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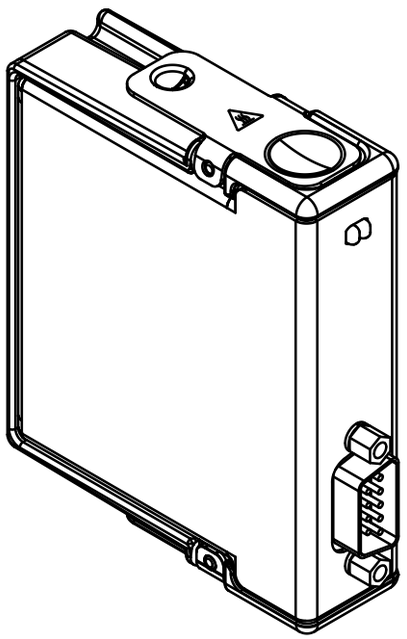
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Find the *National Instruments NI 9881* at our website: ***Click HERE***

GETTING STARTED GUIDE

NI 9881

1-Port CANopen Module



This document explains how to connect to the NI 9881.

The NI 9881 module requires the latest NI-CANopen software to be installed. The latest version of the NI-CANopen software is at *ni.com/downloads*.

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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 9881. 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 9881 only as described in this document.

Caution Do not operate the NI 9881 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.

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Safety Guidelines for Hazardous Locations

The NI 9881 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 9881 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.

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Caution For Division 2 and Zone 2 applications, install a protection device between the external power supply and the Vsup pin. The device must prevent the Vsup-to-COM voltage from exceeding 50 V if there is a transient overvoltage condition.

Caution For Zone 2 applications, install a protection device between the CAN signals and the NI 9881 CAN pins. The device must prevent the CAN Port-to-COM voltage from exceeding 55 V if there is a transient overvoltage condition.

Special Conditions for Hazardous Locations Use in Europe and Internationally

The NI 9881 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 9881 is marked Ⓔx 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 9881 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.

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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.

Wiring the NI 9881

The NI 9881 has one 9-pin male D-Sub connector that provides connections to a CAN bus. The NI 9881 has pins for CAN_H and CAN_L, to which you connect the CAN bus signals. Connect these signals using twisted-pair cable.

The port has two common pins (COM) that are internally connected to the module's isolated reference and serve as the

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reference ground for CAN_H and CAN_L. You can connect the CAN bus reference ground (sometimes referred to as CAN_V-) to one or both COM pins. The port also has an optional shield pin, SHLD, that you can connect to a shielded CAN cable. Connecting SHLD may improve signal integrity and EMC performance in a noisy environment.



Caution You must use a UL listed ITE power supply marked LPS with the NI 9881.

The NI 9881 requires an external power supply of +9 to +30 V to operate. Supply power to the NI 9881 V_{SUP} pin.



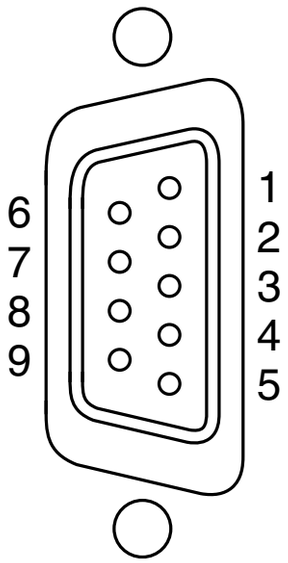
Note Power on V_{SUP} is required for CANopen operation.

The NI 9881 pinout is listed in Table 1.

The NI 9881 features software-selectable bus termination for High-Speed CAN transceivers. On the NI 9881, you can enable 120 Ω termination resistors between CAN_H and CAN_L through an API call. Table 3 lists recommended termination resistor values.

