

Messrs.

Date:

## APPROVAL SHEET

Product Name : Ultra High Voltage Multilayer Ceramic Chip Capacitors

Part No. : FV Series

Description : Size 0805~2225, C0G/X7R,  $\geq$  1KVdc, RoHS Compliant

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

信昌電子陶瓷股份有限公司

PROSPERITY DIELECTRICS CO., LTD.

桃園縣蘆竹鄉南山路二段 220-1 號 <http://www.pdc.com.tw>

Tel: 03-322-4471 ext: Fax: 03-322-5231 / 03-321-221

Contact: \_\_\_\_\_ Mobile: \_\_\_\_\_

SPECIFICATION FOR

ULTRA HIGH VOLTAGE MULTILAYER CERAMIC CHIP CAPACITORS

Part No. : FV Series

Description : Size 0805~2225, C0G/X7R,  $\geq 1KVdc$ , RoHS Compliant

| <u>DRAWN BY</u> | <u>CHECKED BY</u> | <u>APPROVED BY</u> |
|-----------------|-------------------|--------------------|
| 蕭敏珍             | 蔡永承               | 巫宏俊                |

## 1. INTRODUCTION

PDC FV 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. Special interior design offers high voltage rating in a given case size.
- b. High reliability and stability.
- c. RoHS compliant

## 3. APPLICATIONS

- a. DC to DC converter.
- b. High voltage coupling/DC blocking.
- c. Back-lighting inverters.
- d. LAN/WLAN interface.
- e. Modem.
- f. Power supplies.

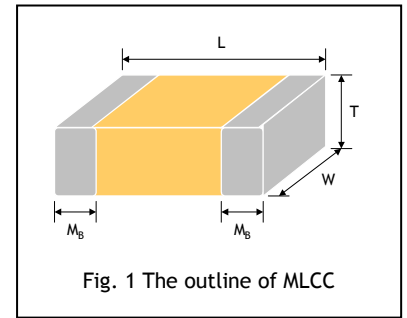
## 4. HOW TO ORDER

| <u>FV</u>  | <u>21</u> | <u>X</u>   | <u>101</u>  | <u>K</u>  | <u>102</u>    | <u>P</u>  | <u>X</u>  | <u>G</u>     |
|------------|-----------|------------|-------------|-----------|---------------|-----------|-----------|--------------|
| PDC Family | Size      | Dielectric | Capacitance | Tolerance | Rated voltage | Packaging | Thickness | Control Code |
| Table1.    | Table2    | Table3     | Table4      | Table5    | Table6        | Table7    | Table8    | Table9       |

Reference document with No.11 reference table detail.

## 5. EXTERNAL DIMENSIONS

| Size<br>Inch (mm) | L (mm)        | W (mm)        | Thickness<br>Spec               | M <sub>b</sub> min (mm) |
|-------------------|---------------|---------------|---------------------------------|-------------------------|
|                   |               |               | T(mm) code                      |                         |
| 0805 (2012)       | 2.00±0.20     | 1.25±0.20     | See<br>No.11 Reference<br>Table | 0.50±0.20               |
| 1206 (3216)       | 3.20+0.3/-0.2 | 1.60+0.3/-0.2 |                                 | 0.60±0.20               |
| 1210 (3225)       | 3.20±0.40     | 2.50±0.30     |                                 | 0.75±0.25               |
| 1808 (4520)       | 4.50±0.40     | 2.00±0.20     |                                 | 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               |
| 2211 (5728)       | 5.70±0.40     | 5.70±0.40     |                                 | 0.85±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               |



## 6. GENERAL ELECTRICAL DATA

| Dielectric                         | C0G(NPO)   |                                    | X7R  |
|------------------------------------|--|------------------------------------|--|
| Size                               | 0805,1206, 1210, 1808, 1812,<br>1825, 2211, 2220, 2225                                   |                                    | 0805,1206, 1210, 1808, 1812,<br>1825, 2211, 2220, 2225   |
| Rated voltage (WVDC)               | 1KV, 1.5KV, 2KV, 3KV   |                                    | 1KV, 1.5KV, 2KV, 3KV   |
| Capacitance range*                 | 1.5pF ~ 12nF   |                                    | 100pF ~ 150nF  |
| Capacitance tolerance              | Cap. Rang  | Tolerance Spec.                    | J (±5%), K (±10%), M (±20%)  |
|                                    | Cap≤5pF:   | B (±0.1pF), C (±0.25pF)            |  |
|                                    | 5pF<Cap<10pF:  | C (±0.25pF), D (±0.5pF)            |  |
|                                    | 10pF≤Cap:  | F (±1%), G (±2%), J (±5%),K (±10%) |  |
| Tan δ*                             | Cap. Rang  | Q Spec.                            | ≤2.5%  |
|                                    | Cap<30pF:  | Q≥400+20C                          |  |
|                                    | Cap≥30pF:  | Q≥1000                             |  |
| Capacitance & Tan δ Test Condition | Measured at the condition of 30~70% related humidity.<br>for 25°C at ambient temperature |                                    | 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. |
|                                    | Cap. Rang  | Test Condition                     | Apply 1.0±0.2Vrms, 1.0kHz±10%,<br>at 25°C ambient temperature.   |
|                                    | Cap≤1000pF   | 1.0±0.2Vrms, 1.0MHz±10%            |  |
|                                    | Cap>1000pF,  | 1.0±0.2Vrms, 1.0kHz±10%            |  |
| Insulation resistance              | ≥100GΩ or R•C≥ 500Ω•F<br>whichever is smaller  |                                    | ≥10GΩ or R•C≥100Ω•F<br>whichever is smaller  |
| Operating temperature              | -55 to +125°C  |                                    |  |
| Temperature coefficient            | ±30ppm / °C  |                                    | ±15%   |
| Termination                        | Ag (or Cu)/Ni/Sn (lead-free termination)   |                                    |  |

