

DATA SHEET

SURFACE-MOUNT CERAMIC MULTILAYER CAPACITORS

High-capacitance: Class 2, X5R/X7R

6.3 V TO 25 V

56 nF to 47 μ F



SCOPE

This specification describes high capacitance X5R/X7R series chip capacitors with lead-free terminations.

APPLICATIONS

- PCs, hard disk, game PCs
- Power supplies
- DVDs, camcorders
- Mobile phones, PDAs

FEATURES

- Supplied in tape on reel
- Nickel-barrier end termination

ORDERING INFORMATION

Part number is identified by the series, size, tolerance, packing style, TC material, rated voltage and capacitance value.

YAGEO ORDERING CODE

CC XXXX X X XXX X **BB** XXX
(1) (2) (3) (4) (5) (6)

(1) SIZE – INCH BASED (METRIC)

0402 (1005)

0603 (1608)

0805 (2012)

1206 (3216)

1210 (3225)

1812 (4532)

(2) TOLERANCE

J = $\pm 5\%$

K = $\pm 10\%$

M = $\pm 20\%$

(3) PACKING STYLE

R = 7" paper tape

K = 7" blister tape

P = 13" paper tape

F = 13" blister tape

C = Bulk case

(4) TC MATERIAL

X5R

X7R

(5) RATED VOLTAGE

5 = 6.3 V

6 = 10 V

7 = 16 V

8 = 25 V

(6) CAPACITANCE VALUE:

First two for significant figures and 3rd for number of zero

Letter "R" for decimal point

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.

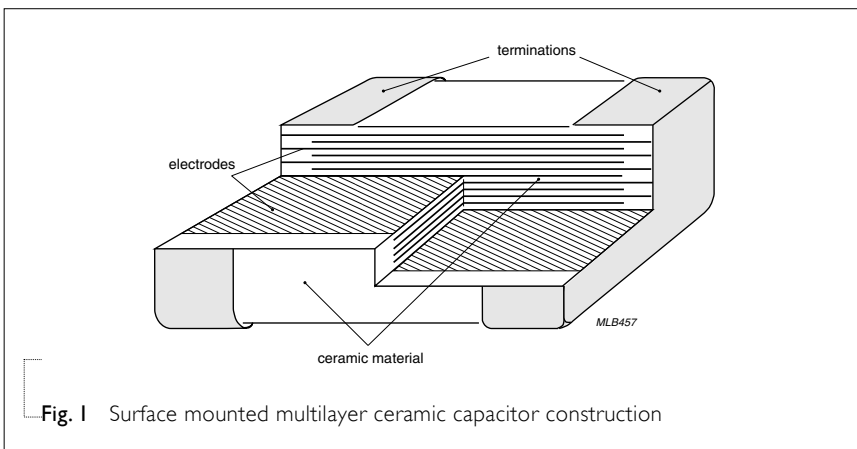


Fig. 1 Surface mounted multilayer ceramic capacitor construction

DIMENSION

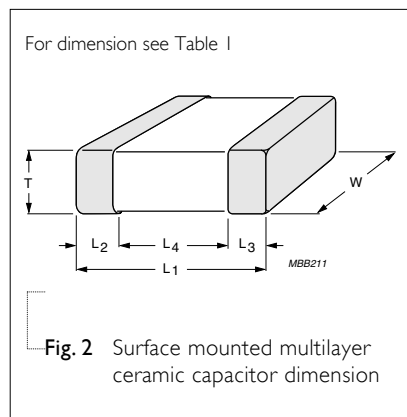


Fig. 2 Surface mounted multilayer ceramic capacitor dimension

Table I

TYPE		CC0402	CC0603	CC0805	CC1206	CC1210	CC1812
L₁ (mm)		1.0 ±0.05	1.6 ±0.10	2.0 ±0.20	3.2±0.20	3.2 ±0.20	4.5 ±0.20
W (mm)		0.5 ±0.05	0.8 ±0.07	1.25 ±0.20	1.6±0.20	2.5 ±0.20	3.2 ±0.20
T (mm)	min.	0.45	0.70	1.05	1.40	1.70	2.30
	max.	0.55	0.90	1.45	1.80	2.70	2.70
L₂/L₃ (mm)	min.	0.15	0.20	0.25	0.25	0.25	0.25
	max.	0.30	0.60	0.75	0.75	0.75	0.75
L₄ (mm)	min.	0.40	0.40	0.55	1.40	1.40	2.20

