

Data Sheet

Customer: _____

Product: Thin Film Precision Chip Resistor - RAR Series

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

Issued Date: 23-Nov.-2023

Edition: Ver. 3

Record of change

Date	Ver.	Description	Page
17-Aug.-2023	1		
04-Oct.-2023	2	Revise Recommend Land Pattern	2
23-Nov.-2023	3	Revise Resistance Range / Add Reflow Profiles	3,4,6

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Prepared by	Checked by	Approved by	Accepted by (customer)
23-Nov.-2023	23-Nov.-2023	23-Nov.-2023	
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Thin Film Precision Chip Resistor

RAR Series

■ Feature

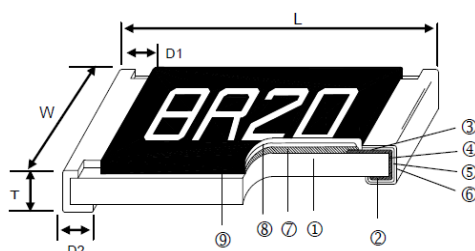
- Advanced thin film technology
- Very tight tolerance down to $\pm 0.01\%$
- Extremely low TCR down to $\pm 1\text{ppm}/^\circ\text{C}$
- Wide resistance range $1\Omega \sim 3\text{M}\Omega$
- Miniature size 0201 available



■ Applications

- Medical Equipment
- Testing / Measurement Equipment
- Printer Equipment
- Automatic Equipment Controller
- Converters
- Communication Device, Cell Phone, GPS, PDA

■ Construction & Dimensions



① Alumina Substrate	④ Edge Electrode	⑦ Resistor Layer
② Bottom Electrode	⑤ Barrier Layer	⑧ Overcoat
③ Top Electrode	⑥ External Electrode	⑨ Marking

Size	L	W	T	D1	D2
0201	0.58 $\pm$ 0.05	0.29 $\pm$ 0.05	0.23 $\pm$ 0.05	0.12 $\pm$ 0.05	0.15 $\pm$ 0.05
0402	1.00 $\pm$ 0.05	0.50 $\pm$ 0.05	0.30 $\pm$ 0.05	0.20 $\pm$ 0.10	0.20 $\pm$ 0.10
0603	1.55 $\pm$ 0.10	0.80 $\pm$ 0.10	0.45 $\pm$ 0.10	0.30 $\pm$ 0.20	0.30 $\pm$ 0.20
0805	2.00 $\pm$ 0.15	1.25 $\pm$ 0.15	0.55 $\pm$ 0.10	0.30 $\pm$ 0.20	0.40 $\pm$ 0.20
1206	3.05 $\pm$ 0.15	1.55 $\pm$ 0.15	0.55 $\pm$ 0.10	0.42 $\pm$ 0.20	0.35 $\pm$ 0.25
1210	3.10 $\pm$ 0.15	2.40 $\pm$ 0.15	0.55 $\pm$ 0.10	0.40 $\pm$ 0.20	0.55 $\pm$ 0.25
2010	4.90 $\pm$ 0.15	2.40 $\pm$ 0.15	0.55 $\pm$ 0.10	0.60 $\pm$ 0.30	0.50 $\pm$ 0.25
2010 (1/2W)	4.90 $\pm$ 0.15	2.40 $\pm$ 0.15	0.55 $\pm$ 0.10	0.60 $\pm$ 0.30	2.20 $\pm$ 0.25
2512	6.30 $\pm$ 0.15	3.10 $\pm$ 0.15	0.55 $\pm$ 0.10	0.60 $\pm$ 0.30	0.50 $\pm$ 0.25
2512 (1W) 1 Ω ~100 Ω	6.30 $\pm$ 0.15	3.10 $\pm$ 0.15	0.55 $\pm$ 0.10	0.60 $\pm$ 0.30	0.50 $\pm$ 0.25
2512 (1W) 101 Ω above	6.30 $\pm$ 0.15	3.10 $\pm$ 0.15	0.55 $\pm$ 0.10	0.60 $\pm$ 0.30	2.50 $\pm$ 0.25

