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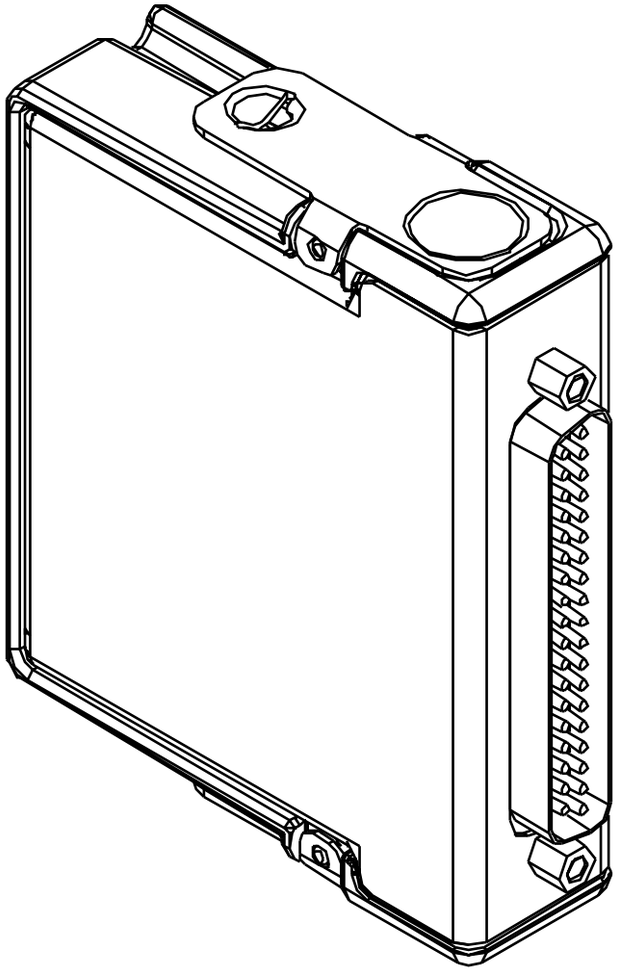
GETTING STARTED GUIDE

NI 9478

16 DO, 0 V to 50 V, Sinking, 50 µs



NATIONAL INSTRUMENTS™

This document explains how to connect to the NI 9478.

Note Before you begin, complete the software and hardware installation procedures in your chassis documentation.

Note The guidelines in this document are specific to the NI 9478. The other components in the system might not meet the same safety ratings. Refer to the documentation for each component in the system to determine the safety and EMC ratings for the entire system.

Safety Guidelines

Operate the NI 9478 only as described in this document.

Caution Do not operate the NI 9478 in a manner not specified in this document. Product misuse can result in a hazard. You can compromise the safety protection built into the product if the product is damaged in any way. If the product is damaged, return it to NI for repair.

Safety Voltages

Connect only voltages that are within the following limits:

Vsup-to-COM	50 VDC maximum, Measurement Category I
Isolation	
Channel-to-channel	None
Channel-to-earth ground	
Continuous	60 VDC, Measurement Category I
Withstand	1,000 Vrms, 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 9478 to signals or use for measurements within Measurement Categories II, III, or IV.

Note Measurement Categories CAT I and CAT O are equivalent. These test and measurement circuits are not intended for direct connection to the MAINS building installations of Measurement Categories CAT II, CAT III, or CAT IV.

Safety Guidelines for Hazardous Locations

The NI 9478 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 9478 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 Division 2 and Zone 2 applications, install the system in an enclosure rated to at least IP54 as defined by IEC/EN 60079-15.

Caution For Division 2 and Zone 2 applications, install a protection device across the external power supply and the COM pin. The device must prevent the external power supply voltage from exceeding 70 V if there is a transient overvoltage condition.

Special Conditions for Hazardous Locations Use in Europe and Internationally

The NI 9478 has been evaluated as Ex nA IIC T4 Gc equipment under DEMKO Certificate No. 07 ATEX 0626664X and is IECEx UL 14.0089X certified. Each NI 9478 is marked Ex II 3G and is suitable for use in Zone 2 hazardous locations, in ambient temperatures of -40 °C ≤ Ta ≤ 70 °C. If you are using the NI 9478

in Gas Group IIC hazardous locations, you must use the device in an NI chassis that has been evaluated as Ex nC IIC T4, Ex IIC T4, Ex nA IIC T4, or Ex nL IIC T4 equipment.

