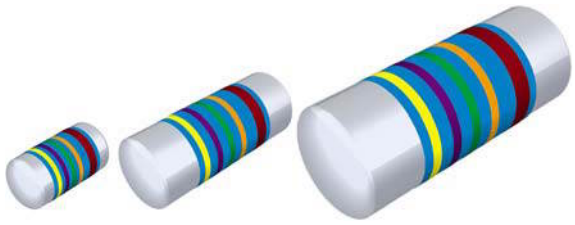
High Frequency Thin Film MELF Resistors



FEATURES

- Specialty product for RF applications
- Low-inductance non-helical trimmed product
- Suitable for more than 10 GHz
- Force fitted steel caps
- Intrinsic sulfur resistance
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free
RoHS COMPLIANT
HALOGEN FREE
GREEN (5-2008)

APPLICATIONS

- Telecommunication equipment
- Industrial electronics

MMU 0102 HF, MMA 0204 HF, and MMB 0207 HF specialty 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.

TECHNICAL SPECIFICATIONS			
DESCRIPTION	**MMU 0102 HF**	**MMA 0204 HF**	**MMB 0207 HF**
DIN size	0102	0204	0207
Metric size code	RC2211M	RC3715M	RC6123M
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		
Rated dissipation, P_{70} (1)	0.3 W	0.4 W	1.0 W
Operating voltage, $U_{max.}$ AC_{RMS}/DC	Limited by P_{70}		
Permissible film temperature, $\vartheta_{F\ max.}$ (1)	155 °C		
Operating temperature range (1)	-55 °C to +155 °C		
Permissible voltage against ambient (insulation): 1 min; U_{ins}	200 V	300 V	500 V
Failure rate: $FIT_{observed}$	≤ 2.0 x 10^{-9}/h	≤ 0.7 x 10^{-9}/h	≤ 0.7 x 10^{-9}/h

Note

(1) Please refer to APPLICATION INFORMATION below.

APPLICATION INFORMATION

When the resistor dissipates power, a temperature rise above the ambient temperature occurs, dependent on the thermal resistance of the assembled resistor together with the printed circuit board. The rated dissipation applies only if the permitted film temperature is not exceeded.

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.

MAXIMUM RESISTANCE CHANGE AT RATED DISSIPATION

OPERATION MODE		STANDARD	POWER
Rated dissipation, P_{70}	MMU 0102 HF	0.2 W	0.3 W
	MMA 0204 HF	0.25 W	0.4 W
	MMB 0207 HF	0.4 W	1.0 W
Operating temperature range		-55 °C to +125 °C	-55 °C to +155 °C
Permissible film temperature, $\vartheta_{F\ max.}$		125 °C	155 °C
Max. resistance change at P_{70} for resistance range, $\lvert\Delta R/R\rvert$ after:	MMU 0102 HF	6.8 Ω to 470 Ω	6.8 Ω to 470 Ω
	MMA 0204 HF	1.5 Ω to 475 Ω	1.5 Ω to 475 Ω
	MMB 0207 HF	6.8 Ω to 470 Ω	6.8 Ω to 470 Ω
	1000 h	≤ 0.25 %	≤ 0.5 %
	8000 h	≤ 0.5 %	≤ 1.0 %
	225 000 h	≤ 1.5 %	-

Note

- The presented operation modes do not refer to different types of resistors, but actually show examples of different loads, that lead to different film temperatures and different achievable load-life stability (drift) of the resistance value. A suitable low thermal resistance of the circuit board assembly must be safeguarded in order to maintain the film temperature of the resistors within the specified limits. Please consider the application note “Thermal Management in Surface-Mounted Resistor Applications” (www.vishay.com/doc?28844) for information on the general nature of thermal resistance.

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE

TYPE / SIZE	TCR	TOLERANCE	RESISTANCE	E-SERIES [1]
MMU 0102 HF	± 50 ppm/K	± 2 %	50 Ω, 6.8 Ω to 470 Ω	E24
MMA 0204 HF	± 50 ppm/K	± 1 %	50 Ω, 1.5 Ω to 475 Ω	E24; E96
MMB 0207 HF	± 50 ppm/K	± 2 %	50 Ω, 6.8 Ω to 470 Ω	E24

Note

[1] Please inquire for the availability of special resistance values.

