

FrelTec GmbH

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High Power Chip Resistors SMD

SMD

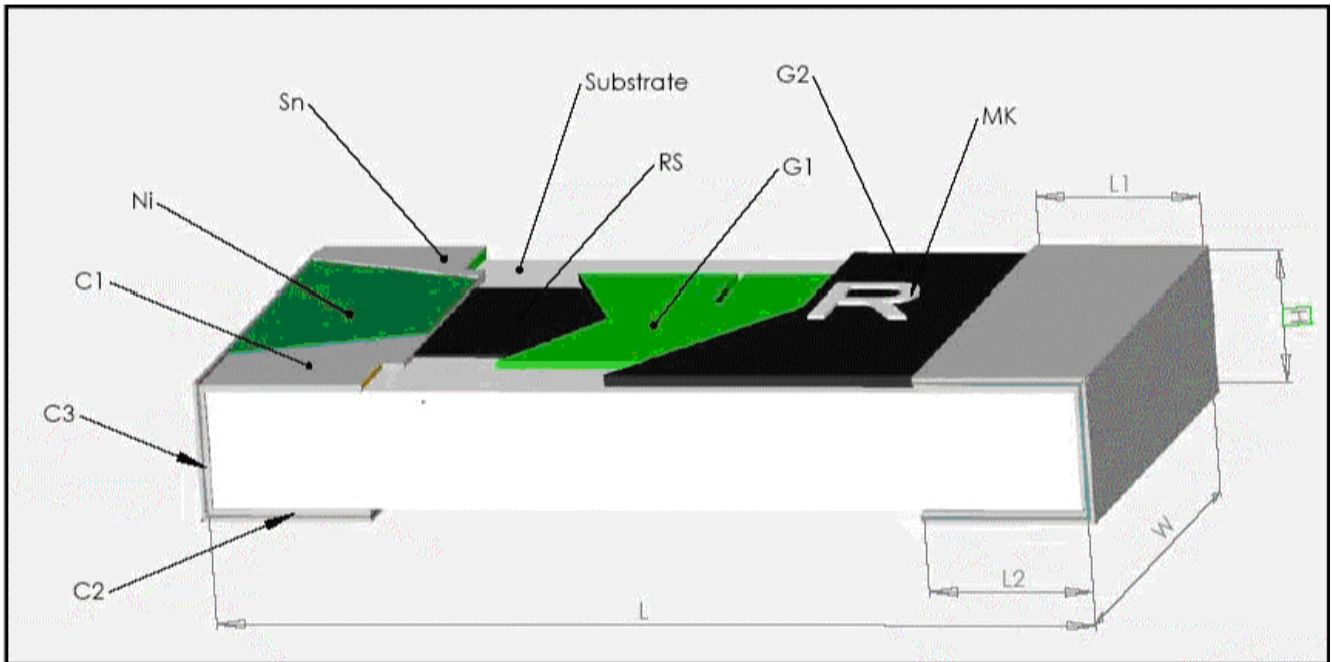
SPECIFICATION

Part Number

031	05*	1001*	J*	T05*	— — —**
Type	Size	Value	Tolerance	Packing	Option
031 : SMD High Power Chip Resistor	03 : 0603	R=Decimal	F : ±1%	T05: Tape and reel for 5k pc (7"reel),	* not all combination is possible ** optional only for special version e.g. special ppm
	05 : 0805	The last digit is the multiplier which denotes the number of zero following	J : ±5%	T10: Tape and reel for 10k pc (10"reel)	
	06 : 1206	0000=0Ohm		T15: Tape and reel for 15k pc (13"reel)	
	Example: R010 = 0,01Ohm			T20: Tape and reel for 20k pc (13"reel)	
	97R6=			All 4mm pitch Paper tape	
	9760 = 976Ohm 1001 = 1kOhm E24-Series is first digit "0"				

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THICK FILM CHIP RESISTORS



Plating Thickness:

Ni: $\geq 1\mu\text{m}$

Sn(Tin): $\geq 3\mu\text{m}$

Sn(Tin) : Matte Sn

C1,C2,C3: Conductor,

G1 G2: Overcoat printing,

RS: Resistance printing,

MK: Marking printing

Dimensions

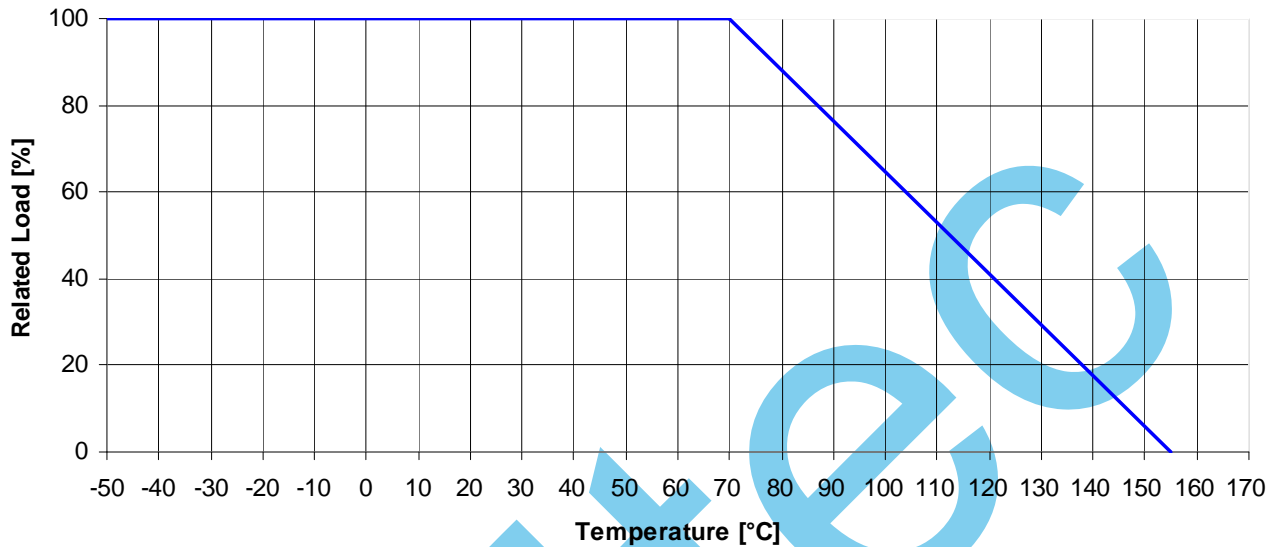
SIZE	L	W	L1	L2	H
0603	1,55+/-0,10	0,80+0,15/-0,10	0,30+/-0,15	0,30+/-0,15	0,45+/-0,10
0805	2,00+/-0,10	1,25+/-0,10	0,35+/-0,20	0,35+/-0,15	0,50+/-0,10
1206	3,05+/-0,10	1,55+/-0,10	0,45+/-0,20	0,35+/-0,15	0,55+0,10/-0,05

(unit: mm)

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Power Derating Curve:

For resistors operated in ambient temperatures above 70°C, power rating must be derated in accordance with the curve below. Operating temperature -55°C to +155°C

**Voltage Rating:**

Rated Voltage: The resistor shall have a DC continuous working voltage or a rms AC continuous working voltage at commercial-line frequency and wave form corresponding to the power rating, as determined from the following:

E= Rated voltage [V]

P= Power rating [W]

R= Nominal resistance [Ω]

$$E = \sqrt{R \cdot P}$$

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THICK FILM CHIP RESISTORS

*Rating***031 Series**

GENERAL PURPOSE CHIP RESISTORS

Type	Size	Power Rating at 70°C	Max. Working Voltage	Max. Overload Voltage	Temperature Coefficient [TCR; ppm/°C]	Resistance Range [Ω]	
						F(±1%) E-96	J(±5%) E-24
03103	0603	1/8W	75V	150V	±100	10Ω~1MΩ	
					±200		10Ω~1MΩ
					±400	1Ω~9,9Ω	1Ω~9,9MΩ
03105	0805	1/4W	150V	300V	±100	10Ω~1MΩ	
					±200		10Ω~1MΩ
					±400	1Ω~9,9Ω	1Ω~9,9MΩ
03106	1206	1/2W	200V	400V	±100	10Ω~1MΩ	
					±200		10Ω~1MΩ
					±400	1Ω~9,9Ω	1Ω~9,9MΩ

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SPECIFICATION



E96 (1%) 0805 to 1206

4 digit marking, first three digits marking are significant figures; fourth digit is multiplier (10^x).

examples: 1542 = $154 \times 10^2 = 15.400 \text{ Ohm} = 15,4 \text{ kOhm}$



E24 (5%) 0603 to 1206

3 digit marking, first two digits marking are significant figures; third digit is multiplier (10^x).

examples: 512 = $51 \times 10^2 = 5,1 \text{ kOhm}$



E96 (1%) 0603

examples: 12C (Table below) = $130 \times 10^2 = 13 \text{ kOhm}$

000 = 0 Ohm

3 digit Marking Table

Code	E96	Code	E96	Code	E96	Code	E96
01	100	25	178	49	316	73	562
02	102	26	182	50	324	74	576
03	105	27	187	51	332	75	590
04	107	28	191	52	340	76	604
05	110	29	196	53	348	77	619
06	113	30	200	54	357	78	634
07	115	31	205	55	365	79	649
08	118	32	210	56	374	80	665
09	121	33	215	57	383	81	681
10	124	34	221	58	392	82	698
11	127	35	226	59	402	83	715
12	130	36	232	60	412	84	732
13	133	37	237	61	422	85	750
14	137	38	243	62	432	86	768
15	140	39	249	63	442	87	787
16	143	40	255	64	453	88	806
17	147	41	261	65	464	89	825
18	150	42	267	66	475	90	845
19	154	43	274	67	487	91	866
20	158	44	280	68	499	92	887
21	162	45	287	69	511	93	909
22	165	46	294	70	523	94	931
23	169	47	301	71	536	95	953
24	174	48	309	72	549	96	976

