DAQ

SCXI™-1161 User Manual

8-Channel Power Relay Module

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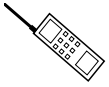

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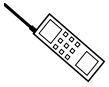

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About This Manual

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, *Signal Connections*, 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.
- Chapter 4, *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.
- Appendix A, *Specifications*, lists the specifications for the SCXI-1161.
- Appendix B, *Contact Protection*, contains technical data on contact protection when you are switching inductive loads.

- Appendix C, *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/PnP 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/PnP 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.
Slot 0	Slot 0 refers to the power supply and control circuitry in the SCXI chassis.
	The *Glossary* lists abbreviations, acronyms, metric prefixes, mnemonics, symbols, and terms.

National Instruments Documentation

The *SCXI-1161 User Manual* is one piece of the documentation set for your data acquisition (DAQ) and SCXI system. You could have any of several types of manuals, depending on the hardware and software in your system. Use the different types of manuals you have as follows:

- *Getting Started with SCXI*—This is the first manual you should read. It gives an overview of the SXCI system and contains the most commonly needed information for the modules, chassis, and software.
- You SCXI hardware user manuals—Read these manuals next for detailed information about signal connections and module configuration. They also explain in greater detail how the module works and contain application hints.
- Your DAQ hardware user manuals—These manuals have detailed information about DAQ hardware that plugs into or is connected to your computer. Use these manuals for hardware installation and configuration instructions, specification information about your DAQ hardware, and application hints.
- Software documentation—Examples of software documentation you may have are the LabVIEW and LabWindows®/CVI documentation sets and the NI-DAQ documentation. After you set up your hardware system, use either the application software (LabVIEW or LabWindows/CVI) or the NI-DAQ documentation to help you write your application. If you have a large, complicated

system, it is worthwhile to look through the software documentation before you configure your hardware.

- Accessory installation guides or manuals—If you are using accessory products, read the terminal block and cable assembly installation guides or accessory board user manuals. They explain how to physically connect the relevant pieces of the system. Consult these guides when you are making your connections.
- *SCXI Chassis User Manual*—Read this manual for maintenance information on the chassis and for installation instructions.

Related Documentation

The following National Instruments manual contains detailed information for the register-level programmer:

- *SCXI Register-Level Programmer Manual*

This manual is available from National Instruments by request. Using NI-DAQ, LabView, or LabWindows/CVI is as easy as using the low-level programming described in the register-level programmer manual. Refer to *Software Programming Choices* in Chapter 1, *Introduction*, of this manual to learn more about your programming options.

If you are designing your own module, the *SCXIbus System Specification* is available from National Instruments upon request. The specification describes the physical, electrical, and timing requirements for the SCXIbus.

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 C, *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.

About the SCXI-1161

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

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/PnP 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 You Need to Get Started

To set up and use your SCXI-1161, you will need the following items:

- ❑ SCXI-1161 module
- ❑ *SCXI-1161 User Manual*

Software Programming Choices

There are several options to choose from when programming your National Instruments DAQ or SCXI hardware. You can use LabVIEW, LabWindows/CVI, ComponentWorks, VirtualBench, NI-DAQ, or register-level programming.

National Instruments Application Software

LabVIEW features interactive graphics, a state-of-the-art user interface, and a powerful graphical programming language. The LabVIEW Data Acquisition Virtual Instrument (VI) Library, a series of VIs for using LabVIEW with National Instruments DAQ hardware, is included with LabVIEW. The LabVIEW Data Acquisition VI Library is functionally equivalent to the NI-DAQ software.

LabWindows/CVI features interactive graphics, a state-of-the-art user interface, and uses the ANSI standard C programming language. The LabWindows/CVI Data Acquisition Library, a series of functions for using LabWindows/CVI with National Instruments DAQ hardware, is included with the NI-DAQ software kit. The LabWindows/CVI Data Acquisition Library is functionally equivalent to the NI-DAQ software.

ComponentWorks contains tools for data acquisition and instrument control built on NI-DAQ driver software. ComponentWorks provides a higher-level programming interface for building virtual instruments through standard OLE controls and DLLs. With ComponentWorks, you can use all of the configuration tools, resource management utilities, and interactive control utilities included with NI-DAQ.

VirtualBench features VIs that combine DAQ products, software, and your computer to create a stand-alone instrument with the added benefit of the processing, display, and storage capabilities of your computer. VirtualBench instruments load and save waveform data to disk in the same forms that can be used in popular spreadsheet programs and word processors.

Using LabVIEW, LabWindows/CVI, ComponentWorks, or VirtualBench software will greatly reduce the development time for your data acquisition and control application.

