

# Kingtronics®

# LKT

## Low Voltage Multilayer Chip Ceramic Capacitor

### Capacitance and Capacitance Tolerance

Different circuit needs different capacitance and capacitance tolerance. So the selection of capacitance is depended on the need of customers.

### Dielectric Material Type of Capacitor

**-NPO** : The capacitor of this kind dielectric material is considered as Class I capacitor, including general capacitor and high frequency NPO capacitor. The electrical properties of NPO capacitor are the most stable one and have little change with temperature, voltage and time. They are suited for applications where low losses and high stability are required, such as filters, oscillators, and timing circuits.

**- X7R, X5R, X6S, X7T, X7S** : material is a kind of material has high dielectric constant. The capacitor made of this kind material is considered as Class II capacitor whose capacitance is higher than that of class I . These capacitors are classified as having a semi stable temperature characteristic and used over a wide temperature range, such in these kinds of circuits, DC blocking, decoupling, bypassing, frequency discriminating etc.

**-Y5V** : The capacitor made of this kind of material is the highest dielectric constant of all ceramic capacitors. They are used over a moderate temperature range in application where high capacitance is required because of its unstable temperature coefficient, but where moderate losses and capacitance changes can be tolerated. Its capacitance and dissipation factors are sensible to measuring conditions, such as temperature and voltage, etc.

### Temperature Range

NPO/ X7R/ X7T/ X7S: -55~125°C

X6S: -55 ~ +105°C

X5R: -55~85°C

Y5V: -30~85°C

### Voltage

4, 6, 6.3, 10, 25, 50 VDC

### Capacitance

0.1pF ~ 100uF

### Terminations

Tin / Nickel

### Tolerance

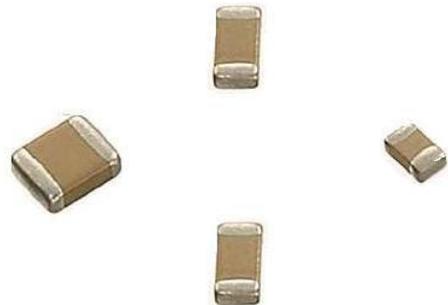
±0.1pF , +80 ~ -20%

### Packing

Tape and Reel (0201, 0402, 0603, 0805, 1206, 1210, 1812, 1808, 2220, 2225)

### Dielectric & Values

NPO X7R X5R X7T X7S X6S Y5V consult product pages of catalog for cap ranges and voltage rating



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### How To Order

<b>LKT</b>	<b>0805</b>	<b>N</b>	<b>102</b>	<b>J</b>	<b>500</b>	<b>R</b>
<u>Series</u>	<u>1.</u>	<u>2.</u>	<u>3.</u>	<u>4.</u>	<u>5.</u>	<u>6.</u>

### NOTE:

#### 1. Dimensions

Size Code	0402	0603	0805	1206
LxW (inch)	0.04x0.02	0.06x0.03	0.08x0.05	0.12x0.06

#### 2. Dielectric Style

Dielectric Code	N	B	X	F
Dielectric material	NPO	X7R	X5R	Y5V

#### 3. Nominal Capacitance

Unit : pF

102	10X10 <sup>2</sup>
0R5	0.5
1R0	1.0
224	22X10 <sup>4</sup>
...	...

Note: First two digits are significant; third digit denotes number of zeros; R = decimal.

