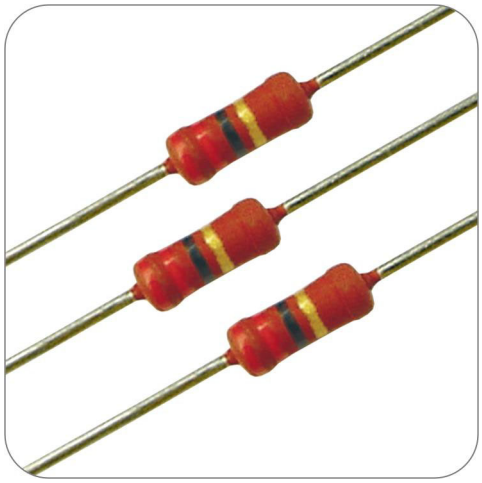
POWER RESISTOR - PR02

FEATURES

- Metal film technology
- High power in small package
- High stability, reliability and uniformity characteristics
- Different leads for different applications
- Various forming styles are available
- Defined interruption behavior (fusing time)
- Non-flammable
- Various packing and taping configurations
- Good performance for pulse applications
- RoHS compliant



MARKET SEGMENTS AND APPLICATIONS

INDUSTRY SECTOR	APPLICATION SEGMENT	END-USER EQUIPMENT
Industrial	Power	Power supplies Motor speed controls
Telecom	Data Communication	Line protection resistor Power supplies
Consumer	Sound & Vision	Amplifiers Color monitor Television Video cassette recorder
	Kitchen Appliances	Blender
	Lighting	Ballast equipment
Automotive	Electronic Systems	Dashboard electronics Lighting equipment Window/mirror steering ABS system, Alarm system, Airbag Electronic fuel injection

TECHNOLOGY

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 or copper-clad iron 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-202, method 215 and IEC 60068-2-45.

QUICK REFERENCE DATA

DESCRIPTION	PR02 ±5% (E24 series)		PR02 ±1% (E24/E96 series)	
	Cu-lead	FeCu-lead	Cu-lead	FeCu-lead
Resistance range	0.33 Ω - 1 MΩ	1 Ω - 1 MΩ	1 Ω - 1 MΩ	
Maximum dissipation at T_{amb} = 70°C	2 W	1.3 W	2 W	1.3 W
Thermal resistance (R_{th})	75 K/W	115 K/W	75 K/W	115 K/W
Limiting voltage (DC or RMS)	500 V			
Rated voltage (1)	$\sqrt{Pn \times R}$			
Temperature coefficient	±250 ppm/°C			
Basic specification	IEC 60115-1 and 60115-4			
Climatic category (IEC 60068)	55/155/56			
Stability $\Delta R/R_{max}$ after:				
Load	±5% + 0.1 Ω		±1% + 0.1 Ω	
Climatic tests	±3% + 0.1 Ω		±1% + 0.1 Ω	
Resistance to soldering heat	±1% + 0.05 Ω		±0.5% + 0.05 Ω	

