Keithley KPCI-3108 Series

Using DriverLINX with Your Hardware

KEITHLEY

Information in this document is subject to change without notice. The software described is this document is furnished under a license agreement. The software may be used or copied only in accordance with the terms of the agreement.

SCIENTIFIC SOFTWARE TOOLS, INC. SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES RELATED TO THE USE OF THIS PRODUCT. THIS PRODUCT IS NOT DESIGNED WITH COMPONENTS OF A LEVEL OF RELIABILITY SUITABLE FOR USE IN LIFE SUPPORT OR CRITICAL APPLICATIONS.

Keithley KPCI-3108 Series: Using DriverLINX with Your Hardware

First Printing.
SST 26-0202-1

Contents

Preface

Software License and Software Disclaimer of Warranty

This is a legal document which is an agreement between you, the Licensee, and Scientific Software Tools, Inc. By opening this sealed diskette package, Licensee agrees to become bound by the terms of this Agreement, which include the Software License and Software Disclaimer of Warranty.

This Agreement constitutes the complete Agreement between Licensee and Scientific Software Tools, Inc. If Licensee does not agree to the terms of this Agreement, do not open the diskette package. Promptly return the unopened diskette package and the other items (including written materials, binders or other containers, and hardware, if any) that are part of this product to Scientific Software Tools, Inc. for a full refund. No refunds will be given for products that have opened disk packages or missing components.

Licensing Agreement

Copyright. The software and documentation is owned by Scientific Software Tools, Inc. and is protected by both United States copyright laws and international treaty provisions. Scientific Software Tools, Inc. authorizes the original purchaser only (Licensee) to either (a) make one copy of the software solely for backup or archival purposes, or (b) transfer the software to a single hard disk only. The written materials accompanying the software may not be duplicated or copied for any reason.

Trade Secret. Licensee understands and agrees that the software is the proprietary and confidential property of Scientific Software Tools, Inc. and a valuable trade secret. Licensee agrees to use the software only for the intended use under this License, and shall not disclose the software or its contents to any third party.

Copy Restrictions. The Licensee may not modify or translate the program or related documentation **without the prior written consent of Scientific Software Tools, Inc.** All modifications, adaptations, and merged portions of the software constitute the software licensed to the Licensee, and the terms and conditions of this agreement apply to same. Licensee may not distribute copies, including electronic transfer of copies, of the modified, adapted or merged software or accompanying written materials to others. Licensee agrees not to reverse engineer, decompile or disassemble any part of the software.

Unauthorized copying of the software, including software that has been modified, merged, or included with other software, or of the written materials is expressly forbidden. Licensee may not rent, transfer or lease the software to any third parties. Licensee agrees to take all reasonable steps to protect Scientific Software Tools' software from theft, disclosure or use contrary to the terms of the License.

License. Scientific Software Tools, Inc. grants the Licensee only a non-exclusive right to use the serialized copy of the software on a single terminal connected to a single computer. The Licensee may not network the software or use it on more than one computer or computer terminal at the same time.

Term. This License is effective until terminated. This License will terminate automatically without notice from Scientific Software Tools, Inc. if Licensee fails to comply with any term or condition of this License. The Licensee agrees upon such termination to return or destroy the written materials and all copies of the software. The Licensee may terminate the agreement by returning or destroying the program and documentation and all copies thereof.

Limited Warranty

Scientific Software Tools, Inc. warrants that the software will perform substantially in accordance with the written materials and that the program disk, instructional manuals and reference materials are free from defects in materials and workmanship under normal use for 90 days from the date of receipt. All express or implied warranties of the software and related materials are limited to 90 days.

Except as specifically set forth herein, the software and accompanying written materials (including instructions for use) are provided “as is” without warranty of any kind. Further, Scientific Software Tools, Inc. does not warrant, guarantee, or make any representations regarding the use, or the results of the use, of the software or written materials in terms of correctness, accuracy, reliability, currentness, or otherwise. The entire risk as to the results and performance of the software is assumed by Licensee and not by Scientific Software Tools, Inc. or its distributors, agents or employees.

EXCEPT AS SET FORTH HEREIN, THERE ARE NO OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WITH RESPECT TO THE SOFTWARE, THE ACCOMPANYING WRITTEN MATERIALS, AND ANY ACCOMPANYING HARDWARE.

Remedy. Scientific Software Tools’ entire liability and the Licensee’s exclusive remedy shall be, at Scientific Software Tools’ option, either (a) return of the price paid or (b) repair or replacement of the software or accompanying materials. In the event of a defect in material or workmanship, the item may be returned within the warranty period to Scientific Software Tools for a replacement without charge, provided the licensee previously sent in the limited warranty registration board to Scientific Software Tools, Inc., or can furnish proof of the purchase of the program. This remedy is void if failure has resulted from accident, abuse, or misapplication. Any replacement will be warranted for the remainder of the original warranty period.

NEITHER SCIENTIFIC SOFTWARE TOOLS, INC. NOR ANYONE ELSE WHO HAS BEEN INVOLVED IN THE CREATION, PRODUCTION, SALE OR DELIVERY OF THIS PRODUCT SHALL BE LIABLE FOR ANY DIRECT, INDIRECT, CONSEQUENTIAL, OR INCIDENTAL DAMAGES (INCLUDING DAMAGES FOR LOSS OF BUSINESS PROFITS, BUSINESS INTERRUPTION, LOSS OF BUSINESS INFORMATION AND THE LIKE) ARISING OUT OF THE USE OF OR THE INABILITY TO USE SUCH PRODUCT EVEN IF SCIENTIFIC SOFTWARE TOOLS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. BECAUSE SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES, OR LIMITATIONS ON DURATION OF AN IMPLIED WARRANTY, THE ABOVE LIMITATIONS MAY NOT APPLY TO LICENSEE.

This agreement is governed by the laws of the Commonwealth of Pennsylvania.

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 input/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 4.0 Installation and Configuration Guide*
- *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-3108 Series boards with DriverLINX.

- For help installing and configuring your hardware and DriverLINX, please see the manual that accompanied your hardware and the *DriverLINX 4.0 Installation and Configuration Guide* for your version of Windows.
- 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-3108 Series

Shows how to configure the KPCI-3108 Series using the *Configure DriverLINX Device* dialog box.

Using the KPCI-3108 Series with DriverLINX

Shows how to set up DriverLINX with the *Edit Service Request* dialog box to use KPCI-3108 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-3108 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-3108 Series boards.

Installing and configuring DriverLINX for a Keithley KPCI-3108 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. **Install your KPCI-3108 hardware.** Follow the instructions in your hardware manual.
3. **Configure DriverLINX.** This creates a Logical Device, which stores configuration information for your board. See "Configure DriverLINX Device Dialog" on page 14 for configuration options specific to a Keithley KPCI-3108 Series model. Configuration is automatic under Windows 2000/XP but you may want to customize the settings.

After installing your board, configuring DriverLINX, and restarting Windows (if required), 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.

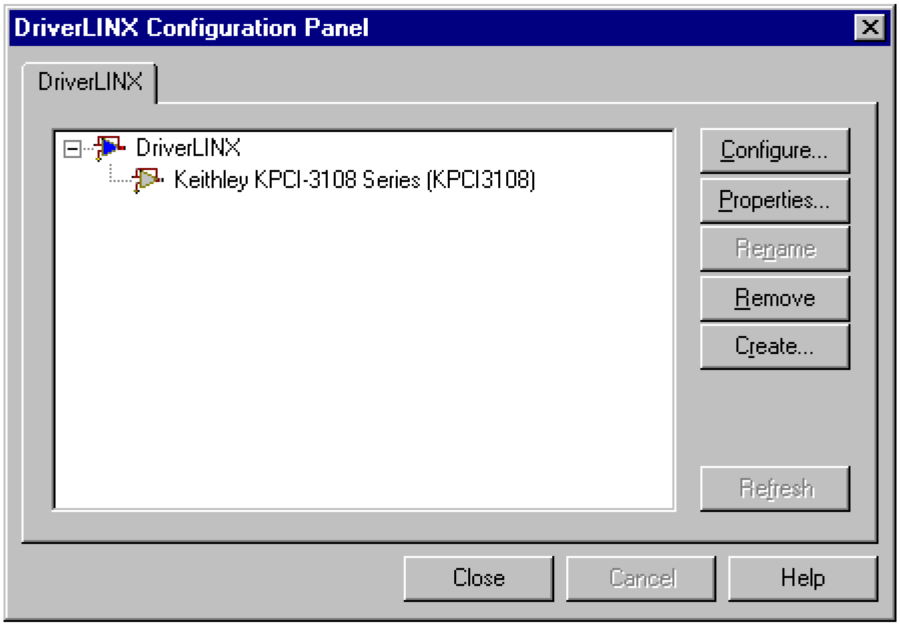
Windows NT

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

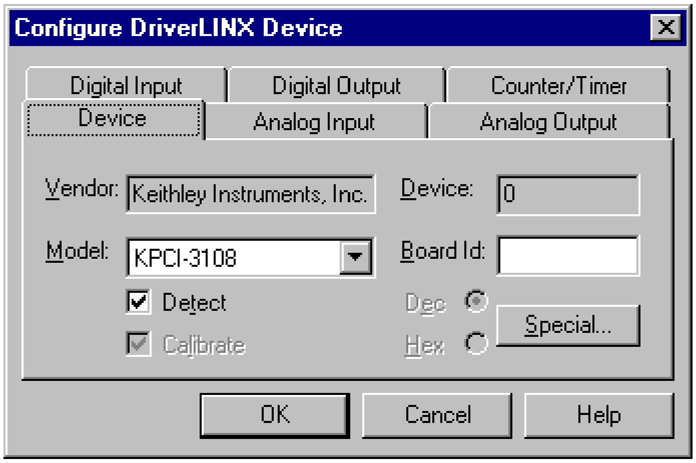
DriverLINX uses a standardized configuration protocol for all data-acquisition hardware. Configuration assigns an identifying device number to a specific KPCI-3108 Series board in your computer and allows you to enable or disable bus mastering.

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-3108 Series. The following sections describe your choices in configuring DriverLINX to work with your board.

Device Subsystem Page



Vendor: Keithley Instruments, Inc.

Device: 0

Model: KPCI-3108

Board Id:

☑ Detect

☑ Calibrate

● Dec

○ Hex

Use the Device subsystem page to tell DriverLINX the model name of, and, optionally, the accessories connected to your KPCI-3108 Series board.

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

Select one of the following models:

KPCI-3108

KPCI-3107

Windows 95/98

Windows 95 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-3108’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

Under Windows NT, 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

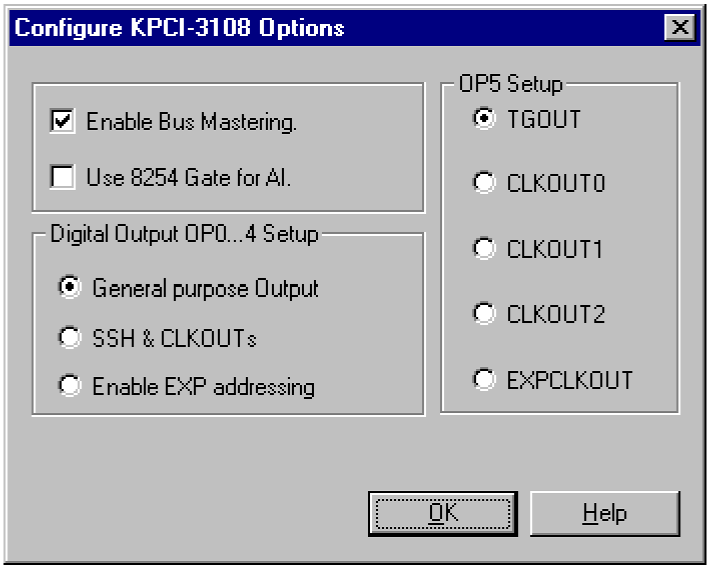
The *Detect* property enables and disables DriverLINX's hardware detection and testing algorithms. For maximum system reliability, always leave this check-box marked.

Calibrate

The *Calibrate* property enables and disables hardware auto-calibration. This option is grayed-out for the KPCI-3108 Series because it does not support automatic calibration.

Special…

The *Special…* button displays the following dialog box of KPCI-3108 Series-specific configuration options:



Configure KPCI-3108 Options

☑ Enable Bus Mastering.

□ Use 8254 Gate for AI.

Digital Output OP0...4 Setup

● General purpose Output

○ SSH & CLKOUTs

○ Enable EXP addressing

OP5 Setup

● TGOUT

○ CLKOUT0

○ CLKOUT1

○ CLKOUT2

○ EXPCLKOUT

Enable Bus Mastering

Bus Mastering is a mode that PCI devices use to perform DMA data transfers. The KPCI-3108 Series can use bus mastering on motherboards that support it. With bus mastering disabled, the board will operate in interrupt mode when the Service Request asks for DMA mode. For maximum throughput, enable bus mastering if your motherboard supports it.

Motherboards compliant with revision 2.1 of the PCI specification support bus mastering. Almost all newer motherboards support bus mastering but some require BIOS settings to enable it for a particular PCI slot. Older motherboards may not support bus mastering at all and may cause the system to hang, *risking loss of unwritten disk data* and requiring you to reboot. Consult your computer manufacturer's documentation to determine if your motherboard supports bus mastering.

To test bus-mastering, check the *Enable Bus Mastering* box, click OK as necessary to exit the DriverLINX Configuration Panel and restart Windows. Close all other applications, wait until all disk activity stops, and then run the DriverLINX AIO Panel. If the AIO Panel can display an input signal then your motherboard is compatible with your KPCI-3108 Series board. As long as your BIOS has enabled bus mastering for the PCI slot your board is in, DriverLINX can use DMA mode.

Use 8254 Gate for AI

The KPCI-3108 Series supports analog input gating from two sources. The TGIN signal directly controls the analog-to-digital converter and is programmable as active high or low. Analog input is normally paced with the three-channel 8254 counter/timer chip. Two of the channels have an active high input available for gating. For compatibility with other Keithley products, DriverLINX normally uses the TGIN signal when an application requests gating. However, you can configure the device to use the counter/timer gate instead.

The two gate sources have the following features and advantages:

TGIN

- High or low level active
- Compatible with portable DriverLINX applications

C/T Gate

- High level active only
- TGIN pin is available for triggering with tasks that require both triggering and gating

Digital Output OP0..4 Setup

The OP0 to OP4 pins output one of three groups of control or data signals. DriverLINX does not automatically select a signal group but allows you to choose which group the board outputs through these connections.

Choose one the following groups of signals:

Group	Signal	Description	Pin
General purpose I/O			
	GP0	Digital output data line	OP0
	GP1	Digital output data line	OP1
	GP2	Digital output data line	OP2
	GP3	Digital output data line	OP3
	GP4	Digital output data line	OP4

Group	Signal	Description	Pin
SSH control/Clock output			
	SSHO	SSH control signal	OP0
	CLK0	Output of 8254 clock 0 (Logical Channel 1)	OP1
	CLK1	Output of 8254 clock 1 (Logical Channel 2)	OP2
	CLK2	Output of 8254 clock 2 (Logical Channels 0 and 3)	OP3
	PCLK	Emits a pulse for each analog input conversion	OP4
Expansion accessory control			
	xA0	Expansion accessory address line	OP0
	xA1	Expansion accessory address line	OP1
	xA2	Expansion accessory address line	OP2
	xA3	Expansion accessory address line	OP3
	K	Expansion accessory gain control	OP4

Notes:

- It is important that you correctly configure digital channel 0 so that the attached accessories or user hardware receive the intended signals.
- Any one of the clock signals is also available from the OP5 depending on the Trigger/Clock Output Selection.

General purpose output

The **General purpose output** option enables writing 5-bits of digital data to the OP0..4 pins. DriverLINX addresses these pins as Logical Channel 0 in the Digital Output subsystem.

To enable the KPCI-3108's 5-bit digital output, perform the following step in the "Digital Output OP0..4 Setup" section of the *Configure KPCI-3108 Options* dialog box:

1. Click the **General purpose output** option

Clock Output

To enable the KPCI-3108's three 8254 counter outputs, perform the following step in the "Digital Output OP0..4 Setup" section of the *Configure KPCI-3108 Options* dialog box:

2. Click the **SSH control & CLKOUTs** option

Note: Any one of the clock signals is also available from the OP5 pin depending on the OP5 Setup.

Expansion accessory control

You can expand the number of analog input channels connected to your KPCI-3108 Series board by using one or more expansion accessories. Each expansion accessory is 1-to-16 multiplexer that replaces one onboard channel with sixteen expansion channels. Configure your DriverLINX Logical Device to use the additional channels by enabling the expansion accessory here.

To enable the KPCI-3108's expansion accessory control signals and allow applications to access expansion channels, perform the following steps:

1. In the "Digital Output OP0..4 Setup" section of the *Configure KPCI-3108 Options* dialog box, click the **Enable EXP addressing** option
2. On the Analog Input Page, configure the subsystem for **16 single-ended** channels

For information on programming a task to access expansion channels, see "Analog Input Expansion Channels" on page 64.

OP5 Setup

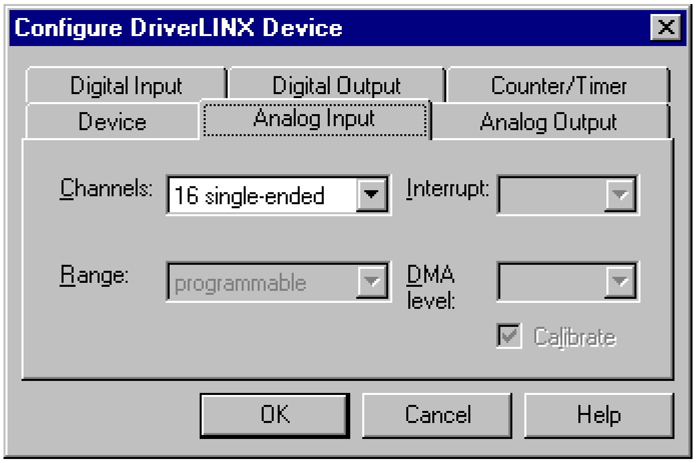
The OP5 pin outputs one of several triggering and clock output signals. DriverLINX does not automatically select an output signal but allows you to choose which signal the board outputs through this connection.

Choose one of the following signals:

- TGOUT—Relays the TGIN signal when using external triggering or gating, or is high during software-triggered analog input sampling
- CLK0—Output of 8254 clock 0 (Logical Channel 1)
- CLK1—Output of 8254 clock 1 (Logical Channel 2)
- CLK2—Output of 8254 clock 2 (Logical Channels 0 and 3)
- PCLK—Emits a pulse for each analog input conversion

Note: The clock signals are also available from the OP1 to OP3 pins when the Digital Output OP0..4 Setup option is **SSH control & CLKOUTs**.

Analog Input Subsystem Page



Channels: 16 single-ended

Range: programmable

☑ Calibrate

Use the Analog Input subsystem page to choose between 16 single-ended or 8 differential analog input channels as a default configuration.

Channels

On the KPCI-3108 Series, each Analog Input channel can use single-ended or differential termination modes. When configuring the Analog Input Subsystem, you choose a default configuration for all channels. Applications can use the default configuration or specify the termination mode for each channel that it uses. This scheme supports applications that use KPCI-3108-specific features as well as those that use only generic features. For applications that do specify the termination mode, configure the subsystem for 16 channels.

For information on programming the termination mode, see “Analog Input Channels” on page 58.

Range

The analog input ranges for the KPCI-3108 Series are fully software programmable. DriverLINX grays out this property in the configuration dialog.

Interrupt

Windows automatically determines the interrupt level for the KPCI-3108 Series board. DriverLINX disables this property.

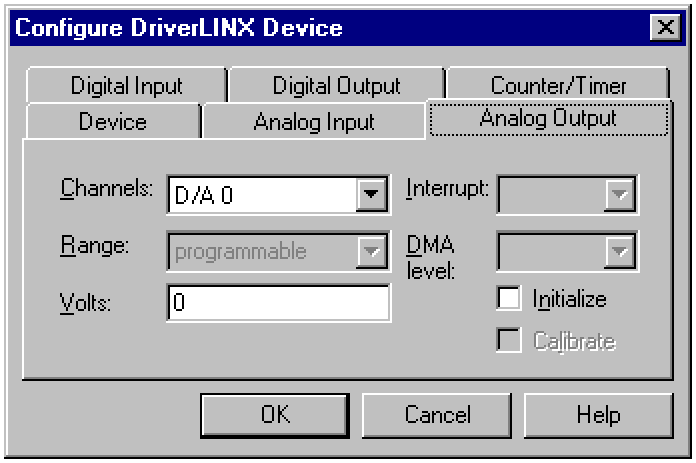
DMA

The KPCI-3108 Series does not use DMA channels for direct memory transfers. PCI devices use bus mastering for DMA. DriverLINX initially disables bus mastering for your KPCI-3108 Series board. See “Special…” on page 16 for more information.

Calibrate

The KPCI-3108 Series supports semi-automatic calibration only. You can start the calibration utility from the Windows Start menu. Additionally, applications can request automatic zero-reference adjustments (offset calibration). For more information, see “Analog Input Zero-Reference Adjustment” on page 63.

Analog Output Subsystem Page



Channels: D/A 0

Range: programmable

Volts: 0

Interrupt:

DMA level:

□ Initialize

□ Calibrate

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.

Range

The analog output ranges for the KPCI-3108 Series are fully software programmable. 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-3108 board. DriverLINX disables this property.

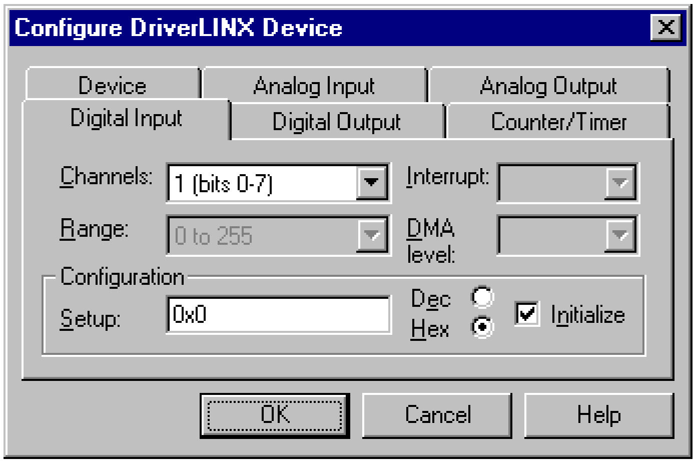
DMA

The KPCI-3108 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



Channels: 1 (bits 0-7)

Range: 0 to 255

Interrupt:

DMA level:

Configuration

Setup: 0x0

Dec ○

Hex ●

☑ Initialize

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-3108 Series supports both fixed and configurable digital channels. DriverLINX defines the following Logical Channels for the KPCI-3108 Series Digital Input Subsystem:

Logical Channel	DriverLINX Function	KPCI-3108 Series External Connector
0	Standard Digital Input	IP0 … IP5
1	Digital Input/Output	Bit 0 … Bit 7
2	Digital Input/Output	Bit 8 … Bit 15
3	Digital Input/Output	Bit 16 … Bit 23
4	Digital Input/Output	Bit 24 … Bit 31
5	External Clock	XPCLK
6	External Trigger	TGIN

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-3108 board. DriverLINX disables this property.

DMA

The KPCI-3108 Series does not use DMA channels for direct memory transfers. DriverLINX disables this property.

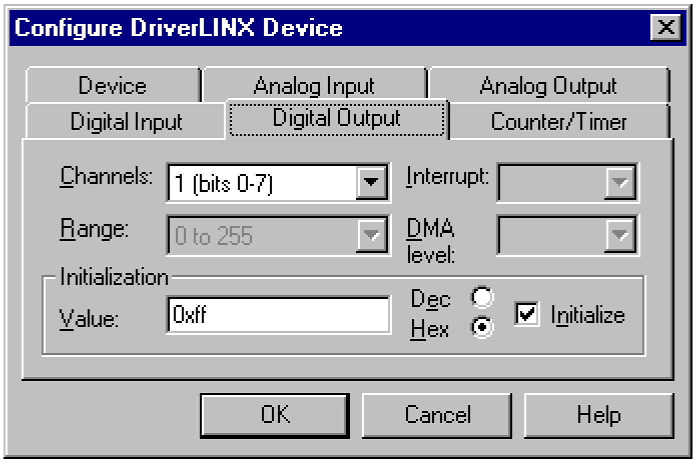
Configuration Setup

The *Configuration Setup* property specifies the hardware configuration of the digital I/O ports. Logical Channels 1 through 4 are configurable as input or output. Enter 1 to initially configure the selected channel as input or 0 to configure it as output.

