

DATA SHEET

**MMU 0102; MMA 0204;
MMB 0207
Professional MELF resistors**

Product specification
Supersedes data of 8th June 2001
File under BCcomponents, BC08

2002 Nov 19

Professional MELF resistors
**MMU 0102; MMA 0204;
MMB 0207**
FEATURES

- Advanced thin film technology
- Power dissipation rating up to 1 W
- Excellent overall stability: Class 0,25
- Wide professional range: 0,1 Ω to 10 M Ω
- Green product, supports lead-free soldering.

Metric sizes

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

APPLICATIONS

- Automotive
- Telecommunication
- Industrial
- Medical equipment.

DESCRIPTION

MMU 0102, MMA 0204 and MMB 0207 professional thin film MELF resistors are the perfect choice for most fields of modern professional electronics where reliability and stability is of major concern. The typical applications in the fields of automotive, telecommunication and medical equipment reflect the outstanding level of proven reliability.

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% Al₂O₃, for MICRO-MELF: 96% Al₂O₃) 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 helical groove 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**.

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**.

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-free, the pure tin plating provides compatibility with lead-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.

The resistors are tested in accordance with **EN 140401-803 (superseding CECC 40401-803)** which refers to **EN 60115-1** and **EN140400**. Approval of conformity is indicated by the CECC logo on the package label.

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

This product family of thin film MELF resistors is completed by **Zero Ohm Jumpers**.

On request, resistors are available with established reliability in accordance with **EN 140101-803 Version E**. Please refer to the special data sheet for information on failure rate level, available resistance ranges and ordering codes.

Professional MELF resistors**MMU 0102; MMA 0204;
MMB 0207****QUICK REFERENCE DATA**

DESCRIPTION	MMU 0102		MMA 0204		MMB 0207	
CECC size	RC 2211M		RC 3715M		RC 6123M	
Resistance range	0,22 Ω to 2,21 M Ω		0,22 Ω to 10 M Ω		0,1 Ω to 8,2 M Ω	
Resistance tolerance	$\pm 5\%$; $\pm 2\%$; $\pm 1\%$; $\pm 0,5\%$		$\pm 5\%$; $\pm 1\%$; $\pm 0,5\%$		$\pm 5\%$; $\pm 2\%$; $\pm 1\%$; $\pm 0,5\%$	
Temperature coefficient	± 50 ppm/K; ± 25 ppm/K				± 100 ppm/K; ± 50 ppm/K; ± 25 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 ⁽²⁾
Operating voltage, U_{\max} AC/DC	150 V		200 V		300 V	
Film temperature	125 $^{\circ}$ C	155 $^{\circ}$ C	125 $^{\circ}$ C	155 $^{\circ}$ C	125 $^{\circ}$ C	155 $^{\circ}$ C
Max. resistance change at P_{70} for resistance range, $\Delta R/R$ max., after:	0,22 Ω to 221 k Ω		0,22 Ω to 332 k Ω		0,22 Ω to 1 M Ω	
1 000 h	$\leq 0,15\%$	$\leq 0,25\%$	$\leq 0,15\%$	$\leq 0,25\%$	$\leq 0,15\%$	$\leq 0,25\%$
8 000 h	$\leq 0,3\%$	$\leq 0,5\%$	$\leq 0,3\%$	$\leq 0,5\%$	$\leq 0,3\%$	$\leq 0,5\%$
225 000 h	$\leq 1\%$	–	$\leq 1\%$	–	$\leq 1\%$	–
Specified lifetime	225 000 h	8 000 h	225 000 h	8 000 h	225 000 h	8 000 h
Permissible voltage against ambient :						
1 minute; U_{ins}	200 V		300 V		500 V	
continuous	75 V		75 V		75 V	
Failure rate	$\leq 2 \times 10^{-9}/\text{h}$		$\leq 0,7 \times 10^{-9}/\text{h}$		$\leq 0,7 \times 10^{-9}/\text{h}$	

Notes

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.

Professional MELF resistors**MMU 0102; MMA 0204;
MMB 0207****Table 1** Temperature coefficient and resistance range

DESCRIPTION		RESISTANCE VALUE ⁽¹⁾		
T.C.	TOLERANCE	MMU 0102	MMA 0204	MMB 0207
±100 ppm/K	±5%	–	–	0,1 Ω to 0,2 Ω
±50 ppm/K	±5%	0,22 Ω to 0,91 Ω	0,22 Ω to 0,91 Ω	0,22 Ω to 0,91 Ω
	±2%	1 Ω to 9,1 Ω	–	0,22 Ω to 0,91 Ω
	±1%	10 Ω to 2,21 MΩ	1 Ω to 10 MΩ	1 Ω to 8,2 MΩ
	±0,5%	47 Ω to 221 kΩ	10 Ω to 475 kΩ	–
±25 ppm/K	±1%	10 Ω to 221 kΩ	10 Ω to 475 kΩ	–
	±0,5%	47 Ω to 221 kΩ	10 Ω to 475 kΩ	10 Ω to 1 MΩ
Jumper	–	≤ 10 mΩ; $I_{\max} = 2A$	≤ 10 mΩ, $I_{\max} = 3A$	≤ 10 mΩ; $I_{\max} = 5A$

Note

1. Resistance values to be selected for ±5% and ±2% tolerance from E24, for ±1% tolerance from E24 and E96 and for ±0,5% tolerance from E24 and E192.

