

## High Frequency Thin Film Leaded Resistors



### DESIGN SUPPORT TOOLS

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**3D**  
Models  
Available

MBA/SMA 0204 HF leaded thin film resistors for RF applications are the perfect choice in high frequency circuit designs; where the impedance change due to the parasitic inductance of regular and professional resistors can not be accepted. Typical applications are in the fields of telecommunication equipment and industrial electronics.

### FEATURES

- Speciality product for RF applications
- Low-inductance non-helical trimmed product
- Suitable for more than 3 GHz
- Resistance range: 1.5  $\Omega$  to 470  $\Omega$
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT

### APPLICATIONS

- Telecommunication equipment
- Industrial electronics

#### METRIC SIZE

|      |      |
|------|------|
| DIN  | 0204 |
| CECC | A    |

### TECHNICAL SPECIFICATIONS

| DESCRIPTION   | MBA/SMA 0204 HF              |                  |              |
|---|------------------------------|------------------|--------------|
| CECC size   | A                            |                  |              |
| Resistance range  | 1.5 $\Omega$ to 470 $\Omega$ |                  |              |
| Resistance tolerance  | $\pm 1\%$ ; $\pm 2\%$        |                  |              |
| Temperature coefficient   | $\pm 50$ ppm/K               |                  |              |
| Operation mode  | Long term                    | Standard         |              |
| Climatic category (LCT / UCT / days)  | 55 / 125 / 56                | 55 / 155 / 56    |              |
| Rated dissipation, $P_{70}$   | 0.25 W                       | 0.4 W            |              |
| Operating voltage, $U_{max}$ . AC/DC  | Limited by $P_{70}$          |                  |              |
| Film temperature  | 125 $^{\circ}$ C             | 155 $^{\circ}$ C |              |
| Max. resistance change at $P_{70}$<br>for resistance range, $\Delta R/R$ max., after: | 1.5 $\Omega$ to 470 $\Omega$ |                  |              |
|   | 1000 h                       | $\leq 0.25\%$    | $\leq 0.5\%$ |
|   | 8000 h                       | $\leq 0.5\%$     | $\leq 1.0\%$ |
|   | 225 000 h                    | $\leq 1.5\%$     | -            |
| Permissible voltage against ambient:  | 300 V                        |                  |              |
|   | 1 min; $U_{ins}$             | 75 V             |              |
| Continuous  | 75 V                         |                  |              |
| Failure rate  | $\leq 0.7 \times 10^{-9}/h$  |                  |              |

#### Note

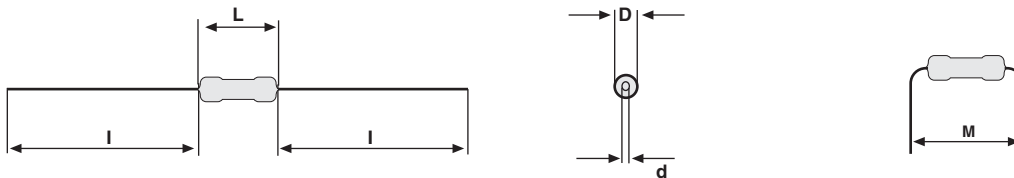
- These resistors do not feature a limited lifetime when operated within the permissible limits. However, resistance value drift increasing over operating time may result in exceeding a limit acceptable to the specific application, thereby establishing a functional lifetime

