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Messrs. : 一般共用

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# APPROVAL SHEET

Product Name : High Capacitance Multilayer Ceramic Chip Capacitors

Part No. : FS Series

Description : Size  $\leq 2225$ , Capacitance  $\geq 1\mu F$ ,  $U_R < 1000V$

| PREPARED BY | APPROVED BY |
|-------------|-------------|
|             |             |

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# SPECIFICATION

FOR

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**Part No. : FS Series**

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|   |
|---|
| <b>SPEC. No. : <u>FS-000-001-06</u></b> |
| <b>DATE : <u>2017/09/15</u></b>         |

| DRAWN BY          | CHECEKED BY       | APPROVED BY      |
|-------------------|-------------------|------------------|
| <b>Yvens Chou</b> | <b>Yvens Chou</b> | <b>Ryan Chen</b> |



# 1. INTRODUCTION

PDC FS Series green type capacitors are manufactured by using environmental friendly material without lead or cadmium. These capacitors feature series connection of multi-layer capacitor units in a MLCC to realize high voltage performance. This special design can distribute voltage gradients throughout the entire capacitor, so as to prevent short circuit failure. It is a safety design for LCD back-lighting inverter application.

# 2. FEATURES

- a. Realize high capacitance in small sizes.
- b. Capacitor with lead-free termination (pure Tin).
- c. RoHS compliant.
- d. HALOGEM compliant.
- e. Surface mount suited for wave and reflow soldering.
- f. High reliability and no polarity.

# 3. APPLICATIONS

- a. Digital circuit coupling or decoupling applications.
- b. For bypassing.
- c. Ideal for smoothing circuits.
- d. DC to DC converter.

# 4. HOW TO ORDER

| <u>FS</u>  | <u>21</u> | <u>X</u>   | <u>471</u>  | <u>K</u>  | <u>500</u>    | <u>P</u>  | <u>X</u>  | <u>G</u>     |
|------------|-----------|------------|-------------|-----------|---------------|-----------|-----------|--------------|
| PDC Family | Size      | Dielectric | Capacitance | Tolerance | Rated Voltage | Packaging | Thickness | Control Code |
| Table 1    | Table 2   | Table 3    | Table 4     | Table 5   | Table 6       | Table 7   | Table 8   | Table 9      |

| Table 1 |   | PDC Family |             |
|---------|---|------------|-------------|
| Code    | Description   | Code       | Description |
| FS      | High Capacitance Capacitor $\geq 1\mu\text{F}(105)$ |            |             |

| Table 2 |             | General Purpose |             |      |             |
|---------|-------------|-----------------|-------------|------|-------------|
| Code    | Description | Code            | Description | Code | Description |
| 03      | 0201 (0603) | 31              | 1206 (3216) | 46   | 1825 (4563) |
| 15      | 0402 (1005) | 32              | 1210 (3225) | 52   | 2211 (5728) |
| 18      | 0603 (1608) | 42              | 1808 (4520) | 55   | 2220 (5750) |
| 21      | 0805 (2012) | 43              | 1812 (4532) | 56   | 2225 (5763) |

| Table 3 |             | Dielectric Material Characteristics |             |
|---------|-------------|-------------------------------------|-------------|
| Code    | Description | Code                                | Description |
| N       | C0G         | X                                   | X7R         |
| B       | X5R         | F                                   | Y5V         |
| S       | X6S         |                                     |             |

| Table 4 |                                  | Capacitance Rule Code |                                    |
|---------|----------------------------------|-----------------------|------------------------------------|
| Code    | Description                      | Code                  | Description                        |
| R47     | 0.47pF                           | 102                   | $102=10 \times 10^2=1000\text{pF}$ |
| 0R5     | 0.5pF                            | 104                   | $104=10 \times 10^4=100\text{nF}$  |
| 100     | $100=10 \times 10^0=10\text{pF}$ | 106                   | $106=10 \times 10^6=10\mu\text{F}$ |

| Table 5 |                       | Tolerance |                       |      |                       |
|---------|-----------------------|-----------|-----------------------|------|-----------------------|
| Code    | Description           | Code      | Description           | Code | Description           |
| A       | $\pm 0.05 \text{ pF}$ | I         | -10% ~ 0%             | Q    | $\pm 0.03 \text{ pF}$ |
| B       | $\pm 0.10 \text{ pF}$ | J         | $\pm 5 \%$            | Z    | -20% ~ +80%           |
| C       | $\pm 0.25 \text{ pF}$ | K         | $\pm 10 \%$           | X    | +10% ~ +20%           |
| D       | $\pm 0.50 \text{ pF}$ | L         | 0% ~ +10%             |      |                       |
| F       | $\pm 1 \%$            | M         | $\pm 20 \%$           |      |                       |
| G       | $\pm 2 \%$            | N         | -5% ~ +10%            |      |                       |
| H       | $\pm 3 \%$            | P         | $\pm 0.02 \text{ pF}$ |      |                       |

| Table 6 |             | Rated Voltage |             |      |             |
|---------|-------------|---------------|-------------|------|-------------|
| Code    | Description | Code          | Description | Code | Description |
| 6R3     | 6.3Vdc      | 201           | 200Vdc      | 152  | 1500Vdc     |
| 100     | 10Vdc       | 251           | 250Vdc      | 202  | 2000Vdc     |
| 160     | 16Vdc       | 401           | 400Vdc      | 302  | 3000Vdc     |
| 250     | 25Vdc       | 501           | 500Vdc      | 402  | 4000Vdc     |
| 500     | 50Vdc       | 631           | 630Vdc      | 502  | 5000Vdc     |
| 101     | 100Vdc      | 102           | 1000Vdc     | 602  | 6000Vdc     |

| Table 7 |                                  | Packaging Type |                               |
|---------|----------------------------------|----------------|-------------------------------|
| Code    | Description                      | Code           | Description                   |
| B       | Bulk                             | T              | Tray package                  |
| E       | Tape and 7" Reel, Embossed Tape  | P              | Tape and 7" Reel, Paper Tape  |
| K       | Tape and 10" Reel, Embossed Tape | D              | Tape and 10" Reel, Paper Tape |
| L       | Tape and 13" Reel, Embossed Tape | G              | Tape and 13" Reel, Paper Tape |

| Table 8 |                                 | Thickness Description |                                 |      |                                  |
|---------|---------------------------------|-----------------------|---------------------------------|------|----------------------------------|
| Code    | Description                     | Code                  | Description                     | Code | Description                      |
| A       | $0.60 \pm 0.10 \text{ mm}$      | I                     | $1.25 \pm 0.20 \text{ mm}$      | Q    | $0.50 \pm 0.02/-0.05 \text{ mm}$ |
| B       | $0.8 \pm 0.15/-0.10 \text{ mm}$ | J                     | $1.15 \pm 0.15 \text{ mm}$      | R    | $3.10 \pm 0.30 \text{ mm}$       |
| C       | $1.25 \pm 0.10 \text{ mm}$      | K                     | $0.50 \pm 0.20 \text{ mm}$      | S    | $0.80 \pm 0.07 \text{ mm}$       |
| D       | $1.40 \pm 0.15 \text{ mm}$      | L                     | $0.30 \pm 0.03 \text{ mm}$      | T    | $0.85 \pm 0.10 \text{ mm}$       |
| E       | $1.60 \pm 0.20 \text{ mm}$      | M                     | $0.95 \pm 0.10 \text{ mm}$      | U    | $0.50 \pm 0.10 \text{ mm}$       |
| F       | $2.00 \pm 0.20 \text{ mm}$      | N                     | $0.50 \pm 0.05 \text{ mm}$      | V    | $0.20 \pm 0.02 \text{ mm}$       |
| G       | $2.50 \pm 0.30 \text{ mm}$      | O                     | $3.50 \pm 0.20 \text{ mm}$      | X    | $0.80 \pm 0.10 \text{ mm}$       |
| H       | $2.80 \pm 0.30 \text{ mm}$      | P                     | $1.60 \pm 0.3/-0.10 \text{ mm}$ | Z    | $0.25 \pm 0.03 \text{ mm}$       |

| Table 9 |                                 | Special Control Code |             |
|---------|---------------------------------|----------------------|-------------|
| Code    | Description                     | Code                 | Description |
| G       | RoHS Compliant                  |                      |             |
| O       | Gold plating (Size $\geq$ 0603) |                      |             |

## 5. EXTERNAL DIMENSIONS

| Size Inch (mm) | L (mm)    | W (mm)    | Code / T (mm)                    | M <sub>B</sub> (mm) |
|----------------|-----------|-----------|----------------------------------|---------------------|
| 0201(0603)     | 0.60±0.03 | 0.30±0.03 | See<br>No.4 Reference<br>Table 8 | 0.15±0.05           |
| 0402(1005)     | 1.00±0.10 | 0.50±0.10 |                                  | 0.25 +0.05/-0.10    |
| 0603(1608)     | 1.60±0.15 | 0.80±0.15 |                                  | 0.40±0.15           |
| 0805(2012)     | 2.00±0.20 | 1.25±0.20 |                                  | 0.50±0.20           |
| 1206(3216)     | 3.20±0.20 | 1.60±0.20 |                                  | 0.60±0.20           |
| 1210(3225)     | 3.20±0.30 | 2.50±0.30 |                                  | 0.75±0.35           |
| 1812(4532)     | 4.50±0.40 | 3.20±0.30 |                                  | 0.75±0.35           |
| 1825(4563)     | 4.50±0.40 | 6.30±0.40 |                                  | 0.75±0.35           |
| 2220(5750)     | 5.70±0.40 | 5.00±0.40 |                                  | 0.85±0.35           |
| 2225(5763)     | 5.70±0.40 | 6.30±0.40 |                                  | 0.85±0.35           |

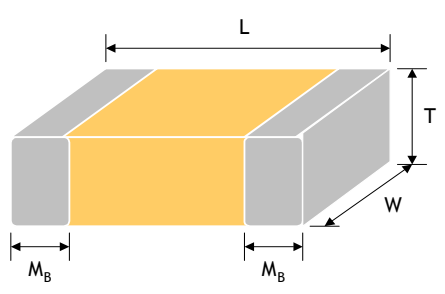


Fig. 5.1 The outline of MLCC

## 6. GENERAL ELECTRICAL DATA

| Dielectric                 | X7R  | X6S                                | X5R                                | Y5V                                 |
|----------------------------|--|------------------------------------|------------------------------------|-------------------------------------|
| Size                       | 0402, 0603, 0805, 1206, 1210, 1812, 1825, 2220, 2225 | 0201, 0402, 0603, 0805, 1206, 1210 | 0201, 0402, 0603, 0805, 1206, 1210 | 0402, 0603, 0805, 1206, 1210, 1812  |
| Rated voltage (WVDC)       | 6.3V, 10V, 16V, 25V, 50V, 100V, 250V, 500V, 630V     | 6.3V, 10V, 16V, 25V, 35V, 50V      | 4V, 6.3V, 10V, 16V, 25V, 35V, 50V  | 6.3V, 10V, 16V, 25V, 35V, 50V, 100V |
| Capacitance range*         | 1μF to 47μF  | 1μF to 100μF                       | 1μF to 220μF                       | 1μF to 100μF                        |
| Capacitance tolerance      | K (±10%), M(±20%)                                    |                                    |                                    | Z (-20/+80%)                        |
| Tan δ                      | Note 1   |                                    |                                    |                                     |
| Operating temperature      | -55 to +125°C  | -55 to +105°C                      | -55 to +85°C                       | -25 to +85 °C                       |
| Capacitance characteristic | ±15%   | ±22%                               | ±15%                               | +30/-80%                            |
| Termination                | Cu or Ag/Ni/Sn or Au (lead-free termination)         |                                    |                                    |                                     |

\* Measured at 1.0±0.2Vrms, 1.0KHz±10% for Cap.≤10μF; 0.5±0.2Vrms, 120Hz±20% for Cap.>10μF, 30~70% related humidity, 25°C ambient temperature for X7R, X5R and at 20°C for Y5V.

\*\* Preconditioning for Class II MLCC : Perform a heat treatment at 150±10°C for 1 hour, then leave in ambient condition for 24±2 hours before measurement.

