Keithley KPCI-3130 Series

Using DriverLINX with Your Hardware

KEITHLEY

Keithley KPCI-3130 Series: Using DriverLINX with Your Hardware

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Contents

Preface

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About DriverLINX

Welcome to DriverLINX® for Microsoft® Windows™, the high-performance real-time data-acquisition device drivers for Windows application development.

DriverLINX is a language- and hardware-independent application programming interface designed to support hardware manufacturers' high-speed analog, digital, and counter/timer data-acquisition boards in Windows. DriverLINX is a multi-user and multitasking data-acquisition resource manager providing more than 100 services for foreground and background data acquisition tasks.

Included with your DriverLINX package are the following items:

- The DriverLINX API DLLs and drivers supporting your data-acquisition hardware
- Analog I/O Panel, a DriverLINX program that verifies the installation and configuration of DriverLINX for your analog output board and demonstrates several virtual bench-top instruments
- Source code for the sample programs
- The DriverLINX Application Programming Interface files for your compiler
- DriverLINX On-line Help System
- *DriverLINX Analog I/O Programming Guide*
- *DriverLINX Technical Reference Manual*
- Supplemental Documentation on DriverLINX and your data-acquisition hardware

About This User's Guide

The purpose of this manual is to help you quickly learn how to configure and use the hardware features of Keithley's KPCI-3130 Series boards with DriverLINX.

- For more information on the DriverLINX API, please see the *DriverLINX Technical Reference Manual.*
- For additional help programming your board, please examine the source code examples on the Distribution Disks.

This manual contains the following chapters:

Configuring the KPCI-3130 Series

Shows how to configure the KPCI-3130 Series using the *Configure DriverLINX Device* dialog box.

Using the KPCI-3130 Series with DriverLINX

Shows how to set up DriverLINX with the *Edit Service Request* dialog box to use KPCI-3130 Series hardware features.

Uninstalling DriverLINX

Describes how to remove DriverLINX hardware drivers and other files.

Troubleshooting

Gives troubleshooting tips for installing, configuring, and loading DriverLINX drivers.

Conventions Used in This Manual

The following notational conventions are used in this manual:

- A round bullet (•) identifies itemized lists.
- Numbered lists indicate a step-by-step procedure.
- DriverLINX Application Programming Interface and Windows macro and function names are set in bold when mentioned in the text.
- **DriverLINX** indicates the exported function name of the device driver DLL while DriverLINX indicates the product as a whole.
- DriverLINX Application Programming Interface identifiers, menu items, and Dialog Box names are italicized when mentioned in the text.
- *Italics* are used for emphasis.
- Source code and data structure examples are displayed in Courier typeface and bounded by a box with a single line.

```
Code
```

- A box with a double line bound tables of information.

Tables

Concept

- Important concepts and notes are printed in the left margin.

Configuring the KPCI-3130 Series

Introduction

The installation program provides general instructions for installing and configuring DriverLINX. This manual explains the steps and special features that apply to Keithley's KPCI-3130 Series boards.

Installing and configuring DriverLINX for a Keithley KPCI-3130 Series board requires three steps:

1. **Install DriverLINX.** Follow the instructions given by the installation program. The *Read Me First* instructions explain the components and drivers you can install.
2. **Configure DriverLINX.** This creates a Logical Device, which stores configuration information for your board. See "Configure DriverLINX Device Dialog" on page 12 for configuration options specific to a Keithley KPCI-3130 Series model.
3. **Install your KPCI-3130 hardware.** Follow the instructions in your hardware manual.

After configuring DriverLINX, installing your board and restarting Windows, reopen the *DriverLINX Configuration Panel* to make sure that DriverLINX loaded the Logical Device for your board. If the Logical Device is not loaded, the Event Log may have a message from the driver that explains why. You can check the Event Log using the *DriverLINX Event Viewer* on the Windows Start Menu.

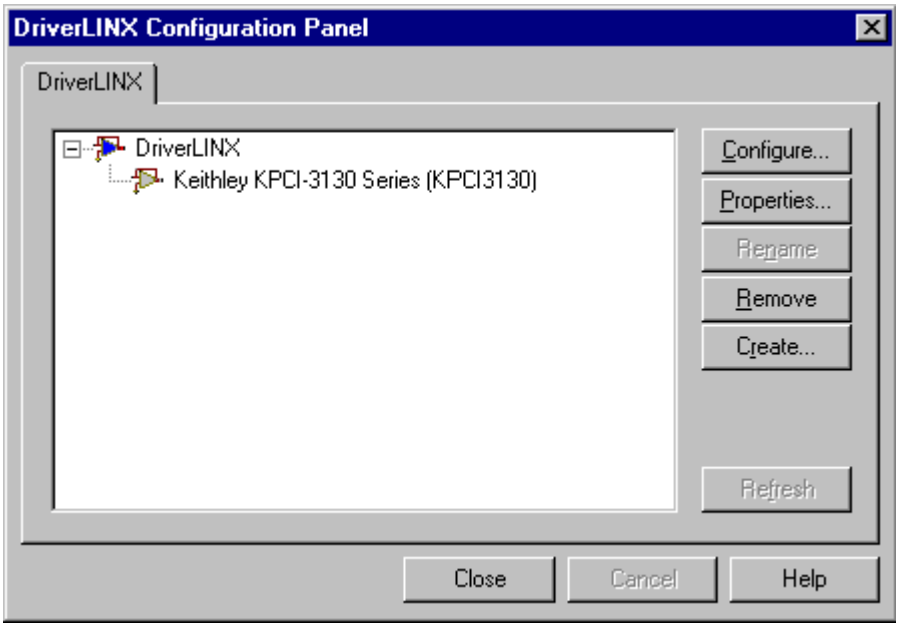
Windows NT

Under Windows NT 4.0, a Logical Device may not load because the operating system does not always configure Plug-and-Play PCI devices properly. To work around this, set your computer's BIOS to configure Plug-and-Play devices before it starts the operating system. On various computers the BIOS setting is called "Plug-and-Play Aware OS – Disabled" or "Plug & Play OS – No".

Configure DriverLINX Device Dialog

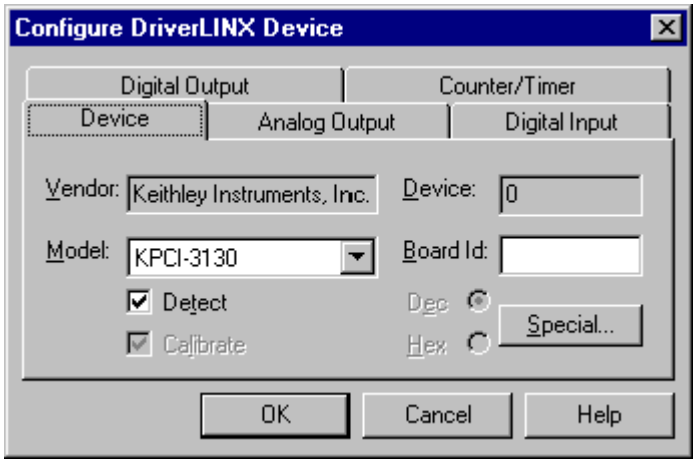
DriverLINX uses a standardized configuration protocol for all data-acquisition hardware. Configuration assigns an identifying device number to a specific KPCI-3130 Series board in your computer and allows you to set the emulated analog output resolution and data format.

The installation program automatically starts the *DriverLINX Configuration Panel*. To start it now, use the shortcut on the Windows Start Menu.



When you click the *Configure…* button on the *DriverLINX Configuration Panel*, DriverLINX displays the *Configure DriverLINX Device* dialog. The dialog has a page for each subsystem on the Keithley KPCI-3130 Series. The following sections describe your choices in configuring DriverLINX to work with your board.

Device Subsystem Page



Use the Device subsystem page to tell DriverLINX the model name of your KPCI-3130 Series board, and, optionally, the emulated analog output resolution and data format and to enable digital I/O testing.

Vendor

The *Vendor* property displays "Keithley Instruments, Inc." It is a read-only property.

Device

The *Device* property designates the Logical Device you are configuring. It is a read-only property. To change it, first save (**OK**) or quit (**Cancel**) the current configuration. Then select or create a new Logical Device using the *DriverLINX Configuration Panel.*

Model

The *Model* property selects or indicates the hardware model of the board you're configuring.

Windows NT

Windows 2000

Select one of the following models:

KPCI-3130

KPCI-3132

Windows 95/98

Windows 95/98 automatically determines the model of your board so DriverLINX disables Model selection.

Board Id

The Board Id property associates this Logical Device with a specific board. DriverLINX automatically enters the KPCI-3130's serial number in this field. DriverLINX uses the board's serial number to uniquely recognize boards if you have installed multiple boards of the same model into your computer.

Windows NT

Windows 2000

Under Windows NT or Windows 2000, Board Id is initially blank. DriverLINX will use the Model setting to match this Logical Device to the first available board and then enter that board's serial number.

Windows 95/98

Windows 95/98 automatically determines which board to associate with this Logical Device. DriverLINX enters the serial number of the board when it starts the configuration.

Detect

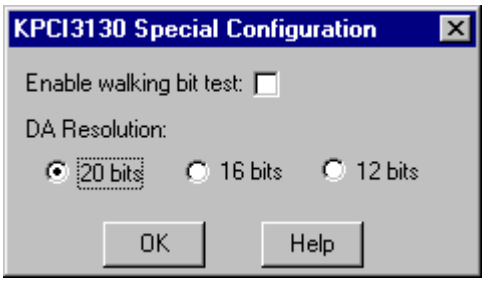
The *Detect* property enables and disables DriverLINX's hardware detection and testing algorithms. For maximum system reliability, always leave this check-box marked.

Calibrate

The *Calibrate* property enables and disables hardware auto-calibration. This option is grayed-out for the KPCI-3130 Series because it does not support automatic calibration.

Special…

The *Special…* button displays the following dialog box of KPCI-3130 Series-specific configuration options:



Enable walking bit test (Model KPCI-3130 only)

DriverLINX can perform a Walking-Bit Test when it next loads this Logical Device. The Walking-Bit Test checks your KPCI-3130 Series board for internal digital input/output line damage.

To perform the Walking-Bit Test:

1. Enable the test using the check box.
2. Remove the cable from your board
3. Restart your computer.

- If the driver finds a damaged line, it makes an entry in the Event Log and does not load the Logical Device.
- If the test passes, the driver loads the Logical Device and clears the check box so the test does not run again.

Important: You must remove the cable from your board for a successful test.

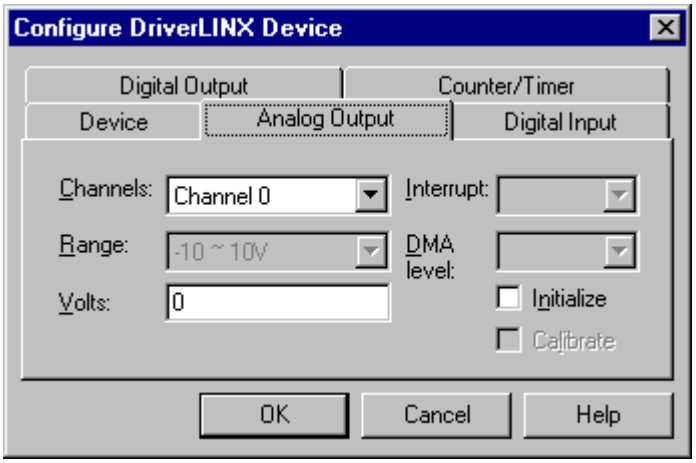
DA Resolution

DA resolution determines the data coding format and data width of digital-to-analog samples. For the KPCI-3130 Series, the normal resolution for analog-output data coding is 20 bits. DriverLINX provides three options for analog-output resolutions for compatibility with application written for other hardware.

Resolution	Format	Width	Usage
20 Bits	Right-justified two's complement	4 Bytes	Normal setting
16 Bits	Two's complement	2 Bytes	Compatible with applications that assume samples are two bytes wide*
12 Bits	Right-justified two's complement	2 Bytes	Compatible with applications that assume a right-justified, 12-bit, two's complement format*

*You would need one of these settings only for applications that do not use DriverLINX's hardware-independent data conversion functions.

Analog Output Subsystem Page



Use the Analog Output subsystem page to set or view the initial output voltages.

Channels

Lists the analog output channels on the board and selects a channel for the Volts and Initialize properties.

Model KPCI-3130

Physical Channel	Connector Name	Logical Channel
1	OUT1, GND	0
2	OUT2, GND	1
3	OUT3, GND	2
4	OUT4, GND	3
5	OUT5, GND	4
6	OUT6, GND	5
7	OUT7, GND	6
8	OUT8, GND	7

Model KPCI-3132

Physical Channel	Connector Name	Logical Channel
1	OUT1, GND	0
2	OUT2, GND	1

Range

The KPCI-3130 Series has a single, fixed analog output range or +/-10V. DriverLINX grays out this property in the configuration dialog.

Volts

The *Initialization Value* property specifies the analog output value DriverLINX will write to the selected Logical Channel upon hardware initialization. DriverLINX only writes this value if you enable the *Initialize* check box.

Interrupt

Windows automatically determines the interrupt level for the KPIC-3130 Series board. DriverLINX disables this property.

