

DAQ

BNC-2140 User Manual

Dynamic Signal Acquisition Signal Conditioning Accessory

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A Return Material Authorization (RMA) number must be obtained from the factory and clearly marked on the outside of the package before any equipment will be accepted for warranty work. National Instruments will pay the shipping costs of returning to the owner parts which are covered by warranty.

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About This Manual

This manual describes the electrical and mechanical aspects of the BNC-2140 accessory and contains information concerning its operation.

Organization of This Manual

The *BNC-2140 User Manual* is organized as follows:

- Chapter 1, *Introduction*, describes the BNC-2140 accessory, lists what you need to get started, explains how to unpack your BNC-2140, and describes optional equipment.
- Chapter 2, *Installation and Configuration*, explains how to install and configure your BNC-2140 accessory.
- Chapter 3, *Signal Connections*, describes how to make input and output signal connections to your BNC-2140.
- Chapter 4, *Theory of Operation*, contains a functional overview of the BNC-2140.
- Appendix A, *Specifications*, lists the specifications of the BNC-2140.
- Appendix B, *Customer Communication*, contains forms you can use to request help from National Instruments or to comment on our products and manuals.
- 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 containing numbers separated by an ellipsis represent a range of values associated with a bit or signal name—for example, DIO<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 or caution.

italic

Italic text denotes a variable, emphasis, a cross reference, or an introduction to a key concept.

SE

SE means referenced single ended (RSE).

Related Documentation

The following documents contain information you may find helpful:

- National Instruments Application Note 025, *Field Wiring and Noise Considerations for Analog Signals*
- *PCI-4451/4452 User Manual*
- *NI 4551/4552 User Manual*

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.

Introduction

This chapter describes the BNC-2140 accessory, lists what you need to get started, explains how to unpack your BNC-2140, and describes optional equipment.

Thank you for buying the BNC-2140 accessory for DSA. The BNC-2140 is a signal conditioning accessory specifically designed for use with a dynamic signal acquisition (DSA) series device. It interfaces four BNC signal inputs and two BNC signal outputs directly to National Instruments DSA products including the PCI-4451, PCI-4452, NI 4551, and NI 4552. The BNC-2140 connects to Integrated Circuit Piezoelectric (ICP[®]) accelerometers and microphone preamplifiers as well as any other voltage source whose output is less than ± 42.4 V.

Each input channel consists of an independent 4 mA current source suitable for use with ICP type accelerometers and microphone preamplifiers. You can manually enable or disable the ICP signal conditioning on a per channel basis. When disabled, the BNC-2140 acts as a direct voltage input. You can manually switch each input channel and each output channel from differential (DIFF) to single-ended (SE) mode. In SE mode, the BNC shell tethers to a clean analog ground through a 50 Ω resistor.

The BNC-2140 receives power for the ICP signal conditioning from the DSA plug-in board via the 68-pin high-density connector. A green LED indicates when the ICP circuitry is powered on. When you do not require ICP signal conditioning, you can manually turn off the power to the circuits.

What You Need to Get Started

To set up and use your BNC-2140 device, you will need the following:

- BNC-2140
- One of the following DSA devices:
 - PCI-4451
 - PCI-4452
 - NI 4551
 - NI 4552
- BNC-2140 User Manual*
- Your computer
- SHC68-C68-A1 analog cable

Unpacking

Your BNC-2140 is shipped in an antistatic plastic package to prevent electrostatic damage to the device. Several components on the device can be damaged by electrostatic discharge. To avoid such damage in handling the device, take the following precautions:

- Ground yourself via a grounding strap or by holding a grounded object.
- Touch the plastic package to a metal part of your computer chassis before removing the device from the package.
- Remove the device from the package and inspect the device for loose components or any other sign of damage. Notify National Instruments if the device appears damaged in any way. *Do not* install a damaged device.
- *Never* touch the exposed pins of connectors.

Optional Equipment

If your application requires that you use transducers with microdot connectors, use the BNC plug screw-on receptacle, part number 033-0101-0001, from Microdot Connector Company. This accessory allows you to connect BNC and microdot connectors

If your application requires that you use a prepolarized microphone with a microphone preamplifier, contact Brüel and Kjær.

