SCXI-1161
User Manual

8-Channel Power Relay Module

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About This Manual

This manual describes the electrical and mechanical aspects of the SCXI-1161 and contains information concerning its operation and programming. The SCXI-1161 is a member of the National Instruments Signal Conditioning eXtensions for Instrumentation (SCXI) Series modules for the National Instruments data acquisition plug-in boards. This module switches and controls power signals. The SCXI-1161 operates as eight relay channels. Each channel is isolated and independently configurable.

This manual describes the installation, basic programming considerations, and theory of operation for the SCXI-1161.

Organization of This Manual

The *SCXI-1161 User Manual* is organized as follows:

- Chapter 1, *Introduction*, describes the SCXI-1161; lists the contents of your SCXI-1161 kit; describes the optional software, optional equipment, and custom cables; and explains how to unpack the SCXI-1161 kit.
- Chapter 2, *Configuration and Installation*, describes the SCXI-1161 jumper configurations, installation of the SCXI-1161 into the SCXI chassis, signal connections to the SCXI-1161, and cable wiring.
- Chapter 3, *Theory of Operation*, contains a functional overview of the SCXI-1161 module and explains the operation of each functional unit making up the SCXI-1161.
- Chapter 4, *Register Descriptions*, describes in detail the SCXI-1161 Module ID Register, the Data Register, and the Slot 0 registers.
- Chapter 5, *Programming*, contains a functional programming description of the SCXI-1161 and Slot 0.
- Appendix A, *Specifications*, lists the specifications for the SCXI-1161.
- Appendix B, *Rear Signal Connector*, describes the pinout and signal names for the SCXI-1161 50-pin rear signal connector, including a description of each connection.
- Appendix C, *SCXIbus Connector*, describes the pinout and signal names for the SCXI-1161 96-pin SCXIbus connector, including a description of each connection.
- Appendix D, *Contact Protection*, contains technical data on contact protection when you are switching inductive loads.
- Appendix E, *SCXI-1161 Cabling*, describes how to use and install the hardware accessories for the SCXI-1161.
- Appendix F, *Customer Communication*, contains forms you can use to request help from National Instruments or to comment on our products.

- The *Glossary* contains an alphabetical list and description of terms used in this manual, including abbreviations, acronyms, metric prefixes, mnemonics, and symbols.
- The *Index* contains an alphabetical list of key terms and topics in this manual, including the page where you can find each one.

Conventions Used in This Manual

The following conventions are used in this manual.

DIO board	DIO board refers to the National Instruments AT-DIO-32F, MC-DIO-24, MC-DIO-32F, NB-DIO-24, NB-DIO-32F, NB-DIO-96, PC-DIO-24, and PC-DIO-96 digital I/O data acquisition boards unless otherwise noted.
DIO-type board	DIO-type board refers to National Instruments data acquisition boards that have only digital inputs and outputs. These boards include the DIO-24, DIO-32F, and DIO-96 boards unless otherwise noted.
italic	Italic text denotes emphasis, a cross reference, or an introduction to a key concept.
Lab board	Lab board refers to the National Instruments Lab-LC, Lab-NB, Lab-PC, and Lab-PC+ boards unless otherwise noted.
MC	MC refers to the Micro Channel series computers.
MIO board	MIO board refers to the National Instruments AT-MIO-16, AT-MIO-16D, AT-MIO-16F-5, AT-MIO-16X, AT-MIO-64F-5, MC-MIO-16, NB-MIO-16, and NB-MIO-16X multichannel I/O data acquisition boards unless otherwise noted.
MIO-type board	MIO-type board refers to National Instruments data acquisition boards that have at least analog and digital inputs and outputs. These boards include the MIO boards, the Lab boards, and the PC-LPM-16 board unless otherwise noted.
`monospace`	Lowercase text in this font denotes text or characters that are to be literally input from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, variables, filenames, and extensions, and for statements and comments taken from program code.
NB	NB refers to the NuBus series computers.
PC	PC refers to the IBM PC/XT, the IBM PC AT, and compatible computers.
SCXIbus	SCXIbus refers to the backplane in the chassis. A signal on the backplane is referred to as the SCXIbus <signal name> line (or signal). The SCXIbus descriptor may be omitted when the meaning is clear. Descriptions of all SCXIbus signals are given in Appendix C, *SCXIbus Connector*.
Slot 0	Slot 0 refers to the power supply and control circuitry in the SCXI chassis.

Abbreviations, acronyms, metric prefixes, mnemonics, symbols, and terms are listed in the *Glossary*.

Related Documentation

The following documents contain information that you may find helpful as you read this manual:

- *AT-DIO-32F User Manual* (part number 320147-01)
- *AT-MIO-16 User Manual* (part number 320476-01)
- *AT-MIO-16D User Manual* (part number 320489-01)
- *AT-MIO-16F-5 User Manual* (part number 320266-01)
- *AT-MIO-16X User Manual* (part number 320488-01)
- *AT-MIO-64F-5 User Manual* (part number 320487-01)
- *Lab-LC User Manual* (part number 320380-01)
- *Lab-NB User Manual* (part number 320174-01)
- *Lab-PC User Manual* (part number 320205-01)
- *Lab-PC+ User Manual* (part number 320502-01)
- *MC-DIO-24 User Manual* (part number 320129-01)
- *MC-DIO-32F User Manual* (part number 320128-01)
- *MC-MIO-16 User Manual*, Revisions A to C (part number 320130-01)
- *MC-MIO-16 User Manual*, Revision D (part number 320560-01)
- *NB-DIO-24 User Manual* (part number 320094-01)
- *NB-DIO-32F User Manual* (part number 320095-01)
- *NB-DIO-96 User Manual* (part number 320384-01)
- *NB-MIO-16 User Manual* (part number 320295-01)
- *NB-MIO-16X User Manual* (part number 320157-01)
- *PC-DIO-24 User Manual* (part number 320288-01)
- *PC-DIO-96 User Manual* (part number 320289-01)
- *PC-LPM-16 User Manual* (part number 320287-01)
- *SCXI-1000/1001 User Manual* (part number 320423-01)

Customer Communication

National Instruments wants to receive your comments on our products and manuals. We are interested in the applications you develop with our products, and we want to help if you have problems with them. To make it easy for you to contact us, this manual contains comment and configuration forms for you to complete. These forms are in Appendix F, *Customer Communication*, at the end of this manual.

Chapter 1
Introduction

This chapter describes the SCXI-1161; lists the contents of your SCXI-1161 kit; describes the optional software, optional equipment, and custom cables; and explains how to unpack the SCXI-1161 kit.

Figure 1-1 shows the SCXI-1161 module.

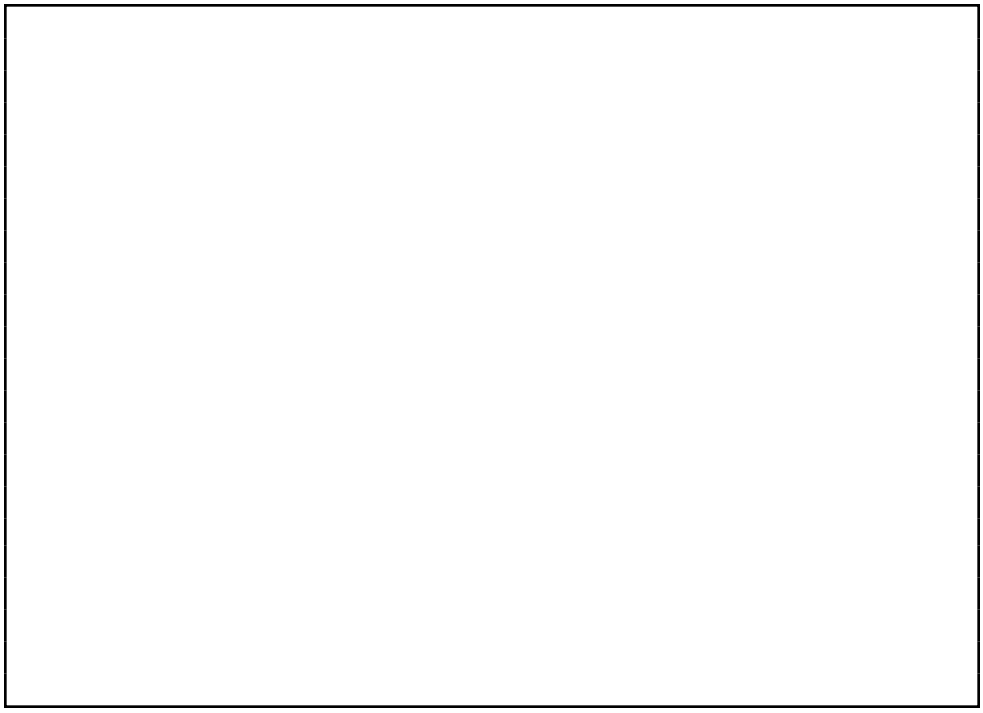


Figure 1-1. SCXI-1161 Relay Module

The SCXI-1161 consists of eight isolated single-pole double-throw (SPDT), or one form C, relay channels.

With the SCXI-1161, the SCXI chassis can serve as a controller or switcher in laboratory testing, production testing, and industrial-process monitoring.

The SCXI-1161 operates with full functionality with National Instruments MIO boards; Lab-NB, Lab-PC, Lab-PC+, Lab-LC, and PC-LPM-16 boards; and with the DIO-24, DIO-32F, and DIO-96 boards. You can control several SCXI-1161s in a single chassis with one data acquisition board, and in combination with other SCXI module types.

The SCXI-1161 has on-board screw terminals for easy signal attachment.

What Your Kit Should Contain

The contents of the SCXI-1161 kit (part number 776572-61) are listed as follows.

Kit Component	Part Number
SCXI-1161 module *SCXI-1161 User Manual*	182138-01 320514-01

If your kit is missing any of the components, contact National Instruments.

Optional Software

This manual contains complete instructions for directly programming the SCXI-1161. You can order separate software packages for controlling the SCXI-1161 from National Instruments.

When you combine the PC, AT, and MC data acquisition boards with the SCXI-1161, you can use LabVIEW for Windows or LabWindows for DOS. LabVIEW and LabWindows are innovative program development software packages for data acquisition and control applications. LabVIEW uses graphical programming, whereas LabWindows enhances Microsoft C and QuickBASIC. Both packages include extensive libraries for data acquisition, instrument control, data analysis, and graphical data presentation.

Your National Instruments data acquisition board is shipped with the NI-DAQ software. NI-DAQ has a library of functions that you can call from your application programming environment. These functions include routines for analog input (A/D conversion), buffered data acquisition (high speed A/D conversion), analog output (D/A conversion), waveform generation, digital I/O, counter/timer, SCXI, RTSI, and self-calibration. NI-DAQ maintains a consistent software interface among its different versions so you can switch between platforms with minimal modifications to your code.

You can also use the SCXI-1161, together with the PC, AT, and MC data acquisition boards, with NI-DAQ software for DOS/Windows/LabWindows. NI-DAQ software for DOS/Windows/LabWindows comes with language interfaces for Professional BASIC, Turbo Pascal, Turbo C, Turbo C++, Borland C++, and Microsoft C for DOS; and Visual Basic, Turbo Pascal, Microsoft C with SDK, and Borland C++ for Windows. NI-DAQ software for DOS/Windows/LabWindows® is on high-density 5.25 in. and 3.5 in. diskettes.

You can use the SCXI-1161, together with the NB Series data acquisition boards, with LabVIEW for Macintosh, a software system that features interactive graphics, a state-of-the-art user interface, and a powerful graphical programming language. The LabVIEW Data Acquisition VI Library, a series of VIs for using LabVIEW with National Instruments boards, is included with LabVIEW. The LabVIEW Data Acquisition VI Library is functionally equivalent to the NI-DAQ software for Macintosh.

You can also use the SCXI-1161, combined with the NB Series data acquisition boards, with NI-DAQ software for Macintosh. NI-DAQ software for Macintosh, which is shipped with all National Instruments Macintosh data acquisition boards, comes with language interfaces for

MPW C, THINK C, Pascal, and Microsoft QuickBASIC. Any language that uses Device Manager Toolbox calls can access NI-DAQ software for Macintosh.

Part numbers for these software products are as follows:

Software	Part Number
LabVIEW for Windows	776670-01
LabWindows	
Standard package	776473-01
Advanced Analysis Library	776474-01
Standard package with Advanced Analysis Library	776475-01
NI-DAQ software for DOS/Windows/LabWindows	776250-01
LabVIEW for Macintosh	776141-01
NI-DAQ software for Macintosh	776181-01

Optional Equipment

Equipment		Part Number
SCXI-1340 cable assembly		776574-40
SCXI-1341 Lab-NB/Lab-PC/Lab-PC+ cable assembly		776574-41
SCXI-1342 PC-LPM-16 cable assembly		776574-42
SCXI-1343 rear screw terminal adapter		776574-43
SCXI-1344 Lab-LC cable assembly		776574-44
SCXI-1348 DIO-32F cable assembly		776574-48
SCXI-1350 multichassis adapter		776575-50
SCXI-1351 one-slot cable extender		776575-51
Standard ribbon cable	0.5 m	180524-05
	1.0 m	180524-10
NB5 cable	0.5 m	181304-05
	1.0 m	181304-10

Refer to the *Signal Connections* section in Chapter 2, *Configuration and Installation*, and to Appendix E, *SCXI-1161 Cabling*, for additional information on cabling, connectors, and adapters.

Custom Cables

The SCXI-1161 rear signal connector is a 50-pin male ribbon-cable header. The manufacturer part number National Instruments uses for this header is as follows:

- AMP Inc. (part number 1-103310-0)

The mating connector for the SCXI-1161 rear signal connector is a 50-position polarized ribbon-socket connector with strain relief. National Instruments uses a polarized or keyed

connector to prevent inadvertent upside-down connection to the SCXI-1161. Recommended manufacturer part numbers for this mating connector are as follows:

- Electronic Products Division/3M (part number 3425-7650)
- T&B/Ansley Corporation (part number 609-5041CE)

Standard 50-conductor 28 AWG stranded ribbon cables that work with these connectors are as follows:

- Electronic Products Division/3M (part number 3365/50)
- T&B/Ansley Corporation (part number 171-50)

Unpacking

Your SCXI-1161 module is shipped in an antistatic package to prevent electrostatic damage to the module. Several components on the module can be damaged by electrostatic discharge. To avoid such damage in handling the module, take the following precautions:

- Touch the antistatic package to a metal part of your SCXI chassis before removing the module from the package.
- Remove the module from the package and inspect the module for loose components or any other sign of damage. Notify National Instruments if the module appears damaged in any way. *Do not* install a damaged module into your SCXI chassis.

Chapter 2
Configuration and Installation

This chapter describes the SCXI-1161 jumper configurations, installation of the SCXI-1161 into the SCXI chassis, signal connections to the SCXI-1161, and cable wiring.

Module Configuration

The SCXI-1161 includes five jumpers that are shown in Figures 2-1 and 2-2, the general and detailed parts locator diagrams.

Figure 2-1. SCXI-1161 General Parts Locator Diagram

Figure 2-2. Detailed Parts Locator Diagram

The following warnings contain important safety information concerning hazardous voltages.

Warnings: *Do not operate the module in an explosive atmosphere or where there may be flammable gases or fumes.*

Keep away from live circuits. Do not remove equipment covers or shields unless you are trained to do so. If signal wires are connected to the module, dangerous voltages may exist even when the equipment is turned off. To avoid dangerous electrical shock, do not perform procedures involving cover or shield removal unless you are qualified to do so.

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

Do not substitute parts or modify equipment. Because of the danger of introducing additional hazards, do not install unauthorized parts or modify the module. Return the module to National Instruments for service and repair to ensure that its safety features are not compromised.

When using the module with high common-mode voltages, you *must* insulate your signal wires appropriately. National Instruments is *not* liable for any damages or injuries resulting from inadequate signal wire insulation.

When connecting or disconnecting signal lines to the SCXI-1161 screw terminals, make sure the lines are powered off. Potential differences between the lines and the SCXI-1161 ground create a shock hazard while you connect the lines.

Connections to any terminal, including power signals to ground and vice versa, that exceed any of the maximum signal ratings on the SCXI-1161 can damage any or all of the boards connected to the SCXI chassis, the host computer, and the SCXI-1161 module. National Instruments *is not liable for any damages or injuries* resulting from incorrect signal connections.

If high voltages (≥42 Vrms) are present, *you must connect the safety earth ground to the strain relief tab*. This complies with UL 1244 and protects against electric shock when the module is not connected to the chassis. To connect the safety earth ground to the strain relief tab, run an earth ground wire in the cable from the signal source to the module. National Instruments is *not* liable for any damages or injuries resulting from inadequate safety earth ground connections.

Jumper Use

Use the jumpers as follows:

- Jumper W1 connects a pullup resistor to the SERDATOUT signal on the rear signal connector.
- Jumper W2 carries the SCXIbus MISO line, after buffering, to the SERDATOUT signal on the rear signal connector.
- Jumpers W3, W4, and W5 select whether the SCXI-1161 is to be connected to a DIO-type board or to an MIO-type board. DIO-type boards are National Instruments boards that have only digital inputs and outputs. These boards include the DIO-24, DIO-32F, and DIO-96. MIO-type boards are National Instruments boards that have at least analog and digital inputs and digital outputs. These boards consist of MIO-16 boards; Lab-NB, Lab-PC, Lab-PC+, and Lab-LC boards; and PC-LPM-16 boards. If nothing is cabled to the rear signal connector of the SCXI-1161, the positions of these jumpers is irrelevant.

Further configuration of the board is software controlled and is described later in this chapter.

Jumper Configuration

All five jumpers on the SCXI-1161 are for digital communication between the data acquisition board and the SCXI-1161 module. Only one module per chassis is connected to the data acquisition board, which allows communication with all other modules. On the other modules, the jumper settings are irrelevant.

