

APPROVAL SHEET

MR10, MR12, MR08, MR06, MR04

$\pm 1\%$, $\pm 5\%$, Jumper

Thick film General Purpose Chip Resistors

Size 1206, 1210, 0805, 0603, 0402

Automotive & Military Compliant

Anti-sulfur ASTM B-809 60°C 500hs

RoHS 2 Compliant with exemption 7C-I

Halogen free

*Contents in this sheet are subject to change without prior notice.

FEATURE

1. High reliability and stability $\pm 1\%$
2. Sulfuration resistant
3. Automotive AEC Q-200 & Military MIL-STD Compliant
4. 100% CCD inspection
5. RoHS 2 compliant with exemption 7C-I and Halogen free products
6. Anti-sulfuration ASTM B-809 60°C 500hrs

APPLICATION

- Automotive application
- Consumer electrical equipment
- EDP, Computer application
- Telecom application

DESCRIPTION

The resistors are constructed in a high grade ceramic body (aluminum 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.

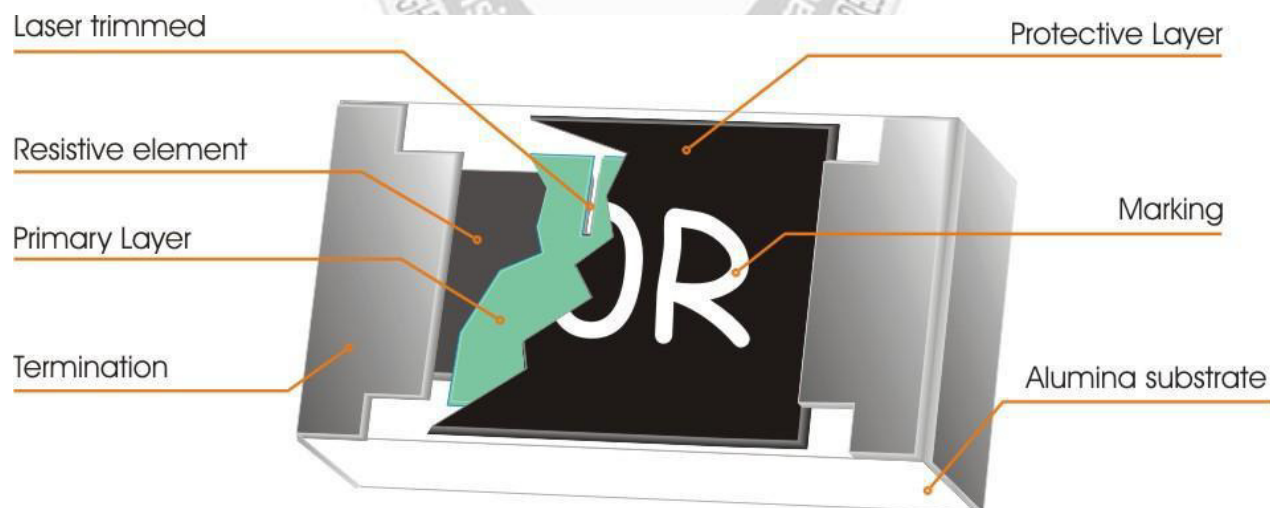


Fig 1. Construction of a Chip-R

QUICK REFERENCE DATA

Item	General Specification				
Series No.	MR10	MR12	MR08	MR06	MR04
Size code	1210(3225)	1206(3216)	0805(2012)	0603(1608)	0402(1005)
Resistance Range	1Ω~10MΩ (±5% tolerance), Jumper E96/E241Ω~10MΩ (±1% tolerance)				
Resistance Tolerance	±1%, E96/E24 ±5%, E24				
TCR (ppm/°C)					
R > 1MΩ	≤ ± 200	≤ ± 200	≤ ± 200	≤ ± 200	≤ ± 200
10Ω < R ≤ 1MΩ	≤ ± 100	≤ ± 100	≤ ± 100	≤ ± 100	≤ ± 100
R ≤ 10Ω	-200~+400	-200~+400	-200~+400	-200~+400	-200~+400
Max. dissipation @ T _{amb} =70°C	1/2 W	1/4 W	1/4 W	1/8 W	1/10 W
Max. Operation Voltage (DC or RMS)	200V	200V	150V	75V	50V
Max. Overload Voltage (DC or RMS)	400V	400V	300V	150V	100V
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. Max. Operation Voltage : So called RCWV (Rated Continuous Working Voltage) is determined by

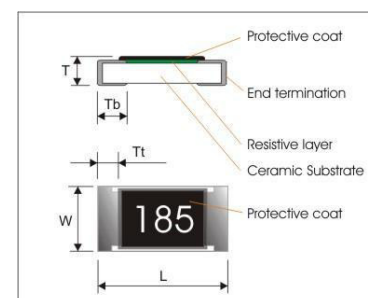
$$RCWV = \sqrt{\text{Rated Power} \times \text{Resistance Value}} \text{ or Max. RCWV listed above, whichever is lower.}$$

For Jumper (0Ω) :

Item	General Specification				
Series No.	MR10	MR12	MR08	MR06	MR04
Size code	1210(3225)	1206(3216)	0805(2012)	0603(1608)	0402(1005)
Resistance Range	≤50mΩ for P tolerance ≤30mΩ for F tolerance				
TCR (ppm/°C)	TCR is not applicable for Jumper product				
Max. dissipation @ T _{amb} =70°C	1/2 W	1/4 W	1/4 W	1/8 W	1/10 W
P tolerance	Rated Current	3A	2A	1.5A	1A
	Peak Current	7.5A	5A	3.5A	2A
F tolerance	Rated Current	4A	2.9A	2A	1.8A
	Peak Current	10A	5.8A	4A	3.6A
Operation temperature	-55 ~ +155°C				

DIMENSIONS (unit : mm)

	MR10	MR12	MR08	MR06	MR04
L	3.10 ± 0.10	3.10 ± 0.10	2.00 ± 0.10	1.60 ± 0.10	1.00 ± 0.05
W	2.60 ± 0.10	1.60 ± 0.10	1.25 ± 0.10	0.80 ± 0.10	0.50 ± 0.05
T	0.55 ± 0.10	0.60 ± 0.15	0.50 ± 0.15	0.45 ± 0.15	0.35 ± 0.05
Tb	0.50 ± 0.20	0.45 ± 0.20	0.40 ± 0.20	0.30 ± 0.15	0.25 ± 0.10
Tt	0.50 ± 0.20	0.50 ± 0.20	0.40 ± 0.20	0.30 ± 0.10	0.20 ± 0.10



CATALOGUE NUMBERS

The resistors have a catalogue number starting with .

MR12	X	472_	J	T	L
Size code	Type code	Resistance code	Tolerance code	Packaging code	Termination code
MR10 : 1210 MR12 : 1206 MR08 : 0805 MR06 : 0603 MR04 : 0402	X : Jumper ±5% tol. 1Ω ~ 10MΩ ±1% tol. 10Ω ~ 1MΩ W : ±1% tol. 1Ω<R<10Ω ±1% tol. 1MΩ<R<10MΩ	±5%,E24: 2 significant digits followed by no. of zeros and a blank 4.7Ω= 4R7_ 10Ω= 100_ 220Ω= 221_ ±1%,E24+E96: 3 significant digits followed by no. of zeros 102Ω= 1020 37.4KΩ= 3742 82Ω= 82R0 For Jumper (0Ω) P tol. ≤ 50mΩ= 000_ F tol. ≤ 30mΩ= 0000 Remark: " _ " means a blank	F : ±1% J : ±5% For Jumper (0Ω) P : ≤ 50mΩ F : ≤ 30mΩ	T : 7" Reeled taping Q : 10" Reeled taping G : 13" Reeled taping H : 13" reel 50Kpcs only for 0402 B : Bulk D : 7" reel 20Kpcs only for 0402 A : 7" reel 15Kpcs only for 0402	L : Sn base (lead-free)

Remark:

1210, 1206, 0805, 0603:

1. 8mm width paper taping 5000pcs per 7" reel, 10kpcs per 10" reel, 20kpcs per 13" reel.
2. Bulk packaging: 5000pcs per poly-bag

0402:

1. 8mm width paper taping 10,000pcs per 7" reel, 70kpcs per 13" reel.
2. Bulk packaging: 5000pcs per poly-bag

MARKING

Size \ Nr. Of digit of code\tolerance	$\pm 5\%$ & Jumper(0Ω)	$\pm 1\%$
1210/1206/0805	3 digits marking	4 digits marking
0603 (1608)	3 digits marking	3 digits marking
0402(1005)	NO MARKING	

3 digits marking 【 $\pm 5\%$: 1210, 1206, 0805, 0603 & Jumper (0Ω)】

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

3 digits marking ($\pm 1\%$: 0603)

Nominal resistance	Description															
1.E-24 series	As 0603 WR06X $\pm 5\%$.															
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 =25X, 178 Ω =25A, 1K78 =25B 17K8=25C, 178K=25D, 1M78=25E															
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	
01	100	13	133	25	178	37	237	49	316	61	422	73	562	85	750	
02	102	14	137	26	182	38	243	50	324	62	432	74	576	86	768	
03	105	15	140	27	187	39	249	51	332	63	442	75	590	87	787	
04	107	16	143	28	191	40	255	52	340	64	453	76	604	88	806	
05	110	17	147	29	196	41	261	53	348	65	464	77	619	89	825	
06	113	18	150	30	200	42	267	54	357	66	475	78	634	90	845	
07	115	19	154	31	205	43	274	55	365	67	487	79	649	91	866	
08	118	20	158	32	210	44	280	56	374	68	499	80	665	92	887	
09	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 ($\pm 1\%$: 1210,1206,0805)

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

Example

RESISTANCE	Jumper (0Ω)	10 Ω	12 Ω	100 Ω	6800 Ω	47000 Ω
3 digits marking (1210, 1206, 0805, 0603 $\pm 5\%$ & Jumper)	000	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 $\pm 5\%$, and E24+E96 series for resistors with a tolerance of $\pm 1\%$. 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

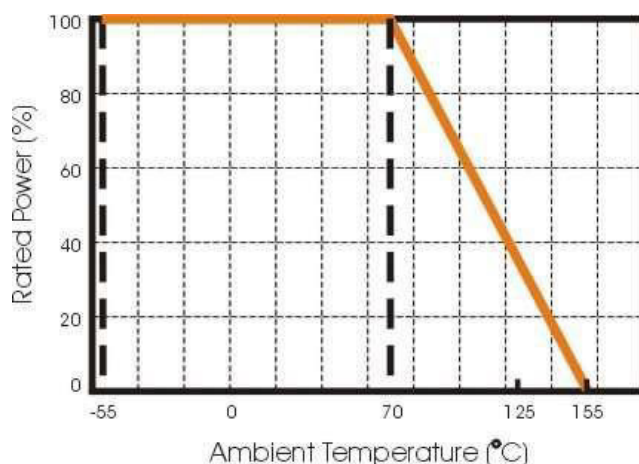


Figure 2 Maximum dissipation in percentage of rated power as a function of the ambient temperature

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.

Storage and Handling Conditions:

1. Products are recommended to be used up within two years since operation date as ensured shelf life. Check solderability in case shelf life extension is needed.

2. To store products with following condition:

Temperature :5 to 40°C

Humidity :20 to 70% relative humidity

3. Caution:

a. Don't store products in a corrosive environment such as sulfide, chloride gas, or acid.

It may cause oxidation of electrode, which easily be resulted in poor soldering

b. To store products on the shelf and avoid exposure to moisture.

c. Don't expose products to excessive shock, vibration, direct sunlight and so on

SOLDERING CONDITION follows J-STD-020D

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.

