Fusible, Non-Flammable Metal Film Leaded Resistors

FEATURES

- Technology: metal film
- Overload protection without risk of fire
- Wide range of overload currents (refer Fusing Characteristics graphs)
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

RoHS COMPLIANT

APPLICATIONS

- Audio
- Video

DESCRIPTION

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 gray, flame retardant lacquer which provides electrical, mechanical, and climatic protection. The encapsulant is resistant to all cleaning solvents in accordance with **IEC 60068-2-45**.

TECHNICAL SPECIFICATIONS		
DESCRIPTION	**NFR25**	**NFR25H**
Resistance range (1)	0.22 Ω to 15 kΩ	0.22 Ω to 15 kΩ
Resistance tolerance	± 5 %	± 5 %
Resistance series	E24	E24
Rated dissipation P_{70}	0.33 W	0.5 W
Thermal resistance (R_{th})	240 K/W	150 K/W
Temperature coefficient 0.22 Ω ≤ R ≤ 4.7 Ω 4.7 Ω ≤ R ≤ 15 Ω 15 Ω ≤ R ≤ 15 kΩ	 ≤ ± 200 ppm/K ≤ ± 200 ppm/K ≤ ± 100 ppm/K	 ≤ ± 200 ppm/K ≤ ± 100 ppm/K ≤ ± 100 ppm/K
Operating voltage, $U_{max.}$ DC or RMS	250 V	350 V
Basic specifications	IEC 60 115-1	IEC 60 115-1
Climatic category (IEC 60068-1)	55/155/56	55/155/56
Maximum resistance change for resistance range, ΔR max., after:		
Load (1000 h, P_{70}):	± (1 % R + 0.05 Ω)	± (1 % R + 0.05 Ω)
Long term damp heat test (56 days):	± (1 % R + 0.05 Ω)	± (1 % R + 0.05 Ω)
Soldering (260 °C, 10 s):	± (0.25 % R + 0.05 Ω)	± (0.25 % R + 0.05 Ω)

Notes

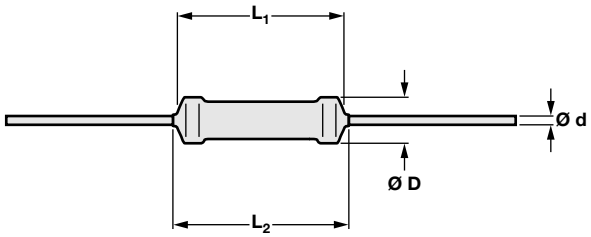
- R value is measured with probe distance of 24 mm ± 1 mm using 4-terminal method

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

PACKAGING

MODEL	TAPING	AMMOPACK		REEL	
		PIECES	CODE	PIECES	CODE
NFR25, NFR25H	Axial, 52 mm	5000	A5	5000	R5
		1000	A1		
NFR25, NFR25H	Radial	2000	N2	-	-

DIMENSIONS



Outline

DIMENSIONS (Resistor types, mass, and relevant physical dimensions)

TYPE	$D_{max.}$ (mm)	$L_{1\ max.}$ (mm)	$L_{2\ max.}$ (mm)	Ø d (mm)	MASS (mg)
NFR25	2.5	6.5	7.5	0.58 ± 0.05	201
NFR25H					

PART NUMBER AND PRODUCT DESCRIPTION

Part Number: NFR2500002207JA100

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

MODEL/SIZE	VARIANT	TCR/MATERIAL	VALUE	TOLERANCE	PACKAGING (1)	SPECIAL
NFR2500 **NFR25H0**	**0** = neutral **Z** = value overload (special)	**0** = standard	**3 digit value** **1 digit multiplier** MULTIPLIER **7** = $*10^{-3}$ **8** = $*10^{-2}$ **9** = $*10^{-1}$ **0** = $*10^{0}$ **1** = $*10^{1}$ **2** = $*10^{2}$	**J** = ± 5 %	**N2** **A5** **A1** **R5**	Up to 2 digits are used for all special parts. **00** = standard

