1 Scope

1.1 This specification is applicable to lead free and halogen free of ROHS directive for RST series anti-sulfurated thick film chip resistors.

1.2 Superior Sulfur resistant capability (Refer to ASTM-B-809-95&EIA977sulfur vapor test).

1.3 The product is for general electronic purpose.

2 Explanation Of Part Numbers

(EX)

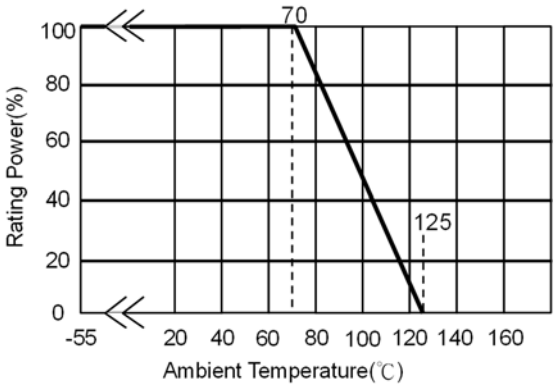
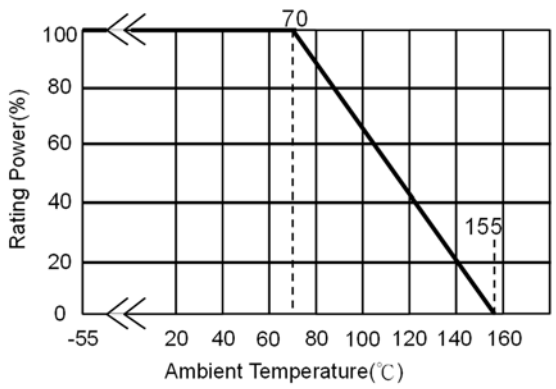
RST 0402 T 100 J A

Type	Size	Packing	Nominal Resistance		Resistance Tolerance	FoS Test
Anti-Sulfurated Thick Film Chip Resistors	0201 0402 0603 0805 1206 1210 2010 2512	**T:Taping 4mm pitch carrier tape 10000pcs**	5% (3-Digit)	EX. 10Ω=100 4.7Ω=4R7 JUMPER=000	B =± 0.1% D=± 0.5% F=± 1% J=± 5%	A : 60℃ B :105℃
			0.1% 0.5% 1% (4-Digit)	EX. 10.2Ω=10R2 10KΩ=1002		

3 General Specifications

Type	Rated Power at 70℃	Max. Working Voltage	Max. Overload Voltage	T.C.R. (ppm/℃)	Resistance Range				JUMPER (0Ω) Rated Current				JUMPER (0Ω) Resistance Value			
					B(±0.1%) E-24、E-96	D(±0.5%) E-24、E-96	F(±1%) E-24、E-96	J(±5%) E-24	J(±5%)		F(±1%)		J(±5%)		F(±1%)	
									A	B	A	B	A	B	A	B
RST (0201)	1/20 W	25V	50V	-200 +400	------	1Ω≦R＜10Ω	1Ω≦R＜10Ω	1Ω≦R＜10Ω	0.5A		0.5A		50mΩ MAX	100mΩ MAX	---	50mΩ MAX.
				±200	------	10Ω≦R≦10MΩ	10Ω≦R≦10MΩ	10Ω≦R≦10MΩ								
RST (0402)	1/16 W	50V	100V	±100	------	10Ω≦R≦1MΩ	10Ω≦R≦10MΩ	10Ω≦R≦20MΩ	1A		1.5A		50mΩ MAX	100mΩ MAX	35mΩ MAX	50mΩ MAX.
				±200	------	------	1Ω≦R＜10Ω	1Ω≦R＜10Ω								
RST (0603)	1/10 W	75V	150V	±100	100Ω≦R≦1MΩ	10Ω≦R≦1MΩ	10Ω≦R≦10MΩ	10Ω≦R≦20MΩ	1A		2A		50mΩ MAX	100mΩ MAX	25mΩ MAX	50mΩ MAX.
				±200	------	1Ω≦R＜10Ω	1Ω≦R＜10Ω	1Ω≦R ＜10Ω								
RST (0805)	1/8 W	150V	300V	±100	100Ω≦R≦1MΩ	10Ω≦R≦1MΩ	10Ω≦R≦10MΩ	10Ω≦R≦20MΩ	2A		2.5A		50mΩ MAX	100mΩ MAX	20mΩ MAX	50mΩ MAX.
				±200	------	1Ω≦R＜10Ω	1Ω≦R＜10Ω	1Ω≦R＜10Ω								
RST (1206)	1/4 W	200V	400V	±100	100Ω≦R≦1MΩ	10Ω≦R≦1MΩ	10Ω≦R≦10MΩ	10Ω≦R≦20MΩ	2A		3.5A		50mΩ MAX	100mΩ MAX	20mΩ MAX	50mΩ MAX.
				±200	------	1Ω≦R＜10Ω	1Ω≦R＜10Ω	1Ω≦R＜10Ω								
RST (1210)	1/2 W	200V	400V	±100	100Ω≦R≦1MΩ	10Ω≦R≦1MΩ	10Ω≦R≦10MΩ	10Ω≦R≦20MΩ	2A		4A		50mΩ MAX	100mΩ MAX	20mΩ MAX	50mΩ MAX.
				±200	------	1Ω≦R＜10Ω	1Ω≦R＜10Ω	1Ω≦R＜10Ω								
RST (2010)	3/4 W	200V	400V	±100	100Ω≦R≦1MΩ	10Ω≦R≦1MΩ	10Ω≦R≦10MΩ	10Ω≦R≦20MΩ	2A		5A		50mΩ MAX	100mΩ MAX	20mΩ MAX	50mΩ MAX.
				±200	------	1Ω≦R＜10Ω	1Ω≦R＜10Ω	1Ω≦R＜10Ω								
RST (2512)	1W	200V	400V	±100	100Ω≦R≦1MΩ	10Ω≦R≦1MΩ	10Ω≦R≦10MΩ	10Ω≦R≦20MΩ	2A		7A		50mΩ MAX	100mΩ MAX	20mΩ MAX	50mΩ MAX.
				±200	------	1Ω≦R＜10Ω	1Ω≦R＜10Ω	1Ω≦R＜10Ω								
Operating Temperature Range				-55℃ ~ +155℃ (0201:-55℃ ~ +125℃)												

