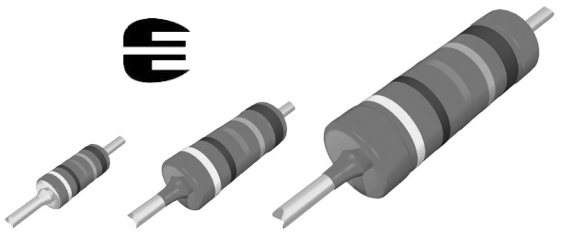
Lead (Pb)-Free Precision Leaded Resistors



FEATURES

- Approved according to CECC 40101-806
- Advanced thin film technology
- Low TC: ± 15 to ± 25 ppm/K
- Precision tolerance of value: ± 0.1 % and ± 0.25 %
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compatible with “Restriction of the use of Hazardous Substances” (RoHS) directive 2002/95/EC (issue 2004)
- Superior overall stability: class 0.05
- Wide precision range: 10 Ω to 1.5 MΩ

DESCRIPTION

MBA 0204, MBB 0207 and MBE 0414 precision leaded thin film 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.

APPLICATIONS

- Test and measuring equipment
- Industrial electronics
- Medical electronics.

METRIC SIZE			
DIN:	0204	0207	0414
CECC:	A	B	D

TECHNICAL SPECIFICATIONS						
DESCRIPTION	**MBA 0204**		**MBB 0207**		**MBE 0414**	
CECC size	**A**		**B**		**D**	
Resistance range	22 Ω to 332 kΩ		10 Ω to 1 MΩ		22 Ω to 1.5 MΩ	
Resistance tolerance	± 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}	0.07 W	0.25 W	0.11 W	0.40 W	0.17 W	0.65 W
Operating voltage, U_{max} AC/DC	200 V		300 V		500 V	
Film temperature	85 °C	125 °C	85 °C	125 °C	85 °C	125 °C
Max. resistance change at P_{70}	100 Ω to 100 kΩ		100 Ω to 270 kΩ		100 Ω to 470 kΩ	
1000 h	≤ 0.05 %	≤ 0.25 %	≤ 0.03 %	≤ 0.15 %	≤ 0.05 %	≤ 0.25 %
8000 h	≤ 0.1 %	≤ 0.5 %	≤ 0.1 %	≤ 0.5 %	≤ 0.1 %	≤ 0.5 %
225000 h	≤ 0.3 %	≤ 1.5 %	≤ 0.3 %	≤ 1.5 %	≤ 0.3 %	≤ 1.5 %
Specified lifetime	225000 h		225000 h		225000 h	
Permissible voltage against ambient :						
1 minute	300 V		500 V		800 V	
continuous	75 V		75 V		75 V	
Failure rate	$\leq 0.7 \times 10^{-9}$/h		$\leq 0.3 \times 10^{-9}$/h		$\leq 0.1 \times 10^{-9}$/h	

12NC INFORMATION

- The resistors have a 12-digit numeric code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packing; see the 12NC Ordering Code table.
- 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 the 12NC Indicating Resistance Decade table.

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

12NC Example

The 12NC code of a MBA 0204 resistor, value 47 kΩ and TC 25 with ± 0.1 % tolerance, supplied on bandolier in a box of 5000 units is: 2312 906 74703.

12NC - resistor type and packing

DESCRIPTION			ORDERING CODE 2312 ... . BANDOLIER IN BOX	
TYPE	T.C.	TOL.	C1 1000 units	CT 5000 units
MBA 0204	± 25 ppm/K	± 0.25 %	901 6....	**906 6....**
		± 0.1 %	901 7....	**906 7....**
	±15 ppm/K	± 0.25 %	902 6....	907 6....
		± 0.1 %	902 7....	**907 7....**
MBB 0207	± 25 ppm/K	± 0.25 %	911 6....	**916 6....**
		± 0.1 %	911 7....	**916 7....**
	± 15 ppm/K	± 0.25 %	912 6....	917 6....
		± 0.1 %	912 7....	**917 7....**
MBE 0414	± 25 ppm/K	± 0.25 %	**921 6....**	–
		± 0.1 %	**921 7....**	–
	± 15 ppm/K	± 0.25 %	922 6....	–
		± 0.1 %	**922 7....**	–