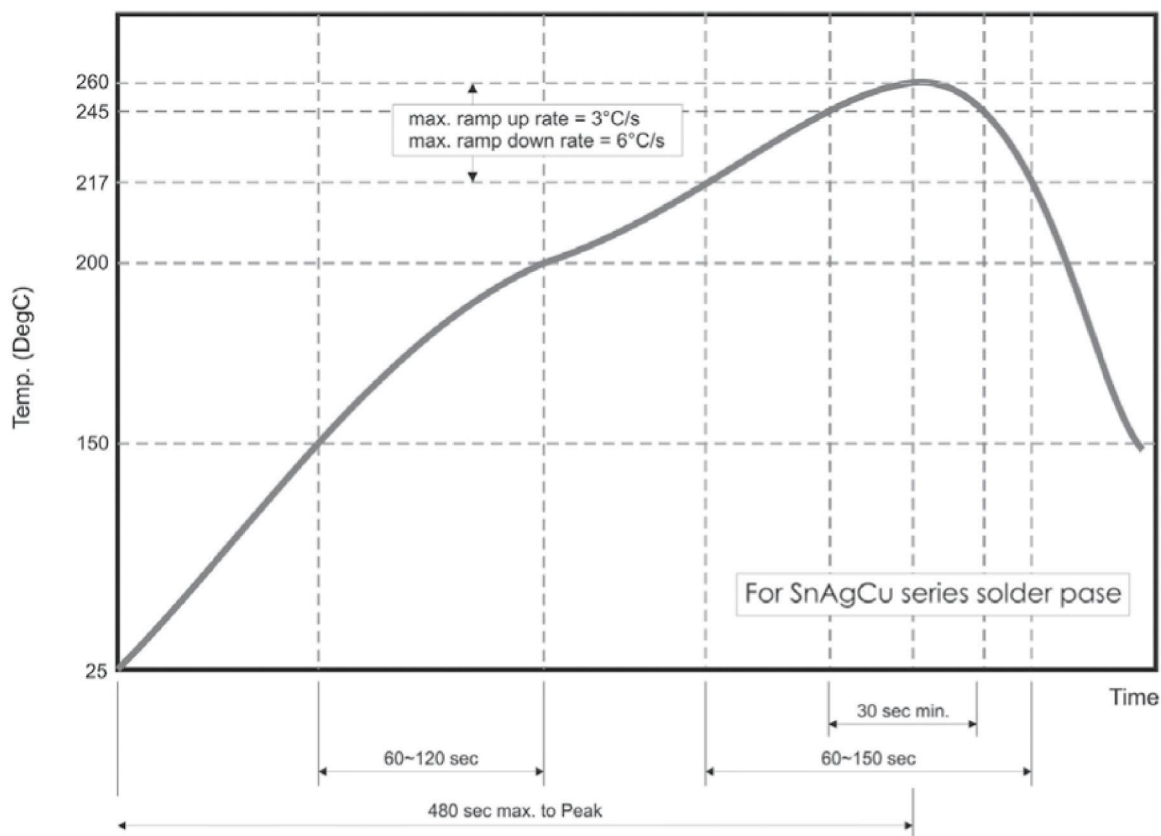


Fig 3. Recommended IR reflow soldering profile for
SMT process with SnAgCu series solder paste

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°C to 35°C.

Relative humidity: 45% to 75%.

Air pressure: 86kPa to 106 kPa (860 mbar to 1060 mbar).

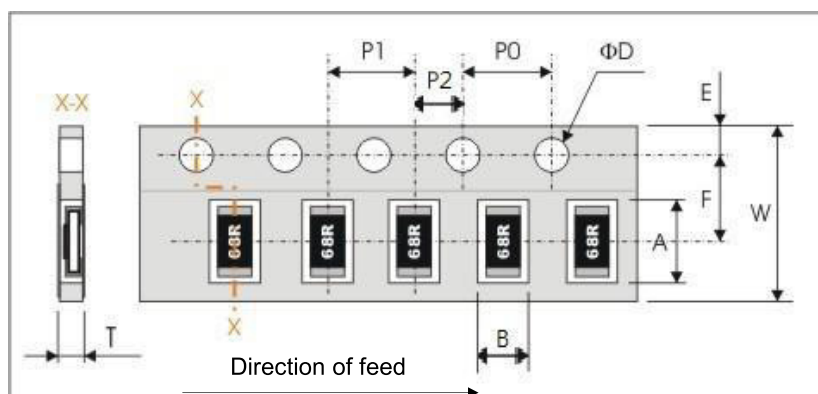
All soldering tests are performed with mildly activated flux.

TEST	PROCEDURE / TEST METHOD	REQUIREMENTS	
		Resistance	0Ω
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. $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/}^\circ\text{C)}$ $t_1 : 20^\circ\text{C}+5^\circ\text{C}-1^\circ\text{C}$ 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±1second in a SAC solder bath at 270°C±5°C	ΔR/R max. ±(0.5%+0.05Ω) No visible damage	<50mΩ
Solderability J-STD-002	a) Bake the sample for 155°C dwell time 4hrs/ solder dipping 235°C/ 5sec. b) Steam the sample dwell time 1 hour/ solder dipping 260°C/ 7sec.	95% coverage min., good tinning and no visible damage	
Temperature cycling JESD22 method JA-104	1000 cycles, -55°C ~ +155°C, dwell time 5~10min	ΔR/R max. ±(0.5%+0.05Ω) No visible damage	<50mΩ
Moisture Resistance MIL-STD-202 method 106	65±2°C, 80~100% RH, 10 cycles, 24 hours/ cycle	ΔR/R max. ±(0.5%+0.05Ω) No visible damage	<50mΩ
Bias Humidity MIL-STD-202 method 103	1000+48/-0 hours; 85°C, 85% RH, 10% of operation power	ΔR/R max. ±(1%+0.05Ω) No visible damage	<50mΩ
Operational Life MIL-STD-202 method 108	1000+48/-0 hours; 35% of operation power, 125±2°C	ΔR/R max. ±(1%+0.05Ω) No visible damage	<50mΩ

TEST	PROCEDURE / TEST METHOD	REQUIREMENTS	
		Resistance	0Ω
High Temperature Exposure MIL-STD-202 method 108	1000+48/-0 hours; without load in a temperature chamber controlled 155±3°C	ΔR/R max. ±(1%+0.05Ω) No visible damage	<50mΩ
Mechanical Shock MIL-STD-202 method 213	1/2 Sine Pulse / 1500g Peak / Velocity 15.4ft/sec	Within the specified tolerance No visible damage	<50mΩ
Board Flex AEC-Q200-005	Resistors mounted on a 90mm glass epoxy resin PCB(FR4), bending once 2mm for 10sec	ΔR/R max. ±(1.0%+0.05Ω). No visible damage	<50mΩ
Terminal strength AEC-Q200-006	Pressurizing force: 1Kg, Test time: 60±1sec.	No remarkable damage or removal of the terminations	
Vibration MIL-STD-202 method 204	Test 5g's for 20min., 12 cycles each of 3 orientations	ΔR/R max. ±(1.0%+0.05Ω) No visible damage	<50mΩ
Thermal shock MIL-STD-202 method 107	Test -55 to 155°C / dwell time 15min/ Max transfer time 20sec 300cycles	ΔR/R max. ±(0.5%+0.05Ω) No visible damage	<50mΩ
Short Time Overload (STOL) JISC5201-1: 1998 Clause 4.13	2.5 times RCWV or max. overload voltage, for 5seconds	±5%: ΔR/R max. ±(2%+0.05Ω) ±1%: ΔR/R max. ±(1%+0.05Ω) No visible damage	<50mΩ
ESD AEC-Q200-002	Test contact 1.0KV (0.5KV for 0402 only)	ΔR/R max. ±(1%+0.05Ω) No visible damage	<50mΩ
Sulfuration test ASTM B-809-95	ASTM B-809 60°C 500hrs	±5%: ΔR/R max.±(2%+0.10Ω) ±1%: ΔR/R max.±(2%+0.05Ω) No visible damage	<50mΩ

PACKAGING

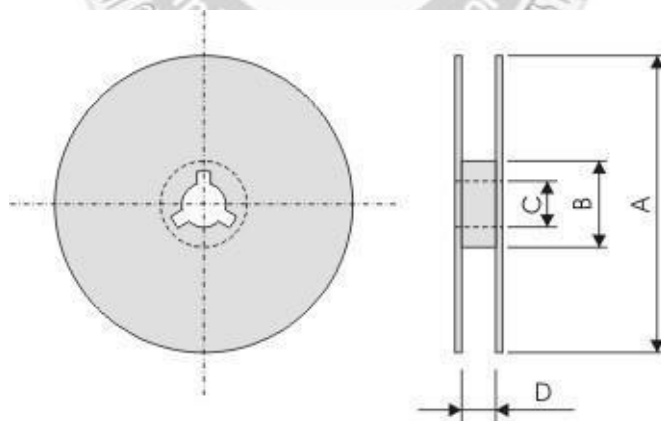
Paper Tape specifications (unit :mm)



Series No.	A	B	W	F	E
MR10	3.60±0.20	3.00±0.20	8.00±0.30	3.50±0.20	1.75±0.10
MR12	3.60±0.20	2.00±0.20			
MR08	2.40±0.20	1.65±0.20			
MR06	1.90±0.20	1.10±0.20			
MR04	1.20±0.10	0.70±0.10			

Series No.	P1	P0	P2	ΦD	T
MR10/12/08	4.00±0.10	4.00±0.10	2.00±0.10	Φ1.50 ^{+0.1} _{-0.0}	Max. 1.0
MR06					0.65±0.05
MR04	2.00±0.10				0.40±0.05

Reel dimensions



Symbol	A	B	C	D
7" reel	Φ178.0±2.0	Φ60.0±1.0	13.0±0.2	9.0±0.5
10" reel	Φ254.0±2.0	Φ100.0±1.0	13.0±0.2	9.0±0.5
13" reel	Φ330.0±2.0	Φ100.0±1.0	13.0±0.2	9.0±0.5

APPROVAL SHEET

MR02X(W)

±5%, ±1%

Thick Film General purpose chip resistors
Automotive compliant AEC Q-200 qualified
Anti-Sulfuration
Size 0201

RoHS 2 Compliant with exemption 7C-I
Halogen free

*Contents in this sheet are subject to change without prior notice.

FEATURE

1. Automotive grade AEC Q200 qualified with 100% CCD visual inspection
2. High reliability and stability 1%
3. Reduced size of final equipment
4. Suitable for high density print circuit board assembly
5. Higher component and equipment reliability
6. RoHS 2 compliant with exemption 7C-I and Halogen free products

APPLICATION

- Mobile phone
- PDA
- Camcorders
- Palmtop computers
- Hybrid module

DESCRIPTION

The resistors are constructed in a high grade ceramic body (aluminum 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 nominated value within tolerance which controlled by laser trimming 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 pure Tin.