Product Description: NFR25 5 % A1 R22

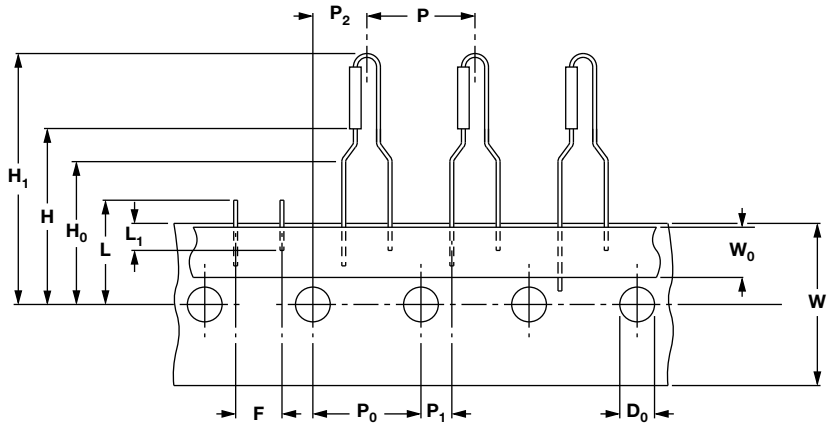
NFR25	5 %	A1	R22
MODEL / SIZE	TOLERANCE	PACKAGING (1)	RESISTANCE VALUE
NFR25 **NFR25H**	**± 5 %**	**N2** **A5** **A1** **R5**	**1K0** = 1 kΩ **4R7** = 4.7 Ω

Notes

- The PART NUMBER is shown to facilitate the introduction of the unified part numbering system

(1) Please refer to table PACKAGING, see next page

PRODUCTS WITH RADIAL LEADS (NFR25, NFR25H)



DIMENSIONS (Radial taping)				
SYMBOL	PARAMETER	VALUE	TOLERANCE	UNIT
P	Pitch of components	12.7	± 1.0	mm
P_0	Feed-hole pitch	12.7	± 0.2	mm
P_1	Feed-hole center to lead at topside at the tape	3.85	± 0.5	mm
P_2	Feed-hole center to body center	6.35	± 1.0	mm
F	Lead-to-lead distance	4.8	+ 0.7 / - 0	mm
W	Tape width	18.0	± 0.5	mm
W_0	Minimum hold down tape width	5.5	-	mm
H_1	Component height	29.0	Max.	mm
H_0	Lead wire clinch height	16.5	± 0.5	mm
H	Height of component from tape center	19.5	± 1	mm
D_0	Feed-hole diameter	4.0	± 0.2	mm
L	Maximum length of snipped lead	11.0	-	mm
L_1	Minimum lead wire (tape portion) shortest lead	2.5	-	mm

Note

- Please refer document number 28721 “Packaging” for more detail

MARKING

The nominal resistance and tolerance are marked on the resistor using four colored bands in accordance with IEC 60062, marking codes for resistors and capacitors.
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 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 60063.

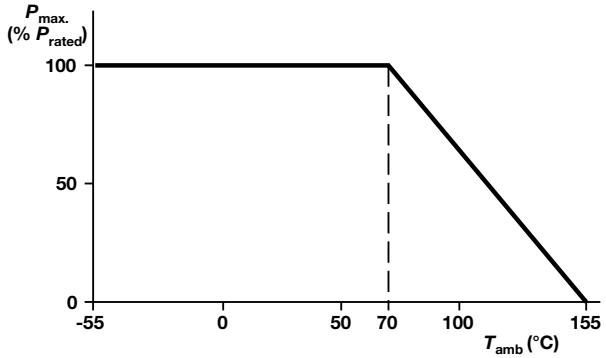
LIMITING VALUES		
TYPE	LIMITING VOLTAGE U [1] (V)	LIMITING POWER P_{70} (W)
NFR25	250	0.33
NFR25H	350	0.5

Note

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

DERATING

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

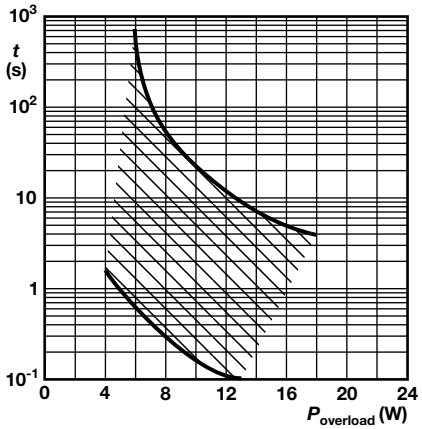


Maximum dissipation ($P_{max.}$) in percentage of rated power as a function of the ambient temperature (T_{amb})

