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USER GUIDE

BNC-2121 Connector Accessory for 660*X* Devices

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

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

What You Need to Get Started

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

- ❑ BNC-2121 connector accessory
- ❑ *BNC-2121 Connector Accessory for 660X Devices User Guide*
- ❑ 660*X* 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

NATIONAL INSTRUMENTS™

Connecting the BNC-2121 to a 660*X* Device

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

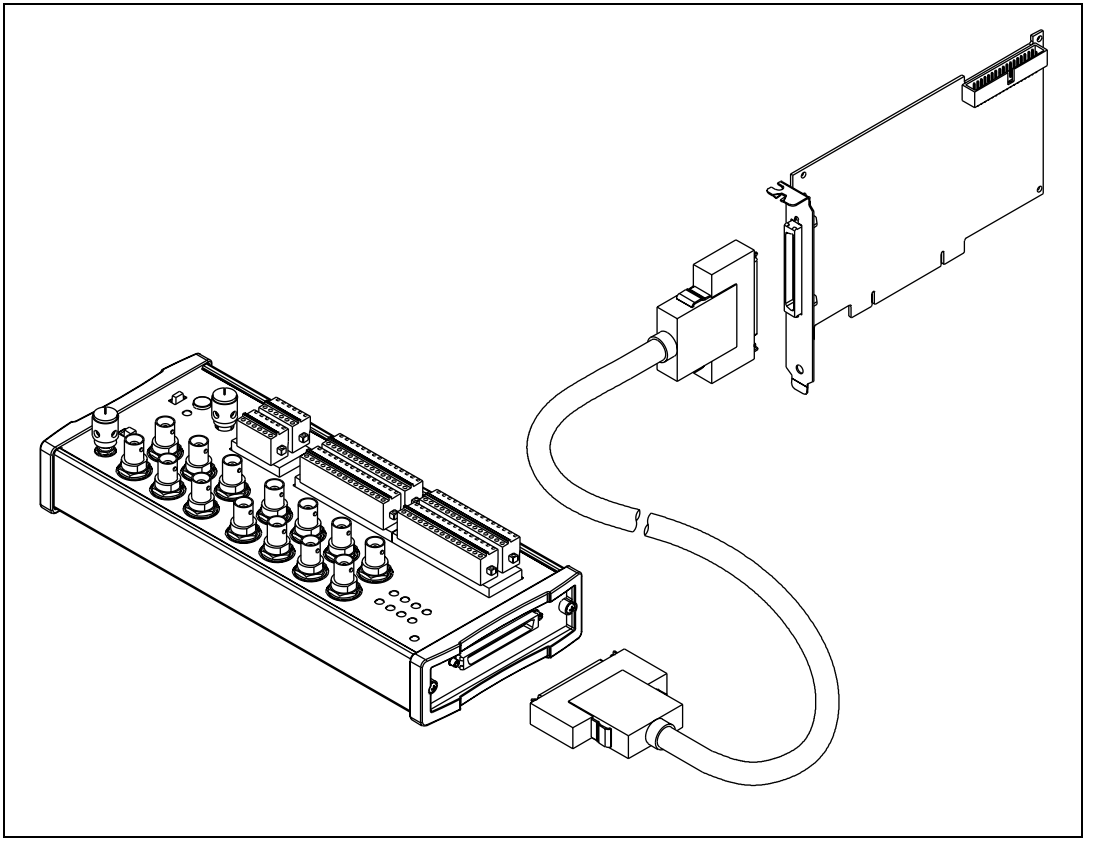
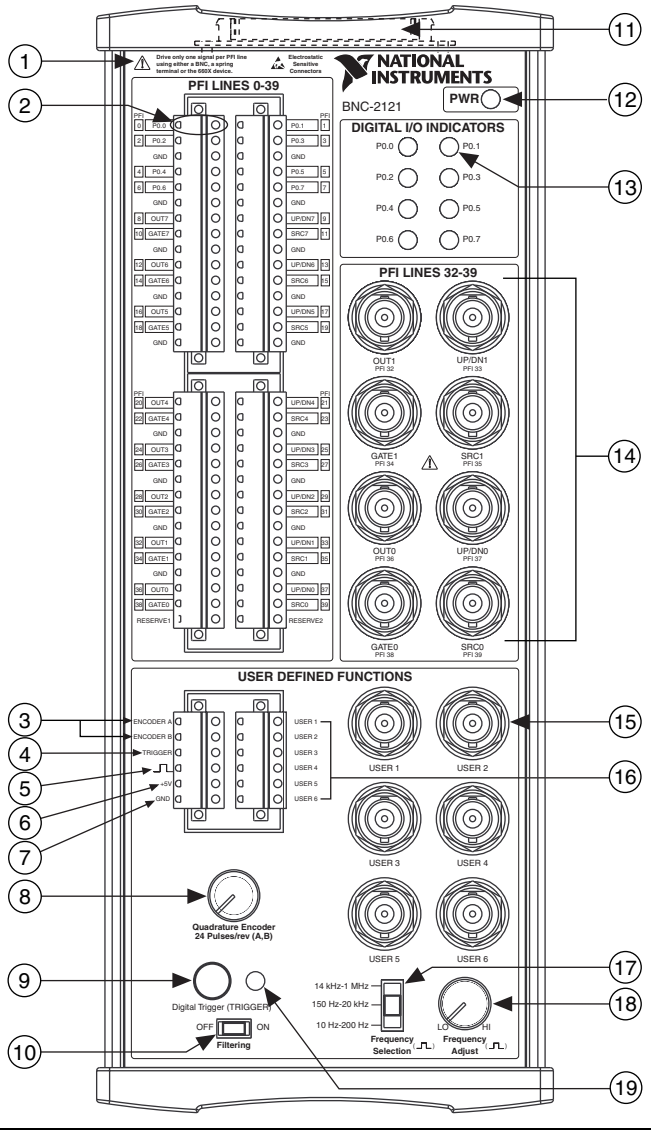


