

# NTC SMD Thermistors

## NC 21 (AgPdPt Termination)



Chip thermistors are high quality and low cost devices especially developed for surface mounting applications. They are widely used for temperature compensation but can also achieve temperature control of printed circuits.

Its silver-palladium-platinum metallization provides a high degree of resistance to dewetting of the terminations (typically 260°C / 15 s). Parts are suitable for hybrid assembly process (conductive adhesive), not suitable for lead free soldering.

Types	NC 21 IEC SIZE : 0603
<b>DIMENSIONS:</b> millimeters (inches)	
Terminations	PdPtAg
Marking	On packaging only
Climatic category	40/125/56
Operating temperature	-55°C to +150°C
Tolerance on R <sub>n</sub> (25°C)	±3%*, ±5%, ±10%, ±20%
Maximum dissipation at 25°C	0.07 W
Thermal dissipation factor	1 mW/°C
Thermal time constant	4 s

Resistance - Temperature characteristics: pages 29 to 33.

### FEATURES

- Fast thermal response
- Commercial, Industrial and Automotive Applications
- PdPtAg Termination
- Suitable for hybrid assembly (conductive adhesive)
- AEC-Q200 based qualification

### APPLICATIONS

- LCD compensation
- Battery packs
- Mobile phones
- CD players
- Heating systems
- Air-conditioning systems
- Refrigeration
- Temperature control of Switch Mode Power Supplies
- Compensation of pressure sensors
- Protection of power transistors in various electronic circuits and more



### HOW TO ORDER

<b>NC 21</b>	<b>K 0</b>	<b>0103</b>	<b>M</b>	<b>BB</b>
<b>Type</b>	<b>Material Code</b>	<b>Resistance</b>	<b>Tolerance</b>	<b>Suffix: Packaging</b>
NC21 (0603)	K (See tables pages 11)	10,000 Ω (See tables page 11)	H (±3%)* J (±5%) K (±10%) M (±20%)	--: Bulk (5000 pcs/bag) BB: Cardboard tape (180mm diam. reel, 4000 pcs/reel) BF: Cardboard tape (1/2 reel, 2000 pcs/reel) BD: Cardboard tape (330mm diam. reel, 10,000 pcs/reel)

\* Optional tolerance, please contact factory

# NTC SMD Thermistors

## NC 21 (Ni Barrier/100% Sn Termination)



### TABLE OF VALUES

NC 21 IEC SIZE : 0603				
Types	Rn at 25°C (Ω)	Material Code	B (K) ( $\Delta B/B$ <sup>(1)</sup> ± 5% <sup>(2)</sup> ± 3%)	α at 25°C (%/°C)
NC 21 KC 0 470	47	KC	3470 ± 5%	- 3.9
NC 21 KC 0 101	100			
NC 21 KC 0 471	470			
NC 21 MC 0 102	1,000	MC	3910 ± 3%	- 4.4
NC 21 J 0 0472	4,700	J	3480 ± 3%	- 3.9
NC 21 J 0 0502	5,000			
NC 21 J 5 0682	6,800	J5	3480 ± 3%	- 3.9
NC 21 J 5 0103	10,000			
NC 21 K 0 0103	10,000	K	3630 ± 3%	- 4.0
NC 21 K 0 0153	15,000			
NC 21 L 0 0223	22,000	L	3790 ± 3%	- 4.2
NC 21 M 0 0333	33,000	M	3950 ± 3%	- 4.4
NC 21 M 0 0473	47,000			
NC 21 M4 0 503	50,000	M4	4000 ± 3%	- 4.4
NC 21 L 2 0683	68,000	L2	3805 ± 3%	- 4.1
NC 21 N 0 0683	68,000	N	4080 ± 3%	- 4.6
NC 21 N 5 0104	100,000	N5	4160 ± 3%	- 4.7
NC 21 P 0 0154	150,000	P	4220 ± 3%	- 4.7
NC 21 Q 0 0334	330,000	Q	4300 ± 3%	- 4.7
NC 21 Q 0 0474	470,000			

# NTC SMD Thermistors

## NC 12 – NC 20 (PdPtAg Termination)



Chip thermistors are a high quality and low cost device especially developed for surface mounting applications. They are widely used for temperature compensation but can also achieve temperature control of printed circuits. Its silver - palladium -

platinum metallization provides a high degree of resistance to dewetting of the terminations during soldering (typically 260°C / 15 s). Parts are suitable for hybrid assembly process, not suitable for lead free soldering.

Types	NC 12 IEC SIZE : 0805	NC 20 IEC SIZE : 1206
<b>DIMENSIONS: millimeters (inches)</b>		
Terminations	Silver – palladium – platinum metallization	
Marking	On packaging only	
Climatic category	40/125/56	
Operating temperature	-55°C to +150°C	
Tolerance on Rn (25°C)	±3%*, ±5%, ±10%, ±20%	
Maximum dissipation at 25°C	0.12 W	0.24 W
Thermal dissipation factor	2 mW/°C	4 mW/°C
Thermal time constant	5 s	7 s

Resistance - Temperature characteristics: pages 29 to 33.

