PXIe-2527

User Manual

Provided by:

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Contents

PXIe-2527 User Manual 3
PXIe-2527 Overview 4
Components of a PXIe-2527 System 5
PXIe-2527 Theory of Operation 9
  PXIe-2527 Motherboard 9
  PXIe-2527 Daughterboard 11
PXIe-2527 Topology 15
  1-Wire 64×1 Multiplexer Topology 15
  1-Wire Dual 32×1 Multiplexer Topology 18
  2-Wire 32×1 Multiplexer Topology 20
  2-Wire Dual 16×1 Multiplexer Topology 22
  4-Wire 16×1 Multiplexer Topology 24
  Independent Topology 26
PXIe-2527 Front Panel 29
PXIe-2527 Pinout 30
NI-SWITCH Examples 33
PXIe-2527 Installation and Configuration 35
  Unpacking the Kit 35
  Preparing the Environment 36
  Installing the Software 37
  Installing a PXIe-2527 into the Chassis 37
  Verifying the Installation 40
Connecting Signals to PXIe-2527 43
Measuring Thermocouples Using PXIe-2527 and TB-2627 48
Maintaining the PXIe-2527 51
  Replacing a Relay for PXIe-2527 51
  Improving Relay Life for PXIe-2527 55
  Cleaning the PXIe-2527 System 56

PXIe-2527 User Manual

The PXIe-2527 User Manual provides detailed descriptions of the product functionality and the step-by-step processes for use.

Looking For Something Else?

For information not found in the User Manual for your product, such as specifications and API reference, browse ***Related Information***.

Related information:

- PXIe-2527 Specifications
- PXIe-2527 Dimensional Drawings
- PXIe-2527 Product Certifications
- PXIe-2527 Letter of Volatility
- NI-SWITCH User Manual
- NI-SWITCH Release Notes
- Download NI-SWITCH
- NI-SWITCH Soft Front Panel
- Download Switch Executive
- NI Switches Cable and Accessory Compatibility
- License Setup and Activation
- Discussion Forums
- NI Learning Center

PXIe-2527 Overview

The PXIe-2527 is a high‐voltage32‐channel, 2‐wire PXI multiplexer switch module. Use the PXIe-2527 for medium‐ to high‐density automated test applications that connect measurement or signal generation instruments to various test points on devices under test (DUTs) or units under test (UUTs).

Key Features

The PXIe-2527 has the following features and capabilities.

- Sources up to 300 V and 2 A of drive capacity per channel
- Provides high-power electromechanical relays (EMRs) and can be used as front end for the PXI DMM modules, offering channel expansion for a variety of measurements
- Supports multiple channel configurations including 64x1 1-wire, 32x1 2-wire, and 16x1 4-wire
- Provides onboard relay counting for relay monitoring and deterministic operation with hardware triggers to improve test throughput

Driver Support

NI recommends that you use the newest version of the driver for your module.

Table 1. Earliest Driver Version Support

Module	Driver Name	Earliest Version Support
PXIe-2527	NI-SWITCH	4.0

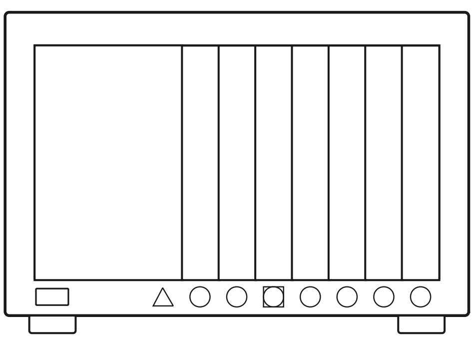
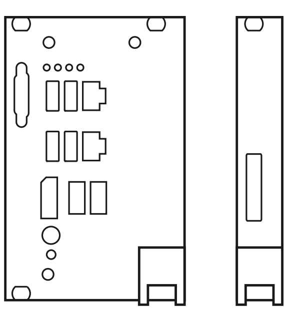
Components of a PXIe-2527 System

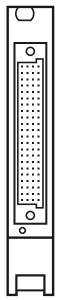
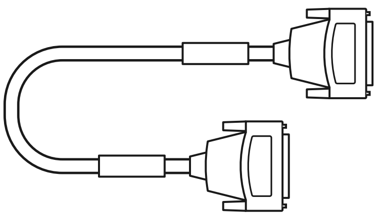
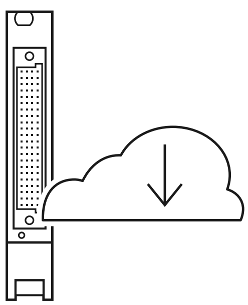
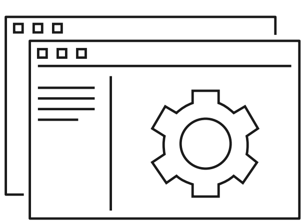
The PXIe-2527 is designed for use in a system that includes other hardware components, drivers, and software.

Notice A system and the surrounding environment must meet the requirements defined in the ***PXIe-2527 Specifications*** .

The following list defines the minimum required hardware and software for a system that includes a PXIe-2527.

Table 2. System Components

Component	Description and Recommendations
PXI Chassis 	A PXI chassis houses the PXIe-2527 and supplies power, communication, and timing for PXIe-2527 functions.
PXI Controller or PXI Remote Control Module 	You can install a PXI controller or a PXI remote control (MXI) module depending on your system requirements. These components, installed in the same PXI chassis as the PXIe-2527, interface with the PXIe-2527 using NI device drivers.
PXIe-2527	Your multiplexer switch module.

Component	Description and Recommendations
	
Cables and Accessories 	Cables and accessories allow connectivity to/from your instrument for measurements. Refer to ***Cables and Accessories*** for recommended cables and accessories and guidance.
NI-SWITCH Driver 	Instrument driver software that provides functions to interact with the PXIe-2527 and execute measurements using the PXIe-2527.
NI Applications 	NI-SWITCH offers driver support for the following ADEs (application development environments): • LabVIEW • LabWindows/CVI • C/C++ • Python • .NET

Cables and Accessories

NI recommends using the following cables and accessories with your module.

Table 3. Cables and Accessories

Accessory Description	Notes	Part Number
PXI Slot Blockers	Set of 5	199198-01
PXI EMC Filler Panel	N/A	778700-01
100-Pin HDI Right-Angle Mating Connector	N/A	779311-01
TB-2627, Screw Terminal Block for PXI Module Multiplexer	Provides necessary routing to configure the PXIe-2527 as a single or dual 1-, 2-, or 4-wire multiplexer.	779358-01

> **Note** Visit ***NI Switches Cable and Accessory Compatibility*** for more information about supported cables and accessories for your instrument.

Additional Cabling and Accessory Guidance

NI recommends the following:

- You can install PXI slot blockers and PXI EMC filler panels in empty slots to improve chassis cooling and control EMC emissions from the chassis. For more information about installing slot blockers and filler panels, go to ni.com/r/pxiblocker.

Related information:

- NI Switches Cable and Accessory Compatibility

Programming Options

You can control the PXIe-2527 interactively using the NI-SWITCH Soft Front Panel (SFP), or you can use the NI-SWITCH instrument driver to program the PXIe-2527 in the supported ADE of your choice.

- NI-SWITCH SFP – provides a graphical interface for controlling and viewing the state of the PXIe-2527. You can access the NI-SWITCH SFP in any of the following ways:
  - From the Windows **Start** menu, select **National Instruments » NI-SWITCH Soft Front Panel**
  - From Measurement & Automation Explorer (MAX), select the PXIe-2527 and then click **Test Panels...**.
  - From Hardware Configuration Utility, select the PXIe-2527 and then click **Soft Front Panel**.
- NI-SWITCH Instrument Driver – features a set of operations and attributes that exercise all the functionality of the PXIe-2527, including configuration, control, and other device-specific functions.
  - LabVIEW—Available on the LabVIEW Functions palette at **Measurement I/O » NI-SWITCH**. Examples are available from the **Start** menu in the **National Instruments** folder.
  - LabWindows/CVI—Available at **Program Files » IVI Foundation » IVI » Drivers » NI-SWITCH**. LabWindows/CVI examples are available from the **Start** menu in the **National Instruments** folder.
  - C/C++—Available at **Program Files » IVI Foundation » IVI**.
  - Python—You can install Python support for NI-SWITCH by running `pip install niswitch`.

For information about how to use NI-SWITCH in ADEs, refer to the ***Creating an application with NI-SWITCH*** topic in ***NI-SWITCH***.

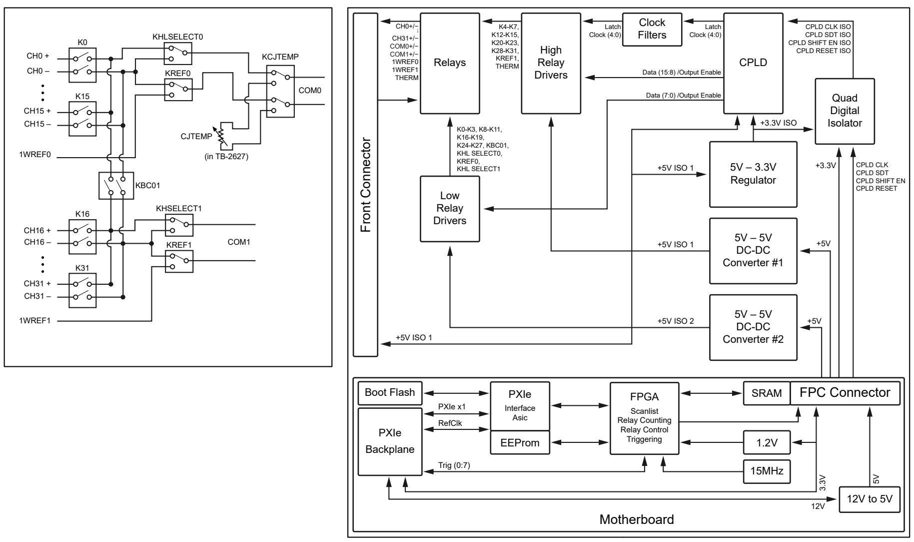
Related information:

- Creating an Application with NI-SWITCH

PXIe-2527 Theory of Operation

The following diagram illustrates the design of the PXIe-2527. Refer to the component sections to understand the design of each component.