# 7. CAPACITANCE RANGE (Con.)

## 7.1 C0G(NPO)

| Dimension |      | 0805 |     |     | 1206 |     |     | 1210 |     |     | 1808 |     |     | 1812 |     |     | 1825 |     |     | 2220 |     |     | 2225 |  |  |
|-----------|------|------|-----|-----|------|-----|-----|------|-----|-----|------|-----|-----|------|-----|-----|------|-----|-----|------|-----|-----|------|--|--|
| Cap(pF)   | code | 1KV  | 1KV | 2KV | 1KV  | 2KV | 3KV | 1KV  | 2KV | 3KV | 1KV  | 2KV | 3KV | 1KV  | 2KV | 3KV | 1KV  | 2KV | 3KV | 1KV  | 2KV | 3KV |      |  |  |
| 0.5       | 0R5  | X    |     |     |      |     |     |      |     |     |      |     |     |      |     |     |      |     |     |      |     |     |      |  |  |
| 1.0       | 1R0  | X    |     |     |      |     |     |      |     |     |      |     |     |      |     |     |      |     |     |      |     |     |      |  |  |
| 1.5       | 1R5  | X    | X   | X   |      |     |     |      |     |     |      |     |     |      |     |     |      |     |     |      |     |     |      |  |  |
| 1.8       | 1R8  | X    | X   | X   |      |     |     |      |     |     |      |     |     |      |     |     |      |     |     |      |     |     |      |  |  |
| 2.2       | 2R2  | X    | X   | X   |      |     |     | C    | C   | C   |      |     |     |      |     |     |      |     |     |      |     |     |      |  |  |
| 2.7       | 2R7  | X    | X   | X   |      |     |     | C    | C   | C   |      |     |     |      |     |     |      |     |     |      |     |     |      |  |  |
| 3.3       | 3R3  | X    | X   | X   |      |     |     | C    | C   | C   |      |     |     |      |     |     |      |     |     |      |     |     |      |  |  |
| 3.9       | 3R9  | X    | X   | X   |      |     |     | C    | C   | C   |      |     |     |      |     |     |      |     |     |      |     |     |      |  |  |
| 4.7       | 4R7  | X    | X   | X   |      |     |     | C    | C   | C   |      |     |     |      |     |     |      |     |     |      |     |     |      |  |  |
| 5.6       | 5R6  | X    | X   | X   |      |     |     | C    | C   | C   |      |     |     |      |     |     |      |     |     |      |     |     |      |  |  |
| 6.8       | 6R8  | X    | X   | X   |      |     |     | C    | C   | C   |      |     |     |      |     |     |      |     |     |      |     |     |      |  |  |
| 8.2       | 8R2  | X    | X   | X   |      |     |     | C    | C   | C   |      |     |     |      |     |     |      |     |     |      |     |     |      |  |  |
| 10        | 100  | X    | X   | X   | M    | M   | F   | C    | C   | C   | C    | C   | C   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 12        | 120  | X    | X   | X   | M    | M   | F   | C    | C   | C   | C    | C   | C   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 15        | 150  | X    | X   | X   | M    | M   | F   | C    | C   | C   | C    | C   | C   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 18        | 180  | X    | X   | X   | M    | M   | F   | C    | C   | C   | C    | C   | C   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 22        | 220  | X    | X   | X   | M    | M   | F   | C    | C   | C   | C    | C   | C   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 27        | 270  | X    | X   | X   | M    | M   | F   | C    | C   | C   | C    | C   | C   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 33        | 330  | X    | X   | M   | M    | M   | F   | C    | C   | C   | C    | C   | C   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 39        | 390  | X    | X   | M   | M    | M   | F   | C    | C   | C   | C    | C   | C   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 47        | 470  | X    | M   | C   | M    | M   | F   | C    | C   | C   | C    | C   | C   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 56        | 560  | X    | M   | C   | M    | C   | F   | C    | C   | C   | C    | C   | C   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 68        | 680  | X    | M   | C   | M    | C   | F   | C    | C   | C   | C    | C   | C   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 82        | 820  | X    | C   | C   | M    | C   | F   | C    | C   | C   | C    | C   | C   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 100       | 101  | X    | C   | C   | C    | C   | F   | C    | C   | F   | C    | C   | C   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 120       | 121  |      | C   | E   | C    | C   | F   | C    | C   | F   | C    | C   | C   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 150       | 151  |      | C   | E   | C    | E   | F   | C    | F   | F   | C    | C   | C   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 180       | 181  |      | E   | E   | C    | E   | F   | C    | F   | F   | C    | C   | F   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 220       | 221  |      | E   | E   | E    | E   | F   | C    | F   | F   | C    | C   | F   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 270       | 271  |      | E   | E   | E    | E   | G   | F    | F   | F   | C    | F   | F   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 330       | 331  |      | E   | E   | E    | E   |     | F    | F   | F   | C    | F   | F   | F    | F   | F   | F    | F   | F   | G    | F   | F   | F    |  |  |
| 390       | 391  |      | E   | E   | E    | E   |     | F    | F   | F   | C    | F   | F   | F    | F   | F   | F    | F   | F   | G    | F   | F   | F    |  |  |
| 470       | 471  |      | E   | E   | E    | E   |     | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    | F   | F   | G    | F   | F   | F    |  |  |
| 560       | 561  |      | E   |     | E    | E   |     | F    | F   | F   | F    | F   | G   | F    | F   | F   | F    | F   | G   | F    | F   | F   | F    |  |  |
| 680       | 681  |      | E   |     | E    | E   |     | F    | F   |     | F    | F   | G   | F    | F   | G   | F    | F   | G   | F    | F   | F   | F    |  |  |
| 820       | 821  |      | E   |     | E    | E   |     | F    | F   |     | F    | F   | G   | F    | F   | G   | F    | F   | G   | F    | F   | G   | G    |  |  |
| 1000      | 102  |      | E   |     | E    | F   |     | F    | F   |     | F    | F   | G   | F    | F   | G   | F    | F   | G   | F    | G   | G   | G    |  |  |
| 1200      | 122  |      | E   |     | E    | F   |     | F    | F   |     | F    | F   |     | F    | F   | G   | G    | G   | G   | F    | G   | G   | G    |  |  |
| 1500      | 152  |      | E   |     | F    | G   |     | F    | F   |     | F    | F   |     | F    | G   | G   | G    | G   | G   | F    | G   | G   | G    |  |  |
| 1800      | 182  |      |     |     | G    |     |     | F    | F   |     | F    | G   |     | F    | G   | G   | G    | G   | G   | F    | G   | G   | G    |  |  |
| 2200      | 222  |      |     |     | G    |     |     | F    |     |     | F    | G   |     | F    | G   | G   | G    | G   | G   | F    | G   | G   | G    |  |  |
| 2700      | 272  |      |     |     |      |     |     | F    |     |     | F    | G   |     | F    | G   | G   | G    | G   | G   | F    | G   | G   | G    |  |  |
| 3300      | 332  |      |     |     |      |     |     |      |     |     | F    |     |     | F    | G   |     | G    | G   |     | F    | G   | G   | G    |  |  |
| 3900      | 392  |      |     |     |      |     |     |      |     |     | G    |     |     | G    | G   |     | G    | G   |     | F    | G   |     |      |  |  |
| 4700      | 472  |      |     |     |      |     |     |      |     |     |      |     |     | G    | G   |     | G    | G   |     | F    | G   |     |      |  |  |
| 5600      | 562  |      |     |     |      |     |     |      |     |     |      |     |     | G    | G   |     | G    | G   |     | G    | G   |     |      |  |  |
| 6800      | 682  |      |     |     |      |     |     |      |     |     |      |     |     | G    | G   |     | G    | G   |     | G    | G   |     |      |  |  |
| 8200      | 822  |      |     |     |      |     |     |      |     |     |      |     |     | G    |     |     | G    |     |     | G    | G   |     |      |  |  |
| 10000     | 103  |      |     |     |      |     |     |      |     |     |      |     |     | G    |     |     |      |     |     | G    | G   |     |      |  |  |
| 12000     | 123  |      |     |     |      |     |     |      |     |     |      |     |     |      |     |     |      |     |     | G    |     |     |      |  |  |

