

# DATA SHEET

## SURFACE-MOUNT CERAMIC MULTILAYER CAPACITORS

Class 2, X7R  
16 V TO 500 V



## Surface-mount ceramic multilayer capacitors

**Class 2, X7R**  
**16 V to 500 V**

### FEATURES

- Six standard sizes
- High capacitance per unit volume
- Supplied in tape on reel or in bulk case
- NiSn terminations.

### APPLICATIONS

- Consumer electronics for example
  - Tuners
  - Television receivers
  - Video recorders
  - All types of cameras
- Telecommunications
- Automotive
- Data processing.

### DESCRIPTION

The capacitor consists of a rectangular block of ceramic dielectric in which a number of interleaved nickel electrodes are contained. This structure gives rise to a high capacitance per unit volume.

The inner electrodes are connected to the two copper terminations, coated with a barrier layer of plated nickel and finally covered with a layer of plated tin (NiSn). A cross section of the structure is shown in Fig.1.

### QUICK REFERENCE DATA

DESCRIPTION	VALUE
Rated voltage $U_R$ (DC)	16 V, 25 V, 50 V, 100 V, 200 V, 250 V and 500 V (IEC)
Capacitance range (E12 series):	
16 V	4.7 nF to 1 $\mu$ F
25 V	3.3 nF to 1 $\mu$ F
50 V	100 pF to 1 $\mu$ F
100 V	220 pF to 560 nF
200 V	220 pF to 150 nF
250 V	220 pF to 33 nF
500 V	470 pF to 15 nF
Tolerance on capacitance	$\pm 10\%$ ; $\pm 5\%$
Test voltage (DC) for 1 minute:	$2.5 \times U_R$
Sectional specifications	IEC 60384-10 second edition 1989-04; also based on CECC 32 100
Detailed specification	based on CECC 32 101-801
Climatic category (IEC 60 068)	55/125/56

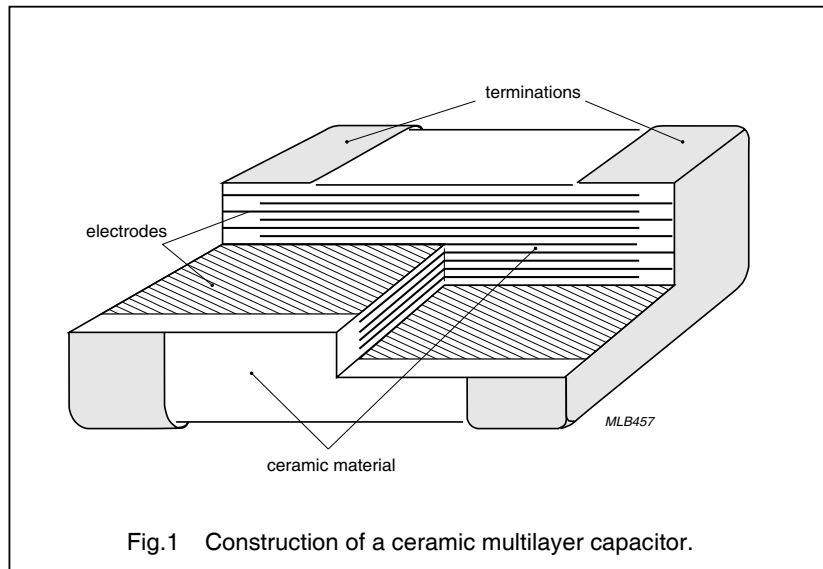
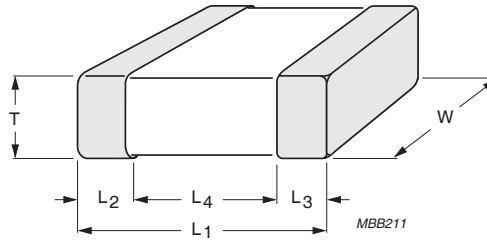


Fig.1 Construction of a ceramic multilayer capacitor.

# Surface-mount ceramic multilayer capacitors

## Class 2, X7R 16 V to 500 V

### MECHANICAL DATA



For dimensions see Table 1.

Fig.2. Component outline.

