Internet Support
E-mail: support@natinst.com
FTP Site: ftp.natinst.com
Web Address: http://www.natinst.com

Bulletin Board Support
BBS United States: 512 794 5422
BBS United Kingdom: 01635 551422
BBS France: 01 48 65 15 59

Fax-on-Demand Support
512 418 1111

Telephone Support (USA)
Tel: 512 795 8248
Fax: 512 794 5678

International Offices
Australia 03 9879 5166, Austria 0662 45 79 90 0, Belgium 02 757 00 20, Brazil 011 288 3336,
Canada (Ontario) 905 785 0085, Canada (Québec) 514 694 8521, Denmark 45 76 26 00, Finland 09 725 725 11,
France 01 48 14 24 24, Germany 089 741 31 30, Hong Kong 2645 3186, Israel 03 6120092, Italy 02 413091,
Japan 03 5472 2970, Korea 02 596 7456, Mexico 5 520 2635, Netherlands 0348 433466, Norway 32 84 84 00,
Singapore 2265886, Spain 91 640 0085, Sweden 08 730 49 70, Switzerland 056 200 51 51, Taiwan 02 377 1200,
United Kingdom 01635 523545

National Instruments Corporate Headquarters
6504 Bridge Point Parkway  Austin, Texas 78730-5039  USA  Tel: 512 794 0100

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Class A Compliance

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Federal Communications Commission

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Notices to User: Changes or modifications not expressly approved by National Instruments could void the user’s authority to operate the equipment under the FCC Rules.

This device complies with the FCC rules only if used with shielded interface cables of suitable quality and construction. National Instruments used such cables to test this device and provides them for sale to the user. The use of inferior or nonshielded interface cables could void the user’s authority to operate the equipment under the FCC rules.

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Canadian Department of Communications

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.
The following conventions are used in this manual.

**Angle brackets containing numbers separated by an ellipsis** represent a range of values associated with a port, bit, or signal name (for example, CH<0..15> stands for the signals CH0 through CH15).

This icon to the left of **bold italicized text** denotes a note, which alerts you to important information.

This icon to the left of **bold italicized text** denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.

This icon to the left of **bold italicized text** denotes a warning, which advises you of precautions to take to avoid being electrically shocked.

**Bold italic** text denotes a note, caution, or warning.

**Italic** text denotes variables, emphasis, a cross reference, or an introduction to a key concept. This font also denotes text from which you supply the appropriate word or value, as in CHx.
Contents

Chapter 1
Routing Signals with Your NI 2565

About the NI 2565 .........................................................................................................1-1
Triggers ......................................................................................................................1-1
High Voltage ...............................................................................................................1-2
Contact Protection .....................................................................................................1-2
Connecting Signals ....................................................................................................1-3
Front Connector .........................................................................................................1-3
Screw Terminal Accessory .........................................................................................1-4
Software Choices .......................................................................................................1-4
  NI-SWITCH Driver Software .................................................................................1-4
  National Instruments Application Software ...........................................................1-4
  Third-Party Software ..............................................................................................1-5

Chapter 2
NI 2565 Operation

Safety Instructions ........................................................................................................2-1
Functional Overview ..................................................................................................2-2
General Purpose Relays .............................................................................................2-4
Switch Control Circuitry .............................................................................................2-4
Random Scanning ........................................................................................................2-4
PXI Interface ...............................................................................................................2-5
  Triggers ....................................................................................................................2-5
    External Trigger Input .........................................................................................2-5
    Scanner Advanced ...............................................................................................2-6
    Modes ....................................................................................................................2-6
  Initiating Scanning .................................................................................................2-6
  Multicard Triggering ...............................................................................................2-7

Appendix A
Specifications

Appendix B
Customizing Your Card
Routing Signals with Your NI 2565

This manual describes the electrical and mechanical aspects of the NI 2565 general-purpose 16-channel 1form A mechanical relay switch card and contains information concerning its installation and operation.

About the NI 2565

This section summarizes the features and operation of the NI 2565 switch card. Refer to Chapter 2, NI 2565 Operation, for more complete details. In addition, refer to Appendix A, Specifications, for detailed specifications of the switch card.

The NI 2565 is a 16-channel general purpose relay switch card. The NI 2565 uses single-pole single-throw (also known as 1form A) relays. The board can switch voltages up to 250 VAC and 125 VDC, and currents up to 7 A AC and 5 A DC. You can use the National Instruments NI-SWITCH software included with your kit to configure and operate the NI 2565 switch card.

Triggers

Two triggers are used to handshake the NI 2565 switch with other PXI instruments. The Scanner Advanced trigger indicates when the card has closed all the necessary switches for the next scan and the switches have settled, or debounced.

The External Trigger Input trigger is sourced by another instrument or by software, and causes the NI 2565 to advance to the next entry in the scan list. The triggers can be routed to any of the PXI TTL triggers or to the PXI star trigger. If no external trigger input is available, you can have the software trigger the NI 2565 to advance to the next entry in the scan list.

