CR Series
Chip Resistors - Thick Film Chip Resistors

1. Scope

This specification prescribes thick film chip resistors for use in electronics system.

2. Designation

2.1 Designation is made in accordance with the following system.

3. Part Number

CR - 0805 - J - 100 - TR - PPM - LF

1 - 2 - 3 - 4 - 5 - 6 - 7

1. Type	CR=Thick Film Chip Resistors

2. Size	CODE	0201	0402	0603	0805	1206	1210	2010	2512
	SIZE	0201(0502)	0402(1005)	0603(1608)	0805(2012)	1206(3216)	1210(3225)	2010(5025)	2512(6332)

3. Tolerance	CODE	A	B	C	D	F	G	J	SPECIFIC
	%	±0.05%	±0.1%	±0.25%	±0.5%	±1%	±2%	±5%	0Ω(CR0805Z0)

4. Ohmage	OHM	0.22	1.0	10	100	1M	20M
	E24 CODE	0R22	1R0	100	101	105	205
	E96 CODE	R220	1R00	10R0	1000	1004	2004

5. Packing	TYPE	0201	0402	0603	0805	1206	1210	2010	2512
	CODE = TR	10K REEL	10K REEL	5K REEL	5K REEL	5K REEL	5K REEL	4K REEL	4K REEL

6. PPM	CODE	BLANK	TA	TB	T1	T2	T9
	PPM	SPEC	±5	±10	±100	±50	±25

7.Green	CODE	BLANK	LF
	TYPE	LEADED	LEAD FREE

Remark:

(1) Common code for chip resistors

(2) Resistance tolerance: refer to 3.3 for tolerance system

(3) Normal resistance value: the first two digits are significant figures of Resistance value and the third one denotes the Number of zeros following

Example: 330 ohm: 331 4.7K ohm: 472 –E24

330 ohm: 33R0 4.7K ohm: 4701 –E96

4.Rating

4.1Rated Power (%)

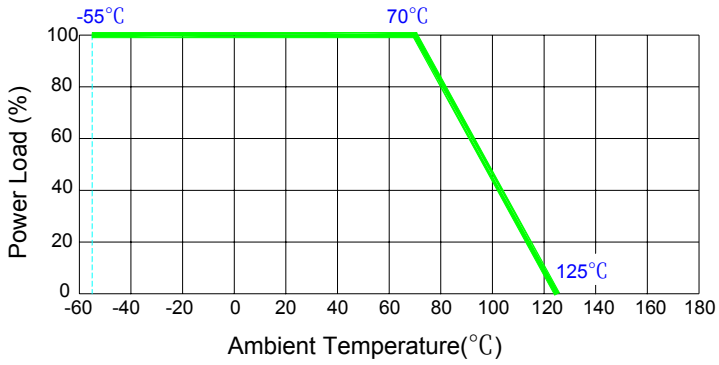
Rated power shall be load power corresponding to normal wattage suitable for continuous use at 70℃ ambient temperature In case the ambient temperature exceeds 70℃ reduce the load power in accordance with derating curve shown as graph 4.2.

Type	Power Rating At 70 ℃	Max. RCWV	Max. Overload Voltage (V)	Resistance Tolerance	Resistance Range		Standard Resistance Values	Temperature Coefficient (TCR; PPM/℃)
					Min.	Max.		
CR0201	1/20W	50V	100V	±1% (F) ±5% (J)	100Ω 10Ω	100KΩ 1MΩ	E-96 E-24	±50, ±100 ±200
CR0402	1/16W	50V	100V	±1% (F) ±5% (J)	100Ω 10Ω	100KΩ 1MΩ	E-96 E-24	±50, ±100 ±200
CR0603	1/10W	50V	100V	±1% (F) ±2% (G) ±5% (J)	10Ω 1Ω 1Ω	1MΩ 10MΩ 10MΩ	E-96 E-24 E-24	±50, ±100 ±200 ±200
CR0805	1/8W	150V	300V	±1% (F) ±2% (G) ±5% (J)	10Ω 1Ω 1Ω	1MΩ 10MΩ 10MΩ	E-96 E-24 E-24	±50, ±100 ±200 ±200
CR1206	1/4W	200V	400V	±1% (F) ±2% (G) ±5% (J)	10Ω 1Ω 1Ω	1MΩ 10MΩ 10MΩ	E-96 E-24 E-24	±50, ±100 ±200 ±200
CR1210	1/4W	200V	400V	±1% (F) ±2% (G) ±5% (J)	10Ω 1Ω 1Ω	1MΩ 10MΩ 10MΩ	E-96 E-24 E-24	±50, ±100 ±200 ±200
CR2010	1/2W	200V	400V	±5% (J)	1Ω	10MΩ	E-24	±200
CR2512	1W	200V	400V	±5% (J)	1Ω	10MΩ	E-24	±200

*Lesser of $\sqrt{PR}$ or maximum working voltage.

