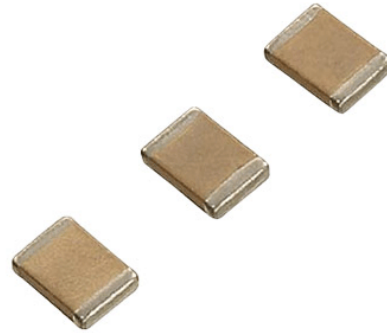


MULTILAYER CERAMIC CHIP CAPACITOR - SMD

TS18



| S P E C I F I C A T I O N S | |
|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dielectris & Values | NPO X7R Y5V Z5U consult product pages of catalog for cap ranges and voltage rating |
| Terminations | Tin / Nickel |
| Voltage | 16, 25, 50, 63 VDC |
| Packing | tape and reel (0402, 0603, 0805, 1206, 1210, 1812, 2220) |
| Capacitance | 0.5pF ~ 10uF |
| Tolerance | ±0.1pF ~ +80-20% |
| Types of Capacitor and Dielectric Material | 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: X7R 、X5R 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 |

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Specification and Test Condition:

1. Appearance

| Dielectrics | Specification | Testing Condition |
|-----------------|-----------------------------|--------------------|
| NPO/X7R/X5R/Y5V | No defects or abnormalities | Visual inspection. |

2. Dimensions

| Dielectrics | Specification | Testing Condition |
|-----------------|---------------------------------|------------------------------|
| NPO/X7R/X5R/Y5V | Within the specified dimensions | Using calipers on micrometer |

3. Capacitance

| Dielectrics | Specification | Testing Condition |
|-------------|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NPO | Within the specified tolerance B: $\pm 0.1\text{pF}$; C: $\pm 0.25\text{pF}$; D: $\pm 0.5\text{pF}$; J: $\pm 5\%$ | $1.0 \pm 0.2\text{Vrms}$, $1\text{MHz} \pm 10\%$ ($C > 1000\text{pF}$, $1.0 \pm 0.2\text{Vrms}$, $1\text{KHz} \pm 10\%$,) 25°C ° |
| X7R/X5R | Within the specified tolerance J: $\pm 5\%$; K: $\pm 10\%$; M: $\pm 20\%$ | $1.0 \pm 0.2\text{Vrms}$, $1\text{KHz} \pm 10\%$ ($C_p > 10\mu\text{F}$, $0.5 \pm 0.1\text{Vrms}$, $120 \pm 24\text{Hz}$) at 25°C , 48hrs after annealing |
| Y5V | Within the specified tolerance M: $\pm 20\%$; Z: -20% , $+80\%$ | $1.0 \pm 0.2\text{Vrms}$, $1\text{KHz} \pm 10\%$ ($C_p > 10\mu\text{F}$, $0.5 \pm 0.1\text{Vrms}$, $120 \pm 24\text{Hz}$) at 25°C , 48hrs after annealing |

4. Dissipation Factor

| Dielectrics | Specification | Testing Condition |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NPO | $C_p < 30\text{pF}$, $Q \geq 400 + 20C_p$; $C_p \geq 30\text{pF}$, $Q \geq 1000$ | $1.0 \pm 0.2\text{Vrms}$, $1\text{MHz} \pm 10\%$, 25°C ($C_p > 1000\text{pF}$, $1.0 \pm 0.2\text{Vrms}$, $1\text{KHz} \pm 10\%$) |
| X7R/X5R | $U_R \geq 25\text{V}$, $DF \leq 2.5\%$ $U_R = 16\text{V}$, $DF \leq 3.5\%$ $U_R \leq 10\text{V}$, $DF \leq 5.0\%$ | $1.0 \pm 0.2\text{Vrms}$, $1\text{KHz} \pm 10\%$, ($C_p > 10\mu\text{F}$, $0.5 \pm 0.1\text{Vrms}$, $120 \pm 24\text{Hz}$) at 25°C , 48hrs after annealing |
| Y5V | $U_R \geq 25\text{V}$, $DF \leq 7.0\%$ ($C < 1.0\mu\text{F}$) $DF \leq 9.0\%$ ($C \geq 1.0\mu\text{F}$) $U_R = 16\text{V}$, $DF \leq 9.0\%$ $U_R \leq 10\text{V}$, $DF \leq 12.5\%$ | $1.0 \pm 0.2\text{Vrms}$, $1\text{KHz} \pm 10\%$, ($C_p > 10\mu\text{F}$, $0.5 \pm 0.1\text{Vrms}$, $120 \pm 24\text{Hz}$) at 25°C , 48hrs after annealing |

