

# DATA SHEET

## SURFACE-MOUNT CERAMIC MULTILAYER CAPACITORS

Soft termination

NPO and X7R

16V TO 3KV

0.47pF to 2.2 uF

RoHS compliant & Halogen Free



**SCOPE**

This specification describes X7R series chip capacitors with Flexible leadfree terminations.

**APPLICATIONS**

High flexure stress circuit boards  
Switch power supplies  
Telecom base station

**FEATURES**

- Supplied in tape on reel
- Flexible termination system
- Leaded-free termination meet RoHS requirements
- Improved resistance to thermal stresses
- Increased mechanical performance

**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 ordering code**

**GLOBAL PART NUMBER (PREFERRED)**

**CS** XXXX X X **X7R** X **BX** XXX  
(1) (2) (3) (4) (5) (6)

**(1) SIZE – INCH BASED (METRIC)**

0402 (1005)	1206 (3216)
0603 (1608)	1210 (3225)
0805 (2012)	1808 (4520)
	1812 (4532)

**(2) TOLERANCE**

- G = ±2% (1)
- J = ±5% (2)
- K = ±10%
- M = ±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

**(4) RATED VOLTAGE**

7 = 16 V	Y = 250 V
8 = 25 V	B = 500 V
9 = 50 V	Z = 630 V
0 = 100 V	C = 1 kV
A = 200 V	D = 2 kV
	E = 3 kV

**(5) PROCESS**

- N = NPO
- B = Class 2 MLCC

**(6) 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

**NOTE**

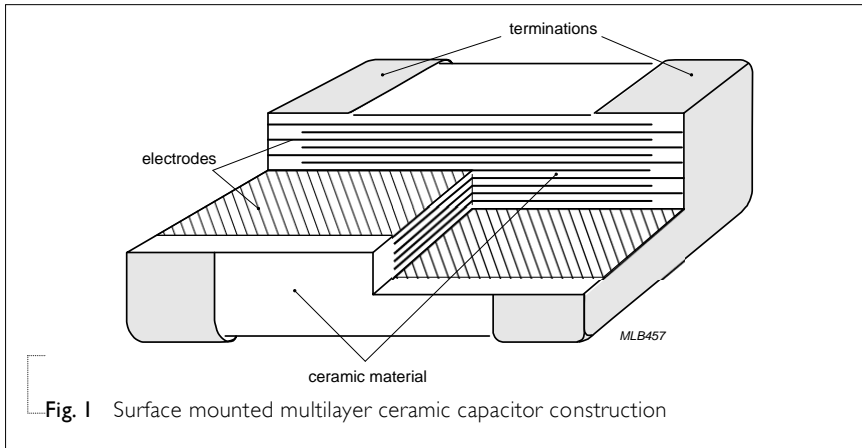
1. Tolerance ±2% doesn't available for full NPO product range, please contact local sales force before order.
2. Tolerance ±5% doesn't available for full X7R product range, please contact local sales force before order.

**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 flexible 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 and Fig.2.