CAPACITANCE RANGE & THICKNESS FOR X5R/X7R 6.3 V

Table 2

CAPACITANCE (μ F)	6.3 V 0402	0603	0805	I206	I210
0.056					
0.068					
0.082					
0.10					
0.15					
0.22	0.5 $\pm$ 0.05				
0.27					
0.33					
0.39					
0.47	0.5 $\pm$ 0.05				
0.56					
0.68					
1.0	0.5 $\pm$ 0.05	0.8 $\pm$ 0.07			
1.5					
2.2		0.8 $\pm$ 0.1	1.25 $\pm$ 0.1		
4.7			1.25 $\pm$ 0.2		
10				1.6 $\pm$ 0.2	
22					2.5 $\pm$ 0.2
47					

NOTE

- Values in shaded cells indicate thickness class in mm.
- X5R: ; X7R: ; both X5R and X7R: .

CAPACITANCE RANGE & THICKNESS FOR X5R/X7R 10V

Table 3

CAPACITANCE (μF)	10 V 0402	0603	0805	1206	1210
0.056	0.5 $\pm$ 0.05				
0.068					
0.082					
0.10	0.5 $\pm$ 0.05				
0.15					
0.22	0.5 $\pm$ 0.05				
0.27		0.8 $\pm$ 0.07			
0.33					
0.39					
0.47					
0.56					
0.68		0.8 $\pm$ 0.07			
1.0			1.25 $\pm$ 0.1		
1.5					
2.2		0.8 $\pm$ 0.1	1.25 $\pm$ 0.1		
4.7			1.25 $\pm$ 0.2	1.6 $\pm$ 0.2	
10				1.6 $\pm$ 0.2	1.9 $\pm$ 0.2
22					2.5 $\pm$ 0.2

NOTE

- Values in shaded cells indicate thickness class in mm.
- X5R: ; X7R: ; both X5R and X7R: .

CAPACITANCE RANGE & THICKNESS FOR X5R/X7R 16V TO 25V

Table 4

CAPACITANCE (μF)	16V 0402	0603	0805	1210	1812	25V 0603	1206	1210
0.056	0.5 ± 0.05							
0.068								
0.082								
0.10								
0.15		0.8 ± 0.07						
0.22								
0.27								
0.33						0.8 ± 0.07		
0.39								
0.47						0.8 ± 0.07		
0.56								
0.68								
1.0			1.25 ± 0.2				1.6 ± 0.2	
1.5								
2.2								
4.7				1.9 ± 0.2				1.9 ± 0.2
10				2.5 ± 0.2				2.5 ± 0.2
22					2.5 ± 0.2			

NOTE

- Values in shaded cells indicate thickness class in mm.
- X5R: ; X7R: ; both X5R and X7R: .

THICKNESS CLASSES AND PACKING QUANTITY

Table 5

THICKNESS CLASSIFICATION (mm)	8mm TAPE WIDTH / AMOUNT PER REEL				12mm TAPE WIDTH / AMOUNT PER REEL	AMOUNT PER BULK CASE			
	Ø180mm, 7"		Ø330mm, 13"		Ø180mm, 7" Blister	1812	0402	0603	0805
	Paper	Blister	Paper	Blister					
0.5±0.05	10,000	---	50,000	---	---	50,000	---	---	---
0.6±0.10	4,000	---	20,000	---	---	---	---	---	10,000
0.8±0.07	4,000	---	15,000	---	---	---	15,000	---	---
0.8 ±0.1	4,000	---	15,000	---	---	---	15,000	---	---
0.85±0.10	4,000	---	15,000	---	---	---	---	---	8,000
1.15±0.10	---	3,000	---	10,000	---	---	---	---	---
1.25±0.10	---	3,000	---	10,000	---	---	---	---	5,000
1.25 ±0.20	---	3,000	---	10,000	---	---	---	---	5,000
1.6 ±0.20	---	2,000	---	---	---	---	---	---	---
1.9 ±0.20	---	2,000	---	---	---	---	---	---	---
2.5 ±0.20	---	1,000	---	---	1,000	---	---	---	---