(1) Maximum rated voltage is the limiting voltage

MECHANICAL DATA

AXIAL STYLE

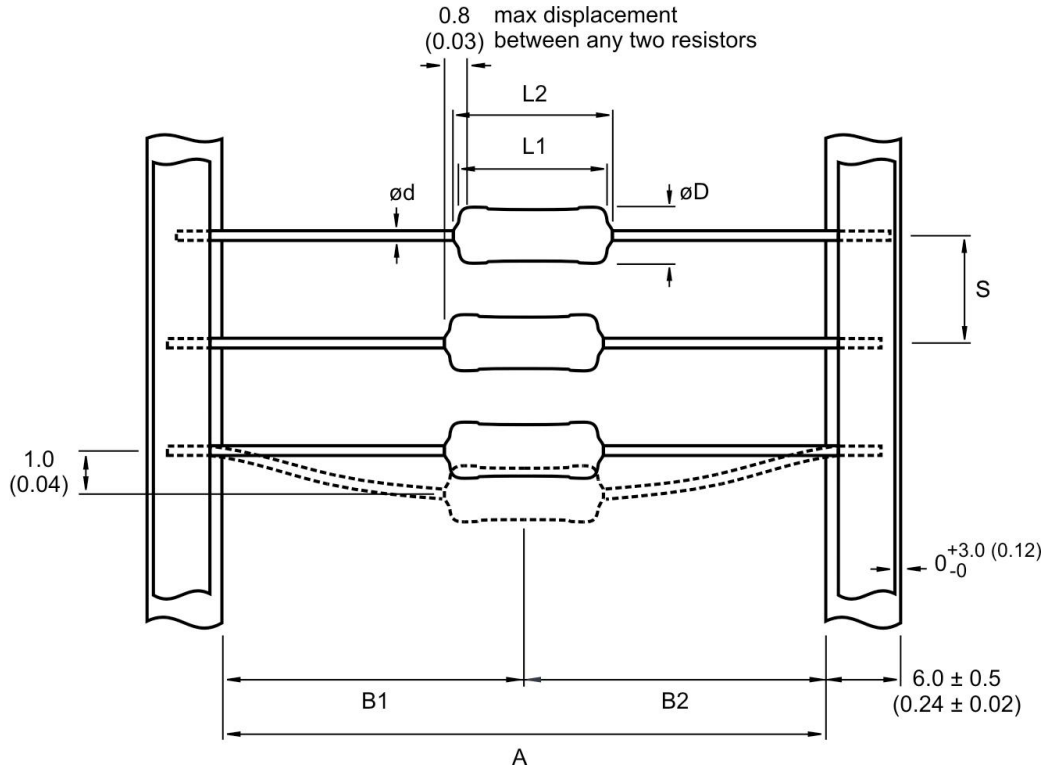


Fig. 1

Table 1. Mechanical Data.

PRODUCT	A	L1 max	L2 max	ØD max	|B1-B2| max	Ød	S	WEIGHT gr/100 pcs
PR02	52.0 + 1.5 / - 0.0 (2.05 + 0.06 / - 0.00)	10.0 (0.40)	12.0 (0.48)	3.9 (0.16)	1.2 (0.05)	0.80 ±0.03 Cu (1) (0.031 ±0.001 Cu)	5.0 ±0.1 (0.20 ±0.01)	52.0
						0.60 ±0.05 FeCu (2) (0.024 ±0.002 FeCu)		46.0

Dimensions unless specified in mm (inches)
(1) Preferred type
(2) 0.80 FeCu available for preformed types

MOUNTING

The resistors are suitable for processing on automatic insertion equipment, cutting and bending machines. A radial taped version economizes space on the PCB. The double kink style offers great advantages for manual insertion improving the mounting stability for the customer. They have a real *snap in* function to fix the resistor in PCB without weakening the connecting leads.

ELECTRICAL CHARACTERISTICS

DERATING

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

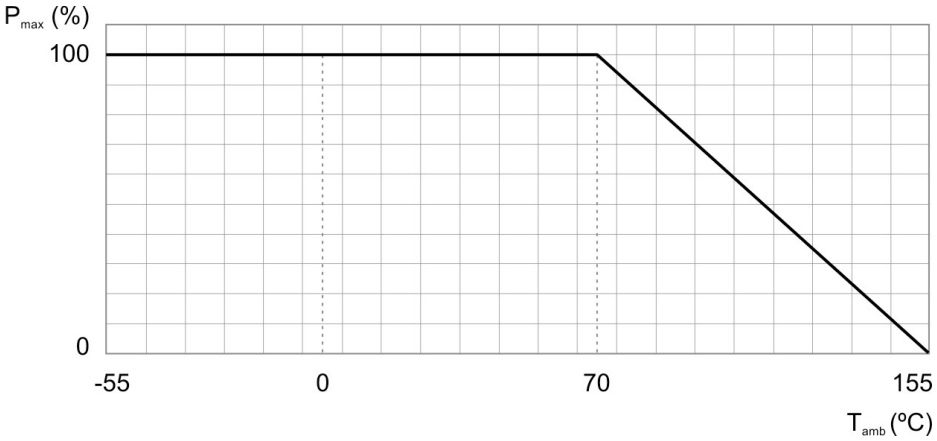


Fig. 2. Maximum dissipation (P_{max}) in percentage of rated power as a function of ambient temperature (T_{amb})

APPLICATION INFORMATION

Hot spot

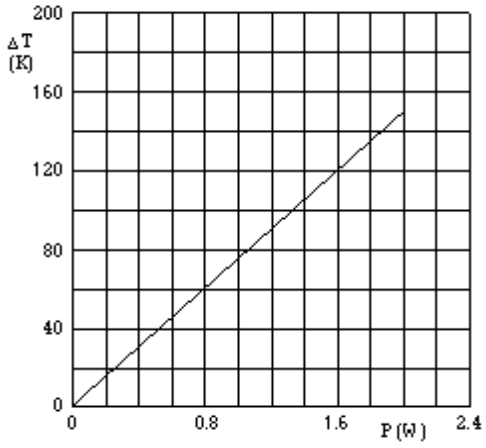


Fig. 3. ϕ0.80 mm Cu - leads
Hot spot temperature rise (ΔT) as a function of dissipated power.

