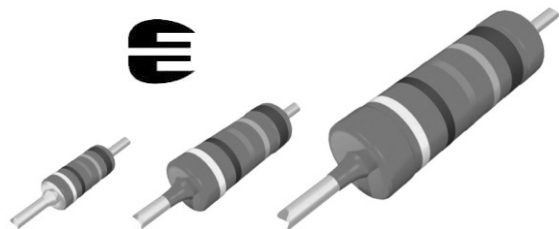


## Precision Leaded Resistors



### 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

- Approved according to CECC 40101-806
- Advanced thin film technology
- Low TCR:  $\pm 15$  to  $\pm 25$  ppm/K
- Precision tolerance of value:  $\pm 0.1$  % and  $\pm 0.25$  %
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with "Restriction of the use of Hazardous Substances" (RoHS) directive 2002/95/EC (issue 2004)
- Superior overall stability: class 0.05
- Wide precision range:  $10 \Omega$  to  $1.5 \text{ M}\Omega$



### 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, $U_{\max}$ 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             |           |
|                                                                                    | ≤ 0.05 %                    | ≤ 0.25 %  | ≤ 0.03 %                    | ≤ 0.15 %  | ≤ 0.05 %                    | ≤ 0.25 %  |
|                                                                                    | ≤ 0.1 %                     | ≤ 0.5 %   | ≤ 0.1 %                     | ≤ 0.5 %   | ≤ 0.1 %                     | ≤ 0.5 %   |
|                                                                                    | ≤ 0.3 %                     | ≤ 1.5 %   | ≤ 0.3 %                     | ≤ 1.5 %   | ≤ 0.3 %                     | ≤ 1.5 %   |
| Specified lifetime                                                                 | 225 000 h                   |           | 225 000 h                   |           | 225 000 h                   |           |
| Permissible voltage against ambient:                                               |                             |           |                             |           |                             |           |
| 1 minute                                                                           | 300 V                       |           | 500 V                       |           | 800 V                       |           |
| continuous                                                                         | 75 V                        |           | 75 V                        |           | 75 V                        |           |
| Failure rate                                                                       | ≤ 0.7 x 10 <sup>-9</sup> /h |           | ≤ 0.3 x 10 <sup>-9</sup> /h |           | ≤ 0.1 x 10 <sup>-9</sup> /h |           |

#### Note:

MB\_ series has been merged with the related SMA series to form one series "MB\_/SMA\_".



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

Precision Leaded Resistors

Vishay Beyschlag

## PART NUMBER AND PRODUCT DESCRIPTION

PART NUMBER: MBB02070D1001BCT00

|                                                                                     |   |                                                           |   |   |                                  |   |   |                                                                                                                                                                                                                                         |   |   |                             |   |                                  |   |               |   |   |
|-------------------------------------------------------------------------------------|---|-----------------------------------------------------------|---|---|----------------------------------|---|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|-----------------------------|---|----------------------------------|---|---------------|---|---|
| M                                                                                   | B | B                                                         | 0 | 2 | 0                                | 7 | 0 | D                                                                                                                                                                                                                                       | 1 | 0 | 0                           | 1 | B                                | C | T             | 0 | 0 |
| MODEL/SIZE                                                                          |   | SPECIAL                                                   |   |   | TCR/MATERIAL                     |   |   | VALUE                                                                                                                                                                                                                                   |   |   | TOLERANCE                   |   | PACKAGING <sup>(1)</sup>         |   | SPECIAL       |   |   |
| MBA0204 =<br>MBA/SMA 0204<br>MBB0207 =<br>MBB/SMA 0207<br>MBE0414 =<br>MBE/SMA 0414 |   | 0 = neutral<br>N = RB Radial 5 mm<br>S = UB Radial 2.5 mm |   |   | E = ± 15 ppm/K<br>D = ± 25 ppm/K |   |   | 3 digit value<br>1 digit multiplier<br>MULTIPLIER<br>8 = *10 <sup>-2</sup> 2 = *10 <sup>2</sup><br>9 = *10 <sup>-1</sup> 3 = *10 <sup>3</sup><br>0 = *10 <sup>0</sup> 4 = *10 <sup>4</sup><br>1 = *10 <sup>1</sup> 5 = *10 <sup>5</sup> |   |   | B = ± 0.1 %<br>C = ± 0.25 % |   | CT<br>C1<br>R1<br>R2<br>R4<br>N4 |   | 00 = standard |   |   |

