Low (pin 20 of the STP-36) to the (-) terminal of the load.

NOTE Terminate all unused channel sense lines (Sense HI to Output and Sense LO to GND/return).

Figure 4-6
Four-wire mode connections

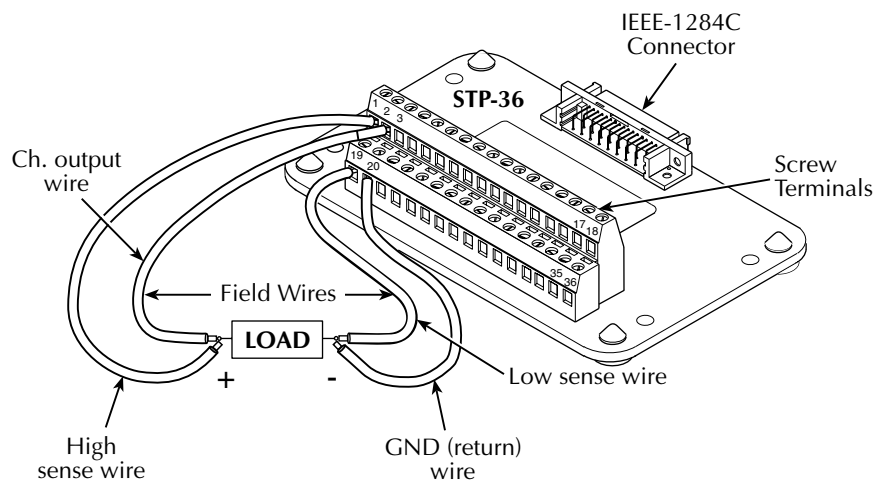
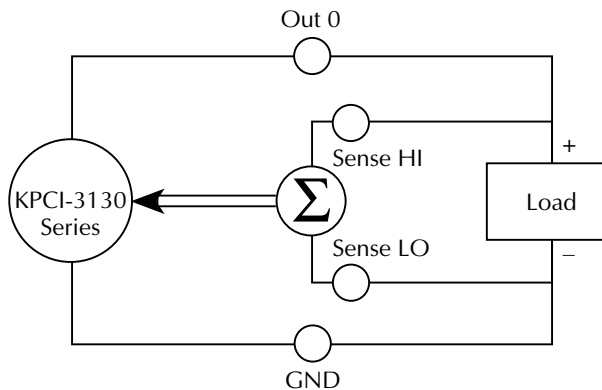


Figure 4-7
Example of a four-wire mode connection



4. Verify overload detection on a specific channel, as follows:
 - a. Perform a disconnect on a two-wire or four-wire setup at the channel.
 - b. Open the AIO Test Panel.
 - c. Click on the DIO tab.
 - d. On the Input Panel, select Channel 4.
 - e. Verify a zero in the applicable bit (bit 7 represents channel 7, bit 6 represents channel 6, etc.).

Overload detection

Each DAC features an overload protection circuit that monitors inaccuracies in the potential range of the DAC. Overload detection occurs when one or more of the following conditions exist:

- Nothing is connected to the Analog I/O Connector.
- An accessory board is connected to the Analog I/O Connector; however, the accessory board is not connected for two-wire or four-wire sensing.
- The Analog I/O Connector is connected for two-wire or four-wire sensing but the wiring is incorrect or there is a missing or bad connection.
- There is a voltage output discrepancy due to a short circuit.

Use the following procedure to determine if an overload condition exists on a DAC:

1. Open the AIO Test Panel.
2. Click on the DIO tab.
3. On the Input Panel, select Channel 4. An overload is indicated by a one in the applicable bit (bit 7 represents DAC7, bit 6 represents DAC6, etc.).

If applicable, clear the overload(s) by writing a “1” to the appropriate Channel 4 bit(s).

Wiring digital input and output signals (KPCI-3130 only)

This section provides a few guidelines for wiring Digital I/O signals that are available on the KPCI-3130 board.

WARNING Do NOT connect data acquisition inputs to the AC line. Keep data acquisition cables and connections away from any AC line connections. Interconnections or shorting between data and power lines can result in personal injury or death or extensive damage to your computer.

CAUTION Ensure that both the computer and external circuits are turned OFF before making any connections. Making connections while the computer and external circuits are powered can damage the computer, the board, and the external circuit.

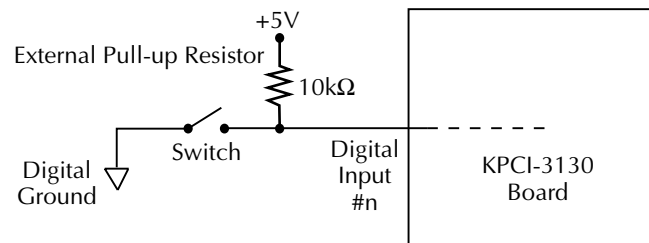
NOTE KPCI-3130 boards contain separate ground connections for analog and digital signals. Use the analog ground (GND) for analog signals and analog power; use the digital ground (DGND) for digital signals and other power supply returns. Do this to avoid interference from digital switching noise currents on sensitive analog signals. However, be aware that both analog and digital grounds are tied together at the board PCI connector and are ultimately connected to the building system ground via the mains.

Monitoring contact closure at an input

To ensure that the KPCI-3130 reliably monitors an open contact as an input-high condition, connect a 10k Ω pull-up resistor between the input line and a +5VDC source. See Figure 4-8.

Figure 4-8

Contact-closure monitoring at a KPCI-3130 Series board input

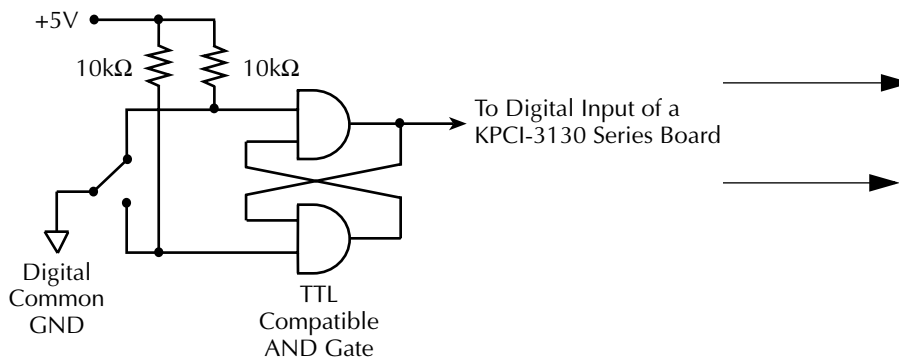


Eliminating contact bounce at an input

The effects of contact bounce may be eliminated by programming in the application software. However, it is often desirable to eliminate contact bounce from the signal, using a de-bounce circuit between the contacts and the KPCI-3130 input. Figure 4-9 shows a typical de-bounce circuit that can be used with Form C contacts.

Figure 4-9

De-bounce circuit for an input of a KPCI-3130 Series board



Using +5VDC from the computer power supply

CAUTION Do not connect the +5VDC outputs to an external +5VDC supply. This may damage the external supply, the board, and the computer.

Do not draw more than 2.0A, total, from the board to power external circuits.

Drawing excessive current may damage the KPCI-3130 board and, potentially, the computer.

The board extends fuse-protected power from the +5VDC computer supply to the I/O connector. This power is convenient for use in light external circuits, such as pull-up resistors. If the conditions noted in the above CAUTION are maintained, this power may also be used to energize external accessories.

5 Calibration

Introduction

The KPCI-3130 Series board was initially calibrated at the factory. Keithley advises that the calibration is checked every six months and the board re-calibrated when necessary. This section provides KPCI-3130 Series calibration information.

Objectives

This procedure calibrates the analog outputs by attempting to independently zero the offset and adjust the gain for each of the digital-to-analog converters (DACs) on the KPCI-3130 Series board.

Calibration summary

Analog outputs are calibrated using a DVM/DMM, and the DriverLINX Calibration Utility. (The DriverLINX Calibration Utility is installed when the DriverLINX software is installed.)

NOTE *KPCI-3130 Series calibration is accomplished by adjusting two internal registers inside the DAC through the Calibration Utility software. Connection to the board test points is via a screw terminal accessory connected to the I/O connector. There are no calibration potentiometers to adjust or test points to monitor.*

The DAC calibration values are stored in on-board nonvolatile RAM (NVRAM), which retains its contents even when the board is unpowered. During bootup (only), DriverLINX reads these values and stores them in the DAC's internal offset and gain registers.

Equipment

The following equipment is needed to calibrate the KPCI-3130 Series board:

- A digital voltmeter (DVM) or digital multimeter (DMM) accurate to 6½ digits, such as a Keithley Model 2000.
- An STP-36 screw terminal accessory to make analog connections to the board.
- A Keithley CAB-1284CC series cable or a standard IEEE-1284 Type C-C mini-Centronics cable to connect the screw terminal accessory to the “Analog” I/O connector of the KPCI-3130 Series board. To achieve factory calibration results, use a cable length of 2 meters.

Calibration procedure

This section describes the steps required to calibrate the analog outputs of the KPCI-3130 Series board.

Preparing for the calibration

Prepare the system for calibration as follows:

1. Warm up the DVM/DMM.
2. Turn OFF the host computer.
3. Set up STP-36 screw terminal accessory with all channels sense lines (even unused) configured.
4. Connect the STP-36 screw terminal accessory to the KPCI-3130 Series board.
5. Turn ON the host computer.
6. Allow 20 minutes for the system (board) to warm up.
7. Start the calibration utility as follows:
 - a. Click on the Windows **Start** tab.
 - b. In the **Start** menu, click **Programs**.
 - c. Find the **DriverLINX** folder and click the **Test Panels → KPCI-3130 Calibration Utility** entry. The Select DriverLINX Device dialog box appears.
 - d. In the Select DriverLINX Device dialog box, select the device number for the board and click **OK**. The KPCI-3130 Calibration Utility dialog box appears.

Calibrating the analog outputs

The KPCI-3130 Series boards have independent analog outputs provided by digital-to-analog converters (DACs or D/A converters). In this part of the procedure, offset and gain adjustments for the DACs are made. Do the following:

NOTE *The KPCI-3130 has eight analog outputs (and 8 DACs) while the KPCI-3132 has two analog outputs (and 2 DACs).*

1. In the KPCI-3130 Calibration Utility dialog box, click the **D/A Calibration** tab. The D/A Calibration dialog box appears.
2. Refer to DriverLINX's on-line help for a detailed description of the Calibration Utility.

6

Basic Troubleshooting

If the KPCI-3130 Series board is not operating properly, use the information provided in this section to attempt to isolate and resolve the problem.

The information in this section is a general overview. Detailed systematic isolation procedures are provided in [Appendix B](#).

Be sure to follow procedures outlined in this section and in [Appendix B](#) before calling Keithley Technical Support. If, after completing the basic troubleshooting and systematic problem isolation procedures, the board is still not working properly, refer to [Appendix B](#), “[Technical support](#),” for instructions on contacting Keithley Technical Support.

[Table 6-1](#) lists general symptoms and possible solutions for KPCI-3130 Series board problems.

Table 6-1
Basic troubleshooting information

Symptom	Possible cause	Possible cause validation/solution
Computer does not boot when board is installed.	Resource conflict. KPCI-3130 Series board is conflicting with other boards in the system.	<ol style="list-style-type: none"> 1. Validate the cause of the conflict. Temporarily unplug boards—especially ISA boards¹—one at a time, and try booting the computer. Repeat until a boot is attained. 2. Try resolving conflicts by reinstalling one PCI board at a time and rebooting after each reinstallation.² However, the ISA board resource allocations, such as base address or interrupt assignments, may need to be changed.
	Board not seated properly.	Check the installation of the board.
	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.
After board and software are installed, mouse control is lost or system freezes.	An interrupt conflict occurred.	Unplug the board to regain mouse control. Look closely at the COM ports and at the interrupts of other devices.
Board does not respond to the Analog I/O Panel that comes with the KPCI-3130 Series DriverLINX.	DriverLINX is not installed properly.	Check the Windows Device Manager and follow the installation troubleshooting instructions in the DriverLINX on-line help.
	The board is incorrectly aligned in the expansion slot.	Check the board for proper seating.
	The board is damaged.	Contact Keithley Applications Engineering.
Data appears to be invalid.	An open connection exists.	Check screw terminal wiring.
Intermittent operation.	Vibrations or loose connections exist.	Cushion source of vibration and tighten connections.
	The board is overheating.	Check environmental and ambient temperature. Refer to the computer documentation.
	Electrical noise exists.	Provide better shielding or reroute unshielded wiring.
System lockup during operation.	A timing error occurred.	Restart the computer. Analyze the program by debugging and narrowing the list of possible failure locations.

¹Plug and Play cannot tell if an ISA board already uses an address that it assigns to a PCI board.

²Plug and Play may then assign different, nonconflicting addresses to the PCI boards.

A

Specifications

KPCI-3130 Series Board Specifications

Analog Outputs

NUMBER OF CHANNELS: Eight (3130), two (3132).

RESOLUTION: 19.1 μ V/count per channel.

RANGE: ± 10 V for each channel.

ACCURACY: $\pm 700\mu\text{V} \pm 0.008\%$ setting (VDC), at 25°C $\pm 1^\circ\text{C}$. To maintain this accuracy, all unused channel sense lines must be terminated (Sense HI to Output and Sense LO to GND/ Return).

TEMPERATURE COEFFICIENT: 150 $\mu\text{V}/^\circ\text{C} \pm 20$ ppm setting/ $^\circ\text{C}$. (Calibration at the operating temperature can remove this error.)

OUTPUT CURRENT: 20mA per channel, four quadrant (shunt required if current sourcing/sinking).

SETTLING TIME: 15ms to 600 μV (typ.) for transients b/w ± 9.5 V.

DIFFERENTIAL REMOTE SENSE:

Differential remote sense eliminates errors due to long return lines.

Enable current sourcing or sinking within voltage range with use of external sense resistor.

Maintain accuracy with up to 82 Ω of loop resistance in leads.

PROTECTION: Withstand continuous short circuit of Output + to Output - (GND), 35mA draw from short-circuit (typ.).

Out of Range Alarm - can be detected as interrupt.

CAPACITIVE LOAD: Stable to 1 μF or less.

POWER UP: 0V (± 15 mV) (typ.).

DATA TRANSFER MODES: Target-mode transfers only

D/A CONTROL MODES:

Target Mode: Update one D/A Converter with value by software command.

Approximately 10ms/command execution.

Readback of setting and calibration values.

D/A CALIBRATION: Separate 2 point calibration of each channel using software and a DMM; Calibration through PCI Interface

Auxiliary High-Current Digital I/O (KPCI-3130 only)

NUMBER OF BITS: 32 bits; four 74FCT652 bi-directional 8-bit registers. Each byte register is separately configurable as input or output.

