



信昌電子陶瓷股份有限公司

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Messrs. : 一般共用

Date : 2023/03/22

APPROVAL SHEET

Product Name : Medium Voltage Multilayer Ceramic Chip Capacitors

Part No. : FM Series

Description : Size 0402~2225, C0G/X7R, 100Vdc~630Vdc

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

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SPECIFICATION

FOR**Product Name : Medium Voltage Multilayer Ceramic Chip Capacitors****Part No. : FM Series****Description : Size 0402~2225, C0G/X7R, 100Vdc~630Vdc****SPEC. No. : FM-000-001-24****DATE : 2023/03/22**

| DRAWN BY | CHECEKED BY | APPROVED BY |
|-------------------|-------------------|------------------|
| <i>Jane Hsiao</i> | <i>Yvens Chou</i> | <i>Jason Lin</i> |

1. INTRODUCTION

FM Series green type capacitors are manufactured by using green materials without lead and cadmium. These capacitors feature series connection of multi-layer capacitor units in a MLCC to realize high voltage performance. Reliable performances are built-in through exact formulation of dielectric powders, preparation of conductive paste, advanced automatic manufacturing, and strict quality control to assure excellent control in dielectric thickness, electrode integrity, and electrode-to-termination continuity.

2. FEATURES

- a. Medium voltage in a given case size.
- b. High reliability and stability.
- c. RoHS & HALOGEN compliant.

3. APPLICATIONS

- a. DC to DC converter.
- b. High voltage coupling/DC blocking.
- c. Back-lighting inverters.
- d. Snubbers in high frequency power converters.

4. HOW TO ORDER

| FM | 31 | X | 471 | K | 251 | P | X | G |
|------------|-----------|------------|-------------|-----------|---------------|-----------|-----------|--------------|
| 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 |
| FM | 100V≤Rated Voltage≤630V series |

| Table 6 Rated Voltage | | | | | |
|-----------------------|-------------|------|-------------|------|-------------|
| Code | Description | Code | Description | Code | Description |
| 101 | 100Vdc | 251 | 250Vdc | 501 | 500Vdc |
| 201 | 200Vdc | 401 | 400Vdc | 631 | 630Vdc |

| Table 2 Size | | | | | |
|--------------|-------------|------|-------------|------|-------------|
| Code | Description | Code | Description | Code | Description |
| 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) |
| 31 | 1206 (3216) | 46 | 1825 (4563) | | |

| Table 3 Dielectric Material Characteristics | | | |
|---|-------------|------|-------------|
| Code | Description | Code | Description |
| N | COG | X | X7R |

| 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 4 Capacitance Rule Code | | | |
|-------------------------------|------------------------------|------|--------------------------------|
| Code | Description | Code | Description |
| R47 | 0.47pF | 102 | 102=10x10 ² =1000pF |
| OR5 | 0.5pF | 104 | 104=10x10 ⁴ =100nF |
| 100 | 100=10x10 ⁰ =10pF | 106 | 106=10x10 ⁶ =10μF |

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

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

| Table 9 Special Control Code | |
|------------------------------|----------------------------------|
| Code | Description |
| G | RoHS Compliant |
| Q | Surface Coating (Size 1206~2225) |

5. EXTERNAL DIMENSIONS

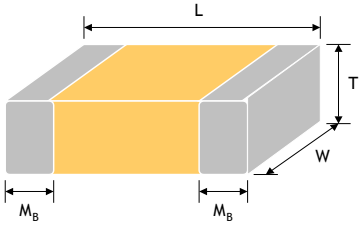
| Size Inch (mm) | L (mm) | W (mm) | Code / T (mm) | M _B (mm) | |
|----------------|--|--|----------------------------|---------------------|---|
| 0402(1005) | 1.00±0.10 | 0.50±0.10 | See No.4 Reference Table 8 | 0.25 +0.05/-0.10 |  |
| 0603(1608) | 1.60±0.15 | 0.80±0.15 | | 0.40±0.15 | |
| 0805(2012) | 2.00±0.20 | 1.25±0.20 | | 0.50±0.20 | |
| 1206(3216) | 3.20±0.20 3.20 +0.30/-0.10 [#] | 1.60±0.20 1.60 +0.30/-0.10 [#] | | 0.60±0.20 | |
| 1210(3225) | 3.20±0.30 | 2.50±0.30 | | 0.75±0.35 | |
| 1808(4520) | 4.50±0.40 | 2.00±0.25 | | 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

[#]For 1206 size P thickness products.

6. GENERAL ELECTRICAL DATA

| Dielectric | C0G | X7R |
|------------------------------------|--|--|
| Size | 0402, 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220, 2225 | 0402, 0603, 0805, 1206, 1210, 1808, 1812, 1825, 2220, 2225 |
| Rated voltage (WVDC) | 100V, 200V, 250V, 500V, 630V | 100V, 200V, 250V, 500V, 630V |
| Capacitance range | 0.5pF ~ 100nF | 100pF ~ 820nF |
| Capacitance tolerance | Reference to Table5 | Reference to Table5 |
| Tan δ | Cap. Rang | Q Spec. |
| | Cap.<30pF | Q≥400+20C |
| | Cap.≥30pF | Q≥1000 |
| Capacitance & Tan δ Test condition | Measured at the condition of 30~70% related humidity | |
| | 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 |
| Insulation resistance at Ur | ≥10GΩ or RxC≥500Ω-F, whichever is smaller | ≥10GΩ or RxC≥100Ω-F, whichever is smaller |
| | -55 to +125°C | |
| Operating temperature | | |
| Capacitance characteristic | ±30ppm/°C | ±15% |
| Termination | Cu or Ag/Ni/Sn or Au (lead-free termination) | |

