BNC-2120 Connector Accessory for E Series Devices

This user guide describes how to install, configure, and use your BNC-2120 accessory.

Introduction

The BNC-2120 is a desktop or DIN rail-mountable accessory you can connect directly to E Series devices. The BNC-2120 has the following features:

- Eight BNC connectors for analog input (AI) connection with an optional thermocouple connector, an optional temperature reference, and optional 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 TIO connection
- Two user-defined BNC connectors
- A function generator with a frequency-adjustable, TTL-compatible square wave, and a frequency- and amplitude-adjustable sine wave or triangle wave
- A quadrature encoder

The BNC-2120 has a 68-pin input/output (I/O) connector that connects directly to your E Series device.

322444A-01 *July 1999*

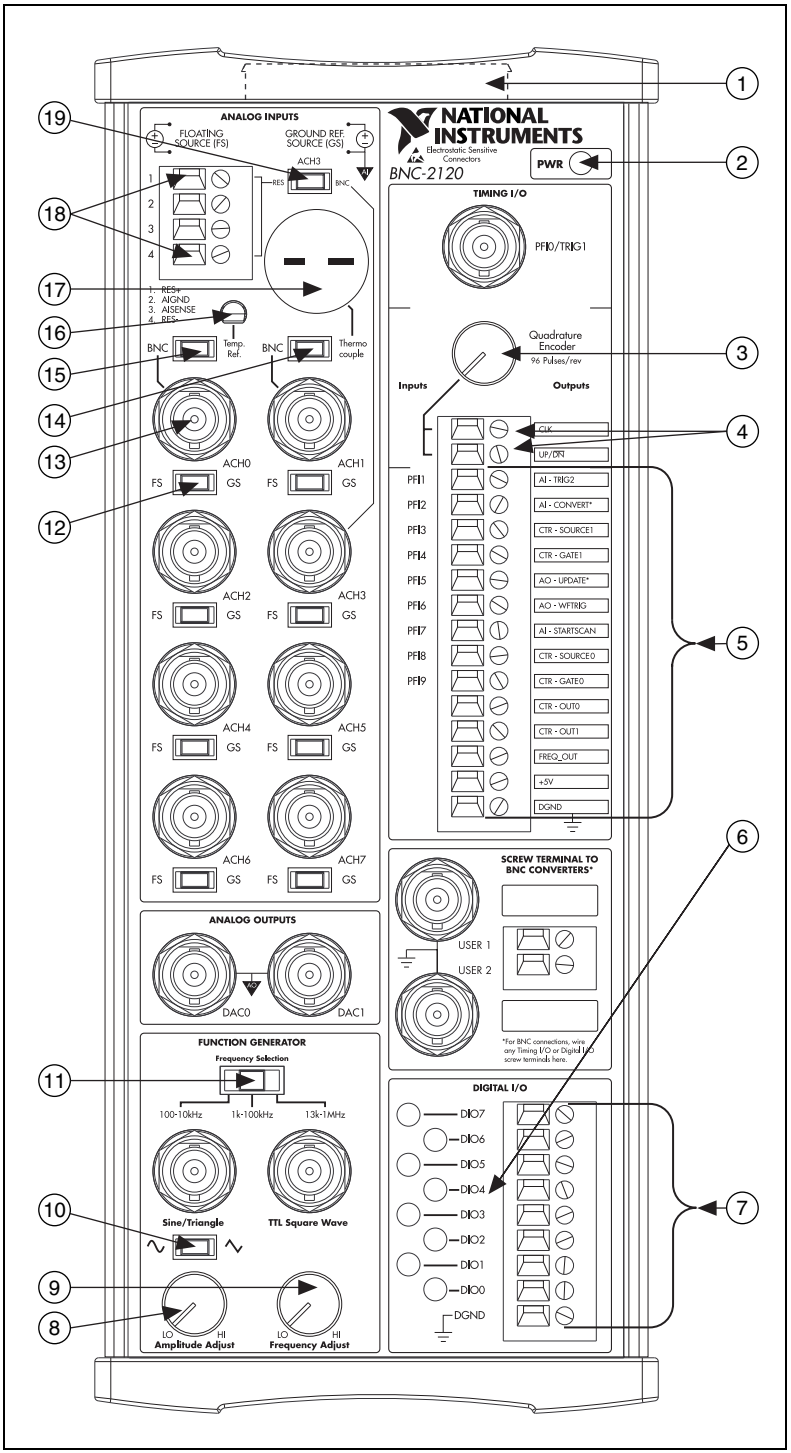
What You Need to Get Started

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

- ❑ BNC-2120 accessory
- ❑ *BNC-2120 Connector Accessory for E Series Devices User Guide*
- ❑ 68-pin E Series device
- ❑ 68-position cable, such as the SH6868 or R6868
- ❑ BNC cables
- ❑ No larger than 24 AWG wire
- ❑ Wire strippers
- ❑ Flathead screwdriver (supplied)

Installing Your BNC-2120

To connect your BNC-2120 accessory to your E Series device, connect one end of your 68-position cable to your E Series device and the other end to the 68-position I/O connector on the BNC-2120. The power LED indicator on the BNC-2120 should be lit. If it is not, check your cable connections to make sure that the cables are securely connected. Figure 1 shows the BNC-2120 front panel.



1. 68-Position I/O Connector
2. Power LED Indicator
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

