

INSTALLATION GUIDE

BNC-2120

Connector Accessory for Multifunction DAQ Devices

This installation guide describes how to install, configure, and use your BNC-2120 accessory. If you have not already installed your DAQ device, refer to the *DAQ Quick Start Guide* for instructions.

The BNC-2120 is a desktop or DIN rail-mountable accessory you can connect to E Series, S Series, and waveform generation Multifunction DAQ devices. The BNC-2120 has the following features:

- Eight BNC connectors for analog input (AI) connection with the following optional features:
 - Thermocouple connector
 - Temperature reference
 - Resistor measurement screw terminals
- Two BNC connectors for analog output (AO) connection
- Screw terminals for digital input/output (DIO) connection with state indicators
- Screw terminals for Timing I/O connections
- Two user-defined BNC connectors
- A function generator with the following outputs:
 - Frequency-adjustable, TTL-compatible square wave
 - Frequency- and amplitude-adjustable sine wave or triangle wave
- Quadrature encoder

The BNC-2120 has a 68-pin input/output (I/O) connector that connects to your E Series, S Series, or waveform generation Multifunction DAQ device.

What You Need to Get Started

To set up and use your BNC-2120 accessory, you need the following:

- BNC-2120 accessory
- BNC-2120 Installation Guide*
- E Series, S Series, or waveform generation Multifunction DAQ device
- 68-position or 100-position cable
- BNC cables
- 24 AWG wire or smaller
- Wire strippers
- Flathead screwdriver (supplied)

Installing the BNC-2120



Note If you have not already installed your DAQ device, refer to the *DAQ Quick Start Guide* for instructions.

Complete the following steps to install the BNC-2120.

1. Place the BNC-2110 near the host computer or use the optional DIN rail-mounting kit, which you can order from National Instruments. For more information about the DIN rail-mounting kit, refer to the National Instruments Web site at ni.com or call the office nearest you.
2. Connect the BNC-2120 to your DAQ device. Refer to Table 1 to make sure that you have the proper cable for your DAQ device.
3. Make sure the floating source (FS)/ground-referenced source (GS) switches under BNC connectors AI <0...7> are set correctly for your application. Refer to the *Connecting Analog Inputs* section for more information.
4. Connect the field signals to the BNC connectors and/or digital screw terminal plugs. Refer to the *Configuring the BNC-2120* section for more information.
5. Power on your DAQ device. If the power indicator LED does not light, check the cable connections.

6. Refer to the steps in the *DAQ Quick Start Guide* to launch Measurement & Automation Explorer (MAX), confirm that your DAQ device is recognized, and configure your device settings.
7. Test specific device functionality, such as the ability to send and receive data. Refer to the *DAQ Quick Start Guide* for more detailed information on running test panels in MAX.

When you have finished using the BNC-2120, power off any external signals connected to the BNC-2120 before you power off your computer.



Caution Do *not* connect the BNC-2120 to any device other than the National Instruments E Series, S Series, or waveform generation DAQ devices. Doing so can damage the BNC-2120, the DAQ device, or the host computer. National Instruments is *not* liable for damage resulting from these connections.

Connecting the Cables

The BNC-2120 has one 68-position connector on the rear panel to connect to your DAQ device. Refer to Table 1 to make this connection.

