

>185.65546 67616.122287 5777 50
 >198.65546 65612.232829 955 50
 >198.65546 65612.232829 95556 50
 >152.698016 68818.282399 92356 50
 >198.643636 78617.732289 783 50
 >124.634546 78672.237779 683 50
 >458.11142 83417.782397 876 56
 >145.523286 64486.222889 986 56
 >140.77060 32814.077060 328 56

MODEL AccuBridge



Self Calibration Ratio Bridge

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

MODEL INFORMATION

AccuBridge is a fully automated resistance ratio bridge based on the Direct-Current-Comparator (DCC) principle. Using innovative technology, AccuBridge speed and measurement accuracy accounts for its preferred status as the primary resistance measurement system in most national laboratories throughout the world. It is designed for flexibility and ease of use and is perfectly suited for stand-alone use or with Measurements International's Windows based Software with real time uncertainty analysis, history logging, graphing and regression analysis.

Only after many years of research and development is it possible to elaborate on this remarkable instrument. Recognized as the worlds leading Automated Resistance/ Thermometry Bridge, AccuBridge is ideal for both resistance and temperature measurements. Automatic current reversal insures that dc offsets and thermals are cancelled out during the measurement.

Accubridge has two inputs, Rx and Rs. The number of inputs can be expanded to 40 when the AccuBridge is used in conjunction with the 4200 Series Low Thermal Four Terminal Matrix Scanners. Measurements and values can be performed automatically with Measurements International's AccuBridge, delayed or scheduled measurements can all be performed at any time.

Self-calibration of the DCC can be carried out at any time. The instrument determines resistance by measuring the ratio of the unknown resistance to a known resistance standard.

Overview:

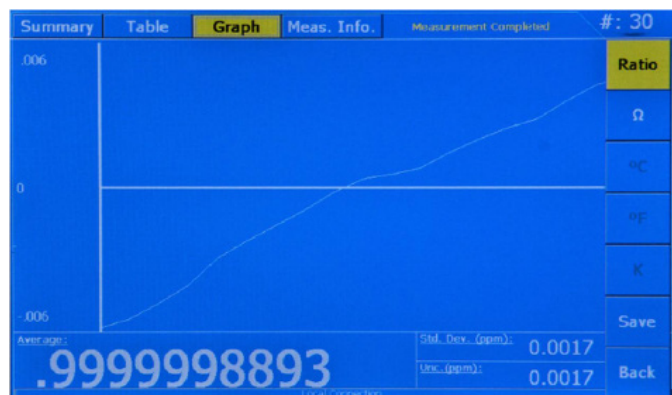
As a stand-alone device, AccuBridge will measure both ratio and absolute values. Menu driven functions are selectable using the menu displayed on the large touch screen display. For absolute measurements the value and related uncertainty for Rs are entered in from the keypad displayed on the touch screen display. Measurement functions such as current through the unknown resistor and settle time, number of measurements and number of statistics are all also entered using the keypad on the touch screen.

Calibration of the AccuBridge is performed by first calibrating the linearity of the DC Current Comparator. The accuracy of the AccuBridge can be verified by performing an interchange measurement at any ratio. Previously the interchange method was only used to verify 1:1 ratios. With the increased ampere turns for ratios below 1, the interchange method works at all ratios from 13:1 down to 0.0769.

The large Touch Screen display chosen for its low noise characteristics is interactive with the measurements. The user has the choice to display data (several measurements at a time), a combination of data and a graph of the measurements or just the graph. When the reading is complete the average value and uncertainty based on the number for statistics are displayed. All uncertainty calculations are 2 sigma calculations.



For Resistance Measurements the Summary tab screen displays measurement data as well as graphical information for current measurement and can be viewed in ratio or Ohms at any time.



The graph screen displays a graphical representation of the individual measurement data plots.

Summary	Table	Graph	Meas. Info.	Measurement Completed	#: 30
#	Ratio	Resistance (Ω)	Ratio		
22	.9999998902	99.99998902			
23	.9999998909	99.99998909			
24	.9999998915	99.99998915			
25	.999999892	99.9999892			
26	.9999998924	99.99998924			
27	.9999998932	99.99998932			
28	.9999998939	99.99998939			
29	.9999998943	99.99998943			
30	.9999998949	99.99998949			
Average:	.9999998893		Std. Dev. (ppm): 0.0017		
			Unc. (ppm): 0.0017		

The Table screen list is a chronological list of measurement results for ratio and resistance.