3.1 Power Derating Curve:

Type	RST 0201	Othe r
Operating Temperature Range	－55℃ ~ ＋125℃	－55℃ ~ ＋155℃
Explain	If the ambient temperature exceeds 70 degrees centigrade to 125 degrees centigrade, the power can be modified by the curve as below.	If the ambient temperature exceeds 70 degrees centigrade to 155 degrees centigrade, the power can be modified by the curve as below.
Figure		

3.2 Voltage Rating:

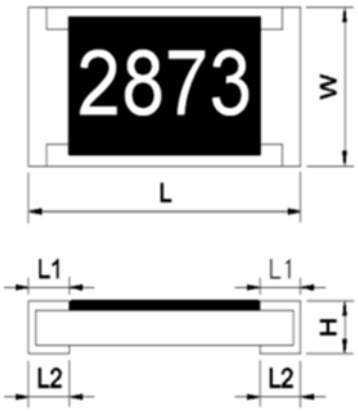
Rated Voltage: DC voltage or AC voltage (rms) based on the rated power.

The voltage can be calculated by the following formula. If the calculated value exceeds the Max. voltage specified in the Table 3, the Max. Voltage rating is set as the voltage rating.

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

E= Voltage rating (v)
P= Power rating (w)
R= Nominal resistance(Ω)

