

NTC SMD THERMISTORS

NC 12 – NC 20 (PdPtAg Termination)

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

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

| Types | NC 12 IEC SIZE : 0805 | NC 20 IEC SIZE : 1206 |
|-----------------------------------------|---------------------------------------------|--------------------------|
| 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) | ±3%*, ±5%, ±10%, ±20% | |
| Maximum dissipation at 25°C | 0.12 W | 0.24 W |
| Thermal dissipation factor | 2 mW/°C | 4 mW/°C |
| Thermal time constant | 5 s | 7 s |

Resistance - Temperature characteristics: pages 29 to 33.

FEATURES

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

APPLICATIONS

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



HOW TO ORDER

NC 20
Type
NC12 (0805)
NC20 (1206)

K 0
Material Code
K
(See tables pages 15)

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

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

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

* Optional tolerance, please contact factory

NTC SMD THERMISTORS

NC 12 – NC 20 (PdPtAg Termination)



TABLE OF VALUES

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

| NC 20 IEC SIZE : 1206 | | | | |
|--------------------------|----------------|---------------|-------------------------------------------------------|------------------|
| Types | Rn at 25°C (Ω) | Material Code | B (K) ($\frac{\Delta B}{B}$ (1) ± 5% (2) ± 3%) | α at 25°C (%/°C) |
| NC 20 KC 0 100 | 10 | KC | 3470 ± 5% | - 3.9 |
| NC 20 KC 0 120 | 12 | | | |
| NC 20 KC 0 150 | 15 | | | |
| NC 20 KC 0 180 | 18 | | | |
| NC 20 KC 0 220 | 22 | | | |
| NC 20 KC 0 270 | 27 | | | |
| NC 20 KC 0 330 | 33 | | | |
| NC 20 KC 0 390 | 39 | | | |
| NC 20 KC 0 470 | 47 | | | |
| NC 20 KC 0 560 | 56 | | | |
| NC 20 KC 0 680 | 68 | MC | 3910 ± 3% | - 4.4 |
| NC 20 KC 0 820 | 82 | | | |
| NC 20 KC 0 101 | 100 | | | |
| NC 20 MC 0 121 | 120 | | | |
| NC 20 MC 0 151 | 150 | | | |
| NC 20 MC 0 181 | 180 | | | |
| NC 20 MC 0 221 | 220 | | | |
| NC 20 MC 0 271 | 270 | | | |
| NC 20 MC 0 331 | 330 | | | |
| NC 20 MC 0 391 | 390 | | | |
| NC 20 MC 0 471 | 470 | | | |
| NC 20 MC 0 561 | 560 | | | |
| NC 20 MC 0 681 | 680 | | | |
| NC 20 MC 0 821 | 820 | | | |
| NC 20 MC 0 102 | 1,000 | | | |
| NC 20 MC 0 122 | 1,200 | | | |
| NC 20 MC 0 152 | 1,500 | | | |
| NC 20 I 0 0182 | 1,800 | | | |
| NC 20 I 0 0222 | 2,200 | | | |
| NC 20 I 0 0272 | 2,700 | | | |
| NC 20 I 0 0332 | 3,300 | J | 3480 ± 3% | - 3.9 |
| NC 20 J 0 0392 | 3,900 | | | |
| NC 20 J 0 0472 | 4,700 | | | |
| NC 20 J 0 0502 | 5,000 | K | 3630 ± 3% | - 4.0 |
| NC 20 J 0 0562 | 5,600 | | | |
| NC 20 J 0 0682 | 6,800 | | | |
| NC 20 K 0 0822 | 8,200 | L | 3790 ± 3% | - 4.2 |
| NC 20 K 0 0103 | 10,000 | | | |
| NC 20 K 0 0123 | 12,000 | | | |
| NC 20 K 0 0153 | 15,000 | M | 3950 ± 3% | - 4.4 |
| NC 20 L 0 0183 | 18,000 | | | |
| NC 20 L 0 0223 | 22,000 | | | |
| NC 20 M 0 0273 | 27,000 | M | 3950 ± 3% | - 4.4 |
| NC 20 M 0 0333 | 33,000 | | | |
| NC 20 M 0 0393 | 39,000 | | | |
| NC 20 M 4 0473 | 47,000 | M4 | 3995 ± 3% | - 4.4 |
| NC 20 M 4 0503 | 50,000 | | | |
| NC 20 N 0 0563 | 56,000 | N | 4080 ± 3% | - 4.6 |
| NC 20 N 0 0683 | 68,000 | | | |
| NC 20 N 0 0823 | 82,000 | | | |
| NC 20 N 0 0104 | 100,000 | | | |
| NC 20 P 0 0124 | 120,000 | | | |
| NC 20 P 0 0154 | 150,000 | P | 4220 ± 3% | - 4.7 |
| NC 20 P 0 0184 | 180,000 | | | |
| NC 20 P 0 0224 | 220,000 | | | |
| NC 20 Q 0 0274 | 270,000 | Q | 4300 ± 3% | - 4.7 |
| NC 20 Q 0 0334 | 330,000 | | | |
| NC 20 Q 0 0394 | 390,000 | | | |
| NC 20 Q 0 0474 | 470,000 | | | |
| NC 20 R 0 0564 | 560,000 | | | |
| NC 20 R 0 0684 | 680,000 | R | 4400 ± 3% | - 4.8 |
| NC 20 R 0 0824 | 820,000 | | | |
| NC 20 R 0 0105 | 1,000,000 | | | |