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



Channels: 1 (bits 0-7)

Range: 0 to 255

Interrupt:

DMA level:

Initialization

Value: 0xff

Dec ○ Hex ●

☑ Initialize

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.

Logical Channel	DriverLINX Function	KPCI-3108 Series External Connector
0	Standard Digital Output	OP0 … OP4
1	Digital Input/Output	Bit 0 … Bit 7
2	Digital Input/Output	Bit 8 … Bit 15
3	Digital Input/Output	Bit 16 … Bit 23
4	Digital Input/Output	Bit 24 … Bit 31

Note: To use Logical Channel 0, you configure pins OP0..4 as **General purpose output** on the Special… dialog.

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-3108 board. DriverLINX disables this property.

DMA

The KPCI-3108 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.

Initialize

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

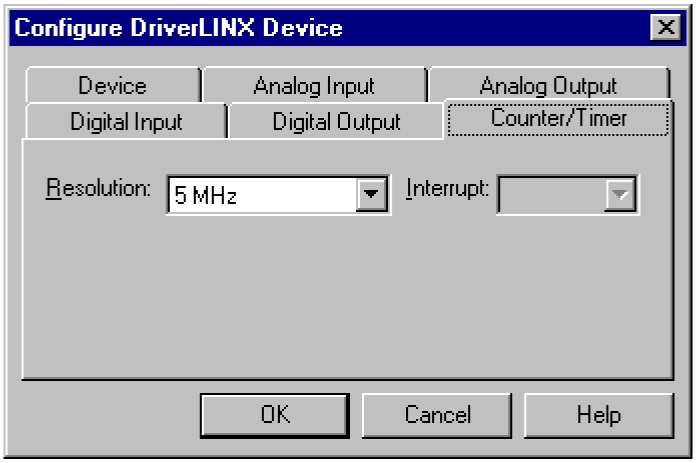
Dec

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



Resolution: 5 MHz

Interrupt:

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

Resolution

The *Resolution* property specifies the default clock frequency of the master oscillator. All models have a programmable 10 MHz, 5 MHz, 1 MHz or 100 kHz clock source for pacing input/output tasks. This setting selects the default frequency. Applications can use the default or specify a frequency for each task.

Interrupt

Windows automatically determines the interrupt level for the KPIC-3108 board. DriverLINX disables this property.

Using the KPCI-3108 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-3108 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-3108 Series Hardware Features

The KPCI-3108 Series offers your data-acquisition application a wide variety of useful features. Analog inputs support mixed gains, termination modes and polarities, as well as auto-zeroing, digital pre-, post- and about-triggering, and analog pre- and about-triggering. Analog outputs are waveform-quality. The counter/timers are user-accessible. DriverLINX accesses these feats 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**
Calibration of each analog input and output range	DriverLINX provides a stand-alone *KPCI-3108 Calibration Utility.*
Auto-zeroing of analog input channels	Analog Input Zero-Reference Adjustment
Analog triggering	Analog Stop Event (Pre- and About-Triggering)
Digital triggering	Digital Start Event (Post-Triggering) Digital Stop Event (Pre- and About-Triggering)

Hardware Feature	DriverLINX Feature
Programmable single-ended or differential termination modes	Analog Input Channel Termination modes
Programmable gains	Analog Input Channel Gains Analog Output Channel Gains
Waveform-quality analog outputs	Analog Output Subsystem
User-accessible counter/timers	Counter/Timer Subsystem

DriverLINX Hardware Model for KPCI-3108 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-3108 Series hardware capabilities.

The following sections describe how DriverLINX implements KPCI-3108 Series hardware features as Subsystems, Modes, Operations, Events, Logical Channels, Buffers, and Messages.

DriverLINX Subsystems

The KPCI-3108 Series supports the following DriverLINX subsystems:

1. **Device**—refers to a KPCI-3108 Series board as a whole.
2. **Analog Input**—refers to the analog input channels, clocks, and control signals.
3. **Analog Output**—refers to the analog output channels, clocks, and control signals.
4. **Digital Input**—refers to the digital input port as well as 1-bit digital input (TTL) control signals, such as TGIN.
5. **Digital Output**—refers to the digital output port.
6. **Counter/Timer**—refers to the onboard counter/timer channels for pacing analog input/output or performing measuring and waveform generation functions.

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-3108 Series for its commands (Service Requests).

- **Polled Mode**—This is a foreground or synchronous operation. DriverLINX supports this mode for simple, single-value 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.
- **DMA Mode—**This is a background or asynchronous operation. DriverLINX programs the data-acquisition board to transfer data between the computer's memory and the board.
- **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-3108 Series.

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

KPCI-3108 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-3108 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 Input				
Polled	Start	null	null, cmd	null, TC
Interrupt	Start, Stop, Status, Convert	dig, rate	cmd, dig	cmd, TC, dig
DMA	Start, Stop, Status, Convert	dig, rate	cmd, dig	cmd, TC, ana, dig
Other	Initialize			
Analog Output				
Polled	Start	null	null, cmd	null, TC
Interrupt	Start, Stop, Status, Convert	rate	cmd	cmd, TC
DMA	Start, Stop, Status, Convert	rate	cmd	cmd, TC
Other	Initialize			
Digital Input				
Polled	Start	null	null, cmd	null, TC
Interrupt	Start, Stop, Status	rate	cmd	cmd, TC
Other	Initialize, Configure	DIO Setup		

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

Allowed Operations and Events for KPCI-3108 Series Subsystems and Modes.

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
- **ana**—Analog Event specifies a trigger to 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 1 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-3108 Series

The Keithley hardware manual describes the data and control signals for the KPCI-3108 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 Input Subsystem Signals

The Analog Input subsystem has 16 analog inputs and an analog ground. You set the default subsystem configuration as 8 differential or 16 single-ended channels. Applications can then use the default configuration or request a specific configuration for each channel. See “Analog Input Channels” on page 58 for programming information.

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

Physical Channels	Connector Name	Logical Channels
0 – 7 Differential	CH00 LO, HI – CH07 LO, HI	0 – 7
0 – 15 Single-ended	CH00 HI – CH15 HI, AGND	0 – 15

How DriverLINX maps analog input hardware channels to Logical Channels.

Analog Input Pacing, Triggering and Gating Signals

Analog input tasks can use any of the Counter/Timer Logical Channels for pacing, but uses Logical Channel 0 as the default. The clock sources can be internal or external.

The Analog Input subsystem can use several control signals that DriverLINX defines as external clocks, triggers and gates as shown in the following table:

Connector Name	DriverLINX Usage
TGIN	External trigger: • Digital Start Event (Post-Triggering) • Digital Stop Event (Pre- and About-Triggering) External gate: • Rate Timing Event • Digital Start Event (Gating)
XPCLK	External pacer clock: • Rate Generator: External Clocking • Burst Generator: External Clocking

Connector Name	DriverLINX Usage
CLKIN0 CLKIN1	Divided external pacer clock: • Divider-Rate Generator: External Clocking • Divider-Burst Generator: External Clocking
GATEIN0 GATEIN1	External gate: • Rate Timing Event

How DriverLINX uses analog input control signals.

Analog Output Subsystem Signals

The Analog Output subsystem has 2 analog differential output connections.

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

Physical Channel	Connector Name	Logical Channel
0	DAC0 IN,DAC0 OUT	0
1	DAC1 IN, DAC1 OUT	1

How DriverLINX maps analog output hardware channels to Logical Channels.

Analog Output Pacing, Triggering and Gating Signals

Analog output tasks can use any of the Counter/Timer Logical Channels for pacing, but uses Logical Channel 1 as the default. The clock sources can be internal or external.

The Analog Output subsystem can use several control signals that DriverLINX defines as external clocks and gates as shown in the following table:

Connector Name	DriverLINX Usage
XPCLK	External pacer clock: • Rate Generator: External Clocking • Burst Generator: External Clocking
CLKIN0 CLKIN1	Divided external pacer clock: • Divider-Rate Generator: External Clocking • Divider-Burst Generator: External Clocking
GATEIN0 GATEIN1	External gate: • Rate Timing Event

How DriverLINX uses analog output control signals.

Digital Input Subsystem Signals

The Digital Input Subsystem has a 6-bit digital input port and a 32-bit digital input/output port, as well as two control inputs which DriverLINX models as 1-bit logical digital input ports. DriverLINX maps these signals to Logical Channels as shown in the following table:

Logical Channel	DriverLINX Function	KPCI-3108 Series External Connector
0	Standard Digital Input	IP0 … IP5
1	Digital Input/Output	Bit 0 … Bit 7
2	Digital Input/Output	Bit 8 … Bit 15
3	Digital Input/Output	Bit 16 … Bit 23
4	Digital Input/Output	Bit 24 … Bit 31
5	External Clock	XPCLK
6	External Trigger	TGIN

How DriverLINX maps digital input 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.
- 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 88.)

Digital Input Pacing, Triggering and Gating Signals

Digital input tasks can use any of the Counter/Timer Logical Channels for pacing, but use Logical Channel 3 as the default. The clock sources can be internal or external.

The Digital Input subsystem can use several control signals that DriverLINX defines as external clocks and gates as shown in the following table:

Connector Name	DriverLINX Usage
CLKIN0 CLKIN1	Divided external pacer clock: • Divider-Rate Generator: External Clocking
GATEIN0 GATEIN1	External gate: • Rate Timing Event

How DriverLINX uses digital input control signals.

Digital Output Subsystem Signals

The Digital Output subsystem has a 5-bit digital output port and a 32-bit digital input/output port. DriverLINX maps these signals to Logical Channels as shown in the following table:

Logical Channel	DriverLINX Function	KPCI-3108 Series External Connector
0	Standard Digital Output	OP0 … OP4
1	Digital Input/Output	Bit 0 … Bit 7
2	Digital Input/Output	Bit 8 … Bit 15
3	Digital Input/Output	Bit 16 … Bit 23
4	Digital Input/Output	Bit 24 … Bit 31

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 88.)
- The board has an OP5 pin for any one of several clock outputs but not for data output. To select which clock signal the board outputs through OP5, see “Special…” on page 16.

Digital Output Pacing, Triggering and Gating Signals

Digital output tasks can use any of the Counter/Timer Logical Channels for pacing, but use Logical Channel 2 as the default. The clock sources can be internal or external.

The Digital Output subsystem can use several control signals that DriverLINX defines as external clocks and gates as shown in the following table:

Connector Name	DriverLINX Usage
CLKIN0 CLKIN1	Divided external pacer clock: • Divider-Rate Generator: External Clocking
GATEIN0 GATEIN1	External gate: • Rate Timing Event

How DriverLINX uses digital output control signals.

Counter/Timer Subsystem Signals

The Counter/Timer subsystem has a Logical Channel for each of the 8254 chip’s three counter/timers. DriverLINX defines an additional Logical Channel for counters 1 and 2 in cascade mode.

Analog I/O tasks can use the board’s external clock source (XPCLK) for pacing instead of the output of an 8254 counter/timer. Also, analog input tasks can use the board’s trigger/gate input (TGIN) for either triggering or gating.

DriverLINX maps these signals as shown in the following table:

Logical Channel	8254 Chip Counter	Connector Name
0	Counters 1 & 2	XPCLK, TGIN, CLKIN1, GATEIN1, CTOUT2
1	Counter 0	XPCLK, TGIN, CLKIN0, GATEIN0, CTOUT0
2	Counter 1	XPCLK, TGIN, CLKIN1, GATEIN1, CTOUT1
3	Counter 2	XPCLK, TGIN, CTOUT2

How DriverLINX maps counter/timer hardware channels to Logical Channels.

Device Subsystem

The following sections describe how DriverLINX implements Device Subsystem features for the KPCI-3108 Series.

Device Modes

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

Device Operations

The KPCI-3108 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 Input Subsystem

The following sections describe how DriverLINX implements Analog Input Subsystem features for the KPCI-3108 Series.

Analog Input Modes

The Analog Input Subsystem supports the following modes:

- **Polled**—For single-value or single-scan analog input samples.
- **Interrupt**—For buffered transfers using programmed I/O.
- **DMA**—For buffered transfers using direct memory access.
- **Other**—For subsystem initialization and data conversion.

Analog Input Operations

The KPCI-3108 Series Analog Input Subsystem supports the following DriverLINX operations:

- **Initialize**—aborts all active analog input 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.
- **Status**—reports the buffer position of the next sample that DriverLINX will write into a buffer.
- **Stop**—terminates an analog input data-acquisition task.
- **Message**—DriverLINX displays a pop-up dialog box for the user containing the text for the current DriverLINX error message.

Analog Input Pacing, Triggering and Gating Options

The *KPCI-3108 Series User's Manual* describes several pacing, triggering and gating options available on KPCI-3108 Series models. The following table summarizes these options and identifies which Service Request properties use them. Except as indicated, all tasks must use Interrupt or DMA mode.

Parameter	Option	Service Request Properties
Pacing Mode		
	Periodic (paced)	Rate generator timing event
	Burst	Burst generator timing event
Clock Source		
	Software	Single-value or single-scan (Polled mode)
	Internal	Rate timing event with an internal clock source
	External +/-	Rate timing event with an external clock source
	Burst	Rate timing event in burst generator mode with an internal or external clock source
Trigger		
	Internal (software)	Command start event Command stop event Terminal count stop event
	Digital +/-	Digital start event Digital stop event
	Analog	Analog stop event
Trigger Mode		
	Post-trigger	Digital start event
	About-trigger	Analog or Digital stop event with positive delay
	Pre-trigger	Analog or Digital stop event with 0-delay
	Trigger-to-trigger	Digital start event Digital stop event
	Trigger-to-about-trigger	Digital start event Digital stop event with positive delay
Gate		
	Level +/-	Rate timing event Digital start event (for use with a digital timing event)

Analog Input Timing Events

Timing Events specify how the hardware paces or clocks the acquisition of analog input samples. DriverLINX uses the Timing Event to program when the KPCI-3108 Series acquires the next analog input sample.

The KPCI-3108 Series supports the following Timing Events:

- **None**—Sampling requires no pacing as DriverLINX is acquiring only a single value or scan.
- **Rate**—The KPCI-3108 Series supports fixed rate and burst mode sampling using internal and external clocks.

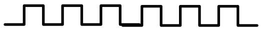
None or Null Timing Event

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

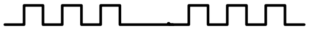
Rate Timing Event

The KPCI-3108 Series supports two types of Rate Events for analog input:

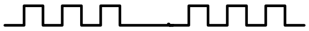
- **Rate Generator**—Generates a fixed rate clock with equal time intervals between tics.



- **Burst Generator**—Generates a dual frequency clock with a fixed number of tics at a high frequency separated by a time interval at a lower frequency.



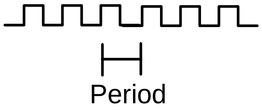
- **Divider**—Generates a fixed rate or dual frequency clock by dividing an external input frequency.



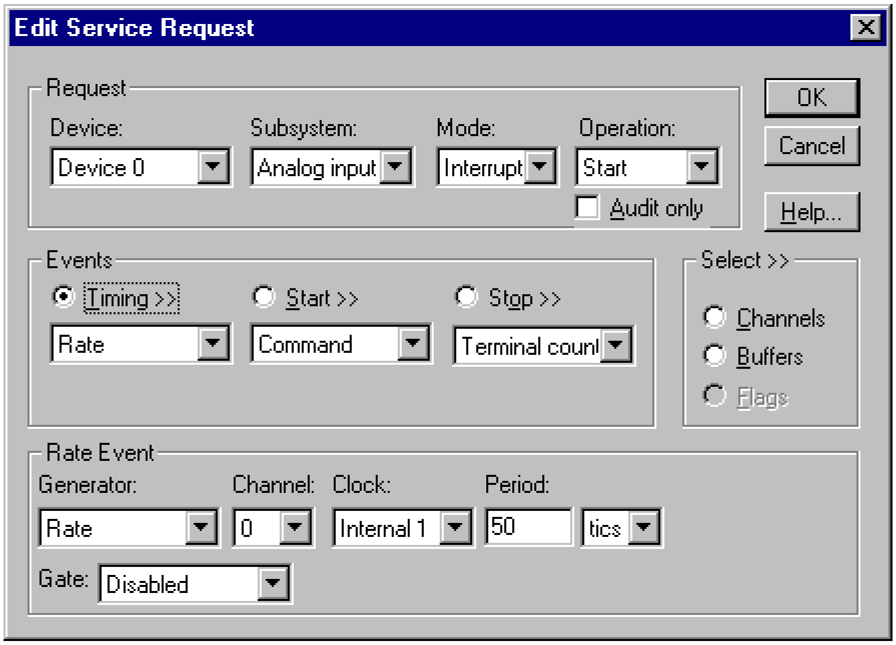
KPCI-3108 Series boards have a programmable 10 MHz, 5 MHz, 1 MHz or 100 kHz master clock frequency. The sample period can range from 10 µs to $2^{32} - 1$ tics with a 100 kHz timebase. This means the sample rate can range from 0.000233 Hz to 100 kHz. However, using multiple channels or non-unity gains may reduce the maximum sample rate that the hardware can accurately acquire. Consult your hardware manual for details.

Rate Generator: Internal Clocking

An internally clocked Rate Generator produces a fixed rate clock with equal time intervals between tics.



Use an internally clocked rate generator when you want to acquire all analog input samples at equally spaced time intervals.


Edit Service Request

Request
Device: Device 0
Subsystem: Analog input
Mode: Interrupt
Operation: Start
□ Audit only

Events
● Timing >> Rate
○ Start >> Command
○ Stop >> Terminal count

Select >>
○ Channels
○ Buffers
○ Flags

Rate Event
Generator: Rate
Channel: 0
Clock: Internal 1
Period: 50 tics
Gate: Disabled

How to set up the KPCI-3108 Series for fixed rate sampling using an internal clock.

For hardware independence, specify the clock channel using the symbolic constant, DEFAULTTIMER, which always maps to the default Logical Channel for analog input timing.

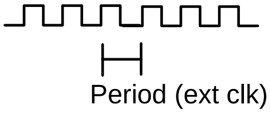
- Specify internal clocking using a **Rate** *Generator* on any available *Channel* with any **Internal** *Clock* source. See “Counter/Timer Subsystem” on page 110 for a description of clock sources.
- The *Period* property specifies the time interval between samples in tics. The minimum period is 10 μs.
- The *Gate* property specifies how the gate signal affects the operation of the pacer clock. For analog input, DriverLINX uses the gate specified in the device configuration. Valid settings for the TGIN gate are Enabled, Disabled, NoConnect, High Level and Low Level. Valid settings for the GATEIN0 or GATEIN1 gate are Enabled, Disabled, NoConnect, and High Level. Valid settings, when pacing with channel 3, which has no external gate input, are Disabled and NoConnect. See “Counter/Timer Subsystem” on page 110 for a description of each *Gate* setting.

  Note: When configured for the TGIN gate, the hardware does not support using a gated clock with a digital start or stop trigger.

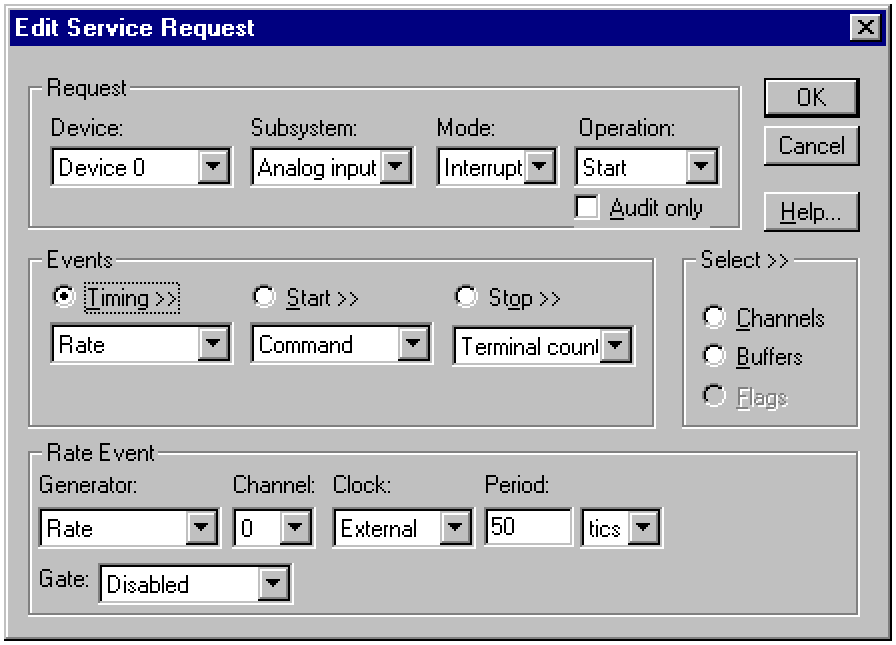
- **Example:** For a programming example, see AIBUFFER in your DrvLINX4\Source folder.

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 analog input samples with a recurrent external signal. In this mode you will need a separate external clock tic for each analog sample you want to acquire.



Edit Service Request

Request
Device: Device 0
Subsystem: Analog input
Mode: Interrupt
Operation: Start
□ Audit only

Events
● Timing >> Rate
○ Start >> Command
○ Stop >> Terminal count

Select >>
○ Channels
○ Buffers
○ Flags

Rate Event
Generator: Rate
Channel: 0
Clock: External
Period: 50 tics
Gate: Disabled

How to set up the KPCI-3108 Series for fixed rate sampling using an external clock.

For hardware independence, specify the clock channel using the symbolic constant, DEFAULTTIMER, which always maps to the default Logical Channel for analog input timing.

- Specify external clocking using a **Rate** *Generator* on any available *Channel* with an **External, External+**, or **External-** *Clock* source. See “Counter/Timer Subsystem” on page 110 for a description of clock sources.

Be sure that the external clock source is TTL compatible, 0 V minimum to +5 V maximum!

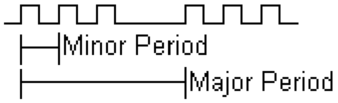
- Users should connect the external clock signal to the XPCLK line.
- The frequency of the external clock must not exceed 100 kHz.
- Specify a *Period* between the minimum and maximum external clocking period. The value doesn’t affect the external clock frequency, but DriverLINX requires a valid hardware value in case the application requests a timebase operation and to optimize data transfer between the driver and the application.

- The *Gate* property specifies how the gate signal affects the operation of the pacer clock. For analog input, DriverLINX uses the gate specified in the device configuration. Valid settings for the TGIN gate are Enabled, Disabled, NoConnect, High Level and Low Level. Valid settings for the GATEIN0 or GATEIN1 gate are Enabled, Disabled, NoConnect, and High Level. Valid settings, when pacing with channel 3, which has no external gate input, are Disabled and NoConnect. See “Counter/Timer Subsystem” on page 110 for a description of each *Gate* setting.

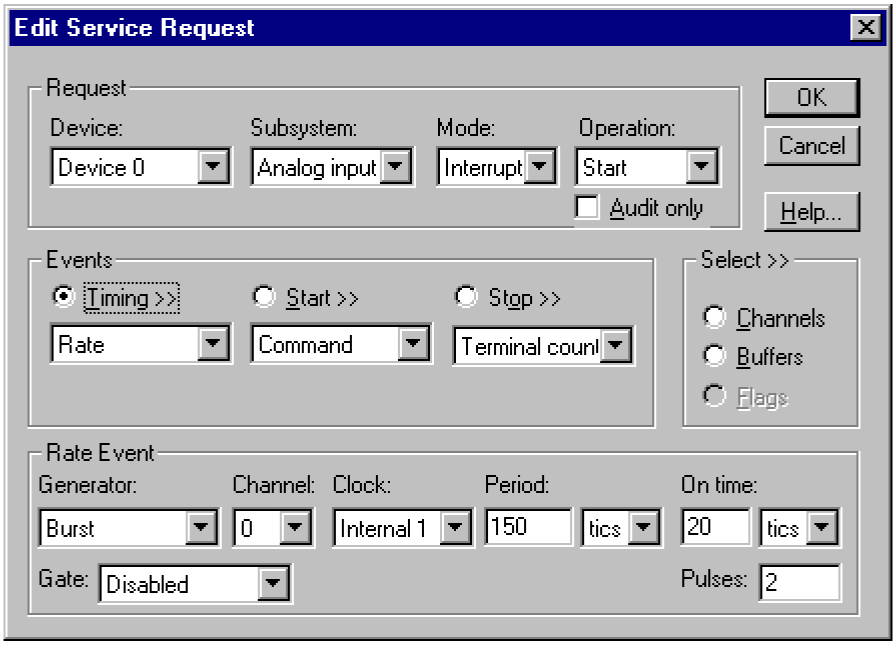
  Note: When configured for the TGIN gate, the hardware does not support using a gated clock with a digital start or stop trigger.