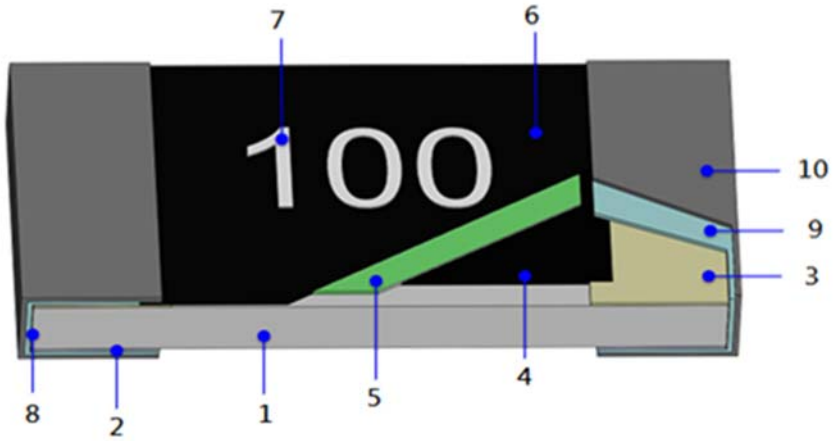
4 Dimensions



Unit:mm

Type \ Dimensions / Size Code		L	W	H	L1	L2
RST	**0201**	0.60±0.03	0.30±0.03	0.23±0.03	0.10±0.05	0.20±0.10
RST	**0402**	1.00±0.10	0.50±0.05	0.30±0.05	0.20±0.10	0.30±0.15
RST	**0603**	1.60±0.10	0.80±0.10	0.45±0.10	0.30±0.15	0.30±0.20
RST	**0805**	2.00±0.10	1.25±0.10	0.50±0.10	0.35±0.20	0.35±0.20
RST	**1206**	3.05±0.10	1.55±0.10	0.50±0.10	0.45±0.20	0.35±0.20
RST	**1210**	3.05±0.10	2.55±0.10	0.55±0.10	0.50±0.20	0.50±0.30
RST	**2010**	5.00±0.20	2.50±0.20	0.55±0.10	0.60±0.20	0.60±0.30
RST	**2512**	6.30±0.20	3.20±0.20	0.55±0.10	0.60±0.20	0.60±0.30

5 Structure Graph:



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

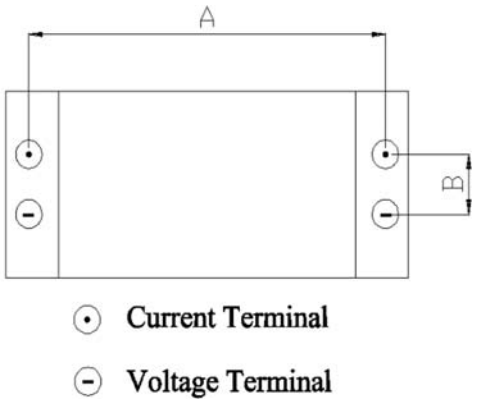
6 Reliability Test

Item	Conditions	Specifications	
		Resistors	Jumper
High Temperature Exposure (Storage)	Put the specimens in the chamber with temperature of 155±3℃ for 1000 hours. Then take them out to stabilize in room temperature for 24±4hr or more, and measure of its resistance variance rate. Experiment evidence: AEC-Q200	1. 0.1%、0.5%、1%： △R=±1.0% 2. 5%： △R=±2.0%	Refer to item 3. general specifications
Temperature Cycling	Put the specimens in the High & low temperature test chamber with temperature varies from -55℃ to 125℃ for 15 minutes and total 1000 cycles. Then take them out to stabilize in room temperature for 24±4hr or more, and measure of its resistance variance rate. Experiment evidence: AEC-Q200	△R=±2.0%	Refer to item 3. general specifications
Biased Humidity	Solder the specimens on the test PCB and put them into the constant temperature humidity chamber with 85±2℃ and 85±5%RH. Then apply the test voltage that calculates based on the 10% of rated power for 1000hrs. Then take them out to stabilize in room temperature for 24±4hr or more, and measure of its resistance variance rate. Experiment evidence: AEC-Q200	1. 0.1%、0.5%、1%： △R=±2.0% 2. 5%： △R=±3.0%	Refer to item 3. general specifications
Operational Life	Solder the specimens on the test PCB and Put them in the chamber with temperature of 125±3℃ and load the voltage for 1000 hours. Then take them out to stabilize in room temperature for 24±4hr or more, and measure of its resistance variance rate. Note: The input voltage shall refer to the power de-rating curve (referring to page 2,No.3.1) Experiment evidence: AEC-Q200	1. 0.1%、0.5%、1%： △R=±2.0% 2. 5%： △R=±3.0%	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-C5201-14.13	1. 0.1%、0.5、1%： △R=±1.0% 2. 5%： △R=±2.0%	Refer to item 3. general specification
Resistance to Soldering Heat	The specimens are fully immersed into the Pb-free solder pot, then take them out to stabilize for 1 hour or more and measure of its resistance variance rate. Temp of solder pot：260±5℃ Soldering duration：10±1sec. Experiment evidence AEC-Q200	△R=±1.0%	Refer to item 3. general specifications .
ESD	Put the specimens on the test fixture and two (2)discharges (2KVDC) shall be applied to each PUT, one (1) with a positive polarity and one (1) with a negative polarity. Afterwards, the specimens stabilize for 30min or more and measure of its resistance variance rate. The test is performed with direct contact and regular discharge mode. The resistor and capacitor used on the spearhead is 2000Ω and 150pF respectively. Experiment evidence AEC-Q200	△R=±3.0%	Refer to item 3. general specifications

