

DATA SHEET

SURFACE MOUNT MULTILAYER CERAMIC CAPACITORS

General purpose class II

X5R

4 V TO 50 V
100 pF to 10 μ F

X7R

6.3 V TO 50 V
47 pF to 2.2 μ F

RoHS compliant & Halogen free



SCOPE

This specification describes X5R/X7R 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, PHYCOMP

CTC & I2NC

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 **X5R** 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)
1812 (4532)

(2) TOLERANCE

J = $\pm 5\%$ ⁽¹⁾
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 = $10 \times 10^3 = 10,000 \text{ pF} = 10 \text{ nF}$

NOTE

1. Tolerance $\pm 5\%$ is not available for full product range, please contact local sales force before ordering

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.

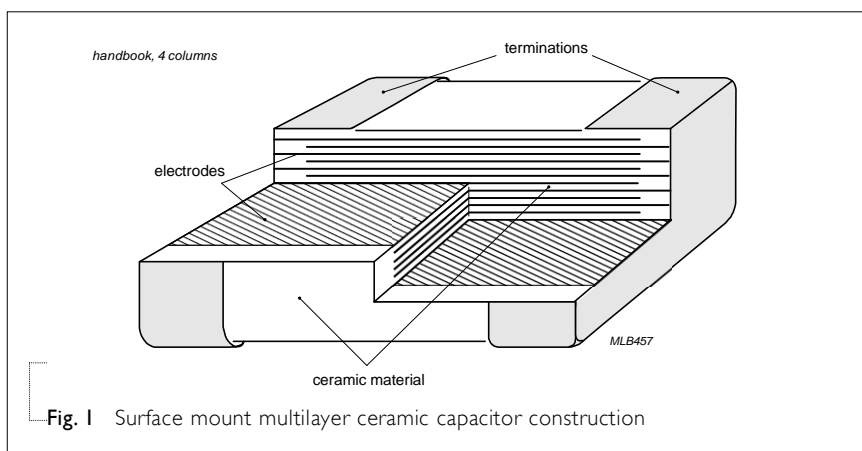


Fig. 1 Surface mount multilayer ceramic capacitor construction

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 ⁽¹⁾	0.3 ±0.03 ⁽¹⁾	Refer to table 2 to 4	0.10	0.20	0.20
	0.6 ±0.05 ⁽²⁾	0.3 ±0.05 ⁽²⁾				
0402	1.0 ±0.05 ⁽¹⁾	0.5 ±0.05 ⁽¹⁾		0.20	0.30	0.40
	1.0 ±0.15 ⁽²⁾	0.5 ±0.15 ⁽²⁾				
	1.0 ±0.20 ⁽³⁾	0.5 ±0.20 ⁽³⁾				
0603	1.6 ±0.10 ⁽¹⁾	0.8 ±0.10 ⁽¹⁾		0.20	0.60	0.40
	1.6 ±0.15 ⁽²⁾	0.8 ±0.15 ⁽²⁾				
	1.6 ±0.20 ⁽³⁾	0.8 ±0.20 ⁽³⁾				
0805	2.0 ±0.10 ⁽¹⁾	1.25 ±0.10 ⁽¹⁾		0.25	0.75	0.55
	2.0 ±0.20 ⁽²⁾	1.25 ±0.20 ⁽²⁾				
1206	3.2 ±0.15 ⁽¹⁾	1.6 ±0.15 ⁽¹⁾		0.25	0.75	1.40
	3.2 ±0.30 ⁽²⁾	1.6 ±0.20 ⁽²⁾				
	3.2 ±0.30 ⁽³⁾	1.6 ±0.30 ⁽³⁾				
1210	3.2 ±0.20 ⁽¹⁾	2.5 ±0.20 ⁽¹⁾		0.25	0.75	1.40
	3.2 ±0.40 ⁽²⁾	2.5 ±0.30 ⁽²⁾				
1812	4.5 ±0.20 ⁽¹⁾	3.2 ±0.20 ⁽¹⁾		0.25	0.75	2.20
	4.5 ±0.40 ⁽²⁾	3.2 ±0.40 ⁽²⁾				

