

Multi Layer Ceramic Capacitors



General Application

5

Automotive Application

14



General Application

Introduction

SAMWHA's series of multilayer ceramic(MLC) chip capacitors is designed to meet a wide variety of need. Multilayer ceramic chip capacitors are available in both class I and class II formulations. Temperature compensation formulations are class I and temperature stable and general application formulations are classified at class II. The class I multilayer ceramic capacitors are C0G with negligible dependence of electrical properties on temperature, voltage, frequency. The most commonly used class II dielectric are X7R, X5R and Y5V. The X7R provides intermediate capacitance values which vary +15% over the temperature range of -55°C to 125°C. The X5R provides intermediate capacitance values which vary +15% over the temperature range of -55°C to 85°C. The Y5V provides the highest capacitance value which vary from 22% to -82% over the temperature range of -30°C to 85°C. All class II capacitors vary in capacitance value under the influence of temperature, operating voltage and frequency. We offer a complete line of products for both class I and II.

Features

- SAMWHA's high density ceramic bodies offer superior performance and reliability
- SAMWHA offer various temperature characteristics, rated voltage and packing method
- Material with high dielectric constant and superior manufacturing technology allows very high values in a small size
- Solder coated terminals offer superior solderability

Applications

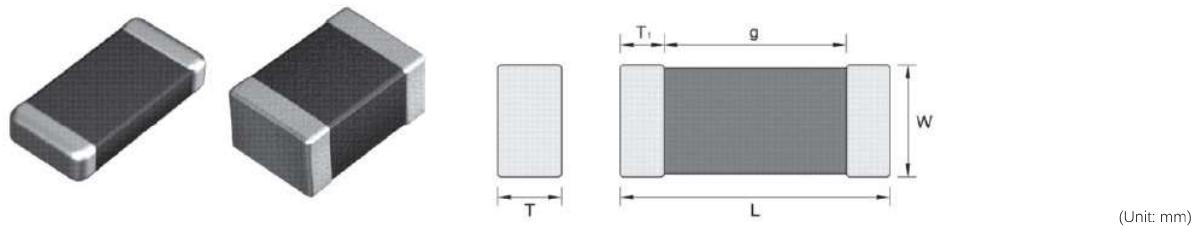
Wide applications throughout commercial and industrial market.

- Communication (Cellular Phone, Pager, Codeless Phone)
- Multimedia (DVD, CD-ROM, FDD, HDD, Game machine, Computer, Notebook, Digital camera, LCD)
- Audio Visual (TV, Camcorder, Minidisk, MP3 Player)
- Communication (Electronic tuner, Duplexer, VCXO, TCXO, Modem)
- OA Equipment (Printer, Copy Machine, Fax Machine)

* special specification like a Automobile, Medical, Military, Aviation should be discuss with our sales representatives

SMD Type

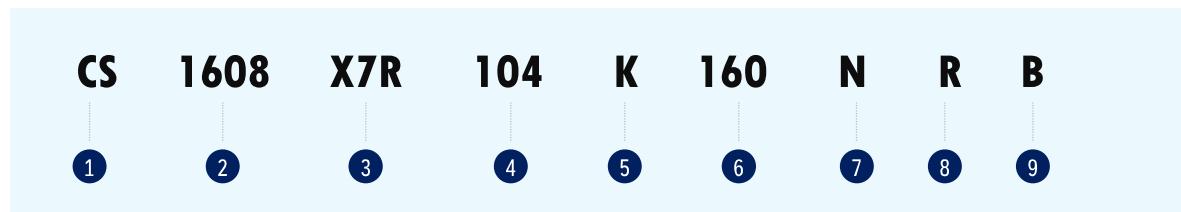
Shape & Dimensions



| Code(inch) | Dimensions | | | | |
|------------|------------|--------|-------|--------|---------|
| | Length | | Width | | T1(min) |
| | L | Tol(±) | W | Tol(±) | |
| 0603(0201) | 0.60 | 0.03 | 0.30 | 0.03 | 0.05 |
| 1005(0402) | 1.00 | 0.05 | 0.50 | 0.05 | 0.05 |
| 1608(0603) | 1.60 | 0.15 | 0.80 | 0.10 | 0.10 |
| 2012(0805) | 2.00 | 0.20 | 1.25 | 0.15 | 0.10 |
| 3216(1206) | 3.20 | 0.30 | 1.60 | 0.20 | 0.15 |
| 3225(1210) | 3.20 | 0.40 | 2.50 | 0.25 | 0.15 |
| 4520(1808) | 4.50 | 0.40 | 2.00 | 0.25 | 0.20 |
| 4532(1812) | 4.50 | 0.40 | 3.20 | 0.30 | 0.20 |
| 5750(2220) | 5.70 | 0.50 | 5.00 | 0.40 | 0.30 |

*1608 Size $\geq 10\mu F = W: 0.8 \pm 0.15$, T: 0.8 ± 0.15

How to Order (Product Identification)



1 Type

CS : SMD
SA : ARRAY

2 Size Code

This is expressed in tens of a millimeter. The first two digits are the length, the last two digits are width.

| | | | | | | | | | |
|----------|------|------|------|------|------|------|------|------|------|
| Size(mm) | 0603 | 1005 | 1608 | 2012 | 3216 | 3225 | 4520 | 4532 | 5750 |
|----------|------|------|------|------|------|------|------|------|------|

3 Temperature Coefficient Code

| Temperature Characteristic | Temperature Range | Capacitance Change or Temperature Coefficient | Operating Temperature Range |
|----------------------------|-------------------|---|-----------------------------|
| C0G | -55 to 125°C | $0 \pm 30\text{ppm}/^\circ\text{C}$ | -55 to 125°C |
| X7R | -55 to 125°C | $\pm 15\%$ | -55 to 125°C |
| X5R | -55 to 85°C | $\pm 15\%$ | -55 to 85°C |
| Y5V | -30 to 85°C | +22, -82% | -55 to 85°C |

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 = 100000pF R denotes decimal 8R2 = 8.2pF

5 Capacitance Tolerance Code

| Code | Tolerance | Code | Tolerance |
|------|-----------|------|------------|
| B | ±0.1pF | M | ±20% |
| C | ±0.25pF | P | +100, -0% |
| D | ±0.5pF | Z | +80, -20% |
| F | ±1.0% | H | +0.25/-0pF |
| G | ±2.0% | I | +0/-0.25pF |
| J | ±5.0% | U | +5/-0% |
| K | ±10% | V | +0/-5% |

6 Voltage Code

| Code | 6R3 | 100 | 160 | 250 | 500 | 101 | 201 | 251 | 631 | 302 |
|------|---------|--------|---------|--------|--------|---------|---------|---------|---------|----------|
| Vol. | DC 6.3V | DC 10V | DC 160V | DC 25V | DC 50V | DC 100V | DC 200V | DC 250V | DC 630V | DC 3000V |

7 Termination Code

Ex.) N : Ni-Sn(Nickel-Tin Plating)

8 Packing Code

Ex.) R: Reel Type B: Bulk Type

9 Thickness Option

| Size(mm) | Thickness(mm) | | Code | Size(mm) | Thickness(mm) | | Code |
|-----------|---------------|--------|------|----------------|---------------|--------|------|
| | t | Tol(±) | | | t | Tol(±) | |
| 0603/1005 | 0.3 | 0.03 | - | 3216 | 1.15 | 0.15 | E |
| 1005 | 0.5 | 0.05 | - | 3216 | 1.6 | 0.2 | I |
| 2012 | 0.6 | 0.1 | A | 3225 | 1.8 | 0.2 | J |
| 1608 | 0.8 | 0.1 | B | 3225/4532/5750 | 2 | 0.25 | K |
| 2012/3216 | 0.85 | 0.15 | B | 3225/4532/5750 | 2.5 | 0.25 | L |
| 2012 | 1.25 | 0.15 | E | | | | |

| Size(mm) | Code | Packaging | Size(mm) | Code | Packaging |
|-----------|------|-----------------|----------------|------|-----------------|
| 0603/1005 | - | Paper Taping | 3216 | E | Embossed Taping |
| 1005 | - | Paper Taping | 3216 | I | Embossed Taping |
| 2012 | A | Paper Taping | 3225 | J | Embossed Taping |
| 1608 | B | Paper Taping | 3225/4532/5750 | K | Embossed Taping |
| 2012/3216 | B | Paper Taping | 3225/4532/5750 | L | Embossed Taping |
| 2012 | E | Embossed Taping | | | |

Typical Performance Characteristics

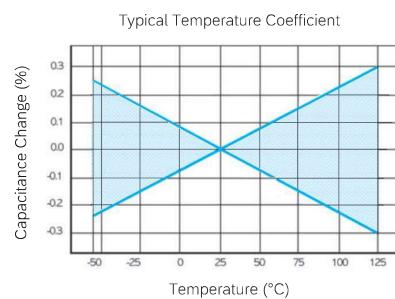
COG

Application

Suited for precision circuits, requiring stable dielectric characteristics, negligible dependence of capacitance and dissipation factor on time, voltage and frequency.