(Unit:mm)

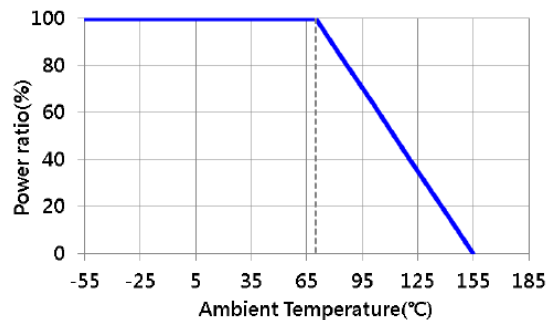
Thin Film Precision Chip Resistor

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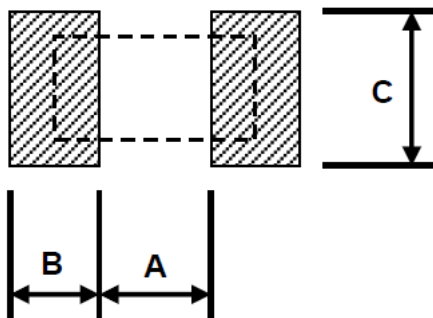
■ Part Numbering:

<u>RAR</u>	<u>0805</u>	<u>B</u>	<u>R</u>	<u>C</u>	<u>S</u>	<u>-</u>	<u>100R</u>
Series	Size	Tolerance	Packing Style	TCR (ppm/°C)	Power Rated	Packing Code	Resistance Value
	0201 0402 0603 0805 1206 1210 2010 2512	T: ±0.01% A: ±0.05% B: ±0.1% C: ±0.25% D: ±0.5% F: ±1%	R = Paper K = Embossed Plastic (2010 / 2512)	5: ±1 X: ±2 O: ±3 A: ±5 B: ±10 C: ±15 D: ±25 E: ±50	S: Standard N: 1/20W Y: 1/16W X: 1/10W W: 1/8W M: 1/6W P: 1/5W V: 1/4W O: 1/3W U: 1/2W Q: 3/4W T: 1W	- = 7 inch Reel (Standard) V = 13 inch Reel	for example: 1R 4R99 10R 100R 499R 1KR 10KR 49K9R 1MR 4M7R

■ Derating Curve



■ Recommend Land Pattern



Size	A	B	C
0201	0.25	0.30	0.40±0.2
0402	0.50	0.50	0.60±0.2
0603	0.80	1.00	0.90±0.2
0805	1.00	1.00	1.35±0.2
1206	2.00	1.15	1.70±0.2
1210	2.00	1.15	2.50±0.2
2010	3.60	1.40	2.50±0.2
2010 (1/2W)	1.00	2.70	2.50±0.2
2512	4.90	1.60	3.10±0.2
2512 (1W) 1Ω ~ 100Ω	4.90	1.60	3.10±0.2
2512 (1W) 101Ω above	1.00	3.55	3.10±0.2

(Unit:mm)

Thin Film Precision Chip Resistor RAR Series

■ Standard Electrical Specifications

Item Size	Power Rating at 70°C	Operating Temperature Range	Max. Operating Voltage	Max. Overload Voltage	Resistance Range					TCR (ppm/°C)
					±0.05 %	±0.1%	±0.25%	±0.5%	±1%	
0201	1/32W	-55~+155°C	15V	30V	--	22Ω ~ 75KΩ				±25,±50
0402	1/16W	-55~+155°C	50V	100V	49.9Ω ~ 12KΩ	4Ω ~ 511KΩ				±25,±50
0603	1/16W	-55~+155°C	50V	100V	4.7Ω ~ 332KΩ	1Ω ~ 1MΩ				±25,±50
0805	1/10W	-55~+155°C	100V	200V	4.7Ω ~ 1MΩ	1Ω ~ 2MΩ				±25,±50
1206	1/8W	-55~+155°C	150V	300V	4.7Ω ~ 1MΩ	1Ω ~ 3MΩ				±25,±50
1210	1/4W	-55~+155°C	150V	300V	4.7Ω ~ 1MΩ	1Ω ~ 3MΩ				±25,±50
2010	1/4W	-55~+155°C	150V	300V	4.7Ω ~ 1MΩ	1Ω ~ 3MΩ				±25,±50
2512	1/2W	-55~+155°C	150V	300V	4.7Ω ~ 1MΩ	1Ω ~ 3MΩ				±25,±50

