



**LEAD FREE TRIMMABLE
CHIP RESISTOR SPECIFICATION**

Reference No. : SYS-ENG-211

Revision No. : E

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1.0 SCOPE

This specification specifies fixed thick film chip resistor (referred to as resistor hereinafter) for use in electronic equipment. In case there are discrepancies in specifications between this specification and the Customer's specifications, the latter shall precede.

2.0 PART NUMBERING SYSTEM

Part Numbering is made in accordance with the following system:

<u>TR</u> <u>XX</u>	-	<u>XXXX</u>	-	<u>X</u>	-	<u>X</u>
Resistance		Resistance Value		Tolerance		Packaging
TR10 - 0402				N - 0 ~ -30%		L - 5K reel
TR16 - 0603				M - 0 ~ -15%		K - 10K reel
TR21 - 0805				K - ± 10%		E - 4K reel
TR32 - 1206				L - ± 15%		
TR40 - 1210						
TR50 - 2010						
TR63 - 2512						

3.0 RATING

3.1 Rated Power

3.1.1 Resistor Rated Power

	Rated Power	Maximum Working Voltage	Maximum Overload Voltage	Maximum Intermittent Overload Voltage	Dielectric Withstanding Voltage
TR10	1/16W	50V	100V	100V	300V
TR16	1/10W	50V	100V	100V	300V
TR21	1/8W	150V	300V	300V	500V
TR32	1/4W	200V	400V	400V	500V
TR40	1/3W	200V	400V	400V	500V
TR50	3/4W	200V	400V	400V	500V
TR63	1W	200V	400V	400V	500V

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3.2 Power Derating Characteristics

Rated Power shall be the load power corresponding to nominal wattage suitable for continuous use at 70°C ambient temperature. In case the ambient temperature exceeds 70°C, reduce the load power in accordance with Derating curve in Fig. 1.

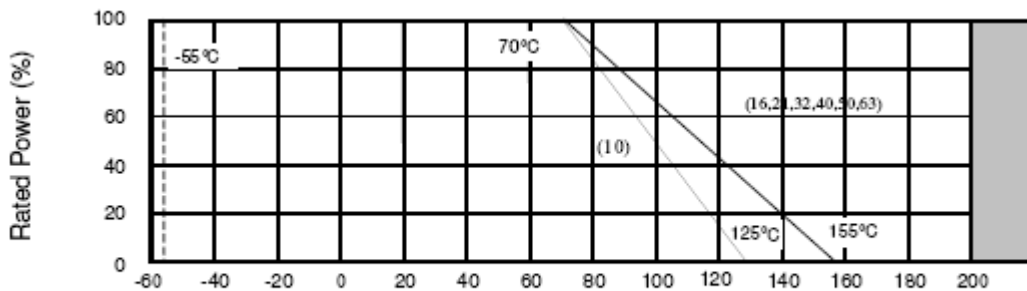


Fig.1 Power Derating Characteristics

3.3 Standard Atmospheric Condition

Unless otherwise specified, the standard range of atmospheric conditions for making measurements and tests is as follows :

Ambient Temperature = +5°C to +35°C
 Relative Humidity = < 85% RH
 Air Pressure = 86 to 106kPa

If there may be any doubt about the results, measurement shall be made within the following limits :

Ambient Temperature = 20± 2°C
 Relative Humidity = 60 to 70% RH
 Air Pressure = 86 to 106kPa

3.4 Operating Temperature Range -55°C to +155°C

3.5 Storage Temperature Range -5°C to +40°C

3.6 Flammability Rating Tested in accordance to UL-94, V-0

3.7 Moisture Sensitivity Level Rating : Level 1

3.8 Product Assurance

ASJ resistor shall warranty 12 months from the date of shipment.

3.9 ASJ resistors are RoHS compliance in accordance to RoHS Directive 2002/95/EC.

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3.10 Rated Voltage

The rated voltage is calculated from the rated power and nominal resistance by the following formula:

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

Where E : Rated Voltage (V)

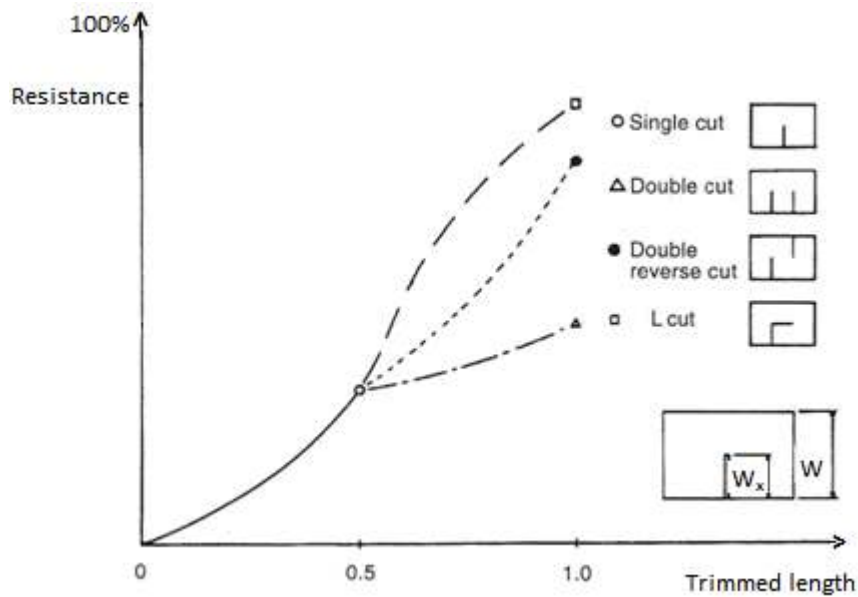
P : Rated Power (W)

R : Nominal Resistance (Ω)

In case the value calculated by the formula exceeds the maximum working voltage given in Section 3.1.2, the maximum working voltage in Section 3.1.2 shall be regarded as the rated voltage.

