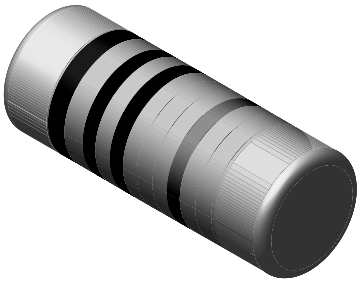
# Thin Film Micro-MELF Resistors



## FEATURES

- Advanced thin film technology
- Low TCR and tight tolerances
- Excellent stability in different environmental conditions
- Intrinsic sulfur resistance
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

RoHS COMPLIANT

HALOGEN FREE GREEN (5-2008)

## APPLICATIONS

- Automotive
- Telecommunication
- Industrial
- Medical equipment

SMM0102 thin film Micro-MELF resistors are the perfect choice for most fields of modern professional electronics where reliability and stability is of major concern. The typical applications in the fields of automotive and medical equipment reflect the outstanding level of proven reliability.

| TECHNICAL SPECIFICATIONS | |
|---|---|
| **DESCRIPTION** | **SMM0102** |
| DIN size | 0102 |
| Metric size code | RC2211M |
| Resistance range | 10 Ω to 2.21 MΩ; 0 Ω |
| Resistance tolerance | ± 1 %; ± 0.1 % |
| Temperature coefficient | ± 50 ppm/K; ± 25 ppm/K; ± 15 ppm/K |
| Rated dissipation, $P_{70}$ (1) | 0.200 W |
| Operating voltage, $U_{max.}$ $AC_{RMS}$/DC | 150 V |
| Permissible film temperature, $\vartheta_{F\ max.}$ (1) | 125 °C |
| Operating temperature range (1) | -55 °C to 125 °C |
| Permissible voltage against ambient (insulation): 1 min; $U_{ins}$ | 200 V |
| Failure rate: $FIT_{observed}$ | ≤ 0.1 x $10^{-9}$/h |

**Note**

(1) Please refer to APPLICATION INFORMATION below.

## APPLICATION INFORMATION

When the resistor dissipates power, a temperature rise above the ambient temperature occurs, dependent on the thermal resistance of the assembled resistor together with the printed circuit board. The rated dissipation applies only if the permitted film temperature is not exceeded.

These resistors do not feature a limited lifetime when operated within the permissible limits. However, resistance value drift increasing over operating time may result in exceeding a limit acceptable to the specific application, thereby establishing a functional lifetime.

| MAXIMUM RESISTANCE CHANGE AT RATED DISSIPATION | | |
|---|---|---|
| **OPERATION MODE** | | **STANDARD** |
| Rated dissipation, $P_{70}$ | **SMM0102** | 0.200 W |
| Operating temperature range | | -55 °C to 125 °C |
| Permissible film temperature, $\vartheta_F$ max. | | 125 °C |
| Max. resistance change at $P_{70}$ for resistance range, $\|\Delta R/R\|$ after: | **SMM0102** | 10 Ω to 2.21 MΩ |
| | 1000 h | ≤ 0.5 % |
| | 8000 h | ≤ 1 % |

**Note**

- A suitable low thermal resistance of the circuit board assembly must be safeguarded in order to maintain the film temperature of the resistors within the specified limits. Please consider the application note "Thermal Management in Surface-Mounted Resistor Applications" (www.vishay.com/doc?28844) for information on the general nature of thermal resistance.

| TEMPERATURE COEFFICIENT AND RESISTANCE RANGE | | | | |
|---|---|---|---|---|
| **TYPE / SIZE** | **TCR** | **TOLERANCE** | **RESISTANCE** | **E-SERIES** |
| **SMM0102** | ± 50 ppm/K | ± 1 % | 10 Ω to 2.21 MΩ | E24; E96 |
| | ± 25 ppm/K | ± 0.1 % | 100 Ω to 100 kΩ | E24; E192 |
| | ± 15 ppm/K | ± 0.1 % | 100 Ω to 100 kΩ | |
| **OMM0102** | Jumper, $I_{max.}$ = 2 A | ≤ 10 mΩ | 0 Ω | - |

| PACKAGING | | | | | | |
|---|---|---|---|---|---|---|
| **TYPE / SIZE** | **CODE** | **QUANTITY** | **PACKAGING STYLE** | **WIDTH** | **PITCH** | **PACKAGING DIMENSIONS** |
| **SMM0102 OMM0102** | B1 (1) | 1000 | Antistatic blister tape acc. IEC 60286-3, Type 2a | 8 mm | 4 mm | Ø 180 mm / 7" |
| | B3 | 3000 | | | | Ø 180 mm / 7" |
| | B0 | 10 000 | | | | Ø 330 mm / 13" |

**Note**

(1) Package of 1000 pieces, code B1, is available only for products with tolerance ± 0.1 %.

