

## SPECIFICATIONS

# NI PXI/PXIe-2531

## 512-Crosspoint, 1-Wire Matrix

This document lists specifications for the NI PXI/PXIe-2531 (NI 2531) 512-crosspoint, 1-wire matrix. All specifications are subject to change without notice. Visit [ni.com/manuals](http://ni.com/manuals) for the most current specifications.

Topology	1-wire $4 \times 128$ matrix, 1-wire $8 \times 64$ matrix, 1-wire dual $4 \times 64$ matrix, 1-wire dual $8 \times 32$ matrix
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**Caution** To ensure the specified EMC performance, operate this product only with shielded cables and accessories.



**Caution** Refer to the *Read Me First: Safety and Electromagnetic Compatibility* document for important safety and electromagnetic compatibility information. To obtain a copy of this document online, visit [ni.com/manuals](http://ni.com/manuals) and search for the document title.

### Related Information

[Refer to the NI Switches Help for detailed topology information.](#)

## About These Specifications

*Specifications* characterize the warranted performance of the instrument under the stated operating conditions.

*Typical Specifications* are specifications met by the majority of the instrument under the stated operating conditions and are tested at 23 °C ambient temperature. Typical specifications are not warranted.

All voltages are specified in DC, AC<sub>pk</sub>, or a combination unless otherwise specified.



**Caution** The protection provided by the NI 2531 can be impaired if it is used in a manner not described in this document.

# Input Characteristics

## Maximum switching voltage

Channel-to-channel	60 VDC, 30 VAC <sub>rms</sub>
Channel-to-ground	60 VDC, 30 VAC <sub>rms</sub> , CAT 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 the NI 2531 to signals or use for measurements within Measurement Categories II, III, or IV.



**Note** Measurement Categories CAT I and CAT O are equivalent. These test and measurement circuits are not intended for direct connection to the MAINS building installations of Measurement Categories CAT II, CAT III, or CAT IV.

Maximum current (switching or carry, per channel)	0.5 A
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**Caution** The maximum switching power is limited by the maximum switching current and the maximum voltage, and must not exceed 10 W.

Maximum switching power (per channel)	10 W
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## DC path resistance

Initial	<1 $\Omega$
End-of-life	$\geq 2 \Omega$
Open channel	$\geq 1 * 10^9 \Omega$



**Note** DC path resistance typically remains low for the life of the relay. At the end of relay life, the path resistance rapidly rises above 2  $\Omega$ . Load ratings apply to relays used within the specification before the end of relay life.

## Thermal EMF

1-wire	<50 $\mu\text{V}$ , typical
2-wire	<20 $\mu\text{V}$ , typical

# RF Performance Characteristics

Bandwidth (-3 dB, 50 Ω termination), 1-wire ≥20 MHz, typical  
row/column

Crosstalk (50 Ω termination), channel-to-channel

10 kHz	<-70 dB, typical
100 kHz	<-70 dB, typical
1 MHz	<-58 dB, typical
10 MHz	<-38 dB, typical

Isolation (50 Ω termination), open channel

10 kHz	>91 dB, typical
100 kHz	>71 dB, typical
1 MHz	>51 dB, typical
10 MHz	>32 dB, typical

# Dynamic Characteristics

Simultaneous drive limit

PXI	40 relays
PXI Express	64 relays
Relay operate time	0.25 ms



**Note** Certain applications may require additional time for proper settling.

Release time	0.25 ms
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Relay life (no load)

Mechanical	1 * 10 <sup>9</sup> cycles, typical
Electrical (resistive, <10 pF load)	
10 V, 100 mA	1 * 10 <sup>7</sup> cycles, typical
20 V, 500 mA	5 * 10 <sup>6</sup> cycles, typical
100 V, 10 mA	1 * 10 <sup>5</sup> cycles, typical



**Note** Reed relays are highly susceptible to damage caused by switching capacitive and inductive loads. Capacitive loads can cause high inrush currents while inductive loads can cause high flyback voltages. The addition of appropriate resistive protection can greatly improve contact lifetime. For more information about adding

protection circuitry to a capacitive load, visit [ni.com/info](http://ni.com/info) and enter the Info Code `relaylifetime`. For information about inductive loads, enter the Info Code `relayflyback`.