Burst Generator: Internal Clocking

An internally clocked Burst Generator produces a dual frequency clock with a fixed number of tics at a high frequency repeated at a lower frequency.



Use an internally clocked rate generator when you want to acquire analog input samples from a several channels at closely spaced time intervals and then repeat at longer intervals.


Edit Service Request

Request

Device: Device 0

Subsystem: Analog input

Mode: Interrupt

Operation: Start

□ Audit only

Events

● Timing >> Rate

○ Start >> Command

○ Stop >> Terminal count

Select >>

○ Channels

○ Buffers

○ Flags

Rate Event

Generator: Burst

Channel: 0

Clock: Internal 1

Period: 150 tics

On time: 20 tics

Gate: Disabled

Pulses: 2

How to set up the KPCI-3108 Series for burst mode sampling using an internal clock.

For hardware independence, specify the clock channel using the symbolic constant, DEFAULTTIMER, which always maps to the default Logical Channel for analog input timing.

- Specify internal clocking using a **Burst** *Generator* on any available *Channel* with any **Internal** *Clock* source. See “Counter/Timer Subsystem” on page 110 for a description of clock sources.
- The *Period* property specifies the time interval between bursts in tics. The minimum period is 10 µs.
- The *On time* property specifies the time interval between samples. It must be in the range of 10µs to 255µs. Also *Pulses* × (*On time +1µs*) must be **less than** *Period*.
- The *Gate* property specifies how the gate signal affects the operation of the pacer clock. For analog input, DriverLINX uses the gate specified in the device configuration. Valid settings for the TGIN gate are Enabled, Disabled, NoConnect, High Level and Low Level. Valid settings for the GATEIN0 or GATEIN1 gate are Enabled, Disabled, NoConnect, and High Level. Valid settings, when pacing with channel 3, which has no external gate input, are Disabled and NoConnect. See “Counter/Timer Subsystem” on page 110 for a description of each *Gate* setting.

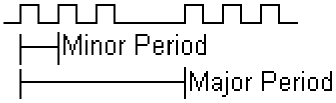
Note: When configured for the TGIN gate, the hardware does not support using a gated clock with a digital start or stop trigger.

- The *Pulses* property specifies how many channels the board samples in each *Period*. *Pulses* must equal the number of channels in the channel list.

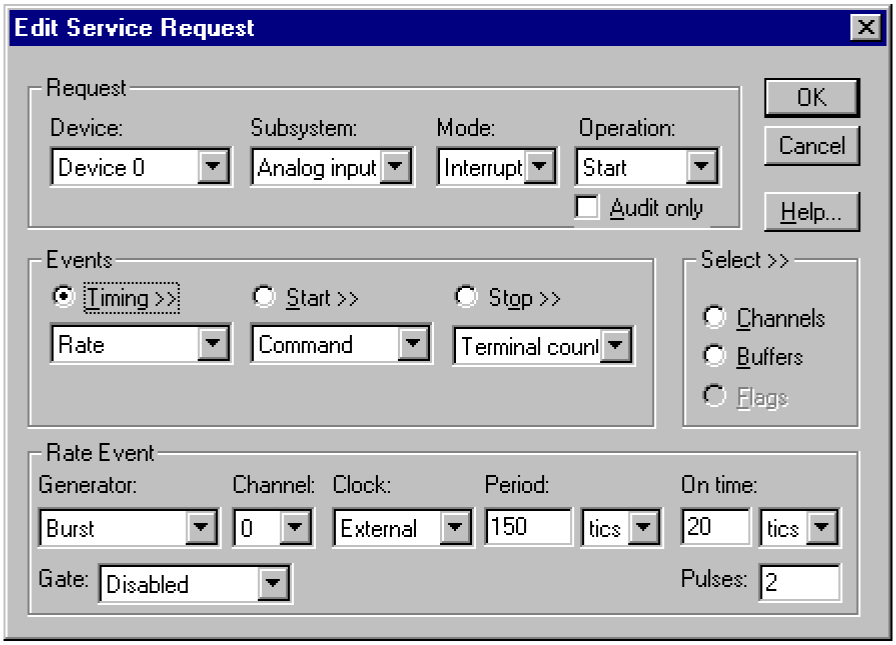
Example: For a programming example, see AIBURST in your DrvLINX4\Source folder.

Burst Generator: External Clocking

An externally clocked Rate Generator produces a dual frequency clock with a fixed number of tics at a high, internal frequency repeated at a lower, externally controlled frequency.



Use an externally clocked burst generator when you want to synchronize a burst of analog input samples with a recurrent external signal. In this mode you will need a separate external clock tic for each burst of analog samples you want to acquire.



Edit Service Request

Request

Device: Device 0

Subsystem: Analog input

Mode: Interrupt

Operation: Start

☐ Audit only

Events

● Timing >> ○ Start >> ○ Stop >>

Rate | Command | Terminal count

Select >>

○ Channels

○ Buffers

○ Flags

Rate Event

Generator: Burst

Channel: 0

Clock: External

Period: 150 tics

On time: 20 tics

Gate: Disabled

Pulses: 2

How to set up the KPCI-3108 Series for burst mode sampling using an external clock.

***BE SURE** that the external clock source is TTL compatible, 0 V minimum to +5 V maximum!*

- Specify external clocking using a **Burst** *Generator* on any available *Channel* with an **External, External+**, or **External-** *Clock* source. See “Counter/Timer Subsystem” on page 110 for a description of clock sources.
- Users should connect the external clock signal to the XPCLK line.
- Specify a *Period* between the minimum and maximum external clocking period. The value doesn’t affect the external clock frequency, but DriverLINX requires a valid hardware value in case the application

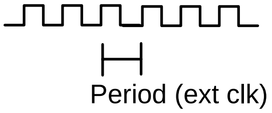
requests a timebase operation and to optimize data transfer between the driver and the application.

- The *On time* property specifies the time interval between samples. It must be within the range of 10µs to 255µs. Also, *Pulses* × (*On time +1µ*s) must be **less than** *Period*.
- The frequency of the external clock must not exceed 100 kHz.
- The *Gate* property specifies how the gate signal affects the operation of the pacer clock. For analog input, DriverLINX uses the gate specified in the device configuration. Valid settings for the TGIN gate are Enabled, Disabled, NoConnect, High Level and Low Level. Valid settings for the GATEIN0 or GATEIN1 gate are Enabled, Disabled, NoConnect, and High Level. Valid settings, when pacing with channel 3, which has no external gate input, are Disabled and NoConnect. See "Counter/Timer Subsystem" on page 110 for a description of each *Gate* setting.

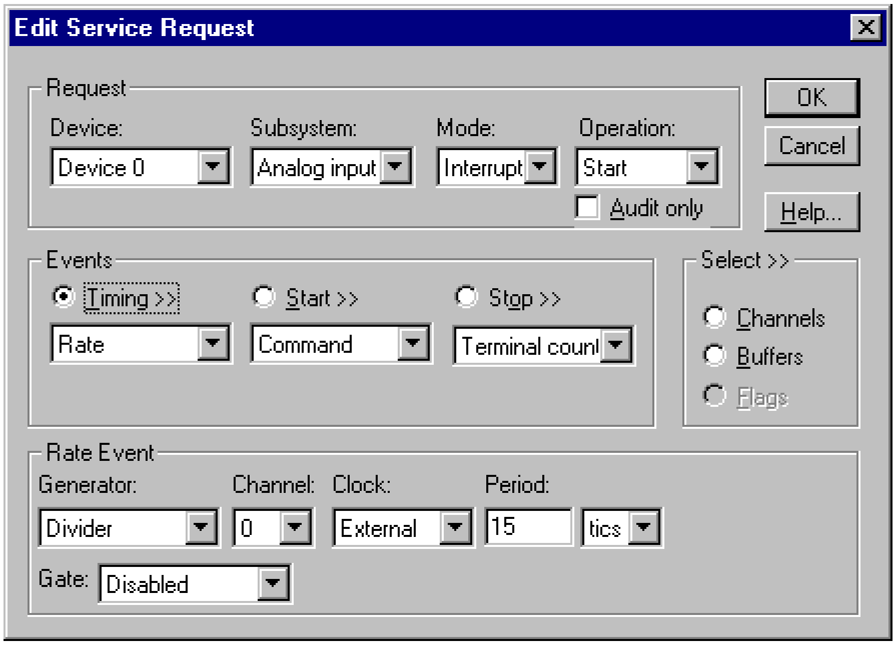
  Note: When configured for the TGIN gate, the hardware does not support using a gated clock with a digital start or stop trigger.
- The *Pulses* property specifies how many channels the board samples in each *Period*. *Pulses* must equal the number of channels in the channel list.

Divider-Rate Generator: External Clocking

A divided, externally clocked Rate Generator produces a rate clock with unknown time intervals between tics.



Use a divider-rate generator when you want to synchronize analog input samples with a recurrent, higher frequency, external signal. In this mode you will need a specified number of external clock tics for each analog sample you want to acquire.



Request

Device: Device 0

Subsystem: Analog input

Mode: Interrupt

Operation: Start

□ Audit only

Events

● Timing >>: Rate

○ Start >>: Command

○ Stop >>: Terminal count

Rate Event

Generator: Divider

Channel: 0

Clock: External

Period: 15 tics

Gate: Disabled

How to set up the KPCI-3108 Series for rate sampling using a divided external clock.

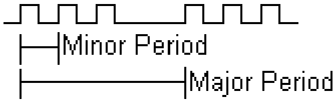
Be sure that the external clock source is TTL compatible, 0 V minimum to +5 V maximum!

- Specify external clocking using a **Divider** *Generator* on any available *Channel* with an **External,** or **External+** *Clock* source. See "Counter/Timer Subsystem" on page 110 for a description of clock sources.
- Users should connect the external clock signal to the CLKIN0 line for the channel 1 or the CLKIN1 line for channels 0 and 2.
- Specify the divisor for the external frequency in the *Period* property. The resulting pacing frequency must not exceed 100 kHz.
- The *Gate* property specifies how the gate signal affects the operation of the pacer clock. For analog input, DriverLINX uses the gate specified in the device configuration. Valid settings for the TGIN gate are Enabled, Disabled, NoConnect, High Level and Low Level. Valid settings for the GATEIN0 or GATEIN1 gate are Enabled, Disabled, NoConnect, and High Level. Valid settings, when pacing with channel 3, which has no external gate input, are Disabled and NoConnect. See "Counter/Timer Subsystem" on page 110 for a description of each *Gate* setting.

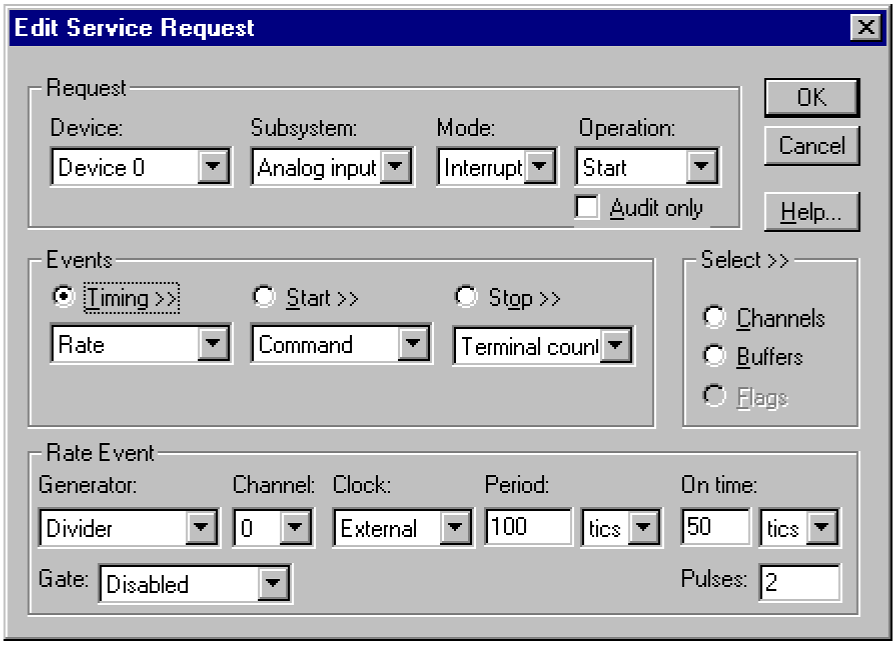
Note: When configured for the TGIN gate, the hardware does not support using a gated clock with a digital start or stop trigger.

Divider-Burst Generator: External Clocking

A divided, externally clocked Burst Generator produces a dual frequency clock with a fixed number of tics at a high, internal frequency repeated at a lower, externally controlled frequency.



Use a divider-burst generator when you want to synchronize a burst of analog input samples with a recurrent, higher frequency, external signal. In this mode you will need a specified number of external clock tics for each burst of analog samples you want to acquire.



Edit Service Request

Request
Device: Device 0
Subsystem: Analog input
Mode: Interrupt
Operation: Start
□ Audit only

Events
● Timing >> Rate
○ Start >> Command
○ Stop >> Terminal count

Select >>
○ Channels
○ Buffers
○ Flags

Rate Event
Generator: Divider
Channel: 0
Clock: External
Period: 100 tics
On time: 50 tics
Gate: Disabled
Pulses: 2

How to set up the KPCI-3108 Series for burst mode sampling using a divided external clock.

Note: The *Edit Service Request* dialog does not actually display all the properties for a divider-burst generator. However, you can access all the properties programmatically.

Be sure that the external clock source is TTL compatible, 0 V minimum to +5 V maximum!

- Specify external clocking using a **Divider** *Generator* on any available *Channel* with an **External,** or **External+** *Clock* source. See “Counter/Timer Subsystem” on page 110 for a description of clock sources.
- Users should connect the external clock signal to the CLKIN0 line for the channel 1 or the CLKIN1 line for channels 0 and 2.
- Specify the divisor for the external frequency in the *Period* property. The resulting pacing frequency must not exceed 100 kHz.

- The *On time* property specifies the time interval between samples. It must be within the range of 10µs to 255µs. Also, *Pulses* × (*On time +1µ*s) must be **less than** *Period*.
- The *Gate* property specifies how the gate signal affects the operation of the pacer clock. For analog input, DriverLINX uses the gate specified in the device configuration. Valid settings for the TGIN gate are Enabled, Disabled, NoConnect, High Level and Low Level. Valid settings for the GATEIN0 or GATEIN1 gate are Enabled, Disabled, NoConnect, and High Level. Valid settings, when pacing with channel 3, which has no external gate input, are Disabled and NoConnect. See “Counter/Timer Subsystem” on page 110 for a description of each *Gate* setting.

  Note: When configured for the TGIN gate, the hardware does not support using a gated clock with a digital start or stop trigger.
- The *Pulses* property specifies how many channels the board samples in each *Period*. *Pulses* must equal the number of channels in the channel list.

Analog Input Start Events

Start Events specify when the KPCI-3108 hardware starts acquiring analog input data.

The KPCI-3108 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-3108 hardware for the task.
- **Digital**—The hardware starts acquiring analog input samples when the hardware detects the digital Logical Channel input satisfies the condition specified in the Start Event.

None or Null Start Event

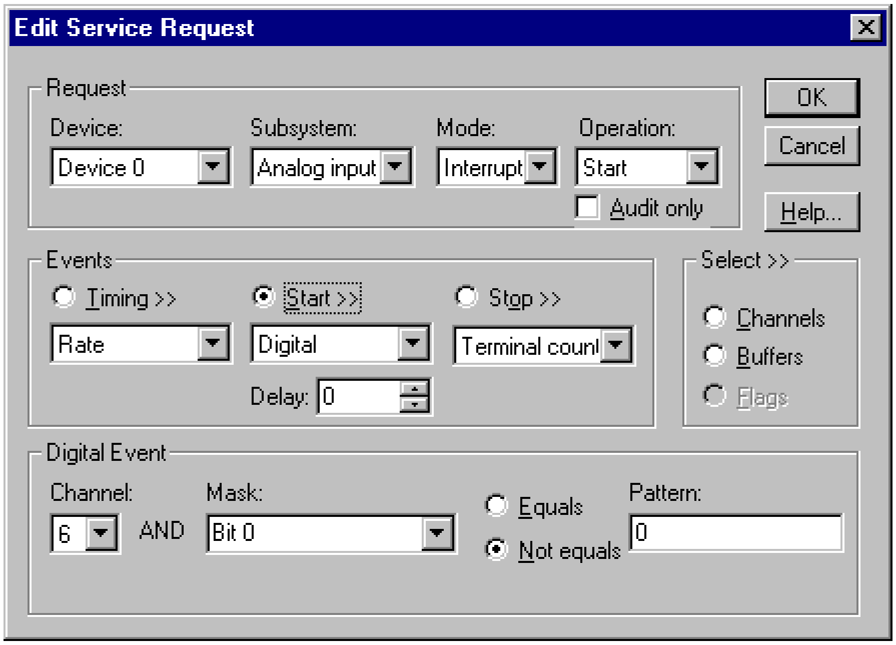
The Null Event specifies that the task does not need a Start Event to begin the task.

Command Start Event

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

Digital Start Event (Post-Triggering)

The KPCI-3108 can acquire analog input samples ***after*** the hardware detects a digital trigger condition. Use post-triggering when you want to synchronize the start of data acquisition with an external signal.


Edit Service Request

Request

Device: Device 0

Subsystem: Analog input

Mode: Interrupt

Operation: Start

□ Audit only

Events

○ Timing >> Rate

● Start >> Digital

Delay: 0

○ Stop >> Terminal count

Select >>

○ Channels

○ Buffers

○ Flags

Digital Event

Channel: 6 AND Mask: Bit 0

○ Equals

● Not equals

Pattern: 0

How to set up the KPCI-3108 Series for post-triggered analog input.

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

- Specify the *Channel* as **6**. For hardware-independence, you can specify the hardware external trigger channel by the symbolic constant, *DI_EXTTRG*.
- Users should connect the external trigger signal to the TGIN line.
- Specify the *Mask* property as **1**, or **Bit 0**, to indicate that DriverLINX should only compare a 1-bit digital input value against the *Pattern* property.
- Specify the *Match* property as **Not equals**.
- Specify the *Pattern* property as **0** for a rising, or positive, edge trigger (≠0) or **1** for a falling, or negative, edge trigger (≠1).
- Specify the *Delay* property as 0. The KPCI-3108 does not support a delay in sampling after the start trigger.

Notes:

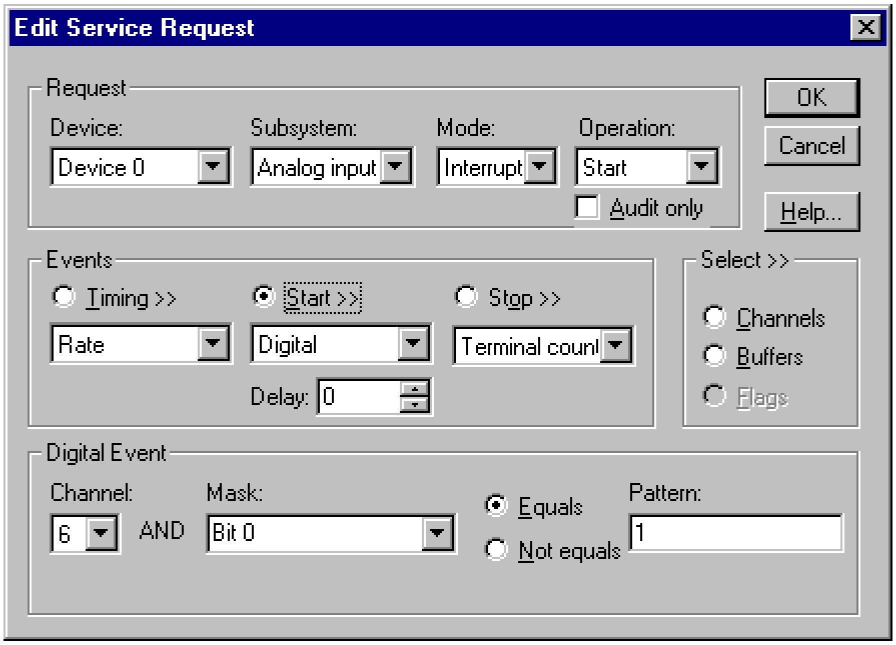
- When configured for the TGIN gate, the hardware does not support using a gated clock with a digital start or stop trigger.
- If both the start trigger and stop trigger are digital events, they must have identical *Pattern* settings.
- The hardware does not support using a digital start trigger with an analog stop trigger.

When the hardware detects the trigger, DriverLINX sends a StartEvent message (or event). For more information on messages, see “Analog Input Messages” on page 68.

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

Digital Start Event (Gating)

The KPCI-3108 can pause and resume acquiring analog input samples based on the level of a digital input condition. Use a digital start event to set up gating when using a digital timing event. To set up gating for a Rate timing event, see “Rate Timing Event” on page 42.



Edit Service Request

Request

Device: Device 0

Subsystem: Analog input

Mode: Interrupt

Operation: Start

□ Audit only

Events

○ Timing >> Rate

● Start >> Digital

Delay: 0

○ Stop >> Terminal count

Select >>

○ Channels

○ Buffers

○ Flags

Digital Event

Channel: 6 AND Mask: Bit 0

● Equals

○ Not equals

Pattern: 1

How to set up the KPCI-3108 Series for gated analog input.

Digital Start Events contain *mask*, *pattern*, and *match* fields. The mask selects which bit in the Logical Channel to use as a gate input. The *pattern* selects whether the gate is active, or enables data-acquisition, when the gate signal is high or low.

- Specify the *Channel* as **6**. For hardware-independence, you can specify the hardware external trigger channel by the symbolic constant, *DI_EXTTRG*.
- Users should connect the external gating signal to the TGIN line.
- Specify the *Mask* property as **1**, or **Bit 0**, to identify the gate input bit of the Logical Channel.
- Specify the *Match* property as **Equals**.
- Specify the *Pattern* property as **0** for a low-level active gate or **1** for a high-level active gate.
- Specify the *Delay* property as 0. DriverLINX does not use a delay with gating.

Analog Input Stop Events

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

The KPCI-3108 Series supports the following Stop Events:

- **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 data-acquisition hardware has filled all the data buffers once.
- **Analog**—The hardware stops acquiring analog input samples when the hardware detects the analog Logical Channel input satisfies the condition specified in the Start Event.
- **Digital**—The hardware stops acquiring analog input samples when the hardware detects the digital Logical Channel 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.

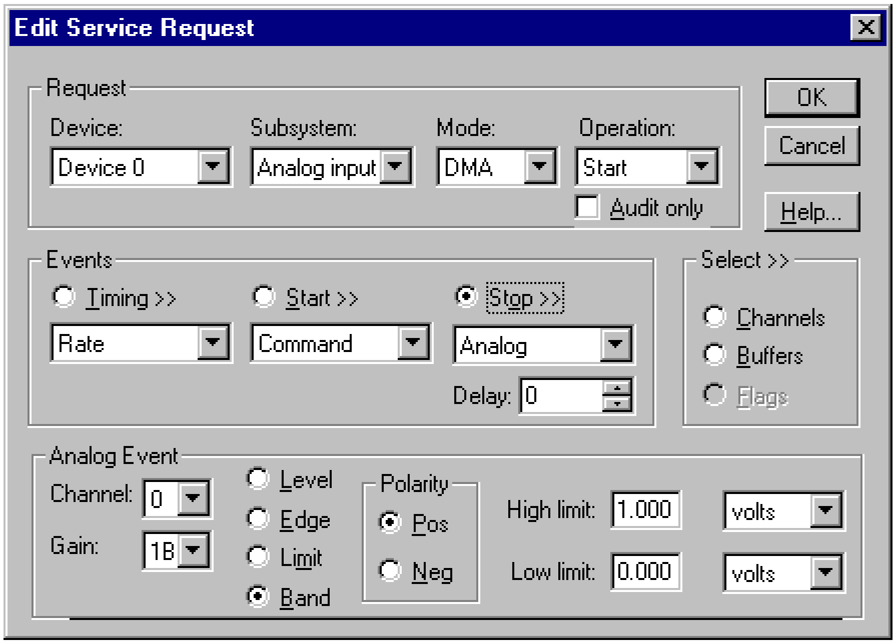
In Stop-on-Command mode, DriverLINX continuously cycles through all the data buffers filling them with analog input data from the data-acquisition hardware.