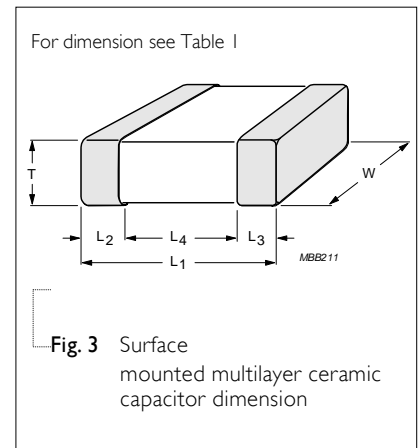


**DIMENSION**

Table I For outlines see fig. 3

TYPE	LI (mm)	W (mm)	T (mm)	L2/L3(mm) min	L2/L3(mm) max	L4(mm) min	Dimension code				
0402	1.0 ± 0.15	0.5 ± 0.15	0.50 ± 0.15	0.10	0.35	0.30	CA				
0603	1.6 ± 0.20	0.8 ± 0.15	0.80 ± 0.15	0.20	0.65	0.50	DA				
	1.6 ± 0.25	0.8 ± 0.25	0.80 ± 0.25	0.20	0.85	0.20	DB				
0805	2.0 ± 0.3	1.25 ± 0.2	0.60 ± 0.15	0.25	0.75	0.70	EA				
			0.85 ± 0.15				EB				
			1.25 ± 0.20				EC				
			1.25 ± 0.25				1.25 ± 0.25	0.25	0.85	0.50	ED
			0.60 ± 0.15				FA				
1206	3.2 ± 0.4	1.6 ± 0.2	0.85 ± 0.15	0.25	0.85	1.50	FC				
			1.15 ± 0.20				FD				
			1.25 ± 0.20				FE				
			1.60 ± 0.20				FF				
			1.6 ± 0.3				1.60 ± 0.30	0.25	1.00	1.20	GA
1210	3.2 ± 0.5	2.5 ± 0.3	0.85 ± 0.20	0.25	0.85	1.40	GB				
			1.15 ± 0.30				GC				
			1.25+/-0.20				GD				
			1.25+/-0.30				GE				
			1.60+/-0.30				GF				
			2.00+/-0.30				GG				
			2.5 ± 0.3				0.25	1.0	1.2	HA	
1808	4.5+0.6/-0.4	2.0+/-0.4	1.25+/-0.20	0.25	0.85	2.20	HB				
			1.35+/-0.40				HC				
			1.60+/-0.20				HD				
			1.60+/-0.40				HE				
			2.00+/-0.40				IA				
1812	4.5+0.6/-0.4	3.2+/-0.4	0.85+/-0.30	0.25	0.85	2.20	IB				
			1.15+/-0.40				IC				
			1.25+/-0.20				ID				
			1.25+/-0.40				IE				
			1.35+/-0.40				IF				
			1.60+/-0.40								

**OUTLINES**



**CAPACITANCE RANGE & THICKNESS**

Table 2 NPO / 0402 to 0805

CAP.	0402		0603			0805					
	50V	100V	50V	100V	250V	50V	100V	250V	500V	630V	1000V
0.47 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA		
0.56 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA		
0.68 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA		
0.82 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA		
1 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA		
1.2 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA		
1.5 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA		
1.8 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA		
2.2 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA		
2.7 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA		
3.3 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA		
3.9 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA		
4.7 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA		
5.6 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA		
6.8 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA		
8.2 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA		
10 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA	EA	EB
12 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA	EA	EB
15 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA	EA	EB
18 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA	EA	EB
22 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA	EA	EB
27 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA	EA	EB
33 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA	EA	EB
39 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA	EA	EB
47 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA	EA	EB
56 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA	EA	EC
68 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA	EA	EC
82 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA	EA	EC
100 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA	EA	

Tape width

8 mm

**NOTE**

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-12 series is on request
3. For product with 2% tolerance, please contact local sales force before ordering

**CAPACITANCE RANGE & THICKNESS**

Table 3 NPO / 0402 to 0805

CAP.	0402		0603			0805					
	50V	100V	50V	100V	250V	50V	100V	250V	500V	630V	1000V
120 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA	EA	
150 pF	CA	CA	DA	DA	DA	EA	EA	EA	EA	EA	
180 pF	CA		DA	DA	DA	EA	EA	EA	EA	EA	
220 pF	CA		DA	DA	DA	EA	EA	EB	EB	EB	
270 pF	CA		DA	DA	DA	EA	EA	EB	EB	EB	
330 pF	CA		DA	DA	DA	EA	EA	EB	EB	EB	
390 pF	CA		DA	DA	DA	EA	EA	EB	EB	EB	
470 pF	CA		DA	DA	DA	EA	EA	EB	EB	EB	
560 pF			DA	DA	DA	EA	EA	EB	EC	EC	
680 pF			DA	DA	DA	EA	EA	EB	EC	EC	
820 pF			DA	DA		EA	EA	EB	EC	EC	
1.0 nF			DA	DA		EA	EA	EB	EC	EC	
1.2 nF			DA			EB	EB	EC			
1.5 nF			DA			EB	EB	EC			
1.8 nF			DA			EB	EB	EC			
2.2 nF			DA			EC	EC	EC			
2.7 nF			DA			EC	EC	EC			
3.3 nF			DA			EC	EC	EC			
3.9 nF						EC	EC	EC			
4.7 nF						EC	EC	EC			
5.6 nF						EC	EC				
6.8 nF						EC	EC				
8.2 nF						EC	EC				
10 nF						EC	EC				

Tape width 8 mm

**NOTE**

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-12 series is on request
3. For product with 2% tolerance, please contact local sales force before ordering

