Professional Metal Film Leaded Resistors

DESIGN SUPPORT TOOLS

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3D Models Available

DESCRIPTION

MBA/SMA 0204, MBB/SMA 0207, and MBE/SMA 0414 professional leaded thin film resistors are the general purpose resistor for all fields of professional electronics where reliability and stability is of major concern. Typical applications include industrial, telecommunication, automotive, and medical equipment.

FEATURES

- CECC version (IECQ-CECC approved according to EN 140101-806)
- Excellent overall stability: class 0.25
- Wide ohmic range: 0.22 Ω to 22 MΩ
- AEC-Q200 qualified available [1]
- Radial version available for MBB/SMA 0207
- Alternative termination wires available e.g. weldable wire (MBA/SMA 0204 only)
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free
RoHS COMPLIANT
HALOGEN FREE

Note

[1] AEC-Q200 qualified parts are available per tables "Temperature Coefficient and Resistance Range"

APPLICATIONS

- Industrial
- Telecommunication
- Medical equipment
- Automotive

TECHNICAL SPECIFICATIONS

DESCRIPTION	MBA/SMA 0204	MBB/SMA 0207	MBE/SMA 0414
DIN size	0204	0207	0414
CECC size	A	B	D
Resistance range	0.22 Ω to 10 MΩ; 0 Ω	0.22 Ω to 22 MΩ; 0 Ω	0.22 Ω to 22 MΩ
Resistance tolerance	± 5 %; ± 1 %; ± 0.5 %		
Temperature coefficient	± 50 ppm/K; ± 25 ppm/K		
Rated dissipation, P_{70} [2]	0.4 W	0.6 W	1.0 W
Operating voltage, $U_{max.}$ AC/DC	200 V	350 V	500 V
Operating temperature range [2]	-55 °C to 155 °C		
Peak permissible film temperature [2]	155 °C	155 °C	155 °C
Insulation voltage:			
1 min.; U_{ins}	300 V	500 V	800 V
Continuous	75 V	75 V	75 V
Failure rate: $FIT_{observed}$	≤ 0.1 x 10^{-9}/h	≤ 0.1 x 10^{-9}/h	≤ 0.1 x 10^{-9}/h

Notes

- MB_ series has been merged with the related SMA series to form one series "MB_/SMA__"

[2] Please refer to APPLICATION INFORMATION below

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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. Furthermore, a high level of ambient temperature or of power dissipation may raise the temperature of the solder joint, hence special solder alloys or board materials may be required to maintain the reliability of the assembly.

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. 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
Climatic category		-55 °C / +125 °C / 56 days	-55 °C / +155 °C / 56 days
Rated dissipation, P_{70}	MBA/SMA 0204	0.25 W	0.4 W
	MBB/SMA 0207	0.4 W	0.6 W
	MBE/SMA 0414	0.65 W	1.0 W
Applied maximum film temperature, $\vartheta_{F\ max.}$		125 °C	155 °C
Max. resistance change at rated dissipation $\lvert\Delta R/R$ max.$\rvert$, after:	MBA/SMA 0204	1 Ω to 475 kΩ	1 Ω to 475 kΩ
	1000 h	≤ 0.25 %	≤ 0.5 %
	8000 h	≤ 0.5 %	≤ 1.0 %
	225 000 h	≤ 1.5 %	–
	MBB/SMA 0207	1 Ω to 1 MΩ	1 Ω to 1 MΩ
	1000 h	≤ 0.25 %	≤ 0.5 %
	8000 h	≤ 0.5 %	≤ 1.0 %
	225 000 h	≤ 1.5 %	–
	MBE/SMA 0414	1 Ω to 2.4 MΩ	1 Ω to 2.4 MΩ
	1000 h	≤ 0.2 %	≤ 0.4 %
	8000 h	≤ 0.4 %	≤ 0.8 %
	225 000 h	≤ 1.2 %	–

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TEMPERATURE COEFFICIENT AND RESISTANCE RANGE - Standard Products				
TYPE	**TCR**	**TOLERANCE**	**RESISTANCE** [(1)(2)]	**E-SERIES**
MBA/SMA 0204	± 50 ppm/K	± 5 %	0.22 Ω to 0.91 Ω	E24
		± 1 %	**1 Ω to 10 MΩ**	E24; E96
		± 0.5 %	10 Ω to 475 kΩ	E24; E192
	± 25 ppm/K	± 1 %	10 Ω to 475 kΩ	E24; E96
		± 0.5 %	**10 Ω to 475 kΩ**	E24; E192
	Jumper	-	**< 10 mΩ; $I_{max.}$ = 3 A**	-
MBB/SMA 0207	± 50 ppm/K	± 5 %	0.22 Ω to 0.91 Ω 11 MΩ to 22 MΩ	E24
		± 1 %	**1 Ω to 10 MΩ**	E24; E96
		± 2 %	0.22 Ω to 0.91 Ω	E24
		± 0.5 %	10 Ω to 1 MΩ	E24; E192
	± 25 ppm/K	± 1 %	10 Ω to 1 MΩ	E24; E96
		± 0.5 %	**10 Ω to 1 MΩ**	E24; E192
	Jumper	-	**< 10 mΩ; $I_{max.}$ = 5 A**	-
MBE/SMA 0414	± 50 ppm/K	± 5 %	0.22 Ω to 0.91 Ω	E24
		± 1 %	**1 Ω to 22 MΩ**	E24; E96
		± 0.5 %	10 Ω to 2.43 MΩ	E24; E192
	± 25 ppm/K	± 1 %	10 Ω to 2.43 MΩ	E24; E96
		± 0.5 %	**10 Ω to 2.43 MΩ**	E24; E192

