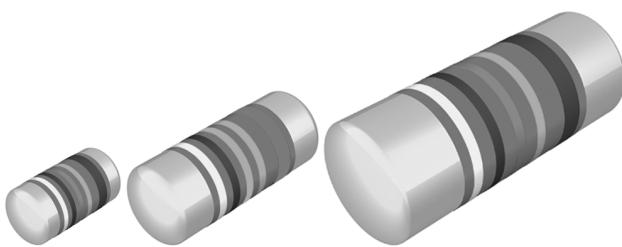


## High Frequency MELF Resistors



MMU 0102 HF, MMA 0204 HF and MMB 0207 HF speciality thin film MELF 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 10 GHz
- Green product, supports lead-free soldering.

### APPLICATIONS

- Telecommunication equipment
- Industrial electronics.

### METRIC SIZE

DIN:	0102	0204	0207
CECC:	RC 2211M	RC 3715M	RC 6123M

### TECHNICAL SPECIFICATIONS

DESCRIPTION	MMU 0102 HF		MMA 0204 HF		MMB 0207 HF	
Metric CECC size	RC 2211M		RC 3715M		RC 6123M	
Resistance range	6.8 Ω to 470 Ω		1.5 Ω to 475 Ω		6.8 Ω to 470 Ω	
Resistance tolerance	± 2 %		± 1 %		± 2 %	
Temperature coefficient			± 50 ppm/K			
Operation mode	standard	power	standard	power	standard	power
Climatic category (LCT/UCT/days)	55/125/56	55/155/56	55/125/56	55/155/56	55/125/56	55/155/56
Rated dissipation, $P_{70}^{(1)}$	0.2 W	0.3 W	0.25 W	0.4 W	0.4 W	1.0 W <sup>(2)</sup>
Operating voltage, $U_{max}$ AC/DC	limited by $P_{70}$		limited by $P_{70}$		limited by $P_{70}$	
Film temperature	125 °C	155 °C	125 °C	155 °C	125 °C	155 °C
Max. resistance change at $P_{70}$ for resistance range, $\Delta R/R$ max., after:	6.8 Ω to 470 Ω		1.5 Ω to 475 Ω		6.8 Ω to 470 Ω	
1000 h	≤ 0.25 %	≤ 0.5 %	≤ 0.25 %	≤ 0.5 %	≤ 0.25 %	≤ 0.5 %
8000 h	≤ 0.5 %	≤ 1.0 %	≤ 0.5 %	≤ 1.0 %	≤ 0.5 %	≤ 1.0 %
225000 h	≤ 1.5 %	-	≤ 1.5 %	-	≤ 1.5 %	-
Specified lifetime	225000 h	8000 h	225000 h	8000 h	225000 h	8000 h
Permissible voltage against ambient (insulation):						
1 minute; $U_{ins}$	150 V		300 V		500 V	
continuous	75 V		75 V		75 V	
Failure rate	$\leq 2.0 \times 10^{-9}/h$		$\leq 0.7 \times 10^{-9}/h$		$\leq 0.7 \times 10^{-9}/h$	

### Note

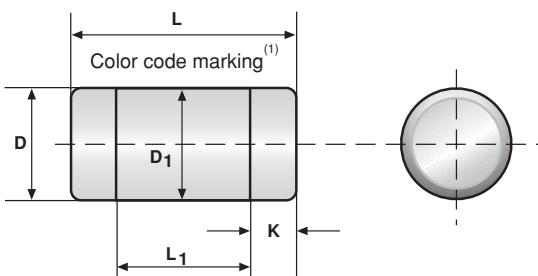
1. The power dissipation on the resistor generates a temperature rise against the local ambient, depending on the heatflow support of the printed-circuit board (thermal resistance). The rated dissipation applies only if the permitted film temperature is not exceeded. Furthermore, a high level of ambient 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.
2. Specified power rating requires dedicated heat-sink pads.

**ORDERING INFORMATION** - type description and ordering code

M	M	U	0102	- 50	2 %	HF	BL	50 R	RESISTANCE VALUE
FILM TYPE M = Metal	PRODUCT CODE	SIZE CODE	METRIC DIN SIZE	TEMPERATURE COEFFICIENT	TOLERANCE	SUFFIX HF = High Frequency	PACKAGING <sup>(1)</sup> B1 = 1000 units B2 = 2000 units BL = 3000 units B7 = 7000 units B0 = 10000 units	RESISTANCE VALUE See Temperature Coefficient and Resistance Range Table.	
M = MELF, cylindrical	U = 0102	0102	± 50 ppm/K	± 1 %	± 2 %				
	A = 0204	0204							
	B = 0207	0207							
									M3 = 3000 units (bulk case) M8 = 8000 units (bulk case)

**Note:** We recommend that the clear text ordering code is used to minimize the possibility of errors in order handling.

