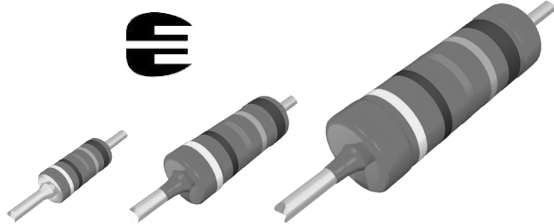




Precision Leaded Resistors



DESCRIPTION

MBA 0204, MBB 0207 and MBE 0414 precision leaded thin film resistors combine the professional 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.

FEATURES

- Approved according to CECC 40101-806
- Advanced thin film technology
- Low TC: ± 15 to ± 25 ppm/K
- Precision tolerance of value: $\pm 0.1\%$ and $\pm 0.25\%$
- Superior overall stability: class 0.05
- Wide precision range: $10\ \Omega$ to $1.5\ \text{M}\Omega$
- Green product, supports lead-free soldering.

APPLICATIONS

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

METRIC SIZE

DIN:	0204	0207	0414
CECC:	A	B	D

TECHNICAL SPECIFICATIONS

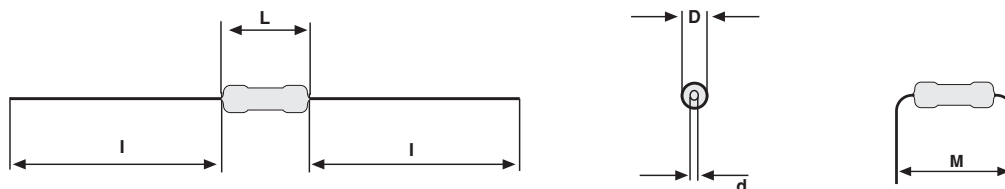
DESCRIPTION	MBA 0204		MBB 0207		MBE 0414	
CECC size	A		B		D	
Resistance range	22 Ω to 332 k Ω		10 Ω to 1 M Ω		22 Ω to 1.5 M Ω	
Resistance tolerance	$\pm 0.25\%$; $\pm 0.1\%$					
Temperature coefficient	± 25 ppm/K; ± 15 ppm/K					
Operation mode	precision	standard	precision	standard	precision	standard
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 $^{\circ}\text{C}$	125 $^{\circ}\text{C}$	85 $^{\circ}\text{C}$	125 $^{\circ}\text{C}$	85 $^{\circ}\text{C}$	125 $^{\circ}\text{C}$
Max. resistance change at P_{70}	100 Ω to 100 k Ω		100 Ω to 270 k Ω		100 Ω to 470 k Ω	
1000 h	$\leq 0.05\%$	$\leq 0.25\%$	$\leq 0.03\%$	$\leq 0.15\%$	$\leq 0.05\%$	$\leq 0.25\%$
8000 h	$\leq 0.1\%$	$\leq 0.5\%$	$\leq 0.1\%$	$\leq 0.5\%$	$\leq 0.1\%$	$\leq 0.5\%$
225000 h	$\leq 0.3\%$	$\leq 1.5\%$	$\leq 0.3\%$	$\leq 1.5\%$	$\leq 0.3\%$	$\leq 1.5\%$
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	$\leq 0.7 \times 10^{-9}/\text{h}$		$\leq 0.3 \times 10^{-9}/\text{h}$		$\leq 0.1 \times 10^{-9}/\text{h}$	

ORDERING INFORMATION - type description and ordering code

M	B	A	0204	-25	0.1 %	CT	47 K
FILM TYPE	PRODUCT CODE	SIZE CODE	DIN SIZE	TEMPERATURE COEFFICIENT	TOLERANCE	PACKAGING	RESISTANCE VALUE
M = Metal	B = Axial Leaded	A = 0204 B = 0207 E = 0414	0204 0207 0414	± 15 ppm/K ± 25 ppm/K	$\pm 0.1\%$ $\pm 0.25\%$	C1 = 1000 units (cardboard box) CT = 5000 units (cardboard box)	See Temperature coefficient and resistance range table

Note: We recommend that the clear text ordering code is used to minimize the possibility of errors in order handling.

