

Lead (Pb)-Free Ultra Precision Leaded Resistors



DESCRIPTION

A homogeneous film of metal alloy is deposited on a high grade ceramic body. After a helical groove has been cut in the resistive layer, tinned connecting wires of electrolytic copper are welded to the end-caps. The resistors are coated with lacquer which provides electrical, mechanical, and climatic protection.

FEATURES

- Ultra high precision resistors
- Ultra high stability
- Ultra low temperature coefficient
- 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)



APPLICATIONS

- Test and measurement
- Telecom.

TECHNICAL SPECIFICATIONS		
DESCRIPTION	MPR24	
CECC size	B	
Resistance range	10 Ω to 1 M Ω	
Resistance tolerance	$\pm 0.05\%$; $\pm 0.02\%$; $\pm 0.01\%$	$\pm 0.5\%$; $\pm 0.25\%$; $\pm 0.1\%$
Temperature coefficient	± 25 ppm/K; ± 15 ppm/K; ± 10 ppm/K; ± 05 ppm/K	
Climatic category (LCT/UCT/days)	55/125/56	55/155/56
Max. rated dissipation, P_{70}	0.125 W	0.25 W
Operating voltage, U_{max} AC/DC	250 V	
Film temperature	125 $^{\circ}$ C	155 $^{\circ}$ C
Max. resistance change for resistance range, $\Delta R/R$ max., after:		
load	$\pm (0.05\% + 0.01 \Omega)$	
climatic tests	$\pm (0.05\% + 0.01 \Omega)$	
soldering	$\pm (0.01\% + 0.01 \Omega)$	
short time overload	$\pm (0.01\% + 0.01 \Omega)$	
Permissible voltage against ambient :		
1 minute	500 V	
continuous	75 V	
Failure rate	$\leq 0.3 \times 10^{-9}/h$	



12NC INFORMATION

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

- The resistors have a 12-digit numeric code starting with 2322 14.
- The subsequent 3 digits indicate the resistor type, specification and packing; see the 12NC table.
- The remaining 3 digits indicate the resistance value. The number is available upon request and is fixed by the supplier.

12NC Example

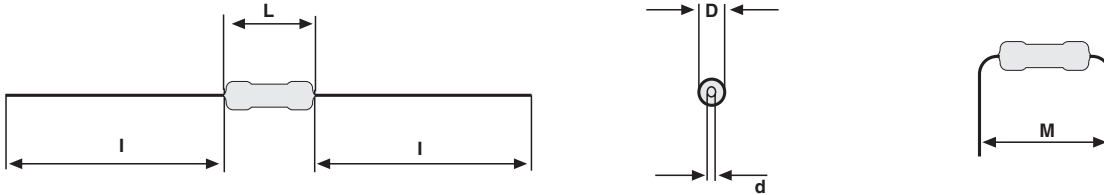
The 12NC of an MPR24 resistor with tolerance of $\pm 0.02\%$ and TC ± 05 ppm/K, taped on bandolier in box of 100 units starts with 2322 141 77...; the last 3 digits are available upon request and are fixed by the supplier.

12NC - resistor type and packing					
DESCRIPTION			ORDERING CODE 2322 14.		
			BANDOLIER IN BOX	BANDOLIER IN BOX	BANDOLIER ON REEL
TYPE	T.C.	TOL.	100 units	1000 units	5000 units
MPR24	± 25 ppm/K	$\pm 0.5\%$	1 00...	1 10...	3 10...
		$\pm 0.25\%$	1 20...	1 30...	3 30...
		$\pm 0.1\%$	1 40...	1 50...	3 50...
		$\pm 0.05\%$	1 64...	3 64...	-
		$\pm 0.02\%$	1 74...	3 74...	-
		$\pm 0.01\%$	1 84...	3 84...	-
	± 15 ppm/K	$\pm 0.5\%$	1 05...	1 15...	3 15...
		$\pm 0.25\%$	1 25...	1 35...	3 35...
		$\pm 0.1\%$	1 45...	1 55...	3 55...
		$\pm 0.05\%$	1 65...	3 65...	-
		$\pm 0.02\%$	1 75...	3 75...	-
		$\pm 0.01\%$	1 85...	3 85...	-
	± 10 ppm/K	$\pm 0.5\%$	1 06...	1 16...	3 16...
		$\pm 0.25\%$	1 26...	1 36...	3 36...
		$\pm 0.1\%$	1 46...	1 56...	3 56...
		$\pm 0.05\%$	1 66...	3 66...	-
		$\pm 0.02\%$	1 76...	3 76...	-
		$\pm 0.01\%$	1 86...	3 86...	-
	± 05 ppm/K	$\pm 0.5\%$	1 07...	1 17...	3 17...
		$\pm 0.25\%$	1 27...	1 37...	3 37...
$\pm 0.1\%$		1 47...	1 57...	3 57...	
$\pm 0.05\%$		1 67...	3 67...	-	
$\pm 0.02\%$		1 77...	3 77...	-	
$\pm 0.01\%$		1 87...	3 87...	-	

