



## PT-100 Series Platinum RTDs

### PT-100 Series features

- Temperature range: 14 K to 873 K (model dependant)
- Conforms to IEC 751 standards down to 70 K
- High reproducibility:  $\pm 5$  mK at 77 K
- Low magnetic field dependence above 40 K
- Excellent for use in ionizing radiation
- SoftCal™ calibration available
- Non-magnetic packages available (PT-103 variants)

### Matching

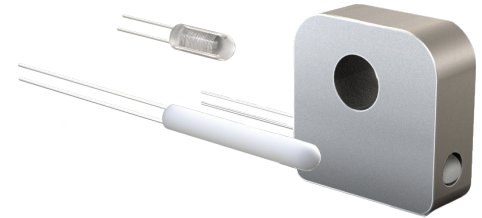
*If your application requires more than one platinum resistor, up to five platinum resistors can be matched to one another to within  $\pm 0.1$  K at liquid nitrogen temperature with the purchase of only one calibration.*

PT-100 platinum resistance thermometers (PRTs) are an excellent choice for use as cryogenic temperature sensing and control elements in the range from 30 K to 873 K ( $-243$  °C to  $600$  °C). Over this temperature span, PRTs offer high repeatability and nearly constant sensitivity ( $dR/dT$ ). Platinum resistors are also useful as control elements in magnetic field environments where errors approaching one degree can be tolerated. PRTs are interchangeable above 70 K. The use of controlled-purity platinum assures uniformity from one device to another.

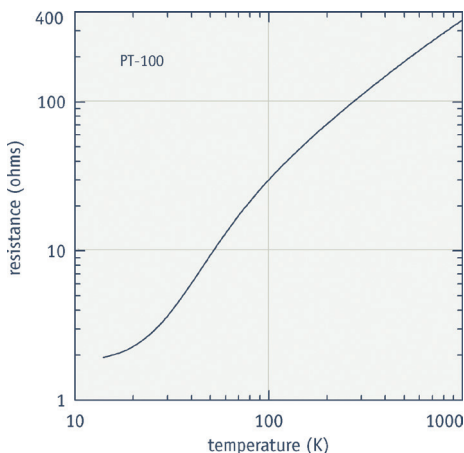
PRTs experience rapidly decreasing sensitivity below approximately 30 K. They should be calibrated in order to achieve maximum accuracy for use below 100 K. The plot illustrates platinum sensor conformance to the IEC 751 curve.