Caution You must make sure that transient disturbances do not exceed 140% of the rated voltage.

Caution The system shall only be used in an area of not more than Pollution Degree 2, as defined in IEC 60664-1.

Caution The system shall be mounted in an ATEX/IECEx-certified enclosure with a minimum ingress protection rating of at least IP54 as defined in IEC/EN 60079-15.

Caution The enclosure must have a door or cover accessible only by the use of a tool.

Electromagnetic Compatibility Guidelines

This product was tested and complies with the regulatory requirements and limits for electromagnetic compatibility (EMC) stated in the product specifications. These requirements and

limits provide reasonable protection against harmful interference when the product is operated in the intended operational electromagnetic environment.

This product is intended for use in industrial locations. However, harmful interference may occur in some installations, when the product is connected to a peripheral device or test object, or if the product is used in residential or commercial areas. To minimize interference with radio and television reception and prevent unacceptable performance degradation, install and use this product in strict accordance with the instructions in the product documentation.

Furthermore, any changes or modifications to the product not expressly approved by National Instruments could void your authority to operate it under your local regulatory rules.

Special Conditions for Marine Applications

Some products are Lloyd's Register (LR) Type Approved for marine (shipboard) applications. To verify Lloyd's Register certification for a product, visit *ni.com/certification* and search for the LR certificate, or look for the Lloyd's Register mark on the product.

Caution In order to meet the EMC requirements for marine applications, install the product in a shielded enclosure with shielded and/or filtered power and input/output ports. In addition, take precautions when designing, selecting, and installing measurement probes and cables to ensure that the desired EMC performance is attained.

Preparing the Environment

Ensure that the environment in which you are using the NI 9478 meets the following specifications.

Operating temperature (IEC 60068-2-1, IEC 60068-2-2)	-40 °C to 70 °C
Operating humidity (IEC 60068-2-78)	10% RH to 90% RH, noncondensing
Pollution Degree	2
Maximum altitude	2,000 m

Indoor use only.

Note Refer to the device datasheet on *ni.com/manuals* for complete specifications.