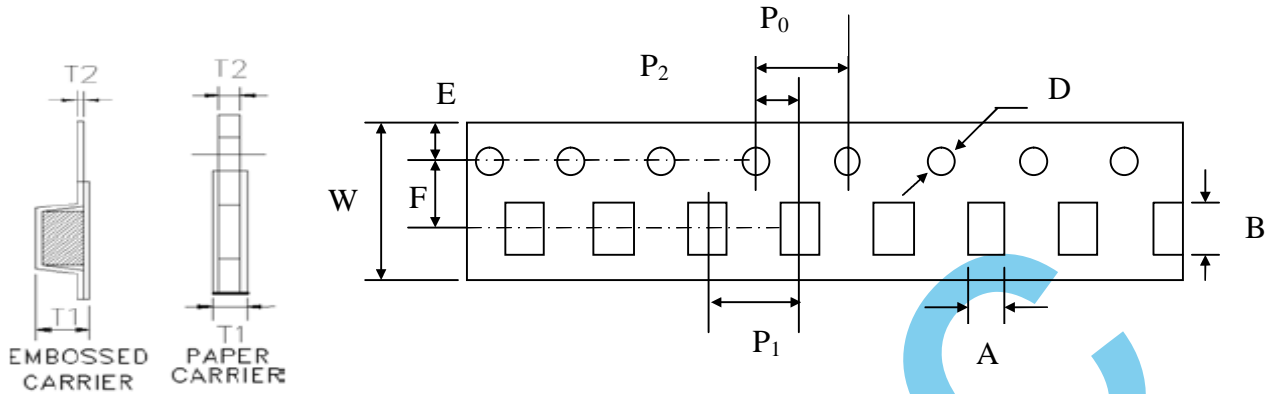
Code	A	B	C	D	E	F	G	H	X	Y	Z
Multiplier	10^0	10^1	10^2	10^3	10^4	10^5	10^6	10^7	10^{-1}	10^{-2}	10^{-3}

E24	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91
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SPECIFICATION

Tape And Reel Package

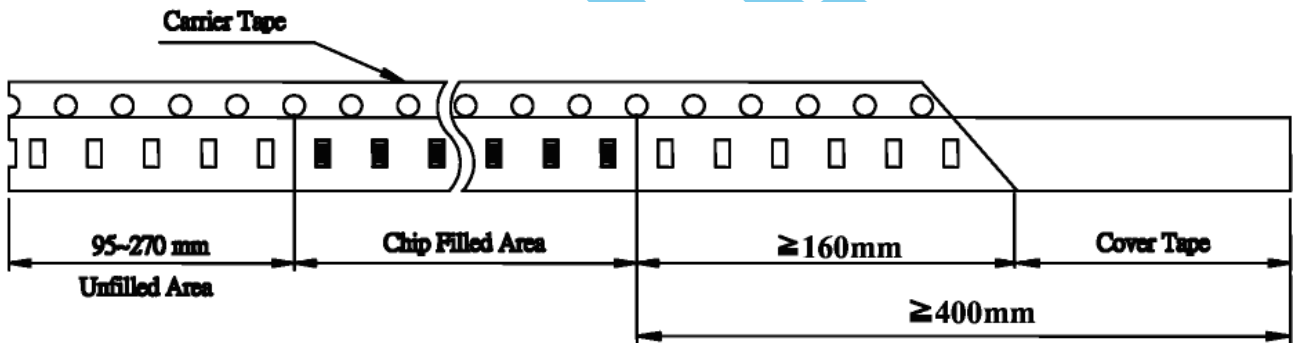


P₀: Accumulated dimensional tolerance 40±0,2mm

In Accordance with EIA RS-481

Packing	Size	A	B	W	F	E	P ₁	P ₂	P ₀	D	T ₁	T ₂
Paper Tape (T)	0603	1,00+0,1/-0,05	1,70±0,1	8,00±0,2	3,50±0,05	1,75±0,1	4,0±0,1	2,0±0,05	4,0±0,05	1,50+0,1/-0	0,60+0,2/-0	0,60±0,1
	0805	1,55±0,1	2,30±0,2	8,00±0,2	3,50±0,05	1,75±0,1	4,0±0,1	2,0±0,05	4,0±0,05	1,50+0,1/-0	0,75+0,2/-0	0,75±0,1
	1206	1,9±0,2	3,50±0,2	8,00±0,2	3,50±0,05	1,75±0,1	4,0±0,1	2,0±0,05	4,0±0,05	1,50+0,1/-0	0,75+0,2/-0	0,75±0,1

Lead Dimensions:



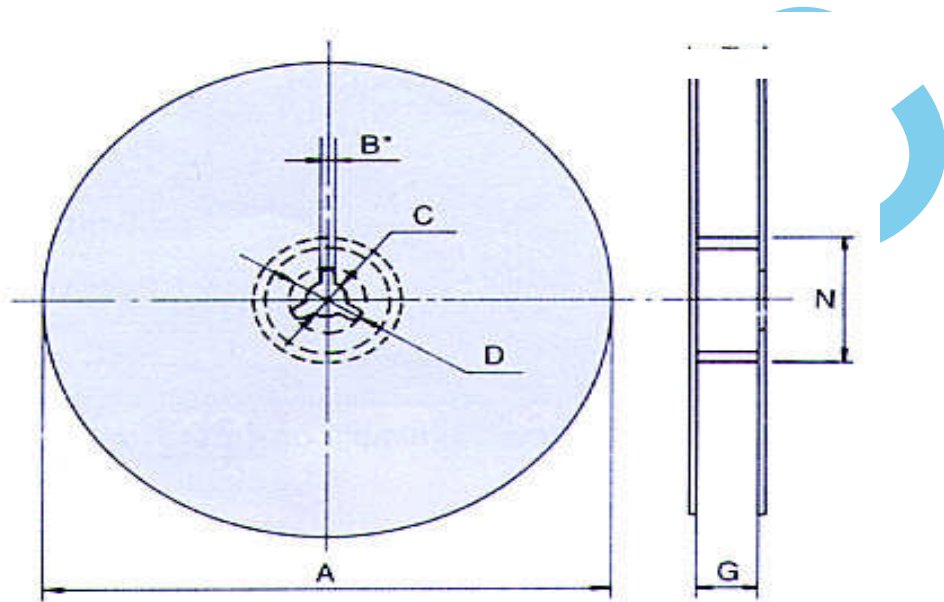
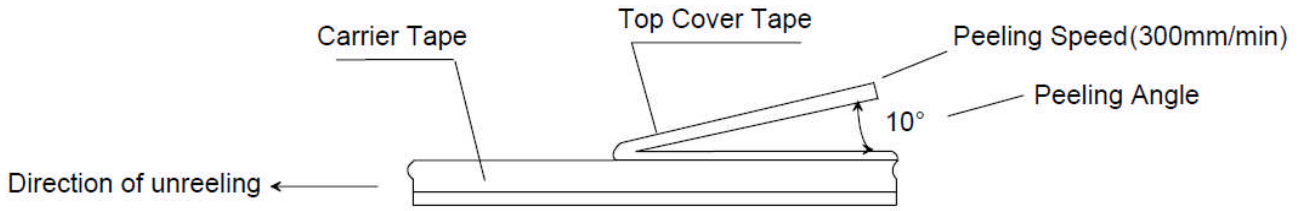
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High Power Chip Resistors

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Cover Tape Peel off Strength

Specifications: 0603, 0805, 1206, 2010, 2512 => 0,07~0,7N (7,1~71,4gf)



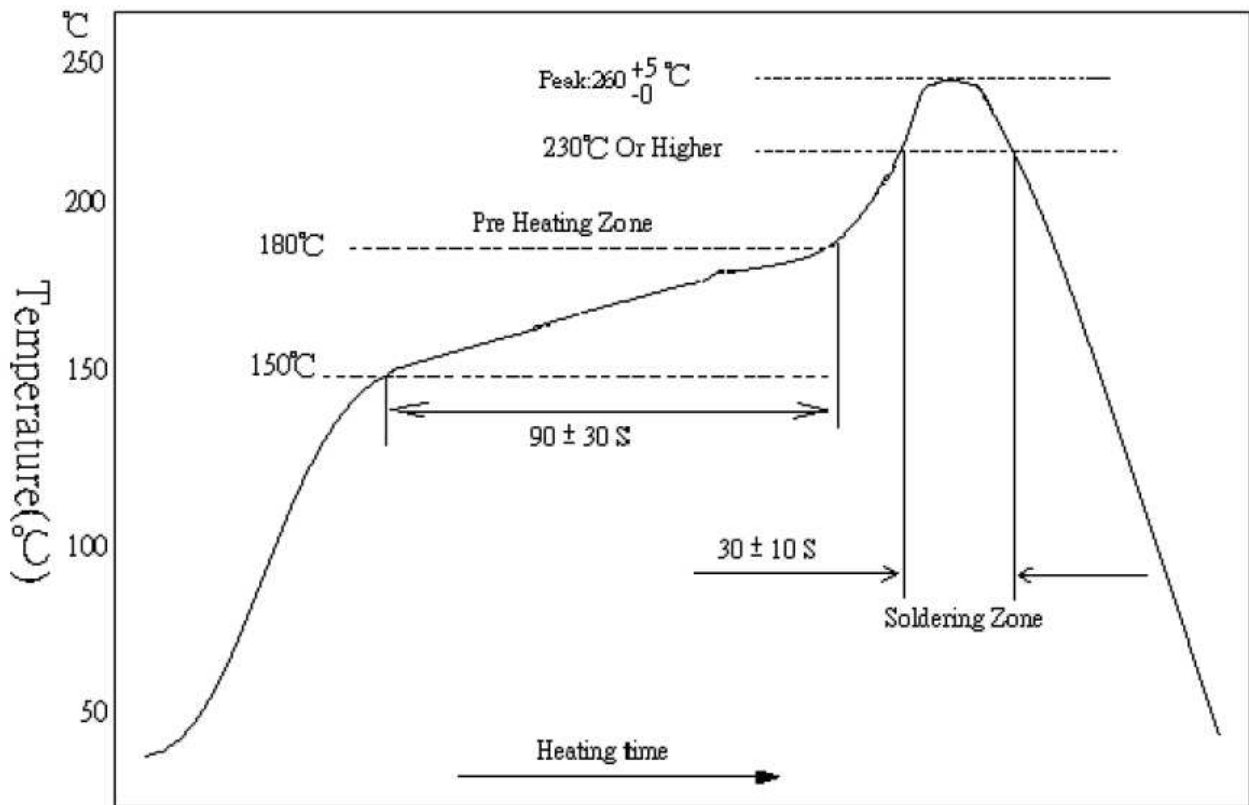
Symbol	Reel Type / Tape	A	N	C	D	B	G
Dimension	7" reel for 8 mm Tape	178±2,0	60,0±1,0	13,5±0,5	21,0±0,5	2,0±0,5	9,0±0,5
	7" reel for 12 mm Tape	178±2,0	80,0±1,0				13,8±0,5
	10" reel for 8 mm Tape	254±2,0	100,0±1,0				10,0±0,5
	13" reel for 8 mm Tape	330±2,0	100,0±1,0				10,0±0,5

in mm

Stock period

The temperature condition must be controlled at 25± 5 °C, the R.H. must be controlled at 60±15%. The stock can maintain quality level in two years.

