Innovative Service Around the Globe YAGEO

DATA SHEET

SURFACE-MOUNT CERAMIC MULTILAYER CAPACITORS

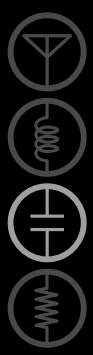
High-Voltage

NP0/X7R

1 KV TO 3 KV

0.47 pF to 33 nF

RoHS compliant & Halogen Free



YAGEO Phicomp

Product Specification – August 08, 2011 V.4

SCOPE

This specification describes High-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 & 12NC

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)

(1) SIZE – INCH BASED (METRIC)

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

(2) TOLERANCE

C = ±0.25 pF

D = ±0.5 pF

G = ±2%

J = ±5%

K = ±10%

(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) TC MATERIAL

NPO

X7R

(5) RATED VOLTAGE

C = 1 KV

D = 2 KV

E = 3 KV

(6) PROCESS

N = NP0

B = Class 2 MLCC

(7) CAPACITANCE VALUE

2 significant digits+number of zeros

The 3rd digit signifies the multiplying factor, and letter R is decimal point

Example: 121 = 12×10^1 = 120 pF

PHYCOMP BRAND ordering codes

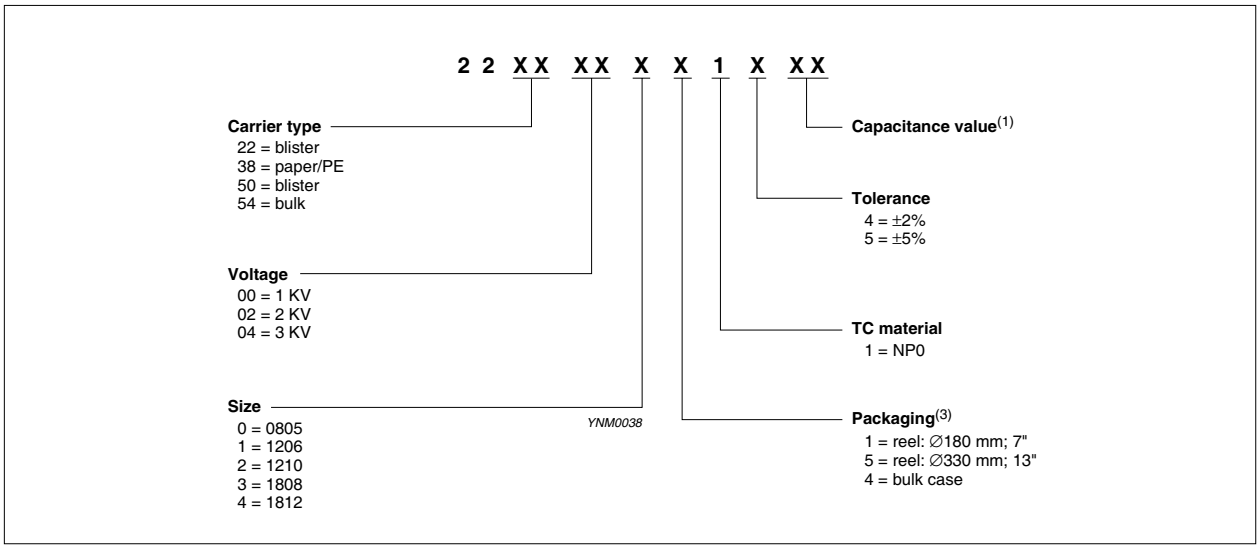
GLOBAL PART NUMBER (preferred), PHYCOMP CTC (for North America) and 12NC (traditional) codes are acceptable to order Phycomp brand products.

GLOBAL PART NUMBER (PREFERRED)