### FEATURES

- Fast thermal response
- Commercial, Industrial and Automotive Applications
- PdPtAg Termination
- Suitable for hybrid assembly
- AEC-Q200 based qualified

### APPLICATIONS

- LCD compensation
- Battery packs
- Mobile phones
- CD players
- Heating systems
- Air-conditioning systems
- Refrigeration
- Temperature control of Switch Mode Power Supplies
- Compensation of pressure sensors
- Protection of power transistors in various electronic circuits and more



### HOW TO ORDER

**NC 20**  
Type  
NC12 (0805)  
NC20 (1206)

**K 0**  
Material Code  
K  
(See tables pages 15)

**0103**  
Resistance  
10,000 Ω  
(See tables page 15)

**M**  
Tolerance  
H (±3%)\*  
J (±5%)  
K (±10%)  
M (±20%)

**BA**  
Suffix: Packaging  
--: Bulk (5000 pcs/bag)  
NB20 BA: Plastic tape (180mm diam. reel, 3000 pcs/reel)  
BE: Plastic tape (1/2 reel, 1500 pcs/reel)  
BC: Plastic tape (330mm diam. reel, 10,000 pcs/reel)  
NB12 BB: Cardboard tape (180mm diam. reel, 4000 pcs/reel)  
BF: Cardboard tape (1/2 reel, 2000 pcs/reel)  
BD: Cardboard tape (330mm diam. reel, 10,000 pcs/reel)

\* Optional tolerance, please contact factory

# NTC SMD Thermistors

## NC 12 – NC 20 (PdPtAg Termination)



### TABLE OF VALUES

NC 12 IEC SIZE : 0805					NC 20 IEC SIZE : 1206				
Types	Rn at 25°C (Ω)	Material Code	B (K) ( $\frac{\Delta B}{B}$ (1) ± 5% (2) ± 3%)	α at 25°C (%/°C)	Types	Rn at 25°C (Ω)	Material Code	B (K) ( $\frac{\Delta B}{B}$ (1) ± 5% (2) ± 3%)	α at 25°C (%/°C)
NC 12 KC 0 180	18	KC	3470 ± 5%	- 3.9	NC 20 KC 0 100	10	KC	3470 ± 5%	- 3.9
NC 12 KC 0 220	22				NC 20 KC 0 120	12			
NC 12 KC 0 270	27				NC 20 KC 0 150	15			
NC 12 KC 0 330	33				NC 20 KC 0 180	18			
NC 12 KC 0 390	39				NC 20 KC 0 220	22			
NC 12 KC 0 470	47				NC 20 KC 0 270	27			
NC 12 KC 0 560	56				NC 20 KC 0 330	33			
NC 12 KC 0 680	68				NC 20 KC 0 390	39			
NC 12 KC 0 820	82				NC 20 KC 0 470	47			
NC 12 KC 0 101	100				NC 20 KC 0 560	56			
NC 12 MC 0 121	120	MC	3910 ± 3%	- 4.4	NC 20 KC 0 680	68	MC	3910 ± 3%	- 4.4
NC 12 MC 0 151	150				NC 20 KC 0 820	82			
NC 12 MC 0 181	180				NC 20 KC 0 101	100			
NC 12 MC 0 221	220				NC 20 MC 0 121	120			
NC 12 MC 0 271	270				NC 20 MC 0 151	150			
NC 12 MC 0 331	330				NC 20 MC 0 181	180			
NC 12 MC 0 391	390				NC 20 MC 0 221	220			
NC 12 MC 0 471	470				NC 20 MC 0 271	270			
NC 12 MC 0 561	560				NC 20 MC 0 331	330			
NC 12 MC 0 681	680				NC 20 MC 0 391	390			
NC 12 MC 0 821	820				NC 20 MC 0 471	470			
NC 12 MC 0 102	1,000				NC 20 MC 0 561	560			
NC 12 MC 0 122	1,200				NC 20 MC 0 681	680			
NC 12 MC 0 152	1,500				NC 20 MC 0 821	820			
NC 12 MC 0 182	1,800				NC 20 MC 0 102	1,000			
NC 12 MC 0 222	2,200				NC 20 MC 0 122	1,200			
NC 12 MC 0 272	2,700	NC 20 MC 0 152	1,500						
NC 12 MC 0 332	3,300	NC 20 MC 0 182	1,800						
NC 12 J 0 0332	3,300	J	3480 ± 3%	- 3.9	NC 20 I 0 0182	1,800	I	3250 ± 5%	- 3.7
NC 12 J 0 0392	3,900				NC 20 I 0 0222	2,200			
NC 12 J 0 0472	4,700				NC 20 I 0 0272	2,700			
NC 12 J 0 0502	5,000				NC 20 I 0 0332	3,300			
NC 12 J 0 0562	5,600				NC 20 J 0 0392	3,900	J	3480 ± 3%	- 3.9
NC 12 K 0 0682	6,800				NC 20 J 0 0472	4,700			
NC 12 K 0 0822	8,200	NC 20 J 0 0502	5,000						
NC 12 K 0 0103	10,000	NC 20 J 0 0562	5,600						
NC 12 K 0 0123	12,000	NC 20 J 0 0682	6,800						
NC 12 L 0 0153	15,000	NC 20 K 0 0822	8,200	K	3630 ± 3%	- 4.0			
NC 12 L 0 0183	18,000	NC 20 K 0 0103	10,000						
NC 12 M 0 0223	22,000	NC 20 K 0 0123	12,000						
NC 12 M 0 0273	27,000	NC 20 K 0 0153	15,000						
NC 12 M 0 0333	33,000	M	3950 ± 3%	- 4.4	NC 20 L 0 0183	18,000	L	3790 ± 3%	- 4.2
NC 12 M 0 0393	39,000				NC 20 L 0 0223	22,000			
NC 12 N 0 0473	47,000	N	4080 ± 3%	- 4.6	NC 20 M 0 0273	27,000	M	3950 ± 3%	- 4.4
NC 12 N 0 0503	50,000				NC 20 M 0 0333	33,000			
NC 12 N 0 0563	56,000				NC 20 M 0 0393	39,000			
NC 12 L 2 0683	68,000				NC 20 M 0 0473	47,000			
NC 12 N 0 0823	82,000	L2	3805 ± 3%	- 4.1	NC 20 M 4 0503	50,000	M4	4000 ± 3%	- 4.4
NC 12 P 0 0104	100,000				NC 20 N 0 0563	56,000			
NC 12 P 0 0124	120,000				NC 20 N 0 0683	68,000			
NC 12 P 0 0154	150,000				NC 20 N 0 0823	82,000			
NC 12 P 0 0184	180,000	N	4080 ± 3%	- 4.6	NC 20 N 0 0104	100,000	N	4080 ± 3%	- 4.6
NC 12 Q 0 0224	220,000				NC 20 P 0 0124	120,000			
NC 12 Q 0 0274	270,000				NC 20 P 0 0154	150,000			
NC 12 Q 0 0334	330,000				NC 20 P 0 0184	180,000			
NC 12 Q 0 0394	390,000	P	4220 ± 3%	- 4.7	NC 20 Q 0 0274	270,000	P	4220 ± 3%	- 4.7
NC 12 Q 0 0474	470,000				NC 20 Q 0 0334	330,000			
NC 12 R 0 0564	560,000				NC 20 Q 0 0394	390,000			
NC 12 R 0 0684	680,000				NC 20 Q 0 0474	470,000			
NC 12 R 0 0824	820,000	Q	4300 ± 3%	- 4.7	NC 20 R 0 0564	560,000	Q	4300 ± 3%	- 4.7
NC 12 R 0 0105	1,000,000				NC 20 R 0 0684	680,000			
					NC 20 R 0 0824	820,000			
					NC 20 R 0 0105	1,000,000			
		R	4400 ± 3%	- 4.8			R	4400 ± 3%	- 4.8