P.s. Broader ohmage range, tighter tolerance and low TCR are also available too upon special request. Please consult factory for availability.

4.2 Derating Curve



4.3 Operating and Storage Temperature Range -55℃~ +125℃

4.4 Rated Voltage

The rated voltage is calculated from the rated power and normal resistance by the following formula： $E=\sqrt{RP}$

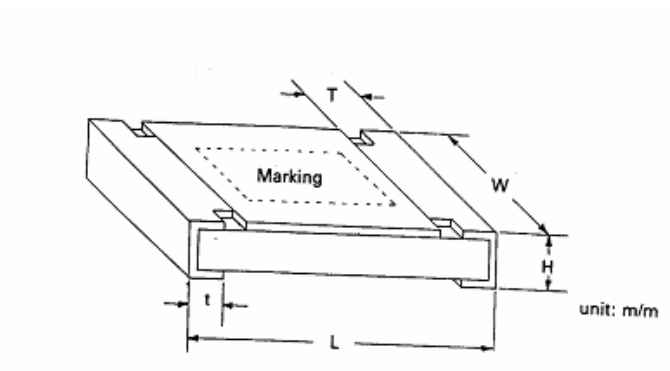
Where： E：Rated Voltage (V)

P：Rated Power (W)

R：Normal Resistance (OHM)

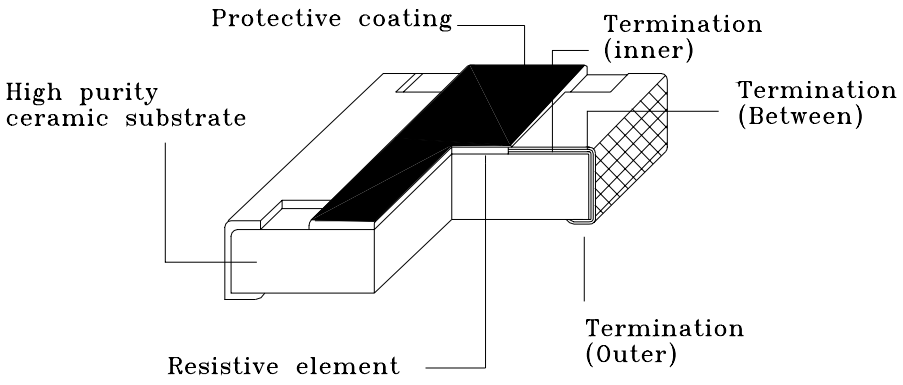
In case the value calculated by the formula exceed the maximum working voltage as 4.1, the maximum working voltage shall be regarded as rated

