



DISCOVER ^{THE}
“BLUE BOX”
DIFFERENCE

ELECTRICAL AND TEMPERATURE METROLOGY PRODUCTS GUIDE



Measurements International
Metrology is Our Science, Accuracy is Our Business™

Metrology is our Science, Accuracy is Our Business™

Measurements International (MI) is the world's premier metrology company. MI provides innovative Standards Technology for both the Metrology and AC Power Industries. For the Metrology industry MI designs, develops, and manufactures electrical and temperature metrology instruments using AccuBridge™ technology. For the AC power industry MI designs, develops and manufactures high-voltage transformer test instruments, capacitance/Inductance Bridges, voltage dividers, wattmeters and current transformers using the AccuLoss™ and two-stage-compensated current transformers. All instruments are manufactured with the highest quality in support of our customer's organization.

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 6800 system has been developed to meet the needs of National Laboratories and Primary Industrial Laboratories around the world.

Don't be misled by other manufacturers claims. Ask for references and consult any NMI in regards to modern resistance measurement systems.

AccuBridge™

Self Calibrating Primary Resistance Bridge



- Featuring true ratio self calibration
- Self Calibrating Master and Slave Current Source
- Self Calibrating Nanovolt Detector
- Binary wound current comparator
- Range 0.01Ω to 100KΩ
- Quantum Hall applications including V_{xx} (3 terminal Contact Resistance, Dissipation) and V_{xy} Measurements
- 7" touch screen and USB
- Accuracy < 20 x 10⁻⁹
- Linearity < 5 x 10⁻⁹

MI CALIBRATION SERVICES

DC Measurements

- ISO/IEC 17025 accredited calibration service
- Direct traceability to NRC, NIST, NPL UK and METAS
- Lowest uncertainty levels for resistance calibration from 1μΩ to 100TΩ
- Four different calibration methods available depending on the standard
- Fast and reliable turnaround time
- Email us at micallab@mintl.com with your inquiry

AC Calibration Service

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



6800

Automated QHR "Turn Key" Intrinsic Resistance Standard with AccuBridge™ Measurement Technology

- Transportable & affordable
- Manual or IEEE488 controlled
- Accuracy to 10 x 10⁻⁹
- Modular turn key system
- Transfer to 1Ω and 10KΩ Resistance Standard
- Built in controller

MI is fully Accredited in both
AC & DC Measurement Disciplines
www.micallab.com



6242/300 or 6010/300 Resistance System

- 10uA to 300A
- Consisting of 6242/300 or 6010/300 self calibrating system
- Resistance range 0.1uΩ to 100MΩ with 6242B
- Bridge accuracy's as low as 50×10^{-9} with 6242B
- Resistance range 0.1uΩ to 100kΩ with 6010D
- Bridge accuracy's as low as 20×10^{-9} with 6010D
- Linearity $< 5 \times 10^{-9}$
- Optional 4310 Resistance Standard
- Optional 4200 Series of Scanner
- Complete turnkey system

6242/5000 or 6010/5000 Resistance System

- 10uA to 5000A, (custom systems to 20 000 Amps and beyond available!)
- Consisting of 6242or 6010 self calibrating resistance Bridge
- Resistance range 0.1uΩ to 100MΩ with 6242B
- Bridge accuracy's to $< 50 \times 10^{-9}$ with 6242B
- Resistance range 0.1uΩ to 100kΩ with 6010D
- Bridge accuracy's to $< 20 \times 10^{-9}$ with 6010D
- Linearity $< 5 \times 10^{-9}$
- Optional 4310 Resistance Standard
- Optional 4200 Series of Scanner
- Complete turn key system



The MI series of 6010 Bridges are used in nearly every NMI around the world as well as the US AirForce, US Army, US Navy Primary and Lockheed's Laboratories for their superior speed and low uncertainties.

