

ASJ

DATA SHEET

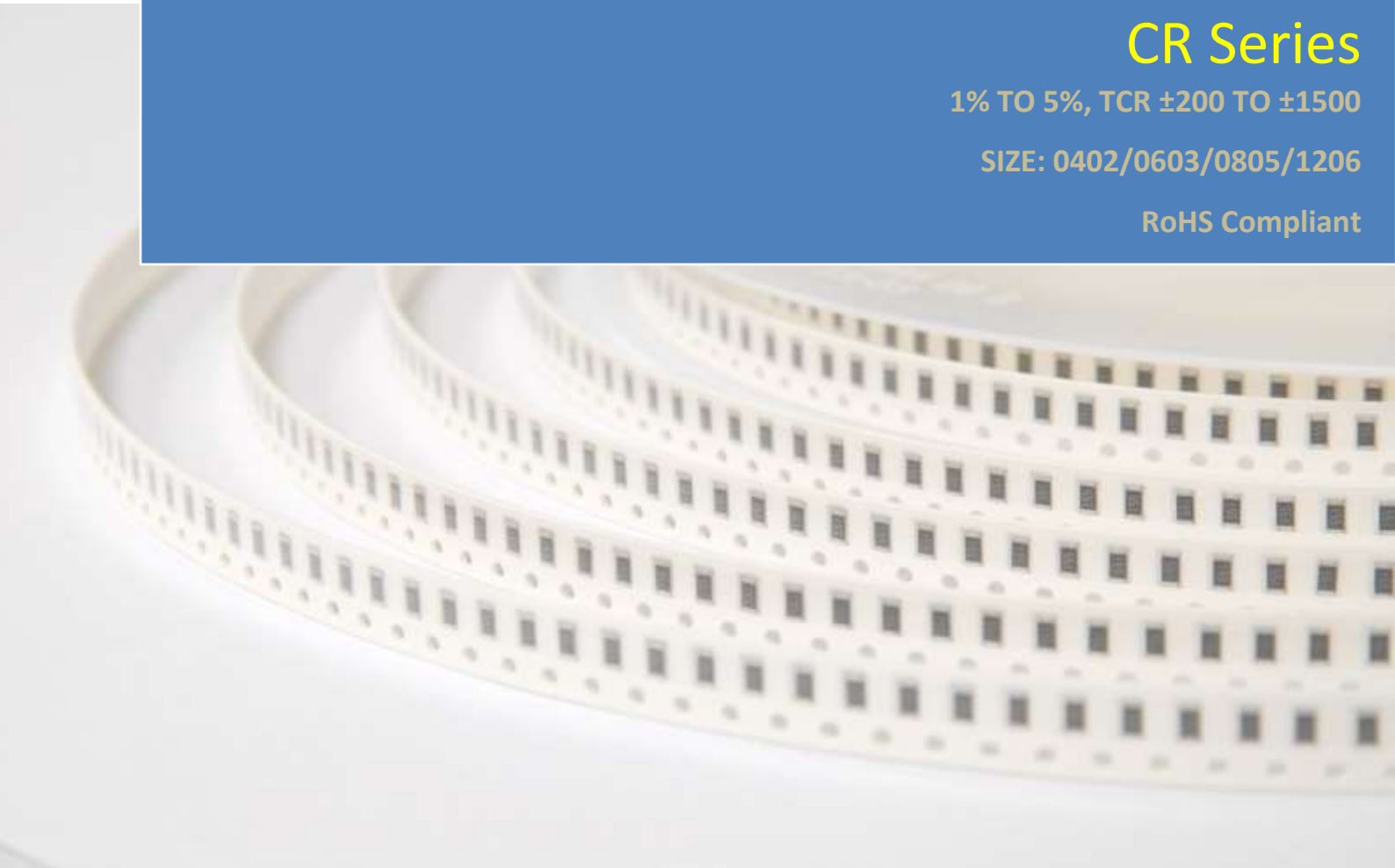
Milli-Ohm Thick Film Chip Resistor

CR Series

1% TO 5%, TCR ± 200 TO ± 1500

SIZE: 0402/0603/0805/1206

RoHS Compliant



MILLI-OHM THICK FILM CHIP RESISTOR

CR Series

DS-ENG-005

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1. SCOPE

- 1.1 This specification is applicable to Lead and Halogen-free CR 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 is exempted by RoHS directive.
- 1.3 The products are tested and passed based on the test conditions and methods defined in AEC-Q200.

2. PART NUMBERING SYSTEM

Part Numbering is made in accordance with the following system:

CR	16	-	R100		-	J	L
Type	Size(Inch/mm)	Nominal Resistance			Resistance Tolerance	Packaging	
Milliohm and Ultra Low Ohmic Thick Film Chip Resistor	10 (0402/1005) 16 (0603/1608) 21 (0805/2012) 32 (1206/3216)	Resistors	4-Digit	E24 Series 0.1Ω=R100 0.24Ω=R240	F=±1% G=±2% J=±5%	L=5,000 pcs Lead Free K=10,000 pcs Lead Free Y=20,000 pcs Lead Free N=50,000 pcs Lead Free Remark : Refer to clause 7.3.2	
			4-Digit	E96 Series 0.091Ω=R091 0.03Ω=R030			

3. RATING

3.1 Rated Power

3.1.1 Resistor Rated Power

Type	Rated Power	Maximum Rated Current	Maximum Overload Current
CR10	1/16W	1.58A	3.95A
CR16	1/10W	3.16A	7.91A
CR21	1/8W	3.53A	8.82A
CR32	1/3W	5.77A	14.42A



3.2 Power Derating Characteristics

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

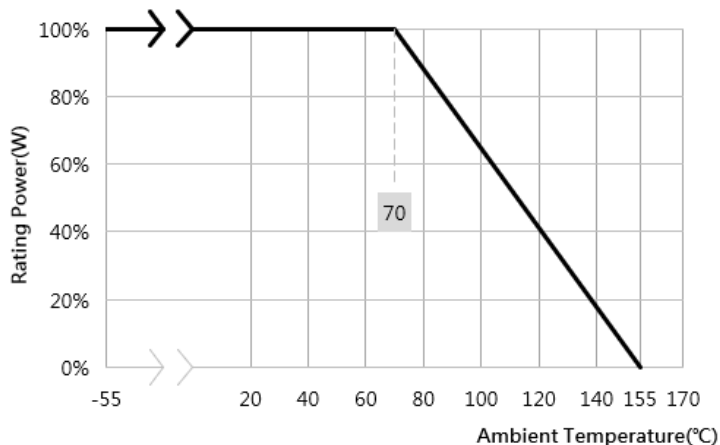


Fig.1 Power Derating Characteristics

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 kPa 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 kPa to 106kPa

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

3.5 Storage Temperature Range -5°C to + 40°C / < 85% RH

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 24 months from manufacturing date with control conditions.

3.9 ASJ resistors are RoHS-compliant in accordance to RoHS Directive.

3.10 Resistance, Resistance Tolerance and Temperature Coefficient of Resistance.

Type	Rated Power @ 70°C	T.C.R (ppm/°C) Max	Resistance Range E96, E24 F(±1%), G(±2%), J(±5%)	Max Rated Current	Max Overload Current
CR10 0402(1005)	1/16W	±1500	25mΩ ≤ R < 37mΩ	1.58A	3.95A
		±1200	37mΩ ≤ R < 60mΩ		
		±600	60mΩ ≤ R < 200mΩ		
		±300	200mΩ ≤ R < 400mΩ		
		±250	400mΩ ≤ R < 600mΩ		
CR16 0603(1608)	1/10W	±1500	10mΩ ≤ R < 37mΩ	3.16	7.91
		±1200	37mΩ ≤ R < 60mΩ		
		±600	60mΩ ≤ R < 100mΩ		
		±300	100mΩ ≤ R < 200mΩ		
		±400	200mΩ ≤ R < 500mΩ		
CR21 0805(2012)	1/8W	±1500	10mΩ ≤ R < 19mΩ	3.53A	8.82A
		±1200	19mΩ ≤ R < 33mΩ		
		±800	33mΩ ≤ R < 50mΩ		
		±600	50mΩ ≤ R < 100mΩ		
		±200	100mΩ ≤ R < 1000mΩ		
CR32 1206(3216)	1/3W	±1500	10mΩ ≤ R < 19mΩ	5.77A	14.42A
		±1200	19mΩ ≤ R < 25mΩ		
		±1000	25mΩ ≤ R < 50mΩ		
		±600	50mΩ ≤ R < 100mΩ		
		±200	100mΩ ≤ R < 1000mΩ		
Operating Temperature Range		-55°C ~ +155°C			

3.11 Rated Current

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

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

I=Rating Current(A)
P= Rating Power(W)
R=Resistance(Ω)

In case the value calculated by the formula exceeds the maximum working current given in Section 3.1.1, the maximum working current in Section 3.1.1 shall be regarded as the rated current.





3.12 All product, product specifications and data are subject to change without notice to improve reliability, function or design or otherwise.



4. MARKING ON PRODUCT

The nominal resistance shall be marked on the surface of each resistor

Type	Resistance Range	Tolerance ≤1%	Tolerance > 1%
Sizes: CR10(0402)	All	No Marking	
	Jumper=0Ω		
Size: CR16(0603)	<1Ω	3-digits Marking	3-digits Marking
	≥1Ω	3-digits Marking	3-digits Marking
	Jumper=0Ω	1-digits Marking	1-digit Marking
Sizes: CR21(0805) 、 CR32(1206)	<1Ω	4-digits Marking	4-digits Marking
	≥1Ω	4-digits Marking	3-digits Marking
	Jumper=0Ω	1-digits Marking	1-digit Marking

Marking	Description
	No Marking - CR10
	Tolerance: <1Ω, E24, 2%, 5% - CR16 - Marking R22 = 0.22Ω = 220mΩ
	Tolerance: <1Ω, E24, 1% - CR16 - The marking is expressed by one short bar under marking letter - Marking R <u>2</u> 2 = 0.22Ω = 220mΩ
	Tolerance: <1Ω, E24, E96, 1%, 5% - CR21 - CR32 - Marking R220 = 0.22Ω = 220mΩ

4.1 Numeric Numbering

4.1.1 0805, 1206, 2%, 5% Tolerance : Four Numerals Marking

Later 3 digits are significant figures, Firth digit is multiplier (10-3).

Examples:

Nominal Resistance	Marking	Remarks
100 mΩ	R100	100 X 10 ⁻³ = 0.1Ω

4.1.2 0805, 1206, 1% Tolerance : Four Numerals Marking

Later 3 digits are significant figures, first digit is multiplier (10-3).

