

# NTC ACCURATE THERMISTORS

## NP30 - NJ 28 – NI 24 – NK 20

High precision resistance and an outstanding ability to reproduce the sensibility index B, make these ranges of products the types of thermistors ideal for temperature measurement applications.

Leaded or unleaded, these small size and rapid response time thermistors

are able to meet the most accurate requirements.

### FEATURES

- High Accuracy
- Fast thermal response
- Commercial, Industrial and Automotive Applications
- AEC-Q200 based qualification

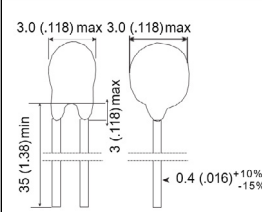
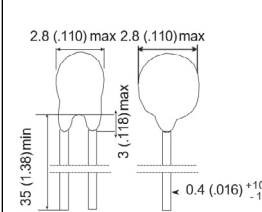
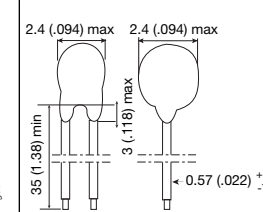
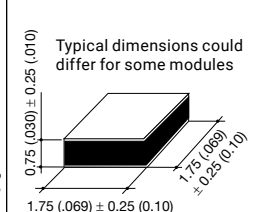
### OPTIONS

Consult factory for availability of options

- other nominal resistance values
- other tolerances
- controlled dimensions (e.g. reduced head size for NP30)
- alternative lead materials (e.g. steel, nickel)
- customized lead lengths, spacing, forming (kink) etc.
- epoxy coating on leads (NP30)

### APPLICATIONS

- Temperature measurement
- Liquid level or flow detection
- Alarms and fire detectors
- HVAC and Refrigeration
- Fans
- Air intake temperature
- Electric pump module
- Water Temperature
- Evaporator probe
- and more

Types	NP 30	NJ 28	NI 24	NK 20
Finish	Coated chip with epoxy+ tinned copper wires	Coated chip with phenolic resin + varnish + tinned copper wires	Coated chip with epoxy AWG30 insulated leads + Silver plated nickel wires	Chip for Wire bonding
<b>DIMENSIONS:</b> millimeters (inches)				 <p>Typical dimensions could differ for some modules</p>
Marking	On packaging only			
Operating temperature	-55°C to +150°C			
Tolerance on Rn (25°C)	±1%, ±2%, ±3%, ±5%			
Maximum dissipation at 25°C	0.16 W			
Thermal dissipation factor	4 mW/°C	3 mW/°C	1.5 mW/°C	2 mW/°C
Thermal time constant	9 s	8 s	16 s	6 s
Response time	< 2 s			

# NTC ACCURATE THERMISTORS

## NP30 - NJ 28 – NI 24 – NK 20

### HOW TO ORDER

<b>NP30</b>	<b>MA</b>	<b>0502</b>	<b>H</b>	<b>--</b>
<b>Type</b> NP30 NJ28 NI24 NK20	<b>Material Code</b> MA (See table above)	<b>Resistance</b> 5 kΩ (See table above)	<b>Tolerance</b> F (±1%) G (±2%) H (±3%) J (±5%)	<b>Packaging</b> --: Bulk CA: Ammopack, H=16mm* CB: Tape & Reel, H=16mm* CC: Tape & Reel, H=19mm* CD: Tape & Reel, H=19mm*

\*Available for NP30 and NJ28 only  
(See table page 25)

### TABLE OF VALUES–NP30–NJ28–NI24–NK20

Part Number	Rn at 25°C (Ω)	Available Rn Tol at 25°C	Material Code	B25/85 (K)	at 25°C (%/°C)
N_ _ _JA0501 - - -	500	F, G, H, J	JA	3564±1%	-3.91
N_ _ _JA0102 - - -	1,000	F, G, H, J	JA	3564±1%	-3.91
N_ _ _JA0202 - - -	2,000	F, G, H, J	JA	3564±1%	-3.91
N_ _ _KA0202 - - -	2,000	F, G, H, J	KA	3625±1%	-4.38
N_ _ _JA0212 - - -	2,100	F, G, H, J	JA	3564±1%	-3.91
N_ _ _MA0222 - - -	2,200	F, G, H, J	MA	3965±0.5%	-4.38
N_ _ _ME0222 - - -	2,200	F, G, H, J	ME	3975±0.5%	-4.40
N_ _ _MA0272 - - -	2,700	F, G, H, J	MA	3965±0.5%	-4.38
N_ _ _ME0272 - - -	2,700	F, G, H, J	ME	3975±0.5%	-4.40
N_ _ _MN0272 - - -	2,700	F, G, H, J	MN	4077±0.5%	-4.47
N_ _ _MA0282 - - -	2,800	F, G, H, J	MA	3965±0.5%	-4.38
N_ _ _ME0282 - - -	2,800	F, G, H, J	ME	3975±0.5%	-4.40
N_ _ _MN0282 - - -	2,800	F, G, H, J	MN	4077±0.5%	-4.47
N_ _ _MA0302 - - -	3,000	F, G, H, J	MA	3965±0.5%	-4.38
N_ _ _ME0302 - - -	3,000	F, G, H, J	ME	3975±0.5%	-4.40
N_ _ _MN0302 - - -	3,000	F, G, H, J	MN	4077±0.5%	-4.47
N_ _ _MA0392 - - -	3,900	F, G, H, J	MA	3965±0.5%	-4.38
N_ _ _MN0392 - - -	3,900	F, G, H, J	ME	3975±0.5%	-4.40
N_ _ _ME0392 - - -	3,900	F, G, H, J	MN	4077±0.5%	-4.47
N_ _ _MA0472 - - -	4,700	F, G, H, J	MA	3965±0.5%	-4.38
N_ _ _ME0472 - - -	4,700	F, G, H, J	ME	3975±0.5%	-4.40
N_ _ _MN0472 - - -	4,700	F, G, H, J	MN	4077±0.5%	-4.47
N_ _ _MA0502 - - -	5,000	F, G, H, J	MA	3965±0.5%	-4.38
N_ _ _ME0502 - - -	5,000	F, G, H, J	ME	3975±0.5%	-4.40
N_ _ _MN0502 - - -	5,000	F, G, H, J	MN	4077±0.5%	-4.47
N_ _ _MA0512 - - -	5,100	F, G, H, J	MA	3965±0.5%	-4.38
N_ _ _ME0512 - - -	5,100	F, G, H, J	ME	3975±0.5%	-4.40
N_ _ _MN0512 - - -	5,100	F, G, H, J	MN	4077±0.5%	-4.47
N_ _ _MA0602 - - -	6,000	F, G, H, J	MA	3965±0.5%	-4.38
N_ _ _ME0602 - - -	6,000	F, G, H, J	ME	3975±0.5%	-4.4
N_ _ _MN0602 - - -	6,000	F, G, H, J	MN	4077±0.5%	-4.47

\_ \_ \_ = Insert Product type (NP30, NJ28, NI24, NK20)

