

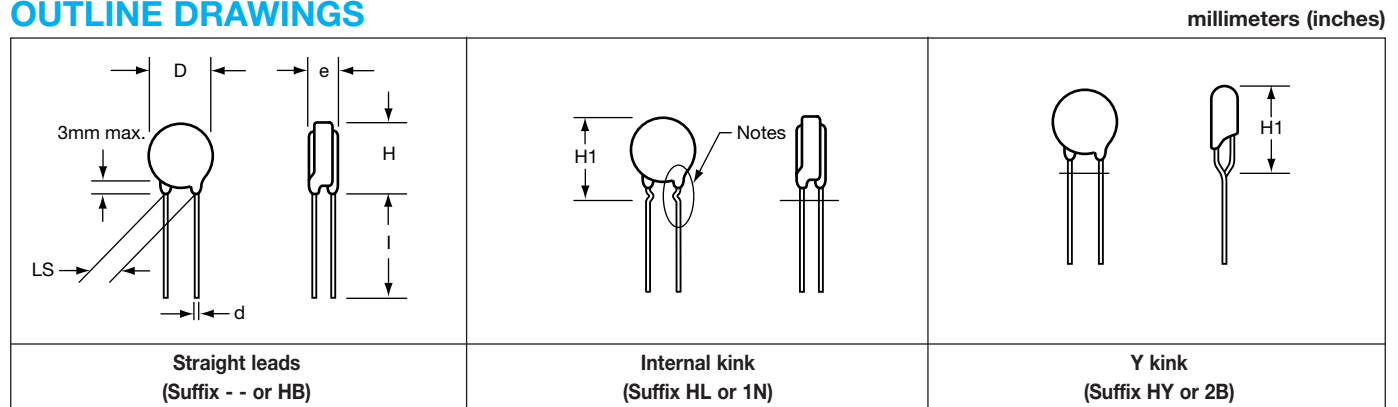
# NTC Inrush Current Limiters Thermistors



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<br>mm | e max<br>mm | H max<br>mm | H1 max<br>mm | l min<br>mm | d<br>±0.02 mm<br>(±0.008) | LS<br>±0.8 mm<br>(±0.030) |
|-------|-------------|-------------|-------------|--------------|-------------|---------------------------|---------------------------|
| 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<br>tolerance**<br>% | Maximum<br>operating<br>T°C | Max power<br>25°C<br>Watts | Thermal<br>dissipation<br>$\delta_{th}$ (mW/K) | Thermal time<br>constant<br>$\tau_c$ (s) | Heat<br>capacity<br>H (mJ/K) | Packing<br>bulk<br>✓ | tape<br>✓ |
|-------|------------------------------|-----------------------------|----------------------------|------------------------------------------------|------------------------------------------|------------------------------|----------------------|-----------|
| 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 35)

- - straight leads 0.8 or 1 mm wire diameter and 7.62 lead spacing
- HB straight leads 0.6 mm wire diameter and 5.08 lead spacing
- HL internal kink 0.8 mm or 1 mm wire diameter and 7.62 lead spacing
- 1N internal kink 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
- 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<br>ø (mm) | Part number<br>reference<br>T <sub>ype</sub> | Zero power<br>resistance<br>R <sub>25°C</sub> (Ω) | Max steady<br>state current<br>I <sub>ss</sub> max 25°C (A) | Resistance<br>at max current<br>R <sub>iss</sub> 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                     | 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

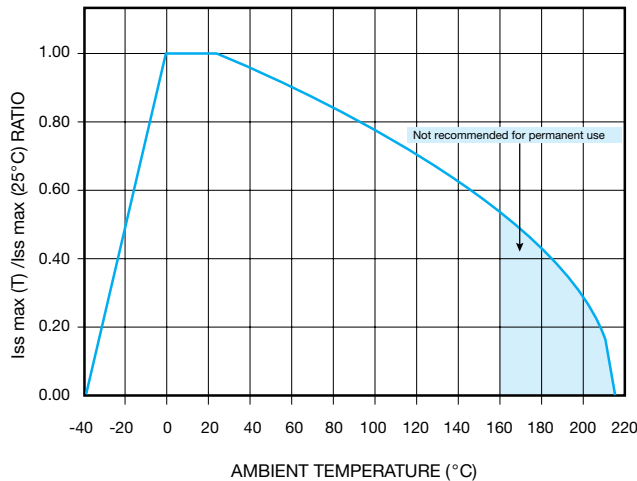
### Application Guide

#### 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 30.
- 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 32, we find  $V_{SS} = 2.2 \text{ V}$  therefore,  $R_{SS} = 11 \Omega$
- From the graph R(T), page 32, 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 29)