Refer to Chapter 2, NI 2565 Operation, for more information on triggers.
High Voltage

The NI 2565 general purpose switch card is rated for reinforced insulation, 250 V, Cat. II. This classification provides safety insulation from any terminal to any other accessible part on the card. The switch card is rated for basic insulation, 250 V Cat. II, from any screw terminal connection to any other screw terminal connection.

Insulation coordination can be achieved only if transient overvoltages are controlled to specified levels. Refer to the Glossary for more information about Categories I and II overvoltage specifications.

⚠️ Caution  For additional safety, if you will be switching power lines or high voltage, place an F7A 250 V in-line fuse before the switch card.

Always disconnect the screw terminal plug from the front connector before removing the module from the PXI chassis.

Before applying high voltage to the module, always tighten the four captive screws to provide a ground connection from the module to the chassis.

⚠️ Warning  Do not exceed 250 V channel-to-channel or channel-to-ground. Any connections that exceed the maximum settings for the NI 2565 can result in an electrical shock hazard and damage to the switch card and any or all of the boards connected to the PXI backplane. National Instruments is NOT liable for any damages or injuries resulting from exceeding maximum voltage ratings. Refer to Appendix A, Specifications, for information.

Contact Protection

⚠️ Caution  When inductive loads are connected to the relays, a large counter electromotive force may occur at relay switching time due to the energy stored in the inductive load. These flyback voltages can severely damage the relay contacts and greatly shorten the life of the relay.

It is best to limit flyback voltages at your inductive load by installing a flyback diode for DC loads or a varistor for AC loads. Refer to Appendix B, Customizing Your Card, for more information on flyback voltage protection.
Connecting Signals

This section describes the signal connections to the NI 2565 module via the module front connector. This section also includes specifications and connection instructions for the signals on the NI 2565 module connectors.

Caution  Static electricity is a major cause of component failure. To prevent damage to the electrical components in the module, observe antistatic precautions whenever removing a module from the chassis or whenever working on a module.

Front Connector

The following diagram shows the pin assignments for the NI 2565 front connector. Table 1-1 describes the connector signals.

![Front Connector Pinout Assignments](image)

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH0</td>
<td>1</td>
<td>CH8</td>
</tr>
<tr>
<td>COM0</td>
<td>2</td>
<td>COM6</td>
</tr>
<tr>
<td>CH1</td>
<td>3</td>
<td>CH9</td>
</tr>
<tr>
<td>COM1</td>
<td>4</td>
<td>COM9</td>
</tr>
<tr>
<td>CH2</td>
<td>5</td>
<td>CH10</td>
</tr>
<tr>
<td>COM2</td>
<td>6</td>
<td>COM10</td>
</tr>
<tr>
<td>CH3</td>
<td>7</td>
<td>CH11</td>
</tr>
<tr>
<td>COM3</td>
<td>8</td>
<td>COM11</td>
</tr>
<tr>
<td>CH4</td>
<td>9</td>
<td>CH12</td>
</tr>
<tr>
<td>COM4</td>
<td>10</td>
<td>COM12</td>
</tr>
<tr>
<td>CH5</td>
<td>11</td>
<td>CH13</td>
</tr>
<tr>
<td>COM5</td>
<td>12</td>
<td>COM13</td>
</tr>
<tr>
<td>CH6</td>
<td>13</td>
<td>CH14</td>
</tr>
<tr>
<td>COM6</td>
<td>14</td>
<td>COM14</td>
</tr>
<tr>
<td>CH7</td>
<td>15</td>
<td>CH15</td>
</tr>
<tr>
<td>COM7</td>
<td>16</td>
<td>COM15</td>
</tr>
</tbody>
</table>

Figure 1-1. Front Connector Pinout Assignments

Table 1-1. Front Connector Signal Description

<table>
<thead>
<tr>
<th>Signal Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH&lt;0..15&gt;</td>
<td>Input/Output</td>
<td>Channels—Where signals are connected to the switch card.</td>
</tr>
<tr>
<td>COM&lt;0..15&gt;</td>
<td>Input/Output</td>
<td>Common—The common for the respective channel.</td>
</tr>
</tbody>
</table>
Screw Terminal Accessory

Your kit includes a screw terminal mini-combicon connector with protective housing and strain relief.

Software Choices

You have several options to choose from when programming your National Instruments switch card. You can use the NI-SWITCH driver software or National Instruments application software.

NI-SWITCH Driver Software

The NI-SWITCH instrument driver is an Interchangeable Virtual Instrument (IVI compliant instrument driver that is bundled with NI-SWITCH cards at no cost).

NI-SWITCH features a set of operations and attributes that exercise all the functionality of the switching hardware, including configuration, opening/closing, and scanning. In addition, NI-SWITCH comes with an interactive soft front panel and online documentation.

