

# DT-414 Unencapsulated Silicon Diode Temperature Sensor



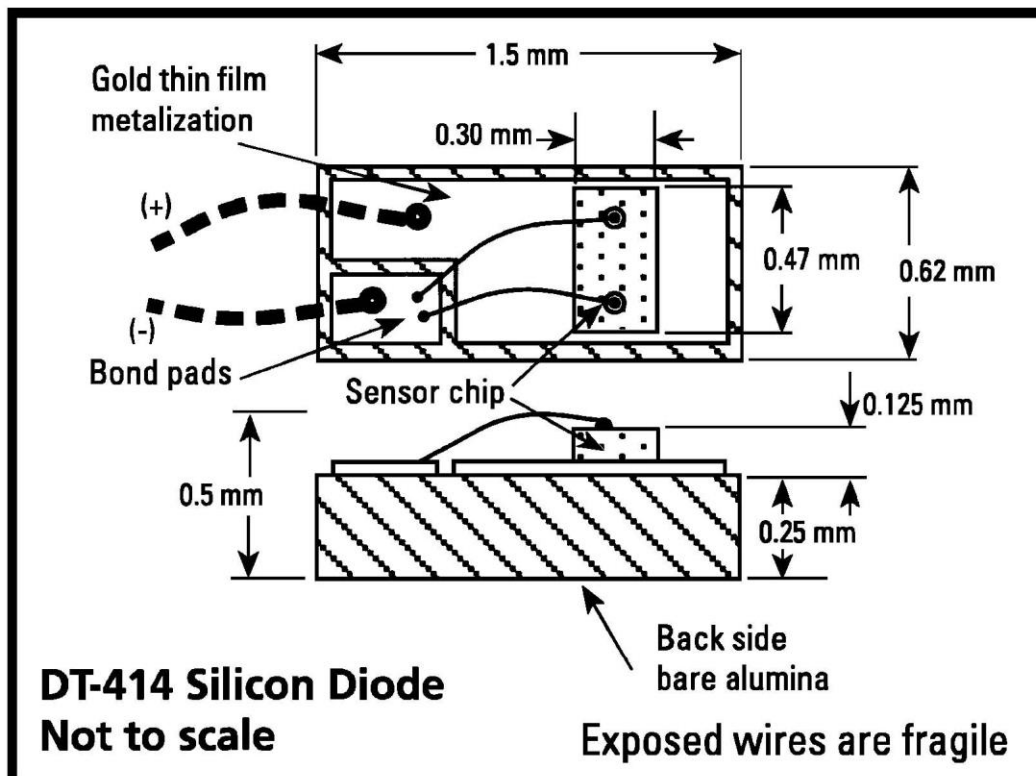
**CAUTION:** This temperature sensor is sensitive to electrostatic discharge (ESD). Use ESD precautionary procedures when handling, or making mechanical or electrical connections to this device in order to avoid performance degradation or loss of functionality.

## DT-414 Features

- Temperature range: 1.4 K to 375 K (calibration not available above 325 K)
- Small mass for rapid thermal response
- Incorporates non-magnetic materials

The Lake Shore Model DT-414 uses the same silicon diode chip used in the DT-470 Series. It is mounted on a flat substrate. This chip-level sensor offers minimal thermal mass and minimal physical size. Die attachment is with silver epoxy. The chip is unencapsulated, leaving the fragile gold wires exposed.

The DT-414 is supplied in a Gel-Pak™ with 0.5 in to 1 in long, 50 μm diameter gold leads. If it is desired to wire bond the chip into a circuit using the user's wire, the gold ball bonds can be removed using a sharp blade. This will leave more room for attachment of new gold or aluminum wire. The leads (as supplied) can also be thermo-compression bonded or soldered at their free ends.



## DT-414 Specifications

### Temperature

Useful Range: Minimum – 1.4 K, Maximum – 375 K

Maximum Storage Temperature: 305 K

Standard Curve: Curve 10. Refer to Lake Shore Application Note 1401, “Curve 10 Technical Data”

Voltage: 1.626 V at 4.2 K, 1.020 V at 77 K, 0.507 V at 305 K

Sensitivity (typical): –33.6 mV/K at 4.2 K, –1.91 mV/K at 77 K, –2.41 mV/K at 305 K

Repeatability (typical):  $\pm 10$  mK or better at 4.2 K,  $\pm 20$  mK (1.4 K to 330 K)

Accuracy (interchangeability):  $\pm 1.5$  K or  $\pm 1.5\%$  whichever is greater

Accuracy (calibrated):  $\pm 20$  mK < 10 K,  $\pm 50$  mK (10 K to 330 K),  $\pm 55$  mK (330 K to 475 K) Stability, Short Term:  $\pm 20$  mK or better (1.4 K to 330 K)

Stability, Long Term:  $\pm 10$  mK/year at 4.2 K,  $\pm 40$  mK/year at 77 K,  $\pm 25$  mK/year at 300 K

Thermal Response Time: Typical < 10 msec at 4.2 K, 100 msec at 77 K, 200 msec at 305 K

Recommended Recalibration Schedule: Annual

### Excitation

Recommended: 10  $\mu$ A  $\pm 0.05\%$

Maximum Reverse Voltage (diode): 40 VDC

Maximum Forward Current (diode): 500  $\mu$ A Continuous or 5 mA in <100  $\mu$ sec pulses

Maximum Current Before Damage: 1 mA Continuous

Dissipation At Rated Excitation: 17  $\mu$ W at 4.2 K, 10  $\mu$ W at 77 K, 5  $\mu$ W at 300 K

Units Range: 0 to 2 V

Lead Wire Configuration (polarity): Positive lead on left with chip up and leads toward user

### Physical Specifications

Materials: Alumina base, with metallization 0.1 mm of molybdenum, 0.2 mm gold

Size: 0.5 mm high  $\times$  0.63 mm wide  $\times$  1.52 mm diameter

Mass: 3 milligrams

Lead Size: 25 mm +5 mm / -0 mm

Lead Number: Two

Lead Material: Gold

Lead Insulation: None

### Environmental

Radiation Effects: Refer to Lake Shore Application Note 1006, “Neutron and Gamma Radiation Effects on Cryogenic Temperature Sensors”

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

Vacuum Versus Liquid Differences at 4.2 K: Typically 5 mK to 35 mK depending on configuration.

Refer to Lake Shore Temperature Measurement and Control Catalog, Page A-42, Self-Heating

ESD Sensitivity: 3000 static volts

Noise Sensitivity: Can be significant. Refer to Lake Shore Application Note 1420, “Measurement System Induced Errors in Diode Thermometry”