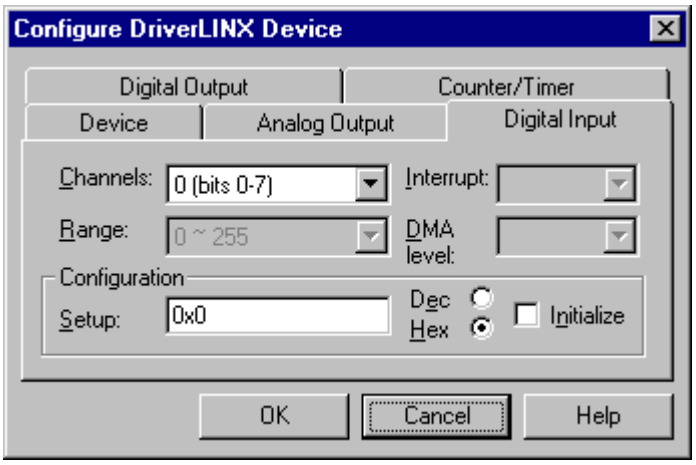
DMA

The KPCI-3130 Series does not use DMA channels for direct memory transfers. DriverLINX disables this property.

Initialize

Checking the *Initialize* check box instructs DriverLINX to use the *Volts* property for to initialize the selected analog output channel.

Digital Input Subsystem Page



Use the Digital Input subsystem page to set configurable digital channels as input or output.

Channels

The *Channels* property allows you to select a Logical Channel for configuration or viewing the channel's range.

The KPCI-3130 Series supports both fixed and configurable digital channels. DriverLINX defines the following Logical Channels for the KPCI-3130 Series Digital Input Subsystem:

Model KPCI-3130

Logical Channel	DriverLINX Function	KPCI-3130 Series External Connector
0	Digital Input/Output	Bit 0, DGND … Bit 7, DGND
1	Digital Input/Output	Bit 8, DGND … Bit 15, DGND
2	Digital Input/Output	Bit 16, DGND … Bit 23, DGND
3	Digital Input/Output	Bit 24, DGND … Bit 31, DGND
4	Digital Input/Output (read DAC overload flags)	S1H,S1L … S8H, S8L
5	*Reserved*	
6	External Clock (sample on DAC overload)	S1H,S1L … S8H, S8L
7	External Trigger (trigger on DAC overload)	S1H,S1L … S8H, S8L

Model KPCI-3132

Logical	DriverLINX	KPCI-3130 Series External

Channel	Function	Connector
0	*Reserved*	
1	*Reserved*	
2	*Reserved*	
3	*Reserved*	
4	Digital Input/Output (read DAC overload flags)	S1H,S1L … S2H, S2L
5	*Reserved*	
6	External Clock (sample on DAC overload)	S1H,S1L … S2H, S2L
7	External Trigger (trigger on DAC overload)	S1H,S1L … S2H, S2L

Range

The *Range* property specifies the supported digital input range for the selected Logical Channel. This is a read-only property.

Interrupt

Windows automatically determines the interrupt level for the KPIC-3130 board. DriverLINX disables this property.

DMA

The KPCI-3130 Series does not use DMA channels for direct memory transfers. DriverLINX disables this property.

Configuration Setup

The *Configuration Setup* property specifies the hardware configuration of the digital I/O ports. Logical Channels 0 through 3 are configurable as input or output. A setup value of 1 initially configures the selected channel as input; 0 initially configures it as output.

To specify an initial configuration:

1. Select the C*hannel* to configure
2. Select *Dec* (decimal) or *Hex* (hexadecimal)
3. Enter a *Setup* value
4. Check the *Initialize* box
5. Repeat for each channel

After completing the device configuration, click OK and restart Windows to reload the device with the new configuration.

Note: Channels configured as output can have initial output values other than the hardware default. See “Initialization Value” on page 22.

Initialize

Checking the *Initialize* check box instructs DriverLINX to use the *Configuration Setup* property to configure the selected digital I/O channel.

Digital Output Subsystem Page

Use the Digital Output subsystem page to change the default digital output port initialization values.

Channels

The *Channels* property allows you to select a Logical Channel for initialization or viewing the channel's range.

Models KPCI-3130

Logical Channel	DriverLINX Function	KPCI-3130 Series External Connector
0	Digital Input/Output	Bit 0, DGND … Bit 7, DGND
1	Digital Input/Output	Bit 8, DGND … Bit 15, DGND
2	Digital Input/Output	Bit 16, DGND … Bit 23, DGND
3	Digital Input/Output	Bit 24, DGND … Bit 31, DGND
4	Digital Input/Output (reset DAC overload flags)	S1H,S1L … S8H, S8L

Models KPCI-3132

Logical Channel	DriverLINX Function	KPCI-3130 Series External Connector
0	*Reserved*	
1	*Reserved*	
2	*Reserved*	
3	*Reserved*	
4	Digital Input/Output (reset DAC overload flags)	S1H,S1L … S2H, S2L

Range

The *Range* property specifies the supported digital output range for the selected Logical Channel. This is a read-only property.

Interrupt

Windows automatically determines the interrupt level for the KPIC-3130 board. DriverLINX disables this property.

DMA

The KPCI-3130 Series does not use DMA channels for direct memory transfers. DriverLINX disables this property.

Initialization Value

The *Initialization Value* property specifies the digital output value DriverLINX will write to the selected Logical Channel upon hardware initialization. DriverLINX only writes this value if you enable the *Initialize* check box.

To specify an initial output value:

1. Select the C*hannel* to initialize
2. Select *Dec* (decimal) or *Hex* (hexadecimal)
3. Enter an *Initialization* value
4. Check the *Initialize* box
5. Repeat for each channel

Initialize

Checking the *Initialize* check box instructs DriverLINX to use the *Initialization Value* property for digital output port initialization.

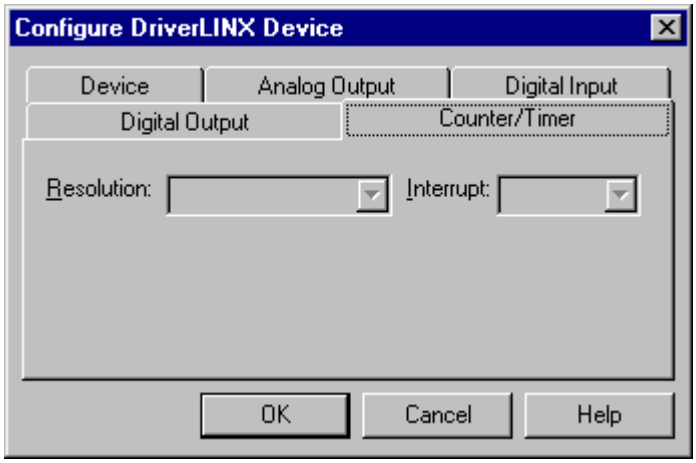
Dec

This check box converts the *Initialization Value* property to decimal.

Hex

This check box converts the *Initialization Value* property to hexadecimal.

Counter/Timer Subsystem Page



Use the Counter/Timer subsystem page to set the default clock source frequency.

Resolution

The KPCI-3130 Series does not have a clock. DriverLINX provides a counter/timer subsystem so that changes in DAC overload conditions can pace sampling the DAC overload status registers Therefore, DriverLINX disables the *Resolution* property.

Interrupt

Windows automatically determines the interrupt level for the KPIC-3130 Series board. DriverLINX disables this property.

Using the KPCI-3130 Series with DriverLINX

Introduction

See the Analog I/O Programming Guide *for an overview of DriverLINX programming.*

This chapter shows you how to set up and use KPCI-3130 Series hardware features with DriverLINX.

The descriptions here use the *Edit Service Request* dialog for language and API independence. For the correct syntax with the language you're using, please see the *DriverLINX Technical Reference Manuals.* For DriverLINX examples in your programming language, please see the source code examples in the subdirectories of your DriverLINX installation directory or on the original distribution media.

KPCI-3130 Series Hardware Features

The KPCI-3130 Series offers your data-acquisition application stable, remotely sensed analog outputs and 32-bits of digital input/output. DriverLINX accesses these features through its hardware independent Applications Programming Interface (API).

The following table is a cross-reference between hardware features and the DriverLINX features that access them.

Hardware Feature	DriverLINX Feature
Differential remote sensing of DAC voltage	Polled read of DAC status register. Polled reset of DAC status register. Interrupt mode sampling of DAC status register.
Calibration of analog output channels	DriverLINX provides a stand-alone *KPCI-3130 Calibration Utility.*

Hardware Feature	DriverLINX Feature
32 bits of digital I/O	Four 8-bit Logical Channels, individually configurable in either the digital input or digital output subsystems.

DriverLINX Hardware Model for KPCI-3130 Series

DriverLINX provides a portable, hardware-independent API for data-acquisition boards while still allowing applications to access unique or proprietary hardware features of specific products. To achieve this goal, DriverLINX maps a hardware-independent, or abstract, data-acquisition model onto KPCI-3130 Series hardware capabilities.

The following sections describe how DriverLINX implements KPCI-3130 Series hardware features as Subsystems, Modes, Operations, Events, Logical Channels, Buffers, and Messages.

DriverLINX Subsystems

The KPCI-3130 Series supports the following DriverLINX subsystems:

- **Device**—refers to a KPCI-3130 Series board as a whole.
- **Analog Output**—refers to the analog output channels.
- **Digital Input**—refers to the digital input/output ports as well the status of the DAC sensing lines.
- **Digital Output**—refers to the digital input/output ports as well a virtual output port to reset the status of the DAC sensing lines.
- **Counter/Timer**—refers to a virtual counter/timer channel for pacing digital input tasks that read the overload register.

DriverLINX Modes

Applications use modes in Service Requests to advise DriverLINX on their preferred hardware data transfer technique. The DriverLINX modes fall into two general classes:

- **Foreground or synchronous modes.** The calling application doesn't regain control until DriverLINX completes the Service Request. DriverLINX supports this mode for simple, single value I/O operations or software housekeeping functions that DriverLINX can complete without a significant delay.
- **Background or asynchronous modes.** The calling application regains control as soon as DriverLINX initiates the task. The calling application must synchronize with the data-acquisition task using status polling or DriverLINX's messages (preferred). DriverLINX supports this mode for buffered data transfers or for commands that require a significant time to complete.

DriverLINX supports four modes with the KPCI-3130 Series for its commands (Service Requests).

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

The following table summarizes the data acquisition modes that DriverLINX supports for each subsystem with the Keithley KPCI-3130 Series.

Subsystem	Polled	Interrupt	DMA	Other
Analog Output	√			√
Digital Input	√	√		√
Digital Output	√			√
Counter/Timer				√
Device				√

KPCI-3130 Series Supported DriverLINX Modes.

DriverLINX Operations and Events

Applications construct DriverLINX data-acquisition tasks by combining a small number of DriverLINX operations and events in many possible ways. The following table summarizes the operations and events that DriverLINX supports for the Keithley KPCI-3130 Series. Later sections for each DriverLINX subsystem will describe the operations and events in more detail.

Note: In addition to the operations shown in the table below, all subsystems allow the *MESSAGE* operation in any Mode.

Subsystem	Operation	Events		
Mode		Timing	Start	Stop
Analog Output				
Polled	Start	null	null, cmd	null, TC
Other	Initialize			
Digital Input				
Polled	Start	null	null, cmd	null, TC
Interrupt	Start, Stop, Status	rate, dig	cmd, dig	cmd, TC, dig
Other	Initialize, Configure*	DIO Setup*		
Digital Output				
Polled	Start	null	null, cmd	null, TC
Other	Initialize, Configure*	DIO Setup*		
Counter/Timer				
Other				
Device				
Other	Initialize, Capabilities			

Allowed Operations and Events for KPCI-3130 Series Subsystems and Modes.

*Model KPCI-3130 only.

The following list explains the Event abbreviations in the preceding table:

- **null**—Null or None Event specifies when a Service Request doesn't require an event
- **cmd**—Command Event specifies when DriverLINX starts or stops a task on software command
- **TC**—Terminal Count Event specifies when DriverLINX processes all data buffers once
- **rate**—Rate Event specifies how DriverLINX paces or clocks data transfer
- **dig**—Digital Event specifies a trigger, clock, or other control signal to pace, start, or stop a task
- **DIO Setup**—DIO Setup Event assigns a digital channel to either the Digital Input or Digital Output Subsystem.

Logical Channels

DriverLINX designates the individually addressable hardware channels for each subsystem as "Logical Channels." Generally, the zero-based Logical Channel numbering sequence closely follows the hardware manufacturer's channel numbering scheme.

In some cases, however, DriverLINX assigns Logical Channel numbers to hardware features that users don't commonly think of as "channels." For instance, DriverLINX commonly models external hardware clock input lines, external hardware trigger input lines, and external interrupt inputs as 1-bit digital Logical Channels. In other cases, DriverLINX models subsystem-specific features, such as internal pacer clocks, as members of a more general-purpose set of counter/timer channels.

For a list of DriverLINX assigned Logical Channel numbers, see the notes on each supported subsystem.

Buffers

Applications usually use data buffers to exchange data between the application and the data-acquisition hardware. When using data buffers, please note the following points about DriverLINX's data buffers:

- DriverLINX supports data-acquisition tasks with 0 to 255 data buffers per task.
- DriverLINX imposes no size limits on a single buffer, although the operating system or some hardware products may have size restrictions.
- User applications must allow DriverLINX to allocate all data buffers to guarantee application portability to different hardware and operating systems and to insure that the hardware can physically access the buffer memory.
- User applications usually don't have concurrent or immediate access to the in-use data buffer while DriverLINX is executing a data-acquisition task.

Connecting Signals to the KPCI-3130 Series

The Keithley hardware manual describes the data and control signals for the KPCI-3130 Series and the connector pinouts for these signals. This section summarizes how DriverLINX numbers the I/O data signals and how DriverLINX uses the control connections for external clock, trigger, and gating inputs.

Analog Output Subsystem Signals

The Analog Output subsystem has 2 or 8 singled-ended analog output connections, depending on the model.