Dielectric Characteristics

| | |
|----------------------------|---|
| Temperature Characteristic | $0 \pm 30 \text{ ppm}/^\circ\text{C}$ |
| Operating Temperature | -55~125°C |
| Capacitance Tolerance | $> 10 \text{ pF} : \pm 5\%, \pm 10\%, (\pm 1\%, \pm 2\%, \pm 20\%) \leq 10 \text{ pF}$ $\pm 0.1 \text{ pF}, \pm 0.25 \text{ pF}, \pm 0.5 \text{ pF}$ |
| Dissipation Factor & Q | $\geq 30 \text{ pF} : DF \leq 0.1\%$, $Q \geq 1000$ $< 30 \text{ pF} : DF \leq 1/(400 + 20 \times C)$, $Q \geq 100 + 20 \times C$ |
| Insulation Resistance | More than $10,000 \text{ M}\Omega$ or 500 QF (Whichever is smaller) |
| Dielectric Strength | $> 3 \times R_{VDC}$ |
| Test Voltage | 0.5 to 5 Vrms ($< 1000 \text{ pF}$), $1 \pm 0.2 \text{ Vrms} (\geq 1000 \text{ pF})$ |
| Test Frequency | $1 \pm 0.1 \text{ MHz} (< 1000 \text{ pF})$, $1 \pm 0.1 \text{ kHz} (\geq 1000 \text{ pF})$ |



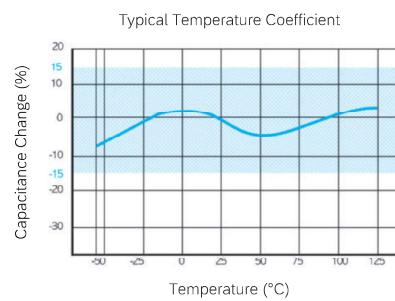
X7R

Application

Stable class II dielectric properties, suited for by-pass and coupling purposes, filtering, frequency discrimination, DC blockage, and as voltage transient suppression elements

Dielectric Characteristics

| | |
|----------------------------|--|
| Temperature Characteristic | $\pm 15\%$ |
| Operating Temperature | -55~125°C |
| Capacitance Tolerance | $\pm 10\%, \pm 20\% (\pm 5\%, +80\% \sim -20\%)$ |
| Dissipation Factor & Q | 50V Min. : 2.5% Max. 25V Min. : 3.0% Max. 16V Min. : 3.5% Max. 10V Min. : 5.0% Max. 6.3V Min. : 5.0% Max. Thin layer large capacitors type 12.5% Max. |
| Insulation Resistance | More than $10,000 \text{ M}\Omega$ or 500 QF (Whichever is smaller) Thin layer large capacitors type 50 QF Min. |
| Dielectric Strength | $> 2.5 \times R_{VDC}$ |
| Test Voltage | $1 \pm 0.2 \text{ Vrms} (\leq 10 \mu\text{F})$ $0.5 \pm 0.1 \text{ Vrms} (> 10 \mu\text{F})$ |
| Test Frequency | $1 \pm 0.1 \text{ VkHz} (\leq 10 \mu\text{F})$ $120 \pm 24 \text{ Hz} (> 10 \mu\text{F})$ |



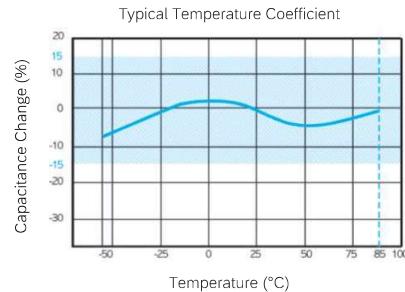
X5R

Application

Stable class II dielectric properties, suited for by-pass and coupling purposes, filtering, frequency discrimination, DC blockage, and as voltage transient suppression elements.

Dielectric Characteristics

| | |
|----------------------------|--|
| Temperature Characteristic | $\pm 15\%$ |
| Operating Temperature | -55~85°C |
| Capacitance Tolerance | $\pm 10\%, \pm 20\%, (\pm 5\%, +80\%~-20\%)$ |
| Dissipation Factor & Q | 50V Min. : 2.5% Max. 25V Min. : 3.0% Max. 16V Min. : 3.5% Max. 10V Min. : 5.0% Max. 6.3V Min. : 5.0% Max. Thin layer large capacitors type 12.5% Max. |
| Insulation Resistance | More than 10,000MΩ or 500ΩF (Whichever is smaller) Thin layer large capacitors type 50ΩF Min. |
| Dielectric Strength | $> 2.5 \times RVDC$ |
| Test Voltage | $1 \pm 0.2 V_{rms} (\leq 10\mu F)$ $0.5 \pm 0.1 V_{rms} (> 10\mu F)$ |
| Test Frequency | $1 \pm 0.1 V_{kHz} (\leq 10\mu F)$ $120 \pm 24 Hz (> 10\mu F)$ |



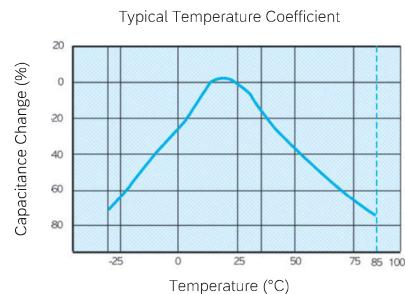
Y5V

Application

The Hi-K(Y5V) dielectrics deliver high capacitance density and are ideally suited for applications where space is at a premium, or as replacement for tantalum capacitors. Typically applications include use as by-pass or decoupling elements. Best performance is obtained at or near room temperature, with low DC bias.

Dielectric Characteristics

| | |
|----------------------------|--|
| Temperature Characteristic | +22%~82% |
| Operating Temperature | -30~85°C |
| Capacitance Tolerance | -20~+80%($\pm 20\%$) |
| Dissipation Factor & Q | 50V Min. : 5% Max. 25V Min. : 7% Max. 16V Min. : 9% Max. 10V Min. : 12.5% Max. 6.3V Min. : 15% Max. Thin layer large capacitors type 20% Max. |
| Insulation Resistance | More than 10,000MΩ or 500ΩF (Whichever is smaller) Thin layer large capacitors type 50ΩF Min. |
| Dielectric Strength | $> 2.5 \times RVDC$ |
| Test Voltage | $1 \pm 0.2 V_{rms} (\leq 10\mu F)$ $0.5 \pm 0.1 V_{rms} (> 10\mu F)$ |
| Test Frequency | $1 \pm 0.1 V_{kHz} (\leq 10\mu F)$ $120 \pm 24 Hz (> 10\mu F)$ |



Appendix I

COG-Temperature Compensating Type(0603~3216)

| Type | COG | | | | | | | | | |
|--------------|------------|----|------------|----|------------|-----|------------|------|------------|------|
| Size(inch) | 0603(0201) | | 1005(0402) | | 1608(0603) | | 2012(0805) | | 3216(1206) | |
| Volt(V) | 25 | 50 | 25 | 50 | 25 | 50 | 25 | 50 | 25 | 50 |
| 0.5pF(0R5) | | | | | | | | | | |
| 1pF(010) | | | | | | | | | | |
| 2pF(020) | | | | | | | | | | |
| 3pF(030) | | | | | | | | | | |
| 4pF(040) | | | | | | | | | | |
| 5pF(050) | | | | | | | | | | |
| 6pF(060) | | | | | | | | | | |
| 7pF(070) | | | | | | | | | | |
| 8pF(080) | | | | | | | | | | |
| 9pF(090) | | | | | | | | | | |
| 10pF(100) | | | | | | | | | | |
| 12pF(120) | | | | | | | | | | |
| 15pF(150) | | | | | | | | | | |
| 18pF(180) | | | | | | | | | | |
| 22pF(220) | | | | | | | | | | |
| 27pF(270) | | | | | | | | | | |
| 33pF(330) | | | | | | | | | | |
| 39pF(390) | | | | | | | | | | |
| 47pF(470) | | | | | | | | | | |
| 56pF(560) | | | | | | | | | | |
| 68pF(680) | | | | | | | | | | |
| 82pF(820) | | | | | | | | | | |
| 100pF(101) | | | | | | | | | | |
| 120pF(121) | | | | | | | | | | |
| 150pF(151) | | | | | | | | | | |
| 180pF(181) | | | | | | | | | | |
| 220pF(221) | | | | | | | | | | |
| 270pF(271) | | | | | | | | | | |
| 330pF(331) | | | | | | | | | | |
| 390pF(391) | | | | | | | | | | |
| 470pF(471) | | | | | | | | | | |
| 560pF(561) | | | | | | | | | | |
| 680pF(681) | | | | | | | | | | |
| 820pF(821) | | | | | | | | | | |
| 1000pF(102) | 0.3 | | | | | | | | | |
| 1200pF(122) | 0.3 | | | | | | | | | |
| 1500pF(152) | | | | | | | | | | |
| 1800pF(182) | | | | | | | | | | |
| 2200pF(222) | | | | | | | | | | |
| 2700pF(272) | | | | | | | | | | |
| 3300pF(332) | | | | | | | | | | |
| 3900pF(392) | | | | | | | | | | |
| 4700pF(472) | | | | | | | | | | |
| 5600pF(562) | | | | | | | | | | |
| 6800pF(682) | | | | | | | | | | |
| 10000pF(103) | 0.5 | | 0.5 | | 0.8 | 0.8 | | | | |
| 12000pF(123) | 0.5 | | | | 0.8 | | | | | |
| 15000pF(153) | | | | | | | | | | |
| 18000pF(183) | | | | | | | | | | |
| 22000pF(223) | | | | | | | | | | |
| 27000pF(273) | | | | | | | | | | |
| 33000pF(333) | | | | | | | | | | |
| 47000pF(473) | | | | | | | 1.25 | 1.25 | | |
| 56000pF(563) | | | | | | | | | | |
| 68000pF(683) | | | | | | | | | | |
| 82000pF(823) | | | | | | | | | | |
| 0.1μF(104) | | | | | | | | | 1.60 | 1.60 |

