## High Frequency Thin Film Leaded Resistors

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 Ω to 470 Ω
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compliant to RoHS directive 2002/95/EC

Pb-free 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 Ω to 470 Ω | |
| Resistance Tolerance | ± 1 %; ± 2 % | |
| Temperature Coefficient | ± 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 °C | 155 °C |
| Max. Resistance Change at $P_{70}$ for Resistance Range, $\Delta R/R$ max., After: | 1.5 Ω to 470 Ω | |
| 1000 h | ≤ 0.25 % | ≤ 0.5 % |
| 8000 h | ≤ 0.5 % | ≤ 1.0 % |
| 225 000 h | ≤ 1.5 % | - |
| Permissible Voltage Against Ambient: | | |
| 1 Minute; $U_{ins}$ | 300 V | |
| Continuous | 75 V | |
| Failure Rate | ≤ 0.7 x $10^{-9}$/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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| MODEL/SIZE | VARIANT | TCR/MATERIAL | VALUE | 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** = $*10^{-2}$<br>**9** = $*10^{-1}$<br>**0** = $*10^{0}$ | **F** = ± 1.0 %<br>**G** = ± 2.0 % | **CT**<br>**C1**<br>**RP** | **00** = Standard |

**PRODUCT DESCRIPTION: MBA/SMA 0204-50 2 % HF CT 51R0**

| MBA/SMA 0204 | - | 50 | 2 % | HF | CT | 51R0 |
|---|---|---|---|---|---|---|
| MODEL/SIZE | | TCR | TOLERANCE | VARIANT | PACKAGING (1) | RESISTANCE VALUE |
| **MBA/SMA 0204** | | **50 ppm** | **± 1.0 %**<br>**± 2.0 %** | **HF** | **CT**<br>**C1**<br>**RP** | **51R0** = 51 Ω |

**Notes**

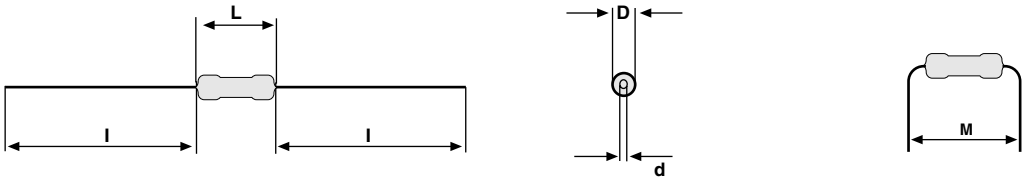
(1) Please refer to table PACKAGING for complete information

- 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 | 5000 | RP | 1000<br>5000 | C1<br>CT |

## DIMENSIONS




## DIMENSIONS - leaded resistor types, mass and relevant physical dimensions

| TYPE | $D_{max.}$ (mm) | $L_{max.}$ (mm) | $d_{nom.}$ (mm) | $l_{min.}$ (mm) | $M_{min.}$ (mm) | MASS (mg) |
|---|---|---|---|---|---|---|
| MBA/SMA 0204 HF | 1.6 | 3.6 | 0.5 | 29.0 | 5.0 | 125 |

## TEMPERATURE COEFFICIENT AND RESISTANCE RANGE

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

**Note**

(2) 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 % $Al_2O_3$) 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 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** [1] and the **CEFIC-EECA-EICTA** [2] 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.**

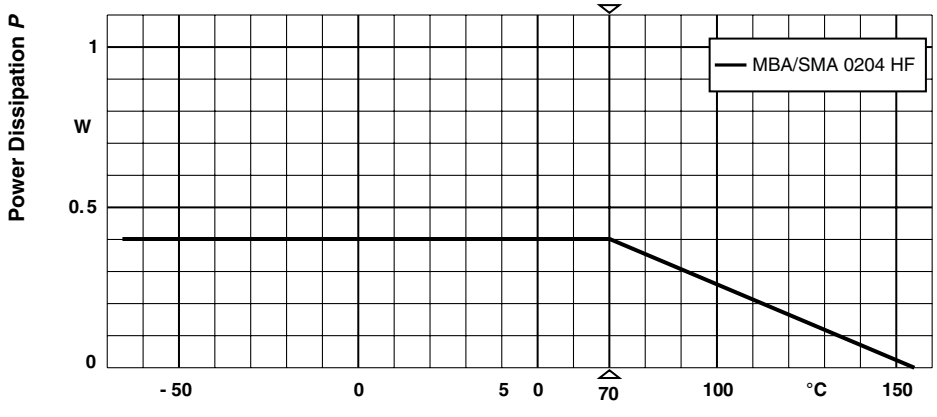
Vishay Beyschlag has achieved **"Approval of Manufacturer"** in accordance with **IEC QC 001002-3, clause 2**. The release certificate for **"Technology Approval Schedule"** in accordance with **CECC 240001** based on **IEC QC 001002-3, clause 6** is granted for the Vishay Beyschlag manufacturing process.