## 7. CAPACITANCE RANGE(Con.)

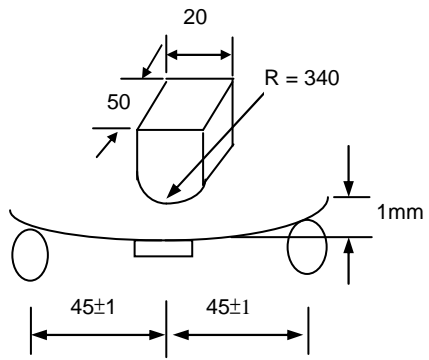
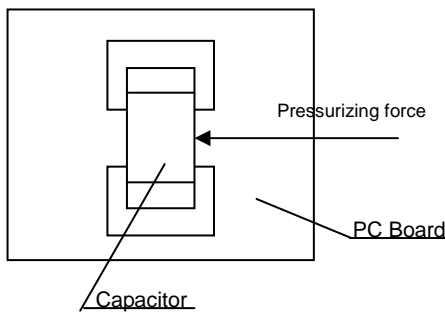
### 7.2 X7R

| Dimension |      | 0805 |     |     | 1206 |     |     | 1210 |     | 1808 |     |     | 1812 |     |     | 1825 |     |     | 2220 |     |     | 2225 |  |  |
|-----------|------|------|-----|-----|------|-----|-----|------|-----|------|-----|-----|------|-----|-----|------|-----|-----|------|-----|-----|------|--|--|
| Cap(pF)   | code | 1KV  | 1KV | 2KV | 1KV  | 2KV | 1KV | 2KV  | 3KV | 1KV  | 2KV | 3KV | 1KV  | 2KV | 3KV | 1KV  | 2KV | 3KV | 1KV  | 2KV | 3KV |      |  |  |
| 100       | 101  | X    | C   | C   |      |     |     |      |     |      |     |     |      |     |     |      |     |     |      |     |     |      |  |  |
| 120       | 121  | X    | C   | C   |      |     |     |      |     |      |     |     |      |     |     |      |     |     |      |     |     |      |  |  |
| 150       | 151  | X    | C   | C   |      |     | C   | C    | C   |      |     |     |      |     |     |      |     |     |      |     |     |      |  |  |
| 180       | 181  | X    | C   | C   |      |     | C   | C    | C   |      |     |     |      |     |     |      |     |     |      |     |     |      |  |  |
| 220       | 221  | X    | C/X | C/X | C    | F/E | C   | C    | C   |      |     |     |      |     |     |      |     |     |      |     |     |      |  |  |
| 270       | 271  | X    | C   | C   | C    | F/E | C   | C    | C   | C    | C   | E   |      |     |     |      |     |     |      |     |     |      |  |  |
| 330       | 331  | X    | C   | C   | C    | F/E | C   | C    | F   | C    | C   | E   |      |     |     |      |     |     |      |     |     |      |  |  |
| 390       | 391  | X    | C   | C   | C    | F/E | C   | C    | F   | C    | C   | E   |      |     |     |      |     |     |      |     |     |      |  |  |
| 470       | 471  | X    | C   | C   | C    | F/E | C   | C    | F   | C    | C   | E   |      |     |     |      |     |     |      |     |     |      |  |  |
| 560       | 561  | X    | C   | C   | C    | F/E | C   | C    | F   | C    | C   | E   |      |     |     |      |     |     |      |     |     |      |  |  |
| 680       | 681  | X    | C   | C   | C    | F/E | C   | C    | F   | C    | C   | F   |      |     |     |      |     |     |      |     |     |      |  |  |
| 820       | 821  | X    | C   | C/E | C    | F/E | C   | C    | F   | C    | C   | F   |      |     |     |      |     |     |      |     |     |      |  |  |
| 1000      | 102  | X    | C   | C/E | C    | F/E | C   | F/C  | F   | C    | C   | F   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 1200      | 122  | C    | C   | E   | C    | F   | C   | F    | F   | C    | C   | F   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 1500      | 152  | C    | C   | E   | C    | F   | C   | F    | F   | C    | C   | F   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 1800      | 182  | C    | C   | E   | C    | F   | C   | F    | F   | C    | C/E | G   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 2200      | 222  | C    | C   | E   | C    | F   | C   | F    | F   | C    | C/E | G   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 2700      | 272  |      | C/E |     | C    | F   | C   | F    |     | C    | C/E | G   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 3300      | 332  |      | C/E |     | C    | F   | C   | F    |     | C    | F   | G   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 3900      | 392  |      | C/E |     | E    | F   | C   | F    |     | C    | F   | G   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 4700      | 472  |      | C   |     | E    | F   | C   | F    |     | C    | F   | G   | F    | F   | F   | F    | F   | F   | F    | F   | F   | F    |  |  |
| 5600      | 562  |      | C   |     | E    | G   | C   | F    |     | C    | G   |     | F    | F   | G   | F    | F   | F   | F    | F   | F   | G    |  |  |
| 6800      | 682  |      | C   |     | E    |     | E/F |      |     | C    | G   |     | F    | F   | G   | F    | F   | G   | F    | F   | F   | G    |  |  |
| 8200      | 822  |      | C   |     | E    |     | E/F |      |     | C    | G   |     | F    | F   | G   | F    | G   | G   | F    | F   | F   | G    |  |  |
| 10000     | 103  |      | C   |     | E    |     | E/F |      |     | C/E  | G   |     | F    | F   | G   | F    | G   | G   | F    | F   | F   | G    |  |  |
| 12000     | 123  |      | E   |     | E    |     | F   |      |     | F    |     |     | F    | G   | G   | F    | G   | G   | F    | G   | G   |      |  |  |
| 15000     | 153  |      | E   |     | E    |     | F   |      |     | F    |     |     | F    | G   |     | F    | G   |     | F    | G   | G   |      |  |  |
| 18000     | 183  |      | E   |     | E    |     | F   |      |     | G    |     |     | F    | G   |     | F    | G   |     | F    | G   |     |      |  |  |
| 22000     | 223  |      | E   |     | E    |     | F   |      |     | G    |     |     | F    | G   |     | F    | G   |     | F    | G   |     |      |  |  |
| 27000     | 273  |      |     |     | E    |     | F   |      |     | G    |     |     | F    | G   |     | F    | G   |     | F    | G   |     |      |  |  |
| 33000     | 333  |      |     |     | E    |     |     |      |     | G    |     |     | F    |     |     | F    |     |     | F    | G   |     |      |  |  |
| 39000     | 393  |      |     |     |      |     |     |      |     | G    |     |     | F    |     |     | F    |     |     | F    |     |     |      |  |  |
| 47000     | 473  |      |     |     |      |     |     |      |     | G    |     |     | F    |     |     | F    |     |     | F    |     |     |      |  |  |
| 56000     | 563  |      |     |     |      |     |     |      |     | G    |     |     | F    |     |     | F    |     |     | F    |     |     |      |  |  |
| 68000     | 683  |      |     |     |      |     |     |      |     |      |     |     | F    |     |     | G    |     |     | F    |     |     |      |  |  |
| 82000     | 823  |      |     |     |      |     |     |      |     |      |     |     | G    |     |     | G    |     |     | F    |     |     |      |  |  |
| 100000    | 104  |      |     |     |      |     |     |      |     |      |     |     | G    |     |     | G    |     |     | G    |     |     |      |  |  |
| 120000    | 124  |      |     |     |      |     |     |      |     |      |     |     |      |     |     | G    |     |     | G    |     |     |      |  |  |
| 150000    | 154  |      |     |     |      |     |     |      |     |      |     |     |      |     |     |      |     |     | G    |     |     |      |  |  |

