TRC-8543 Getting Started

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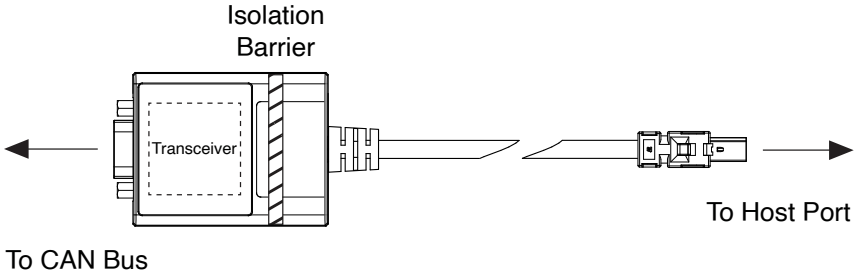
TRC-8543 Hardware Overview

The TRC-8543 has one full-featured CAN port that is isolated from the host it is plugged into. Software can select between either an NXP TJA1043T High-Speed CAN transceiver or NXP TJA1055T Low-Speed/Fault-Tolerant CAN transceiver by controlling on-board relays. The TJA1043T is fully compatible with the ISO 11898 standard and supports baud rates up to 2 Mb/s. The NI-XNET driver enables baud rates up to 8 Mb/s. The TJA1055T is fully compatible with the ISO 11898 standard and supports baud rates up to 125 Kb/s.

Figure 1. TRC-8543 Hardware Overview



Mounting the TRC-8543

Mounting the TRC-8543

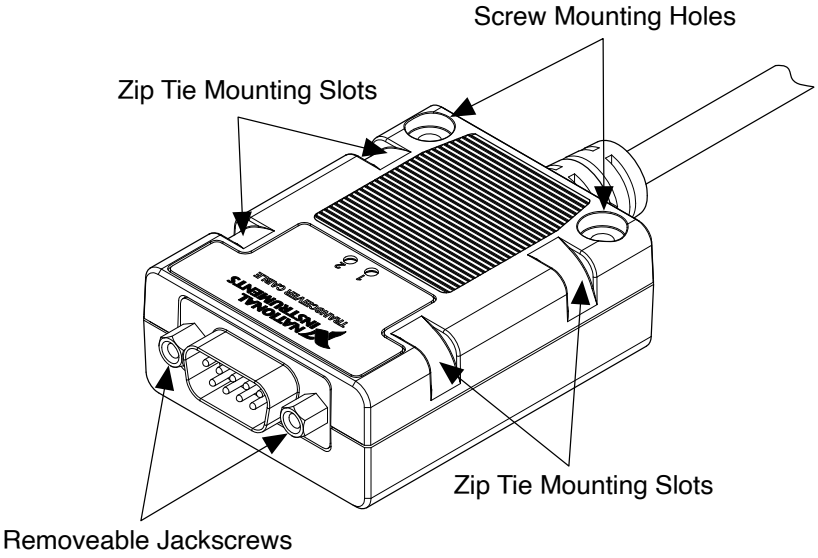
Notice The TRC-8543 is a thermally active product that dissipates heat. Refer to the user manual of the host this product directly connects to for specific information regarding thermal management. Not following mounting requirements may affect the system ambient temperature and/or the measurement accuracy of modules in the system.

Notice To meet thermal management requirements, do not zip tie more than six cables in a bundle, and allow for air flow around the bundle. If used with a CompactRIO or CompactDAQ chassis, mount all cables at least 152 mm (6.0 in.) from the chassis and do not mount more than six cables directly beneath the chassis.

You can route and strain relieve the TRC-8543 similarly to ordinary cables. You also can panel mount it using its removable jackscrews, zip tie, or screw mount it. The screw mounting holes support #6 and M3 screws spaced 35.56 mm (1.400 in.) center-to-center, with minimum length of 23 mm (7/8 in.). The TRC-8543 supports zip ties up to 5.33 mm (0.210 in.) wide.

The following figure shows jackscrews, zip tie mounting slots, and screw mounting holes on the TRC-8543.

