USER GUIDE AND SPECIFICATIONS

NI 9683

General Purpose Inverter Controller RIO Mezzanine Card

Français	Deutsch	日本語	한국어	简体中文

`ni.com/manuals`

This document provides pinouts, connectivity information, and specifications for the National Instruments 9683 General Purpose Inverter Control (GPIC) RIO Mezzanine Card (RMC).

Caution National Instruments makes no product safety, electromagnetic compatibility (EMC), or CE marking compliance claims for the NI 9683. The end-product supplier is responsible for conformity to any and all compliance requirements.

Caution The NI 9683 must be installed inside a suitable enclosure prior to use. Hazardous voltages may be present.

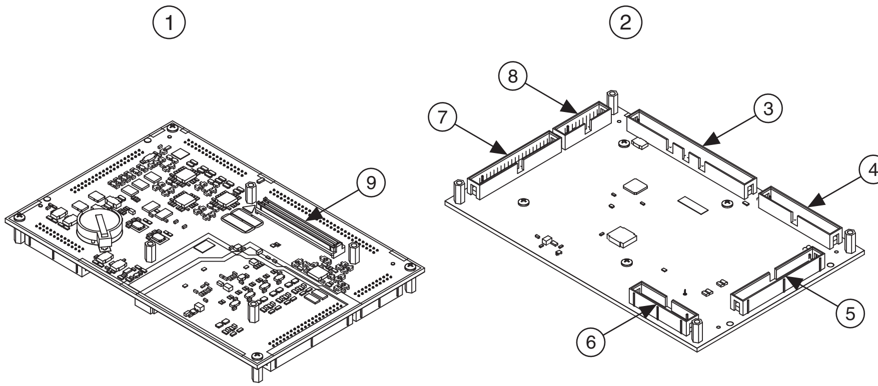
Caution Exercise caution when placing the NI 9683 inside an enclosure. Auxiliary cooling may be necessary to keep the device under the maximum ambient temperature rating for the NI 9683. Refer to the *Specifications* section for more information about the maximum ambient temperature rating.

Caution The NI 9683 is designed for low voltage signals. You must ensure that all signals connected to the NI 9683 are isolated and no unsafe voltages are present at the NI 9683 inputs. Voltages that exceed the specifications could result in damage to the NI 9683.

Caution Use the NI 9683 with only NI sbRIO-9605/9606 devices. The NI 9683 is not electrically or mechanically compatible with other NI sbRIO devices.

Caution Do not operate the NI 9683 in a manner not specified in this user guide. Product misuse can result in a hazard. You can compromise the safety protection built into the product if the product is damaged in any way. If the product is damaged, return it to National Instruments for repair.

Figure 1. NI 9683 Parts Locator Diagram



1	Primary Side	4	Sourcing DI	7	Simultaneous AI
2	Secondary Side	5	Sinking DO and Relay Control DO	8	Scanned AI and AO
3	LVTTL DIO	6	Half-bridge DO	9	sbRIO Mezzanine Connector

Dimensions

Figures 2 through 4 show dimensional drawings of the NI 9683.

Figure 2. NI 9683 Primary Side Dimensions in Millimeters (Inches)

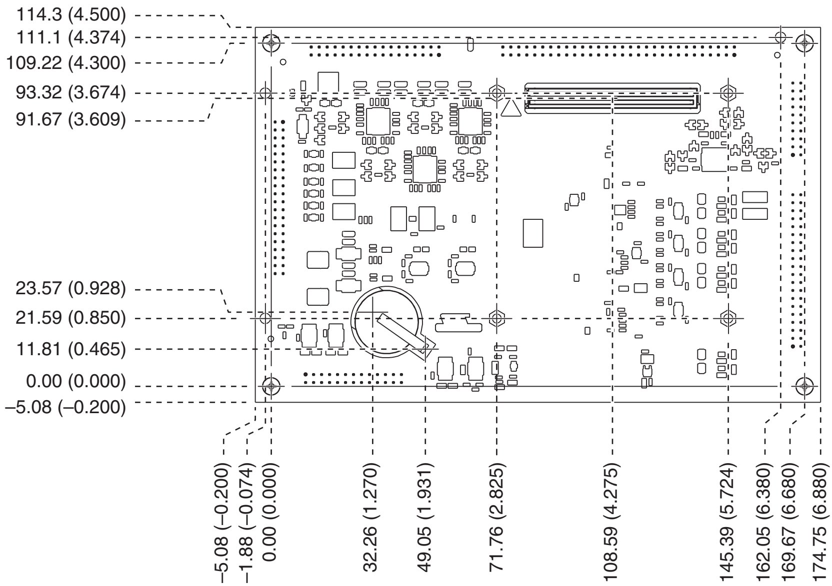


Figure 3. NI 9683 Secondary Side Dimensions in Millimeters (Inches)

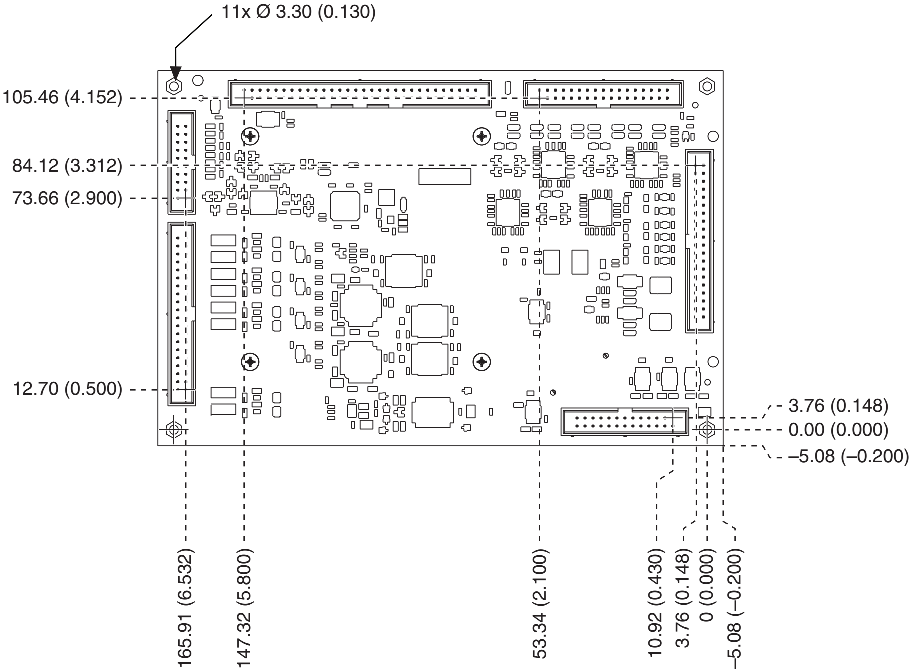
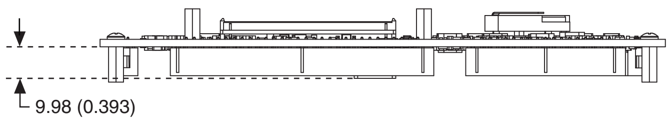