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

- For $7.5 \leq M < 10.0$ 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

- 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

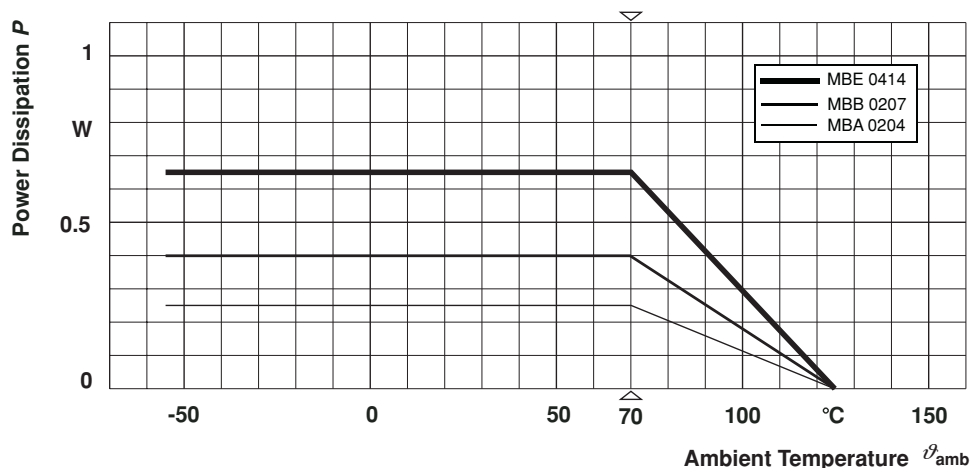
Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A homogeneous film of metal alloy is deposited on a high grade ceramic body (85 % Al₂O₃) and conditioned to achieve the desired temperature coefficient. Nickel plated steel termination caps 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.

FUNCTIONAL PERFORMANCE



Derating - Long Term Operation

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 compatibility 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)

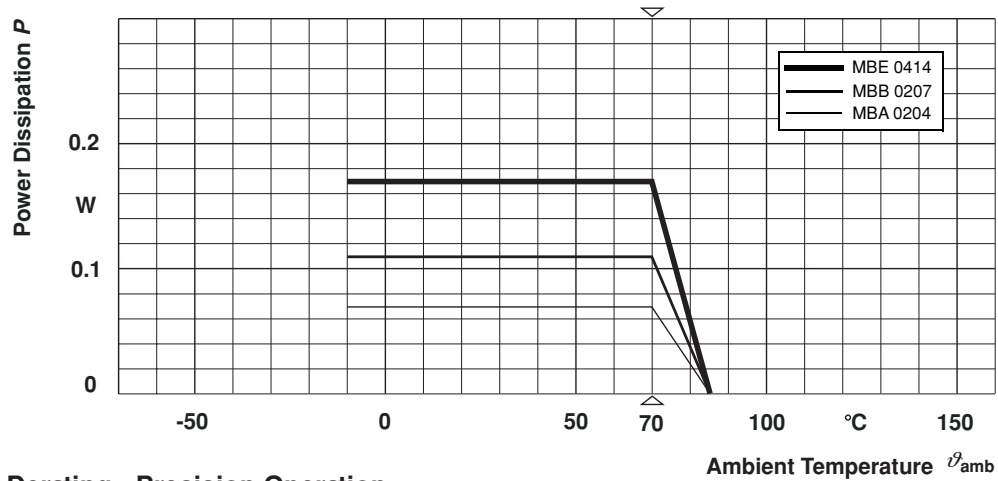
APPROVALS

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.

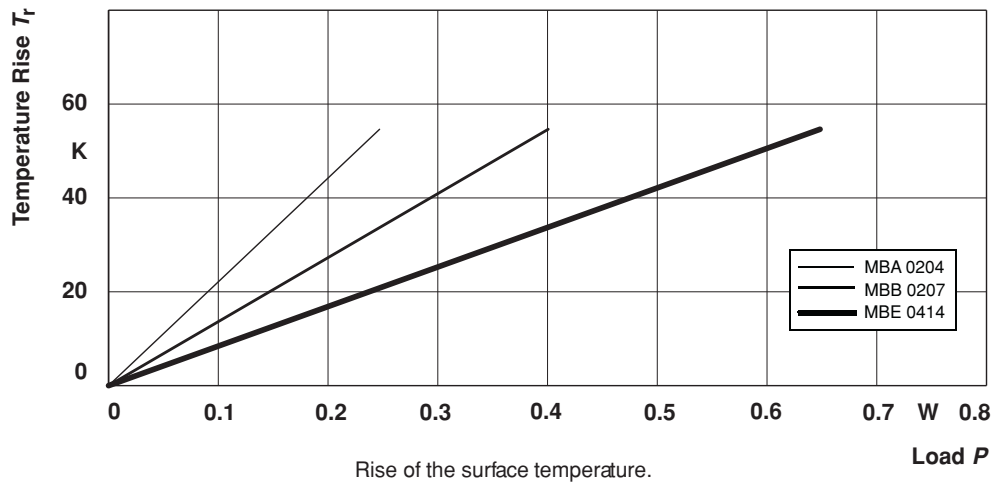
Vishay BEYSCHLAG has achieved "Approval of Manufacturer" in accordance with **EN 100114-1**.

