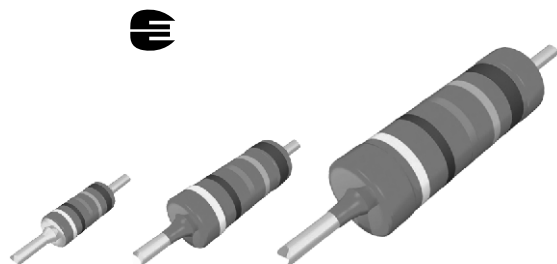


## Precision Thin Film Leaded Resistors



### DESCRIPTION

MBA/SMA 0204, MBB/SMA 0207 and MBE/SMA 0414 precision leaded thin film resistors combine the proven reliability of the professional products with an advanced level of precision and stability. Therefore they are perfectly suited for applications in the fields of test and measuring equipment along with industrial and medical electronics.

### FEATURES

- IECQ-CECC approved according to EN 140101-806
- Advanced thin film technology
- Low TCR:  $\pm 15$  ppm/K to  $\pm 25$  ppm/K
- Precision tolerance of value:  $\pm 0.1\%$  and  $\pm 0.25\%$
- Superior overall stability: Class 0.05
- Wide precision range:  $10\ \Omega$  to  $1.5\ \text{M}\Omega$
- Lead (Pb)-free termination wire
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



### APPLICATIONS

- Test and measuring equipment
- Industrial electronics
- Medical electronics

### 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                                                                   | 22 Ω to 332 kΩ              |           | 10 Ω to 1 MΩ    |           | 22 Ω to 1.5 MΩ  |           |          |
| Resistance Tolerance                                                               | ± 0.25 %; ± 0.1 %           |           |                 |           |                 |           |          |
| Temperature Coefficient                                                            | ± 25 ppm/K; ± 15 ppm/K      |           |                 |           |                 |           |          |
| Operation Mode                                                                     | Precision                   | Standard  | Precision       | Standard  | Precision       | Standard  |          |
| Climatic Category (LCT/UCT/Days)                                                   | 10/85/56                    | 55/125/56 | 10/85/56        | 55/125/56 | 10/85/56        | 55/125/56 |          |
| Rated Dissipation, $P_{70}$                                                        | 0.07 W                      | 0.25 W    | 0.11 W          | 0.40 W    | 0.17 W          | 0.65 W    |          |
| Operating Voltage, $U_{\text{max}}$ . AC/DC                                        | 200 V                       |           | 350 V           |           | 500 V           |           |          |
| Film Temperature                                                                   | 85 °C                       | 125 °C    | 85 °C           | 125 °C    | 85 °C           | 125 °C    |          |
| Max. Resistance Change at $P_{70}$ for Resistance Range, $\Delta R/R$ max., After: | 100 Ω to 100 kΩ             |           | 100 Ω to 270 kΩ |           | 100 Ω to 470 kΩ |           |          |
|                                                                                    | 1000 h                      | ≤ 0.05 %  | ≤ 0.25 %        | ≤ 0.03 %  | ≤ 0.15 %        | ≤ 0.05 %  | ≤ 0.25 % |
|                                                                                    | 8000 h                      | ≤ 0.1 %   | ≤ 0.5 %         | ≤ 0.1 %   | ≤ 0.5 %         | ≤ 0.1 %   | ≤ 0.5 %  |
|                                                                                    | 225 000 h                   | ≤ 0.3 %   | ≤ 1.5 %         | ≤ 0.3 %   | ≤ 1.5 %         | ≤ 0.3 %   | ≤ 1.5 %  |
| Permissible Voltage Against Ambient (Insulation):                                  |                             |           |                 |           |                 |           |          |
|                                                                                    | 1 Minute; $U_{\text{ins}}$  | 300 V     | 500 V           |           | 800 V           |           |          |
|                                                                                    | Continuous                  | 75 V      | 75 V            |           | 75 V            |           |          |
| Failure Rate: FIT <sub>observed</sub>                                              | ≤ 0.1 x 10 <sup>-9</sup> /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.