Figure 4. NI 9683 Maximum Height of Components in Millimeters (Inches)

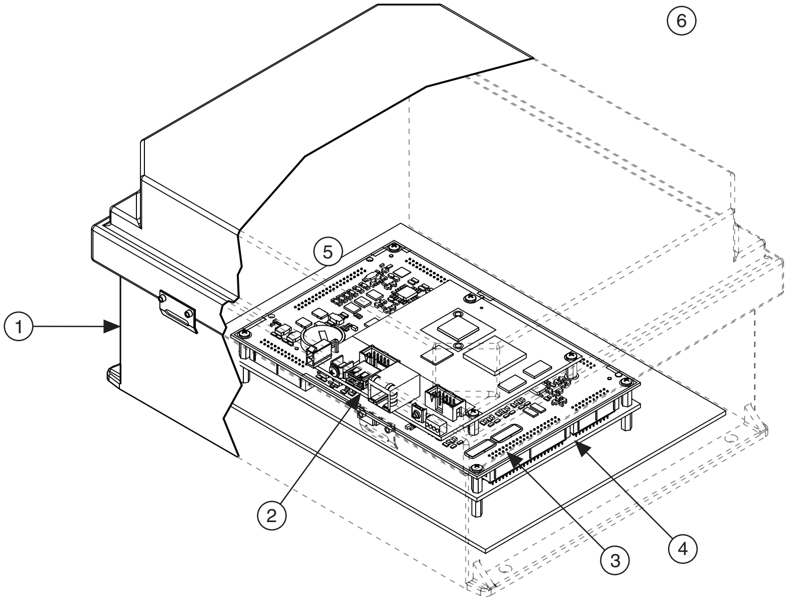


Note For more information about the dimensions of the NI 9683, including two-dimensional drawings and three-dimensional models, go to `ni.com/dimensions`.

Typical NI 9683 System

Figure 5 shows a typical NI 9683 system.

Figure 5. Typical NI 9683 System



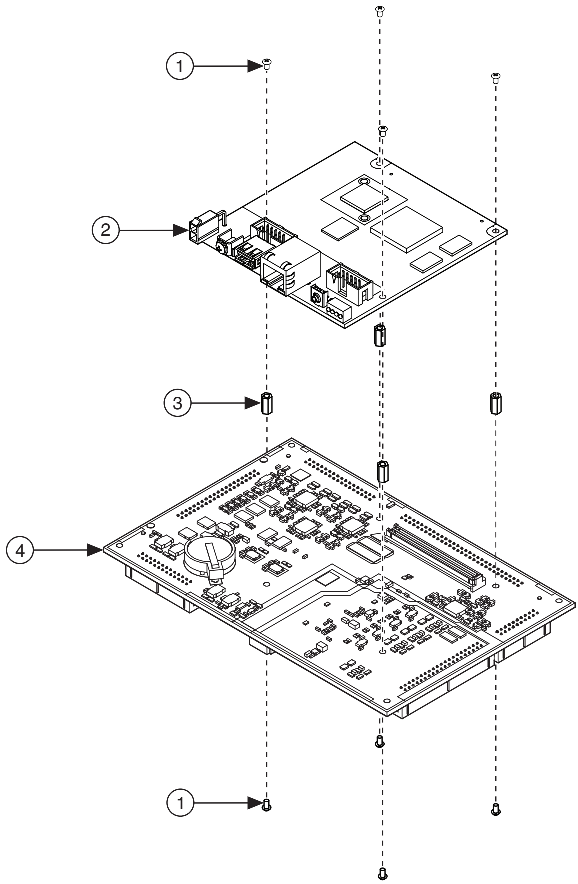
1. Enclosure. The NI 9683 must be installed inside a suitable enclosure.
2. NI sbRIO-9605/9606. Use the NI 9683 with only NI sbRIO-9605/9606 sbRIO devices.
3. NI 9683.
4. Interface board. The NI 9683 specifications assume direct board-to-board connections. Refer the *Selecting a Wire Gauge for Relay Control Digital Outputs* section for information about designing ribbon cables to meet the relay control DO specifications on the NI 9683.
5. Local ambient temperature location. The local ambient temperature is the operating temperature of the NI 9683 inside the enclosure. Refer to the *Environmental* section for more information about the operating temperature.
6. Ambient temperature location. The ambient temperature is the operating temperature outside of the enclosure. Refer to the *Environmental* section for more information about the operating temperature.

Mating the NI 9683 to the NI sbRIO-9605/9606

Figure 6 shows how to mate the NI 9683 to the NI sbRIO-9605/9606. Ensure that the NI sbRIO-9605/9606 is powered off before connecting the NI 9683.

Caution You must use the standoffs specified below when mating the NI 9683 to the NI sbRIO-9605/9606 to properly seat the sbRIO mezzanine connectors and prevent damaging the device.

Figure 6. Mating the NI 9683 to the NI sbRIO-9605/9606



1	4-40 × 0.250 in. Screw (×8)	3	4-40 × 0.380 in. Standoff (×4)
2	NI sbRIO-9605/9606	4	NI 9683

Note The screws include a nylon patch to prevent them from loosening when subject to vibration. NI recommends using a 3/16 in. socket and Phillips screwdriver when mating the NI 9683 to the NI sbRIO-9605/9606 to ensure the screw installs in the standoff correctly.

Connecting the NI 9683

The NI 9683 provides connections for 16 simultaneous analog input channels, 8 scanned analog input channels, 8 analog output channels, 28 sourcing digital input channels, 14 half-bridge digital output channels, 24 sinking digital output channels, 4 relay control digital output channels, and 32 LVTTL digital input/output channels.

