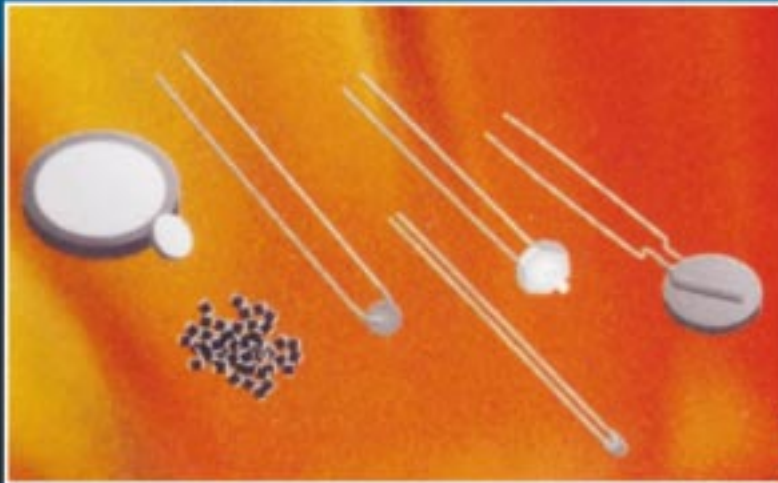




TPC NTC Thermistors - Preliminary Catalog

NTC SMD Thermistors



With Nickel Barrier Termination NB 12 - NB 20 - NB 21

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.

A nickel barrier metallization provides outstanding qualities of solderability and enables this chip to meet the requirements of the most severe soldering processes.

Types	NB 21 IEC SIZE : 06-03	NB 12 IEC SIZE : 08-05	NB 20 IEC SIZE : 12-06
DIMENSIONS: millimeters (inches)			
Terminations	Nickel Barrier		
Marking	On packaging only		
Climatic category	40/125/56		
Operating temperature	-55°C to +150°C		
Tolerance on R _n (25°C)	±5%, ±10%, ±20%		
Maximum dissipation at 25°C	0.7 W	0.12 W	0.24 W
Thermal dissipation factor	1 mW/°C	2 mW/°C	4 mW/°C
Thermal time constant	4 s	5 s	7s

Resistance - Temperature characteristics: pages 32 to 35.

APPLICATIONS

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

HOW TO ORDER

NB 20

Type

K 0

Material Code
K
(See tables page 13)

0103

Resistance
10,000 Ω

M

Tolerance
M (±20%)

BA

Suffix: Packaging
— : Bulk
BA: Super 8 plastic tape
BE: Super 8 plastic tape (1/2 reel)

NTC SMD Thermistors



With Nickel Barrier Termination NB 12 – NB 20 – NB 21

TABLE OF VALUES

NB 12 IEC SIZE : 08-05				
Types	Rn at 25°C ()	Material Code	B (K) ($\Delta B/B$ (1) $\pm 5\%$ (2) $\pm 3\%$)	α at 25°C (%/°C)
NB 12 KC 0 180 NB 12 KC 0 220 NB 12 KC 0 270 NB 12 KC 0 330 NB 12 KC 0 390 NB 12 KC 0 470 NB 12 KC 0 560 NB 12 KC 0 680 NB 12 KC 0 820 NB 12 KC 0 101	18 22 27 33 39 47 56 68 82 100	KC	3470 (1)	- 3.9
NB 12 MC 0 121 NB 12 MC 0 151 NB 12 MC 0 181 NB 12 MC 0 221 NB 12 MC 0 271 NB 12 MC 0 331 NB 12 MC 0 391 NB 12 MC 0 471 NB 12 MC 0 561 NB 12 MC 0 681 NB 12 MC 0 821 NB 12 MC 0 102 NB 12 MC 0 122 NB 12 MC 0 152 NB 12 MC 0 182 NB 12 MC 0 222 NB 12 MC 0 272 NB 12 MC 0 332	120 150 180 220 270 330 390 470 560 680 820 1,000 1,200 1,500 1,800 2,200 2,700 3,300	MC	3910 (1)	- 4.4
NB 12 J 5 0 392 NB 12 J 5 0 472	3,900 4,700	J5	3480 (1)	- 3.9
NB 12 K 0 0562 NB 12 K 0 0682 NB 12 K 0 0822 NB 12 K 0 0103	5,600 6,800 8,200 10,000	K	3630 (1)	- 4.0
NB 12 L 0 0123 NB 12 L 0 0153	12,000 15,000	L	3790 (2)	- 4.2
NB 12 M 0 0183 NB 12 M 0 0223 NB 12 M 0 0273 NB 12 M 0 0333	18,000 22,000 27,000 33,000	M	3950 (2)	- 4.4
NB 12 N 0 0393 NB 12 N 0 0473 NB 12 N 0 0563	39,000 47,000 56,000	N	4080 (2)	- 4.6
NB 12 N 5 0683 NB 12 N 5 0823	68,000 82,000	N5	4160 (2)	- 4.7
NB 12 P 0 0104 NB 12 P 0 0124 NB 12 P 0 0154 NB 12 P 0 0184	100,000 120,000 150,000 180,000	P	4220 (2)	- 4.7

NB 20 IEC SIZE : 12-06				
Types	Rn at 25°C ()	Material Code	B (K) ($\Delta B/B$ (1) $\pm 5\%$ (2) $\pm 3\%$)	α at 25°C (%/°C)
NB 20 J 0 0472 NB 20 J 0 0562	4,700 5,600	J	3480 (1)	- 3.9
NB 20 J 5 0682 NB 20 J 5 0822	6,800 8,200	J5	3480 (2)	- 3.9
NB 20 K 0 0103 NB 20 K 0 0123	10,000 12,000	K	3630 (1)	- 4.0
NB 20 L 0 0153 NB 20 L 0 0183	15,000 18,000	L	3790 (2)	- 4.2
NB 20 M 0 0223 NB 20 M 0 0273 NB 20 M 0 0333 NB 20 M 0 0393	22,000 27,000 33,000 39,000	M	3950 (2)	- 4.4
NB 20 N 0 0473 NB 20 N 0 0563 NB 20 N 0 0683 NB 20 N 0 0823	47,000 56,000 68,000 82,000	N	4080 (2)	- 4.6
NB 20 N 5 0104	100,000	N5	4160 (2)	- 4.7
NB 20 P 0 0124 NB 20 P 0 0154 NB 20 P 0 0184	120,000 150,000 180,000	P	4220 (2)	- 4.7
NB 20 Q 0 0224 NB 20 Q 0 0274 NB 20 Q 0 0334 NB 20 Q 0 0394 NB 20 Q 0 0474 NB 20 Q 0 0564	220,000 270,000 330,000 390,000 470,000 560,000	Q	4300 (2)	- 4.7
NB 20 R 0 0684 NB 20 R 0 0824 NB 20 R 0 0105	680,000 820,000 1,000,000	R	4400 (2)	- 4.8

NB 21 IEC SIZE : 06-03				
Types	Rn at 25°C ()	Material Code	B (K) ($\Delta B/B$ (1) $\pm 5\%$ (2) $\pm 3\%$)	α at 25°C (%/°C)
NB 21 PC 0472	4,700	PC	4200 (1)	- 4.7
NB 21 J 5 0103	10,000	J5	3480 (1)	- 3.9
NB 21 K 0 0153	15,000	K	3630 (2)	- 4.0
NB 21 L 0 0223	22,000	L	3790 (2)	- 4.2
NB 21 M 0 0473	47,000	M	3950 (2)	- 4.4
NB 21 N 5 0104	100,000	N5	4160 (2)	- 4.7
NB 21 P 0 0154	150,000	P	4220 (2)	- 4.7

NTC SMD Thermistors



NC 12 – NC 20

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 / 30 s).

Types	NC 12 IEC SIZE : 08-05	NC 20 IEC SIZE : 12-06
DIMENSIONS: millimeters (inches)		
Terminations	Silver – palladium – platinum metallization	
Marking	On packaging only	
Climatic category	40/125/56	
Operating temperature	-55°C to +150°C	
Tolerance on R _n (25°C)	±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 32 to 35.

APPLICATIONS

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

HOW TO ORDER

NC 20

Type

K 0

Material Code
K

(See tables pages 11, 32-35)

0103

Resistance
10,000 Ω

M

Tolerance
M (±20%)

BA

Suffix: Packaging
-- : Bulk
BA: Super 8 plastic tape
BE: Super 8 plastic tape (1/2 reel)

NTC SMD Thermistors



NC 12 – NC 20

TABLE OF VALUES

NC 12 IEC SIZE : 08-05				
Types	Rn at 25°C (Ω)	Material Code	B (K) $\left(\frac{\Delta B/B}{(1) \pm 5\%}, (2) \pm 3\%\right)$	α at 25°C (%/°C)
NC 12 KC 0 180 NC 12 KC 0 220 NC 12 KC 0 270 NC 12 KC 0 330 NC 12 KC 0 390 NC 12 KC 0 470 NC 12 KC 0 560 NC 12 KC 0 680 NC 12 KC 0 820 NC 12 KC 0 101	18 22 27 33 39 47 56 68 82 100	KC	3470 (1)	- 3.9
NC 12 MC 0 121 NC 12 MC 0 151 NC 12 MC 0 181 NC 12 MC 0 221 NC 12 MC 0 271 NC 12 MC 0 331 NC 12 MC 0 391 NC 12 MC 0 471 NC 12 MC 0 561 NC 12 MC 0 681 NC 12 MC 0 821 NC 12 MC 0 102 NC 12 MC 0 122 NC 12 MC 0 152 NC 12 MC 0 182 NC 12 MC 0 222 NC 12 MC 0 272 NC 12 MC 0 332	120 150 180 220 270 330 390 470 560 680 820 1,000 1,200 1,500 1,800 2,200 2,700 3,300	MC	3910 (1)	- 4.4
NC 12 J 5 0 392 NC 12 J 5 0 472 NC 12 J 5 0 562	3,900 4,700 5,600	J5	3480 (1)	- 3.9
NC 12 K 0 0682 NC 12 K 0 0822 NC 12 K 0 0103 NC 12 K 0 0123	6,800 8,200 10,000 12,000	K	3630 (1)	- 4.0
NC 12 L 0 0153 NC 12 L 0 0183	15,000 18,000	L	3790 (2)	- 4.2
NC 12 M 0 0223 NC 12 M 0 0273 NC 12 M 0 0333 NC 12 M 0 0393	22,000 27,000 33,000 39,000	M	3950 (2)	- 4.4
NC 12 N 0 0473 NC 12 N 0 0563 NC 12 N 0 0683 NC 12 N 0 0823	47,000 56,000 68,000 82,000	N	4080 (2)	- 4.6
NC 12 P 0 0104 NC 12 P 0 0124 NC 12 P 0 0154 NC 12 P 0 0184	100,000 120,000 150,000 180,000	P	4220 (2)	- 4.7
NC 12 Q 0 0224	220,000	Q	4300 (2)	-4.7

