

# BNC-2121 CONNECTOR ACCESSORY FOR 660X DEVICES

Your BNC-2121 connector accessory is a terminal block that connects signals to your 660X counter device and can be used to test features of your 660X device. Use this guide to install and connect signals to your BNC-2121 connector accessory for testing or for performing counter applications.

For specific information about using your 660X device, refer to the *660X User Manual*.

## What You Need to Get Started

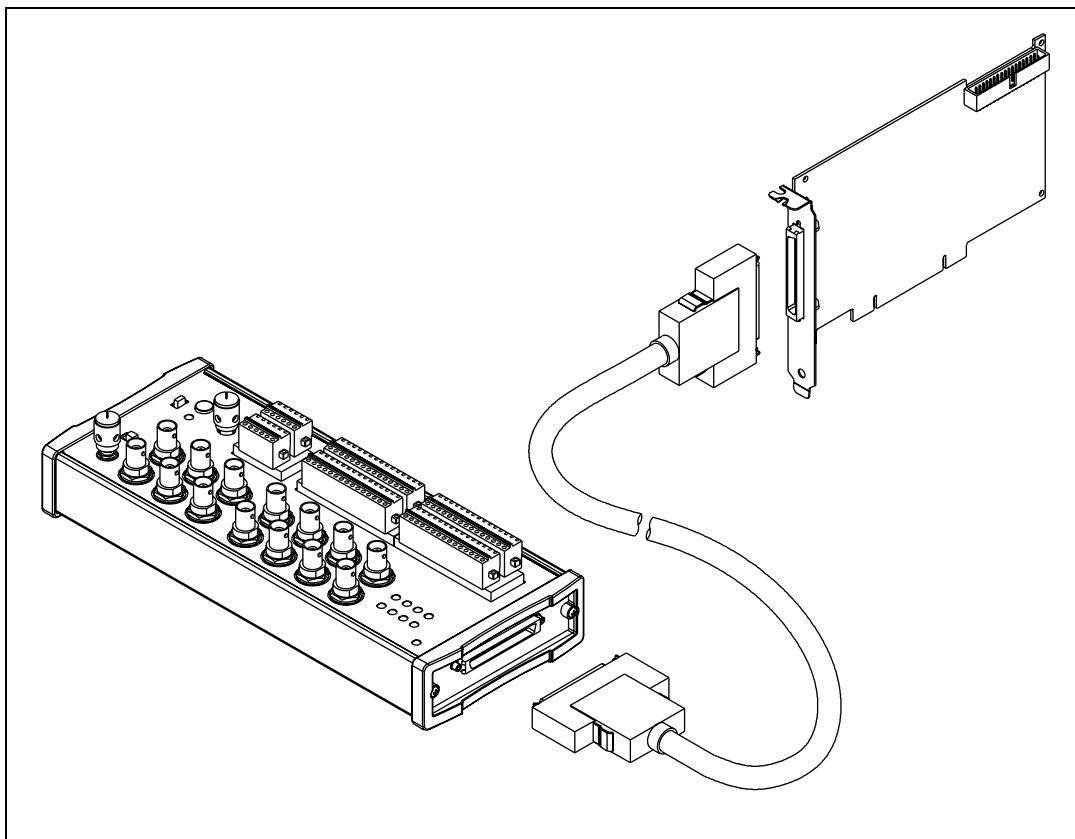
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You need the following items to install and use your BNC-2121 connector accessory:

- BNC-2121 connector accessory
- BNC-2121 Connector Accessory for 660X Devices User Guide*
- 660X device
- 660X User Manual*
- 68-position cable, such as the SH68-68-D1 or R6868
- BNC cables
- Wire no larger than 24 AWG
- Wire strippers

# Connecting the BNC-2121 to a 660X Device

You can use your BNC-2121 with any installed 660X device. Connect one end of a 68-position cable to your 660X device and the other end to the I/O connector on the BNC-2121 as shown in Figure 1.