### Physical dimensions

Table 1 Capacitor dimensions

CASE SIZE	L <sub>1</sub>	W	T		L <sub>2</sub> and L <sub>3</sub>		L <sub>4</sub> MIN.
			MIN.	MAX.	MIN.	MAX.	
<b>Dimensions in millimetres</b>							
0402	1.0 ±0.05	0.5 ±0.05	0.45	0.55	0.20	0.30	0.40
0603	1.6 ±0.10	0.8 ±0.07	0.73	0.87	0.25	0.65	0.40
0805	2.0 ±0.10	1.25 ±0.10	0.50	1.35	0.25	0.75	0.55
1206	3.2 ±0.15	1.6 ±0.15	0.50	1.25	0.25	0.75	1.40
1210	3.2 ±0.20	2.5 ±0.20	0.50	2.10	0.25	0.75	1.40
1812	4.5 ±0.20	3.2 ±0.20	0.90	1.75	0.25	0.75	2.20
<b>Dimensions in inches</b>							
0402	0.040 ±0.002	0.020 ±0.002	0.018	0.022	0.008	0.012	0.016
0603	0.063 ±0.004	0.032 ±0.003	0.029	0.035	0.010	0.026	0.016
0805	0.079 ±0.004	0.049 ±0.004	0.020	0.053	0.010	0.030	0.022
1206	0.126 ±0.006	0.063 ±0.006	0.020	0.049	0.010	0.030	0.056
1210	0.126 ±0.008	0.098 ±0.008	0.020	0.083	0.010	0.030	0.056
1812	0.177 ±0.008	0.126 ±0.008	0.035	0.069	0.010	0.030	0.088

**Surface-mount ceramic  
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**SELECTION CHART FOR 16 V**

C (nF)	LAST TWO DIGITS OF 12NC	16 V			
		0402	0603	0805	1206
4.7	32				
5.6	33				
6.8	34				
8.2	35	0.5 ±0.05			
10	36				
12	37				
15	38				
18	39				
22	41				
27	42				
33	43				
39	44				
47	45		0.8 ±0.07		
56	46			0.6 ±0.1	
68	47				
82	48				
100	49				
120	51				
150	52			0.85 ±0.1	
180	53				
220	54				
270	55				
330	56				0.85 ±0.1
390	57			1.25 ±0.1	
470	58				
560	59				
680	61				1.15 ±0.1
820	62				
1 000	63				

**Note**

1. Values in shaded cells indicate thickness class in mm.
2. Thickness classification and packing quantities refer to table 2.

**Surface-mount ceramic  
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**Class 2, X7R  
16 V to 500 V**
**SELECTION CHART FOR 25 V**

C (nF)	LAST TWO DIGITS OF 12NC	25 V				
		0402	0603	0805	1206	1210
3.3	29					
3.9	31					
4.7	32					
5.6	33	0.5 ±0.05				
6.8	34					
8.2	35					
10	36					
12	37					
15	38					
18	39			0.6 ±0.1		
22	41					
27	42					
33	43		0.8 ±0.07			
39	44					
47	45					
56	46					
68	47			0.85 ±0.1		
82	48					
100	49					
120	51					
150	52				0.85 ±0.1	
180	53					
220	54					
270	55					
330	56				1.15 ±0.1	
390	57					
470	58					
560	59					1.15 ±0.1
680	61					
820	62					1.6 ±0.2
1 000	63					

**Note**

1. Values in shaded cells indicate thickness class in mm.
2. Thickness classification and packing quantities refer to table 2.

## Surface-mount ceramic multilayer capacitors

## Class 2, X7R 16 V to 500 V

### Thickness classification and packing quantities for 16 V to 500 V

**Table 2** Quantities for all sizes and thickness

SIZE CODE	THICKNESS CLASSIFICATION (mm)	8 mm TAPE WIDTH QUANTITY PER REEL				12 mm TAPE WIDTH QUANTITY PER REEL	QUANTITY PER BULK CASE
		Ø180 mm; 7"		Ø330 mm; 13"		Ø180 mm; 7"	
		Paper	Blister	Paper	Blister	Blister	
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 ±0.1	4,000	–	20,000	–	–	10,000
	0.85 ±0.1	4,000	–	15,000	–	–	8,000
	1.25 ±0.1	–	3,000	–	10,000	–	5,000
1206	0.85 ±0.1	4,000	–	15,000	–	–	–
	1.15 ±0.1	–	3,000	–	10,000	–	–
1210	0.85 ±0.1	–	4,000	–	10,000	–	–
	1.15 ±0.1	–	3,000	–	10,000	–	–
	1.6 ±0.2	–	2,000	–	–	–	–
1812	1.15 ±0.1	–	–	–	–	1,500	–
	1.6 ±0.2	–	–	–	–	1,000	–

