



## Precision Metal Film Leaded Resistors



### FEATURES

- IECQ-CECC approved according to EN 140101-806
- Superior overall stability: class 0.05
- Wide precision ohmic range: 10  $\Omega$  to 1.5 M $\Omega$
- Radial version available for MBB/SMA 0207
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

### APPLICATIONS

- Test and measuring equipment
- Industrial electronics
- Medical electronics

### LINKS TO ADDITIONAL RESOURCES



### DESCRIPTION

MBA/SMA 0204, MBB/SMA 0207, and MBE/SMA 0414 precision led 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.

| TECHNICAL SPECIFICATIONS                                         |                                |                             |                               |
|------------------------------------------------------------------|--------------------------------|-----------------------------|-------------------------------|
| DESCRIPTION                                                      | MBA/SMA 0204                   | MBB/SMA 0207                | MBE/SMA 0414                  |
| DIN size                                                         | 0204                           | 0207                        | 0414                          |
| CECC size                                                        | A                              | B                           | D                             |
| Resistance range                                                 | 22 $\Omega$ to 332 k $\Omega$  | 10 $\Omega$ to 1 M $\Omega$ | 22 $\Omega$ to 1.5 M $\Omega$ |
| Resistance tolerance                                             | $\pm 0.25\%$ ; $\pm 0.1\%$     |                             |                               |
| Temperature coefficient                                          | $\pm 25$ ppm/K; $\pm 15$ ppm/K |                             |                               |
| Rated dissipation, $P_{70}$                                      | 0.25 W                         | 0.40 W                      | 0.65 W                        |
| Operating voltage, $U_{max}$ , AC <sub>RMS</sub> /DC             | 200 V                          | 350 V                       | 500 V                         |
| Operating temperature range <sup>(1)</sup>                       | -55 °C to +125 °C              |                             |                               |
| Permissible film temperature, $\vartheta_{F max}$ <sup>(1)</sup> | 125 °C                         |                             |                               |
| Permissible voltage against ambient (insulation):                |                                |                             |                               |
| 1 min; $U_{ins}$                                                 | 300 V                          | 500 V                       | 800 V                         |
| Continuous                                                       | 75 V                           | 75 V                        | 75 V                          |
| Failure rate: FIT <sub>observed</sub>                            | $\leq 0.1 \times 10^{-9}/h$    |                             |                               |

#### Notes

- MB\_ series has been merged with the related SMA series to form one series "MB\_/SMA\_"
- <sup>(1)</sup> Please refer to APPLICATION INFORMATION below



## APPLICATION INFORMATION

The power dissipation on the resistor generates a temperature rise against the local ambient, depending on the heat flow support of the printed-circuit board (thermal resistance). The rated dissipation applies only if the permitted film temperature is not exceeded. Furthermore, a high level of ambient temperature or of power dissipation may raise the temperature of the solder joint, hence special solder alloys or board materials may be required to maintain the reliability of the assembly.

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. The designer may estimate the performance of the particular resistor application or set certain load and temperature limits in order to maintain a desired stability.