Example

Nominal Resistance	Marking	Remarks
100 mΩ	R100	100 X 10 ⁻³ = 0.1 Ω
120 mΩ	R120	120 X 10 ⁻³ = 0.12 Ω
220 mΩ	R220	220 X 10 ⁻³ = 0.22 Ω

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4.1.3 0603 1% Tolerance : **Three Numerals Marking.**

Later 2 digits are significant figures, Firth digit is multiplier (10^{-3}).

The marking is expressed by one short bar under marking letter.

Example

Nominal Resistance	Marking	Remarks
100 mΩ	R <u>1</u> 0	$100 \times 10^{-3} = 0.1\Omega$
220 mΩ	R <u>2</u> 2	$220 \times 10^{-3} = 0.22\Omega$

0603 2%, 5% Tolerance : **Three Numerals Marking.**

Later 2 digits are significant figures, Firth digit is multiplier (10^{-3}).

Example

Nominal Resistance	Marking	Remarks
330 mΩ	R33	$330 \times 10^{-3} = 0.33\Omega$
470 mΩ	R47	$470 \times 10^{-3} = 0.47\Omega$



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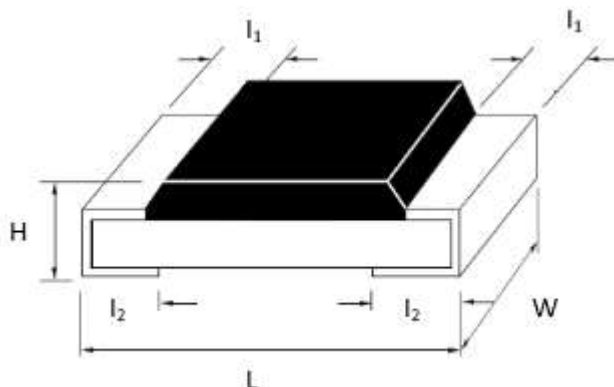
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5. DIMENSION, CONSTRUCTION AND MATERIAL

5.1 Dimension

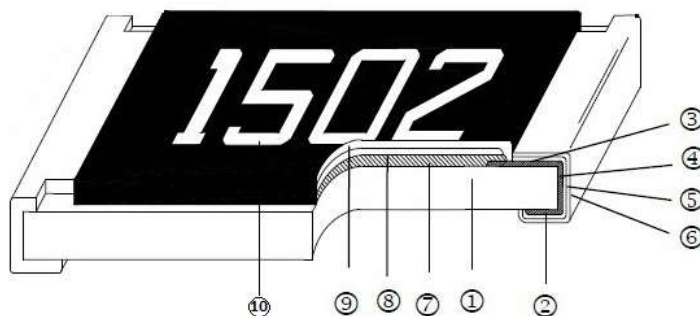


Unit: Inches (Millimeters)

CODE	L	W	H	l ₁	l ₂
CR10 (0402)	0.040±0.004 (1.00±0.10)	0.020±0.002 (0.50±0.05)	0.014±0.002 (0.35±0.05)	0.008±0.004 (0.20±0.10)	0.010±0.004 (0.25±0.10)
CR16 (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)
CR21 (0805)	0.079±0.006 (2.00±0.15)	0.049±0.004 (1.25±0.10)	0.020±0.004 (0.50±0.10)	0.016±0.008 (0.40±0.20)	0.016±0.008 (0.40±0.20)
CR32 (1206)	0.122±0.004 (3.10±0.10)	0.063±0.006 (1.60±0.15)	0.022±0.002 (0.55±0.05)	0.020±0.010 (0.50±0.25)	0.020±0.010 (0.50±0.25)

* Measurement accuracy within ±0.02mm from the product specification.

5.2 Resistor Construction



1	ALUMINA SUBSTRATE	6	PURE TIN PLATING
2	BOTTOM CONDUCTOR	7	RESISTOR
3	TOP CONDUCTOR	8	OVERGLAZE
4	SPUTTERING EDGE TERMINAL	9	OVERCOAT
5	NICKEL PLATING	10	MARKING (CR10 No Marking)



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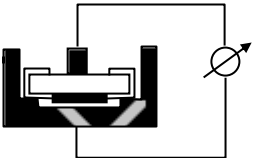
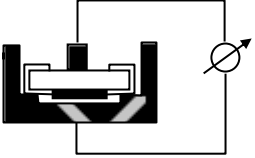
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6. ELECTRICAL CHARACTERISTICS AND TEST CONDITIONS

Item	Conditions	Specifications														
		Resistors														
Resistance Value	<p>JIS C 5201-1 4.5 Application time to be within 5 secs . Applied Voltage for resistance measurement :</p> <table border="1"> <tr> <td><10Ω</td> <td>0.1V</td> </tr> <tr> <td>10~99Ω</td> <td>0.3V</td> </tr> <tr> <td>100~999</td> <td>1.0V</td> </tr> <tr> <td>1K~ 9.9K</td> <td>3.0V</td> </tr> <tr> <td>10K~ 99.9K</td> <td>10.0V</td> </tr> <tr> <td>100K~999K</td> <td>25.0V</td> </tr> <tr> <td>1M & Over</td> <td>50.0V</td> </tr> </table>	<10Ω	0.1V	10~99Ω	0.3V	100~999	1.0V	1K~ 9.9K	3.0V	10K~ 99.9K	10.0V	100K~999K	25.0V	1M & Over	50.0V	Resistance accuracy being fully relies with respect to tolerance of resistor.
<10Ω	0.1V															
10~99Ω	0.3V															
100~999	1.0V															
1K~ 9.9K	3.0V															
10K~ 99.9K	10.0V															
100K~999K	25.0V															
1M & Over	50.0V															
Resistance Temperature Coefficient	<p>MIL-STD-202 Method 304 Measure R at t₀=25°C and after 45 minutes measure R at t=125°C. Calculation: $TCR(ppm/^{\circ}C) = \frac{R - R_0}{R_0(t - t_0)} \times 10^6$</p>	Refer to 3.10														
Voltage Coefficient (Applicable for >1KΩ only)	<p>JIS C 5201-1 4.11 Measured resistance R₂ at 100%V rated voltage or the limiting element voltage (>0.5s in every 5s) and R₁ 10% V (4.5s) Calculation: $V_c = \frac{R_2 - R_1}{0.9 \times U \times R_1}$</p>	Voltage coefficient ≤ 100ppm/V														
Short Time Overload	<p>JIS C 5201-1 4.13 Apply at 2.5 times rated voltage for 5 seconds. Applied voltage shall not exceed maximum overload voltage or current.</p>	±0.5% for 1% tolerance resistor ±1.0% for 5% tolerance resistor														
Insulation Resistance	<p>JIS C 5201-1 4.6 Apply (100 ±15) Vdc for 1 minute. Measured the insulation resistance between electrodes and insulating enclosure or between electrodes and base</p> 	> 10G Ω														
Dielectric Withstanding Voltage	<p>JIS C 5201-1 4.7 Apply 500Vac for 1 minute ± 5secs. for chip ≥ 0805. Apply 300Vac for 1 minute ± 5secs. for chip 0402 & 0603</p>  <p>The variation in relation to the initial resistance shall be within ±1%.</p>	±(1%+0.05Ω) for 1% & 5% tolerance resistor No failure of resistor such as short-circuit, burning, breakdown.														



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Item	Conditions	Specifications															
		Resistors															
Intermittent Overload	<p>JIS C 5201-1 4.13 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.</p>	±(5%+0.1Ω) for 1% & 5% tolerance resistor															
Noise	<p>JIS C 5201-1 4.12 $V_o(\text{dB}) = T - f(T-S) - D$</p>	<table border="1"> <tr> <td>1~9</td> <td>-10dB(0.32μv/v)</td> </tr> <tr> <td>10~99</td> <td>- 5 dB(0.52μv/v)</td> </tr> <tr> <td>100~999</td> <td>0 dB(1.0μv/v)</td> </tr> <tr> <td>1K~9.9K</td> <td>10 dB(3.2μv/v)</td> </tr> <tr> <td>10K~99.9K</td> <td>18 dB(5.6μv/v)</td> </tr> <tr> <td>100K~999.9K</td> <td>20 dB(10μv/v)</td> </tr> <tr> <td>>1M</td> <td>30 dB(32μv/v)</td> </tr> </table>		1~9	-10dB(0.32μv/v)	10~99	- 5 dB(0.52μv/v)	100~999	0 dB(1.0μv/v)	1K~9.9K	10 dB(3.2μv/v)	10K~99.9K	18 dB(5.6μv/v)	100K~999.9K	20 dB(10μv/v)	>1M	30 dB(32μv/v)
1~9	-10dB(0.32μv/v)																
10~99	- 5 dB(0.52μv/v)																
100~999	0 dB(1.0μv/v)																
1K~9.9K	10 dB(3.2μv/v)																
10K~99.9K	18 dB(5.6μv/v)																
100K~999.9K	20 dB(10μv/v)																
>1M	30 dB(32μv/v)																
Terminal Strength																	
A)Bend Test (Applicable for chip size smaller than 1210)	<p>JIS C 5201-1 4.16 / AEC Q200-005 Board Flex : Apply force till 2mm bend and hold for 60±5 secs. Measure resistance while applying pressure.</p>	Tolerance resistor. With no evidence of mechanical damage after releasing the pressure. ±(0.5%+0.05Ω) for 1% & 5%															
B)Pull Test (Applicable for chip size bigger than 0805)	<p>JIS C 5201-1 4.16.2 Pull Test : Apply 0.5kgF for 30 sec</p>	±(1.0%+0.05Ω) for 1% & 5%															
C)Push Test	<p>AEC Q200-006 Push Test : Apply 1.8kgF for 60±1secs</p>	±(1.0%+0.05Ω) for 1% & 5%															
D)Robustness Test	<p>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.</p>	After reading/initial reading ≥5N															