DATA TRANSFER MODE: Target mode.

INPUT LOW: $V_{IL} = 0.8$ V max.; $I_{IL} = -0.2$ mA max.

INPUT HIGH: $V_{IH} = 2.0$ V min.; $I_{IH} = 20\mu\text{A}$ max.

OUTPUT LOW: $V_{OL} = 0.55$ V max.; $I_{OL} = 64$ mA max.

OUTPUT HIGH: $V_{OH} = 2.4$ V min.; $I_{OH} = -8$ mA max.
 $V_{OH} = 2.0$ V min.; $I_{OH} = -15$ mA max.

POWER ON STATE: Input (High-Z).

General

POWER INPUT:

+5V: 72mA typ.

+12V: 485mA typ., 500mA max.

POWER OUTPUT:

+5V: 1.0A max. (May also be limited by computer or bus capability.)

ENVIRONMENT:

Temperature, Operating: 0°C to 50°C.

Temperature, Non-Operating: -40°C to 100°C.

Humidity: 0 to 90% Relative (non-condensing), operating or non-operating.

EMC: Conforms to European Union Directive 89/336/EEC.

SAFETY: Meets EN 61010-1/IEC 1010.

DIMENSIONS: 175mm (6.88 in) L × 108mm (4.25 in) H × 20mm (0.75 in) D. Standard-Size PCI Short Card.

WARMUP: 20 minutes to rated accuracy.

ACCESSORIES AVAILABLE:**Termination:**

STA-3108-D1 (Provides 50-pin digital connector compatible with KPCI-PIO-96 pinout for Digital I/O connector – 3130 only)

STP-36 (Terminates CAB-1284 into 36 screw terminals)

Cables:

CAB-1284CC (IEEE-1284C standard shielded cable with 18 twisted pairs, used for analog and digital connections to 3130)

B

Advanced Troubleshooting

This appendix provides the following troubleshooting procedures:

- Systematic problem isolation
- Specified hardware I/O tests
- Specified software I/O tests
- Technical support

NOTE *Before starting the detailed procedures in this Appendix, attempt to resolve problems with the board using the guidelines provided in “Section 6.”*

Systematic problem isolation

The following schemes are provided to systematically isolate and eliminate problems:

- Scheme A troubleshoots the basic system.
- Scheme B troubleshoots DriverLINX installation.
- Scheme C troubleshoots application program interfaces.
- Scheme D troubleshoots PCI connections to the system.
- Scheme E troubleshoots wiring and external connections.
- Scheme F isolates malfunctioning KPCI-3130 Series boards.
- Scheme G verifies that all problems have been isolated and remedied.

Start with Scheme A and work through the other schemes as directed in the procedure.

NOTE *The troubleshooting schemes provided in this Appendix are not stand-alone procedures; they are designed to systematically isolate and eliminate/resolve problem causes. Always start with scheme A unless specifically directed otherwise (from an earlier section of this manual or by a Keithley Technical Support person).*

CAUTION **Always turn OFF the computer and any external circuits connected to the KPCI-3130 Series board before removing or replacing the board. Removing or replacing a board with the power ON can damage the board, the computer, the external circuit, or all three.**

Handle the board at the mounting bracket, using a grounded wrist strap. Do not touch the circuit traces or connector contacts.

NOTE *Throughout the troubleshooting schemes, the term “board” refers to a KPCI-3130 Series board.*

Problem isolation Scheme A: basic system

Scheme A:

- Checks for apparent damage to KPCI-3130 Series board(s) installed in the system.
- Checks the independent functionality of the computer.
- Checks the expansion slots that hold the KPCI-3130 Series board(s).

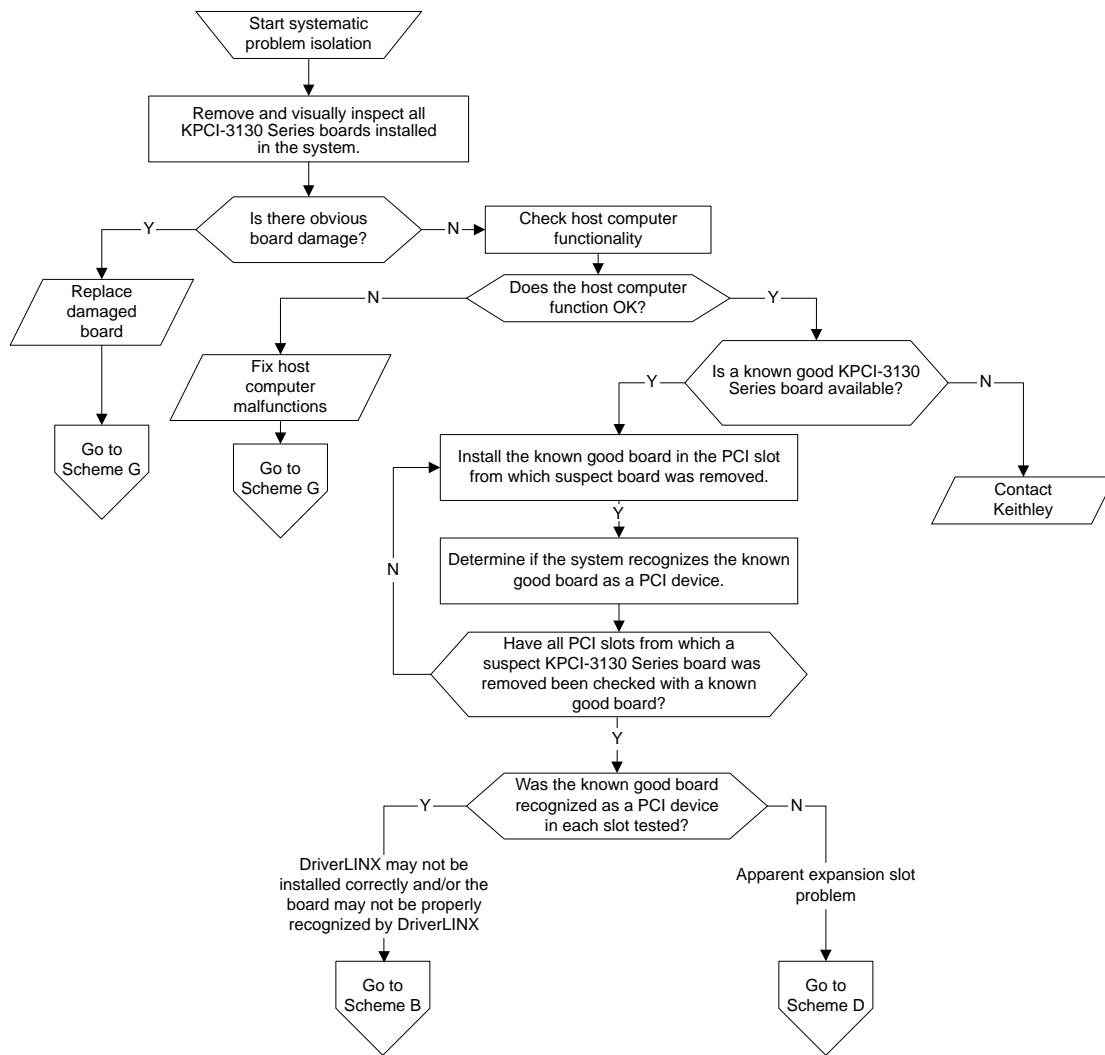
A flow chart is provided in [Figure B-1](#).

1. Remove and inspect the KPCI-3130 Series board(s) for damage as follows:
 - a. Shut down Windows 95/98/NT/2000 and turn OFF power to the host computer.
 - b. Turn OFF power to all external circuits and accessories connected to the KPCI-3130 Series board(s) that is installed.
 - c. Disconnect STP-36 screw terminal accessories from the KPCI-3130 Series board(s).
 - d. Remove all KPCI-3130 Series boards from the computer, noting the slots from which each board is removed.
 - e. Visually inspect each removed KPCI-3130 Series board for damage.
2. If any of the boards removed in step 1 appear damaged:
 - a. Repair or replace the damaged boards.

NOTE *Refer to “[Technical support](#)” for information on returning boards for repair or replacement.*

- b. Go to “[Problem isolation Scheme G: verification of problem solution.](#)”

Figure B-1

Problem isolation Scheme A: basic system

3. If none of the board(s) removed in step 1 appear damaged, check for host computer malfunctions, as follows:
 - a. Place the board(s) removed in step 1 in an electrostatically safe location. Do not reinstall them at this time.
 - b. Turn ON power to the host computer.
 - c. Perform system diagnostics as required to determine if the computer hardware and operating system are functioning properly.
4. If the computer or operating system malfunctions in step 3:
 - a. Determine the cause of the computer hardware or operating system malfunctions.
 - b. Fix the computer hardware or operating system malfunctions.
 - c. Go to “[Problem isolation Scheme G: verification of problem solution.](#)”
5. If the host computer seems to be operating on its own without problems, locate a KPCI-3130 Series board that is known to work properly.

NOTE

If a working KPCI-3130 Series board is not available, refer to the instructions in “[Technical support](#)” and contact Keithley for help in isolating the cause of the problem.

6. Determine the PCI resources detected by the computer, as follows:
 - a. Shut down Windows 95/98/2000/NT and turn OFF power to the host computer.
 - b. Insert a blank diskette, or any unbootable diskette, into the A: drive.
 - c. Turn ON the computer and allow it to start the boot cycle.
 - d. The boot cycle stalls at a text screen listing system characteristics and resources with the following message displayed at the bottom of the screen: **Non-system disk or disk error. Replace and press any key when ready.**

NOTE *Having an unbootable diskette in the A: drive automatically pauses the boot cycle at the system characteristics and resources screen. Another method of pausing the boot cycle (e.g., pressing the PAUSE key) may be used.*

- e. Note and record the displayed **PCI device listing**... (If a printer is attached to the system, press the PRINT SCREEN key to print a copy of the screen.)
 - f. Remove the diskette, press any key, and allow the boot cycle to finish.
7. Install the known good KPCI-3130 Series board into the system, as follows:
 - a. Shut down Windows 95/98/NT/2000 and turn OFF power to the host computer.
 - b. Install the known good KPCI-3130 Series board in the slot from which the potentially faulty board was removed in step 1. Refer to Section 3, "[Installing the KPCI-3130 Series boards](#)," for board installation instructions.

NOTE *The purpose of this step is to verify that the PCI slot from which the suspect board(s) was removed is not faulty. One slot is verified at a time; therefore, if more than one board was removed in Step 1, this step will need to be repeated (Step 8).*

Do not connect any external circuits to the board at this point.

8. Repeat Step 5 to determine the PCI resources detected by the computer with the KPCI-3130 Series board installed. Windows 95 Plug and Play should find and configure the new board as a PCI resource if all of the following are true:
 - The board functions properly as a PCI device.
 - The contacts of the expansion slot in which the board is installed are in good condition.
 - The board is seated properly in the expansion slot.
9. If more than one KPCI-3130 Series board was removed (from other PCI slots) in step 1, repeat steps 6 and 7 with the good board installed in each of the other slots.
10. If the good board is recognized as a PCI component in each slot tested, the PCI slot(s) can be eliminated as the cause of the problem. Go to "[Problem isolation Scheme B: installation](#)" to verify DriverLINX installation and board configuration.
11. If the good board is not recognized as a PCI component in one of the slots tested, the PCI slot connector may be causing the problem. Go to "[Problem isolation Scheme D: expansion slot connectors](#)."

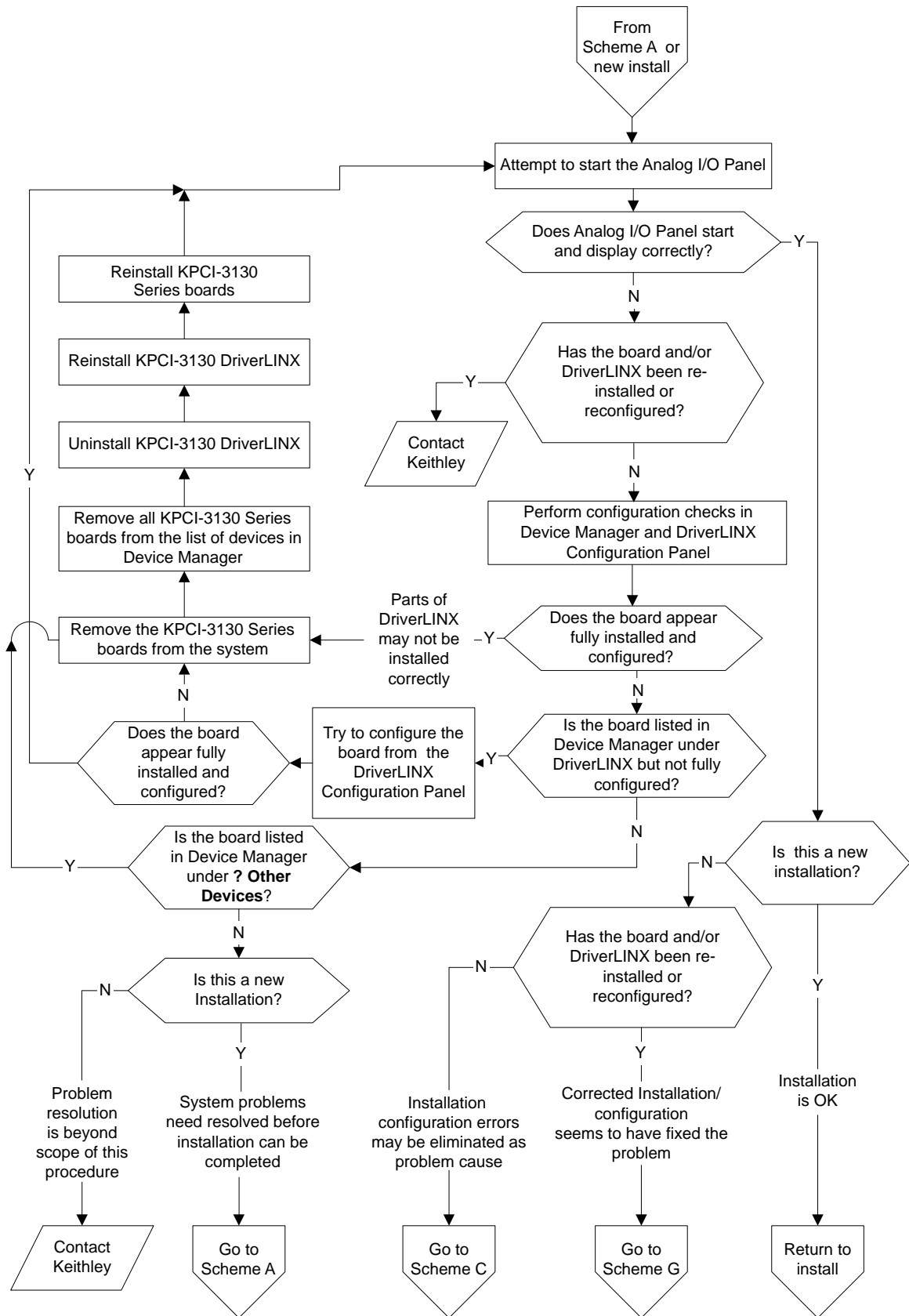
Problem isolation Scheme B: installation

Scheme B:

- Checks DriverLINX installation.
- Checks the KPCI-3130 Series board installation and configuration.
- Checks that DriverLINX and the board are working together.

