Thin Film MELF Resistors

FEATURES

- IECQ-CECC approved according to EN 140401-803
- AEC-Q200 qualified
- Superior stability: class 0.05
- Best in class pulse load capability up to 1500 W for 1 µs
- Intrinsic sulfur resistance
- Products are PFAS free
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

AUTOMOTIVE GRADE

Pb-free

RoHS COMPLIANT

HALOGEN FREE

GREEN (5-2008)

LINKS TO ADDITIONAL RESOURCES

Product Page | 3D Models | Order Samples

MMU 0102, MMA 0204 and MMB 0207 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.

APPLICATIONS

- Automotive
- Telecommunication
- Industrial
- Medical equipment

TECHNICAL SPECIFICATIONS

DESCRIPTION	MMU 0102	MMA 0204	MMB 0207
DIN size	0102	0204	0207
Metric size code	RC2211M	RC3715M	RC6123M
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 %; ± 0.25 %; ± 0.1 %		
Temperature coefficient	± 100 ppm/K; ± 50 ppm/K; ± 25 ppm/K; ± 15 ppm/K		
Rated dissipation, P_{70} (1)	0.3 W	0.4 W	1.0 W
Operating voltage, $U_{max.}$ AC_{RMS}/DC	150 V	200 V	350 V
Permissible film temperature, ϑ_F max. (1)	155 °C		
Operating temperature range (1)	-55 °C to 155 °C		
Internal thermal resistance (1)	-	46 K/W	26 K/W
Permissible voltage against ambient (insulation): 1 min, U_{ins}	200 V	300 V	500 V
Failure rate: $FIT_{observed}$	≤ 0.05 x 10^{-9}/h		

Note

(1) Please refer to APPLICATION INFORMATION below

APPLICATION INFORMATION

When the resistor dissipates power, a temperature rise above the ambient temperature occurs, dependent on the thermal resistance of the assembled resistor together with the printed circuit board. 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.

MAXIMUM RESISTANCE CHANGE AT RATED POWER				
OPERATION MODE		**PRECISION MODE (1)**	**GENERAL MODE**	**POWER MODE**
Rated power dissipation, P_{70}	**MMU 0102**	0.06 W	0.2 W	0.3 W
	MMA 0204	0.07 W	0.25 W	0.4 W
	MMB 0207	0.11 W	0.4 W	1.0 W
Operating temperature range		-10 °C to 85 °C	-55 °C to 125 °C	-55 °C to 155 °C
Permissible film temperature, ϑ_F max.		85 °C	125 °C	155 °C
Max. resistance change at P_{70} for resistance range, $\lvert\Delta R/R\rvert$ after:	**MMU 0102**	22 Ω to 332 kΩ	0.22 Ω to 2.21 MΩ	0.22 Ω to 2.21 MΩ
	MMA 0204	10 Ω to 1 MΩ	0.22 Ω to 10 MΩ	0.22 Ω to 10 MΩ
	MMB 0207	15 Ω to 1 MΩ	0.1 Ω to 15 MΩ	0.1 Ω to 15 MΩ
	1000 h	≤ 0.05 %	≤ 0.1 %	≤ 0.2 %
	8000 h	≤ 0.1 %	≤ 0.2 %	≤ 0.4 %
	225 000 h	≤ 0.3 %	≤ 0.6 %	≤ 1.2 %

Notes

- The presented operation modes do not refer to different types of resistors, but actually show examples of different loads, that lead to different film temperatures and different achievable load-life stability (drift) of the resistance value. A suitable low thermal resistance of the circuit board assembly must be safeguarded in order to maintain the film temperature of the resistors within the specified limits. Please consider the application note "Thermal Management in Surface-Mounted Resistor Applications" (www.vishay.com/doc?28844) for information on the general nature of thermal resistance

(1) Precision operation modes are only tested for 25 ppm/K in combination with 0.25 % and 0.1 % tolerance, as well as for 15 ppm/K in combination with 0.5 %, 0.25 % and 0.1 % tolerance, in line with the previous MELF precision thin film datasheet 28714

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE (1)				
TYPE/SIZE	**TCR**	**TOLERANCE**	**RESISTANCE**	**E-SERIES**
MMU 0102	± 50 ppm/K	± 5 %	0.22 Ω to 0.91 Ω	E24
		± 2 %	1 Ω to 9.1 Ω	
		± 1 %	10 Ω to 2.21 MΩ	E24, E96
		± 0.5 %	10 Ω to 221 kΩ	E24, E192
	± 25 ppm/K	± 1 %		E24, E96
		± 0.5 %		E24, E192
		± 0.25 %	47 Ω to 332 kΩ	
		± 0.1 %	100 Ω to 221 kΩ	
	± 15 ppm/K	± 0.5 %	22 Ω to 100 kΩ	
		± 0.25 %	47 Ω to 100 kΩ	
		± 0.1 %	100 Ω to 100 kΩ	
	Jumper; $I_{max.}$ = 2 A	≤ 10 mΩ	0 Ω	-
MMA 0204	± 50 ppm/K	± 5 %	0.22 Ω to 0.91 Ω	E24
		± 1 %		
		± 1 %	1 Ω to 10 MΩ	E24, E96
		± 0.5 %	10 Ω to 2.21 MΩ	E24, E192
	± 25 ppm/K	± 1 %	10 Ω to 511 kΩ	E24, E96
		± 0.5 %		E24, E192
		± 0.25 %	10 Ω to 5.11 MΩ	
		± 0.1 %		
	± 15 ppm/K	± 0.5 %	10 Ω to 1 MΩ	
		± 0.25 %	20 Ω to 1 MΩ	
		± 0.1 %		
	Jumper; $I_{max.}$ = 3 A	≤ 10 mΩ	0 Ω	-

