General Purpose Chip Resistors

Anti-Sulfuration

Features:

- High reliability and stability ±1%
- Sulfuration resistant
- Automotive grade AEC Q-200 compliant
- 100% CCD inspection
- Lead-free

Applications:

Automotive application
Consumer electrical equipment
EDP, computer application
Telecom application

RoHS Compliant

Description

The resistors are constructed in a high grade ceramic body (aluminium oxide). Internal metal electrodes are added at each end and connected by a resistive paste that is applied to the top surface of the substrate. The composition of the paste is adjusted to give the approximate resistance required and the value is trimmed to within tolerance by laser cutting of this resistive layer

The resistive layer is covered with a protective coat. Finally, the two external end terminations are added. For ease of soldering the outer layer of these end terminations is a Tin (lead free) alloy

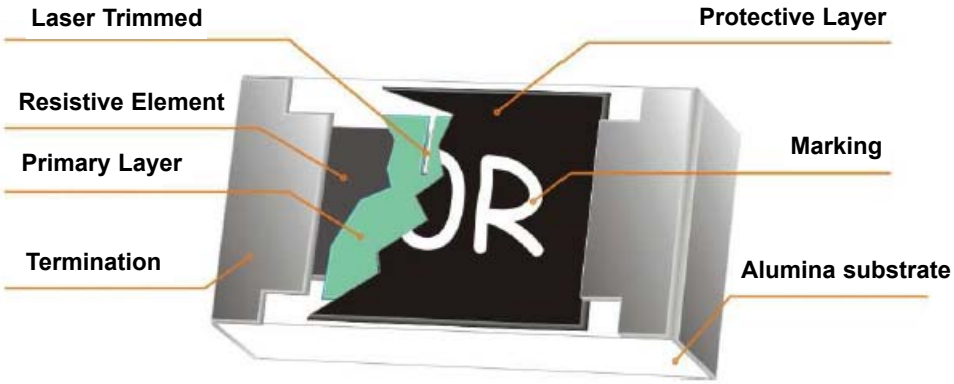


Fig 1. Construction of a Chip-R

Quick Reference Data

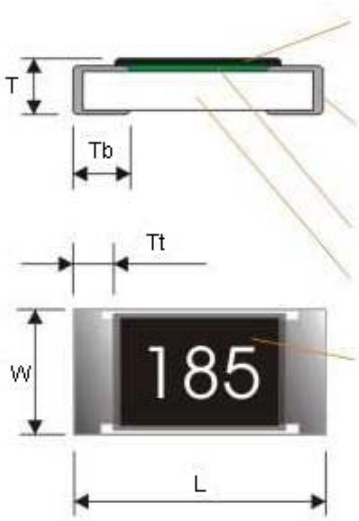
Item	General Specification							
Series no.	MCMR12		MCMR08		MCMR06		MCMR04	
Size code	1206 (3216)		0805 (2012)		0603 (1608)		0402 (1005)	
Resistance range	1 Ω to 10 MΩ (±5% tolerance), jumper 1 Ω to 10 MΩ (±1% tolerance)							
Resistance tolerance	±1% E96 / E24	±5% E24	±1% E96 / E24	±5% E24	1% E96 / E24	±5% E24	±1% E96 / E24	±5% E24
TCR (ppm/°C) R > 1MΩ 10Ω < R ≤ 1MΩ R ≤ 10Ω	≤ +200 ≤ +100 -200 to +400		≤ +200 ≤ +100 -200 to +400		≤ +200 ≤ +100 -200 to +400		≤ +200 ≤ +100 -200 to +400	
Maximum dissipation at T_{amb} = 70°C	1/4 W		1/8 W		1/10 W		1/16 W	
Maximum operation voltage (DC or RMS)	200 V		150 V		75 V		50 V	
Maximum overload voltage (DC or RMS)	400 V		300 V		150 V		100 V	
Climatic category (IEC 60068)	55/155/56							

Note:

1. This is the maximum voltage that may be continuously supplied to the resistor element, see “IEC publication 60115-8”
2. Maximum operation voltage : So called RCWV (rated continuous working voltage) is determined by

$$RCWV = \sqrt{\text{Rated Power} \times \text{Resistance Value}}$$ or maximum RCWV listed above, whichever is lower

3. The resistance of jumper is defined < 0.05 Ω



Protective Coat

End Termination

Resistive Layer

Ceramic Substrate

Protective Coat

Dimensions (unit : mm)

