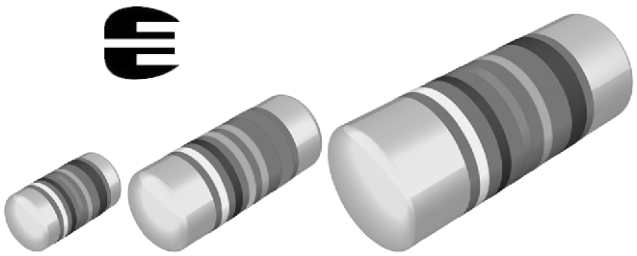
Professional MELF Resistors



FEATURES

- Approved to EN 140401-803
- AEC-Q200 qualified
- Advanced thin film technology
- Excellent overall stability: Exceeds class 0.25
- Matte Sn termination on Ni barrier layer
- Compliant to RoHS Directive 2011/65/EU

AUTOMOTIVE GRADE

Pb-free

RoHS COMPLIANT

APPLICATIONS

- Automotive
- Telecommunication
- Industrial
- Medical equipment

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.

METRIC SIZE			
DIN	0102	0204	0207
CECC	RC 2211M	RC 3715M	RC 6123M

TECHNICAL SPECIFICATIONS

DESCRIPTION	MMU 0102		MMA 0204		MMB 0207	
CECC size	RC 2211M		RC 3715M		RC 6123M	
Resistance range	0.22 Ω to 2.21 MΩ; 0 Ω		0.22 Ω to 10 MΩ; 0 Ω		0.1 Ω to 15 MΩ; 0 Ω	
Resistance tolerance	± 5 %; ± 2 %; ± 1 %; ± 0.5 %		± 5 %; ± 1 %; ± 0.5 %		± 5 %; ± 2 %; ± 1 %; ± 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
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	
Permissible film temperature, ϑ_F max.	125 °C	155 °C	125 °C	155 °C	125 °C	155 °C
Operating temperature range	- 55 °C to 125 °C	- 55 °C to 155 °C	- 55 °C to 125 °C	- 55 °C to 155 °C	- 55 °C to 125 °C	- 55 °C to 155 °C
Max. resistance change at P_{70} for resistance range, $\Delta R/R$ max., after:	0.22 Ω to 221 kΩ		0.22 Ω to 332 kΩ		0.22 Ω to 1 MΩ	
1000 h	≤ 0.15 %	≤ 0.25 %	≤ 0.15 %	≤ 0.25 %	≤ 0.15 %	≤ 0.25 %
8000 h	≤ 0.3 %	≤ 0.5 %	≤ 0.3 %	≤ 0.5 %	≤ 0.3 %	≤ 0.5 %
225 000 h	≤ 1 %	-	≤ 1 %	-	≤ 1 %	-
Permissible voltage against ambient (insulation):						
1 min; U_{ins}	200 V		300 V		500 V	
Continuous	75 V		75 V		75 V	
Failure rate: $FIT_{observed}$	≤ 0.1 x 10^{-9}/h					

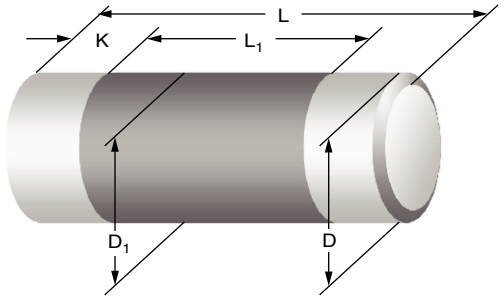
Notes

- 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.

(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.

DIMENSIONS

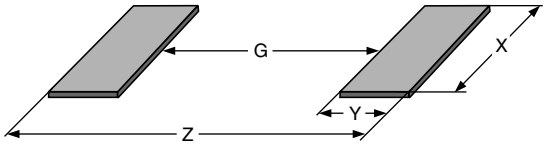


DIMENSIONS AND MASS						
TYPE	L (mm)	D (mm)	$L_{1\ min.}$ (mm)	D_1 (mm)	K (mm)	MASS (mg)
MMU 0102	2.2 + 0/- 0.1	1.1 + 0/- 0.1	1.2	D + 0/- 0.1	0.4 ± 0.05	8
MMA 0204	3.6 + 0/- 0.2	1.4 + 0/- 0.1	1.8	D + 0/- 0.15	0.8 ± 0.1	22
MMB 0207	5.8 + 0/- 0.15	2.2 + 0/- 0.2	3.2	D + 0/- 0.2	1.15 ± 0.1	80

Note

- Color code marking is applied according to IEC 60062 (3) in four bands (E24 series) or 5 bands (E96 or E192 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 yellow band between the 4th and 5th full band indicates TC25.

