

# DATA SHEET

## SURFACE-MOUNT CERAMIC MULTILAYER CAPACITORS

Mid-voltage

NP0/X7R

100 V TO 630 V

0.47 pF to 2.2  $\mu$ F

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, Charger  
LCD panel  
ADSL, Modem

FEATURES

Supplied in tape on reel  
Nickel-barrier end termination  
RoHS compliant  
MSL class MSL I  
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)

**(1) SIZE – INCH BASED (METRIC)**

0201 (0603) / 0402 (1005) / 0603 (1608) / 0805 (2012) / 1206 (3216) / 1210 (3225)  
1808 (4520) / 1812 (4532) / 2220 (5750)

**(2) TOLERANCE**

C = ±0.25 pF  
D = ±0.5 pF  
F = ±1%  
G = ±2%  
J = ±5%  
K = ±10%  
M = ±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

**(4) TC MATERIAL**

NPO  
X7R

**(5) RATED VOLTAGE**

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

**(6) PROCESS**

N = NPO  
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<sup>1</sup> = 120 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.1.

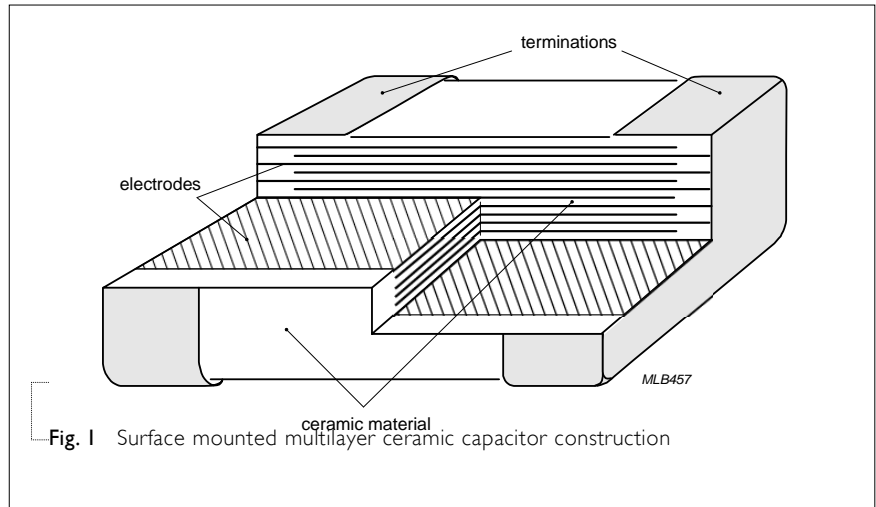


Fig. 1 Surface mounted multilayer ceramic capacitor construction

**DIMENSION**

Table 1 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.
0201	0.6 ±0.03	0.3±0.03	0.3±0.03	0.10	0.20	0.20
0402	1.0 ±0.05	0.5 ±0.05	0.5 ±0.05	0.15	0.30	0.40
0603	1.6 ±0.10	0.8 ±0.10	0.8 ±0.10	0.20	0.60	0.40
0805	2.0 ±0.10	1.25 ±0.10	0.6 ±0.10	0.25	0.75	0.70
			0.85 ±0.10			
	2.0 ±0.20	1.25 ±0.20	1.25 ±0.20			
1206	3.2 ±0.15	1.6 ±0.15	0.6 ±0.10	0.25	0.75	1.40
			0.85 ±0.10			
	3.2 ±0.30	1.6 ±0.20	1.25 ±0.20			
1210	3.2 ±0.20	2.5 ±0.20	1.6 ±0.20	0.25	0.75	1.40
			1.25 ±0.20			
	3.2 ±0.30	2.5 ±0.20	1.6 ±0.20			
1808	4.5 ±0.40	2.0 ±0.30	1.25 ±0.20	0.25	0.75	2.20
			0.85 ±0.10			
1812	4.5 ±0.40	3.2 ±0.30	1.25 ±0.20	0.25	0.75	2.20
			1.60 ±0.20			
2020	5.7 ±0.40	5.0 ±0.30	2.0 ±0.20	0.25	0.75	3.40

**OUTLINES**

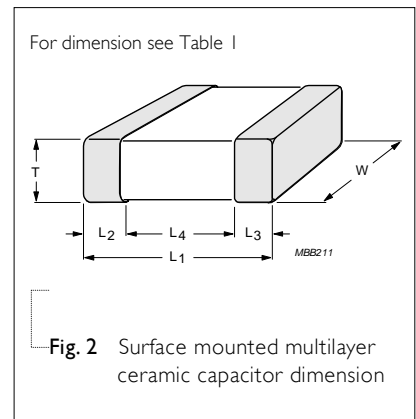


Fig. 2 Surface mounted multilayer ceramic capacitor dimension

**CAPACITANCE RANGE & THICKNESS FOR NPO**

**Table 2** Sizes from 0201 to 0805

CAP.	0201	0402	0603	0805		0805		0805		0805
	100V	100V	100 V	200 V	250 V	100 V	200 V	250 V	500 V	630V
0.22 pF										
0.47 pF										
0.56 pF										
0.68 pF										
0.82 pF										
1.0 pF										
1.2 pF										
1.5 pF										
1.8 pF										
2.2 pF										
2.7 pF										
3.3 pF										
3.9 pF										
4.7 pF										
5.6 pF										
6.8 pF	0.3±0.03	0.5±0.05	0.8±0.1	0.8±0.1	0.8±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1	0.6±0.1
8.2 pF										
10 pF										
12 pF										
15 pF										
18 pF										
22 pF										
27 pF										
33 pF										
39 pF										
47 pF										
56 pF										
68 pF										
82 pF										
100 pF										