**CAPACITANCE RANGE & THICKNESS**

Table 4 NPO / I206 to I210

CAP.	I206				I210											
	50V	100V	250V	500V	630V	1000V	2000V	3000V	50V	100V	250V	500V	630V	1000V	2000V	
0.47 pF	FA	FA	FA													
0.56 pF	FA	FA	FA													
0.68 pF	FA	FA	FA													
0.82 pF	FA	FA	FA													
1 pF	FA	FA	FA													
1.2 pF	FA	FA	FA													
1.5 pF	FA	FA	FA													
1.8 pF	FA	FA	FA													
2.2 pF	FA	FA	FA	FA												
2.7 pF	FA	FA	FA	FA												
3.3 pF	FA	FA	FA	FA												
3.9 pF	FA	FA	FA	FA												
4.7 pF	FA	FA	FA	FA												
5.6 pF	FA	FA	FA	FA												
6.8 pF	FA	FA	FA	FA												
8.2 pF	FA	FA	FA	FA												
10 pF	FA	FA	FA	FA	FD	FD	FD	FD								
12 pF	FA	FA	FA	FA	FD	FD	FD	FD								
15 pF	FA	FA	FA	FA	FD	FD	FD	FD								
18 pF	FA	FA	FA	FA	FD	FD	FD	FD								
22 pF	FA	FA	FA	FA	FD	FD	FD	FD								
27 pF	FA	FA	FA	FA	FD	FD	FD	FD								
33 pF	FA	FA	FA	FA	FD	FD	FD	FD						GC	GC	GC
39 pF	FA	FA	FA	FA	FD	FD	FD	FD						GC	GC	GC
47 pF	FA	FA	FA	FA	FD	FD	FD	FD	GC	GC	GC	GC	GC	GC	GC	GC
56 pF	FA	FA	FA	FA	FD	FD	FD		GC	GC	GC	GC	GC	GC	GC	GC
68 pF	FA	FA	FA	FA	FD	FD	FD		GC	GC	GC	GC	GC	GC	GC	GC
82 pF	FA	FA	FA	FA	FD	FD	FD		GC	GC	GC	GC	GC	GC	GC	GC
100 pF	FA	FA	FA	FA	FD	FD	FD		GC	GC	GC	GC	GC	GC	GC	GC

Tape width

**CAPACITANCE RANGE & THICKNESS**

Table 5 NPO / I206 to I210

CAP.	I206							I210						
	50V	100V	250V	500V	630V	1000V	2000V	50V	100V	250V	500V	630V	1000V	2000V
120 pF	FA	FA	FA	FA	FD	FD	FD	GC	GC	GC	GC	GC	GC	GC
150 pF	FA	FA	FA	FA	FD	FD	FD	GC	GC	GC	GC	GC	GC	GC
180 pF	FA	FA	FA	FA	FD	FD	FD	GC	GC	GC	GC	GC	GC	GC
220 pF	FA	FA	FA	FA	FD	FD	FD	GC	GC	GC	GC	GC	GC	GC
270 pF	FA	FA	FA	FA	FD	FD		GC	GC	GC	GC	GC	GC	
330 pF	FA	FA	FA	FA	FD	FD		GC	GC	GC	GC	GC	GC	
390 pF	FA	FA	FA	FA	FD	FD		GC	GC	GC	GC	GC	GC	
470 pF	FA	FA	FA	FA	FD	FD		GC	GC	GC	GC	GC	GC	
560 pF	FA	FA	FA	FA	FD	FD		GC	GC	GC	GC	GC	GC	
680 pF	FA	FA	FA	FA	FD	FD		GC	GC	GC	GC	GC	GC	
820 pF	FA	FA	FB	FB	FD	FD		GC	GC	GC	GC	GC	GC	
1.0 nF	FA	FA	FB	FB	FD	FD		GC	GC	GC	GC	GC	GC	
1.2 nF	FA	FA	FB	FB	FD			GC	GC	GC	GC			
1.5 nF	FA	FA	FB	FB	FD			GC	GC	GC	GC			
1.8 nF	FA	FA	FD	FD	FD			GC	GC	GC	GC			
2.2 nF	FA	FA	FD	FD	FD			GC	GC	GC	GC			
2.7 nF	FA	FA	FD					GC	GC	GC	GC			
3.3 nF	FB	FB	FD					GC	GC	GC	GC			
3.9 nF	FB	FB	FD					GC	GC	GC	GC			
4.7 nF	FB	FB						GC	GC	GC	GC			
5.6 nF	FB	FB						GC	GC					
6.8 nF	FB	FB						GC	GC					
8.2 nF	FD	FD						GC	GC					
10 nF	FD	FD						GC	GC					