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

Professional MELF resistors

**MMU 0102; MMA 0204;
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ORDERING INFORMATION

Components may be ordered by using either a simple clear text ordering code, see "Type description and ordering code" or 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 Table 3.
- 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 Table 4.

Table 2 12NC ordering code indicating resistor type and packaging

DESCRIPTION			ORDERING CODE 2312					
			BLISTER TAPE ON REEL				BULK CASE	
TYPE	T.C.	TOL.	B2 2000 units	BL 3000 units	B7 7000 units	B0 10000 units	M3 3000 units	M8 8000 units
MMU 0102	±50 ppm/K	±5%	–	165 3....	–	175 3....	–	060 3....
		±2%	–	165 2....	–	175 2....	–	060 2....
		±1%	–	165 1....	–	175 1....	–	060 1....
		±0,5%	–	165 5....	–	175 5....	–	060 5....
	±25 ppm/K	±1%	–	166 1....	–	176 1....	–	061 1....
		±0,5%	–	166 5....	–	176 5....	–	061 5....
jumper	–	–	165 90001	–	175 90001	–	060 90001	
MMA 0204	±50 ppm/K	±5%	–	155 3....	–	145 3....	040 3....	–
		±1%	–	155 1....	–	145 1....	040 1....	–
		±0,5%	–	155 5....	–	145 5....	040 5....	–
	±25 ppm/K	±1%	–	156 1....	–	146 1....	041 1....	–
		±0,5%	–	156 5....	–	146 5....	041 5....	–
	jumper	–	–	155 90001	–	145 90001	040 90001	–

Professional MELF resistors

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DESCRIPTION			ORDERING CODE 2312					
			BLISTER TAPE ON REEL				BULK CASE	
TYPE	T.C.	TOL.	B2 2000 units	BL 3000 units	B7 7000 units	B0 10000 units	M3 3000 units	M8 8000 units
MMB 0207: $\leq 0,2 \Omega$	± 100 ppm/K	$\pm 5\%$	195 3....	–	185 3....	–	–	–
MMB 0207: $> 0,2 \Omega$	± 50 ppm/K	$\pm 5\%$	195 3....	–	185 3....	–	–	–
		$\pm 2\%$	195 2....	–	185 2....	–	–	–
		$\pm 1\%$	195 1....	–	185 1....	–	–	–
MMB 0207	± 25 ppm/K	$\pm 0,5\%$	196 5....	–	186 5....	–	–	–
	jumper	–	195 90001	–	185 90001	–	–	–

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

Table 3 Last digit of 12NC indicating resistance decade

RESISTANCE DECADE	LAST DIGIT
0,1 Ω to 0,999 Ω	7
1 Ω to 9,99 Ω	8
10 Ω to 99,9 Ω	9
100 Ω to 999 Ω	1
1 k Ω to 9,99 k Ω	2
10 k Ω to 99,9 k Ω	3
100 k Ω to 999 k Ω	4
1 M Ω to 9,99 M Ω	5
10 M Ω to 99,9 M Ω	6

ORDERING EXAMPLE

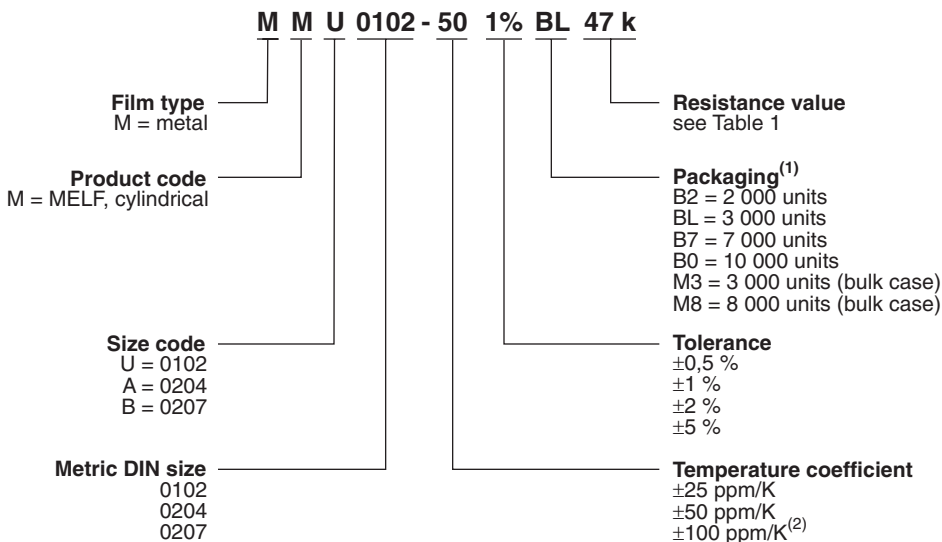
The ordering code of a MMU 0102 resistor, value 47 k Ω and TC 50 with $\pm 1\%$ tolerance, supplied in blister tape of 3000 units per reel is: 2312 165 14703.

Professional MELF resistors

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Type description and ordering code

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



Jumpers are ordered by the resistance value 0 Ω, e.g. MMA 0204 BL 0R0.

(1) Availability in accordance with Table 2.

(2) A temperature coefficient 100 is marked -00.

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FUNCTIONAL DESCRIPTION

Derating

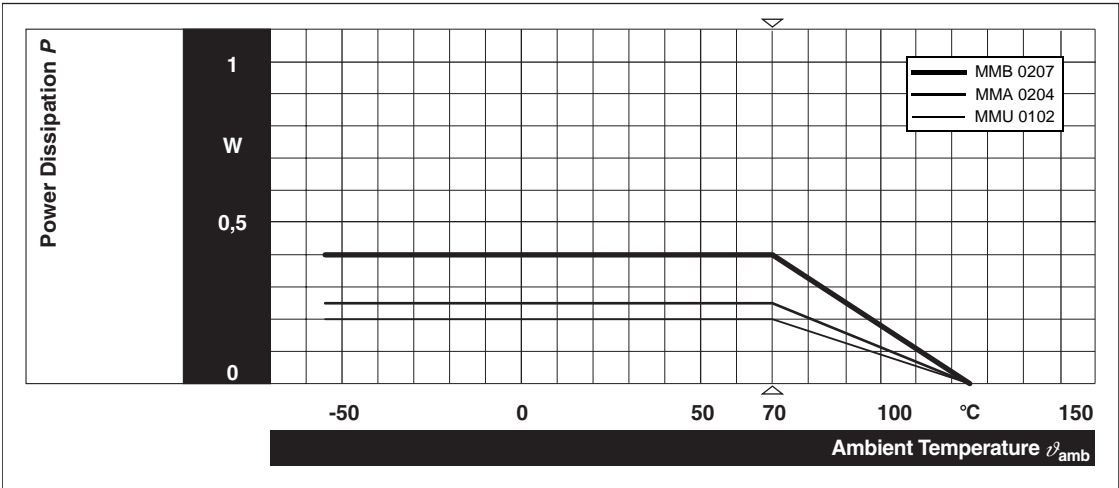


Fig.1 Derating, standard operation.

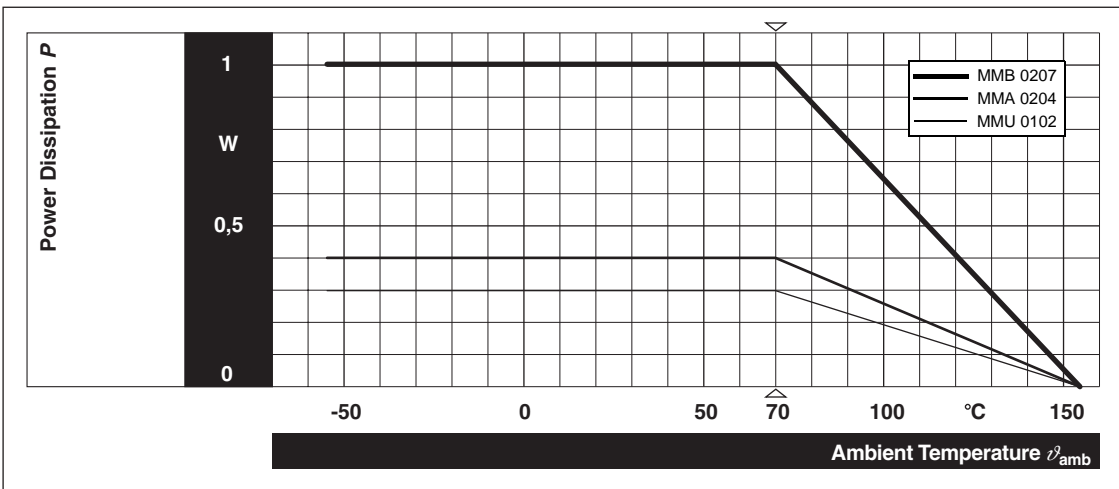


Fig.2 Derating, power operation.