### Packaging options

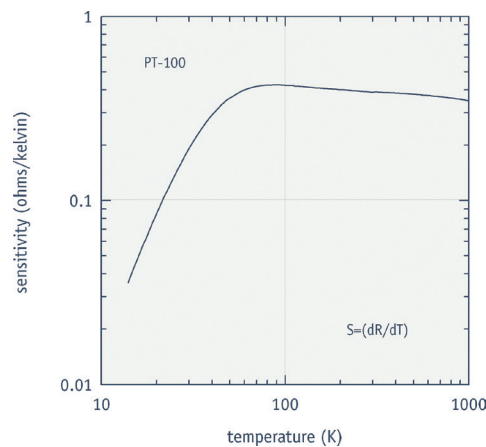
AL, AM



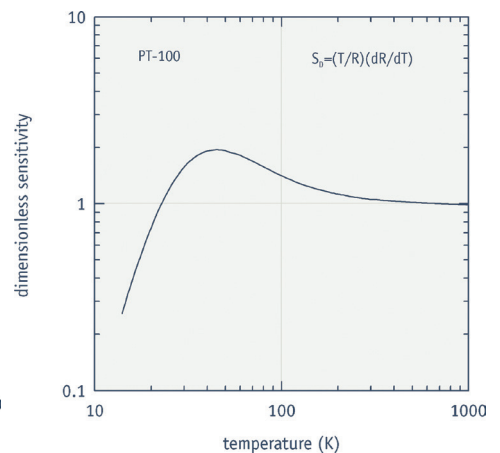
### Typical platinum resistance



### Typical platinum sensitivity



### Typical platinum dimensionless sensitivity



## Specifications

**Standard curve** IEC 751

**Recommended excitation** 1 mA

**Dissipation at recommended excitation** 100  $\mu$ W at 273 K

**Thermal response time** PT-103: 1.75 s at 77 K, 12.5 s at 273 K; PT-111: 2.5 s at 77 K, 20 s at 273 K

**Use in radiation** Recommended for use in ionizing radiation environments—see Appendix B

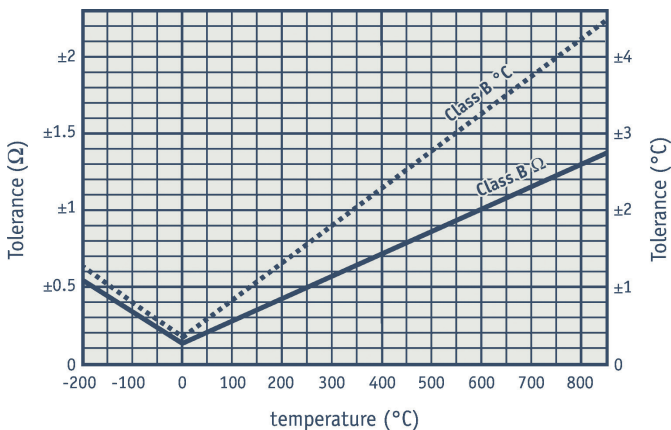
**Use in magnetic field** Because of their relatively low magnetic field dependence above 30 K, platinum sensors are useful as control elements in magnetic field applications when some error can be tolerated—see Appendix B

**Reproducibility**<sup>1</sup>  $\pm 5$  mK at 77 K

**Soldering standard** J-STD-001 Class 2

<sup>1</sup> Short-term reproducibility data is obtained by subjecting sensor to repeated thermal shocks from 305 K to 77 K

## PT-100 Series interchangeability



## Physical specifications

	Mass	Lead type	Internal atmosphere	Materials used	Maximum vacuum	Non-magnetic package
PT-103	120 mg	2, platinum	Fully filled powder	Platinum winding fully supported by a high temperature alumina powder inside a ceramic tube, platinum/rhodium lead wires	$1 \times 10^{-4}$ Pa	Yes
PT-111	52 mg	2, platinum-coated nickel	Solid glass	One platinum band wound onto a glass tube which is protected from the environment by a layer of glaze, platinum coated nickel lead wires	$1 \times 10^{-7}$ Pa	No

## Range of use

	Minimum limit	Maximum limit
PT-103	14 K	873 K
PT-111	14 K	673 K

## SoftCal™ accuracy

	30 K to 305 K	305 K to 400 K	400 K to 475 K	475 K to 500 K	500 K to 670 K
2S	$\pm 0.25$ K	$\pm 0.9$ K	$\pm 1.3$ K	$\pm 1.4$ K	$\pm 2.3$ K
3S	$\pm 0.25$ K	$\pm 0.25$ K	$\pm 0.25$ K	$\pm 1.4$ K	$\pm 2.3$ K

2S: 77 K and 305 K

3S: 77 K, 305 K and 480 K

## Calibrated accuracy

	Typical sensor accuracy <sup>2</sup>		Long-term stability <sup>3</sup>
	Calibrations to 800 K	All other calibrations	
30 K	$\pm 10$ mK	$\pm 10$ mK	—
77 K	$\pm 12$ mK	$\pm 12$ mK	$\pm 10$ mK
305 K	$\pm 23$ mK	$\pm 23$ mK	—
400 K	$\pm 210$ mK	$\pm 41$ mK	—
500 K	$\pm 210$ mK	$\pm 46$ mK	—
800 K	$\pm 310$ mK	—	—

<sup>2</sup>  $[(\text{Calibration uncertainty})^2 + (\text{reproducibility})^2]^{0.5}$  for more information see Appendices B, D, and E

<sup>3</sup> If not heated above 475 K—long-term stability data is obtained by subjecting sensor to 200 thermal shocks from 305 K to 77 K

## Typical magnetic field-dependent temperature errors<sup>4</sup> $\Delta T/T$ (%) at B (magnetic field)

	Package parallel to field B				
	2.5 T	5 T	8 T	14 T	19 T
20 K	20	—	100	250	—
40 K	0.5	1.5	3	6	8.8
87 K	0.04	0.14	0.4	1	1.7
300 K	0.01	0.001	0.02	0.07	0.13

