

## High Precision Thin Film Leaded Resistors



### DESCRIPTION

A homogenous 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

- High precision resistors (TCR up to  $\pm 5$  ppm/K, 0.01 % tol.)
- High stability (0.05 %)
- Low temperature coefficient (up to  $\pm 5$  ppm/K)
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Compliant to RoHS directive 2002/95/EC



**RoHS**  
COMPLIANT

### APPLICATIONS

- Test and measurement
- Telecom

TECHNICAL SPECIFICATIONS		
DESCRIPTION	MPR24	
CECC Size, DIN Size	B, 0207	
Resistance Range	10 $\Omega$ to 1 M $\Omega$	
Resistance Tolerance	$\pm 0.05$ %; $\pm 0.02$ %; $\pm 0.01$ %	$\pm 0.5$ %; $\pm 0.25$ %; $\pm 0.1$ %
Temperature Coefficient	$\pm 25$ ppm/K; $\pm 15$ ppm/K; $\pm 10$ ppm/K; $\pm 05$ ppm/K	
Climatic Category (LCT/UCT/Days)	55/125/56	55/155/56
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, $\Delta R$ max., After:		
Load (1000 h, $P_{70}$ )	$\pm (0.05$ % $R + 0.01$ $\Omega)$	
Long Term Damp Heat Test (56 Days)	$\pm (0.05$ % $R + 0.01$ $\Omega)$	
Soldering (10 s, 260 $^{\circ}$ C)	$\pm (0.01$ % $R + 0.01$ $\Omega)$	
Permissible Voltage Against Ambient :		
1 Minute; $U_{ins}$	500 V	
Continuous	75 V	
Failure Rate	$\leq 0.1 \times 10^{-9}$ /h	

**PART NUMBER AND PRODUCT DESCRIPTION**

**PART NUMBER: MPR24000E1001DC100**

M	P	R	2	4	0	0	0	E	1	0	0	1	D	C	1	0	0
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<b>MODEL/SIZE</b> MPR2400	<b>VARIANT</b> 0 = Neutral	<b>TCR</b> Z = ± 5 ppm/K Y = ± 10 ppm/K X = ± 15 ppm/K E = ± 25 ppm/K	<b>VALUE</b> 3 digit value 1 digit multiplier MULTIPLIER 9 = *10 <sup>-1</sup> 2 = *10 <sup>2</sup> 0 = *10 <sup>0</sup> 3 = *10 <sup>3</sup> 1 = *10 <sup>1</sup> 4 = *10 <sup>4</sup>	<b>TOLERANCE</b> T = ± 0.01 % H = ± 0.02 % A = ± 0.05 % B = ± 0.1 % C = ± 0.25 % D = ± 0.5 %	<b>PACKAGING (1)</b> RP CU C1	<b>SPECIAL</b> Up to 2 digits 00 = Standard
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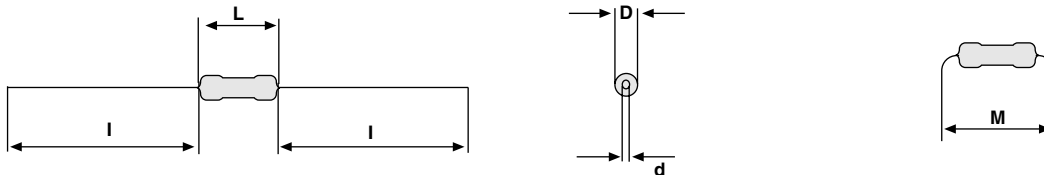
**PRODUCT DESCRIPTION: MPR24 - 25 0.5 % C1 1K0**

<b>MPR24</b> MODEL/SIZE MPR24	<b>25</b> TCR ± 5 ppm/K ± 10 ppm/K ± 15 ppm/K ± 25 ppm/K	<b>0.5 %</b> TOLERANCE ± 0.01 % ± 0.02 % ± 0.05 % ± 0.1 % ± 0.25 % ± 0.5 %	<b>C1</b> PACKAGING (1) RP CU C1	<b>1K0</b> RESISTANCE VALUE 1K0 = 1 kΩ 50R5 = 50.5 Ω
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**Notes**

(1) Please refer to table PACKAGING for complete information

- The PART NUMBER is shown to facilitate the introduction of a unified part numbering system for ordering products

**DIMENSIONS**

**DIMENSIONS - Leaded resistor types, mass and relevant physical dimensions**

TYPE	D <sub>max.</sub> (mm)	L <sub>max.</sub> (mm)	d <sub>nom.</sub> (mm)	I <sub>min.</sub> (mm)	M <sub>min.</sub> (mm)	MASS (mg)
MPR 24	2.5	6.3	0.6	28.0	7.5	220

**SCRIPT MARKING (2)**
**TEMPERATURE COEFFICIENT AND TOLERANCE - Printed resistance value and letter coding**

RESISTANCE VALUE	TOL. (%)	LETTER CODE	TCR (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**

(2) Resistors of TCR ± 25 ppm/K in combination with tolerances ± 0.5 %, ± 0.25 % and ± 0.1 % are only available with color coding in accordance with IEC 60062.

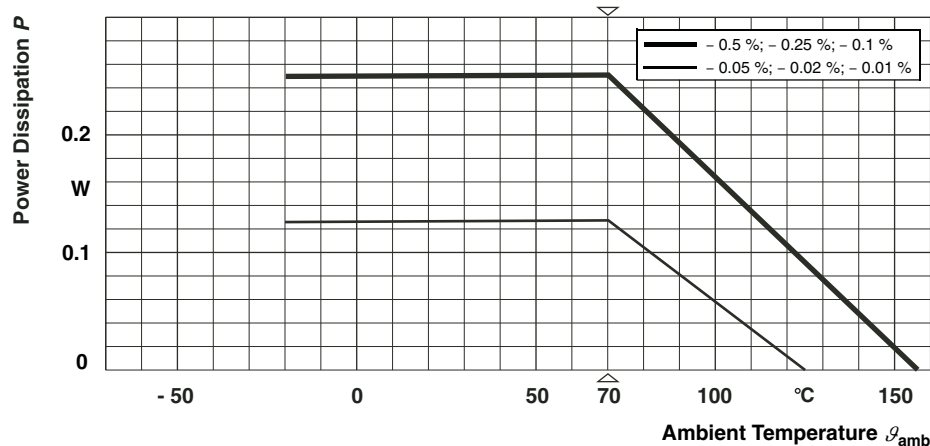
TEMPERATURE COEFFICIENT AND RESISTANCE RANGE		
TCR (1)	DESCRIPTION	RESISTANCE VALUE (2)
± 25 ppm/K	TOLERANCE	MPR24
	± 0.5 %	10 Ω to 1 MΩ
	± 0.25 %	10 Ω to 1 MΩ
	± 0.1 %	10 Ω to 1 MΩ
	± 0.05 %	24 Ω to 100 kΩ
	± 0.02 %	24 Ω to 100 kΩ
± 15 ppm/K	± 0.5 %	10 Ω to 1 MΩ
	± 0.25 %	10 Ω to 1 MΩ
	± 0.1 %	10 Ω 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
± 5 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**

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

PACKAGING				
MODEL	REEL		BOX	
	PIECES/REEL	CODE	PIECES/BOX	CODE
MPR24	5000	RP	100 1000	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 60115-1, Generic specification (includes tests)

EN 140100, 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 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, 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 1060 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-xx test methods. A short description of the test procedure is also given.

TEST PROCEDURES AND REQUIREMENTS				
IEC 60115-1 CLAUSE	IEC 60068-2-xx TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ( $\Delta R$ )
			Stability for product types:	24 $\Omega$ to 100 k $\Omega$ 4.99 $\Omega$ to < 24 $\Omega$ ; > 100 k $\Omega$ to 1 M $\Omega$
4.5	-	Resistance ( $\Delta R/R$ )	-	$\pm 0.5\%$ ; $\pm 0.25\%$ ; $\pm 0.1\%$ ; $\pm 0.05\%$ ; $\pm 0.02\%$ ; $\pm 0.01\%$ $\pm 0.5\%$ ; $\pm 0.25\%$ ; $\pm 0.1\%$
4.8	-	Temperature coefficient	At 20/70/20 °C	$\pm 25$ ppm/K; $\pm 15$ ppm/K; $\pm 10$ ppm/K; $\pm 05$ ppm/K
			At 20/LCT/20 °C and 20/UCT/20 °C	$\pm 25$ ppm/K
4.25.1	-	Endurance at 70 °C	$U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$ ; 1.5 h ON; 0.5 h OFF  70 °C; 2000 h	$\pm (0.05\% R + 0.01 \Omega)$
4.24	78 (Cab)	Damp heat, steady state	(40 $\pm$ 2) °C; 56 days; (93 $\pm$ 3) % RH	$\pm (0.05\% R + 0.01 \Omega)$
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 °C to 35 °C	

TEST PROCEDURES AND REQUIREMENTS				
IEC 60115-1 CLAUSE	IEC 60068-2-xx TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ( $\Delta R$ )
			Stability for product types:	24 $\Omega$ to 100 k $\Omega$ 4.99 $\Omega$ to < 24 $\Omega$ ; > 100 k $\Omega$ to 1 M $\Omega$
4.23.6	30 (Db)	Damp heat, cyclic	55 °C; 5 days; 95 % to 100 % RH; 5 cycles	$\pm (0.05 \% R + 0.01 \Omega)$ no visible damage
4.13	-	Short time overload	Room temperature; $U = 2.5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max.}$ ; 5 s	$\pm (0.01 \% R + 0.01 \Omega)$ no visible damage
4.19	14 (Na)	Rapid change of temperature	30 min at LCT= - 55 °C and 30 min at UCT = 155 °C 5 cycles 200 cycles	$\pm (0.01 \% R + 0.01 \Omega)$ $\pm (0.25 \% R + 0.05 \Omega)$
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 $\pm$ 3) °C; (10 $\pm$ 1) s	$\pm (0.01 \% R + 0.01 \Omega)$ no visible damage
4.17	20 (Ta)	Solderability	+ 235 °C; 2 s solder bath method; SnPb40	Good tinning ( $\geq$ 95 % covered, no visible damage)
			+ 245 °C; 3 s solder bath method; SnAg3Cu0.5	
4.22	6 (B4)	Vibration	6 h; 10 Hz to 2000 Hz 1.5 mm or 196 m/s <sup>2</sup>	$\pm (0.01 \% R + 0.01 \Omega)$ ; no visible damage
4.16	21 (Ua <sub>1</sub> ) 21 (Ub) 21 (Uc)	Robustness of terminations	Tensile, bending and torsion	$\pm (0.01 \% R + 0.01 \Omega)$ ; no visible damage
4.7	-	Voltage proof	$U_{RMS} = U_{ins}$ ; 60 s	No flashover or breakdown
4.12	-	Noise	IEC 60195: $R \leq 100 \text{ k}\Omega$ $R > 100 \text{ k}\Omega$	max. 0.25 $\mu\text{V/V}$ max. 0.5 $\mu\text{V/V}$
4.40	-	Electrostatic discharge (human body model)	IEC 61340-3-1; 3 pos. + 3 neg. 4 kV	$\pm (0.5 \% + 0.05 \Omega)$



**12NC INFORMATION FOR HISTORICAL CODING REFERENCE**

- The resistors have a 12-digit numeric code starting with 2322 14.
- The subsequent 3 digits indicate the resistor type, specification and packaging; 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 TCR  $\pm 05$  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.

<b>12NC - Resistor type and packaging</b>					
DESCRIPTION			2322 14. ....		
			BANDOLIER IN BOX	BANDOLIER IN BOX	BANDOLIER ON REEL
TYPE	TCR	TOL.	100 units	1000 units	5000 units
MPR24	$\pm 25$ 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...	-
	$\pm 15$ 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...	-
	$\pm 10$ 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...	-
	$\pm 5$ 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...	-



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