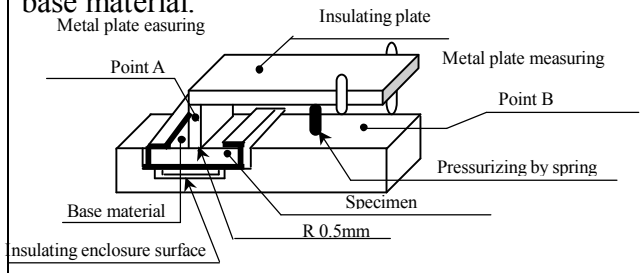
☐ Electrical performance Test

Test Item	Test Methods	Description
Temperature Cofficient of Resistance	TCR= $\frac{(R2-R1)}{R1(T2-T}$ ×106(PPM/℃) R1: Resistance at room temperature R2: Resistance at -55℃ or +125℃ T1: Room temperature T2: Temperature -55℃ or +125℃	JIS C 5202……clause 5.2 Refer to Page 3. Ratings
Short Time Overload	Apply 2.5 times rated voltage for 5 sec., and released to load for about 30 minutes, then measure the resistance. Jumper: Apply Maximum overload current CR02、03 : 2.5A CR05、06、12、20、25 : 5A	JIS C 5202……clause 5.8 (WV)=2.5 $\sqrt{WR}$ ON 5sec. Requirement: ±(2.0%±0.1Ω)Max No evidence of mechanical damage, no short or burned on the appearance
Intermittent Overload	Put tested resistors in chamber under temperature 25±2℃ for 1 sec. On , 25 sec. off under this condition the 2.5 times rated DC Voltage is applied for 10000 $^{+400}_{-0}$ test cycles then they will be left at no-load for 1 hr. Jumper: Apply Maximum overload current CR02、03:2.5A CR05、06、12、20、25:5A	JIS C 5202……clause 5.8 Resistance Range:≥1 Ω
Noise Level	Noise / Resistance ≤-10db(0.32uV/V) R＜100 Ω ≤0db(1.0uV/V) 100 Ω ≤R＜1K Ω ≤10db(3.2uV/V) 1K Ω ≤R＜10K Ω ≤15db(5.6uV/V) 10K Ω ≤R＜100K Ω ≤20db(10uV/V) 100K Ω ≤R＜1M Ω ≤30db(32uV/V) 1M Ω ≤R	JIS C 5202……clause 5.9 NA
Insulation Resistance	Put the resistor in the fixture, add 100V DC in +,- ≥10^9 Ω terminal for 60 sec. then measured the insulation resistance between electrodes and insulating enclosure or between electrodes and base material. 	JIS C 5202……clause 5.6 ≥109 Ω
Dielectric Withstanding Voltage	Put the resistor in the fixture, add V AC (see SPEC below) in +,- terminal. CR05 、06、12、20、25 apply 500V AC for 1 minute. CR02、03 apply 300V AC for 1 minute.	JIS C 5202……clause 5.7 No short or burned on the appearance.

☐ Mechanical performance Test

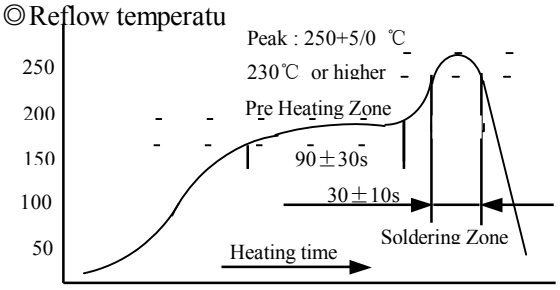
<table>
<tr><th>Test Item</th><th>Test Methods</th><th>Description</th></tr>
<tr><td rowspan="2">Solderability</td><td>Preconditioning
Put the tested resistor in the apparatus of PCT, at temperature of 105℃, humidity of 100% RH, and pressure of 1.22×10^5Pa for a duration of 4 hrs. Then after left the tested resistor in room temperature for 2 hrs or more.
Test Method:
◎Test item 1 (solder pot test):
The resistor be immersed into solder pot at temperature 245±3℃ for 3 sec., then the resistor is left as placed under microscope to observed its solder area.
<table>
<tr><th colspan="2">Testing conditions for wetting balance method with solder pot</th></tr>
<tr><td></td><td>Condition</td></tr>
<tr><td>Solder temperature</td><td>245±3℃</td></tr>
<tr><td>Immersion speed</td><td>1 to 5 mm/s</td></tr>
<tr><td>Immersion depth</td><td>0.1mm</td></tr>
<tr><td>Immersion angle</td><td>Horizontial</td></tr>
<tr><td rowspan="3">Mass of solder ball</td><td>25mg→0402、0603</td></tr>
<tr><td>200mg→0805、1206</td></tr>
<tr><td>1210、2010、2512</td></tr>
</table>
By SONY(SS-00254-2)</td><td>JIS C 5202……clause 6.11