Table 1. BNC-2120 Connecting Options

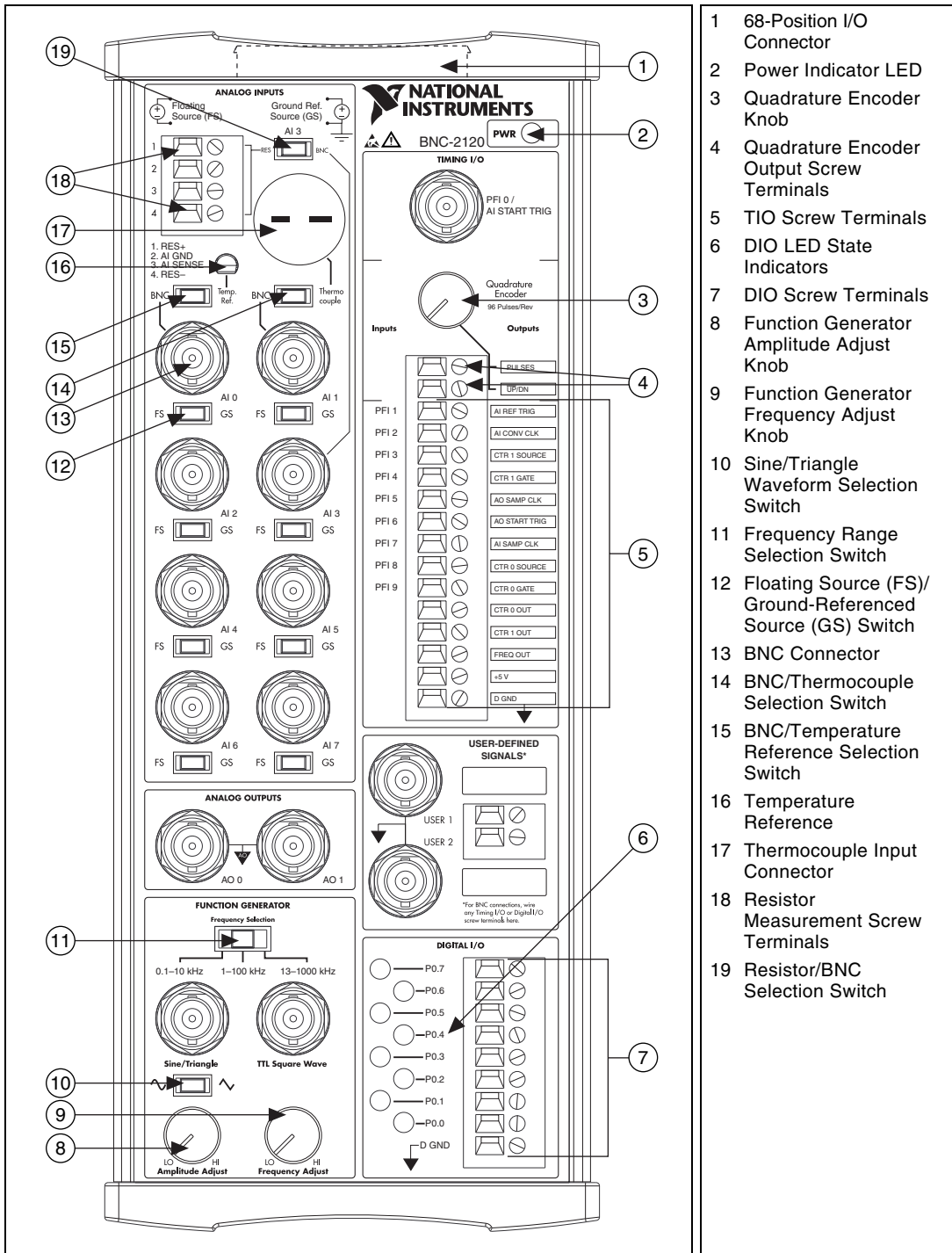
DAQ Device	Required Cable
100-pin MIO connector	SH1006868
68-pin SCSI connector	SH6868, SH68-68-EP ¹ , or R6868
68-pin DAQCard (VHDCI) connector	SHC68-68-EP
¹ SH68-68-EP is necessary for use with NI 61XX DAQ devices.	

Configuring the BNC-2120

This section describes how to configure the BNC-2120. Figure 1 shows the front panel of the BNC-2120.



Note With NI-DAQmx, National Instruments has revised its terminal names so they are easier to understand and more consistent among NI hardware and software products. The revised terminal names used in this document are usually similar to the names they replace. For a complete list of traditional NI-DAQ terminal names and the NI-DAQmx equivalents, refer to the *Terminal Name Equivalences* table of the *E Series Help* at ni.com/manuals.



- 1 68-Position I/O Connector
- 2 Power Indicator LED
- 3 Quadrature Encoder Knob
- 4 Quadrature Encoder Output Screw Terminals
- 5 TIO Screw Terminals
- 6 DIO LED State Indicators
- 7 DIO Screw Terminals
- 8 Function Generator Amplitude Adjust Knob
- 9 Function Generator Frequency Adjust Knob
- 10 Sine/Triangle Waveform Selection Switch
- 11 Frequency Range Selection Switch
- 12 Floating Source (FS)/Ground-Referenced Source (GS) Switch
- 13 BNC Connector
- 14 BNC/Thermocouple Selection Switch
- 15 BNC/Temperature Reference Selection Switch
- 16 Temperature Reference
- 17 Thermocouple Input Connector
- 18 Resistor Measurement Screw Terminals
- 19 Resistor/BNC Selection Switch

Figure 1. BNC-2120 Front Panel

The BNC-2120 is compatible with all E Series, S Series, and waveform generation Multifunction DAQ devices. Some of the connectors on this accessory may have a different function, depending on the device to which it is connected.