- - - = Insert Tolerance and packaging code

# NTC ACCURATE THERMISTORS

## NP30 - NJ 28 – NI 24 – NK 20

### TABLE OF VALUES–NP30–NJ28–NI24–NK20

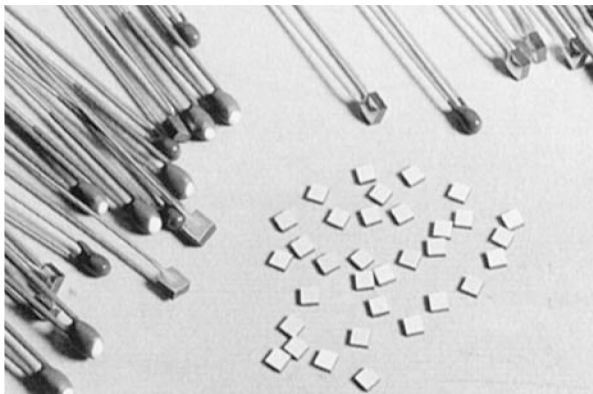
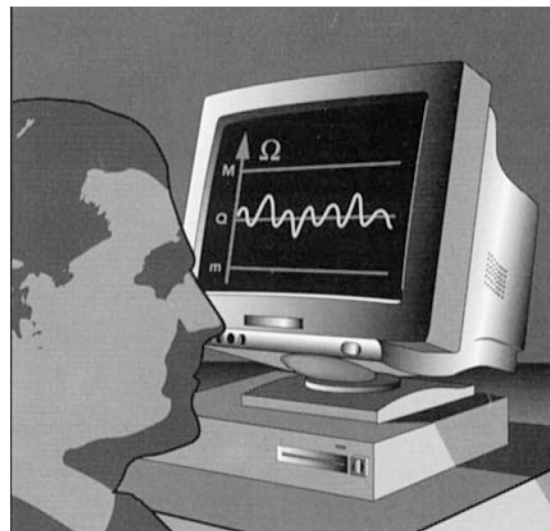
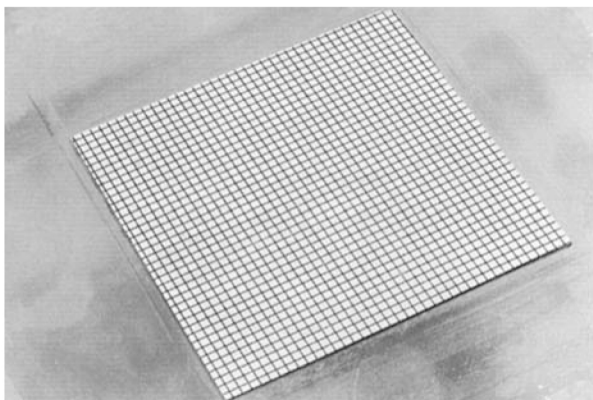
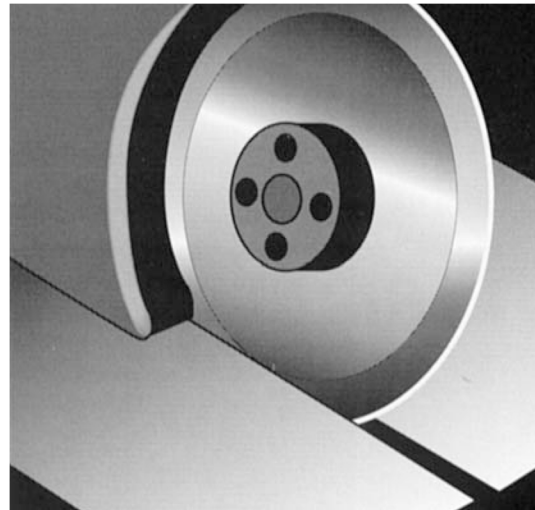
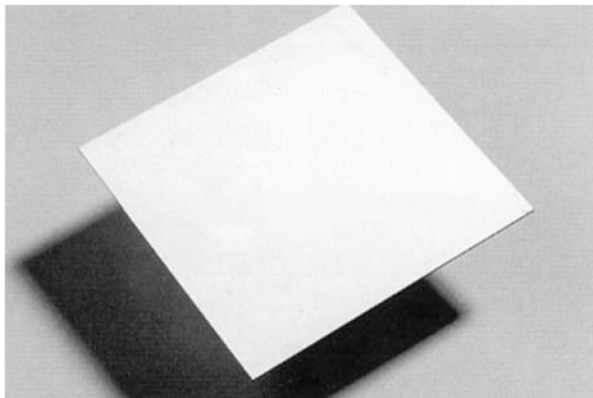
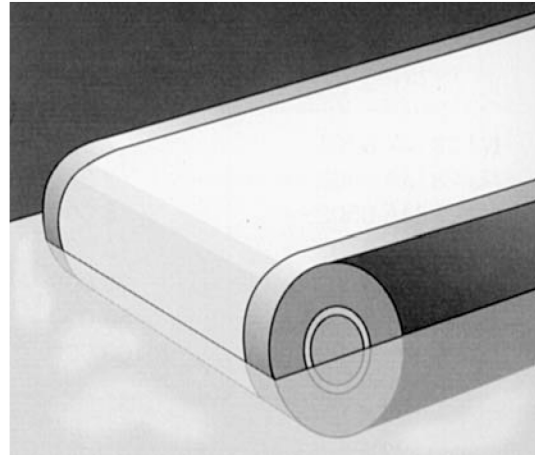
Part Number	Rn at 25°C (Ω)	Available Rn Tol at 25°C	Material Code	B25/85 (K)	at 25°C (%/°C)
N___MA0702 ---	7,000	F, G, H, J	MA	3965±0.5%	-4.38
N___ME0702 ---	7,000	F, G, H, J	ME	3975±0.5%	-4.4
N___MN0702 ---	7,000	F, G, H, J	MN	4077±0.5%	-4.47
N___MA0802 ---	8,000	F, G, H, J	MA	3965±0.5%	-4.38
N___ME0802 ---	8,000	F, G, H, J	ME	3975±0.5%	-4.4
N___MN0802 ---	8,000	F, G, H, J	MN	4077±0.5%	-4.47
N___MA0103 ---	10,000	F, G, H, J	MA	3965±0.5%	-4.38
N___NA0103 ---	10,000	F, G, H, J	NA	4100±1%	-4.6
N___NA0123 ---	12,000	F, G, H, J	NA	4100±1%	-4.6
N___NA0153 ---	15,000	F, G, H, J	NA	4100±1%	-4.6
N___PA0203 ---	20,000	F, G, H, J	PA	4235±1%	-4.8
N___PA0253 ---	25,000	F, G, H, J	PA	4235±1%	-4.8
N___PA0303 ---	30,000	F, G, H, J	PA	4235±1%	-4.8
N___QA0473 ---	47,000	F, G, H, J	QA	4250±1%	-4.8
N___QA0503 ---	50,000	F, G, H, J	QA	4250±1%	-4.8
N___RA0104 ---	100,000	F, G, H, J	RA	4380±1%	-4.9
N___RA0154 ---	150,000	F, G, H, J	RA	4380±1%	-4.9
N___RA0204 ---	200,000	F, G, H, J	RA	4380±1%	-4.9

\_\_\_ = Insert Product type (NP30, NJ28, NI24, NK20)

--- = Insert Tolerance and packaging code

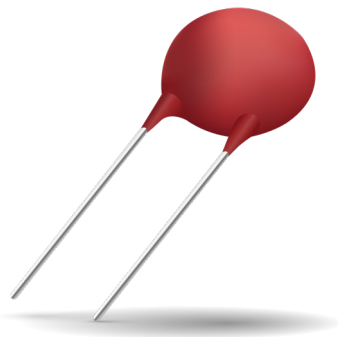
# NTC THERMISTORS MANUFACTURING PROCESS

NP30 - NJ 28 - NI 24 - NK 20



# NTC DISC THERMISTORS

ND 03/06/09 – NE 03/06/09 – NV 06/09



## APPLICATIONS

- ND or NE: Commercial, Industrial and Automotive Applications AEC-Q200 based Qual  
NV: Professional Applications
- Alarm and temperature measurement application
- Temperature regulation application
- Level detection application
- Compensation application and more

## TECHNOLOGY

- ND: epoxy-phenolic resin coating  
NE: epoxy resin coating (recommended for severe mounting conditions)  
NV: epoxy varnish coating
- Leads: Radial copper wire tinned
- Marking: on package only for ND03 & NE03  
ND/NE 06/09: Nominal resistance and tolerance for  $\pm 5\%$ ,  $\pm 10\%$   
NV06/09: Nominal resistance and tolerance
- Delivery Mode: Bulk, reeled or ammopacked

## PERFORMANCE CHARACTERISTICS

Types	General purpose			Professional	
	ND03 or NE03	ND06 or NE06	ND09 or NE09	NV06	NV09
Climatic category				55/125/56-434	55/125/56-434
Operating Temperature	-55 to +150°C	-55 to +150°C	-55 to +150°C	-55 to +150°C	-55 to +150°C
Tolerance on Rn (25°C)	330Ω to 1MΩ : $\pm 3^*$ , 5, 10, 20% 1500Ω to 150 kΩ : $\pm 3\%$	$\pm 3^*$ , 5, 10, $\pm 20\%$	$\pm 3^*$ , 5, 10, $\pm 20\%$	$\pm 2, 3, 5, \pm 10\%$	$\pm 2, 3, 5, \pm 10\%$
Maximum dissipation at 25°C	0.25 W	0.71 W	0.9 W	0.69 W	0.85 W
Thermal dissipation factor	5 mW/°C	7.1 mW/°C	9 mW/°C	6.9 mW/°C	8.5 mW/°C
Thermal time constant	10 s	22 s	30 s	18 s	30 s
Response time	< 3s				

## STANDARDIZATION

NV range : approved by  
 NFC 93271  
 Type: TN115 A for NV06  
 TN116 for NV09  
 List: GAM-T1  
 List: LNZ

\* Optional tolerance, please contact factory

## OPTIONS

Consult factory for availability of options:

- other nominal resistance values
- other tolerances
- alternative lead materials or lengths
- controlled dimensions

# NTC DISC THERMISTORS

## ND/NE 03

### HOW TO ORDER

#### ND06

##### Type

ND03  
NE03  
ND06  
NE06  
NV06

ND09  
NE09  
NV09

#### P0

##### Material Code

P  
(See tables  
page 23-25)

#### 0103

##### Resistance

10 kΩ  
(See tables  
page 22-24)

#### K

##### Tolerance

G (±2%) for NV  
H (±3%)\*  
J (±5%)  
K (±10%)  
M (±20%)

#### --

##### Packaging

--: Bulk  
Ammopack  
(See table page 26)  
Tape and reel  
(See table page 26)

