

DATA SHEET

SURFACE-MOUNT CERAMIC MULTILAYER CAPACITORS

Ultra small: NP0/X5R/X7R/Y5V
(Pb Free & RoHS compliant)

6.3 V TO 50 V

1 pF to 100 nF



SCOPE

This specification describes ultra small NP0/X5R/X7R/Y5V series chip capacitors with lead-free terminations.

APPLICATIONS

- Mobile phones
- Digital cameras
- Camcorders
- Tuners

FEATURES

- High capacitance per unit volume
- Supplied in bulk case or in tape on reel.

ORDERING INFORMATION

Components may be ordered by using either a Phycomp's unique I2NC or Phycomp clear text code.

PHYCOMP ORDERING CODE

I2NC CODE

For NP0 25V / X5R / X7R / Y5V

	2 2 X X X X X X X X X			
Carrier type		Capacitance value		See conversion table (1)
22 blister		Tolerance		4 ±2%
38 paper		5 ±5%		6 ±10%
50 blister Ur ≤ 6.3 V		7 ±20%		8 -20/+80%
54 bulk		Temperature characteristic		1 NP0 25 V only
55 paper Ur ≤ 6.3 V		3 X5R		5 X7R
Rated voltage		5 X7R		9 Y5V
20 6.3 V		Packaging⁽²⁾		1 reel: Ø180 mm; 7"
24 10 V		5 reel: Ø330 mm; 13"		4 bulk case
78 16 V				
91 25 V				
58 50 V				
Size				
8 0201				

SCM043

For NP0 50V

	2 2 X X X X X X X X X			
Carrier type		Capacitance value		See conversion table (1)
38 paper		Tolerance		4 ±0.1 pF for 0.47 pF ≤ C < 5 pF
54 bulk		±0.25 pF for 5 pF ≤ C < 10 pF		±2% for C ≥ 10 pF
Voltage		5 ±0.25 pF for C < 5 pF		±0.5 pF for 5 pF ≤ C < 10 pF
86 50 V		±5% for C ≥ 10 pF		
Size		Packing		1 reel: Ø180 mm; 7"
8 0201		7 reel: Ø330 mm; 13"		4 bulk case

SCM044

(1) Refer to "Conversion table of capacitance & last 2/3 digits of I2NC"

(2) Quantity on reel depends on thickness classification; see section "Thickness classification and packing quantities"

Conversion table of capacitance & last 2/3 digits of I2NC - NP0 25V

CAP. (nF)	LAST 2 DIGITS OF I2NC	CAP. (nF)	LAST 2 DIGITS OF I2NC	CAP. (nF)	LAST 2 DIGITS OF I2NC	CAP. (nF)	LAST 2 DIGITS OF I2NC
27	28	39	31	56	33	82	35
33	29	47	32	68	34	100	36

Conversion table of capacitance & last 2/3 digits of I2NC - NP0 50V

CAP. (nF)	LAST 3 DIGITS OF I2NC	CAP. (nF)	LAST 3 DIGITS OF I2NC	CAP. (nF)	LAST 3 DIGITS OF I2NC
1.0	108	3.3	338	10	109
1.2	128	3.9	398	12	129
1.5	158	4.7	478	15	159
1.8	188	5.6	568	18	189
2.2	228	6.8	688	22	229
2.7	278	8.2	33		

Conversion table of capacitance & last 2/3 digits of I2NC - X5R/X7R/Y5V

CAP. (nF)	LAST 2 DIGITS OF I2NC	CAP. (nF)	LAST 2 DIGITS OF I2NC	CAP. (nF)	LAST 2 DIGITS OF I2NC
0.047	05	0.68	21	10	36
0.068	07	1.0	23	15	38
0.10	09	1.5	25	22	41
0.15	12	2.2	27	33	43
0.22	14	3.3	29	47	45
0.33	16	4.7	32	68	47
0.47	18	6.8	34	100	49

CTC CODE

U Example: 02012R102K8B20D

0201	2R	102	K	8	B	2	0	D
Size code	Temp. Char.	Capacitance in pF	Tolerance	Rated voltage	Termination	Packing	Marking	Range identifier
0201	CG = NP0	102 = 1,000 pF;	B = ±0.1 pF	5 = 6.3 V	B = NiSn	2 = 180 mm; 7" paper	0 = no marking	0 = conv.
0402	2B = X5R	the third digit	C = ±0.25 pF	6 = 10 V		3 = 330 mm; 13" paper		ceramic
0603	2R = X7R	signifies the	D = ±0.5 pF	7 = 16 V		B = 180 mm; 7" blister		D = BME
0805	2F = Y5V	multiplying factor:	F = ±1%	8 = 25 V		F = 330 mm; 13" blister		L = low
1206	2E = Z5U	8 = × 0.01	G = ±2%	9 = 50 V		P = Bulk case		inductance
1210		9 = × 0.1	J = ±5%	0 = 100 V				M = microwave
1808		0 = × 1	K = ±10%	B = 200 V				
1812		1 = × 10	M = ±20%	C = 250 V				
0306		2 = × 100	Z = -20%~+80%	D = 500 V				
0508		3 = × 1,000		E = 1 KV				
0612		4 = × 10,000		F = 2 KV				
		5 = × 100,000		G = 3 KV				
		6 = × 1,000,000		H = 4 KV				
		7 = × 10,000,000						

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.

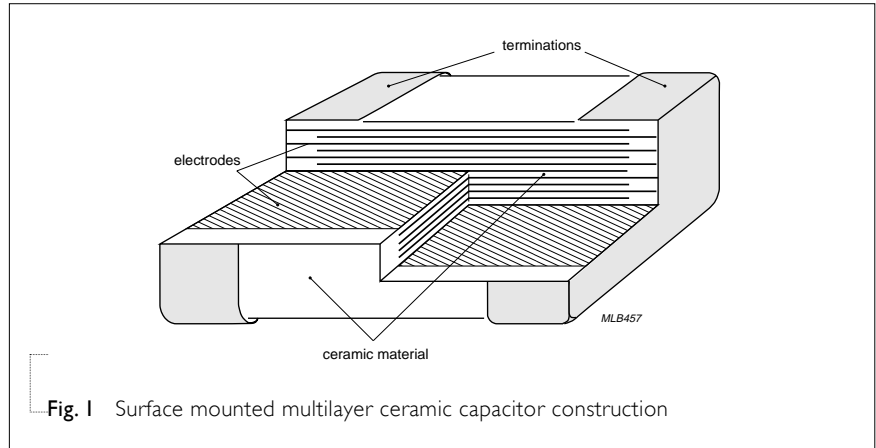


Fig. I Surface mounted multilayer ceramic capacitor construction

DIMENSION

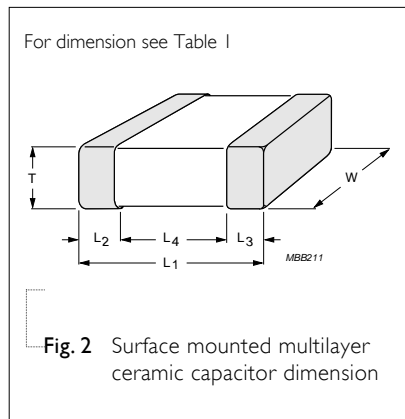


Fig. 2 Surface mounted multilayer ceramic capacitor dimension

Table I

TYPE	L ₁ (mm)	W (mm)	T (mm)	L ₂ /L ₃ (mm)		L ₄ (mm)
				min.	max.	min.
CC0201	0.6 ±0.03	0.3 ±0.03	0.3 ±0.03	0.10	0.20	0.20

CAPACITANCE RANGE & THICKNESS FOR SIZE 0201 OF NP0 25/50 V

Table 2

CAPACITANCE (pF)	0201 25 V	0201 50 V
1.0		0.3 ±0.03
1.2		
1.5		
1.8		
2.2		
2.7		
3.3		
3.9		
4.7		
5.6		
6.8		
8.2		
10		
12		
15		
18		
22		
27	0.3 ±0.03	
33		
39		
47		
56		
68		
82		
100		

NOTE

1. Values in shaded cells indicate thickness class in mm.
2. Capacitance range < 1 pF is on request.

CAPACITANCE RANGE & THICKNESS FOR SIZE 0201 OF X5R/X7R/Y5V/ 6.3/10/16/25/50 V

Table 3

CAPACITANCE (nF)	X5R 6.3 V	X7R 10 V	16 V	25 V	50 V	Y5V 6.3 V
0.047					0.3 ±0.03	
0.068						
0.10						
0.15						
0.22						
0.33						
0.47						
0.68				0.3 ±0.03		
1.0		0.3 ±0.03	0.3 ±0.03			
1.5						
2.2						
3.3						
4.7						
6.8						
10						
15						
22						
33						
47						
68						
100	0.3 ±0.03					0.3 ±0.03