Table 2 describes the BNC connectors on the front panel of your BNC-2120.

Table 2. BNC-2120 Connector Signal Descriptions

Front Panel BNC Connectors	Signal Description
AI <0..1>	Differential Analog Input channels 0 and 1 ¹ .
AI <2..7>/AO <7..2>	Differential Analog Input channels 2 through 7 ² or Analog Outputs 7 through 2 ³ .
AO <1..0>	Analog Output channels 1 and 0.
PFI 0/AI START TRIG	Programmable Function Input 0/Trigger 1—As an input, this connector is either one of the PFIs or the source for the hardware analog trigger. As an output, it is the AI start trigger.
USER <1..2>	User-defined 1 and 2—Connected to USER 1 and USER 2 digital terminal blocks. This connector allows you to use a BNC connector for a digital or timing I/O signal of your choice.
¹ E Series and S Series devices only, reserved in waveform generation Multifunction DAQ devices ² When connected to E Series or S Series devices ³ When connected to waveform generation Multifunction DAQ devices	

For more detailed information about how the accessory terminals correspond one-to-one to the Multifunction DAQ device, refer to the I/O Connector Pinouts Table of the *E Series Help* at ni.com/manuals.

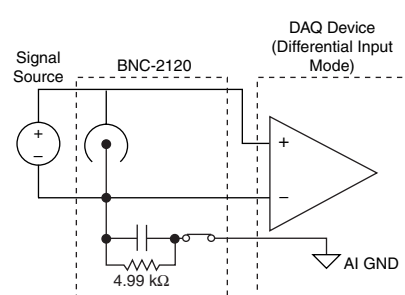
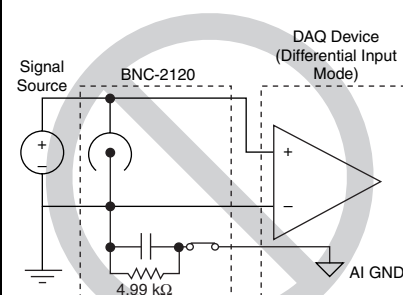
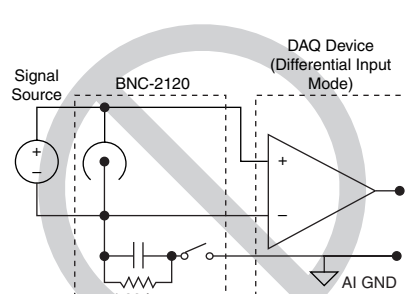
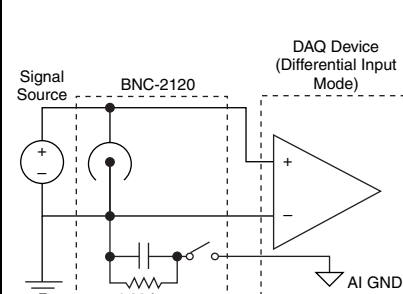
Connecting Analog Inputs

You can use the BNC-2120 to measure floating and ground-referenced AI signals. Refer to the *E Series Help* for more information on measuring floating and ground-referenced signals. You also can use the BNC-2120 to measure temperature and resistance.

Measuring Floating Signal Sources

To measure floating signal sources, move the FS/GS switches below the AI connectors you are using to the floating source (FS) position. The FS/GS switches are located below the AI BNC connectors. In the floating source switch position, the amplifier negative terminal connects to ground through a 4.99 kΩ resistor. Table 3 shows the switch configuration options.

Table 3. Switch Configuration Summary

BNC-2120 Switch Configuration	Signal Source Types	
	Floating Source	Ground-Referenced Source
Floating Source (FS)	 <p>Recommended</p>	 <p>Not Recommended</p>
Ground-Referenced Source (GS)	 <p>Improper Configuration</p>	 <p>Recommended</p>

Measuring Ground-Referenced Signals

To measure ground-referenced signals, move the switches of your choice to either the floating or ground-referenced source position. For best performance, use the ground-referenced source position labeled GS to avoid ground loops.

AI GND and AI SENSE signals are located at the screw terminals in the AI section of the BNC-2120. When connecting signals to the screw terminals, use wire no larger than 24 AWG with the insulation stripped to 0.28 in.

