

# DATA SHEET

## SURFACE-MOUNT CERAMIC MULTILAYER CAPACITORS

Mid-voltage

NP0/X7R

100 V TO 630 V

0.47 pF to 470 nF

RoHS compliant & Halogen Free



SCOPE

This specification describes Mid-voltage NP0/X7R series chip capacitors with lead-free terminations.

APPLICATIONS

- PCs, Hard disk, Game PCs
- Power supplies
- LCD panel
- ADSL, Modem

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 xxx x **B** x xxx  
 (1) (2) (3) (4) (5) (6) (7)

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**(1) SIZE – INCH BASED (METRIC)**

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

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**(2) TOLERANCE**

C = ±0.25 pF  
 D = ±0.5 pF  
 G = ±2%  
 J = ±5%  
 K = ±10%

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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) TC MATERIAL**

NPO  
 X7R

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**(5) RATED VOLTAGE**

0 = 100 V  
 A = 200 V  
 Y = 250 V  
 B = 500 V  
 Z = 630 V

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**(6) PROCESS**

N = NPO  
 B = Class 2 MLCC

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**(7) CAPACITANCE VALUE**

2 significant digits+number of zeros  
 The 3rd digit signifies the multiplying factor, and letter R is decimal point  
 Example: 121 = 12 × 10<sup>1</sup> = 120 pF

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**PHYCOMP BRAND ordering codes**

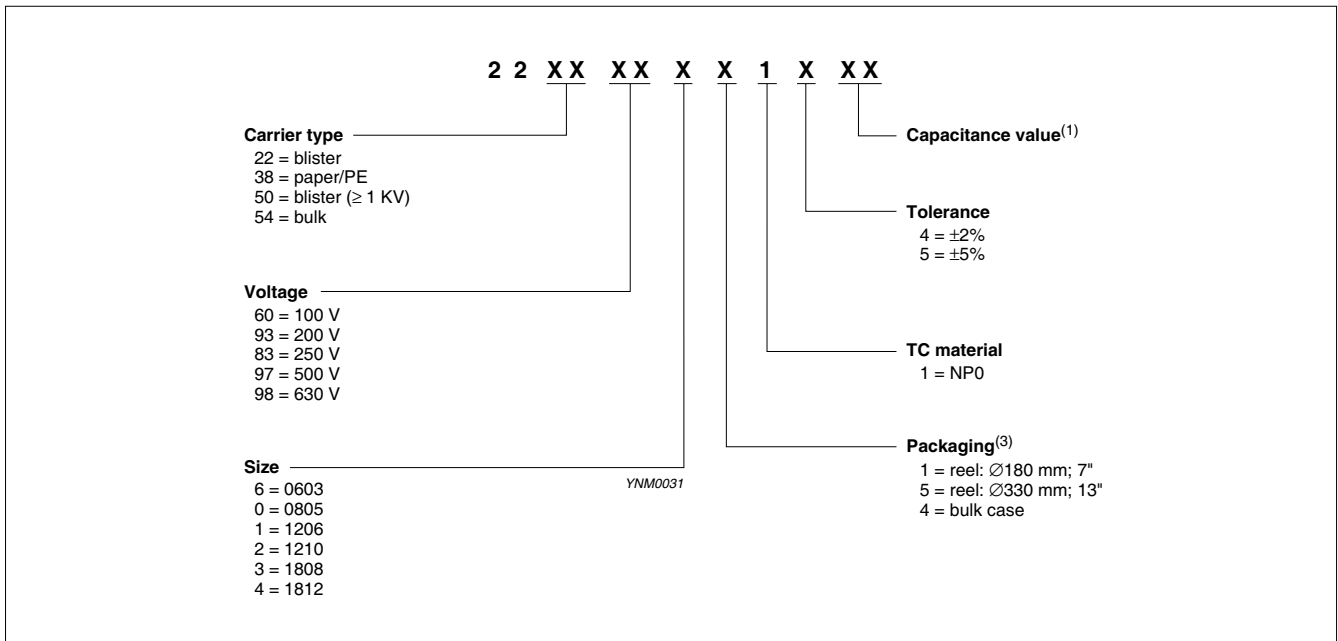
GLOBAL PART NUMBER (preferred), PHYCOMP CTC (for North America) and I2NC (traditional) codes are acceptable to order Phycomp brand products.