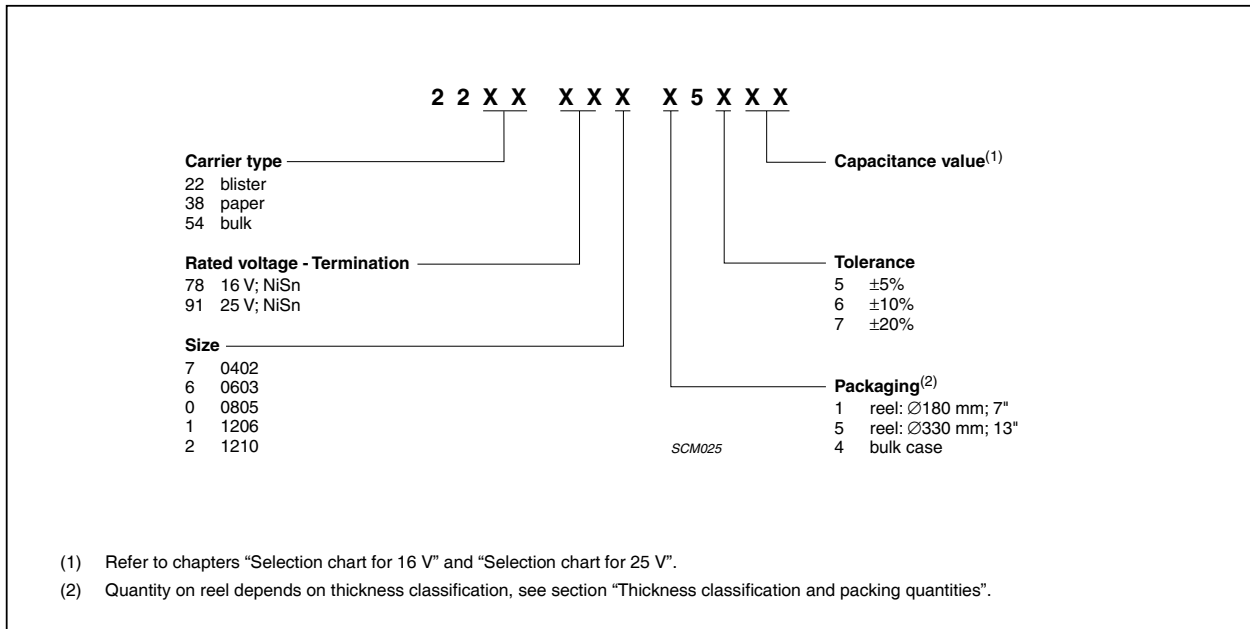
## Surface-mount ceramic multilayer capacitors

## Class 2, X7R 16 V to 500 V

### ORDERING INFORMATION FOR 16 V AND 25 V

Components may be ordered by using either a Phycomp's unique 12NC or simple 15-digit clear text code.

#### Ordering code 12NC (preferred)



#### Clear text code

EXAMPLE: 08052R104K8BB0D

Size Code	Temp. Char.	Capacitance	Tol.	Vol.	Termination	Packing	Marking	Series
0402 0603 0805 1206 1210	2R = X7R	104 = 100000 pF; the third digit signifies the multiplying factor: 2 = × 100 3 = × 1000 4 = × 10 000 5 = × 100 000	J = ±5% K = ±10% M = ±20%	7 = 16 V 8 = 25 V	B = NiSn	2 = 180 mm; 7" paper 3 = 330 mm; 13" paper B = 180 mm; 7" blister F = 330 mm; 13" blister P = bulk case	0 = no marking	D = BME

