# NFR25/25H

Vishay BCcomponents

## Fusible, Non-Flammable Resistors

### FEATURES

- Overload protection without risk of fire
- Wide range of overload currents
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)

### APPLICATIONS

- Audio
- Video

A homogeneous film of metal alloy is deposited on a high grade ceramic body. After a helical groove has been cut in the resistive layer, tinned connecting wires of electrolytic copper are welded to the end-caps. The resistors are coated with a grey, flame retardant lacquer which provides electrical, mechanical, and climatic protection. The encapsulation is resistant to all cleaning solvents in accordance with “MIL-STD-202E, method 215”, and “IEC 60068-2-45”.

### TECHNICAL SPECIFICATIONS

| DESCRIPTION | VALUE | |
|---|---|---|
| | NFR25 | NFR25H |
| Resistance range[1)] | 0.22 Ω to 15 kΩ | |
| Resistance tolerance and series | ± 5 %; E24 series | |
| Maximum dissipation at $T_{amb}$ = 70 °C | 0.33 W | 0.5 W |
| Thermal resistance $R_{th}$ | 240 K/W | 150 K/W |
| Temperature coefficient:<br>0.22 Ω ≤ R ≤ 4.7 Ω<br>4.7 Ω < R ≤ 15 Ω<br>15 Ω < R ≤ 15 kΩ | <br>≤ ± 200 × $10^{-6}$/K<br>≤ ± 200 × $10^{-6}$/K<br>≤ ± 100 × $10^{-6}$/K | <br>≤ ± 200 × $10^{-6}$/K<br>≤ ± 100 × $10^{-6}$/K<br>≤ ± 100 × $10^{-6}$/K |
| Maximum permissible voltage (DC or RMS) | 250 V | 350 V |
| Basic specifications | IEC 60115-1 and 60115-2 | |
| Climatic category (IEC 60068) | 55/155/56 | |
| Stability after:<br>load<br>climatic tests<br>soldering | <br>ΔR/R max.: ± 1 % + 0.05 Ω<br>ΔR/R max.: ± 1 % + 0.05 Ω<br>ΔR/R max.: ± 0.25 % + 0.05 Ω | |

**Note**

1. Ohmic values (other than resistance range) are available on request.

### 12NC INFORMATION

- The resistors have a 12-digit numeric code starting with 23
- The subsequent 7 digits indicate the resistor type and packing
- The remaining 3 digits indicate the resistance values:
  - The first 2 digits indicate the resistance value
  - The last digit indicates the resistance decade

**Last Digit of 12NC Indicating Resistance Decade**

| RESISTANCE DECADE | LAST DIGIT |
|---|---|
| 0.22 to 0.91 Ω | 7 |
| 1 to 9.1 Ω | 8 |
| 10 to 91 Ω | 9 |
| 100 to 910 Ω | 1 |
| 1 to 9.1 kΩ | 2 |
| 10 to 15 kΩ | 3 |

**12NC Example**

The 12NC for a NFR25 resistor with value 750 Ω, supplied on a bandolier of 1000 units in ammopack is: 2322 205 13751.


For technical questions contact: ff3dresistors@vishay.com
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## 12NC - resistor type and packing

| TYPE | ORDERING CODE 23.. ... ..... | | | |
|---|---|---|---|---|
| | BANDOLIER IN AMMOPACK | | | BANDOLIER ON REEL |
| | RADIAL TAPED | STRAIGHT LEADS | | STRAIGHT LEADS |
| | 4000 units | 1000 units | 5000 units | 5000 units |
| NFR25 | 06 204 03... | 22 205 13... | 22 205 33... | 22 205 23... |
| NFR25H | 06 207 03... | 22 207 13... | 22 207 33... | 22 207 23... |