**GLOBAL PART NUMBER (PREFERRED)**

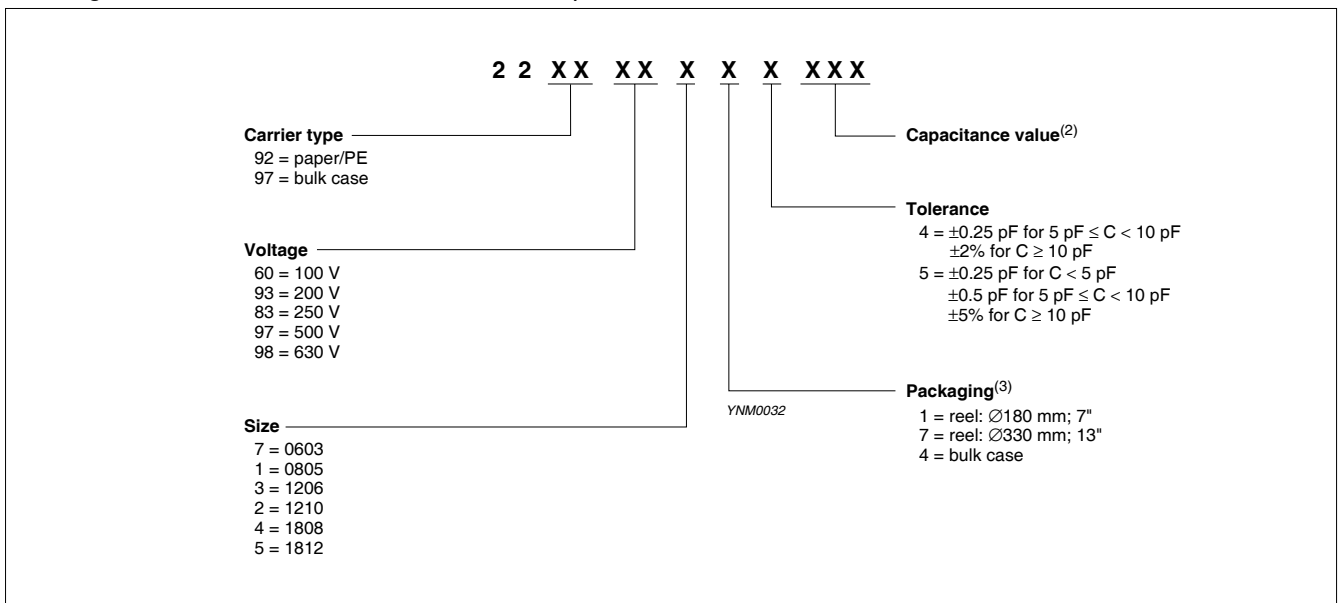
For detailed information of GLOBAL PART NUMBER and ordering example, please refer to page 2.

**I2NC CODE**

Ordering information for NP0 100 V to 630 V, C ≥ 10 pF

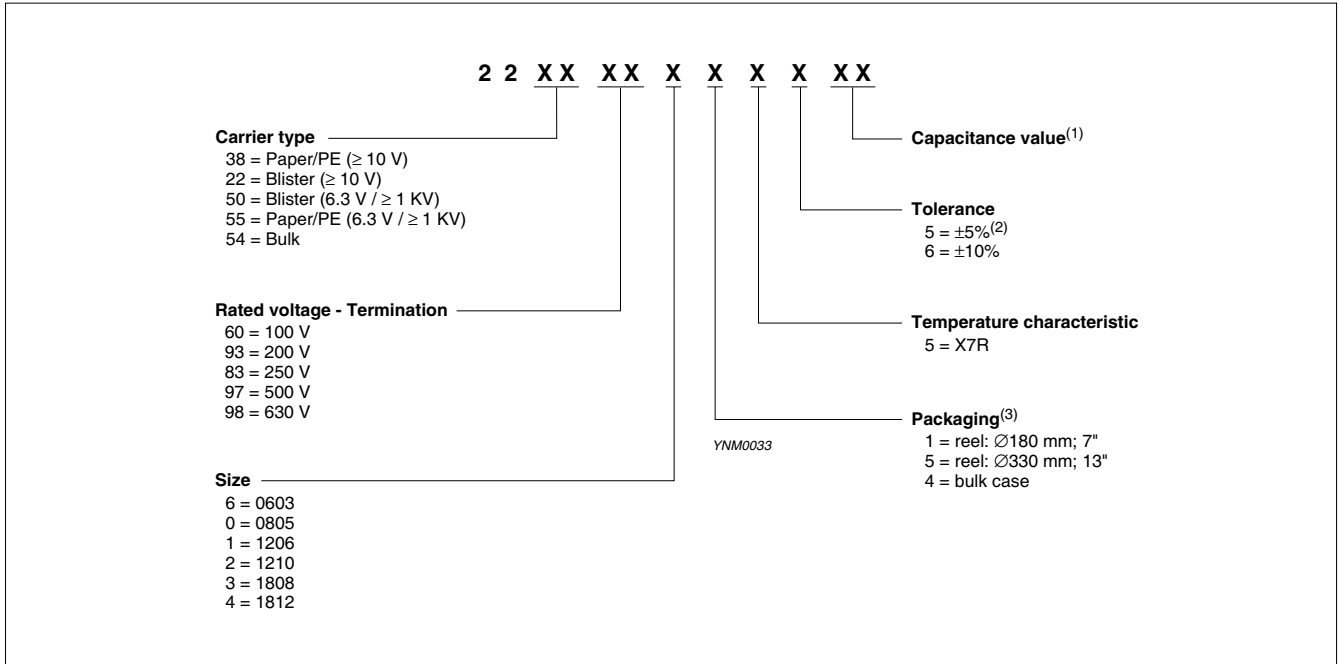


Ordering information for NP0 100 V to 630 V, C < 10 pF



(1) Please refer to "Last 2-digit of I2NC" in "CAPACITANCE RANGE & THICKNESS FOR NP0"  
 (2) Please refer to "Last 3-digit of I2NC" in "CAPACITANCE RANGE & THICKNESS FOR NP0"  
 (3) Quantity on reel depends on thickness classification; see table I4

