



2. High Voltage Capacitors(250~3000VDC)

- These high voltage Capacitors feature a special internal electrode design which reduces voltage concentrations by distributing voltage gradients throughout the entire capacitor. This unique design is specially for using in Power Supply, Charger, VOIP and other electronic equipment.

•High Voltage Capacitor Application:

| Application | Circuit Diagram | Products |
|----------------------|-----------------|---|
| AC to DC Converter | | Such as AC adapter, Battery charger, Power supply(for every electric goods, such as PC, TV, PDA...etc) |
| EMI / ESD Protection | | Such as Network, ADSL, VDSL, VOIP...etc. |
| DC to AC Regulator | | Such as Digital TV, Digital Camera...etc. |



2. High Voltage Capacitors(250~3000VDC)

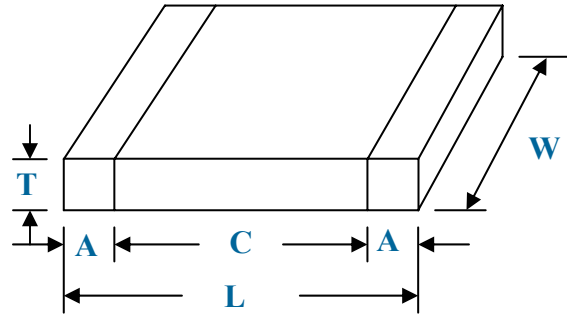
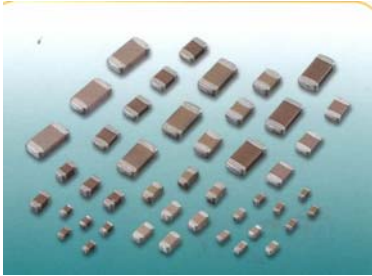
◆ Summary of Specification

| | |
|--------------------------------|---|
| Rated Voltage | 250Vdc~3000Vdc |
| Temperature Coefficient | NP0 : -55~±125°C , <30ppm/°C X7R : -55~±125°C , ±15% |
| Capacitance Range | NP0 : 0.22pF~5.6nF X7R : 150pF~330nF |
| Dissipation Factor | NP0: More than 30 pF: $Q \geq 1000$ (DF $\leq 0.1\%$) Less than 30 pF: $Q \geq 400+20 C$ ($Q=1/DF$) X7R : D.F $\leq 2.5\%$ |
| Insulation Resistance | NP0 : 100GΩmin X7R : $\geq 10G\Omega$ or $RiCr \geq 500\Omega F$, whichever is smaller |
| Dielectric Strength | $200 \leq V < 500$ At 2Vr for 5 seconds $500V \leq V \leq 1000$ At 1.5Vr for 5 seconds $1000 \leq$ At 1.2Vr for 5 seconds |



2. High Voltage Capacitors (250 ~ 3000VDC)

◆ Dimension



| Case size | Length (L) (mm) | Width (W) (mm) | Thickness (T) (mm) | Thickness Symbol | Termination length (A) (mm) | Distance between terminations (C) (mm) |
|-----------|--------------------|-------------------|-----------------------|---------------------|-----------------------------------|--|
| 0603 | 1.6±0.10 | 0.80±0.10 | 0.80±0.10 | C | 0.25~0.65 | 0.40 min |
| 0805 | 2.0±0.10 | 1.25±0.10 | 0.60±0.10 | B | 0.25~0.75 | 0.55 min |
| | | | 0.80±0.10 | C | | |
| | | | 1.25±0.20 | E | | |
| 1206 | 3.2±0.15 | 1.60±0.15 | 0.80±0.10 | C | 0.25~0.75 | 1.40 min |
| | | | 1.25±0.20 | E | | |
| | | | 1.60±0.20 | G | | |
| 1210 | 3.2±0.20 | 2.5±0.20 | 1.25±0.20 | E | 0.25~0.75 | 1.40 min |
| | | | 1.60±0.20 | G | | |
| | | | 2.00±0.20 | K | | |
| 1808 | 4.6±0.30 | 2.00±0.30 | 1.25±0.20 | E | 0.30 min. | 2.60 min. |
| | | | 1.60±0.20 | G | | |
| | | | 2.00±0.20 | K | | |
| 1812 | 4.6±0.30 | 3.20±0.30 | 1.25±0.20 | E | 0.30 min. | 2.60 min. |
| | | | 1.60±0.20 | G | | |
| | | | 2.00±0.20 | K | | |



2. High Voltage Capacitors(250 ~ 3000VDC)

◆ How To Order

| CC | 0805 | NP0 | 8 | J | 471 | B | L |
|---------------------|--|-------------------|--|--|--|---|-------------|
| <u>Type</u> | <u>Size</u> | <u>Dielectric</u> | <u>Dielectric</u> | <u>Tolerance</u> | <u>Capacitance</u> | <u>Packing</u> | <u>ROHS</u> |
| CC = Chip Capacitor | 0603 0805 1206 1210 1808 1812 | NP0 X7R | <u>Voltage</u> 8 = 250V 9 = 500V P = 1KV R = 2KV T = 3KV Especially I=400V H = 630V X = 1.5KV S= 2.5KV | B=±0.10pF C=±0.25pF D=±0.50pF F=±1.0% G=±2.0% J=±5.0% K=±10% M=±20% | 1st two digits are significant; third digits denote number of zeros, And A is in place of decimal point. example : 47A=4.7pF 102=10*10 ² pF =1000pF =1nF | <u>Quantity</u> B : Bulk P : 4K/reel R : 3K/reel 2K/reel 1K/reel | compliance |

| Tolerance | Capacitance for dielectric | | |
|-----------|----------------------------|------------|--------------|
| B=±0.10pF | NP0 | | X7R |
| C=±0.25pF | 0.22pF~10pF | 12pF~5.6nF | 150pF~0.33uF |
| D=±0.50pF | B,C,D | G,J | J,K,M |
| G=±2.0% | | | |
| J=±5.0% | | | |
| K=±10% | | | |
| M=±20% | | | |



