

AccuBridge® MODEL 6020T



Automated Thermometry Bridge

- Self Calibrating Ratio Bridge
- Accuracy Whole Range (SPRT $R_0 \geq 2.5\Omega$) 15ppb
- NEW Quick Measure Mode under 20 Seconds to First Reading
- NEW Reversal Rate of 2 Seconds
- 0.01 Ω to 100 k Ω range
- Front and rear panel inputs
- Linearity < 0.005ppm
- IEEE488 and manual operation
- Accu-T-Cal™ Software for calibrating PRTs

MODEL INFORMATION

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 is 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 new voltage feedback circuit to improve on the linearity error of the nano-volt 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 4.05 allowing customers to meet all of these requirements.

Quick Measure Mode Provides Customers with the ability to have first reading within 20 seconds from pressing Start, Reversal Rates have been improved for 2 second's. Only MI offers a DC Bridge with these improvements that can meet specification!

NEW Features

For years customers have been asked for MI to extend on the measurement features of the DC Comparator Bridge to replace existing AC Technology. MI has finally answered the requests with the release of the 6020T. The 6020T features a new QUICK MEASURE mode which allows the bridge to balance faster thus improving the first measurement reading to be displayed within less than 20 seconds from pressing START!

Next we focused on current reversal time. Customers have been requesting that a DC Current Comparator Bridge meet that again of AC Bridges. This again, has been accomplished with the improved reversal rate function of 2 seconds! MI is the only DC Current Comparator Bridge that has improved with these features and still meets stated specification!

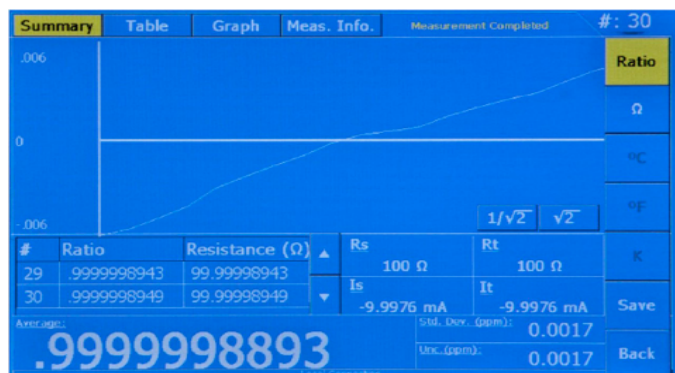
Ratio Range and Accuracy

The AccuBridge® Direct Current Comparator (DCC) with its binary wound current comparator technology balances current with effective resolution of 25 bits. It provides ratio measurements with an accuracy to better than 15 ppb at ratios. It covers a ratio range of 0.1 to a maximum ratio of 4.05, with a linearity of better than 5 ppb. The 6020T can perform ratio measurements with resistances valued from 0.01 Ω to 100 k Ω . Optional 10—, 16— or 20—channel scanners can be used individually or together to connect to up to 40 channels of ratio measurement for up to 40 different test resistors/PRT's to be calibrated. The 6020T is perfectly suited for front panel operation or you can team it with MI's Acc-T-Cal™ Operating Software for fully automated measurements, history logging, graphing, and regression analysis. Stand-alone operation with the touch sensitive display panel provides full bridge capabilities to the operator. Ratio or direct resistance measurements can be made. Multiple measurements over time can be numerically displayed or graphically displayed to best fit your needs.

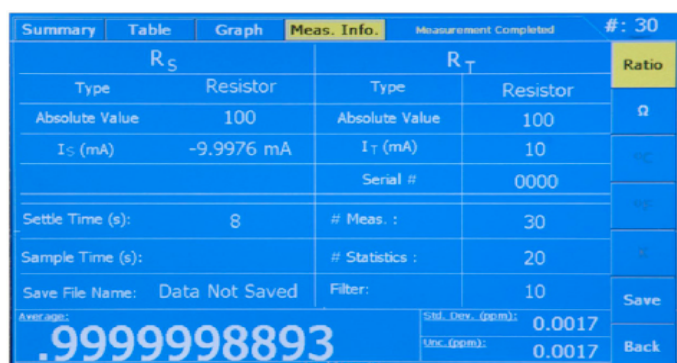
Overview

The 6020T measures both ratio and absolute values. You select functions using the menu on the large touch screen display. For absolute measurements, you enter the value and related uncertainty of the standard resistor using the display's keypad. You enter the measurement functions such as current through the unknown resistor, settle time, number of measurements, and number of statistics the same way. The 6020T's low-noise, touch screen display is interactive with the measurements. When a reading is complete, the average value and uncertainty (based on the number for statistics) are displayed. All uncertainty calculations are 2 sigma level.