7. CAPACITANCE RANGE

7-1. C0G

| Dimension | | 0402 | | | 0603 | | | 0805 | | | | | 1206 | | | | |
|-----------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Cap(pF) | code | 100V | 200V | 250V | 100V | 200V | 250V | 100V | 200V | 250V | 500V | 630V | 100V | 200V | 250V | 500V | 630V |
| 0.5 | 0R5 | N | N | N | S | S | S | A | A | A | A | A | | | | | |
| 1.0 | 1R0 | N | N | N | S | S | S | A | A | A | A | A | | | | | |
| 1.2 | 1R2 | N | N | N | S | S | S | A | A | A | A | A | X | | | X | |
| 1.5 | 1R5 | N | N | N | S | S | S | A | A | A | A | A | X | X | X | X | X |
| 1.8 | 1R8 | N | N | N | S | S | S | A | A | A | A | A | X | X | X | X | X |
| 2.2 | 2R2 | N | N | N | S | S | S | A | A | A | A | A | X | X | X | X | X |
| 2.7 | 2R7 | N | N | N | S | S | S | A | A | A | A | A | X | X | X | X | X |
| 3.3 | 3R3 | N | N | N | S | S | S | A | A | A | A | A | X | X | X | X | X |
| 3.9 | 3R9 | N | N | N | S | S | S | A | A | A | A | A | X | X | X | X | X |
| 4.7 | 4R7 | N | N | N | S | S | S | A | A | A | A | A | X | X | X | X | X |
| 5.6 | 5R6 | N | N | N | S | S | S | A | A | A | A | A | X | X | X | X | X |
| 6.8 | 6R8 | N | N | N | S | S | S | A | A | A | A | A | X | X | X | X | X |
| 8.2 | 8R2 | N | N | N | S | S | S | A | A | A | A | A | X | X | X | X | X |
| 10 | 100 | N | N | N | S | S | S | A | A | A | A | A | X | X | X | X | X |
| 12 | 120 | N | N | N | S | S | S | A | A | A | A | A | X | X | X | X | X |
| 15 | 150 | N | N | N | S | S | S | A | A | A | A | A | X | X | X | X | X |
| 18 | 180 | N | N | N | S | S | S | A | A | A | A | A | X | X | X | X | X |
| 22 | 220 | N | N | N | S | S | S | A | A | A | A | A | X | X | X | X | X |
| 27 | 270 | N | N | N | S | S | S | A | A | A | A | A | X | X | X | X | X |
| 33 | 330 | N | N | N | S | S | S | A | A | A | A | A | X | X | X | X | X |
| 39 | 390 | N | N | N | S | S | S | A | A | A | A | A | X | X | X | X | X |
| 47 | 470 | N | N | N | S | S | S | A | A | A | A | A | X | X | X | X | X |
| 56 | 560 | N | N | N | S | S | S | A | A | A | A | A | X | X | X | X | X |
| 68 | 680 | N | N | | S | S | S | A | A | A | A | A | X | X | X | X | X |
| 82 | 820 | N | N | | S | S | S | A | A | A | X | X | X | X | X | X | X |
| 100 | 101 | N | N | | S | S | S | A | A | X | X | X | X | X | X | X | X |
| 120 | 121 | N | | | S | S | S | A | A | X | C | C | X | X | X | X | X |
| 150 | 151 | N | | | S | S | S | A | X | X | C | C | X | X | X | X | X |
| 180 | 181 | N | | | S | S | S | A | X | C | C | C | X | X | X | X | X |
| 220 | 221 | N | | | S | S | S | A | C | C | C | C | X | X | X | X | X |
| 270 | 271 | | | | S | B | B | A | C | C | C | C | X | X | M | M | M |
| 330 | 331 | | | | S | B | B | A | C | C | C | C | X | X | M | M | M |
| 390 | 391 | | | | S | B | B | X | C | C | C | C | X | X | M | M | M |
| 470 | 471 | | | | S | B | B | X | C | C | I | I | X | M | M | M | M |
| 560 | 561 | | | | S | B | B | X | C | C | I | I | X | M | C | C | C |
| 680 | 681 | | | | S | B | B | X | C | C | I | I | X | M | C | C | C |
| 820 | 821 | | | | S | B | B | X | C | C | I | I | X | M | E | E | E |
| 1000 | 102 | | | | S | B | B | X | C | C | I | I | X | M | E | E | E |
| 1200 | 122 | | | | B | B | B | X | C | C | I | I | X | M | E | E | E |
| 1500 | 152 | | | | B | B | B | X | C | C | I | I | X | C | E | E | E |
| 1800 | 182 | | | | B | B | B | X | C | C | I | I | X | C | E | E | E |
| 2200 | 222 | | | | B | B | B | X | C | C | I | I | M | C | E | E | E |
| 2700 | 272 | | | | | | | C | C/I | C/I | | | M | C | E | E | E |
| 3300 | 332 | | | | | | | C | I | I | | | C | C | E | E | E |
| 3900 | 392 | | | | | | | C | I | I | | | C | E | E | E | E |
| 4700 | 472 | | | | | | | C | I | I | | | C | E | E | E | E |
| 5600 | 562 | | | | | | | C | | | | | E | E | E | E | E |
| 6800 | 682 | | | | | | | C | | | | | E | E | E | E | C/E |
| 8200 | 822 | | | | | | | C | | | | | E | E | E | E | E |
| 10000 | 103 | | | | | | | C | | | | | E | E | E | E | E |
| 12000 | 123 | | | | | | | C | | | | | P | | | | |
| 15000 | 153 | | | | | | | C | | | | | P | | | | |
| 18000 | 183 | | | | | | | C | | | | | P | | | | |
| 22000 | 223 | | | | | | | C | | | | | P | | | | |
| 27000 | 273 | | | | | | | | | | | | | | | | |
| 33000 | 333 | | | | | | | | | | | | | | | | |

7. CAPACITANCE RANGE

7-1. C0G

| Dimension | | 1210 | | | | | 1808 | | | | | 1812 | | | | |
|-----------|------|------|-------|-------|------|------|------|------|------|------|------|------|------|------|------|------|
| Cap(pF) | code | 100V | 200V | 250V | 500V | 630V | 100V | 200V | 250V | 500V | 630V | 100V | 200V | 250V | 500V | 630V |
| 2.2 | 2R2 | | | | | | C | C | C | C | C | | | | | |
| 2.7 | 2R7 | | | | | | C | C | C | C | C | | | | | |
| 3.3 | 3R3 | | | | | | C | C | C | C | C | | | | | |
| 3.9 | 3R9 | | | | | | C | C | C | C | C | | | | | |
| 4.7 | 4R7 | | | | | | C | C | C | C | C | | | | | |
| 5.6 | 5R6 | | | | | | C | C | C | C | C | | | | | |
| 6.8 | 6R8 | | | | | | C | C | C | C | C | | | | | |
| 8.2 | 8R2 | | | | | | C | C | C | C | C | | | | | |
| 10 | 100 | M | M | M | M | M | C | C | C | C | C | C | C | C | C | C |
| 12 | 120 | M | M | M | M | M | C | C | C | C | C | C | C | C | C | C |
| 15 | 150 | M | M | M | M | M | C | C | C | C | C | C | C | C | C | C |
| 18 | 180 | M | M | M | M | M | C | C | C | C | C | C | C | C | C | C |
| 22 | 220 | M | M | M | M | M | C | C | C | C | C | C | C | C | C | C |
| 27 | 270 | M | M | M | M | M | C | C | C | C | C | C | C | C | C | C |
| 33 | 330 | M | M | M | M | M | C | C | C | C | C | C | C | C | C | C |
| 39 | 390 | M | M | M | M | M | C | C | C | C | C | C | C | C | C | C |
| 47 | 470 | M | M | M | M | M | C | C | C | C | C | C | C | C | C | C |
| 56 | 560 | M | M | M | M | M | C | C | C | C | C | C | C | C | C | C |
| 68 | 680 | M | M | M | M | M | C | C | C | C | C | C | C | C | C | C |
| 82 | 820 | M | M | M | M | M | C | C | C | C | C | C | C | C | C | C |
| 100 | 101 | M | M | M | M | M | C | C | C | C | C | C | C | C | C | C |
| 120 | 121 | M | M | M | M | M | C | C | C | C | C | C | C | C | C | C |
| 150 | 151 | M | M | M | M | M | C | C | C | C | C | C | C | C | C | C |
| 180 | 181 | M | M | M | M | M | C | C | C | C | C | C | C | C | C | C |
| 220 | 221 | M | M | M | M | M | C | C | C | C | C | C | C | C | C | C |
| 270 | 271 | M | M | M | M | M | C | C | C | F | F | C | C | C | C | C |
| 330 | 331 | M | M | M | M | M | C | C | C | F | F | C | C | C | C | C |
| 390 | 391 | M | M | M | M | M | C | C | C | F | F | C | C | C | C | C |
| 470 | 471 | M | M | M | M | M | C | C | C | F | F | C | C | C | C | C |
| 560 | 561 | M | M | M | M | M | C | C | C | F | F | C | C | C | C | C |
| 680 | 681 | M | M | M | M | M | C | C | C | F | F | C | C | C | C | C |
| 820 | 821 | M | M | M | M | M | C | C | C | F | F | C | C | C | C | C |
| 1000 | 102 | M | C | C | C | C | C | C | C | F | F | C | C | C | C | C |
| 1200 | 122 | M | C | C | C | C | C | C | C | F | F | C | C | C | C | C |
| 1500 | 152 | M | C | C | C | C | C | C | C | F | F | C | C | C | C | C |
| 1800 | 182 | M | C | C | C | C | C | C | C | F | F | C | C | C | C | C |
| 2200 | 222 | M | C | C | C | C | C | C | C | F | F | C | C | C | C | C |
| 2700 | 272 | M | C | C | C | C | C | C | C | F | F | C | C | C | C | C |
| 3300 | 332 | M | C | C | C | C | C | C | C | F | F | C | C | C | C | C |
| 3900 | 392 | M | C | C | C | C | C | C | C | | | C | C | C | C | C |
| 4700 | 472 | M | E/C | E/C | C | C | C | C | C | | | C | C | C | C | C |
| 5600 | 562 | C | E/C | E/C | C | C | C | E | E | | | C | C | C | C | C |
| 6800 | 682 | C | E | E | E/C | E/C | C | E | E | | | C | C | C | C | C |
| 8200 | 822 | C | E | E | E | E | E | F | F | | | C | C | C | C | C |
| 10000 | 103 | E | F | F | F | F | E | F | F | | | C | C | C | C | C |
| 12000 | 123 | E | C/E/F | C/E/F | G/F | G/F | | | | | | C | E | E | E | E |
| 15000 | 153 | F | C/E/F | C/E/F | G/F | G/F | | | | | | C | E | E | E | E |
| 18000 | 183 | F/G | E/F/G | E/F | F | F | | | | | | E | F | F | F | F |
| 22000 | 223 | F/G | E/F/G | E/F | F | F | | | | | | E | F | F | F | F |
| 27000 | 273 | F | F | F | G | G | | | | | | F | G | G | | |
| 33000 | 333 | F | F/G | F/G | G | G | | | | | | F | | | | |
| 39000 | 393 | F | F | F | | | | | | | | G | | | | |
| 47000 | 473 | F | F | F | | | | | | | | G | | | | |
| 56000 | 563 | | | | | | | | | | | G | | | | |
| 68000 | 683 | | | | | | | | | | | G | | | | |
| 82000 | 823 | | | | | | | | | | | G | | | | |
| 100000 | 104 | | | | | | | | | | | G | | | | |

