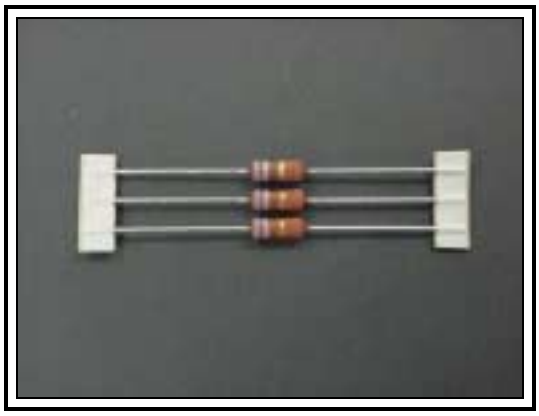
# POWER RESISTOR - PR02

## FEATURES

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



## MARKET SEGMENTS AND APPLICATIONS

| Industry sector | Application segment | End-user equipment |
|---|---|---|
| Industrial | Power | Power supplies<br>Motor speed controls |
| Telecom | Data Communication | Line protection resistor<br>Power supplies |
| Consumer | Sound & Vision | Amplifiers, Color monitor<br>Television,<br>Video cassette recorder |
| | Kitchen Appliances | Blender |
| | Lighting | Ballast equipment |
| Automotive | Electronic Systems | Dashboard electronics<br>Lighting equipment<br>Window/mirror steering<br>ABS system, Alarm system<br>Airbag, Electronic fuel injection |

## TECHNOLOGY

A homogenous 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, nonflammable 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”.



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## QUICK REFERENCE DATA

| DESCRIPTION | PR02 ±5% (E24 serie) | | PR02 ±1% (E24/E96 series) | |
|---|---|---|---|---|
| | **Cu-lead** | **FeCu-lead** | **Cu-lead** | **FeCu-lead** |
| Resistance range | 0.33 Ω to 1MΩ | 1Ω to 1MΩ | 1Ω to 1MΩ | |
| Maximum dissipation at Tamb 70ºC | 2W | 1.3W | 2W | 1.3W |
| Thermal resistance (Rth) | 75K/W | 115K/W | 75K/W | 115K/W |
| Temperature coefficient | ≤ ± 250 ppm/ºC | | | |
| Limiting voltage (DC or RMS) | 500V | | | |
| Rated Voltage (1) | $\sqrt{Pn \times R}$ | | | |
| Basic specification | IEC 60115-1 and 60115-4 | | | |
| Climatic category (IEC 60068) | 55/155/56 | | | |
| Stability, ΔR/Rmax., after: | | | | |
| Load | ±5% +0.1Ω | | ±1% +0.1Ω | |
| Climatic test | ±3% +0.1Ω | | ±1% +0.1Ω | |
| Resistance to Soldering heat | ±1% +0.05Ω | | ±0.5% +0.05Ω | |

Note:
1- Maximum rated voltage is the “Limiting voltage”.



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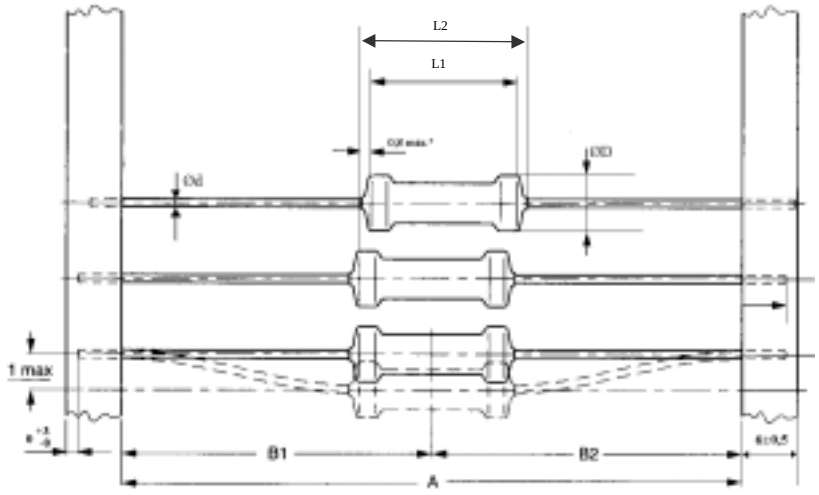
## MECHANICAL DATA




* Max. displacement between any two resistors.
Dimensions in mm.