therefore, the equation becomes:

$$T = 562.5 R_T + 60$$

from the  $R_T$  curve page 33 we find  $R_T$  starting from  $T$ :

| $T (^\circ\text{C})$ | $R_T (\Omega)$ | $\Rightarrow$ | $562.5 R_T + 60 (^\circ\text{C})$ |
|----------------------|----------------|---------------|-----------------------------------|
| 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  $T = 562.5 R_T + 60$ ).

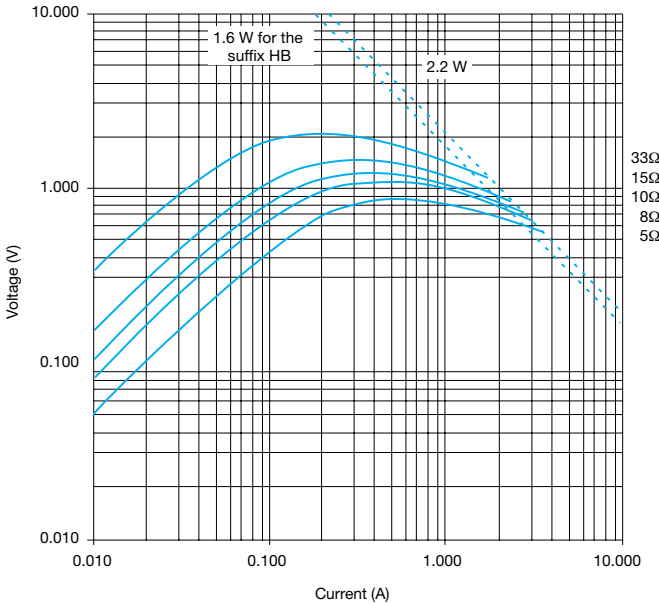
**Important:** A discrepancy may exist between practice and theory due to the tolerance of the thermistor ( $\pm 20\%$  usually).