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

PART NUMBER AND PRODUCT DESCRIPTION

PART NUMBER: MBA02040D4702BCT

M	B	A	0	2	0	4	0	D	4	7	0	2	B	C	T		

MODEL/SIZE	SPECIAL CHARACTER	TC	VALUE	TOLERANCE	PACKING	SPECIAL
MBA0204 **MBB0207** **MBE0414**	**0** = neutral	**E** = ± 15 ppm/K **D** = ± 25 ppm/K	**3 digit value** **1 digit multiplier** MULTIPLIER **7** = $*10^{-3}$ **2** = $*10^{2}$ **8** = $*10^{-2}$ **3** = $*10^{3}$ **9** = $*10^{-1}$ **4** = $*10^{4}$ **0** = $*10^{0}$ **5** = $*10^{5}$ **1** = $*10^{1}$ **6** = $*10^{6}$	**B** = ± 0.1 % **C** = ± 0.25 %	**CT** **C1**	up to 2 digits **00** = standard

PRODUCT DESCRIPTION: MBA 0204 -25 0.1% CT 47K

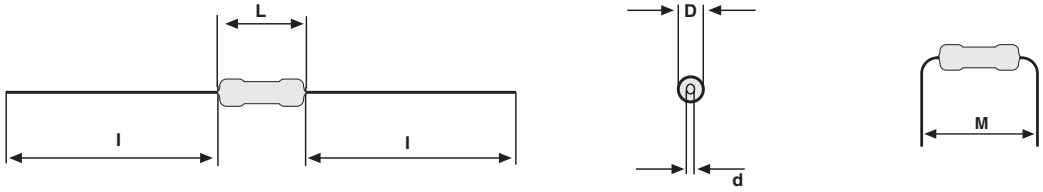
MBA	0204	-25	0.1 %	CT	47K
MODEL	SIZE	TC	TOLERANCE	PACKING[1)]	RESISTANCE VALUE
MBA **MBB** **MBE**	**0204** **0207** **0414**	± **15** ppm/K ± **25** ppm/K	± **0.1** % ± **0.25** %	**CT** **C1**	**47K** = 47KΩ **50R1** = 50.1Ω

[1)] Please refer to table PACKING, page 3.

NOTE: Products can be ordered using either the 12NC or the PRODUCT DESCRIPTION. The PART NUMBER is shown to facilitate the introduction of the unified part numbering system. Currently, this PART NUMBER is applicable in the Americas only.

PACKING		
MODEL	BOX	
	PIECES/BOX	CODE
MBA 0204	1 000 5 000	C1 CT
MBB 0207	1 000 5 000	C1 CT
MBE 0414	1 000 5 000	C1 CT

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 0204	1.6	3.6	0.5	29.0	5.0	125
MBB 0207	2.5	6.3	0.6	28.0	10.0(1)	220
MBE 0414	4.0	11.9	0.8	31.0	15.0	700

Note

1. For 7.5 ≤ M < 10.0 mm, use version MBB 0207 ... L0 without lacquer on the leads.

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE				
DESCRIPTION		RESISTANCE VALUE(1)		
T.C.	TOLERANCE	MBA 0204	MBB 0207	MBE 0414
± 25 ppm/K	± 0.25 %	**22 Ω to 332 kΩ**	**10 Ω to 1 MΩ**	**22 Ω to 1.5 MΩ**
	± 0.1 %	**43 Ω to 332 kΩ**	**10 Ω to 1 MΩ**	**43 Ω to 1 MΩ**
± 15 ppm/K	± 0.25 %	22 Ω to 221 kΩ	10 Ω to 1 MΩ	22 Ω to 1 MΩ
	± 0.1 %	**43 Ω to 221 kΩ**	**10 Ω to 1 MΩ**	**43 Ω to 1 MΩ**

Note

1. Resistance values to be selected from E96 and E192 series, for other values please contact factory.

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

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 (85 % 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. Connecting wires of electrolytic copper plated with 100 pure tin are welded to the termination caps. The resistors are covered by protective coating designed for electrical, mechanical and climatic protection.The terminations receive a final pure tin on nickel plating. Four or 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 stuck directly on the adhesive tapes in accordance with **IEC 60286-1**.

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 encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions.

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 has been proven under extensive testing. All products comply with the CEFIC-EECA-EICTA list of legal restrictions on hazardous substances. This includes full compliance with the following directives:

- 2000/53/EC End of Vehicle Life Directive (ELV)
- 2000/53/EC Annex II to End of Vehicle Life Directive (ELV II)
- 2002/95/EC Restriction of the use of Hazardous Substances Directive (RoHS)
- 2002/96/EC Waste Electrical and Electrical Equipment Directive (WEEE)