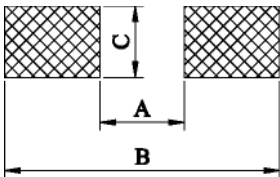
Lead Free Reflow Soldering Profile



Remark: The peak temperature of soldering heat is 260 +5/-0 °C for 10 seconds.

Soldering Iron: Temperature 350°C ± 10°C , dwell time shall be less than 3 seconds.

Recommended Land Pattern Design (For Reflow Soldering):

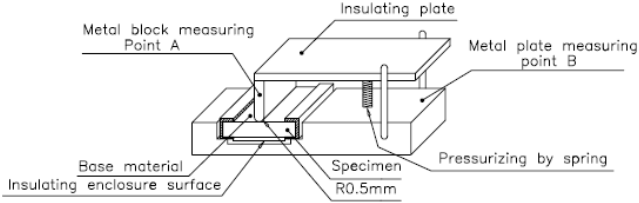


Size	A	B	C
1206	2,0	4,5	1,5
0805	1,0	3,5	1,2
0603	0,8	2,5	0,8

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Reliability Test

Electrical Performance Test

ITEM	SPECIFICATION		TEST METHOD
	Resistor		
Short time Overload	1%: $\Delta R \pm (1,0\% + 0,05\Omega)$ 5%: $\Delta R \pm (2,0\% + 0,10\Omega)$		JIS C 5201-1 4.13 Applied 2.5 times rated voltage for 5 seconds and release the load for about 30 minutes , then measure its resistance variance rate.(Rated voltage refer to above item "General specifications") Jumper: Applied Maximum overload current
	No evidence of mechanical damage.		
Temperature Coefficient of Resistance (TCR)	Refer to general specification above		JIS C 5201-1 4.8 R1: Resistance at room temperature R2: Resistance at -55°C or +125°C T1: Room temperature T2:Temperature -55°C or +125°C $TCR(ppm/^{\circ}C) = \frac{R2 - R1}{R1} \cdot \frac{1}{T2 - T1} \cdot 10^6$
Intermittent Overload	$\Delta R \leq \pm(5,0\% + 0,10\Omega)$		JIS C 5201-1 4.13 Put the tested resistor in chamber under temperature $25 \pm 2^{\circ}C$ and load the rated DC voltage for 1 sec on , 25 sec off, 10.000 ⁺⁴⁰⁰ ₋₀ test cycles, then it be left at no-load for 1 hour, then measure its resistance variance rate.
Noise Level	Resistance	Noise	JIS C 5201-1 4.12
	R < 100Ω	≤-10db(0,32 uV/V)	
	100Ω≤R<1KΩ	≤0db(1,0 uV/V)	
	1KΩ≤R<10KΩ	≤10db(3,2 uV/V)	
	10KΩ≤R<100KΩ	≤15db(5,6 uV/V)	
	100KΩ≤R<1MΩ	≤20db(10 uV/V)	
1MΩ≤R	≤30db(32 uV/V)		
Insulation Resistance	Between termination and coating must be over 1000MΩ		JIS C 5201-1 4.6 Put the resistor in the fixture, add 100 VDC in + , - terminal for 60 sec then measured the insulation resistance between electrodes and insulating enclosure or between electrodes and base material. 
Dielectric Withstand Voltage	No short or burned on the appearance.		JIS C 5201-1 4.7 Put the resistor in the fixture, add VAC (see SPEC below) in +, - terminal for 0805, 1206, 2010, 2512 apply 500 VAC 1 minute. 0603 apply 300 VAC 1 minute.

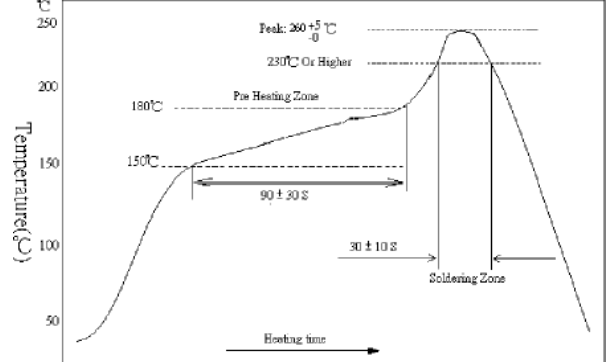
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Mechanical Performance Test