PATTERN STYLES FOR MELF RESISTORS



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

Note

- The given solder pad dimensions reflect the considerations for board design and assembly as outlined e.g. in standards IEC 61188-5-x, or in publication IPC-7351. They do not guarantee any supposed thermal properties, however, they will be found adequate for most general applications.

PART NUMBER AND PRODUCT DESCRIPTION

Part Number: MMB02070D5620DB200
Part Number: MMB02070Z0000ZB200

M	M	B	0	2	0	7	0	D	5	6	2	0	D	B	2	0	0
M	M	B	0	2	0	7	0	Z	0	0	0	0	Z	B	2	0	0

TYPE/SIZE	VERSION	TCR	RESISTANCE	TOLERANCE	PACKAGING
MMU0102 **MMA0204** **MMB0207**	**0** = EN 140401-803, "Version A"	**D** = ± 25 ppm/K **C** = ± 50 ppm/K **B** = ± 100 ppm/K **Z** = Jumper	3 digit value 1 digit multiplier **Multiplier** **7** = $*10^{-3}$ **8** = $*10^{-2}$ **9** = $*10^{-1}$ **0** = $*10^{0}$ **1** = $*10^{1}$ **2** = $*10^{2}$ **3** = $*10^{3}$ **4** = $*10^{4}$ **5** = $*10^{5}$ **0000** = Jumper	**D** = ± 0.5 % **F** = ± 1 % **G** = ± 2 % **J** = ± 5 % **Z** = Jumper	**B3** **B0** **B2** **B7** **M3** **M8**

Product Description: MMB 0207 - 25 0.5 % B2 562R
Product Description: MMB 0207 B2 0R0

MMB	**0207**	**- 25**	**0.5 %**	**B2**	**562R**
MMB	**0207**	**-**	**-**	**B2**	**0R0**
TYPE	SIZE	TCR	TOLERANCE	PACKAGING	RESISTANCE
MMU **MMA** **MMB**	**0102** **0204** **0207**	± **25** ppm/K ± **50** ppm/K ± **100** ppm/K	± **0.5** % ± **1** % ± **2** % ± **5** %	**BL** **B0** **B2** **B7** **M3** **M8**	**562R** = 562 Ω **0R0** = Jumper

Note

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

PACKAGING

TYPE	CODE	QUANTITY	CARRIER TAPE	WIDTH	PITCH	REEL DIAMETER
MMU 0102	B3 = BL	3000	Antistatic blister tape acc. IEC 60286-3 type II	8 mm	4 mm	180 mm/7"
	B0	10 000				330 mm/13"
	M8	8000	Bulk case acc. IEC 60286-6	-	-	-
MMA 0204	B3 = BL	3000	Antistatic blister tape acc. IEC 60286-3 type II	8 mm	4 mm	180 mm/7"
	B0	10 000				330 mm/13"
	M3	3000	Bulk case acc. IEC 60286-6	-	-	-
MMB 0207	B2	2000	Antistatic blister tape acc. IEC 60286-3 type II	12 mm	4 mm	180 mm/7"
	B7	7000				330 mm/13"

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE				
DESCRIPTION		RESISTANCE		
TCR	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	-	0.2 Ω to 0.91 Ω
	± 1 %	**10 Ω to 2.21 MΩ**	**1 Ω to 10 MΩ**	**1 Ω to 15 MΩ**
	± 0.5 %	10 Ω to 221 kΩ	10 Ω to 2.21 MΩ	-
± 25 ppm/K	± 1 %	10 Ω to 221 kΩ	10 Ω to 511 kΩ	-
	± 0.5 %	**10 Ω to 221 kΩ**	**10 Ω to 511 kΩ**	**10 Ω to 1 MΩ**
Jumper		**≤ 10 mΩ; $I_{max.}$ = 2 A**	**≤ 10 mΩ, $I_{max.}$ = 3 A**	**≤ 10 mΩ; $I_{max.}$ = 5 A**

Notes

- Resistance ranges printed in bold are preferred TCR/tolerance combinations with optimized availability.
- 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.