NI-DAQ Driver Software

The NI-DAQ driver software is included at no charge with all National Instruments DAQ hardware. NI-DAQ is not packaged with SCXI or accessory products, except for the SCXI-1200. NI-DAQ has an extensive 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 (timed D/A conversion), digital I/O, counter/timer operations, SCXI, RTSI, self-calibration, messaging, and acquiring data to memory.

NI-DAQ has both high-level DAQ I/O functions for maximum ease of use and low-level DAQ I/O functions for maximum flexibility and performance. Examples of high-level functions are streaming data to disk or acquiring a certain number of data points. An example of a low-level function is writing directly to registers on the DAQ device. NI-DAQ does not sacrifice the performance of National Instruments DAQ devices because it lets multiple devices operate at their peak performance.

NI-DAQ also internally addresses many of the complex issues between the computer and the DAQ hardware such as programming interrupts and DMA controllers. NI-DAQ maintains a consistent software interface among its different versions so that you can change platforms with minimal modifications to your code. Whether you are using conventional programming languages, LabVIEW, LabWindows/CVI, or other application software, your application uses the NI-DAQ driver software, as illustrated in Figure 1-1.

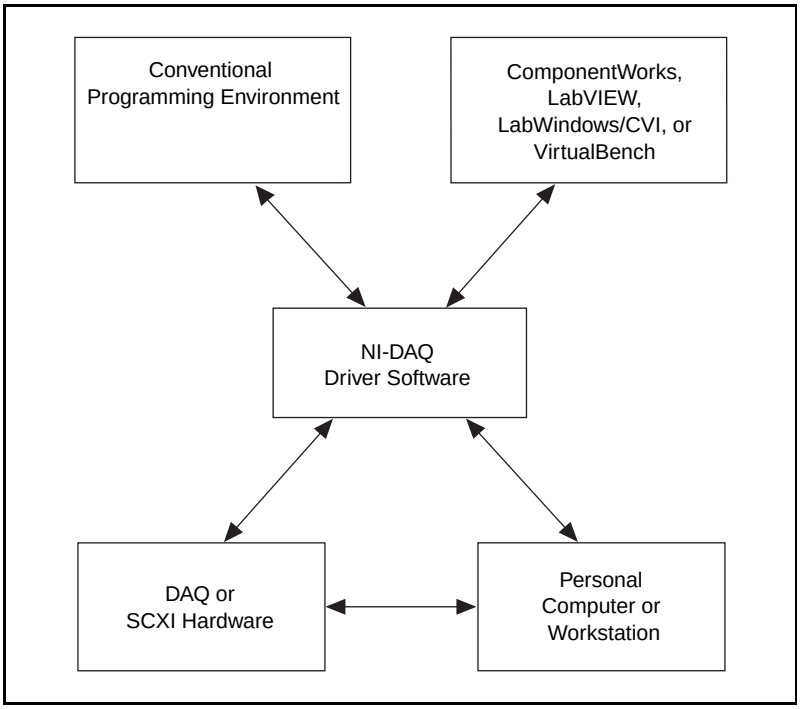


Figure 1-1. The Relationship between the Programming Environment, NI-DAQ, and Your Hardware

Register-Level Programming

The final option for programming any National Instruments DAQ hardware is to write register-level software. Writing register-level programming software can be very time-consuming and inefficient, and is not recommended for most users.

Even if you are an experienced register-level programmer, consider using NI-DAQ, LabVIEW, LabWindows/CVI or other National Instruments application software to program your National Instruments DAQ hardware. Using the National Instruments application software is easier than, and as flexible as, register-level programming, and can save weeks of development time.

Optional Equipment

National Instruments offers a variety of products to use with your SCXI-1611, including cables and other accessories as follows:

- Cables and cable assemblies
- Multichassis adapter
- One-slot cable extender

For more specific information about these products, refer to your National Instruments catalogue or call the office nearest you.

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. Electrostatic discharge can damage several components on the module. To avoid such damage in handling the module, take the following precautions:

- Ground yourself via a grounding strap or by holding a grounded object.
- 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.
- Never touch the exposed pins of the connectors.

Configuration and Installation

Chapter 2

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, shown in Figure 2-1.