## PART NUMBER AND PRODUCT DESCRIPTION

**Part Number: SMM01020D5620BB300**
**Part Number: OMM01020000000B300**

| S | M | M | 0 | 1 | 0 | 2 | 0 | D | 5 | 6 | 2 | 0 | B | B | 3 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| O | M | M | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | B | 3 | 0 | 0 |

| TYPE / SIZE | VERSION | TCR | RESISTANCE | TOLERANCE | PACKAGING |
|---|---|---|---|---|---|
| **SMM0102**<br>**OMM0102** | **0** = neutral | **E** = ± 15 ppm/K<br>**D** = ± 25 ppm/K<br>**C** = ± 50 ppm/K<br>**0** = jumper | 3 digit value<br>1 digit multiplier<br>**0000** = Jumper<br><br>**Multiplier**<br>**9** = $*10^{-1}$<br>**0** = $*10^{0}$<br>**1** = $*10^{1}$<br>**2** = $*10^{2}$<br>**3** = $*10^{3}$<br>**4** = $*10^{4}$ | **B** = ± 0.1 %<br>**F** = ± 1 %<br>**0** = jumper | **B1**<br>**B3**<br>**B0** |

**Product Description: SMM0102 25 562R 0.1 % B3**
**Product Description: OMM0102 0R0 B3**

| SMM0102 | 25 | 562R | 0.1 % | B3 |
|---|---|---|---|---|
| **OMM0102** | **-** | **0R0** | **-** | **B3** |
| TYPE / SIZE | TCR | RESISTANCE | TOLERANCE | PACKAGING |
| **SMM0102**<br>**OMM0102** | ± **15** ppm/K<br>± **25** ppm/K<br>± **50** ppm/K | **100** = 100 Ω<br>**2M21** = 2.21 MΩ<br>**0R0** = jumper | ± **0.1 %**<br>± **1 %** | **B1**<br>**B3**<br>**B0** |

**Note**

- Products can be ordered using either the PART NUMBER or PRODUCT DESCRIPTION.

## DESCRIPTION

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A homogeneous film of metal alloy is deposited on a high grade ceramic body ($Al_2O_3$) and conditioned to achieve the desired temperature coefficient. Nickel plated steel termination caps are firmly pressed on the metallized rods. A special laser is used to achieve the target value by smoothly cutting a helical groove in the resistive layer without damaging the ceramic. The resistor elements are covered by a protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure tin on nickel and copper plating for enhanced temperature cycling stability. Four or five color code rings designate the resistance value and tolerance in accordance with **IEC 60062** [(1)].

The result of the determined production is verified by an extensive testing procedure performed on 100 % of the individual resistors. This includes full screening for the elimination of products with a potential risk of early field failures according to EN 140401-803, 2.1.2.2. Only accepted products are laid directly into the blister tape in accordance with **IEC 60286-3, Type 2a** [(1)].

## ASSEMBLY

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow or vapor phase as shown in **IEC 61760-1** [(1)]. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions. The suitability of conformal coatings, potting compounds and their processes, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system.

The resistors are completely lead (Pb)-free, the pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes. Solderability is specified for 2 years after production or requalification, however, excellent solderability is proven after extended storage in excess of 10 years. The permitted storage time is 20 years. The immunity of the plating against tin whisker growth has been proven under extensive testing.

## 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 [(2)]
- The Global Automotive Declarable Substance List (GADSL) [(3)]
- The REACH regulation (1907/2006/EC) and the related list of substances with very high concern (SVHC) [(4)] 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.