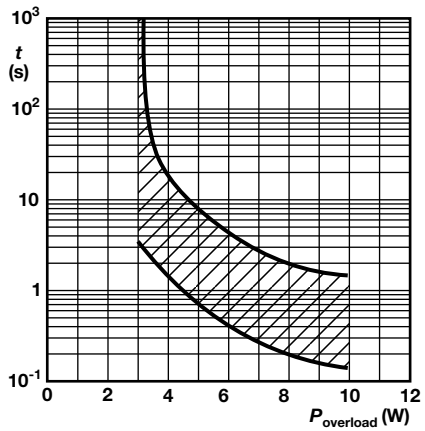
FUSING CHARACTERISTICS

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.

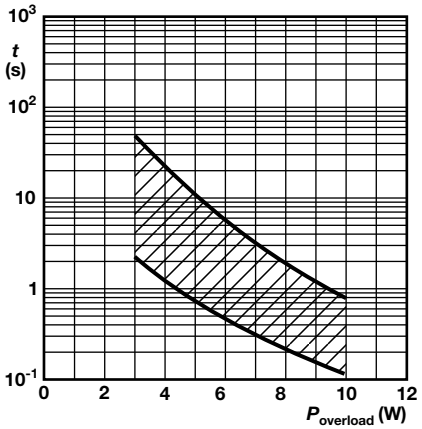
The fusing characteristic is measured under constant voltage.



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

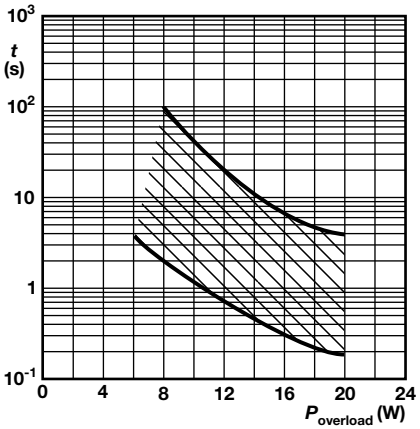


NFR25 This graph is based on measured data which may deviate according to the application.
Fusing Characteristics: 1 Ω ≤ *R* ≤ 15 Ω

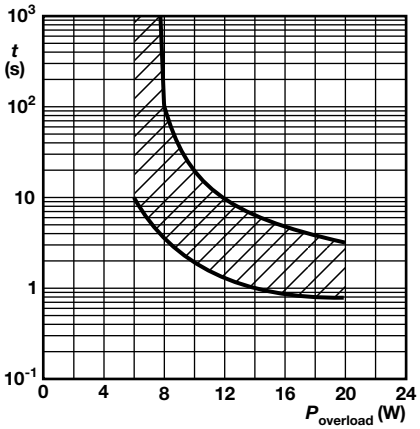


NFR25 This graph is based on measured data which may deviate according to the application.
Fusing Characteristics: 15 Ω ≤ *R* ≤ 15 kΩ