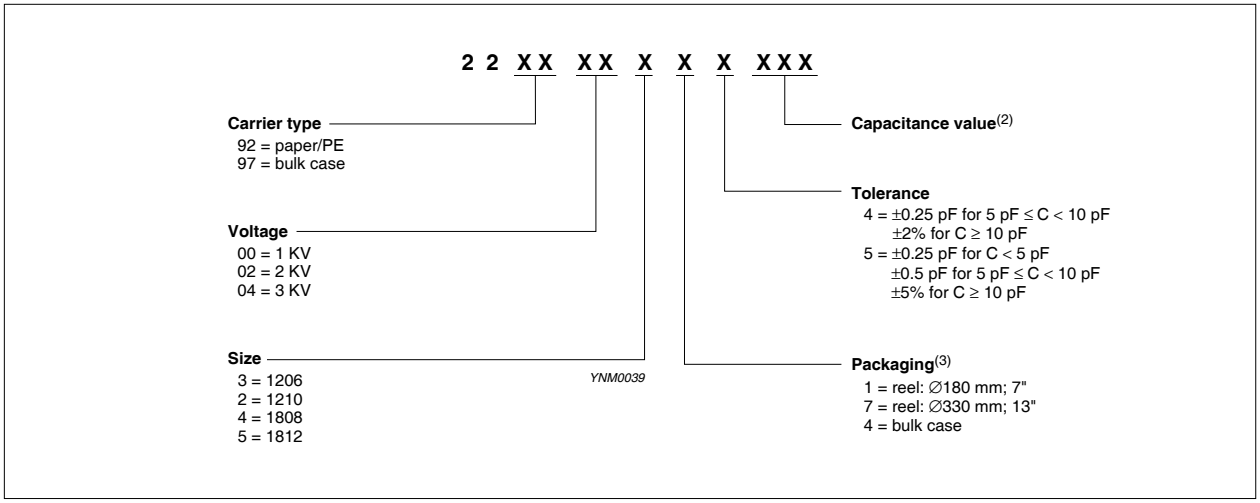
For detailed information of GLOBAL PART NUMBER and ordering example, please refer to page 2.

12NC CODE

Ordering information for NP0 1 KV to 3 KV, C ≥ 10 pF



Ordering information for NP0 1 KV to 3 KV, C < 10 pF

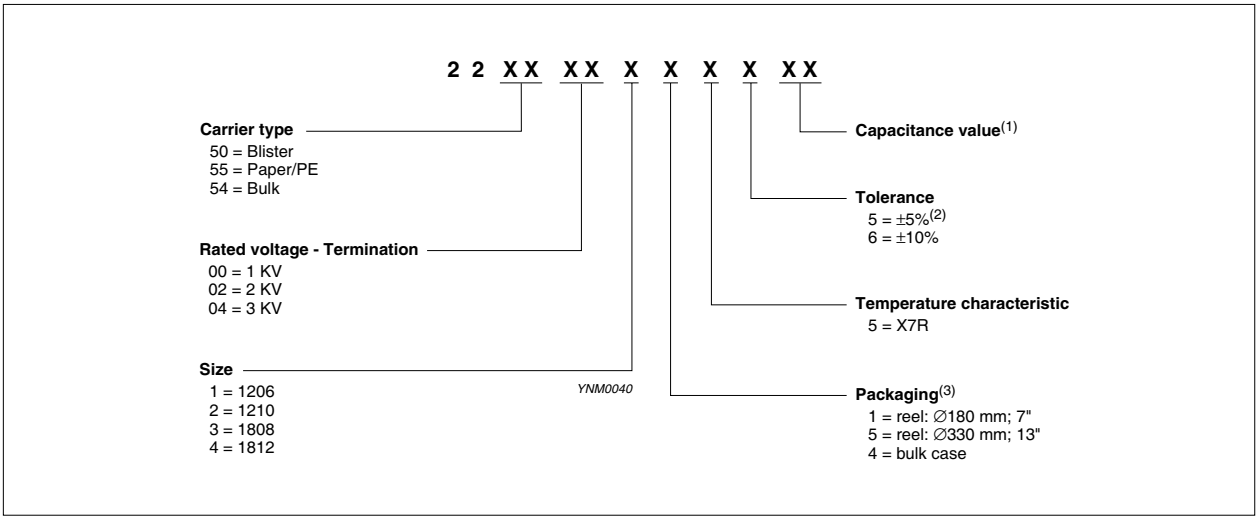


(1) Please refer to "Last 2-digit of 12NC" in "CAPACITANCE RANGE & THICKNESS FOR NP0"

(2) Please refer to "Last 3-digit of 12NC" in "CAPACITANCE RANGE & THICKNESS FOR NP0"

(3) Quantity on reel depends on thickness classification; see table 5

Ordering information for X7R 1 KV to 3 KV



(1) Please refer to "Last 2-digit of 12NC" in "CAPACITANCE RANGE & THICKNESS FOR X7R"

(2) Tolerance ±5% is not available for full product range, please contact local sales force before ordering

(3) Quantity on reel depends on thickness classification; see table 5

PHYCOMP CTC CODE (FOR NORTH AMERICA)

Example: 12102R102KFBB00

1210	2R	102	K	F	B	B	0	0
Size code	Temp. Char.	Capacitance in pF	Tolerance	Voltage	Termination	Packing	Marking	Range identifier
0805 1206 1210 1808 1812	CG = NP0 2R = X7R	101 = 100 pF; the third digit signifies the multiplying factor: 8 = × 0.01 9 = × 0.1 0 = × 1 1 = × 10 2 = × 100 3 = × 1,000	C = ±0.25 pF D = ±0.5 pF G = ±2% J = ±5% K = ±10%	E = 1 KV F = 2 KV G = 3 KV	B = NiSn	2 = 180 mm 7" Paper/PE 3 = 330 mm 13" Paper/PE B = 180 mm 7" Blister F = 330 mm 13" Blister P = Bulk case	0 = no marking	0 = conv. Ceramic D = Class 2 MLCC

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.