# Packaging for Automatic Insertion

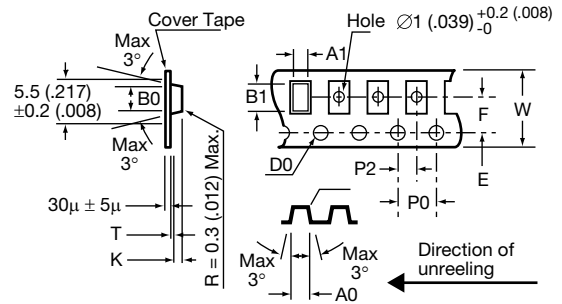
## NTC Chip Thermistors / NC/NB Series



### AUTOMATIC INSERTION

#### Super 8 Plastic Tape Packaging:

The mechanical and dimensional reel characteristics are in accordance with the IEC publication 286-3.



Designation	Symbol	Value	Tolerance	
Tape width	W	8	±0.2	
Tape thickness	T	0.4 max.		
Pitch of the sprocket holes	P0	4	±0.1	
Diameter of the sprocket holes	D0	1.5	±0.1	
Distance	E	1.75	±0.1	
Distance (center to center)	F	3.5	±0.05	
Distance (center to center)	P2	2	±0.1	
Sizes of the cavities	NC 12 (0805)	A0	1.5	±0.1
		B0	2.4	±0.1
		K	1.4 max.	K ±0.1 (size is adjustable) (K = t1 +0.2)
	NC 20 (1206)	A0	1.95	±0.1
		B0	3.55	±0.1
		K	1.5 max.	K ±0.1 (size is adjustable) (K = t1 +0.2)



### QUANTITY PER REEL

Type	Suffix	Description	Qty Per Reel
NB20 NC20	BA	Plastic tape (180mm diam. reel)	3,000 pcs
	BE	Plastic tape (1/2 reel)	1,500 pcs
	BC	Plastic tape (330mm diam. reel)	10,000 pcs