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Single pulse

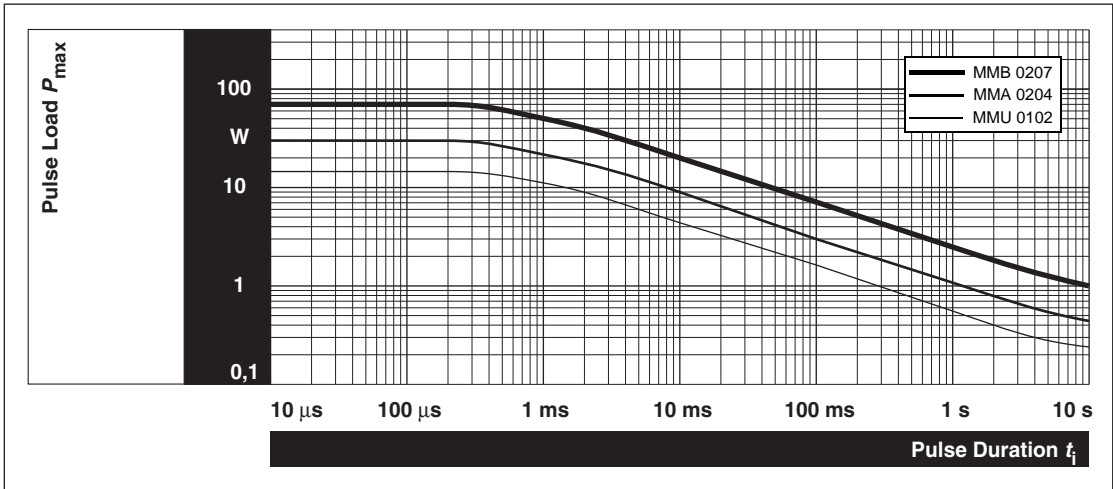


Fig.3 Maximum pulse load, single pulse; for permissible resistance change equivalent to 8000 h operation.

Continuous pulses

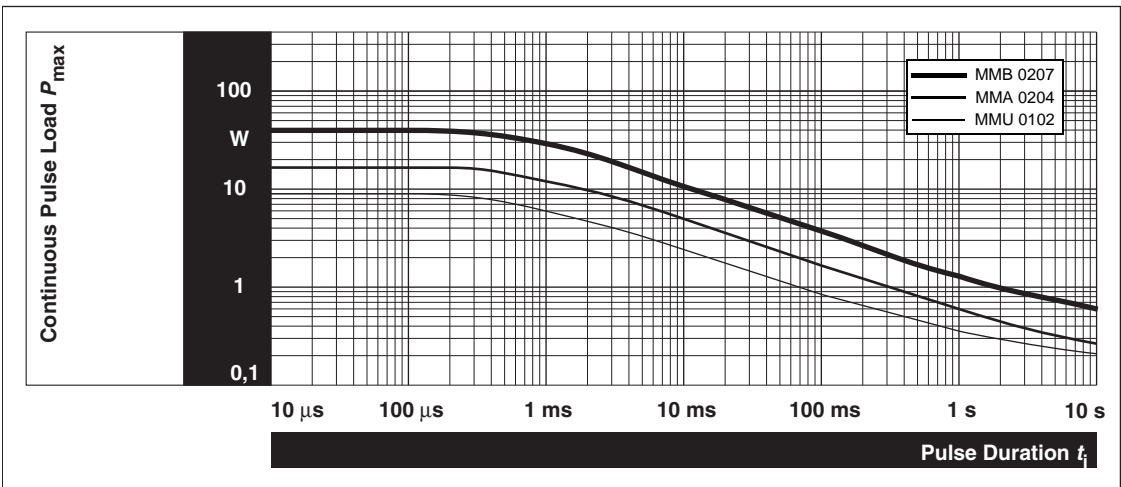


Fig.4 Maximum pulse load, continuous pulses; for permissible resistance change equivalent to 8000 h operation.

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Pulse voltage

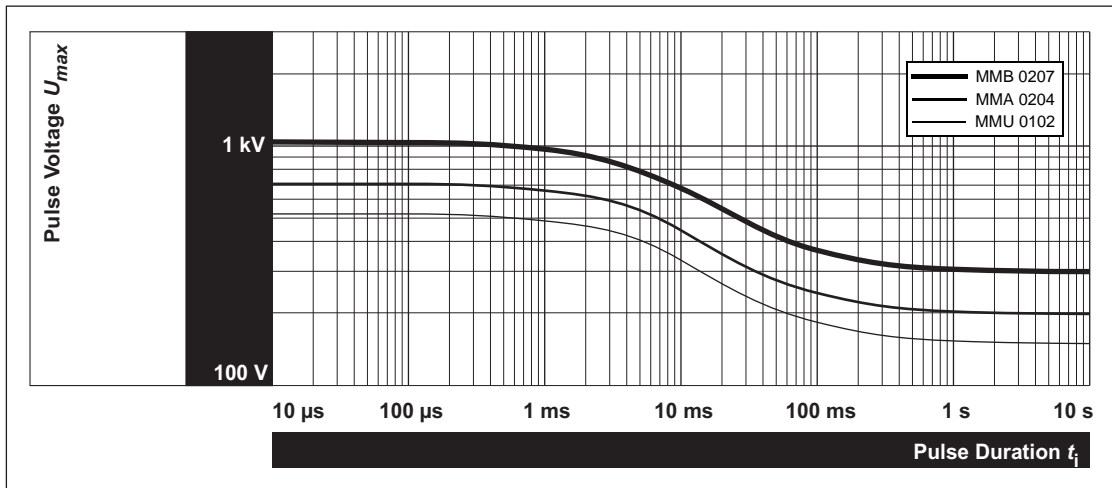


Fig.5 Maximum pulse voltage, single and continuous pulses; for permissible resistance change equivalent to 8000 h operation.