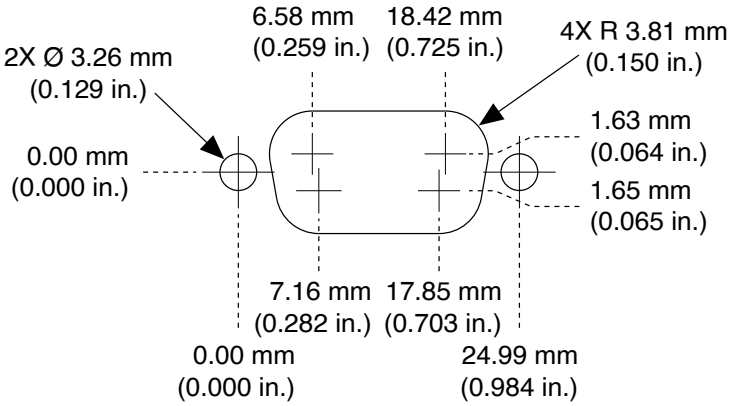
Figure 2. TRC-8543 Mounting Features



Panel Mounting the TRC-8543

The recommended panel mounting cutout dimensions are shown below.

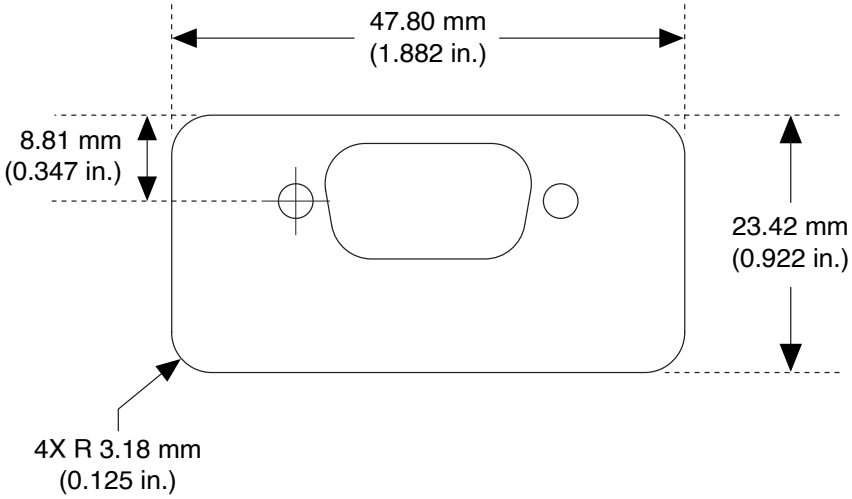
Figure 3. Recommended Cutout Dimensions



Tighten the jackscrews to a maximum torque of 0.56 N · m (5.0 lb · in.).

The jackscrews included with the TRC-8543 work with panel thicknesses up to 2.21 mm (0.087 in.). If your panel is thicker than 2.21 mm (0.087 in.), you can mill out a recessed pocket for the TRC-8543. The following figure shows the recommended pocket dimensions and cutout position.

Figure 4. Recommended Pocket Dimensions

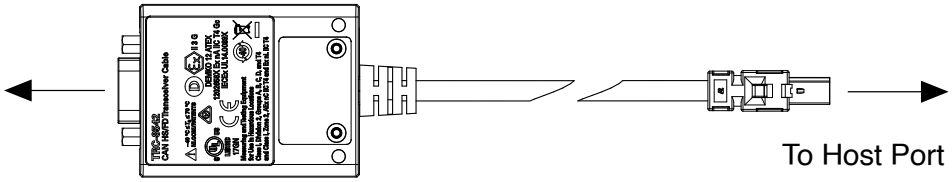


Wiring to the TRC-8543

Wiring to the TRC-8543

The TRC-8543 is used with an NI-XNET interface host port.

Figure 5. TRC-8543 Connections



The TRC-8543 has one 9-pin male D-Sub connector that provides connections to a CAN bus. The TRC-8543 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 TRC-8543 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 D-Sub connector shell connects through the TRC-8543 shielding to the connector on the host port end. The shielding does not electrically connect to the COM signals.

Notice When tightening the D-Sub connector jackscrews, do not exceed the maximum jackscrew torque of 0.56 N · m (5.0 lb · in.).

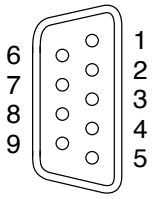
The TRC-8543 receives power from the NI-XNET host port, but also requires an external power supply of +9 V to +30 V to operate in Low-Speed/Fault-Tolerant mode. Supply power from the CAN bus to the V_{SUP} pin.

