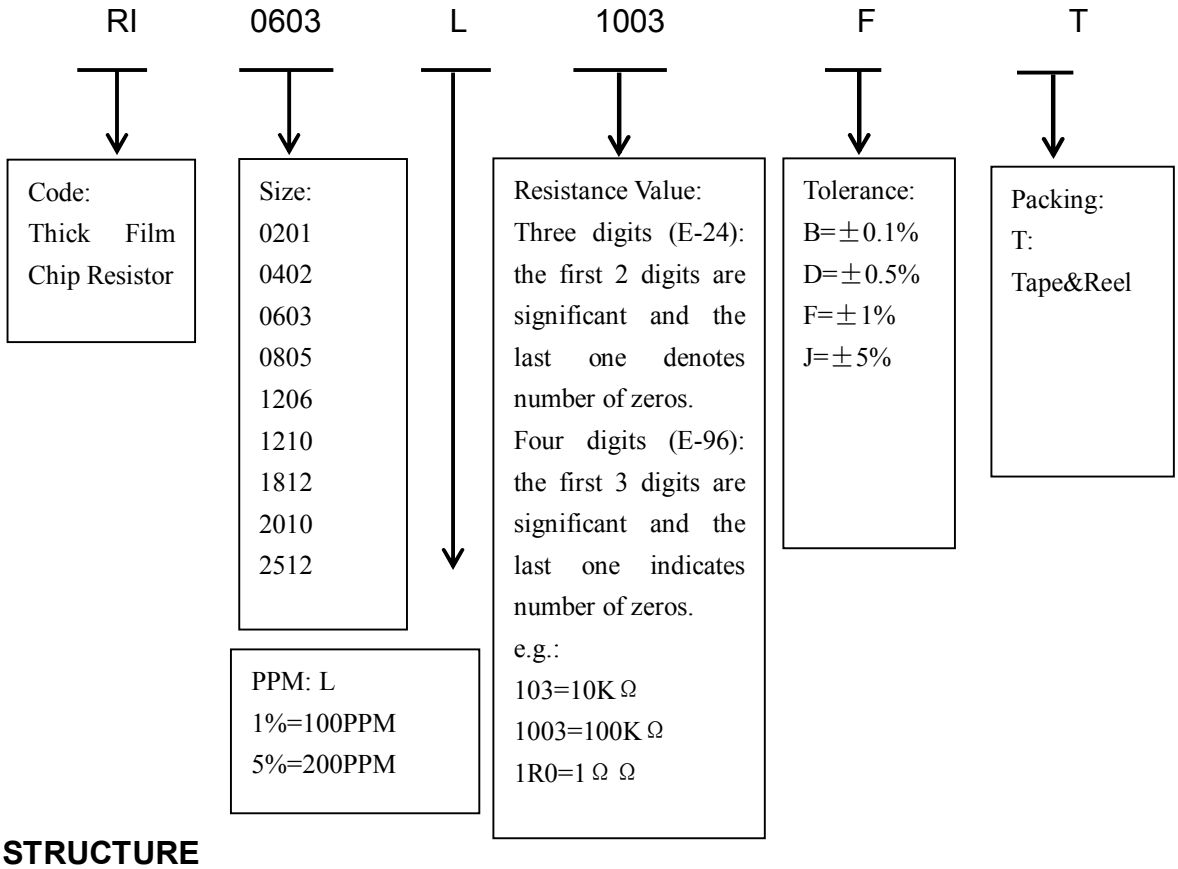
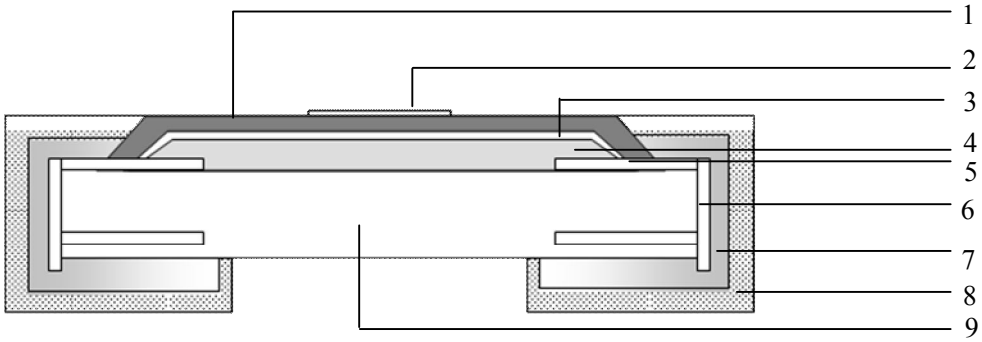
1. PART NUMBER

