

DATA SHEET

Precision Thick Film Chip Resistor

CR Series

0.1% TO 1%, TCR ± 50 TO ± 100

SIZE: 0201/0402/0603/0805/1206/1210/2010/2512

RoHs Compliant



PRECISION THICK FILM CHIP RESISTOR

CR Series

DS-ENG-002

Page: 2 of 18

1. SCOPE

- 1.3 This specification is applicable to lead and halogen free CR series precision thick film chip resistors.
- 1.3 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 for 0402, 0603, 0805, 1206, 1210, 2010 and 2512 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	10	-	XXXX	-	B	K	-	E
----	----	---	------	---	---	---	---	---

Type	Size (Inch / mm)	Nominal Resistance		Resistance Tolerance	Packaging	T.C.R	
Precision Thick Film Chip Resistors	05 (0201/0603)	Resistors	4-Digit	E96 Series 10.2Ω=10R2 10KΩ=1002	B = ±0.1% D = ±0.5% F = ±1%	E = 4,000 pcs Lead Free L = 5,000 pcs Lead Free K = 10,000 pcs Lead Free Y = 20,000 pcs Lead Free	E = ±50ppm F = ±100ppm (Leave Blank for Standard)
	10 (0402/1005)						
	16 (0603/1608)						
	21 (0805/2012)						
	32 (1206/3216)						
	40 (1210/3225)						
	50 (2010/5025)						
	63 (2512/6432)						

3. RATING

3.3 Rated Power

3.3.1 Resistor Rated Power

Product Type	Power Rating @ 70°C	T.C.R (ppm/°C) Max	Resistance Range E-24, E-96 B(±0.1%)	Resistance Range E-24, E-96 D(±0.5%)	Resistance Range E-96, E-24 F(±1%)	Max Working Voltage	Max Overload Voltage	Operating Temperature Range
CR05 0201 (0603)	1/20W	-200 to +400	---	1Ω ≤ R < 10Ω	---	25V	50V	-55°C to +125°C
		±200		10Ω ≤ R ≤ 10MΩ				
		±100	10Ω ≤ R ≤ 1MΩ	---	10Ω ≤ R < 1MΩ	30V	60V	-55°C to +155°C



Product Specification

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PRECISION THICK FILM CHIP RESISTOR

CR Series

DS-ENG-002

Page: 3 of 18

Product Type	Power Rating @ 70°C	T.C.R (ppm/°C) Max	Resistance Range E-24, E-96 B(±0.1%)	Resistance Range E-24, E-96 D(±0.5%)	Resistance Range E-96, E-24 F(±1%)	Max Working Voltage	Max Overload Voltage	Operating Temperature Range
CR10 0402 (1005)	1/16W	±50	100Ω ≤ R ≤ 1MΩ	---	100Ω ≤ R ≤ 1MΩ	50V	100V	-55°C to +155°C
		±100	---	---	1Ω ≤ R < 10Ω			
CR16 0603 (1608)	1/10W	±50	100Ω ≤ R ≤ 1MΩ	---	100Ω ≤ R ≤ 1MΩ	75V	150V	
		±100	---	---	1Ω ≤ R < 10Ω			
CR21 0805 (2012)	1/8W	±50	100Ω ≤ R ≤ 1MΩ	---	100Ω ≤ R ≤ 1MΩ	150V	300V	
		±100	---	---	1Ω ≤ R < 10Ω			
CR32 1206 (3216)	1/4W	±50	100Ω ≤ R ≤ 1MΩ	---	100Ω ≤ R ≤ 1MΩ	200V	400V	
		±100	---	---	1Ω ≤ R < 10Ω			
CR40 1210 (3225)	1/2W	±50	100Ω ≤ R ≤ 1MΩ	---	100Ω ≤ R ≤ 1MΩ	200V	400V	
		±100	100Ω ≤ R ≤ 1MΩ	10Ω ≤ R ≤ 10MΩ	1Ω ≤ R < 10Ω			
CR50 2010 (5025)	3/4W	±50	100Ω ≤ R ≤ 1MΩ	---	100Ω ≤ R ≤ 1MΩ	200V	400V	
		±100	100Ω ≤ R ≤ 1MΩ	10Ω ≤ R ≤ 10MΩ	1Ω ≤ R < 10Ω			
CR63 2512 (6432)	1W	±50	100Ω ≤ R ≤ 1MΩ	---	100Ω ≤ R ≤ 1MΩ	200V	400V	
		±100	100Ω ≤ R ≤ 1MΩ	10Ω ≤ R ≤ 10MΩ	1Ω ≤ R < 10Ω			

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.