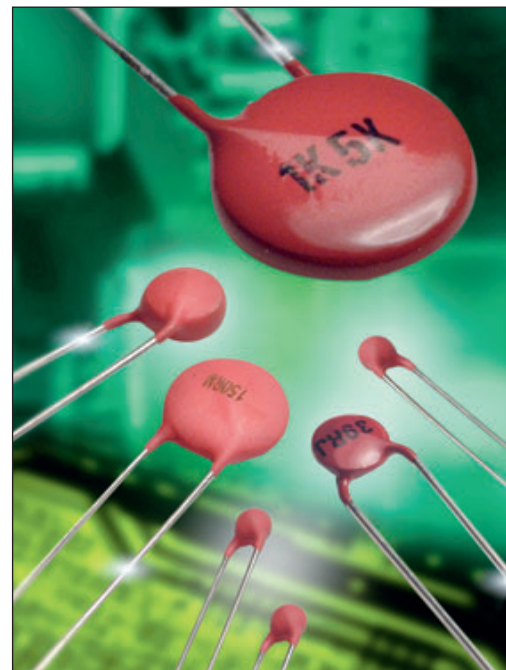
NC 20 IEC SIZE : 12-06				
Types	Rn at 25°C (Ω)	Material Code	B (K) $\left(\frac{\Delta B/B}{(1) \pm 5\%}, (2) \pm 3\%\right)$	α at 25°C (%/°C)
NC 20 KC 0 100 NC 20 KC 0 120 NC 20 KC 0 150 NC 20 KC 0 180 NC 20 KC 0 220 NC 20 KC 0 270 NC 20 KC 0 330 NC 20 KC 0 390 NC 20 KC 0 470 NC 20 KC 0 560 NC 20 KC 0 680 NC 20 KC 0 820 NC 20 KC 0 101	10 12 15 18 22 27 33 39 47 56 68 82 100	KC	3470 (1)	- 3.9
NC 20 MC 0 121 NC 20 MC 0 151 NC 20 MC 0 181 NC 20 MC 0 221 NC 20 MC 0 271 NC 20 MC 0 331 NC 20 MC 0 391 NC 20 MC 0 471 NC 20 MC 0 561 NC 20 MC 0 681 NC 20 MC 0 821 NC 20 MC 0 102 NC 20 MC 0 122 NC 20 MC 0 152	120 150 180 220 270 330 390 470 560 680 820 1,000 1,200 1,500	MC	3910 (1)	- 4.4
NC 20 I 0 0 182 NC 20 I 0 0 222 NC 20 I 0 0 272 NC 20 I 0 0 332	1,800 2,200 2,700 3,300	I	3250 (1)	- 3.7
NC 20 J 0 0 392 NC 20 J 0 0 472 NC 20 J 0 0 562 NC 20 J 0 0 682	3,900 4,700 5,600 6,800	J	3480 (1)	- 3.9
NC 20 K 0 0 822 NC 20 K 0 0 103 NC 20 K 0 0 123 NC 20 K 0 0 153	8,200 10,000 12,000 15,000	K	3630 (1)	- 4.0
NC 20 L 0 0 183 NC 20 L 0 0 223	18,000 22,000	L	3790 (2)	- 4.2
NC 20 M 0 0 273 NC 20 M 0 0 333 NC 20 M 0 0 393 NC 20 M 0 0 473	27,000 33,000 39,000 47,000	M	3950 (2)	- 4.4
NC 20 N 0 0 563 NC 20 N 0 0 683 NC 20 N 0 0 823 NC 20 N 0 0 104	56,000 68,000 82,000 100,000	N	4080 (2)	- 4.6
NC 20 P 0 0 124 NC 20 P 0 0 154 NC 20 P 0 0 184 NC 20 P 0 0 224	120,000 150,000 180,000 220,000	P	4220 (2)	- 4.7
NC 20 Q 0 0 274 NC 20 Q 0 0 334 NC 20 Q 0 0 394 NC 20 Q 0 0 474	270,000 330,000 390,000 470,000	Q	4300 (2)	- 4.7
NC 20 R 0 0 564 NC 20 R 0 0 684 NC 20 R 0 0 824 NC 20 R 0 0 105	560,000 680,000 820,000 1,000,000	R	4400 (2)	- 4.8

APPLICATIONS

- Commodity Product: 2 ranges
ND : general purpose
NV : professional
- Alarm and temperature measurement application
- Temperature regulation application
- Level detection application
- Compensation application

TECHNOLOGY

- Coated disc phenolic resin
- Leads: Radial copper wire tinned
- Marking: on package only for ND03
ND06/09: Nominal resistance and tolerance for $\pm 5\%$, $\pm 10\%$
NV06/09: Nominal resistance and tolerance
- Delivery Mode: Bulk, reeled or ammpacked



Leaded Discs

N.03

N.06

N.09



PERFORMANCE CHARACTERISTICS

Types	General purpose			Professional	
	ND03	ND06	ND09	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)	220Ω to 1MΩ : $\pm 5, 10, 20\%$ 1500Ω to 150 kΩ : $\pm 3\%$	$\pm 5\%, \pm 10\%, \pm 20\%$	$\pm 5\%, \pm 10\%, \pm 20\%$	$\pm 2\%, \pm 5\%, \pm 10\%$	$\pm 2\%, \pm 5\%, \pm 10\%$
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: LN2

OPTIONS

Consult factory for availability of options:

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

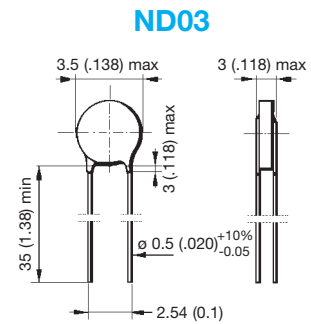
NTC Disc Thermistors

ND 03/06/09 • NV 06/09



TABLE OF VALUES

ND03



Part Number	R _n at 25°C (Ω)	Material Code	B (K) ($\Delta B/B$) (1) ± 5% (2) ± 3%	α at 25°C (%/°C)
ND03I00331 ND03I00471	330 470	I	3250 (1)	– 3.7
ND03J00681 ND03J00102	680 1,000	J	3480 (1)	– 3.9
ND03K00152 ND03K00222	1,500 2,200	K	3630 (2)	– 4.0
ND03L00332	3,300	L	3790 (2)	– 4.2
ND03M00472 ND03M00682	4,700 6,800	M	3950 (2)	– 4.4
ND03N00103 ND03N00153	10,000 15,000	N	4080 (2)	– 4.6
ND03P00223 ND03P00333	22,000 33,000	P	4220 (2)	– 4.7
ND03Q00473 ND03Q00683	47,000 68,000	Q	4300 (2)	– 4.7
ND03R00104 ND03R00154	100,000 150,000	R	4400 (2)	– 4.8
ND03S00224	220,000	S	4520 (2)	– 5.0
ND03T00334 ND03T00474	330,000 470,000	T	4630 (2)	– 5.1
ND03U00105	1,000,000	U	4840 (2)	– 5.3

NTC Disc Thermistors

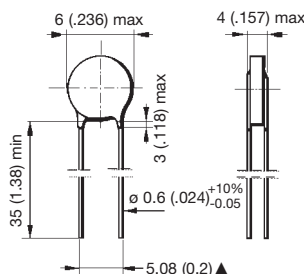
ND 03/06/09 • NV 06/09



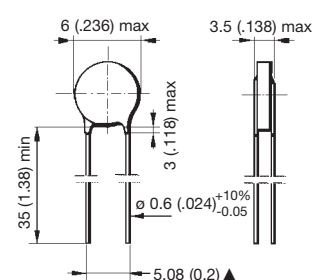
TABLE OF VALUES

ND06/NV06

ND06



NV06



Part Number	R _n at 25°C (Ω)	Material Code	B (K) ($\Delta B/B$ (1) $\pm 5\%$ (2) $\pm 3\%$)	α at 25°C (%/°C)
ND06I00101 ND06I00121	100 120	I	3250 (1)	- 3.7
ND06J00151 ND06J00221	150 220	J	3480 (1)	- 3.9
ND06K00331 ND06K00471	330 470	K	3630 (2)	- 4.0
ND06L00681 ND06L00102	680 1,000	L	3790 (2)	- 4.2
ND06M00152	1,500	M	3950 (2)	- 4.4
ND06N00222 ND06N00332	2,200 3,300	N	4080 (2)	- 4.6
ND06P00472 ND06P00682 ND06P00103	4,700 6,800 10,000	P	4220 (2)	- 4.7
ND06Q00153 ND06Q00223	15,000 22,000	Q	4300 (2)	- 4.7
ND06R00333	33,000	R	4400 (2)	- 4.8
ND06S00473 ND06S00683	47,000 68,000	S	4520 (2)	- 5.0
ND06T00104	100,000	T	4630 (2)	- 5.1
ND06U00154 ND06U00224 ND06U00334	150,000 220,000 330,000	U	4840 (2)	- 5.3
NV06I00101	100	I	3250 (1)	- 3.7
NV06J00151 NV06J00221	150 220	J	3480 (1)	- 3.9
NV06K00331 NV06K00471	330 470	K	3630 (2)	- 4.0
NV06L00681 NV06L00102	680 1,000	L	3790 (2)	- 4.2
NV06M00152	1,500	M	3950 (2)	- 4.4
NV06N00222 NV06N00332	2,200 3,300	N	4080 (2)	- 4.6
NV06P00472 NV06P00682 NV06P00103	4,700 6,800 10,000	P	4220 (2)	- 4.7
NV06Q00153 NV06Q00223	15,000 22,000	Q	4300 (2)	- 4.7
NV06R00333	33,000	R	4400 (2)	- 4.8
NV06S00473 NV06S00683	47,000 68,000	S	4520 (2)	- 5.0
NV06T00104	100,000	T	4630 (2)	- 5.1
NV06U00154 NV06U00224 NV06U00334	150,000 220,000 330,000	U	4840 (2)	- 5.3

NTC Disc Thermistors

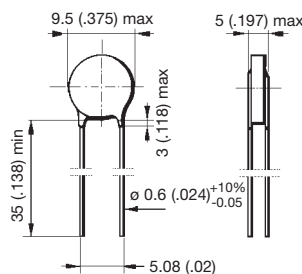
ND 03/06/09 • NV 06/09



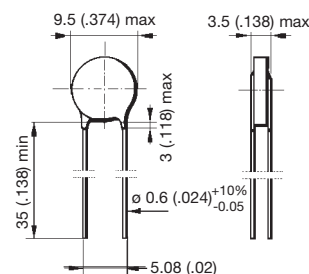
TABLE OF VALUES

ND09/NV09

ND09



NV09



Part Number	Rn at 25°C ()	Material Code	B (K) ($\Delta B/B$ (1) $\pm 5\%$ (2) $\pm 3\%$)	α at 25°C (%/°C)
ND09J00680 ND09J00101	68 100	J	3480 (1)	- 3.9
ND09K00151 ND09K00221	150 220	K	3630 (2)	- 4.0
ND09L00331	330	L	3790 (2)	- 4.2
ND09M00471 ND09M00681	470 680	M	3950 (2)	- 4.4
ND09N00102 ND09N00152	1,000 1,500	N	4080 (2)	- 4.6
ND09P00222 ND09P00332	2,200 3,300	P	4220 (2)	- 4.7
ND09Q00472 ND09Q00682	4,700 6,800	Q	4300 (2)	- 4.7
ND09R00103 ND09R00153	10,000 15,000	R	4400 (2)	- 4.8
ND09S00223	22,000	S	4520 (2)	- 5.0
ND09T00333 ND09T00473	33,000 47,000	T	4630 (2)	- 5.1
ND09U00683 ND09U00104 ND09U00154	68,000 100,000 150,000	U	4840 (2)	- 5.3
NV09J00680 NV09J00101	68 100	J	3480 (1)	- 3.9
NV09K00151 NV09K00221	150 220	K	3630 (2)	- 4.0
NV09L00331	330	L	3790 (2)	- 4.2
NV09M00471 NV09M00681	470 680	M	3950 (2)	- 4.4
NV09N00102 NV09N00152	1,000 1,500	N	4080 (2)	- 4.6
NV09P00222 NV09P00332	2,200 3,300	P	4220 (2)	- 4.7
NV09Q00472 NV09Q00682	4,700 6,800	Q	4300 (2)	- 4.7
NV09R00103 NV09R00153	10,000 15,000	R	4400 (2)	- 4.8
NV09S00223	22,000	S	4520 (2)	- 5.0
NV09T00333 NV09T00473	33,000 47,000	T	4630 (2)	- 5.1
NV09U00683 NV09U00104 NV09U00154	68,000 100,000 150,000	U	4840 (2)	- 5.3

