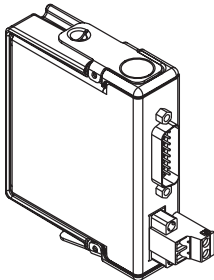


OPERATING INSTRUCTIONS

NI 9411

6-Channel Differential Digital Input Module

このドキュメントの日本語版については、ni.com/jp/manualsを参照してください。(For a Japanese language version, go to ni.com/jp/manuals.)



These operating instructions describe how to use the National Instruments NI 9411. For information about installing, configuring, and programming your system, refer to your system documentation. To determine which software you need for the modules you are using, go to ni.com/info and enter `rdsoftwareversion`.



Note The safety guidelines and specifications in this document are specific to the NI 9411. The other components in your system may not meet the same safety ratings and specifications. Refer to the documentation for each component in your system to determine the safety ratings and specifications for the entire system.

Safety Guidelines

Operate the NI 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 NI 9411 is suitable for use in Class I, Division 2, Groups A, B, C, D, T4 hazardous locations; Class I, Zone 2, AEx nC IIC T4 and Ex nC IIC T4 hazardous locations; and nonhazardous locations only. Follow these guidelines if you are installing the NI 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 your system in an enclosure rated to at least IP 54 as defined by IEC 60529 and EN 60529.



Caution For Zone 2 applications, install a protection device between the V_{sup} and COM terminal. The device must prevent the V_{sup} -to-COM voltage from exceeding 42 V if there is a transient overvoltage condition.

Special Conditions for Hazardous Locations 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 Ex II 3G and is suitable for use in Zone 2 hazardous locations.

Special Conditions for Marine Applications

Some modules are Lloyd's Register (LR) Type Approved for marine applications. To verify Lloyd's Register certification, go to ni.com/certification for the LR certificate, and look for the Lloyd's Register mark on the module.



Caution To meet radio frequency emission requirements for marine applications, use shielded cables and install the system in a metal enclosure. Suppression ferrites must be installed on power supply inputs near power entries to modules and controllers. Power supply and module cables must be separated on opposite sides of the

enclosure, and must enter/exit through opposing enclosure walls.

Wiring the NI 9411

The NI 9411 has a DSUB 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 NI 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, V_{sup} , and the negative lead to terminal 1, COM.

Wiring for High-Vibration Applications

National Instruments recommends using ferrules for terminating wires to the detachable screw-terminal connector when you use the NI 9411 in high-vibration applications. Refer to Figure 1 for an illustration.

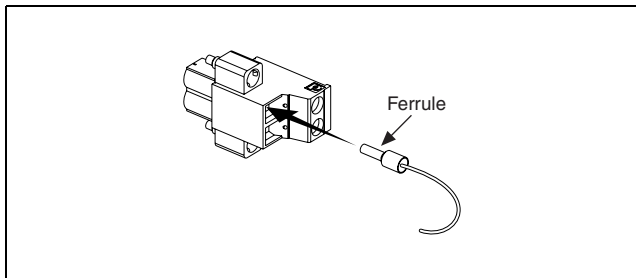
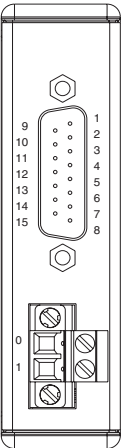


Figure 1. 2-pin Detachable Screw-Terminal Connector with a Ferrule

Table 1. Pin Assignments

Module	DSUB Pins	Signal
	1	DI0a
	2	DI1a
	3	DI2a
	4	Supply (+5 V _{out})
	5	Supply (+5 V _{out})
	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 NI 9411

You can connect differential devices to the NI 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 2 shows a possible configuration.

