

**KEITHLEY**

# KPCI-3140 PCI Bus Data Acquisition Board

## User's Manual

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KPCI-3140  
PCI Bus Data Acquisition Board  
User's Manual

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The print history shown below lists the printing dates of all Revisions and Addenda created for this manual. The Revision Level letter increases alphabetically as the manual undergoes subsequent updates. Addenda, which are released between Revisions, contain important change information that the user should incorporate immediately into the manual. Addenda are numbered sequentially. When a new Revision is created, all Addenda associated with the previous Revision of the manual are incorporated into the new Revision of the manual. Each new Revision includes a revised copy of this print history page.

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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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# Preface

This manual describes the features of the KPCI-3140 boards, the capabilities of the DriverLINX software, and how to configure the KPCI-3140 board using DriverLINX. Troubleshooting and calibration information is also provided.

## Intended audience

This document is intended for engineers, scientists, technicians, or others responsible for using and/or programming the KPCI-3140 boards for data acquisition operations in Microsoft Windows 95, Windows 98, or Windows NT. It is assumed that you have some familiarity with data acquisition principles and that you understand your application.

This manual focuses primarily on describing the KPCI-3140 boards and their capabilities, setting up the boards and their associated software, making typical hookups, and troubleshooting. There are also sections that summarize characteristics of DriverLINX test-panel software.

## What you should learn from this manual

This manual provides detailed information about the features of the KPCI-3140 board and the capabilities of the KPCI-3140 DriverLINX software.

**Section 1** — Describes the major features of the board, as well as the supported software and accessories for the board.

**Section 2** — Describes all of the board's features and how to use them in your application.

**Section 3** — Describes how to install DriverLINX software, install the KPCI-3140 board, wire accessories, and configure the software to work with the board.

**Section 4** — Describes the use of the DriverLINX Analog I/O Panel for testing board functions.

**Section 5** — Provides information that you can use to resolve problems with the board, computer, or DriverLINX should they occur.

**Appendix A** — Lists the specifications of the board and data acquisition subsystems and the associated features accessible using DriverLINX for the KPCI-3140 board.

**Appendix B** — Shows the pin assignments for the connectors on the board and for the screw termination panel.

**Appendix C** — Describes how to systematically isolate problems with the board, computer, software, and programming.

An index completes this manual.

## Viewing the KPCI-3140 documentation online

The *DriverLINX Manuals* and this manual have been provided in electronic form (in PDF file format) on the KPCI-3140 CD-ROM. To view these documents, you need to install Rev 3.01 or later of Adobe Acrobat Reader on your hard drive (refer to DriverLINX for installation instructions).

View the KPCI-3140 documentation by clicking the manual title.

Here are a few helpful hints about using Adobe Acrobat Reader:

- To navigate to a specific section of the document, click a heading from the table of contents on the left side of the document.
- Within the document, click 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**.
- By default, text and monochrome images are smoothed in Acrobat Reader, resulting in blurry images. If you wish, you can turn smoothing off by clicking **File**, then **Preferences/General**, and unchecking **Smooth Text** and **Monochrome Images**.

## Conventions used in this manual

The following conventions are used in this manual:

- Notes provide useful information or information that requires special emphasis, cautions provide information to help you avoid losing data or damaging your equipment, and warnings provide information to help you avoid catastrophic damage to yourself or your equipment.
- Items that you select or type are shown in **bold**.

## Related information

Refer to the following documents for more information on using the KPCI-3140 board:

- *KPCI-3140 Read This First*. This “Quick Start Guide” describes how to install the KPCI-3140 board and related software.
- DriverLINX Installation and Configuration
- DriverLINX Appendix: Using DriverLINX with your Hardware: Keithley KPCI-3140 installation information)
- DriverLINX Technical Reference Manual
- DriverLINX Analog I/O Programming Guide
- DriverLINX Digital I/O Programming Guide
- DriverLINX Counter/Timer Programming Guide
- *PCI Specification*: PCI Local Bus Specification, PCI Special Interest Group, Portland, OR.
- Microsoft Windows 95, Windows 98, and/or Windows NT user manuals
- Other manuals appropriate to your installation

## Where to get help

Should you run into problems installing or using a KPCI-3140 board, our Technical Support Department is available to provide technical assistance. Refer to [Section 5](#) for more information. If you are outside the U.S. or Canada, call your local distributor, whose number is listed in your Keithley product catalog.



# 1 Overview



## Introduction

This manual is provided for persons needing to understand the installation, interface requirements, functions, and operation of the KPCI-3140 boards.

This manual focuses primarily on describing the KPCI-3140 boards and their capabilities, setting up the boards and their associated software, making typical hookups, and troubleshooting. There are also sections that summarize characteristics of DriverLINX test-panel software.

## Features

The KPCI-3140 is a low-cost counter/timer and digital I/O board for the PCI bus. The KPCI-3140 consists of the following major features:

- Eight 16-bit counter/timers programmable for event counting, frequency measurement, rate generation (continuous pulse output), one-shot pulse output, and repetitive one-shot pulse output
- Four 24-bit interval timers
- Interrupt capability for each counter/timer and interval timer (interrupts can be individually enabled for the eight counter/timers and the four interval timers)
- Programmable gate types
- Programmable pulse output polarities (output types) and duty cycles
- Four 8-bit digital ports programmable as inputs or outputs on a per-port basis
- Digital outputs capable of driving external solid-state relays (15mA)
- Change on interrupt capability for one 8-bit digital port

For a discussion of these features in detail, refer to [Section 2](#).

## System requirements

The system capabilities required to run the KPCI-3140 board, and to use the DriverLINX software supplied with the board, are listed in Table 1-1.

Table 1-1  
**System requirements**

<b>CPU Type</b>	Pentium or higher processor on motherboard with PCI bus version 2.1
<b>Operating system</b>	Windows 95 or 98
	Windows NT version 4.0 or higher
<b>Memory</b>	16 MB or greater RAM when running Windows 95 or 98
	32 MB or greater RAM when running Windows NT
<b>Hard disk space</b>	4 MB for minimum installation
	50 MB for maximum installation
<b>Other</b>	A CD-ROM drive*
	A free PCI-bus expansion slot capable of bus mastering
	Enough reserve computer power supply capacity to power the KPCI-3140 board, which draws 405mA at 5VDC.

\*Any CD-ROM drive that came installed with the required computer should be satisfactory. However, if you have post-installed an older CD-ROM drive or arrived at your present system by updating the microprocessor or replacing the motherboard, some early CD-ROM drives may not support the long file names often used in 32-bit Windows files.

## DriverLINX software

The following software is available for use with the KPCI-3140 board:

- **KPCI-3140 standard software package** — Shipped with KPCI-3140 boards. Includes DriverLINX for Microsoft Windows and function libraries for writing application programs under Windows in a high-level language such as C/C++, Visual Basic, Delphi, and TestPoint; LabVIEW support files; utility programs; and language-specific example programs.
- **DriverLINX** — the high-performance real-time data-acquisition device drivers for Windows application development includes:
  - *DriverLINX API DLLs* and drivers supporting the KPCI-3140 hardware
  - *Learn DriverLINX* — an interactive learning and demonstration program for DriverLINX that includes a Digital Storage Oscilloscope
  - *Source Code* — for the sample programs
  - *DriverLINX Application Programming Interface files* — for the KPCI-3140 interfaces
  - *DriverLINX On-line Help System* — provides immediate help as you operate DriverLINX
  - *Supplemental Documentation* — on DriverLINX installation and configuration; analog and digital I/O programming; counter/timer programming; technical reference; and information specific to the KPCI-3140 hardware.

## Other software options

The user can select a fully integrated data acquisition software package such as TestPoint or LabVIEW or write a custom program supported by DriverLINX.

DriverLINX is the basic Application Programming Interface (API) for the KPCI-3140 boards:

- It supports programmers who wish to create custom applications using Visual C/C++, Visual Basic, or Delphi.
- It accomplishes foreground and background tasks to perform data acquisition.
- It is the needed interface between TestPoint and LabVIEW and a KPCI-3140 board.

DriverLINX software and user's documentation on a CD-ROM are included with your board.

TestPoint is an optional, 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 an optional, fully featured graphical programming language used to create virtual instrumentation.

Refer to [Section 3, "Installation and Configuration,"](#) for more information about DriverLINX, TestPoint, and LabView.

## Accessories

The following optional accessories are available for the KPCI-3140 board:

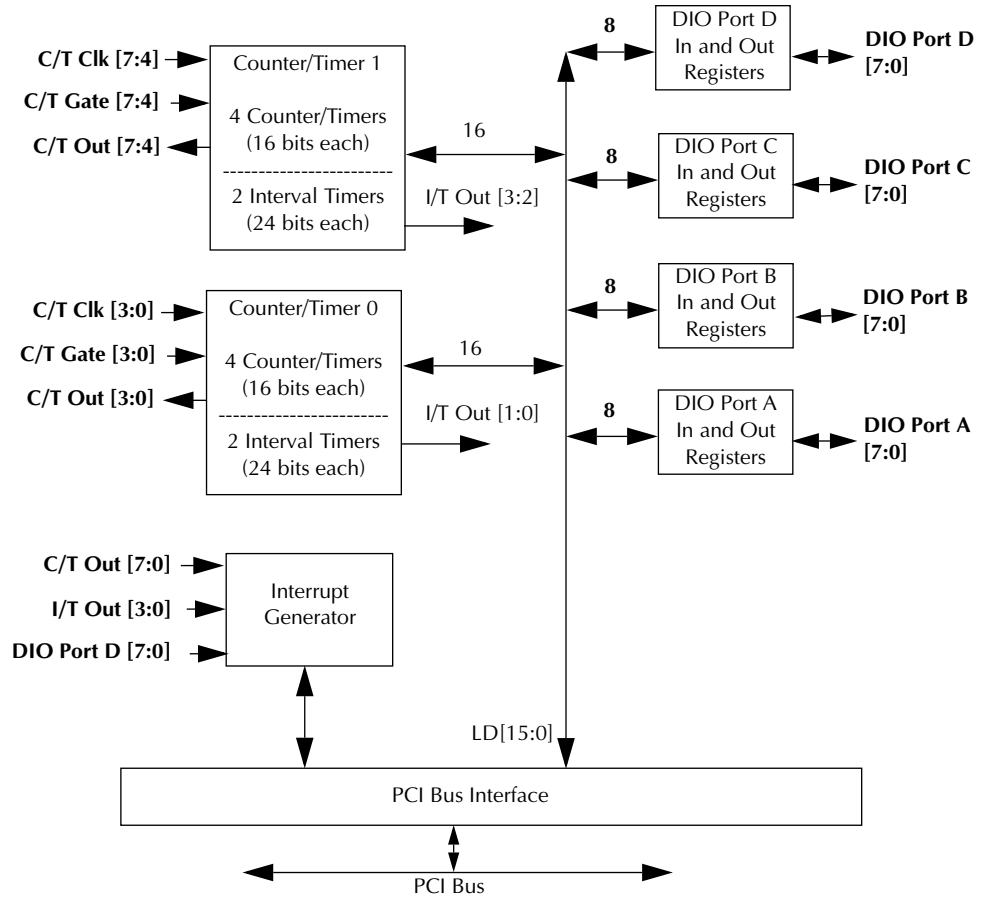
- **STP-3140 screw terminal panel** — A screw terminal panel designed specifically for the KPCI-3140 board, and used in the CE configuration of the board. It measures 3-15/16 inches by 3-15/16 inches (100mm × 100mm), and has one connector to accommodate the counter/timer and digital I/O signals provided by the KPCI-3140 board.
- **STP-68 screw terminal panel** — A generic, 68-pin screw terminal panel that has one connector to accommodate the counter/timer and digital I/O signals provided by the KPCI-3140 board.
- **CAB-305 cable** — A 2-meter, twisted-pair, shielded cable that connects the 68-pin connector (J1) on the KPCI-3140 board to the J1 connector on the STP-3140 or STP-68 screw terminal panel.

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# 2 Functional Description

This section describes the counter/timer and digital I/O features of the KPCI-3140 board. To frame the discussions, refer to the block diagram shown in Figure 2-1. Note that bold entries indicate signals you can access.

Figure 2-1  
Block diagram of the KPCI-3140 board



## Counter/Timer features

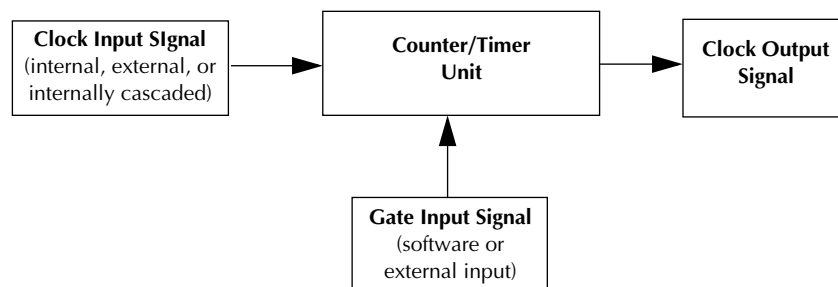
This section describes the following user counter/timer features:

- Units
- Clock sources
- Gate types
- Pulse output types and duty cycles
- Operation modes

### Units

KPCI-3140 boards support eight 16-bit user counter/timer units (numbered 0 to 7). Each unit accepts a clock input signal and gate input signal, and outputs a clock output signal (also called a pulse output signal), as shown in [Figure 2-2](#).

Figure 2-2  
**Counter/Timers**



Each counter/timer unit corresponds to a counter/timer (C/T) channel. To select the unit to use in software, specify the corresponding C/T channel. For example, to select counter/timer 0, specify C/T channel 0; to select counter/timer 7, specify C/T channel 7.

## Clock sources

The following clock sources are available for the counter/timers:

- Internal C/T clock
- External C/T clock
- Internally cascaded clock

Refer to the following subsections for more information on these clock sources.

*NOTE* When using clock sources greater than 1MHz, it is recommended that you use counter/timers 0 to 3. This is the CE configuration of the board.

### Internal C/T clock

The internal C/T clock uses a 40MHz time base. Counter/timer operations start on the rising edge of the clock input signal.

Through software, specify the clock source as internal and the frequency at which to pace the counter/timer operation (this is the frequency of the clock output signal). Using the internal clock source, the maximum frequency that you can specify for the clock output signal is 20MHz. The minimum frequency that you can specify for the clock output signal is 610Hz.

### External C/T clock

The external C/T clock is useful when you want to pace counter/timer operations at rates not available with the internal C/T clock, or if you want to pace at uneven intervals. The rising edge of the external C/T clock input signal is the active edge.

Using software, specify the clock source as external and the clock divider used to determine the frequency at which to pace the operation (this is the frequency of the clock output signal). The minimum clock divider that you can specify is 2.0; the maximum clock divider that you can specify is 65,535. For example, assume that you want to generate a continuous rate and you supplied an external C/T clock with a frequency of 5MHz. If you specify a clock divider of 5, the resulting frequency of the external C/T clock output signal is 1MHz.

You can use an external C/T clock source with an input frequency of up to 20MHz; however, the resulting frequency of the external C/T clock output signal must not exceed 10MHz.

Connect the external C/T clock to the board through the STP-3140 screw terminal panel. Table 2-1 lists the screw terminals that correspond to the external C/T clock signals of each counter/timer.

Table 2-1  
**External C/T clock signals**

Counter/Timer	Screw Terminal on STP-3140	Pin on Connector J1
0	TB2	67
1	TB6	33
2	TB11	62
3	TB15	28
4	TB18	41
5	TB22	7
6	TB27	36
7	TB31	2

### Internally cascaded clock

You can also internally route the clock output signal from one counter/timer to the clock input signal of the next counter/timer to internally cascade the counter/timers. In this way, you can create a 32-bit counter/timer without externally connecting two counter/timers together. KPCI-3140 boards support internal (software) cascading on the following counter/timers:

- 0 and 1
- 1 and 2
- 2 and 3
- 4 and 5
- 5 and 6
- 6 and 7

Use DriverLINX to specify internal cascade mode in software. The rising edge of the clock input signal is active.

Using DriverLINX software, specify the clock source as internal and the frequency at which to pace the counter/timer operation (this is the frequency of the clock output signal). The maximum frequency that you can specify for the clock output signal is 10MHz. For a 32-bit cascaded counter, the minimum frequency that you can specify for the clock output signal is 0.00931Hz, which corresponds to a rate of once every 107 seconds.

**NOTE** *In software, specify the clock input and gate input for the first counter/timer in the cascaded pair. For example, if counter/timers 1 and 2 are cascaded, specify the clock input and gate input for counter/timer 1.*



## Gate types

The active edge or level of the gate input to the counter enables counter/timer operations. The operation starts when the clock input signal is received. KPCI-3140 boards provide the following gate input types:

- **None** — A software command enables any specified counter/timer operation immediately after execution. This gate type is useful for all counter/timer modes.
- **Logic-low level external gate input** — Enables a counter/timer operation when the external gate signal is low, and disables the counter/timer operation when the external gate signal is high. Note that this gate type is used only for event counting, frequency measurement, and rate generation; refer to [page 2-8](#) for more information on these modes.
- **Logic-high level external gate input** — Enables a counter/timer operation when the external gate signal is high, and disables a counter/timer operation when the external gate signal is low. Note that this gate type is used only for event counting, frequency measurement, and rate generation; refer to [page 2-8](#) for more information on these modes.
- **Falling-edge external gate input** — Enables a counter/timer operation on the transition from the high level to the low level (falling edge). In software, this is called a low-edge gate type. Note that this gate type is used only for one-shot and repetitive one-shot mode; refer to [page 2-8](#) for more information on these modes.
- **Rising-edge external gate input** — Enables a counter/timer operation on the transition from the low level to the high level (rising edge). In software, this is called a high-edge gate type. Note that this gate type is used only for one-shot and repetitive one-shot mode; refer to [page 2-8](#) for more information on these modes.

Specify the gate type in software.

[Table 2-2](#) lists the screw terminals that correspond to the gate input signals of each counter/timer.

*Table 2-2*  
**Gate input signals**

Counter/Timer	Screw Terminal on STP-3140	Pin on Connector J1
0	TB4	65
1	TB8	31
2	TB9	64
3	TB13	30
4	TB20	39
5	TB24	5
6	TB25	38
7	TB29	4

## Pulse output types and duty cycles

KPCI-3140 boards can output pulses from each user counter/timer. [Table 2-3](#) lists the screw terminals that correspond to the pulse output signals of each counter/timer.