DriverLINX maps these connections to Logical Channels as shown in the following table:

Model KPCI-3130

Physical Channel	Connector Name	Logical Channel
1	OUT1, GND	0
2	OUT2, GND	1
3	OUT3, GND	2
4	OUT4, GND	3
5	OUT5, GND	4
6	OUT6, GND	5
7	OUT7, GND	6
8	OUT8, GND	7

Model KPCI-3132

Physical Channel	Connector Name	Logical Channel
1	OUT1, GND	0
2	OUT2, GND	1

DAC Overload Signals

Each analog output has positive and negative sense lines that set a flag in a register and, optionally, raise an interrupt upon a DAC overload condition. DriverLINX models the register as Digital Input channels 4 and 5for reading or Digital Output channels 4 and 5 for resetting. An interrupt can start, stop or pace a Digital Input task that samples the register.

Digital Input Subsystem Signals

The Digital Input Subsystem, on model KPCI-3130, has a 32-bit digital input/output port that DriverLINX models as four 8-bit Logical Channels. All models have a pair of DAC overload sense lines for each analog output channel. DriverLINX models the overload sense lines as three Logical Channels in the Digital Input subsystem: one to read the overload status register, one the pace a task that samples the status register and another to start or stop a status sampling task. DriverLINX maps these signals to Logical Channels as shown in the following table:

Model KPCI-3130

Logical Channel	DriverLINX Function	KPCI-3130 Series External Connector
0	Digital Input/Output	Bit 0, DGND … Bit 7, DGND
1	Digital Input/Output	Bit 8, DGND … Bit 15, DGND
2	Digital Input/Output	Bit 16, DGND … Bit 23, DGND
3	Digital Input/Output	Bit 24, DGND … Bit 31, DGND
4	Digital Input/Output (read DAC overload flags)	S1H,S1L … S8H, S8L
5	*Reserved*	
6	External Clock (sample on DAC overload)	S1H,S1L … S8H, S8L
7	External Trigger (trigger on DAC overload)	S1H,S1L … S8H, S8L

Model KPCI-3132

Logical Channel	DriverLINX Function	KPCI-3130 Series External Connector
0	*Reserved*	
1	*Reserved*	
2	*Reserved*	
3	*Reserved*	
4	Digital Input/Output (read DAC overload flags)	S1H,S1L … S2H, S2L
5	*Reserved*	
6	External Clock (sample on DAC overload)	S1H,S1L … S2H, S2L
7	External Trigger (trigger on DAC overload)	S1H,S1L … S2H, S2L

Notes:

- If a channel is configured for output, reading it using the Digital Input subsystem returns the last value written.
- The External Clock and External Trigger channels are not available for reading but are available for clocking and triggering.
- Applications can assign a configurable channel to either subsystem using a Configure operation. (See “Digital Channel Configuration” on page 45.)

Digital Input Pacing and Triggering Signals

A Digital Input task that samples Logical Channel 4, the DAC overload status register can be started, stopped and paced by changes in the DAC overload status. DriverLINX defines as external clocks and triggers as shown in the following table:

Connector Name	DriverLINX Usage
S1H,S1L … S8H, S8L	External pacer clock: • Rate Generator: External Clocking • Digital Timing Event Start trigger: • Post-Trigger Sampling with a Digital Event Stop trigger: • Pre-Trigger Sampling with a Digital Event

How DriverLINX uses digital input control signals.

Digital Output Subsystem Signals

The Digital Output Subsystem, on model KPCI-3130, has a 32-bit digital input/output port that DriverLINX models as four 8-bit Logical Channels. All models have a Logical Channel to reset bits in the DAC overload register. DriverLINX maps these signals to Logical Channels as shown in the following table:

Models KPCI-3130

Logical Channel	DriverLINX Function	KPCI-3130 Series External Connector
0	Digital Input/Output	Bit 0, DGND … Bit 7, DGND
1	Digital Input/Output	Bit 8, DGND … Bit 15, DGND
2	Digital Input/Output	Bit 16, DGND … Bit 23, DGND
3	Digital Input/Output	Bit 24, DGND … Bit 31, DGND
4	Digital Input/Output (reset DAC overload flags)	S1H,S1L … S8H, S8L

Models KPCI-3132

Logical Channel	DriverLINX Function	KPCI-3130 Series External Connector
0	*Reserved*	
1	*Reserved*	
2	*Reserved*	
3	*Reserved*	
4	Digital Input/Output (reset DAC overload flags)	S1H,S1L … S2H, S2L

Notes:

- If a channel is configured for output, reading it (using the Digital Input subsystem) returns the last value written.
- Applications can assign a configurable channel to either subsystem using a Configure operation. (See “Digital Channel Configuration” on page 45.)

Counter/Timer Subsystem Signals

DriverLINX defines a Counter/Timer subsystem for the KPCI-3130 to allow applications to use the DAC Overload Sense Lines as external clock sources.

DriverLINX maps these signals as shown in the following table:

Model KPCI-3130

Logical Channel	DriverLINX Function	KPCI-3130 Series External Connector
0	External Clock (sample on DAC overload)	+/- DAC Overload Sense Lines 0 … 7

Device Subsystem

The following sections describe how DriverLINX implements Device Subsystem features for the KPCI-3130 Series.

Device Modes

The Device Subsystem supports only DriverLINX's *Other* mode for all operations.

Device Operations

The KPCI-3130 Series Device Subsystem supports the following DriverLINX operations:

If another application is using the same data-acquisition board, DriverLINX will prevent Device Initialization from interfering with another application's data-acquisition tasks.

- **Initialize**—DriverLINX aborts all data-acquisition tasks for every subsystem controlled by the current application. DriverLINX then initializes each subsystem.
- **Capabilities**—DriverLINX provides hardware-specific and configuration information in the form of a Logical Device Descriptor database. (If you are using the DriverLINX ActiveX controls, access the Logical Device Descriptor with a DriverLINXLDD control rather than with this operation.)

Analog Output Subsystem

The following sections describe how DriverLINX implements Analog Output Subsystem features for the KPCI-3130 Series.

Analog Output Modes

The Analog Output Subsystem supports the following modes:

- **Polled**—For single-value or single-scan analog output samples.
- **Other**—For subsystem initialization and data conversion.

Analog Output Operations

The KPCI-3130 Series Analog Output Subsystem supports the following DriverLINX operations:

- **Initialize**—aborts all active analog output data-acquisition tasks. However, DriverLINX prevents one application from interfering with another application's data-acquisition tasks.
- **Start**—initiates a data-acquisition task using the Mode, Timing, Start, and Stop Events, the Logical Channels, and the Buffers the application specified in the Service Request.
- **Message**—DriverLINX displays a pop-up dialog box for the user containing the text for the current DriverLINX error message.

Analog Output Pacing, Triggering and Gating Options

The KPCI-3130 Series' highly stable analog outputs are designed for polled operation only. Therefore, DriverLINX allows only polled single-value or single-scan operations without any pacing, triggering or gating. DriverLINX does optimize outputs by grouping channels with the same output values and updating them all in the same operation. This can reduce the time required for a scan.

Analog Output Timing Events

Timing Events specify how the hardware paces or clocks the writing of analog output samples. DriverLINX uses the Timing Event to program when the KPCI-3130 Series writes the next analog output sample.

The KPCI-3130 Series supports the following Timing Events:

- **None**—Task requires no pacing as DriverLINX is writing only a single value or scan.

None or Null Timing Event

The Null Event specifies that the task does not need a clock to determine when to write the next sample.

Analog Output Start Events

Start Events specify when the hardware starts acquiring analog output data.

The KPCI-3130 Series supports the following Start Events:

- **None**—Use this event when the DriverLINX operation does not require a Start Event.
- **Command**—DriverLINX starts the task on software command, i.e., as soon as DriverLINX finishes programming the KPCI-3130 hardware for the task.

None or Null Start Event

The Null Event specifies that the task does not need a Start Event to begin the task.

Command Start Event

The Command Event starts data acquisition as soon as DriverLINX has completed programming the data-acquisition hardware with the task parameters.

Analog Output Stop Events

Stop Events specify when the hardware stops acquiring analog output data.

The KPCI-3130 Series supports the following Stop Events:

- **None**—Use this event when the DriverLINX operation doesn't require a Stop Event.
- **Terminal count**—DriverLINX stops the task after the data-acquisition hardware has filled all the data buffers once.

None or Null Stop Event

The Null Event specifies that the task does not need a Stop Event to end the task.

Terminal Count Stop Event

The Terminal Count Event stops data acquisition after DriverLINX has filled all the data buffers ***once*** with analog output data. Use Terminal Count when you want to write a single scan or fixed amount of data.

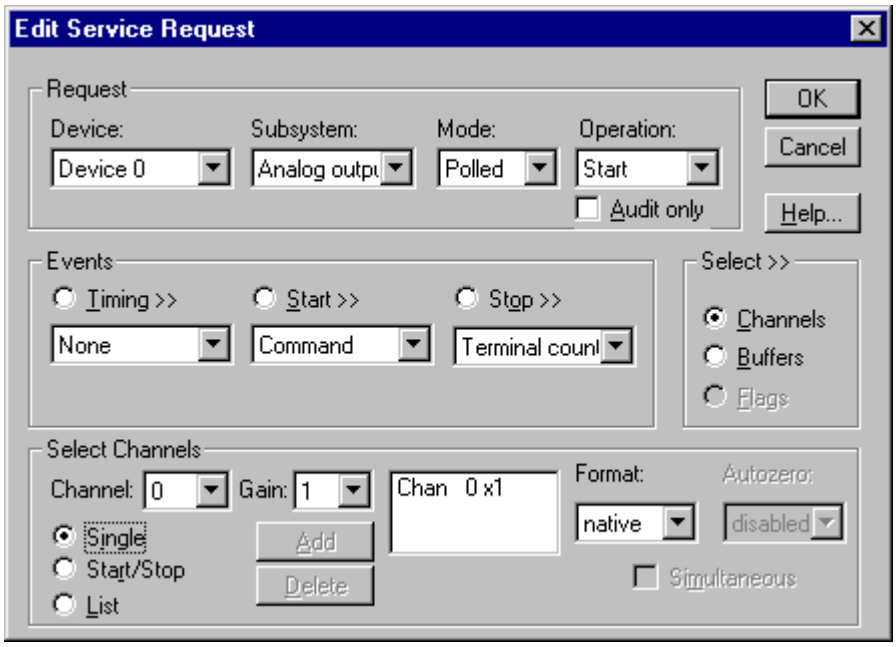
Analog Output Channels

The KPCI-3130 Series allows applications to specify the analog channels using three techniques:

- **Start Channel**—Write data to a single channel.
- **Start/Stop Channel Range**—Write data to a consecutive range of channels.
- **Channel List**—Write data to a list of channels.

Single Channel Analog Output

In single channel mode, the KPCI-3130 Series writes data to one channel.

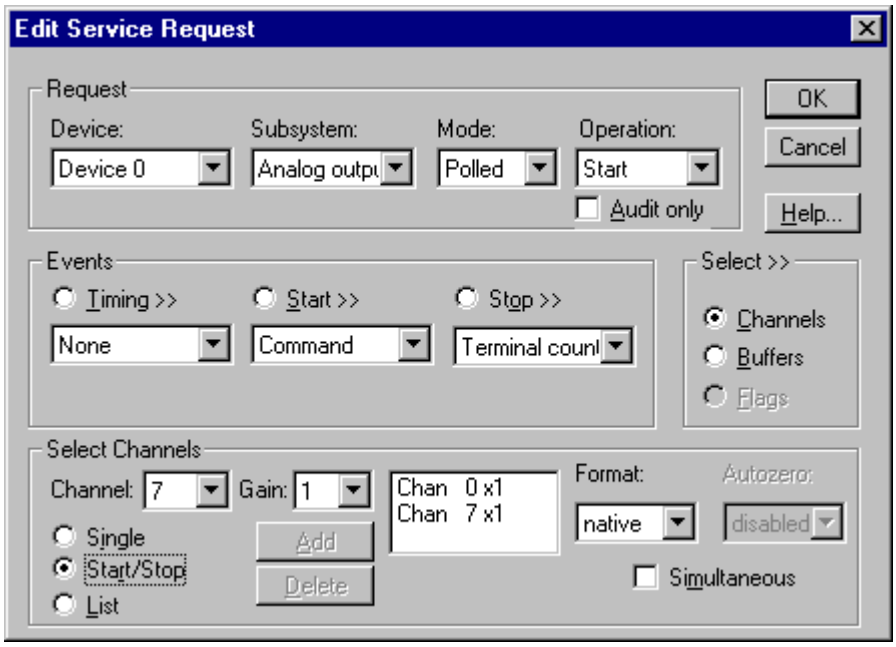


How to set up the KPCI-3130 Series for writing to a single channel.

Multi-channel Analog Output Range

In multi-channel range mode, the KPCI-3130 Series writes data to a consecutive range of analog channels.

- The Stop Channel must be greater than the Start Channel.

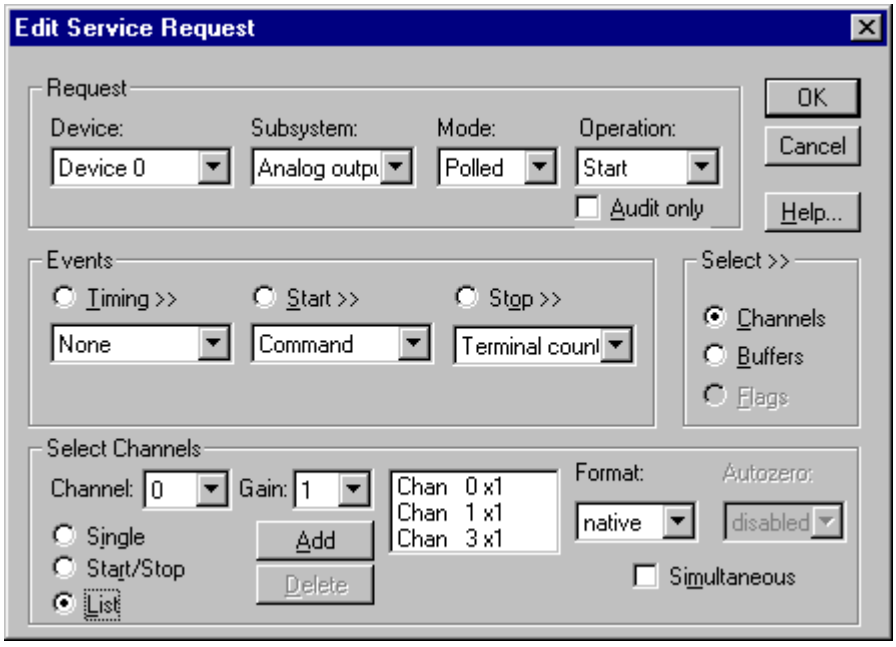


How to set up the KPCI-3130 Series for writing to a consecutive range of channels.