Figure 1. Connecting a BNC-2121 to a 660*X* Device

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 the BNC-2121

Connect signals using the spring terminals or BNC connectors shown in Figure 2. For pinout diagrams and more specific information about connecting signals, refer to the *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 Terminals	9	Digital Trigger Button	17	Frequency Selection Switch
4	Digital Trigger Output Spring Terminal	10	Digital Trigger Filtering Switch	18	Frequency Adjust Knob
5	Frequency Output Spring Terminal (⎍)	11	68-Position I/O Connector	19	Digital Trigger Line LED State Indicator
6	+5 V Output Spring Terminal	12	Power LED Indicator		
		13	Digital Line LED State Indicator		
		14	BNC Connectors for Counters 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 the 660*X* device. The digital I/O indicators reflect the state of the dedicated digital I/O P.<0..7> spring terminals.

The user-defined function connections include the following:

- Six output spring terminals—Encoder A, Encoder B, Trigger, Square Wave (⎍), +5 V, and GND
- Controls for the outputs listed above—Quadrature Encoder, Digital Trigger, Frequency Selection, and Frequency Adjust

  Table 1 lists the controls and the outputs associated with them.

Table 1. User-Defined Function Controls and the Corresponding Outputs

Controls	Spring Terminal Outputs
Quadrature Encoder Knob	Encoder A
Quadrature Encoder Knob	Encoder B
Digital Trigger Button	Trigger
Frequency Selection	⎍
Frequency Adjust	⎍

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

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

Connecting to the Spring Terminals

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

To make the connection, complete the following steps.

1. Using 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 the 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 that no bare wire extends past the spring terminal. Exposed wire increases the risk of a short circuit or a failure.

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

The user-defined functions area of the BNC-2121 has six user-defined spring terminals, USER <1..6>, and six corresponding BNC connectors, USER <1..6>. 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 the 660*X* device to a user-defined spring terminal (USER 1) on the BNC-2121, and the signal is available through the corresponding BNC connector (USER 1).

