

## POWER RESISTOR - PR01

### FEATURES

- Metal film technology
- High power in small package
- High stability, reliability and uniformity characteristics
- Good performance for pulse applications
- Different leads for different applications
- Various forming styles are available
- Defined interruption behavior (fusing time)
- Non-flammable
- Various packing and taping configurations
- Precision tolerance is available (1%)



### 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 Television, Color monitor 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

### PR01

## 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	PR01 ±5% (E24 series)	PR01 ±1% (E24/E96 series)
	Cu / FeCu lead	
Resistance range	0.22 Ω - 1 MΩ	1 Ω - 1 MΩ
Maximum dissipation at T <sub>amb</sub> = 70 °C	1 W	
Thermal resistance (R <sub>th</sub> )	135 K/W	
Limiting voltage (DC or RMS)	350 V	
Rated voltage <sup>(1)</sup>	$\sqrt{P_n \times R}$	
Temperature coefficient	≤ ±250 ppm/°C	
Basic specification	IEC 60115-1 and 60115-4	
Climatic category (IEC 60068)	55/155/56	
Stability ΔR/R <sub>max</sub> 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

## PR01

**MECHANICAL DATA**

**AXIAL STYLE**

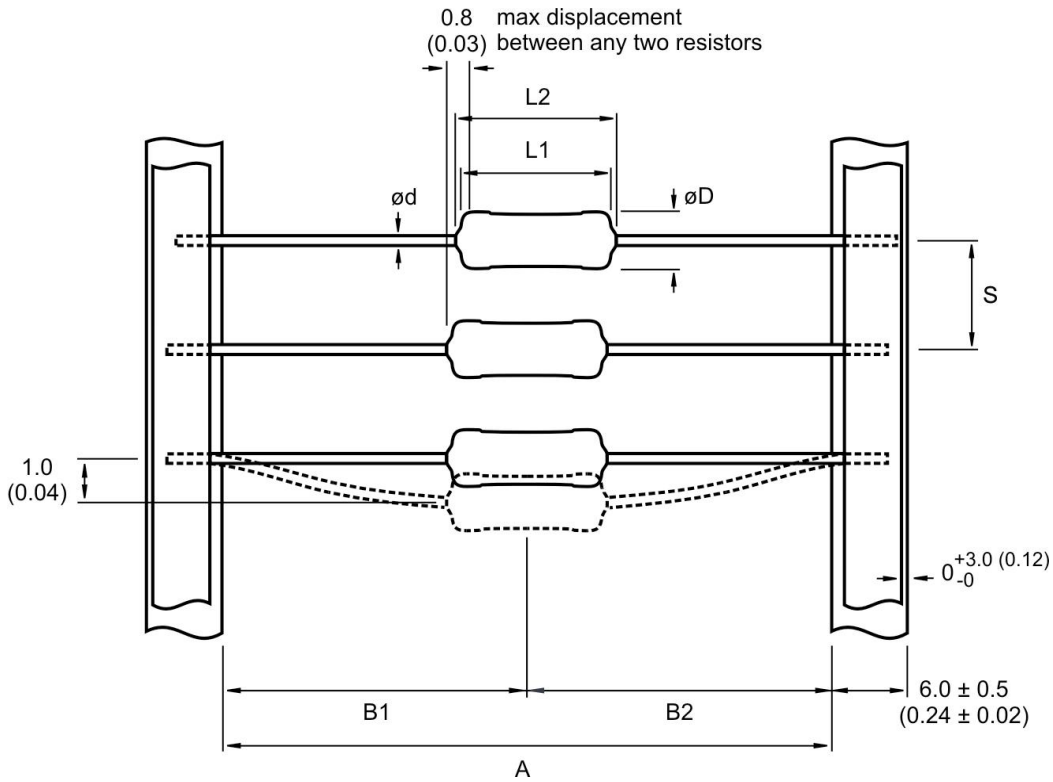


Fig. 1

Table 1. Mechanical Data.