The SCXI-1161 has two jumpers, W1 and W2, for communication between the SCXI-1161 and the data acquisition board. Jumpers W3, W4, and W5 indicate to the module what type of data acquisition board will be connected to the module rear signal connector.

Jumper W1

Position 1 connects a 2.2 kΩ pullup resistor to the SERDATOUT line. This is the factory-default setting. Position 3 disconnects the pullup resistor from the SERDATOUT line.

Jumper W2

Position 1 connects the SCXIbus MISO line, after buffering, to the SERDATOUT pin of the rear signal connector. This is the factory-default setting. In this setting, along with the proper setting of jumper W1, the data acquisition board can read the Module ID Register of the SCXI-1161. See the *Timing Requirements and Communication Protocol* section later in this chapter, and Chapter 4, *Register Descriptions*, for information on reading the Module ID Register. See Appendix E, *SCXI-1161 Cabling*, for the pin equivalences of the SCXI-1161 rear signal connector and the data acquisition board I/O connector.

Position 3 disconnects SERDATOUT from the SCXIbus MISO line.

Using Jumpers W1 and W2

If you do not connect a module to a data acquisition board, the positions of jumpers W1 and W2 are irrelevant. Jumpers W1 and W2 give the data acquisition board access to the MISO line on the backplane. You can use the MISO line to read the Module ID Register of modules. National Instruments software does not use this ability. You must indicate to the software which module is in which slot.

An open-collector driver drives the SERDATOUT line. An open-collector driver actively drives low or goes to a high-impedance state, relying on a pullup resistor to make the signal line go high. When using a single chassis, set both jumpers W1 and W2 to position 1 on the SCXI-1161 that is connected to the data acquisition board. In this setting, the module drives MISO to SERDATOUT and connects the necessary pullup resistor to the SERDATOUT line. When using multiple chassis, set jumper W2 to position 1 on all of the SCXI-1161s that are cabled to the data acquisition board. Set jumper W1 to position 1 on only one of the SCXI-1161s that are cabled to the data acquisition board. It does not matter which of the SCXI-1161s that are cabled to the data acquisition board has the pullup connected. Set jumper W1 to position 3 on all of the other SCXI-1161 modules that are cabled to the data acquisition board. If too many pullup resistors are attached to the SERDATOUT line, the drivers cannot drive the line low. Tables 2-1 and 2-2 list the description and configuration of the jumper settings.

Table 2-1. Configuration of Jumpers W1 and W2

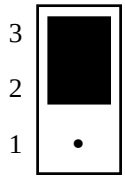
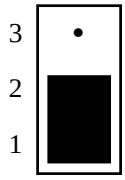
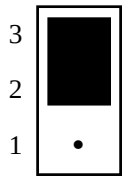
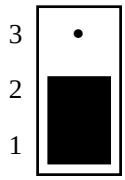
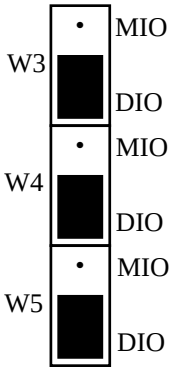
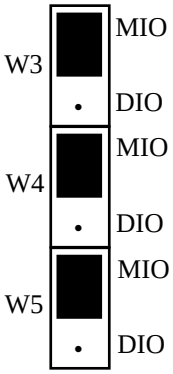
Jumper	Description	Configuration
W1	Parking position	
W1	Factory setting–Connects pullup to SERDATOUT	
W2	Parking position	
W2	Factory setting–Connects MISO to SERDATOUT	

Table 2-2. Configuration of Jumpers W3, W4, and W5 for DIO-Type and MIO-Type Boards

Jumper	Configuration for DIO-Type Board (Factory Setting)	Configuration for MIO-Type Board
W3		
W4		
W5		

Jumpers W3, W4, and W5

You can use two types of data acquisition boards with the SCXI-1161–DIO-type boards and MIO-type boards. All three jumpers have labels indicating the DIO and the MIO configurations. If you want to use the SCXI-1161 with a DIO-type board, place all three jumpers in the DIO position, the factory setting. If you want to use the SCXI-1161 with an MIO-type board, place all three jumpers in the MIO position. If nothing is cabled to the SCXI-1161 rear signal connector, the positions of these jumpers are irrelevant.

Hardware Installation

You can install the SCXI-1161 in any available SCXI chassis. After you have made any necessary changes and have verified and recorded the jumper settings on the form in Appendix F, *Customer Communication*, you are ready to install the SCXI-1161. The following are general installation instructions; consult the user manual or technical reference manual of your SCXI chassis for specific instructions and warnings.

1. Turn off the computer that contains the data acquisition board or disconnect the data acquisition board from your SCXI chassis.

2. Turn off the SCXI chassis. Do not insert the SCXI-1161 into a chassis that is turned on.

3. After you have connected your signals to the screw terminals, insert the SCXI-1161 into the board guides. Gently guide the module into the back of the slot until the connectors make good contact. If you have already installed a cable assembly in the rear of the chassis, you must firmly engage the module and cable assembly; however, do not *force* the module into place.

4. Screw the front mounting panel of the SCXI-1161 to the top and bottom threaded strips of your SCXI chassis.

5. If you will connect this module to an MIO-16 or a DIO-24 data acquisition board, attach the connector at the metal end of the SCXI-1340 cable assembly to the rear signal connector on the SCXI-1161 module. Screw the rear panel to the rear threaded strip. Attach the loose end of the cable to the data acquisition board.

   Note: For installation procedures with other SCXI accessories and data acquisition boards, consult Appendix E, *SCXI-1161 Cabling.*

6. Check the installation.

7. Turn on the SCXI chassis.

8. Turn on the computer or reconnect the data acquisition board to your chassis.

The SCXI-1161 module is installed and ready for operation.

Signal Connections

This section describes the signal connections to the SCXI-1161 board via the SCXI-1161 screw terminals and rear signal connector, and includes specifications and connection instructions for the SCXI-1161 connector signals.

Warning: Connections to any terminal that exceed any of the maximum ratings of input signals on the SCXI-1161 can damage the SCXI-1161 module and the SCXIbus. Maximum input ratings for each signal are given in this chapter under the discussion of that signal. National Instruments is *not* liable for any damages resulting from signal connections that exceed these ratings.

Screw Terminal Connections

The SCXI-1161 has 24 screw terminals for easy signal connection to the inputs. Each input consists of a common (COM) position, a normally closed (NC) position, and a normally open (NO) position. At power up and at reset, the SCXI-1161 COM positions on all the channels connect to the NC positions.

All contacts have a working common-mode voltage of 250 VAC or VDC. The contact-to-contact breakdown voltage is 750 Vrms. The contact-to-coil breakdown voltage is 1,500 Vrms. Please refer to the module specifications listed in Appendix A, *Specifications*, for further details before connecting the signals to the relay contacts.

Contact Protection for Inductive Load Connections

When inductive loads are connected to the relays, a large counter-electromotive force can occur at relay switching time because of 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 these flyback voltages at your inductive load by installing, across your inductive load, a flyback diode for DC loads (see Figure 2-3) or an MOV for AC loads. Refer to Appendix D, *Contact Protection*, for further details.

In addition, the module has pads on which you can place an arc suppressor protection circuit to limit the voltage spike generated during the switching of inductive loads. These pads are between the COM position and the NO position and between the COM position and the NC position of the relays.

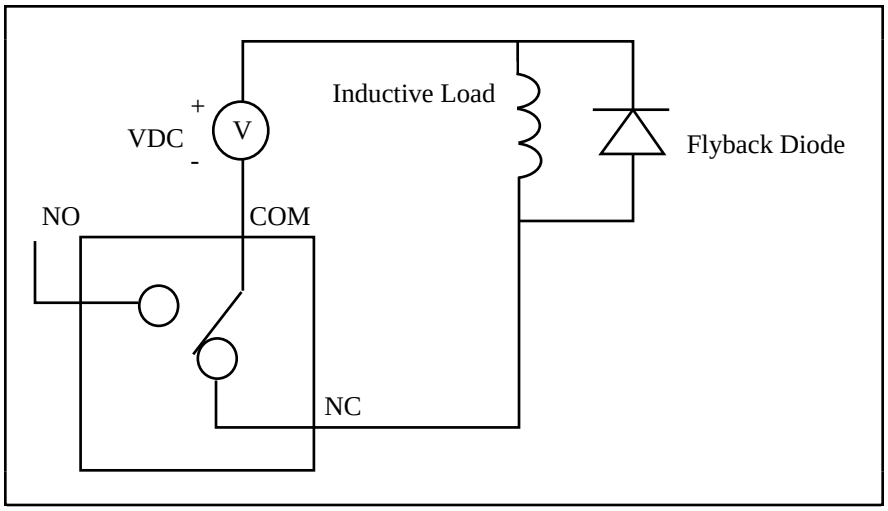


Figure 2-3. Contact Protection Using a Flyback Diode for DC Inductive Loads

To determine where to place each arc suppressor, refer to Tables 2-3 and 2-4, which indicate the channel and suppressor pad assignments.

Table 2-3. Arc Suppressor Placement, COM to NO

COM to NO Channel Number	Transient Voltage Suppressor Reference Designator
0	VR1
1	VR3
2	VR5
3	VR7
4	VR9
5	VR11
6	VR13
7	VR15

Table 2-4. Arc Suppressor Placement, COM to NC

COM to NC Channel Number	Transient Voltage Suppressor Reference Designator
0	VR2
1	VR4
2	VR6
3	VR8
4	VR10
5	VR12
6	VR14
7	VR16

Figure 2-4 shows how to connect a transient voltage suppressor for AC and DC inductive loads.

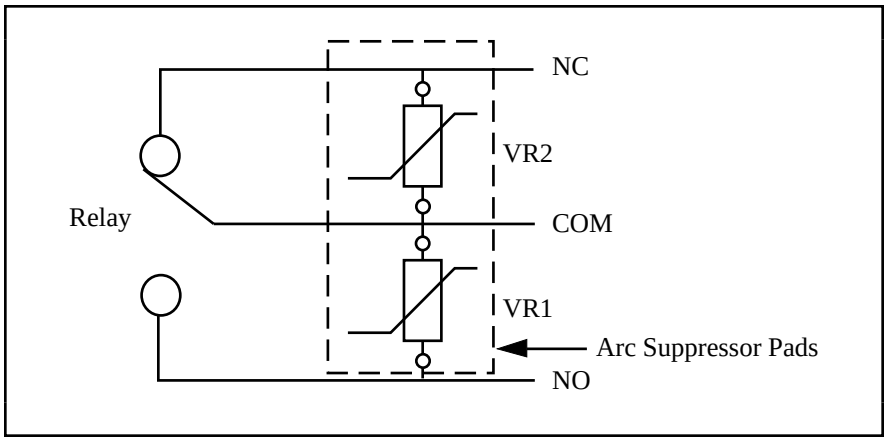


Figure 2-4. Arc Suppressor Pad Locations

The following warnings contain important safety information concerning hazardous voltages.

Warnings: When using the module with high common-mode voltages, you *must* insulate your signal wires appropriately. National Instruments is *not* liable for any damages or injuries resulting from inadequate signal wire insulation.

When connecting or disconnecting signal lines to the SCXI-1161 screw terminals, make sure the lines are powered off. Potential differences between the lines and the SCXI-1161 ground create a shock hazard while you connect the lines.

Connections to any terminal, including power signals to ground and vice versa, that exceed any of the maximum signal ratings on the SCXI-1161 can damage any or all of the boards connected to the SCXI chassis, the host computer, and the SCXI-1161 module. National Instruments *is not liable for any damages or injuries* resulting from incorrect signal connections.

If high voltages (≥42 Vrms) are present, *you must connect the safety earth ground to the strain relief tab*. This complies with UL 1244 and protects against electric shock when the module is not connected to the chassis. To connect the safety earth ground to the strain relief tab, run an earth ground wire in the cable from the signal source to the module. National Instruments is *not* liable for any damages or injuries resulting from inadequate safety earth ground connections.

Signal Connection

To connect the signal to the screw terminals, use the following procedure:

1. Remove the grounding screw of the top cover.
2. Snap out the top cover of the shield by placing a screwdriver in the groove at the bottom of the module.

3. Install contact protection, preferably across your load, as described in the previous section, if your load is inductive.

4. Slide the signal wires one at a time through the front panel strain relief. You can use additional insulation or padding if necessary.

5. Connect the wires to the screw terminals.

6. Tighten the strain relief by tightening the larger screws.

7. Snap the top cover back in place.

8. Replace the grounding screw to ensure proper shielding.

Rear Signal Connector

Note: If you will use the SCXI-1161 with a National Instruments data acquisition board and cable assembly, you do not need to read the remainder of this chapter. If you will also use the SCXI-1180 feedthrough panel, the SCXI-1343 rear screw terminal adapter, or the SCXI-1351 one-slot cable extender with the SCXI-1161, read this section.

Figure 2-5 shows the pin assignments for the SCXI-1161 rear signal connector.

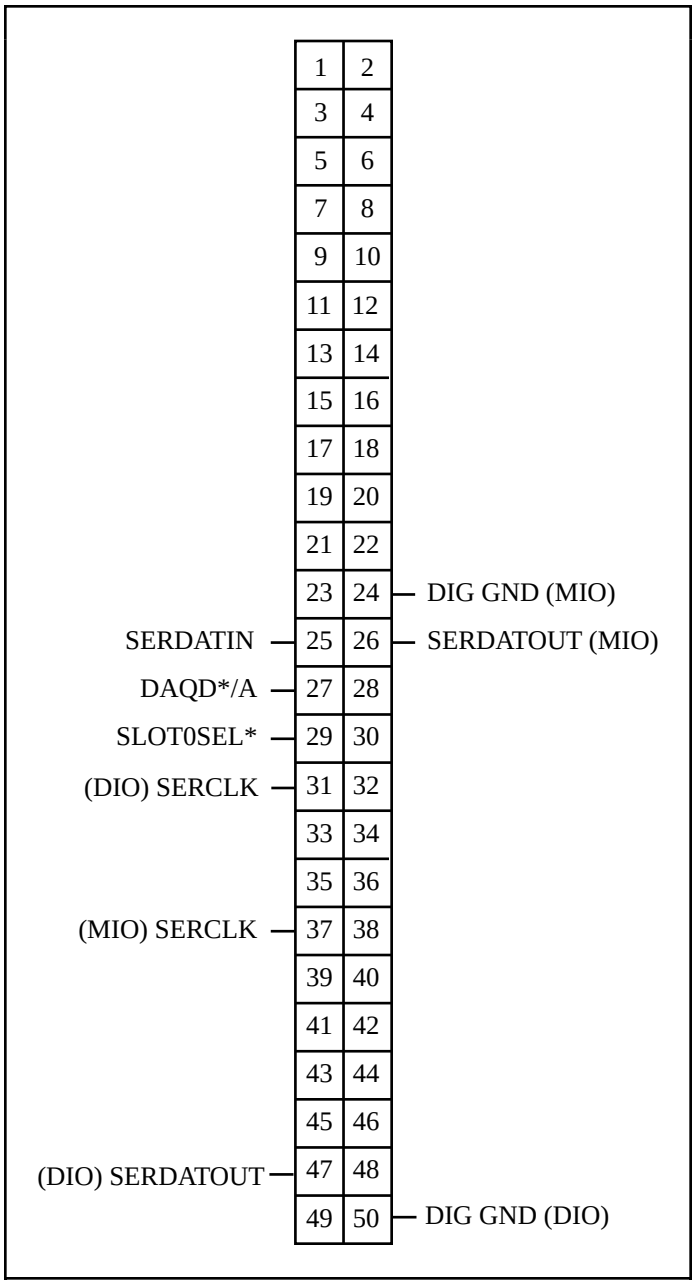


Figure 2-5. SCXI-1161 Rear Signal Connector Pin Assignment

Rear Signal Connector Signal Descriptions

Pin	Signal Name	Description
24 or 50	DIG GND	Digital Ground – Supplies the reference for data acquisition board digital signals and is tied to the module digital ground. Pin 50 is for DIO-type boards. Pin 24 is for MIO-type boards. Jumper W3 selects the pin.
25	SERDATIN	Serial Data In – Taps into the SCXIbus MOSI line to provide serial input data to a module or Slot 0.
26 or 47	SERDATOUT	Serial Data Out – Taps into the SCXIbus MISO line to accept serial output data from a module. Pin 47 is for DIO-type boards. Pin 26 is for MIO-type boards. Jumper W5 selects the pin.
27	DAQD*/A	Data Acquisition Board Data/Address Line – Taps into the SCXIbus D*/A line to indicate to the module whether the incoming serial stream is data or address information.
29	SLOT0SEL*	Slot 0 Select – Taps into the SCXIbus INTR* line to indicate whether the information on MOSI is sent to a module or to Slot 0.
31 or 37	SERCLK	Serial Clock – Taps into the SCXIbus SPICLK line to clock the data on the MOSI and MISO lines. Pin 31 is for DIO-type boards. Pin 37 is for MIO-type boards. Jumper W4 selects the pin.

* Indicates active low.

All other pins are not connected.

See the *Timing Requirements and Communication Protocol* section later in this chapter for more detailed information on timing.

The signals on the rear signal connector are digital I/O signals. The following section describes signal connection guidelines for each of these groups.

Digital I/O Signal Connections

Pins 24 through 27, 29, 31, 37, 47, and 50 are the digital I/O lines of the rear signal connector. The lines are divided into three categories–the digital input signals, the digital output signals, and the digital timing signals.

The digital input signals are pins 24 or 50, 25, 27, 29, and 31 or 37. The data acquisition board uses these pins to configure the SCXI module that the data acquisition board controls.