*Table 2-3*  
**Pulse output signals**

Counter/Timer	Screw Terminal on STP-3140	Pin on Connector J1
0	TB3	66
1	TB7	32
2	TB10	63
3	TB14	29
4	TB19	40
5	TB23	6
6	TB26	37
7	TB30	3

KPCI-3140 boards support the following pulse output types on the clock output signal:

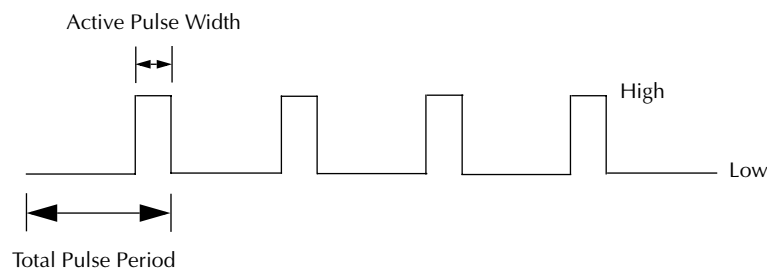
- **High-to-low transitions** — The low portion of the total pulse output period is the active portion of the counter/timer clock output signal.
- **Low-to-high transitions** — The high portion of the total pulse output period is the active portion of the counter/timer pulse output signal.

You specify the pulse output type in software.

The duty cycle (or pulse width) indicates the percentage of the total pulse output period that is active. A duty cycle of 50, then, indicates that half of the total pulse is low and half of the total pulse output is high. You specify the duty cycle in software.

[Figure 2-3](#) illustrates a low-to-high pulse with a duty cycle of approximately 30%.

*Figure 2-3*  
**Example of a low-to-high pulse output type**



## Interrupts

You can use any of the eight user counter/timers to generate an interrupt to the host computer. The interrupt occurs when the pulse output of the counter/timer changes from a low to a high state.

In a typical pulse output application where you want an interrupt to occur, it is recommended that you specify the pulse output type as high-to-low. When the pulse output changes from a low to high state (based on the frequency and duty cycle of the pulse), the interrupt occurs. If the pulse output type is low-to-high, you can use the duty cycle to generate an interrupt whenever the pulse output changes from a low to high state.

In a typical event counting application where you want an interrupt to occur, the pulse output falls sometime before the terminal count is reached, then rises when the counter rolls over from the terminal count to the initial count. The terminal count is  $2^{16}$  for a non-cascaded counter/timer or  $2^{32}$  for a cascaded counter/timer.

In a typical event notification application where you want an interrupt to occur after a specified number of external events has occurred, use an external clock and specify an external clock divider. In this case, the value for the external clock divider determines the number of events that are counted before an interrupt is generated.

## Hardware operation modes

There are 3 software selectable modes for each user counter/timer:

- Re-triggerable one shot
- Non re-triggerable one shot
- Continuous increment

In re-triggerable one shot mode, an external gate rising or falling edge, or a transition from software logic low to software logic high can be used as the trigger. When the trigger occurs, the counter begins incrementing. When the counter increments to the value specified in the pulse register, the user output is activated. The user output stays active until the counter increments to the terminal count. The user output is then deactivated and the counter is automatically reloaded with the initial count, which is specified in the period register. The user output then stays inactive, and the counter stays disabled, until the next trigger. Note that all triggers that occur while the counter is incrementing are ignored.

Non re-triggerable one shot mode is the same as re-triggerable one shot mode with the following exception: when the counter reaches the terminal count, the board clears the one shot trigger enable bit. The board will ignore subsequent triggers until the host sets the one shot trigger enable bit.

In continuous increment mode, an external gate high, external gate low, or software logic high can be used to enable the counter to increment. When the counter increments to the value specified in the pulse register, the user output is activated. The user output stays active until the counter increments to the terminal count. The user output is then deactivated and the counter is automatically reloaded with the initial count, which is specified in the period register. This sequence is repeated as long as the counter is enabled by the gate.

The active polarity of each user output is software selectable.

## DriverLINX subsystems and modes

The DriverLINX software, which accompanies the KPCI-3140 board, provides the application programming interface (API) between the board and its applications. DriverLINX provides more than 100 services for creating foreground and background tasks to perform input and output, time and frequency measurement, event counting, pulse output, and period measurements. These services are implemented through DriverLINX Service Requests.

### DriverLINX subsystems

KPCI-3140 boards support the following DriverLINX counter/timer operation subsystems:

- **Device** — refers to the KPCI-3140 board as a whole.
- **Digital Input** — refers to the digital input ports as well as 1-bit digital control signals and external clock inputs.
- **Digital Output** — refers to the digital output ports.
- **Counter/Timer** — refers to the onboard counter/timer channels for pacing analog input/output or performing measuring and waveform generation functions.

Refer to the DriverLINX manuals that accompany your DriverLINX software for more details.

### DriverLINX modes

Applications use modes in Service Requests to advise DriverLINX on their preferred hardware data transfer technique. The DriverLINX modes are either **foreground (synchronous)** or **background (asynchronous)**. KPCI-3140 boards support the following DriverLINX counter/timer operation modes for its commands (Service Requests):

- **Polled Mode** — is a foreground (synchronous) mode used for simple, single-value I/O operations that the data-acquisition board can complete without significant delay.
- **Interrupt Mode** — is a background (asynchronous) operation that is used to transfer data between the computer's memory and the board using hardware interrupts and programmed I/O transfers.
- **Other Mode** — is a foreground (synchronous) operation that is used for initialization, configuration, calibration, data conversion, and timebase operations.

Refer to the DriverLINX manuals that accompany your DriverLINX software for more details.

### DriverLINX service requests

The service request is the form you use to specify all data-acquisition tasks through DriverLINX. A service request uses four major groups of properties to define tasks:

- **Request Group** — specifies the target logical device and logical channel of a task and the data-acquisition mode and operation to perform.
- **Events Group** — specifies how DriverLINX should time or pace data acquisition, when DriverLINX should start acquisition, and when it should end.
- **Select Group** — specifies the logical channels to acquire and the number and length of data buffers to acquire.
- **Results Group** — DriverLINX uses these properties to return result codes and single data values.

You can fill out service requests either interactively using the *Edit Service Request* property page in DriverLINX or programmatically by assigning values to the required properties in each group.

## Typical applications

Some typical applications of the KPCI-3140 include event counting, frequency measurement, rate generation, one-shot pulse output, and repetitive one-shot pulse output.

### Event counting

Use event counting to count events from the counter's external clock input source.

If you are using one counter/timer, you can count a maximum of 65,536 events before the counter rolls over to 0 and starts counting again. If you are using a cascaded 32-bit counter, you can count a maximum of 4,294,967,296 events before the counter rolls over to 0 and starts counting again.

**NOTE** *If interrupts are enabled for a C/T channel operating in event counting mode, the interrupt occurs when the maximum number of events is reached (before the counter rolls over to 0).*

In event counting applications, use an external C/T clock source; refer to [page 2-4](#) for more information on the external C/T clock source.

**NOTE** *An external clock divider is not used when counting events.*

Use DriverLINX software to specify the counter/timer mode as event counting (count), the C/T clock source as external, and the gate type that enables the operation. Refer to [page 2-6](#) for information on gates.

Ensure that the signals are wired appropriately. [Figure 2-4](#) shows one example of connecting an event counting application to the STP-3140 screw terminal panel using user counter 0. In this example, rising clock edges are counted while the gate is active.

**Figure 2-4**  
**Connecting event counting signals (shown for Clock Input 0 and External Gate 0)**

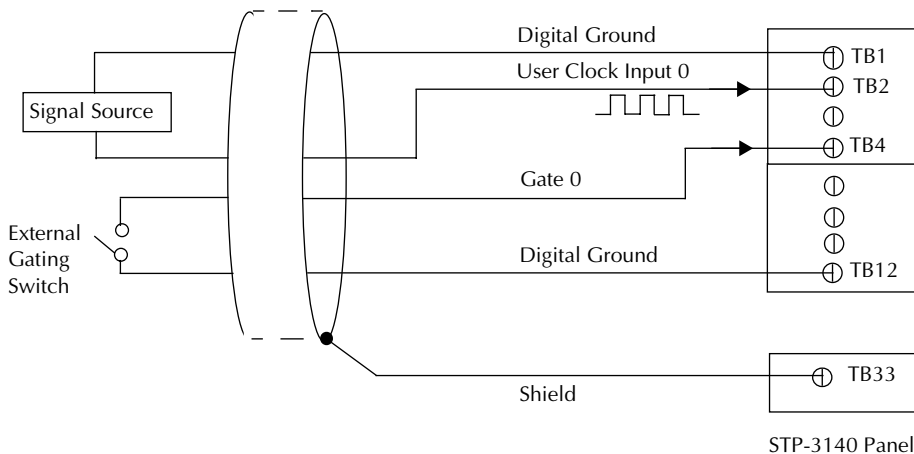
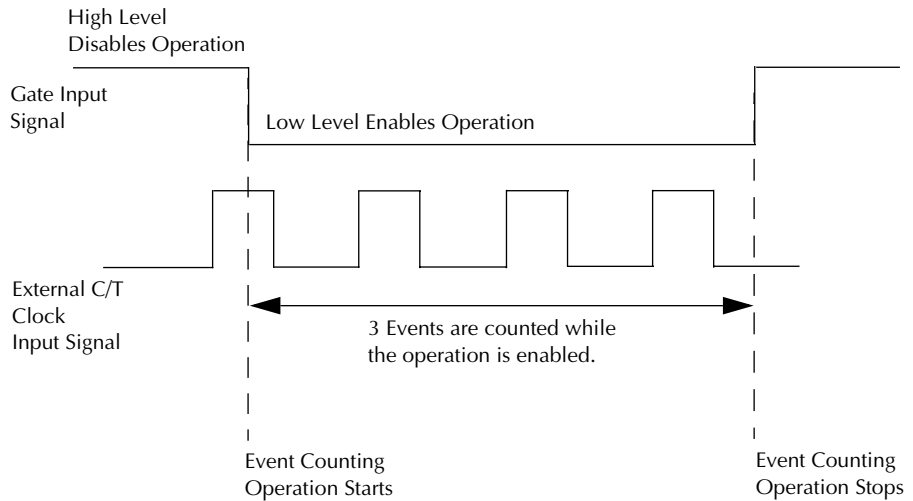


Figure 2-5 shows an example of an event counting operation. In this example, the gate type is low level.

Figure 2-5  
**Example of event counting**

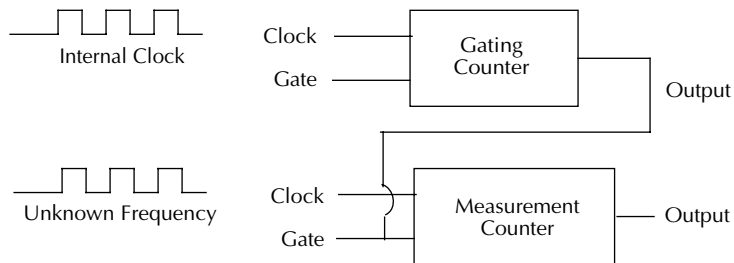


### Frequency measurement

Use frequency measurement applications to measure the frequency of the signal from counter's external clock input source over a specified duration. In this mode, use an external C/T clock source; refer to page 2-4 for more information on the external C/T clock source.

DriverLINX can measure the time-averaged frequency of an unknown frequency source connected to the Clock input. Frequency measurement requires two, or more counter/timers configured as gating and measurement counters. (See Figure 2-6.)

Figure 2-6  
**Frequency measurement using DriverLINX**



The measurement counter counts the unknown frequency at its **Clock** input for a time interval defined by the gating counter. DriverLINX clocks the gating counter from an internal crystal reference oscillator to produce a precise counting duration. Applications can calculate the unknown input frequency as:

$$\text{Frequency} = \frac{\text{measurementCount}}{\text{gatingCount} \times \text{clockPeriod}}$$

where *measurementCount* is the counter value DriverLINX reads from the measurement counter, *gatingCount* is the counter value the application specifies for the measurement interval in the Service Request, and *clockPeriod* is the duration of the reference oscillator's period. Refer to DriverLINX manuals for details and conversion between counts and time.

### 16-Bit frequency measurement using DriverLINX

In DriverLINX 16-bit frequency measurement two counters are used as gating counters, and a third is used as a measurement counter. Logical channels N and N+1 are gating counters, and Channel N+2 is the measurement counter. In the Service Request, set up a polled mode task. In RateEvent, set the mode to be **FREQ**, and specify a channel N and measuring period.

**NOTE** Channel N must be designated as Channel 0, 1, 4, or 5.

The unknown frequency signal is connected to the terminal (Channel N+2) that the application specifies in the Service Request *Clock* property. Depending on the counting mode, a signal may be connected to the **Gate** input. Before a frequency measurement is performed, a physical connection must be made between the **Output** terminal of the gating counter, Logical Channel N+1, and the **Gate** terminal of the first measurement counter, Logical Channel N+2. When using multiple counter/timer channels, the application's Service Request specifies the first gating counter/timer (N), and DriverLINX then automatically uses consecutive counter/timer channels for the second gating counter/timer (N+1) and the measurement counters (N+2).

### 32-Bit frequency measurement using DriverLINX

In DriverLINX 32-bit frequency measurement two counters are used as gating counters, and two counters are used as a measurement counters. Logical channels N and N+1 are gating counters, and channels N+2 and N+3 are the measurement counters.

**NOTE** Channel N must be designated as Channel 0 or 4.

The unknown frequency signal is connected to the terminal (Channel N+3) that the application specifies in the Service Request *Clock* property. Depending on the counting mode, a signal may be connected to the **Gate** input. Before a frequency measurement is performed, a physical connection must be made between the **Output** terminal of the gating counter, Logical Channel N+1, and the **Gate** terminal of the first measurement counter, Logical Channel N+2. When using multiple counter/timer channels, the application's Service Request specifies the first gating counter/timer (N), and DriverLINX then automatically uses consecutive counter/timer channels for the second gating counter/timer (N+1) and the measurement counters (N+2).

## Rate generation

Use rate generation applications to generate a continuous pulse output signal from the counter; this application is sometimes referred to as continuous pulse output or pulse train output. You can use this pulse output signal as an external clock to pace other operations.

While the pulse output operation is enabled, the counter outputs a pulse of the specified type and frequency continuously. As soon as the operation is disabled, rate generation stops.

**NOTE** *If interrupts are enabled for a C/T channel operating in rate generation mode, the interrupt occurs when the pulse output signal changes from a low to a high state.*

The period of the output pulse is determined by the clock input signal and the external clock divider. If you are using one counter (not cascaded), you can output pulses using a maximum frequency of 20MHz (this is the frequency of the clock output signal). In rate generation mode, either the internal or external C/T clock input source is appropriate depending on your application; refer to [page 2-4](#) for more information on the C/T clock source.

Use DriverLINX software to specify a *Rate Generation* service request for the counter/timer, the C/T clock source as either internal or external, the polarity of the output pulses (high-to-low transitions or low-to-high transitions), the duty cycle of the output pulses, and the gate type that enables the operation. Refer to [page 2-7](#) for more information on pulse output signals and to [page 2-6](#) for more information on gate types.

**NOTE** *If you want to use interrupts, it is recommended that you specify the output pulse type as high to low. The interrupt occurs when the output pulse completes.*

*For rate generation operations, use a duty cycle as close to 100% as possible to output a pulse immediately. Using a duty cycle closer to 0% acts as a pulse output delay.*

Ensure that the signals are wired appropriately. [Figure 2-7](#) shows one example of connecting a pulse output operation to the STP-3140 screw terminal panel using user counter 0. In this example, a software gate type is used.

**Figure 2-7**  
**Connecting rate generation signals (shown for Counter Output 0; a software gate is used)**

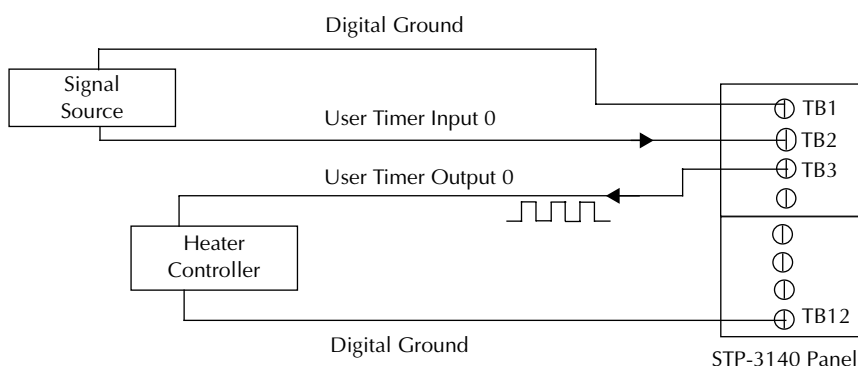




Figure 2-8 shows an example of an enabled rate generation operation using an external C/T clock source with an input frequency of 4kHz, a clock divider of 4, a high-to-low pulse type, and a duty cycle of 75%. (The gate type does not matter for this example.) A 1kHz square wave is the generated output. Figure 2-9 shows the same example using a duty cycle of 25%.

Figure 2-8  
**Example of rate generation with a 75% duty cycle**

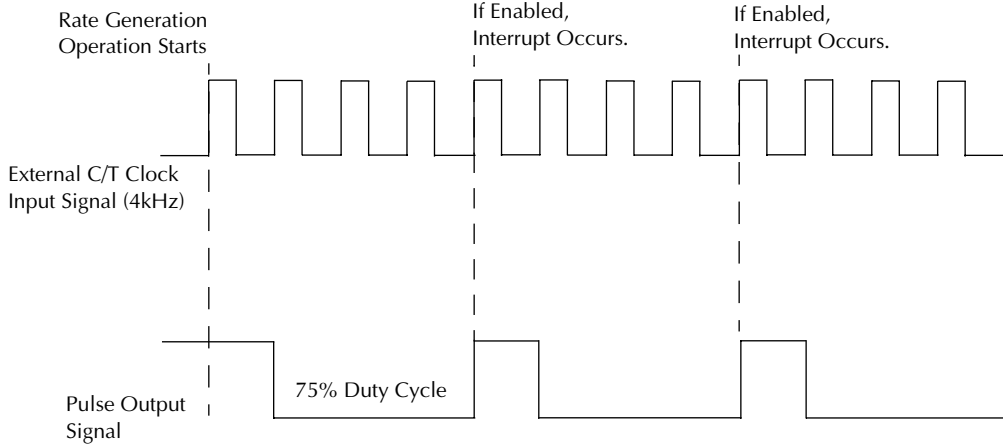
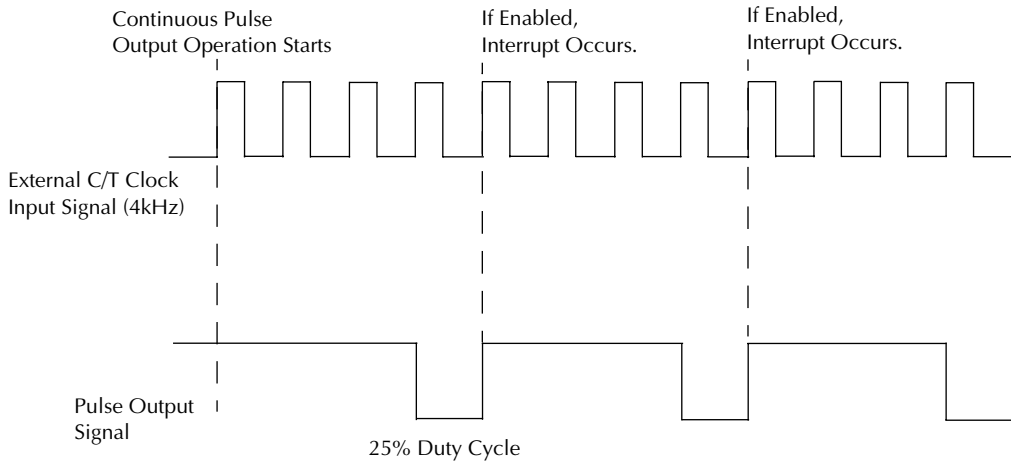


Figure 2-9  
**Example of rate generation with a 25% duty cycle**



## One-shot

Use the one-shot application to generate a single pulse output signal from the counter when the operation is triggered (determined by the gate input signal). You can use this pulse output signal as an external gate to start other operations.