<sup>4</sup> Recommended for use when  $T \geq 30$  K

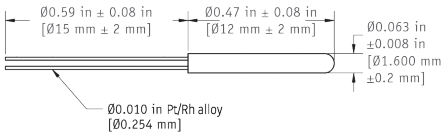
## Temperature response data table (typical)

See Appendix G for expanded response table

	PT-100		
	R ( $\Omega$ )	S ( $\Omega/K$ )	(T/R)(dR/dT)
20 K	2.2913	0.085	0.74
50 K	9.3865	0.360	1.90
77 K	20.380	0.423	1.60
150 K	50.788	0.409	1.20
300 K	110.354	0.387	1.10
600 K	221.535	0.372	1.00
800 K	289.789	0.360	1.00

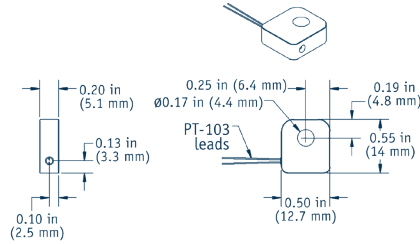


**PT-103**



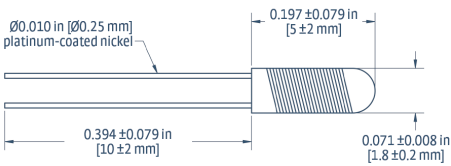
General tolerance of  $\pm 0.010$  in [ $\pm 0.254$  mm] unless otherwise noted

**PT-103-AM**



General tolerance of  $\pm 0.010$  in [ $\pm 0.254$  mm] unless otherwise noted

**PT-111**



**Ordering information**

**Uncalibrated sensor**—Specify the model number in the left column only, for example PT-103.

**Calibrated sensor**—Add the calibration range suffix code to the end of the model number, for example PT-103-14L.

Platinum RTD	Calibration range suffix codes					
	Numeric figure is the low end of the calibration					
	Letters represent the high end: S=SoftCal™, L=325 K, H = 500 K, J = 800 K					
Part number	Uncal	2S	3S	14L	14H	14J
PT-103	■	■	■	■	■	■
PT-103-AM	■	■	■	■	■	■
PT-111	■	■	■	■	■	■

ADD -LN\* Matching PT sensors to  $\pm 0.1$  K at 77 K

\*MUST be purchased with all matching sensors, as well as with the sensor to be matched

**Notes:**

- Upper temperature of AL and AM packages is limited to 800 K.
- If your application requires more than one platinum resistor, up to five platinum resistors can be matched with one another to within  $\pm 0.1$  K at liquid nitrogen temperature with the purchase of only one calibration. If absolute accuracy is required, one of these matched RTDs can be calibrated. For larger quantities, or for different requirements, consult Lake Shore. At the time of order, add -LN to the model number.  
Example: PT-103-14L-LN is a PT-103-LN RTD with a calibration range of 14 K to 325 K that is matched with at least one other uncalibrated PT-103 to within  $\pm 0.1$  K at liquid nitrogen temperature.
- For metrological applications below 30 K, use a germanium RTD. PT-100 sensors are not useful below 14 K for metrology and are of limited use below 30 K for temperature control, due to rapid decline in sensitivity.
- For use above 500 K, anneal at  $T_{max} + 10$  °C for 4 h.

**Accessories available for sensors**  
 8000-CD Calibration report on CD-ROM  
 8000-USB Calibration report on USB  
 COC-SEN Certificate of conformance

**Accessories suggested for installation—see Accessories section for full descriptions**  
 Stycast® epoxy VGE-7031 varnish  
 Apiezon® grease Phosphor bronze wire  
 90% Pb, 10% Sn solder Manganin wire  
 Indium solder CryoCable™



**Packaging options**

For more information on sensor packages and mounting adapters, see page 20.



See the appendices for a detailed description of:  
 Installation  
 Uncalibrated sensors  
 SoftCal™  
 Calibrated sensors  
 CalCurve™  
 Sensor packages

To add length to sensor leads see page 25.