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

|                                              |   |                          |                     |                                        |                             |
|----------------------------------------------|---|--------------------------|---------------------|----------------------------------------|-----------------------------|
| MBB/SMA 0207                                 | - | 25                       | 0.1 %               | CT                                     | 1K0                         |
| MODEL/SIZE                                   |   | TCR                      | TOLERANCE           | PACKAGING (1)                          | RESISTANCE                  |
| MBA/SMA 0204<br>MBB/SMA 0207<br>MBE/SMA 0414 |   | ± 15 ppm/K<br>± 25 ppm/K | ± 0.1 %<br>± 0.25 % | CT<br>C1<br>RP<br>R1<br>R2<br>R4<br>N4 | 1K0 = 1 kΩ<br>51R1 = 51.1 Ω |

### Note:

(1) Please refer to table PACKAGING for complete information.

The PART NUMBER shown above is to facilitate the unified part numbering system for ordering products.

## PACKAGING

| MODEL        | REEL                 |                             | BOX                  |                             |
|--------------|----------------------|-----------------------------|----------------------|-----------------------------|
|              | PIECES               | CODE                        | PIECES               | CODE                        |
| MBA/SMA 0204 | 1000<br>5000         | R1<br>RP                    | 1000<br>5000         | C1<br>CT                    |
| MBB/SMA 0207 | 1000<br>4000<br>5000 | R1<br>R4 (for RB, UB)<br>RP | 1000<br>4000<br>5000 | C1<br>N4 (for RB, UB)<br>CT |
| MBE/SMA 0414 | 2500                 | R2                          | 1000                 | C1                          |

## 12NC CODE FOR HISTORICAL CODING REFERENCE OF MBA 0204/MBB 0207/MBE 0414

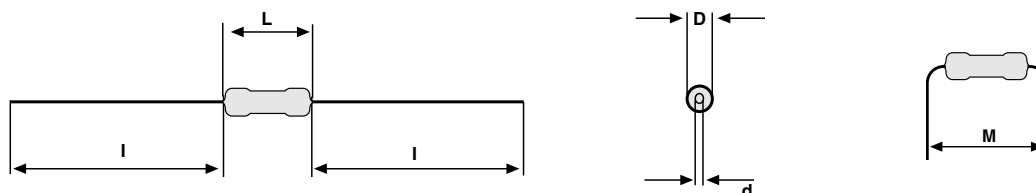
| DESCRIPTION |            |          | ORDERING CODE 2312 ... .. (BANDOLIER) |               |               |               |               |
|-------------|------------|----------|---------------------------------------|---------------|---------------|---------------|---------------|
|           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

**12NC INFORMATION****Last Digit of 12NC Indicating 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          |

**12NC Example (For Historical coding reference of MBA 0204/MBB 0207/MBE 0414)**

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 is: 2312 906 74703.

**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 without lacquer on the leads.

**TEMPERATURE COEFFICIENT AND RESISTANCE RANGE**

| DESCRIPTION    |              | RESISTANCE VALUE <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>   |

**Note:**

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

Resistance ranges printed in bold are preferred TCR/tolerance combinations with optimized availability.

**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 (85 %  $\text{Al}_2\text{O}_3$ ) and conditioned to achieve the desired temperature coefficient. Nickel plated steel termination caps are firmly pressed on the metallized rods. A special laser is used to achieve the target value by smoothly cutting a helical groove in the resistive layer without damaging the 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. The terminations receive a final pure tin on nickel plating. Four or five colour 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**.