Ordering information for X7R 100 V to 630 V



- (1) Please refer to "Last 2-digit of I2NC" in "CAPACITANCE RANGE & THICKNESS FOR X7R"
- (2) Tolerance ±5% doesn't available for full product range, please contact local sales force before order
- (3) Quantity on reel depends on thickness classification; see table I4

**PHYCOMP CTC CODE (FOR NORTH AMERICA)**

🔗 Example: 0603CG101J0B200

0603	CG	101	J	0	B	2	0	0
Size code	Temp. Char.	Capacitance in pF	Tolerance	Voltage	Termination	Packing	Marking	Range identifier
0603	CG = NP0	101 = 100 pF; the third digit signifies the multiplying factor:	C = ±0.25 pF	0 = 100 V	B = NiSn	2 = 180 mm	0 = no marking	0 = conv. Ceramic
0805	2R = X7R		D = ±0.5 pF	B = 200 V		7" Paper/PE		D = Class 2 MLCC
1206			G = ±2%	C = 250 V		3 = 330 mm		
1210		0 = × 1	J = ±5%	D = 500 V		13" Paper/PE		
1808		1 = × 10	K = ±10%	Z = 630 V		B = 180 mm		
1812		2 = × 100				7" Blister		
		3 = × 1,000				F = 330 mm		
						13" Blister		
						P = Bulk case		

**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.

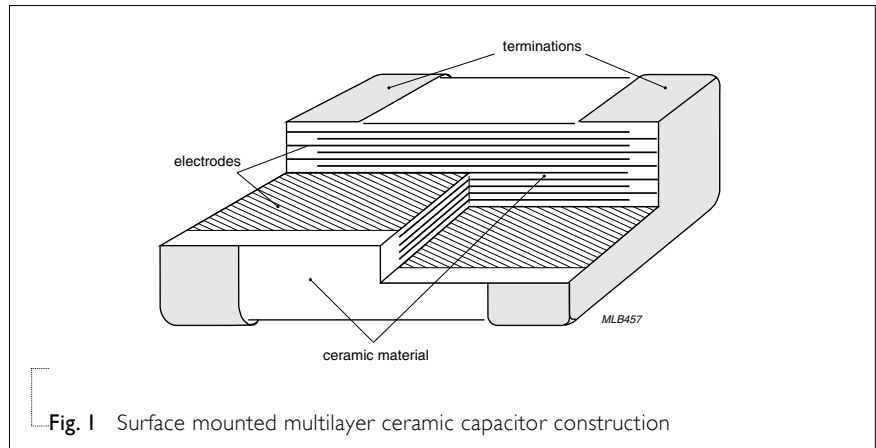


Fig. 1 Surface mounted multilayer ceramic capacitor construction

**DIMENSION**

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.
0603	1.6 ±0.10	0.8 ±0.10	Refer to table 2 to 13	0.20	0.60	0.40
0805	2.0 ±0.10	1.25 ±0.10		0.25	0.75	0.55
1206	3.2 ±0.15	1.6 ±0.15		0.25	0.75	1.40
1210	3.2 ±0.30	2.5 ±0.20		0.25	0.75	1.40
1808	4.5 ±0.40	2.0 ±0.30		0.25	0.75	2.20
1812	4.5 ±0.40	3.2 ±0.20		0.25	0.75	2.20

**OUTLINES**

For dimension see Table I

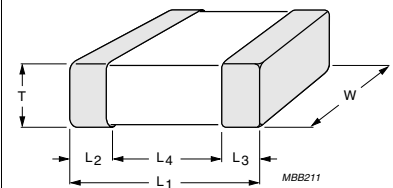


Fig. 2 Surface mounted multilayer ceramic capacitor dimension

**CAPACITANCE RANGE & THICKNESS FOR NP0**

**Table 2** Sizes from 0603 to 0805

CAP.	Last 3-digit of	0603			0805			
		12NC	100 V	200 V	250 V	100 V	200 V	250 V
0.47 pF	477							
0.56 pF	567							
0.68 pF	687							
0.82 pF	827							
1.0 pF	108							
1.2 pF	128							
1.5 pF	158							
1.8 pF	188							
2.2 pF	228		0.8±0.1		0.6±0.1 (3)0.85±0.1	0.6±0.1 (3)0.85±0.1	0.6±0.1 (3)0.85±0.1	0.6±0.1 (3)0.85±0.1
2.7 pF	278							
3.3 pF	338							
3.9 pF	398							
4.7 pF	478							
5.6 pF	568							
6.8 pF	688							
8.2 pF	828							

**Table 3** Sizes from 0603 to 0805

CAP.	Last 2-digit of	0603			0805			
		12NC	100 V	200 V	250 V	100 V	200 V	250 V
10 pF	23							
12 pF	24							
15 pF	25							
18 pF	26							
22 pF	27							
27 pF	28							
33 pF	29		0.8±0.1	0.8±0.1	0.8±0.1	0.6±0.1 (3)0.85±0.1	0.6±0.1 (3)0.85±0.1	0.6±0.1 (3)0.85±0.1
39 pF	31							
47 pF	32							
56 pF	33							
68 pF	34							
82 pF	35							

