RTI Electronics, Inc.

Precision Temperature Measurement and Control Devices

Interchangeables

NTC Thermistors

ACCU-CURVE™ Features

- Wide Ohmic Value Range
- Accurate & Stable
- D.C. 1mW/°C
- Fast Thermal Response Time
- T.C. 10 Sec. in Air
- Compact Epoxy Package Style
- 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 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

RTI 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 ±0.2°C is available over the 0° C to 70°C temperature range. Standard ohmic values at 25°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 (mw/°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 (α) 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 (%/°C).

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

ACCU-CURVE™ Selection Considerations

- Determine Resistance Value & Temperature Coefficient
- Review Power Dissipation
- Select Temperature Range
- Review Thermal Time Constant

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. RTI's **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.
$(\Delta T = \Delta R/(\alpha * R)$ and $\Delta R = \alpha * R * \Delta T)$ 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%/°C @ 25°C will have an **Alpha** of -3.8%/°C @ 50°C. For practical applications we recommend that the standardized R/T curves be used.

RTI **ACCU-CURVE™** thermistors can dissipate 1mW/°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, RTI 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.

RTI offers two standard R/T curves, "C" & "W", with temperature coefficients of resistance (α) of -4.4%/°C and -4.7%/°C, and Beta (ß) values of 3965°K and 4250°K. To determine the nominal resistance value of a thermistor at a specified temperature, multiply its resistance at 25°C value by the corresponding RT/R25 value for the desired temperature and applicable R-T curve from the **ACCU-CURVE™ Resistance/Temperature Conversion Table**.

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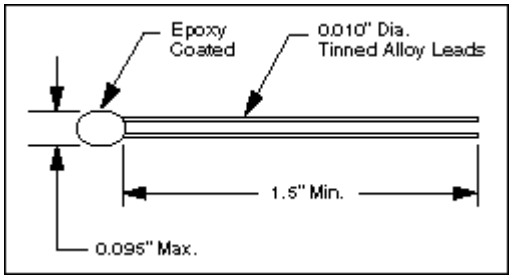
ACCU-CURVE™ Specifications

Resistance @ 25° C (ohms)	Temperature Tolerance from 0° C to 70° C			Color Code
	±0.2° C	±0.5° C	±1.0° C	
	Part Number	Part Number	Part Number	
2,252	ACCX-001	ACCX-011	ACCX-021	Brown
3,000	ACCX-002	ACCX-012	ACCX-022	Red
5,000	ACCX-003	ACCX-013	ACCX-023	Orange
10,000	ACCX-004	ACCX-014	ACCX-024	Yellow
30,000	ACWX-005	ACWX-015	ACWX-025	Green
50,000	ACWX-006	ACWX-016	ACWX-026	Blue
100,000	ACWX-007	ACWX-017	ACWX-027	Violet

ACCU-CURVE™ Resistance/Temperature Table

TEMP (°C)	"C" CURVES				"W" CURVES		
	2,252 ohm s @ 25°C	3,000 ohms @ 25°C	5,000 ohm s @ 25°C	10,000 ohm s @ 25°C	30,000 ohm s @ 25°C	50,000 ohm s @ 25°C	100,000 ohms @ 25°C
-40	75,780	100,950	168,250	336,500	1,204,600	2,007,700	4,015,500
-30	39,860	53,100	88,500	177,000	619,200	1,032,000	2,064,000
-20	21,860	29,121	48,535	97,070	331,030	551,720	110,3400
-10	12,460	16,599	27,665	55,330	183,560	305,940	611,870
0	7,352.8	9,795.0	16,325	32,650	105,310	175,510	351,020
10	4,481.5	5,970.0	9,950.0	19,900	62,354	103,920	207,850
20	2,812.8	3,747.0	6,245.0	12,490	38,022	63,370	126,740
25	2,252.0	3,000.0	5,000.0	10,000	30,000	50,000	100,000
30	1,814.4	2,417.1	4,028.5	8,057.0	23,827	39,711	79,422
40	1,199.6	1,598.1	2,663.3	5,327.0	15,314	25,524	51,048
50	811.40	1,080.9	1,801.5	3,603.0	10,077	16,795	33,591
60	560.30	746.40	1,244.0	2,488.0	6,777.1	11,295	22,590
70	394.55	525.60	876.00	1,752.0	4,650.5	7,750.9	15,502
80	282.63	376.50	627.50	1,255.0	3,251.2	5,418.7	10,837
90	206.13	274.59	457.65	915.30	2,312.3	3,853.9	7,707.7
100	152.75	203.49	339.15	678.30	1,670.8	2,784.6	5,569.3
110	114.92	153.09	255.15	510.30	1,224.9	2,041.5	4,082.9
120	87.671	116.79	194.65	389.30	909.99	1,516.7	3,033.3
130	67.770	90.279	150.47	300.93	684.31	1,140.5	2,281.0
140	52.983	70.581	117.64	235.27	520.30	867.16	1,734.3
150	41.881	55.791	92.985	185.97	399.56	665.94	1,331.9



The ACCU-CURVE™ device can also be supplied with 30 AWG solid Teflon insulated leads of 3, 6, 9 and 12 inches in length. contact RTI applications engineering for additional information.
Warning: Use Heat sinks when soldering to Thermistor Leads.

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ACCU-CURVE™ Resistance/Temperature Conversion Tables

ACCX-0XX "C" CURVE

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

ACWX-0XX "W" CURVE

TEMP. °C	RT/R25	TEMP. °C	RT/R25
0	3.5102	36	0.6074
1	3.3264	37	0.5814
2	3.1532	38	0.5566
3	2.9899	39	0.5330
4	2.8360	40	0.5105
5	2.6908	41	0.4891
6	2.5539	42	0.4686
7	2.4246	43	0.4492
8	2.3026	44	0.4306
9	2.1873	45	0.4129
10	2.0785	46	0.3961
11	1.9756	47	0.3800
12	1.8784	48	0.3646
13	1.7865	49	0.3499
14	1.6995	50	0.3359
15	1.6173	51	0.3225
16	1.5395	52	0.3098
17	1.4658	53	0.2976
18	1.3961	54	0.2859
19	1.3300	55	0.2748
20	1.2674	56	0.2641
21	1.2081	57	0.2539
22	1.1519	58	0.2442
23	1.0985	59	0.2348
24	1.0480	60	0.2259
25	1.0000	61	0.2174
26	0.9545	62	0.2092
27	0.9113	63	0.2014
28	0.8702	64	0.1939
29	0.8313	65	0.1867
30	0.7942	66	0.1798
31	0.7590	67	0.1732
32	0.7256	68	0.1669
33	0.6938	69	0.1608
34	0.6636	70	0.1550
35	0.6348		

To determine the nominal resisteance 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.

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