Notes

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

(1) Resistance value to be selected from E24 series for ± 5 %, ± 2 %, from E24/E96 series for ± 1 % tolerance and from E24/E192 for ± 0.5 % tolerance

(2) AEC-Q200 qualification applies to products with TCR = ± 50 ppm/K and tolerance = ± 1 % in the ranges of 10 Ω to 301 kΩ for MBA/SMA 0204, 10 Ω to 7.5 MΩ for MBB/SMA 0207, and 10 Ω to 22 MΩ for MBE/SMA 0414

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PART NUMBER AND PRODUCT DESCRIPTION - Standard Products

PART NUMBER: MBB02070C1001FCT00

M	B	B	0	2	0	7	0	C	1	0	0	1	F	C	T	0	0

TYPE/SIZE	VARIANT	TCR	RESISTANCE	TOLERANCE	PACKAGING	SPECIAL
MBA0204 = MBA/SMA 0204 **MBB0207** = MBB/SMA 0207 **MBE0414** = MBE/SMA 0414	**0** = neutral **N** = RB radial 5 mm for MBB/SMA0207 **S** = UB radial 2.5 mm for MBB/SMA0207 **I** = L0 welding joint not lacquered for MBB/SMA 0207 **B** = KL lacquered welding joint for MBA/SMA 0204 **D** = Ni wire for MBA/SMA 0204	**D** = ± 25 ppm/K **C** = ± 50 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** = $*10^{5}$ **6** = $*10^{6}$ **0000** = jumper	**D** = ± 0.5 % **F** = ± 1 % **G** = ± 2 % **J** = ± 5 % **Z** = jumper	**CT** **C1** **RP** **R2** **R4** **N4**	**00** = standard Special termination wires for MBA/SMA 0204: **FE** = coppered steel **CA** = tinned CuAg **NS** = tinned Ni

Product Description: MBB/SMA 0207-50 1 % CT 1K0

MBB/SMA 0207	-	50	1 %		CT	1K0
TYPE/SIZE		TCR	TOLERANCE	VARIANT	PACKAGING	RESISTANCE
MBA/SMA 0204 **MBB/SMA 0207** **MBE/SMA 0414**		± **25** ppm/K ± **50** ppm/K	**± 0.5 %** **± 1.0 %** **± 2.0 %** **± 5.0 %**	**RB** **UB** **L0** **KL** **NISN** **AG**	**CT** **C1** **RP** **R2** **R4** **N4**	**1K0** = 1 kΩ **51R1** = 51.1 Ω

Notes

- The products can be ordered using either the PRODUCT DESCRIPTION or the PART NUMBER
- Standard products are not CECC approved
- Radial version (RB,UB) cannot be qualified according to CECC so these can only be ordered as standard products

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TEMPERATURE COEFFICIENT AND RESISTANCE RANGE - CECC Approved Products				
TYPE	**TCR**	**TOLERANCE**	**RESISTANCE** [(1)(2)]	**E-SERIES**
MBA/SMA 0204	± 50 ppm/K	± 5 %	0.22 Ω to 0.91 Ω	E24
		± 1 %	**1 Ω to 10 MΩ**	E24; E96
		± 0.5 %	10 Ω to 475 kΩ	E24; E192
	± 25 ppm/K	± 1 %	10 Ω to 475 kΩ	E24; E96
		± 0.5 %	**10 Ω to 475 kΩ**	E24; E192
	Jumper	-	**< 10 mΩ; $I_{max.}$ = 3 A**	-
MBB/SMA 0207	± 50 ppm/K	± 5 %	0.22 Ω to 0.91 Ω 11 MΩ to 22 MΩ	E24
		± 1 %	**1 Ω to 10 MΩ**	E24; E96
		± 0.5 %	10 Ω to 1 MΩ	E24; E192
	± 25 ppm/K	± 1 %	10 Ω to 1 MΩ	E24; E96
		± 0.5 %	**10 Ω to 1 MΩ**	E24; E192
	Jumper	-	**< 10 mΩ; $I_{max.}$ = 5 A**	-
MBE/SMA 0414	± 50 ppm/K	± 5 %	0.22 Ω to 0.91 Ω	E24
		± 1 %	**1 Ω to 22 MΩ**	E24; E96
		± 0.5 %	10 Ω to 2.43 MΩ	E24; E192
	± 25 ppm/K	± 1 %	10 Ω to 2.43 MΩ	E24; E96
		± 0.5 %	**10 Ω to 2.43 MΩ**	E24; E192

Notes

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

(1) Resistance value to be selected from E24 series for ± 5 %, from E24/E96 series for ± 1 % tolerance and from E24/E192 for ± 0.5 % tolerance

(2) AEC-Q200 qualification applies to products with TCR = ± 50 ppm/K and tolerance = ± 1 % in the ranges of 10 Ω to 301 kΩ for MBA/SMA 0204, 10 Ω to 7.5 MΩ for MBB/SMA 0207, and 10 Ω to 22 MΩ for MBE/SMA 0414