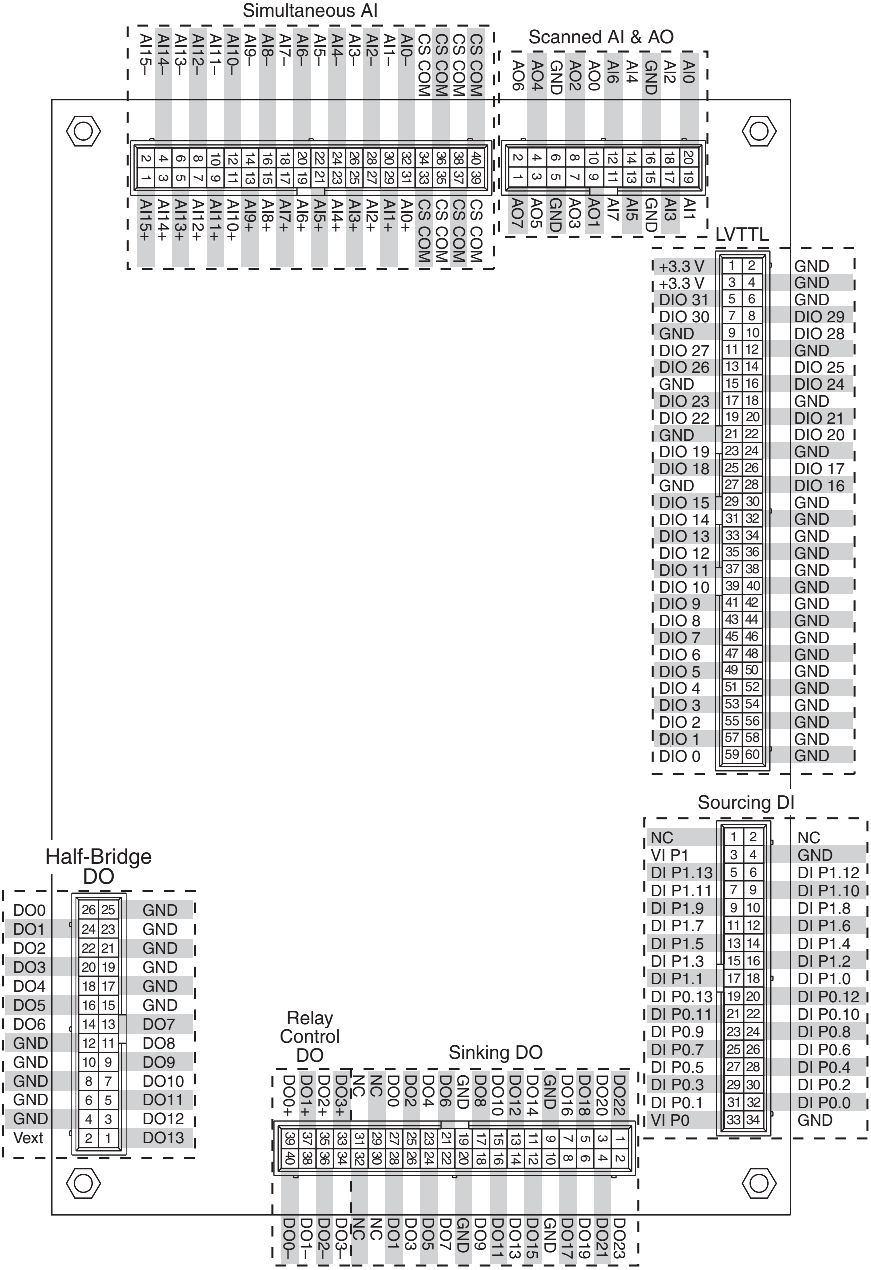
Table 7 lists and describes the connectors on the NI 9683 and the part number and manufacturer of each connector. Refer to the manufacturer for information about using and matching these connectors.

Figure 7. NI 9683 Connector Descriptions

Connector	Description	Recommended Mating Connector
Simultaneous AI	40-position header	On-Shore Technology, Inc. (SH2-40G-PT)
Scanned AI, AO	20-position header	On-Shore Technology, Inc. (SH2-20G-PT)
Sourcing DI	34-position header	On-Shore Technology, Inc. (SH2-34G-PT)
Sinking DO, Relay Control DO	40-position header	On-Shore Technology, Inc. (SH2-40G-PT)
Half-Bridge DO	26-position header	On-Shore Technology, Inc. (SH2-26G-PT)
LVTTL DIO	60-position header	On-Shore Technology, Inc. (SH2-60G-PT)

Figure 8 shows the NI 9683 pin assignments.

Figure 8. NI 9683 Pin Assignments



Simultaneous Analog Input

The NI 9683 provides connections for 16 pseudo-differential analog input channels.

Each channel has an AI+ and AI- pin to which you can connect a voltage signal. AI- is internally connected to the isolated ground reference through a high value resistor.

Connecting Differential and Single-Ended Voltage Signals to the NI 9683

You can connect grounded or floating signal sources to the NI 9683. Connect the positive voltage signal to AI+ and the negative voltage signal to the AI-.

Figure 9. Connecting a Differential Voltage Signal to a Simultaneous AI Channel

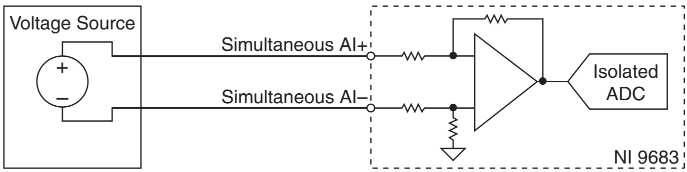
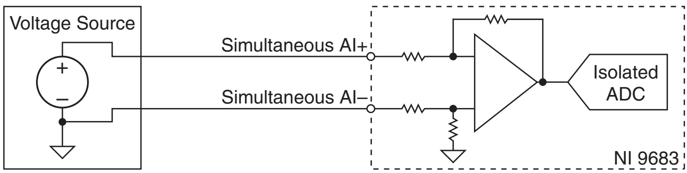


Figure 10. Connecting a Single-Ended Voltage Signal to a Simultaneous AI Channel



NI 9683 Circuitry

The NI 9683 analog channels share a common ground that is isolated from other parts of the board. The NI 9683 protects each channel from overvoltages. Refer to the *Specifications* section for more information about overvoltage protection. The incoming analog signal on each channel is buffered and conditioned by the differential amplifier and then sampled by a 12-bit ADC.

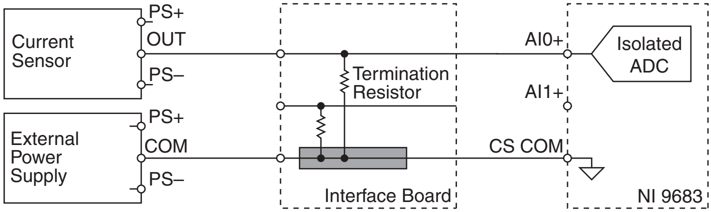
Each channel has an independent track-and-hold amplifier and ADC that allow you to sample and convert all 16 channel simultaneously.