# MBA/SMA 0204, MBB/SMA 0207, MBE/SMA 0414 - Precision

Precision Thin Film Leaded Resistors

Vishay Beyschlag

## PART NUMBER AND PRODUCT DESCRIPTION - CECC APPROVED PRODUCTS <sup>(1)</sup>

PART NUMBER: MBB0207VD1001BCT00

M B B 0 2 0 7 V D 1 0 0 1 B C T 0 0

| TYPE/SIZE                                                                                                | VARIANT                                                                                                                    | TCR                                                    | RESISTANCE                                                                                                                                                                                                                                                                               | TOLERANCE                                         | PACKAGING                                                     | SPECIAL                                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>MBA0204</b> =<br>MBA/SMA 0204<br><b>MBB0207</b> =<br>MBB/SMA 0207<br><b>MBE0414</b> =<br>MBE/SMA 0414 | <b>V</b> = CECC 06<br><b>N</b> = RB Radial<br>5 mm for<br>MBB/SMA0207<br><b>S</b> = UB Radial<br>2.5 mm for<br>MBB/SMA0207 | <b>E</b> = $\pm 15$ ppm/K<br><b>D</b> = $\pm 25$ ppm/K | <b>3 digit value</b><br><b>1 digit multiplier</b><br><b>MULTIPLIER</b><br><b>8</b> = $\cdot 10^{-2}$ <b>2</b> = $\cdot 10^2$<br><b>9</b> = $\cdot 10^{-1}$ <b>3</b> = $\cdot 10^3$<br><b>0</b> = $\cdot 10^0$ <b>4</b> = $\cdot 10^4$<br><b>1</b> = $\cdot 10^1$ <b>5</b> = $\cdot 10^5$ | <b>B</b> = $\pm 0.1$ %<br><b>C</b> = $\pm 0.25$ % | <b>CT</b><br><b>C1</b><br><b>RP</b><br><b>R2</b><br><b>N4</b> | <b>00</b> = Standard<br><br><b>L0</b> = Welding joint<br>not lacquered for<br>MBB/SMA 0207<br><b>KL</b> = Lacquered<br>welding joint for<br>MBA/SMA 0204 |

PRODUCT DESCRIPTION: MBB/SMA 0207-25 0.1 % CECC 06 CT 1K0

|                                                                   |   |                                  |                             |                                                          |                                                               |                                                          |
|-------------------------------------------------------------------|---|----------------------------------|-----------------------------|----------------------------------------------------------|---------------------------------------------------------------|----------------------------------------------------------|
| <b>MBB/SMA 0207</b>                                               | - | <b>25</b>                        | <b>0.1 %</b>                | <b>CECC 06</b>                                           | <b>CT</b>                                                     | <b>1K0</b>                                               |
| TYPE/SIZE                                                         |   | TCR                              | TOLERANCE                   | VARIANT                                                  | PACKAGING                                                     | RESISTANCE                                               |
| <b>MBA/SMA 0204</b><br><b>MBB/SMA 0207</b><br><b>MBE/SMA 0414</b> |   | $\pm 15$ ppm/K<br>$\pm 25$ ppm/K | $\pm 0.1$ %<br>$\pm 0.25$ % | <b>CECC 06</b><br><b>CECC 06 L0</b><br><b>CECC 06 KL</b> | <b>CT</b><br><b>C1</b><br><b>RP</b><br><b>R2</b><br><b>N4</b> | <b>1K0</b> = 1 k $\Omega$<br><b>51R1</b> = 51.1 $\Omega$ |

## TEMPERATURE COEFFICIENT AND RESISTANCE RANGE - CECC APPROVED PRODUCTS <sup>(1)</sup>

| DESCRIPTION    |              | RESISTANCE RANGE <sup>(2)</sup>                           |                                                         |                                                           |
|----------------|--------------|-----------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------|
| TCR            | TOLERANCE    | MBA/SMA 0204                                              | MBB/SMA 0207                                            | MBE/SMA 0414                                              |
| $\pm 25$ ppm/K | $\pm 0.25$ % | <b>22 <math>\Omega</math> to 332 k<math>\Omega</math></b> | <b>10 <math>\Omega</math> to 1 M<math>\Omega</math></b> | <b>22 <math>\Omega</math> to 1.5 M<math>\Omega</math></b> |
|                | $\pm 0.1$ %  | <b>43 <math>\Omega</math> to 332 k<math>\Omega</math></b> | <b>10 <math>\Omega</math> to 1 M<math>\Omega</math></b> | <b>43 <math>\Omega</math> to 1 M<math>\Omega</math></b>   |
| $\pm 15$ ppm/K | $\pm 0.25$ % | 22 $\Omega$ to 221 k $\Omega$                             | 10 $\Omega$ to 1 M $\Omega$                             | 22 $\Omega$ to 1 M $\Omega$                               |
|                | $\pm 0.1$ %  | <b>43 <math>\Omega</math> to 221 k<math>\Omega</math></b> | <b>10 <math>\Omega</math> to 1 M<math>\Omega</math></b> | <b>43 <math>\Omega</math> to 1 M<math>\Omega</math></b>   |

### Notes

<sup>(1)</sup> Approval is according to EN 140101-806, version A

<sup>(2)</sup> Resistance values to be selected from E96 and E192 series, for other values please contact the factory

