GETTING STARTED GUIDE

NI 9218

2 AI, 51.2 kS/s/ch Simultaneous, Universal Measurements
This document explains how to connect to the NI 9218. In this
document, the NI 9218 with LEMO and the NI 9218 with DSUB
are referred to inclusively as the NI 9218.

**Note** Before you begin, complete the software and
hardware installation procedures in your chassis
documentation.

**Note** The guidelines in this document are specific to
the NI 9218. The other components in the system might
not meet the same safety ratings. Refer to the
documentation for each component in the system to
determine the safety and EMC ratings for the entire
system.

**Safety Guidelines**

Operate the NI 9218 only as described in this document.

**Caution** Do not operate the NI 9218 in a manner not
specified in this document. 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 NI for repair.

NI 9218 with LEMO Safety Voltages

Connect only voltages that are within the following limits:

<table>
<thead>
<tr>
<th>Maximum voltage, from any pin to any pin on a single connector&lt;sup&gt;1&lt;/sup&gt;</th>
<th>±30 V</th>
</tr>
</thead>
</table>

Isolation

<table>
<thead>
<tr>
<th>Channel-to-channel, channel-to-Vsup, channel-to-earth, Vsup-to-earth (up to 5,000 m)&lt;sup&gt;2&lt;/sup&gt;</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous</td>
<td>60 VDC, Measurement Category I</td>
</tr>
<tr>
<td>Withstand</td>
<td>1,000 Vrms, verified by a 5 s dielectric withstand test</td>
</tr>
</tbody>
</table>

---

<sup>1</sup> The maximum voltage between pin 2 and pin 3 on a single connector is -20 V to +30 V.

<sup>2</sup> Must use crimp contact LEMO plug (784162-01) to maintain these ratings. Ratings are invalidated if solder version is used.
Caution  Any excitation output voltage to earth ground must remain below 60 VDC for each channel. To determine excitation output voltage to earth ground for a channel, add the maximum excitation voltage to the maximum potential on pin 3. The maximum excitation voltages are 2 V +3% and 3.3 V +3% for the bridge excitations, 12 V +5% for the +12 V excitation, and 22 V for the IEPE excitation.

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 9218 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.

**NI 9218 with DSUB Safety Voltages**

Connect only voltages that are within the following limits:

<table>
<thead>
<tr>
<th>Maximum voltage, from any pin to any pin on a single connector&lt;sup&gt;3&lt;/sup&gt;</th>
<th>±30 V</th>
</tr>
</thead>
</table>

**Isolation**

<table>
<thead>
<tr>
<th>Channel-to-channel, channel-to-Vsup inputs (up to 5,000 m)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous</td>
<td>60 VDC, Measurement Category I</td>
</tr>
<tr>
<td>Withstand</td>
<td>1,000 Vrms, verified by a 5 s dielectric withstand test</td>
</tr>
</tbody>
</table>

---

<sup>3</sup> The maximum voltage between pin 2 and pin 3 on a single connector is -20 V to +30 V.
<table>
<thead>
<tr>
<th>Channel-to-earth ground (up to 3,000 m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous</td>
</tr>
<tr>
<td>Withstand</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Channel-to-earth ground (up to 5,000 m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous</td>
</tr>
<tr>
<td>Withstand</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vsup inputs-to-earth ground (up to 5,000 m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous</td>
</tr>
<tr>
<td>Withstand</td>
</tr>
</tbody>
</table>

**Caution**  Any excitation output voltage to earth ground must remain below 60 VDC for each channel. To determine excitation output voltage to earth ground for a channel, add the maximum excitation voltage to the maximum potential on pin 3. The maximum excitation
voltages are 2 V +3% and 3.3 V +3% for the bridge excitations, 12 V +5% for the +12 V excitation, and 22 V for the IEPE excitation.

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 9218 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.
Safety Guidelines for Hazardous Locations

The NI 9218 is suitable for use in Class I, Division 2, Groups A, B, C, D, T4 hazardous locations; Class I, Zone 2, AEx nA IIC T4 and Ex nA IIC T4 hazardous locations; and nonhazardous locations only. Follow these guidelines if you are installing the NI 9218 in a potentially explosive environment. Not following these guidelines may result in serious injury or death.

Caution  Do not disconnect I/O-side wires or connectors unless power has been switched off or the area is known to be nonhazardous.

Caution  Do not remove modules unless power has been switched off or the area is known to be nonhazardous.

Caution  Substitution of components may impair suitability for Class I, Division 2.

