VISHAY INTERTECHNOLOGY, INC.

INTERACTIVE
data book

NTC THERMISTOR ASSEMBLIES
VISHAY DALE

VSE-DB0060-0611

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VISHAY INTERTECHNOLOGY, INC.

DATA BOOK

NTC THERMISTOR ASSEMBLIES

VISHAY DALE

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NTC
Thermistor Assemblies

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NTC THERMISTOR ASSEMBLIES

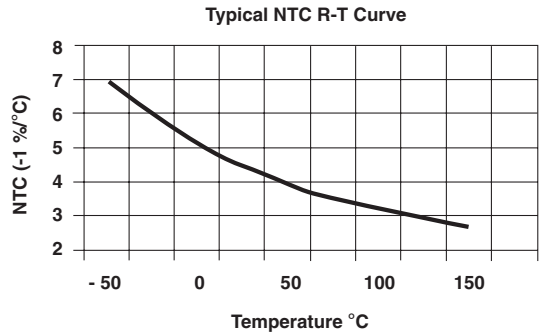
NTC THERMISTOR ASSEMBLIES

NTC Thermistors

INTRODUCTION

Thermistors are temperature sensitive resistors that have a greater than normal change in resistance value when the temperature changes. The change in resistance is predictable with changes in temperature. The extreme sensitivity to temperature change enables a thermistor to perform many functions and is utilized in an increasing variety of thermal sensing/control applications.

The basic style of thermistor assembly are generally available today in NTC technology. NTC thermistors are ceramic semiconductors with a high Negative Temperature Coefficient of resistance. NTC thermistors decrease in resistance as the temperature increases.



NTC THERMISTORS

NTC thermistors are composed of sintered metal oxides such as manganese, nickel, cobalt, iron, copper and aluminum.

NTC THERMISTOR APPLICATIONS

Temperature Measurement

The high sensitivity of a thermistor makes it an ideal candidate for low cost temperature measurement applications.

Temperature Control

NTC thermistors can be used for temperature control (off/on) using a minimum amount of circuitry.

Temperature Compensation

In many cases, circuit precision requires that there is some sort of temperature compensation. Oscillators, LCD displays, a battery under charge and some amplifiers are examples of circuits that may require temperature compensation.

Fluid Level Applications

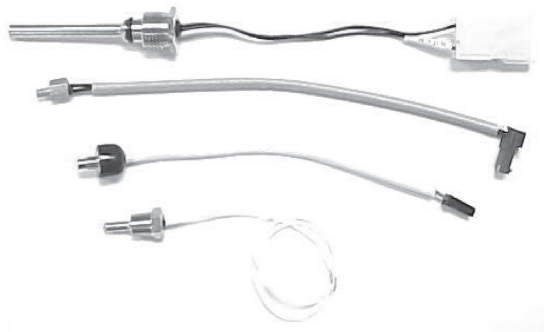
The thermistor can be used to sense the presence or absence of a liquid by using the difference in dissipation constants between a liquid and a gas.

THERMISTOR ASSEMBLIES

Thermistor assembly probes are available in a wide variety of configurations. The choice of assembly mounting, housing, etc., is dependent on the application. Primary factors that determine the configuration of a thermistor assembly is operating environment, method of mounting and thermal time response.

For specialized applications Vishay Dale offers a custom design service which allows the customer to advance from conception to design, manufacture and installation.

Typical thermistor assemblies are shown below.



DESCRIPTION OF TERMS USED

Thermistor

A thermally sensitive resistor whose primary function is to exhibit a change in electrical resistance with a change in body temperature.

Standard Reference Temperature

The thermistor body temperature at which nominal zero-power resistance is specified (25 °C).

Zero-Power Resistance

This is the DC resistance value of a thermistor measured at a specified temperature with a power dissipation by the thermistor low enough that any further decrease in power will result in not more than 1.0 percent (or 1/10 of the specified measurement tolerance, whichever is smaller) change in resistance.

Resistance Ratio Characteristic

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

Negative Temperature Coefficient (NTC)

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

Maximum Operating Temperature

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

Maximum Power Rating

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

Dissipation Constant (D.C.)

The ratio, 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 (T.C.)

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. This is normally expressed in seconds.

Resistance-Temperature Characteristic

The relationship between the zero-power resistance of a thermistor and its body temperature.

Stability

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

Base Resistance (Ro)

The resistance value of a thermistor at a specified temperature with negligible electrical power to avoid self heating. Usually base resistance will be defined at 25 °C.

Temperature Coefficient of Resistance (alpha, α)

The temperature coefficient of resistance is the ratio at a specified temperature, T, of the rate of change of zeropower resistance with temperature to the zero-power resistance of the thermistor. The temperature coefficient is commonly expressed in percent per degree C (%/°C).

$$\alpha T = \frac{(dRt)}{(dt)}$$

Ambient Operating Temperature

The temperature of the air surrounding an object, neglecting small localized variations.

Material Constant (Beta , β)

The material constant of an NTC thermistor is a measure of its resistance at one temperature compared to its resistance at a different temperature. Its value may be calculated by the formula shown below and is expressed in degrees Kelvin (°K). The reference temperatures used in this formula for determining material constant ratings of RT1 thermistors are 298.15 °K and 348.15 °K.

b = ln (R @ T2/R @ T1)/(T21 - T1-1)

Maximum Operating Voltage (Vmax)

The maximum rated voltage the thermistor can continuously withstand at 60 cycles AC or DC.

NTC Thermistors

HOW TO SELECT AN NTC THERMISTOR

1. Dissipation Constant (D.C.)

The dissipation constant is the amount of power (expressed in milliwatts) required to self-heat the thermistor suspended by its two-inch leads in still air 1 °C above its environment. The dissipation constant of NTC thermistor/NTC thermistor sensor assembly is typically defined as the ratio (at a specified ambient temperature) of the power dissipated in the thermistor to the resultant change in the temperature of the thermistor.

This constant (expressed as the power in milliwatts required to self-heat the thermistor 1 °C above ambient temperature) increases slightly with increasing temperature. The lead length and type of lead, the type of encapsulating material (epoxy, Durez, stainless steel probe, thermoplastic probe, etc.) the mounting of the NTC thermistor/assembly, the medium of the surrounding environment (flowing gas, still air, water, oil, etc.) and other factors generally determine the dissipation constant of an NTC thermistor/NTC thermistor sensor assembly.

Given the variables that affect D.C., it is recommended that a prototype should be tested under actual operating conditions to determine the maximum allowable input current. The current through the thermistor must be small enough to produce negligible self-heating error in the thermistor at the maximum measuring or controlling temperature. At the same time, the current should be as large as possible to maximize system sensitivity.

If the rate of heat loss under actual operating conditions could be fixed and was constant from system to system, the D.C. would only be a consideration for determining the maximum power dissipated and an offset allowance could be made. For example, if the D.C. of a thermistor assembly had been determined as 3 mW/°C in a stirred oil bath (the medium to be measured) and it was desired to measure the oil bath to an absolute temperature accuracy of ± 0.1 °C, the maximum power that should be developed in the thermistor by the measuring current is 0.15 mW.

This is to keep the self-heat factor to 50 % or less of the measurement accuracy.

The formula for this is:

3 mW/°C x 0.1 °C x 50 % = 0.15 mW

The D.C. of an NTC thermistor/NTC thermistor sensor assembly can be determined by first measuring the zero-power resistance of the NTC thermistor at two temperature points 10 °C to 25 °C apart. The thermistor is then placed in series with a variable voltage supply, a current meter, and a sufficiently large enough resistor to prevent too much current flowing through the circuit and allowing the thermistor to “run-away”. A highresistance voltmeter is connected across the thermistor. The power supply is then gradually increased until the voltage across the thermistor and the current through it indicate a resistance equal to the measured resistance at the upper temperature. This is determined by using Ohm's Law E ÷ I = R (E = volts, I = current, R = resistance). The D.C. is then calculated by dividing the power dissipated in the NTC thermistor by the temperature difference between the two measured temperatures. Power is calculated by using Ohm's Law, P = E x I.

2. Thermal Time Constant (T.C.)

The time constant is the time in seconds required for the thermistor to change through 63.2 % of the difference between its initial and final body temperatures, when subjected to a step change in temperature under zero-power conditions. Since the NTC thermistor's T.C. is determined by the same factors as D.C. (i.e., encapsulation, mounting, lead length, etc.), a prototype should be built if T.C. is important.

The time constant is determined by measuring the resistance of the thermistor at three temperature points, the middle point being 63.2 % of the difference between the upper one and the lower one. A precision bridge is set for the middle temperature resistance with the bridge voltage supply set so as not to produce the selfheat error. An auxiliary bridge voltage is set for the higher temperature resistance. The thermistor is placed in the operating medium at the lower temperature and is connected to the auxiliary bridge. The auxiliary bridge is adjusted to balance the bridge, which in effect, will self-heat the thermistor to the upper temperature. The thermistor is then immediately switched to the precision bridge.

The time required for the precision bridge to balance is the time constant of the NTC thermistor/NTC thermistor sensor assembly in the operating medium.

3. Selection Of Resistance Value

Typically, NTC thermistors are specified and/or referenced to + 25 °C. However, it is equally important to consider the minimum and maximum resistance values at the extremes of the operating temperature range.

The minimum resistance at the maximum temperature point must not be too low to meet the input requirements of the measuring circuit. If the resistance is too low, errors due to contact resistance, line resistance and self-heating increase.

It is recommended to have at least 500 Ω - 1000 Ω at the high end of the temperature range.

Conversely, the maximum resistance at the minimum temperature point must not be too high for the measurement circuit input. Range switching with two or more probes should be considered if the minimum/maximum resistance values cannot be met with one thermistor.

Sensitivity also is an important consideration in the selection of the correct resistance value. Usually, the minimum and maximum allowable resistance values typically limit this selection. It then must be determined which resistance values maximize the output of the measuring system over the entire range, taking into consideration the maximum input current as determined by the dissipation constant and allowable self-heat error.

4. R-T Curve Selection

At present, 11 R-T curves are available from Vishay Dale. Each material has a different R-T characteristic. Given the different resistivities of the different R-T materials and the desirability of maintaining uniformity in size, not all resistance values (R_{25}) are available in all R-T curves.

Once the minimum resistance at the maximum temperature is determined, divide this resistance value by a given R-T/R_{25} ratio from one of any of the R-T curves to determine an approximate R_{25} value. (**NOTE:** R-T ratio tables in 1 °C increments are included on pages 11 - 16.) If the R_{25} value is not available in one R-T curve, select another until an appropriate R-T curve is determined. Then, select a standard R_{25} value that is closest to the approximate value. Calculate the maximum resistance at the minimum temperature by multiplying the selected R_{25} by the given R-T/R_{25} ratio. If the selected R-T curve and R_{25} value meet the predetermined minimum resistance, maximum resistance and sensitivity of the measurement system, then tolerance is the next consideration.

5. Tolerance

Most temperature measurement or control applications express their limitations or accuracy in temperature units (i.e. ± 1.0 °C). When designing a system, it is important to consider the overall measurement accuracy of all components. A ± 1.0 °C thermistor, coupled with a ± 1.0 °C system, will insure measurement accuracy to ± 2.0 °C.

Thermistors may be specified with either a temperature tolerance or a resistance tolerance at either a single temperature point or over a temperature range. If the required temperature measurement accuracy is over a temperature range, it is more practical to specify a temperature tolerance in lieu of a resistance tolerance. This is because a resistance tolerance specification over a range will not necessarily guarantee that the required system accuracy will be met unless the nonlinear NTC (negative temperature coefficient) is taken into consideration.

NTC is expressed in % resistance change per degree C. Since one NTC resistance change is approximately equivalent to a 1° temperature change, NTC is useful in specifying temperature tolerances. NTC's are given on the Vishay Dale Specification Sheet in 10 degree increments; however, the NTC may be calculated at any temperature point using a 1 °C R-T table.

$$\left(\text{NTC} = \frac{1}{R} \bullet \frac{dR}{dT} 100\right)$$

Example: What is the NTC of 10 000 Ω (R_{25}) of a Curve 1 thermistor at + 44 °C?

$$100\left(\frac{1}{4543\ \Omega\ @\ 44\ °C} \times \frac{4368\ \Omega\ @\ +45\ °C - 4725\ \Omega\ @\ +43\ °C}{2}\right) = 3.9\ \%$$

To determine the resistance tolerance at any given temperature point, simply multiply the specified temperature tolerance by the NTC at the given temperature.

Example: What are the resistance tolerances at 0 °C, + 25 °C and + 70 °C for a Curve 1 thermistor with a ± 0.5 °C temperature tolerance over the range of 0 °C to + 70 °C?

R_0 = ± 0.5 °C x - 5.1 % = ± 2.55 % resistance tolerance

R_{25} = ± 0.5 °C x - 4.4 % = ± 2.2 % resistance tolerance

R_{70} = ± 0.5 °C x - 3.4 % = ± 1.7 % resistance tolerance

It may now be clear why a single resistance tolerance over a temperature range may not be practical for a particular temperature measurement application.

If a single temperature point is the only design specification, NTC and manufacturing tolerances are useful in determining temperature tolerances at other temperature points. Manufacturing tolerance is given on the Vishay Dale Specification Sheet in a ± % resistance tolerance. Point-matched specifications must have the difference in deviation between the specified temperature point and any other temperature point of interest added to the resistance tolerance at the specified temperature.

Example: What are the resistance tolerances at 0 °C and + 50 °C for a standard 1M1002?

R_0 = ± 10 % + ± 1.1 % = ± 11.1 % resistance tolerance

R_{25} = ± 10 % + ± 0.0 % = ± 10 % resistance tolerance

R_{50} = ± 10 % + ± 1.1 % = ± 11.1 % resistance tolerance

To determine the temperature tolerance at any temperature point, divide the resistance tolerance bythe NTC at that point.

Example: What is the temperature tolerance at 0 °C for a 1M1002?

± 11.1 % ÷ - 5.1 % = ± 2.2 °C temperature tolerances.

It should be noted that the manufacturing tolerances listed on the Vishay Dale Specification Sheet are all referenced at + 25 °C. If the thermistor is referenced at a temperature other than + 25 °C, then the total difference in deviation between the two points, if the + 25 °C is between them, is the sum of the maximum deviations listed at each point.

Example: What is the maximum resistance tolerance of a Curve 1 thermistor at 0 °C if the specified tolerance is ± 5 % at + 70 °C?

(± 5 % resistance tolerance at + 70 °C) + (MT ± 1.8 % at + 70 °C) + (MT ± 1.1 % at 0 °C) = ± 7.9 % resistance tolerance at 0 °C.