NOTE

1. Dimensions for size 0201, C < 1 µF; 0402, C < 4.7 µF; 0603, C < 4.7 µF; 0805 to 1812, C ≤ 100nF
2. Dimensions for size 0201, C ≥ 100 nF (25V), C ≥ 1µ F; 0402, C ≥ 4.7µF, C=2.2µF (16V); 0603, 10µF (6.3V) ≥ C ≥ 4.7µF, C ≥ 2.2µF (25V); 0805 to 1812, C > 100 nF
3. Dimensions for size 0402, C ≥ 10 µF; 0603, C ≥ 10µF (≥10V), C=22µF(6.3V); 1206, C ≥ 22µF (25V), C ≥ 100µF

OUTLINES

For dimension see Table I

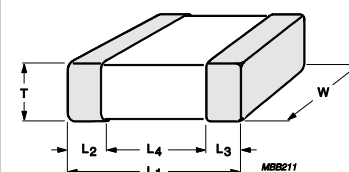


Fig. 2 Surface mount multilayer ceramic capacitor dimension

CAPACITANCE RANGE & THICKNESS FOR X5R
Table 2 Sizes from 0201 to 0402

CAP.	0201						0402					
	4 V	6.3 V	10 V	16 V	25 V	50 V	4 V	6.3 V	10 V	16 V	25 V	50 V
100 pF		0.3±0.03	0.3±0.03	0.3±0.03	0.3±0.03	0.3±0.03						
150 pF												
220 pF												
330 pF												
470 pF												
680 pF												
1.0 nF									0.3±0.03			
1.5 nF												
2.2 nF												
3.3 nF	0.3±0.03						0.3±0.03	0.3±0.03				
4.7 nF												
6.8 nF												
10 nF												
15 nF												
22 nF												
33 nF												
47 nF												
68 nF										0.5±0.05	0.5±0.05	0.5±0.05
100 nF					0.3±0.05							
150 nF								0.5±0.05	0.5±0.05			
220 nF	0.3±0.03	0.3±0.03	0.3±0.03									
330 nF												
470 nF	0.3±0.03	0.3±0.03								0.5±0.05	0.5±0.05	0.5±0.05
680 nF												
1.0 μF	0.3±0.05	0.3±0.05								0.5±0.05	0.5±0.05	
2.2 μF										0.5±0.15		
4.7 μF							0.5±0.15	0.5±0.15	0.5±0.15			
10 μF							0.5±0.20	0.5±0.20				

NOTE

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-6 series is available on request

CAPACITANCE RANGE & THICKNESS FOR X5R
Table 3 Sizes from 0603 to 0805

CAP.	0603					0805				
	6.3 V	10 V	16 V	25 V	50V	6.3 V	10 V	16 V	25 V	50V
10 nF										
15 nF										
22 nF										
33 nF										
47 nF										
68 nF										
100 nF										
150 nF										
220 nF										
330 nF										
470 nF				0.8±0.1	0.8±0.1					
680 nF	0.8±0.1	0.8±0.1	0.8±0.1	0.8±0.1	0.8±0.1			0.85±0.1 1.25±0.2	1.25±0.2	1.25±0.2
1.0 µF						0.85±0.1 1.25±0.2	0.85±0.1 1.25±0.2			
2.2 µF				0.8±0.15				0.85±0.1 1.25±0.2		
4.7 µF			0.8±0.15							
10 µF	0.8±0.15	0.8±0.2	0.8±0.2	0.8±0.20				1.25±0.2	1.25±0.2	

NOTE

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-6 series is available on request

Table 4 Sizes from 1206 to 1812
CAPACITANCE RANGE & THICKNESS FOR X7R

Table 5 Sizes from 0201 to 0402

CAP.	1206					1210					1812	
	6.3 V	10 V	16 V	25 V	50V	6.3 V	10 V	16 V	25 V	50V	6.3 V	
10 nF												
15 nF												
22 nF												
33 nF												
47nF												
68 nF												
100 nF												
150 nF												
220 nF												
330 nF												
470 nF												
680 nF												
1.0 μ F	1.15 \pm 0.1	1.15 \pm 0.1	1.15 \pm 0.1	1.15 \pm 0.1	1.6 \pm 0.2	1.25 \pm 0.2	1.25 \pm 0.2	1.25 \pm 0.2	1.25 \pm 0.2	1.25 \pm 0.2		
2.2 μ F					1.6 \pm 0.2						1.9 \pm 0.2	
4.7 μ F	1.6 \pm 0.2	1.6 \pm 0.2	1.6 \pm 0.2	1.6 \pm 0.2		1.9 \pm 0.2	1.9 \pm 0.2	1.9 \pm 0.2	1.9 \pm 0.2			
10 μ F					1.6 \pm 0.3					2.5 \pm 0.2		