Caution  For Division 2 and Zone 2 applications, install the system in an enclosure rated to at least IP54 as defined by IEC/EN 60079-15.
Special Conditions for Hazardous Locations Use in Europe and Internationally

The NI 9218 has been evaluated as Ex nA IIC T4 Gc equipment under DEMKO Certificate No. 12 ATEX 1202658X and is IECEx UL 14.0089X certified. Each NI 9218 is marked Ex II 3G and is suitable for use in Zone 2 hazardous locations, in ambient temperatures of -40 °C ≤ Ta ≤ 70 °C. If you are using the NI 9218 in Gas Group IIC hazardous locations, you must use the device in an NI chassis that has been evaluated as Ex nC IIC T4, Ex IIC T4, Ex nA IIC T4, or Ex nL IIC T4 equipment.

Caution  You must make sure that transient disturbances do not exceed 140% of the rated voltage.

Caution  The system shall only be used in an area of not more than Pollution Degree 2, as defined in IEC 60664-1.

Caution  The system shall be mounted in an ATEX/IECEx-certified enclosure with a minimum ingress protection rating of at least IP54 as defined in IEC/EN 60079-15.
Caution  The enclosure must have a door or cover accessible only by the use of a tool.

Electromagnetic Compatibility Guidelines

This product was tested and complies with the regulatory requirements and limits for electromagnetic compatibility (EMC) stated in the product specifications. These requirements and limits provide reasonable protection against harmful interference when the product is operated in the intended operational electromagnetic environment.

This product is intended for use in industrial locations. However, harmful interference may occur in some installations, when the product is connected to a peripheral device or test object, or if the product is used in residential or commercial areas. To minimize interference with radio and television reception and prevent unacceptable performance degradation, install and use this product in strict accordance with the instructions in the product documentation.
Furthermore, any changes or modifications to the product not expressly approved by National Instruments could void your authority to operate it under your local regulatory rules.

Caution  To ensure the specified EMC performance, operate this product only with shielded cables and accessories connected to the CH 0 and CH 1 ports. Do not use unshielded cables or accessories unless they are installed in a shielded enclosure with properly designed and shielded input/output ports and connected to the 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.

Special Conditions for Marine Applications
Some products are Lloyd’s Register (LR) Type Approved for marine (shipboard) applications. To verify Lloyd’s Register certification for a product, visit ni.com/certification and search for the LR certificate, or look for the Lloyd’s Register mark on the product.

Caution  In order to meet the EMC requirements for marine applications, install the product in a shielded
enclosure with shielded and/or filtered power and input/output ports. In addition, take precautions when designing, selecting, and installing measurement probes and cables to ensure that the desired EMC performance is attained.

### Preparing the Environment

Ensure that the environment in which you are using the NI 9218 meets the following specifications.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature</td>
<td>-40 °C to 70 °C (IEC 60068-2-1, IEC 60068-2-2)</td>
</tr>
<tr>
<td>Operating humidity</td>
<td>10% RH to 90% RH, noncondensing (IEC 60068-2-78)</td>
</tr>
<tr>
<td>Pollution Degree</td>
<td>2</td>
</tr>
<tr>
<td>Maximum altitude</td>
<td>5,000 m</td>
</tr>
</tbody>
</table>

Indoor use only.

**Note** Refer to the device datasheet on [ni.com/manuals](http://ni.com/manuals) for complete specifications.
### Table 1. Signals by Measurement Type

<table>
<thead>
<tr>
<th>Mode</th>
<th>Pin</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>±16 V</td>
<td>EX+</td>
<td>—</td>
<td>—</td>
<td>AI-,</td>
<td>—</td>
<td>—</td>
<td>AI+</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>±65 mV</td>
<td>EX+</td>
<td>—</td>
<td>—</td>
<td>EX-</td>
<td>—</td>
<td>—</td>
<td>AI+</td>
<td>AI-</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Full-Bridge</td>
<td>EX+</td>
<td>—</td>
<td>—</td>
<td>EX-</td>
<td>RS+</td>
<td>RS-</td>
<td>AI+</td>
<td>AI-</td>
<td>SC</td>
<td>SC</td>
<td>—</td>
</tr>
<tr>
<td>IEPE</td>
<td>—</td>
<td>AI+</td>
<td>AI-</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>TEDS</td>
<td>—</td>
<td>T+</td>
<td>T-</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>T+</td>
</tr>
</tbody>
</table>

