

## 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 $P_{70}$ 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

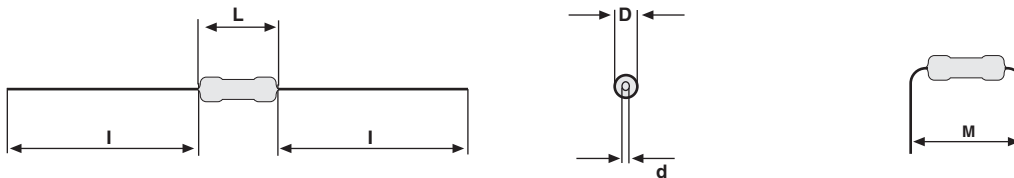
- These resistors do not feature a limited lifetime when operated within the permissible limits. However, resistance value drift increasing over operating time may result in exceeding a limit acceptable to the specific application, thereby establishing a functional lifetime

PART NUMBER AND PRODUCT DESCRIPTION																	
<b>PART NUMBER: MBA0204AC5109GCT00</b>																	
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 1 digit multiplier Multiplier 8 = *10 <sup>-2</sup> 9 = *10 <sup>-1</sup> 0 = *10 <sup>0</sup>		F = ± 1.0 % G = ± 2.0 %		CT C1		00 = standard					
<b>PRODUCT DESCRIPTION: MBA/SMA 0204-50 2 % HF CT 51R0</b>																	
MBA/SMA 0204	-	50	2 %	HF	CT	51R0											
TYPE/SIZE		TCR	TOLERANCE	VARIANT	PACKAGING (1)	RESISTANCE											
MBA/SMA 0204		50 ppm	± 1.0 % ± 2.0 %	HF	CT 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:

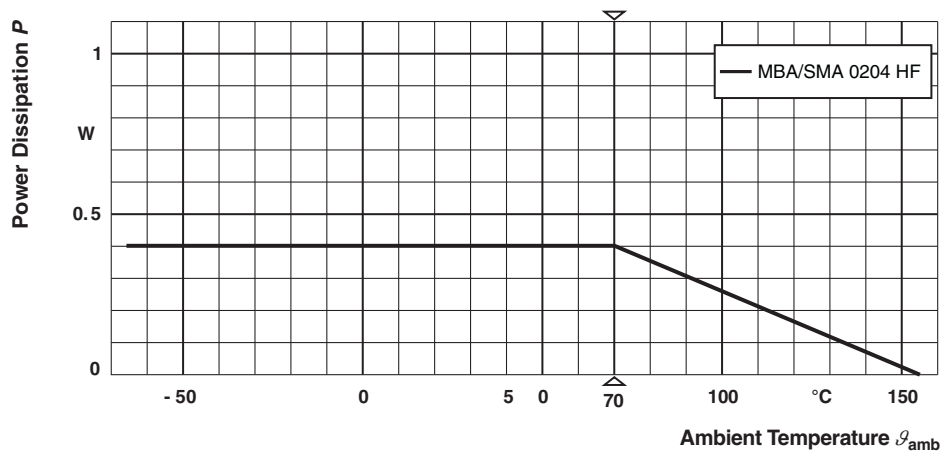
- 2000/53/EC End of Vehicle Life Directive (ELV) and Annex II (ELVII)
- 2002/95/EC Restriction of the use of Hazardous Substances Directive (RoHS)
- 2002/96/EC Waste Electrical and Electrical Equipment Directive (WEEE)

### APPROVALS

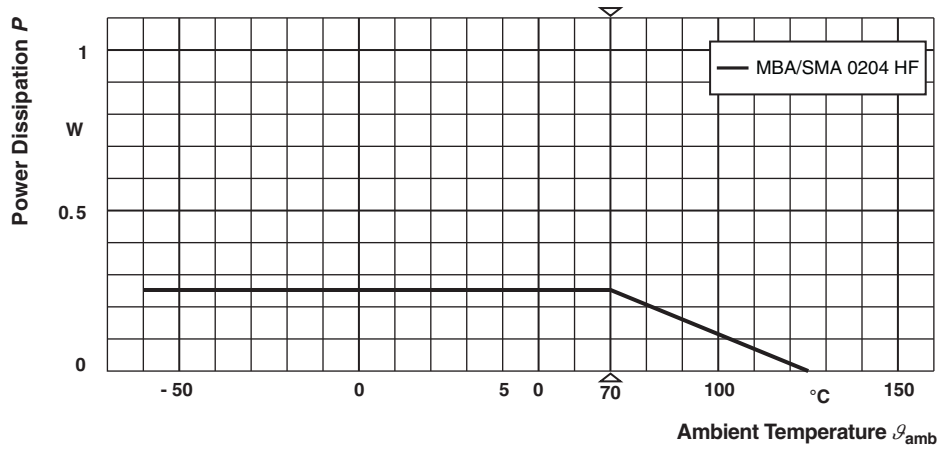
Where applicable, the resistors are tested in accordance with **CECC 40101-806** which refers to **EN 60115-1** and **EN 140100**.

