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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 customers' organization.

- Cryogen Free
- System Accuracy to < 0.02 ppm
- Built in Rxx (uVolt) Measurements in ADCC Bridge
- Built in Rxx (nVolt) Measurements in ADCC Bridge
- 9 Tesla Standard System Magnet
- Up to 14 Tesla Available
- No Liquid Helium Required
- Stable Controlled Sample Environment
- Temperature Range 1.3 K to 300 K
- Low Operating Costs
- Direct Transfer to 1 kΩ and 10 kΩ Standards
- System Range 0.1 Ω to 100 kΩ
- Graphene Compatible
- Features AccuBridge® Technology
- Dual Sample Probe

6800C Shown

The MI 6800C QHR System is a fully automated primary standard developed as an economic means to provide a highly reproducible resistance standard. Liquid helium shortages, erratic deliveries, and steady price increases have become commonplace. This shortage, along with continuous price increases causes many labs to have difficulty efficiently reaching their measurement goals. The 6800C requires no liquid helium to operate. The 6800C was developed over many years' experience in quantized hall system design, resistance measurements, and cryogenics. It is modular in design and consists of three parts: sample, cryogenics system, and bridge measurement system. These components may be purchased separately.

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RATIO BRIDGES/ADCC TECHNOLOGY – 1 μΩ to 1 GΩ

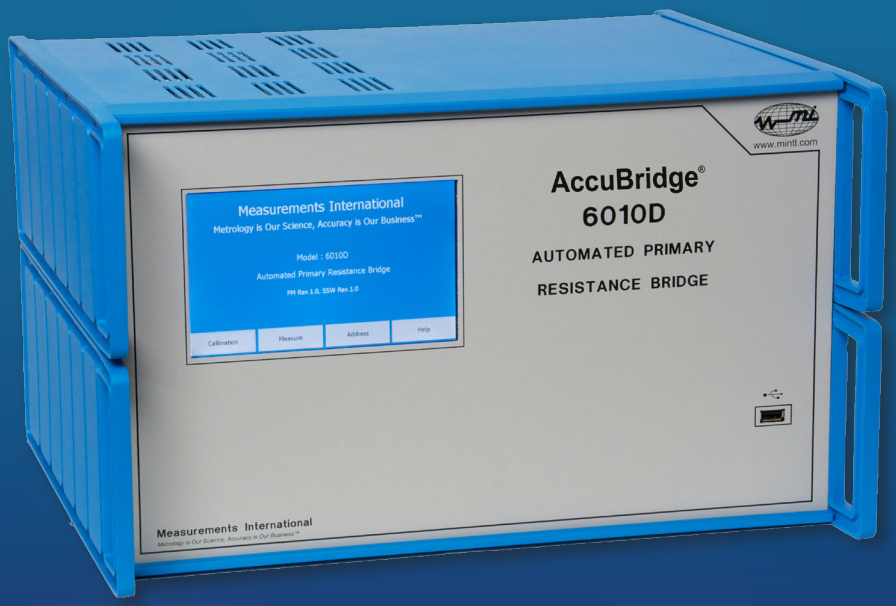
6020Q
Self-Calibration ADCC Ratio Bridge AccuBridge® QUANTΩ Bridge

- Quantum Hall Applications Including Gallium Arsenide and Graphene Sample Measurements
- V_{cr}, Vxx, and Vxy Measurements
- Self-Calibration
- Ratio 0 to 14:1
- Resistance Range 0.1 Ω to 100 kΩ
- Best Accuracy < 15 ppb

The MI series of the 60XX Bridges are used in nearly every NMI around the world as well as the US Air Force, US Army, US Navy Primary, Lockheed's Laboratories, and Boeing for their superior speed and low uncertainties.