7. CAPACITANCE RANGE

7-1. C0G

| Dimension | | 1825 | | | | | 2220 | | | | | 2225 | | | | |
|-----------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Cap(pF) | code | 100V | 200V | 250V | 500V | 630V | 100V | 200V | 250V | 500V | 630V | 100V | 200V | 250V | 500V | 630V |
| 10 | 100 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 12 | 120 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 15 | 150 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 18 | 180 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 22 | 220 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 27 | 270 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 33 | 330 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 39 | 390 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 47 | 470 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 56 | 560 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 68 | 680 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 82 | 820 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 100 | 101 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 120 | 121 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 150 | 151 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 180 | 181 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 220 | 221 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 270 | 271 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 330 | 331 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 390 | 391 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 470 | 471 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 560 | 561 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 680 | 681 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 820 | 821 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 1000 | 102 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 1200 | 122 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 1500 | 152 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 1800 | 182 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 2200 | 222 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 2700 | 272 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 3300 | 332 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 3900 | 392 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 4700 | 472 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 5600 | 562 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 6800 | 682 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 8200 | 822 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 10000 | 103 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 12000 | 123 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 15000 | 153 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 18000 | 183 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 22000 | 223 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 27000 | 273 | F | F | F | F | F | F | F | F | E/F | F | F | F | F | F | F |
| 33000 | 333 | F | F | F | F | F | F | F | F | E/F | F | F | F | F | F | F |
| 39000 | 393 | F | F | F | G | G | F | F | F | G | E/F | F | F | F | F | F |
| 47000 | 473 | F | F | F | | | F | G | G | G | E/F | F | F | F | F | F |
| 56000 | 563 | F | G | G | | | F | G | G | | F | F | G | G | G | G |
| 68000 | 683 | F | G | G | | | F | G | G | | F | F | G | G | G | G |
| 82000 | 823 | G | | | | | G | | | | F | F | G | G | G | |
| 100000 | 104 | G | | | | | G | | | | G | G | G | G | | |
| 120000 | 124 | | | | | | | | | | | | | | | |
| 150000 | 154 | | | | | | | | | | | | | | | |
| 180000 | 184 | | | | | | | | | | | | | | | |
| 220000 | 224 | | | | | | | | | | | | | | | |

7. CAPACITANCE RANGE

7-2. X7R

| Dimension | | 0402 | | 0603 | | 0805 | | | | | 1206 | | | | | |
|-----------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------------|------|
| Cap(pF) | code | 100V | 100V | 200V | 250V | 100V | 200V | 250V | 500V | 630V | 100V | 200V | 250V | 500V | 400 450 | 630V |
| 100 | 101 | N | S | B | B | X | X | X | X | X | X | C | C | C | | C |
| 120 | 121 | N | S | B | B | X | X | X | X | X | X | C | C | C | | C |
| 150 | 151 | N | S | B | B | X | X | X | X | X | X | C | C | C | | C |
| 180 | 181 | N | S | B | B | X | X | X | X | X | X | C | C | C | | C |
| 220 | 221 | N | S | B | B | X | X | X | X | X | X | C | C | C | | C |
| 270 | 271 | N | S | B | B | X | X | X | X | X | X | C | C | C | | C |
| 330 | 331 | N | S | B | B | X | X | X | X | X | X | C | C | C | | C |
| 390 | 391 | N | S | B | B | X | X | X | X | X | X | C | C | C | | C |
| 470 | 471 | N | S | B | B | X | X | X | X | X | X | C | C | C | | C |
| 560 | 561 | N | S | B | B | X | X | X | X | X | X | C | C | C | | C |
| 680 | 681 | N | S | B | B | X | X | X | X | X | X | C | C | C | | C |
| 820 | 821 | N | S | B | B | X | X | X | X | X | X | C | C | C | | C |
| 1000 | 102 | N | S | B | B | X | X | X | X | X | X | C | C | C | | C |
| 1200 | 122 | N | S | B | B | X | X | X | X | X | X | C | C | C | | C |
| 1500 | 152 | N | S | B | B | X | X | X | X | X | X | C | C | C | | C |
| 1800 | 182 | N | S | B | B | X | X | X | X | X | X | C | C | C | | C |
| 2200 | 222 | N | S | B | B | X | X | X | X | X | X | C | C | C | | C |
| 2700 | 272 | N | S | B | B | X | X | X | X | X | X | C | C | C | | C |
| 3300 | 332 | N | S | B | B | X | X | X | X | X | X | C | C | C | | C |
| 3900 | 392 | N | S | B | B | X | X | X | X | X | X | C | C | C | | C |
| 4700 | 472 | N | S | B | B | X | X | X | C | C | X | C | C | C | | C |
| 5600 | 562 | | S | B | B | X | X | X | C | C | X | C | C | C | | C |
| 6800 | 682 | | S | B | B | X | X | X | C | C | X | C | C | C | | C |
| 8200 | 822 | | S | B | B | X | X | X | C | C | X | C | C | C | | C |
| 10000 | 103 | | S | B | B | X | C | C | C | C | X | C | C | C | | C |
| 12000 | 123 | | B | | | X | C | C | C | C | X | C | C | C | | C |
| 15000 | 153 | | B | | | X | C | C | C | C | X | C | C | C | | C |
| 18000 | 183 | | B | | | X | C | C | C | C | X | C | C | C | | C |
| 22000 | 223 | | B | | | X | C | C | C | C | X | C | C | E | | E |
| 27000 | 273 | | B | | | C | C | C | C | C | X | C | C | E | | E |
| 33000 | 333 | | B | | | C | C | C | C | | X | E | E | E | | E |
| 39000 | 393 | | B | | | C | C | C | | | X | E | E | E | | E |
| 47000 | 473 | | B | | | C | C | C | | | X | E | E | E | | E |
| 56000 | 563 | | B | | | C | C | C | | | X | E | E | E | | E |
| 68000 | 683 | | B | | | C | C | C | | | X | E | E | | E | |
| 82000 | 823 | | B | | | C | C | | | | C | E | E | | E | |
| 100000 | 104 | | B | | | C | C | | | | C | E | E | | E | |
| 120000 | 124 | | | | | I | | | | | C | E | E | | | |
| 150000 | 154 | | | | | I | | | | | E | E | E | | | |
| 180000 | 184 | | | | | I | | | | | E | E | E | | | |
| 220000 | 224 | | | | | I | | | | | E | E | E | | | |
| 270000 | 274 | | | | | I | | | | | E | | | | | |
| 330000 | 334 | | | | | I | | | | | E | | | | | |
| 390000 | 394 | | | | | I | | | | | E | | | | | |
| 470000 | 474 | | | | | I | | | | | E | | | | | |
| 560000 | 564 | | | | | | | | | | P | | | | | |
| 680000 | 684 | | | | | | | | | | P | | | | | |
| 820000 | 824 | | | | | | | | | | P | | | | | |