# NTC Inrush Current Limiters Thermistors

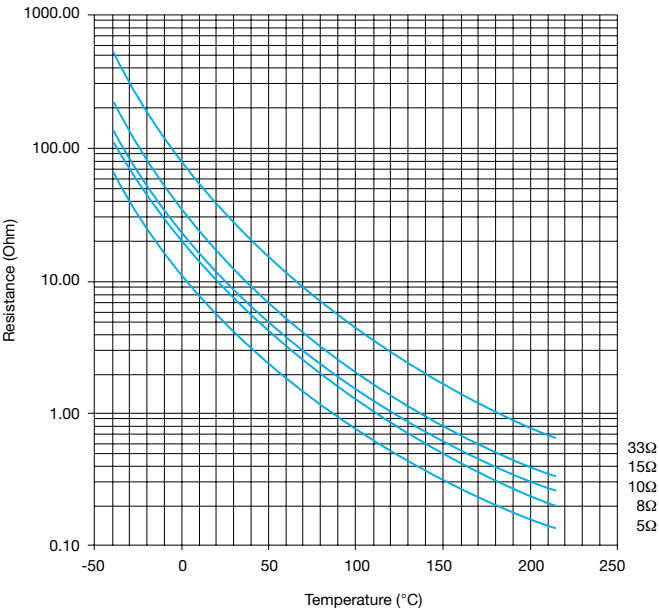


## Voltage-Current and Resistance-Temperature Characteristics

### TYPICAL VOLTAGE/CURRENT CHARACTERISTICS FOR TYPE NF08



### TYPICAL RESISTANCE/TEMPERATURE CHARACTERISTICS FOR TYPE NF08

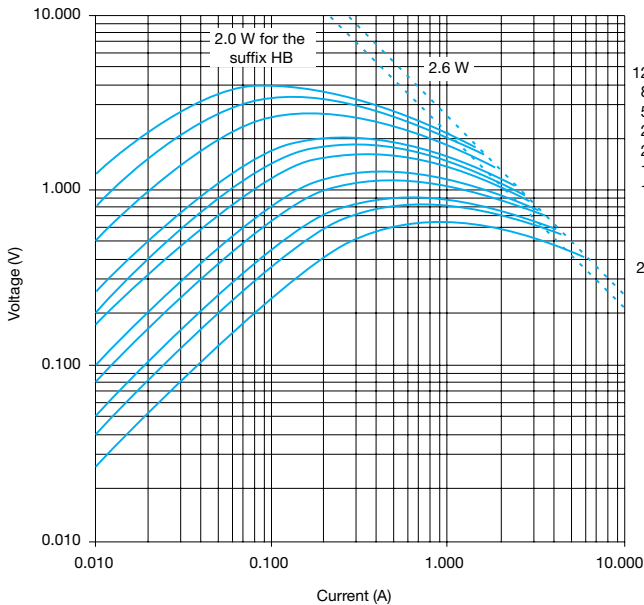


# NTC Inrush Current Limiters Thermistors

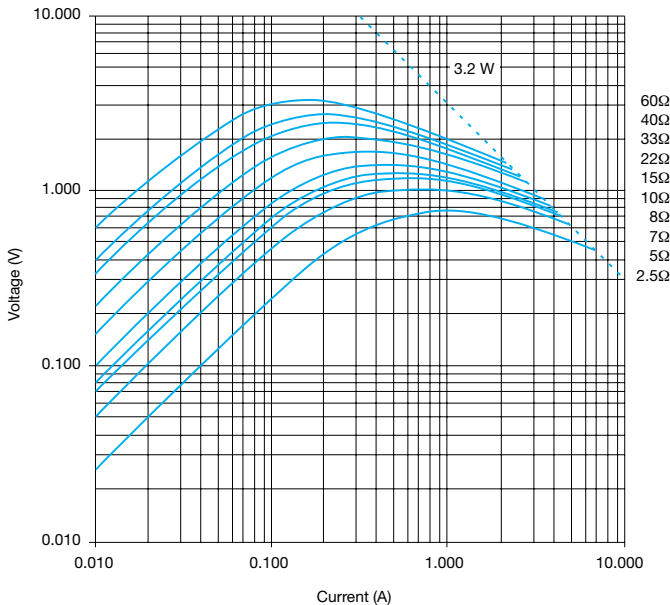


## Voltage-Current and Resistance-Temperature Characteristics

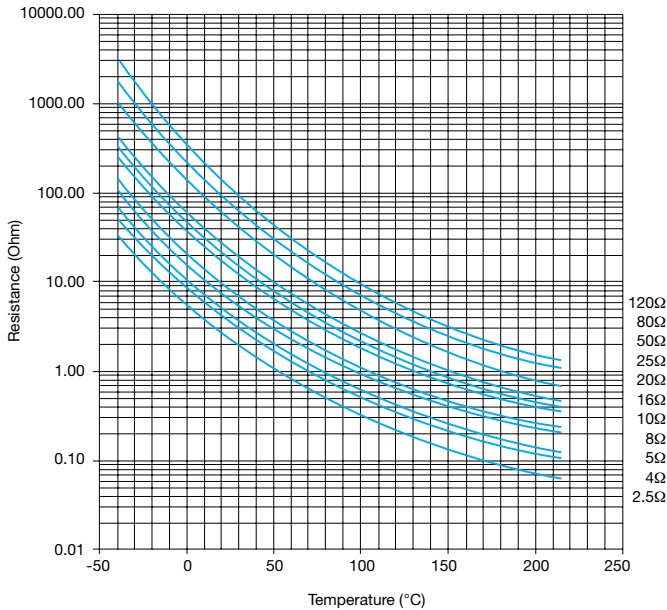
**TYPICAL VOLTAGE/CURRENT  
CHARACTERISTICS FOR TYPE NF10**



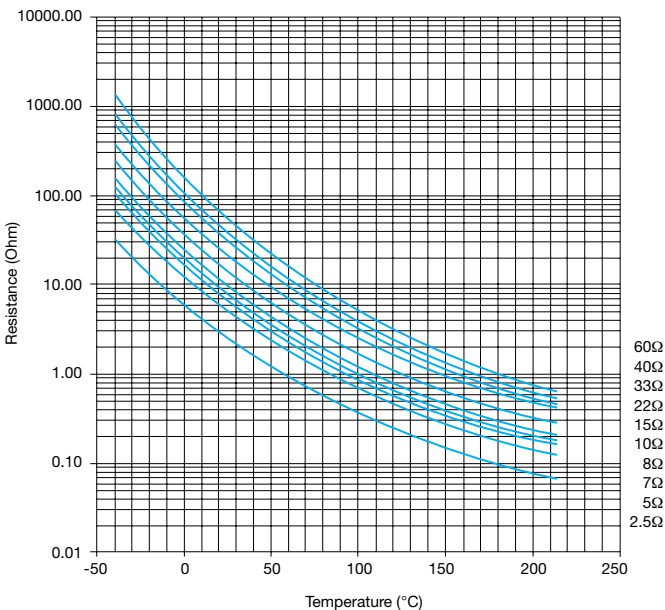
**TYPICAL VOLTAGE/CURRENT  
CHARACTERISTICS FOR TYPE NF13**



**TYPICAL RESISTANCE/TEMPERATURE  
CHARACTERISTICS FOR TYPE NF10**



**TYPICAL RESISTANCE/TEMPERATURE  
CHARACTERISTICS FOR TYPE NF13**

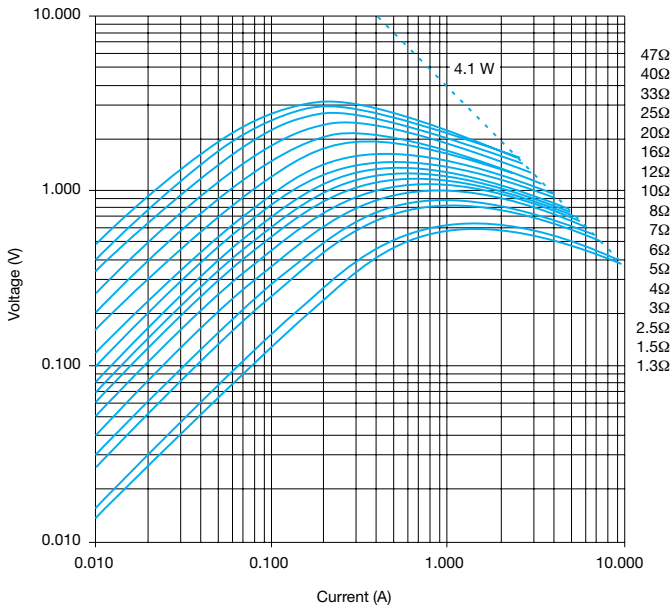


# NTC Inrush Current Limiters Thermistors

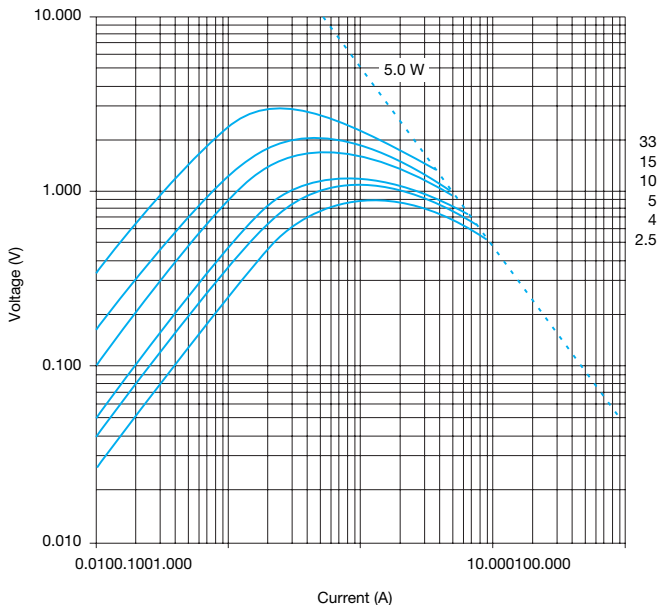


## Voltage-Current and Resistance-Temperature Characteristics

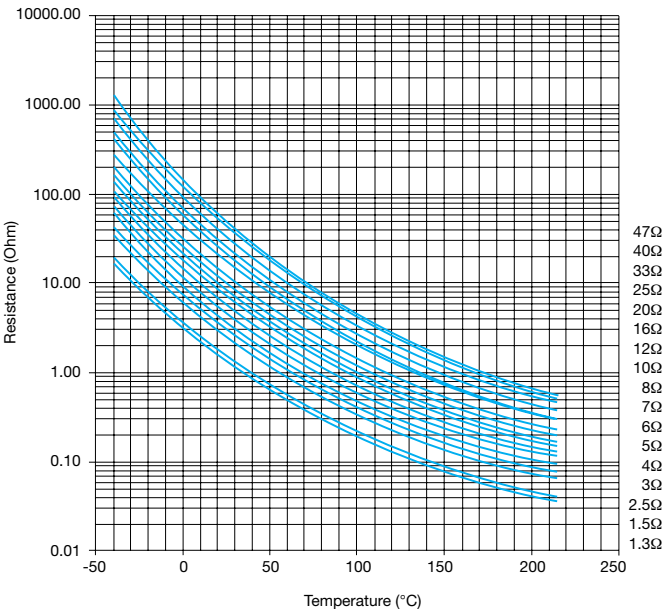
**TYPICAL VOLTAGE/CURRENT  
CHARACTERISTICS FOR TYPE NF15**



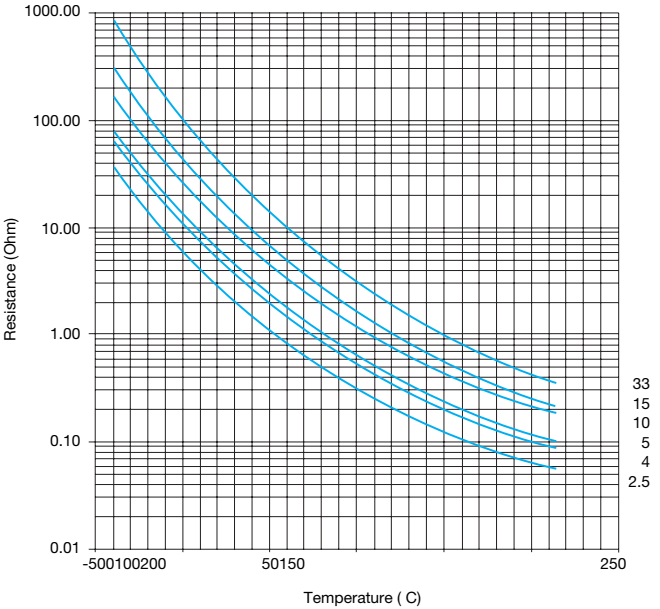
**TYPICAL VOLTAGE/CURRENT  
CHARACTERISTICS FOR TYPE NF20**