PACKAGING

TYPE / SIZE	CODE	QUANTITY	PACKAGING STYLE	WIDTH	PITCH	PACKAGING DIMENSIONS
MMU 0102 HF	B1	1000	Antistatic blister tape acc. IEC 60286-3, Type 2a	8 mm	4 mm	Ø 180 mm / 7"
	B3 = BL	3000				
	B0	10 000				Ø 330 mm / 13"
MMA 0204 HF	B1	1000		8 mm	4 mm	Ø 180 mm / 7"
	B3 = BL	3000				
	B0	10 000				Ø 330 mm / 13"
MMB 0207 HF	B1	1000		12 mm	4 mm	Ø 180 mm / 7"
	B2	2000				
	B7	7000				Ø 330 mm / 13"

PART NUMBER AND PRODUCT DESCRIPTION

Part Number: MMA0204AC5009FBL00

M	M	A	0	2	0	4	A	C	5	0	0	9	F	B	L	0	0

TYPE / SIZE	VERSION	TCR	RESISTANCE	TOLERANCE	PACKAGING
MMU0102 **MMA0204** **MMB0207**	**A** = high frequency	**C** = ± 50 ppm/K	3 digit value 1 digit multiplier **Multiplier** **8** = $*10^{-2}$ **9** = $*10^{-1}$ **0** = $*10^{0}$	**F** = ± 1 % **G** = ± 2 %	**B1** **B3** **B0** **B2** **B7**

Product Description: MMA 0204-50 1 % HF BL 50R

MMA	0204	-50	1 %	HF	BL	50R
TYPE	SIZE	TCR	TOLERANCE	VERSION	PACKAGING	RESISTANCE
MMU **MMA** **MMB**	**0102** **0204** **0207**	± **50** ppm/K	**± 1 %** **± 2 %**	**HF** = high frequency	**B1** **BL** **B0** **B2** **B7**	**50R** = 50 Ω

Note

- Products can be ordered using either the PART NUMBER or the PRODUCT DESCRIPTION.

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, for MICRO-MELF: 96 % Al_2O_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 non helical pattern with a resulting low inductance 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 matte tin on nickel plating. Four or five color code rings designate the resistance value and tolerance in accordance with **IEC 60062** (1). Additional black dots near the 3rd color 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, Type 2a** (1).

ASSEMBLY

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow or vapor phase as shown in **IEC 61760-1** (1). 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, potting compounds, and their processes, 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. Solderability is specified for 2 years after production or requalification, however, excellent solderability is proven after extended storage in excess of 10 years. The permitted storage time is 20 years. The immunity of the plating against tin whisker growth has been proven under extensive testing.

MATERIALS

Vishay acknowledges the following systems for the regulation of hazardous substances:

- IEC 62474, Material Declaration for Products of and for the Electrotechnical Industry, with the list of declarable substances given therein (2)
- The Global Automotive Declarable Substance List (GADSL) (3)
- The REACH regulation (1907/2006/EC) and the related list of substances with very high concern (SVHC) (4) for its supply chain

The products do not contain any of the banned substances as per IEC 62474, GADSL, or the SVHC list, see www.vishay.com/how/leadfree.
Hence the products fully comply with the following directives:

- 2000/53/EC End-of-Life Vehicle Directive (ELV) and Annex II (ELV II)
- 2011/65/EU Restriction of the Use of Hazardous Substances Directive (RoHS) with amendment 2015/863/EU
- 2012/19/EU Waste Electrical and Electronic Equipment Directive (WEEE)

Vishay pursues the elimination of conflict minerals from its supply chain, see the Conflict Minerals Policy at www.vishay.com/doc?49037.

APPROVALS

Where applicable the resistors are tested in accordance with **EN 140 401-803** which refers to **EN 60115-1**, **EN 60115-8** and the variety of environmental text procedures of the **IEC 60068** (1) series.

Vishay Beyschlag has achieved "**Approval of Manufacturer**" in accordance with **IECQ 03-1**. The release certificate for "**Technology Approval Schedule**" in accordance with **CECC 240001** based on **IECQ 03-3-1** is granted for the Vishay Beyschlag manufacturing process.