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 (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 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 color code rings designate the resistance value and tolerance in accordance with **IEC 60062** [3].

The result of the determined production is verified by an extensive testing procedure performed on 100 % of the individual resistors. This includes pulse load screening (for $R \geq 10\ \Omega$) and additional non-linearity screening (for $R \geq 30\ \Omega$) for the elimination of products with a potential risk of early life failures according to EN 140401-803, 2.1.2.2. Only accepted products are laid directly into the blister tape in accordance with **IEC 60286-3, Type II** [3] or bulk case in accordance with **IEC 60286-6** [3].

ASSEMBLY

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow or vapour phase as shown in **IEC 61760-1** [3]. 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 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.

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, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system.

All products comply with the **GADSL** [1] and the **CEFIC-EECA-EICTA** [2] list of legal restrictions on hazardous substances. This includes full compliance with the following directives:

- 2000/53/EC End of Vehicle Life Directive (ELV) and Annex II (ELV II)
- 2011/65/EU Restriction of the use of Hazardous Substances Directive (RoHS)
- 2002/96/EC Waste Electrical and Electronic Equipment Directive (WEEE)

APPROVALS

The resistors are approved within the IECQ-CECC Quality Assessment System for Electronic Components to the detail specification **EN 140401-803** which refers to **EN 60115-1**, **EN 140400** and the variety of environmental test procedures of the **IEC 60068** [3] series.

Conformity is attested by the use of the **CECC** logo ( ) as the mark of conformity on the package label.

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.

The resistors are qualified according to AEC-Q200.

RELATED PRODUCTS

For products with precision specification see the datasheet:

- "Precision MELF Resistors" (www.vishay.com/doc?28714)
- "High Precision MINI-MELF Resistor" (www.vishay.com/doc?28715)

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).