Custom Cabling

National Instruments offers cables of different lengths for the BNC-2140 accessory to connect your analog I/O signals to the DSA devices. National Instruments recommends that you not develop your own cabling solution due to the high-density connector that is required and the necessity to maintain high signal integrity.

If your application requires you to develop your own cable, use the following guidelines:

- Use shielded twisted-pair wires for each differential analog input or output channel pair. Since the signals are differential, using this type of wire yields the best results.
- When connecting the cable shields, be sure to connect the analog input grounds to the AIGND pins and the analog output grounds to the AOGND pins. For a connector pinout description refer to Table 3-2 in Chapter 3, *Signal Connections*.
- You can create your own accessories by using a 68-pin very high density cable interconnect (VHDCI) receptacle header using AMP 68-position right-angle PWB receptacle header 787254-1.
- Recommended manufacturer part numbers for the 68-pin mating connector (for the cable assembly) are as follows:
 - AMP 68-position cable straight plug, part number 787131-3
 - AMP 68-position backshell with jackscrews, part number 787191-1

Installation and Configuration

This chapter explains how to install and configure your BNC-2140 accessory.

Installation

**Note**

You must turn the power off to your computer before installing the BNC-2140.

The following are general installation instructions.

1. Insert either end of your SHC68-C68-A1 analog cable into the 68-pin connector on the BNC-2140. Insert the other end into the 68-pin connector on the DSA plug-in device.
2. Tighten the jack screws finger-tight on both ends of the cable.
3. Check the installation.
4. Turn on your computer.

The BNC-2140 accessory is now installed.

Device Configuration

You must manually configure the BNC-2140 accessory by setting the channel switches. You can configure each input channel to have ICP signal conditioning enabled or disabled, and for DIFF and SE measurements. You can also configure each output channel for DIFF or SE measurements. You can turn the power on or off for the ICP signal conditioning circuitry. If you do not require ICP signal conditioning, turn off the ICP power. Refer to Figure 2-1 for the location of the switches.

**Note**

You can connect or disconnect BNC cables carrying signals without turning off the computer.