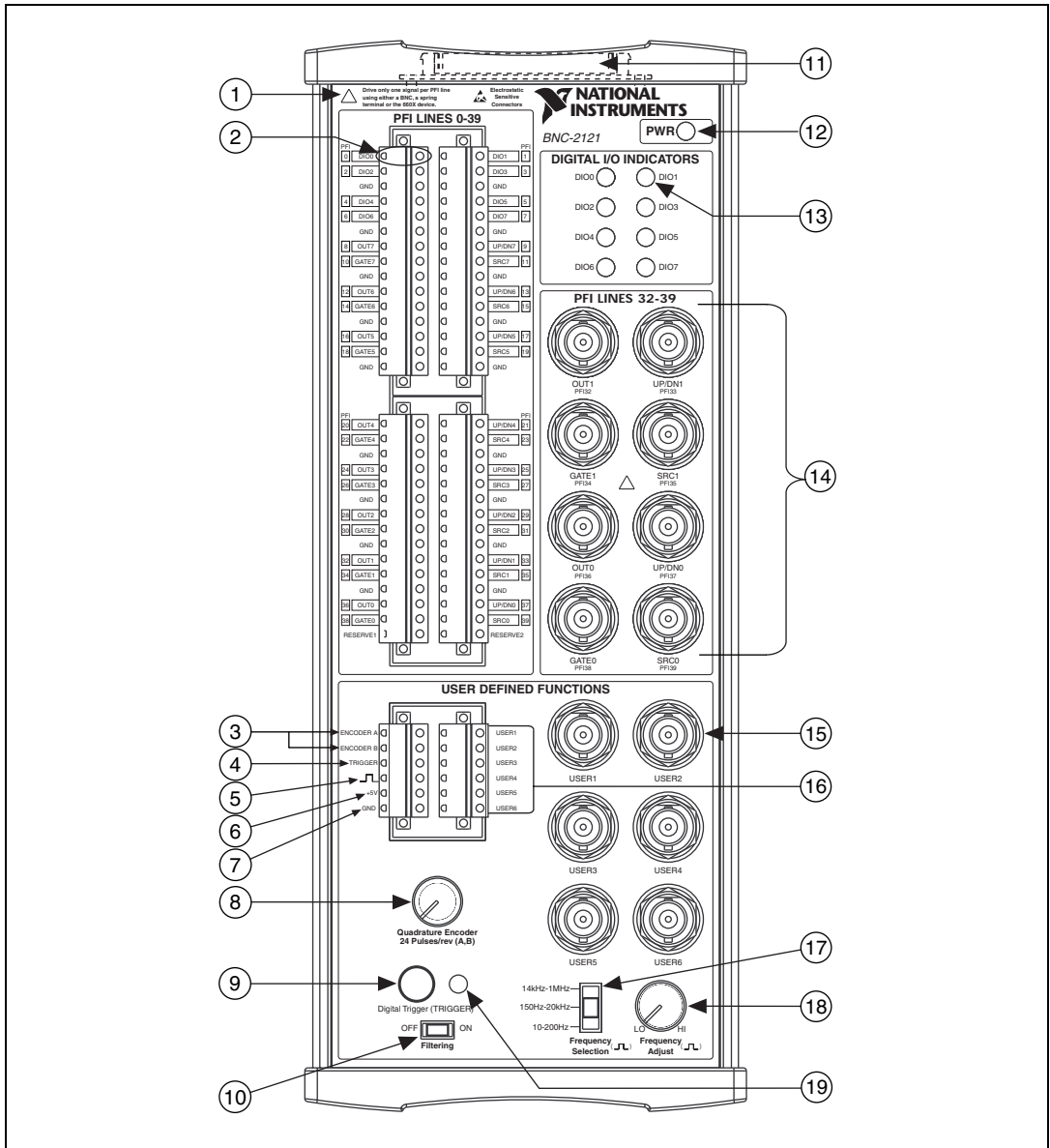
**Figure 1.** Connecting Your BNC-2121 to Your 660X Device



**Note** If the power LED indicator does not light up, check the cable connections to make sure the cable is connected securely.

# Connecting Signals to Your BNC-2121

You can use your BNC-2121 with any installed 660X device. Connect signals using the spring terminals or BNC connectors, as shown in Figure 2. For pinout diagrams and more specific information about connecting signals, see your *660X User Manual*.