- Availability in accordance to table on 12NC ordering codes at the end of this datasheet.

**DIMENSIONS**

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

TYPE	L (mm)	D (mm)	L <sub>1</sub> min (mm)	D <sub>1</sub> (mm)	K (mm)	MASS (mg)
MMU 0102 HF	2.2 + 0/-0.1	1.1 + 0/-0.1	1.2	D + 0/-0.1	0.4 ± 0.05	7
MMA 0204 HF	3.6 + 0/-0.2	1.4 + 0/-0.1	1.8	D + 0/-0.15	0.8 ± 0.1	19
MMB 0207 HF	5.8 + 0/-0.2	2.2 + 0/-0.2	2.8	D + 0/-0.2	1.25 ± 0.15	79

**Note**

- Color code marking is applied according to IEC 60062 in four bands (E24 series) or five bands (E96 series). Each colour band appears as a single solid line, voids are permissible if at least 2/3 of the band is visible from each radial angle of view. The last color band for tolerance is approx. 50% wider than the other bands. An interrupted band between the 3rd and 4th full band identifies the special high frequency type.

**TEMPERATURE COEFFICIENT AND RESISTANCE RANGE**

DESCRIPTION		RESISTANCE VALUE <sup>(1)</sup>		
T.C.	TOLERANCE	MMU 0102 HF	MMA 0204 HF	MMB 0207 HF
± 50 ppm/K	± 2 %	6.8 Ω to 470 Ω; 50 Ω	–	6.8 Ω to 470 Ω; 50 Ω
	± 1 %	–	1.5 Ω to 475 Ω; 50 Ω	–

**Note**

- Resistance value to be selected from E24 series for ± 2 % tolerance and from E96 series for ± 1 % tolerance, for other values please contact the factory.

### 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 (85 %  $\text{Al}_2\text{O}_3$ , for MICRO-MELF: 96 %  $\text{Al}_2\text{O}_3$ ) ceramic body 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 non helical pattern with a resulting low inductivity in the resistive layer without damaging the ceramics. The resistor elements are covered by a 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**. 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 laid directly into the blister tape in accordance with **IEC 60286-3** or bulk case in accordance with **IEC 60286-6**.

### ASSEMBLY

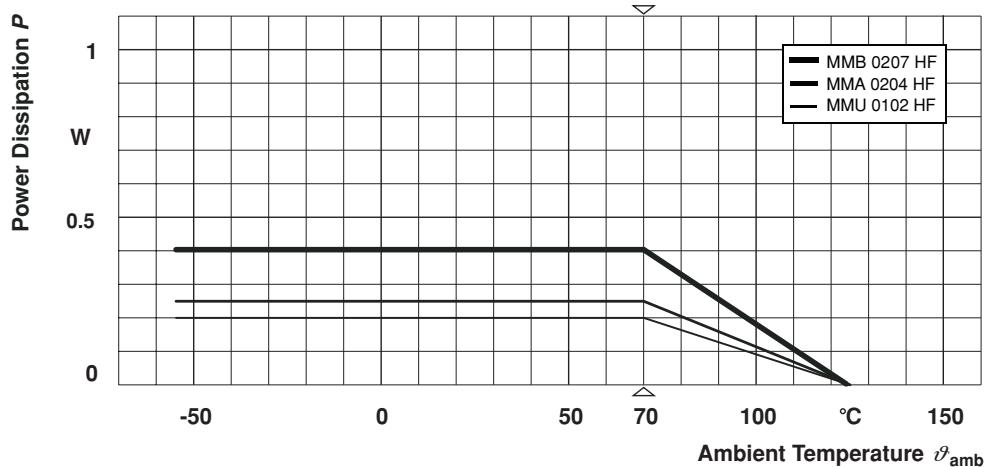
The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow or vapour phase. Excellent solderability is proven, even after extended storage in excess of 10 years. The encapsulation is resistant to all cleaning solvents commonly 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 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 compatibility with European RoHS directive.

