

TO. : \_\_\_\_\_

NO. : M171222



# APPROVAL SHEET

ITEM : MONOLITHIC MULTILAYER  
CERAMIC CAPACITOR  
(Thin Layer Large-Capacitance Type)

Approved by customer : (signing or stamping here)

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|--|

| SAMWHA CAPACITOR CO., LTD.                                                          |                                                                                     |                                                                                      |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Writtern by                                                                         | Checked by                                                                          | Approved by                                                                          |
|  |  |  |

2017. 12. 22.



**SAMWHA CAPACITOR CO., LTD.**

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Home page : [www.samwha.com](http://www.samwha.com)

## < SPEC SUMMARY >

| SAMWHA Part no.       | CS1608X7R105K250NRB          |            |                                                                                                                            |
|-----------------------|------------------------------|------------|----------------------------------------------------------------------------------------------------------------------------|
| Type                  | Thin Layer Large-Capacitance |            |                                                                                                                            |
| Item                  | Specification                | Unit       | Test methods and Conditions(Capacitance,IR)                                                                                |
| Capacitance           | 1                            | $\mu F$    | Testing Frequency : 1 $\pm$ 0.1kHz<br>Testing Voltage : 1 $\pm$ 0.2Vrms                                                    |
| Capacitance Tolerance | $\pm 10$                     | %          |                                                                                                                            |
| Dissipation Factor    | Max. 12.5                    | %          |                                                                                                                            |
| Insulation Resistance | More than 50                 | M $\Omega$ | Applied the rated voltage for 2 minutes of charging.                                                                       |
| Chip Size             | 1.60 $\pm$ 0.15              | L (mm)     | *Capacitance Tolerance Code ---- page 1/8<br>*Chip size ----- page 2/8<br>*Characteristics & Test Method----- page 3/8~5/8 |
|                       | 0.80 $\pm$ 0.10              | W (mm)     |                                                                                                                            |
|                       | 0.80 $\pm$ 0.10              | T (mm)     |                                                                                                                            |

|                              |                                                          |      |              |
|------------------------------|----------------------------------------------------------|------|--------------|
| Enactment :<br>March 27,1996 | STANDARD                                                 | NO   | SW - M - 04B |
|                              | MONOLITHIC MULTILAYER<br>CERAMIC CAPACITOR LEADLESS TYPE | Page | 1 / 8        |

## 1. General Article

### Application Range

These specifications refer to the "Monolithic Multilayer Ceramic Capacitors Leadless Type "mainly used to the computer equipment, communication equipment.

**\*Caution : Industrial equipment / For the high reliability equipment / LED equipment / Etc.**  
**Please contact sales representatives or product engineers before using the products.**  
**(For details, please refer Page 8)**

## 2. General Code

### (1) Type Designation

|           |             |            |            |          |            |          |          |          |
|-----------|-------------|------------|------------|----------|------------|----------|----------|----------|
| <u>CS</u> | <u>1608</u> | <u>X7R</u> | <u>105</u> | <u>K</u> | <u>250</u> | <u>N</u> | <u>R</u> | <u>B</u> |
| (1)       | (2)         | (3)        | (4)        | (5)      | (6)        | (7)      | (8)      | (9)      |

1) Monolithic Multilayer Ceramic Capacitor Leadless Type

2) Size Code :

This is expressed in tens of a millimeter.

The first two digits are the length, The last two digits are width.

3) Temperature Coefficient Code

| Classification | Code | Temperature Range | Capacitance Tolerance |
|----------------|------|-------------------|-----------------------|
| Class I        | C0G  | -55 to +125℃      | ±30 ppm/℃             |
| Class II       | X5R  | -55 to +85℃       | ±15%                  |
|                | X7R  | -55 to +125℃      | ±15%                  |
|                | Y5V  | -30 to +85℃       | +22% ~ -82%           |

4) Capacitance Code(Pico farads) :

The nominal Capacitance Value in pF is expressed by three digit numbers.

