1 Scope:

1.1 This specification is applicable to fully lead-free Anti-Surge and halogen-free FTG series thick film chip resistors。

1.2 Fully lead-free products – No RoHS exemptions。

1.3 The product is for general electronic purpose。

2 Explanation Of Part Numbers:

(EX)

FTG 1206 T 100 J

Type	Size	Packaging	Nominal Resistance		Resistance Tolerance
EU Pb-Free Anti-Surge Thick Film Chip Resistors	0402 0603 0805 1206 1210 2010 2512	T : Taping Type	3-Digit	E24 Series EX. 10Ω=100 47Ω=470	J=±5% K=± 10% M=± 20%

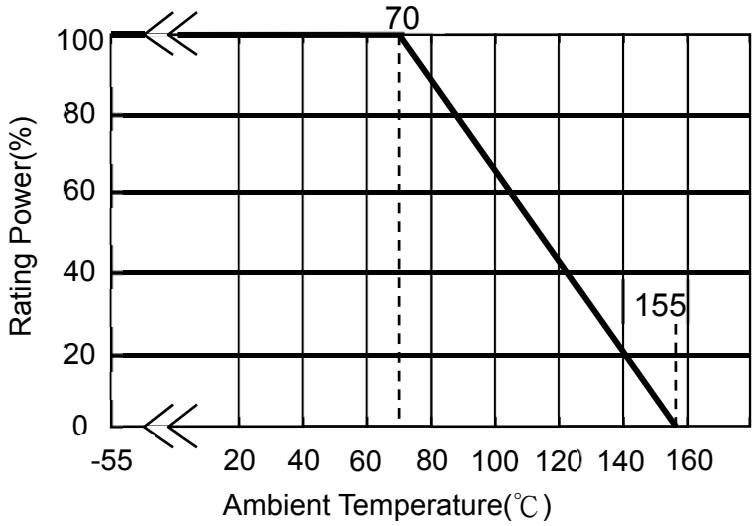
3 General Specifications:

Type	Rate Power at	Max. Working Voltage	Max. Overload Voltage	T.C.R (ppm/℃)	Resistance Range J(±5%) K(±10%) M(±20%) E-24
FTG (0402)	1/8 W	50V	100V	±250	1Ω≦R≦1MΩ
FTG (0603)	1/4 W	75V	150V	±250	1Ω≦R≦1MΩ
FTG (0805)	1/3 W	150V	300V	±250	1Ω≦R≦1MΩ
FTG (1206)	1/2 W	200V	400V	±250	1Ω≦R≦1MΩ
FTG (1210)	3/4 W	200V	400V	±250	1Ω≦R≦1MΩ
FTG (2010)	3/4 W	200V	400V	±250	1Ω≦R≦1MΩ
FTG (2512)	1W	200V	400V	±250	1Ω≦R≦1MΩ
Operating Temperature Range				-55℃ ~ +155℃	

3.1 Power Derating Curve:

Temperature Range: -55℃~+155℃

If the ambient temperature exceeds 70 degrees centigrade to 155 degrees centigrade, the power can be modified by the curve as below