Solder spot

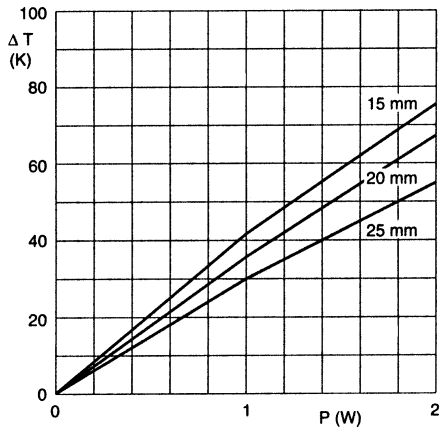


Fig. 4. ϕ0.80 mm Cu - leads
Minimum distance from resistor body to PCB = 1mm.
Temperature rise (ΔT) at the lead end (solder spot) as a function of dissipated power at various leads lengths after mounting.

Hot spot

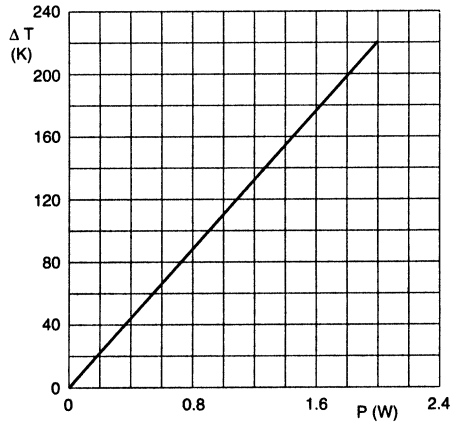


Fig. 5. ϕ0.60 mm FeCu - leads
Hot spot temperature rise (ΔT) as a function of dissipated power

Solder spot

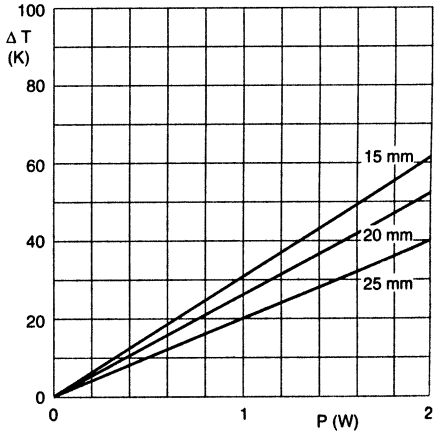


Fig. 6. ϕ0.60 mm FeCu - leads
Minimum distance from resistor body to PCB = 1mm.
Temperature rise (ΔT) at the lead end (solder spot) as a function of dissipated power at various leads lengths after mounting

Hot spot

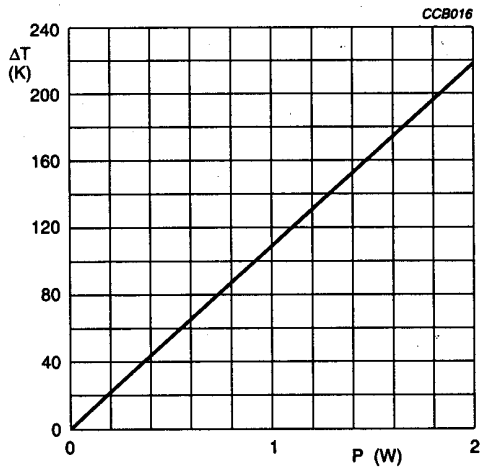


Fig. 7. ϕ0.80 mm FeCu - leads
Hot spot temperature rise (ΔT) as a function of dissipated power (preformed types only)

