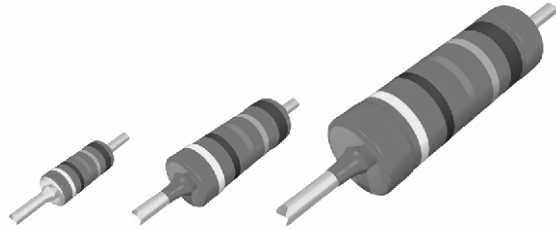


Professional Thin Film Leaded Resistors



DESCRIPTION

MBA/SMA 0204, MBB/SMA 0207 and MBE/SMA 0414 professional leaded thin film resistors are the general purpose resistor for all fields of professional electronics where reliability and stability is of major concern. Typical applications include industrial, telecommunication and medical equipment.

FEATURES

- Available in standard version or CECC version (approved according to EN 140101-806)
- Advanced thin film technology
- Power dissipation rating up to 1 W
- Excellent overall stability: Class 0.25
- Wide professional range: 0.22 Ω to 22 M Ω
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compliant to RoHS directive 2002/95/EC
- AEC-Q200 qualified available



RoHS
COMPLIANT

APPLICATIONS

- Industrial
- Telecommunication
- Medical equipment

METRIC SIZE

| DIN | 0204 | 0207 | 0414 |
|------|------|------|------|
| CECC | A | B | D |

TECHNICAL SPECIFICATIONS

| DESCRIPTION | MBA/SMA 0204 | | MBB/SMA 0207 | | MBE/SMA 0414 | |
|--|---|------------------|---|------------------|--------------------------------|------------------|
| CECC Size | A | | B | | D | |
| Resistance Range | 0.22 Ω to 10 M Ω ; 0 Ω | | 0.22 Ω to 22 M Ω ; 0 Ω | | 0.22 Ω to 22 M Ω | |
| Resistance Tolerance | $\pm 5\%$; $\pm 1\%$; $\pm 0.5\%$ | | | | | |
| Temperature Coefficient | ± 50 ppm/K; ± 25 ppm/K | | | | | |
| Operation Mode | Long term | Standard | Long term | Standard | Long term | Standard |
| Climatic Category (LCT/UCT/Days) | 55/125/56 | 55/155/56 | 55/125/56 | 55/155/56 | 55/125/56 | 55/155/56 |
| Rated Dissipation, P_{70} | 0.25 W | 0.4 W | 0.4 W | 0.6 W | 0.65 W | 1.0 W |
| Operating Voltage, U_{max} AC/DC | 200 V | | 350 V | | 500 V | |
| Film Temperature | 125 $^{\circ}$ C | 155 $^{\circ}$ C | 125 $^{\circ}$ C | 155 $^{\circ}$ C | 125 $^{\circ}$ C | 155 $^{\circ}$ C |
| Max. Resistance Change at P_{70} for Resistance Range, $\Delta R/R$ max., After: | 1 Ω to 332 k Ω | | 1 Ω to 1 M Ω | | 1 Ω to 2.4 M Ω | |
| 1000 h | $\leq 0.25\%$ | $\leq 0.5\%$ | $\leq 0.25\%$ | $\leq 0.5\%$ | $\leq 0.2\%$ | $\leq 0.4\%$ |
| 8000 h | $\leq 0.5\%$ | $\leq 1.0\%$ | $\leq 0.5\%$ | $\leq 1.0\%$ | $\leq 0.4\%$ | $\leq 0.8\%$ |
| 225 000 h | $\leq 1.5\%$ | - | $\leq 1.5\%$ | - | $\leq 1.2\%$ | - |
| Permissible Voltage Against Ambient (Insulation): | | | | | | |
| 1 Minute; U_{ins} | 300 V | | 500 V | | 800 V | |
| Continuous | 75 V | | 75 V | | 75 V | |
| Failure Rate: FIT _{observed} | $\leq 0.1 \times 10^{-9}/h$ | | $\leq 0.1 \times 10^{-9}/h$ | | $\leq 0.1 \times 10^{-9}/h$ | |

Notes

- MB_ series has been merged with the related SMA series to form one series "MB_/SMA_"
- 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.



| PART NUMBER AND PRODUCT DESCRIPTION - STANDARD PRODUCTS (1) | | | | | | | | | | | | | | | | | |
|--|---|---------------------------------|---|--|---|---|--|---------------------------------|---|---|---|---|---|---|---|---|---|
| PART NUMBER: MBB02070C1001FCT00 | | | | | | | | | | | | | | | | | |
| M | B | B | 0 | 2 | 0 | 7 | 0 | C | 1 | 0 | 0 | 1 | F | C | T | 0 | 0 |
| MODEL/SIZE MBA0204 = MBA/SMA 0204 MBB0207 = MBB/SMA 0207 MBE0414 = MBE/SMA 0414 | VARIANT 0 = Neutral N = RB Radial 5 mm for MBB/SMA0207 S = UB Radial 2.5 mm for MBB/SMA0207 I = L0 Welding joint not lacquered for MBB/SMA 0207 B = KL Lacquered welding joint for MBA/SMA 0204 | | TCR/MATERIAL D = ± 25 ppm/K C = ± 50 ppm/K Z = Jumper | VALUE 3 digit value 1 digit multiplier MULTIPLIER 7 = *10 ⁻³ 2 = *10 ² 8 = *10 ⁻² 3 = *10 ³ 9 = *10 ⁻¹ 4 = *10 ⁴ 0 = *10 ⁰ 5 = *10 ⁵ 1 = *10 ¹ 6 = *10 ⁶ 0000 = Jumper | | TOLERANCE D = ± 0.5 % F = ± 1 % J = ± 5 % Z = Jumper | PACKAGING (2) CT C1 RP R2 R4 N4 | SPECIAL 00 = Standard | | | | | | | | | |
| PRODUCT DESCRIPTION: MBB/SMA 0207-50 1% CT 1K0 | | | | | | | | | | | | | | | | | |
| MBB/SMA 0207 | - | 50 | 1% | CT | 1K0 | | | | | | | | | | | | |
| MODEL/SIZE MBA/SMA 0204 MBB/SMA 0207 MBE/SMA 0414 | | TCR ± 25 ppm/K ± 50 ppm/K | TOLERANCE ± 0.5 % ± 1.0 % ± 5.0 % | VARIANT RB UB L0 KL | PACKAGING (2) CT C1 RP R2 R4 N4 | RESISTANCE 1K0 = 1 kΩ 51R1 = 51.1 Ω | | | | | | | | | | | |