5.Dimensions



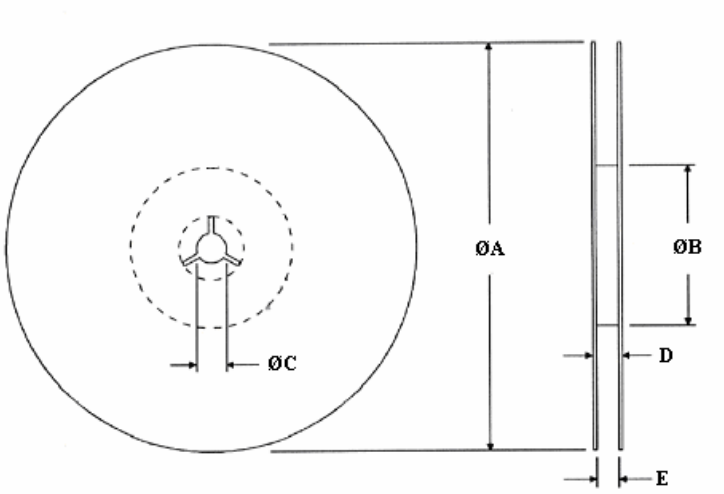
Type	Power Rating	EIA Size	Units	L	W	H	T	t
CR0201	1/20W	0201	mm	0.6 ± 0.03	0.3 ± 0.03	0.23 ± 0.03	0.1 ± 0.05	0.15 ± 0.05
			Inch	0.024 ± 0.001	0.011 ± 0.001	0.009 ± 0.001	0.004 ± 0.002	0.006 ± 0.002
CR0402	1/16W	0402	mm	1.0 + 0.1 - 0.05	0.5 + 0.1 -0.05	0.35 ± 0.05	0.2 ± 0.1	0.25 + 0.05 - 0.1
			Inch	0.039 +0.004 -0.002	0.02 +0.004 -0.002	0.014 ± 0.002	0.08 ± 0.004	0.010 +0.002 -0.004
CR0603	1/10W	0603	mm	1.6 ± 0.15	0.8 ± 0.15	0.45 ± 0.1	0.3 ± 0.2	0.2 + 0.2 - 0.1
			Inch	0.063 ± 0.006	0.031 ± 0.006	0.018 ± 0.004	0.012 ± 0.008	0.008 +0.008 -0.004
CR0805	1/8W	0805	mm	2 ± 0.2	1.25 ± 0.1	0.5 ± 0.1	0.4 ± 0.2	0.4± 0.2
			Inch	0.079 ± 0.008	0.049 ± 0.004	0.020 ± 0.004	0.016 ± 0.008	0.016 ± 0.008
CR1206	1/4W	1206	mm	3.1 ± 0.15	1.55 ± 0.15	0.55 ± 0.1	0.5 ± 0.2	0.5 ± 0.25
			Inch	0.122 ± 0.006	0.061 ± 0.006	0.021 ± 0.004	0.020 ± 0.008	0.02 ± 0.01
CR2010	1/2W	2010	mm	5.0 ± 0.15	2.5 ± 0.15	0.55 ± 0.1	0.6 ± 0.2	0.5 ± 0.25
			Inch	0.197 ± 0.006	0.098 ± 0.006	0.021 ± 0.004	0.024 ± 0.008	0.02 ± 0.01
CR2512	1W	2512	mm	6.4 ± 0.2	3.2 ± 0.15	0.55 ± 0.1	0.6 ± 0.2	0.6 ± 0.3
			Inch	0.252 ± 0.008	0.126 ± 0.006	0.021 ± 0.004	0.024 ± 0.008	0.024 ± 0.012
CRxxxxZ0	Jumper	0201-2512	0.05 OHM Max. DC Resistance, Rated Current 2A Max.					

6.Construction and materials



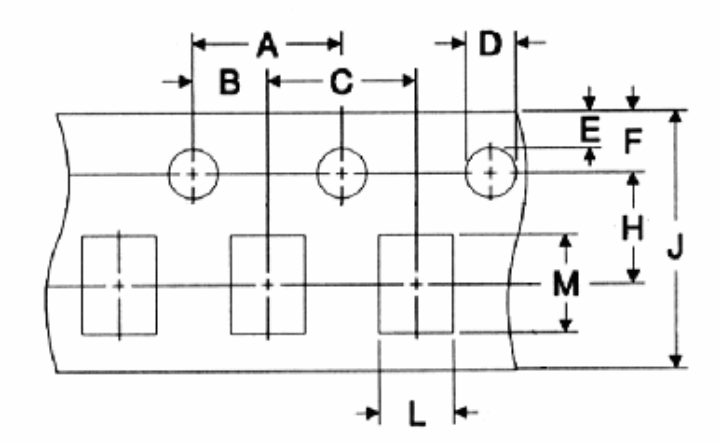
7. Package

7.1 Tapping Specification



Dimensions

Type	Units	ØA	ØB	ØC	D	E
CR0201 CR0402 CR0603 CR0805 CR1206	mm	178 ± 2	60 ± 2	13.5 ± 0.5	12.5 ± 1.5	9.8 ± 1.5
	Inch	7.008±0.08	2.362±0.08	0.512±0.02	0.492±0.06	0.386±0.06
CR2010 CR2512	mm	178 ± 2	60 ± 2	13.5 ± 0.5	15.4 ± 1	13 ± 0.3
	Inch	7.008±0.08	2.362±0.08	0.512±0.02	0.606±0.04	0.511±0.011



