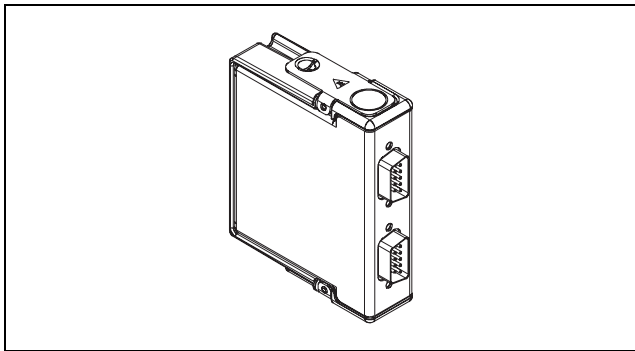


# OPERATING INSTRUCTIONS

# NI 9853

## 2-Port, High-Speed CAN Module



These operating instructions describe how to use the National Instruments (NI) 9853 module. For information about installing, configuring, and programming your system, refer to your system documentation. The NI 9853 module requires the NI 9853 software to be installed. The latest version of the NI 9853 software is located at [ni.com/downloads](http://ni.com/downloads).



**Note** The safety guidelines and specifications in this document are specific to the NI 9853. The other components in your system may not meet the same safety ratings and specifications. Refer to the documentation for each component in your system to determine the safety ratings and specifications for the entire system.

## Safety Guidelines

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Operate the NI 9853 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 9853 is suitable for use in Class I, Division 2, Groups A, B, C, D, T4 hazardous locations; Class I, Zone 2, AEx nA II T4 and Ex nA II T4 hazardous locations; and nonhazardous locations only. Follow these guidelines if you are installing the NI 9853 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.



**Caution** For Zone 2 applications, install a protection device between the CAN signals and the NI 9853 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 Safe Use in Europe

This equipment has been evaluated as EEx nA II T4 equipment under DEMKO Certificate No. 03 ATEX 0324020X. Each module is marked  $\text{Ex}$  II 3G and is suitable for use in Zone 2 hazardous locations.

## Wiring the NI 9853

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The NI 9853 has two 9-pin male D-Sub connectors that provide connections to a CAN bus. Each port on the NI 9853 has pins for CAN\_H and CAN\_L, to which you connect the CAN bus signals. These signals should be connected using twisted-pair cable.

Each port has two common pins (COM) that are internally connected to the isolated reference of the module 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 of the COM pins. Each port also has an optional shield pin, SHLD, that can be connected to a shielded CAN cable. Connecting SHLD may improve signal integrity and EMC performance in a noisy environment.

CAN0 of the NI 9853 is internally powered, and therefore requires no external power supply. CAN1 requires an external power supply of +8 to +25 V to operate. Supply power to the  $V_{SUP}$  pin of CAN1 from the CAN bus.

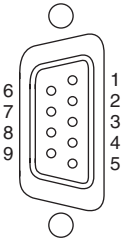


**Note** Although CAN0 of the NI 9853 does not require an external power supply to operate, it can be connected to a powered CAN bus without being damaged.

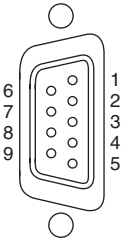
Pinouts for CAN0 and CAN1 of the NI 9853 are listed in Table 1 and Table 2.

Table 4 lists recommended termination resistor values.

**Table 1.** Pin Assignments for CAN0

<b>Connector</b>	<b>Pin</b>	<b>Signal</b>
	1	No Connection (NC)
	2	CAN_L
	3	COM
	4	NC
	5	SHLD
	6	COM
	7	CAN_H
	8	NC
	9	NC