| TEMPERATURE COEFFICIENT AND RESISTANCE RANGE - STANDARD PRODUCTS (1) | | | | |
|--|-----------|------------------------------------|------------------------------------|-----------------------|
| DESCRIPTION | | RESISTANCE VALUE (3) | | |
| TCR | TOLERANCE | MBA/SMA 0204 | MBB/SMA 0207 | MBE/SMA 0414 |
| ± 50 ppm/K | ± 5 % | 0.22 Ω to 0.91 Ω | 0.22 Ω to 0.91 Ω 11 MΩ to 22 MΩ | 0.22 Ω to 0.91 Ω |
| | ± 2% | - | 0.22 Ω to 0.91 Ω | - |
| | ± 1 % | 1 Ω to 10 MΩ | 1 Ω to 10 MΩ | 1 Ω to 22 MΩ |
| | ± 0.5 % | 10 Ω to 475 kΩ | 10 Ω to 1 MΩ | 10 Ω to 2.4 MΩ |
| ± 25 ppm/K | ± 1 % | 10 Ω to 475 kΩ | 10 Ω to 1 MΩ | 10 Ω to 2.4 MΩ |
| | ± 0.5 % | 10 Ω to 475 kΩ | 10 Ω to 1 MΩ | 10 Ω to 2.4 MΩ |
| Jumper | - | ≤ 10 mΩ; I _{max.} = 3.0 A | ≤ 10 mΩ, I _{max.} = 5.0 A | - |

Notes

- (1) Standard products are not CECC approved
- (2) Please refer to table PACKAGING for complete information
- (3) Resistance value to be selected from E24 series for ± 5 %, ± 2 % tolerance, from E24/E96 series for ± 1 % tolerance and from E24/E192 for ± 0.5 % tolerance
- Resistance ranges printed in bold are preferred TCR/tolerance combinations with optimized availability
- The PART NUMBER shown above is to facilitate the unified part numbering system for ordering products



| PART NUMBER AND PRODUCT DESCRIPTION - CECC APPROVED PRODUCTS (1) | | | | | | | | | | | | | | | | | |
|---|-------------|--|--------------------------|--|-------------------------------|---|---|----------------------|----------------------|---|-----------------------------|---|---|---|---|---|---|
| PART NUMBER: MBB0207VC1001FCT00 | | | | | | | | | | | | | | | | | |
| M | B | B | 0 | 2 | 0 | 7 | V | C | 1 | 0 | 0 | 1 | F | C | T | 0 | 0 |
| MODEL/SIZE | VARIANT | TCR/MATERIAL | | VALUE | | | TOLERANCE | PACKAGING (2) | | SPECIAL | | | | | | | |
| MBA0204 = MBA/SMA 0204 MBB0207 = MBB/SMA 0207 MBE0414 = MBE/SMA 0414 | V = CECC 06 | D = ± 25 ppm/K C = ± 50 ppm/K Z = Jumper | | 3 digit value 1 digit multiplier MULTIPLIER 7 = *10 ⁻³ 2 = *10 ² 8 = *10 ⁻² 3 = *10 ³ 9 = *10 ⁻¹ 4 = *10 ⁴ 0 = *10 ⁰ 5 = *10 ⁵ 1 = *10 ¹ 6 = *10 ⁶ 0000 = Jumper | | | D = ± 0.5 % F = ± 1 % J = ± 5 % Z = Jumper | CT C1 RP R2 | | 00 = Standard L0 = Welding joint not lacquered for MBB/SMA 0207 KL = Lacquered welding joint for MBA/SMA 0204 | | | | | | | |
| PRODUCT DESCRIPTION: MBB/SMA 0207-50 1 % CECC 06 CT 1K0 | | | | | | | | | | | | | | | | | |
| MBB/SMA 0207 | | - | 50 | | 1 % | | CECC 06 | | CT | | 1K0 | | | | | | |
| MODEL/SIZE | | | TCR | | TOLERANCE | | VARIANT | | PACKAGING (2) | | RESISTANCE | | | | | | |
| MBA/SMA 0204 MBB/SMA 0207 MBE/SMA 0414 | | | ± 25 ppm/K ± 50 ppm/K | | ± 0.5 % ± 1.0 % ± 5.0 % | | CECC 06 CECC 06 L0 CECC 06 KL | | CT C1 RP R2 | | 1K0 = 1 kΩ 51R1 = 51.1 Ω | | | | | | |

| TEMPERATURE COEFFICIENT AND RESISTANCE RANGE - CECC APPROVED PRODUCTS (1) | | | | |
|---|-----------|------------------------------------|------------------------------------|------------------------|
| DESCRIPTION | | RESISTANCE VALUE (3) | | |
| TCR | TOLERANCE | MBA/SMA 0204 | MBB/SMA 0207 | MBE/SMA 0414 |
| ± 50 ppm/K | ± 5 % | 0.22 Ω to 0.91 Ω | 0.22 Ω to 0.91 Ω 11 MΩ to 22 MΩ | 0.22 Ω to 0.91 Ω |
| | ± 1 % | 1 Ω to 10 MΩ | 1 Ω to 10 MΩ | 1 Ω to 22 MΩ |
| | ± 0.5 % | 10 Ω to 332 kΩ | 10 Ω to 1 MΩ | 10 Ω to 2.43 MΩ |
| ± 25 ppm/K | ± 1 % | 10 Ω to 475 kΩ | 10 Ω to 1 MΩ | 10 Ω to 2.43 MΩ |
| | ± 0.5 % | 10 Ω to 332 kΩ | 10 Ω to 1 MΩ | 10 Ω to 2.43 MΩ |
| Jumper | - | ≤ 10 mΩ; I _{max.} = 3.0 A | ≤ 10 mΩ, I _{max.} = 5.0 A | - |