1,2/50 pulse

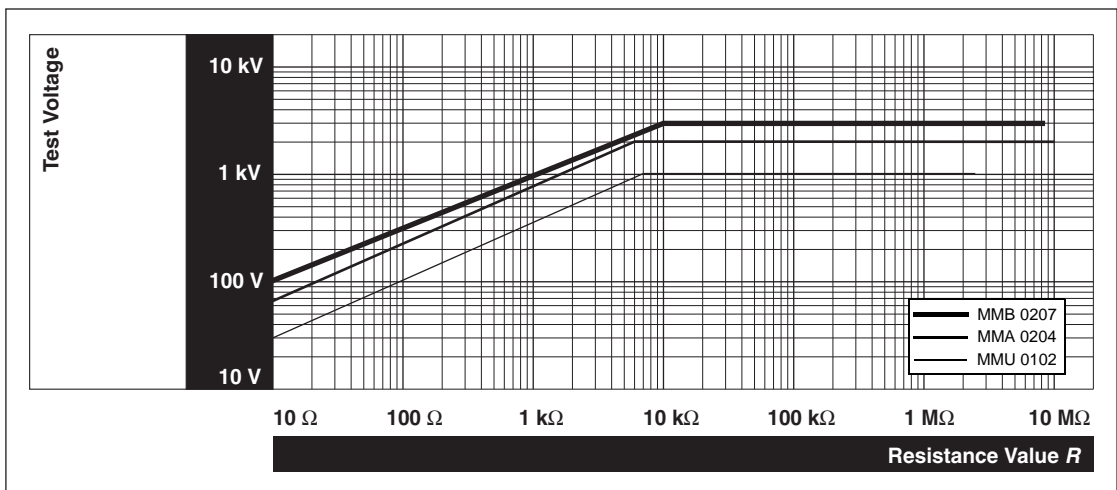


Fig.6 Pulse load rating in accordance with IEC 60115-1 clause 4.27; 1,2 μ s / 50 μ s; 5 pulses at 12 s intervals; for permissible resistance change 0,5%.

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10/700 pulse

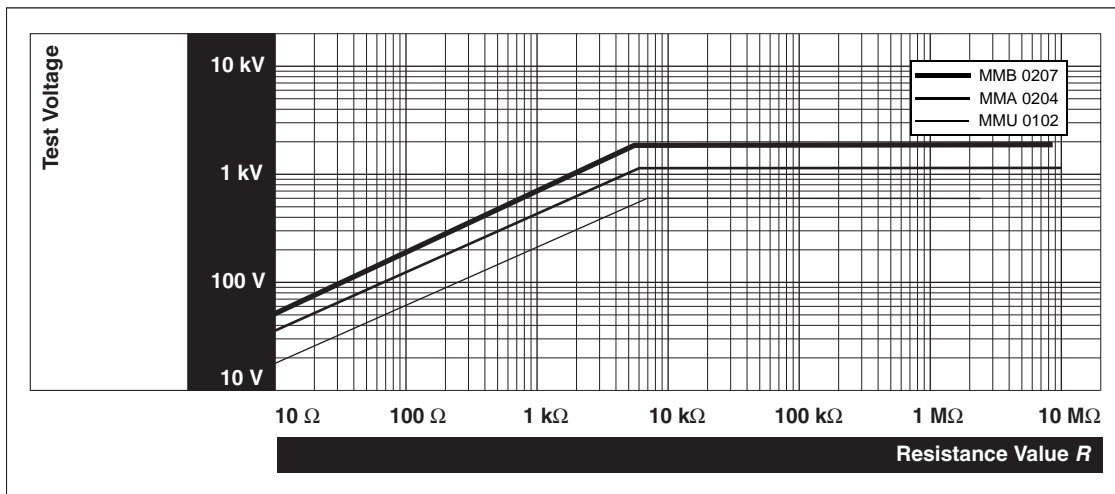


Fig.7 Pulse load rating in accordance with IEC 60115-1 clause 4.27; 10 μs / 700 μs; 10 pulses at 1 minute intervals; for permissible resistance change 0,5%.