| MAXIMUM RESISTANCE CHANGE AT RATED DISSIPATION                                   |              |                                |                                |
|----------------------------------------------------------------------------------|--------------|--------------------------------|--------------------------------|
| Operation mode                                                                   |              | Precision                      | Standard                       |
| Climatic category                                                                |              | -10 °C / +85 °C / 56 days      | -55 °C / +125 °C / 56 days     |
| Rated dissipation, $P_{70}$                                                      | MBA/SMA 0204 | 0.07 W                         | 0.25 W                         |
|                                                                                  | MBB/SMA 0207 | 0.11 W                         | 0.40 W                         |
|                                                                                  | MBE/SMA 0414 | 0.17 W                         | 0.65 W                         |
| Permissible film temperature, $\vartheta_F$ max.                                 |              | 85 °C                          | 125 °C                         |
| Max. resistance change at rated dissipation $ \Delta R/R \text{ max.} $ , after: | MBA/SMA 0204 | 100 $\Omega$ to 100 k $\Omega$ | 100 $\Omega$ to 100 k $\Omega$ |
|                                                                                  | 1000 h       | $\leq 0.05 \%$                 | $\leq 0.25 \%$                 |
|                                                                                  | 8000 h       | $\leq 0.1 \%$                  | $\leq 0.5 \%$                  |
|                                                                                  | 225 000 h    | $\leq 0.3 \%$                  | $\leq 1.5 \%$                  |
|                                                                                  | MBB/SMA 0207 | 100 $\Omega$ to 270 k $\Omega$ | 100 $\Omega$ to 270 k $\Omega$ |
|                                                                                  | 1000 h       | $\leq 0.03 \%$                 | $\leq 0.15 \%$                 |
|                                                                                  | 8000 h       | $\leq 0.1 \%$                  | $\leq 0.5 \%$                  |
|                                                                                  | 225 000 h    | $\leq 0.3 \%$                  | $\leq 1.5 \%$                  |
|                                                                                  | MBE/SMA 0414 | 100 $\Omega$ to 470 k $\Omega$ | 100 $\Omega$ to 470 k $\Omega$ |
|                                                                                  | 1000 h       | $\leq 0.05 \%$                 | $\leq 0.2 \%$                  |
|                                                                                  | 8000 h       | $\leq 0.1 \%$                  | $\leq 0.4 \%$                  |
|                                                                                  | 225 000 h    | $\leq 0.3 \%$                  | $\leq 1.2 \%$                  |

### Note

- The presented operation modes do not refer to different types of resistors, but actually show examples of different loads, that lead to different film temperatures and different achievable load-life stability (drift) of the resistance value. 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

| TEMPERATURE COEFFICIENT AND RESISTANCE RANGE <sup>(1)</sup> |                        |               |                               |           |
|-------------------------------------------------------------|------------------------|---------------|-------------------------------|-----------|
| TYPE / SIZE                                                 | TCR                    | TOLERANCE     | RESISTANCE <sup>(2)</sup>     | E-SERIES  |
| MBA/SMA 0204                                                | $\pm 25 \text{ ppm/K}$ | $\pm 0.25 \%$ | 22 $\Omega$ to 332 k $\Omega$ | E96; E192 |
|                                                             |                        | $\pm 0.1 \%$  | 43 $\Omega$ to 332 k $\Omega$ |           |
|                                                             | $\pm 15 \text{ ppm/K}$ | $\pm 0.25 \%$ | 22 $\Omega$ to 221 k $\Omega$ |           |
|                                                             |                        | $\pm 0.1 \%$  | 43 $\Omega$ to 221 k $\Omega$ |           |
| MBB/SMA 0207                                                | $\pm 25 \text{ ppm/K}$ | $\pm 0.25 \%$ | 10 $\Omega$ to 1 M $\Omega$   |           |
|                                                             |                        | $\pm 0.1 \%$  | 10 $\Omega$ to 1 M $\Omega$   |           |
|                                                             | $\pm 15 \text{ ppm/K}$ | $\pm 0.25 \%$ | 10 $\Omega$ to 1 M $\Omega$   |           |
|                                                             |                        | $\pm 0.1 \%$  | 10 $\Omega$ to 1 M $\Omega$   |           |
| MBE/SMA 0414                                                | $\pm 25 \text{ ppm/K}$ | $\pm 0.25 \%$ | 22 $\Omega$ to 1.5 M $\Omega$ |           |
|                                                             |                        | $\pm 0.1 \%$  | 43 $\Omega$ to 1 M $\Omega$   |           |
|                                                             | $\pm 15 \text{ ppm/K}$ | $\pm 0.25 \%$ | 22 $\Omega$ to 1 M $\Omega$   |           |
|                                                             |                        | $\pm 0.1 \%$  | 43 $\Omega$ to 1 M $\Omega$   |           |

### Notes

- Radial version (RB, UB) cannot be qualified according to CECC so these can only be ordered with variant N or S