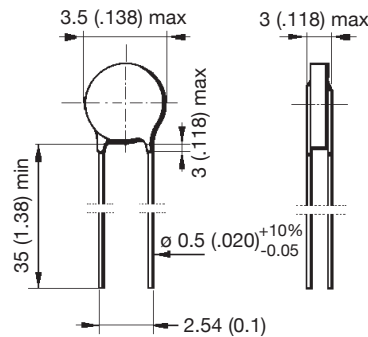
\* Optional tolerance, please contact factory

### TABLE OF VALUES

#### ND03/NE03 TYPE

Part Number	Rn at 25°C (Ω)	Material Code	B (K) (B/B <sup>(1)</sup> ± 5% (2) ± 3%)	α at 25°C (%/°C)
N_03J00681	680	J	3480 (2)	- 3.9
N_03J00102	1,000			
N_03K00152	1,500	K	3630 (2)	- 4.0
N_03K00222	2,200			
N_03L00272	2,700	L	3790 (2)	- 4.2
N_03L00332	3,300			
N_03M00472	4,700	M	3950 (2)	- 4.4
N_03M00682	6,800			
N_03N00103	10,000	N	4080 (2)	- 4.6
N_03N00153	15,000			
N_03P00223	22,000	P	4220 (2)	- 4.7
N_03P00333	33,000			
N_03Q00473	47,000	Q	4300 (2)	- 4.7
N_03Q00683	68,000			
N_03R00104	100,000	R	4400 (2)	- 4.8
N_03R00154	150,000			
N_03S00224	220,000	S	4520 (2)	- 5.0
N_03T00334	330,000			
N_03T00474	470,000	T	4630 (2)	- 5.1
N_03U00105	1,000,000			
N_03U00105	1,000,000	U	4840 (2)	- 5.3

#### ND03/NE03



# NTC DISC THERMISTORS

## ND/NE/NV 06

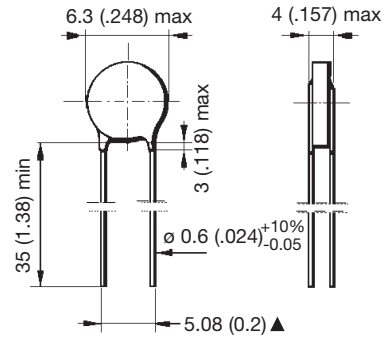
### TABLE OF VALUES

#### ND06/NE06/NV06

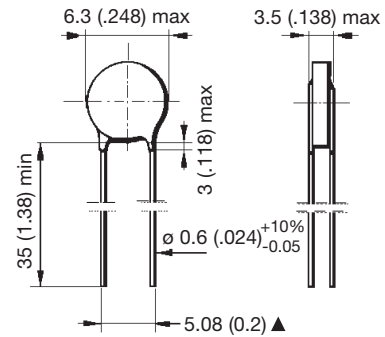
Part Number	Rn at 25°C (Ω)	Material Code	B (K) ( $B/B$ ) (1) ± 5% (2) ± 3%	α at 25°C (%/°C)
N_06J00151	150	J	3480 (2)	- 3.9
N_06J00221	220			
N_06K00331	330	K	3630 (2)	- 4.0
N_06K00471	470			
N_06L00681	680	L	3790 (2)	- 4.2
N_06L00102	1,000			
N_06M00152	1,500	M	3950 (2)	- 4.4
N_06N00222	2,200	N	4080 (2)	- 4.6
N_06N00332	3,300			
N_06P00472	4,700	P	4220 (2)	- 4.7
N_06P00682	6,800			
N_06P00103	10,000	Q	4300 (2)	- 4.7
N_06Q00153	15,000			
N_06Q00223	22,000	R	4400 (2)	- 4.8
N_06R00333	33,000			
N_06S00473	47,000	S	4520 (2)	- 5.0
N_06S00683	68,000			
N_06T00104	100,000	T	4630 (2)	- 5.1
N_06U00154	150,000	U	4840 (2)	- 5.3
N_06U00224	220,000			
N_06U00334	330,000			

For other resistance values, please consult us.

#### ND06/NE06



#### NV06



# NTC DISC THERMISTORS

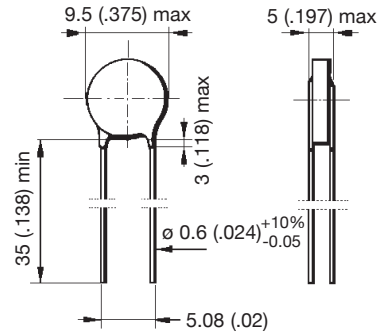
## ND/NE/NV 09

### TABLE OF VALUES

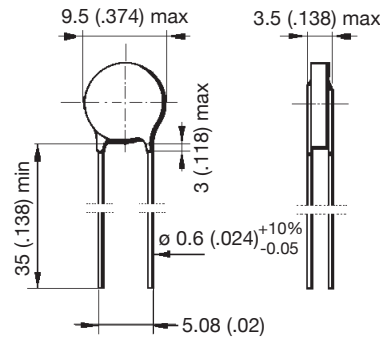
#### ND09/NE09/NV09

Part Number	Rn at 25°C (Ω)	Material Code	B (K) (B/B (1) ± 5% (2) ± 3%)	α at 25°C (%/°C)
N_09J00680	68	J	3480 (2)	- 3.9
N_09J00101	100			
N_09K00151	150	K	3630 (2)	- 4.0
N_09K00221	220			
N_09L00331	330	L	3790 (2)	- 4.2
N_09M00471	470	M	3950 (2)	- 4.4
N_09M00681	680			
N_09N00102	1,000	N	4080 (2)	- 4.6
N_09N00152	1,500			
N_09P00222	2,200	P	4220 (2)	- 4.7
N_09P00332	3,300			
N_09Q00472	4,700	Q	4300 (2)	- 4.7
N_09Q00682	6,800			
N_09R00103	10,000	R	4400 (2)	- 4.8
N_09R00153	15,000			
N_09S00223	22,000	S	4520 (2)	- 5.0
N_09T00333	33,000	T	4630 (2)	- 5.1
N_09T00473	47,000			
N_09U00683	68,000	U	4840 (2)	- 5.3
N_09U00104	100,000			
N_09U00154	150,000			

#### ND09/NE09



#### NV09





# NTC DISC THERMISTORS

## Packaging for Automatic Insertion

### PACKAGING AND KINK SUFFIXES

Tables below indicate the suffixes to specify when ordering to get the required kink and packaging. For devices on tape, it is necessary to specify the height (H or Ho) which is the distance between the tape axis (sprocket holes axis) and the seating plane on the printed circuit board. The following types can be ordered on tape either in AMMOPACK (fan folder) or on REEL in accordance with IEC 286-2.

– **Straight leads:**

H represents the distance between the sprocket holes axis and the bottom plane of component body (base of resin or base of stand off).

– **Kinked leads and flat leads:**

Ho represents the distance between the sprocket holes axis and the base on the knee (kinked leads) or the bottom of the flat part (flat leads).

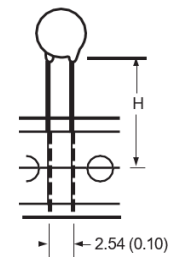
### • Reel & Ammopack

millimeters (inches)

Types	Suffix	H or Ho	Leads	Quantity/Size	Packaging
ND/NE 03 & NJ28	CA	16 ± 0.5 (0.630 ± 0.020)	Straight	3000	AMMOPACK
	CB	16 ± 0.5 (0.630 ± 0.020)	Straight	3000	REEL
	CC	19.5 ± 0.5 (0.768 ± 0.020)	Straight	3000	AMMOPACK
	CD	19.5 ± 0.5 (0.768 ± 0.020)	Straight	3000	REEL
NP30	CA	16 ± 0.5 (0.630 ± 0.020)	Straight	2000	AMMOPACK
	CB	16 ± 0.5 (0.630 ± 0.020)	Straight	2000	REEL
	CC	19.5 ± 0.5 (0.768 ± 0.020)	Straight	2000	AMMOPACK
	CD	19.5 ± 0.5 (0.768 ± 0.020)	Straight	2000	REEL
ND/NE/NV 06/09	DA	16 ± 0.5 (0.630 ± 0.020)	Straight	1500	AMMOPACK
	DB	16 ± 0.5 (0.630 ± 0.020)	Straight	1500	REEL
	DC	19.5 ± 0.5 (0.768 ± 0.020)	Straight	1500	AMMOPACK
	DD	19.5 ± 0.5 (0.768 ± 0.020)	Straight	1500	REEL
	DL	16 ± 0.5 (0.630 ± 0.020)	Kinked	1500	AMMOPACK
	DM	16 ± 0.5 (0.630 ± 0.020)	Kinked	1500	REEL
	DN	19.5 ± 0.5 (0.768 ± 0.020)	Kinked	1500	AMMOPACK
	DP	19.5 ± 0.5 (0.768 ± 0.020)	Kinked	1500	REEL