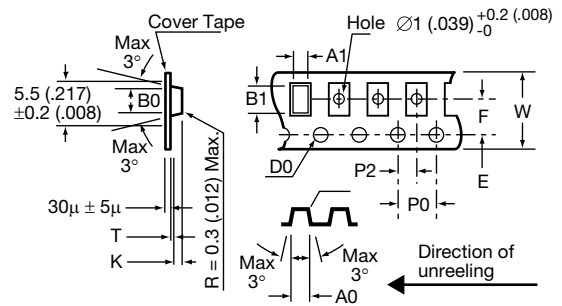
PACKAGING FOR AUTOMATIC INSERTION

NTC Chip Thermistors / NC/NB Series

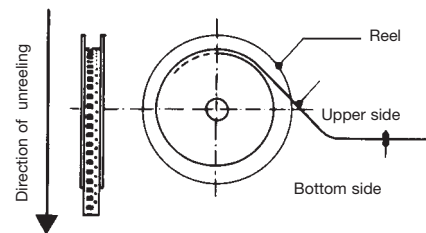
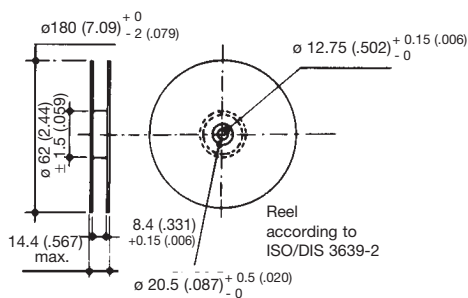
AUTOMATIC INSERTION

Super 8 Plastic Tape Packaging:

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



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



QUANTITY PER REEL

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

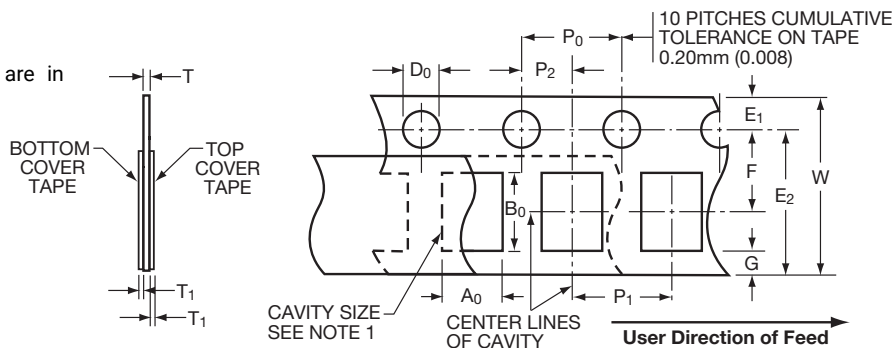
PACKAGING FOR AUTOMATIC INSERTION

NTC Chip Thermistors / NC/NB Series

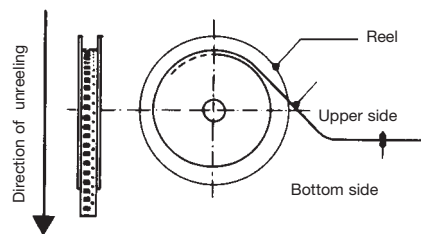
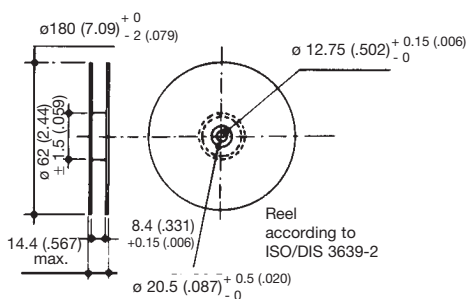
AUTOMATIC INSERTION

8mm Paper Tape Packaging:

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



| Designation | | Symbol | Value | Tolerance |
|--------------------------------|-----------|----------------|-----------|-----------|
| Tape width | | W | 8 | -0.1/+0.3 |
| Tape thickness | | T | 1.1 max. | |
| Pitch of the sprocket holes | | P ₀ | 4 | ±0.1 |
| Diameter of the sprocket holes | | D ₀ | 1.5 | ±0.1 |
| Distance | | E ₁ | -0/+0.1 | ±0.1 |
| Distance (center to center) | | F | 1.75 | ±0.1 |
| Distance (center to center) | | P ₂ | 3.5 | ±0.05 |
| Distance (center to center) | | P ₁ | 2 | ±0.05 |
| Cover tape thickness | | T ₁ | 0.10 max. | |
| Distance | | E ₂ | 6.25 min. | |
| Distance | | G | 0.75 min. | |
| Component pitch | 0805/0603 | P ₁ | 4 | ±0.1 |
| | 0402 | | 2 | ±0.1 |



QUANTITY PER REEL

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

SURFACE MOUNTING GUIDE

Chip Thermistor – Application Notes

STORAGE

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

SOLDERABILITY / LEACHING

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

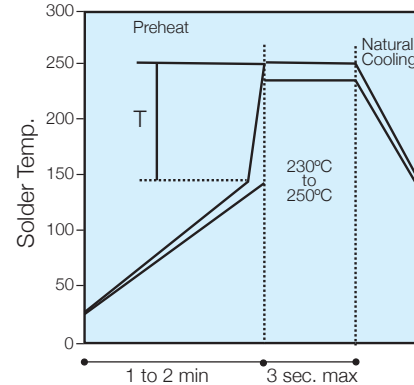
Terminations will resist leaching for at least the immersion times and conditions recommendations shown below.

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

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

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

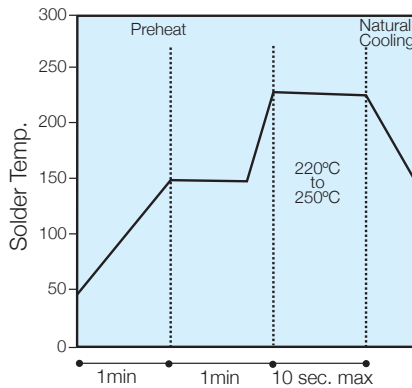
Wave



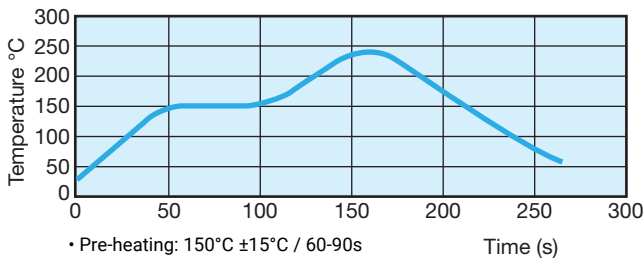
(Preheat chips before soldering)
T/maximum 150°C