NI 9478 Pinout

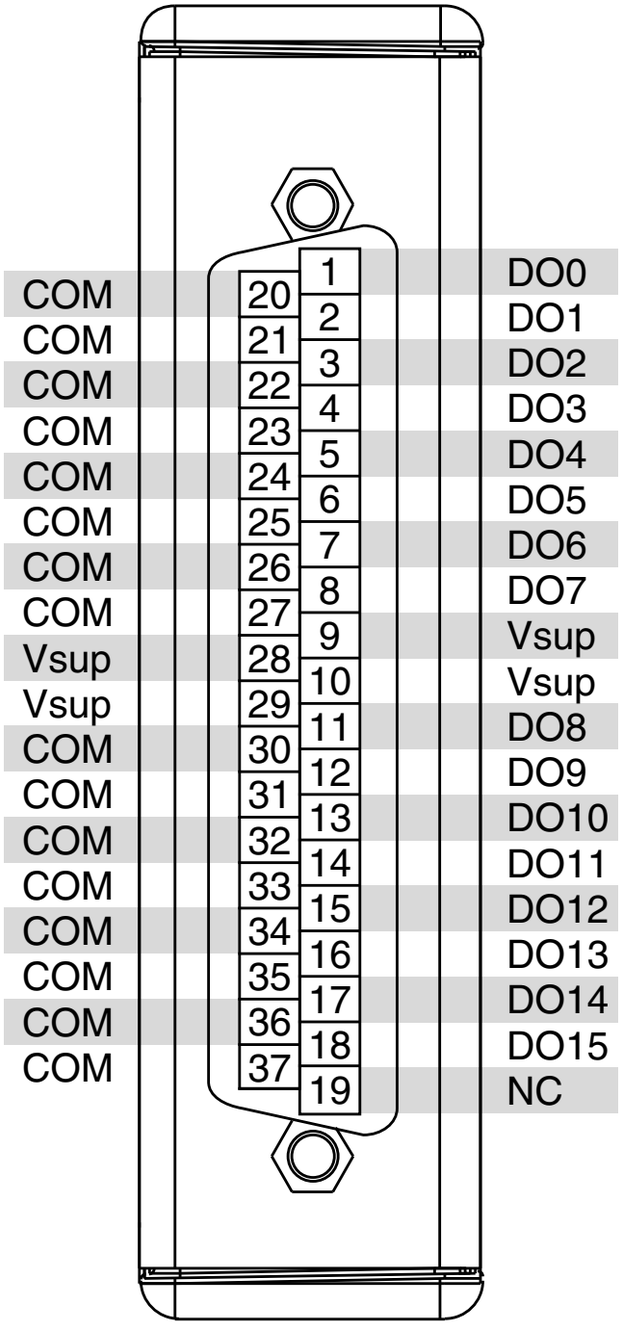


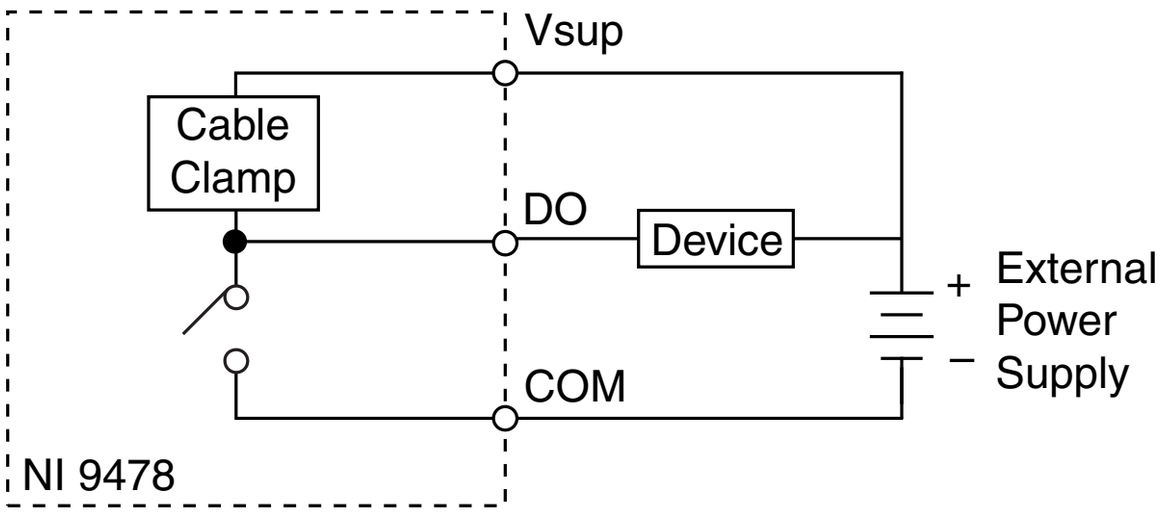
Table 1. NI 9478 Signal Descriptions

Signal	Description
COM	Common reference connection
DO	Digital output signal connection
NC	No connection
Vsup	Voltage supply connection

Connecting Digital Devices

You can connect a variety of industrial devices, such as solenoids, motors, actuators, relays, and lamps to the NI 9478. You must connect an external power supply to the NI 9478. The power supply provides the current for the output channels.