Current noise

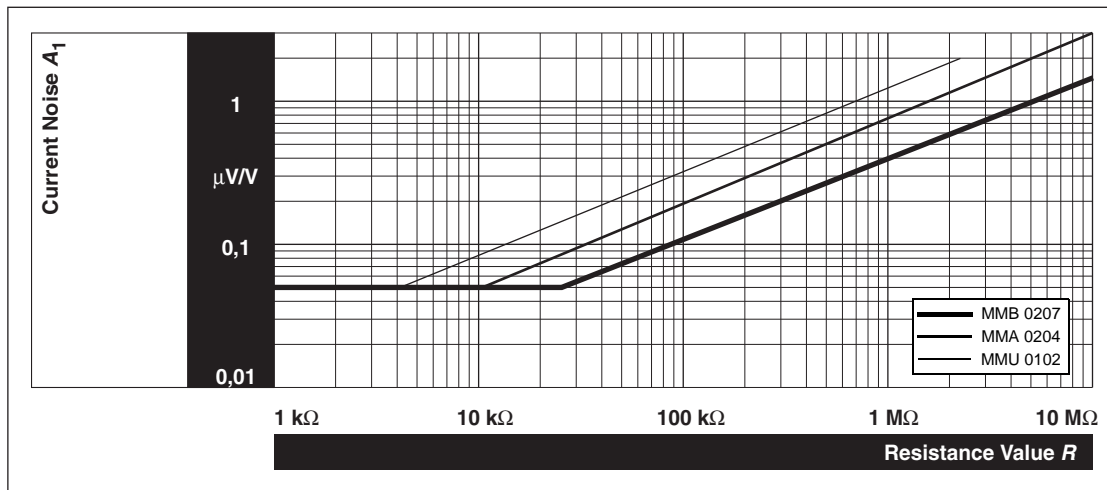
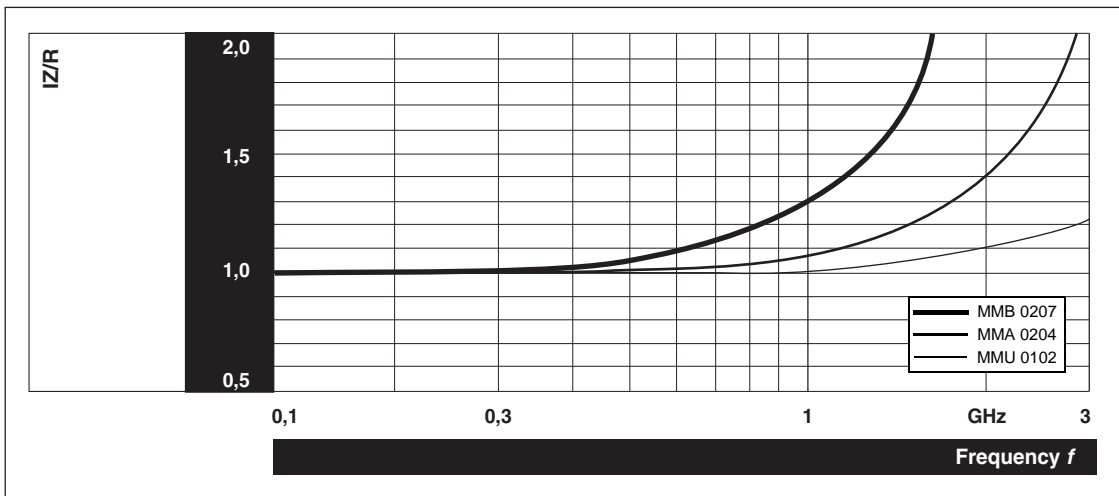


Fig.8 Current Noise A₁ in accordance with IEC 60195.

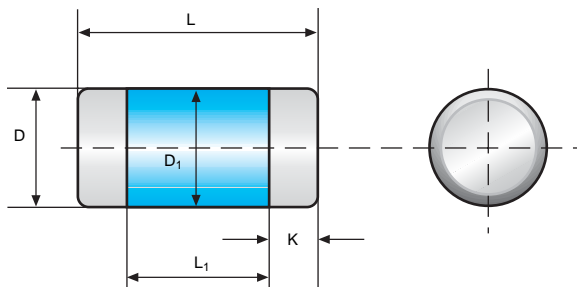
Professional MELF resistors**MMU 0102; MMA 0204;
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MECHANICAL DATA

Outlines



For dimensions see Table 4.

Fig.10 Outlines.

Table 4 MELF resistor types, mass and relevant physical dimensions; see Fig.10

TYPE	L (mm)	D (mm)	L ₁ min (mm)	D ₁ (mm)	K (mm)	MASS (mg)
MMU 0102	2,2 +0/-0,1	1,1 +0/-0,1	1,2	D +0/-0,1	0,4 ±0,05	7
MMA 0204	3,6 +0/-0,2	1,4 +0/-0,1	1,8	D +0/-0,15	0,8 ±0,1	19
MMB 0207	5,8 +0/-0,2	2,2 +0/-0,2	2,8	D +0/-0,2	1,2 ±0,2	79

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TESTS AND REQUIREMENTS

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 components are approved in accordance with the European CECC-system, where applicable. For the full test schedule refer to the documents listed above. The testing also covers most of the requirements specified by EIA/IS-703 and JIS-C-5202.

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 Table 5 are based on the required tests and permitted limits of EN 140401-803. However, some additional tests and a number of improvements against those minimum requirements have been included. The stated requirements for long-term tests are typically fulfilled with a statistical safety of at least $\bar{x} + 5$ s.

