

# DATA SHEET

## SURFACE MOUNT MULTILAYER CERAMIC CAPACITORS

General purpose class II

X6S

4 V TO 50 V

100 pF to 47 $\mu$ 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)

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**(1) SIZE – INCH BASED (METRIC)**

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

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**(2) TOLERANCE**

K = ±10%  
 M = ±20%

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**(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

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**(4) RATED VOLTAGE**

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

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**(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 × 10<sup>3</sup> = 10,000 pF = 10 nF

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**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.

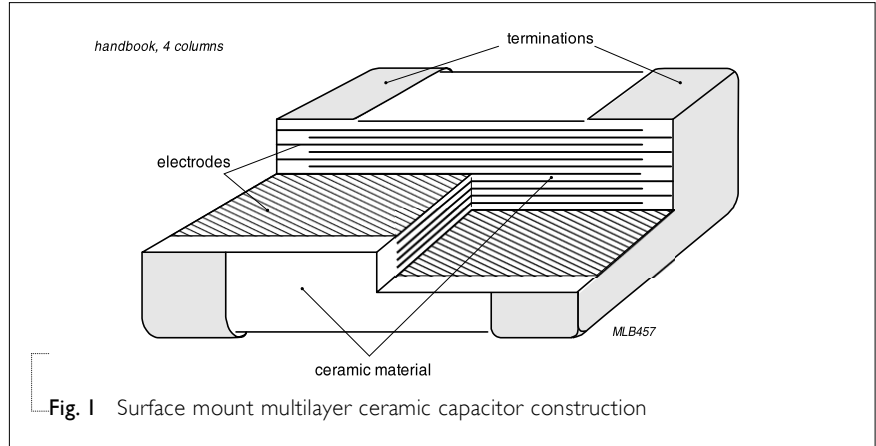


Fig. 1 Surface mount multilayer ceramic capacitor construction

**DIMENSION**

Table I For outlines see fig. 2

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

**NOTE**

1. 0402/4.7uF/6.3V
2. 0402/2.2uF/16V
3. 0603/1uF/50V
4. 0603/4.7uF~22uF/4V, 6.3V; 0603/2.2uF/16V

**OUTLINES**

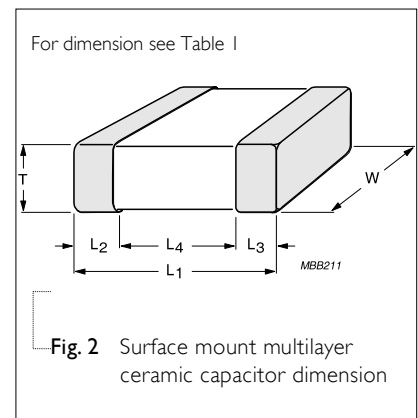


Fig. 2 Surface mount multilayer ceramic capacitor dimension

**CAPACITANCE RANGE & THICKNESS FOR X6S**

**Table 2** Sizes from 0201 to 0402

CAP.	0201		0402			0603					
	6.3V	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										
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 uF		0.5±0.05	0.5±0.05	0.5±0.05	0.5±0.1	0.8±0.1	0.8±0.1	0.8±0.1	0.8±0.1	0.8±0.1	0.8±0.15
2.2 uF		0.5±0.05	0.5±0.05	0.5±0.2		0.8±0.1	0.8±0.1	0.8±0.1	0.8±0.2		
4.7 uF		0.5±0.15				0.8±0.2	0.8±0.2				
10 uF						0.8±0.2	0.8±0.2				
22 uF						0.8±0.2	0.8±0.2				
47 uF											

**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
100 nF											
220 nF											
470 nF											
1 uF											
2.2 uF	1.25±0.2	1.25±0.2	1.25±0.2	1.25±0.2	1.25±0.2						
4.7 uF	1.25±0.2	1.25±0.2	1.25±0.2	1.25±0.2							
10 uF	1.25±0.2	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 uF	1.25±0.2	1.25±0.2	1.25±0.2			1.6±0.2	1.6±0.2	1.6±0.2			
47 uF										2.5±0.2	2.50±0.2
100 uF										2.5±0.2	

**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 mm	8 mm	---	1,000 500	---	---	---

**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 47 µF
Capacitance tolerance	±10% and ±20%
Dissipation factor (D.F.)	≤10%
	$R_{ins} \times Cr \geq 500 \Omega \cdot F$
	$R_{ins} \times Cr \geq 100 \Omega \cdot F$ : 0603/4.7µF/4V & 6.3V; 0603/2.2µF/10V & 16V; 0603/1µF/25V & 50V; 0805/10µF/16V; 0805/2.2µF/50V;
Insulation resistance after 1 minute at $U_r$ (DC)	$R_{ins} \times Cr \geq 50 \Omega \cdot F$ : 0402/4.7µF/6.3V; 0402/1µF/16V & 25V; 0402/2.2µF/16V; 0603/10µF & 22µF/4V & 6.3V; 0805/22µF/10V & 16V; 0805/10µF/25V; 0805/4.7µF/50V; 1206/22µF/16V; 1206/10µF/25V; 1210/100µF/6.3V; 1210/47µF/10V;
Maximum capacitance change as a function of temperature (temperature characteristic/coefficient):	±22%
Operating temperature range:	-55 °C to +105 °C