PRODUCT	A	L1 max	L2 max	ØD max	B1-B2	Ød	S	WEIGHT gr/100 pcs
PR01	52.0 + 1.5 / - 0.0 (2.05 + 0.06 / - 0.00)	6.5 (0.26)	8.5 (0.34)	2.5 (0.10)	±1.2 (±0.05)	0.58 ± 0.05 Cu (0.023 ± 0.002 Cu)	5.0 ± 0.1 (0.20 ± 0.01)	24.0

Dimensions unless specified in mm (inches)

**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.

**PR01**

**ELECTRICAL CHARACTERISTICS**

**DERATING**

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

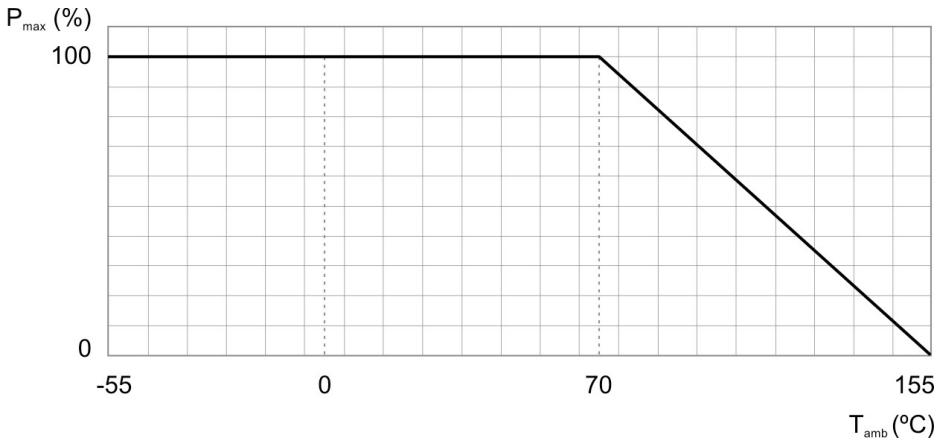


Fig. 2. Maximum dissipation (P<sub>max</sub>) in percentage of rated power as a function of ambient temperature (T<sub>amb</sub>)

**APPLICATION INFORMATION**

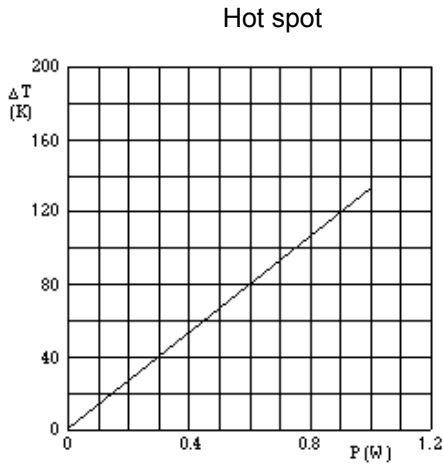


Fig. 3. φ 0.58 mm Cu – leads  
Hot spot temperature rise (ΔT) as a function of dissipated power

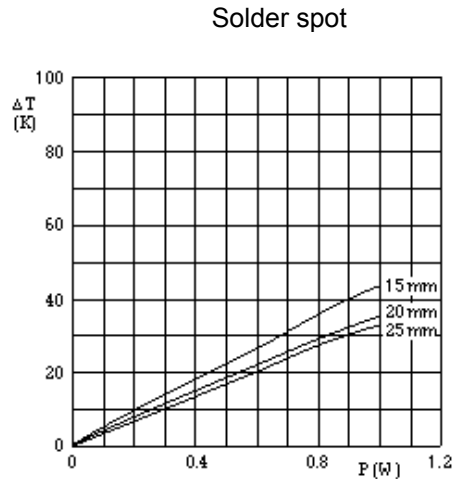


Fig. 4. φ 0.58 mm Cu - leads  
Minimum distance from resistor body to PCB =1mm  
Temperature rise (ΔT) at the lead end (solder spot) as a function of dissipated power at various leads lengths after mounting