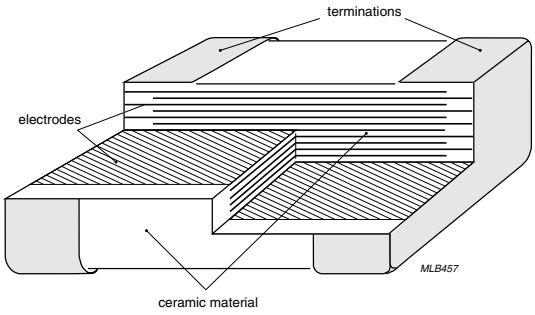


Fig. 1 Surface mounted multilayer ceramic capacitor construction

DIMENSION

Table 1 For outlines see fig. 2

TYPE	L_1 (mm)	W (mm)	T (MM)	L_2 / L_3 (mm)		L_4 (mm)
				min.	max.	min.
0805	2.0 ±0.20	1.25 ±0.20	Refer to table 2 to 4	0.25	0.75	0.55
1206	3.2 ±0.30	1.6 ±0.20		0.25	0.75	1.40
1210	3.2 ±0.30	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 1

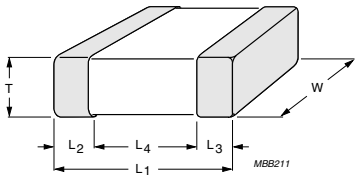


Fig. 2 Surface mounted multilayer ceramic capacitor dimension

CAPACITANCE RANGE & THICKNESS FOR NP0

Table 2 Sizes from 1206 to 1808

CAP.	Last 3-digit of 12NC	1206		1210		1808		
		1 KV	2 KV	1 KV	2 KV	1 KV	2 KV	3 KV
0.47 pF	477	0.85±0.1	0.85±0.1	1.25±0.2	1.25±0.2	1.25±0.2	1.25±0.2	1.6±0.2
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							

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 3 Sizes from 0805 to 1812

CAP.	Last 2-digit of 12NC	0805	1206		1210		1808			1812		
		1 KV	1 KV	2 KV	1 KV	2 KV	1 KV	2 KV	3 KV	1 KV	2 KV	3 KV
10 pF	23	1.0±0.1	1.25±0.2	1.25±0.2	1.25±0.2	1.25±0.2	1.25±0.2	1.25±0.2	1.6±0.2	1.25±0.2	1.25±0.2	1.25±0.2
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											
100 pF	36											
120 pF	37											
150 pF	38											
180 pF	39											
220 pF	41											
270 pF	42											
330 pF	43											
390 pF	44											
470 pF	45											
560 pF	46											
680 pF	47											
820 pF	48											
1.0 nF	49											
1.2 nF	51											
1.5 nF	52											
1.8 nF	53											
2.2 nF	54											
2.7 nF	55											
3.3 nF	56											

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 4 Sizes from 0805 to 1812

CAP.	Last 2-digit of 12NC	0805	1206		1210		1808			1812		
		1 KV	1 KV	2 KV	1 KV	2 KV	1 KV	2 KV	3 KV	1 KV	2 KV	3 KV
100 pF	09		1.25±0.2									
150 pF	12								1.6±0.2			
220 pF	14			1.25±0.2								
330 pF	16							1.35±0.15				
470 pF	18						1.35±0.15					
680 pF	21											
1.0 nF	23				1.25±0.2	1.25±0.2			2.0±0.2	1.35±0.15	1.35±0.15	1.6±0.2
1.5 nF	25											2.0±0.2
2.2 nF	27					1.6±0.2		1.6±0.2				
3.3 nF	29											
4.7 nF	32											
6.8 nF	34						1.6±0.2				1.6±0.2	
10 nF	36										2.0±0.2	
15 nF	38											
22 nF	41				1.6±0.2							
33 nF	43				2.0±0.2					1.6±0.2		
47 nF	45											
68 nF	47											
100 nF	49											

