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**Messrs. :** 一般共用

**Date :** 2023/10/05

# APPROVAL SHEET

**Product Name :** Safety Certified Multilayer Ceramic Chip Capacitors

**Part No. :** FK / FH Series

**Description :** X1/Y2 & X2 Class, Size 1808~2220, C0G/X7R, 250Vac & UL 62368-1 Certified, Size 1206, X7R, 2.5KVdc

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

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# SPECIFICATION

## FOR

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**SPEC. No. : FKFH-000-001-21**

**DATE : 2023/10/05**

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

**1. INTRODUCTION**

PROSPERITY's SAFETY CERTIFIED CAPACITORS are designed for surge or lightning immunity in modem facsimile and other equipments. The capacitors of FK series are class X1/Y2 compliant, and the capacitors of FH series are class X2 compliant respectively.

The green type capacitors in FK/FH series are manufactured by using environmentally friendly materials without lead or cadmium.

The terminations are composed of plated nickel and pure tin to feature the superior leaching resistance during soldering.

**2. FEATURES**

- a. High reliability and stability.
- b. Small size and high capacitance.
- c. Safety standard approval by :  
 EN 60384-14 : 2013/A1 : 2016  
 IEC 60384-14 : 2013/AMD1 : 2016  
 UL 60384-14 (Ed 2.0) UL 62368-1 (2nd Edition)
- d. Certificate number :  
 R 50041666 & R 50359148 by TUV.  
 E346791 (FOWX2/8) by UL, E231248 by UL.
- e. CQC20001247849 by CQC (FK series)  
 CQC20001247848 by CQC (FH series)
- f. License No. ENEC-03020 (FK series)  
 License No. ENEC-03021 (FH series)
- g. RoHS and HALOGEN compliant.

**3. APPLICATIONS**

- a. Modem.
- b. Facsimile.
- c. Telephone.
- d. Other electronic equipment for lighting or surge protection and isolation.



**4. HOW TO ORDER**

| <u>FK</u>  | <u>08</u> | <u>N</u>   | <u>100</u>  | <u>J</u>  | <u>502</u>      | <u>E</u>  | <u>F</u>  | <u>G</u>      |
|------------|-----------|------------|-------------|-----------|-----------------|-----------|-----------|---------------|
| PDC Family | Size      | Dielectric | Capacitance | Tolerance | Impulse Voltage | Packaging | Thickness | Customer 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           |
| FK                 | Safety X1 & Y2 series |
| FH                 | Safety X2 series      |

| Table 6 Impulse Voltage |             |                    |             |      |             |
|-------------------------|-------------|--------------------|-------------|------|-------------|
| Code                    | Description | Code               | Description | Code | Description |
| 252<br>(FH06X)          | 2.5KV       | 302<br>(FH series) | 2.5KV       | 502  | 5KV         |
|                         |             |                    |             | 602  | 6KV         |

| Table 2 Size |             |      |             |      |             |
|--------------|-------------|------|-------------|------|-------------|
| Code         | Description | Code | Description | Code | Description |
| 06           | 1206 (3216) | 12   | 1812 (4532) | 20   | 2220 (5750) |
| 08           | 1808 (4520) | 21   | 2211 (5728) |      |             |

| Table 7 Packaging Type |             |      |               |
|------------------------|-------------|------|---------------|
| Code                   | Description | Code | Description   |
| B                      | Bulk        | E    | Embossed Tape |

| Table 3 Dielectric Material Characteristics |             |      |             |
|---|-------------|------|-------------|
| Code  | Description | Code | Description |
| N   | C0G         | X    | X7R         |

| Table 8 Thickness Description |              |      |              |      |              |
|-------------------------------|--------------|------|--------------|------|--------------|
| Code                          | Description  | Code | Description  | Code | Description  |
| C                             | 1.25±0.10 mm | E    | 1.60±0.20 mm | G    | 2.50±0.30 mm |
| D                             | 1.40±0.15 mm | F    | 2.00±0.20 mm | H    | 2.80±0.30 mm |

| Table 4 Capacitance Rule Code |             |      |                               |
|-------------------------------|-------------|------|-------------------------------|
| Code                          | Description | Code | Description                   |
| 0R5                           | 0.5pF       | 104  | 104=10x10 <sup>4</sup> =100nF |

| Table 9 Customer Code |   |      |             |          |              |
|-----------------------|---|------|-------------|----------|--------------|
| Code                  | Description   | Code | Description | Code     | Description  |
| G                     | RoHs compliant  | Q    | Anti-Arcing | E        | Anti-Bending |
| Z                     | Anti-Arcing+Anti-Bendin                               |      | A           | AEC-Q200 |              |
| M                     | AEC Q200 + Anti-Arcing                                |      |             |          |              |
| H                     | AEC Q200 + Anti-Arcing + Anti-Bending                 |      |             |          |              |
| S                     | Safety Certified MLCC with AEC-Q200, Soft termination |      |             |          |              |

| Table 5 Tolerance |             |      |             |      |             |
|-------------------|-------------|------|-------------|------|-------------|
| Code              | Description | Code | Description | Code | Description |
| A                 | ±0.05 pF    | D    | ±0.50 pF    | J    | ±5 %        |
| B                 | ±0.10 pF    | F    | ±1 %        | K    | ±10 %       |
| C                 | ±0.25 pF    | G    | ±2 %        | M    | ±20 %       |

### 5. EXTERNAL DIMENSIONS

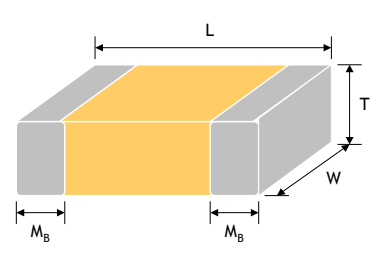
| Size Inch (mm) | L (mm)        | W (mm)    | Code / T (mm)              | M <sub>B</sub> (mm) |   |
|----------------|---------------|-----------|----------------------------|---------------------|---|
| 1206(3216)     | 3.30±0.40     | 1.60±0.20 | See No.4 Reference Table 8 | 0.50±0.25           |  |
| 1808(4520)     | 4.50+0.6/-0.3 | 2.00±0.30 |                            | 0.50±0.25           |   |
| 1812(4532)     | 4.50+0.6/-0.3 | 3.20±0.40 |                            | 0.50±0.25           |   |
| 2211(5728)     | 5.70±0.50     | 2.80±0.40 |                            | 0.60±0.30           |   |
| 2220(5750)     | 5.70±0.50     | 5.00±0.50 |                            | 0.60±0.30           |   |

Fig. 5.1 The outline of MLCC

### 6. GENERAL ELECTRICAL DATA

| Dielectric                         | C0G  |  | X7R  |                 |             |  |             |   |  |  |
|------------------------------------|--|--|--|-----------------|-------------|--|-------------|---|--|--|
| Size                               | 1808, 1812, 2211   |  | 1808, 1812, 2211, 2220   | 1206            |             |  |             |   |  |  |
| Rated voltage                      | 250Vac   |  |  | 2.5KVdc         |             |  |             |   |  |  |
| Capacitance range                  | X1/Y2 Class (Impulse 6KV) : 4pF ~ 100pF<br>X1/Y2 Class (Impulse 5KV) : 3pF ~ 720pF<br>X2 Class : 3pF ~ 1000pF  |  | X1/Y2 Class : 100pF ~ 4700pF<br>X2 Class : 100pF ~ 56000pF   | 100pF ~ 1000pF  |             |  |             |   |  |  |
| Capacitance tolerance              | <table border="1"> <thead> <tr> <th>Cap. Rang</th> <th>Tolerance Spec.</th> </tr> </thead> <tbody> <tr> <td>Cap.&lt;10pF</td> <td>A (±0.05pF), B (±0.1pF), C (±0.25pF)D (±0.5pF)</td> </tr> <tr> <td>10pF≤Cap.</td> <td>F (±1%), G (±2%), J (±5%), K (±10%), M (±20%)</td> </tr> </tbody> </table> |  | Cap. Rang  | Tolerance Spec. | Cap.<10pF   | A (±0.05pF), B (±0.1pF), C (±0.25pF)D (±0.5pF) | 10pF≤Cap.   | F (±1%), G (±2%), J (±5%), K (±10%), M (±20%) | J (±5%)<br>K (±10%)<br>M (±20%)                      |  |
| Cap. Rang                          | Tolerance Spec.  |  |  |                 |             |  |             |   |  |  |
| Cap.<10pF                          | A (±0.05pF), B (±0.1pF), C (±0.25pF)D (±0.5pF)   |  |  |                 |             |  |             |   |  |  |
| 10pF≤Cap.                          | F (±1%), G (±2%), J (±5%), K (±10%), M (±20%)  |  |  |                 |             |  |             |   |  |  |
| Tan δ                              | <table border="1"> <thead> <tr> <th>Cap. Range</th> <th>Q Spec.</th> </tr> </thead> <tbody> <tr> <td>Cap.&lt;30pF</td> <td>Q≥400+20C</td> </tr> <tr> <td>Cap.≥30pF</td> <td>Q≥1000</td> </tr> </tbody> </table>  |  | Cap. Range   | Q Spec.         | Cap.<30pF   | Q≥400+20C                                      | Cap.≥30pF   | Q≥1000  | ≤2.5%  |  |
| Cap. Range                         | 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 |                 |             |  |             |   |  |  |
|                                    | <table border="1"> <thead> <tr> <th>Cap. Rang</th> <th>Test Condition</th> </tr> </thead> <tbody> <tr> <td>Cap.≤1000pF</td> <td>1.0±0.2Vrms, 1.0MHz±10%</td> </tr> <tr> <td>Cap.&gt;1000pF</td> <td>1.0±0.2Vrms, 1.0KHz±10%</td> </tr> </tbody> </table>   |  | Cap. Rang  | Test Condition  | Cap.≤1000pF | 1.0±0.2Vrms, 1.0MHz±10%                        | Cap.>1000pF | 1.0±0.2Vrms, 1.0KHz±10%                       | 1.0±0.2Vrms, 1.0KHz±10%, at 25°C ambient temperature |  |
| Cap. Rang                          | Test Condition   |  |  |                 |             |  |             |   |  |  |
| Cap.≤1000pF                        | 1.0±0.2Vrms, 1.0MHz±10%  |  |  |                 |             |  |             |   |  |  |
| Cap.>1000pF                        | 1.0±0.2Vrms, 1.0KHz±10%  |  |  |                 |             |  |             |   |  |  |
| Insulation resistance              | ≥100GΩ or RxC≥1000Ω-F, whichever is smaller  |  | ≥10GΩ or RxC≥500Ω-F, whichever is smaller  |                 |             |  |             |   |  |  |
| Operating temperature              | -55°C to +125°C  |  |  |                 |             |  |             |   |  |  |
| Temperature coefficient            | ±30ppm /°C   |  | ±15%   |                 |             |  |             |   |  |  |
| Termination                        | Cu/Ni/Sn (lead-free termination)   |  |  |                 |             |  |             |   |  |  |

**7. CAPACITANCE RANGE**

| Class         |          | X1/Y2 (FK series)             |      |      |           |           |      |      |      | X2 (FH series) |      |      |      |      |      |          |
|---------------|----------|-------------------------------|------|------|-----------|-----------|------|------|------|----------------|------|------|------|------|------|----------|
| Rated voltage |          | 250Vac                        |      |      |           |           |      |      |      |                |      |      |      |      |      | 2.5KVdc  |
| Certificated  |          | TUV / UL / CQC (IEC 60384-14) |      |      |           |           |      |      |      |                |      |      |      |      |      | UL 62368 |
| Dielectric    |          | C0G                           |      |      |           | X7R       |      |      |      | C0G            |      |      | X7R  |      |      | X7R      |
| Cap.(pF)      | EIA Size | 1808                          | 1812 | 2211 | 2211      | 1808      | 1812 | 2211 | 2220 | 1808           | 1812 | 1808 | 1812 | 2220 | 1206 |          |
|               | Impulse  | 5KV (502)                     |      |      | 6KV (602) | 5KV (502) |      |      |      | 2.5KV (302)    |      |      |      |      |      | (252)    |
| 3.0           | 3R0      | D                             |      |      |           |           |      |      |      | D              |      |      |      |      |      |          |
| 3.3           | 3R3      | D                             |      |      |           |           |      |      |      |                |      |      |      |      |      |          |
| 4.0           | 4R0      | D                             |      | F    | F         |           |      |      |      | D              |      |      |      |      |      |          |
| 4.7           | 4R7      | D                             |      | F    | F         |           |      |      |      |                |      |      |      |      |      |          |
| 5.0           | 5R0      | D                             |      | F    | F         |           |      |      |      | D              |      |      |      |      |      |          |
| 5.6           | 5R6      | D                             |      | F    | F         |           |      |      |      |                |      |      |      |      |      |          |
| 6.0           | 6R0      | D                             |      | F    | F         |           |      |      |      | D              |      |      |      |      |      |          |
| 6.8           | 6R8      | D                             |      | F    | F         |           |      |      |      |                |      |      |      |      |      |          |
| 7.0           | 7R0      | D                             |      | F    | F         |           |      |      |      | D              |      |      |      |      |      |          |
| 8.0           | 8R0      | D                             |      | F    | F         |           |      |      |      | D              |      |      |      |      |      |          |
| 8.2           | 8R2      | D                             |      | F    | F         |           |      |      |      |                |      |      |      |      |      |          |
| 9.0           | 9R0      | D                             |      |      |           |           |      |      |      | D              |      |      |      |      |      |          |
| 10            | 100      | D                             | C    | F    | F         |           |      |      |      | D              | C    |      |      |      |      |          |
| 12            | 120      | D                             | C    | F    | F         |           |      |      |      | D              | C    |      |      |      |      |          |
| 15            | 150      | D                             | C    | F    | F         |           |      |      |      | D              | C    |      |      |      |      |          |
| 18            | 180      | D                             | C    | F    | F         |           |      |      |      | D              | C    |      |      |      |      |          |
| 22            | 220      | D                             | C    | F    | F         |           |      |      |      | D              | C    |      |      |      |      |          |
| 27            | 270      | D                             | C    | F    | F         |           |      |      |      | D              | C    |      |      |      |      |          |
| 33            | 330      | D                             | C    | F    | F         |           |      |      |      | D              | C    |      |      |      |      |          |
| 39            | 390      | E                             | C    | F    | F         |           |      |      |      | E              | C    |      |      |      |      |          |
| 47            | 470      | E                             | C    | F    | F         |           |      |      |      | E              | C    |      |      |      |      |          |
| 56            | 560      | E                             | C    | F    | F         |           |      |      |      | E              | C    |      |      |      |      |          |
| 68            | 680      | E                             | C    | F    | G         |           |      |      |      | E              | C    |      |      |      |      |          |
| 82            | 820      | E                             | C    | F    | G         |           |      |      |      | E              | C    |      |      |      |      |          |
| 100           | 101      | F                             | C    | F    | H         | E         |      | E    |      | F              | C    |      |      |      | C    |          |
| 120           | 121      | F                             | C    | G    |           | E*        |      | E*   |      | F              | C    |      |      |      | C    |          |
| 130           | 131      | F                             | C    |      |           |           |      | E*   |      |                |      |      |      |      | C    |          |
| 150           | 151      | F                             | C    | G    |           | E*        | E*   | E*   |      | F              | C    | E    |      |      | C    |          |
| 160           | 161      | F                             | C    | G    |           | E*        |      | F*   |      |                |      | E    |      |      | C    |          |
| 180           | 181      | F                             | C    | G    |           | E*        | E*   | E*   | F*   | F              | C    | E    |      |      | C    |          |
| 220           | 221      | F                             | F    | G    |           | E*        | E*   | E*   | F*   | F              | C    | E    |      |      | C    |          |
| 270           | 271      | F                             | F    | G    |           | F*        | E*   | E*   | F*   | F              | D    | E    | E    |      | C    |          |
| 300           | 301      |                               | F    |      |           |           |      |      |      |                |      | E    | E    |      | C    |          |
| 330           | 331      |                               | F    | G    |           | F*        | E*   | E*   | F*   | F              | D    | E    | E    |      | C    |          |
| 390           | 391      |                               | F    | G    |           | F*        | E*   | E*   | F*   | F              | D    | E    | E    |      | C    |          |
| 470           | 471      |                               | F    | G    |           | F*        | E*   | F*   | F*   | F              | E    | E    | E    |      | C    |          |
| 560           | 561      |                               |      | G    |           | F*        | E*   | F*   | F*   | F              | F    | E    | E    |      | C    |          |
| 680           | 681      |                               |      | G    |           | F*        | F*   | F*   | F*   | F              | F    | E    | E    |      | C    |          |
| 720           | 721      |                               |      |      |           |           |      |      | F*   | F              |      |      | E    |      | C    |          |
| 820           | 821      |                               |      |      |           | F*        | F*   | F*   | F*   | F              | G    | E    | E    |      | C    |          |
| 1000          | 102      |                               |      |      |           | F*        | G*   | G*   | F*   | F              | G    | F    | E    |      | C    |          |
| 1200          | 122      |                               |      |      |           |           |      | G*   | G*   |                |      | F    | E    |      |      |          |
| 1500          | 152      |                               |      |      |           |           |      | G*   | G*   |                |      | F    | F    |      |      |          |
| 1800          | 182      |                               |      |      |           |           |      | G*   | G*   |                |      | F    | F    |      |      |          |
| 2200          | 222      |                               |      |      |           |           |      | G*   | G*   |                |      | F    | G    |      |      |          |
| 2700          | 272      |                               |      |      |           |           |      | H*   | F/G* |                |      |      | G    |      |      |          |
| 3300          | 332      |                               |      |      |           |           |      |      | G*   |                |      |      | G    |      |      |          |
| 3900          | 392      |                               |      |      |           |           |      |      | G*   |                |      |      | G    |      |      |          |
| 4700          | 472      |                               |      |      |           |           |      |      | F/G* |                |      |      | G    |      |      |          |
| 5600          | 562      |                               |      |      |           |           |      |      |      |                |      |      | G    |      |      |          |
| 6800          | 682      |                               |      |      |           |           |      |      |      |                |      |      |      |      |      |          |
| 8200          | 822      |                               |      |      |           |           |      |      |      |                |      |      |      |      |      |          |
| 10000         | 103      |                               |      |      |           |           |      |      |      |                |      |      |      |      | G    |          |
| 12000         | 123      |                               |      |      |           |           |      |      |      |                |      |      |      |      | G    |          |
| 15000         | 153      |                               |      |      |           |           |      |      |      |                |      |      |      |      | G    |          |
| 18000         | 183      |                               |      |      |           |           |      |      |      |                |      |      |      |      | G    |          |
| 22000         | 223      |                               |      |      |           |           |      |      |      |                |      |      |      |      | H    |          |
| 27000         | 273      |                               |      |      |           |           |      |      |      |                |      |      |      |      | H*   |          |
| 33000         | 333      |                               |      |      |           |           |      |      |      |                |      |      |      |      | H*   |          |
| 39000         | 393      |                               |      |      |           |           |      |      |      |                |      |      |      |      | H*   |          |
| 47000         | 473      |                               |      |      |           |           |      |      |      |                |      |      |      |      | H*   |          |
| 56000         | 563      |                               |      |      |           |           |      |      |      |                |      |      |      |      | H*   |          |

\*\* Surface coating only.

Specification No. : FKFH-000-001-21

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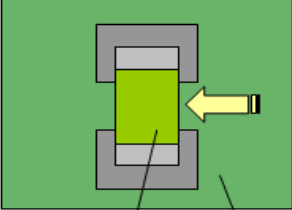
8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

| No.            | Item  | Standard Methods                              | Test Condition  | Requirements   |                 |                |                   |               |                   |   |               |   |                |              |               |   |                |   |
|----------------|---|---|---|--|-----------------|----------------|-------------------|---------------|-------------------|---|---------------|---|----------------|--------------|---------------|---|----------------|---|
| 1.             | Visual examination and Dimensions             | IEC 60384-1<br>4.1                            | ---   | * No remarkable defect.<br>* Dimensions to confirm to individual specification sheet.  |                 |                |                   |               |                   |   |               |   |                |              |               |   |                |   |
| 2.             | Capacitance                                   | IEC 60384-1<br>4.2.2                          |   | * Capacitance is within specified tolerance.<br>* $C_R$ means rated capacitance for conform to the E6 series of preferred values given in IEC 60063.   |                 |                |                   |               |                   |   |               |   |                |              |               |   |                |   |
| 3.             | Q/D.F. (Dissipation Factor)                   | IEC 60384-1<br>4.2.3                          | * Class I : (C0G)<br>Cap. ≤ 1000pF, 1.0 ± 0.2Vrms, 1MHz ± 10%.<br>Cap. > 1000pF, 1.0 ± 0.2Vrms, 1KHz ± 10%.<br><br>* Class II : (X7R)<br>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. &lt; 30pF</td> </tr> <tr> <td>Class II (X7R)</td> <td>D.F. ≤ 2.5%</td> <td>-</td> </tr> </tbody> </table> | Dielectric      | Q/D.F.         | Remark            | Class I (C0G) | Q ≥ 1000          | Cap. ≥ 30pF   | Q ≥ 400 + 20C | Cap. < 30pF   | Class II (X7R) | D.F. ≤ 2.5%  | -             |   |                |   |
| Dielectric     | Q/D.F.  | Remark  |   |  |                 |                |                   |               |                   |   |               |   |                |              |               |   |                |   |
| Class I (C0G)  | Q ≥ 1000                                      | Cap. ≥ 30pF                                   |   |  |                 |                |                   |               |                   |   |               |   |                |              |               |   |                |   |
|                | Q ≥ 400 + 20C                                 | Cap. < 30pF                                   |   |  |                 |                |                   |               |                   |   |               |   |                |              |               |   |                |   |
| Class II (X7R) | D.F. ≤ 2.5%                                   | -   |   |  |                 |                |                   |               |                   |   |               |   |                |              |               |   |                |   |
| 4.             | Temperature Coefficient                       | IEC 60384-21/22<br>4.6                        | * 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>±30ppm/°C</td> </tr> <tr> <td>X7R</td> <td>±15%</td> </tr> </tbody> </table> | T.C.          | Capacitance Change  | C0G            | ±30ppm/°C    | X7R           | ±15%  |                |   |
| T.C.           | Operating Temp.                               |   |   |  |                 |                |                   |               |                   |   |               |   |                |              |               |   |                |   |
| C0G            | -55~125°C at 25°C                             |   |   |  |                 |                |                   |               |                   |   |               |   |                |              |               |   |                |   |
| X7R            | -55~125°C at 25°C                             |   |   |  |                 |                |                   |               |                   |   |               |   |                |              |               |   |                |   |
| T.C.           | Capacitance Change                            |   |   |  |                 |                |                   |               |                   |   |               |   |                |              |               |   |                |   |
| C0G            | ±30ppm/°C                                     |   |   |  |                 |                |                   |               |                   |   |               |   |                |              |               |   |                |   |
| X7R            | ±15%  |   |   |  |                 |                |                   |               |                   |   |               |   |                |              |               |   |                |   |
| 5.             | Voltage proof (Dielectric Strength)           | IEC 60384-14<br>4.2.1                         | * To apply voltage :<br>X Capacitor : 1075Vdc (4.3U <sub>R</sub> ).<br>Y Capacitor : 1500Vac.<br>* Duration : 60 sec.<br>* The charge current shall not exceed 0.05A.<br>* The voltage shall be raised from the near zero to the test voltage a rate not exceeding 150V(r.m.s.)/sec.<br>* For FH06X series : 1500Vac / 1~5 sec.<br>* For FK20X series : 4000Vdc / 1~5 sec. (Validation by UL)<br>* For FK08X series : 3000Vdc / 1~5 sec. (Internal validation by PDC) | * No evidence of damage or flash over during test.   |                 |                |                   |               |                   |   |               |   |                |              |               |   |                |   |
| 6.             | Insulation Resistance                         | IEC 60384-21/22<br>4.5.3                      | <table border="1"> <thead> <tr> <th>Rated Vol.(V)</th> <th>Apply Voltage</th> <th>Charge Current</th> <th>Charge Time</th> </tr> </thead> <tbody> <tr> <td>&gt;500</td> <td>500Vdc</td> <td>≤50mA</td> <td>60 sec.</td> </tr> </tbody> </table>   | Rated Vol.(V)  | Apply Voltage   | Charge Current | Charge Time       | >500          | 500Vdc            | ≤50mA   | 60 sec.       | <table border="1"> <thead> <tr> <th>Dielectric</th> <th>Requirements</th> </tr> </thead> <tbody> <tr> <td>Class I (C0G)</td> <td>≥100GΩ or RxC ≥ 1000Ω-F, whichever is smaller</td> </tr> <tr> <td>Class II (X7R)</td> <td>≥10GΩ or RxC ≥ 500Ω-F, whichever is smaller</td> </tr> </tbody> </table> | Dielectric     | Requirements | Class I (C0G) | ≥100GΩ or RxC ≥ 1000Ω-F, whichever is smaller | Class II (X7R) | ≥10GΩ or RxC ≥ 500Ω-F, whichever is smaller |
| Rated Vol.(V)  | Apply Voltage                                 | Charge Current                                | Charge Time   |  |                 |                |                   |               |                   |   |               |   |                |              |               |   |                |   |
| >500           | 500Vdc  | ≤50mA   | 60 sec.   |  |                 |                |                   |               |                   |   |               |   |                |              |               |   |                |   |
| Dielectric     | Requirements                                  |   |   |  |                 |                |                   |               |                   |   |               |   |                |              |               |   |                |   |
| Class I (C0G)  | ≥100GΩ or RxC ≥ 1000Ω-F, whichever is smaller |   |   |  |                 |                |                   |               |                   |   |               |   |                |              |               |   |                |   |
| Class II (X7R) | ≥10GΩ or RxC ≥ 500Ω-F, whichever is smaller   |   |   |  |                 |                |                   |               |                   |   |               |   |                |              |               |   |                |   |
| 7.             | Solderability                                 | IEC 60384-21/22<br>4.10                       | * Solder temperature : 235 ± 5°C (1206).<br>* Solder temperature : 245 ± 5°C (1808~2220).<br>* Dipping time : 2.0 ± 0.5 sec.  | * 75% min. coverage of all metalized area.   |                 |                |                   |               |                   |   |               |   |                |              |               |   |                |   |
| 8.             | Resistance to Soldering Heat                  | IEC 60384-14<br>4.4<br>IEC 60384-21/22<br>4.9 | * Solder temperature : 260 ± 5°C.<br>* Dipping time : 10 ± 1 sec.<br>* Preheating : 120 to 150°C for 1 minute before immerse the capacitor in a eutectic solder.<br>* Measurement to be made after keeping at room temperature for 24 ± 2 hrs (Class I) and 48 ± 4 hrs (Class II).  | * Appearance :<br>No remarkable damage.<br>* Cap. change :<br>C0G within ±2.5% or ±0.25pF, whichever is larger.<br>X7R within ±7.5%.<br>* D.F. value :<br>C0G to meet initial requirement.<br>X7R to meet initial requirement.<br>* I.R. : ≥1GΩ.   |                 |                |                   |               |                   |   |               |   |                |              |               |   |                |   |

8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

| No.  | Item                              | Standard Methods                            | Test Condition   | Requirements   |           |            |   |                            |      |   |            |     |   |                            |      |   |            |     |   |
|------|-----------------------------------|---|--|--|-----------|------------|---|----------------------------|------|---|------------|-----|---|----------------------------|------|---|------------|-----|---|
| 9.   | Temperature Cycle                 | IEC 60384-21/22<br>4.11                     | <p>* Conduct the five cycles according to the temperatures and time.</p> <table border="1"> <thead> <tr> <th>Step</th> <th>Temp.(°C)</th> <th>Time(min.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min. operating temp. +0/-3</td> <td>30±3</td> </tr> <tr> <td>2</td> <td>Room temp.</td> <td>2~3</td> </tr> <tr> <td>3</td> <td>Max. operating temp. +3/-0</td> <td>30±3</td> </tr> <tr> <td>4</td> <td>Room temp.</td> <td>2~3</td> </tr> </tbody> </table> <p>* Measurement to be made after keeping at room temperature for 24±2 hrs (Class I) and 48±4 hrs (Class II).</p>   | Step   | Temp.(°C) | Time(min.) | 1 | Min. operating temp. +0/-3 | 30±3 | 2 | Room temp. | 2~3 | 3 | Max. operating temp. +3/-0 | 30±3 | 4 | Room temp. | 2~3 | <p>* Appearance :<br/>No remarkable damage.</p> <p>* Cap. change :<br/>C0G within ±2.5% or ±0.25pF, whichever is larger.<br/>X7R within ±7.5%.</p> <p>* D.F. value :<br/>C0G to meet initial requirement.<br/>X7R≤150% of initial requirement.</p> <p>* I.R. : To meet initial requirement.</p> |
| Step | Temp.(°C)                         | Time(min.)                                  |  |  |           |            |   |                            |      |   |            |     |   |                            |      |   |            |     |   |
| 1    | Min. operating temp. +0/-3        | 30±3  |  |  |           |            |   |                            |      |   |            |     |   |                            |      |   |            |     |   |
| 2    | Room temp.                        | 2~3   |  |  |           |            |   |                            |      |   |            |     |   |                            |      |   |            |     |   |
| 3    | Max. operating temp. +3/-0        | 30±3  |  |  |           |            |   |                            |      |   |            |     |   |                            |      |   |            |     |   |
| 4    | Room temp.                        | 2~3   |  |  |           |            |   |                            |      |   |            |     |   |                            |      |   |            |     |   |
| 10.  | Humidity (Damp Heat) Steady State | IEC 60384-14<br>4.12                        | <p>* Test temp. : 40±2°C.</p> <p>* Humidity : 90~95% RH.</p> <p>* Test time : 500 +24/-0hrs.</p> <p>* Applied voltage : 250Vac. (FH06X series without the voltage)</p> <p>* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) and 48±4 hrs (Class II).</p>   | <p>* Appearance :<br/>No remarkable damage.</p> <p>* Cap. change :<br/>C0G within ±3.0% or ±2.0pF, whichever is larger.<br/>X7R within ±15%.</p> <p>* D.F. value :<br/>C0G≤0.25%.<br/>X7R≤200%.</p> <p>* I.R. : ≥1GΩ or RxC≥25Ω-F, whichever is smaller.</p>   |           |            |   |                            |      |   |            |     |   |                            |      |   |            |     |   |
| 11.  | Passive Flammability              | IEC 60384-14<br>4.17<br>IEC 60384-1<br>4.38 | <p>* Volume sample : 21.56 mm<sup>3</sup></p> <p>* Flame exposure time : 5 sec. Max.</p> <p>* Category of flammability : C.</p>  | <p>* Capacitor didn't burn at all.<br/>(FH06X series not include)</p>  |           |            |   |                            |      |   |            |     |   |                            |      |   |            |     |   |
| 12.  | Active Flammability               | IEC 60384-14<br>4.17<br>IEC 60384-1<br>4.38 | <p>* The capacitors applied UR (250Vac). Then each sample shall be subjected to 20 discharges from a tank capacitor, charge to a voltage that, when discharged, places U<sub>i</sub> 2500V for X2, U<sub>i</sub> 5000V for X1Y2 across the capacitor under test. The interval between successive discharges shall be 5 sec.</p>  | <p>* The cheese cloth shall not burn with a flame.<br/>(FH06X series not include)</p>  |           |            |   |                            |      |   |            |     |   |                            |      |   |            |     |   |
| 13.  | High Temperature Load (Endurance) | IEC 60384-14<br>4.14                        | <p>* Impulse Voltage :<br/>Each individual capacitor shall be subjected to a V<sub>p</sub> = 5.0KV (X1Y2 Class Impulse 5KV) or V<sub>p</sub> = 2.5KV (X2 Class Impulse 2.5KV) impulse for three times before applied to endurance test.</p> <p>* Test temp. : 125±3°C.</p> <p>* Test time : 1000 +48/-0 hrs.</p> <p>* Applied voltage :<br/>X capacitor : 1.25U<sub>R</sub> (312.5Vac).<br/>Y capacitor : 1.70U<sub>R</sub> (425Vac).<br/>Once every hour the voltage shall be increased to 1000V<sub>rms</sub> for 0.1 sec.</p> <p>* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) and 48±4 hrs (Class II).</p> <p>For FH06X series :<br/>* Test temp. : 125±3°C.<br/>* To apply voltage : 2.5KVdc.<br/>* Test time : 1000 +24/-0 hrs.<br/>* Measurement to be made after keeping at room temp. for 48±4 hrs.</p> | <p>* Appearance :<br/>No mechanical damage.</p> <p>* Cap. change :<br/>C0G within ±5.0% or ±0.5pF, whichever is larger.<br/>X7R within ±20%.</p> <p>* D.F. value :<br/>C0G≤0.25%.<br/>X7R≤5.0%.</p> <p>* I.R. : ≥1GΩ.</p> <p>* Dielectric strength satisfies the specified initial value. (FH06X series not include)</p> |           |            |   |                            |      |   |            |     |   |                            |      |   |            |     |   |

8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

| No.            | Item  | Standard Methods                               | Test Condition   | Requirements  |            |             |
|----------------|---|--|--|---|------------|-------------|
| 14.            | Resistance to Flexure of Substrate          | IEC 60384-21/22<br>4.8                         | *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.<br>* Anti-bend : 3mm.<br>*Measurement to be made after keeping at room temp. for 24±2hrs.  | * No remarkable damage.   |            |             |
|                |   |  |  | <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> (This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test) | Dielectric | Cap. Change |
| Dielectric     | Cap. Change                                 |  |  |   |            |             |
| Class I (C0G)  | Within ±3.0% or ±2.0pF, whichever is larger |  |  |   |            |             |
| Class II (X7R) | Within ±12.5%                               |  |  |   |            |             |
| 15.            | Adhesive Strength of Termination            | IEC 60384-21/22<br>4.15<br>IEC 60384-1<br>4.13 | * 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 10±1 sec.<br><br>   | * No remarkable damage or removal of the terminations.  |            |             |
| 16.            | Vibration                                   | IEC 60384-1<br>4.17                            | * Reflow solder the capacitors on P. C. Board before test.<br>* Vibration frequency : 10~55 Hz/min.<br>* Total amplitude : 1.5mm.<br>* Repeat the conditions for 2 hours each in 3 perpendicular directions.<br>* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) and 48±4 hrs (Class II). | * No remarkable damage.<br>* Cap. change and Q/D.F. : To meet initial spec.   |            |             |



**9. PACKAGE DIMENSION AND QUANTITY**

| Size       | Thickness (mm) | Plastic tape |          |
|------------|----------------|--------------|----------|
|            |                | 7" reel      | 13" reel |
| 1206(3216) | 1.25±0.10      | 3k           | 10k      |
| 1808(4520) | 1.25±0.10      | 2k           | 10k      |
|            | 1.40±0.15      | 2k           | 10k      |
|            | 1.60±0.20      | 2k           | 8k       |
|            | 2.00±0.20      | 1k           | 6k       |
| 1812(4532) | 1.25±0.10      | 1k           | 5k       |
|            | 1.40±0.15      | 1k           | 4k       |
|            | 1.60±0.20      | 1k           | 4k       |
|            | 2.00±0.20      | 1k           | 3k       |
|            | 2.50±0.30      | 0.5k         | 3k       |
|            | 2.80±0.30      | 0.5k         |          |
| 2211(5728) | 1.60±0.20      | 1k           | 4k       |
|            | 2.00±0.20      | 1k           | 3k       |
|            | 2.50±0.30      | 0.5k         | 3k       |
|            | 2.80±0.30      | 0.5k         | -        |
| 2220(5750) | 2.00±0.20      | 1k           | 3k       |
|            | 2.50±0.30      | 0.5k         | 2k       |
|            | 2.80±0.30      | 0.5k         | 2k       |

| REEL DIMENSIONS |                   |   |
|-----------------|-------------------|---|
| Size            | 1206              | 1808, 1812, 2211, 2220                            |
| Reel size       | 7"                | 7"  |
| C               | 13.0<br>+0.5/-0.2 | 13.0<br>+0.5/-0.2                                 |
| W <sub>1</sub>  | 8.4<br>+1.5/-0    | 12.4<br>+2.0/-0                                   |
| W               | 14.4max           | shall accommodate tape width without interference |
| A               | 178.0<br>±0.1     | 178.0<br>±0.1                                     |
| N               | 60.0<br>+1.0/-0   | 60.0<br>+1.0/-0                                   |

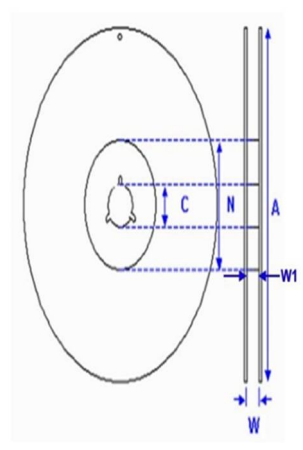


Fig. 9.1 The dimension of reel

**9.1. EMBOSSED TAPE DIMENSIONS**

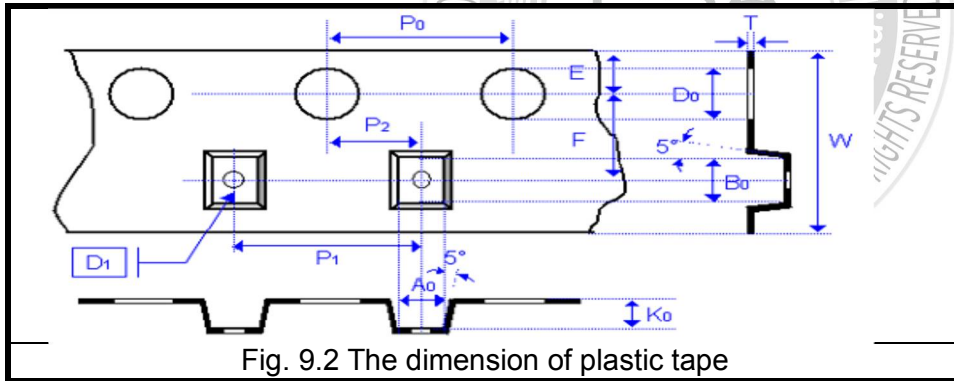


Fig. 9.2 The dimension of plastic tape

| Size              | 1206         | 1808                                |              | 1812   |              | 2211                   |                        | 2220         |                        |
|-------------------|--------------|-------------------------------------|--------------|--|--------------|------------------------|------------------------|--------------|------------------------|
| Chip Thickness    | 1.25±0.10    | 1.25±0.10<br>1.40±0.15<br>1.60±0.20 | 2.00±0.20    | 1.25±0.10<br>1.40±0.15<br>1.60±0.20<br>2.00±0.20 | 2.50±0.30    | 1.60±0.20<br>2.00±0.20 | 2.50±0.30<br>2.80±0.30 | 2.00±0.20    | 2.50±0.30<br>2.80±0.30 |
| A <sub>0</sub>    | <2.00        | <2.50                               | <2.50        | <3.90  | <3.90        | <3.30                  | <3.30                  | <5.80        | <5.80                  |
| B <sub>0</sub>    | <3.60        | <5.30                               | <5.30        | <5.30  | <5.30        | <6.50                  | <6.50                  | <6.50        | <6.50                  |
| T                 | 0.23±0.05    | 0.25±0.05                           | 0.25±0.05    | 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 <sub>0</sub>    | <2.50        | <2.50                               | <2.50        | <2.50  | <3.00        | <2.50                  | <3.10                  | <2.50        | <3.10                  |
| W                 | 8.00±0.10    | 12.00±0.20                          | 12.00±0.20   | 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 <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              |
| 10xP <sub>0</sub> | 40.00±0.20   | 40.00±0.20                          | 40.00±0.20   | 40.00±0.20                                       | 40.00±0.20   | 40.00±0.20             | 40.00±0.20             | 40.00±0.20   | 40.00±0.20             |
| P <sub>1</sub>    | 4.00±0.10    | 4.00±0.10                           | 4.00±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              |
| D <sub>0</sub>    | 1.50+0.10/-0 | 1.50+0.10/-0                        | 1.50+0.10/-0 | 1.50+0.10/-0                                     | 1.50+0.10/-0 | 1.50+0.10/-0           | 1.50+0.10/-0           | 1.50+0.10/-0 | 1.50+0.10/-0           |
| D <sub>1</sub>    | 1.00±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±0.10    | 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    | 1.75±0.10              |
| F                 | 3.50±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              |
| Unit :            | mm           | mm                                  | mm           | mm   | mm           | mm                     | mm                     | mm           | mm                     |

**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.

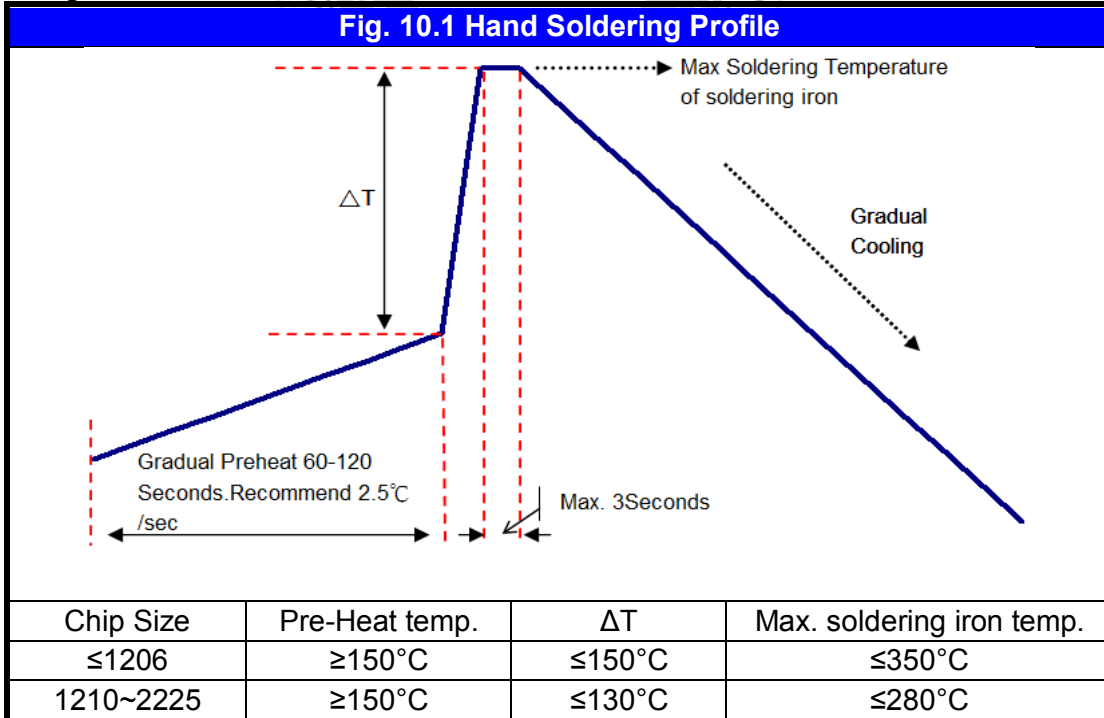
**PREHEAT**

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.

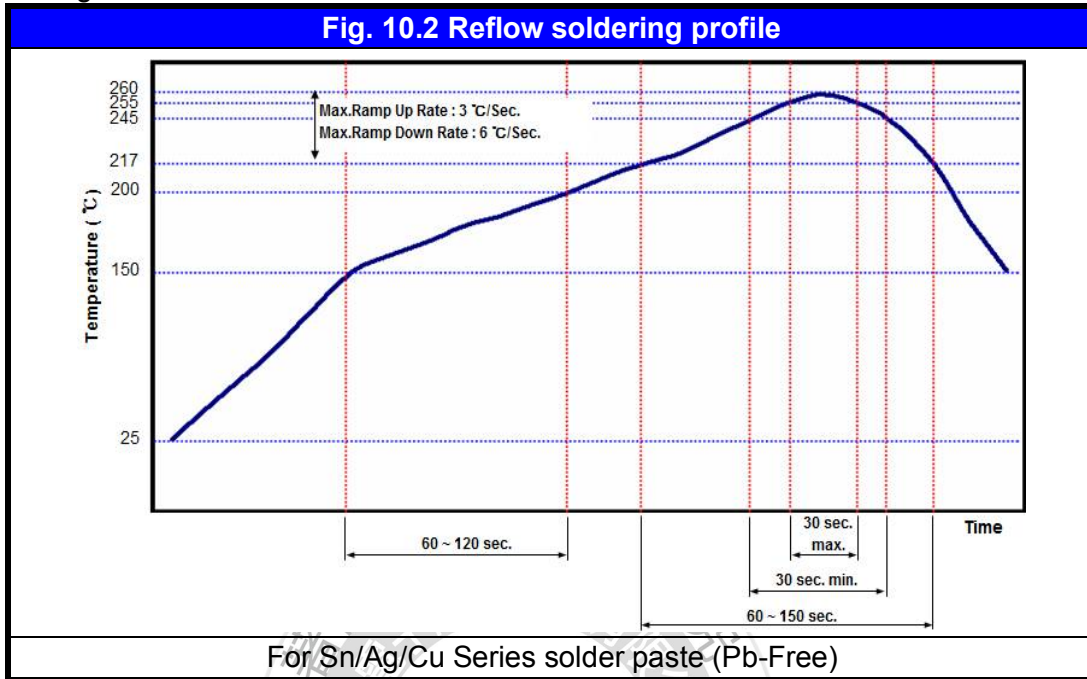
a.) Hand soldering :



- \* 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 :

Do not apply wave soldering for size >1206 products, the condition for FH06X series products please contact with our sales representative.

Soldering height :

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

**COOLING**

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

**CLEANING**

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

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