2. High Voltage Capacitors(250 ~ 3000VDC)

◆ High Voltage Capacitance Range

| DIELECTRIR | | NP0 | | | | | | | | | | | | | | | | | | | | | | |
|------------|------|------|------|------|------|------|------|-----|------|-----|------|-----|------|------|------|-----|-----|------|------|------|-----|-----|---|--|
| SIZE | | 0603 | | | 0805 | | 1206 | | | | 1210 | | | | 1808 | | | | | 1812 | | | | |
| CAP | CODE | 250V | 250V | 500V | 250V | 500V | 1KV | 2KV | 250V | 500 | 1KV | 2KV | 250V | 500V | 1KV | 2KV | 3KV | 250V | 500V | 1KV | 2KV | 3KV | | |
| 0.22pF | 22B | C | C | C | C | C | C | C | | | E | E | | | E | E | G | | | | | | | |
| ~ | ~ | C | C | C | C | C | C | C | | | E | E | | | E | E | G | | | | | | | |
| 10pF | 100 | C | C | C | C | C | C | C | | | E | E | | | E | E | G | | | | | E | E | |
| 12pF | 120 | C | C | C | C | C | C | C | | | E | E | | | E | E | G | | | | | E | E | |
| 15pF | 150 | C | C | C | C | C | C | C | | | E | E | | | E | E | G | | | | | E | E | |
| 18pF | 180 | C | C | C | C | C | C | C | | | E | E | | | E | E | G | | | | | E | E | |
| 22pF | 220 | C | C | C | C | C | C | C | | | E | E | | | E | E | G | | E | E | E | E | E | |
| 27pF | 270 | C | C | C | C | C | C | C | | | E | E | | | E | E | G | | E | E | E | E | E | |
| 33pF | 330 | C | C | C | C | C | C | C | | | E | E | | | E | E | G | | E | E | E | E | E | |
| 39pF | 390 | C | C | C | C | C | C | C | | | E | E | | | E | E | G | | E | E | E | E | E | |
| 47pF | 470 | C | C | C | C | C | C | C | | | E | E | | | E | E | G | | E | E | E | E | E | |
| 56pF | 560 | C | C | C | C | C | C | C | | | E | E | | | E | E | G | | E | E | E | E | E | |
| 68pF | 680 | C | C | C | C | C | C | C | | | E | E | | | E | E | G | | E | E | E | E | E | |
| 82pF | 820 | C | C | C | C | C | C | C | | | E | E | | | E | E | G | | E | E | E | E | E | |
| 100pF | 101 | C | C | C | C | C | C | C | | | E | E | | | E | E | G | | E | E | E | E | E | |
| 120pF | 121 | C | C | C | C | C | C | C | | | E | E | | | E | E | G | | E | E | E | E | E | |
| 150pF | 151 | C | C | C | C | C | C | C | | | E | E | | | E | E | G | | E | E | E | E | E | |
| 180pF | 181 | C | C | C | C | C | C | C | E | E | E | E | | | E | E | K | | E | E | E | E | E | |
| 220pF | 221 | C | C | C | C | C | C | E | E | E | E | | | E | E | K | | E | E | E | E | E | | |
| 270pF | 271 | C | C | C | C | C | E | E | E | E | E | | | E | E | | | E | E | E | E | G | | |
| 330pF | 331 | C | C | C | C | C | E | | E | E | E | E | E | E | E | | | E | E | E | E | G | | |
| 390pF | 391 | C | C | C | C | C | E | | E | E | E | E | E | E | E | | | E | E | E | E | G | | |
| 470pF | 471 | C | C | C | C | C | E | | E | E | E | E | E | E | E | | | E | E | E | E | G | | |
| 560pF | 561 | | C | C | C | C | E | | E | E | E | | | E | E | | | E | E | E | E | K | | |
| 680pF | 681 | | C | E | C | C | E | | E | E | E | | | E | E | | | E | E | E | E | K | | |
| 820pF | 821 | | C | E | C | C | | | E | E | E | | | E | E | | | E | E | E | E | K | | |
| 1nF | 102 | | C | E | C | C | | | E | E | E | | | E | E | | | E | E | E | E | K | | |
| 1.2nF | 122 | | E | E | C | C | | | E | E | | | | E | E | | | E | E | E | | | | |
| 1.5nF | 152 | | E | | C | E | | | E | E | | | | E | E | | | E | E | E | | | | |
| 1.8nF | 182 | | E | | C | E | | | E | E | | | | E | E | | | E | E | E | | | | |
| 2.2nF | 222 | | | | E | E | | | E | E | | | | E | E | | | E | E | E | | | | |
| 2.7nF | 272 | | | | E | | | | E | | | | | E | E | | | E | E | | | | | |
| 3.3nF | 332 | | | | E | | | | E | | | | | E | | | | E | E | | | | | |
| 3.9nF | 392 | | | | E | | | | E | | | | | E | | | | E | E | | | | | |
| 4.7nF | 472 | | | | | | | | E | | | | | E | | | | E | E | | | | | |
| 5.6nF | 562 | | | | | | | | E | | | | | E | | | | | | | | | | |



2. High Voltage Capacitors(250 ~ 3000VDC)

◆ High Voltage Capacitance Range

| DIELECTRIC | | X7R | | | | | | | | | | | | | | | | | | | | | |
|------------|------|------|------|------|------|-----|------|-------|------|------|------|-----|------|------|-----|-----|-----|------|------|-----|-----|-----|---|
| SIZE | | 0805 | | 1206 | | | 1210 | | | | 1808 | | | 1812 | | | | | | | | | |
| CAP | CODE | 250V | 500V | 250V | 500V | 1KV | 2KV | 2.5KV | 250V | 500V | 1KV | 2KV | 250V | 500V | 1KV | 2KV | 3KV | 250V | 500V | 1KV | 2KV | 3KV | |
| 100pF | 101 | | | | | | | | | | | | | | | | | | | | | | |
| 120pF | 121 | | | | | | | | | | | | | | | | | | | | | | |
| 150pF | 151 | C | C | | | | | | | | | | | | | | G | | | | | | |
| 180pF | 181 | C | C | | | | | | | | | | | | | | G | | | | | | |
| 220pF | 221 | C | C | | | | | | | | | | | | | | G | | | | | | |
| 270pF | 271 | C | C | C | C | C | E | E | | | | | | | | | G | | | | | E | |
| 330pF | 331 | C | C | C | C | C | E | E | | | | | | | | | G | | | | | E | |
| 390pF | 391 | C | C | C | C | C | E | E | | | | | | | | | G | | | | | E | |
| 470pF | 471 | C | C | C | C | C | E | E | | | | | | | | | G | | | | | E | |
| 560pF | 561 | C | C | C | C | C | E | E | | | | | | | | E | G | | | | | E | |
| 680pF | 681 | C | C | C | C | C | E | E | | | | | | | | E | G | | | | | E | |
| 820pF | 821 | C | C | C | C | C | E | E | | | | | | | | E | K | | | | | E | |
| 1nF | 102 | C | C | C | C | C | E | E | | E | E | | | | E | G | K | | | | | E | G |
| 1.2nF | 122 | C | C | C | C | C | E | E | | E | E | | | | E | G | K | | | | | E | K |
| 1.5nF | 152 | C | C | C | C | C | E | E | | E | E | | | | E | G | K | | | | | E | K |
| 1.8nF | 182 | C | C | C | C | E | | | | | | | | | E | G | | | | | | E | K |
| 2.2nF | 222 | C | C | E | E | E | | | | | | | | | E | G | | | | | | E | K |
| 2.7nF | 272 | C | C | E | E | E | | | | | E | G | | | | | | | | | E | E | K |
| 3.3nF | 332 | C | C | E | E | E | | | | | | | | | E | | | | | | | E | G |
| 3.9nF | 392 | C | C | E | E | E | | | E | E | E | | | | E | E | | | | | | E | G |
| 4.7nF | 472 | C | C | E | E | E | | | E | E | E | | | | E | E | | | | | | E | G |
| 5.6nF | 562 | C | C | E | E | E | | | E | E | E | | | | E | E | G | | | | | E | G |
| 6.8nF | 682 | C | C | E | E | E | | | E | E | E | | | | E | E | G | | | | | E | G |
| 8.2nF | 822 | C | E | E | E | E | | | E | E | E | | | | E | E | G | | | | | E | G |
| 10nF | 103 | C | E | E | E | E | | | E | E | E | | | | E | E | G | | | E | E | E | K |
| 12nF | 123 | C | | E | E | | | | E | E | E | | | | E | E | G | | | | | E | |
| 15nF | 153 | C | | E | E | | | | E | E | E | | | | E | E | | | | | | E | |
| 18nF | 183 | E | | E | E | | | | E | E | E | | | | E | E | | | | | | E | |
| 22nF | 223 | E | | E | E | | | | E | E | E | | | | E | E | | | | | | E | |
| 27nF | 273 | E | | E | G | | | | E | E | K | | | | E | E | | | | | | E | G |
| 33nF | 333 | | | E | G | | | | E | E | K | | | | E | E | | | | | | E | G |
| 39nF | 393 | | | E | | | | | E | E | | | | | E | E | | | | | | E | |
| 47nF | 473 | | | E | | | | | E | E | | | | | E | E | | | | | | E | |
| 56nF | 563 | | | E | | | | | E | | | | | | E | | | | | | | E | |
| 68nF | 683 | | | E | | | | | E | | | | | | E | | | | | | | E | |
| 82nF | 823 | | | | | | | | E | | | | | | E | | | | | | | E | |
| 100nF | 104 | | | | | | | | E | | | | | | E | | | | | | | E | G |
| 120nF | 124 | | | | | | | | | | | | | | E | | | | | | | E | |
| 150nF | 154 | | | | | | | | | | | | | | | | | | | | | E | |
| 180nF | 184 | | | | | | | | | | | | | | | | | | | | | E | |
| 220nF | 224 | | | | | | | | | | | | | | | | | | | | | G | |
| 270nF | 274 | | | | | | | | | | | | | | | | | | | | | K | |
| 330nF | 334 | | | | | | | | | | | | | | | | | | | | | K | |
| 390nF | 394 | | | | | | | | | | | | | | | | | | | | | K | |
| 470nF | 474 | | | | | | | | | | | | | | | | | | | | | | |