Multi-channel Analog Output List

In multi-channel list mode, the KPCI-3130 Series writes data to an arbitrary list of analog channels.

- For the KPCI-3130 Series, a channel cannot appear more than once in the list.



How to set up the KPCI-3130 Series to write to an arbitrary list of channels.

Analog Output Channel Gains

The KPCI-3130 Series models support a single analog output range. The following table shows the correspondence between DriverLINX gains, the maximum output signal range, and the gain code for each output range. Note: DriverLINX uses a negative (-) gain value to signify a bipolar (±) range.

Gain	Range	Gain Code
-1	±10 V	0

Gains, Ranges, and Gain Codes for the KPCI-3130 Series.

Use the DriverLINX **Gain2Code** method to easily convert between the gains in the above table and hardware Gain Codes.

Special Flags for Channels

On the KPCI-3130 Series, each analog output channel in a task can have several independent configuration options. DriverLINX uses special flags in the channel's gain property to indicate these options. For the KPCI-3130 Series the option are:

- Coupling—DC or ground
- DAC overload monitoring control

The KPCI-3130 Series provides remote differential sensing lines for each analog output channel to determine when the voltage across the load does not match the output voltage. DriverLINX allows you to control how an analog output task affects DAC Overload monitoring using special flags in a channel's gain property. (For a complete list of DAC overload monitoring options, see "Checking for DAC Overload" on page 44.)

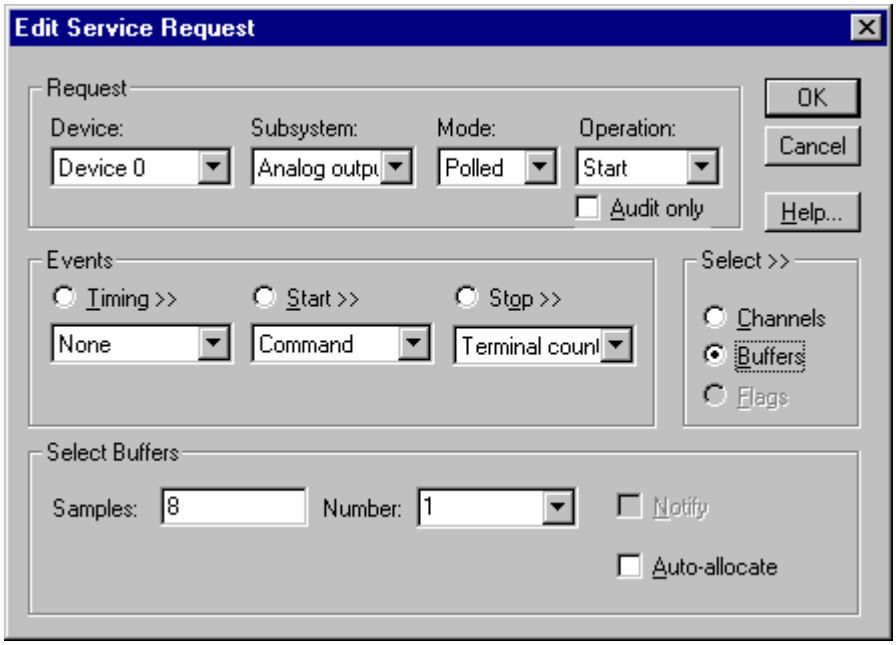
Flag	Set Meaning	Clear Meaning (Default)
CHAN_COUPLING_DC (2 * 2^11)	Uses the DC coupling mode.	Uses the default coupling mode for the device (DC for the KPCI-3130 Series).
CHAN_COUPLING_GND (3 * 2^11)	Grounds the output pins.	Uses the default coupling mode for the device (DC for the KPCI-3130 Series).
NO_OVLD_CLR (2^3) + CHAN_OEM_FLAG (2^15)	Does not clear the channel's overload status. Until it is cleared by a digital output task, this channel can be monitored for DAC overload only by polling with a digital input task.	Clears the channel's overload status. This enables DAC overload monitoring for this channel by a paced digital input task.

To use a gain flag, simply determine gain code for the desired gain using **Gain2Code** and then add the applicable flags.

Analog Output Buffers

DriverLINX supports single-value and single-scan analog output.

- **For single-value output**, specify the *Number* of buffers as **0**. The buffer for a single value is the *ioValue* property.
- **For a single-scan output**, specify the *Number* of buffers as **1** and the number of *Samples* equal to the number of channels in the channel range or list.



How to set up the KPCI-3130 Series to store samples in buffers.

Buffer Size

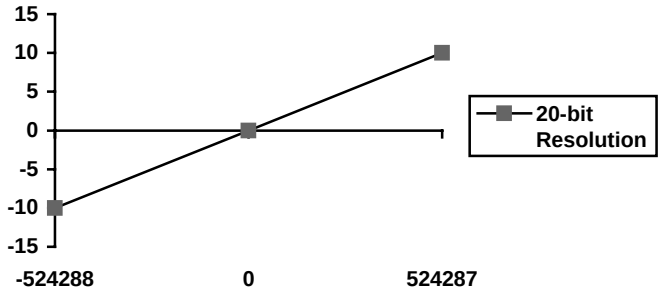
For the single-scan analog output that the KPCI-3130 Series supports, an analog output task can have only one buffer and it must hold exactly one scan of the channels in the channel range or list. Each sample occupies two or four bytes, depending on the emulated resolution.

Analog Output Data Coding

KPCI-3130 Series uses a right-shifted, two's complement binary format to encode analog output data, as shown in the following table. DriverLINX refers to this coding scheme as the "native" format.

Analog Output Resolution	Analog Output Hardware Code
12 bits	-4096 to 4095
16 bits	-32768 to 32767
20 bits	-524288 to 524287

Native Analog Output hardware codes for the KPCI-3130 Series.



KPCI-3130 Series native Analog Output Codes versus Voltage with a resolution of 20 bits.

DriverLINX refers to the default hardware analog-coding scheme as the “native” format. For computer arithmetic in a higher level language, the 16-bit two’s complement short integer or 32-bit two’s complement long integer format is generally easier to use. Applications can use DriverLINX’s data conversion operations to transform an entire data buffer from many common integer and floating-point formats to native format.

Analog Output Messages

For analog output operations, DriverLINX can report the following messages to the application:

DriverLINX Message	Explanation
Service Start	DriverLINX has started the acquisition task.
Service Done	DriverLINX has completed the acquisition task.
Critical Error	DriverLINX has encountered an unexpected hardware or software condition.

DriverLINX Event messages for analog output.

For detailed explanations of these messages see one of the following references:

- *DriverLINX Technical Reference Manual* for C/C++ users
- *DriverLINX/VB Technical Reference Manual* for VB or Delphi users

Checking for DAC Overload

The KPCI-3130 Series provides remote differential sensing lines for each analog output channel to determine when the voltage across the load does not match the output voltage. DriverLINX offers several techniques to check for such a DAC overload. An application can:

- Status poll at any time after settling

  To check for DAC overload, simply sample digital input channel 4 or 5. (See “Special Flags” on page 41.)

- Acquire a sample from the DAC overload status register upon each overload that the board detects

  To sample upon DAC overload, set up a paced task in the digital input subsystem that samples digital input channel 4 or 5. (See “Digital Input Timing Events” on page 46, “Digital Input Start Events” on page 48 and “Digital Input Stop Events” on page 50).

Digital Input Subsystem

The following sections describe how DriverLINX implements Digital Input Subsystem features for the KPCI-3130 Series.

Digital Input Modes

The Digital Input Subsystem supports the following modes:

- **Polled**—For single-value or scan digital input samples.
- **Interrupt**—For buffered transfers using programmed I/O.
- **Other**—For subsystem initialization.

Digital Input Operations

The KPCI-3130 Series Digital Input Subsystem supports the following DriverLINX operations:

- **Initialize**—aborts any active interrupt data-acquisition tasks and stops the clock. DriverLINX prevents one application from interfering with another application's data-acquisition tasks.
- **Configure**—assigns a configurable digital channel to the input subsystem.
- **Start**—initiates a data-acquisition task using the Mode, Timing, Start, and Stop Events, the Logical Channels, and the Buffers the application specified in the Service Request.
- **Status**—reports the buffer position of the next sample that DriverLINX will write into a buffer.
- **Stop**—terminates a digital input data-acquisition task.
- **Message**—DriverLINX displays a pop-up dialog box for the user containing the text for the current DriverLINX error message.

Digital Channel Configuration

Model KPCI-3130 supports four configurable digital channels. To use them as inputs you must first assign them to the Digital Input Subsystem using the "Configure DriverLINX Device Dialog" (page 12) or by using a Configure operation. Only channels 0 through 3 are configurable.

To configure a digital channel submit a service request with following settings:

- Subsystem—Digital Input or Digital Output
- Mode—Other
- Operation—Configure
- Timing Event—DIO Setup
- DIO Setup Channel—Channel number
- DIO Setup Mode—DIO BASIC

Example: For a programming example, see DIOCNFIG in your DrvLINX4\Source folder.

Digital Input Pacing, Triggering and Gating Options

The KPCI-3130 Series' 32-bit digital input/output lines are designed for polled operation only. However, as the *KPCI-3130 Series User's Manual* describes, a DAC overload can raise an interrupt. DriverLINX models this interrupt as an external digital trigger and external pacing clock of tasks that read the DAC overload register.

Digital Input Timing Events

Timing Events specify how the hardware paces or clocks the reading of Digital Input samples. DriverLINX uses the Timing Event to program when the KPCI-3130 Series reads the next sample from the digital input subsystem.

For the KPCI-3130 Series, a timed digital input task can sample only the DAC overload register channels (4 and 5). It is paced by changes in the DAC overload status.

The KPCI-3130 Series supports the following Timing Events:

- **None**—Input requires no pacing as DriverLINX is reading only a single value.
- **Rate**—DriverLINX models the DAC overload interrupt as an external clock for compatibility with applications written for other hardware.
- **Digital**—DriverLINX uses the DAC overload interrupt to pace the acquisition of each sample.

None or Null Timing Event

The Null Event specifies that the task does not need a clock to determine when to read the next sample.

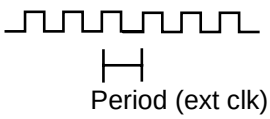
Rate Timing Event

The KPCI-3130 Series supports only the Rate Generator mode for Rate Events for digital input:

- **Rate Generator**—Generates a fixed rate clock with equal time intervals between tics.

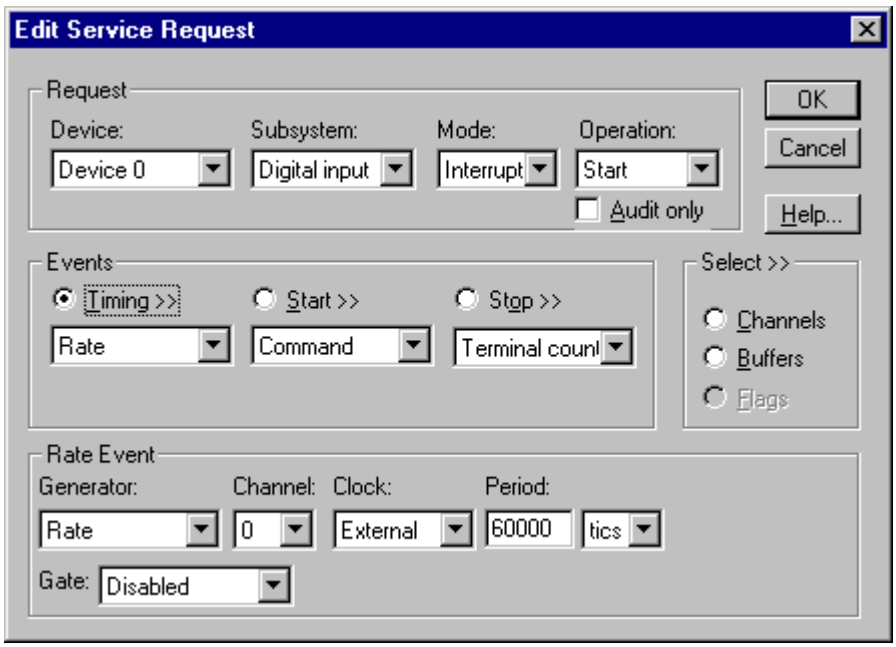
Rate Generator: External Clocking

An externally clocked Rate Generator produces a rate clock with unknown time intervals between tics.



Use an externally clocked rate generator when you want to synchronize digital input samples with a recurrent external signal.

For the KPCI-3130 Series, a timed digital input task can sample only the DAC overload register channels (4 and 5). It is paced by changes in the DAC overload status.