ELECTRICAL CHARACTERISTICS

CLASS 2 CAPACITORS; X5R/X7R DIELECTRIC; NISN TERMINATIONS

Unless otherwise stated all electrical values apply at an ambient temperature of 20 ± 1 °C, an atmospheric pressure of 86 to 106 kPa, and a relative humidity of 63 to 67%.

Table 6

DESCRIPTION	VALUE
Capacitance range ⁽¹⁾	56 nF to 47 µF
Capacitance tolerance ⁽¹⁾	±5%, ±10%, and ±20%
Dissipation factor (D.F.) ⁽¹⁾	See table 7 - 12
Insulation resistance after 1 minute at U_r (DC)	$R_{ins} \geq 10 \text{ G}\Omega$ or $R_{ins} \times C \geq 500$ seconds whichever is less
Maximum capacitance change as a function of temperature (temperature characteristic/coefficient)	±15%
Operating temperature range:	
X5R	-55 °C to +85 °C
X7R	-55 °C to +125 °C

NOTE

1. f=1 KHz for $C \leq 10 \mu\text{F}$; measuring at voltage 1 V_{rms}; f=120 Hz for $C > 10 \mu\text{F}$; measuring at voltage 0.5 V_{rms}.

PRODUCT SPECIFICATION, ORDERING AND PACKAGING INFORMATION FOR 0402 TO 1812 SIZES

Table 7 For size 0402 (1005 metric)

TC	SIZE	CAP. VALUE ⁽³⁾ (μ F)	CAP. TOLERANCE (%)	DC RATED VOLTAGE (V)	D.F. (%)	THICKNESS (mm)	YAGEO ORDERING CODE ⁽¹⁾	QUANTITY PER 7" REEL ⁽²⁾
X7R	0402	0.056	$\pm 10; \pm 20$	10	5.0	0.50	CC0402_RX7R6BB563	10,000
X5R	0402	0.056	$\pm 10; \pm 20$	16	5.0	0.50	CC0402_RX5R7BB563	10,000
X7R	0402	0.056	$\pm 10; \pm 20$	16	5.0	0.50	CC0402_RX7R7BB563	10,000
X7R	0402	0.068	$\pm 10; \pm 20$	10	5.0	0.50	CC0402_RX7R6BB683	10,000
X5R	0402	0.068	$\pm 10; \pm 20$	16	5.0	0.50	CC0402_RX5R7BB683	10,000
X7R	0402	0.068	$\pm 10; \pm 20$	16	5.0	0.50	CC0402_RX7R7BB683	10,000
X7R	0402	0.082	$\pm 10; \pm 20$	10	5.0	0.50	CC0402_RX7R6BB823	10,000
X5R	0402	0.082	$\pm 10; \pm 20$	16	5.0	0.50	CC0402_RX5R7BB823	10,000
X7R	0402	0.082	$\pm 10; \pm 20$	16	5.0	0.50	CC0402_RX7R7BB823	10,000
X5R	0402	0.1	$\pm 10; \pm 20$	10	5.0	0.50	CC0402_RX5R6BB104	10,000
X7R	0402	0.1	$\pm 10; \pm 20$	10	5.0	0.50	CC0402_RX7R6BB104	10,000
X5R	0402	0.1	$\pm 10; \pm 20$	16	5.0	0.50	CC0402_RX5R7BB104	10,000
X7R	0402	0.1	$\pm 10; \pm 20$	16	5.0	0.50	CC0402_RX7R7BB104	10,000
X5R	0402	0.22	$\pm 10; \pm 20$	6.3	7.0	0.50	CC0402_RX5R5BB224	10,000
X5R	0402	0.22	$\pm 10; \pm 20$	10	7.0	0.50	CC0402_RX5R6BB224	10,000
X5R	0402	0.47	$\pm 10; \pm 20$	6.3	10	0.50	CC0402_RX5R5BB474	10,000
X5R	0402	1	$\pm 10; \pm 20$	6.3	10	0.50	CC0402_RX5R5BB105	10,000