A flow chart is provided in [Figure B-2](#).

Figure B-2
Problem isolation Scheme B: installation



1. Attempt to start the DriverLINX Analog I/O Panel, as follows:
 - a. In the **Start** menu, click **Programs**.
 - b. Locate the **DriverLINX → Test Panels** folder.
 - c. Click **AIO Panel**.
2. If the DriverLINX Analog I/O Panel appears:

NOTE *The exact layout of the DriverLINX Analog I/O Panel depends on the number and kind of DriverLINX boards installed in the system.*

- a. Select the KPCI-3130 Series driver for the KPCI-3130 and KPCI-3132 boards from the **Driver Selection** list and the appropriate device number from the **Device Selection** list (0 if only one KPCI-3130 Series board is installed).
- b. Verify that the Analog I/O Panel specific to the KPCI-3130 or KPCI-3132 is displayed.

NOTE *If the appropriate driver is not available from the **Driver Selection** list, go to Step 4.*

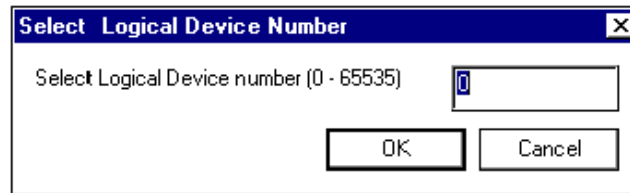
- c. Go to Step 12.
3. If the DriverLINX Analog I/O Panel does not start:
 - a. If this is the first time through this scheme for this specific problem, go to step 4.
 - b. If this is not the first time through this scheme for this specific problem (i.e., DriverLINX and the board have been re-installed), the problem lies beyond the scope of this procedure. Refer to the instructions provided in “**Technical support**” and contact Keithley for further assistance.
4. Determine if and how the KPCI-3130 Series board is listed in the **Windows Device Manager**, as follows:
 - a. Right-click the **My Computer** icon on the desktop to display its shortcut menu.
 - b. On the shortcut menu, click **Properties**. The **System Properties** dialog box opens.
 - c. In the **System Properties** dialog box:
 - For Windows 2000, click the **Hardware** tab and the **Device Manager ...** button.
 - For Windows 95/98, click the **Device Manager** tab.
 - d. In the **Device Manager**, with **View devices by type** selected, locate the **DriverLINX drivers** item.
 - e. Click the + sign to the left of the **DriverLINX drivers** item. A list of all installed DriverLINX boards should appear.
 1. If the KPCI-3130 Series board is recognized as a device under DriverLINX and is configured to work with DriverLINX (i.e., the board is listed without a large exclamation point over it), keep the **Device Manager** open and go to step 5.
 2. If one or more KPCI-3130 Series boards are recognized as a device under DriverLINX but are not configured to work with DriverLINX (i.e., board displayed with a large exclamation point over it) keep the **Device Manager** open and go to step 5.
 - f. If there is a ? **Other Devices** listed and one or more KPCI-3130 Series boards listed under ? **Other Devices**, keep the **Device Manager** open and go to step 5.
 - g. If the KPCI-3130 Series board is listed in more than one place in the **Device Manager**, go to step 6.
 - h. If the installed KPCI-3130 Series board is not listed anywhere in the **Device Manager**:
 1. If basic system operation has not been verified using the procedure in scheme A, go to Scheme A.
 2. If basic system operation has been verified using the procedure in Scheme A, the problem lies beyond the scope of this procedure. Refer to the instructions provided in “**Technical support**” and contact Keithley for further assistance.

5. Determine whether the KPCI-3130 Series board is recognized by and properly configured for DriverLINX, as follows:
 - a. In the **Start** menu, click **Programs**.
 - b. Locate the **DriverLINX** folder and click **DriverLINX Configuration Panel**. The **DriverLINX Configuration Panel** appears.
 - c. If **Keithley KPCI-3130 Series** is listed under DriverLINX with a pale grey amplifier icon and a device number (e.g., **Device0** or **Device1**) is listed under it with a green lamp icon, the board is recognized as a device under DriverLINX and *is* properly configured. The inability to run the Analog I/O Panel may be due to an improperly installed component of DriverLINX. Go to step 8.
 - d. If **Keithley KPCI-3130 Series** is listed under DriverLINX with a yellow amplifier icon and **Keithley KPCI-3130 Series Analog Board** is listed under it with an unlit lamp icon, the board is recognized as a device under DriverLINX but not properly configured. Keep the configuration panel open and go to step 6.
6. Reconfigure each unconfigured board from the DriverLINX configuration panel, as follows:
 - a. Click on the name of the **Keithley KPCI-3130 Series Analog Board** to configure.

NOTE *Boards that are not properly configured are indicated by an unlit lamp icon to the left of the board name.*

- b. Click the **Configure** button. The **Select Logical Device Number** dialog box appears as in [Figure B-3](#).

Figure B-3
Selecting the logical device number

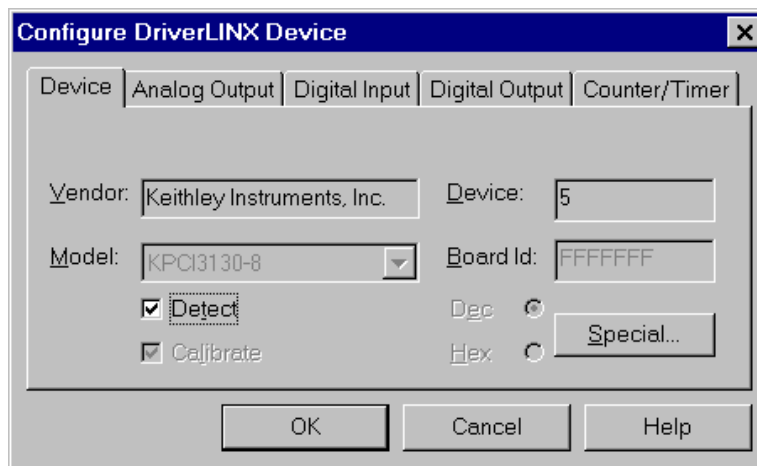


1. If only one KPCI-3130 Series board is installed, click **OK** to select the displayed default device number of **0**. The **Configure DriverLINX Device** dialog box (Figure B-4) appears.
2. If more than one KPCI-3130 Series boards are installed and configured and have been assigned device numbers, enter a device number for the board being configured and click **OK**. The **Configure DriverLINX Device** dialog box (Figure B-4) appears.

NOTE *The device number entered should be the next unassigned number in the numbering sequence.*

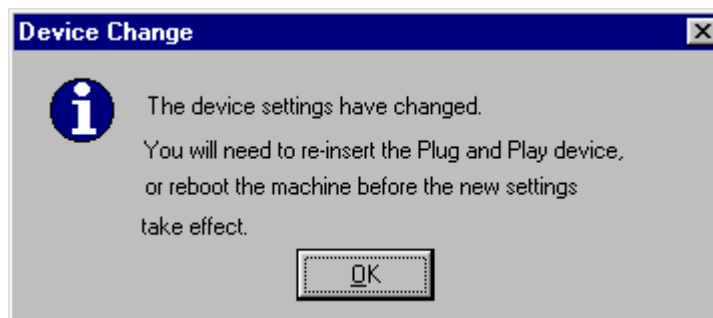
- c. Click **OK** to close the **Configure DriverLINX Device** dialog box. A **Device Change** message may be displayed, as in Figure B-5.

Figure B-4
Configure DriverLINX Device dialog box example



- d. Click **OK** to close the **Device Change** message box (Figure B-5).

Figure B-5
Device Change message



- e. Repeat steps a through f for each KPCI-3130 Series board that needs reconfigured.
- f. Close all programs and reboot the computer.
- g. Open the **Device Manager** (as in Step 4) and verify that all installed KPCI-3130 Series board(s) are listed under DriverLINX without exclamation marks.
- h. Open and check the **DriverLINX Configuration** panel (as in step 5).
 1. If the KPCI-3130 Series board(s) is properly configured, go back to Step 1 and retry starting the Analog I/O Panel.

NOTE Properly configured boards are indicated as device numbers with green lamp icons.

2. If the KPCI-3130 Series board(s) is not properly configured, there may be a problem with the DriverLINX and KPCI-3130 Series board installation. Go to step 7.
7. Physically uninstall all KPCI-3130 Series boards, as follows.

NOTE Remove all KPCI-3130 Series boards before reinstalling the KPCI-3130 Series version of DriverLINX. If a KPCI-3130 Series board is present, physically or in the computer list of devices, driver installation may not be error-free.

- a. Turn OFF the computer.
- b. Remove the chassis cover.
- c. Remove all KPCI-3130 Series boards from their computer expansion slots.
- d. Replace the chassis cover.
- e. Restart the computer.

CAUTION Wear a grounded wrist strap to avoid electrostatic damage to the board. Do not touch board components or conductors when handling the board.

8. Remove all KPCI-3130 Series boards from the list of devices in the **Device Manager**, as follows:

NOTE KPCI-3130 Series boards may be listed under the **DriverLINX drivers** item or the **? Other Devices** item.

For Windows 95/98:

- a. Open the **Device Manager** by right clicking the **My Computer** icon, clicking **Properties** on the menu that appears, then clicking the **Device Manager** tab. A list of installed devices appears.
- b. Locate all KPCI-3130 Series boards in the **Device Manager**.
- c. Select one of the KPCI-3130 Series boards.
- d. At the bottom of the list of devices, click **Remove**. A **Confirm Device Removal** dialog box appears.
- e. Click **OK**. The board is removed from the list of devices.
- f. If more than one KPCI-3130 Series board was listed in the **Device Manager**, repeat steps c, d, and e until all KPCI-3130 Series boards are removed from the **Device Manager**.

For Windows NT:

- a. Run **Control Panel** and double click on **Devices**.
- b. Stop the **DriverLINX for Keithley 3130 Series** device driver. If the device driver does not stop, set the startup type to disabled and reboot the computer.
- c. Shut down and restart the computer.

For Windows 2000:

- a. From the **Add/Remove Hardware Wizard**, click **Next**.
- b. Click **Uninstall/Unplug** a device.
- c. Click **Uninstall** a device.
- d. Select the **DriverLINX for Keithley 3130 Series**.

9. Uninstall only the KPCI-3130 Series versions of DriverLINX from the system as follows:
 - a. In the **Start** menu of Windows 95/98/NT/2000, click **Settings** → **Control Panel**.
 - b. In the **Control Panel**, click **Add/Remove Programs**. A dialog box appears.
 - c. In the **Add/Remove Programs Properties** dialog box, select **DriverLINX for Keithley 3130 Series**.

NOTE *Uninstall only **DriverLINX for Keithley 3130 Series**. If additional DriverLINX versions are installed, leave them installed.*

- d. For Windows 95/98/NT, at the bottom of the **Add/Remove Programs Properties** dialog box, click **Add/Remove** and follow the Windows uninstall prompts. For Windows 2000, click **Change/Remove** and follow the Windows uninstall prompts.

CAUTION **During the uninstall procedure, the system typically asks to delete files that may be shared by other programs. Always click **No**. Uninstalling files needed by other programs may cause serious problems, whereas leaving unneeded installed files will not harm the system.**

10. Reinstall DriverLINX, using the procedure outlined in Section 3, “[Installing DriverLINX](#).”
11. Reinstall the board(s), as follows:

CAUTION **Wear a grounded wrist strap to avoid electrostatic damage to the board. Do not touch board components or conductors when handling the board.**

NOTE *If Scheme B is being performed independently as an installation check, reinstall all boards removed in step 9. If Scheme B is being performed as part of the systematic problem isolation procedure, reinstall only the known good board (refer to Scheme A).*

- a. Shut down and turn OFF the computer.
 - b. Install the board(s) in its expansion slot(s) using the procedure outlined in Section 3, “[Installing the KPCI-3130 Series boards](#).”
 - c. Turn ON and reboot the computer.
 - d. Configure the board and software using the procedure outlined in Section 3, “[Configuring the software and board](#).”
 - e. Return to step 1 and run the installation check again.
12. DriverLINX and the KPCI-3130 Series board(s) are installed correctly.
 - a. If starting the I/O panel was performed as an installation check, return to Section 4 and finish installing the data acquisition system, starting with Section 4, “[Identifying I/O connector pin assignments for KPCI-3130 Series](#).”
 - b. If starting the I/O panel was performed as part of the systematic problem isolation procedure AND the board has been reconfigured and/or DriverLINX has been re-installed, go to “[Problem isolation Scheme G: verification of problem solution](#).”
 - c. If starting the I/O panel was performed as part of the systematic problem isolation procedure AND the board and DriverLINX software were not re-configured or re-installed to allow the test panel to start, then the problem must lie elsewhere. Go to “[Problem isolation Scheme C: application software](#)” to check for application software issues.

Problem isolation Scheme C: application software

Scheme C:

- Checks custom application software source code.
- Checks compatibility and installation of commercial application software.

A flow chart is provided in [Figure B-6](#).