Dimensions

Type	Units	A	B	C	ØD	E	F	H	J	L	M
CR0402	mm	4 ± 0.1	2 ± 0.05	4 ± 0.1	1.5 +0.1 -0	1 ± 0.1	1.75 ± 0.1	3.5 ± 0.05	8 ± 0.2	0.65 ± 0.1	1.15 ± 0.1
	Inch	0.157±0.004	0.079±0.002	0.157±0.04	0.059+0.004 -0	0.039±0.004	0.069±0.004	0.138±0.002	0.315±0.008	0.026±0.004	0.045±0.004
CR0603	mm	4 ± 0.1	2 ± 0.05	4 ± 0.1	1.5 +0.1 -0	1 ± 0.1	1.75 ± 0.1	3.5 ± 0.05	8 ± 0.2	1.1 ± 0.1	1.9 ± 0.1
	Inch	0.157±0.004	0.079±0.002	0.157±0.04	0.059+0.004 -0	0.039±0.004	0.069±0.004	0.138±0.002	0.315±0.008	0.043±0.004	0.079±0.004
CR0805	mm	4 ± 0.1	2 ± 0.05	4 ± 0.1	1.5 +0.1 -0	1 ± 0.1	1.75 ± 0.1	3.5 ± 0.05	8 ± 0.2	1.65 ± 0.2	2.4 ± 0.2
	Inch	0.157±0.004	0.079±0.002	0.157±0.04	0.059+0.004 -0	0.039±0.004	0.069±0.004	0.138±0.002	0.315±0.008	0.065±0.008	0.094±0.008
CR1206	mm	4 ± 0.1	2 ± 0.05	4 ± 0.1	1.5 +0.1 -0	1 ± 0.1	1.75 ± 0.1	3.5 ± 0.05	8 ± 0.2	2 ± 0.2	3.6 ± 0.2
	Inch	0.157±0.004	0.079±0.002	0.157±0.04	0.059+0.004 -0	0.039±0.004	0.069±0.004	0.138±0.002	0.315±0.008	0.079±0.008	0.142±0.008
CR2010	mm	4 ± 0.1	2 ± 0.05	4 ± 0.1	1.5 +0.1 -0	1 ± 0.1	1.75 ± 0.1	5.5 ± 0.05	12.5 ± 0.2	2.9 ± 0.1	5.3 ± 0.1
	Inch	0.157±0.004	0.079±0.002	0.157±0.04	0.059+0.004 -0	0.039±0.004	0.069±0.004	0.216±0.002	0.492±0.008	0.114±0.004	0.208±0.004
CR2512	mm	4 ± 0.1	2 ± 0.05	4 ± 0.1	1.5 +0.1 -0	1 ± 0.1	1.75 ± 0.1	5.5 ± 0.05	12.5 ± 0.2	3.4 ± 0.1	6.6 ± 0.1
	Inch	0.157±0.004	0.079±0.002	0.157±0.04	0.059+0.004 -0	0.039±0.004	0.069±0.004	0.216±0.002	0.492±0.008	0.133±0.004	0.26±0.004

JIS C5202 5.1

8.Characteristics And Test Methods

8.1 Electrical characteristics test methods

8.1.1 Resistance Value

Measurement of resistance takes place by the bridge methods or by use of a measuring instrument corresponding accuracy. It's accuracy being fully reliable with respect to tolerances on resistance. The applied voltage for measurement shall be as specified in Table as following.

Resistance (R)	Voltage applied (V)
2.2Ω~100Ω	0.3V
100Ω~1KΩ	1V
1KΩ~10KΩ	3V
10KΩ~100KΩ	10V
100KΩ~1MΩ	25V
1MΩ~10MΩ	50V
10MΩ~aboveΩ	100V

8.1.2 Temperature Coefficient of Resistance

In according with 8.1.1, measure initial value of resistor mounted on the test board, Then keep the temperature at each step as following table, hold for 30 minutes after reaching a given temperature and measure resistance under the same condition as initial value measurement. The temperature coefficient of resistance calculated from these measured values by the following formula shall be within ±300ppm/℃ (or as table 4.2 or as per customer request).

$$\text{Temperature coefficient (PPM/℃)} = \frac{R - R_0}{R} * \frac{1}{t - t_0} * 10^6$$

Where R = Resistance value at tested temperature

R_0 = Initial resistance value

t = Actual measurement of tested temperature

t_0 = Initial temperature

Step	Temperature
1	25 ± 5℃
2	-55 ± 5℃
3	25 ± 5℃
4	125 ± 5℃

*(1) is reference Temperature at Step 2.
*(2) is reference Temperature at Step 4.