Figure 1. PXIe-2527 Block Diagram



PXIe-2527 Motherboard

The PXIe-2527 motherboard design centers around an ***field-programmable gate array*** (FPGA), which contains the bulk of the switch logic. The FPGA interfaces with a variety of other components, including:

- 15 MHz crystal oscillator for clock input
- ***Static random-access memory*** (SRAM), for storing hardware-timed relay scanlist entries
- Flash, for storing configuration data and relay operation counts and to support nonvolatile hardware-timed relay scanlists
- Various trigger interfaces and connectors, and their buffer chips
- Switch daughterboards, for sending relay operation commands
- Device-specific interface chips, such as the PXIe interface ***application-specific integrated circuit*** (ASIC).

The motherboard also includes a flash that is connected directly to the PXIe interface ASIC bus. The flash allows the ASIC to self-configure, and it also stores the FPGA program. The FPGA program is then loaded by the ASIC's integrated boot loader.

Power

The PXIe-2527 motherboard routes the 12 V and 3.3 V power sources from the PXIe backplane through fuses to supply the board power. These two fused power supplies are also routed to the ***flexible printed circuit*** (FPC) daughterboard connector. The PXIe-2527 daughterboard does not use the 12 V. Instead, a 12 V to 5 V DC-DC converter supplies 5 V at 3.2 A to the daughterboard.

Relay Ranges

To enable relay addressing, relays in the PXIe-2527 are grouped into banks of 8. So the PXIe-2527 contains 5 relay banks. The PXIe-2527 motherboard gathers the number of addressable banks from the ***Highest Relay Bank Address*** value written in the configuration ***electrically erasable programmable read-only memory*** (EEPROM). The PXIe-2527 ignores relay commands to addresses that exceed this value. When an ***Open All*** command is issued, the PXIe-2527 only opens latching relays up to this address.

The PXIe-2527 uses latching relays only. When the power budget, programmed onto the configuration EEPROM, is reached, the motherboard powers down the relay drive lines to relays that are being driven open or closed. The power is then reallocated to open or close additional relays.

Power Counting

The PXIe-2527 is able to keep track of the number of relays driven, and, if enabled, can perform certain actions if the activated count exceeds a preset limit. The power count in the motherboard architecture is very accurate. Relays are only counted when they are driven from a undriven state. Driving the same relay multiple times, either open or closed, does not affect the power count. The count also decrements when a previously driven relay is powered down.

Relay Counting

In the PXIe-2527 motherboard architecture, a relay's operation count is updated only when the relay is driven open and was not previously open or in the process of opening. The Flash EEPROM, populated on the PXIe-2527's motherboard, stores relay operation counts. When individual relay commands are executed, the PXIe-2527 updates the FPGA SRAM copies of the relay operation counts. To protect the relay operation counts from resets or power cycles, the PXIe-2527 transfers the counts back to the EEPROM regularly.

PXIe-2527 Daughterboard

The PXIe-2527 daughterboard contains 38 relays. 32 relays are channel relays that control which channels are selected. These relays, connected to the front panel, control the channels and temperature sensing circuitry (housed in the accompanying terminal block) by switching them on or off. The other 6 relays are configuration relays, with 3 of them connected to the front panel to route the signals for COM0, COM1 and CJTEMP. The 32 channel relays route input signals to the 6 configuration relays.

The front connector is a 100-pin right-angle HDI connector that provides the necessary pin density and creepage & clearance requirements. The relay drivers used on the PXIe-2527 are octal D flip-flops.

Complex Programmable Logic Device (CPLD)

The CPLD on the PXIe-2527 transports the serial data stream from the motherboard and runs the data stream through a shift register. This behavior creates a 24-bit wide parallel data stream. The 24-bit array consists of 16 data bits and 8 address bits. The 16 data bits are ***least significant bits*** (LSBs) and the 8 address bits are ***most significant bits*** (MSBs). The address specifies the bank that the CPLD wants to communicate with, while the 16 data bits represent the data that is written to each of the 8 relays within that bank.

Relay Operation

The PXIe-2527 uses single-coil latching relays. When you apply a positive voltage across the set polarity of the coil, the relay operates to the set position if it is not already there. Once the relay contacts reach the set position, the drive voltage can be removed and the relay contacts stay in the same position until a voltage of the opposite polarity is applied to the coil. To open or close a relay, you can apply a voltage of one polarity or the other across the relay coils.

Relay Configuration

The following list describes the 6 configuration relays on the PXIe-2527.

Table 4. Configuration Relays in PXIe-2527

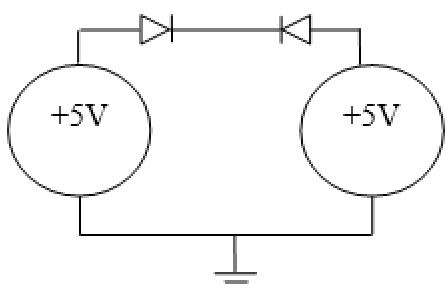
Configuration Relay	Description
The KBC01 Relay	When set, this relay multiplexes all channels to COM0 for 1-wire and 2-wire mode. This relay is reset for 4-wire mode so half the channels are multiplexed to COM0 and the other half to COM1.
The CJTEMP Relay	When set, this relay connects COM0 to the temperature circuitry in the terminal block. When reset, this relay connects to the channels.
The KREF0 Relay	When set, this relay is used only in 1-wire mode to connect to a reference voltage. When reset, this relay connects to the channels.
The KREF1 Relay	This relay functions the same as the KREF0 relay which enables a dual, 16x1, 2-wire mode configuration.
The KHLSELECT0 Relay	When reset, this relay connects COM0 to channels 0-31 in 1-wire mode. When reset, it connects to channels 32-63 1-wire mode.
The KHLSELECT1 Relay	This relay functions the same as the KHLSELECT0 relay which enables a dual 32x1 1-wire mode configuration. For 1-wire and 2-wire mode, only one channel relay is multiplexed to the COM at a time. For 4-wire mode, only one channel relay from Bank 0 and one channel relay from Bank 1 are set at a time.

Isolated Power Supply

The PXIe-2527 is designed for CAT I isolation at 300 V continuous and 1500 V impulse channel-to-channel and channel-to-ground. This design means the power lines and CPLD inputs from the motherboard must be isolated from the daughterboard.

The PXIe-2527 daughterboard gets all of the isolation from the power lines through two 1 W DC-DC converters providing 3000 V of isolation. One converter drives the CPLD, the 3.3 V regulator, other electronics, half the relay drivers, and half the relays. The second converter drives the other half of the relay drivers and relays. The output grounds of these converters are tied together and two diodes are placed between the 5 V outputs of the converters going in opposite directions. These diodes enable one converter to power the circuitry of the other converter for a short period of time during the power-up process. This occurs when one converter reaches a voltage of up to 5 V before the other converter.

Figure 1. PXIe-2527 Isolated Power Supply

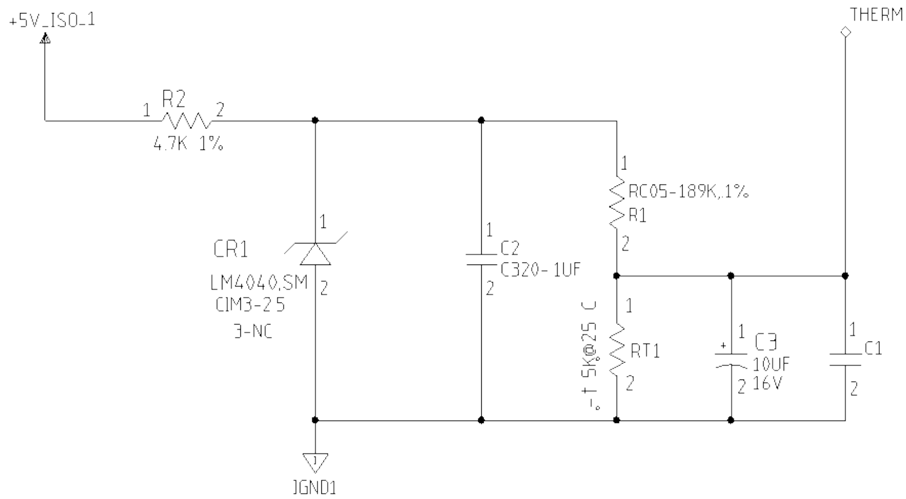


The CPLD inputs coming from the motherboard have 2500 V of isolation through a quad digital isolator.

Terminal Block Temperature Sensing Circuit

The TB-2627 terminal block for the PXIe-2527 uses a temperature sensing circuit. This circuit uses a 2.5 V voltage reference and a thermistor that reads 5 K ohms at 25 degrees Celsius. Issues with the voltage reference and the load resistor may cause temperature errors. Refer to the ***PXIe-2527 Specifications*** for calculating thermocouple error.