NOTE

1. Specify capacitance tolerance on position 7 of the Yageo ordering code: K = $\pm 10\%$; M = $\pm 20\%$.
For ordering code of large reel packing (330 mm/13"), change position 8 of Yageo ordering code: specify P instead of R.
2. For quantity per reel for large reel (330 mm/13") packing, see section "Thickness classification and packing quantities".
3. $\pm 5\%$ capacitance tolerance is on request for capacitance value $< 1 \mu\text{F}$.

Table 8 For size 0603 (1608 metric)

TC	SIZE	CAP. VALUE ⁽³⁾ (μ F)	CAP. TOLERANCE (%)	DC RATED VOLTAGE (V)	D.F. (%)	THICKNESS (mm)	YAGEO ORDERING CODE ⁽¹⁾	QUANTITY PER 7" REEL ⁽²⁾
X7R	0603	0.22	$\pm 10; \pm 20$	10	5.0	0.80	CC0603_RX7R6BB224	4,000
X7R	0603	0.27	$\pm 10; \pm 20$	10	5.0	0.80	CC0603_RX7R6BB274	4,000
X7R	0603	0.27	$\pm 10; \pm 20$	16	5.0	0.80	CC0603_RX7R7BB274	4,000
X7R	0603	0.33	$\pm 10; \pm 20$	10	5.0	0.80	CC0603_RX7R6BB334	4,000
X5R	0603	0.33	$\pm 10; \pm 20$	16	5.0	0.80	CC0603_RX5R7BB334	4,000
X7R	0603	0.33	$\pm 10; \pm 20$	16	5.0	0.80	CC0603_RX7R7BB334	4,000
X5R	0603	0.33	$\pm 10; \pm 20$	25	5.0	0.80	CC0603_RX5R8BB334	4,000
X7R	0603	0.39	$\pm 10; \pm 20$	10	5.0	0.80	CC0603_RX7R6BB394	4,000
X7R	0603	0.39	$\pm 10; \pm 20$	16	5.0	0.80	CC0603_RX7R7BB394	4,000
X7R	0603	0.47	$\pm 10; \pm 20$	10	5.0	0.80	CC0603_RX7R6BB474	4,000
X7R	0603	0.47	$\pm 10; \pm 20$	16	5.0	0.80	CC0603_RX7R7BB474	4,000
X5R	0603	0.47	$\pm 10; \pm 20$	25	5.0	0.80	CC0603_RX5R8BB474	4,000
X5R	0603	0.68	$\pm 10; \pm 20$	10	7.0	0.80	CC0603_RX5R6BB684	4,000
X5R	0603	1	$\pm 10; \pm 20$	6.3	7.0	0.80	CC0603_RX5R5BB105	4,000
X5R	0603	1	$\pm 10; \pm 20$	10	7.0	0.80	CC0603_RX5R6BB105	4,000
X5R	0603	2.2	$\pm 10; \pm 20$	6.3	10.0	0.80	CC0603_RX5R5BB225	4,000
X5R	0603	2.2	$\pm 10; \pm 20$	10	10.0	0.80	CC0603_RX5R6BB225	4,000
X5R	0603	4.7	± 20	6.3	10.0	0.80	CC0603_RX5R5BB475	4,000

NOTE

1. Specify capacitance tolerance on position 7 of the Yageo ordering code: K = $\pm 10\%$; M = $\pm 20\%$.
For ordering code of large reel packing (330 mm/13"), change position 8 of Yageo ordering code: specify P instead of R.
2. For quantity per reel for large reel (330 mm/13") packing, see section "Thickness classification and packing quantities".
3. $\pm 5\%$ capacitance tolerance is on request for capacitance value $< 1 \mu\text{F}$.

