Electrical and Temperature Metrology Products Guide

Discover the "Blue Box" Difference

Measurements International

Metrology is Our Science, Accuracy is Our Business™

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Measurements International (MI) is recognized worldwide as the premier metrology company, delivering Innovative Standards Technology for both the Metrology Industry and the AC Power Industry.
For the Metrology Industry MI designs, develops, and manufactures advanced Electrical and Temperature Metrology Instruments powered by our world-leading AccuBridge® technology.
For the AC Power Industry MI produces High-Voltage Transformer Test Instruments, Capacitance/ Inductance Bridges, Voltage Dividers, Wattmeters, and Current Transformers, featuring AccuLoss® technology and two-stage-compensated Current Transformers.
All MI instruments are built to the highest standards of quality, ensuring accuracy, reliability, and long-term support for our customers worldwide.

The Quantized Hall Resistance Standard is Internationally recognized as the representation of the ohm and is the most stable resistance standard known. Many developing countries and industries are finding a need to provide highly accurate, traceable reference standards in support of their "hi-tech" environments. The 6800C/6820T System has been developed to meet the needs of National Laboratories and Primary Industrial Laboratories around the world.

AccuBridge®

6820T QHR Standard

- Cryogen Free
- System Accuracy to < 0.015 μΩ/Ω (6020Q)
- System Accuracy to < 0.003 μΩ/Ω (CCC)
- Built-in Rxx (uV Measurements in ADCC Bridge
- Built-in Rxx (nV) Measurements in ADCC Bridge
- 5 T Standard System Magnet
- No Liquid Helium or Gas Required
- Stable Controlled Sample Environment
- Temperature Range < 4 K
- Low Operating Costs
- Direct Transfer to 1 kΩ and 10 kΩ Standards
- System Range 0.1 Ω to 10 kΩ
- Graphene Based System
- Features AccuBridge® Technology

6800C QHR Standard

- System Accuracy to < 0.015 μΩ/Ω (6020Q)
- System Accuracy to < 0.003 μΩ/Ω (CCC)
- Built-in Rxx (μV) Measurements in ADCC Bridge
- Built-in Rxx (nV) Measurements in ADCC Bridge
- 9 T Standard System Magnet (Up to 14 T)
- No Liquid Helium Required
- Stable Controlled Sample Environment
- Temperature Range 1.3 K to 300 K
- Direct Transfer to 1 kΩ and 10 kΩ Standards
- System Range 0.1 Ω to 10 kΩ
- Graphene/Gallium Compatible

6200A Cryogenic Current Comparator CCC

- Best Accuracy of < 0.003 μΩ/Ω
- Resistance Range 0.1 Ω to 1 MΩ
- Ratios 1:1, 10:1, and 100:1
- Designed by Dr. Carlos Sanchez
- Helium re-condensing unit for low-loss system
- Operate via Front Panel or Computer Controlled Operation

Feature	Benefit
Measurement Range 0.1 Ω to 1 MΩ	Offers users a wide range of measurements at very low uncertainties.
Re-condensing unit for low-loss helium	Offers continuous operation without need for liquid helium supply.
Wide Ratio capabilities for comparison of standard resistors to QHR	R_K/2:100 Ω, R_K/4:100 Ω, R_K/2:1 kΩ and R_K/2:10 kΩ

The design of the CCC Bridge draws on the expertise of Dr. Carlos Sanchez, a former researcher at the National Research Council of Canada with a wide knowledge of precision electrical metrology and many years of experience in the design and operation of CCC Bridges and Quantum Hall Resistance Standards (QHR).

6020 Series of Bridges

Featuring

- New Micro-Controller for improved speed and functionality
- Capacitive touchscreen with enhanced design and easy-to-use operation
- New PID for enhanced accuracy and stability
- Zero filter option

"The 6020 series brings the world's best DCC bridge technology to todays standards, for superior performance"

6020Q

- Best Accuracy < 0.015 μΩ/Ω
- Resistance Range 0.1 Ω to 13 kΩ
- Maximum Ratio 14:1
- Advanced Current Algorithm following CCC methodology
- Optional LEMO Connectors for resistor connections
- Quantum Hall Applications including Gallium Arsenide and Graphene Sample Measurements
- Vcr, Vxx, and Vxy Measurements
- Self-Calibration of the Binary Wound Current Comparator (27-bit) Plus Nanovolt Detector Reading
- Capacitive 7" Touch Screen
- IEEE488.2 Standard

6020A Automated Resistance Bridge

- Best Accuracy < 0.025 μΩ/Ω
- Range 0.001 Ω to 13 kΩ
- Next Generation Bridge
- Maximum Ratio 14:1
- IEEE488.2 Standard
- System Integration with Measurements International (MI) Matrix Scanners and High-Current Range Extenders
- Two Selectable Measurement Algorithms

