

DATA SHEET

SURFACE MOUNT MULTILAYER CERAMIC CAPACITORS

General purpose class II

X6S

4 V TO 50 V

100 pF to 47 μ F

RoHS compliant & Halogen free



SCOPE

This specification describes X6S series chip capacitors with lead-free terminations.

APPLICATIONS

PCs, Hard disk, Game PCs
Power supplies
DVD players
Mobile phones
Data processing

FEATURES

Supplied in tape on reel
Nickel-barrier end termination
RoHS compliant
Halogen free compliant

ORDERING INFORMATION - GLOBAL PART NUMBER.

All part numbers are identified by the series, size, tolerance, TC material, packing style, voltage, process code, termination and capacitance value.

YAGEO BRAND ordering code**GLOBAL PART NUMBER (PREFERRED)**

CC xxxx x x **X6S** x **BB** xxx
(1) (2) (3) (4) (5)

(1) SIZE – INCH BASED (METRIC)

0201 (0603)
0402 (1005)
0603 (1608)
0805 (2012)
1206 (3216)
1210 (3225)

(2) TOLERANCE

K = $\pm 10\%$
M = $\pm 20\%$

(3) PACKING STYLE

R = Paper/PE taping reel; Reel 7 inch
K = Blister taping reel; Reel 7 inch
P = Paper/PE taping reel; Reel 13 inch
F = Blister taping reel; Reel 13 inch
C = Bulk case

(4) RATED VOLTAGE

4 = 4 V
5 = 6.3 V
6 = 10 V
7 = 16 V
8 = 25 V
9 = 50 V

(5) CAPACITANCE VALUE

2 significant digits+number of zeros
The 3rd digit signifies the multiplying factor, and letter R is decimal point
Example: 103 = $10 \times 10^3 = 10,000 \text{ pF} = 10 \text{ nF}$

CONSTRUCTION

The capacitor consists of a rectangular block of ceramic dielectric in which a number of interleaved metal electrodes are contained. This structure gives rise to a high capacitance per unit volume.

The inner electrodes are connected to the two end terminations and finally covered with a layer of plated tin (NiSn). The terminations are lead-free. A cross section of the structure is shown in Fig.1.

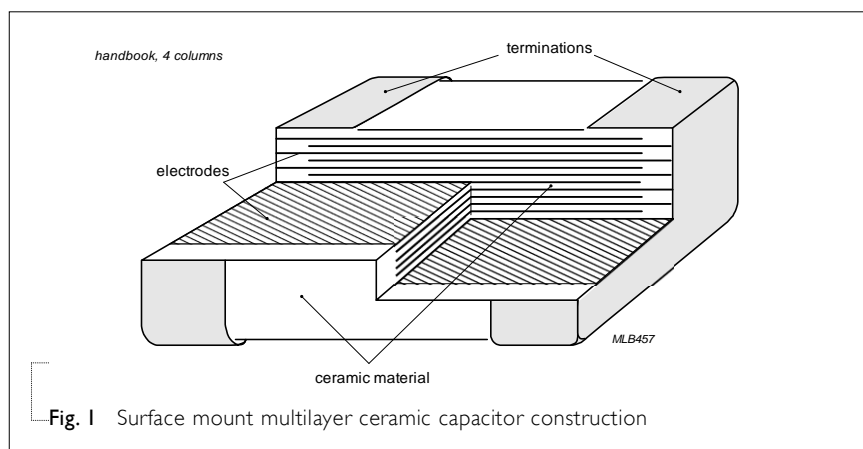


Fig. 1 Surface mount multilayer ceramic capacitor construction

DIMENSION

Table I For outlines see fig. 2

| TYPE | L ₁ (mm) | W (mm) | T (MM) | L ₂ / L ₃ (mm) | | L ₄ (mm) |
|------|---------------------|------------|------------|--------------------------------------|------|---------------------|
| | | | | min. | max. | min. |
| 0201 | 0.6 ±0.03 | 0.3 ±0.03 | 0.3 ±0.03 | | | |
| | 0.6±0.09 | 0.3 ±0.09 | 0.3±0.09 | 0.10 | 0.20 | 0.20 |
| 0402 | 1.0 ±0.05 | 0.5 ±0.05 | 0.5 ±0.05 | | | |
| | 1.0 ±0.15 | 0.5 ±0.15 | 0.5 ±0.15 | 0.15 | 0.30 | 0.40 |
| | 1.0 ±0.20 | 0.5 ±0.20 | 0.5 ±0.20 | | | |
| 0603 | 1.6±0.10 | 0.8 ±0.10 | 0.8 ±0.10 | | | |
| | 1.6 ±0.15 | 0.8 ±0.15 | 0.8 ±0.15 | 0.20 | 0.60 | 0.40 |
| | 1.6 ±0.20 | 0.8 ±0.20 | 0.8 ±0.20 | | | |
| 0805 | 2.0±0.20 | 1.25 ±0.20 | 1.25 ±0.20 | 0.25 | 0.75 | 0.55 |
| 1206 | 3.2 ±0.30 | 1.6 ±0.20 | 1.6 ±0.20 | 0.25 | 0.75 | 1.40 |
| 1210 | 3.2 ±0.40 | 2.5 ±0.30 | 2.5 ±0.20 | 0.25 | 0.75 | 1.40 |
| | 3.2 ±0.40 | 2.5 ±0.30 | 2.5 ±0.30 | | | |

