OPERATING INSTRUCTIONS

CompactRIO™ cRIO-9472/9474

8-Channel Digital Output Modules

NATIONAL INSTRUMENTS™
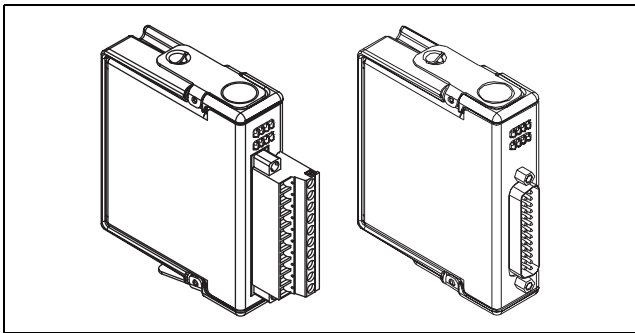
These operating instructions describe how to use the NI cRIO-9472 and the NI cRIO-9474. In this document, the cRIO-9472 with screw-terminal and cRIO-9472 with DSUB are referred to inclusively as the cRIO-9472. For information about installing, configuring, and programming the CompactRIO system, refer to the *CompactRIO Bookshelf* at **Start»All Programs»National Instruments»CompactRIO»Search the CompactRIO Bookshelf**.

Safety Guidelines

Operate the cRIO-9472/9474 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-9472/9474 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 IIC T4 hazardous locations; and nonhazardous locations only. Follow these guidelines if you are installing the cRIO-9472/9474 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 ⟨Ex⟩ II 3G and is suitable for use in Zone 2 hazardous locations.

Safety Guidelines for Hazardous Voltages

You can connect hazardous voltages to the cRIO-9472 with screw-terminal and cRIO-9474 only. Do not connect hazardous voltages to the cRIO-9472 with DSUB.

If *hazardous voltages* are connected to the module, take the following precautions. A hazardous voltage is a voltage greater than 42.4 V_{peak} or 60 VDC to earth ground.

⚠ **Caution** Ensure that hazardous voltage wiring is performed only by qualified personnel adhering to local electrical standards.

⚠ **Caution** Do *not* mix hazardous voltage circuits and human-accessible circuits on the same module.

⚠ **Caution** Make sure that devices and circuits connected to the module are properly insulated from human contact.

⚠ **Caution** When module terminals are live with hazardous voltages, make sure that the terminals are *not* accessible. You can use the cRIO-9932 connector kit or put the CompactRIO chassis in a suitably rated enclosure to prevent access to the terminals.
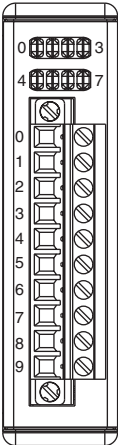
Wiring the cRIO-9472/9474

The cRIO-9472/9474 provides connections for eight digital output channels. The cRIO-9472/9474 has a 10-terminal, detachable screw-terminal connector. The cRIO-9472 with DSUB has a 25-pin DSUB connector.

Each channel of the cRIO-9472/9474 has a terminal or pin, DO, to which you can connect your device. Each channel has an LED that indicates the state of the channel.

You must connect an external power supply to the cRIO-9472/9474. This power supply provides the current for the devices you connect to the module. Connect the positive lead of the power supply to the supply terminal or pin, Vsup, and the negative lead of the power supply to the common terminal or pin, COM. The eight digital output channels are internally referenced to COM. Refer to Table 1 for the terminal assignments of the cRIO-9472 with screw terminal and cRIO-9474. Refer to Figure 1 for the pin assignments of the cRIO-9472 with DSUB.

Table 1. Terminal Assignments

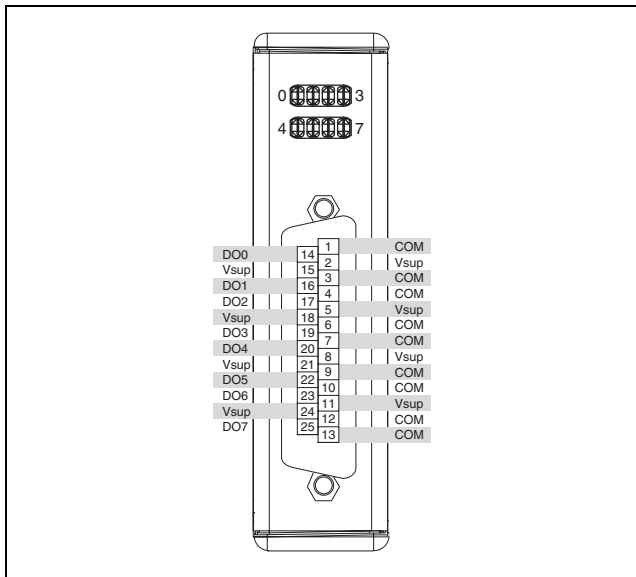| Module	Terminal	Signal
	0	DO0
	1	DO1
	2	DO2
	3	DO3
	4	DO4
	5	DO5
	6	DO6
	7	DO7
	8	Supply (Vsup)
	9	Common (COM)

Figure 1. Pin Assignments

Connecting Devices to the cRIO-9472/9474

The cRIO-9472/9474 has current *sourcing outputs*, meaning the DO terminal or pin drives current or applies voltage to the device to which it is connected.