Thermocouple and IC Temperature Reference

To measure temperature, AI 0 and AI 1 have switches for selecting the BNC connectors, used for connecting floating and ground-referenced AI signals, or the temperature reference and the thermocouple connector. These switches are located above the BNC connectors for AI 0 and AI 1. The integrated circuit (IC) temperature reference provides cold-junction compensation (CJC) through software. The IC sensor voltage is linearly proportional to the sensor temperature where:

$$^{\circ}\text{C} = \text{Volts} \times 100$$

The sensor is accurate to $\pm 1.5^{\circ}\text{C}$. The thermocouple connector is for connecting any type of thermocouple having a two-prong miniature or subminiature male connector.

For more information on thermocouples and CJC, refer to Application Note 043, *Measuring Temperature with Thermocouples*, at zone.ni.com.

Measuring Resistance

The BNC-2120 has terminals for measuring resistance. Figure 2 is a schematic representation of how the BNC-2120 measures resistance.

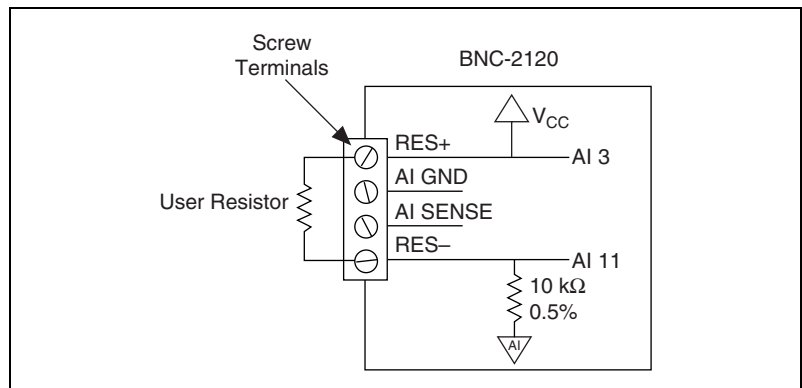


Figure 2. BNC-2120 Ohmmeter

RES+ is internally connected to the AI 3 and V_{CC} . RES- is internally connected to AI 11. There is also a resistor between AI 11 and AI GND.

Complete the following steps to measure resistance.

1. Move the AI 3 switch (Figure 1, number 19) to the RES position.
2. Connect the resistor to the RES+ and RES– screw terminals. You can measure resistors with values ranging from 100 Ω to 1 M Ω .
3. Measure V_{CC} on AI 3 and the voltage drop across the internal 10 k Ω resistor on AI 11.
4. With these measurements, calculate the resistor value using the following formula:

$$\text{Resistor Value} = \frac{V_{AI3} - V_{AI11}}{V_{AI11}/(10 \text{ k}\Omega)}$$



Note For LabVIEW 7.0, use the National Instruments Example Finder to locate the ohmmeter example VI to calculate resistance. The VI is also included with NI-DAQ 6.6.0 or later.

Connecting Analog Outputs

The BNC-2120 connects to the AO channels of the E Series or S Series device with the AO 0 and AO 1 BNC connectors. AO GND is the reference for these BNC connectors.

Using the Function Generator

The BNC-2120 has a function generator that produces sine or triangle waveforms and TTL-compatible square waveforms. Use the switch below the Sine/Triangle BNC connector to select a sine wave or triangle wave output for the Sine/Triangle BNC connector. A TTL-compatible square wave is always present at the BNC connector labeled TTL Square Wave.

To adjust the frequency of the function generator, select your frequency range using the Frequency Selection switch. You can select either 100–10 kHz, 1k–100 kHz, or 13k–1 MHz. The Frequency Adjust knob adjusts the frequency within the preselected range for the sine or triangle wave, and the TTL square wave outputs. The Amplitude Adjust knob adjusts the amplitude of the sine or triangle wave output up to 4.4 V_{p-p} .

Connecting Timing I/O

Connect to the Timing I/O signals of the E Series device at the screw terminals in the Timing I/O section of the BNC-2120. The Timing I/O output signal names are categorized and color-coded for specific types of applications. When connecting signals to the screw terminals, use 24 AWG wire or smaller with the insulation stripped to 0.28 in.

Table 4 describes the digital terminals on the front panel of the BNC-2120.