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE (1)				
TYPE/SIZE	**TCR**	**TOLERANCE**	**RESISTANCE**	**E-SERIES**
UMA 0204 (2)	± 15 ppm/K	± 0.05 %	47 Ω to 332 kΩ	E24, E192
	± 10 ppm/K	± 0.25 %	10 Ω to 332 kΩ	
		± 0.1 %	43 Ω to 332 kΩ	
		± 0.05 %	75 Ω to 221 kΩ	
	± 5 ppm/K	± 0.25 %	33 Ω to 221 kΩ	
		± 0.1 %	56 Ω to 221 kΩ	
		± 0.05 %	75 Ω to 150 kΩ	
		± 0.02 %	75 Ω to 100 kΩ	
MMB 0207	± 100 ppm/K	± 5 %	0.1 Ω to 0.2 Ω	E24
		± 2 %		
	± 50 ppm/K	± 5 %	0.22 Ω to 0.91 Ω	
		± 2 %		
		± 1 %		
		± 1 %	1 Ω to 15 MΩ	E24, E96
	± 25 ppm/K	± 0.5 %	10 Ω to 1 MΩ	E24, E192
		± 0.25 %	15 Ω to 10 MΩ	
		± 0.1 %	20 Ω to 10 MΩ	
	± 15 ppm/K	± 0.1 %	20 Ω to 1 MΩ	
	Jumper; $I_{max.}$ = 5 A	≤ 10 mΩ	0 Ω	-
UMB 0207 (2)	± 15 ppm/K	± 0.05 %	100 Ω to 390 kΩ	E24, E192
	± 10 ppm/K	± 0.25 %	100 Ω to 390 kΩ	
		± 0.1 %	100 Ω to 390 kΩ	
		± 0.05 %	100 Ω to 390 kΩ	
	± 5 ppm/K	± 0.25 %	270 Ω to 390 kΩ	
		± 0.1 %	270 Ω to 390 kΩ	
		± 0.05 %	270 Ω to 390 kΩ	
		± 0.02 %	270 Ω to 390 kΩ	

Notes

(1) For the approved IECQ-CECC resistance range, please refer to www.vishay.com/doc?28945

(2) For more information on UMA 0204 or UMB 0207 MELF, please refer to www.vishay.com/doc?28715

PACKAGING						
TYPE / SIZE	**CODE**	**QUANTITY**	**PACKAGING STYLE**	**WIDTH**	**PITCH**	**PACKAGING DIMENSIONS**
MMU 0102	B3 = BL	3000	Antistatic blister tape acc. IEC 60286-3, Type 2a	8 mm	4 mm	Ø 180 mm / 7"
	B0	10 000				Ø 330 mm / 13"
MMA 0204	B3 = BL	3000				Ø 180 mm / 7"
	B0	10 000				Ø 330 mm / 13"
MMB 0207	B2	2000		12 mm		Ø 180 mm / 7"
	B7	7000				Ø 330 mm / 13"

PART NUMBER AND PRODUCT DESCRIPTION

Part Number: MMA02040D5620BB300
Part Number: MMA02040Z0000ZB300

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

TYPE / SIZE	VERSION	TCR	RESISTANCE	TOLERANCE	PACKAGING
MMU0102 **MMA0204** **MMB0207**	**0** = EN 140401-803, “Version A”	**E** = ± 15 ppm/K **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	**B** = ± 0.1 % **C** = ± 0.25 % **D** = ± 0.5 % **F** = ± 1 % **G** = ± 2 % **J** = ± 5 % **Z** = jumper	**B0** **B2** **B3** **B7**

Product Description: MMA 0204-25 0.1 % BL 562R
Product Description: MMA 0204 BL 0R0

MMA	0204	-25	0.1 %	BL	562R
TYPE	SIZE	TCR	TOLERANCE	PACKAGING	RESISTANCE
MMU **MMA** **MMB**	**0102** **0204** **0207**	± **15** ppm/K ± **25** ppm/K ± **50** ppm/K ± **100** ppm/K	± **0.1** % ± **0.25** % ± **0.5** % ± **1** % ± **2** % ± **5** %	**B0** **B2** **BL** **B7**	**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 matte tin on nickel plating. Four (E24 series) or five (E96 and E192 series) 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 full screening for the elimination of products with a potential risk of early life failures (feasible for $R \geq 10\ \Omega$) 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 2a** [(1)].

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)]. 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, potting compounds and their processes, if applied, shall be qualified by appropriate means to ensure the long term stability of the whole system.

The resistors are completely lead (Pb)-free, the pure matte tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes. 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 immunity of the plating against tin whisker growth has been proven under extensive testing.

MATERIALS

Vishay acknowledges the following systems for the regulation of hazardous substances:

- **IEC 62474**, Material Declaration for Products of and for the Electrotechnical Industry, with the list of declarable substances given therein [(2)]
- The Global Automotive Declarable Substance List (**GADSL**) [(3)]
- The **REACH** regulation (1907/2006/EC) and the related list of substances with very high concern (SVHC) [(4)] for its supply chain

The products do not contain any of the banned substances as per **IEC 62474**, GADSL, or the SVHC list, see www.vishay.com/how/leadfree.

Hence the products fully comply with the following directives:

- 2000/53/EC End-of-Life Vehicle Directive (ELV) and Annex II (ELV II)
- 2011/65/EU Restriction of the Use of Hazardous Substances Directive (RoHS) with amendment 2015/863/EU
- 2012/19/EU Waste Electrical and Electronic Equipment Directive (WEEE)

Vishay pursues the elimination of conflict minerals from its supply chain, see the Conflict Minerals Policy at www.vishay.com/doc?49037.