Notes

- (1) Approval is according to EN 140101-806, version A
- (2) Please refer to table PACKAGING for complete information
- (3) Resistance value to be selected from E24 series for ± 5 %, ± 2 % tolerance, from E24/E96 series for ± 1 % tolerance and from E24/E192 for ± 0.5 % tolerance
- Resistance ranges printed in bold are preferred TCR/tolerance combinations with optimized availability
- The PART NUMBER shown above is to facilitate the unified part numbering system for ordering products
- Radial version (RB, UB) cannot be qualified according to CECC so these can only be ordered as standard products



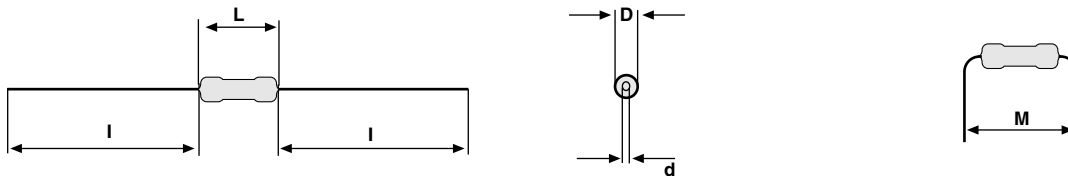
MBA/SMA 0204, MBB/SMA 0207, MBE/SMA 0414 - Professional

Professional Thin Film Leaded Resistors

Vishay Beyschlag

| PACKAGING - Axial products | | | | |
|----------------------------|---------------------------------|------|--------------------------------|----------|
| MODEL | REEL TAPING ACC. IEC 60286-1 | | BOX TAPING ACC. IEC 60286-1 | |
| | PIECES | CODE | PIECES | CODE |
| MBA/SMA 0204 | 5000 | RP | 1000 5000 | C1 CT |
| MBB/SMA 0207 | 5000 | RP | 1000 5000 | C1 CT |
| MBE/SMA 0414 | 2500 | R2 | 1000 | C1 |

DIMENSIONS



| DIMENSIONS - Leaded resistor types, mass and relevant physical dimensions | | | | | | |
|---|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|--------------|
| TYPE | D _{max.} (mm) | L _{max.} (mm) | d _{nom.} (mm) | l _{min.} (mm) | M _{min.} (mm) | MASS (mg) |
| MBA/SMA 0204 | 1.6 | 3.6 | 0.5 | 29.0 | 5.0 | 125 |
| MBB/SMA 0207 | 2.5 | 6.5 | 0.6 | 28.0 | 10.0 ⁽¹⁾ | 220 |
| MBE/SMA 0414 | 4.2 | 11.9 | 0.8 | 31.0 | 15.0 | 700 |

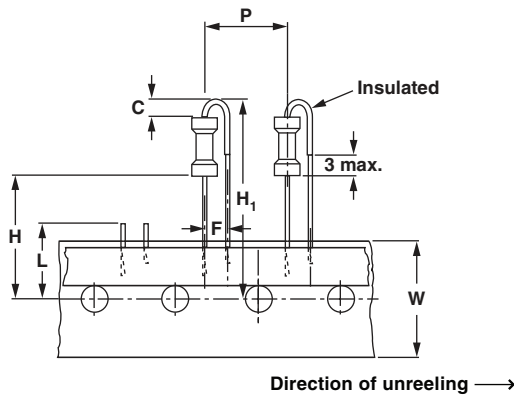
Note

⁽¹⁾ For $7.5 \leq M < 10.0$ mm, use version MBB/SMA 0207 ... L0 (welding joint not lacquered)

| PACKAGING - Radial products | | | | |
|-----------------------------|---------------------------------|------|--------------------------------|------|
| MODEL | REEL TAPING ACC. IEC 60286-2 | | BOX TAPING ACC. IEC 60286-2 | |
| | PIECES | CODE | PIECES | CODE |
| MBB/SMA 0207 RB | 4000 | R4 | 4000 | N4 |
| MBB/SMA 0207 UB | | | | |

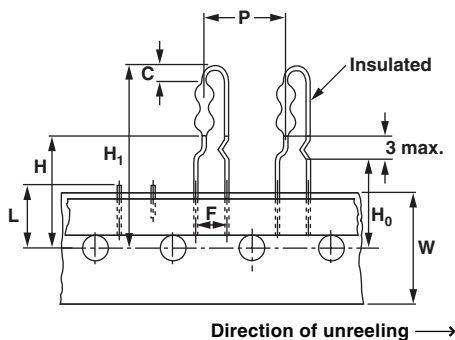
MBB/SMA 0207 WITH RADIAL TAPING

LEAD SPACING (UB = 2.5 mm), SIZE 0207



| DIMENSIONS in millimeters | | |
|-----------------------------|----------------|-------------------|
| Pitch of components | P | 12.7 ± 1.0 |
| Lead spacing | F | 2.5 + 0.6, - 0.1 |
| Width of carrier tape | W | 18.0 + 1.0, - 0.5 |
| Body to hole center | H | 18.0 ± 2.0 |
| Height for cutting (max.) | L | 11 |
| Height for bending | C | 2.5 + 0, - 0.5 |
| Height for insertion (max.) | H ₁ | 32 |

