

1 Scope:

- 1.1 This specification is applicable to lead and halogen free RTR series precision thick film chip resistors.
- 1.2 Lead free products mean lead free termination meets RoHS requirement. Pb contained in glass material of resistor element are exempted by RoHS directive.

2 Explanation Of Part Numbers:

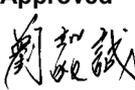
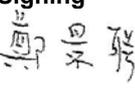
(EX)

	RTR		01		1002		D		TH
Type	Size (Refer to 3. General Specifications)		Nominal Resistance		Resistance Tolerance		Packaging (Refer to Packing Specification)		
Precision Thick Film Chip Resistors	01(0201) . . .		4-Digit	EX. 10.2Ω=10R2 10KΩ=1002	B=± 0.1% D=± 0.5% F=± 1%		TH : 2 mm Pitch Carrier Tape 10000 pcs . . .		

3 General Specifications:

3.1 Resistance Range: ≥ 1Ω

Type	Rated Power at 70°C	Max. Working Voltage	Max. Overload Voltage	T.C.R (ppm/°C)	Resistance Range	
					B(±0.1%) · D(±0.5%) E-24 · E-96	F(±1.0%) E-24 · E-96
RTR01 (0201)	1/20 W	30V	60V	±100	10Ω ≤ R ≤ 1MΩ	10Ω ≤ R ≤ 1MΩ
RTR02 (0402)	1/16 W	50V	100V	±50	100Ω ≤ R ≤ 1MΩ	100Ω ≤ R ≤ 1MΩ
				±100	-----	1Ω ≤ R < 10Ω
RTR03 (0603)	1/10 W	75V	150V	±50	100Ω ≤ R ≤ 1MΩ	100Ω ≤ R ≤ 1MΩ
				±100	-----	1Ω ≤ R < 10Ω
RTR05 (0805)	1/8 W	150V	300V	±50	100Ω ≤ R ≤ 1MΩ	100Ω ≤ R ≤ 1MΩ
				±100	-----	1Ω ≤ R < 10Ω
RTR06 (1206)	1/4 W	200V	400V	±50	100Ω ≤ R ≤ 1MΩ	100Ω ≤ R ≤ 1MΩ
				±100	-----	1Ω ≤ R < 10Ω
RTR12 (1210)	1/2 W	200V	400V	±50	100Ω ≤ R ≤ 1MΩ	100Ω ≤ R ≤ 1MΩ
				±100	-----	1Ω ≤ R < 10Ω
RTR20 (2010)	3/4 W	200V	400V	±50	100Ω ≤ R ≤ 1MΩ	100Ω ≤ R ≤ 1MΩ
				±100	-----	1Ω ≤ R < 10Ω
RTR25 (2512)	1W	200V	400V	±50	100Ω ≤ R ≤ 1MΩ	100Ω ≤ R ≤ 1MΩ
				±100	-----	1Ω ≤ R < 10Ω
Operating Temperature Range				-55°C ~ +155°C		

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3.2 Resistance Range: <math>< 1\Omega</math>

Type	Rated Power at 70°C	Max. Rated Current	Max. Overload Current	T.C.R (ppm / °C)	Resistance Range
					F(±1%) E-96
RTR05 (0805)	$\frac{1}{8}$ W	0.83A	2.08A	±100	150 mΩ ≤ R < 1Ω
RTR06 (1206)	$\frac{1}{4}$ W	1.29A	1.94A	±100	150 mΩ ≤ R < 1Ω
RTR20 (2010)	$\frac{3}{4}$ W	2.50A	6.25A	±100	120 mΩ ≤ R < 1Ω
RTR25 (2512)	1W	2.89A	7.22A	±100	120 mΩ ≤ R < 1Ω
Operating Temperature Range				-55°C ~ +155°C	

