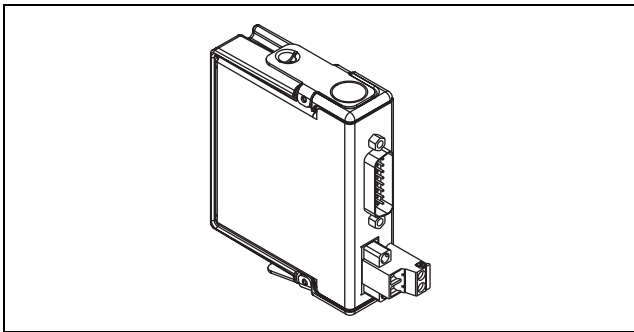


OPERATING INSTRUCTIONS

CompactRIO™ cRIO-9411

6-Channel Differential Digital Input Module



These operating instructions describe how to use the National Instruments cRIO-9411 module. For information about installing, configuring, and programming the CompactRIO system, refer to the *CompactRIO Bookshelf* at **Start»Program Files»National Instruments»CompactRIO»Search the CompactRIO Bookshelf**.

Safety Guidelines

Operate the cRIO-9411 only as described in these operating instructions.



Hot Surface This icon denotes that the component may be hot. Touching this component may result in bodily injury.

Safety Guidelines for Hazardous Locations

The cRIO-9411 is suitable for use in Class I, Division 2, Groups A, B, C, and D hazardous locations; Class 1, Zone 2, AEx nC IIC T4 and Ex nC T4 hazardous locations; and nonhazardous locations only. Follow these guidelines if you are installing the cRIO-9411 in a potentially explosive environment. Not following these guidelines may result in serious injury or death.



Caution Do *not* disconnect I/O-side wires or connectors unless power has been switched off or the area is known to be nonhazardous.



Caution Do *not* remove modules unless power has been switched off or the area is known to be nonhazardous.




Caution Substitution of components may impair suitability for Class I, Division 2.



Caution For Zone 2 applications, install the CompactRIO system in an enclosure rated to at least IP 54 as defined by IEC 60529 and EN 60529.

Special Conditions for Safe Use in Europe

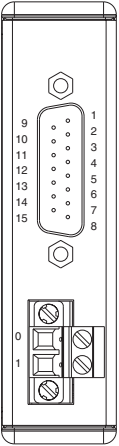
This equipment has been evaluated as EEx nC IIC T4 equipment under DEMKO Certificate No. 03 ATEX 0324020X. Each module is marked  II 3G and is suitable for use in Zone 2 hazardous locations.

Wiring the cRIO-9411

The cRIO-9411 has a D-Sub connector that provides connections for the six digital input channels, two connections for supplying power to an external device, and a connection for common. Each channel has two pins to which you can connect a pair of digital input signals, DIa and DIb. Refer to Table 1 for the pin assignments for each channel.

The cRIO-9411 also has a screw-terminal connector that provides connections for an external power supply. You can connect the positive lead of the power supply to terminal 0, Vsup, and the negative lead to terminal 1, COM.

Table 1. Pin Assignments

Module	D-Sub Pins	Signal
	1	DI0a
	2	DI1a
	3	DI2a
	4	Supply (+5 Vout)
	5	Supply (+5 Vout)
	6	DI3a
	7	DI4a
	8	DI5a
	9	DI0b
	10	DI1b
	11	DI2b
	12	Common (COM)
	13	DI3b
	14	DI4b
	15	DI5b

Connecting Differential Devices to the cRIO-9411

You can connect differential devices to the cRIO-9411. Connect a positive signal to one of the pins in a pair of DI pins. Connect a negative signal to the other pin in the pair. For example, connect the signals to DI0a and DI0b, pins 1 and 9 respectively. Figure 1 shows a possible configuration.

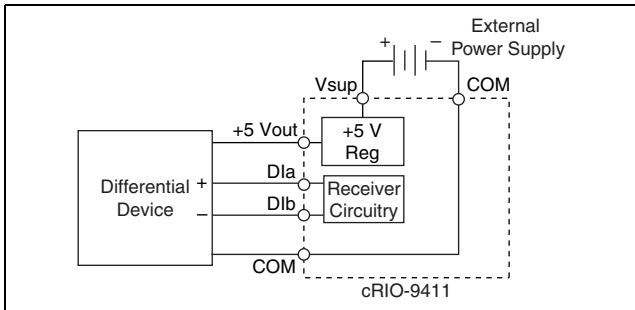


Figure 1. Connecting a Differential Device to the cRIO-9411

The cRIO-9411 measures whether the difference between the DIa and DIb terminals is greater than or less than the digital logic levels. If the difference between the pins is within the input high

range, the channel registers as high. If the difference between the pins is within the input low range, the channel registers as low. Refer to the *Specifications* section for more information about digital logic levels.

