NI-9351 Getting Started

2025-03-22

Contents

NI-9351 Getting Started

NI-9351 Pinout

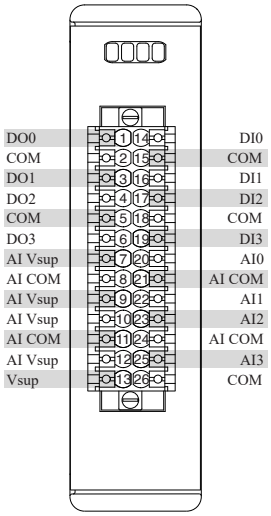


Table 1. Signal Descriptions

Signal	Description
AI	Analog input signal connection
AI COM	Analog input common reference connection. Internally connected to COM.
AI V_{sup}	Voltage supply connection. Not internally connected to V_{sup}.
COM	Common reference connection
DI	Digital input signal connection
DO	Digital output signal connection
V_{sup}	Voltage supply connection

NI-9351 LEDs

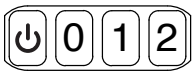


Table 2. LED Descriptions

LED	Description
⏻	V_{sup}/Status
0	Internal Fault
1	I/O Fault
2	UserLED0

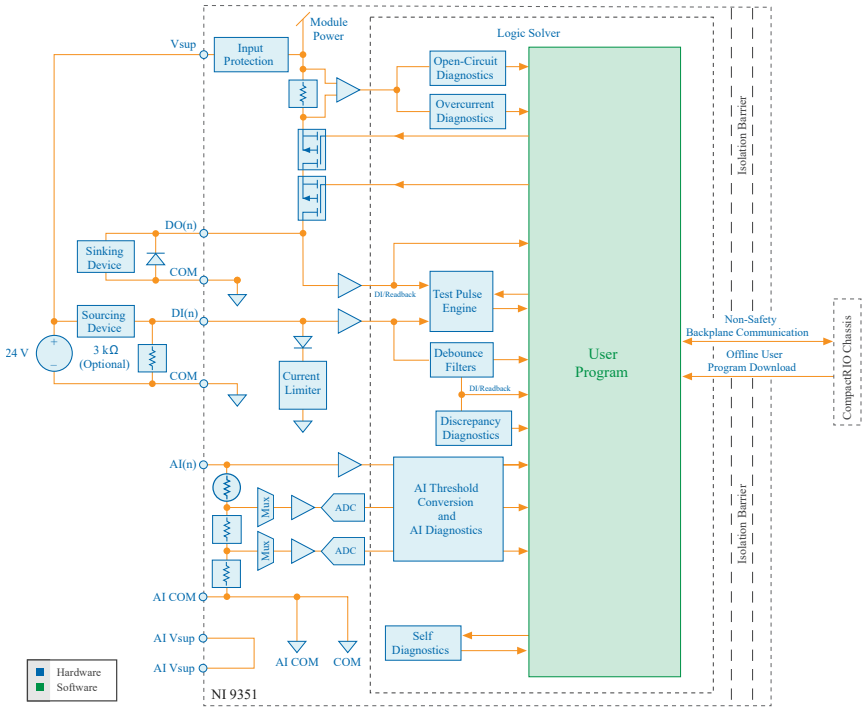
Table 3. LED Indicators

LED	LED Color	LED Pattern	Indication
V_{sup}/Status	Green	On	Module is powered on. Module is in Operational Mode and User Program is running.
		Flashing	Module powered on. Module is not in Operational Mode or User Program is not running.
		Off	Module is powered off.
Internal Fault	Red	Flashing	Module is in Fail-safe

LED	LED Color	LED Pattern	Indication
			Mode.
		Off	Module is not in Fail-safe Mode.
I/O Fault	Red	Flashing	An I/O fault has been detected.
		Off	No I/O Fault has been detected.
UserLED0	Red	On	User-configurable.
		Flashing	
		Off	

Note Refer to the C Series Functional Safety Manual on ni.com/manuals for detailed information on flash patterns in status and fault LEDs.

NI-9351 Block Diagram



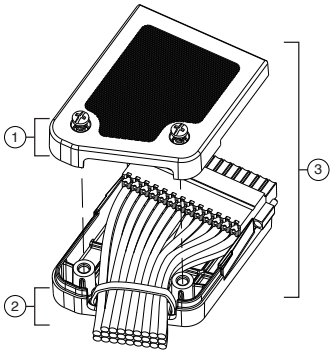
The analog input signals are scanned, amplified, conditioned, and then sampled by two independent ADCs. The module provides overvoltage protection for each channel. Only one channel can be in an overvoltage condition at a time.

