

DATA SHEET

SURFACE-MOUNT CERAMIC MULTILAYER CAPACITORS

General purpose

Class 1, NPO

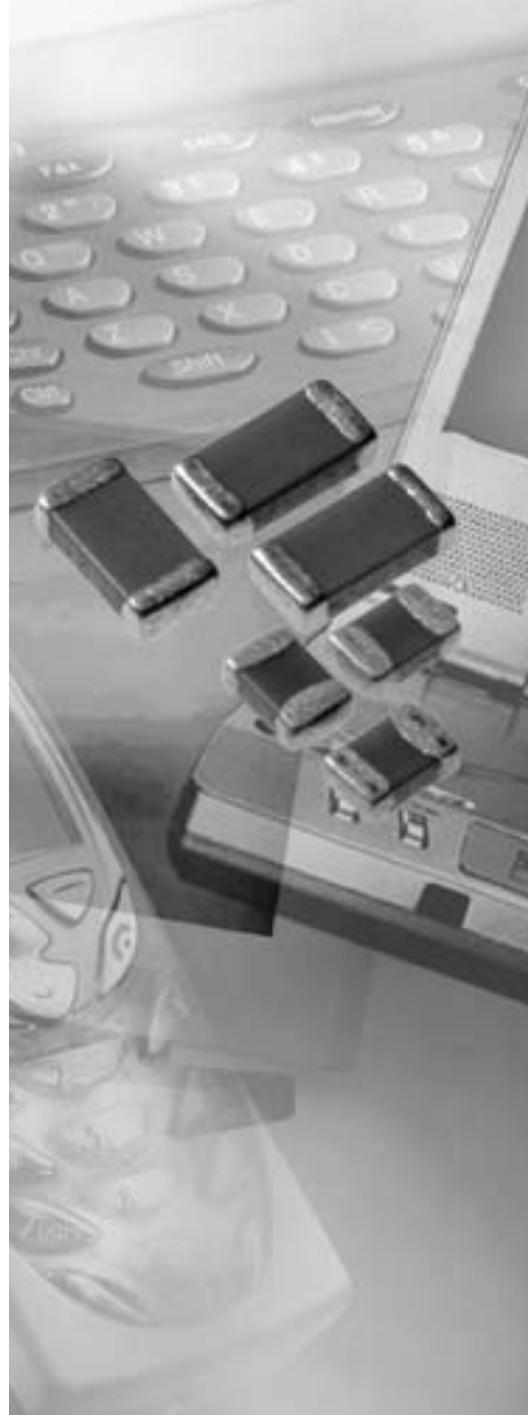
16 V TO 50 V

0.22 pF to 33 nF

RoHS compliant & Halogen Free



Product Specification – August 05, 2011 V.8



YAGEO
Phicomp

PHYCOMP BRAND ordering codes

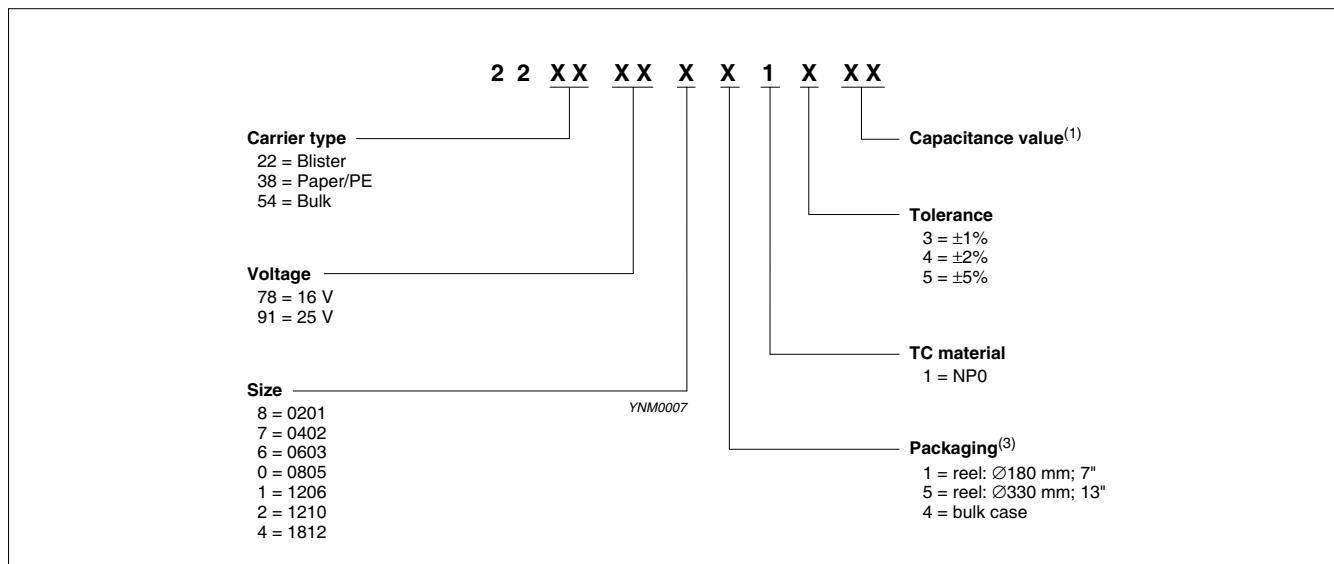
GLOBAL PART NUMBER (preferred), PHYCOMP CTC (for North America) and 12NC (traditional) codes are acceptable to order Phycomp brand products.

