

FTT Series Thick Film Resistors Specifications

Document No.	IE-SP-088
Released Date	2020/12/31
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1 Scope:

- 1.1 This specification is applicable to fully lead-free and halogen-free FTT 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)



Type	Size	Nominal Resistance		Resistance Tolerance	Packaging(Refer to IE-SP-055)
Fully Lead-free Thick Film Chip Resistors	01(0201) 02(0402) 03(0603) 05(0805) 06(1206) 12(1210) 20(2010) 25(2512)	5% (3-Digit)	EX. 10Ω=100 4.7Ω=4R7	B =± 0.1% D=± 0.5% F=± 1% J=± 5%	Q1 : 1 mm Pitch Carrier Tape 20000 pcs QE : 1mm Pitch Carrier Tape 150000 pcs TH : 2 mm Pitch Carrier Tape 10000 pcs H1 : 2 mm Pitch Carrier Tape 20000 pcs H2 : 2 mm Pitch Carrier Tape 20000 pcs H3 : 2 mm Pitch Carrier Tape 30000 pcs H4 : 2 mm Pitch Carrier Tape 40000 pcs H5 : 2 mm Pitch Carrier Tape 50000 pcs H6 : 2 mm Pitch Carrier Tape 60000 pcs TP : 4 mm Pitch Carrier Tape 5000 pcs P2 : 4 mm Pitch Carrier Tape 10000 pcs P3 : 4 mm Pitch Carrier Tape 15000 pcs P4 : 4 mm Pitch Carrier Tape 20000 pcs TE : 4 mm Pitch Carrier Tape 4000pcs BA : Bulk Case
	0.1% 0.5% 1% (4-Digit)	EX. 10.2Ω=10R2 10KΩ=1002			

Written	IE	Checked	Approved	QA	Remark	Issue Dep. DATA Center.
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3 General Specifications:

Type	Rated Power at 70°C	Max. Working Voltage	Max. Overload Voltage	T.C.R (ppm/°C)	Resistance Range				JUMPER (0Ω)		JUMPER (0Ω)	
					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%)
FTT01 (0201)	$\frac{1}{20}$ W	25V	50V	±200	$100\Omega \leq R \leq 1M\Omega$	$1\Omega \leq R \leq 1M\Omega$	$1\Omega \leq R \leq 10M\Omega$	$1\Omega \leq R \leq 10M\Omega$	0.5A	0.5A	50mΩ MAX.	35mΩ MAX.
FTT02 (0402)	$\frac{1}{16}$ W	50V	100V	±200	$100\Omega \leq R \leq 1M\Omega$	$1\Omega \leq R \leq 2.2M\Omega$	$1\Omega \leq R \leq 16M\Omega$	$1\Omega \leq R \leq 16M\Omega$	1A	1.5A	50mΩ MAX.	20mΩ MAX.
FTT03 (0603)	$\frac{1}{10}$ W	75V	150V	±150	$100\Omega \leq R \leq 1M\Omega$	$1\Omega \leq R \leq 2.2M\Omega$	$1\Omega \leq R \leq 2.2M\Omega$	$1\Omega \leq R \leq 2.2M\Omega$	1A	2A	50mΩ MAX.	20mΩ MAX.
				±200	-----	-----	$2.2M\Omega < R \leq 10M\Omega$	$2.2M\Omega < R \leq 10M\Omega$				
FTT05 (0805)	$\frac{1}{8}$ W	150V	300V	±150	$100\Omega \leq R \leq 1M\Omega$	$1\Omega \leq R \leq 2.2M\Omega$	$1\Omega \leq R \leq 2.2M\Omega$	$1\Omega \leq R \leq 2.2M\Omega$	2A	2.5A	50mΩ MAX.	20mΩ MAX.
				±200	-----	-----	$2.2M\Omega < R \leq 10M\Omega$	$2.2M\Omega < R \leq 10M\Omega$				
FTT06 (1206)	$\frac{1}{4}$ W	200V	400V	±150	$100\Omega \leq R \leq 1M\Omega$	$1\Omega \leq R \leq 2.2M\Omega$	$1\Omega \leq R \leq 2.2M\Omega$	$1\Omega \leq R \leq 2.2M\Omega$	2A	3.5A	50mΩ MAX.	20mΩ MAX.
				±200	-----	-----	$2.2M\Omega < R \leq 10M\Omega$	$2.2M\Omega < R \leq 10M\Omega$				
FTT12 (1210)	$\frac{1}{2}$ W	200V	400V	±150	$100\Omega \leq R \leq 1M\Omega$	$1\Omega \leq R \leq 2.2M\Omega$	$1\Omega \leq R \leq 2.2M\Omega$	$1\Omega \leq R \leq 2.2M\Omega$	2A	4A	50mΩ MAX.	20mΩ MAX.
				±200	-----	-----	$2.2M\Omega < R \leq 10M\Omega$	$2.2M\Omega < R \leq 10M\Omega$				
FTT20 (2010)	$\frac{3}{4}$ W	200V	400V	±150	$100\Omega \leq R \leq 1M\Omega$	$1\Omega \leq R \leq 2.2M\Omega$	$1\Omega \leq R \leq 2.2M\Omega$	$1\Omega \leq R \leq 2.2M\Omega$	2A	5A	50mΩ MAX.	20mΩ MAX.
				±200	-----	-----	$2.2M\Omega < R \leq 10M\Omega$	$2.2M\Omega < R \leq 10M\Omega$				
FTT25 (2512)	1W	200V	400V	±150	$100\Omega \leq R \leq 1M\Omega$	$1\Omega \leq R \leq 2.2M\Omega$	$1\Omega \leq R \leq 2.2M\Omega$	$1\Omega \leq R \leq 2.2M\Omega$	2A	7A	50mΩ MAX.	20mΩ MAX.
				±200	-----	-----	$2.2M\Omega < R \leq 10M\Omega$	$2.2M\Omega < R \leq 10M\Omega$				
Operating Temperature Range				-55°C ~ +155°C (0201:-55°C ~ +125°C)								