At MI, it's not only about the equipment and science, it's about what you can do and the ease with which you can do it.



The Summary screen displays data for both ratio or resistance



The Measurement Info screen displays the measurement parameters

Automated Temperature Operation

Measurements International's Accu-T-Cal™ SW is a software package for the automation of measurements and calibrations of platinum resistance thermometers at primary and secondary level. Accu-T-Cal™ SW is based on over 15 years of experience and research of metrologists from Laboratory of Metrology and Quality, Faculty of Electrical Engineering, University of Ljubljana (ULFE/LMK). ULFE/LMK is the holder of the National Standard for Thermodynamic Temperature in Slovenia.

Platinum resistance thermometers (PRTs) are calibrated at the highest level in fixed points, as specified in the International temperature scale ITS90. In this method the PRT is calibrated by making measurements at the fixed temperature maintained by the fixed point cell. This method gives the best achievable calibration uncertainties, usually down to about 1 mK.

In order to reduce cost and time, platinum resistance thermometers can also be calibrated by comparison. In this method the PRT is calibrated by comparing its reading with the reading of a reference thermometer, placed at the same temperature inside the temperature controlled calibration medium. The reference thermometer and the UUT are measured with the same resistance bridge. The resistance bridge uses a switching matrix (scanner) to switch between both thermometers and alternately take resistance readings. Measurement method allows appropriate handling of readings from both thermometers to minimize possible sources of errors resulting from short term stability of the calibration medium temperature and measurement speed of the bridge. In the temperature range from -50 °C to 300 °C it is possible to achieve uncertainties down to 5 mK, which is 3 to 5 times larger compared to calibration in fixed points.

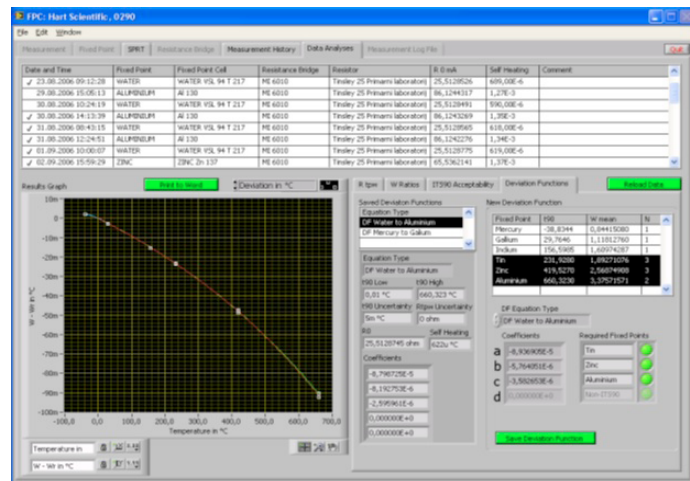
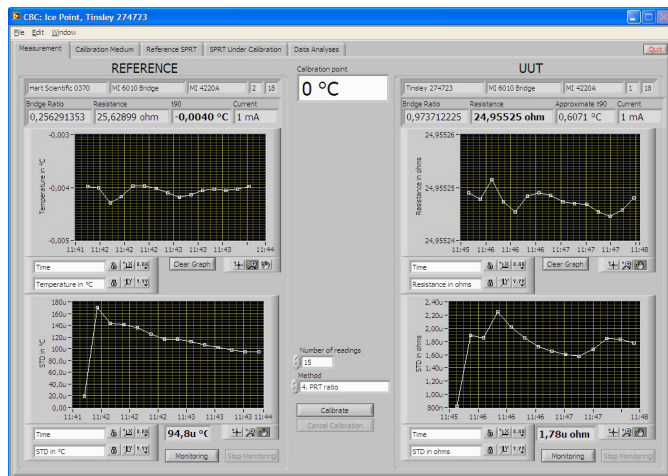
Accu-T-Cal™ SW has built drivers for all Measurements International Temperature and Resistance bridges as well as the MIL scanners, allowing to configure multiple PRT's to be calibrated. Communication with all equipment uses the IEEE-488 bus that comes standard with all MIL equipment. Configuration of hardware, standard PRT's as well as DUT's is easily entered into SW and is stored for future use or for later measurement data analysis.