3.3 Power Derating Curve:

Operating Temperature Range	-55°C ~ +155°C
Explain	For resistors operated in ambient temperatures above 70°C, power rating shall be derated in accordance with figure below.
Figure	<p>The graph shows a power derating curve. The y-axis is 'Rated Power (%)' ranging from 0 to 100. The x-axis is 'Ambient temperature (°C)' ranging from -55 to 160. A horizontal line is drawn at 100% power from -55°C to 70°C. From 70°C, the power derates linearly to 0% at 155°C. Dashed vertical lines indicate the 70°C and 155°C points. The x-axis has a break between -55 and 20, and another between 140 and 160.</p>

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3.4 Voltage Rating or Current Rating

3.4.1 Resistance Range: $\geq 1\Omega$

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:

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

E= Rated voltage (v)

P= Power rating (w)

R= Nominal resistance(Ω)

3.4.2 Resistance Range: $< 1\Omega$

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

$$I = \sqrt{P/R}$$

I= Rated current (A)

P= Power rating (w)

R= Nominal resistance(Ω)

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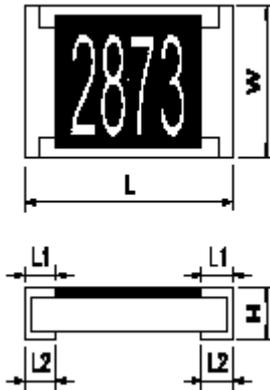
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4 Dimensions:

4.1 Resistance Range: $\geq 1\Omega$

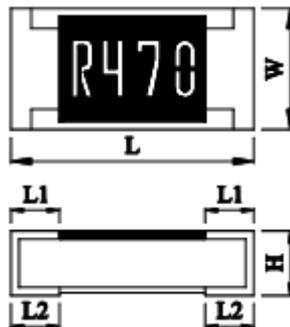
Unit:mm



Dimension		L	W	H	L1	L2
Type	Size Code					
RTR01	0201	0.60±0.03	0.30±0.03	0.23±0.03	0.15±0.05	0.15±0.05
RTR02	0402	1.00±0.10	0.50±0.05	0.30±0.05	0.20±0.10	0.25±0.10
RTR03	0603	1.60±0.10	0.80±0.10	0.45±0.10	0.30±0.15	0.30±0.15
RTR05	0805	2.00±0.10	1.25±0.10	0.50±0.10	0.35±0.20	0.35±0.15
RTR06	1206	3.05±0.10	1.55±0.10	0.50±0.10	0.45±0.20	0.35±0.15
RTR12	2010	3.05±0.10	2.55±0.10	0.55±0.10	0.50±0.20	0.50±0.20
RTR20	2010	5.00±0.20	2.50±0.20	0.55±0.10	0.60±0.20	0.60±0.20
RTR25	2512	6.30±0.20	3.20±0.20	0.55±0.10	0.60±0.20	0.60±0.20

4.2 Resistance Range: $< 1\Omega$

Unit:mm



Dimension		L	W	H	L1	L2
Type	Size Code					
RTR05	0805	2.00±0.10	1.25±0.10	0.50±0.10	0.35±0.20	0.35±0.20
RTR06	1206	3.05±0.10	1.55±0.10	0.50±0.10	0.45±0.20	0.65±0.15
RTR20	2010	5.00±0.10	2.50±0.10	0.60±0.10	0.65±0.20	0.65±0.20
RTR25	2512	6.40±0.20	3.20±0.10	0.60±0.10	0.65±0.20	0.65±0.20