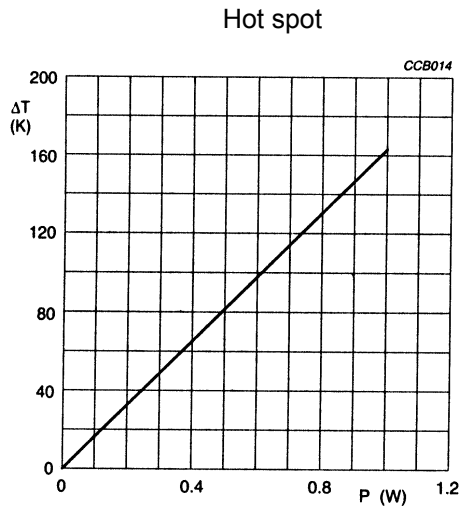


Fig. 5.  $\phi$  0.60 mm FeCu – leads  
Hot spot temperature rise ( $\Delta T$ ) as a function of dissipated power (preformed types only)

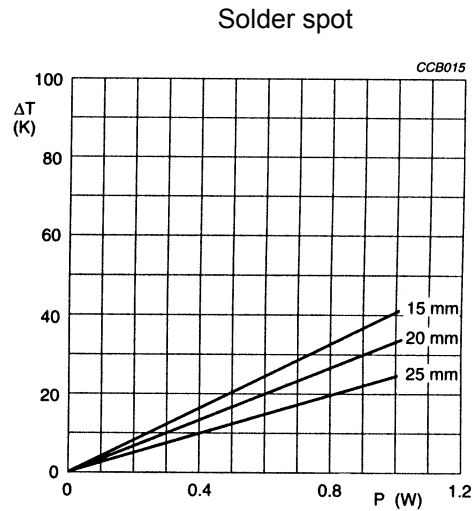


Fig. 6.  $\phi$  0.60 mm FeCu - leads  
Minimum distance from resistor body to PCB = 1mm  
Temperature rise ( $\Delta T$ ) at the lead end (solder spot) as a function of dissipated power at various leads lengths after mounting (preformed types only)