RELATED PRODUCTS

For products with professional specification see the datasheet:

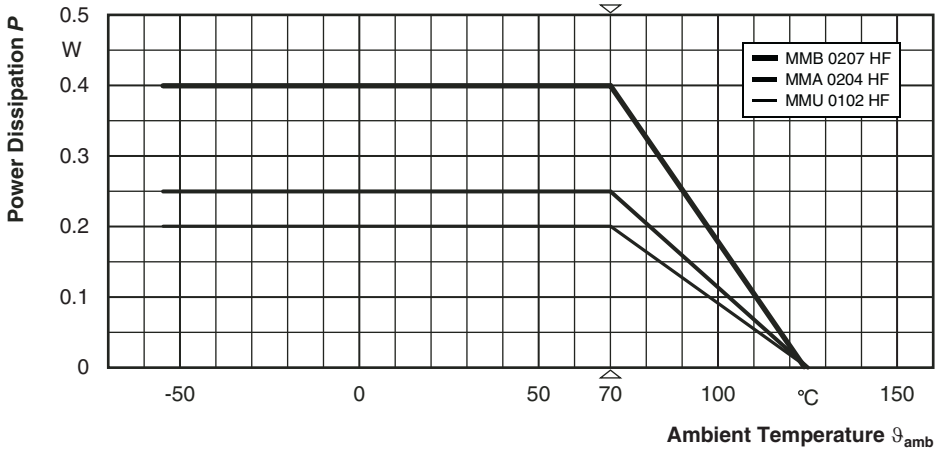
"Professional Thin Film MELF Resistors"
(www.vishay.com/doc?28713)

Resistors are available with established reliability in accordance with **EN 140401-803 version E**. Please refer to datasheet "MELF Resistors with Established Reliability". (www.vishay.com/doc?28707)

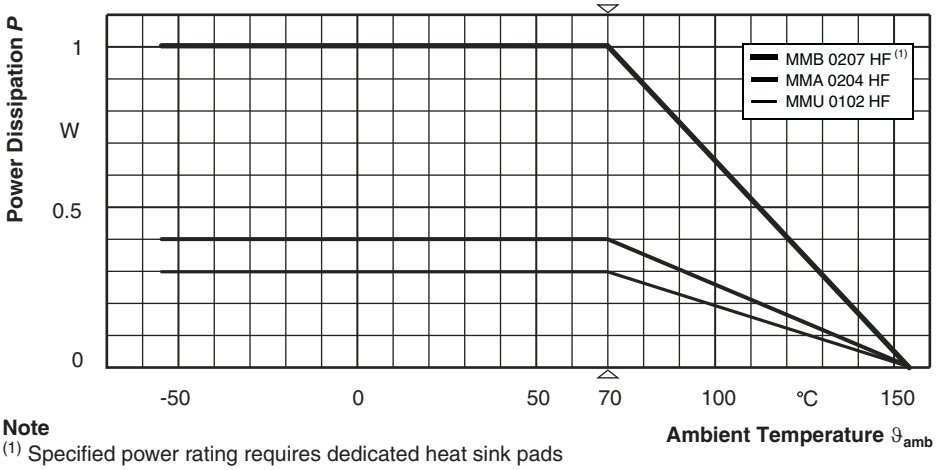
Notes

(1) The quoted IEC standards are also released as EN standards with the same number and identical contents.
(2) The IEC 62474 list of declarable substances is maintained in a dedicated database, which is available at http://std.iec.ch/iec62474.
(3) The Global Automotive Declarable Substance List (GADSL) is maintained by the American Chemistry Council and available at www.gadsl.org.
(4) The SVHC list is maintained by the European Chemical Agency (ECHA) and available at http://echa.europa.eu/candidate-list-table.