## Surface-mount ceramic multilayer capacitors

## Class 2, X7R 16 V to 500 V

### SELECTION CHART FOR 50 V

C (pF)	LAST TWO DIGITS OF 12NC	50 V					
		0402	0603	0805	1206	1210	1812
100	09						
120	11						
150	12						
180	13						
220	14						
270	15						
330	16						
390	17						
470	18						
560	19						
680	21	0.5 ±0.05					
820	22						
1,000	23						
1,200	24		0.8 ±0.07				
1,500	25						
1,800	26			0.6 ±0.1			
2,200	27						
2,700	28				0.85 ±0.1		
3,300	29						
3,900	31						
4,700	32						
5,600	33						
6,800	34						
8,200	35						
10,000	36						
12,000	37						
15,000	38					0.85 ±0.1	
18,000	39						
22,000	41						

#### Note

1. Values in shaded cells indicate thickness class in mm.
2. Thickness classification and packing quantities refer to table 2.



**Surface-mount ceramic  
multilayer capacitors**
**Class 2, X7R  
16 V to 500 V**
**SELECTION CHART FOR 50 V CONTINUED**

C (pF)	LAST TWO DIGITS OF 12NC	50 V					
		0402	0603	0805	1206	1210	1812
27,000	42						
33,000	43						
39,000	44						
47,000	45			0.85 ±0.1		0.85 ±0.1	
56,000	46				0.85 ±0.1		
68,000	47						
82,000	48						
100,000	49						
120,000	51						
150,000	52						
180,000	53				1.15 ±0.1	1.15 ±0.1	
220,000	54						1.15 ±0.1
270,000	55						
330,000	56						
390,000	57					1.6 ±0.2	
470,000	58						
560,000	59						
680,000	61						
820,000	62						1.6 ±0.2
1,000,000	63						

**Note**

1. Values in shaded cells indicate thickness class in mm.
2. Thickness classification and packing quantities refer to table 2.

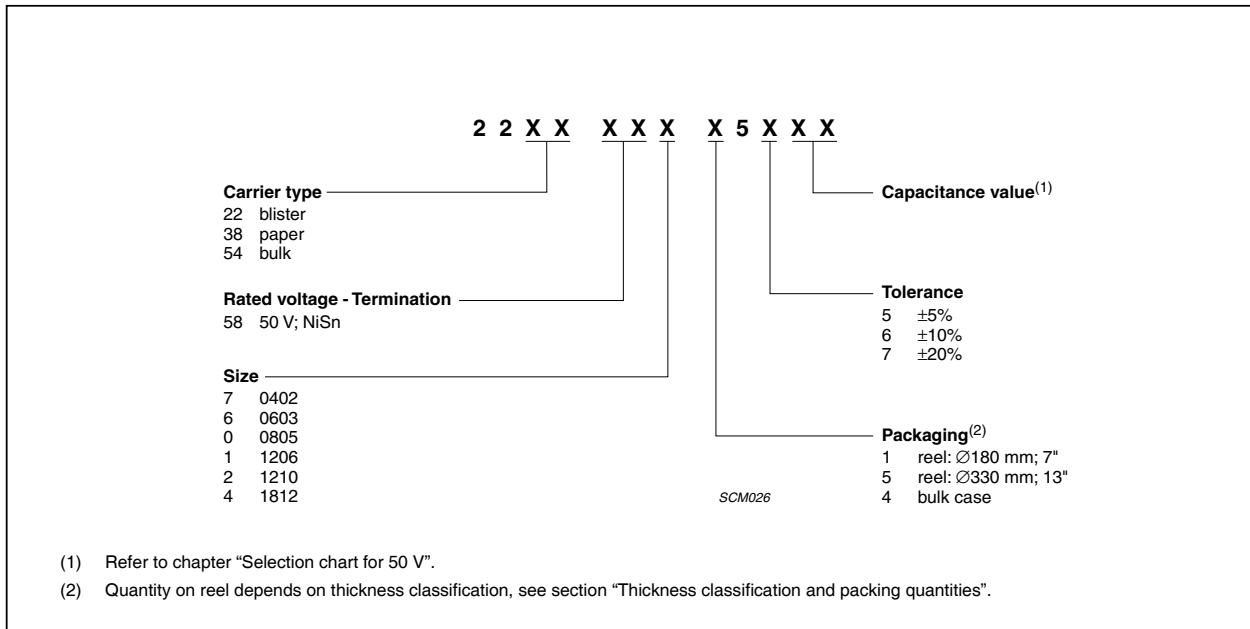
## Surface-mount ceramic multilayer capacitors

## Class 2, X7R 16 V to 500 V

### ORDERING INFORMATION FOR 50 V

Components may be ordered by using either a Phycomp's unique 12NC or simple 15-digit clear text code.