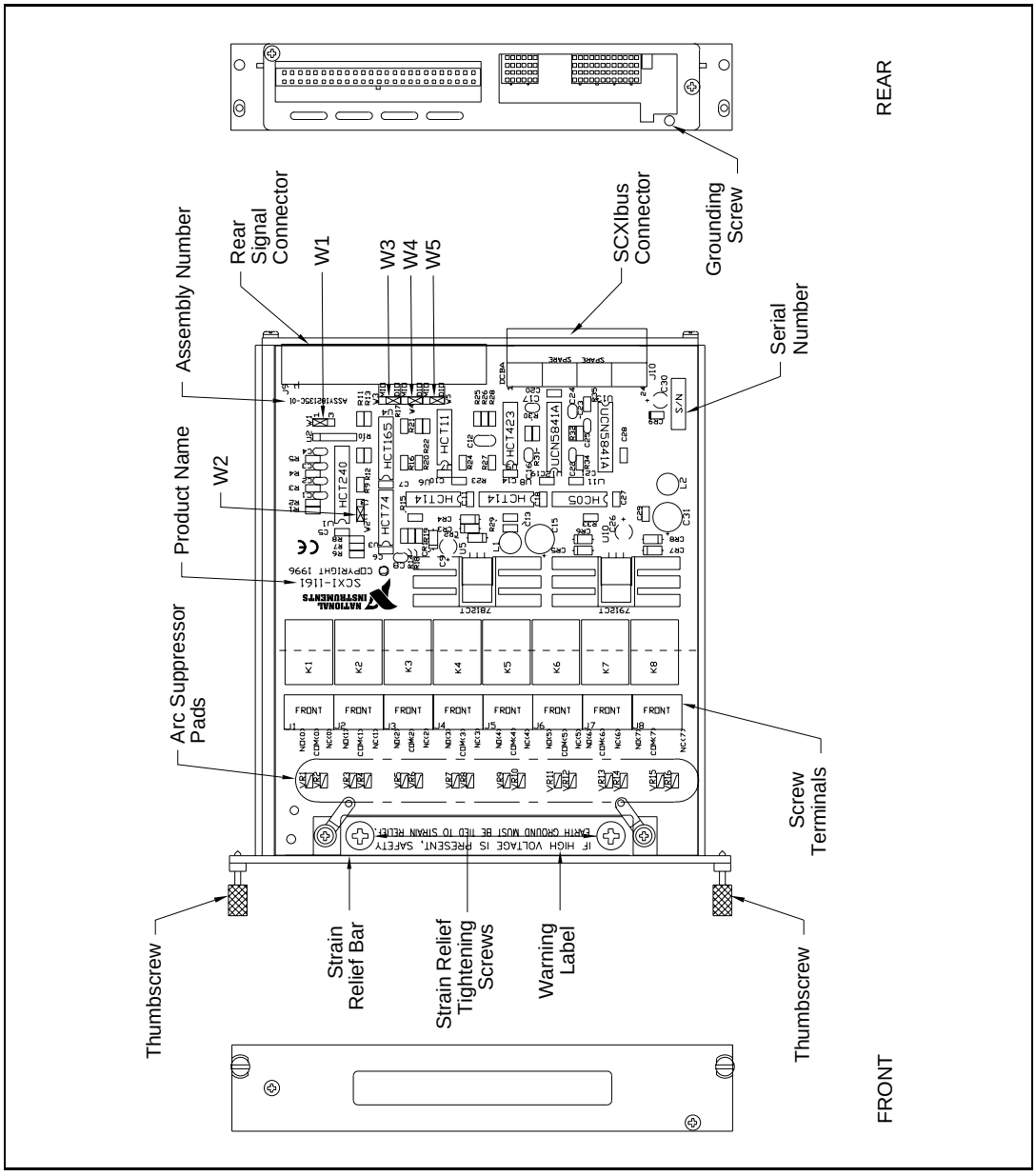


Figure 2-1. SCXI-1161 General Parts Locator Diagram

Caution: ***DO NOT OPERATE THE DEVICE 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 device, hazardous voltages may exist even when the equipment is turned off. To avoid a shock hazard, do not perform procedures involving cover or shield removal unless you are qualified to do so and disconnect all field power prior to removing covers or shields.

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

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

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

Terminals are for use only with equipment that has no accessible live parts.

DO NOT SUBSTITUTE PARTS OR MODIFY EQUIPMENT. Because of the danger of introducing additional hazards, do not install unauthorized parts or modify the device. Return the device to National Instruments for service and repair to ensure that its safety features are not compromised.

When using the device with high common-mode voltages, you MUST insulate your signal wires for the highest input voltage. National Instruments is NOT liable for any damages or injuries resulting from inadequate signal wire insulation. Use only 26 to 14 AWG wire with a voltage rating of 300 V and 60° C for measuring 250 to 300 V; use only 600 V and 60° C for measuring 480 V. Prepare your signal wire by stripping the insulation no more than 7 mm.

When connecting or disconnecting signal lines to the SCXI terminal block screw terminals, make sure the lines are powered off. Potential differences

between the lines and the SCXI ground create a shock hazard while you connect the lines.