Table 5 Test procedures and requirements

EN 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)			
				STABILITY CLASS 0,25 OR BETTER	STABILITY CLASS 0,5 OR BETTER	STABILITY CLASS 1 OR BETTER	STABILITY CLASS 2 OR BETTER
			stability for product types:				
			MMU 0102	10 Ω to 221 k Ω	1 Ω to < 10 Ω	< 1 Ω	> 221 k Ω
			MMA 0204	10 Ω to 332 k Ω	1 Ω to < 10 Ω	< 1 Ω	> 332 k Ω
			MMB 0207	10 Ω to 1 M Ω	1 Ω to < 10 Ω	< 1 Ω	> 1 M Ω
4.5	–	resistance	–	$\pm 1\%$; $\pm 0,5\%$	$\pm 2\%$; $\pm 1\%$	$\pm 5\%$	$\pm 1\%$
4.8.4.2	–	temperature coefficient	at –20 / –55 / 20 °C and 20 / 125 / 20 °C	± 50 ppm/K; ± 25 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	$\pm(0,15\%R + 10 \text{ m}\Omega)$		$\pm(0,5\%R + 10 \text{ m}\Omega)$ $\pm(1\%R + 10 \text{ m}\Omega)$	
				$\pm(0,3\%R + 10 \text{ m}\Omega)$			

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EN 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)			
				STABILITY CLASS 0,25 OR BETTER	STABILITY CLASS 0,5 OR BETTER	STABILITY CLASS 1 OR BETTER	STABILITY CLASS 2 OR BETTER
			stability for product types:				
			MMU 0102	10 Ω to 221 k Ω	1 Ω to < 10 Ω	< 1 Ω	> 221 k Ω
			MMA 0204	10 Ω to 332 k Ω	1 Ω to < 10 Ω	< 1 Ω	> 332 k Ω
			MMB 0207	10 Ω to 1 M Ω	1 Ω to < 10 Ω	< 1 Ω	> 1 M Ω
4.25.1 (cont.)	–	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	$\pm(0,25\%R + 10 \text{ m}\Omega)$ $\pm(0,5\%R + 10 \text{ m}\Omega)$			$\pm(0,5\%R + 10 \text{ m}\Omega)$ $\pm(1\%R + 10 \text{ m}\Omega)$
4.25.3	–	endurance at upper category temperature	125 °C; 1000 h 155 °C; 1000 h	$\pm(0,15\%R + 5 \text{ m}\Omega)$ $\pm(0,3\%R + 5 \text{ m}\Omega)$	$\pm(0,25\%R + 5 \text{ m}\Omega)$ $\pm(0,5\%R + 5 \text{ m}\Omega)$	$\pm(0,5\%R + 5 \text{ m}\Omega)$ $\pm(1\%R + 5 \text{ m}\Omega)$	$+(1\%R + 5 \text{ m}\Omega)$ $+(2\%R + 5 \text{ m}\Omega)$
4.24	3 (Ca)	damp heat, steady state	40 ± 2 °C; 56 days; 93 $\pm 2/-3\%$ RH	$\pm(0,15\%R + 10 \text{ m}\Omega)$	$\pm(0,5\%R + 10 \text{ m}\Omega)$	$\pm(1\%R + 10 \text{ m}\Omega)$	$\pm(1\%R + 10 \text{ m}\Omega)$
4.39	67 (Cy)	damp heat, steady state, accelerated	85 ± 2 °C; 85 $\pm 5\%$ RH; $U = 0,1 \times \sqrt{P_{70} \times R}$ $\leq 100 \text{ V}$; 1000 h	$\pm(0,25\%R + 10 \text{ m}\Omega)$	$\pm(0,5\%R + 10 \text{ m}\Omega)$	$\pm(1\%R + 10 \text{ m}\Omega)$	$\pm(2\%R + 10 \text{ m}\Omega)$
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; $\geq 90\%$ 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; $\geq 90\%$ RH; 5 cycles LCT = –55 °C; UCT = 155 °C	$\pm(0,15\%R + 10 \text{ m}\Omega)$	$\pm(0,5\%R + 10 \text{ m}\Omega)$	$\pm(1\%R + 10 \text{ m}\Omega)$	$\pm(1\%R + 10 \text{ m}\Omega)$

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EN 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)			
				STABILITY CLASS 0,25 OR BETTER	STABILITY CLASS 0,5 OR BETTER	STABILITY CLASS 1 OR BETTER	STABILITY CLASS 2 OR BETTER
			stability for product types:				
			MMU 0102	10 Ω to 221 k Ω	1 Ω to < 10 Ω	< 1 Ω	> 221 k Ω
			MMA 0204	10 Ω to 332 k Ω	1 Ω to < 10 Ω	< 1 Ω	> 332 k Ω
			MMB 0207	10 Ω to 1 M Ω	1 Ω to < 10 Ω	< 1 Ω	> 1 M Ω
–	1 (Aa)	cold	–55 °C; 2 h	$\pm(0,05\% + 5 \text{ m}\Omega)$			$\pm(0,1\% + 5 \text{ m}\Omega)$
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT; 30 minutes at UCT; LCT = –55 °C; UCT = 125 °C 5 cycles	$\pm(0,05\%R + 10 \text{ m}\Omega)$			$\pm(0,1\%R + 10 \text{ m}\Omega)$
			1000 cycles	$\pm(0,15\%R + 10 \text{ m}\Omega)$			$\pm(0,25\%R + 10 \text{ m}\Omega)$
			LCT = –55 °C; UCT = 155 °C 1000 cycles	$\pm(0,25\%R + 10 \text{ m}\Omega)$			$\pm(0,5\%R + 10 \text{ m}\Omega)$
4.13	–	short time overload; standard mode	$U = 2,5 \times \sqrt{P_{70} \times R}$ $\leq 2 \times U_{\text{max}}; 5 \text{ s}$	$\pm(0,03\%R + 5 \text{ m}\Omega)$			$\pm(0,15\%R + 5 \text{ m}\Omega)$
		short time overload; power mode		$\pm(0,05\%R + 5 \text{ m}\Omega)$			$\pm(0,15\%R + 5 \text{ m}\Omega)$
4.27	–	single pulse high voltage overload; standard mode	severity no. 4: $U = 10 \times \sqrt{P_{70} \times R}$ $\leq 2 \times U_{\text{max}};$ 10 pulses 10 $\mu\text{s}/700 \mu\text{s}$	$\pm(0,25\%R + 5 \text{ m}\Omega)$			
		single pulse high voltage overload; power mode		$\pm(0,5\%R + 5 \text{ m}\Omega)$			

