Fusible Power Metal Film Leaded Resistors

A homogenous film of metal alloy is depositded on a high grade ceramic body. After a helical groove has been cut in the resistive layer, tinned electrolytic copper wires are welded to the end-caps. The resistors are coated with a red non-flammable 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“.

FEATURES

- Metal film technology
- High power (upto 3 W) in small package
- Small standard sizes (0207/0414/0617)
- High stability, reliability and uniformity characteristics
- Defined interruption behaviour (fusing time)
- Various forming styles
- Non flammable
- Compatible with lead (Pb)-free and lead containing soldering processes
- Lead (Pb)-free and RoHS compliant

APPLICATIONS

- Audio
- Video

TECHNICAL SPECIFICATIONS			
DESCRIPTION	**NFR01**	**NFR02**	**NFR03**
Resistance Range (1)	0.47 Ω to 1 kΩ		
Resistance Tolerance	± 5 %; E24 series		
Temperature Coefficient	± 200 ppm/K		
Climatic Category (LCT/UCT/days)	55/155/56		
Rated Dissipation P_{70}	1 W	2 W	3 W
Maximum Permissible Voltage: DC or RMS	350 V	500 V	
Fusing Power	0.47 Ω to 10 Ω; ≥ 20 x Pn		
	10.1 Ω to 1 kΩ; ≥ 16 x Pn		
Fusing Time	≤ 60 s		
Maximum Resistance Change at P_{70} for Resistance Range, ΔR max., after:			
Load	± (5 % R + 0.1 Ω)		
Climatic Tests	± (3 % R + 0.1 Ω)		
Resistance to Soldering Heat	± (1 % R + 0.05 Ω)		

Note

(1) Resistance values below 0.47 Ω with ± 10 % tolerance are available on request

12NC INFORMATION FOR HISTORICAL CODING REFERENCE ONLY

- The resistors have a 12 digit ordering code starting with 2306
- The next 5 digits indicate the resistor type and packaging
- The last 3 digits indicate the resistance value:
  - The first 2 digits indicate the actual resistance value
  - The last digit indicates the resistance decade in accordance with table

Last Digit of 12NC Indicating Resistance Decade

RESISTANCE DECADE	LAST DIGIT
0.47 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	2

12NC Example

NFR01, 1 Ω, ± 5 %, ammopack 1000 pieces is
2306 208 13108

12NC - resistor type and packaging

DESCRIPTION			ORDERING CODE 2306			
			BANDOLIER IN AMMOPACK			BANDOLIER ON REEL
TYPE	TAPE WIDTH	TOL.	500 UNITS	1000 UNITS	5000 UNITS	5000 UNITS
NFR01	52.5	± 5 %	-	208 13...	208 53...	208 23...
NFR02	52.5	± 5 %	-	209 13...	-	209 23...
NFR03	63.0	± 5 %	210 13...	-	-	-

PART NUMBER AND PRODUCT DESCRIPTION

PART NUMBER [1]: NFR0100001008JA100

N	F	R	0	1	0	0	0	0	1	0	0	8	J	A	1	0	0

MODEL/SIZE	SPECIAL CHARACTER	TCR/MATERIAL	VALUE	TOLERANCE	PACKAGING [2]	SPECIAL
NFR0100 **NFR0200** **NFR0300**	**0** = neutral	**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** = $*10^{2}$ **3** = $*10^{3}$ **4** = $*10^{4}$	**J** = ± 5 %	**A1** **A5** **R5** **AC**	up to 2 digits 00 = standard

PRODUCT DESCRIPTION: NFR01 5 % A1 1R0

NFR01	5 %	A1	1R0
MODEL	TOLERANCE	PACKAGING [2]	RESISTANCE VALUE
NFR01 **NFR02** **NFR03**	± **5** %	**A1** **A5** **R5** **AC**	**1R0** = 1 Ω **470R** = 470 Ω

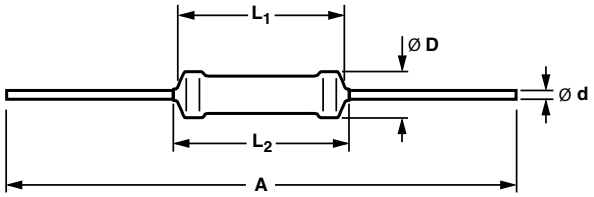
Notes

[1] The PART NUMBER is shown to facilitate the introduction of the unified part numbering system

[2] Please refer to table PACKAGING, see next page

PACKAGING				
MODEL	REEL		BOX	
	PIECES	CODE	PIECES	CODE
NFR01	5000	R5	1000 5000	A1 A5
NFR02	5000	R5	1000	A1
NFR03	-	-	500	AC

DIMENSIONS



DIMENSIONS - resistor types, mass and relevant physical dimensions						
TYPE	$L_{1\ max.}$ (mm)	$L_{2\ max.}$ (mm)	$D_{max.}$ (mm)	Ø d (mm)	A (mm)	MASS (g)/ 100 pieces
NFR01	6.5	8.5	2.5	0.58 ± 0.05	52.5 ± 1.5	22
NFR02	10	12	4	0.80 ± 0.03	52.5 ± 1.5	50
NFR03	16.7	19.5	5.3	0.80 ± 0.03	63.0 ± 1.5	120

MARKING

The nominal resistance and tolerance are marked on the resistor using four colored bands in accordance with IEC 60062 “Color code for fixed resistors”. There is a fifth black band in order to indicate the type of resistor. Standard values of nominal resistance are taken from the E24 series for resistors with a tolerance of ± 5 %.