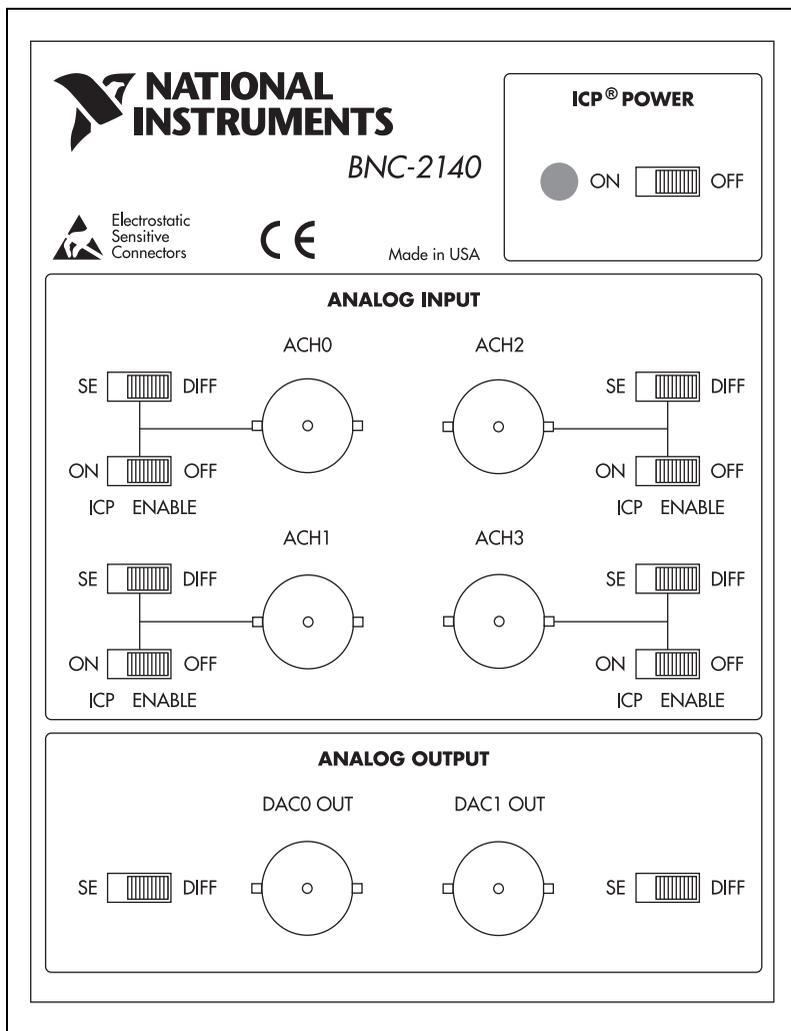


Figure 2-1. Switch Settings and Signal Connections

Signal Connections

This chapter describes how to connect input and output signals to your BNC-2140.

You can connect the external analog signals through six BNC connectors. Four BNC connectors are for input signals and two connectors are for output signals.

The SHC68-C68-A1 shielded cable connects the BNC-2140 internal analog signal connector to the DSA plug-in device. A single 68-pin 0.8 mm VHDCI connector connects the analog I/O signals to the shielded cable.

I/O Connectors

Table 3-1 shows the pin assignments for the six external I/O BNC connectors.

Table 3-1. BNC Analog I/O Connector Signal Descriptions

Signal Name	Reference	Direction	Description
+ACH<0..3>	AIGND	Input	+Analog Input Channel 0 through 3—Each channel can have ICP enabled or disabled. This signal passes through the BNC internal conductor.
-ACH<0..3>	AIGND	Input	-Analog Input Channel 0 through 3—In SE mode the inverting (-) terminal is tethered to ground through a 50 Ω resistor. This signal passes through the external BNC shell.
+DAC0OUT	-DAC0OUT	Output	+Analog Output Channel 0—This pin supplies the analog non-inverting output channel 0. This signal passes through the internal BNC conductor.
-DAC0OUT	+DAC0OUT	Output	-Analog Output Channel 0—This pin supplies the analog inverting output channel 0. This signal passes through the external BNC shell. In SE mode, the inverting (-) terminal is tethered to ground through a 50 Ω resistor.

Table 3-1. BNC Analog I/O Connector Signal Descriptions (Continued)

Signal Name	Reference	Direction	Description
+DAC1OUT	-DAC1OUT	Output	+Analog Output Channel 1—This pin supplies the analog non-inverting output channel 1. This signal passes through the internal BNC conductor.
-DAC1OUT	+DAC1OUT	Output	-Analog Output Channel 1—This pin supplies the analog inverting output channel 1. This signal passes through the external BNC shell. In SE mode, the inverting (-) terminal is tethered to ground through a 50 Ω resistor.

Figure 3-1 describes the pin connections on the BNC-2140 68-pin connector.

-ACH0	1	35	+ACH0
AIGND [†]	2	36	AIGND
-ACH1	3	37	+ACH1
AIGND [†]	4	38	AIGND
-ACH2	5	39	+ACH2
AIGND [†]	6	40	AIGND
-ACH3	7	41	+ACH3
AIGND [†]	8	42	AIGND
NC	9	43	NC
NC	10	44	NC
NC	11	45	NC
NC	12	46	NC
NC	13	47	NC
NC	14	48	NC
NC	15	49	NC
NC	16	50	NC
NC	17	51	NC
NC	18	52	NC
NC	19	53	NC
NC	20	54	NC
NC	21	55	NC
NC	22	56	NC
NC	23	57	NC
NC	24	58	NC
-DAC0OUT	25	59	+DAC0OUT
AOGND [†]	26	60	AOGND
-DAC1OUT	27	61	+DAC1OUT
AOGND [†]	28	62	AOGND
NC	29	63	NC
NC	30	64	NC
NC	31	65	NC
NC	32	66	NC
+5 V	33	67	+5 V
DGND	34	68	DGND

[†]These AIGND and AOGND pins are not connected in the SHC6868-A1 cable

Figure 3-1. BNC-2140 External 68-Pin Analog Connector

**Note**

This BNC-2140 pin assignment maps to the pin assignment of the DSA device you are connecting to the BNC-2140. Refer to your DSA device user manual for the pin assignments specific to your device connection.