Figure 1. TB-2627 Temperature Sensing Circuit



Related reference:

- Measuring Thermocouples Using PXIe-2527 and TB-2627

Related information:

- PXIe-2527 Specifications

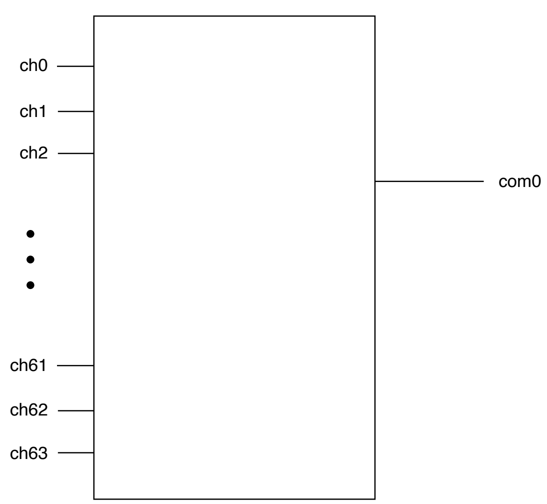
PXIe-2527 Topology

The following table lists the topologies supported by the module. Each topology supports immediate operation modes.

Topology	Software Name
1-wire 64x1 Multiplexer	2527/1-Wire 64x1 Mux(NISWITCH_TOPOLOGY_2527_1_WIRE_64X1_MUX)
1-wire Dual 32x1 Multiplexer	2527/1-Wire Dual 32x1 Mux(NISWITCH_TOPOLOGY_2527_1_WIRE_DUAL_32X1_MUX)
2-wire 32x1 Multiplexer	2527/2-Wire 32x1 Mux(NISWITCH_TOPOLOGY_2527_2_WIRE_32X1_MUX)
1-wire Dual 16x1 Multiplexer	2527/2-Wire Dual 16x1 Mux(NISWITCH_TOPOLOGY_2527_2_WIRE_DUAL_16X1_MUX)
4-wire 16x1 Multiplexer	2527/4-Wire 16x1 Mux(NISWITCH_TOPOLOGY_2527_4_WIRE_16X1_MUX)
Independent	2527/Independent(NISWITCH_TOPOLOGY_2527_INDEPENDENT)

1-Wire 64×1 Multiplexer Topology

1-Wire 64×1 Multiplexer



Making a Connection

To route signal connected to CH2 to COM0, use any of the following operations:

- In Scan List mode, use the scanning command `ch2->com0;`.
- In LabVIEW, use the niSwitch Connect Channels VI with `ch2` and `com0` as parameters.
- In C, use `niSwitch_Connect` with `ch2` and `com0` as parameters.

Table 5. Pinout

Software Name	Pin Number	Software Name	Pin Number
ch0	A1	ch36	B3
ch1	D1	ch37	C3
ch2	A2	ch38	B4
ch3	D2	ch39	C4
ch4	A3	ch40	B5
ch5	D3	ch41	C5
ch6	A4	ch42	B6
ch7	D4	ch43	C6
ch8	A5	ch44	B7
ch9	D5	ch45	C7
ch10	A6	ch46	B8
ch11	D6	ch47	C8
ch12	A7	ch48	B10
ch13	D7	ch49	C10
ch14	A8	ch50	B11
ch15	D8	ch51	C11
ch16	A10	ch52	B12
ch17	D10	ch53	C12
ch18	A11	ch54	B13
ch19	D11	ch55	C13

Software Name	Pin Number	Software Name	Pin Number
ch20	A12	ch56	B14
ch21	D12	ch57	C14
ch22	A13	ch58	B15
ch23	D13	ch59	C15
ch24	A14	ch60	B16
ch25	D14	ch61	C16
ch26	A15	ch62	B17
ch27	D15	ch63	C17
ch28	A16	com0	A9
ch29	D16	—	—
ch30	A17	—	—
ch31	D17	—	—
ch32	B1	—	—
ch33	C1	—	—
ch34	B2	—	—
ch35	C2	—	—

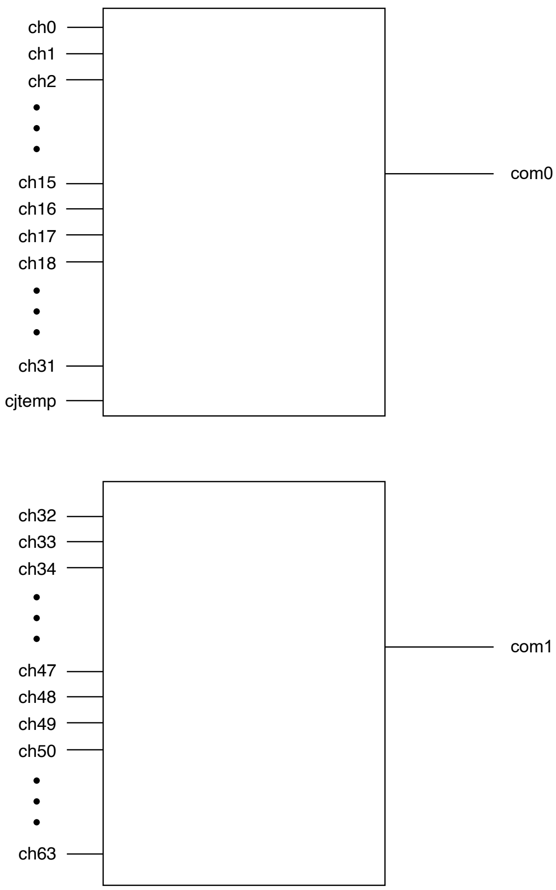
Table 10. Additional Pin References

Module Connector Pin Number	Signal Name
B9	com0–
A18	com1+
B18	com1–
C9	1wref0
C18	1wref1
A25	cjtemp+
D25	cjtemp–

Note In the 1-wire 64×1 multiplexer topology, do not connect to A18 or B18, as they are internally connected to certain routes.

1-Wire Dual 32×1 Multiplexer Topology

1-Wire Dual 32×1 Multiplexer



Making a Connection

To route signal connected to CH2 to COM0, use any of the following operations:

- In Scan List mode, use the scanning command `ch2->com0;`.
- In LabVIEW, use the niSwitch Connect Channels VI with `ch2` and `com0` as parameters.
- In C, use `niSwitch_Connect` with `ch2` and `com0` as parameters.

Table 7. Pinout

Software Name	Pin Number	Software Name	Pin Number
ch0	A1	ch36	A12
ch1	D1	ch37	D12
ch2	A2	ch38	A13
ch3	D2	ch39	D13
ch4	A3	ch40	A14
ch5	D3	ch41	D14
ch6	A4	ch42	A15
ch7	D4	ch43	D15
ch8	A5	ch44	A16
ch9	D5	ch45	D16
ch10	A6	ch46	A17
ch11	D6	ch47	D17
ch12	A7	ch48	B10
ch13	D7	ch49	C10
ch14	A8	ch50	B11
ch15	D8	ch51	C11
ch16	B1	ch52	B12
ch17	C1	ch53	C12
ch18	B2	ch54	B13
ch19	C2	ch55	C13
ch20	B3	ch56	B14
ch21	C3	ch57	C14
ch22	B4	ch58	B15
ch23	C4	ch59	C15
ch24	B5	ch60	B16
ch25	C5	ch61	C16

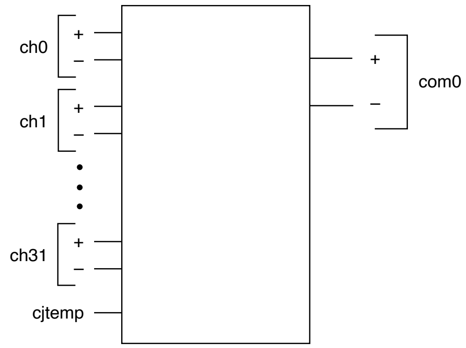
Software Name	Pin Number	Software Name	Pin Number
ch26	B6	ch62	B17
ch27	C6	ch63	C17
ch28	B7	com0	A9
ch29	C7	com1	A18
ch30	B8	—	—
ch31	C8	—	—
ch32	A10	—	—
ch33	D10	—	—
ch34	A11	—	—
ch35	D11	—	—

Table 10. Additional Pin References

Module Connector Pin Number	Signal Name
B9	com0–
B18	com1+
C9	1wref0
C18	1wref1
A25	cjtemp+
D25	cjtemp-

2-Wire 32×1 Multiplexer Topology

2-Wire 32×1 Multiplexer



Making a Connection

To route signal connected to CH2+ to COM0+, and signal connected to CH2– to COM0–, use any of the following operations:

- In Scan List mode, use the scanning command `ch2->com0;`.
- In LabVIEW, use the niSwitch Connect Channels VI with `ch2` and `com0` as parameters.
- In C, use `niSwitch_Connect` with `ch2` and `com0` as parameters.