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Table 1. Pin Assignments for the NI 9881

Connector	Pin	Signal
	1	No Connection (NC)
	2	CAN_L
	3	COM
	4	NC
	5	SHLD
	6	COM
	7	CAN_H
	8	NC
	9	V_{SUP}

CAN Bus Topology and Termination

A CAN bus consists of two or more CAN nodes cabled together. The CAN_H and CAN_L pins of each node are connected to the

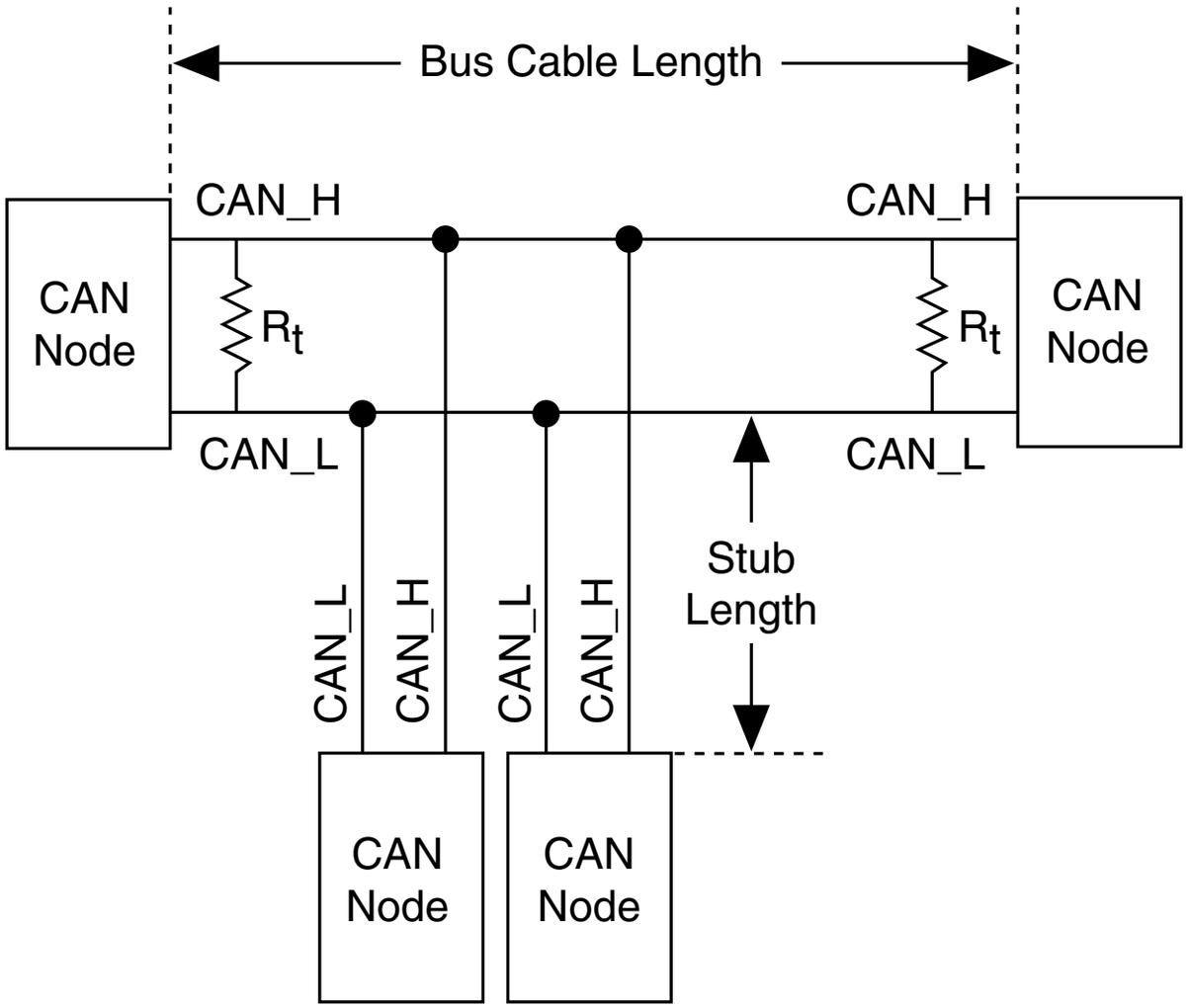
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main CAN bus cable through a short connection known as a "stub." The pair of signal wires, CAN_H and CAN_L, constitutes a transmission line. If the transmission line is not terminated, each signal change on the bus causes reflections that may cause communication errors. Because the CAN bus is bidirectional, both ends of the cable must be terminated. However, this requirement does not mean that every node on the bus should have a termination resistor; only the two nodes at the far end of the cable should have termination resistors.