NOTE *The known good board installed in Scheme A should still be installed. This eliminates possible board I/O problems during Scheme C.*

NOTE *This is not a stand-alone procedure and should only be used when called for by another procedure.*

1. Perform the procedure outlined in the “[Analog output software test](#)” found later in this Appendix.

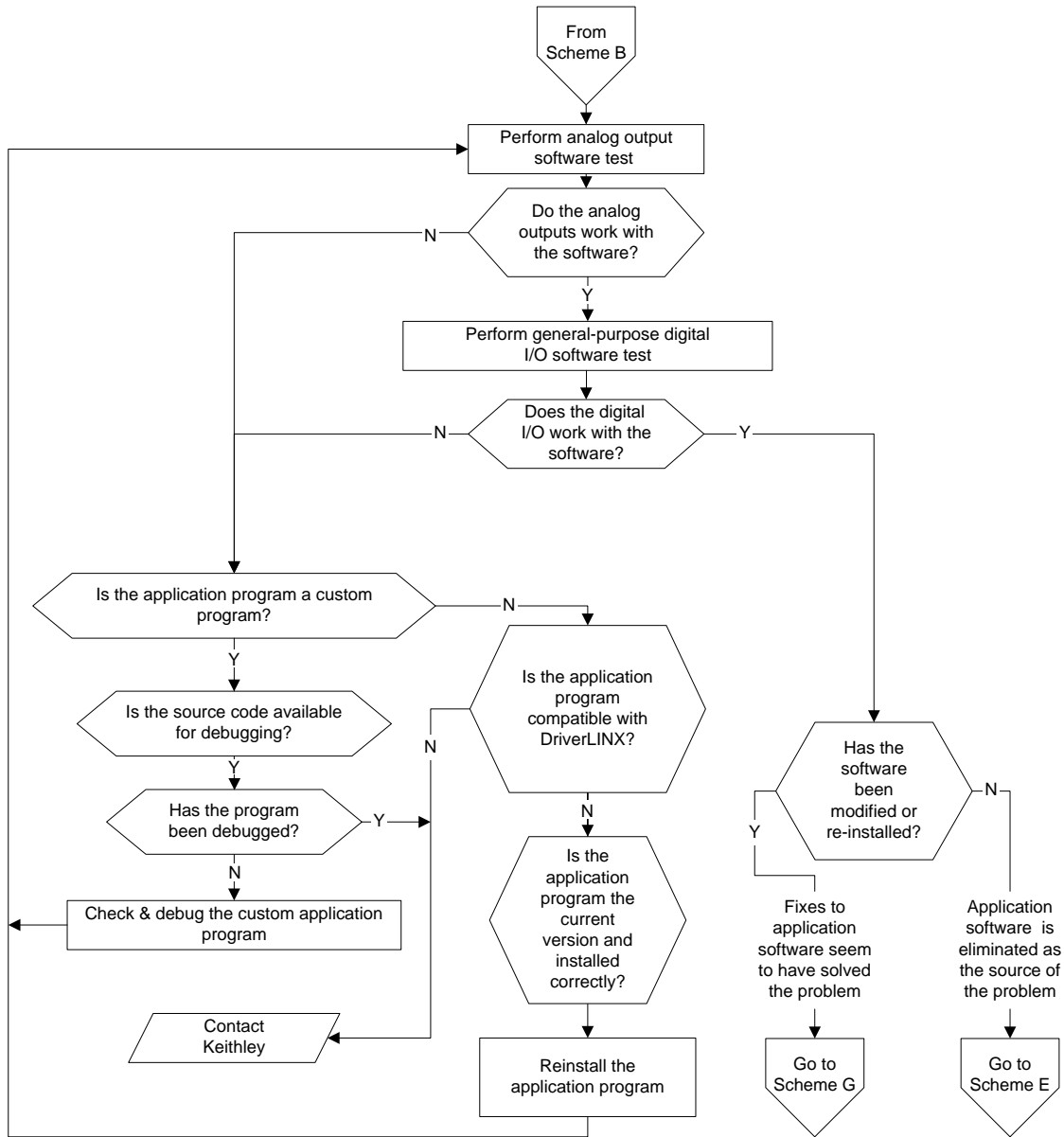
NOTE *If the software appears not to be working properly with the analog outputs, go to step 4.*

2. Perform the procedure outlined in the “[General-purpose digital I/O software test \(KPCI-3130 only\)](#)” found later in this Appendix.

NOTE *If the software appears not to be working properly with the digital I/O, go to step 4.*

3. If the software appears to be working with both the analog outputs (3130 Series) and the digital I/O (KPCI-3130 board only), go to “[Problem isolation Scheme E: user wiring](#)” and check the external connections.
4. If the applications program is a proven program (i.e., a commercial program that cannot be modified), the software may be installed incorrectly or may be incompatible with DriverLINX. Contact the program manufacturer and verify that the current version of the program is installed, that it is installed correctly, and that it is compatible with DriverLINX.
 - a. If the program is the current version and is installed correctly and is compatible with DriverLINX, refer to “[Technical support](#)” and contact Keithley.
 - b. If the program is not the current version or is not installed correctly:
 1. Correct program installation as required.
 2. Repeat the “[Analog output software test](#)” and the “[General-purpose digital I/O software test \(KPCI-3130 only\)](#)” found later in this Appendix.
 3. If the software appears to be working, go to Scheme G to verify the problem solution.
 4. If the software still does not work, refer to “[Technical support](#)” and contact Keithley.
5. If the applications program is a custom program that can be modified:
 - a. Check and debug the source code as necessary.
 - b. Repeat the “[Analog output software test](#)” and the “[General-purpose digital I/O software test \(KPCI-3130 only\)](#)” found later in this Appendix.
 1. If the software appears to be working, go to Scheme G to verify the problem solution.
 2. If the software still does not work, refer to “[Technical support](#)” and contact Keithley.

Figure B-6
Problem isolation Scheme C: application software



Problem isolation Scheme D: expansion slot connectors

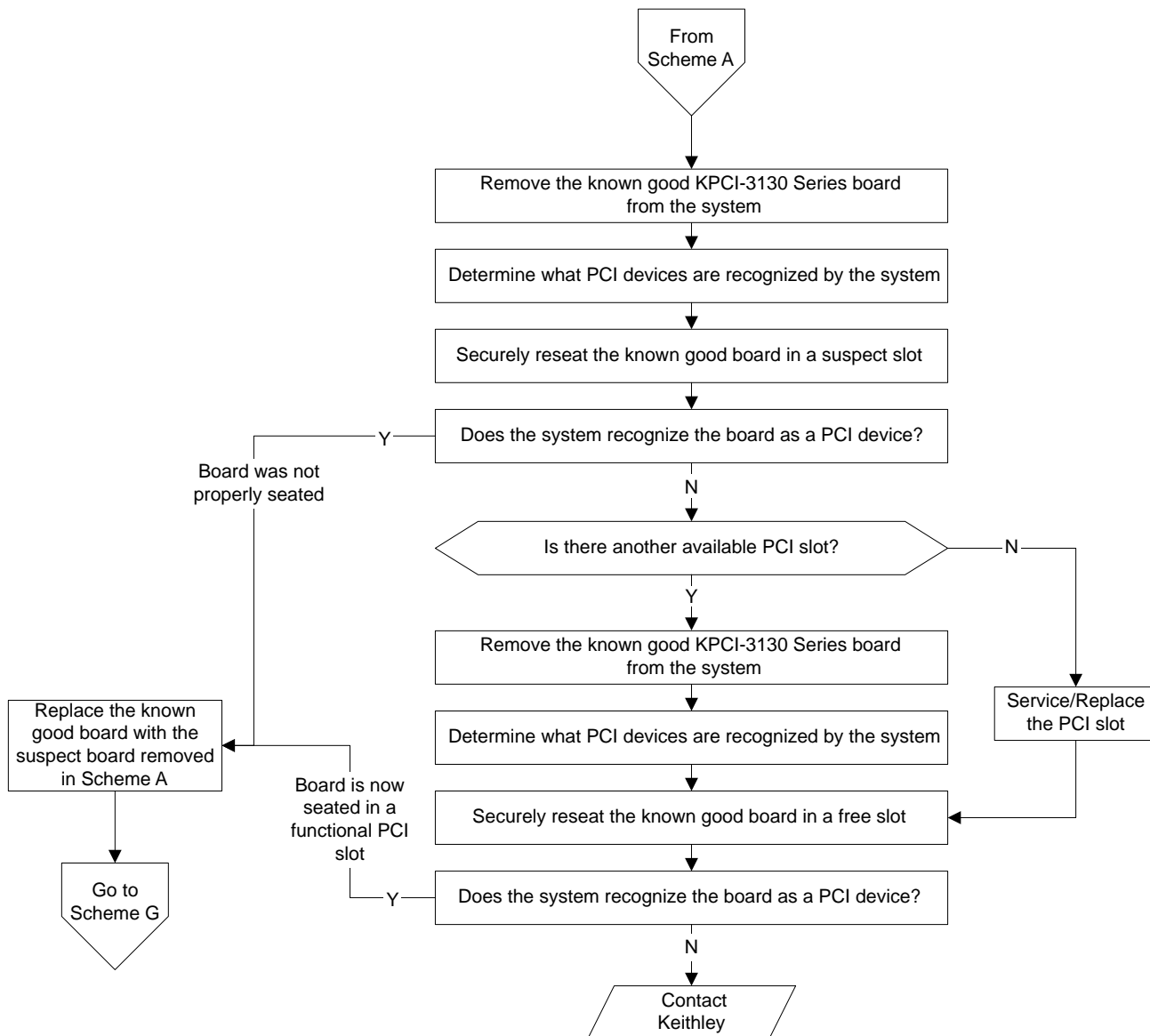
Scheme D checks for expansion slot malfunctions.

Refer to the flow chart in [Figure B-7](#).

NOTE *This is not a stand-alone procedure. Use it only when it is called for by another procedure.*

1. Shut down Windows 95/98/NT/2000 and turn OFF power to the host computer.
2. Remove the known good KPCI-3130 Series board from the suspect PCI slot.
3. Determine what PCI devices are recognized by the system, as follows:
 - a. Insert a blank diskette, or any unbootable diskette, into the A: drive.
 - b. Turn ON the computer and allow it to start the boot cycle.
 - c. When the boot cycle stalls, note and record the displayed **PCI device listing...** (If a printer is attached to the system, press the PRINT SCREEN key to print a copy of the screen.)
 - d. Remove the diskette, press any key, and allow the boot cycle to finish.
4. Shut down Windows 95/98/NT/2000 and turn OFF power to the host computer.
5. Securely reseal the known good board in the suspect slot.
6. Determine if the system recognizes the board as a new PCI device in the suspect slot, as follows:
 - a. Insert a blank diskette, or any unbootable diskette, into the A: drive.
 - b. Turn ON the computer and allow it to start the boot cycle.
 - c. When the boot cycle stalls, note and record the displayed **PCI device listing...** (If a printer is attached to the system, press the PRINT SCREEN key to print a copy of the screen.)
 - d. Compare the PCI device listing to that recorded in Step 3.
 - e. Remove the diskette, press any key, and allow the boot cycle to finish.
7. If the board is found as a new PCI device, replace the known good board with the suspect board removed in Scheme A and go to Scheme G to verify the solution.
8. If the board is not recognized as a new PCI device and there is another available PCI slot:
 - a. Shut down Windows 95/98/NT/2000 and turn OFF power to the host computer.
 - b. Remove the KPCI-3130 Series board from the system.
 - c. Determine what PCI devices are recognized by the system as in Step 3.
 - d. Securely seat the known good board in a free PCI slot.
 - e. Determine if the system recognizes the board as a new PCI device in the appropriate slot, as in Step 6.
 1. If the board is found as a new PCI device, replace the known good board with the suspect board removed in Scheme A and go to Scheme G to verify the solution.
 2. If the board is not recognized as a new PCI device, refer to “[Technical support](#)” and contact Keithley for further assistance.

Figure B-7

Problem isolation Scheme D: expansion slot connectors

9. If the board is not recognized as a new PCI device and there is not another available PCI slot:
 - a. Shut down Windows 95/98/NT/2000 and turn OFF power to the host computer.
 - b. Remove the KPCI-3130 Series board from the system.
 - c. Service or replace the PCI slot.
 - d. Securely seat the board in the serviced slot.
 - e. Determine if the system recognizes the board as a new PCI device in the serviced slot, as in Step 6.
 1. If the board is found as a new PCI device, replace the known good board with the suspect board removed in Scheme A and go to Scheme G to verify the solution.
 2. If the board is not recognized as a new PCI device, refer to “[Technical support](#)” and contact Keithley for further assistance.

Problem isolation Scheme E: user wiring

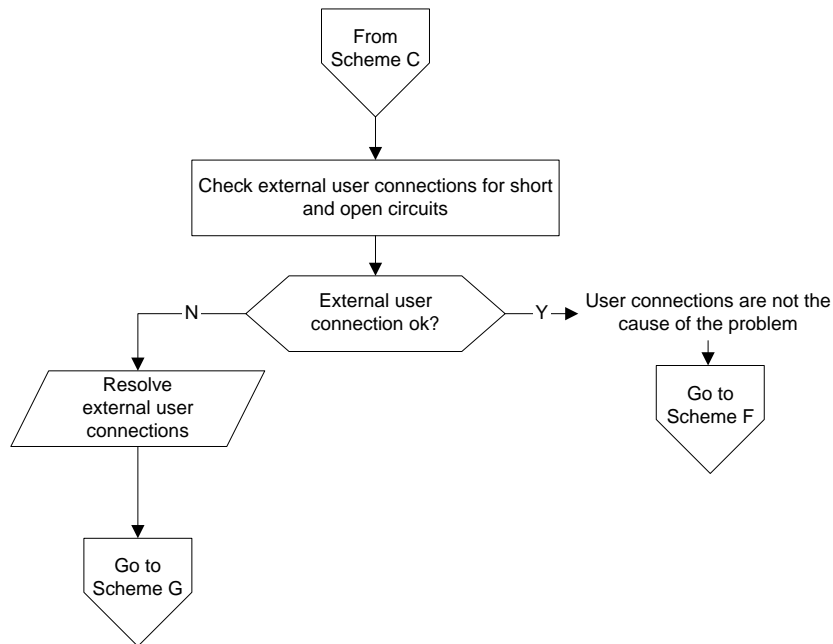
Scheme E checks external connections.

Refer to the flow chart in [Figure B-8](#).

NOTE *This is not a stand-alone procedure. Use it only when it is called for by another procedure.*

Figure B-8

Problem isolation Scheme E: user wiring



1. Check the I/O connections between each external signal source and the screw terminal accessory, one at a time, for short circuits and open circuits. If KPCI-3130 Series boards were installed in more than one PCI slot, check the I/O connections for all boards.

NOTE *Do not connect the screw terminal accessory to the board during this scheme.*

2. If any external I/O connections are found to be faulty:
 - a. Correct the faulty external connections.
 - b. Go to “[Problem isolation Scheme G: verification of problem solution.](#)”
3. If all external I/O connections are found to be normal, the KPCI-3130 Series board(s) originally installed in the computer may be the cause of the problem:
 - a. If there is only one KPCI-3130 Series board installed in the system or suspected to be faulty:
 1. Replace the faulty board with a known good board.
 2. Go to “[Problem isolation Scheme G: verification of problem solution.](#)”
 - b. If there is more than one KPCI-3130 Series board installed in the system, go to Scheme F to determine which board is faulty.

