

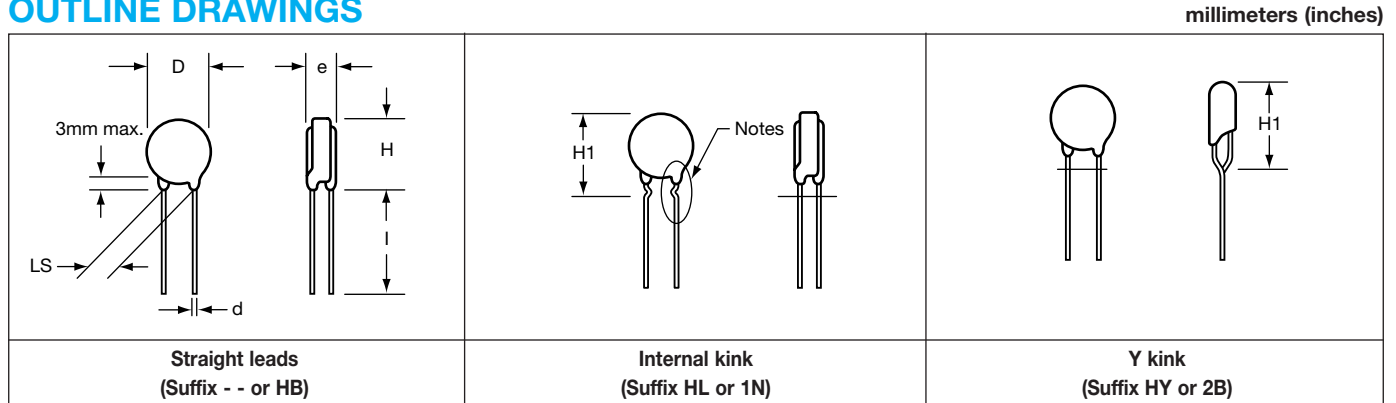
# NTC Inrush Current Limiters Thermistors



NF 08 - 10 - 13 - 15 - 20

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

## OUTLINE DRAWINGS



Notes: In case of adding strength to the lead wire from the side, it may occur crack and fragment at a part of pant leg.  
\* 0.6 mm copper wire and 5.08 mm leads spacing for those two types.

## DIMENSIONS millimeters (inches)

| Type  | D max mm    | e max mm   | H max mm    | H1 max mm    | l min mm   | d ±0.02 mm (±0.008) | LS ±0.8 mm (±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. (.236)  | 25.0 (.984) | 29.0 (1.142) | 30 (1.181) | 1.0 (.039)          | 7.62 (.30)          |

## GENERAL CHARACTERISTICS

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

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

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

## SUFFIXES FOR BULK PACKING (Suffixes for taping: see page 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  |
| *   | 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  |
| *   |                        | 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

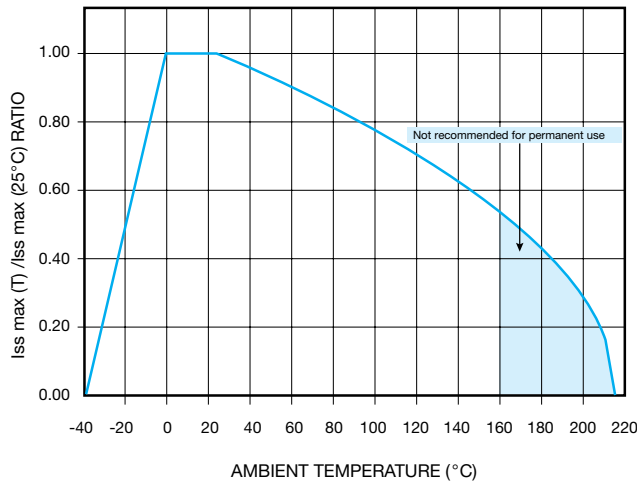
### 1 – HOW TO DETERMINE THE MAXIMUM STEADY STATE CURRENT OF NF THERMISTORS?