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Item	Conditions	Specifications
		Resistors
Resistance to soldering heat	MIL-STD-202 Method 210 Solder bath method Resistor dipped entirely in solder bath of 260±5°C for 10 ₋₀ ⁺¹ sec. After which the sample shall be left at ambient temperature for 1~ 2 hrs before measurement.	±(0.5%+0.05Ω) for 1% & 5% tolerance resistor
Solderability	J-STD-002 For both Leaded & SMD. Electrical test not required. Magnification 50 X. Conditions: Leaded: Method A @ 235°C, category 3. SMD: a) Method B, 4 hrs @ 155°C dry heat @ 235°C b) Method B @ 215°C category 3. c) Method D category 3 @ 260°C.	> 95% Coverage at all terminal
Resistance to Solvent	MIL-STD-202 Method 215 Immerse in 25°C±5°C Isopropyl Alcohol (IPA) for 3±0.5 minutes.	Passed without any damaged to marking & protective material.
High Temperature	MIL-STD-202 Method 108 1000 hours @ T=125°C. Unpowered measurement at 24±2 hours after test conclusion.	±(0.5%+0.05Ω) for 1% tolerance resistor ±(1%+0.05Ω) for 5% tolerance resistor
Temperature Cycling	JESD 22 Method JA-104 1000 cycles (-55°C to 125°C) measurement at 24±2 hours after test conclusion.	±(0.5%+0.05Ω) for 1% tolerance resistor ±(1%+0.05Ω) for 5% tolerance resistor
Resistance to damp Heat (Humidity)	MIL-STD-202 Method 103 1000 hours 40±2°C / 90~95%RH Note: Specified condition 10% of operating power. Measurement at 24±2 hours after test conclusion.	±(1%+0.1Ω) for 1% & 5% tolerance resistor
Loadlife	MIL-STD-202 Method 108 At 70±3°C Apply DC rated voltage at 90minutes On, 30minutes Off for 1,000 ₋₀ ⁺⁴⁸ hours Sample shall be left at ambient temperature for 1~ 2 hrs after test before measuring final resistance.	±(1.0%+0.05Ω) for 1% tolerance resistor ±(2.0%+0.1Ω) for 5% tolerance resistor
Salt Spray	MIL-STD-202 Method 101 Spray 5±1 Wt% salt water for 96±4 hours at 35±2°C	±(3%+0.1Ω) for 1% & 5% tolerance resistor
Mounting Quality Test	JESD22-B102E Solder Paste : Sn-3Ag-0.5Cu Reflow soldering method Peak : 250 ₋₀ ⁺⁵ °C and 230±5°C for 60sec.	Visual check for solder joint wetting condition, resistor body damages



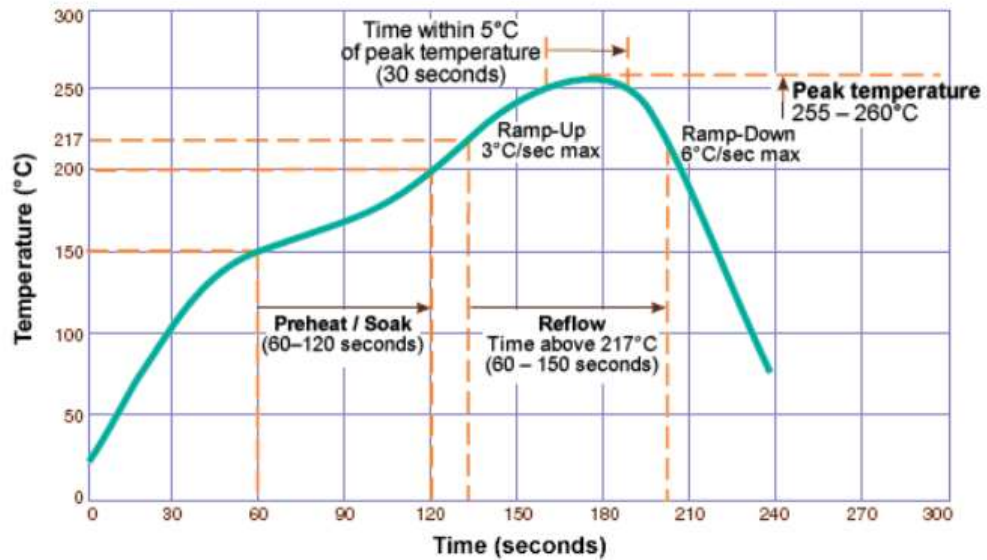
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6.1. Recommended Soldering Method

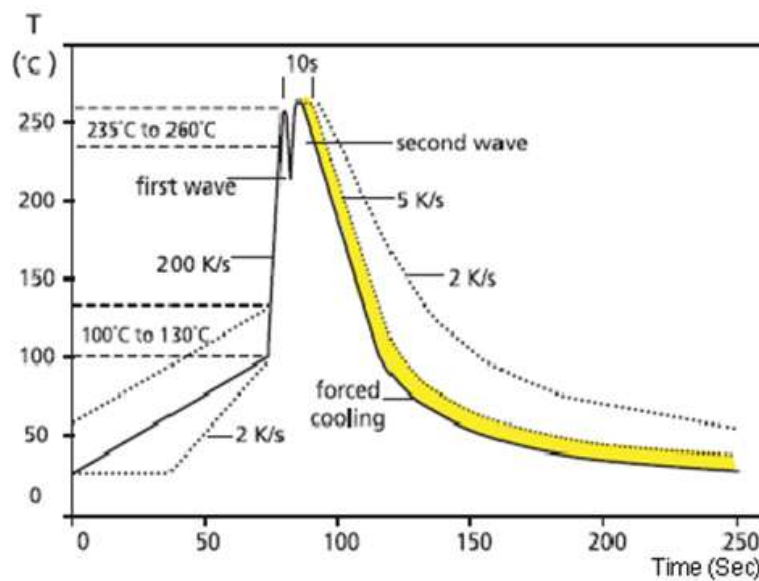
Technical application notes : This is for recommendation, customer please perform adjustment according to actual application.

6.1.1. Lead-Free IR Reflow Soldering Profile (Meet J-STD-020)



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

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

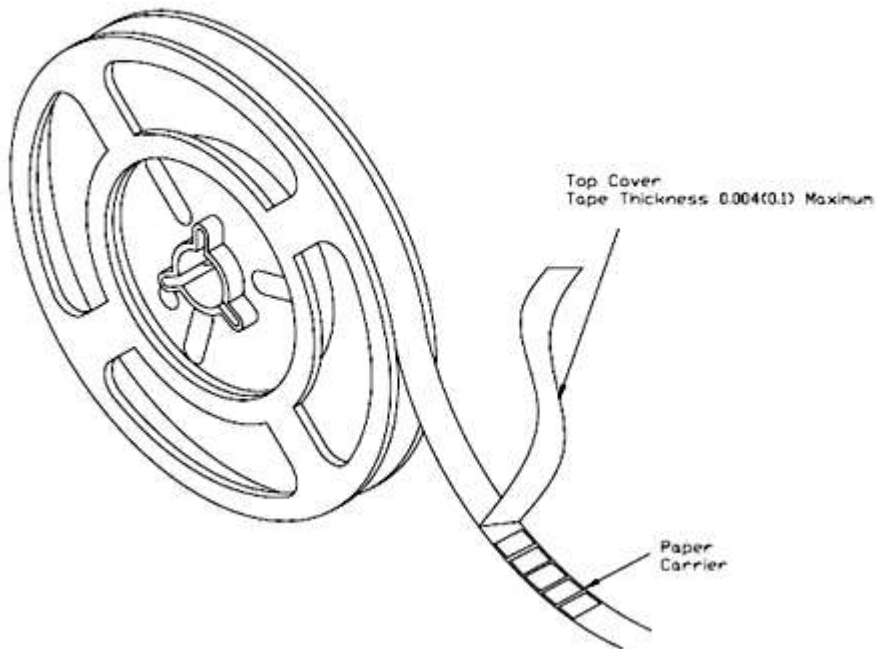


6.1.3. Soldering Iron: Temperature 350°C±10°C , dwell time shall be less than 3 sec.

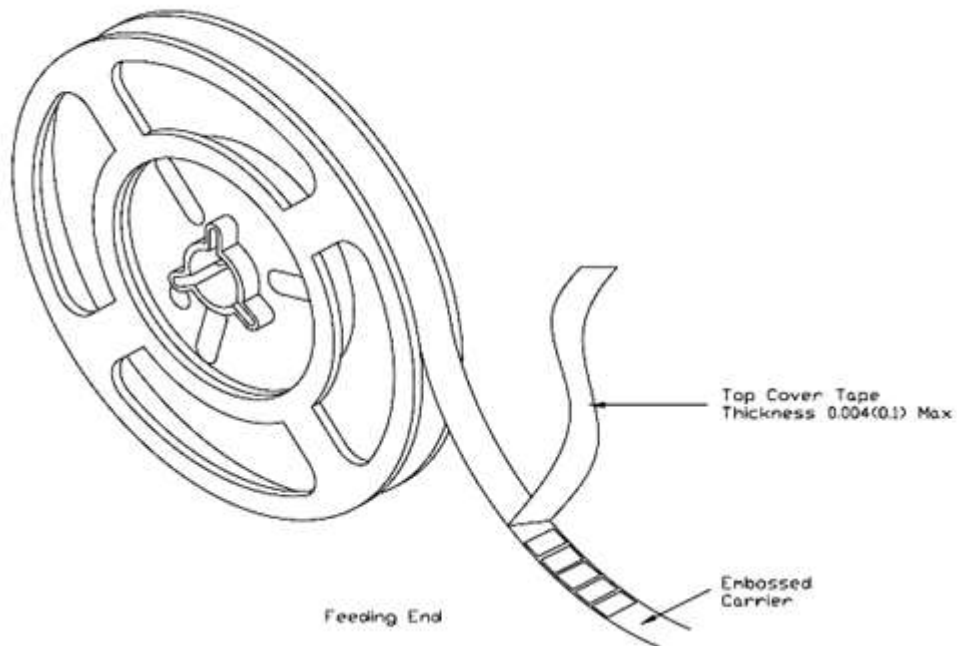
7. TAPING

7.1 Structure of Taping

Paper Carrier



Embossed Plastic Carrier



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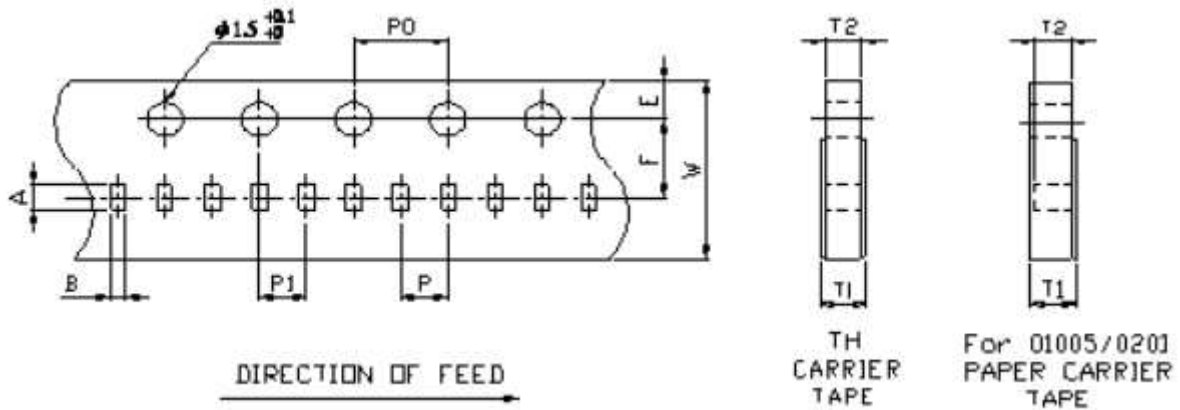
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7.2 Dimension