3.2 Voltage Rating：

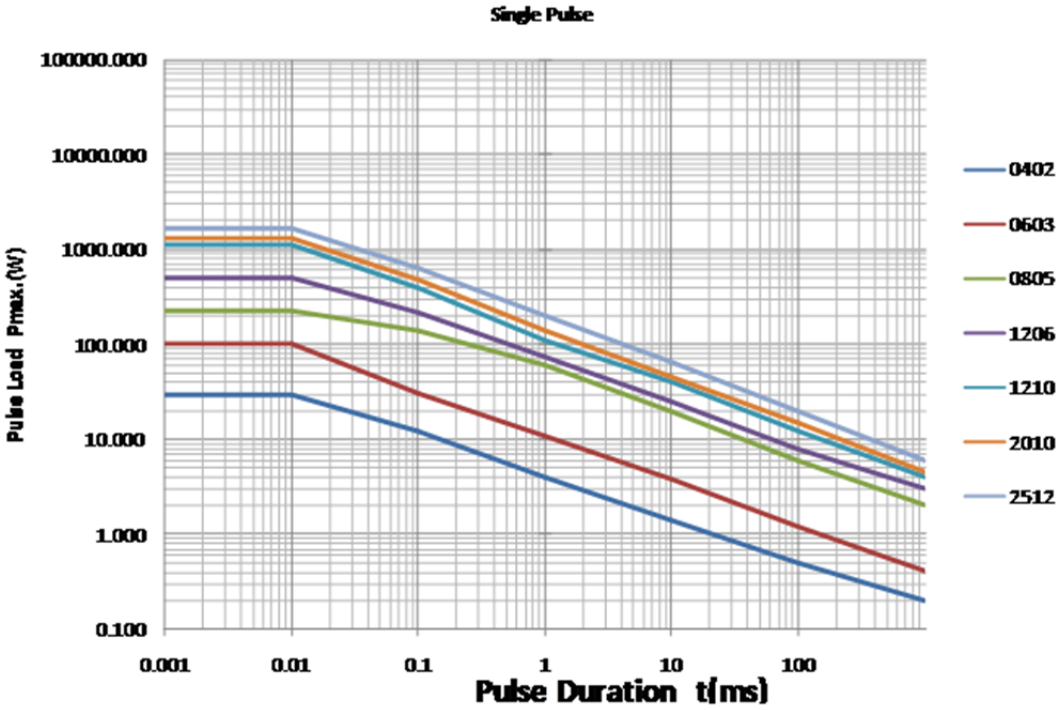
Rated Voltage: The resistor shall have a DC continuous working voltage or a rms. AC continuous working voltage at commercial-line frequency and wave form corresponding to the power rating, as determined from the following

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

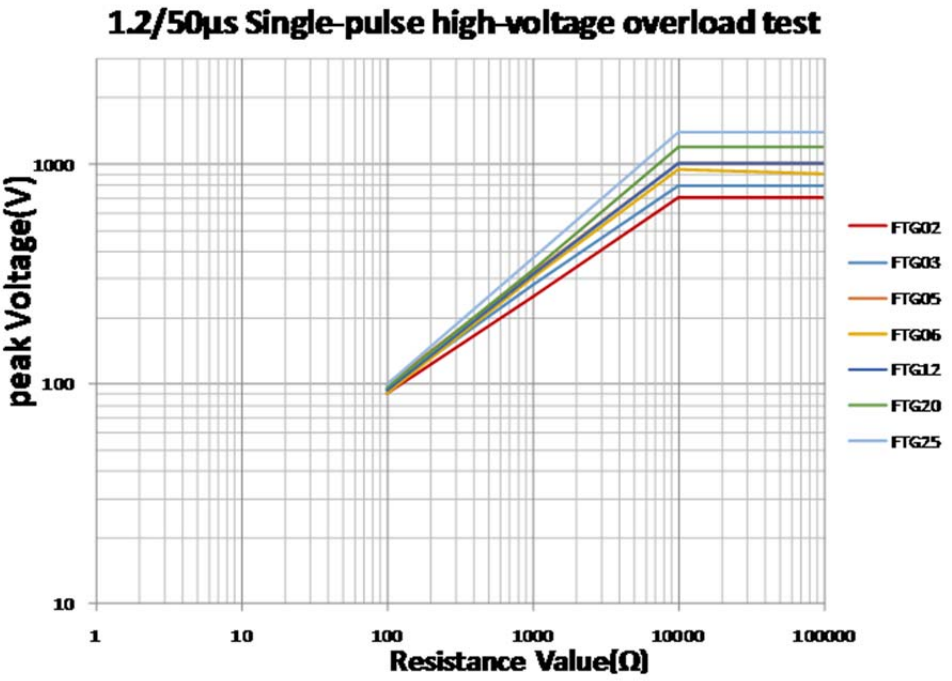
E= Rated voltage (v)
P= Power rating (w)
R=Nominal resistance(Ω)