#### Ordering code 12NC (preferred)



#### Clear text code

EXAMPLE: 08052R104K9BB0D

Size Code	Temp. Char.	Capacitance	Tol.	Vol.	Termination	Packing	Marking	Series
0402 0603 0805 1206 1210 1812	2R = X7R	104 = 100000 pF; the third digit signifies the multiplying factor: 1 = × 10 2 = × 100 3 = × 1000 4 = × 10 000 5 = × 100 000	J = ±5% K = ±10% M = ±20%	9 = 50 V	B = NiSn	2 = 180 mm; 7" paper 3 = 330 mm; 13" paper B = 180 mm; 7" blister F = 330 mm; 13" blister P = bulk case	0 = no marking	D = BME

**Surface-mount ceramic  
multilayer capacitors**
**Class 2, X7R  
16 V to 500 V**
**SELECTION CHART FOR 100 V**

C (pF)	LAST TWO DIGITS OF 12NC	100 V			
		0805	1206	1210	1812
220	14				
270	15				
330	16				
390	17				
470	18				
560	19				
680	21				
820	22				
1,000	23				
1,200	24				
1,500	25	0.6 ±0.1	0.85 ±0.1		
1,800	26				
2,200	27				
2,700	28				
3,300	29				
3,900	31				
4,700	32				
5,600	33				
6,800	34				
8,200	35				
10,000	36				

**Note**

1. Values in shaded cells indicate thickness class in mm.
2. Thickness classification and packing quantities refer to table 2.

**Surface-mount ceramic  
multilayer capacitors**
**Class 2, X7R  
16 V to 500 V**
**SELECTION CHART FOR 100 V CONTINUED**

C (pF)	LAST TWO DIGITS OF 12NC	100 V			
		0805	1206	1210	1812
12,000	37				
15,000	38				
18,000	39	0.85 ±0.1			
22,000	41				
27,000	42		0.85 ±0.1		
33,000	43				
39,000	44				
47,000	45				
56,000	46				
68,000	47			0.85 ±0.1	
82,000	48		1.15 ±0.1		
100,000	49				
120,000	51				
150,000	52			1.15 ±0.1	
180,000	53				1.15 ±0.1
220,000	54				
270,000	55				
330,000	56				
390,000	57				
470,000	58				1.6 ±0.2
560,000	59				

**Note**

1. Values in shaded cells indicate thickness class in mm.
2. Thickness classification and packing quantities refer to table 2.

**Surface-mount ceramic  
multilayer capacitors**
**Class 2, X7R  
16 V to 500 V**
**SELECTION CHART FOR 200 V AND 250 V**

C (pF)	LAST TWO DIGITS OF 12NC	200 V				250 V	
		0805	1206	1210	1812	0805	1206
220	14						
270	15						
330	16						
390	17						
470	18						
560	19						
680	21						
820	22						
1,000	23	0.85 ±0.1				0.85 ±0.1	
1,200	24						
1,500	25						
1,800	26		0.85 ±0.1				0.85 ±0.1
2,200	27						
2,700	28						
3,300	29						
3,900	31						
4,700	32						
5,600	33						
6,800	34	1.25 ±0.1				1.25 ±0.1	
8,200	35						

**Note**

1. Values in shaded cells indicate thickness class in mm.
2. Thickness classification and packing quantities refer to table 2.