**NOTE**

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

**CAPACITANCE RANGE & THICKNESS FOR NP0**

**Table 4** Sizes from 0603 to 0805 (continued)

CAP.	Last 2-digit of	0603			0805				
		12NC	100 V	200 V	250 V	100 V	200 V	250 V	500 V
100 pF	36								
120 pF	37								
150 pF	38								
180 pF	39								
220 pF	41			0.8±0.1	0.8±0.1		0.6±0.1 (3)0.85±0.1	0.6±0.1 (3)0.85±0.1	0.6±0.1 (3)0.85±0.1
270 pF	42								
330 pF	43		0.8±0.1			0.6±0.1 (3)0.85±0.1			
390 pF	44								
470 pF	45								
560 pF	46								
680 pF	47								
820 pF	48					0.85±0.1	0.85±0.1	1.25±0.2	
1.0 nF	49								
1.2 nF	51								
1.5 nF	52					1.25±0.2	1.25±0.2		
1.8 nF	53								
2.2 nF	54								
2.7 nF	55					1.25±0.2			
3.3 nF	56								
3.9 nF	57								
4.7 nF	58								
5.6 nF	59								
6.8 nF	61								
8.2 nF	62								
10 nF	63								
12 nF	64								
15 nF	65								
18 nF	66								
22 nF	67								

**NOTE**

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

**CAPACITANCE RANGE & THICKNESS FOR NP0**

**Table 5** Sizes from 1206 to 1210

CAP.	Last 3-digit of	1206					1210					
		12NC	100 V	200 V	250 V	500 V	630 V	100 V	200 V	250 V	500 V	630 V
0.47 pF	477											
0.56 pF	567											
0.68 pF	687		0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1						
0.82 pF	827											
1.0 pF	108											
1.2 pF	128											
1.5 pF	158											
1.8 pF	188											
2.2 pF	228						0.85±0.1					1.25±0.2
2.7 pF	278		0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1						
3.3 pF	338		<sup>(3)</sup> 0.85±0.1	<sup>(3)</sup> 0.85±0.1	<sup>(3)</sup> 0.85±0.1	<sup>(3)</sup> 0.85±0.1						
3.9 pF	398											
4.7 pF	478											
5.6 pF	568											
6.8 pF	688											
8.2 pF	828											

**Table 6** Sizes from 1206 to 1210

CAP.	Last 2-digit of	1206					1210					
		12NC	100 V	200 V	250 V	500 V	630 V	100 V	200 V	250 V	500 V	630 V
10 pF	23											
12 pF	24											
15 pF	25											
18 pF	26											
22 pF	27											
27 pF	28		0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1						
33 pF	29		<sup>(3)</sup> 0.85±0.1	<sup>(3)</sup> 0.85±0.1	<sup>(3)</sup> 0.85±0.1	<sup>(3)</sup> 0.85±0.1	1.25±0.2					1.25±0.2
39 pF	31											
47 pF	32											
56 pF	33							1.25±0.2				
68 pF	34										1.25±0.2	
82 pF	35											

**NOTE**

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



**CAPACITANCE RANGE & THICKNESS FOR NP0**

**Table 7** Sizes from 1206 to 1210 (continued)

CAP.	Last 2-digit of	1206					1206					
		12NC	100 V	200 V	250 V	500 V	630 V	100 V	200 V	250 V	500 V	630 V
100 pF	36											
120 pF	37											
150 pF	38											
180 pF	39											
220 pF	41											
270 pF	42		0.6±0.1 (3)0.85±0.1	0.6±0.1 (3)0.85±0.1	0.6±0.1 (3)0.85±0.1							
330 pF	43					1.25±0.2						1.25±0.2
390 pF	44											
470 pF	45		0.6±0.1 (3)0.85±0.1							1.25±0.2		
560 pF	46											
680 pF	47											
820 pF	48											
1.0 nF	49		0.85±0.1	0.85±0.1	0.85±0.1			1.25±0.2	1.25±0.2			
1.2 nF	51						1.25±0.2					1.6±0.2
1.5 nF	52											
1.8 nF	53											
2.2 nF	54				1.25±0.2							
2.7 nF	55		1.25±0.2	1.25±0.2								
3.3 nF	56											
3.9 nF	57											
4.7 nF	58		0.85±0.1									
5.6 nF	59											
6.8 nF	61											
8.2 nF	62											
10 nF	63		1.25±0.2									
12 nF	64											
15 nF	65											
18 nF	66											
22 nF	67											

**NOTE**

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

**CAPACITANCE RANGE & THICKNESS FOR NP0**

**Table 8** Sizes from 1808 to 1812

CAP.	Last 3-digit of	1808					1.25±0.2	1812				
		12NC	100 V	200 V	250 V	500 V		630 V	100 V	200 V	250 V	500 V
0.47 pF	477											
0.56 pF	567											
0.68 pF	687											
0.82 pF	827											
1.0 pF	108											
1.2 pF	128											
1.5 pF	158											
1.8 pF	188											
2.2 pF	228											
2.7 pF	278											
3.3 pF	338											
3.9 pF	398											
4.7 pF	478											
5.6 pF	568											
6.8 pF	688											
8.2 pF	828											

