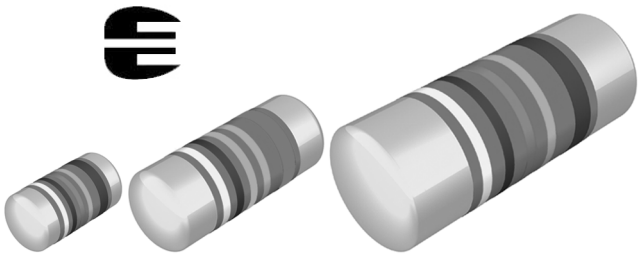
Professional MELF Resistors



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.

FEATURES

- Approved according to EN 140401-803
- Advanced thin film technology
- Excellent overall stability: exceeds Class 0.25
- Green product, supports lead-free soldering

APPLICATIONS

- Automotive
- Telecommunication
- Industrial
- Medical equipment.

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		0.22 Ω to 10 MΩ		0.1 Ω to 15 MΩ	
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
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 °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:	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 %
225000 h	≤ 1 %	-	≤ 1 %	-	≤ 1 %	-
Specified lifetime	225000 h	8000 h	225000 h	8000 h	225000 h	8000 h
Permissible voltage against ambient (insulation):						
1 minute; U_{ins}	200 V		300 V		500 V	
continuous	75 V		75 V		75 V	
Failure rate	≤ 2 x 10^{-9}/h		≤ 0.7 x 10^{-9}/h		≤ 0.7 x 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.

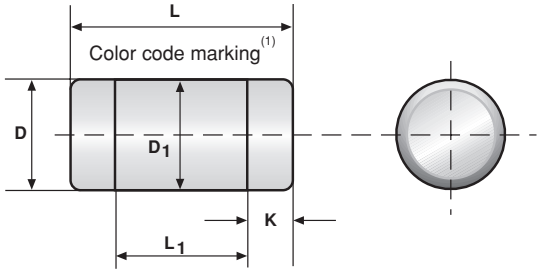
ORDERING INFORMATION - type description and ordering code

M	M	U	0102	-50	1 %	BL	47 K
FILM TYPE	PRODUCT CODE	SIZE CODE	METRIC DIN SIZE	TEMPERATURE COEFFICIENT	TOLERANCE	PACKAGING (1)	RESISTANCE VALUE
M = Metal	M = MELF, cylindrical	U = 0102 A = 0204 B = 0207	0102 0204 0207	± 25 ppm/K ± 50 ppm/K ± 100 ppm/K (2)	± 0.5 % ± 1 % ± 2 % ± 5 %	B2 = 2000 units BL = 3000 units B7 = 7000 units B0 = 10000 units M3 = 3000 units (bulk case) M8 =8000 units (bulk case)	See Temperature coefficient and resistance range table

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

1. Availability in accordance to table on 12NC ordering codes at the end of this datasheet.
2. A temperature coefficient 100 ppm/K is marked -00.

DIMENSIONS



DIMENSIONS - MELF resistor types, mass and relevant physical dimensions

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	1.25 ± 0.15	79

Note

1. Color code marking is applied according to IEC 60062 in four bands (E24 series) or five bands (E96 or E192 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 colour band for tolerance is approximately 50 % wider than the other bands. An interrupted yellow band between the 4th and 5th full band indicates the temperature coefficient of 25 ppm/K.

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	-	0.2 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:

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.

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 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**.

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 the European RoHS directive.

APPROVALS

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 enviromental test procedures of the **IEC 60068** series. Approval of conformity is indicated by the **CECC** logo on the package label.