Item	Conditions		Specifications	
			Resistors	Jumper
Solderability	**Test method:** **Test item 1 (solder pot test): Method B** Precondition: The specimens are subjected to 155℃ dry bake for 4hrs±15min. The specimens are immersed into the flux first, then fully immersed into the solder pot, at a temperature of 235± 5℃ for 5+0/-0.5 sec. Then rinse with water and observe the soldering coverage under the microscope. **Test item 2 (Leaching test): Method D** The specimens are immersed into the flux first, then fully immersed into the solder pot, at a temperature of 260±5℃ for 30+0/-0.5 sec. Then rinse with water and observe the soldering coverage under the microscope. Experiment evidence AEC-Q200		1. Soldering coverage over 95% 2. At the edge of terminal, the object underneath (e.g. white ceramic) shall not expose.	
Electrical Characterization	$TCR(ppm/℃) = \frac{(R2-R1)}{R1(T2-T1)} \times 10^6$ R1: Resistance at room temperature (Ω) R2: Resistance at -55℃ or +125℃(Ω) T1: Room temperature (℃) T2: Temperature -55℃ or +125℃ Experiment evidence: AEC-Q200		Refer to item 3. general specifications	NA
Board Flex (Bending Test)	Solder the specimens on the test PCB and put the PCBA onto the Bending Tester. Add force at the central part of PCB, and the duration of the applied forces shall be 60 (+ 5) Sec. Measure of its resistance variance rate in load. Bending depth D:0402、0603、0805=5mm 0201、1206、1210=3mm 2010、2512=2mm Experiment evidence: AEC-Q200		△R=±1.0%	Refer to item 3. general specifications
			No mechanical damage, peel-off of side end or chip crack.	
Sulfuration Test	Class : A	Put the tested resistor in sulfur vapor, at a temperature of 60±2℃for 1000hrs Refer to ASTM-B-809-95&EIA977	△R=±4.0%	Refer to item 3. general specifications
	Class : B	Put the tested resistor in sulfur vapor, at a temperature of 105±2℃for 750hrs Refer to ASTM-B-809-95&EIA977	△R=±4.0%	

7 Measurement Point

Bottom electrode



Unit : mm

TYPE \ DIM	A	B
RST0201	0.44±0.05	0.22±0.05
RST0402	0.80±0.05	0.24±0.05
RST0603	1.35±0.05	0.35±0.05
RST0805	1.80±0.05	0.35±0.05
RST1206	2.90±0.05	0.35±0.05
RST1210	2.90±0.05	0.35±0.05
RST2010	4.50±0.05	1.15±0.05
RST2512	5.90±0.05	1.60±0.05

8 Plating Thickness

8.1 Ni：≧2μm

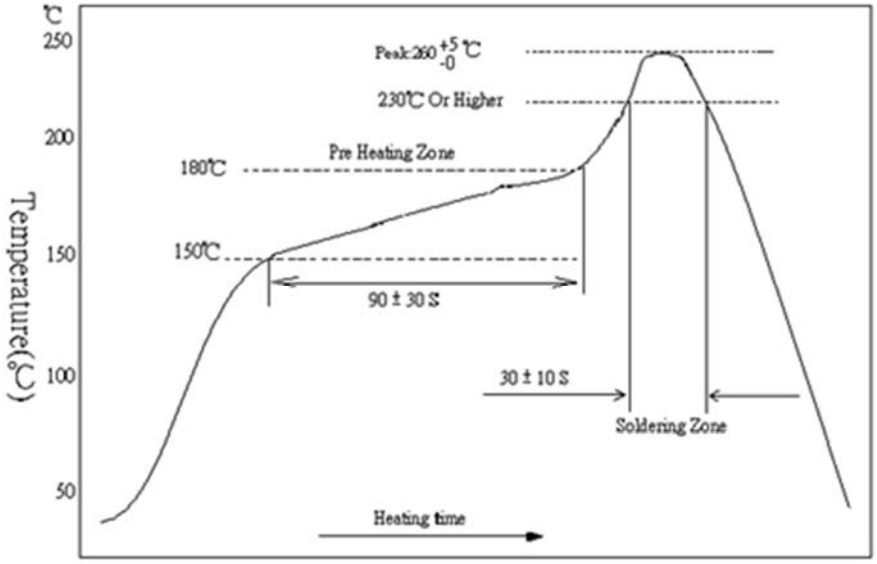
8.2 Sn(Tin)：≧3μm

8.3 Sn(Tin)：Matte Sn

9 Technical application notes: (This is for recommendation, please customer perform adjustment according to actual application)