6. Tolerance Availability vs R-T Curve

Not all temperature/resistance tolerances are available in all R-T curves. If a temperature tolerance over an extended temperature range is required, then at present, Curves 1, 2, 4, 8 or 9 may be selected. All other curves may be specified to a resistance or temperature tolerance at a single temperature point. Curves 12 and 13 may only have ± 5 % or ± 10 % resistance tolerances specified. Contact the factory for further information.

7. Tolerance Availability vs Configuration

Not all temperature/resistance tolerances are available in all configurations. Basically, hybrids, uncoated NTC thermistors without leads and uncoated NTC thermistors with leads are only available in ± 5 % or ± 10 % pointmatched resistance tolerances.

8. Measurement Accuracy

Thermistor resistance measurements must be made at precisely controlled temperature while applying essentially zero-power to assure measurement accuracy.

RESISTANCE-TEMPERATURE RELATIONSHIP

Many empirical equations have been developed over the years in an attempt to accurately describe the non-linear resistance-temperature dependence of NTC thermistors.

An early equation called the “Beta” formula proved to be useful over narrow temperature ranges for broad tolerances. The Beta formula may be written using a single material dependent constant B as:

$$R(T) = R(To)\exp\left[B\left(\frac{1}{T-To}\right)\right]$$

where R (T) is the resistance at the temperature T in Kelvin and R (To) is a reference point at temperature To. The Beta formula requires a two-point calibration, but under the best of conditions is not accurate to ± 1 °C over the range of 0 °C to + 100 °C and typically not to ± 5 °C over our published temperature ranges.

The best empirical expression published to date is the Steinhart-Hart equation written explicitly in temperature T as:

$$\frac{1}{T} = A + B(\ln R) + C(\ln R)^3$$

where ln R is the natural logarithm of the resistance R at temperature T and the A, B and Cís are derived coefficients from actual measurement. This form of the Steinhart-Hart equation requires a minimum of three calibration points to determine the derived coefficients. Typical accuracies would be less than ± 0.15 °C over the range of - 50 °C to + 150 °C.

If the temperature points selected from the R-T tables to calculate A, B and C lie within a + 100 °C range, the accuracy is better than ± 0.01 °C, assuming measurement accuracy to at least four significant figures and preferably five.

The Steinhart-Hart equation is an approximation. If a tighter tolerance than guaranteed is desired, then each thermistor must be individually calibrated.

NTC Thermistors

NTC (- %/°C) is negative temperature coefficient of resistance at temperature (T) expressed in % resistance change per °C. Since one NTC resistance change is approximately equivalent to + 1 °C temperature change, NTC is useful in developing curve tracking thermistor specifications (e.g., Curve 1, 10 000 Ω ± 4.4 % at + 25 °C; 32 660 Ω ± 5.1 % at 0 °C; 1753 Ω ± 3.4 % at + 70 °C results in a ± 1 °C: curve tracking thermistor 0° to 70 °C, 0.5 NTC = ± 0.5 °C, etc.).

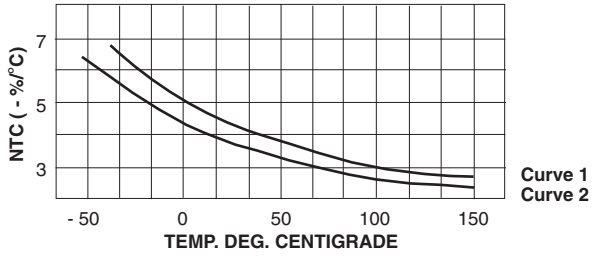
MT ± % is manufacturing tolerance at temperature. Add to resistance tolerance specified at + 25 °C, (e.g., Curve 1, 10 kΩ ± 10 % at + 25 °C, 1257 Ω ± 12.1 % at + 80 °C). Not applicable to curve tracking thermistors.

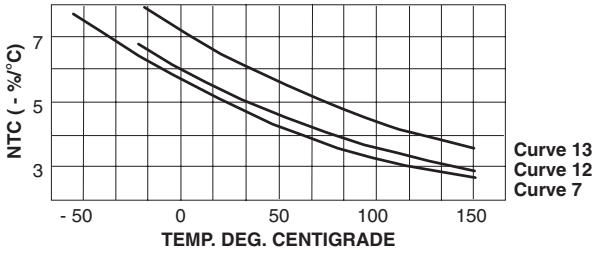
RT-R_{25} Ratio is resistance at temperature T divided by resistance at + 25 °C. To determine the resistance of a NTC thermistor at temperatures other than + 25 °C, multiply the ratio selected from the appropriate curve column above by resistance at + 25 °C (e.g., Curve 1, 10 kΩ at + 25 °C, 1257 Ω at + 80 °C).

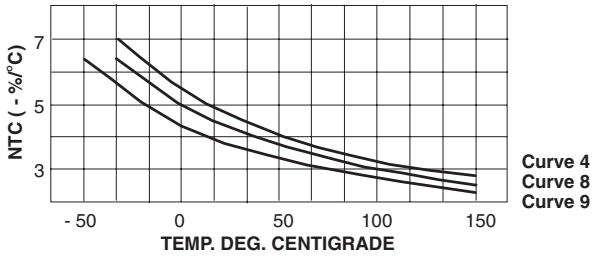
NOTE: For + 1 °C Ratio Tables, see pages 11 to 16.

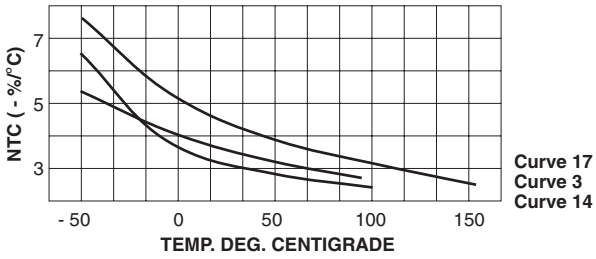
MAXIMUM TEMPERATURE for thermistors listed is + 150 °C; however, continuous operation or cycling above + 125 °C (curve tracking above the specified temperature range) may cause thermistors to exceed the originally specified tolerances.

CURVES









CURVE NUMBER	NTC	BETA
	at + 25°C (%/°C)	+ 25°C/+ 75 °C
1	- 4.40	3964
2	- 3.83	3477
3	- 3.70	3181
4	- 4.68	4247
7	- 4.83	4437
8	- 4.30	3925
9	- 4.03	3679
12	- 5.23	4842
13	- 6.22	5718
14	- 3.10	3022
17	- 4.54	4064

NTC Thermistors

RESISTANCE VS TEMPERATURE CONVERSION TABLES

TEMP °C	CURVE 1			CURVE 2			CURVE 3		
	RATIO	MT ± %	NTC	RATIO	MT ± %	NTC	RATIO	MT ± %	NTC
- 60	141.18	-	-	-	-	-	49.1	-	-
- 55	96.811	4.5	7.4	53.474	6.3	7.0	36.6	-	-
- 50	67.26	3.9	7.2	39.035	6.2	6.2	27.5	18.5	5.5
- 40	33.727	3.3	6.7	21.473	5.8	5.8	16.1	15.4	5.3
- 30	17.721	2.6	6.2	12.284	5.4	5.4	9.70	12.5	4.9
- 20	9.714	2.1	5.8	7.283	4.7	5.1	6.05	9.9	4.5
- 10	5.535	1.5	5.5	4.462	2.1	4.8	3.89	7.4	4.2
0	**3.266**	**1.1**	**5.1**	**2.816**	**1.0**	**4.5**	**2.57**	**5.0**	**4.0**
10	1.990	0.8	4.8	1.827	0.9	4.2	1.72	2.7	3.8
20	1.249	0.1	4.5	1.216	0.2	4.0	1.19	0.5	3.6
25	**1.00**	**0.0**	**4.4**	**1.00**	**0.0**	**3.8**	**1.00**	**0.0**	**3.5**
30	0.8055	0.2	4.3	0.8276	0.4	3.7	0.841	1.4	3.4
37	0.6015	0.6	4.1	0.6406	0.8	-	0.666	-	-
40	0.5325	0.7	4.0	0.5758	0.9	3.5	0.604	3.2	3.2
50	0.3602	1.1	3.9	0.4086	1.5	3.3	0.442	5.0	3.1
60	0.2488	1.3	3.6	0.2954	1.9	3.2	0.328	6.7	2.9
70	**0.1753**	**1.8**	**3.4**	**0.2172**	**2.4**	**3.0**	**0.248**	**8.2**	**2.8**
80	0.1257	2.1	3.2	0.1622	2.7	2.8	0.189	9.8	2.6
90	0.09174	2.3	3.1	0.1229	3.2	2.7	0.147	11.2	2.5
100	0.06798	2.6	2.9	0.09446	3.6	2.6	0.1148	12.6	-
110	0.05110	2.7	2.8	0.07350	4.0	2.4	0.09123	14.5	-
120	0.03894	3.2	2.7	0.05788	4.4	2.3	0.07326	16.0	-
125	0.03416	3.3	2.6	0.05158	-	2.3	0.06589	16.7	-
130	0.03005	3.4	2.5	0.04609	4.7	2.2	0.05940	17.5	-
140	0.02347	3.7	2.4	0.03708	5.0	2.1	0.04862	19.4	-
150	0.01853	4.0	2.3	0.03012	-	-	0.04014	20.9	-
155	0.01653	-	2.3	-	-	-	-	-	-
160	0.01478	-	2.2	-	-	-	-	-	-

TEMP °C	CURVE 4			CURVE 7			CURVE 8		
	RATIO	MT ± %	NTC	RATIO	MT ± %	NTC	RATIO	MT ± %	NTC
- 60	-	-	-	185.100	-	-	-	-	-
- 55	120.615	6.5	7.9	126.433	6.0	7.6	79.674	3.9	7.0
- 50	82.767	6.1	7.4	87.123	5.0	7.3	56.614	3.5	6.7
- 40	40.447	5.3	6.9	42.765	4.2	6.9	29.535	3.0	6.3
- 30	20.690	4.3	6.5	21.873	2.9	6.5	16.042	2.4	5.9
- 20	11.034	3.5	6.1	11.618	2.7	6.2	9.040	1.9	5.6
- 10	6.113	2.6	5.7	6.390	2.1	5.8	5.269	1.4	5.2
0	**3.507**	**1.8**	**5.4**	**3.629**	**1.4**	**5.5**	**3.167**	**1.0**	**4.9**
10	2.078	1.0	5.1	2.123	0.9	5.2	1.958	0.5	4.7
20	1.267	0.2	4.8	1.277	0.2	5.0	1.243	0.1	4.4
25	**1.00**	**0.0**	**4.7**	**1.00**	**0.0**	**4.8**	**1.00**	**0.0**	**4.3**
30	0.7942	0.4	4.6	0.7880	0.4	4.7	0.8090	0.2	4.0
37	0.5814	1.0	4.4	0.5702	0.8	4.5	0.6070	-	-
40	0.5105	1.1	4.3	0.4981	0.9	4.5	0.5383	0.6	3.7
50	0.3359	1.8	4.1	0.3219	1.5	4.3	0.3657	1.0	3.6
60	0.2259	2.4	3.9	0.2124	1.9	4.1	0.2533	1.2	3.4
70	**0.1550**	**2.9**	**3.7**	**0.1429**	**2.4**	**3.9**	**0.1786**	**1.6**	**3.2**
80	0.1084	3.4	3.5	0.09790	2.7	3.7	0.1281	1.9	3.1
90	0.0771	3.9	3.3	0.06823	3.2	3.5	0.0933	2.1	2.9
100	0.0557	4.4	3.2	0.04832	3.6	3.4	0.06897	2.4	2.8
110	0.0408	4.9	3.0	0.03474	4.0	3.2	0.05167	2.6	2.7
120	0.0303	5.3	2.9	0.02533	4.4	3.1	0.03920	2.9	2.7
125	0.0263	5.5	2.9	0.02174	4.5	3.0	0.03430	3.0	2.6
130	0.0228	5.7	2.8	0.01872	4.7	3.0	0.03010	3.1	2.5
140	0.0173	6.0	2.7	0.01401	5.0	2.8	0.02337	3.4	2.4
150	0.0133	6.4	2.6	0.01601	5.5	2.7	0.01834	3.5	2.3

RESISTANCE VS TEMPERATURE CONVERSION TABLES

TEMP °C	CURVE 9			CURVE 12			CURVE 13		
	RATIO	MT ± %	NTC	RATIO	MT ± %	NTC	RATIO	MT ± %	NTC
- 60	-	-	-	265.0	-	-	824.0	-	-
- 55	60.751	3.95	-	176.4	-	8.0	503.0	-	9.7
- 50	44.102	3.90	6.31	119.0	-	7.8	312.0	-	9.4
- 40	23.960	3.30	5.91	55.98	-	7.3	125.0	-	8.9
- 30	13.516	2.65	5.5	27.45	-	6.9	53.0	-	8.4
- 20	7.891	2.10	5.22	13.98	13.7	6.6	23.43	-	7.9
- 10	4.755	1.50	4.92	7.375	11.7	6.2	10.87	-	7.5
0	**2.949**	**1.10**	**4.60**	**4.018**	**9.9**	**5.9**	**5.25**	**13.2**	**7.1**
10	1.879	0.6	4.4	2.256	8.2	5.6	2.635	10.9	6.7
20	1.226	0.1	4.2	1.303	6.6	5.4	1.370	8.7	6.4
25	**1.00**	**0.0**	**4.0**	**1.00**	**5.9**	**5.2**	**1.00**	**-**	**6.2**
30	0.8194	0.2	3.9	0.7723	5.2	5.1	0.7358	6.8	6.1
37	0.6558	0.6	3.8	0.5435	-	4.9	0.4850	-	5.9
40	0.5592	0.7	3.7	0.4690	3.7	4.9	0.4075	4.9	5.8
50	0.3893	1.1	3.5	0.2914	2.4	4.6	0.2322	3.2	5.5
60	0.2760	1.3	3.4	0.1849	1.1	4.4	0.1358	1.5	5.2
70	**0.1990**	**1.8**	**3.2**	**0.1198**	**0.0**	**4.2**	**0.08146**	**0.0**	**5.0**
80	0.1458	2.1	3.1	0.07902	1.0	4.1	0.05000	1.4	4.8
90	0.1084	2.3	2.9	0.05307	2.1	3.9	0.03137	2.8	4.6
100	0.08168	2.6	2.8	0.03624	3.1	3.7	0.02009	4.1	4.4
110	0.06235	2.7	2.6	0.02514	4.0	3.6	0.01311	5.2	4.2
120	0.04818	3.2	2.5	0.01770	4.9	3.4	0.008715	6.4	4.0
125	0.04253	3.3	-	0.01493	5.3	3.4	0.007151	7.0	3.9
130	0.03764	3.4	2.4	0.01264	5.8	3.3	0.005892	7.6	3.8
140	0.02972	3.7	2.3	0.00915	6.6	3.2	0.004048	8.6	3.7
150	0.02370	-	-	0.00670	7.3	3.0	0.002824	9.6	3.5