**Surface-mount ceramic  
multilayer capacitors**
**Class 2, X7R  
16 V to 500 V**
**SELECTION CHART FOR 200 V AND 250 V CONTINUED**

C (pF)	LAST TWO DIGITS OF 12NC	200 V				250 V	
		0805	1206	1210	1812	0805	1206
10,000	36	1.25 ±0.1				1.25 ±0.1	
12,000	37		0.85 ±0.1	0.85 ±0.1			0.85 ±0.1
15,000	38						
18,000	39						
22,000	41		1.15 ±0.1				1.15 ±0.1
27,000	42						
33,000	43						
39,000	44			1.15 ±0.1			
47,000	45						
56,000	46						
68,000	47						
82,000	48				1.15 ±0.1		
100,000	49						
120,000	51						
150,000	52						

**Note**

1. Values in shaded cells indicate thickness class in mm.
2. Thickness classification and packing quantities refer to table 2.

**Surface-mount ceramic  
multilayer capacitors**
**Class 2, X7R  
16 V to 500 V**
**SELECTION CHART FOR 500 V**

C (pF)	LAST TWO DIGITS OF 12NC	500 V		
		1206	1210	1812
470	18			
560	19			
680	21			
820	22			
1,000	23	1.15 ±0.1		
1,200	24			
1,500	25			
1,800	26			
2,200	27			
2,700	28			
3,300	29			
3,900	31			
4,700	32		1.15 ±0.1	
5,600	33			0.85 ±0.1
6,800	34			
8,200	35			
10,000	36			
12,000	37			1.15 ±0.1
15,000	38			

**Note**

1. Values in shaded cells indicate thickness class in mm.
2. Thickness classification and packing quantities refer to table 2.

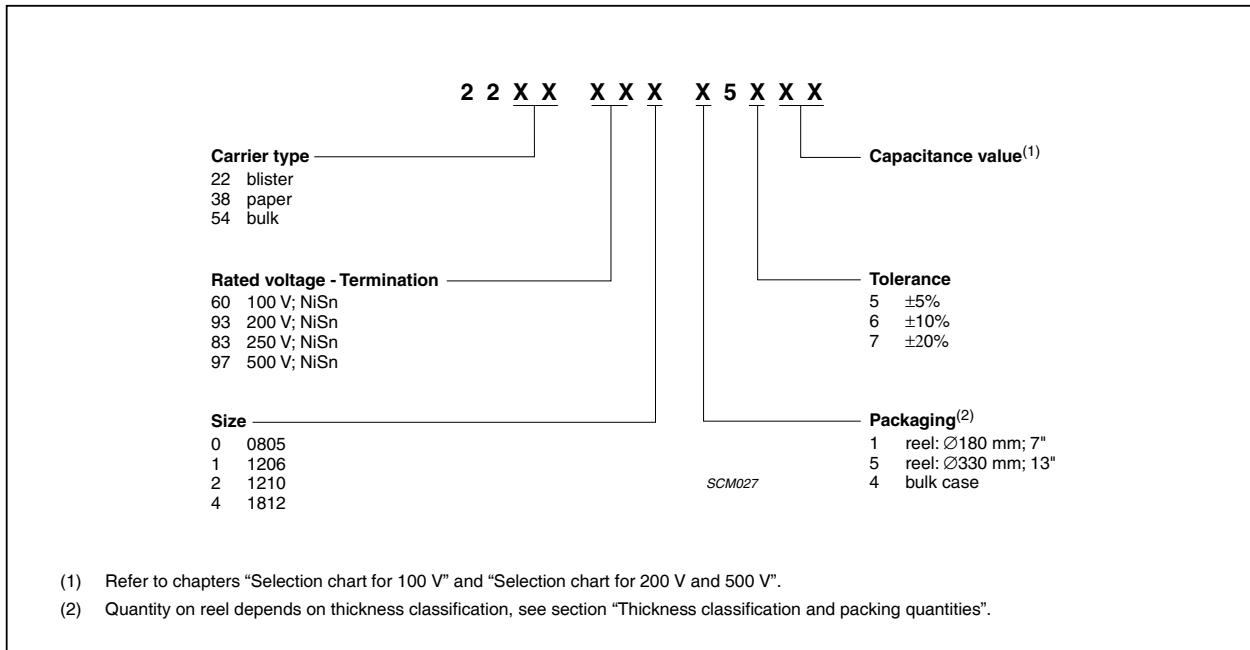
## Surface-mount ceramic multilayer capacitors

## Class 2, X7R 16 V to 500 V

### ORDERING INFORMATION FOR 100 V, 200 V, 250 V AND 500 V

Components may be ordered by using either a Phycomp's unique 12NC or simple 15-digit clear text code.