** Lower Resistance : 1Ω ~ 10Ω

■ Special Electrical Specifications

Item Size	Power Rating at 70℃	Operating Temperature Range	Max. Operating Voltage	Max. Overload Voltage	Resistance Range						TCR (ppm/℃)
					±0.01%	±0.05%	±0.1%	±0.25%	±0.5%	±1%	
0402	1/16W	-55~+155℃	50V	100V	49.9Ω ~ 4.99KΩ			--			±1,±2,±3
					49.9Ω ~ 20KΩ						±5
					49.9Ω ~ 20KΩ			49.9Ω ~ 100KΩ			±10,±15
0603	1/16W	-55~+155℃	50V	100V	24.9Ω ~ 15KΩ			--			±1,±2,±3
					24.9Ω ~ 60KΩ						±5
					24.9Ω ~ 100KΩ	4.7Ω ~ 332KΩ	4.7Ω ~ 511KΩ			±10,±15	
0805	1/10W	-55~+155℃	100V	200V	24.9Ω ~ 30KΩ			--			±1,±2,±3
					24.9Ω ~ 150KΩ						±5
					24.9Ω ~ 200KΩ	4.7Ω ~ 1MΩ			±10,±15		
1206	1/8W	-55~+155℃	150V	300V	24.9Ω ~ 49.9KΩ			--			±1,±2,±3
					24.9Ω ~ 300KΩ						±5
					24.9Ω ~ 499KΩ	4.7Ω ~ 1.5MΩ			±10,±15		
1210	1/4W	-55~+155℃	150V	300V	24.9Ω ~ 49.9KΩ			--			±1,±2,±3
					24.9Ω ~ 300KΩ						±5
					24.9Ω ~ 499KΩ	4.7Ω ~ 1MΩ			±10,±15		
2010	1/4W	-55~+155℃	150V	300V	24.9Ω ~ 100KΩ			--			±1,±2,±3
					24.9Ω ~ 300KΩ						±5
					24.9Ω ~ 499KΩ	4.7Ω ~ 1MΩ			±10,±15		
2512	1/2W	-55~+155℃	150V	300V	24.9Ω ~ 100KΩ			--			±1,±2,±3
					24.9Ω ~ 300KΩ						±5
					24.9Ω ~ 499KΩ	4.7Ω ~ 1MΩ			±10,±15		

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■ High Power Rating Electrical Specifications