**Note** The relays used in the NI 2531 are field replaceable.

### Related Information

*Refer to the [NI Switches Help](#) for information about including additional settling time, and replacing a failed relay.*

*[Estimating Reed Relay Life](#) on page 10*

## Trigger Characteristics

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### Input trigger

Sources	PXI trigger lines 0 to 7
Minimum pulse width	150 ns



**Note** The NI 2531 can recognize trigger pulse widths <150 ns if you disable digital filtering.

### Output trigger

Destinations	PXI trigger lines 0 to 7
Pulse width	Programmable (1 $\mu$ s to 62 $\mu$ s)

### Related Information

*Refer to the [NI Switches Help](#) for information about disabling digital filtering.*

# Physical Characteristics

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Relay type Reed

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**Note** NI advises against installing reed relay modules directly adjacent to an embedded controller with a magnetic hard drive because of the sensitivity of reed relays and the possibility of interference.

Relay contact material Rhodium

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I/O connectors 2, 150 pos, Samtec ERM8 series

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Power requirement

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PXI 10 W at 5 V, 2 W at 3.3 V

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PXI Express 15 W at 12 V, 2 W at 3.3 V

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Dimensions (L × W × H) 3U, one slot, PXI/cPCI module,  
21.6 × 2.0 × 13.0 cm (8.5 × 0.8 × 5.1 in.)

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Weight 454 g (1 lb)

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## Environment

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Operating temperature 0 °C to 55 °C

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Storage temperature -40 °C to 70 °C

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Relative humidity 5% to 85%, noncondensing

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Pollution Degree 2

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Maximum altitude 2,000 m

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Indoor use only.

## Shock and Vibration

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Operational Shock 30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC 60068-2-27. Test profile developed in accordance with MIL-PRF-28800F.)

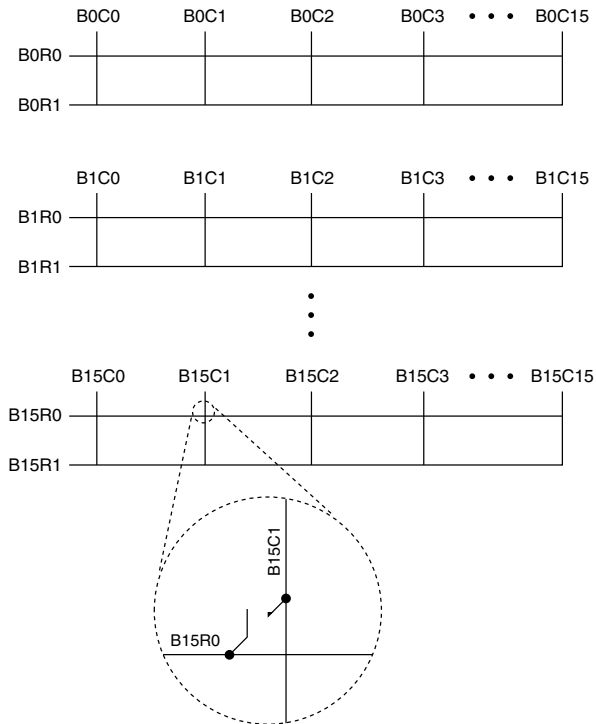
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## Random Vibration

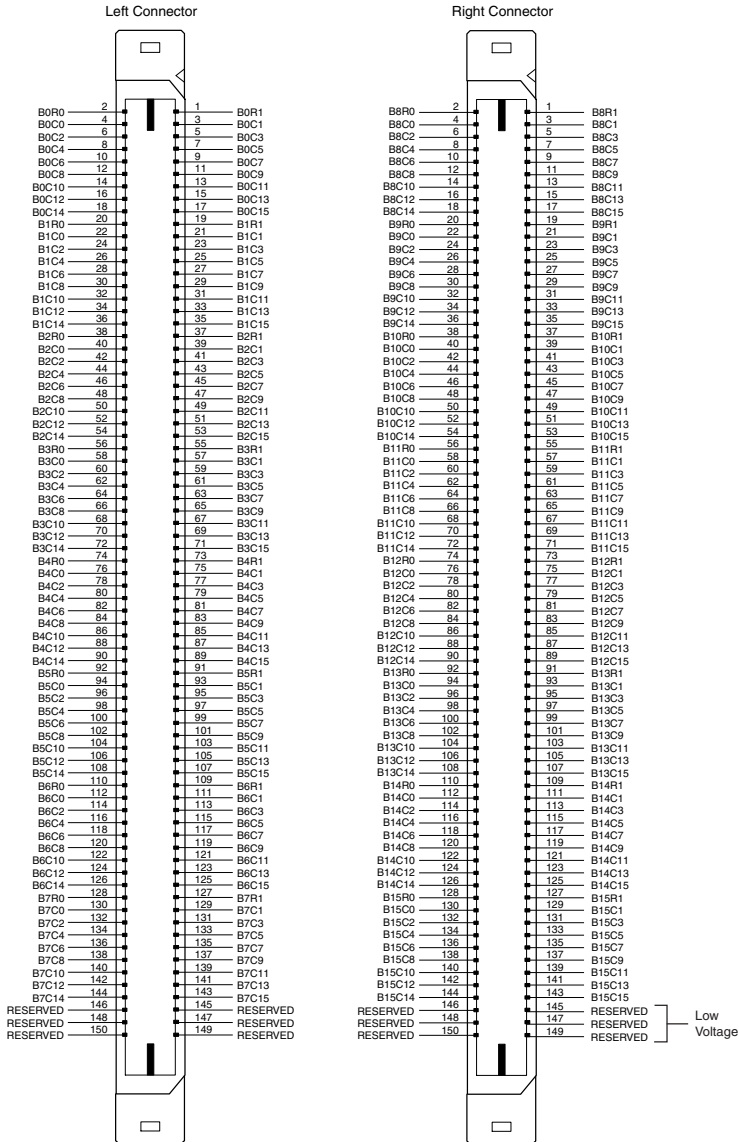
Operating	5 Hz to 500 Hz, 0.3 $g_{rms}$
Nonoperating	5 Hz to 500 Hz, 2.4 $g_{rms}$ (Tested in accordance with IEC 60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