OUTLINES

For dimension see Table I

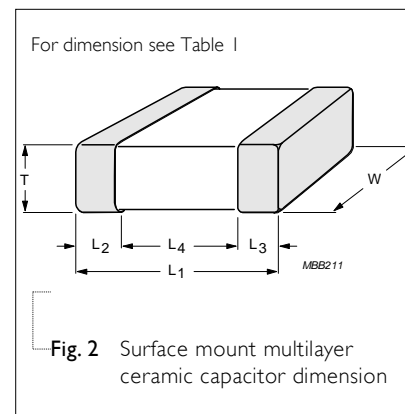


Fig. 2 Surface mount multilayer ceramic capacitor dimension

CAPACITANCE RANGE & THICKNESS FOR X6S

Table 2 Sizes from 0201 to 0402

| CAP. | 0201 | | | | 0402 | | | | 0603 | | | | | |
|--------|----------|----------|------|------|----------|----------|----------|------|---------|---------|---------|---------|---------|------|
| | 6.3 V | 10 V | 16 V | 25 V | 6.3 V | 10 V | 16 V | 25 V | 4 V | 6.3 V | 10 V | 16 V | 25 V | 50 V |
| 100 nF | 0.3±0.03 | 0.3±0.03 | | | | | | | | | | | | |
| 220 nF | | | | | 0.5±0.05 | 0.5±0.05 | 0.5±0.05 | | | | | | | |
| 470 nF | | | | | 0.5±0.05 | 0.5±0.05 | | | | | | | | |
| 1 µF | | | | | 0.5±0.05 | 0.5±0.05 | | | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | |
| 2.2 µF | | | | | 0.5±0.20 | 0.5±0.20 | | | 0.8±0.1 | 0.8±0.1 | 0.8±0.1 | 0.8±0.2 | | |
| 4.7 µF | | | | | 0.5±0.15 | | | | 0.8±0.2 | 0.8±0.2 | | | | |
| 10 µF | | | | | | | | | 0.8±0.2 | 0.8±0.2 | | | | |
| 22 µF | | | | | | | | | 0.8±0.2 | 0.8±0.2 | | | | |
| 47 µF | | | | | | | | | | | | | | |

Table 3 Sizes from 0805 to 1210

| CAP. | 0805 | | | | | 1206 | | | | 1210 | | | |
|--------|----------|----------|----------|----------|----------|---------|---------|---------|---------|---------|---------|------|--|
| | 6.3 V | 10 V | 16 V | 25 V | 50 V | 6.3 V | 10 V | 16 V | 25 V | 6.3 V | 10 V | 16 V | |
| 100 nF | | | | | | | | | | | | | |
| 220 nF | | | | | | | | | | | | | |
| 470 nF | | | | | | | | | | | | | |
| 1 µF | | | | | | | | | | | | | |
| 2.2 µF | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | | | | | | | | |
| 4.7 µF | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | | | | | | | | | |
| 10 µF | 1.25±0.2 | 1.25±0.2 | 1.25±0.2 | | | 1.6±0.2 | 1.6±0.2 | 1.6±0.2 | 1.6±0.2 | | | | |
| 22 µF | 1.25±0.2 | | | | | 1.6±0.2 | 1.6±0.2 | 1.6±0.2 | | | | | |
| 47 µF | | | | | | | | | | 2.5±0.2 | 2.5±0.2 | | |
| 100 µF | | | | | | | | | | | | | |