**Table 2.** Pin Assignments for CAN1

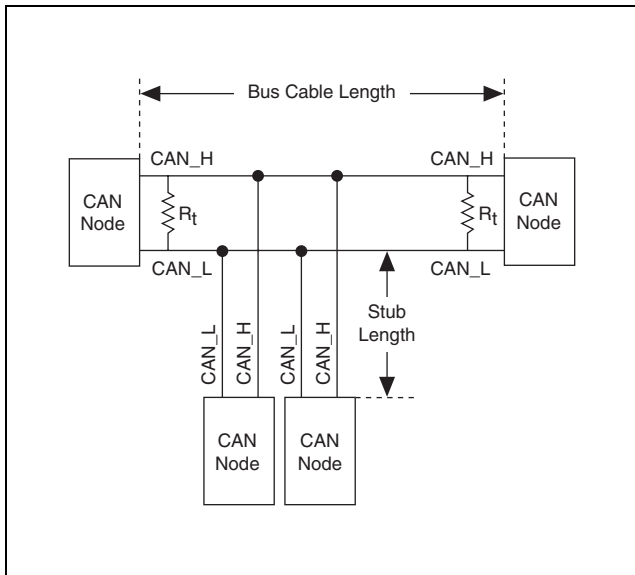
<b>Connector</b>	<b>Pin</b>	<b>Signal</b>
	1	No Connection (NC)
	2	CAN_L
	3	COM
	4	NC
	5	SHLD
	6	COM
	7	CAN_H
	8	NC
	9	V <sub>SUP</sub>

## 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 nodes at the 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.

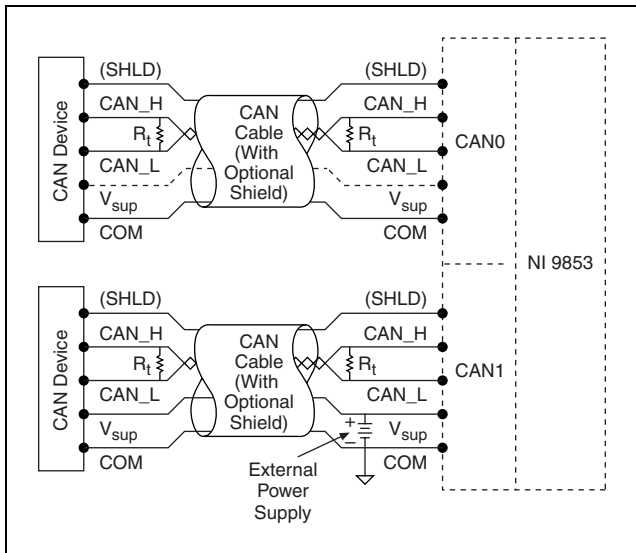




**Figure 1.** CAN Bus Topology and Termination Resistor Locations

## Connecting a CAN Bus to the NI 9853

Each port of the NI 9853 can be connected to any location on a CAN bus. Figure 2 shows one example of the connection of CAN0 of the NI 9853 directly to one CAN node, and CAN1 directly to another CAN node. CAN1 requires an external power supply on the CAN bus.



**Figure 2.** Connecting Both Ports of the NI 9853 to CAN Buses

# Cabling Requirements for NI 9853

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This section deals with cabling specifications, termination resistors, cable lengths, and the number of CAN nodes that can exist in a system.

## Cable Specifications

Cables should meet the physical medium requirements specified in ISO 11898, shown in Table 3. Belden cable (3084A) meets all of those requirements, and should be suitable for most applications.

**Table 3.** ISO 11898 Specifications for Characteristics of a CAN\_H and CAN\_L Pair of Wires

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

## Termination Resistors

The termination resistors ( $R_t$ ) should match the nominal impedance of the CAN cable, and therefore comply with the values in Table 4.

**Table 4.** Termination Resistor Specification

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

## Cable Lengths

The allowable cable length is affected by the characteristics of the cabling and the desired bit transmission rates. Detailed cable length recommendations can be found 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 each node should be analyzed for signal integrity problems.