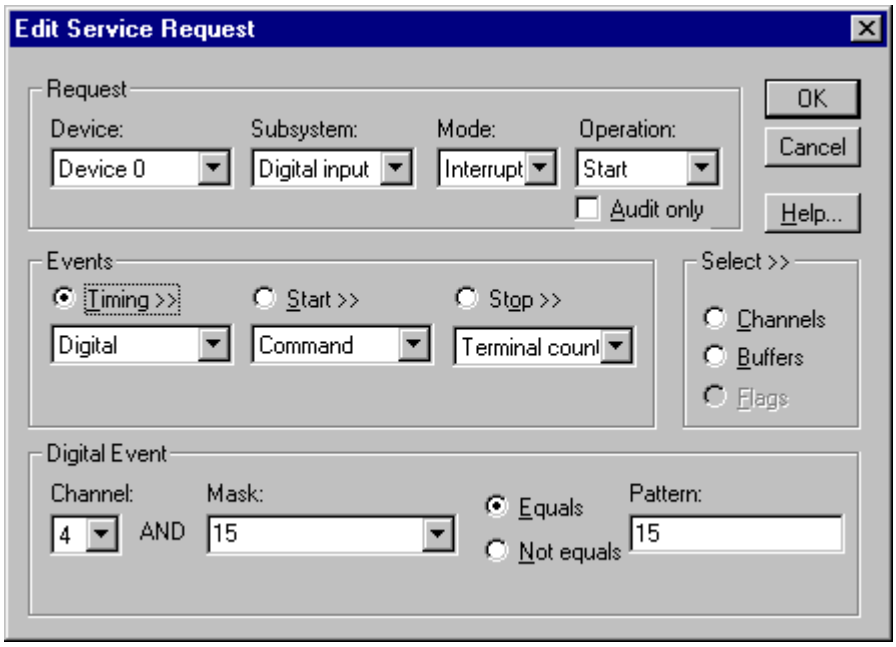
How to set up the KPCI-3130 for fixed rate sampling using an external clock.

- Specify external clocking using a **Rate** *Generator* on *Logical Channel* **0** with an **External** or **External+** *Clock* source. External and External+ both specify sampling on a DAC overload condition.
- Users should connect the sense lines (S*n*H and S*n*L) for each analog output channel being monitored.
- Specify a *Period* between 1 and $2^{32}-1$ tics that estimates the interval between external clocks pulses (DAC overloads). For the KPCI-3130, a tics is 1 µs. (This value is currently only for compatibility with other drivers, where DriverLINX may use the *Period* value to optimize data transfer between the driver and the application.)
- The *Gate* property is not applicable to the KPCI-3130; Values of **Disabled** and **NoConnect** are accepted.
- The channel list can contain only digital input channels **4** and/or **5**.
- If the start event is a digital event then the start event mask determines which DAC channels pace the sampling for the task. Otherwise, overloads on any channel in-use channel pace the sampling. For greater flexibility in specifying which DAC overloads to use for pacing, use a “Digital Timing Event” (see page 48).

Digital Timing Event

DriverLINX supports Digital Events as aliases for externally clocked Rate Generators. Use this technique for compatibility with data-acquisition products that only support external clock sources.

For the KPCI-3130 Series, a timed digital input task can sample only the DAC overload register channels (4 and 5). It is paced by changes in the DAC overload status.



How to set up the KPCI-3130 for external rate sampling using a digital event.

Digital Timing Events contain *mask*, *pattern*, and *match* fields. The mask is logically ANDed with the digital input data on the Logical Channel and then compared against the *pattern* for a match/mismatch.

- Specify external clocking using *Logical Channel* **4** or **5**.
- Specify the *Mask* property with bits set for the corresponding DAC channel to indicate that DriverLINX should sample upon each overload of these DAC channels.
- Specify the *Match* property as **Equals**.
- Specify the *Pattern* property as a subset of the *Mask*.
- Users should connect the sense lines (S*n*H and S*n*L) for each analog output channel in the *Mask*.

Digital Input Start Events

Start Events specify when the KPCI-3130 Series hardware starts reading digital input data.

The KPCI-3130 Series supports the following Start Events for digital input:

- **None**—Use this event when the DriverLINX operation doesn't require a Start Event.
- **Command**—DriverLINX starts the task on software command, i.e., as soon as DriverLINX finishes programming the KPCI-3130 hardware for the task.
- **Digital**—The KPCI-3130 starts acquiring digital input samples when the board detects overloads in selected DAC channels.

None or Null Start Event

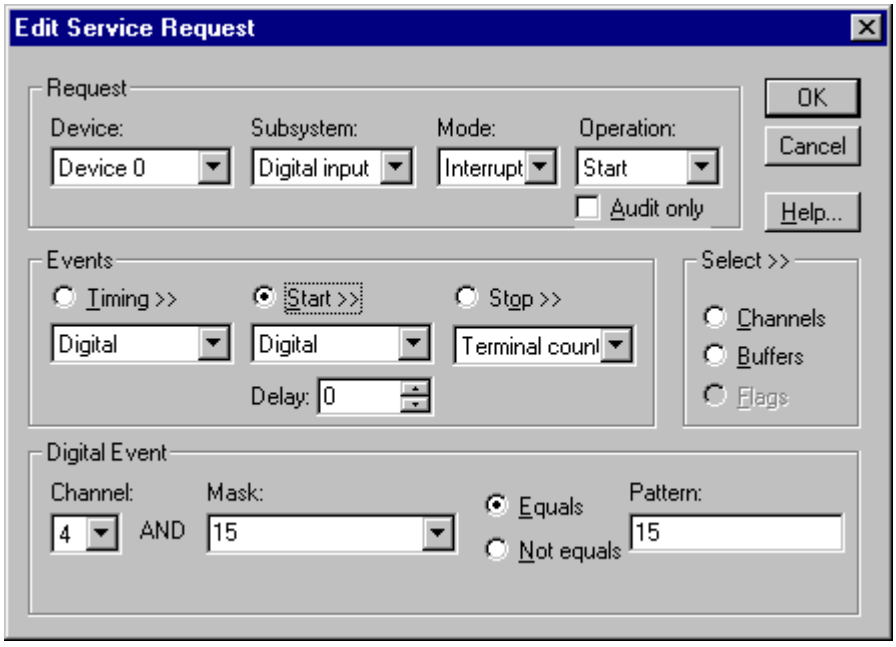
The Null Event specifies that the task does not need a Start Event to begin the task.

Command Start Event

The Command Event starts data acquisition as soon as DriverLINX has completed programming the KPCI-3130 Series hardware with the task parameters.

Post-Trigger Sampling with a Digital Event

The KPCI-3130 Series can acquire digital input samples ***after*** a digital trigger condition. Use post-triggering when you want to synchronize the start of data acquisition with an external signal.



How to set up the KPCI-3130 for post-triggered digital input.

A Digital Start Event requires an external timing source because the KPCI-3130 does not have a hardware clock.

Digital Start Events contain *mask*, *pattern*, and *match* fields. The mask is logically AND with the digital input data on the Logical Channel and then compared against the *pattern* for a match/mismatch.

- Specify the *Logical Channel* as **4** or **5.** DriverLINX checks for the Start Event condition whenever the board raises a DAC overload interrupt.
- Specify the *Mask* property to indicate that DriverLINX should only compare selected bits in the digital input value against the *Pattern* property.
- Users should connect the sense lines (S*n*H and S*n*L) for each analog output channel in the *Mask*.
- Specify the *Match* property as **Equals** triggers on any difference between the masked digital input and the *Pattern*.
- Specify the *Pattern* property to compare with the masked digital input value.
- The *Delay* property is not applicable to the KPCI-3130 Series; specify the value as **0**.

Digital Input Stop Events

Stop Events specify when the KPCI-3130 Series hardware stops reading digital input data.

The KPCI-3130 Series supports the following Stop Events for digital input:

- **None**—Use this event when the DriverLINX operation doesn't require a Stop Event.
- **Command**—DriverLINX stops the task on software command, i.e., when the application issues a Service Request with a *Stop* operation.
- **Terminal count**—DriverLINX stops the task after the KPCI-3130 Series hardware has filled all the data buffers once.
- **Digital**—The KPCI-3130 Series stops the task when the board detects that the digital input satisfies the condition specified in the Stop Event.

None or Null Stop Event

The Null Event specifies that the task does not need a Stop Event to end the task.

Command Stop Event

The Command Event stops data acquisition when the user application changes the *Operation* property in the Service Request to *Stop* and resubmits the Service Request to DriverLINX.

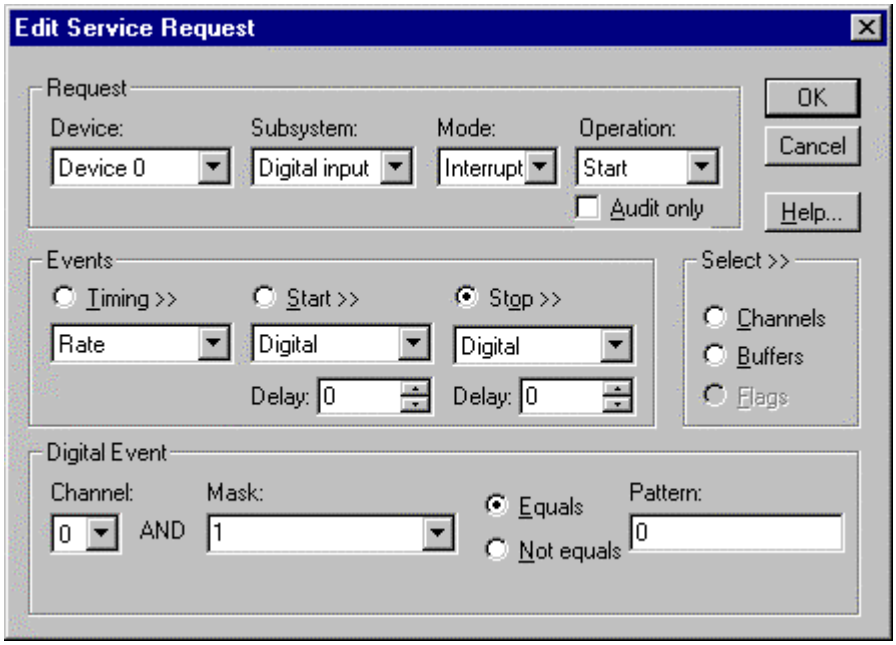
In Stop-on-Command mode, DriverLINX continuously cycles through all the data buffers, reading from the digital port on the KPCI-3130 Series.

Terminal Count Stop Event

The Terminal Count Event stops data acquisition after DriverLINX has read the digital input data into all the data buffers ***once***. Use terminal count when you want to read a fixed amount of data.

Pre-Trigger Sampling with a Digital Event

The KPCI-3130 can acquire digital input samples ***until*** the hardware detects a digital trigger condition. Use pre-triggering when you want to synchronize the end of data acquisition with an external signal.



How to set up the KPCI-3130 for pre-triggered digital input.

A Digital Stop Event requires an external timing source because the KPCI-3130 does not have a hardware clock.

Digital Stop Events contain *mask*, *pattern*, and *match* fields. The mask is logically AND with the digital input data on the Logical Channel and then compared against the *pattern* for a match/mismatch.

- Specify the *Logical Channel* as **4** or **5.** DriverLINX checks for the Start Event condition whenever the board raises a DAC overload interrupt.
- Specify the *Mask* property to indicate that DriverLINX should only compare selected bits in the digital input value against the *Pattern* property. The *Mask* must be a subset of the analog output channels monitored for the timing event (see “Digital Timing Event” on page 48 or “Rate Generator: External Clocking” on page 46).
- Specify the *Match* property as **Equals** to trigger on an exact match of the digital pattern to the masked digital input.
- Users should connect the sense lines (S*n*H and S*n*L) for each analog output channel in the *Mask*.
- Specify the *Pattern* property to compare with the masked digital input value.
- The *Delay* property is not applicable to the KPCI-3130 Series; specify the value as **0**.

Digital Input Channels

The KPCI-3130 Series allows applications to specify the digital channels using three techniques:

- **Start Channel**—Acquire data from a single channel.
- **Start/Stop Channel Range**—Acquire data from a consecutive range of channels.
- **Channel List**—Acquire data from a list of channels.