Connecting Current Sensors to the NI 9683

You can connect current sensors to the NI 9683 using a termination resistor to convert the current measurement to a single-ended voltage measurement.

Connect the current sensor output to AI+ and the external power supply COM to the current sensor common pin (CS COM) on the NI 9683.

Figure 11. Connecting a Current Sensor to the NI 9683



To avoid the affect of common mode impedance on the measurement, connect one end of all the termination resistors to a single, small plane. Then have a single connection from the plane to the CS COM pin of the NI 9683.

The NI 9683 simultaneous analog inputs have ±10 V and ±5 V input ranges that can accommodate termination resistor values in a certain range, based on the sensor peak current. Select the highest possible termination resistor to maximize the dynamic range of the analog input. Refer to the *Specifications* section for more information about the analog input range. Use the following equation to determine the maximum value for the terminal resistor based on the sensor peak current.

$$R_{max} = \frac{5V}{I\_peak_{max}}$$

For a current sensor with a peak output current of 70 mA, the maximum termination resistor that can be used with the NI 9683 is as follows:

$$R_{max} = \frac{5V}{0.07A} = 71\Omega$$

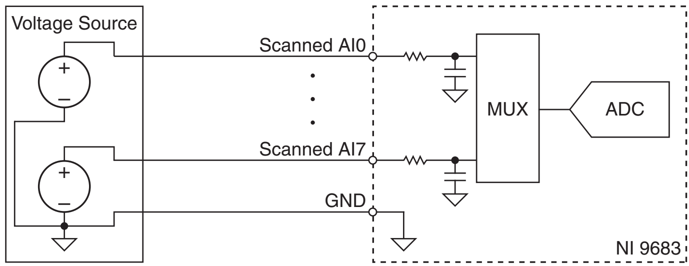
Note Using the ±5 V input range can reduce the power dissipation on the termination resistor by 50% when compared to the power dissipation of the ±10 V input range.

Scanned Analog Input (Monitoring)

The NI 9683 provides connections for 8 single-ended scanned analog input channels.

Each channel has an AI pin to which you can connect a voltage signal. Scanned analog input and scanned analog output channels share four GND pins on the dedicated 20-position connector.

Figure 12. Connecting Single-Ended Voltage Signals to the Scanned Analog Inputs



Scanned Analog Inputs Accuracy and Bandwidth

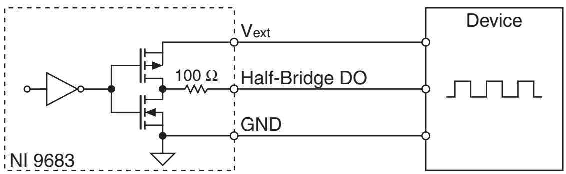
Use signal sources with an output impedance of less than 2 kΩ to ensure specified performance. Large source impedances add to the input resistor inside the NI 9683, which results in increased settling time and decreases the accuracy of the measurement. Increased input impedance also results in a decrease of the -3 dB bandwidth.

Half-Bridge Digital Output

The NI 9683 provides connections for 14 half-bridge digital output channels.

Each channel has an half-bridge DO pin to which you can connect a digital input device. An external power supply referenced to ground of the board must be connected to V_{ext}.

Figure 13. Connecting a Digital Device to a Half-Bridge DO Channel



The NI 9683 has push-pull half-bridge digital outputs, meaning the NI 9683 can sink or source current. When the channel is ON, the half-bridge DO pin is driven to the external power supply minus a voltage drop due to the sourced current. When the channel is turned OFF, the half-bridge DO pin is driven to ground plus a voltage drop due to the sinked current.

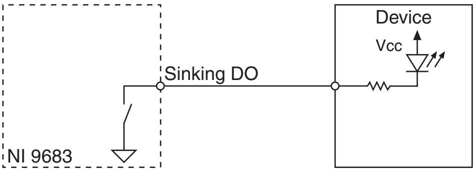
Note Make sure the devices you connect to the NI 9683 are compatible with the half-bridge digital output specifications. Use connections that match the output impedance of the NI 9683 half-bridge outputs. Refer to the *Specifications* section for information about output voltages.

Sinking Digital Output

The NI 9683 provides connections for 24 sinking digital output channels.

Each channel has a sinking DO pin to which you can connect a digital input device. Sinking DO pins have dedicated current return pins, GND, which are referenced to the ground of the board.

Figure 14. Connecting a Digital Device to a Sinking DO Channel



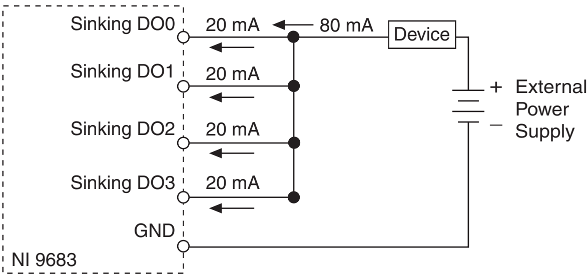
The NI 9683 has current sinking digital outputs, meaning that the output pin is driven to ground (GND) when the channel is ON.

Make sure the devices you connect to the NI 9683 are compatible with the output specifications. Refer to the *Specifications* section for information about output voltages.

Increasing Current Drive

Each channel has a continuous output current of 20 mA. If you want to increase the output current to a device, you can connect any number of channels together in parallel. For example, if you want to drive 80 mA of current, connect DO<0..3> in parallel as shown in Figure 15. You must turn all parallel channels on and off simultaneously so that the current on any single channel cannot exceed the 20 mA rating.

Figure 15. Increasing the Current to a Device Connected to the NI 9683



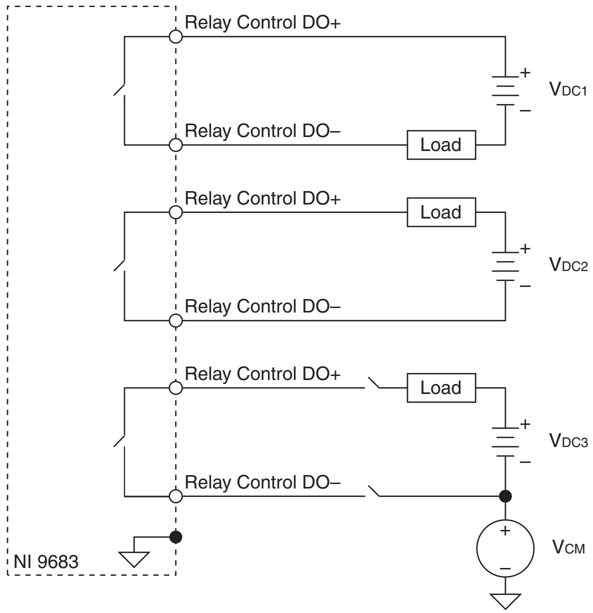
Relay Control Digital Output

The NI 9683 provides connections for four relay control digital output channels. Each channel has a relay control DO+ and a current return pin, relay control DO-.