Test item 1:
Solder coverage over 95%</td></tr>
<tr><td>Resistance to Soldering Heat</td><td>◎Test item 1 (Reflow test):
The tested resistor should be subject in the following procedure,and after finish each step, it should be left for a duration of 2 hrs or longer at temperature of 30℃or lower and humidity of 70% RH or lower.
<table>
<tr><th>Step</th><th>Procedure</th><th>Environmental test condition</th></tr>
<tr><td>1</td><td>Resistance measuring</td><td>Room temperature</td></tr>
<tr><td>2</td><td>Humidification</td><td>125℃, 24hrs</td></tr>
<tr><td>3</td><td>Baking</td><td>85℃, 85%, 168hrs</td></tr>
<tr><td>4</td><td>Reflow(1)</td><td>Reflow temperature curve and component Table 1</td></tr>
<tr><td>5</td><td>Humidification</td><td>85℃, 65%, 24hrs</td></tr>
<tr><td>6</td><td>Reflow(2)</td><td>Reflow temperature curve and component Table 2</td></tr>
<tr><td>7</td><td>Resistance measuring</td><td>Room temperature</td></tr>
</table></td><td>JIS C 5202……clause 6.10

1. Resistance Range:≥1Ω
△R% = ±(1.0%+0.05Ω)

No evidence of electrode damage.
No side conductive peel off.</td></tr>
</table>

☐ Mechanical performance Test

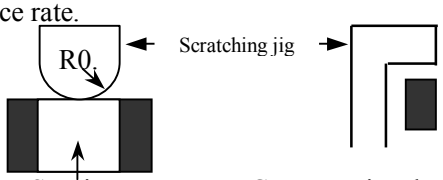
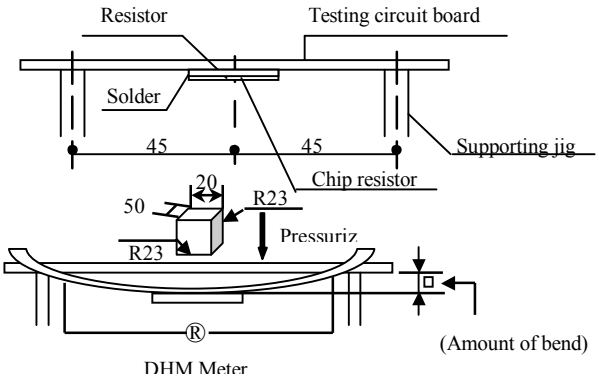
<table>
<tr><th>Test Item</th><th>Test Methods</th><th>Description</th></tr>
<tr><td rowspan="2">Resistance to Soldering Heat</td><td>◎Reflow temperatu
 

◎Component surface temperature
Table 1 Description example in specification document (1)
<table>
<tr><td>Temperature-retaining time: 230℃ or higher</td><td>Peak temperature</td><td>Temperature measured at the component body surface during preheating</td></tr>
<tr><td>30 seconds</td><td>240℃</td><td>150 to 160℃</td></tr>
</table>
Table 2 Description example in specification document (2)
<table>
<tr><td>Temperature</td><td>Peak temperature</td><td>Temperature measured at the component body surface during preheating</td></tr>
<tr><td>220℃ or higher</td><td>90 seconds</td><td rowspan="4">150 to 160℃</td></tr>
<tr><td>230℃ or higher</td><td>60 seconds</td></tr>
<tr><td>240℃ or higher</td><td>5 seconds</td></tr>
<tr><td>Peak</td><td>245℃</td></tr>
</table>
◎Test item 2 (solder pot test):
The tested resistor should be subject in the following procedure, and after finish each step, it should be left for a duration of 2 hours or lower at temperature of 30℃ or lower and humidity of 70% RH or lower.
<table>
<tr><th>Step</th><th>Procedure</th><th>Environmental test condition</th></tr>
<tr><td>1</td><td>Resistance measuring</td><td>Room temperature</td></tr>
<tr><td>2</td><td>Baking</td><td>125℃ , 24hrs</td></tr>
<tr><td>3</td><td>Humidification</td><td>85℃ , 85% , 168hrs</td></tr>
<tr><td>4</td><td>Solder pot test</td><td>260±3℃ , 10sec.</td></tr>
<tr><td>5</td><td>Humidification</td><td>85℃ , 65% , 24hrs</td></tr>
<tr><td>6</td><td>Solder pot test</td><td>260±3℃ , 10sec.</td></tr>
<tr><td>7</td><td>Resistance measuring</td><td>Room temperature</td></tr>
</table>
◎Test item 3 (Electric iron test):
Preheating temperature : 350±10℃
Electric iron preheating time : 3+1/-0 sec.
Preheat the electric iron on electrode termination, as after that step place the iron over 60 mins and measure its resistance rate.
By SONY (SS-00254-5)</td><td>JIS C 5202……clause 6.10