NOTE

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-6 series is available on request

CAP.	0201					0402				
	6.3 V	10 V	16 V	25 V	50 V	6.3 V	10 V	16 V	25 V	50 V
100 pF										
150 pF										
220 pF										
330 pF					0.3±0.03					
470 pF										
680 pF										
1.0 nF	0.3±0.03	0.3±0.03	0.3±0.03	0.3±0.03						
1.5 nF										
2.2 nF										0.5±0.05
3.3 nF						0.5±0.05	0.5±0.05	0.5±0.05	0.5±0.05	
4.7 nF										
6.8 nF										
10 nF										
15 nF										
22 nF										
33 nF										
47 nF										
68 nF										
100 nF										0.5±0.05
150 nF										
220 nF						0.5±0.05	0.5±0.05	0.5±0.05		
330 nF										
470 nF						0.5±0.05	0.5±0.05			
680 nF										
1.0 µF						0.5±0.05				
2.2 µF										

NOTE

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-6 series is on request
3. For product with 5% tolerance, please contact local sales force before ordering

CAPACITANCE RANGE & THICKNESS FOR X7R
Table 6 Sizes from 0603 to 0805

CAP.	0603					0805				
	6.3 V	10 V	16 V	25 V	50 V	6.3 V	10 V	16 V	25 V	50 V
100 pF										
150 pF										
220 pF										
330 pF										
470 pF										
680 pF										
1.0 nF										
1.5 nF										
2.2 nF						0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1
3.3 nF										
4.7 nF					0.8±0.1					
6.8 nF										
10 nF	0.8±0.1	0.8±0.1	0.8±0.1	0.8±0.1						
15 nF										
22 nF										
33 nF										
47 nF										
68 nF						0.85±0.1	0.85±0.1	0.85±0.1	0.85±0.1	0.85±0.1
100 nF										
150 nF										
220 nF										
330 nF										
470 nF										
680 nF						1.25±0.2	1.25±0.2	1.25±0.2	1.25±0.2	1.25±0.2
1.0 µF					0.8±0.15					
2.2 µF										

NOTE

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-6 series is on request
3. For product with 5% tolerance, please contact local sales force before ordering

CAPACITANCE RANGE & THICKNESS FOR X7R
Table 7 Size 1206

CAP.	1206 6.3 V	10 V	16 V	25 V	50 V
100 pF	0.85±0.1	0.85±0.1	0.85±0.1		
150 pF					
220 pF				0.85±0.1 / 1.15±0.1	0.85±0.1
330 pF					
470 pF					
680 pF					
1.0 nF					
1.5 nF					
2.2 nF					
3.3 nF					
4.7 nF					
6.8 nF					
10 nF					
15 nF					
22 nF					
33 nF					
47 nF					
68 nF					
100 nF					
150 nF					
220 nF					
330 nF				0.85±0.1 / 1.15±0.1	0.85±0.1
470 nF				0.85±0.1	1.0±0.1
680 nF					
1.0 µF	1.15±0.1	1.15±0.1	1.15±0.1	1.6±0.2	
2.2 µF					
4.7 µF	1.6±0.2	1.6±0.2	1.6±0.2		
10 µF					
22 µF					

NOTE

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-6 series is on request
3. For product with 5% tolerance, please contact local sales force before ordering
4. Please contact local sales force for special ordering code before ordering