Terminal Count Stop Event

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

Analog Stop Event (Pre- and About-Triggering)

The KPCI-3108 can acquire analog input samples ***until*** the hardware detects an analog trigger condition. Use pre-triggering when you want to synchronize the end of data-acquisition with an external signal. Use about-triggering when you want to delay the end of data-acquisition a fixed number of samples after the trigger.


Edit Service Request

Request
Device: Device 0
Subsystem: Analog input
Mode: DMA
Operation: Start
□ Audit only

Events
○ Timing >> Rate
○ Start >> Command
● Stop >> Analog
Delay: 0

Select >>
○ Channels
○ Buffers
○ Flags

Analog Event
Channel: 0
Gain: 1B
○ Level
○ Edge
○ Limit
● Band
Polarity
● Pos
○ Neg
High limit: 1.000 volts
Low limit: 0.000 volts

How to set up the KPCI-3108 Series for pre-triggered analog input.

Analog Stop Events contain *Channel*, *Gain*, *Polarity* and *Limit* fields. The limits determine the type of analog event (Level, Edge, Limit, or Band). For the KPCI-3108 Series, only edge and band types are allowed. The hardware supports band triggering directly, while DriverLINX emulates edge triggering by programming the smallest band that the hardware supports. As the board acquires samples, it compares data from the specified *Channel* against the *High* and *Low Limits*. The Polarity determines whether the trigger occurs on a rising or falling signal. A rising trigger occurs when a sample above the high limit follows a sample below the low limit. Similarly, a falling trigger occurs when a sample below the low limit follows a sample above the high limit.

- Specify the *Mode* as **DMA**. The KPCI-3108 Series supports analog triggering only in DMA mode.
- Specify the *Logical Channel* from the analog input subsystem. For the KPCI-3108 Series, the analog event channel must be in the channel list. The channel can occur more than once in the channel list, but the board monitors for the trigger condition only while sampling for the first occurrence of the channel.
- Specify the *Gain* property for the analog event channel. Use the same gain as in the channel list.
- Specify the *Polarity* (or Slope) property as **Pos** for a rising trigger or **Neg** for a falling trigger.
- Specify the *Limit* properties in hardware A/D codes as follows:

Type	High Limit	Low Limit
Edge	Threshold	Threshold
Band	Lower Threshold	Upper Threshold

Programming Tip: Use the DriverLINX *Volts2Code* method to easily convert volts to hardware A/D codes for the threshold properties.

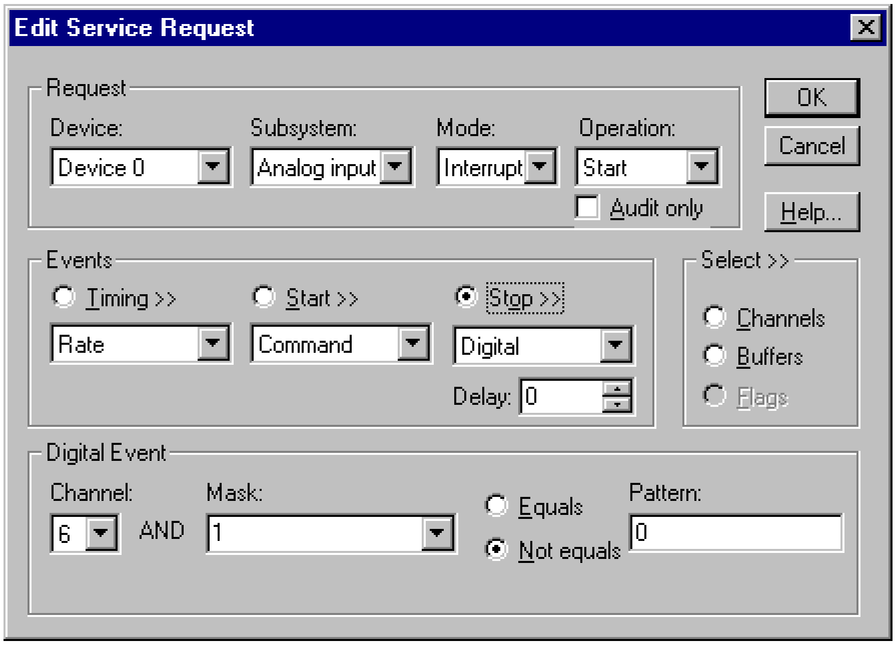
- Specify the *Delay* property as **0** for pre-triggering, or a positive number of samples to obtain after the trigger for about-triggering. The *Delay* value must be a multiple of the number of channels in the channel list.
- The hardware does not support using a digital start trigger with an analog stop trigger.

When the hardware detects the trigger, DriverLINX sends a StopEvent message (or event) that identifies the buffer location of the last sample. For more information on messages, see “Analog Input Messages” on page 68.

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

Digital Stop Event (Pre- and About-Triggering)

The KPCI-3108 can acquire analog 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.



Edit Service Request

Request

Device: Device 0

Subsystem: Analog input

Mode: Interrupt

Operation: Start

□ Audit only

Events

○ Timing >> Rate

○ Start >> Command

● Stop >> Digital

Delay: 0

Select >>

○ Channels

○ Buffers

○ Flags

Digital Event

Channel: 6 AND Mask: 1

○ Equals

● Not equals

Pattern: 0

How to set up the KPCI-3108 Series for pre-triggered analog input.

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

- Specify the *Channel* as **6**. For hardware-independence, you can specify the hardware external trigger channel by the symbolic constant, *DI_EXTTRG*.
- Users should connect the external trigger signal to the TGIN line.
- Specify the *Mask* property as **1**, or **Bit 0**, to indicate that DriverLINX should only compare a 1-bit digital input value against the *Pattern* property.

- Specify the *Match* property as **Not equals**.
- Specify the *Pattern* property as **0** for a rising, or positive, edge trigger (≠0) or **1** for a falling, or negative, edge trigger (≠1).
- Specify the *Delay* property as an integer from 0 to $2^{32} - 1$. The KPCI-3108 continues sampling until it obtains this number of samples after the trigger. The number must be a multiple of the number of channels in the channel list.

Notes:

- Note: When configured for the TGIN gate, the hardware does not support using a gated clock with a digital start or stop trigger.
- If both the start trigger and stop trigger are digital events, they must have identical *Pattern* settings.

When the hardware detects the trigger, DriverLINX sends a StopEvent message (or event) that identifies the buffer location of the last sample. For more information on messages, see “Analog Input Messages” on page 68.

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

Analog Input Channels

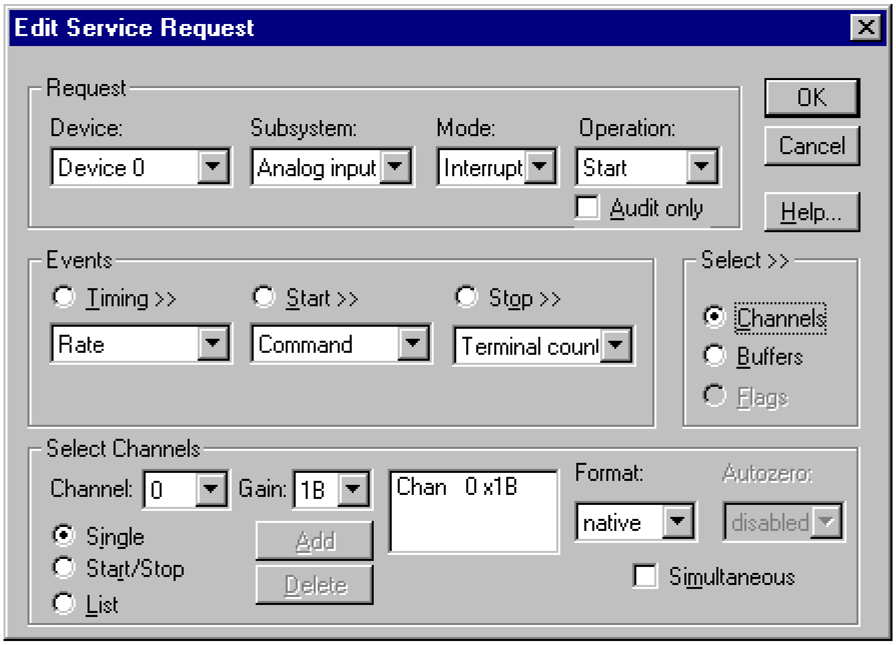
The KPCI-3108 Series models support a variety of channel gains with differential or single-ended termination modes. The Logical Device configuration sets the default termination mode for analog input channels. An application can request a particular termination mode for each channel it uses. The channel gains are also application selectable.

The KPCI-3108 Series allows applications to specify the analog 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.

Single Channel Analog Input

In single channel mode, the KPCI-3108 Series acquires all data from one channel at the specified gain.



Request

Device: Device 0

Subsystem: Analog input

Mode: Interrupt

Operation: Start

□ Audit only

Events

○ Timing >> Rate

○ Start >> Command

○ Stop >> Terminal coun

Select >>

● Channels

○ Buffers

○ Flags

Select Channels

Channel: 0 Gain: 1B

Chan 0 x1B

● Single

○ Start/Stop

○ List

Format: native

Autozero: disabled

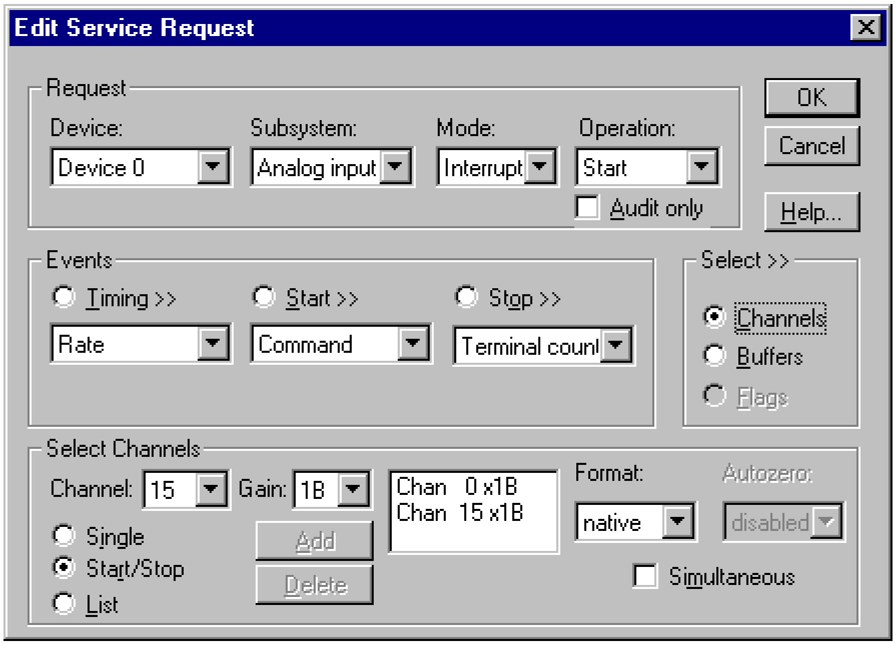
□ Simultaneous

How to set up the KPCI-3108 Series for sampling on a single channel.

Multi-channel Analog Input Range

In multi-channel range mode, the KPCI-3108 Series acquires data from a consecutive range of analog channels.

- The Start Channel’s gain only applies to the first channel.
- DriverLINX uses the Stop Channel’s gain for all the other analog channels in the range.
- The gains may vary but they must all be either unipolar or bipolar.
- If the Start Channel is greater than the Stop Channel, the channel sequence is [Start Channel,… Last Channel, 0,… Stop Channel], where Last Channel is the highest numbered channel.



Request

Device: Device 0
Subsystem: Analog input
Mode: Interrupt
Operation: Start
☐ Audit only

Events

○ Timing >> Rate
○ Start >> Command
○ Stop >> Terminal count

Select >>

● Channels
○ Buffers
○ Flags

Select Channels

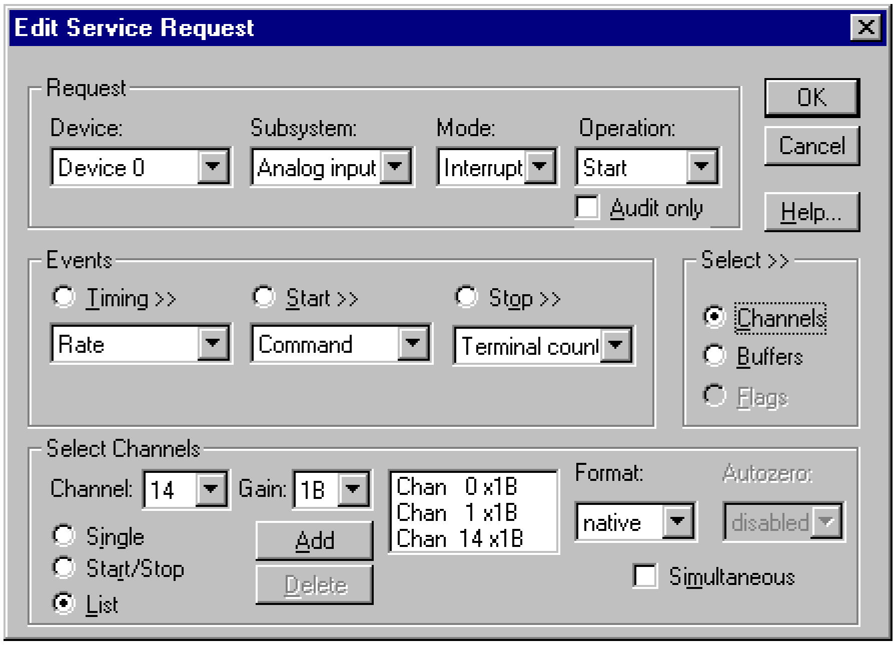
Channel: 15
Gain: 1B
Chan 0 x1B
Chan 15 x1B
Format: native
Autozero: disabled
○ Single
● Start/Stop
○ List
☐ Simultaneous

How to set up the KPCI-3108 Series for sampling on a consecutive range of channels.

Multi-channel Analog Input List

In multi-channel list mode, the KPCI-3108 Series acquires data from an arbitrary list of analog channels.

- The channel-gain list may contain up to 256 channels in any order. The list may repeat the same channel with the same or different gains.



Request

Device: Device 0
Subsystem: Analog input
Mode: Interrupt
Operation: Start
☐ Audit only

Events

○ Timing >> Rate
○ Start >> Command
○ Stop >> Terminal count

Select >>

● Channels
○ Buffers
○ Flags

Select Channels

Channel: 14
Gain: 1B
Chan 0 x1B
Chan 1 x1B
Chan 14 x1B
Format: native
Autozero: disabled
○ Single
○ Start/Stop
● List
☐ Simultaneous

How to set up the KPCI-3108 Series to sample from an arbitrary list of channels.

Analog Input Channel Gains

Each channel in a channel scan list has a gain code property to select the pre-amplifier gain when sampling that channel. The following tables show the correspondence between the gain multiplier, the maximum input signal range, and the gain code for each input range. Note: DriverLINX uses a negative (-) gain multiplier to signify a bipolar (±) range.

You should be aware that using multiple channels or non-unity gains reduces the maximum sample rate. Consult your hardware manual for details.

Gain	Range	Gain Code
-1	±10 V	0
-2	±5 V	1
-4	±2.5 V	2
-8	±1.25 V	3
-10	±1 V	4
-20	±500 mV	5
-40	±250 mV	6
-80	±125 mV	7
-100	±100 mV	8
-200	±50 V	9
-400	±25 mV	10
-800	±12.5 mV	11
1	0 - 10 V	16
2	0 - 5 V	17
4	0 - 2.5 V	18
8	0 - 1.25 V	19
10	0 - 1 V	20
20	0 - 500 mV	21
40	0 - 250 mV	22
80	0 - 125 mV	23
100	0 - 100 mV	24
200	0 - 50 V	25
400	0 - 25 mV	26
800	0 - 12.5 mV	27

Gains, Ranges, and Hardware Gain Codes for KPCI-3108 Series.

Use the DriverLINX **Gain2Code** method to easily convert between the gains in the above tables and Gain Codes. Using this method makes applications portable to different hardware models that have the same analog input ranges.

Expansion Channel Gains

The available gains for an expansion channel are the products of the expansion board’s programmable (1 and 50) and the KPCI board’s programmable gains.

If you are using an expansion accessory with other gain settings then you can scale the data using DriverLINX's conversion functions. For more information see "Converting Entire Buffers" in the *Analog I/O Programming Guide.*

For information on configuring expansion accessories, see "Special…" on page 16. For information on sampling from expansion channels, "Analog Input Expansion Channels" on page 64.

Analog Input Channel Termination modes

On the KPCI-3108 Series, each Analog Input channel can use single-ended or differential termination modes. When configuring the Analog Input Subsystem, you choose a default configuration for all channels. Applications can use the default configuration or specify the termination mode for each channel it uses. This scheme supports applications that use KPCI-3108-specific features as well as those that use only generic features.

Each channel in a channel list has a gain code property. To specify a termination mode for a channel, an application includes a termination mode-type flag in its gain code. The following table shows the flag value for each termination mode:

Termination mode	**Flag Value**
Default Configuration	CHAN_SEDIFF_DEFAULT = 0
Single-Ended	CHAN_SEDIFF_SE = 2×2^{13}
Differential	CHAN_SEDIFF_DIFF = 3×2^{13}

Note: The user chooses the default configuration on the Analog Input page of the DriverLINX Configuration Panel. See "Analog Input Subsystem Page" on page 20.

For example, an application that requires or knows a channel's termination mode obtains the gain code for a single-ended channel with a bipolar gain of 4, with:

```
Gain2Code (-4) + CHAN_SEDIFF_SE

// This code will work with only drivers that allow
applications to specify a termination mode.
```

An application that does not require or know a channel's termination mode obtains the gain code for a channel with a bipolar gain of 4, with:

```
Gain2Code (-4)

// This code will work with any board that supports
bipolar ranges.
```

Analog Input Channel Coupling Modes

The KPCI-3108 Series an Analog Input channel with AC, DC or GND coupling. When configuring the Analog Input Subsystem, you choose a default configuration for all channels. Applications can use the default configuration or specify the coupling mode for each channel it uses. This scheme supports applications that use KPCI-3108-specific features as well as those that use only generic features.

Each channel in a channel list has a gain code property. To specify a coupling mode for a channel, an application includes a coupling-mode flag in its gain code. The following table shows the flag value for each coupling mode:

Coupling Mode	Flag Value
Default Configuration	CHAN_COUPLING_DEFAULT = 0
AC	CHAN_COUPLING_AC = 1×2^{11}
DC	CHAN_COUPLING_DC = 2×2^{11}
GND	CHAN_COUPLING_GND = 3×2^{11}

Note: The user chooses the default configuration on the Analog Input page of the DriverLINX Configuration Panel. See “Analog Input Subsystem Page” on page 20.

For example, an application that requires DC coupling for a for a channel with a bipolar gain of 4, obtains the gain code by:

```
Gain2Code (-4) + CHAN_COUPLING_DC

// This code will work with only drivers that allow
applications to specify a coupling mode.
```

An application that does uses the configured coupling mode obtains the gain code for a channel with a bipolar gain of 4, with:

```
Gain2Code (-4)

// This code will work with any board that supports
bipolar ranges.
```

Analog Input Zero-Reference Adjustment

Applications can request automatic zero-reference adjustments (offset calibration) by selecting **Enabled** for *Autozero* property. Zero-reference adjustments ensure that offset errors are minimized before starting the data-acquisition. Note, this takes several seconds for each gain setting used in the service request.

Analog Input Expansion Channels

Multiplexers can expand the number of analog input channels from the 16 base channels up to 256 differential analog input channels. The KPCI-3108 Series hardware automatically switches the multiplexer channels, allowing you to specify expansion channels along with base channels in a channel list.

To enable DriverLINX to use multiplexers, enable expansion mode in the *Configure KPCI-3108 Options* dialog (see “Special…” on page 16). With expansion mode enabled, DriverLINX considers the board to have the original 16 base channels followed by 256 expansion channels.

DriverLINX uses a static numbering scheme for attaching multiplexers. Attaching or removing a mux from a base channel doesn’t change the Logical Channel number of any other channel. DriverLINX reserves a fixed number of expansion channels for each potential mux, whether it is attached or not.

To determine the DriverLINX Logical Channel number for a multiplexer channel, use the following formula or refer to the table that follows it. Note that DriverLINX uses 0-based numbering for all channels.

<logical chan#> = <num base chan> + <base chan#> × <num mux chan> + <mux chan#>

Term	Description
<logical chan#>	Logical Channel number to use in channel lists.
<num base chan>	Number of base channels on the KPCI-3108 Series board
<base chan#>	Base channel on the KPCI-3108 Series board where you attached the mux.
<num mux chan>	Number of expansion channels DriverLINX reserves for the mux. (16 for KPCI-3108 expansion accessories).
<mux chan#>	Channel on the expansion board where you attached the signal. Mux channels are numbered from 0 to 15.

For example, the Logical Channel address for channel 4 on a mux attached to base channel 3 is

16 + 3 × 16 + 4 = 68.

To specify multiplexer input channels 0, 1, and 2 on an expansion board connected to base channel 0, use 16, 17, and 18 in the channel/gain list.

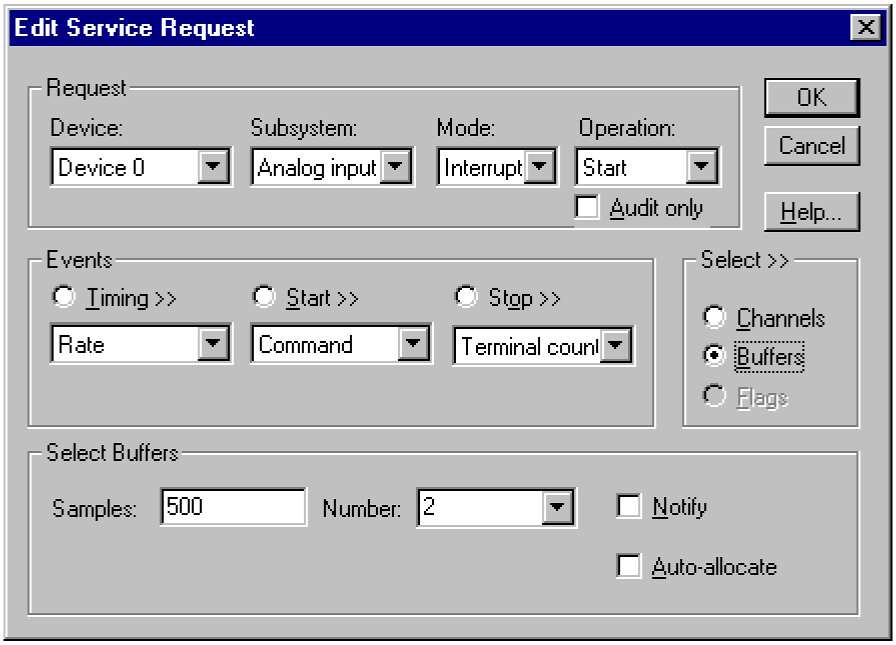
	Base Chan #								
Mux Chan #	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**etc**
0	16	32	48	64	80	96	112	128	
1	17	33	49	65	81	97	113	129	
2	18	34	50	66	82	98	114	130	
3	19	35	51	67	83	99	115	131	
4	20	36	52	68	84	100	116	132	
5	21	37	53	69	85	101	117	133	
6	22	38	54	70	86	102	118	134	
7	23	39	55	71	87	103	119	135	
8	24	40	56	72	88	104	120	136	
9	25	41	57	73	89	105	121	137	
10	26	42	58	74	90	106	122	138	
11	27	43	59	75	91	107	123	139	
12	28	44	60	76	92	108	124	140	
13	29	45	61	77	93	109	125	141	
14	30	46	62	78	94	110	126	142	
15	31	47	63	79	95	111	127	143	

Table of logical channel numbers for KPCI-3108 expansion boards

Analog Input Buffers

DriverLINX supports single-value, single-scan and buffered analog 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.


Edit Service Request

Request

Device: Device 0

Subsystem: Analog input

Mode: Interrupt

Operation: Start

□ Audit only

Events

○ Timing >> Rate

○ Start >> Command

○ Stop >> Terminal count

Select >>

○ Channels

● Buffers

○ Flags

Select Buffers

Samples: 500

Number: 2

□ Notify

□ Auto-allocate

How to set up the KPCI-3108 Series to store samples in buffers.

Buffer Size

For example, 500 samples/2 channels = 250 is ok, but 500 samples/3 channels = 166.67 is incorrect.