APPROVALS

Where applicable, 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 60115-8** 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 Manufacturer**" in accordance with **IECQ 03-1**. The release certificate for "**Technology Approval Schedule**" in accordance with **CECC 240001** based on **IECQ 03-3-1** is granted for the Vishay Beyschlag manufacturing process. The resistors are qualified according to **AEC-Q200**.

RELATED PRODUCTS

For thin film products with higher voltage support, see the datasheets:

- "Precision Automotive High Voltage Thin Film MELF Resistors" (www.vishay.com/doc?28951)
- "Professional High Voltage Thin Film MELF Resistors" (www.vishay.com/doc?28880)

For products with tighter precision specification, see the datasheet

- "Ultra Precision MELF Resistors" (www.vishay.com/doc?28715)

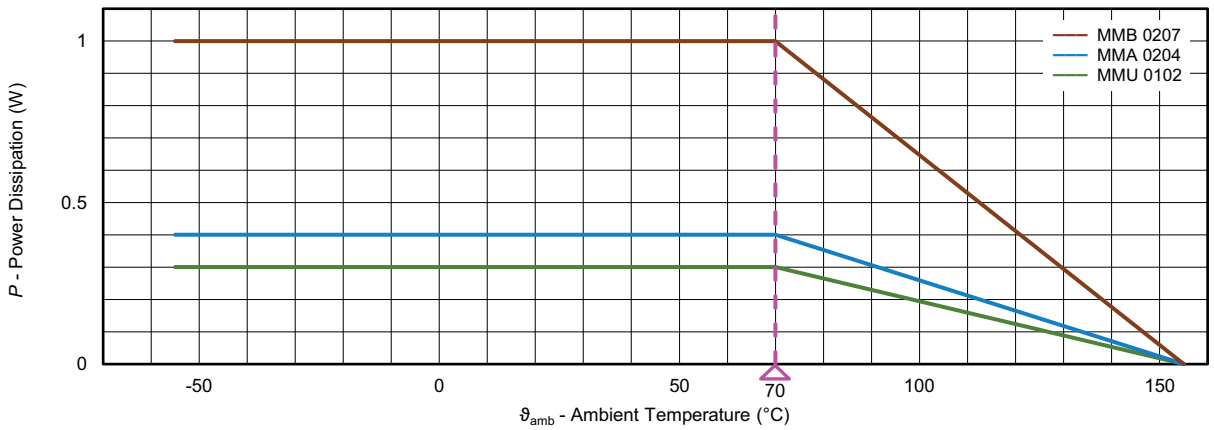
Resistors are available with established reliability in accordance with **EN 140 401-803 Version E** or ESA approved according to **ESCC 4001/0**.

- "MELF Resistors with Established Reliability" (www.vishay.com/doc?28707)
- "Lead (Pb)-Bearing Thin Film MINI-MELF Resistors With Established Reliability" (www.vishay.com/doc?28787)
- "Hi-Rel Thin Film MINI-MELF Resistors" (www.vishay.com/doc?28790)

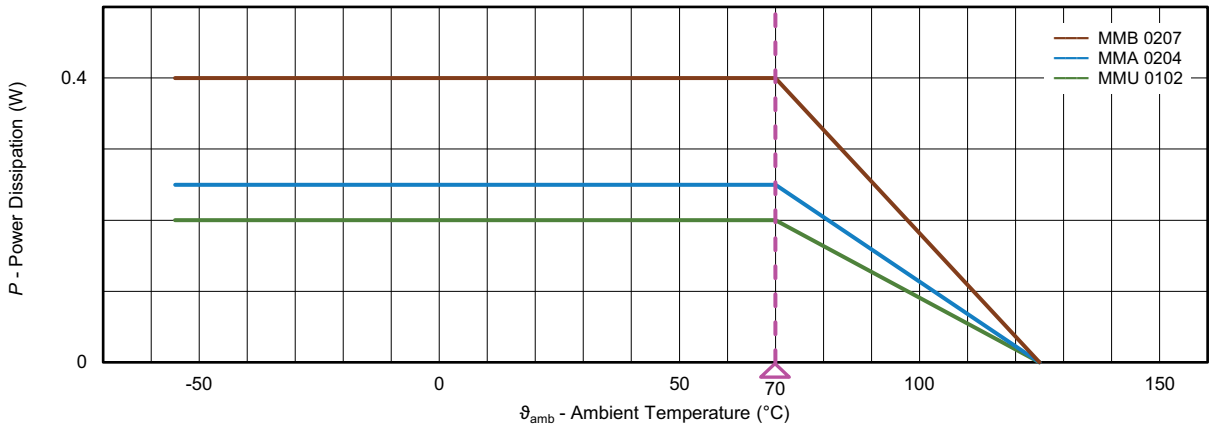
Notes

(1) The quoted IEC standards are also released as EN standards with the same number and identical contents
(2) The IEC 62474 list of declarable substances is maintained in a dedicated database, which is available at http://std.iec.ch/iec62474
(3) The Global Automotive Declarable Substance List (GADSL) is maintained by the American Chemistry Council and available at www.gadsl.org
(4) The SVHC list is maintained by the European Chemical Agency (ECHA) and available at http://echa.europa.eu/candidate-list-table