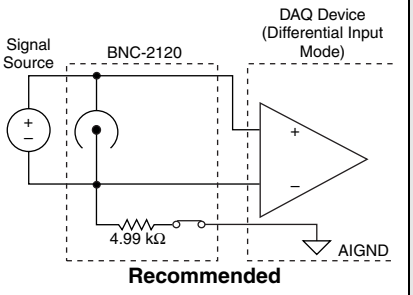
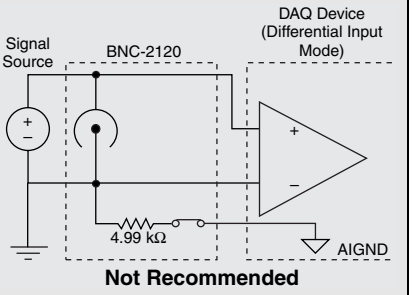
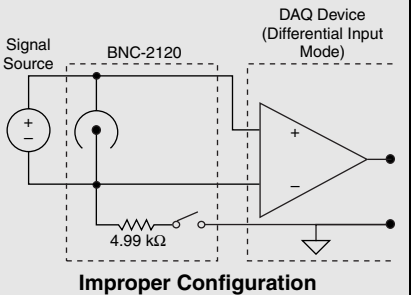
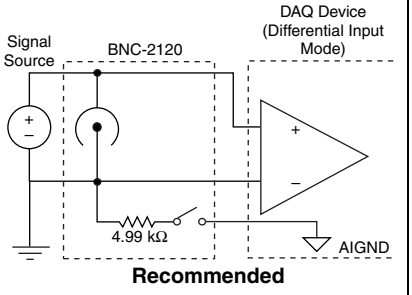
Figure 1. BNC-2120 Front Panel

Analog Inputs

You can use the BNC-2120 to measure floating and ground-referenced AI signals. You also can use the BNC-2120 to measure temperature and resistance.

To measure floating signal sources, move switches ACH0 through ACH7, located below the BNC connectors, to the floating source switch position labeled FS. In the floating source switch position, the amplifier negative terminal connects to ground through a 4.99 kΩ resistor. Table 1 shows the BNC-2120 switch configuration options.

Table 1. Configuration Summary

BNC-2120 Switch Configuration	Signal Source Types	
	Floating Source	**Ground-Referenced Source**
Floating Source (FS)	 **Recommended**	 **Not Recommended**
Ground-Referenced Source (GS)	 **Improper Configuration**	 **Recommended**

To measure ground-referenced signals, move the switches to either the floating or ground-referenced source position. For best performance, use the ground-referenced source position, labeled GS, to avoid ground loops. Refer to your E Series device user manual for more information on measuring floating and ground-referenced signals.

AIGND and AISENSE signals are available at the screw terminals located 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, ACH0 and ACH1 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 just above the BNC connectors for ACH0 and ACH1. 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:

$$°C = \text{Volts} \times 100$$

The sensor is accurate to ±1.5 °C. The thermocouple connector is for connecting any type of thermocouple having a two-prong miniature or sub-miniature male connector.