3.1 Power Derating Curve:

Type	FTT01 (0201)	Other
Operating Temperature Range	-55°C ~ +125°C	-55°C ~ +155°C
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		

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3.2 Voltage Rating :

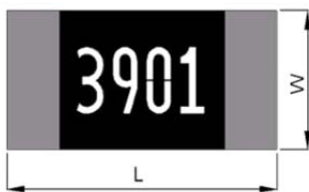
Rated Voltage: The resistor shall have a DC continuous working voltage or a rms. AC continuous working voltage at commercial-line frequency and wave form corresponding to the power rating, as determined from the following

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

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

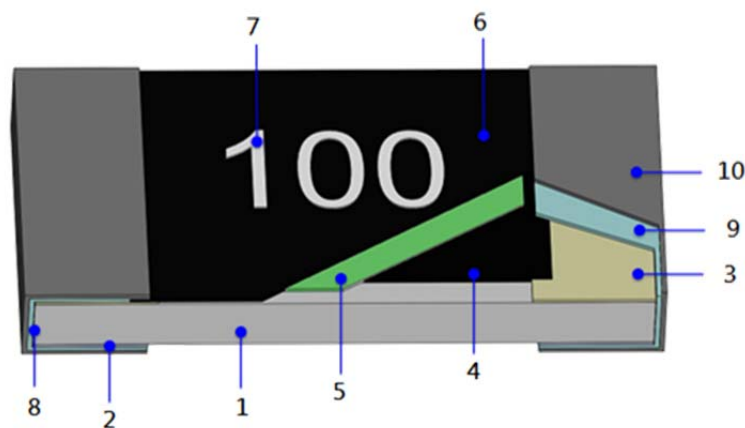
4 Dimensions:

Unit:mm



Dimension		L	W	H	L1	L2
FTT01	0201	0.60±0.03	0.30±0.03	0.23±0.03	0.10±0.05	0.15±0.05
FTT02	0402	1.00±0.10	0.50±0.05	0.30±0.05	0.20±0.10	0.25±0.10
FTT03	0603	1.60±0.10	0.80±0.10	0.45±0.10	0.30±0.15	0.30±0.15
FTT05	0805	2.00±0.10	1.25±0.10	0.50±0.10	0.35±0.20	0.35±0.15
FTT06	1206	3.05±0.10	1.55±0.10	0.50±0.10	0.45±0.20	0.35±0.15
FTT12	1210	3.05±0.10	2.55±0.10	0.55±0.10	0.50±0.20	0.50±0.20
FTT20	2010	5.00±0.20	2.50±0.20	0.55±0.10	0.60±0.20	0.60±0.20
FTT25	2512	6.30±0.20	3.20±0.20	0.55±0.10	0.60±0.20	0.60±0.20