TEMP °C	CURVE 14			CURVE 17		
	RATIO	MT ± %	NTC	RATIO	MT ± %	NTC
- 60	43.0	-	-	-	-	-
- 55	31.9	-	-	-	-	-
- 50	24.3	18.5	5.6	72.50	5.6	7.5
- 40	14.4	15.4	4.9	36.09	4.8	6.9
- 30	8.93	12.5	4.5	18.82	4.2	6.4
- 20	5.69	9.9	4.4	10.23	3.6	6.0
- 10	3.68	7.4	4.3	5.767	2.9	5.7
0	**2.45**	**5.0**	**3.9**	**3.363**	**2.2**	**5.3**
10	1.68	2.7	3.6	2.024	1.7	5.0
20	1.18	0.5	3.4	1.256	1.4	4.7
25	**1.00**	**0.0**	**3.1**	**1.00**	**0.0**	**4.5**
30	0.854	1.4	3.0	0.8013	1.3	4.4
37	0.689	-	-	0.5973	1.7	4.3
40	0.628	3.2	2.9	0.5241	1.9	4.2
50	0.464	5.0	2.8	0.3507	2.4	4.0
60	0.350	6.7	2.7	0.2400	2.5	3.7
70	**0.267**	**8.2**	**2.6**	**0.1677**	**2.6**	**3.5**
80	0.208	9.8	2.5	0.1194	2.7	3.4
90	0.163	11.2	2.4	0.08652	2.8	3.2
100	0.130	12.6	2.3	0.06370	2.9	3.0
110	0.105	-	-	0.04761	3.0	2.8
120	0.085	-	-	0.03610	3.1	2.72
125	0.077	-	-	0.03160	3.2	2.64
130	0.070	-	-	0.02774	3.3	2.58
140	0.058	-	-	0.02158	3.5	2.46
150	0.048	-	-	0.01698	3.6	2.37

NOTE: For 1 °C ratio tables, see pages 11 to 16

NTC Thermistors, Resistance/Temperature Conversion

CURVE 1 R/T CONVERSION TABLE Rt/R_{25}

TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}
- 60	141.18	- 4	4.017	52	0.3340	108	0.05404
- 59	130.76	- 3	3.813	53	0.3217	109	0.05255
- 58	121.18	- 2	3.620	54	0.3099	110	0.05110
- 57	112.36	- 1	3.438	55	0.2987	111	0.04970
- 56	104.24	0	3.266	56	0.2878	112	0.04835
- 55	96.811	1	3.104	57	0.2775	113	0.04704
- 54	89.914	2	2.951	58	0.2675	114	0.04577
- 53	83.554	3	2.806	59	0.2580	115	0.04454
- 52	77.685	4	2.669	60	0.2488	116	0.04335
- 51	72.266	5	2.540	61	0.2401	117	0.04219
- 50	67.260	6	2.418	62	0.2317	118	0.04108
- 49	62.634	7	2.302	63	0.2236	119	0.03999
- 48	58.355	8	2.192	64	0.2158	120	0.03894
- 47	54.396	9	2.089	65	0.2084	121	0.03793
- 46	50.732	10	1.990	66	0.2012	122	0.03694
- 45	47.337	11	1.897	67	0.1944	123	0.03598
- 44	44.191	12	1.809	68	0.1878	124	0.03506
- 43	41.275	13	1.726	69	0.1814	125	0.03416
- 42	38.569	14	1.647	70	0.1753	126	0.03329
- 41	36.058	15	1.571	71	0.1695	127	0.03244
- 40	33.727	16	1.500	72	0.1638	128	0.03162
- 39	31.560	17	1.432	73	0.1584	129	0.03083
- 38	29.547	18	1.368	74	0.1532	130	0.03005
- 37	27.675	19	1.307	75	0.1482	131	0.02930
- 36	25.933	20	1.249	76	0.1433	132	0.02858
- 35	24.312	21	1.194	77	0.1387	133	0.02787
- 34	22.802	22	1.142	78	0.1342	134	0.02718
- 33	21.395	23	1.092	79	0.1299	135	0.02652
- 32	20.084	24	1.045	80	0.1257	136	0.02587
- 31	18.861	25	1.000	81	0.1218	137	0.02524
- 30	17.721	26	0.9572	82	0.1179	138	0.02464
- 29	16.656	27	0.9165	83	0.1142	139	0.02404
- 28	15.662	28	0.8777	84	0.1106	140	0.02347
- 27	14.733	29	0.8408	85	0.1072	141	0.02291
- 26	13.866	30	0.8055	86	0.1039	142	0.02236
- 25	13.054	31	0.7721	87	0.1007	143	0.02184
- 24	12.295	32	0.7402	88	0.09759	144	0.02132
- 23	11.585	33	0.7098	89	0.09461	145	0.02082
- 22	10.920	34	0.6808	90	0.09174	146	0.02034
- 21	10.298	35	0.6531	91	0.08897	147	0.01987
- 20	9.714	36	0.6267	92	0.08630	148	0.01941
- 19	9.167	37	0.6015	93	0.08372	149	0.01896
- 18	8.655	38	0.5774	94	0.08123	150	0.01853
- 17	8.174	39	0.5545	95	0.07882	151	0.01810
- 16	7.722	40	0.5325	96	0.07650	152	0.01770
- 15	7.299	41	0.5116	97	0.07426	153	0.01730
- 14	6.901	42	0.4916	98	0.07209	154	0.01691
- 13	6.527	43	0.4725	99	0.07000	155	0.01653
- 12	6.176	44	0.4543	100	0.06798	156	0.01616
- 11	5.845	45	0.4368	101	0.06602	157	0.01580
- 10	5.535	46	0.4201	102	0.06413	158	0.01545
- 9	5.242	47	0.4041	103	0.06231	159	0.01511
- 8	4.967	48	0.3888	104	0.06054	160	0.01478
- 7	4.708	49	0.3742	105	0.05884		
- 6	4.464	50	0.3602	106	0.05719		
- 5	4.234	51	0.3468	107	0.05559		

CURVE 2 R/T CONVERSION TABLE Rt/R_{25}

TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}
- 55	53.474	1	2.692	57	0.3250	113	0.0683
- 54	50.167	2	2.576	58	0.3147	114	0.0667
- 53	47.086	3	2.465	59	0.3049	115	0.0651
- 52	44.214	4	2.360	60	0.2954	116	0.0636
- 51	41.535	5	2.260	61	0.2862	117	0.0621
- 50	39.035	6	2.164	62	0.2774	118	0.0607
- 49	36.701	7	2.074	63	0.2689	119	0.0593
- 48	34.522	8	1.987	64	0.2607	120	0.0579
- 47	32.486	9	1.905	65	0.2528	121	0.0566
- 46	30.583	10	1.827	66	0.2451	122	0.0553
- 45	28.803	11	1.751	67	0.2378	123	0.0540
- 44	27.138	12	1.680	68	0.2306	124	0.0528
- 43	25.580	13	1.612	69	0.2238	125	0.0516
- 42	24.120	14	1.547	70	0.2172	126	0.0504
- 41	22.754	15	1.485	71	0.2108	127	0.0493
- 40	21.473	16	1.426	72	0.2046	128	0.0482
- 39	20.272	17	1.370	73	0.1986	129	0.0471
- 38	19.145	18	1.316	74	0.1929	130	0.0461
- 37	18.089	19	1.264	75	0.1873	131	0.0451
- 36	17.097	20	1.216	76	0.1820	132	0.0441
- 35	16.165	21	1.168	77	0.1768	133	0.0431
- 34	15.290	22	1.123	78	0.1717	134	0.0422
- 33	14.468	23	1.080	79	0.1669	135	0.0413
- 32	13.695	24	1.039	80	0.1622	136	0.0404
- 31	12.968	25	1.000	81	0.1577	137	0.0395
- 30	12.284	26	0.9624	82	0.1533	138	0.0387
- 29	11.640	27	0.9265	83	0.1490	139	0.0379
- 28	11.034	28	0.8921	84	0.1449	140	0.0371
- 27	10.463	29	0.8591	85	0.1410	141	0.0363
- 26	9.925	30	0.8276	86	0.1371	142	0.0355
- 25	9.418	31	0.7973	87	0.1334	143	0.0348
- 24	8.940	32	0.7684	88	0.1298	144	0.0341
- 23	8.489	33	0.7406	89	0.1263	145	0.0334
- 22	8.064	34	0.7140	90	0.1229	146	0.0327
- 21	7.662	35	0.6885	91	0.1197	147	0.0320
- 20	7.283	36	0.6641	92	0.1165	148	0.0314
- 19	6.925	37	0.6406	93	0.1134	149	0.0307
- 18	6.587	38	0.6181	94	0.1105	150	0.0301
- 17	6.267	39	0.5965	95	0.1076		
- 16	5.960	40	0.5758	96	0.1048		
- 15	5.678	41	0.5559	97	0.1021		
- 14	5.408	42	0.5368	98	0.0995		
- 13	5.151	43	0.5185	99	0.0969		
- 12	4.909	44	0.5008	100	0.0945		
- 11	4.679	45	0.4839	101	0.0921		
- 10	4.462	46	0.4676	102	0.0898		
- 9	4.255	47	0.4520	103	0.0875		
- 8	4.060	48	0.4370	104	0.0853		
- 7	3.875	49	0.4225	105	0.0832		
- 6	3.699	50	0.4086	106	0.0811		
- 5	3.532	51	0.3953	107	0.0792		
- 4	3.374	52	0.3824	108	0.0772		
- 3	3.223	53	0.3700	109	0.0753		
- 2	3.081	54	0.3581	110	0.0735		
- 1	2.945	55	0.3467	111	0.0717		
0	2.816	56	0.3356	112	0.0700		

CURVE 3 R/T CONVERSION TABLE Rt/R_{25}

TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}
- 60	49.1	1	2.47	62	0.310	123	0.0687
- 59	46.3	2	2.37	63	0.301	124	0.0673
- 58	43.6	3	2.28	64	0.293	125	0.0659
- 57	41.1	4	2.19	65	0.285	126	0.0645
- 56	38.8	5	2.10	66	0.277	127	0.0632
- 55	36.6	6	2.02	67	0.269	128	0.0619
- 54	34.5	7	1.94	68	0.262	129	0.0606
- 53	32.6	8	1.87	69	0.255	130	0.0594
- 52	30.8	9	1.80	70	0.248	131	0.0582
- 51	29.1	10	1.72	71	0.241	132	0.0570
- 50	27.5	11	1.67	72	0.234	133	0.0559
- 49	26.1	12	1.60	73	0.228	134	0.0548
- 48	24.7	13	1.55	74	0.222	135	0.0537
- 47	23.3	14	1.49	75	0.216	136	0.0526
- 46	22.1	15	1.43	76	0.211	137	0.0516
- 45	20.9	16	1.38	77	0.205	138	0.0506
- 44	19.8	17	1.33	78	0.200	139	0.0496
- 43	18.8	18	1.28	79	0.195	140	0.0486
- 42	17.8	19	1.24	80	0.189	141	0.0477
- 41	16.9	20	1.19	81	0.185	142	0.0468
- 40	16.1	21	1.15	82	0.180	143	0.0459
- 39	15.2	22	1.11	83	0.175	144	0.0450
- 38	14.5	23	1.07	84	0.171	145	0.0441
- 37	13.8	24	1.04	85	0.167	146	0.0433
- 36	13.1	25	1.00	86	0.162	147	0.0425
- 35	12.4	26	0.966	87	0.158	148	0.0417
- 34	11.8	27	0.933	88	0.154	149	0.0409
- 33	11.2	28	0.901	89	0.151	150	0.0401
- 32	10.7	29	0.870	90	0.147		
- 31	10.2	30	0.841	91	0.143		
- 30	9.70	31	0.813	92	0.140		
- 29	9.24	32	0.786	93	0.136		
- 28	8.81	33	0.760	94	0.133		
- 27	8.40	34	0.735	95	0.130		
- 26	8.01	35	0.711	96	0.127		
- 25	7.64	36	0.688	97	0.124		
- 24	7.28	37	0.666	98	0.121		
- 23	6.95	38	0.645	99	0.1180		
- 22	6.64	39	0.624	100	0.1148		
- 21	6.34	40	0.604	101	0.1121		
- 20	6.05	41	0.585	102	0.1095		
- 19	5.79	42	0.567	103	0.1070		
- 18	5.53	43	0.549	104	0.1046		
- 17	5.29	44	0.532	105	0.1022		
- 16	5.06	45	0.515	106	0.0999		
- 15	4.84	46	0.500	107	0.0976		
- 14	4.63	47	0.484	108	0.0954		
- 13	4.43	48	0.470	109	0.0933		
- 12	4.24	49	0.455	110	0.0912		
- 11	4.06	50	0.442	111	0.0892		
- 10	3.89	51	0.428	112	0.0872		
- 9	3.73	52	0.416	113	0.0853		
- 8	3.57	53	0.403	114	0.0835		
- 7	3.43	54	0.391	115	0.0816		
- 6	3.29	55	0.380	116	0.0799		
- 5	3.15	56	0.369	117	0.0782		
- 4	3.02	57	0.358	118	0.0765		
- 3	2.90	58	0.348	119	0.0748		
- 2	2.79	59	0.338	120	0.0733		
- 1	2.67	60	0.328	121	0.0717		
0	2.57	61	0.319	122	0.0702		