**Table 9** Sizes from 1808 to 1812

CAP.	Last 2-digit of	1808					1.25±0.2	1812				
		12NC	100 V	200 V	250 V	500 V		630 V	100 V	200 V	250 V	500 V
10 pF	23											
12 pF	24											
15 pF	25											
18 pF	26											
22 pF	27											
27 pF	28											
33 pF	29											
39 pF	31											
47 pF	32											
56 pF	33											
68 pF	34											
82 pF	35											

**NOTE**

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-12 series is on request

**CAPACITANCE RANGE & THICKNESS FOR NP0**

**Table 10** Sizes from 1808 to 1812 (continued)

CAP.	Last 2-digit of	1808					1812					
		12NC	100 V	200 V	250 V	500 V	630 V	100 V	200 V	250 V	500 V	630 V
100 pF	36											
120 pF	37											
150 pF	38											
180 pF	39											
220 pF	41											
270 pF	42											
330 pF	43											
390 pF	44						1.25±0.2					
470 pF	45											1.25±0.2
560 pF	46											
680 pF	47									1.25±0.2		
820 pF	48					1.25±0.2						
1 nF	49											
1.2 nF	51	1.25±0.2	1.25±0.2	1.25±0.2								
1.5 nF	52											
1.8 nF	53							1.25±0.2	1.25±0.2			
2.2 nF	54											
2.7 nF	55							1.25±0.2				1.6±0.2
3.3 nF	56											
3.9 nF	57											
4.7 nF	58								1.6±0.2	1.6±0.2		
5.6 nF	59											
6.8 nF	61											
8.2 nF	62											
10 nF	63											
12 nF	64											
15 nF	65											
18 nF	66											
22 nF	67											

**NOTE**

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-12 series is on request

**CAPACITANCE RANGE & THICKNESS FOR X7R**

Table 11 Sizes from 0603 to 0805

CAP.	Last 2-digit of I2NC	0603 100 V	0805 100 V	200 V	250 V	500 V
100 pF	09	0.8±0.1	0.85±0.1	0.85±0.1	0.85±0.1	0.85±0.1
150 pF	12					
220 pF	14					
330 pF	16					
470 pF	18					
680 pF	21					
1.0 nF	23					
1.5 nF	25					
2.2 nF	27					
3.3 nF	29					
4.7 nF	32					
6.8 nF	34					
10 nF	36					
15 nF	38					
22 nF	41					
33 nF	43					
47 nF	45					
68 nF	47					
100 nF	49					
150 nF	52					
220 nF	54					
330 nF	56					
470 nF	58					

**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 order

**CAPACITANCE RANGE & THICKNESS FOR X7R**

**Table 12** Sizes from 1206 to 1210

CAP.	Last 2-digit of	1206					1210				
		12NC	100 V	200 V	250 V	500 V	630 V	100 V	200 V	250 V	500 V
100 pF	09						0.85±0.1				
150 pF	12										
220 pF	14										
330 pF	16										
470 pF	18										
680 pF	21										
1.0 nF	23										
1.5 nF	25										
2.2 nF	27		0.85±0.1	0.85±0.1		1.25±0.2	1.25±0.2				
3.3 nF	29	0.85±0.1									
4.7 nF	32								0.85±0.1	0.85±0.1	
6.8 nF	34										
10 nF	36										
15 nF	38							0.85±0.1			1.25±0.2
22 nF	41						1.6±0.2				
33 nF	43										
47 nF	45		1.25±0.2	1.25±0.2					1.25±0.2	1.25±0.2	
68 nF	47										
100 nF	49										
150 nF	52		1.25±0.2								
220 nF	54							1.25±0.2			
330 nF	56										
470 nF	58		1.6±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 order

**CAPACITANCE RANGE & THICKNESS FOR X7R**

**Table 13** Sizes from 1808 to 1812

CAP.	Last 2-digit of 12NC	1808				1812				
		100 V	200 V	250 V	500 V	100 V	200 V	250 V	500 V	630 V
100 pF	09									
150 pF	12									
220 pF	14									
330 pF	16									
470 pF	18									
680 pF	21									
1.0 nF	23									
1.5 nF	25									
2.2 nF	27									
3.3 nF	29									
4.7 nF	32									1.25±0.2
6.8 nF	34									
10 nF	36				1.25±0.2		0.85±0.1	0.85±0.1		
15 nF	38	1.25±0.2	1.25±0.2	1.25±0.2		0.85±0.1			1.25±0.2	
22 nF	41									
33 nF	43									1.6±0.2
47 nF	45									
68 nF	47									
100 nF	49						1.25±0.2	1.25±0.2		1.6±0.2
150 nF	52									
220 nF	54					1.25±0.2		1.6±0.2	1.6±0.2	
330 nF	56						2.0±0.2	2.0±0.2		
470 nF	58						1.6±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 order

**THICKNESS CLASSES AND PACKING QUANTITY**

Table 14

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
	0.8 / 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	---	---
	0.8 / 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	---	10,000	---
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	---	---	---
	2.5 ±0.2 mm	8 mm	---	1,000 500	---	---	---
1808	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	---	---	---
	2.0 ±0.2 mm	12 mm	---	2,000	---	---	---
1812	0.6 / 0.85 ±0.1 mm	12 mm	---	2,000	---	---	---
	1.15 ±0.1 mm	12 mm	---	1,500	---	---	---
	1.15 ±0.15 mm	12 mm	---	1,500	---	---	---
	1.25 ±0.2 mm	12 mm	---	1,000	---	---	---
	1.35 ±0.15 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	50,000	---	---	

