

Last Revised: 2012-02-29 10:02:54.0

8-Channel Strain Gage Modules

NI 9235, NI 9236



- 8 channels, simultaneous quarter-bridge inputs
- 10 kS/s/ch sample rate
- 1000 Vrms transient isolation
- 24-bit resolution
- Multiple module synchronization
- Built-in excitation
- Built-in shunt calibration

Overview

NI 9235 and 9236 quarter-bridge strain gage modules are designed for higher-channel-count, dynamic strain measurement systems based on NI CompactDAQ, CompactRIO, or other compatible C Series hardware. With eight simultaneous channels per module, you can make more measurements with a smaller, more channel-dense system. Simultaneous sampling is important for higher-speed acquisitions where it is necessary to compare results from different locations at a particular instant in time, such as impact tests. For a bridge-based module with a higher sampling speed or the ability to implement full- and half-bridge as well as quarter-bridge measurements, try the NI 9237 C Series simultaneous bridge module

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Requirements and Compatibility

OS Information

- Real-Time OS
- Windows

Driver Information

- NI-DAQmx
- NI-RIO

Software Compatibility

- ANSI C/C++
- LabVIEW
- LabWindows/CVI
- Measurement Studio
- SignalExpress
- Visual C#
- Visual Studio .NET

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Comparison Tables

Module	Signal Type	Channels	Sample Rate	Resolution (bits)
9201	Voltage	8	500 kS/s	12
9203	Current	8	200 kS/s	16
9205	Voltage	32 SE/16 DI	250 kS/s	16
9206	CAT I isolated voltage	16 DI	250 kS/s	16
9215	Voltage	4	100 kS/s per channel	16

Module	Signal Type	Channels	Sample Rate	Resolution (bits)
9217	RTD	4	400 S/s	24
9221	Voltage	8	800 kS/s	12
9227	Current	4	50 kS/s per channel	24
9233	IEPE	4	50 kS/s per channel	24
9235/9236	Quarter-bridge	8	10 kS/s per channel	24
9237	Bridge	4	50 kS/s per channel	24

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Application and Technology

NI 9235 and 9236 C Series analog input modules are ideal for medium- to high-channel-count strain measurement applications such as structural or impact test. You can use these modules in the eight-slot NI CompactDAQ USB chassis for a plug-and-play, portable setup that can measure up to 64 channels in a single chassis. All channels of all NI C Series modules synchronize in the backplane.

For structural health monitoring or other applications that require embedded logging or processing, you can use NI 9235/9236 modules in four- and eight-slot NI CompactRIO chassis, which include an onboard processor and storage media. CompactRIO has an extended operational temperature range as well as rugged shock and vibration specifications and a Class 1, Division 2 hazardous location rating.

The small size and high performance of C Series hardware make it a good choice for compact test systems with multiple measurement types. You can add and synchronize new measurements by installing additional modules in the chassis. Common systems that use strain gages range from small engine test cells to mountain bike frame tests to in-vehicle chassis and suspension tests. The high bandwidth available in C Series hardware like NI CompactDAQ and CompactRIO delivers high-speed measurements such as dynamic strain, acceleration, and sound. You can mix these measurements with lower-speed measurements such as temperature in the same system with the same program.

High Throughput with Multiple ADCs

The use of multiple analog-to-digital converters (ADCs) in a single module has two main benefits. First, the overall sample rate available to each channel is dramatically increased. This is important when conducting high-speed tests, such as impact or fracture tests, over multiple channels. The other main advantage is the elimination of phase offset between channels when sampling at higher speeds.

Elimination of Unwanted Signals with Built-In Antialias Filters

For dynamic measurements, it is important to filter out unwanted signals. Without some form of filtering, unwanted high-frequency signals can alias the signal you are measuring, causing incorrect readings. To prevent these phenomena, NI 9235/9236 modules have built-in antialiasing filters that adjust to your selected sample rate and ensure that the signal you are measuring has no interference from signals beyond the Nyquist frequency.

