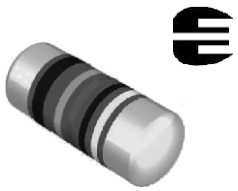
MINI-MELF Resistors with Established Reliability



FEATURES

- Approved to EN 140401-803, version E
- Established reliability, failure rate level E8
- Stable metal film on high quality ceramic
- Single lot date code
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912

Pb-free
RoHS COMPLIANT

APPLICATIONS

- Medical
- Military
- Aerospace

TECHNICAL SPECIFICATIONS	
DESCRIPTION	**SMM0204 .... EN803 E8**
EN style (size)	RC3715M
Resistance range	1 Ω to 2.21 MΩ
Resistance tolerance	± 1 %; ± 0.1 %
Temperature coefficient	± 50 ppm/K; ± 15 ppm/K
Rated dissipation, P_{70}	0.25 W
Operating voltage, $U_{max.}$ AC_{RMS} or DC	200 V
Film temperature, $\vartheta_{F\ max.}$	125 °C
Operating temperature range	- 55 °C to 125 °C
Max. resistance change at P_{70} for resistance range $\lvert\Delta R/R\rvert$ max. after:	1 Ω to 332 kΩ
1000 h	≤ 0.25 %
8000 h	≤ 0.5 %
Insulation resistance	≥ 10 GΩ
Permissible voltage against ambient (insulation): 1 min; U_{ins}	300 V
Assessed failure rate level	E8 = 10^{-8}/h
Quality factor, π_Q	0.03
Failure rate: $FIT_{observed}$	< 0.1 x 10^{-9}/h

Notes

- 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.
- Failure rate level E8 (10^{-8}/h, π_Q = 0.03), corresponding to MIL level S, is superior to level E7 (10^{-7}/h, π_Q = 0.1), E6 (10^{-6}/h, π_Q = 0.3) or E5 (10^{-5}/h, π_Q = 1) and thus can be used as a replacement.

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE		
DESCRIPTION		**RESISTANCE**
TCR	**TOLERANCE**	**SMM0204 .... EN803 E8**
± 50 ppm/K	± 1 %	1 Ω to 2.21 MΩ
± 15 ppm/K	± 0.1 %	75 Ω to 100 kΩ

Note

- According to EN 140401-803, resistance values are to be selected from the E96 series for ± 1 % tolerance and from the E192 series for ± 0.1 % tolerance.

PART NUMBER AND PRODUCT DESCRIPTION

PART NUMBER: SMM0204WE5620BB300

S	M	M	0	2	0	4	W	E	5	6	2	0	B	B	3	0	0

TYPE/SIZE	SPECIFICATION	TCR	RESISTANCE	TOLERANCE	PACKAGING
SMM0204	**W** = EN 140401-803; version E; failure rate level E8	**C** = ± 50 ppm/K **E** = ± 15 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** = $*10^{4}$	**F** = ± 1 % **B** = ± 0.1 %	**B1** **B3**

PRODUCT DESCRIPTION: SMM0204 15 562R 0.1 % B3 EN803 E8

SMM0204	15	562R	0.1 %	B3	EN803	E8
TYPE/SIZE	TCR	RESISTANCE	TOLERANCE	PACKAGING	SPECIFICATION	FAILURE RATE LEVEL
SMM0204	± **50** ppm/K ± **15** ppm/K	**562R** = 562 Ω **4K64** = 4.64 kΩ	± **1 %** ± **0.1 %**	**B1** **B3**	**EN** 140401-**803**; version E	**E8**

Notes

- The products can be ordered using either the PART NUMBER or the PRODUCT DESCRIPTION.
- Products within a packaging unit are single lot date code.

EN 140401-803 ORDERING INFORMATION

Example of the ordering information for a resistor: SMM0204 15 562R 0.1 % EN803 E8

EN140401-803EZRC3715MP562RBE8

The elements used in the component number have the following meaning:

EN140401-803	EN detail specification number
EZ	Assessment level for the zero-defect approach
RC3715M	Style (size)
P	Temperature coefficient, according to EN 60062 R = ± 50 ppm/K; P = ± 15 ppm/K
562R	Resistance, according to EN 60062, 4 characters
B	Tolerance on rated resistance, according to EN 60062 F = ± 1 %; B = ± 0.1 %
E8	Failure rate level according to EN 60115-1, annex ZR

Please note that the EN 140401-803 ordering information is not specific to the nature of the termination plating.