The first two digits represents significant figures and the last digit denotes the number of zero

ex) 104 = 100000 pF

R denotes decimal

8R2 = 8.2 pF

5) Capacitance Tolerance Code

| Code | Tolerance |
|------|-----------|
| B    | ± 0.1 pF  |
| C    | ± 0.25 pF |
| D    | ± 0.5 pF  |
| F    | ± 1.0 %   |
| G    | ± 2.0 %   |
| J    | ± 5 %     |
| K    | ± 10 %    |

| Code | Tolerance    |
|------|--------------|
| M    | ± 20 %       |
| P    | + 100, - 0%  |
| Z    | + 80, - 20%  |
| H    | + 0.25/-0 pF |
| I    | + 0/-0.25 pF |
| U    | + 5/-0 %     |
| V    | + 0/-5 %     |

## 6) Voltage Code

| code | 6R3        | 100       | 160       | 250       | 500       | 101        | 201        | 251        | 501        | 631        | 102       | 202       | 302       |
|------|------------|-----------|-----------|-----------|-----------|------------|------------|------------|------------|------------|-----------|-----------|-----------|
| Vol. | DC<br>6.3V | DC<br>10V | DC<br>16V | DC<br>25V | DC<br>50V | DC<br>100V | DC<br>200V | DC<br>250V | DC<br>500V | DC<br>630V | DC<br>1KV | DC<br>2KV | DC<br>3KV |

## 7) Termination Code

ex) N : Ni-Sn (Nickel-Tin Plate)

A : Ag/Ni-Sn (Ag Epoxy/Nickel-Tin Plate)

## 8) Packing Code

ex) R : 7" Reel Type

L : 13" Reel Type

B : Bulk Type

## 9) Thickness option (Cu, Ag Epoxy)

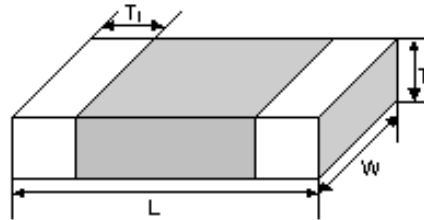
| Thickness(mm) |        | Code  | Thickness(mm) |        | Code |
|---------------|--------|-------|---------------|--------|------|
| t             | Tol(±) |       | t             | Tol(±) |      |
| 0.30          | 0.03   | Blank | 1.30          | 0.20   | E    |
| 0.50          | 0.05   | Blank | 1.35          | 0.20   | H    |
| 0.60          | 0.10   | A     | 1.60          | 0.20   | I    |
| 0.80          | 0.10   | B     | 1.80          | 0.20   | J    |
| 0.85          | 0.15   | B     | 2.00          | 0.25   | K    |
| 1.00          | 0.15   | E     | 2.50          | 0.25   | L    |
| 1.10          | 0.15   | E     | 2.80          | 0.30   | M    |
| 1.15          | 0.15   | E     | 3.20          | 0.30   | N    |
| 1.25          | 0.15   | E     | 5.00          | 0.40   | O    |

## 3. Temperature Characteristics

See Page 5/8 (No.13)

## 4. Constructions and Dimensions

## (I) Dimensions



(Unit : mm)

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\*1005 Size  $\geq 4.7\mu F \Rightarrow L, W, T : Tol \pm 0.15$ \*1608 Size  $\geq 10\mu F \Rightarrow W : 0.80 \pm 0.15, T : 0.80 \pm 0.15$ \*2012 Size  $\geq 10\mu F \Rightarrow W : 1.25 \pm 0.20, T : 0.85 \pm 0.15$ \*3216 Size  $\geq 47\mu F \Rightarrow W : 1.60 \pm 0.30, T : 1.60 \pm 0.30$ 