## Number of CAN Nodes

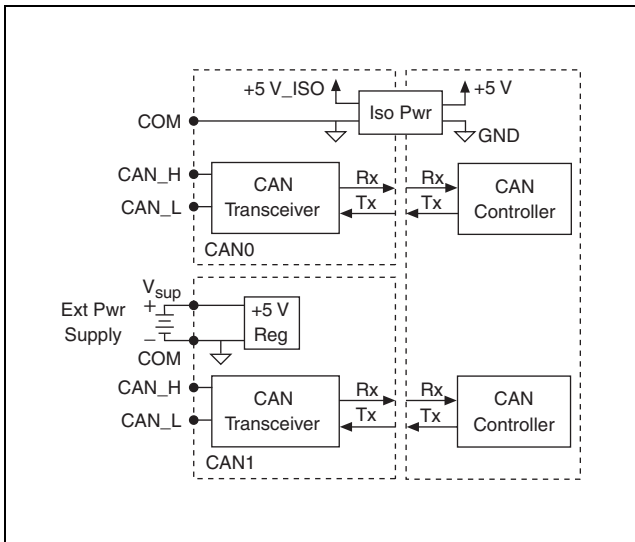
The maximum number of nodes depends on the electrical characteristics of the nodes on the network. If all of the nodes meet the requirements of ISO 11898, at least 30 nodes may be connected to the bus. Higher numbers of nodes may be connected if the electrical characteristics of the nodes do not degrade signal quality below ISO 11898 signal level specifications.

The electrical characteristics of the NI 9853 allow at least 110 CAN ports on a network.

## NI 9853 Hardware Overview

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The NI 9853 has two full-featured, independent CAN ports that are isolated from each other, and from the other modules in the system. Each port of the NI 9853 has a Philips SJA1000 CAN controller that is CAN 2.0B-compatible and fully supports both 11-bit and 29-bit identifiers. Each port also has a Philips TJA1041 High-Speed CAN transceiver that is fully compatible with the ISO 11898 standard and supports baud rates up to 1 Mbps.



**Figure 3.** NI 9853 Hardware Overview

## Sleep Mode (CompactRIO Only)

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.

This system sleep mode should not be confused with the NI 9853 Transceiver Mode Sleep property, which sets only the CAN port to sleep mode. Refer to the FPGA Module topic in *LabVIEW Help* for more information on the Transceiver Mode property.



# Specifications

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

## High-Speed CAN Characteristics

Transceiver..... Philips TJA1041

Max baud rate ..... 1 Mbps

CAN\_H, CAN\_L bus lines

voltage.....  $-27$  to  $+40$  VDC

Supply voltage range ( $V_{SUP}$ )

CAN0 ..... N/A

CAN1 .....  $+8$  to  $+25$  VDC

MTBF ..... 1,816,913 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.

## Power Requirements

Power consumption from chassis

Active mode

Transmitting ..... 625 mW max

Receiving ..... 400 mW max

Sleep mode ..... 25  $\mu$ W max

Thermal dissipation (at 70 °C)

Active mode ..... 1 W max

Sleep mode ..... 250 mW max

## Physical Characteristics

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

Weight..... Approx. 144 g (5.0 oz)

# Safety

## Maximum Voltage<sup>1</sup>

Connect only voltages that are within these limits.

Port-to-COM.....-27 to +40 VDC max,  
Measurement Category I

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

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<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.

## Isolation Voltages

### Port-to-port

Withstand.....	500 V <sub>rms</sub> , verified by a dielectric withstand test, 5 s
Continuous .....	60 VDC, Measurement Category I

### Port-to-earth ground

Withstand.....	500 V <sub>rms</sub> , verified by a dielectric withstand test, 5 s
Continuous .....	60 VDC, Measurement Category I

## Safety Standards

The NI 9853 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](http://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 nA II T4
Canada (C-UL) .....	Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, Ex nA II T4
Europe (DEMKO).....	EEx nA II 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 .....	-40 to 70 °C
Storage temperature .....	-40 to 85 °C
Ingress protection.....	IP 40
Operating humidity .....	10 to 90% RH, noncondensing
Storage humidity.....	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.

Operating vibration, random (IEC 60068-2-64) .....	5 g <sub>rms</sub> , 10 to 500 Hz
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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

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; Minimum 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 marking, 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](http://ni.com/certification), search by model 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](http://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](http://ni.com/environment/weee.htm).

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## National Instruments Contact Information

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Israel 972 3 6393737, Italy 39 02 41309277, Japan 0120-527196,  
Korea 82 02 3451 3400, Lebanon 961 (0) 1 33 28 28,  
Malaysia 1800 887710, Mexico 01 800 010 0793,  
Netherlands 31 (0) 348 433 466, New Zealand 0800 553 322,  
Norway 47 (0) 66 90 76 60, Poland 48 22 3390150,  
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