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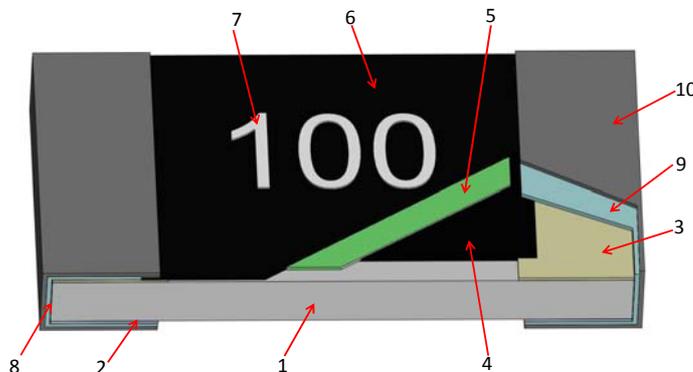
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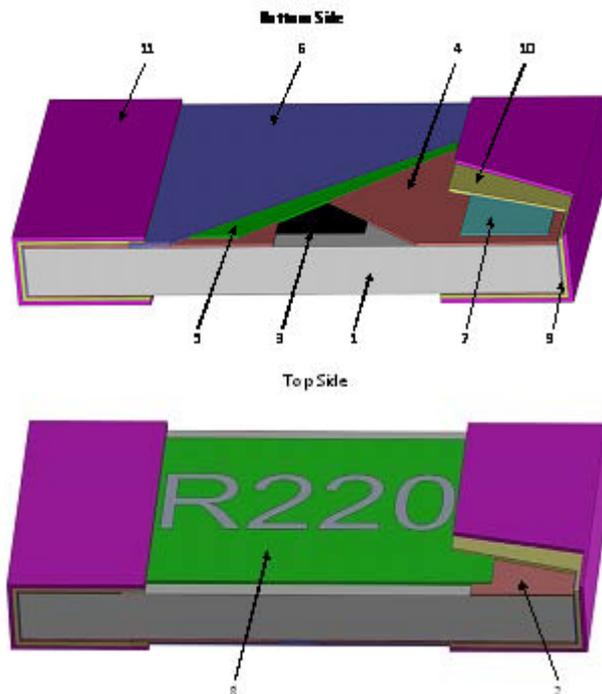
5 Structure Graph:

5.1 Resistance Range: $\geq 1\Omega$



1	Ceramic substrate	6	2nd Protective coating
2	Bottom inner electrode	7	Marking
3	Top inner electrode	8	Terminal inner electrode
4	Resistive layer	9	Ni plating
5	1st Protective coating	10	Sn plating

5.2 Resistance Range: $< 1\Omega$



1	Ceramic substrate	7	C3 layer
2	Top inner electrode	8	G2 layer+Marking
3	Resistive layer	9	Terminal inner electrode
4	Bottom inner electrode	10	Ni plating
5	1st Protective coating	11	Sn plating
6	2nd Protective coating		

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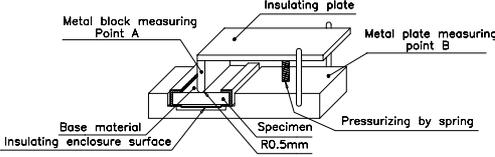
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6 Reliability Test:

6.1 Electrical Performance Test

Item	Conditions	Specifications														
		Resistors														
Temperature Coefficient of Resistance	$TCR (ppm/^{\circ}C) = \frac{(R2 - R1)}{R1 (T2 - T1)} \times 10^6$ R1: Resistance at room temperature R2: Resistance at -55 $^{\circ}$ C or +125 $^{\circ}$ C T1: Room temperature T2: Temperature -55 $^{\circ}$ C or +125 $^{\circ}$ C Refer to JIS-C5201-1 4.8	Refer to item 3. general specifications														
Short Time Overload	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 item 3. general specifications) Refer to JIS-C5201-1 4.13	1. Resistance Range: $\geq 1\Omega$ $\Delta R\% = \pm(1.0\% + 0.05\Omega)$ 2. Resistance Range: $< 1\Omega$ $\Delta R\% = \pm(2.0\% + 0.001\Omega)$ No evidence of mechanical damage. No short or burned on the appearance.														
Insulation Resistance	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. Refer to JIS-C5201-1 4.6 	$\geq 10^9\Omega$														
Dielectric Withstand Voltage	Put the resistor in the fixture, add VAC (see spec. below) in +, - terminal for. RTR05、06、12、20、25 apply 500 VAC 1 minute. RTR01、02、03 apply 300 VAC 1 minute. Refer to JIS-C5201-1 4.7	No short or burned on the appearance.														
Intermittent Overload	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, 10000^{+400}_0 test cycles, then it be left at no-load for 1 hour, then measure its resistance variance rate. Refer to JIS-C5201-1 4.13	1. Resistance Range: $\geq 1\Omega$ $\Delta R\% = \pm(5.0\% + 0.10\Omega)$ 2. Resistance Range: $< 1\Omega$ $\Delta R\% = \pm(5.0\% + 0.001\Omega)$ No evidence of mechanical damage. No short or burned on the appearance.														
Noise Level	Refer to JIS-C5201-1 4.12	<table border="1"> <thead> <tr> <th>Resistance</th> <th>Noise</th> </tr> </thead> <tbody> <tr> <td>$R < 100\Omega$</td> <td>$\leq -10db (0.32 \mu V/V)$</td> </tr> <tr> <td>$100\Omega \leq R < 1K\Omega$</td> <td>$\leq 0db (1.0 \mu V/V)$</td> </tr> <tr> <td>$1K\Omega \leq R < 10K\Omega$</td> <td>$\leq 10db (3.2 \mu V/V)$</td> </tr> <tr> <td>$10K\Omega \leq R < 100K\Omega$</td> <td>$\leq 15db (5.6 \mu V/V)$</td> </tr> <tr> <td>$100K\Omega \leq R < 1M\Omega$</td> <td>$\leq 20db (10 \mu V/V)$</td> </tr> <tr> <td>$1M\Omega \leq R$</td> <td>$\leq 30db (32 \mu V/V)$</td> </tr> </tbody> </table>	Resistance	Noise	$R < 100\Omega$	$\leq -10db (0.32 \mu V/V)$	$100\Omega \leq R < 1K\Omega$	$\leq 0db (1.0 \mu V/V)$	$1K\Omega \leq R < 10K\Omega$	$\leq 10db (3.2 \mu V/V)$	$10K\Omega \leq R < 100K\Omega$	$\leq 15db (5.6 \mu V/V)$	$100K\Omega \leq R < 1M\Omega$	$\leq 20db (10 \mu V/V)$	$1M\Omega \leq R$	$\leq 30db (32 \mu V/V)$
Resistance	Noise															
$R < 100\Omega$	$\leq -10db (0.32 \mu V/V)$															
$100\Omega \leq R < 1K\Omega$	$\leq 0db (1.0 \mu V/V)$															
$1K\Omega \leq R < 10K\Omega$	$\leq 10db (3.2 \mu V/V)$															
$10K\Omega \leq R < 100K\Omega$	$\leq 15db (5.6 \mu V/V)$															
$100K\Omega \leq R < 1M\Omega$	$\leq 20db (10 \mu V/V)$															
$1M\Omega \leq R$	$\leq 30db (32 \mu V/V)$															

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6.2 Mechanical Performance Test