e.g.: RI0603L1003FT



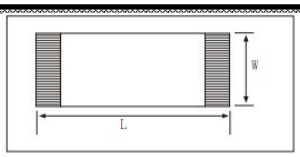
2. STRUCTURE

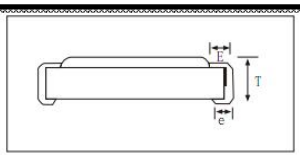


1. External Protective Layer 2. Marking 3. Internal Protective Layer 4.Resistance Layer
5. Conductor Layer 6. Side Conductor Layer 7. Nickel 8. Tin 9. Ceramic Substrate

3. Dimension and Electrical Parameters

Hottech Thick Film Chip Resistors





Size	L	W	T	E	e
0201	0.60±0.03	0.30±0.03	0.23±0.03	0.15±0.05	0.15±0.05
0402	1.00±0.05	0.50±0.05	0.35±0.05	0.15±0.10	0.20±0.10
0603	1.60±0.15	0.80±0.10	0.45±0.10	0.25±0.20	0.30±0.20
0805	2.00±0.15	1.25±0.15	0.50±0.10	0.35±0.20	0.40±0.20
1206	3.10±0.15	1.60±0.15	0.55±0.10	0.45±0.25	0.40±0.25
1210	3.10±0.15	2.50±0.15	0.55±0.15	0.50±0.25	0.50±0.35
1812	4.50±0.15	3.20±0.15	0.55±0.15	0.50±0.25	0.50±0.35
2010	5.00±0.20	2.50±0.20	0.55±0.15	0.65±0.25	0.50±0.25
2512	6.25±0.20	3.10±0.20	0.55±0.15	0.85±0.25	0.95±0.25

Size	Power Rating 70℃	Max working Voltage	Max Overload Voltage	T.C.R (ppm/℃)	Resistance Range				0ohm Jumper	Zero Resistance Max Current
					D(±0.5%) E96	F(±1%) E96	G(±2%) E24	J(±5%) E24		
0201	1/20W	25V	50V	±600	----------	1Ù~25Ù	1Ù~25Ù	1Ù~25Ù	50mÙ MAX	0.5A
				±250	----------	25Ù~10MÙ	25Ù~10MÙ	25Ù~10MÙ		
0402	1/16W	50 V	100V	+500～-250	----------	1Ù~10Ù	1Ù~10Ù	1Ù~10Ù	50mÙ MAX	1A
				±200	----------	----------	10Ù~10MÙ	10Ù~22MÙ		
				±100	----------	10Ù~10MÙ	----------	----------		
0603	1/10W	50V	100V	+500～-250	----------	1Ù~10Ù	1Ù~10Ù	1Ù~10Ù	50mÙ MAX	1A
				±200	----------	----------	10Ù~10MÙ	10Ù~22MÙ		
				±100	10Ù~1MÙ	10Ù~10MÙ	----------	----------		
0805	1/8W	150V	300V	+500～-250	----------	1Ù~10Ù	1Ù~10Ù	1Ù~10Ù	50mÙ MAX	1.5A
				±200	----------	----------	10Ù~10MÙ	10Ù~22MÙ		
				±100	10Ù~1MÙ	10Ù~10MÙ	----------	----------		
1206	1/4W	200V	400V	+500～-250	----------	1Ù~10Ù	1Ù~10Ù	1Ù~10Ù	50mÙ MAX	1.9A
				±200	----------	----------	10Ù~10MÙ	10Ù~22MÙ		
				±100	10Ù~1MÙ	10Ù~10MÙ	----------	----------		
1210	1/2W	200V	400V	+500～-250	----------	1Ù~10Ù	1Ù~10Ù	1Ù~10Ù	50mÙ MAX	2.2A
				±200	----------	----------	10Ù~10MÙ	10Ù~22MÙ		
				±100	----------	10Ù~10MÙ	----------	----------		
1812	3/4W	200V	400V	+500～-250	----------	1Ù~10Ù	1Ù~10Ù	1Ù~10Ù	50mÙ MAX	3A
				±200	----------	----------	10Ù~10MÙ	10Ù~22MÙ		
				±100	----------	10Ù~10MÙ	----------	----------		
2010	3/4W	200V	400V	+500～-250	----------	1Ù~10Ù	1Ù~10Ù	1Ù~10Ù	50mÙ MAX	3A
				±200	----------	----------	10Ù~10MÙ	10Ù~22MÙ		
				±100	----------	10Ù~10MÙ	----------	----------		
2512	1W	200V	400V	+500～-250	----------	1Ù~10Ù	1Ù~10Ù	1Ù~10Ù	50mÙ MAX	3A
				±200	----------	----------	10Ù~10MÙ	10Ù~22MÙ		

