

DATA SHEET

SURFACE-MOUNT CERAMIC MULTILAYER CAPACITORS

High-Voltage NP0/X7R

> I KV TO 3 KV I0 pF to 33 nF

RoHS compliant & Halogen Free



YAGEO Phícomp



Surface-Mount Ceramic Multilayer Capacitors High-Voltage

NP0/X7R 1 KV to 3 KV

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 <u>xxxx x x xxx x</u> B <u>x xxx</u> (2) (3) (4) (5)

(I) SIZE - INCH BASED (METRIC)

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

(2) TOLERANCE

 $C = \pm 0.25 pF$

 $D = \pm 0.5 pF$

 $G = \pm 2\%$

 $| = \pm 5\%$

 $K = \pm 10\%$

 $M = \pm 20\%$

(3) PACKING STYLE

R = Paper/PE taping reel; Reel 7 inch

K = Blister taping reel; Reel 7 inch

P = Paper/PE taping reel; Reel 13 inch

F = Blister taping reel; Reel 13 inch

C = Bulk case

(4) TC MATERIAL

NPO

X7R

(5) RATED VOLTAGE

C = I KV

D = 2 KV

S = 2.5KV

E = 3 KV

(6) PROCESS

N = NP0

B = Class 2 MLCC

(7) CAPACITANCE VALUE

2 significant digits+number of zeros

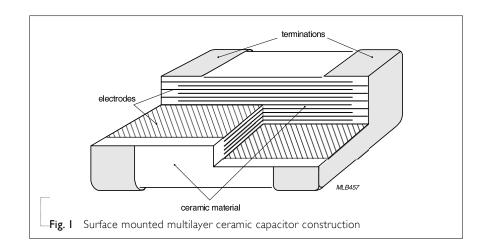
The 3rd digit signifies the multiplying factor, and letter R is decimal point

Example: $121 = 12 \times 10^{1} = 120 \text{ pF}$

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. I.

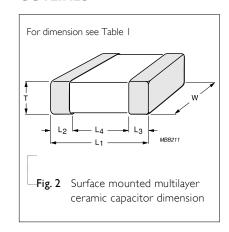


DIMENSION

Table I For outlines see fig. 2

TYPE	l (mm)	\\/ (mm)	T (MM)		(mm)	L ₄ (mm)
1111	PE L _I (mm) W (mm)		1 (11111)	min.	max.	min.
0805	2.0 ±0.20	1.25 ±0.20	_	0.25	0.75	0.70
1206	3.2 ±0.30	1.6 ±0.20	_	0.25	0.75	1.40
1210	3.2 ±0.30	2.5 ±0.20	Refer to table 2 to 4	0.25	0.75	1.40
1808	4.5 ±0.40	2.0 ±0.30	14516 2 10 1	0.25	0.75	2.20
1812	4.5 ±0.40	3.2 ±0.20		0.25	0.75	2.20

