DATA HANDBOOK

Ceramic Capacitors

Philips Components



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Ceramic Capacitors

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Ceramic Capacitors

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DEFINITIONS

Data sheet status						
Objective specification	This data sheet contains target or goal specifications for product development.					
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.					
Product specification	This data sheet contains final product specifications.					
Application information						
Where application information is given, it is advisory and does not form part of the specification.						

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

INTRODUCTION

Ceramic Capacitors

Introduction to ceramic capacitors

GENERAL

Ceramic capacitors are widely used in electronic circuitry for coupling and decoupling, and in filters. These different functions require specific capacitor properties.

Ceramic capacitors can be divided into two classes:

Class 1 In these capacitors dielectric materials are used which have a very high specific resistance, very good Q and linear temperature dependence (ɛ, from 6 up to 550). They are used in such applications as oscillators and filters where low losses, capacitance drift compensation and high stability are required.

Class 2 These capacitors have higher losses and have non-linear characteristics (ϵ_r >250). They are used for coupling and decoupling.

CONSTRUCTION

The capacitance of a ceramic capacitor depends on the area of the electrodes (A), the thickness of the ceramic dielectric (t) and the dielectric constant of the ceramic material (ϵ_i) ; and on the number of dielectric layers (n) with multilayer ceramic capacitors:

$$C = \varepsilon_r \, \varepsilon_o \, \frac{A}{t} \, (n)$$

The rated voltage is dependent on the dielectric strength, this is mainly governed by the thickness of the dielectric layer and the ceramic structure. For this reason a reduction of the layer-thickness is limited.

Two constructions are shown in Figs 2 and 3.

The electrodes are normally copper, silver or some other good electrical conductor. For multilayer capacitors palladium or platinum is used since the electrodes are applied before the ceramic is fired at a temperature where silver would oxidize.

MANUFACTURING OF CERAMIC CAPACITORS

The raw materials are finely milled and carefully mixed. Thereafter the powders are calcined at temperatures between 1100 and 1300 °C to achieve the required chemical compositions. The resultant mass is reground and dopes and/or sintering means are added.

The finely ground material is mixed with a solvent and binding matter. Thin sheets are obtained by casting or rolling.

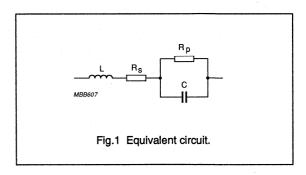
For plate capacitors these sheets are fired in a carefully controlled atmosphere at temperatures between 1200 and 1400 °C. For multilayer capacitors electrode material is printed on the sheets and after stacking and pressing of the sheets cofired with the ceramic compact at temperatures between 1000 and 1400 °C.

To prevent silver migration under humid conditions plate capacitors have copper electrodes. As an extra precaution to ensure good behaviour under humid conditions and to protect the electrodes the capacitors are lacquered. The totally in the ceramic enclosed electrodes of a multilayer capacitor guarantee good life test behaviour as well.

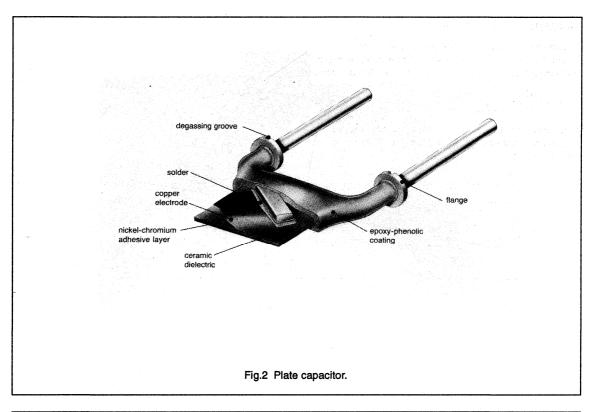
EQUIVALENT CIRCUIT FOR LEADED CAPACITORS

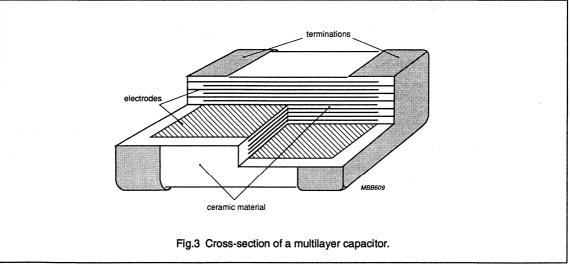
Figure 1 shows the equivalent circuit of a capacitor.

- C is the capacitance between the two electrodes, plus the stray capacitance at the edges and between the leads.
- R_p is the insulation resistance of insulation and dielectric. Generally R_p is very high, and of decreasing importance with increasing frequency.
 R_p also represents the polarization losses of the material in an alternating electric field.
- R_s is the losses in the leads, the electrodes and the contacts. Up to several hundreds of MHz the current penetration depth is greater than the conductor thickness so that no skin-effect occurs. For ceramic capacitors R_s is extremely low.
- L is the inductance of the leads and the internal inductance of the capacitor; the latter, however, is almost negligible. The inductance is only important in high frequency applications, since the capacitor will act as an inductance when the frequency is higher than its resonance frequency.



Introduction to ceramic capacitors



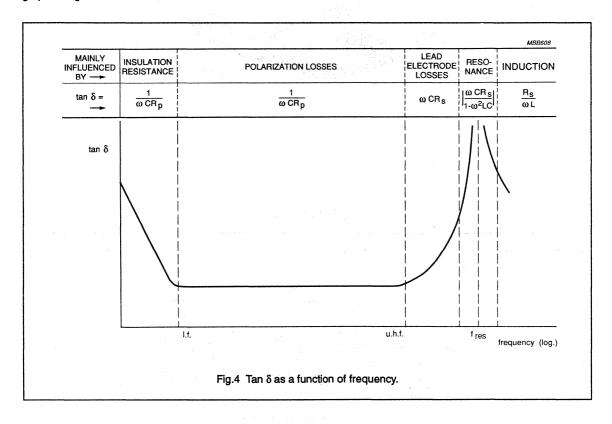


TANGENT OF THE LOSS ANGLE

The losses of a capacitor are expressed in terms of $\tan \delta$ which is the relationship between the resistive and reactive parts of the impedance, specified as follows:

$$\tan \delta = \left| \frac{R}{X} \right| = \frac{R_p + R_s \left\{ 1 + (\omega CR_p)^2 \right\}}{\omega CR_p^2 - \omega L \left\{ 1 + (\omega CR_p)^2 \right\}}$$

From this formula, $\tan \delta$ can be derived for different frequency ranges as shown diagrammatically in the graph of Fig.4.



Ceramic Capacitors

Introduction to ceramic capacitors

RELIABILITY

The failure rates shown in Table 1 have a confidence level of 60% and refer to observations of plate capacitors up to and including 1992.

Table 1 Reliability

NUMBER OF		FAILURE RATE	
COMPONENT HOURS	CATASTROPHIC	DEGRADATION	FIELD RESULT
35 960 000	2.8	1.4	<0.2 FIT

Notes

1 FIT = 1 failure rate within 109 component hours.

Catastrophic and degradation failure rates are given under normalized conditions,

i.e. at 0.5 x rated DC voltage and $T_{amb} = 40$ °C.

Catastrophic failures include capacitance, tan $\,\delta$ and insulation resistance values, which do not meet the requirements after endurance test.

Degradation failures include capacitance, tan $\,\delta$ and insulation resistance values, which are between initial values as given in the data sheet, and the requirements after endurance test.

The determination of failure rates is based on the rated conditions as stated in MIL-HDBK-217D. All the test results should be interpreted as results under rated conditions even if the temperature and voltage exceed the rated values.

The field result value has been obtained from measurements in applications with very low environmental stress, at 0.5 x rated DC voltage, continuous operation, and equipment temperature between 10 and 55 °C.

SURFACE MOUNTED

CERAMIC MULTILAYER CAPACITORS

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General overview

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MSB112A

Solid triangles are for Compact series. Solid circles are for all other types.

Fig.1 General overview for class 1 Ceramic Multilayer Capacitors.

	X7F	25 V				-	X7F	1 63 V	,						X7F	100	V		X7F	200	V		CI 400 "
CLASS II	0603	0805	1206	1210	1812	2220	0603	0805	1206	121	10	18	12	2220	0805	1206	1210	1812	0805	1206	1210	1812	CLASS II
nF	A/N	A/N	A/N	A/N	A	A	A/N	A/N	A/N	A	N	A	N	A	A	A	A	A	A/N	A/N	A/N	A/N	nF
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Solid triangles are for Compact series. Solid circles are for all other types.

Fig.2 General overview for class 2 Ceramic Multilayer Capacitors.

Standard series

FEATURES

- Six standard sizes
- High capacitance per unit volume
- Supplied in tape on reel or in boxes
- · For high frequency applications
- Available with Ag/Pd and Ni/Sn terminations.

APPLICATIONS

- Consumer electronics
- Telecommunications
- Automotive
- · Data processing.

DESCRIPTION

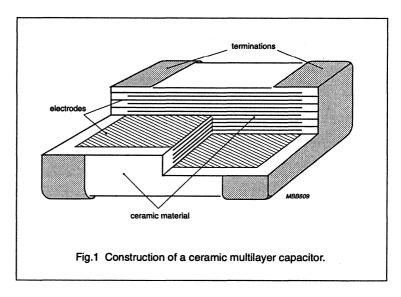
The capacitor consists of a rectangular block of ceramic dielectric in which a number of interleaved precious metal electrodes are contained. This structure gives rise to a high capacitance per unit volume. The inner electrodes are connected to the two terminations, either by silver palladium (Ag/Pd) alloy in the ratio 65: 35, or silver dipped with a barrier layer of plated nickel and finally covered with a layer of plated tin (Ni/Sn). A cross section of the structure is shown in Fig.1.

QUICK REFERENCE DATA

Rated voltage U _R (DC)	63 V (IEC), 100 V (IEC)
Capacitance range class 1,	
NPO dielectric (CG)	0.47 pF to 10 000 pF (E-12 series) (note 1)
N750 dielectric (UJ)	4.7 pF to 1 200 pF (E-12 series)
Capacitance range class 2,	
X7R dielectric (2R)	100 pF to 1 μF (E-12 series)
Tolerance on capacitance	
NPO, N750 dielectrics	±10%, ±5% and ±2% (note 2); below 10 pF, ±0.5 pF and ±0.25 pF (note 2)
X7R dielectric	±20%, ±10% and ±5%
Sectional specifications	IEC 384-10, second edition 1989-04 based on CECC 32 100
Detailed specification	based on CECC 32 101-801
Climatic category (IEC 68)	
NPO, N750 dielectrics	55/125/56
X7R dielectric	55/125/56

Notes

- Other values below 10 pF and values other than E-12 are available on request.
- 2. For lower tolerances see Narrow tolerance series.



Standard series

MECHANICAL DATA

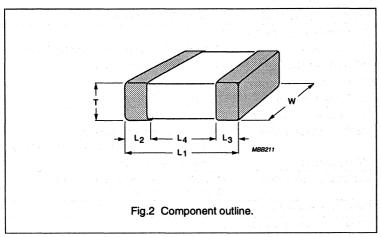


Table 1 Capacitor dimensions

			1	•	L ₂	L ₂ /L ₃					
CASE SIZE	SE SIZE L ₁ W (mm)	MIN. (mm)	MAX. (mm)	MIN. (mm)	MAX. (mm)	MIN. (mm)					
0603	1.6 ±0.1	0.8 ±0.1	0.7	0.9	0.25	0.65	0.4				
0805	2.0 ±0.1	1.25 ±0.1	0.51	1.35	0.25	0.75	0.55				
1206	3.2 ±0.15	1.6 ±0.15	0.51	1.75	0.25	0.75	1.4				
1210	3.2 ±0.2	2.5 ±0.2	0.51	1.8	0.25	0.75	1.4				
1812	4.5 ±0.2	3.2 ±0.2	0.51	1.8	0.25	0.75	2.2				
2220	5.7 ±0.2	5.0 ±0.2	0.51	1.8	0.25	0.75	2.9				

Standard series

CAPACITANCE SELECTION CHART FOR CLASS 1 NPO DIELECTRIC 63 VOLT SERIES

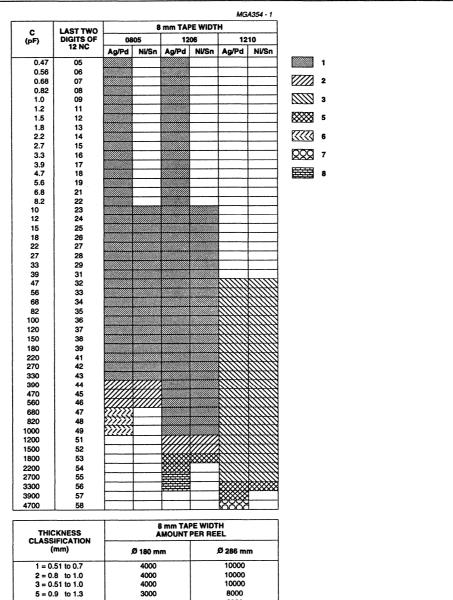
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- 1	271											
- 1	331								IIIII			
- 1	391							IIIII	IIIII	11111	IIIII	
-	471					1		IIIII	MILL	11111	711111	11111
- 1	561					1		IIII	71111	IIIII	IIIII	11111
	681				XXXX				IIIII		11111	11111
	821				\sim			MILL	MILL	IIIII	77777	11111
-	102				<i>((((</i>			au c	IIIII	uuu	m_{I}	uu_{I}
	122							IIIII	MILL	MILLY	uuu	IIIII
	152							uu	ann	777777	uu	m_{L}
1	182					₩₩	⋘⋘	IIIII	IIIII	IIIII	111111	m_L
	222					₩₩	⋘⋘	IIIII	IIIII	uuu	VIIII V	IIIII
	272							IIII		11111	11111	IIIII
	332							₩₩	$\times\!\!\times\!\!\times\!\!\times$	m_{II}	11111	m_L
1	392							*******		IIIII	11111	IIII
	472							ÖÖÖÖ	0000	IIIII	11111	11111
- 1	562									IIIII	IIIII	IIIII
	682											IIIII
- 1	822											IIIII
	103			I		1	l					THIT

THICKNESS CLASSIFICATION	8 mm TA AMOUNT	12 mm TAPE WIDTH AMOUNT PER REEL	
(mm)	Ø 180 mm	Ø 286 mm	Ø 180 mm
1 = 0.51 to 0.7	4000	10000	2000
2 = 0.8 to 1.0	4000	10000	2000
3 = 0.51 to 1.0	4000	10000	2000
4 = 0.8 ± 0.1	4000	10000	_
5 = 0.9 to 1.3	3000	8000	1500
6 = 1.25 ± 0.1	3000	8000	-
7 = 1.2 to 1.75	2500	7000	-
8 = 1.6 ± 0.15	2500	7000	-

Fig.3 Selection chart for class 1 NPO dielectric 63 V with Ag/Pd and Ni/Sn terminations.

Standard series

CAPACITANCE SELECTION CHART FOR CLASS 1 NPO DIELECTRIC 100 VOLT SERIES



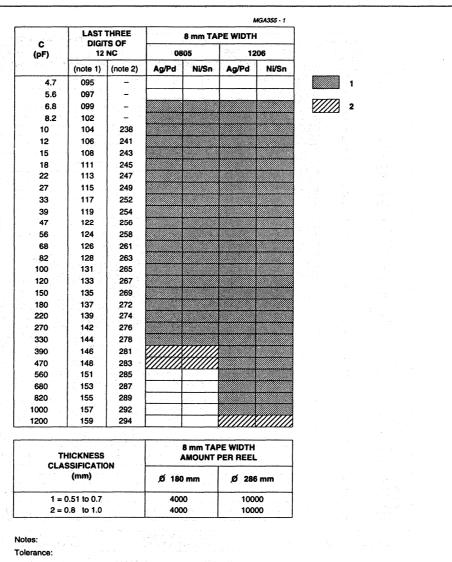
 $6 = 1.25 \pm 0.1$ 3000 8000 2500 7000 7 = 1.2 to 1.75 8 = 1.6 ± 0.15

Fig.4 Selection chart for class 1 NPO dielectric 100 V with Ag/Pd and Ni/Sn terminations.

17 **April 1993**

Standard series

CAPACITANCE SELECTION CHART FOR CLASS 1 N750 DIELECTRIC 63 VOLT SERIES



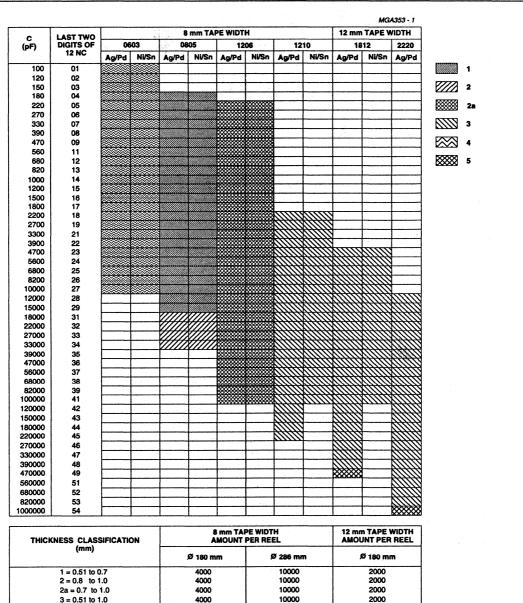
- 1. 0.25 pF for C ≤ 4.7 pF 0.5 pF for 6.6 pF ≤ C ≤ 8.2 pF 5% for C ≥ 10 pF
- 2. 10% for C≥10 pF

Fig.5 Selection chart for class 1 N750 dielectric 63 V with Ag/Pd and Ni/Sn terminations.

