

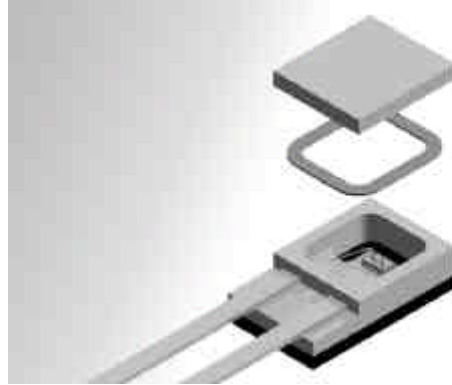
DT-670 Series Silicon Diode Temperature Sensor

Lake Shore's DT-670 diode temperature sensors are the most advanced silicon diodes in Lake Shore's extensive line of cryogenic temperature sensors. Backed by more than thirty years of excellence in cryogenic temperature measurement, the DT-670 series offers significant improvements to diode thermometry. Better accuracy over a wider range, a tight tolerance band designed for applications greater than 25 K, and available in a bare die that has the fastest thermal response time and smallest size of any diode temperature sensor.

Lake Shore's DT-670 diode temperature sensors offer the best accuracy across the widest useful temperature range – 1.4 to 500 K – of any silicon diode sensor in the industry. Sensors within the DT-670 series are interchangeable; that is, sensors conform to a standard voltage *versus* temperature response curve, the Curve DT-670.

DT-670 diode temperature sensors are available in Lake Shore's SD package and as bare die sensors. Rugged and reliable, the SD package is designed to withstand repeated thermal cycling and minimize sensor self-heating. DT-670 sensors in the SD package are compatible with Lake Shore's full line of SD mounting adaptors.

For many applications, DT-670 sensors do not require individual calibration. For applications requiring greater accuracy, DT-670 diodes in the SD package are available with calibration across the full 1.4 to 500 K temperature range.



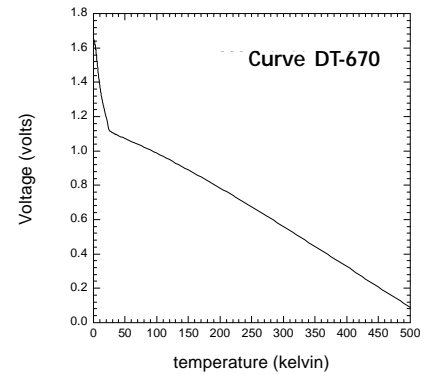
Advantages of the DT-670 include:

- The best accuracy across the widest useful temperature range – 1.4 to 500 K – of any silicon diode in the industry
- The tightest tolerances for temperatures from 25 to 500 K of any silicon diode to date
- Bare die sensors with the smallest size and fastest thermal response time of any silicon diode on the market today
- Lake Shore's rugged, reliable SD package designed to withstand repeated thermal cycling and minimize sensor self-heating
- Sensors conform to Curve DT-670, the DT-670 series standard response curve
- Backed by Lake Shore's tradition of excellence in cryogenic temperature measurement

Diode thermometry is based on the temperature dependence of the forward voltage drop in a p-n junction biased at a constant current, typically 10 mA. Because the voltage signal is relatively large, between 0.1 and 6 V, diodes are easy to use and instrumentation is straightforward.

DT-670 Series Tolerances Bands

DT-670 diode temperature sensors respond to a unique voltage *versus* temperature response curve that Lake Shore refers to as Curve 670. Sensors within the DT-670 series are interchangeable and for many applications, do not require individual calibration.



DT-670 sensors in the SD package are available in four tolerance bands - three for general cryogenic use across the 2 to 500 K temperature range, and one that offers superior accuracy for applications from 25 K to room temperature. Tolerance bands allow users to select the degree of accuracy and value for specific application needs. DT-670 diode temperature sensors are also available in a fifth tolerance band, Band E, these are available only as bare die.

