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# NI-9881 Getting Started

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## Before You Begin

Read the **NI-9881 Safety, Environmental, and Regulatory Information** and complete the software and hardware installation procedures in your chassis documentation.

### Safety Guidelines



**Caution** Observe all instructions and cautions in the user documentation. Using the product in a manner not specified can damage the product and compromise the built-in safety protection.



**Attention** Suivez toutes les instructions et respectez toutes les mises en garde de la documentation d'utilisation. L'utilisation du produit de toute autre façon que celle spécifiée risque de l'endommager et de compromettre la protection de sécurité intégrée.

### 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 Gc and Ex nA IIC T4 Gc 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, or Zone 2.



**Caution** The system must be installed in an enclosure certified for the intended hazardous (classified) location, having a tool secured cover/door, where a minimum protection of at least IP54 is provided.

## 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 07ATEX 0626664X and is IECEx UL 14.0089X certified. Each NI-9881 is marked Ⓢ II 3G and is suitable for use in Zone 2 hazardous locations, in ambient temperatures of  $-40\text{ °C} \leq T_a \leq 70\text{ °C}$ . 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.



**Caution** Transient protection shall be provided that is set at a level not exceeding 140% of the peak rated voltage value of 85 V at the supply terminals to the equipment.



**Caution** The system shall only be used in an area of not more than Pollution Degree 2, as defined in IEC/EN 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 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.

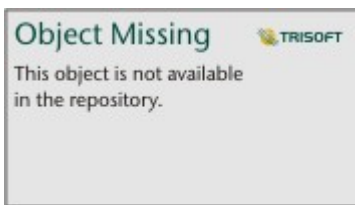


**Note** Power on  $V_{SUP}$  is required for CANopen operation.

The NI-9881 pinout is listed in the table below.

The NI-9881 features software-selectable bus termination for High-Speed CAN transceivers. On the NI-9881, you can enable 120  $\Omega$  termination resistors between CAN\_H and CAN\_L through an API call. The **Termination Resistor Specification** table lists recommended termination resistor values.

Figure 1. NI-9881 Pinout



Pin	Signal
1	No Connection (NC)
2	CAN_L
3	COM

Pin	Signal
4	NC
5	SHLD
6	COM
7	CAN_H
8	NC
9	V <sub>SUP</sub>

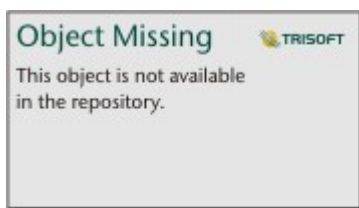
Table 1. Pin Assignments for the NI-9881

## 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 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.

The following figure shows a simplified diagram of a CAN bus with multiple CAN nodes and proper termination resistor ( $R_t$ ) locations.

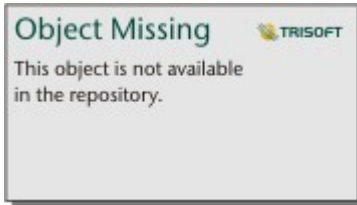
Figure 2. CAN Bus Topology and Termination Resistor Locations



## Connecting a CAN Bus to the NI-9881

You can connect the NI-9881 port to any location on a CAN bus. The following figure shows one example of connecting the NI-9881 directly to one CAN node.

Figure 3. Connecting the NI-9881 to a CAN Device



## 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.

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

Table 2. ISO 11898 Specifications for Characteristics of a CAN\_H and CAN\_L Pair of Wires

## Termination Resistors

The termination resistors ( $R_t$ ) should match the nominal impedance of the CAN cable and therefore comply with the values in the following table. The onboard, software-selectable termination has a nominal value of 120  $\Omega$ . If you are not using the onboard termination, use the values listed in Table 3.

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

Table 3. Termination Resistor Specification

## 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.

## Number of CAN Nodes

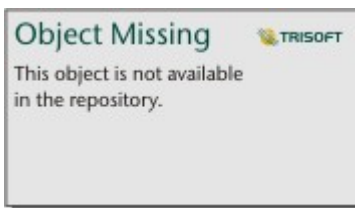
The maximum number of nodes depends on the electrical characteristics of the nodes on the network. If all nodes meet the ISO 11898 requirements, you can connect at least 30 nodes to the bus. You can connect higher numbers of nodes if the nodes' electrical characteristics do not degrade signal quality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

Figure 4. 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
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

<b>Power consumption from chassis</b>	
Active mode	1 W maximum
Sleep mode	2.55 mW maximum
<b>Thermal dissipation (at 70 °C)</b>	
Active mode	1.25 W maximum
Sleep mode	250 mW maximum

## Physical Characteristics

Dimensions	Visit <a href="http://ni.com/dimensions">ni.com/dimensions</a> and search by module number.
Weight	Approximately 144 g (5.0 oz)

## Safety Voltages

Connect only voltages that are within the following limits:

<b>Maximum voltage<sup>[1]</sup></b>	
Port-to-COM	-27 V DC to +40 V DC maximum, Measurement Category I

External power supply ( $V_{sup}$ )	+9 V DC to +30 V DC
<b>Isolation</b>	
<b>Port-to-earth ground</b>	
Continuous	60 V DC, Measurement Category I
Withstand	500 V RMS, verified by a 5 s dielectric withstand test

<sup>1</sup> 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.

## Shock and Vibration

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

<b>Operating vibration</b>	
Random	5 g RMS, 10 Hz to 500 Hz
Sinusoidal	5 g, 10 Hz to 500 Hz
Operating shock	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
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.

## NI Services

Visit [ni.com/support](https://ni.com/support) to find support resources including documentation, downloads, and troubleshooting and application development self-help such as tutorials and examples.

Visit [ni.com/services](https://ni.com/services) to learn about NI service offerings such as calibration options, repair, and replacement.

Visit [ni.com/register](https://ni.com/register) to register your NI product. Product registration facilitates technical support and ensures that you receive important information updates from NI.

NI corporate headquarters is located at 11500 N Mopac Expwy, Austin, TX, 78759-3504, USA.