Summary	Table	Graph	Meas. Info.	Measurement Completed	#: 30
R _S		R _T		Ratio	
Type	Resistor	Type	Resistor		
Absolute Value	100	Absolute Value	100		
I _S (mA)	-9.9976 mA	I _T (mA)	10		
		Serial #	0000		
Settle Time (s):	8	# Meas. :	30		
Sample Time (s):		# Statistics :	20		
Save File Name:	Data Not Saved	Filter:	10		
Average:	.9999998893		Std. Dev. (ppm): 0.0017		
			Unc. (ppm): 0.0017		

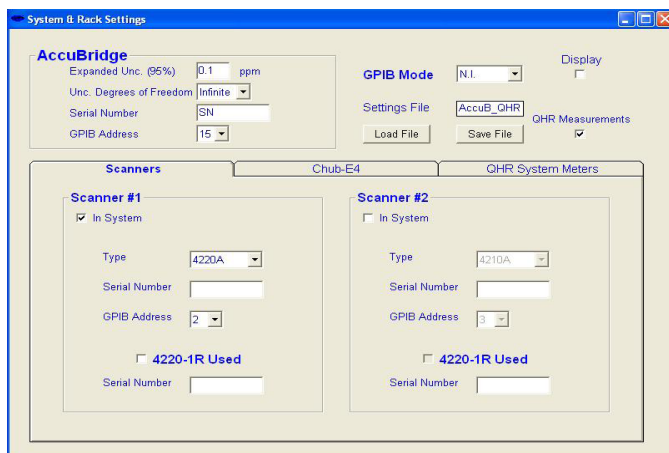
The Measurement Info screen displays measurement parameters such as applied current, number of measurements, reversal rate and value of the standard resistor being used.

Windows Operating Software

Measurements International's AccuBridge Software features report generation, historical analysis and tracks and corrects for resistor drift rates. Combined with a Measurements International 9400 Standard Resistor Oil Bath or 9300A Air Bath, alpha and beta calculations can be performed automatically on resistors under test. All data can be exported directly to Excel for various test patterns or mainframe applications. External atmospheric pressure, humidity and temperature indicators are optional and the entire system can be enclosed in a 4 or 5 ft. rack. Resistor baths (oil or air), instrument controllers, printers, system software, IEEE interface, installation and training are all available for complete system packages.

Measurements International's software was developed by metrologists for metrologists. The software features real time uncertainty analysis, graphing, history logging, and data storage with export to Excel and regression analysis. The AccuBridge provides ultimate programmability and control for all your resistors and temperature calibrations, now and in the future.

AccuBridge – Windows Operating Software



System & Rack Settings

AccuBridge
Expanded Unc. (95%) 0.1 ppm
Unc. Degrees of Freedom Infinite
Serial Number SN
GPIO Address 15

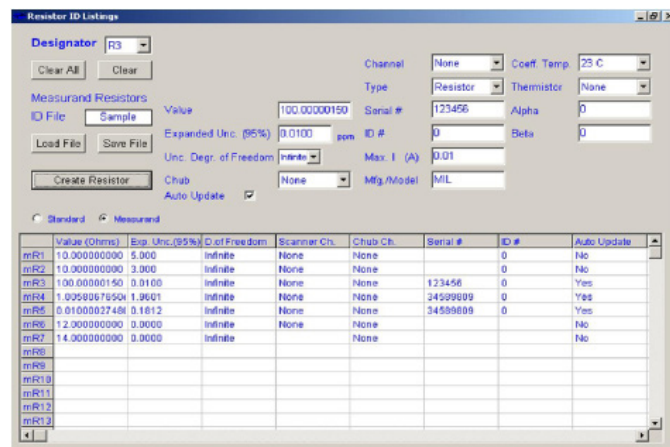
GPIO Mode N.I.
Display ☐
Settings File AccuB_OHR
Load File **Save File** **QHR Measurements** ☒

Scanners
Scanner #1
☒ In System
Type 4220A
Serial Number
GPIO Address 2
☐ 4220-1R Used
Serial Number

Scanner #2
☐ In System
Type 4210A
Serial Number
GPIO Address 3
☐ 4220-1R Used
Serial Number