Digital Input Logical Channels

The KPCI-3130 Series supports both fixed and configurable digital channels. DriverLINX defines the following Logical Channels for the KPCI-3130 Series Digital Input Subsystem:

Model KPCI-3130

Logical Channel	DriverLINX Function	KPCI-3130 Series External Connector
0	Digital Input/Output	Bit 0, DGND … Bit 7, DGND
1	Digital Input/Output	Bit 8, DGND … Bit 15, DGND
2	Digital Input/Output	Bit 16, DGND … Bit 23, DGND
3	Digital Input/Output	Bit 24, DGND … Bit 31, DGND
4	Digital Input/Output (read DAC overload flags)	S1H,S1L … S8H, S8L
5	*Reserved*	
6	External Clock (sample on DAC overload)	S1H,S1L … S8H, S8L
7	External Trigger (trigger on DAC overload)	S1H,S1L … S8H, S8L

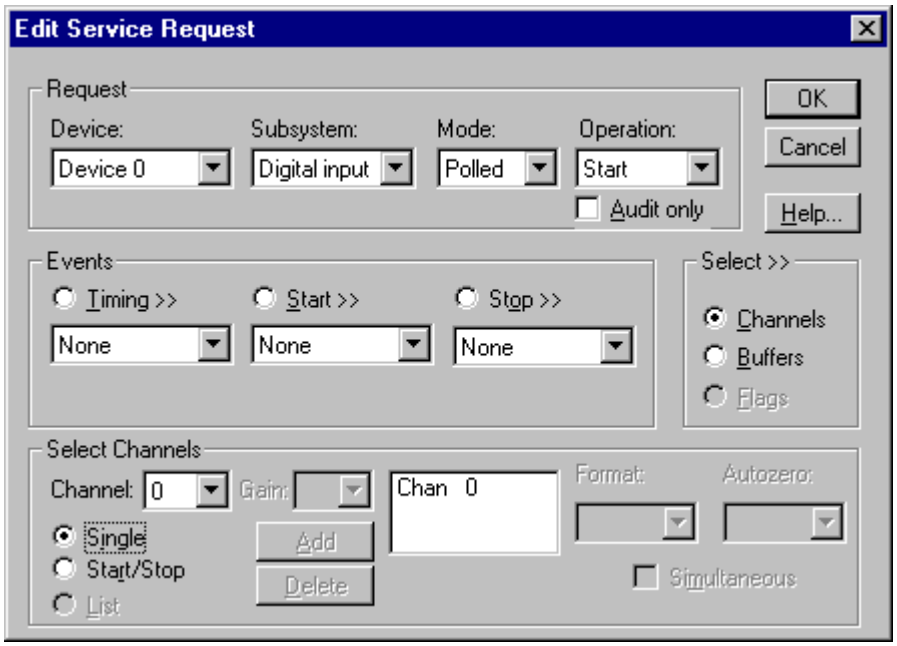
Model KPCI-3132

Logical Channel	DriverLINX Function	KPCI-3130 Series External Connector
0	*Reserved*	
1	*Reserved*	
2	*Reserved*	
3	*Reserved*	
4	Digital Input/Output (read DAC overload flags)	S1H,S1L … S2H, S2L
5	*Reserved*	
6	External Clock	S1H,S1L … S2H, S2L

	(sample on DAC overload)	
7	External Trigger (trigger on DAC overload)	S1H,S1L … S2H, S2L

Single Channel Digital Input

In single channel mode, the KPCI-3130 Series acquires all data from one channel.

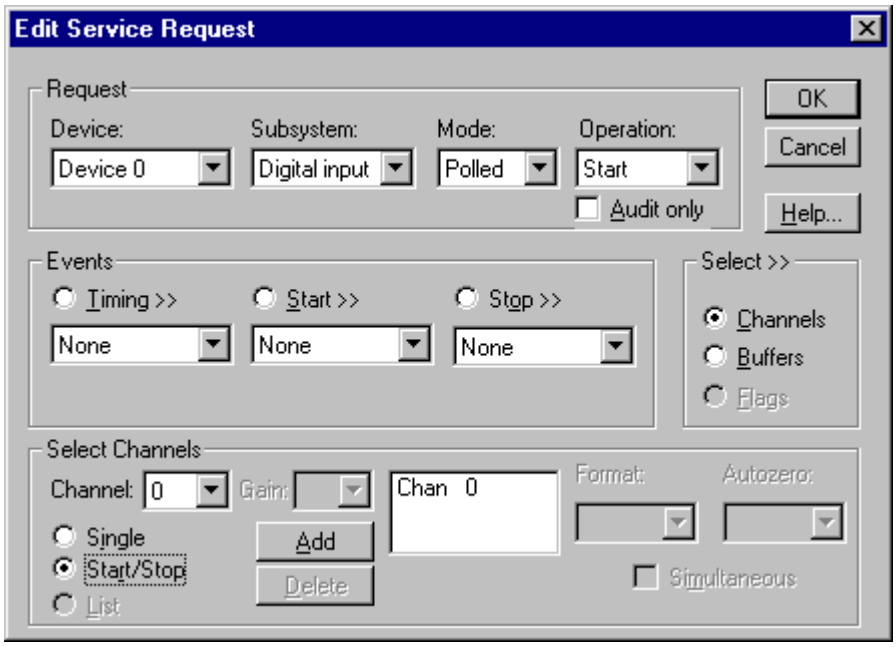


How to set up the KPCI-3130 Series for sampling on a single channel.

Multi-channel Digital Input Range

In multi-channel range mode, the KPCI-3130 Series acquires all data from a consecutive range of digital channels.

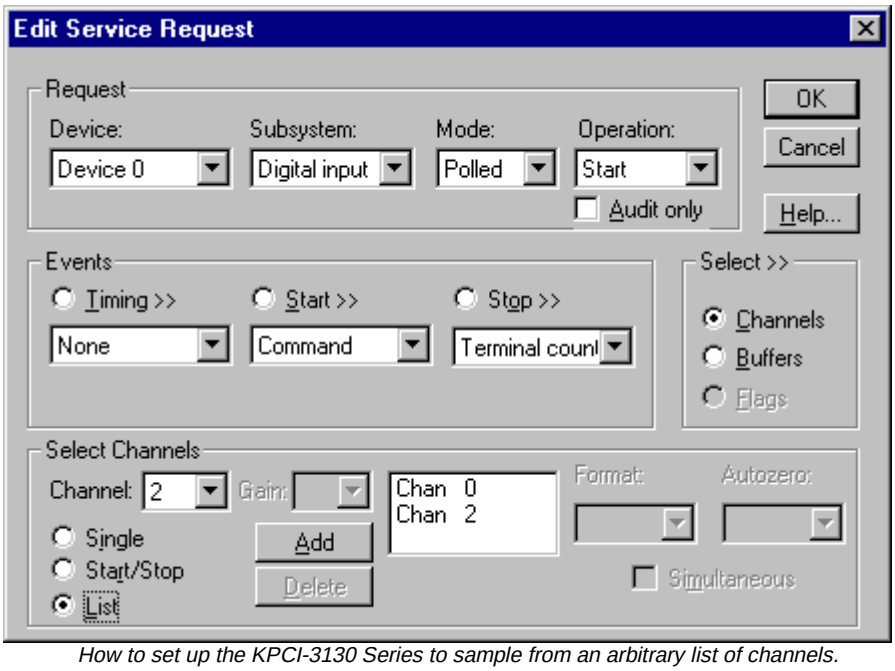
- The Stop Channel must be greater than the Start Channel.



How to set up the KPCI-3130 Series for sampling on a consecutive range of channels.

Multi-channel Digital Input List

In multi-channel list mode, the KPCI-3130 Series acquires all data from an arbitrary list of digital channels.

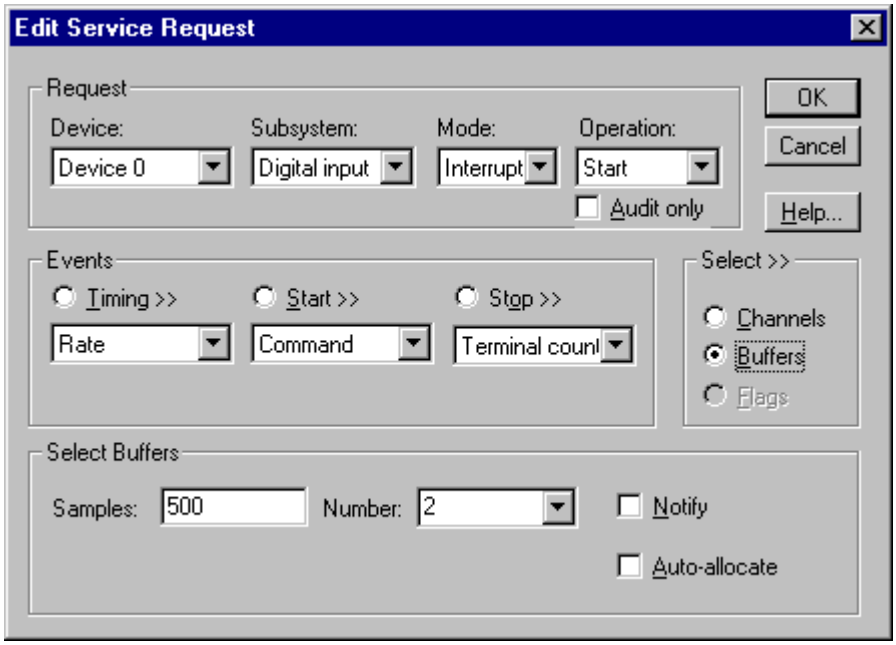


How to set up the KPCI-3130 Series to sample from an arbitrary list of channels.

Digital Input Buffers

DriverLINX supports single-value, single-scan and buffered digital input.

- **For single-value input**, specify the *Number* of buffers as **0**. The buffer for a single value is the *ioValue* property.
- **For single-scan input**, specify the *Number* of buffers as **1** and the number of *Samples* equal to the number of channels.
- **For buffered input**, specify the *Number* of buffers from **1** to **255** and the number of *Samples* as desired.



How to set up the KPCI-3130 Series to read digital samples using data buffers.

Buffer Usage

DriverLINX fills buffers sequentially until the task stops. During the task only complete buffers are available to the application. Except for tasks that stop on terminal count, the last buffer may be only partially full. Use a Status operation to determine the location of the last sample.

Digital Input Messages

For digital input operations, DriverLINX can report the following messages to the application:

DriverLINX Message	Explanation
Service Start	DriverLINX has started the acquisition task.
Service Done	DriverLINX has completed the acquisition task.
Buffer Filled	DriverLINX has filled a digital input buffer.
Start Event	DriverLINX has processed the interrupt for the start event.
Stop Event	DriverLINX has processed the interrupt for the stop event.
Data Lost	DriverLINX has detected a digital input data overrun condition.
Critical Error	DriverLINX has encountered an unexpected hardware or software condition.

DriverLINX Event messages for digital input.

For detailed explanations of these messages see one of the following references:

- *DriverLINX Technical Reference Manual* for C/C++ users
- *DriverLINX/VB Technical Reference Manual* for VB or Delphi users

Digital Output Subsystem

The following sections describe how DriverLINX implements Digital Output Subsystem features for the KPCI-3130 Series.

Digital Output Modes

The Digital Output Subsystem supports the following modes:

- **Polled**—For single-value digital output samples.
- **Other**—For subsystem initialization.

Digital Output Operations

The KPCI-3130 Series Digital Output Subsystem supports the following DriverLINX operations:

- **Initialize**—aborts any active interrupt data-acquisition tasks and stops the clock. DriverLINX prevents one application from interfering with another application's data-acquisition tasks.
- **Start**—initiates a data-acquisition task using the Mode, Timing, Start, and Stop Events, the Logical Channels, and the Buffers the application specified in the Service Request.
- **Message**—DriverLINX displays a pop-up dialog box for the user containing the text for the current DriverLINX error message.

Digital Output Initialization

By default, the Digital Output subsystem writes zero into the digital output port. You can specify a different initial output value using the *Configure DriverLINX Device* dialog. See "Digital Output Subsystem Page" on page 21.

Digital Channel Configuration

The KPCI-3130 supports several configurable digital channels. To use them as outputs you must first assign them to the Digital Output Subsystem using the "Configure DriverLINX Device Dialog" (page 12) or by using a Configure operation. See "Digital Channel Configuration" on page 45 for more information on the configure operation.

Digital Output Pacing, Triggering and Gating Options

The KPCI-3130 Series' 32-bit digital input/output lines are designed for polled operation only. Therefore, DriverLINX allows only polled single-value or single-scan operations without any pacing, triggering or gating.

Digital Output Timing Events

Timing Events specify how the hardware paces or clocks writing Digital Output samples. DriverLINX uses the Timing Event to program when the KPCI-3130 Series writes the next digital output sample from the port.

The KPCI-3130 Series supports the following Timing Events:

- **None**—Output requires no pacing as DriverLINX is writing only a single value or single scan.

None or Null Timing Event

The Null Event specifies that the task does not need a clock to determine when to write the next sample.

Digital Output Start Events

Start Events specify when the KPCI-3130 Series hardware starts writing digital output data.

The KPCI-3130 Series supports the following Start Events for digital output:

- **None**—Use this event when the DriverLINX operation doesn't require a Start Event.
- **Command**—DriverLINX starts the task on software command, i.e., as soon as DriverLINX finishes programming the KPCI-3130 hardware for the task.

None or Null Start Event

The Null Event specifies that the task does not need a Start Event to begin the task.

Command Start Event

The Command Event starts data acquisition as soon as DriverLINX has completed programming the KPCI-3130 Series hardware with the task parameters.

Digital Output Stop Events

Stop Events specify when the KPCI-3130 Series hardware stops writing digital output data.

The KPCI-3130 Series supports the following Stop Events for digital output:

- **None**—Use this event when the DriverLINX operation doesn't require a Stop Event.
- **Terminal count**—DriverLINX stops the task after the KPCI-3130 Series hardware has written all the data buffers once.

None or Null Stop Event

The Null Event specifies that the task does not need a Stop Event to end the task.

Terminal Count Stop Event

The Terminal Count Event stops data acquisition after DriverLINX has written the digital output data from all the data buffers ***once***. Use terminal count when you want to write a fixed amount of data.

Digital Output Channels

The KPCI-3130 Series allows applications to specify the digital channels using three techniques:

- **Start Channel**—Acquire data from a single channel.
- **Start/Stop Channel Range**—Acquire data from a consecutive range of channels.
- **Channel List**—Acquire data from a list of channels.