FUNCTIONAL PERFORMANCE

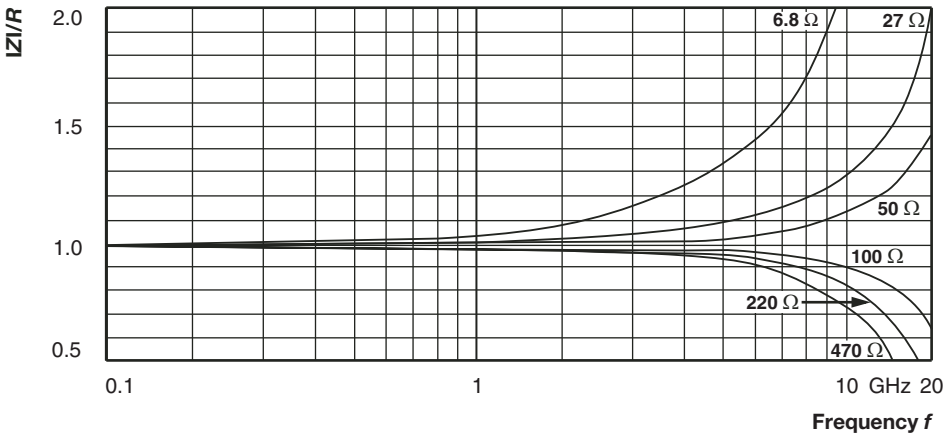


Derating - Standard Operation



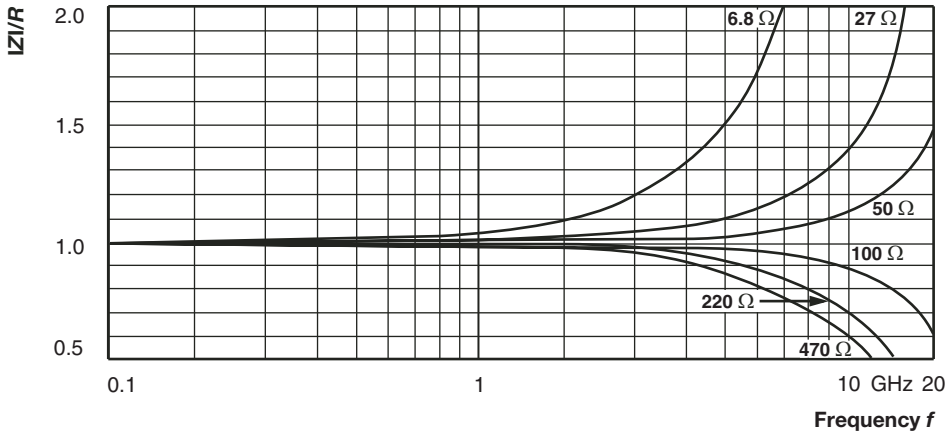
Note
(1) Specified power rating requires dedicated heat sink pads

Derating - Power Operation



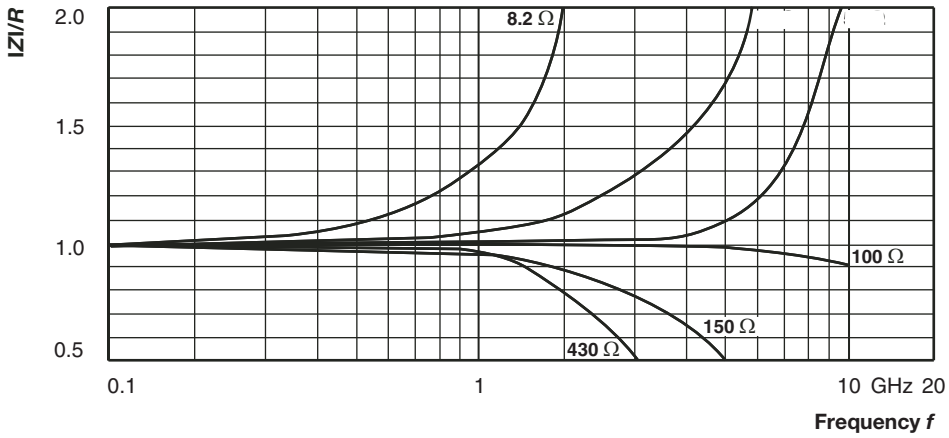
Relative impedance for MMU 0102 HF

RF - Behavior



Relative impedance for MMA 0204 HF

RF - Behavior



Relative impedance for MMB 0207 HF

RF - Behavior

TESTS AND REQUIREMENTS

Where applicable, all tests are carried out in accordance with the following specifications:

EN 60115-1, generic specification

EN 60115-8 (successor of EN 140400), sectional specification

EN 140401-803, detail specification

IEC 60068-2-xx, test methods

The parameters stated in the Test Procedures and Requirements table are based on the required tests and permitted limits of EN 140401-803, where applicable. The table presents only the most important tests, for the full test schedule refer to the documents listed above. However, some additional tests and a number of improvements against those minimum requirements have been included.

