



U.S. SENSOR Corp.

Thermistors, RTDs, Probes & Assemblies

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TERMINOLOGY



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ZERO-POWER RESISTANCE (R_T)

The zero-power resistance is the dc resistance value of a thermistor measured at a specified temperature with power dissipated by the thermistor low enough that any further decrease in power will result in not more than 0.1% (or one tenth of the specified measurement tolerance, whichever is smaller) change in resistance.

RESISTANCE RATIO CHARACTERISTIC

The resistance ratio characteristic identifies the ratio of the zero-power resistance of a thermistor measured at 25°C to that resistance measured at 125°C.

ZERO-POWER TEMPERATURE COEFFICIENT OF RESISTANCE (α_T)

Zero-power coefficient of resistance is the ratio at the specified temperature (T) of the rate of change of zero-power resistance with temperature to the zero-power resistance of the thermistor.

$$\alpha_T = \frac{1}{R_T} \frac{(D R_T)}{(D T)}$$

NEGATIVE TEMPERATURE COEFFICIENT (NTC)

An NTC thermistor is one in which the zero-power resistance decreases with an increase in body temperature.

POSITIVE TEMPERATURE COEFFICIENT (PTC)

A PTC thermistor is one in which the zero-power resistance increases with an increase in body temperature.

MAXIMUM OPERATING TEMPERATURE

The maximum operating temperature is the maximum body temperature at which the thermistor will operate for an extended period of time with acceptable stability of its characteristics. This temperature can be the result of internal or external heating, or both, and should not exceed the maximum value specified.

MAXIMUM POWER RATING

The maximum power rating of a thermistor is the maximum power which a thermistor will dissipate for an extended period of time with acceptable stability of its characteristics.

DISSIPATION CONSTANT

The dissipation constant is the ratio, (expressed in milliwatts per degree C) at a specified ambient temperature, of a change in power dissipation in a thermistor to the resultant body temperature change.

THERMAL TIME CONSTANT

The thermal time constant is the time required for a thermistor to change 63.2% of the total difference between its initial and final body temperature when subjected to a step function change in temperature under zero-power conditions.

RESISTANCE TEMPERATURE CHARACTERISTIC

The resistance temperature characteristic is the relationship between the zero-power resistance of a thermistor and its body temperature. The Steinhart and Hart equation is an empirical expression that is the best mathematical expression of the resistance versus temperature characteristics of an NTC thermistor. The calculation for determining the constants $A_0, A_1, A_2,$ and A_3 is quite lengthy. To solve for the constants, contact U.S. Sensor's application engineering department for a copy of a BASIC program listing.

$$L_1(R_T) = A_0 + \frac{A_1}{T} + \frac{A_2}{T^2} + \frac{A_3}{T^3}$$

T= Temperature (expressed in degrees Kelvin)
R= Resistance (in Ohms)

TEMPERATURE WATTAGE CHARACTERISTICS

The temperature wattage characteristic of a thermistor is the relationship at a specified ambient temperature between a thermistor temperature and the applied steady state wattage.

CURRENT TIME CHARACTERISTIC

The current time characteristic is the relationship at a specified ambient temperature between the current through a thermistor and time, upon application or interruption of voltage to it.

STABILITY

The stability of a thermistor is the ability of a thermistor to retain specified characteristics after being subjected to designated environmental or electrical test conditions.

BETA (°K), (EXPRESSED IN ° KELVIN)

The material constant of a thermistor. Unless otherwise specified, Beta is derived from thermistor resistance measurements obtained at 0° and 50°C.

$$\text{Beta} = \frac{\log_{10} \frac{(R_0T_1)}{(R_0T_2)}}{\left(\frac{1}{T_1} - \frac{1}{T_2}\right) \log e}$$

R_0T_1 is the zero-power resistance at absolute temperature T_1 .
 R_0T_2 is the zero-power resistance at absolute temperature T_2 .
 e is the naperian base 2.71828.
 T_1 is temperature 1, expressed in degrees Kelvin.
 T_2 is temperature 2, expressed in degrees Kelvin.

MAXIMUM STEADY STATE CURRENT (IMAX)

For power thermistors, the maximum continuous steady state current, either DC or RMS AC, which the device is capable of passing. The maximum steady state current for US Sensor power thermistors is determined assuming a maximum operating ambient temperature of 65°C. If a specific application requires ambient temperature operation above 65°C, custom designed devices are available.

RESISTANCE AT MAXIMUM CURRENT (RI max)

For power thermistors, the approximate resistance of the device under maximum steady state current conditions.

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