An individual DriverLINX buffer may have any size as long as the buffer length holds an integral number of channel scans (i.e., a multiple of the number of analog input channels you’re acquiring). This restriction enforces the requirement that all acquired channels have the same number of samples.

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. If the task stops on a trigger, use the StopEvent message (or event) to determine the location of the last sample. For other cases, use a Status operation to determine the location of the last sample.

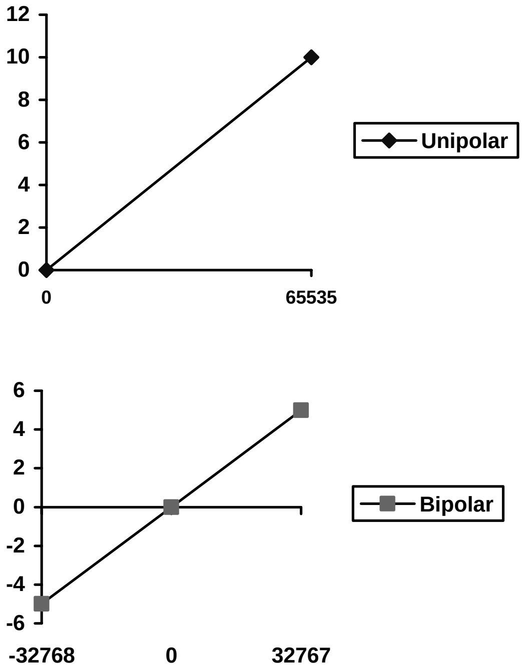
Analog Input Data Coding

KPCI-3108 Series models return Analog Input 16-bit hardware codes in left-shifted binary for unipolar ranges and left-justified two’s complement binary for bipolar ranges. DriverLINX refers to these coding schemes as the “native” format.

For any programmable gain, the KPCI-3108 models return hardware codes with the ranges in the following table:

Polarity	Analog Input Resolution	Analog Input Hardware Code
Unipolar	16 bits	0 to 65535
Bipolar	16 bits	-32768 to 32767

Native Analog Input hardware codes for each KPCI-3108 Series polarity.



KPCI-3108 Series native Analog Input Codes versus Voltage Range for a ten-volt range.

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 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 Input Messages

For analog 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 an analog input buffer.
Start Event	DriverLINX has processed the interrupt for a hardware start event.
Stop Event	DriverLINX has processed the interrupt for a hardware stop event.
Data Lost	DriverLINX has detected an analog input data overrun condition.
Critical Error	DriverLINX has encountered an unexpected hardware or software condition.

DriverLINX Event messages for analog 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

Analog Output Subsystem

The following sections describe how DriverLINX implements Analog Output Subsystem features for the KPCI-3108 Series.

Analog Output Modes

The Analog Output Subsystem supports the following modes:

- **Polled**—For single-value or single-scan analog output samples.
- **Interrupt**—For buffered transfers using programmed I/O.
- **DMA**—For buffered transfers using direct memory access.
- **Other**—For subsystem initialization and data conversion.

Analog Output Operations

The KPCI-3108 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.
- **Status**—reports the buffer position of the next sample that DriverLINX will write from a buffer.
- **Stop**—terminates an analog output data-acquisition task.
- **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-3108 Series User's Manuals* describe several pacing, triggering and gating options available on KPCI-3108 models. Most are available only on the KPCI-3108AO models. The following table summarizes these options and identifies which Service Request properties use them. Except as indicated all tasks must use Interrupt or DMA mode.

Parameter	Option	Service Request Properties
Pacing Mode		
	Periodic (paced)	Rate generator timing event
Clock Source		
	Software	Single-value or single-scan (Polled mode)
	Internal D/A clock	Rate timing event with an internal clock source
	Internal A/D clock	Rate timing event with an internal clock source. A period of 0 signifies that the A/D task operates the clock, which controls both tasks
	External +/-	Rate timing event with an external clock source
Trigger		
	Internal (software)	Command start event Command stop event Terminal count stop event
	Digital +/-	Digital start event
	Retrigger	Digital start event (Interrupt mode; task must meet certain conditions)
Gate		
	Level +/-	Rate timing event Digital start event (for use with a digital timing event)

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-3108 Series writes the next analog output sample.

The KPCI-3108 Series supports the following Timing Events:

- **None**—Task requires no pacing as DriverLINX is writing only a single value or scan.
- **Rate—**The KPCI-3108 Series supports fixed rate writing using internal and external clocks. You can also synchronize an Analog Output task with an Analog Input task using a Rate Event.

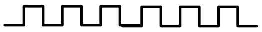
None or Null Timing Event

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

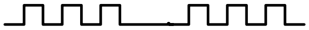
Rate Timing Event

The KPCI-3108 Series supports two types of Rate Events for analog output:

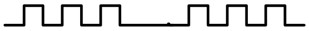
- **Rate Generator**—Generates a fixed rate clock with equal time intervals between tics.



- **Burst Generator**—Generates a dual frequency clock with a fixed number of tics at a high frequency separated by a time interval at a lower frequency.



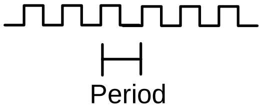
- **Divider**—Generates a fixed rate or dual frequency clock by dividing an external input frequency.



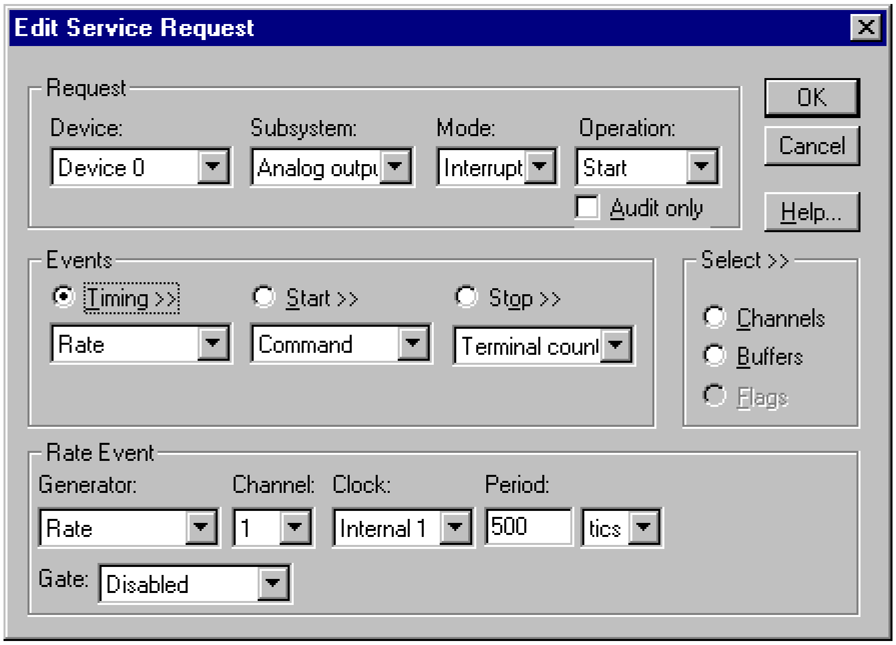
KPCI-3108 Series boards have a configurable 10 MHz, 5 MHz, 1 MHz or 100 kHz master clock frequency. The sample period can range from 2µs to $2^{32} - 1$ tics. This means the sample rate can range from 0.000233 Hz to 500 kHz.

Rate Generator: Internal Clocking

An internally clocked Rate Generator produces a fixed rate clock with equal time intervals between tics.



Use an internally clocked rate generator when you want to write analog output samples at equally spaced time intervals.



Edit Service Request

Request
Device: Device 0
Subsystem: Analog outpu
Mode: Interrupt
Operation: Start
□ Audit only

Events
● Timing >> Rate
○ Start >> Command
○ Stop >> Terminal count

Select >>
○ Channels
○ Buffers
○ Flags

Rate Event
Generator: Rate
Channel: 1
Clock: Internal 1
Period: 500 tics
Gate: Disabled

How to set up the KPCI-3108 Series for fixed rate writing using an internal clock.

For hardware independence, specify the clock channel using the symbolic constant, DEFAULTTIMER, which always maps to the default Logical Channel for analog output timing.

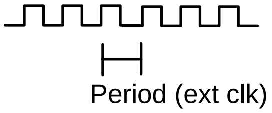
- Specify internal clocking using a **Rate** *Generator* on any available *Channel* with any *Clock* source. See “Counter/Timer Subsystem” on page 110 for a description of clock sources.
- The *Period* property specifies the time interval between samples in tics. The minimum period is 2 µs.
- The *Gate* property specifies how the gate signal affects the operation of the pacer clock. Valid settings for the GATEIN0 or GATEIN1 gate are Enabled, Disabled, NoConnect, and High Level. Valid settings, when pacing with channel 3, which has no external gate input, are Disabled and NoConnect. See “Counter/Timer Subsystem” on page 110 for a description of each *Gate* setting.

Also see: “Synchronizing an Analog Output Task with an Analog Input Task” on page 79.

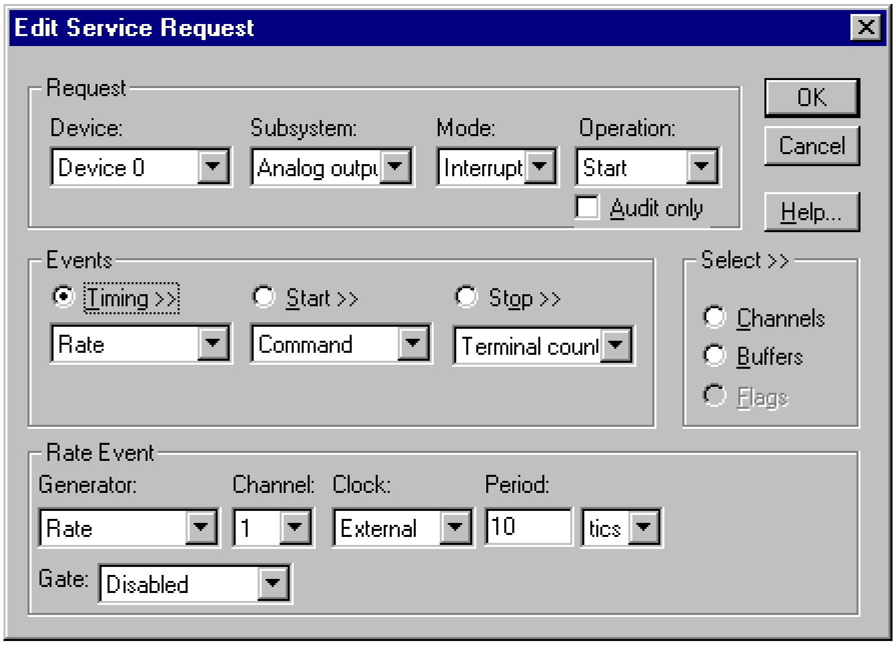
Example: For a programming example, see AOBUFFER in your DrvLINX4\Source folder.

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 analog output samples with a recurrent external signal. In this mode you will need a separate external clock tic for each analog sample you want to write.


Edit Service Request

Request
Device: Device 0
Subsystem: Analog outpu
Mode: Interrupt
Operation: Start
□ Audit only

Events
● Timing >> ○ Start >> ○ Stop >>
Rate Command Terminal count

Select >>
○ Channels
○ Buffers
○ Flags

Rate Event
Generator: Rate
Channel: 1
Clock: External
Period: 10 tics
Gate: Disabled

How to set up the KPCI-3108 Series for fixed rate writing using an external clock.

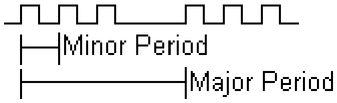
Be sure that the external clock source is TTL compatible, 0 V minimum to +5 V maximum!

- Specify external clocking using a **Rate** *Generator* on *Channel* **1** with an **External, External+**, or **External-** *Clock* source. See “Counter/Timer Subsystem” on page 110 for a description of clock sources.
- Users should connect the external clock signal to the XPCLK line.
- Specify a *Period* between the minimum and maximum external clocking period. The value doesn’t affect the external clock frequency, but DriverLINX requires a valid hardware value in case the application requests a timebase operation and to optimize data transfer between the driver and the application.
- The frequency of the external clock must not exceed 500 kHz.
- The *Gate* property specifies how the gate signal affects the operation of the pacer clock. Valid settings for the GATEIN0 or GATEIN1 gate are Enabled, Disabled, NoConnect, and High Level. Valid settings, when pacing with channel 3, which has no external gate input, are Disabled and NoConnect. See “Counter/Timer Subsystem” on page 110 for a description of each *Gate* setting.

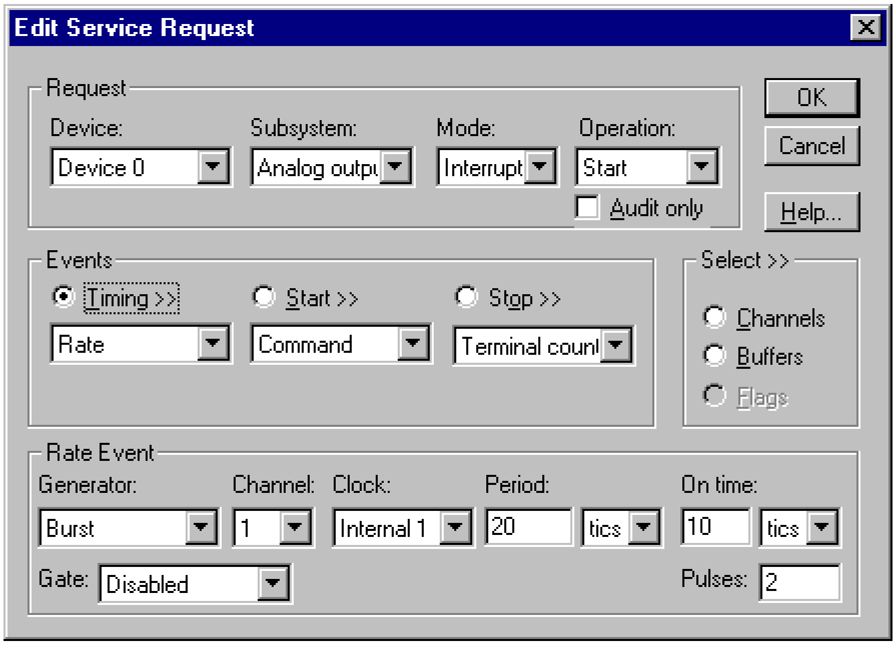
Also see: “Synchronizing an Analog Output Task with an Analog Input Task” on page 79.

Burst Generator: Internal Clocking

An internally clocked Burst Generator produces a dual frequency clock with a fixed number of tics at a high frequency repeated at a lower frequency.



Use an internally clocked rate generator when you want to acquire analog input samples from a several channels at closely spaced time intervals and then repeat at longer intervals.


Edit Service Request

Request
Device: Device 0
Subsystem: Analog outpu
Mode: Interrupt
Operation: Start
□ Audit only

Events
● Timing >> ○ Start >> ○ Stop >>
Rate
Command
Terminal count

Select >>
○ Channels
○ Buffers
○ Flags

Rate Event
Generator: Burst
Channel: 1
Clock: Internal 1
Period: 20 tics
On time: 10 tics
Gate: Disabled
Pulses: 2

How to set up the KPCI-3108 Series for burst mode writing using an internal clock.

For hardware independence, specify the clock channel using the symbolic constant, DEFAULTTIMER, which always maps to the default Logical Channel for analog input timing.

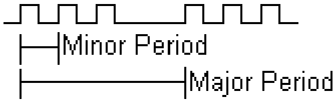
- Specify internal clocking using a **Burst** *Generator* on *Channel* **0** with the **Internal 1** *Clock* source. See "Counter/Timer Subsystem" on page 110 for a description of clock sources.
- The *Period* property specifies the time interval between bursts in tics. The minimum period is 2 µs.
- The *On time* property specifies the time interval between samples. It must be within the range of 2µs to 255µs. Also *Pulses* × (*On time +1µ*s) must be **less than** *Period*.
- The *Gate* property specifies how the gate signal affects the operation of the pacer clock. Valid settings for the GATEIN0 or GATEIN1 gate are Enabled, Disabled, NoConnect, and High Level. Valid settings, when pacing with channel 3, which has no external gate input, are Disabled and NoConnect. See "Counter/Timer Subsystem" on page 110 for a description of each *Gate* setting.

- The *Pulses* property specifies how many channels the board samples in each *Period*. *Pulses* must equal the number of channels in the channel list.

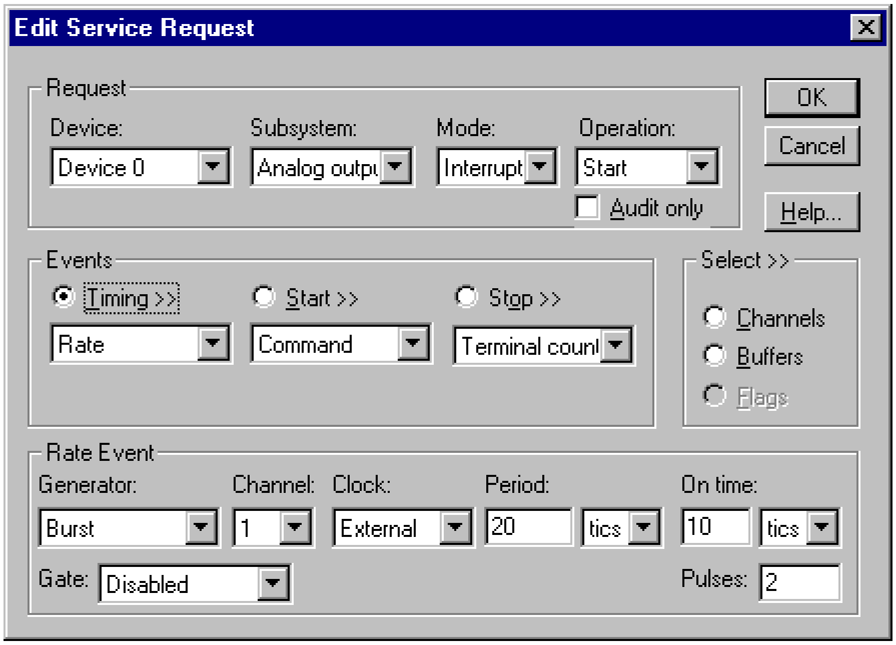
Example: For a programming example, see AOBURST in your DrvLINX4\Source folder.

Burst Generator: External Clocking

An externally clocked Rate Generator produces a dual frequency clock with a fixed number of tics at a high, internal frequency repeated at a lower, externally controlled frequency.



Use an externally clocked burst generator when you want to synchronize a burst of analog input samples with a recurrent external signal. In this mode you will need a separate external clock tic for each burst of analog samples you want to acquire.



Request

Device: Device 0

Subsystem: Analog outpu

Mode: Interrupt

Operation: Start

□ Audit only

Events

● Timing >> ○ Start >> ○ Stop >>

Rate Command Terminal count

Select >>

○ Channels

○ Buffers

○ Flags

Rate Event

Generator: Burst

Channel: 1

Clock: External

Period: 20 tics

On time: 10 tics

Gate: Disabled

Pulses: 2

How to set up the KPCI-3108 Series for burst mode writing using an external clock.

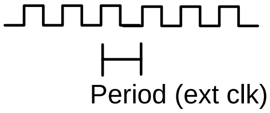
***BE SURE** that the external clock source is TTL compatible, 0 V minimum to +5 V maximum!*

- Specify external clocking using a **Burst** *Generator* on *Channel* **0** with an **External, External+**, or **External-** *Clock* source. See “Counter/Timer Subsystem” on page 110 for a description of clock sources.
- Users should connect the external clock signal to the XPCLK line.
- Specify a *Period* between the minimum and maximum external clocking period. The value doesn’t affect the external clock frequency, but DriverLINX requires a valid hardware value in case the application requests a timebase operation and to optimize data transfer between the driver and the application.

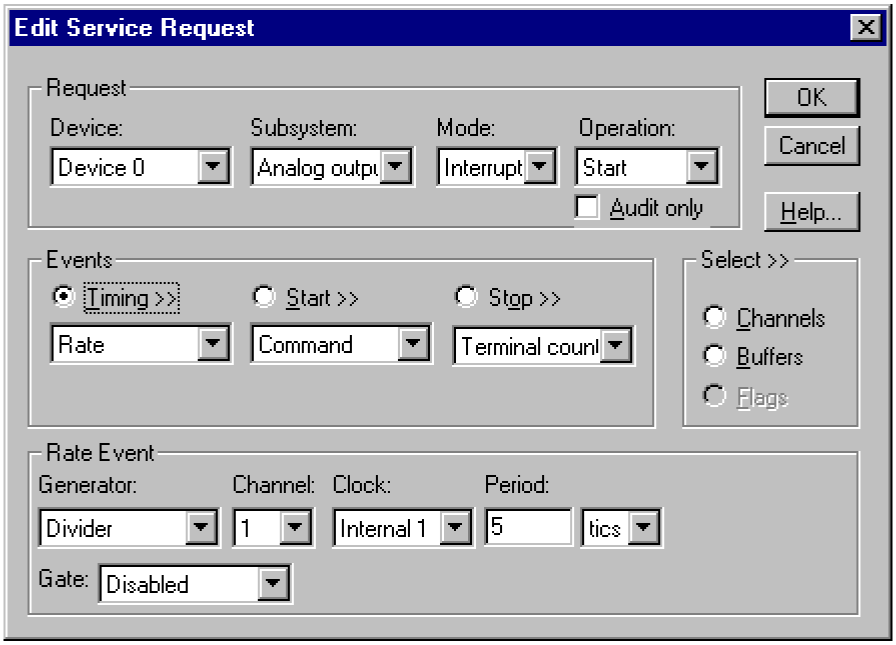
- The *On time* property specifies the time interval between samples. It must be within the range of 2µs to 255µs. Also, *Pulses* × (*On time +1µs*) must be **less than** *Period*.
- The frequency of the external clock must not exceed 500 kHz.
- The *Gate* property specifies how the gate signal affects the operation of the pacer clock. Valid settings for the GATEIN0 or GATEIN1 gate are Enabled, Disabled, NoConnect, and High Level. Valid settings, when pacing with channel 3, which has no external gate input, are Disabled and NoConnect. See "Counter/Timer Subsystem" on page 110 for a description of each *Gate* setting.
- The *Pulses* property specifies how many channels the board samples in each *Period*. *Pulses* must equal the number of channels in the channel list.

Divider-Rate Generator: External Clocking

A divided, externally clocked Rate Generator produces a rate clock with unknown time intervals between tics.



Use a divider-rate generator when you want to synchronize analog output samples with a recurrent, higher frequency, external signal. In this mode you will need a specified number of external clock tics for each analog sample you want to output.



Edit Service Request

Request

Device: Device 0

Subsystem: Analog outpu

Mode: Interrupt

Operation: Start

□ Audit only

Events

● Timing >> Rate

○ Start >> Command

○ Stop >> Terminal coun

Select >>

○ Channels

○ Buffers

○ Flags

Rate Event

Generator: Divider

Channel: 1

Clock: Internal 1

Period: 5 tics

Gate: Disabled

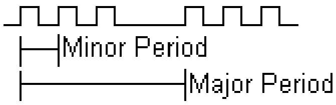
How to set up the KPCI-3108 Series for rate sampling using a divided external clock.

Be sure that the external clock source is TTL compatible, 0 V minimum to +5 V maximum!