Table 9. Pinout

Software Name	Pin Number		Software Name	Pin Number	
	+	–		+	–
ch0	A1	B1	ch18	A11	B11
ch1	D1	C1	ch19	D11	C11
ch2	A2	B2	ch20	A12	B12
ch3	D2	C2	ch21	D12	C12
ch4	A3	B3	ch22	A13	B13
ch5	D3	C3	ch23	D13	C13
ch6	A4	B4	ch24	A14	B14
ch7	D4	C4	ch25	D14	C14
ch8	A5	B5	ch26	A15	B15
ch9	D5	C5	ch27	D15	C15
ch10	A6	B6	ch28	A16	B16

Software Name	Pin Number		Software Name	Pin Number	
	+	–		+	–
ch11	D6	C6	ch29	D16	C16
ch12	A7	B7	ch30	A17	B17
ch13	D7	C7	ch31	D17	C17
ch14	A8	B8	com0	A9	B9
ch15	D8	C8	cjtemp	A25	D25
ch16	A10	B10	—	—	—
ch17	D10	C10	—	—	—

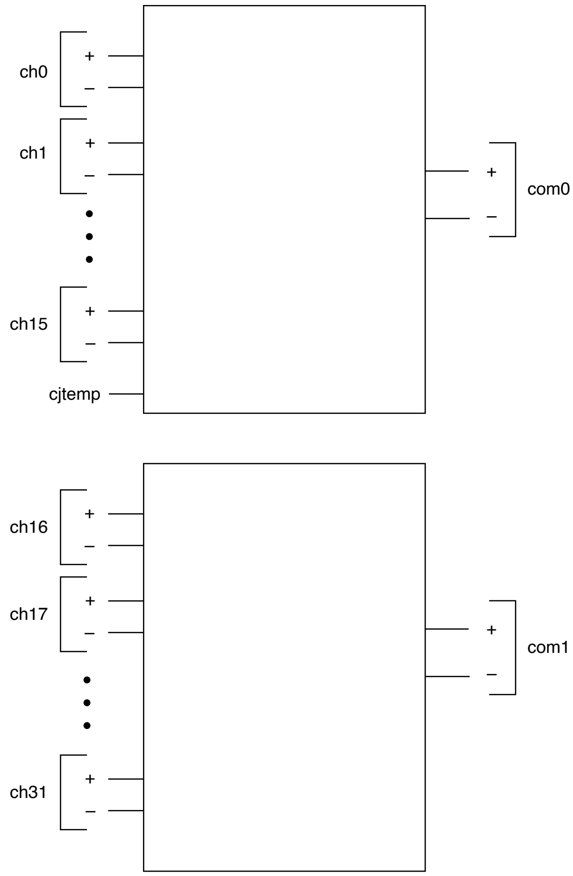
Table 10. Additional Pin References

Module Connector Pin Number	Signal Name
A18	com1+
B18	com1–
C9	1wref0
C18	1wref1

Note In the 2-wire 32×1 multiplexer topology, do not connect to A18 or B18, as they are internally connected to certain routes.

2-Wire Dual 16×1 Multiplexer Topology

2-Wire Dual 16×1 Multiplexer



Making a Connection

To route signal connected to CH2+ to COM0+, and signal connected to CH2– to COM0–, use any of the following operations:

- In Scan List mode, use the scanning command `ch2->com0;`.
- In LabVIEW, use the niSwitch Connect Channels VI with `ch2` and `com0` as parameters.
- In C, use `niSwitch_Connect` with `ch2` and `com0` as parameters.

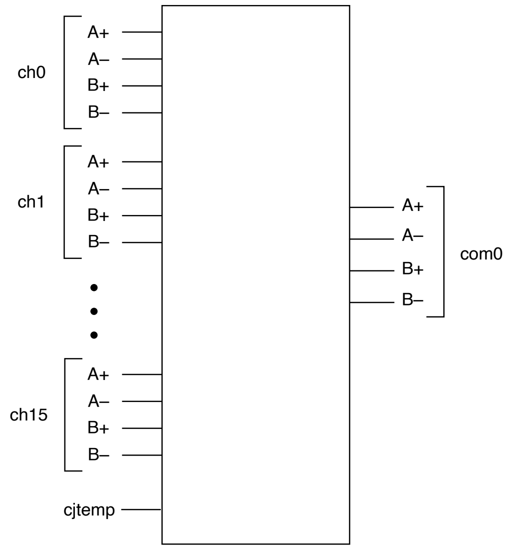
Table 11. Pinout

Software Name	Pin Number		Software Name	Pin Number	
	+	–		+	–
ch0	A1	B1	ch18	A11	B11
ch1	D1	C1	ch19	D11	C11
ch2	A2	B2	ch20	A12	B12

Software Name	Pin Number		Software Name	Pin Number	
	+	–		+	–
ch3	D2	C2	ch21	D12	C12
ch4	A3	B3	ch22	A13	B13
ch5	D3	C3	ch23	D13	C13
ch6	A4	B4	ch24	A14	B14
ch7	D4	C4	ch25	D14	C14
ch8	A5	B5	ch26	A15	B15
ch9	D5	C5	ch27	D15	C15
ch10	A6	B6	ch28	A16	B16
ch11	D6	C6	ch29	D16	C16
ch12	A7	B7	ch30	A17	B17
ch13	D7	C7	ch31	D17	C17
ch14	A8	B8	com0	A9	B9
ch15	D8	C8	com1	A18	B18
ch16	A10	B10	cjtemp	A25	D25
ch17	D10	C10	-	-	-

4-Wire 16×1 Multiplexer Topology

4-Wire 16×1 Multiplexer



Making a Connection

Both the scanning command, `ch2->com0;`, and the immediate operation, niSwitch Connect Channels VI or the `niSwitch_Connect` function with parameters `ch2` and `com0`, result in the following connections:

- signal connected to CH2A+ is routed to COM0A+
- signal connected to CH2A– is routed to COM0A–
- signal connected to CH2B+ is routed to COM0B+
- signal connected to CH2B– is routed to COM0B–

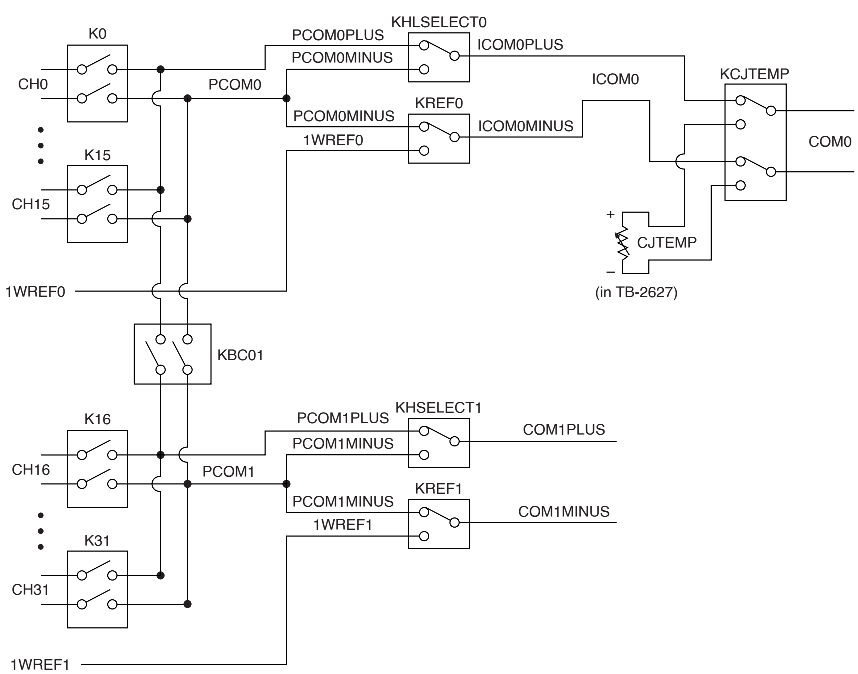
Table 12. Pinout

Software Name	Pin Number			
	A+	A–	B+	B–
ch0	A1	B1	A10	B10
ch1	D1	C1	D10	C10
ch2	A2	B2	A11	B11
ch3	D2	C2	D11	C11
ch4	A3	B3	A12	B12
ch5	D3	C3	D12	C12
ch6	A4	B4	A13	B13

Software Name	Pin Number			
	A+	A–	B+	B–
ch7	D4	C4	D13	C13
ch8	A5	B5	A14	B14
ch9	D5	C5	D14	C14
ch10	A6	B6	A15	B15
ch11	D6	C6	D15	C15
ch12	A7	B7	A16	B16
ch13	D7	C7	D16	C16
ch14	A8	B8	A17	B17
ch15	D8	C8	D17	C17
com0	A9	B9	A18	B18
cjtemp	A25	D25	—	—

Independent Topology

Independent



Making a Connection

With the independent topology, you can let NI-SWITCH determine the path between two specified channels by setting the intermediate channels as reserved for routing and using the niSwitch Connect Channels VI or the `niSwitch_Connect` function, or you can control individual relays using the niSwitch Relay Control VI or the `niSwitch_RelayControl function`.

Table 13. Pinout

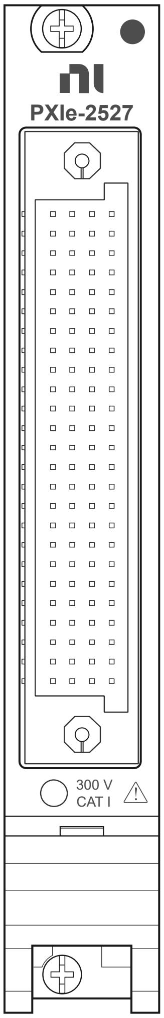
Software Name	Pin Number		Software Name	Pin Number	
	+	–		+	–
ch0	A1	B1	ch17	D10	C10
ch1	D1	C1	ch18	A11	B11
ch2	A2	B2	ch19	D11	C11
ch3	D2	C2	ch20	A12	B12
ch4	A3	B3	ch21	D12	C12
ch5	D3	C3	ch22	A13	B13
ch6	A4	B4	ch23	D13	C13
ch7	D4	C4	ch24	A14	B14
ch8	A5	B5	ch25	D14	C14
ch9	D5	C5	ch26	A15	B15
ch10	A6	B6	ch27	D15	C15
ch11	D6	C6	ch28	A16	B16
ch12	A7	B7	ch29	D16	C16
ch13	D7	C7	ch30	A17	B17
ch14	A8	B8	ch31	D17	C17
ch15	D8	C8	com0	A9	B9
ch16	A10	B10	com1	A18	B18
cjtemp	A25	D25	—	—	—

Table 14. Valid Internal Channel Names

pcom0	pcom1
1wref0	1wref1
cjtemp	icom0
pcom1plus	pcom1minus
icom0plus	icom0minus
pcom0plus	pcom0minus
com1plus	com1minus

PXIe-2527 Front Panel

Figure 1. PXIe-2527 Front Panel



PXIe-2527 Pinout

The following figure shows the terminals on the PXIe-2527 connector.