Temperature Compensating Type : Dissipation Factor Page 20 (No.5)

Appendix II

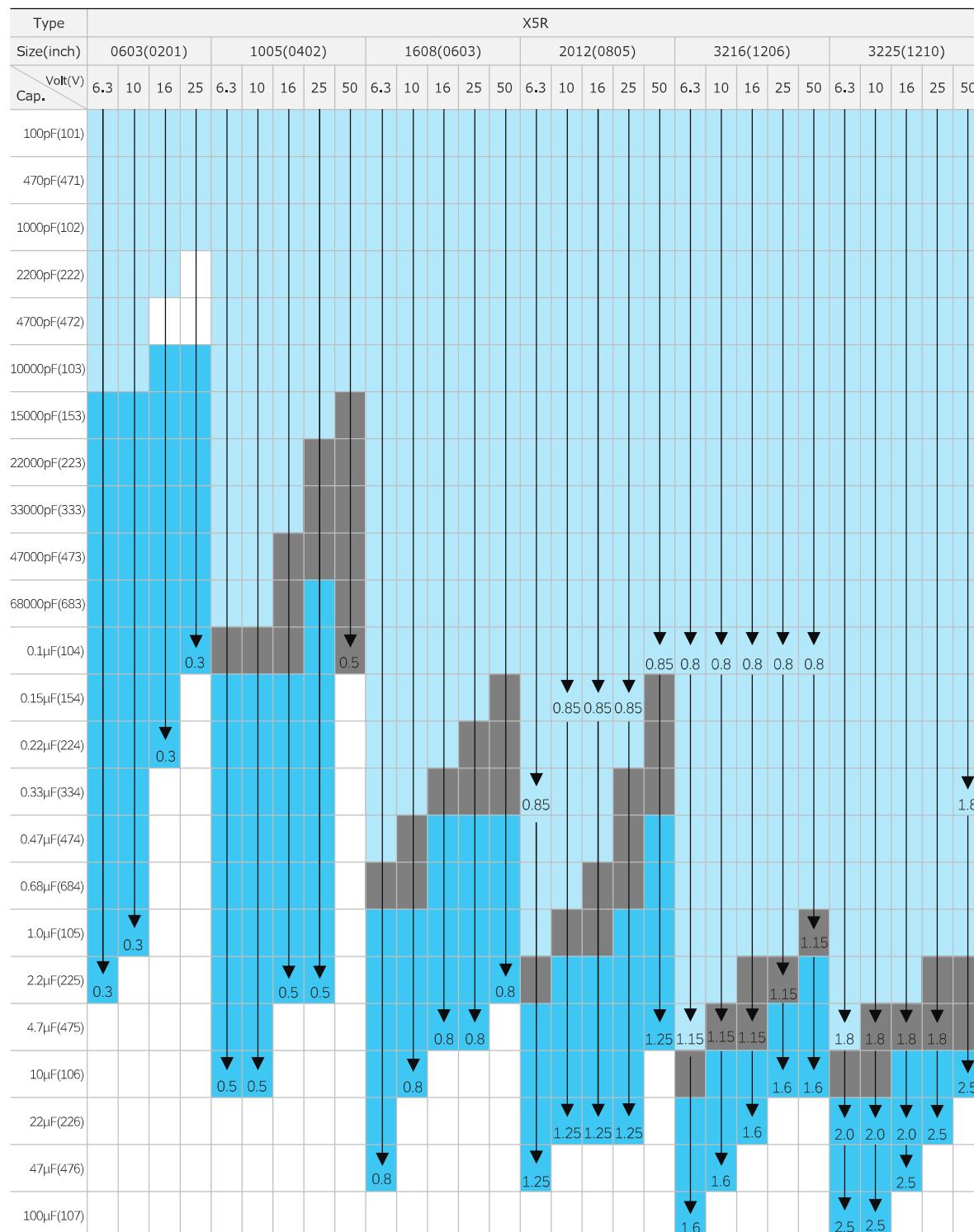
X7R-High Dielectric Constant Type(0603~3225) & Thin Layer Large-Capacitance Type

| Type | X7R | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------------|------------|-----|-----|-----|------------|----|-----|-----|------------|-----|-----|----|------------|----|------|------|------------|------|------|------|------------|------|------|------|-----|-----|
| Size(inch) | 0603(0201) | | | | 1005(0402) | | | | 1608(0603) | | | | 2012(0805) | | | | 3216(1206) | | | | 3225(1210) | | | | | |
| Volt(V) Cap. | 6.3 | 10 | 16 | 25 | 6.3 | 10 | 16 | 25 | 50 | 6.3 | 10 | 16 | 25 | 50 | 6.3 | 10 | 16 | 25 | 50 | 6.3 | 10 | 16 | 25 | 50 | | |
| 100pF(101) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 470pF(471) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1000pF(102) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2200pF(222) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4700pF(472) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10000pF(103) | 0.3 | 0.3 | 0.3 | 0.3 | | | | | | | | | | | | | | | | | | | | | | |
| 15000pF(153) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 22000pF(223) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 33000pF(333) | | | | | | | | | | | | | | | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | | | | | | | |
| 47000pF(473) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 68000pF(683) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.1μF(104) | | | | | | | | | | 0.5 | 0.5 | | | | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | | |
| 0.15μF(154) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.22μF(224) | | | | | | | | 0.5 | | | | | | | 0.8 | | | | | | | | | | | |
| 0.33μF(334) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.47μF(474) | | | | | | | 0.5 | | | | | | | | | | | | | | | | | | | |
| 0.68μF(684) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.0μF(105) | | | | 0.5 | | | | | | | | | | | 0.8 | 0.8 | | | | 1.25 | | | 2.0 | 2.0 | 2.0 | 2.0 |
| 2.2μF(225) | | | | | | | | | | 0.8 | 0.8 | | | | | | | | | | | | | | | |
| 4.7μF(475) | | | | | | | | | | | | | | | | | 1.25 | 1.25 | | | | 1.6 | | | | 2.5 |
| 10μF(106) | | | | | | | | | | | | | | | 1.25 | 1.25 | | | | | | 1.6 | 1.6 | | | |
| 22μF(226) | | | | | | | | | | | | | | | | | | 1.6 | 1.6 | | | | | | 2.5 | 2.5 |
| 47μF(476) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 100μF(107) | | | | | | | | | | | | | | | | | | | | | | | | | | |

General Type : Dissipation Factor Page 20 (No.5)

*General Type : Dissipation Factor Page 20 (No.5)

Thin Layer Large-Capacitance Type: Dissipation Factor Page 20 (No.5)

X5R-High Dielectric Constant Type(0603~3225) & Thin Layer Large-Capacitance Type

General Type : Dissipation Factor Page 20 (No.5)

*General Type : Dissipation Factor Page 20 (No.5)

Thin Layer Large-Capacitance Type: Dissipation Factor Page 20 (No.5)

Y5V-High Dielectric Constant Type(0603-3225) & Thin Layer Large-Capacitance Type

| Type | Y5V | | | | | | | | | | | | | | | | | | | | 3216(1206) | | | | |
|-----------------|------------|-----|----|----|----|------------|----|----|----|----|------------|----|----|----|----|------------|------|----|----|----|------------|----|----|----|----|
| Size(inch) | 1005(0402) | | | | | 1608(0603) | | | | | 2012(0805) | | | | | 3216(1206) | | | | | 3225(1210) | | | | |
| Volt(V) Cap. | 6.3 | 10 | 16 | 25 | 50 | 6.3 | 10 | 16 | 25 | 50 | 6.3 | 10 | 16 | 25 | 50 | 6.3 | 10 | 16 | 25 | 50 | 6.3 | 10 | 16 | 25 | 50 |
| 1000pF(102) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2200pF(222) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4700pF(472) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10000pF(103) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 15000pF(153) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 22000pF(223) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 33000pF(333) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 47000pF(473) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 68000pF(683) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.1μF(104) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.15μF(154) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.22μF(224) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.33μF(334) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.47μF(474) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.68μF(684) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.0μF(105) | 0.5 | 0.5 | | | | | | | | | | | | | | | | | | | | | | | |
| 2.2μF(225) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.3μF(335) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.7μF(475) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10μF(106) | | | | | | | | | | | | | | | | 1.25 | 1.25 | | | | | | | | |
| 22μF(226) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 47μF(476) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 100μF(107) | | | | | | | | | | | | | | | | | | | | | | | | | |