TABLE OF RESISTANCE: TEMPERATURE CHARACTERISTICS

T (°C)	Material code B (K)									T (°C)
	I 3250			J 3480			K 3630			
	R (T) / R25	TF (%)	α (°/°C)	R (T) / R25	TF (%)	α (°/°C)	R (T) / R25	TF (%)	α (°/°C)	
-55	42.35	21.9	5.98	51.74	34.1	6.43	56.26	35.6	6.46	-55
-50	31.48	20.0	5.78	37.97	29.5	6.21	41.21	30.8	6.26	-50
-45	23.63	18.1	5.59	28.15	25.3	6.01	30.47	26.4	6.06	-45
-40	17.91	16.3	5.41	21.07	21.7	5.81	22.73	22.6	5.88	-40
-35	13.70	14.6	5.23	15.91	18.4	5.62	17.11	19.2	5.70	-35
-30	10.58	13.1	5.06	12.13	15.5	5.44	12.98	16.2	5.53	-30
-25	8.232	11.6	4.90	9.320	12.9	5.26	9.930	13.5	5.36	-25
-20	6.460	10.1	4.74	7.221	10.7	5.10	7.654	11.2	5.21	-20
-15	5.110	8.8	4.59	5.640	8.7	4.94	5.945	9.1	5.05	-15
-10	4.072	7.5	4.45	4.438	7.0	4.78	4.650	7.3	4.91	-10
-5	3.268	6.3	4.31	3.517	5.4	4.64	3.663	5.7	4.76	-5
0	2.641	5.1	4.18	2.807	4.1	4.50	2.905	4.3	4.63	0
5	2.148	4.0	4.05	2.255	3.0	4.36	2.319	3.1	4.50	5
10	1.759	2.9	3.92	1.824	2.0	4.23	1.862	2.1	4.37	10
15	1.449	1.9	3.81	1.484	1.2	4.10	1.505	1.3	4.25	15
20	1.200	0.9	3.69	1.215	.5	3.98	1.223	.6	4.13	20
25	1.000	0.0	3.58	1.0000	0.0	3.87	1.0000	0.0	4.01	25
30	0.8377	0.9	3.48	.8278	.5	3.76	.8219	.6	3.90	30
35	0.7054	1.8	3.38	.6889	1.1	3.65	.6792	1.2	3.80	35
40	0.5969	2.6	3.28	.5763	1.8	3.55	.5641	1.9	3.69	40
45	0.5076	3.5	3.19	.4845	2.5	3.45	.4708	2.6	3.59	45
50	0.4336	4.3	3.10	.4092	3.3	3.35	.3949	3.4	3.50	50
55	0.3720	5.1	3.01	.3473	4.1	3.26	.3327	4.3	3.41	55
60	0.3206	5.9	2.93	.2960	5.0	3.17	.2816	5.2	3.32	60
65	0.2774	6.6	2.85	.2534	5.9	3.09	.2393	6.1	3.23	65
70	0.2410	7.4	2.77	.2178	6.8	3.01	.2043	7.1	3.14	70
75	0.2102	8.1	2.70	.1879	7.8	2.93	.1751	8.1	3.06	75
80	0.1839	8.8	2.63	.1628	8.8	2.85	.1507	9.1	2.99	80
85	0.1616	9.5	2.56	.1415	9.8	2.78	.1301	10.2	2.91	85
90	0.1424	10.2	2.49	.1235	10.8	2.70	.1128	11.3	2.84	90
95	0.1259	10.9	2.43	.1081	11.8	2.64	.09812	12.4	2.77	95
100	0.1117	11.5	2.36	.09500	12.9	2.57	.08565	13.5	2.70	100
105	0.09938	12.2	2.30	.08373	14.0	2.50	.07502	14.6	2.63	105
110	0.08869	12.8	2.25	.07403	15.0	2.44	.06592	15.7	2.57	110
115	0.07938	13.4	2.19	.06565	16.1	2.38	.05810	16.8	2.50	115
120	0.07124	14.0	2.14	.05838	17.2	2.33	.05137	18.0	2.44	120
125	0.06410	14.6	2.08	.05207	18.3	2.27	.04555	19.1	2.39	125
130	0.05783	15.2	2.03	.04567	19.4	2.22	.04050	20.3	2.33	130
135	0.05230	15.7	1.98	.04175	20.5	2.16	.03611	21.4	2.27	135
140	0.04741	16.3	1.94	.03753	21.6	2.11	.03229	22.5	2.22	140
145	0.04308	16.8	1.89	.03382	22.7	2.06	.02894	23.7	2.17	145
150	0.03924	17.4	1.85	.03055	23.8	2.02	.02600	24.9	2.12	150

T (°C)	Material code B (K)									T (°C)
	L 3790			M 3950			N 4080			
	R (T) / R25	TF (%)	α (°/°C)	R (T) / R25	TF (%)	α (°/°C)	R (T) / R25	TF (%)	α (°/°C)	
-55	82.52	22.3	7.38	99.56	23.2	7.71	110.1	24.0	7.81	-55
-50	58.01	19.3	7.11	68.95	20.1	7.42	75.90	20.7	7.53	-50
-45	41.30	16.6	6.84	48.38	17.3	7.15	52.98	17.8	7.26	-45
-40	29.75	14.2	6.60	34.37	14.8	6.89	37.43	15.2	7.01	-40
-35	21.67	12.0	6.36	24.71	12.5	6.64	26.75	12.9	6.77	-35
-30	15.96	10.1	6.13	17.96	10.6	6.41	19.33	10.9	6.54	-30
-25	11.88	8.5	5.92	13.20	8.8	6.18	14.12	9.1	6.32	-25
-20	8.930	7.0	5.72	9.803	7.3	5.97	10.41	7.5	6.10	-20
-15	6.776	5.7	5.32	7.351	5.9	5.77	7.758	6.1	5.90	-15
-10	5.188	4.5	5.34	5.585	4.7	5.57	5.834	4.9	5.71	-10
-5	4.007	3.6	5.16	4.251	3.7	5.39	4.426	3.8	5.53	-5
0	3.120	2.7	4.99	3.275	2.8	5.21	3.387	2.9	5.35	0
5	2.449	2.0	4.83	2.544	2.0	5.04	2.614	2.1	5.18	5
10	1.937	1.3	4.68	1.992	1.4	4.88	2.033	1.4	5.02	10
15	1.543	.8	4.53	1.572	.8	4.73	1.593	.9	4.87	15
20	1.238	.4	4.39	1.249	.4	4.58	1.258	.4	4.72	20
25	1.0000	0.0	4.25	1.0000	0.0	4.44	1.0000	0.0	4.57	25
30	.8129	.3	4.12	.8057	.4	4.30	.8004	.4	4.44	30
35	.6648	.7	4.00	.6534	.8	4.17	.6448	.8	4.31	35
40	.5409	1.2	3.88	.5331	1.2	4.05	.5228	1.3	4.18	40
45	.4525	1.6	3.77	.4376	1.7	3.93	.4264	1.8	4.06	45
50	.3765	2.2	3.66	.3612	2.2	3.81	.3497	2.3	3.94	50
55	.3148	2.7	3.55	.2998	2.8	3.71	.2885	2.9	3.83	55
60	.2646	3.3	3.45	.2501	3.4	3.60	.2392	3.5	3.72	60
65	.2235	3.8	3.36	.2097	4.0	3.50	.1994	4.1	3.62	65
70	.1896	4.5	3.26	.1767	4.6	3.40	.1671	4.8	3.52	70
75	.1616	5.1	3.17	.1496	5.3	3.31	.1406	5.5	3.42	75
80	.1383	5.7	3.09	.1272	6.0	3.22	.1189	6.2	3.33	80
85	.1189	6.4	3.00	.1087	6.7	3.13	.1010	6.9	3.24	85
90	.1026	7.1	2.92	.09321	7.4	3.05	.08617	7.6	3.16	90
95	.08889	7.7	2.85	.08027	8.1	2.97	.07381	8.3	3.07	95
100	.07729	8.4	2.77	.06939	8.8	2.89	.06347	9.1	2.99	100
105	.06745	9.1	2.70	.06020	9.5	2.82	.05480	9.8	2.92	105
110	.05906	9.8	2.63	.05243	10.2	2.75	.04148	10.6	2.84	110
115	.05189	10.5	2.57	.04581	11.0	2.68	.04129	11.3	2.77	115
120	.04573	11.3	2.50	.04017	11.7	2.61	.03603	12.1	2.70	120
125	.04043	12.0	2.44	.03533	12.5	2.55	.03155	12.9	2.64	125
130	.03585	12.7	2.38	.03117	13.2	2.48	.02771	13.7	2.57	130
135	.03188	13.4	2.33	.02759	14.0	2.42	.02442	14.4	2.51	135
140	.02843	14.1	2.27	.02449	14.7	2.37	.02158	15.2	2.45	140
145	.02543	14.8	2.22	.02180	15.5	2.31	.01913	16.0	2.39	145
150	.02279	15.6	2.17	.01945	16.2	2.26	.01700	16.8	2.34	150