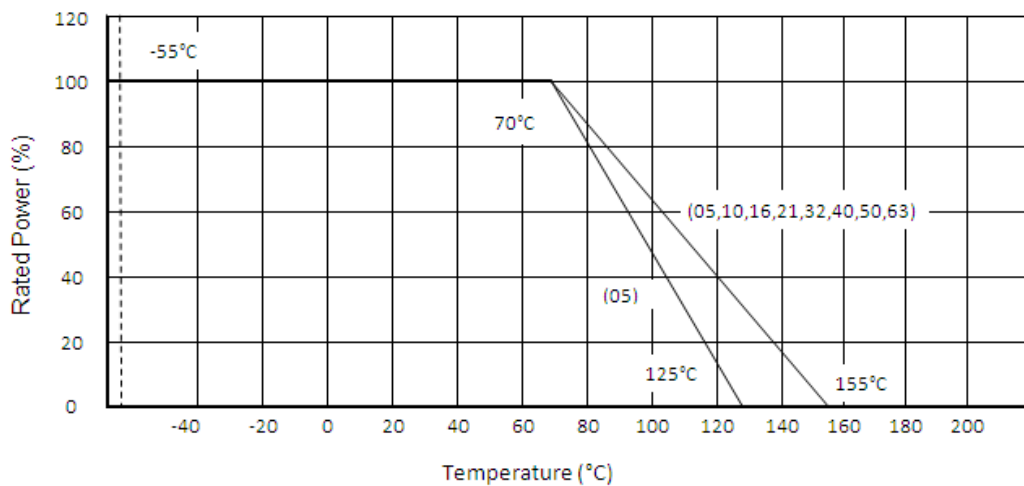


Fig.1 Power Derating Characteristics



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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 = $20 \pm 2^\circ\text{C}$

Relative Humidity = 60 to 70% RH

Air Pressure = 86 kPa to 106kPa

3.4 Operating Temperature Range -55°C to +155°C , (0201: ± 200 to +400) : -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 24 months from the date of shipment.

3.9 ASJ resistors are RoHS compliance in accordance to RoHS Directive 2011/65/EU.

3.10 Resistance, Resistance Tolerance and Temperature Coefficient of Resistance.

Table 1	Resistance Range		
	B (± 0.1%) E-96 E-24	D (± 0.5%) E-96 E-24	F (± 1%) E-96 E-24
CR05 (0201)	10Ω to 1MΩ	10Ω to 1MΩ	10Ω to 1MΩ
CR10 (0402)	1Ω to 1MΩ	1Ω to 1MΩ	1Ω to 1MΩ
CR16 (0603)	1Ω to 1MΩ	1Ω to 1MΩ	1Ω to 1MΩ
CR21 (0805)	1Ω to 1MΩ	1Ω to 1MΩ	1Ω to 1MΩ
CR32 (1206)	1Ω to 1MΩ	1Ω to 1MΩ	1Ω to 1MΩ
CR40 (1210)	1Ω to 1MΩ	1Ω to 1MΩ	1Ω to 1MΩ
CR50 (2010)	1Ω to 1MΩ	1Ω to 1MΩ	1Ω to 1MΩ
CR63 (2512)	1Ω to 1MΩ	1Ω to 1MΩ	1Ω to 1MΩ
Temperature Coefficient Resistance (TCR)	0.1%, 0.5%, & 1% (0201 only)	$10\Omega \leq R < 1M\Omega$	± 100ppm/°C
	0.1% , 0.5% & 1% (For all std product type)	$100\Omega \leq R < 1M\Omega$	± 50ppm/°C
	1% (For all std product type)	$1\Omega \leq R < 10\Omega$	± 100ppm/°C
Zero Ohm Jumper < 0.05Ω (Z,5%)			

3.11 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.

3.12 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

Part Number	Color	Marking on Product
CR05 (0201)	-	No marking
CR10 (0402)	-	No marking
CR16 (0603)	Light Yellow	1) Tolerance : $\pm 1.0\%$ (F) ° Four Numerals Marking (E96 Series) ° 0603 Three Characters Marking based on E-96 marking standard. ° 0603 Three Characters with underline Marking based on E-24 marking standard
CR21 (0805)	Light Yellow	
CR32 (1206)	Light Yellow	
CR40 (1210)	Light Yellow	
CR50 (2010)	Light Yellow	
CR63 (2512)	Light Yellow	

4.1 Numeric Numbering

4.1.1 5% Tolerance: *Three Numerals Marking*

First 2 digits are significant figures, third digit is number of zeros. Letter R is decimal point.

Example

<i>Nominal Resistance</i>	<i>Marking</i>	<i>Remarks</i>
1 Ω	1R0	$1 \times 10^0 = 1$
10 Ω	100	$10 \times 10^0 = 10$
100 Ω	101	$10 \times 10^1 = 100$
4.7K Ω	472	$47 \times 10^2 = 4700$
47K Ω	473	$47 \times 10^3 = 47000$
470K Ω	474	$47 \times 10^4 = 470000$
4.7M Ω	475	$47 \times 10^5 = 4700000$

4.1.2 1% Tolerance : *Four Numerals Marking*

First 3 digits are significant figures, fourth digit is number of zeros.

Examples:

<i>Nominal Resistance</i>	<i>Marking</i>	<i>Remarks</i>
1 Ω	1R00	$1 \times 10^0 = 1$
10 Ω	10R0	$10 \times 10^0 = 10$
100 Ω	1000	$100 \times 10^0 = 100$
4.7K Ω	4701	$470 \times 10^1 = 4700$
47K Ω	4702	$470 \times 10^2 = 47000$
470K Ω	4703	$470 \times 10^3 = 470000$
1M Ω	1004	$100 \times 10^4 = 1000000$

4.1.3 0603 1% Tolerance: *Three Character E-96 Marking Standard*.