18

Standard series

CAPACITANCE SELECTION CHART FOR CLASS 2 X7R DIELECTRIC 63 VOLT SERIES

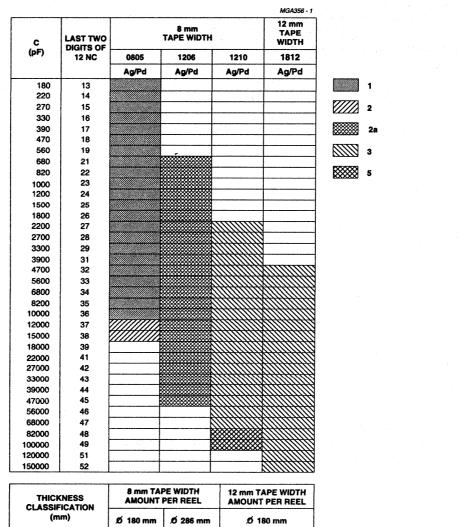


10000 $4 = 0.8 \pm 0.1$ 4000 1500 5 = 0.9 to 1.3

Fig.6 Selection chart for class 2 X7R dielectric 63 V with Ag/Pd and Ni/Sn terminations.

Standard series

CAPACITANCE SELECTION CHART FOR CLASS 2 X7R DIELECTRIC 100 VOLT SERIES



1 = 0.51 to 0.7 4000 10000 2000 2 = 0.8 to 1.0 4000 10000 2000 2a = 0.7 to 1.0 4000 10000 2000 3 = 0.51 to 1.0 4000 10000 2000 5 = 0.9 to 1.3 3000 8000 1500

Fig.7 Selection chart for class 2 X7R dielectric 100 V with Ag/Pd and Ni/Sn terminations.

Standard series

ELECTRICAL CHARACTERISTICS

Class 1 capacitors

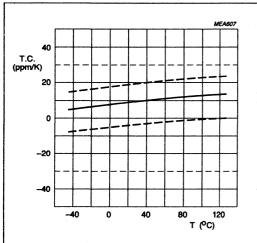
Unless otherwise stated all electrical values apply at an ambient temperature of 20 ± 1 °C, an atmospheric pressure of 86 to 106 kPa, and a relative humidity of 63 to 67%

Capacitance range (E-12 series), (note 1)	
	4 4
NPO dielectric	0.47 pF to 10 000 pF
N750 dielectric	4.7 pF to 1 200 pF
Tolerance on capacitance after 1 000 hours	
C ≥10 pF	±10%, ±5% and ±2% (note 2)
5 pF ≤ C <10 pF	±0.5 pF
C <5 pF	±0.25 pF
Tan δ (note 1)	
C <10 pF	$\leq 1.5 \times (\frac{150}{C} + 7) \times 10^{-4}$; (30 × 10 ⁻⁴ max.)
C ≥10 pF	≤10 × 10 ⁻⁴
Insulation resistance after 1 minute at U _R (DC)	>100 GΩ
Temperature coefficient	
NPO	
C <10 pF	(0 ±150) × 10 ⁻⁶ /K (note 3)
C ≥10 pF	$(0 \pm 30) \times 10^{-6}$ /K (note 3)
N750	
C <10 pF	(-750 ±250) × 10 ⁻⁶ /K
C ≥10 pF	(-750 ±250) × 10 ⁻⁶ /K
Terminations	Ag/Pd or Ni/Sn

Notes

- 1. Measured at 1 V, 1 MHz for C ≤1 000 pF and 1 V, 1 kHz for C >1 000 pF, using a four gauge method.
- 2. For lower tolerances see Narrow tolerance series.
- 3. For size 0603 in NPO all capacitance values from 0.47 pF to 150 pF have a temperature coefficient of $(0 \pm 30) \times 10^{-6}$ /K.

Standard series



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

Fig.8 Typical temperature coefficient as a function of temperature for NPO dielectric.

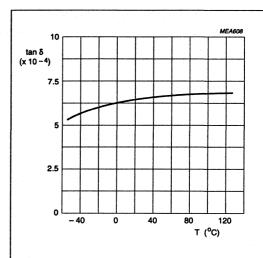


Fig.9 Typical tan δ as a function of temperature for NPO dielectric.

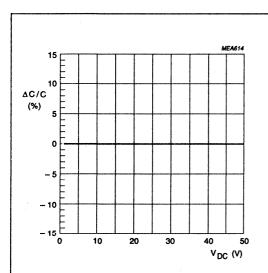


Fig. 10 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage for NPO, N750 dielectrics.

Standard series

HIGH FREQUENCY BEHAVIOUR OF CERAMIC MULTILAYER CAPACITORS

Ceramic multilayer capacitors (CMC) from the high voltage series are suitable for use at high frequencies. At frequencies below the series resonant frequency, the CMC can be represented by an equivalent circuit as shown in Fig.11.

In general, the quantities C, ESR and L are frequency dependent. For most applications, C and L can be regarded as frequency independent below 1 GHz.

The equivalent series self-inductance L is

- independent of the dielectric material
- dependent on the size of the capacitor, it increases with increasing length and decreases with increasing width or thickness of the product
- the value of L is approximately 0.6 nH for size 0603, 1 nH for sizes 0805, 1206 and 1210 and approximately 1.5 nH for sizes 1812 and 2220.

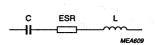
Because of the inductance L, associated with the CMC, there will be a frequency at which the inductive reactance will be equal to that of the capacitor.

This is known as the series resonant frequency (SRF) and is given

by:
$$SRF = \frac{1}{2\pi\sqrt{LC}}$$

At the SRF, the CMC will appear as a small resistor. The transmission loss through the CMC at this series resonant frequency will be low.

Using the values of C, L (= 1 nH) and the ESR at a specific frequency, (f), two often used quantities can be derived.



C = capacitance.

ESR = equivalent series resistance which is determined by the energy dissipation mechanisms (in the dielectric material as well as in the electrodes).

L = equivalent series self-inductance.

Fig.11 Equivalent series representation of a CMC.

The impedance, Z, is given

by:
$$Z = \frac{1 - (2 \pi f)^2 LC}{2 j \pi fC} + ESR$$

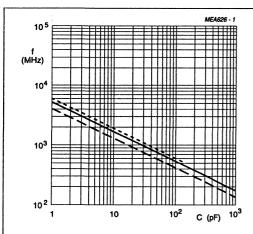
The quality factor is given

by:
$$Q = \frac{11 - (2 \pi f)^2 LC}{2 \pi f ESR C}$$

Philips Components Product specification

Surface mounted ceramic multilayer capacitors

Standard series

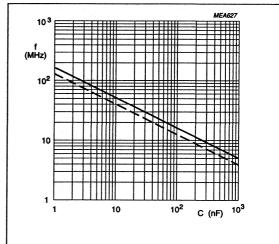


L = 0.6 nH (dotted line).

L = 1 nH (solid line).

L = 1.5 nH (broken lines).

Fig.12 Series resonance frequency as a function of capacitance (pF values).



L = 1 nH (solid line).

L = 1.5 nH (broken lines).

Fig.13 Series resonance frequency as a function of capacitance (nF values).

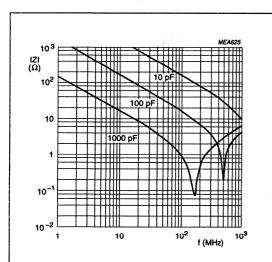


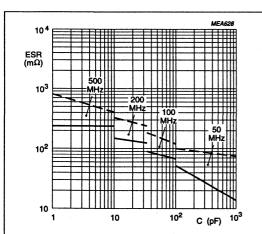
Fig.14 Typical impedance (IZI) as a function of frequency for class 1 dielectric capacitors, sizes 0603 to 1210.

The typical behaviour of IZI for products of sizes 0603, 0805, 1206 and 1210 is shown in Fig. 14.

Figures 15 and 16 show the equivalent series resistance (ESR) as a function of capacitance class 1 dielectric, sizes 0603, 0805 and 1206 respectively.

Figures 17 and 18 show the quality factor (Q) as a function of capacitance class 1 dielectric, sizes 0603, 0805 and 1206 respectively.

Standard series

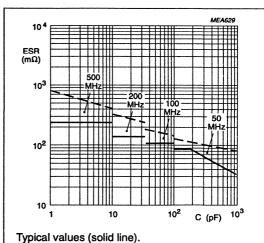


Typical values (solid line).

Maximum values (broken line).

Measuring equipment HP4191A.

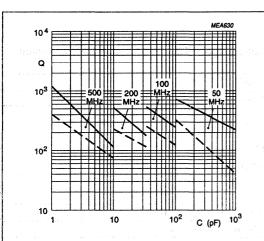
Fig.15 Equivalent series resistance (ESR) as a function of capacitance for class 1 dielectric, size 0603 and 0805.



Maximum values (broken line). Measuring equipment HP4191A. For C >1 nF, maximum value of ESR = $80 \text{ m}\Omega$ measured at 50 MHz.

Fig.16 Equivalent series resistance (ESR) as a function of capacitance for class 1 dielectric, size 1206.

Standard series

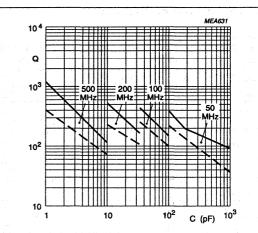


Typical values (solid line).

Maximum values (broken line).

Measuring equipment HP4191A.

Fig.17 Quality factor (Q) as a function of the capacitance for class 1 dielectric, sizes 0603 and 0805.



Typical values (solid line).

Maximum values (broken line).

Measuring equipment HP4191A.

For C >1 nF, Q_{min.} = 35 measured at 50 MHz.

Fig.18 Quality factor (Q) as a function of the capacitance for class 1 dielectric, size 1206.

Standard series

ELECTRICAL CHARACTERISTICS

Class 2 capacitors, X7R dielectric

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%

Capacitance range (E-12 series), (note 1)	100 pF to 1 μF
Tolerance on capacitance after 1 000 hours	±20%, ±10% and ±5%
Tan δ (note 1)	≤2.5%
Insulation resistance after 1 minute at U _R (DC)	
C ≤10 nF	R _{INS} >100 GΩ
C >10 nF	R _{INS} × C >1 000 s
Maximum capacitance variation as a function of temperature (see Fig.21)	±15%
Terminations	Ag/Pd or Ni/Sn
Ageing	typically, 1% per time decade

Note

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

Philips Components Product specification

Surface mounted ceramic multilayer capacitors

Standard series

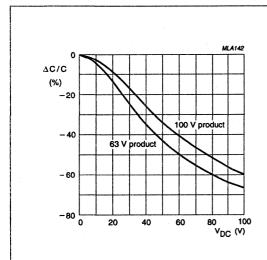
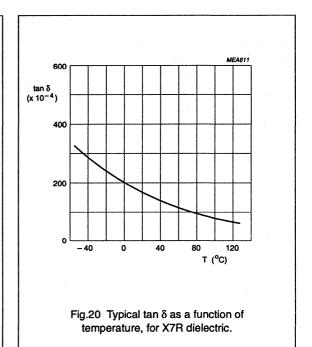


Fig.19 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage, for X7R dielectrics at 20 °C.



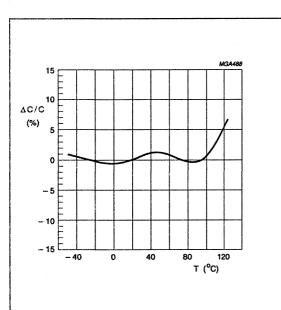


Fig.21 Typical capacitance change as a function of temperature, for X7R dielectric.

Narrow tolerance series

FEATURES

- · Three standard sizes
- · High capacitance per unit volume
- · Supplied in tape on reel
- · For high frequency applications
- Available with Ag/Pd and Ni/Sn terminations.

APPLICATIONS

- Consumer electronics
- Telecommunications
- Automotive
- · Data processing.

DESCRIPTION

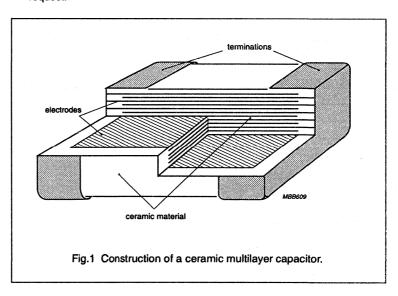
The capacitor consists of a rectangular block of ceramic dielectric in which a number of interleaved precious metal electrodes are contained. This structure gives rise to a high capacitance per unit volume. The inner electrodes are connected to the two terminations, either by silver palladium (Ag/Pd) alloy in the ratio 65: 35, or silver dipped with a barrier layer of plated nickel and finally covered with a layer of plated tin (Ni/Sn). A cross section of the structure is shown in Fig.1.

QUICK REFERENCE DATA

Rated voltage U _R (DC)	63 V (IEC)
Capacitance range class 1, NPO dielectric	0.47 pF to 3 300 pF (E-12 series) (note 1)
Tolerance on capacitance	
C <10 pF	±0.1 pF
C ≥10 pF	±1%
Test voltage (DC) for 1 minute	2.5 × U _R
Sectional specifications	IEC 384-10, second edition 1989-04 based on CECC 32 100
Detailed specification	based on CECC 32 101-801
Climatic category (IEC 68)	55/125/56

Note

 Other values below 10 pF and values other than E12 are available on request.

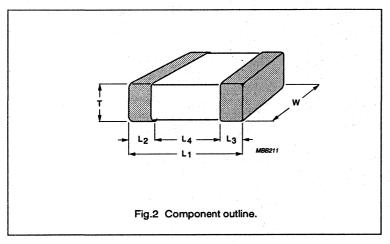


Philips Components Product specification

Surface mounted ceramic multilayer capacitors

Narrow tolerance series

MECHANICAL DATA



Capacitor dimensions

		w		T	L	L ₄ MIN. (mm)	
CASE SIZE L ₁ W (mm)	MIN. (mm)	MAX. (mm)	MIN. (mm)	MAX. (mm)			
0603	1.6 ±0.1	0.8 ±0.1	0.7	0.9	0.25	0.65	0.4
0805	2.0 ±0.1	1.25 ±0.1	0.51	1.35	0.25	0.75	0.55
1206	3.2 ±0.15	1.6 ±0.15	0.51	1.75	0.25	0.75	1.4

Narrow tolerance series

CAPACITANCE SELECTION CHART FOR NARROW TOLERANCE SERIES NPO

C (pF) LAST THR DIGITS O 12NC	LAST THREE		8	mm TAF				
		0603		0805		1206		12.
	4	Ag/Pd	Ni/Sn	Ag/Pd	Ni/Sn	Ag/Pd	NI/Sn	
0.47	477	*****	****					1
0.56	567	*****	****					
0.68	687	*****	****					2
0.82	827	******	******					DANKA .
1.0	108							4
1.2	128	*****	****					DOX:AN
1.5	158		*****					5
1.8	188		****					2277
2.2	228		****					6
2.7	278	******	****					
3.3	338							8
3.9	398	******	*****					
4.7	478							
5.6	568							
6.8	688							
8.2	828	******	*****					
10	109							er in the state of the state of
12	129		****					
15	159	*******	*****					
18 22	189	******						i digra a s
	229		*****					
27 33	279 339	******	****					
39		******	*****					
	399	******	****					
47	479 569	*****	****					
56			****					
68	689 829	*****	****					
82 100	101	******	****					
		*****	****					
120 150	121 151	******	****					
		*******	*****					
180 220	181 221	-						
270	271							
330	331							
390	391			,,,,,,,	,,,,,,			
470	471			WHHA	/////			
560	561			WWW.	<i>4444</i>			
680	681			<i>\////</i>				
820	821			VIIII	****			
1000	102	-		WHA				
1200	122	 		11111	ننسن	77777	77777	
1500	152			1			HHH	
1800	182			 			<i>4441</i> 3	
2200	222	 		 				
2700	272	 		 		∞	∞	
3300	332					*****		

THICKNESS CLASSIFICATION (mm)	8 mm TAPE WIDTH AMOUNT PER REEL				
	Ø 180 mm	Ø 286 mm			
1 = 0.51 to 0.7	4000	10000			
2 = 0.8 to 1.0	4000	10000			
4 = 0.8 ± 0.1	4000	10000			
5 = 0.9 to 1.3	3000	8000			
6 = 1.25 ± 0.1	3000	8000			
8 = 1.6 ± 0.15	2500	7000			

Fig.3 Selection chart for 63 volt narrow tolerance series NPO with Ag/Pd and Ni/Sn terminations.

Narrow tolerance series

ELECTRICAL CHARACTERISTICS

Class 1 capacitors, NPO dielectric

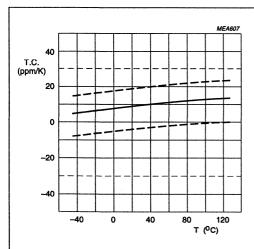
Unless otherwise stated all electrical values apply at an ambient temperature of 20 ± 1 °C, an atmospheric pressure of 86 to 106 kPa, and a relative humidity of 63 to 67%

Capacitance range (E-12 series), (note 1)	0.47 pF to 3 300 pF
Tolerance on capacitance after 1 000 hours	
C <10 pF	±0.1 pF
C ≥10 pF	±1%
Tan δ (note 1)	
C <10 pF	$\leq 1.5 \times (\frac{150}{C} + 7) \times 10^{-4}$; (30 × 10 ⁻⁴ max.)
C ≥10 pF	≤10 × 10 ⁻⁴
Insulation resistance after 1 minute at U _R (DC)	>100 GΩ
Temperature coefficient	
0.47 pF ≤ C <5 pF	0 ±150 × 10 ⁻⁶ /K
5 pF ≤ C <10 pF	0 ±150 × 10 ⁻⁶ /K
C ≥10 pF	0 ±30 × 10 ⁻⁶ /K
Terminations	Ag/Pd or Ni/Sn
High frequency properties	for ESR values see Figs 10 and 11

Note

1. Measured at 1 V, 1 MHz using a four gauge method.

Narrow tolerance series



Sample limits (broken lines).