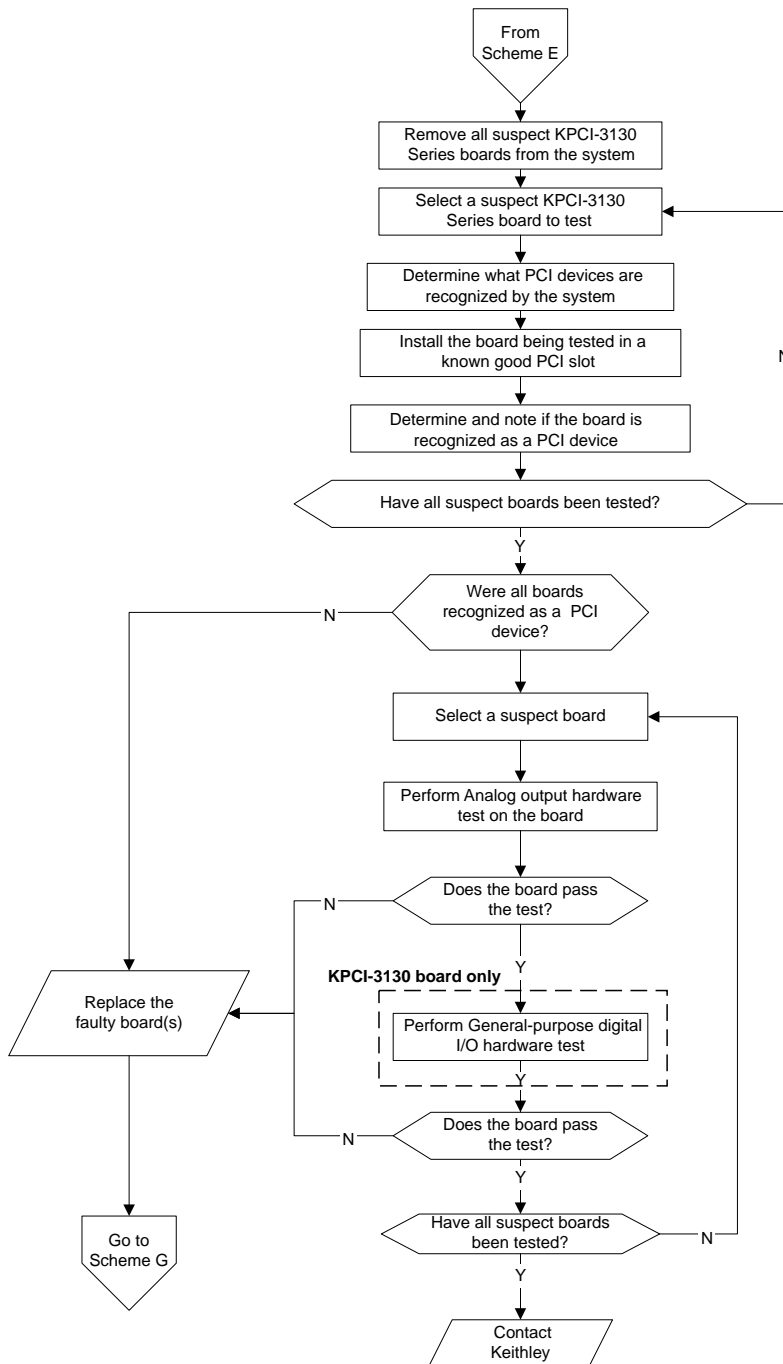
Problem isolation Scheme F: the board

Scheme F determines which KPCI-3130 Series board is faulty (assuming more than one board is installed in the system).

Refer to [Figure B-9](#) for a flow chart.

NOTE *This is not a stand-alone procedure. Use it only when it is called for by another procedure.*

Figure B-9
Problem isolation Scheme F: the board



1. Shut down Windows 95/98/NT/2000 and turn OFF power to the host computer.
2. Remove all KPCI-3130 Series boards from the system.
3. Determine what PCI resources are already recognized by the system, as follows:
 - a. Insert a blank diskette, or any unbootable diskette, into the A: drive.
 - b. Turn ON the computer and allow it to start the boot cycle.
 - c. When the boot cycle stalls, note and record the displayed **PCI device listing...** (If a printer is attached to the system, press the PRINT SCREEN key to print a copy of the screen.)
 - d. Remove the diskette, press any key, and allow the boot cycle to finish.
4. Again, shut down Windows 95/98/NT/2000 and turn OFF power to the host computer.
5. Install, in any available known good PCI slot, one of the suspected KPCI-3130 Series boards.
6. Determine if the system recognizes the board as a new PCI device, as follows:
 - a. Insert a blank diskette, or any unbootable diskette, into the A: drive.
 - b. Turn ON the computer and allow it to start the boot cycle.
 - c. When the boot cycle stalls, note and record the displayed **PCI device listing...** (If a printer is attached to the system, press the PRINT SCREEN key to print a copy of the screen.)
 - d. Remove the diskette, press any key, and allow the boot cycle to finish.
 - e. Compare the PCI device listing to that recorded in step 3c.
7. Repeat steps 1 through 6 for each KPCI-3130 Series board in the system, noting which boards are recognized as PCI devices.
8. If any of the boards tested were not recognized as PCI devices:
 - a. Replace the faulty board with a known good board.
 - b. Go to [“Problem isolation Scheme G: verification of problem solution.”](#)
9. If all of the boards tested were recognized as PCI devices:
 - a. Perform the procedure outlined in the [“Analog output hardware test”](#) found later in this Appendix for each board, noting which boards pass the test.
 - b. Perform the procedure outlined in the [“General-purpose digital I/O hardware test \(KPCI-3130 only\)”](#) found later in this Appendix, noting which boards pass the test.
10. If any of the boards failed either the [Analog output hardware test](#) or the [General-purpose digital I/O hardware test \(KPCI-3130 only\)](#):
 - a. Replace the faulty board(s) with a known good board.
 - b. Go to [“Problem isolation Scheme G: verification of problem solution.”](#)
11. If all of the boards passed the [Analog output hardware test](#) and the [General-purpose digital I/O hardware test \(KPCI-3130 only\)](#), refer to [“Technical support”](#) and contact Keithley for further assistance.

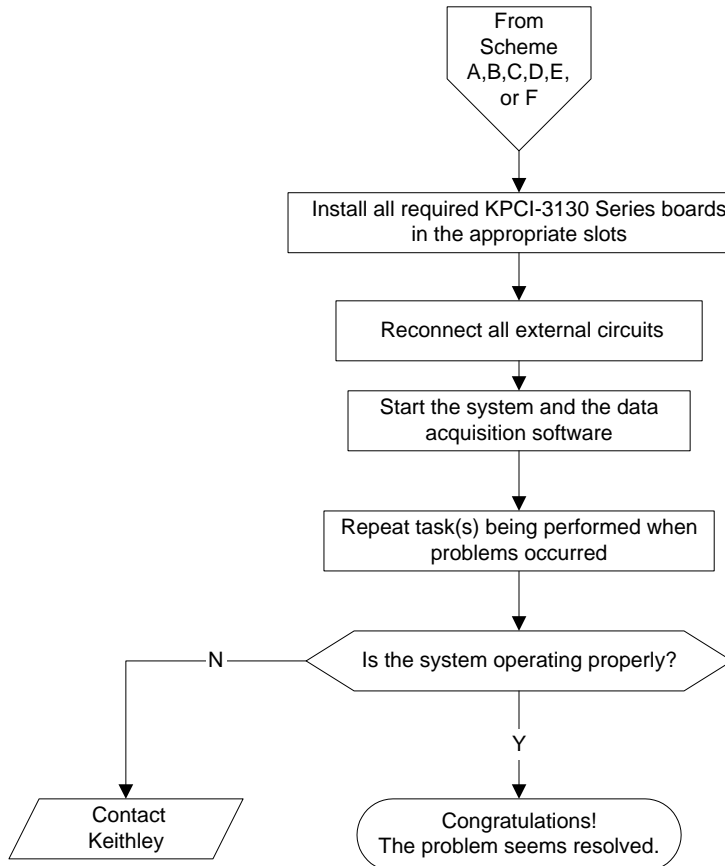
Problem isolation Scheme G: verification of problem solution

Scheme G verifies that the system problem has been resolved. Refer to [Figure B-10](#) for a flow chart of the procedure.

NOTE *This is not a stand-alone procedure. Use it only when it is called for by another procedure.*

Figure B-10

Problem isolation Scheme G: verification of problem solution



1. Shut down Windows and turn OFF power to the computer.
2. Install the required KPCI-3130 Series boards in appropriate slots.
3. Reconnect all external circuits.

NOTE *If external circuits were left connected to the screw terminal accessory, connect the accessory to the board. If the external circuits were disconnected from the screw terminal accessory, reconnect them and the accessory as discussed in Section 3, “Installation.”*

4. Turn ON the computer and start the data acquisition software.
5. Repeat the task(s) being performed when problems occurred.
6. Observe system performance.
7. If the system is operating properly, congratulations on resolving the problem.
8. If the system is not operating properly, refer to “[Technical support](#)” and contact Keithley for further instructions.

Specified hardware I/O tests

The tests in this section check performance of the KPCI-3130 Series board's analog and also the KPCI-3130's digital I/O.

The tests use proven DriverLINX utilities, thereby bypassing any unresolved application software issues.

These tests are intended to be used when specified in the preceding “[Systematic problem isolation](#)” procedure. However, they may also be used at any time for general functional checks of the KPCI-3130 Series board.

NOTE *During these tests, disconnect all user circuits from the board, except as specified in individual test procedures.*

Analog output hardware test

The analog output test checks whether the digital-to-analog converters (DACs) of the board are working correctly. Zero voltages are set at the analog outputs, using the on-screen level control utility supplied with DriverLINX. The two output voltages are then measured with a digital voltmeter to verify reasonable DAC offsets. Similarly, a mid-range voltage is set for each of the analog outputs and the procedure is repeated to verify proper digital to analog conversion.

NOTE *During this test, ensure that no user circuits are connected to the KPCI-3130 Series board, via the required screw terminal accessory, except for analog output connections specified for the test.*

The analog output test is primarily a functional test, not a calibration check, although measured outputs from a properly calibrated board should correspond to DAC settings, within the accuracy specifications of the board. To check and adjust accuracy, refer to Section 5, “[Calibration](#).”

Equipment

The following equipment is required to perform the analog output test:

- A Digital Voltmeter (DVM) or a Digital Multimeter (DMM) set to the 10V range.
- An STP-36 screw terminal accessory, to which the DVM/DMM is connected as indicated in [Table B-1](#).

NOTE *If possible, use a screw terminal accessory that is reserved for I/O tests. Using the screw terminal accessory normally connected to the external circuits may lead to potential wiring errors involved in disconnecting and later reconnecting the external circuits.*

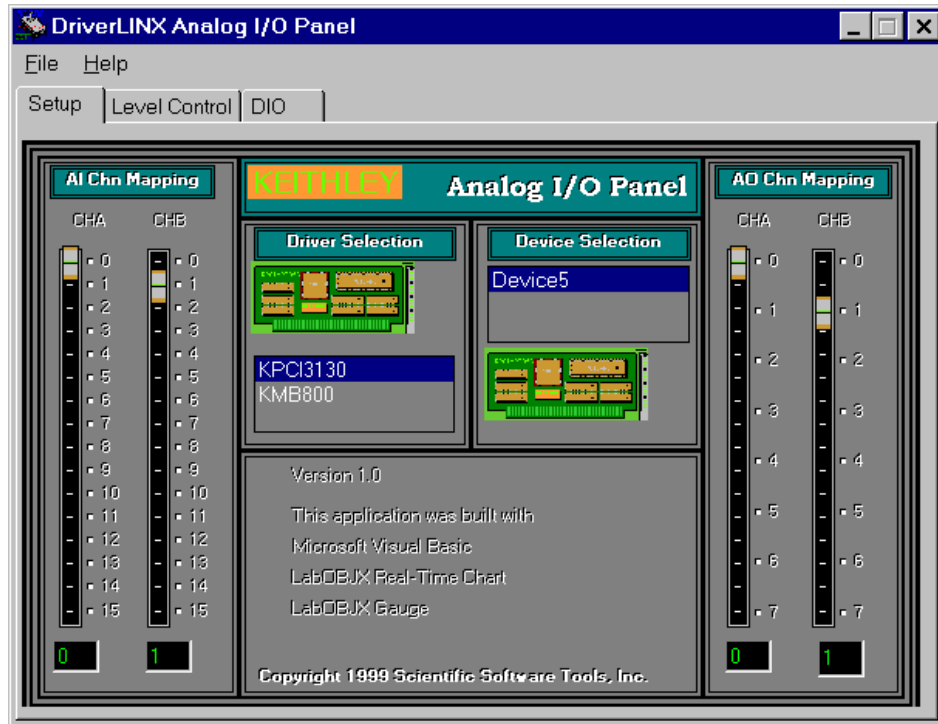
Table B-1
Terminals on accessory for connection during analog output hardware test

To check this analog output (local sense)...	...connect the DVM or DMM to these terminals:		Models
	Analog output and sense high screw terminals	Analog ground and sense low screw terminals	
Analog output 0	1, 2 shorted	19, 20 shorted	KPCI-3130 and KPCI-3132
Analog output 1	3, 4 shorted	21, 22 shorted	
Analog output 2	5, 6 shorted	23, 24 shorted	KPCI-3130 only
Analog output 3	7, 8 shorted	25, 26 shorted	
Analog output 4	9, 10 shorted	27, 28 shorted	
Analog output 5	11, 12 shorted	29, 30 shorted	
Analog output 6	13, 14 shorted	31, 32 shorted	
Analog output 7	15, 16 shorted	33, 34 shorted	

Procedure

1. Turn OFF the host computer.
2. Connect the negative lead of the DVM/DMM to a ground terminal and sense low of the screw terminal accessory, as indicated in [Table B-1](#).
3. Connect the STP-36 screw terminal accessory to the KPCI-3130 Series “Analog” I/O connector.
4. Turn ON the host computer and boot Windows 95/98/NT/2000.
5. In the **Start** menu, click **Programs**.
6. Locate the **DriverLINX → Test Panels** folder and click on **AIO Panel**. A setup screen is displayed (see [Figure B-11](#)).