RESISTANCE RATIO BRIDGES

6010D

Automated Primary Resistance/Thermometry Bridge



- Featuring true ratio self calibration
- Range 0.001Ω to 100KΩ
- 7" touch screen and USB
- Accuracy $< 40 \times 10^{-9}$ for 1:1 ratios
- Accuracy $< 40 \times 10^{-9}$ for 10:1 ratios
- Linearity $< 5 \times 10^{-9}$
- Binary wound current comparator
- Manual and automatic operation
- Full system solutions and full system integration with 4200 series of Matrix Scanners and 6011 Range Extenders

6242B

Automated Secondary Resistance/Temperature Bridge



- Featuring true ratio self calibration
- Range 0.001Ω to 100KΩ
- 7" touch screen and USB
- Accuracy $< 10 \times 10^{-8}$ for 1:1 ratios
- Accuracy $< 10 \times 10^{-8}$ for 10:1 ratios up to 10KΩ
- Accuracy $< 7 \times 10^{-6}$ at 100MΩ
- Linearity $< 5 \times 10^{-9}$
- Binary wound current comparator
- Manual and Automatic Operation
- Full system solutions and full system integration with 4200 series of Matrix Scanners and 6011 Range Extenders

6000B

Automated Primary High Resistance Bridge



- Featuring true ratio self calibration
- Range 10kΩ to 1TΩ
- Built in 4 channel matrix scanner
- Accuracy $< 20 \times 10^{-9}$ for 10kΩ ratios
- Accuracy $< 0.5 \times 10^{-6}$ for 100MΩ
- Linearity $< 5 \times 10^{-9}$
- Full system solutions and full system integration using MI 1000B 110V Source, 6000B software and 4200 series of Matrix Scanners

6600A

Dual Source Resistance Bridge



- Based on NMI Design
- Resistance Range: 100kΩ to 1PΩ
- More Accurate than Teraohmmeters
- Logging, Graphing and Measurement Analysis
- Automatic Operation
- Bridge Measurement Mode
- Direct Measurement Mode



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THERMOMETRY PRODUCTS

6010T

Automated Thermometry Bridge - 14:1 Ratio



- 0.01 Ω to 10k Ω range
- Front or rear panel inputs
- Accuracy < 50 x 10⁻⁹
- Linearity < 5 x 10⁻⁹
- IEEE488 and manual operation
- AccuTcal™ Software for calibrating PRT's

6242T

Automatic Temperature Secondary Bridge - 13:1 Ratio



- 0.01 Ω to 100k Ω range
- Front panel 6 channel scanner
- Keep Warm Currents
- Accuracy < 10 x 10⁻⁸
- Linearity < 5 x 10⁻⁹
- IEEE488 and manual operation
- AccuTcal™ Software for calibrating PRT's

SCANNERS

4210A

10 Channel Four Terminal Matrix Scanner Tellurium Copper Terminals



- 10 four terminal tellurium copper inputs
- 2 four terminal tellurium copper outputs
- Sealed relays
- 4A carrying current
- 250 Volts
- Error contribution < 20 nV
- Insulation resistance 10¹⁴ Ω
- Front panel or IEEE operation

4216A

16 Channel Four Terminal Matrix Scanner Tellurium Copper Terminals



- 16 four terminal tellurium copper inputs
- 2 four terminal tellurium copper outputs
- Sealed relays
- 4A carrying current
- 250 Volts
- Error contribution < 20 nV
- Insulation resistance 10¹⁴ Ω
- Front panel or IEEE operation

4220A

20 Channel Four Terminal Matrix Scanner Tellurium Copper Terminals



- 20 four terminal tellurium copper inputs
- 2 four terminal tellurium copper outputs
- Sealed relays
- 4A carrying current
- 250 Volts
- Error contribution < 20 nV
- Insulation resistance 10¹⁴ Ω
- Front panel or IEEE operation

6015T

Automated Thermometry Bridge - 1.5:1 Ratio



- Self Calibrating Ratio Bridge
- 0.1 Ω to 100k Ω range
- Front or rear panel inputs
- Accuracy < 20 x 10⁻⁹
- Linearity < 5 x 10⁻⁹
- IEEE488 and manual operation
- AccuTcal™ Software for calibrating PRT's

MI9060

Precision Thermometer



- Accuracy +/- 0.01°C
- Resolution 0.0001°C
- Dual Channels
- Data Storage into USB flash disk
- Wireless data transfer to PC