<sup>(1)</sup> Approval is according to EN 140101-806, version A, or the approved IECQ-CECC resistance range, please refer to: [www.vishay.com/doc?28945](http://www.vishay.com/doc?28945)

| TYPE / SIZE                       | CODE | QUANTITY | PACKAGING STYLE                                  | WIDTH | PITCH   | PACKAGING DIMENSIONS    |
|-----------------------------------|------|----------|--------------------------------------------------|-------|---------|-------------------------|
| MBA/SMA 0204                      | C1   | 1000     | Taped acc. to IEC 60286-1<br>fan-folded in a box | 53 mm | 5 mm    | 184 mm x 75 mm x 42 mm  |
|                                   | CT   | 5000     |                                                  |       |         | 330 mm x 75 mm x 55 mm  |
| MBB/SMA 0207                      | C1   | 1000     | Taped acc. to IEC 60286-1<br>fan-folded in a box | 53 mm | 5 mm    | 184 mm x 74 mm x 42 mm  |
|                                   | CT   | 5000     |                                                  |       |         | 324 mm x 77 mm x 82 mm  |
| MBB/SMA 0207<br>UB = 2.5 mm pitch | N4   | 4000     | Taped acc. to IEC 60286-2<br>fan-folded in a box | -     | 12.7 mm | 330 mm x 262 mm x 45 mm |
|                                   | R4   | 4000     | Taped acc. to IEC 60286-2<br>on a reel           | -     |         | 330 mm x 253 mm x 48 mm |
| MBB/SMA 0207<br>RB = 5.0 mm pitch | N4   | 4000     | Taped acc. to IEC 60286-2<br>fan-folded in a box | -     |         | 330 mm x 262 mm x 45 mm |
|                                   | R4   | 4000     | Taped acc. to IEC 60286-2<br>on a reel           | -     |         | 330 mm x 253 mm x 48 mm |
| MBE/SMA 0414                      | C1   | 1000     | Taped acc. to IEC 60286-1<br>fan-folded in a box | 63 mm | 5 mm    | 374 mm x 84 mm x 47 mm  |

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

|                                                                                                          |   |   |                                                                                                                              |   |   |                                                |   |                                                                                                                                                                                                                                                   |   |   |                                           |   |                                                  |   |                                                                                                                                                          |   |   |
|----------------------------------------------------------------------------------------------------------|---|---|------------------------------------------------------------------------------------------------------------------------------|---|---|------------------------------------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|-------------------------------------------|---|--------------------------------------------------|---|----------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|
| M                                                                                                        | B | B | 0                                                                                                                            | 2 | 0 | 7                                              | V | D                                                                                                                                                                                                                                                 | 1 | 0 | 0                                         | 1 | B                                                | C | T                                                                                                                                                        | 0 | 0 |
| TYPE / SIZE                                                                                              |   |   | VERSION                                                                                                                      |   |   | 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/SMA 0207<br><b>S</b> = UB radial<br>2.5 mm for<br>MBB/SMA 0207 |   |   | <b>E</b> = ± 15 ppm/K<br><b>D</b> = ± 25 ppm/K |   | <b>3 digit value</b><br><b>1 digit multiplier</b><br>MULTIPLIER<br><b>9</b> = *10 <sup>-1</sup> <b>2</b> = *10 <sup>2</sup><br><b>0</b> = *10 <sup>0</sup> <b>3</b> = *10 <sup>3</sup><br><b>1</b> = *10 <sup>1</sup> <b>4</b> = *10 <sup>4</sup> |   |   | <b>B</b> = ± 0.1 %<br><b>C</b> = ± 0.25 % |   | <b>CT</b><br><b>C1</b><br><b>N4</b><br><b>R4</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 |   |   |

|                                                                   |          |                          |                     |                                                          |                                                  |                                           |
|-------------------------------------------------------------------|----------|--------------------------|---------------------|----------------------------------------------------------|--------------------------------------------------|-------------------------------------------|
| <b>MBB/SMA 0207</b>                                               | <b>-</b> | <b>25</b>                | <b>0.1 %</b>        | <b>CECC 06</b>                                           | <b>CT</b>                                        | <b>1K0</b>                                |
| TYPE / SIZE                                                       |          | TCR                      | TOLERANCE           | VERSION                                                  | PACKAGING                                        | RESISTANCE                                |
| <b>MBA/SMA 0204</b><br><b>MBB/SMA 0207</b><br><b>MBE/SMA 0414</b> |          | ± 15 ppm/K<br>± 25 ppm/K | ± 0.1 %<br>± 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>N4</b><br><b>R4</b> | <b>1K0</b> = 1 kΩ<br><b>51R1</b> = 51.1 Ω |