Note: The maximum permissible hot spot temperature is 205 °C

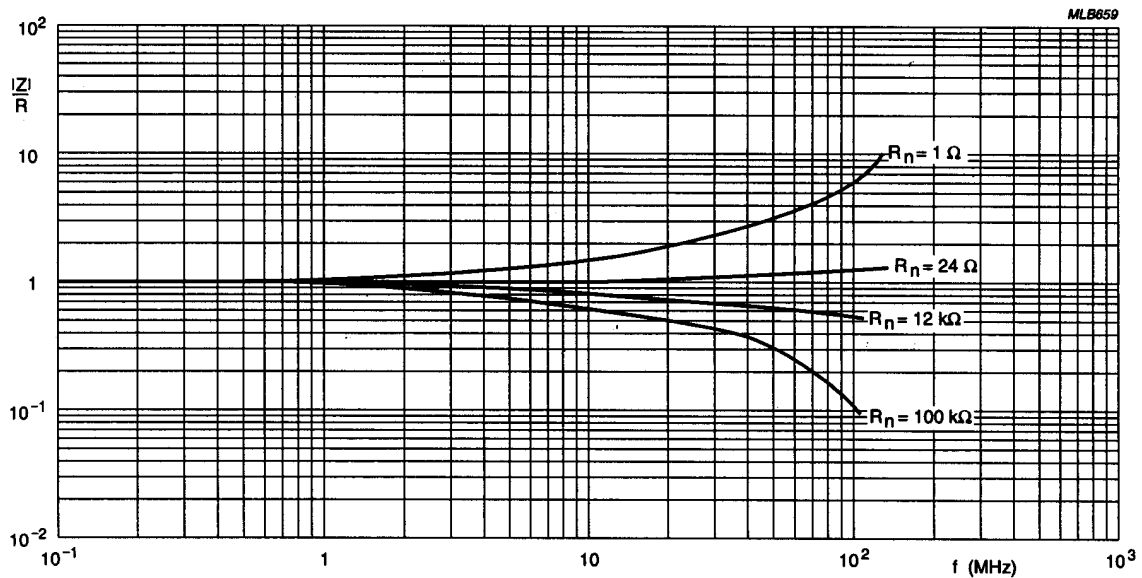


Fig. 7. Impedance as a function of applied frequency

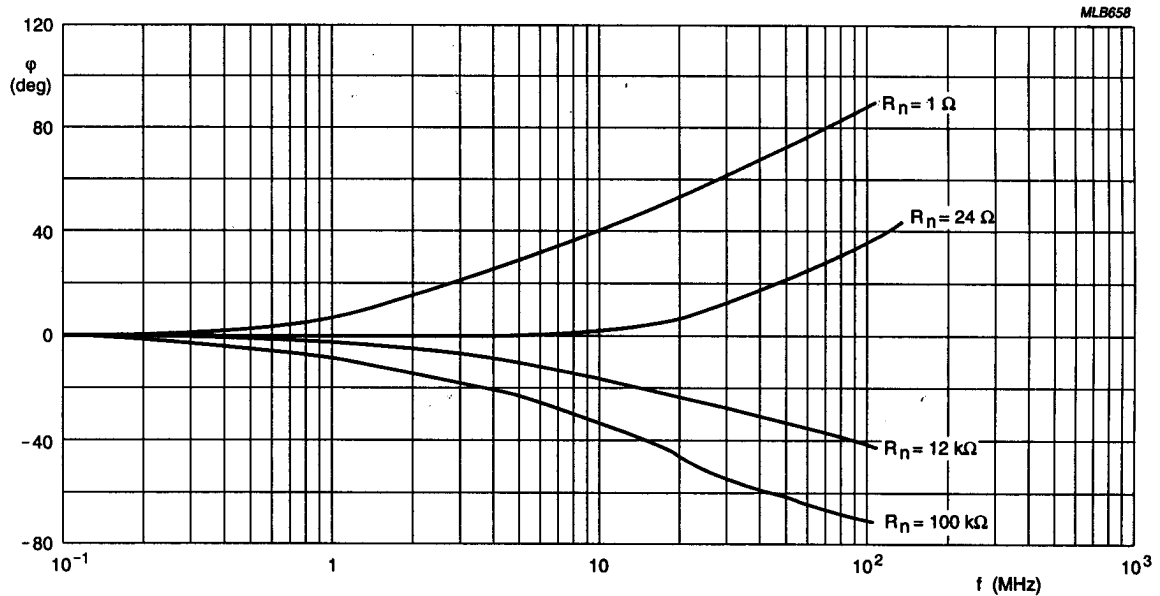


Fig. 8. Phase angle as a function applied frequency

PULSE LOADING CAPABILITIES

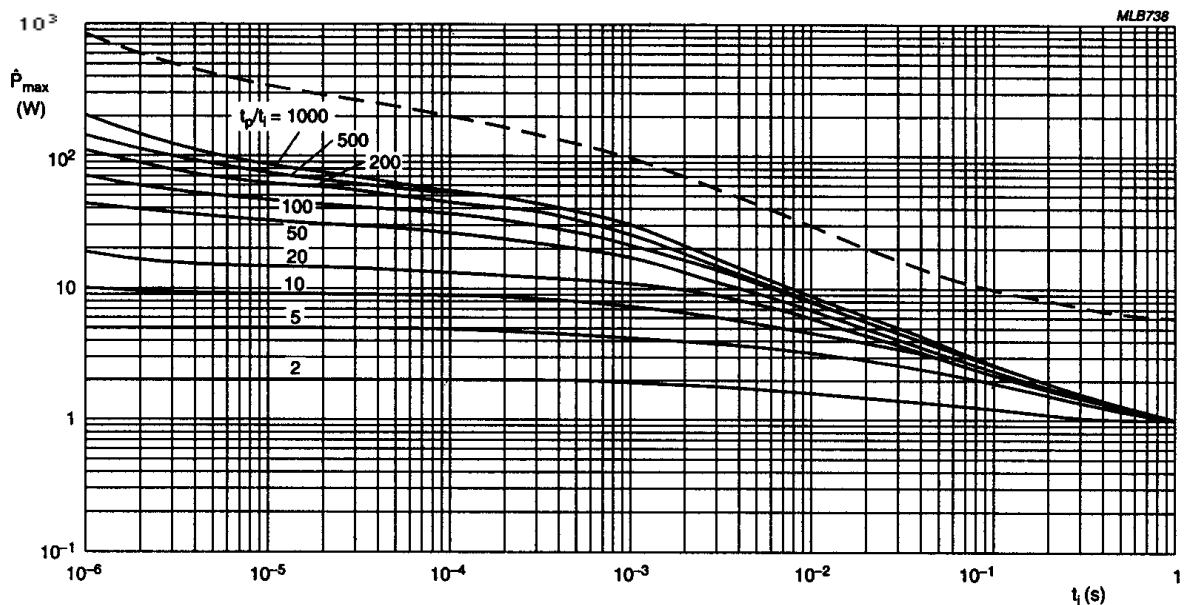


Fig. 9. Pulse on a regular basis, maximum permissible peak pulse power ( $\hat{P}_{max}$ ) as a function of pulse duration ( $t_i$ )

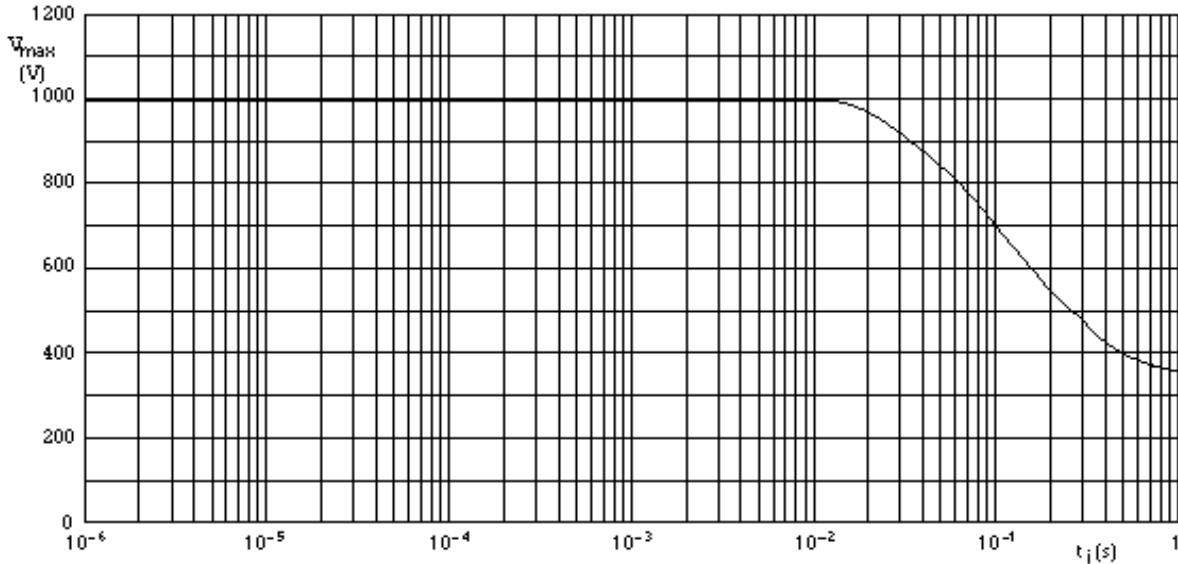


