SUPER-THERMOMETERS

Super-Thermometers	Models 1575 and 1590
Accuracy to 4 ppm (0.001°C) or 1 ppm (0.00025°C)	
Bridge-level performance at less than half the cost	
Accepts 0.25-ohm through 100-ohm SPRTs plus thermistors	
Includes all temperature functions and stores setups	

Hart's Super-Thermometers are recognized in metrology laboratories around the world for their ease of use and reliable accuracy. The Model 1575 Super-Thermometer is accurate to 0.001°C. The Model 1590 Super-Thermometer II is accurate to 0.00025°C, or 1 ppm.

Both Super-Thermometers are perfectly suited for SPRT calibrations. These are the best lab instruments to take advantage of SPRT accuracy. They're easy to use, they read temperature directly, they have automated data collection, they automatically calculate constants for ITS-90, and both of them are priced at less than half the price of the competitors' resistance bridges.

Of course, there's more.

Bridges

Resistance bridges are one of the most expensive pieces of lab equipment you can buy. Most sell for $30,000 to $50,000. The resistance bridge market is very small, and there's hardly any competition. There's nothing to control the price except your willingness to pay.

Resistance bridges are difficult to use. Their learning curve is long and complex, which means you'll spend plenty of time learning to master one. Time spent learning costs you money, and costs multiply if you have to train other people!

So why buy a bridge if you have a legitimate alternative?

If 1 ppm accuracy gets the job done, the easiest and cheapest way to do it is with one of Hart's Super-Thermometers.

Model 1575

The Model 1575 Super-Thermometer is a best-selling thermometer because of its ease of use, high accuracy, built-in software, and reasonable price. Temperature is read directly on the display in your choice of scales. There are no manual resistance-to-temperature conversions. Resistance is converted to temperature for you using the ITS-90 algorithm in any one of the instrument's ranges. Up to 16 independent sets of probe characterizations can be stored in the 1575's memory. Switch SPRTs and simply call up its reference identification number. Forget the extensive, time-consuming setup required by resistance bridges. Read the features common to both units and you'll understand why each is a great buy.

Model 1590

The 1590 Super-Thermometer II has all of the features of the original 1575, plus it has the unbeatable accuracy of 1 ppm and a color screen that tilts to create the best viewing angles. With all of these features, it's still less than half the price of a bridge.

In many labs with standards that require the use of bridges, Super-Thermometers have been accepted as an alternative to bridges because they are a combination of bridge technology and

microprocessor-based solid-state electronics—and they're much easier to use.

Accuracy

The typical benchtop thermometer has an error level 5 to 10 times larger than the Super-Thermometer, and 20 to 40 times higher than a Super-Thermometer II. With common 25- or 100-ohm SPRTs, the 1575 Super-Thermometer achieves ±0.002°C accuracy and ±0.001°C accuracy with a calibrated external standard resistor. The 1590 Super-Thermometer II is even better with ±0.00025°C accuracy.

ITS-90 specifies the use of 2.5-ohm and 0.25-ohm SPRTs as high-temperature standards up to the silver point (962°C). This very small resistance is difficult to measure and is commonly done only with resistance bridges. The Super-Thermometers address ITS-90 problems directly and are absolutely the most cost-effective solution available.

In addition, resolution with a 25-ohm SPRT is 0.0001°C. Comparison calibrations or calibrations against primary standard fixed points are easily performed. Both instruments have two channels for handling two probes at once. Display and record actual temperatures or choose to read the difference between the two directly from the screen.

Both Super-Thermometers have their own on-board resistors. Each is a high-stability, low thermal coefficient, four-terminal resistor for each of the resistance ranges of the thermometer: 0.25 ohms, 2.5 ohms, 25 ohms, 100 ohms, and thermistor ranges. Resistors are housed in an internal temperature-controlled oven. Can it get any better?

Well, actually it does.

Hart's patented DWF Connectors—so easy to use you'll never want to use anything else.