Note Power on V_{SUP} is required for Low-Speed/Fault-Tolerant CAN operation, but is not required for High-Speed CAN operation.

The TRC-8543 features software-selectable bus termination for both CAN High-Speed/Flexible Data-Rate and Low-Speed/Fault-Tolerant transceivers. For High-Speed/Flexible Data-Rate mode, you can enable 115 Ω of termination resistance between CAN_H and CAN_L through an API call. For Low-Speed/Fault-Tolerant mode, you can select either 1.11 kΩ or 4.99 kΩ of termination resistance for RTH and RTL through an API call (refer to the ***Termination Resistors*** section for more information). If you choose to use external termination, Table 4 lists recommended termination resistor values.

The following table lists the TRC-8543 pinout.

Table 1. Pin Assignments for the TRC-8543

Connector	Pin	Signal Name
	1	No Connection (NC)
	2	CAN_L
	3	COM
	4	NC
	5	NC
	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 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

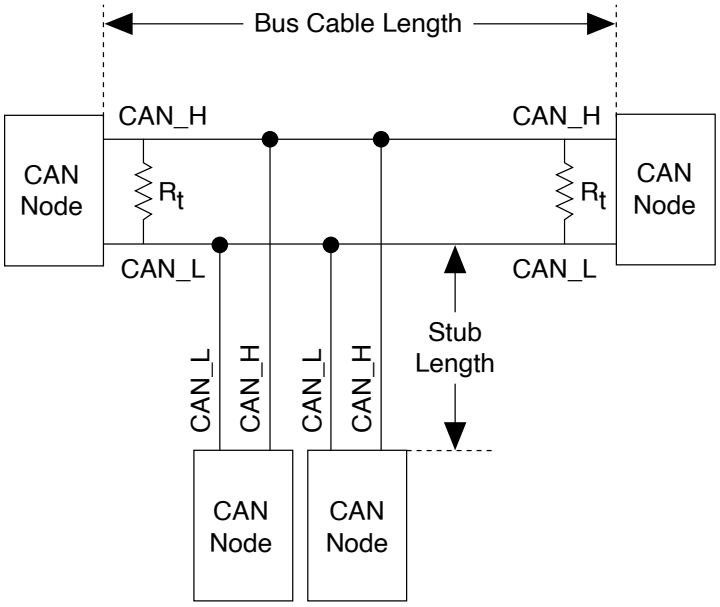
the bus causes reflections that may cause communication errors.

High-Speed/Flexible Data-Rate CAN

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 6. CAN HS/FD Bus Topology and Termination Resistor Locations

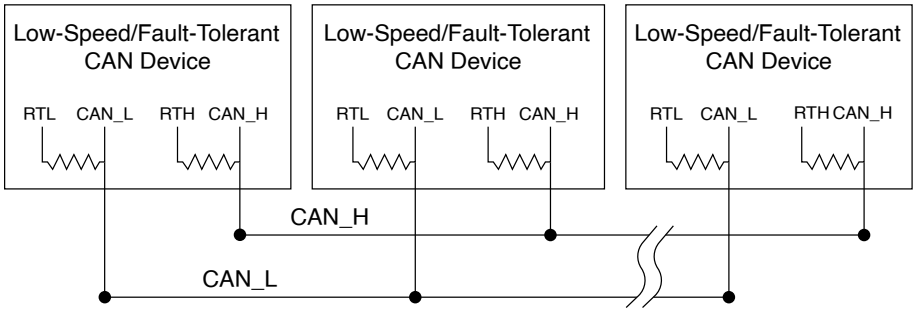


Low-Speed/Fault-Tolerant CAN

Every device on a low-speed/fault-tolerant CAN network requires a termination resistor for each CAN data line: R_{RTH} for CAN_H and R_{RTL} for CAN_L.

The following figure shows a simplified diagram of a low-speed/fault-tolerant CAN bus with termination resistor placements.