4 NI 9218 with LEMO only.
5 Optional sensor excitation.
6 Tie to pin 3.
7 TEDS Class 1 data connection.
8 TEDS Class 2 data connection.
<table>
<thead>
<tr>
<th>Signal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI+</td>
<td>Positive analog input signal connection</td>
</tr>
<tr>
<td>AI-</td>
<td>Negative analog input signal connection</td>
</tr>
<tr>
<td>EX+</td>
<td>Positive sensor excitation connection</td>
</tr>
<tr>
<td>EX-</td>
<td>Negative sensor excitation connection</td>
</tr>
<tr>
<td>RS+</td>
<td>Positive remote sensing connection</td>
</tr>
<tr>
<td>RS-</td>
<td>Negative remote sensing connection</td>
</tr>
<tr>
<td>SC</td>
<td>Shunt calibration connection</td>
</tr>
<tr>
<td>T+</td>
<td>TEDS data connection</td>
</tr>
<tr>
<td>T-</td>
<td>TEDS return connection</td>
</tr>
</tbody>
</table>
Measurement Types

The NI 9218 provides built-in support for the following measurement types.

- ±16 V
- ±65 mV
- Full-Bridge
- IEPE

**Tip**  
NI recommends using the NI 9982 screw-terminal adapter when using built-in measurement types on the NI 9218.

The NI 9218 provides additional support for the following measurement types when using a measurement-specific adapter.

- ±20 mA, requires the NI 9983
- ±60 V, requires the NI 9987
- Half-Bridge, requires the NI 9986
- Quarter-Bridge, requires the NI 9984 (120 Ω) or NI 9985 (350 Ω)
The NI 9218 provides optional 12 V sensor excitation. To use the 12 V excitation, connect a 9 VDC to 30 VDC power supply to Vsup, connect the excitation terminals on your sensor to EX+/EX-, and enable 12 V excitation in your software.

Related Information

NI 9982 ±16 V Connection Pinout on page 35
±65 mV Connections

- You must connect AI- to EX- on the NI 9218.
- The NI 9218 provides optional 12 V sensor excitation. To use the 12 V excitation, connect a 9 VDC to 30 VDC power supply to Vsup, connect the excitation terminals on your 18
sensor to EX+/EX-, and enable 12 V excitation in your software.

Related Information

NI 9982 ±65 mV Connection Pinout on page 36
The NI 9218 provides 2 V excitation to loads $\geq 120 \ \Omega$ or 3.3 V excitation to loads $\geq 350 \ \Omega$.

The NI 9218 provides optional connections for remote sensing (RS) and shunt calibration (SC). Remote sensing
corrects for errors in excitation leads and shunt calibration corrects for errors caused by resistance within one leg of the bridge.

Related Information
NI 9982 Full-Bridge Connection Pinout on page 37

IEPE Connections

![IEPE Connections Diagram]
- The NI 9218 provides an excitation current for each channel that powers IEPE sensors.
- AI+ provides DC excitation and AI- provides the excitation return path.

Related Information

NI 9982 IEPE Connection Pinout on page 38

±20 mA Connections
- Connecting ±20 mA signals requires the NI 9983.
- The NI 9218 provides optional 12 V sensor excitation. To use the 12 V excitation, connect a 9 VDC to 30 VDC power supply to Vsup, connect the excitation terminals on your sensor to EX+/EX-, and enable 12 V excitation in your software.

Related Information
*
NI 9983 Pinout on page 39

±60 V Connections
Connecting ±60 V signals requires the NI 9987.

**Related Information**

*NI 9987 Pinout* on page 42
Half-Bridge Connections

NI 9218

NI 9986

DSUB/LEMO

RS+

EX+

AI+

EX-

RS-

SC

SC

NI 9986

NI 9218
• Connecting half bridges requires the NI 9986.
• The NI 9218 provides 2 V excitation to half bridges of \( \geq 240 \ \Omega \) total or 3.3 V excitation to half bridges of \( \geq 700 \ \Omega \) total.
• The NI 9218 provides optional connections for remote sensing (RS) and shunt calibration (SC). Remote sensing corrects for errors in excitation leads and shunt calibration corrects for errors caused by resistance within one leg of the bridge.

**Related Information**

*NI 9986 Pinout* on page 41
Quarter-Bridge Connections

- Connecting 120 Ω quarter bridges requires the NI 9984.
- Connecting 350 Ω quarter bridges requires the NI 9985.

**Tip** NI recommends 2 V excitation when using a NI 9984 with 120 Ω quarter bridges and 3.3 V
excitation when using the NI 9985 with 350 Ω quarter bridges.