## PART NUMBER

**PART NUMBER: NFR2500002207JA100**

| N | F | R | 2 | 5 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 7 | J | A | 1 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| MODEL/SIZE | SPECIAL CHARACTER | TC/MATERIAL | VALUE | TOLERANCE | PACKING[1] | SPECIAL |
|---|---|---|---|---|---|---|
| **NFR2500**<br>**NFR25H0** | **0** = neutral<br>**Z** = value overflow (Special) | **0** = standard | 3 digit value<br>1 digit multiplier<br>**Multiplier:**<br>**7** = $*10^{-3}$<br>**8** = $*10^{-2}$<br>**9** = $*10^{-1}$<br>**0** = $*10^{0}$<br>**1** = $*10^{1}$<br>**2** = $*10^{2}$ | **J** = ± 5 % | **N4**<br>**A5**<br>**A1**<br>**R5** | The 2 digits are used for all special parts.<br>**00** = standard |

**PRODUCT DESCRIPTION: NFR25 5 % A1 R22**

| NFR25 | 5 % | A1 | R22 |
|---|---|---|---|
| MODEL/SIZE | TOLERANCE | PACKING[1] | RESISTANCE VALUE |
| **NFR25**<br>**NFR25H** | ± **5** % | **A1**<br>**A5** | **47K** = 47 KΩ<br>**50R1** = 50.1 Ω |

[1] Please refer to table PACKING for details.

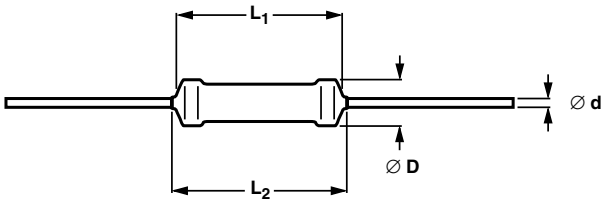
**Note**

Products can be ordered using either the 12NC or the PART NUMBER. The PART NUMBER is shown to facilitate the introduction of a unified part numbering system. Currently, this PART NUMBER is applicable in the Americas only.

## PACKING

| CODE | PIECES | DESCRIPTION | MODEL/SIZE |
|---|---|---|---|
| N4 | 4000 | Bandolier in ammopack radial taped | NFR25, NFR25H |
| A5 | 5000 | Bandolier in ammopack straight leads | |
| A1 | 1000 | Bandolier in ammopack straight leads | |
| R5 | 5000 | Bandolier on reel straight leads | |

## DIMENSIONS




Outline

| **DIMENSIONS** - resistor types and relevant physical dimensions | | | | |
|---|---|---|---|---|
| **TYPE** | **∅ D MAX.** | **$L_1$ MAX.** | **$L_2$ MAX.** | **∅ d** |
| NFR25 | 2.5 | 6.5 | 7.5 | 0.58 ± 0.05 |
| NFR25H | | | | |

| **MASS PER 100 UNITS** | |
|---|---|
| **TYPE** | **MASS (g)** |
| NFR25 | 20.1 |
| NFR25H | 20.1 |

## MARKING

The nominal resistance and tolerance are marked on the resistor using four coloured bands in accordance with IEC publication 60062 “Colour codes for fixed resistors”.

For ease of recognition a fifth ring is added, which is violet for type NFR25 and white for type NFR25H.

## OUTLINES

The length of the body ($L_1$) is measured by inserting the leads into holes of two identical gauge plates and moving these plates parallel to each other until the resistor body is clamped without deformation (“IEC publication 60294”).

## FUNCTIONAL PERFORMANCE

## PRODUCT CHARACTERIZATION

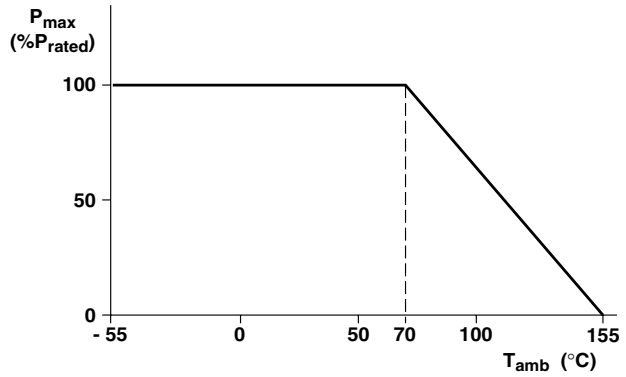
Standard values of nominal resistance are taken from the E24 series for resistors with a tolerance of ± 5 %.
The values of the E24 series are in accordance with “IEC publication 60063”.