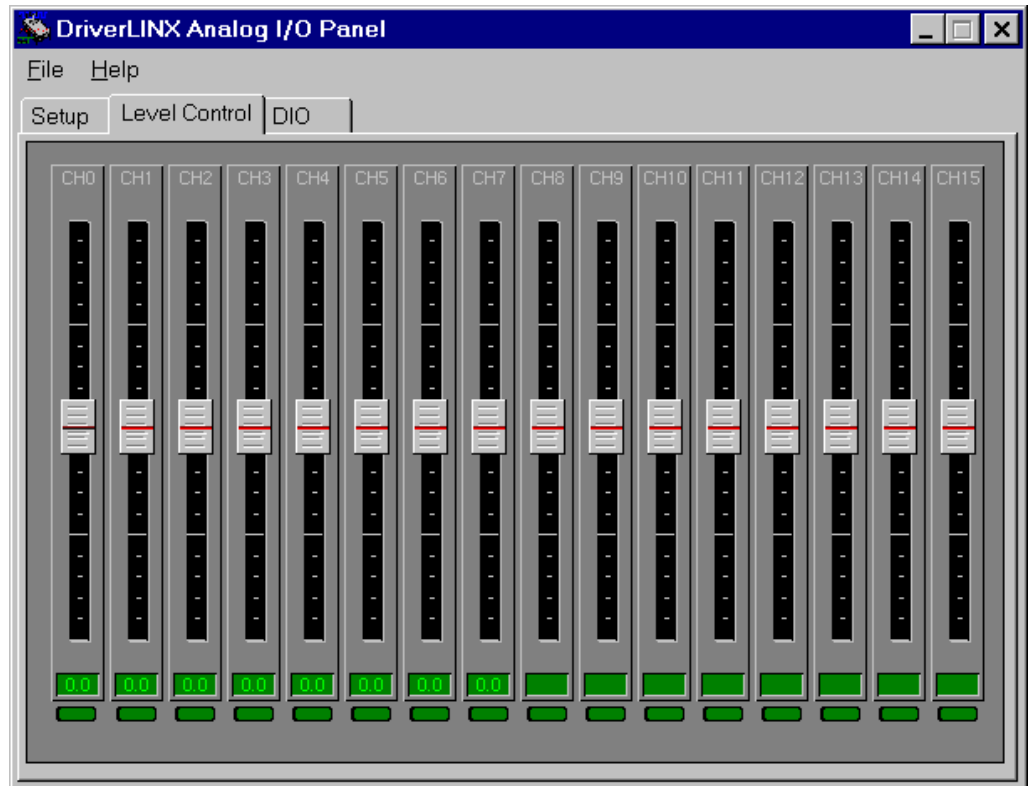
Figure B-11
Analog I/O Panel setup screen example



NOTE Refer to Section 4, "Making two-wire and four-wire mode connections" for making accurate analog output measurements.

- Click the **Level Control** tab. The on-screen analog-output level control appears, similar to Figure B-12.

Figure B-12
On-screen analog-output level control



- Enable CH0 by clicking on the rectangular button below the channel voltage reading.
- Using the mouse, slide the CH0 level control button until the tiny display at the bottom of the level control reads 0.0 (volts).
- Repeat Steps 8 and 9 for each analog channel.
- Measure and compare the analog output voltages as indicated in Table B-2:
 - Measure the voltages with the DVM/DMM at the applicable analog outputs.
 - KPCI-3130 → Analog outputs 0 and 7
 - KPCI-3132 → Analog outputs 0 and 1
 - Compare the voltages measured in step 11a with the voltages set via the analog-output level control.
- Verify overload detection on a specific channel, as follows:
 - Perform a disconnect on a two-wire or four-wire setup at the channel.
 - Open the **AIO Test Panel**.
 - Click on the **DIO** tab.
 - On the **Input Panel**, select **Channel 4**.
 - Verify a zero in the applicable bit (bit 7 represents channel 7, bit 6 represents channel 6, etc.).

Table B-2

Test connections and readings for zero-voltage analog output connected to upper "Analog" I/O connector

To check this analog output (local sense)...	...connect the DVM or DMM to these terminals on an STP-36 accessory:		If the board works correctly, the following voltages should agree:		Models
	Analog output and sense high screw terminals	Analog ground and sense low screw terminals	Level control setting	Voltage reading at DVM or DMM	
Analog output 0	1, 2 shorted	19, 20 shorted	0.0V	0.0V	KPCI-3130 and KPCI-3132
Analog output 1	3, 4 shorted	21, 22 shorted	0.0V	0.0V	
Analog output 2	5, 6 shorted	23, 24 shorted	0.0V	0.0V	KPCI-3130 only
Analog output 3	7, 8 shorted	25, 26 shorted	0.0V	0.0V	
Analog output 4	9, 10 shorted	27, 28 shorted	0.0V	0.0V	
Analog output 5	11, 12 shorted	29, 30 shorted	0.0V	0.0V	
Analog output 6	13, 14 shorted	31, 32 shorted	0.0V	0.0V	
Analog output 7	15, 16 shorted	33, 34 shorted	0.0V	0.0V	

13. Enable CH0 by clicking on the rectangular button below the channel voltage reading.
14. Using the mouse, slide the CH0 level control button until the tiny display at the bottom of the level controls read 5.0.
15. Repeat Steps 12 and 14 for each analog output channel.
16. Measure and compare the analog output voltages as indicated in [Table B-3](#):
 - a. Measure the voltages at analog outputs with the DVM/DMM.
 - b. Compare the voltages measured in step 15a with the voltages set via the analog-output level control.

Table B-3

Test connections and readings for mid-range analog output connected to upper "Analog" I/O connector

To check this analog output (local sense)...	...connect the DVM or DMM to these terminals on an STP-36 accessory:		If the board works correctly, the following voltages should agree:		Models
	Analog output and sense high screw terminals	Analog ground and sense low screw terminals	Level control setting	Voltage reading at DVM or DMM	
Analog output 0	1, 2 shorted	19, 20 shorted	5.0V	5.0V	KPCI-3130 and KPCI-3132
Analog output 1	3, 4 shorted	21, 22 shorted	5.0V	5.0V	
Analog output 2	5, 6 shorted	23, 24 shorted	5.0V	5.0V	KPCI-3130 only
Analog output 3	7, 8 shorted	25, 26 shorted	5.0V	5.0V	
Analog output 4	9, 10 shorted	27, 28 shorted	5.0V	5.0V	
Analog output 5	11, 12 shorted	29, 30 shorted	5.0V	5.0V	
Analog output 6	13, 14 shorted	31, 32 shorted	5.0V	5.0V	
Analog output 7	15, 16 shorted	33, 34 shorted	5.0V	5.0V	

17. Determine whether the board passed or failed the analog output hardware test, as follows:
 - If the voltages measured with the DVM/DMM do not agree with the level control settings, the board failed the analog output hardware test.
 - If the voltages measured with the DVM/DMM do agree with the level control settings, the board passed the analog output hardware test.
18. Return to step 10 in "[Problem isolation Scheme F: the board.](#)"

NOTE *If the analog outputs appear to work satisfactorily, but some measured analog output voltages are outside the accuracy limits specified in Appendix A, consider calibrating the board after concluding the “Systematic problem isolation” procedure. For calibration procedures, refer to Section 5, “Calibration.”*

General-purpose digital I/O hardware test (KPCI-3130 only)

This test checks whether the general-purpose digital input and output circuits of the board are operating properly.

Test summary

- Wire an STP-36 screw terminal accessory in a loop-back configuration. Connect the channel 0 digital I/O terminals, bit-for-bit, to the channel 2 digital I/O terminals. Connect the channel 1 terminals, bit-for-bit, to the channel 3 terminals. See Figure B-13 for the channel and bit number of each terminal on the screw terminal accessory. See Figure B-14 for the loop-back wiring schematic. (These are the same connections as made for the general-purpose digital I/O software test.)

Figure B-13
Channel and bit numbers for an STP-36 screw terminal accessory (KPCI-3130 only)

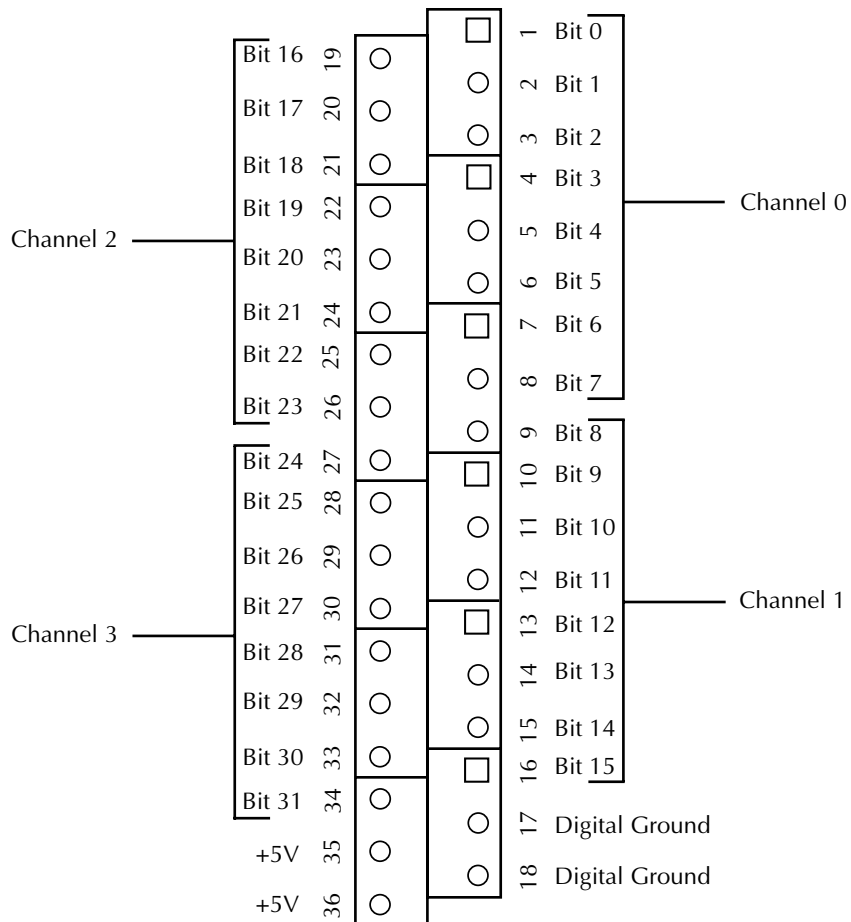
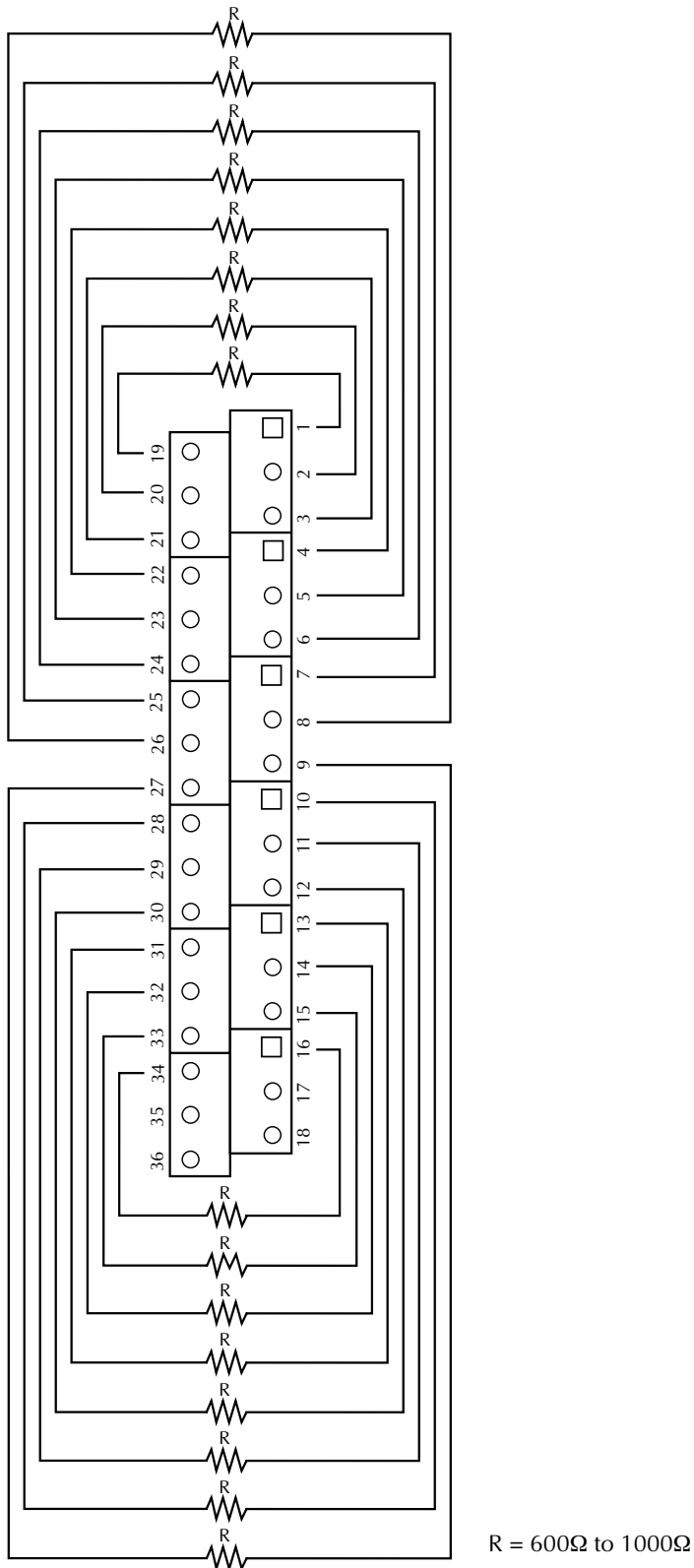


Figure B-14
**Loop-back wiring for general-purpose digital I/O hardware and software test
(KPCI-3130 only)**



- Using a DriverLINX graphical interface, configure the channel 0 and 1 bits as outputs and the channel 2 and 3 bits as inputs.
- Using the same DriverLINX graphical interface, set the channel 0 and 1 outputs in a particular bit pattern and check channels 2 and 3 inputs for the same bit pattern. Repeat, using a second bit pattern.

The digital I/O of the board is performing satisfactorily if all bits respond appropriately. The specified bit patterns check both for direct ON/OFF response and for shorts between bits.

