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For user manuals and dimensional drawings, visit the product page resources tab on ni.com.

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NI 9205

±200 mV to ±10 V, Analog Input, 250 kS/s, 32 Ch Module



- 32 single-ended or 16 differential channels, 250 kS/s sample rate
- ±200 mV, ±1 V, ±5 V, and ±10 V programmable measurement ranges; 16-bit resolution
- 250 Vrms channel-earth, CAT II (spring-terminal), or 60 VDC channel-earth, CAT I (D-SUB), isolation
- 36-position spring-terminal or 37-pin D-SUB connectors available
- -40 °C to 70 °C operating, 5 g vibration, 50 g shock

Overview

The NI 9205 is a C Series module for use with NI CompactDAQ and CompactRIO chassis. It features 32 single-ended or 16 differential analog inputs, 16-bit resolution, and a maximum sample rate of 250 kS/s. Each channel has programmable input ranges of ±200 mV, ±1 V, ±5 V, and ±10 V. To protect against signal transients, the NI 9205 includes up to 60 V of overvoltage protection between input channels and common (COM). In addition, the NI 9205 features a channel-to-earth ground double isolation barrier for safety, noise immunity, and high common-mode voltage range. It is rated for 1,000 Vrms transient overvoltage protection.

You can choose from two connector options for the NI 9205: a 36-position spring-terminal connector for direct connectivity or a 37-position D-SUB connector.

Recommended Accessories

- NI 9940 strain relief operator protection (for spring-terminal variant)
- NI 9923 front-mount D-SUB to screw-terminal connector (for D-SUB variant)

Box Contents

- 1 NI 9205 C Series module
- 1 NI 9205 Operating Instructions and Specifications manual
- 1 NI 9974 36-position spring-terminal connector (for spring-terminal variant)

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Comparison Tables

Product Name	Signal Ranges	Channels	Sample Rate	Simultaneous	Resolution	Isolation	Connectivity
NI 9201	±10 V	8 single-ended	500 kS/s	No	12-Bit	250 Vrms Ch-Earth (Screw Terminal), 60 VDC Ch-Earth (D-SUB)	Screw Terminal, 25-Pin D-SUB
NI 9205	±200 mV, ±1 V, ±5 V, ±10 V	32 single-ended, 16 differential	250 kS/s	No	16-Bit	250 Vrms Ch-Earth (Spring Terminal), 60 VDC Ch-Earth (D-SUB)	Spring Terminal, 37-Pin D-SUB
NI 9206	±200 mV, ±1 V, ±5 V, ±10 V	32 single-ended, 16 differential	250 kS/s	No	16-Bit	600 VDC Ch-Earth	Spring Terminal
NI 9215	±10 V	4 differential	100 kS/s/ch	Yes	16-Bit	250 Vrms Ch-Earth (Screw Terminal), 60 VDC Ch-Earth (BNC)	Screw Terminal, BNC
NI 9220	±10 V	16 differential	100 kS/s/ch	Yes	16-Bit	250 Vrms Ch-Earth (Spring Terminal), 60 VDC Ch-Earth (D-SUB)	Spring Terminal, 37-Pin D-SUB

Product Name	Signal Ranges	Channels	Sample Rate	Simultaneous	Resolution	Isolation	Connectivity
NI 9221	±60 V	8 single-ended	800 kS/s	No	12-Bit	250 Vrms Ch-Earth (Screw Terminal), 60 VDC Ch-Earth (D-SUB)	Screw Terminal, 25-Pin D-SUB
NI 9222	±10 V	4 differential	500 kS/s/ch	Yes	16-Bit	60 VDC Ch-Ch	Screw Terminal
NI 9223	±10 V	4 differential	1 MS/s/ch	Yes	16-Bit	60 VDC Ch-Ch	Screw Terminal
NI 9229	±60 V	4 differential	50 kS/s/ch	Yes	24-Bit	250 Vrms Ch-Ch (Screw Terminal), 60 VDC Ch-Ch (BNC)	Screw Terminal, BNC
NI 9239	±10 V	4 differential	50 kS/s/ch	Yes	24-Bit	250 Vrms Ch-Ch (Screw Terminal), 60 VDC Ch-Ch (BNC)	Screw Terminal, BNC

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Application and Technology

NI C Series Overview



NI C Series modules are designed to provide high-accuracy measurements to meet the demands of advanced DAQ and control applications. Each module contains measurement-specific signal conditioning to connect to an array of sensors and signals, bank and channel-to-channel isolation options, and support for wide temperature ranges to meet a variety of application and environmental needs all in a single rugged package. You can choose from more than 100 C Series modules for measurement, control, and communication to connect your applications to any sensor on any bus.