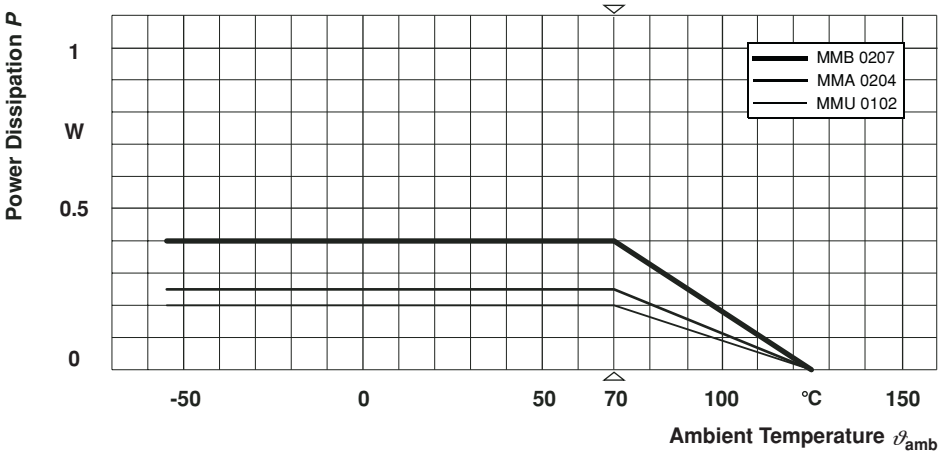
Vishay BEYSCHLAG has achieved **"Approval of Manufacturer"** in accordance with **EN 100114-1**. The release certificate for **"Technology Approval Schedule"** in accordance with **CECC 240001** based on **EN 100114-6** is granted for the Vishay BEYSCHLAG manufacturing process.

SPECIALS

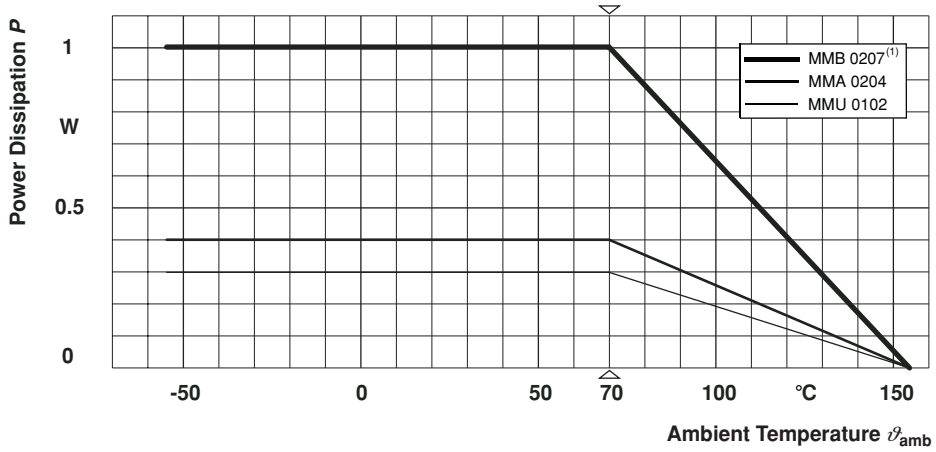
This product family of thin film MELF resistors is completed by **Zero Ohm Jumpers**.

On request, resistors are available with established reliability in accordance with **EN 140401-803 Version E**. Please refer to the special data sheet for information on failure rate level, available resistance ranges and ordering codes.