| PART NUMBER AND PRODUCT DESCRIPTION                 |   |                       |                    |            |               |   |   |                            |   |               |   |               |   |   |   |   |   |
|---|---|-----------------------|--------------------|------------|---------------|---|---|----------------------------|---|---------------|---|---------------|---|---|---|---|---|
| PART NUMBER: MBA0204AC5109GCT00                     |   |                       |                    |            |               |   |   |                            |   |               |   |               |   |   |   |   |   |
| M   | B | A                     | 0                  | 2          | 0             | 4   | A | C                          | 5 | 1             | 0 | 9             | G | C | T | 0 | 0 |
| TYPE/SIZE   |   | VARIANT               |                    | TCR        |               | RESISTANCE  |   | TOLERANCE                  |   | PACKAGING (1) |   | SPECIAL       |   |   |   |   |   |
| MBA0204 = MBA/SMA 0204                              |   | A = HF high frequency |                    | C = 50 ppm |               | 3 digit value<br>1 digit multiplier<br>Multiplier<br>8 = *10 <sup>-2</sup><br>9 = *10 <sup>-1</sup><br>0 = *10 <sup>0</sup> |   | F = ± 1.0 %<br>G = ± 2.0 % |   | CT<br>C1      |   | 00 = standard |   |   |   |   |   |
| PRODUCT DESCRIPTION: MBA/SMA 0204-50 2 % HF CT 51R0 |   |                       |                    |            |               |   |   |                            |   |               |   |               |   |   |   |   |   |
| MBA/SMA 0204  | - | 50                    | 2 %                | HF         | CT            | 51R0  |   |                            |   |               |   |               |   |   |   |   |   |
| TYPE/SIZE   |   | TCR                   | TOLERANCE          | VARIANT    | PACKAGING (1) | RESISTANCE  |   |                            |   |               |   |               |   |   |   |   |   |
| MBA/SMA 0204  |   | 50 ppm                | ± 1.0 %<br>± 2.0 % | HF         | CT<br>C1      | 51R0 = 51 Ω   |   |                            |   |               |   |               |   |   |   |   |   |

**Notes**

- The PART NUMBER shown above is to facilitate the unified part numbering system for ordering products
- (1) Please refer to table PACKAGING for complete information

| PACKAGING    |        |      |
|--------------|--------|------|
| MODEL        | BOX    |      |
|              | PIECES | CODE |
| MBA/SMA 0204 | 1000   | C1   |
|              | 5000   | CT   |

**DIMENSIONS**


| DIMENSIONS - leaded resistor types, mass and relevant physical dimensions |                        |                        |                        |                        |                        |           |
|---|------------------------|------------------------|------------------------|------------------------|------------------------|-----------|
| TYPE  | D <sub>max.</sub> (mm) | L <sub>max.</sub> (mm) | d <sub>nom.</sub> (mm) | I <sub>min.</sub> (mm) | M <sub>min.</sub> (mm) | MASS (mg) |
| MBA/SMA 0204 HF   | 1.6                    | 3.6                    | 0.5                    | 29.0                   | 5.0                    | 125       |

| TEMPERATURE COEFFICIENT AND RESISTANCE RANGE |                      |                      |
|--|----------------------|----------------------|
| DESCRIPTION                                  | RESISTANCE VALUE (1) |                      |
| TCR  | TOLERANCE            | MBA/SMA 0204 HF      |
| ± 50 ppm/K                                   | ± 1 %; ± 2 %         | 1.5 Ω to 470 Ω; 50 Ω |

**Note**

- (1) Resistance values to be selected for ± 1 % from the E24/E96 series and for ± 2 % from E24 series



**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 % Al<sub>2</sub>O<sub>3</sub>) and conditioned to achieve the desired temperature coefficient. Nickel plated steel termination caps are firmly pressed on the metallised rods. A special laser is used to achieve the target value by smoothly cutting a low-inductivity non-helical groove in the resistive layer without damaging the ceramics. Connecting wires of electrolytic copper plated with 100 % pure tin are welded to the termination caps. The resistors are covered by protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure tin on nickel plating. Four colour code rings designate the resistance value and tolerance in accordance with **IEC 60062**. Additional black dots near the 3rd colour ring identify the special HF product.

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

**Notes**

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

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

wave or dipping. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions. 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 **GADSL** <sup>(1)</sup> and the **CEFIC-EECA-EICTA** <sup>(2)</sup> list of legal restrictions on hazardous substances. This includes full compatibility with the following directives:

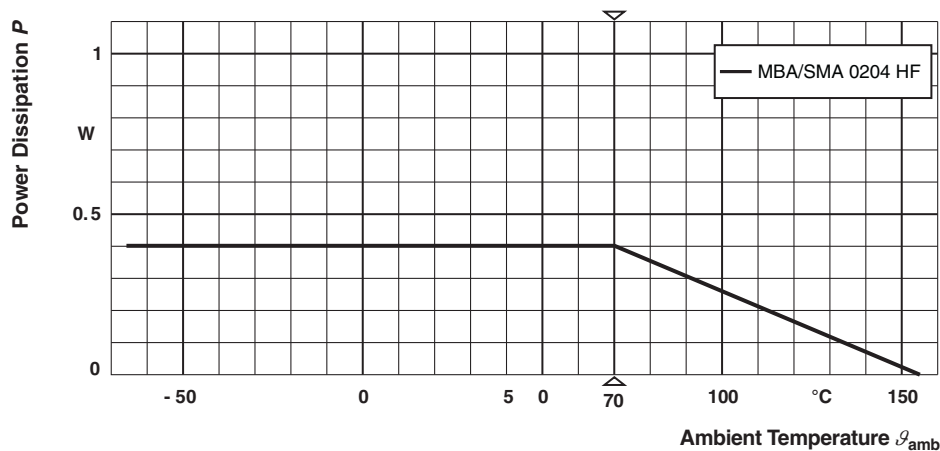
- 2000/53/EC End of Vehicle Life Directive (ELV) and Annex II (ELVII)
- 2002/95/EC Restriction of the use of Hazardous Substances Directive (RoHS)
- 2002/96/EC Waste Electrical and Electrical Equipment Directive (WEEE)

**APPROVALS**

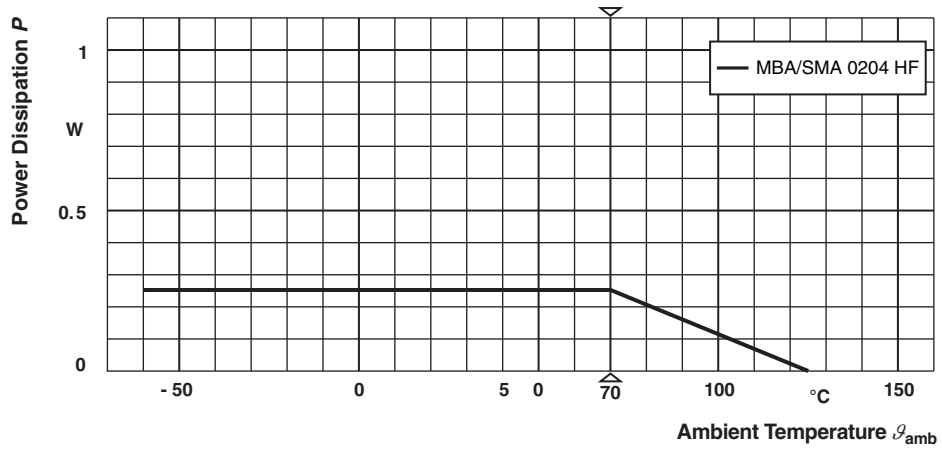
Where applicable, the resistors are tested in accordance with **CECC 40101-806** which refers to **EN 60115-1** and **EN 140100**.