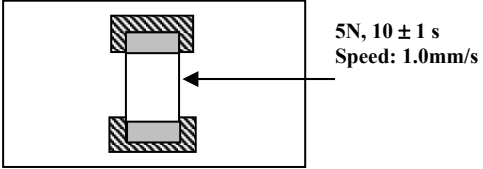
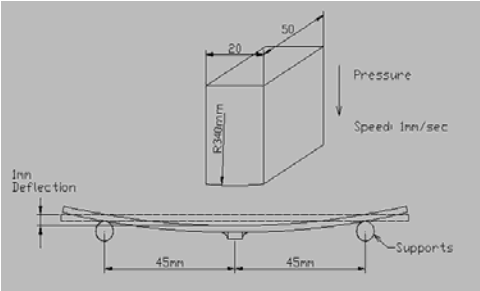
2. High Voltage Capacitors(250 ~ 3000VDC)

◆ Electrical and Mechanical Specification

| No | Test item | Conditions | Requirements | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------------|------------------------------------|--|---|-------------|-----------|------------------------|--|-------------------|------|----|-------------------------|-----|------|------|------|-----|------|----|---|-----|------|------|------|------|------|------|------|
| 1 | Capacitance | | Within specified tolerance | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | Dissipation Factor (tan δ) | <p>The Capacitance and DF shall be measured at 25°C with HP-4288A</p> <p>NP0 :</p> <p>$C \leq 1000 \text{ pF}$ $1 \pm 0.2V_{\text{rm}}$, $f = 1 \text{ MHz}$; $C > 1000 \text{ pF}$ $1 \pm 0.2V_{\text{rm}}$, $f = 1 \text{ kHz}$;</p> <p>X7R :</p> <p>$C \leq 10\mu\text{F}$ $1.0 \pm 0.2V_{\text{rm}}$ $f = @ 1\text{kHz}$ $C > 10\mu\text{F}$ $0.5 \pm 0.2V_{\text{rm}}$ $f = @ 120\text{Hz}$</p> | <p>NP0 :</p> <p>More than 30 pF: $Q \geq 1000$ ($DF \leq 0.1\%$) Less than 30 pF: $Q \geq 400 + 20 C$ ($Q = 1/DF$)</p> <p>X7R :</p> <table border="1"> <thead> <tr> <th>Rated volt.</th> <th>DF \leq</th> <th colspan="2">Exception of DF \leq</th> </tr> </thead> <tbody> <tr> <td>$\geq 50\text{V}$</td> <td>2.5%</td> <td>3%</td> <td>0603 $\geq 47\text{nF}$</td> </tr> <tr> <td>25V</td> <td>3.5%</td> <td>----</td> <td>----</td> </tr> <tr> <td>16V</td> <td>3.5%</td> <td>5%</td> <td>0402 $\geq 33\text{nF}$ 0603 $\geq 150\text{nF}$ 0805 $\geq 680\text{nF}$</td> </tr> <tr> <td>10V</td> <td>5.0%</td> <td>----</td> <td>----</td> </tr> <tr> <td>6.3V</td> <td>7.5%</td> <td>----</td> <td>----</td> </tr> </tbody> </table> | Rated volt. | DF \leq | Exception of DF \leq | | $\geq 50\text{V}$ | 2.5% | 3% | 0603 $\geq 47\text{nF}$ | 25V | 3.5% | ---- | ---- | 16V | 3.5% | 5% | 0402 $\geq 33\text{nF}$ 0603 $\geq 150\text{nF}$ 0805 $\geq 680\text{nF}$ | 10V | 5.0% | ---- | ---- | 6.3V | 7.5% | ---- | ---- |
| Rated volt. | DF \leq | Exception of DF \leq | | | | | | | | | | | | | | | | | | | | | | | | | |
| $\geq 50\text{V}$ | 2.5% | 3% | 0603 $\geq 47\text{nF}$ | | | | | | | | | | | | | | | | | | | | | | | | |
| 25V | 3.5% | ---- | ---- | | | | | | | | | | | | | | | | | | | | | | | | |
| 16V | 3.5% | 5% | 0402 $\geq 33\text{nF}$ 0603 $\geq 150\text{nF}$ 0805 $\geq 680\text{nF}$ | | | | | | | | | | | | | | | | | | | | | | | | |
| 10V | 5.0% | ---- | ---- | | | | | | | | | | | | | | | | | | | | | | | | |
| 6.3V | 7.5% | ---- | ---- | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Insulation resistance | <p>The IR shall be measured with HP-4339B at room temperature.</p> <p>V_r (rated voltage) $\leq 500\text{V}$ At V_r (rated voltage) for 1 minute V_r (rated voltage) $> 500\text{V}$ At 500V for 1 minute</p> | $RiCr \geq 500\Omega\text{-F}$, whichever is smaller. | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | Dielectric Strength | <p>The withstanding voltage shall be measured with Zentech 9072A.</p> <p>V_r (rated voltage) $\leq 100\text{V}$ At $2.5V_r$ for 5 seconds V_r (rated voltage) = 200/250V At $1.5V_r + 100\text{V}$ for 5 seconds V_r (rated voltage) = 500V At $1.5V_r$ for 5 seconds V_r (rated voltage) $> 500\text{V}$ At $1.2V_r$ for 5 seconds</p> | <p>No breakdown</p> <p>No flashover</p> | | | | | | | | | | | | | | | | | | | | | | | | |