# Packaging for Automatic Insertion

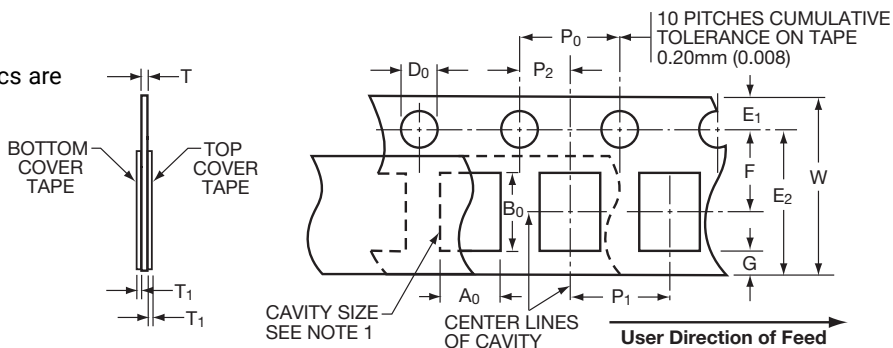
## NTC Chip Thermistors / NC/NB Series



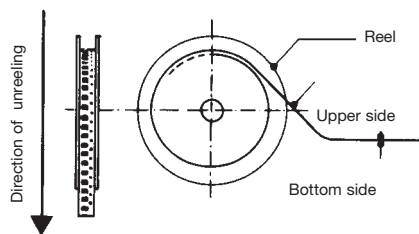
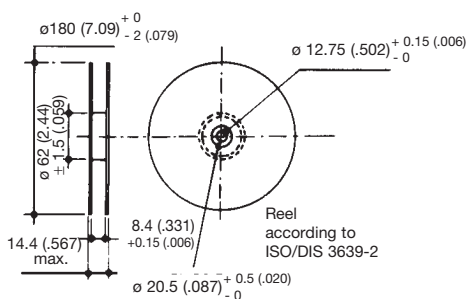
### AUTOMATIC INSERTION

#### 8mm Paper Tape Packaging:

The mechanical and dimensional reel characteristics are in accordance with the IEC publication 286-3.



Designation	Symbol	Value	Tolerance
Tape width	W	8	$-.0.1/+0.3$
Tape thickness	T	1.1 max.	
Pitch of the sprocket holes	$P_0$	4	$\pm 0.1$
Diameter of the sprocket holes	$D_0$	1.5	$\pm 0.1$
Distance	$E_1$	1.75	$\pm 0.1$
Distance (center to center)	F	3.5	$\pm 0.05$
Distance (center to center)	$P_2$	2	$\pm 0.05$
Cover tape thickness	$T_1$	0.10 max.	
Distance	$E_2$	6.25 min.	
Distance	G	0.75 min.	
Component pitch	$P_1$	0805/0603	$\pm 0.1$
		0402	$\pm 0.1$



### QUANTITY PER REEL

Type	Suffix	Description	Qty Per Reel
NB12	BB	Cardboard tape (180mm diam. reel)	4,000 pcs
NC12	BF	Cardboard tape (1/2 reel)	2,000 pcs
NB21	BD	Cardboard tape (330mm diam. reel)	10,000 pcs
NC21			

# Surface Mounting Guide

## Chip Thermistor – Application Notes



### STORAGE

Good solderability is maintained for at least twelve months, provided the components are stored in their “as received” packaging at less than 40°C and 70% RH.

### SOLDERABILITY / LEACHING

Terminations to be well soldered after immersion in a 60/40 tin/lead solder bath at  $235 \pm 5^\circ\text{C}$  for  $2 \pm 1$  seconds.

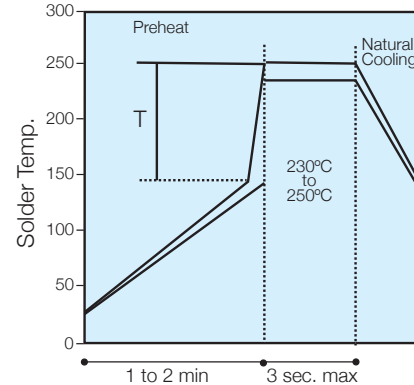
Terminations will resist leaching for at least the immersion times and conditions recommendations shown below.

P/N	Termination Type	Solder Tin/Lead	Solder Temp °C	Immersion Time Seconds
NC	AgPdPt	60/40	$260 \pm 5$	15 max
NB	Nickel Barrier	60/40	$260 \pm 5$	$30 \pm 1$

NB products are compatible with a wide range of soldering conditions consistent with good manufacturing practice for surface mount components. This includes Pb free reflow processes with peak temperatures up to  $270^\circ\text{C}$ . Recommended profiles for reflow and wave soldering are shown below for reference.

NC products are recommended for lead soldering application or gluing techniques.

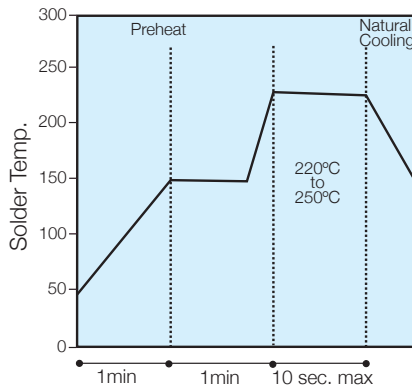
### Wave



(Preheat chips before soldering)  
T/maximum  $150^\circ\text{C}$

- The visual standards used for evaluation of solder joints will need to be modified as lead free joints are not as bright as with tin-lead pastes and the fillet may not be as large.
- Resin color may darken slightly due to the increase in temperature required for the new pastes.
- Lead-free solder pastes do not allow the same self alignment as lead containing systems. Standard mounting pads are acceptable, but machine set up may need to be modified.