ELECTRICAL CHARACTERISTICS

**NP0/X7R DIELECTRIC CAPACITORS; 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 15

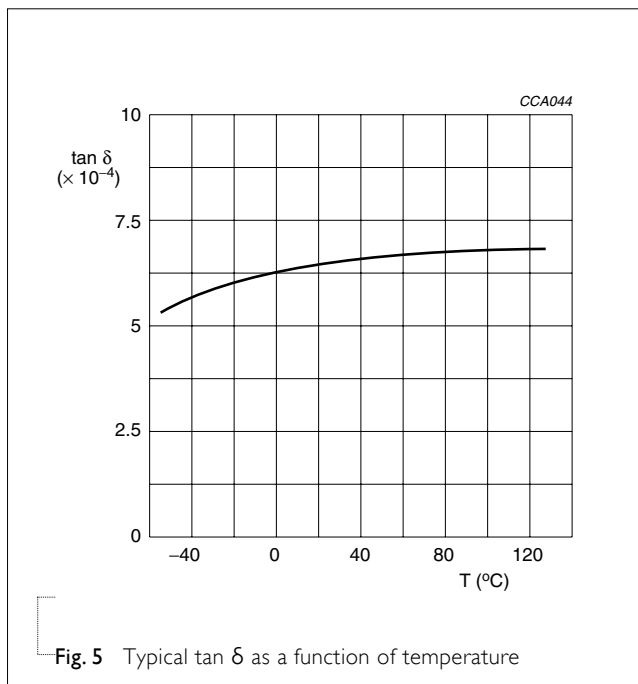
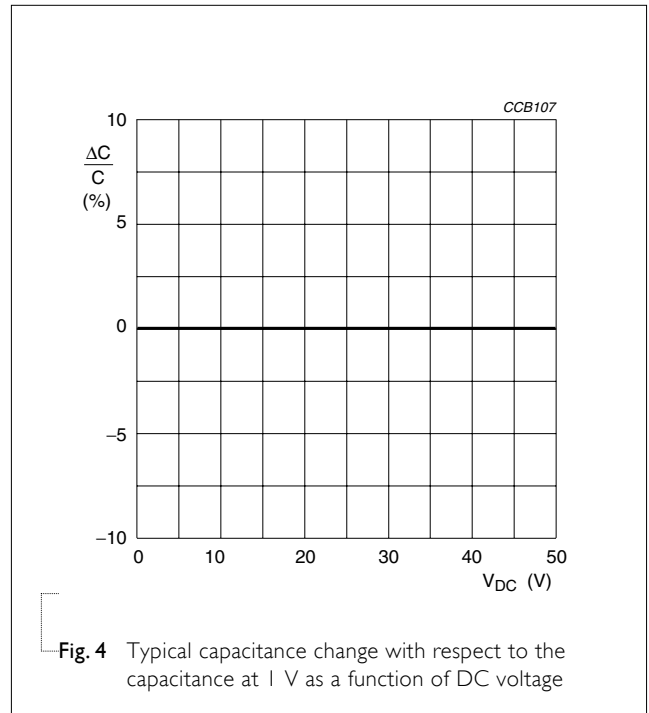
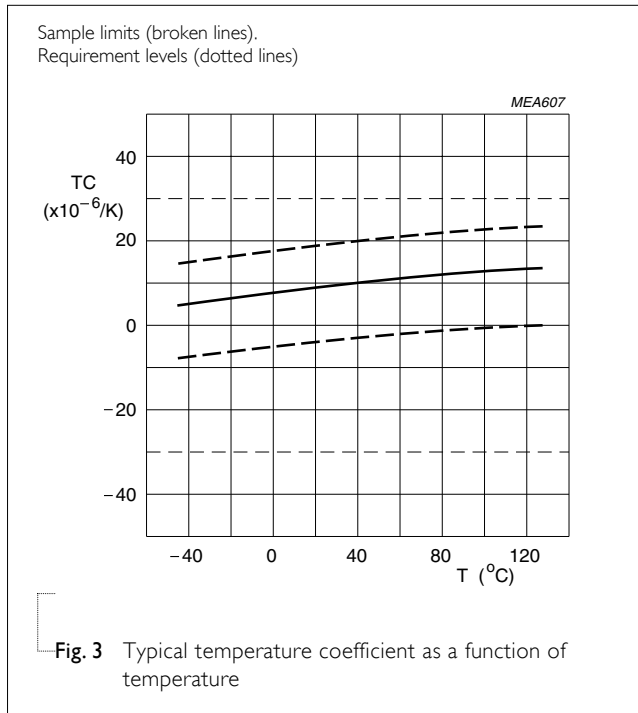
DESCRIPTION		VALUE
Capacitance range		0.47 pF to 470 nF
Capacitance tolerance		
NP0	C < 10 pF	±0.25 pF, ±0.5 pF
	C ≥ 10 pF	±2%, ±5%
X7R		±5% <sup>(1)</sup> , ±10%
Dissipation factor (D.F.)		
NP0	C < 30 pF	≤ 1 / ( 400 + 20C )
	C ≥ 30 pF	≤ 0.1 %
X7R		≤ 2.5 %
Insulation resistance after 1 minute at U <sub>r</sub> (DC)		R <sub>ins</sub> ≥ 10 GΩ or R <sub>ins</sub> × C ≥ 500 seconds whichever is less
Maximum capacitance change as a function of temperature (temperature characteristic/coefficient):		
NP0		±30 ppm/°C
X7R		±15%
Operating temperature range:		
NP0/X7R		-55 °C to +125 °C