NI-SWITCH eliminates the need to understand complex register programming and interrupt handling in the Microsoft operating systems, and frees you to focus on creating your test system.

National Instruments Application Software

LabVIEW and LabWindows/CVI are innovative program development software packages for data acquisition and control applications. LabVIEW uses graphical programming, whereas LabWindows/CVI enhances traditional programming languages. Both packages include extensive libraries for data acquisition, instrument control, data analysis, and graphical data presentation. Using LabVIEW or LabWindows/CVI can significantly reduce the development time for your data acquisition and control application.

LabVIEW features interactive graphics, a state-of-the-art user interface, and a powerful graphical programming language. The LabVIEW NI-SWITCH VI Library, a series of virtual instruments (VIs) for using LabVIEW with National Instruments switch hardware, is included with the NI-SWITCH driver.
LabWindows/CVI features interactive graphics, a state-of-the-art user interface, and uses the ANSI standard C programming language. The LabWindows/CVI NI-SWITCH Library, a series of functions for using LabWindows/CVI with National Instruments switch hardware, is included with the NI-SWITCH driver.

**Third-Party Software**

The NI-SWITCH instrument driver also includes support files for Microsoft Visual C++ and Microsoft Visual Basic. See the NI-SWITCH readme file for version support information.
NI 2565 Operation

This chapter contains safety instructions and a functional overview of the NI 2565 switch card, and explains the operation of each functional unit making up the switch card.

Safety Instructions

Caution

Do not operate this instrument in an explosive atmosphere or where there may be flammable gases or fumes.

Equipment described in this document must be used in an Installation Category II environment per IEC 664. This category requires local level supply mains-connected installation.

To prevent safety hazards, the maximum voltage between any of the channel inputs and the ground of the computer should never exceed ±250 VDC or 250 Vrms.

Do not operate damaged equipment. The safety protection features built into this instrument can become impaired if the instrument becomes damaged in any way. If the instrument is damaged, do not use it until service-trained personnel can check its safety. If necessary, return the instrument to National Instruments for service and repair to ensure that its safety is not compromised.

Do not operate this instrument in a manner that contradicts the information specified in this document. Misuse of this instrument could result in a shock hazard.

Do not substitute parts or modify equipment beyond what is described in Appendix B, Customizing Your Card. Because of the danger of introducing additional hazards, do not install unauthorized parts or modify the instrument. Return the instrument to National Instruments for service and repair to ensure that its safety is not compromised.

Connections that exceed any of the maximum signal ratings on the NI 2565 can create a shock or fire hazard or can damage any or all of the devices connected to
the NI 2565. National Instruments is NOT LIABLE FOR ANY DAMAGES OR INJURIES resulting from incorrect signal connections.

Clean instrument and accessories by brushing off light dust with a soft, nonmetallic brush. Remove other contaminants with a stiff nonmetallic brush. The unit must be completely dry and free from contaminants before returning to service.

**Functional Overview**

The following block diagram illustrates the key functional components of the NI 2565 switch card module.

The major components of the NI 2565 module are as follows:

- General purpose relays
- Relay switch control circuitry
- Random scanning
- PXIbus interface
- Triggers
Figure 2-1. NI 2565 Module Block Diagram
General Purpose Relays

The general-purpose relay consists of 16 channels (CH0 through CH15). Each channel has a corresponding common (COM0 through COM15).

Each channel connects to the corresponding common by closing its relay. The relay name is based on the corresponding signal name. For example, the relay connecting CH9 to COM9 is CH9. You can have multiple channels connected to the corresponding commons simultaneously. See Appendix C, *Architecture Drawing*, for an illustration of the NI 2565 architecture.

The NI 2565 relays are single-side stable. When power is removed from the relay coil, the relay returns to its de-energized state. The de-energized state opens all the relays, disconnecting each channel signal from its corresponding common.

Switch Control Circuitry

The switch control circuitry (SCC) is responsible for opening and closing relays on the NI 2565. You can load commands for the SCC into memory storage using the driver software you received with your kit. Consult the online help or your software documentation for specific information on the appropriate commands. There are two reasons for storing the commands in memory before the SCC can process them:

- The operate and release times for the NI 2565 are 10 ms and 5 ms, respectively. Using memory storage, the software can send multiple commands to the SCC without having to wait for a relay action to complete.
- The memory is used to store a scan list necessary for hardware random scanning.

Random Scanning

The NI 2565 can perform random scanning. In random scanning, the switch card can open or close relays in any order.

The scan list is downloaded to onboard memory. Commands in the scan list can:

- Open or close relays
- Wait for an external trigger
Chapter 2  NI 2565 Operation

- Generate a scanner advanced trigger
- Generate a breakpoint interrupt

You can use the driver software to configure the switch card for continuous or one-time scanning. In continuous scanning, the switch card cycles through the scan list until you disable scanning. For one-time scanning, the switch card runs through the scan list only once.