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

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6 Reliability Test :

6.1 Electrical Performance Test

Item	Conditions	Specifications																																					
		Resistors	Jumper																																				
Temperature Coefficient of Resistance	$TCR \text{ (ppm / } ^\circ\text{C)} = \frac{(R2 - R1)}{R1 (T2 - T1)} \times 10^6$ R1: Resistance at room temperature R2: Resistance at -55°C or +125°C T1: Room temperature T2: Temperature -55°C or +125°C Refer to JIS-C5201-1 4.8	Refer to item 3. general specifications	NA																																				
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	0.1%、0.5%、1%:ΔR%=±1.0% 5%:ΔR%=±2.0%	Refer to item 3. general specifications																																				
Dielectric Withstand Voltage	Put the resistor in the fixture, add VAC (see SPEC below) in +,- terminal for. FTT01、02、03 apply 300 VAC 1 minute. FTT05、06、12、20、25 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°C 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. Jumper : Applied Maximum overload current	ΔR%=±5.0%	Refer to item 3. general specifications																																				
<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Type</th> <th>FTT01 (0201)</th> <th>FTT02 (0402)</th> <th>FTT03 (0603)</th> <th>FTT05 (0805)</th> <th>FTT06 (1206)</th> <th>FTT12 (1210)</th> <th>FTT20 (2010)</th> <th>FTT25 (2512)</th> </tr> </thead> <tbody> <tr> <td>Jumper</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>±5%</td> <td>1.25A</td> <td>2.5A</td> <td>2.5A</td> <td>5A</td> <td>5A</td> <td>5A</td> <td>5A</td> <td>5A</td> </tr> <tr> <td>±1%</td> <td>1.25A</td> <td>3.75A</td> <td>5A</td> <td>6.25A</td> <td>8.75A</td> <td>10A</td> <td>12.5A</td> <td>17.5A</td> </tr> </tbody> </table>				Type	FTT01 (0201)	FTT02 (0402)	FTT03 (0603)	FTT05 (0805)	FTT06 (1206)	FTT12 (1210)	FTT20 (2010)	FTT25 (2512)	Jumper									±5%	1.25A	2.5A	2.5A	5A	5A	5A	5A	5A	±1%	1.25A	3.75A	5A	6.25A	8.75A	10A	12.5A	17.5A
Type	FTT01 (0201)	FTT02 (0402)	FTT03 (0603)	FTT05 (0805)	FTT06 (1206)	FTT12 (1210)	FTT20 (2010)	FTT25 (2512)																															
Jumper																																							
±5%	1.25A	2.5A	2.5A	5A	5A	5A	5A	5A																															
±1%	1.25A	3.75A	5A	6.25A	8.75A	10A	12.5A	17.5A																															
Refer to JIS-C5201-1 4.13																																							

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6.2 Mechanical Performance Test

Item	Conditions	Specifications	
		Resistors	Jumper
Solderability	<p>Preconditioning Put the tested resistor in the apparatus of PCT, at a temperature of 105°C, humidity of 100% RH, and pressure of 1.22×10⁵ 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°C for 2 sec, then the resistor is left as placed under microscope to observed its solder area.</p> <p>Refer to JIS-C5201-1 4.17</p>	Solder coverage over 95%	
Resistance to Soldering Heat	<p>◎Test method 1 (Solder pot test): The tested resistor be immersed into molten solder of 260+5/-0°C for 10 seconds. Then the resistor is left in the room for 1 hour.</p> <p>◎Test method 2 (Solder pot test): The tested resistor be immersed into molten solder of 260+5/-0°C for 30 seconds. Then the resistor is left as placed under microscope to observe its solder area.</p> <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> <p>Refer to JIS-C5201-1 4.18</p>	<p>Test item 1: (1).Variance rate on resistance: ΔR%=±1.0%</p> <p>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.</p> <p>Test item 3: (1).Variance rate on resistance: ΔR%=±1.0%</p>	Refer to item 3. general specifications
Joint Strength of Solder	<p>◎Bending Strength: Solder tested resistor on to PC board add force in the middle down, and under load measured its resistance variance rate. D:FTT02、03、05=5mm FTT01、06、12=3mm FTT20、25=2mm</p> <div style="text-align: center;"> </div> <p>Refer to JIS-C5201-1 4.33</p>	ΔR%=±1.0%	Refer to item 3. general specifications