Item Size	Power Rating at 70°C	Operating Temperature Range	Max. Operating Voltage	Max. Overload Voltage	Resistance Range						TCR (ppm/°C)
					±0.01%	±0.05%	±0.1%	±0.25%	±0.5%	±1%	
0201	1/20W	-55~+155°C	25V	50V	--		22Ω ~ 75KΩ				±25,±50
0402	1/10W	-55~+155°C	50V	100V	49.9Ω ~ 4.99KΩ			--			±1,±2,±3
					49.9Ω ~ 20KΩ						±5
					49.9Ω ~ 12KΩ			49.9Ω ~ 100KΩ			±10,±15
					--	49.9Ω ~ 12KΩ	4.7Ω ~ 255KΩ			±25,±50	
0603	1/10W	-55~+155°C	75V	150V	24.9Ω ~ 15KΩ			--			±1,±2,±3
					24.9Ω ~ 60KΩ						±5
					24.9Ω ~ 100KΩ	4.7Ω ~ 332KΩ	4.7Ω ~ 511KΩ			±10,±15	
		1/6W	-55~+155°C	100V	150V			1Ω ~ 1MΩ			±25,±50
0805	1/8W	-55~+155°C	150V	300V	--	10Ω ~ 332KΩ					±25,±50
					24.9Ω ~ 30KΩ			--			±1,±2,±3
					24.9Ω ~ 150KΩ						±5
		1/4W	-55~+155°C	150V	300V	24.9Ω ~ 200KΩ	4.7Ω ~ 511KΩ	4.7Ω ~ 1MΩ			±10,±15
							1Ω ~ 2MΩ			±25,±50	
1206	1/4W	-55~+155°C	200V	400V	--	10Ω ~ 499KΩ					±25,±50
					24.9Ω ~ 49.9KΩ			--			±1,±2,±3
					24.9Ω ~ 300KΩ						±5
		1/3W	-55~+155°C	200V	400V	24.9Ω ~ 499KΩ	4.7Ω ~ 1MΩ			±10,±15	
						1Ω~1MΩ	1Ω ~ 3MΩ			±25,±50	
1210	1/3W	-55~+155°C	200V	400V	--	10Ω ~ 1MΩ					±25,±50
					24.9Ω ~ 49.9KΩ			--			±1,±2,±3
					24.9Ω ~ 300KΩ						±5
					24.9Ω ~ 499KΩ	4.7Ω ~ 1MΩ			±10,±15		
						1Ω~1MΩ	1Ω ~ 3MΩ			±25,±50	
2010	1/3W	-55~+155°C	200V	400V	24.9Ω ~ 49.9KΩ			--			±1,±2,±3
					24.9Ω ~ 300KΩ						±5
					24.9Ω ~ 499KΩ	4.7Ω ~ 1MΩ			±10,±15		
		1/2W	-55~+155°C	200V	400V	24.9Ω ~ 499KΩ	1Ω~1MΩ	1Ω ~ 3MΩ			±25,±50
						24.9Ω ~ 2KΩ	4.7Ω ~ 1MΩ	1Ω ~ 1MΩ			±10,±15
2512	3/4W	-55~+155°C	200V	400V	24.9Ω ~ 2KΩ	4.7Ω ~ 2KΩ	1Ω ~ 2KΩ			±10,±15	
					4.7Ω~2KΩ	4.7Ω~3MΩ	1Ω ~ 3MΩ			±25,±50	
					24.9Ω ~ 2KΩ	4.7Ω ~ 1MΩ	1Ω ~ 1MΩ			±10,±15	
					4.7Ω~1MΩ	4.7Ω~3MΩ	1Ω ~ 3MΩ			±25,±50	
		1W	-55~+155°C	200V	400V	24.9Ω ~ 2KΩ	4.7Ω ~ 1MΩ	1Ω ~ 1MΩ			±10,±15
							1Ω ~ 3MΩ			±25,±50	

**Operating Voltage= $\sqrt{P \cdot R}$ or Max. operating voltage listed above, whichever is lower.

**Overload Voltage= $2.5 \cdot \sqrt{P \cdot R}$ or Max. overload voltage listed above, whichever is lower.

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■ Environmental Characteristics