NOTE

1. Values in shaded cells indicate thickness class in mm.

THICKNESS CLASSES AND PACKING QUANTITY

Table 4

DESCRIPTION	SIZE CODE	THICKNESS CLASSIFICATION (mm)	8 mm TAPE WIDTH/AMOUNT PER REEL				12 mm TAPE WIDTH /AMOUNT PER REEL	AMOUNT PER BULK CASE
			Ø180 mm, 7"		Ø330 mm, 13"		Ø180 mm, 7" Blister	
			Paper	Blister	Paper	Blister		
Discrete capacitors	0201	0.3 ±0.03	15,000	---	50,000	---	---	
	0402	0.5 ±0.05	10,000	---	50,000	---	50,000	
	0603	0.8 ±0.07	4,000	---	15,000	---	15,000	
	0805	0.6 ±0.10	4,000	---	20,000	---	10,000	
		0.85 ±0.1	4,000	---	15,000	---	8,000	
		1.25 ±0.10	---	3,000	---	10,000	5,000	
	1206	0.6 ±0.10	4,000	---	20,000	---	---	
		0.85 ±0.10	4,000	---	15,000	---	---	
		1.00 / 1.15 ±0.10	---	3,000	---	10,000	---	
		1.6 ±0.15	---	2 500	---	10,000	---	
		1.6 ±0.20	---	2,000	---	10,000	---	
	1210	0.6 / 0.7 ±0.10	---	4,000	---	15,000	---	
		0.85 ±0.10	---	4,000	---	10,000	---	
		1.15 ±0.10	---	3,000	---	10,000	---	
		1.15 ±0.15	---	3,000	---	10,000	---	
		1.5 ±0.10	---	2,000	---	---	---	
		1.6 / 1.9 ±0.20	---	2,000	---	---	---	
		2.5 ±0.20	---	1,000	---	---	---	
	1808	1.15 ±0.15	---	---	---	---	1 500	
		1.35 ±0.15	---	---	---	---	1,000	
		1.5 ±0.10	---	---	---	---	1,000	
	1812	0.6 / 0.85 ±0.10	---	---	---	---	2,000	
		1.15 ±0.10	---	---	---	---	1,500	
		1.15 ±0.15	---	---	---	---	1,500	
		1.35 ±0.15	---	---	---	---	1,000	
		1.5 ±0.1	---	---	---	---	1,000	
		1.6 ±0.2	---	---	---	---	1,000	
	Arrays	0508	0.6 ±0.10	4,000	---	---	---	
0.85 ±0.10			4,000	---	---	---		
0612		0.8 ±0.10	4,000	---	---	---		
		1.2 ±0.10	---	3,000	---	---		

NOTE

1. For bulk case, tape and reel specification/dimensions, please see the special data sheet "Packing" document.

ELECTRICAL CHARACTERISTICS**NP0/X5R/X7R/Y5V 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 5

DESCRIPTION	VALUE
Capacitance range ⁽¹⁾ :	
NP0	1 pF to 100 pF
X5R/Y5V	100 nF
X7R	47 pF to 10 nF
RATED VOLTAGE U_r (DC):	
NP0	25/50 V
X5R/Y5V	6.3 V
X7R	10/16/25/50 V
Capacitance tolerance ⁽¹⁾ :	
NP0	$C < 10$ pF: ± 0.25 pF, ± 0.50 pF; $C \geq 10$ pF: $\pm 5\%$
X5R	$\pm 10\%$
X7R	$\pm 10\%$
Y5V	$-20\% \sim +80\%$
Dissipation factor (D.F.) ⁽¹⁾ (max.):	
NP0	$C \leq 10$ pF: $D.F. = \frac{30+7C}{100 \times C}$ or 0.3%; whichever is smallest; $C > 10$ pF: 0.1%
X5R	10%
X7R	10 V: 5%; 16 V: 3.5%; 25/50 V: 2.5%
Y5V	15%
Insulation resistance after 1 minute at U_r (DC)	$R_{ins} \geq 10$ G Ω or $R_{ins} \times C \geq 500$ seconds whichever is less
Maximum capacitance change as a function of temperature (temperature characteristic/coefficient):	
NP0	± 30 ppm/°C
X5R/X7R	$\pm 15\%$
Y5V	$+22\% \sim -82\%$
Operating temperature range:	
NP0/X7R	-55 °C to $+125$ °C
X5R	-55 °C to $+85$ °C
Y5V	-30 °C to $+85$ °C

NOTE

1. $f=1$ KHz for $C \leq 10$ μ F; measuring at voltage $1 V_{rms}$; $f=120$ Hz for $C > 10$ μ F; measuring at voltage $0.5 V_{rms}$.