GLOBAL PART NUMBER (PREFERRED)

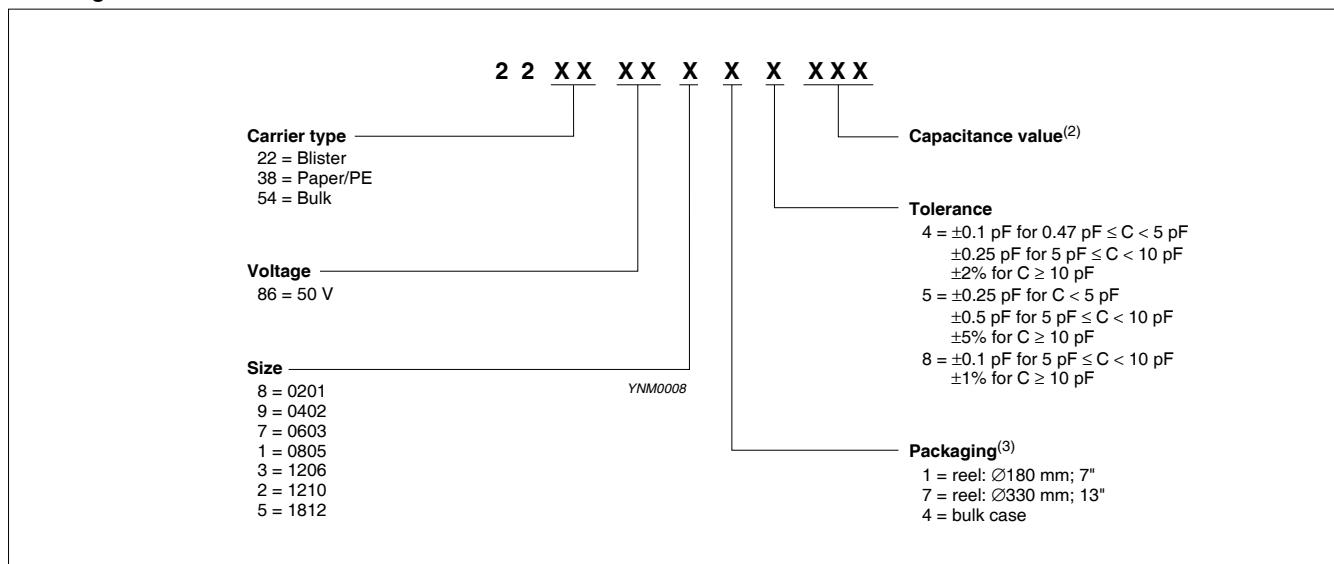
For detailed information of GLOBAL PART NUMBER and ordering example, please refer to page 2.