Item	Conditions	Specifications
		Resistors
Core Body Strength	Applied R0.5 test probe at its central part then pushing 10N { 1.02Kgf } force on the sample for 10 sec. 1.RTR02、03 : probe R0.2 2.RTR05、06、12、20、25 : probe R0.5 (RTR01 is not applicable for this) Refer to JIS-C5201-1 4.15	1.Resistance Range: $\geq 1\Omega$ $\Delta R\% = \pm(1.0\% + 0.05\Omega)$ 2.Resistance Range: $< 1\Omega$ $\Delta R\% = \pm(1.0\% + 0.001\Omega)$ No evidence of mechanical damage. No side conductive peeling off.
Terminal Strength	Test1:The resistor mounted on the board applied 5N pushing force on the sample rear for 10 sec. (RTR01:3N) Test2:The resistor mounted on the board slowly add force on the sample rear until the sample termination is breakdown. Refer to JIS-C5201-1 4.16	Test1:No evidence of mechanical damage. Test2:RTR01 $\geq 3N$ Other Type $\geq 5N$
Resistance to Solvent	The tested resistor be immersed into isopropyl alcohol of 20~25°C for 5 minutes, then the resistor is left in the room for 48 hrs, and measured its resistance variance rate. Refer to JIS-C5201-1 4.29	1.Resistance Range: $\geq 1\Omega$ $\Delta R\% = \pm(0.5\% + 0.05\Omega)$ 2.Resistance Range: $< 1\Omega$ $\Delta R\% = \pm(1.0\% + 0.001\Omega)$ No evidence of mechanical damage, No G2 overcoating and Sn layer by leaching.
Solderability	Preconditioning: Put the tested resistor in the apparatus of PCT, at a temperature of 105°C, humidity of 100% RH, and pressure of 1.22×10^5 Pa for a duration of 4 hours. Then after left the tested resistor in room temperature for 2 hours or more. Test method: 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 observe its solder area. Refer to JIS-C5201-1 4.17	Solder coverage over 95%
Resistance to Soldering Heat	◎Test method 1 (solder pot test): The tested resistor be immersed into molten solder of $260 + 5 / - 0^\circ C$ for 10 seconds. Then the resistor is left in the room for 1 hour. ◎Test method 2 (solder pot test): The tested resistor be immersed into molten solder of $260 + 5 / - 0^\circ C$ for 10 seconds. Then the resistor is left as placed under microscope to observe its solder area. ◎Test method 3 (Electric iron test): Preheating temperature: $350 \pm 10^\circ C$ 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. Refer to JIS-C5201-1 4.18	Test item 1: (1).Variance rate on resistance 1.Resistance Range: $\geq 1\Omega$ $\Delta R\% = \pm(1.0\% + 0.05\Omega)$ 2.Resistance Range: $< 1\Omega$ $\Delta R\% = \pm(1.0\% + 0.001\Omega)$ (2)No evidence of electrode damage. No side conductive peeling off. Test item 2: (1)Solder coverage over 95%. (2)The underlying material (such as ceramic) shall not be visible at the crest corner area of the electrode. Test item 3: (1).Variance rate on resistance 1.Resistance Range: $\geq 1\Omega$ $\Delta R\% = \pm(1.0\% + 0.05\Omega)$ 2.Resistance Range: $< 1\Omega$ $\Delta R\% = \pm(1.0\% + 0.001\Omega)$ (2)No evidence of electrode damage. No side conductive peeling off.