Each digital line emulates the SCXIbus communication signals as follows:

- Pin 24 or 50 is the digital ground reference for the data acquisition board digital signals and is tied to the module digital ground via jumper W3. Pins 24 and 50 are *not* tied together.
  - Pin 24 is for MIO-type boards when SCXI-1161 jumpers W3, W4, and W5 are in the MIO position.
  - Pin 50 is for DIO-type boards when SCXI-1161 jumpers W3, W4, and W5 are in the DIO position.
- Pin 25 is SERDATIN and is equivalent to the SCXIbus MOSI serial data input line.
- Pin 27 is DAQD*/A and is equivalent to the SCXIbus D*/A line. It indicates to the module whether the incoming serial stream on SERDATIN is data (DAQD*/A = 0) or address (DAQD*/A = 1) information.
- Pin 29 is SLOT0SEL* and is equivalent to the SCXIbus INTR* line. It indicates whether the data on the SERDATIN line is being sent to Slot 0 (SLOT0SEL* = 0) or to a module (SLOT0SEL* = 1).
- Pin 31 or 37 is SERCLK and is equivalent to the SCXIbus SPICLK line. These pins clock the serial data on the SERDATIN line into the module registers. Pins 31 and 37 are *not* tied together.
  - Pin 31 is for DIO-type boards when SCXI-1161 jumpers W3, W4, and W5 are in the DIO position.
  - Pin 37 is for MIO-type boards when SCXI-1161 jumpers W3, W4, and W5 are in the MIO position.

The digital output signal is pin 26 or 47:

- Pin 26 or 47 is SERDATOUT and is equivalent to SCXIbus MISO when jumper W2 is in position 1. Pins 26 and 47 are *not* tied together.
  - Pin 26 is for MIO-type boards when SCXI-1161 jumpers W3, W4, and W5 are in the MIO position.
  - Pin 47 is for DIO-type boards when SCXI-1161 jumpers W3, W4, and W5 are in the DIO position.

When you configure the SCXI-1161 for an MIO-type board, the digital I/O signals of the SCXI-1161 match the digital I/O lines of the MIO-type board. When you use the SCXI-1161 with an SCXI-1341, SCXI-1342, or SCXI-1344 cable assembly, the SCXI-1161 signals match the digital lines of the Lab-NB/Lab-PC/Lab-PC+ boards, the PC-LPM-16 board, and the Lab-LC board, respectively. When you configure the SCXI-1161 for a DIO-type board, the digital I/O signals of the SCXI-1161 match the digital I/O lines of the DIO-24 and DIO-96 boards. When you use the SCXI-1161 with an SCXI-1348 cable assembly, the SCXI-1161 signals match the digital lines of the DIO-32F board.

Table 2-4 lists the pin equivalences. For more information, consult Appendix E, *SCXI-1161 Cabling*.

Table 2-5. SCXIbus to SCXI-1161 Rear Signal Connector to Data Acquisition Board Pin Equivalences

SCXIbus Line	SCXI-1161 Rear Signal Connector	MIO Boards	Lab-NB/Lab-PC/ Lab-PC+/Lab-LC	PC-LPM-16	DIO-24	DIO-96	DIO-32F
MOSI	SERDATIN	ADIO0	PB4	DOUT4	PB3	APB3	DIOB3
D*/A	DAQD*/A	ADIO1	PB5	DOUT5	PB2	APB2	DIOB2
INTR*	SLOT0SEL*	ADIO2	PB6	DOUT6	PB1	APB1	DIOB1
SPICLK	SERCLK	EXTSTROBE*	PB7	DOUT7	PB0	APB0	DIOB0
MISO	SERDATOUT	BDIO0	PC1	DIN6	PA0	APA0	DIOA0

The following specifications and ratings apply to the digital I/O lines.

Absolute maximum voltage input rating — 5.5 V with respect to DIG GND

Digital input specifications (referenced to DIG GND):

V_{IH} input logic high voltage — 2 V minimum
V_{IL} input logic low voltage — 0.8 V maximum

I_I input current leakage — ±1 μA maximum

Digital output specifications (referenced to DIG GND):

V_{OH} output logic high voltage — 3.7 V minimum at 4 mA maximum
V_{OL} output logic low voltage — 0.4 V maximum at 4 mA maximum

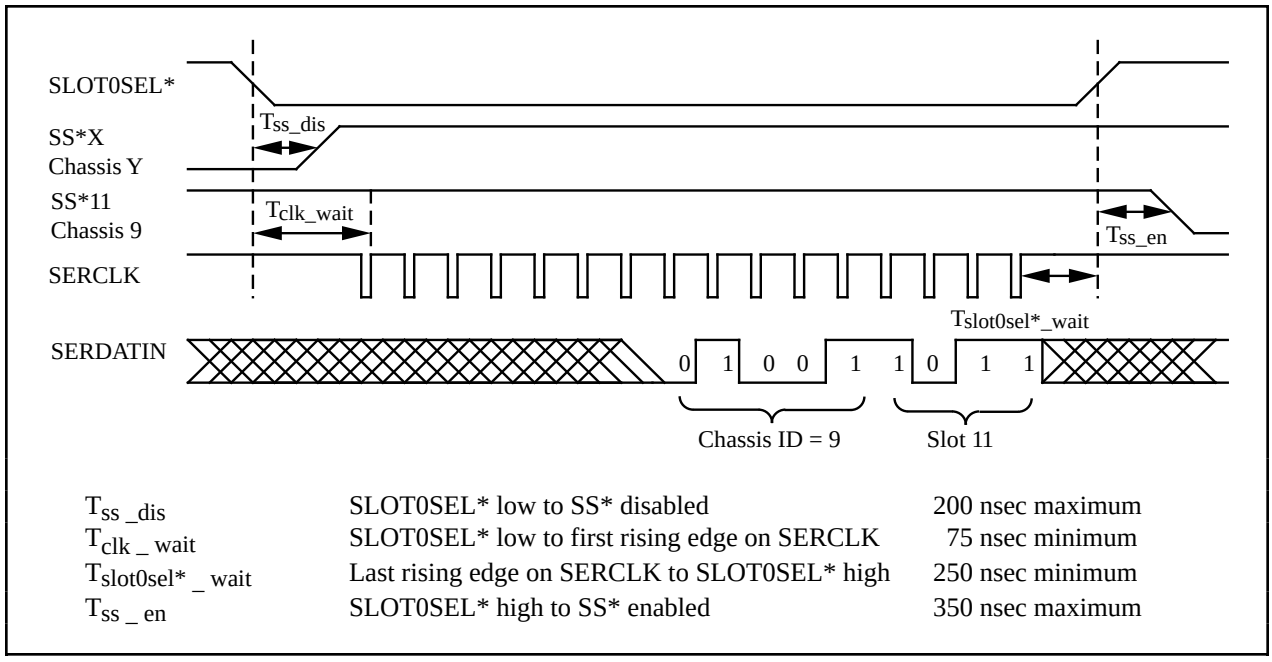
Timing Requirements and Communication Protocol

Communication Signals

This section describes the methods for communicating on the Serial Peripheral Interface (SPI) bus and the timing requirements. The communication signals are SERDATIN, DAQD*/A, SLOT0SEL*, SERDATOUT, and SERCLK. Furthermore, Slot 0 produces SS* according to data acquisition board programming, so this section also discusses SS* timing relationships. For information on the Slot 0 Slot-Select Register, consult Chapter 4, *Register Descriptions*.

The data acquisition board writes a slot-select number to Slot 0 to determine to which slot it will talk. In the case of an SCXI-1001 chassis, this write also determines to which chassis the data acquisition board will talk.

Use the following procedure for selecting a slot in a particular chassis. Figure 2-6 illustrates the timing of this procedure with the example of selecting Slot 11 in Chassis 9. Notice that the factory-default chassis address for the SCXI-1000 is address 0. For information on changing the address of your chassis, consult the *SCXI-1000/1001 User Manual*. An SCXI-1000 chassis will respond to any chassis number.



T_{ss_dis}	SLOT0SEL* low to SS* disabled	200 nsec maximum
T_{clk_wait}	SLOT0SEL* low to first rising edge on SERCLK	75 nsec minimum
$T_{slot0sel*\_wait}$	Last rising edge on SERCLK to SLOT0SEL* high	250 nsec minimum
T_{ss_en}	SLOT0SEL* high to SS* enabled	350 nsec maximum

Figure 2-6. Slot-Select Timing Diagram

To write the 16-bit slot-select number to Slot 0, follow these steps:

1. Initial conditions:

   SERDATIN = don't care.
   DAQD*/A = 1.
   SLOT0SEL* = 1.
   SERCLK = 1.

2. Clear SLOT0SEL* to 0. This deasserts all SS* lines to all modules in all chassis.

3. For each bit, starting with the MSB, perform the following actions:

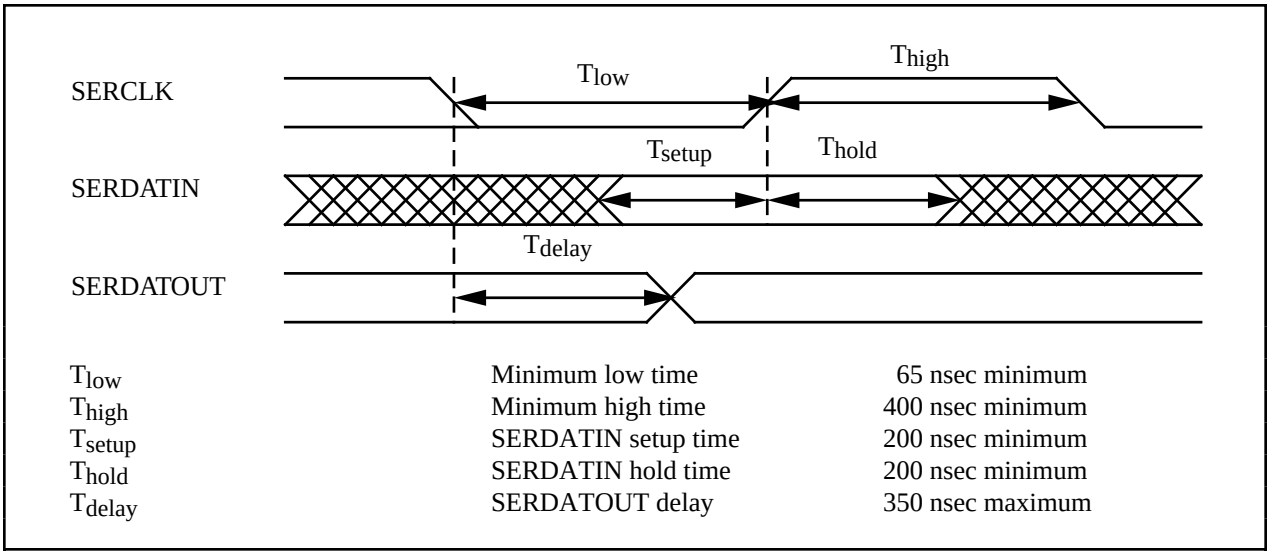
   a. Set SERDATIN = bit to be sent. These bits are the data that are being written to the Slot-Select Register.

   b. SERCLK = 0.

   c. SERCLK = 1. This rising edge clocks the data.

4. Set SLOT0SEL* to 1. This asserts the SS* line of the module whose slot number was written to Slot 0. If you are using multiple chassis, only the appropriate slot in the chassis whose address corresponds to the written chassis number is selected. When no communication is taking place between the data acquisition board and any modules, write zero to the Slot-Select Register to ensure that no accidental writes occur.

Figure 2-7 shows the timing requirements on the SERCLK and SERDATIN signals. You must observe these timing requirements for all communications. T_{delay} is a specification of the SCXI-1161.



T_{low}	Minimum low time	65 nsec minimum
T_{high}	Minimum high time	400 nsec minimum
T_{setup}	SERDATIN setup time	200 nsec minimum
T_{hold}	SERDATIN hold time	200 nsec minimum
T_{delay}	SERDATOUT delay	350 nsec maximum

Figure 2-7. Serial Data Timing Diagram

After selecting the module slot as previously described, you can write to the Data Register or read from the Module ID Register.

The contents of the Module ID Register are reinitialized by deasserting Slot-Select. After the 32 bits of data are read from the Module ID Register, further data will be zeros until reinitialization occurs.

To write to the Data Register, perform the following steps:

1. Initial conditions:

   SS* asserted low.
   SERDATIN = don't care.
   DAQD*/A = 0 (indicates data will be written to a register).
   SLOT0SEL* = 1.
   SERCLK = 1 (and has not transitioned since DAQD*/A went low).

2. For each bit to be written:

   Establish the desired SERDATIN level corresponding to this bit.
   SERCLK = 0.
   SERCLK = 1. This rising edge clocks the data.

3. Pull DAQD*/A high. This disables further writes to the module Data Register.

4. Pull SLOT0SEL* low to deassert the SS* line and establish conditions for writing a new slot-select number to the Slot 0 Slot-Select Register.

5. If you are not selecting another slot, write zero to the Slot 0 Slot-Select Register.

Figure 2-8 illustrates a write to the SCXI-1161 Data Register of the binary pattern:

```
00000011 00001111
```

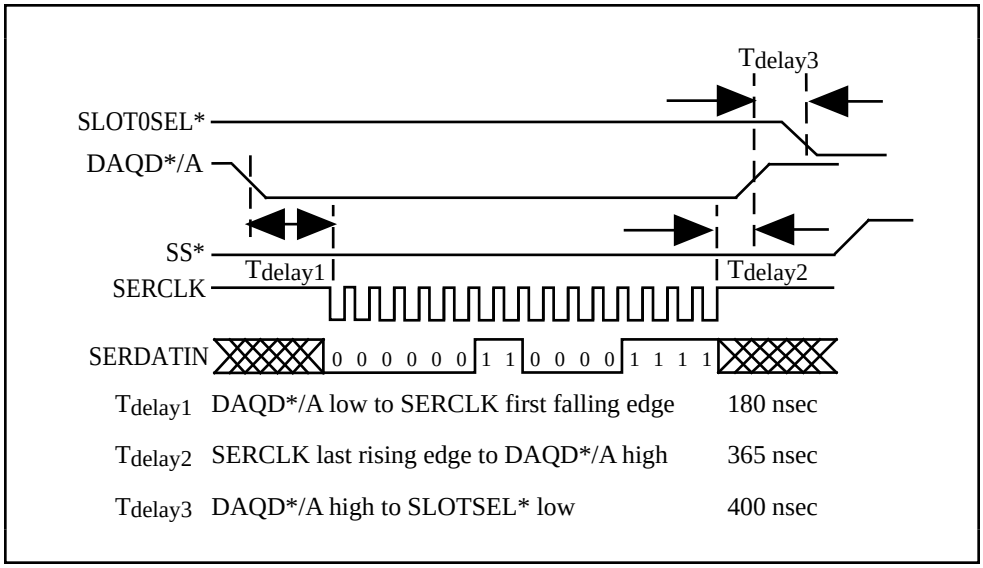


Figure 2-8. Data Register Write Timing Diagram

To read from the Module ID Register, perform the following steps:

1. Initial conditions:

   SS* asserted low.
   SERDATIN = don't care.
   DAQD*/A = 0.
   SLOT0SEL* = 1.
   SERCLK = 1 (and has not changed since DAQD*/A went low).

2. For each bit to be read:

   Set SERCLK = 0.
   SERCLK = 1. This rising edge clocks the data.
   Read the level of the SERDATOUT line.

3. Pull DAQD*/A high. This disables further reads from the Module ID Register.

4. Pull SLOT0SEL* low to deassert the SS* line and establish conditions for writing a new slot-select number to the Slot 0 Slot-Select Register.

5. If you are not selecting another slot, write zero to the Slot 0 Slot-Select Register.

Figure 2-9 illustrates a read of the SCXI-1161 Module ID Register.

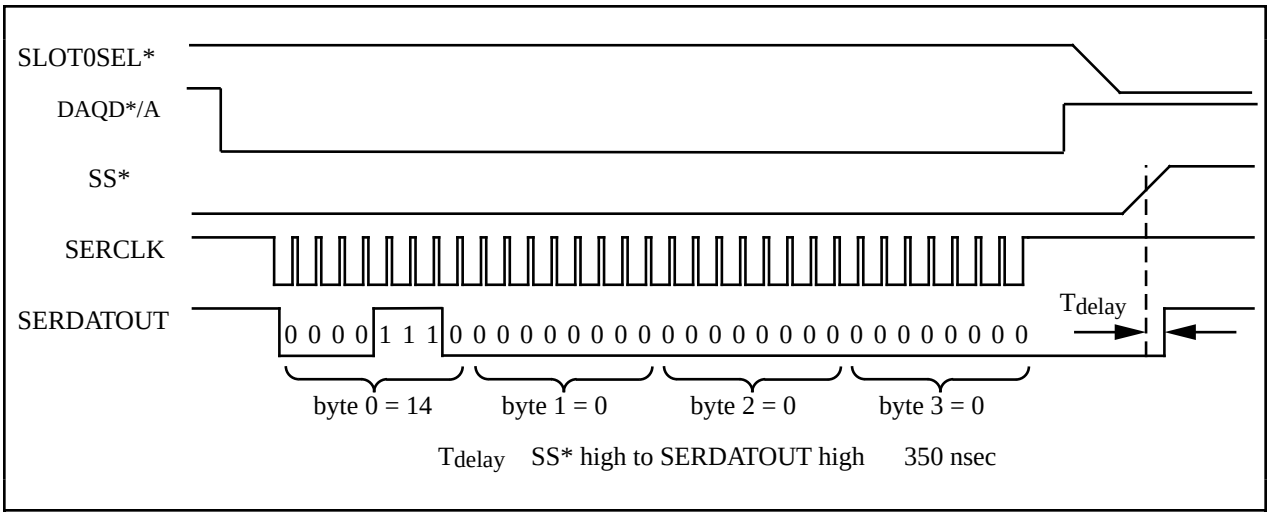


Figure 2-9. SCXI-1161 Module ID Register Timing Diagram

For further details on programming these signals, refer to Chapter 5, *Programming*.