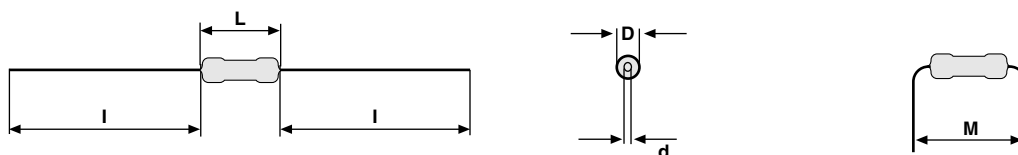
- Resistance ranges printed in bold are preferred TCR/tolerance combinations with optimized availability
- The PART NUMBER shown above is to facilitate the unified part numbering system for ordering products
- Radial version (RB, UB) can not be qualified according to CECC so these can only be ordered with variant N or S

**PACKAGING** - Axial products

| TYPE         | BOX<br>TAPING ACC. IEC 60286-1 |      |
|--------------|--------------------------------|------|
|              | PIECES                         | CODE |
| MBA/SMA 0204 | 1000                           | C1   |
|              | 5000                           | CT   |
| MBB/SMA 0207 | 1000                           | C1   |
|              | 5000                           | CT   |
| MBE/SMA 0414 | 1000                           | C1   |

**Note**

- For details related to packaging specs, refer datasheet link [www.vishay.com/doc?28721](http://www.vishay.com/doc?28721)

**DIMENSIONS****DIMENSIONS** - Leaded resistor types, mass and relevant physical dimensions

| TYPE         | D <sub>max.</sub><br>(mm) | L <sub>max.</sub><br>(mm) | d <sub>nom.</sub><br>(mm) | l <sub>min.</sub><br>(mm) | M <sub>min.</sub><br>(mm) | MASS<br>(mg) |
|--------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|--------------|
| MBA/SMA 0204 | 1.6                       | 3.6                       | 0.5                       | 29.0                      | 5.0                       | 125          |
| MBB/SMA 0207 | 2.5                       | 6.3                       | 0.6                       | 28.0                      | 10.0 <sup>(1)</sup>       | 220          |
| MBE/SMA 0414 | 4.0                       | 11.9                      | 0.8                       | 31.0                      | 15.0                      | 700          |

**Note**

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



# MBA/SMA 0204, MBB/SMA 0207, MBE/SMA 0414 - Precision

Precision Thin Film Leaded Resistors

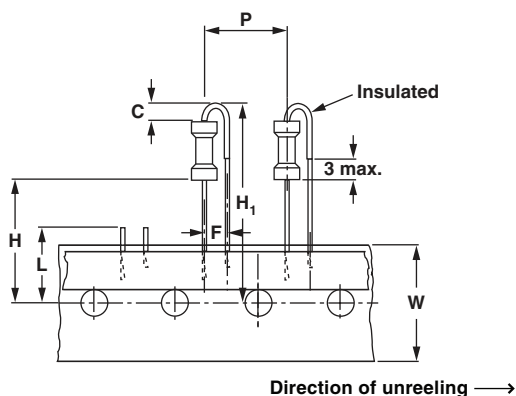
Vishay Beyschlag

## PACKAGING - Radial products

| TYPE            | REEL<br>TAPING ACC. IEC 60286-2 |      | BOX<br>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

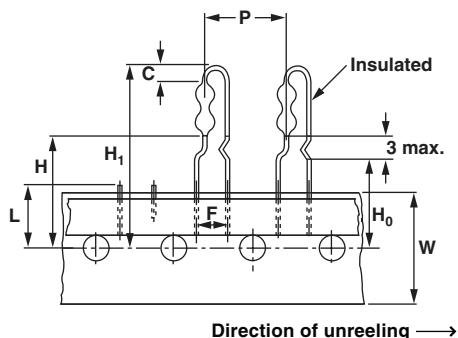
LEAD SPACING (UB = 2.5 mm), SIZE 0207



### DIMENSIONS in millimeters

|                             |                |                     |
|-----------------------------|----------------|---------------------|
| Pitch of components         | P              | $12.7 \pm 1.0$      |
| 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              | $18.0 \pm 2.0$      |
| Height for cutting (max.)   | L              | 11                  |
| Height for bending          | C              | $2.5 + 0, - 0.5$    |
| Height for insertion (max.) | H <sub>1</sub> | 32                  |

