

Installation Instructions, Germanium RTDs GR-50-AA/GR-300-AA/GR-1400-AA



Three aspects of using a temperature sensor 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 standard germanium sensor consists of a doped germanium chip mounted strain free in a cylindrical gold-plated copper can. This 4-lead device is designed for 4-wire potentiometer measurement to eliminate errors due to lead resistance. The copper can is designed for mounting in a hole.

1. A hole should be drilled 3.2 mm (0.125 in) diameter by 8.5 mm (0.335 in) deep minimum for the copper can.
2. Surface area should be cleaned with a solvent such as acetone followed by an isopropyl alcohol rinse. Allow time for the solvents to evaporate before sensor positioning.
3. A small amount of Apiezon® N grease should be applied around the mounting surface and the sensor to enhance thermal contact.
4. Position the copper can so that it is fully submersed in the mounting hole.

NOTE: This package is designed for use up to 325 K (52 °C).

LEAD CONFIGURATION

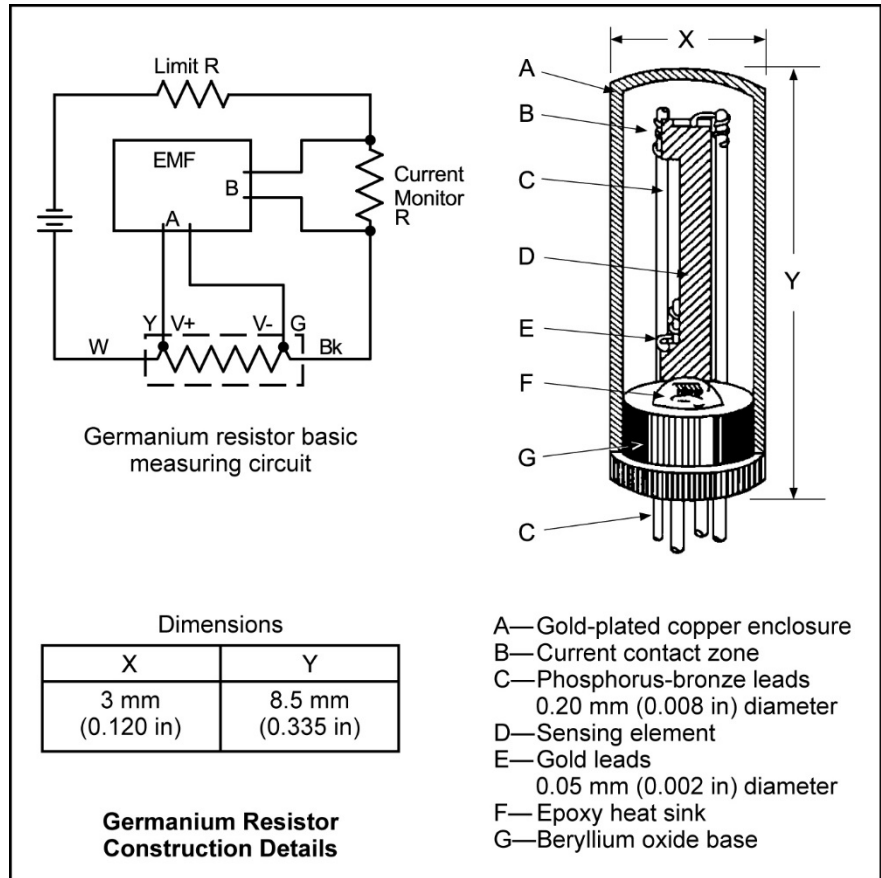
Four leads are attached with epoxy strain relief at the sensor. Each lead is 32 AWG (0.2 mm diameter) phosphor-bronze wire, insulated with heavy build Polyimide to an overall diameter of 0.24 mm (0.0095 in), 150 mm (6 in) long. Thermal rating of the insulation is 220 °C. Leads are color-coded at the base of each sensor.