APPROVALS

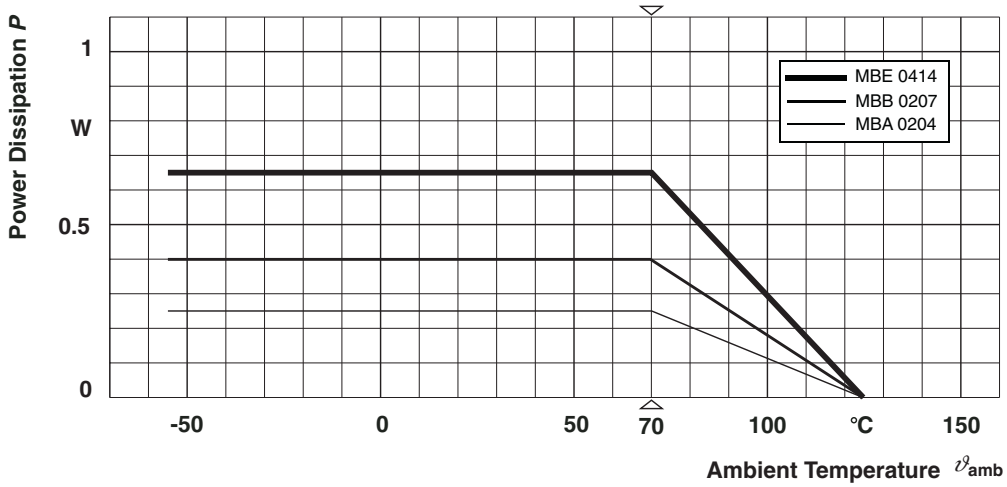
Where applicable, the resistors are tested in accordance with **CECC 40101-806** which refers to **EN 60115-1** and **EN 140100**. Approval of conformity is indicated by the CECC logo on the package label.

Vishay BEYSCHLAG has achieved **"Approval of Manufacturer"** in accordance with **EN 100114-1**.

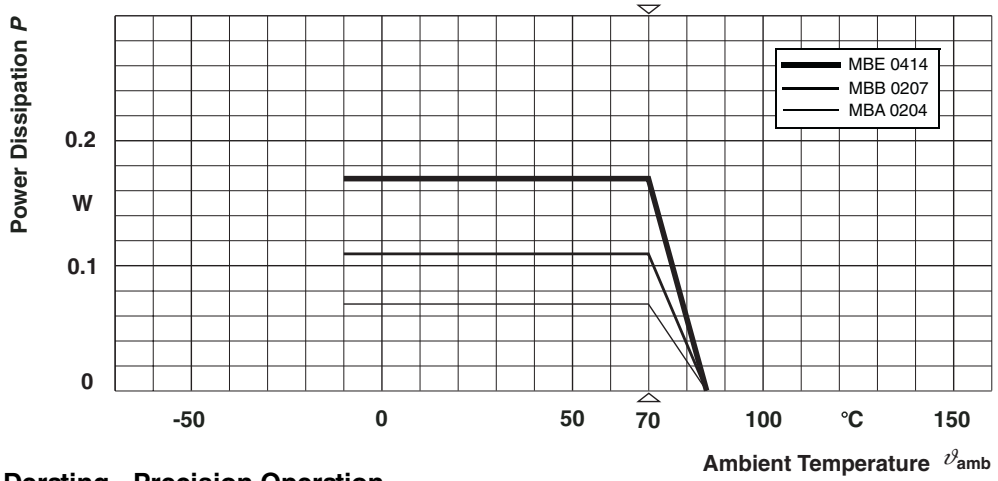
SPECIALS

On request, resistors are available with established reliability in accordance with **CECC 40101-806 Version E**. Please refer to the special data sheet for information on failure rate level, available resistance ranges and ordering codes.

