OPERATING INSTRUCTIONS AND SPECIFICATIONS
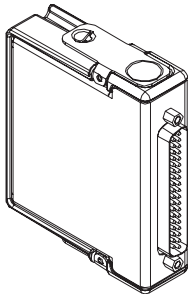# NI 9403

32-Channel, TTL Digital Input/Output Module

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ni.com/manuals

NATIONAL INSTRUMENTS

This document describes how to use the National Instruments 9403 and includes specifications and pin assignments for the NI 9403. Visit ni.com/info and enter rdsoftwareversion to determine which software you need for the modules you are using. For information about installing, configuring, and programming the system, refer to the system documentation. Visit ni.com/info and enter cseriesdoc for information about C Series documentation.

Note The safety guidelines and specifications in this document are specific to the NI 9403. The other components in the system might not meet the same safety ratings and specifications. Refer to the documentation for each component in the system to determine the safety ratings and specifications for the entire system. Visit ni.com/info and enter cseriesdoc for information about C Series documentation.

Safety Guidelines

Operate the NI 9403 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 9403 is suitable for use in Class I, Division 2, Groups A, B, C, D, T4 hazardous locations; Class I, Zone 2, AEx nA IIC T4, and Ex nA IIC T4 hazardous locations; and nonhazardous locations only. Follow these guidelines if you are installing the NI 9403 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 system in an enclosure rated to at least IP 54 as defined by IEC 60529 and EN 60529.

⚠ **Caution** For Zone 2 applications, connected signals must be within the following limit:

Capacitance .... 0.02 µF max

Special Conditions for Hazardous Locations Use in Europe

This equipment has been evaluated as Ex nA IIC T4 equipment under DEMKO Certificate No. 07 ATEX 0626664X. Each module is marked ⟨Ex⟩ II 3G and is suitable for use in Zone 2 hazardous locations. If you are using the NI 9403 in Gas Group IIC hazardous locations or in ambient temperatures of −40 °C ≤ Ta ≤ 70 °C, you must use the device in an NI chassis that has been evaluated as EEx nC IIC T4, Ex nA IIC T4, or Ex nL IIC T4 equipment.

Special Conditions for Marine Applications

Some modules are Lloyd's Register (LR) Type Approved for marine applications. To verify Lloyd's Register certification, visit ni.com/certification and search for the LR certificate, or 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 and exit through opposing enclosure walls.

Connecting the NI 9403

The NI 9403 has a 37-pin DSUB connector that provides connections for the 32 digital input/output channels.

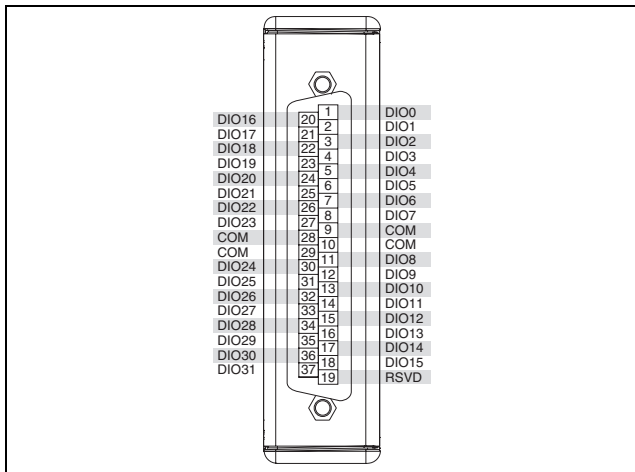|		
DIO16	20	1 DIO0
DIO17	21	2 DIO1
DIO18	22	3 DIO2
DIO19	23	4 DIO3
DIO20	24	5 DIO4
DIO21	25	6 DIO5
DIO22	26	7 DIO6
DIO23	27	8 DIO7
COM	28	9 COM
COM	29	10 COM
DIO24	30	11 DIO8
DIO25	31	12 DIO9
DIO26	32	13 DIO10
DIO27	33	14 DIO11
DIO28	34	15 DIO12
DIO29	35	16 DIO13
DIO30	36	17 DIO14
DIO31	37	18 DIO15
		19 RSVD

Figure 1. NI 9403 Pin Assignments

Each channel has a DIO pin to which you can connect a digital input or output device. The 32 DIO channels are internally referenced to COM, so you can use any of the four COM lines as a reference for the external signal.

You can independently configure each DIO channel in software for input or output. The DIO channels have Schmitt trigger inputs and are compatible with 5 V TTL logic devices. Each input channel has hysteresis for improved performance with noisy and non-monotonic input signals. Each channel also has a pull-down resistor and includes overvoltage, overcurrent, and short-circuit protection. Refer to the *Specifications* section for more information about input thresholds and overvoltage protection. Refer to the *Overcurrent/Short-Circuit Protection* section for more information about overcurrent and short-circuit protection.

Refer to Figure 2 for an illustration of several types of digital devices connected to the NI 9403.
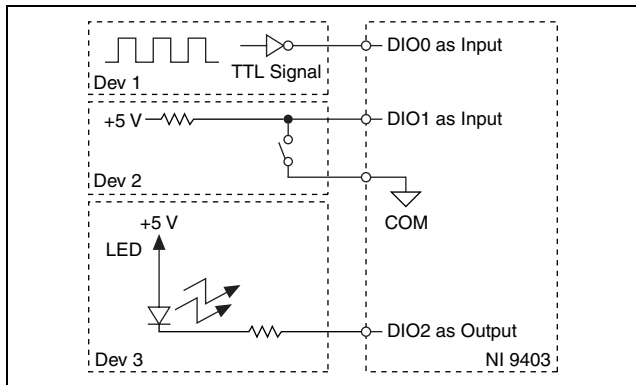

Figure 2. Connecting Digital Devices to the NI 9403

Overcurrent/Short-Circuit Protection

The overcurrent protection allows only a specified amount of current through the output channels to protect the NI 9403 from short circuits. If the NI 9403 goes into an overcurrent state, the module sets all the DIO channels to high impedance for approximately 280 milliseconds. When the channels are in this state, the NI 9403 can accept new line direction configuration and output state data but cannot pass valid input data to the software. After the protection period, the NI 9403 automatically recovers to the latest direction configuration and output state. If the overcurrent condition still exists, the module again sets the channels to high impedance. This cycle continues until the overcurrent condition is removed. Refer to the *Specifications* section for more information about the maximum output current.