CAPACITANCE RANGE & THICKNESS FOR X7R
Table 8 Sizes from 1210 to 1812

CAP.	1210 6.3 V	10 V	16 V	25 V	50 V	1812 50 V
100 pF						
150 pF						
220 pF						
330 pF						
470 pF						
680 pF						
1.0 nF						
1.5 nF						
2.2 nF						
3.3 nF						
4.7 nF						
6.8 nF						
10 nF						
15 nF					0.85±0.1	0.85±0.1
22 nF	0.85±0.1	0.85±0.1	0.85±0.1	0.85±0.1		
33 nF						
47 nF						
68 nF						
100 nF						
150 nF						
220 nF					1.15±0.1	1.15±0.1
330 nF						
470 nF	1.15±0.1	1.15±0.1	1.15±0.1	1.15±0.1		
680 nF					1.25±0.2	
1.0 µF	1.25±0.2	1.25±0.2	1.25±0.2	1.25±0.2		1.6±0.2
2.2 µF	1.9±0.2	1.9±0.2	1.9±0.2	1.9±0.2	1.9±0.2	

NOTE

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-6 series is on request
3. For product with 5% tolerance, please contact local sales force before ordering
4. Please contact local sales force for special ordering code before ordering

THICKNESS CLASSES AND PACKING QUANTITY

Table 9

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	0.6 ±0.1 mm	8 mm	4,000	---	20,000	---	10,000
	0.85 ±0.1 mm	8 mm	4,000	---	15,000	---	8,000
	1.25 ±0.2 mm	8 mm	---	3,000	---	10,000	5,000
1206	0.6 ±0.1 mm	8 mm	4,000	---	20,000	---	---
	0.85 ±0.1 mm	8 mm	4,000	---	15,000	---	---
	1.00 / 1.15 ±0.1 mm	8 mm	---	3,000	---	10,000	---
	1.25 ±0.2 mm	8 mm	---	3,000	---	10,000	---
	1.6 ±0.15 mm	8 mm	---	2,500	---	10,000	---
	1.6 ±0.2 mm	8 mm	---	2,000	---	8,000	---
1210	0.6 / 0.7 ±0.1 mm	8 mm	---	4,000	---	15,000	---
	0.85 ±0.1 mm	8 mm	---	4,000	---	10,000	---
	1.15 ±0.1 mm	8 mm	---	3,000	---	10,000	---
	1.15 ±0.15 mm	8 mm	---	3,000	---	10,000	---
	1.25 ±0.2 mm	8 mm	---	3,000	---	---	---
	1.5 ±0.1 mm	8 mm	---	2,000	---	---	---
	1.6 / 1.9 ±0.2 mm	8 mm	---	2,000	---	---	---
	2.0 ±0.2 mm	8 mm	---	2,000 1,000	---	---	---
1808	2.5 ±0.2 mm	8 mm	---	1,000 500	---	---	---
	1.15 ±0.15 mm	12 mm	---	3,000	---	---	---
	1.25 ±0.2 mm	12 mm	---	3,000	---	---	---
	1.35 ±0.15 mm	12 mm	---	2,000	---	---	---
	1.5 ±0.1 mm	12 mm	---	2,000	---	---	---
	1.6 ±0.2 mm	12 mm	---	2,000	---	---	---
1812	2.0 ±0.2 mm	12 mm	---	2,000	---	---	---
	0.6 / 0.85 ±0.1 mm	12 mm	---	2,000	---	---	---
	1.15 ±0.1 mm	12 mm	---	1,000	---	---	---
	1.25 ±0.2 mm	12 mm	---	1,000	---	---	---
	1.5 ±0.1 mm	12 mm	---	1,000	---	---	---
	1.6 ±0.2 mm	12 mm	---	1,000	---	---	---
	2.0 ±0.2 mm	12 mm	---	1,000	---	---	---
	2.5 ±0.2 mm	12 mm	---	500	---	---	---

ELECTRICAL CHARACTERISTICS**X5R 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 10