Equipment

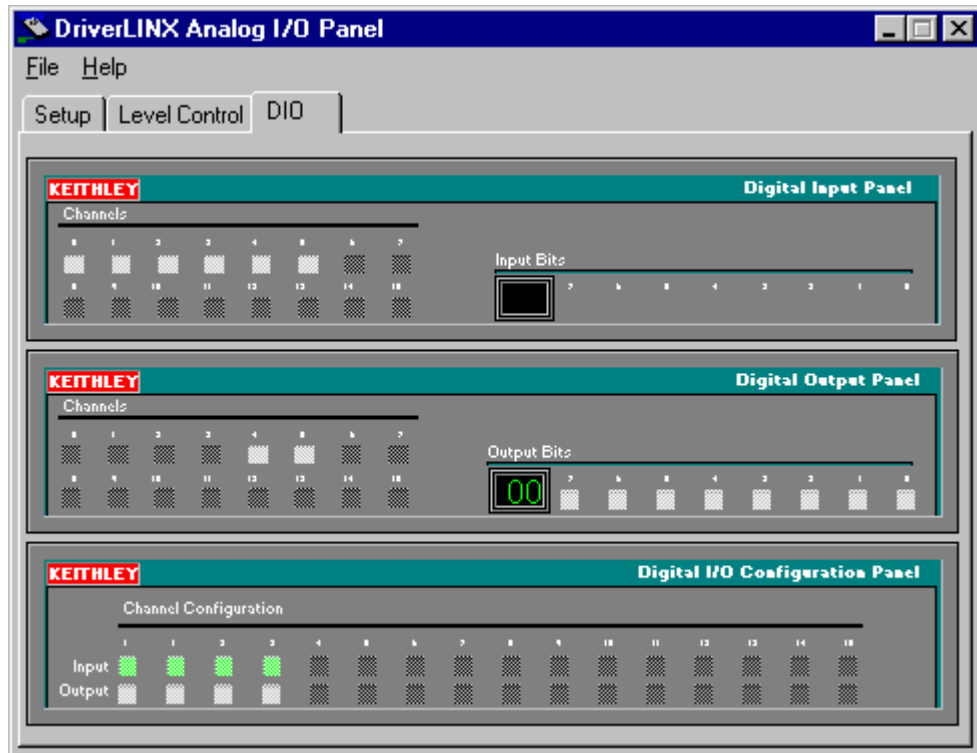
All I/O is set and read using the DriverLINX Digital Input/Output test panel; no instruments are required. However, an STP-36 screw terminal accessory must be wired in the loop-back configuration shown in [Figure B-14](#).

NOTE *If possible, use a screw terminal accessory that is reserved for I/O tests. Using the screw terminal accessory normally connected to the external circuits may lead to potential wiring errors involved in disconnecting and later reconnecting the external circuit.*

Procedure

1. Turn OFF the host computer.
2. If a screw terminal accessory is attached to the upper “Analog” I/O connector of the KPCI-3130 I/O board, remove it. No circuits should be connected to the “Analog” I/O connector during these tests.
3. Wire an STP-36 screw terminal accessory as described in [Figure B-14](#).
4. Attach the wired screw terminal accessory to the lower “Digital” I/O connector of the KPCI-3130 board. Refer to Section 4, “[Connecting interface accessories.](#)”
5. Turn ON the host computer and boot Windows 95/98/NT/2000.
6. In the **Start** menu, click **Programs**.
7. Locate the **DriverLINX → Test Panels** folder.
8. Click on the **AIO Panel** entry. The **Analog I/O Panel** setup screen appears.
9. Click the **DIO** tab. An on-screen digital I/O controller appears, similar to [Figure B-15](#).

Figure B-15
On-screen digital I/O controller



NOTE

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

- Channel 0 refers to the twelve multi-function digital I/O bits. These bits may be manipulated with the digital I/O controller only when the multi-function bits are configured as general-purpose bits.
- Channels 1 to 4 refer to the four 8-bit general-purpose registers in the KPCI-3130. Bits displayed on the **Digital Input Panel** and the **Digital Output Panel** are numbered 0-7 for every channel—instead of 0-7 for channel 0, 8-15 for channel 1, 16-23 for channel 2, and 24-31 for channel 3 as for the KPCI-3130 “Digital” I/O connector. Refer to [Table B-4](#).
- Invalid channels and settings appear as dark gray squares. For example:
 - Non-existent channels always appear as dark gray squares.
 - In the Digital I/O Configuration Panel, Channel 0, corresponding to the twelve multi-function digital I/O bits, appears as dark gray squares. The configuration of the twelve bits is fixed; six are always inputs and six are always outputs.
- 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.
- 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.)

Table B-4

Bit numbering on Digital I/O panel vs. "Digital" I/O connector (KPCI-3130 only)

Channel 0 bit numbers		Channel 1 bit numbers		Channel 2 bit numbers		Channel 3 bit numbers	
On I/O panels	At "Digital" connector	On I/O panels	At "Digital" connector	On I/O panels	At "Digital" connector	On I/O panels	At "Digital" connector
0	0	0	8	0	16	0	24
1	1	1	9	1	17	1	25
2	2	2	10	2	18	2	26
3	3	3	11	3	19	3	27
4	4	4	12	4	20	4	28
5	5	5	13	5	21	5	29
6	6	6	14	6	22	6	30
7	7	7	15	7	23	7	31

10. Under **Digital I/O Configuration Panel**, configure channels 0 and 1 as outputs.
11. In the **Digital Output Panel** under **Channels**, click on channel 1.
12. In the **Digital Output Panel** under **Output Bits**, set the bits of channel 1 for a bit pattern of 0X55.
13. In the **Digital Input Panel** under **Channels**, click on channel 1.
14. In the **Digital Input Panel** under **Input bits**, observe the bit pattern. The proper response should be 0X55.
 - If the displayed response is not 0X55, the digital I/O is not functioning properly. Stop here, and return to the problem isolation step in "**Problem isolation Scheme F: the board**" that asked you to perform the General-purpose digital I/O hardware test.
 - If the displayed response is 0X55, continue with step 15.
15. In the **Digital Output Panel** under **Channels**, click on channel 0.
16. In the **Digital Output Panel** under **Output Bits**, configure channel 0 for a bit pattern of 0X55.
17. In the **Digital Input Panel** under **Channels**, click on channel 0.
18. In the **Digital Input Panel** under **Input bits**, observe the bit pattern. The proper response should be 0X55.
 - If the observed response is not 0X55, the digital I/O is not functioning properly. Stop here, and return to the problem isolation step in "**Problem isolation Scheme F: the board**" that asked you to perform the General-purpose digital I/O hardware test.
 - If the observed response is 0X55, continue with step 19.
19. In the **Digital Output Panel** under **Channels**, click on channel 1.
20. In the **Digital Output Panel** under **Output Bits**, set the bits of channel 1 for a bit pattern of 0XAA.
21. In the **Digital Input Panel** under **Channels**, click on channel 1.
22. In the **Digital Input Panel** under **Input bits**, observe the bit pattern. The proper response should be 0XAA.
 - If the observed response is not 0XAA, the digital I/O is not functioning properly. Stop here, and return to the problem isolation step in "**Problem isolation Scheme F: the board**" that asked you to perform the General-purpose digital I/O hardware test.
 - If the observed response is 0XAA, continue with step 23.
23. In the **Digital Output Panel** under **Channels**, click on channel 0.
24. In the **Digital Output Panel** under **Output Bits**, set the bits of channel 0 for a bit pattern of 0XAA.

25. In the **Digital Input Panel** under **Channels**, click on channel 0.
26. In the **Digital Input Panel** under **Input bits**, observe the bit pattern. The proper response should be 0XAA.
 - If the observed response is not 0XAA, the digital I/O is not functioning properly.
 - If the observed response is 0XAA, the digital I/O is functioning properly.
27. Stop here, and return to the problem isolation step in “[Problem isolation Scheme F: the board](#)” that asked you to perform the General-purpose digital I/O hardware test.

NOTE *When the multi-function bits are configured as general-purpose bits, a similar test of the twelve multi-function digital I/O bits can be performed with the on-screen digital I/O controller. Wire loop-back connections at an STP-36 accessory between same-numbered input and output bits. (If the outputs are always wired only to inputs, no protective series resistors are required. If two output bits are wired together and both are turned ON without adequate current limiting, damage will result.) Turn input bits 0, 2, and 4 ON and look for an identical output bit pattern. Repeat, turning input bits 1, 3, and 5 ON.*

Specified software I/O tests

The tests in this section check whether the application software correctly performs analog and digital I/O tasks. The I/O are tested using a KPCI-3130 Series board known to work properly, thereby bypassing potential board problems. These tests are intended to be used when specified in the preceding “[Systematic problem isolation](#)” procedure.

NOTE *During these tests, disconnect all user circuits from the board, except for connections specified in individual test procedures.*

Analog output software test

This basic analog output test checks whether the application software correctly sets direct current (DC) analog output voltages. Zero volts is set at the analog outputs, using the application software. The output voltages are then measured with a digital voltmeter to verify reasonable DAC offsets. Similarly, a mid-range voltage is set for each of the analog outputs and the procedure is repeated.

NOTE *During this test, ensure that no user circuits are connected to the KPCI-3130 Series board, via the required screw terminal accessory, except for analog output connections specified for the test.*

The analog output software test is a software function test, not a calibration check. To check and adjust the accuracy, refer to Section 5, “[Calibration](#).”

The analog output software test is only a basic check of the application software.

Equipment

The following equipment is required to perform the analog output test:

- A Digital Voltmeter (DVM) or a Digital Multimeter (DMM) set to the 10V range.
- An STP-36 screw terminal accessory, to which the DVM/DMM is connected as indicated in [Table B-5](#).

NOTE *If possible, use a screw terminal accessory that is reserved for I/O tests. Using the screw terminal accessory normally connected to the external circuits may lead to potential wiring errors involved in disconnecting and later reconnecting the external circuit.*

Table B-5
Connection terminals for analog output software test

To check this analog output (local sense)...	...connect the DVM or DMM to these terminals:		Models
	Analog output and sense high screw terminals	Analog ground and sense low screw terminals	
Analog output 0	1, 2 shorted	19, 20 shorted	KPCI-3130 and KPCI-3132
Analog output 1	3, 4 shorted	21, 22 shorted	
Analog output 2	5, 6 shorted	23, 24 shorted	KPCI-3130 only
Analog output 3	7, 8 shorted	25, 26 shorted	
Analog output 4	9, 10 shorted	27, 28 shorted	
Analog output 5	11, 12 shorted	29, 30 shorted	
Analog output 6	13, 14 shorted	31, 32 shorted	
Analog output 7	15, 16 shorted	33, 34 shorted	

CAUTION Before powering the computer, connect the DVM/DMM negative lead to a ground and sense-low screw terminal.

After powering the computer, connect the DVM/DMM positive lead to each specified analog output and sense high screw terminal by touching the tip of the lead to the screw head of the screw terminal (for example, via a probe).

Procedure for the analog output software test

1. Turn OFF the host computer.
2. Connect the negative lead of the DVM/DMM to a ground terminal of the screw terminal accessory, as indicated in [Table B-5](#).
3. Connect the STP-36 screw terminal accessory to the KPCI-3130 Series I/O connector.
4. Turn ON the host computer and boot Windows 95/98/NT/2000.
5. Start DriverLINX and the application software.
6. Set the application software to output 0V at all analog outputs (0 through 7 for KPCI-3130 or 0 through 1 for KPCI-3132).
7. Measure and compare the analog output voltages as indicated in [Table B-6](#):
 - a. Measure the voltages at analog outputs 0 and 1 with the DVM/DMM.
 - b. Compare the voltages measured in step 7a with the voltages set via the analog-output level control.

Table B-6

Test connections and readings for zero-voltage analog output

To check this analog output (local sense)...	...connect the DVM or DMM to these terminals on an STP-36 accessory:		If the board works correctly, the following voltages should agree:		Models
	Analog output and sense high screw terminals	Analog ground and sense low screw terminals	Level control setting	Voltage reading at DVM or DMM	
Analog output 0	1, 2 shorted	19, 20 shorted	0.0V	0.0V	KPCI-3130 and KPCI-3132
Analog output 1	3, 4 shorted	21, 22 shorted	0.0V	0.0V	
Analog output 2	5, 6 shorted	23, 24 shorted	0.0V	0.0V	KPCI-3130 only
Analog output 3	7, 8 shorted	25, 26 shorted	0.0V	0.0V	
Analog output 4	9, 10 shorted	27, 28 shorted	0.0V	0.0V	
Analog output 5	11, 12 shorted	29, 30 shorted	0.0V	0.0V	
Analog output 6	13, 14 shorted	31, 32 shorted	0.0V	0.0V	
Analog output 7	15, 16 shorted	33, 34 shorted	0.0V	0.0V	

8. Set the application software to output +5V at analog outputs 0 and 1.
9. Measure and compare the analog output voltages as indicated in [Table B-7](#):
 - a. Measure the voltages at analog outputs 0 and 1 with the DVM/DMM.
 - b. Compare the voltages measured in step 9a with the voltages set via the analog-output level control.

Table B-7

Test connections and readings for mid-range analog output

To check this analog output (local sense)...	...connect the DVM or DMM to these terminals on an STP-36 accessory:		If the board works correctly, the following voltages should agree:		Models
	Analog output and sense high screw terminals	Analog ground and sense low screw terminals	Output voltage setting	Voltage reading at DVM or DMM	
Analog output 0	1, 2 shorted	19, 20 shorted	5.0V	5.0V	KPCI-3130 and KPCI-3132
Analog output 1	3, 4 shorted	21, 22 shorted	5.0V	5.0V	
Analog output 2	5, 6 shorted	23, 24 shorted	5.0V	5.0V	KPCI-3130 only
Analog output 3	7, 8 shorted	25, 26 shorted	5.0V	5.0V	
Analog output 4	9, 10 shorted	27, 28 shorted	5.0V	5.0V	
Analog output 5	11, 12 shorted	29, 30 shorted	5.0V	5.0V	
Analog output 6	13, 14 shorted	31, 32 shorted	5.0V	5.0V	
Analog output 7	15, 16 shorted	33, 34 shorted	5.0V	5.0V	

10. Determine if the application software is working correctly with the analog output portion of DriverLINX, as follows:
 - If the voltages measured with the DVM/DMM do not agree with the application software settings, the application software is not working correctly with the analog output portion of DriverLINX.
 - If the voltages measured with the DVM/DMM agree with the application software settings, then the software is working correctly with the analog output portion of DriverLINX.

General-purpose digital I/O software test (KPCI-3130 only)

This test checks whether the application software is working correctly with the general-purpose digital I/O functions of DriverLINX.

Test summary

This test includes the following steps:

- Wire an STP-36 screw terminal accessory in a loop-back configuration.
- Connect the channel 0 general-purpose digital I/O terminals, bit-for-bit, to the channel 2 general-purpose digital I/O terminals.
- Connect the channel 1 terminals, bit-for-bit, to the channel 3 terminals.

NOTE See *Figure B-16* for the channel and bit number of each terminal on the screw terminal accessory. See *Figure B-17* for the loop-back wiring schematic. (These are the same loop-back connections as made for the general-purpose digital I/O hardware test.)