3.11 Resistance increase Vs Trimming Diagram

Resistance increase Vs Trimming

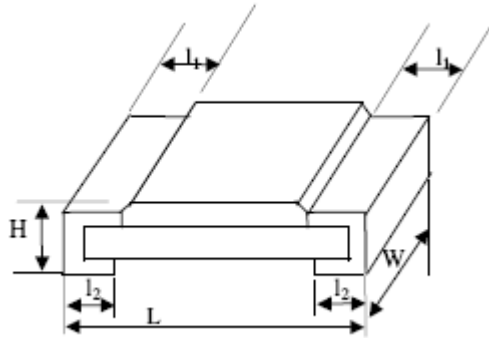


$$W_x / W = \text{Total trimmed length}$$

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4.0 DIMENSIONS, CONSTRUCTIONS AND MATERIALS

4.1 Dimensions

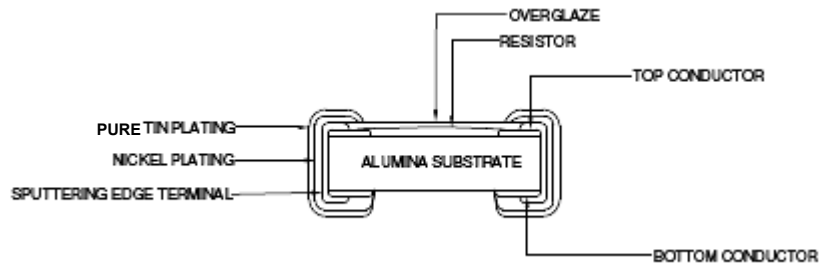


Unit : Inches (Millimeters)

CODE	L	W	H	l ₁	l ₂
TR10 (0402)	0.040±0.004 (1.00±0.10)	0.020±0.002 (0.50±0.05)	0.013±0.002 (0.20±0.05)	0.008±0.004 (0.20±0.10)	0.010±0.004 (0.25±0.10)
TR16 (0603)	0.063±0.004 (1.60±0.10)	0.031±0.004 (0.80±0.10)	0.018±0.004 (0.45±0.10)	0.012±0.008 (0.30±0.20)	0.012±0.008 (0.30±0.20)
TR21 (0805)	0.079±0.006 (2.00±0.15)	0.049±0.004 (1.25±0.10)	0.022±0.002 (0.55±0.10)	0.016±0.008 (0.40±0.20)	0.016±0.008 (0.40±0.20)
TR32 (1206)	0.122±0.004 (3.10±0.10)	0.063±0.006 (1.60±0.15)	0.022±0.002 (0.55±0.10)	0.020±0.010 (0.50±0.25)	0.020±0.010 (0.50±0.25)
TR40 (1210)	0.122±0.004 (3.10±0.10)	0.098±0.006 (2.50±0.15)	0.022±0.002 (0.55±0.10)	0.020±0.010 (0.50±0.25)	0.016±0.008 (0.40±0.20)
TR50 (2010)	0.200±0.006 (5.00±0.15)	0.098±0.006 (2.50±0.15)	0.022±0.002 (0.55±0.10)	0.024±0.010 (0.60±0.25)	0.016±0.008 (0.40±0.20)
TR63 (2512)	0.250±0.006 (6.30±0.15)	0.126±0.006 (3.20±0.15)	0.022±0.002 (0.55±0.10)	0.024±0.010 (0.60±0.25)	0.016±0.008 (0.40±0.20)


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4.2 Resistor Construction

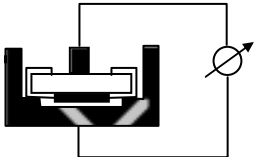


4.3 Materials

<i>Construction</i>		<i>Material Used</i>	<i>Thickness</i>
Substrate	Ceramic Substrate	Alumina substrate, 96% purity	-
Resistive body	Resistor	Ruthenium oxide	-
Protective Film	Overglaze	Borosilicate-glass	-
Internal Electrode	Top/ Bottom Conductor	Silver palladium	30± 2µm (Wet)
Secondary Electrode	Nickel Plating	Nickel	2.5 ~ 12 µm
Tertiary Electrode	Pure Tin Plating	Pure Tin	3.0 ~ 15 µm
Edge Terminal	Sputtering 0402,0603, 0805,1206,1210,2010, 2512	Nickel Chromium	0.08 ~ 0.2 µm