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

Reflow



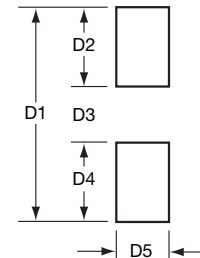
(Minimize soldering time)



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

RECOMMENDED SOLDERING PAD LAYOUT

Dimensions in mm (inches)



REFLOW SOLDERING

| Case Size | P/N | D1 | D2 | D3 | D4 | D5 |
|-----------|------|-------------|-------------|-------------|-------------|-------------|
| 0603 | NB21 | 2.30 (.091) | 0.80 (.031) | 0.70 (.028) | 0.80 (0.31) | 0.75 (.030) |
| 0805 | NB12 | 3.00 (.118) | 1.00 (.039) | 1.00 (.039) | 1.00 (.039) | 1.25 (.049) |
| 1206 | NB20 | 4.00 (.157) | 1.00 (.039) | 2.00 (.079) | 1.00 (.039) | 2.50 (.098) |

WAVE SOLDERING

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

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

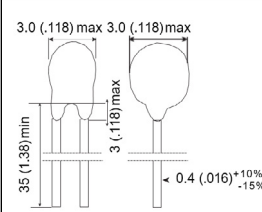
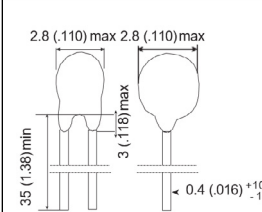
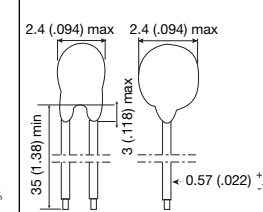
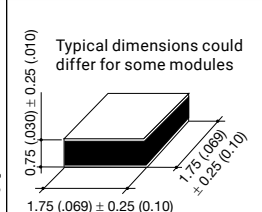
OPTIONS

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 |
| DIMENSIONS: 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

| | | | | |
|---------------------------------------------|-------------------------------------------------|------------------------------------------------|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| NP30 | MA | 0502 | H | -- |
| | | | | |
| Type NP30 NJ28 NI24 NK20 | Material Code MA (See table above) | Resistance 5 kΩ (See table above) | Tolerance F (±1%) G (±2%) H (±3%) J (±5%) | Packaging --: 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