#### 4. Capacitance Tolerance

Code	C	D	J	K	M	Z	A	B
Tolerance	±0.25pF	±0.5pF	±5.0%	±10%	±20%	+80%-20%	±0.05pF	±0.1pF

#### 5. Rated Voltage

Express Method	160	250	500
Actual Value	16V <sup>0</sup>	25V <sup>0</sup>	50V <sup>0</sup>

#### 6. Pb

Code	R
Pb	RoHS

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### Specification and Test Condition:

#### 1. Appearance

Dielectrics	Specification	Testing Condition
NPO/X7R/X5R/X7T/ X6S/X7S	1/10L < L ≤ 1/8L, 1/10W < W ≤ 1/8W, 1/10T < T ≤ 1/8T (None is acceptable All judged unqualified)	Visual inspection

#### 2. Dimensions

Dielectrics	Specification	Testing Condition
NPO/X7R/X5R/X7T/ X6S/X7S	Within the specified dimensions	Using calipers on micrometer

#### 3. Capacitance

Dielectrics	Specification	Testing Condition
NPO	Within the specified tolerance A: ±0.05pF; B: ±0.1pF; C: ±0.25pF; D: ±0.5pF; J: ±5%	1.0±0.2Vrms, 1MHz±10% (C>1000 pF, 1.0±0.2Vrms, 1KHz±10%)
X7R/X5R/X7T/X6S/X7S	Within the specified tolerance J: ±5%; K: ±10%; M: ±20%	1.0±0.2Vrms, 1KHz±10% (Cp > 10uF, 0.5±0.1Vrms, 120±24Hz)

#### 4. Dissipation Factor

Dielectrics	Specification	Testing Condition																																																							
NPO	Cp < 30pF, Q ≥ 400 + 20Cp; Cp ≥ 30pF, Q ≥ 1000	1.0±0.2Vrms, 1MHz±10%, 25°C (Cp > 1000pF, 1.0±0.2Vrms, 1KHz±10%)																																																							
	<table border="1"> <thead> <tr> <th>Type</th> <th>UR</th> <th>Capacitance</th> <th>DF</th> </tr> </thead> <tbody> <tr> <td rowspan="4">0402</td> <td rowspan="2">≤25V</td> <td>C ≤ 0.47uF</td> <td>≤7.0%</td> </tr> <tr> <td>C &gt; 0.47uF</td> <td>≤10.0%</td> </tr> <tr> <td rowspan="2">&gt;25V</td> <td>C ≤ 0.1uF</td> <td>≤7.0%</td> </tr> <tr> <td>C &gt; 0.1uF</td> <td>≤10.0%</td> </tr> <tr> <td rowspan="4">0603</td> <td rowspan="2">≤25V</td> <td>C ≤ 0.47uF</td> <td>≤7.0%</td> </tr> <tr> <td>C &gt; 0.47uF</td> <td>≤10.0%</td> </tr> <tr> <td rowspan="2">&gt;25V</td> <td>C ≤ 0.1uF</td> <td>≤5.0%</td> </tr> <tr> <td>0.1uF &lt; C ≤ 0.22uF</td> <td>≤7.0%</td> </tr> <tr> <td rowspan="4">X7R/X5R/X7T/X6S/ X7S</td> <td rowspan="2">&gt;25V</td> <td>C &gt; 0.22uF</td> <td>≤10.0%</td> </tr> <tr> <td>1.0±0.2Vrms, 1KHz±10%, (Cp &gt; 10uF, 0.5±0.1Vrms, 120±24Hz)</td> <td></td> </tr> <tr> <td rowspan="2">≤25V</td> <td>C ≤ 1uF</td> <td>≤7.0%</td> </tr> <tr> <td>C &gt; 1uF</td> <td>≤10.0%</td> </tr> <tr> <td rowspan="2">&gt;25V</td> <td>C ≤ 0.47uF</td> <td>≤7.0%</td> </tr> <tr> <td>C &gt; 0.47uF</td> <td>≤10.0%</td> </tr> <tr> <td rowspan="3">1206</td> <td rowspan="2">≤25V</td> <td>C &lt; 2.2uF</td> <td>≤7.0%</td> </tr> <tr> <td>2.2uF ≤ C &lt; 47uF</td> <td>≤10.0%</td> </tr> <tr> <td>&gt;25V</td> <td>C &lt; 1uF</td> <td>≤7.0%</td> </tr> <tr> <td></td> <td></td> <td>1uF ≤ C &lt; 47uF</td> <td>≤10.0%</td> </tr> </tbody> </table>	Type	UR	Capacitance	DF	0402	≤25V	C ≤ 0.47uF	≤7.0%	C > 0.47uF	≤10.0%	>25V	C ≤ 0.1uF	≤7.0%	C > 0.1uF	≤10.0%	0603	≤25V	C ≤ 0.47uF	≤7.0%	C > 0.47uF	≤10.0%	>25V	C ≤ 0.1uF	≤5.0%	0.1uF < C ≤ 0.22uF	≤7.0%	X7R/X5R/X7T/X6S/ X7S	>25V	C > 0.22uF	≤10.0%	1.0±0.2Vrms, 1KHz±10%, (Cp > 10uF, 0.5±0.1Vrms, 120±24Hz)		≤25V	C ≤ 1uF	≤7.0%	C > 1uF	≤10.0%	>25V	C ≤ 0.47uF	≤7.0%	C > 0.47uF	≤10.0%	1206	≤25V	C < 2.2uF	≤7.0%	2.2uF ≤ C < 47uF	≤10.0%	>25V	C < 1uF	≤7.0%			1uF ≤ C < 47uF	≤10.0%	
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#### 5. Insulation Resistance