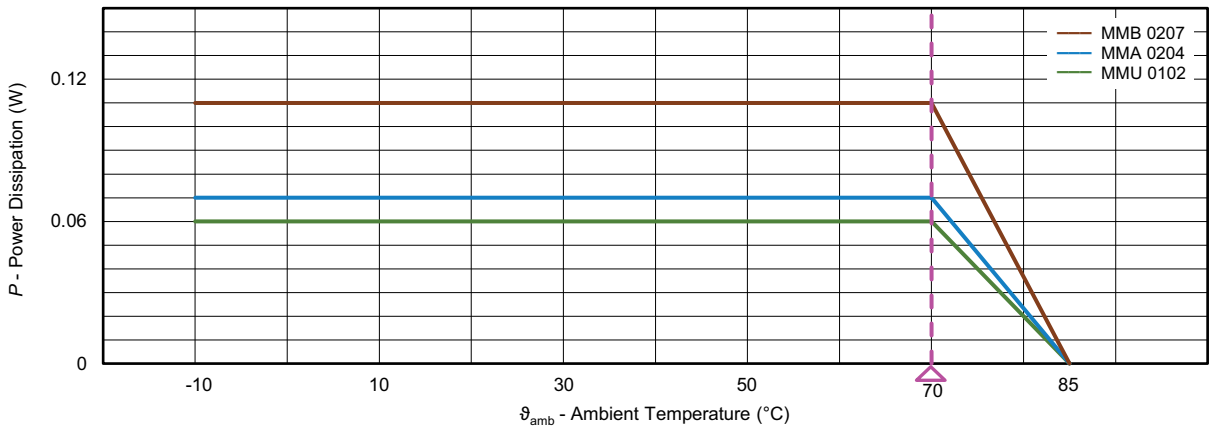
FUNCTIONAL PERFORMANCE



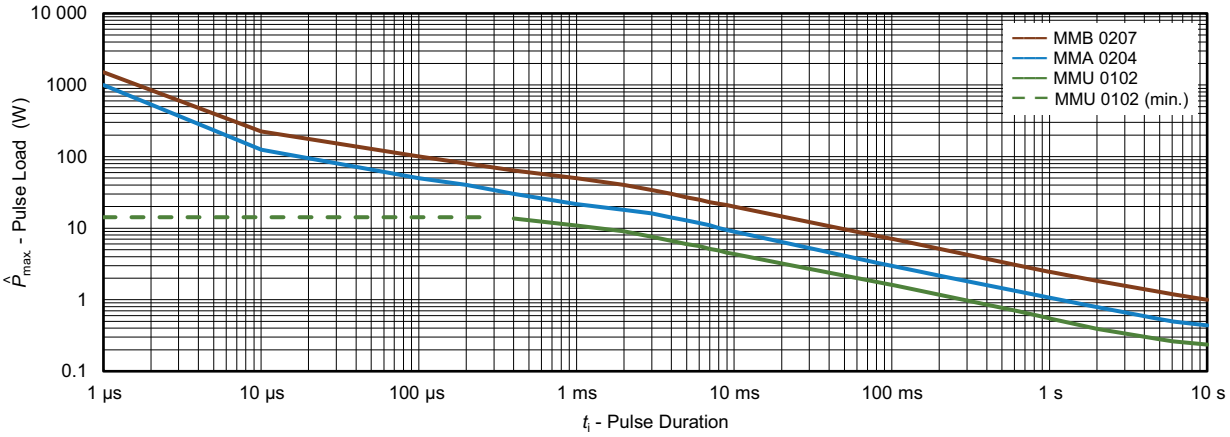
Derating - Power Operation Mode



Derating - General Operation Mode

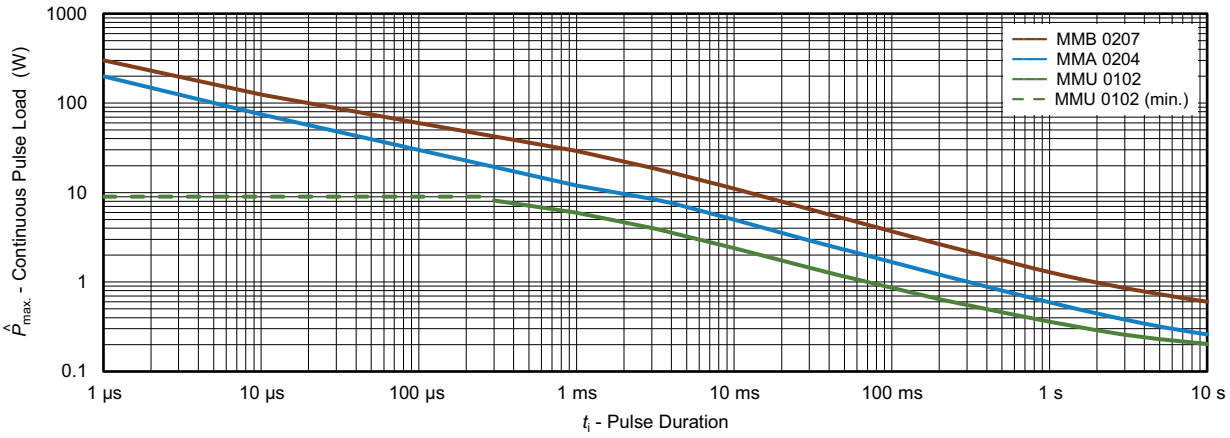


Derating - Precision Operation Mode



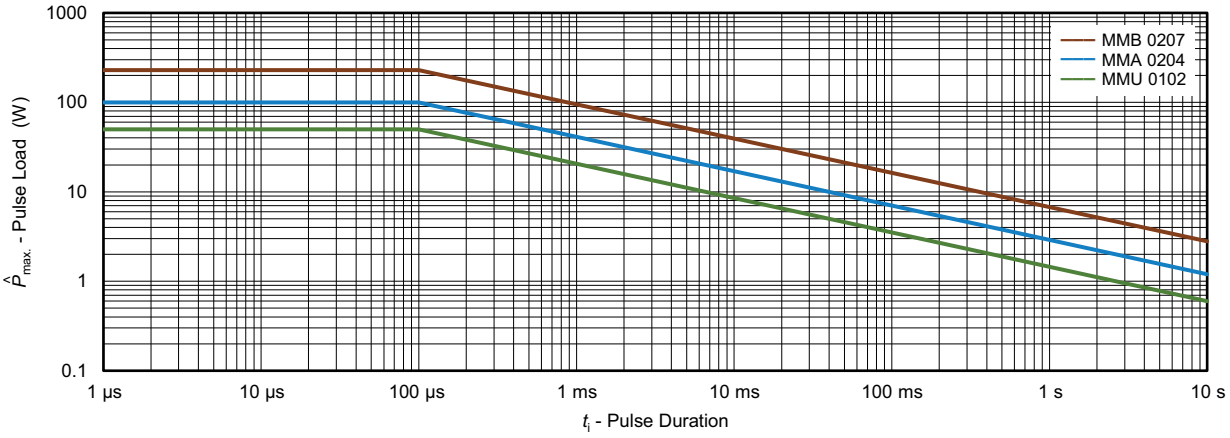
Maximum pulse load, single pulse; applicable if $\overline{P} \rightarrow 0$ and n ≤ 1000 and $\hat{U} \leq \hat{U}_{max.}$;
for permissible resistance change ± (0.5 % R + 0.01 Ω)