4210B

10 Channel Four Terminal Matrix Scanner 4 Conductor Teflon Cable



- 10 four wire teflon cable inputs
- 2 four wire teflon cable outputs
- Sealed relays
- 4A carrying current
- 250 Volts
- Error contribution < 20 nV
- Insulation resistance 10¹⁴ Ω
- Front panel or IEEE operation

4216B

16 Channel Four Terminal Matrix Scanner 4 Conductor Teflon Cable



- 16 four wire Teflon cable inputs
- 2 four wire Teflon Cable outputs
- Sealed relays
- 4A carrying current
- 250 Volts
- Error contribution < 20 nV
- Insulation resistance 10¹⁴ Ω
- Front panel or IEEE operation

4220B

20 Channel Four Terminal Matrix Scanner 4 Conductor Teflon Cable



- 20 four wire Teflon cable inputs
- 2 four wire Teflon Cable outputs
- Sealed relays
- 4A carrying current
- 250 Volts
- Error contribution < 20 nV
- Insulation resistance 10¹⁴ Ω
- Front panel or IEEE operation

DC SOURCES FOR USE AS STAND ALONE OR WITH 6000B HIGH RESISTANCE BRIDGE, 8000A POTENTIOMETER

1000A

100V Reference Standard Manual Selection



- 7 selectable voltage ranges of 1, 2, 5, 10, 20, 50 & 100 volt
- Stability: < 1 PPM - 8 hours
- 6000B or stand alone

1000B

Automated 110V Reference Standard



- DC output from 0 to 110V
- Stability: < 0.1 PPM - 24 hours
- 6000B, 8000A or stand alone

HIGHER CURRENT SYSTEMS ARE AVAILABLE!

RANGE EXTENDERS AND POWER SUPPLIES

6011D/100/300/400

400A Range Extender and Power Supply



- 100, 300, 400 amp capability
- Automatic Range selection
- 10:1, 100:1, 1000:1, 10,000:1, 100,000:1, 1,000,000:1 Ratios
- 10:1, 100:1, 1000:1 Ratio Accuracy < 0.2×10^{-6}
- 10,000:1, 100,000:1, 1,000,000:1 Ratio Accuracy < 1×10^{-6}
- Self-balancing
- For use with the Self Calibrating 6010D or 6242B Resistance Ratio Bridge
- Built in Reversing Switch
- IEEE488 or manual operation

6011D/1000/3000/5000

5000A Range Extender and Power Supply

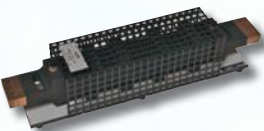


- 1000, 3000, 5000 amp capability
- Shielded Rack
- Automatic Range selection
- 10:1, 100:1, 1000:1, 10,000:1, 100,000:1, 1,000,000:1 Ratios
- 10:1, 100:1, 1000:1 Ratio Accuracy < 0.3×10^{-6}
- 10,000:1, 100,000:1, 1,000,000:1 Ratio Accuracy < 1×10^{-6}
- Self-balancing
- For use with the Self Calibrating 6010D or 6242B Resistance/Ratio Bridge
- Built in Reversing Switch
- IEEE488 or manual operation

HIGH CURRENT RESISTORS AND SHUNTS

9332

Series of High Current Resistors from 10A to 3000A with Optional Air Moving Fans



- Based on NMI design with controlled current distribution
- Stability < 10×10^{-6} long term
- Air or oil cooled applications
- Special values available on request
- Implanted thermocouples
- Improved power dissipation

9311A

Multiple Value Resistor Shunt



- 9 Current ranges
- 0.1mA to 300A
- Accuracy to <0.01%
- Improved temperature coefficient < Temperature coefficient $3 \times 10^{-6}/^{\circ}\text{C}$
- Rack or bench top

9312A

Multiple Value Resistor Shunt



- Calibration of high current meters
- 9 current ranges
- $5\mu\Omega$ to $500\mu\Omega$
- Accuracy's to <0.02%
- Improved temperature coefficient
- Rack or bench top use

9313A

Multiple Value Resistor Shunt



- 5 current ranges
- $1\text{m}\Omega$ to 1Ω
- Accuracy's to <0.02%
- Improved temperature coefficient
- Rack or bench top use



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PRIMARY OIL RESISTORS 0.1Ω TO 100KΩ

9210A-1 (Primary)