You can also use software commands to clear the scan list or reset it to the beginning at any time.

The onboard control logic for the NI 2565 switch card gives you direct access to open and close the relays, and also the capability to download up to 1024 random scanning instructions. The software included with the card automatically configures the NI 2565 and downloads the scan list to hardware for you. The scan list itself downloads directly into the memory of the card to deliver the fastest scan possible with no controller intervention. You can configure the switch card to process the scan list once or to continuously loop through the scan list.

**PXI Interface**

The NI 2565 switch card has a PXI interface through which you can use your driver software to configure and control the card. The NI 2565 takes advantage of PXI features. It uses the PXI TTL triggers to synchronize scanning with a measurement device such as a National Instruments NI 4060 PXI digital multimeter (DMM).

**Triggers**

**External Trigger Input**

The NI 2565 can use an external trigger input to advance between scan setups in a scan list. Using the driver software, you can configure the switch card to route the external trigger from any of the PXI TTL trigger lines or the PXI star trigger. Alternatively, you can use a software command to trigger the switch card.

All external trigger lines are compatible with TTL voltage levels and are edge sensitive. The minimum pulse width from the PXI TTL triggers and PXI star trigger is 70 ns.
Scanner Advanced

The NI 2565 can generate a scanner advanced trigger to indicate when the switch card is set up and ready to take measurements. Using the driver software, you can configure the switch card to route the scanner advanced (SCANADV) trigger to any PXI TTL trigger line or to the PXI star trigger. You can configure the switch card to generate the SCANADV trigger when a relay has settled (or debounced).

Because the NI 2565 has open collector drives on the PXI TTL trigger lines, you can have multiple switch cards using the same trigger line in the multicard SCANADV mode.

Modes

SCANADV has two modes of operation. In its default mode, the SCANADV trigger asserts for 1 µs after the relay has debounced. You can also configure the switch card for handshaking mode, in which the SCANADV trigger goes high after a relay settles, and the SCANADV trigger goes low after the external trigger input asserts. You can use this handshaking mode for multicard scanning.

Note  The NI 2565 ignores external triggers when it is not in a wait-for-trigger state while scanning.

Initiating Scanning

When you use the NI 2565 to initiate a scan, make sure the measurement device is armed (waiting for trigger) before enabling scanning on the switch card. Enabling scanning causes the first switch(es) in the scan list to close and generates a scanner advanced trigger after the relay switches have settled or debounced.

When you use the measurement device to initiate a scan, make sure scanning is enabled on the NI 2565 before the measurement device starts to take measurements. This ensures that the switch card has the correct signal routed and that the switch card is waiting for an external trigger from the measurement device.

Always configure the triggers in a system before configuring the measurement device or the NI 2565 for scanning. When triggers are configured, a state change or pulse could occur on the trigger line. This is also possible when you reset the switch card.
Multicard Triggering

You can use multiple NI 2565 switch cards—or multiple other National Instruments switch cards such as the NI 2503—together in conjunction with an instrument such as a DMM. In multiple switch-card systems, be sure to identify one switch card as the master switch card.

All other switch cards for the system are identified as slave switch cards. The master switch card can route an external trigger from the front connector to a PXI backplane trigger. In addition, the master switch card can route the SCANADV trigger from the PXI backplane to either the front connector or another backplane trigger. This functionality makes it possible to wire external triggers from/to only one switch card in the system, which simplifies the wiring scheme.

>Note The NI 2565 does not support triggers on the front panel connector. If the measurement instrument is external to the chassis you must use a different National Instruments switch card, such as the NI 2503, as the master switch card.

For more information, refer to the NI-SWITCH Software User Manual.
Specifications

This appendix lists the specifications for the NI 2565 switch card. These specifications are typical at 25° C unless otherwise noted.

Input Characteristics

Number of Relays ........................................... 16

Common Mode Voltage
   Channel to Channel.......................... 250 V_{rms}/250 V_{DC}
   Channel to Earth ................................ 250 V_{rms}/250 V_{DC}

Maximum Switching Voltage
   AC .................................................. 250 V_{rms}
   DC .................................................. 125 V_{DC}

Maximum Switching Capacity per Channel
   DC .................................................. 5 A @ 30 V_{DC} (resistive load)
   DC .................................................. 3 A @ 30 V_{DC} (inductive load)
   AC .................................................. 7 A @ 250 V_{AC} (resistive load)
   AC .................................................. 5 A @ 250 V_{AC} (inductive load)

Maximum Switching Power per Channel ................................... 1750 VA, 150 W

Contact On Resistance (Initial) ............... 30 mΩ

Contact Material.................................. Gold-flash over silver alloy
Dynamic Characteristics

Maximum Switching Rate ...................... 5 cycles/s at rated load

Relay Operate Time (@ 20°C)
  Typical ............................................. 5 ms
  Maximum ......................................... 10 ms

Relay Release Time (@ 20°C)
  Typical ............................................. 4 ms
  Maximum ......................................... 5 ms

Expected Life
  Mechanical (@ 180 cpm) ................ 5 × 10^7 operations
  Electrical at Maximum
  Switching Capacity ......................... 10^5 operations

Caution
Exceeding the maximum switching capability will decrease the expected life of the NI 2565.