**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 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.

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. All products comply with the CEFIC-EECA-EICTA list of legal restrictions on hazardous substances. This includes full compliance with the following directives:

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

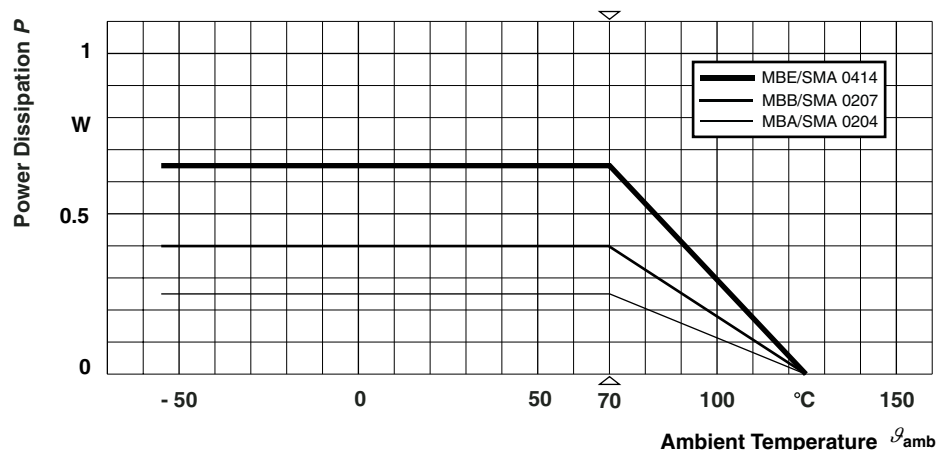
**APPROVALS**

Where applicable, the resistors are tested in accordance with **CECC 40101-806** which refers to **EN 60115-1** and **EN 140100**. Approval of conformity is indicated by the CECC logo on the package label.

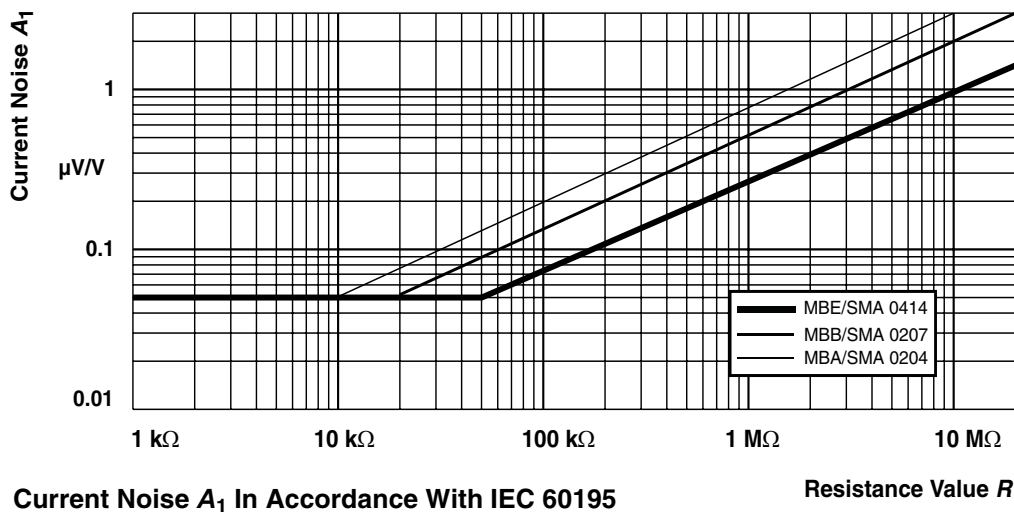
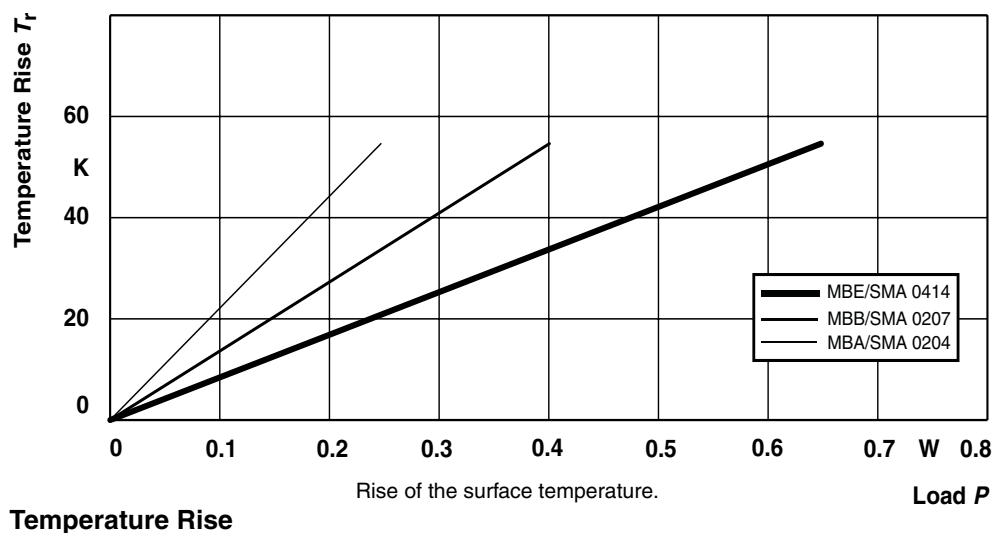
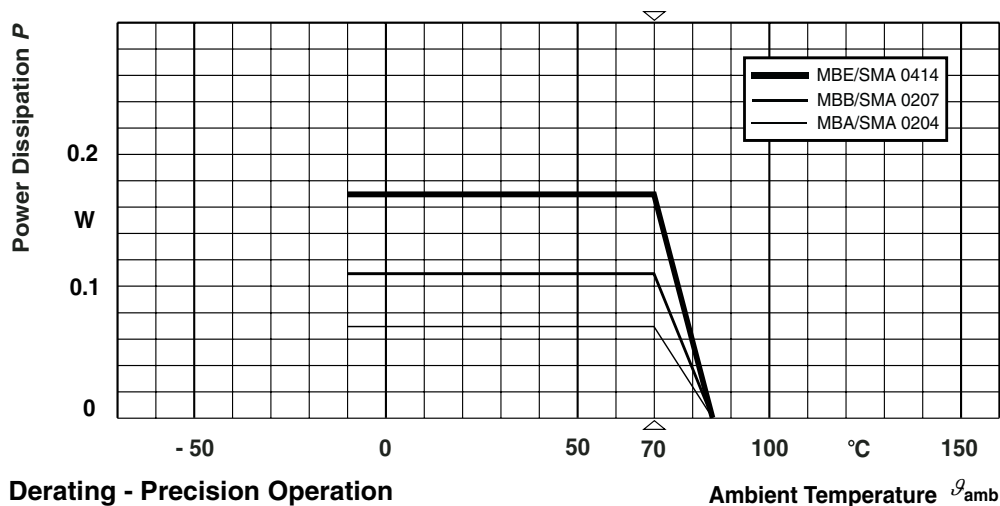
Vishay BEYSCHLAG has achieved "Approval of Manufacturer" in accordance with **EN 100114-1**.