Installing the Connector Backshell

Caution You must use the included connector backshell to secure connections to the NI-9351.

Attention Vous devez utiliser le capot de protection fourni pour sécuriser les connexions au NI-9351.

Figure 1. Connector Backshell Installation



1. Align the connector backshell with the 26-pin spring terminal block.
2. Secure the cable bundle to the connector backshell using a zip tie.
3. Secure the connector backshell using the captive screws. Tighten to 0.5 N · m (4 lb · in.) torque.

Connecting an External Power Supply

You must connect an external power supply to the NI-9351. The module is independent from the chassis and requires an external power supply to operate.

Connect the positive lead of the power supply to the supply pin, V_{sup}, and the negative lead of the power supply to any common pin, COM.

Caution Do not remove or insert modules if the external power supply connected to the V_{sup} and COM pins is powered on.

Attention Ne pas retirer ou insérer de modules si l'alimentation externe connectée aux broches Vsup et COM est sous tension.

The NI-9351 has current sourcing outputs, meaning the DO pin is driven to V_{sup} when the channel is turned on.

Powering Analog Devices

You can connect an external power supply to the NI-9351 to power analog devices connected to the module. Connect the positive lead of the power supply to a AI V_{sup}

pin and the negative lead of the power supply to AI COM. Install a 2 A maximum, fast-acting fuse between the external power supply and the AI V_{sup} pin.

Note The AI V_{sup} pins are internally connected to each other. You can connect only one external voltage supply to the device.

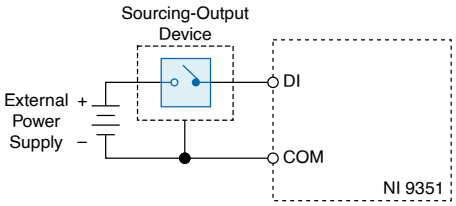
Caution Do not remove or insert modules if the external power supply connected to the AI V_{sup} and AI COM pins is powered on.

Attention Ne pas retirer ou insérer de modules si l'alimentation externe connectée aux broches Vsup et COM est sous tension.

Functional Safety Editor I/O Configurations

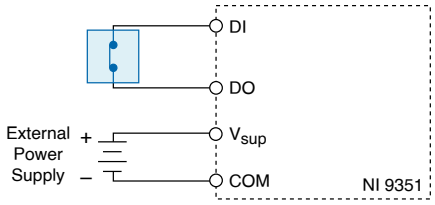
Refer to the following diagrams to connect the NI-9351 based on the I/O configurations in the Functional Safety Editor. For more information about I/O Configurations, refer to the ***C Series Functional Safety Manual*** on ni.com/manuals.

NI-9351 Input Connection



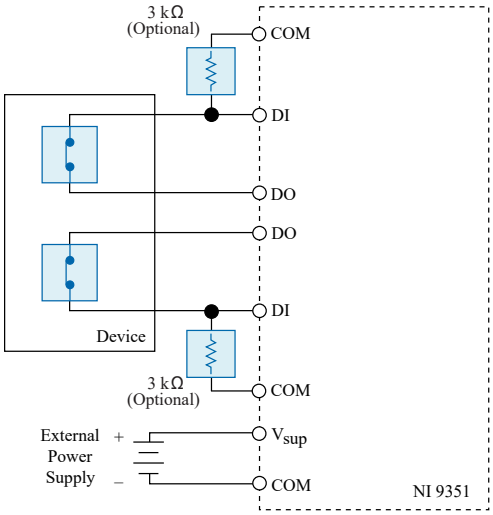
- Use this diagram for single input and dual input configurations.
- Use one of the following pairs for dual switches: DI0 and DI1, DI2 and DI3.

NI-9351 Single Input with Test Pulse Connection



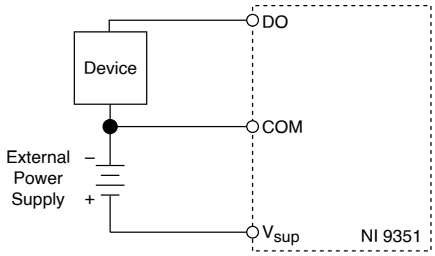
- Use this diagram for single input with test pulse configurations.
- Use test pulses to detect wiring faults on NC (normally closed) switches.
- Connect the DO pin to the NC (normally closed) switch to provide test pulse output.