Note 1 : X7R/X5R/X6S/X7S

Y5V

| Rated | D.F.≤ | Exception of D.F.≤ |  |
|-------|-------|--------------------|--|
| ≥100V | ≤2.5% | ≤3%                | 1206≥0.47μF  |
|       |       | ≤5%                | 0805>0.1μF, 0603≥0.068μF, 1206>1μF, 1210≥2.2μF   |
|       |       | ≤10%               | 0805>0.22μF, 1210≥3.3μF  |
| 50V   | ≤2.5% | ≤3%                | 0201(50V), 0603≥0.047μF, 0805≥0.18μF, 1206≥0.47μF, 1812≥10μF, 2220≥22μF                    |
|       |       | ≤5%                | 0201≥0.01μF, 1210≥4.7μF  |
|       |       | ≤10%               | 0402≥0.1μF, 0603>0.1μF, 0805≥1μF, 1206≥2.2μF, 1210≥10μF                                    |
| 35V   | ≤3.5% | ≤10%               | 0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF  |
| 25V   | ≤3.5% | ≤5%                | 0201≥0.01μF, 0805≥1μF, 1210≥10μF   |
|       |       | ≤7%                | 0603≥0.33μF, 1206≥4.7μF  |
|       |       | ≤10%               | 0201≥0.1μF, 0402≥0.10μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥6.8μF, 1210≥22μF                    |
|       |       | ≤12.5%             | 0402≥0.47μF  |
| 16V   | ≤3.5% | ≤5%                | 0201≥0.01μF, 0402≥0.033μF, 0603≥0.15μF, 0805≥0.68μF, 1206≥2.2μF, 1210≥4.7μF                |
|       |       | ≤10%               | 0201≥0.1μF(0201/X7R≥0.022μF), 0402≥0.22μF, 0603≥0.68μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥22μF  |
|       |       | ≤15%               | 0201≥0.012μF, 0402≥0.33μF(0402/X7R≥0.22μF), 0603≥0.33μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥22μF |
| 10V   | ≤5%   | ≤10%               | 0201≥0.1μF, 0402≥0.33μF(0402/X7R≥0.22μF), 0603≥0.33μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥22μF   |
|       |       | ≤15%               | 0201≥0.1μF, 0402≥1μF   |
| 6.3V  | ≤10%  | ≤15%               | 0201≥0.1μF, 0402≥1μF, 0603≥10μF, 0805≥4.7μF, 1206≥47μF, 1210≥100μF                         |
|       |       | ≤20%               | 0402≥2.2μF   |
| 4V    | ≤15%  | ---                | ---  |

| Rated         | D.F.≤  | Exception of D.F.≤ |   |
|---------------|--------|--------------------|---|
| ≥50V          | ≤5%    | ≤7%                | 0603≥0.1μF, 0805≥0.47μF, 1206≥4.7μF                         |
|               |        | ≤12.5%             | 1210≥6.8μF  |
| 35V           | ≤7%    | ---                | ---   |
| 25V           | ≤5%    | ≤7%                | 0402≥0.047μF, 0603≥0.1μF, 0805≥0.33μF, 1206≥1μF, 1210≥4.7μF |
|               |        | ≤9%                | 0402≥0.068μF, 0603≥0.47μF, 1206≥4.7μF, 1210≥22μF            |
| 16V (C<1.0μF) | ≤7%    | ≤9%                | 0402≥0.068μF, 0603≥0.68μF                                   |
| 16V (C≥1.0μF) | ≤9%    | ≤12.5%             | 0402≥0.22μF   |
|               |        | ≤12.5%             | 0603≥2.2μF, 0805≥3.3μF, 1206≥10μF, 1210≥22μF, 1812≥47μF     |
| 10V           | ≤12.5% | ≤20%               | 0402≥0.47μF   |
| 6.3V          | ≤20%   | ---                | ---   |

# 7. CAPACITANCE RANGE

## 7-1. X7R

| Dimension |      | 0402 |      |     |     |     |     | 0603 |     |     |     |     | 0805 |     |     |     |     | 1206 |  |  |  |  |
|-----------|------|------|------|-----|-----|-----|-----|------|-----|-----|-----|-----|------|-----|-----|-----|-----|------|--|--|--|--|
| Cap(pF)   | code | 16V  | 6.3V | 10V | 16V | 25V | 50V | 6.3V | 10V | 16V | 25V | 50V | 6.3V | 10V | 16V | 25V | 50V | 100V |  |  |  |  |
| 1000000   | 105  | N    | B    | B   | B   | B   | B   |      | C   | C   | C   | I   |      | J   | J   | J   | P   | P    |  |  |  |  |
| 1200000   | 125  |      |      |     |     |     |     |      |     |     |     |     |      |     |     |     | P   | P    |  |  |  |  |
| 1500000   | 155  |      |      |     |     |     |     |      | I   | I   | I   |     | J    | J   | J   | P   | P   |      |  |  |  |  |
| 1800000   | 185  |      |      |     |     |     |     |      |     |     |     |     |      |     |     |     | P   | P    |  |  |  |  |
| 2200000   | 225  |      | B    | B   | B   |     |     | I    | I   | I   | I   | I   | J    | J   | J   | P   | P   | P    |  |  |  |  |
| 2700000   | 275  |      |      |     |     |     |     |      |     |     |     |     |      |     |     |     |     |      |  |  |  |  |
| 3300000   | 335  |      |      |     |     |     |     |      |     |     |     |     |      | P   | P   | P   | P   |      |  |  |  |  |
| 3900000   | 395  |      |      |     |     |     |     |      |     |     |     |     |      |     |     |     |     |      |  |  |  |  |
| 4700000   | 475  |      | B    |     |     |     |     | I    | I   | I   | I   |     | P    | P   | P   | P   | P   |      |  |  |  |  |
| 5600000   | 565  |      |      |     |     |     |     |      |     |     |     |     |      |     |     |     |     |      |  |  |  |  |
| 6800000   | 685  |      |      |     |     |     |     |      |     |     |     |     |      |     |     |     |     |      |  |  |  |  |
| 8200000   | 825  |      |      |     |     |     |     |      |     |     |     |     |      |     |     |     |     |      |  |  |  |  |
| 10000000  | 106  |      |      |     |     |     |     | I    | I   | I*  |     |     | P    | P   | P   | P   |     |      |  |  |  |  |
| 12000000  | 126  |      |      |     |     |     |     |      |     |     |     |     |      |     |     |     |     |      |  |  |  |  |
| 15000000  | 156  |      |      |     |     |     |     |      |     |     |     |     |      |     |     |     |     |      |  |  |  |  |
| 18000000  | 186  |      |      |     |     |     |     |      |     |     |     |     |      |     |     |     |     |      |  |  |  |  |
| 22000000  | 226  |      |      |     |     |     |     |      |     |     |     |     | P    | P   | P*  |     |     |      |  |  |  |  |
| 47000000  | 476  |      |      |     |     |     |     |      |     |     |     |     |      |     |     |     |     |      |  |  |  |  |

| Dimension |      | 1210 |     |     |     |     |      | 1812 |     |     |     |      |      | 1825 |     |     |      |      |      |
|-----------|------|------|-----|-----|-----|-----|------|------|-----|-----|-----|------|------|------|-----|-----|------|------|------|
| Cap(pF)   | code | 6.3V | 10V | 16V | 25V | 50V | 100V | 10V  | 16V | 25V | 50V | 100V | 200V | 250V | 25V | 50V | 100V | 200V | 250V |
| 1000000   | 105  |      | C   | C   | C   | C   | F    | C    | C   | C   | F   | F    | G    | G    | G   | F   | F    | F    | F    |
| 1200000   | 125  |      |     |     |     | G   | G    |      |     | C   | F   | F    |      |      |     | F   | F    | G    | G    |
| 1500000   | 155  |      |     | E   | E   | G   | G    |      |     | C   | F   | F    |      |      |     | F   | F    | G    | G    |
| 1800000   | 185  |      |     |     |     | G   | G    |      |     | E   | F   | F    |      |      |     | F   | F    | G    | G    |
| 2200000   | 225  |      | E   | E   | E   | G   | G    |      |     | E   | F   | G    |      |      |     | F   | F    | G    | G    |
| 2700000   | 275  |      |     |     |     | G   | G    |      |     | F   | F   | G    |      |      |     | F   | F    | H    | H    |
| 3300000   | 335  |      | E   | E   | E   | G   | G    |      |     | F   | F   | G    |      |      |     | F   | F    |      |      |
| 3900000   | 395  |      |     |     |     |     |      |      |     | F   | F   | G    |      |      |     | F   | F    |      |      |
| 4700000   | 475  |      | F   | F   | F   | G   | G    |      |     | G   | G   | G    |      |      |     | F   | G    |      |      |
| 5600000   | 565  |      |     |     |     |     |      |      |     | G   | G   | G    |      |      |     | G   | G    |      |      |
| 6800000   | 685  |      |     |     |     |     |      |      |     | G   | G   |      |      |      |     | G   | G    |      |      |
| 8200000   | 825  |      |     |     |     |     |      |      |     | G   | G   |      |      |      |     | G   | G    |      |      |
| 10000000  | 106  |      | F   | F   | F   | G   |      |      |     | G   | G   |      |      |      |     | G   | G    |      |      |
| 12000000  | 126  |      |     |     |     |     |      |      |     |     |     |      |      |      |     |     |      |      |      |
| 15000000  | 156  |      |     |     |     |     |      |      |     |     |     |      |      |      |     |     |      |      |      |
| 18000000  | 186  |      |     |     |     |     |      |      |     |     |     |      |      |      |     |     |      |      |      |
| 22000000  | 226  |      | G   | G   | G   |     |      |      |     |     |     |      |      |      |     |     |      |      |      |
| 47000000  | 476  | G    | G   |     |     |     |      |      |     |     |     |      |      |      |     |     |      |      |      |

| Dimension |      | 2220 |     |      |      |      |      | 2225 |     |     |      |      |      |      |      |
|-----------|------|------|-----|------|------|------|------|------|-----|-----|------|------|------|------|------|
| Cap(pF)   | code | 25V  | 50V | 100V | 200V | 250V | 500V | 630V | 25V | 50V | 100V | 200V | 250V | 500V | 630V |
| 1000000   | 105  | F    | F   | F    | F    | F    | H    | H    | F   | F   | F    | F    | F    | G    | G    |
| 1200000   | 125  | F    | F   | F    | G    | G    |      |      | F   | F   | F    | G    | G    | H    | H    |
| 1500000   | 155  | F    | F   | F    | G    | G    |      |      | F   | F   | F    | G    | G    | H    | H    |
| 1800000   | 185  | F    | F   | F    | G    | G    |      |      | F   | F   | F    | G    | G    |      |      |
| 2200000   | 225  | F    | F   | F    | G    | G    |      |      | F   | F   | F    | G    | G    |      |      |
| 2700000   | 275  | F    | F   | F    | H    | H    |      |      | F   | F   | F    | G    | G    |      |      |
| 3300000   | 335  | F    | F   | F    |      |      |      |      | F   | F   | F    | H    | H    |      |      |
| 3900000   | 395  | F    | F   | F    |      |      |      |      | F   | F   | F    | H    | H    |      |      |
| 4700000   | 475  | F    | F   | F    |      |      |      |      | F   | F   | G    |      |      |      |      |
| 5600000   | 565  | F    | F   | F    |      |      |      |      | F   | F   | G    |      |      |      |      |
| 6800000   | 685  | F    | F   | F    |      |      |      |      | F   | F   | G    |      |      |      |      |
| 8200000   | 825  | G    | G   | G    |      |      |      |      | G   | G   | G    |      |      |      |      |
| 10000000  | 106  | G    | G   | G    |      |      |      |      | G   | G   | G    |      |      |      |      |
| 12000000  | 126  | H    |     |      |      |      |      |      | H   |     |      |      |      |      |      |
| 15000000  | 156  | H    |     |      |      |      |      |      | H   |     |      |      |      |      |      |
| 18000000  | 186  | H    |     |      |      |      |      |      | H   |     |      |      |      |      |      |
| 22000000  | 226  | H    | H   |      |      |      |      |      | H   | H   |      |      |      |      |      |
| 47000000  | 476  |      |     |      |      |      |      |      |     |     |      |      |      |      |      |

## 7. CAPACITANCE RANGE(Con.)

### 7-2. X5R

| Dimension |      | 0201 |     |     | 0402 |      |     |     | 0603 |    |      |     |     |     |     |
|-----------|------|------|-----|-----|------|------|-----|-----|------|----|------|-----|-----|-----|-----|
| Cap(pF)   | code | 6.3V | 10V | 16V | 4V   | 6.3V | 10V | 16V | 25V  | 4V | 6.3V | 10V | 16V | 25V | 50V |
| 1000000   | 105  | L    | L   | L   |      | N    | N   | N   | N    |    | B    | B   | B   | B   | B   |
| 1500000   | 155  |      |     |     |      |      |     |     |      |    | B    |     |     |     |     |
| 2200000   | 225  | L    |     |     |      | N    | N   | K   | K    |    | B    | B   | B   | B   | B   |
| 3300000   | 335  |      |     |     |      |      |     |     |      |    | B    | B   |     |     |     |
| 4700000   | 475  |      |     |     |      | K    | K   | K   |      |    | B    | B   | B   | B   |     |
| 6800000   | 685  |      |     |     |      |      |     |     |      |    |      |     |     |     |     |
| 10000000  | 106  |      |     |     | K    | K    | K   |     |      | B  | B    | B   | B   | B   |     |
| 22000000  | 226  |      |     |     |      |      |     |     |      | B  | B    | B   |     |     |     |
| 47000000  | 476  |      |     |     |      |      |     |     |      | B  | B    |     |     |     |     |
| 100000000 | 107  |      |     |     |      |      |     |     |      |    |      |     |     |     |     |
| 220000000 | 227  |      |     |     |      |      |     |     |      |    |      |     |     |     |     |

| Dimension |      | 0805 |      |     |     |     | 1206 |    |      |     |     |     |     |
|-----------|------|------|------|-----|-----|-----|------|----|------|-----|-----|-----|-----|
| Cap(pF)   | code | 4V   | 6.3V | 10V | 16V | 25V | 50V  | 4V | 6.3V | 10V | 16V | 25V | 50V |
| 1000000   | 105  |      |      | C   | C   | C   | I    |    |      |     |     |     | P   |
| 1500000   | 155  |      | I    | I   | I   | I   |      |    |      | J   | J   |     |     |
| 2200000   | 225  |      | I    | I   | I   | I   | I    |    |      | J   | J   | P   | P   |
| 3300000   | 335  |      | I    | I   | I   | I   |      |    |      | P   | P   | P   |     |
| 4700000   | 475  |      | I    | I   | I   | I   | I    |    | P    | P   | P   | P   | P   |
| 6800000   | 685  |      |      |     |     |     |      |    | P    | P   |     |     |     |
| 10000000  | 106  |      | I    | I   | I   | I   | I    |    | P    | P   | P   | P   | P   |
| 22000000  | 226  |      | I    | I   | I   | I   |      |    | P    | P   | P   | P   |     |
| 47000000  | 476  |      | I    | I   |     |     |      |    | P    | P   | P   |     |     |
| 100000000 | 107  | I    | I    |     |     |     |      |    | P    |     |     |     |     |
| 220000000 | 227  |      |      |     |     |     |      | P  |      |     |     |     |     |

| Dimension |      | 1210 |      |     |     |     |     |     |
|-----------|------|------|------|-----|-----|-----|-----|-----|
| Cap(pF)   | code | 4V   | 6.3V | 10V | 16V | 25V | 35V | 50V |
| 1000000   | 105  |      |      |     |     |     |     |     |
| 1500000   | 155  |      |      | F   | F   |     |     |     |
| 2200000   | 225  |      |      | F   | F   |     |     |     |
| 3300000   | 335  |      |      |     |     |     |     |     |
| 4700000   | 475  |      |      | F   | F   | F   |     |     |
| 6800000   | 685  |      |      |     |     |     |     |     |
| 10000000  | 106  |      | F    | F   | F   | F   | G   | G   |
| 22000000  | 226  |      | G    | G   | G   | G   | G   |     |
| 47000000  | 476  |      | G    | G   | G   | G   |     |     |
| 100000000 | 107  |      | G    | G   | G   |     |     |     |
| 220000000 | 227  | G    | G    |     |     |     |     |     |

