DATA SHEET

MMU 0102; MMA 0204; MMB 0207
Precision MELF resistors

Product specification
Supersedes data of 6th September 2000
File under BCcomponents, BC08

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BC COMPONENTS

Precision MELF resistors

MMU 0102; MMA 0204; MMB 0207

FEATURES

- Advanced thin film technology
- Lowest TC: 15 to 25 ppm/K
- Precision tolerance of value: ±0,1 and ±0,25%
- Superior overall stability: Class 0,05
- Wide precision range: 10 Ω to 1 MΩ
- Green product, supports lead-free soldering.

Metric sizes

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

APPLICATIONS

- Test and measuring equipment
- Industrial and medical electronics.

DESCRIPTION

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.

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 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 60 286-3**.

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.

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.

QUICK REFERENCE DATA

DESCRIPTION	MMU 0102		MMA 0204		MMB 0207	
Metric CECC size	RC 2211M		RC 3715M		RC 6123M	
Resistance range	100 Ω to 221 kΩ		10 Ω to 332 kΩ		15 Ω to 1 MΩ	
Resistance tolerance	±0,25%; ±0,1%; ±0,5%				±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, $\Delta R/R$ max., after:	10 Ω to 221 kΩ		10 Ω to 332 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%
225000 h	≤ 0,3%	≤ 0,6%	≤ 0,3%	≤ 0,6%	≤ 0,3%	≤ 0,6%
Specified lifetime	225 000 h		225 000 h		225 000 h	
Permissible voltage against ambient:						
1 minute, U_{ins}	200 V		300 V		500 V	
continuous	75 V		75 V		75 V	
Failure rate	≤ $2,0 \times 10^{-9}$/h		≤ $0,7 \times 10^{-9}$/h		≤ $0,7 \times 10^{-9}$/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.

Table 1 Temperature coefficient and resistance range

DESCRIPTION		RESISTANCE VALUE(1)		
T.C.	**TOLERANCE**	**MMU 0102**	**MMA 0204**	**MMB 0207**
±25 ppm/K	±0,25%	**100 Ω to 221 kΩ**	**22 Ω to 332 kΩ**	**15 Ω to 1 MΩ**
	±0,1%	**100 Ω to 100 kΩ**	**43 Ω to 332 kΩ**	**33 Ω to 1 MΩ**
±15 ppm/K	±0,5%	100 Ω to 100 kΩ	10 Ω to 221 kΩ	–
	±0,25%	100 Ω to 100 kΩ	22 Ω to 221 kΩ	–
	±0,1%	**100 Ω to 100 kΩ**	**43 Ω to 221 kΩ**	**33 Ω to 1 MΩ**

Note

1. Resistance values to be selected from E24 and E192 series, for other values please contact the factory.

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

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 2.
- 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 3.

Table 2 12NC ordering code indicating resistor type and packaging

DESCRIPTION			ORDERING CODE 2312						
			BLISTER TAPE ON REEL					BULK CASE	
TYPE	T.C.	TOL.	B1 1000 units	B2 2000 units	BL 3000 units	B7 7000 units	B0 10000 units	M3 3000 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....
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....	–
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 T.C. / tolerance combinations with optimized availability.