The first 2 digits for the 3 digits E-96 part marking standard (Refer Table 2 & 3).

The third character is a letter multiplier:

<i>Nominal resistance</i>	<i>Marking</i>	<i>Remark</i>
33.2 Ω	51 X	$332 \times 10^{-1} \Omega$
150 Ω	18 A	$150 \times 10^0 \Omega$
4.99K Ω	68 B	$499 \times 10^1 \Omega$
10.2K Ω	02 C	$102 \times 10^2 \Omega$
100K Ω	01 D	$100 \times 10^3 \Omega$

4.1.3.1 EIA-96 Marking Scheme

Table 2 Significant figures

Significant Figures	Symbol	Significant Figures	Symbol	Significant Figures	Symbol	Significant Figures	Symbol
100	01	178	25	316	49	562	73
102	02	182	26	324	50	576	74
105	03	187	27	332	51	590	75
107	04	191	28	340	52	604	76
110	05	196	29	348	53	619	77
113	06	200	30	357	54	634	78
115	07	205	31	365	55	649	79
118	08	210	32	374	56	665	80
121	09	215	33	383	57	681	81
124	10	221	34	392	58	698	82
127	11	226	35	402	59	715	83
130	12	232	36	412	60	732	84
133	13	237	37	422	61	750	85
137	14	243	38	432	62	768	86
140	15	249	39	442	63	787	87
143	16	255	40	453	64	806	88
147	17	261	41	464	65	825	89
150	18	267	42	475	66	845	90
154	19	274	43	487	67	866	91
158	20	280	44	499	68	887	92
162	21	287	45	511	69	909	93
165	22	294	46	523	70	931	94
169	23	301	47	536	71	953	95
174	24	309	48	549	72	976	96

Table 3 Multiplier

Symbol	Multiplier	Symbol	Multiplier
A	10^0	G	10^6
B	10^1	H	10^7
C	10^2	X	10^{-1}
D	10^3	Y	10^{-2}
E	10^4		
F	10^5		

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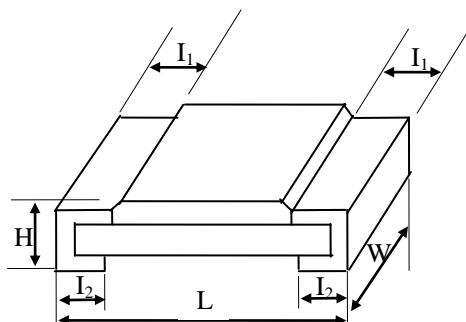
CR Series

DS-ENG-002

Page: 9 of 18

5. DIMENSIONS, CONSTRUCTIONS AND MATERIALS

5.3 Dimensions



Unit: Inches (Millimeters)

CODE	L	W	H	I ₁	I ₂
CR05 (0201)	0.024±0.001 (0.60±0.03)	0.012±0.001 (0.30±0.03)	0.009±0.001 (0.23±0.03)	0.006±0.002 (0.15±0.05)	0.006±0.002 (0.15±0.05)
CR10 (0402)	0.040±0.004 (1.00±0.10)	0.020±0.002 (0.50±0.05)	0.012±0.002 (0.30±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±0.004 (0.30±0.15)	0.012±0.004 (0.30±0.15)
CR21 (0805)	0.079±0.006 (2.00±0.10)	0.049±0.004 (1.25±0.10)	0.020±0.004 (0.50±0.10)	0.014±0.008 (0.35±0.20)	0.014±0.004 (0.35±0.15)
CR32 (1206)	0.118±0.004 (3.05±0.10)	0.060±0.004 (1.55±0.10)	0.020±0.004 (0.50±0.10)	0.016±0.008 (0.45±0.20)	0.014±0.004 (0.35±0.15)
CR40 (1210)	0.118±0.004 (3.05±0.10)	0.100±0.004 (2.55±0.10)	0.022±0.004 (0.55±0.10)	0.020±0.008 (0.50±0.20)	0.020±0.008 (0.50±0.20)
CR50 (2010)	0.200±0.008 (5.00±0.20)	0.098±0.008 (2.50±0.20)	0.022±0.004 (0.55±0.10)	0.024±0.008 (0.60±0.20)	0.024±0.008 (0.60±0.20)
CR63 (2512)	0.250±0.008 (6.30±0.20)	0.126±0.008 (3.20±0.20)	0.022±0.004 (0.55±0.10)	0.024±0.008 (0.60±0.20)	0.024±0.008 (0.60±0.20)