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5.0 ELECTRICAL CHARACTERISTICS AND TEST CONDITIONS

CHARACTERISTICS		SPECIFICATIONS & TESTING CONDITIONS															
		Resistance															
1	Resistance Value	Resistance accuracy being fully relies with respect to tolerance of resistor.	<p>JIS C 5202 5.1 Application time to be within 5 secs .</p> <p>Applied Voltage for resistance measurement :</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;"><10Ω</td> <td style="padding: 2px;">0.1V</td> </tr> <tr> <td style="padding: 2px;">10~99Ω</td> <td style="padding: 2px;">0.3V</td> </tr> <tr> <td style="padding: 2px;">100~999</td> <td style="padding: 2px;">1.0V</td> </tr> <tr> <td style="padding: 2px;">1K~ 9.9K</td> <td style="padding: 2px;">3.0 V</td> </tr> <tr> <td style="padding: 2px;">10K~ 99.9K</td> <td style="padding: 2px;">10.0 V</td> </tr> <tr> <td style="padding: 2px;">100K~999K</td> <td style="padding: 2px;">30.0 V</td> </tr> <tr> <td style="padding: 2px;">1M & Over</td> <td style="padding: 2px;">50.0 V</td> </tr> </table>	<10Ω	0.1V	10~99Ω	0.3V	100~999	1.0V	1K~ 9.9K	3.0 V	10K~ 99.9K	10.0 V	100K~999K	30.0 V	1M & Over	50.0 V
<10Ω	0.1V																
10~99Ω	0.3V																
100~999	1.0V																
1K~ 9.9K	3.0 V																
10K~ 99.9K	10.0 V																
100K~999K	30.0 V																
1M & Over	50.0 V																
2	Voltage Coefficient (Applicable for >1KΩ only)	Voltage coefficient ≤ 100ppm/V	<p>JIS C 5202 5.3 Method II Apply DC Voltage, E₂=1/10 rated voltage and E₁=100% rated voltage to Rx. Measure voltage V₁ & V₂ across Rs. Voltage applied shall be 3secs or less during 5secs of E₁ and not more than 10secs during E₂</p> <p>Calculation :</p> $V_c(\%/V) = \frac{(V_2 * 10) - V_1}{V_1} * \frac{1}{E_1 - E_2} * 100$														
3	Short Time Overload	±0.5% for 1% tolerance resistor ±1.0% for 5% tolerance resistor	<p>JIS C 5202 5.5 Apply at 2.5 times rated voltage for 5 seconds. Applied voltage shall not exceed maximum overload voltage or current.</p>														
4	Insulation Resistance	> 10G Ω	<p>JIS C 5202 5.6 Apply 500V ± 15VDC for 1 minute for chip ≥ 0805. Apply 300V ± 15VDC for 1 minute for chip 0402 & 0603</p> <div style="text-align: center;">  </div>														

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5	Dielectric Withstanding Voltage	No failure of resistor such as short-circuit, burning, breakdown.		JIS C 5202 5.7 Apply 500VAC for 1 minute ± 10secs. for chip ≥ 0805. Apply 300VAC for 1 minute ± 10secs. for chip 0402 & 0603 The variation in relation to the initial resistance shall be within ± 1%.
		±(1%+0.05Ω) for 1% & 5% tolerance resistor		
6	Intermittent Overload	±(5%+0.1Ω) for 1% & 5% tolerance resistor		JIS C 5202 5.8 Apply 4 times rated voltage for 1 secs ON and 25 secs OFF. Total 10 000 ⁺⁴⁰⁰ ₋₀ cycles Applied voltage/current shall not exceed maximum intermittent overload voltage/ current.
7	Noise	1~9 10~99 100~999 1K~9.9K 10K~99.9K 100K~999.9K >1M	-10dB(0.32μv/v) - 5 dB(0.52μv/v) 0 dB(1.0μv/v) 10 dB(3.2μv/v) 18 dB(5.6μv/v) 20 dB(10μv/v) 30 dB(32μv/v)	JIS C 5202 5.9 $V_n(\text{dB}) = T - f(T-S) - D$
8	Terminal Strength	Tolerance resistor. With no evidence of mechanical damage after releasing the pressure. ±(0.5%+0.05Ω) for 1% & 5%		JIS C 5202 6.1 JIS C 5202 6.1.4(1) Method 2 Bend Test : Apply force till 3mm bend and hold for 5±1 secs. Measure resistance while applying pressure. Pull Test : Apply 0.5kgF for 30±5 secs
	A) Bend Test (Applicable for chip size smaller than CR40)	±(1.0%+0.05Ω) for 1% & 5%		
	B) Pull Test (Applicable for chip size bigger than CR21)	±(1.0%+0.05Ω) for 1% & 5%		
	C) Push Test	±(1.0%+0.05Ω) for 1% & 5%		JIS C 5202 6.1.4(3) Method B Push Test : Apply 1.2kgF for 60±5secs

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	D) Robushness test	After reading/initial reading >50-%	Component mounted on board precondition using steam aging for 4 hour. Initial reading = Force required to break away components mounted on board. After Reading = Force required to break away components mounted on board after preconditioned.
9	Resistance to soldering heat	$\pm(0.5\%+0.05\Omega)$ for 1% & 5% tolerance resistor	JIS C 5202 6.10 A) Solder bath method Resistor dipped entirely in solder bath of $260\pm 5^{\circ}\text{C}$ for 10^{+1}_0 sec. B) Flow soldering Preheat : 100°C to 105°C for 30 ± 5 sec. Resistor dipped entirely in solder bath of $265\pm 3^{\circ}\text{C}$ for 5^{+1}_0 C) Reflow soldering method Peak : $250^{+5}_0^{\circ}\text{C}$ $230\pm 5^{\circ}\text{C}$ for 30 - 40secs. D) Soldering Iron method Bit temp.: $350\pm 10^{\circ}\text{C}$ Application time of soldering iron is 3^{+1}_0 sec. After which the sample shall be left at ambient temperature for 1~2 hrs before measurement.
10	Solderability	$\geq 95\%$ Coverage	Precondition by baking 4 hours at 155°C . IEC 60068-2-58 Solder bath method : Solder : H60 Flux: 25% Colophony, 75% 2-Propanol by weight. $215\pm 3^{\circ}\text{C}$ for 2^{+1}_0 sec
11	Low Temperature	$\pm(0.5\%+0.05\Omega)$ for 1% tolerance resistor $\pm(1\%+0.05\Omega)$ for 5% tolerance resistor	JIS C 5202 7.1 $-55\pm 3^{\circ}\text{C}$ for $1000 \pm^{48}_0$ hours Sample shall be left at ambient temperature for 1~2 hrs after test before measuring final resistance.