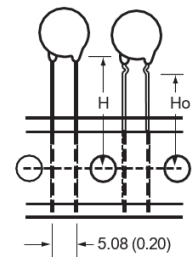
NTC

Type  
ND03  
NE03  
NJ28  
NP30



NTC

Types  
ND/NE/NV  
06/09

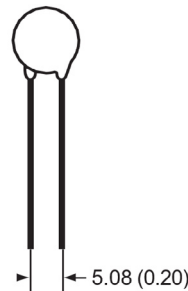
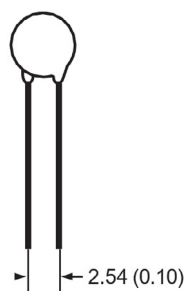


### • Bulk

Type	Quantity/box
ND/NE03	3000
ND/NE06	1500
ND/NE09	1500
NV06	100
NV09	100
NI24 NJ28 NK20 NP30	1000

ND03 / NE03  
NJ28 / NP30

ND/NE/NV  
06/09



# AUTOMATIC INSERTION

## NTC Disc Thermistors

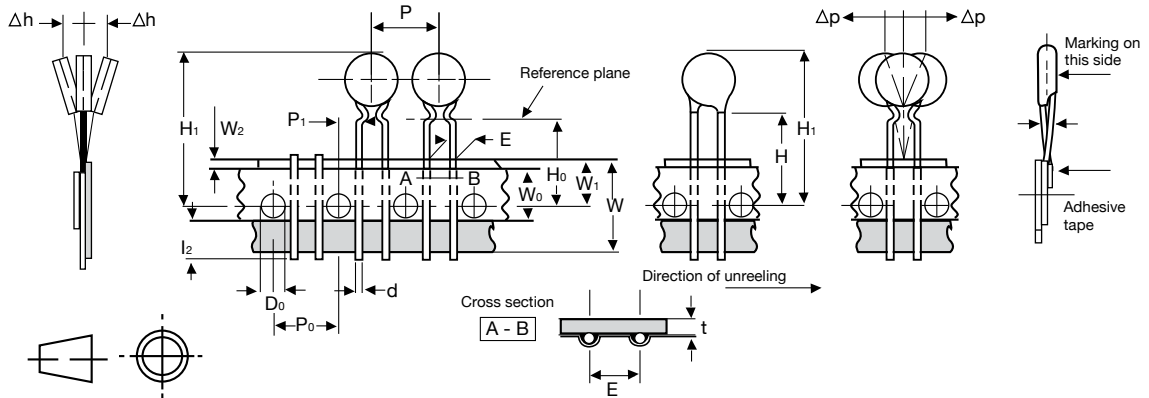
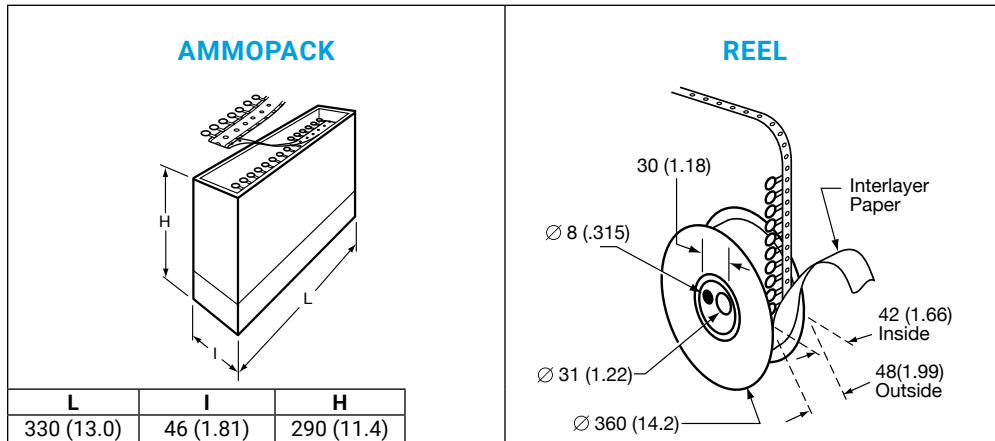
### TAPING CHARACTERISTICS

#### Missing components

A maximum of 3 consecutive components may be missing from the bandolier, surrounded by at least 6 filled positions. The number of missing components may not exceed 0.5% of the total per packing module.

The beginning and the end of tape exhibit 8 or 9 blank positions.

DIMENSIONS: millimeters (inches)

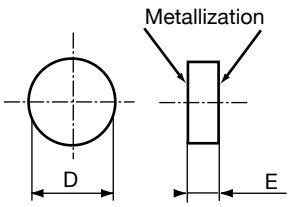


Value	Tolerance	Dimensions Characteristics
18	+1 / -0.5	W Leading tape width
6	$\pm 0.3$	$W_0$ Adhesive tape width
9	+0.75 / -0.5	$W_1$ Sprocket hole position
3 max.		$W_2$ Distance between the top of the tape and the adhesive
4	$\pm 0.2$	$D_0$ Diameter of sprocket hole
16/19.5	$\pm 0.5$	$H_0$ Distance between the tape axis and the seating plane of the component
		$H_1$ Distance between the tape axis and the top of component body

Value	Tolerance	Dimensions Characteristics
12.7	$\pm 0.2$	$P_0$ Sprocket holes pitch
254	$\pm 1$	- Distance between 21 consecutive holes 20 pitches
0.7	$\pm 0.2$	t Total thickness of tape
2.54   5.08	+0.6 -0.1	E Lead spacing
5.08   3.85	$\pm 0.7$	$P_1$ Distance between the sprocket hole axis and the lead axis
12.7	$\pm 1.0$	P Spacing of components
0.5   0.6	$\pm 5\%$	d Lead diameter
0	$\pm 1.3$	$^3P$ Verticality of components
0	$\pm 2$	$^3h$ Alignment of components

# NTC LEADLESS DISC THERMISTORS

This type of product is widely used in automotive and consumer applications. They are assembled in custom-probes for sensing the temperature of liquids (water, oil, ...), gases or surface of any other component. The metallization covers completely the surfaces of the thermistor. The particularly flat and smooth surfaces ensure an excellent electrical and thermal contact under pressure.

Types	NR
Physical data (dim. in mm)	
Marking	On package only / On parts upon request
Operating temperature	-40°C to +200°C
Values and tolerances	Custom - designed products defined with: $D \pm D \quad R_1 \pm R_1/R_1 \text{ at } T_1$ $E \pm E \quad R_2 \pm R_2/R_2 \text{ at } T_2, \dots$

## DESIGN OF THE THERMISTOR

### Choice of the resistances

If the application is to measure the temperature around a defined point, a unique nominal resistance can be chosen (for example, among standard values of the ND range products presented on pages 20 to 24).

When it is required to measure the temperature over selected ranges  $T_1 - T_2$ ,  $T_2 - T_3$ , ..., the corresponding resistance  $R_1$ ,  $R_2$ ,  $R_3$ , ..., must be such that they can be located on the R (T) characteristic of an existing NTC material (for example among standard materials whose R (T) are displayed on pages 29 to 33).

The resistances must also be compatible with the resistivity of the material and the dimensions of the thermistor.

### Choice of the tolerances

The precision of the temperature measurement determines the calculation of the tolerance on the resistance:

$$\Delta R/R = \alpha (\%/^{\circ}\text{C}) \cdot \Delta T (^{\circ}\text{C})$$

For example, the NTC NR55-3049-99, using "N5" material (R (T) characteristic displayed on page 31), requires a precision of 1°C over the temperature range 110°C - 120°C.

The tolerances can be calculated:

$$\Delta R_{110^{\circ}\text{C}}/R_{110^{\circ}\text{C}} = 1^{\circ}\text{C} \cdot 2.91\%/^{\circ}\text{C} = 2.91\%$$

$$\Delta R_{120^{\circ}\text{C}}/R_{120^{\circ}\text{C}} = 1^{\circ}\text{C} \cdot 2.76\%/^{\circ}\text{C} = 2.76\%$$

\*For your specific requirements, please consult us.

## HOW TO ORDER

**NR55 - - 3002 - 99**

Type

P/N Code

# NTC LEADLESS DISC THERMISTORS

We present below some examples of our custom - designed products as an illustration of the different ways to define products.