Dielectrics	Specification	Testing Condition
NPO /X7R/ X5R/ X7T/X6S/X7S	UR ≤ 50V, More than 10 GΩ or 100Ω•F/CR, whichever is smaller.	UR ≤ 50V U <sub>Test</sub> = UR; Charge Time: 60±5 sec; Temperature: 25°C
NPO /X7R/X7T/ X6S/ X7S	UR > 50V, More than 4 GΩ or 100Ω•F/CR, whichever is smaller.	UR ≤ 400V U <sub>Test</sub> = UR; UR > 400V U <sub>Test</sub> = 400V; Charge Time: 60±5 sec; Temperature: 25°C

Test Temperature: 25°C ± 3°C; Test Humidity: < 70%RH.

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### 6. Dielectric Strength

Dielectrics	Specification	Testing Condition
NPO	$U_R \leq 50V$	Force 300%Rated voltage for 5second. Max..current should not exceed 50 mA.
X7R/X5R/X7T/X6S/X7S	$U_R \leq 50V$	Force 250%Rated voltage for 5second. Max..current should not exceed 50 mA.
NPO /X7R/X7T/X7S	$100V \leq U_R < 500V$	Force 200%Rated voltage for 5second. Max..current should not exceed 50 mA.
	$500V \leq U_R < 1000V$	Force 150%Rated voltage for 5second. Max..current should not exceed 50 mA.
	$1000V \leq U_R < 2000V$	Force 150%Rated voltage for 5second. Max..current should not exceed 50 mA.
	$U_R \geq 2000V$	Force 120%Rated voltage for 5second. Max..current should not exceed 50 mA.

### 7. Temperature Coefficient of Capacitance

Dielectrics	Specification	Testing Condition				
NPO	Temperature coefficient within $\pm 30\text{ppm}/^\circ\text{C}$ Cp drift within $\pm 0.2\%$ or $\pm 0.05\text{pF}$	Measure capacitance under follow table list temperature:				
		STEP	NPO, X7R, X7T	X6S	X5R	X7S
		1	25 $\pm$ 2	25 $\pm$ 2	25 $\pm$ 2	25 $\pm$ 2
		2	-55 $\pm$ 3	-55 $\pm$ 3	-55 $\pm$ 3	-55 $\pm$ 3
		3	25 $\pm$ 2	25 $\pm$ 2	25 $\pm$ 2	25 $\pm$ 2
X7R/X5R	Capacitance change within $\pm 15\%$	4	125 $\pm$ 3	105 $\pm$ 3	85 $\pm$ 3	125 $\pm$ 3
		5	25 $\pm$ 2	25 $\pm$ 2	25 $\pm$ 2	25 $\pm$ 2
X7T	Capacitance change within +22%, -33%	1) NPO The capacitance drift is calculated by dividing the differences between the maximum and minimum measured values in the step 1,3 and 5. The temperature coefficient is determined using the Capacitance measured in step 3 as a reference.				
X6S/X7S	Capacitance change within $\pm 22\%$	2) X7R, X5R, X7T, X6S and X7S The ranges of capacitance change compared within the above 25 $^\circ\text{C}$ value over the temperature ranges shall be within the specified ranges.				