- |   |   |    |                                    |    |  |
|---|---|----|------------------------------------|----|--|
| 1 | Warning Label   | 7  | GND Terminal                       | 15 | User-Defined BNC Connector                       |
| 2 | PFI Line Spring Terminal  | 8  | Quadrature Encoder Knob            | 16 | Spring Terminals for User-Defined BNC Connectors |
| 3 | Quadrature Encoder Output Spring Terminal                       | 9  | Digital Trigger Button             | 17 | Frequency Selection Switch                       |
| 4 | Digital Trigger Output Spring Terminals                         | 10 | Digital Trigger Filtering Switch   | 18 | Frequency Adjust Knob                            |
| 5 | Frequency Selection/Adjust Output Spring Terminal ( $\square$ ) | 11 | 68-Position I/O Connector          | 19 | Digital Trigger Line LED State Indicator         |
| 6 | +5 V Output Spring Terminal                                     | 12 | Power LED Indicator                |    |  |
|   |   | 13 | DIO LED State Indicator            |    |  |
|   |   | 14 | BNC Connectors for Counter 0 and 1 |    |  |

Figure 2. BNC-2121 Front Panel

# Overview of Connecting to the BNC-2121

The BNC-2121 has two main areas of connectivity: the PFI lines and the user-defined functions.

The PFI lines include bidirectional spring terminals, PFI<0..39>, and bidirectional BNC connectors, PFI<32..39>. Both connection types provide access to the respective PFI lines on your 660X device. The digital I/O indicators reflect the state of the DIO<0..7> spring terminals.

The user-defined function connections include the following:

- Six output spring terminals—Encoder A, Encoder B, Trigger, Square Wave (  $\square$  ), +5 V, and GND
- Corresponding controls for the outputs listed above—Quadrature Encoder, Digital Trigger, Frequency Selection, and Frequency Adjust.

Use the following table to associate the controls with the outputs:

**Table 1.** User-Defined Functions Controls and Their Corresponding Outputs

Controls	Spring Terminal Outputs
Quadrature Encoder Knob	Encoder A
Quadrature Encoder Knob	Encoder B
Digital Trigger Button	Trigger
Frequency Selection	$\square$
Frequency Adjust	$\square$

- Six bidirectional, user-defined spring terminals—USER<1..6>
- Six user-defined BNC connectors—USER<1..6>



**Note** The user-defined spring terminals are mapped one-to-one to corresponding BNC connectors. For example, USER1 spring terminal is directly wired to USER1 BNC connector. When you want BNC connections for counters other than 0 or 1, you normally use the user-defined connections.

## Connecting to the Spring Terminals

Use your BNC-2121 connector accessory to access the PFI lines on your 660X device.

To make the connection, follow these steps:

1. Using your wire strippers, strip the wire insulation no more than 7 mm.
2. Connect a wire to a spring terminal on the BNC-2121 by depressing the orange tab and inserting the stripped end of the wire fully into the terminal.



**Tip** For best performance, use twisted-pair wire. Connect one wire of the wire pair from the signal on the peripheral device and the other end of the same twisted wire to the signal on the BNC-2121. Connect the other wire of the wire pair to the ground of the peripheral device and the other end to the ground (GND) spring terminal closest to the signal.



**Caution** Make sure there is no bare wire extended past the spring terminal. Exposed wire increases the risk of a short circuit or a failure.

3. If you need to ground your signal, a ground (GND) spring terminal is available between every two PFI lines. For specific details on grounding your signal, refer to your *660X User Manual*.

The user-defined functions area of the BNC-2121 has six user-defined spring terminals, USER<1..6>, with the six corresponding BNC connectors USER<1..6> for greater connectivity options. Use these spring terminals for either input or output. For example, if you want to connect a BNC cable to GATE of a counter other than Counter 0 or 1, connect a wire from the GATE spring terminal on your 660X device to a user-defined spring terminal (USER1) on the BNC-2121, and the signal is available through the corresponding BNC connector (USER1).

The six other spring terminals (ENCODER A, ENCODER B, TRIGGER,  $\square$ , +5 V, and GND) are used as signal outputs only. Connect your output wires to the appropriate spring terminals following steps 1 and 2 above. Use the corresponding controls for each spring terminal, given in Table 1, to regulate your signal.