Most C Series I/O modules work with both the NI CompactDAQ and CompactRIO platforms. The modules are identical, and you can move them from one platform to the other with no modification.

NI CompactRIO Platform



Powered by the NI LabVIEW reconfigurable I/O (RIO) architecture, NI CompactRIO combines an open embedded architecture with small size, extreme ruggedness, and hot-swappable industrial I/O modules. Each system contains an FPGA for custom timing, triggering, and processing with a wide array of modular I/O to meet any embedded application requirement.

[Configure Your Complete NI CompactRIO System](#)

NI CompactDAQ Platform



NI CompactDAQ is a portable, rugged data acquisition platform that integrates connectivity and signal conditioning into modular I/O to directly interface with any sensor or signal. Using NI CompactDAQ with LabVIEW, you can easily customize how you acquire, analyze, present, and manage your measurement data. From research to development to validation, NI provides programmable software, high-accuracy measurements, and local technical support to help ensure you meet your exact measurement application requirements.

[Configure Your Complete NI CompactDAQ System](#)

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Ordering Information

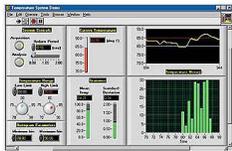
For a complete list of accessories, visit the product page on ni.com.

Products	Part Number	Recommended Accessories	Part Number
NI 9205 Voltage			
NI 9205 with Spring Terminals Requires: 1 Connectivity Accessories ;	779519-01	Connectivity Accessories: screwTerminal - NI 9940 Extra Strain relief, operator protection (qty 1)	779567-01

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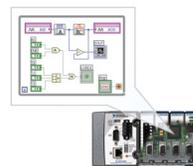
Software Recommendations

LabVIEW Professional Development System for Windows



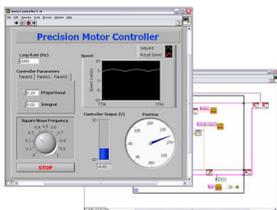
- Advanced software tools for large project development
- Automatic code generation using DAQ Assistant and Instrument I/O Assistant
- Tight integration with a wide range of hardware
- Advanced measurement analysis and digital signal processing
- Open connectivity with DLLs, ActiveX, and .NET objects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

NI LabVIEW FPGA Module



- Design FPGA applications for NI reconfigurable I/O (RIO) hardware targets
- Program with the same graphical environment used for desktop and real-time applications
- Execute control algorithms with loop rates up to 300 MHz
- Implement custom timing and triggering logic, digital protocols, and DSP algorithms
- Incorporate existing HDL code and third-party IP including Xilinx CORE Generator functions
- Included in the LabVIEW Embedded Control and Monitoring Suite

NI LabVIEW Real-Time Module



- Design deterministic real-time applications with LabVIEW graphical programming
- Download to dedicated NI or third-party hardware for reliable execution and a wide selection of I/O
- Take advantage of built-in PID control, signal processing, and analysis functions
- Automatically take advantage of multicore CPUs or set processor affinity manually
- Includes real-time OS, development and debugging support, and board support
- Purchase individually or as part of a LabVIEW suite

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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.

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Detailed Specifications

The following specifications are typical for the range -40 to 70 °C unless otherwise noted. All voltages are relative to COM unless otherwise noted.