| **LIMITING VALUES** | | |
|---|---|---|
| **TYPE** | **LIMITING VOLTAGE[1] (V)** | **LIMITING POWER (W)** |
| NFR25 | 250 | 0.33 |
| NFR25H | 350 | 0.5 |

**Note**

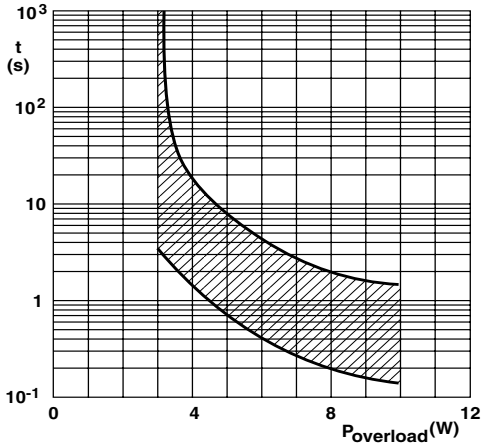
1. The maximum voltage that may be continuously applied to the resistor element, see “IEC publication 60115-1”. The maximum permissible hot-spot temperature is 155 °C.

The power that the resistor can dissipate depends on the operating temperature.

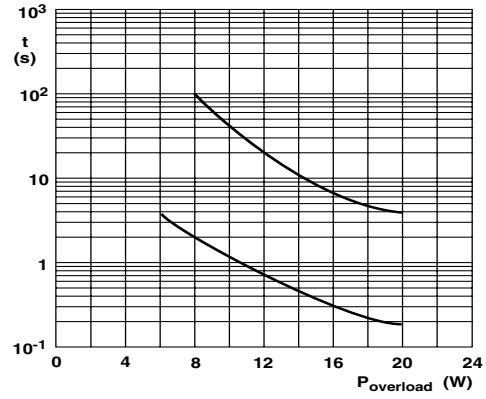



Maximum dissipation ($P_{max}$) in percentage of rated power as a function of the ambient temperature ($T_{amb}$)

## Derating




**NFR25** This graph is based on measured data which may deviate according to the application. Fusing Characteristics: 1 Ω ≤ R ≤ 15 Ω

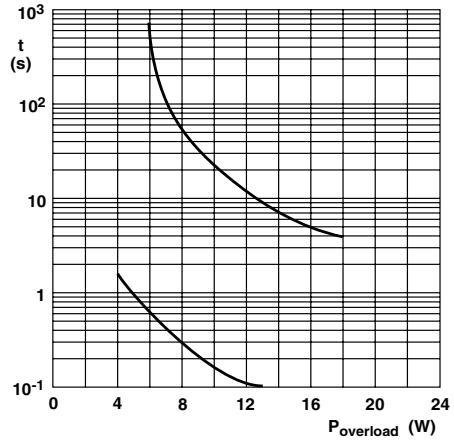



**NFR25H** This graph is based on measured data which may deviate according to the application. Fusing Characteristics: ≤ 1 Ω

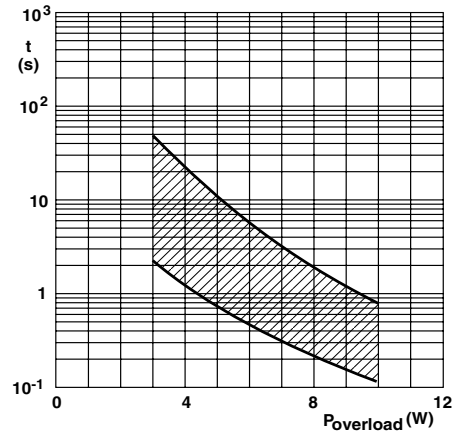
## Fusing Characteristic

The resistors will fuse without the risk of fire and within an indicated range of overload. Fusing means that the resistive value of the resistor increases at least 100 times.