7. CAPACITANCE RANGE

7-2. X7R

| Dimension | | 1210 | | | | | 1808 | | 1812 | | | | | | |
|-----------|------|------|------|------|------------|------|------|------|------|------|------|------|------|------|------|
| Cap(pF) | code | 100V | 200V | 250V | 400 450 | 500V | 630V | 500V | 630V | 100V | 200V | 250V | 450V | 500V | 630V |
| 100 | 101 | | | | | | | | | | | | | | |
| 120 | 121 | | | | | | | | | | | | | | |
| 150 | 151 | | | | | | | C | C | | | | | | |
| 180 | 181 | | | | | | | C | C | | | | | | |
| 220 | 221 | M | M | M | | C | C | C | C | | | | | | |
| 270 | 271 | M | M | M | | C | C | C | C | C | C | C | C | C | C |
| 330 | 331 | M | M | M | | C | C | C | C | C | C | C | C | C | C |
| 390 | 391 | M | M | M | | C | C | C | C | C | C | C | C | C | C |
| 470 | 471 | M | M | M | | C | C | C | C | C | C | C | C | C | C |
| 560 | 561 | M | M | M | | C | C | C | C | C | C | C | C | C | C |
| 680 | 681 | M | M | M | | C | C | C | C | C | C | C | C | C | C |
| 820 | 821 | M | M | M | | C | C | C | C | C | C | C | C | C | C |
| 1000 | 102 | M | M | M | | C | C | C | C | C | C | C | C | C | C |
| 1200 | 122 | M | M | M | | C | C | C | C | C | C | C | C | C | C |
| 1500 | 152 | M | M | M | | C | C | C | C | C | C | C | C | C | C |
| 1800 | 182 | M | M | M | | C | C | C | C | C | C | C | C | C | C |
| 2200 | 222 | M | M | M | | C | C | C | C | C | C | C | C | C | C |
| 2700 | 272 | M | M | M | | C | C | C | C | C | C | C | C | C | C |
| 3300 | 332 | M | M | M | | C | C | C | C | C | C | C | C | C | C |
| 3900 | 392 | M | M | M | | C | C | C | C | C | C | C | C | C | C |
| 4700 | 472 | M | M | M | | C | C | C | C | C | C | C | C | C | C |
| 5600 | 562 | M | M | M | | C | C | F | F | C | C | C | C | C | C |
| 6800 | 682 | M | M | M | | C | C | F | F | C | C | C | C | C | C |
| 8200 | 822 | M | M | M | | C | C | F | F | C | C | C | C | C | C |
| 10000 | 103 | M | M | M | | C | C | F | F | C | C | C | C | C | C |
| 12000 | 123 | M | M | M | | C | C | F | F | C | C | C | C | C | C |
| 15000 | 153 | M | M | M | | C | C | F | F | C | C | C | C | C | C |
| 18000 | 183 | M | M | M | | C | C | F | F | C | C | C | C | C | C |
| 22000 | 223 | M | M | M | | C | C | F | F | C | C | C | C | C | C |
| 27000 | 273 | M | M | M | | E | E | F | F | C | C | C | C | C | C |
| 33000 | 333 | M | M | M | | E | E | F | F | C | C | C | C | C | C |
| 39000 | 393 | M | M | M | | E | E | F | F | C | C | C | C | C | C |
| 47000 | 473 | M | C | C | | E | E | F | F | C | C | C | C | C | C |
| 56000 | 563 | M | C | E | | E | E | F | F | C | C | C | F | F | F |
| 68000 | 683 | M | E | E | | F/E | F/E | F | F | C | C | C | F | F | F |
| 82000 | 823 | M | E | E | | F | F | F | F | C | C | C | F | F | F |
| 100000 | 104 | M | E | E | | F | F | | | C | C | C | F | F | F |
| 120000 | 124 | M | E | E | G | G | G | | | C | C | C | G | G | G |
| 150000 | 154 | C | G | G | G | G | G | | | C | F | F | G | G | G |
| 180000 | 184 | C | G | G | G | | | | | C | F | F | G | G | G |
| 220000 | 224 | C | G | G | G | | | | | C | F | F | G | G | G |
| 270000 | 274 | E | G | G | G | | | | | C | F | F | G | G | |
| 330000 | 334 | E | G | G | G | | | | | C | F | F | G | G | |
| 390000 | 394 | G | G | G | | | | | | C | F | F | G | G | |
| 470000 | 474 | G | G | G | | | | | | F | F | F | G | G | |
| 560000 | 564 | G | G | G | | | | | | F | G | G | G | | |
| 680000 | 684 | F | G | G | | | | | | F | G | G | G | | |
| 820000 | 824 | F | | | | | | | | F | G | G | H | | |

7. CAPACITANCE RANGE

7-2. X7R

| Dimension | | 1825 | | | | | 2220 | | | | | 2225 | | | | |
|-----------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Cap(pF) | code | 100V | 200V | 250V | 500V | 630V | 100V | 200V | 250V | 500V | 630V | 100V | 200V | 250V | 500V | 630V |
| 1000 | 102 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 1200 | 122 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 1500 | 152 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 1800 | 182 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 2200 | 222 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 2700 | 272 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 3300 | 332 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 3900 | 392 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 4700 | 472 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 5600 | 562 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 6800 | 682 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 8200 | 822 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 10000 | 103 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 12000 | 123 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 15000 | 153 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 18000 | 183 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 22000 | 223 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 27000 | 273 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 33000 | 333 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 39000 | 393 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 47000 | 473 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 56000 | 563 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 68000 | 683 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 82000 | 823 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 100000 | 104 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 120000 | 124 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 150000 | 154 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 180000 | 184 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 220000 | 224 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 270000 | 274 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 330000 | 334 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 390000 | 394 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 470000 | 474 | F | F | F | F | F | F | F | F | F | F | F | F | F | F | F |
| 560000 | 564 | F | F | F | G | G | F | F | F | G | G | F | F | F | F | F |
| 680000 | 684 | F | F | F | | | F | F | F | G | G | F | F | F | | |
| 820000 | 824 | F | F | F | | | F | F | F | H | H | F | F | F | | |

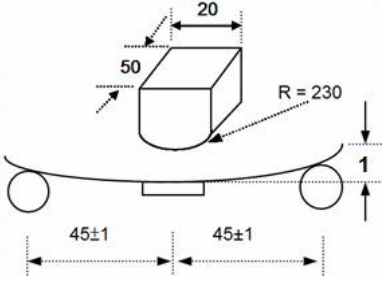
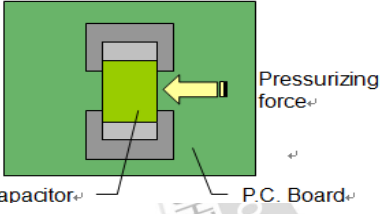
8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