Chub-E4
QHR System Meters

System & Rack Menu



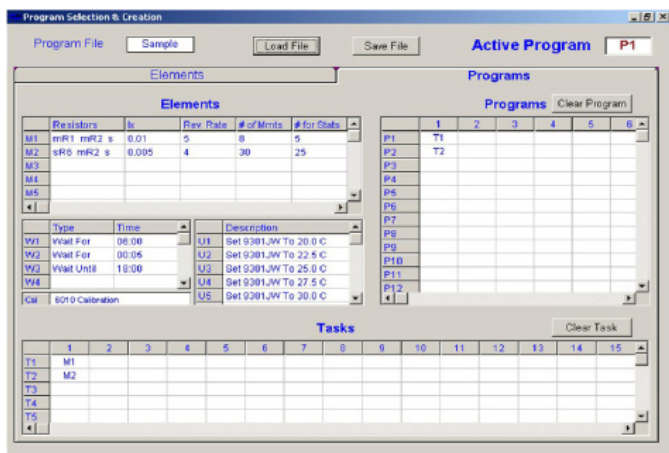
Resistor ID Listings

Designator R3
Clear All **Clear**
Channel None **Coeff. Temp** 25 C
Type Resistor **Thermistor** None

Measure and Resistors
ID File **Sample** **Value** 100.00000150
Expanded Unc. (95%) 0.0100 ppm
Unc. Degr. of Freedom Infinite
Max. I (A) 0.01
Chub None **Mfg./Model** MIL
Create Resistor **Auto Update** ☒

Standard	Measured	Value (Ohms)	Exp. Unc. (95%)	D. of Freedom	Scanner Ch.	Chub Ch.	Serial #	ID #	Auto Update
mR1		10.000000000	5.000	Infinite	None	None		0	No
mR2		10.000000000	3.000	Infinite	None	None		0	No
mR3		100.00000150	1.0100	Infinite	None	None	123456	0	Yes
mR4		1.000000000	1.0000	Infinite	None	None	3456789	0	Yes
mR5		0.010000000	0.0100	Infinite	None	None	3456789	0	Yes
mR6		12.000000000	0.0000	Infinite	None	None		0	No
mR7		14.000000000	0.0000	Infinite	None	None		0	No
mR8									
mR9									
mR10									
mR11									
mR12									
mR13									
mR14									

Resistor ID Menu



Program Selection & Creation

Program File Sample **Load File** **Save File** **Active Program** P1

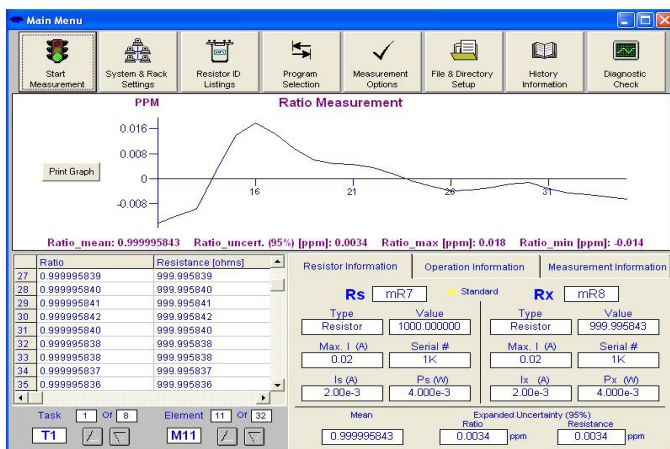
Elements
Resistors
M1 mR1 mR2 5 0.01 5 25
M2 mR6 mR2 5 0.005 4 30 25
M3
M4
M5

Programs
P1 T1
P2 T2
P3
P4
P5
P6
P7
P8
P9
P10
P11
P12

Tasks
T1 M1
T2 M2
T3
T4
T5

Clear Task

Program ID Menu



Main Menu

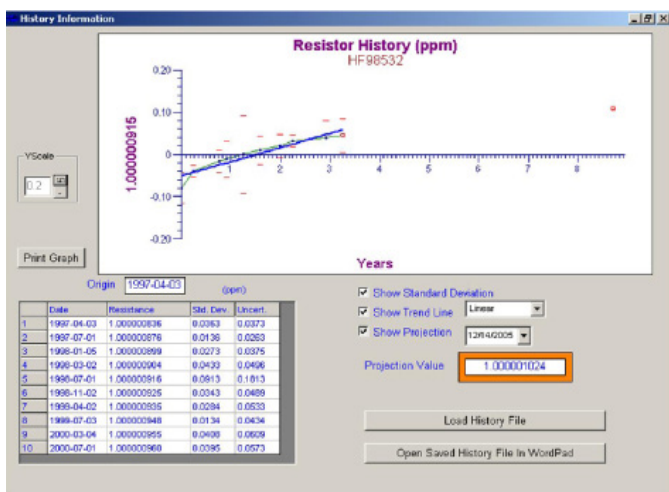
Start Measurement **System & Rack Settings** **Resistor ID Listings** **Program Selection** **Measurement Options** **File & Directory Setup** **History Information** **Diagnostic Check**