				±100	----------	10Ω~10MΩ	----------	----------		

4. MARKING

4.1 Marking for R>=1Ω

- For 0201 and 0402, there is no marking on the body for the small dimension.
- For 0.1%, 0.5% and 1% resistor, there is 4-digit marking on the body, in which the first 3 digits are significant and the last one indicates number of zeros.

e.g.: 1003=100*10^3=100*1000=100000Ω=100KΩ
4703=470*10^3.=470*1000=470000Ω=470KΩ
22R1=22.1Ω (R is decimal point)
1R30=1.3Ω (R is decimal point, add 0 as the fourth digit if there are only 3 digits)

- For 2% and 5% resistor, there is 3-digit marking on the body, in which the first 2 digits are significant and the last one indicates number of zeros.

e.g.: 103=10*$10^{3=}$10*1000=10000Ω=10KΩ
473=47*$10^{3.=}$47*1000=47000Ω=47KΩ
1R3=1.3Ω (R is decimal point)

- For 0603 0.1%, 0.5% and 1% resistor, the marking is E96 code (three digits).

e.g.: 02C=102*$10^{2=}$102*100=10200Ω=10.2KΩ
15E=140*10^4=140*10000=1400000Ω=1.4MΩ

– For special values with tolerance 0.1%, 0.5% and 1% in 0603 size, which belong to E-24 series but not E-96 series, the marking is the same with that for 5% but underlined.

e.g.: 124=120K

4.2 Marking for R<1Ω

- For 0201 and 0402, there is no marking on the body for the small dimension.
- For 0.1%, 0.5% and 1% resistor, there is 4-digit marking on the body, R is the decimal point

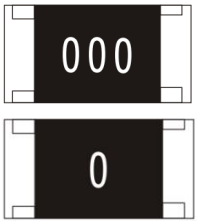
e.g.: R200=0.2Ω
R002=0.002Ω

- For 2% and 5% resistor, there is 3-digit marking on the body, R is the decimal point

e.g.: R20=0.2Ω
R02=0.02Ω

4.3 Marking for R=0Ω

- There is no marking for 0201 and 0402.
- Marking for 0603, 0805, 1206, 1210, 2010 and 2512 is one or three zeros.



E-96 Code (0603)

Code	A	B	C	D	E	F	G	H	X	Y	Z
Zero number	10^0	10^1	10^2	10^3	10^4	10^5	10^6	10^7	10^{-1}	10^{-2}	10^{-3}

Value (Ω)	Code	Value (Ω)	Code	Value (Ω)	Code	Value (Ω)	Code
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