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EN 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)			
				STABILITY CLASS 0,25 OR BETTER	STABILITY CLASS 0,5 OR BETTER	STABILITY CLASS 1 OR BETTER	STABILITY CLASS 2 OR BETTER
			stability for product types:				
			MMU 0102	10 Ω to 221 k Ω	1 Ω to < 10 Ω	< 1 Ω	> 221 k Ω
			MMA 0204	10 Ω to 332 k Ω	1 Ω to < 10 Ω	< 1 Ω	> 332 k Ω
			MMB 0207	10 Ω to 1 M Ω	1 Ω to < 10 Ω	< 1 Ω	> 1 M Ω
4.37	-	periodic electric overload; standard mode	$U = \sqrt{15 \times P_{70} \times R}$ $\leq 2 \times U_{max}$; 0,1 s on; 2,5 s off; 1000 cycles	$\pm(0,5\%R + 5 \text{ m}\Omega)$			
		periodic electric overload; power mode		$\pm(1\%R + 5 \text{ m}\Omega)$			
4.22	6 (Fc)	vibration	endurance by sweeping; 10 to 2000 Hz; no resonance; amplitude $\leq 1,5 \text{ mm}$ or $\leq 200 \text{ m/s}^2$; 6 h	$\pm(0,05\%R + 5 \text{ m}\Omega)$			$\pm(0,1\%R + 5 \text{ m}\Omega)$
4.17.2	58 (Td)	solderability	solder bath method; SnPb40; non-activated flux; 215 ± 3 $^{\circ}\text{C}$; 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 ± 3 $^{\circ}\text{C}$; 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 ± 5 $^{\circ}\text{C}$; 10 ± 1 s	$\pm(0,05\%R + 10 \text{ m}\Omega)$	$\pm(0,1\%R + 10 \text{ m}\Omega)$	$\pm(0,25\%R + 10 \text{ m}\Omega)$	$\pm(0,25\%R + 10 \text{ m}\Omega)$
			reflow method 2 (IR/forced gas convection); 260 ± 5 $^{\circ}\text{C}$; 10 ± 1 s	$\pm(0,02\%R + 10 \text{ m}\Omega)$	$\pm(0,05\%R + 10 \text{ m}\Omega)$	$\pm(0,05\%R + 10 \text{ m}\Omega)$	$\pm(0,1\%R + 10 \text{ m}\Omega)$

Professional MELF resistors

MMU 0102; MMA 0204;
MMB 0207

EN 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)			
				STABILITY CLASS 0,25 OR BETTER	STABILITY CLASS 0,5 OR BETTER	STABILITY CLASS 1 OR BETTER	STABILITY CLASS 2 OR BETTER
			stability for product types:				
			MMU 0102	10 Ω to 221 k Ω	1 Ω to < 10 Ω	< 1 Ω	> 221 k Ω
			MMA 0204	10 Ω to 332 k Ω	1 Ω to < 10 Ω	< 1 Ω	> 332 k Ω
			MMB 0207	10 Ω to 1 M Ω	1 Ω to < 10 Ω	< 1 Ω	> 1 M Ω
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			
4.32	21 (Ue ₃)	shear (adhesion)	45 N	no visible damage			
4.33	21 (Ue ₁)	substrate bending	depth 2 mm, 3 times	no visible damage, no open circuit in bent position			
				$\pm(0,05\%R + 5 \text{ m}\Omega)^{(1)}$			
4.7	–	voltage proof	$U_{\text{rms}} = U_{\text{ins}}$; 60 s	no flashover or breakdown			
4.35	–	flammability	IEC 60 695-2-2, needle flame test; 10 s	no burning after 30 s			

Note

1. Special requirements apply to MICRO-MELF, MMU 0102:

- $R < 100 \Omega$: $\pm(0,25\%R + 10 \text{ m}\Omega)$
- $100 \Omega \leq R \leq 221 \text{ k}\Omega$: $\pm 0,1\%R$
- $221 \text{ k}\Omega < R$: $\pm 0,25\%R$