6010D
Automated Primary Resistance/ Thermometry Bridge

- Resistance and Temperature Applications
- Range 0.001 Ω to 100 kΩ
- Accuracy < 30 ppb
- Ratio Self-Calibration
- System Integration with Measurements International (MI) Matrix Scanners and High-Current Range Extenders
- Make MI Your Partner in ISO 17025 Accreditation Through Coaching, System Design, Implementation, Calibration Services, Documentation Support and Ongoing Expert Support



All DCC Bridges Feature True Ratio Self-Calibration

6242D
AccuBridge® Resistance Bridge

Voltages Up to 1000 V

- Range 0.001 Ω to 1 GΩ
- Accuracy < 10×10^{-8} for 1:1 Ratios
- < 10×10^{-8} for 10:1 Ratios Up to 10 KΩ
- Optional Accuracy < 5×10^{-8} for 10:1 Ratios Up to 10 KΩ
- Optional Accuracy < 3×10^{-8} for 1:1 Ratios Up to 100 Ω
- < 7×10^{-6} at 100 MΩ
- Linearity < 5×10^{-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

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HIGH RESISTANCE RATIO BRIDGES – 10 KΩ TO 10 PΩ

6000B
Automated Resistance Bridge

- Featuring True Ratio Self-Calibration
- Range 10 kΩ to 1 TΩ
- Built In 4-Channel Matrix Scanner
- Accuracy < 20×10^{-9} for 10 kΩ Ratios
- Accuracy < 0.5×10^{-6} for 100 MΩ
- Linearity < 5×10^{-9}
- Full System Solutions and Full System Integration Using MI 1000B 110 V Source, 6000B Software and 4200 Series of Matrix Scanners
- Optional 1000B Automated Voltage Source

6600A
Automated Dual Source High Resistance Bridge

- Based on NMI Design
- Range: 100 kΩ to 10 PΩ
- Voltages: 1 V to 1000 Volts (5,000 V Optional)
- Automatic and Manual Operation
- Not Affected by Temperature Change
- 10 and 20-Channel Coaxial Matrix Scanners (Optional)
- Environmental & Pressure Monitoring (Optional)
- Ratio 1:1, 10:1,100:1, 1000:1
- Multiple Modes of Operation

6652A – Premium
High Resistance Meter – Direct & Substitution Mode

- 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 and 4620 High Resistance Scanners

6652A – Standard
High Resistance Meter – Direct Mode

- 1 MΩ to 100 TΩ
- Direct 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 and 4620 High Resistance Scanners

RANGE EXTENDERS & POWER SUPPLIES – CURRENTS TO 5000 A

6011D/150/300
Range Extender

- Modular Designed Base Unit with Expanded Capabilities to 3000 A
- Ampere-Turn Sensitivity = 2 µAT = 0.02 ppm
- Precision Shunts and DCCT Calibrations
- Stand-Alone Operation or Extends the Range of Measurements International (MI) 6010D/6242D Series of Resistance Bridges
- 6100 Series of High Current Linear Supplies

6014M
Automated 300 Amp Range Extender

- 3000 Amp DCC Extender
- 1000:1 Ratio Capability
- < 2 ppm Uncertainty
- One-of-a-Kind

6511D/10 A
Range Extender with Reversing Switch & Power Supply

- Modular Designed Base Unit with Expanded Capabilities to 3000 A
- Stand-Alone Operation or Extends the Range of Measurements International (MI) 6010D/6242D Series of Resistance Bridges
- Shunt and DCCT Calibration
- Bench or Rack-Mount Configurations

6150A
150 Amp DC Source

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

RESISTANCE SYSTEMS

6242/300 or 6010/300
High Precision DCC Shunt & DCC Measurement Systems

- Modular Designed Base Unit with Expanded Capabilities to 3000 Amps
- Ratio Ranges: 10 to 10,000
- Complete Turnkey System
- Resistance and Temperature Curves
- Linearity < 0.01 ppm
- Complete Measurement Systems Available
- Proven Technology

6242/5000 or 6010/5000
Resistance System

6010/3000 A Shown

* The 6680A has been replaced with Sorensen

- Currents to 5,000 A and Higher
- Modular Design, Expandable Capabilities
- Ratio Ranges from 10 to 1,000,000
- Resistance and Temperature Curves
- Temperature Coefficient of Resistors
- Complete Turnkey System
- No Coefficients to Correct Hardware Errors
- Proven Technology
- Linearity < 0.01 ppm
- Complete Measurement Systems Available
- 6242 System Option to 1 G and 1000 V

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SCANNERS – RESISTANCE 10 MΩ AND BELOW

4210A/4216A/4220A & 4210B/4216B/4220B
10/16/20-Channel Four-Terminal Matrix Scanner

- Tellurium Copper Terminals or 4-Conductor Teflon Cable
- 10, 16 & 20 Channel Outputs
- 2 Four-Terminal Tellurium Copper Outputs
- Sealed Relays
- 4 A Carrying Current
- 250 Volts
- Error Contribution < 20 nV
- Insulation Resistance 10^{13} Ω
- Front Panel or IEEE Operation