When the one-shot operation is triggered, a single pulse is output; then, the one-shot operation stops. All subsequent clock input signals and gate input signals are ignored.

If interrupts are enabled for a C/T channel that is programmed for one-shot operation, the interrupt occurs when the pulse output signal changes from a low to a high state.

The period of the output pulse is determined by the clock input signal. In one-shot applications, generally the internal C/T clock source is more useful than an external C/T clock source. However, if you want to be notified after a number of external events occurs, specify an external clock source; in this case, the external clock divider specifies the number of events that occur before the interrupt is generated. Refer to [page 2-4](#) for more information on the C/T clock sources.

DriverLINX can generate a variety of single pulses, delayed pulses, and strobes or one-shots. Using DriverLINX software, specify the counter/timer as one-shot (polled pulse or strobe output), the clock source, the frequency of the output signal or the number of events that occur before the interrupt, the polarity of the output pulse (high-to-low transition or low-to-high transition), the duty cycle of the output pulse, and the gate type to trigger the operation. Refer to [page 2-7](#) for more information on pulse output types and to [page 2-6](#) for more information on gate types.

If you want to use interrupts, it is recommended that you specify the output pulse type as high to low. The interrupt occurs when the one-shot pulse completes.

For one-shot operations, use a duty cycle as close to 100% as possible to output a pulse immediately. Using a duty cycle closer to 0% acts as a pulse output delay.

Ensure that the signals are wired appropriately. [Figure 2-10](#) shows one example of connecting a pulse output operation to the STP-3140 screw terminal panel using user counter 0.

*Figure 2-10*  
**Connecting one-shot signals (shown for Counter Output 0 and Gate 0)**

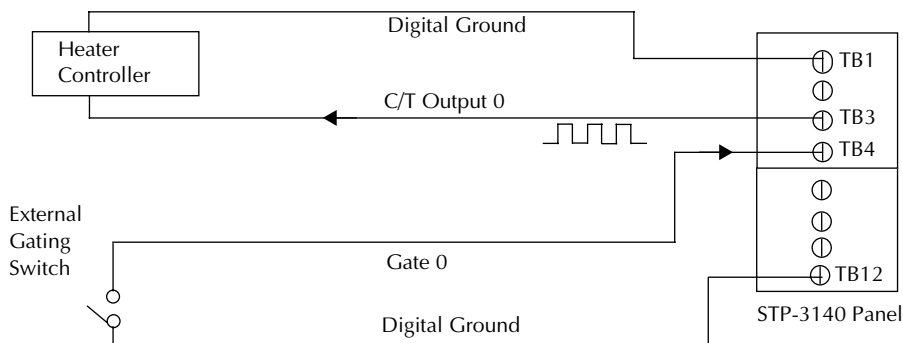
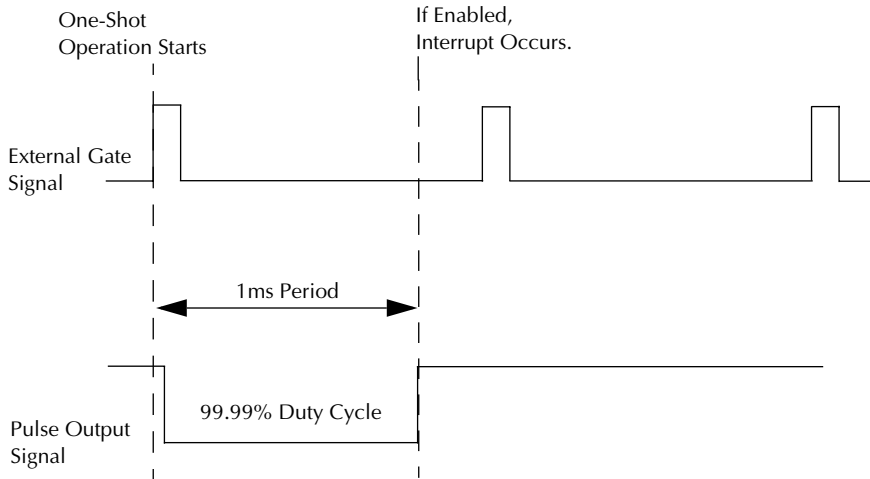
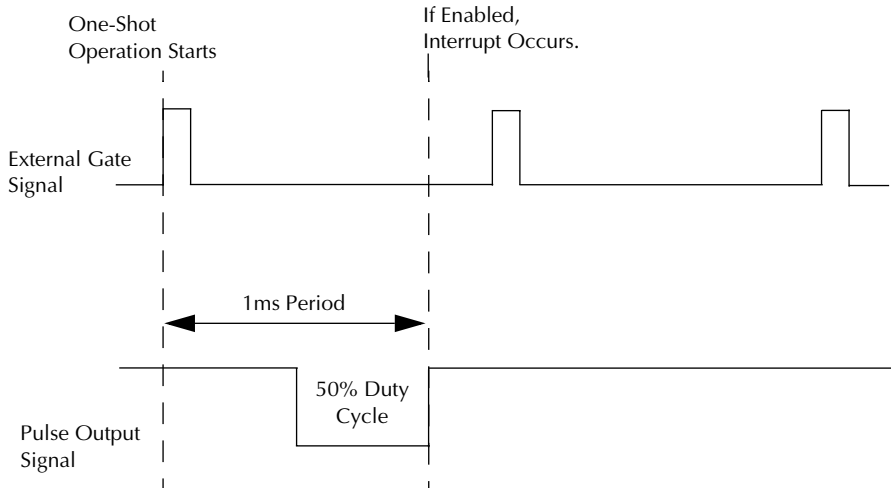


Figure 2-11 shows an example of a one-shot operation using an external gate input (rising edge), a clock output frequency of 1kHz (pulse period of 1ms), a high-to-low pulse type, and a duty cycle of 99.99%. Figure 2-12 shows the same example using a duty cycle of 50%.

**Figure 2-11**  
**Example of one-shot application using a 99.99% duty cycle**



**Figure 2-12**  
**Example of one-shot application using a 50% duty cycle**



## Repetitive one-shot

Use repetitive one-shot applications to generate a pulse output signal each time the board detects a trigger (determined by the gate input signal). You can use this application to clean up a poor clock input signal by changing its pulse width, then outputting it.

**NOTE** *If interrupts are enabled for a C/T channel operating in repetitive one-shot mode, the interrupt occurs each time the pulse output signal changes from a low to a high state.*

The period of the output pulse is determined by the clock input signal. In one-shot applications, generally the internal C/T clock source is more useful than an external C/T clock source. However, if you want to be notified after a number of external events occurs, specify an external clock source; in this case, the external clock divider specifies the number of events that occur before the interrupt is generated. Refer to [page 2-4](#) for more information on the C/T clock sources.

Use DriverLINX service request to specify the counter/timer mode as one-shot and set pulses property to 0 (repetitive), the C/T clock source, the frequency of the output signal or that number of events that occur before the interrupt, the polarity of the output pulses set to zero (0), the duty cycle of the output pulses, and the gate type to trigger the operation. Refer to [page 2-7](#) for more information on pulse output types and to [page 2-6](#) for more information on gates.

**NOTE** *If you want to use interrupts, it is recommended that you specify the output pulse type as high to low. The interrupt occurs when each one-shot pulse completes.*

*For repetitive one-shot operations, use a duty cycle as close to 100% as possible to output a pulse immediately. Using a duty cycle closer to 0% acts as a pulse output delay.*

When the one-shot operation is triggered (determined by the gate input signal), a pulse is output. When the board detects the next trigger, another pulse is output. This operation continues until you stop the operation.

**NOTE** *Triggers that occur while the pulse is being output are not detected by the board.*

Figure 2-13 shows an example of a repetitive one-shot operation using an external gate (rising edge); a clock output frequency of 1kHz (one pulse every 1ms), a high-to-low pulse type, and a duty cycle of 99.99%. Figure 2-14 shows the same example using a duty cycle of 50%.

Figure 2-13

**Example of repetitive one-shot mode using a 99.99% duty cycle**

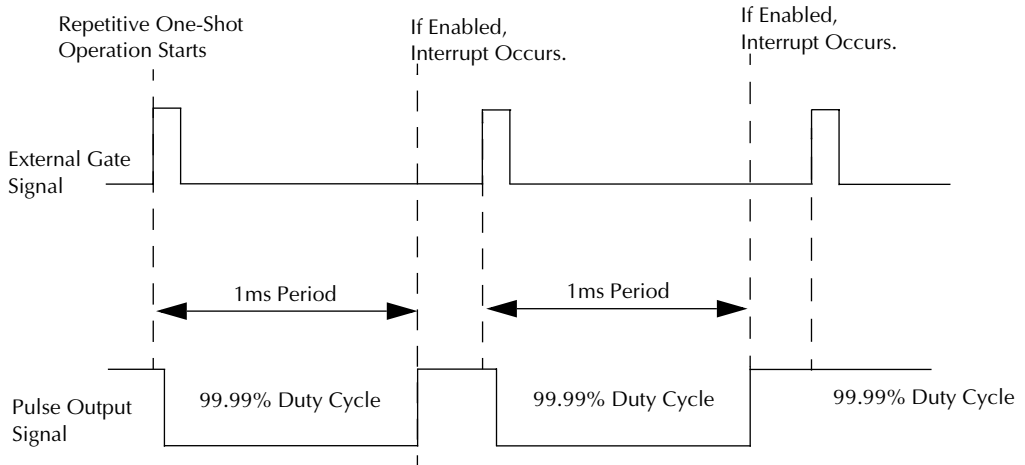
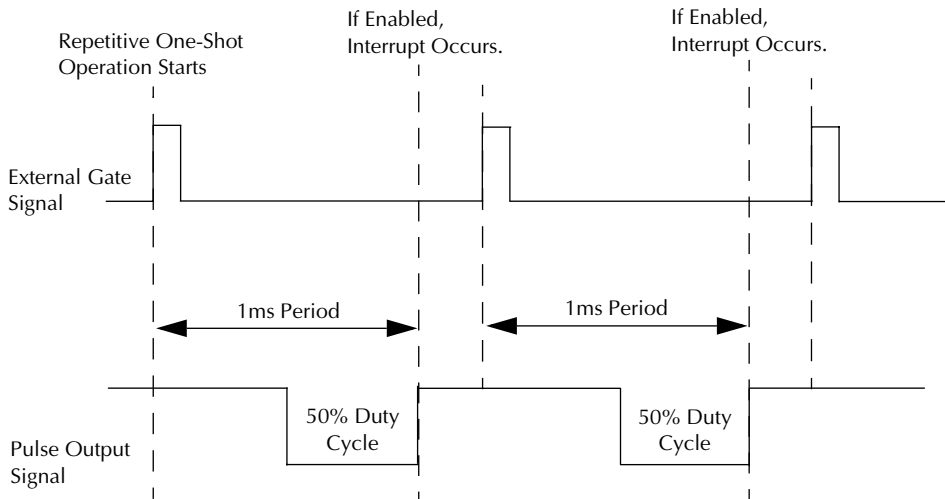


Figure 2-14

**Example of repetitive one-shot mode using a 50% duty cycle**



## Internal timer features

This subsection describes the following user internal timer features:

- Units
- Clock sources
- Gate types
- Pulse types and duty cycles

### Units

KPCI-3140 boards support four 24-bit internal timer units (numbered 8 to 11).

Internal timers use an internal clock input signal and internal gate input signal, and generate an internal clock output signal. No external connections are supported.

Each internal timer corresponds to a counter/timer (C/T) channel. Select the internal timer to use in software by specifying its corresponding C/T channel. For example, to select internal timer 9, specify C/T channel 9.

### Clock sources

Interval timers are clocked by the internal 40MHz clock. In software, specify the clock source as internal. Specify the frequency of the internal timer from 2.39Hz to 20MHz.

### Gate types

For internal timers, use software to specify the gate type as none (software). Only a software gate can enable an internal timer operation.

### Pulse output types and duty cycles

For internal timer operations, the KPCI-3140 board generates a clock output signal that the board uses internally to generate an interrupt condition; it is not brought out for user connection.

The pulse output type is high-to-low; it is not programmable. The pulse output signal is active (low) for one clock pulse (25ns); the duty cycle (pulse width) is not programmable.

### Interrupts

Each of the four internal timers can generate a periodic interrupt to the host computer on each low-to-high transition of the pulse output signal. Interrupts may be enabled through DriverLINX programming. Interrupt frequency is determined by setting of the corresponding counters and clock source. It is equal to the output frequency of the clock that is used.

## Digital I/O features

This section describes the following features of the digital I/O subsystem:

- Digital I/O lines
- Resolution
- Operation modes
- Interrupts

### Digital I/O lines

KPCI-3140 boards support 32 digital I/O lines through the digital input (DIN) and output (DOUT) channels; the DIN and DOUT channels use the same digital I/O lines.

These lines are divided into four ports of eight: Port A, lines 0 to 7; Port B, lines 0 to 7; Port C, lines 0 to 7; and Port D, lines 0 to 7. You can use each port for either input or output; all eight lines within a port have the same configuration. For example, if you use Port A for input, lines 0 to 7 of Port A are configured as inputs. Likewise, if you use Port B for output, lines 0 to 7 of Port B are configured as outputs. (See [Table 2-4](#).)

Specify the digital I/O line to read or write in a single value digital I/O operation or a continuous digital input operation; refer to [page 2-22](#) for more information on digital I/O operation modes; refer to your DriverLINX manuals for information on programming digital I/O operation.

Once the digital I/O lines have been configured using DriverLINX, and the hardware and DriverLINX software have been installed, the configuration is saved. On power up, the hardware resets all ports to digital input, then reads the values that were saved and configures the port to its programmed value; that is, the port retains its configured value on reset.

Table 2-4

**DriverLINX definition of logical channels for KPCI-3140 digital input subsystem**

Logical Channel	DriverLINX Function	KPCI-3140 Digital I/O Connection
0	Digital Input/Output	Digital I/O Bank A 0 – 7
1	Digital Input/Output	Digital I/O Bank B 0 – 7
2	Digital Input/Output	Digital I/O Bank C 0 – 7
3	Digital Input/Output	Digital I/O Bank D 0 – 7
4	Digital Input (interrupt register)	Digital I/O Bank D 0 – 7
5	External Clock (pattern-sensitive)	Digital I/O Bank D 0 – 7
6	External Clock (edge-sensitive)	Digital I/O Bank D 0 – 7
7	External Trigger (pattern-sensitive)	Digital I/O Bank D 0 – 7
8	External Trigger (pattern-sensitive)	Digital I/O Bank D 0 – 7

## Resolution

Using DriverLINX software, specify the number of digital I/O lines to read or write at once by specifying the resolution as 8, 16, 24, or 32. Choosing a resolution greater than 8 effectively combines the digital I/O ports.

DriverLINX supports a software extension to logical channel addressing that allows applications to combine adjacent logical channels into a single channel or split a logical channel into smaller addressable parts.

In DriverLINX, “native” refers to the hardware-defined digital channel size (8 bit for KPCI-3140). When using extended logical channel addressing, DriverLINX groups digital bits in units defined by a size code and then assigns consecutive channel numbers starting from zero. DriverLINX also allows masked I/O operation to a single port (8 bit). Refer to your DriverLINX manuals for information on programming digital I/O ports.

**NOTE** *When using size codes larger than the native addressing unit, you may not be able to address all hardware ports if the number of available digital I/O lines is not an integral multiple of the size unit.*

Table 2-5 shows the effect of resolution on the number of digital I/O lines available for each DIN or DOUT channel.

Table 2-5  
**Resolution, digital I/O lines, and number of channels**

Resolution	Digital I/O Lines	DIN or DOUT Channel
8	Port A, lines 0 to 7	Channel 0
	Port B, lines 0 to 7	Channel 1
	Port C, lines 0 to 7	Channel 2
	Port D, lines 0 to 7	Channel 3
16	Port A and B, lines 0 to 15 combined	Channel 0
	Port C and D, lines 0 to 15 combined	Channel 2
32	Ports A, B, C, and D, lines 0 to 31 combined	Channel 0

**NOTE** *When the resolution is greater than 8, the bit value represents the combined number of digital I/O lines. For example, if the resolution is 32, digital I/O lines 0 to 7 of Port A are represented as bits 0 to 7 of the digital value, digital I/O lines 0 to 7 of Port B are represented as bits 8 to 15 of the digital value, digital I/O lines 0 to 7 of Port C are represented as bits 16 to 23 of the digital value, and digital I/O lines 0 to 7 of Port D are represented as bits 24 to 31 of the digital value.*



## Interrupts

The KPCI-3140 board can generate a PCI-bus interrupt when any of the eight digital I/O lines corresponding to digital Port D (DIN element 3) changes state. This feature is useful when you want to monitor critical signals or when you want to signal the host computer to transfer data to or from the board. DriverLINX automatically enables the interrupt according to the Service Request application.