LEAD SPACING (RB = 5.0 mm), SIZE 0207



| DIMENSIONS in millimeters | | |
|-----------------------------|----------------|-------------------|
| Pitch of components | P | 12.7 ± 1.0 |
| Lead spacing | F | 5.0 + 0.6, - 0.1 |
| Width of carrier tape | W | 18.0 + 1.0, - 0.5 |
| Body to hole center | H | 18.0 ± 2.0 |
| Lead crimp to hole center | H ₀ | 16.0 ± 0.5 |
| Height for cutting (max.) | L | 11 |
| Height for bending | C | 2.5 + 0, - 0.5 |
| Height for insertion (max.) | H ₁ | 32 |



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 and conditioned to achieve the desired temperature coefficient. 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 ceramics. Connecting wires of electrolytic copper plated with 100 % pure tin are welded to the termination caps. The resistor elements are covered by a light blue protective coating designed for electrical, mechanical and climatic protection. Four or five color code rings designate the resistance value and tolerance in accordance with **IEC 60062**.

The result of the determined production is verified by an extensive testing procedure performed on 100 % of the individual resistors. Only accepted products are stuck directly on the adhesive tapes in accordance with **IEC 60286-1** or for the radial versions in accordance to **IEC 60286-2**.

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 has been proven under extensive testing.

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, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system.

All products comply with **GADSL** ⁽¹⁾ and the **CEFIC-EECA-EICTA** ⁽²⁾ list of legal restrictions on hazardous substances. This includes full compliance with the following directives:

Notes

⁽¹⁾ Global Automotive Declarable Substance List, see www.gadsl.org

⁽²⁾ CEFIC (European Chemical Industry Council), EECA (European Electronic Component Manufacturers Association), EICTA (European trade organisation representing the information and communications technology and consumer electronics), see www.eicta.org/index.php?id=1053&id_article=340

- 2000/53/EC End of Vehicle Life Directive (ELV) and Annex II (ELVII)
- 2002/95/EC Restriction of the use of Hazardous Substances Directive (RoHS)
- 2002/96/EC Waste Electrical and Electrical Equipment Directive (WEEE)

APPROVALS

The resistors (CECC version) are approved within the IECQ-CECC Quality Assessment System for Electronic Components to the detail specification **EN 140101-806** which refers to **EN 60115-1** and **EN 140100** and the variety of environmental test procedures of the **IEC 60068** series. Conformity is attested by the use of the **CECC** logo (E) as the Mark of Conformity on the package label for the CECC version.

Vishay BEYSCHLAG has achieved "**Approval of Manufacturer**" in accordance with **IEC QC 001002-3, clause 2**. The release certificate for "**Technology Approval Schedule**" in accordance with **CECC 240001** based on **IEC QC 001002-3, clause 6** is granted for the Vishay BEYSCHLAG manufacturing process.

RELATED PRODUCTS

This product family of leaded thin film resistors for professional applications is complemented by **Zero Ohm Jumpers**.

For a correlated range of precision TCR and tolerance specifications see the datasheet:

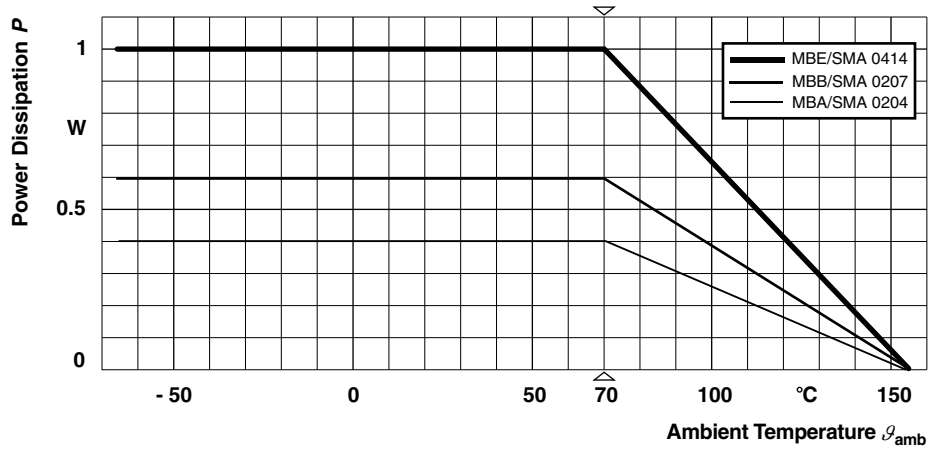
- "Precision Thin Film Leaded Resistors", document no. 28767

For products approved to EN 140101-806, version E, with established reliability and failure rate level E7 (Quality factor $\pi_Q = 0.1$), see the datasheet:

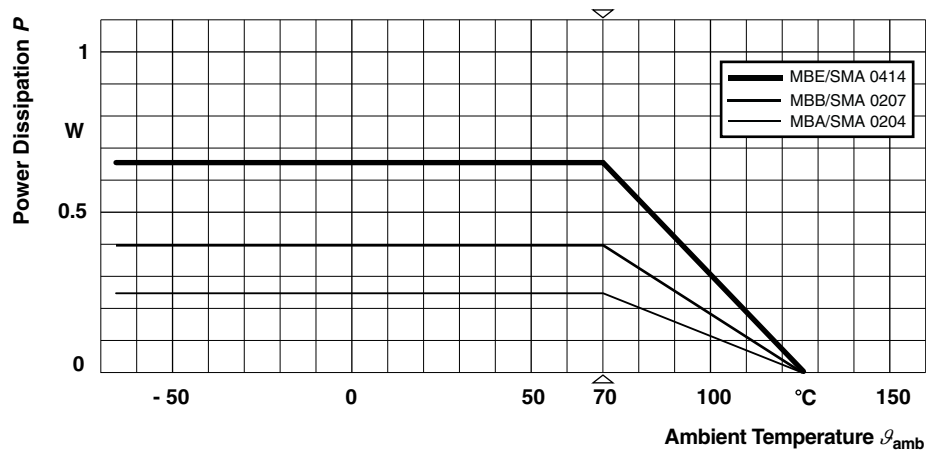
- "Established Reliability Thin Film Leaded Resistors", document no. 28768