THICKNESS CLASSES AND PACKING QUANTITY

Table 4

| SIZE CODE | THICKNESS CLASSIFICATION | TAPE WIDTH QUANTITY PER REEL | Ø180 MM / 7 INCH | | Ø330 MM / 13 INCH | | QUANTITY PER BULK CASE |
|-----------|--------------------------|---------------------------------|------------------|---------|-------------------|---------|---------------------------|
| | | | Paper | Blister | Paper | Blister | |
| 0201 | 0.3 ±0.03 mm | 8 mm | 15,000 | --- | 50,000 | --- | --- |
| 0402 | 0.5 ±0.05 mm | 8 mm | 10,000 | --- | 50,000 | --- | 50,000 |
| 0603 | 0.8 ±0.1 mm | 8 mm | 4,000 | --- | 15,000 | --- | 15,000 |
| 0805 | 1.25 ±0.2 mm | 8 mm | --- | 3,000 | --- | 10,000 | 5,000 |
| 1206 | 1.6 ±0.2 mm | 8 mm | --- | 2,000 | --- | 8,000 | --- |
| 1210 | 2.5±0.2/0.3 mm | 8 mm | --- | 500 | --- | --- | --- |

ELECTRICAL CHARACTERISTICS

X6S DIELECTRIC CAPACITORS; NISN TERMINATIONS

Unless otherwise specified, all tests and measurements shall be made under standard atmospheric conditions for testing as given in 5.3 of IEC 60068-1:

- Temperature: 15 °C to 35 °C
- Relative humidity: 25% to 75%
- Air pressure: 86 kPa to 106 kPa

Before the measurements are made, the capacitor shall be stored at the measuring temperature for a time sufficient to allow the entire capacitor to reach this temperature.

The period as prescribed for recovery at the end of a test is normally sufficient for this purpose.

Table 5

| DESCRIPTION | VALUE |
|---|---|
| Capacitance range | 100 nF to 100 µF |
| Capacitance tolerance | ±10% and ±20% |
| Dissipation factor (D.F.) | ≤10% |
| Insulation resistance after 1 minute at U_r (DC) | $R_{ins} \times C_r \geq 100 / 50 \Omega.F *$ |
| Maximum capacitance change as a function of temperature (temperature characteristic/coefficient): | ±22% |
| Operating temperature range: | -55 °C to +105 °C |

Note:

$R_{ins} \times C_r \geq 100 \Omega.F$

0201: 100nF to 470nF

0402: 470nF, 1µF/ 6.3V to 10V

0603: 1µF, 2.2µF/ 6.3V to 16V, 4.7µF/ 6.3V to 16V

0805: 2.2µF, 4.7µF to 10µF/ 6.3V to 16V

1206: 10µF/ 6.3V to 16V, 22µF/ 6.3V to 10V

$R_{ins} \times C_r \geq 50 \Omega.F$

0201: 1µF

0402: 220nF, 1µF/ 16V to 25V, 2.2µF, 4.7µF to 10µF/ 6.3V

0603: 2.2µF/ 25V, 4.7µF/ 25V, 10µF to 22µF

0805: 4.7µF/ 50V, 10µF/ 25V, 22µF to 47µF

1206: 10µF/ 25V, 22µF/ 16V, 47µF to 100µF

1210: 47µF to 100µF

SOLDERING RECOMMENDATION

Table 6

| SOLDERING METHOD | SIZE ≤ 0402 | 0603 | 0805 | 1206 | ≥ 1210 |
|------------------|----------------|----------|----------|----------|-------------|
| Reflow | Reflow only | ≥ 1.0 μF | ≥ 2.2 μF | ≥ 4.7 μF | Reflow only |
| Reflow/Wave | --- | < 1.0 μF | < 2.2 μF | < 4.7 μF | --- |

TESTS AND REQUIREMENTS

Table 7 Test procedures and requirements

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS |
|--|-----------------|---|----------------------------------|
| Mounting | IEC 60384-21/22 | 4.3 The capacitors may be mounted on printed-circuit boards or ceramic substrates | No visible damage |
| Visual Inspection and Dimension Check | 4.4 | Any applicable method using × 10 magnification | In accordance with specification |
| Capacitance ⁽¹⁾ | 4.5.1 | Class 2: At 20 °C, 24 hrs after annealing Cap ≤ 1 μF, f = 1 KHz, measuring at voltage 1 Vrms at 20 °C Cap > 1 μF, f = 1 KHz for C ≤ 10 μF, rated voltage > 6.3 V, measuring at voltage 1 Vrms at 20 °C f = 1 KHz, for C ≤ 10 μF, rated voltage ≤ 6.3 V, measuring at voltage 0.5 to 1 Vrms at 20 °C f = 120 Hz for C > 10 μF, measuring at voltage 0.5 Vrms at 20 °C | Within specified tolerance |
| Dissipation Factor (D.F.) ⁽¹⁾ | 4.5.2 | Class 2: At 20 °C, 24 hrs after annealing Cap ≤ 1 μF, f = 1 KHz, measuring at voltage 1 Vrms at 20 °C Cap > 1 μF, f = 1 KHz for C ≤ 10 μF, rated voltage > 6.3 V, measuring at voltage 1 Vrms at 20 °C f = 1 KHz, for C ≤ 10 μF, rated voltage ≤ 6.3 V, measuring at voltage 0.5 Vrms at 20 °C f = 120 Hz for C > 10 μF, measuring at voltage 0.5 Vrms at 20 °C | In accordance with specification |
| Insulation Resistance | 4.5.3 | At U _r (DC) for 1 minute | In accordance with specification |