Solder spot

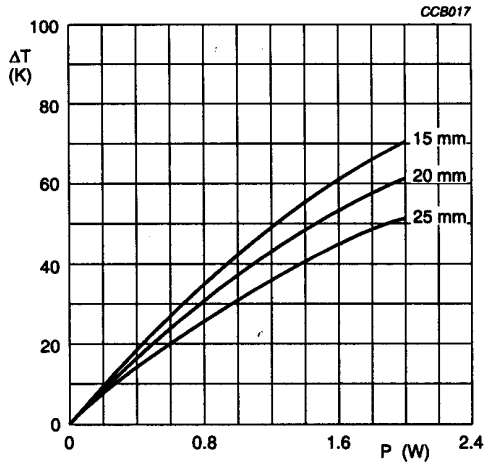


Fig. 8. ϕ0.80 mm FeCu - leads
Minimum distance from resistor body to PCB = 1mm.
Temperature rise (ΔT) at the lead end (solder spot) as a function of dissipated power at various leads lengths after mounting (preformed types only)

Note: The maximum permissible hot spot temperature is 220 °C

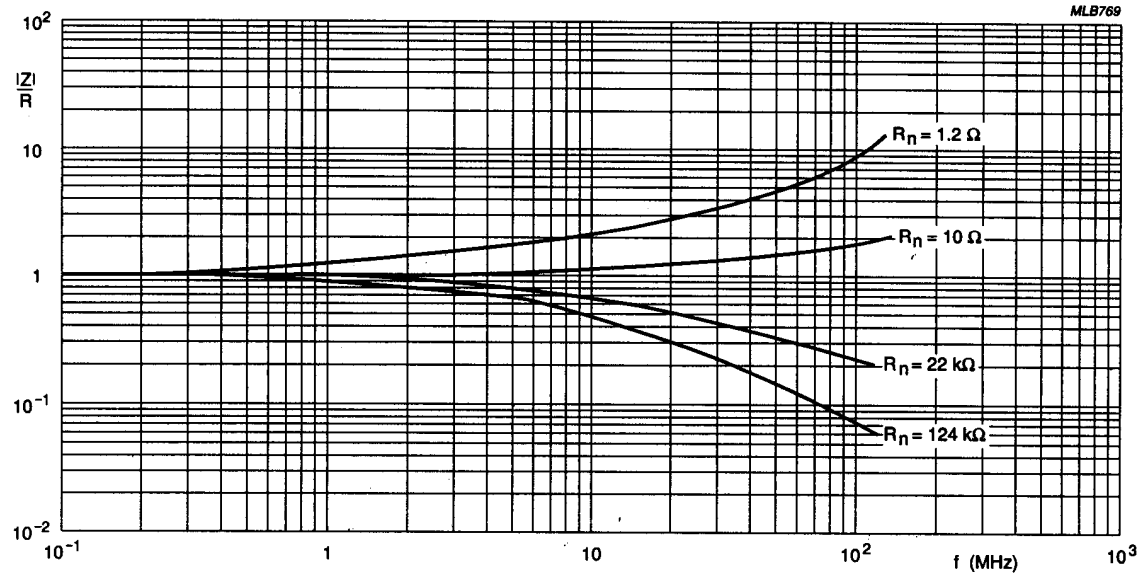


Fig. 9. Impedance as a function of applied frequency.