## Connecting to the BNC Connectors

Use the eight BNC connectors to access PFI<32..39> on your 660X device. Each line corresponds to SOURCE, GATE, OUT, and UP/DOWN of counters 0 and 1.

To make the connection, follow these steps:

1. Insert one end of your BNC cable to one of the PFI<32..39> BNC connectors.
2. Connect the other end of your BNC cable to your output device.

In addition to the BNC connectors associated with the PFI lines of the 660X device, the BNC-2121 has six user-defined BNC connectors, USER<1..6>, that are associated with six corresponding user-defined spring terminals USER<1..6>. You can use these BNC connectors for either input or output.

## Testing Your User-Defined Functions

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You can use the BNC-2121 to test the following features on your 660X device.

### Producing a +5 V Pulse

Use the digital trigger to test an application that counts or measures pulses. Press the **Digital Trigger** button to produce a +5 V pulse for as long as the button is pressed, causing the LED to light up. When you release the button, the trigger line goes low. You can access the digital trigger by connecting a wire to the **Trigger** spring terminal. The digital trigger can also simulate a channel Z pulse for quadrature encoder functions.

If you want to test the debouncing filters on the 660X devices, flip the **Filtering** switch to **OFF**. For all other applications, flip the **Filtering** switch to **ON**.

### Measuring Position

The BNC-2121 can produce 24 pulses per encoder revolution. You can test this feature using the following programs:

- C interface—TIOquadEncoderPosMeasure.c located in Program Files/National Instruments/Measurement Studio/CVI/Samples/DAQ/Ctr
- LabVIEW—Measure Position VI located in Program Files/National Instruments/LabVIEW/Examples/DAQ/Counter/NI-TIO.llb

To measure position using counter 0 of a 660X device, make the following connections:

1. Connect a wire from channel A to SOURCE of the selected counter.
2. Connect a wire from channel B to UP/DOWN of the selected counter.



**Note** If you want to simulate a Z channel, connect a wire from the **Trigger** spring terminal to GATE of the selected counter.

## Creating a Square Wave

The BNC-2121 has a function generator that produces TTL-compatible square waveforms.

To create a square wave, follow these steps:

1. Access the square wave output by connecting signals to the  $\square$  Spring Terminal.
2. Use the **Frequency Selection** switch to select a frequency range of 10–200 Hz, 150 Hz–20 kHz, or 14 kHz–1 MHz.
3. Adjust the frequency within the range you selected by turning the **Frequency Adjust** knob.

## Viewing the State of the DIO Lines

The eight Digital I/O Indicators indicate the state of PFI<0..7> on your 660X device. When the LED is lit, the channel is in the high state. If the LED is off, the channel is in the low state.

## Using Your BNC-2121 to Perform Counter Applications

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This section explains how to connect signals to the BNC-2121 to test, demonstrate, or perform counter applications with your 660X device. To find the correct application to perform, refer to your *660X User Manual*.

Counter program examples mentioned in this section are in the following locations:

- NI-DAQ—Measurement Studio\CVI\Samples\DAQ\Ctr
- LabVIEW—Program Files\National Instruments\LabVIEW\Examples\DAQ\Counter\NI.TIO.llb

## Simple Event Counting

To perform simple event counting, connect a wire from the  $\square$  spring terminal to SOURCE of the selected counter. Your 660X device counts the number of pulses that occur on SOURCE.

Alternatively, you can connect a wire from the **Trigger** spring terminal to provide pulses on SOURCE.

## Gated Event Counting

To perform gated event counting, follow these steps:

1. Connect a wire from the  $\perp$  spring terminal to SOURCE of the selected counter.
2. Connect a wire from the **Trigger** spring terminal to GATE of the selected counter.
3. Press and hold the **Digital Trigger** button to drive GATE into a high state. The counter counts the pulses on SOURCE as long as GATE is high.
4. Release the **Digital Trigger** button to drive GATE into a low state. The counting halts and retains its value until you press **Digital Trigger** button again and counting continues.