Connect the signal wires to the screw terminals by inserting the stripped end of the wire full into the terminals. Tighten the terminals to a torque of 5 to 7 in.-lb.

Connections, including power signals to ground and vice versa, that exceed any of the maximum signal ratings on the SCXI device can create a shock or fire hazard or can damage any or all of the boards connected to the SCXI chassis, the host computer, and the SCXI device. National Instruments is NOT LIABLE FOR ANY DAMAGES OR INJURIES resulting from incorrect signal connections.

If high voltages ($\geq$30 V_{rms} and 42.4 V_{peak} or 60 VDC) are present, YOU MUST CONNECT A SAFETY EARTH GROUND WIRE TO THE TERMINAL BLOCK SAFETY GROUND SOLDER LUG. This complies with safety agency requirements and protects against electric shock when the terminal block is not connected to the chassis. To connect the safety earth ground to the safety ground solder lug, run an earth ground wire in the cable from the signal source to the terminal block. National Instruments is NOT liable for any damages or injuries resulting from inadequate safety earth ground connections.

Do not loosen or re-orient the safety ground solder lug hardware when connecting the safety ground wire. To do so reduces the safety isolation between the high voltage and safety ground.

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

Caution: ***Use this module only with a UL listed SCXI chassis.***

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/PnP 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 *SCXI Register-Level Programmers Manual*, for information on reading the Module ID Register. See the cable installation guide of your cable, 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

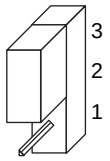
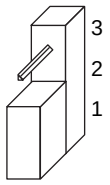
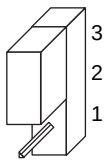
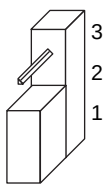
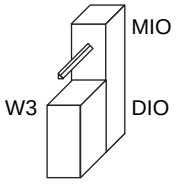
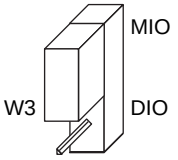
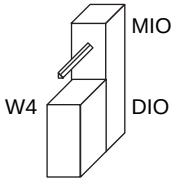
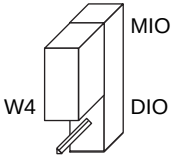
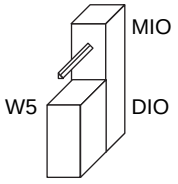
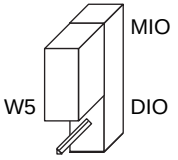
Jumper	Description	Configuration
W1	Parking position	
W1	Factory setting–Connects pullup to SERDATOUT	
W2	Parking position	
W2	Factory setting–Connects MISO to SERDATOUT	

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 C, *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.

☞ **Note:** ***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. For installation procedures with other SCXI accessories and data acquisition boards, consult the cable installation guide of your cable.***

5. Check the installation.
6. Turn on the SCXI chassis.
7. Turn on the computer or reconnect the data acquisition board to your chassis.

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

Chapter 3

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.

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 V_{rms}. The contact-to-coil breakdown voltage is 1,500 V_{rms}. 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 3-1) or an MOV for AC loads. Refer to Appendix B, *Contact Protection*, for further details.

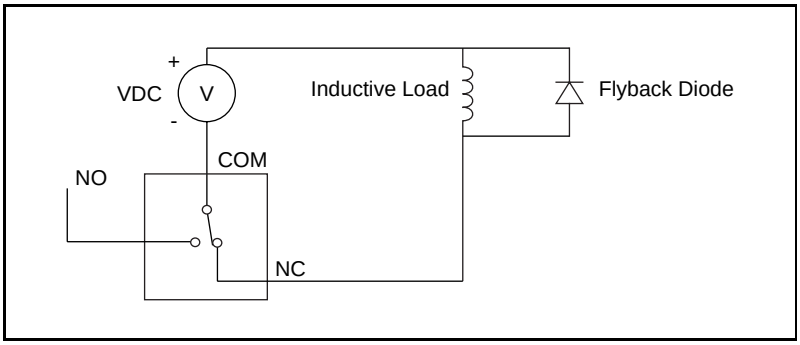


Figure 3-1. Contact Protection Using a Flyback Diode for DC Inductive Loads

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.

To determine where to place each arc suppressor, refer to Tables 3-1 and 3-2, which indicate the channel and suppressor pad assignments.

Table 3-1. 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 3-2. 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 3-2 shows how to connect a transient voltage suppressor for AC and DC inductive loads.