6020HR

- Best Accuracy < 0.1 μΩ/Ω
- Range 0.001 Ω to 1 GΩ
- Maximum Ratio 100:1
- Voltage to 1000 V
- IEEE488.2 Standard
- System Integration with Measurements International (MI) Matrix Scanners and High-Current Range Extenders

Up to 1000 V
Resistance to 1 GΩ

6020HRX

- Best Accuracy < 0.03 μΩ/Ω
- Range 0.001 Ω to 1 GΩ
- Maximum Ratio 100:1
- Voltage Range 1000 V
- IEEE488.2 Standard
- System Integration with Measurements International (MI) Matrix Scanners and High-Current Range Extenders

6020A Systems to 10,000 A

- Modular design base unit with expanded capabilities to 10,000 A
- Ratio ranges 1 to 1,000,000:1
- Complete turnkey system
- Linearity <0.01 μΩ/Ω
- Complete measurement systems available
- System accuracy of < 2 ppm above 1000 Amps

6000C Primary High Resistance Bridge

- Featuring True Ratio Self Calibration
- Range 10 kΩ to 1 TΩ
- Built in 4 Channel Matrix Scanner
- Accuracy < 0.02 μΩ/Ω for 10 kΩ Ratios
- Accuracy < 0.5 μΩ/Ω for 100 MΩ Ratios
- Linearity < 5×10^{-9}
- Full System Solutions and Full System Integration Using MI 1000B 110 V Source, 6000C Software and 4200 Series of Matrix Scanners

6652A High Resistance Meter
(2 Models: Premium & Basic)

- 1 MΩ to 100 TΩ
- Direct or Substitution Measurements
- Automatic and Manual Operation
- No Temperature Coefficient
- Multiple Modes of Operation
- Variable 1 V to 1000 V DC
- 6.5 Digits of Resolution
- Compatible with Model 4610 High Resistance Scanner

6600A Dual Source High Resistance Bridge

- Range: 100 kΩ to 10 PΩ
- Not Affected by Temperature Change
- 10- Channel Coaxial Matrix Scanner (Optional)
- Environmental and Pressure Monitoring (Optional)
- Ratio 1:1, 10:1, 100:1, 1000:1
- Multiple Modes of Operation

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Thermometry Products

6020T-P Thermometry Bridge

- Best Accuracy ± 0.015 ppm from 1 Ω to 10 kΩ (equivalent accuracy of 0.004 mK at TPW[1])
- Range 0.1 Ω to 10 kΩ
- 6 Channel Front Panel Scanner with Keep Warm Currents
- Current Reversal Rate as Low as 1 Second
- Time to first measurement < 25 seconds
- Store Calibration Coefficients for up to 5 Thermometers without Software Aide

6020T-B Thermometry Bridge

- Best Accuracy 0.07 ppm
- Range 0.1 Ω to 10 kΩ
- Multiple Display Modes Including:
    - Temperature (°C, K, °F)
    - Resistance, Ω
    - Ratio
- 6 Channel Front Panel Scanner with Keep Warm Currents
- Current Reversal Rate as Low as 1 Second
- Time to first measurement < 25 seconds
- Store Calibration Coefficients for up to 5 Thermometers without Software Aide

1310T Temperature Resistance Standard with built in scanner

- Exceptional Stability
- Cost Effectiveness
- 10 Ω, 25 Ω, 100 Ω, 200 Ω, 400 Ω and 1000 Ω Internal Standards + 1 external channel
- Built-in Temperature Chamber for Optimal
- Other resistor values available on request

Scanners

4210A/B Automated Low-Thermal Matrix Scanner

- 10 Four-Terminal Channels
- 4-Conductor Wire or Binding Post Inputs
- Optional 30 A Capacity
- Low-Thermal Matrix Design
- 1000 V DC
- Insulation Resistance > 10^{12} Ω
- Front Panel or IEEE-488 Interface

4220A/B Automated Low-Thermal Matrix Scanner

- 20 Four-Terminal Channels
- 4-Conductor Wire or Binding Post Inputs
- Optional 30 A Capacity
- Low-Thermal Matrix Design
- 1000 V DC
- Insulation Resistance > 10^{12} Ω
- Front Panel or IEEE-488 Interface

4610A High Resistance Coaxial Matrix Scanner

- 10 - Two Terminal Channels
- N-Type Connections
- Front Panel or Remote Operation
- Maximum 1000 V Peak
- Resistance Measurements to 10 PΩ
- Insulation Resistance >10^{16} Ω

DC SOURCES FOR USE AS STAND ALONE OR WITH 6000C HIGH RESISTANCE BRIDGE

1000B 110V Reference Standard

- For Use with MI 6000C

MI is Fully Accredited in Both AC & DC Measurement Disciplines
www.mintl.com

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Range Extenders & Power Supplies