### 8. Adhesion

Dielectrics	Specification	Testing Condition
NPO/X7R/X5R/ X7T/X6S/X7S	No removal of the terminations or other defect shall occur.	The pressurizing force shall be 6N (=600g*f) and the duration of application shall be 10 $\pm$ 1sec.

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### 9. Solderability of Termination

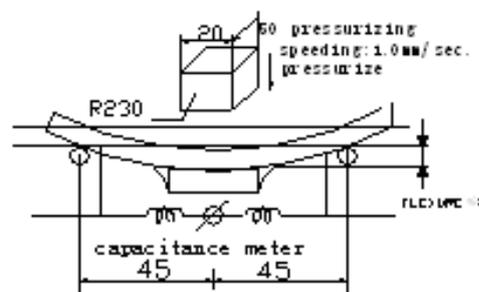
Dielectrics	Specification	Testing Condition
NPO/X7R/X5R/ X7T/X6S/X7S	95% min. coverage of both terminal electrodes and less than 5% have pin holes or rough spots.	Solder temperature: 245±5°C Dipping time: 2±1 seconds. Completely soak both terminal electrodes in solder

### 10. Resistance to leaching

Dielectrics	Specification	Testing Condition
NPO/X7R/X5R/ X7T/X6S/X7S	95% min. coverage of both terminal electrodes and less than 5% have pin holes or rough spots. No remarkable visual damage.	Solder temperature: 270±5°C Preheated: 120°C~150°C/60sec Dipping time: 10±1 seconds. Completely soak both terminal electrodes in solder

### 11. Bending

Dielectrics	Specification	Testing Condition
NPO	No remarkable visual damage Cp change ≤ ±5% or ≤ 0.5 pF, whichever is larger.	Solder the capacitor on testing substrate and put it on testing stand. The middle part of substrate shall successively be pressurized by pressuring rod at a rated of about 1.0mm/sec. Until the deflection become means of the 1.0mm.

X7R/X5R/X7T/  
X6S/X7SNo remarkable visual damage  
Cp change ≤ ±10%

### 12. Resistance to Soldering Heat

Dielectrics	Specification	Testing Condition
NPO	No remarkable visual damage Cp change within ±2.5% or ±0.25pF, whichever is larger. DF meets initial standard value. IR meets initial standard value.	Soldering temperature: 270±5°C Preheating: 120~150°C 60sec. Dipping time: 10±1 seconds. Measurement to be made after being kept at room temperature for 24±2 (NPO) or 48±4 (X7R, X5R, X7S, X7T, X6S) hours. Recovery for the following period under the standard condition after test.
X7R/X5R/X7T/ X6S/X7S	No remarkable visual damage Cp change within ±7.5% DF meets initial standard value. IR meets initial standard value.	*Initial measurement for high dielectric constant type Perform a heat treatment at 140~150°C for 1hr and let sit for 48±4hrs at room temperature. Perform the initial measurement.

