DAQ

SCXI™-1126 User Manual

Eight-Channel Isolated Frequency Input Module for Signal Conditioning

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

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About This Manual

This manual describes the electrical and mechanical aspects of the SCXI-1126 module and contains information concerning its installation and operation. The SCXI-1126 is a member of the National Instruments Signal Conditioning eXtensions for Instrumentation (SCXI) family of modules. The SCXI-1126 provides eight isolated frequency input channels. Each channel is independently configurable via software.

The SCXI-1126 module is designed for signal conditioning of frequency-generating sensors and other analog and digital periodic signal sources.

Organization of This Manual

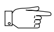
The *SCXI-1126 User Manual* is organized as follows:

- Chapter 1, *Introduction*, describes the SCXI-1126; lists what you need to get started; explains how to unpack the SCXI-1126 kit; and describes the optional software, optional equipment, and custom cables.
- Chapter 2, *Installation*, describes how to install the SCXI-1126 into the SCXI chassis.
- Chapter 3, *Signal Connections*, describes the input and output signal connections to the SCXI-1126 module via the SCXI-1126 front connector and rear signal connector, and includes specifications and connection instructions for the signals given on the SCXI-1126 connectors.
- Chapter 4, *Theory of Operation*, contains a functional overview of the SCXI-1126 module and explains the operation of each functional unit making up the SCXI-1126.
- Chapter 5, *Calibration*, discusses calibration procedures for the SCXI-1126.
- Appendix A, *Specifications*, lists the specifications for the SCXI-1126.
- Appendix B, *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:

<>	Angle brackets enclose the name of a key on the keyboard—for example, <shift>. Angle brackets containing numbers separated by an ellipsis represent a range of values associated with a bit or signal name—for example, DBIO<3..0>.
	This icon to the left of bold italicized text denotes a note, which alerts you to important information.
	This icon to the left of bold italicized text denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.
bold italic	Bold italic text denotes a note, caution, or warning.
italic	Italic text denotes emphasis, a cross reference, or an introduction to a key concept.
E Series	Refers to the National Instruments E Series data acquisition (DAQ) devices. Refer to the National Instruments catalogue for a complete list of these devices.
1200 Series	Refers to the National Instruments 1200 Series data acquisition devices. Refer to the National Instruments catalogue for a complete list of these devices.
`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.
PC	PC refers to the IBM PC/XT, the IBM PC AT, and compatible computers.

SCXIbus — Refers to the backplane in the SCXI 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.

National Instruments Documentation

The *SCXI-1126 User Manual* is one piece of the documentation set for your data acquisition (DAQ) system. You could have any of several types of manuals depending on the hardware and software in your system. Use the manuals you have as follows:

- *Getting Started with SCXI*—This is the first manual you should read. It gives an overview of the SCXI system and contains the most commonly needed information for the modules, chassis, and software.
- Your 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 documentation—This documentation has detailed information about the DAQ hardware that plugs into or is connected to your computer. Use this documentation for hardware installation and configuration instructions, specification information about your DAQ hardware, and application hints.
- Software documentation—You may have both application software and NI-DAQ software documentation. National Instruments application software includes ComponentWorks, LabVIEW, LabWindows/CVI, Measure, and VirtualBench. After you set up your hardware system, use either your application software documentation 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. They explain how to physically connect the relevant pieces of the system. Consult these guides when you are making your connections.
- *SCXI Chassis Manual*—Read this manual for maintenance information on the chassis and for installation instructions.

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 B, *Customer Communication*, at the end of this manual.

1 Introduction

This chapter describes the SCXI-1126; lists what you need to get started; explains how to unpack the SCXI-1126 kit; and describes the optional software, optional equipment, and custom cables.

About the SCXI-1126

The SCXI-1126 is a module for signal conditioning and isolating frequency generating sensors and other analog and digital periodic signal sources. The SCXI-1126 has eight isolated input channels, each with ten selectable input frequency ranges from 250 Hz to 128 kHz, along with programmable input threshold and hysteresis functions. Each channel also has four selectable, 4-pole lowpass filters with cutoff frequencies ranging from 1 Hz to 1 kHz.

The SCXI-1126 operates in two output modes—parallel output and multiplexed output. In parallel output mode, all eight SCXI-1126 channels are connected in parallel to eight DAQ board channels. In multiplexed output mode, all eight SCXI-1126 channels are multiplexed into a single DAQ board channel.

The SCXI-1126 operates with full functionality with the National Instruments E Series and 1200 Series boards. You can multiplex several SCXI-1126 modules into a single channel and greatly increase the number of analog input signals that can be digitized.

For easy signal attachment to the SCXI-1126, you can use a terminal block to connect such signal connection options as screw terminals and BNC connectors.

With the SCXI-1126, the SCXI chassis can serve as a fast-scanning signal conditioner for laboratory testing, production testing, and industrial process monitoring.

Detailed specifications of the SCXI-1126 are listed in Appendix A, *Specifications*.

What You Need to Get Started

To set up and use your SCXI-1126, you will need the following items:

- ❑ SCXI-1126 module
- ❑ *SCXI-1126 User Manual*
- ❑ An SCXI chassis and the *SCXI Chassis Manual*
- ❑ An SCXI terminal block/connector assembly (optional)
- ❑ DAQ board or SCXI-1200 and documentation
- ❑ Your computer

Unpacking

Your SCXI-1126 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 connectors.

Software Programming Choices

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

National Instruments Application 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.

LabVIEW 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.

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 your NI-DAQ software kit. The LabWindows/CVI Data Acquisition Library is functionally equivalent to the NI-DAQ software.

VirtualBench features virtual instruments (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 ComponentWorks, LabVIEW, LabWindows/CVI, 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 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, digital I/O, counter/timer operations, SCXI, RTSI, self-calibration, messaging, and acquiring data to extended memory.

NI-DAQ also internally addresses many of the complex issues between the computer and the plug-in board, 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, or LabWindows/CVI, your application uses the NI-DAQ driver software, as illustrated in Figure 1-1.

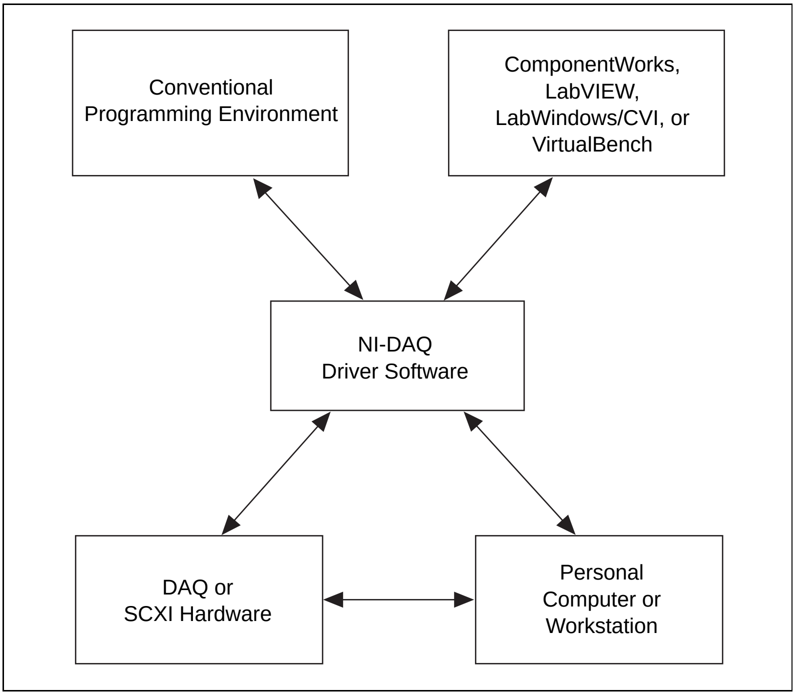


Figure 1-1. The Relationship between the Programming Environment, NI-DAQ, and Your Hardware