8.1.3 Short-Time Overload

In accordance with 8.1.1, measure the initial value of resistor mounted on the test socket, and then apply to the resistor the voltage corresponding to 2.5 times rate voltage. However, in case the voltage corresponding to 2.5 times the rated voltage exceeds the maximum overload voltage, the maximum overload voltage shall be regarded as test voltage. Eliminate the voltage, leave aside with no load for 30 minutes and then measure resistance under the same condition as in initial-value measurement, at this time, the variation in relation to initial resistance shall be within ±(2%+0.1Ω)

8.1.4 Dielectric withstanding voltage test

The applied test voltage shall be slowly increased from 0 V to maximum working voltage with effective commercial frequency (60 Hz or 50 Hz) across electrode and the center of body for 60±5 seconds. At this time there shall be no failure on the resistor as short circuit live, burning, breakdown, etc.

8.2 Mechanical Characteristics and Test Methods

8.2.1 Resistance to Soldering Heat

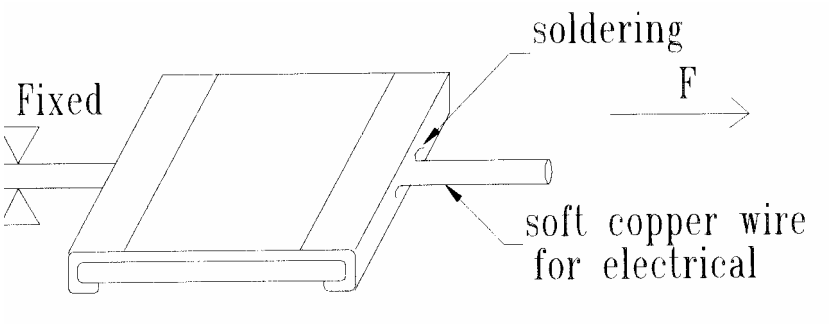
In accordance with 8.1.1, measure the initial value of a resistor. Dip it in a soldering bath at 260±5℃ for 10±1 seconds and take out to room temperature. Then, leave it aside for about one hour and measure resistance under the same condition as in initial value measurement. The variation in relation to the initial resistance shall be within ±(1%+0.1Ω), there being no failure in appearance and mechanical damage.

8.2.2 Solderability

Dip the terminal in a flux (methanol solution containing rosin approx. 25% in weight) for one to two sec. and then dip into a soldering bath at 230℃ for 2±0.5sec. The solder to be used shall be per standard specified per JIS H 4341 H60A.

8.2.3 Terminal Strength

As following figure, solder on both the sides of the resistors a soft copper wire 0.5mm in diameter for electrical use and fix one of its ends. Then, apply a tensile load of 0.5kgf on the other end and hold for 30±5sec. At this time, there shall be no electrode separation. The variation in resistance before and after this test shall also be within ±(1%+0.1Ω)



Test side electrode strength

8.3 Temperature Cycling and Test Methods

8.3.1 Low Temperature Resistance

In accordance with 8.1.1, measure the initial value of a resistor mounted on the test substrate and place it in a thermostats condition at -55℃±3℃ for 1000 $^{+48}/_{-0}$ hours. Take it out to room temperature, leave aside for four hour and then measure resistance under the same condition as in initial value measurement. At this time, the variation in relation to the initial resistance shall be within ±(2%+0.1Ω), there being no mechanical damage.

8.3.2 High Temperature Resistance

In accordance with 8.1.1, measure the initial value of a resistor mounted on the test substrate and place it in a thermostat condition at 125℃±3℃ for 1000$^{+48}/_{-0}$ hours. Take it out to room temperature, leave aside for four hours, and then measure resistance under the same condition as in initial value measurement. At this time, the variation in relation to the initial resistance shall be within ±(3%+0.1Ω), there being no mechanical damage.

8.3.3 Temperature Cycle

In accordance with 8.1.1, measure initial value of the resistor mounted on test substrate and then repeats five cycles continuously with four steps of heat cycle in following table regarded as one cycle. Take it out to room temperature, leave aside for one hour, and then measure resistance under the same condition as in initial value measurement at this time, the variation in relation to the initial resistance shall be within ±(3%+0.1Ω), there being no mechanical injury.