- 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

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

- 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

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

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

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

- 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 (°C) | $R_T$ ( $\Omega$ ) | $\Rightarrow$ | $562.5 R_T + 60$ (°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  $T = 562.5 R_T + 60$ ).

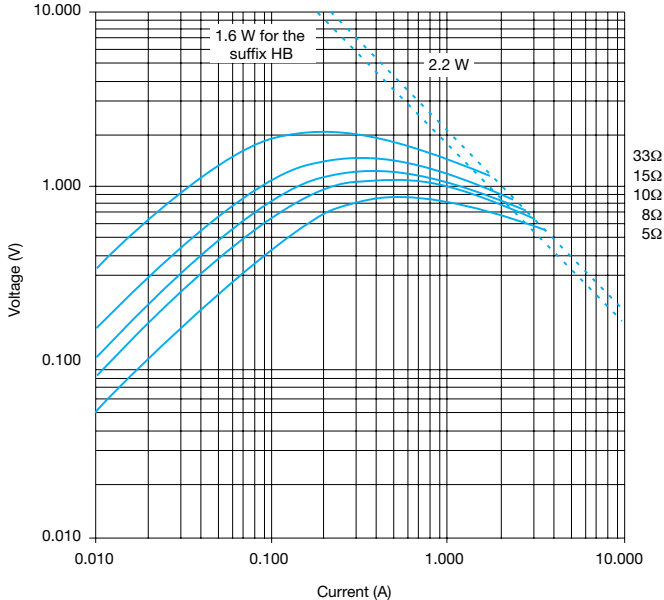
**Important:** A discrepancy may exist between practice and theory due to the tolerance of the thermistor ( $\pm 20\%$  usually).