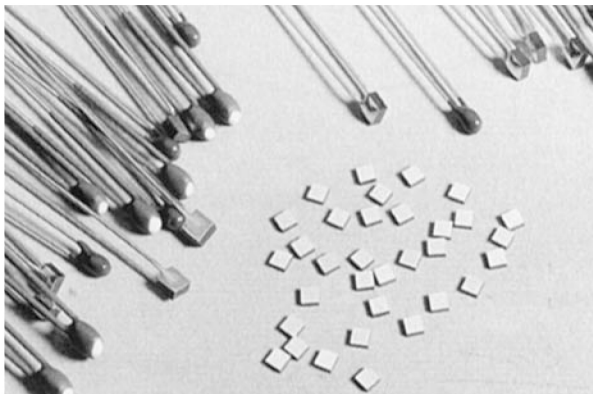
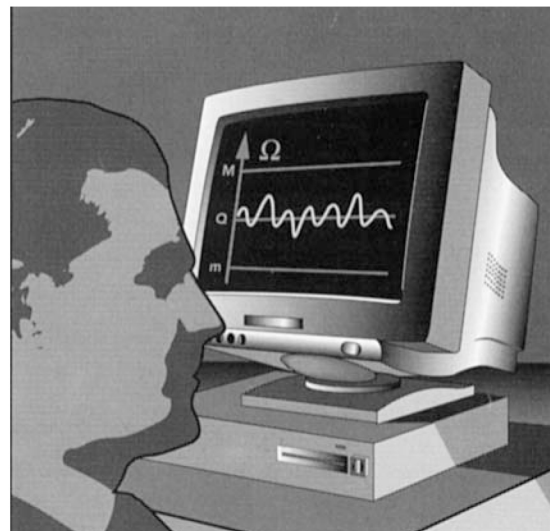
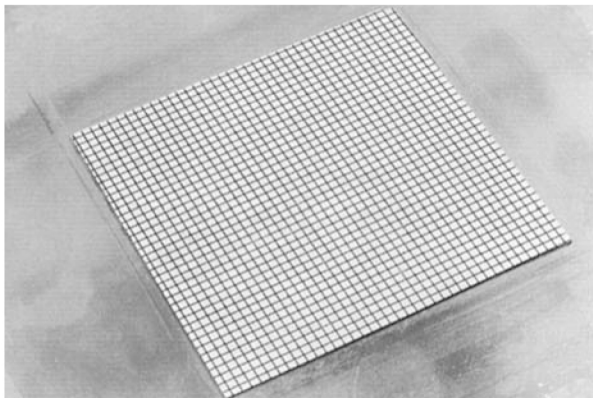
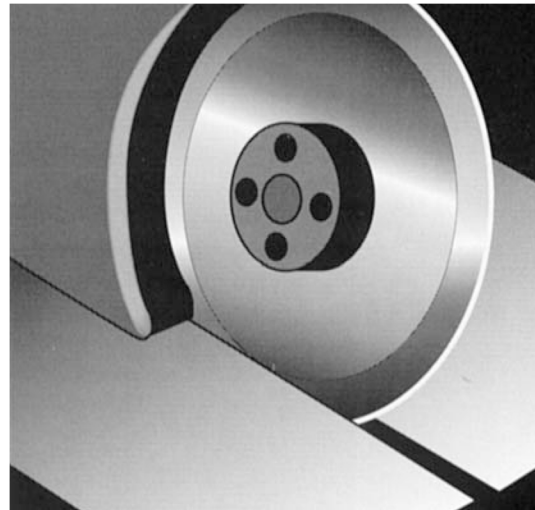
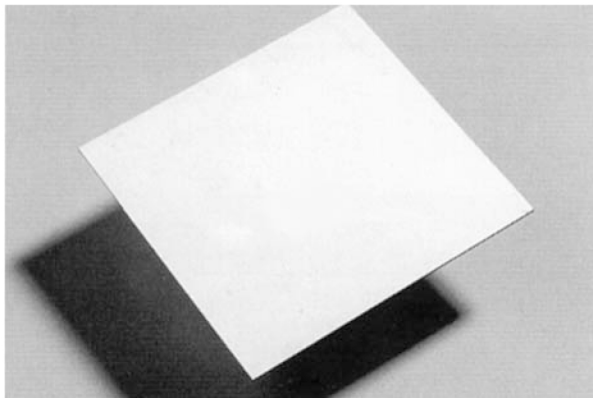
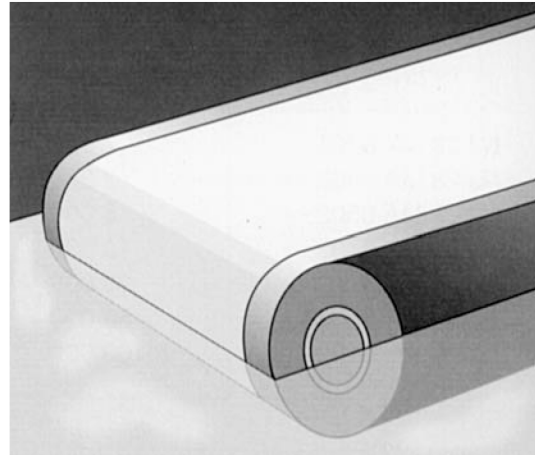
| Part Number | Rn at 25°C (Ω) | Available Rn Tol at 25°C | Material Code | B25/85 (K) | at 25°C (%/°C) |
|----------------|----------------|--------------------------|---------------|------------|----------------|
| N___MA0702 --- | 7,000 | F, G, H, J | MA | 3965±0.5% | -4.38 |
| N___ME0702 --- | 7,000 | 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

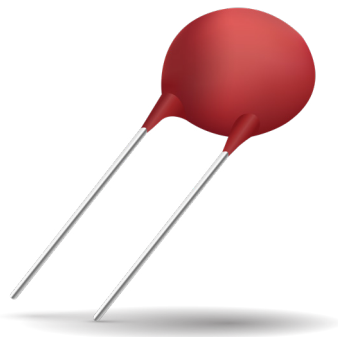
NTC THERMISTORS MANUFACTURING PROCESS

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)