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

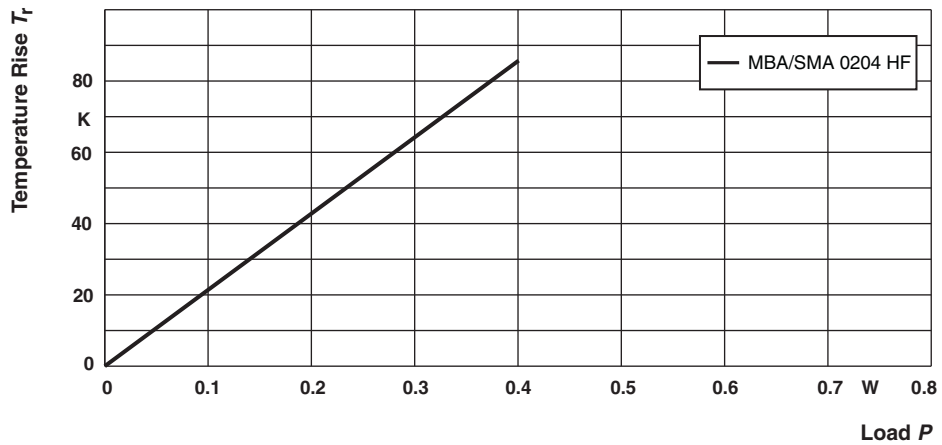
**FUNCTIONAL PERFORMANCE**



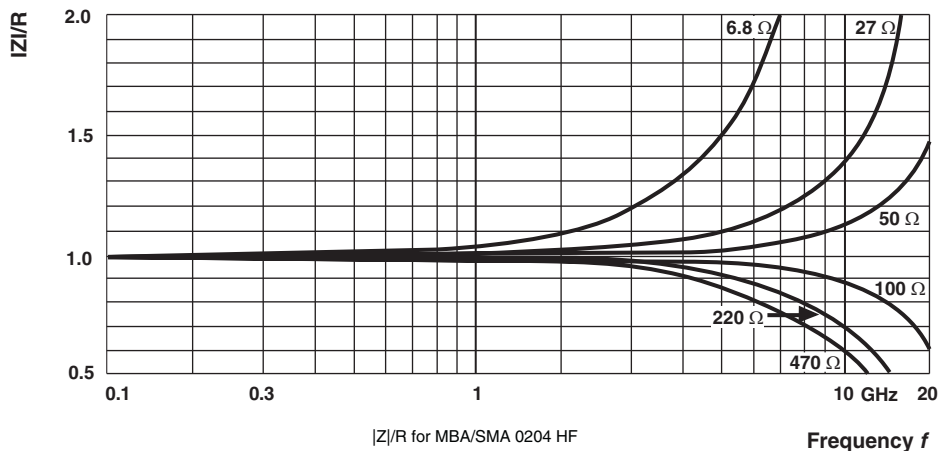
**Derating - Standard Operation**



Rise of the Surface Temperature



Temperature Rise



RF - Behaviour



**TESTS AND REQUIREMENTS**

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

EN 60115-1, generic specification (includes tests)

EN 140100, sectional specification (includes schedule for qualification approval)

CECC 40101-806, detail specification (includes schedule for conformance inspection)

The following table contains the applicable tests selected from the documents listed above.

The tests are carried out in accordance with IEC 60068-xx test method and under standard atmospheric conditions in accordance with IEC 60068-1, 5.3. Climatic category LCT/UCT/56 (rated temperature range: Lower Category Temperature, Upper Category Temperature; damp heat, 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 test methods. A short description of the test procedure is also given.

| <b>TEST PROCEDURES AND REQUIREMENTS</b> |                                   |   |   |  |
|---|-----------------------------------|---|---|--|
| <b>IEC 60115-1 CLAUSE</b>               | <b>IEC 60068-2-xx TEST METHOD</b> | <b>TEST</b>                                 | <b>PROCEDURE</b>  | <b>REQUIREMENTS PERMISSIBLE CHANGE (ΔR MAX.)</b> |
|   |                                   |   | Stability for product types:<br><b>MBA/SMA 0204 HF</b>  | 1.5 Ω to 470 Ω                                   |
| 4.5                                     | -                                 | Resistance                                  |   | ± 1 %; ± 2 %                                     |
| 4.8                                     | -                                 | Temperature coefficient                     | At (20 / LCT / 20) °C and (20 / UCT / 20) °C  | ± 50 ppm/K                                       |
| 4.25.1                                  | -                                 | 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<br>70 °C; 1000 h<br>70 °C; 8000 h | ± (0.5 % R + 0.05 Ω)<br>± (1 % R + 0.1 Ω)        |
|   | -                                 | Endurance at 70°C: long term operation mode | $U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$ ;<br>1.5 h ON; 0.5 h OFF<br>70 °C; 1000 h<br>70 °C; 8000 h | ± (0.25 % R + 0.05 Ω)<br>± (0.5 % R + 0.05 Ω)    |
| 4.25.3                                  | -                                 | Endurance at upper category temperature     | 125 °C; 1000 h<br>155 °C; 1000 h  | ± (0.25 % R + 0.05 Ω)<br>± (0.5 % R + 0.05 Ω)    |
| 4.24                                    | 78 (Cab)                          | Damp heat, steady state                     | (40 ± 2) °C; 56 days;<br>(93 ± 3) % RH  | ± (0.5 % R + 0.05 Ω)                             |
| 4.23                                    |                                   | Climatic sequence:                          |   |  |
| 4.23.2                                  | 2 (Ba)                            | Dry heat                                    | 155 °C; 16 h  |  |
| 4.23.3                                  | 30 (Db)                           | Damp heat, cyclic                           | 55 °C; 24 h; 90 % to 100 % RH;<br>1 cycle   |  |
| 4.23.4                                  | 1 (Aa)                            | Cold  | -55 °C; 2 h   |  |
| 4.23.5                                  | 13 (M)                            | Low air pressure                            | 8.5 kPa; 2 h; 15 °C to 35 °C  |  |
| 4.23.6                                  | 30 (Db)                           | Damp heat, cyclic                           | 55 °C; 5 days;<br>95 % to 100 % RH; 5 cycles  | ± (0.5 % R + 0.05 Ω)<br>no visible damage        |
| -                                       | 1 (Aa)                            | Cold  | -55 °C; 2 h   | ± (0.1 % R + 0.01 Ω)                             |
| 4.13                                    | -                                 | Short time overload                         | Room temperature;<br>$U = 2.5 \times \sqrt{P_{70} \times R}$ or<br>$U = 2 \times U_{max.}$ ; 5 s          | ± (0.1 % R + 0.01 Ω)<br>no visible damage        |
| 4.19                                    | 14 (Na)                           | Rapid change of temperature                 | 30 min at LCT and<br>30 min at UCT; 5 cycles  | ± (0.1 % R + 0.01 Ω)<br>no visible damage        |