Conditions of Heat Cycle Test

Step	Temperature(℃)	Time (min)
1	-55 ± 3	30
2	Room Temperature	10~15
3	125 ± 3	30
4	Room Temperature	10~15

8.3.4 Moisture Resistance

In accordance with 8.1.1, measure the initial value of a resistor mounted on the test substrate. Then leave it in a thermal and humidity chamber having 40±2℃ temperature and 90~95% relative humidity with no load for 1000 $^{+48}/_{-0}$ hours. Take it out to room temperature, leave aside for about one hour, and then measure resistance under the same condition as in initial value measurement. At this time the variation in relation in to the initial resistance shall be within ±(3%+0.1Ω), there being no mechanical damage.

8.3.5 Endurance for Humidity

In accordance with 8.1.1, measure the initial value of a resistor mounted on the test substrate. Then apply the rated D.C. voltage in article 4.1 or 4.4 conditions applied for 90 minutes. in a thermal and humidity chamber having 40±2℃ temperature and 90~95% relative humidity and repeat the 30 minutes. Pause cycle at 1000 $^{+48}/_{-0}$ hours. Then, take it out to room temperature, leave aside for about one hour, and measure resistance under the same condition as in initial value measurement. At this time, the variation in relation to the initial resistance shall be within ±(3%+0.1Ω), there being no mechanical damage.

8.3.6 Endurance at High Temperature

In accordance with 8.1.1, measure the initial value of the resistor mounted on test substrate. Then apply the rated D.C. voltage in article 4.1 or 4.4 condition applied for 90 minutes in constant temperature oven having 70±2 ℃ temperature. Pause cycle at 1000 $^{+48}/_{-0}$ hours. Then, take it out to room temperature, leave aside for about one hour, and measure resistance under the same condition as in initial value measurement. At this time, the variation in relation to the initial resistance shall be within ±(3%+0.1Ω), there being no mechanical damage.

8.3.7 Rated load test

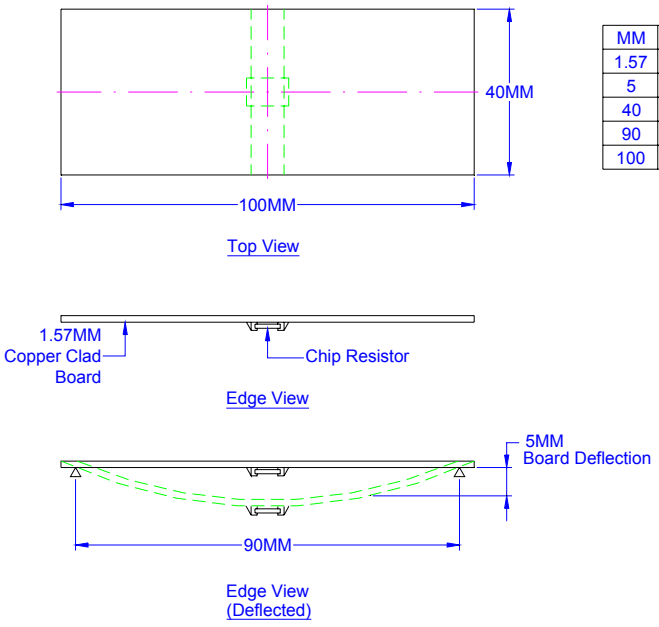
In accordance with 8.1.1, measure the initial value of the resistor mounted on test substrate. Then, depending on respective paragraph 4.4 E= $\sqrt{RP}$ Rated voltage, 1.5 hours on and 1/2 hour off, for a type per total elapsed time of 1000 hours at 70±2℃. Resistors shall be mounted on PC board test pattern.

Resistance determinations shall be made initially and at the end of the first half-hour-off period after 250, 500 and 1000 hours of test. Resistance shall be within ±(J:3%+0.1Ω, F:1%+0.05Ω)

8.3.8 Bending strength test

Bond chip resistor with epoxy resin to center of 100 × 40 × 1.57 mm test substrate. Solder terminals, cool, and then bend in 100 planes to 3 mm from horizontal plane for a period of 10 seconds.