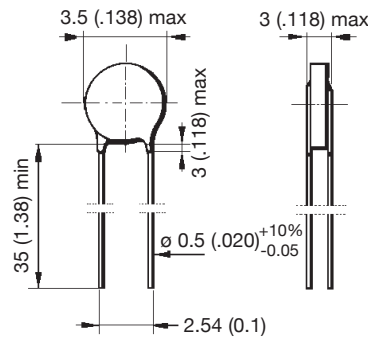
* Optional tolerance, please contact factory

TABLE OF VALUES

ND03/NE03 TYPE

| Part Number | Rn at 25°C (Ω) | Material Code | B (K) (B/B ⁽¹⁾ ± 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 | | | |

ND03/NE03



NTC DISC THERMISTORS

ND/NE/NV 06

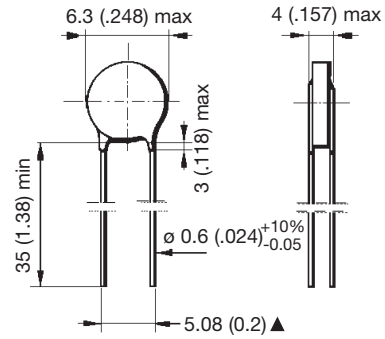
TABLE OF VALUES

ND06/NE06/NV06

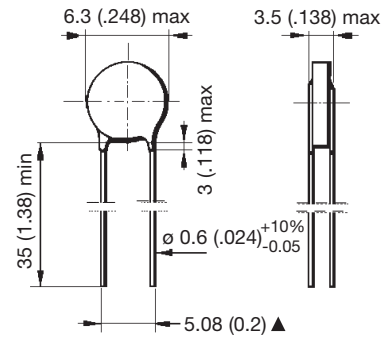
| Part Number | Rn at 25°C (Ω) | Material Code | B (K) (B/B (1) ± 5% (2) ± 3%) | α at 25°C (%/°C) |
|-------------|----------------|---------------|-------------------------------------|------------------|
| N_06J00151 | 150 | J | 3480 (2) | - 3.9 |
| N_06J00221 | 220 | | | |
| N_06K00331 | 330 | K | 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

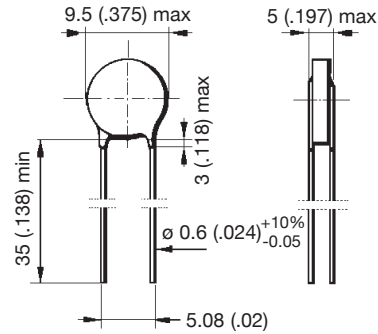
ND/NE/NV 09

TABLE OF VALUES

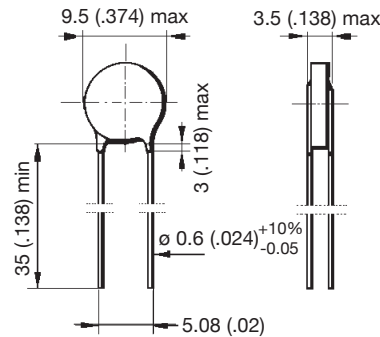
ND09/NE09/NV09

| 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).

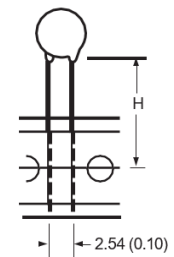
• Reel & Ammopack

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 |

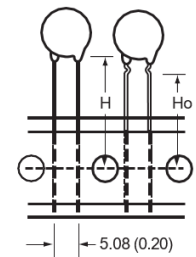
NTC

Type
ND03
NE03
NJ28
NP30



NTC

Types
ND/NE/NV
06/09

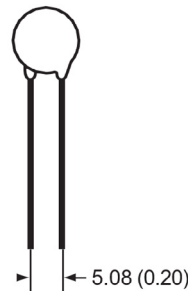
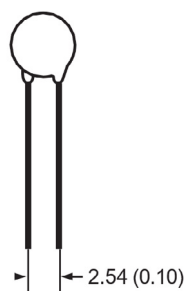