| No. | Item | Test Condition | Requirements | | | | | | | | | | | | | | | | | | |
|---------------|---|---|---|-----------------|----------------|-----------------------------|----------------------------|-----------------------------|---|-----------------------------|--------------------|-----------------------------|---|-----------|---|---|--------------|---|---|-----------------|---|
| 1. | Visual and Dimensions | --- | * No remarkable defect. * Dimensions to confirm to individual specification sheet. | | | | | | | | | | | | | | | | | | |
| 2. | Capacitance | | * Shall not exceed the limits given in the detailed spec. | | | | | | | | | | | | | | | | | | |
| 3. | Q/ D.F. (Tangent of loss angle) | * Class I : C0G Cap.≤1000pF, 1.0±0.2Vrms, 1MHz±10%. Cap.>1000pF, 1.0±0.2Vrms, 1KHz±10%. * Class II : (X7R) 1.0±0.2Vrms, 1KHz±10%. | <table border="1"> <thead> <tr> <th>Dielectric</th> <th>Q/D.F.</th> <th>Remark</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Class I (C0G)</td> <td>Q≥1000</td> <td>Cap.≥30pF</td> </tr> <tr> <td>Q≥400+20C</td> <td>Cap.<30pF</td> </tr> <tr> <td rowspan="4">Class II</td> <td>D.F.≤2.5%</td> <td>X7R items</td> </tr> <tr> <td>D.F.≤3.5%</td> <td>X7R 0603≥0.047μF, 0805=0.1μF, 1206≥0.47μF</td> </tr> <tr> <td>D.F.≤5.0%</td> <td>X7R 0603≥0.068μF, 0805>0.1μF All Y5V items</td> </tr> <tr> <td>D.F.≤10.0%</td> <td>X7R 0805>0.22μF</td> </tr> </tbody> </table> | Dielectric | Q/D.F. | Remark | Class I (C0G) | Q≥1000 | Cap.≥30pF | Q≥400+20C | Cap.<30pF | Class II | D.F.≤2.5% | X7R items | D.F.≤3.5% | X7R 0603≥0.047μF, 0805=0.1μF, 1206≥0.47μF | D.F.≤5.0% | X7R 0603≥0.068μF, 0805>0.1μF All Y5V items | D.F.≤10.0% | X7R 0805>0.22μF | |
| Dielectric | Q/D.F. | Remark | | | | | | | | | | | | | | | | | | | |
| Class I (C0G) | Q≥1000 | Cap.≥30pF | | | | | | | | | | | | | | | | | | | |
| | Q≥400+20C | Cap.<30pF | | | | | | | | | | | | | | | | | | | |
| Class II | D.F.≤2.5% | X7R items | | | | | | | | | | | | | | | | | | | |
| | D.F.≤3.5% | X7R 0603≥0.047μF, 0805=0.1μF, 1206≥0.47μF | | | | | | | | | | | | | | | | | | | |
| | D.F.≤5.0% | X7R 0603≥0.068μF, 0805>0.1μF All Y5V items | | | | | | | | | | | | | | | | | | | |
| | D.F.≤10.0% | X7R 0805>0.22μF | | | | | | | | | | | | | | | | | | | |
| 4. | Temperature Coefficient (Temperature characteristic of capacitance) | * With no electrical load. <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 ±30ppm/°C</td> </tr> <tr> <td>X7R</td> <td>Within ±15%</td> </tr> </tbody> </table> | T.C. | Capacitance Change | C0G | Within ±30ppm/°C | X7R | Within ±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 ±30ppm/°C | | | | | | | | | | | | | | | | | | | | |
| X7R | Within ±15% | | | | | | | | | | | | | | | | | | | | |
| 5. | Insulation Resistance | <table border="1"> <thead> <tr> <th>Rated Vol.(V)</th> <th>Apply Voltage</th> <th>Test Condition</th> </tr> </thead> <tbody> <tr> <td>=100</td> <td>1 times of U_R</td> <td>Max. 120 sec.</td> </tr> <tr> <td>200≤V≤500</td> <td>1 times of U_R</td> <td>60 sec.</td> </tr> <tr> <td>>500</td> <td>500Vdc</td> <td>60 sec.</td> </tr> </tbody> </table> | Rated Vol.(V) | Apply Voltage | Test Condition | =100 | 1 times of U _R | Max. 120 sec. | 200≤V≤500 | 1 times of U _R | 60 sec. | >500 | 500Vdc | 60 sec. | <table border="1"> <thead> <tr> <th>Dielectric</th> <th>Requirements</th> </tr> </thead> <tbody> <tr> <td>Class I</td> <td>≥10GΩ or RxC≥500Ω-F, whichever is smaller</td> </tr> <tr> <td>Class II</td> <td>≥10GΩ or RxC≥100Ω-F, whichever is smaller</td> </tr> </tbody> </table> | Dielectric | Requirements | Class I | ≥10GΩ or RxC≥500Ω-F, whichever is smaller | Class II | ≥10GΩ or RxC≥100Ω-F, whichever is smaller |
| Rated Vol.(V) | Apply Voltage | Test Condition | | | | | | | | | | | | | | | | | | | |
| =100 | 1 times of U _R | Max. 120 sec. | | | | | | | | | | | | | | | | | | | |
| 200≤V≤500 | 1 times of U _R | 60 sec. | | | | | | | | | | | | | | | | | | | |
| >500 | 500Vdc | 60 sec. | | | | | | | | | | | | | | | | | | | |
| Dielectric | Requirements | | | | | | | | | | | | | | | | | | | | |
| Class I | ≥10GΩ or RxC≥500Ω-F, whichever is smaller | | | | | | | | | | | | | | | | | | | | |
| Class II | ≥10GΩ or RxC≥100Ω-F, whichever is smaller | | | | | | | | | | | | | | | | | | | | |
| 6. | Solderability | * Solder temperature : 235±5°C for (0402~1210). * Solder temperature : 245±5°C for (1808~2225). * Dipping time : 2±0.5 sec. | * 75% min. coverage of all metalized area. | | | | | | | | | | | | | | | | | | |
| 7. | Dielectric Strength (Voltage proof) | <table border="1"> <thead> <tr> <th>Rated Vol.(V)</th> <th>Condition</th> </tr> </thead> <tbody> <tr> <td>≤100</td> <td>2.5 times of U_R</td> </tr> <tr> <td>100<V≤250</td> <td>2.0 times of U_R</td> </tr> <tr> <td>250<V≤500</td> <td>1.5 times of U_R</td> </tr> <tr> <td>=630</td> <td>1.2 times of U_R</td> </tr> </tbody> </table> * Duration : 1 to 5 sec. * Charge and discharge current less than 50mA. | Rated Vol.(V) | Condition | ≤100 | 2.5 times of U _R | 100<V≤250 | 2.0 times of U _R | 250<V≤500 | 1.5 times of U _R | =630 | 1.2 times of U _R | * No evidence of damage or flashover during test. | | | | | | | | |
| Rated Vol.(V) | Condition | | | | | | | | | | | | | | | | | | | | |
| ≤100 | 2.5 times of U _R | | | | | | | | | | | | | | | | | | | | |
| 100<V≤250 | 2.0 times of U _R | | | | | | | | | | | | | | | | | | | | |
| 250<V≤500 | 1.5 times of U _R | | | | | | | | | | | | | | | | | | | | |
| =630 | 1.2 times of U _R | | | | | | | | | | | | | | | | | | | | |
| 8. | Resistance to Soldering Heat | * Solder temperature : 260±5°C. * Dipping time : 10±1 sec. * Preheating : 120 to 150°C for 1 minute before immerse the capacitor in a eutectic solder. * Before initial measurement (Class II only) : Perform 150 +0/-10°C for 1 hr and then set for 48±4 hrs at room temp. * Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II). | * No remarkable damage. * Cap. Change : C0G : Within ±2.5% or ±0.25pF, whichever is larger. X7R : Within ±7.5%. * Q/D.F. & I.R. : To meet the initial requirement. * 25% max. leaching on each edge. | | | | | | | | | | | | | | | | | | |
| 9. | Temperature Cycle (Rapid change of temperature) | * Conduct the five cycles according to the temperatures and time. <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> * Before initial measurement (Class II only) : Perform 150 +0/-10°C for 1 hr and then set for 48±4 hrs at room temp. * Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II). | 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 | * No remarkable damage. * Cap. change : C0G : Within ±2.5% or ±0.25pF, whichever is larger. X7R : Within ±7.5%. * Q/D.F. : C0G : To meet the initial requirement. X7R, Y5V : D.F.≤150% of initial requirement. * I.R. : To meet the initial requirement. | | | |
| 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 (Damp Heat) Steady State | * Test temp. : 40±2°C. * Humidity : 90~95%RH. * Test time : 500 +24/-0 hrs. * Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II). | * No remarkable damage. * Cap. change : C0G : Within ±5.0% or ±0.5pF, whichever is larger. X7R : Within ±12.5%. * Q/D.F. : C0G : Cap.>30pF, Q≥350; 10pF≤Cap.≤30pF, Q≥275+2.5C; Cap.<10pF, Q≥200+10C. X7R : D.F.≤200% of initial requirement. * I.R. (Class I) : ≥10GΩ or RxC≥500Ω-F, whichever is smaller. * I.R. (Class II) : ≥1GΩ or RxC≥10Ω-F, whichever is smaller. | | | | | | | | | | | | | | | | | | | | | | | |
| 11. | Humidity (Damp Heat) Load | * Test temp. : 40±2°C. * Humidity : 90~95% RH. * Test time : 500 +24/-0hrs. * To apply voltage : Rated voltage (Max. 500Vdc). * Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II). | * No remarkable damage. * Cap. change : C0G : Within ±7.5% or ±0.75pF, whichever is larger. X7R : Within ±12.5%. * Q/D.F. : C0G : Cap.≥30pF, Q≥200; Cap.<30pF, Q≥100+10/3C. X7R : D.F.≤200% of initial requirement. * I.R. : ≥500MΩ or RxC≥25Ω-F, whichever is smaller. X7R 100V : ≥500MΩ or RxC≥5Ω-F, whichever is smaller. | | | | | | | | | | | | | | | | | | | | | | | |
| 12. | High Temperature Load (Endurance) | * Test temp. : C0G, X7R : 125±3°C. <table border="1" style="margin: 5px 0;"> <thead> <tr> <th>Dielectric</th> <th>Rated Vol.(V)</th> <th>Apply Voltage</th> </tr> </thead> <tbody> <tr> <td rowspan="3">C0G X7R</td> <td>≤100</td> <td>2.0 times of U_R</td> </tr> <tr> <td>200≤V≤500</td> <td>1.5 times of U_R</td> </tr> <tr> <td>400V~450V</td> <td>1.2 times of U_R</td> </tr> <tr> <td></td> <td>=630</td> <td>1.2 times of U_R</td> </tr> </tbody> </table> * Exception items : <table border="1" style="margin: 5px 0;"> <thead> <tr> <th>Rated Vol.(V)</th> <th>Size</th> <th>Cap. Range</th> <th>Apply Voltage</th> </tr> </thead> <tbody> <tr> <td rowspan="2">100</td> <td>0603</td> <td>≥0.082μF</td> <td rowspan="2">150%</td> </tr> <tr> <td>0805</td> <td>≥0.12μF</td> </tr> </tbody> </table> * Test time : 1000 +24/-0 hrs. * Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II). | Dielectric | Rated Vol.(V) | Apply Voltage | C0G X7R | ≤100 | 2.0 times of U _R | 200≤V≤500 | 1.5 times of U _R | 400V~450V | 1.2 times of U _R | | =630 | 1.2 times of U _R | Rated Vol.(V) | Size | Cap. Range | Apply Voltage | 100 | 0603 | ≥0.082μF | 150% | 0805 | ≥0.12μF | * No remarkable damage. * Cap. change : C0G : Within ±3.0% or ±0.3pF, whichever is larger. X7R : Within ±12.5%. * Q/D.F. : C0G : Cap.>30pF, Q≥350; 10pF≤Cap.≤30pF, Q≥275+2.5C; Cap.<10pF, Q≥200+10C. X7R : D.F.≤200% of initial requirement. * I.R. : ≥1GΩ or RxC≥50Ω-F, whichever is smaller. X7R 100V : ≥1GΩ or RxC≥10Ω-F, whichever is smaller. |
| Dielectric | Rated Vol.(V) | Apply Voltage | | | | | | | | | | | | | | | | | | | | | | | | |
| C0G X7R | ≤100 | 2.0 times of U _R | | | | | | | | | | | | | | | | | | | | | | | | |
| | 200≤V≤500 | 1.5 times of U _R | | | | | | | | | | | | | | | | | | | | | | | | |
| | 400V~450V | 1.2 times of U _R | | | | | | | | | | | | | | | | | | | | | | | | |
| | =630 | 1.2 times of U _R | | | | | | | | | | | | | | | | | | | | | | | | |
| Rated Vol.(V) | Size | Cap. Range | Apply Voltage | | | | | | | | | | | | | | | | | | | | | | | |
| 100 | 0603 | ≥0.082μF | 150% | | | | | | | | | | | | | | | | | | | | | | | |
| | 0805 | ≥0.12μF | | | | | | | | | | | | | | | | | | | | | | | | |