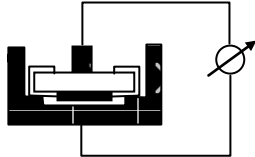
PRECISION THICK FILM CHIP RESISTOR

CR Series

DS-ENG-002

Page: 10 of 18

6. ELECTRICAL CHARACTERISTICS AND TEST CONDITIONS

CHARACTERISTICS		SPECIFICATIONS	TESTING CONDITIONS
		Resistance	
1	Resistance Temperature Coefficient	Refer Section 3.5 Table 1	<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 : $\text{TCR (ppm/}^{\circ}\text{C)} = \frac{R-R_0}{R_0} * \frac{1}{t-t_0} * 10^6$</p>
2	Short Time Overload	0.1%, 0.5%, 1%: $\pm(1.0\%+0.05\Omega)$	<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>
3	Insulation Resistance	$> 10\text{G } \Omega$	<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> 
4	Dielectric Withstanding Voltage	No failure of resistor such as short-circuit, burning, breakdown.	<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 Apply 50VAC for 1 minute ± 5secs for 0201 The variation in relation to the initial resistance shall be within $\pm 1\%$.</p>



Product Specification

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PRECISION THICK FILM CHIP RESISTOR

CR Series

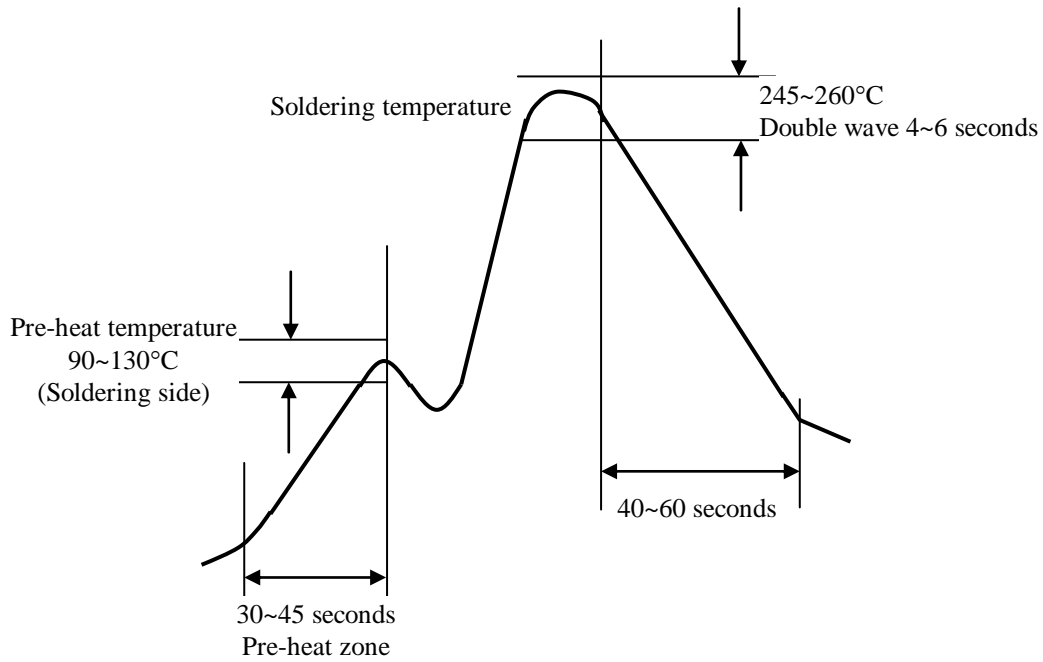
DS-ENG-002

Page: 11 of 18

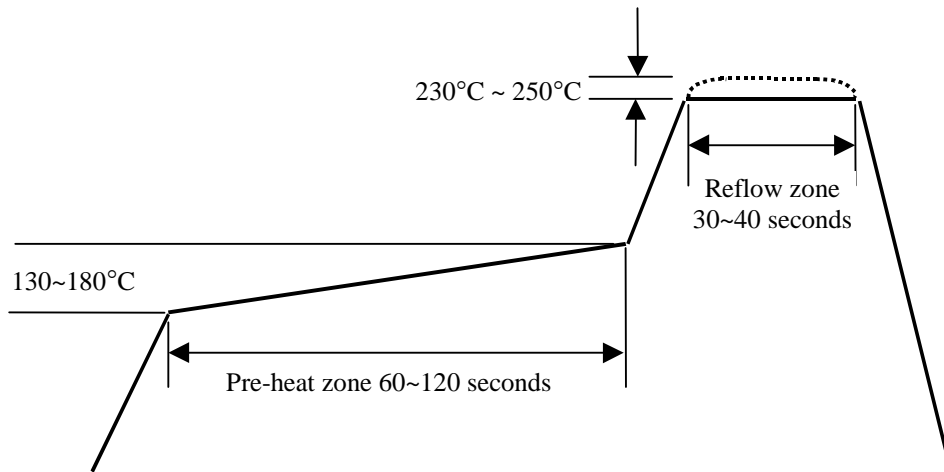
5	Intermittent Overload	$\pm(5\%+0.1\Omega)$ for 1% tolerance resistor	IEC 60115-1 4.39 2.5 times of rated voltage or maximum overload voltage whichever is less for 1 sec ON and 25 secs OFF. Total 1000 $^{+40}_{-0}$ cycles.
6	Terminal Strength	Tolerance resistor. With no evidence of mechanical damage after releasing the pressure. $\pm (0.5\%+ 0.05\Omega)$ for 1%	JIS C 5201-1 4.16 / AEC Q200-005 Test 1: The resistor mounted on the board applied 5N pushing force on the sample rear for 10 sec. Test 2: The resistor mounted on the board slowly add force on the sample rear until the sample termination is breakdown.
7	Resistance to soldering heat	$\pm (0.5\%+0.05\Omega)$ for 1% tolerance resistor	MIL-STD-202 Method 210 Solder bath method Resistor dipped entirely in solder bath of $260 \pm 5^{\circ}\text{C}$ for 10 sec. After which the sample shall be left at ambient temperature for 1~ 2 hrs before measurement.
8	Temperature Cycling	$\pm (0.5\%+0.05\Omega)$ for 1% tolerance resistor	JESD 22 Method JA-104 1000 cycles (-55°C to 125°C) measurement at 24 ± 2 hours after test conclusion.
9	Resistance to damp Heat (Humidity)	$\pm (1\%+0.1\Omega)$ for 1% tolerance resistor	MIL-STD-202 Method 103 1000 hours $40 \pm 2^{\circ}\text{C} / 90 \sim 95\text{RH}$ Note: Specified condition 10% of operating power. Measurement at 24 ± 2 hours after test conclusion.
10	Loadlife	$\pm (1.0\%+0.05\Omega)$ for 1% tolerance resistor	MIL-STD-202 Method 108 At $70 \pm 3^{\circ}\text{C}$ Apply DC rated voltage at 90minutes On, 30minutes Off for 1000 \pm_0^{48} hours Sample shall be left at ambient temperature for 1~ 2 hrs after test before measuring final resistance.
11	Solderability	$\geq 95\%$ Coverage at all terminal	J-STD-002 For both Leaded & SMD. Electrical test not required. Magnification 50 X. Conditions: Leaded: Method A @ 235°C , category 3.