Band	Temperature Range		
	2 K – 100 K	100 K – 305 K	305 K – 500 K
A	+/- 0.25 K	+/- 0.5 K	+/- 0.5 K
B	+/- 0.5 K	+/- 0.5 K	+/- 0.33%
C	+/- 1 K	+/- 1 K	+/- 0.50%

Band	Temperature Range		
	25 K – 100 K	100 K – 305 K	305 K – 500 K
D	+/- 0.25 K	+/- 0.30 K	+/- 0.10%
E	+/- 0.25 K	+/- 0.25%	+/- 0.25%

Bands A, B, C: Wide range cryogenic temperature sensor

For general cryogenic use, DT-670 sensors in three tolerance bands across the 2 to 500 K temperature range allow users to select the degree of accuracy and value for specific application needs.

Band D: The best accuracy from 25 to 500 K

DT-670 sensors in Band D offer the best accuracy for applications above 25 K of any diode temperature sensor to date. With accuracy to ± 0.3 K or less from 25 K to room temperature, these diodes provide better overall accuracy than platinum RTDs over the same temperature range.

Band E (DT-670E-BR): The smallest cryogenic temperature sensor

DT-670 bare die diode temperature sensors conform to a single tolerance band with accuracy to ± 0.25 K from 25 to 100 K and to $\pm 0.25\%$ of temperature above 100 K. At 0.178 mm high x 0.432 mm long x 0.406 wide mm, the bare die sensors offer the smallest physical size and fastest thermal response time of any silicon diode on the market today, an important advantage for applications where size and thermal response time are critical, including focal plane arrays and high temperature superconducting filters for cellular communication.

Specifications

	DT-670-SD	DT-670E-BR (bare die)
Temperature		
Useful range		
Minimum	1.4 K	25 K
Maximum	500 K	500 K
Maximum storage temperature	303 K	303 K
Standard curve	Curve DT-670	Curve DT-670
Voltage (typical)	1.578 V at 4.2 K; 1.027 V at 77 K; 0.548 V at 305 K 0.091 V at 500 K	1.578 V at 4.2 K; 1.027 V at 77 K; 0.548 V at 305 K 0.091 V at 500 K
Sensitivity (typical)	-31.6 mV/K at 4.2 K; -1.73 mV/K at 77 K; -2.31 mV/K at 305 K; -2.12 mV/K at 500 K	-31.6 mV/K at 4.2 K; -1.73 mV/K at 77 K; -2.31 mV/K at 305 K; -2.12 mV/K at 500 K
Repeatability (typically)	±10 mK or better at 4.2 K; ±20 mK (1.4 K to 330 K)	±10 mK or better at 4.2 K; ±20 mK (1.4 K to 330 K)
Accuracy (interchangeability)	DT-670: Curve DT-670 (Band A, B, C, D)	DT-670: Curve DT-670 (Band E)
Accuracy (calibrated)	±20 mK < 10 K; ±55 mK (10 K to 500 K)	Not applicable
Stability		
Short-term	±20 mK or better (1.4 K to 330 K) ±10 mK or better at 4.2 K	±20 mK or better (30 K to 330 K)
Long-term (per year)	±10 mK/year at 4.2 K ±40 mK/year at 77 K ±25 mK/year at 300 K	±10 mK/year at 4.2 K ±40 mK/year at 77 K ±25 mK/year at 300 K
Thermal response time (SD package)	Typical <10 milliseconds at 4.2 K; 100 milliseconds at 77 K; 200 milliseconds at 305 K (all models)	1 microsecond at 4.2 K, 13 microseconds at 77K
Recommended recalibration schedule	Annual	Annual
Excitation		
Recommended	10 µA ±0.05%	10 µA ±0.05%
Maximum reverse voltage (diode)	80 VDC	40 VDC
Maximum forward current (diode)	500 µA continuous or 5 mA in <100 microsecond pulses	500 µA continuous or 5 mA in <100 microsecond pulses
Maximum current before damage	1 mA continuous	1 mA continuous
Dissipation at rated excitation	16 µW at 4.2 K; 10 µW at 77 K; 5 µW at 300 K	16 µW at 4.2 K; 10 µW at 77 K; 5 µW at 300 K
Units range	0 to 2 volts	0 to 2 volts
Lead wire configuration (polarity)	Positive lead on right with package lid up and leads towards user	Positive lead collector connection made through the bottom of the chip; negative connection is made on the base pad on top of the chip
Physical Specifications		
Materials in the sensor/construction	Sapphire base with alumina body and lid Molybdenum/manganese metallization on base and lid top with nickel and gold plating, gold-tin solder as hermetic lid seal, silicon chip with aluminum metallization.	Silicon chip with aluminum metallization on top contacts, gold metallization on bottom
Size	1 mm high x 1.9 mm wide x 3.2 mm long	0.178 mm high x 0.432 mm long x 0.406 mm wide
Mass	37 milligrams	72.7 micrograms
Leads		
Size	0.38 mm x 0.1 mm thick x 12.7 mm long	Not applicable
Number	Two (2)	None
Material	Nickel and gold plated Kovar	Not applicable
Insulation	None	Not applicable
Environmental		
Internal atmosphere	Package hermetically sealed	Not applicable
Radiation effects	Recommended only for low level radiation	Recommended only for low level radiation
Magnetic fields	Not recommended for use in magnetic field applications below 60 K; low magnetic field dependence when used in fields up to 5 tesla above 60 K	Not recommended for use in magnetic field applications below 60 K; low magnetic field dependence when used in fields up to 5 tesla above 60 K
Vacuum vs. liquid differences at -4.2 K	Typically 5 mK to 35 mK depending on package configuration	Typically 5 mK to 35 mK depending on package configuration
ESD sensitivity	Under testing	Under testing
Noise sensitivity	Can be significant	Can be significant