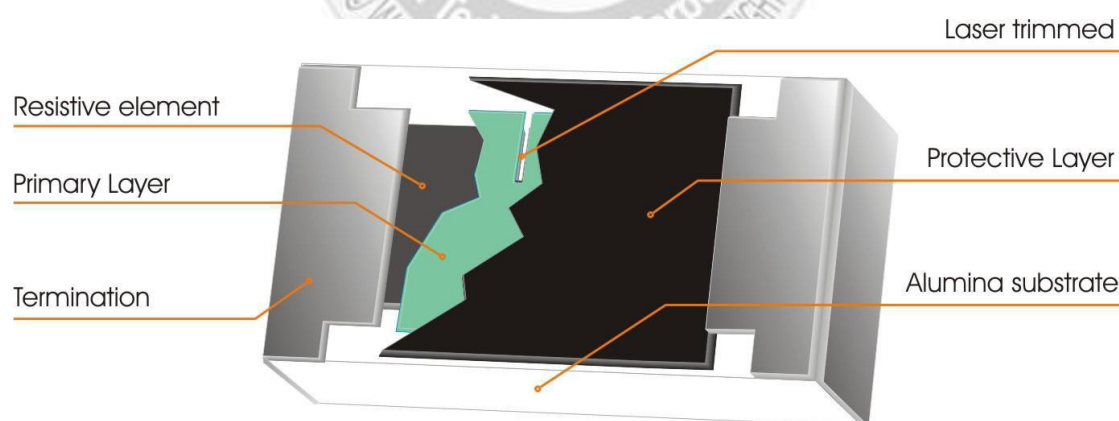


Fig 1. Construction of Chip-R

QUICK REFERENCE DATA

Item	General Specification	
Series No.	MR02X(W)	
Size code	0201(0603)	
Resistance Range	1Ω~10MΩ (±5% tolerance), Jumper 1Ω~ 10MΩ (±1% tolerance)	
Resistance Tolerance	±1% E96+E24	±5% E24
TCR (ppm/°C)	1.02MΩ - 10MΩ, ≤±200ppm 51Ω - 1MΩ, ≤±100ppm 10Ω - 49.9Ω, ≤±200ppm 1 - 9.76Ω, +600 ~ -200ppm	
Max. dissipation @ T _{amb} =70°C	1/20 W	
Max. Operation Voltage	25V	
Max. Overload Voltage	50V	
Operation temperature	-55 ~ +155°C	

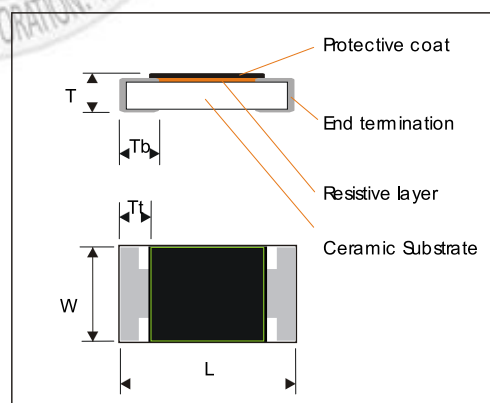
Note :

1. This is the maximum voltage that may be continuously supplied to the resistor element, see "IEC publication 60115-8"
2. Max. Operation Voltage : So called RCWV (Rated Continuous Working Voltage) is determined by

$$RCWV = \sqrt{\text{Rated Power} \times \text{Resistance Value}}$$
or Max. RCWV listed above, whichever is lower.
3. Jumper max. 50mohm, rated current 1A, peak current 2.5A

DIMENSION(unit : mm)

	MR02X(W)
L	0.60 ± 0.03
W	0.30 ± 0.03
T	0.23 ± 0.03
Tb	0.15 ± 0.05
Tt	0.10 ± 0.05



CATALOGUE NUMBERS

The resistors have a catalogue number starting with :

MR02	X	472_	J	A	L
Size code MR02 : 0201	Type code X : Normal W: 1% For <10Ω / >1MΩ	Resistance code 5%, E24: 2 significant digits followed by no. of zeros and a blank 100Ω = 101_ 10KΩ = 103_ ("_" means a blank) 1%, E24+E96: 3 significant digits followed by no. of zeros 100Ω =1000 37.4KΩ =3742	Tolerance J : ±5% F : ±1% P : Jumper	Packaging code A : 7" Reeled (15Kpcs/Reel) H : 13" Reeled (50Kpcs/Reel) G : 13" Reeled (70Kpcs/Reel)	Termination code L = Sn base (lead free)

Standard taping quantity 15,000pcs per 7" reel! 70,000pcs per 13" reel!

MARKING

MR02X(W) has no marking.

FUNCTIONAL DESCRIPTION

Product characterization

Standard values of nominal resistance are taken from the E24/E96 series for resistors with a tolerance of ±5% & ±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

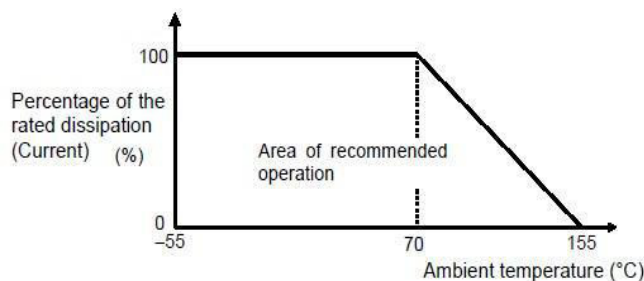


Figure 2. Maximum dissipation in percentage of rated power
As a function of the ambient temperature

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.

Storage and Handling Conditions:

1. Products are recommended to be used up within two years since operation date as ensured shelf life. Check solderability in case shelf life extension is needed.
2. To store products with following condition:
Temperature :5 to 40°C
Humidity :20 to 70% relative humidity
3. Caution:
 - a. Don't store products in a corrosive environment such as sulfide, chloride gas, or acid.
It may cause oxidation of electrode, which easily be resulted in poor soldering.
 - b. To store products on the shelf and avoid exposure to moisture.
- c. Don't expose products to excessive shock, vibration, direct sunlight and so on.

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.

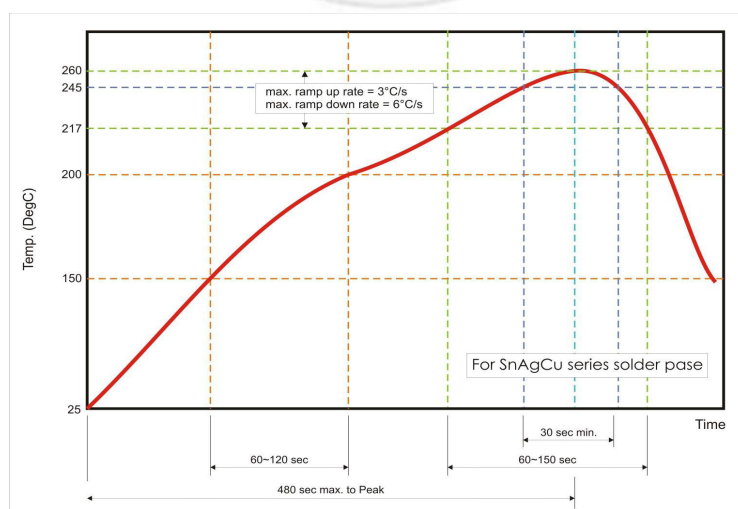
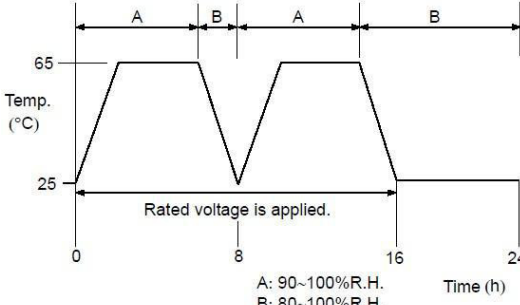


Fig 3. Infrared soldering profile for Chip Resistors
SMT process with SnAgCu series solder paste

TEST AND REQUIREMENTS

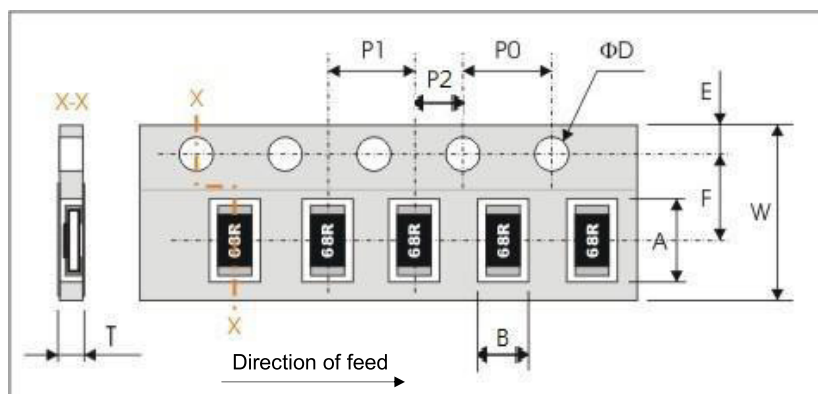
The test standard condition for tests shall be in accordance with Sub-clause 4.2, JIS C 5201-1: 2011
The performance shall be satisfied in follows.

No	Test items	Condition of test	Performance requirements									
1	Resistance	Sub-clause 4.5	As in 4.5.2 The resistance value shall correspond with the rated resistance taking into account the specified tolerance Chip jumper: 50mΩ max.									
2	Temperature characteristic of resistance	4.8 Natural resistance change per change in degree centigrade $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6$ t_1 : 20°C+5°C-1°C, t_2 : 155°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”									
3	Resistance to soldering heat	MIL-STD-202 Method 210 Test by a piece Temperature of solder bath: 270 ±5°C Immersion time: 10 ±1s After immersion into solder, leaving at the room temp. for 1h or more and then measure the resistance	Resistor: ΔR/R: Within ±(0.5%+0.05Ω) Chip jumper: 50mΩ max. No evidence of appearance damage									
4	Solderability	J-STD-002 a)Pre-condition: 155°C, 4h Immersion time: 5s b)Pre-condition: Steam aging, 1h Temp. of solder bath: 260°C Immersion time: 7s	The surface of terminal immersed shall be min. of 95% covered with a new coating of solder									
5	Temperature cycling	JESD22 Method JA-104 Test cycle: 1000 cycles for duty cycle as specified below: <table><tr><th>Step</th><th>Temperature(°C)</th><th>Time(min)</th></tr><tr><td>1</td><td>-55</td><td>5~10</td></tr><tr><td>2</td><td>+125</td><td>5~10</td></tr></table>	Step	Temperature(°C)	Time(min)	1	-55	5~10	2	+125	5~10	Resistor: ΔR/R: Within ±(2%+0.05Ω) Chip jumper: 50mΩ max. No evidence of appearance damage
Step	Temperature(°C)	Time(min)										
1	-55	5~10										
2	+125	5~10										
6	Moisture Resistance	MIL-STD-202 Method 106 Test condition: 10 cycles for duty as shown as below:  A: 90~100%R.H. B: 80~100%R.H.	Resistor: ΔR/R: Within ±(2%+0.1Ω) Chip jumper: 50mΩ max. No evidence of appearance damage									