**NOTE**

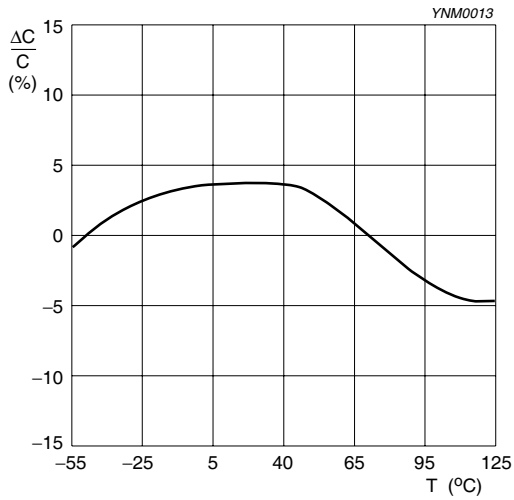
1. Capacitance tolerance ±5% doesn't available for X7R full product range, please contact local sales force before order



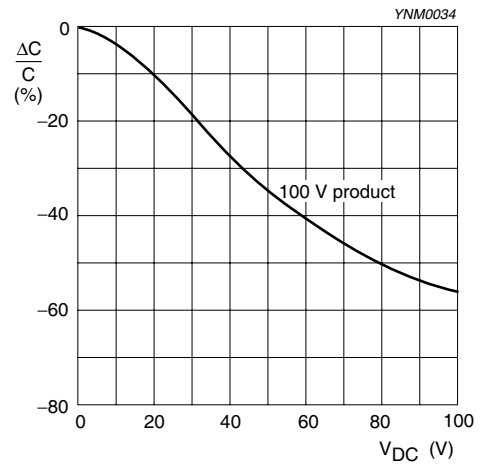
**MID-VOLTAGE NP0**



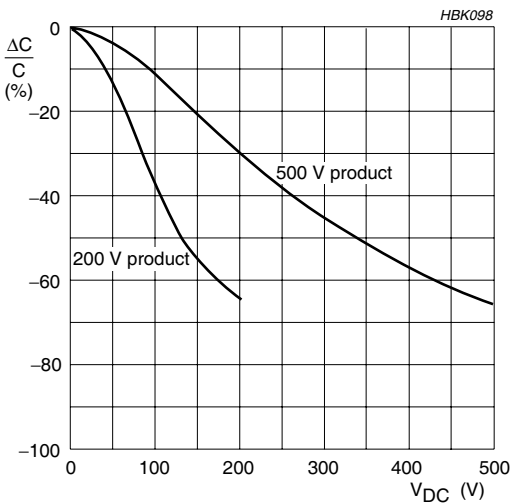
**MID-VOLTAGE X7R**



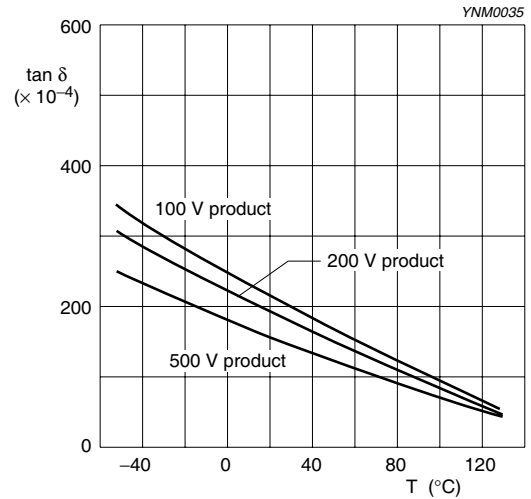
**Fig. 6** Typical capacitance change as a function of temperature



**Fig. 7** Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage at 20 °C



**Fig. 8** Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage at 20 °C



**Fig. 9** Typical tan δ as a function of temperature

**SOLDERING RECOMMENDATION**

Table 16

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

**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 × 10 magnification	In accordance with specification
Capacitance	4.5.1	Class 1: f = 1 MHz for C ≤ 1 nF, measuring at voltage   V <sub>rms</sub> at 20 °C f = 1 KHz for C > 1 nF, measuring at voltage   V <sub>rms</sub> at 20 °C Class 2: f = 1 KHz for C ≤ 10 μF, measuring at voltage   V <sub>rms</sub> at 20 °C	Within specified tolerance
Dissipation factor (D.F.)	4.5.2	Class 1: f = 1 MHz for C ≤ 1 nF, measuring at voltage   V <sub>rms</sub> at 20 °C f = 1 KHz for C > 1 nF, measuring at voltage   V <sub>rms</sub> at 20 °C Class 2: f = 1 KHz for C ≤ 10 μF, measuring at voltage   V <sub>rms</sub> 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
Temperature coefficient	4.6	Class 1: Between minimum and maximum temperature NP0: -55 °C to +125 °C Normal Temperature: 20 °C	ΔC/C: Class 1: NP0: ±30 ppm/°C
Temperature characteristic		Class 2: Between minimum and maximum temperature X7R: -55 °C to +125 °C Normal Temperature: 20 °C	Class 2 X7R: ±15%