**NOTE** *When Port D is configured as input, an interrupt is generated whenever the signal applied changes state. When port D is configured as output, an interrupt is generated whenever the signal written to the port changes the port value.*

*DriverLINX models the interrupt of this port using the DI EVENT. You can use this DI EVENT as a pacer for background tasks or to generate timetics (to interrupt the application). To specify when and how to generate an interrupt, fill in the DriverLINX DI EVENT parameters.*

## Operation modes

KPCI-3140 boards directly support the only single value digital I/O operation mode. However, continuous digital I/O may be achieved through the DriverLINX Service Request.

- **Single value operations** are the simplest to use but do not allow you to check the interrupt status. Use DriverLINX software to specify the DIN or DOUT channel, the resolution, and a gain of 1 (the gain is ignored). Data is then read from or written to the appropriate digital I/O lines. For a single value operation, you cannot specify a clock or trigger source.  
Single value operations stop automatically when finished; you cannot stop a single value operation.
- **Continuous digital input using DriverLINX and buffer transfer** allows the transfer of data from or to the board using transfer buffers. To do this, a continuous digital I/O DriverLINX Service Request is run in the background. In the DriverLINX Service Request:
  1. Specify the data to be written (digital output) or the buffer for data storage (digital Input).
  2. Using the channel gain list, specify where to transfer the data from (digital output), or transfer the data to (digital input). A digital port configured as output can be read; a digital port configured as input cannot be written. Channel 4, which is interrupt pending register, can only be read.
  3. Specify a pacer to do the transfer. A pacer can be any counter/timer on the board or a digital event that models Port D as an interrupt source.
  4. An optional start or stop trigger for the data transfer may be specified.
  5. Send the Service Request to DriverLINX. DriverLINX will notify that the data is ready or that the task is completed.

DriverLINX allows the following operation (refer to [Table 2-4](#)):

- Configuration of Digital I/O ports dynamically for either single-value or continuous operation.
- Configuration of read/write single values to or from the ports, including different resolutions (refer to “Resolution” [page 2-21](#).)
- Programming of background tasks to read/write buffers.
- Use of Channel 4 to show the port interrupt pending information. This channel is read only.
- Use of Channels 5, 6, 7, and 8 to model interrupt behavior of Port D. These channels are neither writable nor readable.

---

# **3**

# **Installation and Configuration**

## Unpacking

Open the shipping box and remove the wrapped KPCI-3140 board.

**CAUTION** Keep the board in its protective antistatic bag until you are ready to install it; this minimizes the likelihood of electro-static damage.

Verify that the following items are present:

- KPCI-3140 data acquisition board
- KPCI-3140 DriverLINX Software and Documentation CD-ROM
- KPCI-3140 User's Manual (this manual)

If an item is missing or damaged, call Keithley at:

**1-888-KEITHLEY**

Monday - Friday, 8:00 a.m. - 5:00 p.m., Eastern Time

An application engineer will guide you through the appropriate steps for replacing missing or damaged items.

## Installing the software

**NOTE** Install the DriverLINX software before installing the KPCI-3140 board. Otherwise, the device drivers will be more difficult to install.

### Software options

Users of KPCI-3140 boards have the following two software options. In both cases, the software interfaces with your system via the DriverLINX software provided with your board:

- The user can run a fully integrated data-acquisition software package such as TestPoint or LabVIEW.
- The user can write and run a custom program in Visual C/C++, Visual Basic, or Delphi, using the programming support provided in the DriverLINX software.

The KPCI-3140 has fully functional driver support for use under Windows 95/98/NT.

**NOTE** The DriverLINX Installation and Configuration Guide explains the DriverLINX installation process. To display this manual from your DriverLINX KPCI-3140 CD-ROM, open the Windows Explorer, then double click on `X:\Drvlinx4\Docs\Instconf.pdf`, where `X` = the letter of the CD-ROM drive. Acrobat Reader must already be installed on the other system. If necessary, you can first install Acrobat Reader directly from the CD-ROM by double clicking `X:\Acrobat\setup.exe`.

## DriverLINX driver software for Windows 95/98/NT

DriverLINX software, supplied by Keithley with the KPCI-3140 board, provides convenient interfaces to configure analog and digital I/O modes without register-level programming.

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

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

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

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

- Built-in capabilities to handle memory and data buffer management.
- A selection of starting and stopping trigger events, including pre-triggering, mid-point triggering and post-triggering protocols.
- Extensive error checking.
- Context-sensitive on-line help system DriverLINX is essentially hardware independent, because its portable APIs (Application Programming Interfaces) work across various operating systems. This capability eliminates unnecessary programming when changing operating system platforms.

## TestPoint™

TestPoint is a fully featured, integrated application package that incorporates many commonly used math, analysis, report generation, and graphics functions. The TestPoint graphical drag-and-drop interface can be used to create data acquisition applications, without programming, for IEEE-488 instruments, data acquisition boards, and RS232-485 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.

TestPoint interfaces with your KPCI-3140 board through DriverLINX, using a driver that is provided by the manufacturer.

## LabVIEW™

LabVIEW is a fully featured graphical programming language used to create virtual instrumentation. It consists of an interactive user interface, complete with knobs, slide 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.

A Keithley VI palette provides standard virtual instruments (VIs) for LabVIEW that interface with your KPCI-3140 board through DriverLINX. The needed driver is provided on your DriverLINX CD-ROM.

## Installing DriverLINX

Refer to the instructions on the *Read this first* sheet and the manuals on the DriverLINX CD-ROM, both shipped with your board, for information on installing and using DriverLINX.

## Installing application software and drivers

### Installing the TestPoint software and driver

The DriverLINX driver for TestPoint is provided as part of the TestPoint software. The driver therefore installs automatically when you install TestPoint.

You can install TestPoint application software at any time—before or after installing DriverLINX and the KPCI-3140 board. For TestPoint installation instructions, consult the manual provided with TestPoint.

**NOTE**      *Before using TestPoint with the KPCI-3140 version of DriverLINX, check with Keithley to ensure that your version of TestPoint is compatible with DriverLINX.*

### Installing the LabVIEW software and driver

A DriverLINX driver for LabVIEW is provided on your DriverLINX CD-ROM. The LabVIEW driver does not install automatically when you install DriverLINX and your board. You must first install the LabVIEW application program, then install the DriverLINX driver. Access the LabVIEW driver installation routine by starting *setup.exe* on the DriverLINX CD-ROM, then selecting LabVIEW™ Support from the Install These DriverLINX components screen.

Consult the manual provided with LabVIEW for installation instructions.

## Installing the KPCI-3140 board

To install the board, check the system requirements, set up the computer, select an available 32-bit or 64-bit PCI expansion slot, and insert the board into the slot. The following subsections describe how to perform these steps.

To install the board, perform the following steps:

- Check the system requirements, described in [Section 1, “Overview”](#)
- Set up the computer, described on [page 3-5](#)
- Select an expansion slot, described on [page 3-5](#)
- Insert the board into any available 32-bit or 64-bit PCI expansion slot in your computer, described on [page 3-6](#)

**NOTE** *The KPCI-3140 is factory-calibrated and requires no further adjustment prior to installation.*

### Setting up the computer

**CAUTION** To prevent electro-static damage that can occur when handling electronic equipment, use a ground strap or similar device when performing this installation procedure.

1. Turn off the computer.
2. Turn off all peripherals (printer, modem, monitor, and so on) connected to the computer.
3. Unplug the computer and all peripherals.
4. Remove the cover from your computer. Refer to your computer's user manual for instructions.

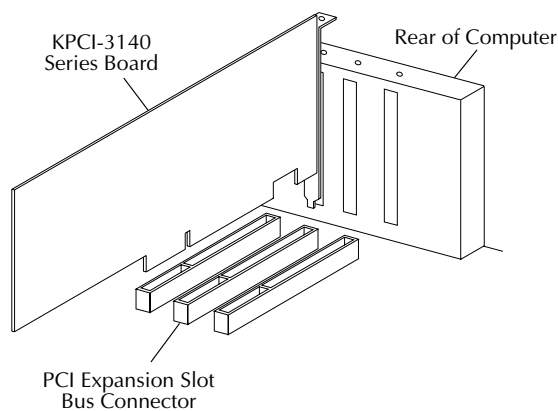
### Selecting an expansion slot

1. Select a 32-bit or 64-bit PCI expansion slot.  
PCI slots are shorter than ISA or EISA slots and are usually white or ivory. Commonly, three PCI slots (one of which may be a shared ISA/PCI slot) are available. If an ISA board exists in the shared slot, you cannot use the slot for a PCI board; likewise if a PCI board exists in the shared slot, you cannot use the slot for an ISA board.
2. Remove the cover plate from the selected expansion slot. Retain the screw that held it in place; you will use it later to install the board.

## Inserting the board in the computer

1. To discharge any static electricity, hold the wrapped board in one hand while placing your other hand firmly on a metal portion of the computer chassis.
2. Carefully remove the antistatic packing material from the board. (We suggest that you save the original packing material in the unlikely event that your board requires servicing in the future.)
3. Hold the board by its edges and do not touch any of the components on the board.
4. Position the board so that the cable connectors are facing the rear of the computer, as shown in Figure 3-1.

Figure 3-1  
**Inserting a KPCI-3140 board in the computer**



5. Carefully lower the board into the PCI expansion slot using the card guide to properly align the board in the slot. When the bottom of the board contacts the bus connector, gently press down on the board until it clicks into place.

**CAUTION** Do not force the board into place. Moving the board from side to side during installation may damage the bus connector. If you encounter resistance when inserting the board, remove the board and try again.

6. Secure the board in place at the rear panel of the system unit using the screw removed from the slot cover.

## Configuring the board to work with DriverLINX

After physically installing the board, turn on and reboot the computer. The DriverLINX Plug and Play Wizard screen appears. Run the Wizard immediately by following the progressive instructions on the screen.

If you do not run the Wizard immediately, it will not appear the next time you reboot. You must then restart the Wizard from a batch file, as follows:

1. Open the Windows Explorer.
2. Double click on X:\DrvLINX4\Help\kpci3140.bat, where X = the letter of the drive on which you installed DriverLINX.

The Wizard appears.

**NOTE** *You can also start this batch file directly from the CD-ROM by double clicking on Y:\DrvLINX4\Help\kpci3140.bat, where Y = the drive letter of your CD-ROM drive.*

### Using the DriverLINX configuration panel

To configure a KPCI-3140 board (logical device), use the DriverLINX icon in the Windows Control Panel application. The DriverLINX Configuration Panel displays a tree list of all the installed DriverLINX drivers on your system and the configured Logical Devices under each driver.

**NOTE** *If you are running Windows NT, Windows NT's security features require that users installing or configuring device drivers log on under an administrative account.*

Use the Configuration Panel to instruct DriverLINX to initialize the hardware into a custom configuration of input and output ports and default output values. This may be useful if you connect your hardware's outputs to external devices that expect high logic signals, rather than the default low logic signals, as their starting state.

Pushing the **Configure...** button on the DriverLINX Configuration Panel displays a *Configure DriverLINX Device* property page for configuring the selected Logical Device. The tabbed dialog box has a page for each Logical Subsystem that your board supports. Select and complete each property page to configure the Logical Device.

1. On the Device Property Page, enter the required fields:
2. At this point, you may select **OK** and accept default initialization, or select another Property Page.
3. If you select the Counter/Timer Property page, you may view the clock source frequency:
  - **Resolution** — shows the master internal clock frequency that the counter/timers use. All models have a 40MHz clock source for pacing input/output tasks and counter/timer functions.
  - **Interrupt** — DriverLINX disables this property. Windows automatically determines the interrupt level for the KPCI-3140 board.
4. If you select the Digital Input Property page, you may configure the Digital I/O ports.
  - **Channels** — shows the available Logical Channels for digital input and selects the Logical Channel for the Configuration properties.
  - **Resolution** — shows the master internal clock frequency that the counter/timers use. All models have a 40MHz clock source for pacing input/output tasks and counter/timer functions.



**NOTE** *DriverLINX disables the Configuration group if the board's digital channels do not support software reprogramming as inputs or outputs.*

5. If you select the Digital Output Property page, you may define output values for initializing the ports.
  - **Channels** — shows the available Logical Channels for digital output and selects the Logical Channel for the Initialization properties.
  - **Value** — specifies the output value DriverLINX uses to initialize the port selected in the **Channels** list box. DriverLINX ignores this property if **Initialize** is not checked.
  - **Initialize** — when checked, this property indicates that DriverLINX should automatically initialize this channel as specified in the **Value** property.
6. To Statistically Initialize Digital Output Ports (initialize Logical Channel 0 with all bits at logic high), on the Digital Output Property page:
  - Select “0 (bits 0 - 7)” in the **Channels list box**.
  - Enter “255” (DEC) or “0xFF: (Hex) in the **Initialization Value** edit box.
  - Click the **Initialize** check box.
  - Repeat this procedure for every Logical Channel that requires user-defined initialization.
7. After completing *all* Property Pages, press **OK** to save your configuration.

For programming your counter/timers with DriverLINX, refer to *DriverLINX Counter/Timer Programming Guide* on the DriverLINX CD ROM.

You can use DriverLINX to verify board operation:

1. To physically initialize the KPCI-3140, select *Device/Initialize* from the main menu in Learn DriverLINX.
2. The first time the KPCI-3140 is initialized, or after a configuration change, DriverLINX runs a diagnostic program to verify the operation and accuracy of the configuration settings.

You are now ready to make I/O connections. Refer to [Section 2](#) for descriptions of common I/O connections for KPCI-3140 boards.

## Checking the combined board and DriverLINX installations

Before making any connections to the board, check whether DriverLINX and your board are installed correctly and working together properly. Refer to [Section 4](#) and the DriverLINX manuals.

Try starting the DriverLINX KPCI-3140 Test Panel. Proceed as follows:

1. In the **Start** menu, click **Programs**.
2. Find the **DriverLINX** → **Test Panels** folder, under which you should find the **KPCI-3140 Test Panel** entry.
3. Click on the **Test Panel** entry.
4. If a KPCI-3140 board is the only board in your computer installed under DriverLINX or if the DriverLINX Test Panel lists the **KPCI-3140** board under **Driver Selection**, then DriverLINX and your board are installed properly and are working together.
5. If you cannot initially run the Test Panel, refer to [Section 5](#).

After DriverLINX and your board are installed properly and working together, continue with installation and wiring.

## Attaching the STP-3140 screw terminal panel

Before you can wire signals, you first need to attach the STP-3140 screw terminal panel to the KPCI-3140 board. Connector J1 on the screw terminal panel brings out all of the digital and counter/timer signals from connector J1 on the KPCI-3140 board; cable CAB-305 connects connector J1 on the screw terminal panel to the KPCI-3140 board.

Figure 3-2 illustrates how to attach the STP-3140 screw terminal panel to the KPCI-3140 board.

Figure 3-2  
Attaching the STP-3140 screw terminal panel to the KPCI-3140 board

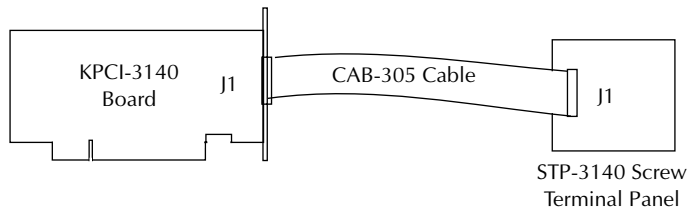
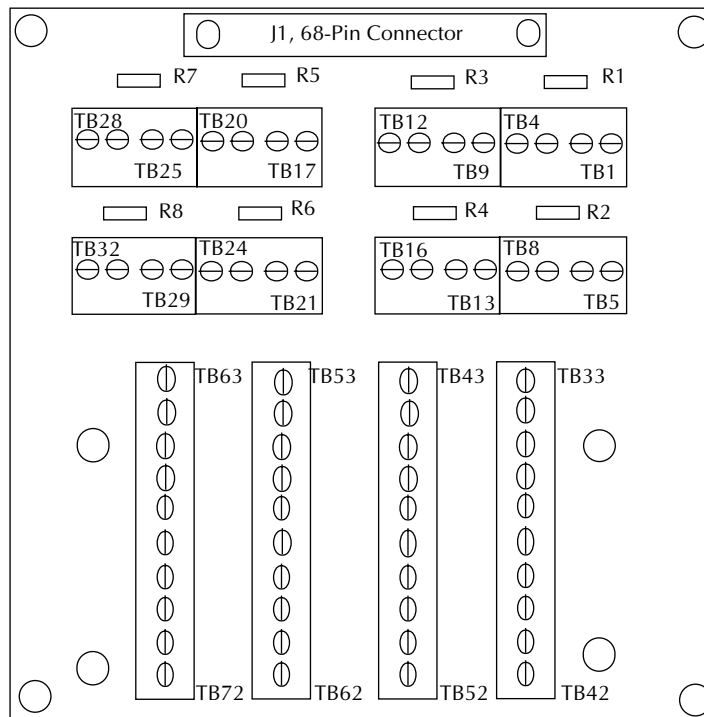


Figure 3-3 shows the layout of the STP-3140 screw terminal panel.

Figure 3-3  
Layout of the STP-3140 screw terminal panel



## Screw terminals

Table 3-1 lists the screw terminal assignments for the STP-3140 screw terminal panel.