Table 3-2 shows the pin assignments for the internal 68-pin I/O connector.

Table 3-2. 68-Pin Analog I/O Connector Signal Descriptions

Signal Name	Reference	Direction	Description
AIGND	—	—	Analog Input Ground—These pins are the reference point for single-ended measurements in SE mode and the bias current return point for differential measurements.
+ACH<0..3>	AIGND	Input	+Analog Input Channel 0 through 3.
–ACH<0..3>	AIGND	Input	–Analog Input Channel 0 through 3.
+DAC0OUT	–DAC0OUT	Output	+Analog Output Channel 0.
–DAC0OUT	+DAC0OUT	Output	–Analog Output Channel 0.
+DAC1OUT	–DAC1OUT	Output	+Analog Output Channel 1.
–DAC1OUT	+DAC1OUT	Output	–Analog Output Channel 1.
AOGND	—	—	Analog Output Ground—The analog output voltages are ultimately referenced to this node.
DGND	—	—	Digital Ground—This pin supplies the reference for the +5 VDC supply.
+5 V	DGND	Output	+5 VDC Source—These pins are fused for up to 0.5 A of +5 V supply on the DSA plug-in device. The fuse is self-resetting. This source powers the ICP circuits of the BNC-2140.
NOTE: For +ACH<0..3>, –ACH<0..3>, +DAC0OUT, –DAC0OUT, +DAC1OUT, and –DAC1OUT descriptions see Table 3-1.			

Refer to Figure 3-1 for the pin assignments for the 68-pin connector.

**Caution**

Connections that exceed any of the maximum ratings of input or output signals on the BNC-2140 accessory can damage not only the BNC-2140, but also the DSA plug-in device and the computer as well. Maximum input ratings for each signal are given in Appendix A, [Specifications](#). National Instruments is not liable for any damages resulting from signal connections exceeding maximum ratings.

The outer shell of the BNC connectors is not GND (0 V). The outer shell of the BNC is not physically connected to the metal box of the BNC-2140. The outer shell is either the inverting differential signal in DIFF mode or is tethered to GND (0 V) through a 50 Ω , 1 W resistor in SE mode.

Analog Input Signal Connections

The analog input signals for the BNC-2140 device are +ACH<0..3> and -ACH<0..3>. Connecting of analog input signals to your BNC-2140 accessory depends on the configuration of the input signal sources.

For most signals, you use a DIFF configuration and simply connect the signal to +ACH x (where x is the BNC-2140 channel) and the signal ground (or signal minus), as appropriate, to -ACH x . If a signal has a high output impedance (greater than 1 k Ω) and is floating, you may find it useful to use an SE configuration that tethers the signal minus to AIGND. This reduces common-mode interference.

Analog Output Signal Connections

The BNC-2140 analog output signals are +DAC0OUT, -DAC0OUT, +DAC1OUT, and -DAC1OUT.

+DAC0OUT is the voltage output signal for analog output channel 0.
+DAC1OUT is the voltage output signal for analog output channel 1.

Connection of analog output signals from your BNC-2140 accessory depends on the configuration of the devices receiving the signals. For most signals, you use a DIFF configuration and simply connect +DAC x OUT (where x is the BNC-2140 channel) to the signal and -DAC x OUT to the signal ground (or signal minus), as appropriate. When driving some floating devices, you may sometimes find it helpful to use the SE configuration and connect the floating ground system of the device to AOGND to reduce common-mode noise coupled from an interfering source to the device.



Caution

When you configure an analog output channel in the SE mode, the voltage between AOGND and -DAC x OUT must not exceed ± 7.07 V (5 V_{rms}). Voltage that exceeds this rating can damage the BNC-2140, the DSA plug-in device, and the computer. National Instruments is not responsible for any damages resulting from connections that exceed this rating.

Theory of Operation

This chapter contains a functional overview of the BNC-2140.

Functional Overview

Figure 4-1 is a block diagram of the BNC-2140.