TABLE OF RESISTANCE: TEMPERATURE CHARACTERISTICS

T (°C)	Material code B (K)									T (°C)
	P 4220			Q 4300			R 4400			
	R (T) / R25	TF (%)	α (%/°C)	R (T) / R25	TF (%)	α (%/°C)	R (T) / R25	TF (%)	α (%/°C)	
-55	121.3	24.8	7.88	98.02	25.5	7.14	113.9	25.9	7.42	-55
-50	83.32	21.4	7.61	69.51	22.0	6.95	79.69	22.4	7.22	-50
-45	57.91	18.4	7.36	49.72	18.9	6.77	56.29	19.2	7.03	-45
-40	40.71	15.8	7.11	35.86	16.2	6.59	40.12	16.4	6.84	-40
-35	28.95	13.4	6.88	26.08	13.7	6.42	28.85	14.0	6.66	-35
-30	20.80	11.3	6.66	19.12	11.6	6.26	20.92	11.8	6.48	-30
-25	15.10	9.4	6.44	14.12	9.7	6.10	15.29	9.8	6.31	-25
-20	11.07	7.8	6.24	10.51	8.0	5.94	11.27	8.1	6.14	-20
-15	8.196	6.3	6.04	7.876	6.5	5.79	8.367	6.6	5.98	-15
-10	6.123	5.1	5.85	5.946	5.2	5.64	6.260	5.3	5.83	-10
-5	4.615	4.0	5.67	4.520	4.1	5.50	4.719	4.1	5.67	-5
0	3.507	3.0	5.49	3.460	3.1	5.36	3.583	3.1	5.53	0
5	2.688	2.2	5.33	2.666	2.2	5.23	2.739	2.3	5.38	5
10	2.078	1.5	5.16	2.067	1.5	5.09	2.108	1.5	5.24	10
15	1.616	.9	5.01	1.613	.9	4.96	1.634	.9	5.11	15
20	1.267	.4	4.86	1.266	.4	4.84	1.274	.4	4.97	20
25	1.0000	0.0	4.72	1.0000	0.0	4.72	1.0000	0.0	4.84	25
30	.7949	.4	4.58	.7944	.4	4.60	.7897	.4	4.72	30
35	.6360	.8	4.45	.6347	.8	4.48	.6273	.9	4.60	35
40	.5120	1.3	4.32	.5099	1.3	4.37	.5012	1.4	4.48	40
45	.4148	1.8	4.20	.4119	1.9	4.26	.4026	1.9	4.36	45
50	.3380	2.4	4.06	.3345	2.5	4.15	.3255	2.5	4.25	50
55	.2769	3.0	3.96	.2730	3.1	4.05	.2644	3.1	4.14	55
60	.2282	3.6	3.86	.2239	3.7	3.95	.2159	3.8	4.04	60
65	.1890	4.3	3.75	.1846	4.4	3.85	.1772	4.5	3.03	65
70	.1573	5.0	3.65	.1529	5.1	3.75	.1462	5.2	3.83	70
75	.1316	5.7	3.55	.1272	5.8	3.66	.1212	5.9	3.74	75
80	.1106	6.4	3.45	.1063	6.5	3.57	.1009	6.7	3.64	80
85	.09338	7.1	3.36	.08928	7.3	3.48	.08441	7.4	3.55	85
90	.07919	7.9	3.28	.07527	8.1	3.39	.07093	8.2	3.46	90
95	.06744	8.6	3.19	.06373	8.8	3.31	.05985	9.0	3.38	95
100	.05767	9.4	3.11	.05417	9.6	3.23	.05072	9.8	3.29	100
105	.04951	10.2	3.03	.04623	10.4	3.15	.04315	10.6	3.21	105
110	.04267	10.9	2.95	.03961	11.2	3.07	.03686	11.4	3.13	110
115	.03691	11.7	2.88	.03405	12.0	3.00	.03160	12.2	3.06	115
120	.03204	12.5	2.81	.02939	12.9	2.93	.02720	13.1	2.98	120
125	.02791	13.3	2.74	.02545	13.7	2.86	.02349	13.9	2.91	125
130	.02440	14.1	2.67	.02211	14.5	2.79	.02036	14.7	2.84	130
135	.02139	14.9	2.61	.01928	15.3	2.72	.01771	15.6	2.77	135
140	.01882	15.7	2.55	.01686	16.1	2.66	.01545	16.4	2.71	140
145	.01660	16.5	2.49	.01479	17.0	2.60	.01353	17.2	2.64	145
150	.01469	17.3	2.43	.01302	17.8	2.54	.01188	18.1	2.58	150

T (°C)	Material code B (K)									T (°C)
	S 4520			T 4630			U 4840			
	R (T) / R25	TF (%)	α (°/°C)	R (T) / R25	TF (%)	α (°/°C)	R (T) / R25	TF (%)	α (°/°C)	
- 55	126.1	26.6	7.55	137.0	27.2	7.64	173.7	28.5	8.04	- 55
- 50	87.73	23.0	7.35	94.92	23.5	7.45	118.2	24.6	7.83	- 50
- 45	61.59	19.8	7.16	66.34	20.2	7.26	81.16	21.2	7.63	- 45
- 40	43.62	16.9	6.97	46.77	17.3	7.09	56.25	18.1	7.44	- 40
- 35	31.17	14.3	6.79	33.25	14.7	6.90	39.33	15.4	7.25	- 35
- 30	22.45	12.1	6.62	23.83	12.4	6.72	27.74	12.9	7.07	- 30
- 25	16.31	10.1	6.45	17.22	10.3	6.56	19.73	10.8	6.89	- 25
- 20	11.94	8.3	6.28	12.54	8.5	6.39	14.15	8.9	6.71	- 20
- 15	8.808	6.8	6.12	9.205	6.9	6.23	10.23	7.3	6.54	- 15
- 10	6.548	5.4	5.96	6.806	5.6	6.08	7.456	5.8	6.38	- 10
- 5	4.904	4.2	5.81	5.069	4.3	5.92	5.475	4.5	6.22	- 5
0	3.699	3.2	5.66	3.803	3.3	5.78	4.051	3.4	6.06	0
5	2.810	2.3	5.52	2.873	2.4	5.63	3.019	2.5	5.91	5
10	2.149	1.6	5.38	2.185	1.6	5.49	2.267	1.7	5.76	10
15	1.654	1.0	5.24	1.673	1.0	5.35	1.714	1.0	5.61	15
20	1.282	.4	5.10	1.289	.4	5.22	1.305	.5	5.47	20
25	1.0000	0.0	4.97	1.0000	0.0	5.09	1.0000	0.0	5.33	25
30	.7848	.4	4.85	.7805	.4	4.96	.7715	.4	5.20	30
35	.6196	.9	4.72	.6129	.9	4.83	.5991	.9	5.06	35
40	.4922	1.4	4.60	.4842	1.4	4.71	.4681	1.5	4.94	40
45	.3932	2.0	4.48	.3847	2.0	4.59	.3681	2.1	4.81	45
50	.3158	2.6	4.37	.3074	2.6	4.48	.2911	2.8	4.69	50
55	.2551	3.2	4.26	.2470	3.3	4.37	.2316	3.4	4.57	55
60	.2072	3.9	4.15	.1996	4.0	4.26	.1853	4.2	4.45	60
65	.1691	4.6	4.05	.1621	4.7	4.15	.1491	4.9	4.34	65
70	.1387	5.3	3.94	.1323	5.4	4.04	.1207	5.7	4.23	70
75	.1144	6.1	3.84	.1086	6.2	3.94	.09813	6.5	4.12	75
80	.09477	6.8	3.75	.08953	7.0	3.84	.08023	7.3	4.02	80
85	.07888	7.6	3.65	.07417	7.8	3.75	.06592	8.2	3.91	85
90	.06595	8.4	3.56	.06173	8.6	3.65	.05443	9.0	3.82	90
95	.05539	9.2	3.47	.05161	9.5	3.56	.04515	9.9	3.72	95
100	.04671	10.1	3.39	.04334	10.3	3.47	.03763	10.8	3.63	100
105	.03956	10.9	3.30	.03655	11.2	3.39	.03151	11.7	3.54	105
110	.03364	11.7	3.22	.03095	12.0	3.31	.02650	12.6	3.45	110
115	.02872	12.6	3.14	.02632	12.9	3.22	.02237	13.5	3.38	115
120	.02461	13.4	3.07	.02247	13.7	3.15	.01897	14.4	3.28	120
125	.02117	14.3	2.99	.01925	14.6	3.07	.01615	15.3	3.20	125
130	.01828	15.1	2.92	.01656	15.5	2.99	.01381	16.2	3.12	130
135	.01584	16.0	2.85	.01429	16.4	2.92	.01185	17.1	3.04	135
140	.01376	16.8	2.78	.01238	17.3	2.85	.01020	18.0	2.97	140
145	.01201	17.7	2.72	.01076	18.1	2.78	.00882	19.0	2.90	145
150	.01050	18.6	2.65	.00938	19.0	2.72	.00765	19.9	2.83	150

NTC Disc Thermistors

ND 03/06/09 • NV 06/09



PACKAGING

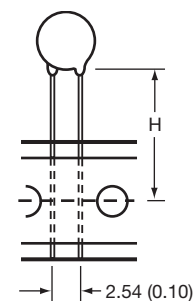
• Reel & Ammopack

millimeters (inches)

Types	Suffix	H or Ho	Leads	Quantity/Size	Packaging
ND03	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
ND/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

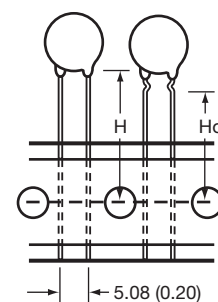
NTC

Type
ND 03



NTC

Types
ND
NV
06/09



• Bulk

Type	Quantity/box
ND03	3000
ND06	1500
ND09	1500
NV06	According to P/N
NV09	According to P/N

HOW TO ORDER

ND06



Type

P0



Material Code
P

0103



Resistance
10 kΩ

K



Tolerance
K (±10%)

—



Packaging
Bulk

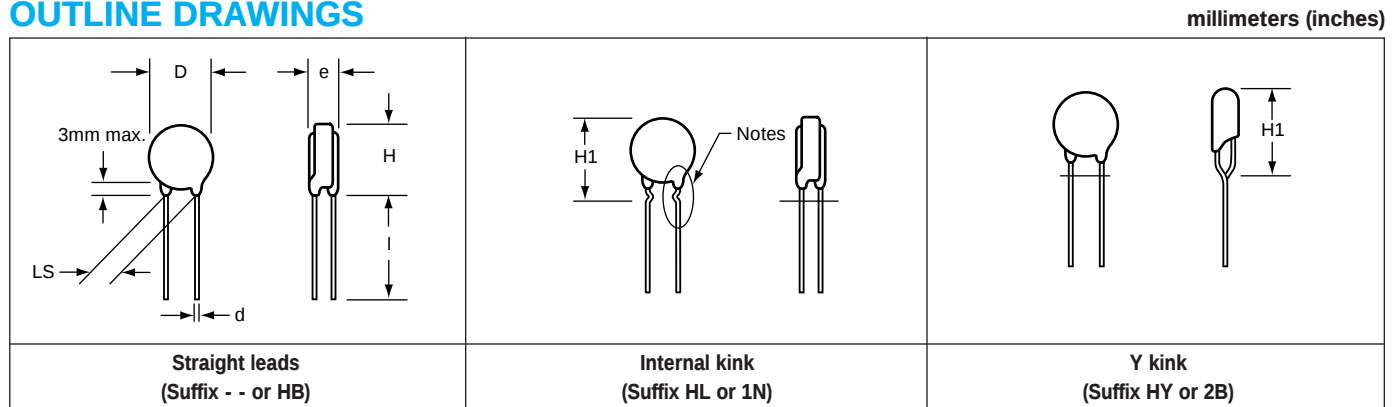
NTC Inrush Current Limiters Thermistors



NF 08 - 10 - 13 - 15 - 20

(For more details see also the catalog dedicated to this range)

OUTLINE DRAWINGS



Notes: In case of adding strength to the lead wire from the side, it may occur crack and fragment at a part of pant leg.

* 0.6 mm copper wire and 5.08 mm leads spacing for those two types.