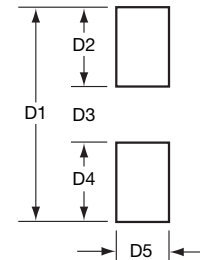
### Reflow



(Minimize soldering time)

### RECOMMENDED SOLDERING PAD LAYOUT

Dimensions in mm (inches)

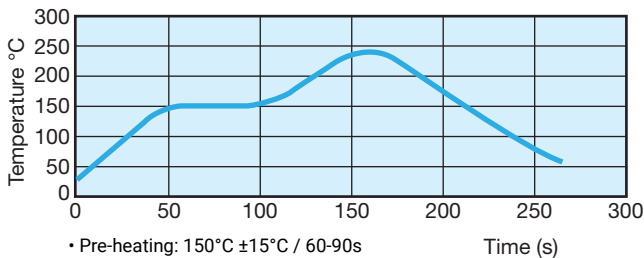


### REFLOW SOLDERING

Case Size	P/N	D1	D2	D3	D4	D5
0603	NB21	2.30 (.091)	0.80 (.031)	0.70 (.028)	0.80 (.031)	0.75 (.030)
0805	NB12	3.00 (.118)	1.00 (.039)	1.00 (.039)	1.00 (.039)	1.25 (.049)
1206	NB20	4.00 (.157)	1.00 (.039)	2.00 (.079)	1.00 (.039)	2.50 (.098)

### WAVE SOLDERING

Case Size	P/N	D1	D2	D3	D4	D5
0603	NB21	3.10 (.122)	1.20 (.047)	0.70 (.028)	1.20 (.047)	0.75 (.030)
0805	NB12	4.00 (.157)	1.50 (.059)	1.00 (.039)	1.50 (.059)	1.25 (.049)
1206	NB20	5.00 (.197)	1.50 (.059)	2.00 (.079)	1.50 (.059)	1.60 (.063)



- Pre-heating:  $150^\circ\text{C} \pm 15^\circ\text{C} / 60-90\text{s}$
- Max. Peak Gradient:  $2.5^\circ\text{C/s}$
- Peak Temperature:  $245^\circ\text{C} \pm 5^\circ\text{C}$
- Time at  $>230^\circ\text{C}$ : 40s Max.

# Tables of Resistance vs Temperature



T (°C)	Material B(K)		
	I 3250		
	R(T) / R25	TF (%)	α (%/°C)
-55	42.35	21.9	-5.98
-50	31.48	20.0	-5.78
-45	23.63	18.1	-5.59
-40	17.91	16.3	-5.41
-35	13.70	14.6	-5.23
-30	10.58	13.1	-5.06
-25	8.232	11.6	-4.90
-20	6.460	10.1	-4.74
-15	5.110	8.8	-4.59
-10	4.072	7.5	-4.45
-5	3.268	6.3	-4.31
0	2.641	5.1	-4.18
5	2.148	4.0	-4.05
10	1.759	2.9	-3.92
15	1.449	1.9	-3.81
20	1.200	0.9	-3.69
25	1.000	0.0	-3.58
30	0.8377	0.9	-3.48
35	0.7054	1.8	-3.38
40	0.5969	2.6	-3.28
45	0.5076	3.5	-3.19
50	0.4336	4.3	-3.10
55	0.3720	5.1	-3.01
60	0.3206	5.9	-2.93
65	0.2774	6.6	-2.85
70	0.2410	7.4	-2.77
75	0.2102	8.1	-2.70
80	0.1839	8.8	-2.63
85	0.1616	9.5	-2.56
90	0.1424	10.2	-2.49
95	0.1259	10.9	-2.43
100	0.1117	11.5	-2.36
105	0.09938	12.2	-2.30
110	0.08869	12.8	-2.25
115	0.07938	13.4	-2.19
120	0.07124	14.0	-2.14
125	0.06410	14.6	-2.08
130	0.05783	15.2	-2.03
135	0.05230	15.7	-1.98
140	0.04741	16.3	-1.94
145	0.04308	16.8	-1.89
150	0.03924	17.4	-1.85

T (°C)	Material B(K)		
	J-J5 3480		
	R(T) / R25	TF (%)	α (%/°C)
-55	51.75	20.5	-6.23
-50	37.98	17.7	-6.03
-45	28.15	15.2	-5.84
-40	21.07	13.0	-5.65
-35	15.91	11.0	-5.48
-30	12.13	9.3	-5.31
-25	9.321	7.8	-5.15
-20	7.222	6.4	-4.99
-15	5.640	5.2	-4.84
-10	4.438	4.2	-4.69
-5	3.517	3.3	-4.55
0	2.807	2.5	-4.42
5	2.255	1.8	-4.29
10	1.824	1.2	-4.17
15	1.484	0.7	-4.05
20	1.215	0.3	-3.93
25	1.0000	0.0	-3.82
30	0.8278	0.3	-3.71
35	0.6889	0.7	-3.61
40	0.5763	1.1	-3.51
45	0.4845	1.5	-3.41
50	0.4092	2.0	-3.32
55	0.3472	2.5	-3.23
60	0.2960	3.0	-3.15
65	0.2533	3.5	-3.06
70	0.2177	4.1	-2.98
75	0.1879	4.7	-2.90
80	0.1628	5.3	-2.83
85	0.1415	5.9	-2.76
90	0.12349	6.5	-2.69
95	0.10813	7.1	-2.62
100	0.09499	7.7	-2.55
105	0.08372	8.4	-2.49
110	0.07402	9.0	-2.43
115	0.06564	9.7	-2.37
120	0.05837	10.3	-2.31
125	0.05206	11.0	-2.26
130	0.04656	11.6	-2.21
135	0.04175	12.3	-2.15
140	0.03753	13.0	-2.10
145	0.03382	13.6	-2.06
150	0.03055	14.3	-2.01