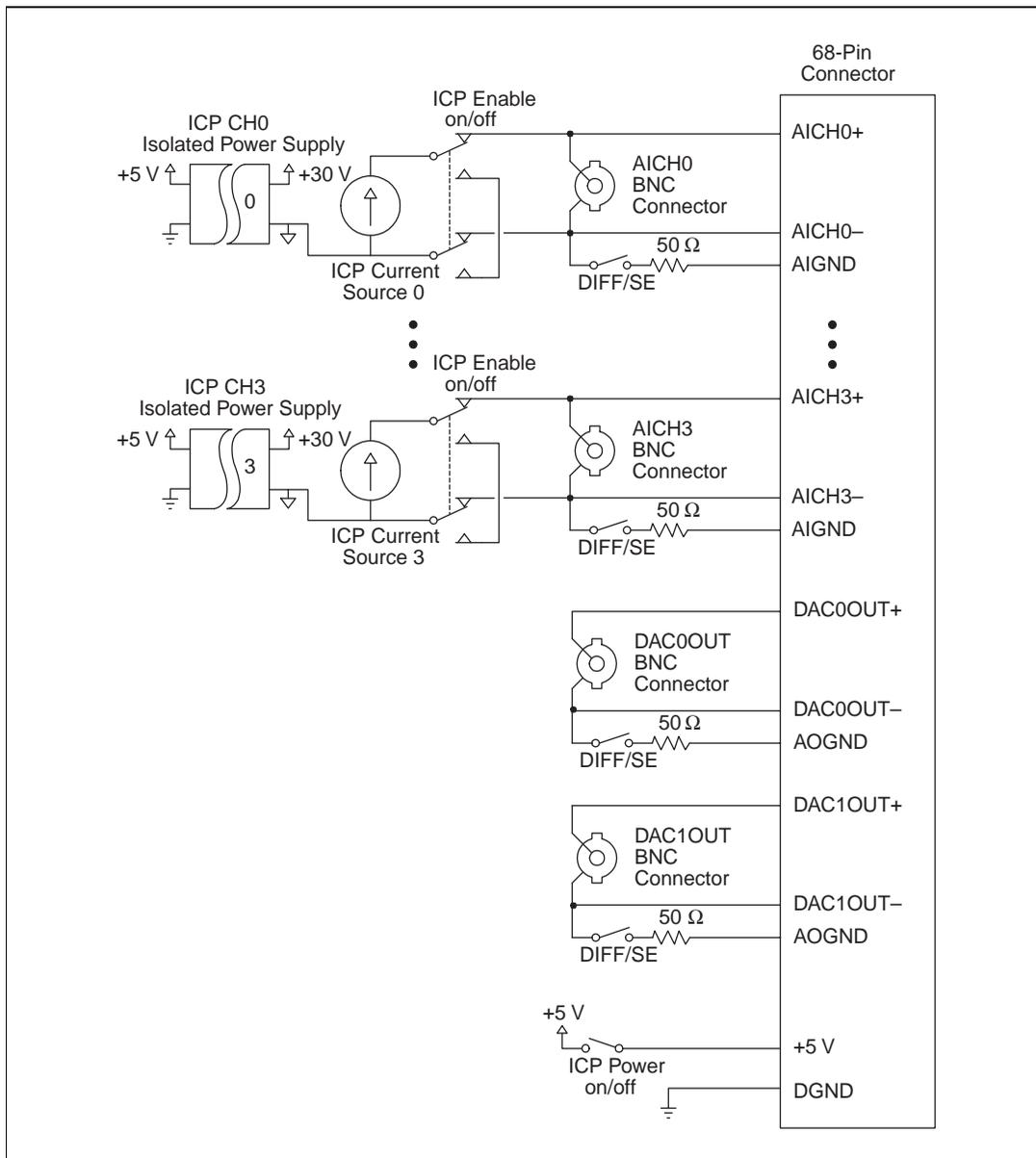


Figure 4-1. BNC-2140 Block Diagram

Analog Input Circuitry

The BNC-2140 has four identical analog input channels.