No	Test items	Condition of test	Performance requirements		
7	Operational life	MIL-STD-202 Method 108 Test temp.: 125 ±2°C Test power: 35% of rated power shall be applied for continuously Test period: 1000 +48/-0 h	Resistor: ΔR/R: Within ±(3%+0.1Ω) Chip jumper: 50mΩ max. No evidence of appearance damage		
8	Bias humidity	MIL-STD-202 Method 103 Test condition: 85°C & 85% R.H. Test power: 10% of rated power shall be applied for continuously Test period: 1000 +48/-0 h	Resistor: ΔR/R: Within ±(3%+0.1Ω) Chip jumper: 50mΩ max. No evidence of appearance damage		
9	High Temperature exposure	MIL-STD-202 Method 108 Test condition: 155 ±2°C Test period: 1000 +48/-0 h	Resistor: ΔR/R: Within ±(3%+0.1Ω) Chip jumper: 50mΩ max. No evidence of appearance damage		
10	Substrate bending test	AEC-Q200-005 Bent value: 2mm(Among the fulcrums: 90mm) Duration: 10s	Resistor: ΔR/R: Within ±(1%+0.05Ω) Chip jumper: 50mΩ max. No evidence of appearance damage		
11	Adhesion	AEC-Q200-006 Force: 3N Duration: 60s±1s	No remarkable damage or removal of the terminations		
12	Mechanical Shock	MIL-STD-202 Method 213 Peak acceleration: 1500g Peak Half sine pulse Velocity 15.4ft/sec The shock specified above shall be applied in each direction of 3 mutually perpendicular axis (3 total of 18 shocks)	The resistance value shall correspond with the rated resistance taking into account the specified tolerance No evidence of appearance damage		
13	Vibration	MIL-STD-202 Method 204 Peak acceleration: 5g's Each direction of 3 mutually perpendicular axis Test cycle: 12 Cycles	Resistor: ΔR/R: Within ±(1%+0.05Ω) Chip jumper: 50mΩ max. No evidence of appearance damage		
14	Thermal shock	MIL-STD-202 Method 107 Test cycle: 300 cycles for duty cycle as specified below:	Resistor: ΔR/R: Within ±(2%+0.1Ω) Chip jumper: 50mΩ max. No evidence of appearance damage		
		Step		Temperature(°C)	Time(min)
		1		-55	15
		2		+125	15
		Max transfer time: 20s			
15	ESD test	AEC-Q200-200 Test condition: 300V	Resistor: ΔR/R: Within ±(1%+0.05Ω) Chip jumper: 50mΩ max. No evidence of appearance damage		
16	Hydrogen sulphide test	H2S concentration: 3ppm Test temp.: 40°C Relative humidity: 90% Test period : 1000h	Resistor: ΔR/R: Within ±(1%+0.05Ω) Chip jumper: 50mΩ max. No evidence of appearance damage		

PACKAGING

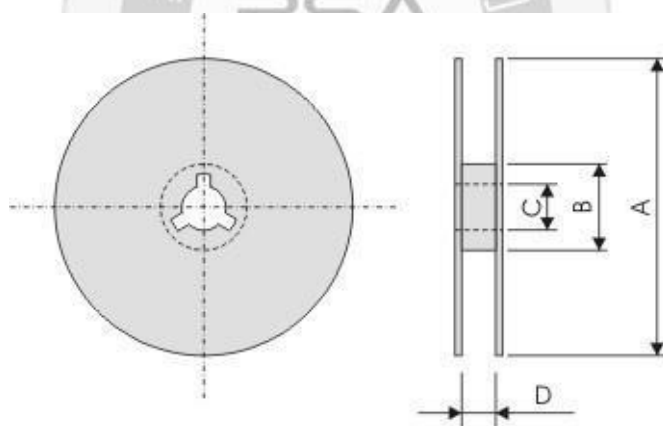
Paper Tape specifications (unit :mm)



Series No.	A	B	W	F	E
MR02X	0.67±0.05	0.37±0.05	8.00±0.20	3.50±0.05	1.75±0.10

Series No.	P1	P0	P2	ΦD	T
MR02X	2.00±0.05	4.00±0.05	2.00±0.05	Φ1.50 ^{+0.1} _{-0.0}	0.45±0.05

Reel dimensions



Symbol	A	B	C	D
7" Reel	Φ178.0±0.2	Φ60.0±1.0	13.0±0.2	9.0±0.5
13" Reel	Φ330.0±2.0	Φ100.0±1.0	13.0±0.2	9.0±0.5

Taping quantity and Tape material

- Chip resistors 15,000 pcs 7" Reel, Paper tape.
- Chip resistors 70,000 pcs 13" Reel, Paper tape.

APPROVAL SHEET

MR18X, MR20X, MR25X

±1%, ±5%

Power chip resistors

Size 1218, 2010, 2512

Automotive & Military Compliant

Anti-sulfur ASTM B-809 60°C 500hs

RoHS 2 Compliant with exemption 7C-I

Halogen free

*Contents in this sheet are subject to change without prior notice.

FEATURE

1. High power rating and compact size
2. High reliability and stability
3. Automotive AEC Q-200 compliant
4. 100% CCD visual inspection
5. RoHS 2 compliant with exemption 7C-I and Halogen free products
6. Anti-sulfuration ASTM B-809 60°C 500hs

APPLICATION

- Power supply
- Industry
- Motor control
- M/B Computer
- Automotives
- Servo

DESCRIPTION

The resistors are constructed in a high grade ceramic body (aluminum 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 nominated value within tolerance which controlled by laser trimming 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.

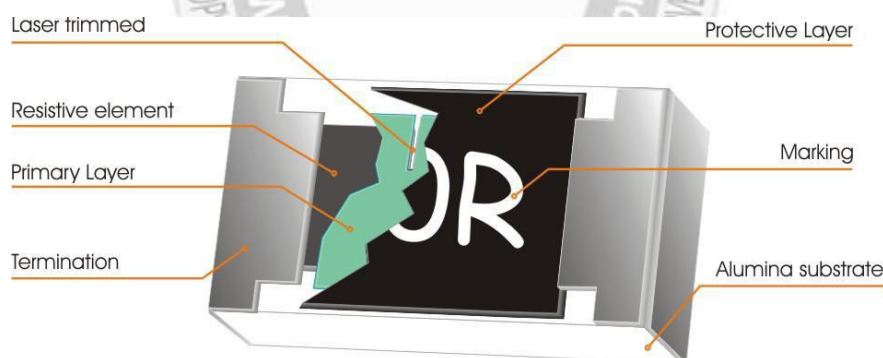


Fig 1. Construction of 2512, 2010 Chip-R

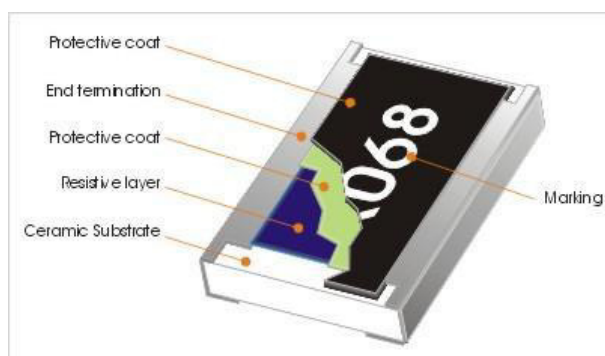


Fig 2. Construction of 1218 Chip-R

QUICK REFERENCE DATA

Item	General Specification		
Series No.	MR18	MR20	MR25
Size code	1218(3248)	2010 (5025),	2512(6432)
Resistance Tolerance	$\pm 5\%$ (E24); $\pm 1\%$ (E24+E96)		
Resistance Range	1 Ω ~ 10M Ω , Jumper (0 Ω)		
TCR (ppm/ $^{\circ}$ C) < 10 Ω 10 Ω ~ 1M Ω > 1M Ω	± 200 ppm/ $^{\circ}$ C	± 200 ppm/ $^{\circ}$ C	± 200 ppm/ $^{\circ}$ C
	± 100 ppm/ $^{\circ}$ C	± 100 ppm/ $^{\circ}$ C	± 100 ppm/ $^{\circ}$ C
	± 200 ppm/ $^{\circ}$ C	± 200 ppm/ $^{\circ}$ C	± 200 ppm/ $^{\circ}$ C
Max. dissipation at T _{amb} =70 $^{\circ}$ C	1W	0.75 W	1W
Max. Operation Voltage (DC or RMS)	200V	200V	250V
Max. Overload Voltage (DC or RMS)	400V	400V	500V
Climatic category (IEC 60068)	55/155/56		

Test conditions for jumper (0 ohm)

Type	MR18X	MR20X	MR25X
Power Rating At 70C	1 W	3/4 W	1 W
Resistance	Max. 50mR	Max. 50mR	Max. 50mR
Rated Current	4.5 A	3.2 A	4.5 A
Peak Current	11 A	8 A	11 A
Operating Temperature	-55 $^{\circ}$ C ~ 155 $^{\circ}$ C		

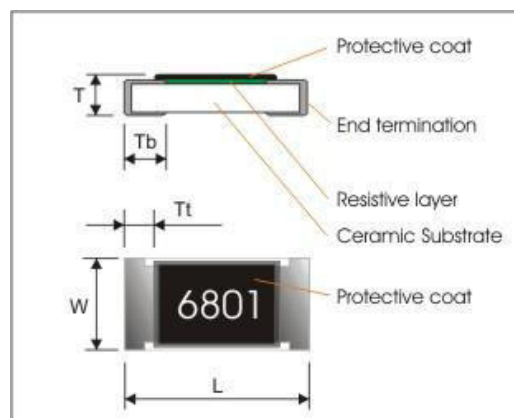
Note :

1. This is the maximum voltage that may be continuously supplied to the resistor element, see "IEC publication 60115-8"
2. Max. Operation Voltage : So called RCWV (Rated Continuous Working Voltage) is determined by

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

MECHANICAL DATA (unit : mm)

TYPE	MR18	MR20	MR25
L	3.05 $\pm$ 0.15	5.00 $\pm$ 0.20	6.40 $\pm$ 0.20
W	4.60 $\pm$ 0.20	2.50 $\pm$ 0.20	3.20 $\pm$ 0.20
T	0.55 $\pm$ 0.10	0.55 $\pm$ 0.10	0.60 $\pm$ 0.10
Tt	0.45 $\pm$ 0.25	0.65 $\pm$ 0.25	0.65 $\pm$ 0.25
Tb	0.50 $\pm$ 0.25	0.60 $\pm$ 0.25	0.90 $\pm$ 0.25



MARKING

Each resistor is marked with a four-digit code on the protective coating to designate the nominal resistance value $\pm 5\%$, $\pm 1\%$ tolerance !

Size	$\pm 5\%$	$\pm 1\%$
2512, 2010, 1218	4-digits marking	4-digits marking

FUNCTIONAL DESCRIPTION

Product characterization

Standard values of nominal resistance are taken from the E96 & E24 series for resistors with a tolerance of $\pm 5\%$ & $\pm 1\%$. The values of the E24/E96 series are in accordance with "IEC publication 60063".

Derating curve

The power that the resistor can dissipate depends on the operating temperature; see Fig.3

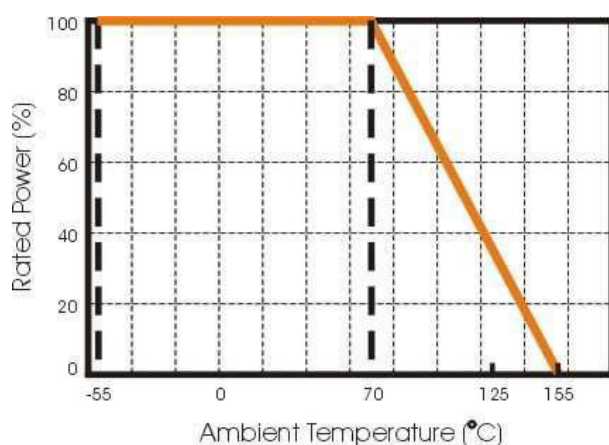


Fig 3 Maximum dissipation in percentage of rated power as a function of the ambient temperature

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 4.