 General Type : Dissipation Factor Page 20 (No.5)

 *General Type : Dissipation Factor Page 20 (No.5)

 Thin Layer Large-Capacitance Type: Dissipation Factor Page 20 (No.5)

Automotive Application

Features

- SAMWHA Series meet AEC-Q200 requirements
- SAMWHA Series Certify IATF 16949(ISO/TS 16949), ISO 9001, ISO 14001
SAMWHA Series are RoHS Compliant

Applications

- Automotive Electronic Equipment

How to Order (Product Identification)



① Monolithic Multilayer Ceramic Capacitor Leadless Type for Automotive Application

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 | Temperature Coefficient |
|----------------|------|-------------------|-------------------------|
| Class I | C0G | -55 to +125°C | ±30 ppm/°C |
| Class II | X7R | -55 to +125°C | +15% |
| Class II | X8R | -55 to +150°C | +15% |

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 = 100000pF

R denotes decimal

8R2 = 8.2pF

5 Capacitance Tolerance Code

| Code | Tolerance | Code | Tolerance |
|------|---------------------|------|-------------|
| B | $\pm 0.1\text{pF}$ | G | $\pm 2.0\%$ |
| C | $\pm 0.25\text{pF}$ | J | $\pm 5\%$ |
| D | $\pm 0.5\text{pF}$ | K | $\pm 10\%$ |
| F | $\pm 1.0\%$ | M | $\pm 20\%$ |

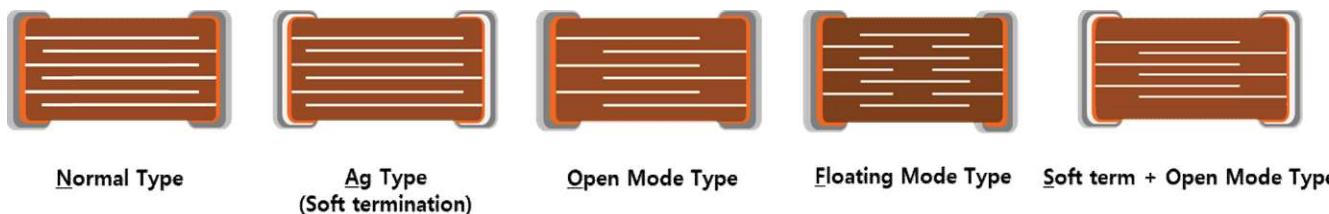
6 Voltage Code

| Code | 6R3 | 100 | 160 | 250 | 500 | 101 | 201 | 251 | 501 | 631 | 102 | 202 | 302 |
|---------------|------------|-----------|-----------|-----------|-----------|------------|------------|------------|------------|------------|-----------|-----------|-----------|
| Rated Voltage | DC 6.3V | DC 10V | DC 16V | DC 25V | DC 50V | DC 100V | DC 200V | DC 250V | DC 500V | DC 630V | DC 1KV | DC 2KV | DC 3KV |

7 Termination & Design Code

N : Nickel-Tin plating, A : Ag epoxy/Nickel-Tin plating, O : Open Mode, F : Floating mode

S : Ag Epoxy/Nickel-Tin plating + Open mode type



8 Packing Code

R: Reel Type, B: Bulk Type

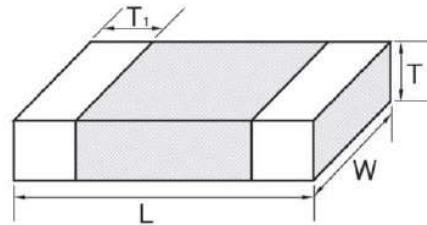
9 Thickness Option

| Size(mm) | Thickness(mm) | | Code | Size(mm) | Thickness(mm) | | Code |
|-----------|---------------|--------|------|----------------|---------------|--------|------|
| | t | Tol(±) | | | t | Tol(±) | |
| 0603/1005 | 0.3 | 0.03 | - | 3216 | 1.15 | 0.15 | E |
| 1005 | 0.5 | 0.05 | - | 3216 | 1.6 | 0.2 | I |
| 2012 | 0.6 | 0.1 | A | 3225 | 1.8 | 0.2 | J |
| 1608 | 0.8 | 0.1 | B | 3225/4532/5750 | 2 | 0.25 | K |
| 2012/3216 | 0.85 | 0.15 | B | 3225/4532/5750 | 2.5 | 0.25 | L |
| 2012 | 1.25 | 0.15 | E | | | | |

| Size(mm) | Code | Packaging | Size(mm) | Code | Packaging |
|-----------|------|-----------------|----------------|------|-----------------|
| 0603/1005 | - | Paper Taping | 3216 | E | Embossed Taping |
| 1005 | - | Paper Taping | 3216 | I | Embossed Taping |
| 2012 | A | Paper Taping | 3225 | J | Embossed Taping |
| 1608 | B | Paper Taping | 3225/4532/5750 | K | Embossed Taping |
| 2012/3216 | B | Paper Taping | 3225/4532/5750 | L | Embossed Taping |
| 2012 | E | Embossed Taping | | | |

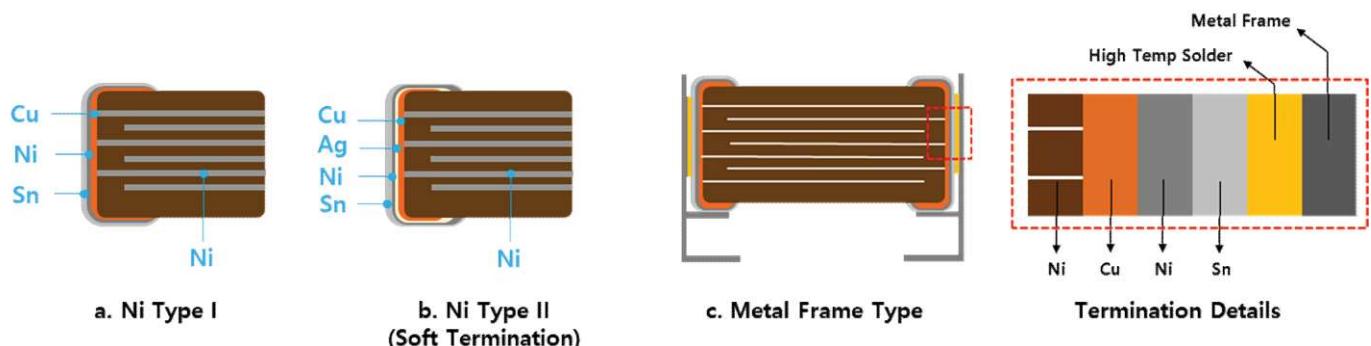
Temperature Characteristic See Page 24 (No.22)

Dimensions



| Code(inch) | Dimensions | | | | $T_1(\text{min})$ | |
|------------|------------|-------------------|-------|-------------------|-------------------|--|
| | Length | | Width | | | |
| | L | $\text{Tol}(\pm)$ | W | $\text{Tol}(\pm)$ | | |
| 1005(0402) | 1.00 | 0.05 | 0.50 | 0.05 | 0.05 | |
| 1608(0603) | 1.60 | 0.15 | 0.80 | 0.10 | 0.10 | |
| 2012(0805) | 2.00 | 0.20 | 1.25 | 0.15 | 0.10 | |
| 3216(1206) | 3.20 | 0.30 | 1.60 | 0.20 | 0.15 | |
| 3225(1210) | 3.20 | 0.40 | 2.50 | 0.25 | 0.15 | |

Construction of Termination



Capacitance Table.