2. High Voltage Capacitors(250 ~ 3000VDC)

| 5 | Adhesion | <p>A force of 5 N shall be applied to the line joining the terminations and in a plane parallel to the substrate time: 10 ± 1 s</p>  | No visible damage | | | | | | | | | | | | | | | | | | |
|---------------------|--|--|---|------------|-----|-----|------------|-----------|--|--------------------|--------------------------|-------|----|------------------|--|----|--|--|---------------------|------------|--|
| 6 | Bending Strength | <p>Mounting in accordance with IEC 384 10, para 4.4 conditions: bending 1 mm at a rate of 1 mm/s</p>  | <p>No visible damage NPO: ΔC/C within ±5 % X7R: ΔC/C within ±10 %</p> | | | | | | | | | | | | | | | | | | |
| 7 | Resistance to soldering heat | <p>Preheat the capacitor at 120°C to 150°C for 1 minute. Immerse the capacitor in a eutectic solder solution at 270±5°C for 10±1seconds. After set it at room temperature for 24±2hours (temperature compensation type) or 48±4hours (high dielectric constant type), then measure.</p> <p>*High dielectric constant type : Initial measurement of X7R and Y5V. Perform a heat treatment at 150±5°C for one hour and then set it at room temperature for 48±4hours. Perform the initial measurement.</p> | <table border="1"> <thead> <tr> <th>Dielectric</th> <th>NP0</th> <th>X7R</th> </tr> </thead> <tbody> <tr> <td>Appearance</td> <td colspan="2">No defect</td> </tr> <tr> <td>Capacitance Change</td> <td><±2.5% or <±0.25pF</td> <td>±7.5%</td> </tr> <tr> <td>DF</td> <td colspan="2">The same as No.2</td> </tr> <tr> <td>IR</td> <td colspan="2">More than 500Ω-F (whichever is smaller)</td> </tr> <tr> <td>Dielectric Strength</td> <td colspan="2">No failure</td> </tr> </tbody> </table> | Dielectric | NP0 | X7R | Appearance | No defect | | Capacitance Change | <±2.5% or <±0.25pF | ±7.5% | DF | The same as No.2 | | IR | More than 500Ω-F (whichever is smaller) | | Dielectric Strength | No failure | |
| Dielectric | NP0 | X7R | | | | | | | | | | | | | | | | | | | |
| Appearance | No defect | | | | | | | | | | | | | | | | | | | | |
| Capacitance Change | <±2.5% or <±0.25pF | ±7.5% | | | | | | | | | | | | | | | | | | | |
| DF | The same as No.2 | | | | | | | | | | | | | | | | | | | | |
| IR | More than 500Ω-F (whichever is smaller) | | | | | | | | | | | | | | | | | | | | |
| Dielectric Strength | No failure | | | | | | | | | | | | | | | | | | | | |
| 8 | Resistance to leaching | <p>The capacitors are dipped into the solder at 260±5°C for 30±1 seconds, and then check the soldering by measuring the areas covered with solder.</p> | <p>95% of the terminations are to be soldered evenly and continuously.</p> | | | | | | | | | | | | | | | | | | |



2. High Voltage Capacitors(250 ~ 3000VDC)

| | | | |
|----|-------------------------------|--|--|
| 9 | Solder ability of termination | Zero hour test, and test after storage (20 to 24 months) in original atmosphere in normal atmosphere; un-mounted chips completely immersed for 2 ± 0.5 s in a solder bath of $235 \pm 5^\circ\text{C}$. | 95% of the termination is to be soldered evenly and continuously. |
| 10 | Rapid change of temperature | NPO/X7R: -55°C to $+125^\circ\text{C}$, 5 cycle Y5V: -25°C to $+85^\circ\text{C}$, 5 cycle Duration: 30 mins. Recovery: 24 ± 2 hrs. | No visible damage after 24 h recovery Class I NPO: $\Delta C/C \leq 2.5\%$ or ± 0.25 pF Class II X7R: $\Delta C/C \leq \pm 15\%$ |
| 11 | Damp heat, steady state | 500 ± 12 hours at $40 \pm 2^\circ\text{C}$; 90 to 95 % RH | No visible damage after 24 ± 2 (NPO) or 48 ± 4 hours recovery Class 1 (NPO) 1. $\Delta C/C \pm 5\%$ or 1 pF, whichever is greater 2. $C < 10\text{pF}$; $Q \geq 200 + 10C$ $10 \leq C \leq 30\text{pF}$; $Q \geq 275 + 5/2C$ $C > 30\text{pF}$; $Q \geq 350$ 3. $IR \geq 4000 \text{ M}\Omega$ or $RiCr \geq 40\Omega\text{F}$, whichever is less Class 2 (X7R) 1. $\Delta C/C$ within $\pm 15\%$ 2. $\tan \delta \leq 7\%$ 3. $R \geq 2000 \text{ M}\Omega$ or $RiCr \geq 50\Omega\text{F}$, whichever is less |
| 12 | Endurance | 1000 h at maximum temperature V_r (rated voltage) $\leq 250\text{V}$ At $2 \times V_r$ V_r (rated voltage) = 500V At $1.5V_r$ V_r (rated voltage) $> 500\text{V}$ At $1.2V_r$ | No visible damage after 24 ± 2 (NPO) or 48 ± 4 hours recovery Class 1 (NPO) 1. $\Delta C/C \pm 2\%$ or 1 pF, whichever is greater 2. $\tan \delta \leq 2 \times$ specified value 3. $IR \geq 4000 \text{ M}\Omega$ or $RiCr \geq 40\Omega\text{F}$, whichever is less Class 2 (X7R) 1. $\Delta C/C$ within $\pm 15\%$ 2. $\tan \delta \leq 7\%$ 3. $IR \geq 2000 \text{ M}\Omega$ or $RiCr \geq 50\Omega\text{F}$, whichever is less |



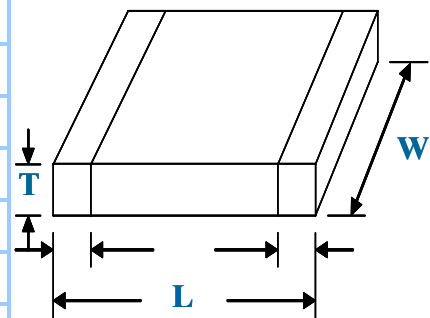
7. Common Capacitors

◆ Summary of Specification

| Specification | NP0 | X7R | Y5V |
|--|---------------------------------------|--------------------------|----------------------------|
| Rated Voltage | 10VDC~200VDC | | |
| Operating Coefficient | -55°C to +125°C, ±30ppm/°C | -55°C to +125°C, ±15% | -30°C to +85°C, +22~82% |
| Capacitance Range | 0.22pF~22nF | 100pF~1μF | 10nF~10μF |
| Dissipation Factor | ≤0.1% | ≤5% | ≤7% |
| Insulation Resistance (after 1min.) | >100GΩ | >10GΩ | >10GΩ |
| Dielectric Withstanding Voltage | 250% of rated voltage for 5±1 seconds | | |