Optional Equipment

National Instruments offers a variety of products to use with your SCXI-1126, as follows:

- Shielded and ribbon cables and cable assemblies
- Shielded terminal blocks and connector-and-shell assemblies

For additional information about optional equipment available from National Instruments, refer to your National Instruments catalogue or call the office nearest you.

Custom Cables

To design your own SCXI-1126 cable solution, use the information in Table 1-1.

Table 1-1. Connector and Cable Information for Custom Solutions

Signal Connector	SCXI–1126 Connector	Mating Connector	Cable
Rear	AMP Inc. (1-103310-0) 50-pin male ribbon cable header	Electronic Products Division/3M (3425-7650) or T&B/Ansley Corp. (609-5041CE) 50-position polarized ribbon-socket connector	Electronic Products Division/3M (3365/50) or T&B/Ansley Corp. (171-50) 50-conductor, 28 AWG stranded ribbon cable
Front	Panduit Corp. (100-932-023) 32-pin DIN C male connector with columns A and C pins only	Panduit Corp. (100-932-434; right-angle pins or 100-632-434 straight-solder pins) 32-pin, polarized, DIN C female connector	N/A

2

Installation

This chapter describes how to install the SCXI-1126 into the SCXI chassis.

Hardware Installation

You can install the SCXI-1126 in any available slot in your SCXI chassis. The following are general installation instructions; consult your SCXI chassis manual for specific instructions and warnings.

1. Turn off the computer that contains the DAQ board or disconnect it from your SCXI chassis.
2. Turn off the SCXI chassis. Do not insert the SCXI-1126 into a chassis that is powered on.
3. Insert the SCXI-1126 into the module guides. Gently guide the module into the back of the slot until the connectors make contact. If you have already installed a cable assembly in the rear of the chassis, the module and cable assembly must be firmly engaged; however, do not *force* the module into place.
4. Screw the front mounting panel of the SCXI-1126 to the top and bottom threaded strips of your SCXI chassis.
5. If you are connecting the module to a DAQ board, connect the cable assembly to your DAQ board by following the instructions in your cable installation guide.

Note ***Cable your DAQ board to only one module in each chassis.***

6. Visually verify the installation.
7. Turn on the SCXI chassis.
8. Turn on the computer or reconnect it to your chassis.

The SCXI-1126 module is installed and ready for operation.

3

Signal Connections

This chapter describes the input and output signal connections to the SCXI-1126 module via the SCXI-1126 front connector and rear signal connector, and includes specifications and connection instructions for the signals on the SCXI-1126 connectors.

The following cautions contain important safety information concerning hazardous voltages.

Cautions ***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 is rated to 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.

When using this module with a terminal block, connect the signal wires to the screw terminals by inserting the stripped end of the wire fully into the terminals. Tighten the terminals to a torque of 5–7 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 (≥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 on the terminal block 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.

Use only National Instruments high-voltage TBX Series cable assemblies with high-voltage TBX Series terminal blocks.

To comply with the UL North America or CE, use this module with a UL or CE marked SCXI chassis.

SCXI-1126 Front Connector

Figure 3-1 shows the pin assignments for the SCXI-1126 front connector.

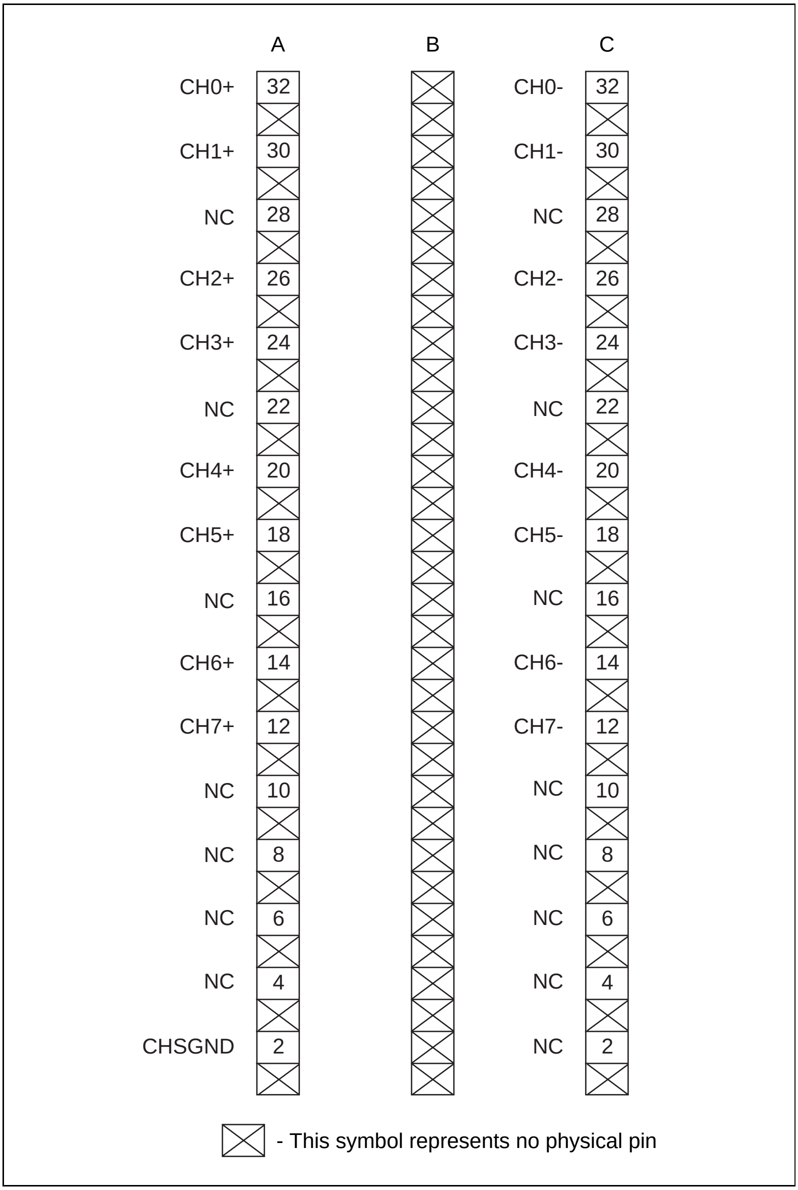


Figure 3-1. SCXI-1126 Front Connector Pin Assignments

Front Connector Signal Descriptions

SCXI-1126 front connector signal descriptions are listed in Table 3-1.