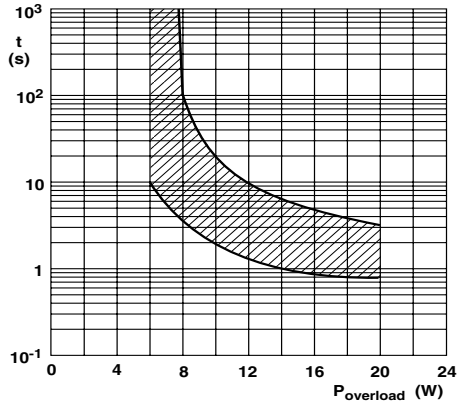
The fusing characteristic is measured under constant voltage.




**NFR25** This graph is based on measured data which may deviate according to the application. Fusing Characteristics: ≤ 1 Ω

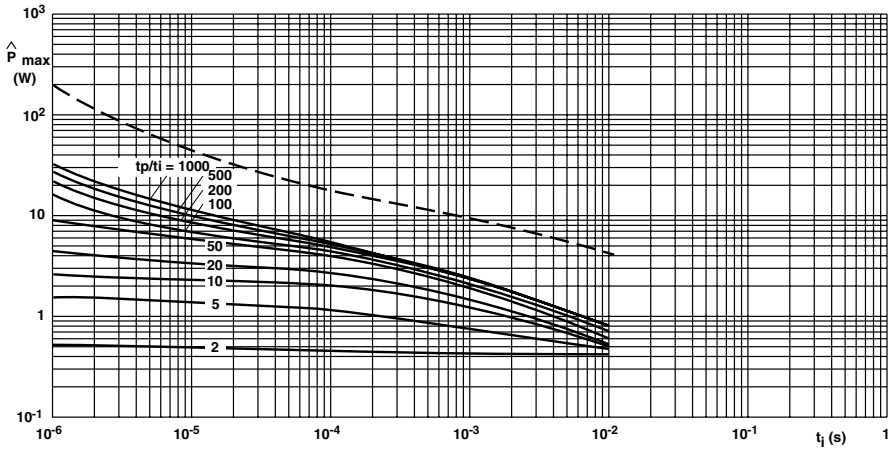



**NFR25** This graph is based on measured data which may deviate according to the application. Fusing Characteristics: 15 Ω ≤ R ≤ 15 kΩ

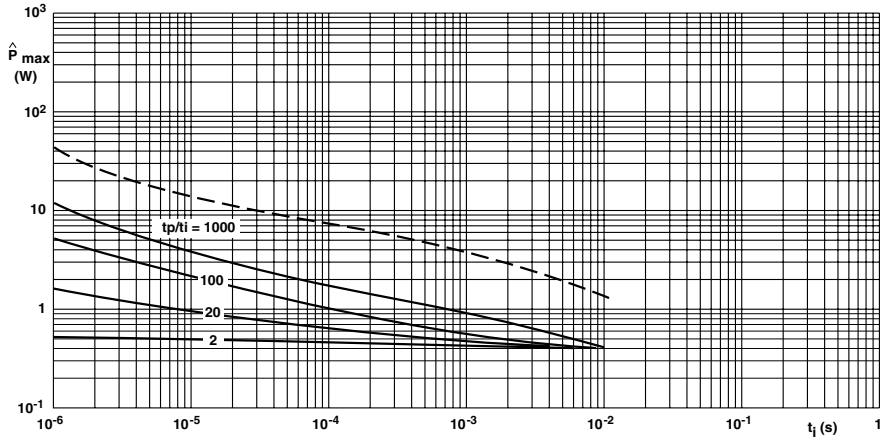



**NFR25H** This graph is based on measured data which may deviate according to the application. Fusing Characteristic: 1 Ω ≤ R ≤ 15 kΩ