**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 0603 to 0805 (continued)

CAP.	0402		0603		0805				
	100 V	100 V	200 V	250 V	100 V	200 V	250 V	500 V	630 V
120 pF									
150 pF						0.6± 0.1	0.6± 0.1	0.6± 0.1	0.6± 0.1
180 pF									
220 pF									
270 pF			0.8± 0.1	0.8± 0.1					
330 pF	0.5± 0.05				0.6± 0.1			0.85±0.1	0.85±0.1
390 pF									
470 pF						0.85±0.1	0.85±0.1		
560 pF									
680 pF								1.25±0.2	1.25±0.2
820 pF									
1.0 nF		0.8± 0.1							
1.2 nF									
1.5 nF					0.85±0.1				
1.8 nF									
2.2 nF									
2.7 nF						1.25±0.2	1.25±0.2		
3.3 nF									
3.9 nF									
4.7 nF					1.25±0.2				
5.6 nF									
6.8 nF									
8.2 nF									
10 nF									
12 nF									
15 nF									
18 nF									
22 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 NP0**

**Table 4** Sizes from 1206 to 1210

CAP.	1206					1210				
	100 V	200 V	250 V	500 V	630 V	100 V	200 V	250 V	500 V	630 V
0.47 pF										
0.56 pF										
0.68 pF										
0.82 pF										
1.0 pF										
1.2 pF										
1.5 pF										
1.8 pF										
2.2 pF										
2.7 pF										
3.3 pF										
3.9 pF										
4.7 pF										
5.6 pF										
6.8 pF	0.6±0.1	0.6±0.1	0.6±0.1							
8.2 pF										
10 pF										
12 pF										
15 pF										
18 pF										
22 pF										
27 pF										
33 pF				0.6±0.1	1.25±0.2					
39 pF										
47 pF										
56 pF										1.25±0.2
68 pF						1.25±0.2	1.25±0.2	1.25±0.2	1.25±0.2	
82 pF										

**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 5 Sizes from 1206 to 1210 (continued)

CAP.	1206					1210				
	100 V	200 V	250 V	500 V	630 V	100 V	200 V	250 V	500 V	630 V
100 pF										
120 pF										
150 pF										
180 pF										
220 pF										
270 pF		0.6±0.1	0.6±0.1	0.6±0.1						
330 pF										1.25±0.2
390 pF										
470 pF	0.6±0.1				1.25±0.2					
560 pF										
680 pF							1.25±0.2	1.25±0.2	1.25±0.2	
820 pF										
1.0 nF		0.85±0.1	0.85±0.1	0.85±0.1						
1.2 nF						1.25±0.2				
1.5 nF										
1.8 nF										
2.2 nF				1.25±0.2						
2.7 nF		1.25±0.2	1.25±0.2							
3.3 nF										
3.9 nF										
4.7 nF	0.85±0.1									
5.6 nF										
6.8 nF					1.60±0.2					
8.2 nF										
10 nF	1.25±0.2				1.60±0.2					
12 nF										
15 nF										
18 nF										
22 nF						1.6±0.2				2.0±0.2

**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 6** Sizes 1812

CAP.	1812		250 V	500 V	630V
	100 V	200 V			
10 pF					
12 pF					
15 pF					
18 pF					
22 pF					
27 pF					
33 pF					
39 pF					
47 pF					
56 pF					
68 pF					
82 pF					
100 pF					
120 pF					
150 pF					
180 pF					
220 pF					
270 pF					
330 pF					1.25±0.2
390 pF					
470 pF					
560 pF				1.25±0.2	
680 pF					
820 pF					
1 nF					
1.2 nF			1.25±0.2	1.25±0.2	
1.5 nF					
1.8 nF					
2.2 nF					
2.7 nF	1.25±0.2				
3.3 nF					
3.9 nF					
4.7 nF					
5.6 nF					
6.8 nF					
8.2 nF					
10 nF					
12 nF					
15 nF					
18 nF					
22 nF					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



**CAPACITANCE RANGE & THICKNESS FOR X7R**

**Table 7** Sizes from 0402 to 0805

CAP.	0402	0603	0805		0805		0805	
	100 V	100 V	200V/250V	100 V	200 V	250 V	500 V	630 V
100 pF								
150 pF								
220 pF								
330 pF								
470 pF								
680 pF								
1.0 nF	0.5±0.05				0.85±0.1	0.85±0.1	0.85±0.1	0.85±0.1
1.5 nF				0.6±0.1				
2.2 nF			0.8±0.1					
3.3 nF		0.8±0.1						
4.7 nF								
6.8 nF								
10 nF								1.25±0.2
15 nF				0.85±0.1			1.25±0.2	
22 nF					1.25±0.2	1.25±0.2		
33 nF								
47 nF								
68 nF								
100 nF								
150 nF				1.25±0.2				
220 nF								
330 nF								
470 nF								
1 μF								