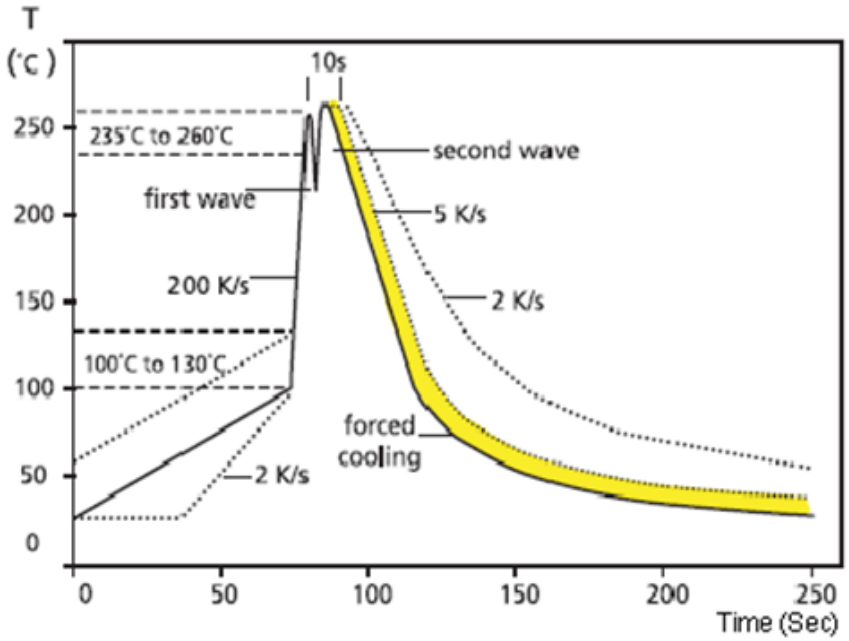
9.1 Recommend Soldering Method:

9.1.1 Lead Free IR Reflow Soldering Profile (MEET J-STD-020D)



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

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

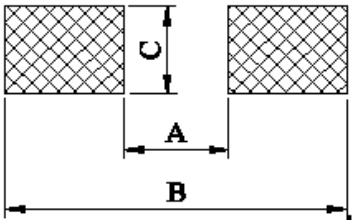


9.1.3 Soldering Iron: temperature 350℃±10℃ , dwell time shall be less than3 sec.

9.2 Recommend Land Pattern Design (For Reflow Soldering)

When a component is soldered, the resistance after soldering changes slightly depending on the size of the soldering area and the amount of soldering. When designing a circuit, it is necessary to consider the effect of a decrease or increase in its resistance.

Unit : mm



DIM / TYPE	A	B	C
RST0201	0.3	1.0	0.4
RST0402	0.5	1.5	0.6
RST0603	0.8	2.1	0.9
RST0805	1.2	3.0	1.3
RST1206	2.2	4.2	1.6
RST1210	2.2	4.2	2.8
RST2010	3.5	6.1	2.8
RST2512	3.8	8.0	3.5

9.3 Environment Precautions:

This specification product is for general electronic use, RALEC will not be responsible for any damage, cost or loss caused by using this specification product in any special environment. If other applications need to confirm with RALEC.

If consumer intends to use our Company product in special environment or condition (including but not limited to those mentioned below), then will need to make individual recognition of product features and reliability accordingly.

(a) Used in high temperature and humidity environment

(b) Exposed to sea breeze or other corrosive gas, such as Cl2、H2S、NH3、SO2 and NO2.

(c) Used in non-verified liquids including water, oil, chemical and organic solvents.

(d) Using non-verified resin or other coating material to seal or coat our Company product.

(e) After soldering, it is necessary to use water-soluble detergents to clean residual solder fluxes, even though no-clean fluxes are recommended.

9.4 Momentary Overload Precautions:

The product might be out of function when momentary overloaded. Please make sure to avoid momentary overloading while using and preserving.

9.5 Operation and Processing Precautions:

(a) Avoid damage to the edge of resistor and protective layer caused by mechanical stress.

(b) Handle with care when printing circuit board (PCB) is divided or fixed on support body, because bending of printing circuit board (PCB) mounting will make mechanical stress for resistors.

(c) Make sure the power rating is under the limit when using the resistor. When power rating is over the limit, the resister will be overloaded. There might be machinery damage due to the climbing temperature.

(d) If the resister will be exposed under massive impact load (shock wave) in a short period of time, the working environment must be set up well before use.

(e) Please make evaluation and confirmation when the product is well used in your company and have a through consideration of it's fail-safe design to ensure the system safety.

10 Storage and transportation requirement:

10.1 The temperature condition must be controlled as25±5℃, the R.H. must be controlled as60±15%. The stock can maintain quality level in two years.

10.2 Please avoid the mentioned harsh environment below when storing to ensure product performance and its' weldability. Places exposed to sea breeze or other corrosive gas, such as Cl2、H2S、NH3、SO2 and NO2.

10.3 When the product is moved and stored, please ensure the correct orientation of the box. Do not drop or squeeze the box. Otherwise, the electrode or the body of the product may be damaged.

11 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

12 Attachments

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

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