Table 9 For size 0805 (2012 metric)

TC	SIZE	CAP. VALUE (μ F)	CAP. TOLERANCE (%)	DC RATED VOLTAGE (V)	D.F. (%)	THICKNESS (mm)	YAGEO ORDERING CODE ⁽¹⁾	QUANTITY PER 7" REEL ⁽²⁾
X7R	0805	1	$\pm 10; \pm 20$	10	5.0	1.25	CC0805_KX7R6BB105	3,000
X7R	0805	1	$\pm 10; \pm 20$	16	5.0	1.25	CC0805_KX7R7BB105	3,000
X5R	0805	2.2	$\pm 10; \pm 20$	6.3	7.0	1.25	CC0805_KX5R5BB225	3,000
X5R	0805	2.2	$\pm 10; \pm 20$	10	7.0	1.25	CC0805_KX5R6BB225	3,000
X7R	0805	2.2	$\pm 10; \pm 20$	6.3	7.0	1.25	CC0805_KX7R5BB225	3,000
X7R	0805	2.2	$\pm 10; \pm 20$	10	5.0	1.25	CC0805_KX7R6BB225	3,000
X5R	0805	4.7	$\pm 10; \pm 20$	6.3	7.0	1.25	CC0805_KX5R5BB475	3,000
X5R	0805	4.7	$\pm 10; \pm 20$	10	7.0	1.25	CC0805_KX5R6BB475	3,000
X5R	0805	10	$\pm 10; \pm 20$	6.3	10	1.25	CC0805_KX5R5BB106	3,000

Table 10 For size 1206 (3216 metric)

TC	SIZE	CAP. VALUE (μ F)	CAP. TOLERANCE (%)	DC RATED VOLTAGE (V)	D.F. (%)	THICKNESS (mm)	YAGEO ORDERING CODE ⁽¹⁾	QUANTITY PER 7" REEL ⁽²⁾
X5R	1206	4.7	$\pm 10; \pm 20$	6.3	7.5	1.6	CC1206_KX5R5BB475	2,000
X5R	1206	4.7	$\pm 10; \pm 20$	10	5.0	1.6	CC1206_KX5R6BB475	2,000
X7R	1206	4.7	$\pm 10; \pm 20$	10	5.0	1.6	CC1206_KX7R6BB475	2,000
X5R	1206	10	$\pm 10; \pm 20$	6.3	7.5	1.6	CC1206_KX5R5BB106	2,000
X5R	1206	10	$\pm 10; \pm 20$	10	7.5	1.6	CC1206_KX5R6BB106	2,000

NOTE

1. Specify capacitance tolerance on position 7 of the Yageo ordering code: K = $\pm 10\%$; M = $\pm 20\%$.
For ordering code of large reel packing (330 mm/13"), change position 8 of Yageo ordering code: specify F instead of K.
2. For quantity per reel for large reel (330 mm/13") packing, see section "Thickness classification and packing quantities".

Table 11 For size 1210 (3225 metric)

TC	SIZE	CAP. VALUE (μ F)	CAP. TOLERANCE (%)	DC RATED VOLTAGE (V)	D.F. (%)	THICKNESS (mm)	YAGEO ORDERING CODE ⁽¹⁾	QUANTITY PER 7" REEL ⁽²⁾
X5R	1210	4.7	$\pm 10; \pm 20$	16	3.5	1.9	CC1210_KX5R7BB475	2,000
X7R	1210	4.7	$\pm 10; \pm 20$	16	3.5	1.9	CC1210_KX7R7BB475	2,000
X5R	1210	4.7	$\pm 10; \pm 20$	25	3.5	1.9	CC1210_KX5R8BB475	2,000
X5R	1210	10	$\pm 10; \pm 20$	10	3.5	1.9	CC1210_KX5R6BB106	2,000
X5R	1210	10	$\pm 10; \pm 20$	16	3.5	2.5	CC1210_KX5R7BB106	1,000
X5R	1210	10	$\pm 10; \pm 20$	25	2.5	2.5	CC1210_KX5R8BB106	1,000
X5R	1210	22	± 20	6.3	2.5	2.5	CC1210_KX5R5BB226	1,000
X5R	1210	22	± 20	10	7	2.5	CC1210_KX5R6BB226	1,000
X5R	1210	47	± 20	6.3	10	2.5	CC1210_KX5R5BB476	1,000