PXI Bus Interface

Slave

PXI Trigger Bus

Trigger Lines ........................................... 8
Star Trigger .............................................. 1

Power Requirement

+5 VDC
  Minimum (All Relays Opened) ........... 350 mA
  Maximum (All Relays Closed) .......... 1.4 A

Generated Wattage

All Relays Opened ................................. 1.75 W
All Relays Closed, 0.0 A per Channel .... 7.0 W
All Relays Closed, 5.0 A per Channel .... 21.5 W
All Relays Closed, 7.0 A per Channel .... 35.0 W
Physical

Dimensions............................................. 10 by 16 by 4 cm
(3.9 by 6.3 by 1.6 in)

Weight.................................................... 0.41 kg (0.9 lb)

I/O Connector......................................... 16 x 2 mini-combicon header

I/O Mating Connector............................ Two 1 x 16 mini-combicon connectors

Environment

Operating Temperature.........................0° to 50° C

Storage Temperature .........................−20° to 70° C

Relative Humidity.............................. 5% to 85% non-condensing

Maximum Altitude.............................. 2,000 m

Safety

Approved Usage..................................... UL-listed PXI or Compact PCI Chassis

Installation Category .........................Category II, Pollution Degree II

Reinforced Insulation Rating,
Channel to Earth.............................. 250 V

Basic Insulation Rating,
Channel to Channel............................ 250 V

Certifications and Compliances

CE Mark Compliance

This product meets applicable EU directives as follows:

Safety Isolation.......................... low-voltage safety,
EN 61010-1:1993

EMC Directive

Immunity................................. EN 50082-1:1992

Emissions................................. EN 55011:1991,
Group 1 Class A at 10 m
Customizing Your Card

This appendix describes options for customizing your NI 2565 card.

Flyback Voltage Protection

When inductive loads are connected to the relays, a large counter electromotive force may occur at relay switching time due to the energy stored in the inductive load. These flyback voltages can severely damage the relay contacts and greatly shorten the life of the relay.

You can limit flyback voltages at your inductive load by installing a flyback diode for DC loads or a varistor for AC loads. The NI 2565 module has solder connections for a diode or varistor. With this diode/varistor installed, you can limit flyback voltages when switching inductive loads.

⚠️ Caution  Before installing the diode or varistor in your module, ensure that no signals are connected to your module front connector.

Before installing your module in the PXI chassis, install the diode/varistor by performing the following steps. Refer to Figure B-1.
1. Ground yourself via a grounding strap or a ground connected to your PXI chassis. Properly grounding yourself prevents damage to your PXI module from electrostatic discharge.

2. Loosen the four screws that fasten the NI 2565 relay module board to the switch carrier module and front panel.

Figure B-1. NI 2565 Parts Locator Diagram
3. Remove the plastic insulator cover.
4. Lift up the card and disconnect the ribbon cable from the relay module.
5. Insert the diode/varistor into the appropriate location, labeled RVx, where x corresponds to the channel number.
6. Solder and trim the leads.
7. Reassemble the module.

**Replacing Relays**

The NI 2565 uses socketed relays, which are easy to replace when they fail. The electrical life of the relay is approximately $10^5$ operations when switching at the rated load.

You can order a relay replacement kit from National Instruments. The replacement kit includes 16 new relays. Follow these instructions to replace the failed relay. Refer to Figure B-1.

1. Ground yourself via a grounding strap or a ground connected to your PXI chassis. Properly grounding yourself prevents damage to your PXI module from electrostatic discharge.
2. Remove the four screws that fasten the NI 2565 relay module board to the switch carrier module and front panel.
3. Lift up the card as shown in Figure B-1.
4. Remove the relay by applying force in the direction shown in Figure B-2.
5. Before inserting the new relay, match the direction of the relay and the socket.
6. Insert the relay, making sure the relay is properly seated and the socket hooks the top of the relay.
7. Reassemble the module.
When removing the relay, apply force in the direction as shown.

1. Match the direction of relay and socket.
2. Seat the relay securely so that the socket hooks on the top surface of the relay.

Correct Incorrect

Figure B-2. Replacing a Relay
This appendix contains an architecture drawing for the NI 2565 switch card.

Relay names are based on the signal names. For example, the relay that connects CH9 to COM9 is named CH9.
Figure C-1. NI 2565 Switch Architecture
Common Questions

This appendix addresses common questions you may have while using your NI 2565 switch card.