FUNCTIONAL PERFORMANCE

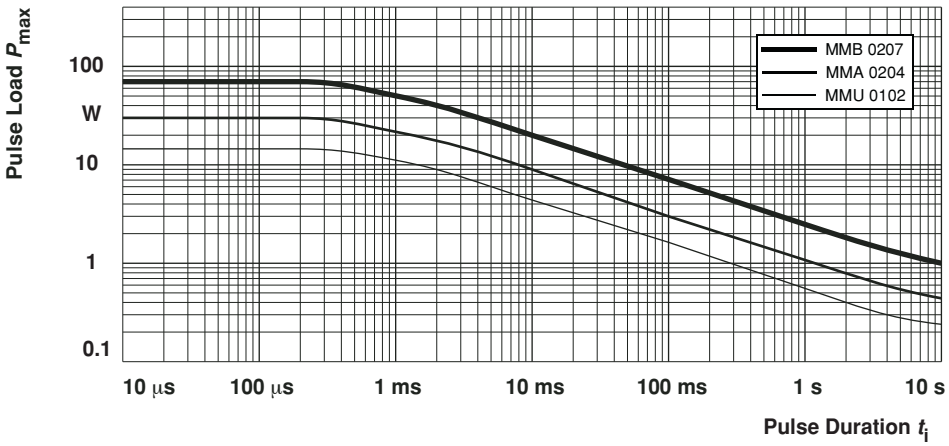


Derating - Standard Operation



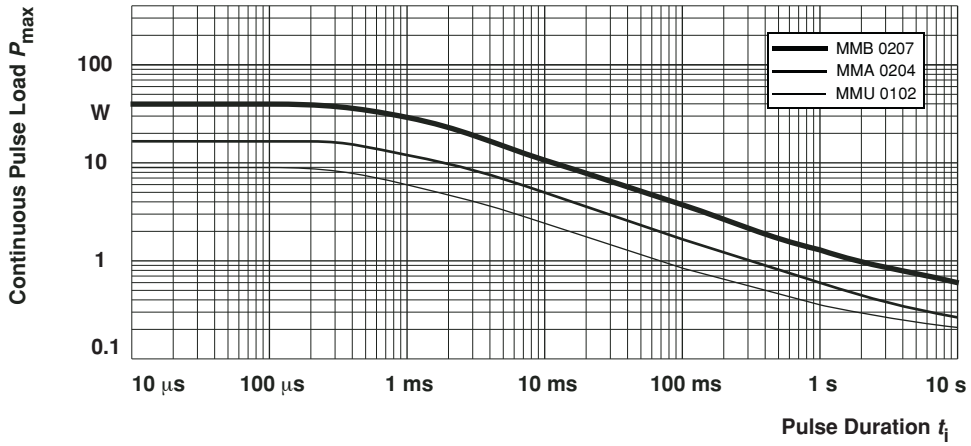
(1)Specified power rating requires dedicated heat sink pads

Derating - Power Operation



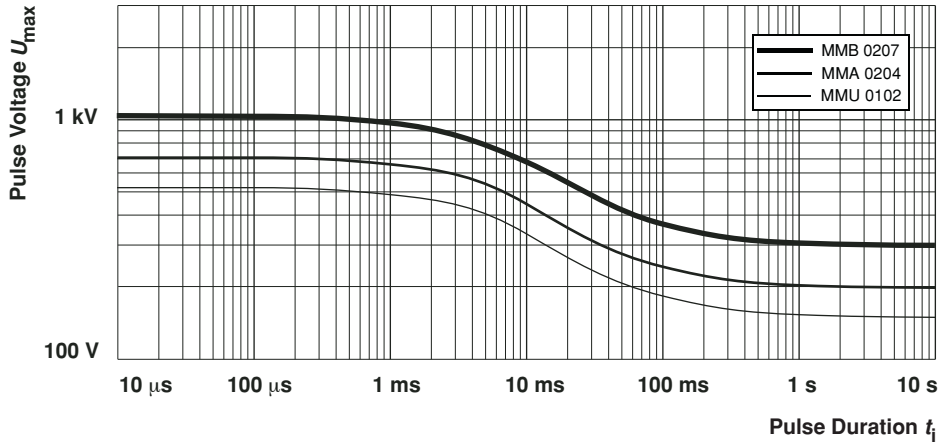
Maximum pulse load, single pulse; for permissible resistance change equivalent to 8000 h operation

Single Pulse



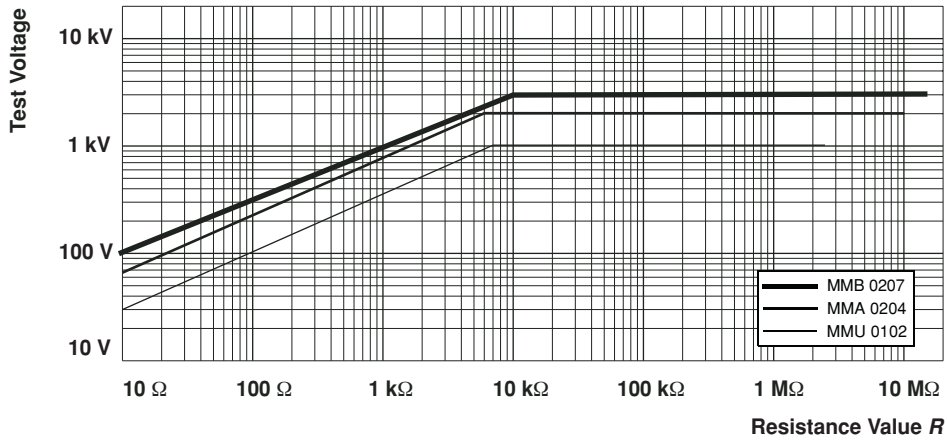
Maximum pulse load, continuous pulses; for permissible resistance change equivalent to 8000 h operation