Table 3-1. SCXI-1126 Front Connector Signal Descriptions

Pin	Signal Name	Description
A2	CHSGND	Chassis Ground—Tied to the SCXI chassis.
A4, A6, A8, A10, C2, C4, C6, C8, C10, A16, C16, A22, C22, A28, C28	Not Connected	*Do not* connect any signals to these pins.
A12, A14, A18, A20, A24, A26, A30, A32	CH7+ through CH0+	Positive Input Channels—Positive inputs to channels 7 through 0, respectively.
C12, C14, C18, C20, C24, C26, C30, C32	CH7– through CH0–	Negative Input Channels—Negative inputs to channels 7 through 0, respectively.

Analog Input Channels

Figure 3-1 column A shows the SCXI-1126 positive input channel locations. Their corresponding negative input channels are located in column C. Each input channel pair corresponds to a separate frequency input channel and is fully isolated from the other inputs and from earth ground. The inputs are designed in a floating single-ended configuration, which allows the measured signal to be referenced to a ground level with common-mode voltage up to 250 V_{rms}. For better noise immunity, connect the negative input channel to the signal reference. If the measured signals are floating, connect the negative input channel to chassis ground on the terminal block. Figure 3-2 shows how to connect a ground-referenced signal on the SCXI-1126. Figure 3-3 shows how to connect a floating signal, and Figures 3-4 and 3-5 show how to connect AC-coupled signals on the SCXI-1126.

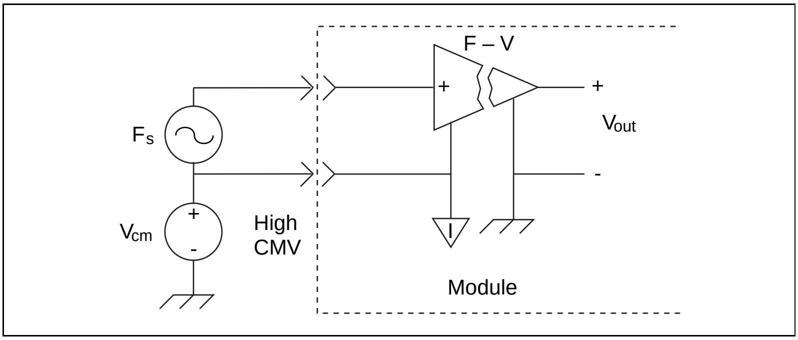


Figure 3-2. Ground-Referenced Signal Connection for the SCXI-1126 with High Common-Mode Voltage

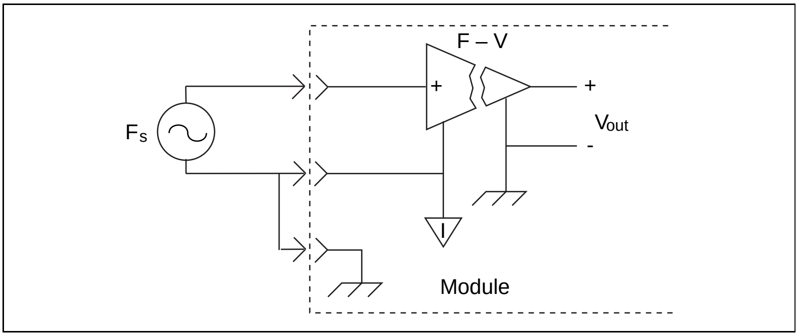


Figure 3-3. Floating Signal Connection for the SCXI-1126 Referenced to Chassis Ground for Better Signal-to-Noise Ratio

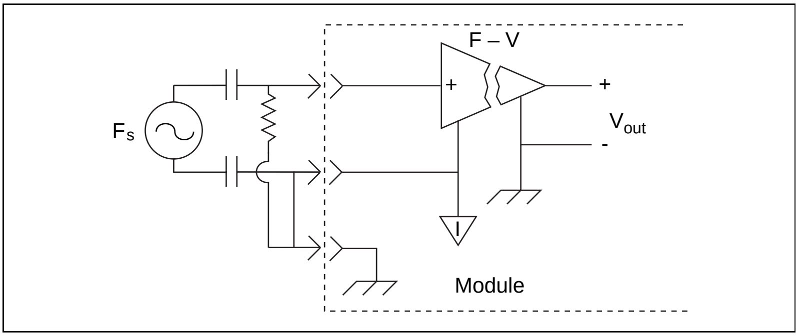


Figure 3-4. Floating AC Coupled Signal Connection for the SCXI-1126

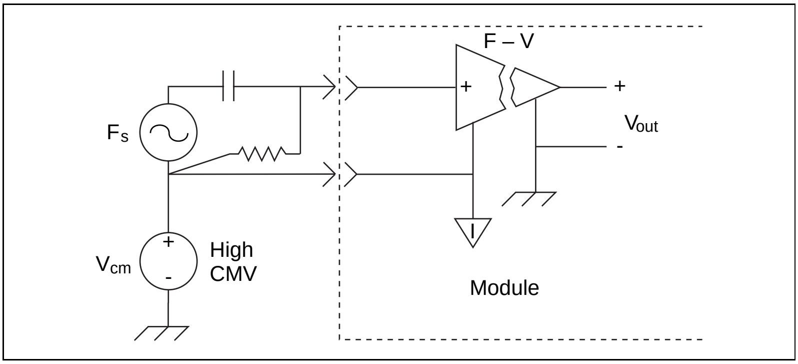


Figure 3-5. AC Coupled Signal Connection for the SCXI-1126 with High Common-Mode Voltage

When you connect AC coupled signals to the SCXI-1126, connect an external resistor from the positive input channel to the signal reference to provide the DC path for the positive input bias current. Typical resistor values range from 100 kΩ to 1 MΩ. This solution, although necessary in this case, reduces the input impedance of the input channel. This may introduce loading errors if your signal source has a high output impedance. Refer to Appendix A, *Specifications*, for information on channel input impedance.

The input signal range of an SCXI-1126 input channel is –0.5 to 4.5 V referenced to its negative input. In addition, the input channels are overvoltage protected to 250 V_{rms} with power on or off at a maximum of 5 mA_{rms} sink or source.

SCXI-1126 Rear Connector

Note ***If you are using the SCXI-1126 with a National Instruments DAQ board and cable assembly, you do not need to read the remainder of this chapter. If you are using the SCXI-1180 feedthrough panel, the SCXI-1343 rear screw terminal adapter, or the SCXI-1351 one-slot cable extender with the SCXI-1126, read this section.***

Figure 3-6 shows the pin assignments for the SCXI-1126 rear signal connector.