DIMENSIONS millimeters (inches)

Type	D max mm	e max mm	H max mm	H1 max mm	l min mm	d ±0.02 mm	LS ±0.8 mm
NF08*	9.5 (.374)	5.0 (.197)	13.0 (.512)	16.0 (.630)	30 (1.181)	0.6 (.024)	5.08 (.20)
NF08	9.5 (.374)	5.0 (.197)	13.0 (.512)	16.0 (.630)	30 (1.181)	0.8 (.031)	7.62 (.03)
NF10*	11.5 (.453)	5.0 (.197)	15.0 (.591)	18.0 (.709)	30 (1.181)	0.6 (.024)	5.08 (.20)
NF10	11.5 (.453)	5.0 (.197)	15.0 (.591)	18.0 (.709)	30 (1.181)	0.8 (.031)	7.62 (.30)
NF13	15.0 (.591)	6.0 (.236)	18.0 (.709)	22.0 (.866)	30 (1.181)	0.8 (.031)	7.62 (.30)
NF15	17.0 (.669)	6.0 (.236)	20.0 (.787)	24.0 (.945)	30 (1.181)	1.0 (.039)	7.62 (.30)
NF20	22.0 (.866)	6.0 (.236)	25.0 (.984)	29.0 (1.142)	30 (1.181)	1.0 (.039)	7.62 (.30)

GENERAL CHARACTERISTICS

Type	Standard tolerance** %	Maximum operating T°C	Max power 25°C Watts	Thermal dissipation δ_{th} (mW/K)	Thermal time constant τ_c (s)	Heat capacity H (mJ/K)	Packing bulk ✓	Packing tape ✓
NF08*	20	-40 / +200	1.6	8	60	480	✓	✓
NF08	20	-40 / +200	2.2	11	60	660	✓	✓
NF10*	20	-40 / +200	2.0	10	75	750	✓	-
NF10	20	-40 / +200	2.6	13	75	975	✓	✓
NF13	20	-40 / +200	3.2	16	100	1600	✓	✓
NF15	20	-40 / +200	4.1	20	115	2300	✓	-
NF20	20	-40 / +200	5.0	25	160	4000	✓	-

* 0.6 mm copper wire and 5.08 mm leads spacing for those two types.

** Other tolerances available: L: ±15, X: ±25%

SUFFIXES FOR BULK PACKING (Suffixes for taping: see page 54-55)

- -	straight leads 0.8 or 1 mm wire diameter and 7.62 lead spacing	1N	internal kink 0.6 mm wire diameter and 5.08 lead spacing
HB	straight leads 0.6 mm wire diameter and 5.08 lead spacing	HY	Y kink 0.8 or 1 mm wire diameter and 7.62 lead spacing
HL	internal kink 0.8 mm or 1 mm wire diameter and 7.62 lead spacing	2B	Y kink 0.6 mm wire diameter and 5.08 lead spacing

HOW TO ORDER

NF13

Type

AA

Inrush
Current
Limiters

0509

Resistance
5 kΩ

M

Tolerance
M (±20%)

--

Suffix
Bulk, Straight Leads
(See illustration above)

Table of Values



NF 08 - 10 - 13 - 15 - 20

cUL	Ceramic Disc ø (mm)	Part number reference T _{type}	Zero power resistance R _{25°C} (Ω)	Max steady state current I _{ss} max 25°C (A)	Resistance at max current R _{iss} max (Ω)
*	08	NF08AA0509MHB	5.0	2.9	0.20
*		NF08AA0809MHB	8.0	2.3	0.30
*		NF08AA0100MHB	10.0	2.1	0.37
*		NF08AA0150MHB	15.0	1.8	0.50
*		NF08AA0330MHB	33.0	1.3	0.97
*	08	NF08AA0509M - -	5.0	3.4	0.20
*		NF08AA0809M - -	8.0	2.7	0.30
*		NF08AA0100M - -	10.0	2.5	0.37
*		NF08AA0150M - -	15.0	2.1	0.50
*		NF08AA0330M - -	33.0	1.5	0.97
*	10	NF10AA0259MHB	2.5	4.5	0.10
*		NF10AA0409MHB	4.0	3.6	0.16
*		NF10AA0509MHB	5.0	3.3	0.19
*		NF10AA0809MHB	8.0	2.6	0.30
*		NF10AA0100MHB	10.0	2.5	0.34
*		NF10AA0160MHB	16.0	2.0	0.50
*		NF10AA0200MHB	20.0	1.9	0.59
*		NF10AA0250MHB	25.0	1.7	0.69
*		NF10AA0500MHB	50.0	1.4	1.07
*		NF10AA0800MHB	80.0	1.1	1.60
*		NF10AA0121MHB	120.0	1.0	1.90
*	10	NF10AA0259M - -	2.5	5.2	0.10
*		NF10AA0409M - -	4.0	4.1	0.16
*		NF10AA0509M - -	5.0	3.8	0.19
*		NF10AA0809M - -	8.0	3.0	0.30
*		NF10AA0100M - -	10.0	2.8	0.34
*		NF10AA0160M - -	16.0	2.3	0.50
*		NF10AA0200M - -	20.0	2.1	0.59
*		NF10AA0250M - -	25.0	2.0	0.69
*		NF10AA0500M - -	50.0	1.6	1.07
*		NF10AA0800M - -	80.0	1.3	1.60
*		NF10AA0121M - -	120.0	1.2	1.90
*	13	NF13AA0259M - -	2.5	5.7	0.10
*		NF13AA0509M - -	5.0	4.2	0.19
*		NF13AA0709M - -	7.0	3.7	0.24
*		NF13AA0809M - -	8.0	3.6	0.25
*		NF13AA0100M - -	10.0	3.3	0.30
*		NF13AA0150M - -	15.0	2.8	0.41
*		NF13AA0220M - -	22.0	2.3	0.61
*		NF13AA0330M - -	33.0	2.2	0.70
*		NF13AA0400M - -	40.0	2.0	0.80
*		NF13AA0600M - -	60.0	1.9	0.95
*	15	NF15AA0139M - -	1.3	8.9	0.05
*		NF15AA0159M - -	1.5	8.3	0.06
*		NF15AA0259M - -	2.5	6.6	0.09
*		NF15AA0309M - -	3.0	6.1	0.11
*		NF15AA0409M - -	4.0	5.5	0.13
*		NF15AA0509M - -	5.0	4.9	0.17
*		NF15AA0609M - -	6.0	4.7	0.19
*		NF15AA0709M - -	7.0	4.3	0.22
*		NF15AA0809M - -	8.0	4.2	0.24
*		NF15AA0100M - -	10.0	3.7	0.30
*		NF15AA0120M - -	12.0	3.5	0.33
*		NF15AA0160M - -	16.0	3.0	0.44
*		NF15AA0200M - -	20.0	3.1	0.43
*		NF15AA0250M - -	25.0	2.8	0.53
*		NF15AA0330M - -	33.0	2.5	0.66
*		NF15AA0400M - -	40.0	2.3	0.80
*		NF15AA0470M - -	47.0	2.3	0.74
*	20	NF20AA0109M - -	1.0	11.4	0.04
*		NF20AA0259M - -	2.5	7.8	0.08
*		NF20AA0409M - -	4.0	6.4	0.13
*		NF20AA0509M - -	5.0	5.9	0.15
*		NF20AA0100M - -	10.0	4.3	0.28
*		NF20AA0150M - -	15.0	4.0	0.32
*		NF20AA0330M - -	33.0	3.1	0.52

* cL/L approval (File E167822)

- Electrical performances for suffixes HL and HY are identical to the suffix - -.
- Electrical performances for suffixes 1N and 2B are identical to the suffix HB

NTC Inrush Current Limiters

Thermistors

Application Guide

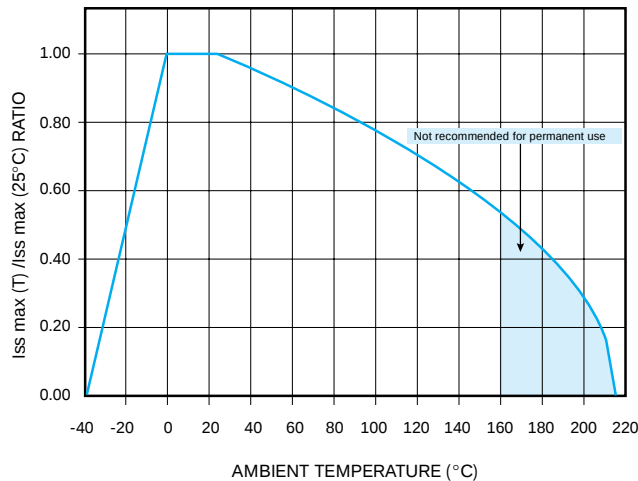


1 – HOW TO DETERMINE THE MAXIMUM STEADY STATE CURRENT OF NF THERMISTORS?

- If the ambient temperature is 25°C: the current is given in table page 27.
- If the ambient temperature is different from 25°C: the current at 25°C must be derated as specified in the graph below.

Example: maximum steady state current of NF13AA0100M at 60°C ambient:
 $I_{SS_{max25}} \times 0.9 = 3.0 \text{ A}$.

Derating of maximum steady state current with ambient temperature



2 – HOW TO CALCULATE THE WORKING TEMPERATURE OF NF THERMISTOR?

Example: NF08AA0330M

$$I_{SS} = 0.2 \text{ A}, \quad T_{\text{ambient}} = 25^\circ\text{C}$$

- From the graph V (I) page 29, we find $V_{SS} = 2.2 \text{ V}$ therefore, $R_{SS} = 11 \Omega$
- From the graph R(T), page 29, at $R = 11 \Omega$, we find $T \pm 65^\circ\text{C}$

3 – HOW TO CALCULATE THE WORKING POINT OF NF THERMISTOR AT A DIFFERENT AMBIENT TEMPERATURE THAN 25°C?

Example: NF13AA0100M

$$I_{SS} = 3 \text{ A}, \quad T_{\text{ambient}} = T_A = 60^\circ\text{C}$$

$$R_T I_{SS}^2 = \delta (T - T_A) \text{ and thus}$$

$$T = \frac{R_T I_{SS}^2}{\delta} + T_A$$

- As R_T depends on T , this equation is quite complex to be solved by an algebraic way. The quickest manner to solve it is to operate by iterations:

for NF13, $\delta = 16 \text{ mW/K}$ (see page 26)

therefore, the equation becomes:

$$T = 562.5 R_T + 60$$

from the R_T curve page 30 we find R_T starting from T :

$T (^\circ\text{C})$	$R_T (\Omega)$	$\geq$	$562.5 R_T + 60 (^\circ\text{C})$
185	0.28		217
190	0.26		206
195	0.24		195
200	0.22		184

The working temperature of this NF thermistor is about 195°C when operating under $I_{SS} = 3 \text{ A}$ and $T_A = 60^\circ\text{C}$ (this temperature is the one for which we have $T = 562.5 R_T + 60$).

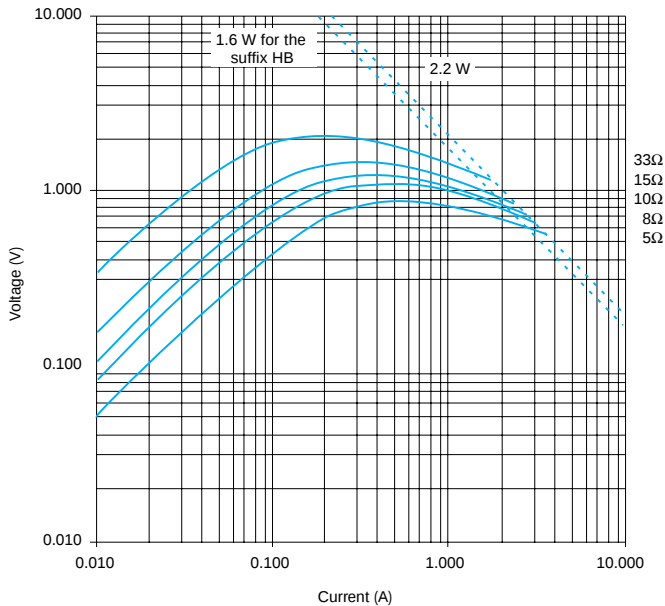
Important: A discrepancy may exist between practice and theory due to the tolerance of the thermistor ($\pm 20\%$ usually).