Item	Requirement		Test Method
	Tol. $\leq 0.05\%$	Tol. $> 0.05\%$	
Temperature Coefficient of Resistance (T.C.R)	As Spec.		MIL-STD-202 Method 304 +25/-55/+25/+125/+25°C
Short Time Overload	$\Delta R \pm 0.05\%$	$\Delta R \pm 0.2\%$	JIS-C-5201 4.13 RCWV*2.5 or Max. overload voltage whichever Is lower for 5 seconds
	$\Delta R \pm 0.2\%$ for high power rating		
Insulation Resistance	>9999 MΩ		MIL-STD-202 Method 302 Apply 100V _{DC} for 1 minute
Endurance	$\Delta R \pm 0.05\%$	$\Delta R \pm 0.2\%$	MIL-STD-202 Method 108A 70±2°C, RCWV for 1000 hrs with 1.5hrs “ON” and 0.5hrs “OFF”
	$\Delta R \pm 0.5\%$ for high power rating		
	0201: $> 7K\Omega \rightarrow \Delta R \pm 0.5\%$ $\leq 7K\Omega \rightarrow \Delta R \pm 0.2\%$		
Damp Heat with Load	$\Delta R \pm 0.05\%$	$\Delta R \pm 0.3\%$	MIL-STD-202 Method 103B 40±2°C, 90~95% R.H. RCWV for 1000 hrs with 1.5 hrs “ON” and 0.5 hrs “OFF”
	$\Delta R \pm 0.5\%$ for high power rating		
Bending Strength	$\Delta R \pm 0.05\%$	$\Delta R \pm 0.1\%$	JIS-C-5201-1 4.33 Bending amplitude 3mm for 60 seconds 2010/2512 size: 2mm / Other size: 3mm
Solderability	95% min. coverage		MIL-STD-202 Method 208H 245±5°C for 3 seconds
Resistance to Soldering Heat	$\Delta R \pm 0.05\%$	$\Delta R \pm 0.1\%$	MIL-STD-202 Method 210E 260±5°C for 10 seconds
Dielectric Withstand Voltage	By Type		MIL-STD-202 Method 301 Max. overload voltage for 1 minute
Low Temperature Operation	$\Delta R \pm 0.05\%$	$\Delta R \pm 0.2\%$	JIS-C-5201-1 4.36 1 hour,-65°C, followed by 45 minutes of RCWV
	$\Delta R \pm 0.5\%$ for high power rating		
High Temperature Exposure	$\Delta R \pm 0.5\%$		MIL-STD-202 Method 108 at +155°C for 1000 hrs

** RCWV(Rated continuous working voltage)= $\sqrt{P \cdot R}$ or Max. Operating voltage whichever is lower

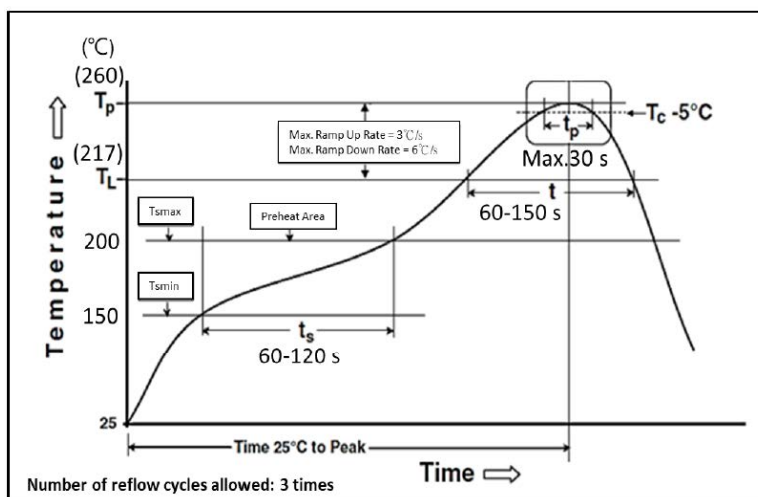
** Storage Temperature : 15 ~ 28°C ; Humidity < 80% RH

** Shelf Life : 2 years from production date.

Thin Film Precision Chip Resistor

RAR Series

■ Soldering Condition(IPC/JEDEC J-STD-020)



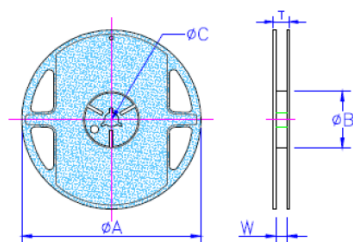
Reflow Profiles	
Profile Feature	Pb-Free Assembly
Preheat	
Min. Temperature (T _{smin})	150 °C
Max Temperature (T _{smax})	200 °C
Preheating time (t _s) from (T _{smin} to T _{smax})	60-120 seconds
Ramp-up rate (T _L to T _p)	3 °C/second max.
Liquidous temperature (T _L)	217 °C
Time (t _L) maintained above T _L	60-150 seconds
Min. Peak temperature (T _p min)	235°C
Max. Peak temperature (T _p max)	260°C
Time (t _p) within 5 °C of the specified classification temperature (T _c)	30 seconds max.
Ramp-down rate (T _p to T _L)	6 °C/second max.
Time 25 °C to peak temperature	8 minutes max.