The six other spring terminals (ENCODER A, ENCODER B, TRIGGER, ⎍, +5 V, and GND) are used as signal outputs only. Follow steps 1 and 2 in this section to connect the output wires to the appropriate spring terminals. Use the corresponding controls for each spring terminal, given in Table 1, to regulate a signal.

Connecting to the BNC Connectors

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

To make the connection, complete the following steps.

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

In addition to the BNC connectors associated with the PFI lines of the 660*X* 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 User-Defined Functions

You can use the BNC-2121 to test the following features on the 660*X* 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 also can simulate a channel Z pulse for quadrature encoder functions.

The lowpass filter on the BNC-2121 is designed to remove glitches on the trigger output. If you want to use unconditional trigger output to test the debouncing filter on a 660*X* device, flip the **Filtering** switch to the OFF position, connect the trigger output to a PFI line, and programmatically enable the debouncing filter on the 660*X* device. For all other applications, flip the **Filtering** switch to the ON position.

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 660*X* device, make the following connections.

1. Connect a wire from channel A to SOURCE of counter 0 (default PFI 39).
2. Connect a wire from channel B to UP/DOWN of counter 0 (default PFI 37).

Note If you want to simulate a Z channel, connect a wire from the **Trigger** spring terminal to GATE of counter 0 (default PFI 38).

Creating a Square Wave

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

To create a square wave, complete the following steps.

1. Access the square wave output by connecting signals to the ⎍ spring terminal.
2. Use the **Frequency Selection** switch to select a frequency range of 10 Hz–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 a 660*X* device. When the LED is lit, the channel is in the high state. When the LED is off, the channel is in the low state.

Using the BNC-2121 to Perform Counter Applications

This section explains how to connect signals to the BNC-2121 to test, demonstrate, and perform counter applications with a 660*X* device. To find the correct application to perform, refer to the *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 ⎍ spring terminal to SOURCE of the selected counter. The 660*X* 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, complete the following steps.

1. Connect a wire from the ⎍ 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 the **Digital Trigger** button again and counting continues.

Single Period Measurement

To take a single period measurement, complete the following steps.

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

Single Pulse-Width Measurement

To take a single pulse-width measurement, complete the following steps.

1. In the C interface or in LabVIEW, select an internal timebase as SOURCE of the selected counter.
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 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, complete the following steps.

1. Connect a wire from the ⎍ spring terminal to UP/DOWN of the selected counter.
2. In the C interface or in LabVIEW, select an internal timebase as SOURCE of the selected counter. 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, complete the following steps.

1. In the C interface or in LabVIEW, select an internal timebase as SOURCE of the selected counter.
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, complete the following steps.

1. In the C interface or in LabVIEW, select an internal timebase as SOURCE of the selected counter.
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, complete the following steps.

1. In the C interface or in LabVIEW, select an internal timebase as SOURCE of the selected counter.
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, complete the following steps.

1. In the C interface or in LabVIEW, select an internal timebase as SOURCE of the selected counter.
2. In the C interface or in LabVIEW, specify the frequency and duty cycle of the pulse train.
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, complete the following steps.

1. In the C interface or in LabVIEW, select an internal timebase as SOURCE of the selected counter.
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, complete the following steps.

1. In the C interface or in LabVIEW, select an internal timebase as SOURCE of the selected counter.
2. Connect a wire from the ⎍ 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, complete the following steps.

1. In the C interface or in LabVIEW, select an internal timebase as SOURCE of the selected counter.
2. Connect a wire from the ⎍ spring terminal to GATE of the selected counter.

Note To ensure valid measurement data, discard the first value because 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, complete the following steps.

1. In the C interface or in LabVIEW, select an internal timebase as SOURCE of the selected counter.
2. Connect a wire from the ⎍ spring terminal to GATE of the selected counter.

Each time GATE goes high, the value of the counter is latched to a buffer. Because 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 because 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, complete the following steps.

1. In the C interface or in LabVIEW, select an internal timebase as SOURCE of the selected counter.
2. Connect a wire from the ⎍ 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 a buffered two-signal edge-separation measurement, complete the following steps.