Requirement levels (dotted lines).

Fig.4 Typical temperature coefficient as a function of temperature for NPO dielectric.

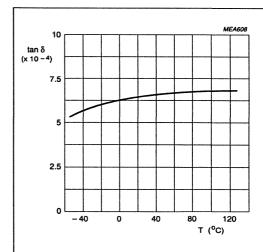


Fig.5 Typical tan δ as a function of temperature for NPO dielectric.

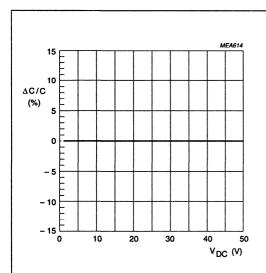


Fig.6 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage for NPO dielectric.

Narrow tolerance series

HIGH FREQUENCY BEHAVIOUR OF NARROW TOLERANCE CMC's OF CLASS 1, NPO DIELECTRIC

Ceramic multilayer capacitors (CMC) from the narrow tolerance series are suitable for use at high frequencies. At frequencies below the series resonant frequency, the CMC can be represented by an equivalent circuit as shown in Fig.7.

In general, the quantities
C, ESR and L are frequency
dependent. For most applications,
C and L can be regarded as
frequency independent below 1 GHz.

The equivalent series self-inductance L is

- independent of the dielectric material
- dependent on the size of the capacitor and is approximately 0.6 nH for size 0603, 1 nH for sizes 0805 and 1206 (these figures are accurate to within ±20%).

Because of the inductance L, associated with the CMC, there will be a frequency at which the inductive reactance will be equal to that of the capacitor.

This is known as the series resonant frequency (SRF) (see Figs 8 and 9)

and is given by: $SRF = \frac{1}{2\pi\sqrt{LC}}$

At the SRF, the CMC will appear as a small resistor. The transmission loss through the CMC at this series resonant frequency will be low.

Using the values of C, L (= 1 nH) and the ESR (see Figs 11 and 12) at a specific frequency, (f), two often used quantities can be derived.



C = capacitance.

ESR = equivalent series resistance which is determined by the energy dissipation mechanisms (in the dielectric material as well as in the electrodes).

L = equivalent series self-inductance.

Fig.7 Equivalent series representation of a CMC.

The impedance, Z, is given $1 - (2\pi f)^2 I C$

by: $Z = \frac{1 - (2 \pi f)^2 LC}{2 j \pi fC} + ESR$

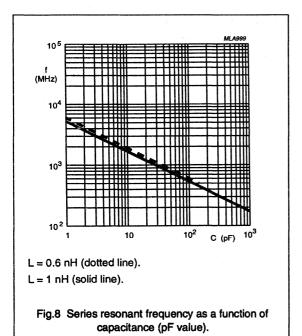
(see Fig.10).

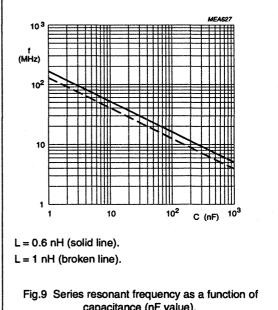
The quality factor is given

by: $Q = \frac{|1 - (2\pi f)^2 LC|}{2\pi f ESR C}$

(see Figs 13 and 14).

Narrow tolerance series





capacitance (nF value).

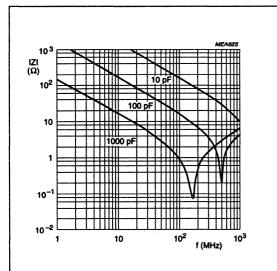


Fig.10 Typical impedance (IZI) as a function of frequency for sizes 0603 and 1206.

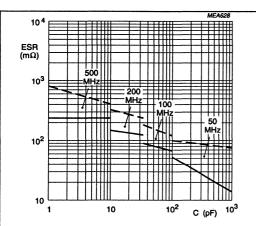
Figures 11 and 12 show the equivalent series resistance (ESR) as a function of capacitance, class 1 dielectric. sizes 0603, 0805 and 1206 respectively.

Figures 13 and 14 show the quality factor (Q) as a function of capacitance, class 1 dielectric, sizes 0603, 0805 and 1206 respectively.

Philips Components Product specification

Surface mounted ceramic multilayer capacitors

Narrow tolerance series

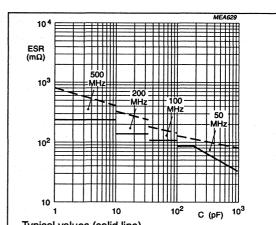


Typical values (solid line).

Maximum values (broken line).

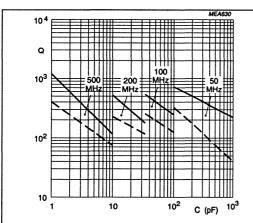
Measuring equipment HP4191A.

Fig.11 Equivalent series resistance (ESR) as a function of capacitance for sizes 0603 and 0805.



Typical values (solid line). Maximum values (broken line). Measuring equipment HP4191A. For C >1 nF, maximum value of ESR = $80 \text{ m}\Omega$ measured at 50 MHz.

Fig.12 Equivalent series resistance (ESR) as a function of capacitance for size 1206.

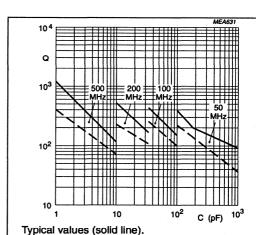


Typical values (solid line).

Maximum values (broken line).

Measuring equipment HP4191A.

Fig.13 Quality factor (Q) as a function of capacitance for sizes 0603 and 0805.



Maximum values (broken line).

Measuring equipment HP4191A.

For C >1 nF, Q_{min.} = 35 measured at 50 MHz.

Fig.14 Quality factor (Q) as a function of capacitance for size 1206.

Microwave series

FEATURES

- Low insertion loss/ESR up to 3 GHz
 1st parallel resonance above
 2 GHz
 2nd parallel resonance above
 3 GHz
- Small dimensions 0603, 0805 and 1206 available
- · High reliability
- Standard tolerance on capacitance ±10%, ±5%, ±2% and ±1%
- Available with Ag/Pd and Ni/Sn terminations
- Suitable for reflow and wave soldering
- S-parameter data available on floppy disk.

APPLICATIONS

- Mobile telephones
- Satellite television
- Instrumentation.

DESCRIPTION

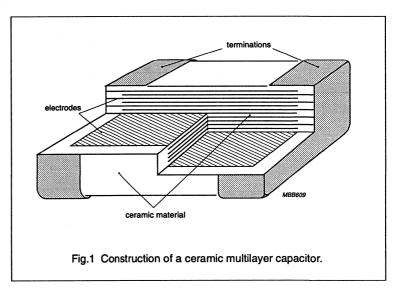
The capacitor consists of a rectangular block of ceramic dielectric in which a number of interleaved precious metal electrodes are contained. This structure gives rise to a high capacitance per unit volume. The inner electrodes are connected to the two terminations, either by silver palladium (Ag/Pd) alloy in the ratio 65: 35, or silver dipped with a barrier layer of plated nickel and finally covered with a layer of plated tin (Ni/Sn). A cross section of the structure is shown in Fig.1.

QUICK REFERENCE DATA

Rated voltage U _R (DC)	63 V (IEC)
Capacitance range class 1, NPO dielectric	
size 0603	0.47 pF to 47 pF (E-12 series) (note 1)
size 0805	0.47 pF to 82 pF (E-12 series) (note 1)
size 1206	0.47 pF to 120 pF (E-12 series) (note 1)
Tolerance on capacitance	
C ≥10 pF	±10%, ±5%, ±2% and ±1%
5 pF ≤ C <10 pF	±0.5 pF, ±0.25 pF and ±0.1 pF
C <5 pF	±0.25 pF and ±0.1 pF
Test voltage (DC) for 1 minute	2.5 × U _R
Insulation resistance, after 60 s at U _R (DC)	>100 GΩ
Sectional specifications	IEC 384-10, second edition 1989-04 based on CECC 32 100
Detailed specification	based on CECC 32 101-801
Climatic category (IEC 68)	55/125/56

Note

Non E-12 values are available on request.



Philips Components Product specification

Surface mounted ceramic multilayer capacitors

Microwave series

MECHANICAL DATA

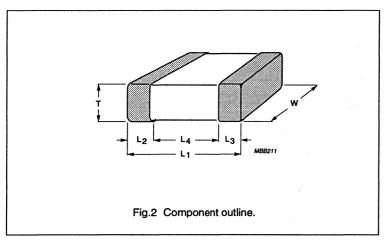


Table 1 Capacitor dimensions

		w		Т	L ₂	/ L ₃	L ₄
CASE SIZE	(mm)	(mm)	MIN. (mm)	MAX. (mm)	MIN. (mm)	MAX. (mm)	MIN. (mm)
0603	1.6 ±0.1	0.8 ±0.1	0.7	0.9	0.25	0.65	0.4
0805	2.0 ±0.1	1.25 ±0.1	0.51	1.35	0.25	0.75	0.55
1206	3.2 ±0.15	1.6 ±0.15	0.51	1.75	0.25	0.75	1.4

Microwave series

CAPACITANCE SELECTION CHART FOR MICROWAVE SERIES

							MGA357	
С	LAST TWO			8 mm TA	PE WIDTH			
(pF)	DIGITS OF 12 NC	0603		0805		1206		
		Ag/Pd	Ni/Sn	Ag/Pd	Ni/Sn	Ag/Pd	Ni/Sn	
0.47	05		l					1
0.56 0.68	06 07							4
0.82	07		-					4
1.0	09							
1.2	11	*****						
1.5	12							
1.8	13							
2.2	14							
2.7	15					!		
3.3	16							
3.9	17						1	
4.7	18							
5.6	19							
6.8	21							
8.2	22							
10	23							
12	24							
15	25							
18	26							
22	27							
27	28							
33	29							
39	31							
47	32		!					
56	33		T					
68	34							
82	35							
100	36		 					
120	37							
		<u> </u>		9 mm TA	PE WIDTH			
THICKNESS CLASSIFICATION								
(n	nm)		Ø 180 mm					
1 = 0.5	to 0.7		4000			10000		
4 = 0.8		4000			1	10000		

Fig.3 Selection chart for 63 volt class 1 NPO dielectric.

Microwave series

ELECTRICAL CHARACTERISTICS

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%

Capacitance range (E-12 series),	
NPO dielectric (note 1)	
size 0603	0.47 pF to 47 pF
size 0805	0.47 pF to 82 pF
size 1206	0.47 pF to 120 pF
Tolerance on capacitance	
C ≥10 pF	±10%, ±5%, ±2% and ±1%
5 pF ≤ C <10 pF	±0.5 pF, ±0.25 pF and ±0.1 pF
C <5 pF	±0.25 pF and ±0.1 pF
Tan δ (note 1)	
C <10 pF	$\leq 1.5 \times (\frac{150}{C} + 7) \times 10^{-4}$; (30 × 10 ⁻⁴ max.)
C ≥10 pF	≤10 × 10 ⁻⁴
Temperature coefficient (note 2)	
0.47 pF ≤ C <5 pF	0 ±150 × 10 ⁻⁶ /K
5 pF ≤ C <10 pF	0 ±150 × 10 ⁻⁶ /K
C ≥10 pF	0 ±30 × 10 ⁻⁶ /K
High frequency properties	for ESR values see Figs 9, 10 and 11. The first parallel resonance frequency in the S ₂₁ and S ₁₂ scattering parameter lies above 2 GHz and the second resonance above 3 GHz

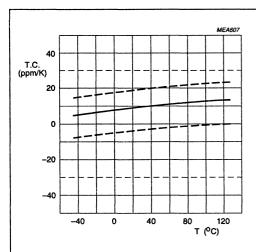
Notes

- 1. Measured at 1 V, 1 MHz using a four gauge method.
- 2. For size 0603 all capacitance values from 0.47 pF to 47 pF have a temperature coefficient of 0 ±30 × 10-6/K.

Philips Components Product specification

Surface mounted ceramic multilayer capacitors

Microwave series



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

Fig.4 Typical temperature coefficient as a function of temperature for NPO dielectric.

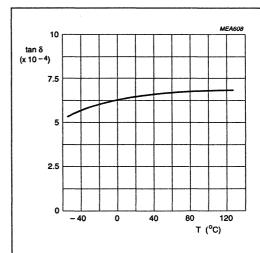


Fig.5 Typical tan δ as a function of temperature for NPO dielectric.

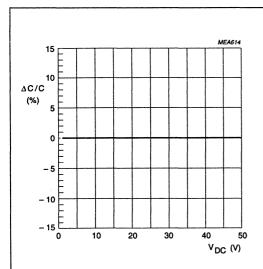


Fig.6 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage for NPO dielectric.

Microwave series

MICROWAVE BEHAVIOUR OF CERAMIC MULTILAYER CAPACITORS

Ceramic multilayer capacitors (CMC) from the microwave series are suitable for use at high frequencies. At frequencies below the series resonant frequency, the CMC can be represented by an equivalent circuit as shown in Fig.7.

In general, the quantities C, ESR and L are frequency dependent. For most applications, C and L can be regarded as frequency independent below 1 GHz.

The equivalent series self-inductance L is

- independent of the dielectric material
- dependent on the size of the capacitor and is approximately 0.6 nH for size 0603,
 1 nH for sizes 0805 and 1206 (these figures are accurate to within ±20%).

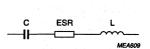
Because of the inductance L, associated with the CMC, there will be a frequency at which the inductive reactance will be equal to that of the capacitor.

This is known as the series resonant frequency (SRF) and is given

by:
$$SRF = \frac{1}{2\pi\sqrt{LC}}$$

At the SRF, the CMC will appear as a small resistor. The transmission loss through the CMC at this series resonant frequency will be low.

Using the values of C, L (= 1 nH) and the ESR (see Figs 9, 10 and 11) at a specific frequency, (f), two often used quantities can be derived.



C = capacitance.

ESR = equivalent series resistance which is determined by the energy dissipation mechanisms (in the dielectric material as well as in the electrodes).

L = equivalent series self-inductance.

Fig.7 Equivalent series representation of a CMC.

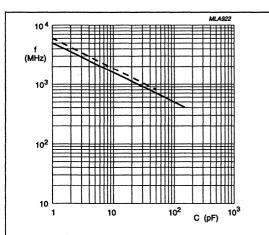
The impedance, Z, is given

by:
$$Z = \frac{1 - (2 \pi f)^2 LC}{2 j \pi fC} + ESR$$

The quality factor is given

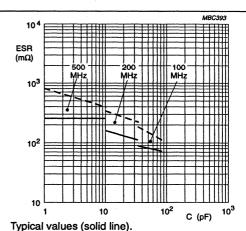
by:
$$Q = \frac{11 - (2 \pi f)^2 LC}{2 \pi f ESR C}$$

Microwave series



Sizes 0805 and 1206 (solid line). Size 0603 (broken line).

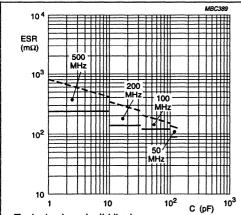
Fig.8 Series resonance frequency as a function of capacitance.



Maximum values (broken line).

Measuring equipment HP4191A.

Fig.9 Equivalent series resistance (ESR) as a function of capacitance for NPO dielectric, sizes 0603 and 0805.

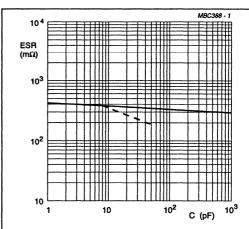


Typical values (solid line).

Maximum values (broken line).

Measuring equipment HP4191A.

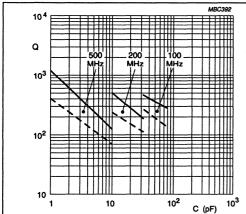
Fig.10 Equivalent series resistance (ESR) as a function of capacitance for NPO dielectric, size 1206.



Sizes 0805 and 1206 (solid line). Size 0603 (broken line). Measuring equipment HP4191A.

Fig.11 Typical ESR values at 1 GHz as a function of the capacitance value.

Microwave series

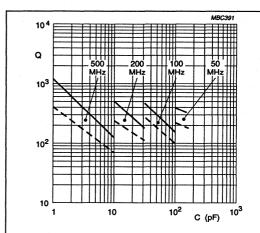


Typical values (solid line).

Minimum values (broken line).

Measuring equipment HP4191A.

Fig.12 Quality factor (Q) as a function of the capacitance for NPO dielectric, sizes 0603 and 0805.



Typical values (solid line).

Minimum values (broken line).

Measuring equipment HP4191A.

Fig.13 Quality factor (Q) as a function of the capacitance for NPO dielectric, size 1206.