Class I (COG)

| Size Code (EIA Code) | 1005(0402) | | | | 1608(0603) | | | | 2012(0805) | | | | 3216(1206) | | | | 3225(1210) | | | |
|-------------------------|------------|----|----|-----|------------|----|----|-----|------------|----|----|-----|------------|----|----|-----|------------|----|----|-----|
| | 16 | 25 | 50 | 100 | 16 | 25 | 50 | 100 | 16 | 25 | 50 | 100 | 16 | 25 | 50 | 100 | 16 | 25 | 50 | 100 |
| Rated Volt(V) Cap. | | | | | | | | | | | | | | | | | | | | |
| 0.5pF(0R5) | | | | | | | | | | | | | | | | | | | | |
| 1pF(010) | | | | | | | | | | | | | | | | | | | | |
| 2.2pF(2R2) | | | | | | | | | | | | | | | | | | | | |
| 3pF(030) | | | | | | | | | | | | | | | | | | | | |
| 4pF(040) | | | | | | | | | | | | | | | | | | | | |
| 4.7pF(4R7) | | | | | | | | | | | | | | | | | | | | |
| 5pF(050) | | | | | | | | | | | | | | | | | | | | |
| 6.8pF(6R8) | | | | | | | | | | | | | | | | | | | | |
| 8pF(080) | | | | | | | | | | | | | | | | | | | | |
| 9pF(090) | | | | | | | | | | | | | | | | | | | | |
| 10pF(100) | | | | | | | | | | | | | | | | | | | | |
| 12pF(120) | | | | | | | | | | | | | | | | | | | | |
| 15pF(150) | | | | | | | | | | | | | | | | | | | | |
| 18pF(180) | | | | | | | | | | | | | | | | | | | | |
| 22pF(220) | | | | | | | | | | | | | | | | | | | | |
| 27pF(270) | | | | | | | | | | | | | | | | | | | | |
| 33pF(330) | | | | | | | | | | | | | | | | | | | | |
| 39pF(390) | | | | | | | | | | | | | | | | | | | | |
| 47pF(470) | | | | | | | | | | | | | | | | | | | | |
| 56pF(560) | | | | | | | | | | | | | | | | | | | | |
| 68pF(680) | | | | | | | | | | | | | | | | | | | | |
| 82pF(820) | | | | | | | | | | | | | | | | | | | | |
| 100pF(101) | | | | | | | | | | | | | | | | | | | | |
| 120pF(121) | | | | | | | | | | | | | | | | | | | | |
| 150pF(151) | | | | | | | | | | | | | | | | | | | | |
| 180pF(181) | | | | | | | | | | | | | | | | | | | | |
| 220pF(221) | | | | | | | | | | | | | | | | | | | | |
| 270pF(271) | | | | | | | | | | | | | | | | | | | | |
| 330pF(331) | | | | | | | | | | | | | | | | | | | | |
| 390pF(391) | | | | | | | | | | | | | | | | | | | | |
| 470pF(471) | | | | | | | | | | | | | | | | | | | | |
| 560pF(561) | | | | | | | | | | | | | | | | | | | | |
| 680pF(681) | | | | | | | | | | | | | | | | | | | | |
| 820pF(821) | | | | | | | | | | | | | | | | | | | | |
| 1000pF(102) | | | | | | | | | | | | | | | | | | | | |
| 1200pF(122) | | | | | | | | | | | | | | | | | | | | |
| 1500pF(152) | | | | | | | | | | | | | | | | | | | | |
| 1800pF(182) | | | | | | | | | | | | | | | | | | | | |
| 2200pF(222) | | | | | | | | | | | | | | | | | | | | |
| 2700pF(272) | | | | | | | | | | | | | | | | | | | | |
| 3300pF(332) | | | | | | | | | | | | | | | | | | | | |
| 4700pF(472) | | | | | | | | | | | | | | | | | | | | |

Class II (X7R)

| Size Code (EIA Code) | 1005(0402) | | | | 1608(0603) | | | | 2012(0805) | | | | 3216(1206) | | | | 3225(1210) | | | |
|-------------------------|------------|----|----|-----|------------|----|----|-----|------------|----|----|-----|------------|----|----|-----|------------|----|----|-----|
| | 16 | 25 | 50 | 100 | 16 | 25 | 50 | 100 | 16 | 25 | 50 | 100 | 16 | 25 | 50 | 100 | 16 | 25 | 50 | 100 |
| 1000pF(102) | | | | | | | | | | | | | | | | | | | | |
| 1500pF(152) | | | | | | | | | | | | | | | | | | | | |
| 2200pF(222) | | | | | | | | | | | | | | | | | | | | |
| 3300pF(332) | | | | | | | | | | | | | | | | | | | | |
| 4700pF(472) | | | | | | | | | | | | | | | | | | | | |
| 6800pF(682) | | | | | | | | | | | | | | | | | | | | |
| 10000pF(103) | | | | | | | | | | | | | | | | | | | | |
| 15000pF(153) | | | | | | | | | | | | | | | | | | | | |
| 22000pF(223) | | | | | | | | | | | | | | | | | | | | |
| 33000pF(333) | | | | | | | | | | | | | | | | | | | | |
| 47000pF(473) | | | | | | | | | | | | | | | | | | | | |
| 68000pF(683) | | | | | | | | | | | | | | | | | | | | |
| 0.1uF(104) | | | | | | | | | | | | | | | | | | | | |
| 0.15uF(154) | | | | | | | | | | | | | | | | | | | | |
| 0.22uF(224) | | | | | | | | | | | | | | | | | | | | |
| 0.33uF(334) | | | | | | | | | | | | | | | | | | | | |
| 0.47uF(474) | | | | | | | | | | | | | | | | | | | | |
| 0.68uF(684) | | | | | | | | | | | | | | | | | | | | |
| 1.0uF(105) | | | | | | | | | | | | | | | | | | | | |
| 2.2uF(225) | | | | | | | | | | | | | | | | | | | | |
| 4.7uF(475) | | | | | | | | | | | | | | | | | | | | |
| 10uF(106) | | | | | | | | | | | | | | | | | | | | |
| 22uF(226) | | | | | | | | | | | | | | | | | | | | |

 General Type for Automotive Application

 Thin Layer Large-Capacitance Type for Automotive Application

Typical Performance Characteristics

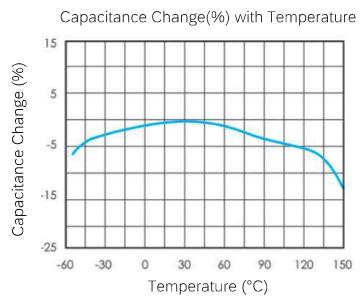
X8R

Application

The X8R series could be applicable to devices that operating in high-temperature environments
Temperature Characteristics (x8r, -55 to 150°C, Capacitance Change +15%) Excellent DC-bias,
Temperature and Aging properties

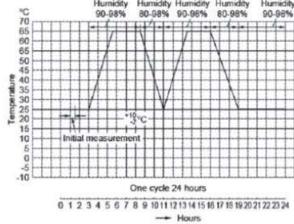
Dielectric Characteristics

| | |
|----------------------------|---|
| Temperature Characteristic | $\pm 15\%$ |
| Operating Temperature | -55~150°C |
| Capacitance Tolerance | $\pm 10\%, \pm 20\%$ |
| Dissipation Factor & Q | 50V : 2.5% max. 25V : 3.0% max. 16V : 3.5% max. 10V : 5.0% max |
| Insulation Resistance | More than 10,000MΩ or 500ΩF (Whichever is smaller) |
| Dielectric Strength | > 2.5×RVDC |
| Test Voltage | 0.5~1.0Vrms |
| Test Frequency | 1±0.1kHz |



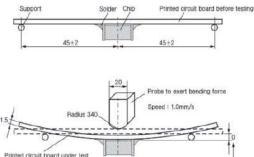
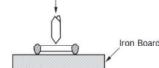
| Size Code (EIA Code) | 1608(0603) | | | | 2012(0805) | | | | 3216(1206) | | | |
|-------------------------|------------|----|----|-----|------------|----|----|-----|------------|----|----|-----|
| | 16 | 25 | 50 | 100 | 16 | 25 | 50 | 100 | 16 | 25 | 50 | 100 |
| 1000pF(102) | | | | | | | | | | | | |
| 4700pF(472) | | | | | | | | | | | | |
| 6800pF(682) | | | | | | | | | | | | |
| 10000pF(103) | | | | | | | | | | | | |
| 22000pF(223) | | | | | | | | | | | | |
| 470000pF(473) | | | | | | | | | | | | |
| 680000pF(683) | | | | | | | | | | | | |
| 0.1uF(104) | | | | | | | | | | | | |
| 0.15uF(154) | | | | | | | | | | | | |
| 0.22uF(224) | | | | | | | | | | | | |
| 0.47uF(474) | | | | | | | | | | | | |
| 0.68uF(684) | | | | | | | | | | | | |
| 1.0uF(105) | | | | | | | | | | | | |
| 2.2uF(225) | | | | | | | | | | | | |
| 4.7uF(475) | | | | | | | | | | | | |
| 10uF(106) | | | | | | | | | | | | |
| 22uF(226) | | | | | | | | | | | | |
| 47uF(476) | | | | | | | | | | | | |
| 100uF(107) | | | | | | | | | | | | |