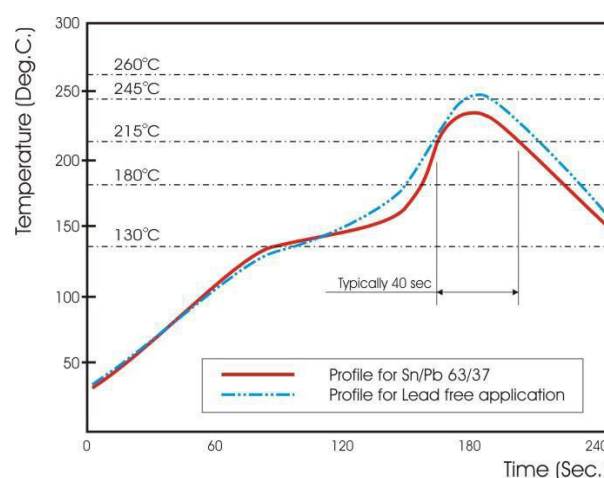


Fig 4. Infrared soldering profile for Chip Resistors

CATALOGUE NUMBERS

The resistors have a catalogue number starting with .

MR25	X	472_	J	T	L
Size code MR25 : 2512 MR20 : 2010 MR18 : 1218	Type code X : ±5%: 1Ω-10MΩ ±1%: 10Ω-1MΩ W : ±1%: < 10Ω; >1MΩ	Resistance code ±5%: E24: 2 significant digits followed by no. of zeros and a blank 100Ω = 101_ 10KΩ = 103_ (" _ " means a blank) ±1%: E24+E96: 3 significant digits followed by no. of zeros 102Ω = 1020 37.4KΩ = 3742	Tolerance F : ±1% J : ±5% P : Jumper	Packaging code T : 7" Reeled taping Q : 10" Reeled taping G : 13" Reeled taping B : Bulk	Termination code L = Sn base (lead free)

* 100% CCD visual inspection to guarantee visual quality !

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, subclause 5.3. Unless otherwise specified, the following value supplied :

Temperature: 15°C to 35°C.

Relative humidity: 45% to 75%.

Air pressure: 86kPa to 106 kPa (860 mbar to 1060 mbar).

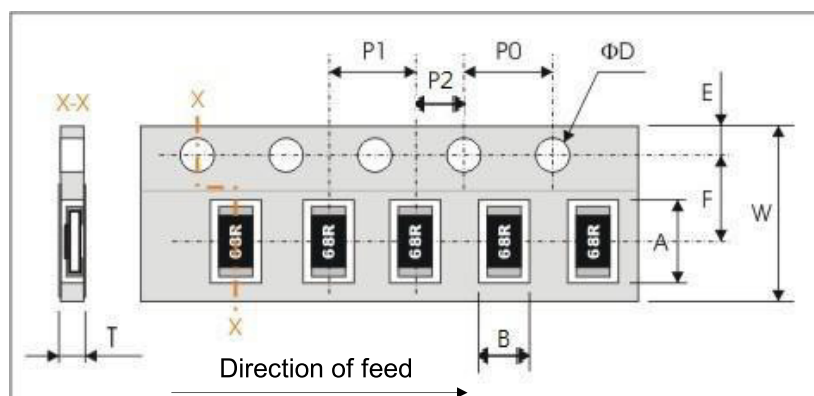
All soldering tests are performed with mildly activated flux.

TEST	PROCEDURE / TEST METHOD	REQUIREMENT	
		Resistor	0Ω
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. $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/°C)} \quad t_1 : 20^\circ\text{C} + 5^\circ\text{C} - 1^\circ\text{C}$ 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±1second in a SAC solder bath at 270°C±5°C	ΔR/R max. ±(0.5%+0.05Ω) No visible damage	

TEST	PROCEDURE / TEST METHOD	REQUIREMENT	
		Resistor	0Ω
Solderability J-STD-002	a) Bake the sample for 155°C dwell time 4hrs/ solder dipping 235°C / 5sec. b) Steam the sample dwell time 1 hour/ solder dipping 260°C / 7sec.	95% coverage min., good tinning and no visible damage	
Temperature cycling JESD22 Method JA-104	1000 cycles, -55°C ~ +155°C, dwell time 5~10min	ΔR/R max. ±(0.5%+0.05Ω) No visible damage	<50mΩ
Moisture Resistance MIL-STD-202 method 106	65±2°C, 80~100% RH, 10 cycles, 24 hours/ cycle	ΔR/R max. ±(0.5%+0.05Ω) No visible damage	<50mΩ
Bias Humidity MIL-STD-202 method 103	1000+48/-0 hours; 85°C, 85% RH, 10% of operation power	ΔR/R max. ±(1.0%+0.05Ω) No visible damage	<50mΩ
Operational Life MIL-STD-202 method 108	1000+48/-0 hours; 35% of operation power, 125±2°C	ΔR/R max. ±(1%+0.05Ω) No visible damage	<50mΩ
High Temperature Exposure MIL-STD-202 Method 108	1000+48/-0 hours; without load in a temperature chamber controlled 155±3°C	ΔR/R max. ±(1.0%+0.05Ω) No visible damage	<50mΩ
Mechanical Shock MIL-STD-202 method 213	1/2 Sine Pulse / 1500g Peak / Velocity 15.4ft/sec	Within the specified tolerance No visible damage	<50mΩ
Board Flex AEC-Q200-005	Resistors mounted on a 90mm glass epoxy resin PCB(FR4), bending once 2mm for 10sec	ΔR/R max. ±(1.0%+0.05Ω). No visible damage	<50mΩ
Terminal strength AEC-Q200-006	Pressurizing force: 1.8Kg, Test time: 60±1sec.	No remarkable damage or removal of the terminations	
Vibration MIL-STD-202 method 204	Test 5g's for 20min., 12 cycles each of 3 orientations	ΔR/R max. ±(1.0%+0.05Ω) No visible damage	<50mΩ
Thermal shock MIL-STD-202 method 107	Test -55 to 155°C / dwell time 15min/ Max transfer time 20sec 300cycles	ΔR/R max. ±(0.5%+0.05Ω) No visible damage	<50mΩ
ESD AEC-Q200-002	Test contact 3.0KV	ΔR/R max. ±(1.0%+0.05Ω). No visible damage	<50mΩ
Sulfuration test ASTM B-809-95	ASTM B-809 60°C 500hrs	±5%: ΔR/R max. ±(2%+0.10Ω) ±1%: ΔR/R max. ±(2%+0.05Ω) No visible damage	<50mΩ

PACKAGING

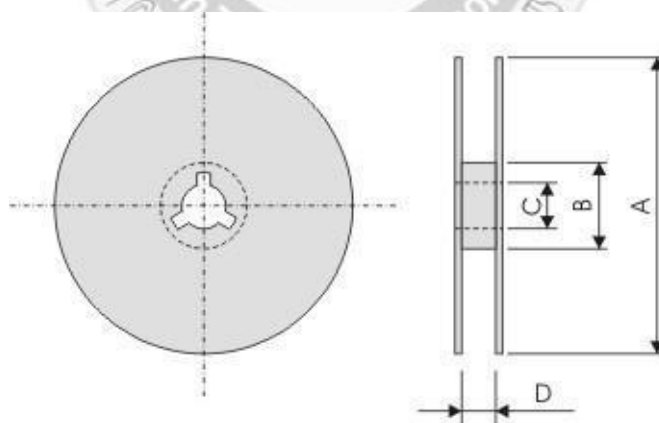
Plastic Tape specifications (unit :mm)



Type	A	B	W	F	E
MR18	4.90±0.20	3.55±0.30	12.00±0.30	5.50±0.10	1.75±0.10
MR20	5.50±0.20	2.80±0.20			
MR25	6.90±0.20	3.60±0.20			

Type	P1	P0	P2	ΦD	T
MR18	8.00±0.10	4.00±0.10	2.00±0.10	Φ1.50 ^{+0.1} _{-0.0}	1.30±0.20
MR20	4.00±0.10				MAX1.2
MR25					

Reel dimensions



Symbol	A	B	C	D
(unit : mm)	Φ178.0±2.0	Φ60.0±1.0	13.0±0.2	14.0±0.2

Taping quantity

MR20, MR25 by plastic tape taping 4,000 pcs per reel.

MR18 by plastic tape taping 3,000 pcs per reel

APPROVAL SHEET

MR12, MR08, MR06, MR04

$\pm 1\%$, $\pm 5\%$

Thick film General Purpose Chip Resistors

Size 1206, 0805, 0603, 0402

Automotive & Military Compliant

RoHS Exemption Free Lead<100ppm

*Contents in this sheet are subject to change without prior notice.

FEATURE

1. High reliability and stability $\pm 1\%$
2. Automotive AEC Q-200 & Military MIL-STD Compliant
3. 100% CCD inspection
4. RoHS Exemption free and Halogen free products

APPLICATION

- Automotive application
- Consumer electrical equipment
- EDP, Computer application
- Telecom application

DESCRIPTION

The LEAD FREE resistors are constructed in a high grade ceramic body (aluminum oxide). Internal metal electrodes are added at each end and connected by a LEAD FREE 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. For all series, overcoat is WATER BLUE color. 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.

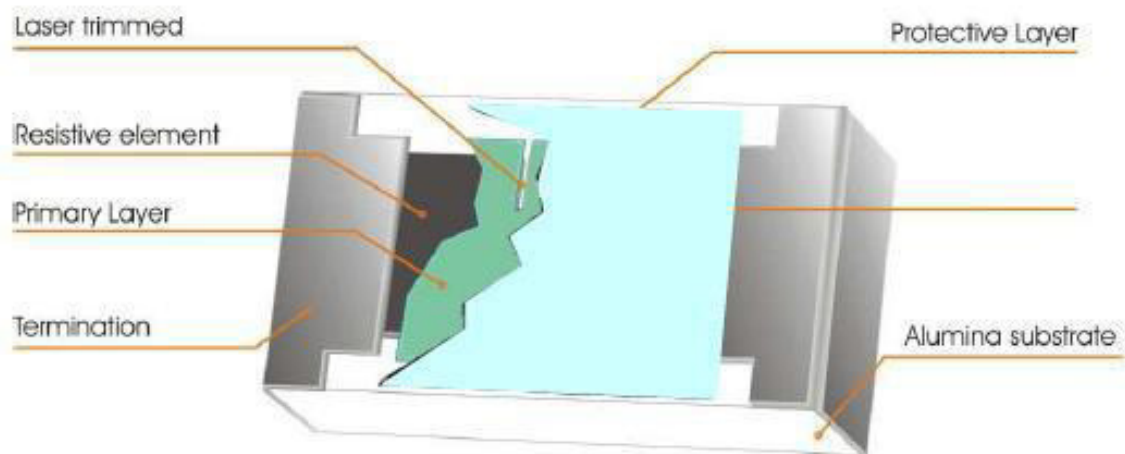


Fig 1. Construction of a Chip-R

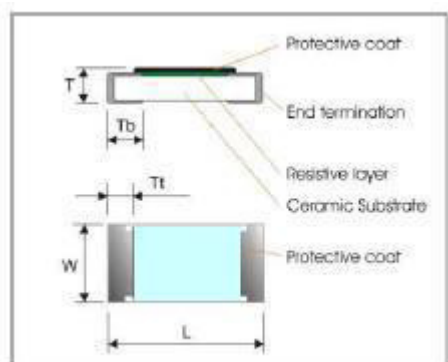
QUICK REFERENCE DATA

Item	General Specification							
Series No.	MR12		MR08		MR06		MR04	
Size code	1206(3216)		0805(2012)		0603(1608)		0402(1005)	
Resistance Range	1Ω~10MΩ (±5% tolerance), Jumper 1Ω~10MΩ (±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	≤ ± 200		≤ ± 200		≤ ± 200		≤ ± 200	
10Ω < R ≤ 1MΩ	≤ ± 100		≤ ± 100		≤ ± 100		≤ ± 100	
R ≤ 10Ω	-200~+400		-200~+400		-200~+400		-200~+400	
Max. dissipation @ T _{amb} =70°C	1/4 W		1/8 W		1/10 W		1/16 W	
Max. Operation Voltage	200V		150V		75V		50V	
Max. Overload Voltage	400V		300V		150V		100V	
Operation temperature	-55/+155C							

Note :

- Max. Operation Voltage : So called RCWV (Rated Continuous Working Voltage) is determined by

$$RCWV = \sqrt{\text{Rated Power} \times \text{Resistance Value}}$$
or Max. RCWV listed above, whichever is lower.
- The resistance of Jumper is defined <0.05Ω.