Chapter 3
Theory of Operation

This chapter contains a functional overview of the SCXI-1161 module and explains the operation of each functional unit making up the SCXI-1161.

Functional Overview

The block diagram in Figure 3-1 shows the key functional components of the SCXI-1161.

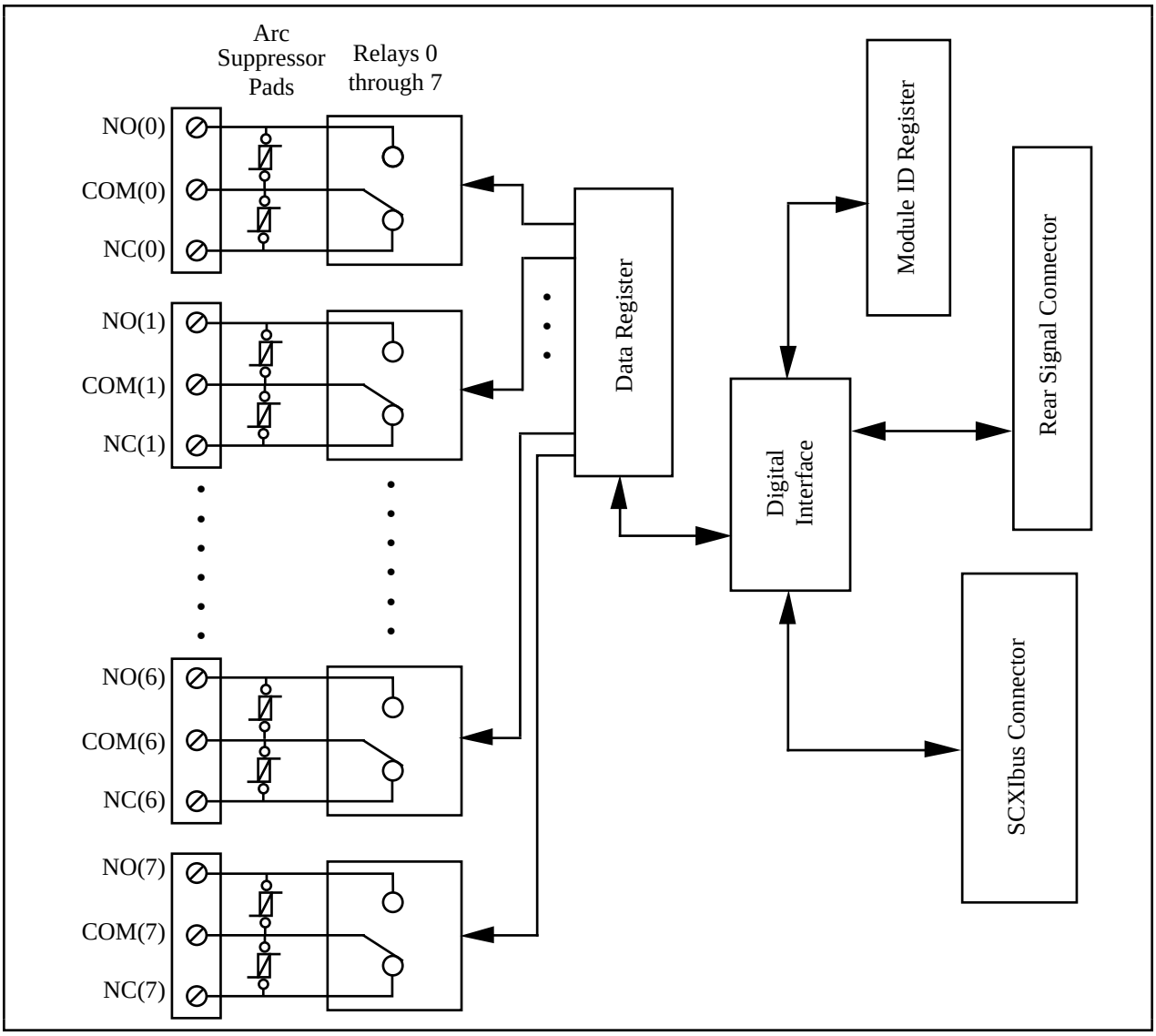


Figure 3-1. SCXI-1161 Block Diagram

The major components of the SCXI-1161 are as follows:

- The SCXIbus connector
- The digital interface
- The digital control circuitry
- The relay channels

The SCXI-1161 module is dedicated to switching and controlling power signal sources. The theory of operation of each of the SCXI-1161 components is explained in the rest of this chapter.

SCXIbus Connector

Figure 3-2 shows the pinout of the SCXIbus connector.

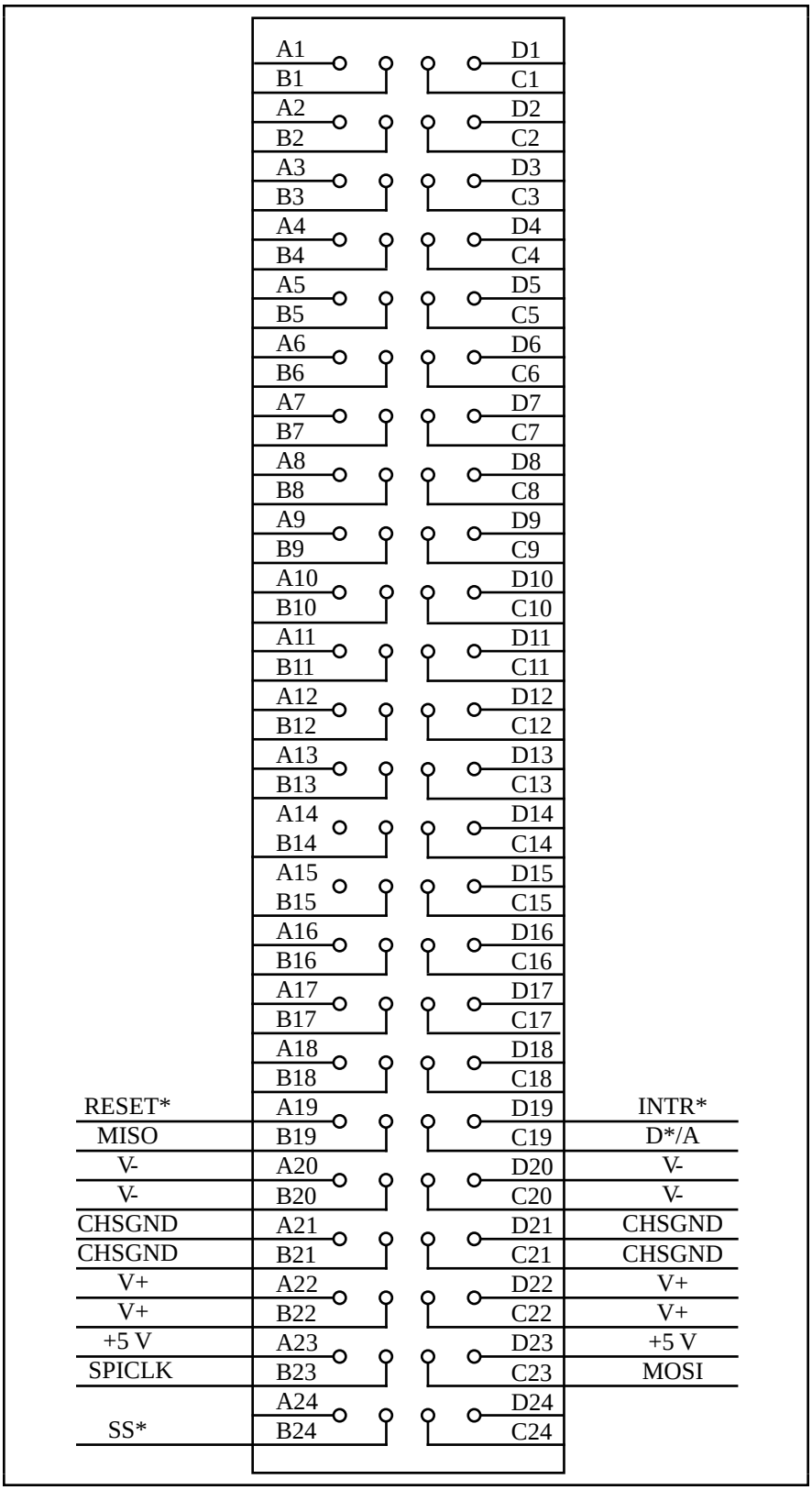


Figure 3-2. SCXIbus Connector Pin Assignment

SCXIbus Connector Signal Descriptions

Pin	Signal Name	Description
A19	RESET*	Reset – When pulled low, reinitializes the module to its power-up state. Totem pole. Input.
B19	MISO	Master-In-Slave-Out – Transmits data from the module to the SCXIbus. Open collector. I/O.
C19	D*/A	Data/Address – Indicates to the module whether address information or data information is being sent to the module on MOSI. Open collector. I/O.
D19	INTR*	Interrupt – Active low. Causes data that is on MOSI to be written to the Slot 0 Slot-Select Register. Open collector. Output.
A20, B20, C20, D20	V-	Negative Analog Supply – -18.5 to -25 V.
A21, B21, C21, D21	CHSGND	Chassis Ground – Digital and analog ground reference.
A22, B22, C22, D22	V+	Positive Analog Supply – +18.5 to +25 V.
A23, D23	+5 V	+5 VDC Source – Digital power supply.
B23	SPICLK	Serial Peripheral Interface (SPI) Clock – Clocks the serial data on the MOSI and MISO lines. Open collector. I/O.
C23	MOSI	Master-Out-Slave-In – Transmits data from the SCXIbus to the module. Open collector. I/O.
B24	SS*	Slot Select – When low, enables module communication over the SCXIbus. Totem pole. Input.

* Indicates active low.

All other pins are not connected.

MOSI, MISO, SPICLK, and SS* form a synchronous communication link that conforms with SPI using an idle-high clock and second-edge data latching. D*/A, INTR*, and RESET* are additional control signals.

When the module is in an SCXI-1000 or SCXI-1001 chassis, the data acquisition board, via the module rear signal connector, must tap into the open-collector backplane signal lines as a master to write to the module. Table 3-1 shows the signal connections from the rear signal connector to the backplane.

Table 3-1. SCXIbus Equivalents for the Rear Signal Connector

Rear Signal Connector Signal	SCXIbus Equivalent
SERDATIN	MOSI
DAQD*/A	D*/A
SLOT0SEL*	INTR*
SERCLK	SPICLK
SERDATOUT	MISO You must set jumper W2 to position 1

The SCXI-1161 module converts the data acquisition board signals to open-collector signals on the backplane of the SCXI chassis. For the data acquisition board to talk to a slot, the board must first assert the SS* for that slot. To do this, assert INTR* low, write a 16-bit number over MOSI corresponding to the desired slot (and chassis if you are using an SCXI-1001 chassis), and then release INTR* high. At this point, Slot 0 asserts the SS* of the desired slot low and the data acquisition board can communicate with the module in that slot according to the SPI protocol.

Digital Interface

Figure 3-3 shows a diagram of the SCXI-1161 and SCXIbus digital interface circuitry.

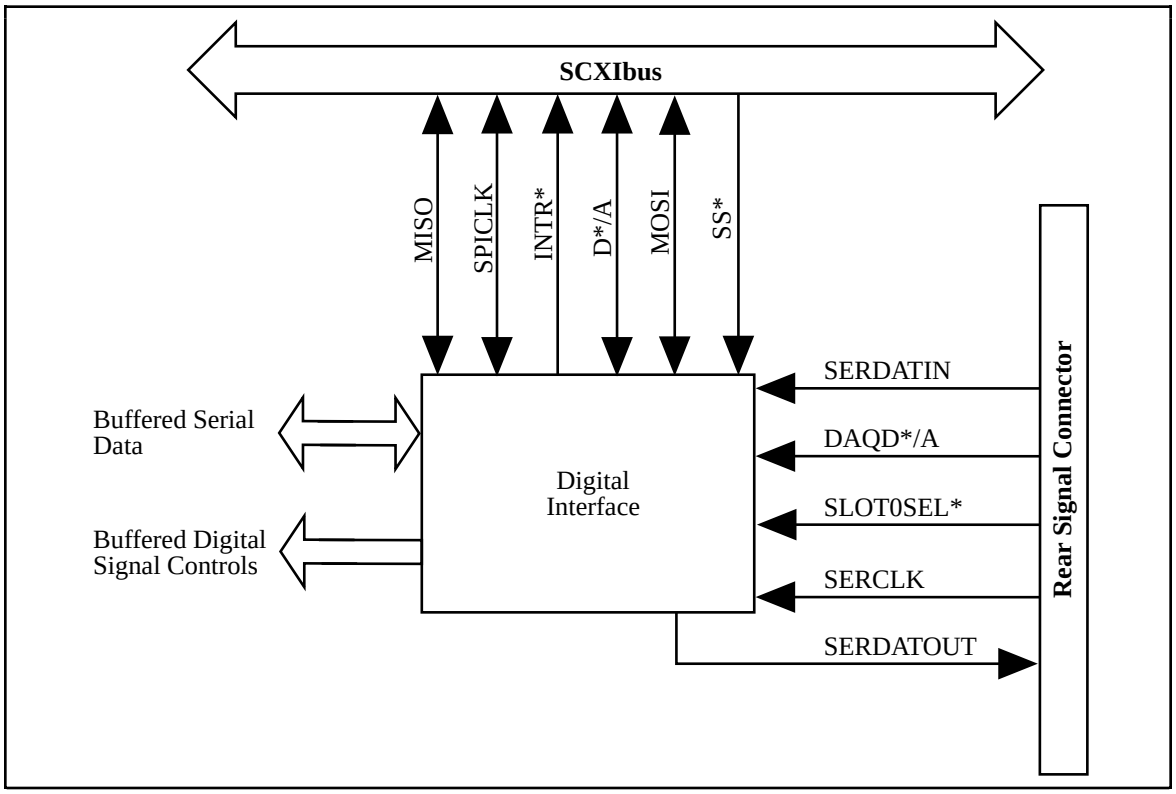


Figure 3-3. Digital Interface Circuitry Block Diagram

The digital interface circuitry is divided into a data acquisition section and an SCXIbus section. The SCXI-1161 connects to the SCXIbus via a 4x24 metral receptacle and to the data acquisition board via a 50-pin ribbon-cable header. The digital interface circuitry buffers the digital signals from the data acquisition board and the SCXIbus and sends signals back and forth between the data acquisition board and the SCXIbus.

Digital Control Circuitry

Figure 3-4 diagrams the SCXI-1161 digital control.

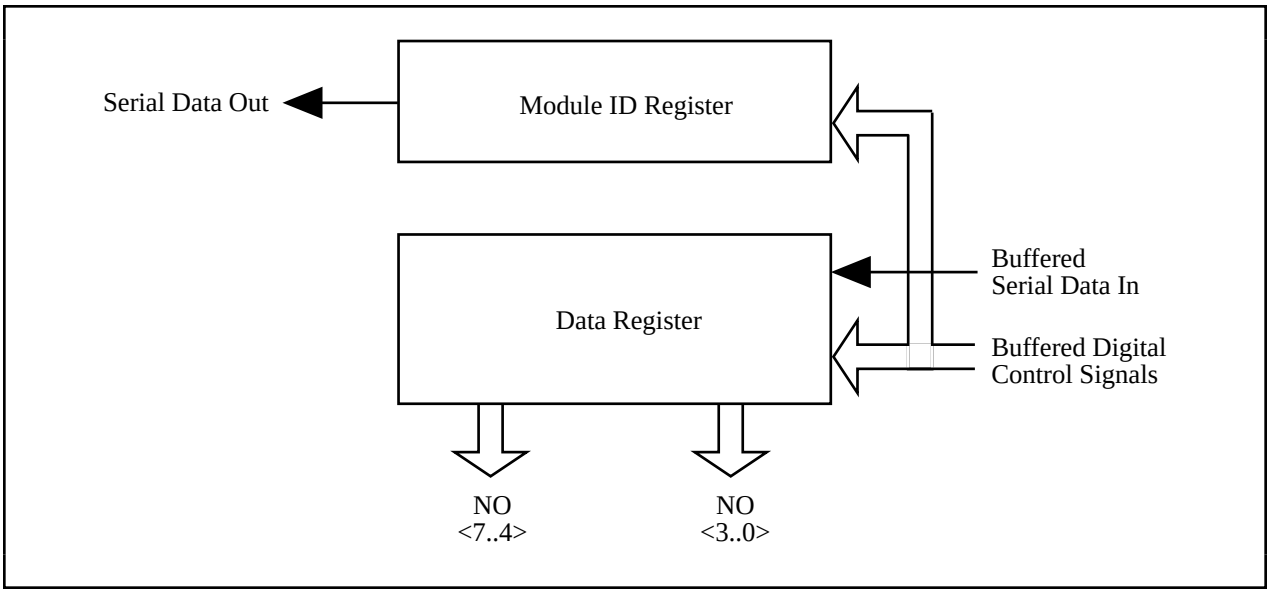


Figure 3-4. SCXI-1161 Digital Control

The digital control section consists of the Data Register and the Module ID Register.

The Data Register is a 2-byte serial-in, parallel-out shift register with relay drive capabilities. Data is received on the MOSI line from either Slot 0 or the data acquisition board when SS* is enabled and D*/A indicates data transfer (D*/A low). The Data Register controls the state of the SCXI-1161 relays. The complete descriptions of the register bits are given in Chapter 4, *Register Descriptions*. Writes to the Data Register require the following steps:

1. SS* goes low, enabling communication with the board.
2. D*/A goes low, indicating that the information sent on the MOSI line is data.
3. The serial data is available on MOSI and SPICLK clocks it into the register.
4. SS* goes high and D*/A goes high, indicating the end of communication. This action latches the Data Register bits.