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## 13. Temperature Cycle

Dielectrics	Specification	Testing Condition
NPO	No remarkable visual damage Cp change within $\pm 2.5\%$ or $\pm 0.25\text{pF}$ , whichever is larger.	To perform 5 cycles of the stated environment: Step      Temperature      Time 1      Min. operating Temp. $+0/-3^{\circ}\text{C}$ 30min 2 $25^{\circ}\text{C}$ 2~3 min 3      Max. operating Temp. $+3/-0^{\circ}\text{C}$ 30 min 4 $25^{\circ}\text{C}$ 2~3 min
X7R/X5R/X7T/ X6S/X7S	No remarkable visual damage Cp change within $\pm 7.5\%$	Measurement to be made after being kept at room temperature for $24\pm 2\text{hrs}$ (NPO) or $48\pm 4\text{hrs}$ (X7R, X5R, X7S, X7T, X6S) at room temperature, then measure. *Initial measurement for high dielectric constant type Perform a heat treatment at $140\sim 150^{\circ}\text{C}$ for 1hr and let sit for $48\pm 4\text{hrs}$ at room temperature. Perform the initial measurement.

## 14. Moisture Resistance ,steady state

Dielectrics	Specification	Testing Condition
NPO	No remarkable visual damage Cp change within $\pm 5\%$ or $\pm 0.5\text{pF}$ , whichever is larger. Cp < $10\text{pF}$ , Q $\geq 200+10\text{Cp}$ ; $10 \leq \text{Cp} < 30\text{pF}$ , Q $\geq 275+2.5\text{Cp}$ Cp $\geq 30\text{pF}$ , Q $\geq 350$ R*C $\geq 1000\text{M}\Omega$ or $10\Omega \cdot \text{F}$ , whichever is smaller	Test temperature: $40\pm 2^{\circ}\text{C}$ Humidity: 90~95% RH Testing time: $500 \pm 12\text{hrs}$  Measurement to be made after being kept at room temperature for $24\pm 2\text{hrs}$ (NPO) or $48\pm 4\text{hrs}$ (X7R, X5R, X7S, X7T, X6S)
X7R/X5R/X7T/ X6S/X7S	Cp change within $\pm 12.5\%$ DF: Not more than 2 times of initial value R*C $\geq 1000\text{M}\Omega$ or $10\Omega \cdot \text{F}$ , whichever is smaller	*Initial measurement for high dielectric constant type Perform a heat treatment at $140\sim 150^{\circ}\text{C}$ for 1hr and let sit for $48\pm 4\text{hrs}$ at room temperature. Perform the initial measurement.

## 15. Damp heat with load

Dielectrics	Specification	Testing Condition
NPO	No remarkable visual damage Cp change $\leq \pm 7.5\%$ or $\pm 0.75\text{pF}$ , whichever is larger. Cp < $30\text{pF}$ , Q $\geq 100+10/3 \cdot \text{Cp}$ Cp $\geq 30\text{pF}$ , Q $\geq 200$ R*C $\geq 500\text{M}\Omega$ or $5\Omega \cdot \text{F}$ , whichever is smaller	Test temperature: $40\pm 2^{\circ}\text{C}$ Humidity: 90~95% RH Voltage: 100% of the rated voltage Testing time: $500 \pm 12\text{hrs}$  Measurement to be made after being kept at room temperature for $24\pm 2\text{hrs}$ (NPO) or $48\pm 4\text{hrs}$ (X7R, X5R, X7S, X7T, X6S)
X7R/X5R/X7T/ X6S/X7S	No remarkable visual damage Cp change $\leq \pm 12.5\%$ DF: Not more than 2 times of initial value R*C $\geq 500\text{M}\Omega$ or $5\Omega \cdot \text{F}$ , whichever is smaller	*Apply the rated DC voltage for 1 hour at $40\pm 2^{\circ}\text{C}$ . Remove and let sit for $48\pm 4\text{hrs}$ at room temperature. Perform the initial measurement.