Digital Output Logical Channels

The Digital Output subsystem has a 32-bit digital input/output port that DriverLINX models as four 8-bit Logical Channels (model KPCI-3130 only), as well as one or two 8-bit Logical Channel to reset bits in the DAC overload register. DriverLINX maps these signals to Logical Channels as shown in the following table:

Models KPCI-3130

Logical Channel	DriverLINX Function	KPCI-3130 Series External Connector
0	Digital Input/Output	Bit 0, DGND … Bit 7, DGND
1	Digital Input/Output	Bit 8, DGND … Bit 15, DGND
2	Digital Input/Output	Bit 16, DGND … Bit 23, DGND
3	Digital Input/Output	Bit 24, DGND … Bit 31, DGND
4	Digital Input/Output (reset DAC overload flags)	S1H,S1L … S8H, S8L

Models KPCI-3132

Logical Channel	DriverLINX Function	KPCI-3130 Series External Connector
0	*Reserved*	
1	*Reserved*	
2	*Reserved*	
3	*Reserved*	
4	Digital Input/Output (reset DAC overload flags)	S1H,S1L … S2H, S2L

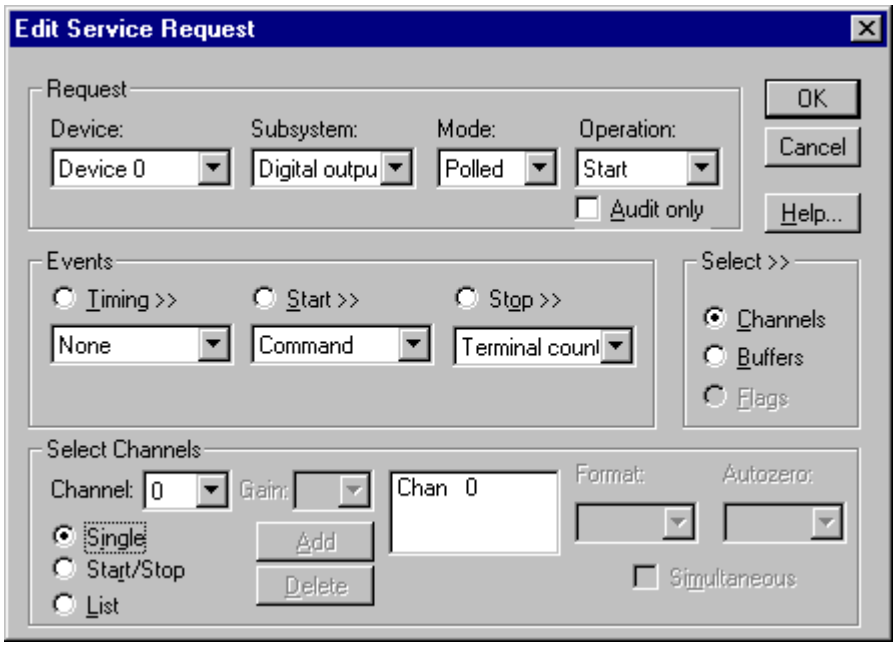
How DriverLINX maps digital output hardware channels to Logical Channels.

Notes:

- If a channel is configured for output, reading it using the Digital Input subsystem returns the last value written.
- Applications can assign a configurable channel to either subsystem using a Configure operation. (See “Digital Channel Configuration” on page 45.)

Single Channel Digital Output

In single channel mode, the KPCI-3130 Series writes all data from one channel.

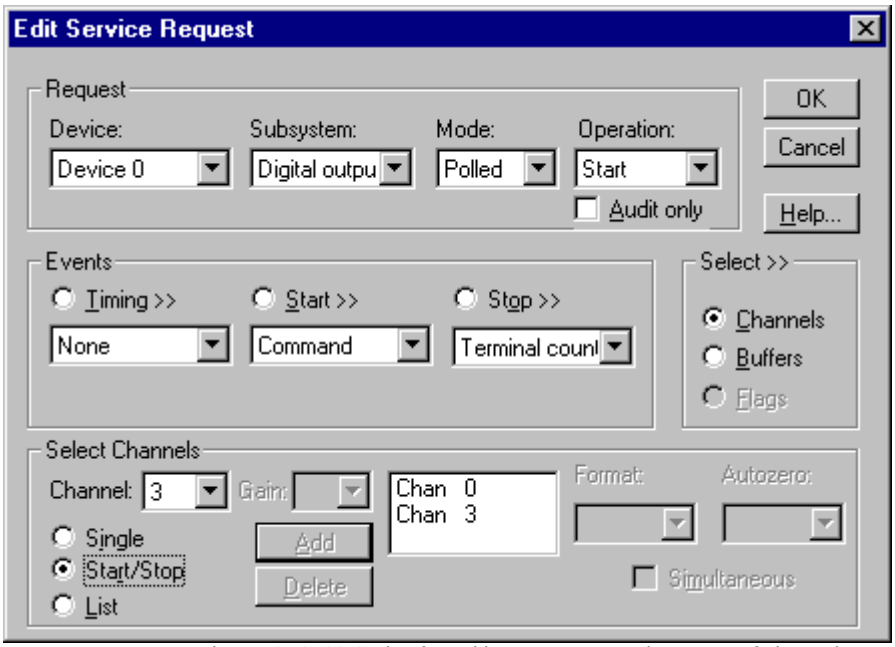


How to set up the KPCI-3130 Series for writing to a single channel.

Multi-channel Digital Output Range

In multi-channel range mode, the KPCI-3130 Series acquires all data from a consecutive range of digital channels.

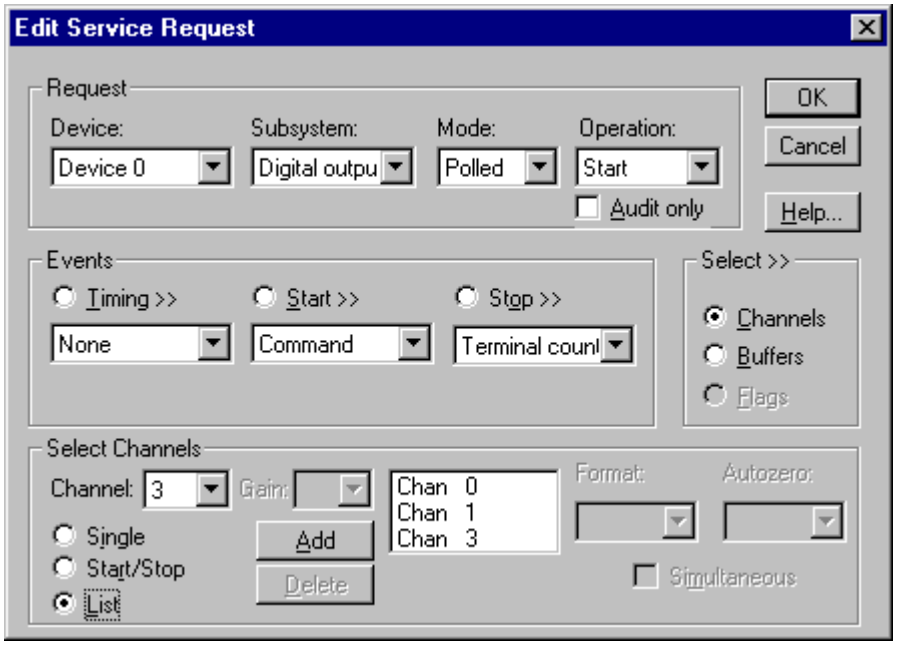
- The Stop Channel must be greater than the Start Channel.



How to set up the KPCI-3130 Series for writing to a consecutive range of channels.

Multi-channel Digital Output List

In multi-channel list mode, the KPCI-3130 Series acquires all data from an arbitrary list of digital channels.

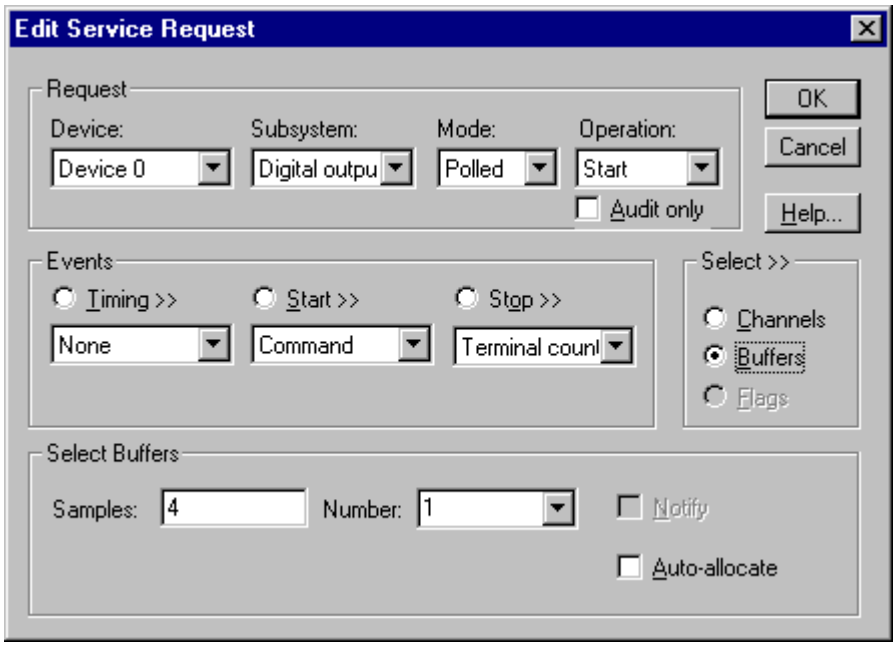


How to set up the KPCI-3130 Series to write to an arbitrary list of channels.

Digital Output Buffers

DriverLINX supports single-value and single-scan digital output.

- **For single-value output**, specify the *Number* of buffers as **0**. The buffer for a single value is the *ioValue* property.
- **For single-scan output**, specify the *Number* of buffers as **1** and the number of *Samples* equal to the number of channels.



How to set up the KPCI-3130 Series to store samples in buffers.

Digital Output Messages

For digital output operations, DriverLINX can report the following messages to the application:

DriverLINX Message	Explanation
Service Start	DriverLINX has started the acquisition task.
Service Done	DriverLINX has completed the acquisition task.
Critical Error	DriverLINX has encountered an unexpected hardware or software condition.

DriverLINX Event messages for digital output.

For detailed explanations of these messages see one of the following references:

- *DriverLINX Technical Reference Manual* for C/C++ users
- *DriverLINX/VB Technical Reference Manual* for VB or Delphi users

Counter/Timer Subsystem

DriverLINX defines a counter/timer system for the KPCI-3130 Series only to model sampling on a DAC overload condition. For information on how to set up a digital input task to sample on a DAC overload condition, see “Digital Input Timing Events” on page 46. For a list of all DAC-overload monitoring techniques see “Checking for DAC Overload” on page 44.

Uninstalling DriverLINX

How do I uninstall DriverLINX?

DriverLINX consists of three separate component installations:

- DriverLINX for Keithley KPCI-3130 Series
- DriverLINX Programming Interfaces
- DriverLINX Documentation

You can uninstall the last two installations at any time without interfering with compiled applications that require DriverLINX drivers. To uninstall the latter components, run the "Add/Remove Programs" tool in the Windows Control Panel.

To uninstall DriverLINX drivers for the Keithley KPCI-3130 Series, you must

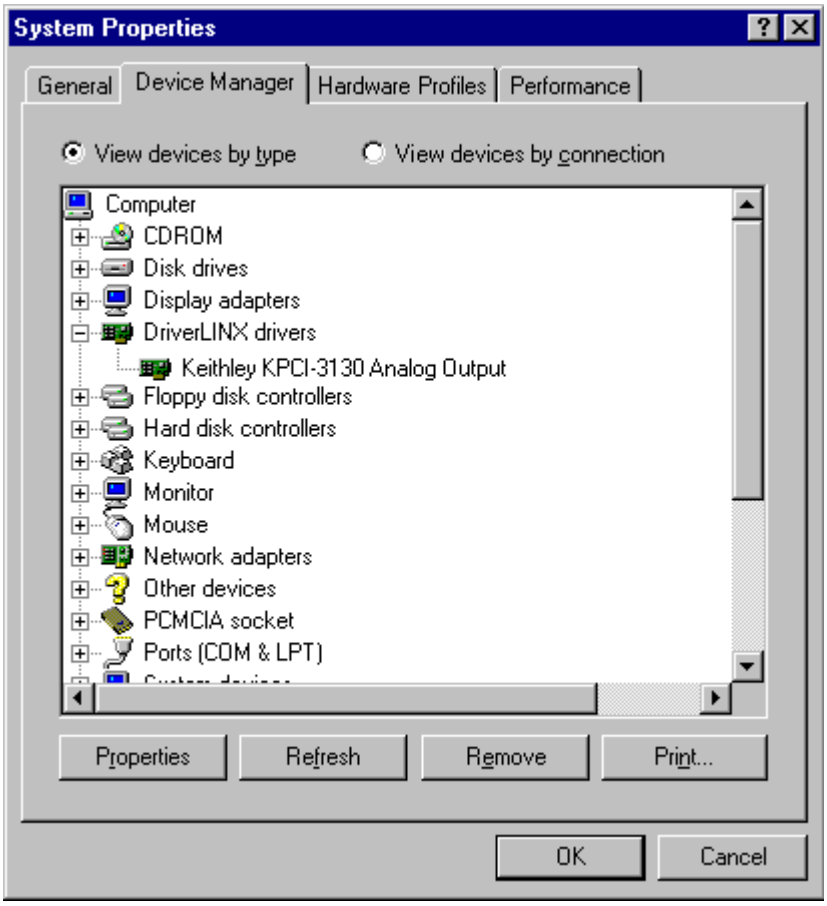
- Disable the DriverLINX driver.
- Shut down your computer to remove the hardware.
- Reboot your computer to unload the driver.
- Run the DriverLINX uninstall program.

How to Disable a DriverLINX Driver in Windows NT

1. From the Windows Start menu, select "Settings", then "Control Panel". Left click on the DriverLINX Configuration icon in the Control Panel.
2. Select the KPCI-3130 Series devices you want to disable.
3. Right click on each device and select "Disabled" on the popup menu.
4. Repeat steps 2-3 for each KPCI-3130 card that you are uninstalling.
5. Close the DriverLINX Configuration Panel.
6. When finished, shut down your computer and physically remove any installed KPCI-3130 hardware.
7. Reboot Windows.
8. To finish uninstalling, see "How to Remove DriverLINX for Keithley KPCI-3130 Series" on page 69.