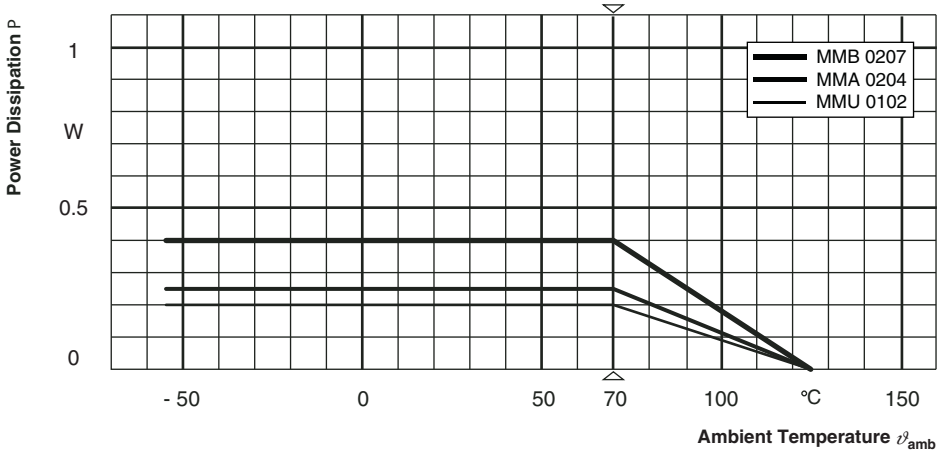
Notes

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

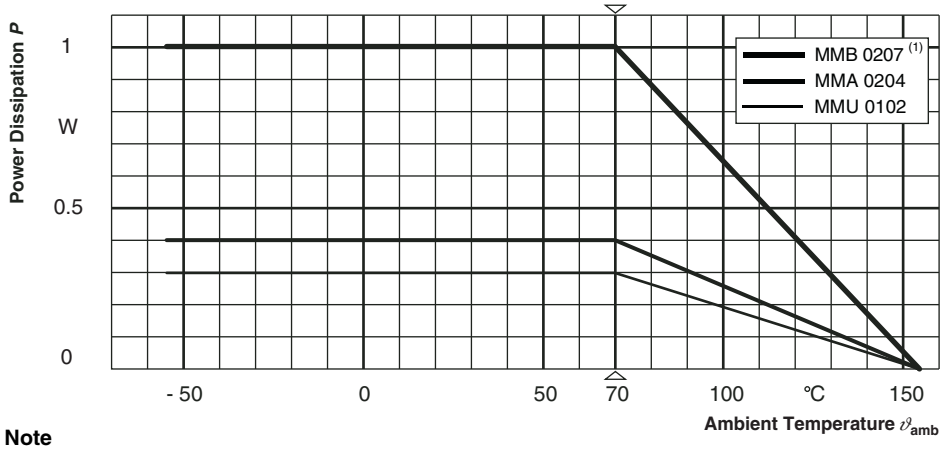
[2] CEFIC (European Chemical Industry Council), EECA (European Electronic Component Manufacturers Association), EICTA (European trade organisation representing the information and communications technology and consumer electronics), see www.eicta.org/index.php?id=995 → issues → environment policy → chemicals → chemicals for electronics.

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

FUNCTIONAL PERFORMANCE



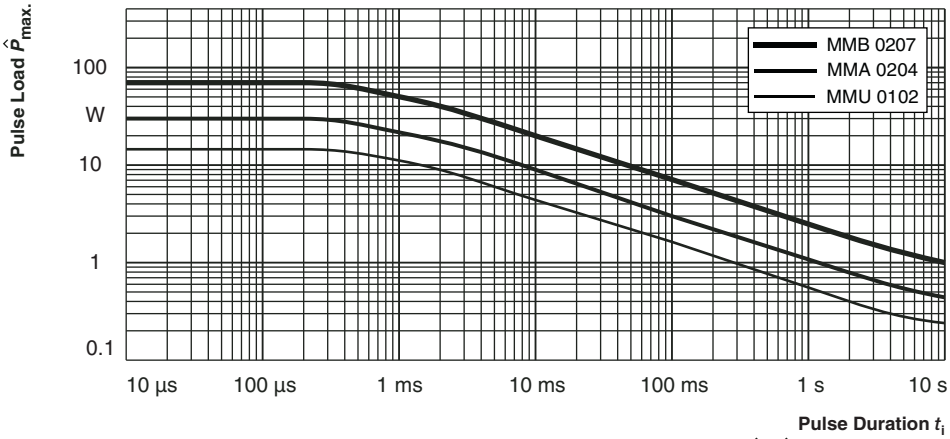
Derating - Standard Operation



Note

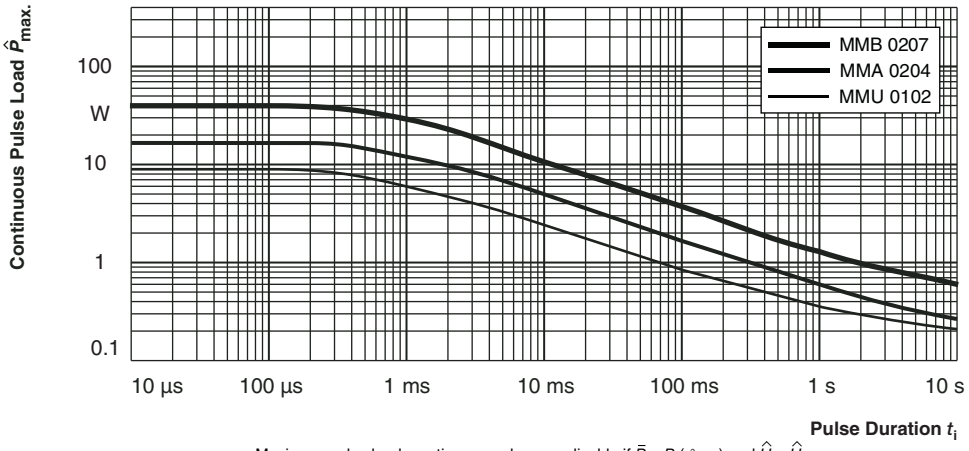
(1) Specified power rating requires dedicated heat sink pads