Table 12 For size 1812 (4532 metric)

TC	SIZE	CAP. VALUE (μ F)	CAP. TOLERANCE (%)	DC RATED VOLTAGE (V)	D.F. (%)	THICKNESS (mm)	YAGEO ORDERING CODE ⁽¹⁾	QUANTITY PER 7" REEL ⁽²⁾
X5R	1812	22	$\pm 10; \pm 20$	16	3.5	2.5	CC1812_KX5R7BB226	1,000

NOTE

1. Specify capacitance tolerance on position 7 of the Yageo ordering code: K = $\pm 10\%$; M = $\pm 20\%$.

TESTS AND REQUIREMENTS

Table 13 soldering method, test specification category and requirement details.

SIZE	CAP. VALUE (μF)	DC RATED VOLTAGE (V)	TC	SOLDERING METHOD	DISSIPATION FACTOR AFTER DAMP HEAT TEST (MAX.)	DISSIPATION FACTOR AFTER ENDURANCE TEST (MAX.)
0402	0.056	10	X7R	reflow	2 × initial value	2 × initial value
0402	0.056	16	X5R	reflow	2 × initial value	2 × initial value
0402	0.056	16	X7R	reflow	2 × initial value	2 × initial value
0402	0.068	10	X7R	reflow	2 × initial value	2 × initial value
0402	0.068	16	X5R	reflow	2 × initial value	2 × initial value
0402	0.068	16	X7R	reflow	2 × initial value	2 × initial value
0402	0.082	10	X7R	reflow	2 × initial value	2 × initial value
0402	0.082	16	X5R	reflow	2 × initial value	2 × initial value
0402	0.082	16	X7R	reflow	2 × initial value	2 × initial value
0402	0.1	10	X5R	reflow	2 × initial value	2 × initial value
0402	0.1	10	X7R	reflow	2 × initial value	2 × initial value
0402	0.1	16	X5R	reflow	2 × initial value	2 × initial value
0402	0.1	16	X7R	reflow	2 × initial value	2 × initial value
0402	0.22	6.3	X5R	wave/reflow	2 × initial value	2 × initial value
0402	0.22	10	X5R	reflow	2 × initial value	2 × initial value
0402	0.47	6.3	X5R	reflow	2 × initial value	2 × initial value
0402	1	6.3	X5R	reflow	2 × initial value	2 × initial value
0603	0.27	10	X7R	wave/reflow	2 × initial value	2 × initial value
0603	0.27	16	X7R	wave/reflow	2 × initial value	2 × initial value
0603	0.33	10	X7R	wave/reflow	2 × initial value	2 × initial value
0603	0.33	16	X5R	wave/reflow	2 × initial value	2 × initial value
0603	0.33	16	X7R	wave/reflow	2 × initial value	2 × initial value
0603	0.39	10	X7R	wave/reflow	2 × initial value	2 × initial value
0603	0.39	16	X7R	wave/reflow	2 × initial value	2 × initial value
0603	0.47	10	X7R	reflow	2 × initial value	2 × initial value
0603	0.47	16	X7R	reflow	2 × initial value	2 × initial value
0603	0.47	25	X5R	reflow	2 × initial value	2 × initial value
0603	0.68	10	X5R	reflow	2 × initial value	2 × initial value
0603	1	6.3	X5R	reflow	2 × initial value	2 × initial value
0603	1	10	X5R	reflow	2 × initial value	2 × initial value
0603	2.2	6.3	X5R	reflow	2 × initial value	2 × initial value