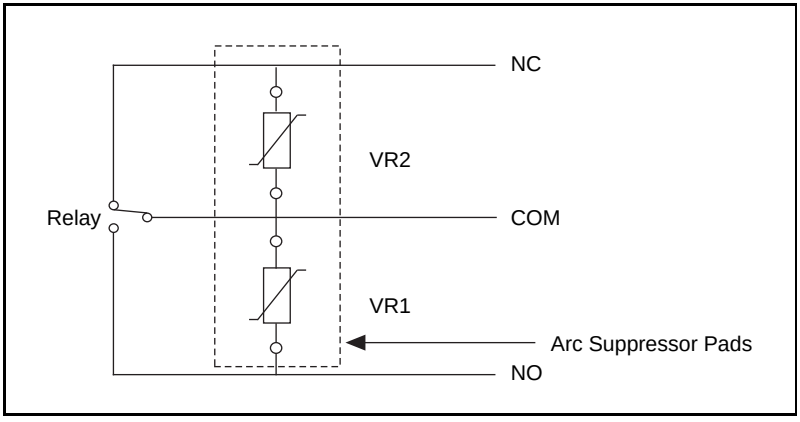


Figure 3-2. Arc Suppressor Pad Locations

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 3-3 shows the pin assignments for the SCXI-1161 rear signal connector.

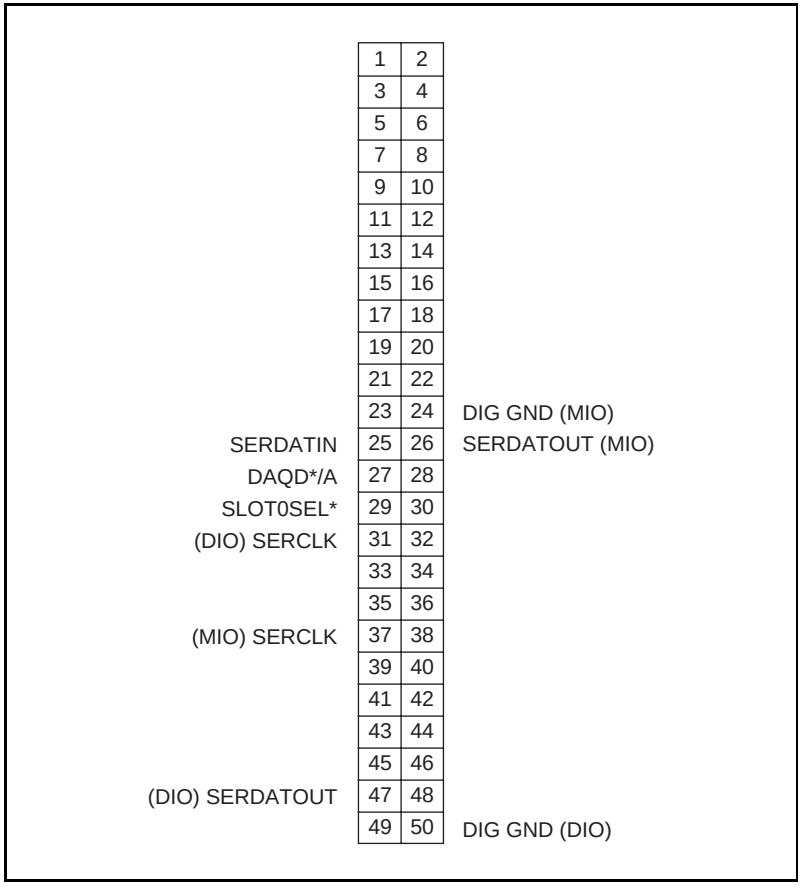


Figure 3-3. SCXI-1161 Rear Signal Connector Pin Assignment

Rear Signal Connector Signal Descriptions

Table 3-3 shows the rear signal connector signal descriptions.

Table 3-3. 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	DAQ*/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.

Table 3-3. Rear Signal Connector Signal Descriptions (Continued)

Pin	Signal Name	Description
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.

Digital I/O Signal Connections

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/PnP 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 3-4 lists the pin equivalences. For more information, consult the installation guide of your cable.

Table 3-4. 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/PnP	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

Chapter 4

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 4-1 shows the key functional components of the SCXI-1161.