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PART NUMBER AND PRODUCT DESCRIPTION - CECC Approved Products

PART NUMBER: MBB0207VC1001FCT00

M	B	B	0	2	0	7	V	C	1	0	0	1	F	C	T	0	0

TYPE/SIZE	VARIANT	TCR	RESISTANCE	TOLERANCE	PACKAGING	SPECIAL
MBA0204 = MBA/SMA 0204 **MBB0207** = MBB/SMA 0207 **MBE0414** = MBE/SMA 0414	**V** = CECC 06	**D** = ± 25 ppm/K **C** = ± 50 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** = $*10^{5}$ **6** = $*10^{6}$ **0000** = jumper	**D** = ± 0.5 % **F** = ± 1 % **J** = ± 5 % **Z** = jumper	**CT** **C1** **RP** **R2**	**00** = standard **L0** = welding joint not lacquered for MBB/SMA 0207 **KL** = lacquered welding joint for MBA/SMA 0204

Product Description: MBB/SMA 0207-50 1 % CECC 06 CT 1K0

MBB/SMA 0207	-	50	1 %	CECC 06	CT	1K0
TYPE/SIZE		TCR	TOLERANCE	VARIANT	PACKAGING	RESISTANCE
MBA/SMA 0204 **MBB/SMA 0207** **MBE/SMA 0414**		± **25** ppm/K ± **50** ppm/K	± **0.5 %** ± **1.0 %** ± **5.0 %**	**CECC 06** **CECC 06 L0** **CECC 06 KL**	**CT** **C1** **RP** **R2**	**1K0** = 1 kΩ **51R1** = 51.1 Ω

Notes

- Approval is according to EN 140101-806, version A
- Radial version (RB, UB) cannot be qualified according to CECC so these can only be ordered as standard products

PACKAGING

TYPE / SIZE	CODE	QUANTITY	PACKAGING STYLE	WIDTH	PITCH	DIMENSIONS
MBA/SMA 0204	C1	1000	Taped acc. to IEC 60286-1 fan-folded in a box	53 mm	5 mm	184 mm x 75 mm x 42 mm
	CT	5000				330 mm x 75 mm x 55 mm
	RP	5000	Taped acc. to IEC 60286-1 on a reel	53 mm	5 mm	242 mm x 76 mm x 86 mm
MBB/SMA 0207 (1)	C1	1000	Taped acc. to IEC 60286-1 fan-folded in a box	53 mm	5 mm	184 mm x 74 mm x 42 mm 260 mm x 78 mm x 31 mm
	CT	5000				260 mm x 75 mm x 114 mm 324 mm x 77 mm x 82 mm
	RP	5000	Taped acc.to IEC 60286-1 on a reel	53 mm	5 mm	315 mm x 76 mm x 86 mm 298 mm x 75 mm x 86 mm
MBB/SMA 0207 UB = 2.5 mm pitch	N4	4000	Taped acc. to IEC 60286-2 fan-folded in a box	-	12.7 mm	330 mm x 262 mm x 45 mm
	R4	4000	Taped acc. to IEC 60286-2 on a reel			330 mm x 253 mm x 48 mm
MBB/SMA 0207 RB = 5 mm pitch	N4	4000	Taped acc. to IEC 60286-2 fan-folded in a box	-	12.7 mm	330 mm x 262 mm x 45 mm
	R4	4000	Taped acc. to IEC 60286-2 on a reel			330 mm x 253 mm x 48 mm
MBE/SMA 0414	C1	1000	Taped acc. to IEC 60286-1 fan-folded in a box	63 mm	5 mm	374 mm x 84 mm x 47 mm
	R2	2500	Taped acc. to IEC 60286-1 on a reel			315 mm x 80 mm x 90 mm

Note

(1) Manufacturing at different production locations may involve use of different size box

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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 and conditioned to achieve the desired temperature coefficient. Plated steel termination caps are firmly pressed on the metallized 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. Connecting wires of electrolytic copper plated with 100 % pure tin are welded to the termination caps. Alternative termination wires available e.g. weldable wire (MBA/SMA 0204 only). The resistor elements are covered by a light blue protective coating designed for electrical, mechanical and climatic protection. Four or 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 stuck directly on the adhesive tapes in accordance with **IEC 60286-1** or for the radial versions in accordance to **IEC 60286-2**.

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 [(1)]
- The Global Automotive Declarable Substance List (GADSL) [(2)]
- The REACH regulation (1907/2006/EC) and the related list of substances with very high concern (SVHC) [(3)] 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.

ASSEMBLY

The resistors are suitable for processing on automatic insertion equipment and cutting and bending machines. Excellent solderability is proven, even after extended storage. They are suitable for automatic soldering using wave or dipping.

The resistors are completely lead (Pb)-free, the pure tin plating provides compatibility with lead (Pb)-free and lead-containing soldering processes. The immunity of the plating against tin whisker growth, in compliance with IEC 60068-2-82, has been proven under extensive testing.