**Notes**

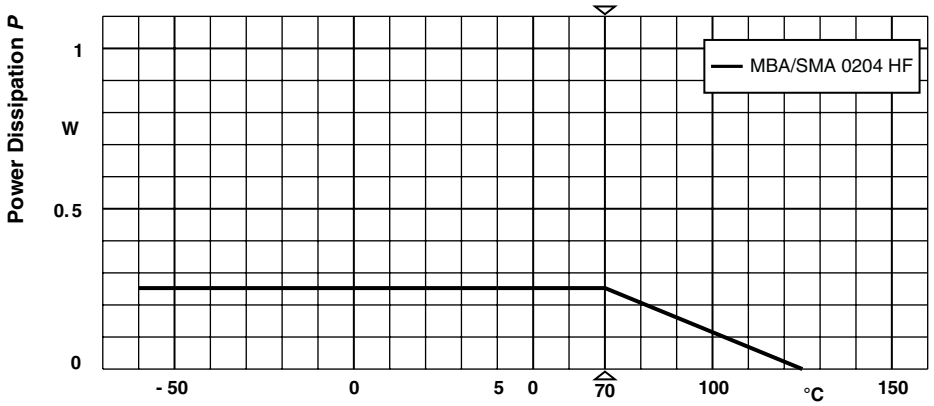
[1] Global Automotive Declarable Substance List, see www.gadsl.org

