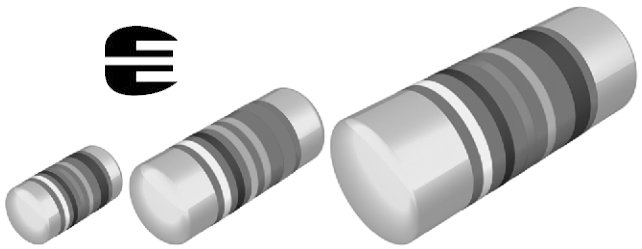
Precision MELF Resistors



FEATURES

- Approved according to EN 140401-803
- Advanced thin film technology
- Superior stability: Class 0.05
- Wide precision range: 10 Ω to 1 MΩ
- Force fitted steel caps, tin plated on nickel barrier
- Pure Sn termination on Ni barrier layer
- Compatible with lead (Pb)-free and lead containing soldering processes
- Lead (Pb)-free and RoHS compliant

APPLICATIONS

- Test and measuring equipment
- Industrial and medical electronics

MMU 0102, MMA 0204 and MMB 0207 precision thin film melf resistors combine the proven reliability of the professional products with an advanced level of precision and stability. Therefore they are perfectly suited for applications in the fields of test and measuring equipment along with industrial and medical electronics.

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

TECHNICAL SPECIFICATIONS						
DESCRIPTION	**MMU 0102**		**MMA 0204**		**MMB 0207**	
Metric CECC size	RC 2211 M		RC 3715 M		RC 6123 M	
Resistance range	22 Ω to 332 kΩ		10 Ω to 511 kΩ		15 Ω to 1 MΩ	
Resistance tolerance	± 0.5 %; ± 0.25 %; ± 0.1 %				± 0.25 %; ± 0.1 %	
Temperature coefficient	± 25 ppm/K; ± 15 ppm/K					
Operation mode	precision	standard	precision	standard	precision	standard
Climatic category (LCT/UCT/days)	10/85/56	55/125/56	10/85/56	55/125/56	10/85/56	55/125/56
Rated dissipation, P_{70} [1]	0.06 W	0.2 W	0.07 W	0.25 W	0.11 W	0.4 W
Operating voltage, U_{max} AC/DC	150 V		200 V		300 V	
Film temperature	85 °C	125 °C	85 °C	125 °C	85 °C	125 °C
Max. resistance change at P_{70} for resistance range, $\lvert\Delta R/R\rvert$ max., after:	22 Ω to 332 kΩ		10 Ω to 511 kΩ		15 Ω to 1 MΩ	
1000 h	≤ 0.05 %	≤ 0.1 %	≤ 0.05 %	≤ 0.1 %	≤ 0.05 %	≤ 0.1 %
8000 h	≤ 0.1 %	≤ 0.2 %	≤ 0.1 %	≤ 0.2 %	≤ 0.1 %	≤ 0.2 %
225 000 h	≤ 0.3 %	≤ 0.6 %	≤ 0.3 %	≤ 0.6 %	≤ 0.3 %	≤ 0.6 %
Permissible voltage against ambient (insulation):						
1 minute, U_{ins}	200 V		300 V		500 V	
continuous	75 V		75 V		75 V	
Failure rate	≤ 2.0×10^{-9}/h		≤ 0.7×10^{-9}/h		≤ 0.7×10^{-9}/h	

Note: 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.

12NC INFORMATION

- The resistors have a 12-digit numeric code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; see the 12NC 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
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

12NC Example

The 12NC of a MMA 0204 resistor, value 47 kΩ and TC 25 with ± 0.1 % tolerance, supplied in blister tape of 3000 units per reel is: 2312 156 74703.