**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 <sup>(1)</sup>	4.5.1	Class 2: At 20 °C, 24 hrs after annealing f = 1 KHz for C ≤ 10 μF, rated voltage > 6.3 V, measuring at voltage 1 V <sub>rms</sub> at 20 °C f = 1 KHz, for C ≤ 10 μF, rated voltage ≤ 6.3 V, measuring at voltage 0.5 V <sub>rms</sub> at 20 °C f = 120 Hz for C > 10 μF, measuring at voltage 0.5 V <sub>rms</sub> at 20 °C	Within specified tolerance
Dissipation Factor (D.F.) <sup>(1)</sup>	4.5.2	Class 2: At 20 °C, 24 hrs after annealing f = 1 KHz for C ≤ 10 μF, rated voltage > 6.3 V, measuring at voltage 1 V <sub>rms</sub> at 20 °C f = 1 KHz, for C ≤ 10 μF, rated voltage ≤ 6.3 V, measuring at voltage 0.5 V <sub>rms</sub> at 20 °C f = 120 Hz for C > 10 μF, measuring at voltage 0.5 V <sub>rms</sub> at 20 °C	In accordance with specification
Insulation Resistance	4.5.3	At U <sub>r</sub> (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	4.6	<p>Capacitance shall be measured by the steps shown in the following table.</p> <p>The capacitance change should be measured after 5 min at each specified temperature stage.</p> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Step</th> <th>Temperature(°C)</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>(1) Class I</p> <p>Temperature Coefficient shall be calculated from the formula as below</p> $\text{Temp. Coefficient} = \frac{C2 - C1}{C1 \times \Delta T} \times 10^6 \text{ [ppm/°C]}$ <p>C1: Capacitance at step c                      C2: Capacitance at 125°C                      ΔT: 100°C(=125°C-25°C)</p> <p>(2) Class II</p> <p>Capacitance Change shall be calculated from the formula as below</p> $\Delta C = \frac{C2 - C1}{C1} \times 100\%$ <p>C1: Capacitance at step c                      C2: Capacitance at step b or d</p>	Step	Temperature(°C)	a	25±2	b	Lower temperature±3°C	c	25±2	d	Upper Temperature±2°C	e	25±2	<p>Class1: Δ C/C: ±30ppm</p> <p>Class2: X6S: Δ C/C: ±22%</p>
Step	Temperature(°C)														
a	25±2														
b	Lower temperature±3°C														
c	25±2														
d	Upper Temperature±2°C														
e	25±2														
Adhesion	4.7	<p>A force applied for 10 seconds to the line joining the terminations and in a plane parallel to the substrate</p>	<p>Force                      size ≥ 0603: 5N                      size = 0402: 2.5N                      size = 0201: 1N</p>												
Bending Strength	IEC 60384-21/22 4.8	<p>Mounting in accordance with IEC 60384-22 paragraph 4.3</p> <p>Conditions: bending 1 mm at a rate of 1 mm/s, radius jig 340 mm</p>	<p>No visible damage</p> <p>ΔC/C                      Class2:                      X6S: ±10%</p>												

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



TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Damp Heat with U <sub>r</sub> Load	4.13	<ol style="list-style-type: none"> <li>1. Preconditioning, class 2 only: 150 +0/-10 °C /1 hour, then keep for 24 ±1 hour at room temp</li> <li>2. Initial measure: Spec: refer to initial spec C, D, IR</li> <li>3. Damp heat test: 500 ±12 hours at 40 ±2 °C; 90 to 95% R.H. 1.0 U<sub>r</sub> applied</li> <li>4. Recovery: Class 2: 24 ±2 hours</li> <li>5. Final measure: C, D, IR</li> </ol> <p>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.</p>	<p>No visual damage after recovery</p> <hr/> <p>ΔC/C Class2: ±20% D.F. Class2: 2 × initial value max R<sub>ins</sub> Class2: Rins × Cr ≥ 5s whichever is less</p>
Endurance	IEC 60384-21/22 4.14	<ol style="list-style-type: none"> <li>1. Preconditioning, class 2 only: 150 +0/-10 °C /1 hour, then keep for 24 ±1 hour at room temp</li> <li>2. Initial measure: Spec: refer to initial spec C, D, IR</li> <li>3. Endurance test: Temperature: X6S: 105 °C Specified stress voltage applied for 1,000 hours: Applied 1.5 × U<sub>r</sub>. Applied 1 U<sub>r</sub>: 0402/4.7uF/6.3V;0603/10uF &amp; 22uF/4V &amp; 6.3V;0805/22uF/16V; 0805/10uF/25V; Recovery time: 24 ±2 hours</li> <li>4. Final measure: C, D, IR</li> </ol> <p>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.</p>	<p>No visual damage</p> <hr/> <p>ΔC/C Class 2: ±20% D.F. Class 2: 2 × initial value max R<sub>ins</sub> Class 2: Rins × Cr ≥ 10s</p>

REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
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