Table 1

| Type | A | L1 max | L2max | Dmax | \|B1-B2\| | ϕd | Mass per 100 units (g) |
|---|---|---|---|---|---|---|---|
| PR02 | 52 +1.5/-0 | 10 | 12 | 3.9 | ± 1.2 | 0.8 ± 0.03 Cu * | 52 |
| | | | | | | 0.6 ± 0.05 FeCu | 46 |

*Preferred type
Dimensions in mm

## MOUNTING

The resistors are suitable for processing on automatic insertion equipment, cutting and bending machines.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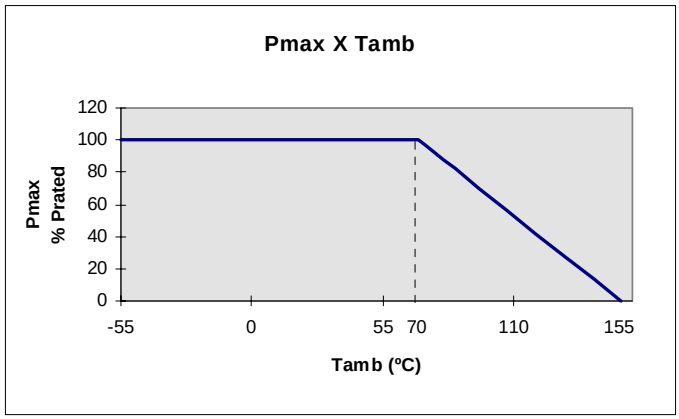
## ELECTRICAL CHARACTERISTICS

### DERATING

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




Maximum dissipation (Pmax.) in percentage of rated power as a function of ambient temperature (Tamb.).

### APPLICATION INFORMATION FOR HOT-SPOT AND SOLDER-SPOT

Hot-spot

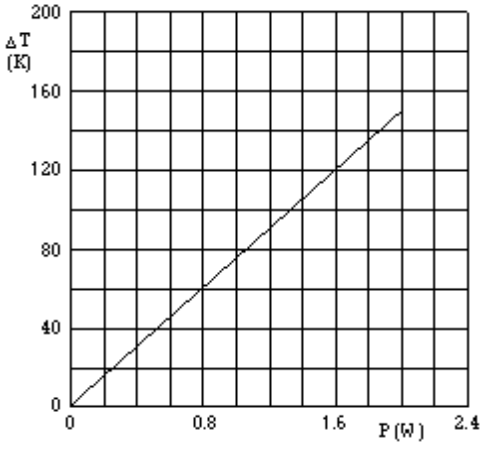



Fig. 1 - ϕ 0.8mm Cu – leads
Hot Spot temperature rise (ΔT)
as a function of dissipated power.

Solder-spot

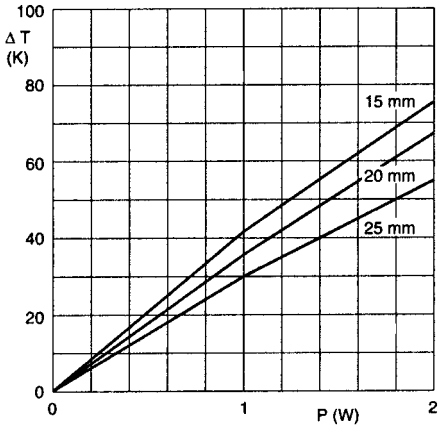



Fig. 2 - ϕ 0.8mm Cu – leads
Minimum distance from resistor body to PCB = 1mm
Temperature rise (ΔT) at the lead end
(Soldering point) as a function of dissipated power
at various leads lengths after mounting