For more information on thermocouples and CJC, refer to National Instruments Application Note 043, *Measuring Temperature with Thermocouples.*

Resistance Measurement

To measure resistance, ACH3 has a switch for selecting the BNC connector, used for connecting floating and ground-referenced AI signals, or the screw terminals, used for connecting resistors. This switch is located above the thermocouple connector.

You can measure resistors with values ranging from 100 Ω to 1 MΩ. Connect your resistor into the screw terminals labeled RES+ and RES–.

You can use the LabVIEW example, `BNC-2120 Ohm Meter.vi`, to calculate the resistance by acquiring a V_{CC} measurement and the voltage drop across an internal 10 kΩ resistor. The VI changes the AI mode of your E Series differential channel 3 to referenced single-ended (RSE). The E Series device measures channel 3 for a V_{CC} measurement and channel 11 for voltage drop across an internal 10 kΩ resistor. Using these measurements, the VI calculates your resistor value:

$$\text{Resistor Value} = \frac{V_{CH3} - V_{CH11}}{V_{CH11} / (10\ \text{k}\Omega)}$$

The VI is included with NI-DAQ 6.6.0 or later, and you also can obtain it from the National Instruments Web site.

Figure 2 is a schematic representation of how the BNC-2120 measures resistance.

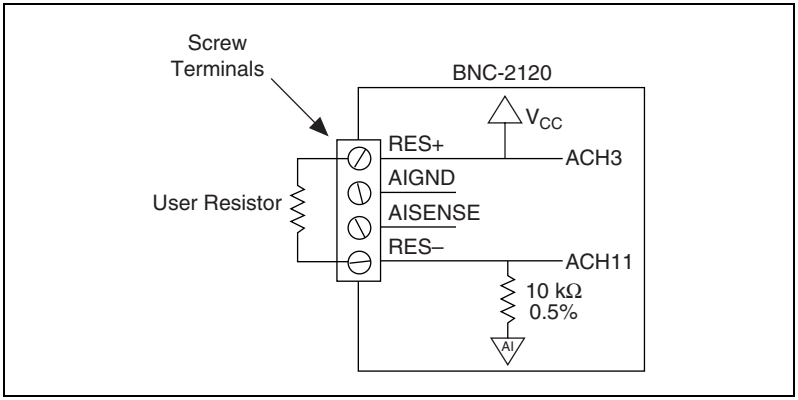


Figure 2. BNC-2120 Ohmmeter

Analog Outputs

The BNC-2120 connects to the AO channels of the E Series device with the DAC0OUT and DAC1OUT BNC connectors. AOGND is the reference for these BNC connectors.

Digital I/O

The DIO channels of the E Series device connect to the screw terminals in the DIO 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 low or is driven low. DGND is available at the screw terminals to supply the reference for the DIO signals.

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 100-10kHz, 1k-100kHz, or 13k-1MHz. 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}.

Timing I/O

Connect to the timing I/O (TIO) signals of the E Series device at the screw terminals in the Timing I/O section of the BNC-2120. The TIO output signal names are categorized and color-coded for specific types of applications. When connecting signals to the screw terminals, use wire no larger than 24 AWG with the insulation stripped to 0.28 in. PFI0/TRIG1 is available at the BNC connector labeled PFI0/TRIG1.

Quadrature Encoder

The BNC-2120 contains a mechanical quadrature encoder circuit that produces 96 pulses per encoder revolution. Two outputs, CLK and UP/$\overline{\text{DN}}$, are available 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. UP/$\overline{\text{DN}}$ outputs a high or a low signal indicating rotation direction. If the direction is counterclockwise, UP/$\overline{\text{DN}}$ is low. If the direction is clockwise, UP/$\overline{\text{DN}}$ is high.

To use the quadrature encoder with E Series counter 0, connect CLK to PFI8 and connect UP/$\overline{\text{DN}}$ to DIO6, which is the up/down pin of counter 0. To use it with counter 1, connect CLK to PFI3 and connect UP/$\overline{\text{DN}}$ to DIO7, which is the up/down pin of counter 1.