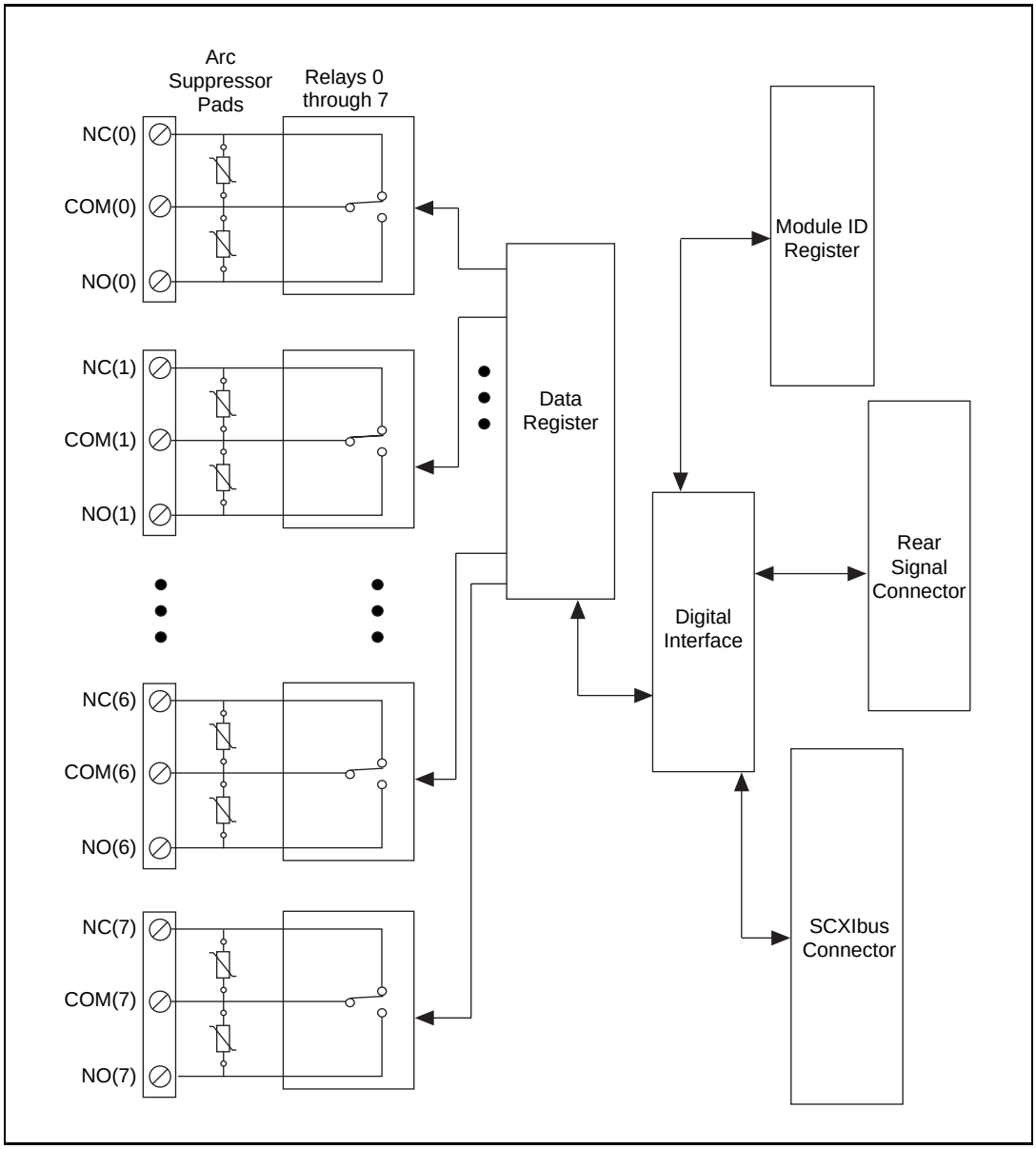


Figure 4-1. SCXI-1161 Block Diagram

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

- 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.

Digital Interface

Figure 4-2 shows a diagram of the SCXI-1161 and SCXIbus digital interface circuitry.