# NTC Inrush Current Limiters Thermistors

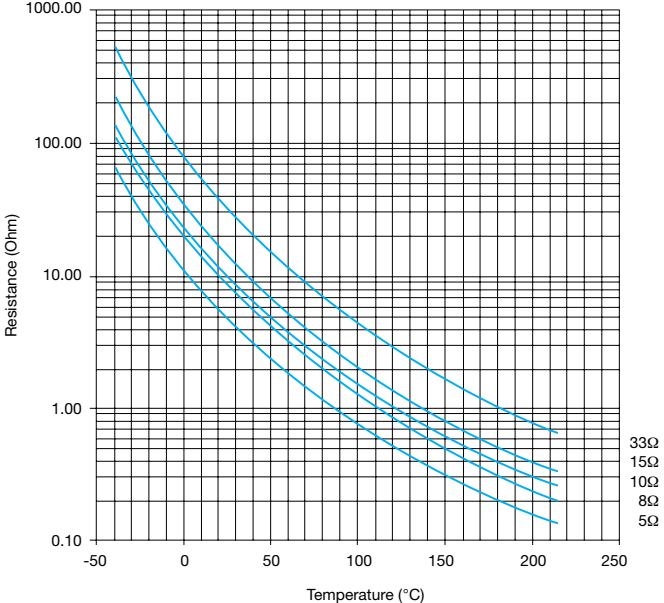


## Voltage-Current and Resistance-Temperature Characteristics

### TYPICAL VOLTAGE/CURRENT CHARACTERISTICS FOR TYPE NF08



### TYPICAL RESISTANCE/TEMPERATURE CHARACTERISTICS FOR TYPE NF08

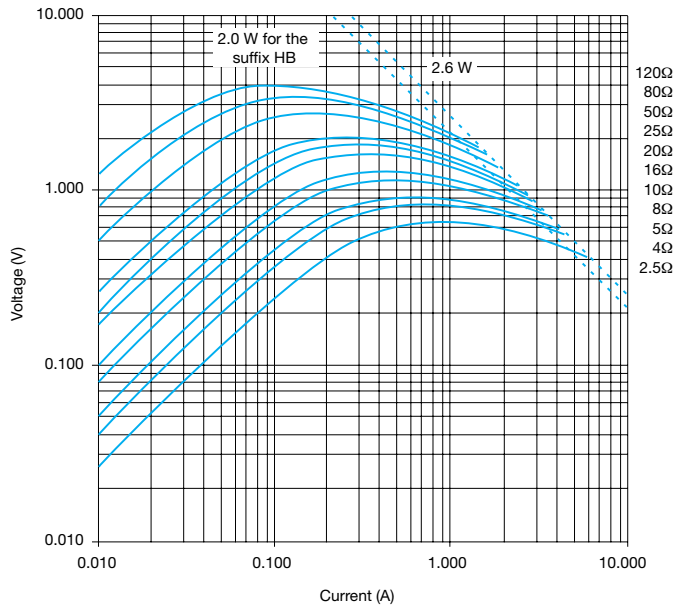


# NTC Inrush Current Limiters Thermistors

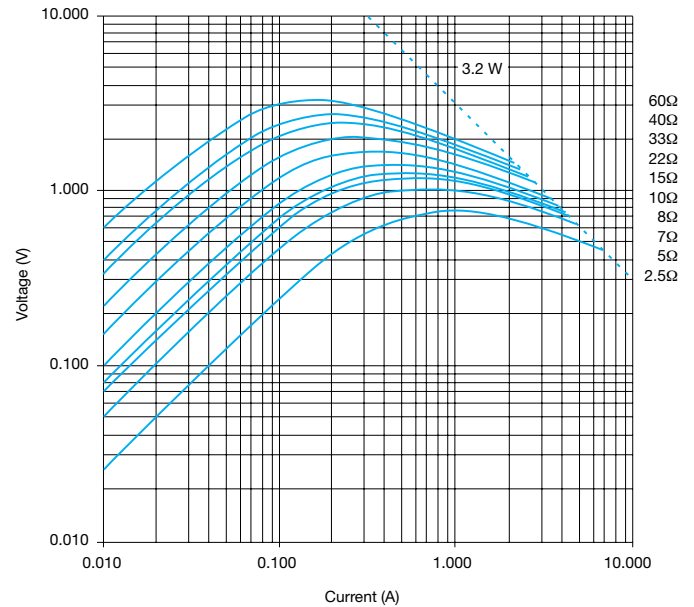


## Voltage-Current and Resistance-Temperature Characteristics

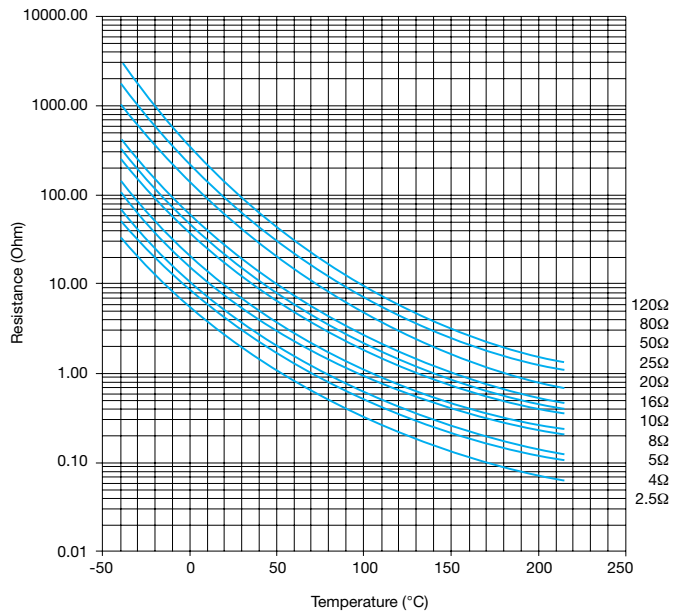
**TYPICAL VOLTAGE/CURRENT CHARACTERISTICS FOR TYPE NF10**



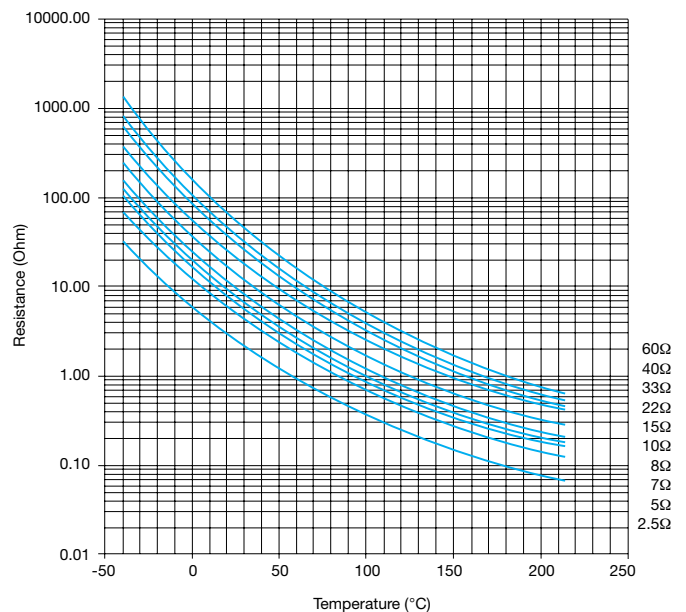
**TYPICAL VOLTAGE/CURRENT CHARACTERISTICS FOR TYPE NF13**



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