**DIMENSIONS (unit : mm)**

	MR12	MR08	MR06	MR04
L	3.10 ± 0.10	2.00 ± 0.10	1.60 ± 0.10	1.00 ± 0.05
W	1.60 ± 0.10	1.25 ± 0.10	0.80 ± 0.10	0.50 ± 0.05
T	0.60 ± 0.15	0.50 ± 0.15	0.45 ± 0.15	0.35 ± 0.05
Tb	0.45 ± 0.20	0.40 ± 0.20	0.30 ± 0.15	0.25 ± 0.10
Tt	0.50 ± 0.20	0.40 ± 0.20	0.30 ± 0.10	0.20 ± 0.10

No MARKING for all series.

FUNCTIONAL DESCRIPTION

Product characterization

Standard values of nominal resistance are taken from the E24 series for resistors with a tolerance of $\pm 5\%$, and E24+E96 series for resistors with a tolerance of $\pm 1\%$. 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

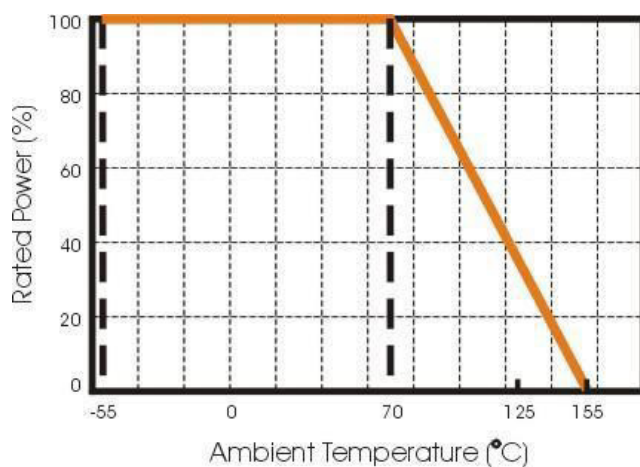


Figure 2.1 Maximum dissipation in percentage of rated power as a function of the ambient temperature

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 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.

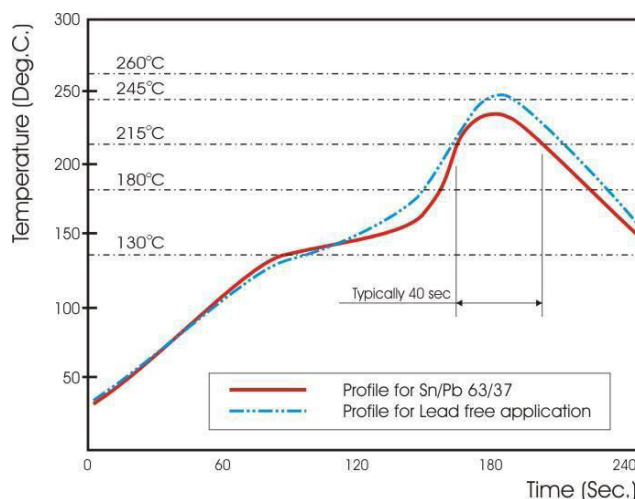


Fig 3. Infrared soldering profile for Chip Resistors

CATALOGUE NUMBERS

The resistors have a catalogue number starting with .

MR12	X	472_	J	T	R
Automotive code	Type code	Resistance code	Tolerance	Packaging code	Termination code
MR12 : 1206	X :	$\pm 5\%$, E24: 2 significant digits followed by no. of zeros and a blank	F : $\pm 1\%$	T : 7" Reeled taping	R = Lead free LEAD<100ppm
MR08 : 0805	$\pm 5\%$, 1 Ω ~ 10M Ω	220 Ω = 221_	J : $\pm 5\%$	D : 7" Reel 20K/RL 0402 size	
MR06 : 0603	$\pm 1\%$, 10 Ω ~ 1M Ω	4K7 = 472_	P : Jumper	Q : 10" Reeled taping	
MR04: 0402	W :	10 Ω = 100_		G : 13" Reeled taping	
	$\pm 1\%$, < 10 Ω ; >1M Ω	1 Ω = 1R0_		B : Bulk	
		(" _ " means a blank)			
		Resistance code			
		$\pm 1\%$, E24+E96: 3 significant digits followed by no. of zeros			
		E96: 37.4K Ω = 3742			
		E24: 220 Ω = 2200			
		4K7 = 4701			
		10 Ω = 10R0			
		1 Ω = 1R00			

MR12,MR08,MR06:

1. Reeled tape packaging : 8mm width paper taping 5000pcs per 7" reel, 10kpcs per 10" reel, 20kpcs per 13" reel.
2. Bulk packaging : 5000pcs per poly-bag

MR04:

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

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°C to 35°C.

Relative humidity: 45% to 75%.

Air pressure: 86kPa to 106 kPa (860 mbar to 1060 mbar).

All soldering tests are performed with mildly activated flux.

TEST	PROCEDURE / TEST METHOD	REQUIREMENTS	
		Resistance	0Ω
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. $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/°C)} \quad t_1 : 20^\circ\text{C} + 5^\circ\text{C} - 1^\circ\text{C}$ 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±1second in a SAC solder bath at 270°C±5°C	ΔR/R max. ±(0.5%+0.05Ω) No visible damage	<50mΩ
Solderability J-STD-002	a) Bake the sample for 155°C dwell time 4hrs/ solder dipping 235°C / 5sec. b) Steam the sample dwell time 8 hrs/ solder dipping 215°C / 5sec. c) Steam the sample dwell time 8 hrs/ solder dipping 260°C / 7sec.	95% coverage min., good tinning and no visible damage	
Temperature cycling JESD22 method JA-104	1000 cycles, -55°C ~ +155°C, dwell time 30min	ΔR/R max. ±(0.5%+0.05Ω) No visible damage	<50mΩ
Moisture Resistance MIL-STD-202 method 106	65±2°C, 80~100% RH, 10 cycles, 24 hours/ cycle	ΔR/R max. ±(0.5%+0.05Ω) No visible damage	<50mΩ
Bias Humidity MIL-STD-202 method 103	1000+48/-0 hours; 85°C, 85% RH, 10% of operation power	ΔR/R max. ±(1%+0.05Ω) No visible damage	<50mΩ
Operational Life MIL-STD-202 method 108	1000+48/-0 hours; 35% of operation power, 125±2°C	ΔR/R max. ±(1%+0.05Ω) No visible damage	<50mΩ
Short Time Overload JIS C 5201-1 Clause 4.13	Permanent resistance change after a 5 second application of a voltage 2.5 times rated voltage or max. overload voltage, whichever is less.	ΔR/R max. ±(2%+0.1Ω) No visible damage	<50mΩ

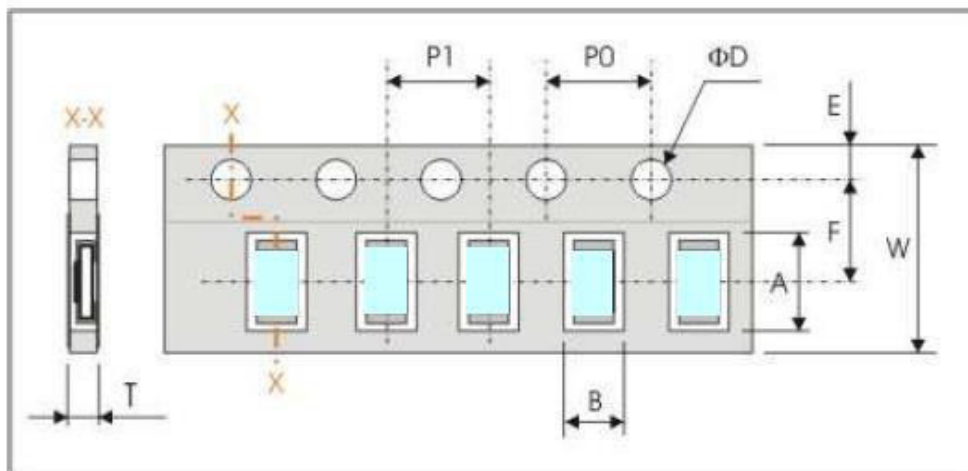
TEST	PROCEDURE / TEST METHOD	REQUIREMENTS	
		Resistance $\pm 5\%$, $\pm 1\%$	0 Ω
High Temperature Exposure MIL-STD-202 method 108	1000+48/-0 hours; without load in a temperature chamber controlled 155 $\pm 3^{\circ}\text{C}$	$\Delta R/R$ max. $\pm(1\%+0.05\Omega)$ No visible damage	<50m Ω
Mechanical Shock MIL-STD-202 method 213	Test 1/2 Sine Pulse/ 1500g peak/ normal duration: 6ms/ Velocity: 15.4ft/sec. Three shocks in each direction, total 18 shocks.	Within the specified tolerance. No visible damage	<50m Ω
Board Flex AEC-Q200-005	Resistors mounted on a 90mm glass epoxy resin PCB(FR4), bending once 2mm for 10sec	$\Delta R/R$ max. $\pm(1.0\%+0.05\Omega)$. No visible damage	<50m Ω
Terminal strength AEC-Q200-006	Pressurizing force: 1.8Kg (1Kg for 0402), Test time: 60 ± 1 sec.	No remarkable damage or removal of the terminations	
Resistance to Solvents MIL-STD-202 Method 215	Solvent is Isopropyl alcohol, immersion 3mins at 25 $^{\circ}\text{C}$ and brush 10 strokes with a toothbrush with a handle made of a non-reactive material (wet bristle), immersion and brush 3 times and then air blow dry	No superficial defect on marking, encapsulation, coating, appearance. Electrical characteristics within products specification and tolerance. Inspect at 3X max. for marking, inspect at 10X for part damage.	
Vibration MIL-STD-202 method 204	Test 5g's for 20min., 12 cycles each of 3 orientations	$\Delta R/R$ max. $\pm(1.0\%+0.05\Omega)$ No visible damage	<50m Ω
Thermal shock MIL-STD-202 method 107	Test -55 to 155 $^{\circ}\text{C}$ / dwell time 15min/ Max transfer time 20sec 300cycles	$\Delta R/R$ max. $\pm(0.5\%+0.05\Omega)$ No visible damage	<50m Ω
ESD AEC-Q200-002	Test contact 1.0KV (0.5KV for 0402 only)	$\Delta R/R$ max. $\pm(1\%+0.05\Omega)$ No visible damage	<50m Ω

TEST CONDITION FOR JUMPER (0 Ω)

Item	MR12	MR08	MR06	MR04
Power Rating At 70 $^{\circ}\text{C}$	1/4W	1/8W	1/10W	1/16W
Resistance	MAX.50m Ω			
Rated Current	2.2A	1.6A	1.4A	1.1A
Peak Current	4.4A	3.2A	2.8A	2.2A
Operating Temperature	-55 ~ +155 $^{\circ}\text{C}$			