# 8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

| No.                       | Item   | Test Condition  | Requirements   |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
|---------------------------|--|---|--|----------------|---------------------------|-----------------------------|--|-----------------------------|--|--|---|---------------|----------------------------|--|--|--|--|--|--------------------|-----|------------|-------|--------------|-------------------------------------|--|--|---------------|-------------------|---|
| 1.                        | Visual and Mechanical  | ---   | <ul style="list-style-type: none"> <li>* No remarkable defect.</li> <li>* Dimensions to conform to individual specification sheet.</li> </ul>  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| 2.                        | Capacitance  | Class I: (C0G)  | * Shall not exceed the limits given in the detailed spec.  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| 3.                        | Q/ D.F.<br>(Dissipation Factor)  | Cap $\leq$ 1000pF, 1.0 $\pm$ 0.2Vrms, 1MHz $\pm$ 10%<br>Cap $>$ 1000pF, 1.0 $\pm$ 0.2Vrms, 1KHz $\pm$ 10%<br>Class II: (X7R)<br>1.0 $\pm$ 0.2Vrms, 1KHz $\pm$ 10%   | <table border="1"> <thead> <tr> <th>Dielectric</th> <th>Rated vol.(V)</th> <th>Q/D.F.</th> <th>Remark</th> </tr> </thead> <tbody> <tr> <td>Class I(NPO)</td> <td><math>\geq 50</math></td> <td>Q<math>\geq</math>1000<br/>Q<math>\geq</math>400+20C</td> <td>Cap<math>\geq</math>30pF<br/>Cap<math>&lt;</math>30pF</td> </tr> <tr> <td>Class II(X7R)</td> <td><math>\geq 50</math></td> <td>D.F. <math>&lt;</math> 2.5%</td> <td></td> </tr> </tbody> </table>   | Dielectric     | Rated vol.(V)             | Q/D.F.                      | Remark   | Class I(NPO)                | $\geq 50$  | Q $\geq$ 1000<br>Q $\geq$ 400+20C                      | Cap $\geq$ 30pF<br>Cap $<$ 30pF                             | Class II(X7R) | $\geq 50$                  | D.F. $<$ 2.5%  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| Dielectric                | Rated vol.(V)  | Q/D.F.  | Remark   |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| Class I(NPO)              | $\geq 50$  | Q $\geq$ 1000<br>Q $\geq$ 400+20C   | Cap $\geq$ 30pF<br>Cap $<$ 30pF  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| Class II(X7R)             | $\geq 50$  | D.F. $<$ 2.5%   |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| 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>C0G</td> <td>-55~125°C at 25°C</td> </tr> <tr> <td>X7R</td> <td>-55~125°C at 25°C</td> </tr> </tbody> </table>  | T.C.   | Operating Temp | C0G                       | -55~125°C at 25°C           | X7R  | -55~125°C at 25°C           | <table border="1"> <thead> <tr> <th>T.C.</th> <th>Capacitance Change</th> </tr> </thead> <tbody> <tr> <td>C0G</td> <td>Within <math>\pm</math>30ppm/°C</td> </tr> <tr> <td>X7R</td> <td>Within <math>\pm</math>15%</td> </tr> </tbody> </table>  | T.C.   | Capacitance Change  | C0G           | Within $\pm$ 30ppm/°C      | X7R  | Within $\pm$ 15%   |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| T.C.                      | Operating Temp   |   |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| C0G                       | -55~125°C at 25°C  |   |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| X7R                       | -55~125°C at 25°C  |   |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| T.C.                      | Capacitance Change   |   |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| C0G                       | Within $\pm$ 30ppm/°C  |   |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| X7R                       | Within $\pm$ 15%   |   |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| 5.                        | Insulation Resistance  | To apply voltage at 500VDC for 60 sec.  | <table border="1"> <thead> <tr> <th>Dielectric</th> <th>Requirements</th> </tr> </thead> <tbody> <tr> <td>Class I(NPO)</td> <td><math>\geq</math>100G<math>\Omega</math> or Rx<math>C \geq</math> 500<math>\Omega</math>-F whichever is smaller</td> </tr> <tr> <td>Class II(X7R)</td> <td><math>\geq</math>10G<math>\Omega</math> or Rx<math>C \geq</math> 100<math>\Omega</math>-F whichever is smaller.</td> </tr> </tbody> </table>  | Dielectric     | Requirements              | Class I(NPO)                | $\geq$ 100G $\Omega$ or Rx $C \geq$ 500 $\Omega$ -F whichever is smaller | Class II(X7R)               | $\geq$ 10G $\Omega$ or Rx $C \geq$ 100 $\Omega$ -F whichever is smaller.   |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| Dielectric                | Requirements   |   |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| Class I(NPO)              | $\geq$ 100G $\Omega$ or Rx $C \geq$ 500 $\Omega$ -F whichever is smaller |   |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| Class II(X7R)             | $\geq$ 10G $\Omega$ or Rx $C \geq$ 100 $\Omega$ -F whichever is smaller. |   |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| 6.                        | Dielectric Strength  | <table border="1"> <thead> <tr> <th>Rated vol.(V)</th> <th>Condition</th> </tr> </thead> <tbody> <tr> <td>1000 <math>\leq</math> V <math>\leq</math> 3000</td> <td>1.2 times of U<sub>R</sub></td> </tr> <tr> <td>4000 <math>\leq</math> V <math>\leq</math> 5000</td> <td>1.1 times of U<sub>R</sub></td> </tr> <tr> <td><math>&gt;</math> 5000</td> <td>1.0 times of U<sub>R</sub></td> </tr> </tbody> </table> Duration: 1 to 5 sec.   | Rated vol.(V)  | Condition      | 1000 $\leq$ V $\leq$ 3000 | 1.2 times of U <sub>R</sub> | 4000 $\leq$ V $\leq$ 5000  | 1.1 times of U <sub>R</sub> | $>$ 5000   | 1.0 times of U <sub>R</sub>                            | * No evidence of damage or flashover during test.           |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| Rated vol.(V)             | Condition  |   |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| 1000 $\leq$ V $\leq$ 3000 | 1.2 times of U <sub>R</sub>  |   |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| 4000 $\leq$ V $\leq$ 5000 | 1.1 times of U <sub>R</sub>  |   |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| $>$ 5000                  | 1.0 times of U <sub>R</sub>  |   |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| 7.                        | Solderability  | <ul style="list-style-type: none"> <li>* Solder temperature: 235<math>\pm</math>5°C for (1206~1210)</li> <li>* Solder temperature: 245<math>\pm</math>5°C for (1808~2225)</li> <li>* Dipping time: 2<math>\pm</math>0.5 sec.</li> </ul>   | 75% min. coverage of all metalized area.   |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| 8.                        | Resistance to Soldering Heat   | <ul style="list-style-type: none"> <li>* Solder temperature: 260<math>\pm</math>5°C</li> <li>* Dipping time: 10<math>\pm</math>1 sec</li> <li>* Preheating: 120 to 150°C for 1 minute before immerse the capacitor in a eutectic solder.</li> <li>* Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 48<math>\pm</math>4 hrs at room temp.</li> <li>* Measurement to be made after keeping at room temp. for 24<math>\pm</math>2 hrs (Class I) or 48<math>\pm</math>4 hrs (Class II).</li> </ul>   | <ul style="list-style-type: none"> <li>* No remarkable damage.</li> </ul> <table border="1"> <thead> <tr> <th>Dielectric</th> <th>I.R</th> <th>Cap Change</th> <th>Q/D.F</th> </tr> </thead> <tbody> <tr> <td>Class I(NPO)</td> <td><math>\geq 1G\Omega</math></td> <td>Within <math>\pm</math>2.5% or <math>\pm</math>0.25pF whichever is larger.</td> <td><math>\leq 1.0 \times</math> Initial requirement</td> </tr> <tr> <td>Class II(X7R)</td> <td><math>\geq 1G\Omega</math></td> <td>within <math>\pm</math>7.5%</td> <td></td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>* 25% max. leaching on each edge.</li> </ul>   | Dielectric     | I.R                       | Cap Change                  | Q/D.F  | Class I(NPO)                | $\geq 1G\Omega$  | Within $\pm$ 2.5% or $\pm$ 0.25pF whichever is larger. | $\leq 1.0 \times$ Initial requirement                       | Class II(X7R) | $\geq 1G\Omega$            | within $\pm$ 7.5%                                      |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| Dielectric                | I.R  | Cap Change  | Q/D.F  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| Class I(NPO)              | $\geq 1G\Omega$  | Within $\pm$ 2.5% or $\pm$ 0.25pF whichever is larger.  | $\leq 1.0 \times$ Initial requirement  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| Class II(X7R)             | $\geq 1G\Omega$  | within $\pm$ 7.5%   |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| 9.                        | Temperature Cycle  | Conduct the five cycles according to the temperatures and time.<br><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<math>\pm</math>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<math>\pm</math>3</td> </tr> <tr> <td>4</td> <td>Room temp.</td> <td>2~3</td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>* Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 48<math>\pm</math>4 hrs at room temp.</li> <li>* Measurement to be made after keeping at room temp. for 24<math>\pm</math>2 hrs (Class I) or 48<math>\pm</math>4 hrs (Class II).</li> </ul> | Step   | Temp. (°C)     | Time (min.)               | 1                           | Min. operating temp. +0/-3   | 30 $\pm$ 3                  | 2  | Room temp.   | 2~3   | 3             | Max. operating temp. +3/-0 | 30 $\pm$ 3   | 4  | Room temp.   | 2~3                                      | <ul style="list-style-type: none"> <li>* No remarkable damage.</li> </ul> <table border="1"> <thead> <tr> <th>Dielectric</th> <th>I.R</th> <th>Cap Change</th> <th>Q/D.F</th> </tr> </thead> <tbody> <tr> <td>Class I(NPO)</td> <td rowspan="2">0.25 <math>\times</math> initial requirements.</td> <td>Within <math>\pm</math>2.5% or <math>\pm</math>0.25pF whichever is larger.</td> <td><math>\leq 1.0(Q) \times</math> Initial requirement</td> </tr> <tr> <td>Class II(X7R)</td> <td>within <math>\pm</math>7.5%</td> <td><math>\leq 1.5(D.F.) \times</math> Initial requirement</td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>* I.R. <math>\geq 0.25 \times</math> initial requirements.</li> </ul> | Dielectric         | I.R | Cap Change | Q/D.F | Class I(NPO) | 0.25 $\times$ initial requirements. | Within $\pm$ 2.5% or $\pm$ 0.25pF whichever is larger. | $\leq 1.0(Q) \times$ Initial requirement | Class II(X7R) | within $\pm$ 7.5% | $\leq 1.5(D.F.) \times$ Initial requirement |
| Step                      | Temp. (°C)   | Time (min.)   |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| 1                         | Min. operating temp. +0/-3   | 30 $\pm$ 3  |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| 2                         | Room temp.   | 2~3   |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| 3                         | Max. operating temp. +3/-0   | 30 $\pm$ 3  |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| 4                         | Room temp.   | 2~3   |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| Dielectric                | I.R  | Cap Change  | Q/D.F  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| Class I(NPO)              | 0.25 $\times$ initial requirements.                                      | Within $\pm$ 2.5% or $\pm$ 0.25pF whichever is larger.  | $\leq 1.0(Q) \times$ Initial requirement   |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| Class II(X7R)             |  | within $\pm$ 7.5%   | $\leq 1.5(D.F.) \times$ Initial requirement  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| 10.                       | Humidity (Damp Heat) Steady State  | <ul style="list-style-type: none"> <li>* Test temp.: 40<math>\pm</math>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 24<math>\pm</math>2 hrs (Class I) or 48<math>\pm</math>4 hrs (Class II).</li> </ul>   | <ul style="list-style-type: none"> <li>* No remarkable damage.</li> </ul> <table border="1"> <thead> <tr> <th>Dielectric</th> <th>I.R</th> <th>Cap Change</th> <th>Q/D.F</th> </tr> </thead> <tbody> <tr> <td>Class I(NPO)</td> <td rowspan="2"><math>\geq 1G\Omega</math> or Rx<math>C \geq 25\Omega</math>-F whichever is smaller.</td> <td>within <math>\pm</math>3.0% or <math>\pm</math>2pF whichever is larger</td> <td>Cap <math>\geq</math>30pF<br/>10pF <math>\leq</math> Cap <math>&lt;</math> 30pF<br/>Cap <math>&lt;</math> 10pF</td> </tr> <tr> <td>Class II(X7R)</td> <td>within <math>\pm</math>15%</td> <td>Q<math>\geq</math>350;<br/>Q<math>\geq</math>275+2.5C<br/>Q<math>\geq</math>200+10C</td> </tr> <tr> <td colspan="3"></td> <td>D.F. <math>\leq 2 \times</math> Initial requirement</td> </tr> </tbody> </table> | Dielectric     | I.R                       | Cap Change                  | Q/D.F  | Class I(NPO)                | $\geq 1G\Omega$ or Rx $C \geq 25\Omega$ -F whichever is smaller.   | within $\pm$ 3.0% or $\pm$ 2pF whichever is larger     | Cap $\geq$ 30pF<br>10pF $\leq$ Cap $<$ 30pF<br>Cap $<$ 10pF | Class II(X7R) | within $\pm$ 15%           | Q $\geq$ 350;<br>Q $\geq$ 275+2.5C<br>Q $\geq$ 200+10C |  |  |  | D.F. $\leq 2 \times$ Initial requirement   |                    |     |            |       |              |                                     |  |  |               |                   |   |
| Dielectric                | I.R  | Cap Change  | Q/D.F  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| Class I(NPO)              | $\geq 1G\Omega$ or Rx $C \geq 25\Omega$ -F whichever is smaller.         | within $\pm$ 3.0% or $\pm$ 2pF whichever is larger  | Cap $\geq$ 30pF<br>10pF $\leq$ Cap $<$ 30pF<br>Cap $<$ 10pF  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| Class II(X7R)             |  | within $\pm$ 15%  | Q $\geq$ 350;<br>Q $\geq$ 275+2.5C<br>Q $\geq$ 200+10C   |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
|                           |  |   | D.F. $\leq 2 \times$ Initial requirement   |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| 11.                       | High Temperature Load (Endurance)  | <ul style="list-style-type: none"> <li>* Test temp.: 125<math>\pm</math>3°C</li> </ul> <table border="1"> <thead> <tr> <th>Rated vol.(V)</th> <th>Apply Voltage</th> </tr> </thead> <tbody> <tr> <td>1000 <math>\leq</math> V <math>\leq</math> 5000</td> <td>1.1 times of U<sub>R</sub></td> </tr> <tr> <td><math>&gt;</math> 5000</td> <td>1.0 times of U<sub>R</sub></td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>* Test time: 1000+24/-0 hrs.</li> <li>* Measurement to be made after keeping at room temp. for 24<math>\pm</math>2 hrs (Class I) or 48<math>\pm</math>4 hrs (Class II).</li> </ul>  | Rated vol.(V)  | Apply Voltage  | 1000 $\leq$ V $\leq$ 5000 | 1.1 times of U <sub>R</sub> | $>$ 5000   | 1.0 times of U <sub>R</sub> | <ul style="list-style-type: none"> <li>* No remarkable damage.</li> </ul> <table border="1"> <thead> <tr> <th>Dielectric</th> <th>I.R</th> <th>Cap Change</th> <th>Q/D.F</th> </tr> </thead> <tbody> <tr> <td>Class I(NPO)</td> <td rowspan="2"><math>\geq 1G\Omega</math> or Rx<math>C \geq 50\Omega</math>-F whichever is smaller.</td> <td>within <math>\pm</math>3.0% or <math>\pm</math>2pF whichever is larger</td> <td>D.F. <math>\leq 2 \times</math> Initial requirement</td> </tr> <tr> <td>Class II(X7R)</td> <td>within <math>\pm</math>12.5%</td> <td></td> </tr> </tbody> </table> | Dielectric   | I.R   | Cap Change    | Q/D.F                      | Class I(NPO)   | $\geq 1G\Omega$ or Rx $C \geq 50\Omega$ -F whichever is smaller. | within $\pm$ 3.0% or $\pm$ 2pF whichever is larger | D.F. $\leq 2 \times$ Initial requirement | Class II(X7R)  | within $\pm$ 12.5% |     |            |       |              |                                     |  |  |               |                   |   |
| Rated vol.(V)             | Apply Voltage  |   |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| 1000 $\leq$ V $\leq$ 5000 | 1.1 times of U <sub>R</sub>  |   |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| $>$ 5000                  | 1.0 times of U <sub>R</sub>  |   |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| Dielectric                | I.R  | Cap Change  | Q/D.F  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| Class I(NPO)              | $\geq 1G\Omega$ or Rx $C \geq 50\Omega$ -F whichever is smaller.         | within $\pm$ 3.0% or $\pm$ 2pF whichever is larger  | D.F. $\leq 2 \times$ Initial requirement   |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |
| Class II(X7R)             |  | within $\pm$ 12.5%  |  |                |                           |                             |  |                             |  |  |   |               |                            |  |  |  |  |  |                    |     |            |       |              |                                     |  |  |               |                   |   |