Tape width 8 mm

**CAPACITANCE RANGE & THICKNESS**

Table 6 NPO / I808 to I812

CAP.	I808			I812						
	1000V	2000V	3000V	100V	250V	500V	630V	1000V	2000V	3000V
10 pF			HC					IC	IC	IC
12 pF			HC					IC	IC	IC
15 pF			HC					IC	IC	IC
18 pF			HC					IC	IC	IC
22 pF			HC					IC	IC	IC
27 pF			HC					IC	IC	IC
33 pF	HA	HA	HC					IC	IC	IC
39 pF	HA	HA	HC					IC	IC	IC
47 pF	HA	HA	HC					IC	IC	IC
56 pF	HA	HA	HC	IC	IC	IC	IC	IC	IC	IC
68 pF	HA	HA	HC	IC	IC	IC	IC	IC	IC	IC
82 pF	HA	HA	HC	IC	IC	IC	IC	IC	IC	IC
100 pF	HA	HA	HC	IC	IC	IC	IC	IC	IC	IC
120 pF	HA	HA		IC	IC	IC	IC	IC	IC	IC
150 pF	HA	HA		IC	IC	IC	IC	IC	IC	IC
180 pF	HA	HA		IC	IC	IC	IC	IC	IC	IC
220 pF	HA	HA		IC	IC	IC	IC	IC	IC	IC
270 pF	HA	HA		IC	IC	IC	IC	IC	IC	
330 pF	HA	HA		IC	IC	IC	IC	IC	IC	
390 pF	HA	HA		IC	IC	IC	IC	IC	IC	
470 pF	HA	HA		IC	IC	IC	IC	IC		
560 pF	HA	HA		IC	IC	IC	IC	IC		
680 pF				IC	IC	IC	IC	IC		
820 pF				IC	IC	IC	IC	IC		
1.0 nF				IC	IC	IC	IC	IC		
1.2 nF				IC	IC	IC	IC	IC		
1.5 nF				IC	IC	IC	IC	IC		
1.8 nF				IC	IC	IC				
2.2 nF				IC	IC	IC				
2.7 nF				IC	IC	IC				
3.3 nF				IC	IC	IC				
3.9 nF				IC	IC	IC				
4.7 nF				IC	IC	IC				
5.6 nF				IC						
6.8 nF				IC						
8.2 nF				IC						
10 nF				IC						
12 nF				IC						
15 nF				IC						
18 nF				IC						
22 nF				IC						
27 nF										
33 nF										

Tape Width 12 mm

**NOTE**

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-12 series is on request
3. For product with 2% tolerance, please contact local sales force before ordering





**CAPACITANCE RANGE & THICKNESS**

Table 7 X7R / 0402 to 0805

CAP.	0402				0603				0805								
	16V	25V	50V	100V	16V	25V	50V	100V	250V	16V	25V	50V	100V	250V	500V	630V	1000V
100 pF	CA	CA	CA	CA	DA	DA	DA	DA	DA								
150 pF	CA	CA	CA	CA	DA	DA	DA	DA	DA	EA	EA	EA	EA	EB	EB	EB	EB
220 pF	CA	CA	CA	CA	DA	DA	DA	DA	DA	EA	EA	EA	EA	EB	EB	EB	EB
330 pF	CA	CA	CA	CA	DA	DA	DA	DA	DA	EA	EA	EA	EA	EB	EB	EB	EB
470 pF	CA	CA	CA	CA	DA	DA	DA	DA	DA	EA	EA	EA	EA	EB	EB	EB	EB
680 pF	CA	CA	CA	CA	DA	DA	DA	DA	DA	EA	EA	EA	EA	EB	EB	EB	EB
1.0 nF	CA	CA	CA	CA	DA	DA	DA	DA	DA	EA	EA	EA	EA	EB	EB	EB	EB
1.5 nF	CA	CA	CA	CA	DA	DA	DA	DA	DA	EA	EA	EA	EA	EB	EB	EB	
2.2 nF	CA	CA	CA	CA	DA	DA	DA	DA	DA	EA	EA	EA	EA	EB	EB	EB	
3.3 nF	CA	CA	CA	CA	DA	DA	DA	DA		EA	EA	EA	EA	EB	EB	EB	
4.7 nF	CA	CA	CA	CA	DA	DA	DA	DA		EA	EA	EA	EA	EB	EB	EB	
6.8 nF	CA	CA	CA	CA	DA	DA	DA	DA		EA	EA	EA	EA	EC	EB	EB	
10 nF	CA	CA	CA	CA	DA	DA	DA	DA		EA	EA	EA	EA	EC	EC	EC	
15 nF	CA	CA	CA		DA	DA	DA	DA		EA	EA	EA	EB	EC	EC		
22 nF	CA	CA	CA		DA	DA	DA	DA		EA	EA	EA	EB	EC	EC		
33 nF	CA	CA	CA		DA	DA	DA	DA		EB	EB	EB	EC				
47 nF	CA	CA	CA		DA	DA	DA	DA		EB	EB	EB	EC				
68 nF	CA	CA			DA	DA	DA	DA		EB	EB	EB	EC				
100 nF	CA	CA			DA	DA	DA	DA		EB	EB	EB	EC				
150 nF					DA	DA	DA			EC	EC	EC					
220 nF					DA	DA	DA			EC	EC	EC					
330 nF					DA	DA				EC	EC	EC					
470 nF					DA	DA				EC	EC	EC					
680 nF					DA					EC	EC	EC					
1000 nF					DA					EC	EC	EC					
2.2 μF										EC	ED						
4.7 μF										ED							