AOGND	1	2	AOGND
MCH0+	3	4	MCH0-
MCH1+	5	6	MCH1-
MCH2+	7	8	MCH2-
MCH3+	9	10	MCH3-
MCH4+	11	12	MCH4-
MCH5+	13	14	MCH5-
MCH6+	15	16	MCH6-
MCH7+	17	18	MCH7-
OUTREF	19	20	NC
NC	21	22	NC
NC	23	24	DIG GND
SERDATIN	25	26	SERDATOUT
DAQD*/A	27	28	NC
SLOT0SEL*	29	30	NC
NC	31	32	NC
DIG GND	33	34	NC
NC	35	36	SCANCLK
SERCLK	37	38	NC
NC	39	40	NC
NC	41	42	NC
RSVD	43	44	NC
NC	45	46	NC
NC	47	48	NC
NC	49	50	NC

Figure 3-6. SCXI-1126 Rear Signal Connector Pin Assignments

Rear Connector Signal Descriptions

SCXI-1126 rear connector signal descriptions are listed in Table 3-2.

Table 3-2. Rear Connector Signal Descriptions

Pin	Signal Name	Direction	Description
1–2	AOGND	Output	Analog Output Ground—These pins are software programmed to connect to the analog reference when the SCXI-1126 is in referenced single-ended (RSE) mode.
3–18	MCH0± through MCH7±	Output	Analog Output Channels 0 through 7—These pins connect to the DAQ board differential analog input channels. In differential (DIFF) mode, MCH0- through MCH7– are software programmed to connect to the analog reference (power-up and reset state).
19	OUTREF	Output	Output Reference—This pin is software programmed to connect to the analog reference when the SCXI-1126 is in nonreferenced single-ended (NRSE) mode. It should be connected to the analog input sense pin of the DAQ board in NRSE mode.
24, 33	DIG GND	—	Digital Ground—These pins supply the reference for DAQ board digital signals and are tied to the SCXI-1126 digital ground.
25	SERDATIN	Input	Serial Data In—The DAQ board uses this signal to program modules in all slots.
26	SERDATOUT	Output	Serial Data Out—A cabled module uses this signal to return serial output data from any module to the DAQ board.
27	DAQD*/A	Input	DAQ Board Data/Address Line—The DAQ board uses this signal to indicate to the module whether the incoming serial stream is data or address information.
29	SLOT0SEL*	Input	Slot 0 Select—The DAQ board uses this signal to indicate whether the information on SERDATIN is being sent to a module or to the Slot 0 controller.

Table 3-2. Rear Connector Signal Descriptions (Continued)

Pin	Signal Name	Direction	Description
36	SCANCLK	Input	Scan Clock—Indicates to the SCXI-1126 that the DAQ board has taken a sample and causes the SCXI-1126 to change channels.
37	SERCLK	Input	Serial Clock—The DAQ board uses this signal to clock the data on the SERDATIN and SERDATOUT lines.
43	RSVD	Input	Reserved.

All other pins are not connected.

The digital I/O and timing signals of the SCXI-1126 connect to the digital I/O and timing lines of the MIO E Series and 1200 Series DAQ boards, as shown in Table 3-3. For more information, consult your cable assembly installation guide.

Table 3-3. SCXIbus to SCXI-1126 Rear Connector to DAQ Board Pin Equivalencies

SCXIbus Line	SCXI-1126 Rear Signal Connector	MIO E Series Board	1200 Series Board
MOSI	SERDATIN	DIO0	PB4
D*/A	DAQD*/A	DIO1	PB5
INTR*	SLOT0SEL*	DIO2	PB6
SPICLK	SERCLK	EXTSTROBE*	PB7
MISO	SERDATOUT	DIO4	PC1

4

Theory of Operation

This chapter contains a functional overview of the SCXI-1126 module and explains the operation of each functional unit making up the SCXI-1126.

Functional Overview

The block diagram in Figure 4-1 illustrates the key functional components of the SCXI-1126.

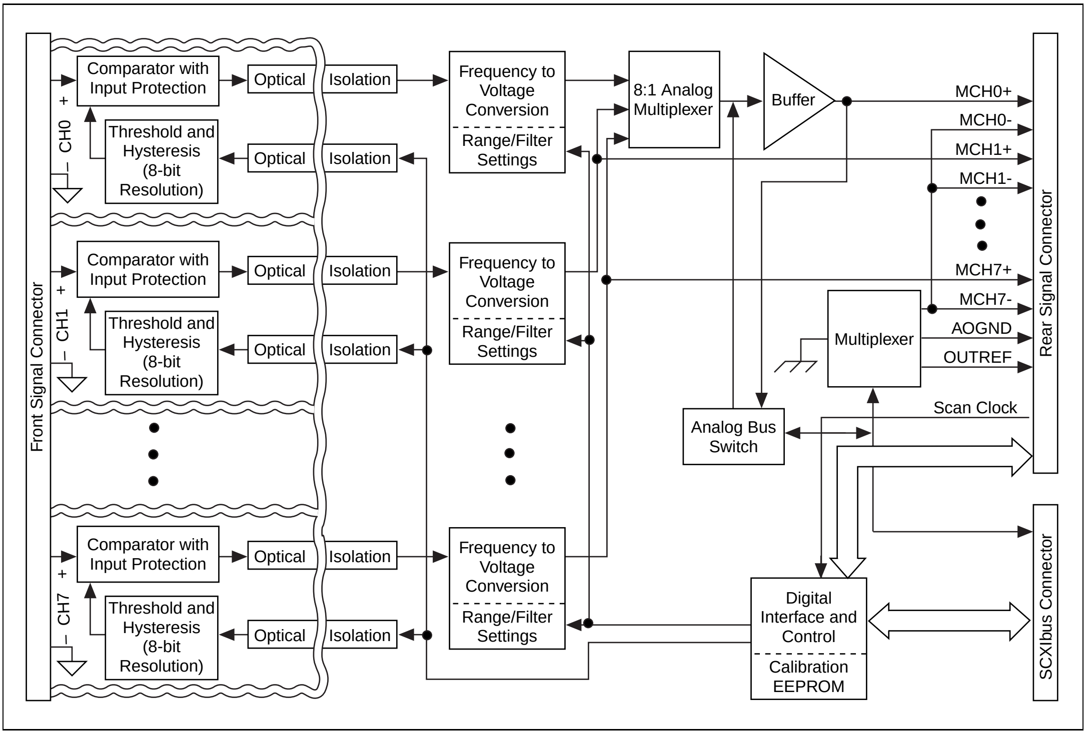


Figure 4-1. SCXI-1126 Block Diagram

The major components of the SCXI-1126 are as follows:

- Rear signal connector and SCXIbus connector
- Digital interface
- Digital control circuitry
- Frequency to voltage conversion and analog circuitry

The SCXI-1126 consists of eight isolated frequency input channels, each with software-programmable frequency ranges of 0–250 Hz, 0–500 Hz, 0–1 kHz, 0–2 kHz, 0–4 kHz, 0–8 kHz, 0–16 kHz, 0–32 kHz, 0–64 kHz, and 0-128 kHz. Each channel has its own software-programmable input threshold and hysteresis with a voltage range of –0.5 to 4.5 V. In addition, each channel also has a 4-pole, lowpass, output filter with software-programmable cutoffs of 1 Hz, 40 Hz, 320 Hz, and 1 kHz. The SCXI-1126 also has a digital section for automatic control of channel scanning, frequency range selection, filter selection, and input threshold and hysteresis level setting.