Figure 1. PXIe-2527 Pinout

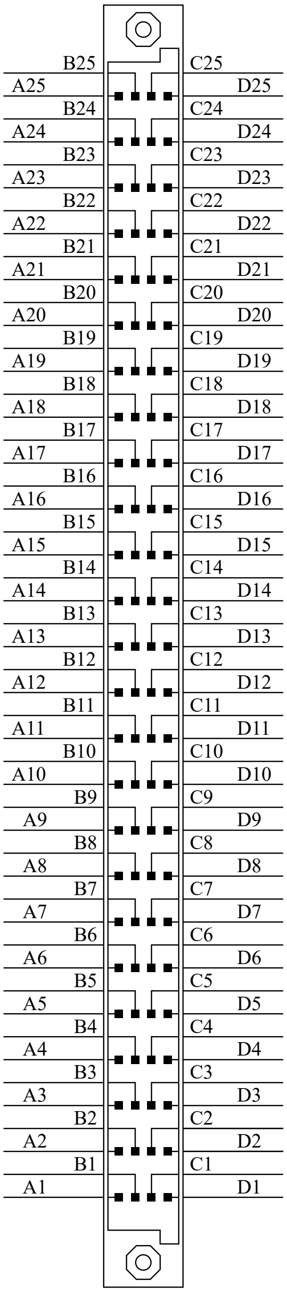


Table 15. 1-Wire 64×1 Multiplexer Signal Descriptions

Signal	Description
CHx	Channel terminals
COM0+	Routing destination for all channel terminals
COM0-	Routing destination for the 1WREF0 lead

Table 16. 1-Wire Dual 32×1 Multiplexer Signal Descriptions

Signal	Description
CH0 through CH31	Channel terminals that route to COM0+
CH 32 through CH63	Channel terminals that route to COM1+
COM0+	Routing destination for CH0 through CH31
COM1+	Routing destination for CH32 through CH63
COM0-	Routing destination for the 1WREF0 lead
COM1-	Routing destination for the 1WREF1 lead

Table 17. 2-Wire 32×1 Multiplexer Signal Descriptions

Signal	Description
CH0+ through CH31+	Channel terminals that route to COM0+
CH0- through CH31-	Channel terminals that route to COM0-
COM0+	Routing destination for all positive channels
COM0-	Routing destination for all negative channels

Table 18. 2-Wire Dual 16×1 Multiplexer Signal Descriptions

Signal	Description
CH0+ through CH15+	Channel terminals that route to COM0+
CH0- through CH15-	Channel terminals that route to COM0-
CH16+ through CH31+	Channel terminals that route to COM1+
CH16- through CH31-	Channel terminals that route to COM1-
COM0+	Routing destination for CH0+ through CH15+

Signal	Description
COM0-	Routing destination for CH0- through CH15-
COM1+	Routing destination for CH16+ through CH31+
COM1-	Routing destination for CH16- through CH31-

Table 19. 4-Wire 16×1 Multiplexer Signal Descriptions

Signal	Description
CH0A+ through CH15A+	Channel terminals that route to COM0+
CH0A- through CH15A-	Channel terminals that route to COM0-
CH0B+ through CH15B+	Channel terminals that route to COM1+
CH0B- through CH15B-	Channel terminals that route to COM1-
COM0+	Routing destination for all positive channels (A and B)
COM0-	Routing destination for all negative channels (A and B)

Table 20. Independent Topology Signal Descriptions

Signal	Description
CHx	Channel terminals
COM0+	Routing destination for all channel terminals
COM0-	Routing destination for the 1WREF0 lead

NI-SWITCH Examples

NI-SWITCH includes several example applications that demonstrate the functionality of your device and can serve as interactive tools, programming models, and building blocks for your own applications.

NI Example Finder

The NI Example Finder is a utility that organizes examples into categories and allows you to browse and search installed examples. For example, search for "`SWITCH`" to locate all NI-SWITCH examples. You can see descriptions and compatible hardware models for each example or see all the examples compatible with one particular hardware model.

To locate examples using the NI Example Finder within LabVIEW, select **Help»Find Examples** and navigate to **Hardware Input and Output»Modular Instruments»NI-SWITCH**.

Example Locations

<table>
<tr><th colspan="2">ADE</th><th>Example Locations</th></tr>
<tr><td colspan="2">LabVIEW</td><td>Within LabVIEW, select Help»Find Examples and navigate to Hardware Input and Output»Modular Instruments.</td></tr>
<tr><td colspan="2">LabWindows/ CVI</td><td><code>C:\Users\Public\Documents\National Instruments\CVI\samples\niSwitch</code></td></tr>
<tr><td colspan="2">C/C++</td><td>Windows — <code>Users\Public\Documents\National Instruments\NIDocDir\NI-SWITCH\examples</code>
Linux — <code>usr/share/niswitch-devel/examples</code></td></tr>
<tr><td rowspan="2">.NET</td><td>4.0</td><td><code>C:\Users\Public\Documents\National Instruments\NI-SWITCH\Examples\DotNET 4.0</code></td></tr>
<tr><td>4.5</td><td><code>C:\Users\Public\Documents\National Instruments\NI-SWITCH\Examples\DotNET 4.5</code></td></tr>
<tr><td colspan="2">Python</td><td>Refer to Python NI-SWITCH Examples.</td></tr>
</table>

Related information:

- Python NI-SWITCH Examples

PXIe-2527 Installation and Configuration

Complete the following steps to install the PXIe-2527 into a chassis and prepare it for use.

1. Unpacking the Kit
2. Preparing the Environment
3. Installing the Software
4. Installing a PXIe-2527 into the Chassis
5. Verifying the Installation
   Before using the PXIe-2527, verify that it is installed correctly through Hardware Configuration Utility or MAX.

Unpacking the Kit

> **Notice** To prevent electrostatic discharge (ESD) from damaging the device, ground yourself using a grounding strap or by holding a grounded object, such as your computer chassis.

1. Touch the antistatic package to a metal part of the computer chassis.
2. Remove the device from the package and inspect the device for loose components or any other sign of damage.

   > **Notice** Never touch the exposed pins of connectors.

   > **Note** Do not install a device if it appears damaged in any way.

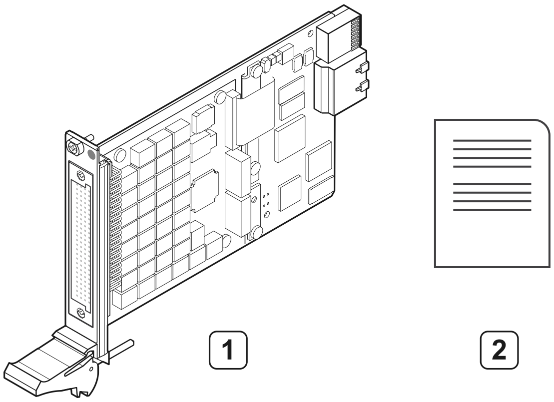
3. Unpack any other items and documentation from the kit.

> **Note** Store the device in the antistatic package when the device is not in use.

Kit Contents

Refer to the following figure to identify the contents of the PXIe-2527 kit.

Figure 1. PXIe-2527 Kit Contents



1. PXIe-2527 Module
2. Documentation

Preparing the Environment

Ensure that the environment in which you are using the PXIe-2527 meets the following specifications.

PXI Express Modules

Operating Environment	
Ambient temperature range	0 °C to 40 °C
Relative humidity range	10% to 90%, noncondensing
Maximum altitude	2,000 m (800 mbar) (at 25 °C ambient temperature)
Pollution Degree	2

Indoor use only.

Installing the Software

You must be an Administrator to install NI software on your computer.

1. Install an ADE, such as LabVIEW or LabWindows™/CVI™.
2. Download the NI-SWITCH driver software installer from ni.com/downloads.
   NI Package Manager downloads with the driver software to handle the installation. Refer to the NI Package Manager Manual for more information about installing, removing, and upgrading NI software using NI Package Manager.
3. Follow the instructions in the installation prompts.

   > **Note** Windows users may see access and security messages during installation. Accept the prompts to complete the installation.

4. When the installer completes, select **Restart** in the dialog box that prompts you to restart, shut down, or restart later.

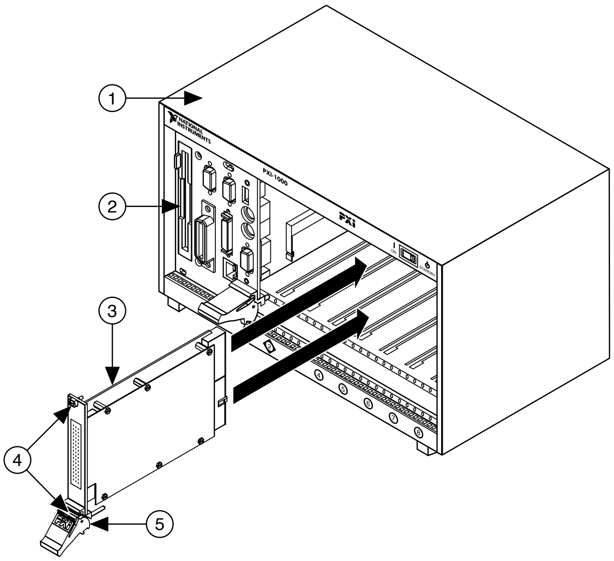
> **Tip** You can use Switch Executive to simplify the configuration, management, and maintenance of the PXIe-2527 system. Visit ni.com/r/switchexecutive to purchase the latest version of Switch Executive. If you need physical media, contact orders@ni.com.

Installing a PXIe-2527 into the Chassis

You must install the software before installing the hardware.

Before you install the PXIe-2527, refer to the guidelines in ***Maintain Forced-Air Cooling Note to Users*** to ensure that the PXIe-2527 can cool itself effectively.