Tape width

8 mm

**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**

Table 8 X7R / I206 to I210

CAP.	I206									I210								
	16V	25V	50V	100V	200/250V	500V	630V	1000V	2000V	16V	25V	50V	100V	250V	500V	630V	1000V	2000V
100 pF																		
150 pF																		
220 pF	FB	FB	FB	FB	FB	FD	FD	FD	FD									
330 pF	FB	FB	FB	FB	FB	FD	FD	FD	FD									
470 pF	FB	FB	FB	FB	FB	FD	FD	FD	FD								GD	GD
680 pF	FB	FB	FB	FB	FB	FD	FD	FD	FD								GD	GD
1.0 nF	FB	FB	FB	FB	FB	FD	FD	FD	FD								GD	GD
1.5 nF	FB	FB	FB	FB	FB	FD	FD	FD	FD								GD	GD
2.2 nF	FB	FB	FB	FB	FB	FD	FD	FD		GA	GA	GA	GA	GA			GD	GE
3.3 nF	FB	FB	FB	FB	FB	FD	FD	FD		GA	GA	GA	GA	GA	GD	GD	GD	
4.7 nF	FB	FB	FB	FB	FB	FD	FD	FD		GA	GA	GA	GA	GA	GD	GD	GD	
6.8 nF	FB	FB	FB	FB	FB	FD	FD	FD		GA	GA	GA	GA	GA	GD	GD	GD	
10 nF	FB	FB	FB	FB	FB	FD	FD	FD		GA	GA	GA	GA	GA	GD	GD	GD	
15 nF	FB	FB	FB	FB	FB	FD	FD			GA	GA	GA	GA	GA	GD	GD	GD	
22 nF	FB	FB	FB	FB	FD	FE	FE			GA	GA	GA	GA	GD	GD	GE	GE	
33 nF	FB	FB	FB	FB	FD	FE	FE			GA	GA	GA	GA	GD	GD			
47 nF	FB	FB	FB	FB	FD					GA	GA	GA	GA	GD	GD			
68 nF	FB	FB	FB	FD	FD					GA	GA	GA	GA	GD				
100 nF	FB	FB	FB	FD	FE					GA	GA	GA	GA	GD				
150 nF	FB	FB	FC	FD						GA	GA	GB	GD	GD				
220 nF	FB	FB	FC	FD						GA	GA	GB	GD	GD				
330 nF	FE	FE	FE	FF						GA	GA	GB	GD					
470 nF	FE	FE	FE	FF						GB	GB	GD	GD					
680 nF	FC	FC	FF	FF						GB	GB	GD	GF					
1000 nF	FC	FC	FF	FF						GD	GD	GD	GF					
2.2 μF	FC	FC	FF	FF						GG	GG	GG	GF					
4.7 μF	FF	FF								GG	GG	GG						
10 μF	FF	FF								GG	GG	GG						
Tape width										8 mm								