Figure 1. Connecting an Industrial Device to the NI 9478



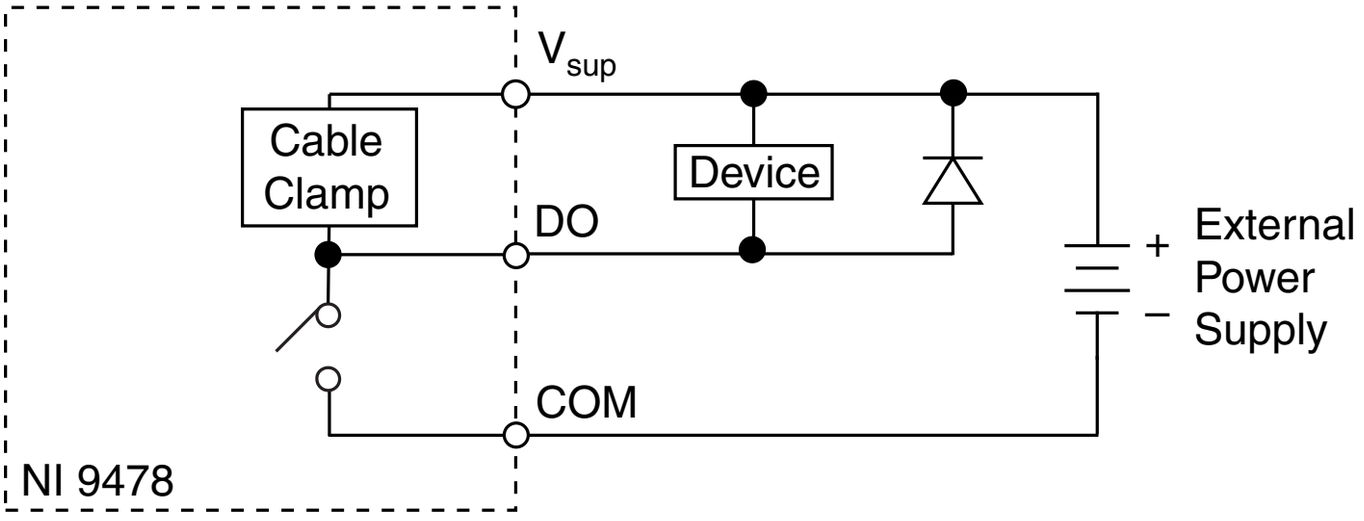
Caution Do not install or remove C Series modules from your system if the external power supply connected to the Vsup and COM pins is powered on.

Ensure that the devices you connect to the NI 9478 are compatible with the output specifications of the NI 9478. Refer to the device datasheet at *ni.com/manuals* for output specifications.

Protecting the Digital Outputs from Flyback Voltages

If the channel is switching an inductive or energy-storing device such as a solenoid, motor, or relay, and the device does not have flyback protection, install an external flyback diode.

Figure 2. Connecting a Flyback Diode



Cable Inductance

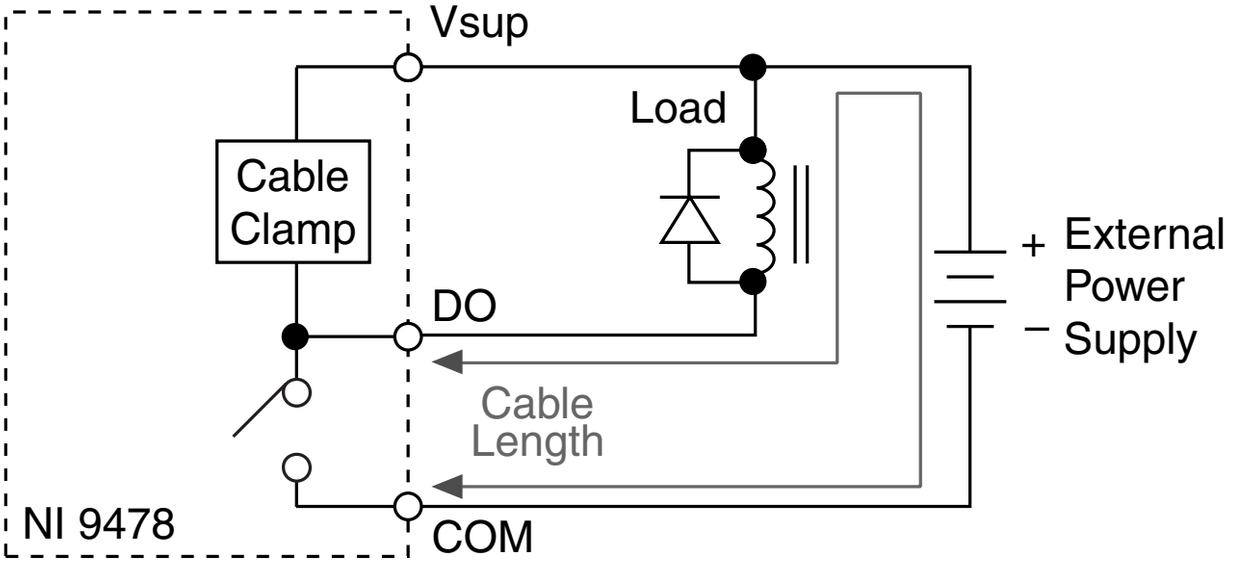
The inductance of the cabling stores energy when a channel is on and driving current. When a channel turns off, energy in the