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.

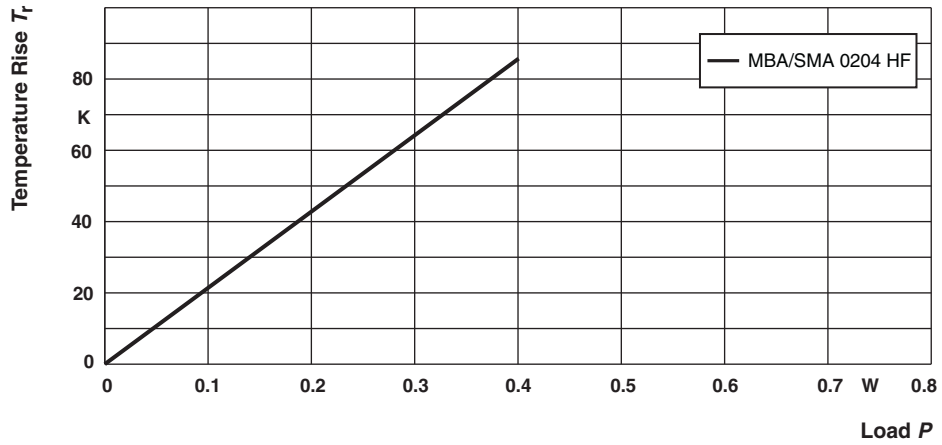
### FUNCTIONAL PERFORMANCE



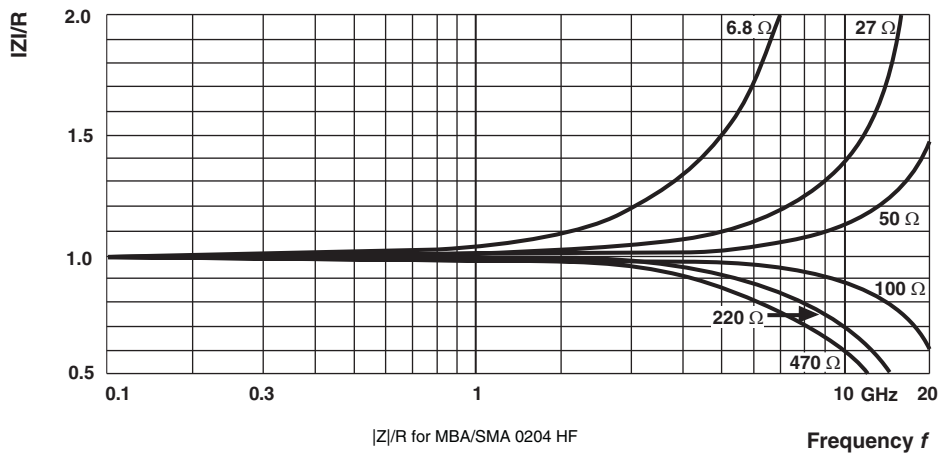
#### Derating - Standard Operation



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: <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 $U = U_{max.}$ ; 1.5 h ON; 0.5 h OFF 70 °C; 1000 h 70 °C; 8000 h	± (0.5 % R + 0.05 Ω) ± (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 70 °C; 8000 h	± (0.25 % R + 0.05 Ω) ± (0.5 % R + 0.05 Ω)
4.25.3	-	Endurance at upper category temperature	125 °C; 1000 h 155 °C; 1000 h	± (0.25 % R + 0.05 Ω) ± (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)
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



<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 $\Omega$ ) no visible damage
4.17	20 (Ta)	Solderability	+235 °C; 2 s solder bath method; SnPb40	Good tinning ( $\geq$ 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/s <sup>2</sup>	$\pm$ (0.1 % $R$ + 0.01 $\Omega$ )
4.16	21 (Ua <sub>1</sub> ) 21 (Ub) 21 (Uc)	Robustness of terminations	Tensile, bending and torsion	$\pm$ (0.1 % $R$ + 0.01 $\Omega$ ) 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 1000 UNITS	CT 5000 UNITS
MBA 0204 HF	$\pm$ 50 ppm/K	$\pm$ 2 %	903 0....	908 0....



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