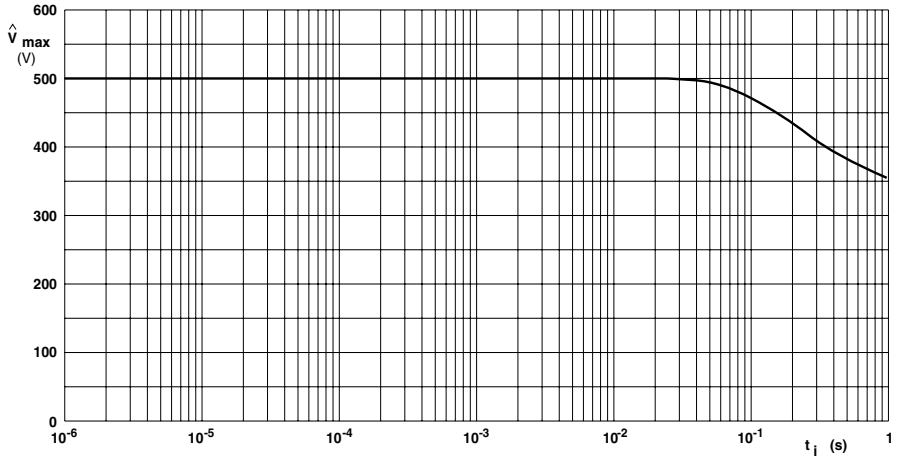
:




**NFR25** Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration ($t_i$), 0.22 Ω ≤ R < 15 Ω

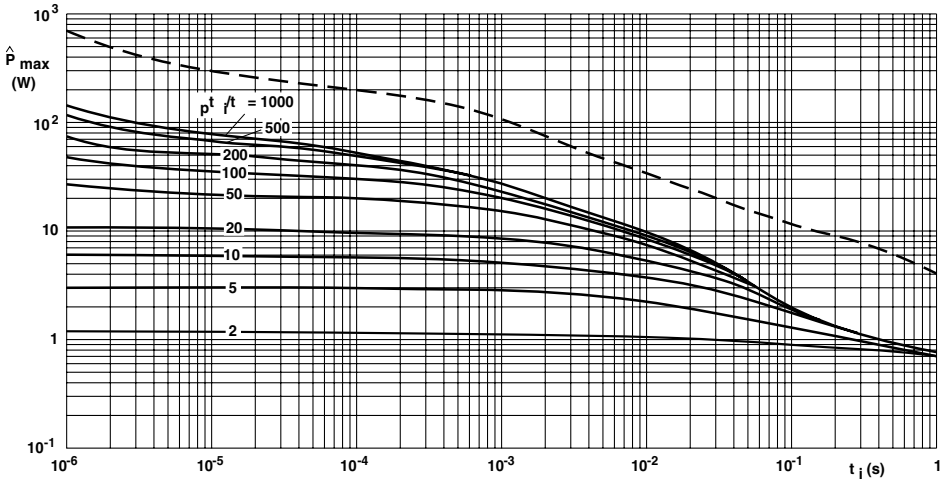



**NFR25** Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration ($t_i$), 15 Ω < R ≤ 15 kΩ

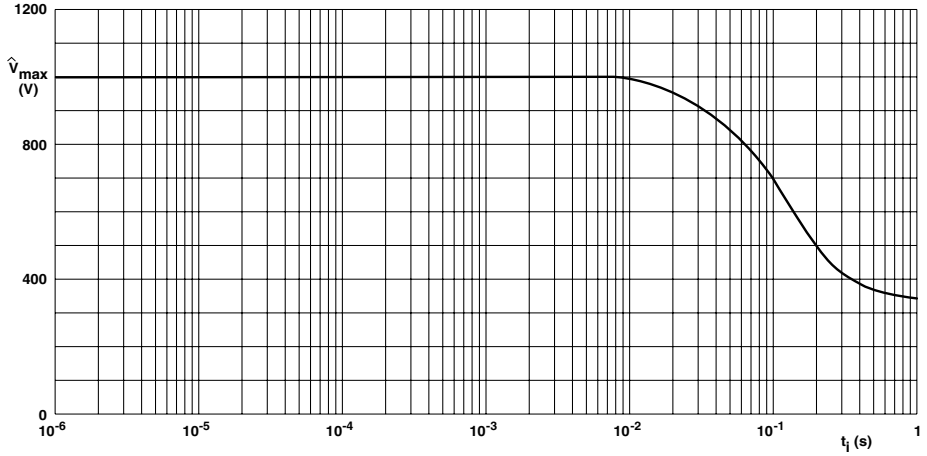



**NFR25** Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max}$) as a function of pulse duration ($t_i$)

### Pulse Loading Capabilities

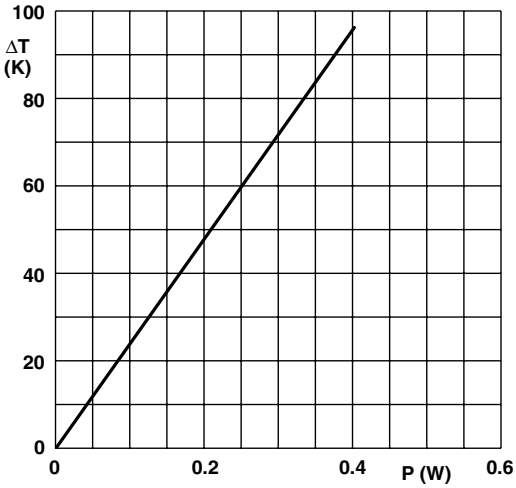



**NFR25H** Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration ($t_i$)



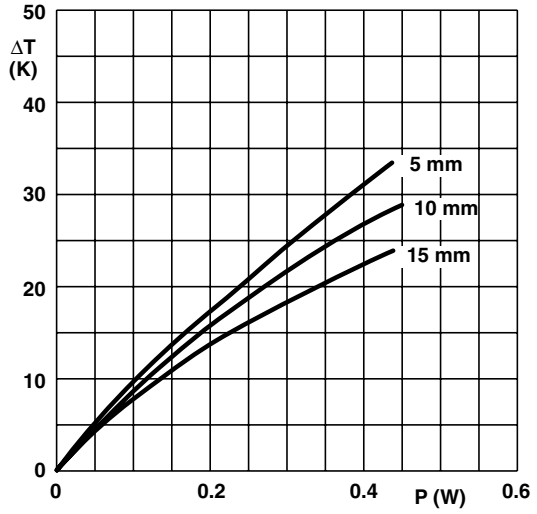

**NFR25H** Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max}$) as a function of pulse duration ($t_i$)

## Pulse Loading Capabilities



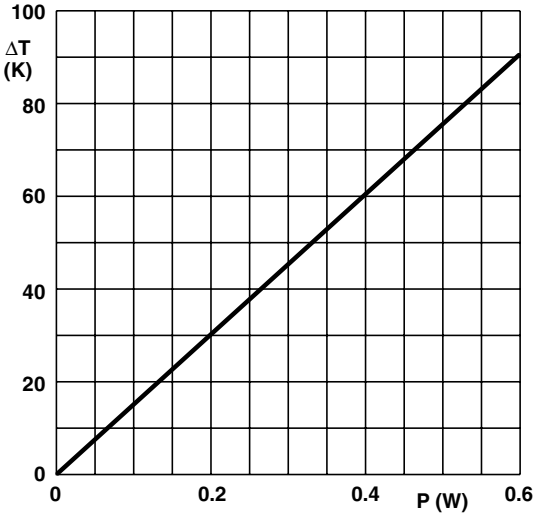

**NFR25** Hot-spot temperature rise (ΔT) as a function of dissipated power

## Application Information

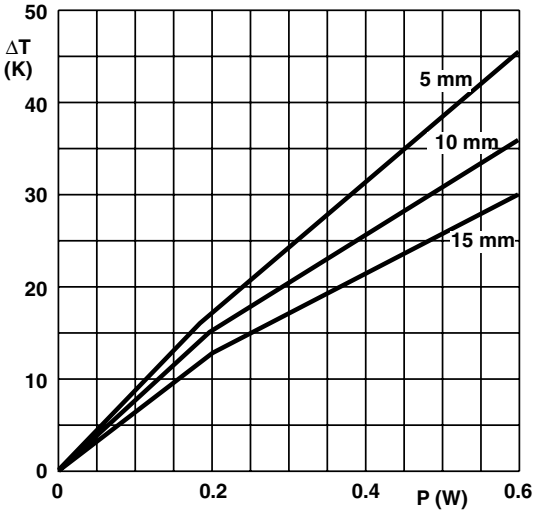



Minimum distance from resistor body to PCB = 1 mm

**NFR25** Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting




**NFR25H** Hot-spot temperature rise (ΔT) as a function of dissipated power.




Minimum distance from resistor body to PCB = 1 mm

**NFR25H** Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting

## Application Information

## TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the schedule of "IEC publication 60115-1", category LCT/UCT/56 (rated temperature range: Lower Category Temperature, Upper Category Temperature; damp heat, long term, 56 days). The testing also covers the requirements specified by EIA and EIAJ.

The tests are carried out in accordance with IEC publication 60068-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components" and under standard atmospheric conditions according to "IEC 60068-1", subclause 5.3.

In the Test Procedures and Requirements table the tests and requirements are listed with reference to the relevant clauses of "IEC publications 60115-1 and 60068-2"; a short description of the test procedure is also given. In some instances deviations from the IEC recommendations were necessary for our method of specifying. For inflammability requirements reference is made to "IEC 60115-1" and to "EN 140000, appendix D".

All soldering tests are performed with mildly activated flux.