NI-9351 Dual Input with Test Pulse Connection



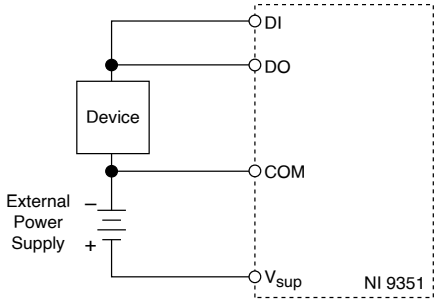
- Use this diagram for dual input with test pulse configurations.
- Use one of the following pairs for dual switches: DI0 and DI1, DI2 and DI3.
- Use test pulses to detect wiring faults on NC (normally closed) switches.

NI-9351 Output Connection



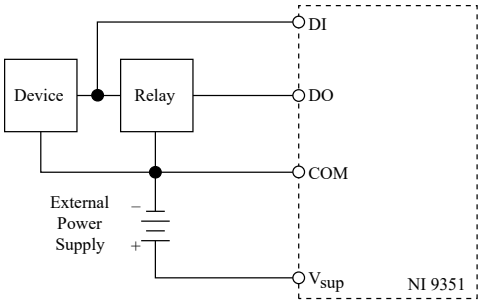
- Use this diagram for the following configurations:
  - Single output
  - Dual output
  - Single output with internal test pulse
  - Dual output with internal test pulse

NI-9351 Output with External Test Pulse Connection



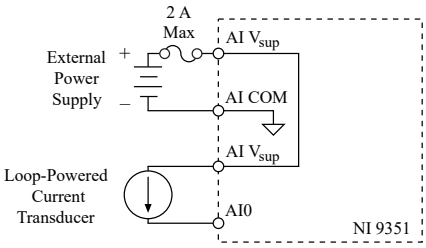
- Use this diagram for single output with external test pulse and dual output with external test pulse configurations.
- Connect a wire from the external monitoring location to a DI channel to monitor the test pulse.
- Connect the DI channel number that corresponds to the DO channel number. Single output with test pulse connections use DOn and DIn. Dual output with test pulse connections use DOn and DIn, DOn+1 and DIn+1.

NI-9351 Single Output with External Readback Connection

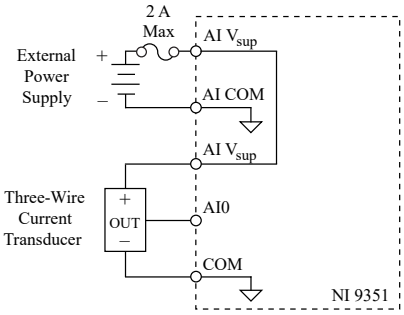


- Use this diagram for single output with external readback configurations.
- Connect a wire from the external monitoring location to a DI channel to monitor the output value.

NI-9351 Loop-Powered Current Transducer Connection

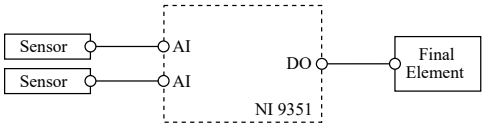


NI-9351 Three-Wire Current Transducer Connection



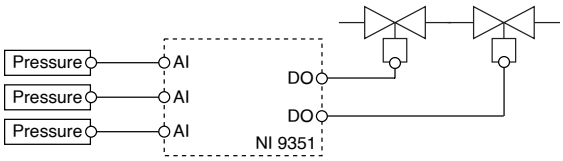
NI-9351 Single Input (1oo1) Configuration

NI-9351 Dual Input (1oo2) Configuration



NI-9351 Triple Input (2oo3) Configuration

NI-9351 HIPPS Configuration



NI-9351 Connection Guidelines

- Make sure that devices you connect to the NI-9351 are compatible with the module specifications.
- You must use a two-wire ferrule to create a secure connection when connecting two wires or stranded wires to a single terminal.
- Push a solid wire or ferrule directly into the terminal.
- When inserting a stranded wire without a ferrule, first open the terminal by pressing the push button.
- Verify that all strands of a stranded wire are securely retained.
- Connect one COM terminal for each DO and each DI connection until all COM

terminals are populated. It is acceptable but not preferred to populate COM terminals with jumpers to meet this requirement. This requirement does not apply to the AI COM terminals.

Caution After inserting a wire into a spring terminal, test the connection by gently pulling on the wire to verify that it is securely retained.

Attention Après avoir inséré un fil dans une borne à ressort, tester la connexion en tirant doucement sur le fil pour vérifier qu'il est bien retenu.