CURVE 4 R/T CONVERSION TABLE Rt/R_{25}

TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}
- 55	120.615	6	2.55	67	0.1732	128	0.0241
- 54	111.749	7	2.43	68	0.1669	129	0.0235
- 53	103.588	8	2.30	69	0.1608	130	0.0228
- 52	96.074	9	2.19	70	0.1550	131	0.0222
- 51	89.150	10	2.078	71	0.1495	132	0.0216
- 50	82.767	11	1.976	72	0.1441	133	0.0210
- 49	76.880	12	1.878	73	0.1390	134	0.0204
- 48	71.447	13	1.787	74	0.1341	135	0.0199
- 47	66.431	14	1.700	75	0.1293	136	0.0193
- 46	61.797	15	1.617	76	0.1248	137	0.0188
- 45	57.514	16	1.540	77	0.1204	138	0.0183
- 44	53.554	17	1.466	78	0.1163	139	0.0178
- 43	49.890	18	1.396	79	0.1122	140	0.0173
- 42	46.498	19	1.330	80	0.1084	141	0.0169
- 41	43.357	20	1.267	81	0.1047	142	0.0164
- 40	40.447	21	1.208	82	0.1011	143	0.0160
- 39	37.750	22	1.152	83	0.0977	144	0.0156
- 38	35.248	23	1.099	84	0.0944	145	0.0152
- 37	32.927	24	1.048	85	0.0912	146	0.0148
- 36	30.772	25	1.000	86	0.0882	147	0.0144
- 35	28.771	26	0.9545	87	0.0852	148	0.0140
- 34	26.912	27	0.9113	88	0.0824	149	0.0137
- 33	25.184	28	0.8702	89	0.0797	150	0.0133
- 32	23.577	29	0.8313	90	0.0771		
- 31	22.082	30	0.7942	91	0.0746		
- 30	20.690	31	0.7590	92	0.0721		
- 29	19.394	32	0.7256	93	0.0698		
- 28	18.187	33	0.6938	94	0.0676		
- 27	17.062	34	0.6636	95	0.0654		
- 26	16.013	35	0.6348	96	0.0633		
- 25	15.035	36	0.6074	97	0.0613		
- 24	14.121	37	0.5814	98	0.0594		
- 23	13.269	38	0.5566	99	0.0575		
- 22	12.473	39	0.5330	100	0.0557		
- 21	11.729	40	0.5105	101	0.0540		
- 20	11.034	41	0.4891	102	0.0523		
- 19	10.384	42	0.4686	103	0.0507		
- 18	9.776	43	0.4492	104	0.0491		
- 17	9.207	44	0.4306	105	0.0476		
- 16	8.680	45	0.4129	106	0.0462		
- 15	8.175	46	0.3961	107	0.0448		
- 14	7.708	47	0.3800	108	0.0434		
- 13	7.270	48	0.3646	109	0.0421		
- 12	6.859	49	0.3499	110	0.0408		
- 11	6.474	50	0.3359	111	0.0396		
- 10	6.113	51	0.3225	112	0.0384		
- 9	5.773	52	0.3098	113	0.0373		
- 8	5.455	53	0.2976	114	0.0362		
- 7	5.156	54	0.2859	115	0.0351		
- 6	4.875	55	0.2748	116	0.0341		
- 5	4.610	56	0.2641	117	0.0331		
- 4	4.362	57	0.2539	118	0.0322		
- 3	4.128	58	0.2442	119	0.0312		
- 2	3.908	59	0.2348	120	0.0303		
- 1	3.701	60	0.2259	121	0.0295		
0	3.507	61	0.2174	122	0.0286		
1	3.33	62	0.2092	123	0.0278		
2	3.15	63	0.2014	124	0.0270		
3	2.99	64	0.1939	125	0.0263		
4	2.84	65	0.1867	126	0.0255		
5	2.69	66	0.1798	127	0.0248		

CURVE 7 R/T CONVERSION TABLE Rt/R_{25}

TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}
- 60	185.1	1	3.434	62	0.1959	123	0.02311
- 59	171.3	2	3.251	63	0.1882	124	0.02241
- 58	158.5	3	3.079	64	0.1808	125	0.02174
- 57	146.8	4	2.918	65	0.1738	126	0.02110
- 56	136.0	5	2.765	66	0.1671	127	0.02047
- 55	126.433	6	2.621	67	0.1606	128	0.01987
- 54	117.250	7	2.485	68	0.1544	129	0.01929
- 53	108.785	8	2.357	69	0.1485	130	0.01872
- 52	100.978	9	2.237	70	0.1429	131	0.01818
- 51	93.774	10	2.123	71	0.1375	132	0.01765
- 50	87.123	11	2.015	72	0.1323	133	0.01714
- 49	80.980	12	1.913	73	0.1273	134	0.01665
- 48	75.304	13	1.817	74	0.1226	135	0.01617
- 47	70.057	14	1.727	75	0.1180	136	0.01571
- 46	65.203	15	1.641	76	0.1136	137	0.01526
- 45	60.713	16	1.560	77	0.1095	138	0.01483
- 44	56.555	17	1.483	78	0.1054	139	0.01442
- 43	52.705	18	1.411	79	0.1016	140	0.01401
- 42	49.138	19	1.342	80	0.0979	141	0.01362
- 41	45.831	20	1.277	81	0.09436	142	0.01324
- 40	42.765	21	1.215	82	0.09096	143	0.01287
- 39	39.920	22	1.157	83	0.08770	144	0.01252
- 38	37.280	23	1.102	84	0.08457	145	0.01218
- 37	34.828	24	1.050	85	0.08156	146	0.01184
- 36	32.551	25	1.000	86	0.07868	147	0.01152
- 35	30.434	26	0.9530	87	0.07591	148	0.01121
- 34	28.467	27	0.9084	88	0.07325	149	0.01090
- 33	26.637	28	0.8662	89	0.07069	150	0.01061
- 32	24.934	29	0.8261	90	0.06823		
- 31	23.349	30	0.7880	91	0.06587		
- 30	21.873	31	0.7519	92	0.06360		
- 29	20.498	32	0.7176	93	0.06142		
- 28	19.217	33	0.6850	94	0.05933		
- 27	18.023	34	0.6541	95	0.05731		
- 26	16.909	35	0.6247	96	0.05537		
- 25	15.869	36	0.5967	97	0.05351		
- 24	14.899	37	0.5702	98	0.05171		
- 23	13.994	38	0.5449	99	0.04998		
- 22	13.148	39	0.5209	100	0.04832		
- 21	12.357	40	0.4981	101	0.04672		
- 20	11.618	41	0.4763	102	0.04518		
- 19	10.927	42	0.4556	103	0.04370		
- 18	10.281	43	0.4359	104	0.04227		
- 17	9.676	44	0.4172	105	0.04090		
- 16	9.103	45	0.3993	106	0.03957		
- 15	8.580	46	0.3823	107	0.03830		
- 14	8.084	47	0.3661	108	0.03707		
- 13	7.618	48	0.3506	109	0.03588		
- 12	7.182	49	0.3359	110	0.03474		
- 11	6.773	50	0.3219	111	0.03364		
- 10	6.390	51	0.3085	112	0.03258		
- 9	6.030	52	0.2957	113	0.03156		
- 8	5.692	53	0.2835	114	0.03057		
- 7	5.375	54	0.2719	115	0.02962		
- 6	5.077	55	0.2608	116	0.02870		
- 5	4.797	56	0.2502	117	0.02781		
- 4	4.534	57	0.2401	118	0.02696		
- 3	4.286	58	0.2304	119	0.02613		
- 2	4.054	59	0.2212	120	0.02533		
- 1	3.835	60	0.2124	121	0.02457		
0	3.629	61	0.2040	122	0.02382		

CURVE 8 R/T CONVERSION TABLE Rt/R_{25}

TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}
- 55	79.674	6	2.365	67	0.1980	128	0.03170
- 54	74.343	7	2.255	68	0.1913	129	0.03089
- 53	69.401	8	2.151	69	0.1848	130	0.03010
- 52	64.817	9	2.052	70	0.1786	131	0.02933
- 51	60.563	10	1.958	71	0.1727	132	0.02859
- 50	56.614	11	1.869	72	0.1669	133	0.02787
- 49	52.945	12	1.785	73	0.1614	134	0.02717
- 48	49.536	13	1.704	74	0.1561	135	0.02649
- 47	46.367	14	1.628	75	0.1510	136	0.02583
- 46	43.419	15	1.556	76	0.1460	137	0.02519
- 45	40.676	16	1.487	77	0.1413	138	0.02456
- 44	38.122	17	1.421	78	0.1367	139	0.02396
- 43	35.744	18	1.359	79	0.1323	140	0.02337
- 42	33.527	19	1.300	80	0.1281	141	0.02280
- 41	31.462	20	1.243	81	0.1240	142	0.02225
- 40	29.535	21	1.190	82	0.1201	143	0.02171
- 39	27.737	22	1.139	83	0.1163	144	0.02119
- 38	26.060	23	1.090	84	0.1126	145	0.02068
- 37	24.493	24	1.044	85	0.1091	146	0.02018
- 36	23.030	25	1.000	86	0.1057	147	0.01970
- 35	21.663	26	0.9580	87	0.1024	148	0.01924
- 34	20.384	27	0.9180	88	0.09930	149	0.01878
- 33	19.188	28	0.8800	89	0.09623	150	0.01834
- 32	18.070	29	0.8437	90	0.09330		
- 31	17.023	30	0.8090	91	0.09047		
- 30	16.042	31	0.7760	92	0.08773		
- 29	15.124	32	0.7443	93	0.08507		
- 28	14.263	33	0.7143	94	0.08253		
- 27	13.456	34	0.6857	95	0.08007		
- 26	12.699	35	0.6580	96	0.07770		
- 25	11.990	36	0.6320	97	0.07540		
- 24	11.323	37	0.6070	98	0.07317		
- 23	10.698	38	0.5830	99	0.07103		
- 22	10.111	39	0.5600	100	0.06897		
- 21	9.559	40	0.5383	101	0.06697		
- 20	9.040	41	0.5173	102	0.06500		
- 19	8.552	42	0.4973	103	0.06313		
- 18	8.094	43	0.4783	104	0.06133		
- 17	7.662	44	0.4600	105	0.05960		
- 16	7.254	45	0.4427	106	0.05790		
- 15	6.874	46	0.4257	107	0.05627		
- 14	6.514	47	0.4097	108	0.05467		
- 13	6.174	48	0.3943	109	0.05313		
- 12	5.855	49	0.3797	110	0.05167		
- 11	5.553	50	0.3657	111	0.05023		
- 10	5.269	51	0.3523	112	0.04883		
- 9	5.001	52	0.3393	113	0.04750		
- 8	4.748	53	0.3269	114	0.04620		
- 7	4.509	54	0.3150	115	0.04493		
- 6	4.283	55	0.3036	116	0.04370		
- 5	4.070	56	0.2927	117	0.04253		
- 4	3.869	57	0.2822	118	0.04137		
- 3	3.678	58	0.2722	119	0.04027		
- 2	3.498	59	0.2625	120	0.03920		
- 1	3.328	60	0.2533	121	0.03817		
0	3.167	61	0.2444	122	0.03713		
1	3.014	62	0.2359	123	0.03617		
2	2.870	63	0.2277	124	0.03523		
3	2.733	64	0.2198	125	0.03430		
4	2.604	65	0.2122	126	0.03340		
5	2.481	66	0.2050	127	0.03254		

CURVE 9 R/T CONVERSION TABLE Rt/R_{25}

TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}
- 55	60.751	6	2.243	67	0.2191	128	0.03951
- 54	56.933	7	2.145	68	0.2122	129	0.03856
- 53	53.379	8	2.052	69	0.2055	130	0.03764
- 52	50.067	9	1.963	70	0.1990	131	0.03674
- 51	46.980	10	1.879	71	0.1928	132	0.03587
- 50	44.102	11	1.798	72	0.1868	133	0.03503
- 49	41.418	12	1.722	73	0.1810	134	0.03420
- 48	38.913	13	1.649	74	0.1754	135	0.03340
- 47	36.574	14	1.579	75	0.1700	136	0.03263
- 46	34.389	15	1.513	76	0.1648	137	0.03187
- 45	32.348	16	1.450	77	0.1598	138	0.03113
- 44	30.440	17	1.390	78	0.1549	139	0.03042
- 43	28.655	18	1.333	79	0.1503	140	0.02972
- 42	26.986	19	1.279	80	0.1458	141	0.02904
- 41	25.423	20	1.226	81	0.1414	142	0.02838
- 40	23.960	21	1.177	82	0.1372	143	0.02774
- 39	22.590	22	1.129	83	0.1332	144	0.02712
- 38	21.306	23	1.084	84	0.1293	145	0.02651
- 37	20.103	24	1.041	85	0.1255	146	0.02592
- 36	18.974	25	1.000	86	0.1218	147	0.02534
- 35	17.915	26	0.9605	87	0.1183	148	0.02478
- 34	16.921	27	0.9227	88	0.1149	149	0.02423
- 33	15.989	28	0.8867	89	0.1116	150	0.02370
- 32	15.113	29	0.8523	90	0.1084		
- 31	14.289	30	0.8194	91	0.1053		
- 30	13.516	31	0.7880	92	0.1023		
- 29	12.789	32	0.7579	93	0.09942		
- 28	12.105	33	0.7291	94	0.09663		
- 27	11.461	34	0.7016	95	0.09393		
- 26	10.855	35	0.6752	96	0.09132		
- 25	10.285	36	0.6500	97	0.08879		
- 24	9.748	37	0.6258	98	0.08634		
- 23	9.242	38	0.6026	99	0.08397		
- 22	8.765	39	0.5805	100	0.08168		
- 21	8.315	40	0.5592	101	0.07946		
- 20	7.891	41	0.5389	102	0.07731		
- 19	7.491	42	0.5193	103	0.07523		
- 18	7.113	43	0.5006	104	0.07321		
- 17	6.757	44	0.4827	105	0.07126		
- 16	6.420	45	0.4655	106	0.06936		
- 15	6.102	46	0.4489	107	0.06753		
- 14	5.802	47	0.4331	108	0.06575		
- 13	5.518	48	0.4179	109	0.06403		
- 12	5.249	49	0.4033	110	0.06235		
- 11	4.995	50	0.3893	111	0.06073		
- 10	4.755	51	0.3758	112	0.05916		
- 9	4.527	52	0.3629	113	0.05764		
- 8	4.312	53	0.3504	114	0.05616		
- 7	4.108	54	0.3385	115	0.05473		
- 6	3.915	55	0.3270	116	0.05334		
- 5	3.732	56	0.3160	117	0.05199		
- 4	3.558	57	0.3054	118	0.05068		
- 3	3.394	58	0.2952	119	0.04941		
- 2	3.238	59	0.2854	120	0.04818		
- 1	3.090	60	0.2760	121	0.04698		
0	2.949	61	0.2669	122	0.04582		
1	2.815	62	0.2582	123	0.04469		
2	2.689	63	0.2497	124	0.04359		
3	2.569	64	0.2417	125	0.04253		
4	2.455	65	0.2339	126	0.04149		
5	2.346	66	0.2264	127	0.04049		