LEAD SPACING (RB = 5.0 mm), SIZE 0207



### DIMENSIONS in millimeters

|                             |                |                     |
|-----------------------------|----------------|---------------------|
| Pitch of components         | P              | $12.7 \pm 1.0$      |
| 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              | $18.0 \pm 2.0$      |
| Lead crimp to hole center   | H <sub>0</sub> | $16.0 \pm 0.5$      |
| Height for cutting (max.)   | L              | 11                  |
| Height for bending          | C              | $2.5 + 0, - 0.5$    |
| Height for insertion (max.) | H <sub>1</sub> | 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. A further conditioning is applied in order to stabilise the trimming result. Connecting wires of electrolytic copper plated with 100 pure tin are welded to the termination caps. The resistors are covered by 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** <sup>(1)</sup> and the **CEPIC-EECA-EICTA** <sup>(2)</sup> list of legal restrictions on hazardous substances. This includes full compliance with the following directives:

- 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 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 () 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

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

- “Professional Thin Film Leaded Resistors”, document no. 28766

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

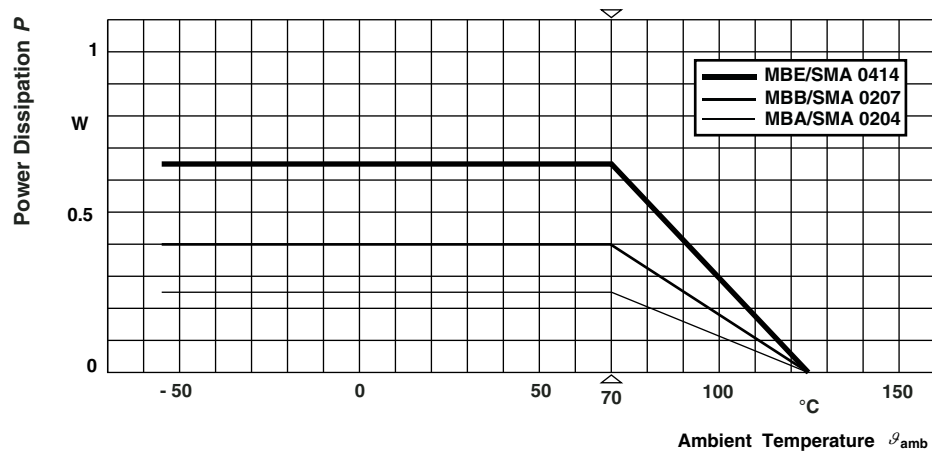
## Notes

<sup>(2)</sup> Global Automotive Declarable Substance List, see [www.gadsl.org](http://www.gadsl.org)

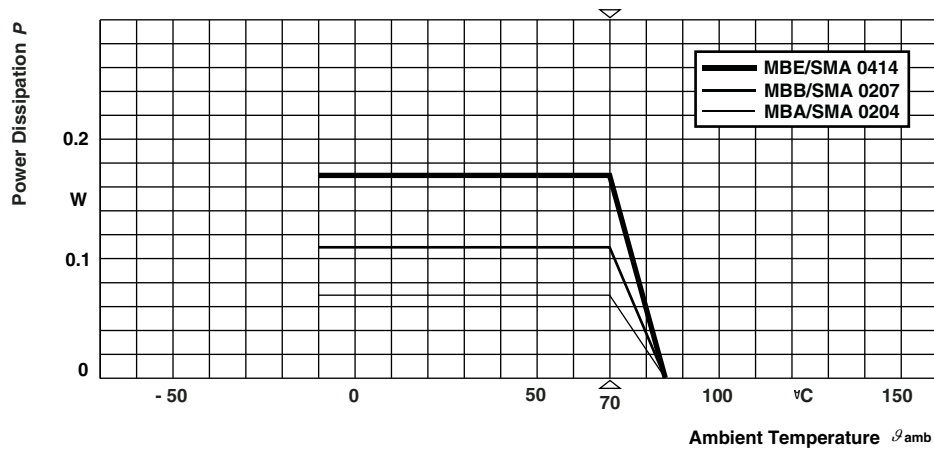
<sup>(3)</sup> CEPIC (European Chemical Industry Council), EECA (European Electronic Component Manufacturers Association), EICTA (European trade organisation representing the information and communications technology and consumer electronics), see [www.eicta.org/index.php?id=1053&id\\_article=340](http://www.eicta.org/index.php?id=1053&id_article=340)