**NOTE**

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

**CAPACITANCE RANGE & THICKNESS FOR X7R**

**Table 8** Sizes from 1206 to 1210

CAP.	1206					1210				
	100 V	200 V	250 V	500 V	630 V	100 V	200 V	250 V	500 V	630V
100 pF										
150 pF										
220 pF										
330 pF										
470 pF										
680 pF										
1.0 nF										
1.5 nF										
2.2 nF		0.85±0.1	0.85±0.1	1.25±0.2	1.25±0.2					
3.3 nF	0.85±0.1									
4.7 nF							0.85±0.1	0.85±0.1		
6.8 nF										1.25±0.2
10 nF									1.25±0.2	
15 nF						0.85±0.1				
22 nF										1.6±0.2
33 nF				1.6±0.2	1.6±0.2					
47 nF		1.25±0.2	1.25±0.2							2.0±0.2
68 nF							1.25±0.2	1.25±0.2		
100 nF		1.6±0.2	1.6±0.2						2.0±0.2	
150 nF	1.25±0.2									
220 nF						1.25±0.2				
330 nF										
470 nF										
680 nF	1.6±0.2									
1 µF						2.0±0.2				
2.2 µF										

**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 9** Sizes from 1808 to 1812

CAP.	1812					2020
	100 V	200 V	250 V	500 V	630 V	630 V
100 pF						
150 pF						
220 pF						
330 pF						
470 pF						
680 pF						
1.0 nF						
1.5 nF						
2.2 nF						
3.3 nF						
4.7 nF					1.35±0.2	
6.8 nF		0.85±0.1	0.85±0.1			
10 nF	0.85±0.1			1.25±0.2		
15 nF						
22 nF						
33 nF						
47 nF						
68 nF					1.6±0.2	
100 nF		1.25±0.2	1.25±0.2		1.6±0.2	
150 nF						
220 nF	1.25±0.2					2.0±0.2
330 nF		1.6±0.2	1.6±0.2			
470 nF						
680 nF	1.6±0.2					
1 μF						

**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 10

SIZE CODE	THICKNESS CLASSIFICATION	PACKING CODE.		TAPE WIDTH	QUANTITY PER REEL			
		7 INCH	13 INCH		Ø180 MM / 7 INCH		Ø330 MM / 13 INCH	
					Paper	Blister	Paper	Blister
0201	0.3 ±0.03 mm	R	P	8 mm	15,000	---	50,000	---
0402	0.5 ±0.05 mm	R	P	8 mm	10,000	---	50,000	---
0603	0.8 ±0.1 mm	R	P	8 mm	4,000	---	15,000	---
0805	0.6 ±0.1 mm	R	P	8 mm	4,000	---	20,000	---
	0.8 / 0.85 ±0.1 mm	R	P	8 mm	4,000	---	15,000	---
	1.25 ±0.2 mm	K	F	8 mm	---	3,000	---	10,000
1206	0.6 ±0.1 mm	R	P	8 mm	4,000	---	20,000	---
	0.8 / 0.85 ±0.1 mm	R	P	8 mm	4,000	---	15,000	---
	1.00 / 1.15 ±0.1 mm	K	F	8 mm	---	3,000	---	10,000
	1.25 ±0.2 mm	K	F	8 mm	---	3,000	---	10,000
	1.6 ±0.15 mm	K	F	8 mm	---	2,500	---	10,000
	1.6 ±0.2 mm	K	F	8 mm	---	2,000	---	8,000
1210	0.6 / 0.7 ±0.1 mm	K	F	8 mm	---	4,000	---	15,000
	0.85 ±0.1 mm	K	F	8 mm	---	4,000	---	10,000
	1.15 ±0.1 mm	K	F	8 mm	---	3,000	---	10,000
	1.15 ±0.15 mm	K	F	8 mm	---	3,000	---	10,000
	1.25 ±0.2 mm	K		8 mm	---	3,000	---	---
	1.5 ±0.1 mm	K		8 mm	---	2,000	---	---
	1.6 / 1.9 ±0.2 mm	K		8 mm	---	2,000	---	---
	2.0 ±0.2 mm	K		8 mm	---	2,000 1,000	---	---
1808	1.15 ±0.15 mm	K		12 mm	---	3,000	---	---
	1.25 ±0.2 mm	K		12 mm	---	3,000	---	---
	1.35 ±0.15 mm	K		12 mm	---	2,000	---	---
	1.5 ±0.1 mm	K		12 mm	---	2,000	---	---
	1.6 ±0.2 mm	K	F	12 mm	---	2,000	---	8,000
	2.0 ±0.2 mm	K		12 mm	---	2,000	---	---
1812	0.6 / 0.85 ±0.1 mm	K		12 mm	---	2,000	---	---
	1.15 ±0.1 mm	K		12 mm	---	1,000	---	---
	1.15 ±0.15 mm	K		12 mm	---	1,000	---	---
	1.25 ±0.2 mm	K		12 mm	---	1,000	---	---
	1.35 ±0.15 mm	K		12 mm	---	1,000	---	---
	1.5 ±0.1 mm	K		12 mm	---	1,000	---	---
	1.6 ±0.2 mm	K		12 mm	---	1,000	---	---
	2.0 ±0.2 mm	K		12 mm	---	1,000	---	---
2.5 ±0.2 mm	K		12 mm	---	500	---	---	
2220	2.0 ±0.2 mm	K		12 mm	---	1000	---	---