Specifications and Test Methods(For Automotive Applications)

| No. | AEC-Q200 | Specification | | Test Methods And Conditions | | | | | | | | | | | | | | | |
|--------------------|---|---|---|---|------|---|---|---|---|----------|--------------------------|------------|--------------------------|------------|-----------|------|---|------|---|
| | | Class I | Class II | | | | | | | | | | | | | | | | |
| 1 | Pre-and Post-Stress Electrical Test | No defects which may affect performance | | | | | | | | | | | | | | | | | |
| 2 | High Temperature Exposure | Appearance | No marking defects | Temperature : Max. operating temperature±3°C Maintenance Time : 1000+48/-0 hrs Let sit for 24±2 hours at room Temperature, then measure. | | | | | | | | | | | | | | | |
| | | Capacitance Change | Within ±2.5% or ±0.25pF (Whichever is larger) | | | | | | | | | | | | | | | | |
| | | Q/D.F | 30pF Min : Q≥1000 30pF Max : Q≥400+20xC C : Nominal Capacitance(pF) | | | | | | | | | | | | | | | | |
| | | I.R. | More than 10,000MΩ or 500Ω.F(Whichever is smaller) | | | | | | | | | | | | | | | | |
| 3 | Temperature Cycle | Appearance | No defects which may affect performance | Perform the 1000 cycles according to the four heat treatments listed in the following table. Let sit for 24+2 hours at room temperature, then measure. <table border="1"><thead><tr><th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th></tr><tr><th>Temp(°C)</th><th>Min. operating temp.+0/3</th><th>Room temp.</th><th>Max. operating temp.+3/0</th><th>Room temp.</th></tr></thead><tbody><tr><td>Time(min)</td><td>15±3</td><td>1</td><td>15±3</td><td>1</td></tr></tbody></table> Initial measurement Perform the initial measurement according to Note1 for Class II. | Step | 1 | 2 | 3 | 4 | Temp(°C) | Min. operating temp.+0/3 | Room temp. | Max. operating temp.+3/0 | Room temp. | Time(min) | 15±3 | 1 | 15±3 | 1 |
| Step | 1 | 2 | 3 | 4 | | | | | | | | | | | | | | | |
| Temp(°C) | Min. operating temp.+0/3 | Room temp. | Max. operating temp.+3/0 | Room temp. | | | | | | | | | | | | | | | |
| Time(min) | 15±3 | 1 | 15±3 | 1 | | | | | | | | | | | | | | | |
| Capacitance Change | Within ±2.5% or ±0.25pF (Whichever is larger) | | | | | | | | | | | | | | | | | | |
| Q/D.F | 30pF Min : Q≥1000 30pF Max : Q≥400+20xC C : Nominal Capacitance(pF) | | | | | | | | | | | | | | | | | | |
| I.R. | More than 10,000MΩ or 500Ω.F(Whichever is smaller) | | | | | | | | | | | | | | | | | | |
| 4 | | | Destructive Physical Analysis | No defects or abnormalities | | | | | | | | | | | | | | | |
| 5 | Moisture Resistance | Appearance | No defects which may affect performance | Temperature : 25-65°C, Humidity: 80-98% Cycle Time: 24 hrs/cycle, 10 cycles Let sit for 24±2 hours at room temperature, then measure.  | | | | | | | | | | | | | | | |
| | | Capacitance Change | Within ±3.0% or ±0.30pF (Whichever is larger) | | | | | | | | | | | | | | | | |
| | | Q/D.F | 30pF Min. : Q≥350 10pF Min. and 30pF Max. : Q≥275+5/2xC 10pF Max. : Q≥200+10xC C : Nominal Capacitance(pF) | | | | | | | | | | | | | | | | |
| | | I.R. | More than 10,000MΩ or 500Ω.F(Whichever is smaller) | | | | | | | | | | | | | | | | |
| 6 | Humidity Bias | Appearance | No defects which may affect performance | Temperature : 85±3°C Humidity: 80-85% Applied Voltage: Rated Voltage and 1.3+0.2/-0V Maintenance Time: 1000+48/-0 hrs Let sit for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA. | | | | | | | | | | | | | | | |
| | | Capacitance Change | Within ±3.0% or ±0.30pF (Whichever is larger) | | | | | | | | | | | | | | | | |
| | | Q/D.F | 30pF Min. : Q≥200 30pF Max. : Q≥100+10/3xC C : Nominal Capacitance(pF) | | | | | | | | | | | | | | | | |
| | | I.R. | More than 1,000MΩ or 50Ω.F(Whichever is smaller) | | | | | | | | | | | | | | | | |
| 7 | High Temperature Operational Life | Appearance | No defects which may affect performance | Temperature : Max. operating temperature±3°C Applied Voltage: Rated Voltage X 200% Maintenance Time: 1000+48/-0 hrs Let sit for 24±2 hours at room temperature, then measure. The charge/discharge current is less than 50mA. Initial Measurement for Class II Applied 200% of the rated voltage for one hour at Max. operating temperature±3°C Remove and let sit for 24±2 hours at room temperature, then measure. | | | | | | | | | | | | | | | |
| | | Capacitance Change | Within ±3.0% or ±0.30pF (Whichever is larger) | | | | | | | | | | | | | | | | |
| | | Q/D.F | 30pF Min. : Q≥350 10pF Min. and 30pF Max. : Q≥275+5/2xC 10pF Max. : Q≥200+10xC C : Nominal Capacitance(pF) | | | | | | | | | | | | | | | | |
| | | I.R. | More than 1,000MΩ or 50Ω.F(Whichever is smaller) | | | | | | | | | | | | | | | | |

| No. | AEC-Q200 | Specification | | Test Methods And Conditions | |
|-----|---------------------------|---------------------------------|---|--|--|
| | | Class I | Class II | | |
| 8 | External Visual | No defects or abnormalities | | Visual inspection | |
| 9 | Physical Dimension | Within the specified dimensions | | Using calipers | |
| 10 | Resistance to Solvents | Appearance | No defects which may affect performance | Per MIL-STD-202 Method 215 | |
| | | Capacitance Change | Within the specified tolerance | | |
| | | Q/D.F | 30pF Min : Q≥1000 30pF Max : Q≥400+20xC C : Nominal Capacitance(pF) | | |
| | | I.R. | More than 10,000MΩ or 500Ω.F(Whichever is smaller) | | |
| 11 | Mechanical Shock | Appearance | No defects which may affect performance | Three shocks in each direction should be applied along 3 mutually perpendicular axes of the test specimen (18 shocks) Test Pulse Wave form: Half-sine Duration : 0.5ms Peak value: 1,500G Velocity change : 4.7m/s | |
| | | Capacitance Change | Within the specified tolerance | | |
| | | Q/D.F | 30pF Min : Q≥1000 30pF Max : Q≥400+20xC C : Nominal Capacitance(pF) | | |
| | | I.R. | More than 10,000MΩ or 500Ω.F(Whichever is smaller) | | |
| 12 | Vibration | Appearance | No defects or abnormalities | The specimens should be subjected to a simple harmonic motion having a total amplitude of 1.5mm. The entire frequency range of 10 to 2,000 Hz and return to 10 Hz should be traversed in 20 minutes. This cycle should be performed 12 times in each of three mutually perpendicular directions (total of 36 times). | |
| | | Capacitance Change | Within the specified tolerance | | |
| | | Q/D.F | 30pF Min : Q≥1000 30pF Max : Q≥400+20xC C : Nominal Capacitance(pF) | | |
| | | I.R. | More than 10,000MΩ or 500Ω.F(Whichever is smaller) | | |
| 13 | Resistance to Solder Heat | Appearance | No defects which may affect performance | Temperature(Eutectic solder solution): 260±5°C Dipping Time : 10±1s Let sit for 24±2 hours at room temperature, then measure. Initial measurement Perform the initial measurement according to Note1 for Class II. | |
| | | Capacitance Change | Within the specified tolerance | | |
| | | Q/D.F | 30pF Min : Q≥1000 30pF Max : Q≥400+20xC C : Nominal Capacitance(pF) | | |
| | | I.R. | More than 10,000MΩ or 500Ω.F(Whichever is smaller) | | |