#### Ordering code 12NC (preferred)



#### Clear text code

EXAMPLE: 18122R104KBBB0D

Size Code	Temp. Char.	Capacitance	Tol.	Vol.	Termination	Packing	Marking	Series
0805 1206 1210 1812	2R = X7R	104 = 100000 pF; the third digit signifies the multiplying factor: 1 = × 10 2 = × 100 3 = × 1000 4 = × 10 000	J = ±5% K = ±10% M = ±20%	0 = 100 V B = 200 V C = 250 V D = 500 V	B = NiSn	2 = 180 mm; 7" paper 3 = 330 mm; 13" paper B = 180 mm; 7" blister F = 330 mm; 13" blister P = bulk case	0 = no marking	D = BME



## Surface-mount ceramic multilayer capacitors

## Class 2, X7R 16 V to 500 V

### ELECTRICAL CHARACTERISTICS

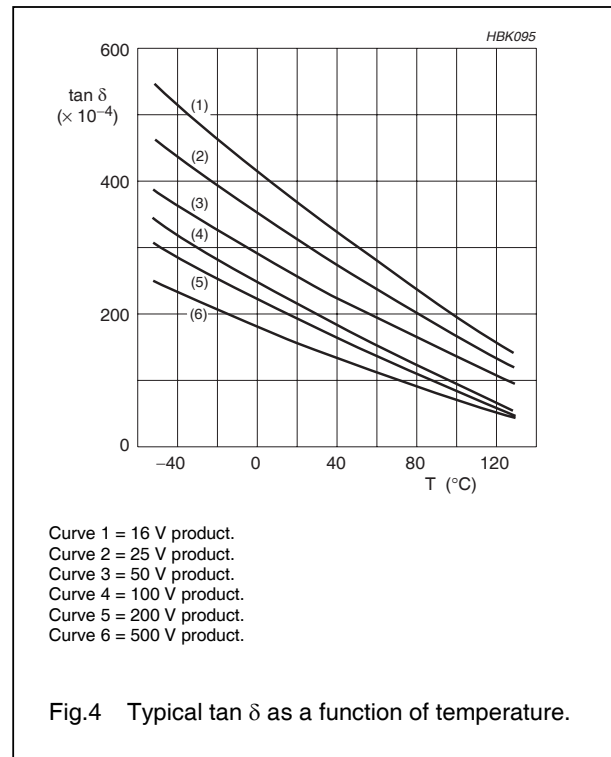
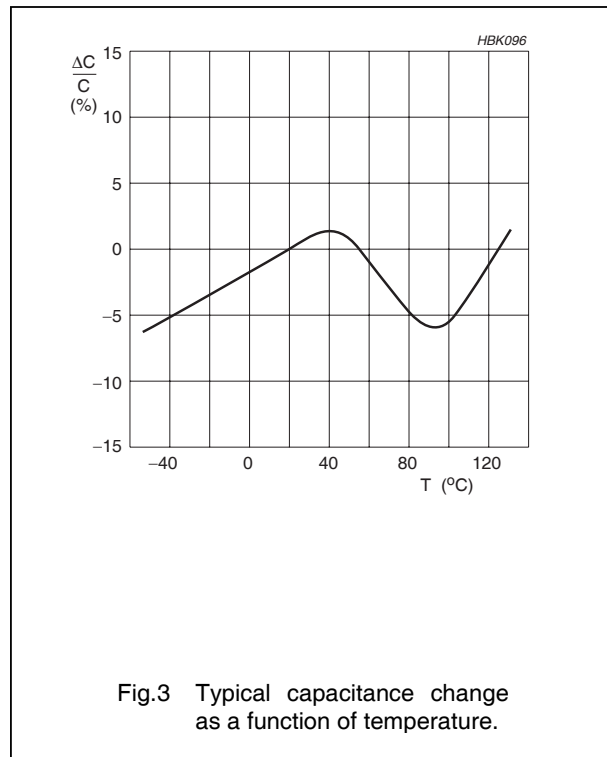
#### Class 2 capacitors; X7R dielectric; NiSn terminations

Unless otherwise stated all electrical values apply at an ambient temperature of  $25 \pm 1$  °C, an atmospheric pressure of 86 to 105 kPa, and a relative humidity of 63 to 67%.