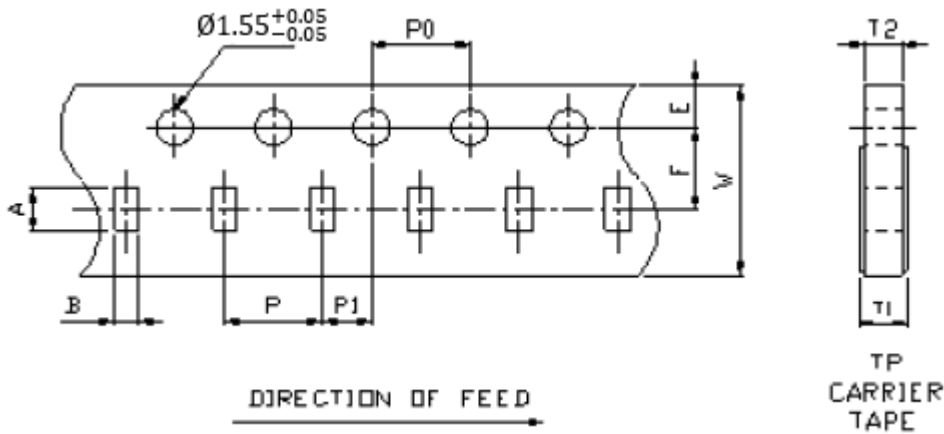
7.2.1 Dimension of Punched Paper Tape Carrier System (CR -10)



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

Code	A	B	W	E	F	T1	T2	P	P0	P1	10P0
CR10	1.15 \pm 0.03	0.65 \pm 0.03	8.00 \pm 0.10	1.75 \pm 0.10	3.50 \pm 0.05	0.42 $^{+0.2}_{-0}$	0.42 $^{+0.03}_{-0.03}$	2.00 \pm 0.05	4.00 \pm 0.10	2.00 \pm 0.05	40.0 \pm 0.20

7.2.2 Dimension of Punched Paper Tape Carrier System Carrier System (CR16, 21, 32)



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

Code	A	B	W	E	F	T1	T2	P	P0	P1	10P0
CR16	1.80 \pm 0.10	1.00 \pm 0.10	8.00 \pm 0.10	1.75 \pm 0.10	3.50 \pm 0.05	0.60 $^{+0.2}_{-0}$	0.60 \pm 0.03	4.00 \pm 0.05	4.00 \pm 0.10	2.00 \pm 0.05	40.0 \pm 0.20
CR21	2.33 \pm 0.05	1.58 \pm 0.05	8.00 \pm 0.10	1.75 \pm 0.10	3.50 \pm 0.05	0.75 $^{+0.2}_{-0}$	0.75 $^{+0.03}_{-0.05}$	4.00 \pm 0.05	4.00 \pm 0.10	2.00 \pm 0.05	40.0 \pm 0.20
CR32	3.30 \pm 0.05	1.90 \pm 0.05	8.00 \pm 0.10	1.75 \pm 0.10	3.50 \pm 0.05	0.75 $^{+0.2}_{-0}$	0.75 $^{+0.03}_{-0.05}$	4.00 \pm 0.05	4.00 \pm 0.10	2.00 \pm 0.05	40.0 \pm 0.20



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7.3 Packaging

7.3.1 Taping

Quantity – Tape and Reels

Code	Quantity	Reel	Remark
CR10	10,000 pcs	7" reel	2mm pitch
	20,000 pcs	7" reel	2mm pitch
	50,000 pcs	13" reel	2mm pitch
CR16	5,000 pcs	7" reel	4mm pitch
CR21	10,000 pcs	10" reel	4mm pitch
CR32	20,000 pcs	13" reel	4mm pitch

7.3.3 Identification

Production label that indicates the 10 digits lot number, product type, resistance value and tolerance shall be pasted on the surface of each reel.



7.3.4 Packaging Reel Box

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

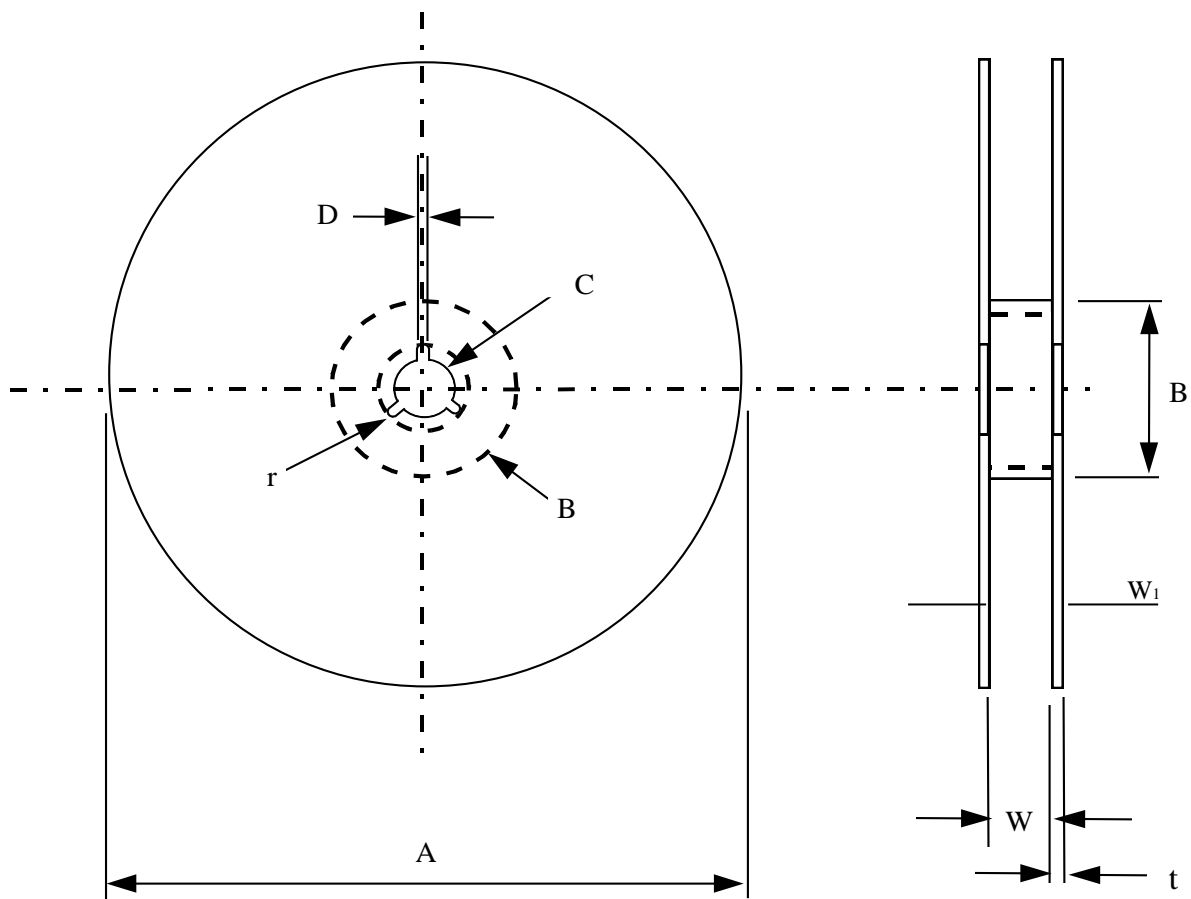
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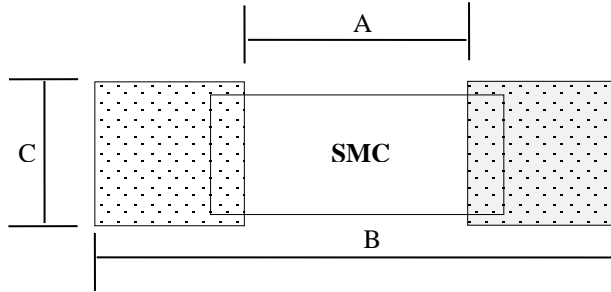
7.3.5 Reel Dimensions



Model	A	B	C	D	W	W ₁	t	r
7" Reel (5K) (except 0402 10K)	$\phi 178 \pm 2.0$	$\phi 60 \text{min}$	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, 50K)	$\phi 330 \pm 2.0$	$\phi 60 \text{min}$	13 ± 0.2	$\phi 2.0 \pm 0.5$	11 ± 1.0	14.4 max	2.1 ± 0.1	-
13" Reel (20K)	$\phi 330 \pm 1.0$	$\phi 100 \pm 1$	13.5 ± 0.5	$2 \sim 3 \pm 0.5$	10 ± 0.5	-	-	-

8. RECOMMENDED 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.



Product (Type)	Land Dimension		
	A	B	C
CR10 (0402)	0.020 [0.5]	0.059 [1.5]	0.024 [0.6]
CR16 (0603)	0.031 [0.8]	0.083 [2.1]	0.035 [0.9]
CR21 (0805)	0.047 [1.2]	0.118 [3.0]	0.051 [1.3]
CR32 (1206)	0.087 [2.2]	0.165 [4.2]	0.063 [1.6]

MILLI-OHM THICK FILM CHIP RESISTOR

CR Series

DS-ENG-005

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9. REVISION HISTORY

Revision	Date	Change Notification	Description
Version.1	13.02.2015		Initial Release
Version.2	11.06.2015		Revise clause 3.1.1 Power Rating - CR32 1/4W - CR40 1/3W
Version.3	06.02.2017	Refer to PCN-ECO: 01/2016	Revise clause 2, typo error Typo error in clause 6.1.1, 6.1.2, change IR reflow to wave soldering, change wave to reflow soldering Revise clause 7.2 dimension Update clause 7.3.5, insert 13" reel information
Verion.4	03.06.2020		Remove all Power chip product, all power chip product include to DS-ENG-067 Revise clause 1.3 Revise clause 2 Part Numbering System Revise clause 3.1.1 Resistor rated power Revise clause 3.2 Power derating characteristic graph Revise clause 3.9 Revise clause 3.10 TCR table Revise clause 4 Marking on product table Add clause 4.1.2 three numerals marking Revise clause 5.1 dimension Add clause 5.2 Resistor construction Revise clause 6 reliability test table Revise clause 7.2.1 & 7.2.2 dimension of punch paper tape Revise clause 7.3.2 tape and reed quantity table Revise clause 8 Land pattern dimension table.
Version.5	09.10.2020		Revise clause 3.5 storage temp. range
Version.6	26.01.2021		Revise clause 2 Part numbering System Revise clause 4 Marking on product Revise clause 4.1.1 ~ 4.1.3 Numeric Numbering
Version.7	22.09.2022		Revise clause 3.10 TCR table
Version 8	13.08.2024		Revise clause 3.1.1 table. Revise clause 3.10 table. Revise clause 5.1 Dimension table. Revise clause 6.1 Recommended Soldering Method. Revise clause 7.3.3 Identification. Revise clause 8 details.