Add 10 channels to a 1575 Super-Thermometer with a 2575 Mighty-Mux. Or add up to 50 channels to a 1590 Super Thermometer II with 10-channel 2590 Mighty-Mux II multiplexers.

DWF Connectors

Hart's patented Model 2392 DWF Connector is unique in the industry (U.S. Patent 5,964,625). Each one is machined from solid brass and then plated with gold. DWF Connectors accept banana plugs, spade connectors, or bare wires. Banana plugs are inserted in the top. Bare wires go in one of the four side holes and are held in place by a spring-loaded pressure plate. Spade connectors are inserted between the top of the connector and pressure plate and are held in place the same as bare wire. The connections are solid and difficult to dislodge. Bare wire and spade connectors require nothing more than pushing the DWF Connector in. There's nothing to screw down or tighten.

Other Features

Super-Thermometers convert resistance to temperature using your choice of ITS-90 or IPTS-68. ITS-90 requires no conversions; just enter your coefficients directly. For IPTS-68 enter R0, ALPHA, DELTA, A4, and C4. Temperature can be converted from IPTS-68 to ITS-90 automatically at your request. Calendar-Van Dusen equations are also provided in an automated mode.

Thermistor probes are characterized by coefficients of a logarithmic polynomial. Save money and use low-cost, rugged thermistor standards for ±0.001°C accuracy in the low-temperature regions. Other thermometers don't do all this.

Measurements can be displayed as temperatures in °C, K, or °F and as resistance in ohms or a ratio of probe resistance to reference resistance. The current source is controllable between 0.001 mA and 15 mA with a resolution of 0.2%. Integration time and digital filtering are programmable to optimize resolution, stability, and response.

Datalogging and memory functions store measurements, and each thermometer has its own 3.5-inch disc drive for archiving data. The display is a backlit LCD for visual display of information. It has an RS-232, an IEEE-488, and a parallel printer port.

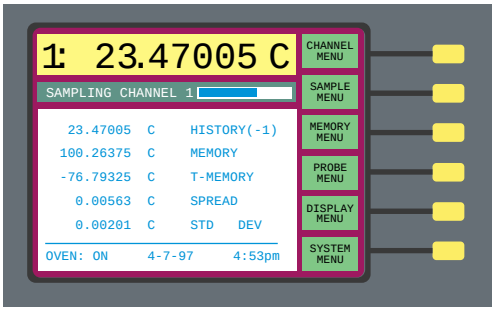
These Super-Thermometers are based on DC electronics, thus eliminating the problems with national lab certification for AC bridges and the removal of quadrature interference from AC-heated fixed-point furnaces.

Multiplexers

If two channels aren't enough, add 10 more with a Mighty-Mux featuring Hart's handy DWF connectors. In fact, add up to 50 more channels to the 1590.

The Model 2575 provides 10 more channels for use with a 1575. For the 1590, the Model 2590 Mighty-Mux II has a cascading ability that lets you have up to 50 channels by chaining more than one Mux together, and you can now set continuous constant current levels on

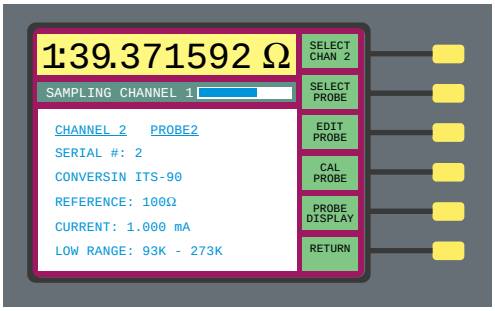
SUPER-THERMOMETERS



Customize Your Display

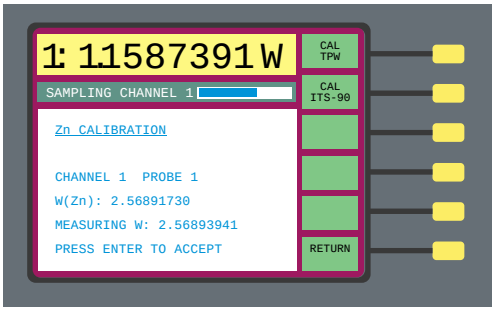
The graphic screen is easily modified to include information that fits your application or preferences. Under the display menu you select up to five lines of on-screen information from 19 different options including:

T-MEMORY	Current value minus the value in memory
T(1) - T(2)	Channel one minus channel two
MAXIMUM	Peak reading since last reset
MINIMUM	Lowest value since last reset
SPREAD	Maximum difference between readings
AVERAGE	Computes average of previous samples
STD DEV	Computes standard deviation of previous samples



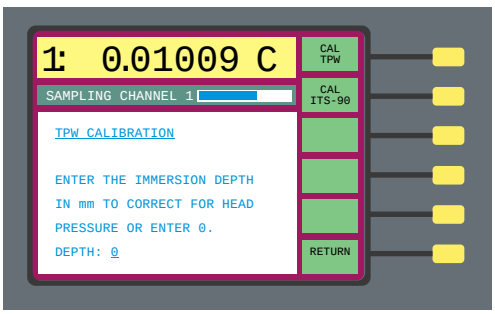
Probe Setup

Each probe's information is identified by its unique serial number for assignment to a specific channel. You select the desired resistance-to-temperature conversion formula, set the probe constants, and select the reference resistor and the drive current. A total of 16 probe setups are stored in internal memory. An unlimited number can be stored to disk and selected when needed. After a probe's information is entered the first time, the Super-Thermometer is immediately set to match that probe by simply selecting the probe's serial number.



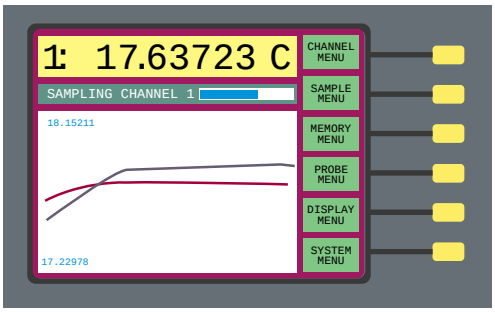
Automatic Calculation of Constants

The Super-Thermometers automatically calculate the required constants for the ITS-90 temperature conversion. Connect your uncalibrated standards probe to the 1590, measure the resistance at the fixed-points or against a calibrated standard, and the 1590 stores the resistance readings and automatically derives the correct constants. You don't need a calculator and a pad of paper. The Super-Thermometers enter the constants directly to the probe setup, saving you time and preventing error in the manual entry of constants.



The Triple Point of Water

Take a reading in the TPW cell just prior to each new measurement. The Super-Thermometers store the current R_{TPW} value and reference it during the conversion from resistance to temperature. This eliminates two sources of measurement error. The drift of R_{TPW} in the SPRT is removed, and the error of the on-board reference resistors is canceled. For convenience and maximum precision, you can even enter the immersion depth of your SPRT in the cell to correct for hydrostatic head.



Graphing Feature

The Super-Thermometers feature real-time, on-scale graphing for monitoring fluid bath stabilization or realizing metal fixed-point plateaus. Simply monitor the graph for stability on one or multiple channels and take your readings in resistance, temperature, or the ratio to the triple point of water. The 3.5-inch disc drive stores readings in an ASCII format for spreadsheet or graphing use. Graphing resolution limits can be manually entered, or maximum resolution is automatically set as the readings stabilize over time. Temperature measurement labs save time by not monitoring or taking data every few seconds.