### APPROVALS

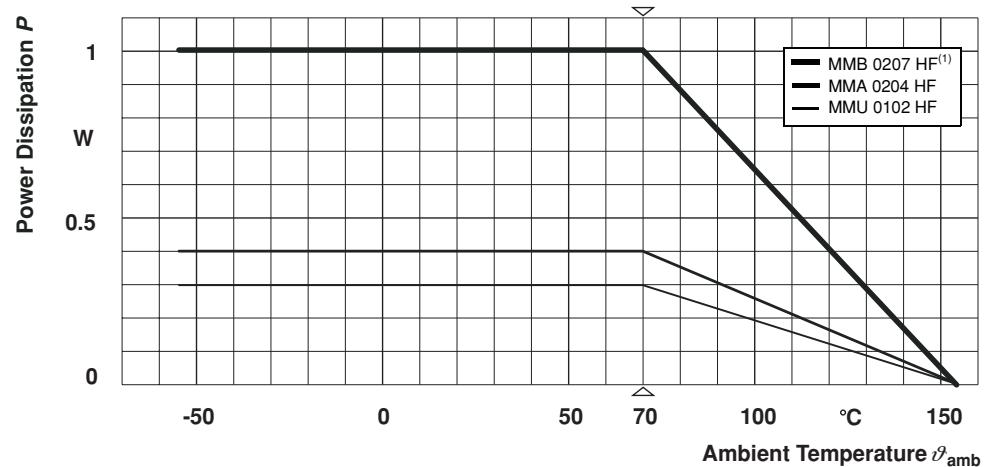
Where applicable the resistors are tested in accordance with **EN 140401-803** (superseding **CECC 40401-803**) which refers to **EN 60115-1**, **EN 140400** and the variety of environmental test procedures of the **IEC 60068** series.

Vishay BEYSCHLAG has achieved "**Approval of Manufacturer**" in accordance with **EN 100 114-1**. The release certificate for "**Technology Approval Schedule**" in accordance with **CECC 240001** based on **EN 100114-6** is granted for the Vishay BEYSCHLAG manufacturing process.