The theory of operation of each of these components is explained in the rest of this chapter.

Rear Signal Connector, SCXIbus Connector, and Digital Interface

The SCXIbus controls the SCXI-1126. The digital interface connects the rear signal connector to the SCXIbus, allowing a DAQ board to control the SCXI-1126 and the rest of the chassis.

Digital Control Circuitry

The digital control circuitry consists of the following:

- The Module ID register, which contains the module ID 1, a code unique to the SCXI-1126
- The registers that configure the modes of operation and control the functions of the SCXI-1126
- The Address Handler, which controls which register is being addressed

Refer to *Software Programming Choices* in Chapter 1, *Introduction*, to learn about options for programming the module.

Frequency-to-Voltage and Analog Circuitry

The frequency-to-voltage and analog circuitry for each channel consists of three stages: the isolated input stage, the frequency-to-voltage conversion stage, and the output stage.

Isolated Input Stage

The input stage of each channel is isolated from the other channels and from the chassis, up to 250 V_{rms}. Each channel is also protected from input overvoltages, up to 250 V_{rms} powered on or off.

This stage consists of a trigger circuit that compares the input waveform to a user-programmed threshold and hysteresis. The programmable range of the threshold is –0.5 to 4.5 V, and the programmable range of the hysteresis is 0 to 5 V. You can extend these ranges by using an attenuator terminal block; for example, the SCXI-1327 100:1 high-voltage attenuator terminal block extends the threshold range from –50 to 250 V, and the hysteresis range from 0 to 250 V. The threshold and hysteresis are programmed to create a window with the upper and lower limits given by the formula:

$$V_{window} = V_{threshold} \pm \frac{1}{2} V_{hysteresis}$$

When the input waveform crosses through this window, a trigger occurs. The frequency of these triggers establishes the frequency to be converted by the frequency-to-voltage conversion stage.

Frequency-to-Voltage Conversion Stage

This stage consists of the following:

- A pulse generator, which triggers on the incoming frequency to produce a pulse per frequency cycle with a precisely controlled pulse width that is set by the input frequency range.
- A 1-bit DAC, which uses a stable voltage reference to translate the amplitude of the pulse train to the output voltage range.
- A programmable, 4-pole, active lowpass filter, which averages the output of the 1-bit DAC to produce a clean analog voltage proportional to the input frequency. You can program the filter to any of four bandwidths: 1 Hz, 40 Hz, 320 Hz, or 1 kHz. This added flexibility allows you to reduce the channel response time by selecting a higher filter bandwidth for input frequencies that exceed the minimum recommended value for the selected filter bandwidth. The minimum

recommended input frequency for each filter bandwidth is listed in Appendix A, *Specifications*.

Note ***Because of the low bandwidths of the output filters, you must wait approximately 3 s after changing any of the settings to allow the channels to settle before you can take an accurate measurement. NI-DAQ automatically queries the module to determine when the module outputs have settled.***

Output Stage

The output stage consists of the following:

- A buffered analog multiplexer, which multiplexes the outputs of all eight channels to a buffer. The buffer output is connected directly to MCH0 on the rear signal connector.
- The analog bus switch circuitry, which can route the buffer output to AB0 on the SCXIbus connector under software control. If the SCXI-1126 is the cabled module, the analog bus switch circuitry can also be configured to route a signal placed on AB0 by another SCXI module, via the output buffer, to MCH0 where it can be read by the DAQ board. When a signal passes on the SCXIbus from the scanned module to the DAQ board via the cabled module, the measurement is called *indirect scanning*. When a signal passes directly from the cabled module to the DAQ board, the measurement is called *direct scanning*. Figure 4-1 illustrates the signal paths controlled by the analog bus switch circuitry.

You can software configure the output stage for two modes of operation—parallel mode or multiplexed mode.

Parallel Mode

In parallel output mode, channel 0 is selected at the output multiplexer and is connected to MCH0. The seven other channels are directly connected to MCH1 through MCH7 respectively on the rear connector.

When the MCH0 signal is configured as channel 0 output, the rear connector simultaneously carries each of the outputs of the SCXI-1126 on different pins, and the module is in parallel mode. In this mode you can use an SCXI-1180 feedthrough panel to make each of the outputs available at the front of the chassis. A DAQ board cabled to an SCXI-1126 in parallel mode reads a separate output signal from the module on each of its analog inputs. You cannot multiplex the parallel outputs of a module onto the SCXIbus; only a DAQ board directly cabled to the module has access to these outputs.

Multiplexed Mode (Recommended)

In multiplexed mode, the output signals for channels 1 through 7 are sent to the rear connector but are usually ignored. All DAQ board reads from the module are from the MCH0 signal of the rear connector, which can be configured as the output of any SCXI-1126 channel or as the output of any other module in multiplexed mode that is sending its output onto the SCXIbus. In multiplexed mode, the SCXI-1126 drives pins 5 through 18 on the rear connector. These rear connector outputs are short-circuit protected. You can also configure the SCXI-1126 to send any one of its outputs to the SCXIbus. Thus, in multiplexed mode, only one module in a chassis needs to be connected to a DAQ board.

You can also use multiplexed mode to perform scanning operations with the SCXI-1126. The SCXI chassis is programmed with a module scan list that dynamically controls which module sends its output to the SCXIbus during a scan. You can specify this list to scan the modules in any order, with an arbitrary number of channels for each module entry in the list. However, the channels on the SCXI-1126 must be scanned in a consecutive, ascending order. You can program the SCXI-1126 to start scans with any channel.

Note ***The SCXI-1126 parallel outputs continuously drive the rear signal connector (RSC) pins even when the module is configured in multiplexed mode.***

For measurement accuracy of 0.012% of full scale, the minimum scan interval is 3 µs. This is the smallest interval in which you can switch between analog channels on the module and still measure accurate voltages. The 3 µs scan interval gives you a maximum sampling rate of 333 kHz. Because this rate is much higher than the 1 kHz maximum output bandwidth of a single SCXI-1126 channel, you can sample multiple channels on multiple SCXI modules without undersampling one of the SCXI-1126 channels.

5

Calibration

This chapter discusses calibration procedures for the SCXI-1126.

The SCXI-1126 converts input frequencies into output voltages using a linear conversion process characterized by the following straight line formula:

$$V_{output} = C_{scale} \bullet F_{input} + V_{output\ offset}$$

where C_{scale} is the conversion scale factor and $V_{output\ offset}$ is the output voltage offset. Your DAQ board then digitizes this output voltage and automatically scales it back to frequency for display, storage, or further processing when you are using National Instruments software.

Using the procedure described in this chapter, you will be able to calculate the conversion scale factor and output offset on a per channel basis. You can store these constants in the onboard EEPROM for future use and for automatic calibration when you are using National Instruments software. The module comes with factory-determined calibration constants in the EEPROM. However, it is recommended that you recalibrate a module at least once per year or when you operate the module outside of the 20° to 30° C temperature range.