The testing also covers most of the requirements specified by EIA/ECA-703 and JIS-C-5201-1.

The tests are carried out under standard atmospheric conditions in accordance with IEC 60068-1, 4.3, whereupon the following values are applied:

Temperature: 15 °C to 35 °C

Relative humidity: 25 % to 75 %

Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar).

A climatic category LCT / UCT / 56 is applied, defined by the lower category temperature (LCT), the upper category temperature (UCT), and the duration of exposure in the damp heat, steady state test (56 days).

The components are mounted for testing on printed circuit boards in accordance with EN 60115-8, 2.4.2, unless otherwise specified.

TEST PROCEDURES AND REQUIREMENTS

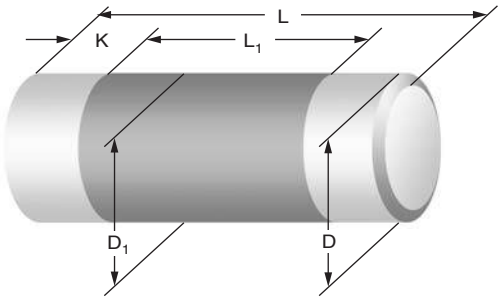
EN 60115-1 CLAUSE	IEC 60068-2 (1) TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)
			Stability for product types:	
			MMU 0102 HF	6.8 Ω to 470 Ω
			MMA 0204 HF	1.5 Ω to 475 Ω
			MMB 0207 HF	6.8 Ω to 470 Ω
4.5	-	Resistance	MMU 0102 HF, MMB 0207 HF: MMA 0204 HF:	± 2 % R ± 1 % R
4.8	-	Temperature coefficient	At (20 / -55 / 20) °C and (20 / 125 / 20) °C	± 50 ppm/K
4.25.1	-	Endurance at 70 °C: standard operation mode	$U = \sqrt{P_{70} \times R}$; 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)
		Endurance at 70 °C: power operation mode	$U = \sqrt{P_{70} \times R}$; 1.5 h on; 0.5 h off; 70°C; 1000 h 70°C; 8000 h	 ± (0.5 % R + 0.05 Ω) ± (1 % R + 0.05 Ω)
4.25.3	-	Endurance at upper category temperature	125 °C; 1000 h 155 °C; 1000 h	± (0.5 % R + 0.05 Ω) ± (1 % 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 (Bb)	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 (Ab)	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	
4.23.7	-	DC load	$U = \sqrt{P_{70} \times R}$; 1 min. LCT = -55 °C; UCT = 155 °C	 ± (0.5 % R + 0.05 Ω)
-	1 (Aa)	Cold	-55 °C; 2 h	± (0.1 % R + 0.01 Ω)
4.19	14 (Na)	Rapid change of temperature	30 min at - 55 °C; 30 min at 155 °C; 5 cycles	± (0.25 % R + 0.05 Ω)

TEST PROCEDURES AND REQUIREMENTS				
EN 60115-1 CLAUSE	**IEC 60068-2 [1] TEST METHOD**	**TEST**	**PROCEDURE**	**REQUIREMENTS PERMISSIBLE CHANGE (ΔR)**
			Stability for product types:	
			MMU 0102 HF	6.8 Ω to 470 Ω
			MMA 0204 HF	1.5 Ω to 475 Ω
			MMB 0207 HF	6.8 Ω to 470 Ω
4.13	-	Short time overload; standard operation mode	$U = 2.5 \times \sqrt{P_{70} \times R}$; 5 s	± (0.1 % R + 0.01 Ω)
		Short time overload; power operation mode	$U = 2.5 \times \sqrt{P_{70} \times R}$; 5 s	± (0.1 % R + 0.01 Ω)
4.40	-	Electrostatic discharge (human body model)	IEC 61340-3-1 [1]; 3 pos. + 3 neg. discharges MMU 0102 HF: 800 V MMA 0204 HF: 1000 V MMB 0207 HF: 2000 V	± (0.5 % R + 50 mΩ)
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	58 (Td)	Solderability	Solder bath method; SnPb40; non-activated flux; (215 ± 3) °C; (3 ± 0.3) s	Good tinning (≥ 95 % covered); no visible damage
			Solder bath method; SnAg3Cu0.5 or SnAg3.5; non-activated flux; (235 ± 3) °C; (2 ± 0.2) s	Good tinning (≥ 95 % covered); no visible damage
4.18	58 (Td)	Resistance to soldering heat	Solder bath method; (260 ± 5) °C; (10 ± 1) s	± (0.5 % R + 0.05 Ω)
4.32	21 (Ue_3)	Shear (adhesion)	45 N	No visible damage
4.35	-	Flammability	IEC 60 695-11-5 [1], needle flame test; 10 s	No burning after 30 s