Table 4. BNC-2120 Digital Terminal Descriptions

Terminal	Description
PFI <1..9>	Programmable Function Input lines 1 through 9.
D GND	Digital Ground—This pin supplies the reference for the digital signals at the I/O connector as well as the +5 VDC supply.
CTR 1 OUT	Counter 1 Output—This terminal is the output from General-Purpose Counter 1.
FREQ OUT	Frequency Output—Output from the frequency generator.
+5 V	+5 V power—These pins are fused on the DAQ device and are self-resetting. The current available depends on the product to which it is connected.
USER <1..2>	User-defined 1 and 2—Connected to USER 1 and USER 2 digital terminal blocks. These terminals provide user-definable BNC terminals.
P0.<7..0>	Digital input/output lines 7 through 0—P0.6 and 7 can control the up/down signal of General-Purpose Counters 0 and 1, respectively.

Using the Quadrature Encoder

The BNC-2120 contains a mechanical quadrature encoder circuit that produces 96 pulses per encoder revolution. Two outputs, CLK and $\overline{UP/DN}$, are at the screw terminals located below the quadrature encoder knob.

CLK outputs a pulse train generated by rotating the encoder shaft. It provides four pulses per one mechanical click of the encoder. $\overline{UP/DN}$ outputs a high or a low signal indicating rotation direction. If the direction is counterclockwise, $\overline{UP/DN}$ is low. If the direction is clockwise, $\overline{UP/DN}$ is high.

To use the quadrature encoder with E Series counter 0, connect CLK to PFI 8 and connect $\overline{UP/DN}$ to P0.6, which is the up/down pin of counter 0. To use it with counter 1, connect CLK to PFI 3 and connect $\overline{UP/DN}$ to P0.7, which is the up/down pin of counter 1.

For LabVIEW, there is an example that configures the DAQ-STC counter on your E Series device for up/down counting in the traditional NI-DAQ API. Use the National Instruments Example Finder to locate the example, `BNC-2120 Quadrature Encoder.vi`. Once the DAQ-STC is properly

configured, the VI retrieves the count from the counter and converts the count into total degrees rotated using the following formula:

$$\text{Total Degrees Rotated} = \text{CLK pulses} \times 3.75^\circ/\text{pulse}$$

where

$$3.75^\circ/\text{pulse} = \frac{360^\circ}{96 \text{ pulses}}$$

The VI then calculates the number of revolutions and remaining degrees by dividing the total degrees rotated by 360° . The calculated quotient is equal to the number of revolutions and the remainder is equal to the remaining degrees. The VI is included with NI-DAQ 6.6.0 or later, and you also can obtain it from the National Instruments Web site.

Using the User-Defined Signal Connectors

Two user-defined BNC connectors, USER 1 and USER 2, connect to the adjacent screw terminals. These screw terminals and their associated BNC connectors give you the flexibility to choose up to two screw terminal signals and interface with them using the BNC connectors. D GND is the reference for these BNC connectors.

Connecting Digital I/O

The P0 channels of the Multifunction DAQ device connect to the screw terminals in the Digital I/O section of the BNC-2120. When connecting signals to the screw terminals, use wire no larger than 24 AWG with the insulation stripped to 0.28 in. The LEDs next to each screw terminal indicate the state of each digital channel. If the LED is lit, the channel is either pulled high or driven high. If the LED is off, the channel is either pulled low or driven low. D GND is available at the screw terminals to supply the reference for the P0 signals.

Specifications

This section lists the specifications of the BNC-2120. These specifications are typical at 25 °C unless otherwise specified.

Analog Input

Number of channels (default) 8 differential

Field connections (default)..... 8 BNC connectors

Protection No additional protection provided. Consult your DAQ device for specifications.

Optional inputs

Input	Description
AI 0	Temperature sensor
AI 1	Thermocouple
AI 3, AI 11	Resistor measurement (requires RSE configuration)

Optional connections

Thermocouple Uncompensated miniature connector, mates with 2-prong miniature or subminiature connector

Resistor 2 screw terminals

Resistor measurement range 100 Ω to 1 M Ω

Resistor measurement error $\leq 5\%$

Screw terminals 4 positions, no larger than 24 AWG wire

Switches

Floating source/grounded source ... 8

BNC/temperature reference IC 1

BNC/thermocouple connector 1

BNC/resistor screw terminals 1

Analog Output

Field connection2 BNC connectors

Digital Input/Output

Screw terminals9 positions, no larger than
24 AWG wire

LED state indicators8, 1 each for lines P0.<7..0>

Protection (DC max V)