At reset or at power up, the relays are set to the NC position.

The Module ID Register connects to MISO on the SCXIbus. The Module ID Register is an 8-bit parallel serial-in, serial-out shift register and an SPI communication adapter. The contents of the Module ID Register are written onto MISO during the first four bytes of transfer after you select the module. Zeros are written to MISO thereafter until you deselect the module. The SCXI-1161 module ID is hex E.

Relay Channels

The SCXI-1161 has eight independent one form C (single-pole double-throw) relays. Each relay has three connections at the front screw terminals–the common (COM), the normally closed (NC), and the normally open (NO) positions. Each relay has pads for arc suppressors to protect the relays from inductive loads. Refer to the *Contact Protection for Inductive Load Connections* section of Chapter 2, *Configuration and Installation*, for further details on contact protection.

All eight relays are single-side stable relays. When you energize the relay coil, the COM connects to the NO position. The Data Register controls the relays as follows. The four LSBs of the least significant byte of the Data Register control the coils of relays 0 through 3. The four LSBs of the most significant byte of the Data Register control the coils of relays 4 through 7. When you do not energize the coils, the COM connects to the NC position.

After a write to the Data Register, the data is latched and the selected relay coils are continuously driven.

Each relay can be set (the relay COM position connected to the NO position) or reset (the relay COM position connected to the NC position) without affecting the other relays, or all relays can change states at the same time. However, each time a relay changes its state, the Data Register is rewritten to. Refer to Chapter 4, *Register Descriptions*, and Chapter 5, *Programming*, for further details.

The relays are break-before-make, but only if you do not exceed the specified relay operation speed. In addition, each relay is fully isolated from the other relays and from earth ground, with a working common-mode voltage of 250 Vrms and a breakdown of 1,500 Vrms.

Note: It is important to notice that this module has no access to the analog backplane; this protects the backplane from faults when high voltages are available on the relay contacts.

Chapter 4
Register Descriptions

This chapter describes in detail the SCXI-1161 Module ID Register, the Data Register, and the Slot 0 registers.

Note: If you plan to use a programming software package such as NI-DAQ, LabWindows, or LabVIEW with your SCXI-1161 board, you do not need to read this chapter.

Register Description

Register Description Format

This register description chapter discusses each of the SCXI-1161 registers and the Slot 0 registers. A detailed bit description of each register is given. The individual register description gives the type, word size, and bit map of the register, followed by a description of each bit.

The register bit map shows a diagram of the register with the MSB shown on the left (bit 31 for a 32-bit register, bit 15 for a 16-bit register, and bit 7 for an 8-bit register) and the LSB shown on the right (bit 0). A rectangle is used to represent each bit. Each bit is labeled with a name inside its rectangle. An asterisk (*) after the bit name indicates that the bit is inverted (negative logic). The Module ID register has a unique format and is described in the *Module ID Register* section.

In many of the registers, several bits are labeled with an X, indicating don't care bits. When you write to a register, you may set or clear these bits without effect.

SCXI-1161 Registers

The SCXI-1161 is a class I module. It has two registers–the Module ID Register and the Data Register. The Module ID Register is a 4-byte read-only register that contains the SCXI-1161 Module ID number. The Data Register is a 16-bit write-only register that controls the SCXI-1161 relay states.

Module ID Register

The Module ID register contains the 4-byte module ID code for the SCXI-1161. This code number is read on the MISO line whenever the SCXI-1161 is accessed. The bytes appear least significant byte first. Within each byte, data is sent out MSB first. Additional data transfers result in all zeros being sent on the MISO line. The Module ID register is reinitialized to its original value each time the module is deselected, reset, or powered up.

Type: Read-only

Word Size: 4-byte

Bit Map:

Byte 0

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

Byte 1

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

Byte 2

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

Byte 3

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

Data Register

The Data Register contains 16 bits that control the state of each relay of the SCXI-1161. Whenever the SCXI-1161 is selected, the Data Register shifts in the data present on the MOSI line, bit 15 first, and then latches the data when the module is deselected. At power up or reset, the Data Register outputs are not driving the relay coils, hence the relays are reset to their NC position. Table 4-1 shows a truth table for setting a given relay.

Table 4-1. Truth Table for Setting Relays

NO(*x*) (Set)	**Function**
0	COM connects to NC position
1	COM connects to NO position

Type: Write-only

Word Size: 16-bit

Bit Map:

15	14	13	12	11	10	9	8
X	X	X	X	NO(7)	NO(6)	NO(5)	NO(4)

7	6	5	4	3	2	1	0
X	X	X	X	NO(3)	NO(2)	NO(1)	NO(0)

Bit	**Name**	**Description**
15-12, 7-4	X	Don't care bits – Unused.
11-8, 3-0	NO<7..0>	Normally Open Relay 7 through 0 – Determine the state of the relays. If set to 0, the relays are reset to the NC position. If set to 1, the NC position on the relay opens and the COM connects to the NO position.

Slot 0 Register Descriptions

Slot 0 has three registers–the FIFO Register, the Hardscan Register (HSCR), and the Slot-Select Register. The SCXI-1161 uses only the Slot-Select Register. The Slot-Select Register is a 16-bit write-only register that determines with which slot the data acquisition board speaks when SLOT0SEL* is released high. With the SCXI-1001 chassis, the Slot-Select Register also determines in which chassis the desired slot is. Write to the Slot-Select Register using the SLOT0SEL* line. Maintain software copies of the Slot-Select Register.

If you are using multiple chassis, it is important to understand the architecture of the Slot-Select Register. Although each chassis has its own physical Slot-Select Register, all are written to at the same time. The jumper settings in Slot 0 of a chassis determine with which chassis number Slot 0 is identified. From the software perspective, only one Slot-Select Register exists in a system composed of multiple chassis.

Slot-Select Register

The Slot-Select Register contains 16 bits that determine which module in which chassis is enabled for communication when the SLOT0SEL* line is high. An SCXI-1000 chassis selects the appropriate module in its chassis, regardless of the chassis number written. The Slot-Select Register shifts in the data present on the MOSI line, bit 16 first, when SLOT0SEL* is low.

Type: Write-only

Word Size: 16-bit

Bit Map:

15	14	13	12	11	10	9	8
X	X	X	X	X	X	X	CHS4

7	6	5	4	3	2	1	0
CHS3	CHS2	CHS1	CHS0	SL3	SL2	SL1	SL0

Bit	Name	Description
15-9	X	Don't care bits – Unused.
8-4	CHS<4..0>	Chassis Bit 4 through 0 – Determine which chassis is selected. On the SCXI-1000 chassis, these are don't care bits.
3-0	SL<3..0>	Slot Bit 3 through 0 – Determine which slot in the selected chassis is selected.

Chapter 5
Programming

This chapter contains a functional programming description of the SCXI-1161 and Slot 0.

Note: If you plan to use a programming software package such as NI-DAQ, LabWindows, or LabVIEW with your SCXI-1161 board, you do not need to read this chapter.

Programming Considerations

Programming the SCXI-1161 involves writing to the Data Register. Programming the data acquisition boards involves writes to their registers. See your data acquisition board user manual for more information. The programming instructions list the sequence of steps to take. The instructions are language independent; that is, they instruct you to write a value to a given register without presenting the actual code.

Notation

For the bit patterns to be written, the following symbols are used:

`0` binary zero
`1` binary one
`X` don't care; either zero or one may be written

The bit patterns are presented MSB first, left to right.

Register Writes

This section describes how to write to the Data Register including the procedure for writing to the Slot-Select Register to select the appropriate slot. For timing specifics, refer to the *Timing Requirements and Communication Protocol* section in Chapter 2, *Configuration and Installation.* Table 5-1 lists the rear signal connector pin equivalences to the different National Instruments data acquisition boards. See also Appendix E, *SCXI-1161 Cabling.* The Data Register is a write-only register.

The different bits in this register control independent relays. There are times when you may want to set or reset a specific relay or relays without affecting the remaining relays. However, a write to the Data Register affects all relays simultaneously. You cannot read the register to determine which relays have been set or reset in the past; therefore, you should maintain a software copy of the Data Register content. You can then read the software copy to determine the status of the relays. To change the state of a single relay without disturbing the remaining relays, change the bits that control the relay coils of interest, leave all other bits in their previous states, and rewrite to the Data Register.

Table 5-1. SCXIbus to SCXI-1161 Rear Signal Connector to Data Acquisition Board Pin Equivalences

SCXIbus Line	SCXI-1161 Rear Signal Connector	MIO Boards	Lab-NB/Lab-PC/ Lab-PC+/Lab-LC	PC-LPM-16	DIO-24	DIO-96	DIO-32F
MOSI	SERDATIN	ADIO0	PB4	DOUT4	PB3	APB3	DIOB3
D*/A	DAQD*/A	ADIO1	PB5	DOUT5	PB2	APB2	DIOB2
INTR*	SLOT0SEL*	ADIO2	PB6	DOUT6	PB1	APB1	DIOB1
SPICLK	SERCLK	EXTSTROBE*	PB7	DOUT7	PB0	APB0	DIOB0
MISO	SERDATOUT	BDIO0	PC1	DIN6	PA0	APA0	DIOA0

Register Selection and Write Procedure

1. Select the slot of the module to be written to. Initial conditions:

   SERDATIN = X.
   DAQD*/A = 1.
   SLOT0SEL* = 1.
   SERCLK = 1.

2. Clear SLOT0SEL* to 0. This deasserts all SS* lines to all modules in all chassis.

3. For each bit, starting with the MSB (bit 15), do the following:

   a. Set SERDATIN = bit to be sent. These bits are the data that is written to the Slot-Select Register.

   b. Clear SERCLK to 0.

   c. Set SERCLK to 1. This rising edge clocks the data. If you are using an MIO-16 board, writing to the EXTSTROBE* register pulses EXTSTROBE* low and then high, accomplishing steps 3b and 3c.

4. Set SLOT0SEL* to 1. This asserts the SS* line of the module whose slot number was written to Slot 0. If you are using multiple chassis, only the appropriate slot in the chassis whose address corresponds to the written chassis number is automatically selected. When no communication is taking place between the data acquisition board and any modules, write zero to the Slot-Select Register to ensure that no accidental writes occur.

5. After you have selected the slot of the SCXI-1161 module, clear DAQD*/A to 0. This selects the Data Register and the data on the MOSI line is written to it.

6. For each bit to be written to the Data Register:

   a. Establish the desired SERDATIN level corresponding to this bit.

   b. Clear SERCLK to 0.

   c. Set SERCLK to 1 (clock the data). If you are using an MIO-16 board, writing to the EXTSTROBE* register pulses EXTSTROBE* low and then high, accomplishing steps 6b and 6c.

   d. After clocking the last data bit, set D*/A to 1.

7. Pull SLOT0SEL* low to deassert the SS* line and establish conditions for writing a new slot-select number to the Slot 0 Slot-Select Register to latch the data in the Data Register.

8. If you are not selecting another slot, write zero to the Slot 0 Slot-Select Register. If you are selecting another slot, repeat the procedure starting at step 3.

For a timing illustration of a Data Register write, see Figure 2-8, *Data Register Write Timing Diagram*.

Initialization

At power up or at reset, the Data Register outputs are in a high-impedance state and the relays are reset to the NC position.

Examples

This section describes how to program the SCXI-1161, either alone or in conjunction with other modules.

The following examples are intended to aid your understanding of module and Slot 0 programming. It will be helpful to refer to the bit descriptions for the Data Register in Chapter 4, *Register Descriptions*.

Example 1

You want to connect the NC position to the COM position on all the relays on an SCXI-1161 in Slot 1 of an SCXI-1000 chassis. The SCXI-1161 is directly cabled to a data acquisition board.

The programming step is as follows:

1. Following the procedure given in the *Register Writes* section of this chapter, write `XXXX1111 XXXX1111` to the Data Register of the SCXI-1161 in Slot 1.

Example 2

An SCXI-1000 chassis has four SCXI-1161 modules in Slots 1, 2, 3, and 4. The SCXI-1161 in Slot 4 is cabled to the data acquisition board. You want to connect the NO position to the COM position on all of the modules and leave all the other channels unchanged. Previously, all the channels had their NC positions connected to their COM positions. The channels of interest in each slot are as follows:

- Channel 3 on the SCXI-1161 in Slot 1
- Channels 0 through 2 on the SCXI-1161 in Slot 4
- Channels 3, 5, and 7 on the SCXI-1161 in Slot 3

The programming steps are as follows:

1. Following the procedure given in the *Register Writes* section of this chapter, write `XXXX0000 XXXX1000` to the Data Register of the SCXI-1161 in Slot 1.
2. Following the procedure given in the *Register Writes* section of this chapter, write `XXXX0000 XXXX0111` to the Data Register of the SCXI-1161 in Slot 4.
3. Following the procedure given in the *Register Writes* section of this chapter, write `XXXX1010 XXXX1000` to the Data Register of the SCXI-1161 in Slot 3.

Example 3

You have a multiple-chassis system with an SCXI-1161 in Slot 4 of Chassis 1, and another SCXI-1161 in Slot 11 of Chassis 2. You want to do the following:

1. In Chassis 1, connect the NC position to the COM position on channels 1 and 5, and connect the NO position to the COM position on channels 3 and 4. Previously, channels 1, 2, 5, and 7 were in the NO position and all the other channels were reset to their NC positions.
2. In Chassis 2, connect the NC position to the COM position on channels 0 through 7.

Leave all other channels unchanged.

Assuming that the modules are correctly cabled and jumpers W3, W4, and W5 are correctly set, do the following:

1. Select Chassis 1, Slot 4 as described in the *Register Writes* section of this chapter.
2. Following the procedure given in the *Register Writes* section of this chapter, write `XXXX1001 XXXX1100`.
3. Select Chassis 2, Slot 11 as described in the *Register Writes* section of this chapter.
4. Following the procedure given in the *Register Writes* section of this chapter, write `XXXX1111 XXXX1111`.

Appendix A
Specifications

This appendix lists the specifications for the SCXI-1161. These are typical at 25° C and 50% humidity unless otherwise stated. The operating temperature range is 0° to 50° C.

Channel Rating

Maximum switching capacity (resistive load)[1]	
AC	8 A at 125 VAC 6 A at 250 VAC
DC	5 A at 30 VDC
Switching current	8 A maximum per channel 50 A maximum per module
Channel on resistance	175 mΩ
Contact material	Silver alloy
Life[2]	
Mechanical (at 180 cpm)	10^7 operations minimum
Electrical (at 20 cpm)	10^5 at rated load
Isolation	
Terminal to terminal and terminal to earth	250 Vrms[3]
Maximum speed	20 cpm at maximum load 180 cpm at no load
Operate time	15 msec
Release time	15 msec

Physical

Dimensions	1.2 by 6.8 by 8.0 in.
Connectors	50-pin male ribbon-cable rear connector 24-screw terminal adapter

[1] If you operate the module at high currents, later operation at low currents may not be possible
[2] Relays are subject to normal wear based on the number of operations
[3] Module tested following the UL 1244 standard to twice the working voltage +1000 Vrms

Operating Environment

Temperature	0° to 50° C
Relative humidity	5% to 90% at 35° C

Storage Environment

Temperature	-55° to 150° C
Relative humidity	5% to 90% noncondensing

Appendix B
Rear Signal Connector

This appendix describes the pinout and signal names for the SCXI-1161 50-pin rear signal connector, including a description of each connection.

Figure B-1 shows the pin assignments for the SCXI-1161 rear signal connector.

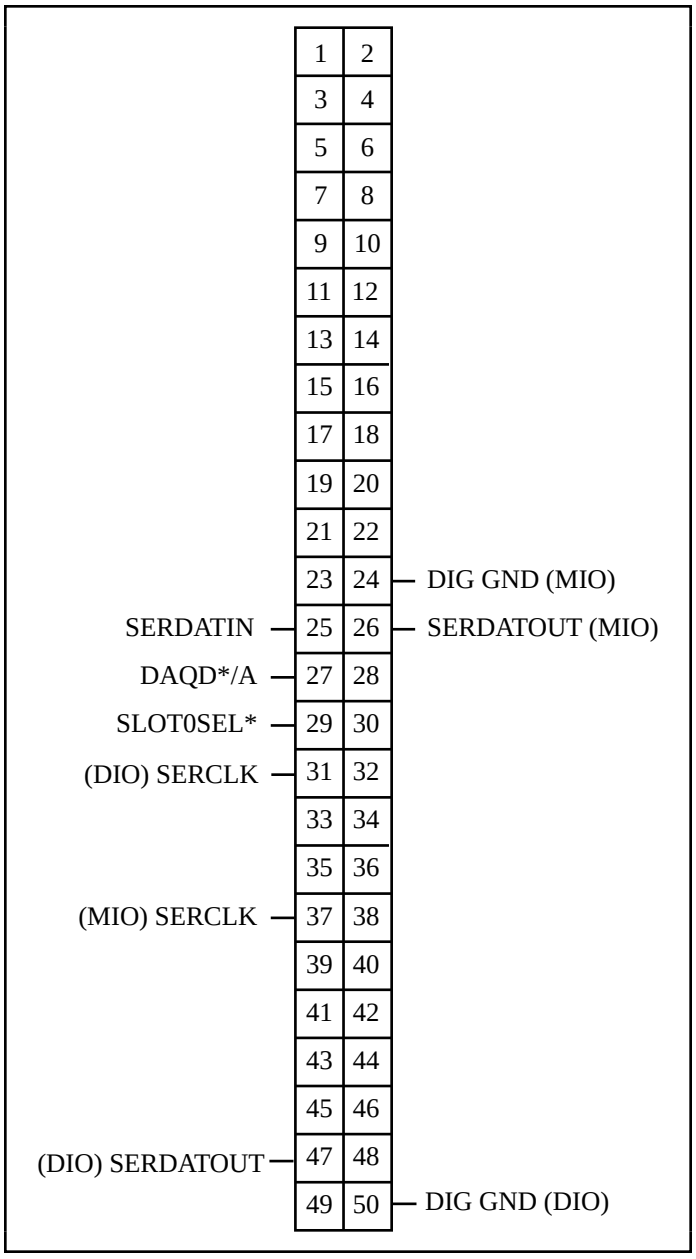


Figure B-1. SCXI-1161 Rear Signal Connector Pin Assignment

Rear Signal Connector Signal Descriptions

Pin	Signal Name	Description
24 or 50	DIG GND	Digital Ground – Supplies the reference for data acquisition board digital signals and is tied to the module digital ground. Pin 50 is for DIO-type boards. Pin 24 is for MIO-type boards. Jumper W3 selects the pin.
25	SERDATIN	Serial Data In – Taps into the SCXIbus MOSI line to provide serial input data to a module or Slot 0.
26 or 47	SERDATOUT	Serial Data Out – Taps into the SCXIbus MISO line to accept serial output data from a module. Pin 47 is for DIO-type boards. Pin 26 is for MIO-type boards. Jumper W5 selects the pin.
27	DAQD*/A	Data Acquisition Board Data/Address Line – Taps into the SCXIbus D*/A line to indicate to the module whether the incoming serial stream is data or address information.
29	SLOT0SEL*	Slot 0 Select – Taps into the SCXIbus INTR* line to indicate whether the information on MOSI is sent to a module or to Slot 0.
31 or 37	SERCLK	Serial Clock – Taps into the SCXIbus SPICLK line to clock the data on the MOSI and MISO lines. Pin 31 is for DIO-type boards. Pin 37 is for MIO-type boards. Jumper W4 selects the pin.