**PAPER/PE TAPE SPECIFICATION**

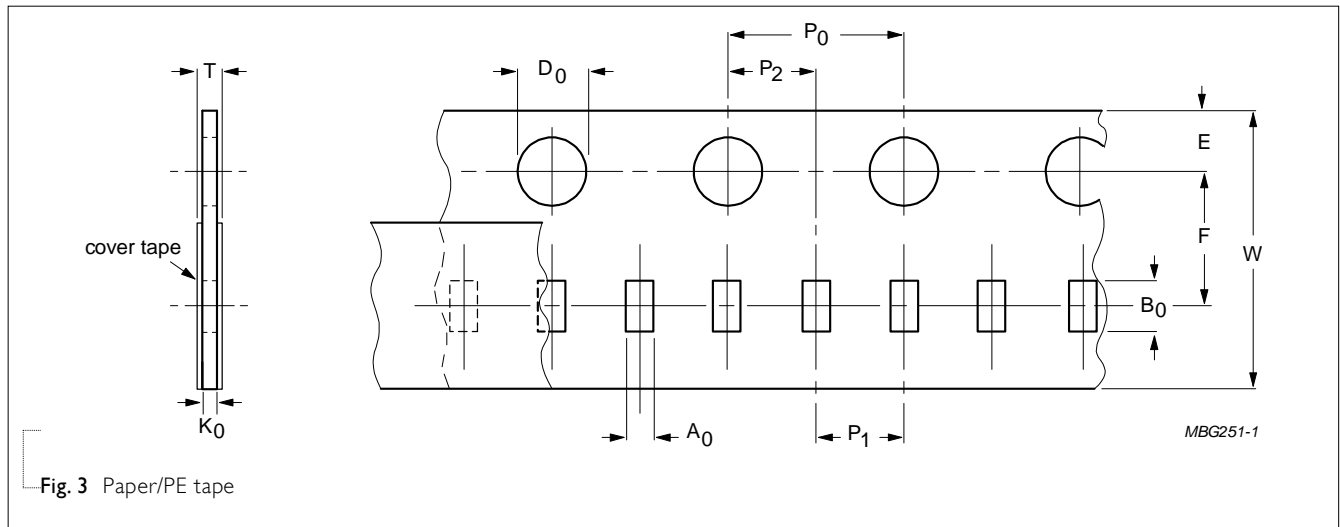


Fig. 3 Paper/PE tape

Table 11 Dimensions of paper/PE tape for relevant chip size; see Fig.3

SIZE CODE	SYMBOL											Unit: mm
	A <sub>0</sub>	B <sub>0</sub>	W	E	F	P <sub>0</sub> <sup>(1)</sup>	P <sub>1</sub>	P <sub>2</sub>	ØD <sub>0</sub>	K <sub>0</sub>	T	
0201	0.39 ± 0.06	0.70 ± 0.06	8.0 ± 0.20	1.75 ± 0.1	3.50 ± 0.05	4.0 ± 0.05	2.0 ± 0.05	2.0 ± 0.05	1.55 ± 0.03	0.38 ± 0.05	(0.47 / 0.55)±0.10	
0402	0.70 ± 0.15	1.21 ± 0.12	8.0 ± 0.20	1.75 ± 0.1	3.50 ± 0.05	4.0 ± 0.05	2.0 ± 0.05	2.0 ± 0.05	1.50 +0.1 /-0	(0.75 / 0.60)±0.10	(0.85 / 0.70)±0.10	
0603	1.05 ± 0.14	1.86 ± 0.13	8.0 ± 0.20	1.75 ± 0.1	3.50 ± 0.05	4.0 ± 0.10	4.0 ± 0.10	2.0 ± 0.05	1.50 +0.1 /-0	(1.05 / 0.95 / 0.75)±0.10	(1.15 / 1.05 / 0.85)±0.10	
0805	1.50 ± 0.15	2.26 ± 0.20	8.0 ± 0.20	1.75 ± 0.1	3.50 ± 0.05	4.0 ± 0.10	4.0 ± 0.10	2.0 ± 0.05	1.50 +0.1 /-0	(1.05 / 0.95 / 0.75)±0.10	(1.15 / 1.05 / 0.85)±0.10	
1206	1.90 ± 0.15	3.50 ± 0.20	8.0 ± 0.20	1.75 ± 0.1	3.50 ± 0.05	4.0 ± 0.10	4.0 ± 0.10	2.0 ± 0.05	1.50 +0.1 /-0	(0.95 / 0.75)±0.10	(1.05 / 0.85)±0.10	