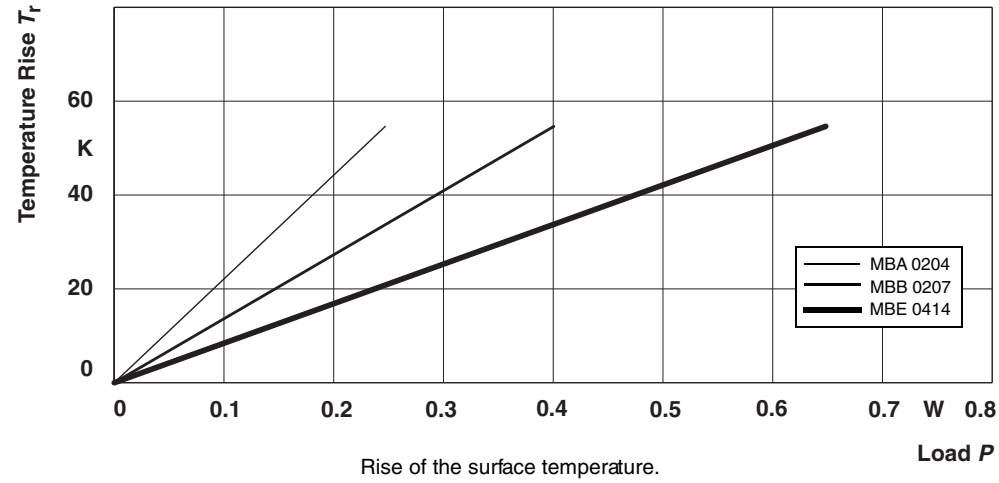
FUNCTIONAL PERFORMANCE



Derating - Long Term Operation

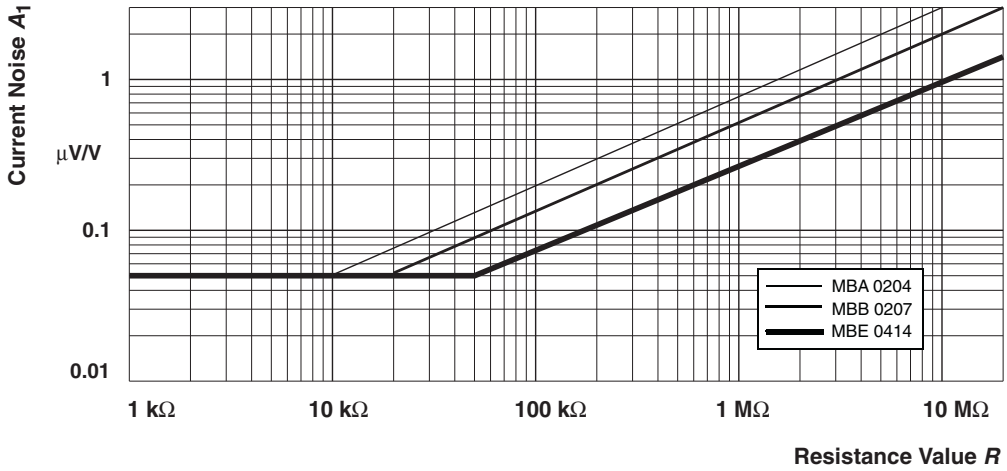


Derating - Precision Operation



Rise of the surface temperature.

Temperature Rise



Current Noise A_1 In Accordance With IEC 60195

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the following specifications:

EN 140000 / IEC 60115-1, Generic specification (includes tests)

EN 140100 / IEC 60115-2, Sectional specification (includes schedule for qualification approval)

CECC 40101-806, Detail specification (includes schedule for conformance inspection)

Most of the components are approved in accordance with the European CECC-system, where applicable. The Test Procedures and Requirements table contains only the most important tests. 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).

For testing the components are mounted on a test board in accordance with IEC 60115-1, 4.31 unless otherwise specified.

In the Test Procedures and Requirements table, only the tests and requirements are listed with reference to the relevant clauses of IEC 60115-1 and IEC 60 068-2; 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 ($\Delta R/R$)		
			stability for product types:	**stability class 0.05**	**stability class 0.1**	**stability class 0.25**
			MBA 0204	100 Ω to 100 kΩ	43 Ω to < 100 Ω; > 100 kΩ to 221 kΩ	22 Ω to < 43 Ω; > 221 kΩ to 332 kΩ
			MBB 0207	100 Ω to 270 kΩ	43 Ω to < 100 Ω; > 270 kΩ to 510 kΩ	10 Ω to < 43 Ω; > 510 kΩ to 1 MΩ
			MBE 0414	100 Ω to 470 kΩ	43 Ω to <100 Ω; > 470 kΩ to 1 MΩ	22 Ω to < 43 Ω; > 1 MΩ to 1.5 MΩ
4.5	–	resistance	–	± 0.25 %; ± 0.1 %		
4.8.4.2	–	temperature coefficient	at 20 / LCT / 20 °C and 20 / UCT / 20 °C	± 25 ppm/K; ±15 ppm/K		
4.25.1	–	endurance at 70 °C: precision operation mode	$U = \sqrt{P_{70} \times R}$ or $U = U_{max}$; 1.5 h on; 0.5 h off			
			70 °C; 1000 h	± (0.05 % +0.01 Ω)(1)	± (0.1 % + 0.01 Ω)	± (0.25 % + 0.05 Ω)(2)
			70 °C; 8000 h	± (0.1 % + 0.01 Ω)	± (0.2 % + 0.01 Ω)	± (0.5 % + 0.05 Ω)
	–	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			