You can connect *sinking-input* devices, such as NPN, open collectors, normally high, IEC negative logic, or other DC devices to the cRIO-9472/9474. A sinking-input device provides a path to ground for current or voltage. Make sure the device you connect to the cRIO-9472/9474 meets the module specifications. Refer to the *Specifications* section for more information about the output specifications of the module.

Connect the device to DO on the cRIO-9472/9474. Connect the common of the device to COM. Figure 2 shows a possible configuration.
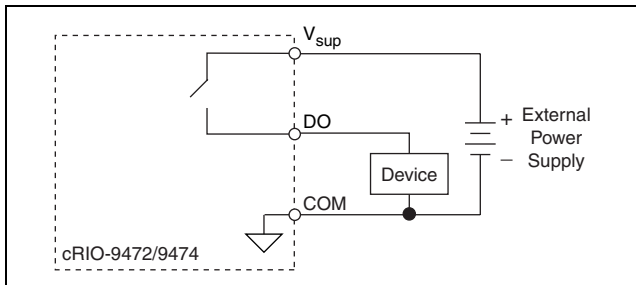
Figure 2. Connecting a Device to the cRIO-9472/9474

When the channel is on, the channel LED is on and the terminal or pin associated with the channel drives a current or applies a voltage to the device. When the channel is off, the channel LED is off and the terminal or pin does not drive current or apply voltage to the device. For more information about writing to digital output channels, refer to the *CompactRIO Bookshelf*.

Sleep Mode

You can enable sleep mode for the CompactRIO system in software. In sleep mode, the system consumes less power and may

dissipate less heat. Typically, when a system is in sleep mode, you cannot communicate with the modules. 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.

I/O Protection

The cRIO-9472/9474 is short-circuit proof in accordance with IEC 1131-2 and provides overcurrent protection.

Understanding Short-Circuit-Proof Devices

Each channel on the cRIO-9472/9474 has circuitry that protects it from current surges resulting from short circuits. Whether the module suffers damage from these overcurrent conditions depends on the following factors:

- The amount of current through the channel
- The amount of time the current is above the current limit
- The frequency of the current surges

When the amount of current through the DO terminal or pin is greater than the guaranteed trip current for the module, the channel trips and goes into an overcurrent state. In an overcurrent state, the

channel turns off and the module is not damaged. If the current through DO is higher than the minimum possible trip current and lower than the guaranteed trip current, the state of the channel is indeterminate and depends on factors such as the current level, the temperature, and the power supply.

To prevent false tripping, higher inrush currents that exist for less than the trip time do not trip the protection circuitry. Refer to the *Specifications* section for more information about the maximum continuous output current, trip current, and trip time. You also can refer to the IEC 1131-2 standard for more information about short-circuit-proof devices.

Power Supplies and Overcurrent Conditions

If a short-circuit occurs, the current through DO can exceed the current rating for the power supply and the maximum continuous output current for the cRIO-9472/9474.

If the power supply you are using with the cRIO-9472/9474 cannot supply more than the guaranteed trip current, the module may be damaged if a short-circuit condition occurs.

Detecting an Overcurrent Condition

If a device connected to the module is not working while the channel is on, the module channel may be in an overcurrent state. Neither the software nor the module LEDs indicate if an overcurrent condition occurs. A channel LED may be on even though the channel is off because of an overcurrent condition. To determine if the channel is in an overcurrent state, measure the voltage between DO and Vsup. If the voltage is equal to the voltage of the external power supply connected to the module, the channel is in an overcurrent state.

Resetting Channels After an Overcurrent Condition

After you have determined and fixed the cause of the overcurrent condition, reset the channel by turning it off. For more information about writing to output channels, refer to the *CompactRIO Bookshelf*. Alternatively, you can disconnect the external power supply from the module. However, doing so disconnects power from all of the module channels. Normal operation can resume after you correct the overcurrent condition and reset the channel.

NI-RIO Software

For information about determining which software you need for the modules you are using, go to ni.com/info and enter rdniriosoftware.

Specifications

The following specifications are typical for the range –40 to 70 °C unless otherwise noted. The specifications are the same for the cRIO-9472/9474 unless otherwise noted.