Continuous Pulse



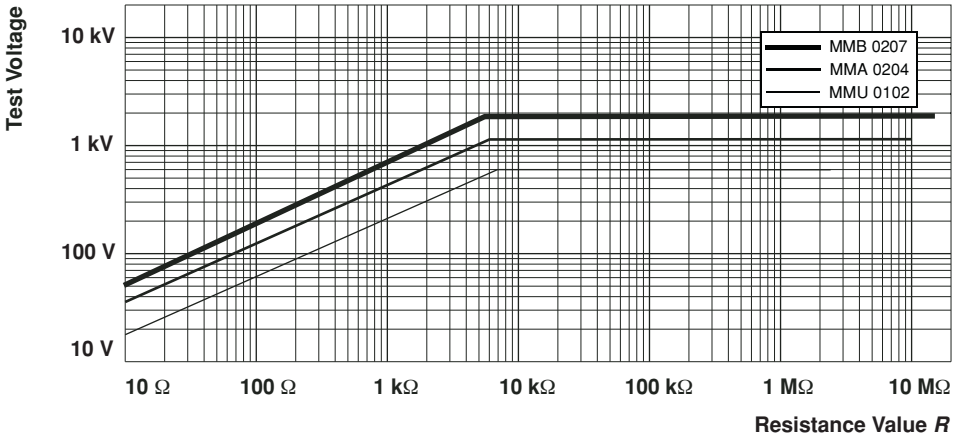
Maximum pulse voltage, single and continuous pulses; for permissible resistance change equivalent to 8000 h operation

Pulse Voltage



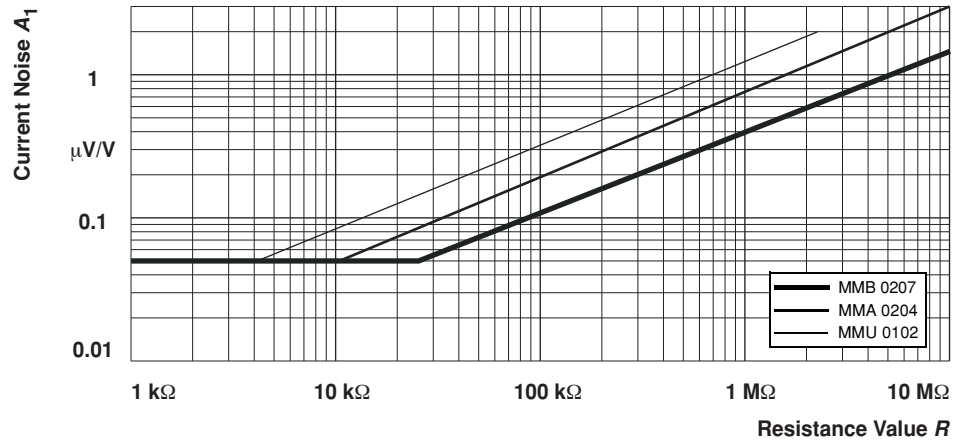
Pulse load rating in accordance with IEC 60115-1, 4.27; 1.2 µs/ 50 µs;
5 pulses at 12 s intervals; for permissible resistance change 0.5 %

1.2/50 Pulse



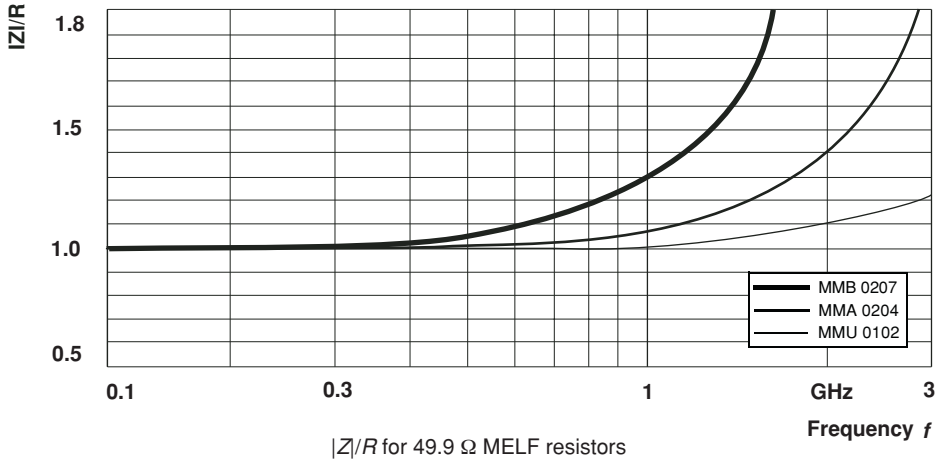
Pulse load rating in accordance with IEC 60115-1, 4.27; 10 µs / 700 µs;
10 pulses at 1 minute intervals; for premissible resistance change 0.5 %