OUTLINES





<u>4</u>

Surface-Mount Ceramic Multilayer Capacitors High-Voltage NP0/X7R 1 KV to 3 KV

CAPACITANCE RANGE & THICKNESS FOR NPO

ı		om 0805 to	o 1812				1808			1812		
CAP.	0805	1206	2 1/1/	2 1/1/	1210	2 1/1/		2 1/1/	2 1/1/		2 1/1/	2 1///
	I KV	I KV	2 KV	3 KV	I KV	2 KV	I KV	2 KV	3 KV	I KV	2 KV	3 KV
		1.25±0.2								1.25±0.2		
		1.25±0.2								1.25±0.2		
		1.25±0.2	1.25±0.2	1.25±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
		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
27 pF	0.85±0.1	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
33 pF	0.85±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	1.25±0.2	1.6±0.2	1.25±0.2	1.25±0.2	1.25±0.2
39 pF	0.85±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	1.25±0.2	1.6±0.2	1.25±0.2	1.25±0.2	1.25±0.2
47 pF	0.85±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	1.25±0.2	1.6±0.2	1.25±0.2	1.25±0.2	1.25±0.2
56 pF		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
68 pF		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
82 pF		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
100 pF		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
120 pF		1.25±0.2	1.25±0.2		1.25±0.2	1.25±0.2	1.25±0.2	1.25±0.2		1.25±0.2	1.25±0.2	1.25±0.2
150 pF		1.25±0.2	1.25±0.2		1.25±0.2	1.25±0.2	1.25±0.2	1.25±0.2		1.25±0.2	1.25±0.2	1.25±0.2
180 pF		1.25±0.2	1.25±0.2		1.25±0.2	1.25±0.2	1.25±0.2	1.25±0.2		1.25±0.2	1.25±0.2	1.25±0.2
220 pF		1.25±0.2	1.25±0.2		1.25±0.2	1.25±0.2	1.25±0.2	1.25±0.2		1.25±0.2	1.25±0.2	1.25±0.2
270 pF		1.25±0.2			1.25±0.2		1.25±0.2	1.25±0.2		1.25±0.2	1.25±0.2	
330 pF		1.25±0.2			1.25±0.2		1.25±0.2	1.25±0.2		1.25±0.2	1.25±0.2	
390 pF		1.25±0.2			1.25±0.2		1.25±0.2	1.25±0.2		1.25±0.2	1.25±0.2	
470 pF		1.25±0.2			1.25±0.2		1.25±0.2	1.25±0.2		1.25±0.2	1.25±0.2	
560 pF		1.25±0.2			1.25±0.2		1.25±0.2	1.25±0.2		1.25±0.2	1.25±0.2	
680 pF		1.25±0.2			1.25±0.2		1.25±0.2			1.25±0.2	1.25±0.2	
820 pF		1.25±0.2			1.25±0.2					1.25±0.2	1.25±0.2	
I.O nF		1.25±0.2			1.25±0.2					1.25±0.2	1.25±0.2	
I.2 nF										1.25±0.2		
1.5 nF										1.25±0.2		
I.8 nF												
2.2 nF												
2.7 nF												
3.3 nF												

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	3 Sizes fr	om 0805 t	:0 1812									
CAP.	0805	1206			1210		1808			1812		
	I KV	I KV	2 KV	2.5KV	I KV	2 KV	I KV	2 KV	3 KV	I KV	2 KV	3 KV
100 pF												
150 pF	0.85±0.1								1.6±0.2			
220 pF	0.85±0.1	1.25±0.2	1.25±0.2		1.25±0.2	1.25±0.2			1.6±0.2			
330 pF	0.85±0.1	1.25±0.2	1.25±0.2		1.25±0.2	1.25±0.2		1.35±0.15	1.6±0.2			
470 pF	0.85±0.1	1.25±0.2	1.25±0.2		1.25±0.2	1.25±0.2	1.35±0.15	1.35±0.15	1.6±0.2			
680 pF	0.85±0.1	1.25±0.2	1.25±0.2		1.25±0.2	1.25±0.2	1.35±0.15	1.35±0.15	1.6±0.2			
1.0 nF	0.85±0.1	1.25±0.2	1.25±0.2	1.6±0.2	1.25±0.2	1.25±0.2	1.35±0.15	1.35±0.15	2.0±0.2	1.35±0.15	1.35±0.15	1.6±0.2
1.5 nF		1.25±0.2	1.25±0.2		1.25±0.2	1.25±0.2	1.35±0.15	1.35±0.15	2.0±0.2	1.35±0.15	1.35±0.15	
2.2 nF		1.25±0.2			1.25±0.2	1.60±0.2	1.35±0.15	1.6±0.2		1.35±0.15	1.35±0.15	
3.3 nF		1.25±0.2			1.25±0.2		1.35±0.15			1.35±0.15	1.35±0.15	
4.7 nF		1.25±0.2			1.25±0.2		1.35±0.15			1.35±0.15	1.35±0.15	
6.8 nF		1.25±0.2			1.25±0.2		1.6±0.2			1.35±0.15		
10 nF		1.25±0.2			1.25±0.2		1.6±0.2			1.35±0.15		
15 nF					1.25±0.2					1.35±0.15		
22 nF					1.6±0.2					1.35±0.15		
33 nF										1.6±0.2		
47 nF												
68 nF												
100 nF												