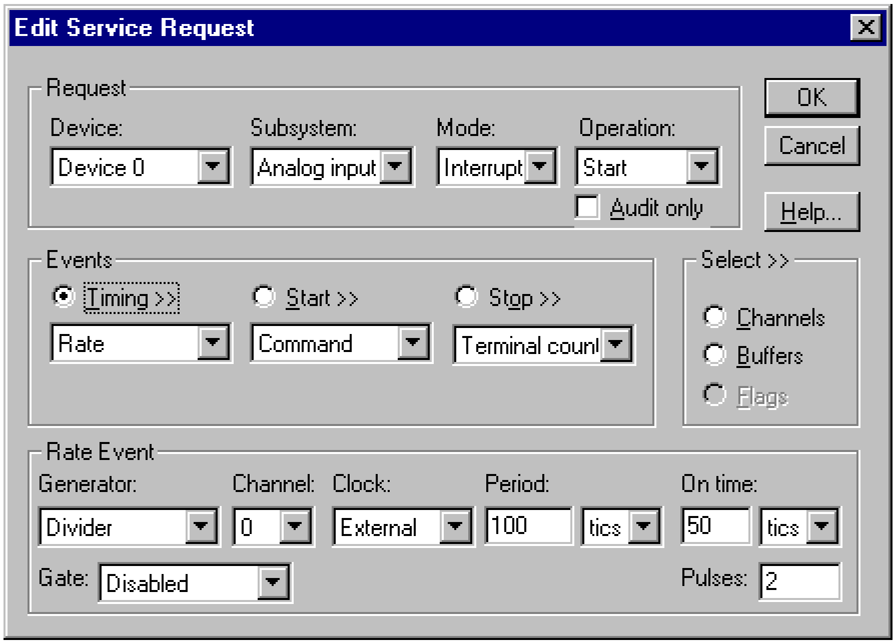
- Specify external clocking using a **Divider** *Generator* on any available *Channel* with an **External,** or **External+** *Clock* source. See "Counter/Timer Subsystem" on page 110 for a description of clock sources.
- Users should connect the external clock signal to the CLKIN0 line for the channel 1 or the CLKIN1 line for channels 0 and 2.
- Specify the divisor for the external frequency in the *Period* property. The resulting pacing frequency must not exceed 500 kHz.
- The *Gate* property specifies how the gate signal affects the operation of the pacer clock. Valid settings for the GATEIN0 or GATEIN1 gate are Enabled, Disabled, NoConnect, and High Level. Valid settings, when pacing with channel 3, which has no external gate input, are Disabled and NoConnect. See "Counter/Timer Subsystem" on page 110 for a description of each *Gate* setting.

Divider-Burst Generator: External Clocking

A divided, externally clocked Burst Generator produces a dual frequency clock with a fixed number of tics at a high, internal frequency repeated at a lower, externally controlled frequency.



Use a divider-burst generator when you want to synchronize a burst of analog output samples with a recurrent, higher frequency, external signal. In this mode you will need a specified number of external clock tics for each burst of analog samples you want to write.



Edit Service Request

Request

Device: Device 0

Subsystem: Analog input

Mode: Interrupt

Operation: Start

☐ Audit only

Events

● Timing >> ○ Start >> ○ Stop >>

Rate | Command | Terminal count

Select >>

○ Channels

○ Buffers

○ Flags

Rate Event

Generator: Divider

Channel: 0

Clock: External

Period: 100 tics

On time: 50 tics

Gate: Disabled

Pulses: 2

How to set up the KPCI-3108 Series for burst mode sampling using a divided external clock.

Note: The *Edit Service Request* dialog does not actually display all the properties for a divider-burst generator. However, you can access all the properties programmatically.

Be sure that the external clock source is TTL compatible, 0 V minimum to +5 V maximum!

- Specify external clocking using a **Divider** *Generator* on any available *Channel* with an **External,** or **External+** *Clock* source. See "Counter/Timer Subsystem" on page 110 for a description of clock sources.
- Users should connect the external clock signal to the CLKIN0 line for the channel 1 or the CLKIN1 line for channels 0 and 2.
- Specify the divisor for the external frequency in the *Period* property. The resulting pacing frequency must not exceed 500 kHz.
- The *On time* property specifies the time interval between samples. It must be within the range of 2µs to 255µs. Also, *Pulses* × (*On time +1µ*s) must be **less than** *Period*.
- The *Gate* property specifies how the gate signal affects the operation of the pacer clock. Valid settings for the GATEIN0 or GATEIN1 gate are Enabled, Disabled, NoConnect, and High Level. Valid settings, when pacing with channel 3, which has no external gate input, are Disabled and NoConnect. See "Counter/Timer Subsystem" on page 110 for a description of each *Gate* setting.
- The *Pulses* property specifies how many channels the board samples in each *Period*. *Pulses* must equal the number of channels in the channel list.

Synchronizing an Analog Output Task with an Analog Input Task

On the KPCI-3108 Series, DriverLINX can synchronize an analog output task with an analog input task. The analog output task uses the same timing event as the input task.

To synchronize an analog output (AO) task with an analog input (AI) task:

1. Set up the AI service request.
2. Set up the AO service request using an identical timing event as the AI task, except with set the *Period* to zero. Both the AI and AO timing event must use Counter/Timer channel 0.
3. Submit the AO service request. The hardware runs the AO task only while the AI task is running.
4. Submit the AI service request to start both tasks.

Although both tasks share the same clock source, they are otherwise logically independent of each other. Your application must manage and respond to each task separately. If the AI task terminates before the AO task, the AO task will still be logically active, but the clock stop sending timing pulses to the AO task until the next AI task starts. If you want to terminate the AO task when the AI task stops, either set up both service requests with equal buffer sizes and Stop Events, or issue a Stop operation request for the AO task.

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

Analog Output Start Events

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

The KPCI-3108 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-3108 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-3108 Series supports the following Stop Events:

- **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 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.

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 the analog output data to the data-acquisition hardware.

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.

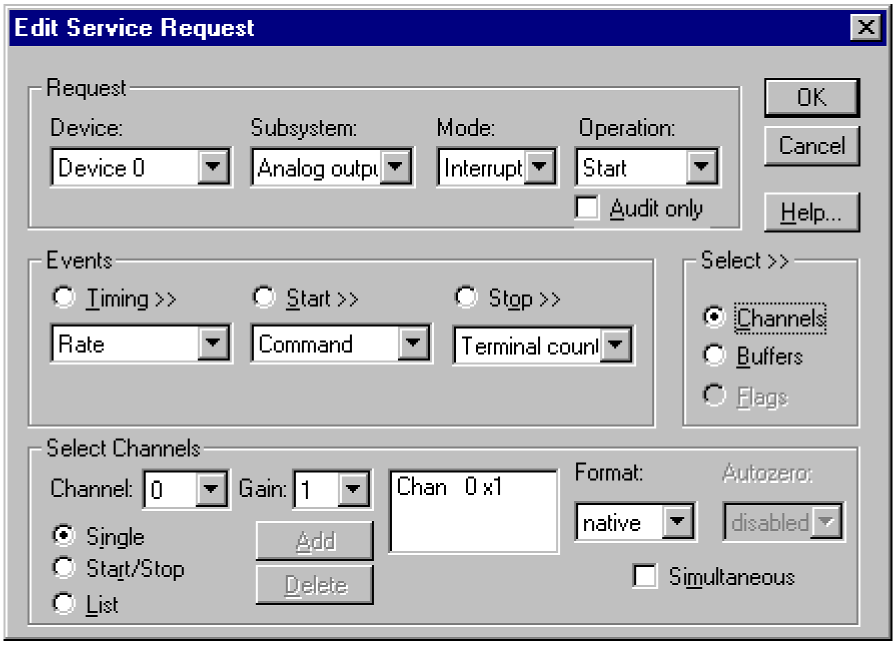
Analog Output Channels

The KPCI-3108 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-3108 Series writes all data to one channel at the specified gain.



Edit Service Request

Request

Device: Device 0

Subsystem: Analog outpu

Mode: Interrupt

Operation: Start

□ Audit only

Events

○ Timing >> Rate

○ Start >> Command

○ Stop >> Terminal count

Select >>

● Channels

○ Buffers

○ Flags

Select Channels

Channel: 0

Gain: 1

Chan 0 x1

● Single

○ Start/Stop

○ List

Format: native

Autozero: disabled

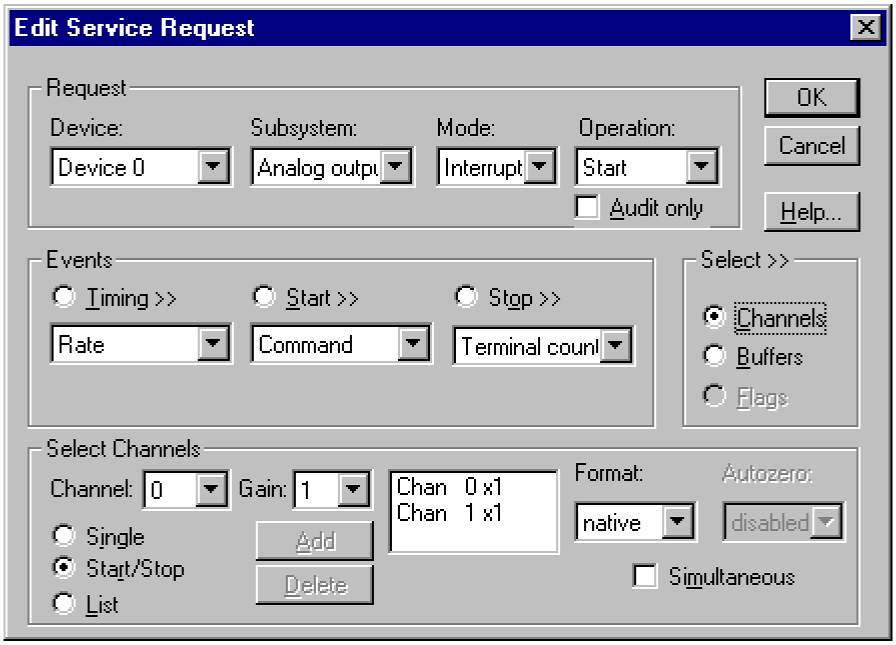
□ Simultaneous

How to set up the KPCI-3108 Series for writing to a single channel.

Multi-channel Analog Output Range

In multi-channel range mode, the KPCI-3108 Series writes data to a consecutive range of analog channels.

- The Start Channel's gain only applies to the first channel.
- DriverLINX uses the Stop Channel's gain for all the other analog channels in the range.
- The Stop Channel must be greater than the Start Channel.



Request
Device: Device 0
Subsystem: Analog outpu
Mode: Interrupt
Operation: Start
□ Audit only

Events
○ Timing >> Rate
○ Start >> Command
○ Stop >> Terminal count

Select >>
● Channels
○ Buffers
○ Flags

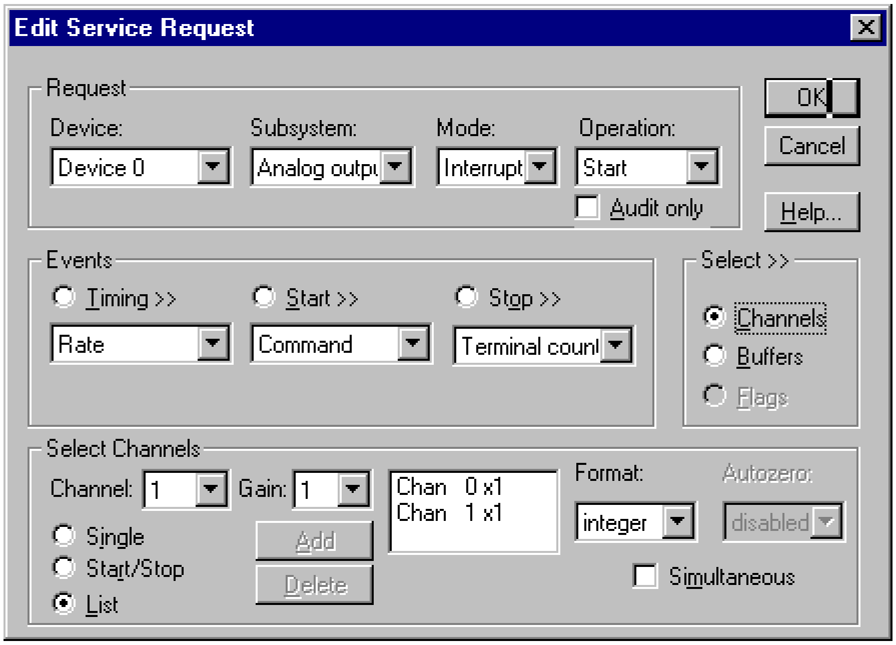
Select Channels
Channel: 0
Gain: 1
Chan 0 x1
Chan 1 x1
Format: native
Autozero: disabled
○ Single
● Start/Stop
○ List
□ Simultaneous

How to set up the KPCI-3108 Series for writing to a consecutive range of channels.

Multi-channel Analog Output List

In multi-channel list mode, the KPCI-3108 Series writes data to an arbitrary list of analog channels.

- For the KPCI-3108 Series, a channel cannot appear more than once in the list.



Request
Device: Device 0
Subsystem: Analog outpu
Mode: Interrupt
Operation: Start
□ Audit only

Events
○ Timing >> Rate
○ Start >> Command
○ Stop >> Terminal count

Select >>
● Channels
○ Buffers
○ Flags

Select Channels
Channel: 1
Gain: 1
Chan 0 x1
Chan 1 x1
Format: integer
Autozero: disabled
○ Single
○ Start/Stop
● List
□ Simultaneous

How to set up the KPCI-3108 Series to write to an arbitrary list of channels.

Analog Output Channel Gains

The KPCI-3108 Series models support a variety of channel gains. 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.

AO Models

Gain	Range	Gain Code
-1	±10 V	0
-2	±5 V	1
1	0 to 10 V	2
2	0 to 5 V	3

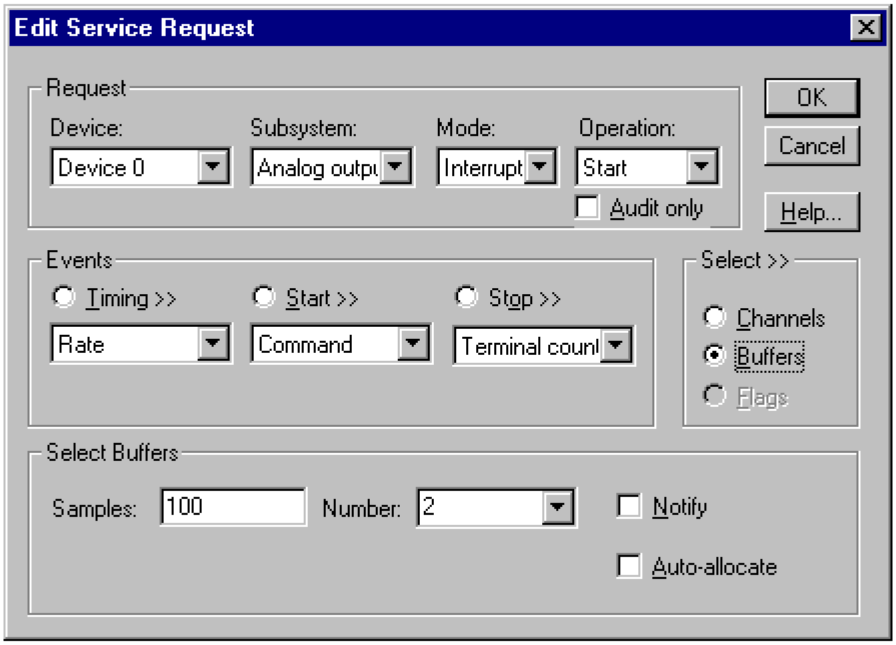
Gains, Ranges, and Gain Codes for the KPCI-3108 Series.

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

Analog Output Buffers

DriverLINX supports single-value, single-scan and buffered 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.
- **For buffered output**, specify the *Number* of buffers from **1** to **255** and the number of *Samples* as desired.



Request
Device: Device 0
Subsystem: Analog outpu
Mode: Interrupt
Operation: Start
□ Audit only

Events
○ Timing >> Rate
○ Start >> Command
○ Stop >> Terminal count

Select >>
○ Channels
● Buffers
○ Flags

Select Buffers
Samples: 100
Number: 2
□ Notify
□ Auto-allocate

How to set up the KPCI-3108 Series to store samples in buffers.

Buffer Size

An individual DriverLINX buffer may have any size as long as the buffer length holds an integral number of channel scans (i.e., a multiple of the number of analog output channels you're acquiring). This restriction enforces the requirement that all acquired channels have the same number of samples.

For example, 500 samples/2 channels = 250 is ok, but 500 samples/3 channels = 166.67 is incorrect.

Buffer Usage

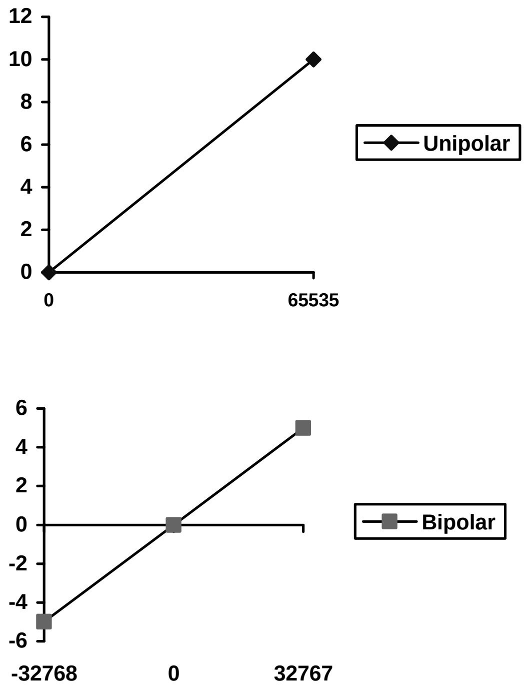
DriverLINX writes from buffers sequentially until the task stops. Except for tasks that stop on terminal count, the last buffer may be only partially used. If the task stops on a trigger, use the StopEvent message (or event) to determine the location of the last sample. For other cases, use a Status operation to determine the location of the last sample.

Analog Output Data Coding

KPCI-3108 Series uses the left-shifted, offset binary format to encode analog output data, as shown in the following table. DriverLINX refers to this coding scheme as the "native" format.

Polarity	Analog Output Resolution	Analog Output Hardware Code
Unipolar	16 bits	0 to 65535
Bipolar	16 bits	-32768 to 32767

Native Analog Output hardware codes for the KPCI-3108 Series.



KPCI-3108 Series native Analog Output Codes versus Voltage Range for a ten-volt range.

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 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.
Buffer Filled	DriverLINX has filled an analog output buffer.
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

Digital Input Subsystem

The following sections describe how DriverLINX implements Digital Input Subsystem features for the KPCI-3108 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-3108 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

The KPCI-3108 supports several 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 14) or by using a Configure operation. Only channels 1 through 4 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-3108 Series User's Manuals* describe several pacing, triggering and gating options available for analog input on KPCI-3108 models. As DriverLINX uses the analog input pacer clock for digital input, many of these options also apply to digital input tasks. The following table summarizes these options and identifies which Service Request properties use them. Except as indicated all tasks must use Interrupt mode.

Parameter	Option	Service Request Properties
Pacing Mode		
	Periodic (paced)	Rate generator timing event
Clock Source		
	Software	Single-value or single-scan (Polled mode)
	Internal	Rate timing event with an internal clock source
	External +	Rate timing event with an external clock source in divider mode
Trigger		
	Internal (software)	Command start event Command stop event Terminal count stop event

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-3108 Series reads the next digital input sample from the port.

The KPCI-3108 Series supports the following Timing Events:

- **None**—Input requires no pacing as DriverLINX is reading only a single value.
- **Rate**—The KPCI-3108 Series supports fixed rate sampling using internal and external clocks.

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-3108 Series supports only the Rate Generator mode for Rate Events for digital input:

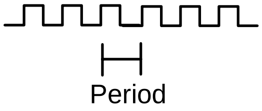
- **Rate Generator**—Generates a fixed rate clock with equal time intervals between tics.

- **Divider**—Generates a fixed rate clock by dividing an external input frequency.

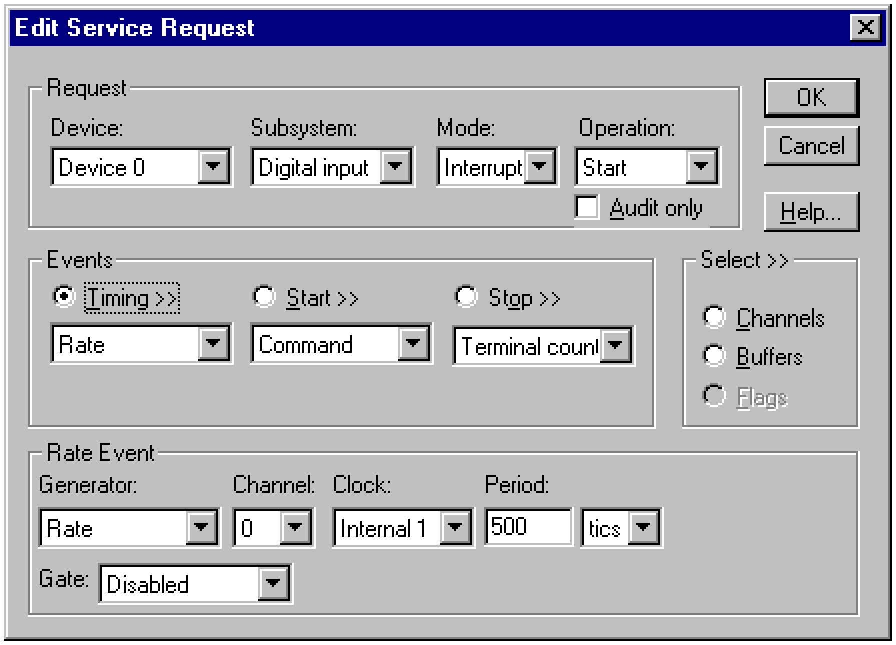
KPCI-3108 Series boards have a configurable 10 MHz, 5 MHz, 1 MHz or 100 kHz master clock frequency. The sample period can range from 100µs to $2^{32}-1$ tics. This means the sample rate can range from 0.000233 Hz to 10 kHz.

Rate Generator: Internal Clocking

An internally clocked Rate Generator produces a fixed rate clock with equal time intervals between tics.



Use an internally clocked rate generator when you want to acquire all digital input samples at equally spaced time intervals.



Edit Service Request

Request

Device: Device 0

Subsystem: Digital input

Mode: Interrupt

Operation: Start

□ Audit only

Events

● Timing >> ○ Start >> ○ Stop >>

Rate | Command | Terminal coun

Select >>

○ Channels

○ Buffers

○ Flags

Rate Event

Generator: Rate

Channel: 0

Clock: Internal 1

Period: 500 tics

Gate: Disabled

How to set up the KPCI-3108 Series for fixed rate sampling using an internal clock.

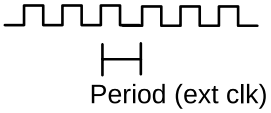
For hardware independence, specify the clock channel using the symbolic constant, DEFAULTTIMER, which always maps to the default Logical Channel for digital output timing.

- Specify internal clocking using a **Rate** *Generator* on any *Channel* with any valid *Clock* source. See “Counter/Timer Subsystem” on page 110 for a description of clock sources.
- The *Period* property specifies the time interval between samples in tics. The minimum period is 100 µs.
- The *Gate* property specifies how the gate signal affects the operation of the pacer clock. Valid settings for the GATEIN0 or GATEIN1 gate are Enabled, Disabled, NoConnect, and High Level. Valid settings, when pacing with channel 3, which has no external gate input, are Disabled and NoConnect. See “Counter/Timer Subsystem” on page 110 for a description of each *Gate* setting.

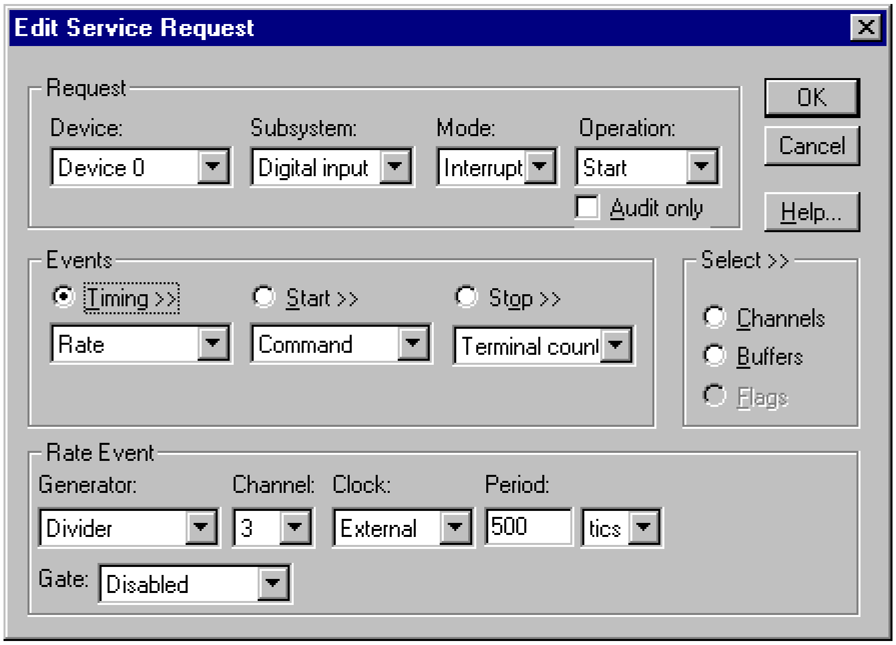
Example: For a programming example, see DIBUFFER in your DrvLINX4\Source folder.