6011D Range Extender with Reversing Switch

- Modular Designed Base Unit with Expanded Capabilities to 3000 A
- Ampere-Turn Sensitivity = 2 μAT=0.02 ppm
- Precision Shunts and DCCT Calibrations
- Bench Top or Rack Mount Configurations

6150A Linear DC Power Supply

- Linear Technology
- Capable of Driving Inductive Loads
- Improved Settling Time
- Two Current Ranges
- IEEE-488 Interface

6511D Automated Range Extender with DC Power Supply

- Modular Designed Base Unit with Expanded Capabilities
- Completely Automated,
- Currents up to 10 A
- Internal Supply
- Shunts and DCCT Calibrations
- Bench Top or Rack Mount Configurations

HIGHER CURRENT SYSTEMS TO 20,000 AMPS AND BEYOND ARE AVAILABLE

High Current Resistors & Shunts

6311A Precision Current Divider

- 10A (100:1) and 300A (1000:1) Ranges
- No Stabilization Period
- No Power Coefficient
- No Temperature Coefficient
- DC and AC Operation

9332 Series of High Current Resistors

- Based on NMI Design with Controlled Current Distribution
- Air or Oil Cooled Applications
- Special Values Available upon Request
- Impoved Power Dissipation

6314A Precision Current Divider

- 1000:1 Range
- No Stabilization Period
- No Power Coefficient
- No Temperature Coefficient
- DC and AC Operation
- 3000 A Max Current DC

Primary Oil Resistors 0.1Ω to 100KΩ

9210A-1 1Ω and 0.1Ω Resistor with Carrying Case

- Replacement for Thomas 1 Ω
- Temperature Coefficient < 5 x 10^{-8}/°C
- Long Term Drift < 2 x 10^{-7}/Year
- No Pressure Coefficient
- Maximum Dissipation 100 mW
- Highest Performance Dissipation 10 mW

9210B Reference Series Standard AC/DC Oil Resistors

- Decade Values 0.1 Ω, 1 Ω, 10 Ω, 100 Ω, 1 kΩ, 10 kΩ, 100 kΩ with Optional Carrying Case
- Temperature Coefficient < 1 x 10^{-7}/°C
- Long Term Drift < 1 x 10^{-6}/Year
- No Pressure Coefficient
- Maximum Dissipation 100 mW
- Highest Performance Dissipation 10 mW

Well designed! The most accurate result can be achieved with minimized temperature *coefficient, pressure coefficient and power effects in the measurement!*

Air Resistors

9331R Precision Standard AC/DC Reference

- High Stability
- 0.1 Ω to 100 MΩ
- Operating Range 18°C to 28°C
- Custom Values Available
- Metal Foil Technology
- Ultra-Low Temperature Coefficient
- Typical AC/DC Error (up to 1kΩ) < 1 μΩ/Ω up to 1 kHz

9331G Series

- Primary High Value 2 Terminal Resistors from 10 MΩ to 100 TΩ
- High Stability
- Split Guard Circuit
- Internal Temperature Sensor
- Custom Values Available

9331 Standard AC/DC Air Resistor

- High Stability
- 100 μΩ to 100 MΩ
- Operating Range 18°C to 28°C
- Custom Values Available
- Low-Temperature Coefficient
- No Air or Oil Bath Required
- Typical AC/DC Error (up to 1 kΩ) < 1 μΩ/Ω up to 1 kHz

MI Calibration Services

DC Measurements

- ISO/IEC 17025 Accredited Calibration Service
- Traceable to the SI through NRC, NIST, NPL UK and METAS
- Lowest Uncertainity Levels for Resistance Calibration from 1 μΩ to 1 PΩ
- Accredited Calibrations available for resistance standards from 1 μΩ to 1 PΩ
- Fast and Reliable Turnaround Time
- Email us at micallab@mintl.com with your Inquiry

AC Calibration Services

- Power and Energy up to 240 V, 5 A
- High Voltage Capacitors
- AC Voltages to 100 kV
- AC Currents to 2000 A
- High Voltage Divider Calibration
- Current Transformer Calibration
- PD Calibration to 250 kV

Certificate of Accreditation

ACCREDITED CALIBRATION LABORATORY
For specific measurement capabilities which are hereby CERTIFIED by CLAS

NRC CLAS Certificate No. 2004-01

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Temperature Controlled Air Resistors

4304 Traveling Resistance Standard

- Battery Backup
- 1 Ω, 10 kΩ, 1 MΩ & 100 MΩ Values
- Custom Values Available
- Stability < 2.5 μΩ/Ω/Year
- Temperature Coefficient < 5 x 10^{-9}/°C
- Temperature Regulation ± 0.01°C/Year