Single Pulse for R < 10 Ω



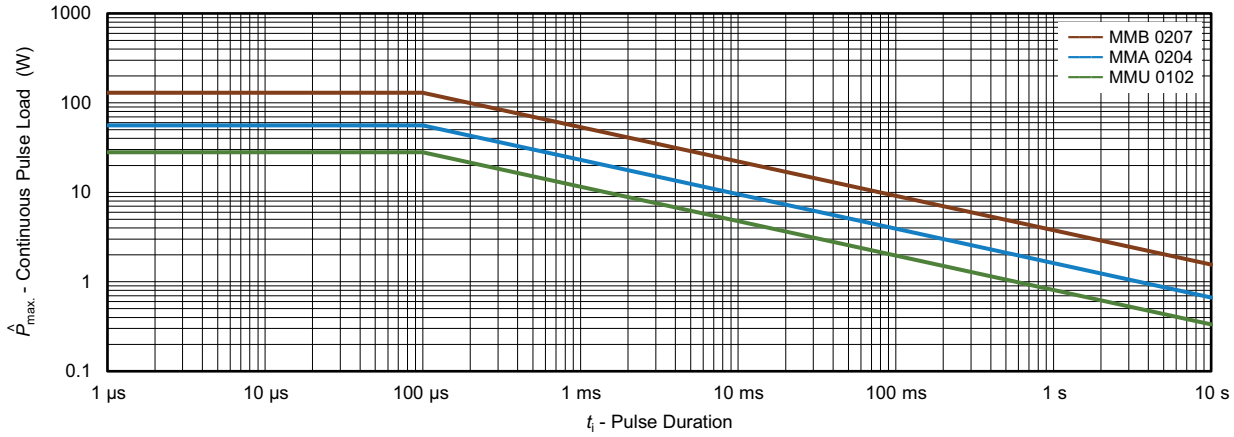
Maximum pulse load, continuous pulse; applicable if $\overline{P} \leq P\ (\vartheta_{amb})$ and $\hat{U} \leq \hat{U}_{max.}$;
for permissible resistance change ± (0.5 % R + 0.01 Ω)

Continuous Pulse for R < 10 Ω



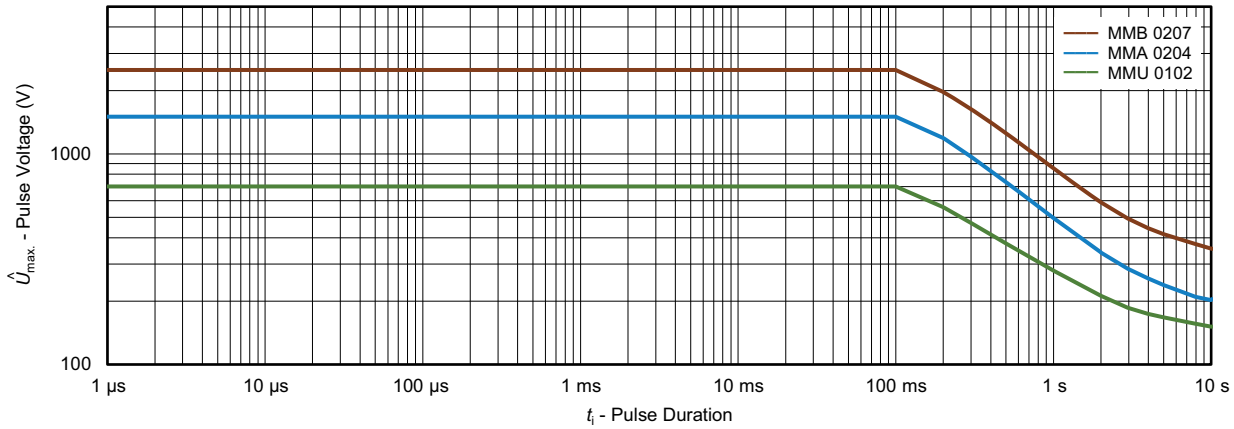
Maximum pulse load, single pulse; applicable if $\overline{P} \rightarrow 0$ and n ≤ 1000 and $\hat{U} \leq \hat{U}_{max.}$;
for permissible resistance change ± (0.5 % R + 0.01 Ω)

Single Pulse for R ≥ 10 Ω



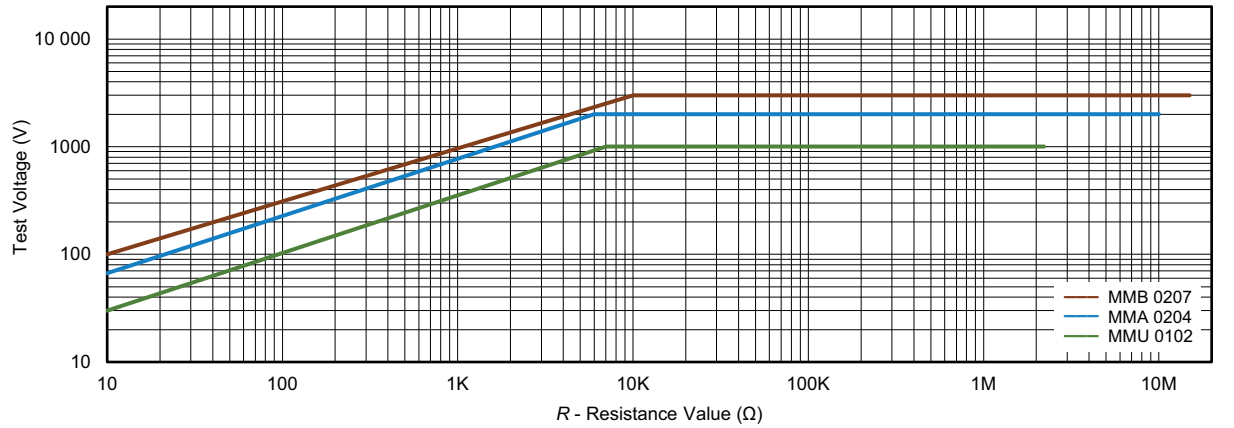
Maximum pulse load, continuous pulse; applicable if $\overline{P} \leq P\,(\vartheta_{amb})$ and $\hat{U} \leq \hat{U}_{max.}$;
for permissible resistance change ± (0.5 % R + 0.01 Ω)

Continuous Pulse for R ≥ 10 Ω



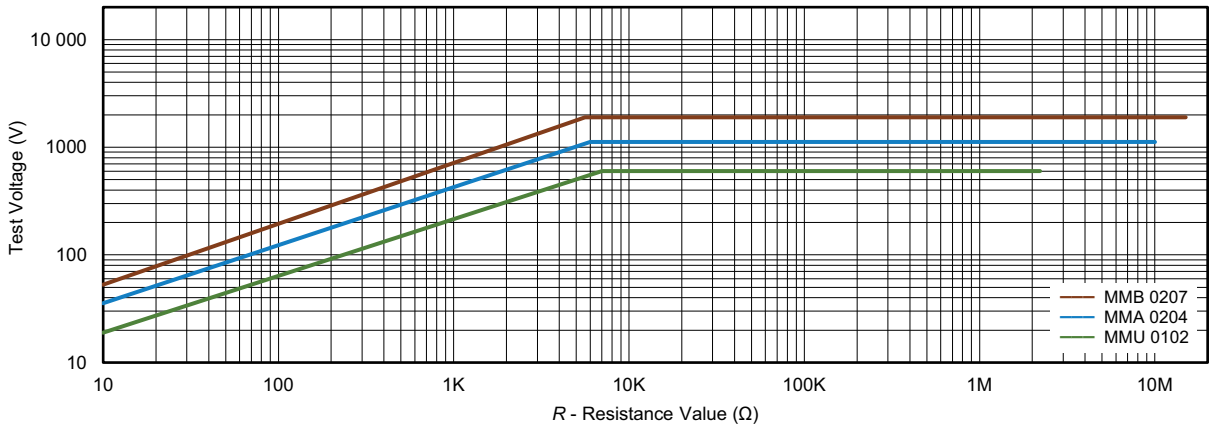
Maximum pulse voltage, single and continuous pulses; applicable if $\hat{P} \leq \hat{P}_{max.}$;
for permissible resistance change ± (0.5 % R + 0.01 Ω)

Pulse Voltage



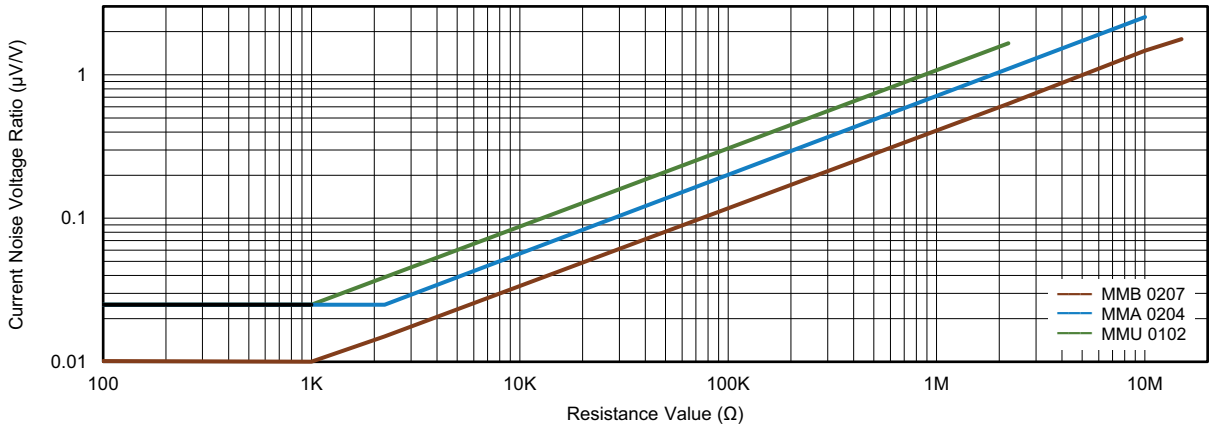
Pulse load rating in accordance with EN 60115-1 clause 8.2; 1.2 µs/50 µs;
5 pulses at 12 s intervals; for permissible resistance change ± (0.5 % R + 0.05 Ω)

1.2/50 Pulse



Pulse load rating in accordance with EN 60115-1 clause 8.2; 1.2 µs/50 µs;
5 pulses at 12 s intervals; for permissible resistance change ± (0.5 % *R* + 0.05 Ω)

10/700 Pulse



In accordance with IEC 60195

Current Noise Voltage Ratio

TESTS AND REQUIREMENTS

All tests are carried out in accordance with the following specifications:

EN 60115-1, generic specification

EN 60115-8, sectional specification

EN 140401-803, detail specification

IEC 60068-2-xx, test methods

The components are approved under the IECQ-CECC quality assessment system for electronic components.