Divider-Rate Generator: External Clocking

A divided, externally clocked Rate Generator produces a rate clock with unknown time intervals between tics.



Use a divider-rate generator when you want to synchronize digital input samples with a recurrent, higher frequency, external signal. In this mode you will need a specified number of external clock tics for each digital sample you want to acquire.



Edit Service Request

Request
Device: Device 0
Subsystem: Digital input
Mode: Interrupt
Operation: Start
□ Audit only

Events
● Timing >> ○ Start >> ○ Stop >>
Rate
Command
Terminal count

Select >>
○ Channels
○ Buffers
○ Flags

Rate Event
Generator: Divider
Channel: 3
Clock: External
Period: 500 tics
Gate: Disabled

How to set up the KPCI-3108 Series for rate sampling using a divided external clock.

Be sure that the external clock source is TTL compatible, 0 V minimum to +5 V maximum!

- Specify external clocking using a **Divider** *Generator* on any available *Channel* with an **External,** or **External+** *Clock* source. See “Counter/Timer Subsystem” on page 110 for a description of clock sources.
- Users should connect the external clock signal to the CLKIN0 line for the channel 1 or the CLKIN1 line for channels 0 and 2.
- Specify the divisor for the external frequency in the *Period* property. The resulting pacing frequency must not exceed 10 kHz.
- The *Gate* property specifies how the gate signal affects the operation of the pacer clock. Valid settings for the GATEIN0 or GATEIN1 gate are Enabled, Disabled, NoConnect, and High Level. Valid settings, when pacing with channel 3, which has no external gate input, are Disabled and NoConnect. See “Counter/Timer Subsystem” on page 110 for a description of each *Gate* setting.

Digital Input Start Events

Start Events specify when the KPCI-3108 Series hardware starts reading digital input data.

The KPCI-3108 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-3108 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-3108 Series hardware with the task parameters.

Digital Input Stop Events

Stop Events specify when the KPCI-3108 Series hardware stops reading digital input data.

The KPCI-3108 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-3108 Series 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.

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-3108 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.

Digital Input Channels

The KPCI-3108 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.

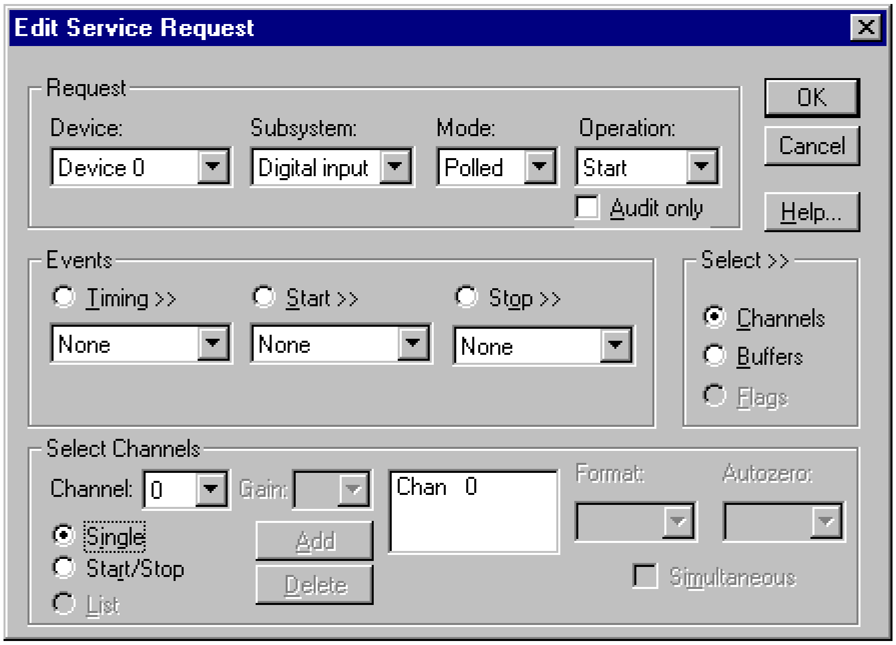
Digital Input Logical Channels

The KPCI-3108 Series supports both fixed and configurable digital channels. DriverLINX defines the following Logical Channels for the KPCI-3108 Series Digital Input Subsystem:

Logical Channel	DriverLINX Function	KPCI-3108 Series External Connector
0	Standard Digital Input	IP0 … IP5
1	Digital Input/Output	Bit 0 … Bit 7
2	Digital Input/Output	Bit 8 … Bit 15
3	Digital Input/Output	Bit 16 … Bit 23
4	Digital Input/Output	Bit 24 … Bit 31
5	External Clock	XPCLK
6	External Trigger	TGIN

Single Channel Digital Input

In single channel mode, the KPCI-3108 Series acquires all data from one channel.



Request

Device: Device 0

Subsystem: Digital input

Mode: Polled

Operation: Start

□ Audit only

Events

○ Timing >> None

○ Start >> None

○ Stop >> None

Select >>

● Channels

○ Buffers

○ Flags

Select Channels

Channel: 0

Gain:

● Single

○ Start/Stop

○ List

Chan 0

Format:

Autozero:

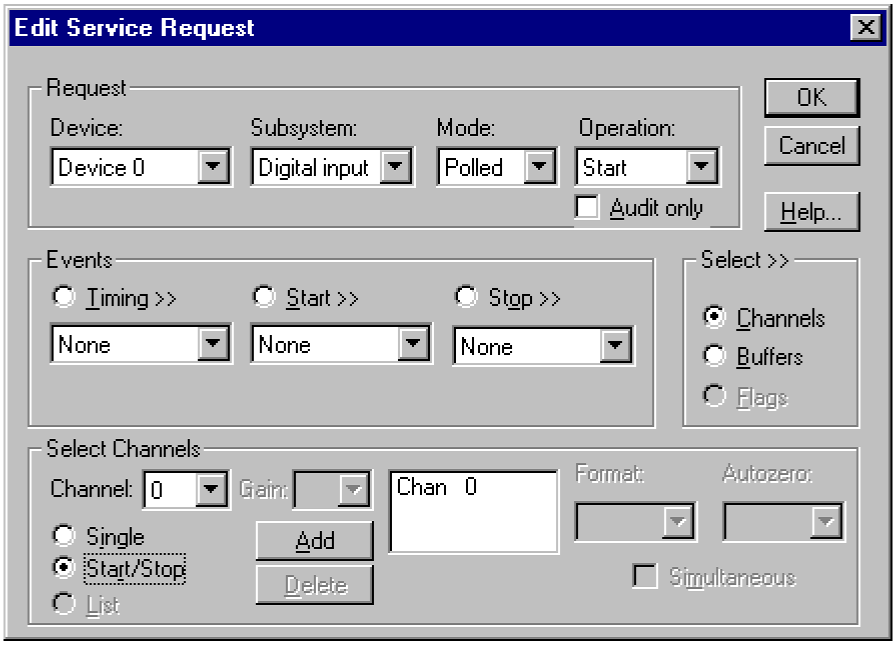
□ Simultaneous

How to set up the KPCI-3108 Series for sampling on a single channel.

Multi-channel Digital Input Range

In multi-channel range mode, the KPCI-3108 Series acquires all data from a consecutive range of digital channels.

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



Request

Device: Device 0
Subsystem: Digital input
Mode: Polled
Operation: Start
□ Audit only

Events

○ Timing >> None
○ Start >> None
○ Stop >> None

Select >>

● Channels
○ Buffers
○ Flags

Select Channels

Channel: 0
Gain:
○ Single
● Start/Stop
○ List

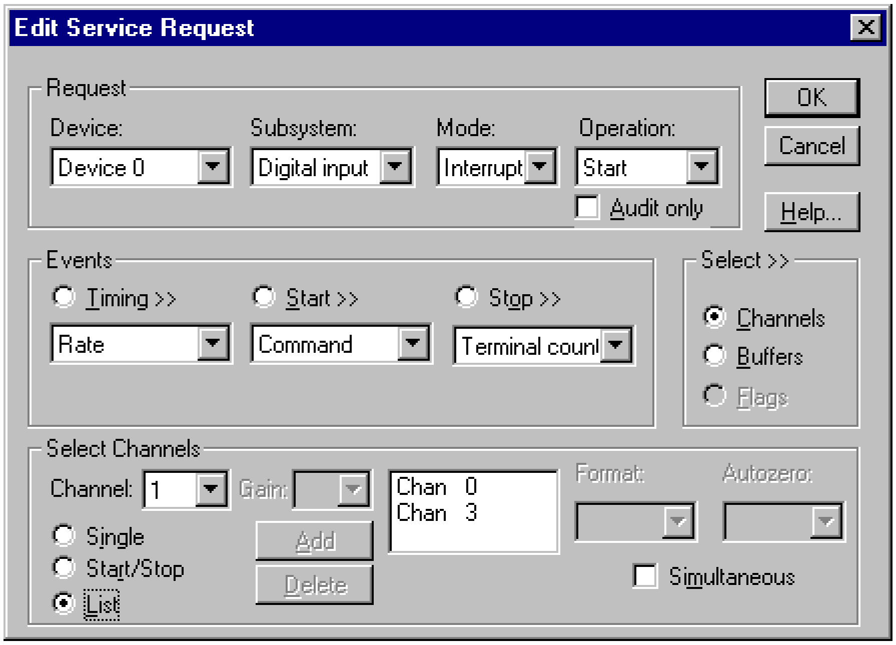
Chan 0

Format:
Autozero:
□ Simultaneous

How to set up the KPCI-3108 Series for sampling on a consecutive range of channels.

Multi-channel Digital Input List

In multi-channel list mode, the KPCI-3108 Series acquires all data from an arbitrary list of digital channels.



Request

Device: Device 0
Subsystem: Digital input
Mode: Interrupt
Operation: Start
□ Audit only

Events

○ Timing >> Rate
○ Start >> Command
○ Stop >> Terminal count

Select >>

● Channels
○ Buffers
○ Flags

Select Channels

Channel: 1
Gain:
○ Single
○ Start/Stop
● List

Chan 0
Chan 3

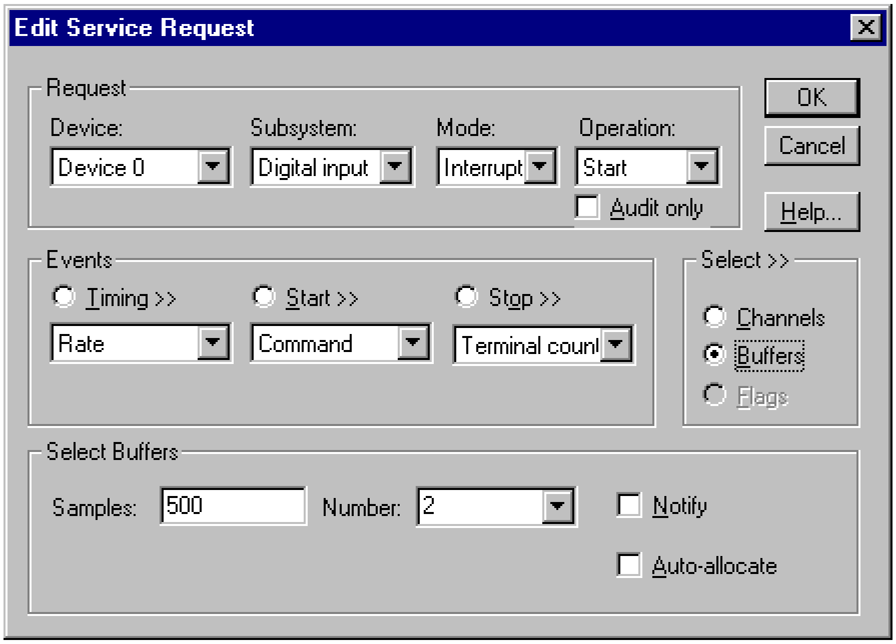
Format:
Autozero:
□ Simultaneous

How to set up the KPCI-3108 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.



Edit Service Request

Request

Device: Device 0

Subsystem: Digital input

Mode: Interrupt

Operation: Start

☐ Audit only

Events

○ Timing >> Rate

○ Start >> Command

○ Stop >> Terminal coun

Select >>

○ Channels

● Buffers

○ Flags

Select Buffers

Samples: 500

Number: 2

☐ Notify

☐ Auto-allocate

How to set up the KPCI-3108 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.
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-3108 Series.

Digital Output Modes

The Digital Output Subsystem supports the following modes:

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

Digital Output Operations

The KPCI-3108 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.
- **Status**—reports the buffer position of the next sample that DriverLINX will write from a buffer.
- **Stop**—terminates a digital output data-acquisition task.
- **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 24.

Digital Channel Configuration

The KPCI-3108 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 14) or by using a Configure operation. See "Digital Channel Configuration" on page 88 for more information on the configure operation.

Digital Output Pacing, Triggering and Gating Options

The *KPCI-3108 Series User's Manuals* describe several pacing, triggering and gating options available for analog input on KPCI-3108 models. As DriverLINX uses the analog input pacer clock for digital output, many of these options also apply to digital output tasks. The following table summarizes these options and identifies which Service Request properties use them. Except as indicated all tasks must use Interrupt mode.

Parameter	Option	Service Request Properties
Pacing Mode		
	Periodic (paced)	Rate generator timing event
Clock Source		
	Software	Single-value or single-scan (Polled mode)
	Internal	Rate timing event with an internal clock source
	External +	Rate timing event with an external clock source in divider mode
Trigger		
	Internal (software)	Command start event Command stop event Terminal count stop event

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-3108 Series writes the next digital output sample from the port.

The KPCI-3108 Series supports the following Timing Events:

- **None**—Output requires no pacing as DriverLINX is writing only a single value.
- **Rate**—The KPCI-3108 Series supports fixed rate writing using internal and external clocks.

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.

Rate Timing Event

The KPCI-3108 Series supports only the Rate Generator mode for Rate Events for digital output:

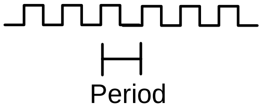
- **Rate Generator**—Generates a fixed rate clock with equal time intervals between tics.

- **Divider**—Generates a fixed rate clock by dividing an external input frequency.

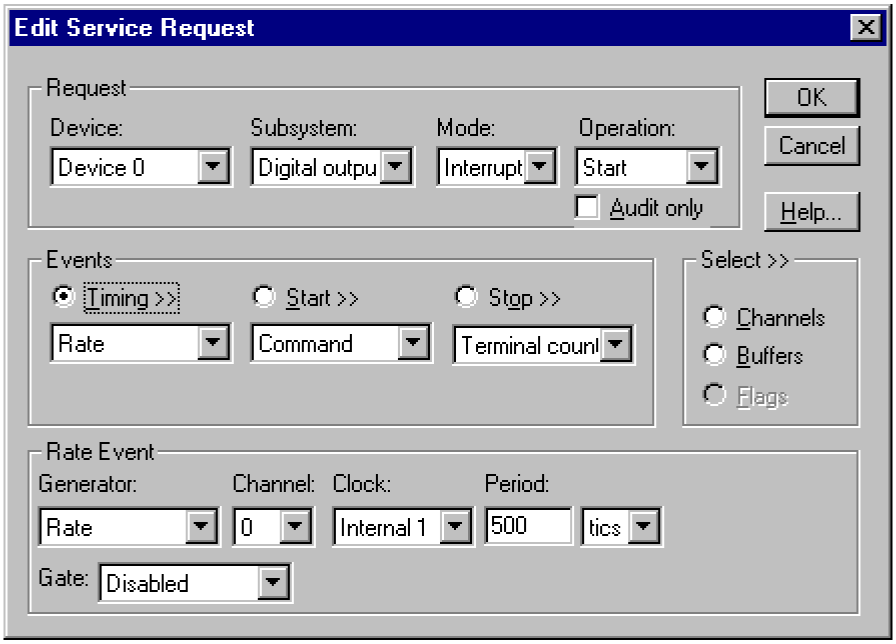
KPCI-3108 Series boards have a configurable 10 MHz, 5 MHz, 1 MHz or 100 kHz master clock frequency. The sample period can range from 100µs to $2^{32}-1$ tics. This means the sample rate can range from 0.000233 Hz to 10 kHz.

Rate Generator: Internal Clocking

An internally clocked Rate Generator produces a fixed rate clock with equal time intervals between tics.



Use an internally clocked rate generator when you want to write digital output samples at equally spaced time intervals.



Edit Service Request

Request

Device: Device 0

Subsystem: Digital outpu

Mode: Interrupt

Operation: Start

□ Audit only

Events

● Timing >> ○ Start >> ○ Stop >>

Rate | Command | Terminal count

Select >>

○ Channels
○ Buffers
○ Flags

Rate Event

Generator: Rate

Channel: 0

Clock: Internal 1

Period: 500 tics

Gate: Disabled

How to set up the KPCI-3108 Series for fixed rate writing using an internal clock.

For hardware independence, specify the clock channel using the symbolic constant, DEFAULTTIMER, which always maps to the default Logical Channel for digital output timing.

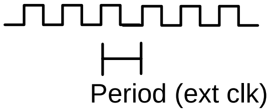
- Specify internal clocking using a **Rate** *Generator* on *Channel* **0** with the **Internal 1** *Clock* source. See “Counter/Timer Subsystem” on page 110 for a description of clock sources.
- The *Period* property specifies the time interval between samples in tics. The minimum period is 100 µs.

- The *Gate* property specifies how the gate signal affects the operation of the pacer clock. Valid settings for the GATEIN0 or GATEIN1 gate are Enabled, Disabled, NoConnect, and High Level. Valid settings, when pacing with channel 3, which has no external gate input, are Disabled and NoConnect. See “Counter/Timer Subsystem” on page 110 for a description of each *Gate* setting.

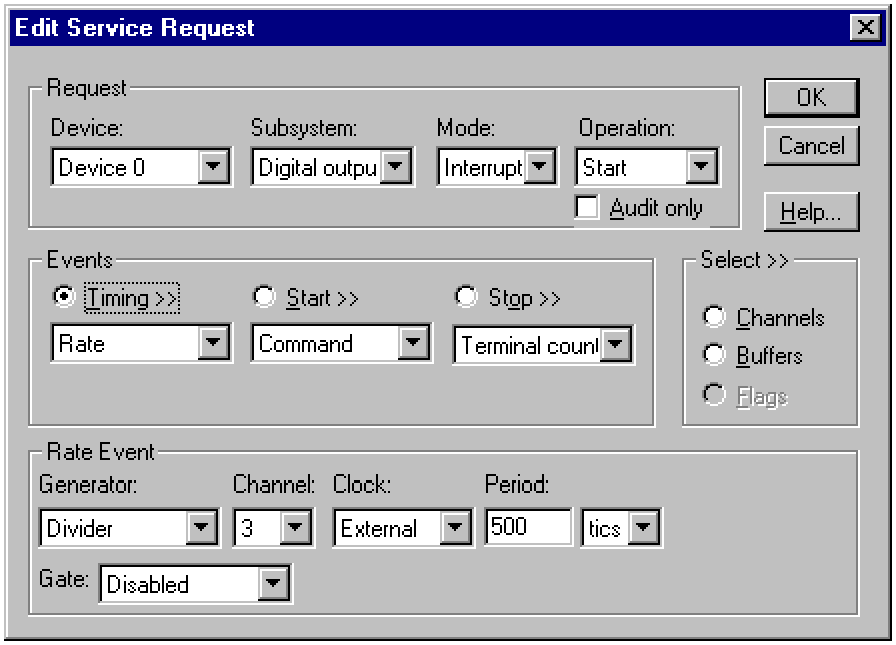
Example: For a programming example, see DOBUFFER in your DrvLINX4\Source folder.

Divider-Rate Generator: External Clocking

A divided, externally clocked Rate Generator produces a rate clock with unknown time intervals between tics.



Use a divider-rate generator when you want to synchronize digital output samples with a recurrent, higher frequency, external signal. In this mode you will need a specified number of external clock tics for each digital sample you want to write.



Edit Service Request

Request

Device: Device 0

Subsystem: Digital outpu

Mode: Interrupt

Operation: Start

□ Audit only

Events

● Timing >>: Rate

○ Start >>: Command

○ Stop >>: Terminal count

Select >>

○ Channels

○ Buffers

○ Flags

Rate Event

Generator: Divider

Channel: 3

Clock: External

Period: 500 tics

Gate: Disabled

How to set up the KPCI-3108 Series for rate sampling using a divided external clock.

Be sure that the external clock source is TTL compatible, 0 V minimum to +5 V maximum!

- Specify external clocking using a **Divider** *Generator* on any available *Channel* with an **External,** or **External+** *Clock* source. See “Counter/Timer Subsystem” on page 110 for a description of clock sources.
- Users should connect the external clock signal to the CLKIN0 line for the channel 1 or the CLKIN1 line for channels 0 and 2.
- Specify the divisor for the external frequency in the *Period* property. The resulting pacing frequency must not exceed 10 kHz.

- The *Gate* property specifies how the gate signal affects the operation of the pacer clock. Valid settings for the GATEIN0 or GATEIN1 gate are Enabled, Disabled, NoConnect, and High Level. Valid settings, when pacing with channel 3, which has no external gate input, are Disabled and NoConnect. See “Counter/Timer Subsystem” on page 110 for a description of each *Gate* setting.

Digital Output Start Events

Start Events specify when the KPCI-3108 Series hardware starts writing digital output data.

The KPCI-3108 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-3108 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-3108 hardware with the task parameters.

Digital Output Stop Events

Stop Events specify when the KPCI-3108 Series hardware stops writing digital output data.

The KPCI-3108 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-3108 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-3108 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 5-bit digital output port and a 32-bit digital input/output port. DriverLINX maps these signals to Logical Channels as shown in the following table:

Logical Channel	DriverLINX Function	KPCI-3108 Series External Connector
0	Standard Digital Output	OP0 … OP4
1	Digital Input/Output	Bit 0 … Bit 7
2	Digital Input/Output	Bit 8 … Bit 15
3	Digital Input/Output	Bit 16 … Bit 23
4	Digital Input/Output	Bit 24 … Bit 31

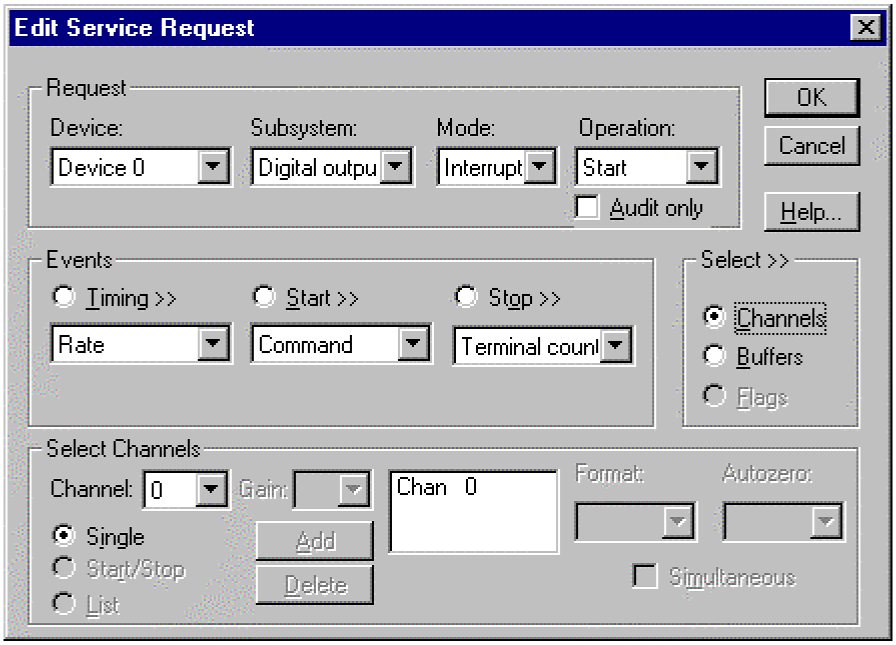
How DriverLINX maps digital output hardware channels to Logical Channels.

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 88.)

Single Channel Digital Output

In single channel mode, the KPCI-3108 Series writes all data from one channel.