## 8.RELIABILITY TEST CONDITIONS AND REQUIREMENTS(Cont.)

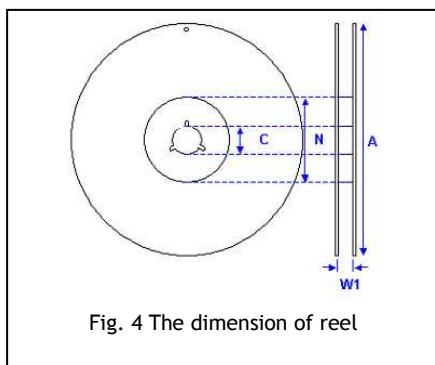
| No.           | Item   | Test Condition  | Requirements   |            |            |              |  |               |                     |
|---------------|--|---|--|------------|------------|--------------|--|---------------|---------------------|
| 12.           | <b>Resistance to Flexure of Substrate</b>                  | <p>* The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1 mm per second until the deflection becomes 1 mm.</p>                                    | <p>* No remarkable damage.</p> <table border="1" data-bbox="805 235 1396 347"> <thead> <tr> <th>Dielectric</th> <th>Cap Change</th> </tr> </thead> <tbody> <tr> <td>Class I(NPO)</td> <td>within <math>\pm 3.0\%</math> or <math>\pm 2\text{pF}</math> whichever is larger</td> </tr> <tr> <td>Class II(X7R)</td> <td>within <math>\pm 12.5\%</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 I(NPO) | within $\pm 3.0\%$ or $\pm 2\text{pF}$ whichever is larger | Class II(X7R) | within $\pm 12.5\%$ |
| Dielectric    | Cap Change   |   |  |            |            |              |  |               |                     |
| Class I(NPO)  | within $\pm 3.0\%$ or $\pm 2\text{pF}$ whichever is larger |   |  |            |            |              |  |               |                     |
| Class II(X7R) | within $\pm 12.5\%$  |   |  |            |            |              |  |               |                     |
| 13.           | <b>Adhesive Strength of Termination</b>                    | <p>* Capacitors mounted on a substrate. A force of 10N applied perpendicular to the place of substrate and parallel the line joining the center of terminations for <math>10 \pm 1</math> sec.</p>  | <p>* No remarkable damage or removal of the terminations.</p>  |            |            |              |  |               |                     |



## 9. PACKAGE DIMENSION AND QUANTITY

| Size        | Thickness (mm) | Paper tape |          | Plastic tape |          |
|-------------|----------------|------------|----------|--------------|----------|
|             |                | 7" reel    | 13" reel | 7" reel      | 13" reel |
| 0805 (2012) | 0.80±0.10      | 4K         | 15k      | -            | -        |
|             | 1.25±0.10      | -          | -        | 3k           | 10k      |
| 1206 (3216) | 0.80±0.10      | 4k         | 15k      | -            | -        |
|             | 0.95±0.10      | -          | -        | 3k           | 10k      |
|             | 1.25±0.10      | -          | -        | 3k           | 10k      |
| 1210 (3225) | 1.60±0.20      | -          | -        | 2k           | -        |
|             | 0.95±0.10      | -          | -        | 3k           | 10k      |
|             | 1.25±0.10      | -          | -        | 3k           | 10k      |
|             | 1.60±0.20      | -          | -        | 2k           | -        |
|             | 2.00±0.20      | -          | -        | 1k           | -        |
| 1808 (4520) | 2.50±0.30      | -          | -        | 1k           | -        |
|             | 1.25±0.10      | -          | -        | 2k           | -        |
|             | 1.40±0.15      | -          | -        | 2k           | -        |
|             | 1.60±0.20      | -          | -        | 2k           | -        |
| 1812 (4532) | 2.00±0.20      | -          | -        | 1k           | -        |
|             | 1.25±0.10      | -          | -        | 1k           | -        |
|             | 1.60±0.20      | -          | -        | 1k           | -        |
|             | 2.50±0.30      | -          | -        | 0.5k         | 3k       |
| 1825 (4563) | 2.00±0.20      | -          | -        | 1k           | -        |
|             | 1.60±0.20      | -          | -        | 1k           | -        |
|             | 2.50±0.30      | -          | -        | 0.5k         | -        |
| 2211 (5728) | 2.50±0.30      | -          | -        | 0.5k         | 3k       |
|             | 2.00±0.20      | -          | -        | 1k           | -        |
|             | 1.25±0.10      | -          | -        | 1k           | -        |
| 2220 (5750) | 1.60±0.20      | -          | -        | 1k           | -        |
|             | 2.50±0.30      | -          | -        | 0.5k         | -        |
|             | 2.00±0.20      | -          | -        | 1k           | -        |
| 2225 (5763) | 2.00±0.20      | -          | -        | 1k           | -        |
|             | 2.50±0.30      | -          | -        | 0.5k         | -        |

Unit: pieces



| Size                 | 0805,1206, 1210, 1812 |               |               | 1808, 1812, 1825, 2220, 2225 | 2211          |
|----------------------|-----------------------|---------------|---------------|------------------------------|---------------|
|                      | 7"                    | 10"           | 7"            | 7"                           | 7"            |
| <b>C</b>             | 13.0+0.5/-0.2         | 13.0+0.5/-0.2 | 13.0+0.5/-0.2 | 13.0+0.5/-0.2                | 13.0+0.5/-0.2 |
| <b>W<sub>1</sub></b> | 8.4+1.5/-0            | 8.4+1.5/-0    | 12.4+2.0/-0   | 12.4+2.0/-0                  | 12.4+2.0/-0   |
| <b>A</b>             | 178.0±0.10            | 250.0±1.0     | 178.0±0.10    | 178.0±0.10                   | 178.0±0.10    |
| <b>N</b>             | 60.5±1.0              | 100.0±1.0     | 80.0±1.0      | 60.5±1.0                     | 80.0±1.0      |