An example of a differential device is a differential encoder. A differential encoder has *phase A*, *phase B*, and *index* signals. Use the phase A signals to measure rotational speed. Use the phase B signals to measure direction. Use the index signals to measure the number of rotations.

Connect each of the signal pairs of the encoder (phase A, phase B, and index) to a pair of DI pins. Figure 2 shows the connections for one differential encoder.

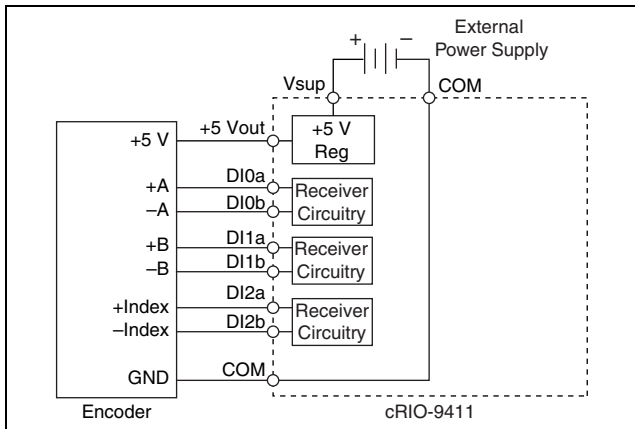


Figure 2. Connecting a Differential Encoder to the cRIO-9411

Connecting Single-Ended Devices to the cRIO-9411

You can connect single-ended (TTL) devices to the cRIO-9411. Connect a signal to a DIa pin. Do not connect a signal to the DIb pin in the pair. For example, if you connect a single-ended signal to the pin for DI0a, leave DI0b unconnected. Figure 3 shows a possible configuration.



Note For single-ended device measurements, you *must* leave the DIb pin unconnected.

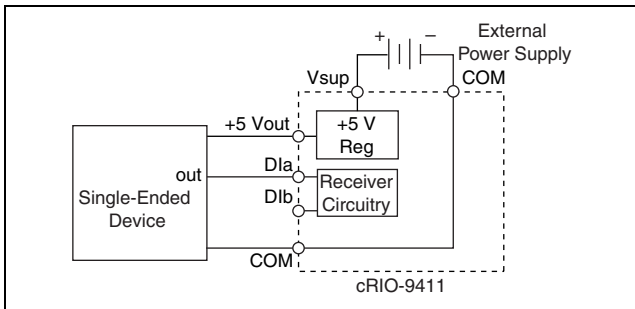


Figure 3. Connecting a Single-Ended Device to the cRIO-9411

An example of a single-ended device is a single-ended encoder. Connect each of the signals of the encoder (phase A, phase B, and index) to one of the pins in a pair of DI pins. Figure 4 shows the connections for one single-ended encoder.

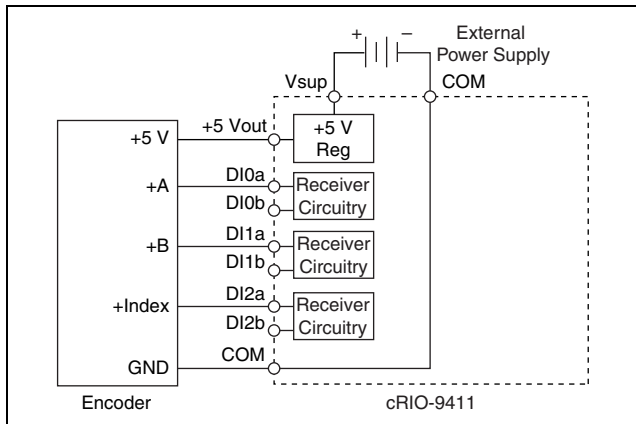


Figure 4. Connecting a Single-Ended Encoder to the cRIO-9411

Powering an External Device through the cRIO-9411

If you do not have a 5 V power supply to directly power the external device or if you want to simplify wiring, you can connect a 5 to 30 VDC power supply to the Vsup and COM terminals on the cRIO-9411, and connect the external device to one of the +5 Vout pins. If the external device is already powered, you do not need to connect a power supply to the cRIO-9411 or connect the +5 Vout pin to the external device.

Sleep Mode

You can enable sleep mode for the CompactRIO system in software. Typically, when a system is in sleep mode, you cannot communicate with the modules. In sleep mode, the system minimizes power consumption. The system thermal dissipation may decrease. Refer to the *Specifications* section for more information about power consumption and thermal dissipation. Refer to the *CompactRIO Bookshelf* for more information about enabling sleep mode in software.

Specifications

The following specifications are typical for the range -40 to 70 °C unless otherwise noted.