Notes

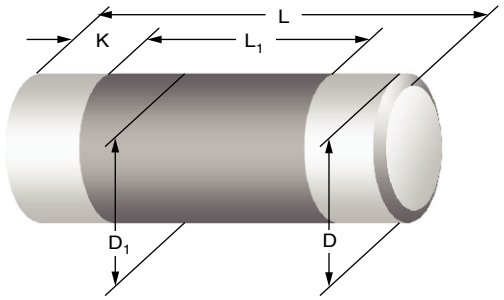
- The ordering information according to EN 140401-803:2007 shown above succeeds and replaces the ordering information according to earlier versions of the detail specification EN 140401-803 or its predecessor CECC 40401-803, for example:

  CECC 40401-803 EZ RC3715M E 562R B E8
  CECC 40401-803 S RC3715 E 562R B E8

  with EZ; S — Assessment level, where EZ is successor to and superior replacement for S
  RC3715M; RC3715 — Style, with added suffix M for "metric"
  E — Temperature coefficient, according to the detail specification
  C = ± 50 ppm/K; E = ± 15 ppm/K.
- EN 140401-803 succeeds the prior specifications CECC 40401-803, CECC 40401-001 (now "Version E") and CECC 40401-005 (now "Version A").

PACKAGING						
TYPE	CODE	QUANTITY	CARRIER TAPE	WIDTH	PITCH	REEL DIAMETER
SMM0204 .... EN803 E8	B1	1000	Blister tape acc. IEC 60286-3, Type II	8 mm	4 mm	180 mm/7"
	B3	3000				

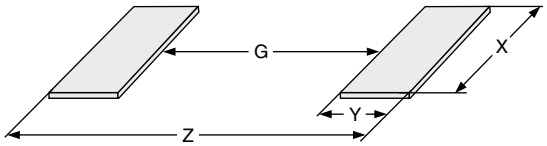
DIMENSIONS



DIMENSIONS AND MASS						
TYPE	L (mm)	D (mm)	$L_{1\ min.}$ (mm)	D_1 (mm)	K (mm)	MASS (mg)
SMM0204 .... EN803 E8	3.6 + 0/- 0.15	1.5 + 0/- 0.2	1.65	D + 0/- 0.15	0.7 ± 0.2	22

Note

- Color code marking is applied according to IEC 60062 [3] 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 wider than the other bands. The color of the body coating is light green for a temperature coefficient of ± 50 ppm/K, or violet for ± 15 ppm/K.



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)
SMM0204 .... EN803 E8	1.5	1.5	1.8	4.5	1.6	1.25	1.7	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.

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 metallized rod. 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. Five color code rings designate the resistance value and tolerance in accordance with **IEC 60062** [3].

The result of the determined production is verified by an extensive testing procedure performed on 100 % of the individual resistors. Only accepted products are placed into the blister tape in accordance with **IEC 60286-3** [3], **Type II**. Products within a packaging unit are from the same production lot and carry the same date code.

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** [3]. Solderability is specified for 2 years after production. The permitted storage time is 20 years.

The resistors are completely lead (Pb)-free, the pure tin plating provides compatibility with both, lead (Pb)-free and tin lead (SnPb) based 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 **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)
- 2011/65/EU Restriction of the use of Hazardous Substances Directive (RoHS)
- 2002/96/EC Waste Electrical and Electronic Equipment Directive (WEEE)

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** [3] series.

Conformity is attested by the use of the **CECC** logo ( ) as the mark of conformity on the package label.
The Vishay Draloric production facility is registered with the CAGE code D1018.

RELATED PRODUCTS

A wider range of TCR, tolerance and resistance values, plus the option of values from a different E series is available with MINI-MELF products SMM0204 ... EN803 E0 approved to **EN 140401-803**, version A, without established reliability, nominal failure rate level E0 (quality factor $\pi_Q = 3$). A further range of MINI-MELF products SMM0204 is available without any approval (quality factor $\pi_Q = 10$).

Zero Ohm Jumpers are available under the product description **OMM0204**.

For details, see the datasheet:

- “SMM0204, Metal Film Cylindrical Resistors”, document no. 20004

A parallel family of MINI-MELF resistors MS1 ... EN803 E8 with established reliability with lead-bearing termination plating is available, see the datasheet:

- “MS1 ... EN803 E8, Lead-Bearing MINI-MELF Resistors with Established Reliability”, document no. 28787