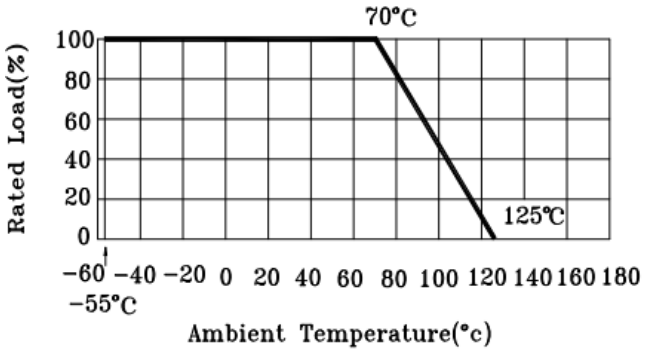
4.4 TOLERANCE RANGE

Type	Tolerance (%)	Code	Resistance Range (ohm)	Standard Resistance
0402 0603 0805 1206	±0.5%	D	10-1M	E96
0201 0402 0603 0805 1206 1210 1812 2010 2512	±1%	F	1R0-10M	E96
	±2%	G		
	±5%	J	1R0~22M (0201:1R0-10M)	E24
	±10%	K		
	±20%	M		

5. POWER RATING

Type	Rated Power	Max Working Voltage	Max Overload Voltage
0201	1/20W	25V	50V
0402	1/16W	50V	100V
0603	1/10W	50V	100V
0805	1/8W	150V	300V
1206	1/4W	200V	400V
1210	1/2W	200V	400V
1812	3/4W	200V	400V
2010	3/4W	200V	400V
2512	1W	200V	400V

Resistors can work with full load under -55℃-70℃, but power dissipation will decrease when the temperature is higher than 70℃, as it is shown in the following graph:



6. TEST METHODS

6.1 Resistance Value: Use high-precision measurement equipment to measure the resistance value by 4-wire test technology. The standard test voltages are as below:

Test Voltage

1Ù~100Ù	0.3V
100Ù~1KÙ	1V
1KÙ~10KÙ	3V
10KÙ~100KÙ	10V
100KÙ~1MÙ	25V
1MÙ~10MÙ	50V
10MÙ 以上	100V

6.2 Voltage Ratings

Formula for rated voltage: $E=\sqrt{RP}$

E: Rated Voltage (V)

P: Rated Power (W) R: Resistance Value (ohm)

If E is higher than the max working voltage in Form 3.1, then the rated voltage is the max working voltage.

6.3 TCR

Solder the resistor on the test board and then test according the following steps. Formula for TCR:

$$TCR(ppm/℃)=\frac{R - R_O}{R_O * (t - t_0)} * 10^6$$

R= Resistance Under Specified Temperature

R0= Resistance Under Room Temperature

t= Specified Test Temperature

t0 = Room Temperature

STEP	TEMPERATURE
1	25±5℃
2	125±5℃

6.4 Short-time Overload

Solder the resistor on the test board and charge 2.5x rated voltage for 5s. If the charged voltage is higher than the max overload voltage, then take the max overload as standard. Measure the resistance value according the steps specified in 7.1.1. Please see the formulas below:

$$\Delta R\% = \frac{R_2 - R_1}{R_1} * 100 \text{------}(\%)$$

R1＝Resistance before test（Ω）

R2＝Resistance after test（Ω）

6.5 Withstand Voltage

Charge the max overload voltage to the insulation layer of the tested resistor for 1 minute, and then

check if it is broken down. Increase the voltage until it is broken down and record this voltage.

7. Mechanical test

7.1 Anti-soldering heat

Resistor 260℃±5℃

The resistor dip in the tin heater, 10 seconds, according to the testing resistance 7.1.1, the count method is as below:

$$\Delta R\% = \frac{R_2 - R_1}{R_1} * 100 \text{------}(\%)$$

R1= Resistance before testing（Ω）

R2= Resistance after testing（Ω）

7.2 Solderability

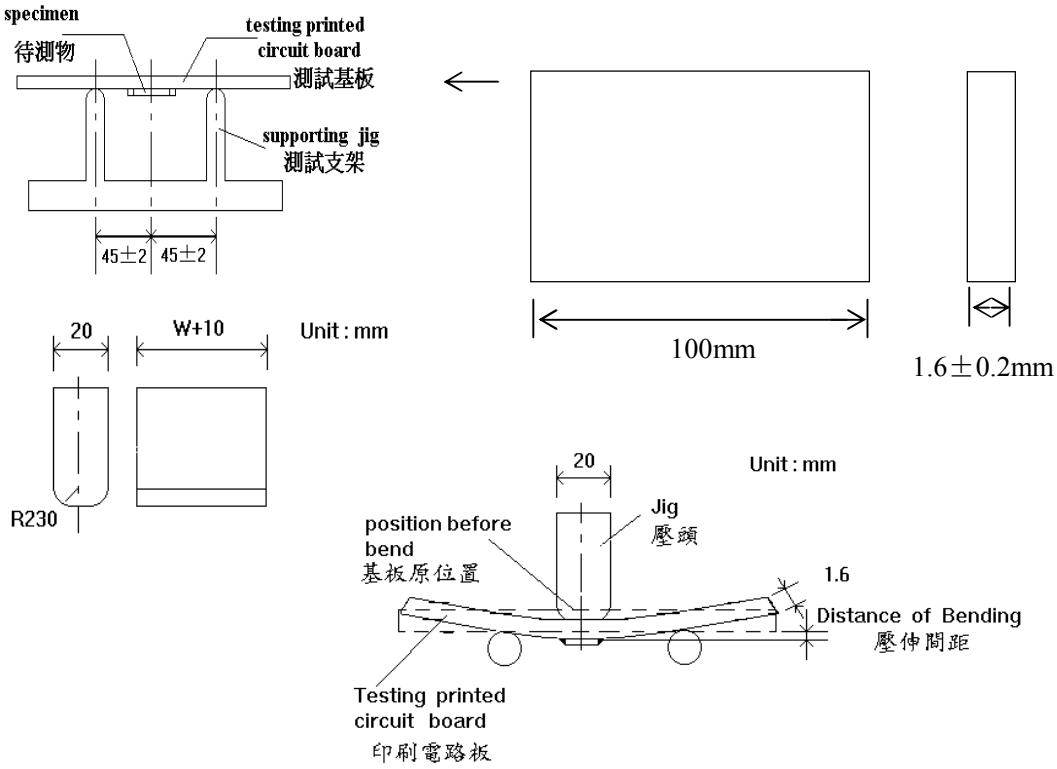
when the resistor terminal wis immersed in the soldering flux , dip in the tin heater 2 or 3 seconds, check the soldering area.

7.3 Bonding test

Test method : JIS C 5202 6.1.4 the resistor soldering on the testing board, follow the below standard to operate:

Category	Time (second)	Bend degree +0.20(mm)
SMD Resistor	5±1	5 or2 （according the spec）
High power resistor	5±1	2
Network resistor	5±1	1

Picture of bonding test board:



7.4 Environment performance test：

7.4.1 Low temperature operation test:

Test method: Following MIL-STD-55342D PARA 4.7.4,

The resistor soldering on the testing board, put it into low temperature box -65+0 -5 ℃, after an hour add the rated voltage about 45+0-5 minute. Took place after 24 hours; Then following 7.1.1 testing result and count it as below steps:

$$\Delta R\% = \frac{R_2 - R_1}{R_1} * 100\text{------}(\%)$$

R1＝Resistance before testing .（Ω）

R2＝Resistance after testing（Ω）

7.4.2 When the temperature-humidity cycling resistor soldering on the testing board, put into the testing box and add the rated voltage; Following the 7.1.1 testing result and count it as below step:

Cycle	1	2	3	4	5	6	7	8	9	10	11
Temperature(℃)	65	65	25	65	65	25	25	-10	-10	25	25
Moisture (%)	92	92	92	92	92	92	92	0	0	0	92
Time (H:m)	2:30	3:00	2:30	2:30	3:00	2:30	1:30	0:30	3:00	0:30	2:30

$$\Delta R\% = \frac{R_2 - R_1}{R_1} * 100\text{------}(\%)$$

7.4.3 Moisture feature

The resistor soldering on the testing board, put it into the RH 90-95% testing box, add the rated voltage, power up about 30mins, power down about 30mins, cycling 1000 +24/-0 hours; Following the testing result 7.1.1, count it as below step:

$$\Delta R\% = \frac{R_2 - R_1}{R_1} * 100\text{------}(\%)$$

R1＝Resistance before testing .（Ω）

R2＝Resistance after testing（Ω）

7.4.4 Load life

Test method: MIL-STD-202F METHOD 108A Test method

The resistor soldering on the testing board, put into the testing box within 70±2℃, add the rated voltage 1000 within +24/-0 hours; Following the 7.1.1 testing result, count it as below:

$$\Delta R\% = \frac{R_2 - R_1}{R_1} * 100\text{------}(\%)$$

R1＝Resistance before testing .（Ω）

R2＝Resistance after testing（Ω）

7.4.5 Thermal shock test

Test method: MIL-STD-202F METHOD 107G

Put the resistor into thermal shock box, following the standard as below:

Test sequence	1	2	3	4
Test temperature (℃)	-55±3℃	Temperature changed	125±2	Temperature haged
Time	2Min	10Sec	2	10Sec
Cycle	5			

Testing result, and count it as below:

$$\Delta R\% = \frac{R_2 - R_1}{R_1} * 100\text{------}(\%)$$

R1＝Resistance before testing .（Ω）

R2＝Resistance after testing（Ω）

8. Reliability test

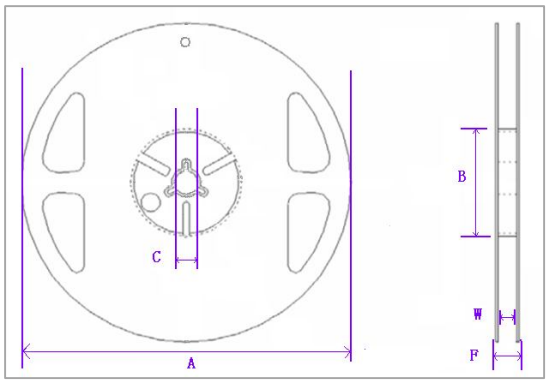
Items	Spec	Test method
Temperature features	(over10ohm) ±200 ppm/℃Max.	JIS C52025.2
	(lower10ohm) +500～-250 ppm/℃	
Short time overload	±(1.00%+0.05ohm) Max.	JIS C52025.5
Anti-soldering heat	±(1.00%+0.05ohm)Max.	JIS C52026.4
Solderability	95%CoverageMin.	JIS C52026.4
Load life	±(3.00%+0.05ohm)Max.	JISC52027.10
Moisture feature	±(2.00%+0.05ohm)Max.	JIS C52027.5
Temperature cycle	±(2.00%+0.05ohm)Max.	JIS C52027.6
Heat test	±(1.00%+0.05ohm) Max.	<260℃ 10 seconds/ 3times
Soldering heat by manual	The iron don't touch the resistor	Approx.350℃for3seconds
MSL (moisture sensitive level)	Level 1	J-STD-020C

9. Packing

Reel

Size		A	B	C	F	W
0201 0402	mm	178±2.0	60.0±1.0	13.5±0.5	11.4±0.1	9.00±0.3

0603 0805 1206 1210	Inch	7.008±0.079	2.362±0.039	0.531±0.020	0.449±0.039	0.354±0.012
1812	mm	178±2.0	60.0±1.0	13.5±0.5	15.4±1.0	13.0±0.3
2010 2512	Inch	7.008±0.079	2.362±0.039	0.531±0.020	0.606±0.039	0.512±0.012