12NC CODE

Ordering information for 16 V to 25 V



Ordering information for 50 V



(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 6



PHYCOMP CTC CODE (FOR NORTH AMERICA)**Example: 0603CG271J7B200**

0603	CG	271	J	7	B	2	0	0
Size code	Temp. Char.	Capacitance in pF	Tolerance	Voltage	Termination	Packing	Marking	Range identifier
0201	CG = NP0	101 = 100 pF; the third digit signifies the multiplying factor:	B = ± 0.1 pF	7 = 16 V	B = NiSn	2 = 180 mm	0 = no marking	0 = conv. ceramic
0402			C = ± 0.25 pF	8 = 25 V		7" paper		
0603			D = ± 0.5 pF	9 = 50 V		3 = 330 mm		
0805			F = $\pm 1\%$			13" paper		
1206	0 = $\times 1$		G = $\pm 2\%$			B = 180 mm		
1210	I = $\times 10$		J = $\pm 5\%$			7" blister		
1812	2 = $\times 100$					F = 330 mm		
	3 = $\times 1,000$					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.

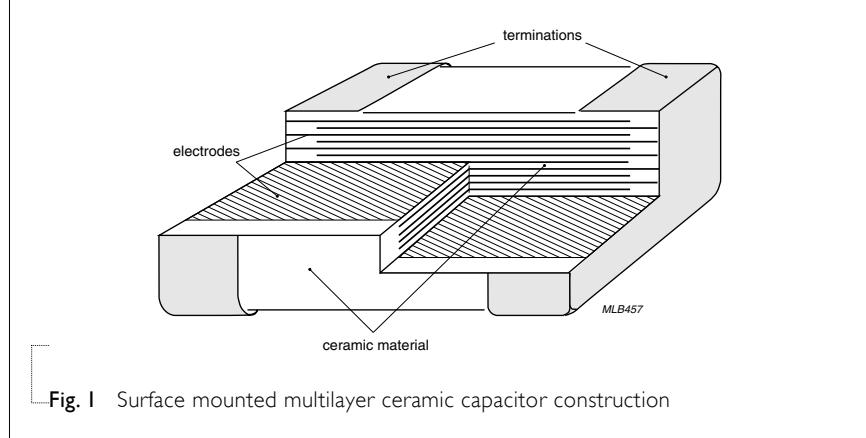
**DIMENSION**

Table I For outlines see fig. 2

TYPE	L ₁ (mm)	W (mm)	T (MM)	L ₂ / L ₃ (mm)		L ₄ (mm) min.
				min.	max.	
0201	0.6 ± 0.03	0.3 ± 0.03		0.10	0.20	0.20
0402	1.0 ± 0.05	0.5 ± 0.05		0.20	0.30	0.40
0603	1.6 ± 0.10	0.8 ± 0.10		0.20	0.60	0.40
0805	2.0 ± 0.10 ⁽¹⁾ 2.0 ± 0.20 ⁽²⁾	1.25 ± 0.10 ⁽¹⁾ 1.25 ± 0.20 ⁽²⁾	Refer to table 2 to 5	0.25	0.75	0.55
1206	3.2 ± 0.15 ⁽¹⁾ 3.2 ± 0.30 ⁽²⁾	1.6 ± 0.15 ⁽¹⁾ 1.6 ± 0.20 ⁽²⁾		0.25	0.75	1.40
1210	3.2 ± 0.20	2.5 ± 0.20		0.25	0.75	1.40
1812	4.5 ± 0.20	3.2 ± 0.20		0.25	0.75	2.20

OUTLINES

For dimension see Table I

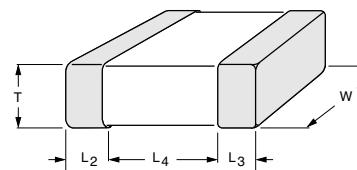


Fig. 2 Surface mounted multilayer ceramic capacitor dimension

NOTE

- Dimension for size 0805 and 1206, C ≤ 1 nF
- Dimension for size 0805 and 1206, C > 1 nF

CAPACITANCE RANGE & THICKNESS FOR NPO

Table 2 Sizes from 0201 to 0603

CAP.	Last 3-digit of 12NC	Last 2-digit of 12NC	0201		0402		0603		
			25 V	50 V	16 V	25 V	50 V	16 V	25 V
0.22 pF	227								
0.47 pF	477								
0.82 pF	827								
1.0 pF	108								
1.2 pF	128								
1.5 pF	158								
1.8 pF	188								
2.2 pF	228	On request							
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				0.3±0.03			0.5±0.05	
10 pF	109	23							
12 pF	129	24							
15 pF	159	25							
18 pF	189	26							
22 pF	229	27							
27 pF	279	28							
33 pF	339	29	0.3±0.03		0.5±0.05	0.5±0.05		0.8±0.1	0.8±0.1
39 pF	399	31							
47 pF	479	32							
56 pF	569	33							
68 pF	689	34							
82 pF	829	35							
100 pF	101	36							