12NC - resistor type and packaging

DESCRIPTION			ORDERING CODE 2312			
			BLISTER TAPE ON REEL			BULK CASE
TYPE	**TCR**	**TOL.**	**B1 1000 units**	**BL 3000 units**	**B0 10 000 units**	**M8 8000 units**
MMU 0102	± 25 ppm/K	± 0.25 %	171 6....	**166 6....**	176 6....	061 6....
		± 0.1 %	171 7....	**166 7....**	176 7....	061 7....
	± 15 ppm/K	± 0.5 %	172 5....	167 5....	177 5....	062 5....
		± 0.25 %	172 6....	167 6....	177 6....	062 6....
		± 0.1 %	172 7....	**167 7....**	177 7....	062 7....
TYPE	**TCR**	**TOL.**	**B1 1000 units**	**BL 3000 units**	**B0 10 000 units**	**M3 3000 units**
MMA 0204	± 25 ppm/K	± 0.25 %	141 6....	**156 6....**	146 6....	041 6....
		± 0.1 %	141 7....	**156 7....**	146 7....	041 7....
	± 15 ppm/K	± 0.5 %	142 5....	157 5....	147 5....	042 5....
		± 0.25 %	142 6....	157 6....	147 6....	042 6....
		± 0.1 %	142 7....	**157 7....**	147 7....	042 7....
TYPE	**TCR**	**TOL.**	**B1 1000 units**	**B2 2000 units**	**B7 7000 units**	
MMB 0207	± 25 ppm/K	± 0.25 %	181 6....	**196 6....**	186 6....	
		± 0.1 %	181 7....	**196 7....**	186 7....	
	± 15 ppm/K	± 0.1 %	182 7....	**197 7....**	187 7....	

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

PART NUMBER AND PRODUCT DESCRIPTION[1)]

PART NUMBER[2)]: MMA02040D5620BBL00

M	M	A	0	2	0	4	0	D	5	6	2	0	B	B	L	0	0

MODEL/SIZE	SPECIAL CHARACTER	TC	VALUE	TOLERANCE	PACKAGING[3)]	SPECIAL
MMU0102 **MMA0204** **MMB0207**	**0** = neutral, acc. CECC E0	**E** = ± 15 ppm/K **D** = ± 25 ppm/K	3 digit value 1 digit multiplier **Multiplier** 9 = $*10^{-1}$ 0 = $*10^{0}$ 1 = $*10^{1}$ 2 = $*10^{2}$ 3 = $*10^{3}$ 4 = $*10^{4}$	**B** = ± 0.1 % **C** = ± 0.25 % **D** = ± 0.5 %	B1 B3 B0 B2 B7 M3 M8	up to 2 digits 00 = standard

PRODUCT DESCRIPTION: MMA 0204-25 0.1 % BL 562R

MMA	0204	-25	0.1 %	BL	562R
MODEL	**SIZE**	**TCR**	**TOLERANCE**	**PACKAGING[3)]**	**RESISTANCE VALUE**
MMU **MMA** **MMB**	**0102** **0204** **0207**	± **15** ppm/K ± **25** ppm/K	± **0.1** % ± **0.25** % ± **0.5** %	**B1** **BL** **B0** **B2** **B7** **M3** **M8**	**562R** = 562 Ω **4K64** = 4.64 kΩ

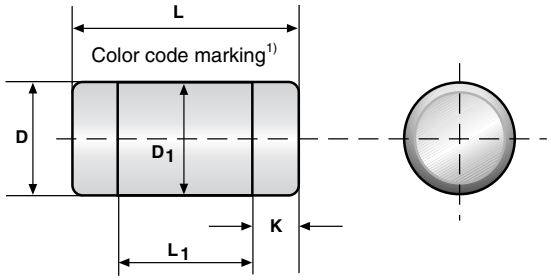
Notes

1. Products can be ordered using either the PRODUCT DESCRIPTION or the 12NC.
2. The PART NUMBER is shown to facilitate the introduction of the unified part numbering system. Currently, this PART NUMBER is applicable in the Americas and in Asia/Pacific only.
3. Please refer to table PACKAGING, see below.

PACKAGING

MODEL	BLISTER TAPE ON REEL ACC. IEC 60286-3			BULK CASE ACC. IEC 60286-6	
	DIAMETER	PIECES/REEL	CODE	PIECES/BULK CASE	CODE
MMU 0102	180 mm/7"	1000	B1	8000	M8
	180 mm/7"	3000	B3 = BL		
	330 mm/13"	10 000	B0		
MMA 0204	180 mm/7"	1000	B1	3000	M3
	180 mm/7"	3000	B3 = BL		
	330 mm/13"	10 000	B0		
MMB 0207	180 mm/7"	1000	B1	-	-
	180 mm/7"	2000	B2		
	330 mm/13"	7000	B7		

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

1) Color code marking is applied according to IEC 60062* in five bands. 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 approx, 50 % wider than the other bands. An interrupted band between the 4rd and 5th full band identifies the temperature coefficient.