## RELATED PRODUCTS

Resistors are available with established reliability in accordance with **EN 140401-803 Version E**. Please refer to datasheet “MELF Resistors with Established Reliability” (www.vishay.com/doc?28707).

MS1 .... ESCC high-reliability thin film MINI-MELF resistors are the premium choice for design and manufacture of equipment, where matured technology and proven reliability are of utmost importance. They are regularly used in communication and research satellites and fit equally well into aircraft and military electronic systems.

Approval of the MS1 .... ESCC products is granted by the European Space Components Coordination and registered in the ESCC Qualified Parts List, REP005 (www.vishay.com/doc?28790).

**Notes**

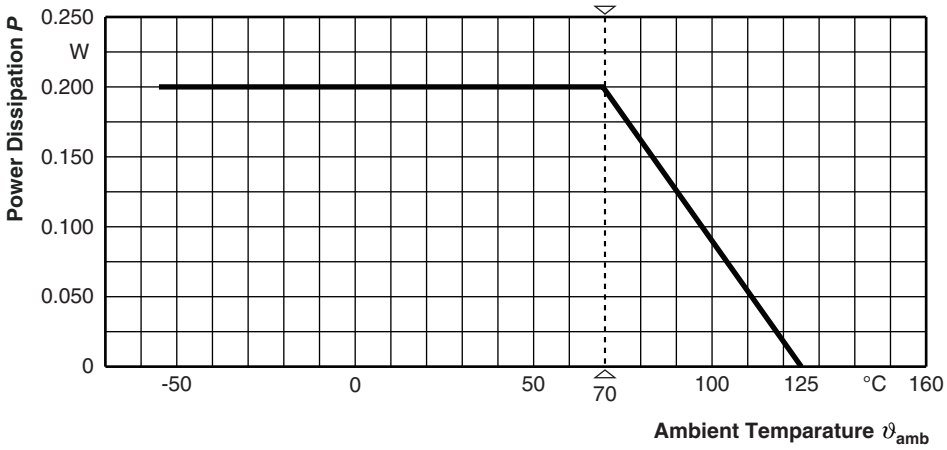
(1) The quoted IEC standards are also released as EN standards with the same number and identical contents.

(2) The IEC 62474 list of declarable substances is maintained in a dedicated database, which is available at http://std.iec.ch/iec62474.

(3) The Global Automotive Declarable Substance List (GADSL) is maintained by the American Chemistry Council and available at www.gadsl.org.

(4) The SVHC list is maintained by the European Chemical Agency (ECHA) and available at http://echa.europa.eu/candidate-list-table.

## FUNCTIONAL PERFORMANCE




**Derating**

## TESTS AND REQUIREMENTS

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

EN 60115-1, generic specification

EN 60115-8 (successor of EN 140400), sectional specification

EN 140401-803, detail specification

IEC 60068-2-xx, test methods

The parameters stated in the Test Procedures and Requirements table are based on the required tests and permitted limits of EN 140401-803. The table presents only the most important tests, for the full test schedule refer to the documents listed above. However, some additional tests and a number of improvements against those minimum requirements have been included.

The testing also covers most of the requirements specified by EIA/ECA-703 and JIS-C-5201-1.

The tests are carried out under standard atmospheric conditions in accordance with IEC 60068-1, 4.3, whereupon the following values are applied:

Temperature: 15 °C to 35 °C

Relative humidity: 25 % to 75 %

Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar).

A climatic category LCT / UCT / 56 is applied, defined by the lower category temperature (LCT), the upper category temperature (UCT), and the duration of exposure in the damp heat, steady state test (56 days).

The components are mounted for testing on printed circuit boards in accordance with EN 60115-8, 2.4.2, unless otherwise specified.