NOTE

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-12 series is on request
3. 16V to 25V, refer to last 2-digit of 12NC
4. 50V, refer to last 3-digit of 12NC

CAPACITANCE RANGE & THICKNESS FOR NPO

Table 3 Sizes from 0201 to 0603 (continued)

CAP.	Last 3-digit of 12NC	Last 2-digit of 12NC	0201		0402			0603		
			25 V	50 V	16 V	25 V	50 V	16 V	25 V	50 V
120 pF	121	37								
150 pF	151	38								
180 pF	181	39								
220 pF	221	41			0.5±0.05	0.5±0.05	0.5±0.05			
270 pF	271	42								
330 pF	331	43								
390 pF	391	44								
470 pF	471	45								
560 pF	561	46								
680 pF	681	47						0.8±0.1	0.8±0.1	0.8±0.1
820 pF	821	48								
1.0 nF	102	49								
1.2 nF	122	51								
1.5 nF	152	52								
1.8 nF	182	53								
2.2 nF	222	54								
2.7 nF	272	55								
3.3 nF	332	56								
3.9 nF	392	57								
4.7 nF	472	58								
5.6 nF	562	59								
6.8 nF	682	61								
8.2 nF	822	62								
10 nF	103	63								
12 nF	123	64								
15 nF	153	65								
18 nF	183	66								
22 nF	223	67								
33 nF	333	69								

NOTE

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-12 series is on request
3. 16V to 25V, refer to last 2-digit of 12NC
4. 50V, refer to last 3-digit of 12NC

CAPACITANCE RANGE & THICKNESS FOR NPO

Table 4 Sizes from 0805 to 1812

CAP.	Last 3-digit of I2NC	Last 2-digit of I2NC	0805			1206			1210			1812	
			16 V	25 V	50 V	16 V	25 V	50 V	16 V	25 V	50 V	16 V	25 V
0.22 pF	227												
0.47 pF	477												
0.82 pF	827												
1.0 pF	108												
1.2 pF	128												
1.5 pF	158												
1.8 pF	188												
2.2 pF	228	On request											
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					0.6±0.1			0.6±0.1				
10 pF	109	23											
12 pF	129	24											
15 pF	159	25											
18 pF	189	26											
22 pF	229	27											
27 pF	279	28											
33 pF	339	29	0.6±0.1	0.6±0.1			0.6±0.1	0.6±0.1					
39 pF	399	31											
47 pF	479	32											
56 pF	569	33											
68 pF	689	34									1.25±0.2	1.25±0.2	
82 pF	829	35											
100 pF	101	36											

NOTE

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-12 series is on request
3. 16V to 25V, refer to last 2-digit of I2NC
4. 50V, refer to last 3-digit of I2NC

CAPACITANCE RANGE & THICKNESS FOR NPO

Table 5 Sizes from 0805 to 1812 (continued)

CAP.	Last 3-digit of I2NC	Last 2-digit of I2NC	0805			1206			1210			1812
			16 V	25 V	50 V	16 V	25 V	50 V	25 V	50 V	50 V	
120 pF	121	37										
150 pF	151	38										
180 pF	181	39										
220 pF	221	41										
270 pF	271	42										
330 pF	331	43		0.6±0.1	0.6±0.1	0.6±0.1						
390 pF	391	44										
470 pF	471	45										
560 pF	561	46					0.6±0.1	0.6±0.1	0.6±0.1	1.25±0.2	1.25±0.2	
680 pF	681	47										
820 pF	821	48										
1.0 nF	102	49										
1.2 nF	122	51										
1.5 nF	152	52	0.85±0.1 1.25±0.2	0.85±0.1 1.25±0.2	0.85±0.1 1.25±0.2							
1.8 nF	182	53										
2.2 nF	222	54										
2.7 nF	272	55										1.25±0.2
3.3 nF	332	56										
3.9 nF	392	57										
4.7 nF	472	58	1.25±0.2	1.25±0.2	1.25±0.2	0.85±0.1	0.85±0.1	0.85±0.1				
5.6 nF	562	59										1.0±0.15
6.8 nF	682	61										
8.2 nF	822	62										
10 nF	103	63										
12 nF	123	64					1.25±0.2	1.25±0.2				
15 nF	153	65										
18 nF	183	66										
22 nF	223	67								2.0±0.2	2.0±0.2	
33 nF	333	69				1.6±0.2						