1Ω Resistor with Carrying Case



- Replacement for Thomas 1Ω
- Temperature Coefficient $< 0.05 \times 10^{-6}/^{\circ}\text{C}$
- Long term drift $< 0.2 \times 10^{-6}/\text{year}$
- No pressure coefficient
- Maximum dissipation 100 milli-watts
- Highest performance dissipation 10 milli-watts

9210A-0.1 (Primary)

0.1Ω Resistor with Carrying Case



- Temperature Coefficient $< 0.05 \times 10^{-6}/^{\circ}\text{C}$
- Long term drift $< 0.1 \times 10^{-6}/\text{year}$
- No pressure coefficient
- Maximum dissipation 1 watt
- Highest performance dissipation 100 milli-watts

9210B (Primary)

Decade Values 1Ω, 10Ω, 100Ω, 1KΩ, 10KΩ, 100KΩ
with Optional Carrying Case



- Temperature Coefficient $< 2 \times 10^{-7}/^{\circ}\text{C}$
- Long term drift $< 2 \times 10^{-7}/\text{year}$
- Low pressure coefficient
- Maximum dissipation 300 milli-watts
- Highest performance dissipation 10 milli-watts

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

AIR RESISTORS

9331R

High Stability Reference Resistors



- 1Ω to 100kΩ
- Operating Range 18°C to 28°C
- Custom Values Available
- Metal Foil Technology
- Ultra Low Temperature Coefficient

9331G (Primary)

Series of Primary High Value 2 Terminal Resistors
from 100M to 100T with Optional Carrying Case



- Based on NIST design
- High stability
- 100MΩ to 100TΩ
- Split guard circuit
- Internal temperature sensor
- Custom values available

9331 (Secondary)

Series of Four Terminal Air Resistors from
1mΩ to 100MΩ with Optional Carrying Case



- Resistance range 1mΩ to 100M
- Wide operating range 18°C to 28°C
- 12 month stabilities low as 2×10^{-6}
- Nominal initial accuracy $< 2 \times 10^{-6}$
- Temperature coefficients $< 0.4 \times 10^{-6}/^{\circ}\text{C}$
- Special values available on request

Highly efficient, reliable, accurate resistance standards for any and all laboratories!

OIL BATHS

9400 Series

Standard Resistor Oil Bath
75 Liters



- Designed for use with cryogenic current comparator
- Electrical and audibly quiet operation
- Stability and uniformity $< 2\text{mK}$
- Temperature band protection
- Peltier cooled
- Adjustable stir speed
- Pressure option
- IEEE488 & RS232
- Interfaces to 6010, 6242 & 6000B for automatic measurements of temperature coefficients using MI software

9400L

Standard Resistor Oil Bath
150 Liters

- 150L Large Capacity Bath
- Electrical and audibly quiet operation
- Stability and uniformity $< 10\text{mK}$
- Temperature band protection
- Peltier cooled
- Quiet Operation
- IEEE488 & RS232

9400B

Bench top Resistor Oil Bath
20 Liters

- 20L Large Capacity Bath
- Electrical and audibly quiet operation
- Stability and uniformity $< 10\text{mK}$
- Temperature band protection
- Peltier cooled
- Quiet Operation
- IEEE488 & RS232
- Interfaces to 6010, 6242 & 6000B for automatic measurements of temperature coefficients using MI software

AIR BATHS

9300

Temperature Controlled Standard Resistor Air Bath



- Stability and uniformity < 50 mK
- Large working area
- Temperature band protection
- Peltier cooled
- Light weight and portable
- Temperature range 15°C to 40°C

9300A

Temperature Controlled Standard Resistor Air Bath with GPIB



- Stability and uniformity < 15 mK
- Large working area (4 SR104's)
- Temperature band protection
- Peltier cooled
- Stainless steel construction
- Temperature range 15°C to 40°C
- IEEE488
- Interfaces to 6010, 6242 & 6000B for automatic measurements of temperature coefficients using MI software

TEMPERATURE CONTROLLED RESISTANCE STANDARDS

4304 (4 Element)