Mixed-Measurement Test System

NI 9235/9236 modules are just two in a collection of more than 50 C Series modules for measurements such as temperature, acceleration, voltage, current, sound, pressure, load, force, torque, and digital I/O. You can easily synchronize every C Series module you use in a chassis to acquire data from all channels at the same rate and at the same time.

C Series Compatibility

The C Series hardware family features more than 50 measurement modules and several chassis and carriers for deployment. With this variety of modules, you can mix and match measurements such as temperature, acceleration, flow, pressure, strain, acoustic, voltage, current, digital, and more to create a custom system. Install the modules in one of several carriers to create a single module USB, Ethernet, or Wi-Fi system, or combine them in chassis such as NI CompactDAQ and CompactRIO to create a mixed-measurement system with synchronized measurements. You can install up to eight modules in a simple, complete NI CompactDAQ USB data acquisition system to synchronize all of the analog output, analog input, and digital I/O from the modules. For a system without a PC, CompactRIO holds up to eight modules and features a built-in processor, RAM, and storage for an embedded data logger or control unit. For higher-speed control, CompactRIO chassis incorporate a field-programmable gate array (FPGA) that you can program with NI LabVIEW software to achieve silicon-speed processing on I/O data from C Series modules.



Advanced Features

When used with CompactRIO, C Series analog input modules connect directly to reconfigurable I/O (RIO) FPGA hardware to create high-performance embedded systems. The reconfigurable FPGA hardware within CompactRIO provides a variety of options for custom timing, triggering, synchronization, filtering, signal processing, and high-speed

decision making for all C Series analog modules. For instance, with CompactRIO, you can implement custom triggering for any analog sensor type on a per-channel basis using the flexibility and performance of the FPGA and the numerous arithmetic and comparison function blocks built into the LabVIEW FPGA Module.

Key Features

- High-accuracy, high-performance analog measurements for any CompactRIO embedded system, R Series expansion chassis, or NI CompactDAQ chassis
- Screw terminals, BNC, D-Sub, spring terminals, strain relief, high voltage, cable, solder cup backshell, and other connectivity options
- Available channel-to-earth ground double-isolation barrier for safety, noise immunity, and high common-mode voltage range
- CompactRIO Extreme Industrial Certifications and Ratings
- Built-in signal conditioning for direct connection to sensors and industrial devices

Visit ni.com/compactrio or ni.com/compactdaq for up-to-date information on module availability, example programs, application notes, and other developer tools.

Connectivity Accessories

NI 9235/9236 modules are shipped with everything you need to take them out of the box and begin connecting signal wires. For added strain relief, you can purchase connector backshells as an accessory kit. Accessory kits are also available for spares or replacements of spring terminal connectors for the modules.



Backshell for NI 9235/9236 Strain Gage Modules

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Ordering Information

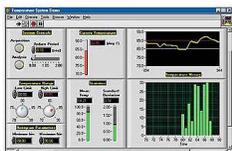
For a complete list of accessories, visit the product page on ni.com.

Products	Part Number	Recommended Accessories	Part Number
NI 9235 Strain and Bridge Module			
NI 9235 Requires: 1 Connectivity Accessories ;	779993-01	Connectivity Accessories: springTerminal - NI 9965 Strain relief, operator protection (qty 1)	780216-01

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Software Recommendations

LabVIEW Professional Development System for Windows



- Advanced software tools for large project development
- Automatic code generation using DAQ Assistant and Instrument I/O Assistant
- Tight integration with a wide range of hardware
- Advanced measurement analysis and digital signal processing
- Open connectivity with DLLs, ActiveX, and .NET objects
- Capability to build DLLs, executables, and MSI installers