- The products can be ordered using either the **PRODUCT DESCRIPTION** or the **PART NUMBER**



## 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 matte 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 with **IEC 60286-2**.

## 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 <sup>(1)</sup>
- The Global Automotive Declarable Substance List (GADSL) <sup>(2)</sup>
- The REACH regulation (1907/2006/EC) and the related list of substances with very high concern (SVHC) <sup>(3)</sup> 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](http://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](http://www.vishay.com/doc?49037).

## Notes

<sup>(1)</sup> Global Automotive Declarable Substance List, see [www.gadsl.org](http://www.gadsl.org)

<sup>(2)</sup> CEFIC (European Chemical Industry Council), EECA (European Electronic Component Manufacturers Association), EICTA (European trade organization representing the information and communications technology and consumer electronics), see [www.digitaleurope.org/SearchResults.aspx?Search=eicta](http://www.digitaleurope.org/SearchResults.aspx?Search=eicta).

All products comply with the IEC 62474, Material Declaration for Products of and for the Electrotechnical Industry

<sup>(3)</sup> Other cleaning solvents with aggressive chemicals should be evaluated in actual cleaning process for their suitability

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

The encapsulant is resistant to cleaning solvent specified in **IEC 60115-1** <sup>(3)</sup>. 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 **IEC 62474** <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 (ELV II)
- 2011/65/EU 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 60115-2** 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 **IECQ 03-3-1, clause 2**. The release certificate for “**Technology Approval Schedule**” in accordance with **CECC 240001** based on **IECQ 03-3-1, clause 6** is granted for the Vishay Beyschlag manufacturing process.

## RELATED PRODUCTS

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

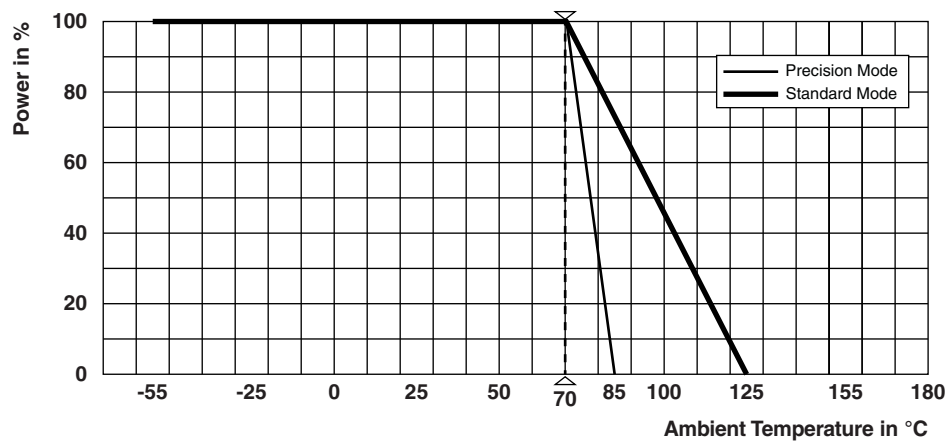
- “Professional Thin Film Leaded Resistors”, [www.vishay.com/doc?28766](http://www.vishay.com/doc?28766)

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:

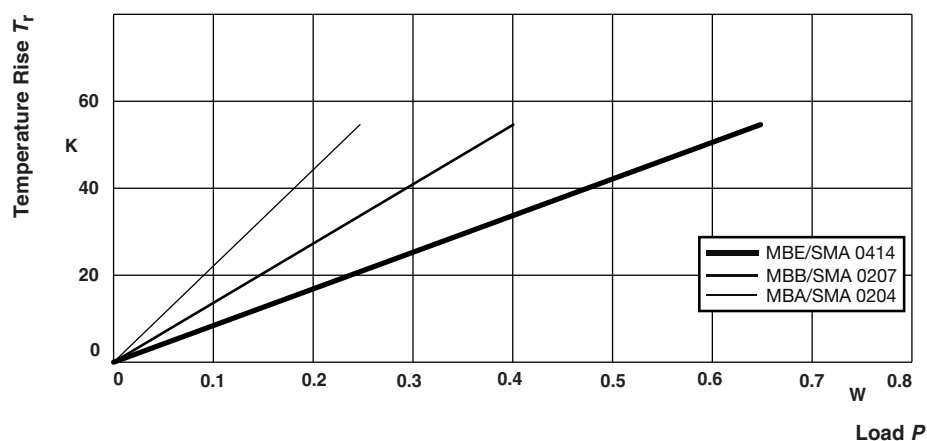
- “Established Reliability Thin Film Leaded Resistors”, [www.vishay.com/doc?28768](http://www.vishay.com/doc?28768)



## FUNCTIONAL PERFORMANCE

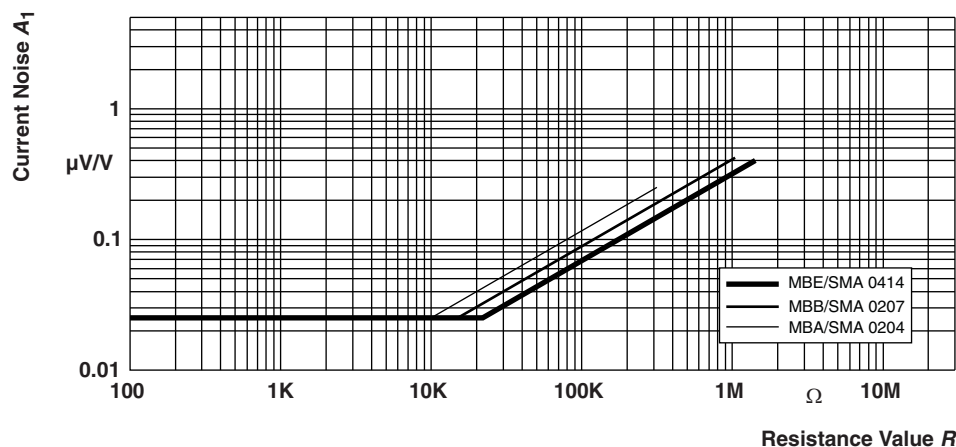


### Derating



Rise of the surface temperature.

### Temperature Rise



Current Noise  $A_1$  in accordance with IEC 60195



## TEST PROCEDURES AND REQUIREMENTS

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

- IEC 60115-1, generic specification
- IEC 60115-2, sectional specification
- EN 140101-806, detail specification
- IEC 60068-2-xx, test methods

The components are approved under the IECQ-CECC quality assessment system for electronic components. The parameters stated in the Test Procedures and Requirements table are based on the required tests and permitted limits of EN 140101-806. 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 IEC 60115-1, 5.5, unless otherwise specified.