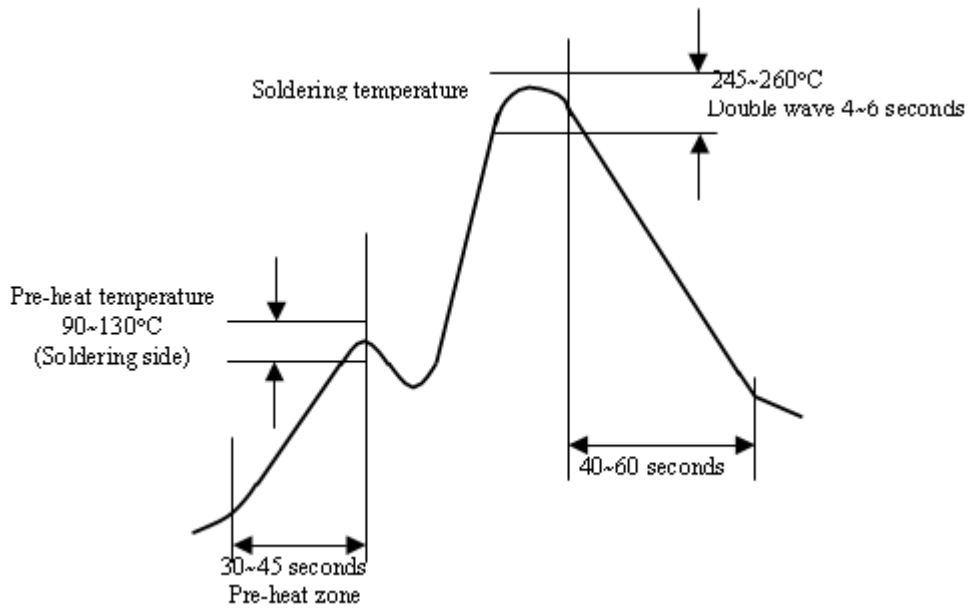
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12	Low Temperature with Load	$\pm(0.5\%+0.05\Omega)$ for 1% tolerance resistor $\pm(1\%+0.05\Omega)$ for 5% tolerance resistor	JIS C 5202 7.1 -55 \pm 3°C for 90 minutes, 0.1 rated continuous working voltage as per 3.5 shall be applied for 45 \pm $\frac{5}{0}$ minutes. Voltage Sample shall be left at ambient temperature for ~ 8 hrs after the removal of the voltage for 15 \pm $\frac{5}{0}$ before measuring final resistance.
13	High Temperature	$\pm(1\%+0.05\Omega)$ for 1% tolerance resistor $\pm(2\%+0.10\Omega)$ for 5% tolerance resistor	JIS C 5202 7.2 155 \pm 5°C for 1000 \pm $\frac{48}{0}$ hours Sample shall be left at ambient temperature for 1~ 2 hrs after test before measuring final resistance.
14	Temperature Cycling	$\pm(0.5\%+0.05\Omega)$ for 1% tolerance resistor $\pm(1\%+0.05\Omega)$ for 5% tolerance resistor	JIS C5202 7.4
			Step Temp. (°C) Time (minute)
			1 -55 \pm 5 30 mins
			2 25 \pm 5 5 mins max
			3 155 \pm 5 30 mins
			4 25 \pm 5 5 mins max
			Repeat step 1 to 4 for 5 cycles
15	Resistance to damp Heat (Humidity)	$\pm(1\%+0.1\Omega)$ for 1% & 5% tolerance resistor	JIS C 5202 7.5 40 \pm 2°C and 90~95%RH for 1000 \pm $\frac{48}{0}$ hours Sample shall be left at ambient temperature for 1~ 2 hrs after test before measuring final resistance.
16	Loadlife	$\pm(1.0\%+0.05\Omega)$ for 1% tolerance resistor $\pm(2.0\%+0.1\Omega)$ for 5% tolerance resistor	JIS C5202 7.10 At 70 \pm 3°C Apply DC rated voltage at 90minutes On, 30minutes Off for 1000 \pm $\frac{48}{0}$ hours Sample shall be left at ambient temperature for 1~ 2 hrs after test before measuring final resistance.
17	Salt Spray	$\pm(3\%+0.1\Omega)$ for 1% & 5% tolerance resistor	JIS C5202 7.7 Spray 5 \pm 1 Wt% salt water for 96 \pm 4 hours at 35 \pm 2°C
18	Mounting Quality Test	Visual check for solder joint wetting condition, resistor body damages	Solder Paste : Sn-3Ag-0.5Cu Reflow soldering method Peak : 250 \pm $\frac{45}{0}$ °C 230 \pm 5°C for 60sec