Fig. 10. Pulse on a regular basis, maximum permissible peak pulse voltage ( $\hat{V}_{max}$ ) as a function of pulse duration ( $t_i$ )

**INTERRUPTION CHARACTERISTICS**

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

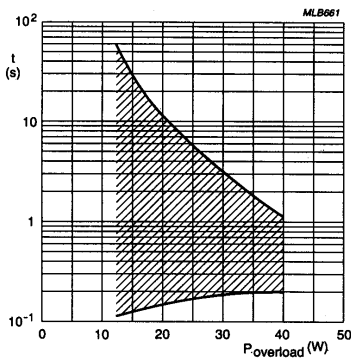


Fig. 11. Time to interruption as a function of overload power for range:  $0R22 \leq R_n < 1R$

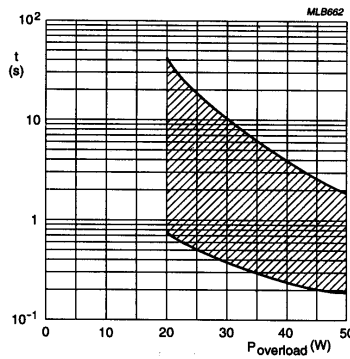


Fig. 12. Time to interruption as a function of overload power for range:  $1R \leq R_n < 15R$