**SPECIALS**

On request, resistors are available with established reliability in accordance with **CECC 40101-806 Version E**. Please refer to the special data sheet for information on failure rate level, available resistance ranges and ordering codes.

**FUNCTIONAL PERFORMANCE**

Derating - Long Term Operation



**TESTS AND REQUIREMENTS**

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

EN 140000/IEC 60115-1, Generic specification (includes tests)

EN 140100/IEC 60115-2, Sectional specification (includes schedule for qualification approval)

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 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, long term, 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; a short description of the test procedure is also given.

| <b>TEST PROCEDURES AND REQUIREMENTS</b> |                               |                                              |                                                                         |                                                          |                                                                       |                                                                      |
|-----------------------------------------|-------------------------------|----------------------------------------------|-------------------------------------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------------------|----------------------------------------------------------------------|
| 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 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 k $\Omega$ to 221 k $\Omega$ | 22 $\Omega$ to < 43 $\Omega$ ;<br>> 221 k $\Omega$ 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 $\Omega$ | 10 $\Omega$ to < 43 $\Omega$ ;<br>> 510 k $\Omega$ 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 < 43 $\Omega$ ;<br>> 1 M $\Omega$ to 1.5 M $\Omega$   |
| 4.5                                     | —                             | resistance                                   | —                                                                       | $\pm 0.25\%$ ; $\pm 0.1\%$                               |                                                                       |                                                                      |
| 4.8.4.2                                 | —                             | temperature coefficient                      | at 20/LCT/20 °C and 20/UCT/20 °C                                        | $\pm 25$ ppm/K; $\pm 15$ ppm/K                           |                                                                       |                                                                      |
| 4.25.1                                  | —                             | endurance at 70 °C: precision operation mode | $U = \sqrt{P_{70} \times R}$ or $U = U_{\max}$ ;<br>1.5 h on; 0.5 h off |                                                          |                                                                       |                                                                      |
|                                         |                               |                                              | 70 °C; 1000 h                                                           | $\pm (0.05\% R + 0.01 \Omega)^{(1)}$                     | $\pm (0.1\% R + 0.01 \Omega)$                                         | $\pm (0.25\% R + 0.05 \Omega)^{(2)}$                                 |
|                                         |                               |                                              | 70 °C; 8000 h                                                           | $\pm (0.1\% R + 0.01 \Omega)$                            | $\pm (0.2\% R + 0.01 \Omega)$                                         | $\pm (0.5\% R + 0.05 \Omega)$                                        |
|                                         | —                             | endurance at 70 °C: standard operation mode  | $U = \sqrt{P_{70} \times R}$ or $U = U_{\max}$ ;<br>1.5 h on; 0.5 h off |                                                          |                                                                       |                                                                      |