Figure 7. CAN LS/FT Bus Topology and Termination Resistor Locations

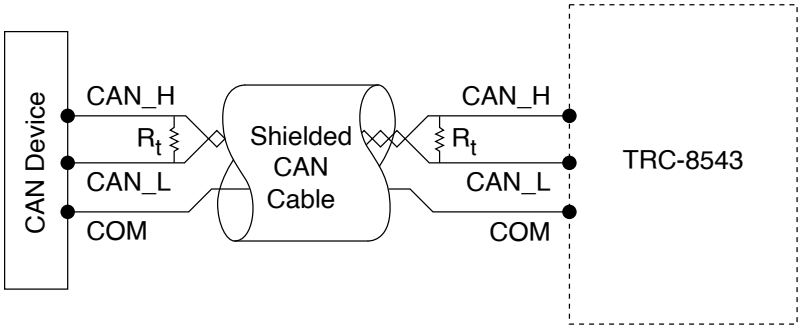


Connecting a High-Speed/Flexible Data-Rate CAN Bus

You can connect the TRC-8543 port to any location on a CAN bus.

The following figure shows one example of connecting the TRC-8543 directly to one CAN node.

Figure 8. Connecting the TRC-8543 to a CAN Device

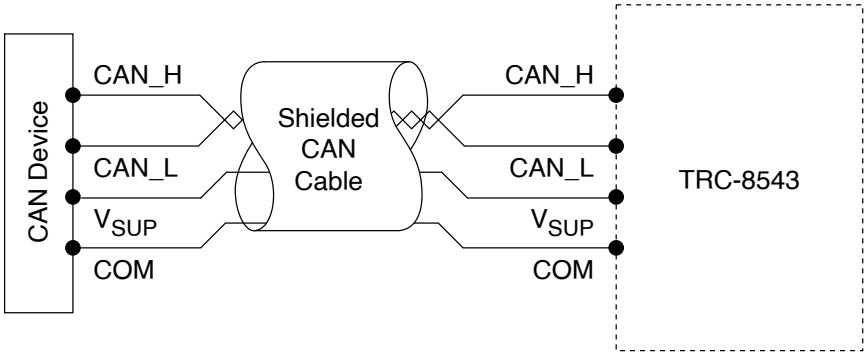


Connecting a Low-Speed/Fault-Tolerant CAN Bus

You can connect the TRC-8543 to any location on a Low-Speed/Fault-Tolerant CAN bus.

The following figure shows one example of connecting the TRC-8543 directly to one CAN node.

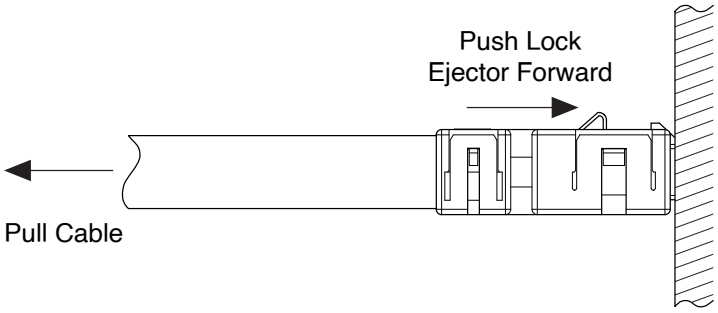
Figure 9. Connecting the TRC-8543 to a CAN Device



Inserting and Removing the TRC-8543

The TRC-8543 connects to a host device with an active latching connector. To connect the TRC-8543 to a host device, push the connector assembly into the host receptacle until the internal latch snaps into position. The latch emits an audible click when engaged. To remove the TRC-8543, push the lock ejector forward to disengage the latch and simultaneously pull the TRC-8543, as shown in the following figure.

Figure 10. Inserting and Removing the TRC-8543



Cable Specifications

Cables should meet the physical medium requirements specified in ISO 11898. Belden cable (3084A) meets all these requirements and should be suitable for most applications. The following tables show the ISO 11898 specifications for characteristics of a CAN_H and CAN_L pair of wires

Table 2. High-Speed/Flexible Data-Rate CAN

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

Table 3. Low-Speed/Fault-Tolerant CAN

Characteristic	Value
Length-related resistance	90 mΩ/m nominal
Length-related capacitance: CAN_L and ground, CAN_H and ground, CAN_L and CAN_H	30 pF/m nominal

Termination Resistors

High-Speed/Flexible Data-Rate CAN

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 115 Ω. If you are not using the onboard termination, use the values listed in the following table.