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6.3 Environmental Test

Item	Conditions	Specifications									
		Resistors	Jumper								
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.(FTT01、FTT03 for 125±3°C) Refer to JIS-C5201-1 4.25	0.1%、0.5%、1%:ΔR%=±1.0% 5%:ΔR%=±2.0%	Refer to item 3. general specifications								
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: 10px auto; border-collapse: collapse; text-align: center;"> <thead> <tr> <th colspan="2">Testing Condition</th> </tr> </thead> <tbody> <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> </tbody> </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	0.1%、0.5%、1%:ΔR%=±0.5% 5%:ΔR%=±1.0%	Refer to item 3. general specifications
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	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Type</th> <th>ΔR%</th> </tr> </thead> <tbody> <tr> <td>FTT01</td> <td>0.1%、0.5%、1%: ΔR%=±1.5% 5%: ΔR%=±3.0%</td> </tr> <tr> <td>Other</td> <td>0.5%、1%: ΔR%=±1.5% 5%: ΔR%=±3.0%</td> </tr> </tbody> </table>	Type	ΔR%	FTT01	0.1%、0.5%、1%: ΔR%=±1.5% 5%: ΔR%=±3.0%	Other	0.5%、1%: ΔR%=±1.5% 5%: ΔR%=±3.0%	Refer to item 3. general specifications		
Type	ΔR%										
FTT01	0.1%、0.5%、1%: ΔR%=±1.5% 5%: ΔR%=±3.0%										
Other	0.5%、1%: ΔR%=±1.5% 5%: ΔR%=±3.0%										
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	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Type</th> <th>ΔR%</th> </tr> </thead> <tbody> <tr> <td>FTT01</td> <td>0.1%、0.5%、1%: ΔR%=±1.5% 5%: ΔR%=±3.0%</td> </tr> <tr> <td>Other</td> <td>0.1%、0.5%、1%: ΔR%=±1.5% 5%: ΔR%=±3.0%</td> </tr> </tbody> </table>	Type	ΔR%	FTT01	0.1%、0.5%、1%: ΔR%=±1.5% 5%: ΔR%=±3.0%	Other	0.1%、0.5%、1%: ΔR%=±1.5% 5%: ΔR%=±3.0%	Refer to item 3. general specifications		
Type	ΔR%										
FTT01	0.1%、0.5%、1%: ΔR%=±1.5% 5%: ΔR%=±3.0%										
Other	0.1%、0.5%、1%: ΔR%=±1.5% 5%: ΔR%=±3.0%										

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7 Measurement Point:

Bottom electrode	Unit : mm		
<p style="text-align: center;"> ● Current Terminal ⊖ Voltage Terminal </p>	DIM	A	B
	TYPE		
	FTT01	0.44±0.05	0.22±0.05
	FTT02	0.80±0.05	0.24±0.05
	FTT03	1.35±0.05	0.35±0.05
	FTT05	1.80±0.05	0.35±0.05
	FTT06	2.90±0.05	0.35±0.05
	FTT12	2.90±0.05	0.35±0.05
	FTT20	4.50±0.05	1.15±0.05
	FTT25	5.90±0.05	1.60±0.05