Related Information

**NI 9984/9985 Pinout** on page 40

TEDS Connections

For more information about TEDS, visit [ni.com/info](https://ni.com/info) and enter the Info Code `rdteds`.

**TEDS Support**

TEDS Class 1 sensors provide an interface for transferring information from sensors. The NI 9218 with LEMO, NI 9218
with DSUB, NI 9982L, NI 9982D, NI 9982F support TEDS Class 1 sensors.

TEDS Class 2 sensors provide an interface for transferring information from TEDS enabled sensors. The NI 9218 with LEMO, NI 9982L, NI 9983L, NI 9984L, NI 9985L, and NI 9986L support TEDS Class 2 sensors.

**Vsup Daisy Chain Topology**

The NI 9218 with LEMO provides four pins on the Vsup connector for daisy chaining.
NI 9218 Connection Guidelines

Make sure that devices you connect to the NI 9218 are compatible with the module specifications.

Custom Cabling Guidelines

Observe the following guidelines when using the NI 9988 solder cup connector adapter or the LEMO crimp connector (784162-01) to create custom cables.

- Use a shielded cable for all signals.
- Connect the cable shield to earth ground.
- Use twisted-pair wiring for the AI+/AI- and RS+/RS- signals to achieve specified EMC performance.
1. Unlock the measurement adapter housing/cover.
2. Slide the measurement adapter housing/cover to access the screw terminals.
Mounting the NI 998xD/998xL

What to Use

• NI 998xD or NI 998xL Measurement Adapter
• M4 or Number 8 Screw
• Screwdriver

What to Do

Mount the measurement adapter to a flat surface using the mounting hole on the measurement adapter and the screw.
Measurement Adapter Grounding

The ground terminals on a measurement adapter are connected to chassis ground when the measurement adapter is connected to the NI 9218 and the NI 9218 is installed in a chassis.
Measurement Adapter Pinouts

The following sections include pinouts for the NI 9218 measurement adapters.

NI 9982 ±16 V Connection Pinout
Pins 3a and 3b are tied together on the NI 9982.

Related Information

$\pm 16 \text{ V Connections}$ on page 17

NI 9982 $\pm 65 \text{ mV Connection Pinout}$

Pins 3a and 3b are tied together on the NI 9982.

Related Information

$\pm 65 \text{ mV Connections}$ on page 18
NI 9982 Full-Bridge Connection Pinout

Pins 3a and 3b are tied together on the NI 9982.

Related Information

*Full-Bridge Connections* on page 20
NI 9982 IEPE Connection Pinout

Pins 3a and 3b are tied together on the NI 9982.

Related Information

*IEPE Connections* on page 21
NI 9983 Pinout

Pins 3a and 3b are tied together on the NI 9983.

Related Information

±20 mA Connections on page 22
NI 9984/9985 Pinout

NI 9984D/9984L/9985D/9985L

NI 9984F/9985F

Related Information

*Quarter-Bridge Connections* on page 27
NI 9986 Pinout

Pins 3a and 3b are tied together on the NI 9986.

Related Information

*Half-Bridge Connections* on page 25
NI 9987 Pinout

Pins 3a and 3b are tied together on the NI 9987.

**Related Information**

±60 V Connections on page 23
Where to Go Next

CompacterIO

NI 9218 Datasheet
NI-RIO Help
LabVIEW FPGA Help

NI CompactDAQ

NI 9218 Datasheet
NI-DAQmx Help
LabVIEW Help

RELATED INFORMATION

C Series Documentation & Resources
ni.com/info » cseriesdoc

Services
ni.com/services

Located at ni.com/manuals
Installs with the software

NI 9218 Getting Started Guide  © National Instruments  43
Worldwide Support and Services

The NI website 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.

Visit ni.com/services for NI Factory Installation Services, repairs, extended warranty, and other services.

Visit ni.com/register to register your NI product. Product registration facilitates technical support and ensures that you receive important information updates from NI.

A Declaration of Conformity (DoC) is our claim of compliance with the Council of the European Communities using the manufacturer’s declaration of conformity. This system affords the user protection for electromagnetic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting ni.com/certification. If your product supports calibration, you can obtain the calibration certificate for your product at ni.com/calibration.
NI corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. NI also has offices located around the world. For telephone support in the United States, create your service request at ni.com/support or dial 1 866 ASK MYNI (275 6964). For telephone support outside the United States, visit the Worldwide Offices section of ni.com/niglobal to access the branch office websites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.