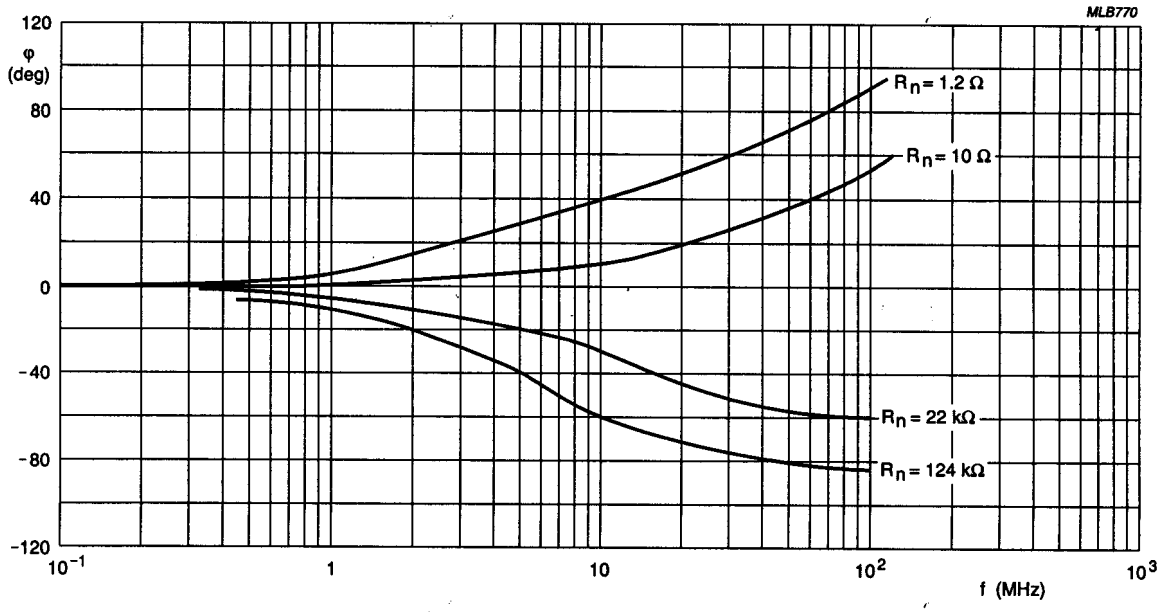


Fig. 10. Phase angle as a function applied frequency

PULSE LOADING CAPABILITIES

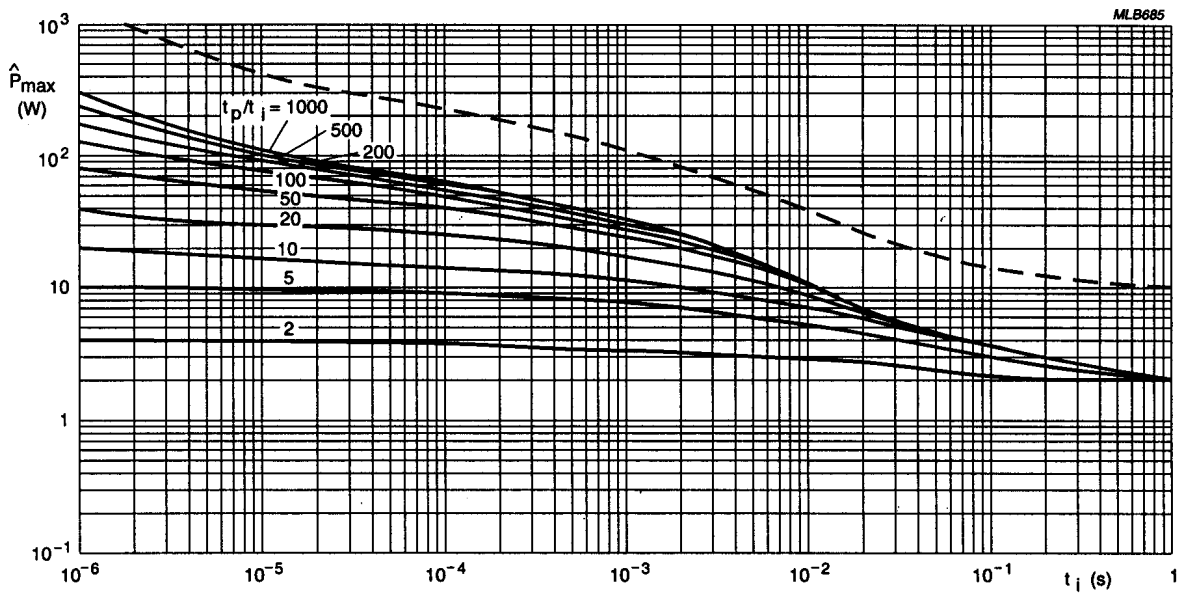


Fig. 11. Pulse on a regular basis, maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration (ti)