NTC Inrush Current Limiters Thermistors

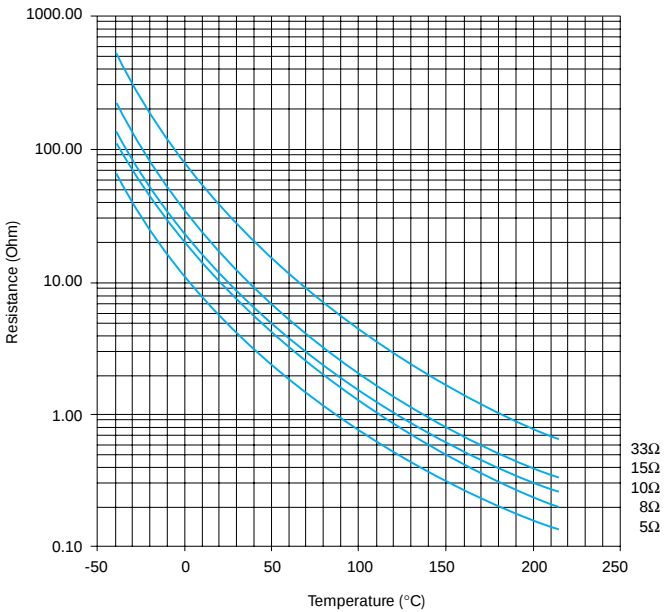


Voltage-Current and Resistance-Temperature Characteristics

TYPICAL VOLTAGE/CURRENT CHARACTERISTICS FOR TYPE NF08



TYPICAL RESISTANCE/TEMPERATURE CHARACTERISTICS FOR TYPE NF08

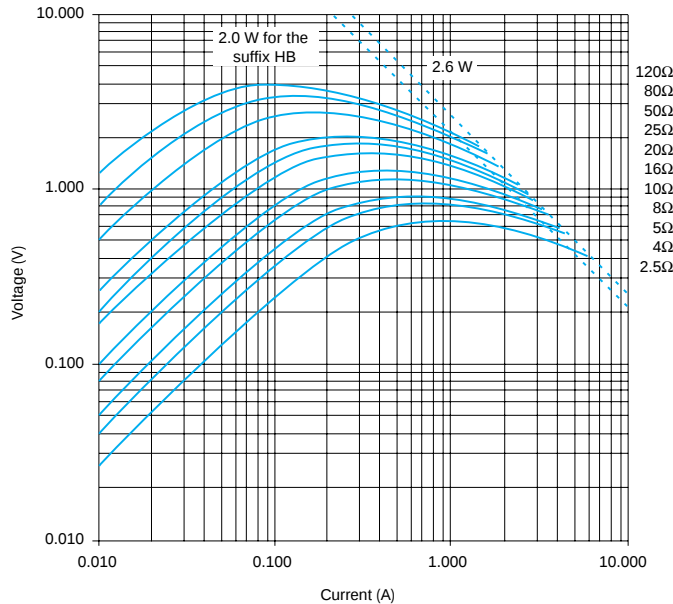


NTC Inrush Current Limiters Thermistors

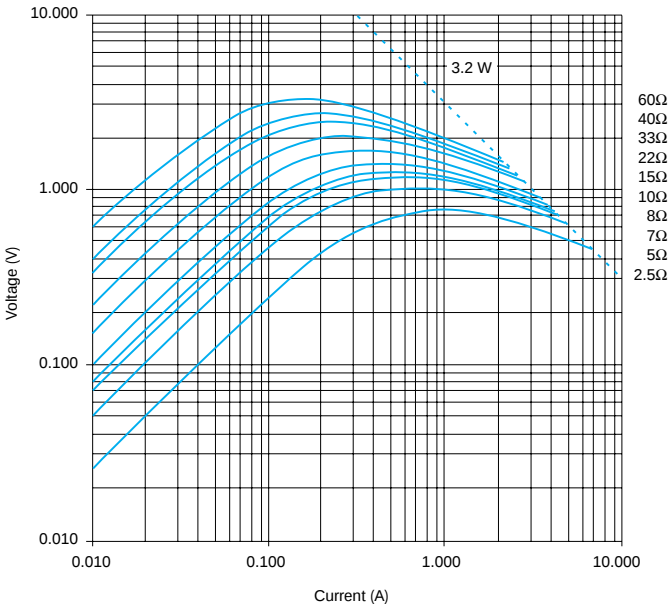


Voltage-Current and Resistance-Temperature Characteristics

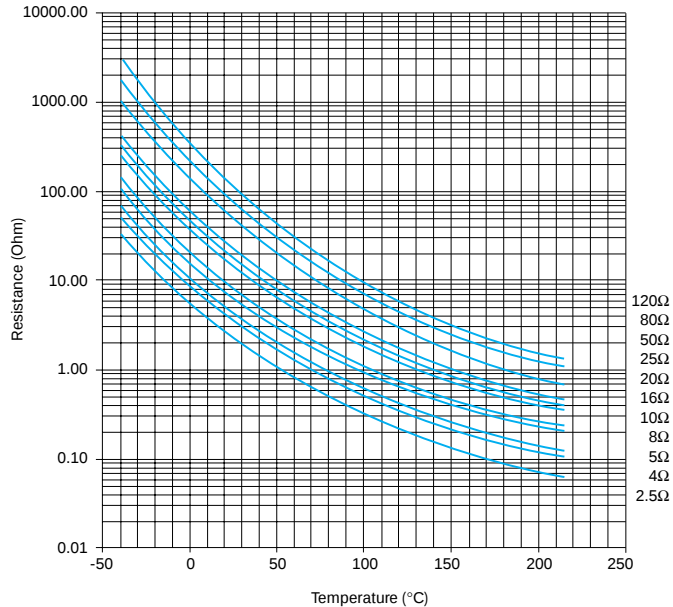
TYPICAL VOLTAGE/CURRENT CHARACTERISTICS FOR TYPE NF10



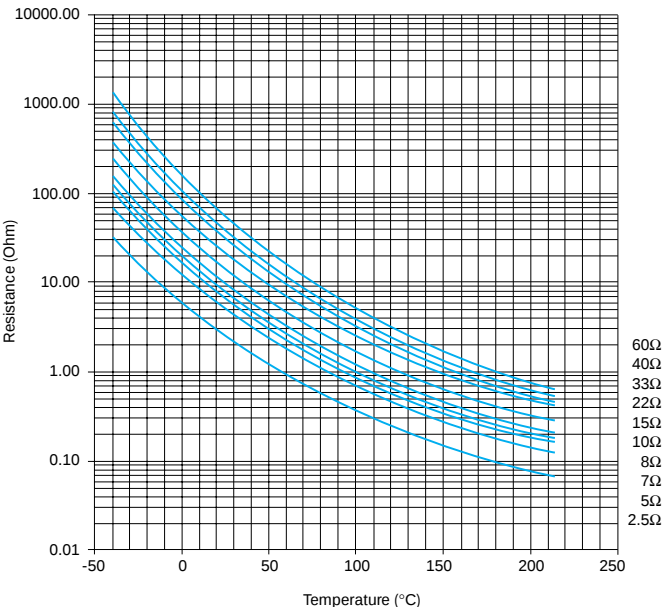
TYPICAL VOLTAGE/CURRENT CHARACTERISTICS FOR TYPE NF13



TYPICAL RESISTANCE/TEMPERATURE CHARACTERISTICS FOR TYPE NF10



TYPICAL RESISTANCE/TEMPERATURE CHARACTERISTICS FOR TYPE NF13

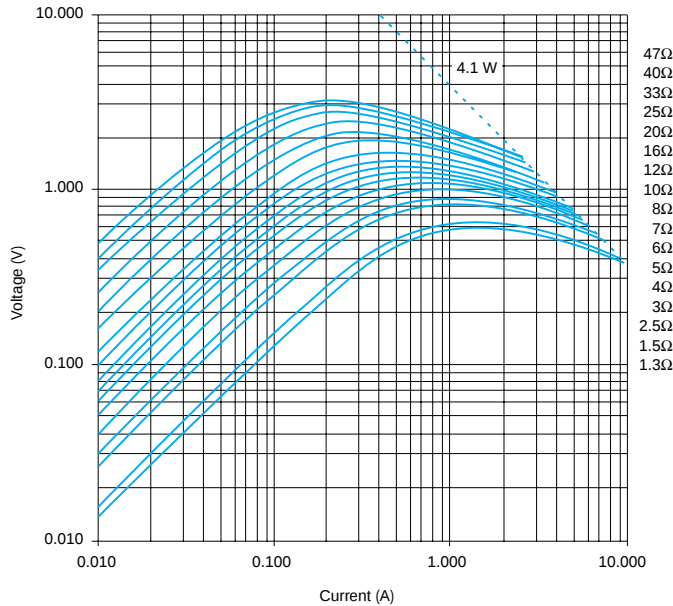


NTC Inrush Current Limiters Thermistors

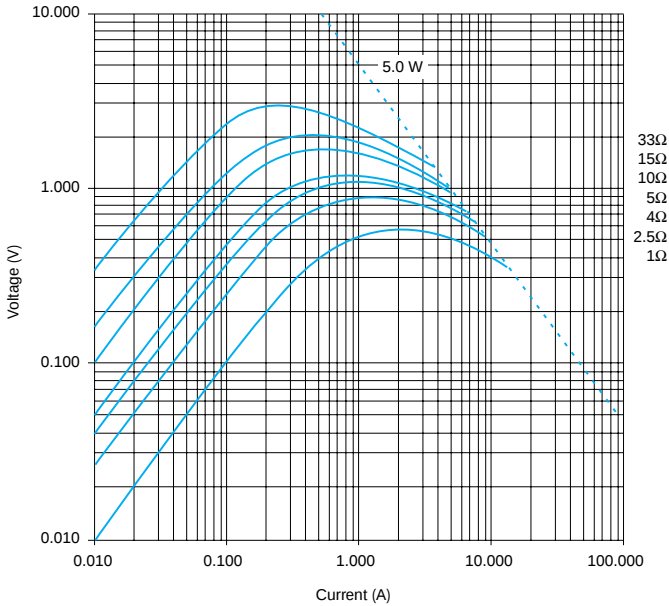


Voltage-Current and Resistance-Temperature Characteristics

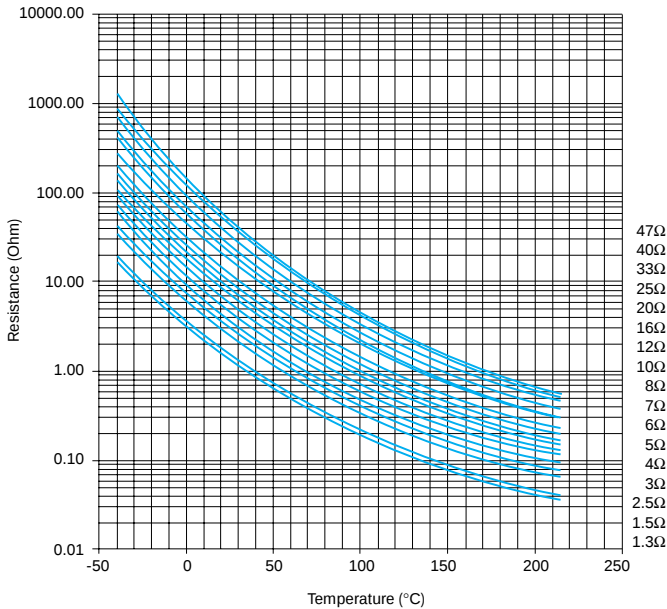
**TYPICAL VOLTAGE/CURRENT
CHARACTERISTICS FOR TYPE NF15**



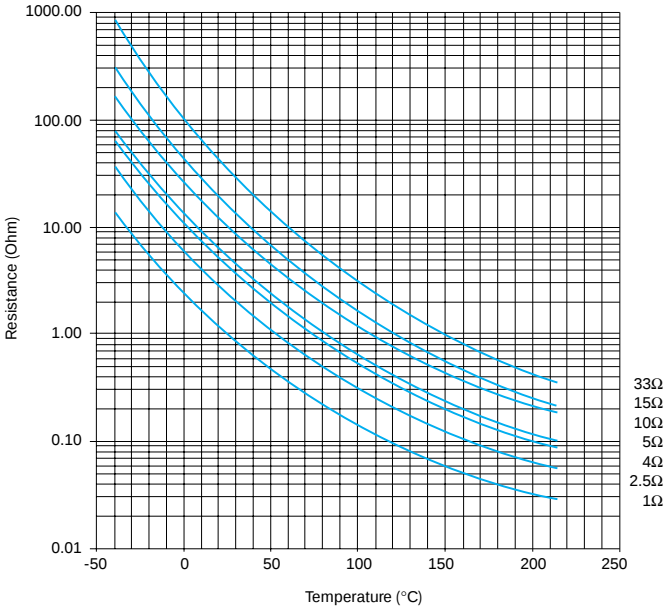
**TYPICAL VOLTAGE/CURRENT
CHARACTERISTICS FOR TYPE NF20**



**TYPICAL RESISTANCE/TEMPERATURE
CHARACTERISTICS FOR TYPE NF15**



**TYPICAL RESISTANCE/TEMPERATURE
CHARACTERISTICS FOR TYPE NF20**



NTC Accurate Leaded Thermistors

NI24 • NJ28



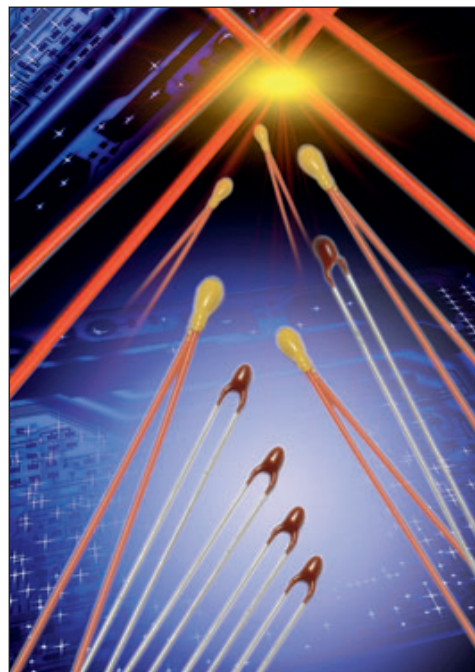
APPLICATIONS

- High precision resistance
- Tight B tolerance
- Ideal for temperature measurement applications

TECHNOLOGY

- NJ range: Coated chip (phenolic resin + varnish overcoat + bare leads)
- NI range: Coated chip (epoxy resin and insulated leads)
- Leads: Radial wire: NJ: tinned copper (*)
NI: PTFE insulated silvered nickel
- Marking: on package only
- Delivery Mode: Bulk for NI range
Bulk or Reel or Ammopack for NJ range

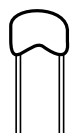
(*) other materials available: consult us



Accuracy Series

NJ28

NI24



PERFORMANCE CHARACTERISTICS

Types	Accurate Thermistors	
	NJ28	NI24
Operating Temperature	-55 to +150°C	
Tolerance on R _n (25°C)	±1%, ±2%, ±3%	
Maximum dissipation at 25°C	0.16 W	
Thermal dissipation factor	3 mW/°C	
Thermal time constant	8 s	
Response time	< 2 s	

HOW TO ORDER

NJ28

Type

MA

Material Code
MA

0502

Resistance
5 kΩ

F

Tolerance
F (±1%)

--

Packaging
Bulk

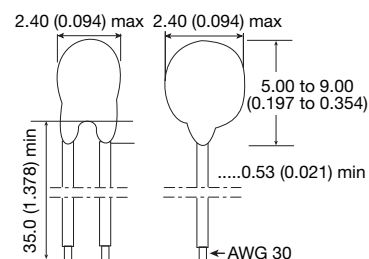
NTC Accurate Leaded Thermistors

NI24 • NJ28



TABLE OF VALUES

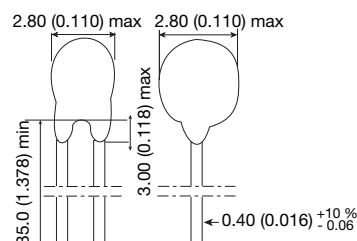
NI24



Part Number	R _n at 25°C (Ω)	Material Code	B (K)	α at 25°C (%/°C)
NI24KA0202	2000	KA	3625 ±1%	-4.1
NI24MA0302	3000	MA	3960 ±0.5%	-4.5
NI24MA0502	5000	MA	3960 ±0.5%	-4.5
NI24MA0103	10000	MA	3960 ±0.5%	-4.5
NI24NA0103	10000	NA	4100 ±1%	-4.6
NI24PA0203	20000	PA	4235 ±1%	-4.8
NI24QA0503	50000	QA	4250 ±1%	-4.8
NI24RA0104	100000	RA	4380 ±1%	-4.9