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Hot-spot

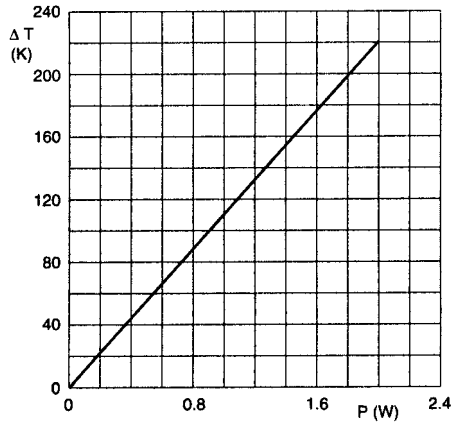


Fig. 3 - ϕ 0.6mm FeCu – leads
Hot Spot temperature rise (ΔT)
as a function of dissipated power.

Solder-spot

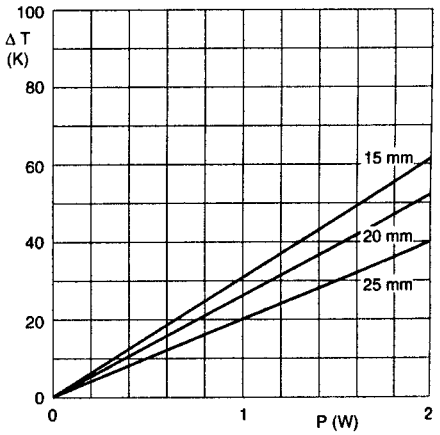


Fig. 4 - ϕ 0.6mm FeCu – leads
Minimum distance from resistor body to PCB = 1mm
Temperature rise (ΔT) at the lead end
(Soldering point) as a function of dissipated power
at various leads lengths after mounting.

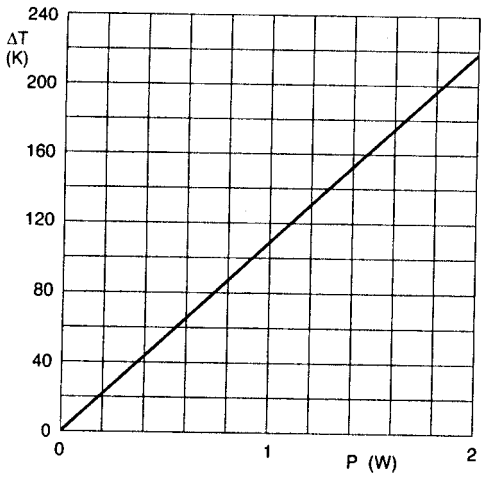


Fig. 5 - ϕ 0.8mm FeCu – leads
Hot Spot temperature rise (ΔT)
as a function of dissipated power.

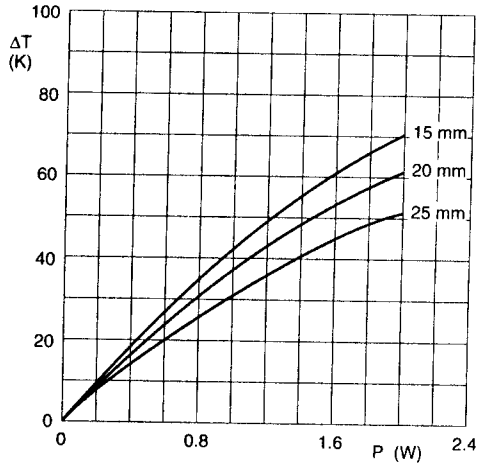


Fig. 6 - ϕ 0.8mm FeCu – leads
Minimum distance from resistor body to PCB = 1mm
Temperature rise (ΔT) at the lead end
(Soldering point) as a function of dissipated power
at various leads lengths after mounting.

Note:
The maximum permissible hot-spot temperature is 220ºC.