* Indicates active low.

All other pins are not connected.

See the *Timing Requirements and Communication Protocol* section in Chapter 2, *Configuration and Installation*, for more detailed information on timing.

Appendix C
SCXIbus Connector

This appendix describes the pinout and signal names for the SCXI-1161 96-pin SCXIbus connector, including a description of each connection.

Figure C-1 shows the pinout of the SCXI-1161 SCXIbus connector.

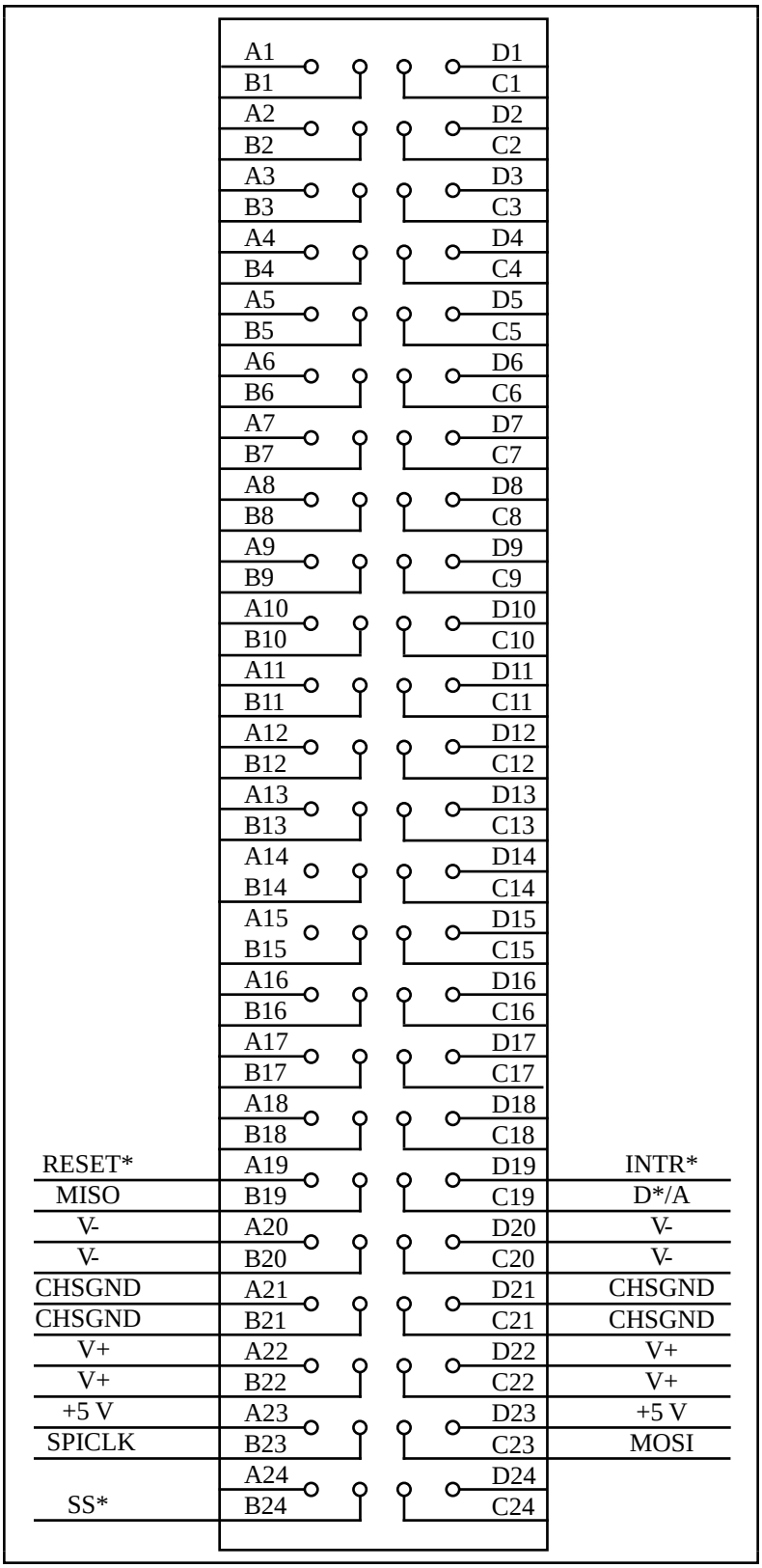


Figure C-1. SCXIbus Connector Pin Assignment

SCXIbus Connector Signal Descriptions

Pin	Signal Name	Description
A19	RESET*	Reset – When pulled low, reinitializes the module to its power-up state. Totem pole. Input.
B19	MISO	Master-In-Slave-Out – Transmits data from the module to the SCXIbus. Open collector. I/O.
C19	D*/A	Data/Address – Indicates to the module whether address information or data information is being sent to the module on MOSI. Open collector. I/O.
D19	INTR*	Interrupt – Active low. Causes data that is on MOSI to be written to the Slot 0 Slot-Select Register. Open collector. Output.
A20, B20, C20, D20	V-	Negative Analog Supply – -18.5 to -25 V.
A21, B21, C21, D21	CHSGND	Chassis Ground – Digital and analog ground reference.
A22, B22, C22, D22	V+	Positive Analog Supply – +18.5 to +25 V.
A23, D23	+5 V	+5 VDC Source – Digital power supply.
B23	SPICLK	Serial Peripheral Interface (SPI) Clock – Clocks the serial data on the MOSI and MISO lines. Open collector. I/O.
C23	MOSI	Master-Out-Slave-In – Transmits data from the SCXIbus to the module. Open collector. I/O.
B24	SS*	Slot Select – When low, enables module communication over the SCXIbus. Totem pole. Input.

* Indicates active low.

All other pins are not connected.

Further information is given in Chapter 3, *Theory of Operation.*

Appendix D
Contact Protection

This appendix contains technical data on contact protection when you are switching inductive loads.

Appendix E
SCXI-1161 Cabling

This appendix describes how to use and install the hardware accessories for the SCXI-1161:

- SCXI-1340 cable assembly
- SCXI-1341 Lab-NB, Lab-PC, and Lab-PC+ cable assembly
- SCXI-1344 Lab-LC cable assembly
- SCXI-1342 PC-LPM-16 cable assembly
- SCXI-1348 DIO-32 cable assembly
- SCXI-1180 feedthrough panel
- SCXI-1302 50-pin terminal block
- SCXI-1351 one-slot cable extender
- SCXI-1350 multichassis adapter
- SCXI-1343 screw terminal adapter

SCXI-1340 Cable Assembly

The SCXI-1340 cable assembly connects an MIO-16 or DIO-24 board to an SCXI-1161 module. The SCXI-1340 consists of a mounting bracket at one end and a 50-conductor ribbon cable that has a 50-pin female connector at the other end. This female connector attaches to the I/O connector of the data acquisition board. Attached to the mounting bracket is a 50-pin female mounting bracket connector that connects to the rear signal connector of the module. A male breakout connector is near the mounting bracket on the ribbon cable. You can use this male breakout connector to extend the signals of the MIO-16 or DIO-24 board to an SCXI-1180 feedthrough panel or an SCXI-1181 breadboard module. All 50 pins from the MIO-16 or DIO-24 board go straight to the rear signal connector. You can use a standard 50-pin ribbon cable instead of the SCXI-1340 cable assembly.

The SCXI-1340 has the following advantages over the ribbon cable:

- The SCXI-1340 produces strain relief so that you cannot accidentally disconnect the cable.
- The SCXI-1340 includes a mounting bracket that mounts to the chassis so that you can remove and reinsert the module without explicitly removing the cable from the back of the chassis. This is especially useful when the SCXI chassis is rack mounted, making rear access difficult.

- The SCXI-1340 has an extra male breakout connector for use with the SCXI-1180 feedthrough panel or additional modules or breadboards that need a direct connection to the MIO-16 or DIO-24 board.
- The SCXI-1340 rear panel gives the module and the chassis both mechanical and electrical shielding.

Table E-1 lists the pin equivalences of the MIO-16 and DIO-24 boards and the SCXI-1161.

Table E-1. SCXI-1161 and Board Pinout Equivalences

Pin	SCXI-1161 Rear Signal Connector	MIO-16 Board Equivalent	DIO-24 Board Equivalent
24	DIG GND (MIO)	DIG GND	
25	SERDATIN	ADIO0	PB3
26	SERDATOUT (MIO)	BDIO0	
27	DAQD*/A	ADIO1	PB2
29	SLOT0SEL*	ADIO2	PB1
31	SERCLK (DIO)		PB0
37	SERCLK (MIO)	EXTSTROBE*	
47	SERDATOUT (DIO)		PA0
50	DIG GND (DIO)		DIG GND

No other pins are connected on the SCXI-1161.

SCXI-1340 Installation

Follow these steps to install the SCXI-1340:

1. Make sure that the computer and the SCXI chassis are turned off.
2. Install the SCXI module in the chassis.
3. Plug the mounting bracket connector onto the module rear signal connector (see Figure E-1). An alignment tab on the bracket should enter the upper board guide of the chassis.
4. Screw the mounting bracket to the threaded strips in the rear of the chassis.
5. Connect the loose end of the cable assembly to the MIO-16 or DIO-24 board rear signal connector.

Check the installation.

After step 1, the order of these steps is not critical; however, it is easier to locate the correct position for the mounting bracket with a module installed in the chassis. If you are attaching a cable to the breakout connector, installation is easiest if you attach the second cable before installing the SCXI-1340.

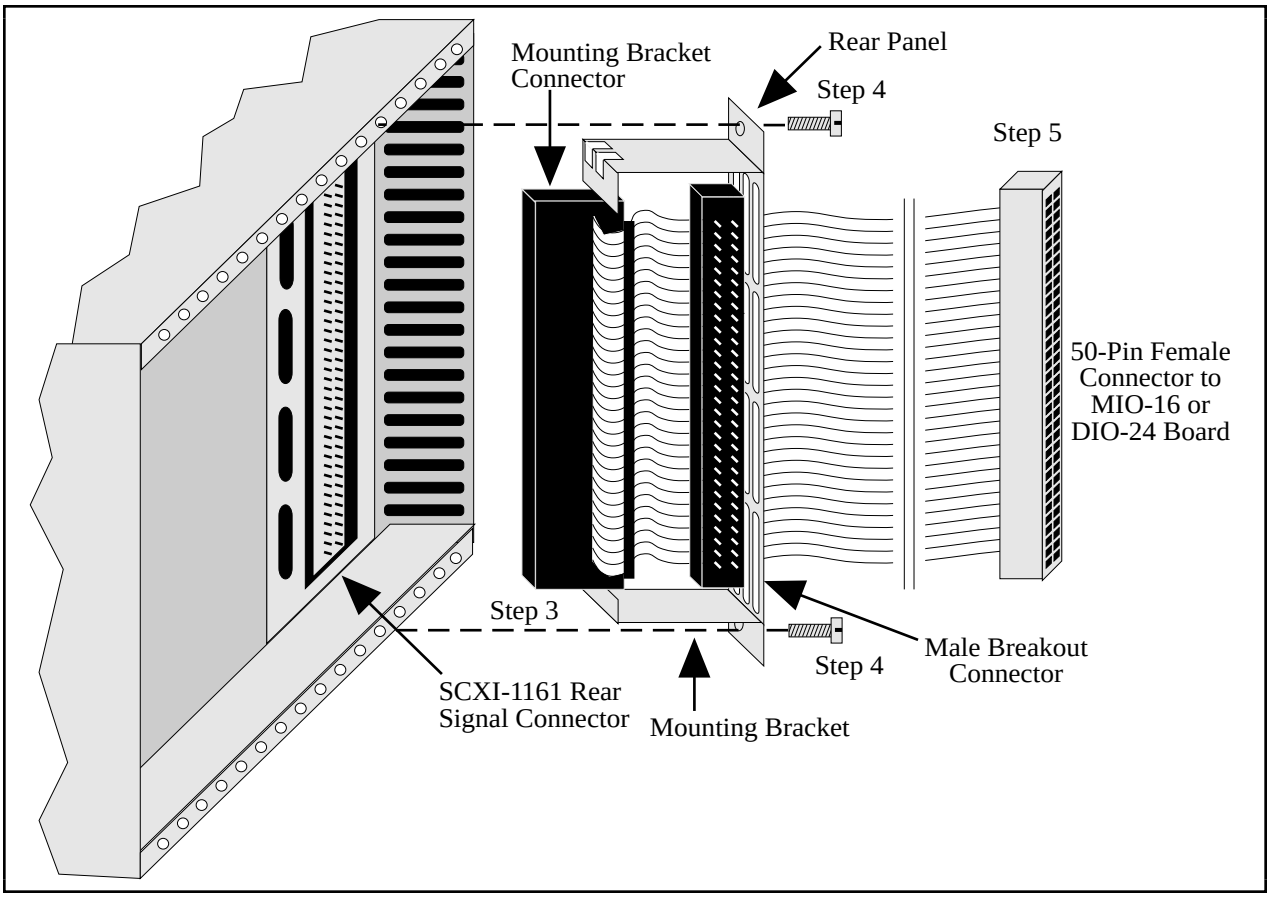


Figure E-1. SCXI-1340 Installation

SCXI-1341 Lab-NB, Lab-PC, or Lab-PC+ and SCXI-1344 Lab-LC Cable Assembly

The SCXI-1341 Lab-NB, Lab-PC, or Lab-PC+ cable assembly connects a Lab-NB, Lab-PC, or Lab-PC+ board to an SCXI-1161 module. The SCXI-1344 Lab-LC cable assembly connects a Lab-LC board to an SCXI-1161 module. The SCXI-1341 and SCXI-1344 cable assemblies consist of two pieces–an adapter board and a 50-conductor ribbon cable that connects the Lab board to the rear connector of the adapter board. The adapter board converts the signals from the Lab board I/O connector to a format compatible with the SCXI-1161 rear signal connector pinout at the front connector of the SCXI-1341 or SCXI-1344. The adapter board also has an additional male breakout connector that provides the unmodified Lab board signals for use with an SCXI-1180 feedthrough panel or SCXI-1181 breadboard module. The adapter board gives the Lab boards full access to the digital control lines. The position of jumper W1 on the SCXI-1341 and SCXI-1344 is irrelevant because the SCXI-1161 does not use jumper W1. Table E-2 lists the SCXI-1341 and SCXI-1344 pin translations.

Table E-2. SCXI-1341 and SCXI-1344 Pin Translations

Lab Board Pin	Lab Board Signal	SCXI-1161 Pin	SCXI-1161 Signal
1	ACH0	3	No Connect
2	ACH1	5	No Connect
3	ACH2	7	No Connect
4	ACH3	9	No Connect
5	ACH4	11	No Connect
6	ACH5	13	No Connect
7	ACH6	15	No Connect
8	ACH7	17	No Connect
9	AIGND	1-2	No Connect
10	DAC0OUT	20	No Connect
11	AOGND	23	No Connect
12	DAC1OUT	21	No Connect
13, 50	DGND	24	DIG GND
26	PB4	25	SERDATIN
27	PB5	27	DAQD*/A
28	PB6	29	SLOT0SEL*
29	PB7	37	SERCLK
31	PC1	26	SERDATOUT
32	PC2	28	No Connect
40	EXTCONV*	36	No Connect
43	OUTB1	46	No Connect
49	+5 V	34-35	No Connect

All other pins of the Lab board pinout are not sent to the SCXI-1161 rear signal connector.

SCXI-1341 and SCXI-1344 Installation

Perform the following steps to install the SCXI-1341 or SCXI-1344:

1. Make sure that the computer and the SCXI chassis are turned off.
2. Install the SCXI module in the chassis.
3. Connect one end of the ribbon cable to the adapter board rear connector. This is the 50-pin connector of the SCXI-1344 cable.
4. Plug the adapter board front connector to the module rear signal connector. A corner of the adapter board should enter the upper board guide of the chassis.
5. Screw the rear panel to the threaded strips in the rear of the chassis.
6. For an SCXI-1341, connect the loose end of the ribbon cable to the Lab-NB, Lab-PC, or Lab-PC+ I/O connector. For an SCXI-1344, connect the two 26-pin connectors to the Lab-LC board according to the instructions given in the *Installation* section of Chapter 2, *Configuration and Installation,* of the *Lab-LC User Manual*.