The NI 9683 has current sinking outputs, meaning the relay control DO+ is driven to relay control DO- when the channel is ON.

You can connect industrial devices such as solenoids, actuators, relays, and lamps to the NI 9683. Refer to Figure 16 for an illustration of how to connect devices to the NI 9683.

Figure 16. Connecting an Industrial Device to a Relay Control DO Channel



Note Ensure that all the relay control DO+/- pins are held within the safety voltage levels. A maximum common mode voltage of 30 VDC is allowed at a relay control DO+/- pin with respect to the GND of the NI 9683. Refer to the *Safety* section for maximum voltages allowed for the relay control DO channels.

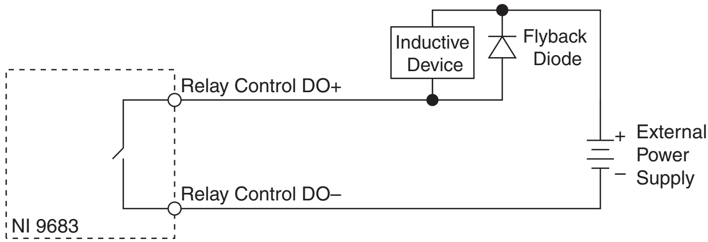
Note NI recommends using the appropriate cabling for the current return pins based on the amount of current returned per each relay control DO- output. Refer to the *Specifications* section for information about peak and continuous current limits based on the update rate.

Make sure the devices you connect to the NI 9683 are compatible with the output specifications. Refer to the *Specifications* section for information about output voltages.

Protecting the Relay Control Digital Outputs from Flyback Voltages

If the NI 9683 is switching an inductive or energy-storing device such as a solenoid, motor, or relay and the device does not have flyback protection, install a flyback diode.

Figure 17. Connecting a Flyback Diode to a Relay Control DO Channel



Selecting a Wire Gauge for Relay Control Digital Outputs

The relay control digital output is capable of sinking 8 A of inrush current for a period of 300 ms on a 60 second cycle and 500 mA of continuous current. Each channel is functionally isolated from the other channels and the rest of the board, meaning that each relay control digital output has a dedicated current return pin.

When using cables, make sure the current rating of the cable is able to handle the expected current for your application. For example, a typical 28 AWG flat ribbon cable is rated at 225 mA of continuous current per wire. In order to use the relay control digital outputs at their maximum current capability, cables within category 24 AWG or lower should be used.

Sourcing Digital Input

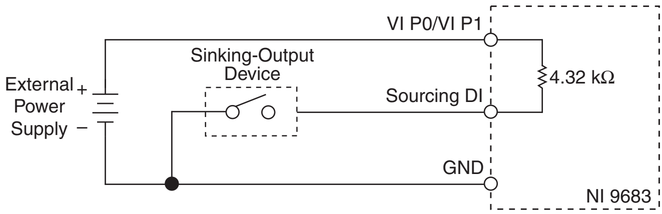
The NI 9683 provides connections for 28 simultaneously sampled digital input channels separated in ports P0 and P1. Ports P0 and P1 are independently powered using separate power supply pins, VI P0 and VI P1. This allows you to connect the DI to multivoltage systems.

The NI 9683 has sourcing inputs, meaning the DI sources current from the VI P0 or VI P1 to the sinking output device.The NI 9683 internally limits current signals connected to DI.

Each channel has a DI pin to which you can connect a digital input signal. The supply pins, VI P0 and VI P1, are referenced to the ground of the board. The DI operates in the low range or high range based on the VI P0 or VI P1 voltage. Refer to the *Specifications* section for more information about the low range and high range.

You can only connect 3-wire sinking-output devices to the NI 9683. Connect the sinking-output device to the DI pin and the external power supply lead to the VI P0 or VI P1.

Figure 18. Connecting a Digital Device to a Sourcing DI Channel



The NI 9683 channel registers ON when the sinking-output is in the ON range. The channel registers as OFF when the sinking-output is in the OFF range. If no device is connected to the sourcing DI, the channel registers as OFF. Refer to the *Specifications* section for more information about the ON and OFF ranges of the sourcing DI.

Note NI recommends that you leave sourcing DI channels that are not used in your application unconnected to lower power dissipation through the onboard pull-up resistor.

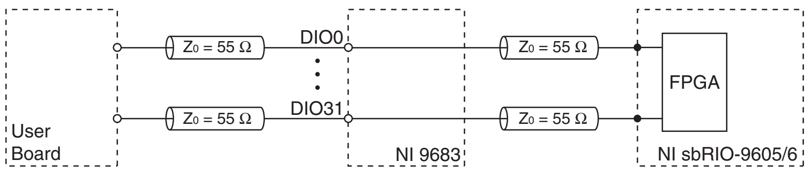
LVTTL Digital Input/Output

The NI 9683 provides connections for 32 LVTTL digital input/output channels.

The NI 9683 LVTTL DIO channels connect directly to the FPGA DIO on the NI sbRIO-9605/9606 and are unbuffered and unprotected. Refer to the *Specifications* section for more information about the maximum current.

Caution Operating the LVTTL DIO outside the rated specifications may result in permanent damage to the FPGA on NI sbRIO-9605/9606.

Figure 19. Connecting to the LVTTL DIO Channels



If overshoot and undershoot aberrations and signal integrity are concerns for your application, use a single load per line that does not exceed 25 pF. For edge sensitive signals, use channels DIO0 through DIO15 for better signal integrity and crosstalk performance since these channels have an individual GND pin.

The LVTTL DIO channels on the NI 9863 are routed with a 55 Ω characteristic trace impedance. Route all external circuitry with a similar impedance to ensure the best signal quality.

You should perform signal integrity measurements to test the effect of signal routing and cable type on your application. To meet defined power-up states for outputs, use a pull-up or pull-down resistor on the line.

System Diagrams

Figures 20 and 21 show diagrams for interfacing digital and analog signals with the NI 9683.