NOTE

1. The figure indicates typical inspection. Please refer to individual specifications.

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS | | | | | | | | | | |
|----------------------------|-----------------------|---|--|------------------------------|---|------|---|-----------------------|---|------|---|-----------------------|---|
| Temperature Characteristic | 4. | Capacitance shall be measured by the steps shown in the following table. | Class1: Δ C/C: ±30ppm | | | | | | | | | | |
| | | The capacitance change should be measured after 5 min at each specified temperature stage. | Class2: X6S: Δ C/C: ±22% | | | | | | | | | | |
| | | <table><tr><td>Step</td><td>Temperature(°C)</td></tr><tr><td>a</td><td>25±2</td></tr><tr><td>b</td><td>Lower temperature±3°C</td></tr><tr><td>c</td><td>25±2</td></tr><tr><td>d</td><td>Upper Temperature±2°C</td></tr><tr><td>e</td><td>25±2</td></tr></table> | Step | Temperature(°C) | a | 25±2 | b | Lower temperature±3°C | c | 25±2 | d | Upper Temperature±2°C | e |
| Step | Temperature(°C) | | | | | | | | | | | | |
| a | 25±2 | | | | | | | | | | | | |
| b | Lower temperature±3°C | | | | | | | | | | | | |
| c | 25±2 | | | | | | | | | | | | |
| d | Upper Temperature±2°C | | | | | | | | | | | | |
| e | 25±2 | | | | | | | | | | | | |
| | | (1) Class I | | | | | | | | | | | |
| | | Temperature Coefficient shall be calculated from the formula as below | | | | | | | | | | | |
| | | $\text{Temp, Coefficient} = \frac{C2 - C1}{C1 \times \Delta T} \times 10^6 \text{ [ppm/°C]}$ | | | | | | | | | | | |
| | | C1: Capacitance at step c | | | | | | | | | | | |
| | | C2: Capacitance at 125°C | | | | | | | | | | | |
| | | ΔT: 100°C(=125°C-25°C) | | | | | | | | | | | |
| | | (2) Class II | | | | | | | | | | | |
| | | Capacitance Change shall be calculated from the formula as below | | | | | | | | | | | |
| | | $\Delta C = \frac{C2 - C1}{C1} \times 100\%$ | | | | | | | | | | | |
| | | C1: Capacitance at step c | | | | | | | | | | | |
| | | C2: Capacitance at step b or d | | | | | | | | | | | |
| Adhesion | 4.7 | A force applied for 10 seconds to the line joining the terminations and in a plane parallel to the substrate | Force size ≥ 0603: 5N size = 0402: 2.5N size = 0201: 1N | | | | | | | | | | |
| Bending Strength | IEC 60384-21/22 | 4.8 | Mounting in accordance with IEC 60384-22 paragraph 4.3 | No visible damage | | | | | | | | | |
| | | | Conditions: bending 1 mm at a rate of 1 mm/s, radius jig 5 mm | ΔC/C Class2: X6S: ±10% | | | | | | | | | |