Table 13 soldering method, test specification category and requirement details (continued)

SIZE	CAP. VALUE (μ F)	DC RATED VOLTAGE (V)	TC	SOLDERING METHOD	DISSIPATION FACTOR AFTER DAMP HEAT TEST (MAX.)	DISSIPATION FACTOR AFTER ENDURANCE TEST (MAX.)
0603	2.2	10	X5R	reflow	2 × initial value	2 × initial value
0603	4.7	6.3	X5R	reflow	2 × initial value	2 × initial value
0805	1	10	X7R	wave/reflow	2 × initial value	2 × initial value
0805	1	16	X7R	wave/reflow	2 × initial value	2 × initial value
0805	2.2	6.3	X5R	reflow	2 × initial value	2 × initial value
0805	2.2	6.3	X7R	reflow	2 × initial value	2 × initial value
0805	2.2	10	X5R	reflow	2 × initial value	2 × initial value
0805	2.2	10	X7R	reflow	2 × initial value	2 × initial value
0805	4.7	6.3	X5R	reflow	2 × initial value	2 × initial value
0805	4.7	10	X5R	reflow	2 × initial value	2 × initial value
0805	10	6.3	X5R	reflow	2 × initial value	2 × initial value
1206	4.7	6.3	X5R	reflow	2 × initial value	2 × initial value
1206	4.7	10	X5R	reflow	2 × initial value	2 × initial value
1206	4.7	10	X7R	reflow	2 × initial value	2 × initial value
1206	10	6.3	X5R	reflow	2 × initial value	2 × initial value
1206	10	10	X5R	reflow	2 × initial value	2 × initial value
1210	4.7	16	X5R	reflow	2 × initial value	2 × initial value
1210	4.7	16	X7R	reflow	2 × initial value	2 × initial value
1210	4.7	25	X5R	reflow	2 × initial value	2 × initial value
1210	10	10	X5R	reflow	2 × initial value	2 × initial value
1210	10	16	X5R	reflow	2 × initial value	2 × initial value
1210	10	25	X5R	reflow	2 × initial value	2 × initial value
1210	22	6.3	X5R	reflow	2 × initial value	2 × initial value
1210	22	10	X5R	reflow	2 × initial value	2 × initial value
1210	47	6.3	X5R	reflow	2 × initial value	2 × initial value
1812	22	16	X5R	reflow	2 × initial value	2 × initial value

Table 14 Test condition, procedure and requirements

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Mounting	IEC 60384-22 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	4.5.1	$f = 1 \text{ kHz}$ for $C \leq 10 \mu\text{F}$: measuring voltage $1 V_{\text{rms}}$ at 20°C $f = 120 \text{ Hz}$ for $C > 10 \mu\text{F}$: measuring voltage $0.5 V_{\text{rms}}$ at 20°C	Within specified tolerance
Dissipation factor (D.F.)	4.5.2	$f = 1 \text{ kHz}$ for $C \leq 10 \mu\text{F}$: measuring voltage $1 V_{\text{rms}}$ at 20°C $f = 120 \text{ Hz}$ for $C > 10 \mu\text{F}$: measuring 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
Voltage proof	4.5.4.2	$2.5 \times U_r$ for 1 minute	No breakdown or flashover
Temperature characteristic	4.6	Between minimum and maximum temperature	In accordance with specification
Adhesion	4.15	A force applied for 10 seconds to the line joining the terminations and in a plane parallel to the substrate for size ≥ 0603 : a force of 5 N applied for size 0402: a force of 2.5 N applied	No visible damage
Bond strength of plating on end face	4.8	Mounting in accordance with IEC 60384-22 paragraph 4.3 Conditions: bending 1 mm at a rate of 1 mm/s, radius jig 340 mm	No visible damage X5R/X7R: $\Delta C/C_i \leq 10\%$ Y5V: $\Delta C/C_i \leq 20\%$
Resistance to soldering heat	4.9	Precondition: $150 \pm 10^\circ\text{C}$ for 1 hour, then keep for 24 ± 1 hours at room temperature Preheating: for size ≤ 1206 : 120 to 150°C for 1 minute Preheating: for size > 1206 : 100 to 120°C for 1 minute and 170 to 200°C for 1 minute Solder bath temperature: $260 \pm 5^\circ\text{C}$ Dipping time: 10 ± 0.5 seconds Recovery time: 24 ± 2 hours.	The termination shall be well tinned X5R/X7R: $\Delta C/C_i \leq 10\%$ Y5V: $\Delta C/C_i \leq 20\%$ D.F.: within initial specified value R_{ins} : within initial specified value
Solderability	4.10	Unmounted chips completely immersed in a solder bath at $235 \pm 5^\circ\text{C}$ Dipping time: size ≤ 1206 for 2 ± 0.5 seconds; size > 1206 for 4 ± 0.5 seconds	The termination shall be well tinned.

Table 14 Test condition, procedure and requirements (continued)

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Rapid change of temperature	IEC 60384-22 4.11	Preconditioning; 150 +0/-10 °C for 1 hour, then keep for 24 ±1 hours at room temperature	No visual damage X5R/X7R: ≤ 15% Y5V: ≤ 20%
		5 cycles with following detail: 30 minutes at lower category temperature; 30 minutes at upper category temperature	D.F.: within initial specified value R _{ins} : within initial specified value
		Recovery time 24±2 hours.	
Damp heat steady state	4.13	Initial measurements; after 150 +0/-10 °C for 1 hour, then keep for 24 ±1 hours at room temperature Duration and conditions: 500 ±12 hours at 40 ±2 °C; 90 to 95% RH Final measurement: perform a heat treatment at 150 +0/-10 °C for 1 hour; final measurements shall be carried out 24 ±1 hours after recovery at room temperature without load.	X5R/X7R: $\Delta C/C_i$: ±20% Y5V: $\Delta C/C_i$: ±30% D.F.: 2 × initial value max. R _{ins} : 1,000 MΩ or R _{ins} × C _r ≥ 50 seconds, whichever is less
Endurance	4.14	Preconditioning; Initial measurements; after 150 +0/-10 °C for 1 hour, then keep for 24 ±1 hours at room temperature Duration and conditions: 1,000 ±12 hours at upper category temperature with 1.5 × U _r voltage applied Final measurement: perform a heat treatment at 150 +0/-10 °C for 1 hour; final measurements shall be carried out 24 ±1 hours after recovery at room temperature without load.	X5R/X7R: $\Delta C/C_i$: ±20% Y5V: $\Delta C/C_i$: ±30% D.F.: 2 × initial value max. R _{ins} : 1,000 MΩ or R _{ins} × C _r ≥ 50 seconds, whichever is less
Resistance to leaching	IEC 60384-10 4.10	Solder bath temperature: 260 ±5 °C Dipping time 30 ±0.5 seconds	Using visual enlargement of × 10, dissolution of the termination shall not exceed 10%
Damp heat, with U _r load	4.14	Initial measurements; after 150 +0/-10 °C for 1 hour, then keep for 24 ±1 hours at room temperature Duration and conditions: 500 ±12 hours at 40 ±2 °C; 90 to 95% RH; U _r applied Final measurement: perform a heat treatment at 150 +0/-10 °C for 1 hour; final measurements shall be carried out 24 ±1 hours after recovery at room temperature without load.	X5R/X7R: $\Delta C/C_i$: ±20% Y5V: $\Delta C/C_i$: ±30% D.F.: 2 × initial value max. R _{ins} : 500 MΩ or R _{ins} × C _r ≥ 25 seconds, whichever is less

REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 8	Nov 19, 2004	-	- Extended capacitance 0.68 μ F and 2.2 μ F of X5R 0603 10 V
Version 7	Sep 09, 2004	-	- Updated contents
Version 6	Aug 13, 2004	-	- Extended capacitance to value 47 μ F