SignalExpress for Windows

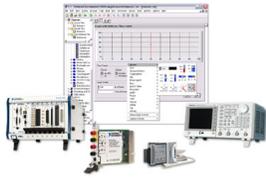


- Quickly configure projects without programming
- Control over 400 PC-based and stand-alone instruments
- Log data from more than 250 data acquisition devices
- Perform basic signal processing, analysis, and file I/O
- Scale your application with automatic LabVIEW code generation
- Create custom reports or easily export data to LabVIEW, DIAdem or Microsoft Excel

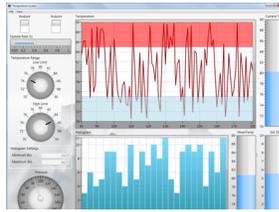
NI LabWindows™/CVI for Windows

- Real-time advanced 2D graphs and charts

NI Measurement Studio Professional Edition



- Complete hardware compatibility with IVI, VISA, DAQ, GPIB, and serial
- Analysis tools for array manipulation, signal processing statistics, and curve fitting
- Simplified cross-platform communication with network variables
- Measurement Studio .NET tools (included in LabWindows/CVI Full only)
- The mark LabWindows is used under a license from Microsoft Corporation.



- Customizable graphs and charts for WPF, Windows Forms, and ASP.NET Web Forms UI design
- Analysis libraries for array operations, signal generation, windowing, filters, signal processing
- Hardware integration support with native .NET data acquisition and instrument control libraries
- Automatic code generation for all NI-DAQmx data acquisition hardware
- Intelligent and efficient data-logging libraries for streaming measurement data to disk
- Support for Microsoft Visual Studio .NET 2012/2010/2008

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Support and Services

System Assurance Programs

NI system assurance programs are designed to make it even easier for you to own an NI system. These programs include configuration and deployment services for your NI PXI, CompactRIO, or Compact FieldPoint system. The NI Basic System Assurance Program provides a simple integration test and ensures that your system is delivered completely assembled in one box. When you configure your system with the NI Standard System Assurance Program, you can select from available NI system driver sets and application development environments to create customized, reorderable software configurations. Your system arrives fully assembled and tested in one box with your software preinstalled. When you order your system with the standard program, you also receive system-specific documentation including a bill of materials, an integration test report, a recommended maintenance plan, and frequently asked question documents. Finally, the standard program reduces the total cost of owning an NI system by providing three years of warranty coverage and calibration service. Use the online product advisors at ni.com/advisor to find a system assurance program to meet your needs.

Calibration

NI measurement hardware is calibrated to ensure measurement accuracy and verify that the device meets its published specifications. To ensure the ongoing accuracy of your measurement hardware, NI offers basic or detailed recalibration service that provides ongoing ISO 9001 audit compliance and confidence in your measurements. To learn more about NI calibration services or to locate a qualified service center near you, contact your local sales office or visit ni.com/calibration.

Technical Support

Get answers to your technical questions using the following National Instruments resources.

- **Support** - Visit ni.com/support to access the NI KnowledgeBase, example programs, and tutorials or to contact our applications engineers who are located in NI sales offices around the world and speak the local language.
- **Discussion Forums** - Visit forums.ni.com for a diverse set of discussion boards on topics you care about.
- **Online Community** - Visit community.ni.com to find, contribute, or collaborate on customer-contributed technical content with users like you.

Repair

While you may never need your hardware repaired, NI understands that unexpected events may lead to necessary repairs. NI offers repair services performed by highly trained technicians who quickly return your device with the guarantee that it will perform to factory specifications. For more information, visit ni.com/repair.

Training and Certifications

The NI training and certification program delivers the fastest, most certain route to increased proficiency and productivity using NI software and hardware. Training builds the skills to more efficiently develop robust, maintainable applications, while certification validates your knowledge and ability.

- **Classroom training in cities worldwide** - the most comprehensive hands-on training taught by engineers.
- **On-site training at your facility** - an excellent option to train multiple employees at the same time.
- **Online instructor-led training** - lower-cost, remote training if classroom or on-site courses are not possible.
- **Course kits** - lowest-cost, self-paced training that you can use as reference guides.
- **Training memberships** and training credits - to buy now and schedule training later.