A principal function of the BNC-2140 is to supply a constant current for ICP type accelerometers and microphone preamplifiers. Many accelerometers use piezoelectric materials to generate a charge that is proportional to the acceleration applied. Although these types of accelerometers have certain advantages, they are very susceptible to external noise. ICP-type sensor manufacturers embed a charge amplifier within the transducer to reduce the effect of cable length, noise, and other spurious effects. The BNC-2140 supplies the constant current required to power that embedded charge amplifier ICP that allows you to use inexpensive cables such as BNC cables. Leveraging off this technology, some manufacturers use ICP signal conditioning to power their prepolarized microphones. If your application requires a microphone preamplifier for use with a prepolarized microphone see *Optional Equipment*, in Chapter 1, for a list of recommended suppliers.

You must enable ICP to generate the required power for each channel that uses these types of accelerometers and microphone preamplifiers. When you disable ICP, the connection from the ICP circuit to the analog input signal breaks and has no impact on the incoming signal. When you disable ICP on an input channel, the circuitry of two channels is still energized. If you do not require ICP to be enabled on any of the four input channels, turn off the ICP power to de-energize the circuitry. Turning off the ICP power removes any noise the circuitry can induce on the incoming signal.

You can also use the BNC-2140 to select between DIFF and SE input modes. The BNC-2140 works with any DSA device that has a differential input stage for each input channel.

In DIFF mode, one line connects to the positive input of the channel, and the other connects to the negative input of that same channel. You can connect the differential input to either floating or ground-referenced signals.

You can use ICP signal conditioning when the BNC-2140 inputs are either in DIFF or SE mode.

Analog Output

The BNC-2140 has two analog output channels. The BNC-2140 can also select between DIFF and SE outputs.

In DIFF mode, one line connects to the positive output of the channel and the other connects to the negative output of that same channel. You can connect the differential output to either floating or ground-referenced signals.

Specifications

This appendix lists the specifications of the BNC-2140 accessory. All specifications are typical at 25° C unless otherwise noted. All specifications are relative to measurement standards and require a 15 minute warm-up period. Specifications do not include transducer error.

Analog Input

Voltage Input

Number of channels 4

Maximum input voltage
(Signal + common mode voltage) Each input should remain within
 ± 42.4 V ($30 V_{\text{rms}}$) of any other
input or of AIGND

Inputs affected ACH0, ACH1, ACH2, ACH3

Input coupling DC

Input capacitance¹

DIFF mode

Current excitation on 85 pF

Current excitation off 75 pF

SE mode

Current excitation on 150 pF

Current excitation off 145 pF

Current Excitation

Level 4 mA

Accuracy $\pm 1.015\%$

¹ Includes the effects of the BNC-2140 with a 1 m SHC68-C68-A1 analog cable

Temperature coefficient.....	± 127 ppm/ $^{\circ}$ C
Voltage compliance	24 V
Excitation overvoltage protection.....	± 42.4 V (30 V _{rms}) powered on or off

Analog Output

Number of channels.....	2, see Caution under <i>Analog Output Signal Connections</i> , in Chapter 3, <i>Signal Connections</i>
Output coupling	DC

Power Requirement (from DSA board)

Power consumption	400 mA at +5 VDC
-------------------------	------------------

Physical

Dimensions	14.0 by 11.2 by 3.8 cm (6.0 by 4.4 by 1.6 in.)
I/O connectors	
I/O Signals.....	6 BNC connectors (outer shell isolated from box metal)
DSA board connection	68-pin 0.8 mm VHDCI female connector

Environment

Operating temperature	0 $^{\circ}$ to 40 $^{\circ}$ C
Storage temperature.....	-55 $^{\circ}$ to 150 $^{\circ}$ C
Relative humidity	5% to 90% non-condensing

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:

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United Kingdom: 01635 551422

Up to 9,600 baud, 8 data bits, 1 stop bit, no parity

France: 01 48 65 15 59

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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

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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: _____

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: *BNC-2140 User Manual*

Edition Date: April 1998

Part Number: 321933A-01

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

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

Thank you for your help.