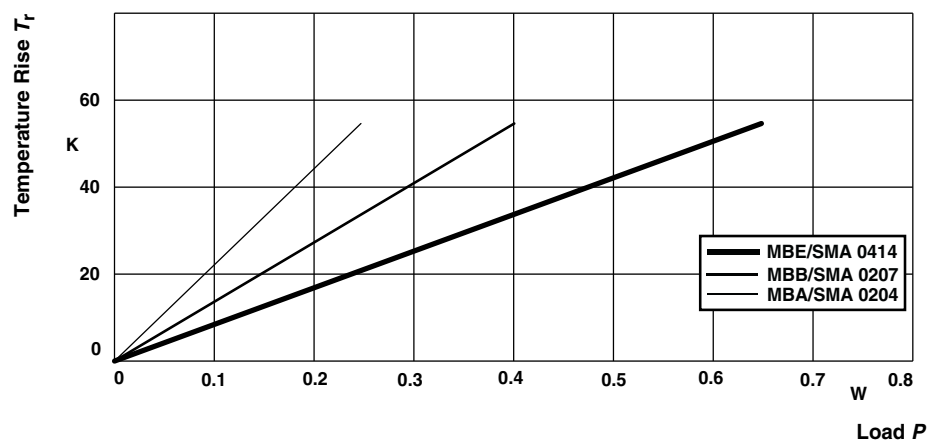
### FUNCTIONAL PERFORMANCE



Derating - Long Term Operation

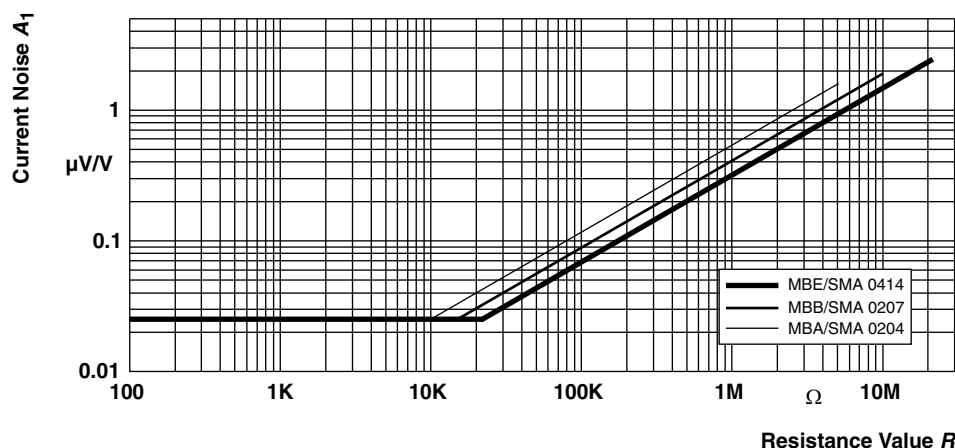


Derating - Precision Operation



Temperature Rise

Rise of the surface temperature.



## 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)

Most of the components are approved in accordance with the European CECC-system, where applicable. The Test Procedures 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 testing the components are mounted on a test board in accordance with IEC 60115-1, 4.31 unless otherwise specified.

In the 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<br>CLAUSE | IEC 60068-2-<br>TEST<br>METHOD | TEST                       | PROCEDURE                           | REQUIREMENTS<br>PERMISSIBLE CHANGE ( $\Delta R$ max.) |                                                                       |                               |
|-----------------------|--------------------------------|----------------------------|-------------------------------------|-------------------------------------------------------|-----------------------------------------------------------------------|-------------------------------|
|                       |                                |                            |                                     | STABILITY<br>CLASS 0.05                               | STABILITY<br>CLASS 0.1                                                | STABILITY<br>CLASS 0.25       |
|                       |                                |                            | Stability for product types:        |                                                       |                                                                       |                               |
|                       |                                |                            | <b>MBA/SMA 0204</b>                 | 100 $\Omega$ to 100 k $\Omega$                        | 43 $\Omega$ to < 100 $\Omega$ ;<br>> 100 $\Omega$ to 221 k $\Omega$   | 22 $\Omega$ to 332 k $\Omega$ |
|                       |                                |                            | <b>MBB/SMA 0207</b>                 | 100 $\Omega$ to 270 k $\Omega$                        | 43 $\Omega$ to < 100 $\Omega$ ;<br>> 270 k $\Omega$ to 510 k $\Omega$ | 22 $\Omega$ to 1 M $\Omega$   |
|                       |                                |                            | <b>MBE/SMA 0414</b>                 | 100 $\Omega$ to 470 k $\Omega$                        | 43 $\Omega$ to < 100 $\Omega$ ;<br>> 470 k $\Omega$ to 1 M $\Omega$   | 22 $\Omega$ to 1.5 M $\Omega$ |
| 4.5                   | -                              | Resistance                 | -                                   | $\pm 0.25$ %; $\pm 0.1$ %                             |                                                                       |                               |
| 4.8                   | -                              | Temperature<br>coefficient | At 20/LCT/20 °C and<br>20/UCT/20 °C | $\pm 25$ ppm/K; $\pm 15$ ppm/K                        |                                                                       |                               |