Microwave series

The frequency region above the SRF is difficult to model using lumped elements and should be described in terms of a network of transmission lines. The behaviour of the CMC in this frequency region can be best described in terms of scattering or "s" parameters. Knowing these parameters, one can predict the response of a network accurately. There are four scattering parameters for a two-port network: S₁₁, S₁₂, S₂₁ and S₂₂.

 S_{11} is the reflection coefficient at the input port with the output port terminated in a 50 Ω load.

 S_{12} is the reverse transmission coefficient in a 50 Ω system.

 S_{21} is the forward transmission coefficient in a 50 Ω system.

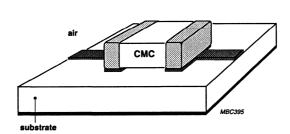
 S_{22} is the reflection coefficient at the output port with the input port terminated into a 50 Ω load.

When comparing the insertion loss (i.e. S21) of a CMC at high frequencies with that of an ideal capacitor, parallel resonances above the SRF are observed. In series or shunt connections parallel resonances are usually detrimental to the operation of the circuit. They may be the cause of unacceptable insertion loss or parasitic oscillations of amplifiers. For the microwave series, we specify that the first parallel resonance lies above 2 GHz and the second above 3 GHz. It is found that the typical insertion loss in the first resonance is more than a factor 5 smaller than in the second resonance.

The high frequency behaviour of our CMC's is measured in a strip line configuration as shown in Fig.14 using a test fixture with the following features:

- microstrip structure (dielectric: Al₂O₃; thickness: 0.635 mm)
- suitable for the TRL calibration method
- de-embedding for the low-frequency range (up to 3 GHz).

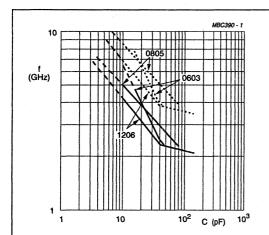
The measurements are carried out using the HP 8510B network analyzer.



Substrate permittivity (ε_r) = 9.8 Substrate thickness = 0.635 mm.

Fig.14 Microwave behaviour measured using a microstrip.

Microwave series



First resonance (solid line). Second resonance (broken line).

Fig.15 Typical first and second parallel resonance frequencies as a function of capacitance for case sizes 0603, 0805 and 1206.

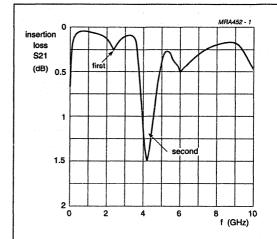


Fig.16 Example of the insertion loss as a function of frequency showing the parallel resonances.

X7R 25 volt series

FEATURES

- · Three standard sizes
- · High capacitance per unit volume
- · Supplied in tape on reel
- Available with Ag/Pd and Ni/Sn terminations.

APPLICATIONS

- · Consumer electronics
- Telecommunications
- Automotive
- · Data processing.

DESCRIPTION

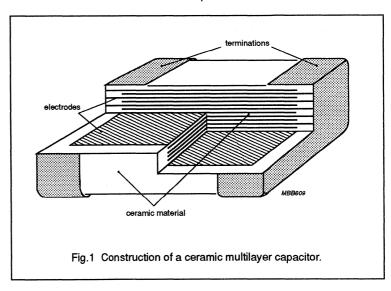
The capacitor consists of a rectangular block of ceramic dielectric in which a number of interleaved precious metal electrodes are contained. This structure gives rise to a high capacitance per unit volume. The inner electrodes are connected to the two terminations, either by silver palladium (Ag/Pd) alloy in the ratio 65: 35, or silver dipped with a barrier layer of plated nickel and finally covered with a layer of plated tin (Ni/Sn). A cross section of the structure is shown in Fig.1.

QUICK REFERENCE DATA

Rated voltage U _R (DC)	25 V (IEC)
Capacitance range class 2, X7R dielectric	10 nF to 220 nF (E-12 series) (note 1)
Tolerance on capacitance	±20%, ±10% and ±5%
Test voltage (DC) for 1 minute	$2.5 \times U_R$
Sectional specifications	IEC 384-10, second edition 1989-04 based on CECC 32 100
Detailed specification	based on CECC 32 101-801
Climatic category (IEC 68)	55/125/56

Note

1. Non E-12 values are available on request.



X7R 25 volt series

MECHANICAL DATA

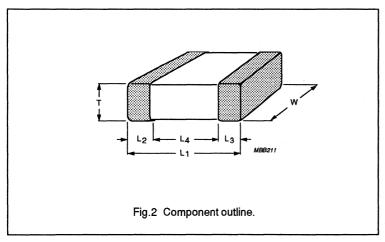


Table 1 Capacitor dimensions

		w		Т	L ₂	/ L ₃	L ₄
CASE SIZE	(mm)	(mm)	MIN. (mm)	MAX. (mm)	MIN. (mm)	MAX. (mm)	MIN. (mm)
0603	1.6 ±0.1	0.8 ±0.1	0.7	0.9	0.25	0.65	0.4
0805	2.0 ±0.1	1.25 ±0.1	0.51	1.35	0.25	0.75	0.55
1206	3.2 ±0.15	1.6 ±0.15	0.51	1.75	0.25	0.75	1.4

X7R 25 volt series

CAPACITANCE SELECTION CHART FOR X7R 25 VOLT SERIES

						MGA449 - 1		
С	LAST TWO		8 n	nm TAPE WID	тн			
(nF)	DIGITS OF	0603	08	05	120	06		
		Ni/Sn	Ag/Pd	Ni/Sn	Ag/Pd	Ni/Sn		
10	36							1
12	37						97777773	
15	38							2
18	39						Management	
22	41							2a
27	42						*********	
33	43							4
39	44						F7777777	
47	45							6
56	46							
68	47							
82	48							
100	49		\$\$\$\$\$\$\$ \$	\$\$\$\$\$\$\$\$\$\$				
120	51							
150	52							
180	53							
220	54		<u></u>					
	CKNESS			mm TAPE WID				
	SIFICATION (mm)	Ø	180 mm		ø 286	mm		
1 = 0.51	to 0.7		4000		10000	!		
2 = 0.8	to 1.0		4000		10000)		

 $6 = 1.25 \pm 0.1$ 3000 8000

Fig.3 Selection chart for X7R 25 volt series with Ag/Pd and Ni/Sn terminations.

X7R 25 volt series

ELECTRICAL CHARACTERISTICS

Class 2 capacitors, X7R dielectric

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%

Capacitance range (E-12 series), (note 1)	10 nF to 220 nF
Tolerance on capacitance after 1 000 hours	±20%, ±10% and ±5%
Tan δ (note 1)	≤2.5%
Insulation resistance after 1 minute at 25 V (DC)	R _{INS} × C >1 000 s
Maximum capacitance variation as a function of temperature (see Fig.4)	±15%
Terminations	Ag/Pd or Ni/Sn (note 2)
Ageing	typically, 1% per time decade

Notes

- 1. Measured at 1 V, 1 kHz using a four gauge method.
- 2. Size 0603 only available with Ni/Sn terminations.

X7R 25 volt series

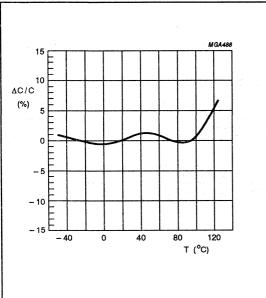
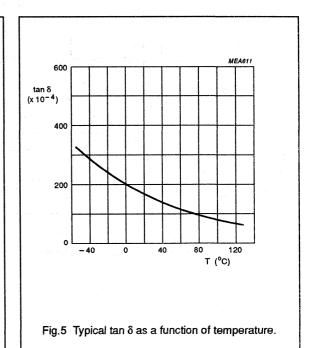


Fig.4 Typical capacitance change as a function of temperature.



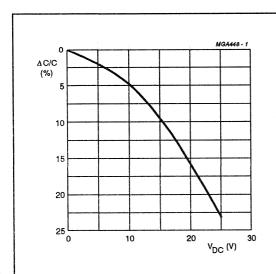


Fig.6 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage at 20 °C.

High voltage series

FEATURES

- · Four standard sizes
- · High capacitance per unit volume
- · Supplied in tape on reel
- Available with Ag/Pd and Ni/Sn terminations.

APPLICATIONS

- · Consumer electronics
- Lighting
- Automotive
- · Telecommunications.

DESCRIPTION

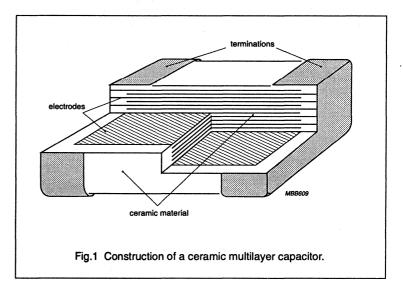
The capacitor consists of a rectangular block of ceramic dielectric in which a number of interleaved precious metal electrodes are contained. This structure gives rise to a high capacitance per unit volume. The inner electrodes are connected to the two terminations, either by silver palladium (Ag/Pd) alloy in the ratio 65: 35, or silver dipped with a barrier layer of plated nickel and finally covered with a layer of plated tin (Ni/Sn). A cross section of the structure is shown in Fig.1.

QUICK REFERENCE DATA

Rated voltage U _R (DC)	200 V (IEC)
Capacitance range class 1,	2
NPO dielectric	10 pF to 1.5 nF (E-12 series) (note 1)
Capacitance range class 2,	
X7R dielectric	180 pF to 100 nF (E-12 series) (note 1)
Tolerance on capacitance	
NPO dielectric	±10%, ±5% and ±2% (note 2)
X7R dielectric	±20%, ±10% and ±5%
Test voltage (DC) for 1 minute	3×U _R
Sectional specifications	IEC 384-10, second edition 1989-04
	based on CECC 32 100
Detailed specification	based on CECC 32 101-801
Climatic category (IEC 68)	
NPO dielectric	55/125/56
X7R dielectric	55/125/56

Notes

- 1. Non E-12 values are available on request.
- 2. ±1% available on request.



High voltage series

MECHANICAL DATA

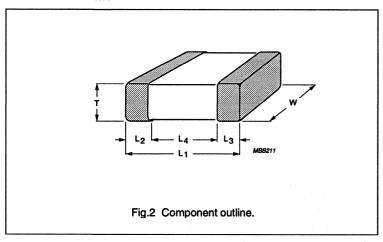


Table 1 Capacitor dimensions

		w		Т	L ₂	/ L ₃	L ₄
CASE SIZE	(mm)	(mm)	MIN. (mm)	MAX. (mm)	MIN. (mm)	MAX. (mm)	MIN. (mm)
0805	2.0 ±0.1	1.25 ±0.1	0.8	1.35	0.25	0.75	0.55
1206	3.2 ±0.15	1.6 ±0.15	8.0	1.75	0.25	0.75	1.4
1210	3.2 ±0.2	2.5 ±0.2	8.0	1.8	0.25	0.75	1.4
1812	4.5 ±0.2	3.2 ±0.2	0.8	1.8	0.25	0.75	2.2

High voltage series

CAPACITANCE SELECTION CHART FOR HIGH VOLTAGE SERIES NPO

	LAST TWO			8 mm TA	12 mm TAPE WIDTH						
(pF)	DIGITS OF	08	05	12	:06	12	10	18	12		
	12.113	Ag/Pd	NI/Sn	Ag/Pd	Ni/Sn	Ag/Pd	Ni/Sn	Ag/Pd	Ni/Sn		
10	23										1
12	24										
15	25					1		V		- 8	ğ
18	26			<i>X////////</i>		1					
22	27			X///////							,
27	28			<i>X///////</i>							_
33	29							7 14		1000	В
39	31							1.1			•
47	32										ł
56	33										-
68	34										
82	35	>>>>>>									
100	36	XXXXXX	???????								
120	37	3333333	<i>>>>></i>								
150	38	???????	>>>>>								
180	39										
220	41										
270	42										
330	43			********	********						
390	44		terit de Maria de Caractería d	*********	********						
470	45	T	THE REAL PROPERTY CONTRACTOR	******	*******	*********					
560	46			500000	KKKKKK	*********	*********				
680	47		NO			*************************************	********				
820	48					*************************************	***************************************				
1000	49										
1200	51							*******			
1500	52										

THICKNESS CLASSIFICATION		PE WIDTH PER REEL	12 mm TAPE WIDTH AMOUNT PER REEL
(mm)	Ø 180 mm	Ø 286 mm	Ø 180 mm
2 = 0.80 to 1.00	4000	10000	2000
5 = 0.90 to 1.30	3000	8000	1500
6 = 1.25 ± 0.10	3000	8000	-
7 = 1.20 to 1.75	2500	7000	
8 = 1.60 ± 0.15	2500	7000	

Fig.3 Selection chart for high voltage series NPO with Ag/Pd and Ni/Sn terminations.

High voltage series

CAPACITANCE SELECTION CHART FOR HIGH VOLTAGE SERIES X7R

C (pF)	LAST TWO	8 mm TAPE WIDTH					12 mm TAPE WIDTH		
	DIGITS OF	0805		1206		1210		1812	
		Ag/Pd	NI/Sn	Ag/Pd	Ni/Sn	Ag/Pd	Ni/Sn	Ag/Pd	Ni/Sn
180	13					1,1 20			
220	14								
270	15								
330	16								
390	17						1.44		
470	18								
560	19			1					
680	21								
820	22								
1000	23								
1200	24							100	
1500	25								
1800	26						- 1 6		
2200	27								
2700	28								
3300	29								
3900	31								
4700	32	******	>>>>>						
5600	33	222222	222222						
6800	34	*****	XXXXX						
8200	35	1	,,,,,,,						
10000	36								
12000	37								
15000	38								
18000	39			*************************************	********				
22000	41			********	*******				
27000	42								
33000	43					*******	*******		
39000	44					*********	**********		
47000	45						00000		
56000	46								
68000	47					11.00		*********	*****
82000	48					1000		***************************************	*****
100000	49	T	I	T T	T	T	T	*********	*******

THICKNESS CLASSIFICATION		PE WIDTH PER REEL	12 mm TAPE WIDTH AMOUNT PER REEL		
(mm)	Ø 180 mm	Ø 286 mm	Ø 180 mm		
2 = 0.80 to 1.00	4000	10000	2000		
5 = 0.90 to 1.30	3000	8000	1500		
$6 = 1.25 \pm 0.10$	3000	8000	_		
7 = 1.20 to 1.75	2500	7000			

Fig.4 Selection chart for high voltage series X7R with Ag/Pd and Ni/Sn terminations.

High voltage series

ELECTRICAL CHARACTERISTICS

Class 1 capacitors, NPO dielectric

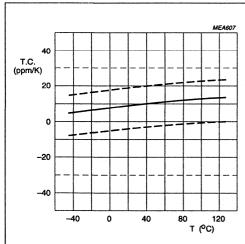
Unless otherwise stated all electrical values apply at an ambient temperature of 20 ± 1 °C, an atmospheric pressure of 86 to 106 kPa, and a relative humidity of 63 to 67%

Capacitance range (E-12 series), (note 1)	10 pF to 1.5 nF		
Tolerance on capacitance after 1 000 hours	±10%, ±5% and ±2% (note 2)		
Tan δ (note 1)	≤10 × 10-4		
Insulation resistance after 1 minute at U _R (DC)	R _{INS} >100 GΩ		
Temperature coefficient	$(0 \pm 30) \times 10^{-6}$ /K		
Terminations	Ag/Pd or Ni/Sn		

Notes

- 1. Measured at 1 V, 1 MHz for C ≤1 000 pF and 1 V, 1 kHz for C >1 000 pF, using a four gauge method.
- 2. ±1% available on request.

High voltage series



Sample limits (broken lines).

Requirement levels (dotted lines).

Fig.5 Typical temperature coefficient as a function of temperature for NPO dielectrics.

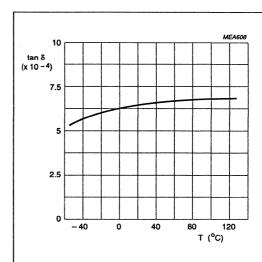


Fig.6 Typical tan δ as a function of temperature for NPO dielectric.

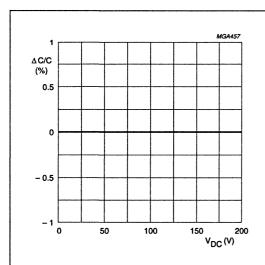


Fig.7 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage for NPO dielectric.

HIGH FREQUENCY BEHAVIOUR OF HIGH VOLTAGE CMCs OF CLASS 1, NPO DIELECTRIC

Ceramic multilayer capacitors (CMC) from the high voltage series are suitable for use at high frequencies. At frequencies below the series resonant frequency, the CMC can be represented by an equivalent circuit as shown in Fig.8.

In general, the quantities C, ESR and L are frequency dependent. For most applications, C and L can be regarded as frequency independent below 1 GHz.

The equivalent series self-inductance L is

- independent of the dielectric material
- dependent on the size of the capacitor and is approximately 1 nH for sizes 0805 and 1206 (this figure is accurate to within ±20%).

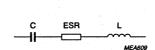
Because of the inductance L, associated with the CMC, there will be a frequency at which the inductive reactance will be equal to that of the capacitor.

This is known as the series resonant frequency (SRF) and is given

by:
$$SRF = \frac{1}{2\pi\sqrt{LC}}$$

At the SRF, the CMC will appear as a small resistor. The transmission loss through the CMC at this series resonant frequency will be low.

Using the values of C, L (= 1 nH) and the ESR (see Figs 9 and 10) at a specific frequency, (f), two often used quantities can be derived.