8 Plating Thickness:

8.1 Ni: $\geq 2 \mu m$

8.2 Sn(Tin): $\geq 3 \mu m$

8.3 Sn(Tin): Matte Sn

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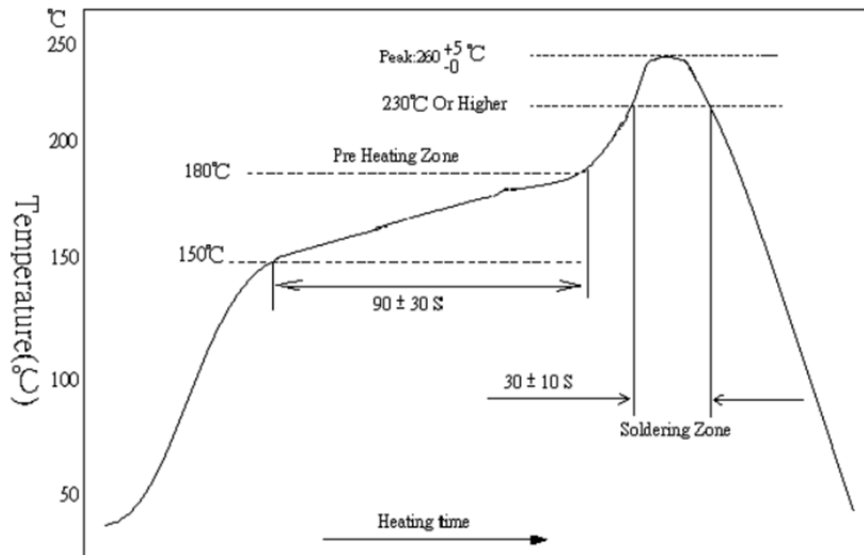
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9 Technical application notes: (This is for recommendation, please customer perform adjustment according to actual application)

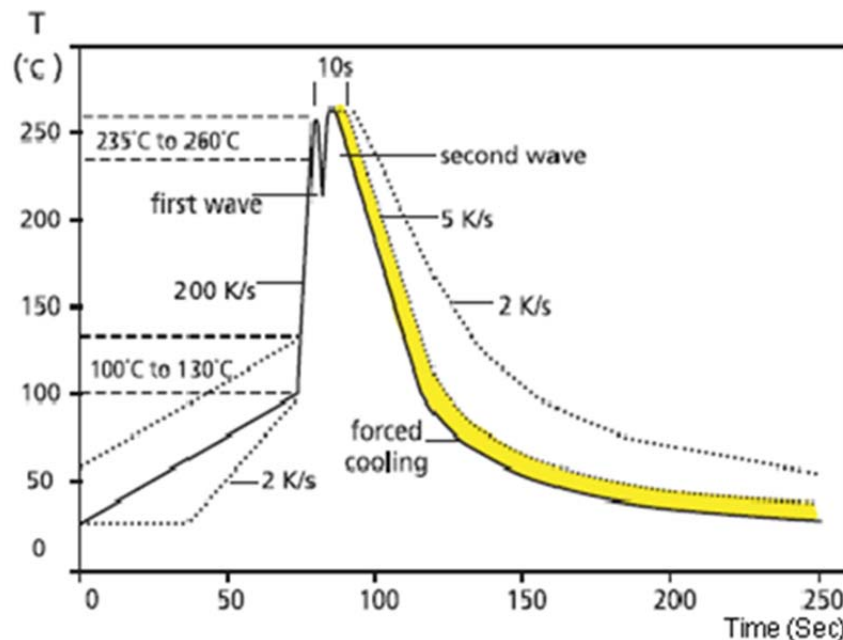
9.1 Recommend Soldering Method:

9.1.1 Lead Free IR Reflow Soldering Profile



Remark: The peak temperature of soldering heat is 260 +5/-0 °C 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°C ± 10°C, dwell time shall be less than 3 sec.

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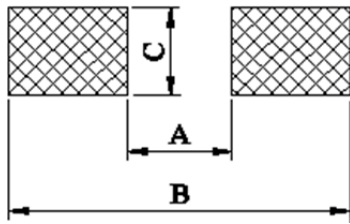
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9.2 Recommend Land Pattern Design (For Reflow Soldering)

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
FTT01	0.3	1.0	0.4
FTT02	0.5	1.5	0.6
FTT03	0.8	2.1	0.9
FTT05	1.2	3.0	1.3
FTT06	2.2	4.2	1.6
FTT12	2.2	4.2	2.8
FTT20	3.5	6.1	2.8
FTT25	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.

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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 resistor will be overloaded. There might be machinery damage due to the climbing temperature.
- (d) If the resistor 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 as $25\pm 5^{\circ}\text{C}$, the R.H. must be controlled as $60\pm 15\%$. The stock can maintain quality level within 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 Cl_2 、 H_2S 、 NH_3 、 SO_2 and NO_2 .
- 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

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FTT Series Thick Film Resistors Specifications

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