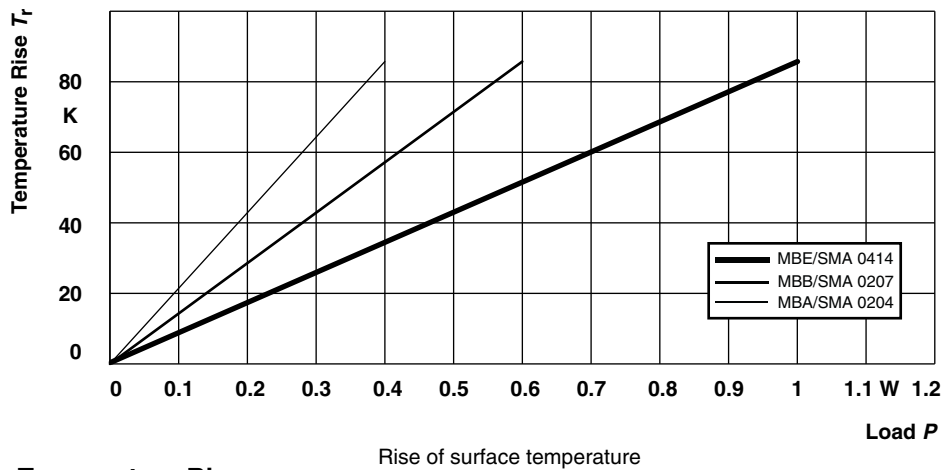
FUNCTIONAL PERFORMANCE



Derating - Standard Operation



Derating Long Term Operation



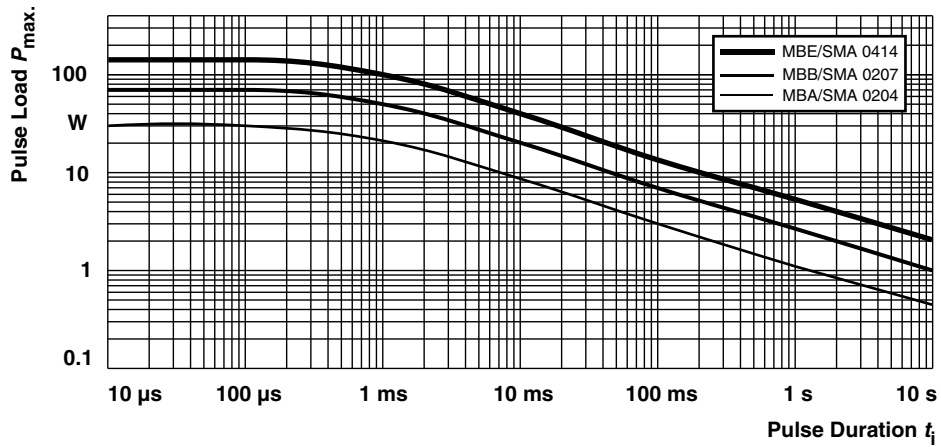
Temperature Rise



MBA/SMA 0204, MBB/SMA 0207, MBE/SMA 0414 - Professional

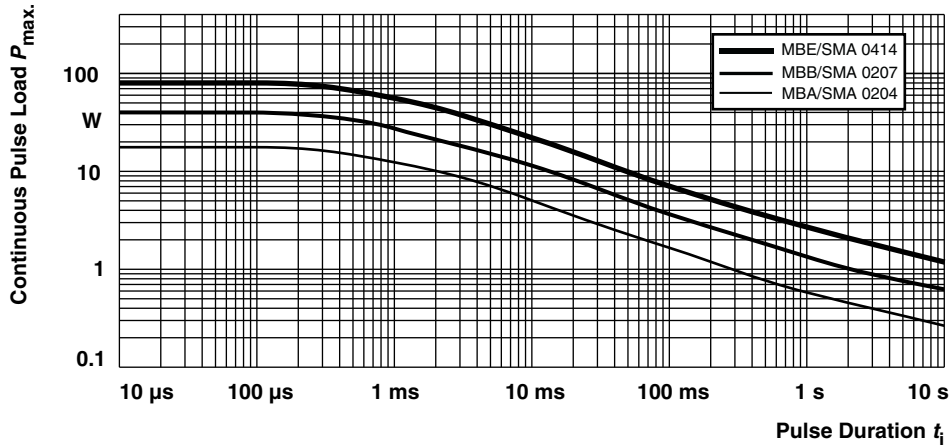
Professional Thin Film Leaded Resistors

Vishay Beyschlag



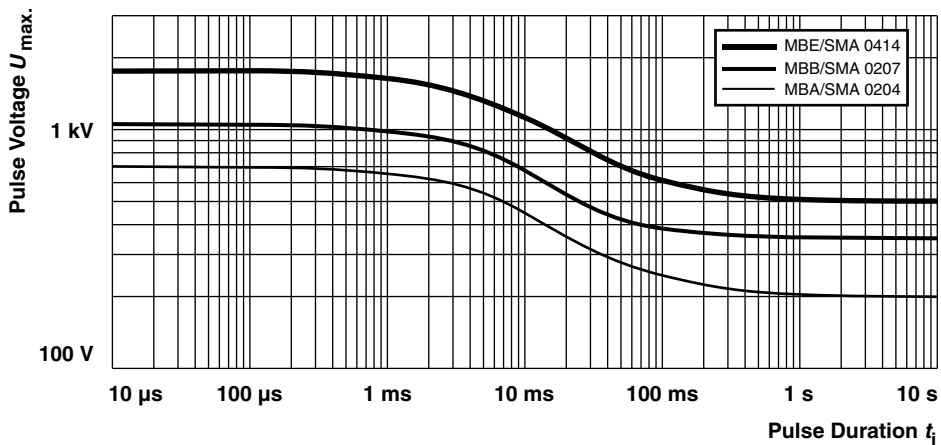
Maximum pulse load, single pulse; for permissible resistance change equivalent to 8000 h operation.

Single Pulse



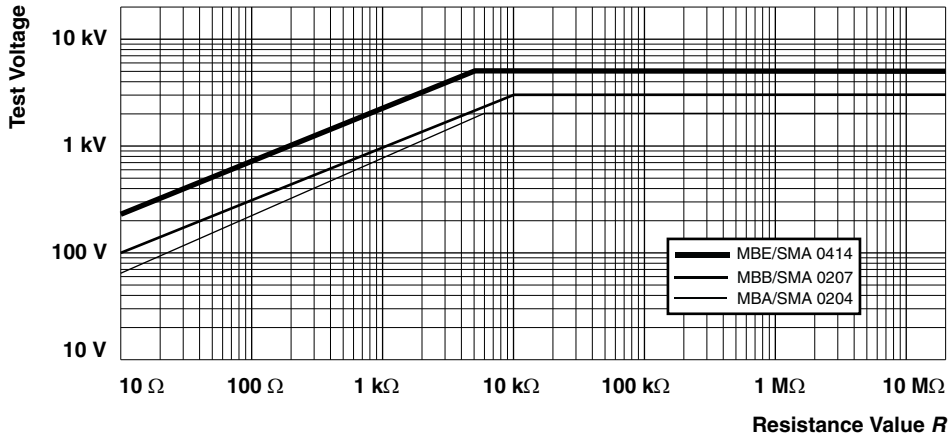
Maximum pulse load, continuous pulses; for permissible resistance change equivalent to 8000 h operation.

Continuous Pulse



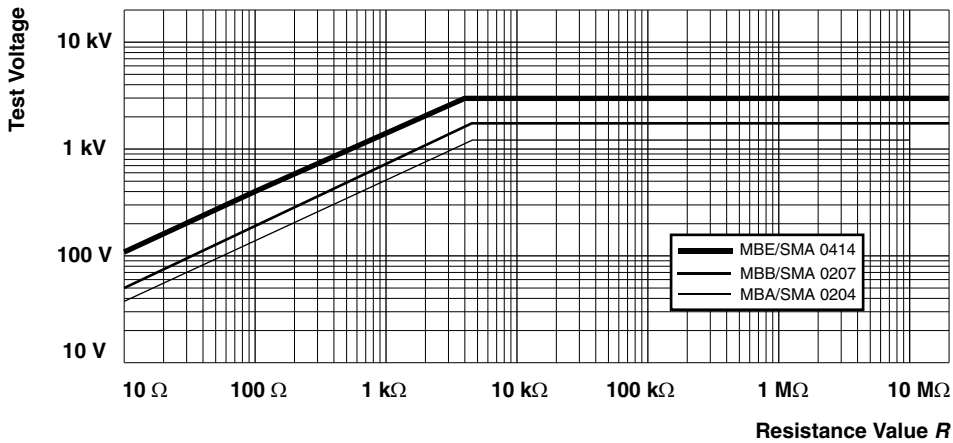
Maximum pulse voltage, single and continuous pulses; for permissible resistance change equivalent to 8000 h operation.

Pulse Voltage



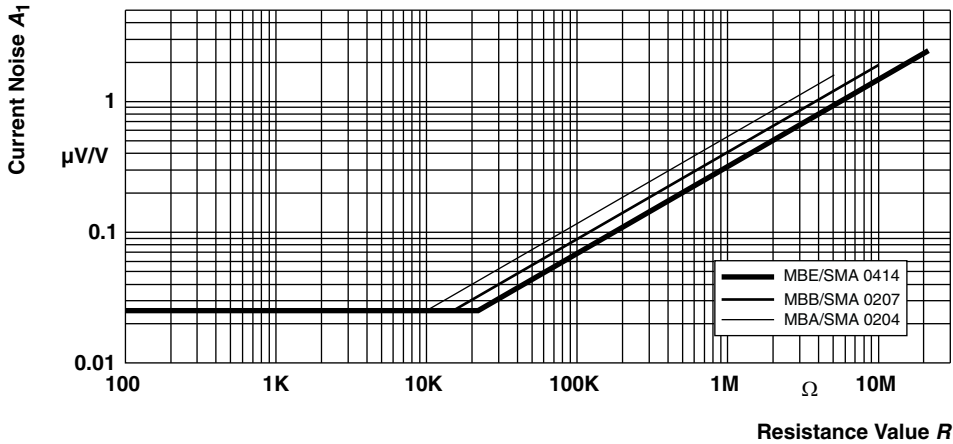
Pulse load rating in accordance with IEC 60115-1, 4.27; 1.2 μs/50 μs; 5 pulses at 12 s intervals; for permissible resistance change 0.5 %.

1.2/50 Pulse



Pulse load rating in accordance with IEC 60115-1, 4.27; 10 μs/700 μs; 10 pulses at 1 minute intervals; for permissible resistance change 0.5 %.