C = capacitance.

ESR = equivalent series resistance which is determined by the energy dissipation mechanisms (in the dielectric material as well as in the electrodes).

L = equivalent series self-inductance.

Fig.8 Equivalent series representation of a CMC.

The impedance, Z, is given by: $Z = \frac{1 - (2 \pi f)^2 LC}{2 j \pi fC} + ESR$

The quality factor is given

by:
$$Q = \frac{|1 - (2\pi f)^2 LC|}{2\pi f ESR C}$$

High voltage series

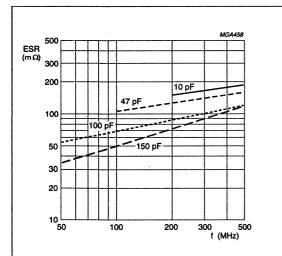


Fig.9 Typical equivalent series resistance as a function of frequency for class 1, NPO dielectric, size 0805.

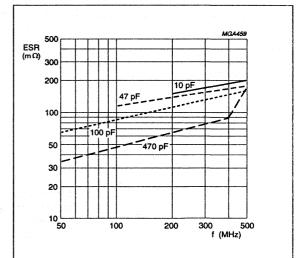


Fig.10 Typical equivalent series resistance as a function of frequency for class 1, NPO dielectric, size 1206.

High voltage series

ELECTRICAL CHARACTERISTICS

Class 2 capacitors, X7R dielectric

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%

Capacitance range (E-12 series), (note 1)	180 pF to 100 nF
Tolerance on capacitance after 1 000 hours	±20%, ±10% and ±5%
Tan δ (note 1)	≤2.5%
Insulation resistance after 1 minute at U _R (DC)	
C ≤10 nF	R _{INS} >100 GΩ
C >10 nF	R _{INS} × C >1 000 s
Maximum capacitance variation as a function of temperature (see Fig.11)	±15%
Terminations	Ag/Pd or Ni/Sn
Ageing	typically, 1% per time decade

Note

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

High voltage series

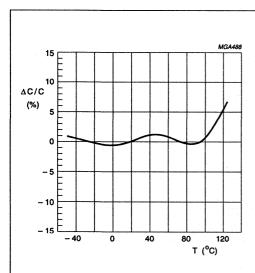
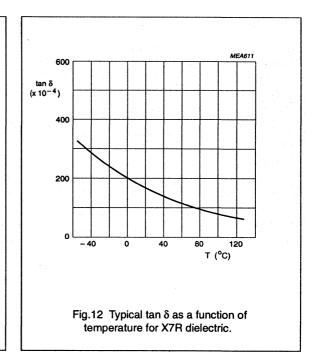


Fig.11 Typical capacitance change as a function of temperature for X7R dielectric.



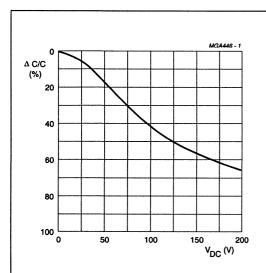


Fig.13 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage at 20 °C for X7R dielectric.

Compact series

FEATURES

- Six standard sizes
- Dense dielectric layers
- Maximum capacitance per unit volume
- Supplied in tape on reel or in boxes
- Available with Ag/Pd and Ni/Sn terminations.

APPLICATIONS

- Professional electronics
- High density consumer electronics
- · Automotive.

DESCRIPTION

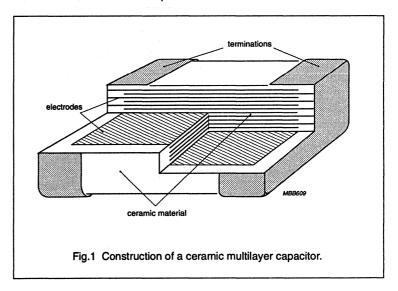
The ceramic multilayer capacitor consists of a rectangular block of ceramic dielectric in which a number of interleaved precious metal electrodes are contained. This structure gives rise to a high capacitance per unit volume. The inner electrodes are connected to the two terminations, either by silver palladium (Ag/Pd) alloy in the ratio 65: 35, or silver dipped with a barrier layer of plated nickel and finally covered with a layer of plated tin (Ni/Sn). A cross section of the structure is shown in Fig.1.

QUICK REFERENCE DATA

	,
Rated voltage U _R (DC)	
NPO dielectric	63 V (IEC)
X7R dielectric	16 V, 25 V and 63 V (IEC)
Capacitance range class 1,	
NPO dielectric	220 pF to 100 000 pF (E-12 series)
Capacitance range class 2,	
X7R dielectric	22 nF to 3.9 μF (E-12 series)
Tolerance on capacitance	
NPO dielectric	±10%, ±5% and ±2% (note 1)
X7R dielectric	±20%, ±10% and ±5%
Sectional specifications	IEC 384-10, second edition 1989-04 based on CECC 32 100
Detailed specification	based on CECC 32 101-801
Climatic category (IEC 68)	
NPO dielectric	55/125/56
X7R dielectric	55/125/56

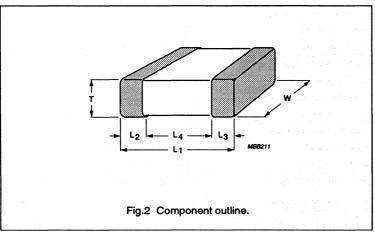
Note

1. Values ±1% available on request.



Compact series

MECHANICAL DATA



Capacitor dimensions

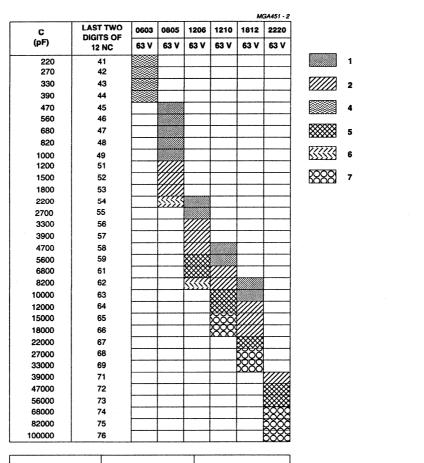
CASE SIZE		w	Т		L2/(L3 10 0 10 10 10 10 10 10 10 10 10 10 10 1		L _i
	(mm)	(mm)	MIN. (mm)	MAX. (mm)	MIN. (mm)	MAX. (mm)	MIN. (mm)
0603	1.6 ±0.1	0.8 ±0.1	0.7	0.9	0.25	0.65	0.4
0805	2.0 ±0.10	1.25 ±0.10	0.51	1.35	0.25	0.75	0.55
1206	3.2 ±0.15	1.6 ±0.15	0.51	1.75	0.25	0.75	1.4
1210	3.2 ±0.15	2.5 ±0.15	0.51	1.8	0.25	0.75	1.4
1812	4.5 ±0.2	3.2 ±0.2	0.51	1.8	0.25	0.75	2.2
2220	5.7 ±0.2	5.0 ±0.2	0.51	1.8	0.25	0.75	2.9

Philips Components Product specification

Surface mounted ceramic multilayer capacitors

Compact series

CAPACITANCE SELECTION CHART FOR CLASS 1 NPO DIELECTRIC SERIES

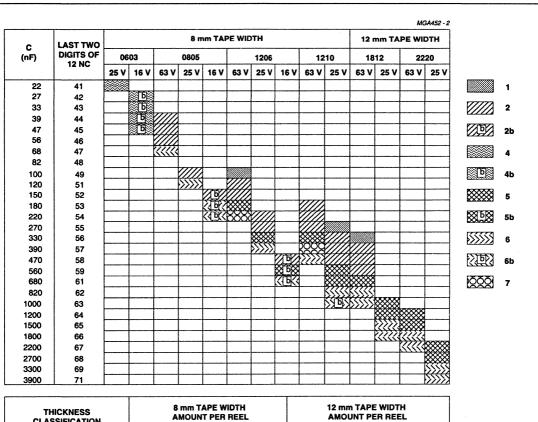


THICKNESS CLASSIFICATION	8 mm TAPE WIDTH AMOUNT PER REEL	12 mm TAPE WIDTH AMOUNT PER REEL	
(mm)	Ø 180 mm	Ø 180 mm	
1 = 0.51 to 0.7	4000	2000	
2 = 0.8 to 1.0	-	-	
2a = 0.7 to 1.0	4000	2000	
3 = 0.51 to 1.0	-	_	
4 = 0.8 ± 0.1	4000	-	
5 = 0.9 to 1.3	3000	1500	
6 = 1.25 ± 0.1	3000	-	
7 = 1.2 to 1.75	2500	1000	

Fig.3 Selection chart for class 1 NPO dielectric.

Compact series

CAPACITANCE SELECTION CHART FOR CLASS 2 X7R DIELECTRIC SERIES



THICKNESS CLASSIFICATION	8 mm TAPE WIDTH AMOUNT PER REEL	12 mm TAPE WIDTH AMOUNT PER REEL
(mm)	Ø 180 mm	Ø 180 mm
1 = 0.51 to 0.7	4000	2000
2 = 0.8 to 1.0		_
2a = 0.7 to 1.0	4000	2000
3 = 0.51 to 1.0	-	_
4 = 0.8 ± 0.1	4000	-
5 = 0.9 to 1.3	3000	1500
6 = 1.25 ± 0.1	3000	-
7 = 1.2 to 1.75	2500	1000

Note: b = in development

Fig.4 Selection chart for class 2 X7R dielectric.

Compact series

ELECTRICAL CHARACTERISTICS

Class 1 capacitors, NPO dielectric

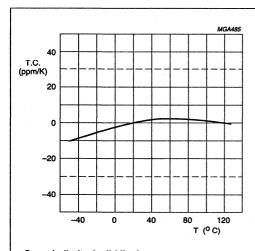
Unless otherwise stated all electrical values apply at an ambient temperature of 20 ± 1 °C, an atmospheric pressure of 86 to 106 kPa, and a relative humidity of 63 to 67%

Capacitance range (E-12 series), (note 1)	220 pF to 100 000 pF		
Tolerance on capacitance after 1 000 hours	±10%, ±5% and ±2% (note 2)		
Tan δ (note 1)	≤10 × 10-4		
Insulation resistance after 1 minute at U _R (DC)	>100 GΩ		
Temperature coefficient	(0 ±30) × 10 ⁻⁶ /K		
Terminations	Ag/Pd		

Notes

- 1. Measured at 1 V, 1 MHz for C ≤1 000 pF, and at 1 V, 1 kHz for C >1 000 pF using a four gauge method.
- 2. Values ±1% available on request.

Compact series



Sample limits (solid line). Requirement levels (broken lines).

Fig.5 Typical temperature coefficient as a function of temperature for NPO dielectrics.

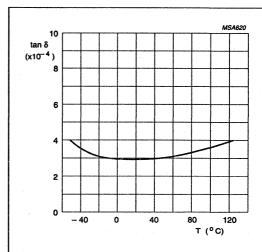


Fig.6 Typical tan δ as a function of temperature for NPO dielectric.

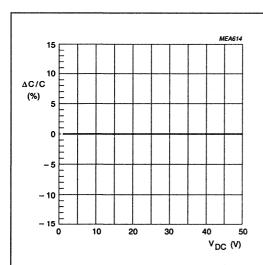


Fig.7 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage for NPO dielectrics.

Compact series

HIGH FREQUENCY BEHAVIOUR OF CERAMIC MULTILAYER CAPACITORS

Ceramic multilayer capacitors (CMC) from the compact series are suitable for use at high frequencies. At frequencies below the series resonant frequency, the CMC can be represented by an equivalent circuit as shown in Fig.8.

In general, the quantities C, ESR and L are frequency dependent. For most applications, C and L can be regarded as frequency independent below 1 GHz.

The equivalent series self-inductance L is

- independent of the dielectric material
- dependent on the size of the capacitor, it increases with increasing length and decreases with increasing width or thickness of the product
- the value of L is approximately 0.6 nH for size 0603, 1 nH for sizes 0805, 1206 and 1210, and approximately 1.5 nH for sizes 1812 and 2220. (These figures are accurate to within ±20%).

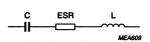
Because of the inductance L, associated with the CMC, there will be a frequency at which the inductive reactance will be equal to that of the capacitor.

This is known as the series resonant frequency (SRF) and is given

by:
$$SRF = \frac{1}{2\pi\sqrt{IG}}$$

At the SRF, the CMC will appear as a small resistor. The transmission loss through the CMC at this series resonant frequency will be low.

Using the values of C, L (= 1 nH) and the ESR at a specific frequency, (f), two often used quantities can be derived.



C = capacitance.

ESR = equivalent series resistance which is determined by the energy dissipation mechanisms (in the dielectric material as well as in the electrodes).

L = equivalent series self-inductance.

Fig.8 Equivalent series representation of a CMC.

The impedance, Z, is given

by:
$$Z = \frac{1 - (2 \pi f)^2 LC}{2 j \pi fC} + ESR$$

The quality factor is given

by:
$$Q = \frac{|1 - (2\pi f)^2 LC|}{2\pi f ESR C}$$

Compact series

Table 1 shows maximum Equivalent Series Resistance values for capacitor sizes 0805 and 1206 at frequencies of 50 MHz and 100 MHz. The measurements were taken using equipment type HP4191A.

Table 1 Maximum Equivalent Resistance (ESR) values

SIZE	VALUE RANGE (pF)	ESR at 50 MHz (mΩ)	ESR at 100 MHz (mΩ)	
0805	470 < C ≤2 200	1347	150	
1206	2 200 < C ≤8 200	80	150	

Compact series

ELECTRICAL CHARACTERISTICS

Class 2 capacitors, X7R dielectric

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%

Capacitance range (E-12 series), (note 1)	22 nF to 3.9 μF
Tolerance on capacitance after 1 000 hours	±20%, ±10% and ±5%
Tan δ (note 1)	≤2.5%
Insulation resistance after 1 minute at U _R (DC)	
C ≤10 nF	R _{INS} >100 GΩ
C >10 nF	R _{INS} × C >1 000 s
Maximum capacitance variation as a function of temperature (see Fig.9)	±15%
Terminations	Ag/Pd or Ni/Sn (note 2)

Notes

- 1. Measured at 1 V, 1 kHz using a four gauge method.
- 2. Ni/Sn for sizes 0805, 1206 and 1210.

Compact series

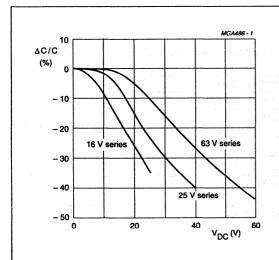


Fig.9 Typical capacitance change with respect to the capacitance at 1 V as a function of DC voltage for X7R dielectrics.

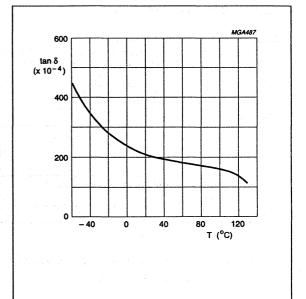
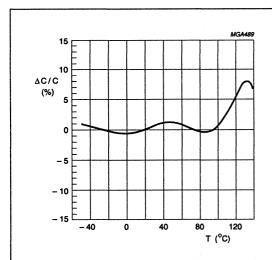
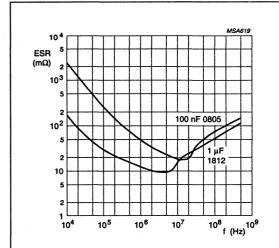


Fig.10 Typical $\tan \delta$ as a function of temperature for X7R dielectric.



 $U_{DC} = 0 V$

Fig.11 Typical capacitance change as a function of temperature for X7R dielectrics.



Measuring equipment HP4191A and HP4194A.

Fig.12 Typical equivalent series resistance (ESR) as a function of frequency.