ITEM	SPECIFICATION	TEST METHOD														
	Resistor															
Core Body Strength	$\Delta R \pm (1,0\% + 0,05\Omega)$	JIS-C5201-1 4.15 Applied R0,5 test probe at its central part then pushing 10N { 1,02Kgf } force on the sample for 10 sec. 0603: probe R 0,2 0805, 1206: probe R 0,5														
	No evidence of mechanical damage. No side conductive peel off.															
Terminal Strength	Test1: No evidence of mechanical damage. Test2: $\geq 5N$	JIS-C5201-1 4.16 Test1: The resistor mounted on the board applied 5N pushing force on the sample rear for 10sec. Test2: The resistor mounted on the board slowly add force on the sample rear until the sample termination is breakdown.														
Resistance to solvent	$\Delta R \pm (0,5\% + 0,05\Omega)$	JIS-C5201-1 4.29 The tested resistor be immersed into isopropyl alcohol of 20~25°C for 5 min, then the resistor is left in the room for 48 hrs, and measured its resistance variance rate.														
	No evidence of mechanical damage, no G2 overcoating and Sn layer by leaching.															
Solderability	1. Test item 1: Solder coverage over 95% 2. Test item 2: Zero cross time within 3 seconds.	JIS-C5201-1 4.17 SONY (SS-00254-2) Preconditioning Put the tested resistor in the apparatus of PCT, at a temperature of 105°C, humidity of 100% RH, and pressure of $1,22 \times 10^5$ Pa for a duration of 4 hours. Then after left the tested resistor in room temperature for 2 hours or more. Test method: Test item1 (solder pot test): The resistor be immersed into solder pot in temperature $235 \pm 5^\circ C$ for 2 sec, then the resistor is left as placed under microscope to observed its solder area. Test item2 (wetting balance method): Add flux into resistors, then put resistor into wetting balance machine, refer to condition as below, then must be measured and recorded its time changed.														
		<table border="1"> <thead> <tr> <th colspan="2">Testing conditions for wetting balance method with solder pot</th> </tr> <tr> <th></th> <th>Condition</th> </tr> </thead> <tbody> <tr> <td>Solder temperature</td> <td>$235 \pm 3^\circ C$</td> </tr> <tr> <td>Immersion speed</td> <td>1 to 5 mm/s</td> </tr> <tr> <td>Immersion depth</td> <td>0,10 mm</td> </tr> <tr> <td>Immersion angle</td> <td>Horizontal</td> </tr> <tr> <td rowspan="2">Mass of solder ball</td> <td>25 mg → 0402, 0603</td> </tr> <tr> <td>200 mg → 0805, 1206</td> </tr> </tbody> </table>	Testing conditions for wetting balance method with solder pot			Condition	Solder temperature	$235 \pm 3^\circ C$	Immersion speed	1 to 5 mm/s	Immersion depth	0,10 mm	Immersion angle	Horizontal	Mass of solder ball	25 mg → 0402, 0603
Testing conditions for wetting balance method with solder pot																
	Condition															
Solder temperature	$235 \pm 3^\circ C$															
Immersion speed	1 to 5 mm/s															
Immersion depth	0,10 mm															
Immersion angle	Horizontal															
Mass of solder ball	25 mg → 0402, 0603															
	200 mg → 0805, 1206															
Resistance to soldering heat	$\Delta R \pm (1,0\% + 0,05\Omega)$	JIS-C5201-1 4.18 Test method 1 (Reflow test): The tested resistor should be subject in the following procedure, and after furnish each step, it should be left for a duration of 2 hours or longer at a temperature of 30°C or lower and a humidity of 70% RH or lower.														
	No evidence of electrode damage. No side conductive peel off.															
		<table border="1"> <thead> <tr> <th>Step</th> <th>Procedure</th> <th>Environmental test condition</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Resistance measuring</td> <td>Room temperature</td> </tr> <tr> <td>2</td> <td>Baking</td> <td>125°C, 24 hours</td> </tr> <tr> <td>3</td> <td>Humidification</td> <td>85°C, 85%, 168 hours</td> </tr> </tbody> </table>	Step	Procedure	Environmental test condition	1	Resistance measuring	Room temperature	2	Baking	125°C, 24 hours	3	Humidification	85°C, 85%, 168 hours		
Step	Procedure	Environmental test condition														
1	Resistance measuring	Room temperature														
2	Baking	125°C, 24 hours														
3	Humidification	85°C, 85%, 168 hours														

4	Reflow (1)	Reflow temperature curve and component surface temperature Table 1
5	Humidification	85°C, 65%, 24 hours
6	Reflow (2)	Reflow temperature curve and component surface temperature Table 2
7	Resistance measuring	Room temperature

Reflow temperature curve



Component surface temperature

Table 1 Description example in specification document (1)

Temperature –retaining or higher 230°C or higher	Peak temperature	Temperature measured at the component body surface during preheating
30 seconds	240°C	150 °C to 160°C

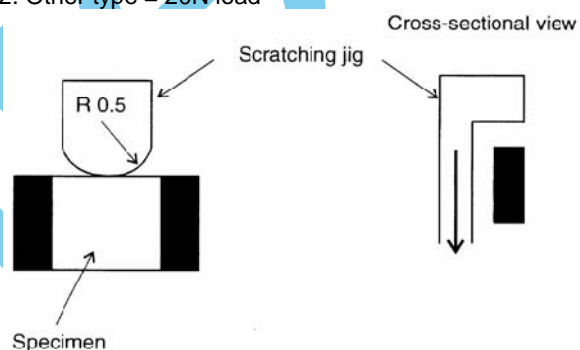
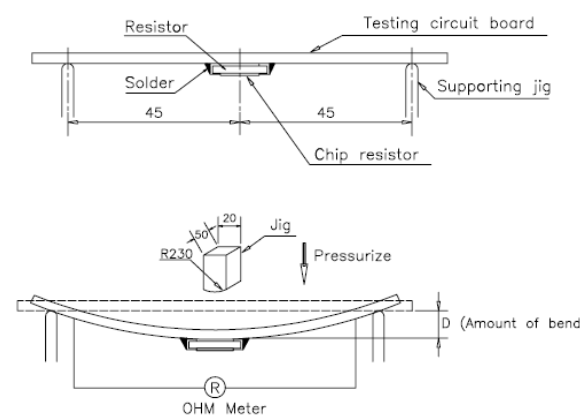
Table 2 Description example in specification document (2)