Derating - Power Operation



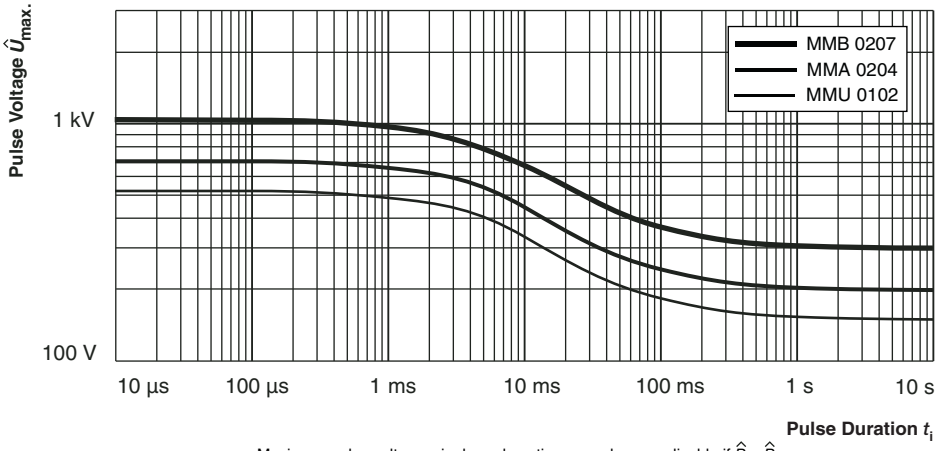
Maximum pulse load, single pulse; applicable if $\bar{P} \rightarrow 0$ and n ≤ 1000 and $\hat{U} \leq \hat{U}_{max.}$; for permissible resistance change equivalent to 8000 h operation

Single Pulse



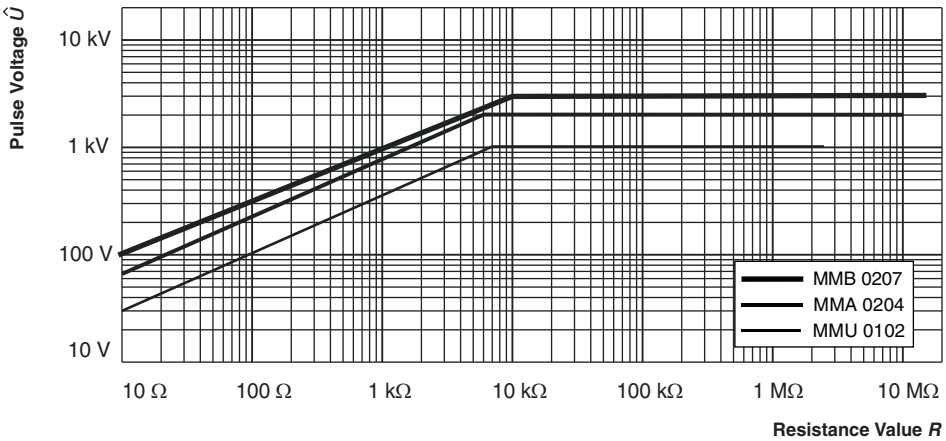
Maximum pulse load, continuous pulses; applicable if $\bar{P} \leq P\,(\vartheta_{amb})$ and $\hat{U} \leq \hat{U}_{max.}$;
for permissible resistance change equivalent to 8000 h operation

Continuous Pulse



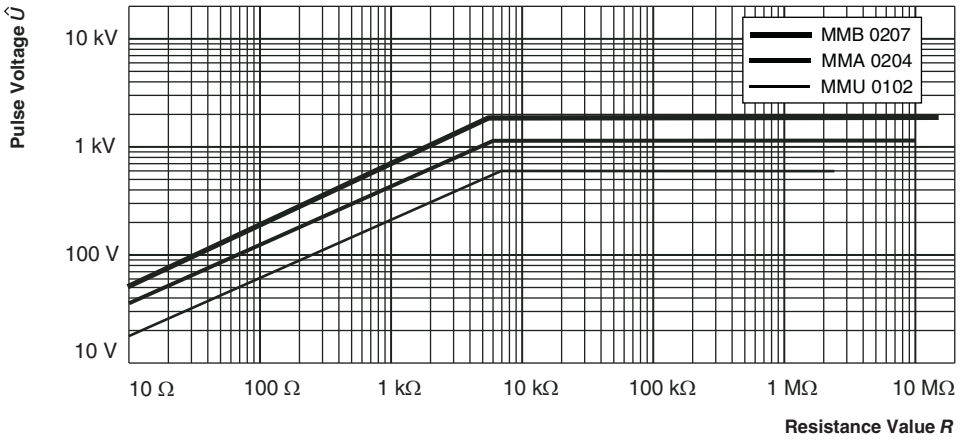
Maximum pulse voltage, single and continuous pulses; applicable if $\hat{P} \leq \hat{P}_{max.}$;
for permissible resistance change equivalent to 8000 h operation