Figure 20. Interfacing Digital Signals with the NI 9683

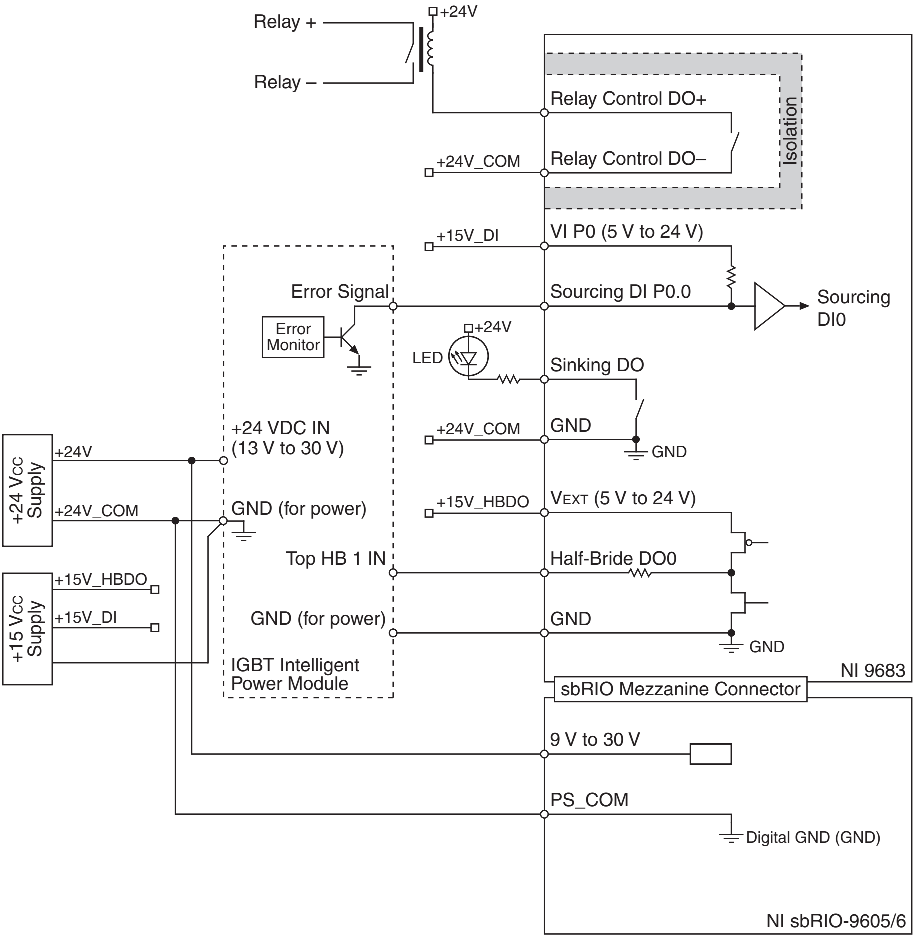
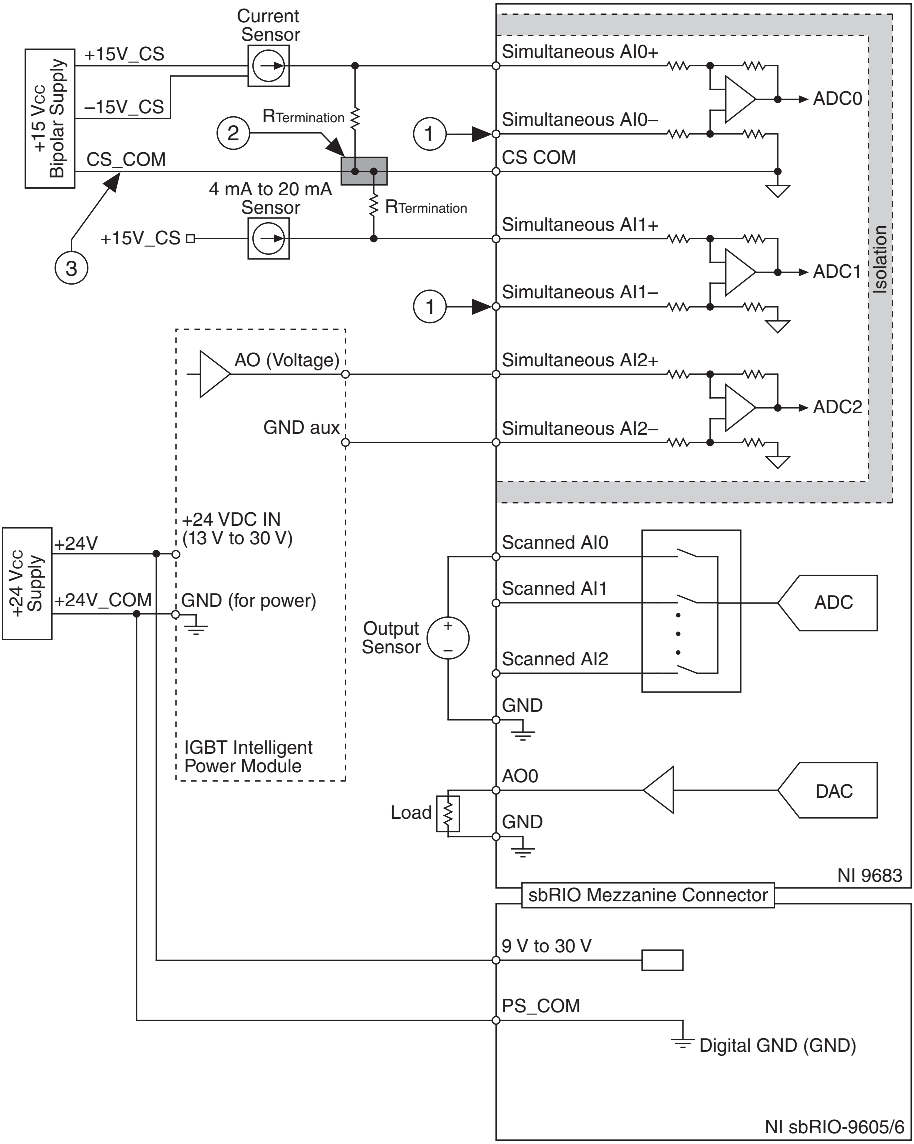


Figure 21. Interfacing Analog Signals with the NI 9683



1 Do not connect the AI- pin when using termination resistors.
2 Use a small plane shape for the current return point to reduce the common-mode impedance.
3 Do not connect CS COM to GND.

Specifications

The following specifications are typical for the full operating temperature range unless otherwise noted. Refer to the *Environmental* section for more information on operating temperatures.

Simultaneous Analog Input

Number of channels.. 16

ADC resolution.. 12 bits

Input range

Typical .... ±5 V, ±10 V

Minimum .... ±4.95 V, ±9.90 V

Common-mode range .... ±10 V

Sample rate (per channel)................................ 100 kS/s max

Accuracy

Nominal Range (V)	Measurement Conditions*	Percent of Reading (Gain Error)	Percent of Range (Offset Error)†
±5	Maximum (-40 °C to 85 °C)	0.70%	0.28%
	Typical (23 ° ±5 °C)	0.25%	0.12%
±10	Maximum (-40 °C to 85 °C)	0.70%	0.16%
	Typical (23 ° ±5 °C)	0.25%	0.07%

AbsoluteAccuracy = Reading(GainError) + Range(OffsetError) + Noise

* Local ambient temperature. Refer to the *Environmental* section for more information about operating temperatures.