## DIMENSIONS: millimeters (inches)

Types	D	E	Material Code	B (k)	$R_1 \pm \Delta R_1$ at $T_1$	$T_1$ (°C)	$R_2 \pm \Delta R_2$ at $T_2$	$T_2$ (°C)	$R_3 \pm \Delta R_3$ at $T_3$	$T_3$ (°C)
NR 55 -- 3002 - 99	5.5 (.217) ± 0.5 (.020)	1.1 (.043) ± 0.4 (.016)	N5	4160	1230 Ω ± 7.5%	40	160 Ω ± 5%	96.5	-	-
NR 67 -- 3068 - 99	6.7 (.264) ± 0.5 (.020)	1.7 (.067) ± 0.3 (.012)	N	4080	150 Ω ± 3.3%	100	51 Ω ± 5.3%	140	-	-
NR 55 -- 3049 - 99	5.5 (.217) ± 0.5 (.020)	1.0 (.040) ± 0.2 (.008)	N5	4160	107 Ω ± 2.9%	110	80.6 Ω ± 2.8%	120	-	-
NR 55 -- 3046 - 99	5.5 (.217) ± 0.5 (.020)	1.3 (.051) ± 0.4 (.016)	S	4520	48600 Ω ± 7.5%	25	3210 Ω ± 5%	90	-	-
NR 49 -- 3119 - 99	4.9 (.193) ± 0.3 (.012)	1.5 (.060) ± 0.4 (.016)	M	3950	840 Ω ± 10%	37.8	84 Ω ± 5%	104.4	-	-
NR 55 -- 3114 - 99	5.5 (.217) ± 0.4 (.016)	1.0 (.040) ± 0.2 (.008)	P	4220	5000 Ω ± 10%	25	-	-	-	-
NR 70 -- 3121 - 99	7.0 (.275) ± 0.3 (.012)	1.2 (.047) ± 0.2 (.008)	L	3790	210 Ω ± 10%	40	40 Ω ± 7.5%	90	30 Ω ± 6.7%	100
NR 29 -- 3107 - 99	2.9 (.014) ± 0.3 (.012)	1.7 (.067) ± 0.3 (.012)	K	3630	2050 Ω ± 6%	25	193 Ω ± 5.4%	96.5	-	-
NR 55 -- 3122 - 99	5.5 (.217) ± 0.5 (.020)	1.5 (.060) ± 0.4 (.016)	J	3480	210 Ω ± 5%	25	-	-	-	-
NR 55 -- 3126 - 99	5.5 (.217) ± 0.5 (.020)	1.0 (.040) ± 0.2 (.008)	P	4220	3340 Ω ± 10%	25	264 Ω ± 7%	90	107 Ω ± 7%	120
NR 47 -- 3116 - 99	4.7 (.185) ± 0.4 (.016)	1.2 (.047) ± 0.2 (.008)	R	4400	33000 Ω ± 2%	25	-	-	-	-
NR 49 -- 3113 - 99	4.9 (.193) ± 0.3 (.012)	1.2 (.047) ± 0.2 (.008)	N	4080	1680 Ω ± 10%	40	382 Ω ± 6.7%	80	176 Ω ± 5%	105
NR 47 -- 3101 - 99	4.6 (.181) ± 0.3 (.012)	1.4 (.055) ± 0.3 (.012)	J	3480	146 Ω ± 13%	40	22 Ω ± 10%	100	-	-
NR 55 -- 3071 - 99	5.8 (.228) ± 0.3 (.012)	1.0 (.040) ± 0.2 (.008)	L	3790	262 Ω ± 8.7%	40	120 Ω ± 10%	60	35.5 Ω ± 7.8%	100
NR 61 -- 3063 - 99	6.1 (.240) ± 0.3 (.012)	1.5 (.060) ± 0.3 (.012)	N	4080	760 Ω ± 9.2%	50	130 Ω ± 8.5%	100	56.6 Ω ± 8.5%	130
NR 67 -- 3053 - 99	6.7 (.264) ± 0.4 (.016)	1.7 (.067) ± 0.3 (.012)	N	4080	540 Ω ± 11%	60	144 Ω ± 7%	100	-	-
NR 50 -- 3048 - 99	5.0 (.197) ± 0.5 (.020)	1.5 (.060) ± 0.5 (.020)	J	3480	233 Ω ± 10%	25	13.3 Ω ± 7%	121	-	-
NR 60 -- 3021 - 99	6.0 (.236) ± 0.5 (.020)	3.2 (.125) ± 0.3 (.012)	P	4220	3640 Ω ± 3%	40	457 Ω ± 3%	96.5	-	-
NR 55 -- 3016 - 99	5.5 (.217) ± 0.5 (.020)	1.1 (.043) ± 0.4 (.016)	Q	4300	5500 Ω ± 9%	40	650 Ω ± 7.7%	96.5	-	-

Resistance - Temperature characteristics: pages 29 to 33.

# 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)
1.4 pt	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

# TABLES OF RESISTANCE VS TEMPERATURE

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)		
	L0 3790		
	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)		
	L2 3805		
	R(T) / R25	TF (%)	α (%/°C)
-55	62.45	22.4	-6.41
-50	45.40	19.3	-6.22
-45	33.33	16.6	-6.03
-40	24.70	14.2	-5.85
-35	18.47	12.1	-5.68
-30	13.92	10.2	-5.52
-25	10.58	8.5	-5.36
-20	8.110	7.0	-5.21
-15	6.260	5.7	-5.07
-10	4.867	4.6	-4.93
-5	3.810	3.6	-4.80
0	3.003	2.7	-4.67
5	2.382	2.0	-4.55
10	1.901	1.3	-4.43
15	1.526	0.8	-4.31
20	1.232	0.4	-4.20
25	1.0000	0.0	-4.10
30	0.8161	0.3	-4.00
35	0.6694	0.7	-3.90
40	0.5518	1.2	-3.80
45	0.4570	1.7	-3.71
50	0.3802	2.2	-3.62
55	0.3178	2.7	-3.53
60	0.2667	3.3	-3.45
65	0.2248	3.9	-3.37
70	0.1902	4.5	-3.29
75	0.1615	5.1	-3.22
80	0.1377	5.8	-3.14
85	0.1179	6.4	-3.07
90	0.1012	7.1	-3.00
95	0.08721	7.8	-2.94
100	0.07539	8.5	-2.87
105	0.06538	9.2	-2.81
110	0.05688	9.9	-2.75
115	0.04963	10.6	-2.69
120	0.04343	11.3	-2.63
125	0.03812	12.0	-2.58
130	0.03354	12.7	-2.53
135	0.02960	13.5	-2.47
140	0.02618	14.2	-2.42
145	0.02322	14.9	-2.37
150	0.02064	15.6	-2.33

T (°C)	Material B(K)		
	M 3950		
	R(T) / R25	TF (%)	α (%/°C)
-55	99.59	15.6	-7.42
-50	68.97	14.3	-7.16
-45	48.40	12.9	-6.91
-40	34.38	11.7	-6.67
-35	24.71	10.5	-6.45
-30	17.97	9.4	-6.23
-25	13.20	8.3	-6.02
-20	9.804	7.3	-5.82
-15	7.352	6.3	-5.63
-10	5.565	5.4	-5.45
-5	4.251	4.5	-5.28
0	3.275	3.7	-5.11
5	2.544	2.9	-4.95
10	1.992	2.1	-4.80
15	1.572	1.4	-4.65
20	1.249	0.7	-4.51
25	1.0000	0.0	-4.38
30	0.8057	0.7	-4.25
35	0.6534	1.3	-4.12
40	0.5331	1.9	-4.00
45	0.4376	2.5	-3.89
50	0.3612	3.1	-3.77
55	0.2998	3.7	-3.67
60	0.2501	4.3	-3.57
65	0.2097	4.8	-3.47
70	0.1767	5.3	-3.37
75	0.1496	5.9	-3.28
80	0.1272	6.4	-3.19
85	0.1087	6.9	-3.11
90	0.09320	7.4	-3.03
95	0.08025	7.8	-2.95
100	0.06937	8.3	-2.87
105	0.06019	8.8	-2.80
110	0.05242	9.2	-2.73
115	0.04580	9.6	-2.66
120	0.04016	10.1	-2.60
125	0.03532	10.5	-2.53
130	0.03117	10.9	-2.47
135	0.02758	11.3	-2.41
140	0.02448	11.7	-2.36
145	0.02179	12.1	-2.30
150	0.01945	12.4	-2.25

T (°C)	Material B(K)		
	MA 3965		
	R(T) / R25	TF (%)	α (%/°C)
-55	101.09	2.47	-7.49
-50	69.81	2.26	-7.22
-45	48.87	2.06	-6.96
-40	34.65	1.87	-6.71
-35	24.87	1.69	-6.48
-30	18.06	1.52	-6.26
-25	13.259	1.35	-6.05
-20	9.837	1.19	-5.84
-15	7.372	1.04	-5.65
-10	5.578	0.89	-5.47
-5	4.259	0.75	-5.29
0	3.280	0.61	-5.12
5	2.548	0.48	-4.96
10	1.994	0.35	-4.81
15	1.573	0.23	-4.66
20	1.250	0.11	-4.52
25	1.0000	0.00	-4.38
30	0.8054	0.11	-4.25
35	0.6528	0.22	-4.13
40	0.5324	0.32	-4.01
45	0.4368	0.42	-3.90
50	0.3603	0.52	-3.79
55	0.2989	0.61	-3.68
60	0.2492	0.70	-3.58
65	0.2088	0.79	-3.48
70	0.1758	0.88	-3.39
75	0.1487	0.96	-3.30
80	0.1263	1.04	-3.21
85	0.1078	1.12	-3.13
90	0.0923	1.20	-3.05
95	0.0794	1.27	-2.97
100	0.06857	1.35	-2.90
105	0.05942	1.42	-2.83
110	0.05167	1.49	-2.76
115	0.04509	1.55	-2.69
120	0.03948	1.62	-2.62
125	0.03467	1.68	-2.56
130	0.03055	1.75	-2.50
135	0.02699	1.81	-2.44
140	0.02392	1.87	-2.39
145	0.02125	1.93	-2.33
150	0.01894	1.98	-2.28