Standard series selection charts

SELECTION CHART FOR CLASS 1 NPO DIELECTRIC 63 VOLT WITH Ag/Pd AND NI/Sn TERMINATIONS

		8 mm TAPE WIDTH							140-		IGA352 - 1			
ı	AST THREE	-						T			TAPE V			
	DIGITS OF 12 NC	0603 Ag/Pd Ni/Sn				1206 Ag/Pd Ni/Sn		Ag/Pd	10 Ni/Sn	Ag/Pd	1812 2220 Pd Ni/Sn Ag/Pd			
7	477		*****	~ y -0	AP 011	79-0	149011	Ayra	Hear	Ayru	NUON	Agra		1
	567		****					-	 	 		\vdash		•
1	687		****						 	 		 		2
1	827									 		\vdash		
1	108													3
	128		****										17773	-
1	158		****									-		4
1	188												(ALALALA)	
1	228		****										****	5
	278													
1	338	*****	****										((((6
	398		*****											
ı	478												88	7
l	568		****										محبب	_
ı	688													8
ı	828	*****	*****									\vdash		
l	109		****						<u> </u>					
	129 159		*****							 				
1	189	*****	****					ļ						
1	229	*****	₩₩					 		 				
1	279	*****	*****					 	ļ	 				
1	339		₩₩		-					 		 		
1	399		₩₩							 		\vdash		
	479							dillion	m	 		\vdash		
1	569	*****	****					HHH	HHH	 				
	689				******		•••••	HHH	HHH					
	829							HH	HH					
	101	******	⋘					HH	11111					
1	121							HH	444	1				
	151							11111	4111					
	181							11117	11111					
	221													
	271							IIIII	IIIII					
1	331			,,,,,,				alli	IIIII	11111	11111			
l	391	l		////	/////			tmi	ШП	TITI	ши			
1	471				4444			alli	m	UIII)	m	WIII)		
1	561			<i>444</i> 2	4444			UHA	HH	UILLA	HH	4444		
1	681 821			<i>444</i>	>>>>>			HHH	HHH	HHH	HHH	HHH		
1	102			<i>444</i>	****			HHH	HHH	HHH	HHH	HHH		
1	122			11114	2222	,,,,,,	m	HHH	HHH	HHH	HHH	HHH		
	152					HHA	444	HHH	HHH	HHH	HHH	HHH		
l	182							HHH	HHH	HHH	HHH	HHH		
l	222					⋘⋘	₩₩	HHH	HHH	HHH	HHH	HHH		
1	272					****	****	HHH	HHH	HHH	HHH	HHH		
١	332						###	*****	*****	HHH	HHH	1444		
	392							******	‱	4444	11111	1444		
ı	472							ÖÖÖÖ	አጽጽ	4444	11111	11111		
ĺ	562									444	11111	11111		
1	682											4111		
1	822											4111		
L	103											11114		
_														
KN	IESS CLASS	IFICATIO	N		8 A	mm TAP	E WIDT	H		12 mm AMOU	TAPE V	VIDTH REEL		
	(mm)		ı	Ø	180 mn	•	1	Ø 286 mr	n		5 180 mi			
	1 = 0.51 to 0.				4000			10000			2000			
	2 = 0.8 to 1.				4000 4000	l		10000			2000	- 1		
3 = 0.51 to 1.0						- 1		10000			2000	1		
	$4 = 0.8 \pm 0.$				4000			10000						

THICKNESS CLASSIFICATION	8 mm TA AMOUNT	12 mm TAPE WIDTH AMOUNT PER REEL	
(mm)	Ø 180 mm	Ø 286 mm	Ø 180 mm
1 = 0.51 to 0.7	4000	10000	2000
2 = 0.8 to 1.0	4000	10000	2000
3 = 0.51 to 1.0	4000	10000	2000
4 = 0.8 ± 0.1	4000	10000	-
5 = 0.9 to 1.3	3000	8000	1500
6 = 1.25 ± 0.1	3000	8000	! -
7 = 1.2 to 1.75	2500	7000	l –
8 = 1.6 + 0.15	2500	7000	-

Fig.1 Selection chart for class 1 NPO dielectric 63 volt with Ag/Pd and Ni/Sn terminations.

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Standard series selection charts

COMPOSITION OF THE 12NC FOR THE CLASS 1 NPO DIELECTRIC 63 VOLT SERIES

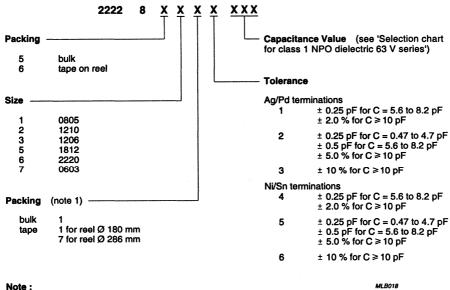


Fig.2 Composition of the 12NC for the class 1 NPO dielectric 63 volt series.

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^{1.} Amount on reel depends on thickness class (see 'Selection chart for class 1 NPO dielectric 63 V series Thickness classification').

Standard series selection charts

SELECTION CHART FOR CLASS 1 NPO DIELECTRIC 100 VOLT WITH Ag/Pd AND NI/Sn TERMINATIONS

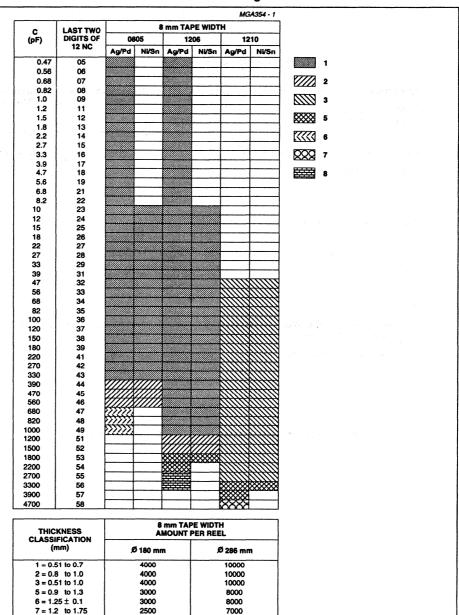


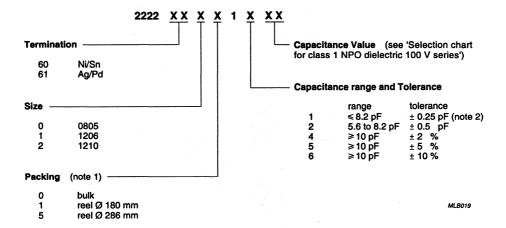
Fig.3 Selection chart for class 1 NPO dielectric 100 volt with Ag/Pd and Ni/Sn terminations.

2500

 $8 = 1.6 \pm 0.15$

Standard series selection charts

COMPOSITION OF THE 12NC FOR THE CLASS 1 NPO DIELECTRIC 100 VOLT SERIES



Notes:

- Amount on reel depends on thickness class (see 'Selection chart for class 1 NPO dielectric 100 V series. Thickness classification').
- 2. Only available with Ag/Pd terminations.

Fig.4 Composition of the 12NC for the class 1 NPO dielectric 100 volt series.

Standard series selection charts

SELECTION CHART FOR CLASS 1 N750 DIELECTRIC 63 VOLT WITH Ag/Pd AND NI/Sn TERMINATIONS

С		THREE IS OF	8 mm TAPE WIDTH						
(pF)		NC	08	05	1206				
	(note 1)	(note 2)	Ag/Pd	Ni/Sn	Ag/Pd	Ni/Sn			
4.7	095								
5.6	097	-							
6.8	099	-							
8.2	102	-							
10	104	238							
12	106	241							
15	108	243							
18	111	245							
22	113	247							
27	115	249							
33	117	252							
39	119	254							
47	122	256							
56	124	258							
68	126	261							
82	128	263							
100	131	265							
120	133	267							
150	135	269							
180	137	272							
220	139	274							
270	142	276							
330	144	278							
390	146	281							
470	148	283							
560	151	285							
680	153	287							
820	155	289				******			
1000	157	292							
1200	159	294			///////	//////			

THICKNESS CLASSIFICATION	8 mm TAPE WIDTH AMOUNT PER REEL					
(mm)	Ø 180 mm	Ø 286 mm				
1 = 0.51 to 0.7	4000	10000				
2 = 0.8 to 1.0	4000	10000				

Notes:

Tolerance:

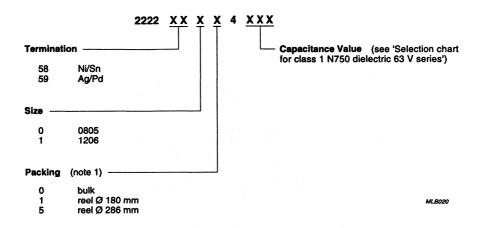
- 1. 0.25 pF for C ≤ 4.7 pF 0.5 pF for 6.6 pF ≤ C ≤ 8.2 pF 5% for C ≥ 10 pF
- 2. 10% for C≥10 pF

Fig.5 Selection chart for class 1 N750 dielectric 63 volt with Ag/Pd and Ni/Sn terminations.

April 1993

Standard series selection charts

COMPOSITION OF THE 12NC FOR THE CLASS 1 N750 DIELECTRIC 63 VOLT SERIES



Note:

 Amount on reel depends on thickness class (see 'Selection chart for class 1 N750 dielectric 63 V series. Thickness classification').

Fig.6 Composition of the 12NC for the class 1 N750 dielectric 63 volt series.

Standard series selection charts

SELECTION CHART FOR CLASS 2 X7R DIELECTRIC 63 VOLT WITH Ag/Pd AND NI/Sn TERMINATIONS

Diditis of Did	c	LAST TWO	8 mm TAPE WIDTH						12 mm TAPE WIDTH						
100		DIGITS OF	06	503	08	105	12	:06	12	10	18	112	2220		
120		12 NC	Ag/Pd	NI/Sn	Ag/Pd	NI/Sn	Ag/Pd	NI/Sn	Ag/Pd	Ni/Sn	Ag/Pd	NI/Sn	Ag/Pd		
120 02 18	100	01													1
180	120	02									T				
2200 06	150	03									†			7///	2
270 06	180	04												222	
270 06 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	220	05					XXXXXX	*************************************			1		1	*************************************	2a
390 08	270	06					*****						1		
390 08 690 112 880 12 880 13 1000 14 1200 15 1500 16 1800 17 2200 18 3300 21 33900 22 47700 23 5500 24 6600 25 8200 26 8200 26 8200 27 7700 36 8200 31 82000 31 82000 31 82000 34 83000 34 84 85000 37 86000 37 86000 37 86000 38 87000 38 87000 38 87000 38 87000 38 87000 38 87000 38 87000 38 87000 38 87000 38 87000 38 87000 38 87000 38 87000 38 87000 38 87000 38 87000 38 87000 38 870000 48 870000 48 870000 48 870000 48 870000 48 870000 48 8700000 48 8700000 48 8700000 48 8700000 48 8700000 52 8700000 52 8700000 53 8700000 52 8700000 53 8700000 52 8700000 53 8700000 55 8700000 55 8700000 55 8700000 55 8700000 55 8700000 55 8700000 55 8700000 55 8700000 55 8700000 55 8700000 55 8700000 55 8700000 55 8700000 55 8700000 55 8700000 55 8700000 55 8700000 55 87000000 55 8700000 55 8700000 55 8700000 55 8700000 55 8700000 55 87000000 55 87000000 55 87000000 55 87000000 55 87000000 55 8700000000000000000000000000000000000	330	07					******	XXXXXX			†		1		3
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2000 28								***************************************	HHH	HHH	UHH	HHH	 		
5000 29 8000 31 22000 32 77000 33 8000 34 99000 35 77000 36 8000 37 80000 38 90000 41 90000 41 90000 42 90000 44 90000 44 90000 44 90000 44 90000 45 90000 46 90000 47 90000 48 90000 47 90000 48 90000 51 90000 52 90000 53 90000 54 THICKNESS CLASSIFICATION 8 mm TAPE WIDTH AMOUNT PER REEL			******	*****			***************************************	**************************************	HHH	HHH	HHH	HHH	m		
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39000 35 17000 36 18000 37 18000 38 18000 38 18000 39 180000 41 180000 42 180000 43 180000 44 180000 44 180000 45 180000 46 180000 47 180000 47 180000 48 180000 51 180000 51 180000 52 180000 53 180000 54 THICKNESS CLASSIFICATION (mm) 8 mm TAPE WIDTH AMOUNT PER REEL AMOUNT PER REEL			 			4444	*********		mm	шш	<i>UUU</i>	ши	WWW.		
17000 36 16000 37 18000 38 18000 39 10000 41 10000 42 10000 43 10000 44 10000 45 10000 46 10000 47 10000 48 10000 47 10000 48 10000 51 10000 52 10000 53 10000 53 10000 54 11 12 mm TAPE WIDTH AMOUNT PER REEL AMOUNT PER REEL			L				***************************************	***************************************	m	mm	UIIII	um	m		
6000 37 8000 38 9000 39 90000 41 90000 42 90000 43 90000 44 90000 45 90000 47 90000 48 90000 49 90000 51 90000 51 90000 52 90000 53 90000 54 THICKNESS CLASSIFICATION (mm) 8 mm TAPE WIDTH AMOUNT PER REEL AMOUNT PER REEL							**********	*************************************	um	mm	UIIII	ши	111111		
38000 38			ļ				********	***************************************	ШШ	ши	UIIII)	ШШ	MILL		
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20000 41 20000 42 20000 43 20000 44 20000 45 20000 46 20000 47 20000 48 20000 51 20000 51 20000 52 20000 53 20000 54 THICKNESS CLASSIFICATION (mm) 8 mm TAPE WIDTH AMOUNT PER REEL AMOUNT PER REEL							***************************************	**********	IIIII	m_{L}	MMM	THE P	IIIIII		
20000 42 20000 43 20000 44 20000 45 20000 46 20000 47 20000 48 20000 47 20000 51 20000 51 20000 52 20000 53 20000 54 THICKNESS CLASSIFICATION (mm) 8 mm TAPE WIDTH AMOUNT PER REEL AMOUNT PER REEL							***************************************	***************************************	WIIII	ШШ	uuu	<u>IIIII</u>	m_{Δ}		
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30000 44 20000 45 30000 47 30000 48 30000 51 30000 51 30000 52 30000 53 30000 54 THICKNESS CLASSIFICATION (mm) 8 mm TAPE WIDTH AMOUNT PER REEL AMOUNT PER REEL									$m_{\tilde{l}}$		IIIII				
20000 45 20000 48 20000 47 20000 48 20000 49 20000 51 20000 52 20000 53 20000 54 THICKNESS CLASSIFICATION 8 mm TAPE WIDTH AMOUNT PER REEL AMOUNT PER REEL									ШП				VIIII		
70000 48 70000 47 70000 48 70000 49 70000 51 70000 52 70000 53 70000 54 THICKNESS CLASSIFICATION (mm) 8 mm TAPE WIDTH AMOUNT PER REEL AMOUNT PER REEL															
0000 47 0000 48 0000 49 0000 51 0000 52 0000 53 0000 54 THICKNESS CLASSIFICATION (mm) 8 mm TAPE WIDTH AMOUNT PER REEL AMOUNT PER REEL											111111		111112		
00000 48											11111				
10000															
00000 51			I			T					m		11111		
0000 52 0000 53 0000 54 THICKNESS CLASSIFICATION (mm) 8 mm TAPE WIDTH AMOUNT PER REEL AMOUNT PER REEL											********		11111		
THICKNESS CLASSIFICATION (mm) 8 mm TAPE WIDTH AMOUNT PER REEL AMOUNT PER REEL													11111		
THICKNESS CLASSIFICATION 8 mm TAPE WIDTH AMOUNT PER REEL AMOUNT PER REEL AMOUNT PER REEL													11111		
THICKNESS CLASSIFICATION AMOUNT PER REEL AMOUNT PER REEL (mm)													11111		
THICKNESS CLASSIFICATION AMOUNT PER REEL AMOUNT PER REEL (mm)	0000	54											******		
THICKNESS CLASSIFICATION AMOUNT PER REEL AMOUNT PER REEL (mm)						8	mm TAP	E WIDT	1		12 mm	TAPE V	VIDTH		
Ø 180 mm Ø 286 mm Ø 180 mm	THICK		IFICATIO	N		Al	MOUNT F								
1 = 0.51 to 0.7 4000 10000 2000		1-0514-5	,	·	5		n	Ø		1	R		n		

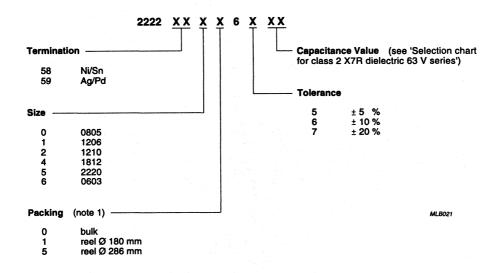
THICKNESS CLASSIFICATION	8 mm TAI AMOUNT	12 mm TAPE WIDTH AMOUNT PER REEL	
(mm)	Ø 180 mm	Ø 286 mm	Ø 180 mm
1 = 0.51 to 0.7	4000	10000	2000
2 = 0.8 to 1.0	4000	10000	2000
2a = 0.7 to 1.0	4000	10000	2000
3 = 0.51 to 1.0	4000	10000	2000
$4 = 0.8 \pm 0.1$	4000	10000	_
5 = 0.9 to 1.3	3000	8000	1500

Fig.7 Selection chart for class 2 X7R dielectric 63 volt with Ag/Pd and Ni/Sn terminations.

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Standard series selection charts

COMPOSITION OF THE 12NC FOR THE CLASS 2 X7R DIELECTRIC 63 VOLT SERIES



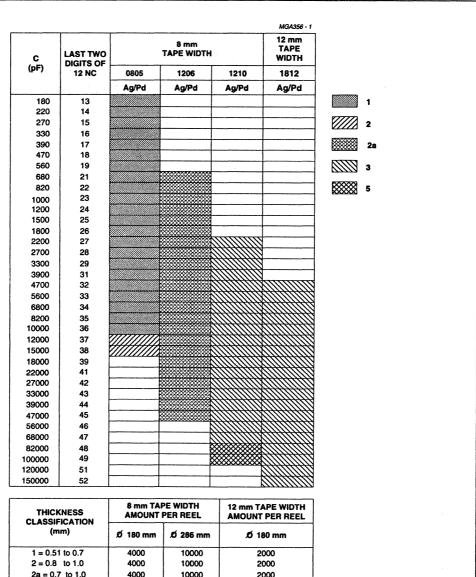
Note:

Fig.8 Composition of the 12NC for the class 2 X7R dielectric 63 volt series.

Amount on reel depends on thickness class (see 'Selection chart for class 2 X7R dielectric 63 V series. Thickness classification').

Standard series selection charts

SELECTION CHART FOR CLASS 2 X7R DIELECTRIC 100 VOLT WITH Ag/Pd TERMINATIONS



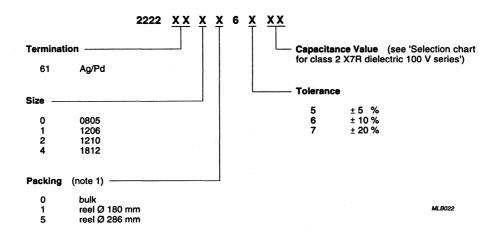
2a = 0.7 to 1.0 4000 10000 2000 3 = 0.51 to 1.0 4000 10000 2000 5 = 0.9 to 1.3 3000 8000 1500

Fig.9 Selection chart for class 2 X7R dielectric 100 volt with Ag/Pd terminations.