HIGH RESISTANCE SCANNERS

4610A/4620A
High Resistance Scanners

- 10/20 Two-Terminal Coaxial Channels
- N-Type Connections
- Front Panel or Remote Operation
- Maximum 1000 V DC
- Resistance Measurements to 10 PΩ
- Insulation Resistance > 10^{16} Ω

RESISTANCE STANDARDS AIR & OIL 0.1 Ω TO 100 KΩ

9210A-1 (Primary)
1 Ω Resistor with Carrying Case

- Replacement for Thomas 1 Ω
- Temperature Coefficient < 0.05×10^{-6}/°C
- Long Term Drift < 0.2×10^{-6}/Year
- No Pressure Coefficient
- Maximum Dissipation 100 mW
- Highest Performance Dissipation 10 mW

9210A-0.1 (Primary)
0.1 Ω Resistor with Carrying Case

- Temperature Coefficient < 0.05×10^{-6}/°C
- Long Term Drift < 0.2×10^{-6}/Year
- No Pressure Coefficient
- Maximum Dissipation 100 mW
- Highest Performance Dissipation 10 mW

RESISTANCE STANDARDS AIR & OIL 0.1 Ω TO 100 KΩ

9210B (Primary)

- Decade Values 10 Ω, 100 Ω, 1 KΩ, 10 KΩ, 100 KΩ with Optional Carrying Case
- Temperature Coefficient < 2×10^{-7}/°C
- Long Term Drift < 2×10^{-6}/Year
- No Pressure Coefficient
- Maximum Dissipation 300 mW
- Highest Performance Dissipation10 mW
- Custom Values Available

9331R
Reference Series of Four-Terminal Air Resistors

- Resistance Range 0.1 Ω to 100 MΩ
- Wide Operating Range 18 °C to 28 °C
- Temperature Coefficient < 0.1 ppm
- Custom Values Available
- Metal Foil Technology
- Optional Carrying Case

9331
Four-Terminal Air Resistors

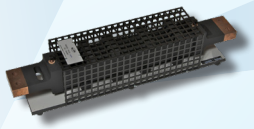
- ISO 17025 Calibrations Available
- High Stability
- 1 Ω to 100 MΩ
- Operating Range 18 °C to 28 °C
- Custom Values Available
- Low Temperature Coefficient
- Stability Better Than 2.5 ppm/Year
- No Air or Oil Bath Required
- Optional Carrying Case

9316/9317
Resistor Transfer Standard

- High Stability
- 1 MΩ to 10 MΩ/Step
- Matched to < 10 ppm
- Low Temperature Coefficient

HIGH CURRENT RESISTORS AND SHUNTS – UP TO 5000 A

9332
High Current Resistors/Shunts



- 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 (Optional)
- Improved Power Dissipation

The model 9332 series of four terminal DC Current Shunts for the measurement of precision DC Current levels to 3000 A are the latest development from Measurements International. The shunts are constructed from specially selected elements which are soldered into copper ends using a special low-thermal solder. The element then goes through a process of annealing which insures the best performance without introducing self-heating errors with improved temperature coefficients.

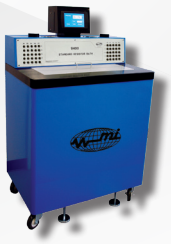
Current connections are made at each end of the shunt while low-thermal potential connectors are used for measuring the output voltage. Only the current connector will vary depending on the size of the shunt. Special values are also available.

The 9332-Forced Air assembly is also available for all shunts. The number of fans will vary depending on the length of the shunt. The forced air assembly attaches to the shunt guard and air is blown down and away from the shunt. Use of the 9332-Forced Air assembly keeps the power coefficient of the shunt low for all currents.

TEMPERATURE CONTROLLED CHAMBERS (OIL OR AIR)

When measuring or calibrating resistors, one of the highest uncertainties can be due to the temperature coefficient of the resistor where Temperature Coefficient (TC) is the change in resistance due to a change in temperature. The series of MI temperature-controlled oil and air baths can be used to reduce the effect of temperature on TC the resistor, whether oil or air, to minimum levels improving on the uncertainty of the measurement. MI's series of Oil Baths (9400) can reduce the change in temperature over a given time to better than 2 mk while the MI series of Air Baths can reduce the change in temperature to better than 15 mK using the 9300A.