Calibration Procedure

Calibration Equipment Requirements

According to standard practice, the equipment you use to calibrate the SCXI-1126 should be 10 times as accurate as the SCXI-1126. However, calibration equipment with four times the accuracy of the SCXI-1126 is generally considered acceptable. To calibrate the SCXI-1126, you will need to apply precision frequencies to the channel inputs and/or ground the channel inputs. You need a frequency source with the following specifications:

- Accuracy — ±2 ppm standard reading; ±10 ppm sufficient reading
- Frequency Range — 15 Hz to 128 kHz

A function generator or arbitrary waveform generator that meets these specifications can supply the necessary input frequencies.

You will also need a voltmeter with the following specifications:

• Accuracy	±6 ppm standard reading ±15 ppm sufficient reading
• Range	–10 to +10 V
• Resolution	8½ digits

A multiranging 8.5-digit digital multimeter (DMM) can perform the necessary calibrations.

To make sure that the DMM does not introduce an additional offset, you can determine the offset error of the DMM by shorting its leads together and reading the measured value. This value, the DMM offset, must be subtracted from all subsequent measurements.

You will need to measure the module's output between MCH0+ and MCH0–. To access these pins, connect an SCXI-1180 feed-through panel to the module rear signal connector or to the rear signal adapter breakout connector. Attach the associated SCXI-1302 terminal block to the SCXI-1180 and connect to MCH0+ and MCH0– on pins 3 and 4, respectively. Alternatively, you can connect a 50-pin ribbon cable from a CB-50 I/O connector block to the module rear signal connector or to the rear signal adapter breakout connector. Then connect to MCH0+ and MCH0– on the CB-50 pins 3 and 4, respectively.

Conversion Scale and Offset Calibration

To determine the offset and conversion scale calibration factors of the SCXI-1126, perform the following steps for a two-point calibration. For two-point calibration, it is best to use input frequencies that correspond to the signal frequency range of interest. For example, if you are planning to measure frequencies over the entire span of one of the module's input frequency ranges, choose the minimum recommended input frequency for your choice of filter bandwidth and 0.99 F_{range} (positive full-scale) as your two input frequencies. However, to measure frequencies between 1 and 3 kHz, choose those two frequencies (1 and 3 kHz) as your input values.

1. Select the desired channel. Set the channel input frequency range, filter bandwidth, threshold, and hysteresis to the desired values.

2. Apply the input for the first calibration point.
   a. Apply the input frequency to the channel selected in step 1. Call the input frequency `input1`.

Note ***The lowest frequency you can measure will be determined by your channel filter bandwidth. See Appendix A,*** *Specifications*, ***for the minimum recommended frequency corresponding to your filter bandwidth selection.***

   b. Wait for the filter to settle. See Appendix A, *Specifications*, for the response time corresponding to your filter bandwidth selection.
   c. Measure the module output between MCH0+ and MCH0– with the DMM. Call the measured voltage `output1`.
3. Repeat step 2, applying the input for the second calibration point. Call the input frequency `input2` and the measured voltage `output2`. To select positive full scale as the calibration point, repeat step 2 and apply 0.99 F_{range}.
4. You now have two pairs of frequency/voltage data (`input1`, `output1`) and (`input2`, `output2`). Each pair consists of an input frequency and an output voltage.
5. Convert the output voltages from volt units to your DAQ board binary unit. You must take into consideration the polarity of your DAQ board, its resolution (12 bits or 16 bits), and gain (G_{MIO}). For E Series DAQ boards, your output voltages will be represented in binary units as given by the formulae shown in Table 5-1.

Table 5-1. Voltage-to-Binary Conversion Formulae for E Series DAQ Boards

DAQ Board Resolution	Polarity	
	Unipolar	Bipolar
12 bits	$Binary = \frac{Output}{10\text{ V}} \bullet 2^{12} \bullet G_{MIO}$	$Binary = \frac{Output}{10\text{ V}} \bullet 2^{12} \bullet G_{MIO}$
16 bits	$Binary = \frac{Output}{10\text{ V}} \bullet 2^{16} \bullet G_{MIO}$	$Binary = \frac{Output}{20\text{ V}} \bullet 2^{16} \bullet G_{MIO}$

For other DAQ boards, refer to your DAQ board user manual to determine the appropriate formula.

6. You now have a new set of pairs referred to as frequency binary pairs (`input1`, `bin_output1`) and (`input2`, `bin_output2`). Pass these pairs, along with the input frequency range, to the

`SCXI_Cal_Constants` function or VI as described in your software user manual.

Note ***When you make a measurement using National Instruments software, the software automatically uses the calibration constants to correct the measured frequencies.***

A

Specifications

All specifications for the SCXI-1126 are from 20° to 30° C and for one year unless otherwise noted. All specifications are relative to calibration standards and require a 15 minute warm-up period. Specifications do not include transducer error.

Frequency Input

Input Characteristics

Number of channels 8

Input frequency ranges (software selectable) and corresponding output voltage range[1]

Input Frequency Ranges	Output Voltage Range
250 Hz	0 to 5 V
500 Hz	
1 kHz	
2 kHz	
4 kHz	
8 kHz	
16 kHz	
32 kHz	
64 kHz	
128 kHz	

[1] V_{rms} refers to sinusoidal waveform; V refers to DC or AC peak

Minimum recommended input frequency

Filter Setting	Minimum Input Frequency
1 Hz	15 Hz
40 Hz	600 Hz
320 Hz	5 kHz
1000 Hz	15 kHz

Minimum input pulse width ....1.5 µs (5 V pulse train at 128 kHz)

Input signal amplitude range ....±50 mV min to ±250 V max

Input coupling.......................................DC (or AC with AC coupled terminal block)

Maximum working voltage[1]
(Signal + common mode voltage) ....Each input should remain within 250 V_{rms} of chassis ground or any other input terminal

Overvoltage protection[2] ....250 V_{rms} powered on or off

Inputs protected ....CH<0..7>

Input impedance

- Powered on ....50 GΩ (–0.5 to 4.5 V)
- Overload ....50 kΩ (–250 to –0.5 V and 4.5 to 250 V)
- Powered off ....50 kΩ

Input bias current ....500 pA max (over operating temperature range)

Threshold (software programmable)

- Range...–0.5 to 4.5 V (–50 to 250 V with SCXI-1327 high-voltage attenuator terminal block)
- Resolution.......................................8 bits

[1] As specified by IEC-1010 for pollution degree 2 and Installation Category II

[2] Voltage is limited to 30 V_{rms} (±42.4 V) if you are using an SCXI-1305 terminal block

Hysteresis.. 0 to 5 V (0 V to 250 V with SCXI-1327 high-voltage attenuator terminal block)

Transfer Characteristics[1]

Input Frequency Ranges	Accuracy				
	% of Reading + Hz			Noise (Hz) (DC to 255 kHz)	
	24 Hours	90 Days	1 Year	Peak	RMS
250 Hz	0.0150% ±0.011 Hz	0.0217% ± 0.018 Hz	0.0418% ± 0.039 Hz	0.05	0.008
500 Hz	0.0150% ± 0.023 Hz	0.0217% ± 0.036 Hz	0.0418% ± 0.077 Hz	0.10	0.015
1 kHz	0.0150% ± 0.045 Hz	0.0217% ± 0.073 Hz	0.0418% ± 0.154 Hz	0.20	0.030
2 kHz	0.0150% ± 0.091 Hz	0.0217% ± 0.145 Hz	0.0418% ± 0.308 Hz	0.40	0.061
4 kHz	0.0150% ± 0.181 Hz	0.0217% ± 0.290 Hz	0.0418% ± 0.616 Hz	0.80	0.121
8 kHz	0.0150% ± 0.363 Hz	0.0217% ± 0.580 Hz	0.0418% ± 1.231 Hz	1.60	0.242
16 kHz	0.0150% ± 0.726 Hz	0.0217% ± 1.160 Hz	0.0418% ± 2.462 Hz	3.20	0.485
32 kHz	0.0150% ± 1.451 Hz	0.0217% ± 2.319 Hz	0.0418% ± 4.924 Hz	6.40	0.970
64 kHz	0.0150% ± 2.902 Hz	0.0217% ± 4.638 Hz	0.0418% ± 9.848 Hz	12.80	1.939
128 kHz	0.0150% ± 5.803 Hz	0.0217% ± 9.276 Hz	0.0418% ± 19.696 Hz	25.60	3.879

[1] Accuracy based on combination of all errors, including effects of temperature drift over 20° to 30° C range. Noise specifications include effects of AT-MIO-16XE-10 with 1 m, 2 m, or 5 m SCXI cable assembly.

Output Characteristics

Filters (software programmable)

Type ....4-pole, active lowpass

Bandwidth and response time

Bandwidth (–3 dB) (Hz)	Step Response Settling Time (Full-Scale Input Step) (ms)		
	To ±1%	To ±0.1%	To ±0.024%
1	800.0	1530.0	5300.0
40	30.0	55.0	180.0
320	3.2	7.0	30.0
1000	0.8	1.0	1.2

Scan interval (per channel, any frequency range and filter bandwidth)

±0.012% accuracy[1] ....3 µs

±0.006% accuracy[2] ....10 µs

±0.0015% accuracy[2] ....20 µs

Output impedance

Multiplexed output mode ....100 Ω

Parallel output mode........................330 Ω

Output short-circuit protection ....Indefinite duration

Outputs protected...................................MCH<0..7>

[1] Includes effects of AT-MIO-16E-2 with 1 m or 2 m SCXI cable assembly

[2] Includes effects of AT-MIO-16XE-10 with 1 m or 2 m SCXI cable assembly

Power-up and Reset States

Function	Power-up State	Software Reset State	Hardware Reset State
Output modes Scanning mode DAQ board connection mode	 Parallel DIFF	 Retains last setting prior to software reset Retains last setting prior to software reset	 Parallel DIFF
Input frequency range	0–128 kHz	0–128 kHz	0–128 kHz
Filter setting	1 Hz	1 Hz	1 Hz
Threshold level	–0.5 V	–0.5 V	Retains last setting prior to software reset
Hysteresis level	0 V	0 V	Retains last setting prior to software reset

Stability

Recommended warm-up time .... 15 minutes

Temperature drift (0° to 20° C, 30° to 50° C)

In ppm/° C...................................... ±9 ppm of reading ±6.4 ppm of range/° C

In Hz/° C

Input Frequency Ranges	Temperature Drift % of Reading/° C + Hz/° C
250 Hz	0.0009% ± 0.002 Hz
500 Hz	0.0009% ± 0.003 Hz
1 kHz	0.0009% ± 0.006 Hz
2 kHz	0.0009% ± 0.013 Hz
4 kHz	0.0009% ± 0.026 Hz
8 kHz	0.0009% ± 0.051 Hz
16 kHz	0.0009% ± 0.102 Hz
32 kHz	0.0009% ± 0.204 Hz
64 kHz	0.0009% ± 0.407 Hz
128 kHz	0.0009% ± 0.814 Hz

Calibration cycle .... one year

Physical

Dimensions .... 17.2 by 20.3 cm
(6.8 by 8.0 in.)

I/O connectors.. 50-pin male ribbon cable rear connector
32-pin male DIN C front I/O connector

Environment

Operating temperature .... 0° to 50° C

Storage temperature .... –55° to 150° C

Relative humidity .... 5% to 90% noncondensing

B

Customer Communication

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

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 USA 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.

Country	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
Brazil	011 288 3336	011 288 8528
Canada (Ontario)	905 785 0085	905 785 0086
Canada (Québec)	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 6120092	03 6120095
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
United Kingdom	01635 523545	01635 523154
United States	512 795 8248	512 794 5678

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: ______________________________________

____

____

____

____

DAQ SCXI-1126 User Manual 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

Hardware revision ____________________

Interrupt level of hardware ____________________

DMA channels of hardware ____________________

Base I/O address of hardware ____________________

Programming choice ____________________

National Instruments software ____________________

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™-1126 User Manual*

Edition Date: April 1998

Part Number: 321844A-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.

Name ____

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Glossary

Prefix	Meanings	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}
G-	giga-	10^{9}

Numbers/Symbols

°	degree
Ω	ohm
/	per
%	percent
+	positive of, or plus
–	negative of, or minus

A

A	amperes
AC	alternating current
AC coupled	allowing the transmission of AC signals only
A/D	analog-to-digital

ADC	analog-to-digital converter—an electronic device, often an integrated circuit, that converts an analog voltage to a digital number
ADC resolution	the resolution of the ADC, which is measured in bits. An ADC with 16 bits has a higher resolution, and thus a higher degree of accuracy, than a 12-bit ADC.
address	character code that identifies a specific location (or series of locations) in memory
alias	a false lower frequency component that appears in sampled data acquired at too low a sampling rate
AOGND	Analog Output Ground signal
A_{rms}	amperes, root mean square
AWG	American Wire Gauge

B

b	bit—one binary digit, either 0 or 1
B	byte—eight related bits of data, an eight-bit binary number. Also used to denote the amount of memory required to store one byte of data.
bandwidth	the range of frequencies present in a signal, or the range of frequencies to which a measuring device can respond

C

C	Celsius
CHAN	Channel Select bit
channel	pin or wire lead to which you apply or from which you read the analog or digital signal. Analog signals can be single-ended or differential. For digital signals, you group channels to form ports. Ports usually consist of either four or eight digital channels.
channel clock	the clock controlling the time interval between individual channel sampling within a scan. Boards with simultaneous sampling do not have this clock.
CHS	Chassis bit

CHSGND	Chassis Ground signal
CLKOUTEN	Scan Clock Output Enable bit
CMV	Common mode voltage—any voltage present at the instrumentation amplifier inputs with respect to amplifier ground
common-mode range	The input range over which a circuit can handle a common-mode signal
common-mode signal	The mathematical average voltage, relative to the computer's ground, of the signals from a differential input

D

D/A	Digital-to-analog
DAC	digital-to-analog converter—an electronic device, often an integrated circuit, that converts a digital number into a corresponding analog voltage or current
DAQ	Data acquisition—(1) collecting and measuring electrical signals from sensors, transducers, and test probes or fixtures and inputting them to a computer for processing; (2) collecting and measuring the same kinds of electrical signals with A/D and/or DIO boards plugged into a computer, and possibly generating control signals with D/A and/or DIO boards in the same computer
DAQD*/A	Data Acquisition Board Data/Address Line signal
dB	Decibels
DC	direct current
DC coupled	Allowing the transmission of both AC and DC signals
default setting	A default parameter value recorded in the driver. In many cases, the default input of a control is a certain value (often 0) that means *use the current default setting*.
device	a plug-in data acquisition board, card, or pad that can contain multiple channels and conversion devices. Plug-in boards, PCMCIA cards, and devices such as the DAQPad-1200, which connects to your computer parallel port, are all examples of DAQ devices. SCXI modules are distinct from devices, with the exception of the SCXI-1200, which is a hybrid.
digital trigger	a TTL level signal having two discrete levels—a high and a low level
DIG GND	Digital Ground signal

DIN	Deutsche Industrie Norme
DIO	digital input/output

F

F	Fahrenheit
F_s	Frequency source

H

Hz	hertz—the number of scans read or updates written per second

I

II	input current leakage
in.	inches
I/O	input/output—the transfer of data to/from a computer system involving communications channels, operator interface devices, and/or data acquisition and control interfaces

K

K	kelvin
kbytes/s	a unit for data transfer that means 1,000 or 10^3 bytes/s
kS	1,000 samples
Kword	1,024 words of memory

M

M	(1) Mega, the standard metric prefix for 1 million or 10^6, when used with units of measure such as volts and hertz; (2) mega, the prefix for 1,048,576, or 2^{20}, when used with B to quantify data or computer memory
MB	megabytes of memory
MCH<0..7>±	Analog Output Channel signals 0 through 7, positive and negative
MIO	multifunction I/O

multiplexed mode	an SCXI operating mode in which analog input channels are multiplexed into one module output so that your cabled DAQ device has access to the module's multiplexed output as well as the outputs on all other multiplexed modules in the chassis through the SCXI bus. Also called serial mode.
mux	multiplexer—a switching device with multiple inputs that sequentially connects each of its inputs to its output, typically at high speeds, in order to measure several signals with a single analog input channel

N

NC	normally closed, or not connected
NI-DAQ	National Instruments driver software for DAQ hardware
noise	an undesirable electrical signal—Noise comes from external sources such as the AC power line, motors, generators, transformers, fluorescent lights, soldering irons, CRT displays, computers, electrical storms, welders, radio transmitters, and internal sources such as semiconductors, resistors, and capacitors. Noise corrupts signals you are trying to send or receive.
NRSE	nonreferenced single-ended mode—all measurements are made with respect to a common (NRSE) measurement system reference, but the voltage at this reference can vary with respect to the measurement system ground

O

OUTREF	Output Reference signal

P

parallel mode	a type of SCXI operating mode in which the module sends each of its input channels directly to a separate analog input channel of the device to the module
peak to peak	a measure of signal amplitude; the difference between the highest and lowest excursions of the signal
ppm	parts per million

R

RAM	random-access memory
referenced signal sources	signal sources with voltage signals that are referenced to a system ground, such as the earth or a building ground. Also called grounded signal sources.
relative accuracy	a measure in LSB of the accuracy of an ADC. It includes all non-linearity and quantization errors. It does not include offset and gain errors of the circuitry feeding the ADC.
resolution	the smallest signal increment that can be detected by a measurement system. Resolution can be expressed in bits, in proportions, or in percent of full scale. For example, a system has 12-bit resolution, one part in 4,096 resolution, and 0.0244% of full scale.
rms	root mean square—the square root of the average value of the square of the instantaneous signal amplitude; a measure of signal amplitude
RSC	rear signal connector
RSE	referenced single-ended mode—all measurements are made with respect to a common reference measurement system or a ground. Also called a grounded measurement system.
RSVD	Reserved signal
RTD	resistance temperature detector—a metallic probe that measures temperature based upon its coefficient of resistivity

S

s	seconds
scan	one or more analog or digital input samples. Typically, the number of input samples in a scan is equal to the number of channels in the input group. For example, one pulse from the scan clock produces one scan which acquires one new sample from every analog input channel in the group.
scan clock	the clock controlling the time interval between scans. On boards with interval scanning support (for example, the AT-MIO-16F-5), this clock gates the channel clock on and off. On boards with simultaneous sampling (for example, the EISA-A2000), this clock clocks the track-and-hold circuitry.
scan rate	the number of scans per second. For example, a scan rate of 10 Hz means sampling each channel 10 times per second.

SCANCLK	Scan Clock signal
SCXI	Signal Conditioning eXtensions for Instrumentation—the National Instruments product line for conditioning low-level signals within an external chassis near sensors so only high-level signals are sent to DAQ boards in the noisy PC environment
SE	single-ended—a term used to describe an analog input that is measured with respect to a common ground
self-calibrating	a property of a DAQ board that has an extremely stable onboard reference and calibrates its own A/D and D/A circuits without manual adjustments by the user
sensor	a device that responds to a physical stimulus (heat, light, sound, pressure, motion, flow, and so on), and produces a corresponding electrical signal
SERCLK	Serial Clock signal
SERDATIN	Serial Data In signal
SERDATOUT	Serial Data Out signal
settling time	the amount of time required for a voltage to reach its final value within specified limits
signal conditioning	the manipulation of signals to prepare them for digitizing
signal divider	performing frequency division on an external signal
SLOT0SEL*	Slot 0 Select signal
system noise	a measure of the amount of noise seen by an analog circuit or an ADC when the analog inputs are grounded

T

thermistor	a semiconductor sensor that exhibits a repeatable change in electrical resistance as a function of temperature. Most thermistors exhibit a negative temperature coefficient.
thermocouple	a temperature sensor created by joining two dissimilar metals. The junction produces a small voltage as a function of the temperature.
throughput rate	the data, measured in bytes/s, for a given continuous operation, calculated to include software overhead.
transducer	*See* sensor

transducer excitation	a type of signal conditioning that uses external voltages and currents to excite the circuitry of a signal conditioning system into measuring physical phenomena
transfer rate	the rate, measured in bytes/s, at which data is moved from source to destination after software initialization and set up operations; the maximum rate at which the hardware can operate
trigger	any event that causes or starts some form of data capture
TTL	transistor-transistor logic

U

unipolar	a signal range that is always positive (for example, 0 to +10 V)
update	the output equivalent of a scan. One or more analog or digital output samples. Typically, the number of output samples in an update is equal to the number of channels in the output group. For example, one pulse from the update clock produces one update which sends one new sample to every analog output channel in the group.
update rate	the number of output updates per second

V

V	volts
V+	Positive Analog Supply signal
V–	Negative Analog Supply signal
VDC	volts direct current
V_{rms}	volts, root mean square

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