Table 3-1

**Screw terminal assignments on the STP-3140 screw terminal panel**

TB #	J1 Pin #	Signal description	TB #	J1 Pin #	Signal description
1	68	Digital Ground	2	67	C/T Clock Input 0
3	66	C/T Clock Output 0	4	65	C/T Gate Input 0
5	34	Digital Ground	6	33	C/T Clock Input 1
7	32	C/T Clock Output 1	8	31	C/T Gate Input 1
9	64	C/T Gate Input 2	10	63	C/T Clock Output 2
11	62	C/T Clock Input 2	12	61	Digital Ground
13	30	C/T Gate Input 3	14	29	C/T Clock Output 3
15	28	C/T Clock Input 3	16	27	Digital Ground
17	42	Digital Ground	18	41	C/T Clock Input 4
19	40	C/T Clock Output 4	20	39	C/T Gate Input 4
21	8	Digital Ground	22	7	C/T Clock Input 5
23	6	C/T Clock Output 5	24	5	C/T Gate Input 5
25	38	C/T Gate Input 6	26	37	C/T Clock Output 6
27	36	C/T Clock Input 6	28	35	Power Ground
29	4	C/T Gate Input 7	30	3	C/T Clock Output 7
31	2	C/T Clock Input 7	32	1	+5V Output
33	-	Shield	34	60	Digital I/O Port A, Line 0
35	26	Digital I/O Port A, Line 1	36	59	Digital I/O Port A, Line 2
37	25	Digital I/O Port A, Line 3	38	58	Digital I/O Port A, Line 4
39	24	Digital I/O Port A, Line 5	40	57	Digital I/O Port A, Line 6
41	23	Digital I/O Port A, Line 7	42	56	Digital Ground
43	-	Shield	44	55	Digital I/O Port B, Line 0
45	21	Digital I/O Port B, Line 1	46	54	Digital I/O Port B, Line 2
47	20	Digital I/O Port B, Line 3	48	53	Digital I/O Port B, Line 4
49	19	Digital I/O Port B, Line 5	50	52	Digital I/O Port B, Line 6
51	18	Digital I/O Port B, Line 7	52	22	Digital Ground
53	-	Shield	54	51	Digital I/O Port C, Line 0
55	17	Digital I/O Port C, Line 1	56	50	Digital I/O Port C, Line 2
57	16	Digital I/O Port C, Line 3	58	49	Digital I/O Port C, Line 4
59	15	Digital I/O Port C, Line 5	60	48	Digital I/O Port C, Line 6
61	14	Digital I/O Port C, Line 7	62	47	Digital Ground
63	-	Shield	64	46	Digital I/O Port D, Line 0
65	12	Digital I/O Port D, Line 1	66	45	Digital I/O Port D, Line 2
67	11	Digital I/O Port D, Line 3	68	44	Digital I/O Port D, Line 4
69	10	Digital I/O Port D, Line 5	70	43	Digital I/O Port D, Line 6
71	9	Digital I/O Port D, Line 7	72	13	Digital Ground

## Resistors

As shown in [Figure 3-3](#), the STP-3140 has eight resistor locations which correspond to the eight clock input signals. [Table 3-2](#) lists the clock input signals and the resistors to which they correspond.

*Table 3-2*  
***Clock input signals and resistor use***

Clock Input Signal	Resistor
Clock Input 0	R1
Clock Input 1	R2
Clock Input 2	R3
Clock Input 3	R4
Clock Input 4	R5
Clock Input 5	R6
Clock Input 6	R7
Clock Input 7	R8

By default, the STP-3140 is shipped with 0 $\Omega$  resistors in these resistor locations. If you are using high-frequency external clock input signals (greater than 1MHz), you may want to change the resistor values on both the KPCI-3140 board and STP-3140 panel. Refer to [page 3-11](#) for more information on changing resistor values.

## Wiring signals

To avoid electrical damage, ensure that power is turned off to the computer and to any attached devices before wiring signals to the STP-3140 screw terminal panel.

When first installing the board, try wiring an external clock and scope to counter/timer 0, and a digital input to digital input Port A. Then run DriverLINX Test Panel to verify that the board is operating properly. Once you have determined that the board is operating properly, wire the signals according to your application's requirements.

## Wiring recommendations

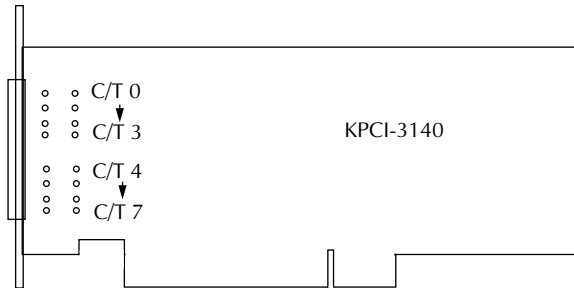
**NOTE**      *When using clock sources greater than 1MHz, it is recommended that use counter/timers 0 to 3. This is the CE configuration of the board.*

When connecting external clock signals greater than 1MHz, it is recommended that you insert a resistor to ground for the corresponding counter/timer clock input signal on the KPCI-3140 board. This resistor is used in parallel with the 1k $\Omega$  resistor on the board. The appropriate value for the user-supplied resistor depends on your application, the frequency of the clock input signal, and the cable length. You should also terminate the corresponding signal on the STP-3140 panel by replacing the 0 $\Omega$  resistor on the STP-3140 with a resistor of an appropriate matching value.

For example, if you are connecting an external clock signal to clock input signal 0 on the KPCI-3140 board and running the board at its maximum clock input frequency, it is recommended that you insert a  $110\Omega$  resistor to ground on the board for the clock input signal 0, and replace the  $0\Omega$  resistor in location R1 on the STP-3140 panel with a  $100\Omega$  resistor for proper termination.

Figure 3-4 shows the location of the resistors on the KPCI-3140 board. Figure 3-3 shows the location of the resistors on the STP-3140 screw terminal panel.

Figure 3-4  
**Location for user-supplied resistors on the KPCI-3140 board**



In addition, keep the following general recommendations in mind when wiring signals to the STP-3140 screw terminal panel:

- Use individually shielded twisted-pair wire (size 14 to 26 AWG) when using the KPCI-3140 board in highly noisy electrical environments.
- Separate power and signal lines by using physically different wiring paths or conduits.
- To avoid noise, do not locate the STP-3140 screw terminal panel and cabling next to sources that produce high electro-magnetic fields, such as large electric motors, power lines, solenoids, and electric arcs, unless the signals are enclosed in a metal shield.
- Connect the shields to one end only (either at the STP-3140 or at the signal source).

**NOTE** *If you are using a screw terminal panel other than the STP-3140, refer to Appendix A for additional wiring considerations.*

## Connecting counter/timer signals

The KPCI-3140 board with the STP-3140 screw terminal panel provides user counter/timers that you can use to perform the following operations:

- Event counting
- Frequency measurement
- Pulse output (rate generation, one-shot, and repetitive one-shot)

This section describes how to connect counter/timer signals to perform these operations.

### Connecting event counting signals

Figure 3-5 shows one example of connecting event counting signals to the STP-3140 screw terminal panel using user counter 0. In this example, rising clock edges are counted while the gate is active.

Figure 3-5  
**Connecting event counting applications to the STP-3140 screw terminal panel (shown for Clock Input 0 and External Gate 0)**

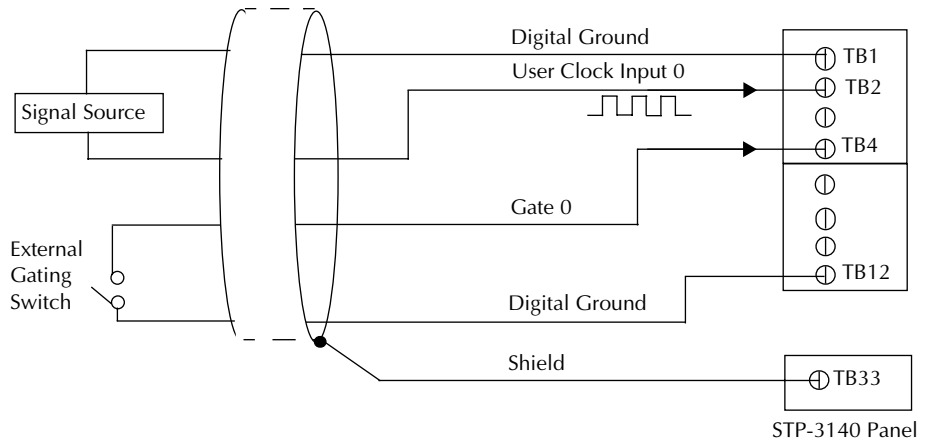


Figure 3-6 shows another example of connecting an event counting application to the STP-3140 screw terminal panel using user counter 0. In this example, a software gate is used to start the event counting operation.

Figure 3-6  
**Connecting event counting applications to the STP-3140 screw terminal panel without an External Gate Input (shown for Clock Input 0)**

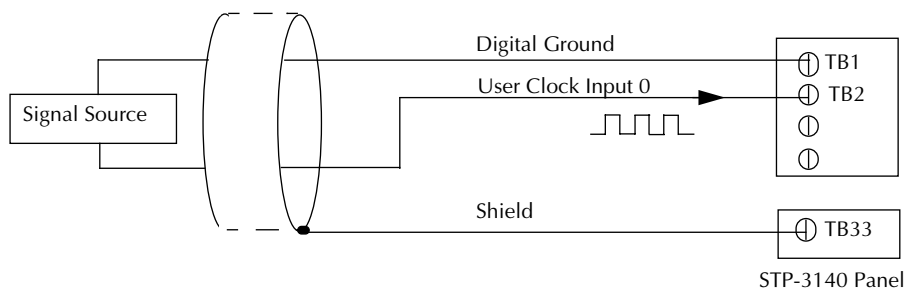
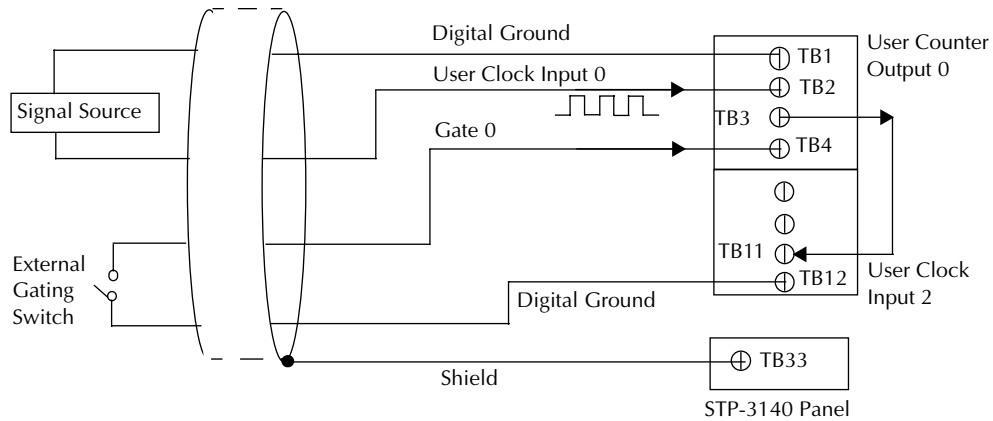


Figure 3-7 shows an example of how to externally cascade two counters to perform an event counting operation using user counters 0 and 2. Note that you can also internally cascade counters using software; if you internally cascade the counters, you do not need to make the external cascading connections. Note also that this example shows the use of an external gate; however, this connection is not required.

Figure 3-7  
**Cascading counters (shown for event counting using Counters 0 and 2 and External Gate 0)**

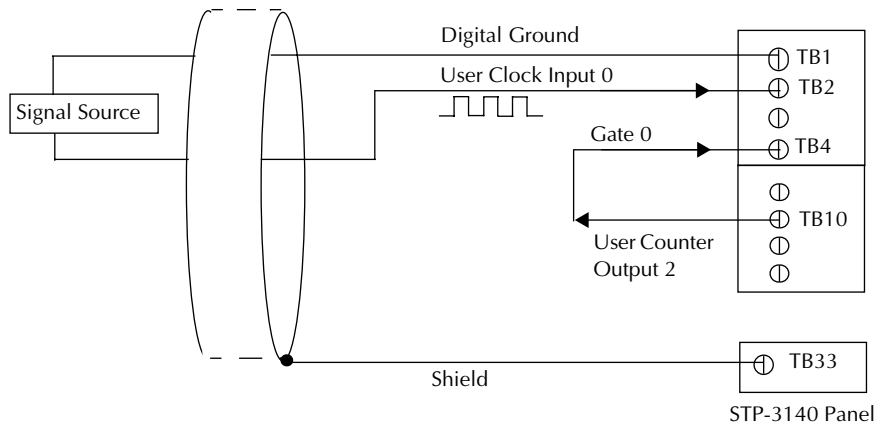


### Connecting frequency measurement signals

In DriverLINX frequency measurement, the application specifies the Logical Channel N, of the gating counter in the Service Request. The unknown frequency signal is connected to the terminal the application specifies in the Service Request *Clock* property. Depending on the counting mode, a signal may be connected to the **Gate** input. Before a frequency measurement is performed, a physical connection must be made between the **Output** terminal of the gating counter, Logical Channel N, and the **Gate** terminal of the first measurement counter, Logical Channel N+1. When using multiple counter/timer channels, the application's Service Request specifies the gating counter/timer, and DriverLINX then automatically uses consecutive counter/timer channels for the measurement counter(s).

You can connect a pulse of a known duration (such as a one-shot output of another user counter) to the external gate input, as shown in Figure 3-8. In this configuration, the frequency of the clock input is the number of counts divided by the period of the external gate input.

**Figure 3-8**  
**Connecting frequency measurement applications to the STP-3140 screw terminal panel**  
**(shown for Clock Input 0 and External Gate 0)**



### Connecting pulse output signals

Figure 3-9 shows one example of connecting a pulse output application to the STP-3140 screw terminal panel using user counter 0. Other combinations of signals can be used.

**Figure 3-9**  
**Connecting pulse output applications to the STP-3140 screw terminal panel**  
**(shown for Counter Output 0 and Gate 0)**

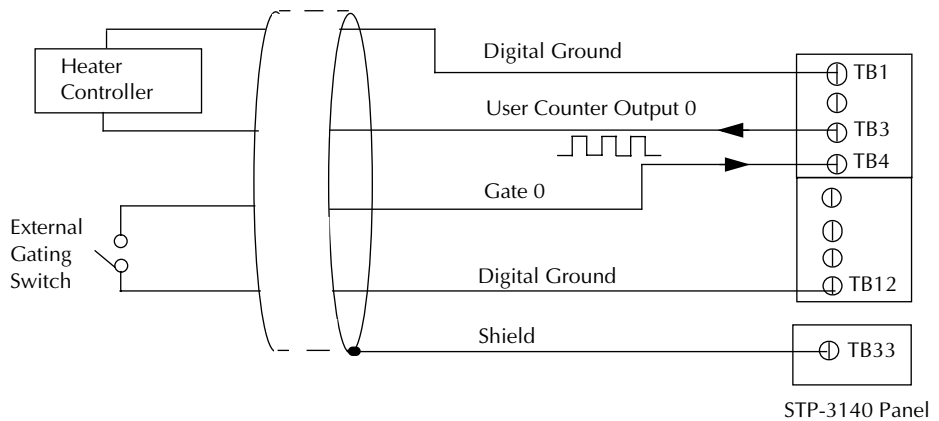




Figure 3-10 shows an example of how to externally cascade two counters to perform a rate generation operation using user counters 0 and 2. Note that you can also internally cascade counters using software; if you internally cascade the counters, you do not have to make the external cascading connections. In this example, counter 2 gate is logic high.

Figure 3-10  
**Cascading counters (shown for rate generation using Counters 0 and 2 and External Gate 0)**

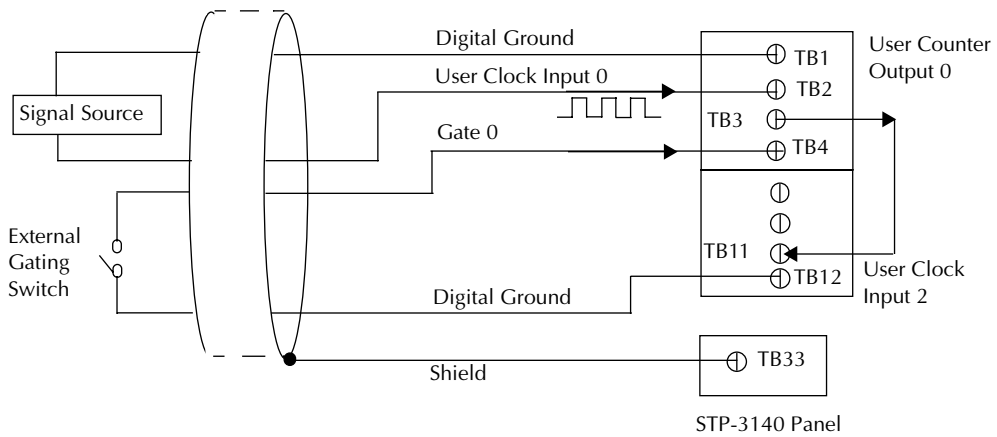
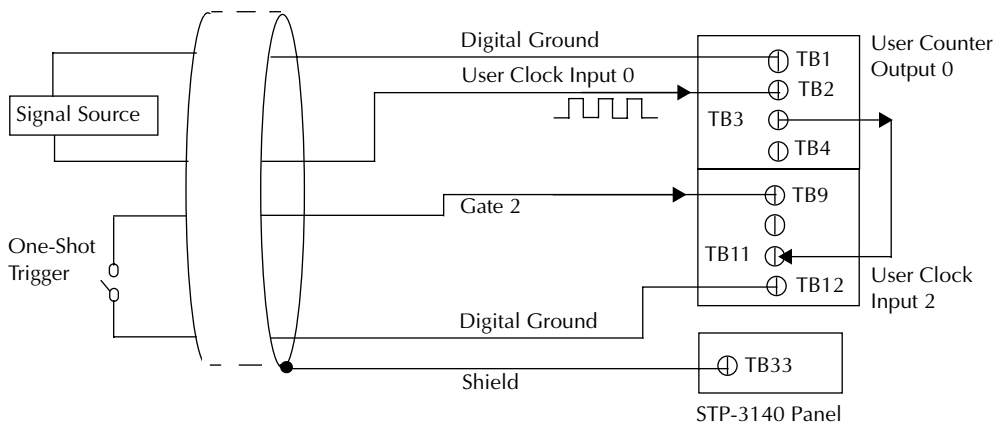


Figure 3-11 shows an example of how to externally cascade two counters to perform a one-shot operation using user counters 0 and 2. Note that you can also internally cascade counters using software; if you internally cascade the counters, you do not have to make the external cascading connections. In this example, counter 0 gate is logic high.

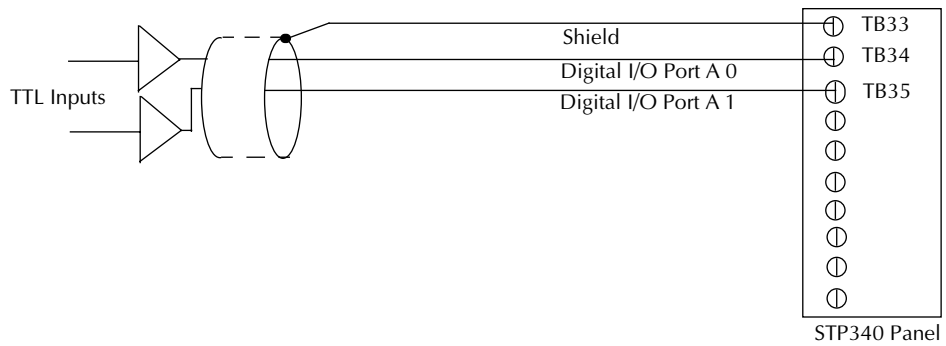
Figure 3-11  
**Cascading counters (shown for one-shot using Counters 0 and 2 and External Gate 2)**



## Connecting digital input signals

Figure 3-12 shows how to connect a digital input signal (lines 0 and 1 of digital Port A, in this case) to the STP-3140 screw terminal panel.