Figure B-16
Channel and bit numbers for an STP-36 screw terminal accessory (KPCI-3130 only)

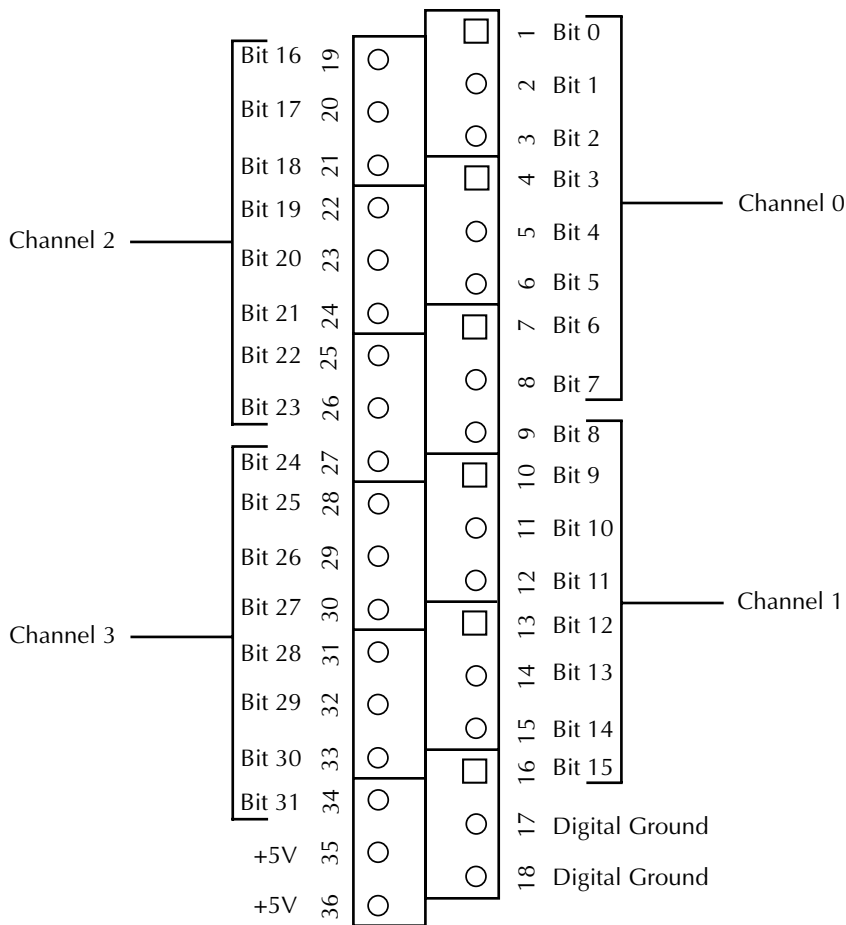
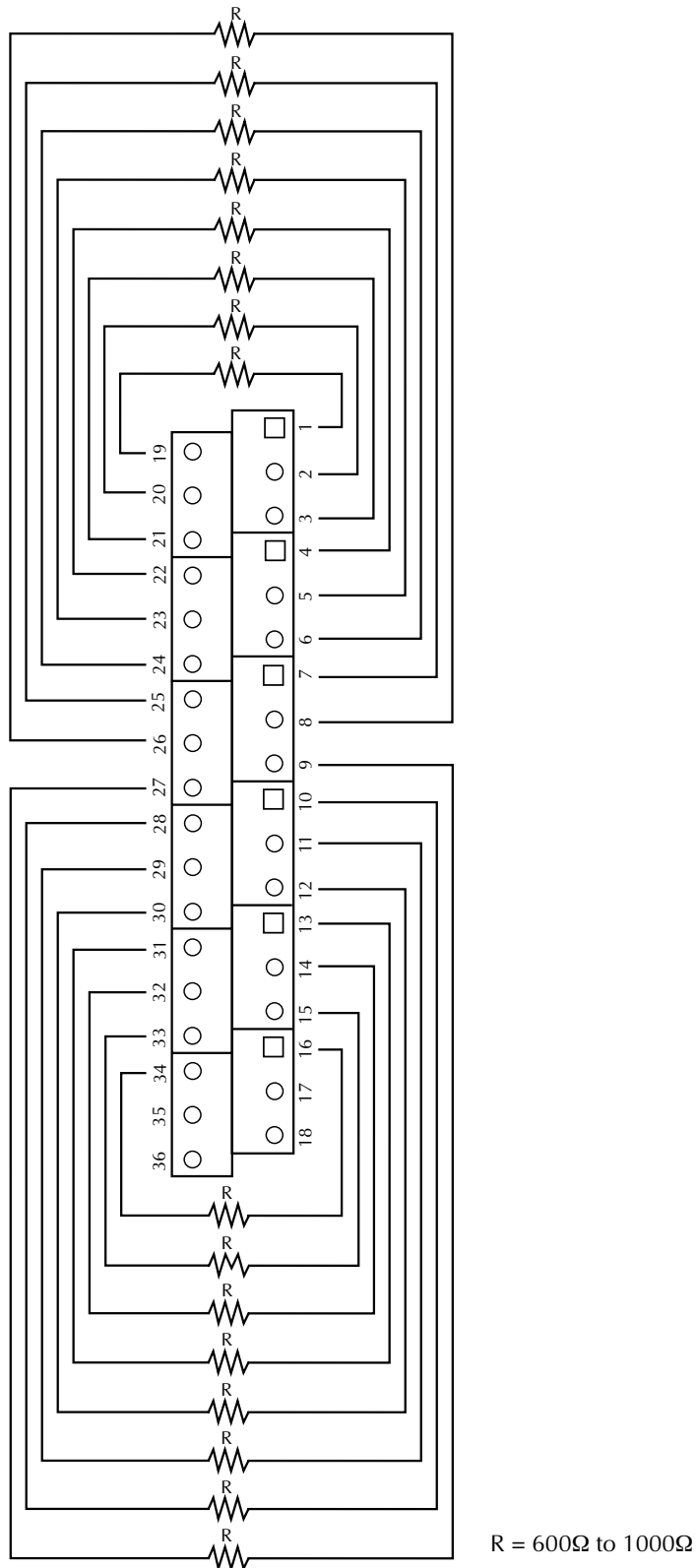


Figure B-17
Loop-back wiring for general-purpose digital I/O hardware and software test (KPCI-3130 only)



- Using the application software, configure the channel 0 and 1 bits as outputs and the channel 2 and 3 bits as inputs.
- Using the application software, set the channel 0 and 1 outputs in a particular bit pattern and check channels 2 and 3 inputs for the same bit pattern. Repeat, using a second bit pattern.

The application software is performing general-purpose digital I/O satisfactorily if all bits respond appropriately.

Equipment

All I/O is set and read using the application software; no instruments are required, with the exception of an STP-36 screw terminal accessory that must be wired in the loop-back configuration shown in [Figure B-17](#).

NOTE *If possible, use a screw terminal accessory that is reserved for I/O tests. Using the screw terminal accessory normally connected to the external circuits may lead to potential wiring errors involved in disconnecting and later reconnecting the external circuit.*

Procedure

NOTE *The bit patterns described in this procedure are shown graphically as follows:*

- OFF bits appear as white squares
 - ON bits appear as green squares when the manual is viewed in color, or as light gray squares when the manual is viewed in black and white.
1. Turn OFF the host computer.
 2. If a screw terminal accessory is attached to the upper “Analog” I/O connector of the KPCI-3130 I/O board, remove it. No circuits should be connected to the “Analog” I/O connector during these tests.
 3. Wire an STP-36 screw terminal accessory as described in [Figure B-17](#).
 4. Attach the wired screw terminal accessory to the lower “Digital” I/O connector of the KPCI-3130 board. Refer to Section 4, “[Connecting interface accessories](#)” of this manual.
 5. Turn ON the host computer and boot Windows 95/98/NT/2000.
 6. Start DriverLINX and the application software.
 7. Set up the application software to configure and monitor general-purpose digital I/O bits.
 8. Using the application software, do the following:
 - a. Configure general-purpose bits 0 to 7 (channel 0) as outputs.
 - c. Configure general-purpose bits 8 to 15 (channel 1) as outputs.
 - d. Configure general-purpose bits 16 to 23 (channel 2) as inputs.
 - e. Configure general-purpose bits 24 to 31 (channel 3) as inputs.
 9. Using the application software, configure bits 0 to 7 (channel 0) for a bit pattern of 0X55.
 10. Using the application software, observe the channel 0 input bits. The proper response should be 0X55.
 - If the observed channel 0 input bit pattern is not 0X55, the application software is not performing general-purpose digital I/O functions properly. Stop here, and return to step 5 of Scheme C in the “[Systematic problem isolation](#)” procedure.
 - If the observed channel 0 input bit pattern is 0X55, continue with step 11.
 11. Using the application software, configure channel 1 for a bit pattern of 0X55.

12. Using the application software, observe the channel 1 input bits. The proper response should be 0X55.
 - If the observed channel 1 input bit pattern is not 0X55, the application software is not performing general-purpose digital I/O functions properly. Stop here, and return to step 5 of Scheme C in the “[Systematic problem isolation](#)” procedure.
 - If the observed channel 1 input bit pattern is 0X55, continue with step 13.
13. Using the application software, configure bits 0 to 7 (channel 0) for a bit pattern of 0XAA.
14. Using the application software, observe the channel 0 input bits. The proper response should be 0XAA.
 - If the observed channel 0 input bit pattern is not the same as bit pattern 0XAA, the application software is not performing general-purpose digital I/O functions properly. Stop here, and return to step 5 of Scheme C in the “[Systematic problem isolation](#)” procedure.
 - If the observed channel 0 input bit pattern is 0XAA, continue with step 15.
15. Using the application software, configure channel 1 for the same bit pattern (0XAA).
16. Using the application software, observe the channel 1 input bits. The proper response should be 0XAA.
 - If the observed channel 1 input bit pattern is not the same as bit pattern 0XAA, the application software is not performing general-purpose digital I/O functions properly. Stop here, and return to step 5 of Scheme C in the “[Systematic problem isolation](#)” procedure.
 - If the observed channel 1 input bit pattern is the same as bit pattern 0XAA, the application software is performing general-purpose digital I/O functions properly. Stop here, and return to step 5 of Scheme C in the “[Systematic problem isolation](#)” procedure.

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

When returning equipment for repair, include the following information:

- Customer 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 handle 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

NOTE *If submitting equipment for repair under warranty, the invoice number and date of purchase must be included.*

To enable Keithley to respond as quickly as possible, be sure the RMA number is on the outside of the package.

C

Glossary

Address¹

A number specifying a location in memory where data is stored.

API

See application programming interface.

Application programming interface¹

A set of routines used by an application program to direct the performance of a procedure by the computer's operating system.

Bus

An interconnection system that allows each part of a computer to communicate with the other parts.

Bus mastering

On a microcomputer bus such as the PCI bus, the ability of an expansion board to take control of the bus and transfer data to memory at high speed, independently of the CPU. Replaces direct memory access (DMA).

Byte

A group of eight bits.

Contact bounce

The intermittent and undesired opening of relay contacts during closure, or closing of relay contacts during opening.

Crosstalk

The coupling of a signal from one input to another (or from one channel to another or to the output) by conduction or radiation. Crosstalk is expressed in decibels at a specified load and up to a specific frequency.

Darlington

A high gain current amplifier composed of two bipolar transistors, typically integrated in a single package.

Direct memory access

See DMA mode.

DLL

See Dynamic Link Library.

DMA mode

Direct memory access mode. Mode in which data transfers directly between an I/O device and computer memory. In the most general sense, PCI bus mastering is a DMA mode. More commonly, however, DMA mode refers to data transfers across the ISA bus, using a special circuitry on the computer motherboard. *See also* bus mastering.

Driver

Software that controls a specific hardware device, such as a data acquisition board.

Dynamic Link Library (DLL)

A software module in Microsoft Windows containing executable code and data that can be called or used by Windows applications or other DLLs. DLL functions and data are loaded and linked at run time when they are referenced by a Windows application or other DLLs.

Expansion slot¹

A socket in a computer designed to hold expansion boards and connect them to the system bus (data pathway).

FIFO

First-in/first-out memory buffer. The first data into the buffer is the first data out of the buffer.

Foreground task

An operation, such as a task that occurs in the single or synchronous mode, that cannot take place while another program or routine is running.

GPIB

Abbreviation for General Purpose Interface Bus. It is a standard for parallel interfaces.

IEEE-488

See GPIB.

Input/Output (I/O)

The process of transferring data to and from a computer-controlled system using its communication channels, operator interface devices, data acquisition devices, or control interfaces.

Input/output port¹

A channel through which data is transferred between an input or output device and the processor.

ISA Bus

Industry Standard Architecture. The 16-bit wide bus architecture used in most MS-DOS and Windows computers. Sometimes called the AT bus.

Map¹

Any representation of the structure of an object. For example, a memory map describes the layout of objects in an area of memory, and a symbol map lists the association between symbol names and memory addresses in a program.

OCX

Abbreviation for OLE Custom Control.

Pass-through operation

See target mode.

PCI

Abbreviation for Peripheral Component Interconnect. It is a standard for a local bus.

Port

See input/output port.

Port group

For digital I/O emulating the I/O of an 8255 programmable peripheral interface chip, a group of three 8 bit ports, commonly labeled PA, PB, and PC. Digital I/O that emulates multiple 8255 chips is typically divided into multiple port groups.

Port I/O call

A software program statement that assigns bit values to an I/O port or retrieves bit values from an I/O port. Examples include a C/C++ statement containing an `inp` or `outp` function or a Basic statement containing a `peek` or `poke` function.

Register¹

A set of bits of high speed memory within a microprocessor or other electronic device, used to hold data for a particular purpose.

Shielding

A metal enclosure for the circuit being measured or a metal sleeve surrounding wire conductors (coax or triax cable) to lessen interference, interaction, or current leakage. The shield is usually grounded.

Target mode

A PCI bus mode in which data from a data acquisition board is transferred indirectly to the computer memory in the foreground, via the host computer CPU, instead of directly, via Bus mastering. Sometimes referred to as pass-through operation. *See also* bus mastering and foreground task.

Trap¹ (verb)

To intercept an action or event before it occurs, usually in order to do something else.

TTL

Abbreviation for transistor-transistor-logic. A popular logic circuit family that uses multiple-emitter transistors. A low signal state is defined as a signal 0.8V and below. A high signal state is defined as a signal +2.0V and above.

¹*Microsoft Press Computer Dictionary, Third Edition.* Refer to "Sources" below.

Sources:

Keithley Instruments, Inc., *Catalog and Reference Guide* (full line catalog), glossary, 1998

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