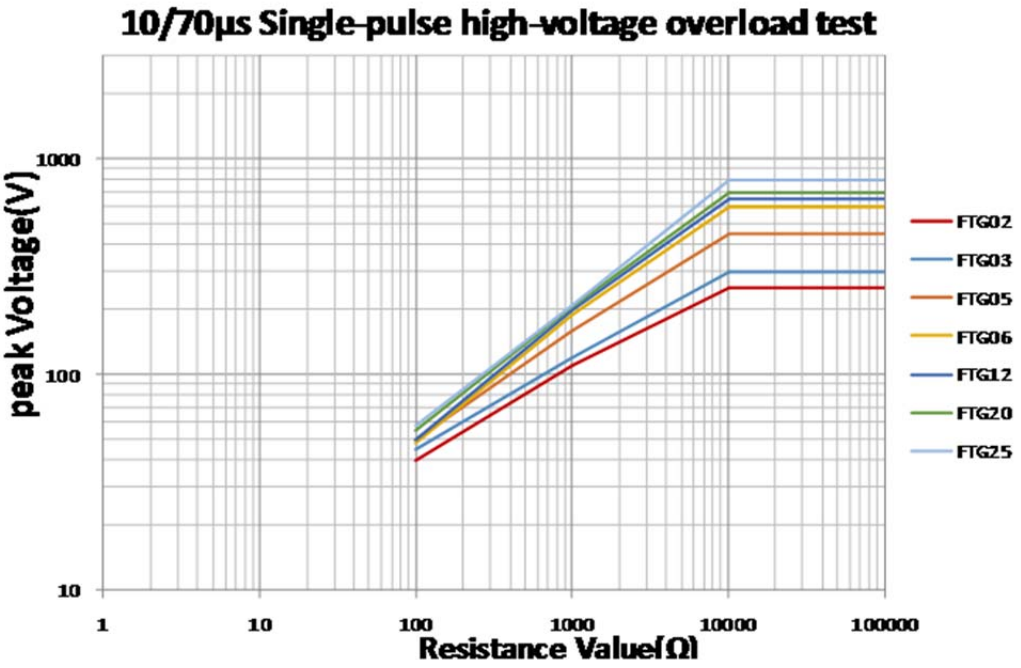
3.3 Pulse Loading Capability：

Pulse power is shown in the curve below; maximum permissible peak pulse power (P_{max}) cannot exceed V_{peak}≦0402(100V)、0603(150V)、0805(300V)、1206(400V)、2010(400V)、2512(400V), when it transforms to voltage.



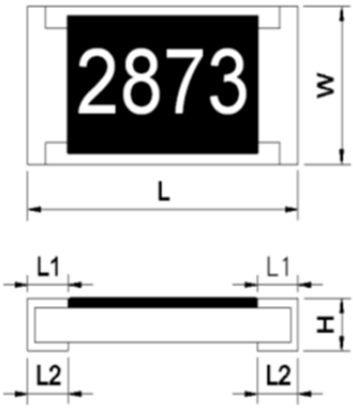
Single-pulse high-voltage overload test:





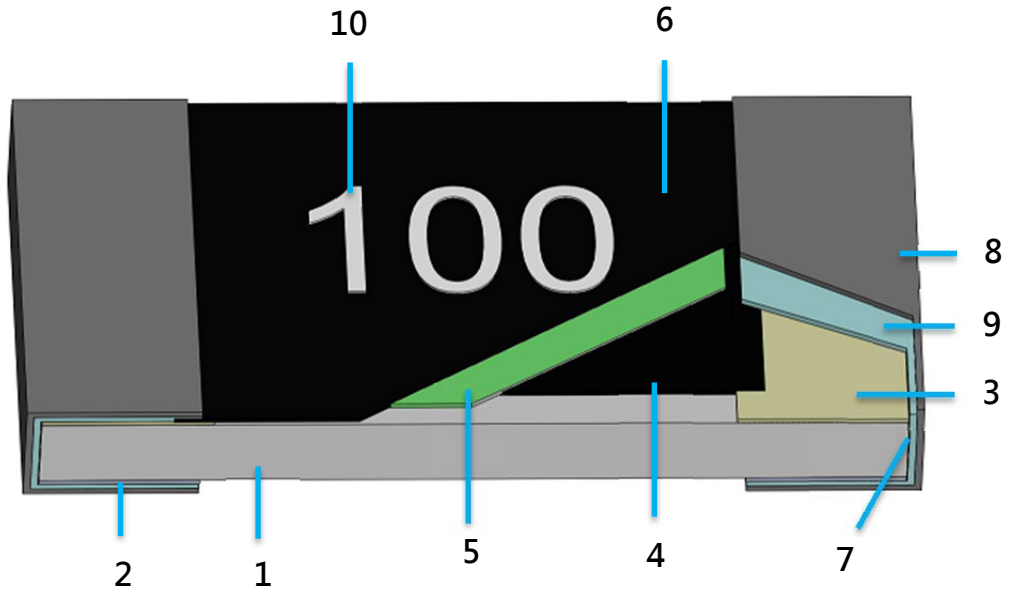
4 Dimensions:

Unit:mm



Type	Dimension / Size Code	L	W	H	L1	L2
FTG	**0402**	1.00±0.10	0.50±0.05	0.30±0.05	0.20±0.10	0.25±0.10
FTG	**0603**	1.60±0.10	0.80±0.10	0.45±0.10	0.30±0.15	0.30±0.15
FTG	**0805**	2.00±0.10	1.25±0.10	0.50±0.10	0.35±0.20	0.35±0.15
FTG	**1206**	3.05±0.10	1.55±0.10	0.50±0.10	0.45±0.20	0.35±0.15
FTG	**1210**	3.05±0.10	2.55±0.10	0.55±0.10	0.50±0.20	0.50±0.20
FTG	**2010**	5.00±0.20	2.50±0.20	0.55±0.10	0.60±0.20	0.60±0.20
FTG	**2512**	6.30±0.20	3.20±0.20	0.55±0.10	0.60±0.20	0.60±0.20

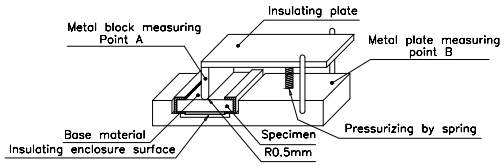
Structure Graph:



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

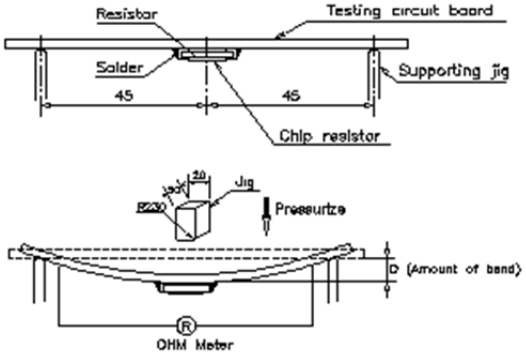
5 Reliability Test:

5.1 Electrical Performance Test

Item	Conditions	Specifications Resistors
Temperature Coefficient of Resistance	$TCR(ppm/℃) = \frac{(R2-R1)}{R1(T2-T1)} \times 10^6$ R1: Resistance at room temperature R2: Resistance at -55℃ or +125℃ T1: Room temperature T2: Temperature -55℃ or +125℃ 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	△R=±2%
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	≧10^9Ω
Dielectric Withstand Voltage	Put the resistor in the fixture, add VAC (see SPEC below) in +,- terminal for. FTG0402、0603 apply 300 VAC 1minute. FTG0805、1206、1210、2010、2512 apply 500 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±2℃ and load 2.5 times 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	△R=±5.0%
ESD	Put the specimens on the test fixture and apply ±2KVDC on terminals for 1sec .Afterwards, the specimens stabilize for30min or more and measure of its resistance variance rate. Refer to AEC-Q200-002	±5.0%
Single-pulse high-voltage overload test	Test 1: 5 pulses of 1.2/50 μs with a period of not less than 12 s. Test 2: 10 pulses of 10/700 μs with a period of not less than 1 min. Refer to IEC 60 115-1 4.27	△R=±5.0%

5.2 Mechanical Performance Test

Item	Conditions	Specifications Resistors
Terminal Strength	Test 1 : The resistor mounted on the board applied 5N pushing force on the sample rear for 10 sec. (RTT0201:3N) Test 2 : 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	Test 1 : No evidence of mechanical damage. Test 2: Type≧5N
Resistance to Solvent	The tested resistor be immersed into isopropyl alcohol of 20~25℃ 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	△R%=±1%
Solderability	Preconditioning Put the tested resistor in the apparatus of PCT, at a temperature of 105℃, humidity of 100% RH, and pressure of 1.22×105 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±5℃ for 2 sec, then the resistor is left as placed under microscope to observed 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℃ 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℃ for 30 seconds. Then the resistor is left as placed under microscope to observe its solder area. ◎Test method 3 (Electric iron test): Preheating temperature : 350±10℃ 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: Variance rate on resistance △R%=±2% 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: Variance rate on resistance △R%=±2%

Item	Conditions	Specifications Resistors
Joint Strength of Solder	◎Bending Strength Solder tested resistor on to PC board add force in the middle down, and under load measured its resistance variance rate. D: 0402、0603、0805=5mm 1206、1210=3mm 2010、2512=2mm  Refer to JIS-C5201-1 4.33	ΔR%=±1.0%