Output Characteristics

Number of channels.........................8 digital output channels

Output type ....Sourcing

Supply voltage range (*Vsup*)

    cRIO-9472.................................6 to 30 V

    cRIO-9474.................................5 to 30 V

Output voltage .... $Vsup - (I_0 \cdot R_0)$

Output impedance (R_0) ....0.13 Ω max; 0.07 Ω typ

Continuous output current (I_0)

    cRIO-9472.................................0.75 A max per channel

    cRIO-9474..................................1 A max per channel

I/O protection

    Voltage..30 V max

    Reversed voltage ....None

    Trip currents

        Minimum possible
        trip current............................6 A

        Minimum guaranteed
        trip current............................13 A

Current	Trips Channel	Damages Module
0 to 1 A	Channel does not trip	Module is not damaged
1 to 6 A	Channel does not trip	Module may be damaged
6 to 13 A	Channel may trip	Module may be damaged
>13 A	Channel trips	Module is not damaged

    Trip time .... 10 μs at 13 A

Output delay time (full load)

    cRIO-9472................................. 100 µs max

    cRIO-9474................................. 1 µs max

MTBF

    cRIO-9472................................. 1,113,301 hours at 25 °C;
                                             Bellcore Issue 6, Method 1,
                                           Case 3, Limited Part Stress
                                         Method

    cRIO-9474................................. 479,889 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. Go to ni.com/certification and search by model number for more information about MTBF and other product certifications.

cRIO-9472 Power Requirements

Power consumption from chassis

    Active mode .... 230 mW max

Sleep mode .... 0.4 mW max

Thermal dissipation (at 70 °C)

    Active mode .... 1.5 W max

    Sleep mode .... 55 mW max

cRIO-9474 Power Requirements

Power consumption from chassis

    Active mode .... 660 mW max

    Sleep mode .... 0.6 mW max

Thermal dissipation (at 70 °C)

    Active mode .... 1.5 W max

    Sleep mode .... 0.6 mW max

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

    cRIO-9472 with
    screw terminal/cRIO-9474 .... Approx. 150 g (5.3 oz)
    cRIO-9472 with DSUB .... Approx. 145 g (5.1 oz)

Safety

cRIO-9472 with Screw Terminal and cRIO-9474 Safety Voltages

Channel-to-COM .... 30 V max

Isolation

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

    Channel-to-earth ground

        Withstand .... 2,300 V_{rms}, 1 minute max

        Continuous .... 250 V_{rms}, Installation Category II

Installation Category II is for measurements performed on circuits directly connected to the electrical distribution system. This category refers to local-level electrical distribution, such as that

provided by a standard wall outlet (for example, 115 V for U.S. or 230 V for Europe).

cRIO-9472 with DSUB Safety Voltages

Channel-to-COM .... 30 V max

Isolation

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

    Channel-to-earth ground

        Withstand .... $1{,}000\ V_{rms}$, 1 minute max

        Continuous .... 60 VDC, 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.

Safety Standards

The cRIO-9472/9474 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 model 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

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
(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 CompactRIO system and, for the cRIO-9472 with screw terminal and cRIO-9474, 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.

FCC Compliance

Go to ni.com/info and enter rdcriofcc for information about using this product in compliance with FCC regulations.

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/certification`, search by model number or
product line, and click the appropriate link in the
Certification column.

National Instruments Contact Information

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 0 662 45 79 90 0,
Belgium 32 0 2 757 00 20, Brazil 55 11 3262 3599,
Canada (Calgary) 403 274 9391,
Canada (Montreal) 514 288 5722,
Canada (Ottawa) 613 233 5949, Canada (Québec) 514 694 8521,
Canada (Toronto) 905 785 0085,
Canada (Vancouver) 514 685 7530, China 86 21 6555 7838,
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,

Germany 49 0 89 741 31 30, Greece 30 2 10 42 96 427,
India 91 80 51190000, Israel 972 0 3 6393737,
Italy 39 02 413091, Japan 81 3 5472 2970,
Korea 82 02 3451 3400, Malaysia 603 9131 0918,
Mexico 001 800 010 0793, Netherlands 31 0 348 433 466,
New Zealand 0800 553 322, Norway 47 0 66 90 76 60,
Poland 48 0 22 3390 150, Portugal 351 210 311 210,
Russia 7 095 783 68 51, Singapore 65 6226 5886,
Slovenia 386 3 425 4200, South Africa 27 0 11 805 8197,
Spain 34 91 640 0085, Sweden 46 0 8 587 895 00,
Switzerland 41 56 200 51 51, Taiwan 886 2 2528 7227,
Thailand 662 992 7519, United Kingdom 44 0 1635 523545

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