8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

| No. | Item | Test Condition | Requirements | | | | | | |
|----------------|--|---|---|------------|-------------|---------------|---|----------------|---------------|
| 13 | Resistance to Flexure of Substrate (Substrate 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>Unit : mm</p> | <p>* No remarkable damage.</p> <table border="1"> <thead> <tr> <th>Dielectric</th> <th>Cap. Change</th> </tr> </thead> <tbody> <tr> <td>Class I (C0G)</td> <td>Within ±3.0% or ±2.0pF, whichever is larger</td> </tr> <tr> <td>Class II (X7R)</td> <td>Within ±12.5%</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 (C0G) | Within ±3.0% or ±2.0pF, whichever is larger | Class II (X7R) | Within ±12.5% |
| Dielectric | Cap. Change | | | | | | | | |
| Class I (C0G) | Within ±3.0% or ±2.0pF, whichever is larger | | | | | | | | |
| Class II (X7R) | Within ±12.5% | | | | | | | | |
| 14. | Adhesive Strength of Termination (Robustness of termination) | <p>* Capacitors mounted on a substrate. A force of 5N(≤0603) or 10N(>0603) applied perpendicular to the place of substrate and parallel the line joining the center of terminations for 10±1 second.</p>  | <p>* No remarkable damage or removal of the terminations.</p> | | | | | | |
| 15. | Vibration Resistance | <p>* Vibration frequency : 10~55 Hz/min. * Total amplitude : 1.5mm. * Test time : 6 hrs. (Two hrs each in three mutually perpendicular directions) * Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</p> | <p>* No remarkable damage. * Cap. change and Q/D.F. : To meet the initial spec.</p> | | | | | | |

9. PACKAGE DIMENSION AND QUANTITY

| Size | Thickness (mm) | Paper tape | | Plastic tape | |
|------------|------------------|------------|----------|--------------|----------|
| | | 7" reel | 13" reel | 7" reel | 13" reel |
| 0402(1005) | 0.50±0.05 | 10k | 50k | - | - |
| | 0.50 +0.02/-0.05 | 10k | 50k | - | - |
| | 0.50±0.20 | 10k | - | - | - |
| 0603(1608) | 0.50±0.10 | 4k | - | - | - |
| | 0.80±0.07 | 4k | 15k | - | - |
| | 0.80 +0.15/-0.10 | 4k | 15k | - | - |
| 0805(2012) | 0.50±0.10 | 4k | 15k | - | - |
| | 0.60±0.10 | 4k | 15k | - | - |
| | 0.80±0.10 | 4k | 15k | - | - |
| | 0.85±0.10 | 4k | 15k | - | - |
| | 1.25±0.10 | - | - | 3k | 10k |
| 1206(3216) | 1.25±0.20 | - | - | 3k | 10k |
| | 0.80±0.10 | 4k | 15k | - | - |
| | 0.85±0.10 | 4k | 15k | - | - |
| | 0.95±0.10 | - | - | 3k | 10k |
| | 1.15±0.15 | - | - | 3k | 10k |
| | 1.25±0.10 | - | - | 3k | 10k |
| | 1.60±0.20 | - | - | 2k | 10k |
| 1210(3225) | 1.60 +0.30/-0.10 | - | - | 2k | 9k |
| | 0.85±0.10 | - | - | 3k | 10k |
| | 0.95±0.10 | - | - | 3k | 10k |
| | 1.25±0.10 | - | - | 3k | 10k |
| | 1.60±0.20 | - | - | 2k | - |
| | 2.00±0.20 | - | - | 1k | 6k |
| 1808(4520) | 2.50±0.30 | - | - | 1k | 6k |
| | 1.25±0.10 | - | - | 2k | 10k |
| | 1.60±0.20 | - | - | 2k | 8k |
| | 2.00±0.20 | - | - | 1k | 6k |
| 1812(4532) | 1.25±0.10 | - | - | 1k | 5k |
| | 1.60±0.20 | - | - | 1k | - |
| | 2.00±0.20 | - | - | 1k | - |
| | 2.50±0.30 | - | - | 0.5k | 3k |
| | 2.80±0.30 | - | - | 0.5k | - |
| 1825(4563) | 1.60±0.20 | - | - | 1k | - |
| | 2.00±0.20 | - | - | 1k | - |
| | 2.50±0.30 | - | - | 0.5k | - |
| | 2.80±0.30 | - | - | 0.5k | - |
| 2220(5750) | 1.60±0.20 | - | - | 1k | - |
| | 2.00±0.20 | - | - | 1k | - |
| | 2.50±0.30 | - | - | 0.5k | - |
| | 2.80±0.30 | - | - | 0.5k | - |
| 2225(5763) | 1.60±0.20 | - | - | 1k | - |
| | 2.00±0.20 | - | - | 1k | - |
| | 2.50±0.30 | - | - | 0.5k | - |
| | 2.80±0.30 | - | - | 0.5k | - |