### TEST PROCEDURES AND REQUIREMENTS

| IEC 60115-1 CLAUSE | IEC 60068-2 TEST METHOD | TEST | PROCEDURE | REQUIREMENTS | |
|---|---|---|---|---|---|
| | | | | NFR25 | NFR25H |
| **TESTS IN ACCORDANCE WITH THE SCHEDULE OF IEC PUBLICATION 60115-8** | | | | | |
| 4.4.1 | | visual examination | | no holes; clean surface; no damage | |
| 4.4.2 | | dimensions (outline) | gauge (mm) | see Dimensions Table | |
| 4.5 | | resistance | applied voltage (+ 0/- 10 %):<br>$R < 10\ \Omega$: 0.1 V<br>$10\ \Omega \le R < 100\ \Omega$: 0.3 V<br>$100\ \Omega \le R < 1\ k\Omega$: 1 V<br>$1\ k\Omega \le R < 10\ k\Omega$: 3 V<br>$10\ k\Omega \le R \le 15\ k\Omega$: 10 V | $R - R_{nom}$: max. ± 5 % | |
| 4.18 | 20 (Tb) | resistance to soldering heat | thermal shock: 3 s; 350 °C;<br>3 mm from body | $\Delta R/R$ max.: ± 0.25 % + 0.05 Ω | |
| 4.29 | 45 (Xa) | component solvent resistance | isopropyl alcohol or $H_2O$ followed by brushing in accordance with *"MIL 202 F"* | no visual damage | |
| 4.17 | 20 (Ta) | solderability | 2 s; 235 °C | good tinning; no damage | |
| 4.7 | | voltage proof on insulation | 500 V (RMS) during<br>1 minute; metal block method | no breakdown or flashover | |
| 4.16 | 21 (U) | robustness of terminations: | | | |
| 4.16.2 | 21 (Ua1) | tensile all samples | load 10 N; 10 s | number of failures $< 10 \times 10^{-6}$ | |
| 4.16.3 | 21 (Ub) | bending half number of samples | load 5 N; 4 × 90° | number of failures $< 10 \times 10^{-6}$ | |
| 4.16.4 | 21 (Uc) | torsion other half of samples | 3 × 360° in opposite directions | no damage<br>$\Delta R/R$ max.: ± 0.25 % + 0.05 Ω | |
| 4.20 | 29 (Eb) | bump | 3 × 1500 bumps in 3 directions; 40 g | no damage<br>$\Delta R/R$ max.: ± 0.25 % + 0.05 Ω | |
| 4.22 | 6 (Fc) | vibration | frequency 10 to 500 Hz; displacement 1.5 mm or acceleration 10 g;<br>3 directions; total 6 hours (3 × 2 hours) | no damage<br>$\Delta R/R$ max.: ± 0.25 % + 0.05 Ω | |
| 4.19 | 14 (Na) | rapid change of temperature | 30 minutes at LCT and<br>30 minutes at UCT; 5 cycles | no visual damage<br>$\Delta R/R$ max.: ± 0.25 % + 0.05 Ω | |
| 4.23 | | climatic sequence: | | | |
| 4.23.3 | 30 (Db) | damp heat (accelerated) 1st cycle | | | |
| 4.23.6 | 30 (Db) | damp heat (accelerated) remaining cycles | 6 days; 55 °C; 95 to 98 % RH | $R_{ins}$ min.: $10^3$ MΩ<br>$\Delta R/R$ max.: ± 1 % + 0.05 Ω | |