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**PULSE LOADING CAPABILITIES**

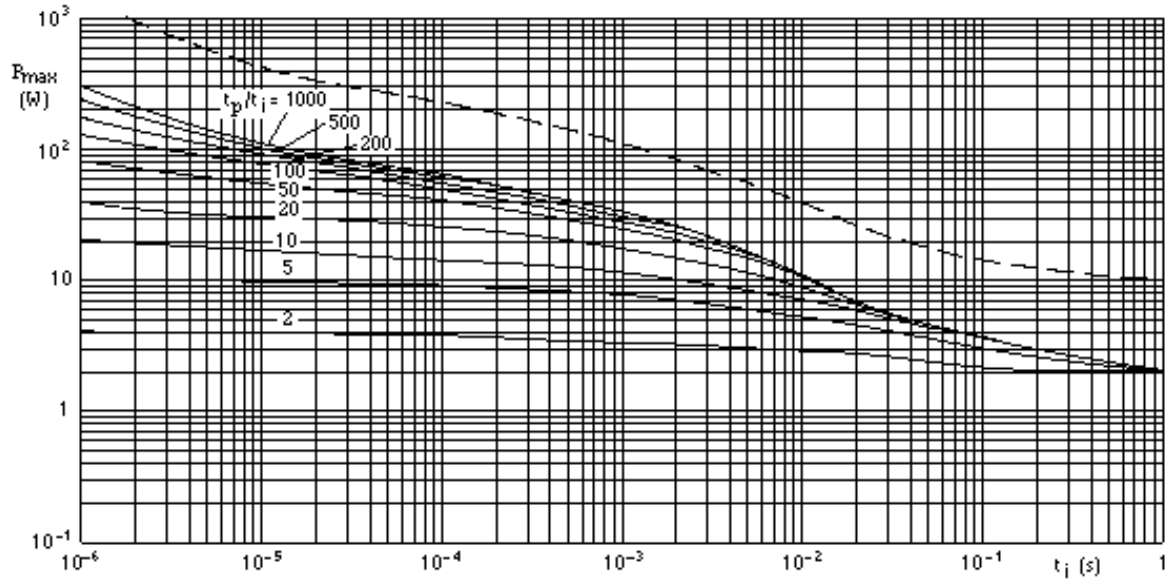


Fig. 7 – Pulse on a regular basis, maximum permissible peak pulse power (^Pmax) as a function of pulse duration (ti).