Check the installation.

SCXI-1342 PC-LPM-16 Cable Assembly

The SCXI-1342 PC-LPM-16 cable assembly connects a PC-LPM-16 board to an SCXI-1161 module. The SCXI-1342 cable assembly consists of two pieces–an adapter board and a 50-conductor ribbon cable that connects the PC-LPM-16 board to the adapter board. The adapter board converts the signals from the PC-LPM-16 I/O connector to a format compatible with the SCXI-1161 rear signal connector pinout. The adapter board also has an additional male breakout connector that provides the unmodified PC-LPM-16 signals for use with an SCXI-1180 feedthrough panel or SCXI-1181 breadboard module. The adapter board gives the PC-LPM-16 full access to the digital control lines. The position of jumper W1 on the SCXI-1342 is irrelevant because the SCXI-1161 does not use jumper W1. Table E-3 lists the SCXI-1342 pin translations.

Table E-3. SCXI-1342 Pin Translations

PC-LPM-16 Pin	PC-LPM-16 Signal	Rear Signal Connector Pin	SCXI-1161 Use
1-2	AIGND	1-2	No Connect
3	ACH0	3	No Connect
4	ACH8	4	No Connect
5	ACH1	5	No Connect
6	ACH9	6	No Connect
7	ACH2	7	No Connect
8	ACH10	8	No Connect
9	ACH3	9	No Connect
10	ACH11	10	No Connect
11	ACH4	11	No Connect
12	ACH12	12	No Connect
13	ACH5	13	No Connect
14	ACH13	14	No Connect
15	ACH6	15	No Connect
16	ACH14	16	No Connect
17	ACH7	17	No Connect
18	ACH15	18	No Connect
19, 50	DGND	24	DIG GND
28	DIN6	26	SERDATOUT
29	DIN7	28	No Connect
34	DOUT4	25	SERDATIN
35	DOUT5	27	DAQD*/A
36	DOUT6	29	SLOT0SEL*
37	DOUT7	37	SERCLK
46	OUT2	46	No Connect
49	+5 V	34-35	No Connect

All other pins of the PC-LPM-16 pinout are not sent to the SCXI-1161 rear signal connector.

SCXI-1342 Installation

Perform the following steps to install the SCXI-1342:

1. Make sure that the computer and the SCXI chassis are turned off.
2. Install the SCXI module to which the SCXI-1342 will connect.
3. Connect one end of the ribbon cable to the adapter board rear connector.
4. Plug the adapter board front connector onto the module rear signal connector. A corner of the adapter board should enter the upper board guide of the chassis.
5. Screw the rear panel to the threaded strips in the rear of the chassis.
6. Connect the loose end of the ribbon cable to the PC-LPM-16 I/O connector.

DIO-96, AT-MIO-16D, and AT-MIO-64F-5 Board Connection

To use your SCXI-1161 with a DIO-96, AT-MIO-16D, or AT-MIO-64F-5 board, you need an NB5 cable. The NB5 cable is a ribbon cable with a 100-pin connector that mates with the data acquisition board rear signal connector. The other end of the cable is divided into two 50-pin connectors. Use positions 1 through 50 of the board connector to control the SCXI-1161. You can either connect the positions 1 through 50 connector of the NB5 cable directly to the SCXI-1161, or use an SCXI-1351 cable extender between the SCXI-1161 and the NB5 cable. The SCXI-1161 does not use positions 51 through 100 of the NB5 cable.

The SCXI-1351 has the following advantages over the ribbon cable:

- The SCXI-1351 produces strain relief so that you cannot accidentally disconnect the cable.
- The SCXI-1351 includes a mounting bracket that mounts to the chassis so that you can remove and reinsert the module without explicitly removing the cable from the back of the chassis. This is especially useful when the SCXI chassis is rack mounted, making rear access difficult.
- The SCXI-1351 has an extra female connector for use with the SCXI-1180 feedthrough panel or additional modules or breadboards that need a direct connection to the data acquisition board.
- The SCXI-1351 rear panel gives the module and the chassis both mechanical and electrical shielding.

Table E-4 lists the pin equivalences of the DIO-96, AT-MIO-16D, and AT-MIO-64F-5 board and the SCXI-1161.

Table E-4. SCXI-1161, DIO-96, AT-MIO-16D, and AT-MIO-64F-5 Board Pinout Equivalences

Pin	SCXI-1161 Rear Signal Connector	AT-MIO-16D and AT-MIO-64F-5 Equivalent	DIO-96 Board Equivalent
24	DIG GND (MIO)	DIG GND	
25	SERDATIN	ADIO0	APB3
26	SERDATOUT (MIO)	BDIO0	
27	DAQD*/A	ADIO1	APB2
29	SLOT0SEL*	ADIO2	APB1
31	SERCLK(DIO)		APB0
37	SERCLK (MIO)	EXTSTROBE*	
47	SERDATOUT (DIO)		APA0
50	DIG GND (DIO)		DIG GND

No other pins are connected on the SCXI-1161.

SCXI-1351 and NB5 Cable Installation

Perform the following steps to install the SCXI-1351:

1. Make sure that the computer and the SCXI chassis are turned off.
2. Install the SCXI module in the chassis.
3. Connect the positions 1 through 50 connector of the NB5 cable to the male breakout connector on the SCXI-1351.
4. Plug the mounting bracket connector onto the module rear signal connector (see Figure E-2). An alignment tab on the bracket should enter the upper board guide of the chassis.
5. Screw the mounting bracket to the threaded strips in the rear of the chassis.
6. Connect the 100-pin connector of the NB5 cable to the data acquisition board.

After step 1, the order of these steps is not critical; however, it is easier to locate the correct position for the mounting bracket with a module installed in the chassis. If you are attaching a cable to the female connector, installation is easiest if you attach the second cable before installing the SCXI-1351.

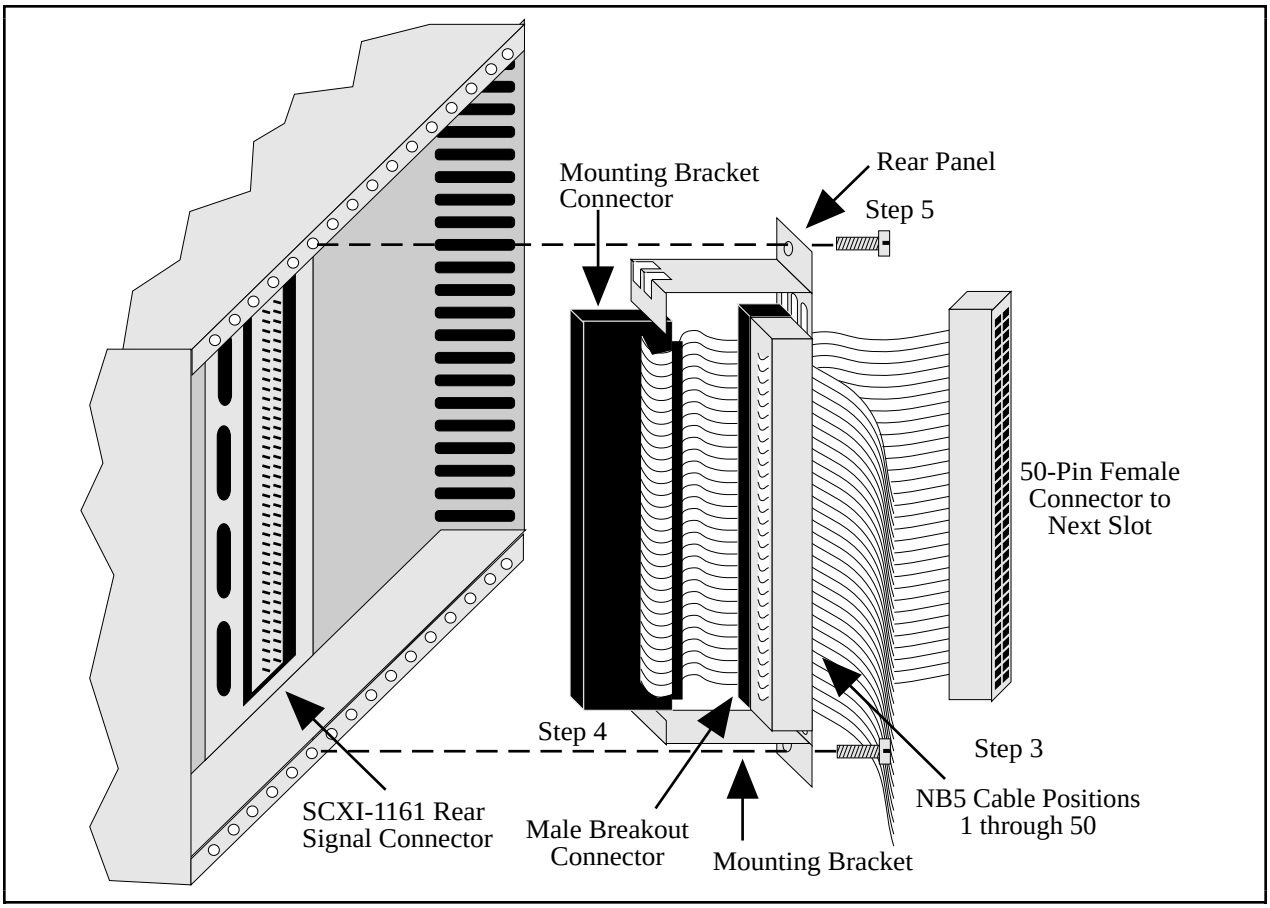


Figure E-2. SCXI-1351 and NB5 Cable Installation

SCXI-1348 DIO-32F Cable Assembly

The SCXI-1348 DIO-32F cable assembly connects a DIO-32F board to an SCXI-1161 module. The SCXI-1348 cable assembly consists of two pieces–an adapter board and a 50-conductor shielded ribbon cable that connects the DIO-32F board to the adapter board. The adapter board converts the signals from the DIO-32F I/O connector to a format compatible with the SCXI-1161 rear signal connector pinout. The adapter board also has an additional male breakout connector that provides the unmodified DIO-32F signals for use with an SCXI-1180 feedthrough panel or SCXI-1181 breadboard module. The adapter board gives the DIO-32F full access to the digital control lines. Table E-5 lists the SCXI-1348 pin translations.

Table E-5. SCXI-1348 Pin Translations

DIO-32F Pin	DIO-32F Signal	Rear Signal Connector Pin	SCXI-1161 Use
1	DIOD1	46	No Connect
2	DIOD4	40	No Connect
3	DIOD3	42	No Connect
4	DIOD0	48	No Connect
5	DIOD6	36	No Connect
6	DIOD7	34	No Connect
7	DIOD2	44	No Connect
8	DIOD5	38	No Connect
9	DIOC5	5	No Connect
10	DIOC7	1	No Connect
11	DIOC3	9	No Connect
12	DIOC1	13	No Connect
13	DIOC2	11	No Connect
14	DIOC0	15	No Connect
15	DIOC6	3	No Connect
16	DIOC4	7	No Connect
17, 19	DIG GND	2, 4	No Connect
21, 23	DIG GND	6, 8	No Connect
25, 26	DIG GND	10, 12	No Connect
28, 30	DIG GND	14, 16	No Connect
32, 34	DIG GND	50	DIG GND
18	ACK2	26	No Connect
20	IN2	28	No Connect
22	OUT2	30	No Connect
24	REQ2	32	No Connect
27	ACK1	18	No Connect
29	IN1	20	No Connect
31	OUT1	22	No Connect
33	REQ1	24	No Connect
35	DIOA4	39	No Connect
36	DIOA6	35	No Connect
37	DIOA0	47	SERDATOUT
38	DIOA2	43	No Connect
39	DIOA1	45	No Connect
40	DIOA3	41	No Connect
41	DIOA7	33	No Connect
42	DIOA5	37	No Connect
43	DIOB5	21	No Connect
44	DIOB2	27	DAQD*/A
45	DIOB7	17	No Connect
46	DIOB6	19	No Connect
47	DIOB0	31	SERCLK
48	DIOB3	25	SERDATIN
49	DIOB4	23	No Connect
50	DIOB1	29	SLOT0SEL*

SCXI-1348 Installation

Perform the following steps to install the SCXI-1348:

1. Make sure that the computer and the SCXI chassis are turned off.
2. Install the SCXI module to which the SCXI-1348 will connect.
3. Connect one end of the ribbon cable to the adapter board rear connector.
4. Plug the adapter board front connector onto the module rear signal connector. A corner of the adapter board should enter the upper board guide of the chassis.
5. Screw the rear panel to the threaded strips in the rear of the chassis.
6. Connect the loose end of the ribbon cable to the DIO-32F I/O connector.

Check the installation.

SCXI-1180 Feedthrough Panel

The SCXI-1180 feedthrough panel provides front panel access to the signals of any data acquisition board that uses a 50-pin I/O connector. The SCXI-1180 consists of a front panel with a 50-pin male front panel connector that occupies one slot in the SCXI chassis, and a ribbon cable with a female rear connector and a male breakout connector. You can attach the rear connector to the male breakout connector of an SCXI-1340, SCXI-1341, SCXI-1342, SCXI-1344, or SCXI-1351 in the adjacent slot. The breakout connector further extends the cabling scheme. The front panel connector has the feedthrough connection. You can attach an SCXI-1302 terminal block to the front panel connector for simple screw terminal connections. A rear filler panel that shields and protects the interior of the SCXI chassis is also included.

SCXI-1180 Installation

Install the SCXI-1180 to the right of a slot that has an SCXI-1340, SCXI-1341, SCXI-1342, or SCXI-1344 cable assembly or an SCXI-1351 slot extender in its rear connector space.

Perform the following steps to install the SCXI-1180:

1. Make sure that the computer and the SCXI chassis are turned off.
2. Remove the front filler panel of the slot where you want to insert the SCXI-1180.
3. Thread the rear connector through the front of the chassis to the rear of the chassis. Attach the rear connector to the breakout connector of the adjacent cable assembly or slot extender, as shown in Figure E-3.
4. Screw in the rear panel to the threaded strip in the rear of the chassis as shown in Figure E-3.
5. Screw the front panel into the front threaded strip as shown in Figure E-4.

Check the installation.

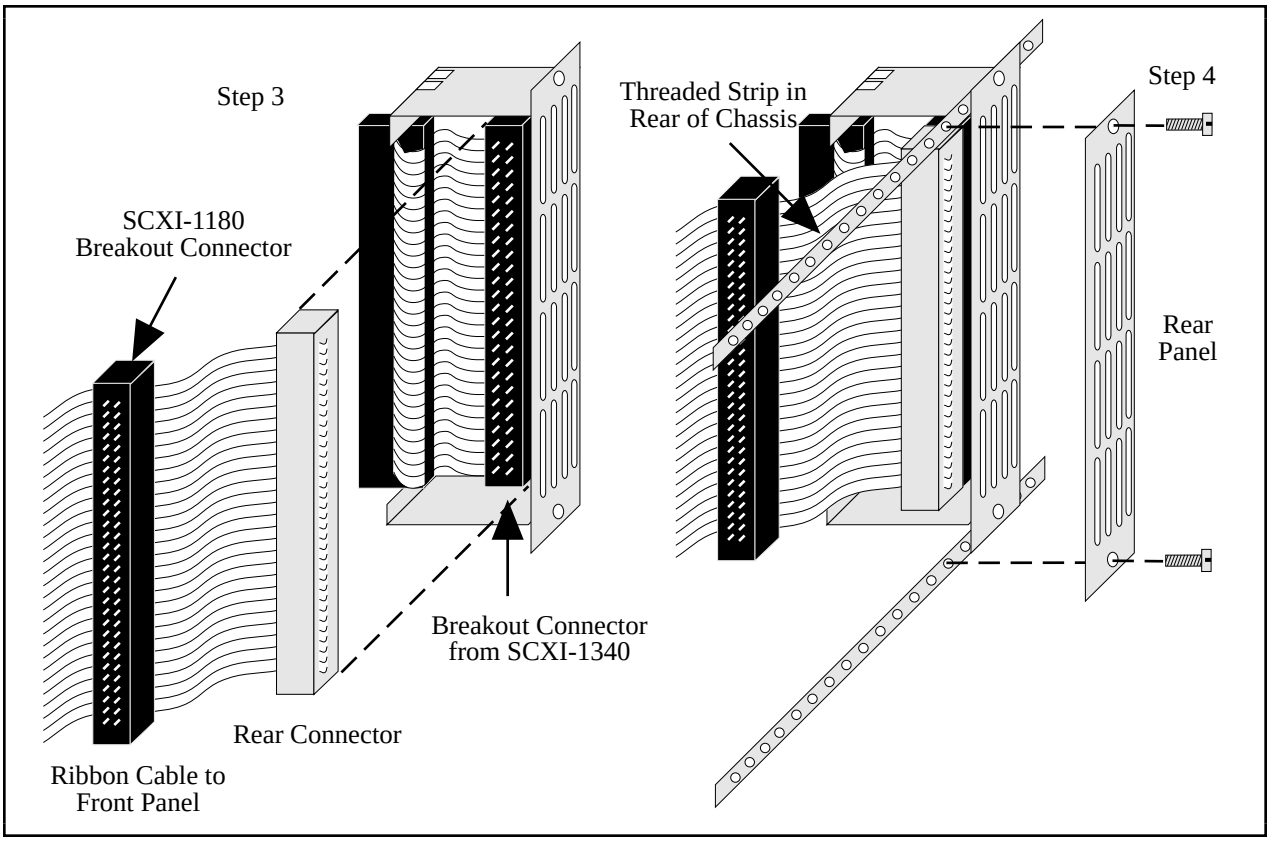


Figure E-3. SCXI-1180 Rear Connections

Note: If you are using the SCXI-1180 with an SCXI-1351 and an NB5 cable, connect the SCXI-1180 breakout connector to the female connector on the SCXI-1351. Place the SCXI-1180 to the *left* of the SCXI-1351 (looking to the front of the chassis).