DESCRIPTION	VALUE
Capacitance range	10 nF to 100 µF
Capacitance tolerance	±10% and ±20%
Dissipation factor (D.F.)	
6.3 V	≤ 5%
Exception:	0402 ≥ 180 nF; 1210 ≥ 22 µF ≤ 7%
	0201 ≥ 12 nF; 0402 ≥ 330 nF; 0603 ≥ 2.2 µF; ≤ 10%
	0805 ≥ 1 µF; 1206 ≥ 22 µF; 1210 ≥ 47 µF
	1206 ≥ 100 µF ≤ 15%
10 V	≤ 5%
Exception:	0402 ≥ 180 nF; 0805 ≥ 1 µF; 1206 ≥ 6.8 µF ≤ 7%
	0201 ≥ 12 nF; 0402 ≥ 330 nF; 0603 ≥ 1 µF; ≤ 10%
	0805 ≥ 2.2 µF; 1206 ≥ 10 µF; 1210 ≥ 10 µF
16 V	≤ 5%
Exception:	0402 ≥ 180 nF; 0603 ≥ 680 nF; 0805 ≥ 1 µF ≤ 7%
	0201 ≥ 100 nF; 0402 ≥ 330 nF; 0603 ≥ 2.2 µF; ≤ 10%
	0805 ≥ 4.7 µF; 1206 ≥ 10 µF; 1210 ≥ 10 µF
25 V	≤ 3.5%
Exception:	0402 ≥ 27 nF; 0603 ≥ 220 nF; 0805 ≥ 2.2 µF; ≤ 5%
	1206 ≥ 4.7 µF; 1210 ≥ 10 µF
	0402 ≥ 180 nF ≤ 7%
	0402 ≥ 470 nF; 0603 ≥ 2.2 µF; 0805 ≥ 4.7 µF; ≤ 10%
	1206 ≥ 10 µF; 1210 ≥ 22 µF
50V	≤ 3.5%
Exception:	0402 ≥ 27nF; ≤ 5%
	0402 ≥ 180nF; ≤ 7%
	0402=470nF; 0603 ≥ 220nF; 0805 ≥ 470nF; ≤ 10%
	1206 ≥ 1uF; 1210 ≥ 1uF

DESCRIPTION	VALUE
	$R_{ins} \geq 10\text{ G}\Omega$ or $R_{ins} \times C_r \geq 500$ (100/50) seconds whichever is less
Insulation resistance after 1 minute at U_r (DC)	$R_{ins} \times C_r \geq 100(50)$ seconds: 0201 $\geq 100\text{nF}$, 0402 $\geq 1\mu\text{F}$, 0603 $\geq 1\mu\text{F}$, 0805 $\geq 10\mu\text{F}$, 1206 $\geq 10\mu\text{F}$, 1210 $\geq 10\mu\text{F}$, 1812 $\geq 47\mu\text{F}$
Maximum capacitance change as a function of temperature (temperature characteristic/coefficient):	$\pm 15\%$
Operating temperature range:	$-55\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$

ELECTRICAL CHARACTERISTICS**X7R DIELECTRIC CAPACITORS; NISN TERMINATIONS**

Unless otherwise specified, all test 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 11

DESCRIPTION	VALUE			
Capacitance range	100 pF to 47 μ F			
Capacitance tolerance	$\pm 5\%$, $\pm 10\%$, $\pm 20\%$			
Dissipation factor (D.F.)				
≤ 10 V	47pF \leq 0201 \leq 10nF 150pF \leq 0805 \leq 2.2 μ F Exception: 220nF \leq 0402 \leq 470nF 1206 \geq 4.7 μ F 0402 = 1 μ F	100pF \leq 0402 \leq 100nF 220 pF \leq 1206 \leq 2.2 μ F 0603 = 2.2 μ F 4.7 μ F \leq 1210 \leq 47 μ F	100pF \leq 0603 \leq 1 μ F 2.2nF \leq 1210 \leq 2.2 μ F 0805 \geq 4.7 μ F 0201 \geq 12 nF	$\leq 5\%$ $\leq 10\%$ $\leq 12.5\%$
16 V	47 pF \leq 0201 \leq 1.2nF 150 pF \leq 0805 \leq 560nF Exception: 1.5 nF \leq 0201 \leq 10nF 1206 = 2.2 μ F 0402 = 220 nF 1210 = 22 μ F	100 pF \leq 0402 \leq 22nF 220pF \leq 1206 \leq 1 μ F 27nF \leq 0402 \leq 100nF 2.2 μ F \leq 1210 \leq 10 μ F 4.7 μ F \leq 0805 \leq 10 μ F	100 pF \leq 0603 \leq 470nF 2.2nF \leq 1210 \leq 1 μ F 680 nF \leq 0805 \leq 2.2 μ F 470 nF \leq 0603 \leq 1 μ F 4.7 μ F \leq 1206 \leq 10 μ F	$\leq 3.5\%$ $\leq 5\%$ $\leq 10\%$
25 V	47pF \leq 0201 \leq 470pF 150pF \leq 0805 \leq 180nF Exception: 12 nF \leq 0402 \leq 47nF 1206 = 1 μ F 560pF \leq 0201 \leq 10nF 1206 = 2.2 μ F 270nF \leq 0603 \leq 1 μ F 1210 \geq 22 μ F	100pF \leq 0402 \leq 10nF 220pF \leq 1206 \leq 680nF 47nF \leq 0603 \leq 220nF 56 nF \leq 0402 \leq 100 nF 2.2 μ F \leq 1210 \leq 10 μ F 2.2 μ F \leq 0805 \leq 4.7 μ F	100pF \leq 0603 \leq 39nF 2.2nF \leq 1210 \leq 1 μ F 220nF \leq 0805 \leq 560 nF 680nF \leq 0805 \leq 1 μ F 1206 \geq 4.7 μ F	$\leq 2.5\%$ $\leq 3.5\%$ $\leq 5\%$ $\leq 10\%$
≥ 50 V	Exception: 0201 \geq 47pF 0603 \geq 47nF 0402 = 100nF 0603 \geq 1 μ F 1210 \geq 2.2 μ F	1 μ F \geq 1206 \geq 680nF 47nF \geq 0402 \geq 12 nF 0805 = 680 nF 0805 \geq 1 μ F 1206 \geq 2.2 μ F	470nF \geq 0805 \geq 330 nF	$\leq 2.5\%$ $\leq 3.5\%$ $\leq 3.0\%$ $\leq 5\%$ $\leq 10\%$
Insulation resistance after 1 minute at U_r (DC)	$R_{ins} \geq 10$ G Ω or $R_{ins} \times C_r \geq 500(100)$ seconds whichever is less			
Maximum capacitance change as a function of temperature (temperature characteristic/coefficient):	$\pm 15\%$			
Operating temperature range:	-55 °C to $+125$ °C			

NOTE

Capacitance tolerance $\pm 5\%$ is not available for full product range, please contact local sales force before ordering

SOLDERING RECOMMENDATION

Table 16

SOLDERING METHOD	SIZE 0402	0603	0805	1206	≥ 1210
Reflow	≥ 0.1 μ F	≥ 1.0 μ F	≥ 2.2 μ F	≥ 4.7 μ F	Reflow only
Reflow/Wave	< 0.1 μ F	< 1.0 μ F	< 2.2 μ F	< 4.7 μ F	---

TESTS AND REQUIREMENTS

Table 17 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 $\times 10$ magnification	In accordance with specification
Capacitance ⁽¹⁾	4.5.1	Class 2: At 20 °C, 24 hrs after annealing $f = 1$ KHz for $C \leq 10 \mu\text{F}$, rated voltage > 6.3 V, measuring at voltage $1 V_{\text{rms}}$ at 20 °C $f = 1$ KHz, for $C \leq 10 \mu\text{F}$, rated voltage ≤ 6.3 V, measuring at voltage $0.5 V_{\text{rms}}$ at 20 °C $f = 120$ Hz for $C > 10 \mu\text{F}$, measuring at voltage $0.5 V_{\text{rms}}$ at 20 °C	Within specified tolerance
Dissipation Factor (D.F.) ⁽¹⁾	4.5.2	Class 2: At 20 °C, 24 hrs after annealing $f = 1$ KHz for $C \leq 10 \mu\text{F}$, rated voltage > 6.3 V, measuring at voltage $1 V_{\text{rms}}$ at 20 °C $f = 1$ KHz, for $C \leq 10 \mu\text{F}$, rated voltage ≤ 6.3 V, measuring at voltage $0.5 V_{\text{rms}}$ at 20 °C $f = 120$ Hz for $C > 10 \mu\text{F}$, measuring at voltage $0.5 V_{\text{rms}}$ 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	4.6	<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><tr><th>Step</th><th>Temperature(°C)</th></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> <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><General purpose series> Class I: Δ C/C: ±30ppm</p> <p>Class2: X7R: Δ C/C: ±15% Y5V: Δ C/C: 22~-82%</p> <p><High Capacitance series> Class2: X7R/X5R: Δ C/C: ±15% Y5V: Δ C/C: 22~-82%</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> <hr/> <p>Conditions: bending 1 mm at a rate of 1 mm/s, radius jig 340 mm</p>	<p>No visible damage</p> <hr/> <p><General purpose series> ΔC/C Class2: X5R: ±10%</p> <p><High Capacitance series> ΔC/C Class2: X5R: ±10%</p>												