**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**

Table 9 X7R / 1808 to 1812

CAP.	1808			1812						
	1000V	2000V	3000V	50V	100V	250V	500V	630V	1000V	2000V
100 pF										
150 pF										
220 pF										
330 pF	HB	HB	HD							
470 pF	HB	HB	HD							
680 pF	HB	HB	HD							
1.0 nF	HB	HB	HE							
1.5 nF	HB	HB	HE							
2.2 nF	HB	HD		IA	IA	IA	ID	IE	IE	IE
3.3 nF	HB			IA	IA	IA	ID	IE	IE	IE
4.7 nF	HB			IA	IA	IA	ID	IE	IE	IE
6.8 nF	HD			IA	IA	IA	ID	IE	IE	
10 nF	HD			IA	IA	IA	ID	IE	IE	
15 nF				IA	IA	IA	ID	IE	IE	
22 nF				IA	IA	IA	ID	IE	IE	
33 nF				IA	IA	IA	ID	IF	IF	
47 nF				IA	IA	ID	ID			
68 nF				IA	IA	ID	ID			
100 nF				IB	ID	ID	IF			
150 nF				IB	ID	ID				
220 nF				IB	ID	IF				
330 nF				IB	ID	IF				
470 nF				IB	IF	IF				
680 nF				IF	IF					
1000 nF				IF	IF					
2.2 μF										
Tape width				12 mm						

**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

**THICKNESS CLASSES AND PACKING QUANTITY**

Table 10

SIZE CODE	THICKNESS CLASSIFICATION	TAPE WIDTH QUANTITY PER REEL	Ø180 MM / 7 INCH		Ø180 MM / 13 INCH	
			PAPER	BLISTER	PAPER	BLISTER
0402	0.50+/-0.15	8mm	10,000	--	50,000	--
0603	0.80+/-0.15	8mm	4,000	--	15,000	--
0805	0.60+/-0.15	8mm	4,000	--	20,000	--
	0.85+/-0.15	8mm	4,000	--	15,000	--
	1.25+/-0.20	8mm	--	3,000	--	10,000
1206	0.60+/-0.15	8mm	4,000	--	20,000	--
	0.85+/-0.15	8mm	4,000	--	15,000	--
	1.15+/-0.20	8mm	--	3,000	--	10,000
	1.25+/-0.20	8mm	--	3,000	--	10,000
	1.60+/-0.20	8mm	--	2,000	--	8,000
	1.60+/-0.30	8mm	--	2,000	--	8,000
1210	0.85+/-0.20	8mm	--	4,000	--	10,000
	1.15+/-0.30	8mm	--	3,000	--	10,000
	1.25+/-0.20	8mm	--	3,000	--	10,000
	1.25+/-0.30	8mm	--	3,000	--	10,000
	1.60+/-0.30	8mm	--	2,000	--	5,000
	2.00+/-0.30	8mm	--	2,000	--	--
1808	1.25+/-0.20	12mm	--	2,000	--	--
	1.35+/-0.40	12mm	--	2,000	--	--
	1.60+/-0.20	12mm	--	2,000	--	--
	1.60+/-0.40	12mm	--	2,000	--	--
	2.00+/-0.40	12mm	--	2,000	--	--
1812	0.85+/-0.30	12mm	--	2,000	--	--
	1.15+/-0.40	12mm	--	1,000	--	--
	1.25+/-0.20	12mm	--	1,000	--	--
	1.25+/-0.40	12mm	--	1,000	--	--
	1.35+/-0.40	12mm	--	1,000	--	--
	1.60+/-0.40	12mm	--	1,000	--	--

**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 2.2µF						
Dissipation factor (D.F.)								
NPO	C < 30 pF	≤ 1 / (400 + 20C)						
	C ≥ 30 pF	≤ 0.1 %						
X7R	0402	0603	0805	1206	1210	1808	1812	
16V	100pF to 22nF	100pF to 220nF	150pF to 470nF	220pF to 1µF	2.2nF to 1µF			≤ 3.5%
	27nF to 100nF	470nF to 1µF	680 nF to 2.2µF	2.2µF				≤ 5%
				4.7µF	4.7µF to 10µF	2.2µF to 10µF		
25V	100pF to 10nF	100pF to 39nF	150pF to 180nF	220pF to 680nF	2.2nF to 1µF			≤ 2.5%
	12 nF to 47nF	47nF to 220nF	220nF to 470nF	1µF				≤ 3.5%
	56nF to 100nF			680nF to 1µF	2.2µF			≤ 5%
		330nF to 470nF	2.2µF	4.7µF to 10µF	2.2µF to 10µF			≤ 10%
50V	100pF to 10nF	100pF to 39nF	150pF to 180nF	220pF to 470nF	2.2nF to 1µF	2.2nF to 1µF		≤ 2.5%
	12 nF to 47nF	47nF to 220nF	220nF to 470nF	680nF to 1µF				≤ 3.5%
				680nF	2.2µF			
			1µF			2.2µF to 10µF		≤ 10%
100V	All	100pF to 10nF	All	220pF to 680nF	2.2nF to 680nF	All		≤ 2.5%
				1µF	1µF			≤ 3.5%
			12nF to 100nF		2.2µF	2.2µF		
250V to 3KV	All	All	All	All	All	All	All	≤ 2.5%