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE				
DESCRIPTION		RESISTANCE VALUE1)		
TCR	TOLERANCE	MMU 0102	MMA 0204	MMB 0207
± 25 ppm/K	± 0.25 %	**47 Ω to 332 kΩ**	**22 Ω to 511 kΩ**	**15 Ω to 1 MΩ**
	± 0.1 %	**100 Ω to 221 kΩ**	**43 Ω to 511 kΩ**	**33 Ω to 1 MΩ**
± 15 ppm/K	± 0.5 %	22 Ω to 100 kΩ	10 Ω to 332 kΩ	-
	± 0.25 %	47 Ω to 100 kΩ	22 Ω to 332 kΩ	-
	± 0.1 %	**100 Ω to 100 kΩ**	**43 Ω to 332 kΩ**	**33 Ω to 1 MΩ**

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

1) Resistance values to be selected from E24 and E192 series, 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 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. A further conditioning is applied in order to stabilise the trimming result. 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. Five color 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 60 286-3*** 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 as shown in **IEC 61760-1***. 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 **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)
- 2002/95/EC Restriction of the use of Hazardous Substances Directive (RoHS)
- 2002/96/EC Waste Electrical and Electronic Equipment Directive (WEEE)

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 -> issues -> environment policy -> chemicals -> chemicals for electronics

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 **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.

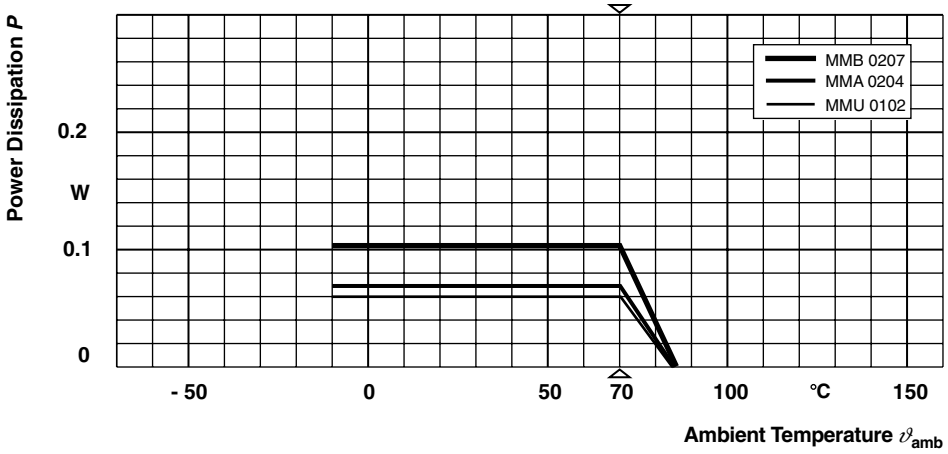
SPECIALS

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.

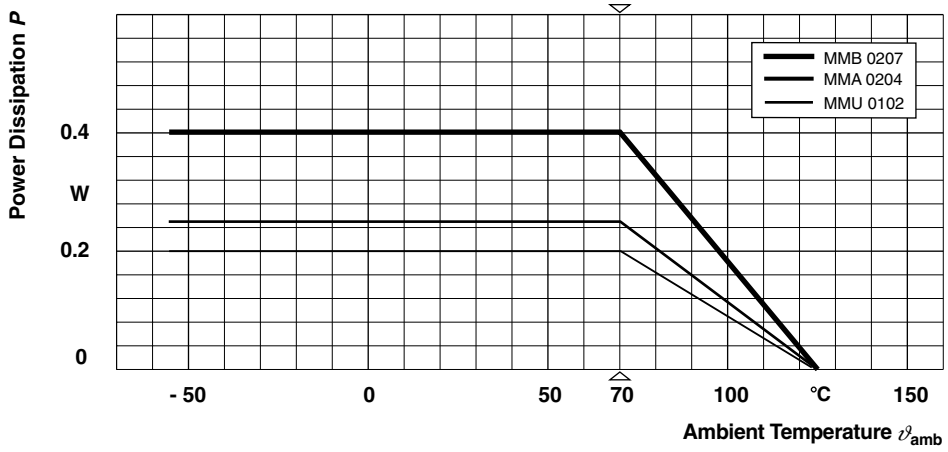
Note:

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

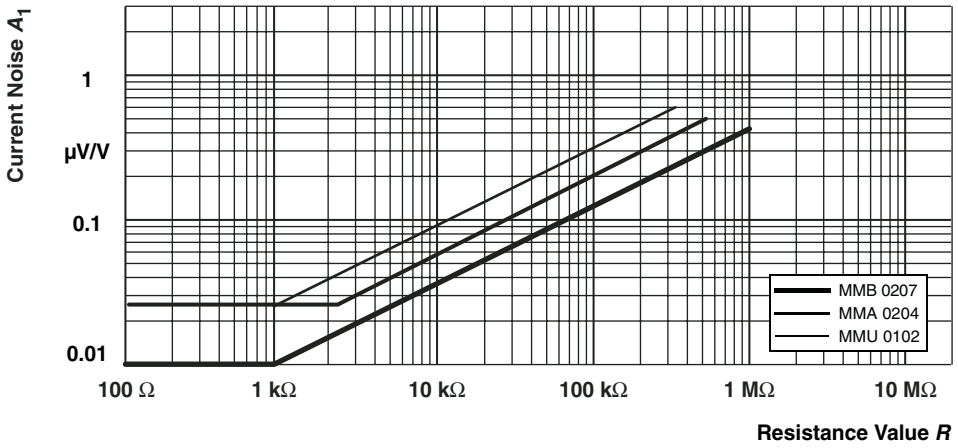
FUNCTIONAL PERFORMANCE



Derating - Precision Operation



Derating - Standard Operation



In accordance with IEC 60195

Current Noise - A_1

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 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 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 (ΔR)		
			stability for product types:	**STABILITY CLASS 0.05 OR BETTER**	**STABILITY CLASS 0.1 OR BETTER**	**STABILITY CLASS 0.25 OR BETTER**
			MMU 0102	100 Ω to 100 kΩ	43 Ω to 147 kΩ	22 Ω to 332 kΩ
			MMA 0204	100 Ω to 100 kΩ	43 Ω to 221 kΩ	10 Ω to 511 kΩ
			MMB 0207	100 Ω to 270 kΩ	43 Ω to 510 kΩ	15 Ω to 1 MΩ
4.5	-	resistance	-	± 0.5 % R; ± 0.25 % R; ± 0.1 % R		
4.8.4.2	-	temperature coefficient	at 20 / - 55 / 20 °C and 20 / 125 / 20 °C	± 25 ppm/K, ± 15 ppm/K		
4.25.1	-	endurance at 70 °C: precision operation mode	$U = \sqrt{P_{70} \times R}$ ≤ U_{max}; 1.5 h on; 0.5 h off; 70 °C; 1000 h	± (0.05 % R + 5 mΩ)		
			70 °C; 8000 h	± (0.1 % R + 5 mΩ)		
		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	± (0.1 % R + 5 mΩ)		
			70 °C; 8000 h	± (0.2 % R + 5 mΩ)		
4.25.3	-	endurance at upper category	85 °C; 1000 h	± (0.02 % R + 5 mΩ)	± (0.05 % R + 5 mΩ)	± (0.1 % R + 5 mΩ)
			125 °C; 1000 h	± (0.05 % R + 5 mΩ)	± (0.1 % R + 5 mΩ)	± (0.15 % R + 5 mΩ)
4.24	78 (Cab)	damp heat, steady state	(40 ± 2) °C; 56 days; (93 ± 3) % RH	± (0.05 % R + 5 mΩ)	± (0.1 % R + 5 mΩ)	
4.39	67 (Cy)	damp heat, steady state, accelerated	(85 ± 2) °C; (85 ± 5) % RH; $U = 0.1 \times \sqrt{P_{70} \times R}$ ≤ 100 V; 1000 h	± (0.15 % R + 5 mΩ)	± (0.25 % R + 5 mΩ)	