## Single Period Measurement

To take a single period measurement, follow these steps:

1. Select an internal timebase as SOURCE of the selected counter in the C interface or LabVIEW.
2. Connect a wire from the  $\perp$  spring terminal to GATE of the selected counter. The counter counts the number of rising edges on SOURCE between two active GATE edges. The period is this count multiplied by the period of the SOURCE.

## Single Pulse-Width Measurement

To take a single pulse-width measurement, follow these steps:

1. Select an internal timebase as SOURCE of the selected counter in the C interface or LabVIEW.
2. Connect a wire from the **Trigger** spring terminal to GATE of the selected counter.
3. Press the **Digital Trigger** button to drive GATE into a high state. The counter counts the rising edges on the SOURCE while GATE is active.
4. Release the **Digital Trigger** button to drive GATE into a low state. The counter value is latched for a software read.

## Two Signal Edge-Separation Measurement

To take a two signal edge-separation measurement, follow these steps:

1. Connect a wire from the  $\perp$  spring terminal to UP/DOWN of the selected counter.
2. Select an internal timebase as SOURCE of the selected counter in the C interface or LabVIEW. As soon as UP/DOWN goes active, the counter counts the edges on SOURCE.



3. Connect a wire from the **Trigger** spring terminal to GATE of the selected counter.
4. Press the **Digital Trigger** button to drive GATE into an active state. As soon as GATE goes active, the counter value is latched for a software read.



**Note** UP/DOWN and AUX\_LINE share the same PFI line on all counters.

## Single Pulse Generation

To generate a single pulse, follow these steps:

1. Select an internal timebase as SOURCE of the selected counter in the C interface or LabVIEW.
2. Specify the pulse delay and pulse width in the C interface or LabVIEW.
3. To see the signal, connect an oscilloscope or analog input device to OUT of the selected counter.

## Single-Triggered Pulse Generation

To generate a single-triggered pulse, follow these steps:

1. Select an internal timebase as SOURCE of the selected counter in the C interface or LabVIEW.
2. Specify the pulse delay and pulse width in the C interface or LabVIEW.
3. Connect a wire from the **Trigger** spring terminal to GATE of the selected counter.
4. Press the **Digital Trigger** button to generate a single pulse. One pulse is generated on OUT of the counter when the trigger is received.
5. To see the signal, connect an oscilloscope or analog input device to OUT of the selected counter.

## Retriggerable Single Pulse Generation

To generate a retriggerable single pulse, follow these steps:

1. Select an internal timebase as SOURCE of the selected counter in the C interface or LabVIEW.
2. Specify the pulse delay and pulse width in the C interface or LabVIEW.
3. Connect a wire from the **Trigger** spring terminal to GATE of the selected counter.

4. Press the **Digital Trigger** button to generate a pulse. Any time you want an additional pulse, press the **Digital Trigger** button to generate a pulse on OUT of the counter.



**Note** A pulse is generated on every active GATE edge.

5. To see the signal, connect an oscilloscope or analog input device to OUT of the selected counter.

## Continuous Pulse-Train Generation

To generate a continuous pulse-train, follow these steps:

1. Select an internal timebase as SOURCE of the selected counter in the C interface or LabVIEW.
2. Specify the frequency and duty cycle of the pulse train in the C interface or LabVIEW.
3. To see the signal, connect an oscilloscope or analog input device to OUT of the selected counter.

## Frequency Shift-Keying

To perform frequency shift-keying, follow these steps:

1. Select an internal timebase as SOURCE of the selected counter in the C interface or LabVIEW.
2. Connect a wire from the **Trigger** spring terminal to GATE of the selected counter.
3. Press the **Digital Trigger** button to drive GATE into a high state.
4. Release the **Digital Trigger** button to drive GATE into a low state.
5. To see the signal, connect an oscilloscope or analog input device to OUT of the selected counter.

## Buffered Event Counting

To perform buffered event counting, follow these steps:

1. Select an internal timebase as SOURCE of the selected counter in the C interface or LabVIEW.
2. Connect a wire from the  $\square$  spring terminal to GATE of the selected counter. Each time GATE goes high, the value of the counter is latched to a buffer.

## Buffered Period Measurement

To perform buffered period measurement, follow these steps:

1. Select an internal timebase as SOURCE of the selected counter in the C interface or LabVIEW.
2. Connect a wire from the  $\square$  spring terminal to GATE of the selected counter.