Unit : pcs

9. PACKAGE DIMENSION AND QUANTITY

9.1. EMBOSSED TAPE DIMENSIONS

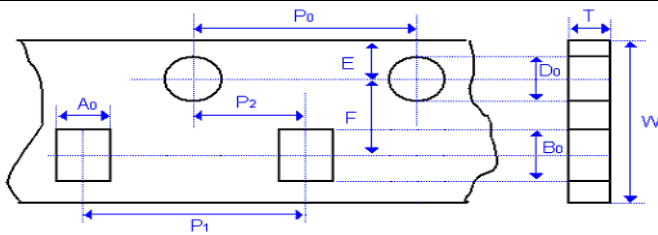


Fig. 9.1 The dimension of paper tape

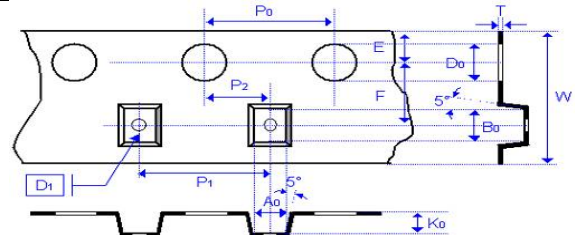


Fig. 9.2 The dimension of plastic tape

| Size | 0402 | 0603 | 0805 | |
|-------------------|------------------------|------------------------------|---------------|------------------------|
| Chip Thickness | 0.50±0.05 0.50±0.10 | 0.80±0.07 0.80 +0.15/-0.1 | 0.80±0.10 | 1.25±0.10 1.25±0.20 |
| A ₀ | 0.70±0.20 | 1.00 +0.05/-0.10 | 1.50±0.20 | <1.80 |
| B ₀ | 1.20±0.20 | 1.80±0.10 | 2.30±0.20 | <2.70 |
| T | ≤0.80 | 0.95±0.05 | 0.95±0.05 | 0.23±0.05 |
| K ₀ | - | - | - | <2.50 |
| W | 8.00±0.10 | 8.00±0.10 | 8.00±0.10 | 8.00±0.10 |
| P ₀ | 4.00±0.10 | 4.00±0.10 | 4.00±0.10 | 4.00±0.10 |
| 10xP ₀ | 40.00±0.10 | 40.00±0.20 | 40.00±0.20 | 40.00±0.20 |
| P ₁ | 2.00±0.05 | 4.00±0.10 | 4.00±0.10 | 4.00±0.10 |
| P ₂ | 2.00±0.05 | 2.00±0.05 | 2.00±0.05 | 2.00±0.05 |
| D ₀ | 1.50 +0.10/-0 | 1.50 +0.10/-0 | 1.50 +0.10/-0 | 1.50 +0.10/-0 |
| D ₁ | - | - | - | 1.00±0.10 |
| E | 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 |
| Unit : | mm | mm | mm | mm |

| Size | 1206 | | | 1210 | | 1808 | |
|-------------------|---------------|------------------------|----------------------------|-------------------------------------|---------------|------------------------|---------------|
| Chip Thickness | 0.80±0.10 | 0.95±0.10 1.25±0.10 | 1.60±0.20 1.60+0.3/-0.1 | 0.95±0.10 1.25±0.10 1.60±0.20 | 2.50±0.30 | 1.25±0.10 1.60±0.20 | 2.00±0.20 |
| A ₀ | 2.00±0.10 | <2.00 | <2.50 | <3.05 | <3.20 | <2.50 | <2.50 |
| B ₀ | 3.50±0.50 | <3.70 | <4.00 | <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 ₀ | - | <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 | 12.00±0.20 | 12.00±0.20 |
| P ₀ | 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 ₀ | 40.00±0.20 | 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 ₁ | 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 ₂ | 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 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 | 1.50 +0.10/-0 | 1.50 +0.10/-0 |
| D ₁ | - | 1.00±0.10 | 1.50±0.10 | 1.50±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±0.10 |
| F | 3.50±0.05 | 3.50±0.05 | 5.50±0.05 | 5.50±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 | 1812 | | 1825 | | 2220 | |
|-------------------|-------------------------------------|------------------------|------------------------|------------------------|-------------------------------------|------------------------|
| Chip Thickness | 1.25±0.10 1.60±0.20 2.00±0.20 | 2.50±0.30 2.80±0.30 | 1.60±0.20 2.00±0.20 | 2.50±0.30 2.80±0.30 | 1.40±0.15 1.60±0.20 2.00±0.20 | 2.50±0.30 2.80±0.30 |
| A ₀ | <3.90 | <3.90 | <6.80 | <6.80 | <5.80 | <6.80 |
| B ₀ | <5.30 | <5.30 | <5.30 | <5.30 | <6.50 | <6.50 |
| T | 0.25±0.05 | 0.25±0.05 | 0.30±0.10 | 0.30±0.10 | 0.30±0.10 | 0.30±0.10 |
| K ₀ | <2.50 | <3.00 | <2.50 | <3.10 | <2.50 | <3.10 |
| W | 12.00±0.20 | 12.00±0.20 | 12.00±0.20 | 12.00±0.20 | 12.00±0.20 | 12.00±0.20 |
| P ₀ | 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 ₀ | 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 ₁ | 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 ₂ | 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 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 | 1.50 +0.10/-0 |
| D ₁ | 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±0.10 | 1.75±0.10 | 1.75±0.10 | 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 |

| Size | 2225 | |
|-------------------|------------------------|------------------------|
| Chip Thickness | 1.60±0.20 2.00±0.20 | 2.50±0.30 2.80±0.30 |
| A ₀ | <6.80 | <6.80 |
| B ₀ | <6.50 | <6.50 |
| T | 0.30±0.10 | 0.30±0.10 |
| K ₀ | <2.50 | <3.10 |
| W | 12.00±0.20 | 12.00±0.20 |
| P ₀ | 4.00±0.10 | 4.00±0.10 |
| 10xP ₀ | 40.00±0.20 | 40.00±0.20 |
| P ₁ | 8.00±0.10 | 8.00±0.10 |
| P ₂ | 2.00±0.05 | 2.00±0.05 |
| D ₀ | 1.50 +0.10/-0 | 1.50 +0.10/-0 |
| D ₁ | 1.50±0.10 | 1.50±0.10 |
| E | 1.75±0.10 | 1.75±0.10 |
| F | 5.50±0.05 | 5.50±0.05 |
| Unit : | mm | mm |

9. PACKAGE DIMENSION AND QUANTITY

9.2. REEL DIMENSIONS

| Size | 0201, 0402, 0603, 0805, 1206, 1210 | | 1808, 1812, 1825, 2220, 2225 |
|----------------|---------------------------------------|-------------------|---------------------------------|
| Reel size | 7" | 13" | 7" |
| C | 13.0 +0.5/-0.2 | 13.0 +0.7/-0.3 | 13.0 +0.5/-0.2 |
| W ₁ | 8.4+1.5/-0 | 8.4 +2.0/-0 | 12.4 +2.0/-0 |
| A | 178.0 ±0.10 | 330.0 ±1.0 | 178.0 ±0.10 |
| N | 60.0 +1.0/-0 | 100 ±1.0 | 60.0 +1.0/-0 |

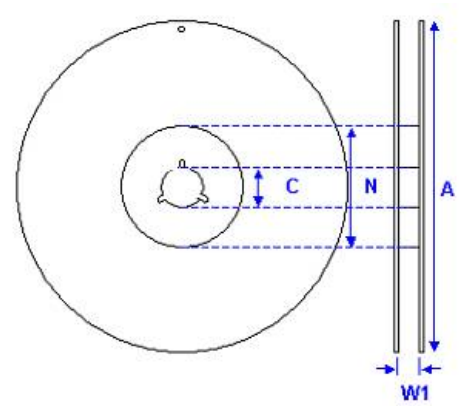
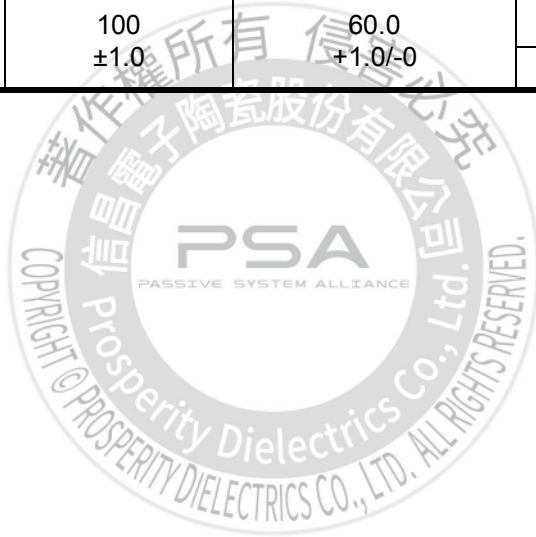


Fig. 9.3 The dimension of reel



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.