Table 3 Last digit of 12NC indicating resistance decade

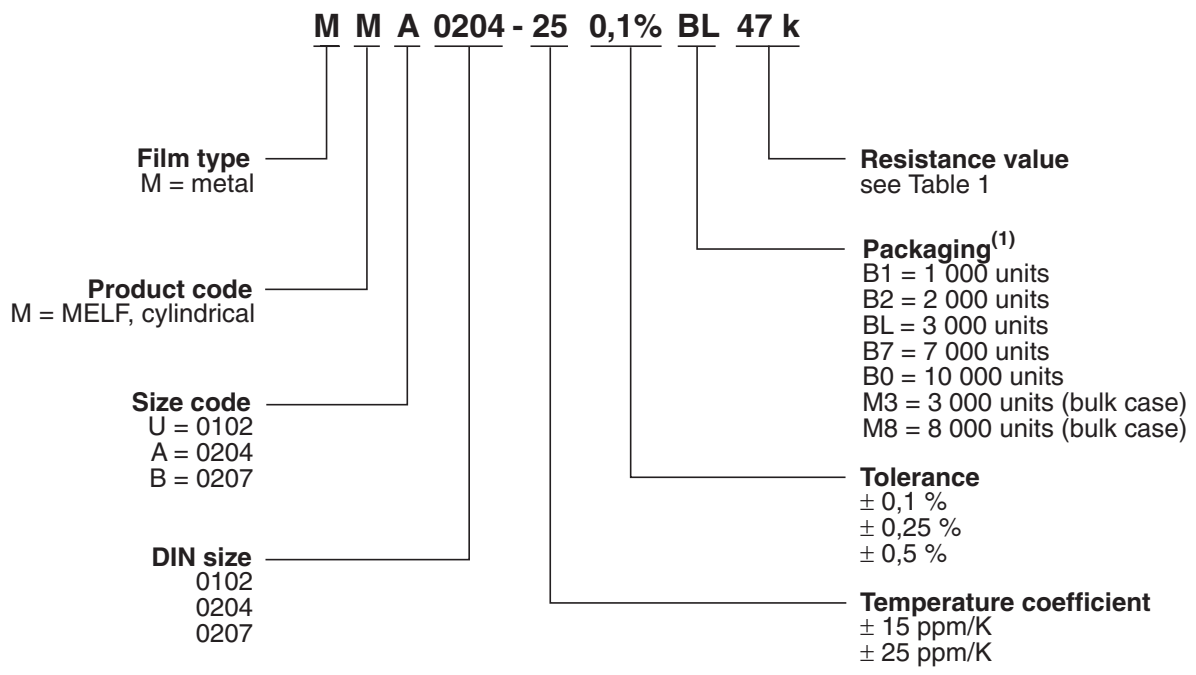
RESISTANCE DECADE	LAST DIGIT
10 Ω to 99,9 Ω	9
100 Ω to 999 Ω	1
1 kΩ to 9,99 kΩ	2
10 kΩ to 99,9 kΩ	3
100 kΩ to 999 kΩ	4
1 MΩ to 9,99 MΩ	5

ORDERING EXAMPLE

The ordering code 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.

Type description and ordering code

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



(1) Availability in accordance with Table 2.

FUNCTIONAL DESCRIPTION

Derating

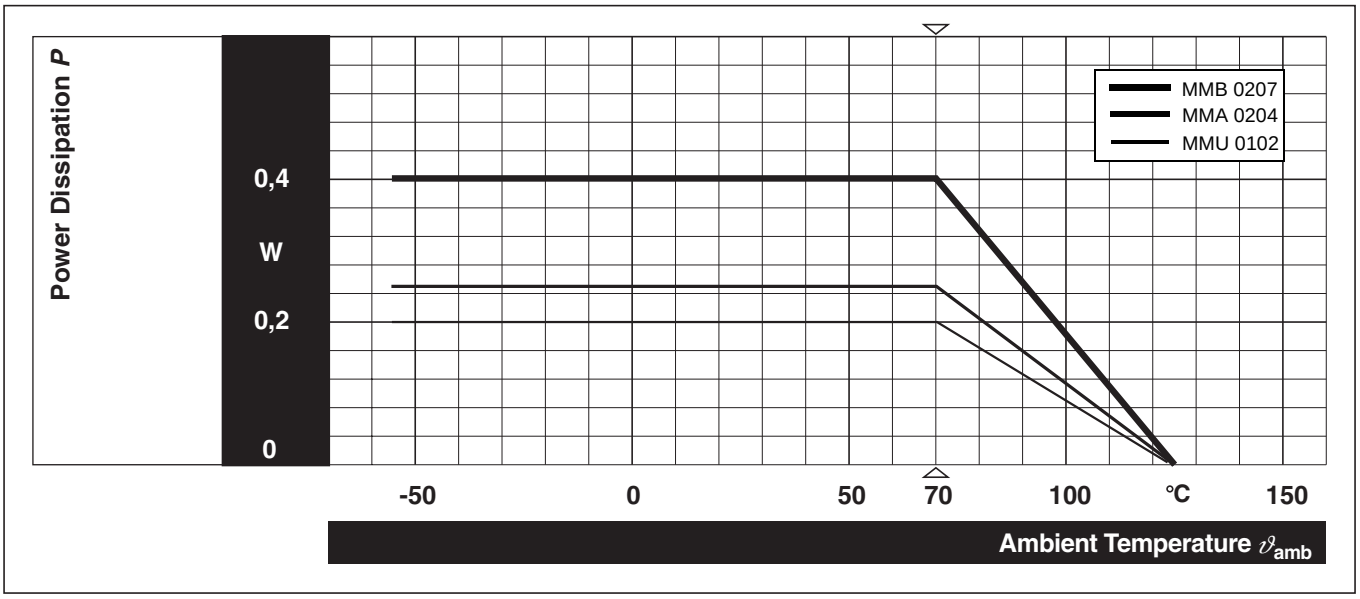


Fig.1 Derating, standard operation.

