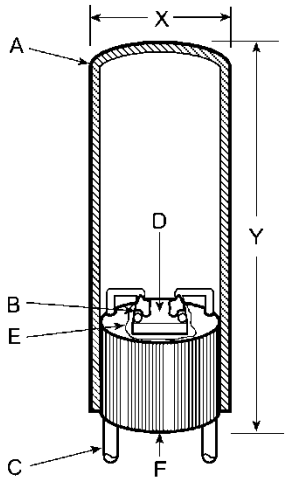
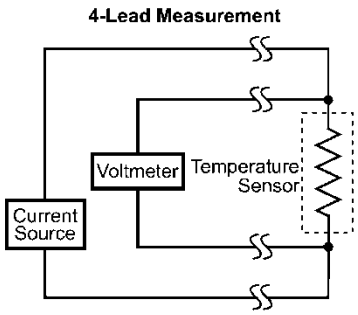
Instructions, Rox™ Ruthenium Oxide RTD Installation, Model RX-102A-AA, RX-202A-AA, and RX-103A-AA

There are three aspects of temperature sensor use critical to optimum performance: mounting the sensor package, joining sensor lead wires to connecting wires, and thermally anchoring wires. Adhere to instructions below for maximum sensor performance.

Ruthenium Oxide Resistor Construction Details



A Gold-plated copper enclosure
B Soldered current/voltage contact zone
C Copper leads 0.185 mm (0.0073 in.) dia.
D Sensing element
E Epoxy attachment
F Sapphire heat sink base



Rox™ Ruthenium Oxide Resistor Basic Measuring Circuit

Dimensions (All Models)

X	Y
3 mm (0.120 in.)	8.5 mm (0.335 in.)

SENSOR MOUNTING

The standard Rox™ sensor consists of a ruthenium oxide/bismuth ruthenate thick film chip resistor epoxied to a sapphire base in a cylindrical gold-plated copper can. The copper can usually mounts in a hole.

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

NOTE: DO NOT heat the sensor above room temperature. The sensor has been thermally cycled multiple times. Microcracks form in the material during initial cycling, causing an initial shift in resistance. Upon heating above room temperature, these microcracks anneal, and the thermal conditioning process must be repeated to ensure a stable sensor.

Alternatively, Lake Shore offers a copper bobbin into which the A-can packaged sensor inserts. The leads wrap around the bobbin for heat sinking, and the bobbin assembly bolts to the sample.

LEAD CONFIGURATION

Two leads are attached with epoxy strain relief at the sensor base. Each lead is 34 AWG (0.16 mm diameter) copper wire, insulated with heavy build polyurethane nylon to an overall diameter of 0.185 mm (0.0073 in), 150 mm (6 in) long. Thermal rating of the insulation is 220 °C. There is no polarity for the device. While the device is built as a 2-lead device, operate the sensor in a 4-lead measurement scheme to eliminate errors due to lead resistance, which can be significant.

EXTRA LEAD ATTACHMENT

To attach long leads, use a 4-lead measurement scheme. Attach two connecting wires to each sensor lead.

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. Put a heat sink clip over the package to protect the sensing element inside the package from excessive heat.
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 to help minimize 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 60% Sn 40% Pb solder. Use a low wattage soldering iron which will not exceed 200 °C.
4. Clean off residual flux with rosin residue remover. Prepare the sensor lead in the same manner.
5. If using the sensor lead, place heat shrink tubing over it to provide both insulation and mechanical strength to the joint.
6. 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.
7. Avoid putting stress on the device leads and leave enough slack to allow for thermal contractions that occur during cooling which may fracture a solder joint or lead.

HEAT SINKING/THERMAL ANCHORING

1. Heat flow through the connecting leads can create an offset between the sensor and the true sample temperature. Thermally anchor the connecting wires to assure that the sensor and the leads are at the same temperature as the sample.
2. Thermally anchor connecting wires at several temperatures between room temperature and cryogenic temperatures to guarantee minimal heat conduction through the leads to the sensing element.
3. If the connecting leads have a thin insulation such as Formvar™ or Polyimide, thermally anchor them by winding them 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. To maintain good electrical isolation over many thermal cycles, 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 evaporate and the varnish fully cures (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.

RECOMMENDED CRYOGENIC ACCESSORIES FOR PROPER INSTALLATION AND USE OF ROX™ 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): Non-permanent 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.

Copper Disk Mounting Adaptor (P/N 207-003): Gold plated oxygen-free high-conductivity (OFHC) flat copper bobbin to facilitate mounting sensors packaged in A-cans.

Instruments: Lake Shore sells a complete line of instrumentation used with Rox™ 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.