TABLE OF VALUES

NJ28



Part Number	R _n at 25°C (Ω)	Material Code	B (K)	α at 25°C (%/°C)
NJ28KA0202	2000	KA	3625 ±1%	-4.1
NJ28MA0302	3000	MA	3960 ±0.5%	-4.5
NJ28MA0502	5000	MA	3960 ±0.5%	-4.5
NJ28MA0103	5000	MA	3960 ±0.5%	-4.5
NJ28NA0103	10000	NA	4100 ±1%	-4.6
NJ28PA0203	20000	PA	4235 ±1%	-4.8
NJ28QA0503	50000	QA	4250 ±1%	-4.8
NJ28RA0104	100000	RA	4380 ±1%	-4.9

NTC Accurate Leaded Thermistors

NI24 • NJ28



TABLE OF RESISTANCE: TEMPERATURE CHARACTERISTICS

T (°C)	Material code B (K)									T (°C)
	KA 3625			MA 3960			NA 4100			
	R (T) / R25	TF (%)	α (%/°C)	R (T) / R25	TF (%)	α (%/°C)	R (T) / R25	TF (%)	α (%/°C)	
-55	61.21	7.1	6.77	104.2	3.9	7.89	109.5	8.0	7.83	-55
-50	44.24	6.1	6.53	71.63	3.4	7.57	75.42	6.9	7.54	-50
-45	32.33	5.3	6.30	49.94	2.9	7.28	52.63	6.0	7.27	-45
-40	23.88	4.5	6.08	35.28	2.5	7.00	37.18	5.1	7.01	-40
-35	17.81	3.8	5.88	25.25	2.1	6.73	26.58	4.3	6.76	-35
-30	13.41	3.2	5.68	18.28	1.8	6.48	19.22	3.7	6.52	-30
-25	10.19	2.7	5.49	13.39	1.5	6.25	14.04	3.1	6.30	-25
-20	7.814	2.2	5.31	9.917	1.2	6.02	10.37	2.5	6.09	-20
-15	6.040	1.8	5.14	7.419	1.0	5.81	7.730	2.1	5.89	-15
-10	4.707	1.5	4.98	5.605	.8	5.61	5.817	1.6	5.70	-10
-5	3.696	1.1	4.83	4.275	.6	5.42	4.416	1.3	5.51	-5
0	2.923	.9	4.68	3.289	.5	5.24	3.382	1.0	5.34	0
5	2.329	.6	4.53	2.552	.3	5.06	2.611	.7	5.17	5
10	1.867	.4	4.40	1.997	.2	4.90	2.032	.5	5.01	10
15	1.507	.3	4.27	1.574	.1	4.74	1.593	.3	4.86	15
20	1.224	.1	4.14	1.250	.1	4.59	1.258	.1	4.71	20
25	1.0000	0.0	4.02	1.0000	0.0	4.45	1.0000	0.0	4.57	25
30	.8217	.1	3.91	.8053	.1	4.31	.8004	.1	4.44	30
35	.6788	.2	3.80	.6527	.1	4.18	.6446	.3	4.31	35
40	.5638	.4	3.69	.5323	.2	4.06	.5224	.4	4.19	40
45	.4707	.5	3.59	.4367	.3	3.94	.4258	.6	4.07	45
50	.3948	.7	3.49	.3604	.4	3.82	.3491	.8	3.96	50
55	.3328	.9	3.40	.2990	.5	3.71	.2877	1.0	3.85	55
60	.2818	1.0	3.31	.2493	.6	3.61	.2383	1.2	3.74	60
65	.2396	1.2	3.22	.2090	.7	3.51	.1984	1.4	3.64	65
70	.2046	1.4	3.14	.1760	.8	3.41	.1660	1.6	3.55	70
75	.1754	1.6	3.06	.1489	.9	3.32	.1396	1.8	3.45	75
80	.1510	1.8	2.98	.1266	1.0	3.23	.1178	2.1	3.36	80
85	.1305	2.0	2.90	.1081	1.1	3.14	.09991	2.3	3.28	85
90	.1131	2.3	2.83	.09262	1.2	3.06	.08507	2.5	3.20	90
95	.09846	2.5	2.76	.07970	1.3	2.98	.07273	2.8	3.12	95
100	.08597	2.7	2.69	.06885	1.5	2.91	.06241	3.0	3.04	100
105	.07531	2.9	2.63	.05969	1.6	2.83	.05376	3.3	2.96	105
110	.06618	3.1	2.56	.05194	1.7	2.76	.04648	3.5	2.89	110
115	.05834	3.4	2.50	.04535	1.8	2.69	.04032	3.8	2.82	115
120	.05158	3.6	2.44	.03973	2.0	2.63	.03510	4.1	2.76	120
125	.04573	3.8	2.39	.03491	2.1	2.56	.03065	4.3	2.69	125
130	.04066	4.0	2.33	.03077	2.2	2.50	.02685	4.6	2.63	130
135	.03625	4.3	2.28	.02721	2.3	2.44	.02359	4.8	2.57	135
140	.03240	4.5	2.23	.02412	2.5	2.39	.02079	5.1	2.51	140
145	.02903	4.7	2.18	.02145	2.6	2.33	.01838	5.4	2.45	145
150	.02608	5.0	2.13	.01912	2.7	2.28	.01629	5.6	2.40	150