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Standard series selection charts

COMPOSITION OF THE 12NC FOR THE CLASS 2 X7R DIELECTRIC 100 VOLT SERIES



Note:

Fig.10 Composition of the 12NC for the class 2 X7R dielectric 100 volt series.

Amount on reel depends on thickness class (see 'Selection chart for class 2 X7R dielectric 100 V series. Thickness classification').

Narrow tolerance series selection chart

1 / 2 / 2 / 4 / 5 / 5 / 6 / 8 / 8

SELECTION CHART FOR CLASS 1 NPO DIELECTRIC 63 VOLT WITH Ag/Pd AND NI/Sn TERMINATIONS

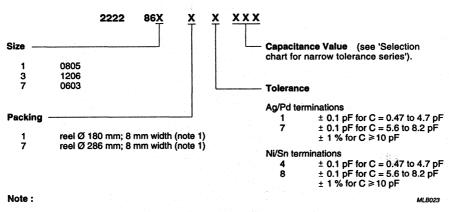
С	LAST THREE		8 mm TAPE WIDTH								
(pF)	DIGITS OF 12NC	06	03	08	305	120)6				
	1	Ag/Pd	NVSn	Ag/Pd	Ni/Sn	Ag/Pd	NI/Sn				
0.47	477	*****	****								
0.56	567										
0.68	687	*****	*****								
0.82	827	*****	*****								
1.0	108										
1.2	128										
1.5	158	*****	*****								
1.8	188										
2.2	228	*****	****		•		•••••				
2.7	278	****									
3.3	338										
3.9	398										
4.7	478										
5.6	568	*****									
6.8	688										
8.2	828						•••••				
10	109										
12	129										
15	159										
18	189		****								
22	229		****								
27	279										
33	339		****								
39	399	*****	*****								
47	479	*****	****								
56	569	******	****								
68	689	*****	****								
		*****	****								
82 100	829	******	*****								
	101	*****									
120	121	*****	*****								
150	151	*****	*****								
180	181										
220	221										
270	271										
330	331										
390	391										
470	471										
560	561										
680	681				/////						
820	821				((((((
1000	102				~~~						
1200	122					//////					
1500	152			-							
1800	182					7////X					
2200	222					*******	⋘⋘				
2700	272					*****	HXXX				
3300	332						444				

THICKNESS CLASSIFICATION	8 mm TAPE WIDTH AMOUNT PER REEL					
(mm)	Ø 180 mm	Ø 286 mm				
1 = 0.51 to 0.7	4000	10000				
2 = 0.8 to 1.0	4000	10000				
$4 = 0.8 \pm 0.1$	4000	10000				
5 = 0.9 to 1.3	3000	8000				
$6 = 1.25 \pm 0.1$	3000	8000				
$8 = 1.6 \pm 0.15$	2500	7000				

Fig.1 Selection chart for class 1 NPO dielectric 63 volt with Ag/Pd and Ni/Sn terminations.

Narrow tolerance series selection chart

COMPOSITION OF THE 12NC FOR THE CLASS 1 NPO DIELECTRIC 63 VOLT SERIES



 Amount on reel depends on thickness class (see 'Selection chart for narrow tolerance series. Thickness classification').

Fig.2 Composition of the 12NC for the class 1 NPO dielectric 63 volt series.

Microwave series selection chart

SELECTION CHART FOR CLASS 1 NPO DIELECTRIC 63 VOLT WITH Ag/Pd AND NI/Sn TERMINATIONS

		en un gue d'Arre.		8 mm TAI	MGA357]		
C C	LAST TWO DIGITS OF	060	3	08		120		
(pF)	12 NC	Ag/Pd	Ni/Sn	Ag/Pd	Ni/Sn	Ag/Pd	Ni/Sn	
0.47	05							1
0.56	06							
0.68	07							4
0.82	08							
1.0	09							
1.2	11							
1.5	12							
1.8	13							
2.2	14							
2.7	15							
3.3	16							
3.9	17				•••••			
4.7	18							
5.6	19							
6.8	21							
8.2	22		*****					
10	23							
12	24					1		
15	25							
18	26		-			 		
22	27		******			1		
27	28		******			†		
33	29		*****					
39	31							
47	32		*****					
56	33	***************************************	******			 		
68	34					1		
82	35	 						
100	36					 		
120	37	 -				 		

THICKNESS CLASSIFICATION	8 mm TAPE WIDTH AMOUNT PER REEL					
(mm)	Ø 180 mm	Ø 286 mm				
1 = 0.51 to 0.7	4000	10000				
$4 = 0.8 \pm 0.1$	4000	10000				

Fig.1 Selection chart for class 1 NPO dielectric 63 volt with Ag/Pd and Ni/Sn terminations.

Microwave series selection chart

COMPOSITION OF THE 12NC FOR THE CLASS 1 NPO DIELECTRIC 63 VOLT SERIES

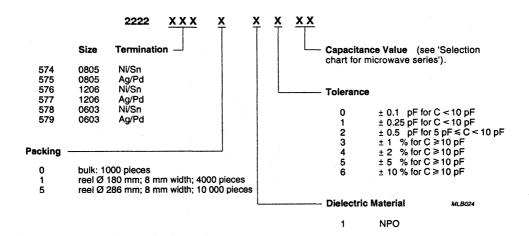


Fig.2 Composition of the 12NC for the class 1 NPO dielectric 63 volt series.

X7R 25 volt series selection chart

SELECTION CHART FOR CLASS 2 X7R DIELECTRIC 25 VOLT WITH Ag/Pd AND Ni/Sn TERMINATIONS

						MGA449 - 1				
c	LAST TWO	8 mm TAPE WIDTH								
(nF)	DIGITS OF	0603	04	805	1206					
		Ni/Sn	Ag/Pd	Ni/Sn	Ag/Pd	Ni/Sn				
10	36									
12	37									
15	38									
18	39									
22	41									
27	42									
33	43									
39	44									
47	45									
56	46									
68	47									
82	48									
100	49									
120	51									
150	52									
180	53									
220	54									

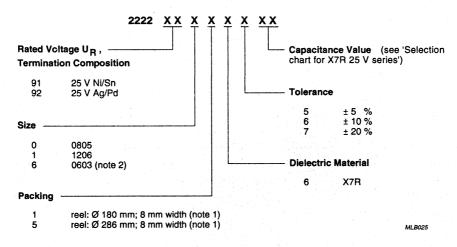
1
2
2a
4
6

THICKNESS CLASSIFICATION	8 mm TAPE WIDTH AMOUNT PER REEL							
(mm)	Ø 180 mm	ø 286 mm						
1 = 0.51 to 0.7	4000	10000						
2 = 0.8 to 1.0	4000	10000						
2a = 0.7 to 1.0	4000	10000						
$4 = 0.8 \pm 0.1$	4000	10000						
6 = 1.25 ± 0.1	3000	8000						

Fig.1 Selection chart for class 2 X7R dielectric 25 volt with Ag/Pd and Ni/Sn terminations.

X7R 25 volt series selection chart

COMPOSITION OF THE 12NC FOR THE CLASS 2 X7R DIELECTRIC 25 VOLT SERIES



Note:

- Amount on reel depends on thickness class (see 'Selection chart for X7R 25 V series. Thickness classification').
- 2. Only available with Ni/Sn terminations.

Fig.2 Composition of the 12NC for the class 2 X7R dielectric 25 volt series.

High voltage series selection charts

SELECTION CHART FOR CLASS 1 NPO DIELECTRIC 200 VOLT WITH Ag/Pd AND NI/Sn TERMINATIONS

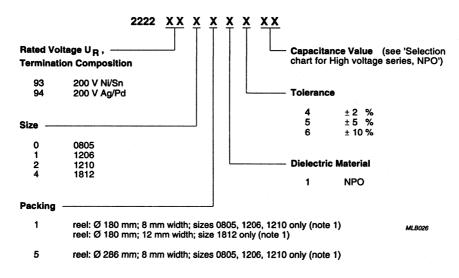
С	LAST TWO		12 mm TAPE WIDTH							
(pF) DIGITS OF 12 NC		086	05	12	06	12	:10	1812		
			Ag/Pd	Ni/Sn	Ag/Pd	Ni/Sn	Ag/Pd	Ni/Sn	Ag/Pd	Ni/Sn
10	23									
12	24									
15_	25					1				
18	26					1				
22	27									
27	28									
33	29									
39	31									
47	32									
56	33									
68	34									
82	35		>>>>>>							
100	36	XXXXXX	??????							
120	37	15555555	******							
150	38	******	·>>>>							
180	39									
220	41									
270	42									
330	43			*******	******					
390	44			*********	**************************************					
470	45			*******	**************************************	*******	*************************************			
560	46				ÖÖÖÖÖ	*******	*******			
680	47	1 1				******	********			
820	48					*******	*******			
1000	49									
1200	51							********	******	
1500	52	1				1		***********	******	

THICKNESS CLASSIFICATION	1	PE WIDTH PER REEL	12 mm TAPE WIDTH AMOUNT PER REEL
(mm)	Ø 180 mm	Ø 286 mm	Ø 180 mm
2 = 0.80 to 1.00	4000	10000	2000
5 = 0.90 to 1.30	3000	8000	1500
$6 = 1.25 \pm 0.10$	3000	8000	-
7 = 1.20 to 1.75	2500	7000	-
8 = 1.60 ± 0.15	2500	7000	_

Fig.1 Selection chart for class 1 NPO dielectric 200 volt with Ag/Pd and Ni/Sn terminations.

High voltage series selection charts

COMPOSITION OF THE 12NC FOR THE CLASS 1 NPO DIELECTRIC 200 VOLT SERIES



Note:

 Amount on reel depends on thickness class (see 'Selection chart for High voltage series, NPO. Thickness classification').

Fig.2 Composition of the 12NC for the class 1 NPO dielectric 200 volt series.

High voltage series selection charts

SELECTION CHART FOR CLASS 2 X7R DIELECTRIC 200 VOLT WITH Ag/Pd AND NI/Sn TERMINATIONS

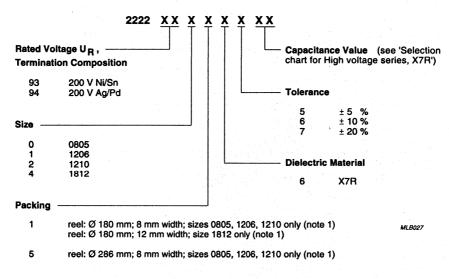
С	LAST TWO			8 mm TAI	PE WIDTH			12 I	
pF)	DIGITS OF 12 NC	08	05	12	06	12	10	18	12
		Ag/Pd	NI/Sn	Ag/Pd	Ni/Sn	Ag/Pd	Ni/Sn	Ag/Pd	Ni/Sn
180	13				The second			10.00	
220	14								
270	15								
330	16								
390	17								
470	18								
560	19								
680	21								
820	22								
1000	23								
1200	24								
1500	25								
1800	26								
2200	27								
2700	28								
3300	29								
3900	31								
4700	32	******	*****						
5600	33	222222	??????						
6800	34	*****	<i>{{{</i> {}						
8200	35	1							
0000	36	T							
2000	37								
5000	38								
8000	39			******	********				
2000	41			*****	*******				
7000	42			7					
3000	43					*************************************	******		
9000	44		1.25		100	*************************************	********		
7000	45					100000			
6000	46								
8000	47							₩₩₩	*****
2000	48							*************************************	******
0000	49	†						**********	*****

THICKNESS CLASSIFICATION		PE WIDTH PER REEL	12 mm TAPE WIDTH AMOUNT PER REEL
(mm)	Ø 180 mm	Ø 286 mm	Ø 180 mm
2 = 0.80 to 1.00	4000	10000	2000
5 = 0.90 to 1.30	3000	8000	1500
$6 = 1.25 \pm 0.10$	3000	8000	- · · · · · · -
7 = 1.20 to 1.75	2500	7000	_ *

Fig.3 Selection chart for class 2 X7R dielectric 200 volt with Ag/Pd and Ni/Sn terminations.

High voltage series selection charts

COMPOSITION OF THE 12NC FOR THE CLASS 2 X7R DIELECTRIC 200 VOLT SERIES



Note:

Amount on reel depends on thickness class (see 'Selection chart for High voltage series, X7R.
 Thickness classification').

Fig.4 Composition of the 12NC for the class 2 X7R dielectric 200 volt series.

Compact series selection charts

SELECTION CHART FOR CLASS 1 NPO DIELECTRIC 63 VOLT WITH Ag/Pd AND NI/Sn TERMINATIONS

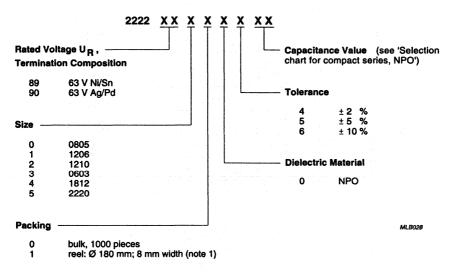
C (pF)	DIGITS OF	0603 63 V	0805 63 V	1206 63 V	1210 63 V	1812 63 V	2220 63 V
220	41						-
270	42						
330	43			 	l		
390	44		-				
470	45	×××××					
560	46	-			 	 	<u> </u>
680	47						
820	48	-			 		·
1000	49	-		 		-	
1200	51		/////		 	 	
1500	52			 		 	
1800	53	-	<i>\\\\\</i>		 	-	
2200	54	-	UUU		-		├
2700	55		22222				├
3300	56			,,,,,	-	 	├
3900	57	-]		
4700	58			<i>\\\\\</i>			
5600	59	-			ļ		
	61	-		₩₩	,,,,,,		<u> </u>
6800	1		ļ	>>>>>			-
8200	62	<u> </u>	<u> </u>	22222		1	-
10000	63				₩₩	,,,,,,	
12000	64		ļ		₩₩		1
15000	65		ļ				1
18000	66				1000		1
22000	67					₩₩	
27000	68					DOĞĞ	
33000	69					5000	
39000	71						
47000	72						‱
56000	73						₩
68000	74						200
82000	75						DOO
100000	76		T		l .		KXX

THICKNESS CLASSIFICATION	8 mm TAPE WIDTH AMOUNT PER REEL	12 mm TAPE WIDTH AMOUNT PER REEL
(mm)	Ø 180 mm	Ø 180 mm
1 = 0.51 to 0.7	4000	2000
2 = 0.8 to 1.0	-	- '
2a = 0.7 to 1.0	4000	2000
3 = 0.51 to 1.0		_
$4 = 0.8 \pm 0.1$	4000	-
5 = 0.9 to 1.3	3000	1500
6 = 1.25 ± 0.1	3000	-
7 = 1.2 to 1.75	2500	1000

Fig.1 Selection chart for class 1 NPO dielectric 63 volt with Ag/Pd and Ni/Sn terminations.

Compact series selection charts

COMPOSITION OF THE 12NC FOR THE CLASS 1 NPO DIELECTRIC 63 VOLT SERIES



Note:

Fig.2 Composition of the 12NC for the class 1 NPO dielectric 63 volt series.

Amount on reel depends on thickness class (see 'Selection chart for class 1 NPO dielectric series. Thickness classification').

Compact series selection charts

SELECTION CHART FOR CLASS 2 X7R DIELECTRIC 16 VOLT, 25 VOLT AND 63 VOLT WITH Ag/Pd AND Ni/Sn TERMINATIONS

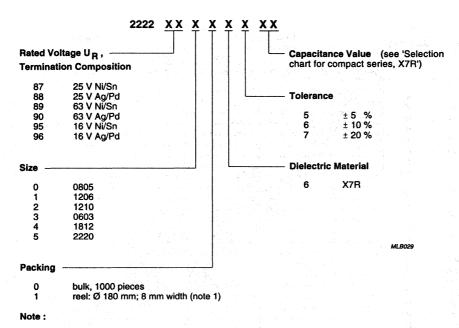
C (nF)	LAST TWO		8 mm TAPE WIDTH							12:	nm TA	PE WI	DTH					
	DIGITS OF	DIGITS OF	06	:03	8 get 1	0805		Γ	1206	,	12	10	18	12	22	20		
	12 NC	25 V	16 V	63 V	25 V	16 V	63 V	r	16 V	63 V		63 V		63 V	25 V			
22	41																1	
27	42		Б									-						
33	43		₩ ₽₩														2	
39	44		₩													12222		
47	45		b										-				2b	
56	46															2777		
68	47			~~~													4	
82	48															CVVVVV		
100	49		1.														4b	
120	51				·>>>>>	1 1												
150	52															- XXXX	5	
180	53					河区	‱											
220	54					營	2000		1							₩5₩	5b	
270	55					, Y .,							1.					
330	56			·	-		44 L	⋘		‱						<i>\$</i> \$\$\$\$\$\$	6	
390	57							>>>>>		ROOC								
470	58									?????						STESS	6b	
560	59								X®X		⋘							
680	61							1	K DK		⋘	‱				IZZZ	7	
820	62							-			>>>>>	\$\$\$\$\$						
1000	63										《回》		‱					
1200	64												‱	****				
1500	65							:					?????	‱				
1800	66																	
2200	67													\sim	*****			
2700	68														****			
3300	69							L										
3900	71		L					L	L						>>>>>			

THICKNESS CLASSIFICATION	8 mm TAPE WIDTH AMOUNT PER REEL	12 mm TAPE WIDTH AMOUNT PER REEL				
(mm)	Ø 180 mm	Ø 180 mm				
1 = 0.51 to 0.7	4000	2000				
2 = 0.8 to 1.0	1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	-				
2a = 0.7 to 1.0	4000	2000				
3 = 0.51 to 1.0	-	-				
4 = 0.8 ± 0.1	4000					
5 = 0.9 to 1.3	3000	1500				
6 = 1.25 ± 0.1	3000					
7 = 1.2 to 1.75	2500	1000				
1						

Note: b = in development

Fig.3 Selection chart for class 2 X7R dielectric 16 volt, 25 volt and 63 volt with Ag/Pd and Ni/Sn terminations.