CURVE 12 R/T CONVERSION TABLE Rt/R_{25}

TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}
- 60	265.0	1	3.788	62	0.1693	123	0.01598
- 59	244.0	2	3.572	63	0.1620	124	0.01544
- 58	225.0	3	3.369	64	0.1551	125	0.01493
- 57	207.0	4	3.179	65	0.1485	126	0.01444
- 56	191.0	5	3.000	66	0.1422	127	0.01396
- 55	176.4	6	2.833	67	0.1362	128	0.01351
- 54	162.9	7	2.675	68	0.1304	129	0.01306
- 53	150.5	8	2.527	69	0.1250	130	0.01264
- 52	139.1	9	2.387	70	0.1198	131	0.01223
- 51	128.6	10	2.256	71	0.1148	132	0.01183
- 50	119.0	11	2.133	72	0.1100	133	0.01145
- 49	110.1	12	2.017	73	0.1055	134	0.01109
- 48	102.0	13	1.908	74	0.1012	135	0.01073
- 47	94.46	14	1.806	75	0.09706	136	0.01039
- 46	87.54	15	1.709	76	0.09311	137	0.01006
- 45	81.17	16	1.618	77	0.08935	138	0.00975
- 44	75.29	17	1.532	78	0.08575	139	0.00944
- 43	69.87	18	1.451	79	0.08231	140	0.00915
- 42	64.87	19	1.375	80	0.07902	141	0.00886
- 41	60.24	20	1.303	81	0.07588	142	0.00859
- 40	55.98	21	1.235	82	0.07287	143	0.00832
- 39	52.03	22	1.171	83	0.07000	144	0.00806
- 38	48.39	23	1.111	84	0.06725	145	0.00782
- 37	45.01	24	1.054	85	0.06462	146	0.00758
- 36	41.89	25	1.000	86	0.06210	147	0.00735
- 35	39.00	26	0.9492	87	0.05969	148	0.00712
- 34	36.33	27	0.9011	88	0.05739	149	0.00691
- 33	33.85	28	0.8558	89	0.05518	150	0.00670
- 32	31.55	29	0.8129	90	0.05307	151	0.00650
- 31	29.42	30	0.7723	91	0.05105		
- 30	27.45	31	0.7339	92	0.04911		
- 29	25.61	32	0.6977	93	0.04725		
- 28	23.91	33	0.6633	94	0.04547		
- 27	22.33	34	0.6308	95	0.04377		
- 26	20.86	35	0.6001	96	0.04213		
- 25	19.50	36	0.5710	97	0.04057		
- 24	18.23	37	0.5434	98	0.03906		
- 23	17.05	38	0.5173	99	0.03762		
- 22	15.95	39	0.4925	100	0.03624		
- 21	14.93	40	0.4690	101	0.03492		
- 20	13.98	41	0.4468	102	0.03364		
- 19	13.09	42	0.4257	103	0.03242		
- 18	12.27	43	0.4057	104	0.03125		
- 17	11.50	44	0.3867	105	0.03013		
- 16	10.78	45	0.3687	106	0.02905		
- 15	10.11	46	0.3516	107	0.02801		
- 14	9.486	47	0.3354	108	0.02702		
- 13	8.903	48	0.3199	109	0.02606		
- 12	8.359	49	0.3053	110	0.02514		
- 11	7.850	50	0.2914	111	0.02426		
- 10	7.375	51	0.2782	112	0.02341		
- 9	6.930	52	0.2656	113	0.02259		
- 8	6.515	53	0.2537	114	0.02181		
- 7	6.126	54	0.2423	115	0.02106		
- 6	5.763	55	0.2316	116	0.02033		
- 5	5.423	56	0.2213	117	0.01964		
- 4	5.104	57	0.2115	118	0.01897		
- 3	4.806	58	0.2022	119	0.01832		
- 2	4.526	59	0.1934	120	0.01770		
- 1	4.264	60	0.1849	121	0.01710		
0	4.018	61	0.1769	122	0.01653		

CURVE 13 R/T CONVERSION TABLE Rt/R_{25}

TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}
- 60	824.0	1	4.892	62	0.1224	123	0.007736
- 59	745.0	2	4.560	63	0.1162	124	0.007437
- 58	675.0	3	4.253	64	0.1104	125	0.007151
- 57	612.0	4	3.967	65	0.1049	126	0.006877
- 56	554.0	5	3.702	66	0.09966	127	0.006615
- 55	503.0	6	3.456	67	0.09473	128	0.006364
- 54	457.0	7	3.228	68	0.09006	129	0.006123
- 53	415.0	8	3.016	69	0.08564	130	0.005892
- 52	377.0	9	2.818	70	0.08146	131	0.005671
- 51	343.0	10	2.635	71	0.07750	132	0.005459
- 50	312.0	11	2.464	72	0.07375	133	0.005256
- 49	284.0	12	2.305	73	0.07020	134	0.005061
- 48	259.0	13	2.158	74	0.06683	135	0.004874
- 47	236.0	14	2.020	75	0.06364	136	0.004695
- 46	215.0	15	1.892	76	0.06062	137	0.004523
- 45	196.0	16	1.772	77	0.05775	138	0.004358
- 44	179.0	17	1.661	78	0.05503	139	0.004200
- 43	163.0	18	1.557	79	0.05245	140	0.004048
- 42	149.0	19	1.460	80	0.05000	141	0.003902
- 41	137.0	20	1.370	81	0.04768	142	0.003762
- 40	125.0	21	1.285	82	0.04548	143	0.003628
- 39	114.0	22	1.207	83	0.04338	144	0.003499
- 38	105.0	23	1.133	84	0.04139	145	0.003375
- 37	96.0	24	1.064	85	0.03950	146	0.003256
- 36	88.0	25	1.000	86	0.03771	147	0.003141
- 35	81.0	26	0.9399	87	0.03600	148	0.003031
- 34	74.0	27	0.8837	88	0.03438	149	0.002925
- 33	68.0	28	0.8311	89	0.03284	150	0.002824
- 32	63.0	29	0.7819	90	0.03137		
- 31	57.0	30	0.7358	91	0.02998		
- 30	53.0	31	0.6927	92	0.02865		
- 29	49.0	32	0.6522	93	0.02739		
- 28	45.0	33	0.6144	94	0.02619		
- 27	41.0	34	0.5789	95	0.02504		
- 26	38.0	35	0.5456	96	0.02395		
- 25	35.0	36	0.5143	97	0.02291		
- 24	32.0	37	0.4850	98	0.02193		
- 23	30.0	38	0.4575	99	0.02098		
- 22	27.0	39	0.4317	100	0.02009		
- 21	25.0	40	0.4075	101	0.01923		
- 20	23.43	41	0.3847	102	0.01842		
- 19	21.65	42	0.3633	103	0.01764		
- 18	20.02	43	0.3432	104	0.01690		
- 17	18.52	44	0.3243	105	0.01619		
- 16	17.14	45	0.3065	106	0.01552		
- 15	15.87	46	0.2898	107	0.01487		
- 14	14.70	47	0.2741	108	0.01426		
- 13	13.62	48	0.2592	109	0.01367		
- 12	12.63	49	0.2453	110	0.01311		
- 11	11.71	50	0.2322	111	0.01258		
- 10	10.87	51	0.2198	112	0.01207		
- 9	10.08	52	0.2081	113	0.01158		
- 8	9.364	53	0.1971	114	0.01111		
- 7	8.699	54	0.1868	115	0.01067		
- 6	8.084	55	0.1770	116	0.01024		
- 5	7.515	56	0.1678	117	0.009833		
- 4	6.990	57	0.1591	118	0.009444		
- 3	6.503	58	0.1509	119	0.009072		
- 2	6.053	59	0.1431	120	0.008715		
- 1	5.636	60	0.1358	121	0.008374		
0	5.250	61	0.1289	122	0.008048		

CURVE 14 R/T CONVERSION TABLE Rt/R_{25}

TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}	TEMP. °C	Rt/ R_{25}
- 60	43.0	1	2.36	62	0.332	123	0.080
- 59	40.4	2	2.27	63	0.323	124	0.079
- 58	38.0	3	2.18	64	0.313	125	0.077
- 57	35.8	4	2.10	65	0.305	126	0.076
- 56	33.8	5	2.02	66	0.297	127	0.074
- 55	31.9	6	1.95	67	0.289	128	0.073
- 54	30.2	7	1.88	68	0.282	129	0.071
- 53	28.6	8	1.81	69	0.274	130	0.070
- 52	27.1	9	1.74	70	0.267	131	0.069
- 51	25.7	10	1.68	71	0.261	132	0.067
- 50	24.3	11	1.62	72	0.254	133	0.066
- 49	23.0	12	1.57	73	0.248	134	0.065
- 48	21.8	13	1.52	74	0.242	135	0.064
- 47	20.7	14	1.47	75	0.236	136	0.062
- 46	19.6	15	1.42	76	0.229	137	0.061
- 45	18.6	16	1.37	77	0.224	138	0.060
- 44	17.6	17	1.32	78	0.218	139	0.059
- 43	16.7	18	1.27	79	0.213	140	0.058
- 42	15.9	19	1.22	80	0.208	141	0.057
- 41	15.1	20	1.18	81	0.203	142	0.056
- 40	14.4	21	1.14	82	0.198	143	0.055
- 39	13.7	22	1.11	83	0.193	144	0.054
- 38	13.1	23	1.07	84	0.188	145	0.053
- 37	12.5	24	1.03	85	0.183	146	0.052
- 36	11.8	25	1.00	86	0.179	147	0.051
- 35	11.3	26	0.970	87	0.175	148	0.050
- 34	10.8	27	0.939	88	0.171	149	0.049
- 33	10.3	28	0.910	89	0.167	150	0.048
- 32	9.79	29	0.881	90	0.163		
- 31	9.32	30	0.854	91	0.159		
- 30	8.93	31	0.828	92	0.156		
- 29	8.51	32	0.802	93	0.152		
- 28	8.12	33	0.779	94	0.148		
- 27	7.78	34	0.756	95	0.145		
- 26	7.41	35	0.732	96	0.142		
- 25	7.10	36	0.710	97	0.139		
- 24	6.80	37	0.689	98	0.136		
- 23	6.49	38	0.668	99	0.133		
- 22	6.21	39	0.647	100	0.130		
- 21	5.93	40	0.628	101	0.127		
- 20	5.69	41	0.608	102	0.124		
- 19	5.43	42	0.589	103	0.122		
- 18	5.20	43	0.571	104	0.119		
- 17	4.98	44	0.554	105	0.117		
- 16	4.75	45	0.537	106	0.114		
- 15	4.56	46	0.522	107	0.112		
- 14	4.37	47	0.507	108	0.109		
- 13	4.18	48	0.492	109	0.107		
- 12	4.01	49	0.477	110	0.105		
- 11	3.84	50	0.464	111	0.103		
- 10	3.68	51	0.452	112	0.101		
- 9	3.52	52	0.438	113	0.098		
- 8	3.39	53	0.426	114	0.096		
- 7	3.25	54	0.414	115	0.094		
- 6	3.12	55	0.403	116	0.092		
- 5	2.99	56	0.393	117	0.091		
- 4	2.87	57	0.382	118	0.089		
- 3	2.76	58	0.372	119	0.087		
- 2	2.65	59	0.361	120	0.085		
- 1	2.55	60	0.350	121	0.084		
0	2.45	61	0.342	122	0.082		

CURVE 17 R/T CONVERSION TABLE Rt/R_{25}

TEMP. °C	Rt/R_{25}	TEMP. °C	Rt/R_{25}	TEMP. °C	Rt/R_{25}	TEMP. °C	Rt/R_{25}	TEMP. °C	Rt/R_{25}	TEMP. °C	Rt/R_{25}	TEMP. °C	Rt/R_{25}	TEMP. °C	Rt/R_{25}
- 50	72.50	- 24	13.09	2	3.057	28	0.8808	54	0.3017	80	0.1194	106	0.05350	132	0.02642
- 49	68.17	- 23	12.37	3	2.905	29	0.8410	55	0.2894	81	0.1158	107	0.05203	133	0.02575
- 48	63.84	- 22	11.66	4	2.752	30	0.8013	56	0.2794	82	0.1122	108	0.05055	134	0.02509
- 47	59.50	- 21	10.94	5	2.599	31	0.7703	57	0.2696	83	0.1086	109	0.04908	135	0.02443
- 46	55.17	- 20	10.23	6	2.484	32	0.7392	58	0.2598	84	0.1050	110	0.04761	136	0.02386
- 45	50.84	- 19	9.713	7	2.369	33	0.7082	59	0.2499	85	0.1014	111	0.04637	137	0.02329
- 44	47.89	- 18	9.196	8	2.254	34	0.6771	60	0.2400	86	0.09842	112	0.04512	138	0.02272
- 43	44.94	- 17	8.680	9	2.139	35	0.6461	61	0.2320	87	0.09545	113	0.04388	139	0.02215
- 42	41.99	- 16	8.163	10	2.024	36	0.6217	62	0.2240	88	0.09247	114	0.04263	140	0.02158
- 41	39.04	- 15	7.646	11	1.937	37	0.5973	63	0.2161	89	0.08950	115	0.04139	141	0.02109
- 40	36.09	- 14	7.270	12	1.850	38	0.5729	64	0.2081	90	0.08652	116	0.04033	142	0.02060
- 39	34.06	- 13	6.894	13	1.763	39	0.5484	65	0.2001	91	0.08404	117	0.03297	143	0.02010
- 38	32.02	- 12	6.519	14	1.676	40	0.5241	66	0.1936	92	0.08155	118	0.03822	144	0.01961
- 37	29.99	- 11	6.143	15	1.589	41	0.5048	67	0.1871	93	0.07907	119	0.03716	145	0.01912
- 36	27.95	- 10	5.767	16	1.522	42	0.4855	68	0.1807	94	0.07658	120	0.03610	146	0.01869
- 35	25.92	- 9	5.491	17	1.456	43	0.4662	69	0.1742	95	0.07410	121	0.03520	147	0.01826
- 34	24.50	- 8	5.215	18	1.389	44	0.4469	70	0.1677	96	0.07202	122	0.03430	148	0.01784
- 33	23.08	- 7	4.940	19	1.323	45	0.4276	71	0.1624	97	0.06994	123	0.03340	149	0.01741
- 32	21.66	- 6	4.664	20	1.256	46	0.4122	72	0.1571	98	0.06786	124	0.03250	150	0.01698
- 31	20.24	- 5	4.388	21	1.205	47	0.3968	73	0.1518	99	0.06578	125	0.03160		
- 30	18.82	- 4	4.183	22	1.154	48	0.3815	74	0.1465	100	0.06370	126	0.03083		
- 29	17.82	- 3	3.978	23	1.102	49	0.3661	75	0.1412	101	0.06195	127	0.03006		
- 28	16.81	- 2	3.773	24	1.051	50	0.3507	76	0.1368	102	0.06021	128	0.02929		
- 27	15.81	- 1	3.568	25	1.000	51	0.3384	77	0.1325	103	0.05846	129	0.02851		
- 26	14.80	0	3.363	26	0.9603	52	0.3261	78	0.1281	104	0.05672	130	0.02774		
- 25	13.80	1	3.210	27	0.9205	53	0.3138	79	0.1238	105	0.05497	131	0.02708		

NTC Thermistor Assemblies

FEATURES

- Standard and custom assemblies are available in a variety of configurations
- Assemblies can conveniently attach to or be an integral part of any system to monitor or control temperature
- No added labor required prior to assembly in the intended application

Standard and custom assemblies are available in a variety of configurations. The choice of assembly style is dependent on the application. The primary factors which determine the optimum configuration of a thermistor assembly are the operating environment, mounting, time response and minimum dissipation constant.