	MCMR12	MCMR08	MCMR06	MCMR04
L	3.1 ± 0.1	2 ± 0.1	1.6 ± 0.1	1 ± 0.05
W	1.6 ± 0.1	1.25 ± 0.1	0.8 ± 0.1	0.5 ± 0.05
T	0.6 ± 0.15	0.5 ± 0.15	0.45 ± 0.15	0.35 ± 0.05
Tb	0.45 ± 0.2	0.4 ± 0.2	0.3 ± 0.15	0.25 ± 0.1
Tt	0.5 ± 0.2	0.4 ± 0.2	0.3 ± 0.1	0.2 ± 0.1

Marking

Size \ No. of Digit of Code \ Tolerance	±5%	±1%
1206 / 0805	3-digits marking	4-digits marking
0603 (1608)	3-digits marking	3-digits marking
0402 (1005)	No marking	

3-digits marking (±5% : 1206, 0805 and 0603)

Each resistor is marked with a three digits code on the protective coating to designate the nominal resistance value

3-Digits Marking (1% : 0603)

Nominal Resistance	Description
1. E-24 series	As 0603 WR06X ±5%
2. E-96 series	The 1st two digit codes are referring to the CODE on the table, the 3rd code is the index of resistance value: Y = 10^{-2}, X = 10^{-1}, A = 10^{0}, B = 10^{1}, C = 10^{2}, D = 10^{3}, E = 10^{4}, F = 10^{5} EX : 17.8 Ω = 25 X, 178 Ω = 25 A, 1K78 = 25 B 17K8 = 25 C, 178 K = 25 D, 1M78 = 25 E
3. Remark	There is no marking for the items are not under E-24 and E-96 series

Code	R_value	Code	R_value	Code	R_value	Code	R_value	Code	R_value	Code	R_value	Code	R_value	Code	R_value
1	100	13	133	25	178	37	237	49	316	61	422	73	562	85	750
2	102	14	137	26	182	38	243	50	324	62	432	74	576	86	768
3	105	15	140	27	187	39	249	51	332	63	442	75	590	87	787
4	107	16	143	28	191	40	255	52	340	64	453	76	604	88	806
5	110	17	147	29	196	41	261	53	348	65	464	77	619	89	825
6	113	18	150	30	200	42	267	54	357	66	475	78	634	90	845
7	115	19	154	31	205	43	274	55	365	67	487	79	649	91	866
8	118	20	158	32	210	44	280	56	374	68	499	80	665	92	887
9	121	21	162	33	215	45	287	57	383	69	511	81	681	93	909
10	124	22	165	34	221	46	294	58	392	70	523	82	698	94	931
11	127	23	169	35	226	47	301	59	402	71	536	83	715	95	953
12	130	24	174	36	232	48	309	60	412	72	549	84	732	96	976

4-digits marking (±1% : 1206 / 0805)

Each resistor is marked with a three digits code on the protective coating to designate the nominal resistance value

Example

Resistance	10 Ω	12 Ω	100 Ω	6,800 Ω	47,000 Ω
3-digits marking(1206, 0805, 0603 ±5%)	100	120	101	682	473
4-digits marking	10R0	12R0	1000	6801	4702

Functional Description

Product characterization

Standard values of nominal resistance are taken from the E24 series for resistors with a tolerance of ±5%, and E24+E96 series for resistors with a tolerance of ±1%. The values of the E24 / E96 series are in accordance with “IEC publication 60063”

Derating

The power that the resistor can dissipate depends on the operating temperature; see Fig. 2.1

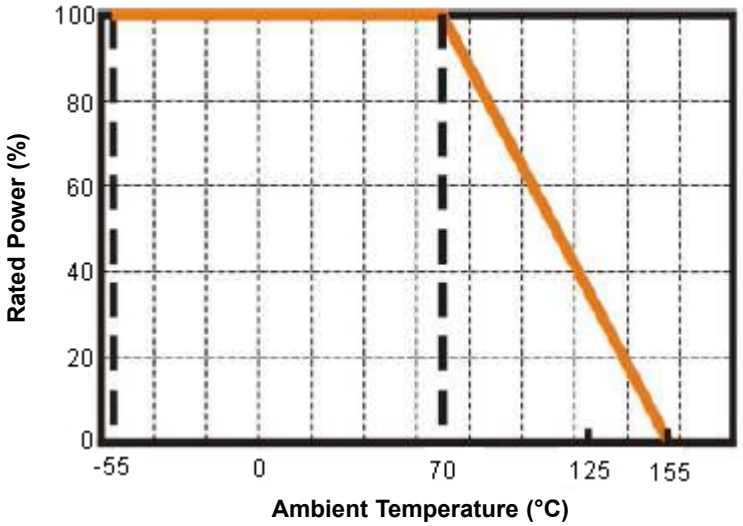


Fig 2.1 Maximum dissipation in percentage of rated power as a function of the ambient temperature

Mounting:

Due to their rectangular shapes and small tolerances, surface mountable resistors are suitable for handling by automatic placement systems
Chip placement can be on ceramic substrates and printed-circuit boards (PCBs)
Electrical connection to the circuit is by individual soldering condition
The end terminations guarantee a reliable contact

Soldering Condition

The robust construction of chip resistors allows them to be completely immersed in a solder bath of 260°C for 10 seconds. Therefore, it is possible to mount surface mount resistors on one side of a PCB and other discrete components on the reverse (mixed PCBs)

Surface mount resistors are tested for solderability at 235°C during 2 seconds. The test condition for no leaching is 260°C for 30 seconds. Typical examples of soldering processes that provide reliable joints without any damage are given in Fig 3

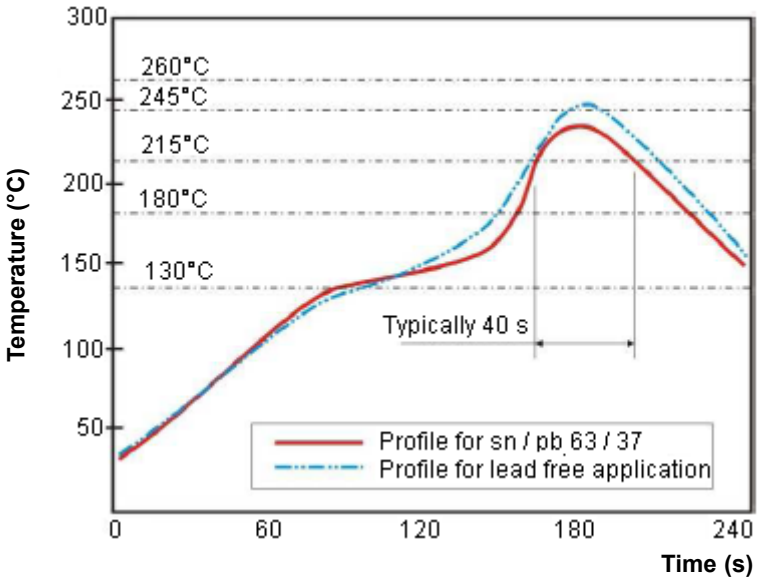


Fig 3. Infrared soldering profile for Chip Resistors

Test and Requirements

Essentially all tests are carried out according to the schedule of IEC publication 115-8, category **LCT/UCT**/56(rated temperature range : Lower Category Temperature, Upper Category Temperature; damp heat, long term, 56 days). The testing also meets the requirements specified by EIA, EIAJ and JIS
The tests are carried out in accordance with IEC publication 68, "Recommended basic climatic and mechanical robustness testing procedure for electronic components" and under standard atmospheric conditions according to IEC 60068-1, sub-clause 5.3. Unless otherwise specified, the following value supplied :
Temperature : 15 to 35°C
Relative humidity : 45 to 75%
Air pressure : 86 kPa to 106 kPa (860 mbar to 1,060 mbar)
All soldering tests are performed with midly activated flux

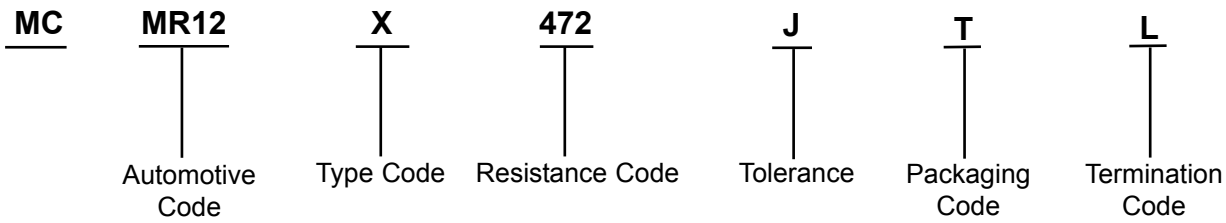
Test	Procedure / Test Method	Requirement	
		Resistance ±5%, ±1%	**0 Ω**
Electrical Characteristics JISC5201-1: 1998 Clause 4.8	- DC resistance values measurement - Temperature Coefficient of Resistance (T.C.R) Natural resistance change per change in degree centigrade $\frac{R2 - R1}{R_1 (t_2 - t_1)} \times 10^6$ (ppm/°C) t_1 : 20°C+5°C-1°C R_1 : Resistance at reference temperature R_2 : Resistance at test temperature	Within the specified tolerance Refer to “Quick Reference Data”	
Resistance to soldering heat (R.S.H) MIL-STD-202 method 210	Un-mounted chips completely immersed for 10 ±1 second in a SAC solder bath at 270°C ±5°C	ΔR/R maximum ± (0.5%+0.05 Ω) No visible damage	< 50 mΩ
Solderability J-STD-002	a) Bake the sample for 155°C dwell time 4 hours / solder dipping 235°C / 5 s b) Steam the sample dwell time 1 hour/ solder dipping 215°C/ 5 s c) Steam the sample dwell time 1 hour/ solder dipping 260°C / 7 s	95% coverage minimum, good tinning No visible damage	
Temperature cycling JESD22 method JA-104	1,000 cycles, -55°C to +155°C, dwell time 5 to 10 mins	ΔR/R maximum ± (0.5%+0.05 Ω) No visible damage	< 50 mΩ
Moisture Resistance MIL-STD-202 method 106	65 ±2°C, 80 to 100% RH, 10 cycles, 24 hours / cycle	ΔR/R maximum ± (0.5%+0.05 Ω) No visible damage	< 50 mΩ
Bias Humidity MIL-STD-202 method 103	1,000 +48/-0 hours; 85°C, 85% RH, 10% of operation Power	ΔR/R maximum ± (1%+0.05 Ω) No visible damage	< 50 mΩ
Operational Life MIL-STD-202 method 108	1,000 +48/-0 hours; 35% of operation power, 125 ±2°C	ΔR/R maximum ± (1%+0.05 Ω) No visible damage	< 50 mΩ
High Temperature Exposure MIL-STD-202 method 108	1,000+48/-0 hours; without load in a temperature chamber controlled 155±3°C	ΔR/R maximum ± (1%+0.05 Ω) No visible damage	< 50 mΩ