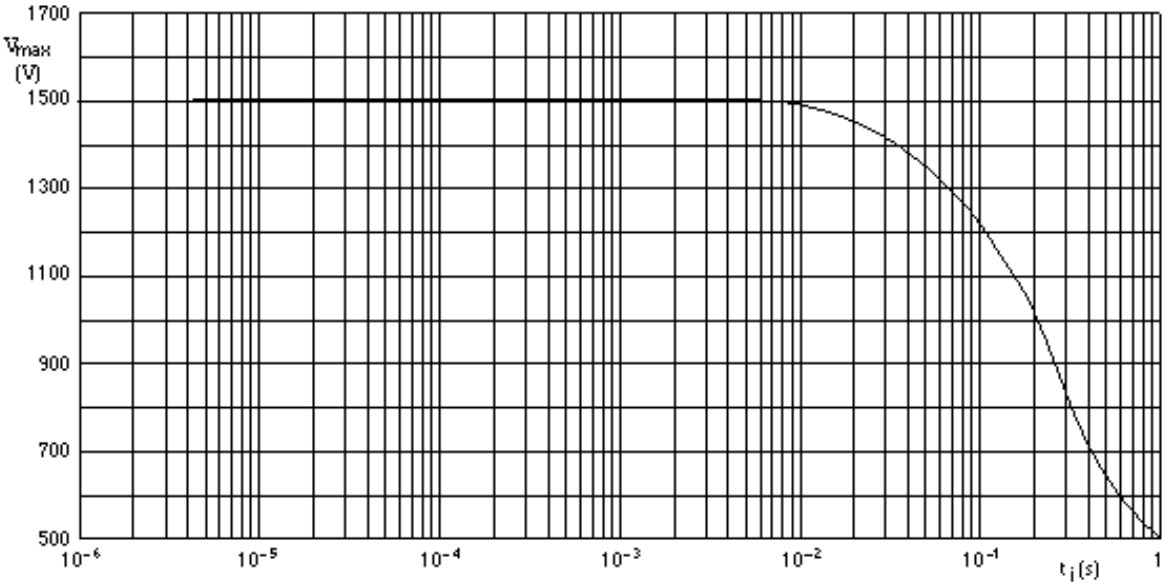


Fig. 12. Pulse on a regular basis, maximum permissible peak pulse voltage ($\hat{V}_{max}$) as a function of pulse duration (ti)

INTERRUPTION CHARACTERISTICS

The graphs are based on measured data under constant voltage conditions; these data may deviate according to the application.

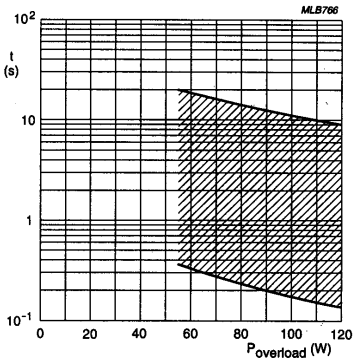


Fig. 13. Time to interruption as a function of overload power for range: 0R33 ≤ Rn < 5R

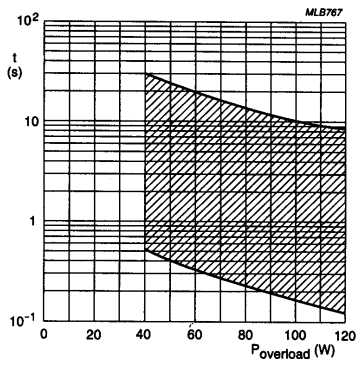


Fig. 14. Time to interruption as a function of overload power for range: 5R ≤ Rn < 68R

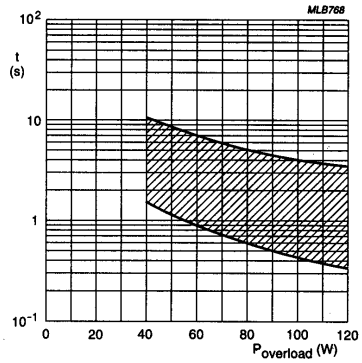


Fig. 15. Time to interruption as a function of overload power for range: 68R ≤ Rn < 560R

MARKING

The nominal resistance and tolerance are marked on the resistor using four or five colored bands in accordance with IEC publication 60062 “color code for fixed resistors”. Standard values of nominal resistance are taken from the E24/E96 series for resistors with a tolerance of ±5% or ±1%. The values of the E24/E96 series are in accordance with IEC publication 60063.

ORDERING INFORMATION

Table 2. Ordering code.

LEAD ∅	TOLERANCE	TAPING	QUANTITY (pcs)	PACKAGING	ORDERING CODE
0.80 Cu (0.031)	±1%	52.0 (2.05)	1000	AMMOPACK	**2322 197 1XXXX**
			5000	REEL	**2306 192 5XXXX**
	±5%			REEL	**2306 198 23XXX**
		52.0 (2.05)	1000	AMMOPACK	**2306 198 53XXX**
0.60 FeCu (0.024)				AMMOPACK	**2322 194 54XXX**

Dimensions unless specified in mm (inches)
Check ”***Formed leads***” specifications to see related part-numbers

The resistors have a 12 digit ordering code starting with 2306 or 2322.
The next 5 digits indicate the resistor type and packaging see table 2.
For 5% tolerance the last 3 digits indicate the resistance value;
- The first 2 digits indicate the resistance value;
- The last digit indicates the resistance decade in accordance with table 3.