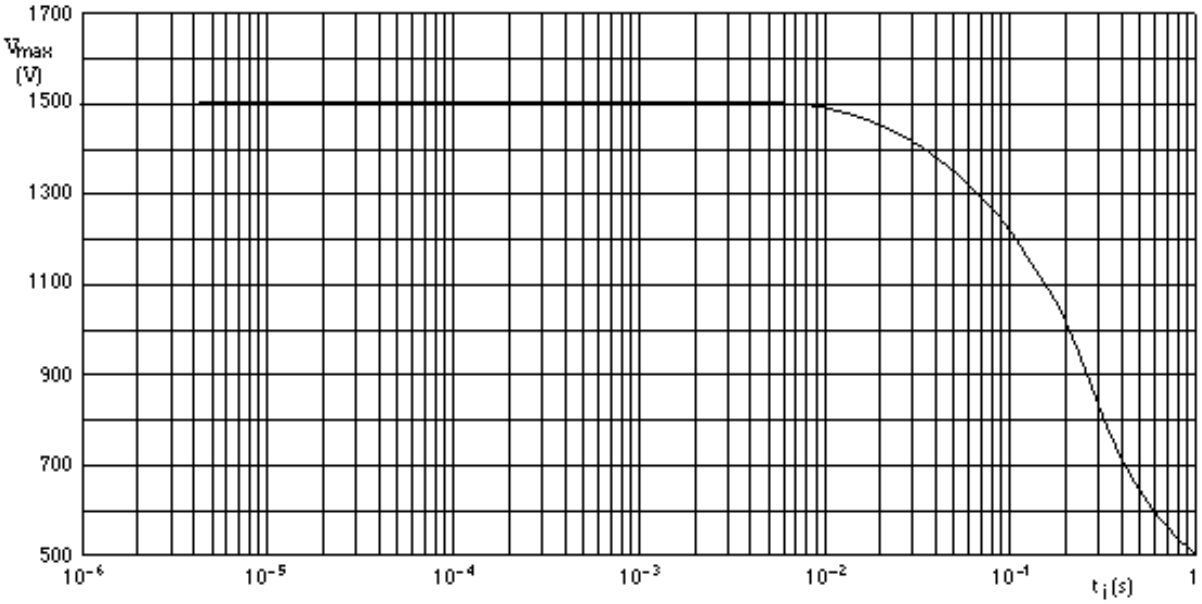


Fig. 8 - Pulse on a regular basis, maximum permissible peak pulse voltage (^Vmax) as a function of pulse duration (ti).



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**INTERRUPTION CHARACTERISTICS**

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

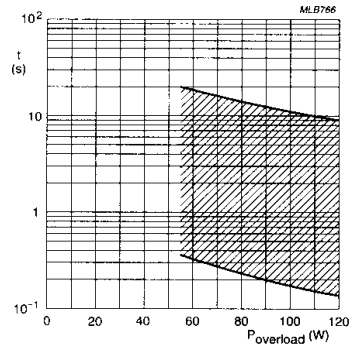


Fig. 9 - Time to interruption as a function of overload power for range: 0R33 ≤ Rn < 5R

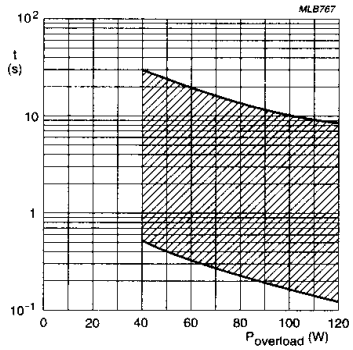


Fig. 10 - Time to interruption as a function of overload power for range: 5R ≤ Rn < 68R

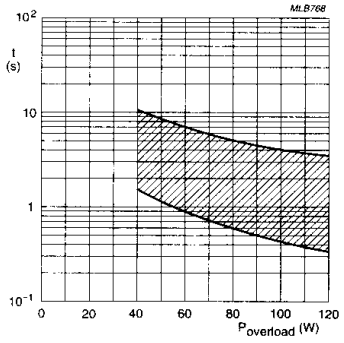


Fig. 11 - Time to interruption as a function of overload power for range: 68R ≤ Rn < 560R

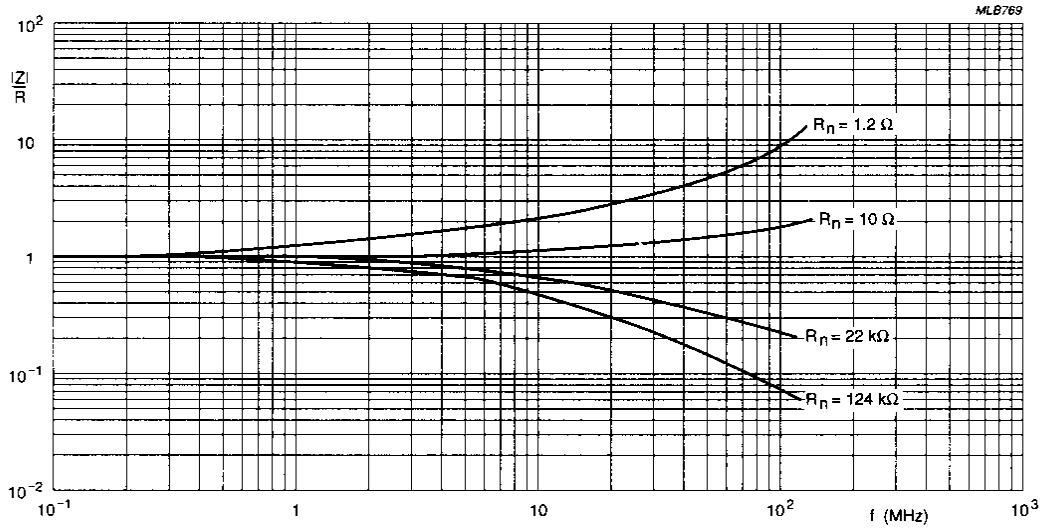


Fig. 12 - Impedance as a function of applied frequency.



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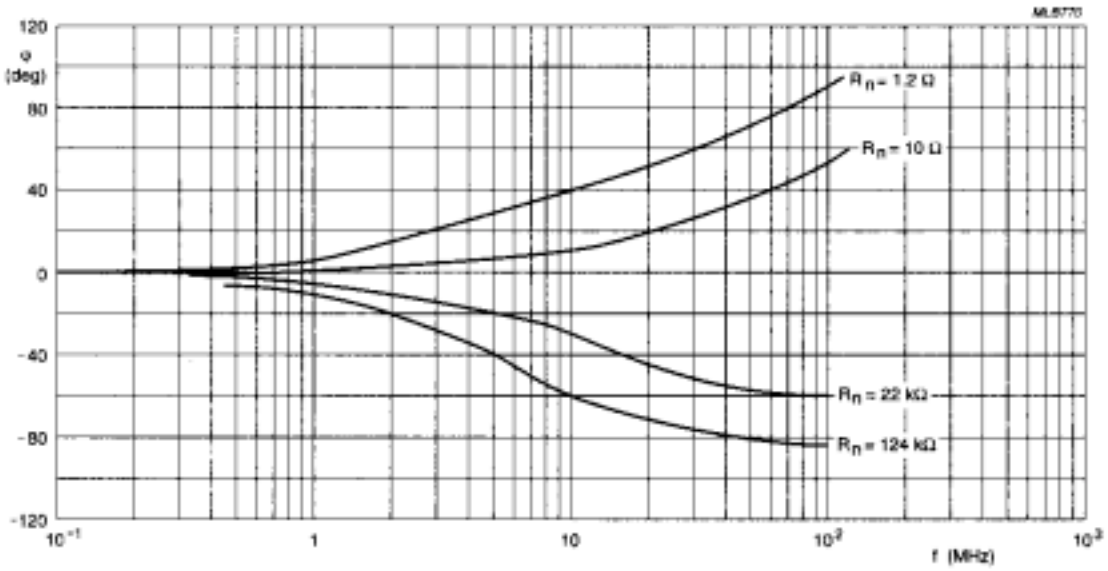


Fig. 13 - Phase angle as a function applied frequency.

## 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 indicating resistor type and packaging

| TYPE | LEAD ∅ (mm) | TOL (%) | ORDERING CODE 23xx xxx xxxxx | |
|---|---|---|---|---|
| | | | BANDOLIER IN AMMOPACK | BANDOLIER ON REEL |
| | | | STRAIGHT LEADS | |
| | | | 52 mm | 52 mm |
| | | | 1000 units | 5000 units |
| PR02 | 0.8 Cu | 1 | 22 197 1xxxx | 06 192 5xxxx |
| | | 5 | 06 198 53xxx | 06 198 23xxx |
| | 0.6 FeCu | | 22 194 54xxx | - |

***Note: For formed types see “Formed Types Specification”***


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## ORDERING CODE

- The resistors have a 12 digit ordering code starting with 23
- The subsequent 6 or 7 digits indicate the resistor type and packaging see table 2.
- For 5% tolerance the remaining 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 remaining 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 12NC

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

Example:
The ordering code for resistor type PR02 with Cu leads and a value of 750Ω 5%, supplied on a bandolier of 1000 units in ammopack, is: 2306 198 53751

## PACKAGING

**Bandolier in ammopack**

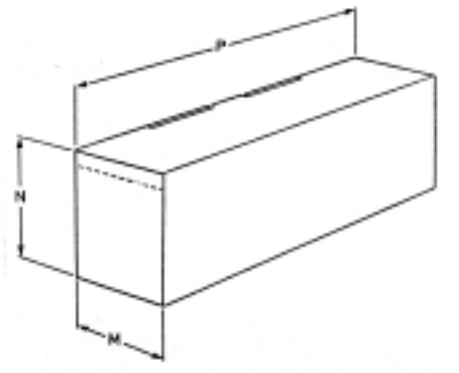


Table 4.

| Product | Quantity | M | N | P | Bandolier Width |
|---|---|---|---|---|---|
| PR02 | 1000 | 78 | 60 | 262 | 52 +1.5/-0 |

Dimensions in mm

**PR02**

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**Bandolier on Reel (optional)**

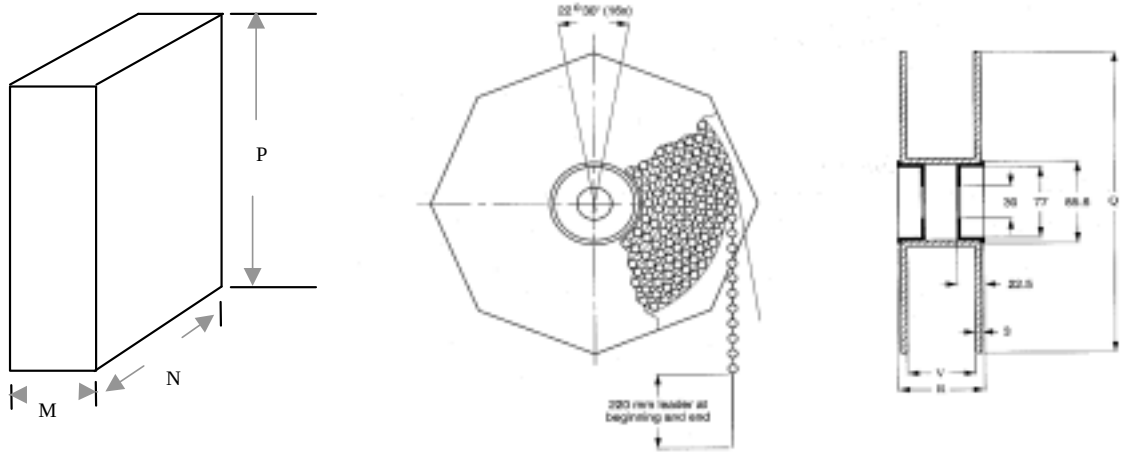


Table 5.

| Product | Quantity | M | N | P | Q | V | R | Bandolier Width |
|---|---|---|---|---|---|---|---|---|
| PR02 | 5000 | 95 | 361 | 361 | 355 | 78 | 89 | 52 +1.5/-0 |

Dimensions in mm

## 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 "EC 60068-1", subclause 5.3.

In Table 6 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 out method of specifying.
All soldering tests are performed with mildly activated flux.

Table 6. Test procedures and requirements

| IEC 60115-1 CLAUSE | IEC 60068-2 TEST METHOD | TEST | PROCEDURE | REQUIREMENTS | |
|---|---|---|---|---|---|
| | | | | PR02 5% | PR02 1% |
| 4.4.1 | | Visual examination | | No holes; clean surface no damage | |
| 4.4.2 | | Dimensions (outline) | gauge (mm) | See table 1 | |
| 4.5 | | Resistance | applied voltage (+0/-10%):<br>R<10Ω: 0.1V<br>10Ω ≤ R < 100Ω: 0.3V<br>100Ω ≤ R <1 kΩ : 1V<br>1kΩ ≤ R < 10 kΩ:3V | R - Rnom: max.: ± 5% | R - Rnom: max.: ± 1% |



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| IEC 60115-1 CLAUSE | IEC 60068-2 TEST METHOD | TEST | PROCEDURE | REQUIREMENTS | |
|---|---|---|---|---|---|
| | | | | PR02 5% | PR02 1% |
| | | | 10 kΩ ≤ R < 100 kΩ: 10V<br>100 kΩ ≤ R < 1MΩ: 25V<br>R = 1MΩ: 50V | | |
| 4.29 | 45 (Xa) | Component solvent resistance | Isopropyl alcohol or $H_2O$ followed by brushing in accordance with "MIL 202F" | No visual damage | |
| 4.18 | 20 (Tb) | Resistance to soldering heat | Thermal shock: 3s; 350ºC ; 6mm from body | ΔR/Rmax.: ±1% + 0.05Ω | ΔR/Rmax.: ±0.5% +0.05Ω |
| 4.16 | 21 (U) | Robustness of Terminations: | | | |
| 4.16.2 | 21 (Ua1) | Tensile all samples | load 10N; 10s | Number of failures:<1x10$^{-6}$ | |
| 4.16.3 | 21 (Ub) | Bending half number of samples | load 5N; 4 X 90º | Number of failures:<1x10$^{-6}$ | |
| 4.16.4 | 21 (Uc) | Torsion other half number of samples | 3 x 360$^{o}$ in opposite directions | No damage<br>ΔR/Rmax.:±0.5% + 0.05Ω | |
| 4.17 | 20 (Ta) | Solderability | 2s; 235ºC; | Good tinning; no damage | |
| 4.7 | | Voltage proof on insulation | Maximum voltage 500V (RMS) during 1 minute; metal block method | No breakdown on flashover | |
| 4.19 | 14 (Na) | Rapid change of temperature | 30 minutes at LCT and 30 minutes at UCT; 5 cycles | No visual damage | |
| | | | | ΔR/Rmax.: ±1%+0.05Ω | ΔR/Rmax.: ±0.5% +0.05Ω |
| 4.22 | 6 (Fc) | Vibration | Frequency 10 to 500 Hz, displacement 1.5mm or acceleration 10g, three directions; total 6h (3x2h) | No damage<br>ΔR/Rmax.: ±0.5% +0.05Ω | |
| 4.23 | | Climatic sequence | | $R_{ins}$ min.: 10$^{3}$ MΩ | |
| 4.23.3 | 30 (Db) | Damp heat (accelerated) 1$^{st}$ cycle | | | |
| 4.23.6 | 30 (Db) | Damp heat (accelerated) remaining cycles | 6 days; 55$^{o}$C; 95 to 98% R.H. | ΔR/Rmax.: ± 3% + 0.1Ω | ΔR/Rmax.: ± 1% + 0.1Ω |
| 4.24.2 | 3 (Ca) | Damp heat (steady state) (IEC) | 56 days; 40 $^{o}$C; 90 to 95% R.H; loaded with 0.01Pn (IEC steps: 4 to 100V) | $R_{ins}$min.: 10$^{3}$ MΩ | |
| | | | | ΔR/R max.: ± 3% + 0.1Ω | ΔR/R max.: ± 1% + 0.1Ω |
| 4.8.4.2 | | Temperature coefficient | At 20/ LCT /20ºC and 20/ UCT / 20ºC: (TC ppm/ºC) | ≤ ± 250ppm | |
| 4.25.1 | | Endurance (at 70 $^{o}$C) | 1000h loaded with Pn or Vmax 1.5h on and 0.5h off | ΔR/Rmax.: ± 5% + 0.1Ω | ΔR/Rmax.: ± 1% + 0.1Ω |
| 4.6.1.1 | | Insulation resistance | Maximum voltage (DC) after 1 minute; metal block method | $R_{ins}$ min.: 10$^{4}$ MΩ | |
| See 2$^{nd}$ amendment to "ÏEC 60115-1". | | Pulse Load | | See figs. 7 and 8 | |



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