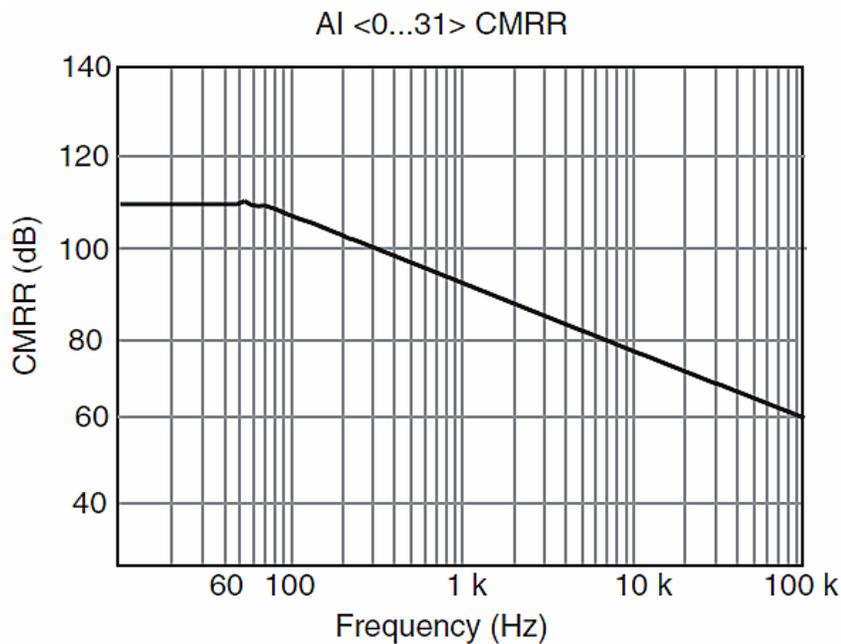
Analog Input Characteristics	
Number of channels	32 single-ended or 16 differential analog input channels, 1 digital input channel, and 1 digital output channel
ADC resolution	16 bits
DNL	No missing codes guaranteed
INL	Refer to the <i>AI Absolute Accuracy Tables and Formulas</i>
MTBF	775,832 hours at 25 °C; Bellcore Issue 6, Method 1, Case 3, Limited Part Stress Method



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

Conversion time	
R Series Expansion chassis	4.50 μ s (222 kS/s)
All other chassis	4.00 μ s (250 kS/s)
Input coupling	DC
Nominal input ranges	± 10 V, ± 5 V, ± 1 V, ± 0.2 V
Minimum overrange (for 10 V range)	4%
Maximum working voltage for analog inputs (signal + common mode)	Each channel must remain within ± 10.4 V of common
Input impedance (AI-to-COM)	
Powered on	>10 G Ω in parallel with 100 pF
Powered off/overload	4.7 k Ω min
Input bias current	± 100 pA
Crosstalk (at 100 kHz)	
Adjacent channels	-65 dB
Non-adjacent channels	-70 dB
Analog bandwidth	370 kHz
Overvoltage protection	
AI channel (0 to 31)	± 30 V (one channel only)
AISENSE	± 30 V
CMRR (DC to 60 Hz)	100 dB

Typical AI+ to AI- CMRR graph



Settling time for multichannel measurements, accuracy, all ranges	
± 120 ppm of full-scale step (± 8 LSB)	4 μ s convert interval
± 30 ppm of full-scale step (± 2 LSB)	8 μ s convert interval
Analog triggers	
Number of triggers	1
Resolution	10 bits, 1 in 1,024
Bandwidth (-3 dB)	370 kHz
Accuracy	$\pm 1\%$ of full scale

Scaling coefficients	
Nominal Range (V)	Typical Scaling Coefficient ($\mu\text{V}/\text{LSB}$)
± 10	328
± 5	164.2
± 1	32.8
± 0.2	6.57

AI Absolute Accuracy Tables and Formulas

The values in the following tables are based on calibrated scaling coefficients, which are stored in the onboard EEPROM.

Accuracy summary			
Nominal Range (V)	Absolute Accuracy at Full Scale ¹ (μV)	Random Noise, σ (μV_{rms})	Sensitivity ² (μV)
± 10	6,230	240	96.0
± 5	3,230	116	46.4
± 1	690	26	10.4
± 0.2	174	10	4.0

Accuracy details						
Nominal Range (V)	Residual Gain Error (ppm of Reading)	Gain Tempco (ppm/ $^{\circ}\text{C}$)	Reference Tempco	Residual Offset Error (ppm of Range)	Offset Tempco (ppm of Range/ $^{\circ}\text{C}$)	INL Error (ppm of Range)
± 10	115	11	5	20	44	76
± 5	135	11	5	20	47	76
± 1	155	11	5	25	66	76
± 0.2	215	11	5	40	162	76

Absolute accuracy formulas

$AbsoluteAccuracy = Reading \cdot GainError + Range \cdot OffsetError + NoiseUncertainty$

$GainError = ResidualGainError + GainTempco \cdot TempChangeFromLastInternalCal + ReferenceTempco \cdot TempChangeFromLastExternalCal$

$OffsetError = ResidualOffsetError + OffsetTempco \cdot TempChangeFromLastInternalCal + INL_Error$

$NoiseUncertainty = (RandomNoise \cdot 3) / \sqrt{100}$ for a coverage factor of 3σ and averaging 100 points.