The encapsulant is resistant to cleaning solvent specified in IEC 60115-1 [(3)]. 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 **GADSL** [(1)] and the **IEC 62474** [(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 (ELVII)
- 2011/65/EU Restriction of the use of Hazardous Substances Directive (RoHS)
- 2012/19/EU Waste Electrical and Electrical Equipment Directive (WEEE)

APPROVALS

The resistors (CECC version) are approved within the IECQ-CECC Quality Assessment System for Electronic Components to the detail specification EN 140101-806 which refers to **EN 60115-1** and **EN 140100 and the variety of environmental test procedures of the IEC 60068 series.** Conformity is attested by the use of the CECC logo (⊜) as the Mark of Conformity on the package label for the CECC version.

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.

RELATED PRODUCTS

For a correlated range of precision TCR and tolerance specifications see the datasheet:

- "Precision Thin Film Leaded Resistors", www.vishay.com/doc?28767

For products approved to EN 140101-806, version E, with established reliability and failure rate level E7 (Quality factor $\pi Q = 0.1$), see the datasheet:

- "Established Reliability Thin Film Leaded Resistors", www.vishay.com/doc?28768

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.digitaleurope.org/SearchResults.aspx?Search=eicta.
All products comply with the IEC 62474, Material Declaration for Products of and for the Electrotechnical Industry

(3) Other cleaning solvents with aggressive chemicals should be evaluated in actual cleaning process for their suitability

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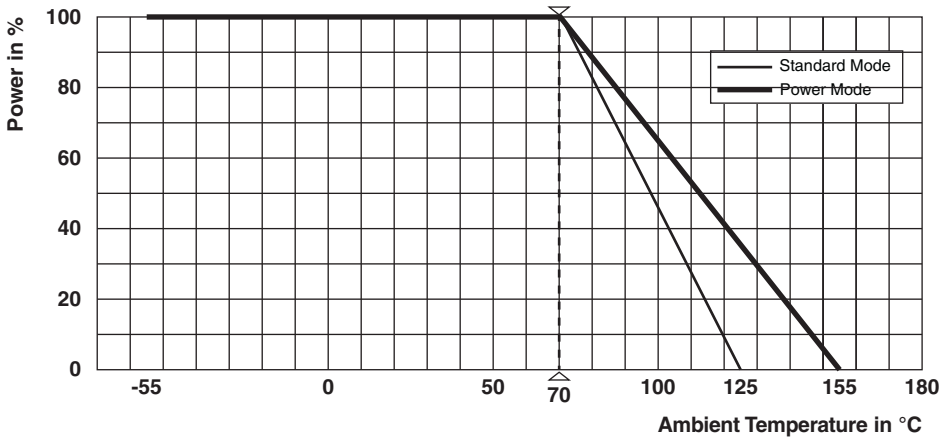
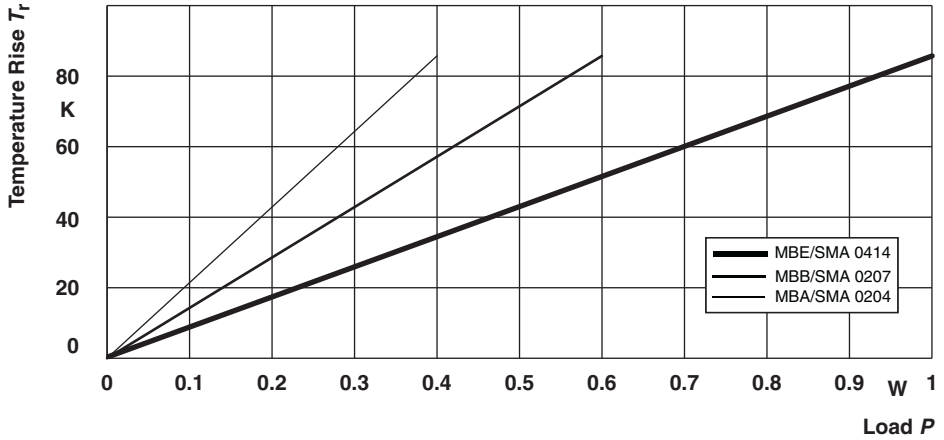
FUNCTIONAL PERFORMANCE