PART NUMBER																	
PART NUMBER: MPR24000E1001DC1																	
M	P	R	2	4	0	0	0	E	1	0	0	1	D	C	1		
MODEL/SIZE	SPECIAL CHARACTER		TC			VALUE			TOLERANCE		PACKING		SPECIAL				
MPR2400	0 = neutral		Z = ± 5 ppm/K Y = ± 10 ppm/K X = ± 15 ppm/K E = ± 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 = $*10^6$			T = $\pm 0.01\%$ H = $\pm 0.02\%$ A = $\pm 0.05\%$ B = $\pm 0.1\%$ C = $\pm 0.25\%$ D = $\pm 0.5\%$		RP CU C1		up to 2 digits 00 = standard				

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

DIMENSIONS



DIMENSIONS - leaded resistor types, mass and relevant physical dimensions

TYPE	D_{max} (mm)	L_{max} (mm)	d_{nom} (mm)	I_{min} (mm)	M_{min} (mm)	MASS (mg)
MPR 24	2.5	6.3	0.6	28.0	7.5	220

SCRIPT MARKING⁽¹⁾

TEMPERATURE COEFFICIENT AND TOLERANCE - printed resistance value and letter coding

RESISTANCE VALUE	TOL. (%)	LETTER CODE	TC (ppm/K)	LETTER CODE
Clear text code for value	± 0.5	D	± 25	E
	± 0.25	C	± 15	F
	± 0.1	B	± 10	B
	± 0.05	A	± 05	A
	± 0.02	P	-	-
	± 0.01	T	-	-

Note

- Resistors of T.C. ± 25 ppm/K in combination with tolerances ± 0.5 %, ± 0.25 % and ± 0.1 % are only available with colour coding in accordance with IEC 60062.

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE

DESCRIPTION		RESISTANCE VALUE ⁽²⁾
T.C. ⁽¹⁾	TOLERANCE	MPR24
± 25 ppm/K	± 0.5 %	10 Ω to 1 MΩ
	± 0.25 %	10 Ω to 1 MΩ
	± 0.1 %	10 Ω to 1 MΩ
	± 0.05 %	24 Ω to 100 kΩ
	± 0.02 %	24 Ω to 100 kΩ
	± 0.01 %	24 Ω to 100 kΩ
± 15 ppm/K	± 0.5 %	10 Ω to 1 MΩ
	± 0.25 %	10 Ω to 1 MΩ
	± 0.1 %	10 Ω to 1 MΩ
	± 0.05 %	24 Ω to 100 kΩ
	± 0.02 %	24 Ω to 100 kΩ
	± 0.01 %	24 Ω to 100 kΩ
± 10 ppm/K	± 0.5 %	10 Ω to 1 MΩ
	± 0.25 %	10 Ω to 1 MΩ
	± 0.1 %	10 Ω to 1 MΩ
	± 0.05 %	24 Ω to 100 kΩ
	± 0.02 %	24 Ω to 100 kΩ
	± 0.01 %	24 Ω to 100 kΩ
± 05 ppm/K	± 0.5 %	10 Ω to 1 MΩ
	± 0.25 %	10 Ω to 1 MΩ
	± 0.1 %	10 Ω to 1 MΩ
	± 0.05 %	24 Ω to 100 kΩ
	± 0.02 %	24 Ω to 100 kΩ
	± 0.01 %	24 Ω to 100 kΩ

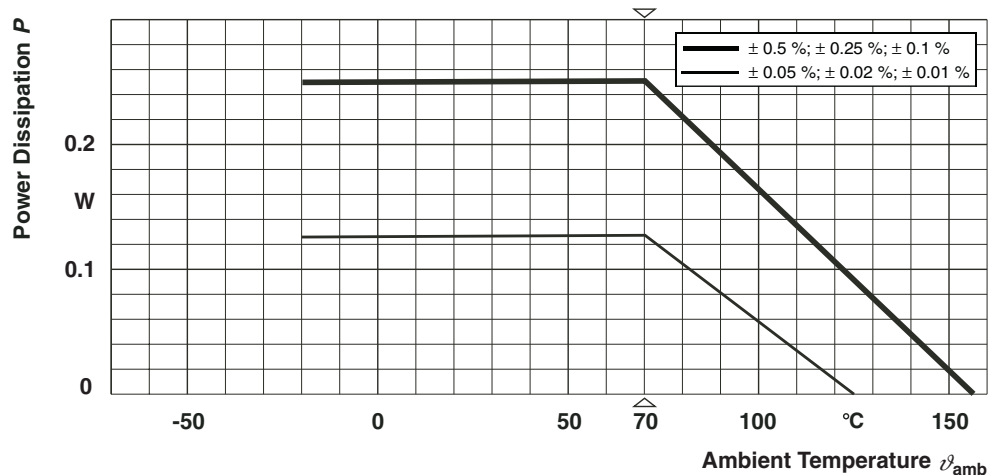
Notes

- The temperature coefficient is specified over the temperature range + 20 °C to + 70 °C.
- Resistance values to be selected from E192 series, for other values please contact the factory.



PACKING				
MODEL	REEL		BOX	
	PIECES/REEL	CODE	PIECES/BOX	CODE
MPR24	5 000	RP	100 1 000	CU C1

FUNCTIONAL PERFORMANCE



Derating - Depending on Resistance Tolerances

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 following 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 60 068 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 60068-2; 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: MPR24	24 Ω to 100 k Ω	4.99 Ω to < 24 Ω ; > 100 k Ω to 1 M Ω
4.5	–	resistance	–	$\pm 0.5\%$; $\pm 0.25\%$; $\pm 0.1\%$; $\pm 0.05\%$; $\pm 0.02\%$; $\pm 0.01\%$	$\pm 0.5\%$; $\pm 0.25\%$; $\pm 0.1\%$
4.8.4.2	–	temperature coefficient	at 20 / 70 / 20 $^{\circ}\text{C}$ at 20 / LCT / 20 $^{\circ}\text{C}$ and	± 25 ppm/K; ± 15 ppm/K; ± 10 ppm/K; ± 05 ppm/K	± 25 ppm/K
4.25.1	–	endurance at 70 $^{\circ}\text{C}$	$U = \sqrt{P_{70} \times R}$ or $U = U_{\text{max}}$; 1.5 h on; 0.5 h off 70 $^{\circ}\text{C}$; 2000 h		$\pm (0.05\% + 0.01 \Omega)$
4.24	78 (Cab)	damp heat, steady state	(40 ± 2) $^{\circ}\text{C}$; 56 days; (93 ± 3) % RH		$\pm (0.05\% + 0.01 \Omega)$
4.23		climatic sequence:			
4.23.2	2 (Ba)	dry heat	125 $^{\circ}\text{C}$; 16 h		
4.23.3	30 (Db)	damp heat, cyclic	55 $^{\circ}\text{C}$; 24 h; 90 to 100 % RH; 1 cycle		
4.23.4	1 (Aa)	cold	–55 $^{\circ}\text{C}$; 2 h		
4.23.5	13 (M)	low air pressure	8.5 kPa; 2 h; 15 to 35 $^{\circ}\text{C}$		
4.23.6	30 (Db)	damp heat, cyclic	55 $^{\circ}\text{C}$; 5 days; 95 to 100 % RH; 5 cycles		$\pm (0.05\% + 0.01 \Omega)$ no visible damage
4.13	–	short time overload	room temperature; $U = 2.5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{\text{max}}$; 5 s		$\pm (0.01\% + 0.01 \Omega)$ no visible damage
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT and 30 minutes at UCT; 5 cycles		$\pm (0.01\% + 0.01 \Omega)$ no visible damage
4.29	45 (XA)	component solvent resistance	isopropyl alcohol +23 $^{\circ}\text{C}$; toothbrush method		marking legible; no visible damage



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: MPR24	24 Ω to 100 k Ω	4.99 Ω to < 24 Ω ; > 100 k Ω to 1 M Ω
4.18.2	20 (Tb)	resistance to soldering heat	unmounted components; (260 \pm 5) $^{\circ}$ C; (10 \pm 1) s	\pm (0.01 % + 0.01 Ω) no visible damage	
4.17	20 (Ta)	solderability	+ 235 $^{\circ}$ C; 2 s solder bath method	good tinning (\geq 95 % coverage);	
4.22	6 (B4)	vibration	6 h; 10 to 2 000 Hz 1.5 mm or 196 m/s ²	\pm (0.01 % + 0.01 Ω); no visible damage	
4.16	21 (Ua ₁) 21 (Ub) 21 (Uc)	robustness of terminations	tensile, bending and torsion	\pm (0.01 % + 0.01 Ω); no visible damage	
4.7	–	voltage proof	U_{rms} = 100 V; 60 s	no flashover or breakdown	
4.12	–	noise	IEC 60 195: R \leq 100 k Ω R > 100 k Ω	max. 0.25 μ V/V max. 0.5 μ V/V	



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