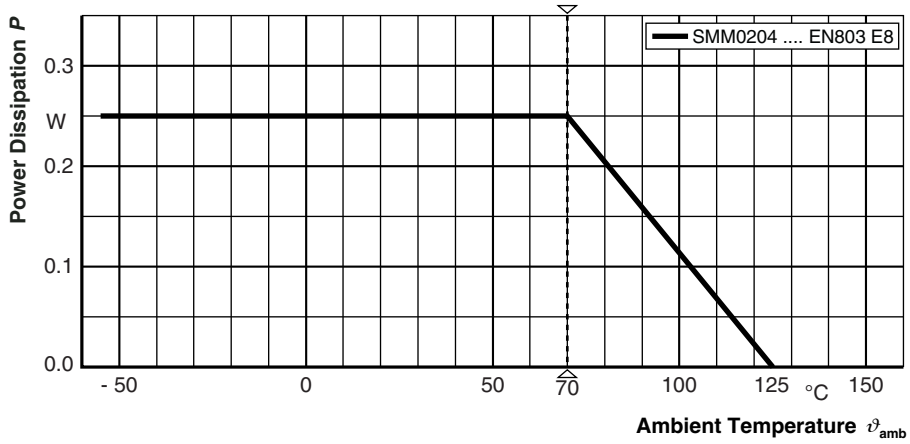
Notes

(1) Global Automotive Declarable Substance List, see www.gadsl.org.

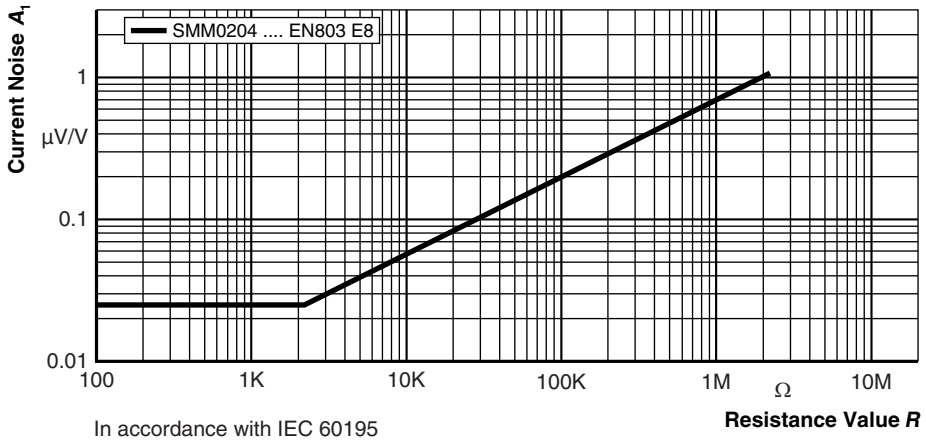
(2) CEFIC (European Chemical Industry Council), EECA (European Electronic Component Manufacturers Association), EICTA (European trade organisation representing the information and communications technology and consumer electronics), see www.eicta.org/index.php?id=1053&id_article=340.

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

FUNCTIONAL PERFORMANCE

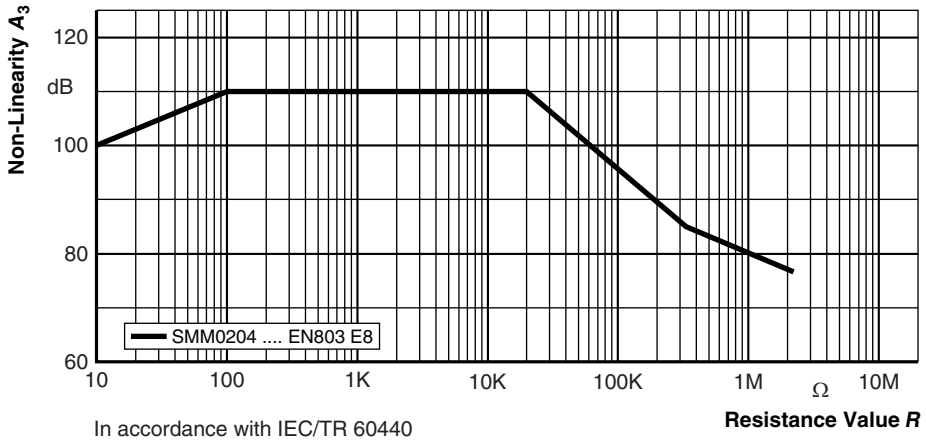


Derating



In accordance with IEC 60195

Current Noise - A_1



In accordance with IEC/TR 60440

Non-Linearity - A_3

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. 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. 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: 25 % 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.