# TABLES OF RESISTANCE VS TEMPERATURE

T (°C)	Material B(K)		
	MC 3910		
	R(T) / R25	TF (%)	α (%/°C)
-55	100.6	23.0	-7.56
-50	69.29	19.9	-7.27
-45	48.40	17.1	-7.00
-40	34.27	14.6	-6.75
-35	24.57	12.4	-6.50
-30	17.83	10.5	-6.27
-25	13.09	8.7	-6.05
-20	9.71	7.2	-5.84
-15	7.282	5.9	-5.64
-10	5.514	4.7	-5.45
-5	4.215	3.7	-5.27
0	3.250	2.8	-5.10
5	2.528	2.0	-4.93
10	1.982	1.4	-4.77
15	1.567	0.8	-4.62
20	1.247	0.4	-4.48
25	1.0000	0.0	-4.34
30	0.8072	0.4	-4.21
35	0.6559	0.8	-4.08
40	0.5362	1.2	-3.96
45	0.4410	1.7	-3.85
50	0.3647	2.2	-3.74
55	0.3033	2.8	-3.63
60	0.2535	3.4	-3.53
65	0.2130	4.0	-3.43
70	0.1798	4.6	-3.34
75	0.1525	5.2	-3.25
80	0.1300	5.9	-3.16
85	0.1112	6.6	-3.08
90	0.09552	7.3	-2.99
95	0.08239	8.0	-2.92
100	0.07133	8.7	-2.84
105	0.06199	9.4	-2.77
110	0.05406	10.1	-2.70
115	0.04731	10.9	-2.63
120	0.04153	11.6	-2.57
125	0.03658	12.3	-2.51
130	0.03231	13.1	-2.45
135	0.02863	13.8	-2.39
140	0.02544	14.6	-2.33
145	0.02267	15.3	-2.28
150	0.02025	16.1	-2.23

T (°C)	Material B(K)		
	ME 3975		
	R(T) / R25	TF (%)	α (%/°C)
-55	103.9	2.47	-7.56
-50	71.53	2.26	-7.28
-45	49.94	2.06	-7.01
-40	35.32	1.87	-6.76
-35	25.29	1.69	-6.53
-30	18.32	1.52	-6.30
-25	13.43	1.35	-6.08
-20	9.945	1.19	-5.88
-15	7.440	1.04	-5.68
-10	5.621	0.89	-5.50
-5	4.286	0.75	-5.32
0	3.297	0.61	-5.15
5	2.557	0.48	-4.98
10	2.000	0.35	-4.83
15	1.576	0.23	-4.68
20	1.251	0.11	-4.54
25	1.0000	0.00	-4.40
30	0.8048	0.11	-4.27
35	0.6519	0.22	-4.14
40	0.5313	0.32	-4.02
45	0.4356	0.42	-3.91
50	0.3591	0.52	-3.80
55	0.2977	0.61	-3.69
60	0.2481	0.70	-3.59
65	0.2078	0.79	-3.49
70	0.1749	0.88	-3.40
75	0.1479	0.96	-3.31
80	0.1256	1.04	-3.22
85	0.1071	1.12	-3.14
90	0.09175	1.20	-3.06
95	0.07890	1.27	-2.98
100	0.06810	1.35	-2.90
105	0.05900	1.42	-2.83
110	0.05130	1.49	-2.76
115	0.04476	1.55	-2.69
120	0.03918	1.62	-2.63
125	0.03441	1.68	-2.57
130	0.03031	1.75	-2.50
135	0.02678	1.81	-2.45
140	0.02373	1.87	-2.39
145	0.02108	1.93	-2.34
150	0.01878	1.98	-2.28

T (°C)	Material B(K)		
	M4 3995		
	R(T) / R25	TF (%)	α (%/°C)
-55	98.22	23.5	-7.38
-50	68.17	20.3	-7.12
-45	47.92	17.5	-6.88
-40	34.11	14.9	-6.64
-35	24.57	12.7	-6.42
-30	17.89	10.7	-6.20
-25	13.17	8.9	-6.00
-20	9.790	7.4	-5.80
-15	7.349	6.0	-5.62
-10	5.568	4.8	-5.44
-5	4.256	3.8	-5.27
0	3.280	2.8	-5.11
5	2.549	2.1	-4.95
10	1.996	1.4	-4.80
15	1.574	0.8	-4.66
20	1.250	0.4	-4.52
25	1.0000	0.0	-4.39
30	0.8049	0.4	-4.27
35	0.6519	0.8	-4.15
40	0.5311	1.2	-4.03
45	0.4352	1.7	-3.92
50	0.3586	2.3	-3.81
55	0.2970	2.8	-3.71
60	0.2472	3.4	-3.61
65	0.2068	4.1	-3.52
70	0.1738	4.7	-3.42
75	0.1468	5.4	-3.34
80	0.1245	6.0	-3.25
85	0.1060	6.7	-3.17
90	0.09060	7.4	-3.09
95	0.07776	8.2	-3.01
100	0.06700	8.9	-2.94
105	0.05793	9.6	-2.87
110	0.05026	10.4	-2.80
115	0.04376	11.1	-2.74
120	0.03822	11.9	-2.67
125	0.03349	12.6	-2.61
130	0.02944	13.4	-2.55
135	0.02595	14.1	-2.49
140	0.02294	14.9	-2.44
145	0.02033	15.6	-2.38
150	0.01807	16.4	-2.33



# TABLES OF RESISTANCE VS TEMPERATURE

T (°C)	Material B(K)		
	MN 4077		
	R(T) / R25	TF (%)	$\alpha$ (%/°C)
-55	103.6	2.54	-7.39
-50	71.79	2.32	-7.14
-45	50.39	2.12	-6.90
-40	35.79	1.92	-6.68
-35	25.71	1.74	-6.46
-30	18.67	1.56	-6.25
-25	13.70	1.39	-6.06
-20	10.15	1.22	-5.87
-15	7.591	1.06	-5.68
-10	5.730	0.91	-5.51
-5	4.362	0.77	-5.34
0	3.349	0.63	-5.18
5	2.592	0.49	-5.03
10	2.021	0.36	-4.88
15	1.587	0.24	-4.74
20	1.256	0.12	-4.60
25	1.0000	0.00	-4.47
30	0.8016	0.11	-4.35
35	0.6465	0.22	-4.23
40	0.5246	0.33	-4.11
45	0.4281	0.43	-4.00
50	0.3514	0.53	-3.89
55	0.2899	0.63	-3.79
60	0.2404	0.72	-3.69
65	0.2004	0.81	-3.59
70	0.1678	0.90	-3.50
75	0.1411	0.99	-3.41
80	0.1193	1.07	-3.32
85	0.1012	1.15	-3.24
90	0.08624	1.23	-3.16
95	0.07378	1.31	-3.08
100	0.06336	1.38	-3.00
105	0.05462	1.46	-2.93
110	0.04725	1.53	-2.86
115	0.04101	1.60	-2.79
120	0.03572	1.67	-2.73
125	0.03122	1.73	-2.66
130	0.02736	1.80	-2.60
135	0.02406	1.86	-2.54
140	0.02121	1.92	-2.49
145	0.01876	1.98	-2.43
150	0.01663	2.04	-2.38

T (°C)	Material B(K)		
	N 4080		
	R(T) / R25	TF (%)	$\alpha$ (%/°C)
-55	110.1	24.0	-7.50
-50	75.89	20.7	-7.25
-45	52.97	17.8	-7.01
-40	37.42	15.2	-6.78
-35	26.75	12.9	-6.56
-30	19.33	10.9	-6.35
-25	14.11	9.1	-6.14
-20	10.41	7.5	-5.95
-15	7.758	6.1	-5.76
-10	5.834	4.9	-5.58
-5	4.426	3.8	-5.41
0	3.387	2.9	-5.24
5	2.614	2.1	-5.08
10	2.033	1.4	-4.93
15	1.593	0.9	-4.78
20	1.258	0.4	-4.64
25	1.0000	0.0	-4.51
30	0.8004	0.4	-4.37
35	0.6449	0.8	-4.25
40	0.5228	1.3	-4.13
45	0.4264	1.8	-4.01
50	0.3497	2.3	-3.90
55	0.2885	2.9	-3.79
60	0.2392	3.5	-3.68
65	0.1994	4.1	-3.58
70	0.1671	4.8	-3.49
75	0.1406	5.5	-3.39
80	0.1189	6.2	-3.30
85	0.1010	6.9	-3.22
90	0.08616	7.6	-3.13
95	0.07381	8.3	-3.05
100	0.06347	9.1	-2.97
105	0.05480	9.8	-2.90
110	0.04748	10.6	-2.83
115	0.04129	11.3	-2.76
120	0.03603	12.1	-2.69
125	0.03155	12.9	-2.62
130	0.02771	13.7	-2.56
135	0.02442	14.4	-2.50
140	0.02158	15.2	-2.44
145	0.01913	16.0	-2.38
150	0.01700	16.8	-2.33