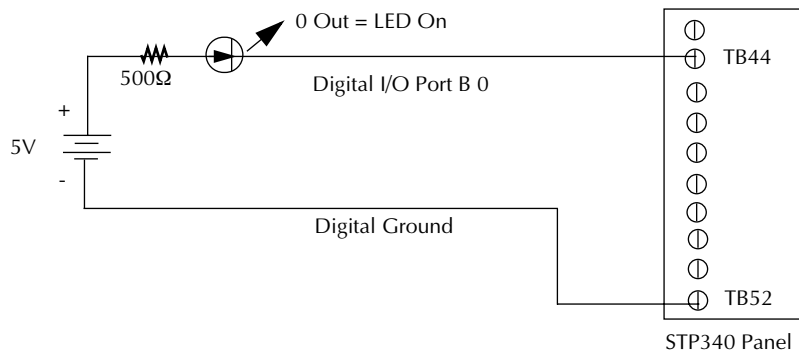
Figure 3-12  
**Connecting digital inputs to the STP-3140 screw terminal panel  
 (Lines 0 and 1, Port A shown)**



## Connecting digital output signals

Figure 3-13 shows how to connect a digital output signal (line 0 of digital Port B, in this case) to the STP-3140 screw terminal panel.

Figure 3-13  
**Connecting digital outputs to the STP-3140 screw terminal panel (Line 0, Port B shown)**



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# 4 Testing the Board

## Using DriverLINX KPCI-3140 test panel for hardware testing

The test panels are small applications programs within DriverLINX that allow you to perform limited data acquisition functions. You can use the panels to do tasks such as:

- Generate Sine, Square and Triangle waves using the SST Signal Generator
- Output pulse and strobe
- Set and read digital input and output bits on your board

The DriverLINX KPCI-3140 Test Panel is useful for:

- Testing the KPCI-3140 DriverLINX installation and configuration
- Verifying signal inputs to your KPCI-3140 board
- Sending test signals to external devices
- Providing a realistic example of a working KPCI-3140 for study

### DriverLINX KPCI-3140 test panel procedure

To start up and use the DriverLINX KPCI-3140 Test Panel, perform the following steps:

1. At the Windows Start Program menu, select DriverLINX.
2. From the DriverLINX menu, select Utilities.
3. From the Utilities menu, select Test Panels.
4. From the Test Panels, select KPCI-3140 Panel.
5. After the test panel starts, perform the necessary setup for the KPCI-3140 board.
6. To set up and perform an operation, click the appropriate input and output panels.
7. To obtain information on the setup and performance of an operation, use the DriverLINX online help.
8. When you finish using the test panel, select File Exit to terminate the program.

**NOTE**      *This utility allows you to verify basic operations on the board; however, it does not support all of the board's features.*

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# 5 Troubleshooting

## General checklist

Should you experience problems using the KPCI-3140 board, please follow these steps:

1. Read all the appropriate sections of this manual. Make sure that you have added any *Read This First* information to your manual and that you have used this information.
2. Check your distribution disk for a README file and ensure that you have used the latest installation and configuration information available.
3. Check that your system meets the requirements stated in this manual.
4. Check that you have installed your hardware properly using the instructions in this manual.
5. Check that you have installed and configured DriverLINX properly using the instructions in the *DriverLINX manuals* that come with the DriverLINX software.

If your KPCI-3140 board is not operating properly, use the information in this section to help you isolate the problem. If the problem appears serious enough to require technical support, refer to [page 5-6](#) for information on how to contact an applications engineer.

If you encounter a problem with a KPCI-3140 board, use the instructions in this section to isolate the cause of the problem before calling Keithley for technical support.

## Using the DriverLINX event viewer

The DriverLINX Event Viewer displays the Windows system event log. Applications and hardware drivers make entries in the system event log to assist in predicting and troubleshooting hardware and software problems.

DriverLINX uses the event log to report problems during driver loading or unexpected system errors. The event log can assist in troubleshooting resource conflicts and DriverLINX configuration errors. If you are having trouble configuring or initializing a Logical Device, check the event log for information from the DriverLINX driver.

Using the DriverLINX Event Viewer, you can view, save and e-mail DriverLINX event log entries under Windows 95/98 or Windows NT. DriverLINX event log entries can help you or technical support troubleshoot data-acquisition hardware and software problems.

## Device initialization error messages

During device initialization, DriverLINX performs a thorough test of all possible subsystems on the KPCI-3140 board as well as the computer interface. If DriverLINX detects any problems or unexpected responses, it reports an error message to help isolate the problem. The device initialization error messages fall into three basic categories:

- **“Device not found”** — Board address does not match hardware setting or conflicts with another board. Verify the board’s address settings. Also, do not confuse hexadecimal with decimal addresses in the DriverLINX Device Configure dialog box.
- **“Invalid IRQ level”** — Selected level does not match hardware setting, conflicts with another board’s IRQ levels, or is dedicated to the computer’s internal functions (COM port, disk drive controller, network adapter, etc.).
- **“Hardware does not match configuration”** — Operating mode/range switch or jumper setting does not match selection(s) made in the DriverLINX Device Configuration dialog box.

## Problem isolation

If you encounter a problem with a KPCI-3140 board, perform the following steps to determine whether the problem is in the computer, in the KPCI-3140 board, or in the I/O circuitry:

1. Remove power connections to the host computer.
2. Unplug the accessory connector(s) or cable(s) from the KPCI-3140 board(s), keeping the connections intact on the accessory or expansion board(s).
3. Remove the KPCI-3140 board(s) from the computer and visually check for damage. If a board is obviously damaged, refer to [page 5-7](#) for information on returning the board.
4. With the KPCI-3140 board(s) out of the computer, check the computer for proper operation. Power up the computer and perform any necessary diagnostics.
5. When you are sure that the computer is operating properly, remove computer power again, and install a KPCI-3140 board that you know is functional. Do not make any I/O connections.
6. Apply computer power and check operation with the functional KPCI-3140 board in place. This test checks the computer accessory slot. If you are using more than one KPCI-3140 board, check the other slots you are using.
7. If the accessory slots are functional, check the I/O hookups. Connect the accessory and expansion boards, one at a time, and check operation.
8. If operation is normal, the problem is in the KPCI-3140 board(s) originally in the computer. Try the KPCI-3140 board(s) one at a time in the computer to determine which is faulty. Use the troubleshooting information in the next section to try to isolate the problem.
9. If you cannot isolate the problem using the general instructions here, refer to [Appendix C, "Systematic Problem Isolation"](#) for a more detailed problem isolation scheme.
10. If you cannot isolate the problem after further investigation, refer to [page 5-6](#) for instructions on getting technical support.

## Troubleshooting table

If you still experience problems, try using the information in to isolate and solve the problem. If you cannot identify the problem, refer to [Section “Technical support”](#) on page 5-6.

Table 5-1  
**Troubleshooting problems**

Symptom	Possible Cause	Possible Solution
Board does not respond.	The board configuration is incorrect.	Check the configuration of your device driver to ensure that the board name and type are correct.
	The board is incorrectly aligned in a PCI expansion slot.	Check that the slot in which your KPCI-3140 board is located is a PCI slot and that the board is correctly seated in the slot.
	The board is damaged.	Contact Keithley Instruments.
Intermittent operation.	Loose connections or vibrations exist.	Check your wiring and tighten any loose connections or cushion vibration sources.
	The board is overheating.	Check environmental and ambient temperature; consult the board's specifications in the Appendix of this manual and the documentation provided by your computer manufacturer for more information.
	Electrical noise exists.	Check your wiring and either provide better shielding or reroute unshielded wiring.
Board does not interrupt.	Counter/timer, interval timer, or digital I/O port is not configured properly.	Check the parameters configured in DriverLINX for the KPCI-3140 board.
Data appears to be invalid.	An open connection exists.	Check your wiring and fix any open connections.
	A transducer is not connected to the channel being read.	Check the transducer connections.
	The interrupt level is unacceptable.	<p>An interrupt conflict exists in your system. The most common interrupt conflict occurs with a PCI device and a device that is plugged into the ISA bus. To correct this problem, change the interrupt setting (usually by changing a jumper) on the ISA device.</p> <p>An interrupt conflict can also occur if a PCI device was not designed to share interrupts. To resolve this problem, select a different interrupt for each PCI slot in the PCI BIOS. To do this, enter the system BIOS program; this is usually done by pressing the DEL key when re-booting your system. Once in the system BIOS, enter the PCI/PnP BIOS setup, and select a unique interrupt for each PCI slot. The PCI BIOS assigns the interrupt; the device on the PCI bus does not have control over the interrupt assignment.</p> <p>Some network devices do not share interrupts. If you still have an interrupt conflict, try removing the network device, installing the KPCI-3140 board and re-booting the system, then reinserting the network device.</p>
Computer does not boot.	Board is not seated properly.	Check that the slot in which your KPCI-3140 board is located is a PCI slot, that the board is correctly seated in the slot, and that the board is secured in the slot with a screw.
	The power supply of the computer is too small to handle all the system resources.	Check the power requirements of your system resources and, if needed, get a larger power supply; consult the board's specifications in the Appendix of this manual.
System lockup.	Board is not seated properly.	Check that the slot in which your KPCI-3140 board is located is a PCI slot, that the board is correctly seated in the slot, and that the board is secured in the slot with a screw.



## Testing the board and host computer

To isolate the problem to the KPCI-3140 board or to the host computer, use the following steps.

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

1. Turn the power to the host computer OFF, and remove power connections to the computer.
2. While keeping connections to accessories intact, unplug the cable to the main I/O connector of the KPCI-3140 board.
3. Remove the board from the computer and visually check for damage. If a board is obviously damaged, refer to “Technical support” for information on returning the board.
4. With the KPCI-3140 board out of the computer, check the computer for proper operation. Power up the computer and perform any necessary diagnostics.

At this point, if you have another KPCI-3140 board that you know is functional, you can test the slot and I/O connections using the instructions in the next section. If you do not have another board, call technical support.

## Testing the accessory slot and I/O connections

When you are sure that the computer is operating properly, test the computer accessory slot and I/O connections using another KPCI-3140 board that you know is functional. To test the computer accessory slot and the I/O connections, follow these steps:

1. Remove computer power again, and install a KPCI-3140 board that you know is functional. Do not make any I/O connections.
2. Turn computer power ON and check operation with the functional board in place. This test checks the computer accessory slot. If you were using more than one board when the problem occurred, use the functional board to also test the other slot.
3. If the accessory slots are functional, use the functional board to check the I/O connections. Reconnect and check the operation of the I/O connections, one at a time.
4. If operation fails for an I/O connection, check the individual inputs one at a time for shorts and opens.
5. If operation remains normal to this point, the problem is in the KPCI-3140 board(s) originally in the computer. If you were using more than one board, try each board one at a time in the computer to determine which is faulty.
6. If you cannot isolate the problem using the general instructions here, refer to [Appendix C](#), “[Systematic Problem Isolation](#)” for a more detailed problem isolation scheme.
7. If you cannot isolate the problem, refer to the following paragraph for information on obtaining technical support.



## Returning equipment to Keithley

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

When returning equipment for repair, include the following information:

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

Repackage the equipment, using the original anti-static wrapping, if possible, and 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 you are submitting your equipment for repair under warranty, you must include the invoice number and date of purchase.*

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

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# **A** **Specifications**

## KPCI-3140 specifications

Table A-1 lists the specifications for the C/T subsystems on the KPCI-3140 boards.

Table A-1  
C/T subsystem specifications

Feature	Specifications
Number of counter/timers	8
Clock Inputs	
Input type:	Pseudo-differential, rising-edge sensitive
Input load:	1 AM26C32
Threshold voltage	
Counter/Timers 0, 1, 2, 3:	0.5V <sup>1</sup>
Counter/Timers 4, 5, 6, 7:	0.98V
Input sensitivity:	±200mV
Input hysteresis:	60mV
Input current ( $V_{in} = 0V$ ):	0
Input current ( $V_{in} = 5V$ ):	1k $\Omega$
Minimum pulse width:	25ns high and low (sampled by 40MHz)
Maximum frequency:	19.9MHz typical
Termination	
Counter/Timers 0, 1, 2, 3:	100 $\Omega$ <sup>1,2</sup>
Counter/Timers 4, 5, 6, 7:	1k $\Omega$ resistor to ground <sup>3</sup>
Gate Inputs	
Input type:	Schmitt trigger, level sensitive
Input load:	1 HCT14 (TTL)
High-level input voltage:	2.0V minimum
Low-level input voltage:	0.8V maximum
Hysteresis:	0.4V (minimum); 1.5V (maximum)
High-level input current:	1.0 $\mu$ A
Low-level input current:	-1.0 $\mu$ A
Minimum pulse width:	25ns high and low (sampled by 40MHz)
Termination:	22k $\Omega$ resistor pullup to +5V
Counter Outputs for Channels 0, 1, 2, 3	
Output driver:	1.2V peak-to-peak <sup>1</sup>
Termination:	100 $\Omega$ <sup>1</sup>
Output driver high voltage:	2.6V maximum at 100 $\Omega$
Output driver low voltage:	1.2V maximum at 100 $\Omega$
Counter Outputs for Channels 4, 5, 6, 7	ALS244 (TTL)
Output driver:	3.0V maximum at 100 $\Omega$
Output driver high voltage:	1.6V maximum at 100 $\Omega$
Output driver low voltage:	100 $\Omega$ series resistor;
Termination:	301 $\Omega$ pull-down resistor to ground (75 $\Omega$ )

<sup>1</sup>This value accommodates high-frequency clock signals.

<sup>2</sup>If you want to use low-frequency clock signals you can clip the 100 $\Omega$  resistors in locations R9 (counter/timer 0), R14 (counter/timer 1), R19 (counter/timer 2), and R27 (counter/timer 3).

<sup>3</sup>You can install a 110 $\Omega$  resistor to ground on the board in parallel with the 1k $\Omega$  resistor to give 100 $\Omega$  termination.

Table A-2 lists the specifications for the DIN/DOUT subsystems on the KPCI-3140 boards.

Table A-2

**DIN/DOUT subsystem specifications**

Feature	Ports A, B, and C Specifications	Port D Specifications
Number of lines	8 per port	8
Direction	bidirectional	
Termination	22k $\Omega$ resistor pullup to +5V; 22 $\Omega$ series resistor	
Inputs		
Input type:	Level sensitive	Level sensitive
Input load:	2 FCT2574 (TTL)	3 FCT2574 (TTL)
High-level input voltage:	2.0V minimum	2.0V minimum
Low-level input voltage:	0.8V maximum	0.8V maximum
High-level input current:	3 $\mu$ A	4.5 $\mu$ A
Low-level input current:	-3 $\mu$ A	4.5 $\mu$ A
Minimum Pulse Width		
High:	Not Applicable	66ns (2 PCI clocks) <sup>1</sup>
Low:	Not Applicable	66ns (2 PCI clocks) <sup>1</sup>
Outputs		
Output driver:	FCT2574 (TTL)	
Output driver high voltage:	2.4V minimum (IOH = -15mA);	
Output driver low voltage:	0.5V maximum (IOL = 12mA)	

<sup>1</sup>The minimum pulse width applies only to interrupt-on-change detection. Pulses less than the minimum may not be detected as a change.

Table A-3 lists the power, physical, and environmental specifications for the KPCI-3140 boards.

Table A-3

**Power, physical, and environmental specifications**

Feature	Specifications
Power	
+5V ( $\pm$ 0.25V)	405mA + output current nominal
- 5V	not used
+12V	not used
-12V	not used
Physical	
Dimensions:	PCI short card 6.875 inches (length) by 4.2 inches (height); 174mm (length) by 106mm (height)
Weight:	4 ounces (113.4 grams)
Environmental	
Operating temperature range:	0° to 70°C
Storage temperature range:	-25° to 85°C
Relative humidity:	To 95%, noncondensing

Table A-4 lists the specifications for the 68-pin connector on the board.

Table A-4

**68-Pin connector specifications**

Feature	Specifications
Connector part number:	AMP 68-pin, 0.05 Subminiature D, #749621-7
Shielded enclosure with jack screws:	AMP 750752-1
Recommended shielded cable:	Madison, 28 GA, Twisted Pair, #68KDK00029

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# **B** **Connector Pin** **Assignments**



Table B-1 lists the pin assignments of connector J1 on the KPCI-3140 board.

Table B-1

**Connector J1 pin assignments on the KPCI-3140 board**

Pin Number	Signal Description	Pin Number	Signal Description
1	+5V Output	2	C/T Clock Input 7
3	C/T Clock Output 7	4	C/T Gate Input 7
5	C/T Gate Input 5	6	C/T Clock Output 5
7	C/T Clock Input 5	8	Digital Ground
9	Digital I/O Port D, Line 7	10	Digital I/O Port D, Line 5
11	Digital I/O Port D, Line 3	12	Digital I/O Port D, Line 1
13	Digital Ground	14	Digital I/O Port C, Line 7
15	Digital I/O Port C, Line 5	16	Digital I/O Port C, Line 3
17	Digital I/O Port C, Line 1	18	Digital I/O Port B, Line 7
19	Digital I/O Port B, Line 5	20	Digital I/O Port B, Line 3
21	Digital I/O Port B, Line 1	22	Digital Ground
23	Digital I/O Port A, Line 7	24	Digital I/O Port A, Line 5
25	Digital I/O Port A, Line 3	26	Digital I/O Port A, Line 1
27	Digital Ground	28	C/T Clock Input 3
29	C/T Clock Output 3	30	C/T Gate Input 3
31	C/T Gate Input 1	32	C/T Clock Output 1
33	C/T Clock Input 1	34	Digital Ground
35	Power Ground	36	C/T Clock Input 6
37	C/T Clock Output 6	38	C/T Gate Input 6
39	C/T Gate Input 4	40	C/T Clock Output 4
41	C/T Clock Input 4	42	Digital Ground
43	Digital I/O Port D, Line 6	44	Digital I/O Port D, Line 4
45	Digital I/O Port D, Line 2	46	Digital I/O Port D, Line 0
47	Digital Ground	48	Digital I/O Port C, Line 6
49	Digital I/O Port C, Line 4	50	Digital I/O Port C, Line 2
51	Digital I/O Port C, Line 0	52	Digital I/O Port B, Line 6
53	Digital I/O Port B, Line 4	54	Digital I/O Port B, Line 2
55	Digital I/O Port B, Line 0	56	Digital Ground
57	Digital I/O Port A, Line 6	58	Digital I/O Port A, Line 4
59	Digital I/O Port A, Line 2	60	Digital I/O Port A, Line 0
61	Digital Ground	62	C/T Clock Input 2
63	C/T Clock Output 2	64	C/T Gate Input 2
65	C/T Gate Input 0	66	C/T Clock Output 0
67	C/T Clock Input 0	68	Digital Ground

Table B-2 lists the screw terminal assignments for the STP-3140 screw terminal panel.