| No. | AEC-Q200 | Specification | | Test Methods And Conditions | | | | | | | | | | | | | | | | | | | | |
|--|---|--|---|---|-------|-----------------|-----------|----------|---------------------------|--------------------------|----------------------|------------------------|----------|---------------------|-----------------------|--------------------------|---------------------|--|---|--|--|--|--|--|
| | | Class I | Class II | | | | | | | | | | | | | | | | | | | | | |
| 14 | Thermal Shock | Appearance | No defects which may affect performance | <p>Perform the 300 cycles according to the two heat treatments listed in the following table. Transfer Time: 20s Max.</p> <p>Let sit for 24±2 hours at room temperature, then measure.</p> <table border="1"> <thead> <tr> <th>Step</th><th>1</th><th>2</th></tr> </thead> <tbody> <tr> <td>Temp(°C)</td><td>Min. operating temp.+0/-3</td><td>Max. operating temp+3/-0</td></tr> <tr> <td>Time(min)</td><td>15±3</td><td>15±3</td></tr> </tbody> </table> | Step | 1 | 2 | Temp(°C) | Min. operating temp.+0/-3 | Max. operating temp+3/-0 | Time(min) | 15±3 | 15±3 | | | | | | | | | | | |
| Step | 1 | 2 | | | | | | | | | | | | | | | | | | | | | | |
| Temp(°C) | Min. operating temp.+0/-3 | Max. operating temp+3/-0 | | | | | | | | | | | | | | | | | | | | | | |
| Time(min) | 15±3 | 15±3 | | | | | | | | | | | | | | | | | | | | | | |
| Capacitance Change | Within ±2.5% or ±0.25pF (Whichever is larger) | | | | | | | | | | | | | | | | | | | | | | | |
| Q/D.F | 30pF Min : Q≥1000 30pF Max : Q≥400+20xC C : Nominal Capacitance(pF) | | | | | | | | | | | | | | | | | | | | | | | |
| I.R. | More than 10,000MΩ or 500Ω.F(Whichever is smaller) | | | | | | | | | | | | | | | | | | | | | | | |
| 15 | ESD | Appearance | No defects which may affect performance | Per AEC-Q200-002 | | | | | | | | | | | | | | | | | | | | |
| | | Capacitance Change | Within the specified tolerance | | | | | | | | | | | | | | | | | | | | | |
| | | Q/D.F | 30pF Min : Q≥1000 30pF Max : Q≥400+20xC C : Nominal Capacitance(pF) | | | | | | | | | | | | | | | | | | | | | |
| | | I.R. | More than 10,000MΩ or 500Ω.F(Whichever is smaller) | | | | | | | | | | | | | | | | | | | | | |
| 16 | Solderability | | | <p>(a) Preheat at 155°C for 4 hours, and then immerse the capacitor in a solution of ethanol and rosin. Immerse in eutectic solder solution for 5+0/-0.5 seconds at 235±5°C.</p> <p>(b) Steam aging for 8 hours, and then immerse the capacitor in a solution of ethanol and rosin. Immerse in eutectic solder solution for 5+0/-0.5 seconds at 235±5°C.</p> <p>(c) Steam aging for 8 hours, and then immerse the capacitor in a solution of ethanol and rosin. Immerse in eutectic solder solution for 120±5 seconds at 260±5°C.</p> | | | | | | | | | | | | | | | | | | | | |
| | | 95% of the terminations is to be soldered evenly And continuously. | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| 17 | Electrical Characterization | Appearance | No defects or abnormalities | <p>The capacitance/Q/D.F. should be measured at 25°C at the frequency and voltage shown in the table</p> <table border="1"> <thead> <tr> <th>Class</th><th>Capacitance (C)</th><th>Frequency</th><th>Voltage</th></tr> </thead> <tbody> <tr> <td>Class I</td><td>C≤1000pF C > 1000pF</td><td>1±0.1MHz 1±0.1kHz</td><td>0.5~5Vrms 1±0.2Vrms</td></tr> <tr> <td>Class II</td><td>C≤110μF C > 10μF</td><td>1±0.1kHz 120±24kHz</td><td>1±0.2Vrms 0.5±0.1Vrms</td></tr> <tr> <td colspan="2">Initial measurement</td><td colspan="2">Perform the initial measurement according to Note1 for Class II</td></tr> <tr> <td colspan="2" rowspan="5">Should be measured with a DC voltage at 25°C and Max. operating temperature for 2 minutes of charging.</td><td colspan="2"></td></tr> </tbody></table> | Class | Capacitance (C) | Frequency | Voltage | Class I | C≤1000pF C > 1000pF | 1±0.1MHz 1±0.1kHz | 0.5~5Vrms 1±0.2Vrms | Class II | C≤110μF C > 10μF | 1±0.1kHz 120±24kHz | 1±0.2Vrms 0.5±0.1Vrms | Initial measurement | | Perform the initial measurement according to Note1 for Class II | | Should be measured with a DC voltage at 25°C and Max. operating temperature for 2 minutes of charging. | | | |
| Class | Capacitance (C) | Frequency | Voltage | | | | | | | | | | | | | | | | | | | | | |
| Class I | C≤1000pF C > 1000pF | 1±0.1MHz 1±0.1kHz | 0.5~5Vrms 1±0.2Vrms | | | | | | | | | | | | | | | | | | | | | |
| Class II | C≤110μF C > 10μF | 1±0.1kHz 120±24kHz | 1±0.2Vrms 0.5±0.1Vrms | | | | | | | | | | | | | | | | | | | | | |
| Initial measurement | | Perform the initial measurement according to Note1 for Class II | | | | | | | | | | | | | | | | | | | | | | |
| Should be measured with a DC voltage at 25°C and Max. operating temperature for 2 minutes of charging. | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Capacitance Change | Within the specified tolerance | | | | | | | | | | | | | | | | | | | | | |
| | | Q/D.F | 30pF Min : Q≥1000 30pF Max : Q≥400+20xC C : Nominal Capacitance(pF) | | | | | | | | | | | | | | | | | | | | | |
| | | I.R. at 25°C | More than 10,000MΩ or 500Ω.F (Whichever is smaller) | | | | | | | | | | | | | | | | | | | | | |
| | | I.R. at Max operating Temp. | 100Ω.F (Whichever is smaller) | | | | | | | | | | | | | | | | | | | | | |
| SAMWHA CAPACITOR | | 22 | | | | | | | | | | | | | | | | | | | | | | |

| No. | AEC-Q200 | Specification | | Test Methods And Conditions | | | | | | | |
|-------------|------------------------|---|--|--|-------------|---------------|-------|------------|----------------------|-----------|-------------|
| | | Class I | Class II | | | | | | | | |
| 18 | Voltage proof | No dielectric breakdown or mechanical breakdown | | Applied 250% of the rated voltage for 1~5 seconds The charge/discharge current is less than 50mA. | | | | | | | |
| 19 | Board Flex | Appearance | No defects which may affect performance | Apply a force in the direction shown in the following figure for 60±5 seconds.  Flexure for Class I: 3mm for Class II: 2mm | | | | | | | |
| | | Capacitance Change | Within ±5.0% or ±0.5pF (Whichever is larger) | | | | | | | | |
| 20 | Terminal Strength | Appearance | No defects which may affect performance | Apply *18N force in parallel with the test jig for 60±1 seconds. *10N for 1608(EIA:0603) size 2N for 1005(EIA:0402) size | | | | | | | |
| | | Capacitance Change | Within ±5.0% or ±0.5pF (Whichever is larger) | | | | | | | | |
| 21 | Beam Load | The chip endure following force. | | Apply a force as shown in the following figure. (i) Chip Length: 2.5mm Max. Beam Speed: 0.5mm/s  | | | | | | | |
| | | <table border="1"> <thead> <tr> <th>Chip Length</th> <th>Thickness (T)</th> <th>Force</th> </tr> </thead> <tbody> <tr> <td>2.5mm Max.</td> <td>T≤0.5mm T > 0.5mm</td> <td>8N 20N</td> </tr> <tr> <td>32. Mm Min.</td> <td>T < 1.25mm T≥1.25mm</td> <td>15N 54.5N</td> </tr> </tbody> </table> | | | Chip Length | Thickness (T) | Force | 2.5mm Max. | T≤0.5mm T > 0.5mm | 8N 20N | 32. Mm Min. |
| Chip Length | Thickness (T) | Force | | | | | | | | | |
| 2.5mm Max. | T≤0.5mm T > 0.5mm | 8N 20N | | | | | | | | | |
| 32. Mm Min. | T < 1.25mm T≥1.25mm | 15N 54.5N | | | | | | | | | |

| No. | AEC-Q200 | Specification | | Test Methods And Conditions | | | | | | | | | | |
|----------------------------|---|--|--|---|------------|---|---|---|---|---|----------------------------|------------|------------------------------|------------|
| | | Class I | Class II | | | | | | | | | | | |
| 22 | Capacitance Temperature Characteristics | Capacitance Change | X7R : Within $\pm 15\%$ X7S : Within $\pm 22\%$ X6S : Within $\pm 22\%$ X7T : Within $+22\% \sim -33\%$ | (i) Class I The temperature coefficient is determined using the capacitance measured in step 3 as a reference. When cycling the temperature sequentially from step 1 through 5, the capacitance should be within the specified tolerance for the temperature coefficient. The capacitance drift is calculated by dividing the differences between the maximum and minimum measured values in steps 1, 3 and 5 by the capacitance value in step 3. | | | | | | | | | | |
| | | Temperature Coefficient | 0 ± 30 ppm/ $^{\circ}\text{C}$ | <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th>Step</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr> <tr> <td>Temp($^{\circ}\text{C}$)</td><td>25± 2</td><td>Min. operating temp. ± 3</td><td>25± 2</td><td>Max. operating temp. ± 3</td><td>25± 2</td></tr> </table> | Step | 1 | 2 | 3 | 4 | 5 | Temp($^{\circ}\text{C}$) | 25 ± 2 | Min. operating temp. ± 3 | 25 ± 2 |
| Step | 1 | 2 | 3 | 4 | 5 | | | | | | | | | |
| Temp($^{\circ}\text{C}$) | 25 ± 2 | Min. operating temp. ± 3 | 25 ± 2 | Max. operating temp. ± 3 | 25 ± 2 | | | | | | | | | |
| Capacitance Drift | Within $\pm 0.2\%$ or $\pm 0.05\text{pF}$ (Whichever is larger) | (ii) Class II The ranges of capacitance change compared with the 25 $^{\circ}\text{C}$ value over the temperature range from -55 $^{\circ}\text{C}$ to 125 $^{\circ}\text{C}$ Initial measurement Perform the initial measurement according to Note 1 for Class II. | | | | | | | | | | | | |

- In case of thin layer type Capacitor, it can be different from normal specification. So Please ask to our sales person.