PACKAGING

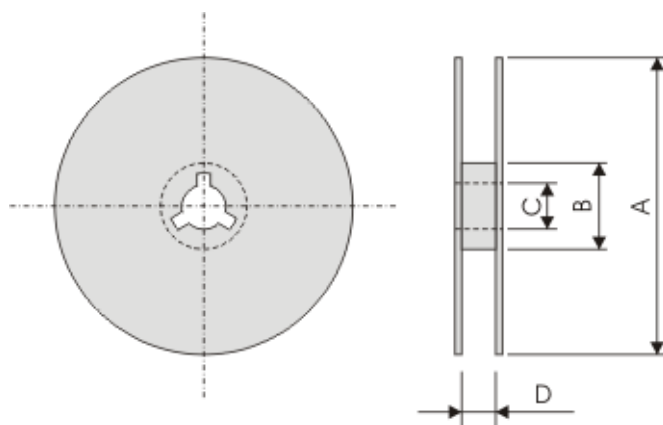
Paper Tape specifications (unit :mm)



Series No.	A	B	W	F	E
MR12	3.60±0.20	2.00±0.20	8.00±0.30	3.50±0.20	1.75±0.10
MR08	2.40±0.20	1.65±0.20			
MR06	1.90±0.20	1.10±0.20			
MR04	1.20±0.10	0.70±0.10			

Series No.	P1	P0	ΦD	T
MR12/08	4.00±0.10	4.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	Max. 1.0
MR06				0.65±0.05
MR04	2.00±0.10			0.40±0.05

7" Reel dimensions



Symbol	A	B	C	D
(unit : mm)	$\Phi 178.0 \pm 2.0$	$\Phi 60.0 \pm 1.0$	13.0 ± 0.2	9.0 ± 0.5

APPROVAL SHEET

**MR12_V, MR10_V, MR08_V, MR06_V,
MR04_V**

$\pm 1\%$, $\pm 5\%$

Thick film General Purpose Chip Resistors

Size 1206, 1210, 0805, 0603, 0402

Automotive & Military Compliant

Anti-Sulfuration

RoHS 2 Compliant with exemption 7C-I

Halogen free

*Contents in this sheet are subject to change without prior notice.

FEATURE

1. High reliability and stability $\pm 2\%$
2. Sulfuration resistant
3. Automotive grade AEC Q-200 Compliant
4. 100% CCD inspection
5. RoHS 2 compliant with exemption 7C-I and Halogen free products

APPLICATION

- Automotive application
- Consumer electrical equipment
- EDP, Computer application
- Telecom application

DESCRIPTION

The resistors are constructed in a high grade ceramic body (aluminum 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.

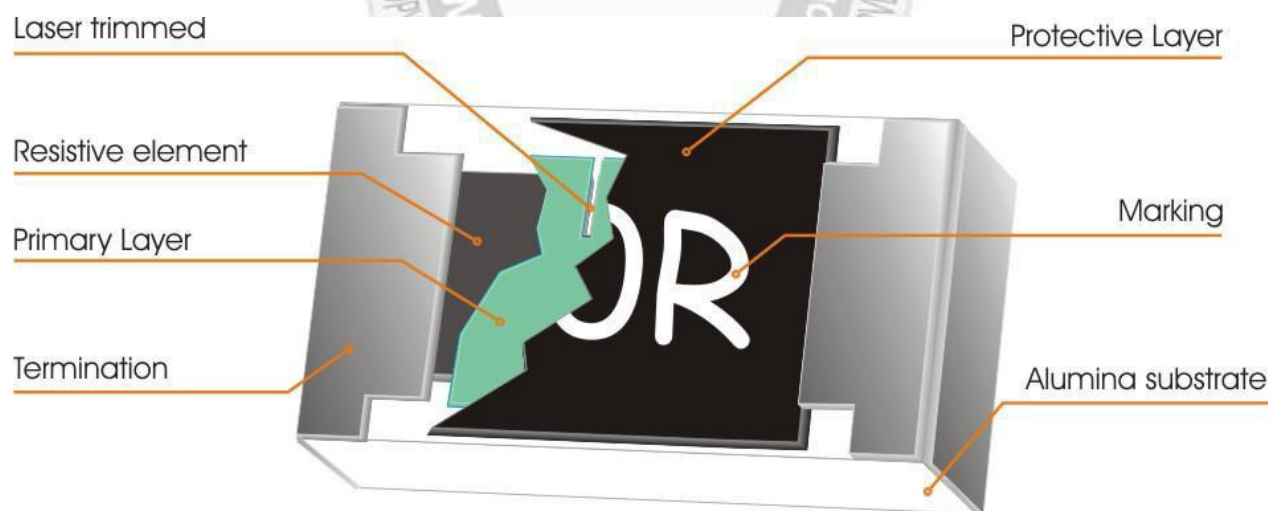


Fig 1. Construction of a Chip-R

QUICK REFERENCE DATA

Item	General Specification				
Series No.	MR10_V	MR12_V	MR08_V	MR06_V	MR04_V
Size code	1210(3225)	1206(3216)	0805(2012)	0603(1608)	0402(1005)
Resistance Range	1Ω~10MΩ (±5% tolerance), Jumper 1Ω~10MΩ (±1% tolerance)				
Resistance Tolerance	±1%, E96/E24 ±5%, E24				
TCR (ppm/°C)					
R > 1MΩ	≤ ± 200	≤ ± 200	≤ ± 200	≤ ± 200	≤ ± 200
10Ω < R ≤ 1MΩ	≤ ± 100	≤ ± 100	≤ ± 100	≤ ± 100	≤ ± 100
R ≤ 10Ω	-200~+400	-200~+400	-200~+400	-200~+400	-200~+400
Max. dissipation @ T _{amb} =70°C	1/2 W	1/4 W	1/8 W	1/10 W	1/16 W
Max. Operation Voltage (DC or RMS)	200V	200V	150V	75V	50V
Max. Overload Voltage (DC or RMS)	400V	400V	300V	150V	100V
Operation temperature	- 55 ~ + 155°C				

Note :

1. This is the maximum voltage that may be continuously supplied to the resistor element, see "IEC publication 60115-8"
2. Max. Operation Voltage : So called RCWV (Rated Continuous Working Voltage) is determined by

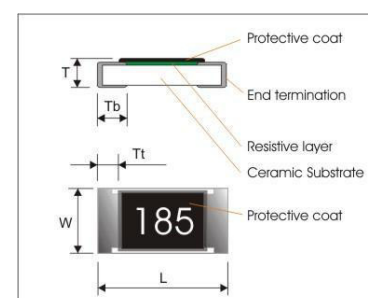
$$RCWV = \sqrt{\text{Rated Power} \times \text{Resistance Value}}$$
or Max. RCWV listed above, whichever is lower.

For Jumper (0Ω) :

Series No.	MR10_V	MR12_V	MR08_V	MR06_V	MR04_V
Size code	1210(3225)	1206(3216)	0805(2012)	0603(1608)	0402(1005)
Resistance	MAX.50mΩ				
TCR (ppm/°C)	TCR is not applicable for Jumper product				
Max. dissipation @ T _{amb} =70°C	1/2W	1/4W	1/8W	1/10W	1/16W
Rated Current	3A	2A	1.5A	1A	1A
Peak Current	7.5A	5A	3.5A	3A	2A
Operating Temperature	-55 ~ +155°C				

DIMENSIONS (unit : mm)

	MR10_V	MR12_V	MR08_V	MR06_V	MR04_V
L	3.10 ± 0.10	3.10 ± 0.10	2.00 ± 0.10	1.60 ± 0.10	1.00 ± 0.05
W	2.60 ± 0.10	1.60 ± 0.10	1.25 ± 0.10	0.80 ± 0.10	0.50 ± 0.05
T	0.55 ± 0.10	0.60 ± 0.15	0.50 ± 0.15	0.45 ± 0.15	0.35 ± 0.05
Tb	0.50 ± 0.20	0.45 ± 0.20	0.40 ± 0.20	0.30 ± 0.15	0.25 ± 0.10
Tt	0.50 ± 0.20	0.50 ± 0.20	0.40 ± 0.20	0.30 ± 0.10	0.20 ± 0.10



CATALOGUE NUMBERS

The resistors have a catalogue number starting with .

MR12	X	472_	J	T	L	V
Automotive code	Type code	Resistance code	Tolerance	Packaging code	Termination code	Special code
MR10 : 1210	X :	±5%, E24:	F : ±1%	T : 7" Reeled taping	L = Sn base	V = meet
MR12 : 1206	±5%, 1Ω ~ 10MΩ	2 significant digits followed by no. of zeros and a blank	J : ±5%	Q : 10" Reeled taping	(lead free)	1+2+3
MR08 : 0805	±1%, 10Ω ~ 1MΩ		P : Jumper	G : 13" Reeled taping		1. 100% CCD visual check
MR06 : 0603	W :	220Ω = 221_		H : 13" reel 50Kpcs only for 0402		2. Meet AEC Q-200 test
MR04: 0402	±1%, < 10Ω; >1MΩ	(" _ " means a blank)		B : Bulk		3. Anti-sulfur
		±1%, E24+E96:		D : 7" reel 20Kpcs only for 0402		ASTM B-809
		3 significant digits followed by no. of zeros		A : 7" reel 15Kpcs only for 0402		60°C x 500hrs
		E96: 37.4KΩ = 3742				
		E24: 220Ω = 2200				

Remark:

1210, 1206, 0805, 0603:

1. 8mm width paper taping 5000pcs per 7" reel, 10kpcs per 10" reel, 20kpcs per 13" reel.
2. Bulk packaging: 5000pcs per poly-bag

0402:

1. 8mm width paper taping 10,000pcs per 7" reel, 70kpcs per 13" reel.
2. Bulk packaging: 5000pcs per poly-bag

MARKING

Size \ Nr. Of digit of code/tolerance	±5% & Jumper(0Ω)	±1%
1210/1206/0805	3 digits marking	4 digits marking
0603 (1608)	3 digits marking	3 digits marking
0402(1005)	NO MARKING	

3 digits marking 【±5% : 1210, 1206, 0805, 0603 & Jumper (0Ω)】

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 : 17.8Ω=25X, 178Ω=25A, 1K78=25B 17K8=25C, 178K=25D, 1M78=25E														
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
01	100	13	133	25	178	37	237	49	316	61	422	73	562	85	750
02	102	14	137	26	182	38	243	50	324	62	432	74	576	86	768
03	105	15	140	27	187	39	249	51	332	63	442	75	590	87	787
04	107	16	143	28	191	40	255	52	340	64	453	76	604	88	806
05	110	17	147	29	196	41	261	53	348	65	464	77	619	89	825
06	113	18	150	30	200	42	267	54	357	66	475	78	634	90	845
07	115	19	154	31	205	43	274	55	365	67	487	79	649	91	866
08	118	20	158	32	210	44	280	56	374	68	499	80	665	92	887
09	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% : 1210/1206/0805)

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

Example

RESISTANCE	Jumper (0Ω)	10Ω	12Ω	100Ω	6800Ω	47000Ω
3 digits marking (1210, 1206, 0805, 0603 ±5% & Jumper)	000	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 $\pm 5\%$, and E24+E96 series for resistors with a tolerance of $\pm 1\%$. 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

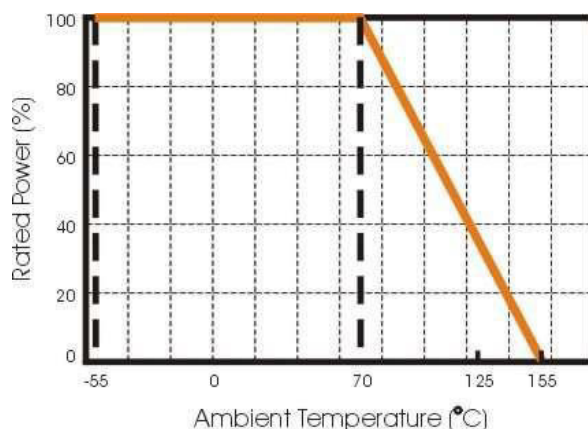


Figure 2.1 Maximum dissipation in percentage of rated power as a function of the ambient temperature

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.