6.1 Soldering Profile

6.1.1 IR Reflow



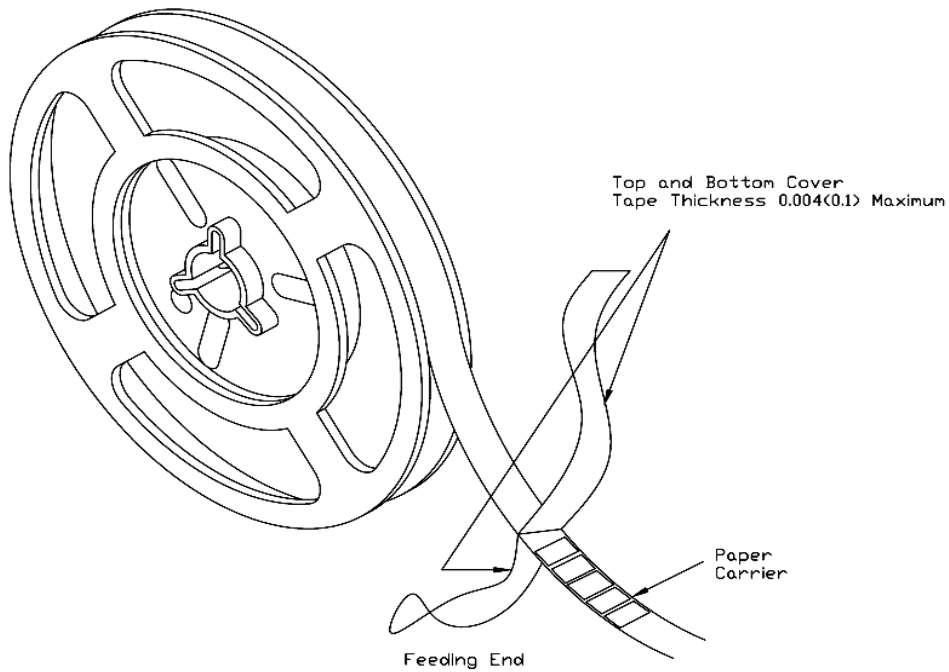
6.1.2 Wave Soldering



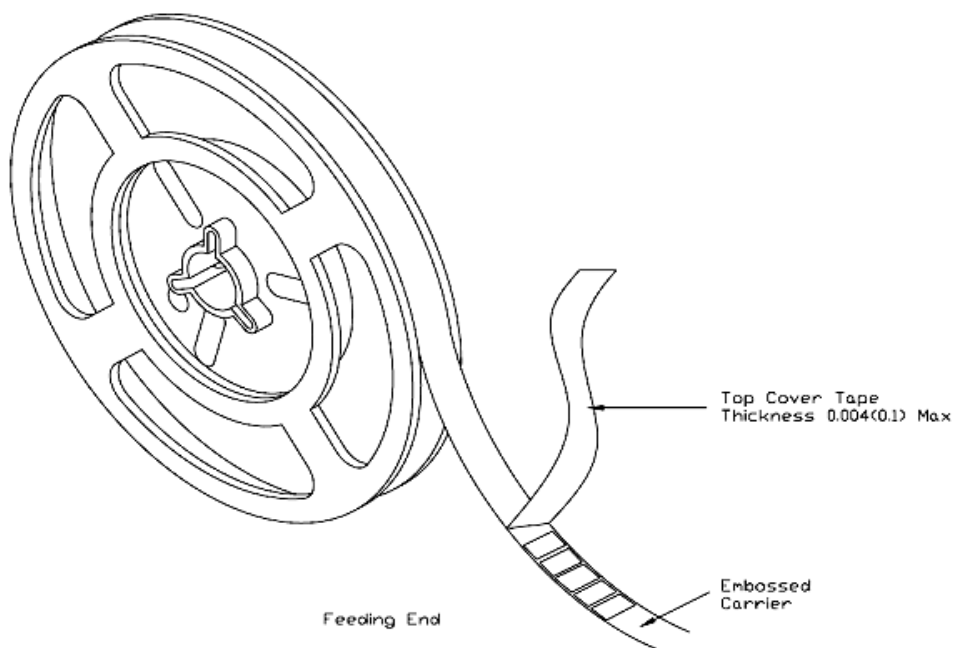
7. TAPING

7.1 Structure of Taping

Paper Carrier



Embossed Plastic Carrier



PRECISION THICK FILM CHIP RESISTOR

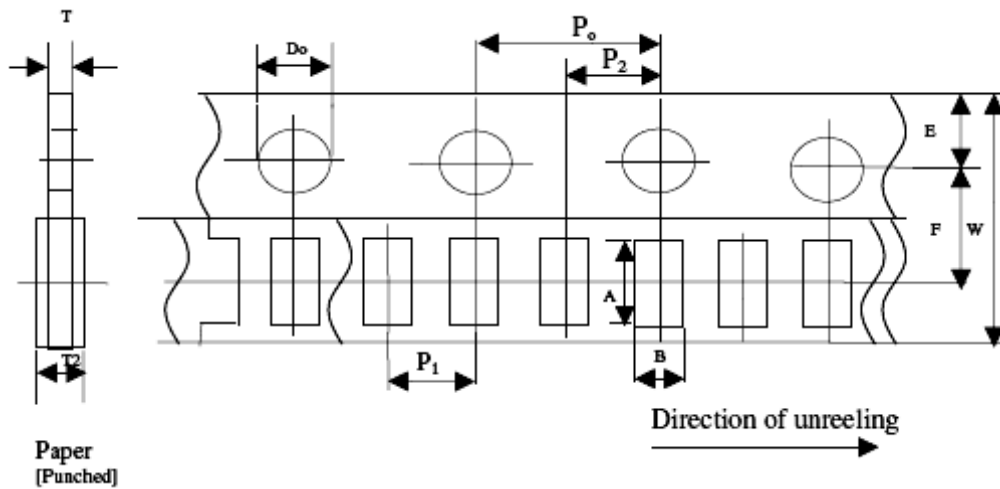
CR Series

DS-ENG-002

Page: 14 of 18

7.2 Dimension

7.5.1 Dimension of Punched Paper Tape Carrier System (CR -05 & 10)