SPECIALS

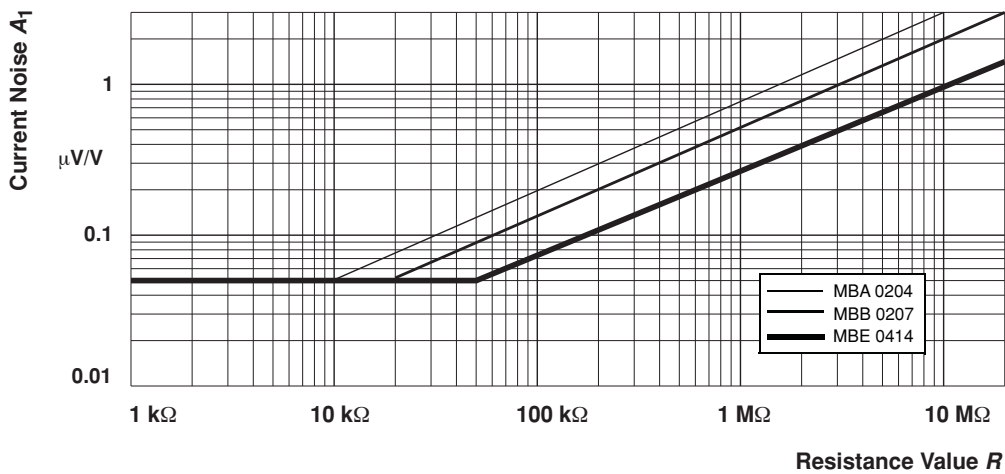
On request, resistors are available with established reliability in accordance with **CECC 40101-806 Version E**. Please refer to the special data sheet for information on failure rate level, available resistance ranges and ordering codes.