## TEST PROCEDURES AND REQUIREMENTS

| IEC 60115-1 CLAUSE | IEC 60068-2 TEST METHOD | TEST | PROCEDURE | REQUIREMENTS | |
|---|---|---|---|---|---|
| | | | | NFR25 | NFR25H |
| 4.24.2 | 3 (Ca) | damp heat (steady state) (IEC) | 56 days; 40 °C; 90 to 95 % RH; loaded with 0.01 $P_n$ (IEC steps: 4 to 100 V) | $R_{ins}$ max.: 1000 MΩ<br>ΔR/R max.: ± 1 % + 0.05 Ω | |
| 4.25.1 | | endurance (at 70 °C) | 1000 hours; loaded with $P_n$ or $V_{max}$; 1.5 hours on and 0.5 hours off | ΔR/R max.: ± 1 % + 0.05 Ω | |
| 4.25.3 | | endurance at upper category temperature | 1000 hours; no load | ΔR/R max.: ± 1 % + 0.05 Ω | |
| 4.8.4.2 | | temperature coefficient | at 20/LCT/20 °C and 20/UCT/20 °C (TC × $10^{-6}$/K): | | |
| | | | 0.22 Ω ≤ R ≤ 4.7 Ω | ≤ ± 200 × $10^{-6}$/K | ≤ ± 200 × $10^{-6}$/K |
| | | | 4.7 Ω < R ≤ 15 Ω | ≤ ± 200 × $10^{-6}$/K | ≤ ± 100 × $10^{-6}$/K |
| | | | 15 Ω < R ≤ 15 kΩ | ≤ ± 100 × $10^{-6}$/K | ≤ ± 100 × $10^{-6}$/K |
| 4.12 | | noise | *"IEC publication 60195"* | < 0.1 μV/V | |
| 4.26 | | accidental overload | cheese-cloth | nonflammable | |
| **OTHER TESTS IN ACCORDANCE WITH IEC 60115 CLAUSES AND IEC 60068 TEST METHOD** | | | | | |
| 4.17 | 20 (Ta) | solderability (after ageing) | 8 hours steam or 16 hours 155 °C; leads immersed 6 mm for 2 ± 0.5 s in a solder bath at 235 ± 5 °C | good tinning (≥ 95 % covered); no damage | |
| 4.6.1.1 | | insulation resistance | maximum voltage 500 V (DC) after 1 minute; metal block method | $R_{ins}$ min.: $10^4$ MΩ | |
| see 2nd amendment to *"IEC 60115-1"*, Jan.'87 | | pulse load | | see the Pulse Loading Capabilities graphs | |

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