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5. Insulation Resistance

| Dielectrics | Specification | Testing Condition |
|---------------------|-----------------------------------------------------|------------------------------------|
| NPO/X7R/ X5R/Y5V | More than 10 GΩ or 500Ω·F, whichever is smaller. | Rated voltage for 60±5sec, at 25°C |

6. Dielectric Strength

| Dielectrics | Specification | Testing Condition |
|------------------|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NPO /X7R/X5R/Y5V | No defects or abnormalities. | No failure shall be observed when 300% (NPO);250%(X7R/ X5R/Y5V)of the rated voltage is applied between the terminations for 1 to 5 seconds, provided the charge /discharge current is less than 500mA |

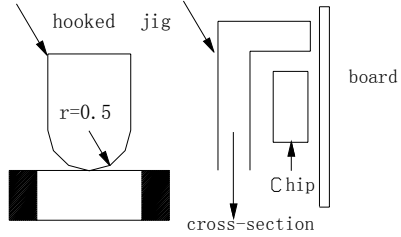
7. Temperature Coefficient of Capacitance

| Dielectrics | Specification | Testing Condition | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------|---------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------|-----|-----|---|-------|-------|-------|---|-------|-------|-------|---|-------|-------|-------|---|-------|------|------|---|-------|-------|-------|
| NPO | Temperature coefficient within ±30ppm/°C Cp drift within ±0.2% or ±0.05pF | Measure capacitance under follow table list temperature: <table border="1"><thead><tr><th>STEP</th><th>NPO, X7R</th><th>X5R</th><th>Y5V</th></tr></thead><tbody><tr><td>1</td><td>25 ±2</td><td>25 ±2</td><td>25 ±2</td></tr><tr><td>2</td><td>-55±3</td><td>-55±3</td><td>-30±3</td></tr><tr><td>3</td><td>25 ±2</td><td>25 ±2</td><td>25 ±2</td></tr><tr><td>4</td><td>125±3</td><td>85±3</td><td>85±3</td></tr><tr><td>5</td><td>25 ±2</td><td>25 ±2</td><td>25 ±2</td></tr></tbody></table> | STEP | NPO, X7R | X5R | Y5V | 1 | 25 ±2 | 25 ±2 | 25 ±2 | 2 | -55±3 | -55±3 | -30±3 | 3 | 25 ±2 | 25 ±2 | 25 ±2 | 4 | 125±3 | 85±3 | 85±3 | 5 | 25 ±2 | 25 ±2 | 25 ±2 |
| STEP | NPO, X7R | X5R | Y5V | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 25 ±2 | 25 ±2 | 25 ±2 | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | -55±3 | -55±3 | -30±3 | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | 25 ±2 | 25 ±2 | 25 ±2 | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | 125±3 | 85±3 | 85±3 | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | 25 ±2 | 25 ±2 | 25 ±2 | | | | | | | | | | | | | | | | | | | | | | | |
| X7R/X5R | Capacitance change within ±15% | | | | | | | | | | | | | | | | | | | | | | | | | |
| Y5V | Capacitance change within +22%, -82% | 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. 2) X7R ,X5R and Y5V The ranges of capacitance change compared within the above 25°C value over the temperature ranges shall be within the specified ranges. | | | | | | | | | | | | | | | | | | | | | | | | |

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8. Adhesion

| Dielectrics | Specification | Testing Condition |
|-----------------------|-------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NPO X7R/X5R Y5V | No removal of the terminations or other defect shall occur. | <p>The pressurizing force shall be 10N (=1000g*f) and the duration of application shall be 10±1sec.</p>  |