• Bulk

| 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

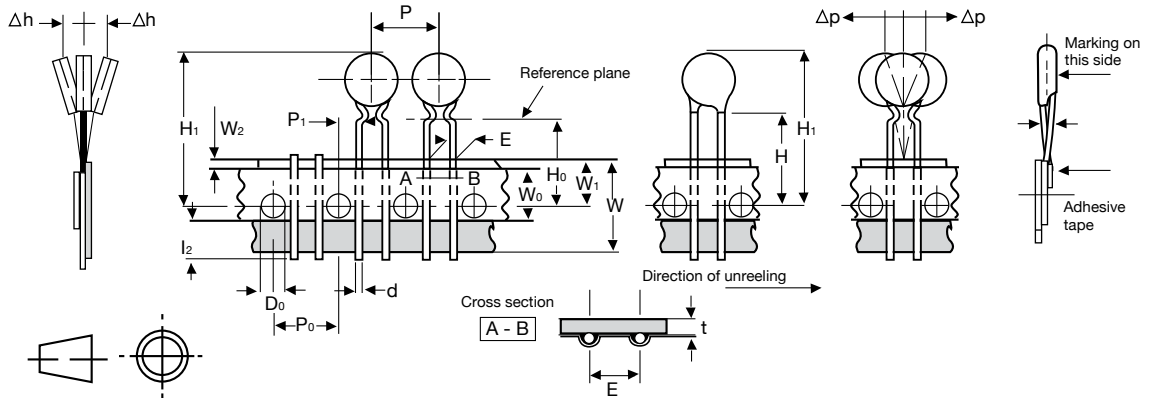
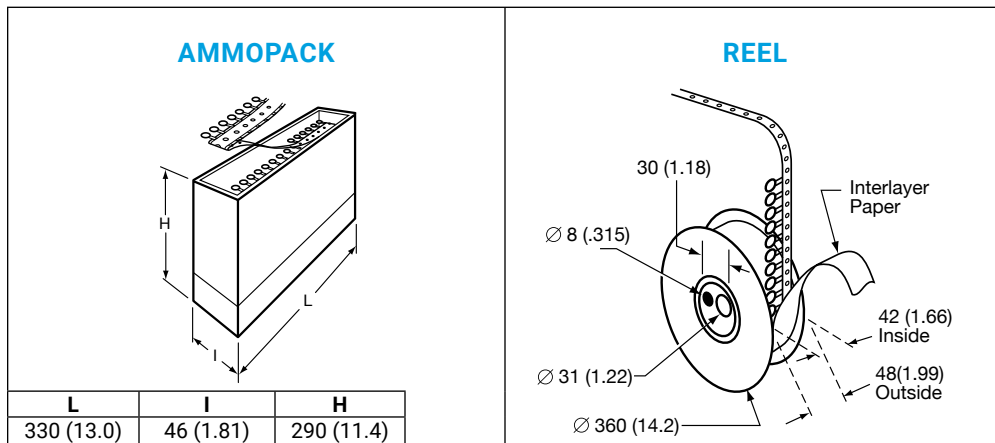
TAPING CHARACTERISTICS

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)

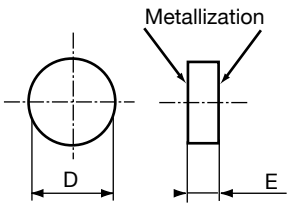


| Value | Tolerance | Dimensions Characteristics |
|---------|--------------|--------------------------------------------------------------------------------------|
| 18 | +1 / -0.5 | W Leading tape width |
| 6 | ±0.3 | W ₀ Adhesive tape width |
| 9 | +0.75 / -0.5 | W ₁ Sprocket hole position |
| 3 max. | | 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 | ³ P Verticality of components |
| 0 | ±2 | ³ h 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:

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

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

*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 (%) | α (%/°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 (%) | α (%/°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 (%) | α (%/°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 |

TABLES OF RESISTANCE VS TEMPERATURE

| 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 |