The two factors which do vary considerably with assembly design are time constant and dissipation constant. The time constant will typically be of greater duration in encapsulated thermistors. This is, of course, due to additional mass surrounding the thermistor element; therefore, extending the thermal transfer time. Dissipation constant will also be greater in assemblies. The additional housing mass serves well as a heat sink. Greater power is therefore required to induce self-heating.

Both time constant and dissipation constant will vary with the selected thermistor and housing. Heat transfer properties of the housing, thermistor location, mass and wire type determine these constants. It is recommended to evaluate or consult the factory in applications where TC and DC are critical.

ASSEMBLY STYLES

IMMERSION PROBES

1. Thread Mounted
2. Penetration Probe
3. Tubular Stainless Steel
4. Tubular Pyrex®
5. Flexible Immersion

GENERAL PURPOSE SENSORS

6. Delrin® Housing
7. Stainless Steel Rod
8. Gold Anodized Flanged Sensor
9. ABS Housing
10. Polyester Housing
11. Epoxy Tip Probe
12. Pipe Sensor

SURFACE SENSORS

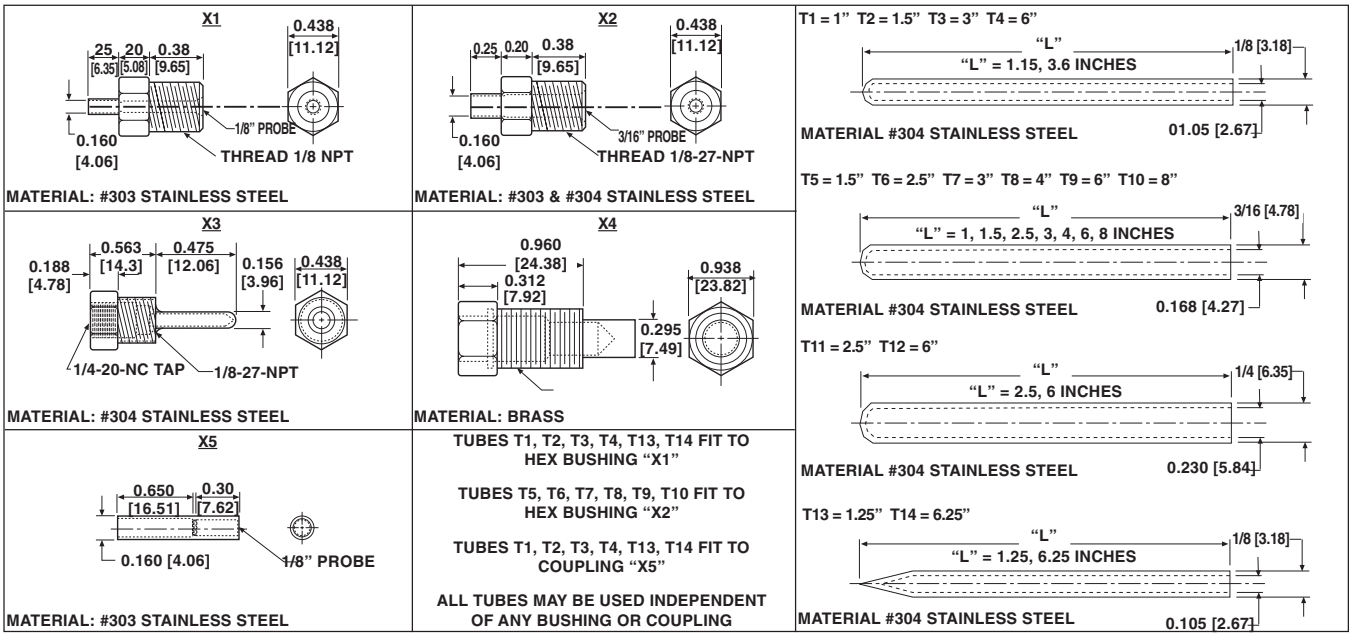
13. Ring Tongue Lugs
14. Heat Sink Sensors
15. Rectangular Block Sensors

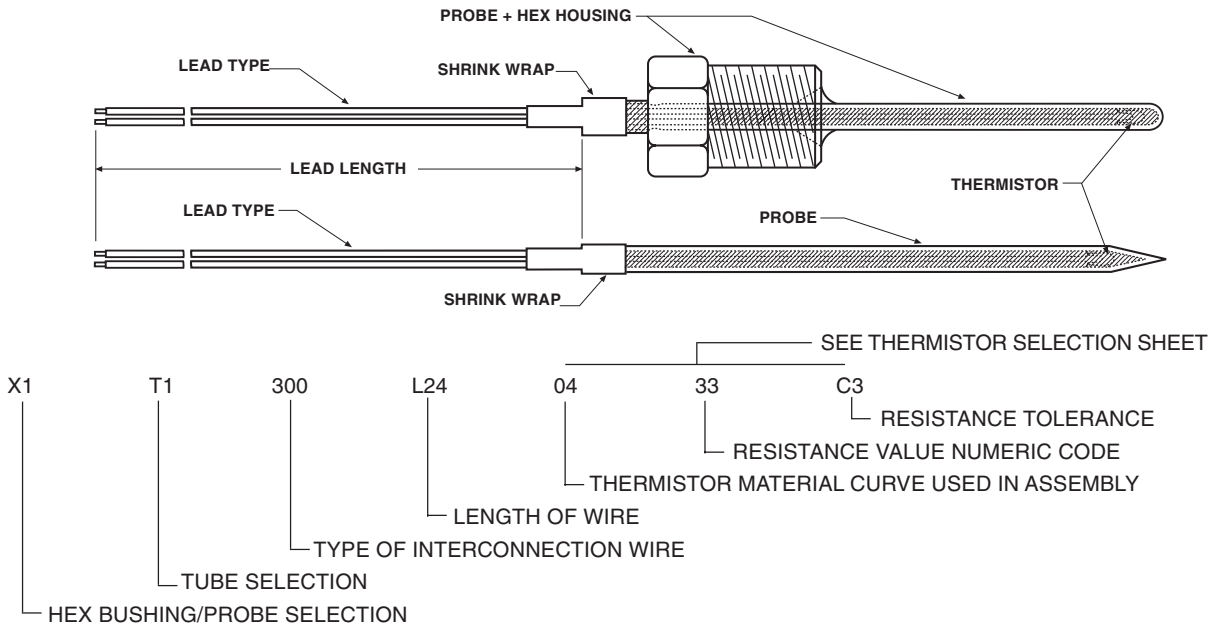
Refer to “How to Select an NTC Thermistor” for general design aids in choice of thermistor value, tolerance and R-T curve.

ORDERING INFORMATION

	1. Choose Style: R07	
	2. Select Wire Type: PVC Insulated - example 300	
	3. Select Wire Length: L06	
	4. Select Thermistor - See thermistor selector sheet	1) Curve 01
		2) Resistance value numeric code - 31
		3) Resistance tolerance 10
	5. Contact factory for part numbers.	

IMMERSION TYPE ASSEMBLY HOUSING

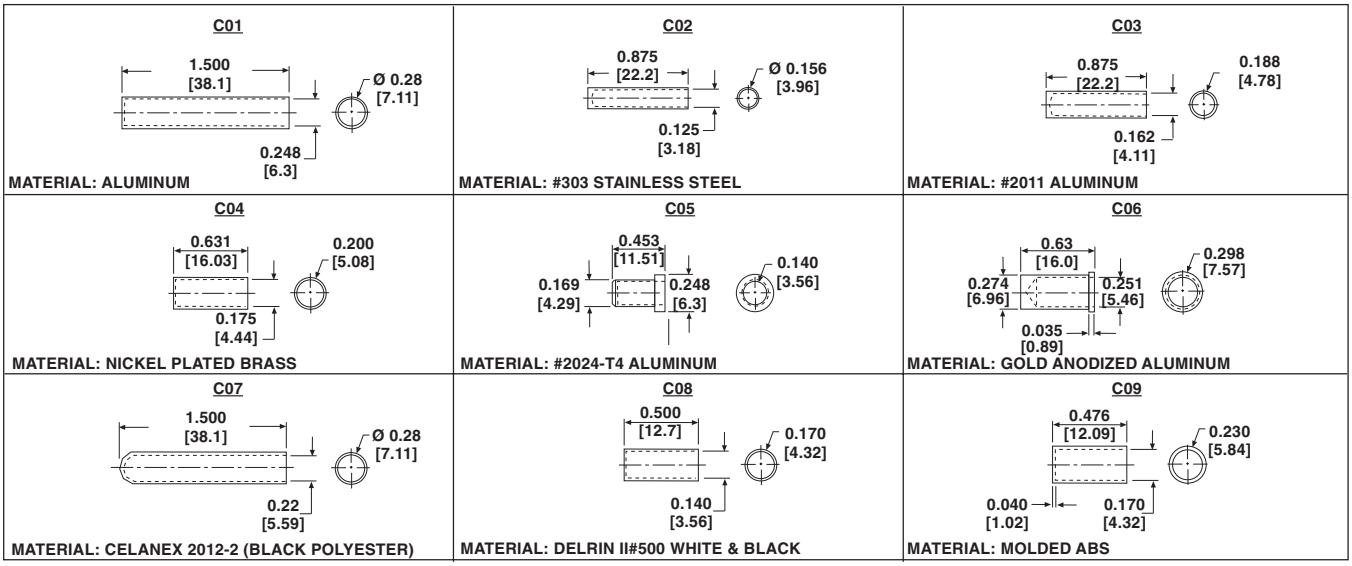


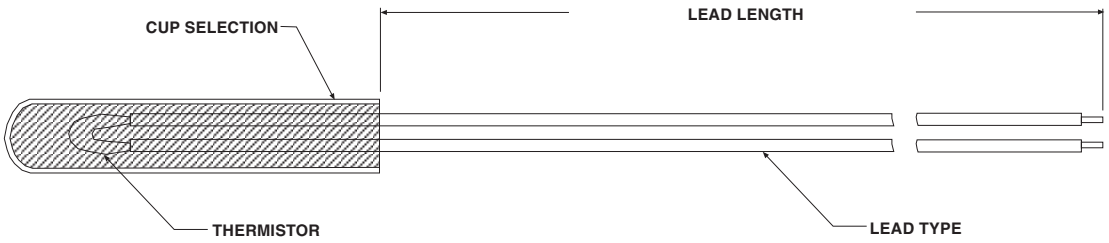


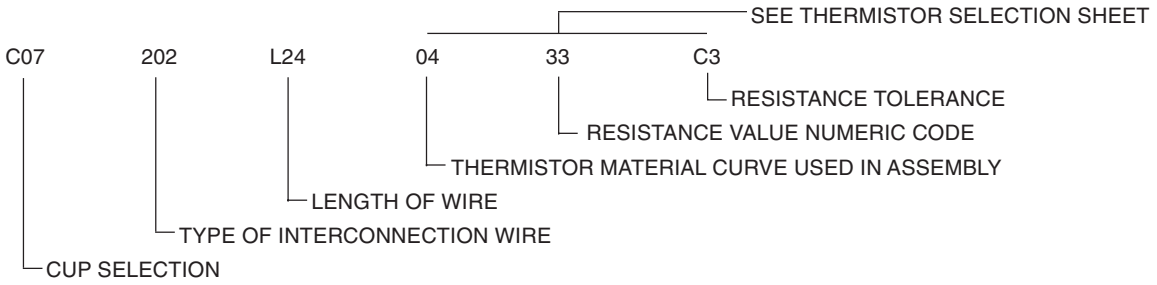
HOOK-UP WIRE TYPE	STANDARD WIRE FOR HEX/TUBE HOUSINGS							
	X1/X5	X2	X3	X4	T1 - T4	T5 - T10	T11 - T12	T13 - T14
Cable	508	503	503	503	508	503	503	508
Teflon Insulated Wire	208	202	202	202	208	202	202	208
PVC Insulated Wire	300	300	300	300	300	300	300	300
Twisted Pair Wire	702	702	702	702	702	702	702	702
Zip (Flat) Wire	601	601	601	601	601	601	601	601
Ni Wire, Teflon Insulated	400	400	400	400	400	400	400	400