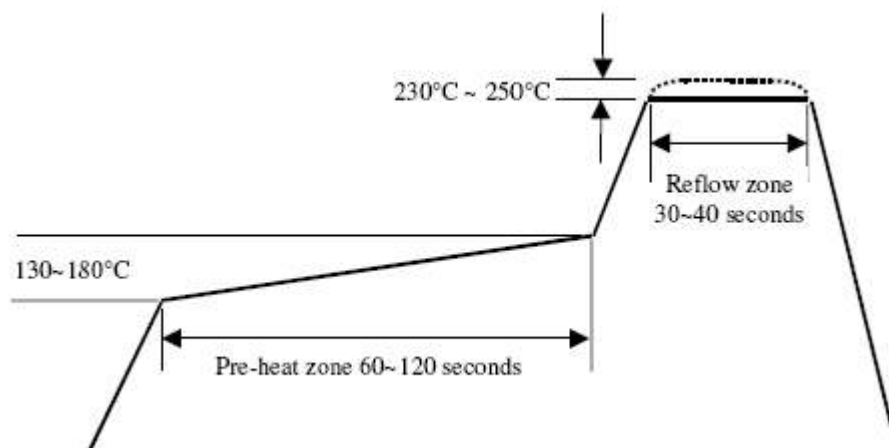
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5.1 Soldering Profile

5.1.1 Flow Soldering



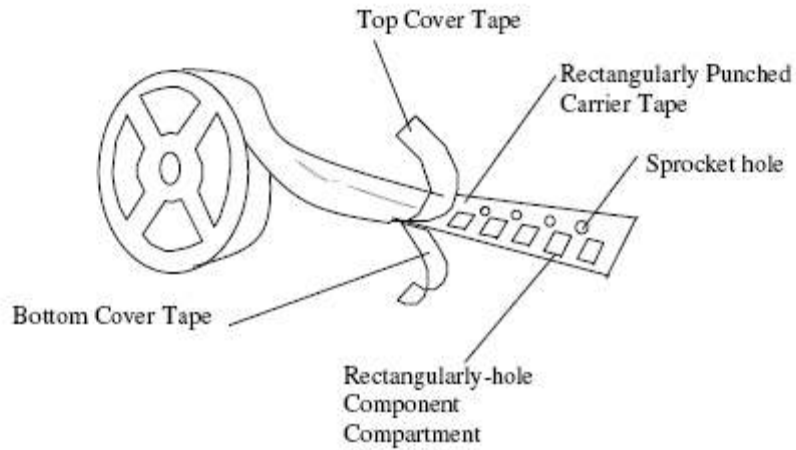
5.1.2 Reflow Soldering



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6.0 TAPING

6.1 Structure of Taping



6.2 Materials

- (1) Every taping shall consist of materials as shown in Table - 4
- (2) Every taping shall not adversely affect the mechanical, electrical and solderability performances.
- (3) Materials of taping shall generate no statics.
- (4) The taped products are stored at a temperature -5 to +40°C and a relative humidity 40 to 50% without exposing to direct sunlight and, after such conditioning, the tape shall show no deterioration in performances such as change in adhesion force or peel forces.

Table 4 Materials of Taping

	Carrier Tape	Top Cover Tape	Bottom Cover Tape
Taping of Rectangularly Punched Carried System	Paper	thermal adhesion polyester	thermal adhesion paper

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6.3 Leader and Trailer Tape

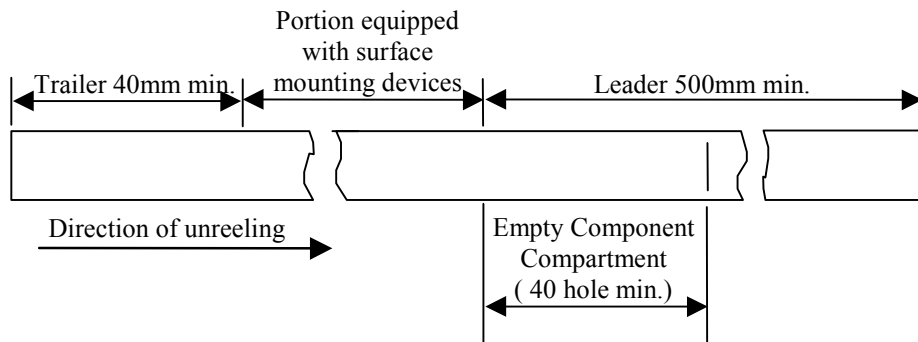
- 1) Leader Tape. The length of leader tape shall be at least 500 mm including 40 or more or rectangular holes (component compartments) in which no component is placed.

The said 40 or more empty component compartments shall be sealed with the top cover tape (see Fig. 2).

- 2) Trailer Tape. The trailer tape at the hub of reel shall be least 40 mm in length including carrier tape with empty component compartments. The empty component compartments shall be sealed with the top cover tape.

