NI-9478 Getting Started

2025-03-21

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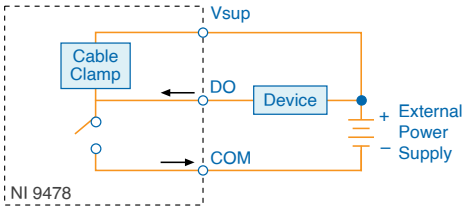
NI-9478 Block Diagram



- The NI-9478 has sinking outputs. Sinking outputs drive current from DO to COM when the channel is on.
- You must connect the Vsup pin to the power supply to enable a weak cable clamping diode that protects the module from cable inductance flyback.
- This power supply provides the current for the devices you connect to the module.

Tip For more information about sinking outputs, visit ni.com/info and enter the Info Code `sinksource`.

Related information:

- Using an Info Code

NI-9478 Pinout

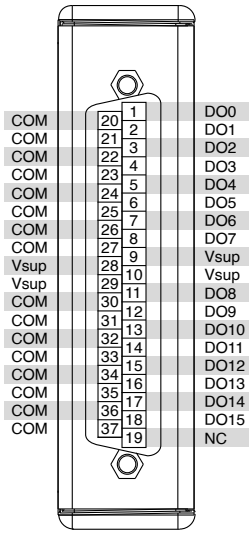


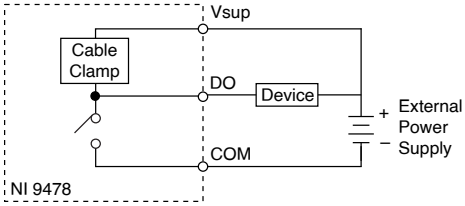
Table 1. NI-9478 Signal Descriptions

Signal	Description
COM	Common reference connection
DO	Digital output signal connection
NC	No connection
V_{sup}	Voltage supply connection

Connecting Digital Devices

You can connect a variety of industrial devices, such as solenoids, motors, actuators, relays, and lamps to the NI-9478. You must connect an external power supply to the NI-9478. The power supply provides the current for the output channels.

Figure 1. Connecting an Industrial Device to the NI-9478



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

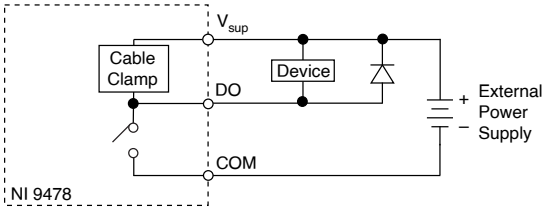
Caution Ne pas retirer ou insérer de modules si l'alimentation externe connectée aux broches Vsup et COM est sous tension.

Ensure that the devices you connect to the NI-9478 are compatible with the output specifications of the NI-9478. Use cables and connectors that are suitably rated for the 20 A module output current limit.

Protecting the Digital Outputs from Flyback Voltages

If the channel is switching an inductive or energy-storing device such as a solenoid, motor, or relay, and the device does not have flyback protection, install an external flyback diode.

Figure 2. Connecting a Flyback Diode



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.

Note For Division 2 and Zone 2 applications, install a protection device across the external power supply and the COM pin. The device must prevent the external power supply voltage from exceeding 70 V if there is a transient overvoltage condition.

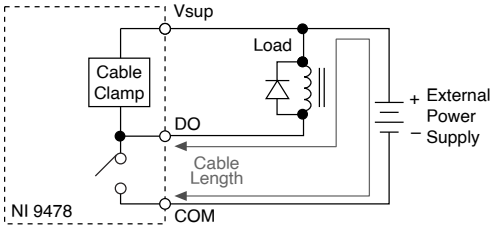
Cable Inductance

The inductance of the cabling stores energy when a channel is on and driving current. When a channel turns off, energy in the cabling is released as flyback voltage, which dissipates as heat in the NI-9478. The heat dissipated increases with higher switching frequencies, higher currents, and longer cables.

Reducing Cable Length

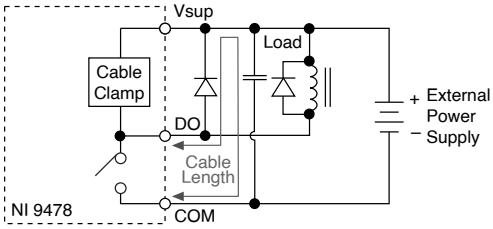
The effective cable length is the total distance from DO to COM.