cabling is released as flyback voltage, which dissipates as heat in the NI 9478. The heat dissipated increases with higher switching frequencies, higher currents, and longer cables.

Reducing Cable Length

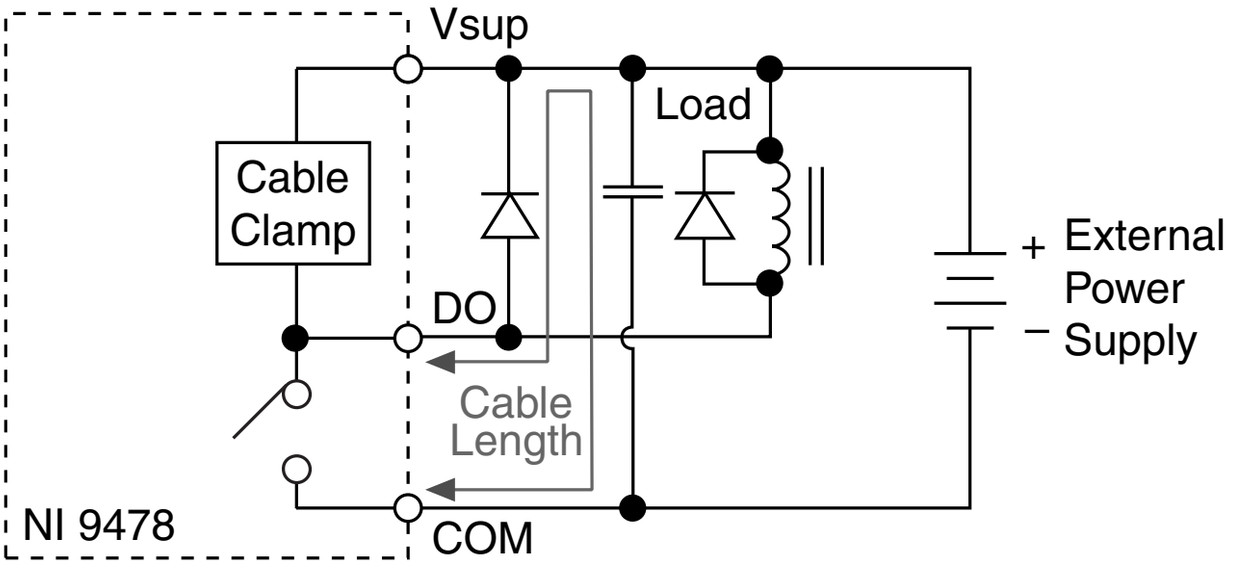
The effective cable length is the total distance from DO to COM.

Figure 3. Cable Length of the NI 9478



NI recommends adding a capacitor across the power supply leads and a diode from the DO lead to the Vsup lead. Connecting a capacitor and a diode reduces the effective cable length and dissipated heat.

Figure 4. Cable Length of the NI 9478 with a Capacitor and Diode



Note NI recommends that you use a capacitor with a capacitance of at least 20 μF.

I/O Protection

The NI 9478 provides protection against overcurrent and short-circuit conditions.

Overcurrent Protection

The NI 9478 provides two configurable current limit thresholds, Limit A and Limit B. The device monitors each output channel.

You can review the output status in software to determine if the current has exceeded the limit threshold.

You can configure each channel on the NI 9478 to disable the output that exceeds the current limit threshold. Some applications require a large inrush current that may exceed the current limit threshold. You can disable overcurrent protection by setting no current limit for that channel.

Caution If you disable overcurrent protection, the NI 9478 is no protected against overcurrent or short-circuit conditions. Verify the wiring is correct and that you are operating the NI 9478 within the specifications.