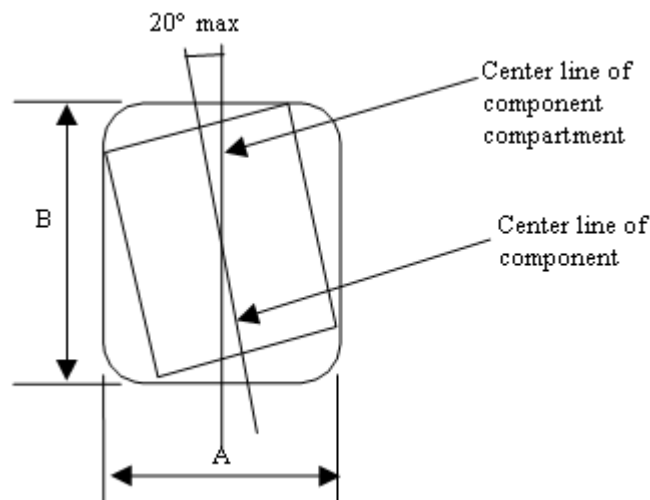
The last portion of the carrier tape shall release from the reel hub.

Fig. 2 Explanation of Leader and Trailer Tape



- 6.4 Position of Taped component. The angle made by the center line of taped component and the center line of component compartment shall not exceed 20 degrees (see Fig. 3).

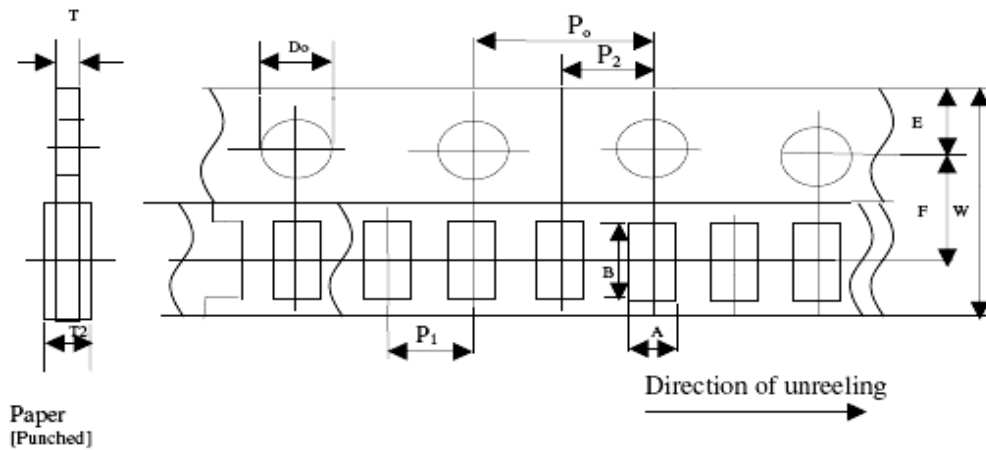
Fig. 3 Angle between Center Line of Component and Center Line of Component compartment



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6.5 Dimension

6.5.1 Dimension of Punched Paper Tape Carrier System (TR10)



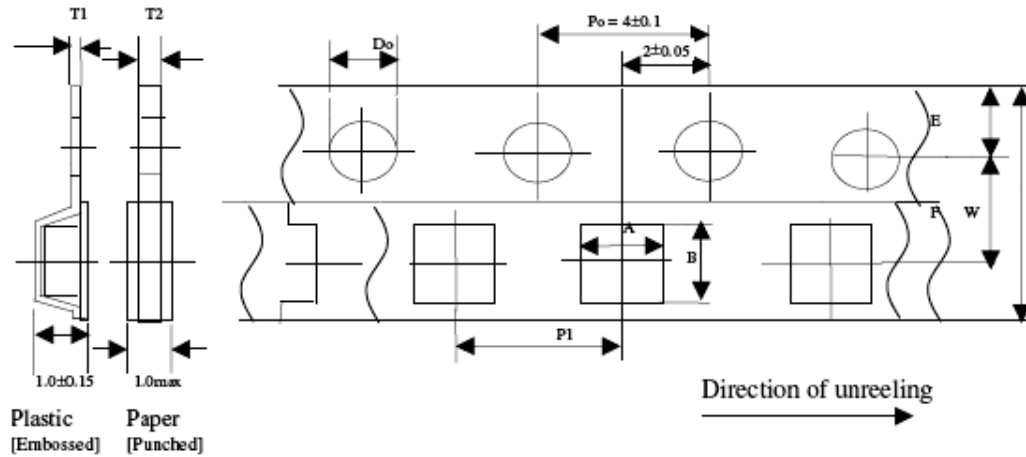
Remark : Pitch tolerance over any 10 pitches of P_0 is ± 0.2 mm

(unit : mm)

Code	A	B	W	E	F	P_1
TR10	0.65 ± 0.1	1.15 ± 0.1	8.0 ± 0.2	1.75 ± 0.1	3.5 ± 0.05	2.0 ± 0.5
Code	P_2	P_0	D_0	T_2	T	
TR10	2.0 ± 0.05	4.0 ± 0.1	1.5	0.35 ± 0.1	--	

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6.5.2 Dimension of Punched Paper Tape Carrier System (TR 16, 21, 32, 40, 50, 63)



Remark : Pitch tolerance over any 10 pitches of P_o is ± 0.2 mm

Dimension of Punched Paper Tape Carrier System (TR – 16, 21, 32, 40)

Code	A	B	W	E	F	P1	D_0	T2
TR16	1.1 ± 0.1	1.9 ± 0.1	8.0 ± 0.2	1.75 ± 0.1	3.5 ± 0.05	4.0 ± 0.1	$1.5 \pm 0^{0.1}$	0.60 ± 0.1
TR21	1.65 ± 0.1	2.4 ± 0.1						0.75 ± 0.1
TR32	1.9 ± 0.1	3.5 ± 0.1						0.75 ± 0.1
TR40	2.8 ± 0.1	3.5 ± 0.1						0.75 ± 0.1