1. Resistance Range:≧1 Ω
△R% = ±(1.0%+0.05 Ω)

No evidence of electrode damage.
No side conductive peel off.</td></tr>
</table>

☐ Mechanical performance Test

Test Item	Test Methods	Description
Joint strength of solder	Precoditioning Put the tested resistor in the apparatus of PCT, at temperature of 105℃, humidity of 100% RH, and pressure of 1.22×105Pa 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 of 20N(2kgf) using a R0.5 scratch tool shall be applied on the core of the arrow and held for 10 seconds and under load measured its resistance variance rate.  ◎Test item 2 (Bending Strength): Solder tested resistors on the PC board. Add force in the middle down, and under load measured its resistance variance rate. D : SCR02、03、05 = 5mm SCR06、12 = 3mm SCR20、25 = 2mm  ◎Test item 3 (Endurance measurement): Measure the initial strength on the specimen prepared as specified in table 1 without application of temperature cycle, and the strength after application of temperature cycle specified and calculated the difference. In case measurement is to be done in the middle of temperature cycle application, it should be done at250±4 cycles,500±4 cycles and 1000±4 cycles. For this measurement, specimens should be separately prepared. Table 1 Temperature cycle test condition Testing condition Lowest temperature: -35±5℃ Highest temperature: 105±5℃ Temperature-retaining time: 15 minutes each By SONY SS-00254-7	JIS C 5202……clause 6.1.4 Test item 1 : (1) Variance rate on resistance Resistance Range:≥1Ω △R% = ±(1.0%+0.05Ω) (2) No evidence of mechanical damage. No terminal peel off. Test item 2 : (1) Variance rate on resistance Resistance Range:≥1Ω △R% = ±(1.0%+0.05Ω) (2) No evidence of mechanical damage. No terminal peel off and core body cracked. Test item 3 : △R1 = The deviation of Resistance value of joint strength or bending test before temperature cycle. △R2 = The deviation of Resistance value of joint strength or bending test after temperature cycle. The ration (△R1/△R2) of deviation should be less than 50%.

☐ Mechanical performance Test

Test ltem	Test Methods	Description
Terminal strength	Test 1: The resistors mounted on the board apply 5N pushing force on the sample rear for 10 sec. Test 2: The resistors mounted on the board slowly add force on the sample rear until the sample termination is breakdown.	JIS C 5202……clause 6.1.4 1. No evidence of mechanical damage. 2. ≥5N
Core Body Strength	Apply R0.5 test probe at its central part then pushing 1Kg force on the sample for 10 sec.	JIS C 5202……clause 6.1.4 Resistance Range:≥1Ω ±(1.0%+0.05Ω) No evidence of mechanical damage. No side conductive peel off.
Leaching Test	The tested resistor be immersed into molten solder of 260±5℃ for 30 seconds. Then the resistor is left as placed under microscope to observed its solder area.	By SONY SS-00254-9 1.Solder coverage over 95%. 2.The underlying material (such as ceramic) shall not be visible at the crest corner area of the electrode.
Resistance to solvent	The tested resistor be immersed into isopropyl alcohol of 20~25℃ for 60 sec. Then the resistor is left in the room for 48hrs.	JIS C 5202……clause 6.9 Resistance Range:≥1Ω ±(5.0%+0.05Ω) No evidence of mechanical damage, no G2 over coating and Sn/Pb layer by leaching.