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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
t-	tera-	10^{12}

Numbers/Symbols

%	percent
+	positive of, or plus
-	negative of, or minus
/	per
°	degree
Ω	ohm
+5 ζ	+5 V VDC source signal

A

A	amperes
AC	alternating current
AC coupled	allowing the transmission of AC signals while blocking DC signals

ACH	analog input channel signal
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
alias	a false lower frequency component that appears in sampled data acquired at too low a sampling rate
amplification	a type of signal conditioning that improves accuracy in the resulting digitized signal and reduces noise
amplitude flatness	a measure of how close to constant the gain of a circuit remains over a range of frequencies
AOGND	analog output ground signal
attenuate	to decrease the amplitude of a signal
attenuation ratio	the factor by which a signal's amplitude is decreased
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
bipolar	a signal range that includes both positive and negative values (for example, -5 V to $+5\text{ V}$)
BNC	a type of coaxial signal connector

C

C	Celsius
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.
CMRR	common-mode rejection ratio—a measure of an instrument’s ability to reject interference from a common-mode signal, usually expressed in decibels (dB)
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
common-mode voltage	any voltage present at the instrumentation amplifier inputs with respect to amplifier ground
compensation range	the range of a parameter for which compensating adjustment can be made
conversion device	device that transforms a signal from one form to another. For example, analog-to-digital converters (ADCs) for analog input, digital-to-analog converters (DACs) for analog output, digital input or output ports, and counter/timers are conversion devices.
conversion time	the time required, in an analog input or output system, from the moment a channel is interrogated (such as with a read instruction) to the moment that accurate data is available
coupling	the manner in which a signal is connected from one location to another
crosstalk	an unwanted signal on one channel due to an input on a different channel
current drive capability	the amount of current a digital or analog output channel is capable of sourcing or sinking while still operating within voltage range specifications
current sinking	the ability of a DAQ board to dissipate current for analog or digital output signals
current sourcing	the ability of a DAQ board to supply current for analog or digital output signals

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
DAC0OUT	analog channel 0 output signal
DAC1OUT	analog channel 1 output signal
dB	decibel—the unit for expressing a logarithmic measure of the ratio of two signal levels: $\text{dB}=20\log_{10}(V_1/V_2)$, for signals in volts
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 <i>use the current default setting</i> . For example, the default input for a parameter may be <i>do not change current setting</i> , and the default setting may be <i>no AMUX-64T boards</i> . If you do change the value of such a parameter, the new value becomes the new setting. You can set default settings for some parameters in the configuration utility or manually using switches located on the device.
delta-sigma modulating ADC	a high-accuracy circuit that samples at a higher rate and lower resolution than is needed and (by means of feedback loops) pushes the quantization noise above the frequency range of interest. This out-of-band noise is typically removed by digital filters.
DGND	digital ground signal
DIFF	differential mode
differential input	an analog input consisting of two terminals, both of which are isolated from computer ground, whose difference is measured
differential measurement system	a way you can configure your device to read signals, in which you do not need to connect either input to a fixed reference, such as the earth or a building ground
DIO	digital input/output

DNL	differential nonlinearity—a measure in least significant bit of the worst-case deviation of code widths from their ideal value of 1 LSB
dynamic range	the ratio of the largest signal level a circuit can handle to the smallest signal level it can handle (usually taken to be the noise level), normally expressed in decibels
E	
EMC	electromechanical compliance
F	
floating signal sources	signal sources with voltage signals that are not connected to an absolute reference or system ground. Also called nonreferenced signal sources. Some common example of floating signal sources are batteries, transformers, or thermocouples.
G	
gain	the factor by which a signal is amplified, sometimes expressed in decibels
gain accuracy	a measure of deviation of the gain of an amplifier from the ideal gain
g_{rms}	level of random vibration
grounded measurement system	<i>See SE.</i>
H	
h	hour
hardware	the physical components of a computer system, such as the circuit boards, plug-in boards, chassis, enclosures, peripherals, and cables
hex	hexadecimal
Hz	hertz—cycles per second. Specifically refers to the repetition frequency of a waveform.