NOTE

1. Values in shaded cells indicate thickness class in mm
2. Capacitance value of non E-12 series is on request
3. 16V to 25V, refer to last 2-digit of I2NC
4. 50V, refer to last 3-digit of I2NC

THICKNESS CLASSES AND PACKING QUANTITY

Table 6

SIZE CODE	THICKNESS CLASSIFICATION	TAPE WIDTH	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
	0.85 ±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	---	---
	0.85 ±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	---
	0.6 / 0.7 ±0.1 mm	8 mm	---	4,000	---	15,000	---
	0.85 ±0.1 mm	8 mm	---	4,000	---	10,000	---
	1.0 ±0.1 mm	8 mm	---	3,000	---	10,000	---
	1.15 ±0.1 mm	8 mm	---	3,000	---	10,000	---
1210	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	---	---	---
	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	---	---	---
1808	1.6 ±0.2 mm	12 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	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	---	---	---
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	---	---	---
	1.35 ±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 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 7

DESCRIPTION	VALUE
Capacitance range	0.22 pF to 33 nF
Capacitance tolerance	
$C < 10$ pF	± 0.1 pF, ± 0.25 pF, ± 0.5 pF
$C \geq 10$ pF	$\pm 1\%$, $\pm 2\%$, $\pm 5\%$
Dissipation factor (D.F.)	
$C < 30$ pF	$\leq 1 / (400 + 20C)$
$C \geq 30$ pF	$\leq 0.1\%$
Insulation resistance after 1 minute at U_r (DC)	$R_{ins} \geq 10$ GΩ or $R_{ins} \times C_r \geq 500$ seconds whichever is less
Maximum capacitance change as a function of temperature (temperature characteristic/coefficient):	± 30 ppm/°C
Operating temperature range:	-55 °C to +125 °C

Sample limits (broken lines).
Requirement levels (dotted lines)