† Offset error includes the effect of INL.

Stability

Gain drift.. 15 ppm/°C

Offset drift .... 15 µV/°C

Noise.. 1.5 mV_{rms}

-3 dB bandwidth .... 210 kHz

CMRR (f_{in} = 60 Hz).. 60 dB min

Input impedance

Differential... 240 kΩ

Single-ended .... 120 kΩ

Overvoltage protection .... ±30 V max

Scanned Analog Input (Monitoring)

Number of channels 8

ADC resolution .... 12 bits

Input range

Typical.. 0 V to 5 V

Minimum .... 12 mV to 4.97 V

Sample rate (all channels)................................ 1 kS/s max

Accuracy[1]

Measurement Conditions*	Percent of Reading (Gain Error)	Percent of Range† (Offset Error)‡
Maximum (-40 °C to 85 °C)	0.30%	0.23%
Typical (23 ° ±5 °C)	0.03%	0.03%

AbsoluteAccuracy = Reading(GainError) + Range(OffsetError) + Noise

* Local ambient temperature. Refer to the *Environmental* section for more information about operating temperatures.

† Range equals 5 V.

‡ Offset error includes the effect of INL.

Stability

Gain drift.. 3 ppm/°C

Offset drift.. 3 µV/°C

Noise .... $0.5\ mV_{rms}$

-3 dB bandwidth... 130 kHz

Input impedance for channel ON...................... 10 kΩ, 120 pF low pass filter

Input current for channel OFF .... 10 µA max

Overvoltage protection .... ±30 V max

Analog Output (Set-Point)

Number of channels 8

DAC resolution .... 12 bits

Startup voltage .... 0 V

[1] With signal source impedance <2 kΩ. Refer to the *Scanned Analog Input (Monitoring)* section for more information about the influence of source impedance over accuracy.

Output range

Typical .... 0 V to 5 V

Minimum .... 14 mV to 4.97 V

Current drive (per channel) .... 4 mA max

Update rate .... 1 kS/s min

Accuracy

Measurement Conditions*	Percent of Reading (Gain Error)	Percent of Range† (Offset Error)‡
Maximum (-40 °C to 85 °C)	0.33%	0.28%
Typical (23 ° ±5 °C)	0.06%	0.06%

AbsoluteAccuracy = OutputValue(GainError) + Range(OffsetError)

* Local ambient temperature. Refer to the *Environmental* section for more information about operating temperatures.

† Range equals 5 V.

‡ Offset error includes the effect of INL.

Stability

Gain drift .... 3 ppm/°C

Offset drift .... 3 μV/°C

Noise

1 MHz bandwidth .... 2.5 mV_{rms}

100 kHz bandwidth .... 0.3 mV_{rms}

Protection

Overvoltage .... +15 V/-5 V max

Short-circuit .... Indefinitely

Sourcing Digital Input

Number of channels 28

Input type .... Sourcing

Input range .... 0 V to 24 V

External power supply voltage range (VI P0, VI P1)

Low-range mode .... 3 V to 6 V

High-range mode .... 10 V to 24 V

Not supported .... 6 V to 10 V

Digital logic levels

Low-range mode

OFF state .... ≥1.8 V min

ON state .... ≤1 V max

High-range mode
OFF state ≥9.6 V min
ON state ≤7.9 V max

Hold time[1] 0 s

Setup time[2] 1 μs min

Update/transfer time 3 μs max

Pull-up resistor 4.32 kΩ

Overvoltage protection ±30 V max

Sinking Digital Output

Number of channels 24

Output type Sinking

Startup voltage Open

Output voltage (V_O) $I_O \cdot R_O$

Continuous output current (I_O)
on each channel 20 mA

Output impedance (R_O) 6 Ω max

External power supply voltage range 0 V to 30 V

Maximum update time 50 μs

Protection
Reversed-voltage None
Short-circuit None

Half-Bridge Digital Output

Number of channels 14

Output type Sourcing/Sinking

Startup voltage 0 V

Maximum continuous output current 10 mA

Output impedance 100 Ω

External power supply voltage range (V_{ext}) 5 V to 30 V

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1 *Hold time* is the amount of time input signals must be stable after initiating a read from the NI 9683.

2 *Setup time* is the amount of time input signals must be stable before reading from the NI 9683.

Digital logic levels

High (V_{OH})

Sourcing 0.1 mA .... V_{ext} - 0.01 V

Sourcing 10 mA .... V_{ext} - 1.05 V

Low (V_{OL})

Sinking 0.1 mA .... 0.01 V

Sinking 10 mA .... 1.05 V

Minimum pulse-width .... 500 ns

Maximum switching frequency[1]

V_{ext} = 30 V, CL = 1 nF .... 100 kHz

V_{ext} = 30 V, CL = 50 pF .... 500 kHz

[1] The maximum switching frequency must be limited to 500 kHz, regardless of the supply voltage or the capacitive load, in order to prevent output driver overstress.

Figure 22. Maximum Switching Frequency Based on the Capacitive Load

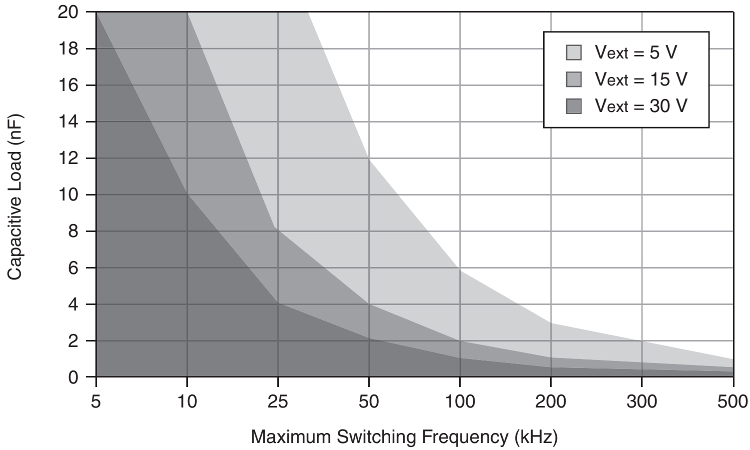
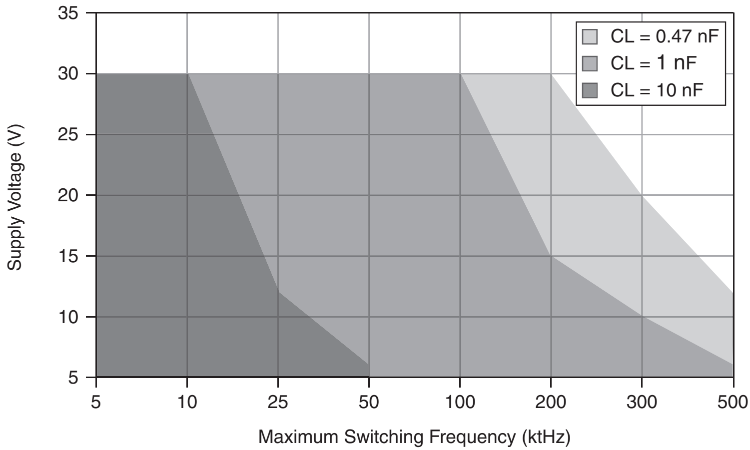