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

Dimension of Punched Paper Tape Carrier System (CR- 05 & 10)

(unit : mm)

Code	A	B	W	E	F	P_1
CR05	0.75 ± 0.1	0.45 ± 0.1	8.0 ± 0.2	1.75 ± 0.1	3.5 ± 0.05	2.0 ± 0.05
CR10	1.15 ± 0.1	0.65 ± 0.05	8.0 ± 0.2	1.75 ± 0.1	3.5 ± 0.05	2.0 ± 0.05

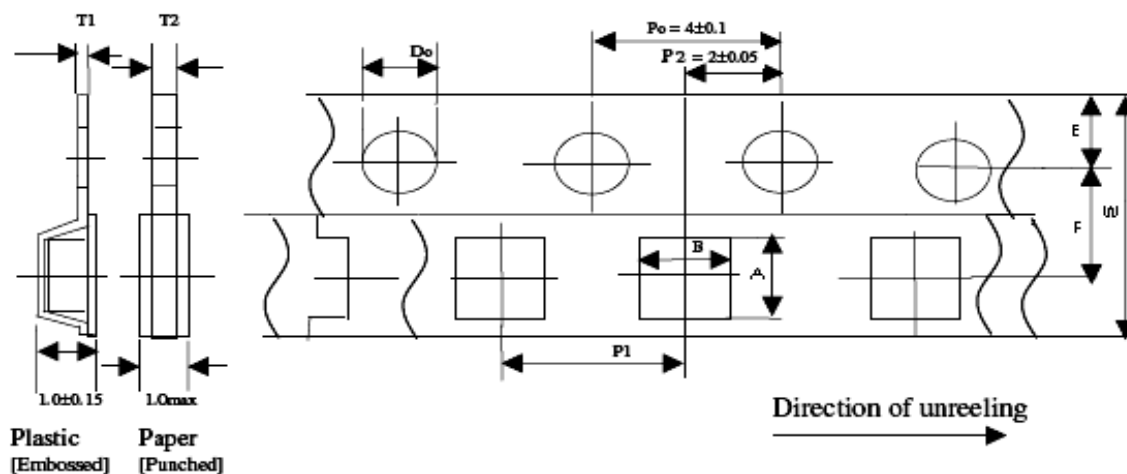
Code	P_2	P_0	D_0	T_2	T
CR05	2.0 ± 0.05	4.0 ± 0.1	1.5	0.53max	-
CR10	2.0 ± 0.05	4.0 ± 0.1	1.5	0.35 ± 0.1	-