NOTE

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

THICKNESS CLASSES AND PACKING QUANTITY

Table 5

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
	1.00 ±0.1 mm	8 mm	---	3,000	---	10,000	---
	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	---	1,000	---	---	---
	1.15 ±0.15 mm	12 mm	---	1,000	---	---	---
	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	---	---	---

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 6

DESCRIPTION		VALUE
Capacitance range		0.47 pF to 33 nF
Capacitance tolerance		
NP0	C < 10 pF	±0.25 pF, ±0.5 pF
	C ≥ 10 pF	±2%, ±5%
X7R		±5% (1), ±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_r (DC)		R_{ins} ≥ 10 GΩ or R_{ins} × 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. ±5% tolerance of capacitance value isn't available for X7R full product range, please contact local sales force before ordering

HIGH-VOLTAGE NP0

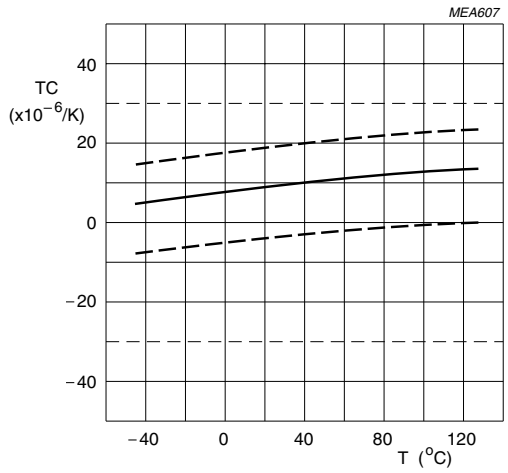


Fig. 3 Typical temperature coefficient as a function of temperature

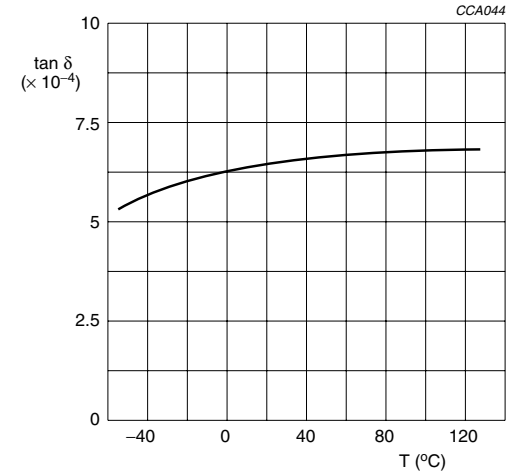


Fig. 4 Typical tan δ as a function of temperature

HIGH-VOLTAGE X7R

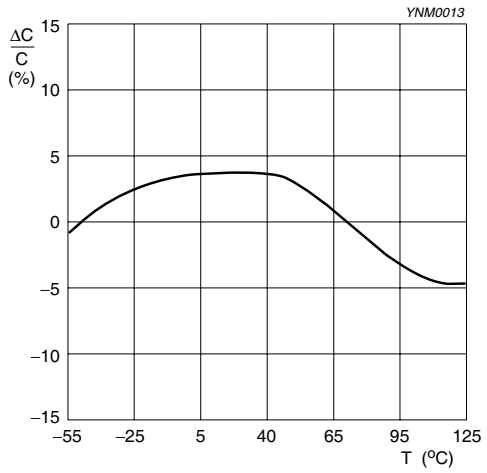


Fig. 5 Typical capacitance change as a function of temperature

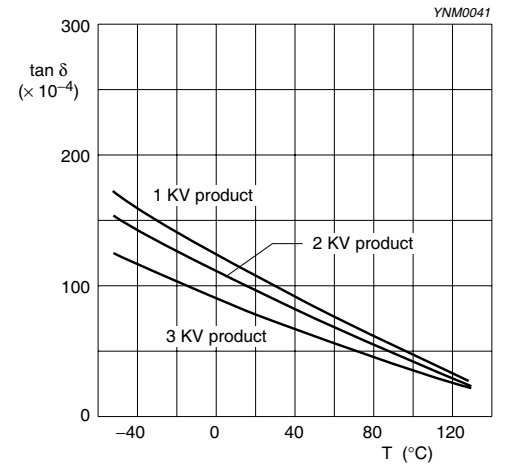


Fig. 6 Typical tan δ as a function of temperature

SOLDERING RECOMMENDATION

Table 7

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 8 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 1 V_{rms} at 20 °C f = 1 KHz for C > 1 nF, measuring at voltage 1 V_{rms} at 20 °C Class 2: f = 1 KHz for C ≤ 10 µF, measuring at voltage 1 V_{rms} 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 1 V_{rms} at 20 °C f = 1 KHz for C > 1 nF, measuring at voltage 1 V_{rms} at 20 °C Class 2: f = 1 KHz for C ≤ 10 µF, measuring at voltage 1 V_{rms} at 20 °C	In accordance with specification
Insulation Resistance		4.5.3	U_r ≤ 500 V: At Ur for 1 minute U_r > 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 ≥ 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 ΔC/C Class 1: NP0: within ±1% or 0.5 pF, whichever is greater Class2: 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 1: NP0: within ±0.5% or 0.5 pF, whichever is greater Class2: X7R: ±10% D.F. within initial specified value R_{ins} within initial specified value
Solderability	4.10	Preheated to a 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 lead-free 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	IEC 60384-21/22 4.11	Preconditioning; 150 +0/–10 °C for 1 hour, then keep for 24 ±1 hours at room temperature 5 cycles with following detail: 30 minutes at lower category temperature 30 minutes at upper category temperature Recovery time 24 ±2 hours	No visual damage ΔC/C Class 1: NP0: within ±1% or 1 pF, whichever is greater Class2: X7R: ±15% D.F. meet initial specified value R_{ins} meet initial specified value