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 the chassis manual for information about support for sleep mode. If the chassis supports sleep mode, refer to the software help for information about enabling sleep mode. Visit

ni.com/info and enter cseriesdoc for information about C Series documentation.

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. All voltages are relative to COM unless otherwise noted.

Input/Output Characteristics

Number of channels .... 32 DIO channels

Input/output type .... TTL, single-ended

Default power-on line direction .... Input

Digital logic levels

    Input

        Voltage .... -0.25 to 5.25 V

        High, V_{IH} .... 2.2 V min

        Low, V_{IL} .... 0.8 V max

        Hysteresis, V_H .... 0.2 V min

    Output

        High, V_{OH} .... 5.2 V max

            Sourcing 100 µA .... 4.75 V min

            Sourcing 2 mA .... 4.4 V min

        Low, V_{OL}

            Sinking 100 µA .... 0.1 V max

            Sinking 2 mA .... 0.26 V max

Input current (0 V $\leq V_{in} \leq$ 4.5 V) ...... ±250 µA max

Module output current[1] .... 64 mA max

Input capacitance .... 30 pF

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[1] Module output current is the maximum guaranteed current that the module can drive from all the I/O lines without going into an overcurrent state.

Timing

Input

Setup time[1] .... 10 ns min

Hold time[2] .... 60 ns min

Output

Propagation delay[3] .... 330 ns max

Channel-to-channel skew[4] ... 265 ns max

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[1] *Setup time* is the amount of time input signals must be stable before reading from the module.

[2] *Hold time* is the amount of time input signals must be stable after initiating a read from the module.

[3] *Propagation delay* is the amount of time after writing to the module that the output signals become valid.

[4] *Channel-to-channel skew* is the amount of time between the first output signal updating and the last output signal updating.

Update/transfer time[1]

    cRIO-9151 R Series

    Expansion chassis .... 8 µS max

    All other chassis .... 7 µS max

    Direction change time[1] .... 18 µS max

Overvoltage protection

Channel-to-COM .... ±30 V max on up to 8 channels at a time; however, continued use at this level will degrade the life of the module.

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[1] The update/transfer and direction change times are valid when the module is used in a CompactRIO system. When used in other systems, driver software and system latencies impact these times.

MTBF ....763,325 hours at 25 °C;
Bellcore Issue 2, 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 .... 1 W max

    Sleep mode .... 25 µW max

Thermal dissipation (at 70 °C)

    Active mode .... 1 W max

    Sleep mode .... 25 µW max

Physical Characteristics

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

Weight.. 150 g (5.3 oz)

Safety

Safety Voltages

Connect only voltages that are within the following limits.

Channel-to-COM .... ±30 V max on up to 8 channels at a time, Measurement Category I

Isolation

    Channel-to-channel .... None

    Channel-to-earth ground

        Continuous .... 60 VDC, Measurement Category I

        Withstand .... 1,000 V_{rms}, verified by a 5 s dielectric withstand test

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.

⚠️ **Caution** Do *not* connect the NI 9403 to signals or use for measurements within Measurement Categories II, III, or IV.

Safety Standards

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 61010-1, CSA 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 nA IIC T4

Canada (C-UL) ....Class I, Division 2,
Groups A, B, C, D, T4;
Class I, Zone 2,
Ex nA IIC T4

Europe (DEMKO).............................Ex nA 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 manual for the chassis you are using for more
information about meeting these specifications.

Operating temperature
(IEC 60068-2-1, IEC 60068-2-2) .....–40 to 70 °C

Storage temperature
(IEC 60068-2-1, IEC 60068-2-2) .....–40 to 85 °C

Ingress protection.............................IP 40

Operating humidity
(IEC 60068-2-56).............................10 to 90% RH,
noncondensing

Storage humidity
(IEC 60068-2-56).............................5 to 95% RH,
noncondensing

Maximum altitude.............................2,000 m

Pollution Degree (IEC 60664) 2

Shock and Vibration

To meet these specifications, you must panel mount the system.

Operating vibration

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

Sinusoidal (IEC 60068-2-6) ....5 g, 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

Electromagnetic Compatibility

This product is designed to meet the requirements of the following standards of EMC for electrical equipment for measurement, control, and laboratory use:

- EN 61326 EMC requirements; Industrial Immunity
- EN 55011 Emissions; Group 1, Class A
- CE, C-Tick, ICES, and FCC Part 15 Emissions; Class A

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:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

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.

Environmental Management

National Instruments is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial not only to the environment but also to NI customers.

For additional environmental information, refer to the *NI and the Environment* Web page at `ni.com/environment`. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

Waste Electrical and Electronic Equipment (WEEE)

EU Customers At the end of their life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers and National Instruments WEEE initiatives, visit `ni.com/environment/weee.htm`.

电子信息产品污染控制管理办法 （中国 RoHS）

中国客户 National Instruments 符合中国电子信息
产品中限制使用某些有害物质指令 (RoHS)。关于
National Instruments 中国 RoHS 合规性信息，请登录
ni.com/environment/rohs_china。(For information
about China RoHS compliance, go to ni.com/
environment/rohs_china.)

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:

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