T (°C)	Material B(K)		
	NA 4100		
	R(T) / R25	TF (%)	$\alpha$ (%/°C)
-55	109.5	8.0	-7.53
-50	75.44	6.9	-7.27
-45	52.64	6.0	-7.02
-40	37.19	5.1	-6.78
-35	26.59	4.3	-6.56
-30	19.22	3.7	-6.34
-25	14.05	3.1	-6.14
-20	10.37	2.5	-5.94
-15	7.730	2.1	-5.75
-10	5.817	1.6	-5.57
-5	4.417	1.3	-5.40
0	3.382	1.0	-5.23
5	2.611	0.7	-5.08
10	2.032	0.5	-4.92
15	1.593	0.3	-4.78
20	1.258	0.1	-4.64
25	1.0000	0.0	-4.51
30	0.8003	0.1	-4.38
35	0.6446	0.3	-4.25
40	0.5224	0.4	-4.14
45	0.4258	0.6	-4.02
50	0.3490	0.8	-3.91
55	0.2877	1.0	-3.81
60	0.2383	1.2	-3.71
65	0.1984	1.4	-3.61
70	0.1660	1.6	-3.51
75	0.1395	1.8	-3.42
80	0.1178	2.1	-3.34
85	0.09989	2.3	-3.25
90	0.08506	2.5	-3.17
95	0.07271	2.8	-3.09
100	0.06240	3.0	-3.02
105	0.05375	3.3	-2.94
110	0.04647	3.5	-2.87
115	0.04032	3.8	-2.81
120	0.03509	4.1	-2.74
125	0.03065	4.3	-2.68
130	0.02685	4.6	-2.61
135	0.02359	4.8	-2.55
140	0.02079	5.1	-2.50
145	0.01837	5.4	-2.44
150	0.01628	5.6	-2.39

# TABLES OF RESISTANCE VS TEMPERATURE

T (°C)	Material B(K)		
	NC 4080		
	R(T) / R25	TF (%)	α (%/°C)
-55	105.4	24.0	-7.45
-50	72.89	20.7	-7.20
-45	51.04	17.8	-6.95
-40	36.18	15.2	-6.72
-35	25.94	12.9	-6.50
-30	18.81	10.9	-6.29
-25	13.78	9.1	-6.08
-20	10.20	7.5	-5.89
-15	7.621	6.1	-5.71
-10	5.748	4.9	-5.53
-5	4.373	3.8	-5.36
0	3.355	2.9	-5.20
5	2.595	2.1	-5.04
10	2.023	1.4	-4.89
15	1.588	0.9	-4.75
20	1.256	0.4	-4.61
25	1.0000	0.0	-4.48
30	0.8014	0.4	-4.35
35	0.6463	0.8	-4.23
40	0.5243	1.3	-4.11
45	0.4278	1.8	-4.00
50	0.3510	2.3	-3.89
55	0.2896	2.9	-3.79
60	0.2401	3.5	-3.69
65	0.2001	4.1	-3.59
70	0.1675	4.8	-3.50
75	0.1409	5.5	-3.41
80	0.1190	6.2	-3.32
85	0.1010	6.9	-3.24
90	0.08605	7.6	-3.16
95	0.07360	8.3	-3.08
100	0.06319	9.1	-3.01
105	0.05446	9.8	-2.94
110	0.04710	10.6	-2.87
115	0.04087	11.3	-2.80
120	0.03559	12.1	-2.73
125	0.03109	12.9	-2.67
130	0.02724	13.7	-2.61
135	0.02394	14.4	-2.55
140	0.02111	15.2	-2.49
145	0.01866	16.0	-2.44
150	0.01654	16.8	-2.38

T (°C)	Material B(K)		
	NE 4100		
	R(T) / R25	TF (%)	α (%/°C)
-55	97.27	24.1	-7.2
-50	67.99	20.8	-7.0
-45	48.08	17.9	-6.8
-40	34.39	15.3	-6.5
-35	24.85	13.0	-6.3
-30	18.15	11.0	-6.1
-25	13.38	9.2	-6.0
-20	9.960	7.6	-5.8
-15	7.479	6.2	-5.6
-10	5.664	4.9	-5.4
-5	4.325	3.8	-5.3
0	3.328	2.9	-5.1
5	2.581	2.1	-5.0
10	2.016	1.4	-4.9
15	1.585	0.9	-4.7
20	1.255	0.4	-4.6
25	1.0000	0.0	-4.5
30	0.8017	0.4	-4.3
35	0.6466	0.8	-4.2
40	0.5245	1.3	-4.1
45	0.4278	1.8	-4.0
50	0.3508	2.3	-3.9
55	0.2891	2.9	-3.8
60	0.2394	3.5	-3.7
65	0.1992	4.2	-3.6
70	0.1666	4.8	-3.5
75	0.1399	5.5	-3.4
80	0.11794	6.2	-3.4
85	0.09987	6.9	-3.3
90	0.08491	7.6	-3.2
95	0.07246	8.4	-3.1
100	0.06207	9.1	-3.1
105	0.05336	9.9	-3.0
110	0.04604	10.6	-2.9
115	0.03985	11.4	-2.8
120	0.03461	12.2	-2.8
125	0.03015	12.9	-2.7
130	0.02635	13.7	-2.7
135	0.02309	14.5	-2.6
140	0.0203	15.3	-2.5
145	0.01789	16.1	-2.5
150	0.01581	16.8	-2.4

T (°C)	Material B(K)		
	N5 4160		
	R(T) / R25	TF (%)	α (%/°C)
-55	115.8	16.3	-7.52
-50	79.72	14.1	-7.28
-45	55.54	12.1	-7.04
-40	39.15	10.4	-6.82
-35	27.91	8.8	-6.61
-30	20.11	7.4	-6.40
-25	14.64	6.2	-6.20
-20	10.77	5.1	-6.01
-15	7.996	4.2	-5.83
-10	5.991	3.3	-5.65
-5	4.529	2.6	-5.48
0	3.454	2.0	-5.31
5	2.655	1.4	-5.16
10	2.057	1.0	-5.00
15	1.606	0.6	-4.86
20	1.263	0.3	-4.72
25	1.0000	0.0	-4.58
30	0.7973	0.3	-4.45
35	0.6398	0.5	-4.32
40	0.5167	0.9	-4.20
45	0.4198	1.2	-4.09
50	0.3430	1.6	-3.97
55	0.2819	2.0	-3.86
60	0.2329	2.4	-3.76
65	0.1934	2.8	-3.66
70	0.1614	3.3	-3.56
75	0.1354	3.7	-3.46
80	0.1141	4.2	-3.37
85	0.09658	4.7	-3.29
90	0.08211	5.2	-3.20
95	0.07010	5.7	-3.12
100	0.06009	6.2	-3.04
105	0.05171	6.7	-2.96
110	0.04467	7.2	-2.89
115	0.03872	7.7	-2.82
120	0.03369	8.2	-2.75
125	0.02941	8.8	-2.68
130	0.02576	9.3	-2.62
135	0.02263	9.8	-2.55
140	0.01995	10.3	-2.49
145	0.01763	10.9	-2.44
150	0.01563	11.4	-2.38

# TABLES OF RESISTANCE VS TEMPERATURE

T (°C)	Material B(K)		
	P 4220		
	R(T) / R25	TF (%)	α (%/°C)
-55	121.4	24.8	-7.56
-50	83.35	21.5	-7.32
-45	57.92	18.4	-7.09
-40	40.72	15.8	-6.87
-35	28.95	13.4	-6.66
-30	20.80	11.3	-6.45
-25	15.10	9.4	-6.26
-20	11.07	7.8	-6.07
-15	8.197	6.3	-5.89
-10	6.123	5.1	-5.71
-5	4.615	4.0	-5.54
0	3.508	3.0	-5.38
5	2.688	2.2	-5.22
10	2.076	1.5	-5.07
15	1.616	0.9	-4.92
20	1.267	0.4	-4.78
25	1.0000	0.0	-4.64
30	0.7949	0.4	-4.51
35	0.6359	0.8	-4.38
40	0.5120	1.3	-4.26
45	0.4148	1.8	-4.14
50	0.3379	2.4	-4.03
55	0.2769	3.0	-3.92
60	0.2281	3.6	-3.81
65	0.1890	4.3	-3.71
70	0.1573	5.0	-3.61
75	0.1316	5.7	-3.52
80	0.1106	6.4	-3.42
85	0.09337	7.1	-3.34
90	0.07918	7.9	-3.25
95	0.06743	8.6	-3.17
100	0.05766	9.4	-3.09
105	0.04950	10.2	-3.01
110	0.04266	10.9	-2.93
115	0.03691	11.7	-2.86
120	0.03204	12.5	-2.79
125	0.02791	13.3	-2.72
130	0.02439	14.1	-2.66
135	0.02139	14.9	-2.59
140	0.01881	15.7	-2.53
145	0.01660	16.5	-2.47
150	0.01469	17.3	-2.42