# MBA/SMA 0204, MBB/SMA 0207, MBE/SMA 0414 - Precision

Precision Thin Film Leaded Resistors

Vishay Beyschlag

| TEST PROCEDURES AND REQUIREMENTS |                          |                                              |                                                                                                                  |                                                                             |                                                                       |                                                                             |
|----------------------------------|--------------------------|----------------------------------------------|------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------------|
| IEC 60115-1 CLAUSE               | IEC 60068-2- TEST METHOD | TEST                                         | PROCEDURE                                                                                                        | REQUIREMENTS PERMISSIBLE CHANGE ( $\Delta R$ max.)                          |                                                                       |                                                                             |
|                                  |                          |                                              | Stability for product types:                                                                                     | <b>STABILITY CLASS 0.05</b>                                                 | <b>STABILITY CLASS 0.1</b>                                            | <b>STABILITY CLASS 0.25</b>                                                 |
|                                  |                          |                                              | <b>MBA/SMA 0204</b>                                                                                              | 100 $\Omega$ to 100 k $\Omega$                                              | 43 $\Omega$ to < 100 $\Omega$ ;<br>> 100 $\Omega$ to 221 k $\Omega$   | 22 $\Omega$ to 332 k $\Omega$                                               |
|                                  |                          |                                              | <b>MBB/SMA 0207</b>                                                                                              | 100 $\Omega$ to 270 k $\Omega$                                              | 43 $\Omega$ to < 100 $\Omega$ ;<br>> 270 k $\Omega$ to 510 k $\Omega$ | 22 $\Omega$ to 1 M $\Omega$                                                 |
|                                  |                          |                                              | <b>MBE/SMA 0414</b>                                                                                              | 100 $\Omega$ to 470 k $\Omega$                                              | 43 $\Omega$ to <100 $\Omega$ ;<br>> 470 k $\Omega$ to 1 M $\Omega$    | 22 $\Omega$ to 1.5 M $\Omega$                                               |
| 4.25.1                           | -                        | Endurance at 70 °C: Precision operation mode | $U = \sqrt{P_{70} \times R}$ or<br>$U = U_{max.}$ ;<br>1.5 h ON; 0.5 h OFF<br>70 °C; 1000 h<br><br>70 °C; 8000 h | $\pm (0.05 \% R + 0.01 \Omega)^{(1)}$<br><br>$\pm (0.1 \% R + 0.01 \Omega)$ | $\pm (0.1 \% R + 0.01 \Omega)$<br><br>$\pm (0.2 \% R + 0.01 \Omega)$  | $\pm (0.25 \% R + 0.05 \Omega)^{(2)}$<br><br>$\pm (0.5 \% R + 0.05 \Omega)$ |
|                                  |                          | Endurance at 70 °C: Standard operation mode  | $U = \sqrt{P_{70} \times R}$ or<br>$U = U_{max.}$ ;<br>1.5 h ON; 0.5 h OFF<br>70 °C; 1000 h<br>70 °C; 8000 h     | $\pm (0.25 \% R + 0.05 \Omega)^{(2)}$<br>$\pm (0.5 \% R + 0.05 \Omega)$     | -<br>-                                                                | -<br>-                                                                      |
|                                  | -                        |                                              |                                                                                                                  |                                                                             |                                                                       |                                                                             |
|                                  |                          |                                              |                                                                                                                  |                                                                             |                                                                       |                                                                             |
| 4.24                             | 78 (Cab)                 | Damp heat, steady state                      | (40 $\pm$ 2) °C;<br>56 days;<br>(93 $\pm$ 3) % RH                                                                | $\pm (0.05 \% R + 0.01 \Omega)$                                             | $\pm (0.1 \% R + 0.01 \Omega)$                                        | $\pm (0.25 \% R + 0.05 \Omega)$                                             |
| 4.23                             |                          | Climatic sequence:                           |                                                                                                                  |                                                                             |                                                                       |                                                                             |
| 4.23.2                           | 2 (Ba)                   | Dry heat                                     | 125 °C; 16 h                                                                                                     |                                                                             |                                                                       |                                                                             |
| 4.23.3                           | 30 (Db)                  | Damp heat, cyclic                            | 55 °C; 24 h;<br>90 % to 100 % RH;<br>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;<br>15 °C to 35 °C                                                                                  |                                                                             |                                                                       |                                                                             |
| 4.23.6                           | 30 (Db)                  | Damp heat, cyclic                            | 55 °C; 5 days;<br>95 % to 100 % RH;<br>5 cycles                                                                  | $\pm (0.05 \% R + 0.01 \Omega)$<br>no visible damage                        | $\pm (0.1 \% R + 0.01 \Omega)$<br>no visible damage                   | $\pm (0.25 \% R + 0.05 \Omega)$<br>no visible damage                        |
| 4.13                             | -                        | Short time overload                          | Room temperature;<br>$U = 2.5 \times \sqrt{P_{70} \times R}$ or<br>$U = 2 \times U_{max.}$ ; 5 s                 | $\pm (0.01 \% R + 0.01 \Omega)$<br>no visible damage                        | $\pm (0.02 \% R + 0.01 \Omega)$<br>no visible damage                  | $\pm (0.05 \% R + 0.01 \Omega)$<br>no visible damage                        |
| 4.19                             | 14 (Na)                  | Rapid change of temperature                  | 30 min at LCT = - 55 °C<br>30 min at UCT = 125 °C<br><br>5 cycles                                                | $\pm (0.01 \% R + 0.01 \Omega)$<br>no visible damage                        | $\pm (0.02 \% R + 0.01 \Omega)$<br>no visible damage                  | $\pm (0.05 \% R + 0.01 \Omega)$<br>no visible damage                        |
|                                  |                          |                                              | MBA/SMA 0204: 500 cycles<br>MBB/SMA 0207: 200 cycles<br>MBE/SMA 0414: 100 cycles                                 | $\pm (0.25 \% R + 0.05 \Omega)$<br>no visible damage                        | $\pm (0.25 \% R + 0.05 \Omega)$<br>no visible damage                  | $\pm (0.25 \% R + 0.05 \Omega)$<br>no visible damage                        |