TEST PROCEDURES AND REQUIREMENTS - continued						
IEC 60115-1 CLAUSE	**IEC 60068-2 TEST METHOD**	**TEST**	**PROCEDURE**	**REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)**		
			stability for product types:	**stability class 0.05**	**stability class 0.1**	**stability class 0.25**
			MBA 0204	100 Ω to 100 kΩ	43 Ω to < 100 Ω; > 100 kΩ to 221 kΩ	22 Ω to < 43 Ω; > 221 kΩ to 332 kΩ
			MBB 0207	100 Ω to 270 kΩ	43 Ω to < 100 Ω; > 270 kΩ to 510 kΩ	10 Ω to < 43 Ω; > 510 kΩ to 1 MΩ
			MBE 0414	100 Ω to 470 kΩ	43 Ω to <100 Ω; > 470 kΩ to 1 MΩ	22 Ω to < 43 Ω; > 1 MΩ to 1.5 MΩ
4.24	78 (Cab)	damp heat, steady state	(40 ± 2) °C; 56 days; (93 ± 3) % RH	± (0.05 % +0.01 Ω)	± (0.1 %+0.01 Ω)	± (0.25 % + 0.05 Ω)
4.23		climatic sequence:				
4.23.2	2 (Ba)	dry heat	125 °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 to 35 °C			
4.23.6	30 (Db)	damp heat, cyclic	55 °C; 5 days; 95 to 100% RH; 5 cycles	± (0.05 %+0.01 Ω) no visible damage	± (0.1 %+ 0.01 Ω) no visible damage	± (0.25 %+ 0.05 Ω) no visible damage
4.13	–	short time overload	room temperature; $U = 2.5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max}$; 5 s	± (0.01 % + 0.01 Ω) no visible damage	± (0.02 %+0.01 Ω) no visible damage	± (0.05 %+ 0.01 Ω) no visible damage
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT and 30 minutes at UCT; 5 cycles	± (0.01 % + 0.01 Ω) no visible damage	± (0.02 % + 0.01 Ω) no visible damage	± (0.05 % + 0.01 Ω) no visible damage

TEST PROCEDURES AND REQUIREMENTS - continued						
IEC 60115-1 CLAUSE	**IEC 60068-2 TEST METHOD**	**TEST**	**PROCEDURE**	**REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R/R$)**		
			stability for product types:	**stability class 0.05**	**stability class 0.1**	**stability class 0.25**
			MBA 0204	100 Ω to 100 kΩ	43 Ω to < 100 Ω; > 100 kΩ to 221 kΩ	22 Ω to < 43 Ω; > 221 kΩ to 332 kΩ
			MBB 0207	100 Ω to 270 kΩ	43 Ω to < 100 Ω; > 270 kΩ to 510 kΩ	10 Ω to < 43 Ω; > 510 kΩ to 1 MΩ
			MBE 0414	100 Ω to 470 kΩ	43 Ω to <100 Ω; > 470 kΩ to 1 MΩ	22 Ω to < 43 Ω; > 1 MΩ to 1.5 MΩ
4.29	45 (XA)	component solvent resistance	isopropyl alcohol + 23 °C; toothbrush method	marking legible; no visible damage		
4.18.2	20 (Tb)	resistance to soldering heat	unmounted components; (260 ± 5) °C; (10 ± 1) s	± (0.01 % + 0.01 Ω) no visible damage	± (0.02 % + 0.01 Ω) no visible damage	± (0.05 % + 0.01 Ω) no visible damage
4.17	20 (Ta)	solderability	+ 235 °C; 2 s solder bath method	good tinning (≥ 95 % covered, no visible damage)		
4.22	6 (B4)	vibration	6 h; 10 to 2000 Hz 1.5 mm or 196 m/s^2	± (0.01 % + 0.01 Ω)	± (0.02 % + 0.01 Ω)	± (0.05 %+0.01 Ω)
4.16	21 (Ua_1) 21 (Ub) 21 (Uc)	robustness of terminations	tensile, bending and torsion	± (0.01 % + 0.01 Ω)	± (0.02 %+ 0.01 Ω)	± (0.05 %+0.01 Ω)
4.7	–	voltage proof	U_{rms} = 100 V; 60 s	no flashover or breakdown		
	–		70 °C; 1000 h	± (0.25 %+0.05Ω)(2)	–	–
			70 °C; 8000 h	± (0.5 % +0.05 Ω)	–	–
4.25.3	–	endurance at upper category temperature	85 °C; 1000 h 125 °C; 1000 h	– ± (0.05 % +0.01 Ω)	– ± (0.1 % + 0.01 Ω)	– ± (0.25 % + 0.05 Ω)

Notes

1. ± (0.03 % + 0.01 Ω) for MBB 0207.
2. ± (0.15 % + 0.05 Ω) for MBB 0207.

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