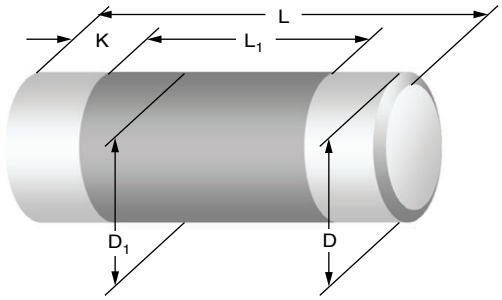
**TEST PROCEDURES AND REQUIREMENTS**

| EN 60115-1 CLAUSE | IEC 60068-2 [1] TEST METHOD | TEST | PROCEDURE | REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R$) | |
|---|---|---|---|---|---|
| | | | **Stability for product types:** | | |
| | | | **SMM0102** | < 211 kΩ | > 211 kΩ |
| 4.5 | - | Resistance | - | ± 1.0 % $R$; ± 0.1 % $R$ | ± 1.0 % $R$ |
| 4.8 | - | Temperature coefficient | At (20 / -55 / 20) °C and (20 / 125 / 20) °C | ± 50 ppm/K; ± 25 ppm/K; ± 15 ppm/K; | ± 50 ppm/K |
| 4.25.1 | - | Endurance at 70 °C: standard operation mode | $U = \sqrt{P_{70} \times R} \leq U_{max.}$; whichever is the less severe; 1.5 h on; 0.5 h off;<br>70 °C; 1000 h<br>70 °C; 8000 h | <br>± 0.25 % $R$<br>± 0.5 % $R$ | <br>± 0.5 % $R$<br>± 1 % $R$ |
| 4.25.3 | - | Endurance at upper category temperature | 125 °C; 1000 h | ± 0.25 % $R$ | ± 1 % $R$ |
| 4.24 | 78 (Cab) | Damp heat, steady state | (40 ± 2) °C; 56 days; (93 ± 3) % RH | ± 0.5 % $R$ | ± 1 % $R$ |
| 4.19 | 14 (Na) | Rapid change of temperature | 30 min at LCT; 30 min at UCT; LCT = -55 °C; UCT = 125 °C; 5 cycles | ± 0.1 % $R$ | ± 0.15 % $R$ |
| 4.13 | - | Short time overload | $U = 2.5 \times \sqrt{P_{70} \times R} \leq 2 \times U_{max.}$; 2 s | ± 0.1 % $R$ | ± 0.15 % $R$ |
| 4.18 | 58 (Td) | Resistance to soldering heat | Solder bath method; (260 ± 5) °C; (10 ± 1) s | ± 0.1 % $R$ | ± 0.25 % $R$ |

**Note**

[1] The quoted IEC standards are also released as EN standards with the same number and identical contents.

## DIMENSIONS

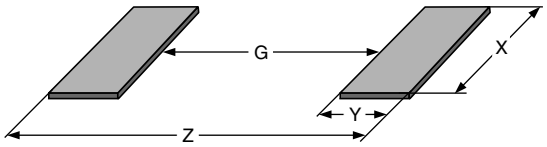



| DIMENSIONS AND MASS | | | | | | |
|---|---|---|---|---|---|---|
| TYPE / SIZE | L (mm) | D (mm) | $L_{1\ min.}$ (mm) | $D_1$ (mm) | K (mm) | MASS (mg) |
| SMM0102<br>OMM0102 | 2.2 + 0 / - 0.15 | 1.1 + 0 / - 0.1 | 1.2 | D + 0 / - 0.1 | 0.4 ± 0.05 | 7 |

**Notes**

- Color code marking is applied according to IEC 60062 (1) in four bands (E24 series) or five bands (E96 series). Each color band appears as a single solid line, voids are permissible if at least $^2/_3$ of the band is visible from each radial angle of view. The last color band for tolerance is approximately 50 % wider than the other bands. An interrupted band between the 4th and 5th full band indicates the temperature coefficient.
- Zero ohm jumper are marked with one centered black band.

## PATTERN STYLES FOR MELF RESISTORS




| RECOMMENDED SOLDER PAD DIMENSIONS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| TYPE / SIZE | WAVE SOLDERING | | | | REFLOW SOLDERING | | | |
| | G (mm) | Y (mm) | X (mm) | Z (mm) | G (mm) | Y (mm) | X (mm) | Z (mm) |
| SMM0102<br>OMM0102 | 0.7 | 1.2 | 1.5 | 3.1 | 1.1 | 0.8 | 1.3 | 2.7 |

**Notes**

- The given solder pad dimensions reflect the considerations for board design and assembly as outlined e.g. in standards IEC 61188-5-x (1), or in publication IPC-7351.

(1) The quoted IEC standards are also released as EN standards with the same number and identical contents.

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