Visit ni.com/training for more information.

Extended Warranty

NI offers options for extending the standard product warranty to meet the life-cycle requirements of your project. In addition, because NI understands that your requirements may change, the extended warranty is flexible in length and easily renewed. For more information, visit ni.com/warranty.

OEM

NI offers design-in consulting and product integration assistance if you need NI products for OEM applications. For information about special pricing and services for OEM customers, visit ni.com/oem.

Alliance

Our Professional Services Team is comprised of NI applications engineers, NI Consulting Services, and a worldwide National Instruments Alliance Partner program of more than 700 independent consultants and integrators. Services range from start-up assistance to turnkey system integration. Visit ni.com/alliance.

Detailed Specifications

The following specifications are typical for the range –40 to 70 °C unless otherwise noted. The specifications are the same for the NI 9235 and the NI 9236 unless otherwise noted.

Input Characteristics

Number of channels	8 analog input channels
Quarter-bridge completion	
NI 9235	120 Ω, 10 ppm/°C max
NI 9236	350 Ω, 10 ppm/°C max
ADC resolution	24 bits
Type of ADC	Delta-Sigma (with analog prefiltering)
Sampling mode	Simultaneous
Internal master timebase (f_M)	
Frequency	12.8 MHz
Accuracy	±100 ppm max
Data rate range (f_s) using internal master timebase	
Minimum	794 S/s
Maximum	10 kS/s
Data rate range (f_s) using external master timebase	
Minimum	195.3125 S/s
Maximum	10.547 kS/s
Data rates f_s ¹	$\frac{f_M \div 256}{n}$, $n = \{2, 4, 5, \dots, 63\}$
Full-scale range	±29.4 mV/V (+62,500 µε/–55,500 µε)
Scaling coefficient	3.5062 nV/V per LSB
Overvoltage protection between any two terminals	±30 V

Accuracy, NI 9235			
Measurement Conditions	Percent of Reading ² (Gain Error)	Percent of Range ^{3 4} (Offset Error)	
		30 days after cal. (±5 °C)	1 year after cal. (±5 °C)
Calibrated typ (25 °C, ±5 °C)	0.02%	0.1%	0.15%
Calibrated max (–40 to 70 °C)	0.07%	0.17%	0.4%
Uncalibrated typ (25 °C, ±5 °C)	0.15%	1.25%	
Uncalibrated max (–40 to 70 °C)	0.53%	2.14%	

Stability, NI 9235	
Gain drift	6 ppm/°C
Offset drift	2.2 µV/V/°C

Accuracy, NI 9236			
Measurement Conditions	Percent of Reading ² (Gain Error)	Percent of Range ^{3 4} (Offset Error)	
		30 days after cal. (± 5 °C)	1 year after cal. (± 5 °C)
Calibrated typ (25 °C, ± 5 °C)	0.02%	0.08%	0.14%
Calibrated max (–40 to 70 °C)	0.07%	0.16%	0.39%
Uncalibrated typ (25 °C, ± 5 °C)	0.15%	0.79%	
Uncalibrated max (–40 to 70 °C)	0.53%	1.67%	

Stability, NI 9236

Gain drift	6 ppm/°C
Offset drift	1.7 μ V/V/°C

Channel-to-channel matching (calibrated)			
Input Signal Frequency (f_{in})	Gain		Phase
	Typical	Maximum	Maximum
0 to 1 kHz	0.08%	0.11%	0.34°/kHz $\cdot f_{in}$
0 to 4 kHz	0.17%	0.32%	

Phase nonlinearity

$f_{in} = 0$ to 1 kHz	$\pm 0.002^\circ$
$f_{in} = 0$ to 4 kHz	$\pm 0.1^\circ$

Input delay	$38.2/f_s + 11 \mu$ s
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Passband