Key	Color Code
I+	White
V+	Yellow
I-	Black
V-	Green

EXTRA LEAD ATTACHMENT

If extra long leads are to be attached, then it is recommended that a 4-lead measurement scheme is used with this sensor. Attaching four connecting wires to the sensor leads is recommended. Refer to the table in Lead Configuration to determine sensor lead polarity.

1. Prepare the sensor leads and connecting lead wires with a RMA (rosin mildly active) soldering flux, tin them with a minimal amount of 60% Sn 40% Pb solder. Use a low wattage soldering iron that will not exceed 200 °C. Clean off residual flux with rosin residue remover. The sensing element inside the package should be protected from excessive heat by putting a heat sink clip over the package.



Extra Lead Attachment (Continued)

- Strip connecting wires insulation by delicately scraping with a razor blade, fine sandpaper 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. Typical wire insulation is polyvinyl formal (Formvar®) or Polyimide (ML). Formvar® insulation has better mechanical properties such as abrasion resistance and flexibility. Polyimide insulation has better resistance to chemical solvents and burnout.
- Prepare the connecting wire ends with a RMA (rosin mildly active) soldering flux, tin them with a minimal amount of 60% Sn 40% Pb solder. Use a low wattage soldering iron that will not exceed 200 °C.
- Clean off residual flux with rosin residue remover. The sensor lead can be prepared in an identical manner.
- Attach one sensor lead with the connector wire and apply the soldering iron above the joint area until the solders melt, then remove the iron immediately. Repeat for the other set of connector wire and the other sensor lead.
- Avoid putting stress on the device leads and leave enough slack to allow for the thermal contractions that occur during cooling which could fracture a solder joint or lead. This can be achieved with heat shrink tubing.

HEAT SINKING/THERMAL ANCHORING

- Since the heat flow through the connecting leads can create an offset between the sensor substrate and the true sample temperature, thermal anchoring of the connecting wires is necessary to ensure that the sensor and the leads are at the same temperature as the sample.
- 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.
- If the connecting leads have a thin insulation such as Formvar® or Polyimide, 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 enough of an anchor. 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 first varnish a single layer of cigarette paper to the anchored area then wrap the wire around the paper and bond in place with a thin layer of IMI 7031 varnish. Formvar® wiring insulation has a tendency to craze with the application of IMI varnish. Once IMI varnish is applied, the wires cannot be disturbed until all solvents have evaporated and the varnish has fully cured (typically 12 to 24 h).
- A final thermal anchor at the sample itself is a good practice to ensure thermal equilibrium between the sample and temperature sensor.

CRYOGENIC ACCESSORIES – Recommended for proper installation and use of germanium sensors.

Stycast® Epoxy 2850FT (P/N 9003-020, 9003-021): Permanent attachment, excellent low temperature properties, poor electrical conductor, and low cure shrinkage.

Apiezon® N Grease (P/N 9004-020): Low viscosity, easy to use, solidifies at cryogenic temperatures, excellent lubricant.

IMI 7031 Varnish (P/N 9009-002): Nonpermanent attachment, excellent thermal conductor, easy to apply and remove.

Indium Solder (P/N 9007-002-05): 99.99% pure, excellent electroplating material, foil form.

Phosphor-bronze Wire (P/N 9001-00X): Available in single, duo, and quad strands, no magnetic attraction, low thermal conduction.

Manganin Wire (P/N 9001-00X): Low thermal conductivity, high resistivity, no magnetic attraction.

Heat Sink Bobbin (P/N 9007-900 Large, 9007-901 Small): Gold plated oxygen-free high-conductivity (OFHC) copper bobbins.

Instruments: Lake Shore sells a complete line of instrumentation used with germanium sensors, such as: current sources, cryopump monitors, temperature controllers, monitors and thermometers, temperature scanners and transmitters.

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 sales@lakeshore.com, or visit our website www.lakeshore.com.