Request
Device: Device 0
Subsystem: Digital outpu
Mode: Interrupt
Operation: Start
□ Audit only

Events
○ Timing >> Rate
○ Start >> Command
○ Stop >> Terminal count

Select >>
● Channels
○ Buffers
○ Flags

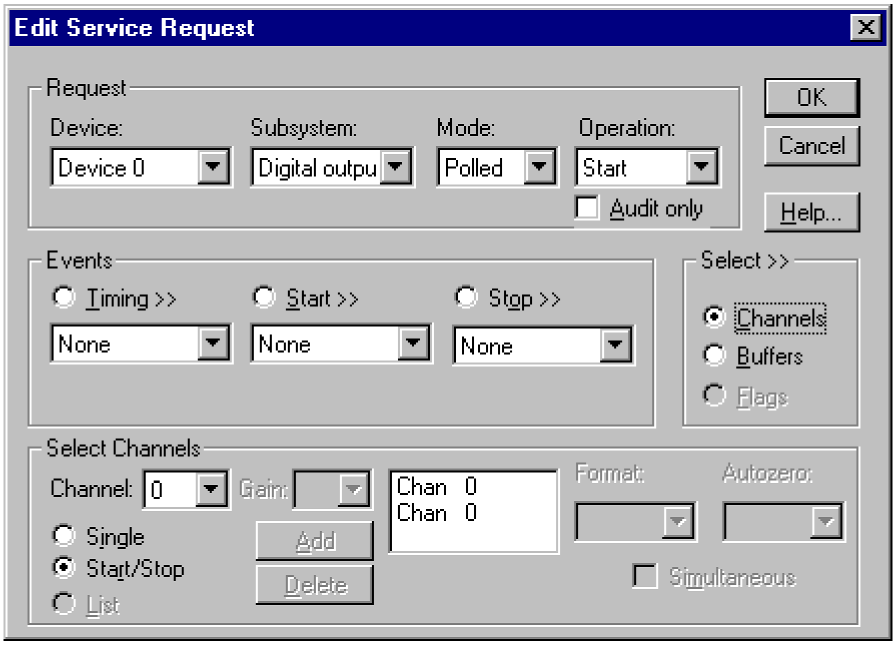
Select Channels
Channel: 0
Gain:
Chan 0
Format:
Autozero:
● Single
○ Start/Stop
○ List
□ Simultaneous

How to set up the KPCI-3108 Series for writing to a single channel.

Multi-channel Digital Output Range

In multi-channel range mode, the KPCI-3108 Series acquires all data from a consecutive range of digital channels.

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



Edit Service Request

Request

Device: Device 0

Subsystem: Digital outpu

Mode: Polled

Operation: Start

□ Audit only

Events

○ Timing >> None

○ Start >> None

○ Stop >> None

Select >>

● Channels

○ Buffers

○ Flags

Select Channels

Channel: 0

Gain:

○ Single

● Start/Stop

○ List

Chan 0
Chan 0

Format:

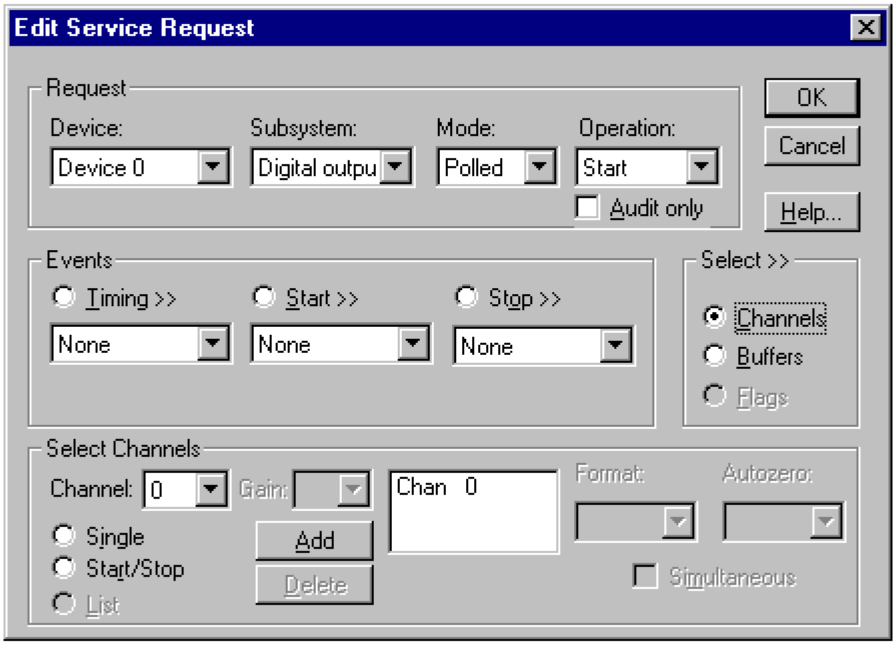
Autozero:

□ Simultaneous

How to set up the KPCI-3108 Series for writing to a consecutive range of channels.

Multi-channel Digital Output List

In multi-channel list mode, the KPCI-3108 Series acquires all data from an arbitrary list of digital channels.



Edit Service Request

Request

Device: Device 0

Subsystem: Digital outpu

Mode: Polled

Operation: Start

□ Audit only

Events

○ Timing >> None

○ Start >> None

○ Stop >> None

Select >>

● Channels

○ Buffers

○ Flags

Select Channels

Channel: 0

Gain:

Chan 0

○ Single

○ Start/Stop

○ List

Format:

Autozero:

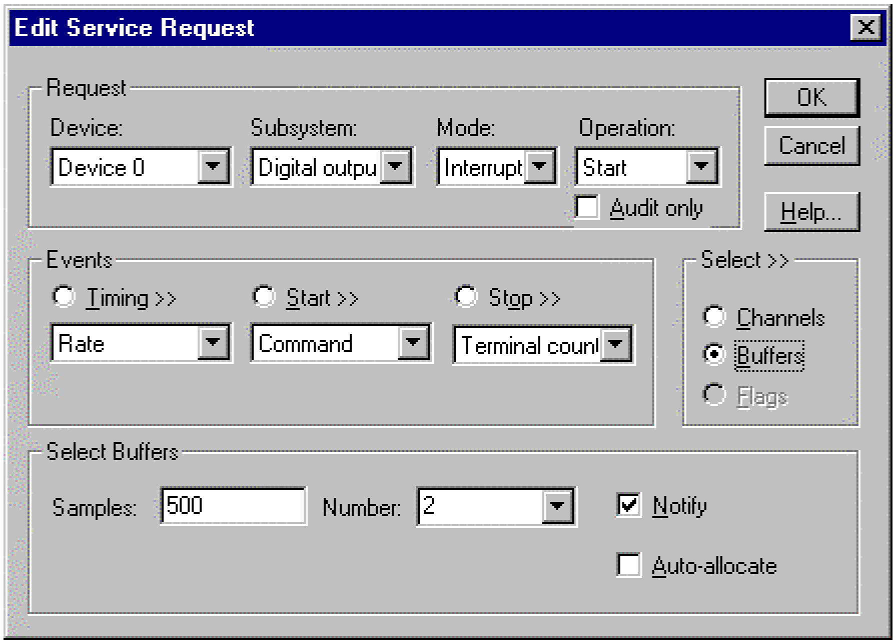
□ Simultaneous

How to set up the KPCI-3108 Series to write to an arbitrary list of channels.

Digital Output Buffers

DriverLINX supports single-value, single-scan and buffered 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.
- **For buffered output**, specify the *Number* of buffers from **1** to **255** and the number of *Samples* as desired.



Edit Service Request

Request

Device: Device 0

Subsystem: Digital outpu

Mode: Interrupt

Operation: Start

□ Audit only

Events

○ Timing >> Rate

○ Start >> Command

○ Stop >> Terminal count

Select >>

○ Channels

● Buffers

○ Flags

Select Buffers

Samples: 500

Number: 2

☑ Notify

□ Auto-allocate

How to set up the KPCI-3108 Series to store samples in buffers.

Buffer Size

For example, 500 samples/2 channels = 250 is ok, but 500 samples/3 channels = 166.67 is incorrect.

An individual DriverLINX buffer may have any size as long as the buffer length holds an integral number of channel scans (i.e., a multiple of the number of digital output channels you're acquiring). This restriction enforces the requirement that all acquired channels have the same number of samples.

Buffer Usage

DriverLINX writes from buffers sequentially until the task stops. Except for tasks that stop on terminal count, the last buffer may be only partially used. Use a Status operation to determine the location of the last sample.

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.
Buffer Filled	DriverLINX has filled an analog input buffer.
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

The KPCI-3108 Series provides counter/timers, with an Intel 8254 Programmable Interval Timer chip, for analog and digital input/output pacing as well as independent counter/timer tasks. DriverLINX defines many useful generic counter/timer functions that can be performed with most counter/timer chips. Alternatively, use DriverLINX to program the board in 8254-specific modes. See the *DriverLINX Counter/Timer User's Guide* for detailed information on programming the Intel 8254 chip.

An 8254 chip consists of three 16-bit counters, Counter 0, Counter 1, and Counter 2. For flexibility and compatibility with the KPCI-1800 Series, DriverLINX defines four Logical Channels for KPCI-3108. Logical Channel 0 operates Counters 1 and 2 in a 32-bit cascaded counter configuration. Logical Channels 1 through 3 operates Counters 0 through 2, respectively, in a 16-bit single counter configuration. Using Logical Channel 0 makes Logical Channels 2 and 3 unavailable, and vice versa.

Each counter has a clock input, a gate input and a counter output. Connection pins on the KPCI-3108 Series are limited so the device configuration requires the user to select from various clock output options. (See "Special…" on page 16 for configuration information).

The KPCI-3108 Series also has a trigger/gate input (TGIN) for the analog input subsystem and an external clock input (XPCLK) for the analog input and output subsystems. You can use these signals to control pacing while using any of the four Counter/Timer Logical Channels. See "Analog Input Subsystem Signals" on page 33 for connection details.

An application specifies operating parameters for a counter/timer using a Rate Event for the timing event in a service request. A Rate Event has clock source, mode and gate properties. The following sections discuss usage of the properties for both input/output task and counter/timer tasks.

Counter/Timer Channel Usage

DriverLINX defines four counter/timer Logical Channels for the board's three counter/timers. The first channel is a 32-bit channel formed by cascading two of the counter/timers together. The other three channels are 16-bit channels, one for each of the counter/timers, separately. All channels are available for pacing input/output tasks. For counter/timer tasks, some functions are limited to certain channels. (See "Counter/Timer Tasks" on page 113 for details.)

The following tables showswhich Logical Channels are available for tasks on each subsystem.

Counter/Timer Logical Channel Usage

Subsystem	Channel 0	Channel 1	Channel 2	Channel 3
Analog Input	Default	Available	Available	Available
Analog Output	Available	Default	Available	Available
Digital Input	Available	Available	Available	Default
Digital Output	Available	Available	Default	Available
Counter/Timer	Available	Available	Default	Available

For portability across drivers, applications can specify the default timing channel using the symbolic constant DEFAULTTIMER.

Clock Sources and Modes

DriverLINX defines a large number of internal and external clock source for the KPCI-3108 Series. Some apply only to pacing certain subsystems. Others are only for counter/timer tasks. The following tables lists the clock sources and modes to which they apply for use with each subsystem:

Analog Input and Analog Output

Name	Source	Modes
Internal 1	As configured	RateGen BurstGen
Internal 2	10 MHz	RateGen BurstGen
Internal 3	5 MHz	RateGen BurstGen
Internal 4	1 MHz	RateGen BurstGen
Internal 5	100 kHz	RateGen BurstGen
External External+ External-	XPCLK	RateGen BurstGen
External External+	CLKIN0 CLKIN1	Divider

Digital Input and Digital Output

Name	Source	Modes
Internal 1	As configured	RateGen
Internal 2	10 MHz	RateGen
Internal 3	5 MHz	RateGen
Internal 4	1 MHz	RateGen
Internal 5	100 kHz	RateGen
External External+	CLKIN0 CLKIN1	Divider

Counter/Timer

Name	Source	Modes
Internal 1	As configured	RateGen SqWave Freq Count PulseWd OneShot RetrigOneShot Interval VDCGen
Internal 2	10 MHz	
Internal 3	5 MHz	
Internal 4	1 MHz	
Internal 5	100 kHz	
External External+	CLKIN0 CLKIN1	

For the **Internal 1** and **External** clock sources, the tic period for the Period and On Time properties is the inverse of the frequency of the default master clock source. The user sets default master clock source on the Counter/Timer Subsystem Page of the *DriverLINX Configuration Panel*. Applications can use the **Sec2Tics** function to determine the tic period of **Internal 1**.

The **Internal 2** to **Internal 5** clock sources are for the *rare* application that needs to specify a particular internal clock source. The tic period for the Period property for these sources is the inverse of the associated clock frequency. Note: the **Sec2Tics** function works only with **Internal 1** and **External** clock sources. The tic period for the **On Time** property for these clock sources is 1 µs, the inverse of the KPCI-3108's 1 MHz burst-counter source.

Gate Settings

The *Gate* setting specifies how the gate signal affects the operation of the internal or external clock. The following settings are valid, depending on the gate input:

Gate Setting	Channel 0	Channel 1	Channel 2	Channel 3
Enabled selects the gate's default enabled mode. On the KPCI-3108 Series this is High Level Enabled.	GATEIN1 TGIN	GATEIN0 TGIN	GATEIN1 TGIN	TGIN
Disabled allows the clock to pace samples independently of the gate signal.	Ignored	Ignored	Ignored	Ignored
No Connect specifies that if the application is running with a board that cannot disable its gate, then the user should leave the gate unconnected so that it does not interfere with the data-acquisition task. This is mode is accepted by all DriverLINX drivers.	NC	NC	NC	NC
High Level allows the clock to pace samples only while the gate signal is high.	GATEIN1 TGIN	GATEIN0 TGIN	GATEIN1 TGIN	TGIN
Low Level allows the clock to pace samples only while the gate signal is low.	TGIN	TGIN	TGIN	TGIN
High Edge is an alias for a digital start trigger. It enables the clock after the first rising edge in the gate signal.	TGIN	TGIN	TGIN	TGIN
Low Edge is an alias for a digital start trigger. It enables the clock after the first falling edge in the gate signal.	GATEIN1 TGIN	GATEIN0 TGIN	GATEIN1 TGIN	TGIN

Note: TGIN is available only for Analog Input tasks. For Rate Events, Analog Input tasks use TGIN as the gate source unless the user configures the device with the "Use 8254 Gate for AI" option in the *Configure DriverLINX Device Dialog* (see page 14).

Counter/Timer Tasks

Counter/timer tasks, as distinguished from input/output task pacing, perform various counting, measuring and wave and pulse generation functions. Counter/timer hardware varies widely in complexity and utility. To simplify most counter/timer tasks while allowing applications to access to features of particular chips, DriverLINX defines function-oriented tasks as well as hardware-oriented tasks.

DriverLINX's function-oriented tasks that the KPCI-3108 Series can perform using its 8254 chip are

- **Event Counting**
  Non-repetitive counting with level gating
- **Frequency Measurement**
  Non-repetitive measurement without hardware gating
- **Interval Measurement**
  Non-repetitive (dual input) measurement

- **Pulse Width Measurement**
  Non-repetitive measurement with level gating
- **Pulse Generation**
  Non-repetitive pulse generation
- **Frequency Generation**
  Variable duty cycle waveform generation
  Square wave generation
  Periodic pulse trains
- **TimerTic**

Some of these functions require external interconnections. For more information see in “Using Function-Oriented Tasks” the *Counter/Timer Programming Guide*.

DriverLINX’s TimerTic task simply starts a single counter/timer using an internal or external clock source. It sends the application a TimerTic message after a specified number of clock pulses. For more information see in “Using a Counter/Timer to Generate Clock Messages” the *Counter/Timer Programming Guide*.

DriverLINX also allows applications to program the KPC1-3108 Series’ 8254 chip in specific hardware modes. The 8254’s modes are

- **0**—Interrupt on Terminal Count
- **1**—Hardware Retriggerable One-Shot
- **2**—Rate Generator
- **3**—Square Wave
- **4**—Software Triggered Strobe
- **5**—Hardware Triggered Strobe

DriverLINX’s hardware-oriented tasks start a counter/timers using an internal or external clock source. Applications can then periodically poll for the current count. For more information see in “Status Polling a Counter/Timer” the *Counter/Timer Programming Guide*.

Applications can start one or more counter/timers at the same time and interconnect them with the KPCI-3108 circuitry. For more information see in “Configuring a Counter/Timer Channel” the *Counter/Timer Programming Guide*.

The following table shows the counter/timer functions available on each Logical Channel.

Function	**Channel 0**	**Channel 1**	**Channel 2**	**Channel 3**
Event counting		√	√	
Frequency measurement		√		
Interval measurement		√		
Pulse width measurement		√	√	
Pulse generation		√	√	√
Variable duty cycle generation	√	√	√	
Square wave generation	√	√	√	√
Periodic pulse trains	√	√	√	√
TimerTic	√	√	√	√
8254 Modes		√	√	√

Counter/Timer Messages

For counter/timer operations, DriverLINX can report the following messages to the application:

DriverLINX Message	**Explanation**
Service Start	DriverLINX has started the counter/timer task.
Service Done	DriverLINX has completed the counter/timer task.
Buffer Filled	DriverLINX has filled a counter/timer input buffer.
TimerTic	DriverLINX has processed the interrupt from an unbuffered counter/timer task.
Data Lost	DriverLINX has encountered an error sending a buffer or a TimerTic message.
Critical Error	DriverLINX has encountered an unexpected hardware or software condition.

DriverLINX Event messages for counter/timer tasks.

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

Uninstalling DriverLINX

How do I uninstall DriverLINX?

DriverLINX consists of three separate component installations:

- DriverLINX for Keithley KPCI-3108 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-3108 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.

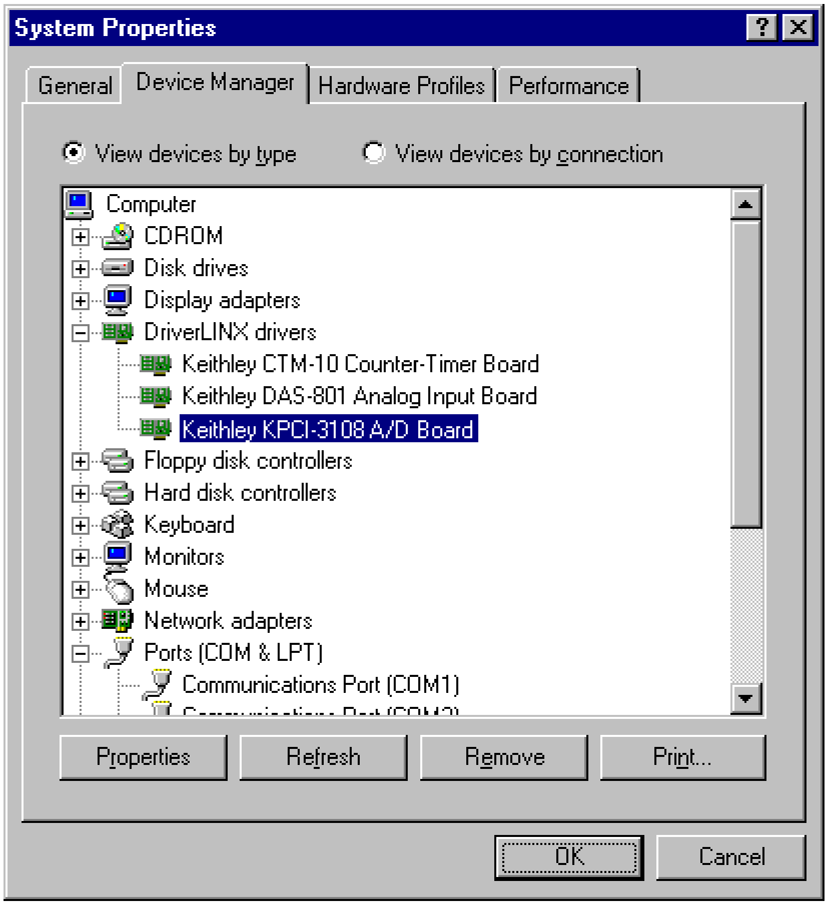
How to Disable a DriverLINX Driver in Windows NT

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-3108 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-3108 card that you are uninstalling.
5. Close the DriverLINX Configuration Panel.
6. When finished, shut down your computer and physically remove any installed KPCI-3108 hardware.
7. Reboot Windows.
8. To finish uninstalling, see “How to Remove DriverLINX for Keithley KPCI-3108 Series” on page 119.

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-3108 devices.



● View devices by type ○ View devices by connection

3. Select the KPCI-3108 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-3108 card or driver that you uninstalling.

7. When finished, click “Close”, shut down your computer, and physically remove any installed KPCI-3108 hardware.

8. Reboot Windows.

9. To finish uninstalling, see “How to Remove DriverLINX for Keithley KPCI-3108 Series” on page 119.

How to Remove DriverLINX for Keithley KPCI-3108 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-3108 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-3108 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-3108 hardware requires successful completion of three steps.

- ➢ Windows recognizes KPCI-3108 hardware and installs drivers.

1. You configure the KPCI-3108 drivers using the DriverLINX Configuration Panel.
2. Windows loads the KPCI-3108 drivers into memory.

If you are having a problem installing or configuring your KPCI-3108 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-3108 hardware and then install KPCI-3108 drivers for the hardware.

- For Windows to automatically recognize the KPCI-3108 hardware, you must install a KPCI-3108 product into your machine and restart the computer.
- For Windows to install KPCI-3108 drivers, you must install the KPCI-3108 driver software on the DriverLINX CD.

If you installed the KPCI-3108 hardware before you installed the DriverLINX software, Windows 95/98 may install the KPCI-3108 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

If you installed the KPCI-3108 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-3108 Series” on page 13.

Solving Problems Configuring the Drivers

Windows automatically assigns hardware resources for the KPCI-3108 Series, but you must still configure the KPCI-3108 drivers before using them. The DriverLINX configuration only requires that you assign each KPCI-3108 product a unique Logical Device number. And, on Windows NT, you must manually select the hardware model of your KPCI-3108 Series board. See “Configuring the KPCI-3108 Series” on page 13 for more information.

Solving Problems Loading Drivers

Before the KPCI-3108 drivers can load, you must

1. Install the DriverLINX software.
2. Install the KPCI-3108 hardware into your computer.
3. Configure DriverLINX.
4. Reboot your computer.

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

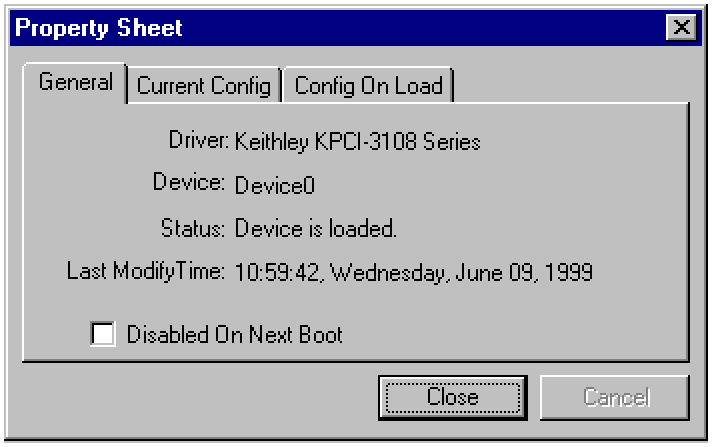
On both Windows NT and Windows 95/98, the operating system will automatically assign hardware resources to the KPCI-3108 cards. Automatic resource assignment can fail sometimes on

- 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-3108 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-3108 Series" on page 13.
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.



Driver: Keithley KPCI-3108 Series

Device: Device0

Status: Device is loaded.

Last ModifyTime: 10:59:42, Wednesday, June 09, 1999

☐ Disabled On Next Boot

8. If you rebooted the computer after configuring and Windows did not load your device, see "Checking for Device Errors" on page 123.

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 124.

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 121.
4. Click the “+” next to “DriverLINX drivers”.
5. Does your KPCI-3108 product appear in the list? If not, see “Solving Problems Recognizing and Installing Drivers” on page 121.
6. Does the icon next to your KPCI-3108 product display an exclamation point (!)? If no, Windows has loaded your KPCI-3108 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).

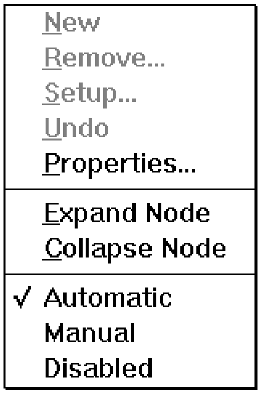
An incorrectly configured driver will report the reasons that it failed to load into the Windows Event Log. See “Checking for Device Errors” on page 123 for more information.

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-3108 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 121, 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

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-3108 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.

ISA

Abbreviation for Industry Standard Architecture. A standard for the original IBM AT bus specification that defines the bus structure, CPU and support chip architecture, and the clock frequency of the ISA bus.

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.