## 7. CAPACITANCE RANGE(Con.)

### 7-3. Y5V

| Dimension |      | 0402 |     | 0603 |     |     |     | 0805 |     |     |     |     | 1206 |     |     |     |     |     |
|-----------|------|------|-----|------|-----|-----|-----|------|-----|-----|-----|-----|------|-----|-----|-----|-----|-----|
| Cap(pF)   | code | 6.3V | 10V | 6.3V | 10V | 16V | 25V | 6.3V | 10V | 16V | 25V | 50V | 6.3V | 10V | 16V | 25V | 35V | 50V |
| 1000000   | 105  | N    | N   |      | S   | B   | B   |      | X   | X   | C   | C   |      | M   | M   | M   |     | M   |
| 1500000   | 155  |      |     |      | S   |     |     |      | C   | C   |     |     |      | M   | M   | M   |     |     |
| 2200000   | 225  |      |     | S    | S   | B   |     |      | C   | C   | I   | I   |      | M   | M   | M   |     | J   |
| 3300000   | 335  |      |     |      |     |     |     |      | C   | C   |     |     |      | J   | J   | J   |     |     |
| 4700000   | 475  |      |     | B    | B   |     |     |      | C   | C   | I   |     |      | J   | J   | J   | J   | P   |
| 6800000   | 685  |      |     |      |     |     |     |      | I   |     |     |     |      | J   | J   |     |     |     |
| 10000000  | 106  |      |     |      |     |     |     | I    | I   | I   |     |     |      | J   | J   | P   |     |     |
| 22000000  | 226  |      |     |      |     |     |     | I    | I   |     |     |     |      | P   | P   |     |     |     |
| 47000000  | 476  |      |     |      |     |     |     |      |     |     |     |     | P    |     |     |     |     |     |
| 100000000 | 107  |      |     |      |     |     |     |      |     |     |     |     |      |     |     |     |     |     |
| 220000000 | 227  |      |     |      |     |     |     |      |     |     |     |     |      |     |     |     |     |     |

| Dimension |      | 1210 |     |     |     |     |     | 1812 |     |     |     |      |
|-----------|------|------|-----|-----|-----|-----|-----|------|-----|-----|-----|------|
| Cap(pF)   | code | 6.3V | 10V | 16V | 25V | 35V | 50V | 10V  | 16V | 25V | 50V | 100V |
| 1000000   | 105  |      | M   | M   | M   |     | M   | C    | C   | C   | C   | C    |
| 1500000   | 155  |      | M   | M   | M   |     |     | C    | C   | C   | C   | C    |
| 2200000   | 225  |      | M   | M   | M   |     | E   | C    | C   | C   | C   | C    |
| 3300000   | 335  |      | M   | M   | M   |     |     | C    | C   | C   | C   | C    |
| 4700000   | 475  |      | M   | M   | C   |     | E   | C    | C   | C   | C   | C    |
| 6800000   | 685  |      | M   | M   | C   |     | F   | C    | C   | C   | C   | C    |
| 10000000  | 106  |      | C   | C   | E   | F   | F   | C    | C   | C   | F   |      |
| 22000000  | 226  |      | F   | F   |     |     |     |      |     |     |     |      |
| 47000000  | 476  | F    | F   |     |     |     |     | G    |     |     |     |      |
| 100000000 | 107  | G    |     |     |     |     |     |      |     |     |     |      |
| 220000000 | 227  |      |     |     |     |     |     |      |     |     |     |      |

### 7-4. X6S

| Dimension |      | 0201 |      | 0402 |     |     |     | 0603 |      |     |     |     | 0805 |      |     |     |     |     |
|-----------|------|------|------|------|-----|-----|-----|------|------|-----|-----|-----|------|------|-----|-----|-----|-----|
| Cap(pF)   | code | 4V   | 6.3V | 6.3V | 10V | 16V | 25V | 4V   | 6.3V | 10V | 16V | 25V | 4V   | 6.3V | 10V | 16V | 25V | 50V |
| 1000000   | 105  | L    | L*   | K    | K   | K   | K   |      |      |     |     |     |      |      |     |     |     |     |
| 1500000   | 155  |      |      |      |     |     |     |      |      |     |     |     |      |      |     |     |     |     |
| 2200000   | 225  |      |      | K    | K   | K   |     |      |      |     | B   | B   |      |      |     |     |     |     |
| 3300000   | 335  |      |      |      |     |     |     |      |      |     |     |     |      |      |     |     |     |     |
| 4700000   | 475  |      |      |      | K*  |     |     |      | B    |     | B   | B   |      |      |     |     | I   | I   |
| 6800000   | 685  |      |      |      |     |     |     |      |      |     |     |     |      |      |     |     |     |     |
| 10000000  | 106  |      |      | K*   |     |     |     |      | B*   | B*  | B*  |     | I    | I    | I   | I   | I   |     |
| 22000000  | 226  |      |      |      |     |     |     | B*   | B*   |     |     |     |      | I*   | I*  | I*  | I*  |     |
| 47000000  | 476  |      |      |      |     |     |     |      |      |     |     |     | I*   | I*   |     |     |     |     |
| 100000000 | 107  |      |      |      |     |     |     |      |      |     |     |     | I*   |      |     |     |     |     |
| 220000000 | 227  |      |      |      |     |     |     |      |      |     |     |     |      |      |     |     |     |     |

| Dimension |      | 1206 |     |     |     | 1210 |     |     |     |
|-----------|------|------|-----|-----|-----|------|-----|-----|-----|
| Cap(pF)   | code | 6.3V | 10V | 16V | 25V | 6.3V | 10V | 16V | 25V |
| 1000000   | 105  |      |     |     |     |      |     |     |     |
| 1500000   | 155  |      |     |     |     |      |     |     |     |
| 2200000   | 225  |      |     |     |     |      |     |     |     |
| 3300000   | 335  |      |     |     |     |      |     |     |     |
| 4700000   | 475  |      |     |     |     |      |     |     |     |
| 6800000   | 685  |      |     |     |     |      |     |     |     |
| 10000000  | 106  |      |     |     | P   |      |     |     |     |
| 22000000  | 226  |      | P   | P*  | P   |      |     |     | G   |
| 47000000  | 476  | p    |     |     |     | G    | G   | G   |     |
| 100000000 | 107  |      |     |     |     | G*   | G*  |     |     |
| 220000000 | 227  |      |     |     |     |      |     |     |     |

\*\*\*\* Means M tolerance only.