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

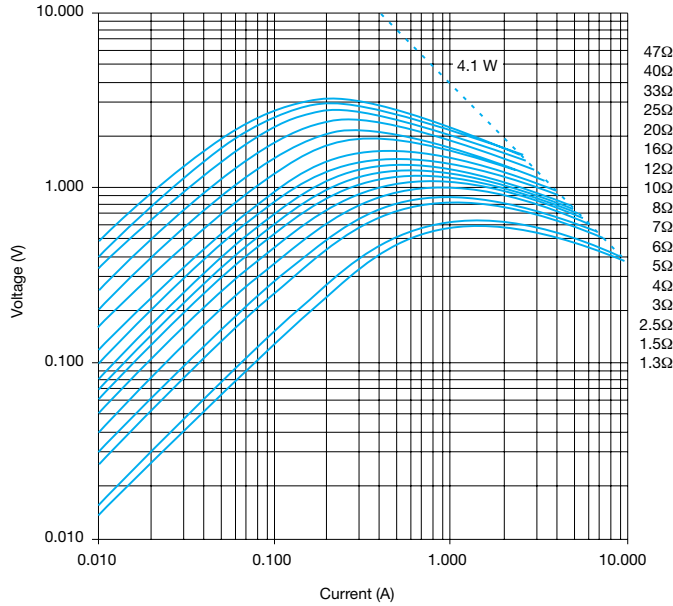


# NTC Inrush Current Limiters Thermistors

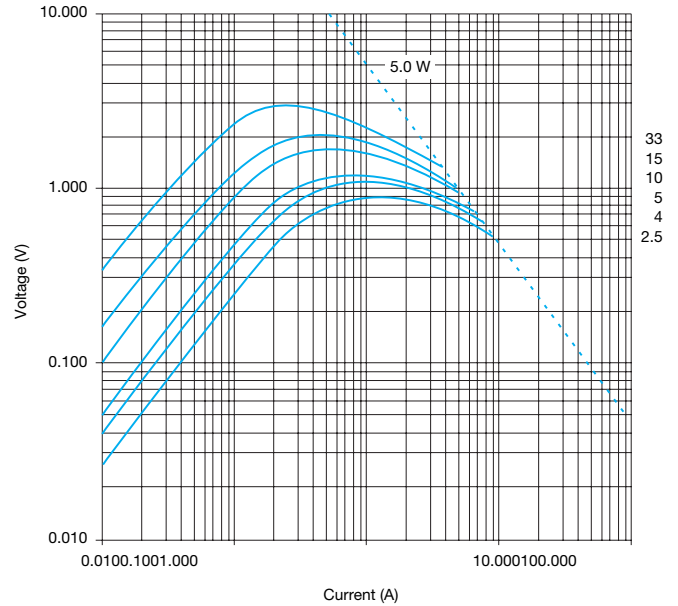


## Voltage-Current and Resistance-Temperature Characteristics

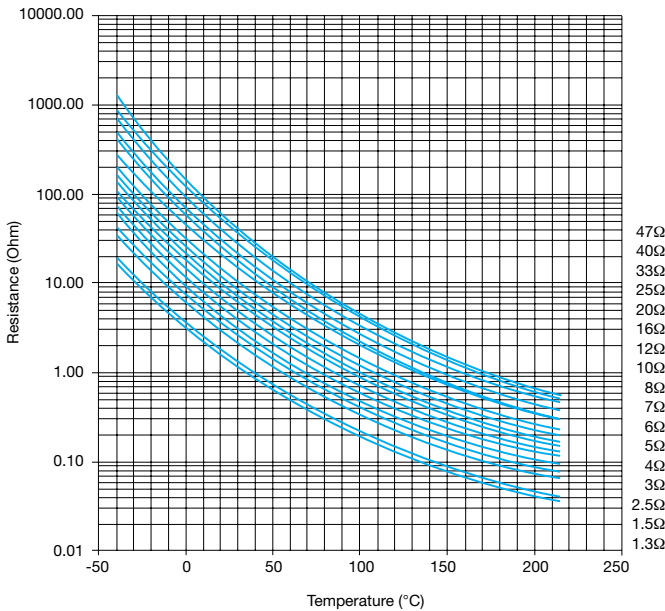
**TYPICAL VOLTAGE/CURRENT CHARACTERISTICS FOR TYPE NF15**



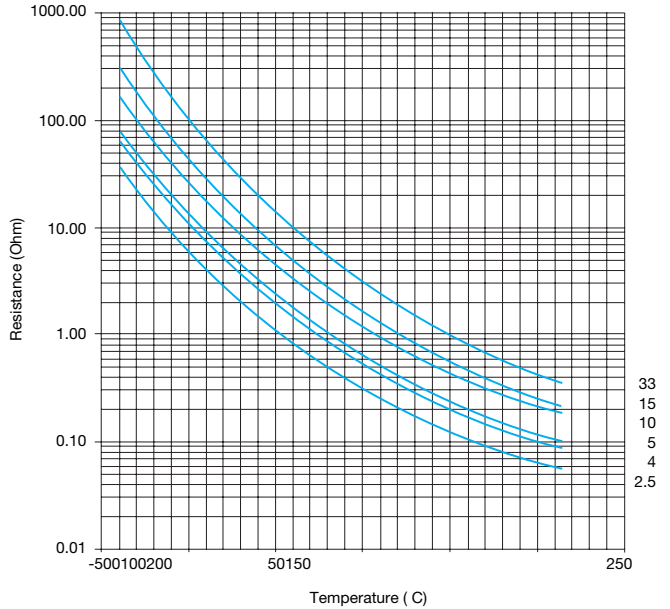
**TYPICAL VOLTAGE/CURRENT CHARACTERISTICS FOR TYPE NF20**



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



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



### PACKAGING 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                                      | Straight |      | NF08<br>Internal Kink |      | "Y" Kink |      |
|--|----------|------|-----------------------|------|----------|------|
| Leads                                      | Straight |      | Internal Kink         |      | "Y" 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                                      | Straight |      | NF08 / 10 / 13<br>Internal Kink |      | "Y" Kink |      |
|--|----------|------|---------------------------------|------|----------|------|
| Leads                                      | Straight |      | Internal Kink                   |      | "Y" 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) |          |      | 450  |
| NF10 (7.62)  | 750      | 750  |      |
| NF13 (7.62)  | 750      | 750  | 400  |
| NF15 (7.62)  | –        | –    | 250  |
| NF20 (7.62)  | –        | –    | 150  |