OIL BATHS



9400 Series
Standard Resistor Oil Bath

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

AIR BATHS

9300
Temperature Controlled Standard Resistor Air Bath

- Volume 50 Litres
- Stability ± 50 mK for ± 1 °C
- Large Working Area
- Temperature Band Protection
- Peltier Cooled
- Temperature Range 15 °C × 35 °C
- Perfect for Temperature Coefficient Measurements
- Lightweight and Portable

9300A
Temperature Controlled Standard Resistor Air Bath with GPIB

- Volume 106 Litres
- Stability ± 0.005 @ 23 °C
- Large Working Area (4 SR104's)
- Temperature Band Protection
- Peltier Cooled
- Stainless Steel Construction
- Temperature Range 15 °C to 40 °C
- Interfaces to 6010, 6242 & 6000B for Automatic Measurements of Temperature Coefficients Using MI Software

9300S
Temperature Controlled Standard Resistor Air Bath

- Volume 53 Litres
- Stability ± 0.005 @ 23 °C
- Temperature Coefficient Measurements
- Peltier Cooled
- Stainless Steel Construction
- Temperature Range 15 °C to 50 °C

9300L
Temperature Controlled Standard Resistor Air Bath with GPIB

- Volume 190 Litres
- Stability ± 0.005 at 23 °C
- Temperature Coefficient Measurements
- Peltier Cooled
- Stainless Steel Construction
- Temperature Range 15 °C to 50 °C

NEW PRODUCTS

Z1000
iSimulator Impedance Simulator

- Impedance Module Range: 1 Ω to 100 MΩ
- Impedance Phase Range: -90° to 90°
- Frequency Range: 1 Hz to 20 kHz
- 3 Probes
- Fully Automated Control
- Full Combined Uncertainty Calculation Included
- Calibration of LCR Meters
- Developed by METAS

METAS

The Measurements International model Z1000 was designed and tested with the initial prototype by METAS in Switzerland. It was designed to address and fill the need and requirement for a better way to calibrate LCR meters. Current method of calibration of LCR meters requires highly accurate impedance standards (inductors, capacitors and resistors) that have to have traceability maintained, in which the procedure for calibration is time consuming and requires a lot of manipulation of the standards making the measurement procedure complicated. With the release of the commercial Z1000 iSimulator, the process for calibration of LCR meters has been taken to a new level. The Z1000 covers the full calibration of LCR meters over simulated impedances from 100 Hz to 20 kHz while eliminating the need for external standards and providing a much easier to use, simple method of LCR meter calibration.

1330A
Automated Artifact Calibrator

- Primary 1 Ω, 10 kΩ, 10 V References
- 3 Standards in One Box Inside a Temperature-Controlled Chamber
- Direct Plug-in Cable to 57XX Terminals
- Front Panel or GPIB Controlled to Select Output
- Front Panel Display Showing Certification Value and Drift of Internal Standards
- Clear Connection for JVolt Comparison of 10 V Zener
- Battery Backup Option > 72 Hours

The model 1330A is a highly versatile, accurate instrument that meets laboratory requirements for automation of artifact calibration on calibrators and DMMs. The model 1330A Artifact Calibrator is made up of one instrument enclosure and three reference standards. Artifact calibration is used to assign values to internally generated parameters of the calibrator or DMM. It is a process that is typically performed in calibrating an instrument using a small number of standards. Artifact calibration is typically performed at the recommended calibration intervals as indicated in the calibrator or DMM manufacturers manual.

THERMOMETRY PRODUCTS

6020T – Premium & 6020T – Base
Thermometry Bridge

- Best Accuracy ± 0.015 ppm from 1 Ω to 10 kΩ
- Quick Measure Mode Under 20 Seconds to First Reading
- Current Reversal Rate of 2 Seconds
- Measurement Rates as Fast as 0.1 Seconds
- ADCC Technology
- Proprietary Comparator Design

5:1 Ratio/10:1 Ratio

- 0.1 Ω to 100 kΩ Range
- Linearity < 0.005 ppm
- IEEE-488 and Manual Operation
- Accu-T-Cal™ Application Software For Calibrating PRTs Designed by NMI
- 6-Channel Front Panel With Keep Warm Currents! (1 mA)
- Smaller Design for Improved Quality and Performance