**NOTE**

1. P<sub>0</sub> pitch tolerance over any 10 pitches is ±0.2 mm

**BLISTER TAPE SPECIFICATION**

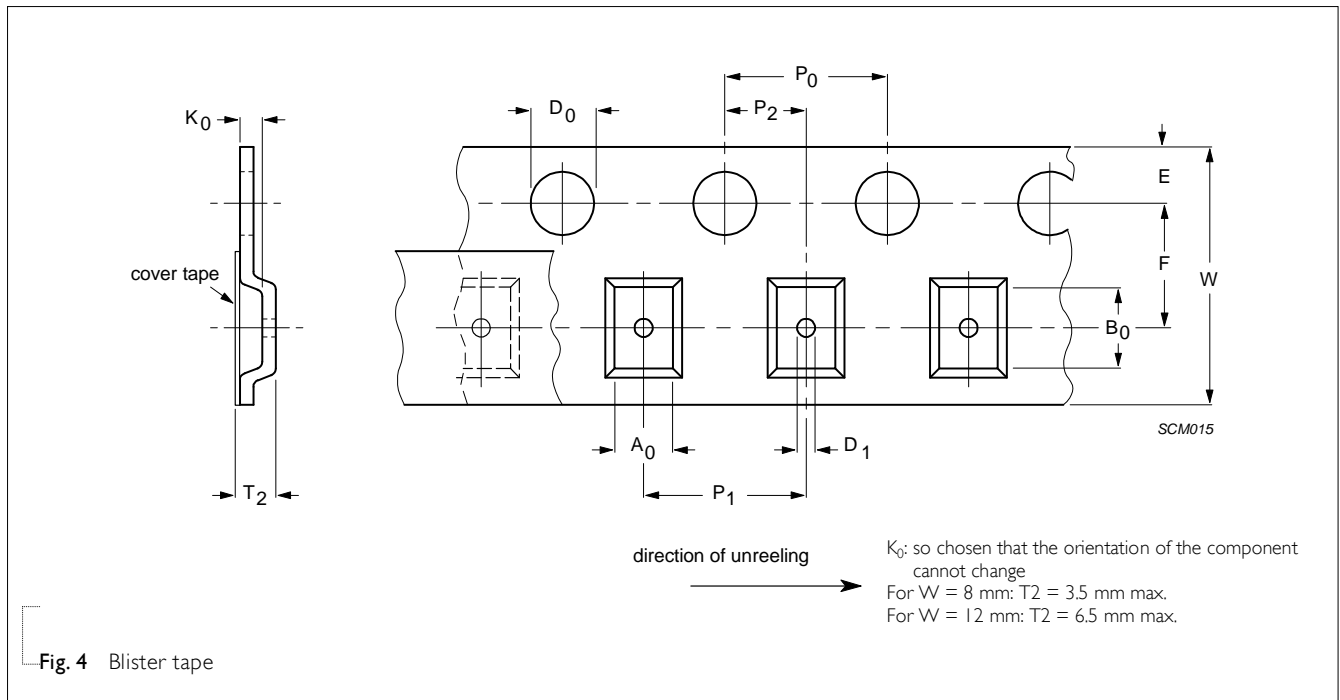


Fig. 4 Blister tape

Table 12 Dimensions of blister tape for relevant chip size; see Fig.4

SIZE CODE	SYMBOL												Unit: mm			
	A <sub>0</sub>		B <sub>0</sub>		K <sub>0</sub>		W	E	F	ØD <sub>0</sub>	ØD <sub>1</sub>	P <sub>0</sub> <sup>(2)</sup>	P <sub>1</sub>	P <sub>2</sub>	T <sub>2</sub>	
	Min.	Max.	Min.	Max.	Min.	Max.									Min.	Max.
0805	1.29	1.65	2.09	2.60	1.25	1.62	8.1 ±0.20	1.75 ±0.1	3.5 ±0.05	1.5 +0.1/-0.0	1 +0.1/-0.0	4.0 ±0.10	4.0 ±0.10	2.0 ±0.05	1.30	1.67
1206	1.65	2.12	3.30	3.75	1.22	2.15	8.1 ±0.20	1.75 ±0.1	3.5 ±0.05	1.5 +0.1/-0.0	1 +0.1/-0.0	4.0 ±0.10	4.0 ±0.10	2.0 ±0.05	1.27	2.20
1210	2.55	3.02	3.31	3.88	0.97	2.92	8.1 ±0.20	1.75 ±0.1	3.5 ±0.05	1.5 +0.1/-0.0	1 +0.1/-0.0	4.0 ±0.10	4.0 ±0.10	2.0 ±0.05	1.02	2.97
1808	2.05	2.55	4.80	5.45	1.30	2.45	12.1 ±0.20	1.75 ±0.1	5.5 ±0.05	1.5 +0.1/-0.0	1.5 +0.1/-0.0	4.0 ±0.10	4.0 ±0.10	2.0 ±0.05	1.35	2.50
1812	3.35	3.75	4.70	5.33	0.70	2.40	12.1 ±0.20	1.75 ±0.1	5.5 ±0.05	1.5 +0.1/-0.0	1.5 +0.1/-0.0	4.0 ±0.10	8.0 ±0.10	2.0 ±0.05	0.75	2.45