Product Specification

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7.5.2 Dimension of Punched Paper Tape Carrier System /Plastic Embossed Carrier System
Carrier System
(CR16, 21, 32 & 40)



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

Dimension of Punched Paper Tape Carrier System (CR - 16, 21, 32, 40)

Code	A	B	W	E	F	P1	Do	T2
CR16	1.9 ± 0.1	1.1 ± 0.1	8.0 ± 0.2	1.75 ± 0.1	3.5 ± 0.05	4.0 ± 0.1	1.5 ± 0 ^{0.1}	0.60 ± 0.1
CR21	2.4 ± 0.1	1.65 ± 0.1						0.75 ± 0.1
CR32	3.5 ± 0.1	1.9 ± 0.1						0.75 ± 0.1
CR40	3.5 ± 0.1	2.8 ± 0.1						0.75 ± 0.1

Dimension of Plastic Embossed Carrier System (CR -50, 63)

Code	A	B	W	E	F	P1	Do	T1
CR50	5.4 ± 0.2	2.9 ± 0.2	12 ± 0.2	1.75 ± 0.1	5.5 ± 0.05	4.0 ± 0.1	1.5 ± 0 ^{0.1}	0.2 ± 0.10
CR63	6.6 ± 0.2	3.6 ± 0.1						

7.7 Packaging

7.7.1 Taping

7.7.1.1 Quantity – Tape and Reels

Code	Quantity	Model	Remarks
CR05	10000 pcs	7" reel	20 000 or 50 000 pcs on request
CR10	10000 pcs	7" Reel	10" Reel upon request
CR16	5000 pcs	7" Reel	10" & 13" Reel for 10 000 or 20 000 pcs on request
CR21			
CR32			
CR40	5000 pcs	7" Reel	-
CR50	4000 pcs	7" Reel	-
CR63	4000 pcs	7" Reel	-

PRECISION THICK FILM CHIP RESISTOR

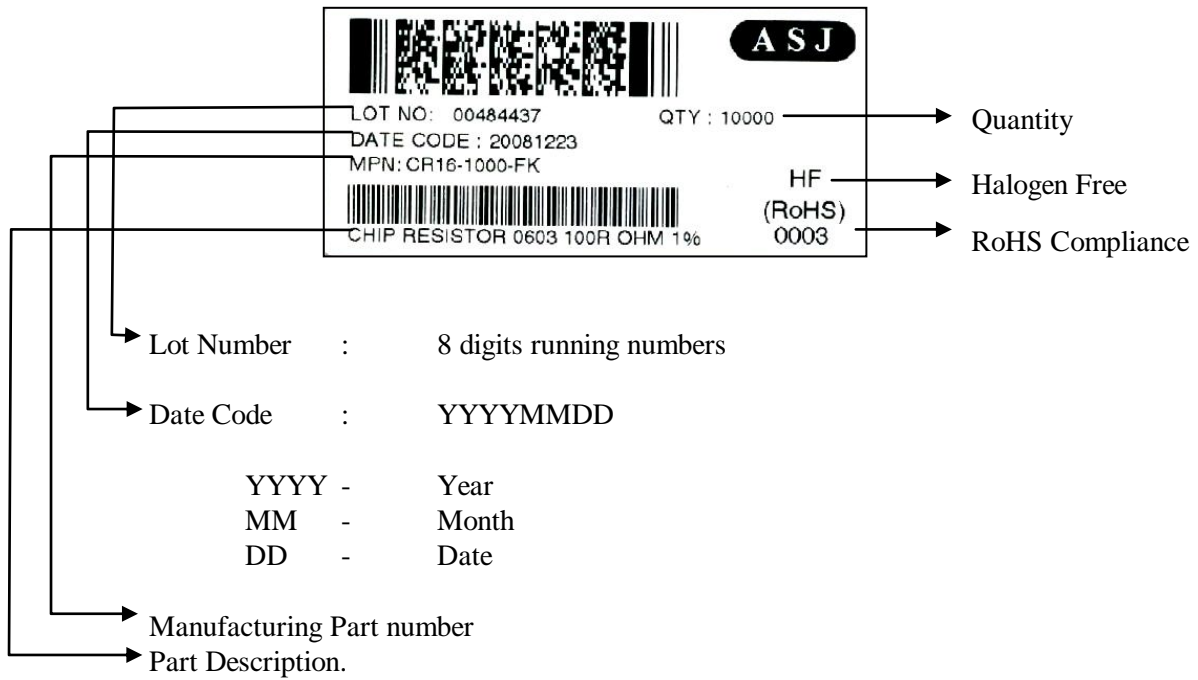
CR Series

DS-ENG-002

Page: 16 of 18

7.7.2 Identification

Production label that indicates the 8 digits lot number, product type, resistance value and tolerance shall be pasted on the surface of each reel.