◆ Dimension

| Case size | Length (L) (mm) | Width (W) (mm) | Thickness (T) (mm) | Thickness Symbol |
|-----------|--------------------|-------------------|-----------------------|---------------------|
| 0402 | 1.0±0.05 | 0.50±0.05 | 0.50±0.05 | A |
| 0603 | 1.6±0.10 | 0.80±0.10 | 0.80±0.10 | C |
| 0805 | 2.0±0.10 | 1.25±0.10 | 0.60±0.10 | B |
| | | | 0.80±0.10 | C |
| | | | 1.25±0.20 | E |
| 1206 | 3.2±0.15 | 1.60±0.15 | 0.80±0.10 | C |
| | | | 1.25±0.20 | E |
| | | | 1.60±0.20 | G |
| 1210 | 3.2±0.20 | 2.5±0.20 | 1.25±0.20 | E |
| | | | 1.60±0.20 | G |
| | | | 2.00±0.2 | K |
| 1808 | 4.6±0.30 | 2.00±0.30 | 1.25±0.20 | E |
| | | | 1.60±0.20 | G |
| | | | 2.00±0.2 | K |
| 1812 | 4.6±0.30 | 3.20±0.30 | 1.25±0.20 | E |
| | | | 1.60±0.20 | G |
| | | | 2.00±0.2 | K |





7. Common Capacitors

◆ How To Order

| CC | 0805 | NP0 | 8 | J | 471 | B | L |
|---------------------|--|-------------------|--|---|--|--|-------------|
| <u>Type</u> | <u>Size</u> | <u>Dielectric</u> | <u>Dielectric</u> | <u>Tolerance</u> | <u>Capacitance</u> | <u>Packing</u> | <u>RoHS</u> |
| CC = Chip Capacitor | 0201 0402 0603 0805 1206 1210 1808 1812 | NP0 X7R Y5V | <u>Voltage</u> 2 = 10V 3 = 16V 4 = 25V 5 = 50V 6 = 100V 7 = 200V especially L=35V E=63V | A=±0.05pF B=±0.10pF C=±0.25pF D=±0.50pF F=±1.0% G=±2.0% J=±5.0% K=±10% M=±20% Z=-20~+80% | 1st two digits are significant; third digit denotes number of zeros, And A is in place of decimal point. example : 47A=4.7pF 102=10*10 ² pF =1000pF =1nF | <u>Quantity</u> B : Bulk C : 50K/reel D : 15K/reel E : 10K/reel F : 8K/reel P : 4K/reel R : 3K/reel 2K/reel 1K/reel Especially G : 16K/reel H : 20K/reel | compliance |

| Tolerance | Capacitance for dielectric | | | |
|------------|----------------------------|-----------|-----------|-----------|
| | NP0 | | X7R | Y5V |
| A=±0.05pF | | | | |
| B=±0.10pF | 0.22pF~10pF | 12pF~22nF | 100pF~1uF | 10nF~10uF |
| C=±0.25pF | | | | |
| D=±0.50pF | | | | |
| F=±1.0% | | | | |
| G=±2.0% | | | | |
| J=±5.0% | B,C,D | G,J | J,K,M | M,Z |
| K=±10% | | | | |
| M=±20% | | | | |
| Z=-20~+80% | | | | |



7. Common Capacitors

◆ Capacitance Range

| DIELECTRIC | | NP0 | | | | | | | | | | | | | | | | | | | |
|------------|------|------|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| SIZE | | 0402 | | 0603 | | | 0805 | | | 1206 | | | 1210 | | | 1808 | | | 1812 | | |
| CAP | CODE | 25V | 50V | 50V | 100V | 200V | 50V | 100V | 200V | 50V | 100V | 200V | 50V | 100V | 200V | 50V | 100V | 200V | 50V | 100V | 200V |
| 0.22pF | 22B | A | A | C | C | C | C | C | C | C | C | C | | | | | | | | | |
| ~ | ~ | A | A | C | C | C | C | C | C | C | C | C | | | | | | | | | |
| 10pF | 100 | A | A | C | C | C | C | C | C | C | C | C | | | | | | | | | |
| 12pF | 120 | A | A | C | C | C | C | C | C | C | C | C | | | | | | | | | |
| 15pF | 150 | A | A | C | C | C | C | C | C | C | C | C | | | | | | | | | |
| 18pF | 180 | A | A | C | C | C | C | C | C | C | C | C | | | | | | | | | |
| 22pF | 220 | A | A | C | C | C | C | C | C | C | C | C | | | | | | | | | |
| 27pF | 270 | A | A | C | C | C | C | C | C | C | C | C | | | | | | | | | |
| 33pF | 330 | A | A | C | C | C | C | C | C | C | C | C | | | | | | | | | |
| 39pF | 390 | A | A | C | C | C | C | C | C | C | C | C | | | | | | | | | |
| 47pF | 470 | A | A | C | C | C | C | C | C | C | C | C | | | | | | | | | |
| 56pF | 560 | A | A | C | C | C | C | C | C | C | C | C | | | | | | | | | |
| 68pF | 680 | A | A | C | C | C | C | C | C | C | C | C | | | | | | | | | |
| 82pF | 820 | A | A | C | C | C | C | C | C | C | C | C | | | | | | | | | |
| 100pF | 101 | A | A | C | C | C | C | C | C | C | C | C | | | | | | | | | |
| 120pF | 121 | A | A | C | C | C | C | C | C | C | C | C | | | | | | | | | |
| 150pF | 151 | A | A | C | C | C | C | C | C | C | C | C | | | | | | | | | |
| 180pF | 181 | A | A | C | C | C | C | C | C | C | C | C | E | E | | | | | | | |
| 220pF | 221 | A | A | C | C | C | C | C | C | C | C | C | E | E | E | | | | | | |
| 270pF | 271 | A | | C | C | C | C | C | C | C | C | C | E | E | E | E | E | | | | |
| 330pF | 331 | A | | C | C | C | C | C | C | C | C | C | E | E | E | E | E | E | | | |
| 390pF | 391 | | | C | C | C | C | C | C | C | C | C | E | E | E | E | E | E | | | |
| 470pF | 471 | | | C | C | C | C | C | C | C | C | C | E | E | E | E | E | E | | | |
| 560pF | 561 | | | C | C | | C | C | C | C | C | C | E | E | E | E | E | E | | | |
| 680pF | 681 | | | C | C | | C | C | C | C | C | C | E | E | E | E | E | E | | | |
| 820pF | 821 | | | C | C | | C | C | C | C | C | C | E | E | E | E | E | E | E | E | |
| 1nF | 102 | | | C | C | | C | C | C | C | C | C | E | E | E | E | E | E | E | E | E |
| 1.2nF | 122 | | | | | | C | C | E | C | C | C | E | E | E | E | E | E | E | E | E |
| 1.5nF | 152 | | | | | | C | C | E | C | C | C | E | E | E | E | E | E | E | E | E |
| 1.8nF | 182 | | | | | | C | C | E | C | C | C | E | E | E | E | E | E | E | E | E |
| 2.2nF | 222 | | | | | | C | C | | C | C | E | E | E | E | E | E | E | E | E | E |
| 2.7nF | 272 | | | | | | E | E | | C | C | E | E | E | E | E | E | E | E | E | E |
| 3.3nF | 332 | | | | | | E | E | | C | C | E | E | E | E | E | E | E | E | E | E |
| 3.9nF | 392 | | | | | | E | E | | C | C | E | E | E | E | E | E | E | E | E | E |
| 4.7nF | 472 | | | | | | E | E | | C | C | | E | E | E | E | E | E | E | E | E |
| 5.6nF | 562 | | | | | | | | | E | E | | E | E | E | | | E | E | E | |
| 6.8nF | 682 | | | | | | | | | E | E | | E | E | | | | E | E | | |
| 8.2nF | 822 | | | | | | | | | E | E | | E | E | | | | E | E | | |
| 10nF | 103 | | | | | | | | | E | E | | E | E | | | | E | E | | |
| 12nF | 123 | | | | | | | | | | | | E | E | | | | E | E | | |
| 15nF | 153 | | | | | | | | | | | | E | E | | | | E | E | | |
| 18nF | 183 | | | | | | | | | | 3 | | | | | | | E | E | | |
| 22nF | 223 | | | | | | | | | | | | | | | | | E | E | | |