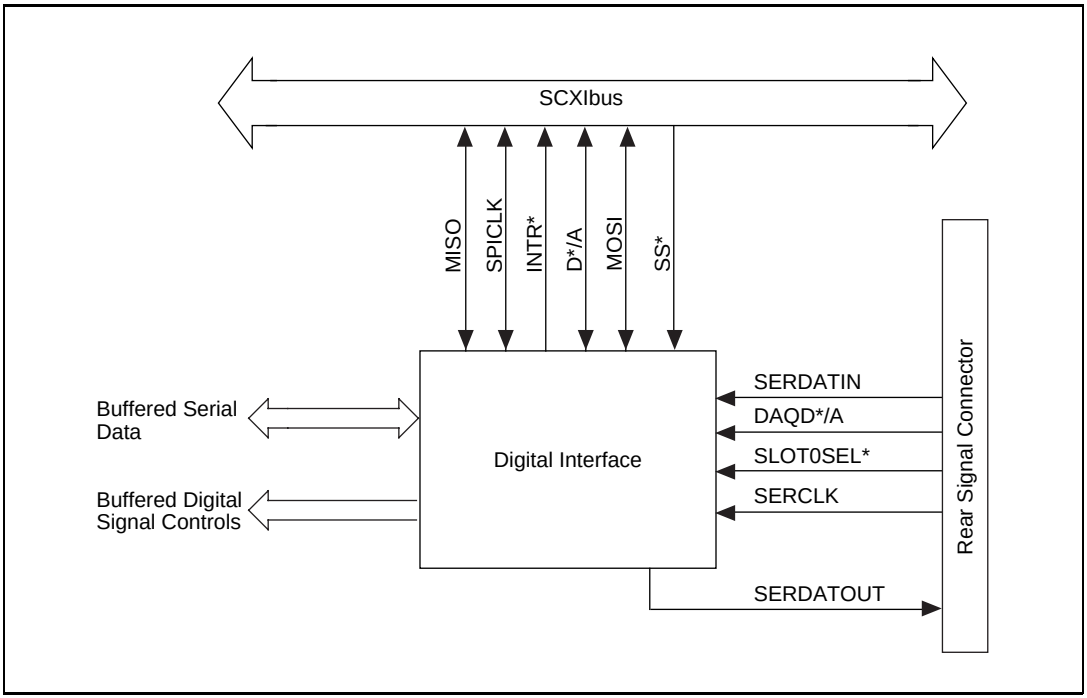


Figure 4-2. Digital Interface Circuitry Block Diagram

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 4-3 diagrams the SCXI-1161 digital control.

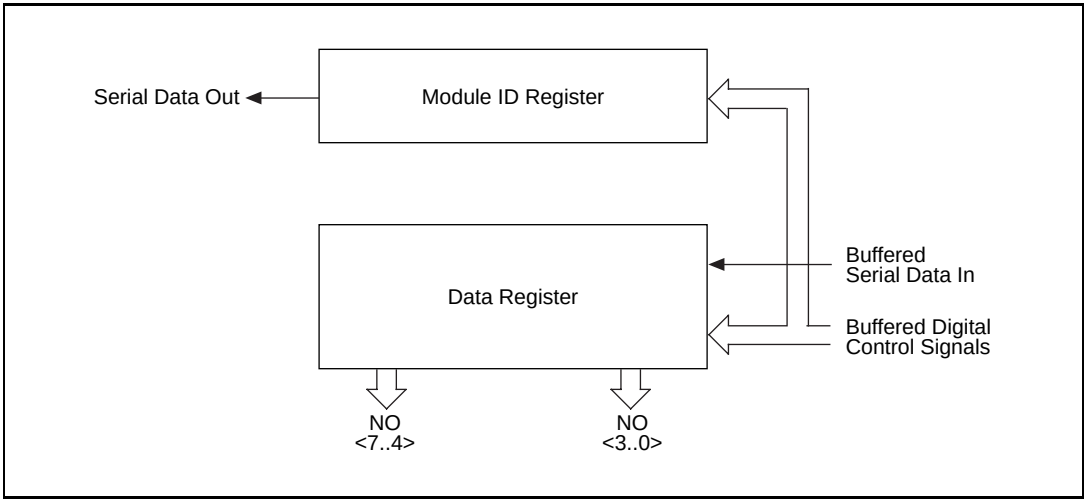


Figure 4-3. SCXI-1161 Digital Control

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. The Data Register controls the state of the SCXI-1161 relays. The complete descriptions of the register bits are given in the *SCXI Register-Level Programmers Manual*.

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

The Module ID Register is an 8-bit parallel serial-in, serial-out shift register. 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 3, *Signal Connections*, 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 the *SCXI-1161 Register-Level Programmers Manual* 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 V_{rms}.

☞ **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.***

Specifications

Appendix A

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 V_{rms}[3]

Maximum speed.....20 cpm at maximum load
180 cpm at no load

[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 3111 and IEC 1010 standard for voltage installation category II for reinforced or double insulation.

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

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

Contact Protection

Appendix B

This appendix contains technical data on contact protection when you are switching inductive loads.[1]

Art not available in PDF version of this document.

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Customer Communication

Appendix
C

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

National Instruments has technical assistance through electronic, fax, and telephone systems to quickly provide the information you need. Our electronic services include a bulletin board service, an FTP site, a Fax-on-Demand system, and e-mail support. If you have a hardware or software problem, first try the electronic support systems. If the information available on these systems does not answer your questions, we offer fax and telephone support through our technical support centers, which are staffed by applications engineers.