Pulse Voltage



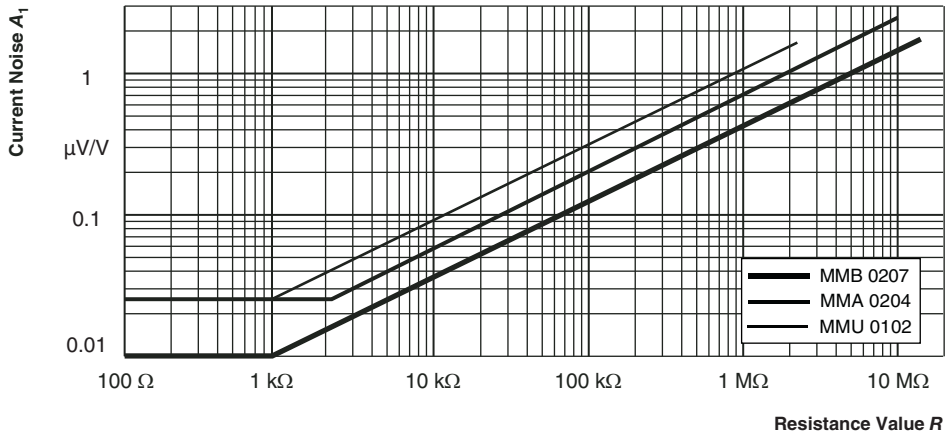
Pulse load rating in accordance with IEC 60 115-1, 4.27; 1.2 µs/50 µs;
5 pulses at 12 s intervals; for permissible resistance change 0.5 %

1.2/50 Pulse



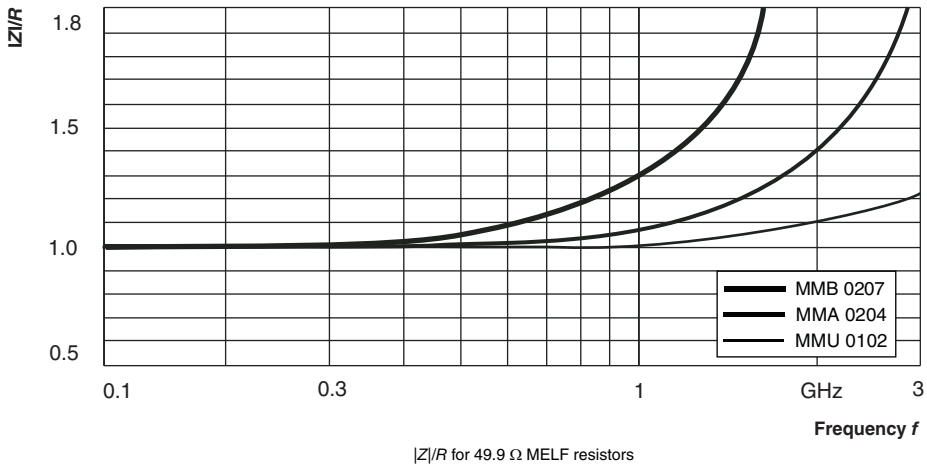
Pulse load rating in accordance with IEC 60115-1, 4.27; 10 µs/700 µs;
10 pulses at 1 minute intervals; for permissible resistance change 0.5 %

10/700 Pulse



Accordance with IEC 60195

Current Noise - A_1



|Z|/R for 49.9 Ω MELF resistors

RF - Behaviour

TEST 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 IECQ-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 under standard atmospheric conditions in accordance with IEC 60068-1, 5.3 (3). Climatic category LCT/UCT/56 (rated temperature range: Lower category temperature, upper category temperature; damp heat, steady state, test duration 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).

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. 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.