| TEST PROCEDURES AND REQUIREMENTS |                                             |                                            |                                                                                                          |                                                          |                                                                       |                                                          |
|----------------------------------|---------------------------------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------------------|----------------------------------------------------------|
| IEC 60115-1<br>CLAUSE            | IEC 60068-2-<br>TEST<br>METHOD              | TEST                                       | PROCEDURE                                                                                                | REQUIREMENTS<br>PERMISSIBLE CHANGE ( $\Delta R$ max.)    |                                                                       |                                                          |
|                                  |                                             |                                            | Stability for product types:                                                                             | <b>STABILITY<br/>CLASS 0.05</b>                          | <b>STABILITY<br/>CLASS 0.1</b>                                        | <b>STABILITY<br/>CLASS 0.25</b>                          |
|                                  |                                             |                                            | <b>MBA/SMA 0204</b>                                                                                      | 100 $\Omega$ to 100 k $\Omega$                           | 43 $\Omega$ to < 100 $\Omega$ ;<br>> 100 $\Omega$ to 221 k $\Omega$   | 22 $\Omega$ to 332 k $\Omega$                            |
|                                  |                                             |                                            | <b>MBB/SMA 0207</b>                                                                                      | 100 $\Omega$ to 270 k $\Omega$                           | 43 $\Omega$ to < 100 $\Omega$ ;<br>> 270 k $\Omega$ to 510 k $\Omega$ | 22 $\Omega$ to 1 M $\Omega$                              |
|                                  |                                             |                                            | <b>MBE/SMA 0414</b>                                                                                      | 100 $\Omega$ to 470 k $\Omega$                           | 43 $\Omega$ to < 100 $\Omega$ ;<br>> 470 k $\Omega$ to 1 M $\Omega$   | 22 $\Omega$ to 1.5 M $\Omega$                            |
| 4.29                             | 45 (XA)                                     | Component solvent resistance               | Isopropyl alcohol<br>+ 23 °C; toothbrush method                                                          | Marking legible;<br>No visible damage                    |                                                                       |                                                          |
| 4.18.2                           | 20 (Tb)                                     | Resistance to soldering heat               | Unmounted components;<br>(260 $\pm$ 3) °C;<br>(10 $\pm$ 1) s                                             | $\pm$ (0.01 % $R$ + 0.01 $\Omega$ )<br>no visible damage | $\pm$ (0.02 % $R$ + 0.01 $\Omega$ )<br>no visible damage              | $\pm$ (0.05 % $R$ + 0.01 $\Omega$ )<br>no visible damage |
| 4.17                             | 20 (Ta)                                     | Solderability                              | + 235 °C; 2 s<br>solder bath method;<br>SnPb40<br><br>+ 245 °C; 3 s<br>solder bath method;<br>SnAg3Cu0.5 | Good tinning ( $\geq$ 95 % covered, no visible damage)   |                                                                       |                                                          |
| 4.22                             | 6 (B4)                                      | Vibration                                  | 6 h;<br>10 Hz to 2000 Hz<br>1.5 mm or 196 m/s <sup>2</sup>                                               | $\pm$ (0.01 % $R$ + 0.01 $\Omega$ )                      | $\pm$ (0.02 % $R$ + 0.01 $\Omega$ )                                   | $\pm$ (0.05 % $R$ + 0.01 $\Omega$ )                      |
| 4.16                             | 21 (Ua <sub>1</sub> )<br>21 (Ub)<br>21 (Uc) | Robustness of terminations                 | Tensile, bending and torsion                                                                             | $\pm$ (0.01 % $R$ + 0.01 $\Omega$ )                      | $\pm$ (0.02 % $R$ + 0.01 $\Omega$ )                                   | $\pm$ (0.05 % $R$ + 0.01 $\Omega$ )                      |
| 4.7                              | -                                           | Voltage proof                              | $U_{RMS} = U_{ins}$ ; 60 s                                                                               | No flashover or breakdown                                |                                                                       |                                                          |
| 4.25.3                           | -                                           | Endurance at upper category temperature    | 85 °C; 1000 h<br>125 °C; 1000 h                                                                          | $\pm$ (0.05 % $R$ + 0.01 $\Omega$ )                      | $\pm$ (0.1 % $R$ + 0.01 $\Omega$ )                                    | $\pm$ (0.25 % $R$ + 0.05 $\Omega$ )                      |
| 4.40                             | -                                           | Electrostatic discharge (human body model) | IEC 61340-3-1;<br>3 pos. + 3 neg.<br>MBA/SMA 0204: 2 kV<br>MBB/SMA 0207: 4 kV<br>MBE/SMA 0414: 6 kV      | $\pm$ (0.5 % $R$ + 0.05 $\Omega$ )                       |                                                                       |                                                          |