Temperature	Temperature -retaining time	Temperature measured at the component body surface during preheating
220°C or higher	90 seconds	150°C to 160°C
230°C or higher	60 seconds	
240°C or higher	5 seconds	
Peak	245°C	

Test method 2 (solder pot test):

The tested resistor should be subject in the following procedure, and after finish each step, it should be left for duration of 2 hours or lower at a temperature of 30°C or lower and a humidity of 70% RH or lower.

Step	Procedure	Environmental test condition
1	Resistance measuring	Room temperature
2	Baking	125°C, 24 hours
3	Humidification	85°C, 85%, 168 hours
4	Solder pot test	260±3°C, 10 sec
5	Placed	85°C, 65%, 24 hours

		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%; text-align: center;">6</td> <td style="width: 40%;">Solder pot test</td> <td style="width: 50%;">260±3°C, 10 sec</td> </tr> <tr> <td style="text-align: center;">7</td> <td>Resistance measuring</td> <td>Room temperature</td> </tr> </table> <p>Test method 3 (Electric iron test): Preheating temperature: 350±10°C Electric iron preheating time: 3+1/-0 sec Preheating the electric iron on electrode termination, as after that step placed the iron over 60 min and measured its resistance variance rate.</p>	6	Solder pot test	260±3°C, 10 sec	7	Resistance measuring	Room temperature
6	Solder pot test	260±3°C, 10 sec						
7	Resistance measuring	Room temperature						
<p>Joint strength of solder</p>	<p>Test item 1: (1) Variance rate on resistance $\Delta R \pm (1,0\% + 0,05\Omega)$ (2) No evidence of mechanical damage No terminal peel off. Test item 2: (1) Variance rate on resistance $\Delta R \pm (1,0\% + 0,05\Omega)$ (2) No evidence of mechanical damage. No terminal peel off and core body cracked. Test item 3: (1) Adhesion: After application of temperature cycle, adhesion should be 50% or more of initial strength. (2) Bending Strength: After application of temperature cycle, bending load should be 50% or more of initial strength.</p>	<p>JIS-C5201-1 4.32 to 33 Preconditioning Put tested resistor in the apparatus of PCT, at a temperature of 105°C humidity of 100% RH, and pressure of $1,22 \times 10^5$ Pa for a duration of 4 hours. Then after left the specimen in a temperature for 2 hours or more. Test method: Test item 1 (Adhesion): A static load using a R 0,5 scratch tool shall be applied on the core of the component and in the direction of the arrow and held for 10 seconds and under load measured its resistance variance rate. 1. 0402 = 10N load 2. Other type = 20N load</p>  <p>Test item 2 (Bending Strength): Solder tested resistor on to PC board. add force in the middle down, and under load measured its resistance variance rate. 0603, 0805 = 5mm 1206 = 3mm 2010, 2512 = 2mm</p>  <p>Test item 3 (Endurance measurement): Put the tested resistor in the chamber under the temperature cycle which shown in table 1 shall be repeated 1000 ± 4 times consecutively. Then separate follow test item 1 and test item 2 50% condition to test, measured its resistance variance rate.</p> <p>Table 1 Temperature cycle test condition</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 80%;"></td> <td style="width: 20%; text-align: center;">Testing condition</td> </tr> </table>		Testing condition				
	Testing condition							

		Lowest temperature	-35±5°C	
		Highest temperature	105±5°C	
		Temperature-retaining time	15 minutes each	
Leaching Test	1.Solder coverage over 95%. 2.The underlying material (such as ceramic) shall not be visible at the crest corner area of the electrode.	SONY (SS-00254-9) The tested resistor be immersed into molten solder of 260±5°C for 30 seconds. Then the resistor is left as placed under microscope to observed its solder area.		
Vibration	1%: ± (0,5%+0,05Ω) 5%: ± (1,0%+0,05Ω)	JIS-C5201-1 4.22 The resistor shall be mounted by its terminal leads to the supporting terminals on the solid table. The entire frequency range: from 10Hz to 55Hz and return to 10Hz, shall be transversed in 1 min. Amplitude :1,5mm This motion shall be applied for a period of 2 hours in each 3 mutually perpendicular directions (a total of 6 hours)		
	No evidence of mechanical damage.			