9. Solderability of Termination

| Dielectrics | Specification | Testing Condition |
|-----------------------|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| NPO X7R/X5R Y5V | 95% min. coverage of both terminal electrodes and less than 5% have pin holes or rough spots. | <p>Solder temperature: 230±5°C Dipping time: 2±1 seconds. Completely soak both terminal electrodes in solder</p> |

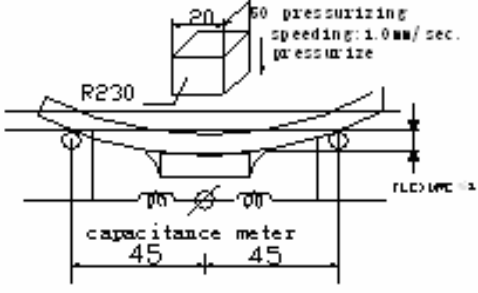
10. Resistance to leaching

| Dielectrics | Specification | Testing Condition |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| NPO X7R/X5R Y5V | <p>95% min. coverage of both terminal electrodes and less than 5% have pin holes or rough spots. No remarkable visual damage.</p> | <p>Solder temperature: 270±5°C Dipping time: 10±1 seconds. Completely soak both terminal electrodes in solder</p> |

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11. Bending

| Dielectrics | Specification | Testing Condition |
|-------------|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NPO | No remarkable visual damage Cp change $\leq \pm 5\%$ or ≤ 0.5 pF | 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 | No remarkable visual damage Cp change $\leq \pm 12.5\%$ | |
| Y5V | No remarkable visual damage Cp change $\leq \pm 30\%$ | |

12. Resistance to Soldering Heat

| Dielectrics | Specification | Testing Condition |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NPO | No remarkable visual damage Cp change within $\pm 2.5\%$ or ± 0.25 pF, whichever is larger. DF meets initial standard value. IR meets initial standard value. | Soldering temperature: $270 \pm 5^\circ\text{C}$ Preheating: $120 \sim 150^\circ\text{C}$ 60sec. Dipping time: 10 ± 1 seconds. Measurement to be made after being kept at room temperature for 24 ± 2 (C0G) or 48 ± 4 (X7R, X5R, Y5V) hours. Recovery for the following period under the standard condition after test. *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 ± 4 hrs at room temperature. Perform the initial measurement. |
| X7R/X5R | No remarkable visual damage Cp change within $\pm 5\%$ DF meets initial standard value. IR meets initial standard value. | |
| Y5V | No remarkable visual damage Cp change within $\pm 20\%$ DF meets initial standard value. IR meets initial standard value. | |

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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: <table border="1"> <thead> <tr> <th>Step</th> <th>Temperature</th> <th>Time</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min. operating Temp. $+0/-3^{\circ}\text{C}$</td> <td>30min</td> </tr> <tr> <td>2</td> <td>25°C</td> <td>2~3 min</td> </tr> <tr> <td>3</td> <td>Max. operating Temp. $+0/-3^{\circ}\text{C}$</td> <td>30 min</td> </tr> <tr> <td>4</td> <td>25°C</td> <td>2~3 min</td> </tr> </tbody> </table> | Step | Temperature | Time | 1 | Min. operating Temp. $+0/-3^{\circ}\text{C}$ | 30min | 2 | 25°C | 2~3 min | 3 | Max. operating Temp. $+0/-3^{\circ}\text{C}$ | 30 min | 4 | 25°C | 2~3 min |
| Step | Temperature | Time | | | | | | | | | | | | | | | |
| 1 | Min. operating Temp. $+0/-3^{\circ}\text{C}$ | 30min | | | | | | | | | | | | | | | |
| 2 | 25°C | 2~3 min | | | | | | | | | | | | | | | |
| 3 | Max. operating Temp. $+0/-3^{\circ}\text{C}$ | 30 min | | | | | | | | | | | | | | | |
| 4 | 25°C | 2~3 min | | | | | | | | | | | | | | | |
| X7R/X5R | No remarkable visual damage Cp change within $\pm 7.5\%$ | Measurement to be made after being kept at room temperature for $24\pm 2\text{hrs}$ (C0G) or $48\pm 4\text{hrs}$ (X7R, X5R, Y5V) 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 < 10pF, 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 ≥ 350 R*C $\geq 1000\text{M}\Omega$ or $50\Omega\cdot\text{F}$, whichever is smaller | Test temperature: $40\pm 2^{\circ}\text{C}$ Humidity: 90~95% RH Testing time: $500 \pm 12\text{hrs}$ |
| X7R/X5R | Cp change within $\pm 12.5\%$ DF: Not more than 2 times of initial value R*C $\geq 1000\text{M}\Omega$ or $50\Omega\cdot\text{F}$, whichever is smaller | Measurement to be made after being kept at room temperature for $24\pm 2\text{hrs}$ (C0G) or $48\pm 4\text{hrs}$ (X7R, X5R, Y5V) *Initial measurement for high dielectric constant type |
| Y5V | No remarkable visual damage Cp change within $\pm 30\%$ DF: Not more than 1.5 times of initial value R*C $\geq 1000\text{M}\Omega$ or $50\Omega\cdot\text{F}$, whichever is smaller | 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. |