Derating



Rise of surface temperature

Temperature Rise

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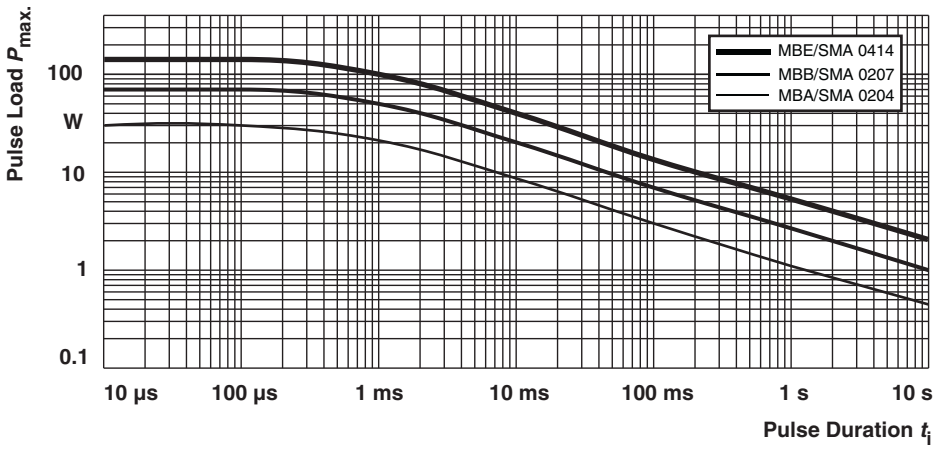
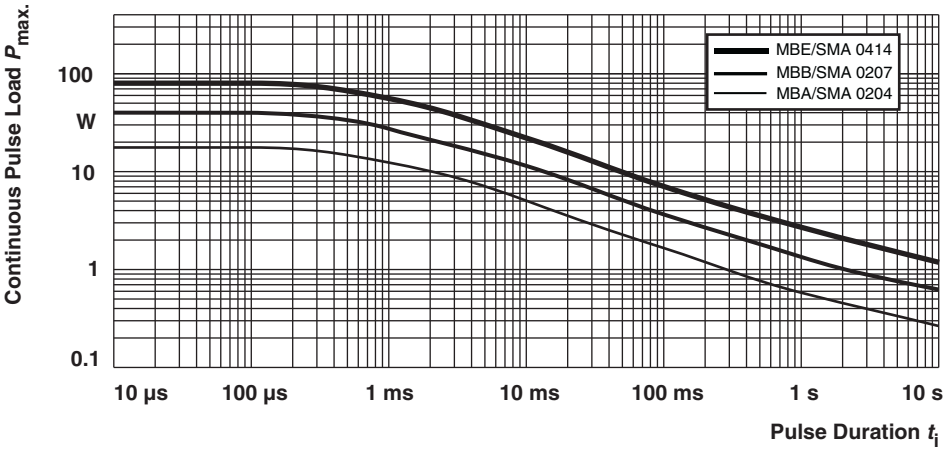


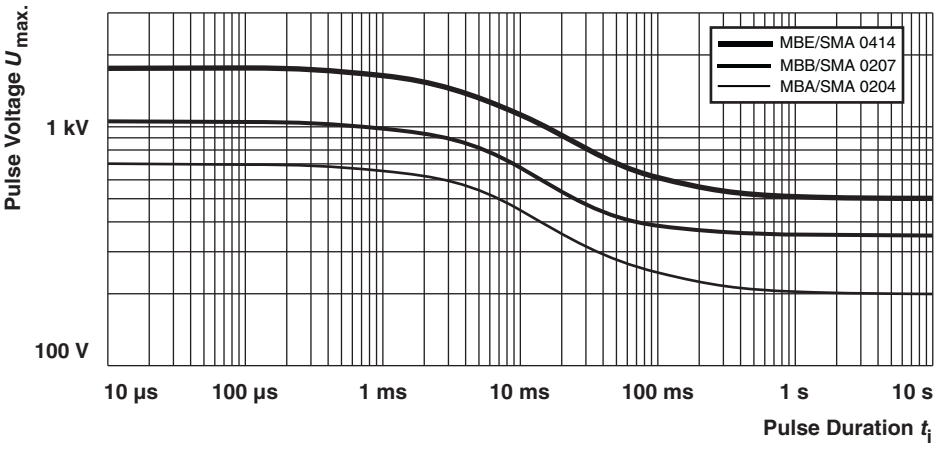
Maximum pulse load, single pulse; for permissible resistance change equivalent to 8000 h operation.

Single Pulse



Maximum pulse load, continuous pulses; for permissible resistance change equivalent to 8000 h operation.

Continuous Pulse



Maximum pulse voltage, single and continuous pulses; for permissible resistance change equivalent to 8000 h operation.

Pulse Voltage

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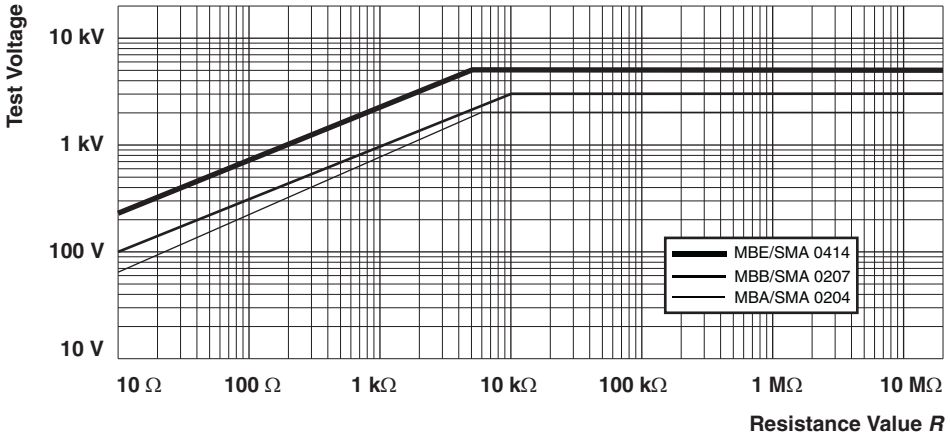
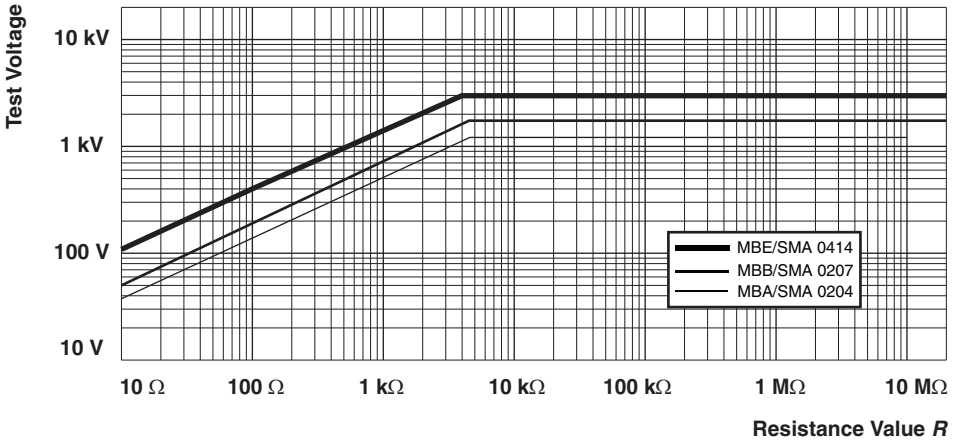