Overcurrent Refresh

The NI 9478 provides an overcurrent refresh setting. This setting enables the channel to recover within a specified refresh period. If the refresh setting is disabled, the channel remains off until it receives a command from the software.

Safe Operating Conditions

The total amount of current that you can switch with a channel depends on the duty cycle of the channel, the ambient

temperature, the switching frequency, and the amount of current switched by other channels within the same module at the same time.

NI recommends using 2 meters of cable for safe operating conditions. Higher currents, higher frequencies, and longer cables contribute to increased heat in the NI 9478. Refer to the device datasheet at *ni.com/manuals* for safe operating conditions.

You can determine safe operating specifications for the NI 9478 by using the following equation.

Figure 5. Safe Operating Conditions Equation

$$P = 4\,\%\left(I_{out}{}^{2}\right) + \left[0.12\,\%\left(length - 0.2\right)\left(I_{out}{}^{2}\right) + 0.04\,\%\ I_{out} + 1\right)\Big]freq$$

where

P is the percentage of total allowable power the channel uses

I_{out} is the output current in amperes while the channel is on

length is the total cable length in meters

freq is the frequency rate in kHz at which the output channel goes through an on-off cycle

Calculate the percentage of total allowable power each channel uses then add the percentages for all the channels. For ambient temperatures from 55 °C to 70 °C, the total power for all channels must remain under 100%. For temperatures below 55 °C, the total power of all channels can run up to 150%.

Example One

The NI 9478 passes 1.25 A current through 2.0 meters of cable. The channel cycles on for 40 µs and off for 10 µs for a total output period of 50 µs. This yields an output frequency of 20 kHz, using 14.8% of the total power budget.

Figure 6. Example Equation One

$$4\,\%\left(1.25^2\right) + \left[0.12\,\%\left(2.0 - 0.2\right)\left(1.25^2\right) + 0.04\,\%(1.25 + 1)\right]20 = 14.8\,\%$$

Example Two

The NI 9478 is on and passing 3 A of current through 2.0 meters of cable for 0.25 seconds. The channel passes 1.25 A of current at 20 kHz for 1.25 seconds. The channel then drives the load off for 4 seconds.

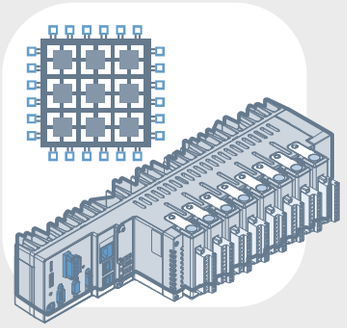
While the channel is on, the output frequency is 0 kHz and the channel uses 36% of the total power budget. The channel uses 14.8% of the total power budget driving at 20 kHz and 0% when the channel is off. The total percentage of allowable power over the complete 5.5 second cycle is 5%.

Figure 7. Example Equation Two

$$\frac{36\,\%\,(0.25s)\ +\ 14.8\,\%\,(1.25s)\ +\ 0\,\%\,(4s)}{5.5s} = 5\,\%$$

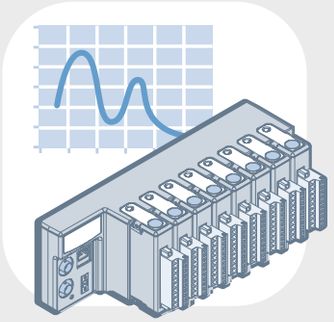
Where to Go Next

CompactRIO



- NI 9478 Datasheet
- NI-RIO Help
- LabVIEW FPGA Help

NI CompactDAQ



- NI 9478 Datasheet
- NI-DAQmx Help
- LabVIEW Help

RELATED INFORMATION

C Series Documentation & Resources
ni.com/info ⇨ cseriesdoc

Services
ni.com/services

Located at ni.com/manuals

Installs with the software

Worldwide Support and Services

The NI website 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.

Visit *ni.com/services* for NI Factory Installation Services, repairs, extended warranty, and other services.

Visit *ni.com/register* to register your NI product. Product registration facilitates technical support and ensures that you receive important information updates from NI.

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