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS |
|------------------------------|-------------------------|---|---|
| Resistance to Soldering Heat | 4.9 | <p>Precondition: 150 +0/-10 °C for 1 hour, then keep for 24 ±1 hours at room temperature</p> <p>Preheating: for size ≤ 1206: 120 °C to 150 °C for 1 minute</p> <p>Preheating: for size >1206: 100 °C to 120 °C for 1 minute and 170 °C to 200 °C for 1 minute</p> <p>Solder bath temperature: 260 ±5 °C</p> <p>Dipping time: 10 ±0.5 seconds</p> <p>Recovery time: 24 ±2 hours</p> | <p>Dissolution of the end face plating shall not exceed 25% of the length of the edge concerned</p> <hr/> <p>$\Delta C/C$</p> <p>Class2:</p> <p>X6S: ±10%</p> <hr/> <p>D.F. within initial specified value</p> <p>R_{ins} within initial specified value</p> |
| Solderability | 4.10 | <p>Preheated the temperature of 80 °C to 140 °C and maintained for 30 seconds to 60 seconds.</p> <p>1. Temperature: 235±5°C / Dipping time: 2 ±0.5 s</p> <p>2. Temperature: 245±5°C / Dipping time: 3 ±0.5 s (lead free)</p> <p>Depth of immersion: 10mm</p> | <p>The solder should cover over 95% of the critical area of each termination</p> |
| Rapid Change of Temperature | IEC 60384-21/22 4.11 | <p>Preconditioning: 150 +0/-10 °C for 1 hour, then keep for 24 ±1 hours at room temperature</p> <p>5 cycles with following detail: 30 minutes at lower category temperature 30 minutes at upper category temperature</p> <p>Recovery time 24 ±2 hours</p> | <p>No visual damage</p> <hr/> <p>$\Delta C/C$</p> <p>Class2:</p> <p>X6S: ±15%</p> <hr/> <p>D.F. meet initial specified value</p> <p>R_{ins} meet initial specified value</p> |

| TEST | TEST METHOD | PROCEDURE | REQUIREMENTS |
|------------------------------|---------------------|--|---|
| Damp Heat with U_r Load | 4.13 | <ol style="list-style-type: none"> Preconditioning, class 2 only: 150 \pm 0/-10 °C /1 hour, then keep for 24 \pm 1 hour at room temp Initial measure: Spec: refer to initial spec C, D, IR Damp heat test: 500 \pm 12 hours at 40 \pm 2 °C; 90 to 95% R.H. 1.0 U_r applied Recovery: Class 2: 24 \pm 2 hours Final measure: C, D, IR P.S. If the capacitance value is less than the minimum value permitted, then after the other measurements have been made the capacitor shall be preconditioned according to "IEC 60384 4.1" and then the requirements shall be met. | No visual damage after recovery <hr/> $\Delta C/C$ Class2: $\pm 20\%$ D.F. Class2: 2 \times initial value max R_{ins} Class2: $R_{ins} \times Cr \geq 5s$ whichever is less |
| Endurance | IEC 60384- 21/22 | 4.14 <ol style="list-style-type: none"> Preconditioning, class 2 only: 150 \pm 0/-10 °C /1 hour, then keep for 24 \pm 1 hour at room temp Initial measure: Spec: refer to initial spec C, D, IR Endurance test: Temperature: X6S: 105 °C Specified stress voltage applied for 1,000 hours: Applied 1.5 $\times U_r$. Applied 1 U_r: 0201: 1uF 0402: 4.7uF, 10uF 0603: 10uF, 22uF 0805: 10uF/ 25V, 22uF/ 16V Recovery time: 24 \pm 2 hours Final measure: C, D, IR P.S. If the capacitance value is less than the minimum value permitted, then after the other measurements have been made the capacitor shall be preconditioned according to "IEC 60384 4.1" and then the requirements shall be met. | No visual damage <hr/> $\Delta C/C$ Class 2: $\pm 20\%$ D.F. Class 2: 2 \times initial value max R_{ins} Class 2: $R_{ins} \times Cr \geq 10s$ |
| Voltage Proof | IEC 60384-I | 4.6 <p>Specified stress voltage applied for 1~5 seconds $U_r \leq 100 V$: series applied 2.5 U_r Charge/Discharge current is less than 50 mA</p> | No breakdown or flashover |

REVISION HISTORY

| REVISION | DATE | CHANGE NOTIFICATION | DESCRIPTION |
|-----------|---------------|---------------------|--|
| Version 5 | Jun. 2, 2020 | - | - Product range updated |
| Version 4 | Aug 7, 2017 | - | - 0402 Dimension update |
| Version 3 | Jul 19, 2017 | - | - Product range updated |
| Version 2 | Feb. 20, 2017 | - | - Dimension & capacitance update |
| Version 1 | Sep. 16, 2015 | - | - Dimension & capacitance update |
| Version 0 | Nov. 18, 2014 | - | - New datasheet for general purpose High Cap X6S |

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| CC0201MRX6S5BB224 | CC0201KRX6S6BB104 | CC0402MRX6S5BB475 | CC0402MRX6S5BB225 |
| CC0603MRX6S5BB226 | CC0603MRX6S5BB106 | CC0603KRX6S5BB475 | CC0805KKX6S7BB106 |
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| CC0805KKX6S6BB106 | CC0402KRX6S7BB105 | CC0402KRX6S8BB105 | CC0805KKX6S8BB106 |
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