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

## FUNCTIONAL PERFORMANCE

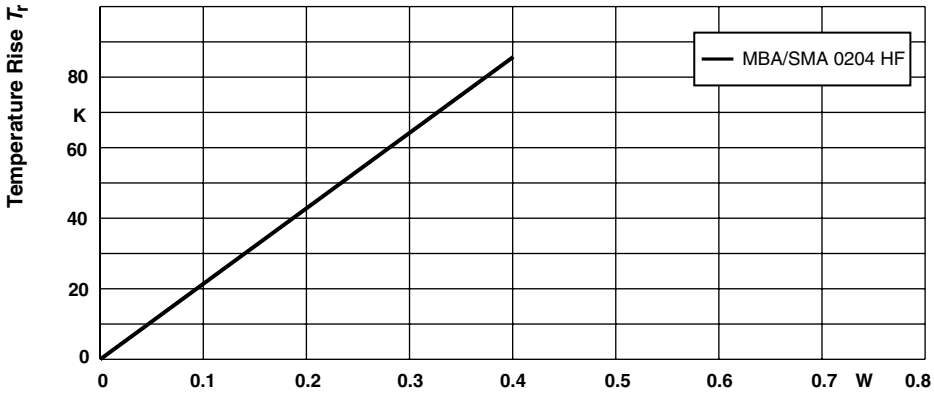



**Derating - Standard Operation**



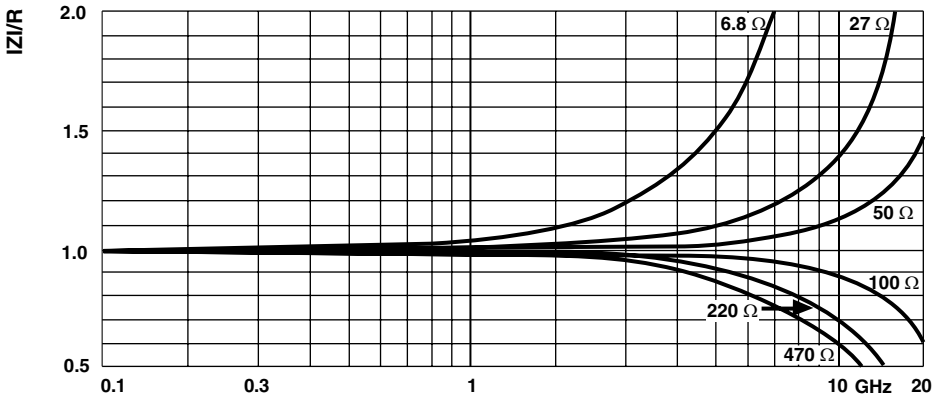

**Rise of the Surface Temperature**

Ambient Temperature $\vartheta_{amb}$




**Temperature Rise**

Load *P*




**RF - Behaviour**

|Z|/R for MBA/SMA 0204 HF

Frequency *f*

## 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.

**TEST PROCEDURES AND REQUIREMENTS**

| IEC 60115-1 CLAUSE | IEC 60068-2-xx TEST METHOD | TEST | PROCEDURE | REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R$ max.) |
|---|---|---|---|---|
| | | | Stability for product types: | |
| | | | **MBA/SMA 0204 HF** | 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 $U = U_{max.}$; 1.5 h ON; 0,5 h OFF | |
| | | | 70 °C; 1000 h | ± (0.5 % $R$ + 0.05 Ω) |
| | | | 70 °C; 8000 h | ± (1 % $R$ + 0.1 Ω) |
| | - | Endurance at 70 °C: long term operation mode | $U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; 1.5 h ON; 0.5 h OFF | |
| | | | 70 °C; 1000 h | ± (0.25 % $R$ + 0.05 Ω) |
| | | | 70 °C; 8000 h | ± (0.5 % $R$ + 0.05 Ω) |
| 4.25.3 | - | Endurance at upper category temperature | 125 °C; 1000 h | ± (0.25 % $R$ + 0.05 Ω) |
| | | | 155 °C; 1000 h | ± (0.5 % $R$ + 0.05 Ω) |
| 4.24 | 78 (Cab) | Damp heat, steady state | (40 ± 2) °C; 56 days; (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; 1 cycle | |
| 4.23.4 | 1 (Aa) | Cold | - 55 °C; 2 h | |
| 4.23.5 | 13 (M) | Low air pressure | 8.5 kPa; 2 h; 15 °C to 35 °C | |
| 4.23.6 | 30 (Db) | Damp heat, cyclic | 55 °C; 5 days; 95 % to 100 % RH; 5 cycles | ± (0.5 % $R$ + 0.05 Ω) no visible damage |
| - | 1 (Aa) | Cold | - 55 °C; 2 h | ± (0.1 % $R$ + 0.01 Ω) |

## TEST PROCEDURES AND REQUIREMENTS

| IEC 60115-1 CLAUSE | IEC 60068-2-xx TEST METHOD | TEST | PROCEDURE | REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R$ max.) |
|---|---|---|---|---|
| | | | Stability for product types: | |
| | | | **MBA/SMA 0204 HF** | 1.5 Ω to 470 Ω |
| 4.13 | - | Short time overload | Room temperature; $U = 2.5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max.}$; 5 s | ± (0.1 % $R$ + 0.01 Ω) no visible damage |
| 4.19 | 14 (Na) | Rapid change of temperature | 30 min at LCT and 30 min at UCT; 5 cycles | ± (0.1 % $R$ + 0.01 Ω) no visible damage |
| 4.29 | 45 (XA) | Component solvent resistance | Isopropyl alcohol + 23 °C; toothbrush method | marking legible; no visible damage |
| 4.18.2 | 20 (Tb) | Resistance to soldering heat | Unmounted components; (260 ± 3) °C; (10 ± 1) s | ± (0.1 % $R$ + 0.01 Ω) no visible damage |
| 4.17 | 20 (Ta) | Solderability | + 235 °C; 2 s solder bath method; SnPb40 | Good tinning (≥ 95 % $R$ covered); no visible damage |
| | | | + 245 °C; 3 s solder bath method; SnAg3Cu0.5 | |
| 4.22 | 6 (B4) | Vibration | 6 h; 10 Hz to 2000 Hz 1.5 mm or 196 m/s² | ± (0.1 % $R$ + 0.01 Ω) |
| 4.16 | 21 ($Ua_1$) 21 (Ub) 21 (Uc) | Robustness of terminations | Tensile, bending and torsion | ± (0.1 % $R$ + 0.01 Ω); 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 Ω to 9.99 Ω | 8 |
| 10 Ω to 99.9 Ω | 9 |
| 100 Ω to 999 Ω | 1 |

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

The ordering code of a MBA 0204 HF resistor, value 51 Ω and TCR 50 with ± 2 % tolerance, supplied on bandolier ammopack, in a box units is: 2312 908 05109.

## 12NC CODE FOR HISTORICAL CODING REFERENCE OF MBA 0204 HF

| DESCRIPTION | | | 2312 ... ..... | |
|---|---|---|---|---|
| | | | BANDOLIER IN BOX AMMOPACK | |
| TYPE | TCR | TOL. | C1 1000 units | CT 5000 units |
| MBA 0204 HF | ± 50 ppm/K | ± 2 % | 903 0.... | 908 0.... |

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