Powered off ± 5.5 V

Powered on+10/-5 V

Drive

V_{ol} 0.6 V, 8 mA
1.6 V, 24 mA

V_{oh} 4.4 V, 8 mA
4 V, 13 mA

Function Generator

Square wave.....TTL compatible

Frequency range100 Hz to 1 MHz

Frequency adjust.....Through Frequency Adjust knob

Rise time.....250 ns

Fall time.....50 ns

Sine/Triangle wave

Frequency range100 Hz to 1 MHz

Frequency adjust.....Through Frequency Adjust knob

Amplitude range60 mV_{p-p} to 4.4 V_{p-p}

Amplitude adjustThrough Amplitude Adjust knob

Comparison.....Triangle wave is approximately
2 times the sine wave output
4.4 V_{p-p} maximum

Output impedance.....600 Ω

Drive capability

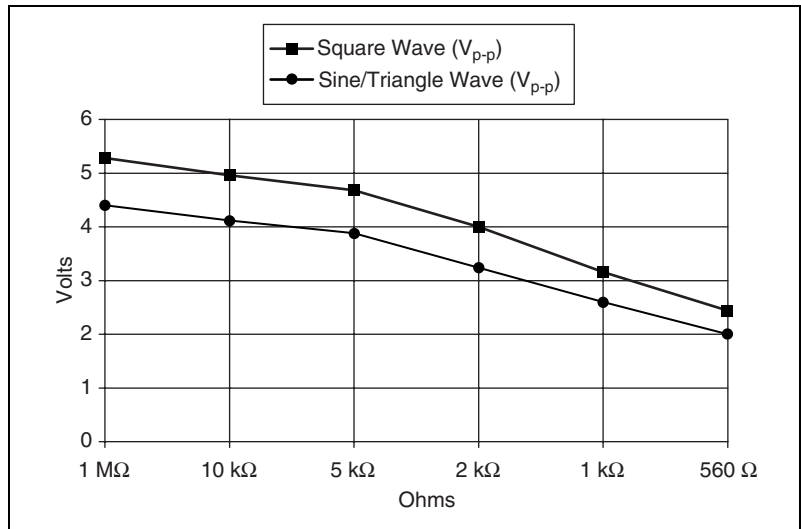


Figure 3. Typical Maximum Voltages versus Load Impedances

Timing Input/Output

Screw terminals..... 14 positions, no larger than 24 AWG wire

BNC connector..... 1, for PFI 0/AI START TRIG

Protection (DC max V)

Powered off..... ± 1.7 V

Powered on +6.7/-1.7 V

Quadrature Encoder

Screw terminals..... 2

Output signals

CLK 96 pulses/revolution

UP/ \overline{DN} High for clockwise rotation,
low for counterclockwise rotation

Pulse width..... 1 μ s

Power Requirement

+5 VDC ($\pm 5\%$)	200 mA, sourced from the Multifunction DAQ device
Power available at +5 V screw terminal.....	Multifunction DAQ device power, less power consumed at +5 VDC ($\pm 5\%$)

Physical

Dimensions	26.7 by 11.2 by 5.97 cm (10.5 by 4.41 by 2.35 in.)
I/O connector	68-pin male SCSI-II type
BNC connectors.....	15
Screw terminal plugs	31

Environment

Operating temperature	0 to 50 °C
Storage temperature	-55 to 125 °C
Relative humidity	5 to 90% noncondensing

Safety

The BNC-2110 meets the requirements of the following standards for safety and electrical equipment for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 3111-1, UL 61010B-1
- CAN/CSA C22.2 No. 1010.1



Note For UL and other safety certifications, refer to the product label or to ni.com.

Electromagnetic Compatibility

Emissions	EN 55011 Class A at 10 m FCC Part 15A above 1 GHz
Immunity	EN 61326:1997 + A2:2001, Table 1
EMC/EMI.....	CE, C-Tick, and FCC Part 15 (Class A) Compliant



Note For EMC compliance, you *must* operate this device with shielded cabling.

CE Compliance

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

Low-Voltage Directive (safety) 73/23/EEC

Electromagnetic Compatibility
Directive (EMC) 89/336/EEC



Note Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain the DoC for this product, click **Declarations of Conformity Information** at ni.com/hardref.nsf/. This Web site lists the DoCs by product family. Select the appropriate product family, followed by your product, and a link to the DoC appears in Adobe Acrobat format. Click the Acrobat icon to download or read the DoC.

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