## 8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

| No.           | Item                        | Test Condition  | Requirements  |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|---------------|-----------------------------|---|---|-----------------|--------------------|--------------------|-----|-------------------|-------|-------------------|-------------|-------------------|--|------------|-------------------------|------|------------|-----|---|------|-------------------------|------|---|------------|-------|----------|---|---------------|-------|------|----------------------------------|------|-------------------------|------|---|------|-------|------------|---|-----------|---|-----------|------|-----------|--|------|----------------------|------|-----------------|------|--|------------|------|---|------|--------------------|-------|--------------------|-----|-------------|-----|-------------|-------------------------------------|------------------|------------|-----|-----|-----|-----|-----|-----|-----|---|-----|--|---------------|-----|-----|---------------------------|--------|-------------|---------------|-----|--------|---|------|-------------|-----|--------|------|-------------|------|------|-----|-----|
| 1.            | Visual and Dimensions       | ---   | * No remarkable defect.<br>* Dimensions to confirm to individual specification sheet.   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| 2.            | Capacitance                 |   | * Shall not exceed the limits given in the detailed spec.<br>X7R, X5R, X6S  |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| 3.            | Q/D.F. (Dissipation Factor) | * Class II : (X7R, X6S, X5R, Y5V)<br>Cap.≤10μF, 1.0±0.2Vrms, 1KHz±10%**.<br>Cap.>10μF, 0.5±0.2Vrms, 120Hz±20%.<br><br>** Test condition : 0.5±0.2Vrms, 1KHz±10%.<br>X7R :<br>0805=106(6.3V&10V), 0603=475(6.3V).<br>X6S :<br>0201≥104(6.3V&10V),0402≥225(6.3V),<br>0402/475(10V), 0603/106(6.3V).<br>X5R :<br>01R5≥103, 0201≥224(6.3V,10V,16V) <sup>#1</sup> ,<br>0402≥475(6.3V,16V), 0402≥225(10V),<br>0603=106(6.3V,10V).   | <table border="1"> <thead> <tr> <th>Rated</th> <th>D.F.≤</th> <th colspan="2">Exception of D.F.≤</th> </tr> </thead> <tbody> <tr> <td rowspan="3">≥100V</td> <td rowspan="3">≤2.5%</td> <td>≤3%</td> <td>1206≥0.47μF</td> </tr> <tr> <td>≤5%</td> <td>0805&gt;0.1μF, 0603≥0.068μF, 1206&gt;1μF, 1210≥2.2μF</td> </tr> <tr> <td>≤10%</td> <td>0805&gt;0.22μF, 1210≥3.3μF</td> </tr> <tr> <td rowspan="3">50V</td> <td rowspan="3">≤2.5%</td> <td>≤3%</td> <td>0201(50V), 0603≥0.047μF, 0805≥0.18μF, 1206≥0.47μF, 1812≥10μF, 2220≥22μF</td> </tr> <tr> <td>≤5%</td> <td>0201≥0.01μF, 1210≥4.7μF</td> </tr> <tr> <td>≤10%</td> <td>0402≥0.1μF, 0603&gt;0.1μF, 0805≥1μF, 1206≥2.2μF, 1210≥10μF</td> </tr> <tr> <td>35V</td> <td>≤3.5%</td> <td>≤10%</td> <td>0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF</td> </tr> <tr> <td rowspan="3">25V</td> <td rowspan="3">≤3.5%</td> <td>≤5%</td> <td>0201≥0.01μF, 0805≥1μF, 1210≥10μF</td> </tr> <tr> <td>≤7%</td> <td>0603≥0.33μF, 1206≥4.7μF</td> </tr> <tr> <td>≤10%</td> <td>0201≥0.1μF, 0402≥0.10μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥6.8μF, 1210≥22μF</td> </tr> <tr> <td rowspan="2">16V</td> <td rowspan="2">≤3.5%</td> <td>≤5%</td> <td>0201≥0.01μF, 0402≥0.033μF, 0603≥0.15μF, 0805≥0.68μF, 1206≥2.2μF, 1210≥4.7μF</td> </tr> <tr> <td>≤10%</td> <td>0201≥0.1μF(0201/X7R≥0.022μF), 0402≥0.22μF, 0603≥0.68μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥22μF</td> </tr> <tr> <td rowspan="2">10V</td> <td rowspan="2">≤5%</td> <td>≤10%</td> <td>0201≥0.012μF, 0402≥0.33μF(0402/X7R≥0.22μF), 0603≥0.33μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥22μF</td> </tr> <tr> <td>≤15%</td> <td>0201≥0.1μF, 0402≥1μF</td> </tr> <tr> <td>6.3V</td> <td>≤10%</td> <td>≤15%</td> <td>0201≥0.1μF, 0402≥1μF, 0603≥10μF, 0805≥4.7μF, 1206≥47μF, 1210≥100μF</td> </tr> <tr> <td>4V</td> <td>≤15%</td> <td>---</td> <td>---</td> </tr> </tbody> </table><br><table border="1"> <thead> <tr> <th>Rated Vol.</th> <th>D.F.≤</th> <th colspan="2">Exception of D.F.≤</th> </tr> </thead> <tbody> <tr> <td rowspan="2">≥50V</td> <td rowspan="2">≤5%</td> <td>≤7%</td> <td>0603≥0.1μF, 0805≥0.47μF, 1206≥4.7μF</td> </tr> <tr> <td>≤12.5%</td> <td>1210≥6.8μF</td> </tr> <tr> <td>35V</td> <td>≤7%</td> <td>---</td> <td>---</td> </tr> <tr> <td rowspan="2">25V</td> <td rowspan="2">≤5%</td> <td>≤7%</td> <td>0402≥0.047μF, 0603≥0.1μF, 0805≥0.33μF, 1206≥1μF, 1210≥4.7μF</td> </tr> <tr> <td>≤9%</td> <td>0402≥0.068μF, 0603≥0.47μF, 1206≥4.7μF, 1210≥22μF</td> </tr> <tr> <td rowspan="2">16V (C&lt;1.0μF)</td> <td rowspan="2">≤7%</td> <td>≤9%</td> <td>0402≥0.068μF, 0603≥0.68μF</td> </tr> <tr> <td>≤12.5%</td> <td>0402≥0.22μF</td> </tr> <tr> <td rowspan="2">16V (C≥1.0μF)</td> <td rowspan="2">≤9%</td> <td>≤12.5%</td> <td>0603≥2.2μF, 0805≥3.3μF, 1206≥10μF, 1210≥22μF, 1812≥47μF</td> </tr> <tr> <td>≤20%</td> <td>0402≥0.47μF</td> </tr> <tr> <td>10V</td> <td>≤12.5%</td> <td>≤20%</td> <td>0402≥0.47μF</td> </tr> <tr> <td>6.3V</td> <td>≤20%</td> <td>---</td> <td>---</td> </tr> </tbody> </table> | Rated           | D.F.≤              | Exception of D.F.≤ |     | ≥100V             | ≤2.5% | ≤3%               | 1206≥0.47μF | ≤5%               | 0805>0.1μF, 0603≥0.068μF, 1206>1μF, 1210≥2.2μF | ≤10%       | 0805>0.22μF, 1210≥3.3μF | 50V  | ≤2.5%      | ≤3% | 0201(50V), 0603≥0.047μF, 0805≥0.18μF, 1206≥0.47μF, 1812≥10μF, 2220≥22μF | ≤5%  | 0201≥0.01μF, 1210≥4.7μF | ≤10% | 0402≥0.1μF, 0603>0.1μF, 0805≥1μF, 1206≥2.2μF, 1210≥10μF | 35V        | ≤3.5% | ≤10%     | 0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF | 25V           | ≤3.5% | ≤5%  | 0201≥0.01μF, 0805≥1μF, 1210≥10μF | ≤7%  | 0603≥0.33μF, 1206≥4.7μF | ≤10% | 0201≥0.1μF, 0402≥0.10μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥6.8μF, 1210≥22μF | 16V  | ≤3.5% | ≤5%        | 0201≥0.01μF, 0402≥0.033μF, 0603≥0.15μF, 0805≥0.68μF, 1206≥2.2μF, 1210≥4.7μF | ≤10%      | 0201≥0.1μF(0201/X7R≥0.022μF), 0402≥0.22μF, 0603≥0.68μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥22μF | 10V       | ≤5%  | ≤10%      | 0201≥0.012μF, 0402≥0.33μF(0402/X7R≥0.22μF), 0603≥0.33μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥22μF | ≤15% | 0201≥0.1μF, 0402≥1μF | 6.3V | ≤10%            | ≤15% | 0201≥0.1μF, 0402≥1μF, 0603≥10μF, 0805≥4.7μF, 1206≥47μF, 1210≥100μF | 4V         | ≤15% | ---   | ---  | Rated Vol.         | D.F.≤ | Exception of D.F.≤ |     | ≥50V        | ≤5% | ≤7%         | 0603≥0.1μF, 0805≥0.47μF, 1206≥4.7μF | ≤12.5%           | 1210≥6.8μF | 35V | ≤7% | --- | --- | 25V | ≤5% | ≤7% | 0402≥0.047μF, 0603≥0.1μF, 0805≥0.33μF, 1206≥1μF, 1210≥4.7μF | ≤9% | 0402≥0.068μF, 0603≥0.47μF, 1206≥4.7μF, 1210≥22μF | 16V (C<1.0μF) | ≤7% | ≤9% | 0402≥0.068μF, 0603≥0.68μF | ≤12.5% | 0402≥0.22μF | 16V (C≥1.0μF) | ≤9% | ≤12.5% | 0603≥2.2μF, 0805≥3.3μF, 1206≥10μF, 1210≥22μF, 1812≥47μF | ≤20% | 0402≥0.47μF | 10V | ≤12.5% | ≤20% | 0402≥0.47μF | 6.3V | ≤20% | --- | --- |
|               |                             |   | Rated   | D.F.≤           | Exception of D.F.≤ |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| ≥100V         | ≤2.5%                       | ≤3%   | 1206≥0.47μF   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               |                             | ≤5%   | 0805>0.1μF, 0603≥0.068μF, 1206>1μF, 1210≥2.2μF  |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               |                             | ≤10%  | 0805>0.22μF, 1210≥3.3μF   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| 50V           | ≤2.5%                       | ≤3%   | 0201(50V), 0603≥0.047μF, 0805≥0.18μF, 1206≥0.47μF, 1812≥10μF, 2220≥22μF   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               |                             | ≤5%   | 0201≥0.01μF, 1210≥4.7μF   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               |                             | ≤10%  | 0402≥0.1μF, 0603>0.1μF, 0805≥1μF, 1206≥2.2μF, 1210≥10μF   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| 35V           | ≤3.5%                       | ≤10%  | 0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| 25V           | ≤3.5%                       | ≤5%   | 0201≥0.01μF, 0805≥1μF, 1210≥10μF  |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               |                             | ≤7%   | 0603≥0.33μF, 1206≥4.7μF   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               |                             | ≤10%  | 0201≥0.1μF, 0402≥0.10μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥6.8μF, 1210≥22μF   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| 16V           | ≤3.5%                       | ≤5%   | 0201≥0.01μF, 0402≥0.033μF, 0603≥0.15μF, 0805≥0.68μF, 1206≥2.2μF, 1210≥4.7μF   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               |                             | ≤10%  | 0201≥0.1μF(0201/X7R≥0.022μF), 0402≥0.22μF, 0603≥0.68μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥22μF   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| 10V           | ≤5%                         | ≤10%  | 0201≥0.012μF, 0402≥0.33μF(0402/X7R≥0.22μF), 0603≥0.33μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥22μF  |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               |                             | ≤15%  | 0201≥0.1μF, 0402≥1μF  |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| 6.3V          | ≤10%                        | ≤15%  | 0201≥0.1μF, 0402≥1μF, 0603≥10μF, 0805≥4.7μF, 1206≥47μF, 1210≥100μF  |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| 4V            | ≤15%                        | ---   | ---   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| Rated Vol.    | D.F.≤                       | Exception of D.F.≤  |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| ≥50V          | ≤5%                         | ≤7%   | 0603≥0.1μF, 0805≥0.47μF, 1206≥4.7μF   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               |                             | ≤12.5%  | 1210≥6.8μF  |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| 35V           | ≤7%                         | ---   | ---   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| 25V           | ≤5%                         | ≤7%   | 0402≥0.047μF, 0603≥0.1μF, 0805≥0.33μF, 1206≥1μF, 1210≥4.7μF   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               |                             | ≤9%   | 0402≥0.068μF, 0603≥0.47μF, 1206≥4.7μF, 1210≥22μF  |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| 16V (C<1.0μF) | ≤7%                         | ≤9%   | 0402≥0.068μF, 0603≥0.68μF   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               |                             | ≤12.5%  | 0402≥0.22μF   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| 16V (C≥1.0μF) | ≤9%                         | ≤12.5%  | 0603≥2.2μF, 0805≥3.3μF, 1206≥10μF, 1210≥22μF, 1812≥47μF   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               |                             | ≤20%  | 0402≥0.47μF   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| 10V           | ≤12.5%                      | ≤20%  | 0402≥0.47μF   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| 6.3V          | ≤20%                        | ---   | ---   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| 4.            | Temperature Coefficient     | * With no electrical load.<br><table border="1"> <thead> <tr> <th>T.C.</th> <th>Operating Temp.</th> </tr> </thead> <tbody> <tr> <td>X7R</td> <td>-55~125°C at 25°C</td> </tr> <tr> <td>X6S</td> <td>-55~105°C at 25°C</td> </tr> <tr> <td>X5R</td> <td>-55~ 85°C at 25°C</td> </tr> <tr> <td>Y5V</td> <td>-25~ 85°C at 20°C</td> </tr> </tbody> </table><br>* Measurement voltage for Class II :<br><table border="1"> <thead> <tr> <th>Size</th> <th>Cap. Range</th> <th>Condition</th> </tr> </thead> <tbody> <tr> <td rowspan="3">0201</td> <td>Cap.&lt;0.1μF</td> <td>1V</td> </tr> <tr> <td>0.1μF≤Cap.&lt;1μF</td> <td>0.2V</td> </tr> <tr> <td>Cap.≥1μF</td> <td>0.1V</td> </tr> <tr> <td rowspan="3">0402</td> <td>Cap.&lt;0.1μF</td> <td>1V</td> </tr> <tr> <td>Cap.=1μF</td> <td>0.5V</td> </tr> <tr> <td>1μF&lt;Cap.&lt;10μF</td> <td>0.2V</td> </tr> <tr> <td rowspan="3">0603</td> <td>Cap.≥10μF</td> <td>0.1V</td> </tr> <tr> <td>Cap.≤1μF</td> <td>1V</td> </tr> <tr> <td>1μF&lt;Cap.≤4.7μF</td> <td>0.5V</td> </tr> <tr> <td rowspan="3">0805</td> <td>Cap.&gt;4.7μF</td> <td>0.2V</td> </tr> <tr> <td>Cap.&lt;10μF</td> <td>1V</td> </tr> <tr> <td>Cap.=10μF</td> <td>0.5V</td> </tr> <tr> <td rowspan="3">1206/1210</td> <td>Cap.&gt;10μF</td> <td>0.2V</td> </tr> <tr> <td>Cap.≤10μF</td> <td>1V</td> </tr> <tr> <td>10μF&lt;Cap.≤100μF</td> <td>0.5V</td> </tr> <tr> <td></td> <td>Cap.&gt;100μF</td> <td>0.2V</td> </tr> </tbody> </table> | T.C.  | Operating Temp. | X7R                | -55~125°C at 25°C  | X6S | -55~105°C at 25°C | X5R   | -55~ 85°C at 25°C | Y5V         | -25~ 85°C at 20°C | Size   | Cap. Range | Condition               | 0201 | Cap.<0.1μF | 1V  | 0.1μF≤Cap.<1μF  | 0.2V | Cap.≥1μF                | 0.1V | 0402  | Cap.<0.1μF | 1V    | Cap.=1μF | 0.5V  | 1μF<Cap.<10μF | 0.2V  | 0603 | Cap.≥10μF                        | 0.1V | Cap.≤1μF                | 1V   | 1μF<Cap.≤4.7μF  | 0.5V | 0805  | Cap.>4.7μF | 0.2V  | Cap.<10μF | 1V  | Cap.=10μF | 0.5V | 1206/1210 | Cap.>10μF  | 0.2V | Cap.≤10μF            | 1V   | 10μF<Cap.≤100μF | 0.5V |  | Cap.>100μF | 0.2V | <table border="1"> <thead> <tr> <th>T.C.</th> <th>Capacitance Change</th> </tr> </thead> <tbody> <tr> <td>X7R</td> <td>Within ±15%</td> </tr> <tr> <td>X6S</td> <td>Within ±22%</td> </tr> <tr> <td>X5R</td> <td>Within ±15%</td> </tr> <tr> <td>Y5V</td> <td>Within +30%/-80%</td> </tr> </tbody> </table> | T.C. | Capacitance Change | X7R   | Within ±15%        | X6S | Within ±22% | X5R | Within ±15% | Y5V                                 | Within +30%/-80% |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| T.C.          | Operating Temp.             |   |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| X7R           | -55~125°C at 25°C           |   |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| X6S           | -55~105°C at 25°C           |   |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| X5R           | -55~ 85°C at 25°C           |   |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| Y5V           | -25~ 85°C at 20°C           |   |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| Size          | Cap. Range                  | Condition   |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| 0201          | Cap.<0.1μF                  | 1V  |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               | 0.1μF≤Cap.<1μF              | 0.2V  |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               | Cap.≥1μF                    | 0.1V  |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| 0402          | Cap.<0.1μF                  | 1V  |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               | Cap.=1μF                    | 0.5V  |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               | 1μF<Cap.<10μF               | 0.2V  |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| 0603          | Cap.≥10μF                   | 0.1V  |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               | Cap.≤1μF                    | 1V  |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               | 1μF<Cap.≤4.7μF              | 0.5V  |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| 0805          | Cap.>4.7μF                  | 0.2V  |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               | Cap.<10μF                   | 1V  |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               | Cap.=10μF                   | 0.5V  |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| 1206/1210     | Cap.>10μF                   | 0.2V  |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               | Cap.≤10μF                   | 1V  |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               | 10μF<Cap.≤100μF             | 0.5V  |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
|               | Cap.>100μF                  | 0.2V  |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| T.C.          | Capacitance Change          |   |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| X7R           | Within ±15%                 |   |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| X6S           | Within ±22%                 |   |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| X5R           | Within ±15%                 |   |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |
| Y5V           | Within +30%/-80%            |   |   |                 |                    |                    |     |                   |       |                   |             |                   |  |            |                         |      |            |     |   |      |                         |      |   |            |       |          |   |               |       |      |                                  |      |                         |      |   |      |       |            |   |           |   |           |      |           |  |      |                      |      |                 |      |  |            |      |   |      |                    |       |                    |     |             |     |             |                                     |                  |            |     |     |     |     |     |     |     |   |     |  |               |     |     |                           |        |             |               |     |        |   |      |             |     |        |      |             |      |      |     |     |