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 (2) TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)			
				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 kΩ	1Ω to < 10 Ω	< 1 Ω	> 221 kΩ
			MMA 0204	10 Ω to 332 kΩ	1Ω to < 10 Ω	< 1 Ω	> 332 kΩ
			MMB 0207	10 Ω to 1 MΩ	1Ω to < 10 Ω	< 1 Ω	> 1 MΩ
4.5	-	Resistance	-	± 1 % R; ± 0.5 % R	± 2 % R; ± 1 % R	± 5 % R	± 1 % R
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	± (0.15 % R + 10 mΩ)			± (0.5 % R + 10 mΩ)
			70 °C; 8000 h	± (0.3 % R + 10 mΩ)			± (1 % R + 10 mΩ)
		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	± (0.25 % R + 10 mΩ)			± (0.5 % R + 10 mΩ)
			70 °C; 8000 h	± (0.5 % R + 10 mΩ)			± (1 % R + 10 mΩ)
4.25.3	-	Endurance at upper category temperature	125 °C; 1000 h	± (0.15 % R + 5 mΩ)	± (0.25 % R + 5 mΩ)	± (0.5 % R + 5 mΩ)	+ (1 % R + 5 mΩ)
			155 °C; 1000 h	± (0.3 % R + 5 mΩ)	± (0.5 % R + 5 mΩ)	± (1 % R + 5 mΩ)	+ (2 % R + 5 mΩ)
4.24	78 (Cab)	Damp heat, steady state	(40 ± 2) °C; 56 days; (93 ± 3) % RH	± (0.15 % R + 10 mΩ)	± (0.5 % R + 10 mΩ)	± (1 % R + 10 mΩ)	± (1 % R + 10 mΩ)

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 (2) TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)			
				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 kΩ	1Ω to < 10 Ω	< 1 Ω	> 221 kΩ
			MMA 0204	10 Ω to 332 kΩ	1Ω to < 10 Ω	< 1 Ω	> 332 kΩ
			MMB 0207	10 Ω to 1 MΩ	1Ω to < 10 Ω	< 1 Ω	> 1 MΩ
4.39	67 (Cy)	Damp heat, steady state, accelerated	(85 ± 2) °C; (85 ± 5) % RH; $U = 0.3 \times \sqrt{P_{70} \times R}$ ≤ 100 V; 1000 h	± (0.25 % R + 10 mΩ)	± (0.5 % R + 10 mΩ)	± (1 % R + 10 mΩ)	± (2 % R + 10 mΩ)
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	± (0.15 % R + 10 mΩ)	± (0.5 % R + 10 mΩ)	± (1 % R + 10 mΩ)	± (1 % R + 10 mΩ)
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 24 h; ≥ 90 % RH; 5 cycles				
4.23.7	-	DC load	$U = \sqrt{P_{70} \times R}$ ≤ U_{max}; 1 min. LCT = - 55 °C; UCT = 155 °C				
-	1 (Ab)	Cold	- 55 °C; 2 h	± (0.05 % R + 5 mΩ)			± (0.1 % R + 5 mΩ)
4.19	14 (Na)	Rapid change of temperature	30 min at LCT; 30 min at UCT; LCT = - 55 °C; UCT = 125 °C				
			5 cycles	± (0.05 % R + 10 mΩ)			± (0.1 % R + 10 mΩ)
			1000 cycles	± (0.15 % R + 10 mΩ)			± (0.25 % R + 10 mΩ)
			LCT = - 55 °C; UCT = 155 °C 1000 cycles	± (0.25 % R + 10 mΩ)			± (0.5 % R + 10 mΩ)
4.13	-	Short time overload: standard operation mode	$U = 2.5 \times \sqrt{P_{70} \times R}$ ≤ 2 x U_{max}; 5 s	± (0.03 % R + 5 mΩ)			± (0.15 % R + 5 mΩ)
		Short time overload: power operation mode		± (0.05 % R + 5 mΩ)			± (0.15 % R + 5 mΩ)