Temperature Controlled Traveling Resistance Standard



- Battery Backup
- 1Ω, 10kΩ, 1MΩ & 100MΩ Values
- Stability < 2 x 10⁻⁶/year
- Temperature coefficient < 0.005 x 10⁻⁶
- Temperature regulation ±0.01°C/year
- Other values available upon request
- Eliminates oil bath requirement

4310 (10 Element)

Temperature Controlled Fixed Resistance Standard



- 6 to 10 decade values available (0.1Ω to 100MΩ)
- Thermometry values available
- Four terminal connections
- Stability < 2 x 10⁻⁶/year
- Temperature coefficient < 0.005 x 10⁻⁶/°C
- Temperature regulation ±0.01°C/year
- Eliminates oil bath requirement

4310HR (4 to 6 Elements)

Temperature Controlled High Resistance Standard



- 100M to 10T or 1G to 100T
- N type connectors
- Temperature coefficient ± 0.2 PPM/°C
- Eliminates air bath requirements
- Ambient temperature range: 23°C ± 5°C
- Temperature regulation: ± 0.01 °C/year
- Guarded resistance element chamber

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!

VOLTAGE MEASUREMENT

8000A (10V)

Automated Potentiometer



- Built in 20 channel scanner
- Interfaces to 4200 Series of Scanners for additional channels
- Bi Polar Voltage Measurements
- Accuracy < 0.05 x 10⁻⁶
- Linearity < 0.01 x 10⁻⁶
- Standard Cell Protection
- Voltage maintenance programs
- Range to 10 volts
- Calibration of fluke 5700A/5720A
- Linearity calibration of DMM's
- Windows system operating software

8000A RVB

Ratio Verification Box



- Ratio verifications of 8000A to 0.02 PPM
- Requires two Standard Resistors of 10KΩ and 100kΩ

8001A (Extender)

Automated 1200 Volt DC Divider



- Calibrate the calibrator
- 30V, 120V, 300V and 1200V ranges
- Accuracy < 1 PPM
- Self calibrating using 8000A
- Bipolar voltage measurements
- Optional lab temperature, humidity and pressure monitoring



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1987

Measurements International (MI) is founded. Developed Four Terminal Automated Resistance Scanner Model 4220A

1990

Developed first commercial Automated Potentiometer based on the Binary Voltage Divider Technology (BVD), Model 8000A Range 1mV to 10V Accuracy $< 5 \times 10^{-8}$

1992

Develops first commercial automated Direct Current Comparator Resistance Bridge (DCC) Model 6010A, Range 1 Ω to 10k Ω , Accuracy 10^{-7}

1993

Developed first commercial automated High Resistance Bridge for the measurement of resistors. Range 10k Ω to 100M Ω , Accuracy 10^{-6}

1993

MI USA was founded

1997

Re-develops DCC Technology which resulted in the world famous 6010B Resistance Bridge from 0.001 Ω to 10k Ω , Accuracy 10^{-7}

1998

Develops 20,000 A Direct Current Comparator for the LHC at CERN

2002

Develops the world's first and only portable cryogenic QUANT Ω (QHR) System Model 6800A Accuracy 1×10^{-8}

25th Anniversary

2003

Developed the world's first room temperature Direct Current Comparator DCC Bridge (6010Q) for cryogenic applications Accuracy 2×10^{-8}

2005

Develops first commercial automated High Resistance Bridge based on the binary voltage divider technology to 100V, Model 6000B Accuracy 2×10^{-8}
MI Europe was founded

2006

Develops first self calibrating Direct Current Comparator Ratio Bridge. Model 6242B with touch screen display. Range 1 Ω to 100M Ω Accuracy 5×10^{-8}

2008

Develops world's first AccuBridge™ Technology DCC Resistance Bridge with complete self calibration. Range 0.1 Ω to 100k Ω Accuracy 2×10^{-8}

2009

Develops first commercial Dual Source Bridge Technology for the measurement of high value resistors Range 10k Ω to 100T Ω Voltage 1V to 1000V

2010

MI China was founded
Develops first automated Direct Current Comparator Resistance Bridge Model 6010D with touch screen display Range 0.01 Ω to 100k Ω , Accuracy 4×10^{-8}

2011

Develops first automated high current 3000A Direct Current Comparator DCC Shunt Measurement System Ratio 1,000,000:1



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