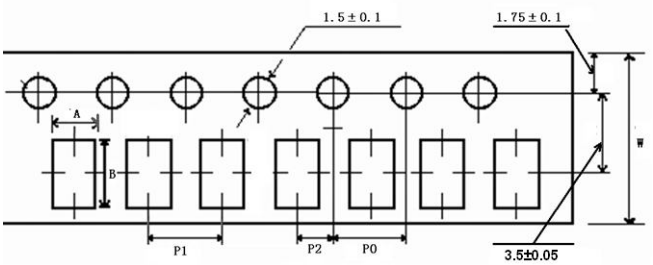


Remark: (1) 0201/0402 Q'ty 10000 pcs/Reel (2) 2010/2512 Q'ty 4000pcs/Reel

(3) 0603/0805/1206/1210 Q'ty 5000pcs/Reel

Tape

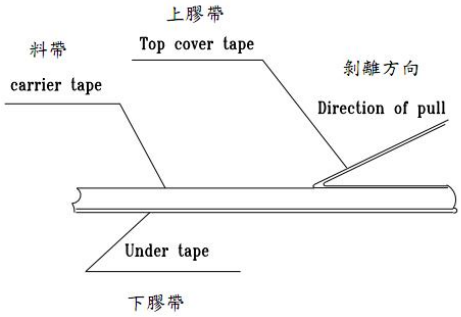
TYPE	A	B	W	P0	P1	P2
0201	0.38±0.05	0.68±0.05	8.00±0.20	4.00±0.10	2.00±0.10	2.00±0.05
0402	0.65±0.10	1.15±0.10	8.00±0.20	4.00±0.10	2.00±0.10	2.00±0.05
0603	1.10±0.10	1.90±0.10	8.00±0.20	4.00±0.10	4.00±0.10	2.00±0.05
0805	1.65±0.20	2.40±0.20	8.00±0.20	4.00±0.10	4.00±0.10	2.00±0.05
1206	2.00±0.20	3.60±0.20	8.00±0.20	4.00±0.10	4.00±0.10	2.00±0.05
1210	2.80±0.10	3.50±0.10	8.00±0.20	4.00±0.10	4.00±0.10	2.00±0.05
1812	3.30±0.20	4.60±0.20	12±0.10	4.00±0.10	4.00±0.10	2.00±0.05
2010	2.90±0.20	5.40±0.20	12±0.10	4.00±0.10	4.00±0.10	2.00±0.05
2512	3.60±0.20	6.90±0.20	12±0.10	4.00±0.10	4.00±0.10	2.00±0.05



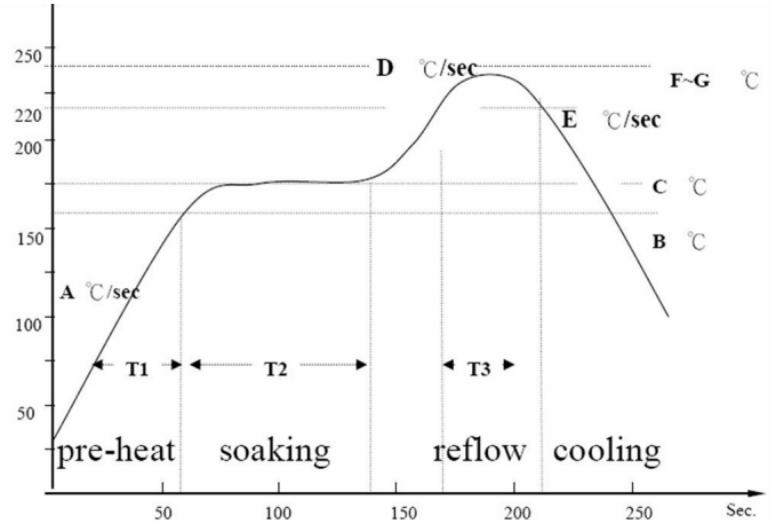
10. Other Parameter

10.1 Tape stripping test:

The range of tape stripping is 0.1N—0.7N (10 to 70 gf), top tape stripping speed is 200mm/min, the degree should be in 165 – 180 degree between the tape and paper tape after stripped; Please refer the picture as below



10.2 Suggestion for re-flow soldering temperature;



A: ramp up rate during preheat 1.0-3.0 ℃/sec

B-C:soaking temperature 155-185℃

D:ramp up rate during reflow 1.2-2.3 ℃/sec

E:ramp down rate during cooling 1.0-6.0 ℃/sec

F-G: peak temperature 230-250 ℃

T1:preheat time 50-80 sec

T2:dwell time during soaking 60-120 sec

T3:time above 220 ℃ 20-40sec