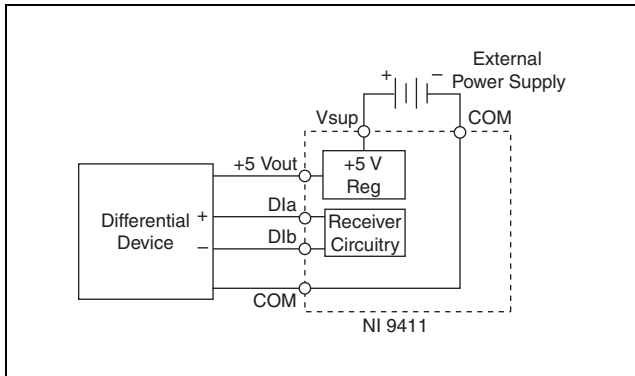


Figure 2. Connecting a Differential Device to the NI 9411

The NI 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 3 shows the connections for one differential encoder.

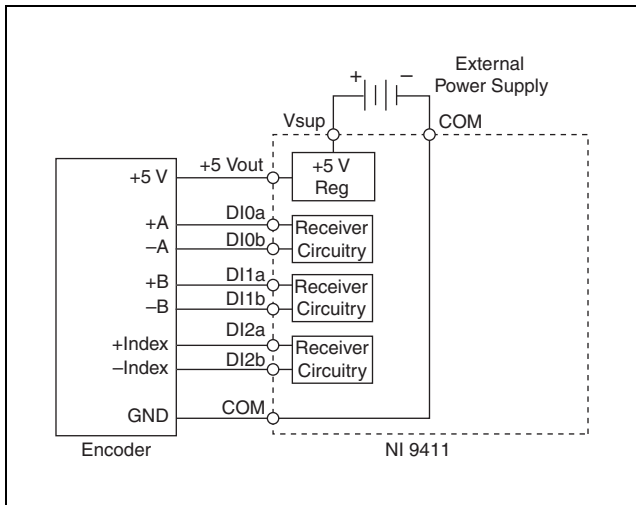


Figure 3. Connecting a Differential Encoder to the NI 9411

Connecting Single-Ended Devices to the NI 9411

You can connect single-ended (TTL) devices to the NI 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 4 shows a possible configuration.



Note For single-ended device measurements, you *must* leave the second signal in the set of signals, such as DIb, unconnected.

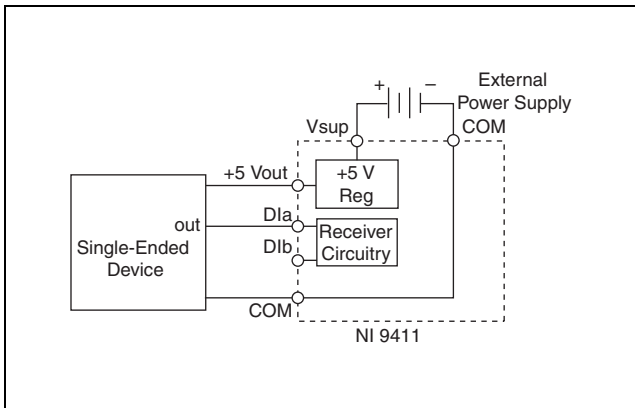


Figure 4. Connecting a Single-Ended Device to the NI 9411

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 5 shows the connections for one single-ended encoder.

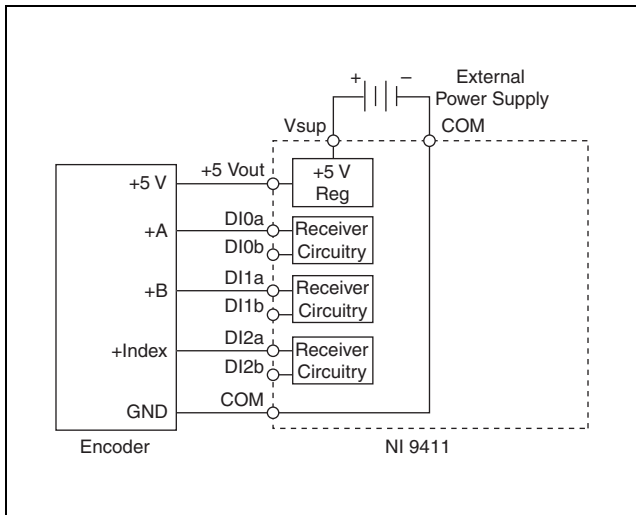


Figure 5. Connecting a Single-Ended Encoder to the NI 9411

Powering an External Device through the NI 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 V_{sup} and COM terminals on the NI 9411, and connect the external device to one of the +5 V_{out} pins. If the external device is already powered, you do not need to connect a power supply to the NI 9411 or connect the +5 V_{out} pin to the external device.

