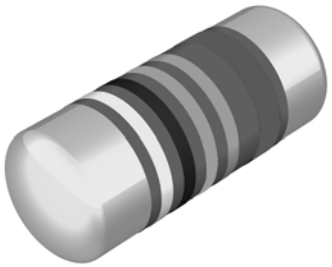
Professional High Temperature MELF Resistors



MMA 0204 professional high temperature MELF resistors are the perfect choice for most fields of modern professional electronics where high operating temperatures, power rating, reliability and stability is of major concern. These improved properties are enabled by a modified resistive film material. The typical applications in the fields of automotive and industrial equipment reflect the outstanding level of proven reliability.

FEATURES

- 175 °C specified operating temperature
- AEC-Q200 qualified
- Advanced thin film technology
- Excellent stability, < 0.1 %
- Matte Sn termination on Ni barrier layer
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

AUTOMOTIVE GRADE

Pb-free

RoHS COMPLIANT

HALOGEN FREE

GREEN (5-2008)

APPLICATIONS

- Automotive
- Industrial

TECHNICAL SPECIFICATIONS

DESCRIPTION	MMA 0204 HT
DIN size	0204
CECC size	RC 3715M
Resistance range	47 Ω to 100 kΩ; 0 Ω
Resistance tolerance	± 1 %; ± 0.5 %
Temperature coefficient	± 50 ppm/K; ± 25 ppm/K
Rated dissipation, P_{70} (1)	0.5 W
Operating voltage, $U_{max.}$ AC/DC	200 V
Permissible film temperature, $\vartheta_{F\,max.}$ (1)	175 °C
Operating temperature range (1)	-55 °C to 175 °C
Permissible voltage against ambient (insulation):	
1 min, U_{ins}	300 V
Continuous	75 V
Failure rate: $FIT_{observed}$	≤ 0.1 x 10^{-9}/h

Note

(1) Please refer to APPLICATION INFORMATION below.

APPLICATION INFORMATION

The power dissipation on the resistor generates a temperature rise against the local ambient, depending on the heat flow support of the printed-circuit board (thermal resistance). The rated dissipation applies only if the permitted film temperature is not exceeded.

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. At the maximum permissible film temperature of 175 °C the useful lifetime is specified for 1000 h. The designer may estimate the performance of the particular resistor application or set certain load and temperature limits in order to maintain a desired stability.

MAXIMUM RESISTANCE CHANGE AT RATED DISSIPATION

OPERATION MODE		STANDARD	POWER	HIGH TEMPERATURE
Rated dissipation, P_{70}	MMA 0204 HT	0.25 W	0.4 W	0.5 W
Operating temperature range		-55 °C to 125 °C	-55 °C to 155 °C	-55 °C to 175 °C
Permissible film temperature, ϑ_F max.		125 °C	155 °C	175 °C
Max. resistance change at P_{70} for resistance range, $\Delta R/R$ after:	MMA 0204 HT	47 Ω to 100 kΩ		
	1000 h	≤ 0.10 %	≤ 0.15 %	≤ 0.25 %
	8000 h	≤ 0.15 %	≤ 0.35 %	-
	225 000 h	≤ 1.0 %	-	-

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE

TYPE / SIZE	TCR	TOLERANCE	RESISTANCE	E-SERIES
MMA 0204 HT	± 50 ppm/K	± 1 %	**47 Ω to 100 kΩ**	E24; E96
		± 0.5 %	47 Ω to 100 kΩ	E24; E192
	± 25 ppm/K	± 1 %	47 Ω to 100 kΩ	E24; E96
		± 0.5 %	**47 Ω to 100 kΩ**	E24; E192
	Jumper	-	**≤ 10 mΩ, $I_{max.}$ = 3 A**	-

Note
- Resistance ranges printed in bold are preferred TCR / tolerance combinations.