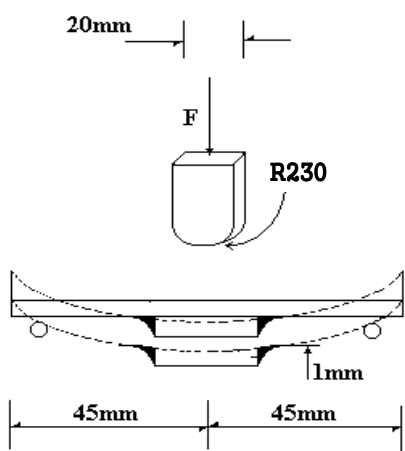
## (2) Construction of Termination



(Inner Electrode : Ni Type I) (Inner Electrode : Ni Type II) (Inner Electrode : Ag/pd Type)

## Specifications and Test Methods (Thin Layer Large-Capacitance Type)

| No.                | Item                                                             |                    | Specification                                                    | Test Methods and Conditions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |                            |           |        |            |             |                            |            |                            |           |            |      |       |      |       |
|--------------------|------------------------------------------------------------------|--------------------|------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------------|-----------|--------|------------|-------------|----------------------------|------------|----------------------------|-----------|------------|------|-------|------|-------|
| 1                  | Operating Temperature Range                                      |                    | X7R : -55 to +125℃<br>X5R : -55 to +85℃<br>Y5V : -30 to +85℃     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                            |           |        |            |             |                            |            |                            |           |            |      |       |      |       |
| 2                  | Insulation Resistance                                            |                    | 50Ω·F min                                                        | ·Applied the rated voltage for 2 minutes of charging,<br>The charge/discharge current is less than 50mA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |             |                            |           |        |            |             |                            |            |                            |           |            |      |       |      |       |
| 3                  | Dielectric Strength                                              |                    | No defects or abnormalities                                      | X7R, X5R, Y5V : The rated voltage × 250%<br>– Applied between the terminations for 1 to 5 seconds.<br>– The charge/discharge current is less than 50mA.                                                                                                                                                                                                                                                                                                                                                                                                                       |             |                            |           |        |            |             |                            |            |                            |           |            |      |       |      |       |
| 4                  | Capacitance                                                      |                    | within the specified tolerance                                   | The capacitance/D.F. should be measured at 25℃ at the frequency and voltage shown in the table.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                            |           |        |            |             |                            |            |                            |           |            |      |       |      |       |
| 5                  | Dissipation Factor                                               |                    | X7R, X5R : 12.5%max<br>*3216 Size 100μF : 15%max<br>Y5V : 20%max | <table><tr><td>Capacitance</td><td>Frequency</td><td>Voltage</td></tr><tr><td>C≤10μF</td><td>1 ± 0.1kHz</td><td>0.5~1.0Vrms</td></tr><tr><td>C&gt;10μF</td><td>120 ± 24Hz</td><td>0.5±0.1Vrms</td></tr></table><br>· Initial measurement<br>Perform the initial measurement according to Note1 for Class II<br>· Measurement after test<br>Take it out and set it for 24±2 hours (Class II) then measure                                                                                                                                                                      | Capacitance | Frequency                  | Voltage   | C≤10μF | 1 ± 0.1kHz | 0.5~1.0Vrms | C>10μF                     | 120 ± 24Hz | 0.5±0.1Vrms                |           |            |      |       |      |       |
| Capacitance        | Frequency                                                        | Voltage            |                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                            |           |        |            |             |                            |            |                            |           |            |      |       |      |       |
| C≤10μF             | 1 ± 0.1kHz                                                       | 0.5~1.0Vrms        |                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                            |           |        |            |             |                            |            |                            |           |            |      |       |      |       |
| C>10μF             | 120 ± 24Hz                                                       | 0.5±0.1Vrms        |                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                            |           |        |            |             |                            |            |                            |           |            |      |       |      |       |
| 6                  | Solderability of Termination                                     |                    | –Termination should be covered with more than 75% of new solder  | *Pb-Free type<br>Solder : 96.5Sn-3Ag-0.5Cu<br>Solder temperature : 245±5℃<br>Immersion time : 3±0.1sec<br>*Pre-Heating : at 80~120℃ for 10~30sec                                                                                                                                                                                                                                                                                                                                                                                                                              |             |                            |           |        |            |             |                            |            |                            |           |            |      |       |      |       |
| 7                  | Resistance to Soldering Heat                                     | Appearance         | No marking defects                                               | Preheat the capacitor at 120 to 150℃ for 1 minute.<br>(Preheating for 3225,4520,4532<br>Step1:100℃ to 120℃, 1min<br>Step2:170℃ to 200℃, 1min )<br>Immerse the capacitor in a eutectic solder solution at 260±5℃ for 10±0.5 seconds.<br><br>·Initial measurement<br>Perform the initial measurement according to Note1 for Class II<br>·Measurement after test<br>Let sit at room temperature for 24±2 hours,then measure.                                                                                                                                                     |             |                            |           |        |            |             |                            |            |                            |           |            |      |       |      |       |
|                    |                                                                  | Capacitance change | X7R, X5R : Within±7.5%<br>Y5V : Within±20%                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                            |           |        |            |             |                            |            |                            |           |            |      |       |      |       |
|                    |                                                                  | Dissipation Factor | X7R, X5R : 12.5%max<br>*3216 Size 100μF : 15%max<br>Y5V : 20%max |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                            |           |        |            |             |                            |            |                            |           |            |      |       |      |       |
|                    |                                                                  | I.R.               | 50Ω·F min                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                            |           |        |            |             |                            |            |                            |           |            |      |       |      |       |
| 8                  | Temperature Cycle                                                | Appearance         | No marking defects                                               | Perform the five cycles according to the four heat treatments listed in the following table.<br><table><tr><td>Step</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>Temp (℃)</td><td>Min. operating temp. +0/-3</td><td>Room Temp</td><td>Max. operating temp. +3/-0</td><td>Room Temp</td></tr><tr><td>Time (min)</td><td>30±3</td><td>2 to3</td><td>30±3</td><td>2 to3</td></tr></table><br>·Initial measurement<br>Perform the initial measurement according to Note1 for Class II<br>·Measurement after test<br>Perform the final measurement according to Note2 | Step        | 1                          | 2         | 3      | 4          | Temp (℃)    | Min. operating temp. +0/-3 | Room Temp  | Max. operating temp. +3/-0 | Room Temp | Time (min) | 30±3 | 2 to3 | 30±3 | 2 to3 |
|                    |                                                                  | Step               | 1                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 2           | 3                          | 4         |        |            |             |                            |            |                            |           |            |      |       |      |       |
|                    |                                                                  | Temp (℃)           | Min. operating temp. +0/-3                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Room Temp   | Max. operating temp. +3/-0 | Room Temp |        |            |             |                            |            |                            |           |            |      |       |      |       |
|                    |                                                                  | Time (min)         | 30±3                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 2 to3       | 30±3                       | 2 to3     |        |            |             |                            |            |                            |           |            |      |       |      |       |
| Capacitance Change | X7R, X5R : Within ±7.5%<br>Y5V : Within ±20%                     |                    |                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                            |           |        |            |             |                            |            |                            |           |            |      |       |      |       |
| Dissipation Factor | X7R, X5R : 12.5%max<br>*3216 Size 100μF : 15%max<br>Y5V : 20%max |                    |                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                            |           |        |            |             |                            |            |                            |           |            |      |       |      |       |
| I.R                | 50Ω·F min                                                        |                    |                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                            |           |        |            |             |                            |            |                            |           |            |      |       |      |       |

| No. | Item                  | Specification                                                                                                                        | Test Methods and Conditions                                                                      |
|-----|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| 9   | High Temperature Load | Appearance                                                                                                                           | No marking defects                                                                               |
|     |                       | Capacitance Change                                                                                                                   | X7R, X5R : Within $\pm 12.5\%$<br>Y5V : Within $\pm 30\%$                                        |
|     |                       | Dissipation Factor                                                                                                                   | X7R, X5R : 20%max<br>*3216 Size 100 $\mu$ F : 30%max<br>Y5V : 40%max                             |
|     |                       | I.R                                                                                                                                  | 12.5 $\Omega$ ·F min                                                                             |
| 10  | Bending strength      |  <p>No cracking or marking defects shall occur</p> |                                                                                                  |
|     |                       | Capacitance Change                                                                                                                   | X7R, X5R: Within $\pm 12.5\%$<br>Y5V : Within $\pm 30\%$<br>Within +30/-40% (cap $\geq 10\mu$ F) |
| 11  | Vibration Resistance  | Appearance                                                                                                                           | No defects or abnormalities                                                                      |
|     |                       | Capacitance                                                                                                                          | Whin the specified tolerance                                                                     |
|     |                       | Dissipation Factor                                                                                                                   | X7R, X5R : 12.5%max<br>*3216 Size 100 $\mu$ F : 15%max<br>Y5V : 20%max                           |
| 12  | Humidity Load         | Appearance                                                                                                                           | No marking defects                                                                               |
|     |                       | Capacitance Change                                                                                                                   | X7R, X5R: Within $\pm 12.5\%$<br>Y5V : Within $\pm 30\%$                                         |
|     |                       | Dissipation Factor                                                                                                                   | X7R, X5R : 20%max<br>*3216 Size 100 $\mu$ F : 30%max<br>Y5V : 40%max                             |
|     |                       | I.R.                                                                                                                                 | 12.5 $\Omega$ ·F min                                                                             |

| No. | Item                                          | Specification |              |                    |                 | Test Methods and Conditions                                                                                                                                                                                                                                  |
|-----|-----------------------------------------------|---------------|--------------|--------------------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13  | Capacitance<br>Temperature<br>Characteristics | Char.         | Temp. Range  | Reference<br>Temp. | Cap. Change     | <p>The capacitance change should be measured after 5 min. at each specified temperature stage.</p> <p>The ranges of capacitance change compared with the 25℃ value over the temperature ranges shown in the table should be within the specified ranges.</p> |
|     |                                               | X5R           | -55 to +85℃  | 25℃                | Within ±15%     |                                                                                                                                                                                                                                                              |
|     |                                               | X7R           | -55 to +125℃ | 25℃                | Within ±15%     |                                                                                                                                                                                                                                                              |
|     |                                               | Y5V           | -30 to +85℃  | 25℃                | Within +22/-82% |                                                                                                                                                                                                                                                              |

\*Note1. Initial Measurement for Class II

Perform a heat treatment at 150+0,-10℃ for one hour and then let sit for 24±2 hours at room temperature, then measure

\*Note2. Measurement after test

Class II

Perform a heat treatment at 150+0,-10℃ for one hour and then let sit for 24±2 hours at room temperature, then measure.

## 5. Packing

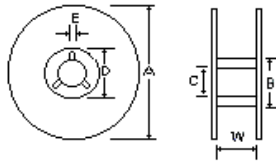
### (1) Bulk packing

- ① 1000 pcs per Polybag
- ② 5 Polybags per Inner box
- ③ 10 Inner boxes per Out box

### (2) Reel Packing

- ① 8~10 Reels per Inner box
- ② 6 Inner boxes per Out box

### (3) Reel Dimensions



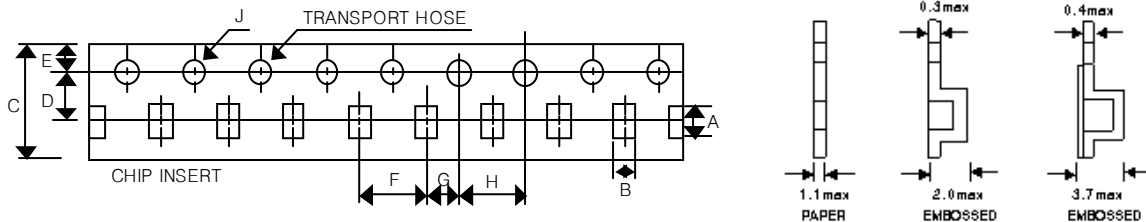
(Unit : mm)

| MARK      | SIZE      | A                 | B                    | C                 | D                 | E           | W            |
|-----------|-----------|-------------------|----------------------|-------------------|-------------------|-------------|--------------|
| 7 " REEL  | 0603~3225 | $\Phi 178 \pm 2$  | $\Phi 50 \text{Min}$ | $\Phi 13 \pm 0.5$ | $\Phi 21 \pm 0.8$ | $2 \pm 0.5$ | $10 \pm 1.5$ |
|           | 4520~4532 | $\Phi 180 +0, -3$ | $\Phi 60 -0, +1$     | $\Phi 13 \pm 0.2$ | $\Phi 57 -0 +1$   | $3 \pm 0.2$ | $13 \pm 0.5$ |
| 13 " REEL | 1005~3225 | $\Phi 330 \pm 2$  | $\Phi 70 \text{Min}$ | $\Phi 13 \pm 0.5$ | $\Phi 21 \pm 0.8$ | $2 \pm 0.5$ | $10 \pm 1.5$ |

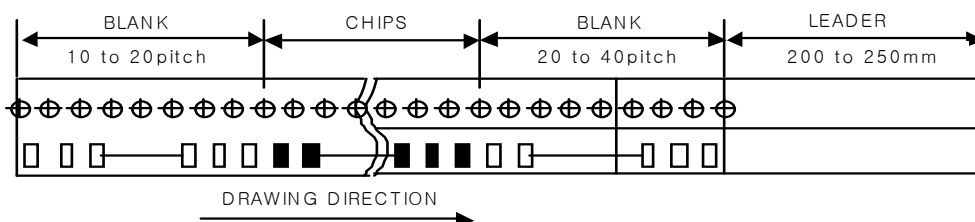
### (4) Number of Package

| TYPE   | EIA CODE | 7"            | 13"            |
|--------|----------|---------------|----------------|
|        |          | Qt/REEL       | Qt/REEL        |
| CS0603 | CC0201   | 15,000        |                |
| CS1005 | CC0402   | 10,000        | 50,000         |
| CS1608 | CC0603   | 4,000         | 16,000         |
| CS2012 | CC0805   | 3,000 ~ 4,000 | 10,000         |
| CS3216 | CC1206   | 2,000 ~ 4,000 | 6,000 ~ 10,000 |
| CS3225 | CC1210   | 1,000 ~ 3,000 | 4,000 ~ 10,000 |
| CS4520 | CC1808   | 1,500 ~ 3,000 | -              |
| CS4532 | CC1812   | 500 ~ 1,000   | 1,500 ~ 5,000  |

### (5) Tape Dimensions



| TYPE   | EIA CODE | A               | B               | C              | D              | E              | F                              | G             | H             | J             |
|--------|----------|-----------------|-----------------|----------------|----------------|----------------|--------------------------------|---------------|---------------|---------------|
| CS0603 | CC0201   | $0.67 \pm 0.05$ | $0.37 \pm 0.05$ | $8.0 \pm 0.3$  | $3.5 \pm 0.05$ | $1.75 \pm 0.1$ | $2.0 \pm 0.05$                 | $2.0 \pm 0.1$ | $4.0 \pm 0.1$ | $1.5 \pm 0.1$ |
| CS1005 | CC0402   | $1.15 \pm 0.1$  | $0.65 \pm 0.1$  | $8.0 \pm 0.3$  | $3.5 \pm 0.05$ | $1.75 \pm 0.1$ | $2.0 \pm 0.05$                 | $2.0 \pm 0.1$ | $4.0 \pm 0.1$ | $1.5 \pm 0.1$ |
| CS1608 | CC0603   | $1.9 \pm 0.2$   | $1.10 \pm 0.2$  | $8.0 \pm 0.3$  | $3.5 \pm 0.05$ | $1.75 \pm 0.1$ | $4.0 \pm 0.1$                  | $2.0 \pm 0.1$ | $4.0 \pm 0.1$ | $1.5 \pm 0.1$ |
| CS2012 | CC0805   | $2.4 \pm 0.2$   | $1.65 \pm 0.2$  | $8.0 \pm 0.3$  | $3.5 \pm 0.05$ | $1.75 \pm 0.1$ | $4.0 \pm 0.1$                  | $2.0 \pm 0.1$ | $4.0 \pm 0.1$ | $1.5 \pm 0.1$ |
| CS3216 | CC1206   | $3.6 \pm 0.2$   | $2.00 \pm 0.2$  | $8.0 \pm 0.3$  | $3.5 \pm 0.05$ | $1.75 \pm 0.1$ | $4.0 \pm 0.1$                  | $2.0 \pm 0.1$ | $4.0 \pm 0.1$ | $1.5 \pm 0.1$ |
| CS3225 | CC1210   | $3.6 \pm 0.2$   | $2.80 \pm 0.2$  | $8.0 \pm 0.3$  | $3.5 \pm 0.05$ | $1.75 \pm 0.1$ | $4.0 \pm 0.1$                  | $2.0 \pm 0.1$ | $4.0 \pm 0.1$ | $1.5 \pm 0.1$ |
| CS4520 | CC1808   | $4.8 \pm 0.2$   | $2.3 \pm 0.2$   | $12.0 \pm 0.3$ | $5.5 \pm 0.1$  | $1.75 \pm 0.1$ | $4.0 \pm 0.1$<br>$8.0 \pm 0.1$ | $2.0 \pm 0.1$ | $4.0 \pm 0.1$ | $1.5 \pm 0.1$ |
| CS4532 | CC1812   | $4.9 \pm 0.2$   | $3.6 \pm 0.2$   | $12.0 \pm 0.3$ | $5.5 \pm 0.1$  | $1.75 \pm 0.1$ | $8.0 \pm 0.1$                  | $2.0 \pm 0.1$ | $4.0 \pm 0.1$ | $1.5 \pm 0.1$ |





## 6. Caution

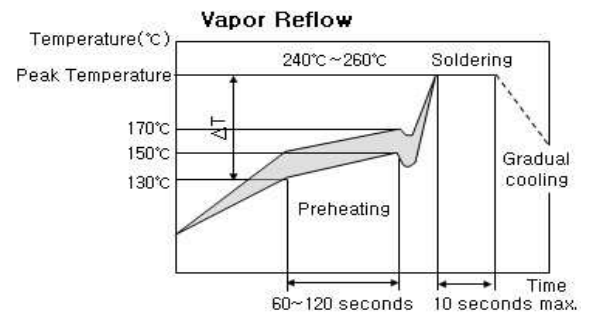
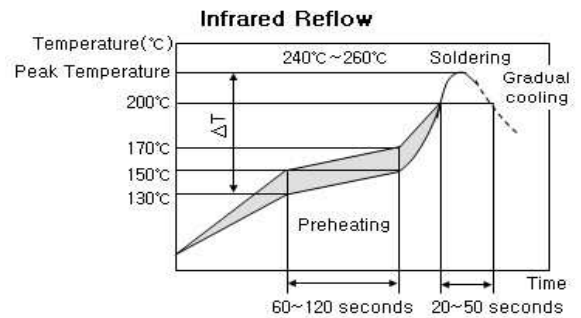
### ▶ Reflow Soldering

1. The sudden temperature change easily causes mechanical damages to ceramic components. Therefore, the preheating procedures should be required for the soldering of ceramic components.
2. Please refer to the recommended soldering profiles as shown in figures, and keep the temperature difference( $\Delta T$ ) within the range recommended in Table 1.

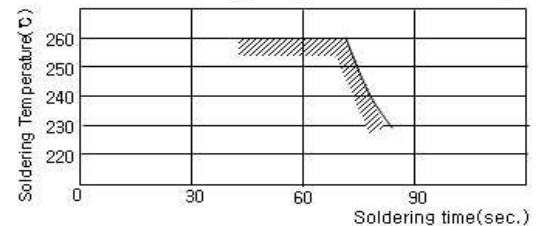
Table 1

| Size code                    | Temperature Difference            |
|------------------------------|-----------------------------------|
| 0603, 1005, 1608, 2012, 3216 | $\Delta T \leq 190^\circ\text{C}$ |
| 3225size and over            | $\Delta T \leq 130^\circ\text{C}$ |

### [Standard Conditions for Reflow Soldering]



### [Allowable Soldering Temperature and Time]



In case of repeated soldering, the accumulated soldering time must be within the range shown above.

### ▶ Storage Condition

\*When Solderability is considered, Capacitor are recommended to be used in 12 months

- (1) Temperature:  $25^\circ\text{C} \pm 10^\circ\text{C}$
- (2) Relative Humidity: Below 70% RH

### ▶ The Regulation of Environmental Pollution Materials.

\*Never use materials mentioned below in MLCC products regulated this document.

Pb, Cd, Hg,  $\text{Cr}^{+6}$ , PBB(Polybromide biphenyl), PBDE(Polybrominated diphenyl ethers), asbestos.

## \* Note

## (1) 'Aging'/'De-aging' Behavior of high dielectric MLCCs

(Typically represented by X7R, Y5V temperature characteristic of which main composition is BaTiO<sub>3</sub>)

'Aging' / 'De-aging' Behavior of high dielectric MLCCs Please note that high dielectric type dielectric Ceramic Capacitors have a "normal" 'aging' behavior / characteristic, that is; their capacitance value decreases with time from its value when it was first manufactured. From that date, the capacitance value begins to decrease at a logarithmic rate defined by:

$$C_t = C_{24} ( 1 - k \log_{10} t )$$

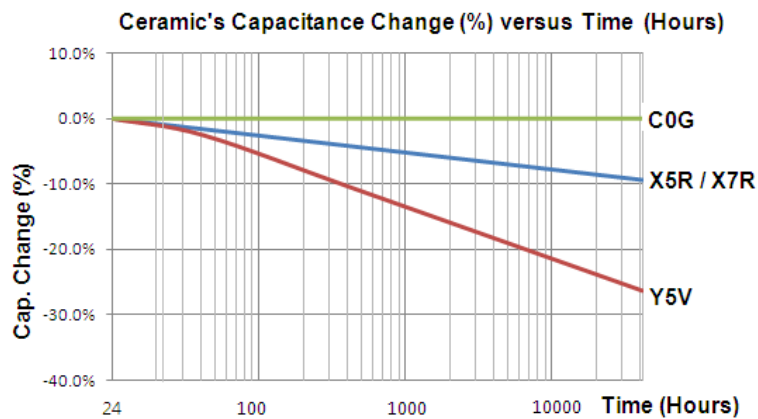
where :

$C_t$  = Capacitance Value,  $t$  hours after the start of 'aging'

$C_{24}$  = Capacitance Value, 24 hours after its manufacture

$k$  = aging constant ( capacitance decrease per decade-hour )

$t$  = time, in hours, from the start of 'aging'



The capacitance value can be restored ( a.k.a. 'de-aged' ) by exposing the component to elevated temperatures approaching its Curie Temperature ( approximately 120°C ). This 'deaging' can occur during the component's solder-assembly onto the PCB, during life or temperature cycle testing., or by ' baking ' at 150°C for about 1 hour.

| Dielectric | Maximum Percent Capacitance Loss per Decade hour, k |
|------------|-----------------------------------------------------|
| C0G        | 0                                                   |
| X5R/X7R    | ~3%                                                 |
| Y5V        | ~8%                                                 |

- (2) Please contact our sales representatives or product engineers before using the products in this catalog for the applications listed below, which require especially high reliability for the prevention of defects which might directly damage a third party's life, body or property, or when one of our products is intended for use in applications other than those specified in this catalog.

- ① Aircraft equipment      ② Aerospace equipment      ③ Undersea equipment      ④ Power plant equipment
- ⑤ Medical equipment      ⑥ Transportation equipment (vehicles, trains, ships, etc.)
- ⑦ Traffic signal equipment      ⑧ Disaster prevention / crime prevention equipment
- ⑨ Industrial equipment (Conveyors, Robot equipment, etc)      ⑩ Led equipment
- ⑪ Application of similar complexity and/or reliability requirements to the applications listed above