1. In the C interface or in LabVIEW, select an internal timebase as SOURCE of the selected counter.
2. Connect a wire from the ⎍ 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 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 several times to obtain multiple GATE edges.

Buffered Periodic Event Counting

To perform buffered periodic event counting, complete the following steps.

1. Connect a wire from the ⎍ 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 of the counter applications described in this document.

Measuring Frequency

To measure a frequency using counter pair 0 and 1, complete the following steps.

1. In the C interface or in LabVIEW, select GATE as the output of the other counter. This selection allows OUT of counter 1 to be the GATE signal for counter 0.
2. Connect a wire from the ⎍ 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 also can be similarly used.

Simultaneously Starting Counters

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

1. Configure two or more counters to generate a pulse after receiving a start trigger. In software, select a PFI line, such as PFI 0, to receive the start trigger.
2. To see the pulse on the outputs, connect an oscilloscope or analog input device to OUT of the selected counters.
3. Connect a wire from the **Trigger** spring terminal to the selected PFI line and use it to produce the start trigger.



Note You can use this method for any counter application.

Specifications

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

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

Channel A/Channel B output channels.....Channel A leads Channel B when the encoder knob is turned 90° clockwise

Pulse width.....1 µs

Resolution.....24 pulses per revolution

Digital Trigger

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

Spring terminals.....1 position

Lowpass filter.....f_0 = 15 Hz

Function Generator

Square wave.....TTL compatible

- Frequency range.....10 Hz–1 MHz; ±10% deviation over entire frequency range
- Rise time.....250 ns

Fall time ..... 50 ns

Spring terminal ..... 1 position

Output voltage..... Refer to Figure 3

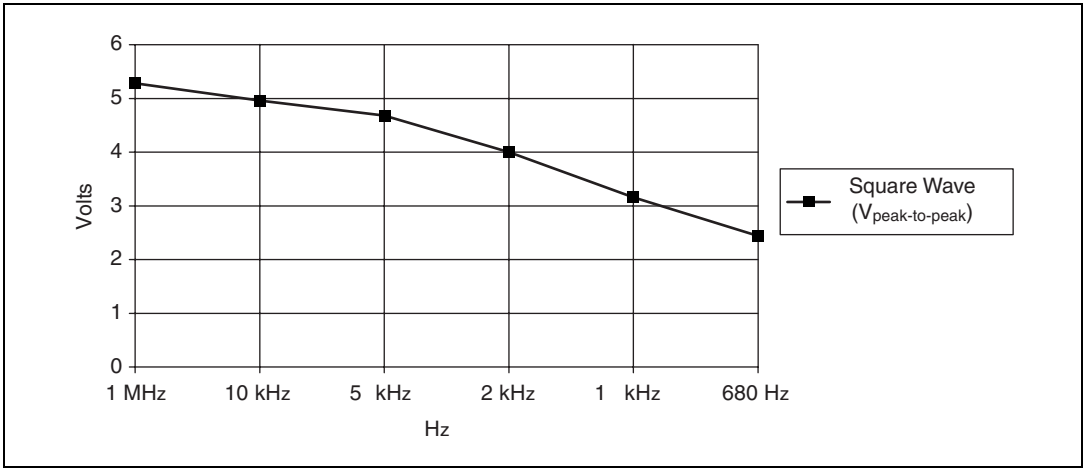


Figure 3. Typical Maximum Voltages versus Load Impedances

Digital Input/Output

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

Power Requirement

5 VDC (±5%)..... 200 mA, sourced from 660*X* device, which provides 1 A

Power available at 5 V spring terminal (±5%)..... 600 mA, sourced from 660*X* 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 .....10 to 90% noncondensing

Safety

This product is designed to meet the requirements of the following standards of safety for 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

CE, C-Tick, and FCC Part 15 (Class A) Compliant

Emissions.....EN 55011 Class A at 10 m
FCC Part 15A above 1 GHz

Immunity .....EN 61326:1997 + A2:2001, Table 1

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/`.

Technical Support Resources

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`.

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