## 8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

| No.  | Item                                      | Test Condition  | Requirements   |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
|--|---|---|--|---------------|------------|-----------------------------|---|---|---|--|---|--|---|----------|---------------|-------------------|--|---|-----------|---|--|--|---|---------------------------------------|
| 5.   | Insulation Resistance                     | <p>* To apply rated voltage for Max. 120sec.</p> <p>* Before initial measurement (Class II only) : To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</p>   | <p>* ≥10GΩ or RxC≥500Ω-F, whichever is smaller.</p> <p>* Class II (X7R, X5R, X6S, Y5V) :</p> <table border="1"> <thead> <tr> <th>Rated voltage</th> <th>I.R.</th> </tr> </thead> <tbody> <tr> <td>100V : All X7R</td> <td rowspan="5">≥10GΩ or RxC≥100Ω-F, whichever is smaller</td> </tr> <tr> <td>50V : 0402&gt;0.01μF, 0603≥1μF, 0805≥1μF, 1206≥4.7μF, 1210≥4.7μF</td> </tr> <tr> <td>35V : 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF</td> </tr> <tr> <td>25V : 0402≥1μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF</td> </tr> <tr> <td>16V : 0201≥0.1μF, 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF</td> </tr> <tr> <td>10V : 0201≥47nF, 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF</td> <td rowspan="5">RxC≥50Ω-F</td> </tr> <tr> <td>6.3V, 4V</td> </tr> <tr> <td>Rated voltage</td> </tr> <tr> <td>100V : 1210≥3.3μF</td> </tr> <tr> <td>50V : 0402≥0.1μF, 0603≥2.2μF, 0805≥10μF, 1206≥10μF</td> </tr> <tr> <td>35V : 0603≥1μF</td> <td rowspan="5">RxC≥50Ω-F</td> </tr> <tr> <td>25V : 0201≥0.1μF, 0402≥2.2μF, 0603≥10μF, 0805≥10μF, 1206≥22μF</td> </tr> <tr> <td>16V : 0603≥10μF, 0402≥1μF, 0201≥0.22μF</td> </tr> <tr> <td>10V : 0201&gt;0.1μF, 0402≥1μF, 0603≥10μF, 0805≥47μF</td> </tr> <tr> <td>6.3V : 0201≥0.1μF, 0603&gt;4.7μF, 0805≥47μF, 1206≥10μF</td> </tr> <tr> <td>4V : 0603≥22μF, 0805≥47μF, 1206≥100μF</td> </tr> </tbody> </table> | Rated voltage | I.R.       | 100V : All X7R              | ≥10GΩ or RxC≥100Ω-F, whichever is smaller | 50V : 0402>0.01μF, 0603≥1μF, 0805≥1μF, 1206≥4.7μF, 1210≥4.7μF | 35V : 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF | 25V : 0402≥1μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF | 16V : 0201≥0.1μF, 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF | 10V : 0201≥47nF, 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF | RxC≥50Ω-F   | 6.3V, 4V | Rated voltage | 100V : 1210≥3.3μF | 50V : 0402≥0.1μF, 0603≥2.2μF, 0805≥10μF, 1206≥10μF | 35V : 0603≥1μF  | RxC≥50Ω-F | 25V : 0201≥0.1μF, 0402≥2.2μF, 0603≥10μF, 0805≥10μF, 1206≥22μF | 16V : 0603≥10μF, 0402≥1μF, 0201≥0.22μF | 10V : 0201>0.1μF, 0402≥1μF, 0603≥10μF, 0805≥47μF | 6.3V : 0201≥0.1μF, 0603>4.7μF, 0805≥47μF, 1206≥10μF | 4V : 0603≥22μF, 0805≥47μF, 1206≥100μF |
| Rated voltage  | I.R.                                      |   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 100V : All X7R   | ≥10GΩ or RxC≥100Ω-F, whichever is smaller |   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 50V : 0402>0.01μF, 0603≥1μF, 0805≥1μF, 1206≥4.7μF, 1210≥4.7μF                |   |   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 35V : 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF                                      |   |   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 25V : 0402≥1μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF                 |   |   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 16V : 0201≥0.1μF, 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF    |   |   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 10V : 0201≥47nF, 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF | RxC≥50Ω-F                                 |   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 6.3V, 4V   |   |   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| Rated voltage  |   |   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 100V : 1210≥3.3μF  |   |   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 50V : 0402≥0.1μF, 0603≥2.2μF, 0805≥10μF, 1206≥10μF                           |   |   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 35V : 0603≥1μF   | RxC≥50Ω-F                                 |   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 25V : 0201≥0.1μF, 0402≥2.2μF, 0603≥10μF, 0805≥10μF, 1206≥22μF                |   |   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 16V : 0603≥10μF, 0402≥1μF, 0201≥0.22μF                                       |   |   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 10V : 0201>0.1μF, 0402≥1μF, 0603≥10μF, 0805≥47μF                             |   |   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 6.3V : 0201≥0.1μF, 0603>4.7μF, 0805≥47μF, 1206≥10μF                          |   |   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 4V : 0603≥22μF, 0805≥47μF, 1206≥100μF  |   |   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 6.   | Dielectric Strength                       | <table border="1"> <thead> <tr> <th>Rated Voltage</th> <th>Condition</th> </tr> </thead> <tbody> <tr> <td>≤100</td> <td>2.5 times of U<sub>R</sub></td> </tr> <tr> <td>100&lt;V≤250</td> <td>2.0 times of U<sub>R</sub></td> </tr> <tr> <td>250&lt;V≤500</td> <td>1.5 times of U<sub>R</sub></td> </tr> <tr> <td>630</td> <td>1.2 times of U<sub>R</sub></td> </tr> </tbody> </table> <p>* Duration : 1 to 5 sec.</p> <p>* Charge and discharge current less than 50mA.</p>   | Rated Voltage  | Condition     | ≤100       | 2.5 times of U <sub>R</sub> | 100<V≤250                                 | 2.0 times of U <sub>R</sub>                                   | 250<V≤500                               | 1.5 times of U <sub>R</sub>                                  | 630   | 1.2 times of U <sub>R</sub>  | <p>* No evidence of damage or flash over during test.</p> |          |               |                   |  |   |           |   |  |  |   |                                       |
| Rated Voltage  | Condition                                 |   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| ≤100   | 2.5 times of U <sub>R</sub>               |   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 100<V≤250  | 2.0 times of U <sub>R</sub>               |   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 250<V≤500  | 1.5 times of U <sub>R</sub>               |   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 630  | 1.2 times of U <sub>R</sub>               |   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 7.   | Solderability                             | <p>* Solder temperature : 235±5°C for (0201~1210).</p> <p>* Solder temperature : 245±5°C for (1808~2225).</p> <p>* Dipping time : 2±0.5 sec.</p>  | <p>* 75% min. coverage of all metalized area.</p>  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 8.   | Resistance to Soldering Heat              | <p>* Solder temperature : 260±5°C.</p> <p>* Dipping time : 10±1 sec.</p> <p>* Preheating : 120 to 150°C for 1 minute before immerse the capacitor in a eutectic solder.</p> <p>* Before initial measurement (Class II only) : To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</p> <p>* Cap. / D.F. / I.R. Measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</p>   | <p>* No remarkable damage.</p> <p>* Cap. change :<br/>X7R, X5R, X6S : Within ±7.5%.<br/>Y5V : Within ±20%.</p> <p>* D.F., I.R. and dielectric strength : To meet initial requirements.</p> <p>* 25% max. leaching on each edge.</p>  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 9.   | Temperature Cycle                         | <p>* Conduct the five cycles according to the temperatures and time.</p> <table border="1"> <thead> <tr> <th>Step</th> <th>Temp.(°C)</th> <th>Time(min.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min. operating temp. +0/-3</td> <td>30±3</td> </tr> <tr> <td>2</td> <td>Room temp.</td> <td>2~3</td> </tr> <tr> <td>3</td> <td>Max. operating temp. +3/-0</td> <td>30±3</td> </tr> <tr> <td>4</td> <td>Room temp.</td> <td>2~3</td> </tr> </tbody> </table> <p>* Before initial measurement (Class II only) : To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</p> <p>* Cap./D.F./I.R. measurement to made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.</p> | Step   | Temp.(°C)     | Time(min.) | 1                           | Min. operating temp. +0/-3                | 30±3  | 2                                       | Room temp.   | 2~3   | 3  | Max. operating temp. +3/-0                                | 30±3     | 4             | Room temp.        | 2~3  | <p>* No remarkable damage.</p> <p>* Cap. change :<br/>X7R, X5R, X6S : Within ±7.5%.<br/>Y5V : Within ±20%.</p> <p>* D.F. : ≤150% of initial requirement.</p> <p>* I.R. : ≥25% of initial requirement.</p> |           |   |  |  |   |                                       |
| Step   | Temp.(°C)                                 | Time(min.)  |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 1  | Min. operating temp. +0/-3                | 30±3  |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 2  | Room temp.                                | 2~3   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 3  | Max. operating temp. +3/-0                | 30±3  |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |
| 4  | Room temp.                                | 2~3   |  |               |            |                             |   |   |   |  |   |  |   |          |               |                   |  |   |           |   |  |  |   |                                       |

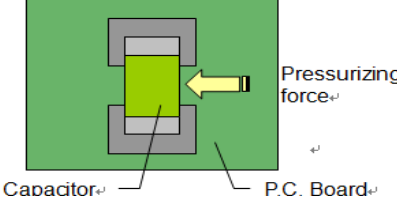
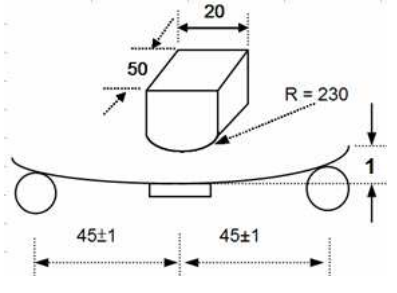
## 8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

| No.  | Item                                     | Test Condition   | Requirements   |               |      |                            |  |   |   |   |   |  |  |
|--|--|--|--|---------------|------|----------------------------|--|---|---|---|---|--|--|
| 10.  | Humidity<br>(Damp Heat)<br>Steady State  | <ul style="list-style-type: none"> <li>* Test temp. : 40±2°C.</li> <li>* Humidity : 90~95%RH.</li> <li>* Test time : 500 +24/-0hrs.</li> <li>* Measurement to be made after keeping at room temp. for 48±4 hrs (Class II).</li> </ul>  | <ul style="list-style-type: none"> <li>* No remarkable damage.</li> <li>* Cap. change :<br/>X7R, X5R, X6S : Within ±12.5% for ≥10V**, within ±25% for 6.3V.<br/>**10V : Within ±25% for 0603≥4.7μF, 0402≥1μF, 0201≥0.1μF.<br/>Y5V : Within ±30% for ≥10V, within +30/-40% for 6.3V.</li> <li>* D.F.(Class II) : ≤200% of initial requirement.</li> <li>* I.R. : ≥10V, ≥1GΩ or RxC≥50Ω-F, whichever is smaller.<br/>6.3V, RxC≥10Ω-F.</li> </ul>   |               |      |                            |  |   |   |   |   |  |  |
| 11.  | Humidity<br>(Damp Heat)<br>Load          | <ul style="list-style-type: none"> <li>* Test temp. : 40±2°C.</li> <li>* Humidity : 90~95%RH.</li> <li>* Test time : 500 +24/-0hrs.</li> <li>* To apply voltage : Rated voltage (500V max.).</li> <li>* Measurement to be made after keeping at room temp. for 48±4 hrs (Class II).</li> </ul> | <ul style="list-style-type: none"> <li>* No remarkable damage.</li> <li>* Cap. change :<br/>X7R, X5R, X6S : Within ±12.5% for ≥10V**, within ±25% for 6.3V.<br/>**10V : Within ±25% for 0603≥4.7μF, 0402≥1μF, 0201≥0.1μF.<br/>Y5V : Within ±30% for ≥10V, within +30/-40% for 6.3V.</li> <li>* D.F.(Class II) : ≤200% of initial requirement.</li> <li>* I.R. : ≥10V, ≥500MΩ or RxC≥25Ω-F, whichever is smaller.</li> </ul> <p>Class II (X7R, X5R, X6S, Y5V)</p> <table border="1"> <thead> <tr> <th>Rated voltage</th> <th>I.R.</th> </tr> </thead> <tbody> <tr> <td>100V : All X7R, 1210≥3.3μF</td> <td rowspan="7">≥500MΩ or RxC≥5Ω-F, whichever is smaller</td> </tr> <tr> <td>50V : 0402&gt;0.01μF, 0603≥1μF, 0805≥1μF, 1206≥4.7μF, 1210≥4.7μF</td> </tr> <tr> <td>35V : 0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF</td> </tr> <tr> <td>25V : 0201≥0.1μF, 0402≥0.22μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF</td> </tr> <tr> <td>16V : 0201≥0.1μF, 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF</td> </tr> <tr> <td>10V : 0201≥47nF, 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF</td> </tr> <tr> <td>6.3V, 4V, All X6S/X7S items, Size≥1812</td> </tr> </tbody> </table> | Rated voltage | I.R. | 100V : All X7R, 1210≥3.3μF | ≥500MΩ or RxC≥5Ω-F, whichever is smaller | 50V : 0402>0.01μF, 0603≥1μF, 0805≥1μF, 1206≥4.7μF, 1210≥4.7μF | 35V : 0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF | 25V : 0201≥0.1μF, 0402≥0.22μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF | 16V : 0201≥0.1μF, 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF | 10V : 0201≥47nF, 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF | 6.3V, 4V, All X6S/X7S items, Size≥1812 |
| Rated voltage  | I.R.                                     |  |  |               |      |                            |  |   |   |   |   |  |  |
| 100V : All X7R, 1210≥3.3μF   | ≥500MΩ or RxC≥5Ω-F, whichever is smaller |  |  |               |      |                            |  |   |   |   |   |  |  |
| 50V : 0402>0.01μF, 0603≥1μF, 0805≥1μF, 1206≥4.7μF, 1210≥4.7μF                |  |  |  |               |      |                            |  |   |   |   |   |  |  |
| 35V : 0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF                            |  |  |  |               |      |                            |  |   |   |   |   |  |  |
| 25V : 0201≥0.1μF, 0402≥0.22μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF  |  |  |  |               |      |                            |  |   |   |   |   |  |  |
| 16V : 0201≥0.1μF, 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF    |  |  |  |               |      |                            |  |   |   |   |   |  |  |
| 10V : 0201≥47nF, 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF |  |  |  |               |      |                            |  |   |   |   |   |  |  |
| 6.3V, 4V, All X6S/X7S items, Size≥1812                                       |  |  |  |               |      |                            |  |   |   |   |   |  |  |