T (°C)	Material B(K)		
	K 3630		
	R(T) / R25	TF (%)	α (%/°C)
-55	56.27	21.4	-6.25
-50	41.22	18.5	-6.06
-45	30.48	15.9	-5.89
-40	22.74	13.6	-5.71
-35	17.11	11.5	-5.55
-30	12.98	9.7	-5.39
-25	9.931	8.1	-5.24
-20	7.655	6.7	-5.09
-15	5.945	5.4	-4.95
-10	4.651	4.4	-4.81
-5	3.663	3.4	-4.67
0	2.905	2.6	-4.54
5	2.319	1.9	-4.42
10	1.862	1.3	-4.30
15	1.505	0.8	-4.18
20	1.223	0.3	-4.07
25	1.0000	0.0	-3.96
30	0.8219	0.3	-3.85
35	0.6792	0.7	-3.75
40	0.5641	1.1	-3.65
45	0.4708	1.6	-3.55
50	0.3949	2.1	-3.46
55	0.3327	2.6	-3.37
60	0.2816	3.1	-3.28
65	0.2393	3.7	-3.20
70	0.2043	4.3	-3.12
75	0.1751	4.9	-3.04
80	0.1506	5.5	-2.96
85	0.1301	6.1	-2.89
90	0.1128	6.8	-2.82
95	0.09811	7.4	-2.75
100	0.08564	8.1	-2.68
105	0.07501	8.7	-2.61
110	0.06591	9.4	-2.55
115	0.05809	10.1	-2.49
120	0.05136	10.8	-2.43
125	0.04554	11.5	-2.37
130	0.04049	12.2	-2.32
135	0.03611	12.8	-2.26
140	0.03228	13.5	-2.21
145	0.02893	14.2	-2.16
150	0.02600	14.9	-2.11

T (°C)	Material B(K)		
	KA 3625		
	R(T) / R25	TF (%)	α (%/°C)
-55	61.22	7.1	-6.55
-50	44.25	6.1	-6.33
-45	32.34	5.3	-6.12
-40	23.88	4.5	-5.92
-35	17.81	3.8	-5.73
-30	13.41	3.2	-5.54
-25	10.19	2.7	-5.37
-20	7.815	2.2	-5.20
-15	6.041	1.8	-5.04
-10	4.707	1.5	-4.89
-5	3.696	1.1	-4.74
0	2.923	0.9	-4.60
5	2.329	0.6	-4.46
10	1.867	0.4	-4.33
15	1.507	0.3	-4.21
20	1.224	0.1	-4.09
25	1.0000	0.0	-3.97
30	0.8217	0.1	-3.86
35	0.6788	0.2	-3.75
40	0.5638	0.4	-3.65
45	0.4707	0.5	-3.55
50	0.3948	0.7	-3.46
55	0.3328	0.9	-3.37
60	0.2817	1.0	-3.28
65	0.2396	1.2	-3.19
70	0.2046	1.4	-3.11
75	0.1754	1.6	-3.03
80	0.1510	1.8	-2.96
85	0.1305	2.0	-2.88
90	0.1131	2.3	-2.81
95	0.09844	2.5	-2.74
100	0.08596	2.7	-2.68
105	0.07530	2.9	-2.61
110	0.06618	3.1	-2.55
115	0.05833	3.4	-2.49
120	0.05157	3.6	-2.43
125	0.04573	3.8	-2.38
130	0.04065	4.0	-2.32
135	0.03624	4.3	-2.27
140	0.03239	4.5	-2.22
145	0.02902	4.7	-2.17
150	0.02607	5.0	-2.12

T (°C)	Material B(K)		
	KC 3470		
	R(T) / R25	TF (%)	α (%/°C)
-55	60.08	34.0	-7.00
-50	43.19	29.4	-6.71
-45	31.42	25.3	-6.44
-40	23.13	21.6	-6.18
-35	17.22	18.4	-5.94
-30	12.95	15.5	-5.71
-25	9.842	12.9	-5.49
-20	7.550	10.7	-5.29
-15	5.845	8.7	-5.10
-10	4.564	6.9	-4.91
-5	3.594	5.4	-4.74
0	2.853	4.1	-4.58
5	2.281	3.0	-4.42
10	1.838	2.0	-4.27
15	1.491	1.2	-4.13
20	1.217	0.5	-4.00
25	1.0000	0.0	-3.90
30	0.8267	0.5	-3.74
35	0.6873	1.1	-3.63
40	0.5747	1.8	-3.52
45	0.4830	2.5	-3.41
50	0.4081	3.3	-3.31
55	0.3465	4.1	-3.21
60	0.2955	5.0	-3.12
65	0.2532	5.9	-3.03
70	0.2179	6.8	-2.94
75	0.1883	7.8	-2.86
80	0.1634	8.7	-2.78
85	0.1423	9.7	-2.71
90	0.1244	10.8	-2.63
95	0.10915	11.8	-2.56
100	0.09608	12.9	-2.50
105	0.08486	13.9	-2.43
110	0.07519	15.0	-2.37
115	0.06683	16.1	-2.31
120	0.05957	17.2	-2.25
125	0.05325	18.3	-2.20
130	0.04774	19.4	-2.14
135	0.04290	20.5	-2.09
140	0.03866	21.6	-2.04
145	0.03492	22.7	-1.99
150	0.03162	23.8	-1.95