Derating - Precision Operation



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 k Ω	43 Ω to < 100 Ω ; > 100 k Ω to 221 k Ω	22 Ω to < 43 Ω ; > 221 k Ω to 332 k Ω
			MBB 0207	100 Ω to 270 k Ω	43 Ω to < 100 Ω ; > 270 k Ω to 510 k Ω	10 Ω to < 43 Ω ; > 510 k Ω to 1 M Ω
			MBE 0414	100 Ω to 470 k Ω	43 Ω to <100 Ω ; > 470 k Ω to 1 M Ω	22 Ω to < 43 Ω ; > 1 M Ω to 1.5 M Ω
4.5	-	resistance	-	$\pm 0.25\%$; $\pm 0.1\%$		
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 70 °C; 8000 h	$\pm (0.05\% + 0.01 \Omega)^{(1)}$ $\pm (0.1\% + 0.01 \Omega)$	$\pm (0.1\% + 0.01 \Omega)$ $\pm (0.2\% + 0.01 \Omega)$	$\pm (0.25\% + 0.05 \Omega)^{(2)}$ $\pm (0.5\% + 0.05 \Omega)$
	-	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 class 0.05	stability class 0.1	stability class 0.25
			stability for product types:			
			MBA 0204	100 Ω to 100 k Ω	43 Ω to < 100 Ω ; > 100 k Ω to 221 k Ω	22 Ω to < 43 Ω ; > 221 k Ω to 332 k Ω
			MBB 0207	100 Ω to 270 k Ω	43 Ω to < 100 Ω ; > 270 k Ω to 510 k Ω	10 Ω to < 43 Ω ; > 510 k Ω to 1 M Ω
			MBE 0414	100 Ω to 470 k Ω	43 Ω to < 100 Ω ; > 470 k Ω to 1 M Ω	22 Ω to < 43 Ω ; > 1 M Ω to 1.5 M Ω
4.24	78 (Cab)	damp heat, steady state	(40 \pm 2) $^{\circ}$ C; 56 days; (93 \pm 3) % RH	\pm (0.05 % + 0.01 Ω)	\pm (0.1 % + 0.01 Ω)	\pm (0.25 % + 0.05 Ω)
4.23		climatic sequence:				
4.23.2	2 (Ba)	dry heat	125 $^{\circ}$ C; 16 h			
4.23.3	30 (Db)	damp heat, cyclic	55 $^{\circ}$ C; 24 h; 90 to 100 % RH; 1 cycle			
4.23.4	1 (Aa)	cold	- 55 $^{\circ}$ C; 2 h			
4.23.5	13 (M)	low air pressure	8.5 kPa; 2 h; 15 to 35 $^{\circ}$ C			
4.23.6	30 (Db)	damp heat, cyclic	55 $^{\circ}$ C; 5 days; 95 to 100% RH; 5 cycles	\pm (0.05 % + 0.01 Ω) no visible damage	\pm (0.1 % + 0.01 Ω) no visible damage	\pm (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	\pm (0.01 % + 0.01 Ω) no visible damage	\pm (0.02 % + 0.01 Ω) no visible damage	\pm (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	\pm (0.01 % + 0.01 Ω) no visible damage	\pm (0.02 % + 0.01 Ω) no visible damage	\pm (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 class 0.05	stability class 0.1	stability class 0.25
			stability for product types:			
			MBA 0204	100 Ω to 100 k Ω	43 Ω to < 100 Ω ; > 100 k Ω to 221 k Ω	22 Ω to < 43 Ω ; > 221 k Ω to 332 k Ω
			MBB 0207	100 Ω to 270 k Ω	43 Ω to < 100 Ω ; > 270 k Ω to 510 k Ω	10 Ω to < 43 Ω ; > 510 k Ω to 1 M Ω
			MBE 0414	100 Ω to 470 k Ω	43 Ω to < 100 Ω ; > 470 k Ω to 1 M Ω	22 Ω to < 43 Ω ; > 1 M Ω to 1.5 M Ω
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 \pm 5) °C; (10 \pm 1) s	\pm (0.01 % + 0.01 Ω) no visible damage	\pm (0.02 % + 0.01 Ω) no visible damage	\pm (0.05 % + 0.01 Ω) no visible damage
4.17	20 (Ta)	solderability	+ 235 °C; 2 s solder bath method	good tinning (\geq 95 % covered, no visible damage)		
4.22	6 (B4)	vibration	6 h; 10 to 2000 Hz 1.5 mm or 196 m/s ²	\pm (0.01 % + 0.01 Ω)	\pm (0.02 % + 0.01 Ω)	\pm (0.05 % + 0.01 Ω)
4.16	21 (Ua ₁) 21 (Ub) 21 (Uc)	robustness of terminations	tensile, bending and torsion	\pm (0.01 % + 0.01 Ω)	\pm (0.02 % + 0.01 Ω)	\pm (0.05 % + 0.01 Ω)
4.7	-	voltage proof	U_{rms} = 100 V; 60 s	no flashover or breakdown		
			70 °C; 1000 h	\pm (0.25 % + 0.05 Ω) ⁽²⁾	-	-
			70 °C; 8000 h	\pm (0.5 % + 0.05 Ω)	-	-
4.25.3	-	endurance at upper category temperature	85 °C; 1000 h 125 °C; 1000 h	- \pm (0.05 % + 0.01 Ω)	- \pm (0.1 % + 0.01 Ω)	- \pm (0.25 % + 0.05 Ω)

Notes

- \pm (0.03 % + 0.01 Ω) for MBB 0207.
- \pm (0.15 % + 0.05 Ω) for MBB 0207.



ORDERING INFORMATION

Components may be ordered by using either a simple clear text ordering code, see "Type Description and Ordering Code" or BCcomponents' unique 12NC.

Type Description and Ordering Code

- We recommend that the clear text ordering code is used to minimize the possibility of errors in order handling.

Numeric Ordering Code (12NC)

- The resistors have a 12-digit ordering code starting with 2312.
- The subsequent 4 digits indicate the resistor type, specification and packaging; 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

Ordering Example

The ordering 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 ORDERING CODE - resistor type and packaging				
DESCRIPTION			ORDERING CODE 2312	
			BANDOLIER IN BOX	
TYPE	T.C.	TOL.	C1 1 000 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.