Thin Film Precision Chip Resistor

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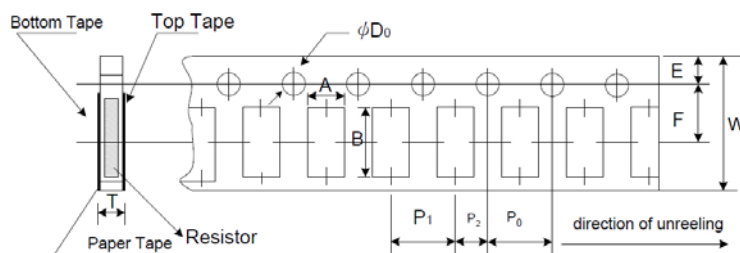
■ Packaging

Packing Quantity & Reel Specifications : (Unit:mm)



Size	φA	φB	φC	W	T	Paper Tape(EA)	Emboss Plastic(EA)
0201	178±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	10,000	-
0402	178±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	10,000	-
0603	178±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
0805	178±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
1206	178±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
1210	178±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
2010	178±1.0	60.0±1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	4,000
2512	178±1.0	60.0±1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	4,000

Paper Tape Specifications : (Unit:mm)

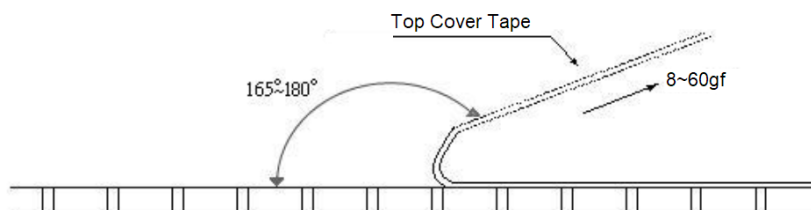


Size	A	B	W	E	F	P ₀	P ₁	P ₂	φD ₀	T
0201	0.40±0.05	0.70±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	2.00±0.05	2.00±0.05	1.55±0.05	0.42±0.02
0402	0.70±0.05	1.16±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	2.00±0.05	2.00±0.05	1.55±0.05	0.40±0.03
0603	1.10±0.05	1.90±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.55±0.05	0.60±0.03
0805	1.60±0.05	2.37±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.55±0.05	0.75±0.05
1206	2.00±0.05	3.55±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.55±0.05	0.75±0.05
1210	2.75±0.05	3.40±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.60±0.10	0.75±0.05

*Peel force of top cover tape

*The peel speed shall be about 300mm/min±5%

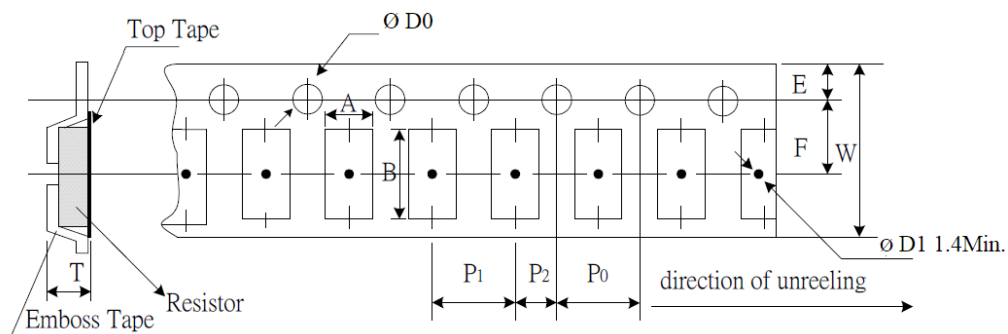
*The peel force of top cover tape shall be between 8gf to 60gf