Figure 1. Installing a PXIe-2527



1. NI PXI/PXI Express or NI PXI/SCXI Combination Chassis
2. Controller
3. PXIe-2527
4. Screws
5. Ejector Handle

Complete the following steps to install your PXIe-2527 into the chassis.

1. Ensure the AC power source is connected to the chassis before installing the PXIe-2527.
   The AC power cord grounds the chassis and protects it from electrical damage while you install the PXIe-2527.
2. Power off the chassis.
3. If the NI PXI/PXI Express chassis has multiple fan speed settings, ensure that the fans are set to high.
4. Position the chassis so that inlet and outlet vents are not obstructed.
   For more information about optimal chassis positioning, refer to chassis documentation.
5. Remove the black vinyl caps from all the captive screws on the front panel of the PXIe-2527.
6. Identify a supported slot in the NI PXI/PXI Express chassis.
   Refer to the following table to determine what slots support PXIe-2527 if you are using a NI PXI Express chassis. Refer to the chassis documentation for details.

Table 21. Slot Identification Symbols in an NI PXI/PXI Express Chassis

2	NI PXI Peripheral Slot
3	NI PXI Express Peripheral Slot
4 H	NI PXI Express Hybrid Peripheral Slot
5	NI PXI Express System Timing Slot

Tip If you plan to use the optional PXIe-6674T Timing and Synchronization Module, reserve the PXI Express system timing slots for its placement in the chassis.

7. Remove the filler panel of an unused PXI/PXI Express slot.
8. Touch any metal part of the chassis to discharge static electricity.
9. Ensure that the ejector handle of the PXIe-2527 is in the unlatched (down) position and swings freely.
10. Holding the PXIe-2527 by the ejector handle, slide it into the empty slot, ensuring that the card engages with the card guides in the chassis.
11. When you begin to feel resistance, pull up on the ejector handle to latch the PXIe-2527.
12. Secure the PXIe-2527 front panel to the chassis using the front-panel mounting screws.

Note Tightening the top and bottom mounting screws increases mechanical stability and also electrically connects the front panel to the chassis, which can improve the signal quality and electromagnetic performance.

13. Cover all empty slots using either filler panels (standard or EMC) or slot blockers with filler panels, depending on your application.

> **Note** For more information about installing slot blockers and filler panels, go to ni.com/r/pxiblocker.

14. Power on the chassis.

Related information:

- Maintain Forced-Air Cooling Note to Users

Verifying the Installation

Before using the PXIe-2527, verify that it is installed correctly through Hardware Configuration Utility or MAX.

Verifying the Installation in Hardware Configuration Utility

NI recommends using Hardware Configuration Utility to perform and validate initial hardware configuration.

1. Open Hardware Configuration Utility.
   The PXIe-2527 should appear in the system pane automatically.
2. Record the name Hardware Configuration Utility assigns to the PXIe-2527 or, if desired, provide a custom name to the PXIe-2527.
   Use this name when programming the PXIe-2527.
3. Validate that your instrument is installed correctly: select the PXIe-2527 module in the system pane, expand the **Troubleshooting** area of the configuration pane, and click **Self-test**.
   Hardware Configuration Utility reports when the hardware setup is validated.

Related information:

- Hardware Configuration Utility User Manual

Verifying the Installation in MAX

You can use Measurement & Automation Explorer (MAX) to configure your NI hardware. MAX informs other programs about which NI hardware products are in the system and how they are configured. MAX is automatically installed with NI-SWITCH.

> **Note** MAX is not available on Linux.

1. Launch MAX.
2. In the configuration tree, expand **Devices and Interfaces** to see the list of installed NI hardware.
   Installed modules appear under the name of their associated chassis.
3. Expand your **Chassis** tree item.
   MAX lists all modules installed in the chassis. Your default names may vary.

   > **Note** If you do not see your module listed, press <F5> to refresh the list of installed modules. If the module is still not listed, power off the system, ensure the module is correctly installed, and restart.

4. Record the name MAX assigns to the hardware. Use this identifier when programming the PXIe-2527.
5. Self-test the hardware by selecting the item in the configuration tree and clicking **Self-Test** in the MAX toolbar.
   MAX self-test performs a basic verification of hardware resources.

What Should I Do if the PXIe-2527 Doesn't Appear in Hardware Configuration Utility or MAX?

1. Check if the connection between the hardware and software needs to be refreshed.

Software	Description
Hardware Configuration Utility	Click the refresh button ( ).
MAX	a. In the MAX configuration tree, expand **Devices and Interfaces**. b. Expand the **Chassis** tree to see the list of installed hardware and press **F5** to refresh the list.

2. If the PXIe-2527 is still not listed, power off the system, ensure that all hardware is

correctly installed, and restart the system.

3. Navigate to the Device Manager by right-clicking the **Start** button and selecting **Device Manager**.
4. Depending on your controller type, verify Device Manager settings.

Controller Type	Description
PXI controller	a. Verify that a **National Instruments** entry appears in the system device list b. If error conditions appear in the list, right-click the module you are using in the **Device Manager** and select **Update Driver**.
MXI controller	Right-click **PCI-to-PCI Bridge** and select **Properties** from the shortcut menu to verify that the bridge is enabled and that no error conditions appear.

If error conditions persist, reinstall NI-SWITCH.

5. Restart your computer.

What Should I Do if the PXIe-2527 Fails the Self-Test?

1. Reset the PXIe-2527 through Hardware Configuration Utility or MAX and then perform the self-test again.
2. Restart the system, and then perform the self-test again.
3. Power off the chassis.
4. Reinstall the failed module in a different slot.
5. Power on the chassis.
6. Perform the self-test again.

> **Note** If the module fails the self-test again, contact NI or visit ni.com/support for further troubleshooting information.

Connecting Signals to PXIe-2527

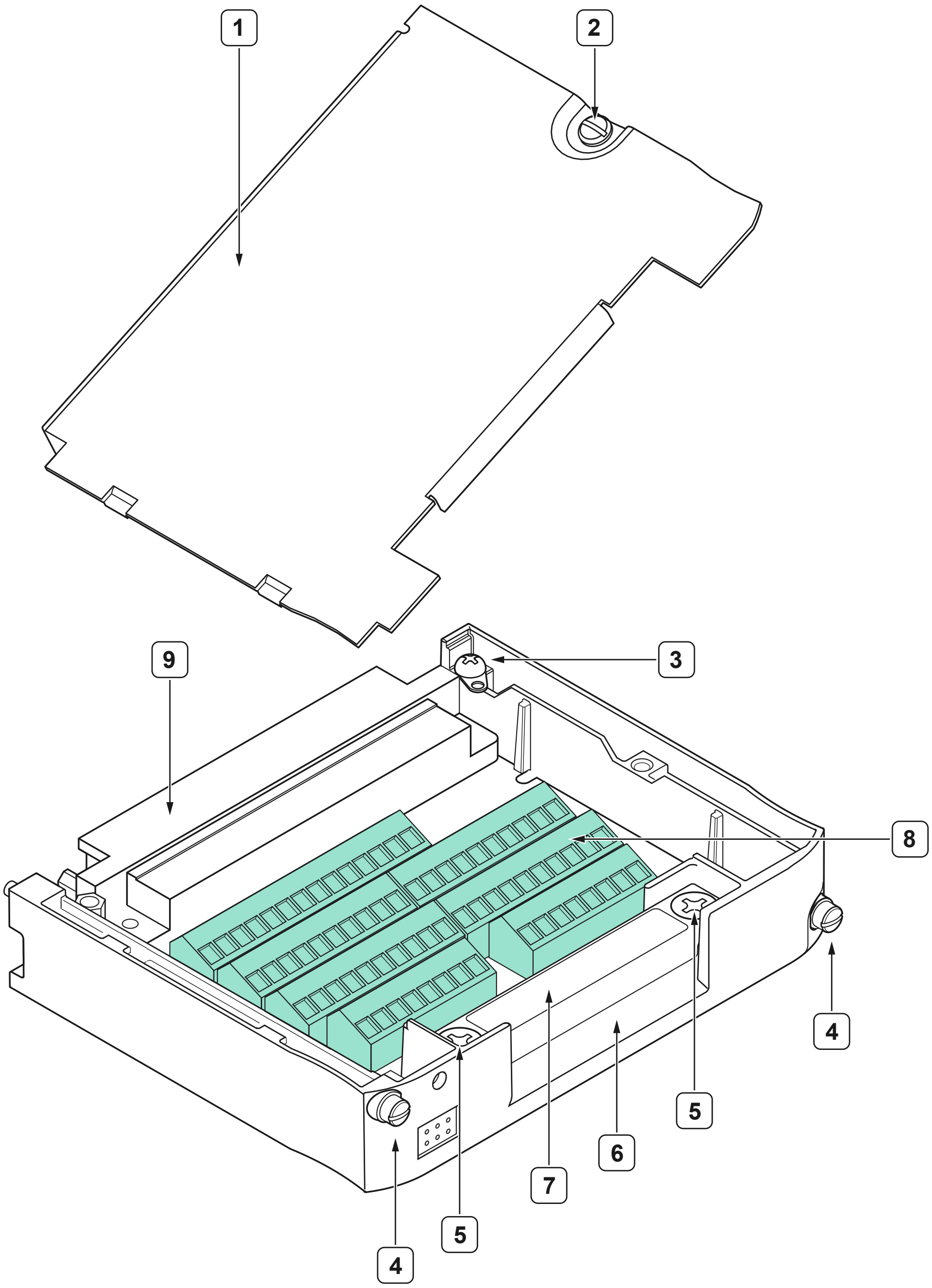
You can connect signals to the PXIe-2527 using the TB-2627, or you can make custom signal connections.