The parameters stated in the Test Procedures and Requirements table are based on the required tests and permitted limits of EN 140401-803. The table presents only the most important tests, for the full test schedule refer to the documents listed above. However, some additional tests and a number of improvements against those minimum requirements have been included.

The testing also covers most of the requirements specified by EIA/ECA-703 and JIS-C-5201-1.

The tests are carried out under standard atmospheric conditions in accordance with IEC 60068-1, 4.3, whereupon the following values are applied:

Temperature: 15 °C to 35 °C

Relative humidity: 25 % to 75 %

Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar)

A climatic category LCT / UCT / 56 is applied, defined by the lower category temperature (LCT), the upper category temperature (UCT), and the duration of exposure in the damp heat, steady state test (56 days).

The components are mounted for testing on printed circuit boards in accordance with EN 60115-8, 2.4.2, unless otherwise specified.

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 (1) TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)			
			MMU 0102	0.22 Ω to < 10 Ω	≥ 10 Ω to 100 kΩ	> 100 kΩ to 332 kΩ	> 332 kΩ to 2.21 MΩ
			MMA 0204	0.22 Ω to < 10 Ω	≥ 10 Ω to 221 kΩ	> 221 kΩ to 1 MΩ	> 1 MΩ to 10 MΩ
			MMB 0207	0.1 Ω to < 10 Ω	≥ 10 Ω to 510 kΩ	> 510 kΩ to 1 MΩ	> 1 MΩ to 15 MΩ
6.1	-	Resistance	-	± 5 %; ± 2 %; ± 1 %; ± 0.5 %; ± 0.25 %; ± 0.1 %			
6.2	-	Temperature coefficient	At (20/- 55/20) °C and (20/155/20) °C	± 100 ppm/K; ± 50 ppm/K; ± 25 ppm/K; ± 15 ppm/K			
7.1	-	Endurance at 70 °C: precision operation mode	$U = \sqrt{P_{70} \times R} \leq U_{max.}$; whichever is the less severe; 1.5 h on; 0.5 h off; 70 °C; 1000 h 70 °C; 8000 h	- -	± (0.05 % R + 5 mΩ) ± (0.1 % R + 5 mΩ)		± (0.08 % R) ± (0.16 % R)
		Endurance at 70 °C: general operation mode	$U = \sqrt{P_{70} \times R} \leq U_{max.}$; whichever is the less severe; 1.5 h on; 0.5 h off; 70 °C; 1000 h 70 °C; 8000 h	± (0.1 % R + 5 mΩ) ± (0.2 % R + 5 mΩ)			
		Endurance at 70 °C: power operation mode	$U = \sqrt{P_{70} \times R} \leq U_{max.}$; whichever is the less severe; 1.5 h on; 0.5 h off; 70 °C; 1000 h 70 °C; 8000 h	± (0.2 % R + 5 mΩ) ± (0.4 % R + 5 mΩ)			
7.3	-	Endurance at upper category temperature	125 °C; 1000 h	± (0.15 % R + 5 mΩ)	± (0.05 % R + 5 mΩ)	± (0.1 % R)	± (0.25 % R)
			155 °C; 1000 h	± (0.3 % R + 5 mΩ)	± (0.15 % R + 5 mΩ)	± (0.3 % R)	± (0.5 % R)
10.4	78 (Cab)	Damp heat, steady state	(40 ± 2) °C; 56 days; (93 ± 3) % RH	± (0.25 % R + 5 mΩ)	± (0.05 % R + 5 mΩ)		± (0.25 % R)