### 9-1. CARDBOARD TAPE DIMENSIONS

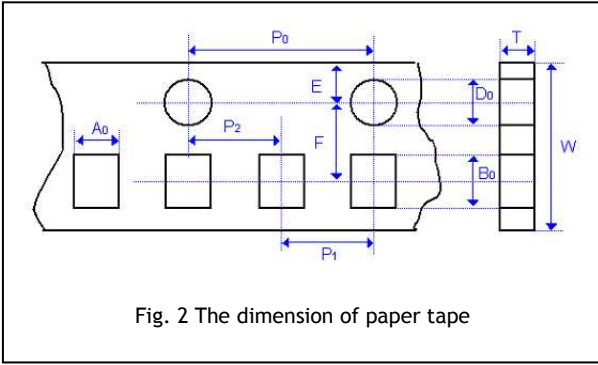


Fig. 2 The dimension of paper tape

### 9-2. EMBOSSED TAPE DIMENSIONS

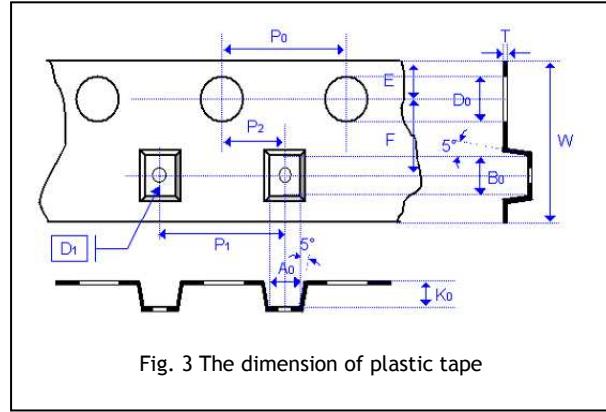


Fig. 3 The dimension of plastic tape

| Size              | 0805       |              | 1206      |                        |                            | 1210   |              | 1808                                |              |
|-------------------|------------|--------------|-----------|------------------------|----------------------------|--|--------------|-------------------------------------|--------------|
| Chip Thickness    | 0.80±0.10  | 1.25±0.10    | 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<br>2.00±0.20 | 2.50±0.30    | 1.25±0.10<br>1.40±0.15<br>1.60±0.20 | 2.00±0.20    |
| A <sub>0</sub>    | 1.50±0.10  | <1.65        | 2.00±0.10 | <2.00                  | <2.00                      | <3.05  | <3.10        | <2.50                               | <2.50        |
| B <sub>0</sub>    | 2.30±0.10  | <2.40        | 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    | 0.95±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                      | <2.50  | <3.50        | <2.50                               | <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  | 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±0.10              | 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   | 40.0±0.20 | 40.00±0.20             | 40.00±0.20                 | 40.00±0.20                                       | 40.0±0.20    | 40.0±0.20                           | 40.0±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                  | 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  | 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±0.05 | 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  | 1.00±0.10    | 1.50±0.10                           | 1.50±0.10    |
| E                 | 1.75±0.05  | 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±0.10                           | 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  | 3.50±0.05    | 5.50±0.05                           | 5.50±0.05    |

| Size              | 2211            |                 |                 | 1812            |                 | 1825            |                 | 2220                                |                 | 2225            |                 |
|-------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-------------------------------------|-----------------|-----------------|-----------------|
| Chip Thickness    | 1.60±0.20       | 2.00±0.20       | 2.50±0.20       | 2.00±0.20       | 2.50±0.30       | 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       | 2.00±0.20       | 2.50±0.30       |
| A <sub>0</sub>    | < 3.30          | < 3.30          | < 3.30          | <3.90           | <3.90           | <6.80           | <6.80           | <5.80                               | <5.80           | <6.80           | <6.80           |
| B <sub>0</sub>    | < 6.50          | < 6.50          | < 6.50          | <5.30           | <5.30           | <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       | 0.25±0.05       | 0.25±0.05       | 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           | <3.0            | <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       | 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       | 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      | 40.0±0.20       | 40.00±0.20      | 40.00±0.20      | 40.00±0.20      | 40.0±0.20                           | 40.0±0.20       | 40.0±0.20       | 40.0±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       | 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       | 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/-0.00 | 1.50+0.10/-0.00 | 1.50+0.10/-0.00 | 1.50+0.10/-0.00 | 1.50+0.10/-0.00 | 1.50+0.10/-0.00 | 1.50+0.10/-0.00 | 1.50+0.10/-0.00                     | 1.50+0.10/-0.00 | 1.50+0.10/-0.00 | 1.50+0.10/-0.00 |
| 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       | 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±0.1        | 1.75±0.1        | 1.75±0.10       | 1.75+/-0.1      | 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       | 5.50±0.05                           | 5.50±0.05       | 5.50±0.05       | 5.50±0.05       |

# 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 capacitors should be used within 6 months 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 4°C per second and the final preheat temperature should be within 100°C of the soldering temperature for small chips such as 0805,1206, within 50°C of the soldering temperature for bigger chips such as 1210, 1808, 1812, 1825, 2211, 2220 and 2225, etc.

## SOLDERING

Use middy 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.

Hand soldering with temperature-controlled iron not exceeding 30 watts and diameter of tip less than 1.2 mm is recommended, tip of iron should not contact the ceramic body directly, and the temperature of iron should be set to not more than 260°C.

For bigger chips such as 1210, 1808, 1812, 2211, 2220 and 2225, etc. wave soldering and hand soldering are no recommended.

Refer IPC/JEDEC J-STD-020D Method recommended soldering profiles :

Reflow not sooner than 15 minutes and not longer than 4 hrs after removal from the temperature/humidity chamber, subject the sample to 3 cycle of the appropriate reflow conditions as defined as blow Table description.

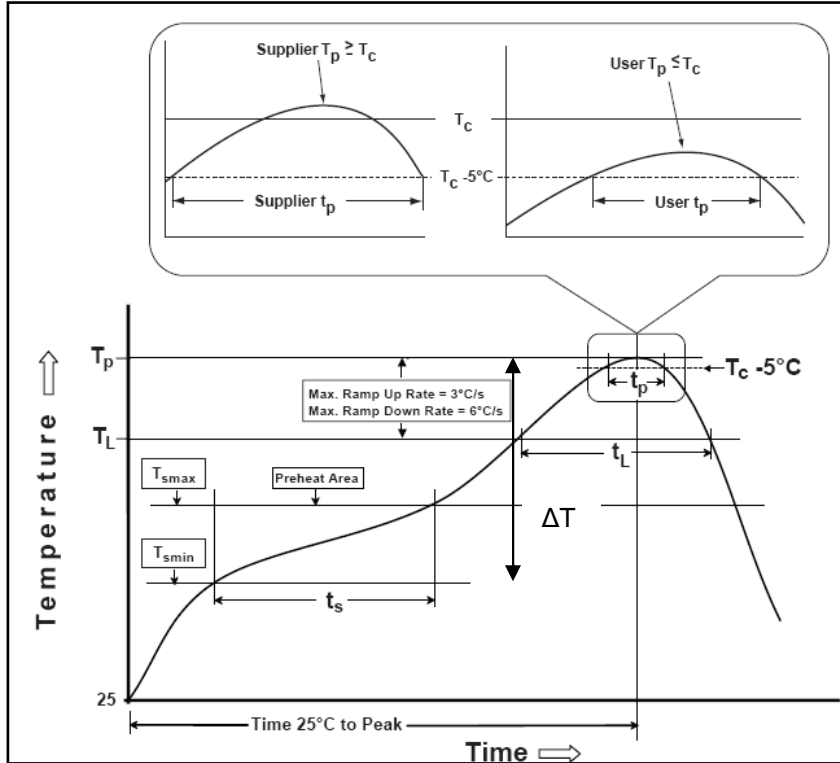
| Profile Feature  | Pb-Free Assembly   |
|--|--|
| Preheat/Soak   |  |
| Temperature Min.(T <sub>smin</sub> )   | 150°C  |
| Temperature Max.(T <sub>smax</sub> )   | 200°C  |
| Time(t <sub>s</sub> ) from (T <sub>smin</sub> to T <sub>smax</sub> )                           | 60 to 120 seconds  |
| Ramp-up rate(T <sub>L</sub> to T <sub>p</sub> )  | 3°C/second max.  |
| Liquidous temperature(T <sub>L</sub> )   | 217°C  |
| Time(t <sub>L</sub> ) maintained above T <sub>L</sub>  | 60 to 150 seconds  |
| Peak package body temperature(T <sub>p</sub> )   | For user T <sub>p</sub> must not exceed the Classification temp 260°C<br>For suppliers T <sub>p</sub> must equal or exceed the Classification temp 260°C |
| Time(T <sub>p</sub> )* within 5°C of the specified classification temperature(T <sub>c</sub> ) | 30* second   |
| Ramp-down rate (T <sub>p</sub> to T <sub>L</sub> )   | 6°C/second max.  |
| Time 25°C to peak temperature 260°C  | 8 minutes max.   |

Lead-free : Soldering temperature = 235 to 260°C, depending on product.