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Emboss Plastic Tape Specifications : (Unit:mm)

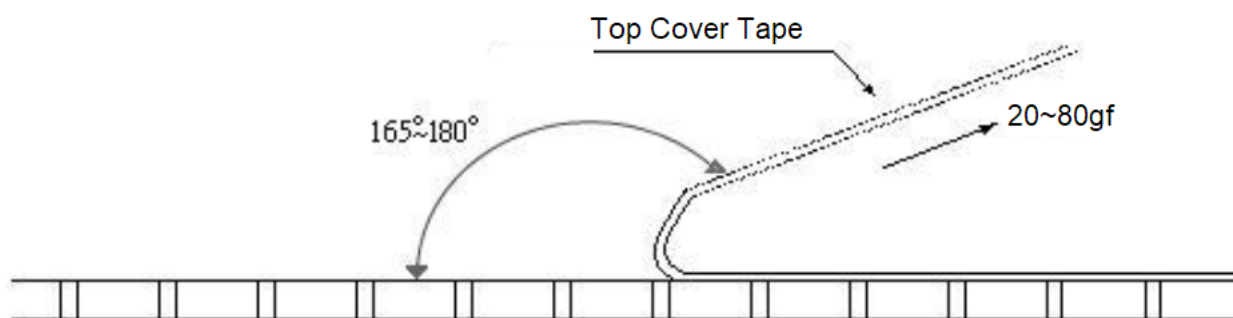


Size	A	B	W	E	F	P ₀	P ₁	P ₂	ØD ₀	T
2010	2.85±0.10	5.45±0.10	12.0±0.10	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50±0.10	1.00±0.02
2512	3.40±0.10	6.65±0.10	12.0±0.10	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50±0.10	1.00±0.02

*Peel force of top cover tape

*The peel speed shall be about 300mm/min±5%

*The peel force of top cover tape shall be between 20gf to 80gf

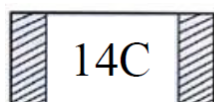


Thin Film Precision Chip Resistor

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■ Marking

0603 3digit marking



3digit marking for Example: 14C=13K7Ω 13C=13K3Ω

68B=4K99Ω 68X=49.9Ω

Marking Table

Marking table

Code	E96		Code	E96		Code	E96		Code	E96		
01	100		25	178		49	316		73	562		
02	102		26	182		50	324		74	576		
03	105		27	187		51	332		75	590		
04	107		28	191		52	340		76	604		
05	110		29	196		53	348		77	619		
06	113		30	200		54	357		78	634		
07	115		31	205		55	365		79	649		
08	118		32	210		56	374		80	665		
09	121		33	215		57	383		81	681		
10	124		34	221		58	392		82	698		
11	127		35	226		59	402		83	715		
12	130		36	232		60	412		84	732		
13	133		37	237		61	422		85	750		
14	137		38	243		62	432		86	768		
15	140		39	249		63	442		87	787		
16	143		40	255		64	453		88	806		
17	147		41	261		65	464		89	825		
18	150		42	267		66	475		90	845		
19	154		43	274		67	487		91	866		
20	158		44	280		68	499		92	887		
21	162		45	287		69	511		93	909		
22	165		46	294		70	523		94	931		
23	169		47	301		71	536		95	953		
24	174		48	309		72	549		96	976		
Code	A		B	C	D	E	F	G	H	X	Y	Z
Multiplier	10 ⁰		10 ¹	10 ²	10 ³	10 ⁴	10 ⁵	10 ⁶	10 ⁷	10 ⁻¹	10 ⁻²	10 ⁻³

0603 3digit marking for E24

Example: 101=100Ω 102=1KΩ

E24	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91
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0805~2512 4digit marking

Example

Resistance	100Ω	2.2KΩ	10KΩ	49.9KΩ	100KΩ
marking	1000	2201	1002	4992	1003