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Adhesion	IEC 60384-21/22 4.7	A force applied for 10 seconds to the line joining the terminations and in a plane parallel to the substrate	Force size $\geq$ 0603: 5N
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  $\Delta C/C$ Class 1: NP0: within $\pm 1\%$ or 0.5 pF, whichever is greater Class2: X7R: $\pm 10\%$
Resistance to soldering heat	4.9	Precondition: 150 $\pm 10$ °C for 1 hour, then keep for 24 $\pm$ 1 hours at room temperature Preheating: for size $\leq$ 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 $\pm$ 5 °C Dipping time: 10 $\pm$ 0.5 seconds Recovery time: 24 $\pm$ 2 hours	Dissolution of the end face plating shall not exceed 25% of the length of the edge concerned  $\Delta C/C$ Class 1: NP0: within $\pm 0.5\%$ or 0.5 pF, whichever is greater Class2: X7R: $\pm 10\%$  D.F. within initial specified value $R_{ins}$ within initial specified value
Solderability	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 $\pm$ 5 °C Dipping time: 2 $\pm$ 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 $\pm$ 5 °C Dipping time: 3 $\pm$ 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	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><math>\Delta C/C</math> Class 1: NP0: within ± 1% or 1 pF, whichever is greater Class2: X7R: ± 15%</p> <hr/> <p>D.F. meet initial specified value <math>R_{ins}</math> meet initial specified value</p>
Damp heat	4.13	<ol style="list-style-type: none"> <li>Preconditioning, class 2 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, IR</li> <li>Damp heat test: 500 ± 12 hours at 40 ± 2 °C; 90 to 95% R.H.</li> <li>Recovery: Class 1: 6 to 24 hours Class 2: 24 ± 2 hours</li> <li>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 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 1: NP0: within ± 2% or 1 pF, whichever is greater Class2: X7R: ± 15%</p> <p>D.F. Class 1: NP0: <math>\leq 2 \times</math> specified value Class2: X7R: <math>\geq 25 V: \leq 5\%</math></p> <p><math>R_{ins}</math> Class 1: NP0: <math>\geq 2,500 M\Omega</math> or <math>R_{ins} \times C_r \geq 25s</math> whichever is less Class2: X7R: <math>\geq 500 M\Omega</math> or <math>R_{ins} \times C_r \geq 25s</math> whichever is less</p>

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
<b>Endurance</b>	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 initial spec C, D, IR</li> <li>3. Endurance test: Temperature: NP0/X7R: 125 °C Specified stress voltage applied for 1,000 hours: High voltage series follows with below stress condition: Applied 2.0 × U<sub>r</sub> for &lt; 500 V series Applied 1.3 × U<sub>r</sub> for 500 V, 630 V series Applied 1.2 × U<sub>r</sub> for 1 KV, 2 KV, 3 KV series</li> <li>4. Recovery time: 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 precondition according to "IEC 60384 4.1" and then the requirement shall be met.</p>	<p>No visual damage</p> <hr/> <p>ΔC/C</p> <p><b>Class1:</b> NP0: within ±2% or 1 pF, whichever is greater</p> <p><b>Class2:</b> X7R: ±15%</p> <p>D.F.</p> <p><b>Class1:</b> NP0: ≤ 2 × specified value</p> <p><b>Class2:</b> X7R: ≥ 25 V: ≤ 5%</p> <p>R<sub>ins</sub></p> <p><b>Class1:</b> NP0: ≥ 4,000 MΩ or R<sub>ins</sub> × C<sub>r</sub> ≥ 40s whichever is less</p> <p><b>Class2:</b> X7R: ≥ 1,000 MΩ or R<sub>ins</sub> × C<sub>r</sub> ≥ 50s whichever is less</p>
<b>Voltage proof</b>	IEC 60384-1 4.6	<p>Specified stress voltage applied for 1 minute</p> <p>U<sub>r</sub> ≤ 100 V: series applied 2.5 U<sub>r</sub></p> <p>100 V &lt; U<sub>r</sub> ≤ 200 V series applied (1.5 U<sub>r</sub> + 100)</p> <p>200 V &lt; U<sub>r</sub> ≤ 500 V series applied (1.3 U<sub>r</sub> + 100)</p> <p>U<sub>r</sub> &gt; 500 V: 1.3 U<sub>r</sub></p> <p>I: 7.5 mA</p>	No breakdown or flashover

**REVISION HISTORY**

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 3	Mar 25, 2010	-	- Product range update
Version 2	Mar 15, 2010	-	- Product range update
Version 1	Oct 30, 2009	-	- Change to dual brand datasheet that describe Mid-voltage NP0/X7R series with RoHS compliant - Replace the "100V to 630V" part of pdf files: UP-NP0X7R_MV_100-to-500V_0, UY-NP0X7R_MV_100-to-500V_0, NP0_16V-to-100V_6, NP0_50-to-500V_10, X7R_16-to-500V_9 and X7R_16V-to-100V_9 - Define global part number - Description of "Halogen Free compliant" added - Test method and procedure updated
Version 0	Sep 08, 2005	-	- New