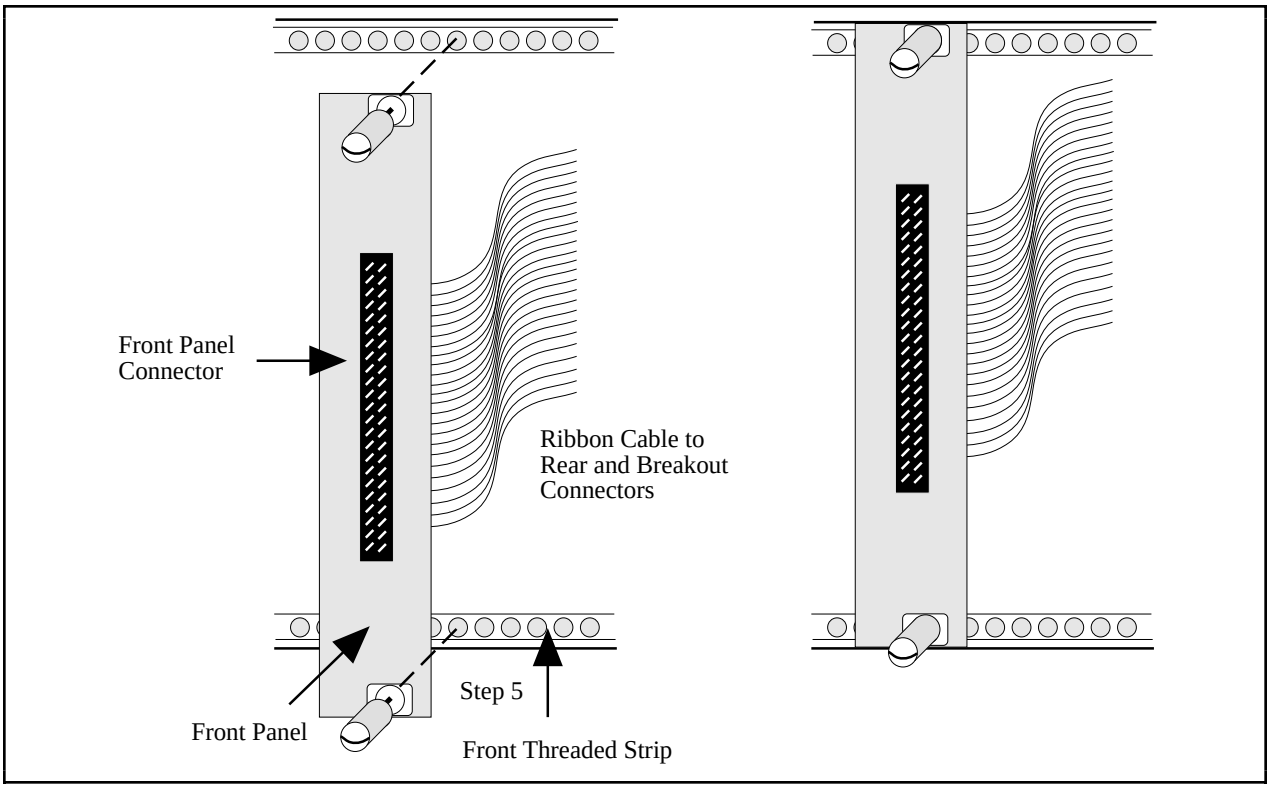


Figure E-4. SCXI-1180 Front Panel Installation

SCXI-1302 50-Pin Terminal Block

The SCXI-1302 terminal block has screw terminal connections for the 50-pin connector on the SCXI-1180 feedthrough panel.

SCXI-1302 Wiring Procedure

To wire the SCXI-1302 terminal block, you must remove the cover, connect all the wiring, and replace the cover. To do so, perform the following steps:

1. Unscrew the rear grounding screw on the back of the terminal block, as shown in Figure E-5.
2. With a flathead screwdriver, carefully pry the cover off the terminal block.
3. Insert each wire through the terminal block strain relief.
4. Connect the wires to the screw terminals.
5. Tighten the large strain relief screws to secure the wires.
6. Snap the cover back in place.
7. Reinsert the rear grounding screw. The terminal block is now ready to be connected to the front panel connector.

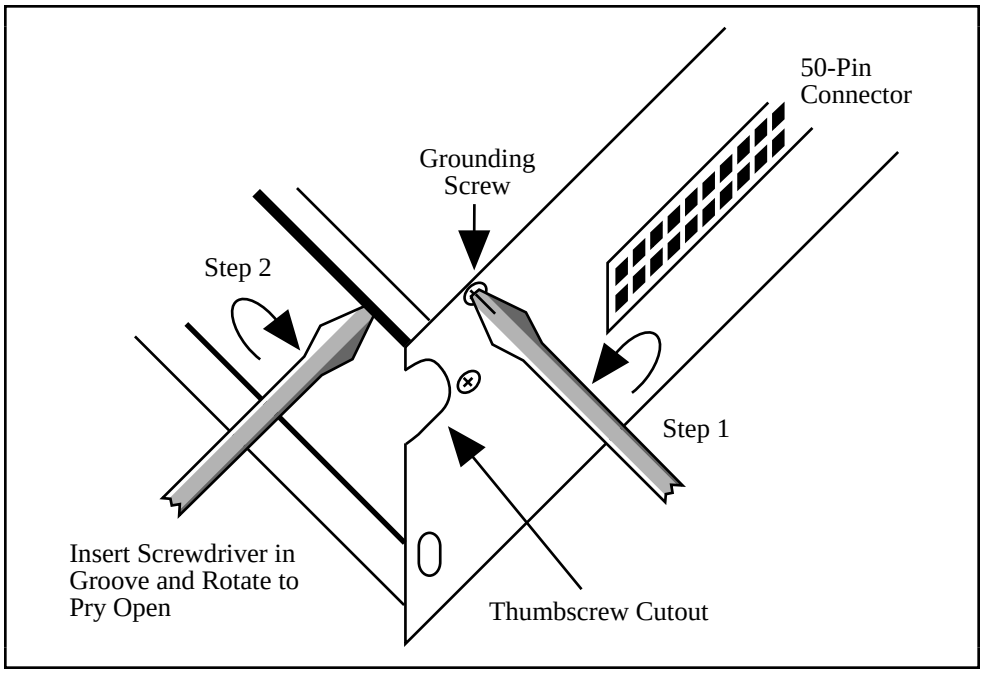


Figure E-5. Cover Removal

SCXI-1302 Installation

Perform the following steps to install the SCXI-1302:

1. Install an SCXI-1180 feedthrough panel as described in the *SCXI-1180 Installation* section earlier in this appendix.

2. Wire the terminal block as previously described in the *SCXI-1302 Wiring Procedure* section earlier in this appendix.

3. Connect the SCXI-1302 terminal block to the front panel connector on the SCXI-1180 feedthrough panel. Be careful to fit the thumbscrews in the thumbscrew cutouts.

4. Tighten the top and bottom captive screws on the back of the terminal block into the screw holes in the front panel to hold the SCXI-1302 securely in place.

Check the installation.

SCXI-1351 One-Slot Cable Extender

The SCXI-1351 cable extender is a miniature SCXI-1340 cable assembly. Instead of connecting to an MIO board 1 m away, the SCXI-1351 female rear connector connects to a male breakout connector that must be in the rear connector space of the slot to the left. The SCXI-1351 has a female mounting bracket connector that mates with the rear signal connector of a module, and also has a male breakout connector on the ribbon cable for connecting to a feedthrough panel or more cable extenders.

SCXI-1351 Installation

Perform the following steps to install the SCXI-1351:

1. Make sure that the computer and the SCXI chassis are turned off.
2. Install the SCXI module in the chassis.
3. Connect the rear connector of the cable extender to the breakout connector in the adjacent slot. This attachment is similar to Step 3 in the *SCXI-1180 Installation* section earlier in this appendix, as shown in Figure E-3.
4. Plug the mounting bracket connector to the module rear signal connector. An alignment tab on the bracket should enter the upper board guide of the chassis.
5. Screw the mounting bracket to the threaded strips in the rear of the chassis.

Check the installation.

Multiple-Chassis Connections for the SCXI-1161

The SCXI-1161 can operate in a multiple-chassis system with the DIO-24, DIO-96, MIO-16, and AT-MIO-64F-5 boards. A multiple-chassis system can consist of up to eight SCXI-1001 chassis controlled by the same data acquisition board. Notice that you cannot use the SCXI-1000 in a multiple-chassis system. For each chassis, you need an SCXI-1350 multichassis adapter board and an NB1 ribbon cable.

Note: When connecting multiple chassis, you should use 0.5 m length ribbon cable between chassis to minimize cable length and maintain signal integrity. However, you can use a 1.0 m cable from the data acquisition board to the first chassis. When you are using the DIO-96, AT-MIO-16D, or AT-MIO-64F-5, use an NB5 ribbon cable from the data acquisition board to the first chassis, connecting positions 1 through 50 to the SCXI-1350 in the first chassis.

Installation

After you have installed the data acquisition board into the computer and the SCXI modules into each of the SCXI-1001 chassis, cable one module from each chassis to the data acquisition board as follows:

1. Make sure the computer and all the SCXI chassis are turned off.
2. Connect one end of the NB1 (the 100-pin connector of the NB5) cable to the data acquisition board.
3. Plug the other end of the cable (positions 1 to 50 of the NB5 cable) into the connector with latches at the rear of the SCXI-1350 adapter board.

4. Connect another ribbon cable to the chassis extender connector in the middle of the SCXI-1350.

5. Plug the SCXI-1350 into the back of the SCXI module in the first chassis so that the module rear connector mates with the front connector on the SCXI-1350 adapter board. When you are connecting to an SCXI-1161, be sure to set the jumpers for either a DIO-type or an MIO-type board as appropriate.

6. Screw the rear panel to the threaded strips in the rear of the chassis.

7. Connect the loose end of the ribbon cable from Step 4 into the rear connector of the second SCXI-1350 and install the adapter board.

8. Continue until all chassis are connected. You do not need to connect anything to the middle connector of the SCXI-1350 adapter board in the last chassis.

SCXI-1343 Rear Screw Terminal Adapter

You use the SCXI-1343 universal adapter to adapt custom wiring to the SCXI-1161. The SCXI-1343 has screw terminals and solder pads for signal connection. A strain relief is on the outside of the rear panel. Table E-6 shows the SCXI-1343 pin connections.

SCXI-1343 Installation

1. Insert each wire through the adapter strain relief.

2. Make all solder connections first.

3. Tighten the strain relief screws to secure the wires.

4. Plug the adapter board front connector into the module rear signal connector. A corner of the adapter board should enter the upper board guide of the chassis.

5. Screw the rear panel to the threaded strips in the rear of the chassis.

Table E-6. SCXI-1343 Pin Connections

Rear Signal Connector Pin	SCXI-1161 Use	Connection
1	No Connect	Solder pad
2	No Connect	Screw terminal
3	No Connect	Screw terminal
4	No Connect	Screw terminal
5	No Connect	Screw terminal
6	No Connect	Screw terminal
7	No Connect	Screw terminal
8	No Connect	Screw terminal
9	No Connect	Screw terminal
10	No Connect	Screw terminal
11	No Connect	Screw terminal
12	No Connect	Screw terminal
13	No Connect	Screw terminal
14	No Connect	Screw terminal
15	No Connect	Screw terminal
16	No Connect	Screw terminal
17	No Connect	Screw terminal
18	No Connect	Screw terminal
19	No Connect	Screw terminal
20	No Connect	Solder pad
21	No Connect	Solder pad
22	No Connect	Solder pad
23	No Connect	Solder pad
24	DIG GND (MIO)	Solder pad
26	SERDATOUT (MIO)	Solder pad
27	DAQD*/A	Solder pad
28	No Connect	Solder pad
29	SLOT0SEL*	Solder pad
30	No Connect	Solder pad
31	SERCLK (DIO)	Solder pad
32	No Connect	Solder pad
33	No Connect	Solder pad
34-35	No Connect	Solder pad
36	No connect	Solder pad
37	SERCLK (MIO)	Solder pad
38	No Connect	Solder pad
39	No Connect	Solder pad
40	No Connect	Solder pad
41	No Connect	Solder pad
42	No Connect	Solder pad
43	No Connect	Solder pad
44	No Connect	Solder pad
45	No Connect	Solder pad
46	No Connect	Solder pad
47	SERDATOUT (DIO)	Solder pad
48	No Connect	Solder pad
49	No Connect	Solder pad
50	DIG GND (DIO)	Solder pad

Appendix F
Customer Communication

For your convenience, this appendix contains forms to help you gather the information necessary to help us solve technical problems you might have as well as a form you can use to comment on the product documentation. Filling out a copy of the *Technical Support Form* before contacting National Instruments helps us help you better and faster.

National Instruments provides comprehensive technical assistance around the world. In the U.S. and Canada, applications engineers are available Monday through Friday from 8:00 a.m. to 6:00 p.m. (central time). In other countries, contact the nearest branch office. You may fax questions to us at any time.

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Denmark	45 76 26 00	45 76 71 11
Finland	90 527 2321	90 502 2930
France	1 48 65 33 00	1 48 65 19 07
Germany	089 7 14 50 93	089 7 14 60 35
Italy	02 48301892	02 48301915
Japan	03 3788 1921	03 3788 1923
Netherlands	01720 45761	01720 42140
Norway	03 846866	03 846860
Spain	91 640 0085	91 640 0533
Sweden	08 730 49 70	08 730 43 70
Switzerland	056 27 00 20	056 27 00 25
U.K.	0635 523545	0635 523154
	or 0800 289877 (in U.K. only)	

Technical Support Form

Photocopy this form and update it each time you make changes to your software or hardware, and use the completed copy of 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.

If you are using any National Instruments hardware or software products related to this problem, include the configuration forms from their user manuals. Include additional pages if necessary.

Name _____

Company _____

Address _____

_____

Fax (___)_____ Phone (___)_____

Computer brand _____ Model _____ Processor _____

Operating system _____

Speed _____ MHz RAM _____ M Display adapter _____

Mouse _____ yes _____ no Other adapters installed _____

Hard disk capacity _____ M Brand _____

Instruments used _____

National Instruments hardware product model _____ Revision _____

Configuration _____

National Instruments software product _____ Version _____

Configuration _____

The problem is _____

_____

_____

_____

_____

List any error messages _____

_____

_____

_____

_____

The following steps will reproduce the problem _____

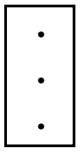
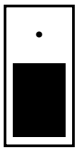
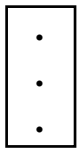
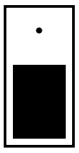
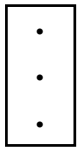
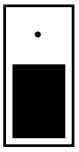
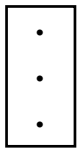
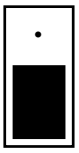
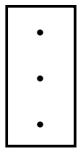
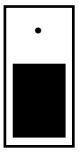
_____

_____

SCXI-1161 Hardware Configuration Form

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.

- SCXI-1161 Revision _____
- Chassis Slot _____
- Chassis Type _____

	My Setting	Factory Setting
• Jumper W1		
• Jumper W2		
• Jumper W3		
• Jumper W4		
• Jumper W5		

Note: Mark your jumper positions on the jumper diagrams in the left column.

- Other Modules and Chassis in System _____
  _____
  _____
- Data Acquisition Boards Installed _____
  _____

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Glossary

Prefix	Meaning	Value
p-	pico-	10^{-12}
n-	nano-	10^{-9}
µ-	micro-	10^{-6}
m-	milli-	10^{-3}
k-	kilo-	10^{3}
M-	mega-	10^{6}

°	degrees
Ω	ohms
+5 V (signal)	+5 VDC Source
A	amperes
AC	alternating current
A/D	analog-to-digital
AWG	American Wire Gauge
C	Celsius
CHS	Chassis
CHSGND	Chassis Ground
COM	common
cpm	cycles per minute
D/A	digital-to-analog
D*/A	Data/Address
DAQD*/A	Data Acquisition Board Data/Address Line
DC	direct current
DIG GND	Digital Ground
DIO	digital I/O
FIFO	first-in-first-out
ft	feet
hex	hexadecimal
HSCR	Hardscan Control Register
Hz	hertz
I/O	input/output
I_I	input current leakage
I_{in}	input current
in.	inches
INTR*	Interrupt
I_{out}	output current
LSB	least significant bit
M	megabytes of memory
m	meters
MIO	multifunction I/O
MISO	Master-In-Slave-Out
MOSI	Master-Out-Slave-In
MOV	metal oxide varistor
MSB	most significant bit

NC	normally closed
NO	normally open
RAM	random-access memory
RESET*	reset
RMA	Return Material Authorization
rms	root mean square
RTSI	Real-Time System Integration
SCXI	Signal Conditioning eXtensions for Instrumentation (bus)
SDK	Software Developer's Kit
sec	seconds
SERCLK	Serial Clock
SERDATIN	Serial Data In
SERDATOUT	Serial Data Out
SL	Slot
SLOT0SEL*	Slot 0 Select
SPDT	single-pole double-throw
SPI	Serial Peripheral Interface
SPICLK	Serial Peripheral Interface Clock
SS*	Slot Select
UL	Underwriters Laboratory
V	volts
V+	Positive Analog Supply
V-	Negative Analog Supply
VAC	volts alternating current
VDC	volts direct current
V_{IH}	volts input high
V_{IL}	volts input low
V_{in}	volts in
V_{OH}	volts output high
V_{OL}	volts output low
V_{out}	volts out
Vrms	volts, root mean square
W	watts

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