5.3 Environmental Test

Item	Conditions	Specifications Resistors
Resistance to Dry Heat	Put tested resistor in chamber under temperature 155±5℃ 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	ΔR%=±2.0%
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. Testing Condition Lowest Temperature: -55±5℃ Highest Temperature: 125±5℃ Temperature-retaining time: 15 minutes each Refer to MIL-STD 202 Method 107	ΔR%=±2.0%
Loading Life in Moisture	Put the tested resistor in the chamber under temperature 40±2℃, 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	ΔR%=±3.0%
Load Life	Put the tested resistor in chamber under temperature 70±2℃ 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	ΔR%=±3.0%

6 Plating Thickness:

6.1 Ni:≧2μm

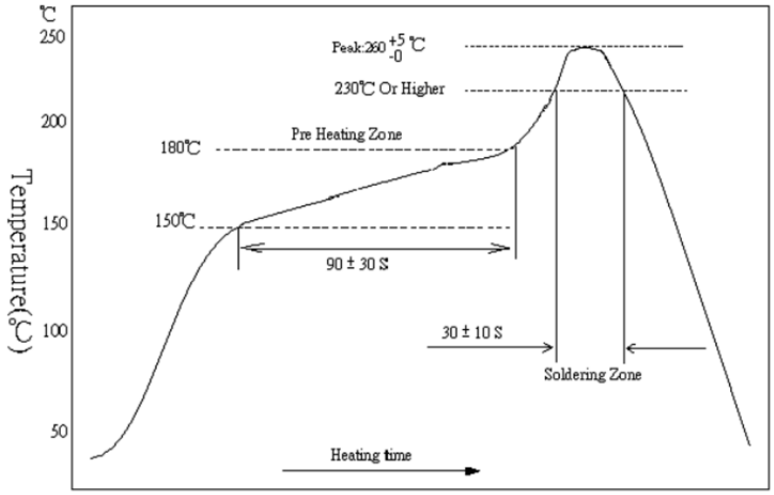
6.2 Sn(Tin):≧3μm

6.3 Sn(Tin):Matte Sn

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

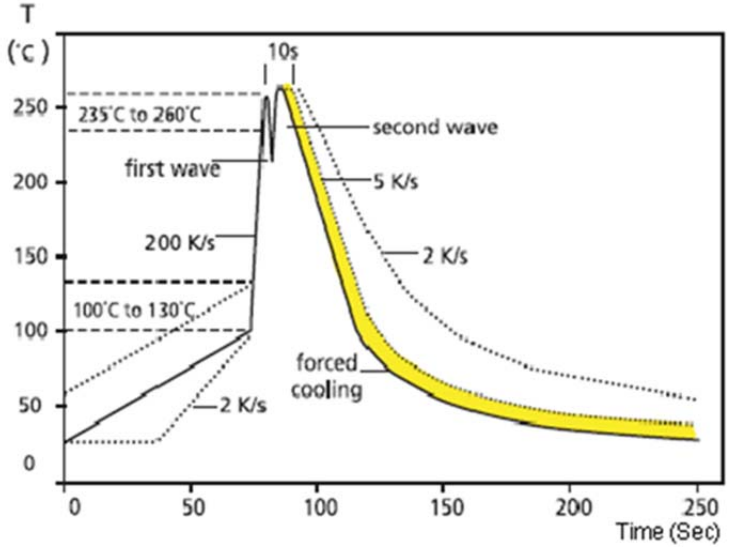
7.1 Recommend Soldering Method:

7.1.1 Lead Free IR Reflow Soldering Profile



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

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

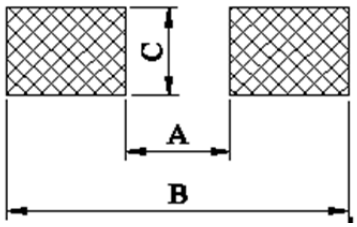


7.1.3 Soldering iron: temperature 350℃±10℃, dwell time shall be less than 3 sec.

7.2 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



TYPE \ DIM	A	B	C
FTG0402	0.5	1.5	0.6
FTG0603	0.8	2.1	0.9
FTG0805	1.2	3.0	1.3
FTG1206	2.2	4.2	1.6
FTG1210	2.2	4.2	2.8
FTG2010	3.5	6.1	2.8
FTG2512	3.8	8.0	3.5

7.3 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.

7.4 Momentary Overload Precautions:

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

7.5 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.

8 Stock period:

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

8.2 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 Cl_2、H_2S、NH_3、SO_2 and NO_2.

8.3 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.

9 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

10 Attachments:

10.1 Document Revise Record(QA-QR-027)

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