Figure 1 shows a simplified diagram of a CAN bus with multiple CAN nodes and proper termination resistor (R_t) locations.

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Figure 1. CAN Bus Topology and Termination Resistor Locations

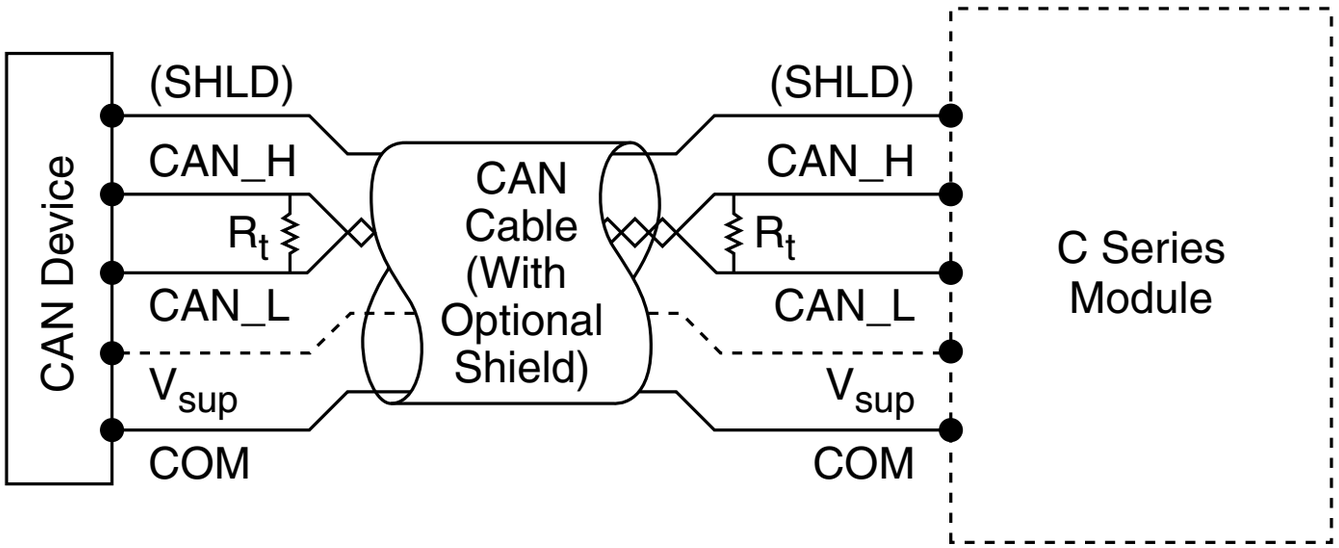


Connecting a CAN Bus to the NI 9881

You can connect the NI 9881 port to any location on a CAN bus. Figure 2 shows one example of connecting the NI 9881 directly to one CAN node.

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Figure 2. Connecting the NI 9881 to a CAN Device



Cabling Requirements for the NI 9881

Cable Specifications

Cables should meet the physical medium requirements specified in ISO 11898, shown in the following table. Belden cable (3084A) meets all these requirements and should be suitable for most applications.