Ratio Measurement
PPM
Ratio_mean: 0.999995843 Ratio_uncert. (95%) [ppm]: 0.0034 Ratio_max [ppm]: 0.018 Ratio_min [ppm]: -0.014

Ratio	Resistance [ohms]
27 0.999995839	999.995839
28 0.999995840	999.995840
29 0.999995841	999.995841
30 0.999995842	999.995842
31 0.999995840	999.995840
32 0.999995838	999.995838
33 0.999995838	999.995838
34 0.999995837	999.995837
35 0.999995836	999.995836

Resistor Information
Rs mR7 **Standard** **Rx** mR8
Type Resistor Value 1000.000000
Max. I (A) 0.02 Serial # 1K
Is (A) 2.00e-3 Ps (W) 4.000e-3
Mean 0.999995843 Expanded Uncertainty (95%) Ratio 0.0034 Resistance 0.0034 ppm

Measurement Menu



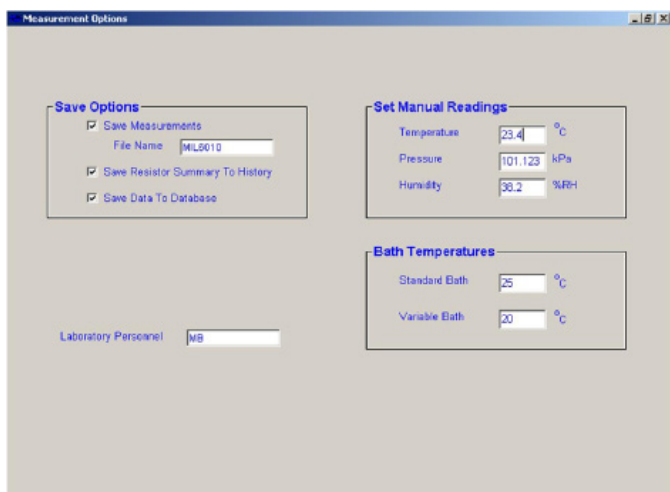
History Information

Resistor History (ppm) HF96532
YScale 0.2 LE
Print Graph
Origin 1997-04-03 (ppm)

Date	Resistance	Std. Dev.	Uncert.
1 1997-04-03	1.000000036	0.0263	0.0373
2 1997-07-01	1.000000076	0.0136	0.0263
3 1998-01-05	1.000000099	0.0273	0.0376
4 1998-03-02	1.000000094	0.0433	0.0496
5 1998-07-01	1.0000000916	0.0513	0.1813
6 1998-11-02	1.000000025	0.0343	0.0489
7 1998-04-02	1.000000035	0.0294	0.0533
8 1998-07-03	1.000000048	0.0134	0.0434
9 2000-03-04	1.000000055	0.0400	0.0609
10 2000-07-01	1.000000060	0.0395	0.0573

Years
☒ Show Standard Deviation
☒ Show Trend Line Linear
☒ Show Projection 12842005
Projection Value 1.00001024
Load History File **Open Saved History File in WordPad**

History Menu



Measurement Options

Save Options
☒ Save Measurements
File Name MIL0010
☒ Save Resistor Summary To History
☒ Save Data To Database

Set Manual Readings
Temperature 23.4 °C
Pressure 101.123 kPa
Humidity 38.2 %RH

Bath Temperatures
Standard Bath 25 °C
Variable Bath 20 °C

Laboratory Personnel MB

Measurement Options

>183.65546 65612.23 2829 9555
 >198.65546 65612.23 2829 9555
 >152.698016 68818.28 2399 92356
 >198.643636 78617.73 2289 783
 >124.634546 78672.23 7779 683
 >458.11142 83417.78 2397 876
 >145.523286 64486.22 2889 986
 >140.77060 32814.07 7060 328

AccuBridge Accessories

AccuBridge Input Channels

The Number of input channels on the AccuBridge can be increased to almost any number from 10 to 80, using combinations of up to 4 scanners. These include the 4210A, 4210B with ten input channels and two output channels, 4216A, 4216B with sixteen input channels and two output channels and the 4220A and 4220B with twenty input channels and two output channels. The A series of scanners have tellurium copper terminals on both the input and output while the B series have four-wire Teflon cable for both the input and output.