FUNCTIONAL PERFORMANCE

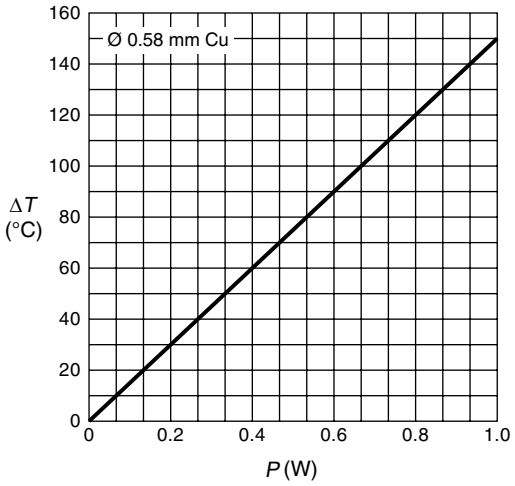
Derating - Standard Operation

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

APPLICATION INFORMATION

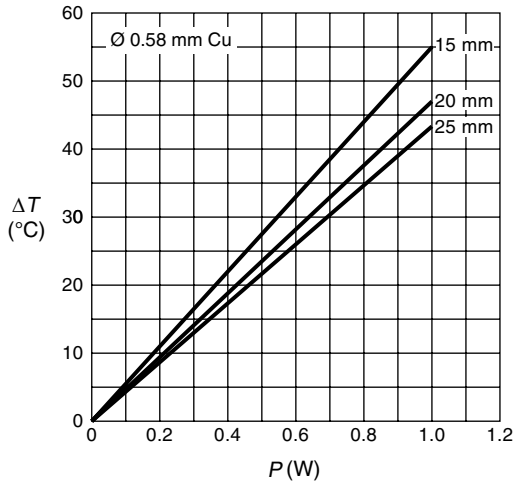
NFR01

Hot Spot



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

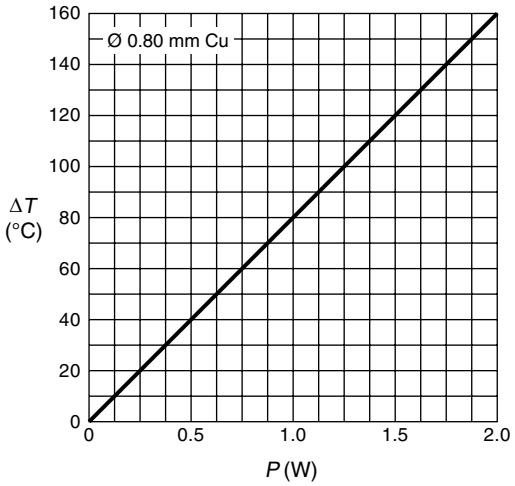
Solder Spot



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

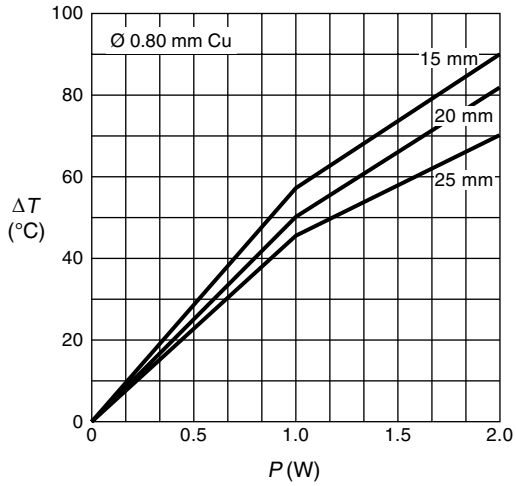
NFR02

Hot Spot



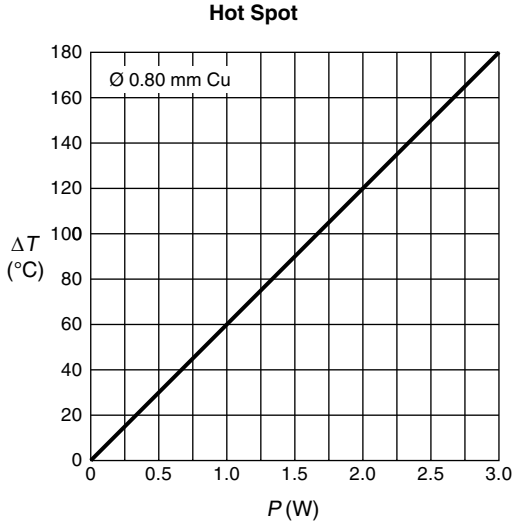
Hot spot temperature rise (ΔT) as a function of dissipated power