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



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



# Packaging for Automatic Insertion



## NTC Disc Thermistors / NF Series

### PACKAGING AND KINK SUFFIXES

The following types can be ordered on tape either in AMMOPACK (fan folder) or on REEL in accordance with IEC 286-2.

| Types                                      | NF08      |               |               |               |
|--------------------------------------------|-----------|---------------|---------------|---------------|
| Leads                                      | Straight  |               | Internal Kink |               |
| <b>DIMENSIONS:</b><br>millimeters (inches) |           |               |               |               |
|                                            |           |               |               |               |
|                                            | Packaging | AMMOPACK REEL | AMMOPACK REEL | AMMOPACK REEL |
|                                            | Ho = 16   | DA DB         | DQ DR         | D7 D5         |
| Ho = 19.5                                  | DC        | DD            | DS            | DT D8 D6      |

| Types                                      | NF08 / 10 / 13 |               |               |               |
|--------------------------------------------|----------------|---------------|---------------|---------------|
| Leads                                      | Straight       |               | Internal Kink |               |
| <b>DIMENSIONS:</b><br>millimeters (inches) |                |               |               |               |
|                                            |                |               |               |               |
|                                            | Packaging      | AMMOPACK REEL | AMMOPACK REEL | AMMOPACK REEL |
|                                            | Ho = 16        | EA EN         | EC EF         | EQ ER         |
| Ho = 19.5                                  | EB             | ED            |               |               |

### PACKAGING QUANTITIES

| Type         | AMMOPACK | REEL | BULK |
|--------------|----------|------|------|
| NF08* (5.08) | 1000     | 1000 | 450  |
| NF08 (7.62)  | 750      | 750  |      |
| NF10* (5.08) | 750      | 750  | 450  |
| NF10 (7.62)  |          |      |      |
| NF13 (7.62)  | 750      | 750  | 400  |
| NF15 (7.62)  | —        | —    | 250  |
| NF20 (7.62)  | —        | —    | 150  |