



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.

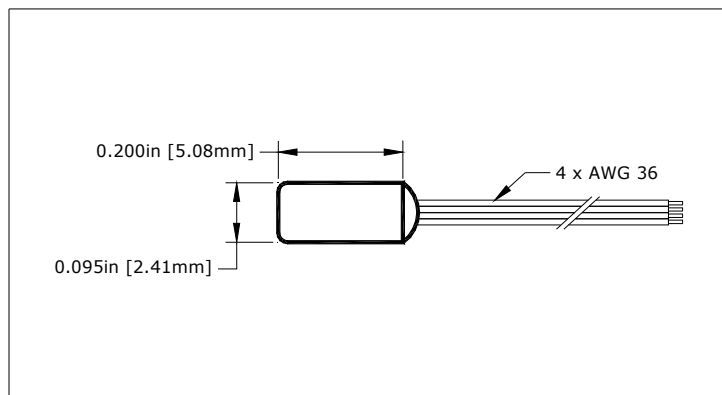
#### Connection:

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

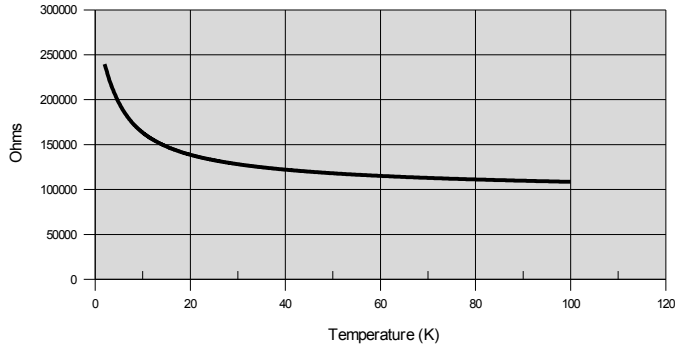
	4.2K	77K	273K
<b>Group A</b>	±100mK	±750mK	±20K
<b>Uncalibrated</b>	±300mK	N/A	N/A

### Ordering Information

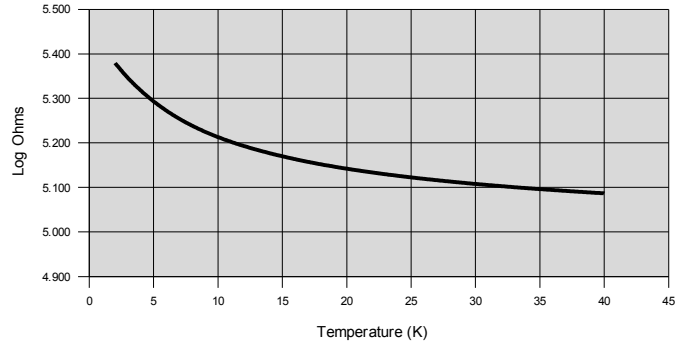
Ruthenium-Oxide Temperature Sensor in Canister Package	
R400-A	Tolerance band A.
R400	Uncalibrated.

# Typical Performance Characteristics

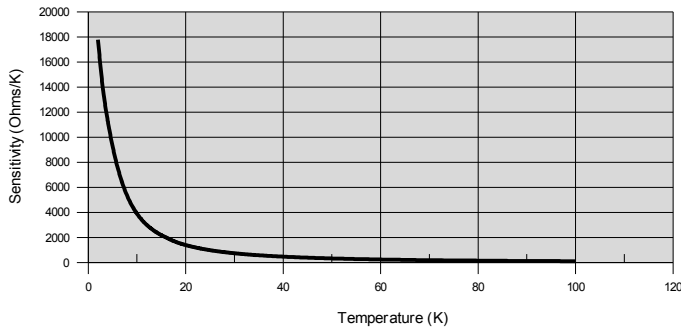
**Temperature Response**



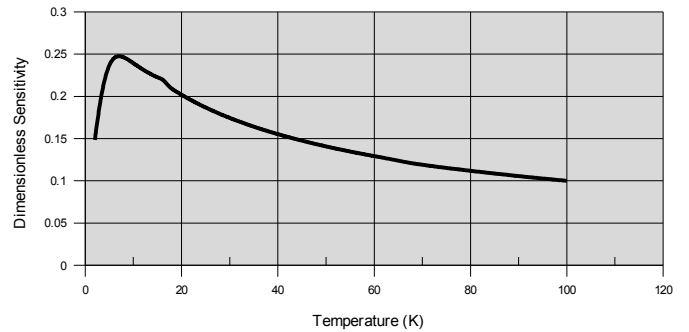
**Temperature Response Below 40.0K**



**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



Cryogenic Control Systems, Inc.

Cryogenic Control Systems, Inc.  
 PO Box 7012  
 Rancho Santa Fe, CA 92067

Tel: (858) 756-3900  
 Fax: (858) 759-3515  
 e-mail: [sales@cryocon.com](mailto:sales@cryocon.com)  
 Web: [www.cryocon.com](http://www.cryocon.com)

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