What should I do if the software detects the board but the switches do not switch?

- Verify that the switches do not switch. Close your application program and then launch the soft front panel as described in the *Set up and Test* document you received with your kit. The soft front panel shows the state of each relay on the board. Try closing and opening the switches.
- Also be sure to check the return codes of the NI-SWITCH operation to ensure that there are no errors (negative value) or warnings (positive value). You can also use the NI-Spy utility to check for error codes.
- Finally, verify that your code is correct. For reference, see the examples described in the *NI-SWITCH Software User Manual*. The NI-SWITCH driver also ships with several examples in source code. Compare your algorithm to those in the examples.

What should I do if scanning does not work?

- First, ensure that you have configured the switch card and the instrument to match trigger lines. The output trigger of the instrument should connect to the trigger input of the switch card. In addition, the scanner advanced trigger of the switch card should be connected to the input trigger of the instrument.
- If the switch card is used to initiate the scan, make sure the DMM is waiting for a trigger before enabling scanning on the switch card. This is the recommended method for hardware scanning.
- If the DMM is used to initiate the scan, enable scanning on the switch card before configuring the DMM to start taking measurements.
- Also be sure to check the return codes of the NI-SWITCH operation to ensure that there are no errors (negative value) or warnings (positive value). You can also use the NI-Spy utility to check for error codes.
Finally, verify that your code is correct. For reference, see the examples described in the *NI-SWITCH Software User Manual*. The NI-SWITCH driver also ships with several examples in source code. Compare your algorithm to the ones in the examples.

**Do I need to program the switch card myself?**

The NI 2565 comes with the NI-SWITCH driver software, which exports the full functionality of the card. NI-SWITCH handles the complex issues of direct memory access, interrupts, and operating system interfacing.
Customer Communication

For your convenience, this appendix contains forms to help you gather the information necessary to help us solve your technical problems and a form you can use to comment on the product documentation. When you contact us, we need the information on the Technical Support Form and the configuration form, if your manual contains one, about your system configuration to answer your questions as quickly as possible.

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Computer brand____________ Model ___________________ Processor _____________________
Operating system (include version number) __________________________________________
Clock speed ______MHz   RAM _____MB   Display adapter __________________________
Mouse ___yes   ___no     Other adapters installed _______________________________________
Hard disk capacity _____MB   Brand_________________________________________________
Instruments used _________________________________________________________________
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National Instruments hardware product model _____________ Revision __________________
Configuration ___________________________________________________________________
National Instruments software product ___________________ Version _____________________
Configuration ___________________________________________________________________
The problem is: __________________________________________________________________
_______________________________________________________________________________
_______________________________________________________________________________
_______________________________________________________________________________
_______________________________________________________________________________
List any error messages: ___________________________________________________________
_______________________________________________________________________________
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The following steps reproduce the problem: __________________________________________
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Record the settings and revisions of your hardware and software on the line to the right of each item. Complete a new copy of this form each time you revise your software or hardware configuration, and use this form as a reference for your current configuration. Completing this form accurately before contacting National Instruments for technical support helps our applications engineers answer your questions more efficiently.

**National Instruments Products**

Hardware revision

Switching mode

List National Instruments Software Installed and Version

NI-SWITCH version

LabVIEW version

LabWindows/CVI version

Other National Instruments software version

Programming choice

**Other Products**

PXI chassis make and model

Microprocessor

Clock frequency or speed

Type of video board installed

Operating system version

Operating system mode

Programming language

Programming language version

Switch accessories

Instruments connected to switch
List All Boards in PXI Mainframe

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Glossary

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Meanings</th>
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<tr>
<td>n-</td>
<td>nano-</td>
<td>$10^{-9}$</td>
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<tr>
<td>µ-</td>
<td>micro-</td>
<td>$10^{-6}$</td>
</tr>
<tr>
<td>m-</td>
<td>milli-</td>
<td>$10^{-3}$</td>
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<tr>
<td>k-</td>
<td>kilo-</td>
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<tr>
<td>M-</td>
<td>mega-</td>
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<tr>
<td>G-</td>
<td>giga-</td>
<td>$10^{9}$</td>
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Numbers and Symbols

° degrees
Ω ohms
% percent
± plus or minus
1form A single-pole, single-throw relay

A

A amperes
AC alternating current
ANSI American National Standards Institute

B

breakpoint a specified point in program code where the program pauses to perform some action; a breakpoint interrupt can be added to a scan list for debugging or other special needs.
bus

the group of conductors that interconnect individual circuitry in a computer. Typically, a bus is the expansion vehicle to which I/O or other devices are connected. Examples of PC buses are the ISA and PCI bus.