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

-	_			_
	la	h	le	5

SIZE	THICKNESS	TAPE WIDTH –	Ø180 MM	/ 7 INCH	Ø330 MM	/ 13 INCH	QUANTITY
CODE	CLASSIFICATION	QUANTITY PER REEL	Paper	Blister	Paper	Blister	PER BULK CASE
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
	0.6 ±0.1 mm	8 mm	4,000		20,000		10,000
0805	0.8 / 0.85 ±0.1 mm	8 mm	4,000		15,000		8,000
0803	1.00 ±0.1 mm	8 mm		3,000		10,000	
	1.25 ±0.2 mm	8 mm		3,000		10,000	5,000
	0.6 ±0.1 mm	8 mm	4,000		20,000		
	0.8 / 0.85 ±0.1 mm	8 mm	4,000		15,000		
1206	1.00 / 1.15 ±0.1 mm	8 mm		3,000		10,000	
1200	1.25 ±0.2 mm	8 mm		3,000		10,000	
	1.6 ±0.15 mm	8 mm		2,500		10,000	
	1.6 ±0.2 mm	8 mm		2,000		8,000	
	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			
1210	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			
	1.15 ±0.15 mm	I2 mm		3,000			
	1.25 ±0.2 mm	I2 mm		3,000			
1808 -	1.35 ±0.15 mm	I2 mm		2,000			
1000	1.5 ±0.1 mm	I2 mm		2,000			
_	1.6 ±0.2 mm	I2 mm		2,000			
	2.0 ±0.2 mm	12 mm		2,000			
_	0.6 / 0.85 ±0.1 mm	12 mm		2,000			
_	1.15 ±0.1 mm	12 mm		1,000			
_	1.15 ±0.15 mm	I2 mm		1,000			
_	1.25 ±0.2 mm	12 mm		1,000			
1812	1.35 ±0.15 mm	12 mm		1,000			
_	1.5 ±0.1 mm	I2 mm		1,000			
	1.6 ±0.2 mm	12 mm		1,000			
	2.0 ±0.2 mm	I2 mm		1,000			
	2.5 ±0.2 mm	I2 mm		500			



7 13

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	e 6				
DESCRI	PTION	VALUE			
Capacita	nce range	10 pF to 33 nF			
Capacita	nce tolerance				
NP0	C < 10 pF	±0.25 pF, ±0.5 pF			
	C ≥ 10 pF	±2%, ±5%			
X7R		±5% ⁽¹⁾ , ±10%			
Dissipation	on factor (D.F.)				
NP0	C < 30 pF	≤ I / (400 + 20C)			
	C ≥ 30 pF	≤ 0.1 %			
X7R		≤ 2.5 %			
Insulation	n resistance after I minute at U _r (DC)	$R_{ins} \ge 10 \text{ G}\Omega$ or $R_{ins} \times C \ge 500$ seconds whichever is less			
	n capacitance change as a function of temperature ature characteristic/coefficient):				
NP0		±30 ppm/°C			
X7R		±15%			
Operatin	ng temperature range:				
NP0/X	7R	–55 °C to +125 °C			

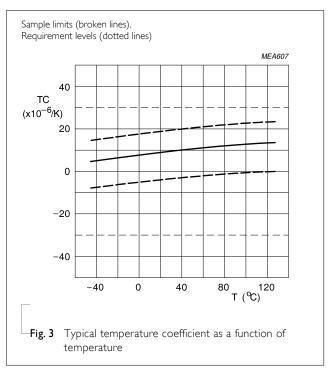
NOTE

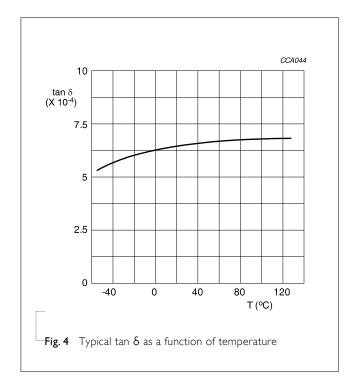
^{1. ±5%} tolerance of capacitance value isn't available for X7R full product range, please contact local sales force before ordering