T (°C)	Material B(K)		
	KC 3470		
	R(T) / R25	TF (%)	α (%/°C)
-55	82.54	22.3	-7.12
-50	58.03	19.3	-6.87
-45	41.31	16.6	-6.63
-40	29.75	14.2	-6.40
-35	21.68	12.0	-6.18
-30	15.97	10.1	-5.98
-25	11.88	8.5	-5.78
-20	8.931	7.0	-5.59
-15	6.777	5.7	-5.40
-10	5.188	4.5	-5.23
-5	4.007	3.6	-5.06
0	3.120	2.7	-4.90
5	2.449	2.0	-4.75
10	1.937	1.3	-4.60
15	1.543	0.8	-4.46
20	1.238	0.4	-4.33
25	1.0000	0.0	-4.20
30	0.8128	0.3	-4.07
35	0.6648	0.7	-3.95
40	0.5469	1.2	-3.84
45	0.4525	1.6	-3.73
50	0.3764	2.2	-3.62
55	0.3148	2.7	-3.52
60	0.2646	3.3	-3.42
65	0.2235	3.8	-3.33
70	0.1896	4.5	-3.24
75	0.1616	5.1	-3.15
80	0.1383	5.7	-3.07
85	0.1189	6.4	-2.98
90	0.1026	7.1	-2.91
95	0.08888	7.7	-2.83
100	0.07728	8.4	-2.76
105	0.06744	9.1	-2.69
110	0.05905	9.8	-2.62
115	0.05188	10.5	-2.56
120	0.04572	11.3	-2.49
125	0.04042	12.0	-2.43
130	0.03585	12.7	-2.37
135	0.03188	13.4	-2.32
140	0.02843	14.1	-2.26
145	0.02542	14.8	-2.21
150	0.02279	15.6	-2.16









# Tables of Resistance vs Temperature



T (°C)	Material B(K)		
	RC 4340		
	R(T) / R25	TF (%)	α (%/°C)
-55	105.70	25.5	-7.15
-50	74.01	22.1	-6.95
-45	52.37	19.0	-6.75
-40	37.43	16.2	-6.56
-35	27.01	13.8	-6.38
-30	19.66	11.6	-6.20
-25	14.44	9.7	-6.04
-20	10.70	8.0	-5.87
-15	7.990	6.5	-5.72
-10	6.013	5.2	-5.57
-5	4.559	4.1	-5.42
0	3.482	3.1	-5.29
5	2.678	2.2	-5.15
10	2.074	1.5	-5.02
15	1.616	0.9	-4.90
20	1.267	0.4	-4.77
25	1.0000	0.0	-4.66
30	0.7936	0.4	-4.54
35	0.6334	0.8	-4.43
40	0.5083	1.3	-4.33
45	0.4100	1.9	-4.23
50	0.3325	2.5	-4.13
55	0.2709	3.1	-4.03
60	0.2218	3.7	-3.94
65	0.1825	4.4	-3.85
70	0.1508	5.1	-3.76
75	0.1251	5.8	-3.67
80	0.1043	6.6	-3.59
85	0.08727	7.3	-3.51
90	0.07332	8.1	-3.43
95	0.06184	8.9	-3.36
100	0.05235	9.7	-3.29
105	0.04448	10.5	-3.22
110	0.03793	11.3	-3.15
115	0.03245	12.1	-3.08
120	0.02785	12.9	-3.01
125	0.02399	13.7	-2.95
130	0.02072	14.5	-2.89
135	0.01796	15.4	-2.83
140	0.01561	16.2	-2.77
145	0.01360	17.0	-2.72
150	0.01189	17.8	-2.66

T (°C)	Material B(K)		
	T 4630		
	R(T) / R25	TF (%)	α (%/°C)
-55	137.10	27.2	-7.33
-50	94.94	23.5	-7.15
-45	66.35	20.2	-6.98
-40	46.78	17.3	-6.82
-35	33.25	14.7	-6.66
-30	23.84	12.4	-6.50
-25	17.23	10.3	-6.35
-20	12.54	8.5	-6.20
-15	9.206	6.9	-6.05
-10	6.807	5.6	-5.91
-5	5.070	4.3	-5.77
0	3.803	3.3	-5.63
5	2.873	2.4	-5.50
10	2.185	1.6	-5.36
15	1.673	1.0	-5.23
20	1.289	0.4	-5.11
25	1.0000	0.0	-4.99
30	0.7805	0.4	-4.86
35	0.6129	0.9	-4.75
40	0.4841	1.4	-4.63
45	0.3847	2.0	-4.52
50	0.3074	2.6	-4.41
55	0.2470	3.3	-4.30
60	0.1996	4.0	-4.19
65	0.1621	4.7	-4.09
70	0.1323	5.4	-3.99
75	0.1086	6.2	-3.89
80	0.08951	7.0	-3.80
85	0.07416	7.8	-3.71
90	0.06172	8.6	-3.62
95	0.05160	9.5	-3.53
100	0.04333	10.3	-3.44
105	0.03655	11.2	-3.36
110	0.03095	12.0	-3.28
115	0.02632	12.9	-3.20
120	0.02246	13.7	-3.12
125	0.01925	14.6	-3.05
130	0.01656	15.5	-2.97
135	0.01429	16.4	-2.90
140	0.01238	17.3	-2.83
145	0.01076	18.1	-2.77
150	0.009383	19.0	-2.70