Sleep Mode

This module supports a low-power sleep mode. Support for sleep mode at the system level depends on the chassis that the module is plugged into. Refer to your chassis documentation for information regarding support for sleep mode functionality. You can enable sleep mode in software. Refer to your driver software documentation for more information.

Typically, when a system is in sleep mode, you cannot communicate with the modules. In sleep mode, the system consumes minimal power and may dissipate less heat than it does in normal mode. Refer to the *Specifications* section for more information about power consumption and thermal dissipation.

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

(input to COM)..... 30 V max

Input current ± 4 mA, internally limited

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	$5\text{ V} \pm 3\%$, $V_{sup} \geq 6\text{ V}$
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,
Measurement Category I

V_{sup} -to-COM 30 V max,
Measurement Category I

Measurement 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. Do not connect to signals or use for measurements within Measurement Categories II, III, or IV.

Isolation Voltages

Channel-to-channel..... No isolation between channels

Channel-to-earth ground

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

Withstand..... 400 V_{rms}, verified by a 5 s dielectric withstand test

Safety Standards

The NI 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 61010-1
- CAN/CSA-C22.2 No. 61010-1



Note For UL and other safety certifications, refer to the product label, or visit ni.com/certification, 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, Ex nC IIC T4
Europe (DEMKO).....	EEx nC IIC T4

Environmental

National Instruments C Series modules are intended for indoor use only, but may be used outdoors if installed in a suitable 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 your 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, operate this device with shielded cabling.

CE Compliance

This product meets the essential requirements of applicable European directives, as amended for CE markings, 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/certification, search by module number or product line, and click the appropriate link in the Certification column.

Where to Go for Support

The National Instruments Web site is your complete resource for technical support. At ni.com/support you have access to everything from troubleshooting and application development self-help resources to email and phone assistance from NI Application Engineers.

National Instruments corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. National Instruments also has offices located around the world to help address your support needs. For telephone support in the United States, create your 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:

Australia 1800 300 800, Austria 43 662 457990-0,
Belgium 32 (0) 2 757 0020, Brazil 55 11 3262 3599,
Canada 800 433 3488, China 86 21 6555 7838,
Czech Republic 420 224 235 774, Denmark 45 45 76 26 00,
Finland 385 (0) 9 725 72511, France 33 (0) 1 48 14 24 24,
Germany 49 89 7413130, India 91 80 41190000,
Israel 972 3 6393737, Italy 39 02 413091, Japan 81 3 5472 2970,

Korea 82 02 3451 3400, Lebanon 961 (0) 1 33 28 28,
Malaysia 1800 887710, Mexico 01 800 010 0793,
Netherlands 31 (0) 348 433 466, New Zealand 0800 553 322,
Norway 47 (0) 66 90 76 60, Poland 48 22 3390150,
Portugal 351 210 311 210, Russia 7 495 783 6851,
Singapore 1800 226 5886, Slovenia 386 3 425 42 00,
South Africa 27 0 11 805 8197, Spain 34 91 640 0085,
Sweden 46 (0) 8 587 895 00, Switzerland 41 56 2005151,
Taiwan 886 02 2377 2222, Thailand 662 278 6777,
Turkey 90 212 279 3031, United Kingdom 44 (0) 1635 523545

National Instruments, NI, ni.com, and LabVIEW are trademarks of National Instruments Corporation. Refer to the *Terms of Use* section on ni.com/legal for more information about National Instruments trademarks. Other product and company names mentioned herein are trademarks or trade names of their respective companies. For patents covering National Instruments products, refer to the appropriate location: **Help»Patents** in your software, the `patents.txt` file on your CD, or ni.com/patents.

© 2003–2007 National Instruments Corp. All rights reserved.