10/700 Pulse



In 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 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. 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 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 kΩ	1 Ω to < 10 Ω	< 1 Ω	> 221 kΩ
			MMA 0204	10 Ω to 332 kΩ	1 Ω to < 10 Ω	< 1 Ω	> 332 kΩ
			MMB 0207	10 Ω to 1 MΩ	1 Ω to < 10 Ω	< 1 Ω	> 1 MΩ
4.5	-	resistance	-	±1 %; ± 0.5 %	± 2 %; ± 1 %	± 5 %	± 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	$U = \sqrt{P_{70} \times R}$ ≤ 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	$U = \sqrt{P_{70} \times R}$ ≤ 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)
4.39	67 (Cy)	damp heat, steady state, accelerated	(85 ± 2) °C; (85 ± 5) % RH; U = 0.1 x $\sqrt{P_{70} \times R}$ ≤ 100 V; 1000 h	± (0.25 %R + 10 mΩ)	± (0.5 %R + 10 mΩ)	± (1 %R + 10 mΩ)	± (2 %R + 10 mΩ)

TEST PROCEDURES AND REQUIREMENTS - continued

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 kΩ	1 Ω to < 10 Ω	< 1 Ω	> 221 kΩ
			MMA 0204	10 Ω to 332 kΩ	1 Ω to < 10 Ω	< 1 Ω	> 332 kΩ
			MMB 0207	10 Ω to 1 MΩ	1 Ω to < 10 Ω	< 1 Ω	> 1 MΩ
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	± (0.15 %R + 10 mΩ)	± (0.5 %R + 10 mΩ)	± (1 %R + 10 mΩ)	± (1 %R + 10 mΩ)
-	1 (Aa)	cold	-55 °C; 2 h	± (0.05 %R + 5 mΩ)			± (0.1 %R + 5 mΩ)
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT; 30 minutes 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)
4.27	-	single pulse high voltage overload; standard operation mode	severity no. 4: $U = 10 \times \sqrt{P_{70} \times R}$ ≤ 2 × 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	$U = \sqrt{15 \times P_{70} \times R}$ ≤ 2 x U_{max}; 0.1 s on; 2.5 s off; 1 000 cycles	± (0.5 %R + 5 mΩ)			
		periodic electric overload; power operation mode		± (1 %R + 5 mΩ)			

TEST PROCEDURES AND REQUIREMENTS - continued

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 kΩ	1 Ω to < 10 Ω	< 1 Ω	> 221 kΩ
			MMA 0204	10 Ω to 332 kΩ	1 Ω to < 10 Ω	< 1 Ω	> 332 kΩ
			MMB 0207	10 Ω to 1 MΩ	1 Ω to < 10 Ω	< 1 Ω	> 1 MΩ
4.22	6 (Fc)	vibration	endurance by sweeping; 10 to 2000 Hz; no resonance; amplitude ≤ 1.5 mm or ≤ 200 m/s^2; 6 h	± (0.05 %R + 5 mΩ)			± (0.1 %R + 5 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 2mm, 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 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 Ω: ± (0.25 %R + 10 mΩ)
   - 100 Ω ≤ R ≤ 221 kΩ: ± 0.1 %R
   - 221 kΩ < R: ± 0.25 %R:

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
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

Ordering Example

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

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**	-
MMB 0207 ≤ 0.2 Ω	± 100 ppm/K	± 5 %	195 3....	-	185 3....	-	-	-
MMB 0207	± 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**	-	-	-

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