Dimension of Plastic Embossed Carrier System (TR – 50, 63)

Code	A	B	W	E	F	P1	D_0	T1
TR50	2.9 ± 0.2	5.4 ± 0.2	12 ± 0.2	1.75 ± 0.1	5.5 ± 0.05	4.0 ± 0.1	$1.5 \pm 0^{0.1}$	0.2 ± 0.10
TR63	3.6 ± 0.2	6.6 ± 0.1						

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6.6 Performance of Taping

6.6.1 Strength of carrier tape and top cover tape

When a tensile force of 10N (1.02 kgf) is applied in the direction of unreeling the tape, the carrier tape and top cover tape shall withstand this force.

6.6.2 Peel force of top cover tape

- a) Ensure that the peel force meter is reset to ϕ initially.
- b) A minimum of 4 holes is required when the top cover tape is pulled.
- c) Do not reset the peel force meter.
- d) The peel force of top cover tape shall be 0.1N to 0.7N (10 to 70 gf) when the top cover tape is pulled at a speed of 300 mm/min with the angle between the tape during peel and the direction of unreeling maintained at 165 to 180 degree as illustrated in Fig 4.

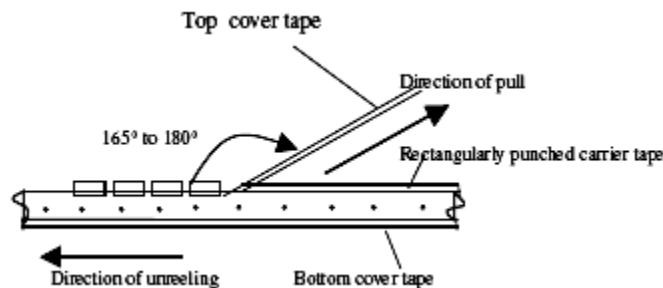


Fig. 4 Peeling Test

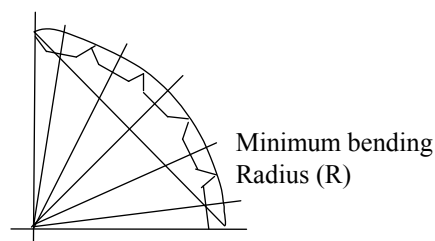
6.6.3 Minimum Bending Radius

When the tape is bent with the minimum bending radius specified in Fig 5 and Table 5, components shall maintain their position and shall be free from abnormalities such as damage.

Table 5

Width of Tape	Minimum Bending Radius
8 mm	30 mm
12 mm	30 mm

Fig. 5 Explanation of Minimum Bending Radius



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6.6.4 Numbering of missing components and mistake in taping

- a) The number of missing components shall not exceed 0.1% of the total number of components (marked number) or one whichever is the larger, and no consecutive missing chip exceeding two is allowed.
- b) No mistake is allowed on the position of polarity or termination or front and rear of component at the time of taping.

6.7 Packaging

6.7.1 Taping

6.7.1.1 Quantity – Tape and Reels

Code	Quantity	Remarks
TR10	10000 pcs	
TR16	5000 pcs	10 000 or 20 000 pcs on request
TR21		
TR32		
TR40	5000 pcs	-
TR50	4000 pcs	-
TR63	4000 pcs	-

6.7.2 Identification

Production label that indicates the 12 digits lot number, product type, resistance value and tolerance shall be pasted on the surface of each reel.



Lot Number: 8 digits running numbers

Date Code: YYYYMMDD

YYYY - Year

MM - Month

DD - Date

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Lot Number: 8 digits running numbers