Figure 23. Maximum Switching Frequency Based on the Supply Voltage



Propagation delay

V_{ext} = 5 V, CL = 50 pF .... 300 ns max

V_{ext} > 15 V, CL = 50 pF .... 100 ns max

Protection

Overcurrent .... None

Short-circuit .... None

Relay Control Digital Output

Relay control DO specifications assume the use of direct board-to-board connections to I/O connectors on the NI 9683. Refer to the *Selecting a Wire Gauge for Relay Control Digital Outputs* section for information about designing ribbon cables to meet the relay control DO specifications on the NI 9683.

Number of channels 4

Output type .... Sinking

Startup voltage .... Open

External power supply voltage range .... 0 V to 30 V

Continuous current .... 500 mA

Maximum inrush current .... 8 A

Maximum inrush time .... 300 ms

Turn ON rate[1] .... 1 operation per 60 s

Turn ON time .... 6 ms max

Turn OFF time .... 0.2 ms max

Protection

Reversed-voltage .... None

Short-circuit .... None

LVTTL Digital Input/Output

Number of DIO channels 32

Maximum tested current (per channel)............ 3 mA

Maximum total current (all lines).................... 96 mA

Note The performance of the LVTTL DIO lines is bound by the FPGA, signal integrity, the applications timing requirements, and your design. For more information on using DIO to connect to RMCs, go to `ni.com/info` and enter the Info Code `RMCDIO`.

[1] *Turn ON rate* is the minimum time between inrush current events and is based on the maximum inrush current over the maximum inrush time. You can turn OFF the relay control DO at any point during operation.

Digital logic levels

- Input low voltage, V_{IL} ... 0 V min, 0.8 V max
- Input high voltage, V_{IH} ... 2.0 V min, 3.465 V max
- Output high voltage, V_{OH} sourcing 3 mA ... 2.7 V min, 3.3 V max
- Output low voltage, V_{OL} sinking 3 mA ... 0.0 V min, 0.4 V max

Protection

- Overvoltage ... None
- Overcurrent ... None
- Short-circuit ... None

Power Requirements

Power consumption from NI Single-Board RIO device ... 2 W max

Power-up time ... 0.1 s

Safety

Maximum Voltage

Connect voltages that are within the following limits.

Relay control digital output

- Relay control DO+ to Relay control DO- ... 0 VDC to 30 VDC
- Relay control DO+/- to GND ... ±30 VDC

Sinking digital output

- DO-to-GND ... ±30 VDC

Simultaneous analog input, scanned analog input, analog output, sourcing digital input

- Pin-to-pin or pin-to-GND ... ±30 VDC

Half-bridge digital output

- V_{ext}-to-GND ... 0 VDC to 30 VDC

LVTTL digital input/output ... 0 VDC to 3.465 VDC

Isolation Voltages

Simultaneous analog input

- Channel-to-channel ... None
- Channel-to-common
  - Continuous ... 60 VDC, Measurement Category I
  - Withstand ... 1,000 V_{rms}

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 the NI 9683 to signals or use for measurements within Measurement Categories II, III, or IV.

Environmental

Operating temperature (IEC 60068-2-1, IEC 60068-2-2)

Ambient temperature outside a 12 in. × 10 in. × 6.34 in. enclosure[1] .... -40 °C to 50 °C

Ambient temperature with forced-air cooling in an open environment[1] .... -40 °C to 70 °C

Note Visit `ni.com/info` and enter the Info Code `sbRIOcooling` for information about NI sbRIO operating temperatures.

Storage temperature (IEC 60068-2-1, IEC 60068-2-2) .... -40 °C to 85 °C

Operating humidity (IEC 60068-2-56) .... 10% to 90% RH, noncondensing

Storage humidity (IEC 60068-2-56) .... 5% to 95% RH, noncondensing

Pollution Degree (IEC 60664) 2

Maximum altitude .... 2,000 m

Indoor use only.

Physical Characteristics

Weight .... 153 g

Environmental Management

NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the *Minimize Our Environmental Impact* web page at `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.

[1] Ensure that the local ambient temperature of the NI 9863 is -40 °C to 85 °C. Measure the local ambient temperature by placing thermocouples on both sides of the PCB, 5 mm (0.2 in.) from the board surface.

Waste Electrical and Electronic Equipment (WEEE)

EU Customers At the end of the product life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste and Electronic Equipment, visit `ni.com/environment/weee`.

Battery Replacement and Disposal

Battery Directive This device contains a long-life coin cell battery. If you need to replace it, use the Return Material Authorization (RMA) process or contact an authorized National Instruments service representative. For more information about compliance with the EU Battery Directives 2006/66/EC about Batteries and Accumulators and Waste Batteries and Accumulators, visit `ni.com/environment/batterydirective`.

电子信息产品污染控制管理办法 （中国 RoHS）

中国客户 National Instruments 符合中国电子信息产品中限制使用某些有害物质指令 (RoHS)。关于 National Instruments 中国 RoHS 合规性信息，请登录 `ni.com/environment/rohs_china`。 (For information about China RoHS compliance, go to `ni.com/environment/rohs_china`.)

Where to Go for Support

The National Instruments Web site is your complete resource for technical support. At `ni.com/support` you have access to everything from troubleshooting and application development self-help resources to email and phone assistance from NI Application Engineers.

National Instruments corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. National Instruments also has offices located around the world to help address your support needs. For telephone support in the United States, create your service request at `ni.com/support` and follow the calling instructions or dial 512 795 8248. For telephone support outside the United States, visit the Worldwide Offices section of `ni.com/niglobal` to access the branch office Web sites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

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