I

IC	integrated circuit
ICP	Integrated Circuit Piezoelectric—identifies products that operate using a constant current source and returns the output signal in the form of voltage modulation on the same line as the constant current source.
IMD	intermodulation distortion—the ratio, in dB, of the total rms signal level of harmonic sum and difference distortion products, to the overall rms signal level. The test signal is two sine waves added together according to the following standards: SMPTE—A 60 Hz sine wave and a 7 kHz sine wave added in a 4:1 amplitude ratio. DIN—A 250 Hz sine wave and an 8 kHz sine wave added in a 4:1 amplitude ratio. CCIF—A 14 kHz sine wave and a 15 kHz sine wave added in a 1:1 amplitude ratio.
in.	inches
INL	integral nonlinearity—a measure in LSB of the worst-case deviation from the ideal A/D or D/A transfer characteristic of the analog I/O circuitry
input bias current	the current that flows into the inputs of a circuit
input impedance	the measured resistance and capacitance between the input terminals of a circuit
input offset current	the difference in the input bias currents of the two inputs of an instrumentation amplifier
instrumentation amplifier	a circuit whose output voltage with respect to ground is proportional to the difference between the voltages at its two inputs
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
I_{OH}	current, output high
I_{OL}	current, output low

K

k	kilo—the standard metric prefix for 1,000, or 10^3 , used with units of measure such as volts, hertz, and meters
K	kilo—the prefix for 1,024, or 2^{10} , used with B in quantifying data or computer memory
kS	1,000 samples

L

LabVIEW	laboratory virtual instrument engineering workbench
linearity	the adherence of device response to the equation $R = KS$, where R = response, S = stimulus, and K = a constant
linearization	a type of signal conditioning in which software linearizes the voltage levels from transducers, so the voltages can be scaled to measure physical phenomena
low frequency corner	in an AC-coupled circuit, the frequency below which signals are attenuated by at least 3 dB

M

m	meters
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
MSB	most significant bit
MTBF	mean time between failure
MTTR	mean time to repair—predicts downtime and how long it takes to fix a product

N

NC	normally closed, or not connected
NIST	National Institute of Standards and Technology
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.
nonreferenced signal sources	signal sources with voltage signals that are not connected to an absolute reference or system ground. Also called floating signal sources. Some common example of nonreferenced signal sources are batteries, transformers, or thermocouples.
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

onboard channels	channels provided by the plug-in data acquisition board
output settling time	the amount of time required for the analog output voltage to reach its final value within specified limits
output slew rate	the maximum rate of change of analog output voltage from one level to another

P

passband	the range of frequencies which a device can properly propagate or measure
PCI	Peripheral Component Interconnect—a high-performance expansion bus architecture originally developed by Intel to replace ISA and EISA. It is achieving widespread acceptance as a standard for PCs and work-stations; it offers a theoretical maximum transfer rate of 132 Mbytes/s.

peak to peak	a measure of signal amplitude; the difference between the highest and lowest excursions of the signal
pF	pico farad—a farad is a unit used to measure capacitance
ppm	parts per million
pts	points

R

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.
rise time	the difference in time between the 10% and 90% points of a system's step response
rms	root mean square—the square root of the average value of the square of the instantaneous signal amplitude; a measure of signal amplitude
RSE	<i>see</i> SE

S

s	seconds
S	samples
SE	single-ended—a term used to describe an analog input that is measured with respect to a common ground
settling time	the amount of time required for a voltage to reach its final value within specified limits

Shannon Sampling Theorem	a law of sampling theory stating that if a continuous bandwidth-limited signal contains no frequency components higher than half the frequency at which it is sampled, then the original signal can be recovered without distortion
SNR	signal-to-noise ratio—the ratio of the overall rms signal level to the rms noise level, expressed in decibels
source impedance	a parameter of signal sources that reflects current-driving ability of voltage sources (lower is better) and the voltage-driving ability of current sources (higher is better)
SS	simultaneous sampling—a property of a system in which each input or output channel is digitized or updated at the same instant
S/s	samples per second—used to express the rate at which a DAQ board samples an analog 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	
THD	total harmonic distortion—the ratio of the total rms signal due to harmonic distortion to the overall rms signal, in decibel or a percentage
THD+N	signal-to-THD plus noise—the ratio in decibels of the overall rms signal to the rms signal of harmonic distortion plus noise introduced
transducer	<i>See</i> 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
U	
unipolar	a signal range that is always positive (for example, 0 to +10 V)
update rate	the number of output updates per second

V

V	volts
V _{DC}	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 _{ref}	reference voltage

W

waveform	multiple voltage readings taken at a specific sampling rate
working voltage	the highest voltage that should be applied to a product in normal use, normally well under the breakdown voltage for safety margin.

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