T (°C)	Material code B (K)									T (°C)
	PA 4235			QA 4250			RA 4380			
	R (T) / R25	TF (%)	α (%/°C)	R (T) / R25	TF (%)	α (%/°C)	R (T) / R25	TF (%)	α (%/°C)	
-55	123.3	8.3	8.00	101.8	8.3	7.36	110.7	8.6	7.53	-55
-50	84.31	7.2	7.71	71.33	7.2	7.13	77.22	7.4	7.29	-50
-45	58.37	6.2	7.43	50.51	6.2	6.91	54.43	6.4	7.07	-45
-40	40.92	5.3	7.17	36.14	5.3	6.70	38.76	5.5	6.85	-40
-35	29.03	4.5	6.92	26.11	4.5	6.50	27.86	4.6	6.65	-35
-30	20.83	3.8	6.69	19.05	3.8	6.31	20.22	3.9	6.46	-30
-25	15.10	3.2	6.46	14.02	3.2	6.12	14.81	3.3	6.27	-25
-20	11.07	2.6	6.25	10.41	2.6	5.85	10.94	2.7	6.09	-20
-15	8.189	2.1	6.05	7.791	2.1	5.78	8.143	2.2	5.92	-15
-10	6.117	1.7	5.85	5.879	1.7	5.62	6.112	1.8	5.76	-10
-5	4.610	1.3	5.67	4.470	1.3	5.46	4.622	1.4	5.60	-5
0	3.504	1.0	5.49	3.424	1.0	5.31	3.522	1.0	5.45	0
5	2.686	.7	5.32	2.642	.7	5.17	2.702	.8	5.31	5
10	2.075	.5	5.16	2.052	.5	5.03	2.087	.5	5.17	10
15	1.615	.3	5.01	1.605	.3	4.90	1.623	.3	5.03	15
20	1.266	.1	4.86	1.263	.1	4.77	1.270	.1	4.91	20
25	1.0000	0.0	4.72	1.0000	0.0	4.65	1.0000	0.0	4.78	25
30	.7949	.1	4.58	.7965	.1	4.53	.7920	.1	4.66	30
35	.6359	.3	4.45	.6380	.3	4.42	.6308	.3	4.55	35
40	.5119	.4	4.32	.5139	.4	4.31	.5052	.5	4.43	40
45	.4145	.6	4.20	.4162	.6	4.20	.4068	.6	4.33	45
50	.3376	.8	4.09	.3388	.8	4.10	.3292	.8	4.22	50
55	.2765	1.0	3.98	.2771	1.0	4.00	.2678	1.0	4.12	55
60	.2276	1.2	3.87	.2278	1.2	3.90	.2189	1.3	4.02	60
65	.1883	1.4	3.77	.1881	1.4	3.81	.1797	1.5	3.93	65
70	.1566	1.7	3.67	.1560	1.7	3.72	.1483	1.7	3.84	70
75	.1308	1.9	3.58	.1300	1.9	3.63	.1228	2.0	3.75	75
80	.1098	2.1	3.48	.1088	2.1	3.55	.1022	2.2	3.67	80
85	.09258	2.4	3.40	.0914	2.4	3.47	.08537	2.5	3.58	85
90	.07838	2.6	3.31	.07708	2.6	3.39	.07160	2.7	3.50	90
95	.06662	2.9	3.23	.06527	2.9	3.31	.06029	3.0	3.42	95
100	.05686	3.1	3.15	.05547	3.2	3.24	.05095	3.2	3.35	100
105	.04871	3.4	3.07	.04731	3.4	3.17	.04322	3.5	3.28	105
110	.04189	3.7	3.00	.04049	3.7	3.10	.03679	3.8	3.21	110
115	.03614	3.9	2.93	.03478	3.9	3.03	.03143	4.1	3.14	115
120	.03130	4.2	2.86	.02996	4.2	2.96	.02693	4.3	3.07	120
125	.02719	4.5	2.79	.02590	4.5	2.90	.02316	4.6	3.01	125
130	.02370	4.7	2.73	.02246	4.7	2.84	.01997	4.9	2.94	130
135	.02072	5.0	2.67	.01953	5.0	2.78	.01728	5.2	2.88	135
140	.01817	5.3	2.61	.01704	5.3	2.72	.01499	5.4	2.82	140
145	.01598	5.5	2.55	.01490	5.5	2.67	.01305	5.7	2.77	145
150	.01410	5.8	2.49	.01307	5.8	2.61	.01138	6.0	2.71	150

NTC Accurate Leaded Thermistors

NI24 • NJ28



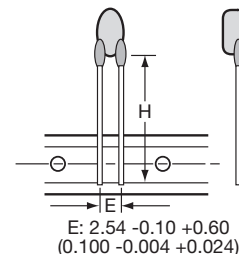
PACKAGING

• Reel & Ammopack

Types	Suffix	H or Ho	Leads	Quantity/Size	Packaging
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

• Bulk

Type	Quantity/box
NJ28	2000
NI24	1000



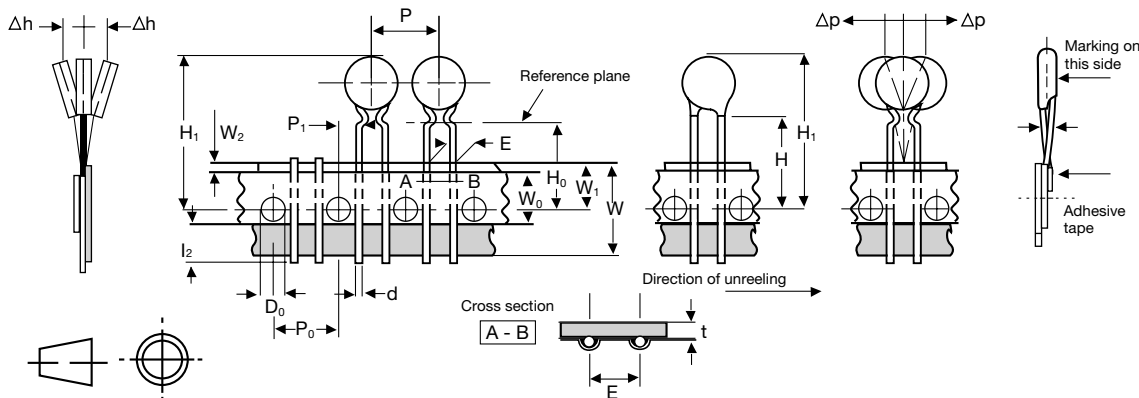
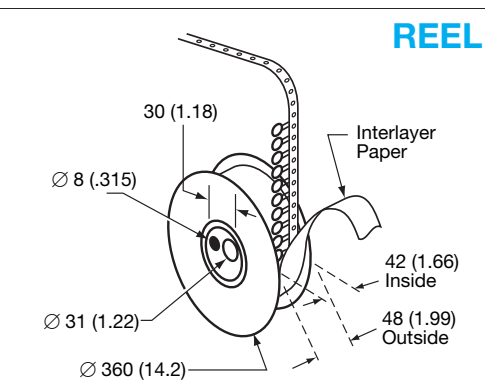
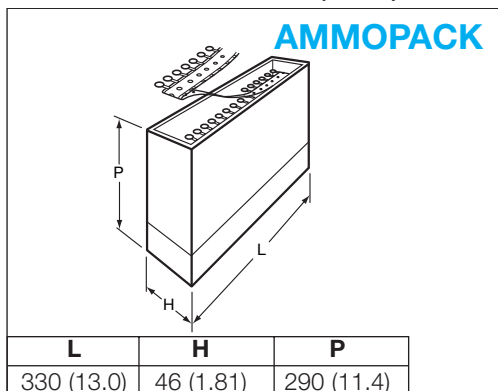
TAPING CHARACTERISTICS

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	±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	±0.2	D ₀ Diameter of sprocket hole
16/19.5	±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		±0.2	P ₀	Sprocket holes pitch
254		±1	–	Distance between 21 consecutive holes 20 pitches
0.7		±0.2	t	Total thickness of tape
2.54	5.08	+0.6 -0.1	E	Lead spacing
5.08	3.85	± 0.7	P ₁	Distance between the sprocket hole axis and the lead axis
12.7		±1.0	P	Spacing of components
0.5	0.6	±5%	d	Lead diameter
0		±1.3	°P	Verticality of components
0		±2	°h	Alignment of components

NTC Thermistors Insulated Metal Case NM 06



Especially designed for mounting on a chassis or screwing on a plate, these thermistors provide an excellent thermal

contact and ensure a good accuracy of measurement and alarm control for different types of equipment.

Type	NM 06
Finish	Disc thermistor, insulated metal case for chassis mounting
DIMENSIONS: millimeters (inches)	This type can be delivered with fixing nut, add suffix WC to the reference.
Marking	Nominal resistance Tolerance for ±10%
Operating temperature	-55°C to +150°C
Table of values	See table on page 25
Tolerance on R _n (25°C)	±10% ±20%
Maximum dissipation at 25°C	0.8 W - without heat sink 2 W - with heat sink Part mounted in the center of a brass plate (dim.: 100 x 100 x 1 mm)
Thermal dissipation factor*	8 mW/°C: without heat sink 20 mW/°C: with heat sink
Thermal time constant	Depending on cooling system
Test voltage to earth	380 Vrms (50 Hz)

*Typical value

HOW TO ORDER

NM06

Type

P0

Material Code
P
(See table page 25)

0103

Resistance
10 kΩ

M --

Tolerance
M (±20%)

Table of Values



NM 06

Types	Rn at 25°C	Material Code	B (K) $\left(\frac{\Delta B}{B} \begin{matrix} (1) \pm 5\% \\ (2) \pm 3\% \end{matrix} \right)$	α at 25°C (%/°C)
NM 06 F 0 0100 NM 06 F 0 0150	10 15	F	2800 (1)	– 3.2
NM 06 G 0 0220 NM 06 G 0 0330	22 33	G	3030 (1)	– 3.4
NM 06 H 0 0470 NM 06 H 0 0680	47 68	H	3160 (1)	– 3.5
NM 06 I 0 0101	100	I	3250 (1)	– 3.7
NM 06 J 0 0151 NM 06 J 0 0221	150 220	J	3480 (1)	– 3.9
NM 06 K 0 0331 NM 06 K 0 0471	330 470	K	3630 (1)	– 4.0
NM 06 L 0 0681 NM 06 L 0 0102	680 1,000	L	3790 (2)	– 4.2
NM 06 M 0 0152	1,500	M	3950 (2)	– 4.4
NM 06 N 0 0222 NM 06 N 0 0332	2,200 3,300	N	4080 (2)	– 4.6
NM 06 P 0 0472 NM 06 P 0 0682 NM 06 P 0 0103	4,700 6,800 10,000	P	4220 (2)	– 4.7
NM 06 Q 0 0153 NM 06 Q 0 0223	15,000 22,000	Q	4300 (2)	– 4.7
NM 06 R 0 0333	33,000	R	4400 (2)	– 4.8
NM 06 S 0 0473 NM 06 S 0 0683	47,000 68,000	S	4520 (2)	– 5.0
NM 06 T 0 0104	100,000	T	4630 (2)	– 5.1
NM 06 U 0 0154 NM 06 U 0 0224 NM 06 U 0 0334	150,000 220,000 330,000	U	4840 (2)	– 5.3

Resistance - Temperature characteristics: pages 32 to 35.

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: $D \pm \Delta D$ $R_1 \pm \Delta R_1 / R_1$ at T_1 $E \pm \Delta E$ $R_2 \pm \Delta R_2 / R_2$ 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 16 to 21).

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 32 to 35).

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 34), 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

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

Resistance - Temperature characteristics: pages 32 to 35.