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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 $\geq 100 + 10/3 * \text{Cp}$ Cp $\geq 30\text{pF}$, Q ≥ 200 R*C $\geq 500\text{M}\Omega$ or $25\Omega \cdot \text{F}$, whichever is smaller | Test temperature: $40 \pm 2^\circ\text{C}$ Humidity: 90~95% RH Voltage: 100% of the rated voltage Testing time: $500 \pm 12\text{hrs}$ |
| X7R/X5R | 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 $25\Omega \cdot \text{F}$, whichever is smaller | Measurement to be made after being kept at room temperature for $24 \pm 2\text{hrs}$ (C0G) or $48 \pm 4\text{hrs}$ (X7R, X5R, Y5V) |
| Y5V | No remarkable visual damage Cp change $\leq \pm 30\%$ DF: Not more than 1.5 times of initial value R*C $\geq 500\text{M}\Omega$ or $25\Omega \cdot \text{F}$, 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 ≥ 350 (Cp $\geq 30\text{PF}$) Q $\geq 275 + (2.5 * \text{Cp})$ ($10\text{pF} \leq \text{Cp} < 30\text{PF}$) Q $\geq 200 + 10 * \text{Cp}$ (Cp $< 10\text{PF}$) R*C $\geq 1000\text{M}\Omega$ or $50\Omega \cdot \text{F}$, whichever is smaller | Test temperature: Max. Operating Temp. $\pm 3^\circ\text{C}$ Voltage: 200% of the rated voltage Testing time: 1000 hrs |
| X7R/X5R | 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 $50\Omega \cdot \text{F}$, whichever is smaller | Measurement to be made after being kept at room temperature for $24 \pm 2\text{hrs}$ (C0G) or $48 \pm 4\text{hrs}$ (X7R, X5R, Y5V) |
| Y5V | No remarkable visual damage Cp change $\leq \pm 30\%$ DF: Not more than 1.5 times of initial value R*C $\geq 1000\text{M}\Omega$ or $50\Omega \cdot \text{F}$, whichever is smaller | *Initial measurement for high dielectric constant type Apply 200% 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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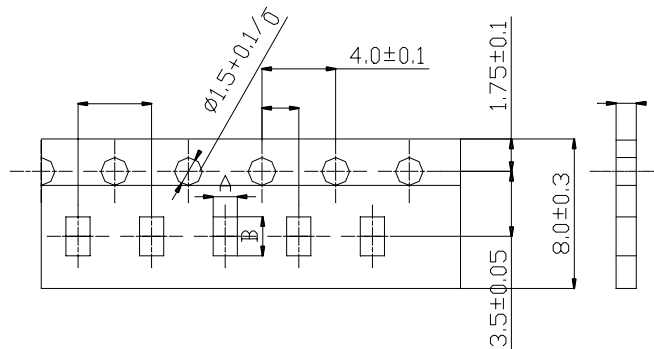
Packing

1. Tape Packing

Paper Tape: Standard taping (8mm paper width) suitable to 0603,0805,4Kpcs/reel
To 0402, 10Kpcs/reel.