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 (2) TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)			
				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 kΩ	1Ω to < 10 Ω	< 1 Ω	> 221 kΩ
			MMA 0204	10 Ω to 332 kΩ	1Ω to < 10 Ω	< 1 Ω	> 332 kΩ
			MMB 0207	10 Ω to 1 MΩ	1Ω to < 10 Ω	< 1 Ω	> 1 MΩ
4.27	-	Single pulse high voltage overload; standard operation mode	Severity no. 4: $U = 10 \times \sqrt{P_{70} \times R} \leq 2 \times U_{max.}$; 10 pulses 10 µs/700 µs	± (0.25 % R + 5 mΩ)			
		Single pulse high voltage overload; power operation mode		± (0.5 % R + 5 mΩ)			
4.37	-	Periodic electric overload; standard operation mode	$U = \sqrt{15 \times P_{70} \times R} \leq 2 \times U_{max.}$; 0.1 s on; 2.5 s off; 1000 cycles	± (0.5 % R + 5 mΩ)			
		Periodic electric overload; power operation mode		± (1 % R + 5 mΩ)			
4.22	6 (Fc)	Vibration	Endurance by sweeping; 10 Hz to 2000 Hz; no resonance; amplitude ≤ 1.5 mm or ≤ 200 m/s²; 7.5 h	± (0.05 % R + 5 mΩ)			± (0.1 % R + 5 mΩ)
4.40	-	Electrostatic discharge (Human Body Model)	IEC 61340-3-1 (2); 3 pos. + 3 neg. discharges MMU 0102: 1.5 kV MMA 0204: 2 kV MMB 0207: 4 kV	± (0.5 % R + 50 mΩ)			

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 [2] TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)			
				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 kΩ	1Ω to < 10 Ω	< 1 Ω	> 221 kΩ
			MMA 0204	10 Ω to 332 kΩ	1Ω to < 10 Ω	< 1 Ω	> 332 kΩ
			MMB 0207	10 Ω to 1 MΩ	1Ω to < 10 Ω	< 1 Ω	> 1 MΩ
4.17.2	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			
4.18.2	58 (Td)	Resistance to soldering heat	Solder bath method; (260 ± 5) °C; (10 ±1) s	± (0.05 % R + 10 mΩ)	± (0.1 % R + 10 mΩ)	± (0.25 % R + 10 mΩ)	± (0.25 % R + 10 mΩ)
			Reflow method 2 (IR/forced gas convection); (260 ± 5) °C; (10 ±1) s	± (0.02 % R + 10 mΩ)	± (0.05 % R + 10 mΩ)	± (0.05 % R + 10 mΩ)	± (0.1 % R + 10 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			
4.32	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 ± (0.05 % R + 5 mΩ) [1]			
4.7	-	Voltage proof	$U_{RMS} = U_{ins}$; 60 s	No flashover or breakdown			
4.35	-	Flammability	IEC 60695-11-5 [2], needle flame test; 10 s	No burning after 30 s			

Notes

[1] Special requirements apply to MICRO-MELF, MMU 0102:
- R < 100 Ω: ± (0.25 % R +10 mΩ).
- 100 Ω ≤ R ≥ 221 kΩ: ± 0.1 % R.
- 221 kΩ < R: ± 0.25 % R.

[2] 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
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 kΩ to 9.99 kΩ	2
10 kΩ to 99.9 kΩ	3
100 kΩ to 999 kΩ	4
1 MΩ to 9.99 MΩ	5
10 MΩ to 99.9 MΩ	6

Historical 12NC Example

The 12NC of a MMU 0102 resistor, value 47 kΩ and TCR 50 with ± 1 % tolerance, supplied in blister tape of 3000 units per reel was: 2312 165 14703.

HISTORICAL 12NC - Resistor type and packaging

DESCRIPTION			2312...		
			BLISTER TAPE ON REEL		BULK CASE
TYPE	**TCR**	**TOL.**	**BL 3000 UNITS**	**B0 10 000 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**
TYPE	**TCR**	**TOL.**	**BL 3000 UNITS**	**B0 10 000 UNITS**	**M3 3000 UNITS**
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**
TYPE	**TCR**	**TOL.**	**B2 2000 UNITS**	**B7 7000 UNITS**	
MMB 0207	± 100 ppm/K	± 5 %	195 3....	185 3....	
	± 50 ppm/K	± 5 %	195 3....	185 3....	
		± 2 %	195 2....	185 2....	
		± 1 %	**195 1....**	**185 1....**	
	± 25 ppm/K	± 0.5 %	**196 5....**	**186 5....**	
	Jumper		**195 90001**	**185 90001**	

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