8

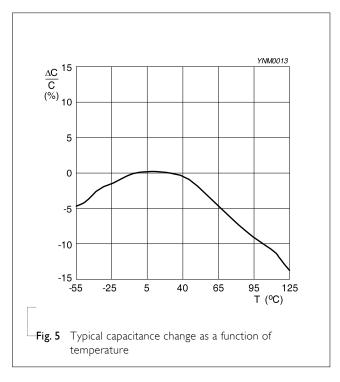
13

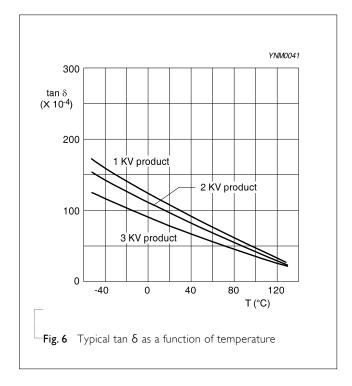
HIGH-VOLTAGE NP0





HIGH-VOLTAGE X7R





SOLDERING RECOMMENDATION

Table 7

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

TESTS AND REQUIREMENTS

Table 8 Test procedures and requirements

TEST	TEST MET	HOD	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: $f = 1 \text{ MHz for C} \le 1 \text{ nF, measuring at voltage I V}_{rms} \text{ at } 20 \text{ °C}$ $f = 1 \text{ KHz for C} > 1 \text{ nF, measuring at voltage I V}_{rms} \text{ at } 20 \text{ °C}$ Class 2: $f = 1 \text{ KHz for C} \le 10 \mu\text{F, measuring at voltage I V}_{rms} \text{ at } 20 \text{ °C}$	Within specified tolerance
Dissipation Factor (D.F.)		4.5.2	Class I: $f = 1 \text{ MHz for C} \le 1 \text{ nF} \text{ , measuring at voltage } 1 \text{ V}_{rms} \text{ at } 20 \text{ °C}$ $f = 1 \text{ KHz for C} > 1 \text{ nF, measuring at voltage } 1 \text{ V}_{rms} \text{ at } 20 \text{ °C}$ Class 2: $f = 1 \text{ KHz for C} \le 10 \mu\text{F, measuring at voltage } 1 \text{ V}_{rms} \text{ at } 20 \text{ °C}$	In accordance with specification
Insulation Resistance		4.5.3	$U_r \le 500 \text{ V: At Ur for I minute}$ $U_r > 500 \text{ V: At } 500 \text{ V for I minute}$	In accordance with specification

TEST TEST METHOD PROCEDURE

NP0/X7R 1 KV to 3 KV

Temperature Coefficient

4.6 Capacitance shall be measured by the steps shown in the following table.

> The capacitance change should be measured after 5 min at each specified temperature stage.

Step	Temperature(°C)
a	25±2
Ь	Lower temperature±3℃
С	25±2
d	Upper Temperature±2℃
е	25±2

(I) Class I

Temperature Coefficient shall be calculated from the formula as below

Temp, Coefficient =
$$\frac{C2 - C1}{C1 \times \Delta T} \times 10^6 \text{ [ppm/°C]}$$

C1: Capacitance at step c

C2: Capacitance at 125°C

 ΔT : 100°C(=125°C-25°C)

(2) Class II

Capacitance Change shall be calculated from the formula as below

$$\Delta C = \frac{C2 - C1}{C1} \times 100\%$$

CI: Capacitance at step c

C2: Capacitance at step b or d

REQUIREMENTS

<General purpose series>

Class I:

 Δ C/C: ± 30 ppm

Class2:

X7R: Δ C/C: $\pm 15\%$ Y5V: Δ C/C: 22~-82%

<High Capacitance series>

Class2:

 \times 7R/ \times 5R: Δ C/C: \pm 15% Y5V: Δ C/C: 22~-82%

Adhesion

21/22

IEC 60384-4.7 A force applied for 10 seconds to the line joining

the terminations and in a plane parallel to the

substrate

Force

size ≥ 0603: 5N

Bending

Strength

4.8 Mounting in accordance with IEC 60384-22 paragraph 4.3

> Conditions: bending I mm at a rate of I mm/s, radius jig 5 mm

No visible damage

 Δ C/C

Class I:

NP0: within $\pm 1\%$ or 0.5 pF, whichever is greater

Class2: X7R: ±10%

TEST	TEST METI	HOD	PROCEDURE	REQUIREMENTS
Resistance to Soldering Heat	4.9		Precondition: I50 +0/–I0 °C for I hour, then keep for 24 ±1 hours at room temperature Preheating: for size ≤ I206: I20 °C to I50 °C for I minute	Dissolution of the end face plating shall not exceed 25% of the length of the edge concerned
			Preheating: for size > 1206: 100 °C to 120 °C for I minute and 170 °C to 200 °C for I minute Solder bath temperature: 260 ±5 °C Dipping time: 10 ±0.5 seconds Recovery time: 24 ±2 hours	Δ 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 to a temperature of 80 °C to 140 °C and maintained for 30 seconds to 60 seconds.	The solder should cover over 95% of the critical area of each termination
			1. Temperature: $235\pm5^{\circ}$ C / Dipping time: 2 ± 0.5 s 2. Temperature: $245\pm5^{\circ}$ C / Dipping time: 3 ± 0.5 s (lead free)Depth of immersion: 10mm	
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	No visual damage ΔC/C Class I:
			5 cycles with following detail: 30 minutes at lower category temperature 30 minutes at upper category temperature	NP0: within $\pm 1\%$ or 1 pF, whichever is greater Class2: X7R: $\pm 15\%$
			Recovery time 24 ±2 hours	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	No visual damage after recovery
			24 ± I hour at room temp 2. Initial measure: Spec: refer to initial spec C, D, IR 3. Damp heat test: 500 ± I 2 hours at 40 ± 2 °C; 90 to 95% R.H. 4. Recovery: Class I: 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.	$\Delta C/C$ Class I: NP0: within ±2% or I pF, whichever is greater Class2: X7R: ±15% D.F. Class I: NP0: ≤ 2 × specified value Class2: X7R: ≥ 25 V: ≤ 5% R_{ins} Class I: NP0: ≥ 2,500 M Ω or R_{ins} × C_r ≥ 25s whichever is less Class2: X7R: ≥ 500 M Ω or R_{ins} × C_r ≥ 25s whichever is

TEST	TEST METH	HOD	PROCEDURE			REQUIREMENTS
Endurance	IEC 60384- 21/22	4.14	I. Preconditioni	ng, class 2 onl C/I hour, the		No visual damage
			24 ±1 hour at room temp			ΔC/C
			2. Initial measur	e:		Class I:
			Spec: refer to	initial spec C	, D, IR	NP0: within $\pm 2\%$ or 1 pF, whichever is greater
			Endurance te	st:		Class2:
			Temperature	: NP0/X7R: 12	25 °C	X7R: ±15%
					lied for 1,000 hours.	D.F.
				series follows	the stress conditions	Class I:
			below:			NP0: ≤ 2 × specified value
			Voltage	NPO	X7R	Class2:
			≤ 100V	2.0 × Ur	2.0 x Ur	X7R: ≥ 25 V: ≤ 5%
			200/250V	1.5 × Ur	1.5 x Ur	R _{ins}
			500/630V	1.3 x Ur	1.2 x Ur	Class I:
≥ IKV 1.2 x Ur 1.1 x U	I.I x Ur	NP0: $\geq 4,000 \text{ M}\Omega \text{ or}$				
			3. Recovery tim	e: 24 +2 hour	~	$R_{ins} \times C_r \ge 40s$ whichever is less Class2:
			4. Final measure		3	X7R: ≥ 1,000 MΩ or
			i, i i i ai i i i casar c	C, D, II ($R_{ins} \times C_r \ge 50s$ whichever is less
			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.			
Voltage Proof			Specified stress	voltage applie	d for 1~5 seconds	No breakdown or flashover
			Ur ≤ 100 V: se	ries applied 2.	5 Ur	
			100 V < Ur≤	200 V series a	pplied	
			(1.5 Ur + 100)			
			200 V < Ur ≤	500 V series a	pplied	
			(1.3 Ur + 100)			
			Ur > 500 V: 1.3	Ur		
			Ur≥ KV: 1.2 U	lr		
			Charge/Dischar	ge current less	than 50mA	

REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 11	Jul. 13, 2018	-	- Add NPO/1206/10pF to 47pF/3KV
Version 10	Mar. 7, 2017	-	- 0805 L4 spec updated
Version 9	Jan. 16, 2017	-	- Product range updated
Version 8	Oct. 12, 2015	-	- Product range updated
Version 7	May 21, 2014	-	- Product range updated
Version 6	Jun. 17, 2012	-	- Product range updated
Version 5	Sep 25, 2012	-	- Product range updated
Version 4	Aug 08, 2011	-	- Product range updated
Version 3	Jan 19, 2011	-	- Dimension updated
			- Add NP0 0805 IKV
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_IK-to-4KV_I and UY-NP0X7R_HV_IK-to-4KV_I
			- Description of "Halogen Free compliant" added
			- Product range updated
			- Define global part number
			- Test method and procedure updated
Version I	Sep 30, 2005	-	- Thickness revised