## Diagrams

**Figure 1. NI 2531 Module-Reset State Diagram**



**Figure 2. NI 2531 Left and Right Connector Pinouts**



**Related Information**

For topology-specific connection information, refer to your device in the [NI Switches Help](#) and the [installation instructions](#) for any associated accessories or terminal blocks.

# Accessories

Visit [ni.com](http://ni.com) for more information about the following accessories.



**Caution** NI products typically must be operated with shielded cables and accessories to ensure compliance with Electromagnetic Compatibility (EMC) requirements. To determine if shielded cables or accessories are required for this product, refer to the EMC specifications in the *Electromagnetic Compatibility* section of this document. If shielded cables or accessories are required for EMC compliance, do not use unshielded cables or accessories unless they are installed in a shielded enclosure with properly designed and shielded input/output ports, and are connected to the NI product using a shielded cable. If unshielded cables or accessories are not properly installed and shielded, the EMC specifications for the product are no longer guaranteed.



**Note** The specifications listed in this document, including the safety and compliance certifications, also apply to the terminal blocks for the NI 2531 unless otherwise noted in the terminal block installation instructions.

**Table 1.** NI Accessories for the NI 2531

Accessory	Part Number
NI TB-2648 terminal block (1-wire 4 × 128 matrix)	781131-01
NI TB-2649 terminal block (1-wire dual 4 × 64 matrix)	781131-02
NI TB-2650 terminal block (1-wire 8 × 64 matrix)	781131-03
NI TB-2651 terminal block (1-wire dual 8 × 32 matrix)	781131-04
NI TBX-68 unshielded, I/O connector block with DIN-rail mounting	777141-01
NI SHC68-68 shielded cable (1 m)	191945-01
NI SHC68-68 shielded cable (2 m)	191945-02



**Note** Refer to the terminal block installation instructions for signal connectivity options. Contact NI for custom terminal block designs.

**Table 2. Third-Party Accessories for the NI 2531**

Accessory	Manufacturer	Manufacturer Part Number
Module mating connector (edge mount) <sup>1</sup>	Samtec	ERF8-075-01-S-D-EM2-L
Module mating connector (vertical PCB mount)	Samtec	ERF8-075-05.0-S-DV-L-K-TR
VHDCI connector	Molex	71430-0013



**Note** Third-party vendors offer mass-interconnect solutions for this module. Refer to Virginia Panel at [www.vpc.com](http://www.vpc.com) or MAC Panel at [www.macpanel.com](http://www.macpanel.com) for connectivity offerings.



**Caution** You must install mating connectors according to local safety codes and standards and according to the specifications provided by the connector manufacturer. You are responsible for verifying safety compliance of third-party connectors and their usage according to the relevant standard(s), including UL and CSA in North America and IEC and VDE in Europe.

## NI Accessory Specifications

This section lists specifications for the NI TB-2648/2649/2650/2651 terminal blocks used with the NI 2531. All specifications are subject to change without notice. Visit [ni.com/manuals](http://ni.com/manuals) for the most current specifications.



**Note** The NI TB-2648/2649/2650/2651 terminal blocks are sold separately from the NI 2531.

All input characteristics are DC,  $AC_{rms}$ , or a combination unless otherwise specified. All specifications reflect the accessory and attached NI 2531.