For 1% tolerance the last 4 digits indicate the resistance value;
- The first 3 digits indicate the resistance value;
- The last digit indicates the resistance decade in accordance with table 3.

Table 3. Last digit of ordering code.

RESISTANCE DECADE (5%)	RESISTANCE DECADE (1%)	LAST DIGIT
0.33 - 0.91 Ω	-	7
1 - 9.1 Ω	1 - 9.76 Ω	8
10 - 91 Ω	10 - 97.6 Ω	9
100 - 910 Ω	100 - 976 Ω	1
1 - 9.1 kΩ	1 - 9.76 kΩ	2
10 - 91 kΩ	10 - 97.6 kΩ	3
100 - 910 kΩ	100 - 976 kΩ	4
1 MΩ	1 MΩ	5

Example:
PR02, 750 Ω, ±5%, 0.80 Cu leads, ammopack 1000 pcs is **2306 198 53751**

NAFTA ORDERING INFORMATION

Table 4. NAFTA ordering code.

LEAD ∅	TOLERANCE	TAPING	QUANTITY (pcs)	PACKAGING	NAFTA ORDERING CODE
0.80 Cu (0.031)	±5%	52.0 (2.05)	1000	AMMOPACK	**5083NWxxxxxJA8AFX**
			5000	REEL	**5083NWxxxxxJ12AFX**
0.60 FeCu (0.024)			1000	AMMOPACK	**5083NWxxxxxJA8AFXF06**
0.80 Cu (0.031)	±1%		1000	AMMOPACK	**5083NWxxxxxFA8AF5**
			5000	REEL	**5083NWxxxxxF12AF5**

Dimensions unless specified in mm (inches)

The ohmic value in the NAFTA ordering code (see table 4) is represented by the “xxxxx” in the middle of the above ordering code. Table 5 gives some examples how to use these 5 digits.

Table 5. Ohmic value examples.

VALUE	5 DIGITS
1 Ω	1R000
10 Ω	10R00
100 Ω	100R0
1 kΩ	1K000
10 kΩ	10K00
100 kΩ	100K0
1 MΩ	1M000

PACKAGING

TAPE IN AMMOPACK

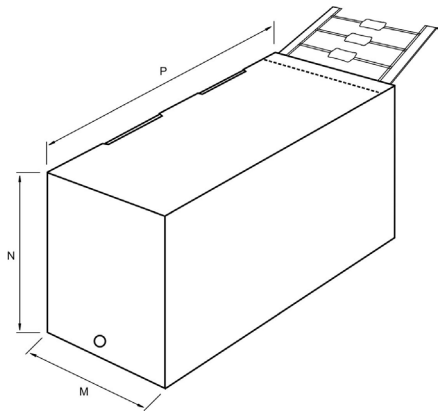


Table 6. Ammopack.

PRODUCT	TAPING	M	N	P	QUANTITY (pcs)
PR02	52.0 + 1.5 / - 0.0 (2.05+ 0.06 / - 0.00)	78 (3.1)	60 (2.4)	262 (10.4)	1000

Dimensions unless specified in mm (inches)