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 (1) TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)			
			MMU 0102	0.22 Ω to < 10 Ω	≥ 10 Ω to 100 kΩ	> 100 kΩ to 332 kΩ	> 332 kΩ to 2.21 MΩ
			MMA 0204	0.22 Ω to < 10 Ω	≥ 10 Ω to 221 kΩ	> 221 kΩ to 1 MΩ	> 1 MΩ to 10 MΩ
			MMB 0207	0.1 Ω to < 10 Ω	≥ 10 Ω to 510 kΩ	> 510 kΩ to 1 MΩ	> 1 MΩ to 15 MΩ
10.5	67 (Cy)	Damp heat, steady state, accelerated: general operation mode	(85 ± 2) °C; (85 ± 5) % RH; $U = 0.3 \times \sqrt{P_{70} \times R}$ ≤ 100 V and $U = 0.3 \times U_{max.}$; (the smaller value is valid) 1000 h	< 1 Ω: ± (1 % R + 10 mΩ) ≥ 1 Ω: ± (0.5 % R + 10 mΩ)	± (0.15 % R + 5 mΩ)	± (0.25 % R)	± (2 % R)
-	1 (Ab)	Cold	-55 °C; 2 h	± (0.02 % R + 5 mΩ)			
10.1	14 (Na)	Rapid change of temperature	30 min at LCT; 30 min at UCT; LCT = -10 °C; UCT = 85 °C 1000 cycles	-	± (0.1 % R + 10 mΩ)		-
			30 min at LCT; 30 min at UCT; LCT = -55 °C; UCT = 125 °C 5 cycles 1000 cycles	± (0.05 % R + 10 mΩ) ± (0.15 % R + 10 mΩ)	± (0.05 % R + 5 mΩ) ± (0.15 % R + 5 mΩ)		± (0.1 % R) ± (0.2 % R)
			30 min at LCT; 30 min at UCT; LCT = -55 °C; UCT = 155 °C 1000 cycles	± (0.25 % R + 10 mΩ)	± (0.25 % R + 5 mΩ)		± (0.5 % R)
8.1	-	Short time overload: precision operation mode	U = 2.5 x $\sqrt{P_{70} \times R}$ ≤ 2 x $U_{max.}$; 5 s	-	± (0.01 % R + 5 mΩ)	± (0.02 % R)	± (0.08 % R)
		Short time overload: general operation mode		± (0.03 % R + 5 mΩ)			± (0.1 % R)
		Short time overload: power operation mode		± (0.05 % R + 5 mΩ)			± (0.15 % R)
8.2	-	Single pulse high voltage overload: general operation mode	Severity no. 4: $U = 10 \times \sqrt{P_{70} \times R}$ ≤ 2 x $U_{max.}$; 10 pulses 10 µs/700 µs	± (0.25 % R + 5 mΩ)			
		Single pulse high voltage overload: power operation mode		± (0.5 % R + 5 mΩ)			
8.4	-	Periodic electric overload: general operation mode	$U = \sqrt{15 \times P_{70} \times R}$ ≤ 2 x $U_{max.}$; 0.1 s on; 2.5 s off; 1000 cycles	± (0.15 % R + 5 mΩ)			
		Periodic electric overload: power operation mode		± (0.3 % R + 5 mΩ)			
8.5	-	Electrostatic discharge (human body model)	IEC 61340-3-1 (1); 3 pos. + 3 neg. discharges MMU 0102: 1500 V MMA 0204: 2000 V MMB 0207: 4000 V	± (0.5 % R + 50 mΩ)			

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 (1) TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (Δ*R*)			
			MMU 0102	0.22 Ω to < 10 Ω	≥ 10 Ω to 100 kΩ	> 100 kΩ to 332 kΩ	> 332 kΩ to 2.21 MΩ
			MMA 0204	0.22 Ω to < 10 Ω	≥ 10 Ω to 221 kΩ	> 221 kΩ to 1 MΩ	> 1 MΩ to 10 MΩ
			MMB 0207	0.1 Ω to < 10 Ω	≥ 10 Ω to 510 kΩ	> 510 kΩ to 1 MΩ	> 1 MΩ to 15 MΩ
9.11	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)	± (0.01 % *R* + 5 mΩ)	± (0.03 % *R*) MMU 0102 < 147 kΩ: ± (0.02 % *R*)	
11.1	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			
11.2	58 (Td2)	Resistance to soldering heat	Reflow (IR / forced gas convection); (260 ± 5) °C; (35 ± 5) s; 3 cycles	± (0.05 % *R* + 10 mΩ)			± (0.25 % *R*)
11.3	45 (XA)	Component solvent resistance	Isopropyl alcohol; 50 °C; method 2	No visible damage			
		Solvent resistance of marking	Isopropyl alcohol; 50 °C; method 1, toothbrush	Marking visible, no visible damage			
9.7	21 (Ue3)	Shear (adhesion)	45 N	No visible damage			
9.8	21 (Ue1)	Substrate bending	Depth 2 mm, 3 times	No visible damage, no open circuit in bent position			
				< 43 Ω ± (0.05 % *R* + 5 mΩ) (2) ≥ 43 Ω ± (0.02 % *R* + 10 mΩ) (2)			± (0.05 % *R*) (2)
12.2	-	Voltage proof	$U_{RMS} = U_{ins}$; 60 s	No flashover or breakdown			
12.4	-	Flammability	IEC 60695-11-5 (1), needle flame test; 10 s	No burning after 30 s			

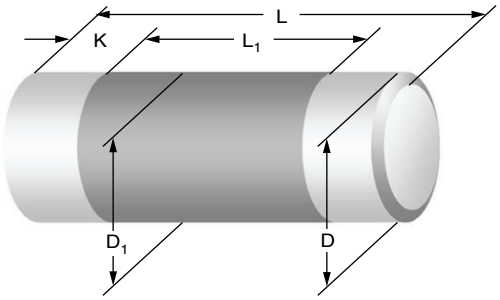
Notes

- If not otherwise stated, specific test PCBs and / or test setups are used. For more information on tests please contact melf@vishay.com

(1) The quoted IEC standards are also released as EN standards with the same number and identical contents

(2) 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*

DIMENSIONS



DIMENSIONS AND MASS						
TYPE / SIZE	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 + 0.1 / - 0.05	8
MMA 0204	3.6 + 0 / - 0.2	1.4 + 0 / - 0.1	1.8	D + 0 / - 0.15	0.75 ± 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

Notes

- Color code marking is applied according to IEC 60062 (1) in four bands (E24 series) or in five bands (E96 and E192). 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 band between the 4th and 5th full band indicates the temperature coefficient (yellow = ± 25 ppm/K, orange = ± 15 ppm/K)

(1) The quoted IEC standards are also released as EN standards with the same number and identical contents

SOLDERING RECOMMENDATIONS

For recommended solder pad dimensions please refer to www.vishay.com/doc?28950.

For recommended soldering profiles please refer to www.vishay.com/doc?31090.

REVISION HISTORY	
REVISION DATE	DESCRIPTION
02-Jun-2026	First combined datasheet revision of previously separated datasheets “Professional Thin Film MELF Resistors” and “Precision Thin Film MELF Resistors”. This datasheet 28963 partly features tightened specifications of former MELF Professional Thin Film products (datasheet 28713). These tightened specifications will be valid for all products delivered with a date code of “2606” and later. For all other date codes, the previous datasheet 28713 in the revision date of 17-Jan-2023 remains valid.

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