C

celsius

Category I, Category II, CA T I, CA T II

These categories refer to different levels in impulse voltage. Category I is at the signal level, and refers to special equipment or parts of equipment, telecommunication, electronic, and so on, with smaller transient overvoltages than Category II. Category II is local level, and refers to such items as appliances and portable equipment. The impulse withstand voltages for each category are as follows:

Voltage Phase-to_Earth Category I Category II
150 V 800 V 1,500 V
300 V 1,500 V 2,500 V

channel

pin or wire lead on the multiplexer to which you apply or from which you read the analog or digital signal. Signals can be single-ended or differential.

Contact bounce

the intermittent switching that occurs when the movable metal parts of a relay make or break contact

D

dc

direct current

debounced

indicates when the contact bounce has ended. See contact bounce.

device

a plug-in board, card, or pad that can contain multiple channels and conversion devices. Some examples of devices are computers, multimeters, multiplexers, oscillators, operator interfaces, and counters.

digital multimeter

a multifunction meter used to make measurements such as voltage, current, resistance frequency, temperature, and so on

DIN

Deutsche Industrie Norme

diode

an electronic component that acts primarily as a one-way valve
| DMA | direct memory access—a method by which data can be transferred to/from computer memory from/to a device or memory on the bus while the processor does something else. DMA is the fastest method of transferring data to/from computer memory. |
| DMM | See digital multimeter. |
| drivers/driver software | software that controls a specific hardware device such as a switch card |
| E | external trigger—a voltage pulse from an external source that triggers an event such as A/D conversion |
| F | flyback voltage—the voltage spike generated the instant current stops flowing through an inductor |
| H | handshaking—the use of two trigger lines between two instruments, such as a switch and a DMM, to synchronize their actions |
| Hz | hertz—the number of scans read or updates written per second |
| I | inches |
| Interchangeable Virtual Instrument | an advanced architecture for instrument drivers that includes features such as simulation and state caching |
| I/O | input/output—the transfer of data to/from a computer system involving communications channels, operator interface devices, and/or data acquisition and control interfaces |
| ISA | Industry Standard Architecture |
| IVI | See Interchangeable Virtual Instrument. |
Glossary

M
MB megabytes of memory

N
NI-SWITCH an IVI-based instrument driver that supports the National Instruments line of switch cards

P
PXI PCI with extensions for instrumentation

R
random scanning scanning the channels in a mux in any order
relay a switch that connects or disconnects the signal to a common through the physical movement of a metal arm
RMA Return Material Authorization
rms root mean square—the square root of the average value of the square of the instantaneous signal amplitude; a measure of signal amplitude
RTD resistance temperature detector—a metallic probe that measures temperature based upon its coefficient of resistivity

S
s seconds
scan the data acquisition of signals connected to multiple channels of a multiplexer. Typically, the measurement device uses a trigger to advance the multiplexer to the next channel in the scan.
scan list a list of channels supplied to NI-SWITCH that indicates the order in which channels will be scanned
scanner advanced trigger
the trigger generated by the switch card when scanning. The trigger occurs after the switch card has closed a switch and the switch has settled.

sensor
a device that responds to a physical stimulus (heat, light, sound, pressure, motion, flow, and so on), and produces a corresponding electrical signal

settling time
the amount of time required for a voltage to reach its final value within specified limits

soft front panel
a graphical program included with NI-SWITCH that you can use to interactively control the switch

T
thermistor
a semiconductor sensor that exhibits a repeatable change in electrical resistance as a function of temperature. Most thermistors exhibit a negative temperature coefficient.

thermocouple
a temperature sensor created by joining two dissimilar metals. The junction produces a small voltage as a function of the temperature.

trigger
any event that causes or starts some form of data capture

TTL
Transistor-Transistor Logic

V

V
volts

varistor
an electrical resistor whose resistance depends on the applied voltage

VDC
volts, direct current

VI
virtual instrument—(1) a combination of hardware and/or software elements, typically used with a PC, that has the functionality of a classic stand-alone instrument (2) a LabVIEW software module (VI), which consists of a front panel user interface and a block diagram program
Glossary

W

W watts

wire data path between nodes
Index

A
antistatic cautions, 1-3
architecture drawing, C-1

B
BBS tech support, E-1

C
C++, 1-5
carrier module, B-2
Categories I and II overvoltage specifications, G-2
certifications and compliances, A-3
commands in scan list, capabilities, 2-4
common mode voltage, A-1
common questions, D-1
configuration
    NI-SWITCH driver software, 1-4
connecting signals, 1-3
contact
    material, A-1
    on resistance, A-1
    protection, 1-2
contact bounce, definition of, G-2
continuous scanning, 2-5
current switching capabilities, 1-1
customer communication, E-1
customizing, B-1

debounced
    See also contact bounce
    definition of, G-2
diagram, parts locator, B-2
dimensions, A-3
diode/varistor installation, B-1
DMM and multicard triggering, 2-7
dynamic characteristics, A-2