**Note** To ensure valid measurement data, discard the first value since the counter may be armed between active edges. The counter is latched at each active GATE edge (rising or falling) and the counter resets to zero.

## Buffered Semi-Period Measurement

To perform buffered semi-period measurement, follow these steps:

1. Select an internal timebase as SOURCE of the selected counter in the C interface or LabVIEW.
2. Connect a wire from the  $\square$  spring terminal to GATE of the selected counter.

Each time GATE goes high, the value of the counter is latched to a buffer. Since buffered semi-period measurement measures each phase of the pulse train, you can detect changes in duty cycle.



**Note** To ensure valid measurement data, discard the first value since the counter may be armed between active edges. The counter is latched at each active GATE edge (rising or falling) and the counter resets to zero.

## Buffered Pulse-Width Measurement

To perform buffered pulse-width measurement, follow these steps:

1. Select an internal timebase as SOURCE of the selected counter in the C interface or LabVIEW.
2. Connect a wire from the  $\square$  spring terminal to GATE of the selected counter.

Each time GATE goes high, the value of the counter is latched to a buffer.



**Note** For buffered pulse-width measurement, the counter value obtained between the rising and falling edges of GATE is latched at the completion of each pulse-width interval of GATE.

## Buffered Two-Signal Edge-Separation Measurement

To perform buffered two-signal edge-separation measurement, follow these steps:

1. Select an internal timebase as **SOURCE** of the selected counter in the C interface or LabVIEW.
2. Connect a wire from the  $\sqcap$  spring terminal to UP/DOWN of the selected counter.
3. Connect a wire from the **Trigger** spring terminal to GATE of the selected counter. The counter counts the number of rising edges on SOURCE between the active edge of UP/DOWN and the active edge of GATE. The counter value latches at each active edge of GATE.
4. Press the **Digital Trigger** button to drive GATE into a high state. Press the **Digital Trigger** button a multiple amount of times to obtain a multiple number of GATE edges.

## Buffered Periodic Event Counting

To perform buffered periodic event counting, follow these steps:

1. Connect a wire from the  $\sqcap$  spring terminal to SOURCE of the selected counter.
2. Connect a wire from the **Trigger** spring terminal to GATE of the selected counter. The counter increments on each active SOURCE edge and latches at each active GATE edge.

## Miscellaneous Functions

Use these functions with any previously stated counter application.

### Measuring Frequency

To measure a frequency using counter pair 0 and 1, follow these steps:

1. Select GATE as the output of the other counter in the C interface or LabVIEW. This selection allows the OUT of counter 1 to be the GATE signal for counter 0.
2. Connect a wire from the  $\sqcap$  spring terminal to SOURCE of counter 0, which is PFI\_39. The counter counts the number of edges received during the interval defined by OUT of counter 1.

The frequency measured is the number of counts divided by the duration of GATE in seconds. Another counter pair can also be similarly used.

## Simultaneously Starting Counters

You can configure two or more counters to arm from the same start trigger using an internal/software or external/hardware command. To simultaneously arm two or more counters to perform single pulse generation, perform the following steps:



**Note** You can use this same method for any counter application.

1. Configure two or more counters to arm off a start trigger and generate a pulse.
2. To see the signal, connect an oscilloscope or analog input device to OUT of the selected counter.
3. Connect a wire from the **Trigger** spring terminal to a PFI line (for example, PFI\_0) and use it to produce the start trigger. Make sure to select this PFI line as the start trigger in software.

## Specifications

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This section lists the specifications of the BNC-2121. These specifications are typical at 25 °C unless otherwise specified.