TESTS AND REQUIREMENTS

Table 6 Test condition, procedure 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	NP0: 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 X5R/X7R/Y5V: 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	NP0: 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 X5R/X7R/Y5V: 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	At U _r (DC) for 1 minute	In accordance with specification
Voltage proof	4.5.4.2	Test voltage (DC) applied for 1 minute U _r ≤ 100 V: 2.5 × U _r applied to NP0/X5R/X7R/Y5V series 100 V < U _r ≤ 200 V: 1.5 × U _r + 100 V applied to NP0/X7R series 200 V < U _r ≤ 500 V: 1.3 × U _r + 100 V applied to NP0/X7R series U _r > 500 V: 1.3 × U _r applied to NP0/X7R series I: 7.5 mA	No breakdown or flashover
Temperature characteristic	4.6	Between minimum and maximum temperature	NP0: ΔC/C: ±30 ppm/°C X5R/X7R: ΔC/C: ±15% Y5V: ΔC/C: +22%~ -82%
Adhesion	4.15	A force applied for 10 seconds to the line joining the terminations and in a plane parallel to the substrate for size ≥ 0603: a force of 5 N applied for size 0402: a force of 2.5 N applied for size 0201: a force of 1 N applied	No visible damage

Table 6 Test condition, procedure and requirements (continued)

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Bond strength of plating on end face	IEC 60384-21/22 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 NP0: $\Delta C/C_I \leq 1\%$ or 0.5 pF whichever is greater X5R/X7R/Y5V: $\Delta C/C_I \leq 10\%$
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 to 150 °C for 1 minute Preheating: for size >1206: 100 to 120 °C for 1 minute and 170 to 200 °C for 1 minute Solder bath temperature: 260 ± 5 °C Dipping time: 10 ± 0.5 seconds Recovery time: 24 ± 2 hours.	The termination shall be well tinned NP0: $\Delta C/C_I \leq 0.5\%$ or 0.5 pF whichever is greater X5R/X7R: $\Delta C/C_I \leq 10\%$ Y5V: $\Delta C/C_I \leq 20\%$ D.F.: within initial specified value R _{ins} : within initial specified value
Solderability	4.10	Unmounted chips completely immersed in a solder bath at 235 ± 5 °C Dipping time: 2 ± 0.5 seconds Depth of immersion: 10 mm	The termination shall be well tinned.
Rapid change of temperature	4.11	Preconditioning; 150 +0/-10 °C for 1 hour, then keep for 24 ± 1 hours at room temperature <hr/> 5 cycles with following detail: 30 minutes at lower category temperature; 30 minutes at upper category temperature <hr/> Recovery time 24 ± 2 hours.	No visual damage NP0: $\Delta C/C_I \leq 1\%$ or 1 pF whichever is greater X5R/X7R: $\Delta C/C_I \leq 15\%$ Y5V: $\Delta C/C_I \leq 20\%$ D.F.: within initial specified value R _{ins} : within initial specified value
Damp heat, with U _r load	4.13	Initial measurements; after 150 +0/-10 °C for 1 hour, then keep for 24 ± 1 hours at room temperature Duration and conditions: 500 ± 12 hours at 40 ± 2 °C; 90 to 95% RH; U _r applied Final measurement: perform a heat treatment at 150 +0/-10 °C for 1 hour, final measurements shall be carried out 24 ± 1 hours after recovery at room temperature without load.	NP0: $\Delta C/C_I \leq 2\%$ or 1 pF whichever is greater X5R/X7R: $\Delta C/C_I \leq 20\%$ Y5V: $\Delta C/C_I \leq 30\%$ NP0/X5R/X7R/Y5V: D.F.: 2 × initial value max. NP0: R _{ins} ≥ 2,500 MΩ or R _{ins} × C _r ≥ 25 seconds, whichever is less X5R/X7R/Y5V: R _{ins} ≥ 500 MΩ or R _{ins} × C _r ≥ 25 seconds, whichever is less

Table 6 Test condition, procedure and requirements (continued)

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Endurance	IEC 60384-21/22 4.14	Preconditioning; Initial measurements; after 150 +0/-10 °C for 1 hour, then keep for 24 ± 1 hours at room temperature Duration and conditions: 1,000 ± 12 hours at upper category temperature with 1.5 × U _r voltage applied Final measurement: perform a heat treatment at 150 +0/-10 °C for 1 hour; final measurements shall be carried out 24 ± 1 hours after recovery at room temperature without load.	NP0: $\Delta C/C_i \leq 2\%$ or 1 pF whichever is greater X5R/X7R: $\Delta C/C_i \leq 20\%$ Y5V: $\Delta C/C_i \leq 30\%$ NP0/X5R/X7R/Y5V: D.F.: 2 × initial value max. NP0: $R_{ins} \geq 4,000 \text{ M}\Omega$ or $R_{ins} \times C_r \geq 40$ seconds, whichever is less X5R/X7R/Y5V: $R_{ins} \geq 1,000 \text{ M}\Omega$ or $R_{ins} \times C_r \geq 50$ seconds, whichever is less

REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 2	Apr 19, 2006	-	- New datasheet for ultra small NP0/X5R/X7R/Y5V series chip capacitors with lead-free terminations - Test method and procedure updated
Version 1	Mar 22, 2004	-	-
Version 0	Mar 18, 2004	-	-