| TEST PROCEDURES AND REQUIREMENTS |                                      |                              |                                                                                                                                                          |                                                                                                                        |                                                                                                                        |                                                                                                                        |
|----------------------------------|--------------------------------------|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| IEC 60115-1<br>CLAUSE<br>(3)     | IEC 60068-2<br>TEST<br>METHOD<br>(3) | TEST                         | PROCEDURE                                                                                                                                                | REQUIREMENTS PERMISSIBLE CHANGE<br>( $\Delta R$ max.)                                                                  |                                                                                                                        |                                                                                                                        |
|                                  |                                      |                              | Stability for product types:                                                                                                                             | STABILITY<br>CLASS 0.05                                                                                                | STABILITY<br>CLASS 0.1                                                                                                 | STABILITY<br>CLASS 0.25                                                                                                |
|                                  |                                      |                              | MBA/SMA 0204                                                                                                                                             | 100 $\Omega$ to 100 k $\Omega$                                                                                         | 43 $\Omega$ to 221 k $\Omega$                                                                                          | 22 $\Omega$ to 332 k $\Omega$                                                                                          |
|                                  |                                      |                              | MBB/SMA 0207                                                                                                                                             | 100 $\Omega$ to 270 k $\Omega$                                                                                         | 43 $\Omega$ to 510 k $\Omega$                                                                                          | 10 $\Omega$ to 1 M $\Omega$                                                                                            |
|                                  |                                      |                              | MBE/SMA 0414                                                                                                                                             | 100 $\Omega$ to 470 k $\Omega$                                                                                         | 43 $\Omega$ to 1 M $\Omega$                                                                                            | 22 $\Omega$ to 1.5 M $\Omega$                                                                                          |
| 6.1                              | -                                    | Resistance                   | -                                                                                                                                                        | $\pm 0.25$ %; $\pm 0.1$ %                                                                                              |                                                                                                                        |                                                                                                                        |
| 12.2                             | -                                    | Voltage proof                | $U_{RMS} = U_{ins}$ ; 60 s                                                                                                                               | No flashover or breakdown                                                                                              |                                                                                                                        |                                                                                                                        |
| 6.2                              | -                                    | Temperature coefficient      | At 20/LCT/20 °C and 20/UCT/20 °C                                                                                                                         | $\pm 25$ ppm/K; $\pm 15$ ppm/K                                                                                         |                                                                                                                        |                                                                                                                        |
| 8.1                              | -                                    | 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                                                                |
| 9.5                              | 21 (Ua)<br>21 (Ub)<br>21 (Uc)        | Robustness of terminations   | Tensile, bending and torsion                                                                                                                             | $\pm (0.01$ % $R + 0.01$ $\Omega)$                                                                                     | $\pm (0.02$ % $R + 0.01$ $\Omega)$                                                                                     | $\pm (0.05$ % $R + 0.01$ $\Omega)$                                                                                     |
| 11.1                             | 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)                                                                 |                                                                                                                        |                                                                                                                        |
| 11.2                             | 20 (Tb)                              | Resistance to soldering heat | Unmounted components;<br>(270 $\pm$ 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                                                                |
| 10.1                             | 14 (Na)                              | Rapid change of temperature  | 30 min at LCT = -55 °C<br>30 min at UCT = 125 °C<br><br>5 cycles<br><br>MBA/SMA 0204: 500 cycles<br>MBB/SMA 0207: 200 cycles<br>MBE/SMA 0414: 100 cycles | $\pm (0.01$ % $R + 0.01$ $\Omega)$<br>no visible damage<br><br>$\pm (0.25$ % $R + 0.05$ $\Omega)$<br>no visible damage | $\pm (0.02$ % $R + 0.01$ $\Omega)$<br>no visible damage<br><br>$\pm (0.25$ % $R + 0.05$ $\Omega)$<br>no visible damage | $\pm (0.05$ % $R + 0.01$ $\Omega)$<br>no visible damage<br><br>$\pm (0.25$ % $R + 0.05$ $\Omega)$<br>no visible damage |
| 9.11                             | 6 (Fc)                               | Vibration                    | 10 sweep cycles per direction;<br>10 Hz to 2000 Hz<br>1.5 mm or 200 m/s <sup>2</sup>                                                                     | $\pm (0.01$ % $R + 0.01$ $\Omega)$                                                                                     | $\pm (0.02$ % $R + 0.01$ $\Omega)$                                                                                     | $\pm (0.05$ % $R + 0.01$ $\Omega)$                                                                                     |