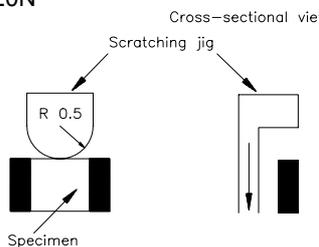
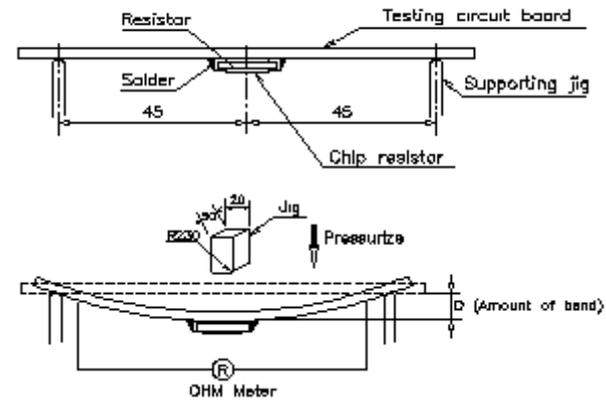
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Item	Conditions	Specifications
		Resistors
Joint Strength of Solder	<p>Preconditioning: Put tested resistor in the apparatus of PCT, at a temperature of 105°C, humidity of 100% RH, and pressure of 1.22×10⁵ Pa for a duration of 4 hours. Then after left the specimen in a temperature for 2 hours or more. Test method: ◎Test item 1(Adhesion): A static load using a R0.5 (RTR01:R0.1) 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. Load: 1.RTR01=5N 2.RTR02=10N 3.Other type=20N</p>  <p>Refer to JIS-C5201-1 4.32</p>	<p>Test item 1: (1).Variance rate on resistance 1.Resistance Range: ≥ 1Ω ΔR%=±(1.0%+0.05Ω) 2.Resistance Range:<1Ω ΔR%=±(1.0%+0.001Ω) (2).No evidence of mechanical damage. No terminal peeling off.</p> <p>Test item 2: (1).Variance rate on resistance 1.Resistance Range: ≥ 1Ω ΔR%=±(1.0%+0.05Ω) 2.Resistance Range:<1Ω ΔR%=±(1.0%+0.001Ω) (2).No evidence of mechanical damage. No terminal peeling off and core body cracked.</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. D:RTR02、03、05=5mm RTR01、06、12=3mm RTR20、25=2mm</p>  <p>Refer to JIS-C5201-1 4.33</p>	
Vibration	<p>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 transferred 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 hrs) Refer to JIS-C5201-1 4.22</p>	<p>1.Resistance Range : ≥ 1 Ω 1%:±(0.5%+0.05Ω) 2%、5%:±(1.0%+0.05Ω) 2.Resistance Range : <1 Ω 1%、2%、5%:±(1.0%+0.001Ω) No evidence of mechanical damage</p>

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6.3 Environmental Test

Item	Conditions	Specifications										
		Resistors										
Resistance to Dry Heat	Put tested resistor in chamber under temperature 155±5°C for 1000 +48/-0 hours. Then leaving the tested resistor in room temperature for 60 minutes, and measure its resistance variance rate. Refer to JIS-C5201-1 4.25	1. Resistance Range: ≥ 1Ω ΔR%=±(1.0%+0.05Ω) 2. Resistance Range: <1Ω ΔR%=±(1.0%+0.001Ω) No evidence of mechanical damage.										
Thermal Shock	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" style="margin-left: auto; margin-right: auto;"> <tr><th colspan="2">Testing Condition</th></tr> <tr><td>Lowest Temperature</td><td>-55±5°C</td></tr> <tr><td>Highest Temperature</td><td>125±5°C</td></tr> <tr><td>Temperature-retaining time</td><td>15 minutes each</td></tr> </table> Refer to MIL-STD 202 Method 107	Testing Condition		Lowest Temperature	-55±5°C	Highest Temperature	125±5°C	Temperature-retaining time	15 minutes each	1. Resistance Range: ≥ 1Ω ΔR%=±(0.5%+0.05Ω) 2. Resistance Range: <1Ω ΔR%=±(1.0%+0.001Ω) No evidence of mechanical damage.		
Testing Condition												
Lowest Temperature	-55±5°C											
Highest Temperature	125±5°C											
Temperature-retaining time	15 minutes each											
Loading Life in Moisture	Put the tested resistor in the chamber under temperature 40±2°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. Refer to JIS-C5201-1 4.24	1. Resistance Range: ≥ 1Ω RTR01 : ΔR%=±(1.0%+0.05Ω) Other Type : ΔR%=±(0.5%+0.05Ω) 2. Resistance Range: <1Ω ΔR%=±(2.0%+0.001Ω) No evidence of mechanical damage.										
Load Life	Put the tested resistor in chamber under temperature 70±2°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. Refer to JIS-C5201-1 4.25	1. Resistance Range: ≥ 1Ω RTR01 : ΔR%=±(1.0%+0.05Ω) Other Type : ΔR%=±(0.5%+0.05Ω) 2. Resistance Range: <1Ω ΔR%=±(2.0%+0.001Ω) No evidence of mechanical damage.										
Low Temperature Operation	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. Refer to MIL-R-55342D 4.7.4	1. Resistance Range: ≥ 1Ω ΔR%=±(0.5%+0.05Ω) 2. Resistance Range: <1Ω ΔR%=±(1.0%+0.001Ω) No evidence of mechanical damage.										
Whisker Test	◎Test item 1 (Thermal Shock test): <table border="1" style="margin-left: auto; margin-right: auto;"> <tr><th colspan="2">Testing Condition</th></tr> <tr><td>Minimum storage temperature</td><td>-55+0/-10°C</td></tr> <tr><td>Maximum storage temperature</td><td>85+10/-0°C</td></tr> <tr><td>Temperature-retaining time</td><td>10 min.</td></tr> <tr><td>Number of temperature cycles</td><td>1,500</td></tr> </table> ◎Inspection: Inspect for whisker formation on specimens that underwent the acceleration test specified in subclause 4.2, with a magnifier (stereo microscope) 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. By JEDEC Standard NO.22A121 class 2.	Testing Condition		Minimum storage temperature	-55+0/-10°C	Maximum storage temperature	85+10/-0°C	Temperature-retaining time	10 min.	Number of temperature cycles	1,500	Max. 50μm
Testing Condition												
Minimum storage temperature	-55+0/-10°C											
Maximum storage temperature	85+10/-0°C											
Temperature-retaining time	10 min.											
Number of temperature cycles	1,500											

