



## NTC Thermistors - Disc and Chip Style



## Temperature Measurement and Control Thermistors

DISC and CHIP Style



**DISC & CHIP NTC  
STYLE NTC THERMISTOR  
Features**

- 
- **Wide Ohmic Value Range**
  - **Accurate & Stable**
  - **Fast Thermal Response Time**
  - **Tight Tolerances**
  - **High Sensitivity**

**NTC Thermistors**

**Negative Temperature Coefficient (NTC) thermistors** are thermally sensitive semiconductor resistors which exhibit a decrease in resistance as absolute temperature increases. Change in the resistance of NTC thermistor can be brought about either by a change in the ambient temperature or internally by self-heating resulting from **current flowing through the device**. Most of the practical applications of NTC thermistors are based on these material characteristics.

## NTC Disc and Chip Style Devices

Ametherm manufactures Disc and Chip style thermistors in **resistance values ranging from 1.0 ohm to 500,000 ohms**. These devices are suitable for a range of resistance values and temperature coefficients from relatively low resistance and temperature coefficients to very high values. Precision resistance tolerances are available to 1%. **Standard resistance tolerances are from 5% to 20%**. All tolerances are **specified at 25°C** or may be specified at any temperature within the operating temperature range of the thermistor.

## Thermistor Terminology for Temperature Measurement & Control Devices

- **The dissipation constant (D.C.)** is the ratio, normally expressed in milliwatts per degree C (mw/°C), at a specified ambient temperature, of a change in power dissipated in a thermistor to the resultant change in body temperature.
- **The thermal time constant (T.C.)** 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 and is normally expressed in seconds (S).
- **Alpha (α) or Temperature Coefficient of Resistance** is the temperature coefficient of resistance is the ratio at a specified temperature, T, of the rate of change of zero-power resistance with temperature to the zero-power resistance of the thermistor. The temperature coefficient is commonly expressed in percent per degree C (%/°C).

$$\alpha_T = \Delta R_T / \Delta T$$

### NTC DISC & CHIP

#### Selection

#### Considerations

- 
- Select Req'd. Resistance Value & Temperature Coefficient

- Determine Accuracy Req'd.
- Review Power Dissipation
- Determine Operating Temperature Range
- Review Thermal Time Constant

## **Thermistor Applications**

**Time and temperature** are two of the most frequently measured variables. There are numerous ways of the measuring temperature electronically, most commonly by **thermocouples and negative temperature coefficient (NTC) thermistors**. For general purpose temperature measurement, NTC temperature sensors can operate over a wide temperature range (-55 to +300°C). They are stable throughout a long lifetime, and are small and comparatively inexpensive. Typically, they have negative temperature coefficients between **-3.3 and -4.9%/°C at 25°C**. This is more than ten (10) times the sensitivity of a platinum resistance thermometer of the same nominal resistance. Ametherm's Disc & Chip style thermistors are used in many applications that require a high degree of accuracy and reliability.

### **Some of the most popular applications of NTC thermistors include:**

- Temperature Compensation
- Temperature Measurement & Control
- Fan Motor Control
- Fluid Level & Temperature Sensors

#### **NTC DISC & CHIP - Selection Process**

- Select R Value
- Determine R @ T
- Calculate DEV for R @ T
- Evaluate Power Rating (D.C.)
- Review T.C. Requirements

### **Selection considerations for NTC Disc and Chip Devices**

Power dissipation is a common problem in the use of thermistors as they can only dissipate a certain amount of power.

- If the **power dissipated exceeds the dissipation constant** (D.C.) rating of the sensor it is likely that it will exhibit self heating.

- Most thermistors dissipate from 1 to 25 mW/°C nominal. This means that the resistance changes by an equivalent of 1°C for each D.C. rating (mW/°C) for the selected device.
- To maintain a higher degree of accuracy, temperature error caused by self-heating should be an order of magnitude less than the required sensor accuracy. For many applications, this degree of accuracy is not required and a less stringent de-rating may be adequate.
- Several options to reduce the thermistor power are to increase the thermistor resistance, lower the source voltage and/or increase the series resistor in the divider circuit.

**As an example,**

- If the D.C. of the thermistor selected is **5 mW/°C** and the power dissipated by the device is 20 mW/°C, then a 4°C error is induced due to the effect of self-heating.
- To minimize this effect, a factor can be derived simply by taking the DC rating times 10-1(one order of magnitude lower) and use it in the power equation to produce a good approximation of the maximum allowable power.
- For instance, if the **desired accuracy is 1°C**, and the rated D.C. of the device selected is 5 mW/°C, adjusting the specified D.C. rating in the power equation to 0.5 mW/°C compensates for self-heating error and effectively predicts the maximum power the device can dissipate without significantly affecting the desired accuracy.
- The resulting maximum power that should be applied would be calculated as **1°C\*0.5mW/°C = 0.5mW**.

**NTC Standard Disc Thermistor Specifications**

| Part Number | Resistance @25°C (Ohms) ±10% | R-T Curve | D (in.) | THK (in.) | D.C. | T.C. | Leads AWG# | S (in) |
|-------------|------------------------------|-----------|---------|-----------|------|------|------------|--------|
| 1DA101J     | 100                          | A         | 0.1     | 0.06      | 3    | 10   | 28         | 0.07   |
| 1DA101J-EC  | 100                          | A         | 0.1     | 0.06      | 3    | 10   | 28         | 0.07   |
| 1DA101K     | 100                          | A         | 0.1     | 0.06      | 3    | 10   | 28         | 0.07   |

|            |         |   |     |      |   |    |    |      |
|------------|---------|---|-----|------|---|----|----|------|
| 1DA101K-EC | 100     | A | 0.1 | 0.06 | 3 | 10 | 28 | 0.07 |
| 1DA131J    | 130     | A | 0.1 | 0.06 | 3 | 10 | 28 | 0.07 |
| 1DA131K    | 130     | A | 0.1 | 0.06 | 3 | 10 | 28 | 0.07 |
| 1DA500J    | 50      | A | 0.1 | 0.03 | 3 | 6  | 28 | 0.07 |
| 1DA500K    | 50      | A | 0.1 | 0.03 | 3 | 6  | 28 | 0.07 |
| 1DB102J    | 1,000   | B | 0.1 | 0.06 | 3 | 10 | 28 | 0.07 |
| 1DB102K    | 1,000   | B | 0.1 | 0.06 | 3 | 10 | 28 | 0.07 |
| 1DB102K-EC | 1,000   | B | 0.1 | 0.06 | 3 | 10 | 28 | 0.07 |
| 1DB501K    | 500     | B | 0.1 | 0.03 | 3 | 6  | 28 | 0.07 |
| 1DC103J    | 10,000  | C | 0.1 | 0.03 | 3 | 6  | 28 | 0.07 |
| 1DC103J-EC | 10,000  | C | 0.1 | 0.08 | 4 | 12 | 28 | 0.07 |
| 1DC302J    | 3,000   | C | 0.1 | 0.08 | 4 | 12 | 28 | 0.07 |
| 1DC502J    | 5,000   | C | 0.1 | 0.08 | 4 | 12 | 28 | 0.07 |
| 1DC502J-EC | 5,000   | C | 0.1 | 0.08 | 4 | 12 | 28 | 0.07 |
| 1DE104J    | 100,000 | E | 0.1 | 0.95 | 3 | 9  | 28 | 0.07 |
| 1DE104K    | 100,000 | E | 0.1 | 0.95 | 3 | 9  | 28 | 0.07 |
| 1DE104K-EC | 10,000  | E | 0.1 | 0.95 | 3 | 9  | 28 | 0.07 |
| 2DA200J    | 20      | A | 0.2 | 0.05 | 7 | 20 | 24 | 0.1  |
| 2DA200K    | 20      | A | 0.2 | 0.05 | 7 | 20 | 24 | 0.1  |
| 2DA503J    | 50,000  | A | 0.2 | 0.05 | 7 | 20 | 24 | 0.1  |

|            |        |   |     |       |   |    |    |     |
|------------|--------|---|-----|-------|---|----|----|-----|
| 2DB101K    | 100    | B | 0.2 | 0.025 | 7 | 18 | 24 | 0.1 |
| 2DB102J    | 1,000  | B | 0.2 | 0.025 | 7 | 18 | 24 | 0.1 |
| 2DB102J-EC | 1,000  | B | 0.2 | 0.025 | 7 | 18 | 24 | 0.1 |
| 2DB102K    | 1,000  | B | 0.2 | 0.025 | 7 | 18 | 24 | 0.1 |
| 2DB151J    | 150    | B | 0.2 | 0.025 | 7 | 18 | 24 | 0.1 |
| 2DB151K    | 150    | B | 0.2 | 0.035 | 7 | 19 | 24 | 0.1 |
| 2DC102K    | 1,000  | C | 0.2 | 0.035 | 7 | 18 | 24 | 0.1 |
| 2DC302J    | 3,000  | C | 0.2 | 0.1   | 7 | 30 | 24 | 0.1 |
| 2DC302K    | 3,000  | C | 0.2 | 0.1   | 7 | 30 | 24 | 0.1 |
| 2DE103J    | 1,0000 | E | 0.2 | 0.04  | 7 | 17 | 24 | 0.1 |
| 2DE103K    | 1,0000 | E | 0.2 | 0.04  | 7 | 17 | 24 | 0.1 |
| 2DE503K    | 5,0000 | E | 0.2 | 0.04  | 7 | 17 | 24 | 0.1 |
| 3DA100J    | 10     | A | 0.3 | 0.06  | 8 | 48 | 24 | 0.1 |
| 3DA100K    | 10     | A | 0.3 | 0.06  | 8 | 48 | 24 | 0.1 |
| 3DB500J    | 50     | B | 0.3 | 0.025 | 8 | 35 | 24 | 0.1 |
| 3DB500K    | 50     | B | 0.3 | 0.025 | 8 | 35 | 24 | 0.1 |
| 3DE502J    | 5,000  | E | 0.3 | 0.025 | 8 | 35 | 24 | 0.1 |
| 3DE502K    | 5,000  | E | 0.3 | 0.025 | 8 | 35 | 24 | 0.1 |

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