## 8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

| No.   | Item                                     | Test Condition   | Requirements  |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|---|--|--|---|------------------|----------------------------|---|---|---|---|---|--|--|-------------|------|------------------|---------------------|----------|------|-------------|---------------|-------------|-----------|---------|----------|---------|-------------|-------------|---------|--------|------|---------|------|-------------|----------|---------|-------------|----------|---------|-------------|-----|-----------|----------|------|---------|---------|------|-----|-----------|----------|-----|------|---------|------|-----|-----------|---------|-----|-----------|---------|
| 12.   | <b>High Temperature Load (Endurance)</b> | * Test temp. :<br>X7R : 125±3°C.<br>X6S : 105±3°C.<br>X5R, Y5V : 85±3°C.   | * No remarkable damage.<br>* Cap. change :<br>X7R, X5R, X6S : Within ±12.5% for ≥10V**, within ±25% for ≤6.3V.<br>**10V : Within ±25% for 0603≥4.7μF, 0402≥1μF, 0201≥0.1μF.<br>Y5V : Within ±30% for ≥10V, within +30/-40% for ≤6.3V.<br>* D.F.(Class II) : ≤200% of initial requirement.<br>* I.R. : ≥10V, ≥1GΩ or RxC≥50Ω-F, whichever is smaller.<br>Class II (X7R, X5R, X6S, Y5V) |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  | * To apply voltage :<br>(1) ≤6.3V or Cap.≥10μF : 150% of rated voltage.<br>(2) 10V≤Ur<500V : 200% of rated voltage.<br>(3) 500V : 150% of rated voltage.<br>(4) Ur≥630V : 120% of rated voltage.<br>(5) 100% of rated voltage for below range :  |   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
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|   |  | Size   |   | Dielectric       | Rated                      | Capacitance range                       |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  | 0201   |   | X5R/X7R/X6S      | ≤10V                       | C≥0.1μF                                 |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  |  |   |                  | ≥16V                       | C>0.1μF                                 |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  | 0402   |   | X5R/X7R/X6S /Y5V | 6.3V, 10V, 16V, 25V        | C≥1.0μF                                 |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  |  |   |                  | 4V                         | C≥22μF                                  |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  | 0603   |   | X5R/X7R/X6S      | 6.3V, 10V                  | C≥4.7μF                                 |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  |  |   |                  | 25V, 35V                   | C≥1.0μF                                 |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  | 0805   |   | X5R/X7R/X6S      | 4V                         | C≥47μF                                  |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  |  |   |                  | 6.3V                       | C≥22μF                                  |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  | 1206   |   | X5R/X7R/X6S      | 10V~50V                    | C≥10μF                                  |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  |  |   |                  | ≤6.3V                      | C≥47μF                                  |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  | 1210   |   | X5R/X7R/X6S      | 16V                        | C≥47μF                                  |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
| X7R   | 100V                                     |  | C≥3.3μF   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
| (6) 150% of rated voltage for below range :   |  |  |   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
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| Size  | Dielectric                               | Rated Voltage  | Capacitance   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
| 0201  | X5R/X7R/X6S                              | 16V/25V  | C≥0.1μF   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  | X7R  | 16V   | C≥0.022μF        |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
| 0402  | X5R/X7R/X6S                              | 50V  | C≥0.1μF   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  | 10~25V   | C≥0.22μF  |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
| 0603  | X5R/X7R/X6S                              | 10V, 16V, 50V  | C≥1.0μF   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  | Y5V  | 16V   | C≥2.2μF          |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
| 0805  | X5R/X7R/X6S                              | 10~50V   | C≥4.7μF   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  | Y5V  | 16V   | C≥4.7μF          |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
| 1206  | X5R/X7R/X6S                              | 50V~100V   | C>1.0μF   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  | X5R/X7R/X6S  | 50V~100V  | C≥1.0μF          |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
| 1210  | X7R                                      | 200V~250V  | C≥0.22μF  |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  | X7R  | 100V  | C≥1.0μF          |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
| 1812  | X7R                                      | 200V~250V  | C≥0.47μF  |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  | X7R  | 100V  | C≥1.0μF          |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
| 1825  | X7R                                      | 100V~250V  | C≥1.0μF   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  | X7R  | 100V~250V   | C≥1.0μF          |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
| (7) 120% of rated voltage for below range :   |  |  |   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
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| Size  | Dielectric                               | Rated Voltage  | Capacitance   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
| 1210  | X7R                                      | 100V   | C≥3.3μF   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  | * Test time : 1000 +24/-0 hrs.   |   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  | * Before initial measurement (Class II only) : To apply de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.  |   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  | * Cap./D.F./I.R. measurement to be made after de-aging at 150°C for 1hr then set for 24±2 hrs at room temp.  |   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  | ** De-rating conditions :  |   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  | <p>The graph shows the de-rating curve for three different temperature classes: 125°C (solid line), 105°C (dashed line), and 85°C (dotted line). The y-axis represents the Ratio (Operating Voltage/Rated Voltage (%)) from 0 to 120. The x-axis represents the Temperature at Product (°C) from 0 to 150. All curves start at 100% at 0°C. The 125°C curve remains at 100% until 75°C, then drops to approximately 70% at 125°C. The 105°C curve remains at 100% until 50°C, then drops to approximately 70% at 125°C. The 85°C curve remains at 100% until 25°C, then drops to approximately 70% at 125°C.</p>   |   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
|   |  | <table border="1"> <thead> <tr> <th>Rated voltage</th> <th>I.R.</th> </tr> </thead> <tbody> <tr> <td>100V : All X7R, 1210≥3.3μF</td> <td rowspan="7">≥1GΩ or RxC≥10Ω-F, whichever is smaller</td> </tr> <tr> <td>50V : 0402&gt;0.01μF, 0603≥1μF, 0805≥1μF, 1206≥4.7μF, 1210≥4.7μF</td> </tr> <tr> <td>35V : 0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF</td> </tr> <tr> <td>25V : 0201≥0.1uF, 0402≥0.22μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF</td> </tr> <tr> <td>16V : 0201≥0.1uF, 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF</td> </tr> <tr> <td>10V : 0201≥47nF, 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF</td> </tr> <tr> <td>6.3V, 4V, All X6S/X7S items, Size≥1812</td> </tr> </tbody> </table>   | Rated voltage   | I.R.             | 100V : All X7R, 1210≥3.3μF | ≥1GΩ or RxC≥10Ω-F, whichever is smaller | 50V : 0402>0.01μF, 0603≥1μF, 0805≥1μF, 1206≥4.7μF, 1210≥4.7μF | 35V : 0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF | 25V : 0201≥0.1uF, 0402≥0.22μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF | 16V : 0201≥0.1uF, 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF | 10V : 0201≥47nF, 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF | 6.3V, 4V, All X6S/X7S items, Size≥1812 |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
| Rated voltage   | I.R.                                     |  |   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
| 100V : All X7R, 1210≥3.3μF  | ≥1GΩ or RxC≥10Ω-F, whichever is smaller  |  |   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
| 50V : 0402>0.01μF, 0603≥1μF, 0805≥1μF, 1206≥4.7μF, 1210≥4.7μF   |  |  |   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
| 35V : 0603≥1μF, 0805≥2.2μF, 1206≥2.2μF, 1210≥10μF   |  |  |   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
| 25V : 0201≥0.1uF, 0402≥0.22μF, 0603≥2.2μF, 0805≥2.2μF, 1206≥10μF, 1210≥10μF   |  |  |   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
| 16V : 0201≥0.1uF, 0402≥0.22μF, 0603≥1μF, 0805≥2.2μF, 1206≥10μF, 1210≥47μF   |  |  |   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
| 10V : 0201≥47nF, 0402≥0.47μF, 0603≥0.47μF, 0805≥2.2μF, 1206≥4.7μF, 1210≥47μF  |  |  |   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |
| 6.3V, 4V, All X6S/X7S items, Size≥1812  |  |  |   |                  |                            |   |   |   |   |   |  |  |             |      |                  |                     |          |      |             |               |             |           |         |          |         |             |             |         |        |      |         |      |             |          |         |             |          |         |             |     |           |          |      |         |         |      |     |           |          |     |      |         |      |     |           |         |     |           |         |

## 8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

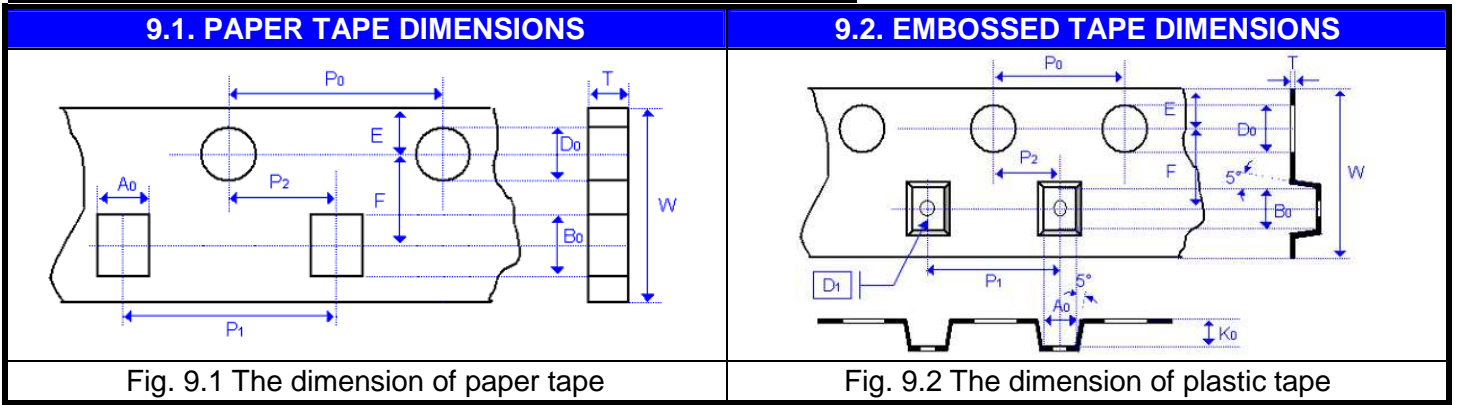
| No.                      | Item                             | Test Condition   | Requirements   |            |             |                          |                     |                |                   |
|--------------------------|----------------------------------|--|--|------------|-------------|--------------------------|---------------------|----------------|-------------------|
| 13.                      | Adhesive Strength of Termination | <p>* Capacitors mounted on a substrate. A force of 5N(<math>\leq 0603</math>) or 10N(<math>&gt;0603</math>) applied perpendicular to the place of substrate and parallel the line joining the center of terminations for <math>10 \pm 1</math> second.</p>  | <p>* No remarkable damage or removal of the terminations.</p>  |            |             |                          |                     |                |                   |
| 14.                      | Bending Test                     | <p>* The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1mm per second until the deflection becomes 1mm.</p>    | <p>* No remarkable damage.</p> <table border="1"> <thead> <tr> <th>Dielectric</th> <th>Cap. Change</th> </tr> </thead> <tbody> <tr> <td>Class II (X7R, X5R, X6S)</td> <td>Within <math>\pm 12.5\%</math></td> </tr> <tr> <td>Class II (Y5V)</td> <td>Within <math>\pm 30\%</math></td> </tr> </tbody> </table> <p>(This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test)</p> | Dielectric | Cap. Change | Class II (X7R, X5R, X6S) | Within $\pm 12.5\%$ | Class II (Y5V) | Within $\pm 30\%$ |
| Dielectric               | Cap. Change                      |  |  |            |             |                          |                     |                |                   |
| Class II (X7R, X5R, X6S) | Within $\pm 12.5\%$              |  |  |            |             |                          |                     |                |                   |
| Class II (Y5V)           | Within $\pm 30\%$                |  |  |            |             |                          |                     |                |                   |
| 15.                      | Vibration Resistance             | <p>* Vibration frequency : 10~55 Hz/min.<br/>           * Total amplitude : 1.5mm.<br/>           * Test time : 6 hrs. (Two hrs each in three mutually perpendicular directions)</p>   | <p>* No remarkable damage.<br/>           * Cap. change and D.F. : To meet initial spec.</p>   |            |             |                          |                     |                |                   |