7. Common Capacitors

| DIELECTRIC | | X7R | | | | | | | | | | | | | | | | | | | | |
|------------|------|------|-----|-----|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| SIZE | | 0402 | | | | 0603 | | 0805 | | | 1206 | | | 1210 | | | 1808 | | | 1812 | | |
| CAP | CODE | 10V | 16V | 25V | 50V | 50V | 100V | 50V | 100V | 200V | 50V | 100V | 200V | 50V | 100V | 200V | 50V | 100V | 200V | 50V | 100V | 200V |
| 100pF | 101 | A | A | A | A | C | C | | | | | | | | | | | | | | | |
| 120pF | 121 | A | A | A | A | C | C | | | | | | | | | | | | | | | |
| 150pF | 151 | A | A | A | A | C | C | | | | | | | | | | | | | | | |
| 180pF | 181 | A | A | A | A | C | C | C | C | C | | | | | | | | | | | | |
| 220pF | 221 | A | A | A | A | C | C | C | C | C | | | | | | | | | | | | |
| 270pF | 271 | A | A | A | A | C | C | C | C | C | C | C | | | | | | | | | | |
| 330pF | 331 | A | A | A | A | C | C | C | C | C | C | C | | | | | | | | | | |
| 390pF | 391 | A | A | A | A | C | C | C | C | C | C | C | | | | | | | | | | |
| 470pF | 471 | A | A | A | A | C | C | C | C | C | C | C | | | | | | | | | | |
| 560pF | 561 | A | A | A | A | C | C | C | C | C | C | C | | | | | | | | | | |
| 680pF | 681 | A | A | A | A | C | C | C | C | C | C | C | | | | | | | | | | |
| 820pF | 821 | A | A | A | A | C | C | C | C | C | C | C | | | | | | | | | | |
| 1nF | 102 | A | A | A | A | C | C | C | C | C | C | C | | | | | | | | | | |
| 1.2nF | 122 | A | A | A | A | C | C | C | C | C | C | C | | | | | | | | | | |
| 1.5nF | 152 | A | A | A | A | C | C | C | C | C | C | C | | | | | | | | | | |
| 1.8nF | 182 | A | A | A | A | C | C | C | C | C | C | C | | | | | | | | | | |
| 2.2nF | 222 | A | A | A | A | C | C | C | C | C | C | E | | | | | | | | | | |
| 2.7nF | 272 | A | A | A | A | C | C | C | C | C | C | E | | | | | E | E | E | | | |
| 3.3nF | 332 | A | A | A | A | C | C | C | C | C | C | E | | | | | E | E | E | | | |
| 3.9nF | 392 | A | A | A | A | C | C | C | C | C | C | E | E | E | E | | E | E | E | | | |
| 4.7nF | 472 | A | A | A | A | C | C | C | C | C | C | E | E | E | E | | E | E | E | | | |
| 5.6nF | 562 | A | A | A | A | C | C | C | C | C | C | E | E | E | E | | E | E | E | | | |
| 6.8nF | 682 | A | A | A | A | C | C | C | C | C | C | E | E | E | E | | E | E | E | | | |
| 8.2nF | 822 | A | A | A | | C | C | C | C | C | C | E | E | E | E | | E | E | E | | | |
| 10nF | 103 | A | A | A | | C | C | C | C | C | C | E | E | E | E | | E | E | E | E | E | E |
| 12nF | 123 | A | A | | | C | | C | C | C | C | E | E | E | E | | E | E | E | E | E | E |
| 15nF | 153 | A | A | | | C | | C | C | C | C | E | E | E | E | | E | E | E | E | E | E |
| 18nF | 183 | A | A | | | C | | C | C | E | C | C | E | E | E | E | | E | E | E | E | E |
| 22nF | 223 | A | A | | | C | | C | C | E | C | C | E | E | E | E | | E | E | E | E | E |
| 27nF | 273 | A | A | | | C | | C | E | E | C | C | E | E | E | E | | E | E | E | E | E |
| 33nF | 333 | A | A | | | | | C | E | | C | C | E | E | E | E | | E | E | E | E | E |
| 39nF | 393 | A | A | | | | | C | E | | C | C | E | E | E | E | | E | E | E | E | E |
| 47nF | 473 | A | A | | | | | C | E | | C | C | E | E | E | E | | E | E | E | E | E |
| 56nF | 563 | | | | | | | C | | | C | E | E | E | E | E | | E | E | E | E | E |
| 68nF | 683 | | | | | | | E | | | C | E | E | E | E | E | | E | E | E | E | E |
| 82nF | 823 | | | | | | | E | | | C | E | | E | E | E | | E | E | E | E | E |
| 100nF | 104 | | | | | | | E | | | C | E | | E | E | E | | E | E | E | E | E |
| 120nF | 124 | | | | | | | | | | E | | | E | E | | | E | E | E | E | E |
| 150nF | 154 | | | | | | | | | | E | | | E | E | | | E | | | E | E |
| 180nF | 184 | | | | | | | | | | E | | | E | G | | | E | | | E | E |
| 220nF | 224 | | | | | | | | | | E | | | E | G | | | E | | | E | E |
| 270nF | 274 | | | | | | | | | | | | | E | | | | E | | | E | G |
| 330nF | 334 | | | | | | | | | | | | | E | | | | E | | | E | G |
| 390nF | 394 | | | | | | | | | | | | | E | | | | | | | E | K |
| 470nF | 474 | | | | | | | | | | | | | | | | | | | | E | K |
| 560nF | 564 | | | | | | | | | | | | | | | | | | | | E | |
| 680nF | 684 | | | | | | | | | | | | | | | | | | | | G | |
| 820nF | 824 | | | | | | | | | | | | | | | | | | | | G | |
| 1uF | 105 | | | | | | | | | | | | | | | | | | | | G | |