## FUNCTIONAL PERFORMANCE

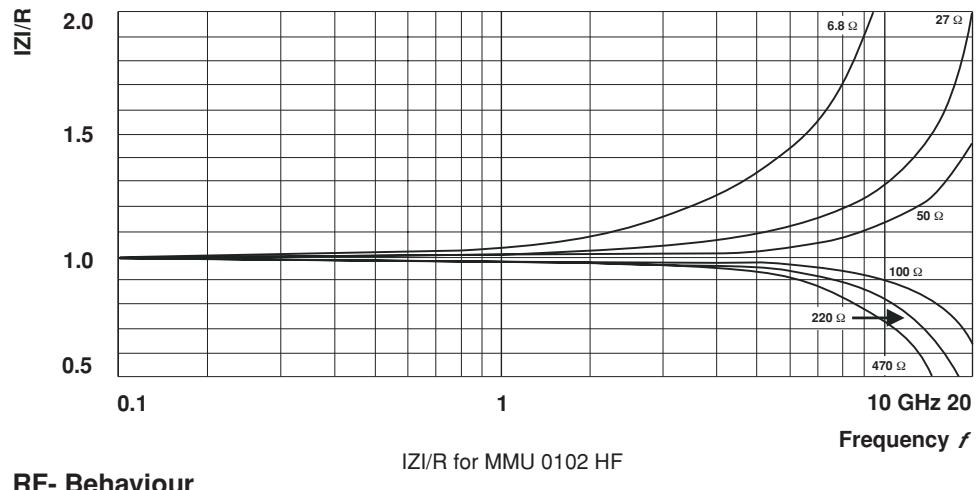


Derating - Standard Operation

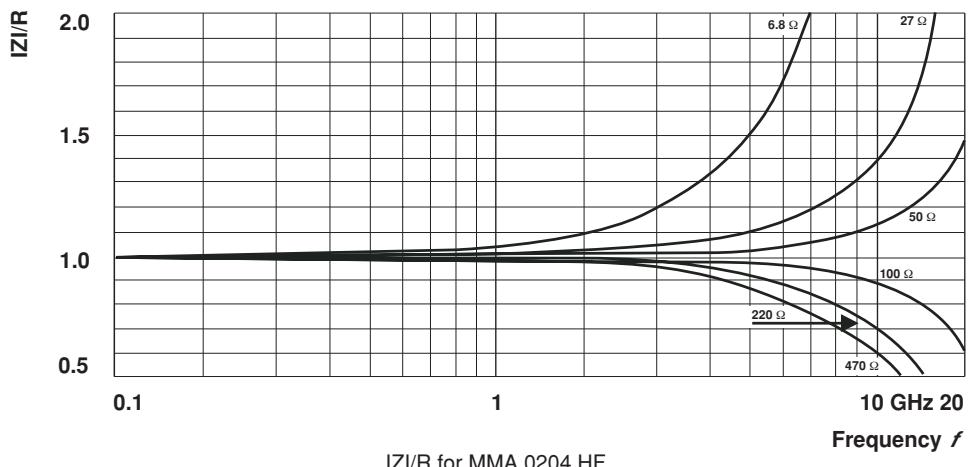
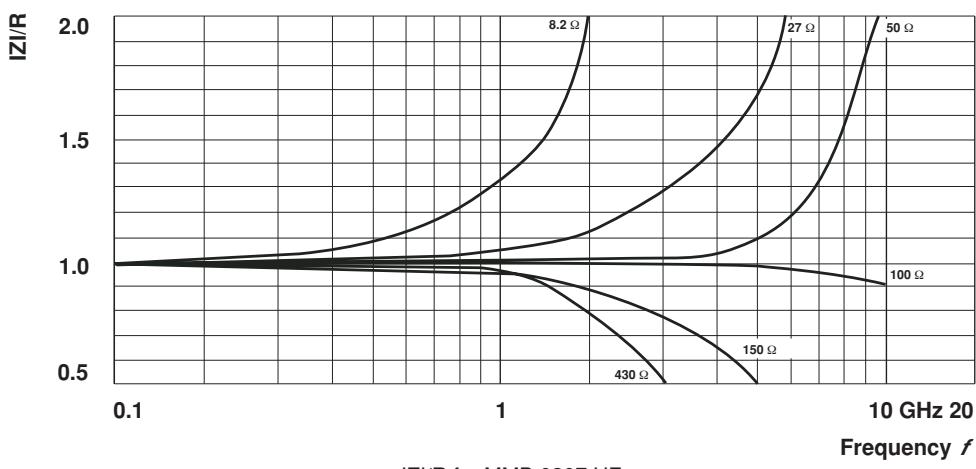


(1) Specified power rating requires dedicated heat sink pads

Derating - Power Operation



RF- Behaviour


**RF- Behaviour**

**RF- Behaviour**

## TESTS AND REQUIREMENTS

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

EN 60115-1, generic specification

EN 140400, sectional specification

EN 140401-803, detail specification

The Test Procedures and Requirements table contains the applicable tests selected from the documents listed above.

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 1 060 mbar).

The components are mounted for testing on printed-circuit boards in accordance with EN 140400, 2.3.3, unless otherwise specified.

The requirements stated in the Test Procedures and Requirements table are based on the required tests and permitted limits of EN 140401-803.

## TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ( $\Delta R/R$ )
			stability for product types:  <b>MMU 0102 HF</b> <b>MMA 0204 HF</b> <b>MMB 0207 HF</b>	6.8 Ω to 470 Ω 1.5 Ω to 475 Ω 6.8 Ω to 470 Ω
4.5	–	resistance	–	MMU 0102 HF, MMB 0207 HF: ± 2 % MMA 0204 HF: ± 1 %
4.8.4.2	–	temperature coefficient	at 20 / – 55 / 20 °C and 20 / 125 / 20 °C	± 50 ppm/K
4.25.1	–	endurance at 70 °C: standard operation mode	$U = \sqrt{P_{70} \times R} \leq U_{max}$ ; 1.5 h on; 0.5 h off; 70 °C; 1000 h; 70 °C; 8000 h	± (0.25 % + 0.05 Ω) ± (0.5 % + 0.05 Ω)
		endurance at 70 °C: power operation mode	$U = \sqrt{P_{70} \times R} \leq U_{max}$ ; 1.5 h on; 0.5 h off; 70 °C; 1000 h 70 °C; 8000 h	± (0.5 % + 0.05 Ω) ± (1 % + 0.05 Ω)
4.25.3	–	endurance at upper category temperature	125 °C; 1000 h 155 °C; 1000 h	± (0.5 % + 0.05 Ω) ± (1 % + 0.05 Ω)
4.24	78 (Cab)	damp heat, steady state	(40 ± 2) °C; 56 days; (93 ± 3) % RH	± (0.5 % + 0.05 Ω)
4.23		climatic sequence:		
4.23.2	2 (Ba)	dry heat	UCT; 16 h	
4.23.3	30 (Db)	damp heat, cyclic	55 °C; 24 h; ≥ 90 % RH; 1 cycle	
4.23.4	1 (Aa)	cold	LCT; 2 h	
4.23.5	13 (M)	low air pressure	8.5 kPa; 2 h; (25 ± 10) °C	
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 24 h; ≥ 90 % RH; 5 cycles LCT = – 55 °C; UCT = 155 °C	± (0.5 % + 0.05 Ω)