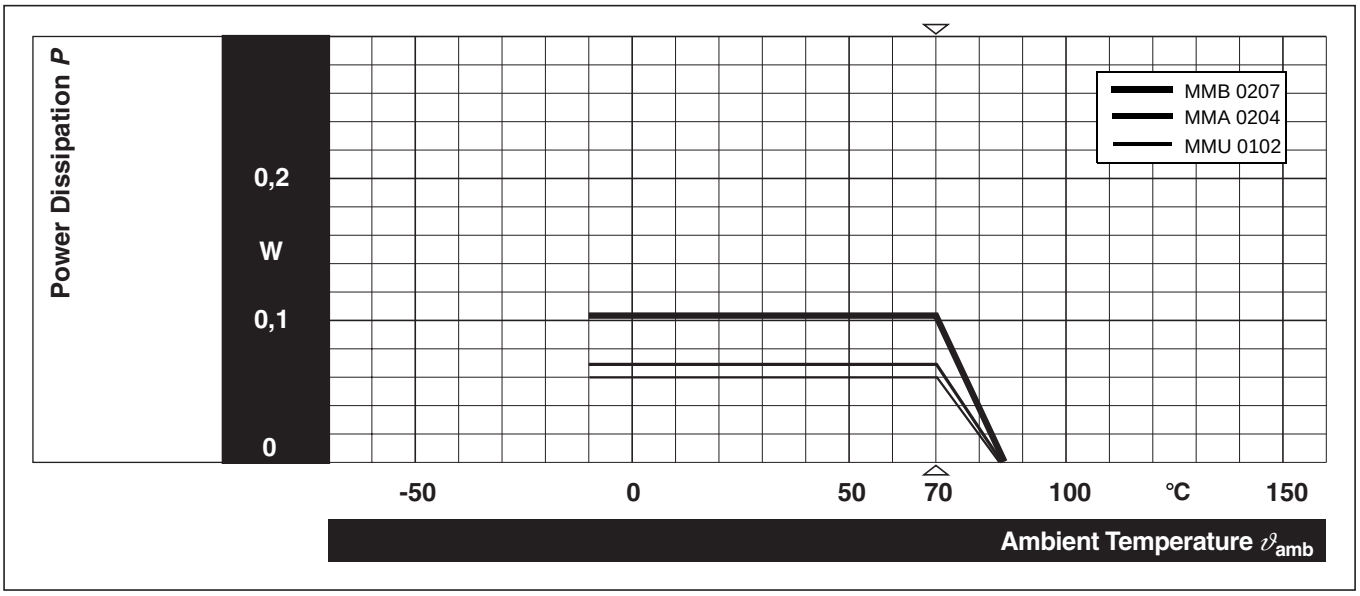


Fig.2 Derating, precision operation.