10/700 Pulse



Current noise - A₁ in accordance with IEC 60195



TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the following specifications:

- EN 60115-1, generic specification (includes tests)
 - EN 140100, sectional specification (includes schedule for qualification approval)
 - EN 140101-806 (successor of CECC 40101-806), detail specification (includes schedule for conformance inspection)
- The Test and Requirements table contains only the most important tests. For the full test schedule refer to the documents listed above. The testing also covers most of the requirements specified by EIA/IS-703 and JIS-C-5202.
- 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, 5.3. 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: 45 % 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 (ΔR max.) | | |
| | | | Stability for product types: | STABILITY CLASS 0.5 | STABILITY CLASS 1 | STABILITY CLASS 2 |
| | | | MBA/SMA 0204 | 1 Ω to 332 k Ω | 0.22 Ω to < 1 Ω | > 332 k Ω |
| | | | MBB/SMA 0207 | 1 Ω to 1 M Ω | 0.22 Ω to < 1 Ω | > 1 M Ω |
| | | | MBE/SMA 0414 | 1 Ω to 2.4 M Ω | 0.22 Ω to < 1 Ω | > 2.4 M Ω |
| 4.5 | - | Resistance | | $\pm 5 \% R$; $\pm 1 \% R$; $\pm 0.5 \% R$ | | |
| 4.8 | - | Temperature coefficient | At (20/LCT/20) °C and (20/UCT/20) °C | ± 50 ppm/K; ± 25 ppm/K | | |
| 4.25.1 | - | Endurance at 70 °C: Standard operation mode | $U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; 1.5 h ON; 0.5 h OFF 70 °C; 1000 h 70 °C; 8000 h | $\pm (0.5 \% R + 0.05 \Omega)^{(1)}$ $\pm (1 \% R + 0.05 \Omega)^{(2)}$ | $\pm 0.5 \% R$ $\pm 1 \% R$ | |
| | - | Endurance at 70 °C: Long term operation mode | $U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; 1.5 h ON; 0.5 h OFF 70 °C; 1000 h 70 °C; 8000 h | $\pm (0.25 \% R + 0.05 \Omega)^{(3)}$ $\pm (0.5 \% R + 0.05 \Omega)^{(4)}$ | $\pm 0.25 \% R$ $\pm 0.5 \% R$ | |
| 4.25.3 | - | Endurance at upper category temperature | 125 °C; 1000 h | $\pm (0.25 \% R + 0.05 \Omega)$ | $\pm (0.5 \% R + 0.05 \Omega)$ | $\pm 1 \% R$ |
| | 155 °C; 1000 h | | $\pm (0.5 \% R + 0.05 \Omega)$ | $\pm (1 \% R + 0.05 \Omega)$ | $\pm 2 \% R$ | |
| 4.24 | 78 (Cab) | Damp heat, steady state | (40 \pm 2) °C; 56 days; (93 \pm 3) % RH | $\pm (0.5 \% R + 0.05 \Omega)$ | $\pm (1 \% R + 0.05 \Omega)$ | $\pm 2 \% R$ |



| TEST PROCEDURES AND REQUIREMENTS | | | | | | |
|----------------------------------|---|--|---|---|--|-------------------------------------|
| IEC 60115-1 CLAUSE | IEC 60068-2- TEST METHOD | TEST | PROCEDURE | REQUIREMENTS PERMISSIBLE CHANGE (ΔR max.) | | |
| | | | Stability for product types: | STABILITY CLASS 0.5 | STABILITY CLASS 1 | STABILITY CLASS 2 |
| | | | MBA/SMA 0204 | 1 Ω to 332 k Ω | 0.22 Ω to < 1 Ω | > 332 k Ω |
| | | | MBB/SMA 0207 | 1 Ω to 1 M Ω | 0.22 Ω to < 1 Ω | > 1 M Ω |
| | | | MBE/SMA 0414 | 1 Ω to 2.4 M Ω | 0.22 Ω to < 1 Ω | > 2.4 M Ω |
| 4.23 | | Climatic sequence: | | | | |
| 4.23.2 | 2 (Ba) | Dry heat | 155 °C; 16 h | | | |
| 4.23.3 | 30 (Db) | Damp heat, cyclic | 55 °C; 24 h; 90 % to 100 % RH; 1 cycle | | | |
| 4.23.4 | 1 (Aa) | Cold | - 55 °C; 2 h | | | |
| 4.23.5 | 13 (M) | Low air pressure | 8.5 kPa; 2 h; 15 °C to 35 °C | | | |
| 4.23.6 | 30 (Db) | Damp heat, cyclic | 55 °C; 5 days; 95 % to 100 % RH; 5 cycles | $\pm (0.5 \% R + 0.05 \Omega)$ no visible damage | $\pm (1 \% R + 0.05 \Omega)$ no visible damage | $\pm 2 \% R$ no visible damage |
| 4.13 | - | Short time overload | Room temperature; $U = 2.5 \times \sqrt{P_{70}} \times R$ or $U = 2 \times U_{max.}; 5 s$ | $\pm (0.1 \% R + 0.01 \Omega)$ no visible damage | $\pm (0.25 \% R + 0.05 \Omega)$ no visible damage | $\pm 0.5 \% R$ no visible damage |
| 4.19 | 14 (Na) | Rapid change of temperature | 30 min at LCT = - 55 °C 30 min at UCT = 155 °C 5 cycles | $\pm (0.1 \% R + 0.01 \Omega)$ | $\pm (0.25 \% R + 0.05 \Omega)$ | $\pm 0.5 \% R$ |
| | | | MBA/SMA 0204: 500 cycles MBB/SMA 0207: 200 cycles MBE/SMA 0414: 100 cycles | $\pm (0.5 \% R + 0.05 \Omega)$ | $\pm (0.5 \% R + 0.05 \Omega)$ | $\pm (0.5 \% R + 0.05 \Omega)$ |
| 4.29 | 45 (XA) | Component solvent resistance | Isopropyl alcohol + 23 °C; toothbrush method | Marking legible; no visible damage | | |
| 4.18.2 | 20 (Tb) | Resistance to soldering heat | Unmounted components; (260 \pm 3) °C; (10 \pm 1) s | $\pm (0.1 \% R + 0.01 \Omega)$ no visible damage | $\pm (0.25 \% R + 0.05 \Omega)$ no visible damage | $\pm 0.5 \% R$ no visible damage |
| 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 | | | |
| 4.22 | 6 (B4) | Vibration | 6 h; 10 Hz to 2000 Hz 1.5 mm or 196 m/s ² | $\pm (0.1 \% R + 0.01 \Omega)$ | $\pm (0.25 \% R + 0.05 \Omega)$ | $\pm 0.5 \% R$ |
| 4.16 | 21 (Ua ₁) 21 (Ub) 21 (Uc) | Robustness of terminations | Tensile, bending and torsion | $\pm (0.1 \% R + 0.01 \Omega)$ | $\pm (0.25 \% R + 0.05 \Omega)$ | $\pm 0.5 \% R$ |
| 4.7 | - | Voltage proof | $U_{RMS} = U_{ins}; 60 s$ | No flashover or breakdown | | |
| 4.40 | - | Electrostatic discharge (human body model) | IEC 61340-3-1; 3 pos. + 3 neg. MBA/SMA 0204: 2 kV MBB/SMA 0207: 4 kV MBE/SMA 0414: 6 kV | $\pm (0.5 \% R + 0.05 \Omega)$ | | |