T (°C)	Material B(K)		
	PA 4235		
	R(T) / R25	TF (%)	α (%/°C)
-55	123.40	8.3	-7.68
-50	84.33	7.2	-7.42
-45	58.39	6.2	-7.17
-40	40.93	5.3	-6.93
-35	29.04	4.5	-6.71
-30	20.83	3.8	-6.49
-25	15.11	3.2	-6.29
-20	11.07	2.6	-6.09
-15	8.190	2.1	-5.90
-10	6.117	1.7	-5.72
-5	4.610	1.3	-5.54
0	3.505	1.0	-5.38
5	2.686	0.7	-5.22
10	2.075	0.5	-5.07
15	1.615	0.3	-4.92
20	1.267	0.1	-4.78
25	1.0000	0.0	-4.64
30	0.7949	0.1	-4.51
35	0.6359	0.3	-4.39
40	0.5119	0.4	-4.27
45	0.4145	0.6	-4.15
50	0.3376	0.8	-4.04
55	0.2764	1.0	-3.93
60	0.2276	1.2	-3.83
65	0.1883	1.4	-3.73
70	0.1566	1.7	-3.63
75	0.1308	1.9	-3.54
80	0.1098	2.1	-3.45
85	0.09257	2.4	-3.37
90	0.07836	2.6	-3.28
95	0.06661	2.9	-3.20
100	0.05685	3.1	-3.13
105	0.04870	3.4	-3.05
110	0.04188	3.7	-2.98
115	0.03614	3.9	-2.91
120	0.03129	4.2	-2.84
125	0.02719	4.5	-2.78
130	0.02370	4.7	-2.71
135	0.02072	5.0	-2.65
140	0.01817	5.3	-2.59
145	0.01598	5.5	-2.54
150	0.01409	5.8	-2.48

T (°C)	Material B(K)		
	Q 4300		
	R(T) / R25	TF (%)	α (%/°C)
-55	98.04	25.3	-6.87
-50	69.53	21.9	-6.70
-45	49.73	18.8	-6.53
-40	35.87	16.1	-6.37
-35	26.08	13.6	-6.22
-30	19.12	11.5	-6.07
-25	14.12	9.6	-5.92
-20	10.51	7.9	-5.78
-15	7.877	6.5	-5.64
-10	5.947	5.2	-5.50
-5	4.521	4.0	-5.37
0	3.460	3.1	-5.24
5	2.666	2.2	-5.11
10	2.067	1.5	-4.99
15	1.613	0.9	-4.87
20	1.266	0.4	-4.75
25	1.0000	0.0	-4.63
30	0.7944	0.4	-4.52
35	0.6347	0.8	-4.41
40	0.5099	1.3	-4.30
45	0.4119	1.9	-4.20
50	0.3344	2.4	-4.09
55	0.2730	3.1	-3.99
60	0.2239	3.7	-3.90
65	0.1846	4.4	-3.80
70	0.1529	5.1	-3.71
75	0.1272	5.8	-3.62
80	0.1063	6.5	-3.53
85	0.08927	7.2	-3.44
90	0.07526	8.0	-3.36
95	0.06372	8.8	-3.28
100	0.05417	9.6	-3.20
105	0.04622	10.4	-3.13
110	0.03960	11.2	-3.05
115	0.03405	12.0	-2.98
120	0.02938	12.8	-2.91
125	0.02545	13.6	-2.84
130	0.02211	14.4	-2.77
135	0.01928	15.2	-2.71
140	0.01686	16.0	-2.64
145	0.01479	16.8	-2.58
150	0.01302	17.7	-2.52

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T (°C)	Material B(K)		
	QA 4250		
	R(T) / R25	TF (%)	α (%/°C)
-55	99.06	8.3	-7.09
-50	69.60	7.2	-6.88
-45	49.42	6.2	-6.68
-40	35.45	5.3	-6.49
-35	25.67	4.5	-6.30
-30	18.77	3.8	-6.13
-25	13.84	3.2	-5.96
-20	10.29	2.6	-5.79
-15	7.719	2.1	-5.64
-10	5.834	1.7	-5.49
-5	4.442	1.3	-5.34
0	3.407	1.0	-5.20
5	2.632	0.7	-5.07
10	2.047	0.5	-4.94
15	1.602	0.3	-4.81
20	1.262	0.1	-4.69
25	1.0000	0.0	-4.57
30	0.7971	0.1	-4.46
35	0.6389	0.3	-4.35
40	0.5149	0.4	-4.24
45	0.4172	0.6	-4.14
50	0.3397	0.8	-4.04
55	0.2780	1.0	-3.95
60	0.2286	1.2	-3.85
65	0.1888	1.4	-3.76
70	0.1567	1.7	-3.68
75	0.1306	1.9	-3.59
80	0.1093	2.1	-3.51
85	0.09179	2.4	-3.43
90	0.07743	2.6	-3.36
95	0.06556	2.9	-3.28
100	0.05571	3.2	-3.21
105	0.04752	3.4	-3.14
110	0.04067	3.7	-3.07
115	0.03492	3.9	-3.01
120	0.03008	4.2	-2.94
125	0.02600	4.5	-2.88
130	0.02254	4.7	-2.82
135	0.01960	5.0	-2.76
140	0.01709	5.3	-2.71
145	0.01495	5.5	-2.65
150	0.01311	5.8	-2.60

T (°C)	Material B(K)		
	R 4400		
	R(T) / R25	TF (%)	α (%/°C)
-55	113.90	25.9	-7.13
-50	79.71	22.4	-6.95
-45	56.30	19.2	-6.77
-40	40.13	16.4	-6.60
-35	28.85	14.0	-6.44
-30	20.92	11.8	-6.28
-25	15.29	9.8	-6.12
-20	11.27	8.1	-5.97
-15	8.368	6.6	-5.82
-10	6.261	5.3	-5.68
-5	4.719	4.1	-5.53
0	3.583	3.1	-5.40
5	2.739	2.3	-5.26
10	2.108	1.5	-5.13
15	1.634	0.9	-5.00
20	1.274	0.4	-4.88
25	1.0000	0.0	-4.75
30	0.7897	0.4	-4.64
35	0.6273	0.9	-4.52
40	0.5012	1.4	-4.41
45	0.4028	1.9	-4.30
50	0.3255	2.5	-4.19
55	0.2644	3.1	-4.09
60	0.2159	3.8	-3.98
65	0.1772	4.5	-3.89
70	0.1462	5.2	-3.79
75	0.1212	5.9	-3.70
80	0.1009	6.7	-3.60
85	0.08440	7.4	-3.52
90	0.07092	8.2	-3.43
95	0.05984	9.0	-3.35
100	0.05071	9.8	-3.26
105	0.04314	10.6	-3.19
110	0.03685	11.4	-3.11
115	0.03160	12.2	-3.03
120	0.02719	13.1	-2.96
125	0.02349	13.9	-2.89
130	0.02036	14.7	-2.82
135	0.01770	15.6	-2.76
140	0.01545	16.4	-2.69
145	0.01352	17.2	-2.63
150	0.01187	18.1	-2.57

T (°C)	Material B(K)		
	RA 4380		
	R(T) / R25	TF (%)	α (%/°C)
-55	110.80	8.6	-7.24
-50	77.24	7.4	-7.03
-45	54.44	6.4	-6.83
-40	38.76	5.5	-6.63
-35	27.87	4.6	-6.45
-30	20.22	3.9	-6.27
-25	14.81	3.3	-6.10
-20	10.94	2.7	-5.93
-15	8.144	2.2	-5.78
-10	6.112	1.8	-5.62
-5	4.623	1.4	-5.48
0	3.522	1.0	-5.34
5	2.702	0.8	-5.20
10	2.087	0.5	-5.07
15	1.623	0.3	-4.94
20	1.270	0.1	-4.82
25	1.0000	0.0	-4.70
30	0.7920	0.1	-4.59
35	0.6308	0.3	-4.47
40	0.5052	0.5	-4.37
45	0.4068	0.6	-4.26
50	0.3292	0.8	-4.16
55	0.2678	1.0	-4.07
60	0.2189	1.3	-3.97
65	0.1797	1.5	-3.88
70	0.1482	1.7	-3.79
75	0.1228	2.0	-3.71
80	0.1022	2.2	-3.63
85	0.08536	2.5	-3.55
90	0.07159	2.7	-3.47
95	0.06028	3.0	-3.39
100	0.05095	3.2	-3.32
105	0.04322	3.5	-3.25
110	0.03679	3.8	-3.18
115	0.03142	4.1	-3.11
120	0.02693	4.3	-3.05
125	0.02315	4.6	-2.98
130	0.01997	4.9	-2.92
135	0.01728	5.2	-2.86
140	0.01499	5.4	-2.80
145	0.01304	5.7	-2.75
150	0.01138	6.0	-2.69

# 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