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2* TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)		
			stability for product types:	**STABILITY CLASS 0.05 OR BETTER**	**STABILITY CLASS 0.1 OR BETTER**	**STABILITY CLASS 0.25 OR BETTER**
			MMU 0102	100 Ω to 100 kΩ	43 Ω to 147 kΩ	22 Ω to 332 kΩ
			MMA 0204	100 Ω to 100 kΩ	43 Ω to 221 kΩ	10 Ω to 511 kΩ
			MMB 0207	100 Ω to 270 kΩ	43 Ω to 510 kΩ	15 Ω to 1 MΩ
4.23		climatic				
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			
4.23.7	-	d.c. load	$U = \sqrt{P_{70} \times R} \leq U_{max}$; 1 min.			
			LCT = - 10 °C; UCT = 85 °C	± (0.05 % R + 5 mΩ)	± (0.1 % R + 5 mΩ)	-
			LCT = - 55 °C; UCT = 125 °C	-	-	± (0.1 % R + 5 mΩ)
-	1 (Aa)	cold	- 55 °C; 2 h	± (0.02 % R + 5 mΩ)		
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT; 30 minutes at UCT; LCT = - 10 °C; UCT = 85 °C			
			5 cycles	± (0.01 % R + 5 mΩ)	± (0.02 % R + 5 mΩ)	-
			1000 cycles	± (0.1 % R + 5 mΩ)	± (0.1 % R + 5 mΩ)	-
			LCT = - 55 °C; UCT = 125 °C			
			5 cycles	-	-	± (0.025 % R + 5 mΩ)
			1000 cycles	-	-	± (0.2 % R + 5 mΩ)
4.13	-	short time overload; precision operation mode	$U = 2.5 \times \sqrt{P_{70} \times R}$ ≤ 2 × U_{max}; 5 s	± (0.01 % R + 5 mΩ)	± (0.02 % R + 5 mΩ)	± (0.03 % R + 5 mΩ)
		short time overload; standard operation mode		± (0.05 % 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)[1)]		
4.37	-	periodic electric overload; standard operation mode	$U = \sqrt{15 \times P_{70} \times R}$ ≤ 2 × U_{max}; 0.1 s on; 2.5 s off; 1000 cycles	± (0.5 % R + 5 mΩ)[1)]		
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	± (0.01 % R + 5 mΩ)	± (0.02 % R + 5 mΩ)	± (0.03 % R + 5 mΩ)

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2* TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)		
			stability for product types:	**STABILITY CLASS 0.05 OR BETTER**	**STABILITY CLASS 0.1 OR BETTER**	**STABILITY CLASS 0.25 OR BETTER**
			MMU 0102	100 Ω to 100 kΩ	43 Ω to 147 kΩ	22 Ω to 332 kΩ
			MMA 0204	100 Ω to 100 kΩ	43 Ω to 221 kΩ	10 Ω to 511 kΩ
			MMB 0207	100 Ω to 270 kΩ	43 Ω to 510 kΩ	15 Ω to 1 MΩ
4.40	-	electrostatic discharge (Human Body Model)	IEC 61340-3-1*; 3 pos. + 3 neg. discharges MMU 0102: 1.5 kV MMA 0204: 2 kV MMB 0207: 4 kV	± (0.5 % R + 50 mΩ)[1)]		
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	note 2		± (0.05 % R + 10 mΩ)
			reflow method 2 (IR/forced gas convection); (260 ± 5) °C; (10 ± 1) s	± (0.01 % R + 5 mΩ)	± (0.025 % R + 5 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		
				± (0.02 % R + 10 mΩ)[3)]		± (0.05 % R + 10 mΩ)[3)]
4.7	-	voltage proof	$U_{rms} = U_{ins}$; 60 s	no flashover or breakdown		
4.35	-	flammability	IEC 60 695-11-5*, needle flame test; 10 s	no burning after 30 s		

Notes

1. The pulse load stability of professional MELF resistors applies for precision resistors also. However, severe pulse loads are likely to jeopardize precision stability requirements.
2. Wave soldering is not recommended.
3. Special requirements apply to MICRO-MELF, MMU 0102:
   - R < 100 Ω: ± (0.15 % R + 10 mΩ)
   - 100 Ω ≤ R ≤ 10 kΩ: ± 0.1 % R
   - R > 10 kΩ: ± 0.05 % R

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

REVISION HISTORY

Compared to the prior revision of this datasheet, 26-Feb-04, the following changes have been applied:

- Introduction of a standardized part numbering system
- Additional emphasis on the clean balance of materials and on the compliance with various EU directives.
- Revision of the current noise diagram based on new test results
- Introduction of a test and requirements for electrostatic discharge (ESD)
- No other change of technical contents
- No product change

Disclaimer

All product specifications and data are subject to change without notice.

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