Maximum temperature = Minimum temperature (235°C)+ $\Delta T$ + Tolerance for oven process and measurement(5 ~ 7°C)

Time at peak temperature = 10sec, Dwell above 217°C = 90sec, Ramping rate = 3°C/sec(heating) and 6°C/sec(heating).

### Classification Reflow Profiles



| Chip Size                                | $\Delta T$ |
|--|------------|
| 0805, 1206                               | 100 °C     |
| 1210, 1808, 1812, 1825, 2211, 2220, 2225 | 50 °C      |

| Soldering | Solder Temp.(T <sub>c</sub> ) | Soldering Time (t <sub>p</sub> ) |
|-----------|-------------------------------|----------------------------------|
| Reflow    | 235 – 260 °C                  | < 15 sec.                        |

Note : For example , T<sub>c</sub> is 260°C and time t<sub>p</sub> is 15sec.

for user : The peak temperature must not exceed 260°C. The time above 255°C must not exceed 15 seconds.

## 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. A cooling rate not exceeding 4°C per second should be used when forced cooling is necessary.

## 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.

# 11.REFERENCE TABLE

| <u>FV</u>  | <u>21</u> | <u>X</u>   | <u>101</u>  | <u>K</u>  | <u>102</u>    | <u>P</u>  | <u>X</u>  | <u>G</u>     |
|------------|-----------|------------|-------------|-----------|---------------|-----------|-----------|--------------|
| PDC Family | Size      | Dielectric | Capacitance | Tolerance | Rated voltage | Packaging | Thickness | Control Code |
| Table1.    | Table2    | Table3     | Table4      | Table5    | Table6        | Table7    | Table8    | Table9       |

**Table 1 PDC family**

| Code | Description                                  | Code | Description  |
|------|--|------|--|
| FH   | Safety X2 & Y3 series                        | FN   | General Purpose Product  |
| FK   | Safety X1 & Y2 series                        | FP   | Anti-bend Series   |
| FL   | Low Dissipation Series                       | FS   | Rated voltage $\leq 250Vdc$<br>Capacitance $\geq 1.0 \mu F$ Series Product |
| FM   | $100V \leq$ Rated Voltage $\leq 630V$ series | FT   | Trigger application and rated voltage 350~630Vdc                           |
| FV   | High voltage application with $\geq 1KVdc$   |      |  |

**Table 2 EIA size**

| General Purpose |             |      |             | FK/FH series |             |
|-----------------|-------------|------|-------------|--------------|-------------|
| Code            | Description | Code | Description | Code         | Description |
| 15              | 0402(1005)  | 43   | 1812 (4532) | 06           | 1206 (3216) |
| 18              | 0603 (1608) | 46   | 1825 (4563) | 08           | 1808 (4520) |
| 21              | 0805 (2012) | 52   | 2211 (5728) | 12           | 1812 (4532) |
| 31              | 1206 (3216) | 55   | 2220 (5750) | 21           | 2211 (5728) |
| 32              | 1210 (3225) | 56   | 2225 (5763) | 20           | 2220 (5750) |
| 42              | 1808 (4520) |      |             |              |             |

**Table 3 Dielectric Material Characteristics**

| Code | Description | Code | Description |
|------|-------------|------|-------------|
| N    | C0G(NPO)    | X    | X7R         |
| B    | X5R         | F    | Y5V         |

**Table 4 Capacitance Rule Code**

| Two significant digits followed by no. of zeros. And R is in place of decimal point. |             |      |                                 |      |                                     |
|--|-------------|------|---------------------------------|------|-------------------------------------|
| Code   | Description | Code | Description                     | Code | Description                         |
| R47  | 0.47pF      | 100  | $100=10 \times 10^0$<br>=10pF   | 104  | $104=10 \times 10^4$<br>=100nF      |
| 0R5  | 0.5pF       | 102  | $102=10 \times 10^2$<br>=1000pF | 106  | $106=10 \times 10^6$<br>=10 $\mu$ F |

**Table 5 Tolerance**

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

| Table 6 Rated voltage |             |      |             |      |             |      |             |              |               |
|-----------------------|-------------|------|-------------|------|-------------|------|-------------|--------------|---------------|
| General Purpose       |             |      |             |      |             |      |             | FK/FH series |               |
| Code                  | Description | Code | Description | Code | Description | Code | Description | Code         | Description   |
| 6R3                   | 6.3VDC      | 101  | 100VDC      | 102  | 1000VDC     | 402  | 4000VDC     | 302          | 2.5KV IMPULSE |
| 100                   | 10VDC       | 201  | 200VDC      | 152  | 1500VDC     | 502  | 5000VDC     | 502          | 5KV IMPULSE   |
| 160                   | 16VDC       | 251  | 250VDC      | 202  | 2000VDC     | 602  | 6000VDC     | 602          | 6KV IMPULSE   |
| 250                   | 25VDC       | 501  | 500VDC      | 252  | 2500VDC     |      |             |              |               |
| 500                   | 50VDC       | 631  | 630VDC      | 302  | 3000VDC     |      |             |              |               |

| 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 ± 0.10 mm      | I    | 1.25 ± 0.20 mm     | Q    | 0.50 + 0.02/-0.05 mm |
| B                             | 0.8 + 0.15/-0.10 mm | J    | 1.15 ± 0.15 mm     | R    | 3.10 ± 0.30 mm       |
| C                             | 1.25 ± 0.10 mm      | K    | 0.50 ± 0.20 mm     | S    | 0.80 ± 0.07 mm       |
| D                             | 1.40 ± 0.15 mm      | L    | 0.30 ± 0.03 mm     | T    | 0.85 ± 0.10 mm       |
| E                             | 1.60 ± 0.20 mm      | M    | 0.95 ± 0.10 mm     | U    | 0.50 ± 0.10 mm       |
| F                             | 2.00 ± 0.20 mm      | N    | 0.50 ± 0.05 mm     | V    | 0.20 ± 0.02 mm       |
| G                             | 2.50 ± 0.30 mm      | O    | 3.50 ± 0.20 mm     | X    | 0.80 ± 0.10 mm       |
| H                             | 2.80 ± 0.30 mm      | P    | 1.60 +0.3/-0.10 mm | Z    | 0.25 ± 0.03 mm       |

| Table 9 Special Control Code |                |      |               |
|------------------------------|----------------|------|---------------|
| Code                         | Description    | Code | Description   |
| G                            | RoHS Compliant | Q    | 表面 Coating 產品 |