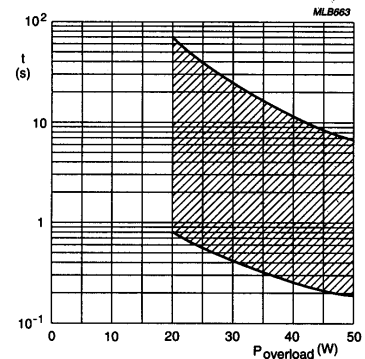


Fig. 13. Time to interruption as a function of overload power for range:  $16R \leq R_n < 560R$

**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  $\pm 5\%$  or  $\pm 1\%$ . The values of the E24/E96 series are in accordance with IEC publication 60063.

**ORDERING INFORMATION**

Table 2. Ordering code.

LEAD Ø	TOL	TAPING	QTY pcs	PACKAGING	ORDERING CODE
0.58 Cu (0.023)	$\pm 1\%$	52.0 (2.05)	5000	REEL	2306 191 5xxxx
				AMMOPACK	2322 196 1xxxx
	$\pm 5\%$		1000	AMMOPACK	2306 191 2xxx
				AMMOPACK	2306 197 53xxx
	5000		AMMOPACK	2322 193 14xxx	
			REEL	2306 197 23xxx	

Dimensions unless specified in mm (inches)

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
0.22 - 0.91 $\Omega$	-	7
1 - 9.1 $\Omega$	1 - 9.76 $\Omega$	8
10 - 91 $\Omega$	10 - 97.6 $\Omega$	9
100 - 910 $\Omega$	100 - 976 $\Omega$	1
1 - 9.1 k $\Omega$	1 - 9.76 k $\Omega$	2
10 - 91 k $\Omega$	10 - 97.6 k $\Omega$	3
100 - 910 k $\Omega$	100 - 976 k $\Omega$	4
1 M $\Omega$	1 M $\Omega$	5

Example:

PR01, 150  $\Omega$ ,  $\pm 5\%$ , ammopack 1000 pcs is **2306 197 53151**

### NAFTA ORDERING INFORMATION

Table 4. NAFTA ordering code.

LEAD $\varnothing$	TOL	TAPING	QTY pcs	PACKAGING	NAFTA ORDERING CODE
0.58 Cu (0.023)	$\pm 5\%$	52.0 (2.05)	5000	REEL	5073NWxxxxxJ12AFX
			1000	AMMOPACK	5073NWxxxxxJA8AFX
			5000	AMMOPACK	5073NWxxxxxJ18AFX
	$\pm 1\%$		5000	AMMOPACK	5073NWxxxxxF18AF5
			1000	AMMOPACK	5073NWxxxxxFA8AF5
			5000	REEL	5073NWxxxxxF12AF5

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. Examples of the ohmic value.

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**

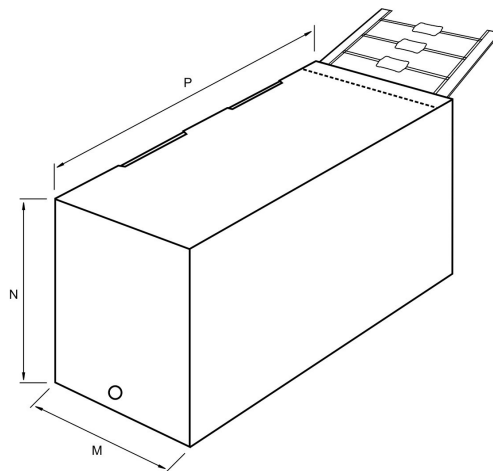


Table 6. Ammpack.