T (°C)	Material B(K)		
	U 4840		
	R(T) / R25	TF (%)	α (%/°C)
-55	173.70	28.5	-7.69
-50	118.20	24.6	-7.50
-45	81.18	21.2	-7.32
-40	56.26	18.1	-7.15
-35	39.34	15.4	-6.98
-30	27.75	12.9	-6.82
-25	19.74	10.8	-6.66
-20	14.15	8.9	-6.50
-15	10.23	7.3	-6.34
-10	7.457	5.8	-6.19
-5	5.476	4.5	-6.04
0	4.051	3.4	-5.90
5	3.020	2.5	-5.76
10	2.267	1.7	-5.62
15	1.714	1.0	-5.48
20	1.305	0.5	-5.35
25	1.0000	0.0	-5.22
30	0.7715	0.4	-5.09
35	0.5991	0.9	-4.97
40	0.4681	1.5	-4.84
45	0.3680	2.1	-4.72
50	0.2911	2.8	-4.61
55	0.2316	3.4	-4.49
60	0.1853	4.2	-4.38
65	0.1491	4.9	-4.28
70	0.1206	5.7	-4.17
75	0.09812	6.5	-4.07
80	0.08022	7.3	-3.97
85	0.06591	8.2	-3.87
90	0.05442	9.0	-3.77
95	0.04515	9.9	-3.68
100	0.03763	10.8	-3.59
105	0.03150	11.7	-3.50
110	0.02649	12.6	-3.42
115	0.02237	13.5	-3.33
120	0.01897	14.4	-3.25
125	0.01615	15.3	-3.17
130	0.01380	16.2	-3.10
135	0.01184	17.1	-3.02
140	0.01020	18.0	-2.95
145	0.008814	19.0	-2.88
150	0.007643	19.9	-2.81

T (°C)	Material B(K)		
	S 4520		
	R(T) / R25	TF (%)	α (%/°C)
-55	126.10	26.6	-7.25
-50	87.75	23.0	-7.07
-45	61.60	19.8	-6.90
-40	43.63	16.9	-6.73
-35	31.17	14.3	-6.56
-30	22.46	12.1	-6.40
-25	16.31	10.1	-6.25
-20	11.94	8.3	-6.10
-15	8.809	6.8	-5.95
-10	6.549	5.4	-5.80
-5	4.904	4.2	-5.66
0	3.699	3.2	-5.52
5	2.810	2.3	-5.39
10	2.149	1.6	-5.26
15	1.654	1.0	-5.13
20	1.282	0.4	-5.00
25	1.0000	0.0	-4.88
30	0.7848	0.4	-4.76
35	0.6196	0.9	-4.64
40	0.4921	1.4	-4.52
45	0.3931	2.0	-4.41
50	0.3158	2.6	-4.30
55	0.2551	3.2	-4.20
60	0.2072	3.9	-4.09
65	0.1691	4.6	-3.99
70	0.1387	5.3	-3.89
75	0.1144	6.1	-3.80
80	0.0948	6.8	-3.71
85	0.0789	7.6	-3.61
90	0.06594	8.4	-3.53
95	0.05538	9.2	-3.44
100	0.04671	10.1	-3.36
105	0.03956	10.9	-3.28
110	0.03364	11.7	-3.20
115	0.02872	12.6	-3.12
120	0.02461	13.4	-3.04
125	0.02117	14.3	-2.97
130	0.01827	15.1	-2.90
135	0.01583	16.0	-2.83
140	0.01376	16.8	-2.77
145	0.01200	17.7	-2.70
150	0.01050	18.6	-2.64

T (°C)	Material B(K)		
	SC 4500		
	R(T) / R25	TF (%)	α (%/°C)
-55	129.80	26.5	-7.51
-50	89.31	22.9	-7.29
-45	62.15	19.7	-7.07
-40	43.72	16.8	-6.87
-35	31.07	14.3	-6.68
-30	22.29	12.0	-6.49
-25	16.15	10.0	-6.31
-20	11.80	8.3	-6.14
-15	8.703	6.8	-5.97
-10	6.470	5.4	-5.81
-5	4.849	4.2	-5.66
0	3.662	3.2	-5.51
5	2.786	2.3	-5.36
10	2.135	1.6	-5.23
15	1.647	0.9	-5.09
20	1.279	0.4	-4.96
25	1.0000	0.0	-4.84
30	0.7865	0.4	-4.72
35	0.6223	0.9	-4.60
40	0.4953	1.4	-4.49
45	0.3963	2.0	-4.38
50	0.3189	2.6	-4.28
55	0.2579	3.2	-4.18
60	0.2096	3.9	-4.08
65	0.1712	4.6	-3.99
70	0.1405	5.3	-3.89
75	0.1159	6.0	-3.80
80	0.09595	6.8	-3.72
85	0.07980	7.6	-3.63
90	0.06664	8.4	-3.55
95	0.05588	9.2	-3.47
100	0.04704	10.0	-3.40
105	0.03975	10.8	-3.32
110	0.03371	11.7	-3.25
115	0.02869	12.5	-3.18
120	0.02450	13.4	-3.12
125	0.02100	14.2	-3.05
130	0.01805	15.1	-2.99
135	0.01557	15.9	-2.92
140	0.01347	16.8	-2.86
145	0.01169	17.6	-2.80
150	0.01017	18.5	-2.75

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