

# **AMETHERM**

***Circuit Protection Thermistors***



## ACCU-CURVE™ Precision Interchangeable Thermistors

Extremely Accurate  
Temperature Sensing  
for Medical, Industrial,  
Automotive, HVAC, and  
Aerospace Applications

Ametherm's Interchangeable ACCU-CURVE™ NTC thermistors provide a high degree of measurement accuracy over the -0°C to +70°C temperature range. With a fast response time and long-term stability, these cost effective devices are ideal for a wide range of applications.

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# Precision Temperature Measurement & Control Devices

## 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 the 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.

## INTERCHANGEABLE THERMISTORS

Ametherm manufactures precision resistance-temperature matched ACCU-CURVE™ thermistors. These devices offer interchangeability over a broad temperature range and eliminate the need to individually calibrate or provide circuit compensation for part variability. Accurate temperature measurement to  $\pm 0.1^\circ\text{C}$  is available over the  $0^\circ\text{C}$  to  $70^\circ\text{C}$  temperature range. Standard ohmic values at  $25^\circ\text{C}$  range from 2,252 to 100,000 ohms.

## THERMISTOR TERMINOLOGY FOR TEMPERATURE MEASUREMENT & CONTROL DEVICES

- **D.C.** – The dissipation constant is the ratio, normally expressed in milliwatts per degree C ( $\text{mW}/^\circ\text{C}$ ), at a specified ambient temperature, of a change in power dissipated in a thermistor to the resultant change in body temperature.
- **T.C.** – 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 and is normally expressed in seconds (S).
- **Alpha ( $\alpha$ ) or Temperature Coefficient of Resistance** – 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 ( $\%/^\circ\text{C}$ ).

## ACCU-CURVE™ FEATURES

- Wide Ohmic Value Range
- Accurate & Stable
- D.C.  $1\text{mW}/^\circ\text{C}$
- Fast Thermal Response Time
- T.C. 10 Sec. in Air
- Compact Epoxy Package Style
- High Sensitivity



## Applications

There are numerous ways of measuring temperature electronically. Improvements in thermistor technology, coupled with the introduction of integrated circuitry, have made precision temperature measurement systems very cost effective. Microprocessors, A/D converters, interface electronics and displays are readily available. Circuit designs with built-in thermistor resistance-temperature algorithms have gained wide spread acceptance in precision temperature metrology. ACCU-CURVE™ style thermistors are used in many applications that require a high degree of accuracy and reliability.

Some of the most popular applications of NTC ACCU-CURVE™ thermistors include:

- Temperature Measurement & Control
- Temperature Sensors

## SELECTION CONSIDERATIONS FOR NTC ACCU-CURVE™ DEVICES

Interchangeable ACCU-CURVE™ NTC thermistors are usually selected when a high degree of measurement accuracy is required over a wide temperature range. By modifying the Alpha equation, the resistance and temperature tolerances can be calculated for various temperature intervals. Because thermistors are non-linear with respect to their resistance-temperature characteristics, Alpha therefore is non-linear across their resistance-temperature range. As an example, a thermistor material curve with an Alpha of  $-4.4\%/^\circ\text{C}$  @  $25^\circ\text{C}$  will have an Alpha of  $-3.8\%/^\circ\text{C}$  @  $50^\circ\text{C}$ . For practical applications we recommend that the standardized R/T curves be used.

ACCU-CURVE™ thermistors can dissipate  $1\text{mW}/^\circ\text{C}$ . As a result, the possibility of error induced by excessive current flow, which would defeat the level of accuracy these devices are capable of representing, may exist in some circuits. To prevent this type of error, Ametherm recommends that circuit design engineers select the highest R value their circuit will tolerate for applications  $> 5$  Volts to minimize any self-heating of the thermistor device. Refer to the ACCU-CURVE™ Specifications table for resistance values and temperature tolerances.

Ametherm offers two standard R/T curves, "C" & "W", with temperature coefficients of resistance ( $\alpha$ ) of  $-4.4\%/^\circ\text{C}$  and  $-4.7\%/^\circ\text{C}$ , and Beta ( $\beta$ ) values of  $3965^\circ\text{K}$  and  $4250^\circ\text{K}$ . To determine the nominal resistance value of a thermistor at a specified temperature, multiply its resistance at  $25^\circ\text{C}$  value by the corresponding RT/R25 value for the desired temperature and applicable R-T curve from the ACCU-CURVE™.

# ACCU-CURVE™ Specifications

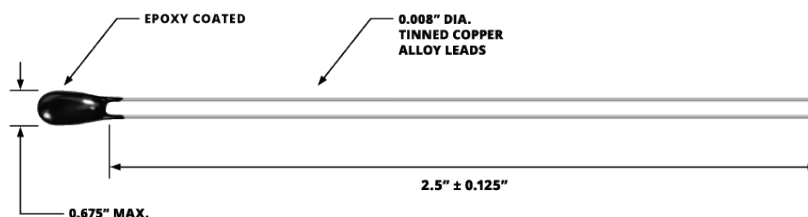


| Part Number | Resistance @ 25°C (Ω) | Accuracy Between 0°C to 70 °C | Dissipation Constant mW/°C | Thermal Time Constant = sec | Beta Value Measured Between 0°C and 50°C | Operating Temperature Range °C | Max Power Rating (mW) | Color (Optional): |
|-------------|-----------------------|-------------------------------|----------------------------|-----------------------------|------------------------------------------|--------------------------------|-----------------------|-------------------|
| ACCI01      | 2252                  | +/-0.1°C                      | ≥ 2                        | ≤ 3.5                       | 3892°K                                   | 0°C ≈ 70°C                     | 250                   | Brown             |
| ACC001      | 2252                  | +/-0.2°C                      | ≥ 2                        | ≤ 3.5                       | 3892°K                                   | 0°C ≈ 70°C                     | 250                   | Brown             |
| ACC011      | 2252                  | +/-0.5°C                      | ≥ 2                        | ≤ 3.5                       | 3892°K                                   | 0°C ≈ 70°C                     | 250                   | Brown             |
| ACC021      | 2252                  | +/-1.0°C                      | ≥ 2                        | ≤ 3.5                       | 3892°K                                   | 0°C ≈ 70°C                     | 250                   | Brown             |
| ACCI02      | 3000                  | +/-0.1°C                      | ≥ 2                        | ≤ 3.5                       | 3892°K                                   | 0°C ≈ 70°C                     | 250                   | Red               |
| ACC002      | 3000                  | +/-0.2°C                      | ≥ 2                        | ≤ 3.5                       | 3892°K                                   | 0°C ≈ 70°C                     | 250                   | Red               |
| ACC012      | 3000                  | +/-0.5°C                      | ≥ 2                        | ≤ 3.5                       | 3892°K                                   | 0°C ≈ 70°C                     | 250                   | Red               |
| ACC022      | 3000                  | +/-1.0°C                      | ≥ 2                        | ≤ 3.5                       | 3892°K                                   | 0°C ≈ 70°C                     | 250                   | Red               |
| ACCI03      | 5000                  | +/-0.1°C                      | ≥ 2                        | ≤ 3.5                       | 3892°K                                   | 0°C ≈ 70°C                     | 250                   | Orange            |
| ACC003      | 5000                  | +/-0.2°C                      | ≥ 2                        | ≤ 3.5                       | 3892°K                                   | 0°C ≈ 70°C                     | 250                   | Orange            |
| ACC013      | 5000                  | +/-0.5°C                      | ≥ 2                        | ≤ 3.5                       | 3892°K                                   | 0°C ≈ 70°C                     | 250                   | Orange            |
| ACC023      | 5000                  | +/-1.0°C                      | ≥ 2                        | ≤ 3.5                       | 3892°K                                   | 0°C ≈ 70°C                     | 250                   | Orange            |
| ACCI04      | 10,000                | +/-0.1°C                      | ≥ 2                        | ≤ 3.5                       | 3892°K                                   | 0°C ≈ 70°C                     | 250                   | Yellow            |
| ACC004      | 10,000                | +/-0.2°C                      | ≥ 2                        | ≤ 3.5                       | 3892°K                                   | 0°C ≈ 70°C                     | 250                   | Yellow            |
| ACC014      | 10,000                | +/-0.5°C                      | ≥ 2                        | ≤ 3.5                       | 3892°K                                   | 0°C ≈ 70°C                     | 250                   | Yellow            |
| ACC024      | 10,000                | +/-1.0°C                      | ≥ 2                        | ≤ 3.5                       | 3892°K                                   | 0°C ≈ 70°C                     | 250                   | Yellow            |
| ACW105      | 30,000                | +/-0.1°C                      | ≥ 2                        | ≤ 3.5                       | 4143°K                                   | 0°C ≈ 70°C                     | 250                   | Green             |
| ACW005      | 30,000                | +/-0.2°C                      | ≥ 2                        | ≤ 3.5                       | 4143°K                                   | 0°C ≈ 70°C                     | 250                   | Green             |
| ACW015      | 30,000                | +/-0.5°C                      | ≥ 2                        | ≤ 3.5                       | 4143°K                                   | 0°C ≈ 70°C                     | 250                   | Green             |
| ACW025      | 30,000                | +/-1.0°C                      | ≥ 2                        | ≤ 3.5                       | 4143°K                                   | 0°C ≈ 70°C                     | 250                   | Green             |
| ACW106      | 50,000                | +/-0.1°C                      | ≥ 2                        | ≤ 3.5                       | 4143°K                                   | 0°C ≈ 70°C                     | 250                   | Blue              |
| ACW006      | 50,000                | +/-0.2°C                      | ≥ 2                        | ≤ 3.5                       | 4143°K                                   | 0°C ≈ 70°C                     | 250                   | Blue              |
| ACW016      | 50,000                | +/-0.5°C                      | ≥ 2                        | ≤ 3.5                       | 4143°K                                   | 0°C ≈ 70°C                     | 250                   | Blue              |
| ACW026      | 50,000                | +/-1.0°C                      | ≥ 2                        | ≤ 3.5                       | 4143°K                                   | 0°C ≈ 70°C                     | 250                   | Blue              |
| ACW107      | 100,000               | +/-0.1°C                      | ≥ 2                        | ≤ 3.5                       | 4143°K                                   | 0°C ≈ 70°C                     | 250                   | Violet            |
| ACW007      | 100,000               | +/-0.2°C                      | ≥ 2                        | ≤ 3.5                       | 4143°K                                   | 0°C ≈ 70°C                     | 250                   | Violet            |
| ACW017      | 100,000               | +/-0.5°C                      | ≥ 2                        | ≤ 3.5                       | 4143°K                                   | 0°C ≈ 70°C                     | 250                   | Violet            |
| ACW027      | 100,000               | +/-1.0°C                      | ≥ 2                        | ≤ 3.5                       | 4143°K                                   | 0°C ≈ 70°C                     | 250                   | Violet            |
| *ACM011     | 10,000                | +/-0.5°C                      | ≥ 0.7                      | ≤ 6                         | 3435°K                                   | -40C≈105C                      | 300                   | Black             |
| *ACY011     | 10,000                | +/-0.5°C                      | ≥ 0.7                      | ≤ 6                         | 3977°K                                   | -40C≈105C                      | 300                   | Black             |
| *ACL011     | 50,000                | +/-0.5°C                      | ≥ 0.7                      | ≤ 6                         | 3950°K                                   | -40C≈105C                      | 300                   | Black             |



\* Denotes the following:

- Different Beta
- Operating temperature change
- Maximum power allowed



# ACC-XXX "C" CURVE

| TEMP. °C | RT/R25 |
|----------|--------|
| 0        | 3.265  |
| 1        | 3.103  |
| 2        | 2.950  |
| 3        | 2.805  |
| 4        | 2.669  |
| 5        | 2.539  |
| 6        | 2.417  |
| 7        | 2.301  |
| 8        | 2.192  |
| 9        | 2.088  |
| 10       | 1.990  |
| 11       | 1.897  |
| 12       | 1.809  |
| 13       | 1.725  |
| 14       | 1.646  |
| 15       | 1.571  |
| 16       | 1.500  |
| 17       | 1.432  |
| 18       | 1.368  |
| 19       | 1.307  |
| 20       | 1.249  |
| 21       | 1.194  |
| 22       | 1.142  |
| 23       | 1.092  |
| 24       | 1.045  |
| 25       | 1.000  |
| 26       | 0.9573 |
| 27       | 0.9167 |
| 28       | 0.8777 |
| 29       | 0.8407 |
| 30       | 0.8057 |
| 31       | 0.7723 |
| 32       | 0.7403 |
| 33       | 0.7097 |
| 34       | 0.6807 |
| 35       | 0.6530 |
| 36       | 0.6267 |
| 37       | 0.6017 |
| 38       | 0.5777 |
| 39       | 0.5547 |
| 40       | 0.5327 |
| 41       | 0.5117 |
| 42       | 0.4917 |
| 43       | 0.4727 |
| 44       | 0.4543 |
| 45       | 0.4370 |
| 46       | 0.4200 |
| 47       | 0.4040 |
| 48       | 0.3890 |
| 49       | 0.3743 |
| 50       | 0.3603 |
| 51       | 0.3467 |
| 52       | 0.3340 |
| 53       | 0.3217 |
| 54       | 0.3099 |
| 55       | 0.2986 |
| 56       | 0.2878 |
| 57       | 0.2774 |
| 58       | 0.2675 |
| 59       | 0.2579 |
| 60       | 0.2488 |
| 61       | 0.2400 |
| 62       | 0.2316 |
| 63       | 0.2235 |
| 64       | 0.2157 |
| 65       | 0.2083 |
| 66       | 0.2011 |
| 67       | 0.1942 |
| 68       | 0.1876 |
| 69       | 0.1813 |
| 70       | 0.1752 |

# ACW-XXX "W" CURVE

| TEMP. °C | RT/R25 |
|----------|--------|
| 0        | 3.265  |
| 1        | 3.103  |
| 2        | 2.950  |
| 3        | 2.805  |
| 4        | 2.669  |
| 5        | 2.539  |
| 6        | 2.417  |
| 7        | 2.301  |
| 8        | 2.192  |
| 9        | 2.088  |
| 10       | 1.990  |
| 11       | 1.897  |
| 12       | 1.809  |
| 13       | 1.725  |
| 14       | 1.646  |
| 15       | 1.571  |
| 16       | 1.500  |
| 17       | 1.432  |
| 18       | 1.368  |
| 19       | 1.307  |
| 20       | 1.249  |
| 21       | 1.194  |
| 22       | 1.142  |
| 23       | 1.092  |
| 24       | 1.045  |
| 25       | 1.000  |
| 26       | 0.9573 |
| 27       | 0.9167 |
| 28       | 0.8777 |
| 29       | 0.8407 |
| 30       | 0.8057 |
| 31       | 0.7723 |
| 32       | 0.7403 |
| 33       | 0.7097 |
| 34       | 0.6807 |
| 35       | 0.6530 |
| 36       | 0.6267 |
| 37       | 0.6017 |
| 38       | 0.5777 |
| 39       | 0.5547 |
| 40       | 0.5327 |
| 41       | 0.5117 |
| 42       | 0.4917 |
| 43       | 0.4727 |
| 44       | 0.4543 |
| 45       | 0.4370 |
| 46       | 0.4200 |
| 47       | 0.4040 |
| 48       | 0.3890 |
| 49       | 0.3743 |
| 50       | 0.3603 |
| 51       | 0.3467 |
| 52       | 0.3340 |
| 53       | 0.3217 |
| 54       | 0.3099 |
| 55       | 0.2986 |
| 56       | 0.2878 |
| 57       | 0.2774 |
| 58       | 0.2675 |
| 59       | 0.2579 |
| 60       | 0.2488 |
| 61       | 0.2400 |
| 62       | 0.2316 |
| 63       | 0.2235 |
| 64       | 0.2157 |
| 65       | 0.2083 |
| 66       | 0.2011 |
| 67       | 0.1942 |
| 68       | 0.1876 |
| 69       | 0.1813 |
| 70       | 0.1752 |



## ACCU-CURVE™ Resistance / Temperature Conversion Tables

To determine the nominal resistance value of a thermistor at a specified temperature, multiply its  $R_T / R_{25}$  value for the desired temperature and R-T curve from the table above by its nominal resistance at 25 °C.

Contact us today for more information  
or to order your free samples.

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