Power Supply

Users must use a limited power source (LPS) supply suitable to the safety needs and configuration of the implemented system. Implement one of the following options to ensure continued compliance with IEC 61010-1.

- The Vsup must be powered from a Class 2 or Limited Power Source (LPS), SELV source, 30 V DC maximum.
- The Vsup must be powered from a SELV source, 30 V DC maximum, with supplementary overcurrent protection in series, 8 A maximum breaking capacity at 120 s.
- The C Series Functional Safety module and associated controller must be installed in an end-use fire enclosure.

Notice For Functional Safety applications, use a power supply with 4 kV common-mode surge rating to meet Functional Safety EMC Requirements. This may be achieved with external surge suppression.

Pull-Down Resistor

- NI recommends connecting an external 3 kΩ pull-down resistor to each digital input channel in use.
- Resistor power must be rated at minimum to 300 mW at system ambient temperatures. A larger rating can increase reliability.
- A pull-down resistor reduces input signal response times when channels are driven

by sourcing outputs.
- The user is responsible for evaluating and choosing the appropriate resistor and terminal block based on the system requirements.
- Follow mounting and thermal guidelines in the CompactRIO controller documentation.

Refer to the table below for suggested terminal blocks for mounting the resistor.

Table 4. Third Party Terminal Blocks

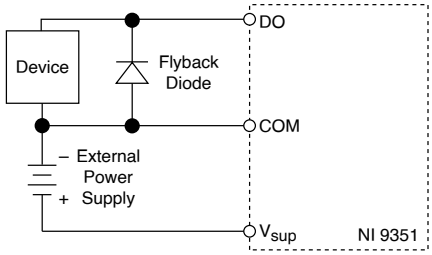
Third Party Manufacturer	Series
Phoenix Contact	UTTB
Weidmuller	WTR

Note For more information on reducing response times, refer to the ***Safety Response Time*** section of the ***C Series Functional Safety Manual*** on ni.com/manuals.

Protecting the NI-9351 from Flyback Voltages

Install an external flyback diode on any digital output connection to inductive or energy-storing devices that do not have flyback protection. Inductive or energy storing devices include solenoids, motors, and relays.

Figure 2. Connecting a Flyback Diode to the NI-9351



High-Vibration Application Connections

If your application is subject to high vibration, NI recommends that you use ferrules to terminate stranded wire.

You must follow these guidelines to meet the shock and vibration performance specifications stated in the device datasheet on ni.com/manuals.

- Panel mount the system.
- Provide strain relief for the module by securing the cabling to a supporting fixture no more than 8 cm (3 in.) away from the opening of the connector backshell.
- Ensure that the supporting fixture for strain relief is stiff and rigidly coupled to the chassis mounting surface.
- Ensure that you do not directionally bias the module when applying strain relief.

Digital I/O Protection

The NI-9351 provides overcurrent and short-circuit protection for each DO channel.

Caution Overvoltage and negative voltage conditions can damage the NI-9351. Check the voltage specifications for all devices that you connect to the NI-9351.

Attention Les conditions de surtension et de tension négative peuvent endommager le NI-9350. Vérifier les spécifications de tension de tous les appareils que vous connectez au NI-9350.

Caution Connecting an external power supply to a DO terminal may cause the module to power on. Carefully check all DO and Vsup connections.

Attention La connexion d'une alimentation externe à une borne DO peut entraîner la mise sous tension du module. Vérifier soigneusement toutes les connexions DO et Vsup.

Note Refer to the device specifications for more information about I/O protection ratings.

Analog Input Protection

The NI-9351 provides overvoltage protection for each AI channel.

Some overvoltage conditions may cause an internal temperature fault, forcing the module into Fail-safe Mode. Conditions that may cause an internal temperature fault include:

- A fault on a single channel exceeding 20 V
- Faults on multiple channels

For fault voltage derating above 55 °C, refer to the device datasheet on ni.com/manuals.

Overtemperature Protection

The NI-9351 has an internal temperature sensor that will cause the module to enter Fail-safe Mode if the internal temperature limit is exceeded.

Note Overtemperature protection will not cause the module to enter Fail-safe Mode under normal operating conditions.

Implementing a Functional Safety System

This document provides information about connecting and installing the NI-9351 hardware. You must download a compiled User Program before deployment. For information about creating User Programs, deploying safety systems using the NI-9351, and diagnostics available on the NI-9351, go to ni.com/info and enter Info Code `safetymanual`.