Frequency	$0.45 \cdot f_s$
Flatness ($f_s = 10$ kS/s)	33 mdB max

Stopband

Frequency	$0.55 \cdot f_s$
Rejection	100 dB

Alias-free bandwidth	$0.45 \cdot f_s$
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Oversample rate	$64 \cdot f_s$
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Rejection at oversample rate ⁵ ($f_s = 10$ kS/s)	80 dB @ 640 kHz
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Input noise

$f_s = 1$ kS/s	
NI 9235	0.38 μ V/V _{rms}
NI 9236	0.25 μ V/V _{rms}
$f_s = 10$ kS/s	
NI 9235	0.85 μ V/V _{rms}
NI 9236	0.5 μ V/V _{rms}

SFDR (1 kHz, –60 dBFS)

NI 9235	110 dB
NI 9236	115 dB

THD (1 kHz, –20 dBFS)

NI 9235	–90 dB
NI 9236	–95 dB

Crosstalk ($f_{in} = 1$ kHz)	–100 dB
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Common-mode voltage, all signals to earth ground	±60 VDC
CMRR ($f_{in} = 0$ to 60 Hz)	
NI 9235	120 dB
NI 9236	110 dB
MTBF	566,796 hours at 25 °C; Bellcore Issue 2, Method 1, Case 3, Limited Part Stress Method

 **Note** Contact NI for Bellcore MTBF specifications at other temperatures or for MIL-HDBK-217F specifications.

Shunt Calibration Characteristics

Shunt calibration accuracy		
Measurement Conditions	NI 9235 Percent of Reading (Gain Error)	NI 9236 Percent of Reading (Gain Error)
Typical (25 °C, ±5 °C)	0.09%	0.07%
Maximum (−40 to 70 °C)	0.22%	0.2%

Resistance	
NI 9235	50 kΩ
NI 9236	100 kΩ
Output value	
NI 9235	−599.28 μV/V
NI 9236	−873.47 μV/V
Temperature drift	15 ppm/°C
Method	Shunt across completion resistor

Excitation Characteristics

Excitation type	Constant voltage
Excitation value	
NI 9235	2.0 V ± 1%
NI 9236	3.3 V ± 1%
Maximum output current	
NI 9235	80 mA
NI 9236	46 mA

Power Requirements

Power consumption from chassis	
NI 9235	
Active mode	735 mW max
Sleep mode	25 μW max
NI 9236	
Active mode	675 mW max
Sleep mode	25 μW max
Thermal dissipation (at 70 °C)	
NI 9235	
Active mode	735 mW max
Sleep mode	25 μW max
NI 9236	
Active mode	675 mW max
Sleep mode	25 μW max

Physical Characteristics

Spring-terminal wiring	18 to 28 AWG copper conductor wire with 7 mm (0.28 in.) of insulation stripped from the end
Weight	153 g (5.4 oz)

Safety

If you need to clean the module, wipe it with a dry towel.

Safety Voltages

Connect only voltages that are within the following limits.

Between any two terminals	±30 V max
Isolation	
Channel-to-channel	None
Channel-to-earth ground	
Continuous	60 VDC, Measurement Category I
Withstand	1,000 V _{rms} , verified by a 5 s dielectric withstand test

Measurement Category I is for measurements performed on circuits not directly connected to the electrical distribution system referred to as MAINS ⁶ voltage. 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 9235/9236 to signals or use for measurements within Measurement Categories II, III, or IV.

Safety Standards

This product is designed to meet the requirements of the following standards of safety for electrical equipment 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.

Hazardous Locations

U.S. (UL)	Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, AEx nA IIC T4
Canada (C-UL)	Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, Ex nA IIC T4
Europe (DEMKO)	Ex nA IIC T4

Environmental

National Instruments C Series modules are intended for indoor use only but may be used outdoors if installed in a suitable enclosure. Refer to the manual for the chassis you are using for more information about meeting these specifications.