Figure 3. Cable Length of the NI-9478



NI recommends adding a capacitor across the power supply leads and a diode from the DO lead to the Vsup lead. Connecting a capacitor and a diode reduces the effective cable length and dissipated heat.

Figure 4. Cable Length of the NI-9478 with a Capacitor and Diode



Note NI recommends that you use a capacitor with a capacitance of at least 20 µF.

I/O Protection

The NI-9478 provides protection against overcurrent and short-circuit conditions.

Overcurrent Protection

The NI-9478 provides two configurable current limit thresholds, Limit A and Limit B. The device monitors each output channel. You can review the output status in software to determine if the current has exceeded the limit threshold.

You can configure each channel on the NI-9478 to disable the output that exceeds the current limit threshold. Some applications require a large inrush current that may

exceed the current limit threshold. You can disable overcurrent protection by setting no current limit for that channel.

> **Caution** If you disable overcurrent protection, the NI-9478 is no protected against overcurrent or short-circuit conditions. Verify the wiring is correct and that you are operating the NI-9478 within the specifications.

Overcurrent Refresh

The NI-9478 provides an overcurrent refresh setting. This setting enables the channel to recover within a specified refresh period. If the refresh setting is disabled, the channel remains off until it receives a command from the software.

Safe Operating Conditions

The total amount of current that you can switch with a channel depends on the duty cycle of the channel, the ambient temperature, the switching frequency, and the amount of current switched by other channels within the same module at the same time.

NI recommends using 2 meters of cable for safe operating conditions. Higher currents, higher frequencies, and longer cables contribute to increased heat in the NI-9478.

You can determine safe operating specifications for the NI-9478 by using the following equation.

Figure 5. Safe Operating Conditions Equation

$$P = 4\ \% \left(I_{out}^{2}\right) + \left[0.12\ \% \left(length - 0.2\right)\left(I_{out}^{2}\right) + \left(0.04\ \% \ I_{out} + 1\right)\right] freq$$

where

- P is the percentage of total allowable power the channel uses
- I_{out} is the output current in amperes while the channel is on
- ***length*** is the total cable length in meters
- ***freq*** is the frequency rate in kHz at which the output channel goes through an on-

off cycle

Calculate the percentage of total allowable power each channel uses then add the percentages for all the channels. For ambient temperatures from 55 °C to 70 °C, the total power for all channels must remain under 100%. For temperatures below 55 °C, the total power of all channels can run up to 150%.

Related information:

- NI Product Documentation Center

Example One

The NI-9478 passes 1.25 A current through 2.0 meters of cable. The channel cycles on for 40 µs and off for 10 µs for a total output period of 50 µs. This yields an output frequency of 20 kHz, using 14.8% of the total power budget.

Figure 6. Example Equation One

$$4\ \%\left(1.25^2\right)+\left[0.12\ \%\left(2.0-\ 0.2\right)\left(1.25^2\right)\ +\ 0.04\ \%\left(1.25+\ 1\right)\right]20=\ 14.8\ \%$$

Example Two

The NI-9478 is on and passing 3 A of current through 2.0 meters of cable for 0.25 seconds. The channel passes 1.25 A of current at 20 kHz for 1.25 seconds. The channel then drives the load off for 4 seconds.

While the channel is on, the output frequency is 0 kHz and the channel uses 36% of the total power budget. The channel uses 14.8% of the total power budget driving at 20 kHz and 0% when the channel is off. The total percentage of allowable power over the complete 5.5 second cycle is 5%.

Figure 7. Example Equation Two

$$\frac{36\ \%\left(0.25s\right)\ +\ 14.8\ \%\left(1.25s\right)\ +\ 0\ \%\left(4s\right)}{5.5s}=\ 5\ \%$$

Conformal Coating

The NI-9478 is available with conformal coating for additional protection in corrosive and condensing environments, including environments with molds and dust.

In addition to the environmental specifications listed in the ***NI-9478 Safety, Environmental, and Regulatory Information***, the NI-9478 with conformal coating meets the following specification for the device temperature range. To meet this specification, you must follow the appropriate setup requirements for condensing environments. Refer to ***Conformal Coating and NI RIO Products*** for more information about conformal coating and the setup requirements for condensing environments.

Operating humidity (IEC 60068-2-30 Test Db)	80 to 100% RH, condensing

Related information:

- Conformal Coating and NI RIO Products