Test	Procedure / Test Method	Requirements	
		Resistance ±5%, ±1%	0 Ω
Mechanical Shock MIL-STD-202 method 213	1/2 sine pulse / 1,500 g peak / Velocity 15.4 ft/s	Within the specified tolerance No visible damage	< 50 mΩ
Board Flex AEC-Q200-005	Resistors mounted on a 90 mm glass epoxy resin PCB(FR4), bending once 2 mm for 10 s	ΔR/R maximum ± (1%+0.05 Ω) No visible damage	< 50 mΩ
Terminal strength AEC-Q200-006	Pressurizing force: 1 Kg, Test time: 60±1 s	No remarkable damage or removal of the terminations	
Vibration MIL-STD-202 method 204	Test 5 g's for 20 minimum, 12 cycles each of 3 orientations	ΔR/R maximum ± (1%+0.05 Ω) No visible damage	< 50 mΩ
Thermal shock MIL-STD-202 method 107	Test –55 to 155 / dwell time 15 minimum / maximum transfer time 20 seconds 300 cycles	ΔR/R maximum ± (0.5%+0.05 Ω) No visible damage	< 50 mΩ
ESD AEC-Q200-002	Test contact 1 KV (0.5 KV for 0402 only)	ΔR/R maximum ± (1%+0.05 Ω) No visible damage	< 50 mΩ

Test Condition for Jumper (0 Ω)

Item	MCMR12	MCMR08	MCMR06	MCMR04
Power rating at 70°C	1/4 W	1/8 W	1/10 W	1/16 W
Resistance	Maximum 50 mΩ			
Rated current	2 A	1.5 A	1 A	1 A
Peak current	5 A	3.5 A	3 A	2 A
Operating temperature	-55 to +155°C			

Part Number Explanation:



General Purpose Chip Resistors

Anti-Sulfuration

Automotive Code	**:** MCMR12 : 1206, MCMR08 : 0805, MCMR06 : 0603 and MCMR04 : 0402
Type Code	**: X :** ±5%, 1 Ω to 10 MΩ, ±1%, < 10 Ω; > 1 MΩ **W :** ±1%, < 10 Ω; > 1 MΩ
Resistance Code	**: ±5%,** E24 : 2 significant digits followed by no. of zeros and a blank 200 Ω = 221_ ("_" means a blank) **: ±1%,** E24+E96 : 3 significant digits followed by no. of zeros E96 : 37.4 KΩ = 3,742 E24 : 200 Ω = 2,200
Tolerance	**: F :** ±1%, **J :** ±5% and **P :** Jumper
Packaging Code	**: T :** 7" Reeled taping
Termination Code	**: L :** Sn base (lead free)

* Anti-Sulfur test conditions : H2S 3 ppm, 40°C, RH 90%, 1,000 hours, criteria : +/-1%

MCMR12, MCMR08, MCMR06:

1. Reeled tape packaging : 8 mm width paper taping 5,000 pieces per 7" reel, 10 k pieces per 10" reel, 20 k pieces per 13" reel
2. Bulk packaging : 5,000 pieces per poly-bag

MCMR04:

1. Reeled tape packaging : 8 mm width paper taping 10,000 pieces per reel
2. Bulk packaging : 10,000 pieces per poly-bag