Solder Spot

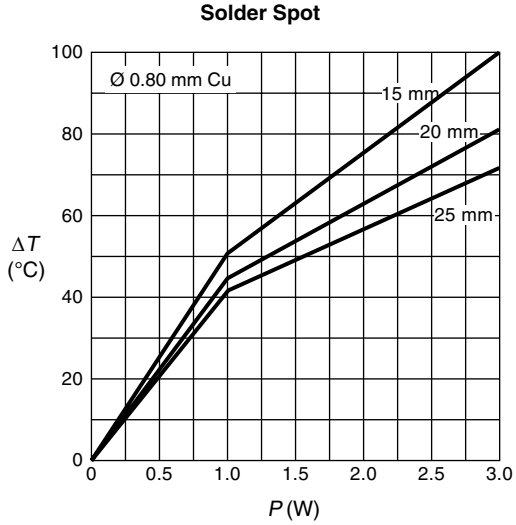


Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various leads lengths after mounting

NFR03



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



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

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.

Resistance Range	Power Overload	Fusing Time
0.47 Ω - 10 Ω	≥ 20 x maximum dissipation at 70 °C (Pn)	≤ 60 s
10.1 Ω - 1 kΩ	≥ 16 x maximum dissipation at 70 °C (Pn)	

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the schedule of IEC 60115-1, category 55/155/56 (rated temperature range - 55 to + 155 °C; damp heat, long term, 56 days) and along the lines of IEC 60068-2; "Recommended basic climatic and mechanical robustness testing procedure for electronic components" and under standard atmosphere conditions according to IEC 60068-1 subclause 5.3, unless otherwise specified. In some instances deviations from IEC applications were necessary for our specified method.

PERFORMANCE						
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)		
				NFR01	NFR02	NFR03
4.8	-	Temperature coefficient	Between - 55 °C and + 155 °C	± 200 ppm/K		
4.25.1	-	Endurance at 70 °C	1000 h; loaded with Pn or $V_{max.}$; 1.5 h ON; 0.5 h OFF	± (5 % R + 0.1 Ω)		
4.26	-	Accidental overload	Overload of 5, 10, 16, 25, 40, 63 and 100 times the rated power, but the applied voltage shall not exceed four times the limiting voltage.	Non-flammable		

PERFORMANCE						
IEC 60115-1 CLAUSE	**IEC 60068-2 TEST METHOD**	**TEST**	**PROCEDURE**	**REQUIREMENTS PERMISSIBLE CHANGE (ΔR)**		
				NFR01	**NFR02**	**NFR03**
4.24	3 (Ca)	Damp heat, steady state	56 days; 40 °C; 90 to 95 % RH loaded with 0.01 Pn	R_{ins} min. 10^3 MΩ ± (3 % R + 0.1 Ω)		
4.16	21 (U)	Robustness of terminations:		No damage ± (0.5 % R + 0.05 Ω)		
4.16.2	21 (Ua1)	Tensile all samples	Load 10 N; 10 s			
4.16.3	21 (Ub)	Bending half number of samples	Load 5 N; 4 x 90°			
4.16.4	21 (Uc)	Torsion other half of samples	3 x 360° in opposite direction			
4.19	14 (Na)	Rapid change of temperature	30 min at LCT; 30 min at UCT; LCT = - 55 °C; UCT = 155 °C; 5 cycles	± (1 % R + 0.05 Ω)	± (1 % R + 0.05 Ω)	± (2 % R + 0.05 Ω)
4.23		Climatic sequence		R_{ins} min. 10^3 MΩ ± (3 % R + 0.1 Ω)		
4.23.2	2 (Ba)	Dry heat	16 h, 155 °C			
4.23.3	30 (Db)	Damp heat (accelerated)	24 h; 25 °C to 55 °C 90 % to 100 % RH; 1 cycle			
4.23.4	1 (Aa)	Cold	2 h, - 55 °C			
4.23.6	30 (Db)	Damp heat, (accelerated) remaining cycles	5 days; 25 °C to 55 °C 90 to 100 % RH			
4.22	6 (Fc)	Vibration	Endurance by sweeping; 10 Hz to 500 Hz; displacement 1.5 mm or acceleration 10 g; 6 h (3 x 2 h)	No visual damage ± (0.5 % R + 0.05 Ω)		
4.17	20 (Ta)	Solderability (after ageing)	16 h at 155 °C; immersed in flux 600, leads immersed 2 mm in solder bath at (235 ± 5) °C for (2 ± 0.5) s	Good tinning (≥ 95% covered); no visible damage		
4.18	20 (Tb)	Resistance to soldering heat	Solder bath method; (350 ± 10) °C; 6 mm from body; for 3 s	± (1 % R + 0.05 Ω)		
4.29	45 (XA)	Component solvent resistance	Isopropyl alcohol; MIL STD 202E	No visible damage		
4.7	-	Voltage proof on insulation	500 V_{RMS} during 1 min, V-block method	No flashover or breakdown		
4.6.1.1	-	Insulation resistance	500 V_{DC} during 1 min, V-block method	R_{ins} min. 10^4 MΩ		

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