For More Information Please Visit www.mintl.com and access the Accu-T-Cal™ SW data sheet

Accu-T-Cal™ Software for the 6020T Automated Resistance Thermometry Bridge

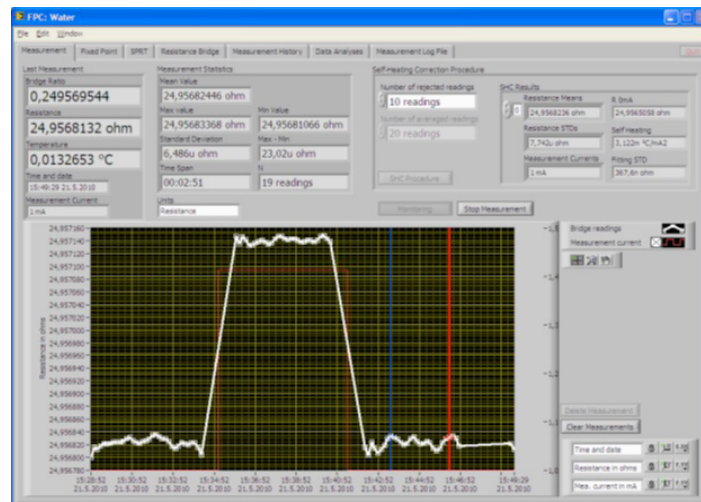
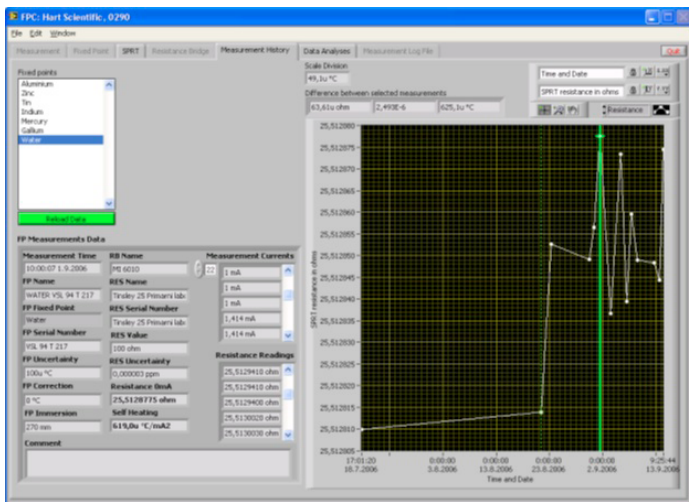
SW includes a list of the ITS90 fixed point cells parameters for use when configuring new measurements. Accu-T-Cal™ SW has built in

automatically saved for detailed analysis and calibration report generation. Users can select evaluation of deviation function as per the



procedure for evaluation and correction of the PRT's self heating, with user selectable steps at the measurement current. All measured data are available as graphical and tabular format and are

ITS90, or polynomial representation of the PRT's characteristics from the data obtained during calibration. Accu-T-Cal™ SW gives the user full freedom of selection or rejection of particular results from the analysis.



AccuBridge® 6020T Accessories

Model 42xx Scanners

Channel Extension By using combinations of matrix scanners, you can increase the number of input channels to almost any number from 10 to 40. Our Automated Low Thermal Matrix Scanners include the 4210A and 4210B with ten input and two output channels; 4216A, 4216B with 16 input and two output channels; and 4220A and 4220B with 20 input and two output channels. Our A-series of matrix scanners have tellurium copper terminals on their inputs and outputs while our B-series units have four-wire Teflon cable on their inputs and outputs. *For more information, see our 4200 Series Model 4210, 4216 and 4220 Automated Low Thermal Matrix Scanners data sheet.*



Model 9300 Air Bath

The Model 9300 Series Air Baths are designed as a convenient and inexpensive way to maintain the temperature of air resistors in your calibration laboratory. It is large enough to house several standard air resistors and features an adjustable shelf to permit easy access to the standards. The shelves are easily removable in order to place a single ESI type SR104 standard in the bath. The bath is small and rugged and may be moved about easily. *For our complete range of Air Baths, see the 9300 Data Sheet.*