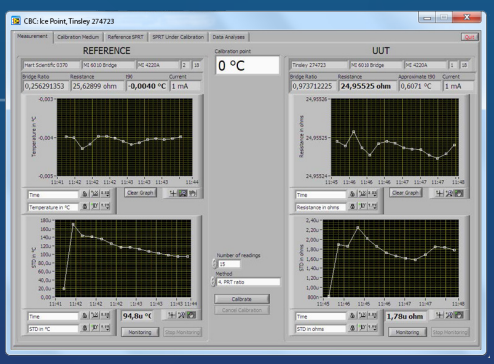
The AccuBridge® 6020T Thermometry Bridge (furthermore 6020T) is the metrologist's choice for primary lab level thermometry measurements. With its innovative technology, the 6020T's speed, measurement accuracy, and data handling capabilities make it the preferred primary thermometry measurement system in National Measurement Institutes (NMIs) and other primary labs worldwide. The 6020T was designed for flexibility and ease of use. The 6020T features increased ampere-turn (AT) sensitivity with more turns on both the master and slave windings and a voltage feedback circuit to improve on the linearity error of the nanovolt amplifier. Also improved is the ratio from previous 1.5:1 ratios to the new ratio range covering from 0.1 up to a maximum ratio of 5 allowing customers to meet all of their requirements. Quick Measure Mode provides customers with the ability to have the first reading within 20 seconds from pressing Start; current reversal rates improved to 2 seconds with measurement sample times as low as 0.1 seconds! Only MI offers a DC Bridge with these improvements that can meet specifications!

FEATURES

For years, customers have been asking for MI to extend the measurement features of the DC Comparator Bridge to replace existing AC technology. MI has finally not only answered these requests with the release of the 6020T, but taken them to the next level.

AUTOMATED THERMOMETRY BRIDGE ACCUBRIDGE® MODEL 6020T

- Best Accuracy ± 0.015 ppm From 1 Ω to 10 kΩ
- Quick Measure Mode under 20 Seconds to First Reading
- Current Reversal Rate of 2 Seconds
- Measurement Rates as Fast as 0.1 Seconds
- ADCC Technology
- Proprietary Comparator Design
- 0.1 Ω to 100 kΩ Range
- Linearity < 0.005 ppm
- IEEE-488 and Manual Operation
- Accu-T-Cal™ Application Software for Calibrating PRTs Designed by NMI
- 6-Channel Front Panel With Keep Warm Currents!
- Keep Warm Current 1 mA
- Smaller Design for Improved Quality and Performance



IMPROVED MEASUREMENT TIME

The 6020T features a Quick Measure mode which allows the bridge to balance faster thus improving the first measurement reading which are displayed within less than 20 seconds from pressing start! Next, we focused on current reversal time. Customers have been requesting that a DC Comparator Bridge meets that again of AC Bridges. We accomplished this with the improved reversal rate function of 2 seconds! MI is the only DC Comparator Bridge that has improved with these features and still meets stated specifications!

VOLTAGE MEASUREMENT – 100 mV TO 1200 V DC

8000B (10 V)
Automated Potentiometer

- Calibrate Up to 20 Voltage References with 8000B (Expandable to 59 Using MI 4240A)
- Best Accuracy < 0.05 ppm with Bipolar Voltage Measurements
- 8000B Voltage Measurements (10 V, 1 V, 0.1 V) or Any Voltage from 1 mV to 10 V
- 8001B Extends Range of 8000B Up to 1200 Volts for Calibration of Fluke 5700/5500 Series Calibrators and 8 ½ Digit DMM's such as 3458A, 8508A
- Calibration and Linearity Verification of Fluke 752A and Guildline 7520 Fixed Voltage Dividers

8000B RVB
Ratio Verification Box

- Ratio Verifications of 8000A to 0.02 ppm
- Two Standard Resistors of 10 KΩ and 100 kΩ

8001B (Extender)
Automated 1200 Volt DC Divider

- Calibrate the Calibrator
- 30 V, 120 V, 300 V & 1200 V Ranges
- Accuracy < 2 ppm
- Self-Calibrating Using 8000B
- Bipolar Voltage Measurements
- Optional Lab Temperature, Humidity and Pressure Monitoring