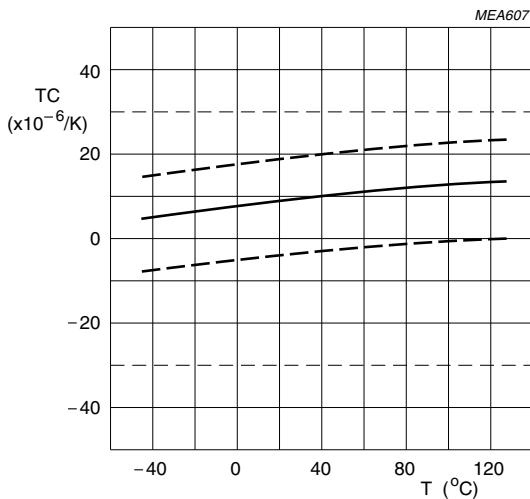


Fig. 3 Typical temperature coefficient as a function of temperature

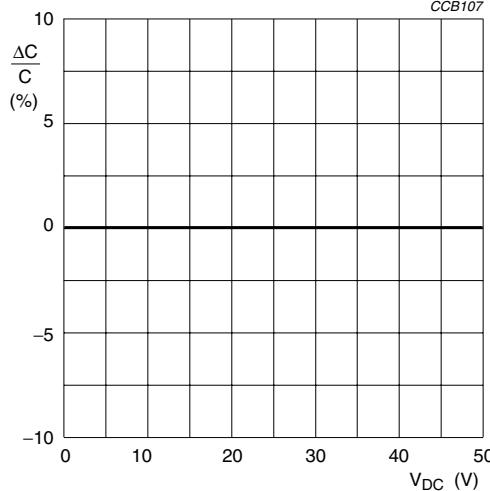


Fig. 4 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage

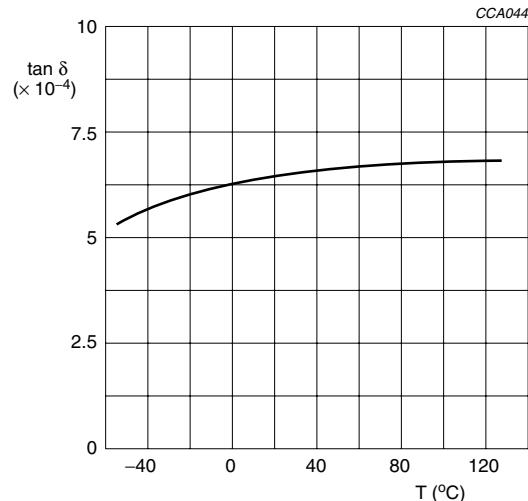


Fig. 5 Typical $\tan \delta$ as a function of temperature

SOLDERING RECOMMENDATION

Table 8

SOLDERING METHOD	SIZE 0402	0603	0805	1206	≥ 1210
Reflow	$\geq 0.1 \mu F$	$\geq 1.0 \mu F$	$\geq 2.2 \mu F$	$\geq 4.7 \mu F$	Reflow only
Reflow/Wave	$< 0.1 \mu F$	$< 1.0 \mu F$	$< 2.2 \mu F$	$< 4.7 \mu F$	---

TESTS AND REQUIREMENTS**Table 9** 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 $\times 10$ magnification	In accordance with specification
Capacitance	4.5.1	Class I: $f = 1 \text{ MHz}$ for $C \leq 1 \text{ nF}$, measuring at voltage 1 V_{rms} at 20°C $f = 1 \text{ KHz}$ for $C > 1 \text{ nF}$, measuring at voltage 1 V_{rms} at 20°C	Within specified tolerance
Dissipation factor (D.F.)	4.5.2	Class I: $f = 1 \text{ MHz}$ for $C \leq 1 \text{ nF}$, measuring at voltage 1 V_{rms} at 20°C $f = 1 \text{ KHz}$ for $C > 1 \text{ nF}$, measuring at voltage 1 V_{rms} at 20°C	In accordance with specification
Insulation resistance	4.5.3	At U_r (DC) for 1 minute	In accordance with specification
Temperature coefficient	4.6	Class I: Between minimum and maximum temperature NP0: -55°C to $+125^\circ\text{C}$ Normal Temperature: 20°C	<General purpose series> $\Delta C/C$: Class I: NP0: $\pm 30 \text{ ppm}/^\circ\text{C}$
Adhesion	4.7	A force applied for 10 seconds to the line joining the terminations and in a plane parallel to the substrate	Force $\text{size} \geq 0603$: 5N $\text{size} = 0402$: 2.5N $\text{size} = 0201$: 1N
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 <General purpose series> $\Delta C/C$: Class I: NP0: within $\pm 1\%$ or 0.5 pF whichever is greater

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Resistance to soldering heat	IEC 60384- 21/22 4.9	<p>Precondition: 150 +0/-10 °C for 1 hour, then keep for 24 ±1 hours at room temperature</p> <p>Preheating: for size ≤ 1206: 120 °C to 150 °C for 1 minute</p> <p>Preheating: for size >1206: 100 °C to 120 °C for 1 minute and 170 °C to 200 °C for 1 minute</p> <p>Solder bath temperature: 260 ±5 °C</p> <p>Dipping time: 10 ±0.5 seconds</p> <p>Recovery time: 24 ±2 hours</p>	<p>Dissolution of the end face plating shall not exceed 25% of the length of the edge concerned</p> <p><General purpose series></p> <p>ΔC/C</p> <p>Class I:</p> <p>NPO: within ±0.5% or 0.5 pF whichever is greater</p>
Solderability	4.10	<p>Preheated the temperature of 80 °C to 140 °C and maintained for 30 seconds to 60 seconds.</p> <p>Test conditions for lead containing solder alloy</p> <p>Temperature: 235 ±5 °C</p> <p>Dipping time: 2 ±0.2 seconds</p> <p>Depth of immersion: 10 mm</p> <p>Alloy Composition: 60/40 Sn/Pb</p> <p>Number of immersions: 1</p> <p>Test conditions for lead-free containing solder alloy</p> <p>Temperature: 245 ±5 °C</p> <p>Dipping time: 3 ±0.3 seconds</p> <p>Depth of immersion: 10 mm</p> <p>Alloy Composition: SAC305</p> <p>Number of immersions: 1</p>	<p>The solder should cover over 95% of the critical area of each termination</p>
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:</p> <p>30 minutes at lower category temperature</p> <p>30 minutes at upper category temperature</p> <p>Recovery time 24 ±2 hours</p>	<p>No visual damage</p> <p><General purpose series></p> <p>ΔC/C</p> <p>Class I:</p> <p>NPO: within ±1% or 1 pF whichever is greater</p>
			<p>D.F. meet initial specified value</p> <p>R_{ins} meet initial specified value</p>