DESCRIPTION	VALUE
Capacitance range; note 1	100 pF to 1 $\mu$ F
Capacitance tolerance	$\pm 20\%$ , $\pm 10\%$ , $\pm 5\%$
Dissipation factor (D.F.); note 1	$\leq 2.5\%$ ; 16 V range $\leq 3.5\%$
Insulation resistance after 1 minute at $U_r$ (DC)	$R_{ins} \geq 10$ G $\Omega$ or $R_{ins} \times C \geq 500$ seconds whichever is less
Maximum capacitance change as a function of temperature (Temperature characteristic/coefficient; for typical values see Fig.3)	$\pm 15\%$
Operation temperature range	$-55$ °C to $+125$ °C

#### Note

- 1 Measured at 1 V, 1 kHz, using a four-gauge method.



## Surface-mount ceramic multilayer capacitors

## Class 2, X7R 16 V to 500 V

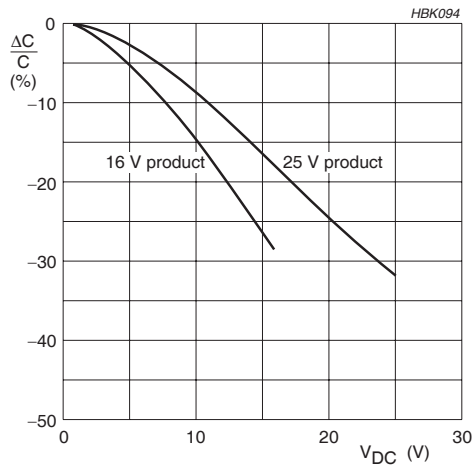


Fig.5 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage at 20 °C.

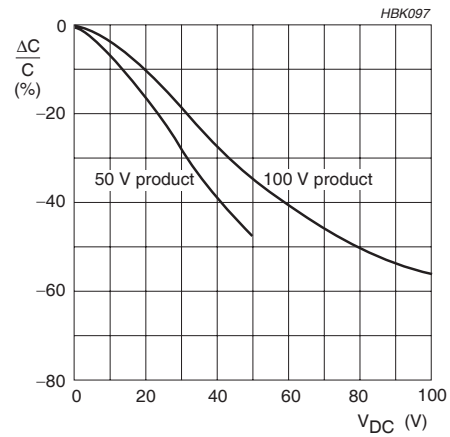


Fig.6 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage at 20 °C.

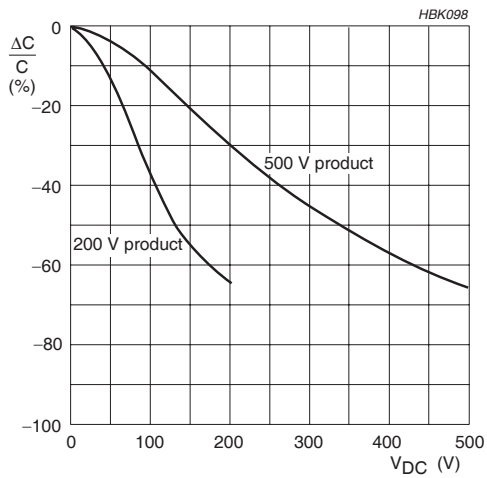


Fig.7 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage at 20 °C.

**Surface-mount ceramic  
multilayer capacitors****Class 2, X7R  
16 V to 500 V****REVISION HISTORY**

<b>Revision</b>	<b>Date</b>	<b>Change Notification</b>	<b>Description</b>
Rev.7	2004 Jan 09	-	- Revise for thickness and product range
Rev.6	2002 Aug 28	-	- Capacitance range changed from 2.2 nF
Rev.5	2002 Jul 15 2003 Jun 26	-	- Capacitance range changed from E6 into E12 - Capacitance range expanded to 4.7 $\mu$ F - Figures 3 through 7 corrected - Updated company logo