Specifications	1575			1590		
	Nominal Resistance	Accuracy (of indicated value)	Equivalent Temperature Value, at 0°C	Nominal Resistance	Accuracy (of indicated value)	Equivalent Temperature Value, at 0°C
Transfer Accuracy (using external reference resistor)	0.25Ω 2.5Ω 25Ω 100Ω 10 KΩ	40 ppm 20 ppm 4 ppm 4 ppm 10 ppm	0.01°C 0.005°C 0.001°C 0.001°C 0.00025°C (thermistor at 25°C)	0.25Ω 2.5Ω 25Ω 100Ω 10 KΩ	20 ppm 5 ppm 1 ppm 1 ppm 5 ppm	0.005°C 0.00125°C 0.00025°C 0.00025°C 0.000125°C (thermistor at 25°C)
Absolute Accuracy (using internal reference resistor)	0.25Ω 2.5Ω 25Ω 100Ω 10 KΩ	100 ppm 40 ppm 8 ppm 8 ppm 20 ppm	0.025°C 0.01°C 0.002°C 0.002°C 0.0005°C (thermistor at 25°C)	0.25Ω 2.5Ω 25Ω 100Ω 10 KΩ	40 ppm 20 ppm 6 ppm 6 ppm 10 ppm	0.01°C 0.005°C 0.0015°C 0.0015°C 0.00025°C (thermistor at 25°C)
Typical Resolution	0.25Ω 2.5Ω 25Ω 100Ω 10 KΩ	10 ppm 5 ppm 1 ppm 1 ppm 3 ppm	0.0025°C 0.00125°C 0.00025°C 0.00025°C 0.000075°C (thermistor at 25°C)	0.25Ω 2.5Ω 25Ω 100Ω 10 KΩ	10 ppm 2 ppm 0.5 ppm 0.5 ppm 2 ppm	0.0025°C 0.0005°C 0.000125°C 0.000125°C 0.00005°C (thermistor at 25°C)
Resistance Range	0Ω to 500 KΩ					
Internal Reference Resistors	1Ω, 10Ω, 100Ω, 10 KΩ					
Minimum Measurement Period	2 seconds					
Current Source	0.001 mA to 15 mA, programmable					
Analog Output	–5 to +5 V					

each channel to avoid self-heating effects. Whatever your application, a Mighty-Mux will make it easier and more efficient.

Both units have low thermal EMF relays that are hermetically sealed and magnetically shielded. You're making true four-wire measurements with a floating guard and support for up to 20 mA of drive current.

Super-Thermometers vs. Digital Multimeters

Good eight-and-a-half-digit multimeters might give you accuracy to ±0.005°C in the resistance measurement. However, DMMs require separate high-stability current sources, and you have to make EMF offsets, worry about a scheme to switch between forward and reverse current during the measurement, and devise a switch to get a second channel for an external standard resistor.

Once you've done all of this, you still have to convert resistance to temperature with tedious manual calculations.

Super-Thermometers do all of this automatically.

Super-Thermometers vs. Everything Else

There really isn't anything else to compare to the 1590 and 1575. No other readout is this easy to use. You'll be doing calibrations with it the first day you receive it, not the first day after the training program is over.

Ordering Information	
1575	Super-Thermometer
2575	Multiplexer, 1575
1590	Super-Thermometer II
2590	Multiplexer, 1590
5420-25	Standard DC Resistor, 25Ω
5420-100	Standard DC Resistor, 100Ω

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Specifications - Muxes	
Channels	**2575:** 10 **2590:** 10 per unit, cascade up to 5 units for 50 channels
Connector	4-wire plug, floating guard
Terminals	Gold-plated Hart DWF Connectors
Relays	Low thermal EMF, hermetically sealed, magnetically shielded
Contact Resistance	< 0.1Ω
Isolation	1 x 10^{12} between relay legs
Channel Selection	Manual or auto
Current Capability	20 mA
Current Levels	**1575:** Current on active channel only **1590:** Standby current 1 mA, 0.5 mA, or 10 µA on all channels
Power	Via connection to 1575 or 1590
Size	20.3" W x 12.6" D x 7" H (516 x 320 x 178 mm)