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Damp heat with U_r load	IEC 60384-21/22	<p>4.13</p> <p>1. Preconditioning, class 2 only: $150 +0/-10$ °C /1 hour, then keep for 24 ± 1 hour at room temp</p> <p>2. Initial measure: Spec: refer to initial spec C, D, IR</p> <p>3. Damp heat test: 500 ± 12 hours at 40 ± 2 °C; 90 to 95% R.H. 1.0 U_r applied</p> <p>4. Recovery: Class I: 6 to 24 hours</p> <p>5. Final measure: C, D, IR</p> <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 preconditioned according to "IEC 60384 4.1" and then the requirement shall be met.</p>	<p>No visual damage after recovery</p> <p><General purpose series></p> <p>$\Delta C/C$</p> <p>Class I: NP0: within $\pm 2\%$ or 1 pF whichever is greater</p> <p>D.F.</p> <p>Class I: NP0: $\leq 2 \times$ specified value</p> <p>R_{ins}</p> <p>Class I: NP0: $\geq 2,500$ MΩ or $R_{ins} \times C_r \geq 25s$ whichever is less</p>
Endurance	4.14	<p>1. Preconditioning, class 2 only: $150 +0/-10$ °C /1 hour, then keep for 24 ± 1 hour at room temp</p> <p>2. Initial measure: Spec: refer to initial spec C, D, IR</p> <p>3. Endurance test: Temperature: NP0: 125 °C Specified stress voltage applied for 1,000 hours: Applied $2.0 \times U_r$ for general product.</p> <p>4. Recovery time: 24 ± 2 hours</p> <p>5. Final measure: C, D, IR</p> <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 preconditioned according to "IEC 60384 4.1" and then the requirement shall be met.</p>	<p>No visual damage</p> <p><General purpose series></p> <p>$\Delta C/C$</p> <p>Class I: NP0: within $\pm 2\%$ or 1 pF whichever is greater</p> <p>D.F.</p> <p>Class I: NP0: $\leq 2 \times$ specified value</p> <p>R_{ins}</p> <p>Class I: NP0: $\geq 4,000$ MΩ or $R_{ins} \times C_r \geq 40s$ whichever is less</p>
Voltage proof	IEC 60384-1	<p>4.6</p> <p>Specified stress voltage applied for 1 minute</p> <p>$U_r \leq 100$ V: series applied $2.5 U_r$</p> <p>$100 V < U_r \leq 200$ V series applied $(1.5 U_r + 100)$</p> <p>$200 V < U_r \leq 500$ V series applied $(1.3 U_r + 100)$</p> <p>$U_r > 500$ V: $1.3 U_r$</p> <p>I: 7.5 mA</p>	No breakdown or flashover

REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 8	Aug 05, 2011		<ul style="list-style-type: none"> - Product range updated
Version 7	Jun 14, 2011	-	<ul style="list-style-type: none"> - Size 1210 T=1.0mm SPQ added - Dimension updated
Version 6	Jan 06, 2011	-	<ul style="list-style-type: none"> - Dimension updated
Version 5	Dec 29, 2010	-	<ul style="list-style-type: none"> - Dimension updated
Version 4	Nov 23, 2010	-	<ul style="list-style-type: none"> - Dimension updated
Version 3	Apr 20, 2010	-	<ul style="list-style-type: none"> - The statement of "Halogen Free" on the cover added - Dimension updated
Version 2	Oct 26, 2009	-	<ul style="list-style-type: none"> - Typo updated
Version 1	Jun 02, 2009	-	<ul style="list-style-type: none"> - I2NC code updated
Version 0	Apr 15, 2009	-	<ul style="list-style-type: none"> - New datasheet for general purpose NP0 series with RoHS compliant - Replace the "16V to 50V" part of pdf files: NP0_16V_7, NP0_16V-to-100V_6, NP0_25V_7, NP0_50-to-500V_11 - Combine 0201 from pdf files: UP-NPOX5RX7RY5V_0201_6.3-to-50V_2 and UY-NPOX5RX7RY5V_0201_6.3-to-50V_2 - Define global part number - Description of "Halogen Free compliant" added - Test method and procedure updated

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