Note

- (1) $\pm (0.4 \% R + 0.05 \Omega)$ for MBE/SMA 0414
- (2) $\pm (0.8 \% R + 0.05 \Omega)$ for MBE/SMA 0414
- (3) $\pm (0.2 \% R + 0.05 \Omega)$ for MBE/SMA 0414
- (4) $\pm (0.4 \% R + 0.05 \Omega)$ for MBE/SMA 0414



HISTORICAL 12NC INFORMATION

- The resistors had a 12-digit numeric code starting with 2312
- The subsequent 4 digits indicated the resistor type, specification and packaging; see the 12NC table
- The remaining 4 digits indicated the resistance value:
 - The first 3 digits indicated the resistance value
 - The last digit indicated the resistance decade in accordance with resistance decade table

Resistance Decade

| RESISTANCE DECADE | LAST DIGIT |
|-------------------|------------|
| 0.1 Ω to 0.999 Ω | 7 |
| 1 Ω to 9.99 Ω | 8 |
| 10 Ω to 99.9 Ω | 9 |
| 100 Ω to 999 Ω | 1 |
| 1 kΩ to 9.99 kΩ | 2 |
| 10 kΩ to 99.9 kΩ | 3 |
| 100 kΩ to 999 kΩ | 4 |
| 1 MΩ to 9.99 MΩ | 5 |
| 10 MΩ to 99.9 MΩ | 6 |

Historical 12NC Example

The 12NC code of a MBA 0204 resistor, value 47.5 kΩ and TCR 50 with ± 1 % tolerance, supplied on bandolier in a box of 5000 units was: 2312 905 14753.

| HISTORICAL 12NC - Resistor type and packaging | | | | | | | |
|--|------------|---------|---------------|---------------|---------------|---------------|---------------|
| DESCRIPTION | | | 2312 | | | | |
| | | | AMMOPACK | | REEL | | |
| TYPE | TCR | TOL. | C1 1000 units | CT 5000 units | R1 1000 units | R2 2500 units | RP 5000 units |
| MBA 0204 | ± 50 ppm/K | ± 5 % | 900 3.... | 905 3.... | 700 3.... | - | 805 3.... |
| | | ± 1 % | 900 1.... | 905 1.... | 700 1.... | - | 805 1.... |
| | | ± 0.5 % | 900 5.... | 905 5.... | 700 5.... | - | 805 5.... |
| | ± 25 ppm/K | ± 1 % | 901 1.... | 906 1.... | 701 1.... | - | 806 1.... |
| | | ± 0.5 % | 901 5.... | 906 5.... | 701 5.... | - | 806 5.... |
| | Jumper | - | 900 90001 | 905 90001 | 700 90001 | - | 805 90001 |
| MBB 0207 | ± 50 ppm/K | ± 5 % | 910 3.... | 915 3.... | 710 3.... | - | 815 3.... |
| | | ± 1 % | 910 1.... | 915 1.... | 710 1.... | - | 815 1.... |
| | | ± 0.5 % | 910 5.... | 915 5.... | 710 5.... | - | 815 5.... |
| | ± 25 ppm/K | ± 1 % | 911 1.... | 916 1.... | 711 1.... | - | 816 1.... |
| | | ± 0.5 % | 911 5.... | 916 5.... | 711 5.... | - | 816 5.... |
| | Jumper | - | 910 90001 | 915 90001 | 710 90001 | - | 815 90001 |
| MBE 0414 | ± 50 ppm/K | ± 5 % | 920 3.... | - | - | 825 3.... | - |
| | | ± 1 % | 920 1.... | - | - | 825 1.... | - |
| | | ± 0.5 % | 920 5.... | - | - | 825 5.... | - |
| | ± 25 ppm/K | ± 1 % | 921 1.... | - | - | 826 1.... | - |
| | | ± 0.5 % | 921 5.... | - | - | 826 5.... | - |



Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and/or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.

Material Category Policy

Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.

Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.

Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.