Damp Heat	4.13	1. Preconditioning, class 2 only: 150 +0/-10 °C /1 hour, then keep for 24 ±1 hour at room temp 2. Initial measure: Spec: refer to initial spec C, D, IR 3. Damp heat test: 500 ±12 hours at 40 ±2 °C; 90 to 95% R.H. 4. Recovery: Class 1: 6 to 24 hours Class 2: 24 ±2 hours 5. Final measure: C, D, IR 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 requirement shall be met.	No visual damage after recovery ΔC/C Class 1: NP0: within ±2% or 1 pF, whichever is greater Class2: X7R: ±15% D.F. Class 1: NP0: ≤ 2 x specified value Class2: X7R: ≥ 25 V: ≤ 5% R_{ins} Class 1: NP0: ≥ 2,500 MΩ or $R_{ins} \times C_r \geq 25s$ whichever is less Class2: X7R: ≥ 500 MΩ or $R_{ins} \times C_r \geq 25s$ whichever is less

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Endurance	IEC 60384-21/22 4.14	1. Preconditioning, class 2 only: 150 +0/-10 °C /1 hour, then keep for 24 ±1 hour at room temp 2. Initial measure: Spec: refer to initial spec C, D, IR 3. Endurance test: Temperature: NP0/X7R: 125 °C Specified stress voltage applied for 1,000 hours. High-Voltage series follows the stress conditions below: Applied 2.0 x U_r for < 500 V series Applied 1.3 x U_r for 500 V, 630 V series Applied 1.2 x U_r for 1 KV, 2 KV, 3 KV series 4. Recovery time: 24 ±2 hours 5. Final measure: C, D, IR 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 requirement shall be met.	No visual damage ΔC/C Class1: NP0: within ±2% or 1 pF, whichever is greater Class2: X7R: ±15% D.F. Class1: NP0: ≤ 2 x specified value Class2: X7R: ≥ 25 V: ≤ 5% R_{ins} Class1: NP0: ≥ 4,000 MΩ or $R_{ins} \times C_r \geq$ 40s whichever is less Class2: X7R: ≥ 1,000 MΩ or $R_{ins} \times C_r \geq$ 50s whichever is less
Voltage Proof	IEC 60384-1 4.6	Specified stress voltage applied for 1 minute $U_r \leq$ 100 V: series applied 2.5 U_r 100 V < $U_r \leq$ 200 V series applied (1.5 U_r + 100) 200 V < $U_r \leq$ 500 V series applied (1.3 U_r + 100) U_r > 500 V: 1.3 U_r I: 7.5 mA	No breakdown or flashover

REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 4	Aug 08, 2011	-	- Product range updated
Version 3	Jan 19, 2011	-	- Dimension updated - Add NP0 0805 1KV
Version 2	Feb 02, 2010	-	- Change to dual brand datasheet that describe High-Voltage NP0/X7R series with RoHS compliant - Replace the high voltage part of pdf files: UP-NP0X7R_HV_1K-to-4KV_1 and UY-NP0X7R_HV_1K-to-4KV_1 - Description of "Halogen Free compliant" added - Product range updated - Define global part number - Test method and procedure updated
Version 1	Sep 30, 2005	-	- Thickness revised
Version 0	Sep 12, 2005	-	- New