TAPE ON REEL

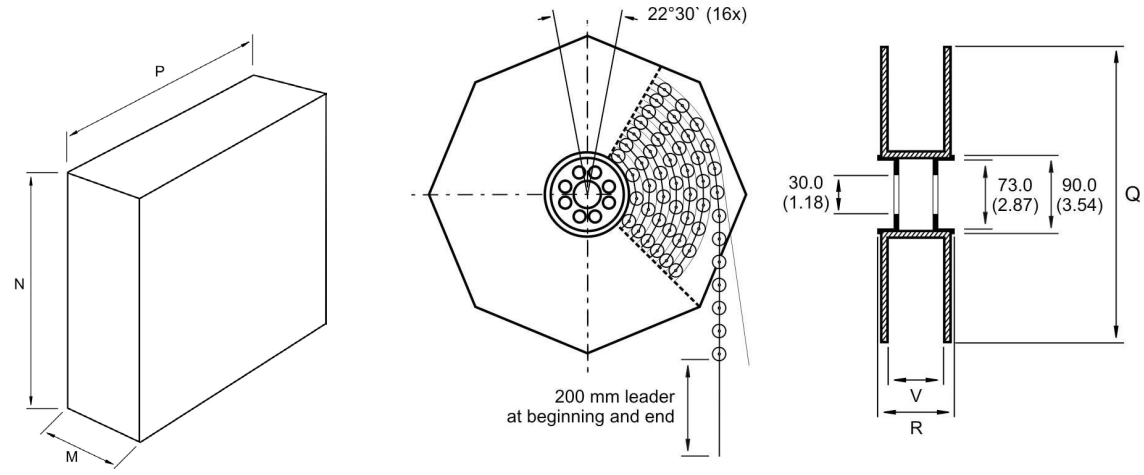


Table 7. Reel.

PRODUCT	TAPING	M	N	P	Q	V	R	QTY (pcs)
PR02	52.0 + 1.5 / - 0.0 (2.05 + 0.06 / - 0.00)	92 (3.6)	361 (14.3)	361 (14.3)	355 (14.0)	75 (2.9)	86 (3.4)	5000

Dimensions unless specified in mm (inches)

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance to the schedule of IEC publications 60115 – 1, category 55/155/56 (rated temperature range - 55 °C to + 155 °C; damp heat, long term, 56 days and along the lines of IEC publications 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 method specified.

Table 8. Test and requirements.

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS	
				PR02 5%	PR02 1%
4.6.1.1	-	Insulation resistance	500V (DC) during 1 minute; V-block method.	$R_{ins\ min}$ 10^4 MΩ	

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS	
				PR02 5%	PR02 1%
4.7	-	Voltage proof on insulation	500V (RMS) during 1 minute; V-block method.	No breakdown or flashover	
4.8	-	Temperature coefficient	Between - 55 °C and+ 155 °C	±250 ppm/°C	
4.16	21(U)	Robustness of Terminations:		No damage $\Delta R/R_{max}$ ±0.5% + 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 directions		
4.17	20(Ta)	Solderability (after ageing)	16 h 155 °C; immersed in flux 600, leads immersed 2 mm for 2 ±0.5 s in a solder bath at 235 ±5 °C	Good tinning (≥95% covered); no damage	
4.18	20(Tb)	Resistance to soldering heat	Thermal shock 3 s; 350 ±10 °C; 6 mm from body	$\Delta R/R_{max}$ ±1% + 0.05 Ω	$\Delta R/R_{max}$ ±0.5%+ 0.05 Ω
4.19	14 (Na)	Rapid change of temperature	30 minutes at – 55 °C and 30 minutes at + 155 °C; 5 cycles	No visual damage	
				$\Delta R/R_{max}$ ±1% + 0.05 Ω	$\Delta R/R_{max}$ ±0.5% + 0.05 Ω
4.22	6 (Fc)	Vibration	Frequency 10 to 500 Hz, displacement 1.5mm or acceleration 10g, three directions; total 6 h (3 x 2 h)	No damage $\Delta R/R_{max}$ ±0.5% + 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; 25 °C to 55 °C; 90 to 100% RH	$R_{ins\ min}$ 10^3 MΩ	
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% R.H.	$\Delta R/R_{max}$ ±3% + 0.05 Ω	$\Delta R/R_{max}$ ±1% + 0.05 Ω

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS	
				PR02 5%	PR02 1%
4.24	3(Ca)	Damp heat (steady state)	56 days; 40 °C; 90 to 95% R.H.; loaded with 0.01Pn	$R_{ins\ min}$ 10^3 MΩ	
				$\Delta R/R_{max}$ ±3% + 0.05 Ω	$\Delta R/R_{max}$ ±1% + 0.05 Ω
4.25.1	-	Endurance (at 70 °C)	1000 h loaded with Pn or V_{max}, 1.5 h ON and 0.5 h OFF	$\Delta R/R_{max}$ ±5% + 0.05 Ω	$\Delta R/R_{max}$ ±1% + 0.05 Ω
4.29	45(Xa)	Component solvent resistance	Isopropyl alcohol followed by brushing in accordance with MIL STD 202	No visible damage	
See 2nd amendment to IEC 60115-1		Pulse Load		See figs. 11 and 12	