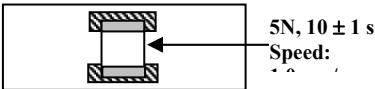
7. Common Capacitors

| DIELECTRIC | | Y5V | | | | | | | | | | | | | | |
|------------|------|------|-----|-----|------|-----|-----|-----|------|-----|-----|-----|------|-----|-----|-----|
| SIZE | | 0402 | | | 0603 | | | | 0805 | | | | 1206 | | | |
| CAP | CODE | 10V | 16V | 25V | 10V | 16V | 25V | 50V | 10V | 16V | 25V | 50V | 10V | 16V | 25V | 50V |
| 10nF | 103 | A | A | A | C | C | C | C | | | C | C | | C | C | C |
| 15nF | 153 | A | A | A | C | C | C | C | | | C | C | | C | C | C |
| 22nF | 223 | A | A | A | C | C | C | C | | | C | C | | C | C | C |
| 33nF | 333 | A | A | | C | C | C | C | | | C | C | | C | C | C |
| 47nF | 473 | A | A | | C | C | C | C | | | C | C | | C | C | C |
| 68nF | 683 | A | A | | C | C | C | C | | | C | C | | C | C | C |
| 100nF | 104 | A | A | | C | C | C | C | | | C | C | | C | C | C |
| 150nF | 154 | A | | | C | C | C | | | | C | C | | C | C | C |
| 180nF | 184 | A | | | C | C | C | | | | C | C | | C | C | C |
| 220nF | 224 | A | | | C | C | C | | | | C | C | | C | C | C |
| 330nF | 334 | | | | C | C | C | | | C | C | | | C | C | C |
| 470nF | 474 | | | | C | C | | | | C | | | | C | C | C |
| 680nF | 684 | | | | C | C | | | E | C | | | | C | C | C |
| 820nF | 824 | | | | C | C | | | E | C | | | | C | E | |
| 1uF | 105 | | | | C | C | | | E | E | | | | C | E | |
| 1.5uF | 155 | | | | | | | | E | E | | | | C | E | |
| 2.2uF | 225 | | | | | | | | E | | | | E | E | E | |
| 3.3uF | 335 | | | | | | | | E | | | | E | E | E | |
| 4.7uF | 475 | | | | | | | | E | | | | E | E | E | |
| 10uF | 106 | | | | | | | | G | | | | E | | | |



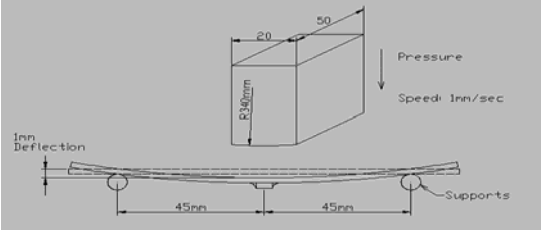
7. Common Capacitors

◆ Electrical and Mechanical Specification

| No | Test item | Conditions | Requirements | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------------|---|---|---|-------------|-----------|------------------------|--|-------------------|------|----|-------------------------|-----|------|------|------|-----|------|----|---|-----|------|------|------|------|------|------|------|-------------|-----------|---------|----|-----|----|-----|-------|
| 1 | Capacitance | <p>The Capacitance and DF should be measured at 25°C with HP-4288A</p> <p>NP0 :</p> <p>$C \leq 1000 \text{ pF}$ $1 \pm 0.2V_{\text{rm}}$, $f = 1 \text{ MHz}$; $C > 1000 \text{ pF}$ $1 \pm 0.2V_{\text{rm}}$, $f = 1 \text{ kHz}$; X7R/Y5V :</p> <p>$C \leq 10\mu\text{F}$ $1.0 \pm 0.2V_{\text{rm}}$ $f = @ 1\text{kHz}$ $C > 10\mu\text{F}$ $0.5 \pm 0.2V_{\text{rm}}$ $f = @ 120\text{Hz}$</p> | <p>Within specified tolerance</p> <p>NP0 :</p> <p>More than 30 pF: $Q \geq 1000$ ($DF \leq 0.1\%$) Less than 30 pF: $Q \geq 400 + 20 C$ ($Q = 1/DF$)</p> <p>X7R :</p> <table border="1"> <thead> <tr> <th>Rated volt.</th> <th>DF \leq</th> <th colspan="2">Exception of DF \leq</th> </tr> </thead> <tbody> <tr> <td>$\geq 50\text{V}$</td> <td>2.5%</td> <td>3%</td> <td>0603 $\geq 47\text{nF}$</td> </tr> <tr> <td>25V</td> <td>3.5%</td> <td>----</td> <td>----</td> </tr> <tr> <td>16V</td> <td>3.5%</td> <td>5%</td> <td>0402 $\geq 33\text{nF}$ 0603 $\geq 150\text{nF}$ 0805 $\geq 680\text{nF}$</td> </tr> <tr> <td>10V</td> <td>5.0%</td> <td>----</td> <td>----</td> </tr> <tr> <td>6.3V</td> <td>7.5%</td> <td>----</td> <td>----</td> </tr> </tbody> </table> <p>Y5V :</p> <table border="1"> <thead> <tr> <th>Rated volt.</th> <th>DF \leq</th> </tr> </thead> <tbody> <tr> <td>25~250V</td> <td>7%</td> </tr> <tr> <td>16V</td> <td>9%</td> </tr> <tr> <td>10V</td> <td>12.5%</td> </tr> </tbody> </table> | Rated volt. | DF \leq | Exception of DF \leq | | $\geq 50\text{V}$ | 2.5% | 3% | 0603 $\geq 47\text{nF}$ | 25V | 3.5% | ---- | ---- | 16V | 3.5% | 5% | 0402 $\geq 33\text{nF}$ 0603 $\geq 150\text{nF}$ 0805 $\geq 680\text{nF}$ | 10V | 5.0% | ---- | ---- | 6.3V | 7.5% | ---- | ---- | Rated volt. | DF \leq | 25~250V | 7% | 16V | 9% | 10V | 12.5% |
| Rated volt. | DF \leq | | Exception of DF \leq | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $\geq 50\text{V}$ | 2.5% | 3% | 0603 $\geq 47\text{nF}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25V | 3.5% | ---- | ---- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16V | 3.5% | 5% | 0402 $\geq 33\text{nF}$ 0603 $\geq 150\text{nF}$ 0805 $\geq 680\text{nF}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10V | 5.0% | ---- | ---- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6.3V | 7.5% | ---- | ---- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rated volt. | DF \leq | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25~250V | 7% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16V | 9% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10V | 12.5% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | Dissipation Factor ($\tan \delta$) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Insulation resistance | <p>The IR should be measured with HP-4339B at room temperature.</p> <p>V_r (rated voltage) $\leq 500\text{V}$ At V_r (rated voltage) for 1 minute V_r (rated voltage) $> 500\text{V}$ At 500V for 1 minute</p> | <p>NP0: $IR \geq 100\text{G}\Omega$ X7R/Y5V: $10\text{G}\Omega$ Min. or $500 \Omega\text{-F}$, whichever is smaller.</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | Dielectric Strength | <p>The withstanding voltage should be measured with Zentech 9072A.</p> <p>$V_r \leq 500\text{V}$ at $2V_r$ for 5 seconds $500\text{V} \leq V_r \leq 1000$ at $1.5V_r$ for 5 seconds $V_r > 1000\text{V}$ at $1.2V_r$ for 5 seconds</p> | <p>No breakdown No flashover</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | Adhesion | <p>A force of 5 N shall be applied to the line joining the terminations and in a plane parallel to the substrate time: $10 \pm 1 \text{ s}$</p>  | <p>No visible damage</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |



7. Common Capacitors

| 6 | Bending Strength | <p>Mounting in accordance with IEC 384 10, Para 4.4 conditions: bending 1 mm at a rate of 1 mm/s</p>  | <p>No visible damage NPO: $\Delta C/C$ within $\pm 5\%$ X7R: $\Delta C/C$ within $\pm 10\%$ Y5V: $\Delta C/C$ within $\pm 30\%$</p> | | | | | | | | | | | | | | | | | | | | | | | | |
|---------------------|--|--|---|------------|-----|-----|-----|------------|-----------|--|--|--------------------|--|-------------|------------|----|------------------|--|--|----|--|--|--|---------------------|------------|--|--|
| 7 | Resistance to soldering heat | <p>Preheat the capacitor at 120°C to 150°C for 1 minute. Immerse the capacitor in an eutectic solder solution at $270 \pm 5^{\circ}\text{C}$ for 10 ± 1 seconds. After set it at room temperature for 24 ± 2 hours (temperature compensation type) or 48 ± 4 hours (high dielectric constant type), then measure. *High dielectric constant type : Initial measurement for X7R and Y5V. Perform a heat treatment at $150 \pm 5^{\circ}\text{C}$ for one hour and then set it at room temperature for 48 ± 4 hours. Perform the initial measurement.</p> | <table border="1"> <thead> <tr> <th>Dielectric</th> <th>NP0</th> <th>X7R</th> <th>Y5V</th> </tr> </thead> <tbody> <tr> <td>Appearance</td> <td colspan="3">No defect</td> </tr> <tr> <td>Capacitance Change</td> <td>$< \pm 2.5\%$ or $< \pm 0.25\text{pF}$</td> <td>$\pm 7.5\%$</td> <td>$\pm 20\%$</td> </tr> <tr> <td>DF</td> <td colspan="3">The same as No.2</td> </tr> <tr> <td>IR</td> <td colspan="3">More than $500\Omega\text{-F}$ (whichever is smaller)</td> </tr> <tr> <td>Dielectric Strength</td> <td colspan="3">No failure</td> </tr> </tbody> </table> | Dielectric | NP0 | X7R | Y5V | Appearance | No defect | | | Capacitance Change | $< \pm 2.5\%$ or $< \pm 0.25\text{pF}$ | $\pm 7.5\%$ | $\pm 20\%$ | DF | The same as No.2 | | | IR | More than $500\Omega\text{-F}$ (whichever is smaller) | | | Dielectric Strength | No failure | | |
| Dielectric | NP0 | X7R | Y5V | | | | | | | | | | | | | | | | | | | | | | | | |
| Appearance | No defect | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Capacitance Change | $< \pm 2.5\%$ or $< \pm 0.25\text{pF}$ | $\pm 7.5\%$ | $\pm 20\%$ | | | | | | | | | | | | | | | | | | | | | | | | |
| DF | The same as No.2 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| IR | More than $500\Omega\text{-F}$ (whichever is smaller) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Dielectric Strength | No failure | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | Resistance to leaching | <p>The capacitors are dipped into the solder at $260 \pm 5^{\circ}\text{C}$ for 30 ± 1 seconds, then check the soldering by measuring the areas covered with solder.</p> | <p>95% of the terminations are to be soldered evenly and continuously.</p> | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | Solder ability of Termination | <p>Zero hour test, and test after storage (20 to 24 months) in original atmosphere in normal atmosphere; un-mounted chips completely immersed for 2 ± 0.5 s in a solder bath of $235 \pm 5^{\circ}\text{C}$.</p> | <p>95% of the termination is to be soldered evenly and continuously.</p> | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | Rapid change of temperature | <p>NPO/X7R: -55°C to $+125^{\circ}\text{C}$, 5 cycle Y5V: -25°C to $+85^{\circ}\text{C}$, 5 cycle Duration: 30 mins. Recovery: 24 ± 2 hrs.</p> | <p>No visible damage after 24 h recovery Class I NPO: $\Delta C/C \leq 2.5\%$ or $\pm 0.25\text{pF}$ X7R: $\Delta C/C \leq \pm 15\%$ Y5V: $\Delta C/C \leq \pm 20\%$</p> | | | | | | | | | | | | | | | | | | | | | | | | |



7. Common Capacitors

| | | | |
|----|-------------------------|--|---|
| 11 | Damp heat, steady state | 500±12hours at 40±2°C; 90 to 95 % RH | <p>No visible damage after 24 ± 2 (NPO) or 48 ± 4 hours recovery</p> <p>Class 1 (NPO)</p> <ol style="list-style-type: none"> 1. $\Delta C/C \pm 5\%$ or 1 pF, whichever is greater 2. $C < 10\text{pF}$; $Q \geq 200+10C$ $10 \leq C \leq 30\text{pF}$; $Q \geq 275+5/2C$ $C > 30\text{pF}$; $Q \geq 350$ 3. $IR \geq 4000\text{ M}\Omega$ or $RiCr \geq 40\Omega F$, whichever is less <p>Class 2 (X7R)</p> <p>$\Delta C/C$ within ± 15 % $\tan \delta \leq 7\%$ $IR \geq 2000\text{ M}\Omega$ or $RiCr \geq 50\Omega F$, whichever is less</p> <p>Class 2 (Y5V)</p> <ol style="list-style-type: none"> 1. $\Delta C/C$ within ± 30 % 2. 50/25V: $\tan \delta \leq 9\%$ 16V: $\tan \delta \leq 12.5\%$ 10V: $\tan \delta \leq 15\%$ 3. $IR \geq 2000\text{ M}\Omega$ or $RiCr \geq 50\Omega F$, whichever is less |
| 12 | Endurance | <p>For General Capacitors: 1000 hrs at maximum temperature V_r (rated voltage) ≤ 250V At 2×V_r V_r (rated voltage) = 500V At 1.5V_r V_r (rated voltage) > 500V At 1.2V_r</p> | <p>No visible damage after 24 ± 2 (NPO) or 48 ± 4 hours recovery</p> <p>Class 1 (NPO)</p> <ol style="list-style-type: none"> 1. $\Delta C/C \pm 2\%$ or 1 pF, whichever is greater 2. $\tan \delta \leq 2 \times$ specified value 3. $IR \geq 4000\text{ M}\Omega$ or $RiCr \geq 40\Omega F$, whichever is less <p>Class 2 (X7R)</p> <p>$\Delta C/C$ within ± 15 % $\tan \delta \leq 7\%$ $IR \geq 2000\text{ M}\Omega$ or $RiCr \geq 50\Omega F$, whichever is less</p> <p>Class 2 (Y5V)</p> <ol style="list-style-type: none"> 1. $\Delta C/C$ within ± 30 % 2. 50/25V: $\tan \delta \leq 9\%$ 16V: $\tan \delta \leq 12.5\%$ 3. $IR \geq 2000\text{ M}\Omega$ or $RiCr \geq 50\Omega F$, whichever is less |