FUSING CHARACTERISTICS

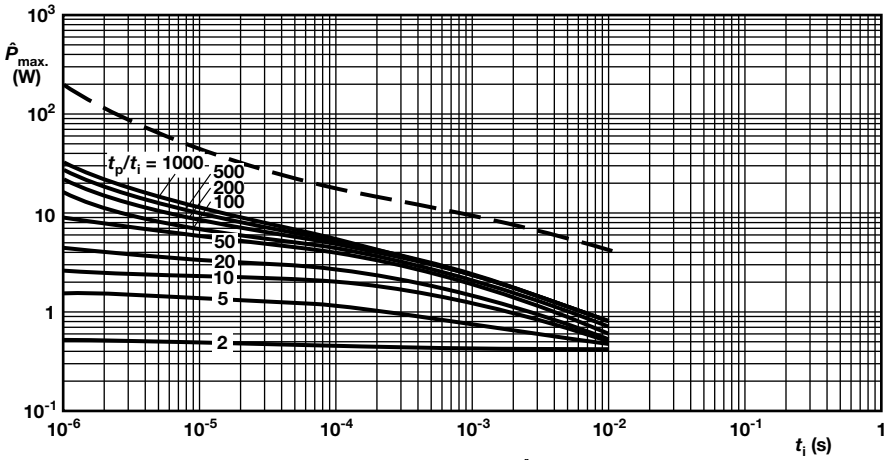


NFR25H This graph is based on measured data which may deviate according to the application.
Fusing Characteristics: ≤ 1 Ω

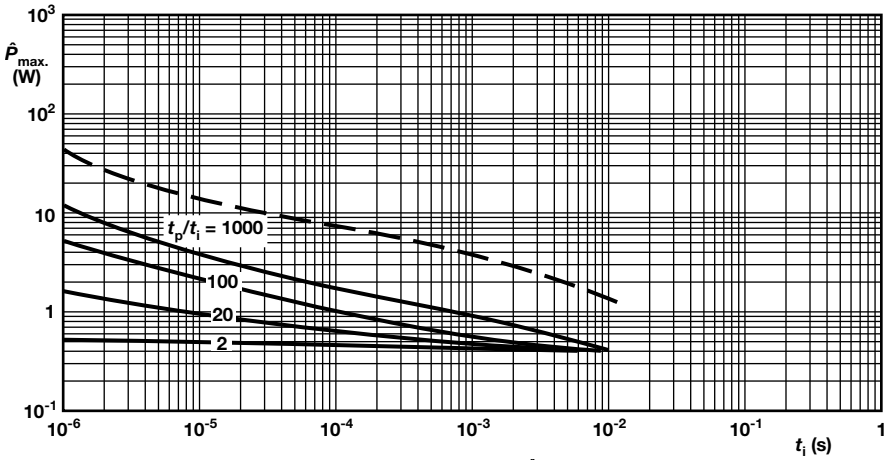


NFR25H This graph is based on measured data which may deviate according to the application.
Fusing Characteristics: 1 Ω ≤ *R* ≤ 15 kΩ

PULSE LOADING CAPABILITIES

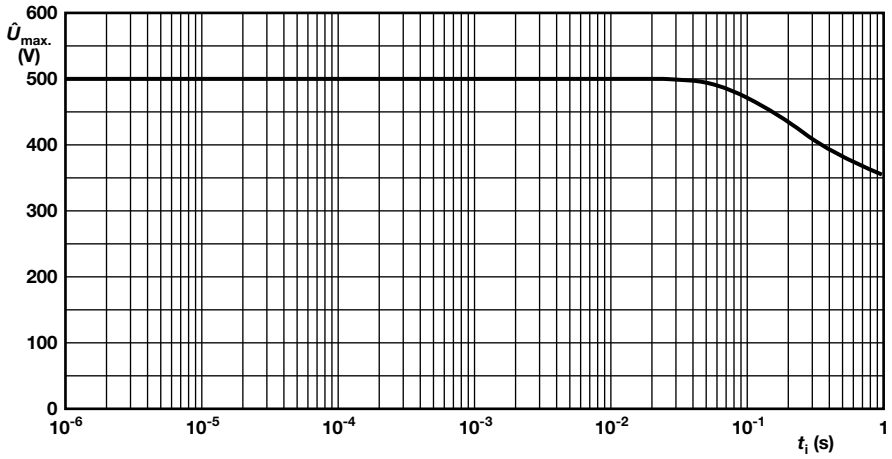


NFR25 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max.}$) as a function of pulse duration (t_i), 0.22 Ω ≤ *R* ≤ 1 kΩ