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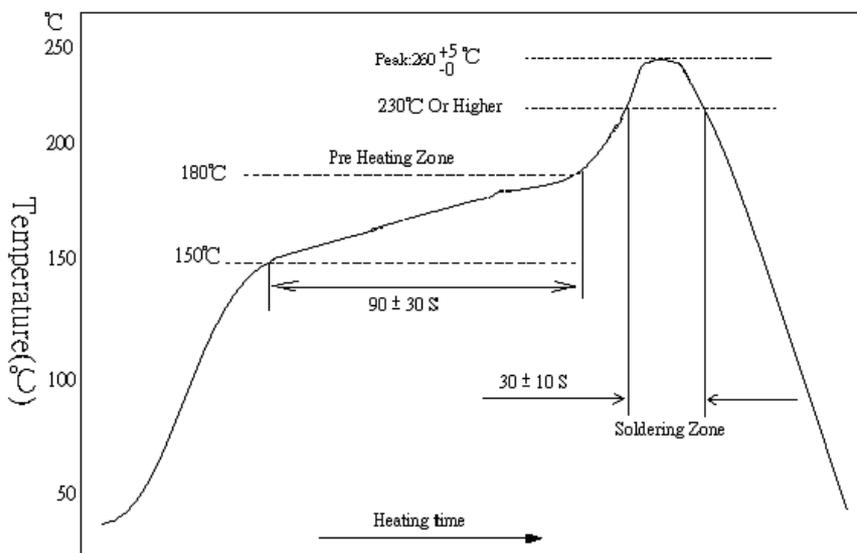
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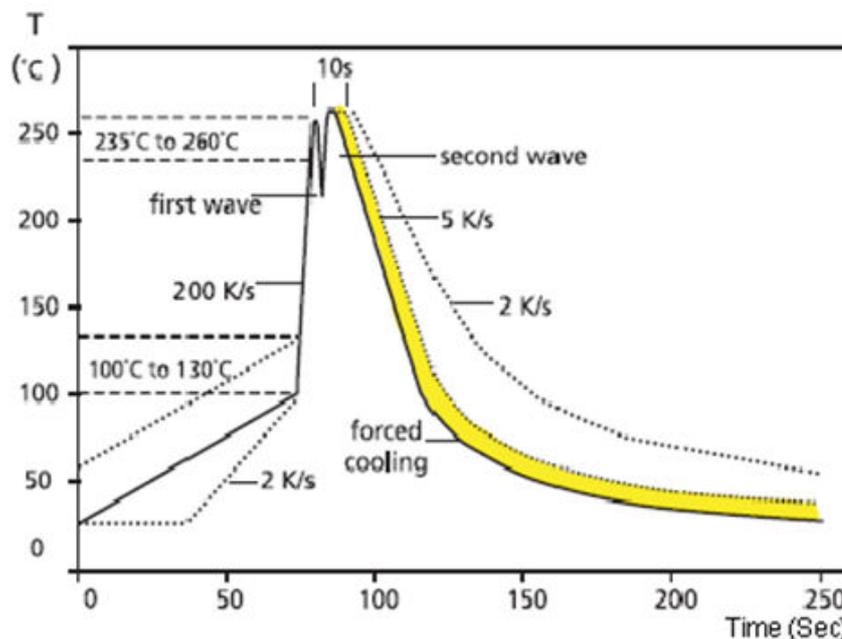
7 Recommend Soldering Method:

7.1 Lead Free IR Reflow Soldering Profile



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

7.2 Lead Free Double-Wave Soldering Profile.(This applies to 0603 size inclusive above products)



7.3 Soldering Iron: temperature 350°C±10°C , dwell time shall be less than 3 sec.

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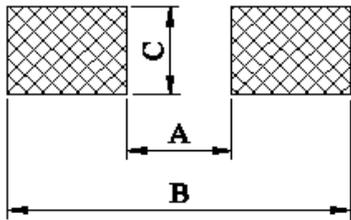
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8 Recommend Land Pattern Design (For Reflow Soldering):

Unit:mm



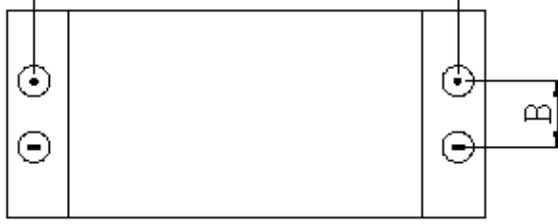
TYPE	DIM		
	A	B	C
RTR01	0.3	1.0	0.4
RTR02	0.5	1.5	0.6
RTR03	0.8	2.1	0.9
RTR05	1.2	3.0	1.3
RTR06	2.2	4.2	1.6
RTR12	2.2	4.2	2.8
RTR20	3.5	6.1	2.8
RTR25	3.8	8.0	3.5

9 Plating Thickness:

- 9.1 Ni: $\geq 1 \mu\text{m}$
- 9.2 Sn(Tin): $\geq 3 \mu\text{m}$
- 9.3 Sn(Tin): Matte Sn

10 Measurement Point:

Bottom electrode		Unit : mm	
TYPE	DIM	A	B
		RTR01	0.44±0.05
RTR02	0.80±0.05	0.24±0.05	
RTR03	1.35±0.05	0.35±0.05	
RTR05	1.80±0.05	0.35±0.05	
RTR06	2.90±0.05	0.35±0.05	
RTR12	2.90±0.05	0.35±0.05	
RTR20	4.50±0.05	1.15±0.05	
RTR25	5.90±0.05	1.60±0.05	



- ⊙ **Current Terminal**
- ⊖ **Voltage Terminal**

Remark

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RALEC 旺詮	Precision Thick Film Chip Resistors Product Specification	Document No.	IE-SP-032
		Released Date	2014/02/14
		Page No.	12/12

11 Stock period:

11.1 The temperature condition must be controlled at $25\pm 5^{\circ}\text{C}$, the R.H. must be controlled at $60\pm 15\%$. The stock can maintain quality level in two years.

12 The carton packaged for electronic-information products is made by the symbol as follows: (For china)

	
Marking for control of pollution cause by electronic-information products	Marking for package recovery

13 Attachments:

13.1 Document Revise Record Paper (QA-QR-027)

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