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\triangle R$)		
				STABILITY CLASS 0.25 OR BETTER	STABILITY CLASS 0.5 OR BETTER	STABILITY CLASS 2 OR BETTER
			Stability for product type:			
			SMM0204 .... EN803 E8	10 Ω to 332 kΩ	< 10 Ω	> 332 kΩ
4.5	-	Resistance	-	± 1 % R; ± 0.1 % R	± 1 % R	± 1 % R
4.7	-	Voltage proof	U = 1.4 x U_{ins}; 60 s	No flashover or breakdown		
4.13	-	Short time overload	$U = 2.5 \times \sqrt{P_{70} \times R}$ ≤ 2 × $U_{max.}$; 2 s	± (0.05 % R + 10 mΩ)	± (0.1 % R + 10 mΩ)	± (0.5 % R + 50 mΩ)
4.17.2	58 (Td)	Solderability	Solder bath method; SnPb40; non-activated flux (235 ± 5) °C; (2 ± 0.2) s	Good tinning (≥ 95 % covered); no visible damage		
			Solder bath method; SnAg3Cu0.5; non-activated flux; (245 ± 5) °C; (3 ± 0.3) s	Good tinning (≥ 95 % covered); no visible damage		
4.8.4.2	-	Temperature coefficient	At (20/- 55/20) °C and (20/125/20) °C	± 50 ppm/K; ± 15 ppm/K	± 50 ppm/K	± 50 ppm/K
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		
				± (0.05 % R + 10 mΩ)	± (0.1 % R + 10 mΩ)	± (0.5 % R + 50 mΩ)
4.19	14 (Na)	Rapid change of temperature	30 min at - 55 °C and 30 min at 125 °C; 5 cycles	± (0.05 % R + 10 mΩ)	± (0.1 % R + 10 mΩ)	± (0.25 % R + 50 mΩ)
			1000 cycles	± (0.25 % R + 50 mΩ)	± (0.25 % R + 50 mΩ)	± (0.25 % R + 50 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 CLASS 0.5 OR BETTER	STABILITY CLASS 2 OR BETTER
			Stability for product type:			
			SMM0204 .... EN803 E8	10 Ω to 332 kΩ	< 10 Ω	> 332 kΩ
4.23		Climatic sequence:				
4.23.2	2 (Ba)	Dry heat	125 °C; 16 h	± (0.25 % R + 50 mΩ)	± (0.5 % R + 50 mΩ)	± (2 % R + 100 mΩ)
4.23.3	30 (Db)	Damp heat, cyclic	55 °C; ≥ 90 % RH; 24 h; 1 cycle			
4.23.4	1 (Aa)	Cold	- 55 °C; 2 h			
4.23.5	13 (M)	Low air pressure	1 kPa; (25 ± 10) °C; 1 h			
4.23.6	30 (Db)	Damp heat, cyclic	55 °C; ≥ 90 % RH; 24 h; 5 cycles			
4.23.7	-	DC load	$U = \sqrt{P_{70} \times R} \leq U_{max.}$; 1 min			
4.25.1	-	Endurance at 70 °C	$U = \sqrt{P_{70} \times R} \leq U_{max.}$ 1.5 h on; 0.5 h off; 70 °C; 1000 h	± (0.25 % R + 50 mΩ)	± (0.25 % R + 50 mΩ)	± (0.5 % R + 50 mΩ)
			70 °C; 8000 h	± (0.5 % R + 50 mΩ)	± (0.5 % R + 50 mΩ)	± (1 % R + 50 mΩ)
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)	± (0.5 % R + 50 mΩ)
4.35	-	Flammability, needle flame test	IEC 60695-11-5 (3); 10 s	No burning after 30 s		
4.24	78 (Cab)	Damp heat, steady state	(40 ± 2) °C; (93 ± 3) % RH 56 days	± (0.25 % R + 50 mΩ)	± (0.5 % R + 50 mΩ)	± (2 % R + 100 mΩ)
4.25.3	-	Endurance at upper category temperature	125 °C; 1000 h	± (0.25 % R + 50 mΩ)	± (0.5 % R + 50 mΩ)	± (0.5 % R + 50 mΩ)
4.40	-	Electrostatic discharge (human body model)	IEC 61340-3-1 (3); 3 pos. + 3 neg. discharge; 2 kV	± (0.5 % R + 50 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		
4.22	6 (Fc)	Vibration, endurance by sweeping	f = 10 Hz to 2000 Hz; $\hat{x}, \hat{y}, \hat{z} \leq$ 1.5 mm; $A \leq 200$ m/s^2; 7.5 h; 10 sweeps per axis	± (0.05 % R + 10 mΩ)	± (0.1 % R + 10 mΩ)	± (0.5 % R + 50 mΩ)
4.37	-	Periodic electric overload	$U = \sqrt{15 \times P_{70} \times R} \leq 2 \times U_{max.}$; 0.1 s on; 2.5 s off; 1000 cycles	± (1 % R + 50 mΩ)		
4.27	-	Single pulse high voltage overload; 10 µs/700 µs	$\hat{U} = 10 \times \sqrt{P_{70} \times R} \leq 2 \times U_{max.}$; 10 pulses	± (0.5 % R + 50 mΩ)		

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