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Table 2. ISO 11898 Specifications for Characteristics of a CAN_H and CAN_L Pair of Wires

Characteristic	Value
Impedance	95 Ω min,
	120 Ω nominal,
	140 Ω max
Length-related resistance	70 mΩ/m nominal
Specific line delay	5 ns/m nominal

Termination Resistors

The termination resistors (Rt) should match the nominal impedance of the CAN cable and therefore comply with the values in the following table.

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Table 3. Termination Resistor Specification

Characteristic	Value	Condition
Termination resistor, R_t	100 Ω min,	Minimum power dissipation: 220 mW
	120 Ω nominal,	
	130 Ω max	

Cable Lengths

The cabling characteristics and desired bit transmission rates affect the allowable cable length. You can find detailed cable length recommendations in the ISO 11898, CiA DS 102, and DeviceNet specifications.

ISO 11898 specifies 40 m total cable length with a maximum stub length of 0.3 m for a bit rate of 1 Mb/s. The ISO 11898 specification says that significantly longer cable lengths may be allowed at lower bit rates, but you should analyze each node for signal integrity problems.

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Number of CAN Nodes

The maximum number of nodes depends on the electrical characteristics of the nodes on the network. If all nodes meet the ISO 11898 requirements, you can connect at least 30 nodes to the bus. You can connect higher numbers of nodes if the nodes' electrical characteristics do not degrade signal quality below ISO 11898 signal level specifications.

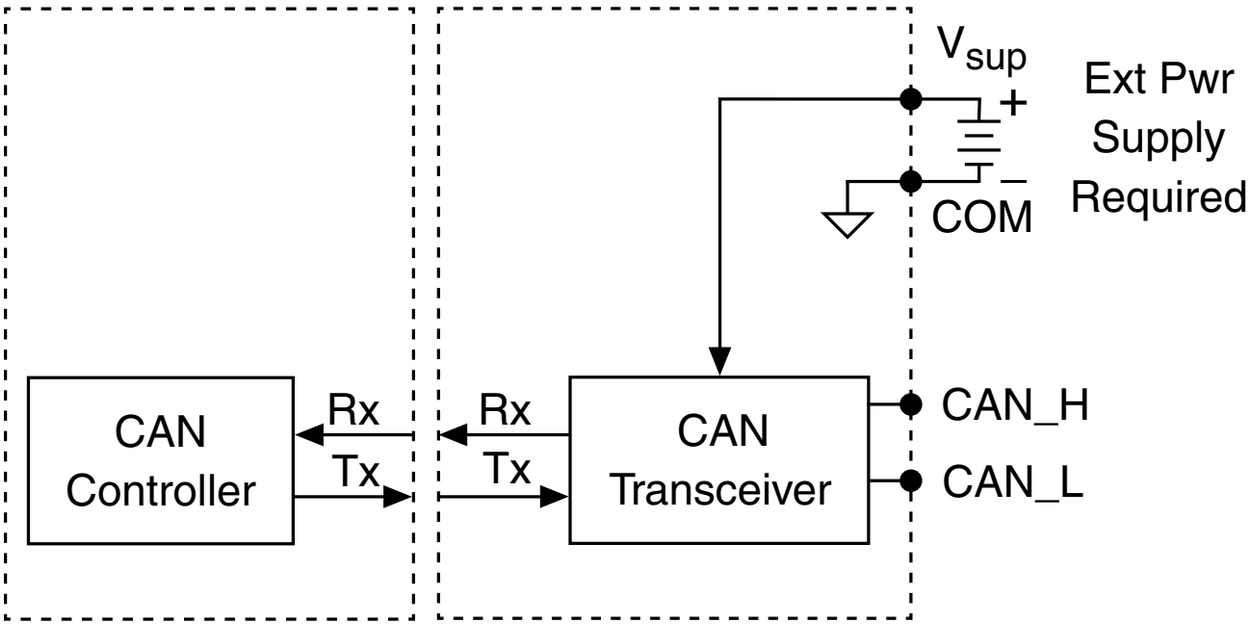
The NI 9881 electrical characteristics allow at least 110 CAN ports on a network.