The LabVIEW example, `BNC-2120 Quadrature Encoder.vi`, configures the DAQ-STC counter on your E Series device for up/down counting. 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:

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

where

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

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.

Screw Terminal to BNC Converters

Two user-defined BNC connectors, USER1 and USER2, connect to the screw terminals next to each BNC connector. 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. DGND is the reference for these BNC connectors.

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) .....Eight differential

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

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

Optional inputs

Input	Description
ACH0	Temperature sensor
ACH1	Thermocouple
ACH3, ACH11	Resistor measurement (requires RSE configuration)

Optional connections

Thermocouple ..... Uncompensated miniature connector, mates with 2-prong miniature or sub-miniature connector

Resistor ..... Two screw terminals

Resistor measurement range ..... 100 Ω to 1 MΩ

Resistor measurement error ..... ≤5%

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

Switches ..... Eight for selecting floating source or grounded source inputs
One for selecting BNC or temperature reference IC
One for selecting BNC or thermocouple connector
One for selecting BNC or resistor screw terminals

Analog Output

Field connection ..... Two BNC connectors

Digital Input/Output

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

LED state indicators ..... Eight, one per DIO line

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 range .....100 Hz to 1 MHz

Frequency adjust.....Through Frequency Adjust knob

Rise time.....250 ns

Fall time.....50 ns

Sine/Triangle wave

Frequency range .....100 Hz to 1 MHz

Frequency adjust.....Through Frequency Adjust knob

Amplitude range .....60 mV_{p-p} to 4.4 V_{p-p}

Amplitude adjust .....Through Amplitude Adjust knob

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

Output impedance.....600 Ω

Drive capability

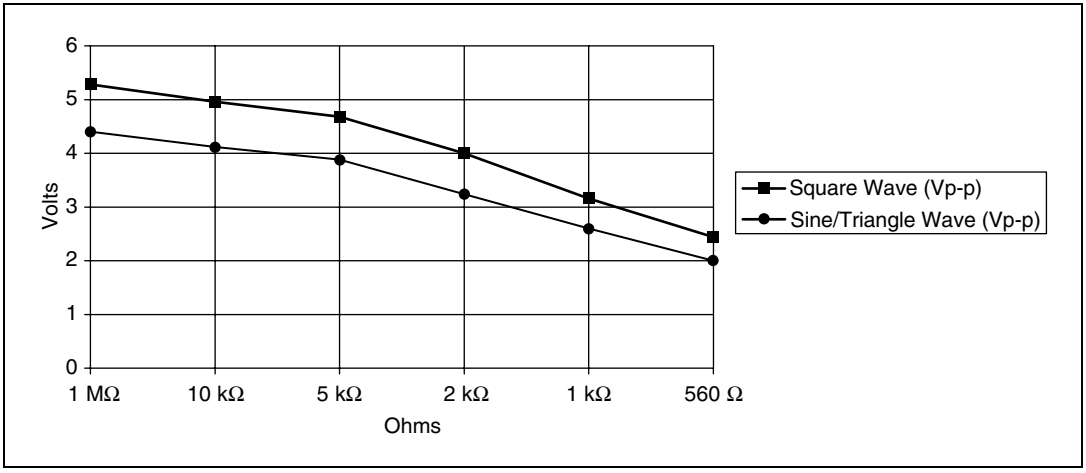


Figure 3. Typical Maximum Voltages versus Load Impedances

Timing Input/Output

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

BNC connector ..... One, for PFI0/TRIG1

Protection (DC max V)

- Powered off ..... ±1.7 V
- Powered on ..... +6.7/–1.7 V

Quadrature Encoder

Screw terminals ..... Two

Output signals

- CLK ..... 96 pulses/revolution
- UP/$\overline{\text{DN}}$ ..... High for clockwise rotation, low for counterclockwise rotation

Pulse width ..... 1 µs

Power Requirement

+5 VDC (±5%) ..... 200 mA, sourced from the E Series device

Power available at +5 V screw terminal ..... E Series power, less power consumed at +5 VDC (±5%)

Physical

Dimensions ..... 27.2 by 11.2 by 5.21 cm (10.69 by 4.41 by 2.05 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