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><General purpose series></p> <p>ΔC/C</p> <p>Class2:</p> <p>X5R: ±10%</p> <hr/> <p><High Capacitance series></p> <p>ΔC/C</p> <p>Class2:</p> <p>X5R: ±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><General purpose series></p> <p>ΔC/C</p> <p>Class2:</p> <p>X5R: ±15%</p> <hr/> <p><High Capacitance series></p> <p>ΔC/C</p> <p>Class2:</p> <p>X5R: ±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 +0/-10 °C /1 hour, then keep for 24 ±1 hour at room temp Initial measure: Spec: refer to initial spec C, D, IR Damp heat test: 500 ±12 hours at 40 ±2 °C; 90 to 95% R.H. 1.0 U_r applied Recovery: Class 2: 24 ±2 hours Final measure: C, D, IR <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> <p><General purpose series></p> <p>$\Delta C/C$</p> <p>Class2: X5R: ±15%</p> <p>D.F.</p> <p>Class2: X5R: $\leq 16V: \leq 7\%$ $\geq 25V: \leq 5\%$</p> <p>R_{ins}</p> <p>Class2: X5R: $\geq 500 M\Omega$ or R_{ins} × C_r ≥ 25s whichever is less</p> <p><High Capacitance series></p> <p>$\Delta C/C$</p> <p>Class2: X5R: ±20%</p> <p>D.F.</p> <p>Class2: X5R: 2 × initial value max</p> <p>R_{ins}</p> <p>Class2: Rins × Cr ≥ 5s whichever is less</p>

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Endurance	IEC 60384-21/22 4.14	<ol style="list-style-type: none"> Preconditioning, class 2 only: 150 +0/-10 °C /1 hour, then keep for 24 ±1 hour at room temp Initial measure: Spec: refer to initial spec C, D, IR Endurance test: Temperature: X5R: 85 °C Specified stress voltage applied for 1,000 hours: Applied 2.0 × Ur for general product. Applied 1.5 × Ur for high cap. product. Applied 1.0 × Ur for high cap. product. 0201: 100nF/25V, 220nF/10V, 1uF/6.3V; 0402: 4.7uF/10V, 6.3V, 10uF/4V, 6.3V; 0603: 10uF/ 10V, 22uF/6.3V, 10V 1206: 10uF/ 50V Recovery time: 24 ±2 hours Final measure: C, D, IR <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><General purpose series></p> <p>$\Delta C/C$</p> <p>Class2:</p> <p>X5R: ±15%</p> <p>D.F.</p> <p>Class2:</p> <p>X5R: ≤ 16V: ≤ 7% ≥ 25V: ≤ 5%</p> <p>R_{ins}</p> <p>Class2:</p> <p>X5R: ≥ 1,000 MΩ or $R_{ins} \times C_r \geq 50s$ whichever is less</p> <p><High Capacitance series></p> <p>$\Delta C/C$</p> <p>Class 2:</p> <p>X5R: ±20%</p> <p>D.F.</p> <p>Class 2:</p> <p>X5R: 2 × initial value max</p> <p>R_{ins}</p> <p>Class 2:</p> <p>$R_{ins} \times C_r \geq 10s$ whichever is less</p>
Voltage Proof		<p>Specified stress voltage applied for 1 min</p> <p>$U_r \leq 50 V$: series applied 2.5 U_r</p> <p>Charge/Discharge current less than 7.5mA</p>	No breakdown or flashover

REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 0	Aug. 18, 2014	-	- New datasheet for general purpose class II with RoHS compliant -Combine "UPY-GPHC_X5R_4V-TO-50V_I8" and "UPY_GPHC_X7R_6.3V-to-50V_I0"