Absolute accuracy at full scale on the analog input channels is determined using the following assumptions:

$TempChangeFromLastExternalCal = 70\text{ }^{\circ}\text{C}$

$TempChangeFromLastInternalCal = 1\text{ }^{\circ}\text{C}$

$NumberOfReadings = 100$

$CoverageFactor = 3\sigma$

For example, on the 10 V range, the absolute accuracy at full scale is as follows:

$GainError = 115\text{ ppm} + 11\text{ ppm} \cdot 1 + 5\text{ ppm} \cdot 70$

$GainError = 476\text{ ppm}$

$OffsetError = 20\text{ ppm} + 44\text{ ppm} \cdot 1 + 76\text{ ppm}$

$OffsetError = 140\text{ ppm}$

$NoiseUncertainty = (240\text{ }\mu\text{V} \cdot 3) / \sqrt{100}$

$Noise\ Uncertainty = 72\text{ }\mu\text{V}$

$AbsoluteAccuracy = 10\text{ V} \cdot 476\text{ ppm} + 10\text{ V} \cdot 140\text{ ppm} + 72\text{ }\mu\text{V}$

$AbsoluteAccuracy = 6,232\text{ }\mu\text{V}$ (rounds to 6,230 μV)

Digital Characteristics

Digital input logic levels		
Level	Min	Max
Input high voltage (V_{IH})	2.0 V	3.3 V
Input low voltage (V_{IL})	0 V	0.34 V

Digital output logic levels		
Level	Min	Max
Output high voltage (V_{OH}), sourcing 75 μ A	2.1 V	3.3 V
Output low voltage (V_{OL}), sinking 250 μ A	0 V	0.4 V

Overvoltage protection ± 30 V

External digital triggers

Source PFI0

Delay 100 ns max



Note The digital output channel is supported only in CompactRIO systems.

Power Requirements

Power consumption from chassis

Active mode 625 mW max

Sleep mode 15 mW

Thermal dissipation (at 70 °C)

Active mode 625 mW max

Sleep mode 15 mW

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

NI 9205 with spring terminal 158 g (5.8 oz)

NI 9205 with DSUB 148 g (5.3 oz)

Safety

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

Maximum Voltage ³

Connect only voltages that are within the following limits.

AI, PFI0, and DO-to-COM ± 30 VDC

NI 9205 with Spring Terminal Isolation Voltages

Channel-to-channel None

Channel-to-earth ground

Continuous 250 V_{rms}, Measurement Category II

Withstand 2,300 V_{rms}, verified by a 5 s dielectric withstand test

Measurement Category II is for measurements performed on circuits directly connected to the electrical distribution system. This category refers to local-level electrical distribution, such as that provided by a standard wall outlet (e.g., 115 V for U.S. or 230 V for Europe). Examples of Measurement Category II are measurements performed on household appliances, portable tools, and similar products.



Caution Do *not* connect the NI 9205 with spring terminal to signals or use for measurements within Measurement Categories III or IV.

NI 9205 with DSUB Isolation Voltages

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 ⁴ 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 9205 with DSUB 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 nC IIC T4
Canada (C-UL)	Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, Ex nC IIC T4
Europe (DEMKO)	EEx nC 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 a backshell kit or shielded cable to protect the connections. Use the NI 9940 backshell for the NI 9205 with spring terminal and a 37-pin shielded cable or the NI 9933 backshell for the NI 9205 with DSUB.

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 (Analog Input)

You can obtain the calibration certificate and information about calibration services for this device at ni.com/calibration.

Calibration interval 2 years

¹ Absolute accuracy values at full scale on the analog input channels assume the device is operating within 70 °C of the last external calibration and are valid for averaging 100 samples immediately following internal calibration. Refer to the *Absolute accuracy formulas* for more information.

² Sensitivity is the smallest voltage change that can be detected. It is a function of noise.

³ The maximum voltage that can be applied or output between AI and COM without creating a safety hazard.

⁴ 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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