Connecting Signals to PXIe-2527 using TB-2627

You can use the NI TB-2627, a front-mounting terminal block, to quickly connect signals the PXIe-2527 for prototyping applications or system deployment. Additionally, you can simplify connectivity with a digital multimeter (DMM) through the use of the HV6-BAN4 cable (P/N 192795-0R2). The HV6-BAN4 cable connects the banana jack inputs of a DMM to the COMs of each multiplexer bank. A cold-junction compensation sensor is also included for more accurate thermocouple measurements.

The following figure shows the main components of the TB-2627:

Figure 8. TB-2627 Components



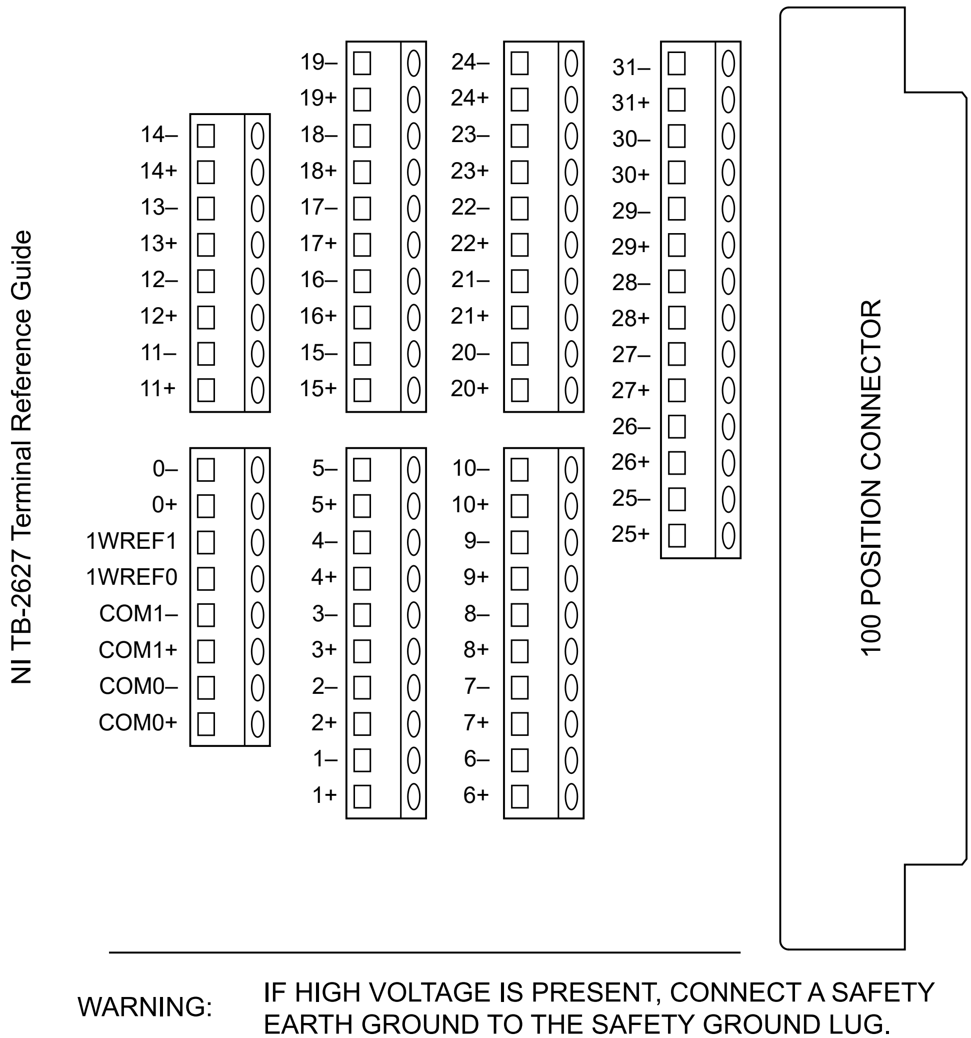
1. Terminal Block Top Cover
2. Top Cover Screw
3. Safety Ground Lug
4. Chassis Screws
5. Strain-Relief Screws
6. Strain-Relief Opening
7. Strain-Relief Bar

8. Screw Terminals
9. Rear Connector

Complete the following steps to connect signals to the PXIe-2527 with TB-2627:

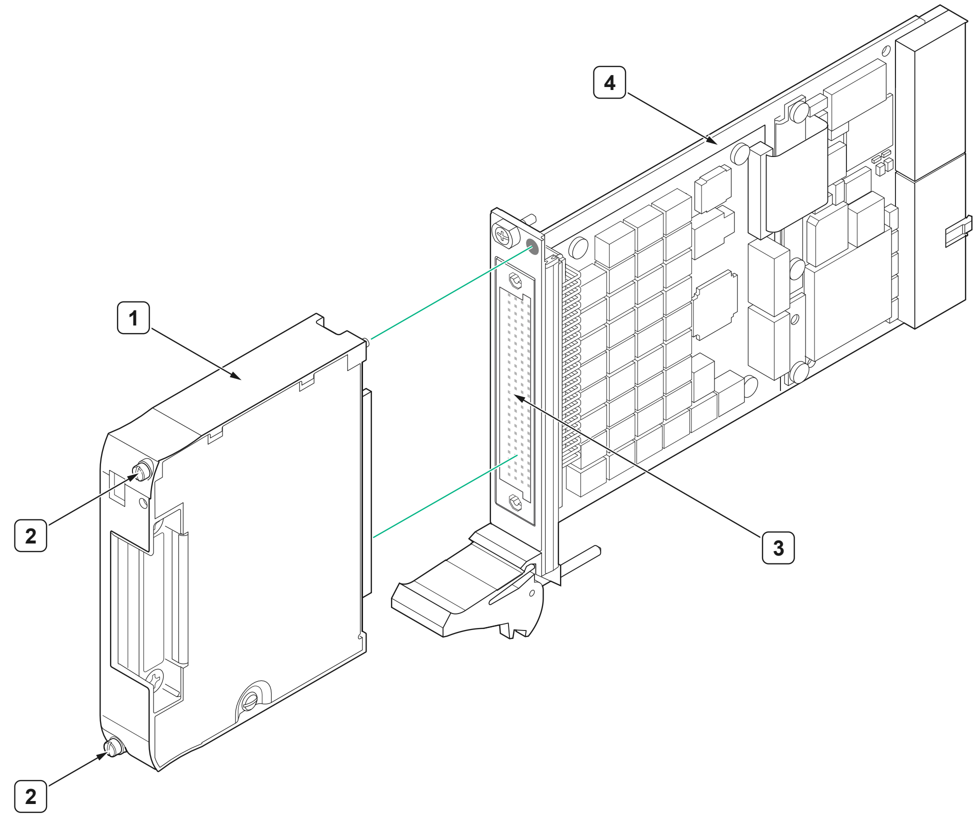
1. Screw the leads into the screw terminals as shown in the following figure. Ensure that the leads are properly reinforced by the strain relief bar.

Figure 9. Mapping TB-2627 Screw Terminals to PXIe-2527 Channels



2. Attach the TB-2627 cover.
3. Connect the TB-2627 directly to the PXIe-2527 with the mating connectors as shown in the following figure:

Figure 10. Connecting PXI/PXIe-2527 to TB-2627



- 1. TB-2627
- 2. Chassis Screws
- 3. Front Connector
- 4. PXI/PXIe-2527

Custom Signal Connections to PXIe-2527

You can also connect signals to the PXIe-2527 without using the TB-2627. You can develop your own terminal block by using a compatible mating front panel connector. A custom terminal block allows for a wide variety of routing options and multiplexer topologies. To determine how the pins on the PXIe-2527 map to the channels of a particular multiplexer topology, refer to ***PXIe-2527 Topology*** and select the desired topology.

Refer to the following table for compatible mating front panel connectors:

Table 23. Compatible Mating Front Panel Connectors

Accessory	100-Pin HDI Right-Angle Mating	Mating Front Panel Connector, Vertical	Mating Front Panel Connector, Right-angle

	Connector		
Manufacturer	NI	AMP	AMP
Part Number	779311-01	533285-1	533285-1

Related reference:

- PXIe-2527 Topology

Measuring Thermocouples Using PXIe-2527 and TB-2627

You can use the PXIe-2527 and the NI TB-2627 to measure thermocouples. When measuring thermocouples, you must account for error in the measurements.

> **Tip** NI software can convert a thermocouple voltage to the thermocouple temperature. Visit ni.com/examples for example programs.

Determining the System Error

To determine the system error for the PXIe-2527/TB-2627, first calculate the thermal EMF error of the PXIe-2527 using the following equation:

$$E_{EMF} = [(T_{+1} - T)/(V_{+1} - V)] * V_{EMF}$$

where:

- E_{EMF} represents the thermal EMF error of the PXIe-2527
- T is the temperature being measured, in degrees Celsius
- T_{+1} is (T + 1 °C)
- V is the voltage that corresponds to T
- V_{+1} is the voltage that corresponds to T_{+1}
- V_{EMF} represents the thermal EMF of the PXIe-2527

> **Note** In thermocouple reference tables, T and T_{+1} are known values used to calculate the slope of the thermocouple Temperature vs. Voltage graph. Refer to a thermocouple reference table to determine the values of V and V_{+1} that correspond to T and T_{+1}, respectively.

> **Note** Refer to the ***PXIe-2527 Specifications*** to determine the thermal

> EMF value. For optimal thermocouple measurement performance (V_{EMF} = 2.5 µV), power down the latching relays of the PXIe-2527. For more information about powering down latching relays, refer to the ***Power Down Latching Relays After Debounce*** property in NI-SWITCH or the ***Power Down Latching Relays After Settling*** property in NI-DAQmx.