Product Specification

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DATA SHEET

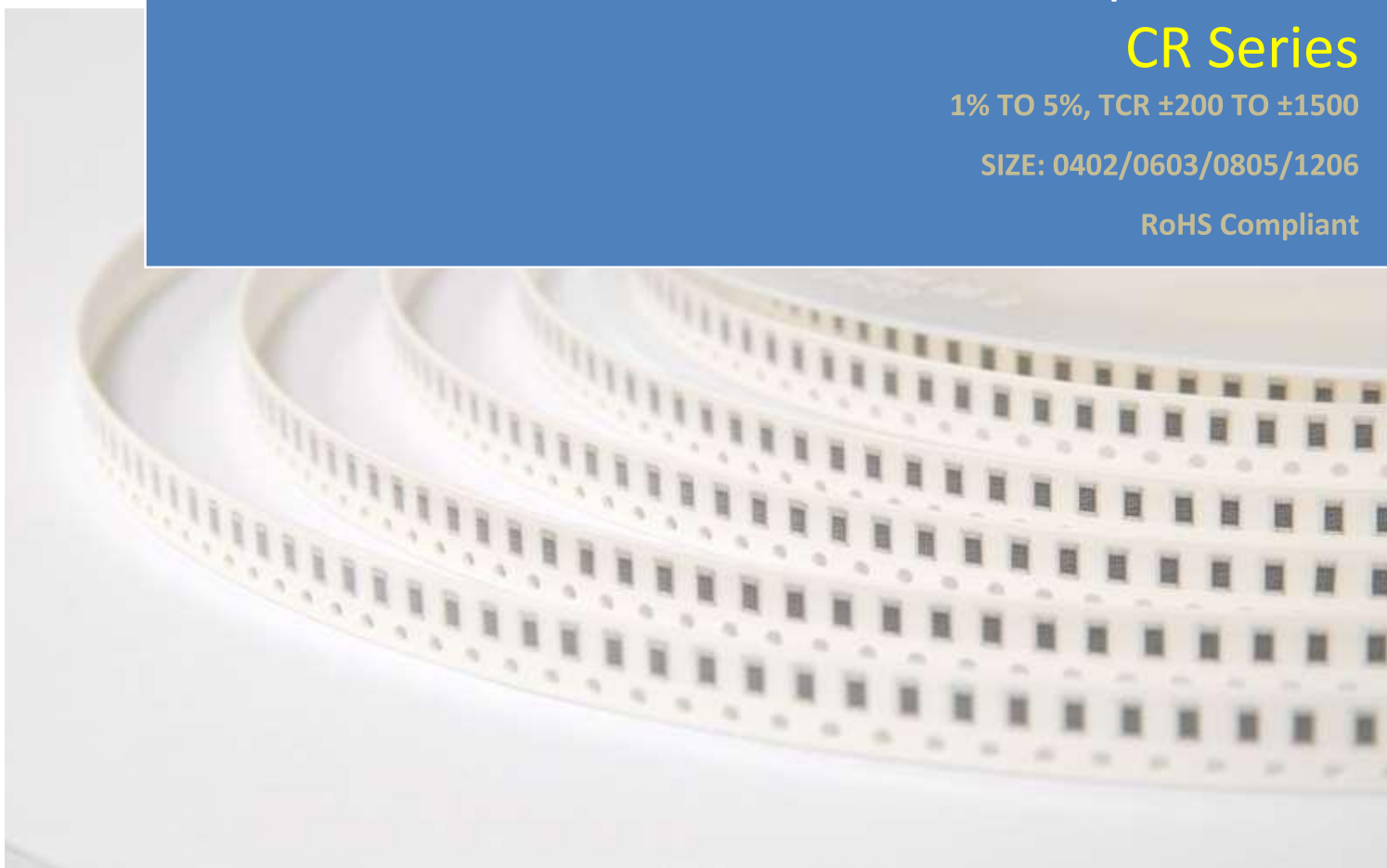
Milli-Ohm Thick Film Chip Resistor

CR Series

1% TO 5%, TCR ± 200 TO ± 1500

SIZE: 0402/0603/0805/1206

RoHS Compliant



MILLI-OHM THICK FILM CHIP RESISTOR

CR Series

DS-ENG-005

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1. SCOPE

- 1.1 This specification is applicable to Lead and Halogen-free CR 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 is exempted by RoHS directive.
- 1.3 The products are tested and passed based on the test conditions and methods defined in AEC-Q200.

2. PART NUMBERING SYSTEM

Part Numbering is made in accordance with the following system:

CR	16	-	R100		-	J	L
Type	Size(Inch/mm)		Nominal Resistance			Resistance Tolerance	Packaging
Milliohm and Ultra Low Ohmic Thick Film Chip Resistor	10 (0402/1005) 16 (0603/1608) 21 (0805/2012) 32 (1206/3216)		Resistors	4-Digit	E24 Series 0.1Ω=R100 0.24Ω=R240	F=±1% G=±2% J=±5%	L=5,000 pcs Lead Free K=10,000 pcs Lead Free Y=20,000 pcs Lead Free N=50,000 pcs Lead Free Remark : Refer to clause 7.3.2
				4-Digit	E96 Series 0.091Ω=R091 0.03Ω=R030		

3. RATING

3.1 Rated Power

3.1.1 Resistor Rated Power

Type	Rated Power	Maximum Rated Current	Maximum Overload Current
CR10	1/16W	1.58A	3.95A
CR16	1/10W	3.16A	7.91A
CR21	1/8W	3.53A	8.82A
CR32	1/3W	5.77A	14.42A



3.2 Power Derating Characteristics

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

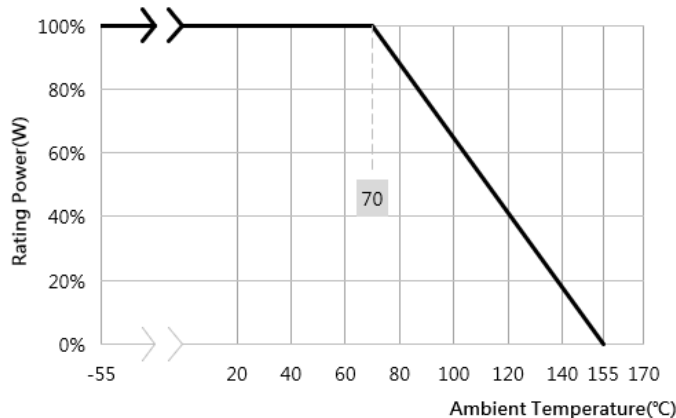


Fig.1 Power Derating Characteristics

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 kPa 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 kPa to 106kPa

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

3.5 Storage Temperature Range -5°C to + 40°C / < 85% RH

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 24 months from manufacturing date with control conditions.

3.9 ASJ resistors are RoHS-compliant in accordance to RoHS Directive.



3.10 Resistance, Resistance Tolerance and Temperature Coefficient of Resistance.

Type	Rated Power @ 70°C	T.C.R (ppm/°C) Max	Resistance Range E96, E24 F(±1%), G(±2%), J(±5%)	Max Rated Current	Max Overload Current
CR10 0402(1005)	1/16W	±1500	25mΩ ≤ R < 37mΩ	1.58A	3.95A
		±1200	37mΩ ≤ R < 60mΩ		
		±600	60mΩ ≤ R < 200mΩ		
		±300	200mΩ ≤ R < 400mΩ		
		±250	400mΩ ≤ R < 600mΩ		
CR16 0603(1608)	1/10W	±1500	10mΩ ≤ R < 37mΩ	3.16	7.91
		±1200	37mΩ ≤ R < 60mΩ		
		±600	60mΩ ≤ R < 100mΩ		
		±300	100mΩ ≤ R < 200mΩ		
		±400	200mΩ ≤ R < 500mΩ		
CR21 0805(2012)	1/8W	±1500	10mΩ ≤ R < 19mΩ	3.53A	8.82A
		±1200	19mΩ ≤ R < 33mΩ		
		±800	33mΩ ≤ R < 50mΩ		
		±600	50mΩ ≤ R < 100mΩ		
		±200	100mΩ ≤ R < 1000mΩ		
CR32 1206(3216)	1/3W	±1500	10mΩ ≤ R < 19mΩ	5.77A	14.42A
		±1200	19mΩ ≤ R < 25mΩ		
		±1000	25mΩ ≤ R < 50mΩ		
		±600	50mΩ ≤ R < 100mΩ		
		±200	100mΩ ≤ R < 1000mΩ		
Operating Temperature Range		-55°C ~ +155°C			

3.11 Rated Current

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

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

I=Rating Current(A)
P= Rating Power(W)
R=Resistance(Ω)

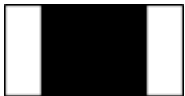



In case the value calculated by the formula exceeds the maximum working current given in Section 3.1.1, the maximum working current in Section 3.1.1 shall be regarded as the rated current.

3.12 All product, product specifications and data are subject to change without notice to improve reliability, function or design or otherwise.

4. MARKING ON PRODUCT

The nominal resistance shall be marked on the surface of each resistor

Type	Resistance Range	Tolerance ≤1%	Tolerance > 1%
Sizes: CR10(0402)	All	No Marking	
	Jumper=0Ω		
Size: CR16(0603)	<1Ω	3-digits Marking	3-digits Marking
	≥1Ω	3-digits Marking	3-digits Marking
	Jumper=0Ω	1-digits Marking	1-digit Marking
Sizes: CR21(0805) 、 CR32(1206)	<1Ω	4-digits Marking	4-digits Marking
	≥1Ω	4-digits Marking	3-digits Marking
	Jumper=0Ω	1-digits Marking	1-digit Marking

Marking	Description
	No Marking - CR10
	Tolerance: <1Ω, E24, 2%, 5% - CR16 - Marking R22 = 0.22Ω = 220mΩ
	Tolerance: <1Ω, E24, 1% - CR16 - The marking is expressed by one short bar under marking letter - Marking R2 $\bar{2}$ = 0.22Ω = 220mΩ
	Tolerance: <1Ω, E24, E96, 1%, 5% - CR21 - CR32 - Marking R220 = 0.22Ω = 220mΩ

4.1 Numeric Numbering

4.1.1 0805, 1206, 2%, 5% Tolerance : Four Numerals Marking

Later 3 digits are significant figures, Firth digit is multiplier (10-3).