STANDARD WIRE LENGTHS: 3, 6, 9, 12, 24, 36 Inches

CUP TYPE ASSEMBLY HOUSING



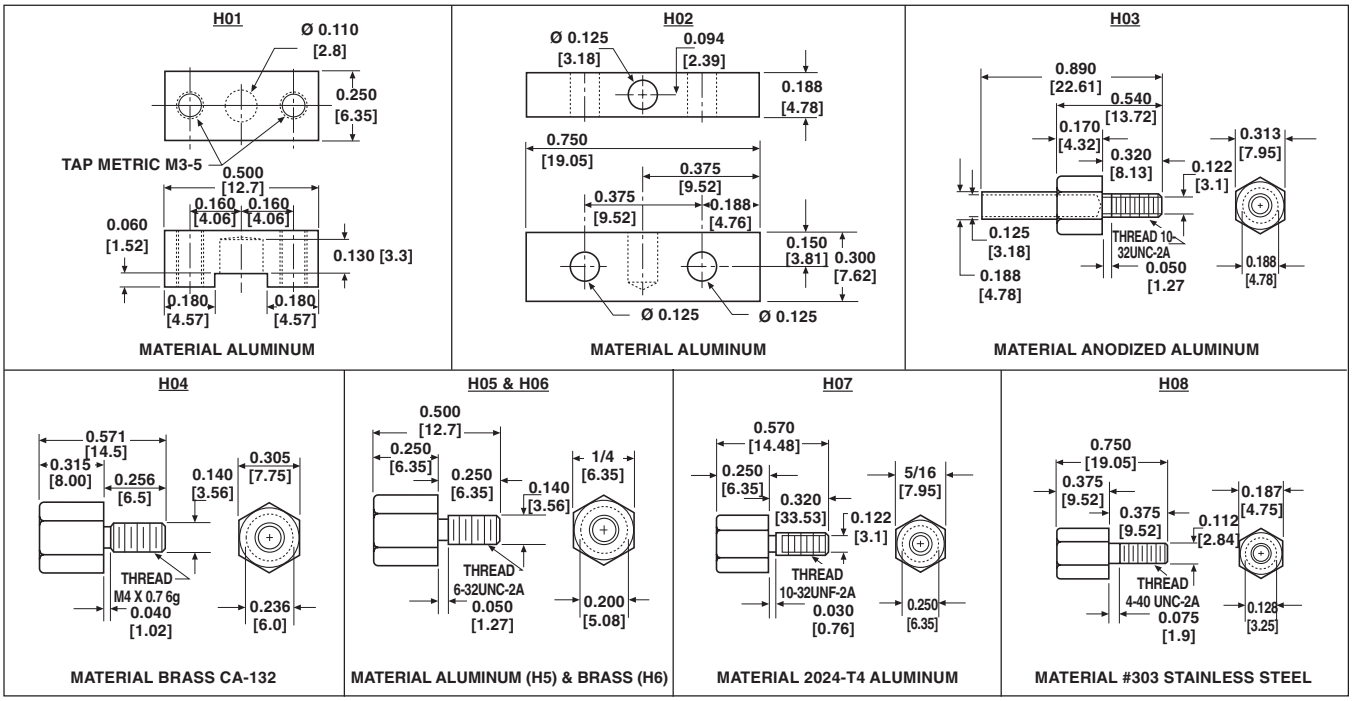


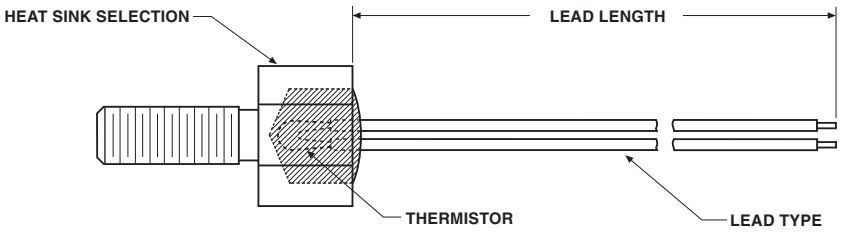


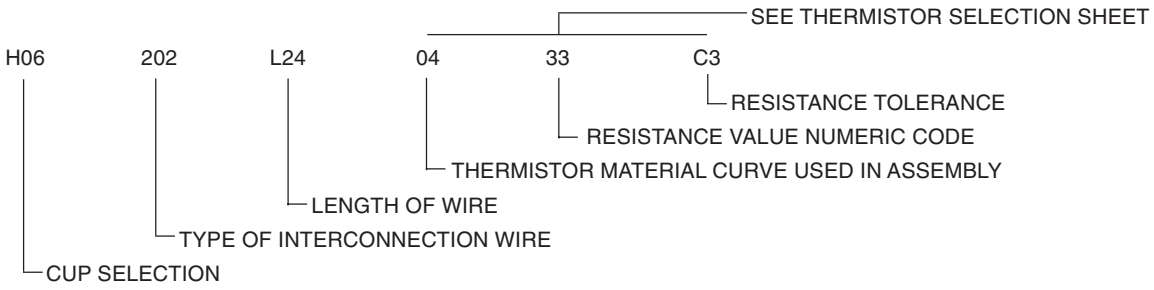
HOOK-UP WIRE TYPE	STANDARD WIRE FOR CUP HOUSINGS							
	C01	C02	C03	C04	C05	C06	C07	C08
Cable	503	N/A	508	508	508	503	503	508
Teflon Insulated Wire	202	202	202	202	202	202	202	202
PVC Insulated Wire	300	300	300	300	300	300	300	300
Zip (Flat) Wire	601	601	601	601	601	601	601	601
Twisted Pair Wire	703	703	703	703	703	703	703	703
Ni Wire, Teflon Insulated	400	400	400	400	400	400	400	400

STANDARD WIRE LENGTHS: 3, 6, 9, 12, 24, 36 Inches

TEX BUSHING/PROBE TYPE ASSEMBLY HOUSING



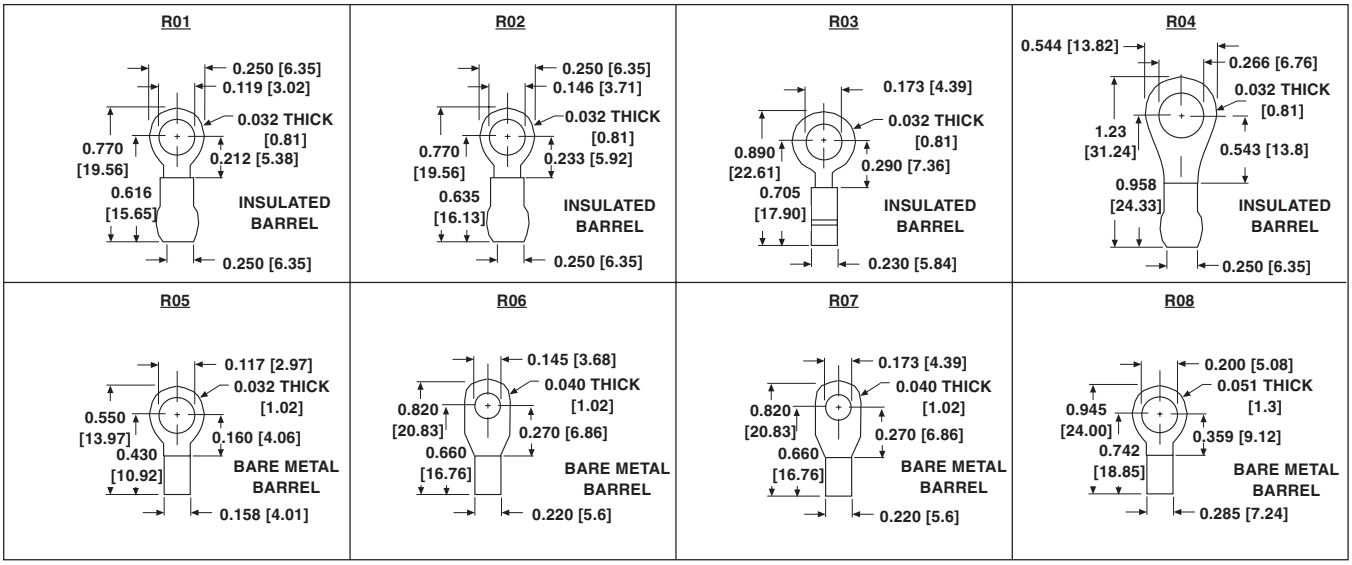


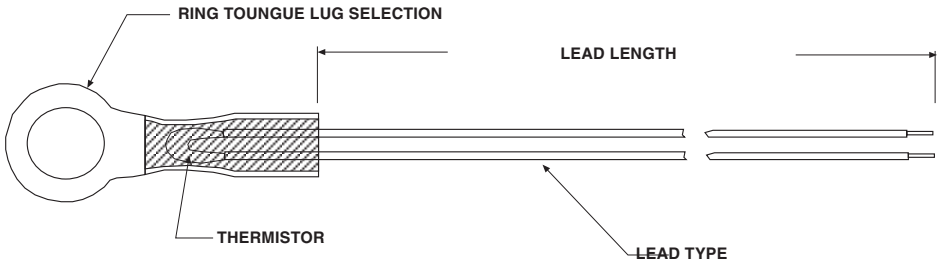


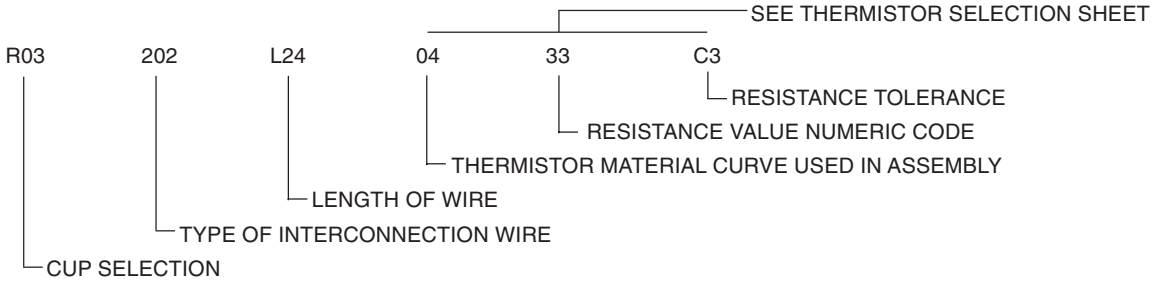
HOOK-UP WIRE TYPE	STANDARD WIRE FOR HEAT SINK HOUSINGS							
	H01	H02	H03	H04	H05	H06	H07	H08
Cable	508	508	508	503	503	503	503	508
Teflon Insulated Wire	202	202	202	202	202	202	202	202
PVC Insulated Wire	306	306	306	306	306	306	306	306
Twisted Pair Wire	703	703	703	703	703	703	703	703
Zip (Flat) Wire	601	601	601	601	601	601	601	601
Ni Wire, Teflon Insulated	400	400	400	400	400	400	400	400

STANDARD WIRE LENGTHS: 3, 6, 9, 12, 24, 36 Inches

RING TONGUE TYPE ASSEMBLY HOUSING



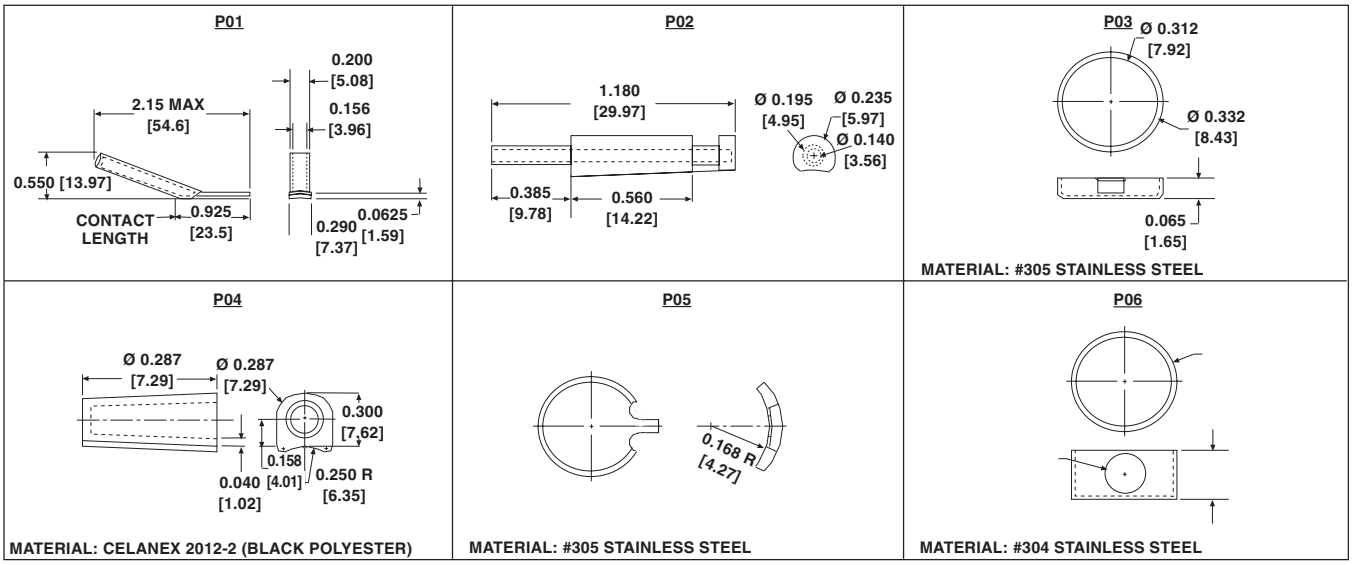


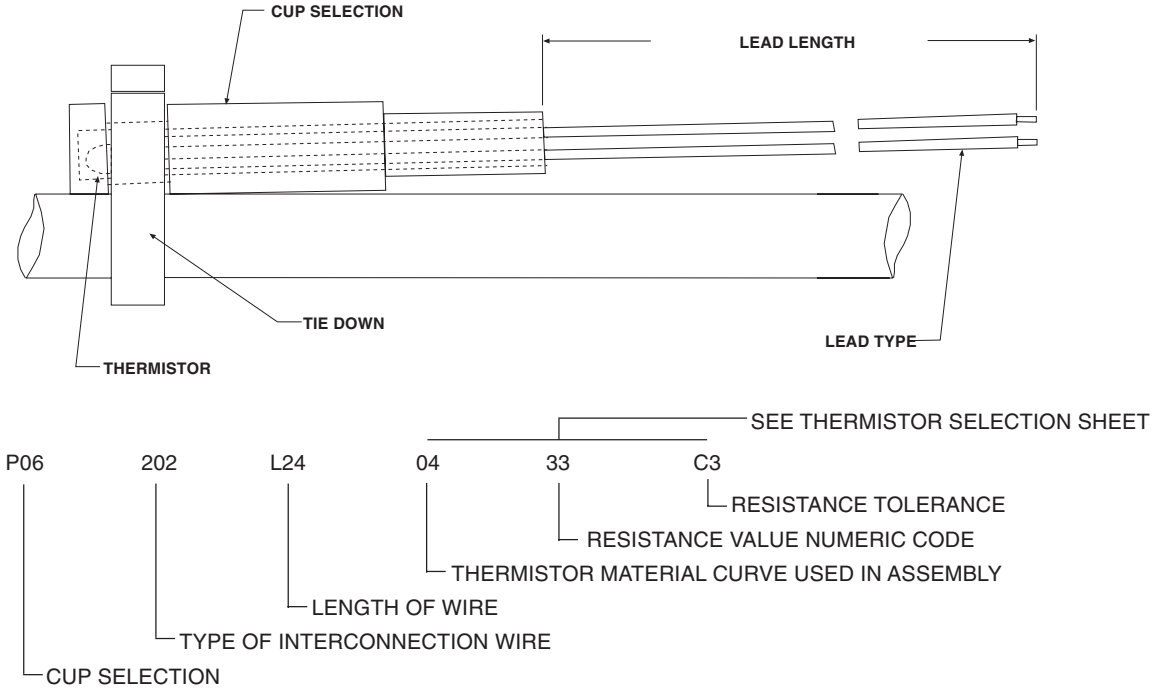


HOOK-UP WIRE TYPE	STANDARD WIRE FOR HEAT SINK STYLES							
	R01	R02	R03	R04	R05	R06	R07	R08
Cable	503	503	503	503	N/A	508	508	503
Teflon Insulated Wire	202	202	202	202	208	207	207	201
PVC Insulated Wire	301	301	304	306	301	301	304	306
Twisted Pair Wire	703	703	703	703	N/A	703	703	702
Zip (Flat) Wire	601	601	601	601	601	601	601	601
Ni Wire, Teflon Insulated	400	400	400	400	400	400	400	400

