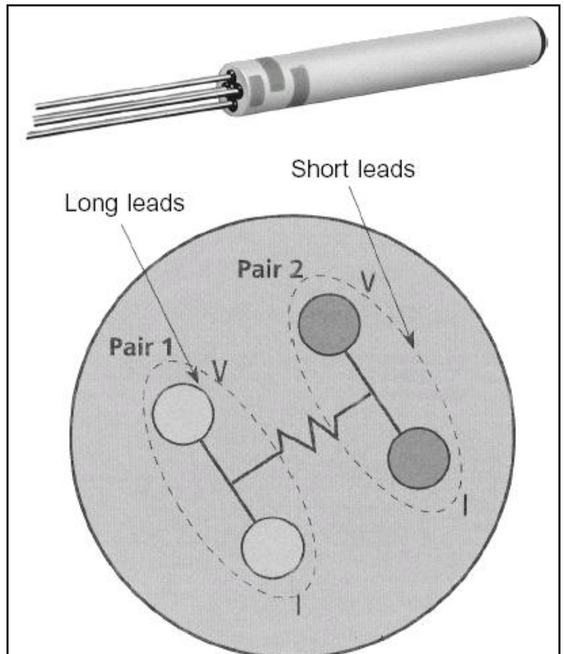
Instructions, Rhodium-Iron Resistance Temperature Sensor Installation, Model RF-800-4 Package

There are three aspects of using a 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 RF-800-4 package construction includes a RhFe alloy wire that is wound and encapsulated into an alumina and glass cylindrical case (3.17 mm in diameter, 20 mm long).



Looking at end with leads toward user.

1. 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.
2. The list below provides brief instructions on mounting a sensor using a number of different methods. The constraints of your application should dictate the most appropriate mounting method to follow.

   Apiezon® N Grease – Is best used as a thermal conductor when the sensor is mounted in a hole or recess and when the sensor is intended to be removed. The sensor should be surrounded with thermal grease and placed into the mounting position. When the temperature is lowered the thermal grease will harden, giving good support and thermal contact.
   NOTE: Use Apiezon® H Grease for high temperature applications (up to 500 K).

   IMI 7031 Varnish – Prepare varnish and apply a thin layer on the mounting surface. Press the sensor firmly against the varnish during curing to ensure a thin bond layer and good thermal contact. Varnish will air dry in 5 to 10 min. Sufficient time must be allowed for the solvents in the varnish to evaporate. There is a small probability of ionic shunting across the sensor during the full cure period of the varnish (typically 12 to 24 h).

   Stycast ® 2850FT Epoxy – Prepare epoxy and apply a thin layer on the mounting surface. Press the sensor firmly into the epoxy during curing to ensure a thin bond layer and good thermal contact. Epoxy will cure in 12 h at 25 °C or in 2 h at 66 °C.

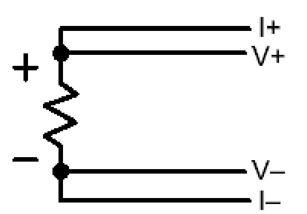
   NOTE: Varnish, epoxies, and other adhesives should be considered permanent mounts and only be used if the sensor is not intended for removal.

3. Follow manufacturers' instructions for adhesives curing schedules.
4. Position the case so that it is fully submersed in the mounting hole.

   NOTE: This package is designed for use up to 800 K (527 °C).

LEAD CONFIGURATION

Four leads extend from the sensor case. Each lead is un-insulated 24 AWG (0.51 mm diameter) platinum wire, approximately 9 mm (0.354 in) long. Since the device is a resistor, polarity is arbitrary. The longer leads represent one side of the resistor, and the short leads, the other. If there is no discernable difference in the lead lengths, the black markings on the bottom edge of the package designate the I/V pairs.



Four-Lead Measurement Scheme

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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 above text or the figure to determine the sensor lead configuration.

1. Prepare the sensor leads and connecting lead wires with an acid-based soldering flux. One suitable acid-based flux is "Stay Clean Solder and Tinning Flux" (J.W. Harris Company, Cincinnati, Ohio). Tin the lead wires with a minimal amount of solder. Use appropriate solder with respect to temperature (recommend Sn 60/Pb 40 for up to 400 K and Pb 90/Sn 10 for up to 500 K). Clean off the residual flux with a solvent which is "basic" in nature. (For example, baking soda dissolved in water will also work.)
2. Strip connecting wires insulation 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 help minimize the heat flow through the leads. Typical wire insulation is Polyvinal 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.
3. Prepare the connecting wire ends with a RMA (rosin mildly active) soldering flux, tin them with a minimal amount of solder.
4. Clean off residual flux with rosin residue remover.
5. 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.
6. 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

1. 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 assure that the sensor and the leads are at the same temperature as the sample.
2. 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.
3. 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).
4. 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 RF-800-4 sensors.

Stycast® Epoxy 2850FT (P/N 9003-020, 9003-021): Permanent attachment, excellent low temperature properties, poor electrical conductor, 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.
90% Pb 10% Sn Solder (P/N 9008-001): Greater lead content, for higher temperature applications no greater than 200 °C.
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 the rhodium-iron 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 at www.lakeshore.com.