Examples:

Nominal Resistance	Marking	Remarks
100 mΩ	R100	100 X 10 ⁻³ = 0.1Ω

4.1.2 0805, 1206, 1% Tolerance : Four Numerals Marking

Later 3 digits are significant figures, first digit is multiplier (10-3).

Example

Nominal Resistance	Marking	Remarks
100 mΩ	R100	100 X 10 ⁻³ = 0.1 Ω
120 mΩ	R120	120 X 10 ⁻³ = 0.12 Ω
220 mΩ	R220	220 X 10 ⁻³ = 0.22 Ω

4.1.3 0603 1% Tolerance : **Three Numerals Marking.**

Later 2 digits are significant figures, Firth digit is multiplier (10^{-3}).

The marking is expressed by one short bar under marking letter.

Example

Nominal Resistance	Marking	Remarks
100 mΩ	R <u>1</u> 0	$100 \times 10^{-3} = 0.1\Omega$
220 mΩ	R <u>2</u> 2	$220 \times 10^{-3} = 0.22\Omega$

0603 2%, 5% Tolerance : **Three Numerals Marking.**

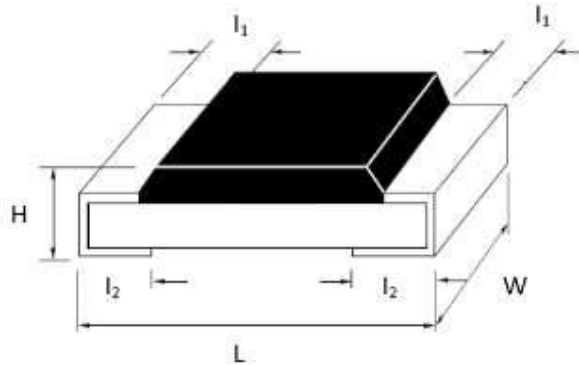
Later 2 digits are significant figures, Firth digit is multiplier (10^{-3}).

Example

Nominal Resistance	Marking	Remarks
330 mΩ	R33	$330 \times 10^{-3} = 0.33\Omega$
470 mΩ	R47	$470 \times 10^{-3} = 0.47\Omega$

5. DIMENSION, CONSTRUCTION AND MATERIAL

5.1 Dimension

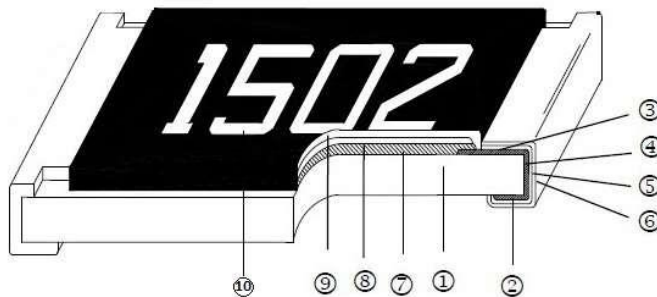


Unit: Inches (Millimeters)

CODE	L	W	H	l ₁	l ₂
CR10 (0402)	0.040±0.004 (1.00±0.10)	0.020±0.002 (0.50±0.05)	0.014±0.002 (0.35±0.05)	0.008±0.004 (0.20±0.10)	0.010±0.004 (0.25±0.10)
CR16 (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)
CR21 (0805)	0.079±0.006 (2.00±0.15)	0.049±0.004 (1.25±0.10)	0.020±0.004 (0.50±0.10)	0.016±0.008 (0.40±0.20)	0.016±0.008 (0.40±0.20)
CR32 (1206)	0.122±0.004 (3.10±0.10)	0.063±0.006 (1.60±0.15)	0.022±0.002 (0.55±0.05)	0.020±0.010 (0.50±0.25)	0.020±0.010 (0.50±0.25)

* Measurement accuracy within ±0.02mm from the product specification.

5.2 Resistor Construction



1	ALUMINA SUBSTRATE	6	PURE TIN PLATING
2	BOTTOM CONDUCTOR	7	RESISTOR
3	TOP CONDUCTOR	8	OVERGLAZE
4	SPUTTERING EDGE TERMINAL	9	OVERCOAT
5	NICKEL PLATING	10	MARKING (CR10 No Marking)

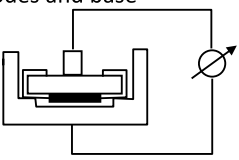
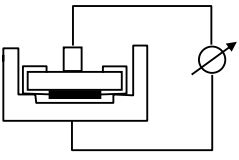
MILLI-OHM THICK FILM CHIP RESISTOR

CR Series

DS-ENG-005

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6. ELECTRICAL CHARACTERISTICS AND TEST CONDITIONS

Item	Conditions	Specifications														
		Resistors														
Resistance Value	<p>JIS C 5201-1 4.5 Application time to be within 5 secs . Applied Voltage for resistance measurement :</p> <table border="1"> <tr> <td><10Ω</td> <td>0.1V</td> </tr> <tr> <td>10~99Ω</td> <td>0.3V</td> </tr> <tr> <td>100~999</td> <td>1.0V</td> </tr> <tr> <td>1K~ 9.9K</td> <td>3.0V</td> </tr> <tr> <td>10K~ 99.9K</td> <td>10.0V</td> </tr> <tr> <td>100K~999K</td> <td>25.0V</td> </tr> <tr> <td>1M & Over</td> <td>50.0V</td> </tr> </table>	<10Ω	0.1V	10~99Ω	0.3V	100~999	1.0V	1K~ 9.9K	3.0V	10K~ 99.9K	10.0V	100K~999K	25.0V	1M & Over	50.0V	Resistance accuracy being fully relies with respect to tolerance of resistor.
<10Ω	0.1V															
10~99Ω	0.3V															
100~999	1.0V															
1K~ 9.9K	3.0V															
10K~ 99.9K	10.0V															
100K~999K	25.0V															
1M & Over	50.0V															
Resistance Temperature Coefficient	<p>MIL-STD-202 Method 304 Measure R at $t_0=25^{\circ}\text{C}$ and after 45 minutes measure R at $t=125^{\circ}\text{C}$. Calculation: $TCR(ppm/^{\circ}C) = \frac{R - R_0}{R_0(t - t_0)} \times 10^6$</p>	Refer to 3.10														
Voltage Coefficient (Applicable for >1KΩ only)	<p>JIS C 5201-1 4.11 Measured resistance R2 at 100%V rated voltage or the limiting element voltage (>0.5s in every 5s) and R1 10% V (4.5s) Calculation: $V_c = \frac{R_2 - R_1}{0.9 \times U \times R_1}$</p>	Voltage coefficient $\leq 100\text{ppm/V}$														
Short Time Overload	<p>JIS C 5201-1 4.13 Apply at 2.5 times rated voltage for 5 seconds. Applied voltage shall not exceed maximum overload voltage or current.</p>	$\pm 0.5\%$ for 1% tolerance resistor $\pm 1.0\%$ for 5% tolerance resistor														
Insulation Resistance	<p>JIS C 5201-1 4.6 Apply (100 ±15) Vdc for 1 minute. Measured the insulation resistance between electrodes and insulating enclosure or between electrodes and base</p> 	> 10G Ω														
Dielectric Withstanding Voltage	<p>JIS C 5201-1 4.7 Apply 500Vac for 1 minute ± 5secs. for chip ≥ 0805. Apply 300Vac for 1 minute ± 5secs. for chip 0402 & 0603</p>  <p>The variation in relation to the initial resistance shall be within ±1%.</p>	$\pm(1\%+0.05\Omega)$ for 1% & 5% tolerance resistor No failure of resistor such as short-circuit, burning, breakdown.														



Product Specification

Towards Excellence in Quality, Service & Innovation

MILLI-OHM THICK FILM CHIP RESISTOR

CR Series

DS-ENG-005

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Item	Conditions	Specifications															
		Resistors															
Intermittent Overload	<p>JIS C 5201-1 4.13 Apply 4 times rated voltage for 1 secs ON and 25 secs OFF. Total 10,000₋₀⁺⁴⁰⁰ cycles. Applied voltage/current shall not exceed maximum intermittent overload voltage/ current.</p>	±(5%+0.1Ω) for 1% & 5% tolerance resistor															
Noise	<p>JIS C 5201-1 4.12 $V_o(\text{dB}) = T - f(T-S) - D$</p>	<table border="1"> <tr> <td>1~9</td> <td>-10dB(0.32μv/v)</td> </tr> <tr> <td>10~99</td> <td>- 5 dB(0.52μv/v)</td> </tr> <tr> <td>100~999</td> <td>0 dB(1.0μv/v)</td> </tr> <tr> <td>1K~9.9K</td> <td>10 dB(3.2μv/v)</td> </tr> <tr> <td>10K~99.9K</td> <td>18 dB(5.6μv/v)</td> </tr> <tr> <td>100K~999.9K</td> <td>20 dB(10μv/v)</td> </tr> <tr> <td>>1M</td> <td>30 dB(32μv/v)</td> </tr> </table>		1~9	-10dB(0.32μv/v)	10~99	- 5 dB(0.52μv/v)	100~999	0 dB(1.0μv/v)	1K~9.9K	10 dB(3.2μv/v)	10K~99.9K	18 dB(5.6μv/v)	100K~999.9K	20 dB(10μv/v)	>1M	30 dB(32μv/v)
1~9	-10dB(0.32μv/v)																
10~99	- 5 dB(0.52μv/v)																
100~999	0 dB(1.0μv/v)																
1K~9.9K	10 dB(3.2μv/v)																
10K~99.9K	18 dB(5.6μv/v)																
100K~999.9K	20 dB(10μv/v)																
>1M	30 dB(32μv/v)																
Terminal Strength	<p>A)Bend Test (Applicable for chip size smaller than 1210) JIS C 5201-1 4.16 / AEC Q200-005 Board Flex : Apply force till 2mm bend and hold for 60±5 secs. Measure resistance while applying pressure.</p> <p>B)Pull Test (Applicable for chip size bigger than 0805) JIS C 5201-1 4.16.2 Pull Test : Apply 0.5kgF for 30 sec</p> <p>C)Push Test AEC Q200-006 Push Test : Apply 1.8kgF for 60±1secs</p> <p>D)Robustness Test 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.</p>	<p>Tolerance resistor. With no evidence of mechanical damage after releasing the pressure. ±(0.5%+0.05Ω) for 1% & 5%</p> <p>±(1.0%+0.05Ω) for 1% & 5%</p> <p>±(1.0%+0.05Ω) for 1% & 5%</p> <p>After reading/initial reading ≥5N</p>															