STANDARD WIRE LENGTHS: 3, 6, 9, 12, 24, 36 Inches

PIPE STYLE ASSEMBLY HOUSING





HOOK-UP WIRE TYPE	STANDARD WIRE FOR PIPE HOUSINGS					
	P01	P02	P03	P04	P05	P06
Cable	508	508	N/A	503	N/A	N/A
Teflon Insulated Wire	202	202	202	202	202	202
PVC Insulated Wire	304	304	301	304	301	301
Zip (Flat) Wire	601	601	601	601	601	601
Twisted Pair Wire	703	703	703	703	703	703
Ni Wire, Teflon Insulated	400	400	400	400	400	400

STANDARD WIRE LENGTHS: 3, 6, 9, 12, 24, 36 Inches

ASSEMBLY CONNECTORS

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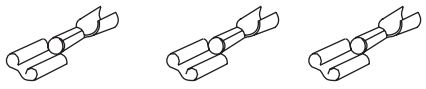
18 - 22 WIRE
20 - 24 WIRE
24 - 26 WIRE
RECEPTABLE FOR 3/16 X 0.020 TAB
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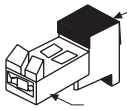
I4
22 AWG. 2-CIRCUIT HOUSING AND DUST COVER

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HOUSING (AMP P/N: 641219-2)
TIN COPPER ALLOY CONTACTS, GOLD PLATED
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2 CAP HOUSINGS
2 SOCKETS
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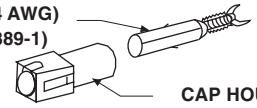
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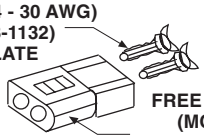
1 RECEPTACLE
2 TERMINALS
FEMALE TERMINAL (24 - 30 AWG) (MOLEX P/N: 02-08-1132) BRASS W/TIN PLATE

FREE HANGING RECEPTACLE (MOLEX P/N: 03-06-1023)
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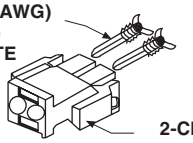
I7
1 PLUGHOUSINGS
2 TERMINALS
MALE TERMINAL (18 - 24 AWG) (AMP P/N: 350690-2) BRASS W/GOLD PLATE

2-CIRCUIT PLUG HOUSING (AMP P/N: 350777-1)
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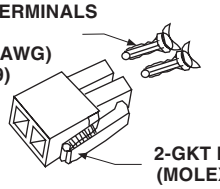
I8
1 MINI-FIT HOUSING
2 TERMINALS
FEMALE TERMINAL (18 - 24 AWG) (MOLEX P/N: 39-00-0039) BRASS W/TIN PLATE

2-GKT MINI-FIT HOUSING (MOLEX P/N: 39-01-2020)
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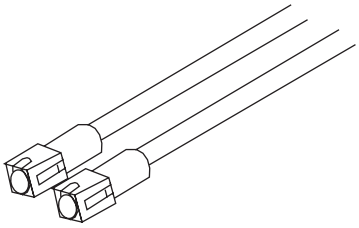
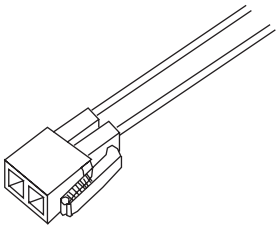




ASSEMBLY STRAIN RELIEF AND MARKING

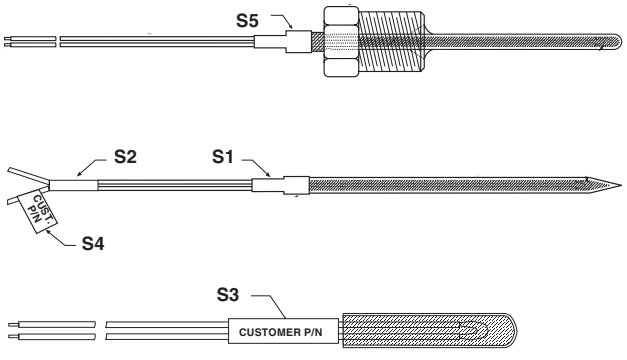
S1: SHRINK WRAP STRAIN RELIEF, HOUSING/LEAD

S2: SHRINK WRAP STRAIN RELIEF, LEADS

S3: SHRINK WRAP WITH MARKING

S4: AVERY LABEL MARKING

S5: SPRING - STRAIN RELIEF



HOOK UP WIRES AVAILABLE

WIRE P/N	# COND'S	AWG	CONDUCTOR MATERIAL	INSULATOR	NOM. DIA	COMMENTS	
Bare, Copper Wire, Tin Plated							
100	1	20	Cu/Tin Plate		0.032	"G" Series Thermistor Std.	250201-05
101	1	22	Cu/Tin Plate		0.025		250201-04
102	1	26	Cu/Tin Plate		0.016	"B" Series Thermistor Std.	220049-04
103	1	28	Cu/Tin Plate		0.013	"C" Series Thermistor Std.	220049-01
104	1	30	Cu/Tin Plate		0.010	"M" Series Thermistor Std.	220049-02
105	1	32	Cu/Tin Plate		0.008	"F" Series Thermistor Std.	220049-03
Copper Conductor, Silver Plated with Teflon Insulation							
200	1	18 - 19/30	Cu/Silver Plate	Teflon	0.079	Black	220019-06
201	1	22 - 19/34	Cu/Silver Plate	Teflon	0.053	Black	220019-04
202	1	24 - 7/32	Cu/Silver Plate	Teflon	0.047	Black, White	220019-02, -03
203	1	24 - 19/36	Cu/Silver Plate	Teflon	0.047	White	220019-05
204	1	24 - 7/32	Cu/Silver Plate	Teflon	0.036	Black	220166-03
205	1	26 - 19/38	Cu/Silver Plate	Teflon	0.042	Red	
206	1	28 - 7/36	Cu/Silver Plate	Teflon	0.038	Orange, Red, Black	220086-02, -03, -09
207	1	28 - 7/36	Cu/Silver Plate	Teflon	0.027	Black, White, Green	220166-01, -02, -04
208	1	30 - 7/38	Cu/Silver Plate	Teflon	0.035	Black	220019-05
209	1	24	Cu/Silver Plate	Teflon	0.040	Black, White	220019-01, -07
210	1	26	Cu/Silver Plate	Teflon	0.035	Black	
211	1	28	Cu/Silver Plate	Teflon	0.032	Black	220086-06
212	1	30	Cu/Silver Plate	Teflon	0.029	Black	220086-08
Copper Conductor, Tin Plated with PVC Insulation							
300	1	26 - 19/38	Cu/Tin Plate	PVC	0.038	Black, White, MIL-W-16878/1, Type B	220079-01
301	1	28 - 7/36	Cu/Tin Plate	PVC	0.034	Black, White,Green, MIL-W-16878/1, Type B	220079-02, -05, -11
302	1	24 - 7/32	Cu/Tin Plate	PVC	0.044	Black, White, MIL-W-16878/1, Type B	220079-04, -06
303	1	22 - 19/34	Cu/Tin Plate	PVC	0.050	Black, MIL-W-16878/1, Type B	220079-07
304	1	30 - 7/38	Cu/Tin Plate	PVC	0.032	Black, MIL-W-16878/1, Type B	220079-08
305	1	22 - 7/30	Cu/Tin Plate	PVC	0.095	Black, UL 1015	220234-01
306	1	24 - 7/32	Cu/Tin Plate	PVC	0.089	Yellow, UL 1015	220234-03
307	1	22 - 7/30	Cu/Tin Plate	PVC	0.062	White, UL 1569	220234-02
308	1	26 - 7/34	Cu/Tin Plate	PVC	0.038	Light Blue, UL 1061	220262-01
309	1	22 - 7/30	Cu/Tin Plate	PVC	0.058	Black, UL 1569	220313-01
310	1	26 - 7/34	Cu/Tin Plate	PVC	0.051	Black, UL 1569	220323-01
311	1	24 - 7/32	Cu/Tin Plate	PVC	0.056	Black, UL 1569	220323-02
312	1	24	Cu/Tin Plate	PVC	0.040	Black, UL 1061	220332-01
313	1	30	Cu/Tin Plate	PVC	0.027	Black	220181-01
Miscellaneous Insulated Wires							
400	1	30	Nickel	Teflon	0.020	Yellow, Black, "T" Series Thermistor	220215-02, -03
401	1	30	Cu/Silver Plate	Kynar	0.020	Black, UL 1423	220316-01
402	1	28 - 7/36	Cu/Silver Plate	Kapton	0.025	Black	220317-01

HOOK UP WIRES AVAILABLE (continued)

WIRE P/N	# COND'S	AWG	CONDUCTOR MATERIAL	INSULATOR	NOM. O.D.	COMMENTS	
Cables - Wires w/ Jackets Exterior							
500	2	18 - 19/30	Cu/Tin Plate	PVC	0.22/0.075	Gray Jacket w/ Black/White/Braid Shield	220298-01
501	2	20 - 7/28	Cu/Tin Plate	PVC	0.175/0.059	Gray Jacket w/ Red/Black Wires	220014-02
502	2	22 - 19/34	Cu/Silver Plate	Teflon	0.142/0.050	White Jacket w/ Black/White/Braid Shield	220131-01
503	2	22 - 7/30	Cu/Tin Plate	PVC	0.160/0.048	Gray Jacket w/ Red/Black Wires	220014-01
504	3	22 - 7/30	Cu/Tin Plate	PVC	0.160/0.048	Gray Jacket w/ Red/Black/White Wires	220014-03
505	3	22 - 7/30	Cu/Tin Plate	PVC	0.130/0.048	Gray Jacket w/ Red/Black/Drain Wires	220112-01
506	2	22 - 7/30	Cu/Tin Plate	PVC	0.170/0.057	Gray Jacket w/ Red/Black Wires	220177-01
507	3	22 - 7/30	Cu/Tin Plate	PVC	0.160/0.048	Gold Jacket w/ Black/White Wires	220121-01
508	2	28 - 7/36	Cu/Tin Plate	PVC	0.100/0.033	Gray Jacket w/ Black/White/Paper Wrap	220202-01
509	3	20	Cu/Tin Plate	Teflon	0.150	Red, White, Black in Stainless Steel Braid	220021-01
Flat Wire & Zip Cords							
600	2	24 - 7/32	Cu/Tin & Cu	PVC	0.065 X 0.130	Clear w/ 1 Tin Plated Cu and 1 Bare Cu	220016-01
601	2	28 - 7/36	Cu/Tin & Cu	PVC	0.034 X 0.067	Black w/ 1 Tin Plated Cu and 1 Bare Cu	220016-03
602	2	18 - 41/34	Cu/Tin & Cu	PVC	0.105 X 0.205	Black w/ 1 Tin Plated Cu and 1 Bare Cu	220180-01
603	2	28 - 7/36	Cu/Tin Plate	PVC	0.200 X 0.041	Gray, UL 2651	220223-01
Twisted Pair Wires							
700	2	24 - 7/32	Cu/Silver Plate	Teflon	0.044	White, UL 1213 - 2 Twists/Inch	220334-01
701	2	22 - 19/34	Cu/Tin Plate	Tefzel	0.043	Blue	220113-01
702	2	22 - 7/30	Cu/Tin Plate	PVC	0.063	Black/White, UL 1007	220176-01
703	2	24 - 7/32	Cu/Tin Plate	PVC	0.057	Black/White, UL 1007	220176-02
704	2	24 - 7/32	Cu/Tin Plate	PVC	0.057	White/White, UL 1007	220176-03

THERMISTOR SELECTIONS FOR SPECIAL ASSEMBLIES

R_{25} Code	R_{25} (Ohms)	CURVE NUMBER									
		01	02	03	04	07	08	09	12	14	17
01	50									•	
02	56									•	
03	68									•	
04	82									•	
05	100									•	
06	120									•	
07	150			•						•	
08	180			•						•	
09	220			•						•	
10	270			•							
11	330			•							
12	390			•							
13	470			•							
14	500			•							
15	560			•							
16	680		•								
17	820		•								
18	1K		•								
19	1.2K		•								
20	1.5K		•								
21	1.8K		•								
22	2.2K		•								
23	2.7K		•								
24	3.3K		•								
25	3.9K	•									
26	4.7K	•									
27	5K	•									
28	5.6K	•									
29	6.8K	•									
30	8.2K	•									
31	10K	•									
32	12K	•									
33	15K	•						•			•
34	18K	•						•			•
35	22K							•			•
36	27K							•			•
37	33K				•			•			•
38	39K				•			•			•
39	47K				•		•	•			•
40	50K				•		•	•			•
41	56K				•	•	•	•			
42	68K				•	•	•				
43	82K				•	•	•				
44	100K				•	•	•				
45	120K					•	•				
46	150K					•	•				
47	180K					•	•				
48	220K					•					
49	270K					•					
49	500K								•		
50	560K								•		
51	680K								•		
52	820K								•		
53	1 Meg								•		

Curve 1, 10K Thermistor, ± 5 % at 25 °C

01	31	05
CURVE NUMBER	VALUE CODE	TOLERANCE at + 25 °C

THERMISTOR TOLERANCES

POINT MATCHED AT 25 °C

01	± 1 %
02	± 2 %
03	± 3 %
05	± 5 %
10	± 10 %

CURVE TRACKING

B3	± 0.5 %	0 °C to + 70 °C
A3	± 1 %	0 °C to + 70 °C
B4	± 0.5 %	0 °C to + 100 °C
A4	± 1 %	0 °C to + 100 °C
B5	± 0.5 %	+ 25 °C to + 90 °C
A5	± 1 %	+ 25 °C to + 90 °C
B8	± 0.5 %	0 °C to + 50°C
C8	± 1 %	0 °C to + 50 °C

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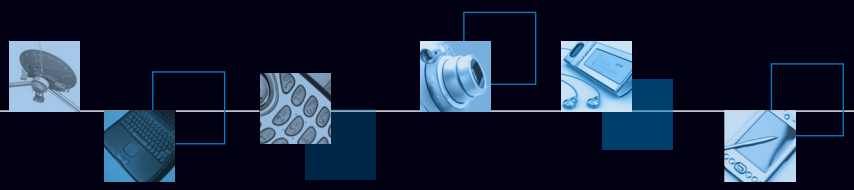

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