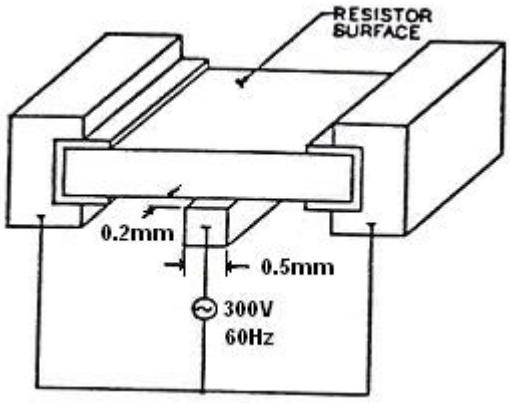
Following the bending test, the change in resistance shall be within ±(1%+0.1Ω) from initial measured value with no evidence of mechanical damage.



MM	INCH
1.57	0.062
5	0.197
40	1.57
90	3.54
100	3.94

8.3.9 Dielectric Withstanding Voltage test

Resistors of each value shall be placed into clamping fixture. Test voltage to be applied between center electrode and two outside electrodes. The resistors shall withstand the application of 100V, 60Hz without mechanical damage, arcing and breakdown.



8.3.10 Insulation Resistance test

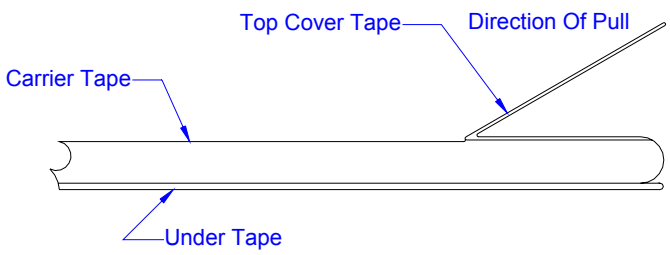
Measure the resistance value between terminal and coating must be over 1000MΩ after applied 100V DC±15V for 1 minutes. No spark and mechanical damage.

8.3.11 Intermittent Overload test

Apply 2.5 times of rating voltage but not exceeding the max. Overload voltage for 1 second on, 25 seconds off. Which test 10,000 cycles.
The specimen is allowed to stand without load for 30minutes or more after removal of voltage, then the resistance is measured and the variation in the resistance value is calculated.
Resistance shall be within ±(5%+0.1Ω) no mechanical damage.

8.3.12 Peel force of top cover tape

The peel force of top cover tape shall be 0.1N to 0.7N (10 to 70 gf), when the top cover tape is pulled at a speed of 200 mm/min with the angle between the tape during peel and the direction of unreeling maintained at 165 to 180 degree as illustrated in below figure.



9.Explanation Of Body Marking System For 0603, ±1%

EIA-96 Marking

Standard E-96 Values And 0603 Resistance Code

E24 Value	E96 Value	Code	E96 Value	Code	E96 Value	Code	E96 Value	E96 Value
100	100	01	102	02	105	03	107	04
110	110	05	113	06	115	07	118	08
120	121	09	124	10	127	11	130	12
130	133	13	137	14	140	15	143	16
150	147	17	150	18	154	19	158	20
160	162	21	165	22	169	23	174	24
180	178	25	182	26	187	27	191	28
200	196	29	200	30	205	31	210	32
220	215	33	221	34	226	35	232	36
240	237	37	243	38	249	39	255	40
270	261	41	267	42	274	43	280	44
300	287	45	294	46	301	47	309	48
330	316	49	324	50	332	51	340	52
360	348	53	357	54	365	55	374	56
390	383	57	392	58	402	59	412	60
430	422	61	432	62	442	63	453	64
470	464	65	475	66	487	67	499	68
510	511	69	523	70	536	71	549	72
560	562	73	576	74	590	75	604	76
620	619	77	634	78	649	79	665	80
680	681	81	698	82	715	83	732	84
750	750	85	768	86	787	87	806	86
820	825	89	845	90	866	91	887	92
910	909	93	931		953	95	976	

Multiplier Code

Code	A	B	C	D	E	F	G	H	X	Y	Z
Multiplier	10^0	10^1	10^2	10^3	10^4	10^5	10^6	10^7	10^{-1}	10^{-2}	10^{-3}

This table shows the first two digits for the three-digit EIA-96 part-marking scheme
The third character is a letter multiplier: