

# Installation Instructions

## Silicon Diode and GaAlAs High Temperature Sensor

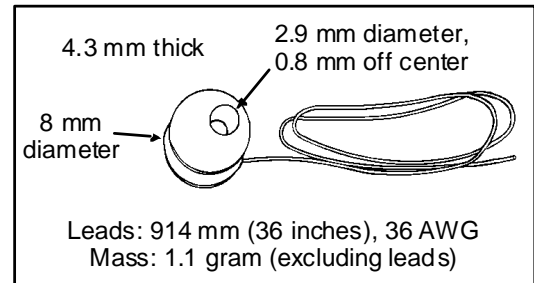
### DT-470/471-CU-HT, DT-670-CU-HT and TG-120-CU-HT Package



There are three aspects of using a cryogenic temperature sensor which are critical to its optimum performance. The first involves the proper mounting of the sensor package. The second relates the proper joining of sensor lead wires and connecting wires. The final concern is the thermal anchoring of the lead wires. Although the sequence in which these areas should be addressed is not set in stone, all elements covered under each aspect should be adhered to for maximum operating capabilities of the sensor.

#### SENSOR MOUNTING

The DT 470/471/670-CU-HT and TG-120-CU-HT package combine a standard SD sensor with a gold-plated copper mounting bobbin to form the CU-HT. The mounting bobbin of this package contains a 2.9 mm (0.114 inch) diameter hole (0.03 inch off center) designed for mounting with a #4-40 screw.



1. A threaded hole in your mounting surface is necessary for mounting the sensor package. The hole in the sensor package will accommodate a #4-40 screw. A brass screw is recommended due to the thermal contractions/expansions of the final assembly.
2. The threaded hole and surrounding surface should be cleaned with a solvent such as Acetone followed by an Isopropyl Alcohol rinse. Allow time for the solvents to evaporate before sensor mounting.
3. For use to 500 K, apply a small amount of Apiezon<sup>®</sup> H grease to the threads of the screw. To ensure good thermal contact between the sensor and mounting surface, use an indium washer/preform (use to 425 K only) or a thin layer of Apiezon<sup>®</sup> H grease between the mounting surface and the sensor package. **NOTE:** An overabundance of grease will increase the thermal barrier. Keep the thickness to 0.05 mm or less.
4. Insert screw through sensor mounting bobbin and tighten screw firmly enough to hold sensor in place. Avoid over tightening (torque of 3–5 in-oz [0.02–0.035 N-M] should be sufficient).

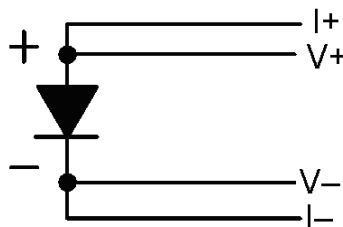
**NOTE:** The high temperature -CU is designed for use up to 500 K (227°C) with a silicon diode sensor or GaAlAs diode. Subjecting the sensor to temperature in excess of this limit will cause a shift in the sensor values.

#### LEAD ATTACHMENT

The SD sensor has been attached to the mounting bobbin and encapsulated in Stycast<sup>®</sup> epoxy. The 0.91 meter (36 inch) heavy build Polyimide (ML) insulated sensor leads are quad twist, 36 AWG, phosphor bronze wire which are thermally anchored to the bobbin. Teflon<sup>®</sup> tubing is used as a strain relief to reinforce the leads at the bobbin assembly. Standard lead configuration for the CU-HT is Red (I-), Green (V-), Black or Dark Blue (V+), Clear (I+).

#### CU (HT) Package - Four-lead measurement scheme

The current is confined to one twisted pair of current leads with the sensor voltage measured across the twisted pair of voltage leads as shown in Figure 1.



Four-Lead Measurement Scheme  
(CU Package)

Figure 1. Four-Lead Measurement Scheme

Thirty-six inches of Quad Twist lead wire are attached during the production process. If additional connection wire is required, use the following instructions:

1. Prepare the sensor leads with a RMA (rosin mildly active) soldering flux, tin them with a minimal amount of solder. One common solder that can be used to 500 K (227°C) is 90% Pb – 10% Sn. Note that common 60% Sn - 40% Pb or 63% Sn – 37% Pb solder will melt at temperatures above ~165°C. Use a low wattage soldering iron that will not exceed 300 °C. Clean off residual flux with rosin residue remover.
2. Strip the insulation from the connecting wires by delicately scraping with a razor blade, fine sand paper, or steel wool. (Phosphor-bronze or Manganin wire, in sizes 32 or 36 AWG, is commonly used as the connecting lead wire. These wires have low thermal conductivity which helps minimize the heat flow through the leads. For use to 500 K, polyimide or other suitable insulation must be used on the lead extension wire. Follow the same procedure in step 1 for preparing connecting wires.
3. Identify lead polarities and apply the soldering iron above the joint area until the solders melt; remove the iron immediately. Leave enough slack to allow for the thermal contractions that occur during cooling which could fracture a solder joint or lead. Insulating the soldering joint is recommended to prevent shorts. Use heat-shrink tubing rated to the appropriate temperature to insulate the electrical joint.

### HEAT SINKING/THERMAL ANCHORING

Depending on the application, sufficient heat sinking of the leads may already exist in the bobbin. Use the following procedure if additional heat sinking is recommended. For additional heat sinking/thermal anchoring:

1. Connecting wires should be thermally anchored at several temperatures between room temperature and cryogenic temperatures to guarantee that heat is not being conducted through the leads to the sensing element.
2. A simple thermal anchor can be made by winding the wires around a copper post, bobbin, or other thermal mass. A minimum of five wraps around the thermal mass should provide sufficient thermal anchoring. However, if space permits, additional wraps are recommended for good measure. To maintain good electrical isolation over many thermal cycles, it is good practice to apply a single layer of heat sinking medium (e.g. high temperature epoxy or high temperature Stycast) to the anchored area then wrap the wire around the paper and bond in place with an additional layer.

**CRYOGENIC ACCESSORIES** – Recommended for proper installation and use of DT-470/471/670-CU-HT and TG-120-CU-HT Sensors:

**Apiezon® Type N and H Grease.** P/N GAN-25 and GAH-25 – 25 g tube. Low viscosity, easy to use, solidifies at cryogenic temperatures, excellent lubricant. Difference is melting point: Type N is 316 K, Type H is 523 K.

**Heat Sink Bobbins.** P/N HSB-40 Large, HSB-8 Small. Gold-plated copper bobbins. Large bobbin holds up to 40 wires, small bobbin holds up to 8 wires, depending on wire gauge and number of turns.

**High-Temperature Solder.** P/N SLT-10 – 3 meters (10 feet). Greater lead content (90% Pb 10% Sn) for soldering in applications up to 500 K.

**Indium Foil/Solder.** P/N IF-5 for 5 foil sheets (2" square x 0.005" thick), ID-10-31/ID-10-56 for 10 disks, 0.31" or 0.56" diameter x 0.005" thick respectively. Indium is 99.99% pure, exceptional pressure seal, extremely malleable. Melting point is 429 K (156 °C).

**Ostalloy® 158 Solder.** P/N SOSY-16 – 16 oz. Reusable eutectic alloy with sharply defined melting point of 343.16 K (70 °C).

**Stycast® Epoxy 2850FT, Catalyst 9.** P/N ES-2-20 – 20 packets, 2 g each. Permanent attachment, excellent low temperature properties, poor electrical conductor, low cure shrinkage. Rated to 403 K (130 °C). [Requires Hazardous shipping.]

**VGE-7031 Varnish.** P/N VGE-7031 – 0.5 liter (1 pint) can. Nonpermanent attachment, excellent thermal conductor, easy to apply and remove. Rated to 423 K (150°C). [Requires Hazardous shipping.]

**Instruments:** Lake Shore sells a complete line of instrumentation used with your sensor, such as: Current Sources, Temperature Controllers, Monitors and Thermometers, Temperature Scanners and Transmitters.

**Wire.** Lake Shore offers numerous types of wires for various applications, including phosphor-bronze wires: Single Strand, Duo-Twist™, Quad-Twist™, and Quad-Lead™, Nichrome heater wire, non-magnetic Manganin wire, and more. Use unbonded, polyimide insulated wire for use to 500 K.

**Cable.** Lake Shore offers ultra-miniature coaxial cable (Type C, SC, and SS), semi-rigid coaxial cable (Type SR), and a robust 4-wire CryoCable™ (Type CYRC).

For complete product description and detailed specifications on the above accessories and instruments, consult the Lake Shore Temperature Measurement and Control Catalog, call (614) 891-2243, e-mail at [sales@lakeshore.com](mailto:sales@lakeshore.com), or visit our website at [www.lakeshore.com](http://www.lakeshore.com).