**Notes**(1)  $\pm$  (0.03 %  $R$  + 0.01  $\Omega$ ) for MBB/SMA 0207(2)  $\pm$  (0.15 %  $R$  + 0.05  $\Omega$ ) for MBB/SMA 0207



### 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 shown below

### Resistance Decade

| RESISTANCE DECADE                | LAST DIGIT |
|----------------------------------|------------|
| 10 $\Omega$ to 99.9 $\Omega$     | 9          |
| 100 $\Omega$ to 999 $\Omega$     | 1          |
| 1 k $\Omega$ to 9.99 k $\Omega$  | 2          |
| 10 k $\Omega$ to 99.9 k $\Omega$ | 3          |
| 100 k $\Omega$ to 999 k $\Omega$ | 4          |
| 1 M $\Omega$ to 9.99 M $\Omega$  | 5          |

### Historical 12NC Example

The 12NC code of a MBA 0204 resistor, value 47 k $\Omega$  and TCR 25 with  $\pm 0.1$  % tolerance, supplied on bandolier in a box of 5000 units was: 2312 906 74703.

| HISTORICAL 12NC - Resistor type and packaging |                |              |                            |               |               |               |               |
|-----------------------------------------------|----------------|--------------|----------------------------|---------------|---------------|---------------|---------------|
| DESCRIPTION                                   |                |              | 2312 ... ..... (BANDOLIER) |               |               |               |               |
|                                               |                |              | AMMOPACK                   |               | REEL          |               |               |
| TYPE                                          | TCR            | TOL.         | C1 1000 units              | CT 5000 units | R1 1000 units | R2 2500 units | RP 5000 units |
| MBA 0204                                      | $\pm 25$ ppm/K | $\pm 0.25$ % | 901 6....                  | 906 6....     | 701 6....     | -             | 806 6....     |
|                                               |                | $\pm 0.1$ %  | 901 7....                  | 906 7....     | 701 7....     | -             | 806 7....     |
|                                               | $\pm 15$ ppm/K | $\pm 0.25$ % | 902 6....                  | 907 6....     | 702 6....     | -             | 807 6....     |
|                                               |                | $\pm 0.1$ %  | 902 7....                  | 907 7....     | 702 7....     | -             | 807 7....     |
| MBB 0207                                      | $\pm 25$ ppm/K | $\pm 0.25$ % | 911 6....                  | 916 6....     | 711 6....     | -             | 816 6....     |
|                                               |                | $\pm 0.1$ %  | 911 7....                  | 916 7....     | 711 7....     | -             | 816 7....     |
|                                               | $\pm 15$ ppm/K | $\pm 0.25$ % | 912 6....                  | 917 6....     | 712 6....     | -             | 817 6....     |
|                                               |                | $\pm 0.1$ %  | 912 7....                  | 917 7....     | 712 7....     | -             | 817 7....     |
| MBE 0414                                      | $\pm 25$ ppm/K | $\pm 0.25$ % | 921 6....                  | -             | -             | 826 6....     | -             |
|                                               |                | $\pm 0.1$ %  | 921 7....                  | -             | -             | 826 7....     | -             |
|                                               | $\pm 15$ ppm/K | $\pm 0.25$ % | 922 6....                  | -             | -             | 827 6....     | -             |
|                                               |                | $\pm 0.1$ %  | 922 7....                  | -             | -             | 827 7....     | -             |



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