8000B/8001B
Automated Potentiometer Binary Voltage Divider System

- Calibrate Up to 20 Voltage References with 8000B (Expandable to 59 Using MI 4240A)
- Best Accuracy < 0.05 ppm with Bipolar Voltage Measurements
- 8000B Voltage Measurements from 1 mV to 10 V
- 8001B Extends Range of 8000B Up to 1200 Volts for Calibration of Fluke 5700/5500 Series Calibrator and 8½ Digit DMM's Such As 3458A, 8508A
- Both 2-Wire Output and 4-Wire Output Using the Calibration Sense Function
- Calibration and Linearity Verification of Fluke 752A and Guildline 7520 Fixed Voltage Dividers
- Full "Turn-Key" Automated Systems Available

Measurements International
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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 1 mV to 10 V, accuracy < 5×10^{-8}

1992
Developed first commercial automated Direct Current Comparator Resistance Bridge (DCC) model 6010A, range 1 Ω to 10 KΩ, accuracy 10^{-7}

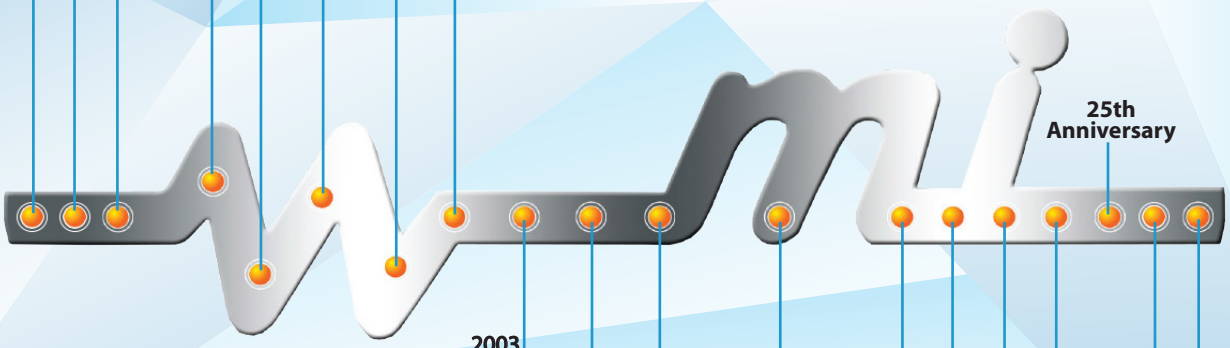
1993
Developed first commercial automated High Resistance Bridge for the measurement of resistors. Range 10 kΩ to 100 MΩ, accuracy 10^{-6}

1993
MI USA was founded

1997
Re-developed DCC Technology which resulted in the world famous 6010B Resistance Bridge from 0.001 Ω to 10 kΩ, accuracy 10^{-7}

1998
Developed 20,000 A Direct Current Comparator for the LHC at CERN

2002
Developed the world's first and only portable cryogenic QUANTΩ (QHR) System model 6800A, accuracy 1×10^{-8}



2003
Developed the world's first room temperature Direct Current Comparator DCC Bridge (6010Q) for cryogenic applications – accuracy 2×10^{-8}

2005
Developed first commercial automated High Resistance Bridge based on the binary voltage divider technology to 100 V, model 6000B, accuracy 2×10^{-8}
MI Europe was founded

2006
Developed first self-calibrating Direct Current Comparator Ratio Bridge. model 6242B with touch screen display, range 1 Ω to 100 MΩ, accuracy 5×10^{-8}

2008
Developed world's first AccuBridge® technology DCC Resistance Bridge with complete self calibration, range 0.1 Ω to 100 KΩ, accuracy 2×10^{-8}

2009
Developed first commercial Dual Source Bridge Technology for the measurement of high value resistors range 10 KΩ to 100 TΩ, voltage 1 V to 1000 V

2010
MI China was founded
Developed first automated Direct Current Comparator Resistance Bridge model 6010D with touch screen display range 0.01 Ω to 100 kΩ, accuracy 4×10^{-8}

2011
Developed first automated high current 3000 A Direct Current Comparator DCC Shunt Measurement System, ratio 1,000,000:1

2013
Developed first benchtop High Resistance Bridge

2016
AccuBridge® line introduced as the improved next generation of MI Bridges

2019
Developed first commerical Impedance Simulator

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