*Note 1. Initial Measurement for Class II

Perform a heat treatment at 150+0/-10 $^{\circ}\text{C}$ for one hour, and then let sit for 24+2 hours at room temperature, then measure.

"Following the International standards, the title of each test item is subject to change."

Packing

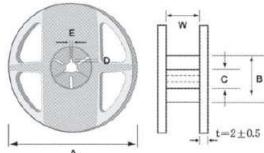
Bulk packing

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

Reel Packing

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

Reel Dimensions

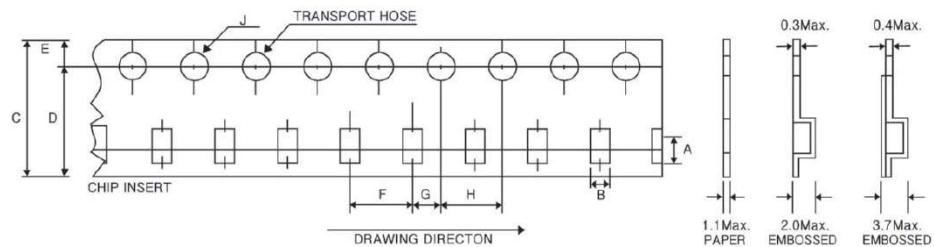


| Mark | Size Code | EIA Code | A | B | C | D | E | W |
|----------|-----------|-----------|--------|---------|---------|---------|-------|--------|
| 7" REEL | 1005~3225 | 0402~1210 | Ø178±2 | Ø50Min. | Ø13±0.5 | Ø21±0.8 | 2±0.5 | 10±1.5 |
| 13" REEL | 1005~3225 | 0402~1210 | Ø178±2 | Ø50Min. | Ø13±0.5 | Ø21±0.8 | 2±0.5 | 10±1.5 |

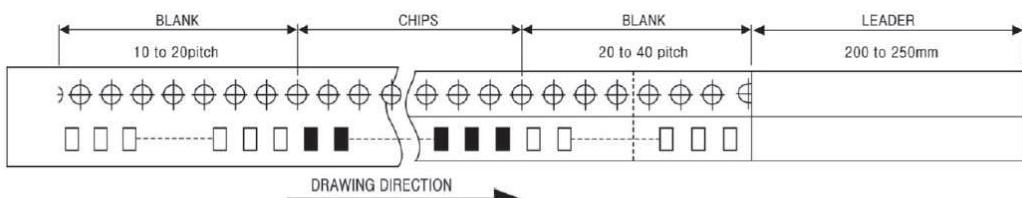
Number of Packages

| Type | EIA CODE | 7" Quantity(EA)/Reel | 13" Quantity(EA)/Reel |
|------|----------|----------------------|-----------------------|
| 1005 | 0402 | 10,000 | 50,000 |
| 1608 | 0603 | 4,000 | 16,000 |
| 2012 | 0805 | 3,000 ~ 4,000 | 10,000 |
| 3216 | 1206 | 2,000 ~ 4,000 | 6,000 ~ 10,000 |
| 3225 | 1210 | 1,000 ~ 3,000 | 4,000 ~ 10,000 |

Tape Dimensions



| Type | EIA CODE | A | B | C | D | E | F | G | H | J |
|------|----------|----------|----------|----------|----------|----------|----------|---------|---------|---------|
| 1005 | 0402 | 1.15±0.1 | 0.65±0.1 | 8.00±0.3 | 3.5±0.05 | 1.75±0.1 | 2.0±0.05 | 2.0±0.1 | 4.0±0.1 | 1.5±0.1 |
| 1608 | 0603 | 1.9±0.2 | 1.10±0.2 | 8.00±0.3 | 3.5±0.05 | 1.75±0.1 | 4.0±0.1 | 2.0±0.1 | 4.0±0.1 | 1.5±0.1 |
| 2012 | 0805 | 2.4±0.2 | 1.65±0.2 | 8.00±0.3 | 3.5±0.05 | 1.75±0.1 | 4.0±0.1 | 2.0±0.1 | 4.0±0.1 | 1.5±0.1 |
| 3216 | 1206 | 3.6±0.2 | 2.00±0.2 | 8.00±0.3 | 3.5±0.05 | 1.75±0.1 | 4.0±0.1 | 2.0±0.1 | 4.0±0.1 | 1.5±0.1 |
| 3225 | 1210 | 3.6±0.2 | 2.80±0.2 | 8.00±0.3 | 3.5±0.05 | 1.75±0.1 | 4.0±0.1 | 2.0±0.1 | 4.0±0.1 | 1.5±0.1 |



Caution

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

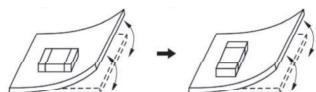
The Regulation of Environmental Pollution Materials

Never use materials mentioned below in MLCC products regulated this document. Pb, Cd, Hg, Cr⁺⁶, PBB(Polybrominated biphenyl), PBDE(Polybrominated diphenyl ethers), asbestos

Mounting Position

Choose a mounting position that minimizes the stress imposed on the chip during flexing or bending of the board.

(Component direction)



Locate chip horizontal to the direction in which stress acts

(Chip Mounting Close to Board Separation Point)



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(ΔT) within the range recommended in Table 1.

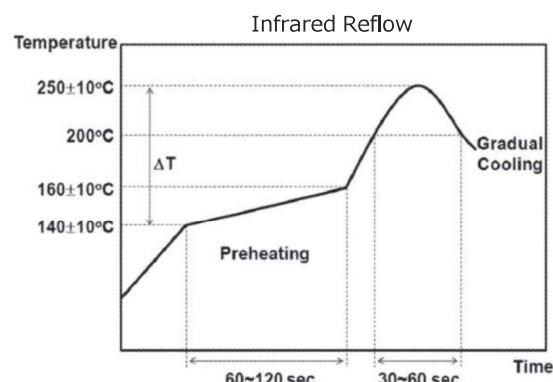
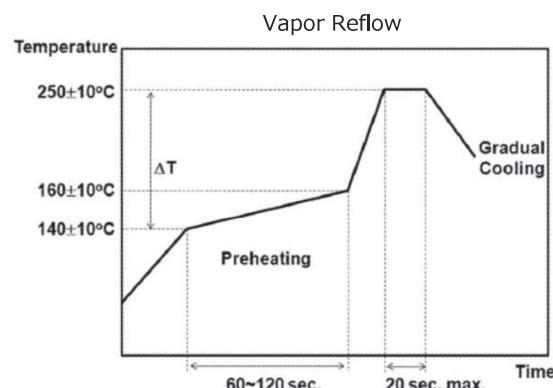


Table 1.

| Size code (EIA Code) | Temperature Difference |
|-----------------------|-------------------------------------|
| 1005~3216 (0402~1206) | $\Delta T \leq 190^{\circ}\text{C}$ |
| 3225 (1210) | $\Delta T \leq 130^{\circ}\text{C}$ |



'Aging'/'De-aging' behavior of high dielectric constant type MLCCs

(Typically represented by X7R temperature characteristic of which main composition is BaTiO₃)

'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:

$$C_t = C_{48}(1 - K \log 10 t)$$

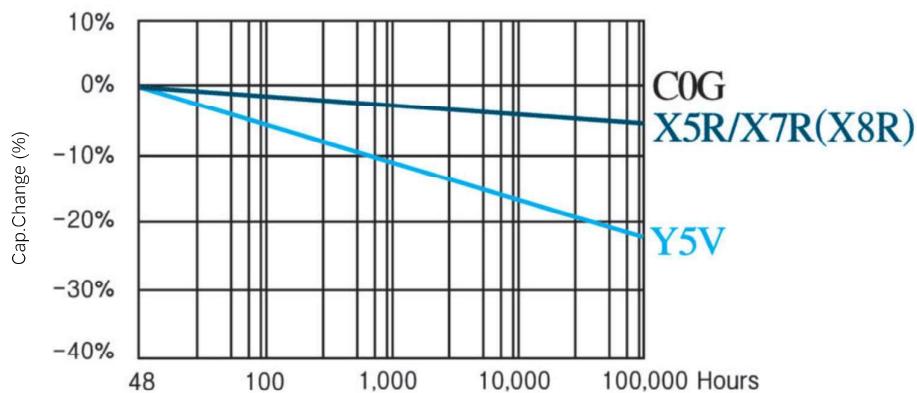
C_t : Capacitance value, t hours after the start of 'aging'

C_{48} : Capacitance value, 48 hours after its manufacture

K : Aging constant (capacitance decrease per decade-hour)

t : time, in hours, from the start of 'aging'

Ceramic's Capacitance Change(%) versus Time (hours)



The capacitance value can be restored(also known as 'de-aged') by exposing the component to elevated temperatures approaching its curie temperature(approximately 120°C).

This 'de-aging' 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 |
| X7R | ~3% |