### PFI<0..39>

Spring terminals ..... 40 positions, wire no larger than 24 AWG

BNC connectors ..... 8 for PFI<32..39>

### User-Defined

Field connections ..... 6 BNC connectors

Spring terminals ..... 6 positions, wire no larger than 24 AWG

### Quadrature Encoder

Spring terminals ..... 2

Output signals

Channel A/channel B ..... Channel A leads channel B by 90° clockwise

Pulse width ..... 1  $\mu$ s

## Digital Trigger

Number of signals.....1 (TRG signal for triggering)

Spring terminals.....1 position

## Function Generator

Square wave.....TTL compatible

Frequency range .....10 Hz–1 MHz

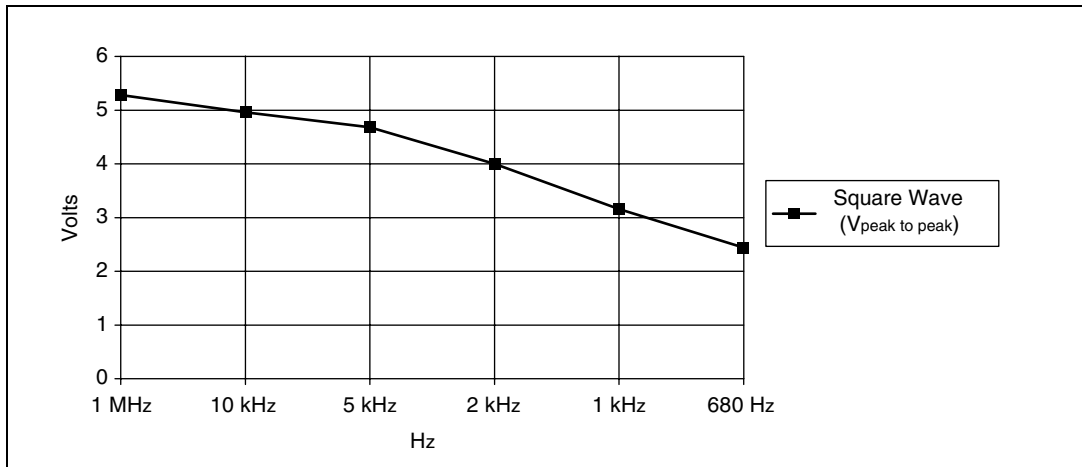
Frequency .....Frequency adjust knob

Rise time.....250 ns

Fall time.....50 ns

Spring terminal.....1 position

Drive capability .....Refer to Figure 3



**Figure 3.** Typical Maximum Voltages versus Load Impedances

## Digital Input/Output

LED state indicators .....8 (1 per DIO line on PFI <0..7>)

## Power Requirement

+5 VDC ( $\pm 5\%$ ) .....200 mA, sourced from  
660X device, which provides 1 A

+5 V spring terminal ( $\pm 5\%$ ).....600 mA, sourced from  
660X device, which provides 1 A

## 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 .....	14
Spring terminal plugs .....	72

## Environment

Operating temperature.....	0 to 50 °C
Storage temperature .....	-20 to 70 °C
Relative humidity .....	1 to 90% noncondensing

## Safety

Evaluated to.....	EN61010-1:1993/A2:1995
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## Electromagnetic Compatibility

EMC/EMI.....	CE, C-Tick, and FCC Part 15 (Class A) Compliant
Electrical Emissions .....	EN 55011 Class A at 10 m; FCC Part 15A above 1 GHz
Electrical Immunity.....	Evaluated to EN 61326:1998 Table 1



**Caution** The BNC-2121 should only be operated with shielded cabling for full EMC and EMI compliance. See the Declaration of Conformity for this product for any additional regulatory compliance information.

# Technical Support Resources

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## NI Web Support

National Instruments Web support is your first stop for help in solving installation, configuration, and application problems and questions. Online problem-solving and diagnostic resources include frequently asked questions, knowledge bases, product-specific troubleshooting wizards, manuals, drivers, software updates, and more. Web support is available through the Technical Support section of [ni.com](http://ni.com)

## Worldwide Support

National Instruments has offices located around the world to help address your support needs. You can access our branch office Web sites from the Worldwide Offices section of [ni.com](http://ni.com). Branch office Web sites provide up-to-date contact information, support phone numbers, e-mail addresses, and current events.

If you have searched the technical support resources on our Web site and still cannot find the answers you need, contact your local office or National Instruments corporate. For telephone support in the United States, dial 512 795 8248. For telephone support outside the United States, contact your local branch office:

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Germany 089 741 31 30, Greece 30 1 42 96 427, Hong Kong 2645 3186,  
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