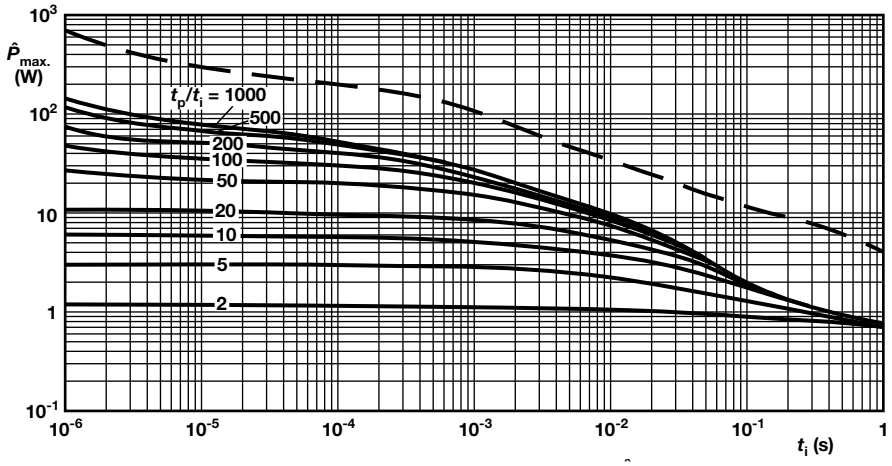


NFR25 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max.}$) as a function of pulse duration (t_i),15 Ω ≤ *R* ≤ 15 kΩ

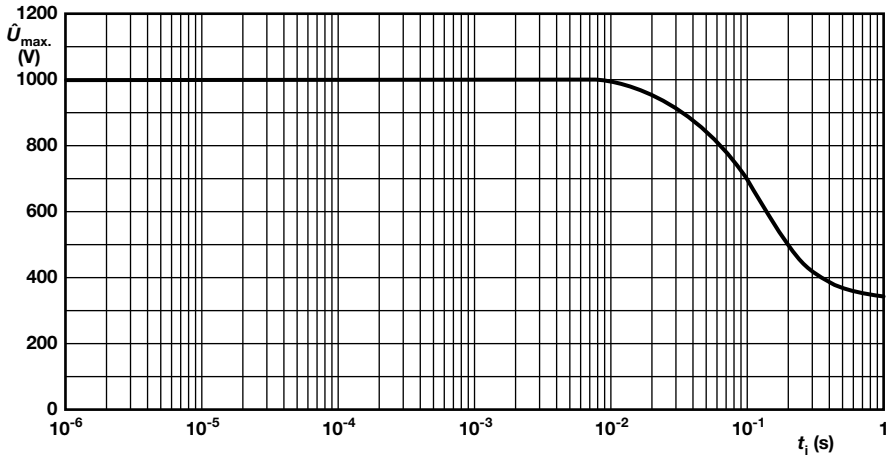
PULSE LOADING CAPABILITIES



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

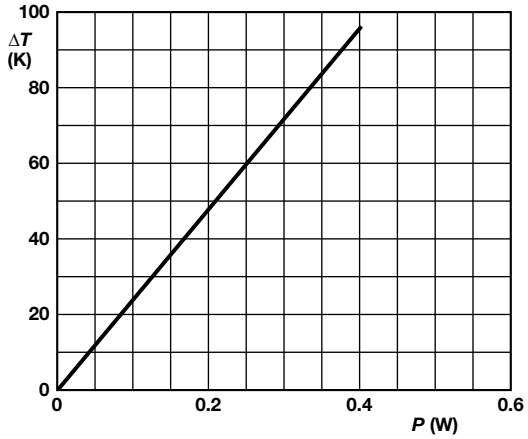


NFR25H Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max.}$) as a function of pulse duration (t_i)

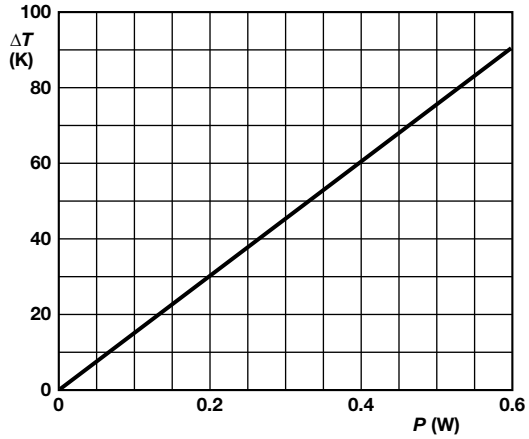


NFR25H Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max.}$) as a function of pulse duration (t_i)