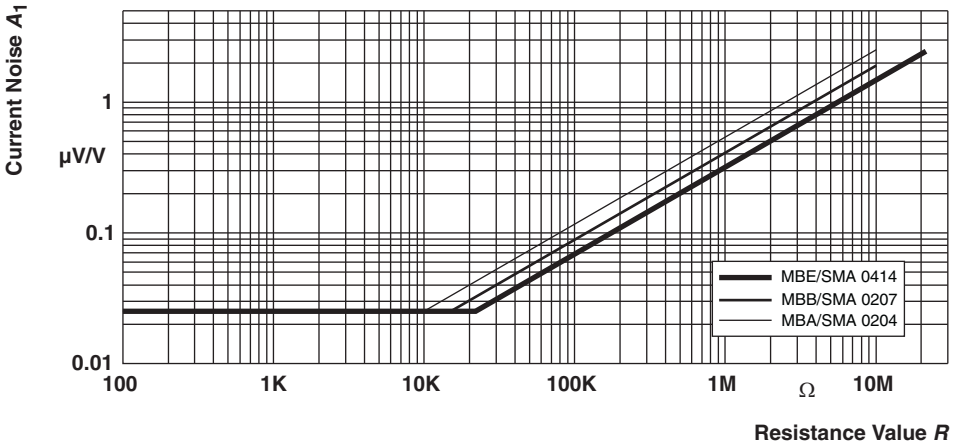
Pulse load rating in accordance with IEC 60115-1, 4.27; 1.2 µs/50 µs; 5 pulses at 12 s intervals; for permissible resistance change (0.5 % R + 0.05 Ω)

1.2/50 Pulse



Pulse load rating in accordance with IEC 60115-1, 4.27; 10 µs/700 µs; 10 pulses at 1 minute intervals; for permissible resistance change (0.5 % R + 0.05 Ω)

10/700 Pulse



Current noise - A_1 in accordance with IEC 60195

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TESTS PROCEDURES AND REQUIREMENTS

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

- EN 60115-1, generic specification (includes tests)
- EN 140100, sectional specification (includes schedule for qualification approval)
- EN 140101-806 (successor of CECC 40101-806), detail specification (includes schedule for conformance inspection)

The test and requirements table contains only the most important tests. For the full test schedule refer to the documents listed above.

The tests are carried out in accordance with IEC 60068-2-xx test method 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, 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).

For performing some of the tests, the components are mounted on a test board in accordance with IEC 60115-1, 4.31.

In Test Procedures and Requirements table, only the tests and requirements are listed with reference to the relevant clauses of IEC 60115-1 and IEC 60068-2-xx test methods. A short description of the test procedure is also given.