Note

[1] The quoted IEC standards are also released as EN standards with the same number and identical contents.

DIMENSIONS

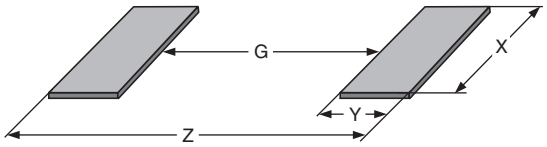


DIMENSIONS AND MASS						
TYPE / SIZE	L (mm)	D (mm)	$L_{1\ min.}$ (mm)	D_1 (mm)	K (mm)	MASS (mg)
MMU 0102 HF	2.2 + 0 / - 0.1	1.1 + 0 / - 0.1	1.2	D + 0 / - 0.1	0.4 ± 0.05	8
MMA 0204 HF	3.6 + 0 / - 0.2	1.4 + 0 / - 0.1	1.8	D + 0 / - 0.15	0.75 ± 0.1	22
MMB 0207 HF	5.8 + 0 / - 0.15	2.2 + 0 / - 0.2	3.2	D + 0 / - 0.2	1.1 ± 0.1	80

Note

- Color code marking is applied according to IEC 60062 (1) in four bands (E24 series) or five bands (E96 series). Each color 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 approximately 50 % wider than the other bands. An interrupted band between the 3rd and 4th full band identifies the special high frequency type.

PATTERN STYLES FOR MELF RESISTORS



RECOMMENDED SOLDER PAD DIMENSIONS								
TYPE / SIZE	WAVE SOLDERING				REFLOW SOLDERING			
	G (mm)	Y (mm)	X (mm)	Z (mm)	G (mm)	Y (mm)	X (mm)	Z (mm)
MMU 0102 HF	0.7	1.2	1.5	3.1	1.1	0.8	1.3	2.7
MMA 0204 HF	1.5	1.5	1.8	4.5	1.7	1.2	1.6	4.1
MMB 0207 HF	2.8	2.1	2.6	7.0	3.2	1.7	2.4	6.6

Notes

- The given solder pad dimensions reflect the considerations for board design and assembly as outlined e.g. in standards IEC 61188-5-x (1), or in publication IPC-7351.

(1) The quoted IEC standards are also released as EN standards with the same number and identical contents.

HISTORICAL 12NC INFORMATION

- The resistors had a 12-digit numeric code starting with 2312.
- The subsequent 4 digits indicated the resistor type, specification and packaging; see the 12NC table.
- The remaining 4 digits indicated the resistance value:
  - The first 3 digits indicated the resistance value.
  - The last digit indicated 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

Historical 12NC Example

The 12NC of a MMU 0102 HF resistor, value 50 Ω and TCR 50 with ± 2 % tolerance, supplied in blister tape of 3000 units per reel was: 2312 168 0500 9.

HISTORICAL 12NC - Resistor type and packaging

DESCRIPTION			2312						
			BLISTER TAPE ON REEL					BULK CASE	
TYPE	TCR	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....	-	**168 0....**	-	178 0....	-	063 0....
MMA 0204 HF	± 50 ppm/K	± 1 %	143 0....	-	**158 0....**	-	148 0....	043 0....	-
MMB 0207 HF	± 50 ppm/K	± 2 %	183 0....	**198 0....**	-	188 0....	-	-	-

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