Product Specification

Towards Excellence in **Quality, Service & Innovation**

MILLI-OHM THICK FILM CHIP RESISTOR

CR Series

DS-ENG-005

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Item	Conditions	Specifications
		Resistors
Resistance to soldering heat	MIL-STD-202 Method 210 Solder bath method Resistor dipped entirely in solder bath of 260±5°C for 10 ⁺¹ ₋₀ sec. After which the sample shall be left at ambient temperature for 1~ 2 hrs before measurement.	±(0.5%+0.05Ω) for 1% & 5% tolerance resistor
Solderability	J-STD-002 For both Leaded & SMD. Electrical test not required. Magnification 50 X. Conditions: Leaded: Method A @ 235°C, category 3. SMD: a) Method B, 4 hrs @ 155°C dry heat @ 235°C b) Method B @ 215°C category 3. c) Method D category 3 @ 260°C.	> 95% Coverage at all terminal
Resistance to Solvent	MIL-STD-202 Method 215 Immerse in 25°C±5°C Isopropyl Alcohol (IPA) for 3±0.5 minutes.	Passed without any damaged to marking & protective material.
High Temperature	MIL-STD-202 Method 108 1000 hours @ T=125°C. Unpowered measurement at 24±2 hours after test conclusion.	±(0.5%+0.05Ω) for 1% tolerance resistor ±(1%+0.05Ω) for 5% tolerance resistor
Temperature Cycling	JESD 22 Method JA-104 1000 cycles (-55°C to 125°C) measurement at 24±2 hours after test conclusion.	±(0.5%+0.05Ω) for 1% tolerance resistor ±(1%+0.05Ω) for 5% tolerance resistor
Resistance to damp Heat (Humidity)	MIL-STD-202 Method 103 1000 hours 40±2°C / 90~95%RH Note: Specified condition 10% of operating power. Measurement at 24±2 hours after test conclusion.	±(1%+0.1Ω) for 1% & 5% tolerance resistor
Loadlife	MIL-STD-202 Method 108 At 70±3°C Apply DC rated voltage at 90minutes On, 30minutes Off for 1,000 ⁺⁴⁸ ₋₀ hours Sample shall be left at ambient temperature for 1~ 2 hrs after test before measuring final resistance.	±(1.0%+0.05Ω) for 1% tolerance resistor ±(2.0%+0.1Ω) for 5% tolerance resistor
Salt Spray	MIL-STD-202 Method 101 Spray 5±1 Wt% salt water for 96±4 hours at 35±2°C	±(3%+0.1Ω) for 1% & 5% tolerance resistor
Mounting Quality Test	JESD22-B102E Solder Paste : Sn-3Ag-0.5Cu Reflow soldering method Peak : 250 ⁺⁵ ₋₀ °C and 230±5°C for 60sec.	Visual check for solder joint wetting condition, resistor body damages



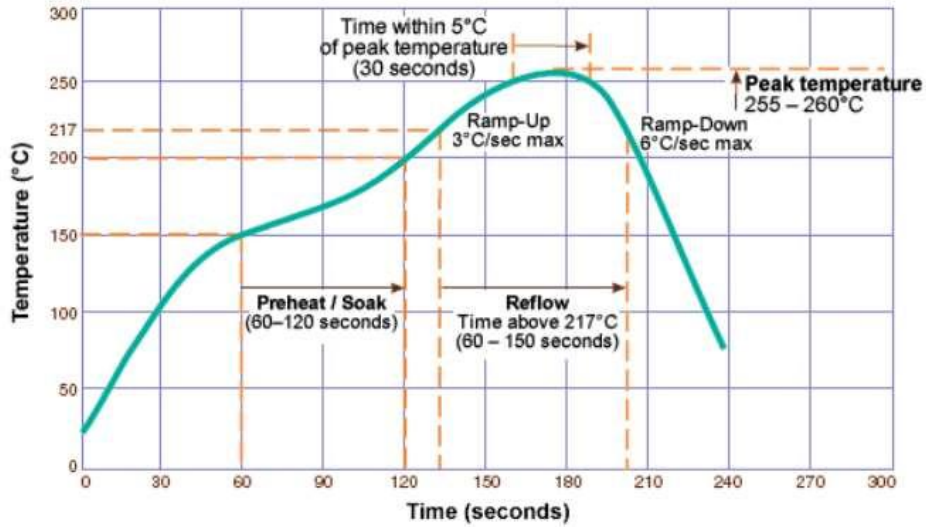
Product Specification

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6.1. Recommended Soldering Method

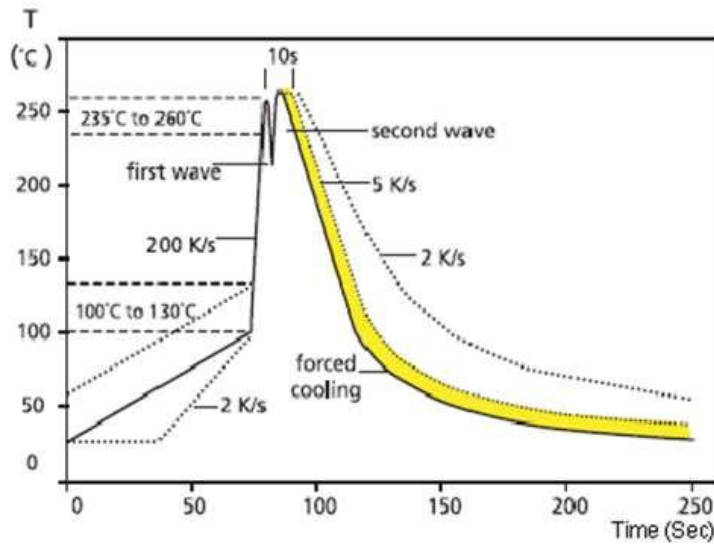
Technical application notes : This is for recommendation, customer please perform adjustment according to actual application.