Ordering Information

Uncalibrated sensor

Specify the model number followed by the tolerance band, DT-670A-SD, for example.

To order a mounting adaptor for the SD package, substitute the adaptor suffix for the SD suffix, for example, DT-670A-CU

Calibrated sensor

Specify the calibration range suffix code after the model number and package suffix, DT-670-SD-1.4L, for example.

Before sensors are calibrated they fall into the following tolerances; ± 1.5 K (2-100 K), $\pm 1.5\%$ of T (100-300 K), $\pm 1.5\%$ of T (305-500 K). Refer to the specification table for the accuracy of calibrated sensors.

Calibration Range Suffix Codes
 Numeric figure is the low end of the calibration
 Letters represent the high end: L=325 K, H=500 K

Model number	1.4L	1.4H	4L	4H
DT-670E-BR				
DT-670A-SD				
DT-670B-SD				
DT-670C-SD				
DT-670D-SD				
DT-670-SD-	✓	✓	✓	✓

Lake Shore's CU, CO, LR, CY, ET, and BO mounting adaptors are available for use with the SD package.

Note: Use CU, LR, CY, ET, BO adaptors only up to 325 K.

DT-670A-SD-1.4H

Diode Thermometry

Diode Series

Tolerance Band

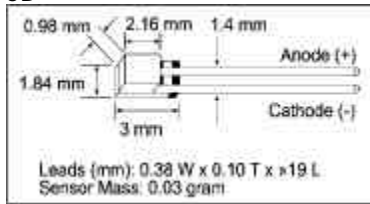
Package

Calibration - if applicable

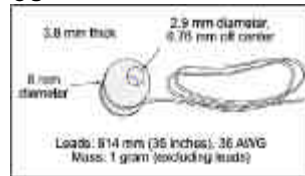
Upgrade Conversion Chart

	From:	To:
Sensor	DT-470	DT-670
Band	11	A
	11A	A or D
	12	B
	12A	B or C
	13	C

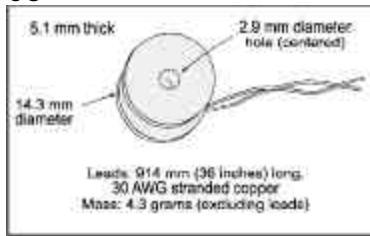
SD



CU



CO



CY