**NOTE**

1. Typical capacitor displacement in pocket
2. P<sub>0</sub> pitch tolerance over any 10 pitches is ±0.2 mm

**REEL SPECIFICATION**

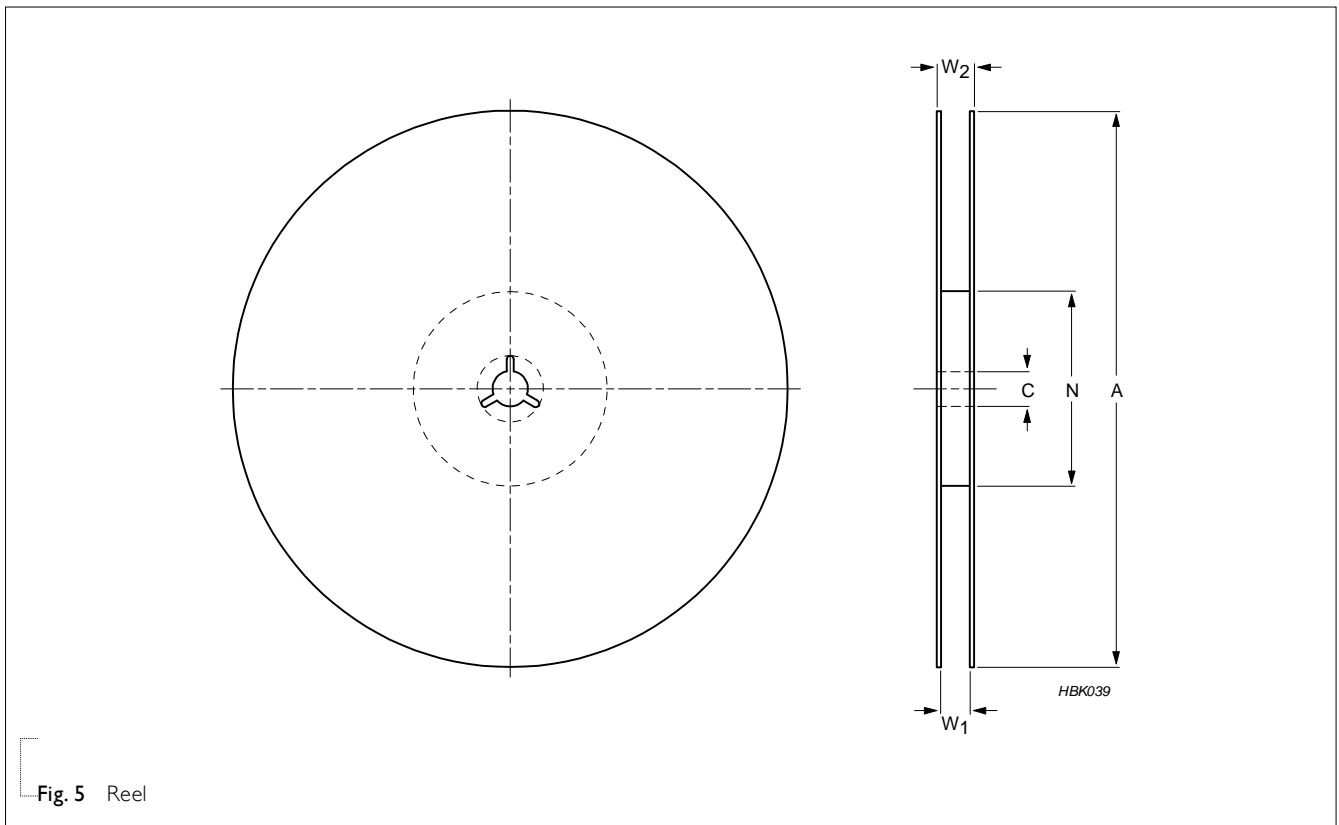


Fig. 5 Reel

Table 13 Reel dimensions; see Fig.5

TAPE WIDTH	SYMBOL					Unit: mm
	A	N	C	$W_1$	$W_{2max.}$	
8 (Ø178 mm/7")	178 ±1.0	60 ±1.0	13 +0.50/-0.20	9.4 ±1.5	14.4	
8 (Ø330 mm/13")	330 ±1.0	100 ±1.0	13 +0.50/-0.20	9.0 ±0.2	14.4	
12 (Ø178 mm/7")	178 ±1.0	60 ±1.0	13 +0.50/-0.20	13.4 ±1.5	18.4	

**PROPERTIES OF REEL**

Material: polystyrene

Surface resistance:  $<10^{10} \text{ } \Omega/\text{sq.}$

ELECTRICAL CHARACTERISTICS**NP0/X7R DIELECTRIC CAPACITORS; NISN TERMINATIONS**

Unless otherwise specified, all test and measurements shall be made under standard atmospheric conditions for testing as given in 5.3 of IEC 60068-1:

- Temperature: 15 °C to 35 °C
- Relative humidity: 25% to 75%
- Air pressure: 86 kPa to 106 kPa

Before the measurements are made, the capacitor shall be stored at the measuring temperature for a time sufficient to allow the entire capacitor to reach this temperature.

The period as prescribed for recovery at the end of a test is normally sufficient for this purpose.

Table 14

DESCRIPTION		VALUE
Capacitance range		0.47 pF to 2.2 μF
Capacitance tolerance		
NP0	C < 10 pF	±0.25 pF, ±0.5 pF
	C ≥ 10 pF	±2%, ±5%, ±10%
X7R		±5% <sup>(1)</sup> , ±10%, ±20%
Dissipation factor (D.F.)		
NP0	C < 30 pF	≤ 1 / ( 400 + 20C )
	C ≥ 30 pF	≤ 0.1 %
X7R	General	≤ 2.5 %
	Exception	1206/100V/ 560nF to 1uF, 1210/100V/1uF and 2.2uF ≤ 3.5% 0603/100V/12nF to 100nF, 0805/100V/560nF to 1uF, 1206/100V/2.2uF ≤ 5%
Insulation resistance after 1 minute at U <sub>r</sub> (DC)		R <sub>ins</sub> ≥ 10 GΩ or R <sub>ins</sub> × C ≥ 500Ω·F whichever is less R <sub>ins</sub> × C ≥ 100Ω·F <sup>(2)</sup>
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
2. 1210/ X7R/ 630V/ 27nF to 47nF  
1210/ X7R/ 500V/ 56nF to 100nF  
1812/ X7R/ 630V/ 39nF to 100nF



**SOLDERING RECOMMENDATION**

Table 15

SOLDERING METHOD	SIZE					
	0201	0402	0603	0805	1206	≥ 1210
Reflow	Reflow only	> 100 nF	> 1.0 μF	> 2.2 μF	> 2.2 μF	Reflow only
Reflow/Wave		≤ 100 nF	≤ 1.0 μF	≤ 2.2 μF	≤ 2.2 μF	---

**TESTS AND REQUIREMENTS**

Table 13 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 (in Table 14)
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 (in Table 14)

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS									
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.	<General purpose series> Class I: $\Delta C/C: \pm 30\text{ppm}/^\circ\text{C}$  Class2: X7R: $\Delta C/C: \pm 15\%$  <High Capacitance series> Class2: X7R: $\Delta C/C: \pm 15\%$									
		<table border="1"> <thead> <tr> <th>Step</th> <th>Temperature(°C)</th> </tr> </thead> <tbody> <tr> <td>a</td> <td>25±2</td> </tr> <tr> <td>b</td> <td>Lower temperature±3°C</td> </tr> <tr> <td>c</td> <td>25±2</td> </tr> <tr> <td>d</td> <td>Upper Temperature±2°C</td> </tr> <tr> <td>e</td> <td>25±2</td> </tr> </tbody> </table> <p>(1) Class I Temperature Coefficient shall be calculated from the formula as below  <math display="block">\text{Temp. Coefficient} = \frac{C2 - C1}{C1 \times \Delta T} \times 10^6 \text{ [ppm}/^\circ\text{C]}</math>                     C1: Capacitance at step c                      C2: Capacitance at 125°C                      ΔT: 100°C (=125°C -25°C)</p> <p>(2) Class II Capacitance Change shall be calculated from the formula as below  <math display="block">\Delta C = \frac{C2 - C1}{C1} \times 100\%</math>                     C1: Capacitance at step c                      C2: Capacitance at step b or d</p>		Step	Temperature(°C)	a	25±2	b	Lower temperature±3°C	c	25±2	d
Step	Temperature(°C)											
a	25±2											
b	Lower temperature±3°C											
c	25±2											
d	Upper Temperature±2°C											
e	25±2											
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 size = 0402: 2-5N size = 0201: 1N									
Bending Strength		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 5 mm	No visible damage  $\Delta C/C$ Class I: NP0: within ±1% or 0.5 pF, whichever is greater Class2: X7R: ±10%									

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS
Resistance to Soldering Heat	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 &gt; 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> <hr/> <p><math>\Delta C/C</math></p> <p>Class 1: NP0: within ±0.5% or 0.5 pF, whichever is greater</p> <p>Class2: X7R: ±10%</p> <hr/> <p>D.F. within initial specified value</p> <p>R<sub>ins</sub> within initial specified value</p>
Solderability	4.10	<p>Preheated the temperature of 80 °C to 140 °C and maintained for 30 seconds to 60 seconds.</p> <p>1. Temperature: 235±5°C / Dipping time: 2 ±0.5 s</p> <p>2. Temperature: 245±5°C / Dipping time: 3 ±0.5 s (lead free)</p> <p>Depth of immersion: 10mm</p>	<p>The solder should cover over 95% of the critical area of each termination</p>
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></p> <p>Class 1: NP0: within ±1% or 1 pF, whichever is greater</p> <p>Class2: X7R: ±15%</p> <hr/> <p>D.F. meet initial specified value</p> <p>R<sub>ins</sub> meet initial specified value</p>