Electronic Services

Bulletin Board Support

National Instruments has BBS and FTP sites dedicated for 24-hour support with a collection of files and documents to answer most common customer questions. From these sites, you can also download the latest instrument drivers, updates, and example programs. For recorded instructions on how to use the bulletin board and FTP services and for BBS automated information, call (512) 795-6990. You can access these services at:

United States: (512) 794-5422
Up to 14,400 baud, 8 data bits, 1 stop bit, no parity

United Kingdom: 01635 551422
Up to 9,600 baud, 8 data bits, 1 stop bit, no parity

France: 01 48 65 15 59
Up to 9,600 baud, 8 data bits, 1 stop bit, no parity

FTP Support

To access our FTP site, log on to our Internet host, `ftp.natinst.com`, as `anonymous` and use your Internet address, such as `joesmith@anywhere.com`, as your password. The support files and documents are located in the `/support` directories.

Fax-on-Demand Support

Fax-on-Demand is a 24-hour information retrieval system containing a library of documents on a wide range of technical information. You can access Fax-on-Demand from a touch-tone telephone at (512) 418-1111.

E-Mail Support (currently U.S. only)

You can submit technical support questions to the applications engineering team through e-mail at the Internet address listed below. Remember to include your name, address, and phone number so we can contact you with solutions and suggestions.

`support@natinst.com`

Telephone and Fax Support

National Instruments has branch offices all over the world. Use the list below to find the technical support number for your country. If there is no National Instruments office in your country, contact the source from which you purchased your software to obtain support.

	Telephone	Fax
Australia	03 9879 5166	03 9879 6277
Austria	0662 45 79 90 0	0662 45 79 90 19
Belgium	02 757 00 20	02 757 03 11
Canada (Ontario)	905 785 0085	905 785 0086
Canada (Quebec)	514 694 8521	514 694 4399
Denmark	45 76 26 00	45 76 26 02
Finland	09 725 725 11	09 725 725 55
France	01 48 14 24 24	01 48 14 24 14
Germany	089 741 31 30	089 714 60 35
Hong Kong	2645 3186	2686 8505
Israel	03 5734815	03 5734816
Italy	02 413091	02 41309215
Japan	03 5472 2970	03 5472 2977
Korea	02 596 7456	02 596 7455
Mexico	5 520 2635	5 520 3282
Netherlands	0348 433466	0348 430673
Norway	32 84 84 00	32 84 86 00
Singapore	2265886	2265887
Spain	91 640 0085	91 640 0533
Sweden	08 730 49 70	08 730 43 70
Switzerland	056 200 51 51	056 200 51 55
Taiwan	02 377 1200	02 737 4644
U.K.	01635 523545	01635 523154

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 (include version number) _____

Clock speed _____MHz RAM _____MB Display adapter _____

Mouse ___yes ___no Other adapters installed _____

Hard disk capacity _____MB 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 reproduce the problem:_____

_____

_____

_____

_____

_____

SCXI-1161 Hardware and Software 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.

National Instruments Products

DAQ hardware _____

Interrupt level of hardware _____

DMA channels of hardware _____

Base I/O address of hardware _____

Programming choice _____

HiQ, NI-DAQ, LabVIEW, or LabWindows/CVI version _____

Other boards in system _____

Base I/O address of other boards _____

DMA channels of other boards _____

Interrupt level of other boards _____

Other Products

Computer make and model _____

Microprocessor _____

Clock frequency or speed _____

Type of video board installed _____

Operating system version _____

Operating system mode _____

Programming language _____

Programming language version _____

Other boards in system _____

Base I/O address of other boards _____

DMA channels of other boards _____

Interrupt level of other boards _____

Documentation Comment Form

National Instruments encourages you to comment on the documentation supplied with our products. This information helps us provide quality products to meet your needs.

Title: *SCXI™-1161 User Manual*

Edition Date: May 1997

Part Number: 320514B-01

Please comment on the completeness, clarity, and organization of the manual.

_____

_____

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If you find errors in the manual, please record the page numbers and describe the errors.

_____

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Thank you for your help.

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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}

Numbers/Symbols

°	degrees
Ω	ohms
+5 V (signal)	+5 VDC Source

A

A	amperes
AC	alternating current
A/D	analog-to-digital
AWG	American Wire Gauge

C

C	Celsius
CHS	Chassis
CHSGND	Chassis Ground
COM	common
cpm	cycles per minute

D

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

F

FIFO	first-in-first-out
ft	feet

H

hex	hexadecimal
HSCR	Hardscan Control Register
Hz	hertz

I

I/O	input/output
I_I	input current leakage
I_{in}	input current
in.	inches
INTR*	Interrupt
I_{out}	output current

L

LSB	least significant bit

M

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

N

NC	normally closed
NO	normally open

R

RAM	random-access memory
RESET*	reset
RMA	Return Material Authorization
rms	root mean square
RTSI	Real-Time System Integration

S

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

U

UL	Underwriters Laboratory

V

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
V_{rms}	volts, root mean square

W

W	watts

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