☐ Environmental Test

Test ltem	Test Methods	Description
Temperature Cycling	Put the tested resistor in the chamber under the temperature cycle which shown in the following table shall be repeated 5 times consecutively. Then leaving the tested resistor in the room temperature for 1hr, and measure its resistance variance rate.	JIS C 5202……clause 7.4 Resistance Range:≥1Ω 0.1%、0.5%、1%: ±(1.0%+0.05Ω) 2%、5%: ±(2.0%+0.10Ω) No evidence of mechanical damage, no short or burned on the appearance.

Step	Temperature(℃)	Time(minute)
1	-55±5	30
2	25±5	3
3	125±5	30
4	25±5	3

☐ Environmental Test

<table>
<tr><th>Test Item</th><th>Test Methods</th><th>Description</th></tr>
<tr><td rowspan="2">Loading Life in Moisture</td><td rowspan="2">Put tested resistor in the chamber under temperature 40±2℃, relative humidity 90~95% for 90 minutes on , 30 minutes off, total 1,000 hours. Leaving the tested resistor in the room temperature for 60 minutes, measure the resistance.</td><td>JIS C 5202……clause 7.9</td></tr>
<tr><td>Resistance Range:≥1Ω
0.1%、0.5%、1%:
±(0.5%+0.05Ω)
2%、5%: ±(2.0%+0.05Ω)</td></tr>
<tr><td rowspan="2">Load Life</td><td rowspan="2">Put the tested resistor in the chamber under the temperature 70±2℃ and load the rated voltage for 90 minutes on, 30 minutes off, total 1,000 hours. Then leaving the tested resistor in the room temperature for 60 minutes, and measure its resistance variance rate.</td><td>JIS C 5202……clause 7.10</td></tr>
<tr><td>Resistance Range:≥1Ω
0.1%、0.5%、1%:
±(1.0%+0.05Ω)
2%、5%: ±(3.0%+0.10Ω)</td></tr>
<tr><td rowspan="2">Resistance To Dry Heat</td><td rowspan="2">Put tested resistors in the chamber under temperature 125±5℃ for 96±4 hrs, leaving in the room temperature for 60 minutes, measure the resistance.
Refer to 1997 JIS-C-5202-7.2</td><td>JIS C 5202……clause 7.2</td></tr>
<tr><td>Resistance Range:≥1Ω
0.1%、0.5%、1%:
±(1.0%+0.05Ω)
2%、5%: ±(2.0%+0.10Ω)
No evidence of mechanical damage, no short or burned on the appearance.</td></tr>
<tr><td rowspan="2">Low Temperature Operation</td><td rowspan="2">Put the tested resistors in the chamber at room temperature 25℃. Decreasing the temperature to -55℃ and keep the temperature at -55℃ for 1 hr. Then load the rated voltage for 45 minutes on, and 15 minutes off. Then leaving the tested resistor in the room temperature for 8±1 hours, and measure its resistance variance rate.</td><td>According our company standard</td></tr>
<tr><td>Resistance Range:≥1Ω
0.1%、0.5%、1%:
±(0.5%+0.05Ω)
2%、5%: ±(1.0%+0.05Ω)
No evidence of electrode damage.</td></tr>
<tr><td>Whisker Test</td><td>Chip resistor can classify 2 tests as following:
◎Test item 1 (Temperature cycle test):
<table><tr><td>Minimum storage temperature</td><td>-35±5℃</td></tr><tr><td>Maximum storage temperature</td><td>125±5℃</td></tr><tr><td>Temperature-rataining time</td><td>7min</td></tr><tr><td>Number of temperature cycles</td><td>500±4</td></tr></table>◎Test item 2 (Constant temperature/humidity test):
<table><tr><td>Temperature</td><td>85℃</td></tr><tr><td>Humidity</td><td>85%</td></tr><tr><td>Testing duration</td><td>500±4 hours</td></tr></table></td><td>JIS C 5202
Max × 50μm</td></tr>
</table>

☐ Environmental Test

Test ltem	Test Methods	Description
Whisker Test	◎Inspection: Inspect for whisker formation on specimens that underwent the acceleration test specified in subciause 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 1000 or higher magnification. BY SONY SS-00254-8	JIS C 5202 Max × 50μm

☐ Lead Free Soldering Profile