Storage and Handling Conditions:

- Products are recommended to be used up within two years since operation date as ensured shelf life. Check solderability in case shelf life extension is needed.
- To store products with following condition:
 - Temperature :5 to 40°C
 - Humidity :20 to 70% relative humidity
- Caution:
 - Don't store products in a corrosive environment such as sulfide, chloride gas, or acid.
It may cause oxidation of electrode, which easily be resulted in poor soldering.
 - To store products on the shelf and avoid exposure to moisture.
 - Don't expose products to excessive shock, vibration, direct sunlight and so on.

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.

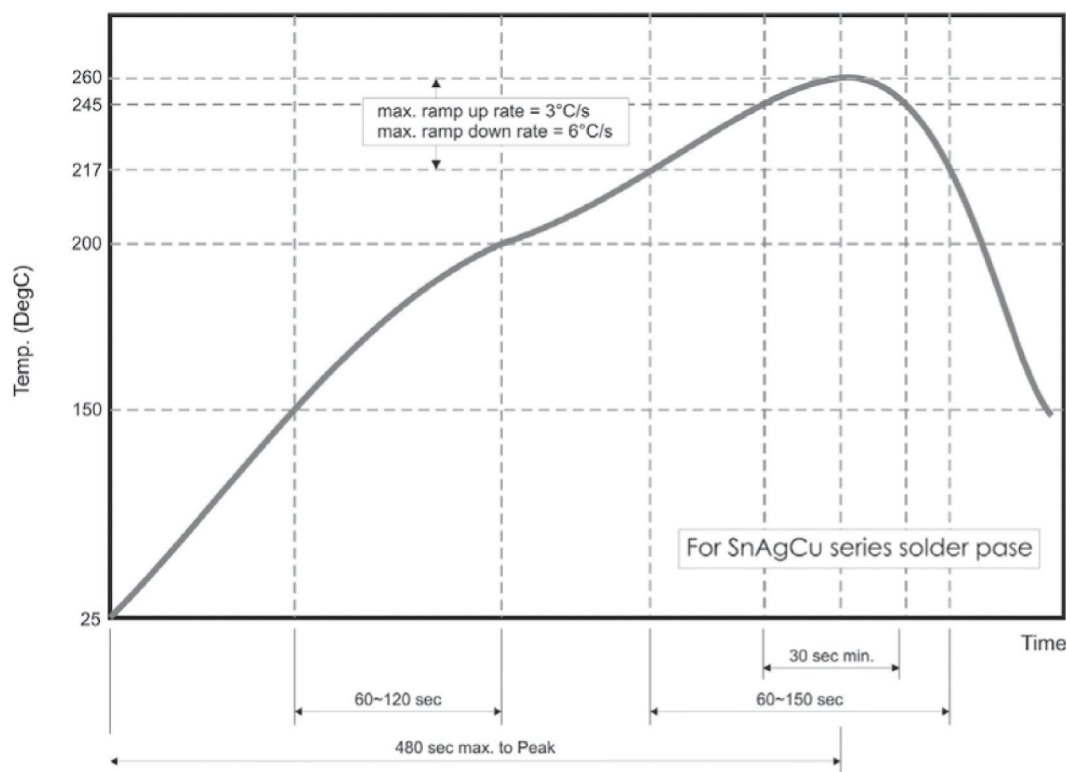


Fig 3. Recommended IR reflow soldering profile for
SMT process with SnAgCu series solder paste

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°C to 35°C.

Relative humidity: 45% to 75%.

Air pressure: 86kPa to 106 kPa (860 mbar to 1060 mbar).

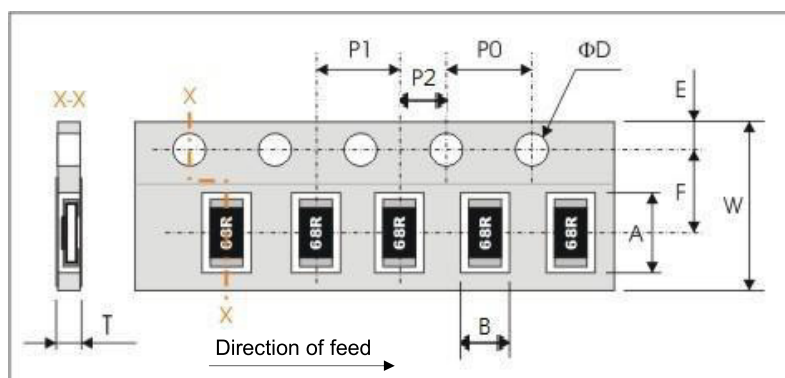
All soldering tests are performed with mildly activated flux.

TEST	PROCEDURE / TEST METHOD	REQUIREMENTS	
		Resistance	0Ω
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. $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (ppm/°C)} \quad t_1 : 20^\circ\text{C} + 5^\circ\text{C} - 1^\circ\text{C}$ 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±1second in a SAC solder bath at 270°C ±5°C	ΔR/R max. ±(1%+0.05Ω) No visible damage	<50mΩ
Solderability J-STD-002	a) Bake the sample for 155°C dwell time 4hrs/ solder dipping 235°C / 5sec. b) Steam the sample dwell time 1 hour/ solder dipping 260°C / 7sec.	95% coverage min., good tinning and no visible damage	
Temperature cycling JESD22 method JA-104	1000 cycles, -55°C ~ +155°C, dwell time 5~10min	ΔR/R max. ±(1%+0.05Ω) No visible damage	<50mΩ
Moisture Resistance MIL-STD-202 method 106	65±2°C, 80~100% RH, 10 cycles, 24 hours/ cycle	ΔR/R max. ±(1%+0.05Ω) No visible damage	<50mΩ
Bias Humidity MIL-STD-202 method 103	1000+48/-0 hours; 85°C, 85% RH, 10% of operation power	±5%: ΔR/R max. ±(2%+0.10Ω) ±1%: ΔR/R max. ±(1%+0.10Ω) No visible damage	<50mΩ
Operational Life MIL-STD-202 method 108	1000+48/-0 hours; 35% of operation power, 125±2°C	±5%: ΔR/R max. ±(2%+0.10Ω) ±1%: ΔR/R max. ±(1%+0.10Ω) No visible damage	<50mΩ

TEST	PROCEDURE / TEST METHOD	REQUIREMENTS	
		Resistance	0Ω
High Temperature Exposure MIL-STD-202 method 108	1000+48/-0 hours; without load in a temperature chamber controlled 155±3°C	±5%: ΔR/R max. ±(2%+0.10Ω) ±1%: ΔR/R max. ±(1%+0.10Ω) No visible damage	<50mΩ
Board Flex AEC-Q200-005	Resistors mounted on a 90mm glass epoxy resin PCB(FR4), bending once 2mm for 10sec	ΔR/R max. ±(1.0%+0.05Ω). No visible damage	<50mΩ
Terminal strength AEC-Q200-006	Pressurizing force: 1Kg, Test time: 60±1sec.	No remarkable damage or removal of the terminations	
Vibration MIL-STD-202 method 204	Test 5g's for 20 mins., 12 cycles each of 3 orientations.	ΔR/R max. ±(1%+0.05Ω) No visible damage	<50mΩ
Thermal shock MIL-STD-202 method 107	Test -55 to 155°C / dwell time 15min/ Max transfer time 20sec 300cycles	ΔR/R max. ±(0.5%+0.05Ω) No visible damage	<50mΩ
ESD AEC-Q200-002	Test contact 1.0KV (0.5KV for 0402 only)	ΔR/R max. ±(1%+0.05Ω) No visible damage	<50mΩ
Short Time Overload JISC5201-1: 1998 Clause 4.13	2.5 times RCWV or max. overload voltage, for 5seconds	±5%: ΔR/R max. ±(2%+0.10Ω) ±1%: ΔR/R max. ±(1%+0.10Ω) No visible damage	<50mΩ
Load life in Humidity JISC5201-1: 1998 Clause 4.24	1000 +48/-0 hours, loaded with RCWV or Vmax in humidity chamber controller at 40°C±2°C and 90~95% relative humidity, 1.5hours on and 0.5 hours off	±5%: ΔR/R max. ±(2%+0.10Ω) ±1%: ΔR/R max. ±(1%+0.10Ω) No visible damage	<50mΩ
Load life (endurance) JISC5201-1: 1998 Clause 4.25	1000 +48/-0 hours, loaded with RCWV or Vmax in chamber controller 70±2°C, 1.5 hours on and 0.5 hours off	±5%: ΔR/R max. ±(2%+0.10Ω) ±1%: ΔR/R max. ±(1%+0.10Ω) No visible damage	<50mΩ
Sulfuration test ASTM B-809-95	ASTM B-809 60°C 500hrs	±5%: ΔR/R max.±(2%+0.10Ω) ±1%: ΔR/R max.±(2%+0.05Ω) No visible damage	<50mΩ

PACKAGING

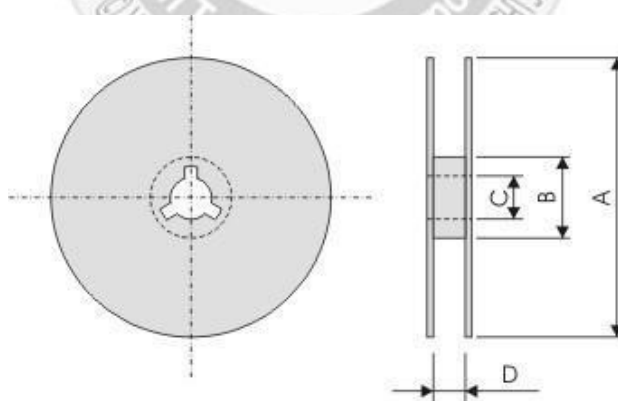
Paper Tape specifications (unit :mm)



Series No.	A	B	W	F	E
MR10	3.60±0.20	3.00±0.20	8.00±0.30	3.50±0.20	1.75±0.10
MR12	3.60±0.20	2.00±0.20			
MR08	2.40±0.20	1.65±0.20			
MR06	1.90±0.20	1.10±0.20			
MR04	1.20±0.10	0.70±0.10			

Series No.	P1	P0	P2	ΦD	T
MR10/12/08	4.00±0.10	4.00±0.10	2.00±0.10	$\Phi 1.50^{+0.1}_{-0.0}$	Max. 1.0
MR06					0.65±0.05
MR04	2.00±0.10				0.40±0.05

Reel dimensions



Symbol	A	B	C	D
7" reel	$\Phi 178.0 \pm 2.0$	$\Phi 60.0 \pm 1.0$	13.0±0.2	9.0±0.5
10" reel	$\Phi 254.0 \pm 2.0$	$\Phi 100.0 \pm 1.0$	13.0±0.2	9.0±0.5
13" reel	$\Phi 330.0 \pm 2.0$	$\Phi 100.0 \pm 1.0$	13.0±0.2	9.0±0.5