How to Disable a DriverLINX Driver in Windows 95/98

1. From the Windows Start menu, select “Settings”, then “Control Panel”. Left click on the System icon in the Control Panel. Select the “Device Manager” tab in the System Properties dialog.
2. Left click the “+” icon next to “DriverLINX drivers” to display the installed Keithley KPCI-3130 devices.



3. Select the KPCI-3130 Series device you want to disable.
4. Click the “Remove” button.
5. In the “Confirm Device Removal” dialog, select “OK”.
6. Repeat steps 3-5 for each KPCI-3130 Series card or driver that you uninstalling.
7. When finished, click “Close”, shut down your computer, and physically remove any installed KPCI-3130 hardware.
8. Reboot Windows.
9. To finish uninstalling, see “How to Remove DriverLINX for Keithley KPCI-3130 Series” on page 69.

How to Remove DriverLINX for Keithley KPCI-3130 Series

1. From the Windows Start menu, select "Settings", then "Control Panel". Left click on the Add/Remove Programs icon in the Control Panel.
2. Select "DriverLINX for Keithley KPCI-3130 Series" in the Add/Remove Programs Properties dialog.
3. Click the "Add/Remove…" button.
4. Answer "Yes" to "Are you sure you want to remove 'DriverLINX for Keithley KPCI-3130 Series' and all of its components?" in the Confirm File Deletion dialog.
5. The DriverLINX uninstall program will proceed.

The uninstall program will not remove the folder, "\DrvLINX4\System". This folder contains copies of any \Windows\System or \Windows\System32 files that the original DriverLINX installation updated.

Troubleshooting

Solving Problems

Correct operation of your KPCI-3130 hardware requires successful completion of three steps.

- Windows recognizes KPCI-3130 hardware and installs drivers.

1. You configure the KPCI-3130 drivers using the DriverLINX Configuration Panel.
2. Windows loads the KPCI-3130 drivers into memory.

If you are having a problem installing or configuring your KPCI-3130 product, review the following notes. If these notes do not solve your problem, or your problem is not described, then contact technical support and fully describe your problem.

Solving Problems Recognizing and Installing Drivers

Windows must recognize the KPCI-3130 hardware and then install KPCI-3130 drivers for the hardware.

- For Windows to automatically recognize the KPCI-3130 hardware, you must install a KPCI-3130 product into your machine and restart the computer.
- For Windows to install KPCI-3130 drivers, you must install the KPCI-3130 driver software on the DriverLINX CD.

If you installed the KPCI-3130 hardware before you installed the DriverLINX software, Windows 95/98/2000 may install the KPCI-3130 hardware without drivers. To fix this, you must instruct Windows to reinstall the Plug-and-Play driver. Follow the notes below for instructions.

Fixing Problems Installing Hardware Before Software on Windows 95/98/2000

If you installed the KPCI-3130 hardware before installing the DriverLINX software, Windows 95/98 may install the hardware incorrectly.

1. Start Windows Device Manager.
2. Search for “DriverLINX drivers”. If you do not see it, go to step 4.
3. Click on the “+” icon next to “DriverLINX drivers” and search for “PCI Card”. If you find “PCI Card”, go to step 6, otherwise go to the next step.
4. Search for “Other devices”.
5. Click on the “+” icon next to “Other devices” and search for “PCI Card”.
6. Select “PCI Card”.
7. Click “Remove” in the Device Manager.
8. Highlight “Computer” in the Device Manager and click “Refresh”.
9. Windows should re-install your hardware under “DriverLINX drivers”.
10. Answer “Yes” to “Do you want to restart your computer now?”.
11. After rebooting your computer, you must configure DriverLINX. See “Configuring the KPCI-3130 Series” on page 11.

Solving Problems Configuring the Drivers

Windows automatically assigns hardware resources for the KPCI-3130 Series, but you must still configure the KPCI-3130 drivers before using them. The DriverLINX configuration only requires that you assign each KPCI-3130 product a unique Logical Device number. And, on Windows NT and Windows 2000, you must manually select the hardware model of your KPCI-3130 Series board. See “Configuring the KPCI-3130 Series” on page 11.

Solving Problems Loading Drivers

Before the KPCI-3130 drivers can load, you must

1. Install the DriverLINX software.
2. Install the KPCI-3130 hardware into your computer.
3. Configure DriverLINX.
4. Reboot your computer.

If you have not completed the above steps, please do so before proceeding.

On both Windows NT and Windows 95/98, the operating system will automatically assign hardware resources to the KPCI-3130 cards. Automatic resource assignment can fail sometimes on

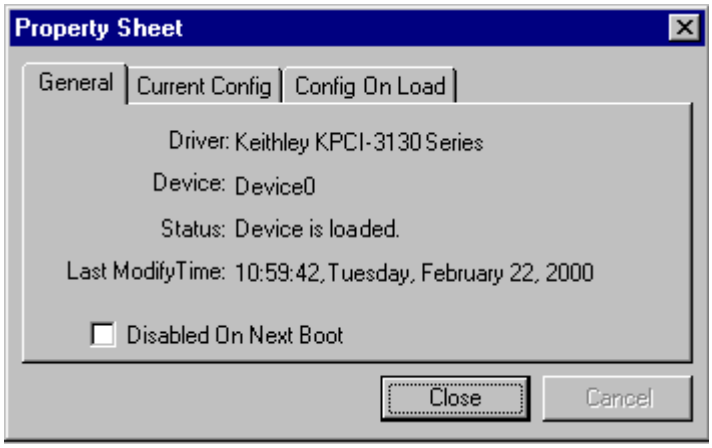
- Older PCI computers.
- Computers with ISA cards installed.

- Computers with no free hardware resources.
- Computers running Windows NT 4.0 with a BIOS setting designating the operating system as Plug-and-Play Aware.

Sorting through all possibilities can be a challenge due to the sheer number of combinations of PCI hardware designs, PC plug-in boards, and versions of Windows. The following sections will help you gather information about why a driver may have failed to load. This information is essential for you or technical support to solve your problem.

Did the DriverLINX Driver Load?

1. Run "DriverLINX Configuration" from Windows Control Panel.
2. Select the "DriverLINX" tab.
3. Click the "+" icon next to DriverLINX to expand the list of drivers, if necessary.
4. Select "Keithley KPCI-3130 Series". Click "+", if necessary, to expand the list.
5. Select the line with the number of the Logical Device you configured. If the number does not exist on Windows NT or, on Windows 95/98, you see only a hardware description, you did not configure the driver. See "Configuring the KPCI-3130 Series" on page 11.
6. Click the "Properties…" button and then select the "General" tab.
7. Do you see "Status: Device Loaded"? If not, did you reboot the computer after configuring? If not, reboot now and repeat the above steps.



8. If you rebooted the computer after configuring and Windows did not load your device, see "Checking for Device Errors" on page 73.

Checking for Device Errors

When a DriverLINX kernel driver cannot load, it usually writes an explanation into the system event log. You can view this log under Windows 95/98 or Windows NT using the DriverLINX Event Viewer.

Windows 95/98 maintains additional driver information in the Device Manager. Also see "Getting More Driver Information on Windows 95/98" on page 74.

1. Run “DriverLINX Event Viewer” from the DriverLINX folder.
2. Click on the “+” icon next to “DriverLINX” in the left panel.
3. Select the abbreviation for your driver.
4. Does the first line in the right panel show a current error?
5. Double click on the error line to see more detail and an explanatory message.
6. If you cannot resolve the problem yourself, please provide this error information when contacting technical support.

Getting More Driver Information on Windows 95/98

Windows 95/98 reports additional information about device status using the Device Manager. To access this utility,

1. Right click on “My Computer” and then select “Properties”.
2. Select “Device Manager” and “View devices by type
3. Does “DriverLINX drivers” appear in the list? If not, see “Solving Problems Recognizing and Installing Drivers” on page 71.
4. Click the “+” next to “DriverLINX drivers”.
5. Does your KPCI-3130 product appear in the list? If not, see “Solving Problems Recognizing and Installing Drivers” on page 71.
6. Does the icon next to your KPCI-3130 product display an exclamation point (!)? If no, Windows has loaded your KPCI-3130 driver.
7. Select the line with the “!” and then click “Properties”.
8. The General tab will show the reason why the driver did not load.
9. The Resources tab will show if Windows detected an unresolvable hardware conflict.

Getting More Driver Information on Windows NT

On Windows NT, the only reasons that a driver does not load are

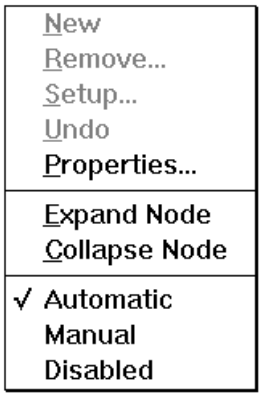
- You did not install the driver software.
- You did not correctly configure the driver.
- You changed the driver startup parameters.
- Your BIOS setting designates the operating system as Plug-and-Play aware. (Applies only to Window NT 4.0).

An incorrectly configured driver will report the reasons that it failed to load into the Windows Event Log. See “Checking for Device Errors” on page 73 for more information.

Under Windows NT 4.0, a Logical Device may not load because the operating system does not always configure Plug-and-Play PCI devices properly. This may result in unexpected or no Event Log entries. To work around this, set your computer’s BIOS to configure Plug-and-Play devices before it starts the operating system. On various computers the BIOS setting is called “Plug-and-Play Aware OS – Disabled” or “Plug & Play OS – No”.

On Windows NT, DriverLINX drivers load automatically during system boot. An administrator can change the startup command for any NT driver to either “manual” or “disabled”.

1. Run “DriverLINX Configuration” from Windows Control Panel.
2. Select the “DriverLINX” tab.
3. Click the “+” icon next to DriverLINX to expand the list of drivers, if necessary.
4. Select “Keithley KPCI-3130 Series”. Click “+”, if necessary, to expand the list.
5. Select the line with the number of the Logical Device that did not load.
6. Right click the mouse to see a popup menu.



7. Select “Automatic” to instruct Windows to load the driver the next time you reboot.

Generating a DriverLINX Configuration Report

Your DriverLINX installation includes a troubleshooting tool that generates a report of your DriverLINX configuration. If you call Technical Support, after reading “Solving Problems” on page 71, they may ask you to generate and e-mail this report to help you solve installation and configuration problems.

What is in the Report?

The troubleshooting tool analyzes your computer to obtain information about DriverLINX and operating system software that would assist Technical Support in troubleshooting a problem you are having. It includes information on DriverLINX files, environment variables, registry entries, hardware and the operating system.

How do I Generate the Report?

You can easily generate the report by clicking this shortcut . Once the troubleshooting tool generates the report, you will have the opportunity to review it and make deletions, if desired, before e-mailing it to Technical Support. If you do not have direct access to e-mail, you can save the report to a disk file and send a copy

later. A Technical Support engineer will guide you through these steps when you are asked to send a report.

Glossary of Terms

CHAN_OEM_FLAG

A flag that you add to a gain code to indicate that you are using OEM-specific gain flags. (=2^15)

A/D

Abbreviation for Analog-to-Digital, a process that converts a continuous analog signal into a discrete digital approximation of the analog signal.

ADC

Abbreviation for Analog-to-Digital Converter, the hardware that performs the A/D conversion.

API

Abbreviation for Application Programming Interface. An API defines the syntax of the data structures and functions of software services.

Buffer

A block of memory used to receive data from a data-acquisition device or to write data to a data-acquisition device.

Bus mastering

Bus mastering is a mode that PCI devices use to perform DMA data transfers. Bus mastering requires a compatible PCI device and motherboard. The KPCI-3130 Series and most motherboards support bus mastering.

Clocking

A periodic pulse or signal that data-acquisition hardware uses to read or write the next sample or block of samples. Also referred to as “pacing”.

D/A

Abbreviation for digital-to-analog, a process that converts a discrete digital value into a continuous analog voltage representing that value.

DAC

Abbreviation for digital-to-analog converter, the hardware that performs the D/A conversion process.

DMA

Abbreviation for Direct Memory Access, a technique where the system board can transfer data between a device and memory without using the CPU. In the PC, a standard chip on the system board controls the transfer.

Event

For DriverLINX, an event is the occurrence of a signal that clocks, starts, or stops a data-acquisition task.

In an ActiveX control, an event is a procedure in the client application called by the control.

Gating

A signal that enables and disables another signal or data-acquisition task depending on the value of the gate signal.

IRQ

Abbreviation for interrupt request. Peripheral hardware signals the CPU that it is ready to transfer data.

ISR

Abbreviation for interrupt service routine, the software function inside a device driver that handles interrupt requests.

Logical Device

DriverLINX's designation for a specific data-acquisition board inside your computer.

Messages

In Windows and DriverLINX, a message notifies the application about the state of a process. In DriverLINX's ActiveX controls, DriverLINXSR and DriverLINXLDD, messages fire a control event.

Modes

DriverLINX data-acquisition techniques.

Operations

Allowed DriverLINX data-acquisition commands.

Pacing

A periodic pulse or signal that data-acquisition hardware uses to read or write the next sample or block of samples. Also referred to as "clocking".

Process

Refers to the collection of data and code segments and hardware resources that the operating system assigns to one application.

Scan List

The channels sampled or written by a task, whether specified using a range or a list.

Service Request

A DriverLINX object or data structure that completely defines a data-acquisition task.

Single-scan

A task that samples once from each channel in the scan list. Such a task requires a buffer that holds exactly one scan.

Subsystem

DriverLINX subdivides a general-purpose data-acquisition device into six subsystems—Device, Analog Input, Analog Output, Digital Input, Digital Output, and Counter/Timer.

Triggering

The technique of using a pulse or signal to start or stop a data-acquisition task.

TTL

Abbreviation for transistor-transistor logic, a family of digital logic elements.