| TEST PROCEDURES AND REQUIREMENTS |                                         |                                              |                                                                                                              |                                                                                  |                                                                  |                                                                                  |
|----------------------------------|-----------------------------------------|----------------------------------------------|--------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|------------------------------------------------------------------|----------------------------------------------------------------------------------|
| IEC<br>60115-1<br>CLAUSE<br>(3)  | IEC<br>60068-2<br>TEST<br>METHOD<br>(3) | TEST                                         | PROCEDURE                                                                                                    | REQUIREMENTS PERMISSIBLE CHANGE<br>( $\Delta R$ max.)                            |                                                                  |                                                                                  |
|                                  |                                         |                                              | Stability for product types:                                                                                 | STABILITY<br>CLASS 0.05                                                          | STABILITY<br>CLASS 0.1                                           | STABILITY<br>CLASS 0.25                                                          |
|                                  |                                         |                                              | <b>MBA/SMA 0204</b>                                                                                          | 100 $\Omega$ to 100 k $\Omega$                                                   | 43 $\Omega$ to 221 k $\Omega$                                    | 22 $\Omega$ to 332 k $\Omega$                                                    |
|                                  |                                         |                                              | <b>MBB/SMA 0207</b>                                                                                          | 100 $\Omega$ to 270 k $\Omega$                                                   | 43 $\Omega$ to 510 k $\Omega$                                    | 10 $\Omega$ to 1 M $\Omega$                                                      |
|                                  |                                         |                                              | <b>MBE/SMA 0414</b>                                                                                          | 100 $\Omega$ to 470 k $\Omega$                                                   | 43 $\Omega$ to 1 M $\Omega$                                      | 22 $\Omega$ to 1.5 M $\Omega$                                                    |
| 10.3                             |                                         | Climatic sequence:                           |                                                                                                              |                                                                                  |                                                                  |                                                                                  |
| 10.3.4.2                         | 2 (Bb)                                  | Dry heat                                     | 125 °C; 16 h                                                                                                 |                                                                                  |                                                                  |                                                                                  |
| 10.3.4.3                         | 30 (Db)                                 | Damp heat, cyclic                            | 55 °C; 24 h;<br>90 % to 100 % RH;<br>1 cycle                                                                 | $\pm (0.05 \% R + 0.01 \Omega)$<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                             |
| 10.3.4.4                         | 1 (Ab)                                  | Cold                                         | -55 °C; 2 h                                                                                                  |                                                                                  |                                                                  |                                                                                  |
| 10.3.4.5                         | 13 (M)                                  | Low air pressure                             | 8.5 kPa; 2 h;<br>15 °C to 35 °C                                                                              |                                                                                  |                                                                  |                                                                                  |
| 10.3.4.6                         | 30 (Db)                                 | Damp heat, cyclic                            | 55 °C; 5 days;<br>95 % to 100 % RH; 5 cycles                                                                 |                                                                                  |                                                                  |                                                                                  |
| 10.3.4.7                         |                                         | DC load                                      | Apply rated power for 1 min                                                                                  |                                                                                  |                                                                  |                                                                                  |
| 10.4                             | 78 (Cab)                                | Damp heat, steady state                      | (40 $\pm$ 2) °C;<br>56 days;<br>(93 $\pm$ 3) % RH                                                            | $\pm (0.05 \% R + 0.01 \Omega)$                                                  | $\pm (0.1 \% R + 0.01 \Omega)$                                   | $\pm (0.25 \% R + 0.05 \Omega)$                                                  |
| 7.1                              | -                                       | 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>70 °C; 8000 h | $\pm (0.05 \% R + 0.01 \Omega)$ <sup>(1)</sup><br>$\pm (0.1 \% R + 0.01 \Omega)$ | $\pm (0.1 \% R + 0.01 \Omega)$<br>$\pm (0.2 \% R + 0.01 \Omega)$ | -<br>-                                                                           |
|                                  | -                                       | 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 | -<br>-                                                                           | -<br>-                                                           | $\pm (0.25 \% R + 0.05 \Omega)$ <sup>(2)</sup><br>$\pm (0.5 \% R + 0.05 \Omega)$ |
|                                  | -                                       | Endurance at upper category temperature      | 85 °C; 1000 h<br>125 °C; 1000 h                                                                              | $\pm (0.05 \% R + 0.01 \Omega)$                                                  | $\pm (0.1 \% R + 0.01 \Omega)$                                   | $\pm (0.25 \% R + 0.05 \Omega)$                                                  |
|                                  | -                                       | Endurance at upper category temperature      | 85 °C; 1000 h<br>125 °C; 1000 h                                                                              | $\pm (0.05 \% R + 0.01 \Omega)$                                                  | $\pm (0.1 \% R + 0.01 \Omega)$                                   | $\pm (0.25 \% R + 0.05 \Omega)$                                                  |
| 11.3                             | 45 (XA)                                 | Component solvent resistance                 | Isopropyl alcohol +23 °C or<br>+50 °C; toothbrush method                                                     | Marking legible;<br>No visible damage                                            |                                                                  |                                                                                  |
| 8.5                              | -                                       | 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**