Model 9300A Temperature Controlled Chamber with IEEE 488

Temperature Controlled Chamber with IEEE 488 The 6020T is also ideal for verifying the temperature and power coefficient of resistors or shunts using the MI 9300A Air Bath. 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 software for automated measurements and calculations of alpha, beta coefficients and resistor values. A Hi/Lo temperature protection circuit is built into the bath to protect your resistors. *For our complete range of Air Baths, see the 9300A Data Sheet.*



Model 9400 Oil Bath with IEEE 488

We designed our Model 9400 Standard Resistor Oil Bath based on years of customer feedback on existing resistor oil baths. You control this bath through a touch screen interface. Due to its low electrical noise, the quiet 9400 can be used with the Cryogenic Current Comparator (CCC) and Quantum Hall Resistance (QHR) Standard. Depending on the quantity of resistors in the bath, the stirrer motor speed can be changed. The IEEE drivers for this bath are built into the 6020SW software for automated measurements and calculations of alpha and beta coefficients and resistor values. *For more information, see our 9400 Series Model 9400 Standard Resistor Oil Bath data sheet.*



Model 9331 & 9331R Series Air Resistors

Our high-accuracy working standard air resistors are used for precision on-site resistance calibrations for values from 1 mΩ to 100 MΩ. Our series of air resistors are small, light, and rugged resistance standards. The stability and temperature coefficients of the resistors make them ideal for easy transport and for operation in any working environment within the range of 18 °C to 28 °C.

The Model 9331R series ranges from 1mΩ to 10MΩ. Connections to the 9331R Reference resistors are made with tellurium copper 5-way binding posts for values to 10 MΩ. A separate ground terminal is included for guarding and the case is hermetically sealed to keep moisture out.



For more information, see

our Model 9331R Reference Series Standard Air Resistors and Model 9331 Standard Air Resistor data sheets.

Model 9210 Series Standard Oil Resistors

Standard Oil Resistors provide better stability and temperature coefficients over air resistors and provide the highest precision and stability in resistance measurements. Our standard oil resistors include the 9210A Primary 1 Ω, 9210A Primary 0.1 Ω, and 9210B series from 10 Ω to 100 kΩ. The 9210A 1 Ω and 9210A 0.1 Ω resistors have a negligible pressure coefficient. *For more information, see our Model 9210A MI-Type Standard and Model 9210B Reference Series Standard Oil Resistors data sheets.*



Specification

Note: Either Rs or Rx can be selected as the standard for values $\geq 0.1\Omega$. Uncertainties specified at 2 sigma level (95%) includes all secondary specifications such as linearity and noise with a $\pm 2^\circ\text{C}$ temperature variance. Optimal performance stated at $R_x \geq R_s$. Accuracy for values $< 0.1\Omega$ and $> 10\text{k}\Omega$ is 0.15ppm	0.01 Ω to 100 kΩ	
	Resistance Ratio Accuracy, 95% Confidence Level	
	Ratio: 0.1 to 0.5	< 0.015ppm
	Ratio: 0.5 to 0.95	< 0.015ppm
	Ratio: 0.95 to 1.05	< 0.015ppm
	Ratio: 1.05 to 4.05	< 0.015ppm

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 150 mA
Test Current Accuracy	<100 ppm +10 μA (Full-Range)
Test Current resolution	18-bit
Interface	IEEE488.2
Display	Touch Screen Display (No external keyboard), Resolution 0.001 ppm

Dimensions (W x D x H):
438 x 406 x 267 (mm)
17.2 x 16.0 x 10.5 (inch)

Weight:
19 (kg)
42 (lb)

Shipping Weight:
23 (kg)
51 (lb)

Main Power:

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

ORDERING INFORMATION

Model	Description
6020T	Resistance Bridge with Software
4210A	10 Channel Matrix Scanner, terminal inputs
4210B	10 Channel Matrix Scanner, wire inputs
4216A	16 Channel Matrix Scanner, terminal inputs
4216B	16 Channel Matrix Scanner, wire inputs
4220A	20 Channel Matrix Scanner, terminal inputs
4220B	20 Channel Matrix Scanner, wire inputs
9300A	Air Bath
9400	Oil Bath
9210A	Evanohm Resistor (1 Ω and 0.1 Ω)
9210B	Oil Resistors 10 Ω , 100 Ω , 1k Ω , 10k Ω , 100k Ω Air
9331	Resistors 0.1 Ω to 100k Ω Values Available

SPSCW30/100 4-conductor teflon cable, 30m or 100m