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Environmental Test

ITEM	SPECIFICATION	TEST METHOD														
	Resistor															
Resistance to Dry Heat	1%: $\pm (1,0\%+0,05\Omega)$ 5%: $\pm (2,0\%+0,10\Omega)$	JIS-C5201-1 4.25 Put tested resistor in chamber under temperature $155\pm 5^{\circ}\text{C}$ for 1000 +48/-0 hours. Then leaving the tested resistor in room temperature for 60 minutes, and measure its resistance variance rate.														
	No evidence of mechanical damage. No evidence of mechanicge.															
Thermal Shock	1%: $\pm (0,5\%+0,05\Omega)$ 5%: $\pm (1,0\%+0,05\Omega)$	MIL-STD 202 Method 107 Put the tested resistor in the chamber under the Thermal Shock which shown in the following table shall be repeated 300 times consecutively. Then leaving the tested resistor in the room temperature for 1 hours, and measure its resistance variance rate. <table border="1" data-bbox="828 645 1417 819"> <thead> <tr> <th></th> <th>Testing Condition</th> </tr> </thead> <tbody> <tr> <td>Lowest Temperature</td> <td>$-55\pm 5^{\circ}\text{C}$</td> </tr> <tr> <td>Highest Temperature</td> <td>$125\pm 5^{\circ}\text{C}$</td> </tr> <tr> <td>Temperature-retaining time</td> <td>15 minutes each</td> </tr> </tbody> </table>		Testing Condition	Lowest Temperature	$-55\pm 5^{\circ}\text{C}$	Highest Temperature	$125\pm 5^{\circ}\text{C}$	Temperature-retaining time	15 minutes each						
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Lowest Temperature	$-55\pm 5^{\circ}\text{C}$															
Highest Temperature	$125\pm 5^{\circ}\text{C}$															
Temperature-retaining time	15 minutes each															
No evidence of mechanical damage.																
Loading Life in Moisture	1%: $\pm (0,5\%+0,05\Omega)$ 5%: $\pm (2,0\%+0,10\Omega)$	JIS-C5201-1 4.24 Put the tested resistor in the chamber under temperature $40\pm 2^{\circ}\text{C}$, relative humidity 90~95% and load the rated voltage for 90 minutes on, 30 minutes off, total 1000 hours. Then leaving the tested resistor in room temperature for 60 minutes, and measure its resistance variance rate.														
	No evidence of mechanical damage.															
Load Life	1%: $\pm (0,5\%+0,05\Omega)$ 5%: $\pm (2,0\%+0,10\Omega)$	JIS-C5201-1 4.25 Put the tested resistor in chamber under temperature $70\pm 2^{\circ}\text{C}$ and load the rated voltage for 90 minutes on, 30 minutes off, total 1000 hours. Then leaving the tested resistor in room temperature for 60 minutes, and measure its resistance variance rate.														
	No evidence of mechanical damage.															
Low Temperature Operation	1%: $\pm (0,5\%+0,05\Omega)$ 5%: $\pm (1,0\%+0,05\Omega)$	MIL-R-55342D 4.7.4 Put the tested resistor in the chamber at room temperature 25°C . Decreasing the temperature to -55°C and keep the temperature at -55°C for 1 hour. Then load the rated voltage for 45 minutes on, and 15 minutes off . Then leaving the tested resistor in room temperature for 8 ± 1 hours, and measure its resistance variance rate.														
	No evidence of mechanical damage.															
Whisker Test	Max 50 μm	SONY (SS-00254-8) Test item 1 (Thermal Shock test): <table border="1" data-bbox="828 1422 1417 1565"> <tbody> <tr> <td>Minimum storage temperature</td> <td>$-40\pm 2^{\circ}\text{C}$</td> </tr> <tr> <td>Maximum storage temperature</td> <td>$85\pm 2^{\circ}\text{C}$</td> </tr> <tr> <td>Temperature-retaining time</td> <td>7 min min.</td> </tr> <tr> <td>Number of temperature cycles</td> <td>1.500</td> </tr> </tbody> </table> Test item 2 (Constant temperature/humidity test): <table border="1" data-bbox="828 1599 1417 1711"> <tbody> <tr> <td>Temperature</td> <td>85</td> </tr> <tr> <td>Humidity</td> <td>85%</td> </tr> <tr> <td>Testing duration</td> <td>5004 hours</td> </tr> </tbody> </table> Inspection: Inspect for whisker formation on specimens that underwent the acceleration test specified in subclasses 4.2, with a magnifier (stereomicroscope) of about 40 or higher magnification. If judgment is hard in this method, use a scanning electron microscope (SEM) of about 1.000 or higher magnification.	Minimum storage temperature	$-40\pm 2^{\circ}\text{C}$	Maximum storage temperature	$85\pm 2^{\circ}\text{C}$	Temperature-retaining time	7 min min.	Number of temperature cycles	1.500	Temperature	85	Humidity	85%	Testing duration	5004 hours
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For this part: It does not use the materials that include the substances specified in RoHS, the detail refer to the part of prohibition or exclusion items in RoHS (2002/95/EC).

Cadmium and cadmium compounds (permissive content < 100 ppm)

Lead and lead compounds (permissive content < 1000 ppm)

Exceptions specified:

Lead contained in the glass of cathode ray tubes, electronic components and fluorescent tubes.

The glass material used in the electronic components, which includes resistor elements, conductive pastes (silver or copper ones), adhesives, glass frit and sealing materials.

Mercury and its mercury compounds (permissive content < 100 ppm)

Hexavalent chromium compounds (permissive content < 100 ppm)

Polybrominated biphenyls (PBB) (permissive content < 100 ppm)

Polybrominated diphenylethers (PBDE) (permissive content < 100 ppm)

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