

High Pulse, Fusible, Non-Inductive, Flameproof, Metal Film Leaded Resistor



DESCRIPTION

The specially developed product PR02-FS can be used for applications in which defined fusible characteristics and high voltage pulse handling is required. So this makes it easy for designers to meet safety requirements in their designs by selecting such products. Main applications are in lighting electronics.

FEATURES

- UL 1412, Ed.5 US safety standard recognized; UL file no. E362452
- CAN/CSA C22.2 No.60065 Ed.2 Canadian safety standard recognized; UL file no. E362452
- Defined fusing characteristics
- Inherent non-inductive design
- Superior surge handling capability > 600 V (1.2 / 50 μ s pulse)
- Meets active and passive flammability requirements as defined in IEC 60115-1 and UL 94 V-0
- Radial version is available
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



APPLICATIONS

- All general purpose power applications
- Lighting ballast
- Lighting electronics
- Snubber resistor for inductive loads

| TECHNICAL SPECIFICATIONS | |
|---|---|
| DESCRIPTION | PR02-FS |
| DIN size | 0411 |
| Resistance range | 1 Ω to 100 Ω |
| Resistance tolerance | $\pm 10 \%$; $\pm 20 \%$ |
| Temperature coefficient | ± 250 ppm/K |
| Operating Temperature | -55 $^{\circ}$ C to +200 $^{\circ}$ C |
| Rated dissipation, P_{70} | 2 W |
| E-series | E12 ($\pm 10 \%$ and $\pm 20 \%$) |
| Generic specification | IEC 60115-1 |
| Stability after: | |
| Endurance at 70 $^{\circ}$ C; 1000 h | ΔR max.: $\pm (5 \% R + 0.1 \Omega)$ |
| Damp heat, steady state (56 days) | ΔR max.: $\pm (3 \% R + 0.1 \Omega)$ |
| Resistance to soldering heat (10 s, 260 $^{\circ}$ C) | ΔR max.: $\pm (0.5 \% R + 0.05 \Omega)$ |



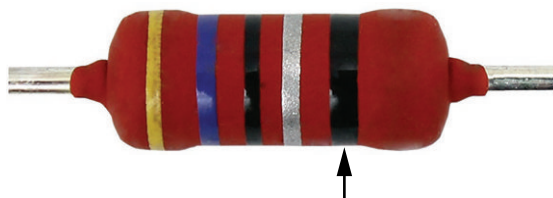
| PART NUMBER AND PRODUCT DESCRIPTION | | | | | | | | | | | | | | | | | |
|--|-------------|----------------------|------------------|--|--------------------------|----------------------|---------------|---|---|---|---|---|---|---|---|---|---|
| Part Number: PR02FS0206809KA100 | | | | | | | | | | | | | | | | | |
| P | R | 0 | 2 | F | S | 0 | 2 | 0 | 6 | 8 | 0 | 9 | K | A | 1 | 0 | 0 |
| TYPE | VARIANT | WIRE TYPES | TCR / MATERIAL | RESISTANCE | TOLERANCE | PACKAGING | SPECIAL | | | | | | | | | | |
| PR02FS | 0 = neutral | 2 = Cu 0.78 | 0 = standard | 3 digit value 1 digit multiplier Multiplier 8 = *10 ⁻² 9 = *10 ⁻¹ 0 = *10 ⁰ | K = ± 10 % M = ± 20 % | N3 A1 A7 R5 | 00 = standard | | | | | | | | | | |
| Product Description: PR02-FS 10 % A1 68R | | | | | | | | | | | | | | | | | |
| PR02-FS | 10 % | A1 | 68R | | | | | | | | | | | | | | |
| TYPE | TOLERANCE | PACKAGING | RESISTANCE VALUE | | | | | | | | | | | | | | |
| PR02-FS | 10 % | N3 A1 A7 R5 | 68R = 68 Ω | | | | | | | | | | | | | | |

| PACKAGING | | | | | | | |
|-----------|------|----------|--------|-------------------------------|---------|-------|--------------------------|
| TYPE | CODE | QUANTITY | STYLE | DESCRIPTION | PITCH | WIDTH | PACKAGING DIMENSIONS |
| PR02-FS | N3 | 3000 | Radial | Ammo pack acc. to IEC 60286-2 | 12.7 mm | - | 45 mm x 262 mm x 330 mm |
| | A1 | 1000 | Axial | Ammo pack acc. to IEC 60286-1 | 5 mm | 52 mm | 72 mm x 60 mm x 258 mm |
| | A7 | 1000 | Axial | Ammo pack acc. to IEC 60286-1 | 5 mm | 73 mm | 95 mm x 74 mm x 260 mm |
| | R5 | 5000 | Axial | Reel pack acc. to IEC 60286-1 | 5 mm | 52 mm | 100 mm x 375 mm x 375 mm |

DESCRIPTION

A homogeneous film of metal alloy is deposited on a high grade ceramic body. Tinned connecting wires of electrolytic copper are welded to the end-caps. The resistors are coated with a red, non-flammable lacquer conformal coating which provides electrical, mechanical and climatic protection. This coating is not resistant to aggressive fluxes and cleaning solvents. The encapsulation is resistant to all cleaning solvents in accordance with IEC 60068-2-45.

The nominal resistance and tolerance are marked on the resistor using colored bands in accordance with IEC 60062, marking codes for resistors and capacitors. An additional black color band is applied to differentiate the PR02-FS from standard PR02 product.



Additional marking for identification of PR02-FS product

MATERIALS

Vishay acknowledges the following systems for the regulation of hazardous substances:

- IEC 62474, Material Declaration for Products of and for the Electrotechnical Industry, with the list of declarable substances given therein ⁽¹⁾
- The Global Automotive Declarable Substance List (GADSL) ⁽²⁾
- The REACH regulation (1907/2006/EC) and the related list of substances with very high concern (SVHC) ⁽³⁾ for its supply chain

The products do not contain any of the banned substances as per IEC 62474, GADSL, or the SVHC list, see www.vishay.com/how/leadfree.

Hence the products fully comply with the following directives:

- 2000/53/EC End-of-Life Vehicle Directive (ELV) and Annex II (ELV II)
- 2011/65/EU Restriction of the Use of Hazardous Substances Directive (RoHS) with amendment 2015/863/EU
- 2012/19/EU Waste Electrical and Electronic Equipment Directive (WEEE)

Vishay pursues the elimination of conflict minerals from its supply chain, see the Conflict Minerals Policy at www.vishay.com/doc?49037.

Notes

- ⁽¹⁾ The IEC 62474 list of declarable substances is maintained in a dedicated database, which is available at <http://std.iec.ch/iec62474>
- ⁽²⁾ The Global Automotive Declarable Substance List (GADSL) is maintained by the American Chemistry Council, and available at www.gadsl.org
- ⁽³⁾ The SVHC list is maintained by the European Chemical Agency (ECHA) and available at <http://echa.europa.eu/candidate-list-table>

ASSEMBLY

The resistors are suitable for processing on automatic insertion equipment and cutting and bending machines. Excellent solderability is proven, even after extended storage. They are suitable for automatic soldering using wave or dipping.

The resistors are completely lead (Pb)-free, the pure tin plating provides compatibility with lead (Pb)-free and lead-containing soldering processes. The immunity of the plating against tin whisker growth, in compliance with IEC 60068-2-82, has been proven under extensive testing.

The encapsulant is resistant to cleaning solvent specified in IEC 60115-1. The suitability of conformal coatings, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system.

APPROVALS

The PR02-FS series is specially designed to meet all safety requirements defined in UL1412. Essentially all tests are carried out in accordance with IEC 60115-1 specification, category -55 °C / +200 °C / 56 days (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 under standard atmospheric conditions according to IEC 60068-1, 5.3.

RELATED PRODUCTS

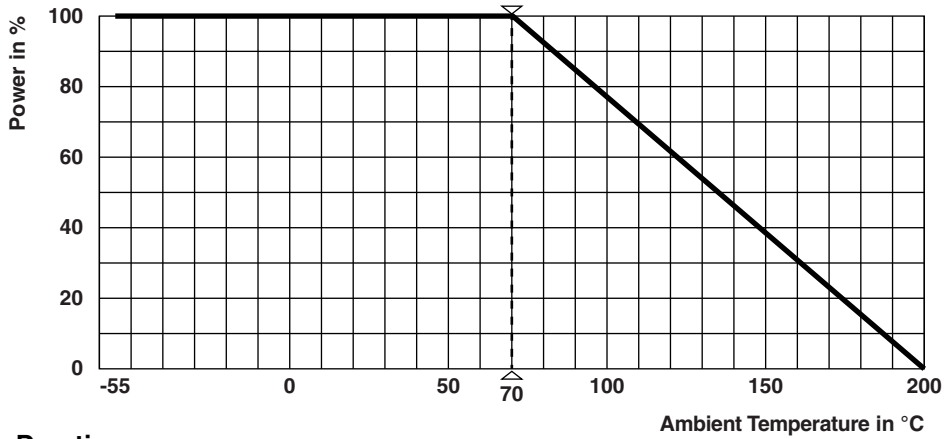
For more information on products with higher wattage, higher pulse load capability and metal oxide film technology, please refer to the WK/WR datasheet at the link: www.vishay.com/doc?20128

For products with higher rated dissipation with small body size, with metal film technology, please refer to the PR01, PR02, PR03 datasheet at the link: www.vishay.com/doc?28729



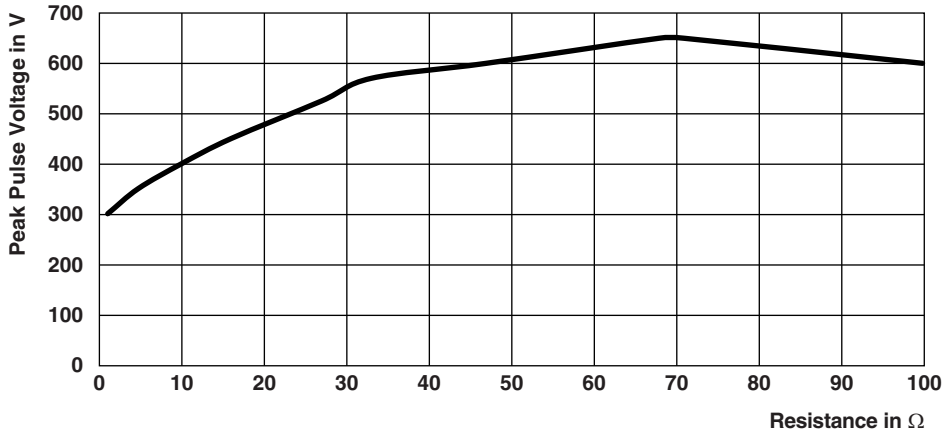
FUNCTIONAL PERFORMANCE

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

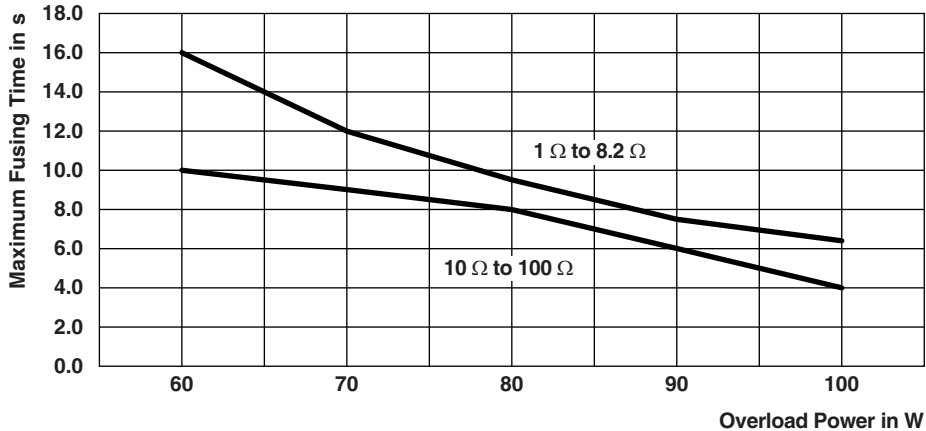


Derating

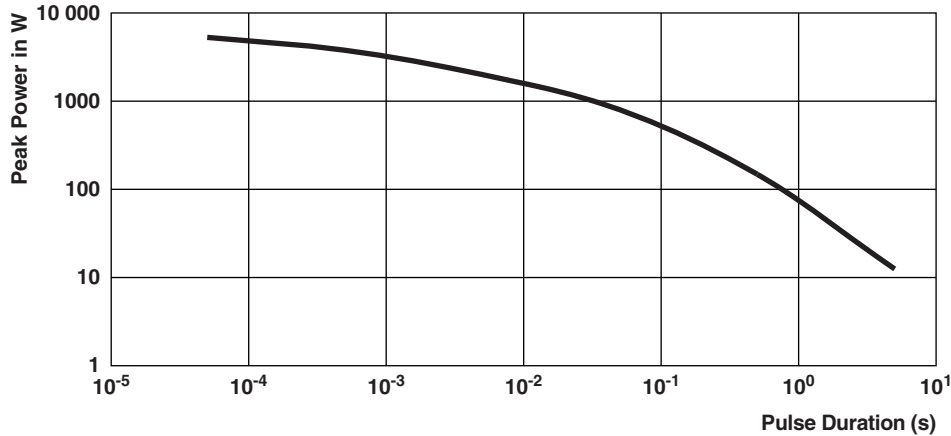
Maximum dissipation (P_{max}) in percentage of rated power as a function of the ambient temperature (T_{amb})



Pulse performance w.r.t. IEC 61000-4-5 after 10 pulses (5 positive and 5 negative with 30 s repetition time) of 1.2/50 μs are applied



Fusing performance in response to defined overload



Pulse performance after a rectangular pulse of defined duration is applied

TEST PROCEDURES AND REQUIREMENTS

All tests are carried out in accordance with the following specifications:

- IEC 60115-1, generic specification (includes tests)

The test and requirements table contains only the most important tests. For the full test schedule refer to the documents listed above.

The tests are carried out in accordance with IEC 60068-2-xx test method and under standard atmospheric conditions in accordance with IEC 60068-1, 4.3.

Climatic category LCT / UCT / 56 (rated temperature range: lower category temperature, upper category temperature; damp heat, steady state, test duration: 56 days) is valid.

Unless otherwise specified the following values apply:

- Temperature: 15 °C to 35 °C
- Relative humidity: 25 % to 75 %
- Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar)

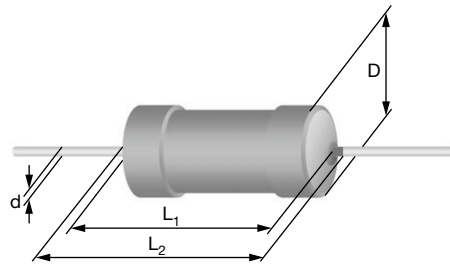
For performing some of the tests, the components are mounted on a test board in accordance with IEC 60115-1, 4.31.

In test procedures and requirements table, only 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.

| TEST PROCEDURES AND REQUIREMENTS | | | | |
|----------------------------------|-------------------------------|----------------------------|---|--|
| IEC 60115-1 CLAUSE | IEC 60068-2-TEST METHOD | TEST | PROCEDURE | REQUIREMENTS PERMISSIBLE CHANGE ($\delta R_{max.}$) |
| 4.4.1 | - | Visual examination | | No holes; clean surface; no damage |
| 4.4.2 | - | Dimensions (outline) | Gauge (mm) | See Dimensions table |
| 4.5 | - | Resistance | | $\pm 10 \% R$ $\pm 20 \% R$ |
| 4.6.1.1 | - | Insulation resistance | 500 V after 1 min; metal block method | $R_{ins \text{ min.}}: 10^4 \text{ M}\Omega$ |
| 4.7 | - | Voltage proof | $U_{ins} = 500 \text{ V}_{RMS}; 60 \text{ s}$ | No breakdown or flashover |
| 4.8 | - | Temperature coefficient | At (20 / -55 / 20) °C and (20 / 155 / 20) °C | $\leq \pm 250 \text{ ppm/K}$ |
| 4.16 | 21 (Ua) 21 (Ub) 21 (Uc) | Robustness of terminations | Tensile, bending, and torsion | No damage $\Delta R_{max.}: \pm (0.5 \% R + 0.05 \Omega)$ |



| TEST PROCEDURES AND REQUIREMENTS | | | | |
|----------------------------------|--|--|---|--|
| IEC 60115-1 CLAUSE | IEC 60068-2- TEST METHOD | TEST | PROCEDURE | REQUIREMENTS PERMISSIBLE CHANGE ($\delta R_{max.}$) |
| 4.17 | 20 (Ta) | Solderability | +235 °C; 2 s; solder bath method; SnPb40 | Good tinning (≥ 95 % covered, no visible damage) |
| | | | +245 °C; 3 s; solder bath method; SnAg3Cu0.5 | Good tinning (≥ 95 % covered, no visible damage) |
| 4.18 | 20 (Tb) | Resistance to soldering heat | Unmounted components (260 \pm 5) °C; (10 \pm 1) s | $\Delta R_{max.}: \pm (0.5 \% R + 0.05 \Omega)$ |
| 4.19 | 14 (Na) | Rapid change of temperature | 30 min at -55 °C and 30 min at +200 °C; 5 cycles | No visual damage $\Delta R_{max.}: \pm (1 \% R + 0.05 \Omega)$ |
| 4.20 | 29 (Eb) | Bump | 3 x 1500 bumps in three directions; 40 g | No damage $\Delta R_{max.}: \pm (0.5 \% R + 0.05 \Omega)$ |
| 4.22 | 6 (Fc) | Vibration | 10 sweep cycles per direction; 10 Hz to 2000 Hz; 1.5 mm or 200 m/s ² | No damage $\Delta R_{max.}: \pm (0.5 \% R + 0.05 \Omega)$ |
| 4.23 | 2 (Bb) 30 (Db) 1 (Ab) 13 (M) 30 (Db) | Climatic sequence: | | $R_{ins \text{ min.}}: 10^3 \text{ M}\Omega$ $\Delta R_{max.}: \pm (1.5 \% R + 0.1 \Omega)$ |
| 4.23.2 | | Dry heat | 200 °C; 16 h | |
| 4.23.3 | | Damp heat, cyclic | 55 °C; 24 h; 90 % to 100 % RH; 1 cycle | |
| 4.23.4 | | Cold | -55 °C; 2 h | |
| 4.23.5 | | Low air pressure | 8.5 kPa; 2 h; 15 °C to 35 °C | |
| 4.23.6 | Damp heat, cyclic | 55 °C; 24 h; 95 % to 100 % RH; 5 cycles | | |
| 4.24 | 78 (Cab) | Damp heat (steady state) | (40 \pm 2) °C; 56 days; (93 \pm 3) % RH | $\Delta R_{max.}: \pm (3 \% R + 0.1 \Omega)$ |
| 4.25.1 | - | Endurance (at 70 °C) | $U = \sqrt{P_{70} \times R}$; 1.5 h on; 0.5 h off; 70 °C; 1000 h | $\Delta R_{max.}: \pm (5 \% R + 0.1 \Omega)$ |
| 4.26 | - | Active flammability | Accidental overload test | No damage, no flaming of gauze cylinder |
| 4.30 | 45 (Xa) | Solvent resistance for marking | Isopropyl alcohol (used in industrial application) +23 °C; toothbrush method | Marking legible; no visible damage |
| 4.35 | - | Passive flammability | Needle flame test | No ignition of product, no ignition of under layer burning time is less than 30 s |

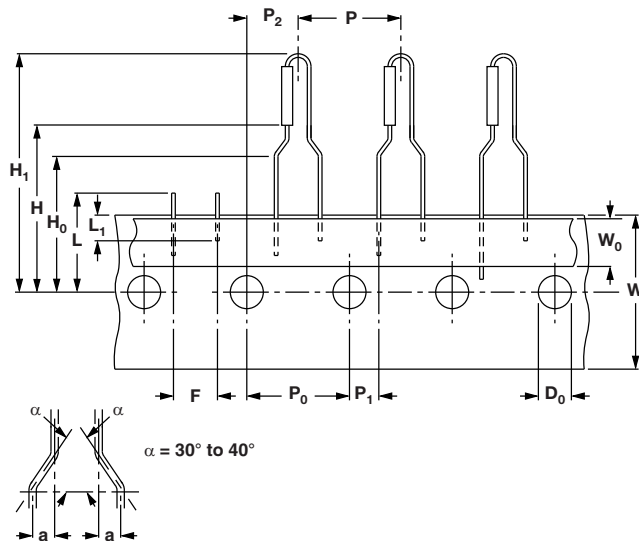
DIMENSIONS


Type with straight leads

| DIMENSIONS - Straight lead type and relevant physical dimensions; see straight leads outline | | | | | |
|---|-----------------------------|-----------------|-----------------|----------------------|-----------|
| TYPE | $\varnothing D_{MAX.}$ (mm) | L_1 MAX. (mm) | L_2 MAX. (mm) | $\varnothing d$ (mm) | MASS (mg) |
| PR02-FS | 3.9 | 10.0 | 12.0 | 0.78 ± 0.05 | 504 |

PR02-FS WITH RADIAL TAPING

Height for insertion (max.) = 29 mm



| DIMENSIONS in millimeters | | |
|---|-------|----------------|
| Pitch of components | P | 12.7 ± 1.0 |
| Feed-hole pitch | P_0 | 12.7 ± 0.2 |
| Feed-hole center to lead at topside at the tape | P_1 | 3.85 ± 0.5 |
| Feed-hole center to body center | P_2 | 6.35 ± 1.0 |
| Lead spacing | F | $4.8 +0.7/-0$ |
| Width of carrier tape | W | 18.0 ± 0.5 |
| Minimum hold down tape width | W_0 | 5.5 |
| Height for insertion (max.) | H1 | 29 |
| Lead wire clinch height | H_0 | 16.5 ± 0.5 |
| Body to hole center | H | 19.5 ± 1 |
| Feed-hole diameter | D_0 | 4.0 ± 0.2 |
| Height for cutting (max.) | L | 11.0 |
| Minimum lead wire (tape portion) shortest lead | L_1 | 2.5 |



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