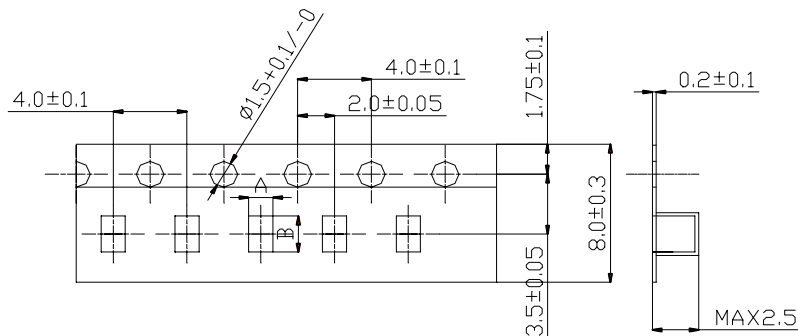
Plastic Tape: Suitable 0805 , 1206 sizes, for chip thickness over 0.95 mm, 4Kpcs/reel
or 3Kpcs/reel are available.

2. Dimensions of Packing Paper:



| 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 |

3. Dimensions of Embossed Packing

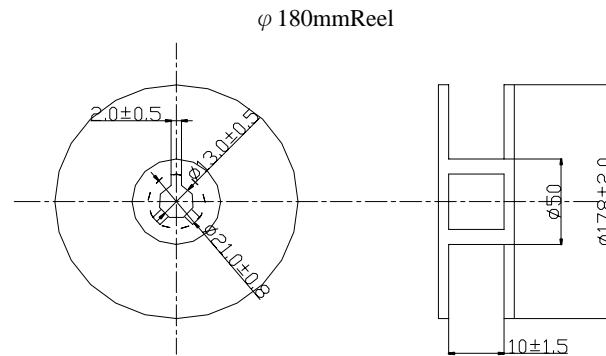


A : 1.45±0.20 B : 2.25±0.20 (0805)
A : 1.95±0.20 B : 3.50±0.20 (1206)

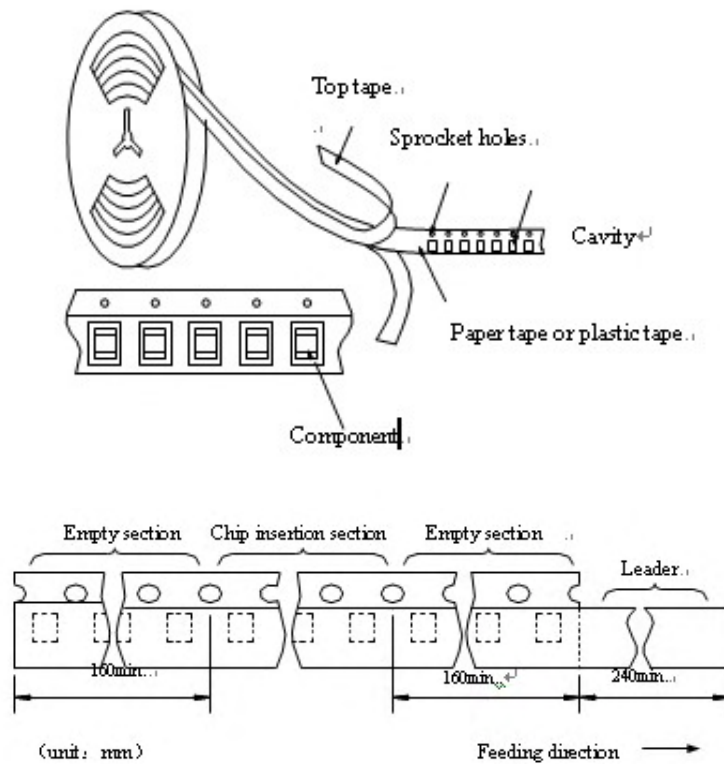
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4. Dimensions of Reel:



5. Taping Figure



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6. 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.