PRODUCT	TAPING	M	N	P	QTY pcs
PR01	52.0 + 1.5 / - 0.0 (2.05 + 0.06 / - 0.00)	82 (3.3)	28 (1.2)	262 (10.4)	1000
	52.0 + 1.5 / - 0.0 (2.05 + 0.06 / - 0.00)	78 (3.1)	100 (4.0)	260 (10.3)	5000

Dimensions unless specified in mm (inches)

**PR01**

**TAPE ON REEL**

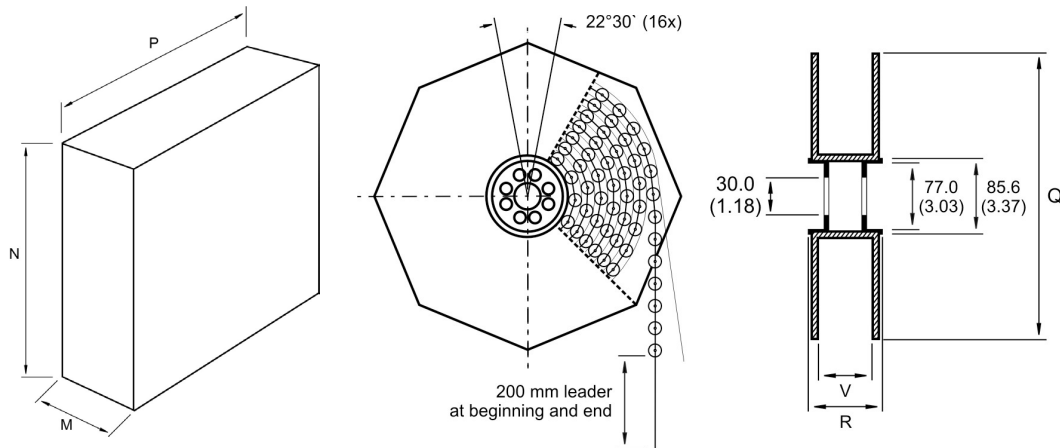


Table 7. Reel.

PRODUCT	TAPING	M	N	P	Q	V	R	QTY pcs
PR01	52.0 + 1.5 / - 0.0 (2.05 + 0.06 / - 0.00)	92 (3.7)	311 (12.3)	311 (12.3)	305 (12.1)	75 (3.0)	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 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	
				PR01 5%	PR01 1%
4.6.1.1	-	Insulation resistance	500 V (DC) during 1 minute; V-block method.	R <sub>ins min</sub> 10 <sup>4</sup> MΩ	

**PR01**

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS	
				PR01 5%	PR01 1%
4.7	-	Voltage proof on insulation	500 V (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 $\Delta R/R_{\max} \pm 0.5\% + 0.05 \Omega$	
4.16.2	21(Ua1)	Tensile all samples	Load 10 N, 10s		
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	$\Delta R/R_{\max} \pm 1\% + 0.05 \Omega$	$\Delta R/R_{\max} \pm 0.5\% + 0.05 \Omega$
4.19	14(Na)	Rapid change of temperature	30 minutes at – 55 °C and 30 minutes at + 155 °C; 5 cycles	No visual damage	
				$\Delta R/R_{\max} \pm 1\% + 0.05 \Omega$	$\Delta R/R_{\max} \pm 0.5\% + 0.05 \Omega$
4.22	6(Fc)	Vibration	Frequency 10 to 500 Hz, displacement 1.5mm or acceleration 10g; three directions; total 6 hours (3 x 2 h)	No damage $\Delta R/R_{\max} \pm 0.5\% + 0.05 \Omega$	
4.23		Climatic sequence:		$R_{\text{ins min}} 10^3 \text{ M}\Omega$	
4.23.2	2(Ba)	Dry heat	16 h; 155 °C		
4.23.3	30(Db)	Damp heat (accelerated) 1 <sup>st</sup> cycle	24 h; 25 °C to 55 °C; 90 to 100% RH		
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.	$\Delta R/R_{\max} \pm 3\% + 0.05 \Omega$	$\Delta R/R_{\max} \pm 1\% + 0.05 \Omega$

PR01

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS	
				PR01 5%	PR01 1%
4.24	3(Ca)	Damp heat (steady state)	56 days; 40 °C; 90 to 95% R.H. loaded with 0.01Pn	$R_{ins\ min} 10^3\ M\Omega$	
				$\Delta R/R_{max}$ ±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 <sub>max</sub> 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 2 <sup>nd</sup> amendment to IEC 60115-1		Pulse Load		See figs. 9 and 10	