TEST	TEST METHOD	PROCEDURE	REQUIREMENTS															
Damp Heat	4.13	<p>3. Preconditioning, class 2 only: 150 +0/-10 °C /1 hour, then keep for 24 ±1 hour at room temp</p> <p>4. Initial measure: Spec: refer initial spec C, D, IR</p> <p>5. Damp heat test: 500 ±12 hours at 40 ±2 °C; 90 to 95% R.H.</p> <p>6. Recovery: Class 1: 6 to 24 hours Class 2: 24 ±2 hours</p> <p>7. 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 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% D.F. Class 1: NP0: ≤ 2 x specified value Class2: X7R: ≥ 25 V: ≤ 5% <math>R_{ins}</math> Class 1: NP0: ≥ 2,500 MΩ or <math>R_{ins} \times C_r \geq 25\Omega \cdot F</math> whichever is less Class2: X7R: ≥ 500 MΩ or <math>R_{ins} \times C_r \geq 25\Omega \cdot F</math> whichever is less</p>															
Endurance	IEC 60384-21/22	<p>4.14</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 initial spec C, D, IR</p> <p>3. Endurance test: Temperature: NP0/X7R: 125 °C Specified stress voltage applied for 1,000 hours:</p> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Voltage</th> <th>NP0</th> <th>X7R</th> </tr> </thead> <tbody> <tr> <td>≤ 100V</td> <td>2.0 × Ur</td> <td>2.0 × Ur</td> </tr> <tr> <td>200/250V</td> <td>1.5 × Ur</td> <td>1.5 × Ur</td> </tr> <tr> <td>500/630V</td> <td>1.3 × Ur</td> <td>1.2 × Ur</td> </tr> <tr> <td>≥ 1KV</td> <td>1.2 × Ur</td> <td>1.1 × Ur</td> </tr> </tbody> </table> <p>* NP0, 0603, 100V, 5.1nF to 10nF, apply voltage : 1.5 × Ur</p> <p>4. High voltage series follows with below stress condition:</p> <p>5. Recovery time: 24 ±2 hours</p> <p>6. 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 precondition according to "IEC 60384 4.1" and then the requirement shall be met.</p>	Voltage	NP0	X7R	≤ 100V	2.0 × Ur	2.0 × Ur	200/250V	1.5 × Ur	1.5 × Ur	500/630V	1.3 × Ur	1.2 × Ur	≥ 1KV	1.2 × Ur	1.1 × Ur	<p>No visual damage</p> <hr/> <p><math>\Delta C/C</math> 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% <math>R_{ins}</math> Class 1: NP0: ≥ 4,000 MΩ or <math>R_{ins} \times C_r \geq 40\Omega \cdot F</math> whichever is less Class2: X7R: ≥ 1,000 MΩ or <math>R_{ins} \times C_r \geq 50\Omega \cdot F</math> whichever is less</p>
Voltage	NP0	X7R																
≤ 100V	2.0 × Ur	2.0 × Ur																
200/250V	1.5 × Ur	1.5 × Ur																
500/630V	1.3 × Ur	1.2 × Ur																
≥ 1KV	1.2 × Ur	1.1 × Ur																
Voltage Proof	4.6	<p>Specified stress voltage applied for 1~5 seconds Ur ≤ 100 V: series applied 2.5 Ur 100 V &lt; Ur ≤ 200 V series applied (1.5 Ur + 100) 200 V &lt; Ur ≤ 500 V series applied (1.3 Ur + 100) Ur &gt; 500 V: 1.3 Ur Ur ≥ 1000 V: 1.2 Ur Charge/Discharge current is less than 50 mA</p>	<p>No breakdown or flashover</p>															

REVISION HISTORY

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 24	Jun. 11, 2021	-	- Add X7R : 1812/630V/ 39nF to 100nF - $R_{ins}$ revised to $R_{ins} \times C \geq 100 \Omega \cdot F$ X7R : 1210/630V/27nF to 47nF 1210/500V/56nF to 100nF
Version 23	Mar. 25, 2021	-	- Add NPO : 1206/630V 6.8nF/10nF 1210/630V/22nF 1812/630V/22nF X7R : 2220/630V/150nF to 220nF
Version 22	Jun. 10, 2020	-	- Add NPO : 0603/100V/1.8nF to 10nF, 1206/250V/3.3nF to 3.9nF 1206/630V/2.2nF X7R : 0805/100V330nF to 1 $\mu$ F, 0805/250V/68nF to 100nF 1206/100V/680nF, 1210/500V/68nF to 100nF, 1210/630V/47nF - Modify NPO :1210/100V/12nF to 15nF thickness to 1.25mm X7R :1210/630V/22nF thickness to 1.6mm 1210/630V/27nF to 33nF thickness to 2.0mm
Version 21	Jul. 13, 2018	-	- Add NPO : 0402/120pF to 1nF/100V, 0603/1.2nF to 1.5nF/100V, 1206/1.8nF/630V, 1210/12nF to 22nF/100V X7R : 0805/33nF to 47nF/200 to 250V
Version 20	Sep. 14, 2017	-	- Dimension outlines updated
Version 19	Mar 7, 2017	-	- 0805 L4 spec updated
Version 18	Dec 9, 2016	-	- Soldering recommendation update
Version 17	Aug 16, 2016	-	- Capacitance range & thickness update
Version 16	Apr. 16, 2015	-	- Capacitance range & thickness
Version 15	Apr. 16, 2015	-	- Electrical characteristics update
Version 14	Sep. 25, 2014	-	- Electrical characteristics update
Version 13	Apr. 21, 2014	-	- Electrical characteristics update
Version 12	Dec. 12, 2013	-	- Electrical characteristics update
Version 11	Jun. 17, 2013	-	- Test method and procedure updated
Version 10	Nov 22, 2012	-	- Test method and procedure updated
Version 9	Feb 02, 2012	-	- Test method and procedure updated
Version 8	Apr 22, 2011	-	- NPO 0402 100V added
Version 7	Mar 01, 2011	-	- Dimension updated
Version 6	Sep 30, 2010	-	- Update the thickness of 0805 100V
Version 5	Sep 28, 2010	-	- Product range updated - Thickness classes and packing quantity table updated

**REVISION HISTORY**

REVISION	DATE	CHANGE NOTIFICATION	DESCRIPTION
Version 2	Mar 15, 2010	-	- Product range update
Version 1	Oct 30, 2009	-	<ul style="list-style-type: none"> <li>- Change to dual brand datasheet that describe Mid-voltage NP0/X7R series with RoHS compliant</li> <li>- 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</li> <li>- Define global part number</li> <li>- Description of "Halogen Free compliant" added</li> <li>- Test method and procedure updated</li> </ul>
Version 0	Sep 08, 2005	-	- New

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