TEST PROCEDURES AND REQUIREMENTS

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR max.)		
			Stability for product types:	STABILITY CLASS 0.5	STABILITY CLASS 1	STABILITY CLASS 2
			MBA/SMA 0204	1 Ω to 332 kΩ	0.22 Ω to < 1 Ω	> 332 kΩ
			MBB/SMA 0207	1 Ω to 1 MΩ	0.22 Ω to < 1 Ω	> 1 MΩ
			MBE/SMA 0414	1 Ω to 2.43 MΩ	0.22 Ω to < 1 Ω	> 2.43 MΩ
4.5	-	Resistance	-	± 5 % R; ± 1 % R; ± 0.5 % R		
4.7	-	Voltage proof	$U_{RMS} = U_{ins}$; 60 s	No flashover or breakdown		
4.8	-	Temperature coefficient	At (20 / -55 / 20) °C and (20 / 155 / 20) °C	± 50 ppm/K; ± 25 ppm/K		
4.13	-	Short time overload	Room temperature; $U = 2.5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max.}$; 5 s	± (0.1 % R + 0.01 Ω) no visible damage	± (0.25 % R + 0.05 Ω) no visible damage	± 0.5 % R no visible damage
4.16	21 (Ua_1) 21 (Ub) 21 (Uc)	Robustness of terminations	Tensile, bending, and torsion	± (0.1 % R + 0.01 Ω)	± (0.25 % R + 0.05 Ω)	± 0.5 % R
4.17	20 (Ta)	Solderability	+235 °C; 2 s; solder bath method; SnPb40	Good tinning (> 95 % covered, no visible damage)		
			+245 °C; 3 s; solder bath method; SnAg3Cu0.5			
4.18.2	20 (Tb)	Resistance to soldering heat	Unmounted components; (260 ± 5) °C; (10 ± 1) s	± (0.1 % R + 0.01 Ω) no visible damage	± (0.25 % R + 0.05 Ω) no visible damage	± 0.5 % R no visible damage
4.19	14 (Na)	Rapid change of temperature	30 min at -55 °C 30 min at 155 °C 5 cycles	± (0.1 % R + 0.01 Ω)	± (0.25 % R + 0.05 Ω)	± 0.5 % R
			MBA/SMA 0204: 500 cycles MBB/SMA 0207: 200 cycles MBE/SMA 0414: 100 cycles	± (0.5 % R + 0.05 Ω)	± (0.5 % R + 0.05 Ω)	± (0.5 % R + 0.05 Ω)
4.22	6	Vibration	10 sweep cycles per direction; 10 Hz to 2000 Hz 1.5 mm or 200 m/s²	± (0.1 % R + 0.01 Ω)	± (0.25 % R + 0.05 Ω)	± 0.5 % R
4.23		Climatic sequence:				
4.23.2	2 (Ba)	Dry heat	155 °C; 16 h			
4.23.3	30 (Db)	Damp heat, cyclic	55 °C; 24 h; ≥ 90 % to 100 % RH; 1 cycle			
4.23.4	1 (Aa)	Cold	-55 °C; 2 h			
4.23.5	13 (M)	Low air pressure	8.5 kPa; 2 h; 15 °C to 35 °C			
4.23.6	30 (Db)	Damp heat, cyclic	55 °C; 5 days; ≥ 95 % to 100 % RH; 5 cycles	± (0.5 % R + 0.05 Ω) no visible damage	± (1 % R + 0.05 Ω) no visible damage	± 2 % R no visible damage
4.23.7		DC load	apply rated power for 1 min			

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TEST PROCEDURES AND REQUIREMENTS						
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR max.)		
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			MBE/SMA 0414	1 Ω to 2.43 MΩ	0.22 Ω to < 1 Ω	> 2.43 MΩ
4.24	78 (Cab)	Damp heat, steady state	(40 ± 2) °C; 56 days; (93 ± 3) % RH	± (0.5 % R + 0.05 Ω)	± (1 % R + 0.05 Ω)	± 2 % R
4.25.1	-	Endurance at 70 °C: power operation mode	$U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; 1.5 h on; 0.5 h off 70 °C; 1000 h 70 °C; 8000 h	± (0.5 % R + 0.05 Ω) (1) ± (1 % R + 0.05 Ω) (2)		± 0.5 % R ± 1 % R
	-	Endurance at 70 °C: standard operation mode	$U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; 1.5 h on; 0.5 h off 70 °C; 1000 h 70 °C; 8000 h	± (0.25 % R + 0.05 Ω) (3) ± (0.5 % R + 0.05 Ω) (4)		± 0.25 % R ± 0.5 % R
4.25.3	-	Endurance at 125 °C and 155 °C	125 °C; 1000 h	± (0.25 % R + 0.05 Ω)	± (0.5 % R + 0.05 Ω)	± 1 % R
			155 °C; 1000 h	± (0.5 % R + 0.05 Ω)	± (1 % R + 0.05 Ω)	± 2 % R
4.29	45 (XA)	Component solvent resistance	Isopropyl alcohol (used in industrial application) +23 °C; toothbrush method	Marking legible; no visible damage		
4.40	-	Electrostatic discharge (human body model)	IEC 61340-3-1; 3 pos. + 3 neg. MBA/SMA 0204: 2 kV MBB/SMA 0207: 4 kV MBE/SMA 0414: 6 kV	± (0.5 % R + 0.05 Ω)		

Notes

(1) ± (0.4 % R + 0.05 Ω) for MBE/SMA 0414
(2) ± (0.8 % R + 0.05 Ω) for MBE/SMA 0414
(3) ± (0.2 % R + 0.05 Ω) for MBE/SMA 0414
(4) ± (0.4 % R + 0.05 Ω) for MBE/SMA 0414

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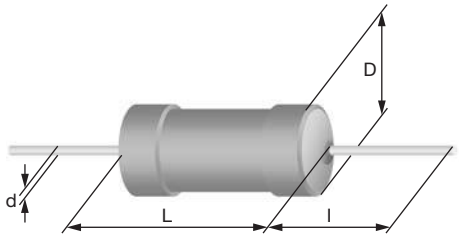
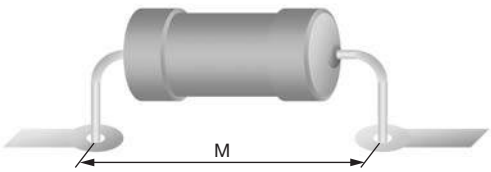
DIMENSIONS





