Alfalight Technical Note TN05: Standard Thermistor Parameters

Standard Thermistor Parameters

Thermistor material properties
R_T=10,000 ohms ± 2% @ 25°C
α @25C = -4.39%
β (0/50C) =3892K ± 1.4%

Background
Alpha, α, is a thermistor material characteristic, is defined as the percentage resistance change per degree Centigrade. Alpha is also referred to as the temperature coefficient. Because the resistance of NTC thermistors is a nonlinear function of temperature, the alpha value of a particular thermistor material is nonlinear, therefore Alpha is specified at a specific temperature, typically 25C.

Beta is another material characteristic. A simple approximation for the relationship between resistance and temperature for an NTC thermistor assumes an exponential relationship. Beta is the exponential term. This equation provides a reasonable approximation to measured data, but the thermistor materials are not ideal materials so this equation can only be applied over limited temperature ranges (typically 0C to 50C).

Example: Calculate the resistance of a 10KΩ thermistor at 33°C using the following information:
The resistance of the thermistor at 25 °C is R_T =10000 ohms, the 0-50 Beta value is 3892K

Using the equation:
$R2 = R1 / e^{(ß (1/T1 - 1/T2))}$
where
T1 = 25°C = 298.15 K, R1 = 10000 ohms.
T2 = 33°C = 306.15 K, ß= 3892 K
Using these values, the value of R2 is calculated as:
$R2 = 10000 / e^{0.3411094}$
Resistance at 33°C calculated using Beta value: R2 = 7109.81ohms.

Some TEC controllers require A,B and C parameters for the Steinhart-Hart approximation:

$1/T = A + B(\ln(R))+C(\ln(R))^3$

The equation is considered for three temperature points in the range – usually at the low end, the middle and the high end of the range. This ensures best fit along the full range. (The smaller the temperature range, the better the calculations will match measured data.) The temperature values are usually taken to be 0°C, 25 °C and 70 °

For this thermistor (using 0°C, 25°C and 70°C):

$A = 1.1292 \times 10^{-3}$
$B = 2.3412 \times 10^{-4}$
$C = 8.7674 \times 10^{-8}$

Finally, it is often convenient to look up temperatures for a given resistance or resistances to give a specific temperature; this can be done on Table 1.

Table 1. Thermistor Resistance Table

Temp	R Value	Temp	R Value	Temp	R Value	Temp	R Value
C	(Ohms)	C	(Ohms)	C	(Ohms)	C	(Ohms)
-20	97006.9	7	23015.9	34	6807.1	61	2399.4
-19	91553.3	8	21921.2	35	6530.3	62	2315.2
-18	86439.2	9	20884.7	36	6266.2	63	2234.4
-17	81641.4	10	19903.2	37	6014.3	64	2156.8
-16	77138.6	11	18973.3	38	5773.8	65	2082.3
-15	72911.1	12	18092.2	39	5544.2	66	2010.8
-14	68940.4	13	17256.9	40	5325	67	1942.1
-13	65209.7	14	16464.9	41	5115.6	68	1876
-12	61702.9	15	15713.7	42	4915.6	69	1812.6
-11	58405.5	16	15000.9	43	4724.4	70	1751.6
-10	55303.9	17	14324.5	44	4541.7	71	1693
-9	52385.2	18	13682.3	45	4367	72	1636.6
-8	49637.8	19	13072.6	46	4200	73	1582.4
-7	47050.6	20	12493.3	47	4040.2	74	1530.2
-6	44613.4	21	11943	48	3887.4	75	1480.1
-5	42316.7	22	11419.9	49	3741.1	76	1431.8
-4	40151.6	23	10922.7	50	3601.1	77	1385.3
-3	38110	24	10449.8	51	3467	78	1340.6
-2	36184	25	10000	52	3338.7	79	1297.5
-1	34366.6	26	9572	53	3215.8	80	1256.1
0	32650.9	27	9164.7	54	3098	81	1216.1
1	31030.8	28	8777	55	2985.2	82	1177.7
2	29500.5	29	8407.7	56	2877	83	1140.6
3	28054.4	30	8056.1	57	2773.3	84	1104.9
4	26687.5	31	7721	58	2673.9	85	1070.5
5	25395	32	7401.7	59	2578.6		
6	24172.5	33	7097.3	60	2487.1		

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