Maximum switching voltage	
Channel-to-channel	60 VDC, 30 $VAC_{rms}$ I
Channel-to-ground	60 VDC, 30 $VAC_{rms}$ , CAT I
Maximum current (per channel)	0.5 A
DC path resistance	<1.8 $\Omega$ , typical
Bandwidth (-3 dB, 50 $\Omega$ termination)	
NI TB-2648	$\geq 10$ MHz, typical
NI TB-2649	$\geq 11$ MHz, typical

<sup>1</sup> PCB mount, additional cover or enclosure required. Refer to previous safety caution.

NI TB-2650	$\geq 11$ MHz, typical
NI TB-2651	$\geq 14$ MHz, typical
Crosstalk (50 $\Omega$ termination), channel-to-channel	
10 kHz	$< -66$ dB
100 kHz	$< -55$ dB
1 MHz	$< -35$ dB
Terminal block I/O connectors	2, 68-pin VHDCI

## Estimating Reed Relay Life

Complete the following steps to estimate relay lifetimes using the nomograph:

1. Determine the peak voltage experienced across the relay while switching and mark this value on the *Volts* line.
2. Determine the sum of the DUT, cable, and instrumentation capacitances and mark this value on the *Load Capacitance* line.
3. Draw a straight line between both values.

The intersection points of this line and the *No Protection* and *50  $\Omega$  Protection* axes are the corresponding estimated relay lifetimes in cycles.

## Estimating Reed Relay Life Example

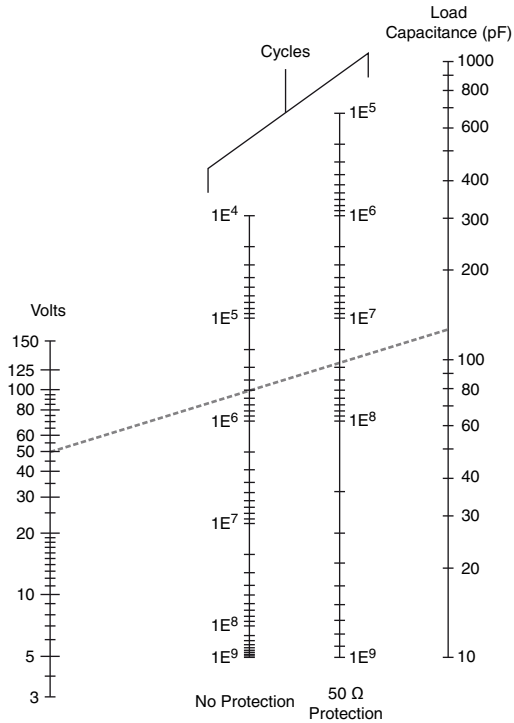
The reed relay module is connected to a DMM through 1 meter of cable. The DMM and cable capacitances are 100 pF and 30 pF respectively. The maximum voltage switched across the relay is 50 V. Determine the estimated number of relay cycles with and without protection resistance.

### Solution

The total load capacitance is the sum of the cable and DMM capacitance, which is 130 pF. Draw a line between the 50 V point on the *Volts* axis and 130 pF on the *Load Capacitance* axis.

The line drawn intersects the *Cycles* axes at approximately 500,000 on the *No Protection* axis and about 25,000,000 on the *50  $\Omega$  Protection* axis, as shown in the following figure. This series resistance should be placed as close as possible to the relay for maximum effect.

**Figure 3. Reed Relay Lifetime Nomograph**



## Compliance and Certifications

### Safety

This product is designed to meet the requirements of the following electrical equipment safety standards 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 the [Online Product Certification](#) section.

### Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for sensitive electrical equipment for measurement, control, and laboratory use:

- EN 61326-2-1 (IEC 61326-2-1): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions

- AS/NZS CISPR 11: Group 1, Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions



**Note** In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe, Canada, Australia and New Zealand (per CISPR 11) Class A equipment is intended for use only in heavy-industrial locations.



**Note** Group 1 equipment (per CISPR 11) is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for the treatment of material or inspection/analysis purposes.



**Note** For EMC declarations and certifications, and additional information, refer to the *Online Product Certification* section.

## CE Compliance

This product meets the essential requirements of applicable European Directives, as follows:

- 2014/35/EU; Low-Voltage Directive (safety)
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)

## Online Product Certification

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for this product, visit [ni.com/certification](https://ni.com/certification), search by model number or product line, and click the appropriate link in the Certification column.

## 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](https://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 the product life cycle, all NI products must be disposed of according to local laws and regulations. For more information about how to recycle NI products in your region, visit [ni.com/environment/weee](https://ni.com/environment/weee).

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