E
electronic services, E-1
expected life, A-2
external trigger, 2-7

F
flyback voltage, B-1
    definition of, G-3
flyback voltage protection, B-1
front connector, 1-3
    signal description of, 1-3
functional overview, 2-2
fuse, safety, 1-2

G
general-purpose relays, 2-4
generated wattage, A-2

H
high voltage, 1-2

I
I/O connector, A-3
I/O mating connector, A-3
initiating scanning, 2-6
input characteristics, A-1
Index

installation
  of diode varistor, B-1
  of NI 2565 module, B-1

insulation
  coordination of, 1-2
  rating, A-3
  reinforced, 1-2

insulator (in Parts Locator Diagram), B-2
interrupt handling, 1-4

IVI (Interchangeable Virtual Instrument), 1-4
definition of, G-3

LabVIEW, 1-4
LabVIEW NI-SWITCH VI Library, 1-4
LabWindows/CVI, 1-4
LabWindows/CVI NI-SWITCH Library, 1-5

master switch card, 2-7
maximum altitude (environment), A-3
maximum switching
  capacity per channel, A-1
  exceeding capability, A-2
  power per channel, A-1
  rate (dynamic characteristics), A-2
  voltage, A-1
modes, 2-6
module block diagram, 2-3
multicard triggering, 2-7

NI 2503 switch card, using in conjunction, 2-7
NI 2565
  about, 1-1
  architecture drawing, C-1
  common questions, D-1
  customizing, B-1

definition of, 1-1
expected life, A-2
front connector, 1-3
functional overview, 2-2
general purpose relays, 2-4
module block diagram, 2-3
operate and release times, 2-4
operation, 2-1
parts locator diagram, B-2
routing signals, 1-1
safety instructions, 2-1
switch architecture, C-2
technical support form, E-3, E-5
NI-Spy utility, D-1
NI-SWITCH driver software, 1-4, D-2
  features of, 1-4
NI-SWITCH Software User Manual, 2-7, D-1, D-2
number of relays, A-1

onboard control logic
  capabilities, 2-5
one-time scanning, 2-5
operate and release times, 2-4
operating temperature, A-3
operation, 2-1
overvoltage specifications, categories, G-2

parts locator diagram, B-2
pin assignments
  front connector, 1-3
power requirement, A-2
programming, 1-4
PXI interface, 2-5, A-2
PXI star trigger, 2-5, 2-6
PXI trigger bus, A-2
PXI TTL trigger, 2-5, 2-6
Index

R
random scanning, 2-4
reinforced insulation, 1-2
relative humidity (environment), A-3
relay
  1form A, 1-1
electrical life of, B-3
names, C-1
operate time, A-2
release time, A-2
relay and socket (in Parts Locator Diagram), B-2
replacing relays, B-3, B-4
ribbon cable, B-2
routing signals, 1-1

S
safety, 2-1, A-3, B-1
scan list
  clearing, resetting, 2-5
SCANADV trigger modes, 2-6
scanner advanced trigger, 1-1, 2-6
definition of, G-5
scanning
  common questions, D-1
  continuous, 2-5
  initiating, 2-6
  NI-SWITCH driver software, 1-4
  one-time, 2-5
  random, 2-4
SCC (switch control circuitry), 2-4
screw terminal accessory, 1-4
signals
  connections, 1-3
  single-pole single-throw relays, 1-1
slave switch card, 2-7
software choices, 1-4
data acquisition, 1-4
data analysis, 1-4
  graphical data presentation, 1-4
  instrument control, 1-4
National Instruments application software, 1-4
NI-SWITCH driver software, 1-4
third-party software, 1-5
solder location for flyback-voltage protection, B-2
specifications, A-1
  overvoltage specifications categories, G-2
storage temperature, A-3
storing commands in memory, reasons for, 2-4
switch architecture, C-2
switch card
  common questions, D-1
  master, 2-7
  programming, D-2
  slave, 2-7
switch control circuitry (SCC), 2-4

T
technical support
  bulletin board support, E-1
  configuration form, E-3
  customer communication, E-1
  documentation comment form, E-7
  e-mail support, E-2
  fax-on-demand support, E-2
  FTP support, E-1
  hardware and software configuration, E-5
  telephone and fax support, E-2
transient overvoltages, 1-2
triggers
  external trigger input, 1-1, 2-5, 2-7
  minimum pulse width from, 2-5
  multicard, 2-7
  on front panel connector, 2-7
  PXI star trigger, 2-5, 2-6
  PXI TTL, 2-5, 2-6
Index

SCANADV trigger modes, 2-6, 2-7
scanner advanced trigger, 1-1, 2-6
definition of, G-5
types used, 1-1
wait-for-trigger state, 2-6

U
user interface, 1-5

V
Visual Basic, 1-5
voltage switching capabilities, 1-1

W
wait-for-trigger state, 2-6
weight, A-3