<b>TEST PROCEDURES AND REQUIREMENTS</b>				
<b>EN 60115-1 CLAUSE</b>	<b>IEC 60068-2 TEST METHOD</b>	<b>TEST</b>	<b>PROCEDURE</b>	<b>REQUIREMENTS PERMISSIBLE CHANGE (<math>\Delta R/R</math>)</b>
			stability for product types:  <b>MMU 0102 HF</b> <b>MMA 0204 HF</b> <b>MMB 0207 HF</b>	6.8 $\Omega$ to 470 $\Omega$ 1.5 $\Omega$ to 475 $\Omega$ 6.8 $\Omega$ to 470 $\Omega$
-	1 (Aa)	cold	- 55 °C; 2 h	$\pm (0.1\% + 0.01\Omega)$
4.19	14 (Na)	rapid change of temperature	30 minutes at -55 °C; 30 minutes at 155°C; 5 cycles	$\pm (0.25\% + 0.05\Omega)$
4.13	-	short time overload; standard operation mode	$U = 2.5 \times \sqrt{P_{70} \times R} \leq 2 \times U_{max}$ ; 5 s	$\pm (0.1\% + 0.01\Omega)$
		short time overload; power operation mode	$U = 2.5 \times \sqrt{P_{70} \times R} \leq 2 \times U_{max}$ ; 5 s	$\pm (0.1\% + 0.01\Omega)$
4.29	45 (XA)	component solvent resistance	isopropyl alcohol; 50 °C; method 2	no visible damage
4.30	45 (XA)	solvent resistance of marking	isopropyl alcohol; 50 °C; method 1, toothbrush	marking legible; no visible damage
4.17.2	58 (Td)	solderability	solder bath method; SnPb40; non-activated flux; (215 $\pm$ 3) °C; (3 $\pm$ 0.3) s	good tinning ( $\geq 95\%$ covered); no visible damage
			solder bath method; SnAg3Cu0.5 or SnAg3.5; non-activated flux; (235 $\pm$ 3) °C; (2 $\pm$ 0.2) s	good tinning ( $\geq 95\%$ covered); no visible damage
4.18.2	58 (Td)	resistance to soldering heat	solder bath method; (260 $\pm$ 5) °C; (10 $\pm$ 1) s	$\pm (0.5\% + 0.05\Omega)$
4.32	21 (Ue <sub>3</sub> )	shear (adhesion)	45 N	no visible damage
4.35	-	flammability	IEC 60 695-2-2, needle flame test; 10 s	no burning after 30 s

## ORDERING INFORMATION

Components may be ordered by using either a simple clear text ordering code, see "Type description and ordering code" or Vishay BCcomponents' unique 12NC.

### Numeric Ordering Code (12NC)

- The resistors have a 12-digit ordering code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; see the 12NC Ordering Code table.
- The remaining 4 digits indicate the resistance value:
  - The first 3 digits indicate the resistance value.
  - The last digit indicates the resistance decade in accordance with the 12NC Indicating Resistance Decade table.

### 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

The ordering code of a MMU 0102 HF resistor, value 50 Ω and TC 50 with ± 2 % tolerance, supplied in blister tape of 3000 units per reel is: 2312 168 0500 9.

### 12NC ORDERING CODE - resistor type and packaging

DESCRIPTION			ORDERING CODE 2312 ... .....							
			BLISTER TAPE ON REEL					BULK CASE		
TYPE	T.C.	TOL.	B1 1000 UNITS	B2 2000 UNITS	BL 3000 UNITS	B7 7000 UNITS	B0 10000 UNITS	M3 3000 UNITS	M8 8000 UNITS	
MMU 0102 HF	± 50 ppm/K	± 2 %	173 0....	–	<b>168 0....</b>	–	178 0....	–	063 0....	
MMA 0204 HF	± 50 ppm/K	± 1 %	143 0....	–	<b>158 0....</b>	–	148 0....	043 0....	–	
MMB 0207 HF	± 50 ppm/K	± 2 %	183 0....	<b>198 0....</b>	–	188 0....	–	–	–	

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