After you have determined the thermal EMF error, calculate the system error using the following equation:

$E_S = E_{EMF} + E_{CJC}$

where:

- E_S represents the system error of the PXIe-2527/TB-2627
- E_{EMF} represents the error due to thermal EMF of the PXIe-2527
- E_{CJC} represents the error due to the CJC temperature sensor of the TB-2627

Example: Measuring a K-type thermocouple at 200 °C with a CJC temperature of 25 °C, the system error of the PXIe-2527/TB-2627 is calculated in the following example.

Assuming typical thermal EMF (2.5 µV), first calculate the error due to thermal EMF.

E_{EMF} = [(201 °C – 200 °C)/(8.178 µV – 8.138 µV)] × 0.0025 µV = 0.063 °C

> **Note** In this example, the values of V and V_{+1} are found in the thermocouple reference tables of Omega Engineering's The Temperature Handbook. Vol. 29. Stamford, CT: Omega Engineering Inc, 1995.

To determine the system error, add the error due to thermal EMF to the error due to the CJC temperature sensor.

E_S = 0.063 °C + 0.5 °C = 0.563 °C

Determining the Thermocouple Error

Independent of the PXIe-2527/TB-2627 system, thermocouple error is the greater of the following values: ± a temperature range or ± a percent of the measurement.

In the example, a standard grade K-type thermocouple is used to measure 200 °C. The Temperature Handbook lists the error for a standard grade K-type thermocouple as ±2.2 °C or ±0.75% of the measurement temperature. Because ±0.75% of 200 °C (±1.5 °C) is less than ±2.2 °C, the error of a standard grade K-type thermocouple is ±2.2 °C.

Determining the Total Error

The total error in thermocouple measurement is the sum of the system error and the thermocouple error. Use the following equation to determine the total error in thermocouple measurement.

$$E_T = E_S + E_{TH}$$

where:

- E_T represents the total error in thermocouple measurement
- E_S represents the system error
- E_{TH} represents the thermocouple error

To determine the total error in thermocouple measurement in the example, add the thermocouple error to the system error, as illustrated in the following calculation.

$$E_T = 0.56\ °C + 2.2\ °C = 2.76\ °C$$

Assuming typical thermal EMF, the total error in thermocouple measurement at 200 °C for the PXIe-2527/TB-2627 with a K-type thermocouple is ±2.76 °C.

Maintaining the PXIe-2527

Understand how to maintain the PXIe-2527.

Replacing a Relay for PXIe-2527

Complete the following procedures to disassemble the PXIe-2527, replace a relay, and reassemble the PXIe-2527.

The PXIe-2527 uses electromechanical armature relays.

Replacement Relay	Part Number
AXICOM (Tyco Electronics)	IM42PGR (5-1462039-7)
NI (10 relays, Tyco)	782051-01

Disassembling the PXIe-2527

1. Ground yourself using a grounding strap or a ground connected to your PXI chassis.

   Note Properly grounding yourself prevents damage to your PXIe-2527 from electrostatic discharge.

2. Refer to ***PXIe-2527 Topology*** and the following table to locate the relay you want to replace.

   Note Use the numbers printed on the board to verify the revision letter of the PXIe-2527. (Revision B = ASSY192245B-01; Revision A = ASSY192245A-01.) Use the revision letter to determine the correct reference designator for the relay you want to replace.

Relay Name	Reference Designator (Revision B)	Reference Designator (Revision A)
k0	k0	k33

Relay Name	Reference Designator (Revision B)	Reference Designator (Revision A)
k1	k1	k35
k2	k2	k30
k3	k3	k38
k4	k4	k34
k5	k5	k29
k6	k6	k25
k7	k7	k24
k8	k8	k21
k9	k9	k20
k10	k10	k17
k11	k11	k31
k12	k12	k16
k13	k13	k37
k14	k14	k36
k15	k15	k26
k16	k16	k13
k17	k17	k22
k18	k18	k6
k19	k19	k18
k20	k20	k14
k21	k21	k11
k22	k22	k8
k23	k23	k12
k24	k24	k9
k25	k25	k7
k26	k26	k5
k27	k27	k10

Relay Name	Reference Designator (Revision B)	Reference Designator (Revision A)
k28	k28	k1
k29	k29	k3
k30	k30	k4
k31	k31	k2
kbc01	k32	k32
khlselect0	k33	k28
kref0	k34	k27
khlselect1	k35	k23
kref1	k36	k19
kcjtemp	k37	k15

3. Locate the assembly and serial number labels on the board with the relay you want to replace. White labels indicate the board was assembled using lead solder (Sn 63 Pb 37). Green labels indicate the board was assembled using lead-free solder (Sn 96.5 Ag 3.0 Cu 0.5). Lead-free assemblies have assembly numbers ending in L.

Replacing the Relay

Ensure you have the following:

- Temperature-regulated soldering iron
  - Set to 371 °C (700 °F) for lead-free solder rework
  - Set to 316 °C (600 °F) for lead solder rework
- Solder
  - 96.5/3.0/0.5 tin/silver/copper solder (flux core) for lead-free solder rework
  - 63/37 tin/lead solder (flux core) for lead solder rework
- Solder wick
- Fine pick
- Isopropyl alcohol
- Cotton swabs

> **Note** NI recommends using a lead-free solder for relay replacement on lead-free assemblies, and lead solder for relay replacement on lead assemblies.

> **Notice** Do not rework lead assemblies using a lead-free work station. Lead solder from the unit could contaminate the station.

> **Notice** If a lead-free assembly is reworked with lead solder, label the assembly to indicate this. This can prevent the same unit from being reworked later on a lead-free solder station, which could contaminate the station.

If you have a surface mount rework station, replace the relay as you would any other surface mount part. Otherwise, complete the following steps to replace the relay:

1. Use the soldering iron and solder wick to remove as much solder from the relay pads as possible. Do not leave the soldering iron on any lead for more than 5 seconds.

    > **Note** If it is necessary to reapply the soldering iron to the pad, allow the connection to cool completely before reapplying the soldering iron.

2. Apply heat to the pads one at a time, and use the pick to gently pry the relay pins from the pads. Make sure that the solder is molten before prying.

    > **Notice** Using excessive force on a soldered pad can result in lifting the PCB trace and ruining the board.

3. Remove the relay.
4. Clean the pads with isopropyl alcohol and cotton swabs.
5. Place the new relay on the PCB pads and solder.
6. Remove the excess flux with isopropyl alcohol and cotton swabs.

    > **Notice** Do not use flux remover to clean the board after relay replacement.

Reassembling the PXIe-2527

Complete the ***Disassembling the PXIe-2527*** steps in reverse order to reassemble your PXIe-2527.

> **Tip** Use the NI-SWITCH Soft Front Panel to reset the relay count after you have replaced a failed relay. Refer to ***NI-SWITCH Soft Front Panel*** for more information.

Related reference:

- PXIe-2527 Topology

Related information:

- NI-SWITCH Soft Front Panel

Improving Relay Life for PXIe-2527

You can improve relay life by monitoring relay usage, preventing high currents, and limiting flyback voltages.

Monitoring Relay Usage

- Use the `niSwitch Get Relay Count` VI or the `niSwitch_GetRelayCount` function to track relay usage. You can then analyze the relay counts on your PXIe-2527 to better manage the use of each relay.
- Edit test sequences to reduce the number of switching cycles.

Preventing High Currents from Damaging Relays

High inrush current can damage relays when switching with capacitive loads. This is because the inrush current needed to charge the capacitive load may be substantially higher than the steady-state current through the system. To mitigate damage from high currents, consider the following approaches:

- Use series resistance when switching with capacitive loads to prevent high inrush

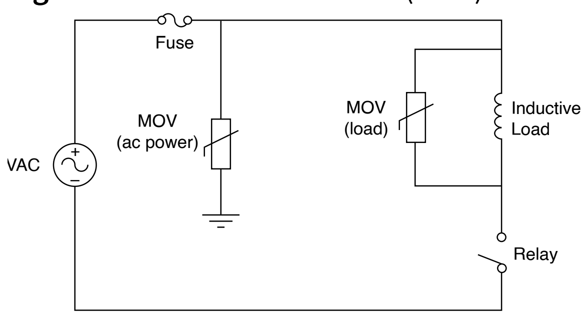
currents from damaging relays. Examples of capacitive loads include: DMMs, long cabling, and DUTs.
- Turn off power supplies or other voltage sources connected to the relay before switching to ensure that voltage levels are the same on both sides of the relay.

Limiting Flyback Voltages

Flyback voltages are large counter electromotive forces that occur when relays that are connected to inductive loads open. This counter electromotive force generates large voltage spikes across your relay contact because of the reactive energy stored in the load. The flyback voltages can severely damage the relay contacts and greatly shorten the relay life. To limit flyback voltages at your inductive load, consider either of the following options:

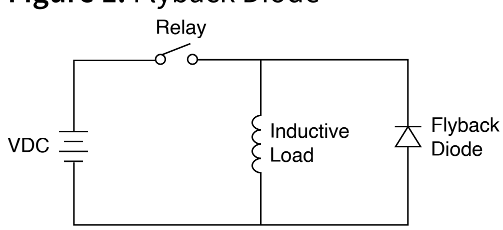
- Install a metal oxide varistor (MOV) for AC loads as shown in the following figure.

  Figure 1. Metal Oxide Varistor (MOV)

- Install a flyback diode for AC loads as shown in the following figure.

  Figure 1. Flyback Diode

Cleaning the PXIe-2527 System

NI recommends the following to clean and maintain your instrument's system:

- Clean the fan filters on the chassis regularly to prevent fan blockage and to ensure efficient air circulation. Cleaning frequency depends on the amount of use and the operating environment. For specific information about cleaning procedures and other recommended maintenance, refer to the chassis user documentation.

- Clean the hardware with a soft, nonmetallic brush. Make sure that the hardware is completely dry and free from contaminants before returning it to service.

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