6.1.1. Lead-Free IR Reflow Soldering Profile (Meet J-STD-020)



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

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

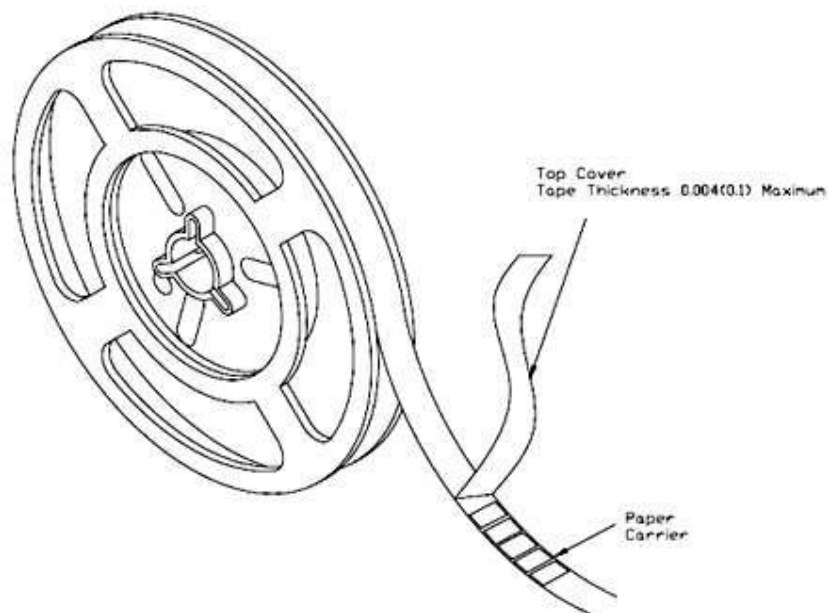


6.1.3. Soldering Iron: Temperature 350°C±10°C , dwell time shall be less than 3 sec.

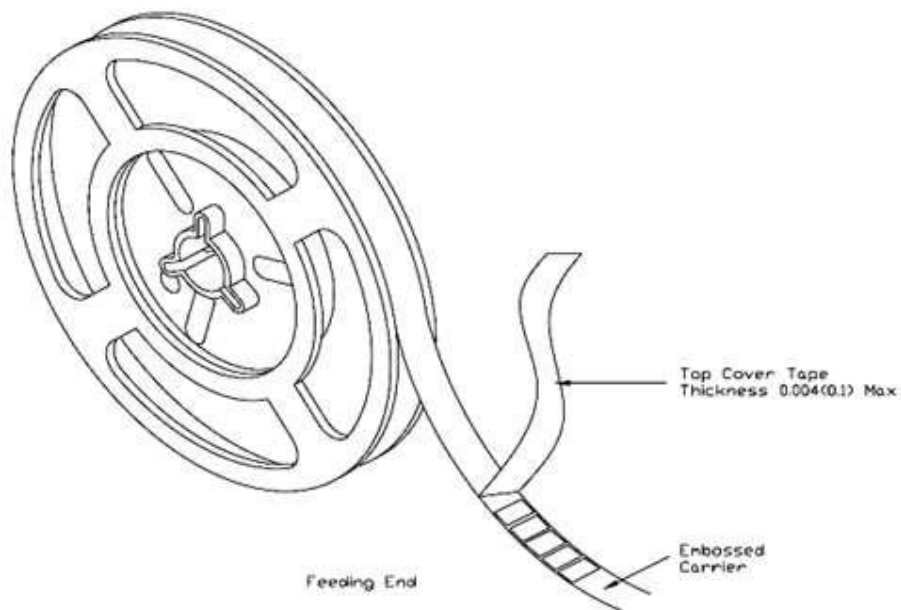
7. TAPING

7.1 Structure of Taping

Paper Carrier

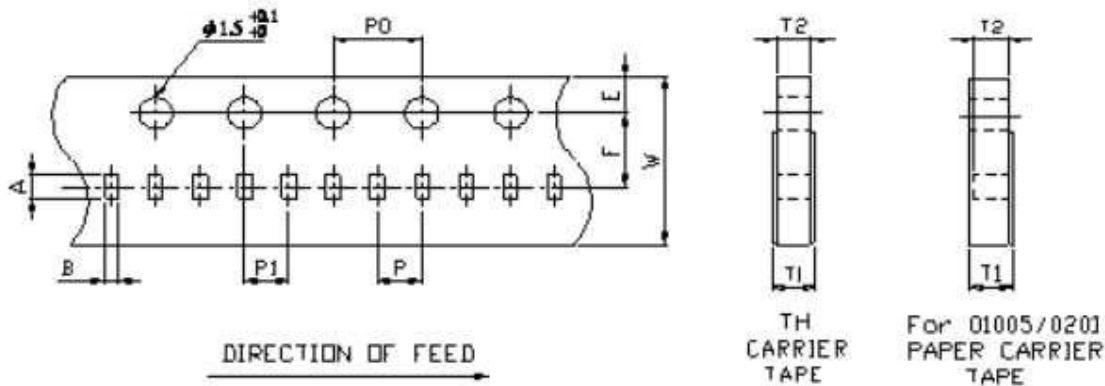


Embossed Plastic Carrier



7.2 Dimension

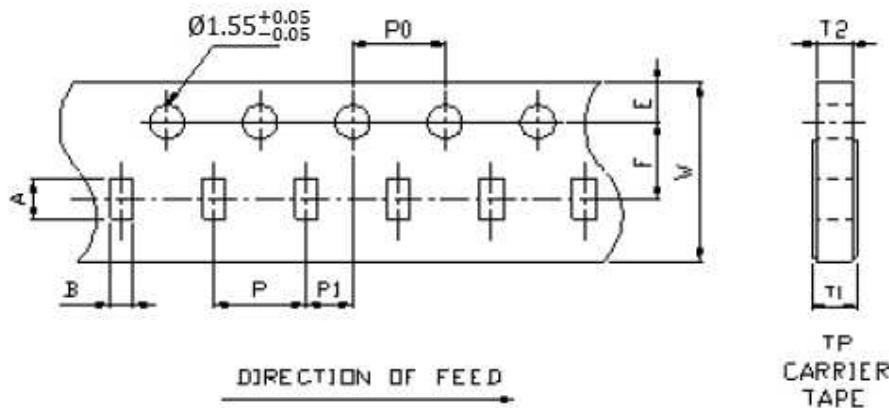
7.2.1 Dimension of Punched Paper Tape Carrier System (CR -10)



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

Code	A	B	W	E	F	T1	T2	P	P0	P1	10P0
CR10	1.15±0.03	0.65±0.03	8.00±0.10	1.75±0.10	3.50±0.05	0.42 ^{+0.2} ₋₀	0.42 ^{+0.03} _{-0.03}	2.00±0.05	4.00±0.10	2.00±0.05	40.0±0.20

7.2.2 Dimension of Punched Paper Tape Carrier System Carrier System (CR16, 21, 32)



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

Code	A	B	W	E	F	T1	T2	P	P0	P1	10P0
CR16	1.80±0.10	1.00±0.10	8.00±0.10	1.75±0.10	3.50±0.05	0.60 ^{+0.2} ₋₀	0.60±0.03	4.00±0.05	4.00±0.10	2.00±0.05	40.0±0.20
CR21	2.33±0.05	1.58±0.05	8.00±0.10	1.75±0.10	3.50±0.05	0.75 ^{+0.2} ₋₀	0.75 ^{+0.03} _{-0.05}	4.00±0.05	4.00±0.10	2.00±0.05	40.0±0.20
CR32	3.30±0.05	1.90±0.05	8.00±0.10	1.75±0.10	3.50±0.05	0.75 ^{+0.2} ₋₀	0.75 ^{+0.03} _{-0.05}	4.00±0.05	4.00±0.10	2.00±0.05	40.0±0.20

7.3 Packaging

7.3.1 Taping

Quantity – Tape and Reels

Code	Quantity	Reel	Remark
CR10	10,000 pcs	7" reel	2mm pitch
	20,000 pcs	7" reel	2mm pitch
	50,000 pcs	13" reel	2mm pitch
CR16	5,000 pcs	7" reel	4mm pitch
CR21	10,000 pcs	10" reel	4mm pitch
CR32	20,000 pcs	13" reel	4mm pitch

7.3.3 Identification

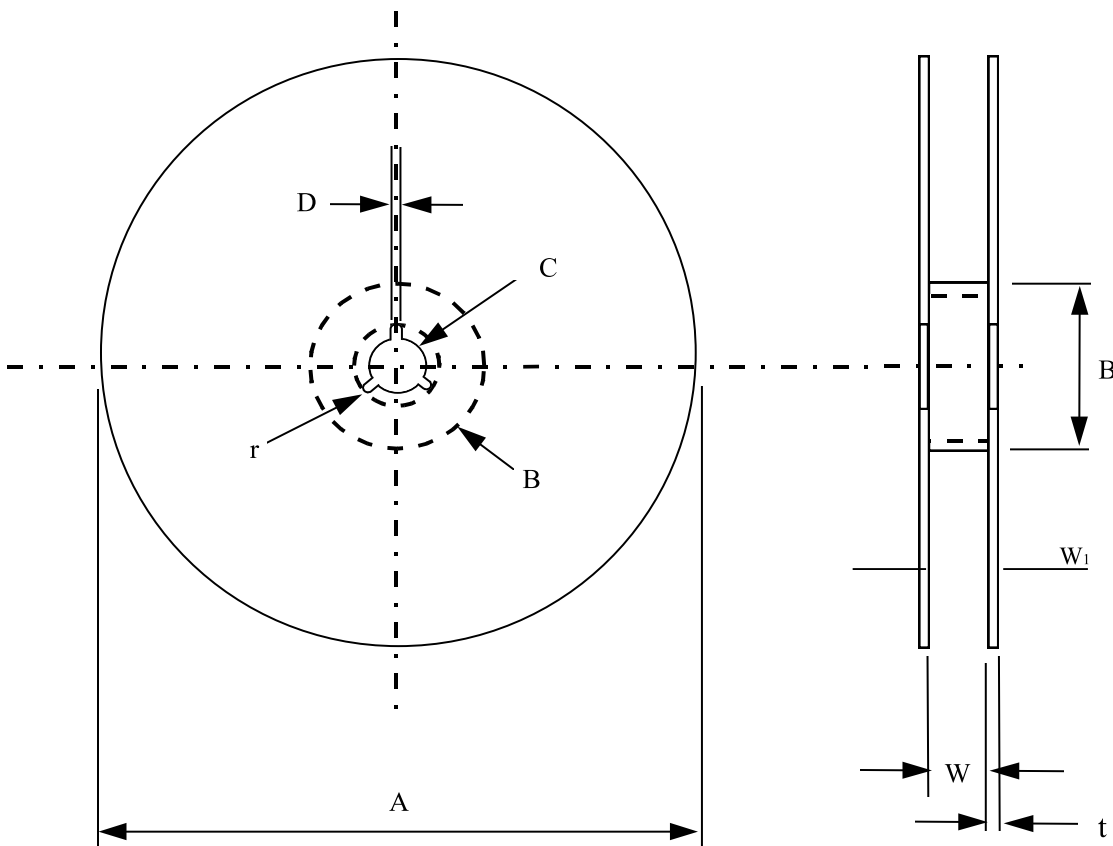
Production label that indicates the 10 digits lot number, product type, resistance value and tolerance shall be pasted on the surface of each reel.



7.3.4 Packaging Reel Box

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

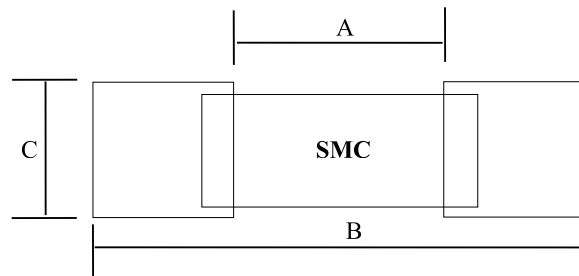
7.3.5 Reel Dimensions



Model	A	B	C	D	W	W ₁	t	r
7" Reel (5K) (except 0402 10K)	φ178±2.0	φ60min	13± 0.2	φ2.0± 0.5	11± 0.1	14.4 max	1.0± 0.1	1.0
7" Reel (4K)	φ178±2.0	φ60min	13± 0.2	φ2.0± 0.5	13±1.0	14.4 max	1.2± 0.1	1.0
10" Reel (10K)	φ254±2.0	φ60min	13± 0.2	φ2.0± 0.5	11± 1.0	14.4 max	1.5± 0.1	1.0
13" Reel (20K, 50K)	φ330±2.0	φ60min	13± 0.2	φ2.0± 0.5	11± 1.0	14.4 max	2.1± 0.1	-
13" Reel (20K)	φ330±1.0	φ100±1	13.5±0.5	2~3±0.5	10±0.5	-	-	-

8. RECOMMENDED 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.



Product (Type)	Land Dimension		
	A	B	C
CR10 (0402)	0.020 [0.5]	0.059 [1.5]	0.024 [0.6]
CR16 (0603)	0.031 [0.8]	0.083 [2.1]	0.035 [0.9]
CR21 (0805)	0.047 [1.2]	0.118 [3.0]	0.051 [1.3]
CR32 (1206)	0.087 [2.2]	0.165 [4.2]	0.063 [1.6]

MILLI-OHM THICK FILM CHIP RESISTOR

CR Series

DS-ENG-005

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9. REVISION HISTORY

Revision	Date	Change Notification	Description
Version.1	13.02.2015		Initial Release
Version.2	11.06.2015		Revise clause 3.1.1 Power Rating - CR32 1/4W - CR40 1/3W
Version.3	06.02.2017	Refer to PCN-ECO: 01/2016	Revise clause 2, typo error Typo error in clause 6.1.1, 6.1.2, change IR reflow to wave soldering, change wave to reflow soldering Revise clause 7.2 dimension Update clause 7.3.5, insert 13" reel information
Version.4	03.06.2020		Remove all Power chip product, all power chip product include to DS-ENG-067 Revise clause 1.3 Revise clause 2 Part Numbering System Revise clause 3.1.1 Resistor rated power Revise clause 3.2 Power derating characteristic graph Revise clause 3.9 Revise clause 3.10 TCR table Revise clause 4 Marking on product table Add clause 4.1.2 three numerals marking Revise clause 5.1 dimension Add clause 5.2 Resistor construction Revise clause 6 reliability test table Revise clause 7.2.1 & 7.2.2 dimension of punch paper tape Revise clause 7.3.2 tape and reel quantity table Revise clause 8 Land pattern dimension table.
Version.5	09.10.2020		Revise clause 3.5 storage temp. range
Version.6	26.01.2021		Revise clause 2 Part numbering System Revise clause 4 Marking on product Revise clause 4.1.1 ~ 4.1.3 Numeric Numbering
Version.7	22.09.2022		Revise clause 3.10 TCR table
Version 8	13.08.2024		Revise clause 3.1.1 table. Revise clause 3.10 table. Revise clause 5.1 Dimension table. Revise clause 6.1 Recommended Soldering Method. Revise clause 7.3.3 Identification. Revise clause 8 details.



Product Specification

Towards Excellence in **Quality, Service & Innovation**