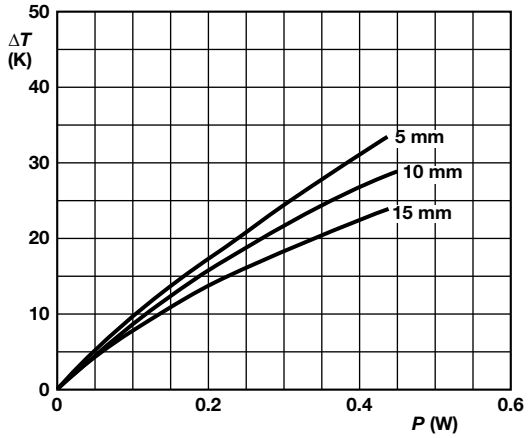
APPLICATION INFORMATION



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

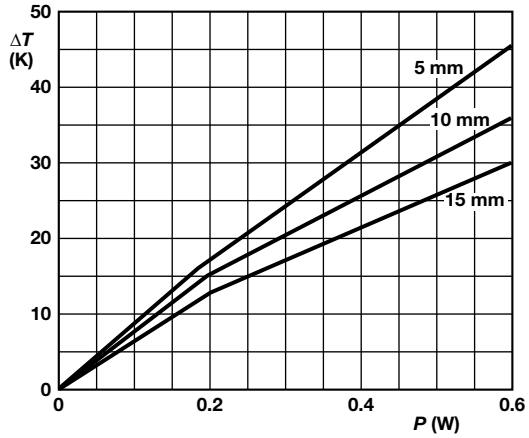


NFR25H Hot-spot temperature rise (Δ*T*) as a function of dissipated power



Minimum distance from resistor body to PCB. = 1 mm

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



Minimum distance from resistor body to PCB. = 1 mm

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

TESTS AND REQUIREMENTES

Essentially all tests are carried out in accordance with IEC 60115-1 specification, category LCT/UCT/56 (rated temperature range: Lower category temperature, upper category temperature; damp heat, long term, 56 days).
The tests are carried out in accordance with IEC 60068-2-xx test method, “Recommended basic climatic and mechanical robustness testing procedure for electronic components” and under standard atmospheric conditions according to IEC 60068-1, 5.3.