I.R. ≥ 10 GΩ or R × C ≥ 500 seconds whichever is less

R × C ≥ 100 seconds :

X7R/0805/2.2µF/25V;

X7R/0805/4.7µF/16V;

X7R/1206/4.7µF to 10µF/16V to 25V ;

X7R/1210/2.2µF to 10µF/16V to 50V, X7R/1210/2.2µF/100V ;

Insulation resistance after 1 minute at U<sub>r</sub> (DC)

Maximum capacitance change as a function of temperature

NPO: ±30ppm

(temperature characteristic/coefficient):

X7R: ±15%

Operating temperature range:

-55 °C to +125 °C

Table 12

**SOLDERING RECOMMENDATION**

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



**TESTS AND REQUIREMENTS**

Table 13 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		4.5.1 Class I: f = 1 MHz for C ≤ 1 nF, measuring at voltage 1 Vrms at 20 °C f = 1 KHz for C > 1 nF, measuring at voltage 1 Vrms at 20 °C  Class II: At 20 °C, 24 hrs after annealing f = 1 KHz for C ≤ 10 μF, measuring at voltage 1 Vrms at 20 °C f = 120Hz for C > 10 μF, measuring at voltage 0.5 Vrms at 20 °C	Within specified tolerance
Dissipation Factor (D.F.)		4.5.2 Class I: f = 1 MHz for C ≤ 1 nF, measuring at voltage 1 Vrms at 20 °C f = 1 KHz for C > 1 nF, measuring at voltage 1 Vrms at 20 °C  Class II: At 20 °C, 24 hrs after annealing f = 1 KHz for C ≤ 10 μF, measuring at voltage 1 Vrms at 20 °C f = 120Hz for C > 10 μF, measuring at voltage 0.5 Vrms at 20 °C	In accordance with specification
Insulation Resistance		4.5.3 U <sub>r</sub> ≤ 500 V: At U <sub>r</sub> for 1 minute U <sub>r</sub> > 500 V: At 500 V for 1 minute	In accordance with specification

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS												
Temperature Characteristic	IEC 60384- 21/22 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"> <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>Class I:                      Δ C/C: ±30ppm</p> <p>Class II:                      X7R: Δ C/C: ±15%</p>
Step	Temperature(°C)														
a	25±2														
b	Lower temperature±3°C														
c	25±2														
d	Upper Temperature±2°C														
e	25±2														

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
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	4.8	Mounting in accordance with IEC 60384-22 paragraph 4.3  Conditions: bending at a rate of 1 mm/s, radius jig 5 mm NPO: 5 mm X7R/0402 to 0603: 5 mm X7R/0805 to 1812: 3 mm	No visible damage  ΔC/C Class I: NPO: within ±1% or 0.5 pF, whichever is greater Class II: X7R: ±10%
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  ΔC/C Class I: NPO: within ±0.5% or 0.5 pF, whichever is greater Class II: X7R: ±10%  D.F. within initial specified value I.R. within initial specified value
Solderability	IEC 60384-21/22 4.10	Preheated the temperature of 80 °C to 140 °C and maintained for 30 seconds to 60 seconds.  Test conditions for lead containing solder alloy Temperature: 235 ±5 °C Dipping time: 2 ±0.2 seconds Depth of immersion: 10 mm Alloy Composition: 60/40 Sn/Pb Number of immersions: 1  Test conditions for leadfree containing solder alloy Temperature: 245 ±5 °C Dipping time: 3 ±0.3 seconds Depth of immersion: 10 mm Alloy Composition: SAC305 Number of immersions: 1	The solder should cover over 95% of the critical area of each termination



TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Rapid Change of Temperature	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><math>\Delta C/C</math> Class I: NPO: within ±1% or 1 pF, whichever is greater Class II: X7R: ±15%</p> <hr/> <p>D.F. meet initial specified value I.R. meet initial specified value</p>
Damp Heat with $U_r$ Load	IEC 60384-21/22 4.13	<ol style="list-style-type: none"> <li>Preconditioning, class II only: 150 +0/-10 °C /1 hour, then keep for 24 ±1 hour at room temp</li> <li>Initial measure: Spec: refer initial spec C, D, I.R.</li> <li>Damp heat test: 500 ±12 hours at 40 ±2 °C; 90 to 95% R.H. 1.0 <math>U_r</math> applied</li> <li>Recovery: Class 2: 24 ±2 hours</li> <li>Final measure: C, D, I.R.</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 precondition according to "IEC 60384 4.1" and then the requirement shall be met.</p>	<p>No visual damage after recovery</p> <hr/> <p><math>\Delta C/C</math> Class I: NPO: within ±2% or 1 pF, whichever is greater Class II: X7R: ±15%</p> <hr/> <p>D.F. Class I: NPO: ≤ 2 × specified value Class II: X7R: ≤ 2 × specified value</p> <hr/> <p>I.R. Class I: NPO: ≥ 2,500 MΩ or <math>R \times C \geq 25\Omega.F</math> whichever is less Class II: X7R: ≥ 500 MΩ or <math>R \times C \geq 25\Omega.F</math> whichever is less</p> <hr/> <p>X7R/0805/4.7μF/16V ; X7R/1206/10μF/16V to 25V ; X7R/1210/2.2μF to 10μF/16V to 50V, X7R/1210/2.2μF/100V ;</p> <p><math>\Delta C/C</math> ±20% D.F. ≤ 2 × specified value I.R. <math>R \times C \geq 5 \Omega.F</math></p>

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS													
Endurance	IEC 60384-21/22	4.14 1. Preconditioning, class II only: 150 +0/-10 °C /1 hour, then keep for 24 ±1 hour at room temp 2. Initial measure: Spec: refer initial spec C, D, I.R. 3. Endurance test: Temperature: NPO/X7R: 125 °C Specified stress voltage applied for 1,000 hours: 4. High voltage series follows with below stress condition:	No visual damage <hr/> $\Delta C/C$ Class I: NPO: within ±2% or 1 pF, whichever is greater Class II: X7R: ±15% <hr/> D.F. Class I: NPO: ≤ 2 x specified value Class II: X7R: ≤ 2 x specified value <hr/> I.R. Class I: NPO: ≥ 4,000 MΩ or R x C ≥ 40Ω.F whichever is less Class II: X7R: ≥ 1,000 MΩ or R x C ≥ 50Ω.F whichever is less <hr/> $\Delta C/C$ ±20% D.F. ≤ 2 x specified value I.R. R x C ≥ 10 Ω.F													
			<table border="1"> <thead> <tr> <th>Voltage</th> <th>NPO</th> <th>X7R</th> </tr> </thead> <tbody> <tr> <td>≤ 100V</td> <td>2.0 x Ur</td> <td>2.0 x Ur</td> </tr> <tr> <td>200/250V</td> <td>1.5 x Ur</td> <td>1.5 x Ur</td> </tr> <tr> <td>500/630V</td> <td>1.3 x Ur</td> <td>1.2 x Ur</td> </tr> <tr> <td>≥ 1KV</td> <td>1.2 x Ur</td> <td>1.1 x Ur</td> </tr> </tbody> </table> 5. Recovery time: 24 ±2 hours 6. Final measure: C, D, I.R. 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 precondition according to "IEC 60384 4.1" and then the requirement shall be met.	Voltage	NPO	X7R	≤ 100V	2.0 x Ur	2.0 x Ur	200/250V	1.5 x Ur	1.5 x Ur	500/630V	1.3 x Ur	1.2 x Ur	≥ 1KV
Voltage	NPO	X7R														
≤ 100V	2.0 x Ur	2.0 x Ur														
200/250V	1.5 x Ur	1.5 x Ur														
500/630V	1.3 x Ur	1.2 x Ur														
≥ 1KV	1.2 x Ur	1.1 x Ur														
Voltage Proof	IEC 60384-1	4.6 Specified stress voltage applied for 1~5 seconds Ur ≤ 100 V: series applied 2.5 Ur 100 V < Ur ≤ 200 V series applied (1.5 Ur + 100) 200 V < Ur ≤ 500 V series applied (1.3 Ur + 100) Ur > 500 V: 1.3 Ur Ur ≥ 1000 V: 1.2 Ur Charge/Discharge current is less than 50 mA	No breakdown or flashover													

**REVISION HISTORY**

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 6	Feb 18, 2020		- Modify X7R, 1206, 22nF, 500V thickness to 1.6mm
Version 5	May 23, 2019	-	- Product range changed
Version 4	Jun.19, 2017	-	- Product range updated
Version 3	Jan. 26, 2017	-	- Global part number coding rule update
Version 2	Dec. 30, 2016	-	- Dimension updated
Version 1	Dec. 16, 2016	-	- Product range updated
Version 0	May 20, 2016	-	- New datasheet for soft termination NPO & X7R series with RoHS compliant

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