| 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 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 k $\Omega$ to 221 k $\Omega$ | 22 $\Omega$ to < 43 $\Omega$ ;<br>> 221 k $\Omega$ 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 $\Omega$ | 10 $\Omega$ to < 43 $\Omega$ ;<br>> 510 k $\Omega$ 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 < 43 $\Omega$ ;<br>> 1 M $\Omega$ to 1.5 M $\Omega$   |
| 4.24                             | 78 (Cab)                      | damp heat, steady state     | (40 $\pm$ 2) $^{\circ}$ 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 $^{\circ}$ C; 16 h                                                                              |                                                          |                                                                       |                                                                      |
| 4.23.3                           | 30 (Db)                       | damp heat, cyclic           | 55 $^{\circ}$ C; 24 h;<br>90 % to 100 % RH;<br>1 cycle                                              |                                                          |                                                                       |                                                                      |
| 4.23.4                           | 1 (Aa)                        | cold                        | - 55 $^{\circ}$ C; 2 h                                                                              |                                                          |                                                                       |                                                                      |
| 4.23.5                           | 13 (M)                        | low air pressure            | 8.5 kPa; 2 h;<br>15 $^{\circ}$ C to 35 $^{\circ}$ C                                                 |                                                          |                                                                       |                                                                      |
| 4.23.6                           | 30 (Db)                       | damp heat, cyclic           | 55 $^{\circ}$ 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>$U = 2.5 \times \sqrt{P_{70}} \times R$<br>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 minutes at LCT and<br>30 minutes at UCT;<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             |



| 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 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 k $\Omega$ to 221 k $\Omega$ | 22 $\Omega$ to < 43 $\Omega$ ;<br>> 221 k $\Omega$ 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 $\Omega$ | 10 $\Omega$ to < 43 $\Omega$ ;<br>> 510 k $\Omega$ 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 < 43 $\Omega$ ;<br>> 1 M $\Omega$ to 1.5 M $\Omega$   |
| 4.29                             | 45 (XA)                                     | component solvent resistance            | isopropyl alcohol + 23 °C; toothbrush method                 | marking legible;<br>no visible damage                    |                                                                       |                                                                      |
| 4.18.2                           | 20 (Tb)                                     | resistance to soldering heat            | unmounted components;<br>(260 $\pm$ 5) °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 solder bath method                             | 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                           | $U_{\text{RMS}}$ = 100 V; 60 s                               | no flashover or breakdown                                |                                                                       |                                                                      |
|                                  | –                                           |                                         | 70 °C; 1000 h                                                | $\pm$ (0.25 % $R$ + 0.05 $\Omega$ ) <sup>(2)</sup>       | –                                                                     | –                                                                    |
|                                  | –                                           |                                         | 70 °C; 8000 h                                                | $\pm$ (0.5 % $R$ + 0.05 $\Omega$ )                       | –                                                                     | –                                                                    |
| 4.25.3                           | –                                           | endurance at upper category temperature | 85 °C; 1000 h<br>125 °C; 1000 h                              | –<br>$\pm$ (0.05 % $R$ + 0.01 $\Omega$ )                 | –<br>$\pm$ (0.1 % $R$ + 0.01 $\Omega$ )                               | –<br>$\pm$ (0.25 % $R$ + 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



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