Table B-2

**Screw terminal assignments on the STP-3140 screw terminal panel**

TB #	J1 Pin #	Signal Description	TB #	J1 Pin #	Signal Description
1	68	Digital Ground	2	67	C/T Clock Input 0
3	66	C/T Clock Output 0	4	65	C/T Gate Input 0
5	34	Digital Ground	6	33	C/T Clock Input 1
7	32	C/T Clock Output 1	8	31	C/T Gate Input 1
9	64	C/T Gate Input 2	10	63	C/T Clock Output 2
11	62	C/T Clock Input 2	12	61	Digital Ground
13	30	C/T Gate Input 3	14	29	C/T Clock Output 3
15	28	C/T Clock Input 3	16	27	Digital Ground
17	42	Digital Ground	18	41	C/T Clock Input 4
19	40	C/T Clock Output 4	20	39	C/T Gate Input 4
21	8	Digital Ground	22	7	C/T Clock Input 5
23	6	C/T Clock Output 5	24	5	C/T Gate Input 5
25	38	C/T Gate Input 6	26	37	C/T Clock Output 6
27	36	C/T Clock Input 6	28	35	Power Ground
29	4	C/T Gate Input 7	30	3	C/T Clock Output 7
31	2	C/T Clock Input 7	32	1	+5V Output
33	-	Shield	34	60	Digital I/O Port A, Line 0
35	26	Digital I/O Port A, Line 1	36	59	Digital I/O Port A, Line 2
37	25	Digital I/O Port A, Line 3	38	58	Digital I/O Port A, Line 4
39	24	Digital I/O Port A, Line 5	40	57	Digital I/O Port A, Line 6
41	23	Digital I/O Port A, Line 7	42	56	Digital Ground
43	-	Shield	44	55	Digital I/O Port B, Line 0
45	21	Digital I/O Port B, Line 1	46	54	Digital I/O Port B, Line 2
47	20	Digital I/O Port B, Line 3	48	53	Digital I/O Port B, Line 4
49	19	Digital I/O Port B, Line 5	50	52	Digital I/O Port B, Line 6
51	18	Digital I/O Port B, Line 7	52	22	Digital Ground
53	-	Shield	54	51	Digital I/O Port C, Line 0
55	17	Digital I/O Port C, Line 1	56	50	Digital I/O Port C, Line 2
57	16	Digital I/O Port C, Line 3	58	49	Digital I/O Port C, Line 4
59	15	Digital I/O Port C, Line 5	60	48	Digital I/O Port C, Line 6
61	14	Digital I/O Port C, Line 7	62	47	Digital Ground
63	-	Shield	64	46	Digital I/O Port D, Line 0
65	12	Digital I/O Port D, Line 1	66	45	Digital I/O Port D, Line 2
67	11	Digital I/O Port D, Line 3	68	44	Digital I/O Port D, Line 4
69	10	Digital I/O Port D, Line 5	70	43	Digital I/O Port D, Line 6
71	9	Digital I/O Port D, Line 7	72	13	Digital Ground

Table B-3 lists the screw terminal assignments for the STP-68 screw terminal panel.

Table B-3

**Screw terminal assignments for the STP-68 screw terminal panel**

TB #	J1 Pin #	Signal Description	TB #	J1 Pin #	Signal Description
1	1	+5V Output	2	2	C/T Clock Input 7
3	3	C/T Clock Output 7	4	4	C/T Gate Input 7
5	5	C/T Gate Input 5	6	6	C/T Clock Output 5
7	7	C/T Clock Input 5	8	8	Digital Ground
9	9	Digital I/O Port D, Line 7	10	10	Digital I/O Port D, Line 5
11	11	Digital I/O Port D, Line 3	12	12	Digital I/O Port D, Line 1
13	13	Digital Ground	14	14	Digital I/O Port C, Line 7
15	15	Digital I/O Port C, Line 5	16	16	Digital I/O Port C, Line 3
17	17	Digital I/O Port C, Line 1	18	18	Digital I/O Port B, Line 7
19	19	Digital I/O Port B, Line 5	20	20	Digital I/O Port B, Line 3
21	21	Digital I/O Port B, Line 1	22	22	Digital Ground
23	23	Digital I/O Port A, Line 7	24	24	Digital I/O Port A, Line 5
25	25	Digital I/O Port A, Line 3	26	26	Digital I/O Port A, Line 1
27	27	Digital Ground	28	28	C/T Clock Input 3
29	29	C/T Clock Output 3	30	30	C/T Gate Input 3
31	31	C/T Gate Input 1	32	32	C/T Clock Output 1
33	33	C/T Clock Input 1	34	34	Digital Ground
35	35	Power Ground	36	36	C/T Clock Input 6
37	37	C/T Clock Output 6	38	38	C/T Gate Input 6
39	39	C/T Gate Input 4	40	40	C/T Clock Output 4
41	41	C/T Clock Input 4	42	42	Digital Ground
43	43	Digital I/O Port D, Line 6	44	44	Digital I/O Port D, Line 4
45	45	Digital I/O Port D, Line 2	46	46	Digital I/O Port D, Line 0
47	47	Digital Ground	48	48	Digital I/O Port C, Line 6
49	49	Digital I/O Port C, Line 4	50	50	Digital I/O Port C, Line 2
51	51	Digital I/O Port C, Line 0	52	52	Digital I/O Port B, Line 6
53	53	Digital I/O Port B, Line 4	54	54	Digital I/O Port B, Line 2
55	55	Digital I/O Port B, Line 0	56	56	Digital Ground
57	57	Digital I/O Port A, Line 6	58	58	Digital I/O Port A, Line 4
59	59	Digital I/O Port A, Line 2	60	60	Digital I/O Port A, Line 0
61	61	Digital Ground	62	62	C/T Clock Input 2
63	63	C/T Clock Output 2	64	64	C/T Gate Input 2
65	65	C/T Gate Input 0	66	66	C/T Clock Output 0
67	67	C/T Clock Input 0	68	68	Digital Ground

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**C**  
**Systematic**  
**Problem Isolation**

## Problem isolation schemes

If you were unable to isolate the problem by using Section 5, then try to isolate the problem systematically using the schemes detailed in this Appendix.

For clarity, the systematic problem isolation procedure is divided into seven schemes, each of which checks for, eliminates, and/or resolves problem causes. Each scheme consists of a flowchart and, in most cases, an amplified written procedure. The numbers of flowchart blocks are keyed to the numbers of written steps.

For simplicity, your problem is assumed to have only one cause. One particular scheme may not alone isolate this cause. Rather, performance of several schemes in series may be required to analyze your problem. One scheme may eliminate potential causes from further consideration, then direct you to another scheme(s) that ultimately isolates the problem. You need perform only those schemes to which you are directed.

If the cause of your problem appears to be outside the scope of the systematic isolation procedure, the procedure directs you to call Keithley for help.

The seven problem isolation schemes are as follows:

- Scheme A checks for three basic system problems.
- Scheme B checks DriverLINX installation and board recognition by DriverLINX.
- Scheme C addresses application software issues.
- Scheme D addresses apparent expansion slot malfunctions and attempted remedies.
- Scheme E addresses potential external connection problems.
- Scheme F addresses apparently malfunctioning board(s).
- Scheme G verifies that earlier schemes have found and addressed the problem.

Start the systematic isolation procedure at the next section, entitled “Problem isolation Scheme A: basic system), unless you have been directed otherwise in this manual.

**CAUTION** Always turn OFF your computer and any external circuits connected to the KPCI-3140 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.**

In the following procedure, the term “board” always refers to a KPCI-3140 board. The procedure never directs you to install or remove any type of board other than a KPCI-3140 board.

The logic used in the systematic problem isolation schemes assumes that the problem has only one cause. Therefore, once a cause is found and corrected, the reader is instructed to reassemble the system and verify proper operation.

Each individual scheme in this procedure, except for Scheme A, is designed to be used only if called for by other schemes or procedures. If you attempt to use schemes independently, you lose the benefits of systematic problem isolation.

## Problem isolation Scheme A: basic system

In Scheme A, you start the systematic problem isolation procedure. You remove your KPCI-3140 board(s) and check for apparent damage. If the board looks okay, you check the independent functionality of your computer. If the computer is okay, you check the expansion slots that held your KPCI-3140 board(s).

Follow these instructions as you perform Scheme A:

1. Remove and inspect the KPCI-3140 board(s) for damage as follows:
  - a. Shut down Windows 95/98/NT and turn off power to the host computer.
  - b. Turn off power to all external circuits and accessories connected to the KPCI-3140 board(s) that is installed.
  - c. Disconnect screw terminal accessories from your KPCI-3140 board(s).
  - d. Remove the KPCI-3140 boards from the computer, making note of the socket(s) in which the board(s) was installed. (If more than one KPCI-3140 board is installed, remove all boards and note which board was in which socket.)
  - e. Visually inspect the removed KPCI-3140 board(s) for damage.
2. Based on the results of step 1, do the following:
  - If the board(s) you removed is obviously damaged, then repair or replace the board. Refer to “[Technical support](#)” for information on returning the board for repair or replacement. Skip to “[Problem isolation Scheme G: verification of problem solution](#).”
  - If the board(s) you removed is not obviously damaged, then continue with step 3 and check for host computer malfunction.
3. Check if the computer functions satisfactorily by itself. Proceed as follows:
  - a. Place the board(s) that you removed from the computer in an electrostatically safe location. Do not reinstall it.
  - b. Turn on power to the host computer.
  - c. Perform all needed diagnostics to determine whether your computer hardware and operating system are functioning properly.
4. Based on the results of step 3, do one of the following:
  - If you find no computer or operating system malfunctions in step 3, then the problem likely lies elsewhere; take action as follows:
    - If you do not have another KPCI-3140 board that you know is working properly, read the instructions in “[Technical support](#).” Then contact Keithley for help in isolating the cause of your problem.
    - If you have another KPCI-3140 board that you know is working properly, then continue with step 5.
  - If you find computer or operating system malfunctions in step 3, do the following:
    - a. Determine the cause of the computer hardware or operating system malfunctions.
    - b. Fix the computer hardware or operating system malfunctions.
    - c. Assume that fixing the malfunctions has solved your problem, and skip to “[Problem isolation Scheme G: verification of problem solution](#).”

5. Determine the PCI resources detected by your computer before any KPCI-3140 boards are installed. Proceed as follows:
  - a. Shut down Windows 95/98/NT and turn off power to the host computer.
  - b. Insert a blank diskette, or any diskette that you are sure is unbootable, into the A: drive.
  - c. Turn on the computer and allow it to start the boot cycle.

The boot cycle stalls at a text screen listing system characteristics and resources and saying at the bottom: **Non-system disk or disk error. Replace and press any key when ready.**

**NOTE** *This system characteristics and resources screen is normally displayed only fleetingly during the boot cycle. Having an unbootable diskette in your computer automatically stops the boot cycle at this screen, allowing for convenient viewing. This is not harmful to your computer. The more common approach—using the PAUSE key to pause the boot cycle at this screen—requires fast reflexes with some systems.*

- d. Note the displayed list of PCI devices under a heading something like **PCI device listing...** If you have a printer, print the screen by pressing the PRINT SCREEN key.
  - e. Remove the diskette and allow the boot cycle to finish.
6. Install a good board—a KPCI-3140 board that you know is fully functional—as follows:
  - a. Shut down Windows 95/98/NT and turn off power to the host computer.
  - b. Install the good board in the slot from which you removed the potentially faulty board in step 1. Refer to [Section 3](#) for board installation instructions.

**NOTE** *If you removed more than one board in step 1, install only one good board in only one expansion slot.*

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

7. Again determine the PCI resources detected by your computer, after the KPCI-3140 board is 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 OK board is installed are in good condition.
  - The OK board is seated properly in the expansion slot.
8. Do the following, as you did in step 5:
  - a. Insert an unbootable diskette.
  - b. Turn on the computer and allow the boot cycle to stall at the **Non-system disk or disk error...** message.
  - c. Again, note the displayed list of PCI devices. A new device should be listed, likely as an unidentified peripheral. If your resource listing includes PCI slot numbers, the slot number for the new device should match the number of the slot in which your board is installed.
  - d. Remove the diskette and allow the boot cycle to finish.
9. If you removed KPCI-3140 boards from other PCI slots in step 1, then repeat steps 6 and 7 with the good board in each of these other slots.

10. Based on the results of steps 5 through 8, do one of the following:
  - a. If the good board is recognized as a PCI component in all slots tested, then the PCI slots are apparently satisfactory. DriverLINX may not be installed correctly and/or the board may not be properly configured. Continue with “[Problem isolation Scheme B: installation.](#)”
  - b. If the good board is not recognized as a PCI component in a slot(s), then the PCI slot connector(s) is suspect. Continue with “[Problem isolation Scheme D: expansion slot connectors.](#)”

## Problem isolation Scheme B: installation

In Scheme B, you check whether DriverLINX and your board are installed correctly and work together properly. A proper start of the DriverLINX Digital I/O Panel utility means that the combined DriverLINX/board installation is okay. If the installation is not okay, you try to diagnose and fix the problem, ultimately reinstalling DriverLINX and the board if necessary.

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

Follow these instructions as you perform Scheme B:

1. Try starting the DriverLINX Digital I/O Panel. Proceed as follows:
  - a. In the **Start** menu, click **Programs**.
  - b. Find the **DriverLINX → Test Panels** folder, under which you should find the **DIO Panel** entry.
  - c. Click on the **DIO Panel** entry.
2. Based on the results of Step 1, select one of the following:
  - Case A — If both of the following statements are true, then skip to step 16; DriverLINX and your board are installed properly and are working together.
    - A KPCI-3140 board is the only board in your computer installed under DriverLINX.
    - The DriverLINX Digital I/O Panel appears with the **KPCI-3140** board listed under **Driver Selection**.
  - Case B — If all three of the following statements are true, then skip to step 16; DriverLINX and your board are installed properly and are working together.
    - More than one type of board is installed in your computer under DriverLINX.
    - The DriverLINX Digital I/O Panel initially appears, but perhaps with any or all of the following differences: 1) tiny buttons located at the right side of the **Driver Selection** text box and/or the **Device Selection** text box; 2) a different board driver under **Driver Selection**; 3) a different device number under **Device Selection**; 4) different tabs at the top of the screen.
    - To change the tabs at the top of the screen, use the tiny buttons next to the text boxes: 1) select the board driver under **Driver Selection** to be **KPCI-3140** and 2) select the correct device number under **Device Selection**, which is **0** if only one KPCI-3140 board is installed.
  - Case C — If neither of the two scenarios above apply—neither Case A nor Case B, then continue with step 3; there may be a problem with the DriverLINX installation and/or the board configuration.



3. Select the next step in Scheme B based on the criteria given in the following alternatives:
  - If you have already reconfigured or reinstalled DriverLINX and the board, yet still cannot successfully start the Digital I/O Panel, then the cause of your problem may be outside the scope of these diagnostics. Read the instructions in “[Technical support](#)” and then contact Keithley for help in isolating the cause of your problem.
  - If you have not yet tried to fix the combined DriverLINX/board problem, then continue with step 4.
4. See if and how your KPCI-3140 board is listed in the Windows Device Manager. Proceed as follows:
  - a. Right-click the **My Computer** icon on your desktop.
  - b. On the menu that appears, click **Properties**.
  - c. On the System Properties dialog box that appears, click the **Device Manager** tab. The Device Manager appears.
  - d. In the Device Manager look for a **DriverLINX drivers** item.
  - e. If you find a **DriverLINX drivers** item, click the + sign to the left of this item. A second level list may appear with the specific model number of your KPCI-3140 board. More than one KPCI-3140 board may be listed here if you installed more than one KPCI-3140 board.
  - f. Select your next action based on the criteria given in the following alternatives:
    - If a board is recognized as a device under DriverLINX but is not configured to work with DriverLINX, then the board is normally listed with a large exclamation point over it. If you find a KPCI-3140 board listed with an exclamation point over it, keep the Device Manager open and go directly to step 5. Skip substeps 4g through 4j.
    - If a board is recognized as a device under DriverLINX and *is* configured to work with DriverLINX, then the board is listed without the large exclamation point over it. However, this is not by itself a sufficient indication in at least one situation. Therefore, if you find that *all* of your KPCI-3140 boards are listed in the Device Manager without exclamation points, do as follows:
      - Leave the Device Manager open for now.
      - Continue with substeps 4g through 4j, in which you open and check the DriverLINX Configuration Panel.
    - If the list of devices in the Device Manager includes an **? Other Devices** item, also click the + sign to the left of this item. If a KPCI-3140 board is listed under **? Other Devices**, then keep the Device Manager open and go directly to step 5. Skip substeps 4g through 4j.
    - If one or more of your KPCI-3140 boards is not listed anywhere in the Device Manager, then keep the Device Manager open and go directly to step 5. Skip substeps 4g through 4j.
  - g. In the **Start** menu, click **Programs**.
  - h. Find the **DriverLINX** folder and under it click **DriverLINX Configuration Panel**. The DriverLINX Configuration Panel appears.
  - i. Inspect the DriverLINX Configuration Panel.
    - If you see the following on the screen for a KPCI-3140 board, then the board is recognized as a device under DriverLINX but is **not** properly configured:
      - **Keithley KPCI-3140** is listed under DriverLINX.
      - The amplifier icon next to **Keithley KPCI-3140** board listing is colored yellow.
      - The specific board part number(s) of the unconfigured Keithley KPCI-3140 board(s) is listed under Keithley KPCI-3140.
      - The lamp icon next to the specific board part number is uncolored.