## 16. Life Test

Dielectrics	Specification	Testing Condition
NPO	No remarkable visual damage Cp change $\leq \pm 3\%$ or $\pm 0.3\text{pF}$ , whichever is larger. Q $\geq 350$ (Cp $\geq 30\text{pF}$ ) Q $\geq 275+(2.5 \cdot \text{Cp})$ ( $10\text{pF} \leq \text{Cp} < 30\text{pF}$ ) Q $\geq 200+10 \cdot \text{Cp}$ (Cp < $10\text{pF}$ ) R*C $\geq 1000\text{M}\Omega$ or $5\Omega \cdot \text{F}$ , whichever is smaller	Test temperature: Max. Operating Temp. $\pm 3^{\circ}\text{C}$ Voltage: $U_R < 100\text{V}$ 150% of the rated voltage (*Remarks) Testing time: 1000 hrs
X7R/X5R/X7T/ X6S/X7S	No remarkable visual damage Cp change $\leq \pm 12.5\%$ DF: Not more than 2 times of initial value R*C $\geq 1000\text{M}\Omega$ or $5\Omega \cdot \text{F}$ , whichever is smaller	Measurement to be made after being kept at room temperature for $24\pm 2\text{hrs}$ (NPO) or $48\pm 4\text{hrs}$ (X7R, X5R, X7S, X7T, X6S)  *Initial measurement for high dielectric constant type Apply 150% of the rated DC voltage for one hour at the maximum operating temperature $\pm 3^{\circ}\text{C}$ . Remove and let sit for $48\pm 4\text{hrs}$ at room temperature. Perform the initial measurement

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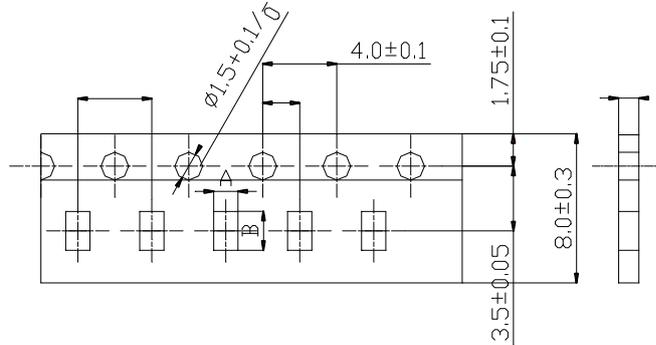
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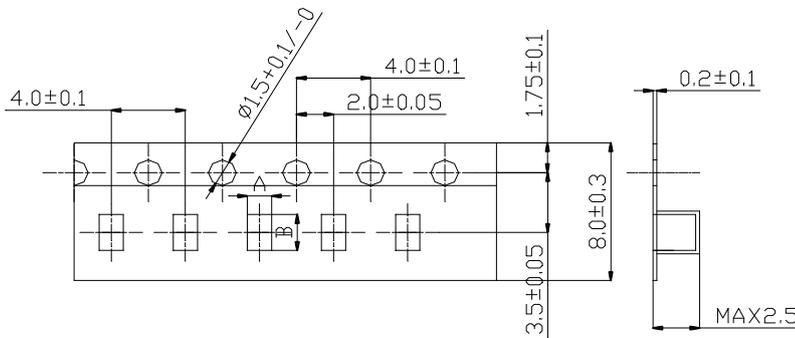
### Packing

1. Dimensions of Packing Paper: (Unit: mm)



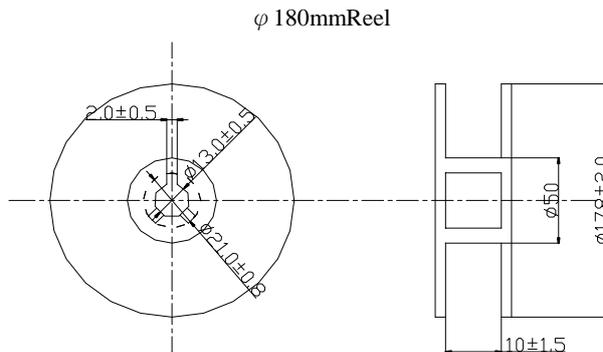
Type	A	B	C	D	T
0402	0.65±0.10	1.15±0.10	2.0±0.05	2.0±0.05	0.8max
0603	1.05±0.10	1.85±0.10	4.0±0.10	2.0±0.10	1.1max
0805	1.55±0.15	2.3±0.15	4.0±0.10	2.0±0.10	1.1max
1206	1.95±0.15	3.5±0.15	4.0±0.10	2.0±0.10	1.1max