Table 4. Termination Resistor Specification

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

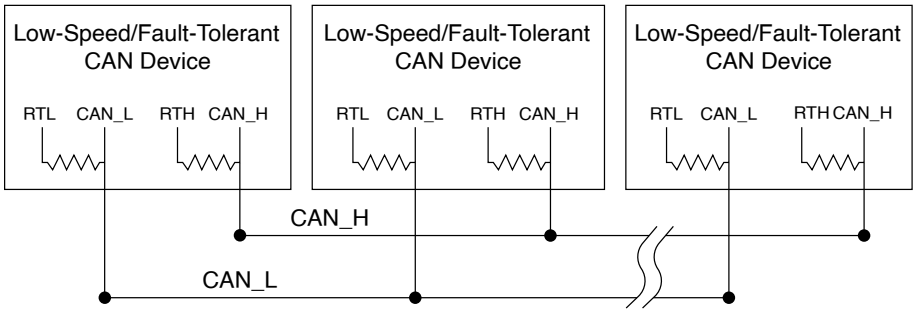
Low-Speed/Fault-Tolerant CAN

Unlike High-Speed/Flexible Data-Rate CAN, Low-Speed/Fault-Tolerant CAN requires termination at the Low-Speed/Fault-Tolerant CAN transceiver instead of on the cable itself. Termination requires two resistors, RTH for CAN_H and RTL for CAN_L. This configuration allows the NXP fault-tolerant CAN transceiver to detect and recover from bus faults. It is important to determine the overall termination of the existing network, or the termination of the individual device, before connecting it to a low-speed/fault-tolerant port. NXP recommends an overall RTH and RTL termination of 100 Ω to 500 Ω (each) for a properly terminated low-speed network. You can determine the overall network termination as follows:

$$\frac{1}{R_{RTHoverall}} = \frac{1}{R_{RTHnode1}} + \frac{1}{R_{RTHnode2}} + \frac{1}{R_{RTHnode3}} + \frac{1}{R_{RTHnoden}}$$

NXP also recommends an individual device RTH and RTL termination of 500 Ω to 16 kΩ. After determining the existing network or device termination, you can use the following formula to indicate which nearest value the termination property needs to be set to produce the proper overall RTH and RTL termination of 100 Ω to 500 Ω upon

connection of the card:



where $R_{RTH\ overall}$ should be 100 Ω to 500 Ω

NI-XNET Low-Speed/Fault-Tolerant CAN hardware features software selectable bus termination resistors, allowing you to adjust the overall network termination through an API call. In general, if the existing network has an overall network termination of 125 Ω or less, you should select the 5 kΩ option for your NI-XNET device. For existing overall network termination above 125 Ω, you should select the 1 kΩ termination option for your NI-XNET device.

Onboard termination on the low-speed/fault-tolerant ports of the TRC-8543 is set through the NI-XNET software to either 1.11 kΩ or 4.99 kΩ.

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.

High-Speed/Flexible Data-Rate CAN

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 TRC-8543 electrical characteristics allow at least 110 CAN ports on a network.

Low-Speed/Fault-Tolerant CAN

If all of the nodes meet the requirements of Low-Speed/Fault-Tolerant CAN, up to 32 nodes may be connected to the bus.

TRC-8543 LEDs

The TRC-8543 includes two LEDs to help you monitor hardware and bus status. LED 1 primarily indicates whether the hardware is currently in use. LED 2 primarily indicates the activity information of the connected bus. Each LED can display two colors (red or green), which display in the following four patterns:

Table 5. LED Pattern Definitions

Pattern	Meaning
Off	No LED illumination
Solid	LED fully illuminated
Blink	Blinks at a constant rate of several times per second
Activity	Blinks in a pseudo-random pattern

Table 6. LED Pattern Indications

Condition/State	LED 1	LED 2
Port identification	Blinks green	Blinks green
NI-XNET catastrophic error	Blinks red	Blinks red
No open session on hardware	Off	Off
Open session on hardware, port is properly powered, and hardware is not communicating	Solid green	Off
Hardware is communicating, and controller is in Error Active state	Solid green	Activity green (returns to idle/off one second after last TX or RX)
Hardware is communicating, and controller is in Error Passive state	Solid green	Activity red (returns to idle/off one second after last TX or RX)
Hardware is running, and controller transitioned to bus off	Solid green	Solid red