## 9. PACKAGE DIMENSION AND QUANTITY

| Size       | Thickness (mm)/Symbol |   | Paper tape |          | Plastic tape |          |
|------------|-----------------------|---|------------|----------|--------------|----------|
|            |                       |   | 7" reel    | 13" reel | 7" reel      | 13" reel |
| 0201(0603) | 0.30±0.03             | L | 15k        | 70k      | -            | -        |
|            | 0.30±0.05             | L | 15k        | -        | -            | -        |
|            | 0.30±0.09             | L | 15k        | -        | -            | -        |
| 0402(1005) | 0.50±0.05             | N | 10k        | 50k      | -            | -        |
|            | 0.50 +0.02/-0.05      | Q | 10k        | 50k      | -            | -        |
|            | 0.50±0.20             | K | 10k        | -        | -            | -        |
| 0603(1608) | 0.50±0.10             | U | 4k         | -        | -            | -        |
|            | 0.80±0.07             | S | 4k         | 15k      | -            | -        |
|            | 0.80 +0.15/-0.10      | B | 4k         | 15k      | -            | -        |
| 0805(2012) | 0.50±0.10             | U | 4k         | 15k      | -            | -        |
|            | 0.60±0.10             | A | 4k         | 15k      | -            | -        |
|            | 0.80±0.10             | X | 4k         | 15k      | -            | -        |
|            | 0.85±0.10             | T | 4k         | 15k      | -            | -        |
|            | 1.25±0.10             | C | -          | -        | 3k           | 10k      |
|            | 1.25±0.20             | I | -          | -        | 3k           | 10k      |
| 1206(3216) | 0.80±0.10             | X | 4k         | 15k      | -            | -        |
|            | 0.85±0.10             | T | 4k         | 15k      | -            | -        |
|            | 0.95±0.10             | M | -          | -        | 3k           | 10k      |
|            | 1.15±0.15             | J | -          | -        | 3k           | 10k      |
|            | 1.25±0.10             | C | -          | -        | 3k           | 10k      |
|            | 1.60±0.20             | E | -          | -        | 2k           | 10k      |
|            | 1.60 +0.30/-0.10      | P | -          | -        | 2k           | 9k       |
| 1210(3225) | 0.85±0.10             | T | -          | -        | 3k           | 10k      |
|            | 0.95±0.10             | M | -          | -        | 3k           | 10k      |
|            | 1.25±0.10             | C | -          | -        | 3k           | 10k      |
|            | 1.60±0.20             | E | -          | -        | 2k           | -        |
|            | 2.00±0.20             | F | -          | -        | 1k           | 6k       |
|            | 2.50±0.30             | G | -          | -        | 1k           | 6k       |
| 1808(4520) | 1.25±0.10             | C | -          | -        | 2k           | 10k      |
|            | 1.60±0.20             | E | -          | -        | 2k           | 8k       |
|            | 2.00±0.20             | F | -          | -        | 1k           | 6k       |
| 1812(4532) | 1.25±0.10             | C | -          | -        | 1k           | 5k       |
|            | 1.60±0.20             | E | -          | -        | 1k           | -        |
|            | 2.00±0.20             | F | -          | -        | 1k           | -        |
|            | 2.50±0.30             | G | -          | -        | 0.5k         | 3k       |
| 1825(4563) | 2.80±0.30             | H | -          | -        | 0.5k         | -        |
|            | 1.60±0.20             | E | -          | -        | 1k           | -        |
|            | 2.00±0.20             | F | -          | -        | 1k           | -        |
|            | 2.50±0.30             | G | -          | -        | 0.5k         | -        |
| 2220(5750) | 2.80±0.30             | H | -          | -        | 0.5k         | -        |
|            | 1.60±0.20             | E | -          | -        | 1k           | -        |
|            | 2.00±0.20             | F | -          | -        | 1k           | -        |
| 2225(5763) | 2.50±0.30             | G | -          | -        | 0.5k         | -        |
|            | 2.80±0.30             | H | -          | -        | 0.5k         | -        |
|            | 1.60±0.20             | E | -          | -        | 1k           | -        |

Unit : pcs

## 9. PACKAGE DIMENSION AND QUANTITY



| Size              | 0201       | 0402       | 0603            |                 | 0805      |                        |
|-------------------|------------|------------|-----------------|-----------------|-----------|------------------------|
| Chip Thickness    | 0.30±0.03  | 0.50±0.10  | 0.80±0.07       | 0.80 +0.15/-0.1 | 0.80±0.10 | 1.25±0.10<br>1.25±0.20 |
| A <sub>0</sub>    | 0.39±0.07  | 0.70±0.2   | 1.00 +0.05/-0.1 | 1.02 +0.05/-0.1 | 1.50±0.10 | <1.65                  |
| B <sub>0</sub>    | 0.69±0.07  | 1.20±0.2   | 1.80±0.10       | 1.80±0.10       | 2.30±0.10 | <2.40                  |
| T                 | ≤0.50      | ≤0.80      | 0.95±0.05       | 0.97±0.05       | 0.95±0.05 | 0.23±0.05              |
| K <sub>0</sub>    | -          | -          | -               | -               | -         | <2.50                  |
| W                 | 8.00±0.10  | 8.00±0.10  | 8.00±0.10       | 8.00±0.10       | 8.00±0.10 | 8.00±0.10              |
| P <sub>0</sub>    | 4.00±0.10  | 4.00±0.10  | 4.00±0.10       | 4.00±0.10       | 4.00±0.10 | 4.00±0.10              |
| 10xP <sub>0</sub> | 40.00±0.10 | 40.00±0.10 | 40.00±0.2       | 40.00±0.2       | 40.00±0.2 | 40.00±0.20             |
| P <sub>1</sub>    | 2.00±0.05  | 2.00±0.05  | 4.00±0.10       | 4.00±0.10       | 4.00±0.10 | 4.00±0.10              |
| P <sub>2</sub>    | 2.00±0.05  | 2.00±0.05  | 2.00±0.05       | 2.00±0.05       | 2.00±0.05 | 2.00±0.05              |
| D <sub>0</sub>    | 1.55±0.05  | 1.55±0.05  | 1.55±0.05       | 1.55±0.05       | 1.55±0.05 | 1.50 +0.10/-0          |
| D <sub>1</sub>    | -          | -          | -               | -               | -         | 1.00±0.10              |
| E                 | 1.75±0.05  | 1.75±0.05  | 1.75±0.05       | 1.75±0.05       | 1.75±0.05 | 1.75±0.10              |
| F                 | 3.50±0.05  | 3.50±0.05  | 3.50±0.05       | 3.50±0.05       | 3.50±0.05 | 3.50±0.05              |
| Unit :            | mm         | mm         | mm              | mm              | mm        | mm                     |

| Size              | 1206       |                        |                            | 1210                                |               | 1812                                |               |
|-------------------|------------|------------------------|----------------------------|-------------------------------------|---------------|-------------------------------------|---------------|
| Chip Thickness    | 0.80±0.10  | 0.95±0.10<br>1.25±0.10 | 1.60±0.20<br>1.60+0.3/-0/1 | 0.95±0.10<br>1.25±0.10<br>1.60±0.20 | 2.50±0.30     | 1.25±0.10<br>1.60±0.20<br>2.00±0.20 | 2.50±0.30     |
| A <sub>0</sub>    | 2.00±0.10  | <2.00                  | <2.00                      | <3.05                               | <3.10         | <3.90                               | <3.90         |
| B <sub>0</sub>    | 3.50±0.10  | <3.60                  | <3.70                      | <3.80                               | <4.00         | <5.30                               | <5.30         |
| T                 | 0.95±0.05  | 0.23±0.05              | 0.23±0.05                  | 0.23±0.05                           | 0.23±0.05     | 0.25±0.05                           | 0.25±0.05     |
| K <sub>0</sub>    | -          | <2.50                  | <2.50                      | <2.50                               | <3.50         | <2.50                               | <3.00         |
| W                 | 8.00±0.10  | 8.00±0.10              | 8.00±0.10                  | 8.00±0.10                           | 8.00±0.10     | 12.0±0.20                           | 12.0±0.20     |
| P <sub>0</sub>    | 4.00±0.10  | 4.00±0.10              | 4.00±0.10                  | 4.00±0.100                          | 4.00±0.10     | 4.00±0.10                           | 4.00±0.10     |
| 10xP <sub>0</sub> | 40.00±0.20 | 40.00±0.20             | 40.00±0.20                 | 40.00±0.20                          | 40.0±0.10     | 40.00±0.20                          | 40.00±0.20    |
| P <sub>1</sub>    | 4.00±0.10  | 4.00±0.10              | 4.00±0.10                  | 4.00±0.10                           | 4.00±0.10     | 8.00±0.10                           | 8.00±0.10     |
| P <sub>2</sub>    | 2.00±0.05  | 2.00±0.05              | 2.00±0.05                  | 2.00±0.05                           | 2.00±0.05     | 2.00±0.05                           | 2.00±0.05     |
| D <sub>0</sub>    | 1.55±0.05  | 1.50 +0.10/-0          | 1.50 +0.10/-0              | 1.50 +0.10/-0                       | 1.50 +0.10/-0 | 1.50 +0.10/-0                       | 1.50 +0.10/-0 |
| D <sub>1</sub>    | -          | 1.00±0.10              | 1.00±0.10                  | 1.00±0.10                           | 1.00±0.10     | 1.50±0.10                           | 1.50±0.10     |
| E                 | 1.75±0.10  | 1.75±0.10              | 1.75±0.10                  | 1.75±0.10                           | 1.75±0.10     | 1.75±0.10                           | 1.75±0.1      |
| F                 | 3.50±0.05  | 3.50±0.05              | 3.50±0.05                  | 3.50±0.05                           | 3.50±0.05     | 5.50±0.05                           | 5.50±0.05     |
| Unit :            | mm         | mm                     | mm                         | mm                                  | mm            | mm                                  | mm            |

## 9. PACKAGE DIMENSION AND QUANTITY

| Size              | 1825                   |               | 2220                                |               | 2225                   |               |
|-------------------|------------------------|---------------|-------------------------------------|---------------|------------------------|---------------|
| Chip Thickness    | 1.60±0.20<br>2.00±0.20 | 2.50±0.30     | 1.40±0.15<br>1.60±0.20<br>2.00±0.20 | 2.50±0.30     | 1.60±0.20<br>2.00±0.20 | 2.50±0.30     |
| A <sub>0</sub>    | <6.80                  | <6.80         | <5.80                               | <5.80         | <6.80                  | <6.80         |
| B <sub>0</sub>    | <5.30                  | <5.30         | <6.50                               | <6.50         | <6.50                  | <6.50         |
| T                 | 0.30±0.10              | 0.30±0.10     | 0.30±0.10                           | 0.30±0.10     | 0.30±0.10              | 0.30±0.10     |
| K <sub>0</sub>    | <2.50                  | <3.10         | <2.50                               | <3.10         | <2.50                  | <3.10         |
| W                 | 12.0±0.20              | 12.0±0.20     | 12.0±0.20                           | 12.0±0.20     | 12.0±0.20              | 12.0±0.20     |
| P <sub>0</sub>    | 4.00±0.10              | 4.00±0.10     | 4.00±0.10                           | 4.00±0.10     | 4.00±0.10              | 4.00±0.10     |
| 10xP <sub>0</sub> | 40.00±0.20             | 40.00±0.20    | 40.00±0.20                          | 40.00±0.20    | 40.00±0.20             | 40.00±0.20    |
| P <sub>1</sub>    | 8.00±0.10              | 8.00±0.10     | 8.00±0.10                           | 8.00±0.10     | 8.00±0.10              | 8.00±0.10     |
| P <sub>2</sub>    | 2.00±0.05              | 2.00±0.05     | 2.00±0.05                           | 2.00±0.05     | 2.00±0.05              | 2.00±0.05     |
| D <sub>0</sub>    | 1.50 +0.10/-0          | 1.50 +0.10/-0 | 1.50 +0.10/-0                       | 1.50 +0.10/-0 | 1.50 +0.10/-0          | 1.50 +0.10/-0 |
| D <sub>1</sub>    | 1.50±0.10              | 1.50±0.10     | 1.50±0.10                           | 1.50±0.10     | 1.50±0.10              | 1.50±0.10     |
| E                 | 1.75±0.1               | 1.75±0.10     | 1.75±0.1                            | 1.75±0.10     | 1.75±0.10              | 1.75±0.10     |
| F                 | 5.50±0.05              | 5.50±0.05     | 5.50±0.05                           | 5.50±0.05     | 5.50±0.05              | 5.50±0.05     |
| Unit :            | mm                     | mm            | mm                                  | mm            | mm                     | mm            |

### 9.3. REEL DIMENSIONS

| Size           | 0201, 0402, 0603<br>0805, 1206, 1210 |                   |                   | 1808, 1812, 1825<br>2220, 2225 |
|----------------|--------------------------------------|-------------------|-------------------|--------------------------------|
| Reel size      | 7"                                   | 7"                | 13"               | 7"                             |
| C              | 13.0<br>+0.5/-0.2                    | 13.0<br>+0.5/-0.2 | 13.0<br>+0.5/-0.2 | 13.0<br>+0.5/-0.2              |
| W <sub>1</sub> | 8.4<br>+1.5/-0                       | 12.4<br>+2.0/-0   | 8.4<br>+1.5/-0    | 8.4<br>+1.5/-0                 |
| A              | 178.0<br>±0.10                       | 178.0<br>±0.10    | 330.0<br>±1.0     | 178.0<br>±0.10                 |
| N              | 60.0<br>+1.0/-0                      | 80.0<br>±1.0      | 100<br>±1.0       | 60.0<br>+1.0/-0                |

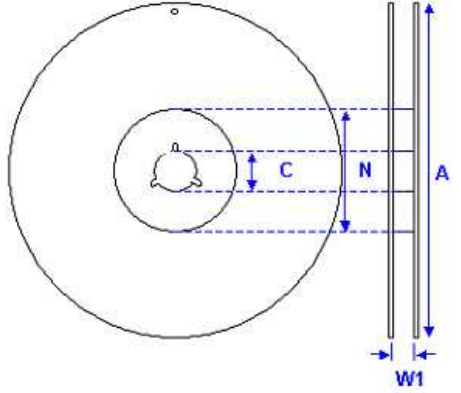


Fig. 9.3 The dimension of reel

## 10. APPLICATION NOTES

### STORAGE

To prevent the damage of solderability of terminations, the following storage conditions are recommended :

Indoors under 5 ~ 40°C and 20% ~ 70% RH.