Input Characteristics

Number of channels 6

Input type Differential or single-ended

Digital logic levels

 Single-ended

 Input high range 2 to 24 V

 Input low range 0 to 0.8 V

 Differential (DIa–DIb)

 Input high range 300 mV to 24 V

 Input low range -300 mV to -24 V

 Common-mode voltage¹ -7 to 12 V

¹ Common-mode voltage is the average of DIa and DIb.

Input current

At 5 V..... ± 1 mA

At 24 V..... ± 4 mA

I/O protection

Input voltage..... 30 V max

Input current..... ± 4 mA, internally limited

Short-circuit protection 400 mA

Input delay time 500 ns max

MTBF 800,319 hours at 25 °C;
Bellcore Issue 6, Method 1,
Case 3, Limited Part Stress
Method



Note Contact NI for Bellcore MTBF specifications at other temperatures or for MIL-HDBK-217F specifications.

Power Requirements

Power consumption from chassis

Active mode 340 mW max

Sleep mode 1.1 mW max

Thermal dissipation (at 70 °C)

Active mode	1.4 W max
Sleep mode	1.1 W max

External Power Supply

Input voltage range (V_{sup})	5 to 30 VDC, user-provided
5 V regulated output	
Voltage tolerance	5 V \pm 3%, $V_{sup} \geq 6$ V
Current.....	200 mA
Short-circuit protection	400 mA

Physical Characteristics

If you need to clean the module, wipe it with a dry towel.

Screw-terminal wiring	12 to 24 AWG copper conductor wire with 10 mm (0.39 in.) of insulation stripped from the end
Torque for screw terminals	0.5 to 0.6 N · m (4.4 to 5.3 lb · in.)
Weight.....	Approx. 136 g (4.8 oz)

Safety

Safety Voltages

Connect only voltages that are within these limits.

Channel-to-COM..... 30 V max,
Installation Category I

Vsup-to-COM..... 30 V max,
Installation Category I

Installation Category I is for measurements performed on circuits not directly connected to the electrical distribution system referred to as *MAINS* voltage. *MAINS* is a hazardous live electrical supply system that powers equipment. This category is for measurements of voltages from specially protected secondary circuits. Such voltage measurements include signal levels, special equipment, limited-energy parts of equipment, circuits powered by regulated low-voltage sources, and electronics.

Isolation

Channel-to-channel No isolation between channels

Channel-to-earth ground

Continuous 30 V_{rms}, 42.4 V_{peak}, 60 VDC

Withstand 400 V_{rms}, 1 minute max

Safety Standards

The cRIO-9411 is designed to meet the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

- EN 61010-1, IEC 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 visit ni.com/hardref.nsf, search by module number or product line, and click the appropriate link in the Certification column.

Hazardous Locations

U.S. (UL)	Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, AEx nC IIC T4
Canada (C-UL)	Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, AEx nC IIC T4
Europe (DEMKO).....	EEx nC IIC T4

Environmental

CompactRIO modules are intended for indoor use only. For outdoor use, mount the CompactRIO system in a suitably rated enclosure. Refer to the installation instructions for the chassis you are using for more information about meeting these specifications.

Operating temperature	-40 to 70 °C
Storage temperature	-40 to 85 °C
Ingress protection.....	IP 40
Humidity	10 to 90% RH, noncondensing

Maximum altitude.....2,000 m
Pollution Degree (IEC 60664) 2

Shock and Vibration

To meet these specifications, you must panel mount the CompactRIO system and affix ferrules to the ends of the terminal wires.

Operating vibration, random
(IEC 60068-2-64)..... 5 g_{rms}, 10 to 500 Hz

Operating shock
(IEC 60068-2-27)..... 30 g, 11 ms half sine,
50 g, 3 ms half sine,
18 shocks at 6 orientations

Operating vibration, sinusoidal
(IEC 60068-2-6)..... 5 g, 10 to 500 Hz

Electromagnetic Compatibility

Emissions.....	EN 55011 Class A at 10 m FCC Part 15A above 1 GHz
Immunity.....	Industrial levels per EN 61326-1:1997 + A2:2001, Table A.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, visit

ni.com/hardref.nsf, search by module number or product line, and click the appropriate link in the Certification column.

National Instruments Contact Information

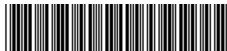
Go to ni.com/support for the most current manuals, examples, and troubleshooting information. For telephone support in the United States, create a service request at ni.com/support and follow the calling instructions or dial 512 795 8248. For telephone support outside the United States, contact your local branch office:

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Czech Republic 420 2 2423 5774, Denmark 45 45 76 26 00,
Finland 385 0 9 725 725 11, France 33 0 1 48 14 24 24,
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