Date Code: YYYYMMDD

YYYY - Year
MM - Month
DD - Date

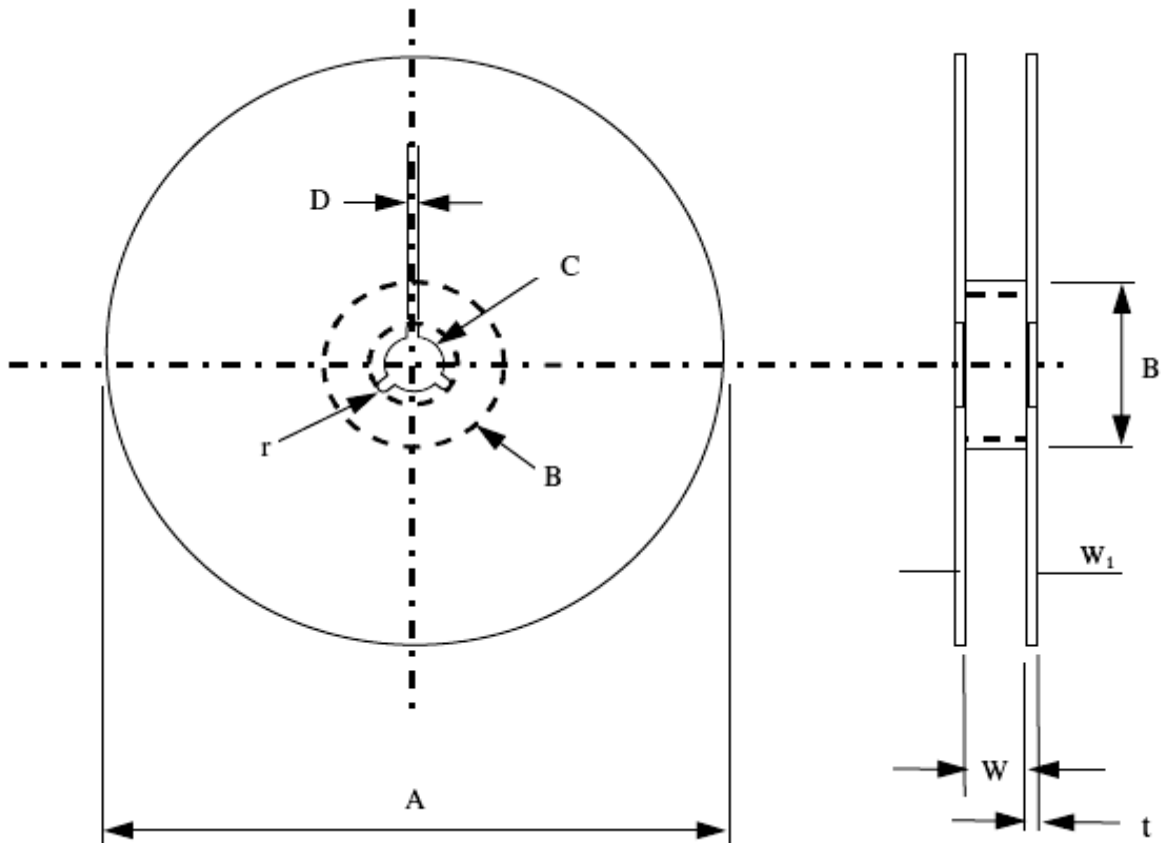
Manufacturing Part number
Part Description.

6.7.3 Packaging Reel Box

Dimension	Reel Box	Number of Reels
185 × 60 × 186 mm	25K Box	5
185 × 120 × 186 mm	50K Box	10

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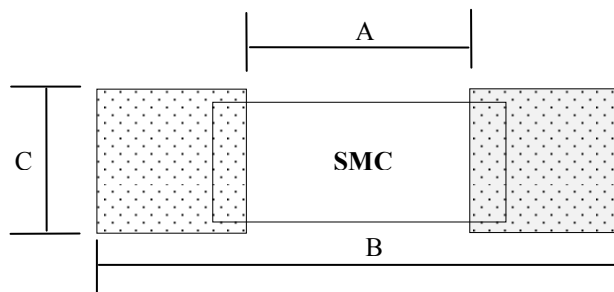
6.7.4 Reel Dimensions



Model	A	B	C	D	W	W ₁	t	r
7"Reel (5K)	$\phi 178 \pm 2.0$	$\phi 80 \text{min}$	13 ± 0.2	$\phi 2.0 \pm 0.5$	11 ± 0.1	14.4 max	1.0 ± 0.1	1.0
7"Reel (4K)	$\phi 178 \pm 2.0$	$\phi 60 \text{min}$	13 ± 0.2	$\phi 2.0 \pm 0.5$	13 ± 1.0	14.4 max	1.2 ± 0.1	1.0
10"Reel (10K)	$\phi 254 \pm 2.0$	$\phi 60 \text{min}$	13 ± 0.2	$\phi 2.0 \pm 0.5$	11 ± 1.0	14.4 max	1.5 ± 0.1	1.0
13"Reel (20K)	$\phi 330 \pm 2.0$	$\phi 60 \text{min}$	13 ± 0.2	$\phi 2.0 \pm 0.5$	11 ± 1.0	14.4 max	2.1 ± 0.1	-

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7.0 Surface Mount Land Patterns



Product Type	Land Dimension		
	A	B	C
TR10 (0402)	0.020 [0.5]	0.059 [1.5]	0.020 ~ 0.024 [0.5 ~ 0.6]
TR16 (0603)	0.039 [1.0]	0.106 [2.7]	0.020 ~ 0.035 [0.5 ~ 0.9]
TR21 (0805)	0.047 [1.2]	0.138 [3.5]	0.043 ~ 0.051 [1.1 ~ 1.3]
TR32 (1206)	0.087 [2.2]	0.197 [5.0]	0.055 ~ 0.071 [1.4 ~ 1.8]
TR40 (1210)	0.087 [2.2]	0.197 [5.0]	0.083 ~ 0.118 [2.1 ~ 3.0]
TR50 (2010)	0.15 [3.9]	0.331 [8.4]	0.083 ~ 0.118 [2.1 ~ 3.0]
TR63 (2512)	0.205 [5.2]	0.413 [10.5]	0.098 ~ 0.189 [2.5 ~ 4.8]

8.0 APPLICABLE STANDARDS

JIS C 5202	Test Methods of Fixed Resistors for Electronic Equipment.
JIS C 5223	Fixed Thick Film Chip Resistors, Rectangular Type for Use in Electronic Equipment.
JIS C 0806	Packaging of Electronic Components on continuous tapes (surface mount devices).
MIL-R-55342	Resistors, Fixed, Film, Chip, Established Reliability, General Specifications for.
MIL-STD-202	Test Methods for Electronic and Electrical Parts.
IPC/JEDEC J STD 020	Moisture / Reflow sensitivity classification for non hermetic solid state surface mount devices.
2002/95/EC	RoHS Directive
IEC 60068-2-58	Solderability