2. Dimensions of Embossed Packing



A : 1.45±0.20    B : 2.25±0.20    (0805)  
 A : 1.95±0.20    B : 3.50±0.20    (1206)

3. Dimensions of Reel:



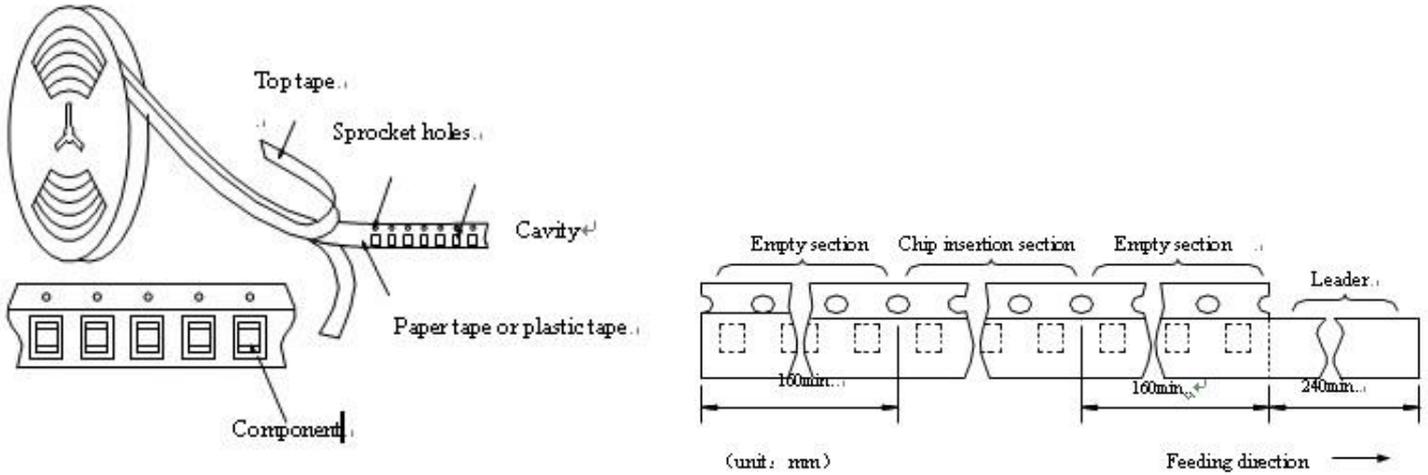
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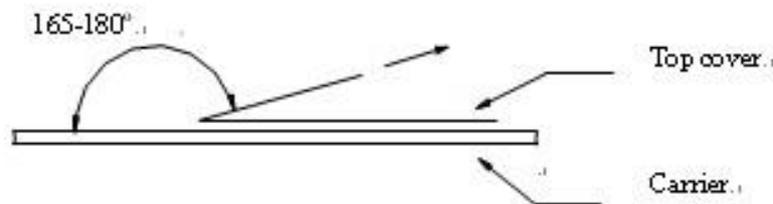
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### 4. Taping Figure



### 5. Taping Method

- ① Tapes for capacitors are wound clockwise. The sprocket holes are to the right as the tape is pulled toward the user.
- ② The top tape and base tape are not attached at the end of the tape for a minimum of 5 pitches.
- ③ Part of the leader and part of the empty tape shall be attached to the end of the tape as follows.
- ④ Missing capacitors number within 0.1% of the number per reel or 1pc, whichever is greater, and are not continuous.
- ⑤ The top tape and bottom tape shall not protrude beyond the edges of the tape and shall not cover sprocket holes.
- ⑥ Cumulative tolerance of sprocket holes, 10 pitches:  $\pm 0.3\text{mm}$ .
- ⑦ Peeling off force: 0.1 to 0.6N in the direction shown down.



Note: Specifications are subject to change without notice.

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