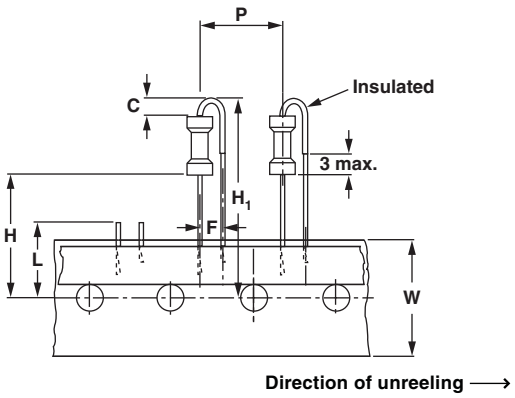
DIMENSIONS - Leaded resistor types, mass and relevant physical dimensions						
TYPE	**$D_{max.}$ (mm)**	**$L_{max.}$ (mm)**	**$d_{nom.}$ (mm)**	**$l_{min.}$ (mm)**	**$M_{min.}$ (mm)**	**MASS (mg)**
MBA/SMA 0204	1.6	3.6	0.5	29.0	5.0	125
MBB/SMA 0207 (1)	2.5	6.5	0.6	28.0	10.0 (1)	220
MBE/SMA 0414	4.2	11.9	0.8	31.0	15.0	700

Note

(1) For 7.5 ≤ M < 10.0 mm, use version MBB/SMA 0207 ... L0 (welding joint not lacquered)

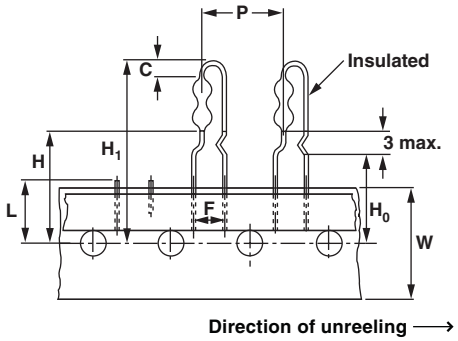
MBB/SMA 0207 WITH RADIAL TAPING

LEAD SPACING (UB = 2.5 mm), SIZE 0207



DIMENSIONS in millimeters		
Pitch of components	P	12.7 ± 1.0
Lead spacing	F	2.5 + 0.6 / - 0.1
Width of carrier tape	W	18.0 + 1.0 / - 0.5
Body to hole center	H	18.0 ± 2.0
Height for cutting (max.)	L	11
Height for bending	C	2.5 + 0 / - 0.5
Height for insertion (max.)	H_1	32

LEAD SPACING (RB = 5.0 mm), SIZE 0207



DIMENSIONS in millimeters		
Pitch of components	P	12.7 ± 1.0
Lead spacing	F	5.0 + 0.6 / - 0.1
Width of carrier tape	W	18.0 + 1.0 / - 0.5
Body to hole center	H	18.0 ± 2.0
Lead crimp to hole center	H_0	16.0 ± 0.5
Height for cutting (max.)	L	11
Height for bending	C	2.5 + 0 / - 0.5
Height for insertion (max.)	H_1	32

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HISTORICAL 12NC INFORMATION

- The resistors had a 12-digit numeric code starting with 2312
- The subsequent 4 digits indicated the resistor type, specification and packaging; see the 12NC table
- The remaining 4 digits indicated the resistance value:
  - the first 3 digits indicated the resistance value
  - the last digit indicated the resistance decade in accordance with resistance decade table

Resistance Decade

RESISTANCE DECADE	LAST DIGIT
0.1 Ω to 0.999 Ω	7
1 Ω to 9.99 Ω	8
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
10 MΩ to 99.9 MΩ	6

Historical 12NC Example

The 12NC code of a MBA 0204 resistor, value 47.5 kΩ and TCR 50 with ± 1 % tolerance, supplied on bandolier in a box of 5000 units was: 2312 905 14753.

HISTORICAL 12NC - Resistor Type and Packaging

DESCRIPTION			2312				
			AMMOPACK		REEL		
TYPE	TCR	TOL.	C1 1000 units	CT 5000 units	R1 1000 units	R2 2500 units	RP 5000 units
MBA 0204	± 50 ppm/K	± 5 %	900 3....	905 3....	700 3....	-	805 3....
		± 1 %	900 1....	905 1....	700 1....	-	805 1....
		± 0.5 %	900 5....	905 5....	700 5....	-	805 5....
	± 25 ppm/K	± 1 %	901 1....	906 1....	701 1....	-	806 1....
		± 0.5 %	901 5....	906 5....	701 5....	-	806 5....
	Jumper	-	900 90001	905 90001	700 90001	-	805 90001
MBB 0207	± 50 ppm/K	± 5 %	910 3....	915 3....	710 3....	-	815 3....
		± 1 %	910 1....	915 1....	710 1....	-	815 1....
		± 0.5 %	910 5....	915 5....	710 5....	-	815 5....
	± 25 ppm/K	± 1 %	911 1....	916 1....	711 1....	-	816 1....
		± 0.5 %	911 5....	916 5....	711 5....	-	816 5....
	Jumper	-	910 90001	915 90001	710 90001	-	815 90001
MBE 0414	± 50 ppm/K	± 5 %	920 3....	-	-	825 3....	-
		± 1 %	920 1....	-	-	825 1....	-
		± 0.5 %	920 5....	-	-	825 5....	-
	± 25 ppm/K	± 1 %	921 1....	-	-	826 1....	-
		± 0.5 %	921 5....	-	-	826 5....	-

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