| <b>TEST PROCEDURES AND REQUIREMENTS</b> |   |                              |   |   |
|---|---|------------------------------|---|---|
| IEC 60115-1 CLAUSE                      | IEC 60068-2-xx TEST METHOD                  | TEST                         | PROCEDURE   | REQUIREMENTS PERMISSIBLE CHANGE ( $\Delta R$ MAX.)            |
| 4.29                                    | 45 (XA)                                     | Component solvent resistance | Stability for product types:                            | 1.5 $\Omega$ to 470 $\Omega$                                  |
|   |   |                              | <b>MBA/SMA 0204 HF</b>                                  |   |
|   |   |                              | Isopropyl alcohol +23 °C; toothbrush method             | marking legible; no visible damage                            |
| 4.18.2                                  | 20 (Tb)                                     | Resistance to soldering heat | Unmounted components; (260 $\pm$ 3) °C; (10 $\pm$ 1) s  | $\pm$ (0.1 % $R$ + 0.01 $\Omega$ )<br>no visible damage       |
| 4.17                                    | 20 (Ta)                                     | Solderability                | +235 °C; 2 s<br>solder bath method;<br>SnPb40           | Good tinning ( $\geq$ 95 % $R$ covered);<br>no visible damage |
|   |   |                              | + 245 °C; 3 s<br>solder bath method;<br>SnAg3Cu0.5      |   |
| 4.22                                    | 6 (B4)                                      | Vibration                    | 6 h; 10 Hz to 2000 Hz 1.5 mm<br>or 196 m/s <sup>2</sup> | $\pm$ (0.1 % $R$ + 0.01 $\Omega$ )                            |
| 4.16                                    | 21 (Ua <sub>1</sub> )<br>21 (Ub)<br>21 (Uc) | Robustness of terminations   | Tensile, bending and torsion                            | $\pm$ (0.1 % $R$ + 0.01 $\Omega$ )<br>no visible damage       |
| 4.7                                     | -   | Voltage proof                | $U_{RMS} = U_{ins}$ ; 60 s                              | No flashover or breakdown                                     |

**12NC INFORMATION FOR HISTORICAL CODING REFERENCE**

**Last Digit of 12NC Indicating Resistance Decade**

| RESISTANCE DECADE            | LAST DIGIT |
|------------------------------|------------|
| 1 $\Omega$ to 9.99 $\Omega$  | 8          |
| 10 $\Omega$ to 99.9 $\Omega$ | 9          |
| 100 $\Omega$ to 999 $\Omega$ | 1          |

**Ordering Example (For historical coding reference of MBA 0204 HF)**

The ordering code of a MBA 0204 HF resistor, value 51  $\Omega$  and TCR 50 with  $\pm$  2 % tolerance, supplied on bandolier ammpack, in a box units is: 2312 908 05109.

| <b>12NC CODE FOR HISTORICAL CODING REFERENCE OF MBA 0204 HF</b> |                |           |                           |                     |
|---|----------------|-----------|---------------------------|---------------------|
| DESCRIPTION   |                |           | 2312 ... ..               |                     |
|   |                |           | BANDOLIER IN BOX AMMOPACK |                     |
| TYPE  | TCR            | TOL.      | C1<br>1000<br>UNITS       | CT<br>5000<br>UNITS |
| MBA 0204 HF   | $\pm$ 50 ppm/K | $\pm$ 2 % | 903 0....                 | 908 0....           |



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