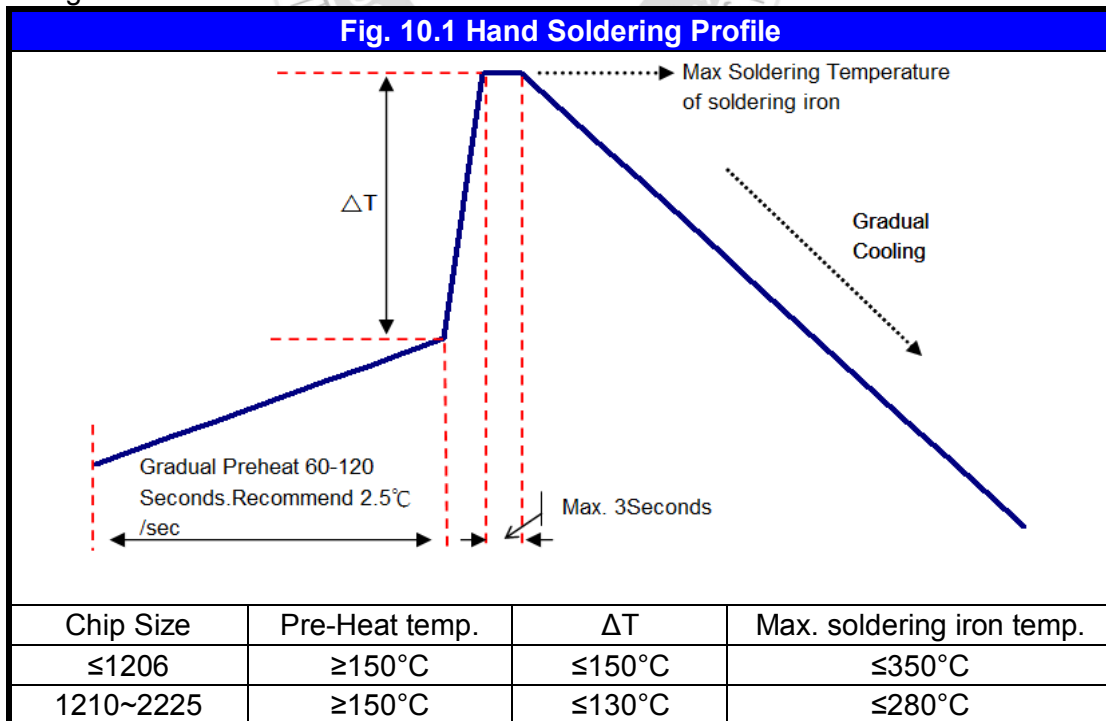
PREHEAT

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 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.

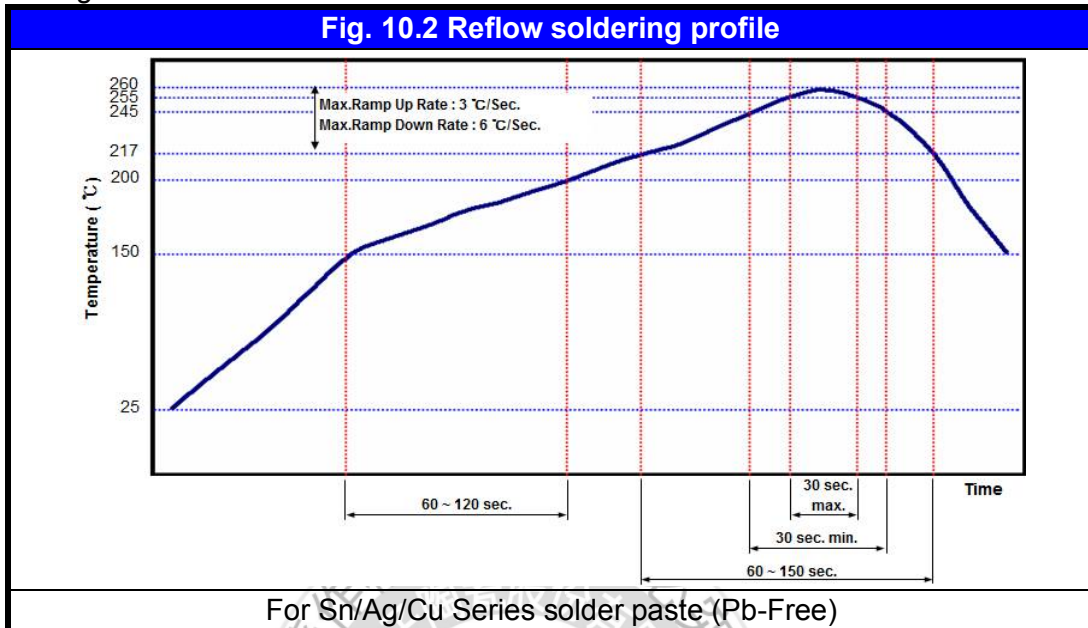
a.) Hand soldering :



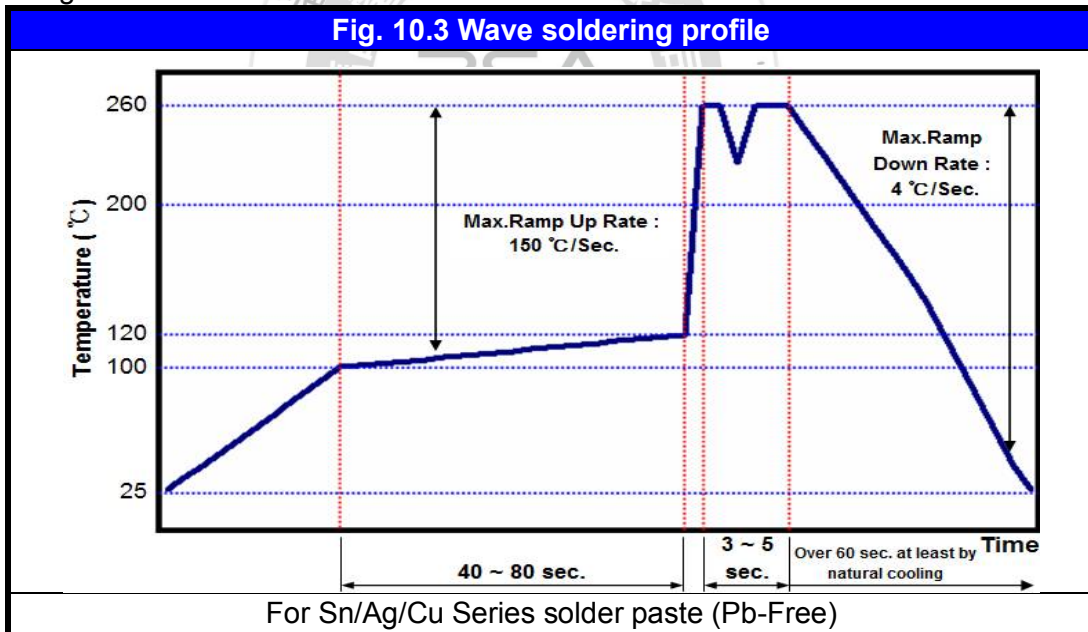
- * Soldering iron tip diameter ≤1.0 mm and wattage max. 20W.
- * The Capacitors shall be pre-heated and that the temperature gradient between the devices and the tip of the soldering iron.
- * The required amount of solder shall be melted on the soldering tip.
- * The tip of iron should not contact 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 | All | X | O |
| 0603 (1608) | Class I | All | O | O |
| 0805 (2012) | Class I | All | O | O |
| 1206 (3216) | Class I | All | O | O |
| | | Thickness >0.95mm | X | O |
| ≥1210 (3225) | Class I | All | X | O |
| Coating Products | All | All | X | O |

10. APPLICATION NOTES

Soldering conditions :

Class II :

| Size Inch (mm) | Temper. Cher. | Capacitance | Condition | |
|------------------|---------------|--------------------|-----------|--------|
| | | | Wave | Reflow |
| ≤0402 (1005) | Class II | All | X | O |
| 0603 (1608) | Class II | Cap. <2.2μF | O | O |
| | | Cap. ≥2.2μF | X | O |
| 0805 (2012) | Class II | Thickness ≤ 0.95mm | O | O |
| | | Thickness > 0.95mm | X | O |
| 1206 (3216) | Class II | Thickness ≤ 0.95mm | O | O |
| | | Thickness > 0.95mm | X | O |
| ≥1210 (3225) | Class II | All | X | O |
| Coating Products | All | All | X | O |

Soldering height :

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

The diagram illustrates a cross-section of a chip on a substrate. A yellow rectangular chip is mounted on a grey substrate. A vertical double-headed arrow on the left indicates the 'Chip Thickness'. A vertical double-headed arrow on the right indicates the 'Soldering Height', which is the height of the solder joint between the chip and the substrate.

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.