In the Test Procedures and Requirements table the tests and requirements are listed with reference to the relevant clauses of IEC 60115-1 and IEC 60068-2-xx test methods. 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.
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
4.4.1		Visual examination		No holes; clean surface; no damage	
4.4.2		Dimensions (outline)	Gauge (mm)	See Dimensions Table	
4.5		Resistance (refer note on first page for measuring distance)	Applied voltage (+ 0 % / - 10 %): $R < 10\ \Omega$: 0.1 V $10\ \Omega \le R < 100\ \Omega$: 0.3 V $100\ \Omega \le R < 1\ k\Omega$: 1 V $1\ k\Omega \le R < 10\ k\Omega$ 3 V $10\ k\Omega \le R \le 15\ k\Omega$: 10 V	R - $R_{nom.}$: max. ± 5 %	
4.18	20 (Tb)	Resistance to soldering heat	Thermal shock: 10 s; 260 °C; 3 mm from body	ΔR max.: ± (0.25 % R + 0.05 Ω)	
4.29	45 (Xa)	Component solvent resistance	Isopropyl alcohol or H_2O followed by brushing	No visual damage	
4.17	20 (Ta)	Solderability	2 s; 235 °C: Solder bath method; SnPb40 3 s; 245 °C: Solder bath method; SnAg3Cu0.5	Good tinning (≥ 95 % covered); no damage	
		Solderability (after aging)	8 h steam or 16 h, 155 °C; leads immersed 6 mm; for 2 s at 235 °C: Solder bath (SnPb40) for 3 s at 245 °C: Solder bath (SnAg3Cu0.5) method	Good tinning (≥ 95 % covered); no damage	
4.7		Voltage proof on insulation	U_{RMS} = 500 V during 1 min; metal block method	No breakdown or flashover	
4.16		Robustness of terminations:			
4.16.2	21 (Ua1)	Tensile all samples	Load 10 N; 10 s	Number of failures < 10 x 10^{-6}	
4.16.3	21 (Ub)	Bending half number of samples	Load 5 N; 4 x 90°	Number of failures < 10 x 10^{-6}	
4.16.4	21 (Uc)	Torsion other half of samples	3 x 360° in opposite directions	No damage ΔR max.: ± (0.25 % R + 0.05 Ω)	
4.20	29 (Eb)	Bump	3 x 1500 bumps in 3 directions; 40 g	No damage ΔR max.: ± (0.25 % R + 0.05 Ω)	
4.22	6 (Fc)	Vibration	Frequency 10 Hz to 500 Hz; displacement 1.5 mm or acceleration 10 g; 3 directions; total 6 h (3 x 2 h)	No damage ΔR max.: ± (0.25 % R + 0.05 Ω)	
4.19	14 (Na)	Rapid change of temperature	30 min at LCT and 30 min at UCT; 5 cycles	No visual damage ΔR max.: ± (0.25 % R + 0.05 Ω)	
4.23		Climatic sequence:			
4.23.2	2 (Ba)	Dry heat	16 h; 155 °C		
4.23.3	30 (Db)	Damp heat (accelerated) 1st cycle	24 h; 55 °C; 90 % to 100 % RH		
4.23.4	1 (Aa)	Cold	2 h; -55 °C		
4.23.5	13 (M)	Low air pressure	2 h; 8.5 kPa; 15 °C to 35 °C		
4.23.6	30 (Db)	Damp heat (accelerated) remaining cycles	5 days; 55 °C; 95 % to 100 % RH	R_{ins} min. 10^3 MΩ ΔR max.: ± (1.5 % R + 0.1 Ω)	
4.24	78 (Cab)	Damp heat (steady state)	56 days; 40 °C; 90 % to 95 % RH; loaded with 0.01 P_{70} (IEC steps: 0 V to 100 V)	R_{ins} min. 10^3 MΩ ΔR max.: ± (1 % R + 0.05 Ω)	
4.25.1		Endurance (at 70 °C)	1000 h; loaded with P_{70} or $U_{max.}$; 1.5 h ON and 0.5 h OFF	ΔR max.: ± (1 % R + 0.05 Ω)	
4.25.3		Endurance at upper category temperature	1000 h; no load	ΔR max.: ± (1 % R + 0.05 Ω)	
4.8		Temperature coefficient	Between -55 °C and +155 °C $0.22\ \Omega \le R \le 4.7\ \Omega$ $4.7\ \Omega < R \le 15\ \Omega$ $15\ \Omega < R \le 15\ k\Omega$	≤ ± 200 ppm/K ≤ ± 200 ppm/K ≤ ± 100 ppm/K	≤ ± 200 ppm/K ≤ ± 100 ppm/K ≤ ± 100 ppm/K
4.12		Noise	IEC 60195	< 0.1 µV/V	
4.26		Accidental overload	Cheese-cloth	Non flammable	
4.6.1.1		Insulation resistance	Maximum voltage $U_{max.}$ DC = 500 V after 1 min; metal block method	R_{ins} min. 10^4 MΩ	

12NC INFORMATION FOR HISTORICAL CODING REFERENCE

- The resistors have a 12 digit numeric code starting with 23
- The subsequent 7 digits indicate the resistor type and packaging
- The remaining 3 digits indicate the resistance value:
  - 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 Ω to 0.91 Ω	7
1 Ω to 9.1 Ω	8
10 Ω to 91 Ω	9
100 Ω to 910 Ω	1
1 kΩ to 9.1 kΩ	2
10 kΩ to 15 kΩ	3

12NC Example

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

12NC (Resistors Type and Packaging)

TYPE	23..			
	BANDOLIER IN AMMOPACK			BANDOLIER ON REEL
	RADIAL TAPED	STRAIGHT LEADS		STRAIGHT LEADS
	2000 UNITS	1000 UNITS	5000 UNITS	5000 UNITS
NFR25	22 204 03...	22 205 13...	22 205 33...	22 205 23...
NFR25H	22 207 03...	22 207 13...	22 207 33...	22 207 23...

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