



Cryogenic Control Systems, Inc.

R400

Ruthenium Oxide Temperature Sensor

General Description

The R400 Ruthenium Oxide temperature sensor is a Thick-Film resistance temperature sensor that is designed primarily for low temperature operation. They feature high interchangeability by conforming to a standard calibration curve. Additionally, they are useful in high magnetic fields.

Applications

- Low temperature super-conducting magnet systems.
- Liquid Helium Systems.

Features

- **Temperature range:** 2.0K to 273K.
- **High Sensitivity** in the 2.0K to 40K range. Monotonic to 273K.
- **Low Temperature use:** High sensitivity and relatively low resistance below 20K.
- **Interchangeability:** Conforms to a standard curve without special calibrations.
- **Magnetic Field Dependence:** Extremely low. Useful in magnetic fields to 16T with a small but predictable temperature shift.
- **Extremely stable:** Minimum long-term drift.
- **Very low susceptibility to ionizing radiation.**



Specifications

Useful Temperature Range: 2.0K to 273K.

Standard Curve: Cryo-con R400.

Temperature Coefficient: Negative

Leads: 36AWG Phosphor-Bronze. Four-lead color-coded cryogenic ribbon cable, 24", Other lengths available by special order.

Lead Resistance: 10Ω/m or

Recommended Excitation

Constant-Voltage AC excitation of 1.0V or less for full range.
Constant-Current DC excitation of 10μA for operation above 3.0K.

Maximum Storage Temperature: 400K

Maximum excitation current: 3.0mA

Thermal Response Time: 0.5S at 4.2K

Use in Radiation: Recommended for use in ionizing radiation environments.

Magnetic Field Dependence: See graph below.

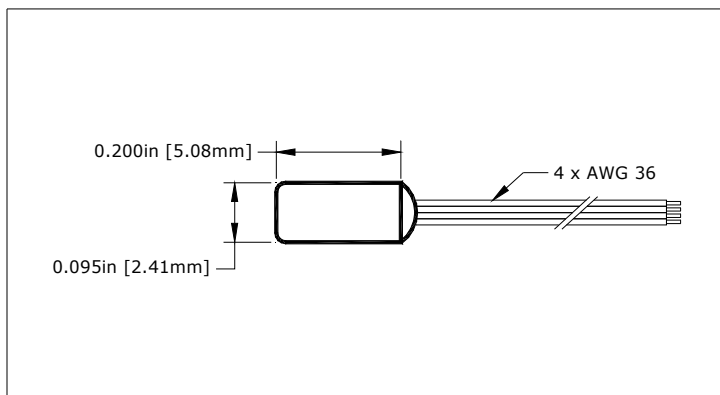
Connection:

All connections should be 4-wire in order to eliminate errors due to lead resistance.

Leads are coated with Butyl and may be separated by dipping them in Isopropyl Alcohol.

Lead insulation is heavy Formvar® which is difficult to strip. Techniques include use of a mechanical stripper or scraping with a razor blade.

Cable Color Code	
V+	Clear
V-	Green
I+	Black
I-	Red



R400 Canister Package

Construction: Gold-plated cylindrical OHFC copper canister, Stycast® epoxy filler. There is no internal atmosphere. Epoxy limits the maximum storage temperature to 400K.

Leads: Four, 36 AWG, Phosphor-Bronze, color coded. Formvar® insulation.

Mass: 0.4g.

Installation: Use a 0.101" diameter drill. Place a small amount of Apiezon® N grease in the hole before inserting the sensor. Ensure that the leads are thermally anchored.

Tolerance Bands

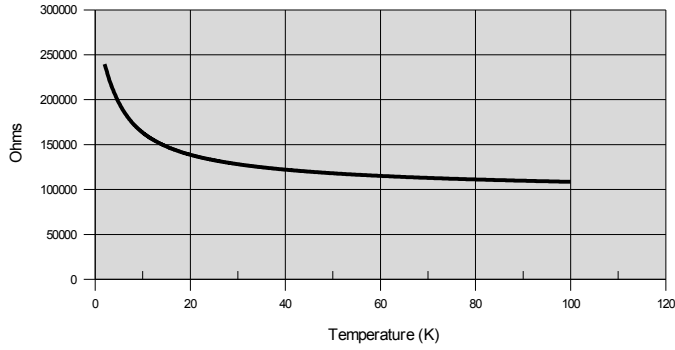
	4.2K	77K	273K
Group A	±100mK	±750mK	±20K
Uncalibrated	±300mK	N/A	N/A

Ordering Information

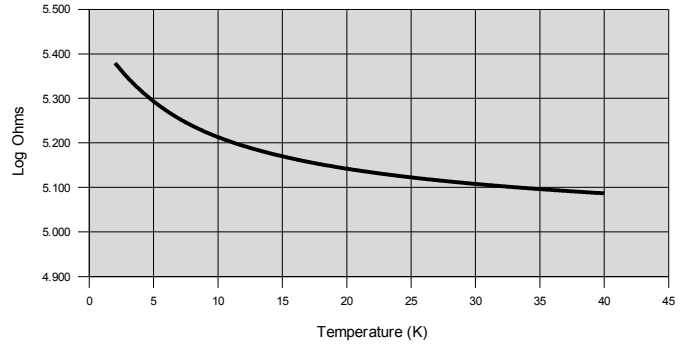
Ruthenium-Oxide Temperature Sensor in Canister Package	
R400-A	Tolerance band A.
R400	Uncalibrated.

Typical Performance Characteristics

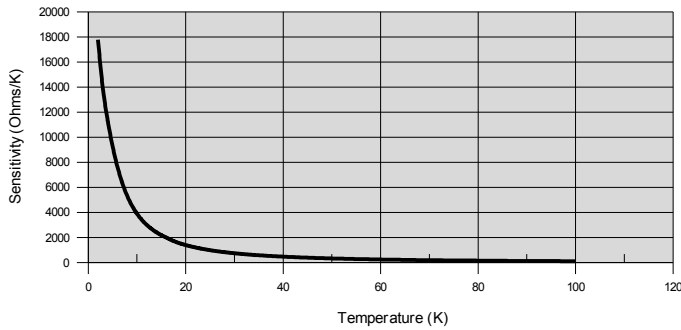
Temperature Response



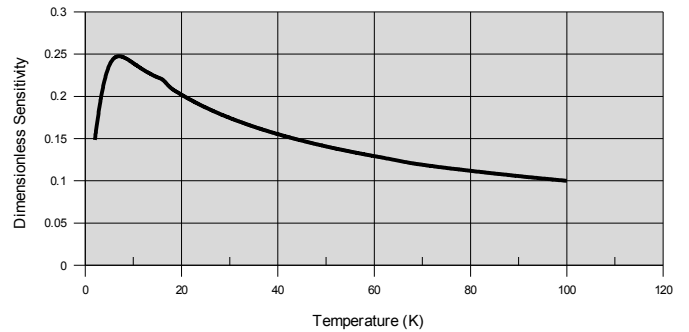
Temperature Response Below 40.0K



Sensitivity (Ohms/K)



Dimensionless Sensitivity (T/R)(dR/dT)



Temperature Dependence in Magnetic Fields

		Magnetic Field (Tesla)		
		2	7	10
Temperature	2.2	0	250mK	350mK
	4.2	0	80mK	--
	75	0	90mK	--

Typical Temperature Response

T(K)	R(Ω)	S(Ω/K)
273	101K	18
100	109K	91
77.35	112K	162
20	139K	1,400
4.2	205K	11,060
2.0	239K	17,390



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