7.7.3 Packaging Reel Box

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



Product Specification

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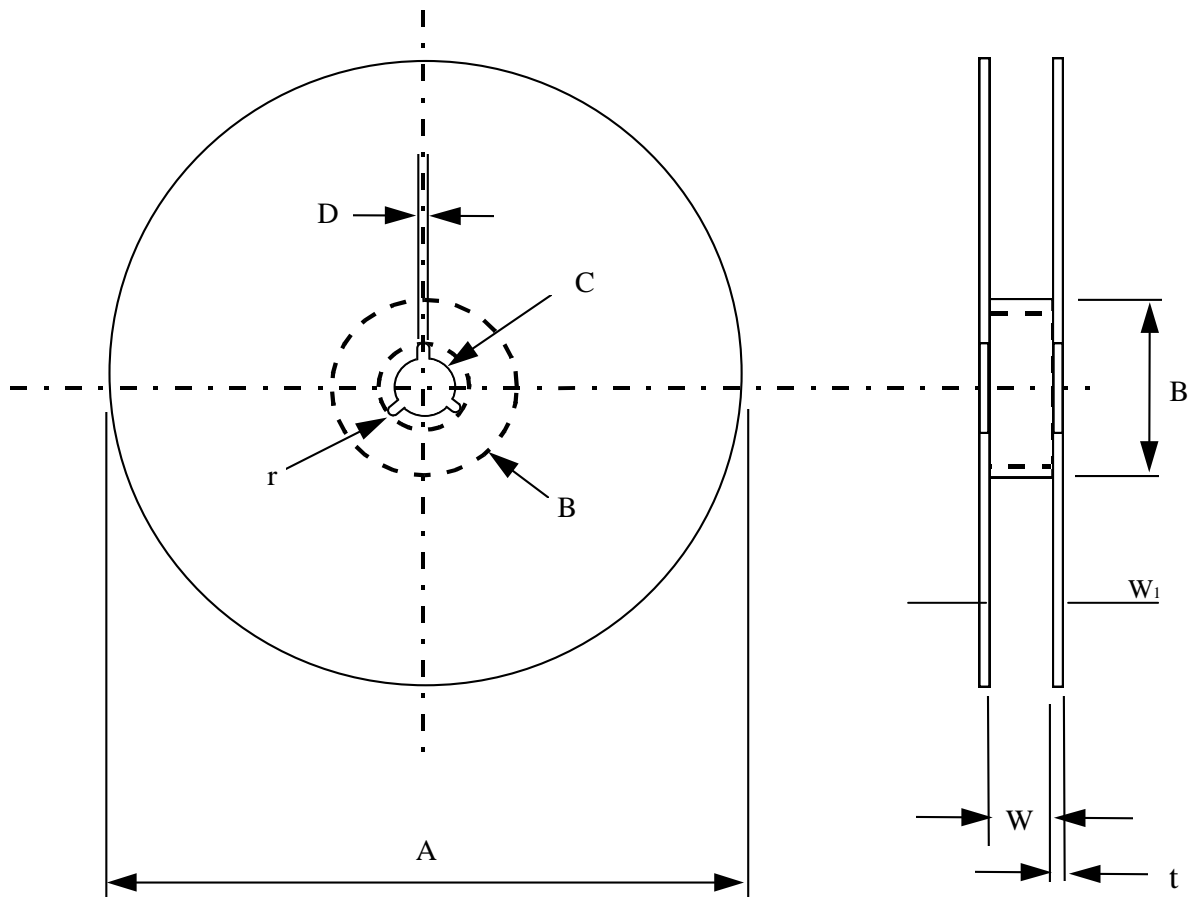
PRECISION THICK FILM CHIP RESISTOR

CR Series

DS-ENG-002

Page: 17 of 18

7.7.4 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
7" Reel (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
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	-

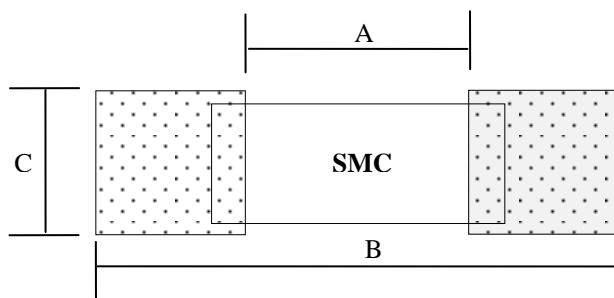
PRECISION THICK FILM CHIP RESISTOR

CR Series

DS-ENG-002

Page: 18 of 18

8. SURFACE MOUNT LAND PATTERNS



Product (Type)	Land Dimension		
	A	B	C
CR05 (0201)	0.012 [0.3]	0.04 [1.0]	0.016 [0.4]
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]
CR40 (1210)	0.087 [2.2]	0.165 [4.2]	0.110 [2.8]
CR50 (2010)	0.138 [3.5]	0.240 [6.1]	0.110 [2.8]
CR63 (2512)	0.149 [3.8]	0.315 [8.0]	0.137 [3.5]

9. REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version. 1	February 13,2015		Initial Release