NI 9881 Hardware Overview

The NI 9881 has one full-featured CAN port that is isolated from the other modules in the system. The port has a Bosch DCAN CAN controller that is CAN 2.0B-compatible and fully supports both 11-bit and 29-bit identifiers. The port also has an NXP PCA82C251T High-Speed CAN transceiver that is fully compatible with the ISO 11898 standard and supports baud rates up to 1 Mbps.

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Figure 3. NI 9881 Hardware Overview



NI 9881 Specifications

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

High-Speed CAN Characteristics

Transceiver	NXP PCA82C251T
Max baud rate	1 Mbps

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CAN_H, CAN_L bus lines voltage	-27 to +40 VDC
CAN Supply voltage range (V_{SUP})	+9 to +30 VDC
MTBF	Contact NI for Bellcore MTBF or MIL-HDBK-217F specifications.

Power Requirements

Power consumption from chassis	
Active mode	1 W max
Sleep mode	2.55 mW max
Thermal dissipation (at 70 °C)	
Active mode	1.25 W max
Sleep mode	250 mW max

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Physical Characteristics

To clean the module, wipe it with a dry towel.

Weight	Approx. 144 g (5.0 oz)

Safety

Connect only voltages that are within the following limits:

Maximum Voltage[1]	
Port-to-COM	-27 to +40 VDC max, Measurement Category I
Isolation	
Port-to-earth ground	
Continuous	60 VDC, Measurement Category I
Withstand	500 V_{rms}, verified by a 5 s dielectric withstand test

[1] The maximum voltage that can be applied or output between any port or V_{SUP} terminal and a COM terminal without creating a safety hazard.

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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 9881 to signals or use for measurements within Measurement Categories II, III, or IV.

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 Gc

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Safety and Hazardous Locations Standards

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

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1
- EN 60079-0:2012, EN 60079-15:2010
- IEC 60079-0: Ed 6, IEC 60079-15; Ed 4
- UL 60079-0; Ed 5, UL 60079-15; Ed 3
- CSA 60079-0:2011, CSA 60079-15:2012



Note For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

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Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for sensitive electrical equipment for measurement, control, and laboratory use:

- EN 61326 (IEC 61326): Class A emissions; Industrial immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions



Note In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe, Canada, Australia and New Zealand (per CISPR 11) Class A equipment is intended for use only in heavy-industrial locations.



Note Group 1 equipment (per CISPR 11) is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for

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the treatment of material or inspection/analysis purposes.

Note For EMC declarations and certifications, and additional information, refer to the *Online Product Certification* section.

CE Compliance CE

This product meets the essential requirements of applicable European Directives, as follows:

- 2014/35/EU; Low-Voltage Directive (safety)
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)
- 94/9/EC; Potentially Explosive Atmospheres (ATEX)

Online Product Certification

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and 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.

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Shock and Vibration

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

Operating vibration	
Random (IEC 60068-2-64)	5 g_{rms}, 10 Hz to 500 Hz
Sinusoidal (IEC 60068-2-6)	5 g, 10 Hz 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

Environmental

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 °C to 70 °C
Storage temperature (IEC 60068-2-1, IEC 60068-2-2)	-40 °C to 85 °C

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Ingress protection (with power plug attached)	IP 40
Operating humidity (IEC 60068-2-78)	10% RH to 90% RH, noncondensing
Storage humidity (IEC 60068-2-78)	5% RH to 95% RH, noncondensing
Pollution Degree	2
Maximum altitude	5,000 m

Indoor use only.

Environmental Management

NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the *Minimize Our Environmental Impact* 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.

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Waste Electrical and Electronic Equipment (WEEE)



EU Customers At the end of the product life cycle, all NI products must be disposed of according to local laws and regulations. For more information about how to recycle NI products in your region, visit *ni.com/environment/weee*.

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