4310 Temperature Stabilized Resistance Standard

- 6-10 Decade Values
- Resistance Range 0.1 Ω to 100 MΩ
- Other Values Available
- Thermometry Values Available
- Four-Terminal Connections
- < 2.5 μΩ/Ω/Year
- Temperature Coefficient < 5 x 10^{-9}/°C
- Temperature Regulation ± 0.01°C per Year

4310HR Temperature Stabilized Resistance Standard

- 100 MΩ to 10 TΩ Elements
- Other Values Available
- N-Type Connectors
- Temperature Coefficient < 0.2 μΩ/Ω/°C
- Eliminates Oil Bath/Air Bath Requirements
- Low-Thermal EMF's - Shielded Chamber
- Temperature Regulation: ± 0.01°C Per Year

1310A Automated Resistance Standard

- Exceptional Stability
- Cost-effectiveness
- 9 Values + 1 external value
- Customizable

Air Baths

9300A Temperature Controlled Standard Resistor Air Bath with GPIB

- Volume 106 Litres
- Temperature Ranges 15°C to 40°C
- Stability ± 0.005°C @ 23°C
- Peltier Cooled
- Fast Heating/Cooling Rate
- Stainless Steel Construction
- Perfect for Temperature Coefficient Measurements
- Large Working Area
- Temperature Band Protection
- IEEE-488.2

Oil Baths

9400 Standard Resistor Oil Bath

- Peltier Cooled
- DC Stirrer Motors for Low Electrical Noise
- Dual Drain Ports
- Adjustable Stir Speed
- 2-Stage Temperature Band Protection
- Free Standing Bench Height
- Compatible with MI Bridge Software
- Grounded Stainless Steel Tank
- Optional 10-Channel Interface Panel

Best in the class with its proven stability, and excellent performance for the applications of being as a transfer standard or working under the rugged condition !

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Voltage Measurement

8000C Binary Voltage Divider

- 20-Channel Scanner
- Bipolar Voltage Measurements
- Best Accuracy < 0.05 µV/V
- Standard Cell Protection
- Voltage Maintenance Programs
- Calibration of Fluke 57X0A
- Linearity Calibration of DMM's
- Traceability to 10 V Zener Reference

8000C/8001C Automated 1200V Voltage Mesaurement System

- Intrinsically Accurate Self-Calibratin Ratio Divider
- Best Accuracy < 0.05 µV/V
- Built-in 20-Channel Scanner
- Arbitrary Voltages from 1 mV to 1200 V
- Bipolar Voltage Measurements
- Calibration of Fluke 57X0A
- Calibration of 3458A and 8508A
- Calibration of Voltage Ratio Dividers (F752A, MI1340A, G7520)
- Linearity Calibration of DMM's
- Traceability to 10 V Zener Reference

8110A - 10 V Reference

- 8110A 10 volt reference
- Industry Leading Stability
- Built-in reversing switch for + 10 V, – 10 V
- 30 Days: ± 0.25 µV/V
- 90 Days: ± 0.75 µV/V
- 1 Year: ± 1.5 µV/V
- Built-in battery backup

8001C Range Extender

- Calibrate the Calibrator
- 10 V, 30 V, 120 V, 300 V & 1200 V Ranges
- Best Accuracy < 0.1 µV/V
- Self Calibrating using 8000C
- Optional Lab Temperature, Humidity and Pressure Monitoring

1340A High Precision Voltage Divider

- High Stability
- No Self-Alignment
- 10:1, 100:1, 1000:1 and 10,000:1 reference divider inputs to 1100 V

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NEW PRODUCTS

6311A Precision Current Divider

- 10A (100:1) and 300A (1000:1) Ranges
- No Stabilization Period
- No Power Coefficient
- No Temperature Coefficient
- DC and AC Operation

Replaces Current Shunts up to 300 A

6314A Precision Current Divider

- 1000:1 Range
- No Stabilization Period
- No Power Coefficient
- No Temperature Coefficient
- DC and AC Operation
- 3000 A Max Current DC

Replaces Current Shunts from 300 A to 3000 A

1310A Automated Resistance Standard

- Exceptional Stability
- Cost-effectiveness
- 9 Values + 1 external value
- Customizable

Temperature Controlled Design for Improved Stability

1330A Artifact Transfer Standard

- Fully Automated Artifact Calibration of Calibrators and DMMs from a Single Instrument
- Primary 1 Ω and 10 kΩ
- 10 V Zener Reference

Three Artifacts for DVM & Calibrator Calibration

1340A High Precision Voltage Divider

- High Stability
- No Self-Alignment
- 10:1, 100:1, 1000:1 and 10,000:1 reference divider inputs to 1100 V

No Self Alignment Required

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