Operating temperature (IEC 60068-2-1, IEC 60068-2-2)	−40 to 70 °C
Storage temperature (IEC 60068-2-1, IEC 60068-2-2)	−40 to 85 °C
Ingress protection	IP 40
Operating humidity (IEC 60068-2-56)	10 to 90% RH, noncondensing
Storage humidity (IEC 60068-2-56)	5 to 95% RH, noncondensing
Maximum altitude	2,000 m
Pollution Degree (IEC 60664)	2

Shock and Vibration

To meet these specifications, you must panel mount the system and use the NI 9965 backshell to protect the connections.

Operating vibration

Random (IEC 60068-2-64)	5 g _{rms} , 10 to 500 Hz
Sinusoidal (IEC 60068-2-6)	5 g, 10 to 500 Hz
Operating shock (IEC 60068-2-27)	30 g, 11 ms half sine, 50 g, 3 ms half sine, 18 shocks at 6 orientations

Electromagnetic Compatibility

This product is designed to meet the requirements of the following standards of EMC for electrical equipment for measurement, control, and laboratory use:

- EN 61326 EMC requirements; Industrial Immunity
- EN 55011 Emissions; Group 1, Class A
- CE, C-Tick, ICES, and FCC Part 15 Emissions; Class A



Note For EMC compliance, operate this device with shielded cables.

CE Compliance

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)



Note For the standards applied to assess the EMC of this product, refer to the *Online Product Certification* section.

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, search by module number or product line, and click the appropriate link in the Certification column.

Environmental Management

National Instruments is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial not only to the environment but also to NI customers.

For additional environmental information, refer to the *NI and the Environment* 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.

Waste Electrical and Electronic Equipment (WEEE)



EU Customers At the end of their life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers and National Instruments WEEE initiatives, visit ni.com/environment/weee.htm.

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.)

Calibration

You can obtain the calibration certificate for this device at ni.com/calibration.

Calibration interval

1 year

¹ The data rate must remain within the appropriate data rate range. Refer to the *Understanding NI 9235/9236 Data Rates* section of the *NI 9235/9236 Operating Instructions and Specifications* for more information.

² Exclusive of lead wire desensitization error.

³ Range equals 29.4 mV/V.

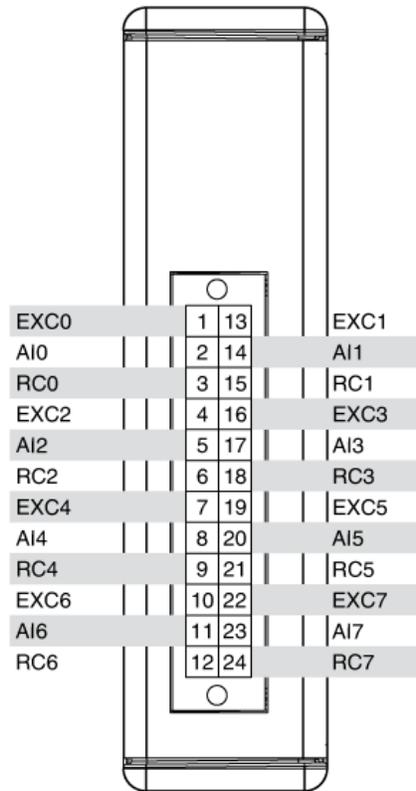
⁴ Calibrated errors represent offset stability following unstrained measurement. Errors include the effect of completion resistor tolerance and drift.

⁵ Rejection by analog prefilter of signal frequencies at oversample rate.

⁶ MAINS is defined as the (hazardous live) electrical supply system to which equipment is designed to be connected for the purpose of powering the equipment. Suitably rated measuring circuits may be connected to the MAINS for measuring purposes.

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Pinouts/Front Panel Connections



NI 9235/9236 Terminal Assignments

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