4220A



4220B

Matrix Scanner 20 Channels

See the 4200 Data Sheet for a complete range of Matrix Scanners.

Temperature and Power Coefficients

Model 9300A Air Bath with IEEE 488

The AccuBridge is also ideal for verifying the temperature and power coefficient of resistors or shunts using the MI 9300A Air Bath. Two internal fans are used to achieve temperature stability. Up to four SR104's or combination thereof can be installed in the bath, two shelves are provided. The IEEE Drivers for this bath are built into the AccuBridge software for automated measurements and calculations of alpha, beta coefficients and resistor values. A Hi, Lo temperature protection circuit is built in.



See the 9300A Data Sheet for a complete range of Air Baths

Model 9400 Oil Bath with IEEE 488

The Model 9400 oil bath was designed after compiling years of customer feedback on existing resistor oil baths. Control is provided through a touch screen interface. The result is a stable, quiet oil bath that can be used with the CCC and QHR due to its low electrical noise.

The bath also features the capability of changing speed on the stirrer motors depending on the quantity of resistors in the bath. IEEE Drivers for this bath are built into the AccuBridge software for automated measurements and calculations of alpha and beta coefficients and resistor values.



See the 9400 Data Sheet for a complete spec

STANDARD AIR RESISTORS

MODEL 9331 SERIES OF AIR RESISTORS

These high accuracy working standards are used for precision, on-site, resistance calibrations for values from 1mΩ to 100MΩ. They are small, light and rugged resistance standards that do not require a temperature controlled oil or air bath for the specifications shown. Stability and temperature coefficients of the 9331 make this resistor ideal for easy transport and for operation in any working environment within the range of 18°C to 28°C.

Connections to the Model 9331 are made using tellurium copper binding posts for values to 100 MΩ. A separate ground terminal is included for guarding and the case is hermetically sealed to keep moisture out. The Model 9331G (shown), based on the NIST design, ranges from 100MΩ to 100TΩ.



See the 9331, 9331G and 9331R Data Sheet for a complete range of Air Resistors

MODEL 9210 STANDARD OIL RESISTORS

Oil resistors provide better stability and temperature coefficients over air resistors and will give you the highest precision and stability in resistance measurements. The standard oil resistors manufactured by MI include the 9210A Primary 1Ω, the 9210A Primary 0.1Ω and the 9210B series of oil resistors from 1Ω to 100kΩ. The 9210A 1Ω and 9210A 0.1Ω have a negligible pressure coefficient.



See the 9210A and 9210B Data Sheets for a complete range of Oil Resistors.

Specification

Note: Either Rs or Rx can be selected as standard Uncertainties specified at 2 sigma level (95%) and Includes all secondary specifications such as linearity, noise and ampere turn with a $\pm 2^{\circ}\text{C}$ temperature variance	0.01 Ω to 100k Ω				
	Rs or Rx	Ratio Uncertainty			
		0.01:1	1:1	10:1	14:1
	1 Ω	0.02	0.02	0.02	0.02
	10 Ω	0.02	0.02	0.02	0.02
	100 Ω	0.02	0.02	0.02	0.02
	1k Ω	0.02	0.02	0.02	0.02
	10k Ω	0.02	0.02	0.02	0.02

General Specifications

Measurement Mode	4 Wire
Linearity	± 0.005 ppm of full scale
Operating Conditions	10°C to 35°C, 10% to 90% RH non-condensing
Test Current Range	10 μA to 150mA
Test Current Accuracy	100 ppm +10 μA (Full Range)
Test Current resolution	18 bit
Interface	IEEE488.2 with Standard Code Programmable Interchange (SCPI)
Display	Touch Screen Display (No external keyboard), Resolution 0.001 ppm

Dimensions (W x D x H):

438 x 406 x 267 (mm)

Weight:

19 kg

Shipping Weight:

23 kg

Main Power:

100, 120, 220, 240V – 50/60Hz
200 VA Max.

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