- If you see the following on the screen for a KPCI-3140 board, then the board is recognized as a device under DriverLINX and *is* properly configured:
    - **Your Keithley KPCI-3140 Board** is listed under DriverLINX.
    - The amplifier icon next to **Keithley KPCI-3140** listing is colored pale gray.
    - A device number—for example, **Device0** (or **Device1**, **Device2**, etc.)—is listed under your **Keithley KPCI-3140** board, instead of a specific board part number.
    - The lamp icon next to the device number is colored green.
  - j. Leave the DriverLINX Configuration Panel open for now and continue with step 5.
5. Based on the results of step 4, do one of the following:
- If your board is properly installed and configured, your inability to run the Digital I/O Panel may be due to an improperly installed component of DriverLINX. Skip to step 9, and begin uninstalling, then reinstalling DriverLINX and the board.
  - If one of your KPCI-3140 boards is apparently recognized by DriverLINX but is listed in the Device Manager under DriverLINX with a large exclamation point, then try configuring it with the DriverLINX Configuration Panel. Skip to step 7.
  - If one of your KPCI-3140 boards is listed under **? Other Devices**, or is listed in the Device Manager at multiple places, then the installation is faulty. Skip to step 9 and begin uninstalling, then reinstalling DriverLINX and the board.
  - If your board is not listed at all in the Device Manager, there are apparently issues other than the combined DriverLINX/board installation. Continue with step 6.
6. Select the next step in Scheme B based on the criteria given in the following alternatives:
- If you are performing Scheme B independently as an installation check, then non-installation issues must apparently be resolved before you can successfully run your board. Starting at “[Problem isolation Scheme A: basic system](#),” proceed through the systematic problem isolation procedure.
  - If you are performing Scheme B as part of the systematic problem isolation procedure, then you should have seen your board listed in the device manager at this point in the procedure. The cause of your problem may be outside the scope of these diagnostics. Read the instructions in “[Technical support](#),” and then contact Keithley for help in isolating the cause of your problem.
7. Try to reconfigure your board using the DriverLINX configuration panel, which you opened in step 4 and should still be open. Proceed as follows:
- a. In the DriverLINX Configuration Panel, select an unconfigured KPCI-3140 board by clicking on its part number. An unconfigured KPCI-3140 board may be identified as follows:
    - The specific board part number of the unconfigured Keithley KPCI-3140 board is listed under **Keithley KPCI-3140**.
    - The lamp icon next to the specific board part number is uncolored.
    - The amplifier icon next to **Keithley KPCI-3140** is colored yellow.
  - b. Click the **Configure** button. The Select Logical Device dialog box appears.
  - c. Select your next action based on the criteria given in the following alternatives:
    - If only one KPCI-3140 board is installed, a default device number of **0** in the text box is correct. Click **OK**.
    - If other KPCI-3140 boards are installed and configured and have been assigned device numbers, then type in a device number for the board you are configuring—the next, unassigned number in the numbering sequence. Then click **OK**.
  - d. The Configure DriverLINX Device dialog box appears, as well as the Device Manager.
  - e. No changes in the Device dialog box changes are normally required. Click **OK**.
  - f. If a Device Change message appears, then click **OK**.

- g. If more than one unconfigured board was found in the DriverLINX Configuration Manager in step 4, configure the additional boards now. Repeat substeps 7a through 7e for each remaining unconfigured board.
- h. Close out all programs and reboot your computer to complete the configuration process.
- i. Open and check the Device Manager as you did in step 4. Your KPCI-3140 board(s) should now be listed under the DriverLINX with no exclamation mark over it.
- j. Open and check the DriverLINX Configuration panel as you did in step 4. If you successfully configured your board(s), you should now see the following listed below **Keithley KPCI-3140**. Refer back to step 4.
  - Instead of a specific board part number(s), there should now be a device number(s)—for example, **Device0**.
  - The lamp icon next to the device number(s) should be colored green.
8. Based on the results of step 7, do one of the following:
  - If the board was successfully configured, return to step 1 and retry starting the Digital I/O Panel.
  - If the board was not successfully configured, continue with step 9 and begin uninstalling, then reinstalling DriverLINX and the board.
9. Remove all KPCI-3140 boards physically.

**NOTE** *You should remove all KPCI-3140 boards before reinstalling the KPCI-3140 version of DriverLINX, because the installation order is DriverLINX first, board second. If a KPCI-3140 board is present, physically or in the computer list of devices, driver installation difficulties may occur.*

10. Proceed as follows:
  - a. Turn off the computer.
  - b. Remove all KPCI-3140 boards from their computer expansion slots.

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

11. Remove all KPCI-3140 boards from the list of devices in your system. If your operating system is Windows 95/98, remove the KPCI-3140 boards using the Windows 95/98 Device Manager, as follows:
  - a. Shut down and turn off the computer.
  - b. 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.
  - c. Select your next step based on the criteria given in the following alternatives:
    - If the Device Manager lists a **DriverLINX drivers** item, click the + sign to the left of this item. A second level list may appear with the specific model number of your KPCI-3140 board. More than one KPCI-3140 board may be listed if you previously installed more than one KPCI-3140 board. Alternatively, if a previously installed board is not properly recognized by DriverLINX, it may not be listed here or may be listed with a large exclamation point over it.
    - If the Device Manager lists an ? **Other Devices** item, also click the + sign to the left of this item. You should not, but could, find a KPCI-3140 board listed under this item if it is not properly recognized by DriverLINX.

- d. Select any one of the KPCI-3140 boards that you find in the Device Manager, wherever you find it.
  - e. At the bottom of the list of devices, click **Remove**.
  - f. On the Confirm Device Removal dialog box that appears, click **OK**. The board is removed from the list of devices.
  - g. If more than one KPCI-3140 board was listed in the Device Manager, or if the same board was listed in more than one place, then repeat substeps d, e, and f of step 10 until no KPCI-3140 boards are listed anywhere in the Device Manager.
12. Uninstall *only* the KPCI-3140 version of DriverLINX from your system using the Windows 95/98/NT Add/Remove Programs feature. Proceed as follows:
    - a. In the **Start** menu of Windows 95/98/NT, click **Settings** → **Control Panel**.
    - b. In the Control Panel that appears, click **Add/Remove Programs**.
    - c. In the Add/Remove Programs Properties dialog box that appears, select **DriverLINX for Keithley KPCI-3140**.

**NOTE** *Uninstall only DriverLINX for Keithley KPCI-3140. If additional DriverLINX versions are installed, leave them installed.*

- d. At the bottom of the Add/Remove Programs Properties dialog box, click **Add/Remove** and then follow the remainder of the Windows uninstall prompts.

**CAUTION** **During the course of an uninstall procedure, you will typically be asked if you wish to uninstall certain files that may be shared by other programs. In such cases, always click *No*. Mistakenly uninstalling files needed by other programs causes serious problems. Mistakenly keeping files causes no harm, and some uninstalled files may be overwritten anyway when you subsequently reinstall DriverLINX.**

13. Reinstall DriverLINX, referring to the brief DriverLINX installation instructions on the *Read This First* sheet that was shipped with your KPCI-3140 board and is also provided on the CD-ROM containing this manual. Make sure that DriverLINX installs smoothly and completely.
14. Reinstall the board(s).

**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 you are performing Scheme B independently as an installation check, then reinstall all boards that you removed in step 9. If you are performing Scheme B as part of the systematic problem isolation procedure, then reinstall only the good board that you began using near the end of Scheme A.*

15. Proceed as follows:
  - a. Shut down and turn off the computer.
  - b. Install the board(s) in its expansion slot(s), following this brief procedure in [Section 3](#) of the manual.
  - c. Turn on and reboot the computer.
  - d. Run the procedure for configuring the board to work with DriverLINX, in [Section 3](#).
  - e. Return to step 1 and run the installation check again.

16. You arrived at this step from step 2, after successfully starting the Digital I/O Panel. Select your next action based on the criteria given in the following alternatives:
  - If you are performing Scheme B independently as an installation check, then DriverLINX and your KPCI-3140 board are installed correctly. Return to [Section 3](#) and finish installing your data acquisition system.
  - If you performed Scheme B as part of the systematic problem isolation procedure AND arrived at this point after reconfiguring the board or reinstalling DriverLINX and the board, then go to “[Problem isolation Scheme G: verification of problem solution](#).”
  - If you performed Scheme B as part of the systematic problem isolation procedure AND arrived at this point without performing any remedial efforts, then your problem must lie elsewhere. Go to “[Problem isolation Scheme C: application software](#)” and check for application software issues.

## Problem isolation Scheme C: application software

In Scheme C, you check for bugs in custom application software, assuming that you can access the source code. Alternatively, you check for compatibility and installation issues in commercial application software. In Scheme A, you temporarily installed a KPCI-3140 board that is known to be good in place of a KPCI-3140 board that you removed from the computer. This substitution, still in place, eliminates possible board I/O problems during Scheme C. You now perform I/O tests using your application software. You debug custom code, if necessary, and recheck.

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

Follow these instructions as you perform Scheme C:

1. Perform the procedure outlined in the “[General-purpose digital I/O software test](#),” found later in this appendix.
2. Based on the results of the “[General-purpose digital I/O hardware test](#),” do one of the following:
  - If your software appears not to be working properly with your digital I/O, skip to step 4.
  - If your software appears to be working properly with your digital I/O, continue.
3. Select the next step in Scheme C based on the criteria given in the following alternatives:
  - If you reached this point without modifying the custom software or reinstalling the commercial software—if you experienced no problems in the tests at any point—then the problem you originally experienced must lie elsewhere. Go to “[Problem isolation Scheme E: user wiring](#)” and check your external connections.
  - If you reached this point by having to modify the custom software or reinstall the commercial software—if you no longer experience problems in the tests—then assume that you have solved the original problem. Go to “[Problem isolation Scheme G: verification of problem solution](#)” and verify that the problem is solved.
4. You arrived at this point because one of the I/O software tests failed. Select the next step in Scheme C based on the criteria given in the following alternatives:
  - If your applications program is a proven program—potentially a commercial program that you cannot modify—then the software may be installed incorrectly or perhaps is incompatible with DriverLINX.
  - If your applications program is a custom program that can be modified—the source code is available—then continue.
5. Check and debug the source code as necessary.

6. At this point, you have presumably found and corrected some program bugs. Select the next step in Scheme C based on the criteria given in the following alternatives:
  - If *both* of the following statements are true, then the cause of your problem may be outside the scope of these diagnostics. Read the instructions in “[Technical support](#),” and then contact Keithley for help in isolating the cause of your problem.
    - You are at this point after having debugged the source code at least once and after having failed the I/O software tests at least a second time.
    - You have tried to find more code bugs after two or more I/O test failures and cannot find any more bugs.
  - If none or only one of the above statements are true, then continue with step 7, and selectively redo I/O software tests.
7. Select your next step in Scheme C based on the criteria given in the following alternatives:
  - If you have done the input software test at least once AND your software did not pass the input software test the last time, then return to step 1 and redo that test.
  - If you have done the input software test at least once AND your software passed the input software test the last time, then assume that you do not need to repeat it. Continue.
8. Select your next step in Scheme C based on the criteria given in the following alternatives:
  - If all three of the following apply, then return to step 3 and redo the digital output software test:
    - Your board has digital outputs.
    - You have done the digital output software test at least once.
    - Your software did not pass the output software test the last time you tried.
9. You arrived at this point from step 4, because presumably you have a commercial or otherwise unmodifiable applications program that is assumed to be proven. Contact the maker of your software to determine whether you have a version designed to work with the KPCI-3140 version of DriverLINX. For example, not all versions of TestPoint will work with KPCI-3140 DriverLINX. Also, check whether the program is installed correctly.
10. Select your next step in Scheme C based on the criteria given in the following alternatives:
  - If you are certain at this point that your application program is the correct version AND is properly installed, then the cause of your problem may be outside the scope of these diagnostics. Read the instructions in “[Technical support](#),” and then contact Keithley for help in isolating the cause of your problem. Also, contact Keithley if you have been unable to find out elsewhere whether you have the correct version of software.
  - If you are uncertain at this point that your application program is properly installed, then reinstall it now. When you are satisfied that it is properly installed, retry selected I/O software tests.

## Problem isolation Scheme D: expansion slot connectors

In Scheme D, you further check and try to remedy apparent expansion slot malfunctions.

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

1. Remove computer power again, and install a KPCI-3140 board that you know is functional. Do not make any I/O connections.
2. Turn computer power ON and check operation with the functional board in place. This test checks the computer accessory slot. If you were using more than one board when the problem occurred, use the functional board to also test the other slot.
3. If the accessory slots are functional, use the functional board to check the I/O connections. Reconnect and check the operation of the I/O connections, one at a time.
4. If operation fails for an I/O connection, check the individual inputs one at a time for shorts and opens.
5. If operation remains normal to this point, the problem is in the KPCI-3140 board(s) originally in the computer. If you were using more than one board, try each board one at a time in the computer to determine which is faulty.

## Problem isolation Scheme E: user wiring

In Scheme E, after having eliminated other problem causes, you physically check your external connections to see if they are the problem cause.

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

Follow these instructions as you perform Scheme E:

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-3140 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. Based on the results of step 1, do the following:
  - If any external I/O connections are found to be faulty, assume that the problem was caused by the faulty connections, then proceed as follows:
    - a. Correct the faulty external connections.
    - b. Skip to “[Problem isolation Scheme G: verification of problem solution.](#)”
  - If all external I/O connections are found to be normal, then, by process of elimination, the KPCI-3140 board(s) originally installed in the computer is likely the cause of the problem. Continue with “[Problem isolation Scheme F: the board.](#)”

## Problem isolation Scheme F: the board

In Scheme F, after having eliminated other problem causes, you assume that KPCI-3140 hardware malfunctions are at fault. If only one KPCI-3140 board was installed, you replace or repair it. If more than one KPCI-3140 board was installed, you use PCI connection tests, and if necessary, I/O tests, to find which board is bad.

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

## Problem isolation Scheme G: verification of problem solution

In Scheme G, you put your system back together and verify that it works, after apparently resolving the problem in prior schemes.

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

Follow these instructions as you perform Scheme G:

1. Assuming that the problem has been resolved, do the following:
  - a. Turn off the computer.
  - b. Install good KPCI-3140 boards in good slots.
  - c. Reconnect all external circuits. If you left external circuits connected to the screw terminal accessory, connect the accessory to your board. If you disconnected external circuits from the screw terminal accessory, reconnect them and the accessory as discussed in Section 3, “[Installation and Configuration](#).”
  - d. Turn on the computer and start your data acquisition software.
2. Repeat the task that you were doing with your data acquisition system when the problem occurred, and observe the performance.
3. Based on the results of step 2, do one of the following:
  - If the system now performs satisfactorily, you have successfully isolated and corrected the problem.
  - If the system still does not perform satisfactorily, then the cause of your problem may be outside the scope of these diagnostics. Read the instructions in “[Technical support](#),” and then contact Keithley for help in isolating the cause of your problem.



## Specified hardware I/O tests

The tests in this section check whether the digital I/O of the board work properly. The I/O are tested using proven DriverLINX utilities, thereby bypassing any unresolved application software issues. These tests are intended to be used when specified in the preceding procedure. However, they may also be used at any time for general functional checks of your KPCI-3140 board.

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

### General-purpose digital I/O hardware test

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

All I/O is set and read using the DriverLINX Digital Input/Output test panel, and no instruments are required. However, you must wire a screw terminal accessory in the loop-back configuration. If possible, use a screw terminal accessory that is reserved for I/O tests. Avoid using a screw terminal accessory that is normally connected to your external circuits. You thereby avoid the extra labor and potential wiring errors involved in disconnecting and later reconnecting your external circuits.

The following summarizes the test procedure:

- Wire a screw terminal accessory in a loop-back configuration. Connect the channel 0 digital I/O terminals, bit-for-bit, to the channel 3 digital I/O terminals. Connect the channel 1 terminals, bit-for-bit, to the channel 2 terminals.
- 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. Choose bit patterns that check both for direct ON/OFF response and for shorts between bits.

## Specified software I/O tests

The tests in this section check whether your application software correctly performs digital I/O tasks. The I/O are tested using a KPCI-3140 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.*

### General-purpose digital I/O software test

This test checks whether your application software is performing general-purpose digital I/O functions properly.

## Test summary

The following summarizes the test procedure:

- Wire a screw terminal accessory in a loop-back configuration. Connect the channel 0 general-purpose digital I/O terminals, bit-for-bit, to the channel 3 general-purpose digital I/O terminals. Connect the channel 1 terminals, bit-for-bit, to the channel 2 terminals. (These are the same loop-back connections as made for the general-purpose digital I/O *hardware* test.)
- Using your application software, set the channel 0 and 1 outputs in a particular alternating OFF-ON bit pattern and check channels 2 and 3 inputs for the same bit pattern. Repeat, using a second ON-OFF bit pattern.

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

## Equipment for general-purpose digital I/O software test

All I/O is set and read using your application software; no instruments are required. However, you must wire a screw terminal accessory in the loop-back configuration. If possible, use a screw terminal accessory that is reserved for I/O tests. Avoid using a screw terminal accessory that is normally connected to your external circuits. You thereby avoid the extra labor and potential wiring errors involved in disconnecting and later reconnecting your external circuits.

## Procedure for general-purpose digital I/O software test

**NOTE** *The bit patterns prescribed 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.*

Perform the I/O hardware test as follows:

1. Turn off the host computer
2. If a screw terminal accessory is attached to C/T connections of the KPCI-3140 I/O board, remove it. No circuits should be connected to other connections during these tests.
3. Attach the wired screw terminal accessory.
4. Turn on the host computer and boot Windows 95, 98, or NT.
5. Start DriverLINX and your application software.
6. Set up your application software to configure and monitor general-purpose digital I/O bits.
7. Using your application software, do the following:
  - a. Configure general-purpose bits 0 to 7 (channel 1) as outputs.
  - b. Configure general-purpose bits 8 to 15 (channel 2) as inputs.
8. Using your application software, configure bits 0 to 7 (channel 1) for an alternating OFF-ON bit pattern.

9. Using your application software, observe the channel 2 input bits.
  - If the observed channel 2 output bit pattern is not the same as the pattern you input, your application software is not performing general-purpose digital I/O functions properly. Stop here, and return to the “[Problem isolation Scheme C: application software,](#)” procedure.
  - If the observed channel 2 input bit pattern is the same OFF-ON pattern, continue.
10. Using your application software, configure bits 0 to 7 (channel 1) for an alternating ON-OFF bit pattern.
11. Using your application software, observe the channel 2 input bits.
12. If the observed channel 2 input bit pattern is not the same ON-OFF pattern, your application software is not performing general-purpose digital I/O functions properly. Stop here, and return to step 5 of “[Problem isolation Scheme C: application software,](#)” procedure.
  - If the observed channel 2 input bit pattern is the same ON-OFF pattern, continue with step 13.
13. Using your application software, repeat the procedure for channels 1 and 3 with OFF-ON and ON-OFF bit patterns.
14. If the observed channel 3 input bit pattern is not the same ON-OFF pattern, your application software is not performing general-purpose digital I/O functions properly. Stop here, and return to step 5 of “[Problem isolation Scheme C: application software,](#)” procedure.
  - If the observed channel 3 input bit pattern is the same pattern, your application software is performing general-purpose digital I/O functions properly. Stop here, and return to the “[Problem isolation Scheme C: application software,](#)” procedure.

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