Current noise

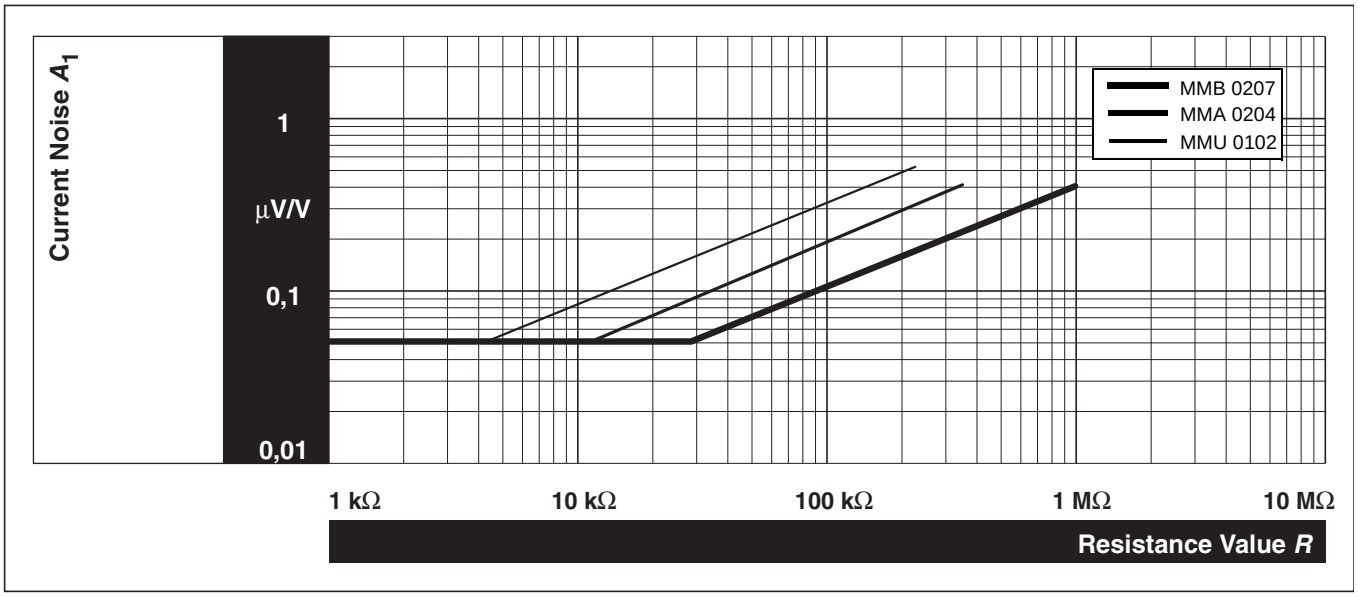
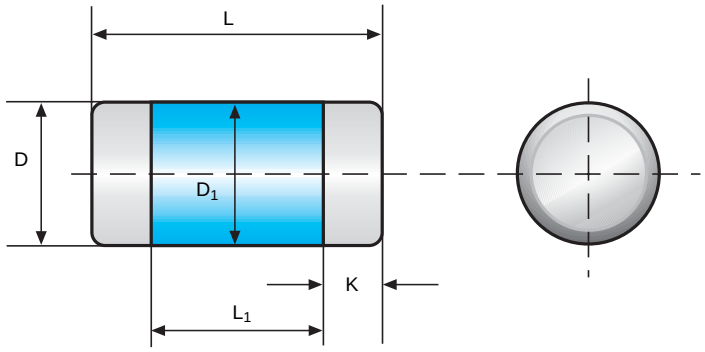


Fig.3 Current noise A_1 in accordance with IEC 60 195.

MECHANICAL DATA

Outlines



For dimensions see Table 4.

Fig.4 Outlines.

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

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

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 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 (ΔR/R)		
			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	10 Ω to 221 kΩ
			MMA 0204	100 Ω to 100 kΩ	43 Ω to 221 kΩ	10 Ω to 332 kΩ
			MMB 0207	100 Ω to 270 kΩ	43 Ω to 510 kΩ	15 Ω to 1 MΩ
4.5	–	resistance	–	±0,5%; ±0,25%; ±0,1%		
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)		

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			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	10 Ω to 221 kΩ
			MMA 0204	100 Ω to 100 kΩ	43 Ω to 221 kΩ	10 Ω to 332 kΩ
			MMB 0207	100 Ω to 270 kΩ	43 Ω to 510 kΩ	15 Ω to 1 MΩ
4.25.3	–	endurance at upper category temperature	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	3 (Ca)	damp heat, steady state	40 ±2 °C; 56 days; 93 +2/–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; $U = 0{,}1 \times \sqrt{P_{70} \times R} \leq 100$ V; 1000 h	±(0,15%R + 5 mΩ)	±(0,25%R + 5 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 = –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)		

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			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	10 Ω to 221 kΩ
			MMA 0204	100 Ω to 100 kΩ	43 Ω to 221 kΩ	10 Ω to 332 kΩ
			MMB 0207	100 Ω to 270 kΩ	43 Ω to 510 kΩ	15 Ω to 1 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 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 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)

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			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	10 Ω to 221 kΩ
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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		

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			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	10 Ω to 221 kΩ
			MMA 0204	100 Ω to 100 kΩ	43 Ω to 221 kΩ	10 Ω to 332 kΩ
			MMB 0207	100 Ω to 270 kΩ	43 Ω to 510 kΩ	15 Ω to 1 MΩ
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 60 695-2-2,* 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