No harmful gases containing sulfuric acid, ammonia, hydrogen sulfide or chlorine.

Packaging should not be opened until the capacitors are required for use. If opened, the pack should be re-sealed as soon as is practicable. Taped product should be stored out of direct sunlight, which might promote deterioration in tape or adhesion performance. The product is recommended to be used within 12 months after shipment and checked the solderability before use.

### HANDLING

Chip capacitors are dense, hard, brittle, and abrasive materials. They are liable to suffer mechanical damage, in the form of cracks or chips. Chip Capacitors should be handled with care to avoid contamination or damage. To use vacuum or plastic tweezers to pick up or plastic tweezers is recommended for manual placement. Tape and reeled packages are suitable for automatic pick and placement machine.

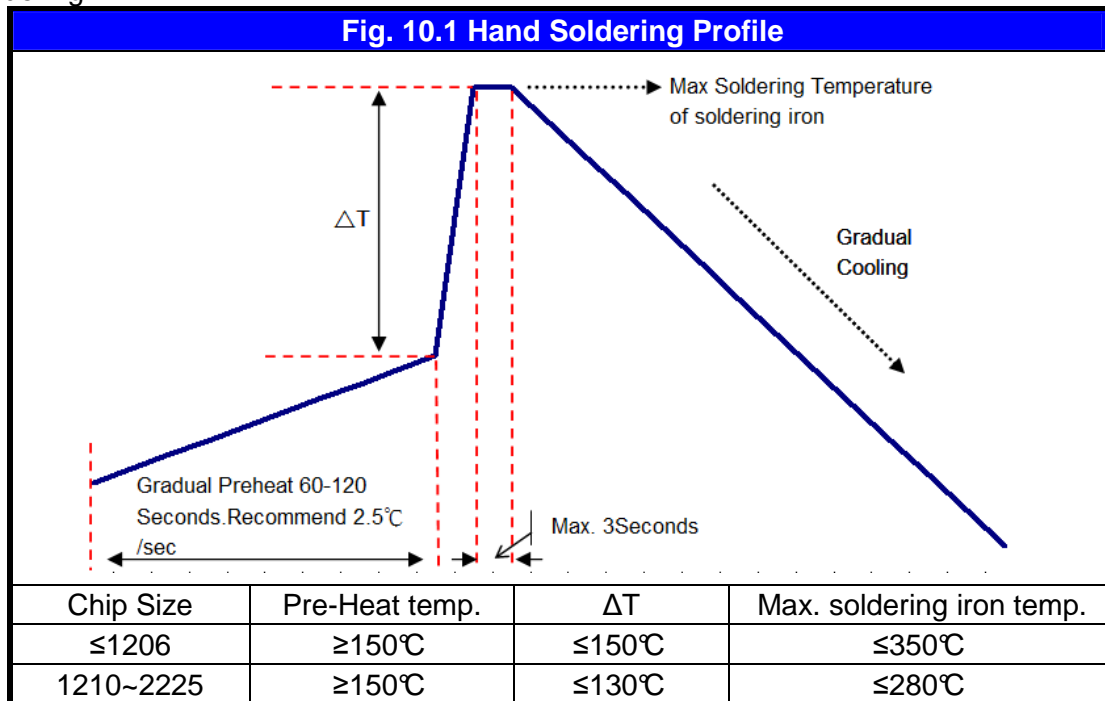
### PREHEAT

In order to minimize the risk of thermal shock during soldering, a carefully controlled preheat is required. The rate of preheat should not exceed 3°C per second.

### SOLDERING

Use mildly activated rosin RA and RMA fluxes do not use activated flux. The amount of solder in each solder joint should be controlled to prevent the damage of chip capacitors caused by the stress between solder, chips, and substrate.

a.) Hand soldering :



\* Soldering iron tip diameter  $\leq 1.0$  mm and wattage max. 20W.

\* The Capacitors shall be pre-heated and that the temperature gradient between the devices and the tip of the soldering iron.

\* The required amount of solder shall be melted on the soldering tip.

\* The tip of iron should not contact the ceramic body directly.

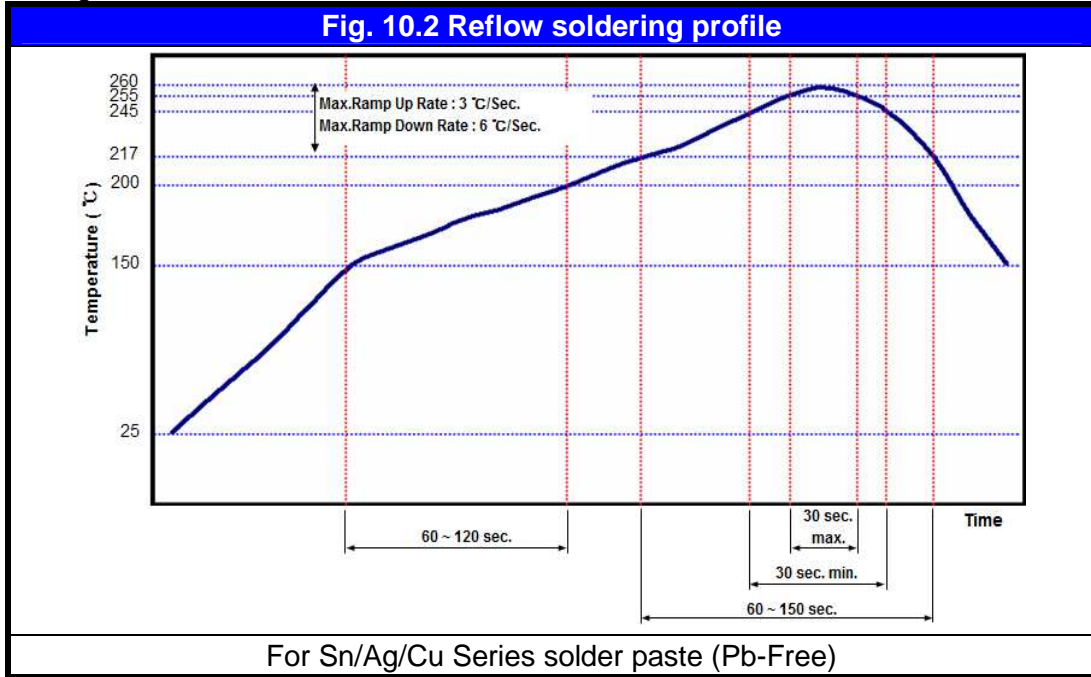
\* The Capacitors shall be cooled gradually at room temperature after soldering.

\* Forced air cooling is not allowed.

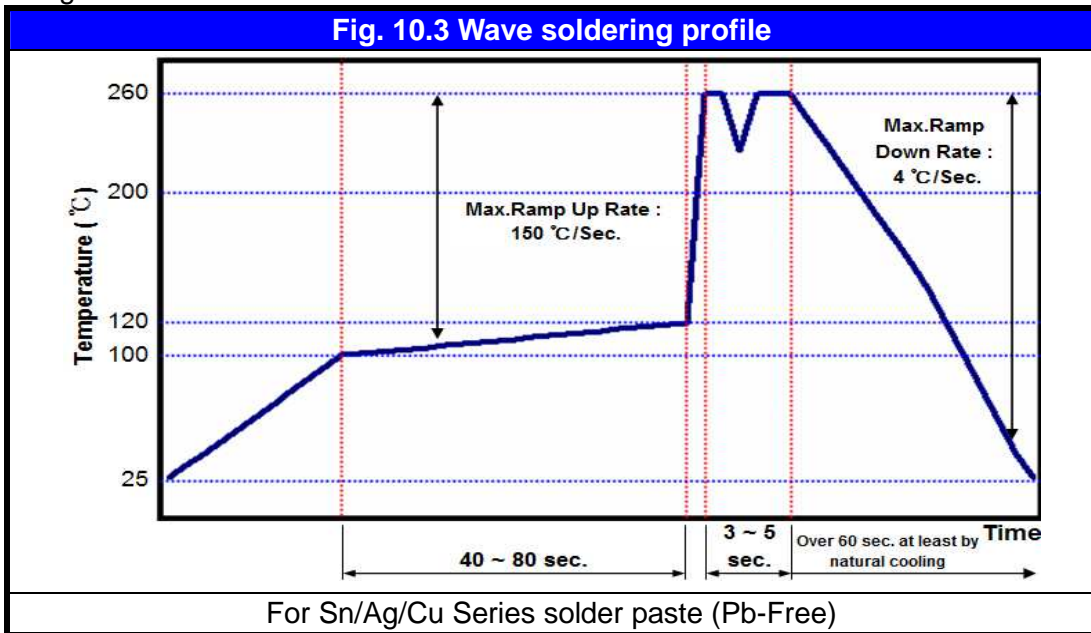


## 10. APPLICATION NOTES

b.) Reflow soldering :



c.) Wave soldering :



Soldering conditions :

Class I :

| Size Inch (mm) | Temper. Cher. | Capacitance | Condition |        |
|----------------|---------------|-------------|-----------|--------|
|                |               |             | Wave      | Reflow |
| ≤0402(1005)    | Class I - C0G | All         | X         | O      |
| 0603(1608)     | Class I - C0G | All         | O         | O      |
| 0805(2012)     | Class I - C0G | All         | O         | O      |
| 1206(3216)     | Class I - C0G | All         | O         | O      |
| ≥1210(3225)    | Class I - C0G | All         | X         | O      |

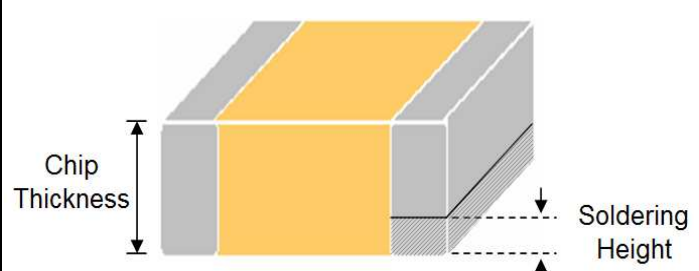
## 10. APPLICATION NOTES

Soldering conditions :

Class II :

| Size Inch (mm) | Temper. Cher.  | Capacitance | Condition |        |
|----------------|----------------|-------------|-----------|--------|
|                |                |             | Wave      | Reflow |
| ≤0402(1005)    | Class II - X7R | All         | X         | O      |
| 0603 (1608)    | Class II - X7R | Cap. <2.2μF | O         | O      |
|                |                | Cap. ≥2.2μF | X         | O      |
| 0805 (2012)    | Class II - X7R | Cap. <4.7μF | O         | O      |
|                |                | Cap. ≥4.7μF | X         | O      |
| 1206 (3216)    | Class II - X7R | Cap. <4.7μF | O         | O      |
|                |                | Cap. ≥4.7μF | X         | O      |
| ≥1210 (3225)   | Class II - X7R | All         | X         | O      |

Soldering height :

|  |   |
|--|---|
| <p>The solder climbing minimum height is suggesting to 25% of chip thickness or 500um whichever is less.<br/>(Reference from IPC-610E)</p> |  |
|--|---|

### COOLING

After soldering, cool the chips and the substrate gradually to room temperature. Natural cooling in air is recommended to minimize stress in the solder joint.

### CLEANING

All flux residues must be removed by using suitable electronic-grade vapor-cleaning solvents to eliminate contamination that could cause electrolytic surface corrosion. Good results can be obtained by using ultrasonic cleaning of the solvent. The choice of the proper system is depends upon many factors such as component mix, flux, and solder paste and assembly method. The ability of the cleaning system to remove flux residues and contamination from under the chips is very important.

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