PACKAGING

TYPE / SIZE	CODE	QUANTITY	CARRIER TAPE	WIDTH	PITCH	REEL DIAMETER
MMA 0204 HT	B3 = BL	3000	Antistatic blister tape acc. 60286-3 Type 2a	8 mm	4 mm	180 mm/7"
	B0	10 000				330 mm/13"

PART NUMBER AND PRODUCT DESCRIPTION

Part Number: MMA0204TD5620DB300
Part Number: MMA0204TZ0000ZB300

M	M	A	0	2	0	4	T	D	5	6	2	0	D	B	3	0	0
M	M	A	0	2	0	4	T	Z	0	0	0	0	Z	B	3	0	0

TYPE/SIZE	VERSION	TCR	RESISTANCE	TOLERANCE	PACKAGING
MMA0204	**T** = HT	**D** = ± 25 ppm/K **C** = ± 50 ppm/K **Z** = jumper	3 digit value 1 digit multiplier **Multiplier** **9** = $*10^{-1}$ **0** = $*10^{0}$ **1** = $*10^{1}$ **2** = $*10^{2}$ **3** = $*10^{3}$ **4** = $*10^{4}$ **5** = $*10^{5}$ **0000** = Jumper	**D** = ± 0.5 % **F** = ± 1 % **Z** = jumper	**B3** **B0**

Product Description: MMA 0204 - 25 0.5 % HT BL 562R
Product Description: MMA 0204 HT BL 0R0

MMA	0204	- 25	0.5 %	HT	BL	562R
MMA	0204	-	-	HT	BL	0R0
TYPE	SIZE	TCR	TOLERANCE	VERSION	PACKAGING	RESISTANCE
MMA	**0204**	± **25** ppm/K ± **50** ppm/K	± **0.5** % ± **1** %	**HT** = high temperature	**BL** **B0**	**562R** = 562 Ω **0R0** = jumper

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

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** (1).

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** (1) or bulk case in accordance with **IEC 60286-6** (2).

ASSEMBLY

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow or vapor phase as shown in **IEC 61760-1** (1). 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 **IEC 62474**, Material Declaration for Products of and for the Electrotechnical Industry.

The dedicated database (2), that list declarable substances, ensures 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)
- 2012/19/EU Waste Electrical and Electronic Equipment Directive (WEEE)

Solderability is specified for 2 years after production or requalification. The permitted storage time is 20 years.

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** (1) 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 Manufacture"** 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

A wider range of TCR, tolerance and resistance values, plus the option of values from a different E series is available with products approved to **EN 140401-803**, Version A, without established reliability, nominal failure rate level E0 (Quality factor $\pi_Q = 3$). See the datasheets:

- "Professional MELF Resistors" (www.vishay.com/doc?28713)
- "Precision MELF Resistors" (www.vishay.com/doc?28714)
- "High Precision MELF Resistor" (www.vishay.com/doc?28715)

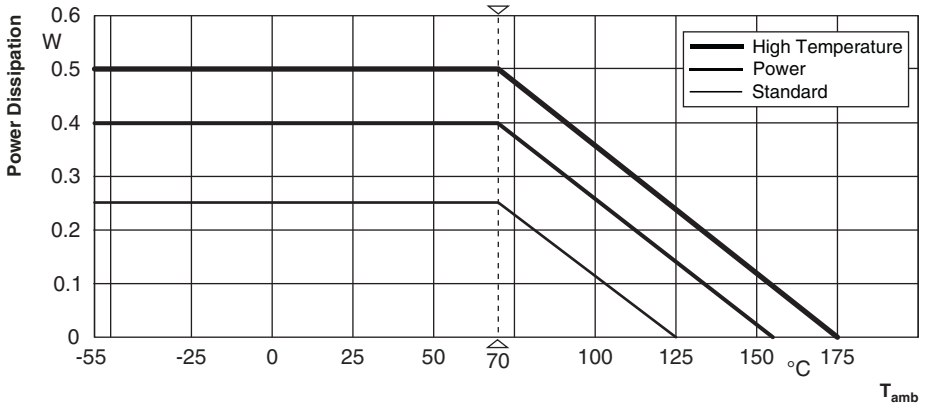
For products with superior pulse load capability, see the datasheets:

- "High Pulse Load Carbon Film MINI-MELF Resistor" (www.vishay.com/doc?28717)
- "High Pulse Load Carbon Film MELF Resistor" (www.vishay.com/doc?28755)

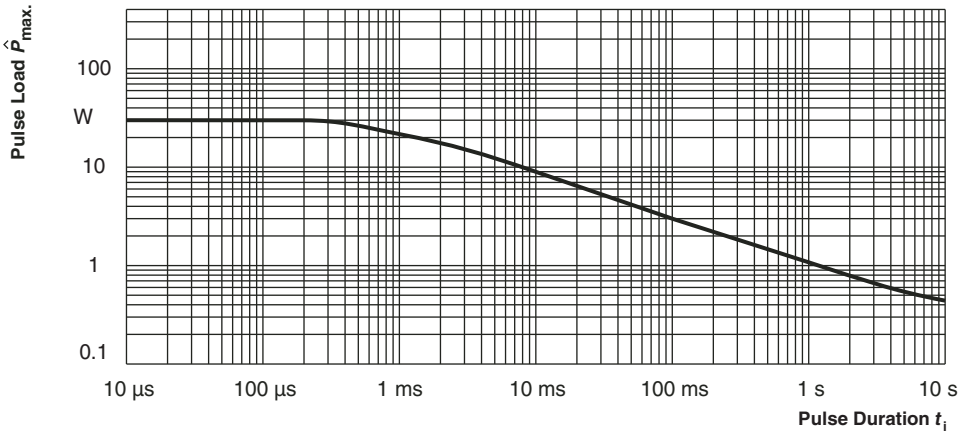
Notes

(1) The quoted IEC standards are also released as EN standards with the same number and identical contents.
(2) IEC 62474 database can be found at http://std.iec.ch/iec62474.

FUNCTIONAL PERFORMANCE

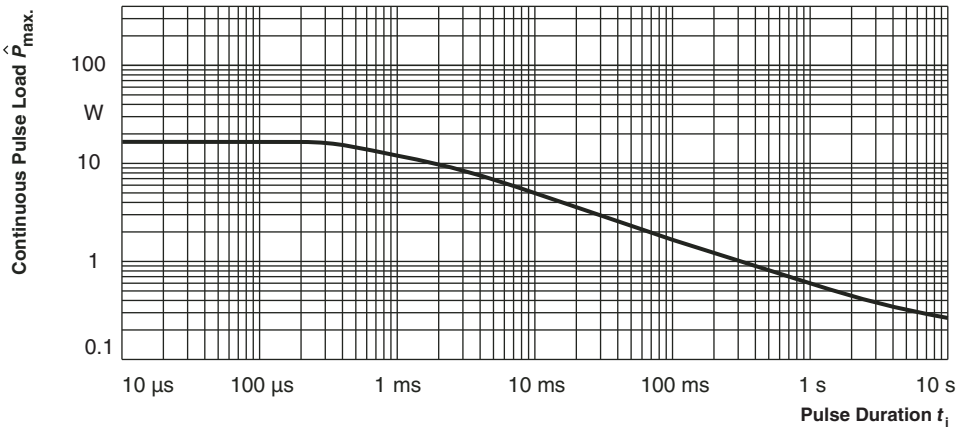


Derating for Operation Modes



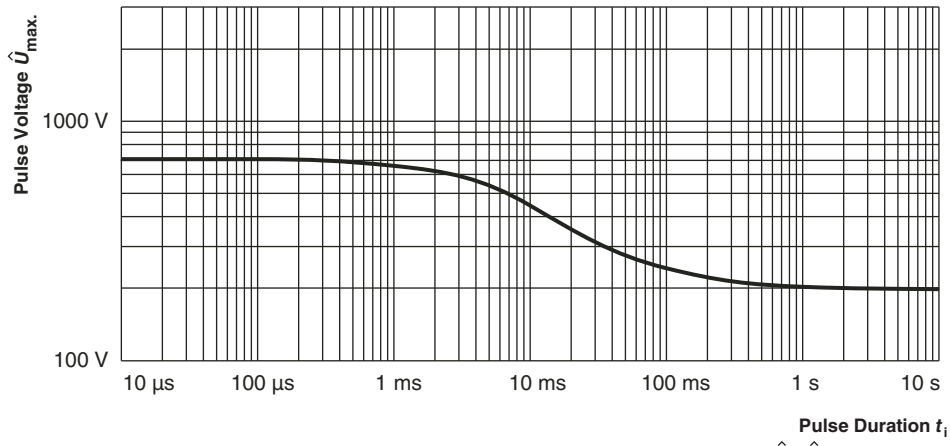
Maximum pulse load, single pulse; applicable if $\bar{P} \rightarrow 0$ and $n \leq 1000$ and $\hat{U} \leq \hat{U}_{max.}$;
for permissible resistance change equivalent to 8000 h operation

Single Pulse



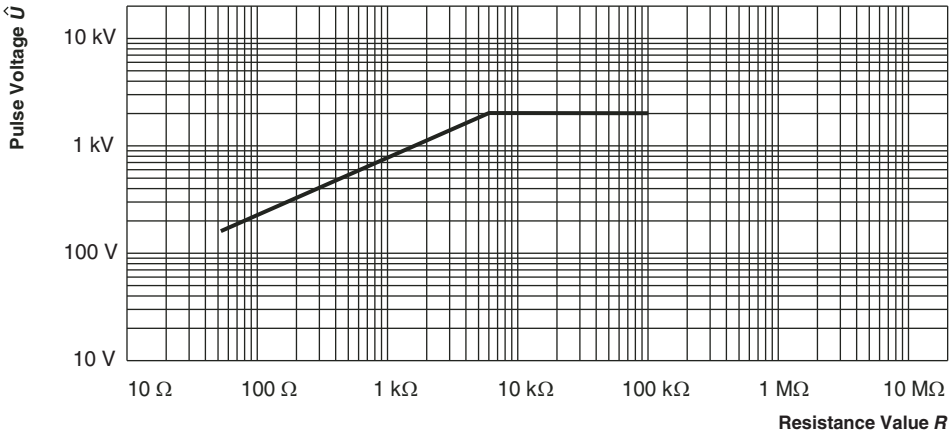
Maximum pulse load, continuous pulses; applicable if $\bar{P} \leq P\,(\vartheta_{amb})$ and $\hat{U} \leq \hat{U}_{max.}$;
for permissible resistance change equivalent to 8000 h operation

Continuous Pulse



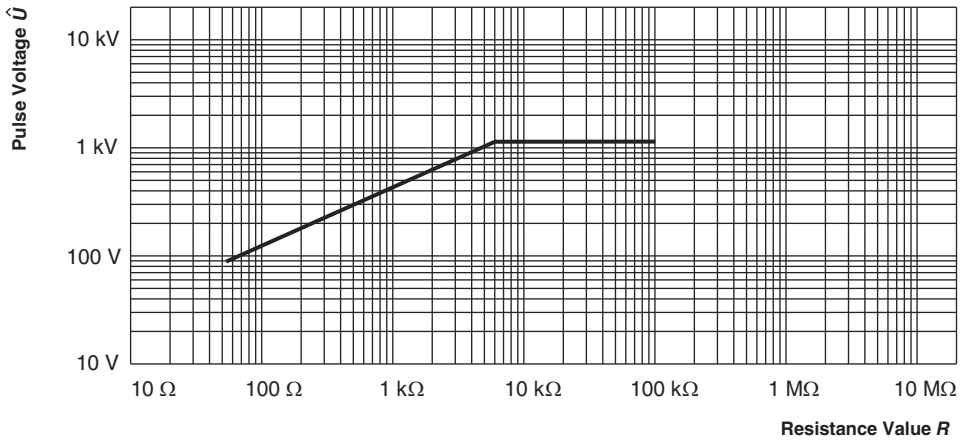
Pulse Voltage

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



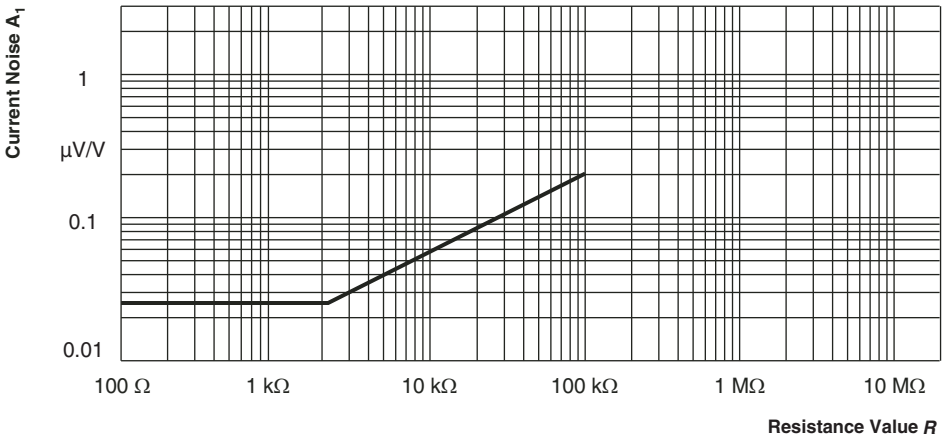
1.2/50 Pulse

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 %



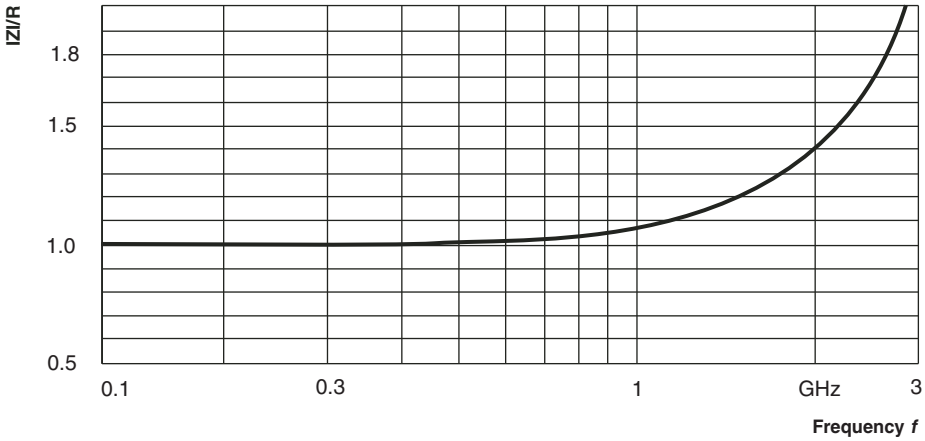
10/700 Pulse

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



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 resistors are approved within the IECQ-CECC Quality Assessment System for Electronic Components. 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 (2). 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

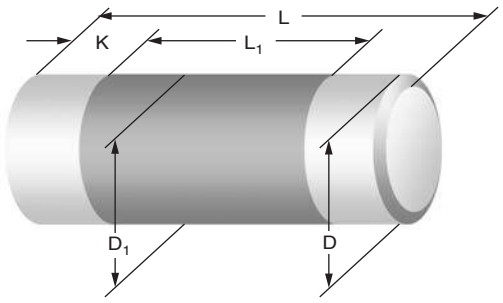
EN 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR) STABILITY CLASS 0.25 OR BETTER
			Stability for product types: MMA 0204 HT	47 Ω to 100 KΩ
4.5	-	Resistance	-	± 1 % R; ± 0.5 % R
4.8.4.2	-	Temperature coefficient	At (20/-55/20) °C and (20/155/20) °C	± 50 ppm/K; ± 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	± (0.10 % R + 10 mΩ)
			70°C; 8000 h	± (0.15 % 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	± (0.15 % R + 10 mΩ)
			70°C; 8000 h	± (0.35 % R + 10 mΩ)
		Endurance at 70 °C: High temperature 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)
4.25.3	-	Endurance at upper category temperature	125 °C; 1000 h	± (0.05 % R + 5 mΩ)
			155 °C; 1000 h	± (0.15 % R + 5 mΩ)
			175 °C; 1000 h	± (0.25 % R + 5 mΩ)
4.24	78 (Cab)	Damp heat, steady state (standard mode)	(40 ± 2)°C; 56 days; $U = 0.3 \times U_{rated}$; (93 ± 3) % RH	± (0.15 % R + 10 mΩ)
4.39	67 (Cy)	Damp heat, steady state, accelerated (standard mode)	(85 ± 2) °C; (85 ± 5) % RH; $U = 0.3 \times U_{rated}$; 1000 h	± (0.25 % R + 10 mΩ)
4.23		Climatic sequence:		± (0.15 % R + 10 mΩ)
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	
4.23.6	30 (Db)	Damp heat, cyclic	55 °C; 24 h; ≥ 90 % RH; 5 cycles	
4.23.7	-	DC load (High temperature mode)	$U = \sqrt{P_{70} \times R} \leq U_{max.}$; 1 min LCT = - 55 °C; UCT = 155 °C	
-	1 (Ab)	Cold	-55 °C; 2 h	± (0.05 % R + 5mΩ)
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)
			1000 cycles	±(0.15 % R + 10 mΩ)
			LCT = -55 °C; UCT = 155 °C 1000 cycles	±(0.25 % R + 10 mΩ)
4.13	-	Short time overload: Standard operation mode	$U = 2.5 \times \sqrt{P_{70} \times R} \leq 2 \times U_{max.}$; 5 s	±(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 CLASS 0.25 OR BETTER
			Stability for product types: MMA 0204 HT	47 Ω to 100 KΩ
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)
-	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)
4.22	6 (Fc)	Vibration	Endurance by sweeping; 10 Hz to 2000 Hz; no resonance; amplitude ≤ 1.5 mm or ≤ 200 m/s^2; 7.5 h	± (0.05 % R + 5 mΩ)
4.40	-	Electrostatic discharge (Human Body Model)	IEC 61340-3-1*; 3 pos. + 3 neg. discharges MMA 0204: 2 kV	± (0.5 % R + 50 mΩ)
4.17.2	58 (Td)	Solderability	Solder bath method; SnPb40; non-activated flux; (215 ± 3) °C; (2 ± 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 ± 0.3) 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)
			Reflow method 2 (IR/forced gas convection); (260 ± 5) °C; (40 ± 1) s (3 times)	±(0.03 % 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	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)
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

Note

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

DIMENSIONS

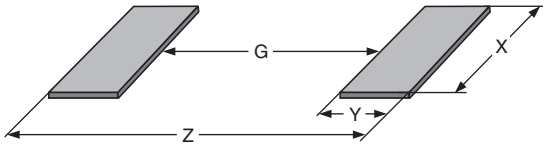


DIMENSIONS AND MASS						
TYPE	L (mm)	D (mm)	$L_{1\ min.}$ (mm)	D_1 (mm)	K (mm)	MASS (mg)
MMA 0204 HT	3.6 + 0/- 0.2	1.4 + 0/- 0.1	1.8	D + 0/-0.15	0.8 ± 0.1	22

Note

- Color code marking is applied according to IEC 60062 (1) in four bands (E24 series) or five 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)
MMA 0204 HT	1.5	1.5	1.8	4.5	1.7	1.2	1.6	4.1

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.

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