<sup>(1)</sup>  $\pm (0.03 \% R + 0.01 \Omega)$  for MBB/SMA 0207

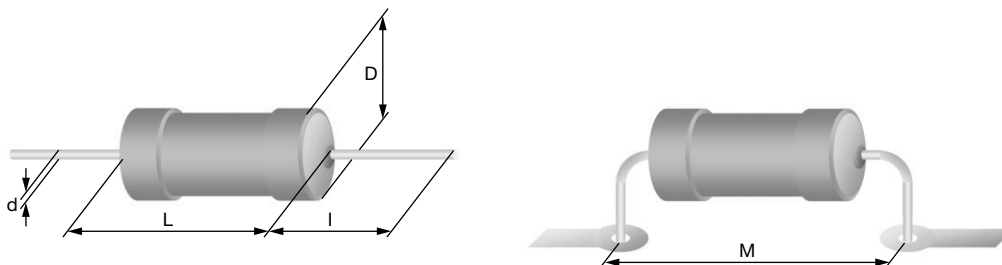
<sup>(2)</sup>  $\pm (0.15 \% R + 0.05 \Omega)$  for MBB/SMA 0207

<sup>(3)</sup> The quoted IEC standards are also released as EN standards with the same number and identical contents





## DIMENSIONS



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

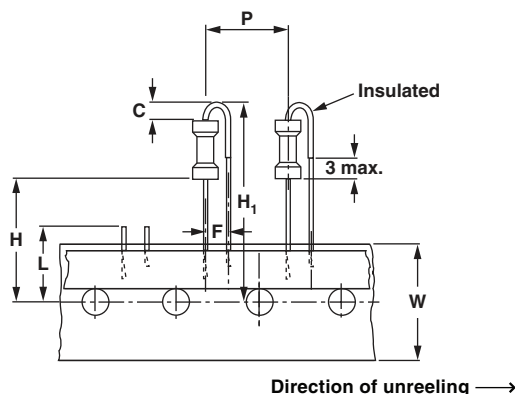
| TYPE / SIZE                 | D <sub>max.</sub><br>(mm) | L <sub>max.</sub><br>(mm) | d <sub>nom.</sub><br>(mm) | I <sub>min.</sub><br>(mm) | M <sub>min.</sub><br>(mm) | MASS<br>(mg) |
|-----------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|--------------|
| MBA/SMA 0204                | 1.6                       | 3.6                       | 0.5                       | 29.0                      | 5.0                       | 125          |
| MBB/SMA 0207 <sup>(1)</sup> | 2.5                       | 6.5                       | 0.6                       | 28.0                      | 10.0 <sup>(1)</sup>       | 220          |
| MBE/SMA 0414                | 4.2                       | 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)

## MBB/SMA 0207 WITH RADIAL TAPING

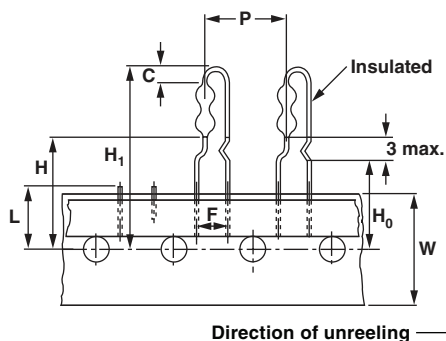
### LEAD SPACING (UB = 2.5 mm), SIZE 0207



**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.) | H1 | 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                   |





## 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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