COMPOSITION OF THE 12NC FOR THE CLASS 2 X7R DIELECTRIC 16 VOLT, 25 VOLT AND 63 VOLT SERIES

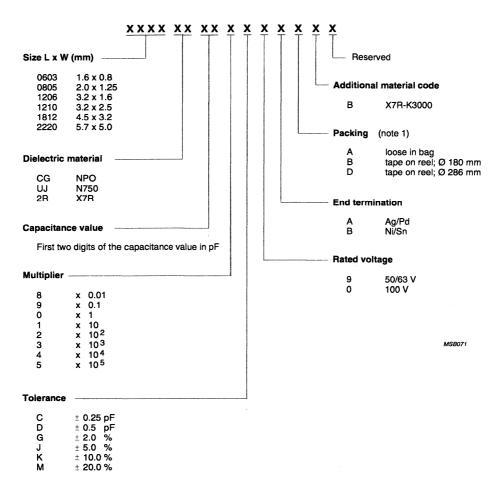


Amount on reel depends on thickness class (see 'Selection chart for class 2 X7R dielectric series. Thickness classification').

Fig.4 Composition of the 12NC for the class 2 X7R dielectric 16 volt, 25 volt and 63 volt series.

Standard series 15 digit code

COMPOSITION OF THE 15 DIGIT CODE



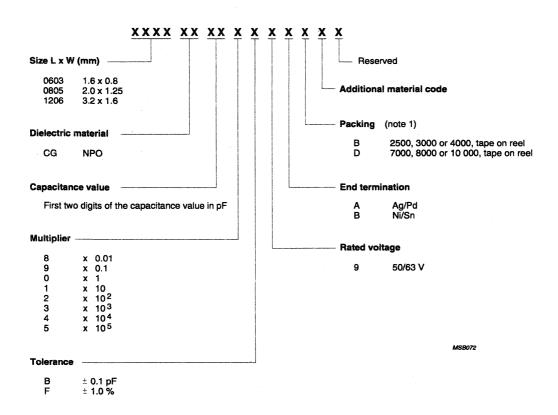
Note:

1. Amount on reel depends on thickness class (see standard series selection charts).

Fig.1 Standard series 15 digit code.

Narrow tolerance series 15 digit code

COMPOSITION OF THE 15 DIGIT CODE



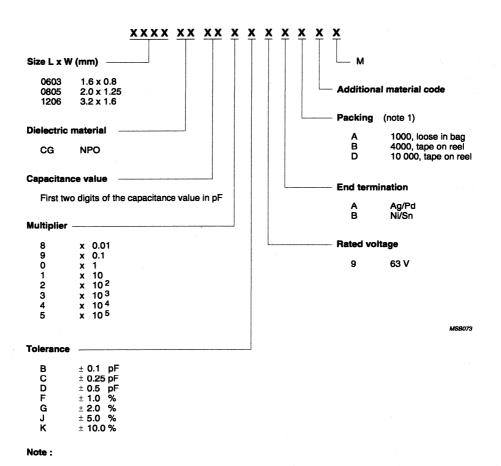
Note:

1. Amount on reel depends on thickness class (see narrow tolerance series selection chart).

Fig.1 Narrow tolerance series 15 digit code.

Microwave series 15 digit code

COMPOSITION OF THE 15 DIGIT CODE

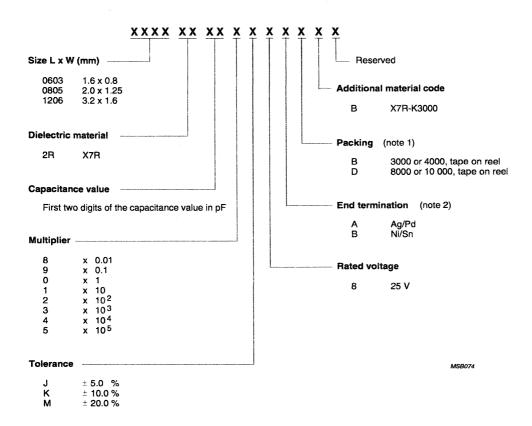


1. Amount on reel depends on thickness class (see microwave series selection chart).

Fig.1 Microwave series 15 digit code.

X7R 25 volt series 15 digit code

COMPOSITION OF THE 15 DIGIT CODE



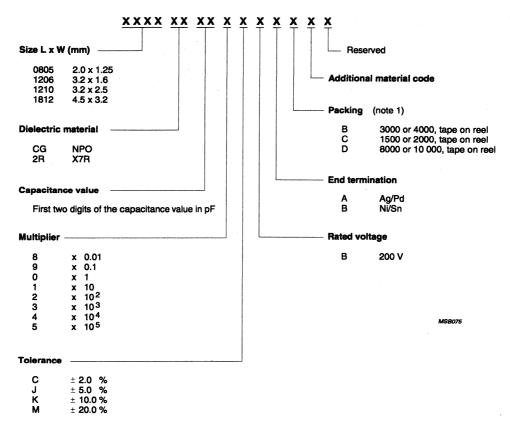
Note:

- 1. Amount on reel depends on thickness class (see X7R 25 V series selection chart).
- 2. Size 0603 only available with Ni/Sn terminations.

Fig.1 X7R 25 volt series 15 digit code.

High voltage series 15 digit code

COMPOSITION OF THE 15 DIGIT CODE



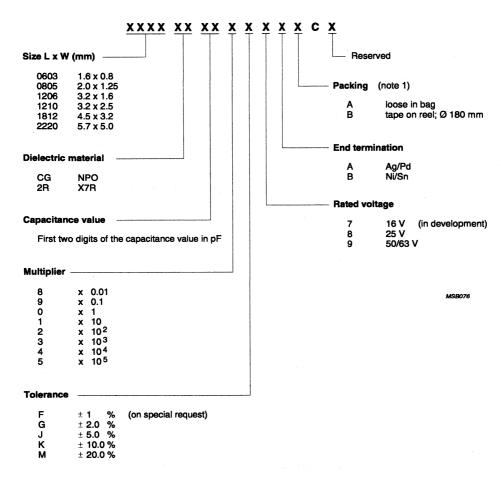
Note:

1. Amount on reel depends on thickness class (see high voltage series selection charts).

Fig.1 High voltage series 15 digit code.

Compact series 15 digit code

COMPOSITION OF THE 15 DIGIT CODE



Note:

1. Amount on reel depends on thickness class (see compact series selection charts).

Fig.1 Compact series 15 digit code.

General data

TAPE PACKING SPECIFICATIONS

The capacitors are available on tape on reel.

Packaging conforms fully with IEC 286-3, EIA 481-1 and JIS C0806 industrial standards.

Cover tape

Polyester:

12 µm.

Adhesive:

20 μm.

Sealant:

30 µm (styrene resin).

Table 1 Properties of cover tape

Width	5.5 ±0.1 mm	9.5 ±0.1 mm	
Breaking force	≥10.7 N	≥17.6 N	
Elongation at break	≥63%	≥63%	
Surface resistance	10 ⁷ to 10 ⁹ Ω	10 ⁷ to 10 ⁹ Ω	
Softening point	71 ±5 ℃	71 ±5 ℃	

Carrier tape

Polycarbonate

Table 2 Properties of carrier tape

Width	8.1 ±0.2 mm	12 ±0.2 mm
Thickness	240 ±20 μm	240 ±20 μm
Tensile strength at break	>60 N/mm²	>60 N/mm²
Elongation at break	100 to 150%	100 to 150%
Surface resistance	>10 ¹² Ω	>10 ¹² Ω

For the combination carrier/cover tape no static behaviour is observed (relative humidity ≥30%). The products do not stick to the cover tape and no voltage is measured if the cover tape is separated from the carrier tape.

The technical and thermal properties of polycarbonate tapes are excellent, so there is no change in dimensions as a function of time. The peel off force is very stable as a function of time and temperature, and it is defined as 10 to 70 cN (centiNewton) at a peel off speed of 120 mm/minute.

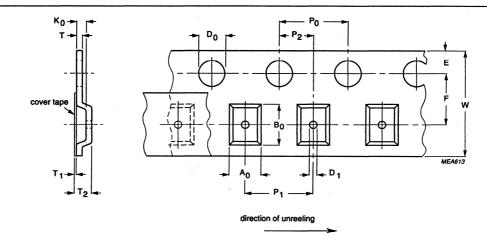
BULK PACKING

The capacitors are supplied in bulk in cardboard boxes of 1 000 pieces.

ENVIRONMENTAL CONSIDERATIONS:

- Cover tape, carrier tape and reel do not contain the environmentally harmful PVC materials.
- Because the carrier tape is made of a homogeneous material (so called mono-plastic), it is ideally suited for recycling.
- Compared to other PVC free materials
 Polycarbonate shows excellent stiffness and very
 little deformation as a function of temperature.

General data



 K_{o} : so chosen that the orientation of the component cannot change.

T: 0.6 mm max.

For W = 8 mm, $T_2 = 2.5$ mm max.

For W = 12 mm, T_2 = 4.5 mm max.

Fig.1 Blister tape.

Table 3 Physical dimensions of blister tape

	PRODUCT		CAPACITOR SIZE (mm)									
DIMENSIONS		0603	0805	1206	1210	1812	2220	TOLERANCE				
	WIDTH	0.8 ±0.1	1.25 ±0.1	1.6 ±0.15	2.5 ±0.2	3.2 ±0.2	5.0 ±0.2	(mm)				
	LENGTH	1.6 ±0.1	2.0 ±0.1	3.2 ±0.15	3.2 ±0.2	4.5 ±0.2	5.7 ±0.2					
A _o		1.1	1.55	1.95	2.9	3.6	5.4	±0.1				
B ₀	_	1.9	2.3	3.55	3.6	4.9	6.1	±0.1				
W	-	8.1	8.1	8.1	8.1	12	12	±0.2				
E	-	1.75	1.75	1.75	1.75	1.75	1.75	±0.1				
F	, , <u> </u>	3.5	3.5	3.5	3.5	5.5	5.5	±0.05				
D _o	· -	1.5	1.5	1.5	1.5	1.5	1.5	+0.1/-0				
D ₁	-	-	≥1	≥1	≥1	≥1.5	≥1.5	-				
P ₀	_	2	4	4	4	4	4	±0.1				
P ₁	_	2 and 4	4	4	4	8	8	±0.1				
P ₂	_	2	2	2	2	2	2	±0.05				

Note

 P_0 pitch tolerance over any 10 pitches is ± 0.2 mm.

General data

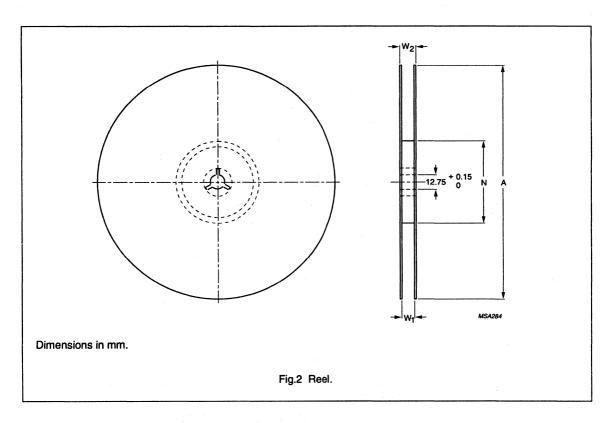
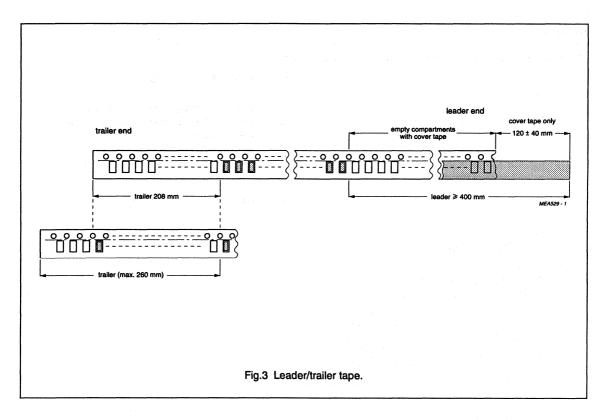


Table 4 Reel dimensions

TAPE WIDTH (mm)	A (mm)	N (mm)	W₁ (mm)	W ₂ max. (mm)
8	180	62 ±1.5	8.4 +1.5/-0	14.4
8	286	62 ±1.5	8.4 +1.5/-0	14.4
12	180	62 ±1.5	12.4 +2/-0	18.4

General data



TAPE DATA

Minimum length of empty compartments at leader end	≥400 mm of which a minimum 240 mm of empty compartments are covered with cover tape and 120 ±40 mm cover tape only
Minimum length of empty compartments at trailer end	208 mm or 260 mm. If the length is 260 mm an extra product is placed at 208 mm to mark this position.

General data

LABELING

The label on the package containing the capacitors is as shown.

LINE

- 1 MADE IN HOLLAND
- 2 2R1 55/125/56 ESR
- 3 1206A 100n +/-10% 63V

LINE MARKING EXPLANATION

- 1 Country of origin
- 2 Material code and climatic category
- 3 Size, termination code, value, tolerance and rated voltage
- Unique batch number 4
- 5 Country of origin in code: A670 is Holland
- 6 Quantity and date code
- 15 digit code 7
- Catalogue number (12NC). 8

4 BATCH 00307240



ORIG A670

RPC RS



QTY 4000

DATE 9303

TYPE 12062R104K9ABB



CODENO 2222 591 16641

The label on the reel is as shown.

LINE



- 1 BATCH 90304263 PHILIPS
- 2 10000 A670 RS 9302
- 2R1 55/125/56
- 4 1206J 100n +/-20% 63V
- 5 12062R104M9BDB



6 CODENO 2222 581 56741

LINE MARKING EXPLANATION

- Unique batch number
- 2 Quantity and date code
- 3 Material code and climatic category
- Size, termination code, value, tolerance and rated voltage
- 5 15 digit code

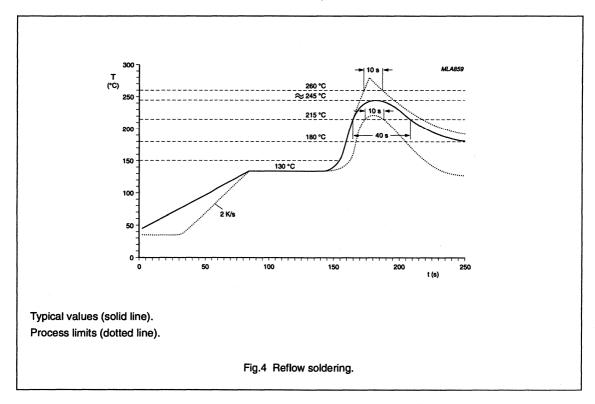
1

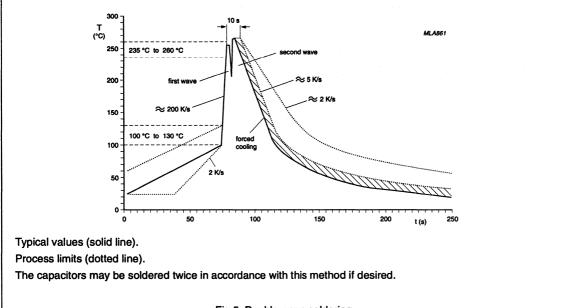
Catalogue number (12NC).

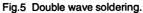
METHOD OF MOUNTING AND DIMENSIONS OF SOLDERLANDS

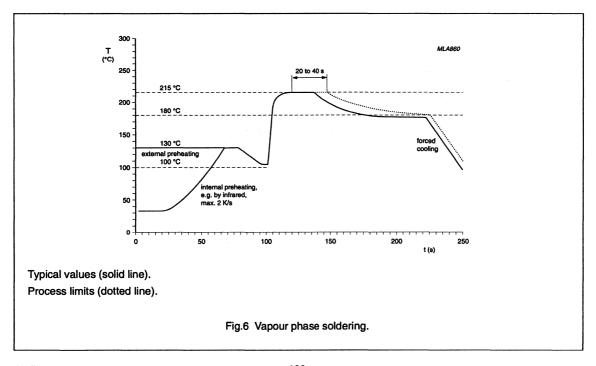
For normal use the capacitors may be mounted on printed-circuit boards or ceramic substrates by applying wave soldering, reflow soldering (including vapour phase soldering) or conductive adhesive. For advised soldering profiles, see Figs 4, 5 and 6.

An improper combination of soldering, substrate and chip size can lead to a damaging of the component. The risk increases with the chip size and with temperature fluctuations (>100 °C). Therefore, it is advised to use the smallest possible size and follow the dimensional recommendations given in Tables 5 and 6 for reflow and wave soldering. More detailed information is available on request.









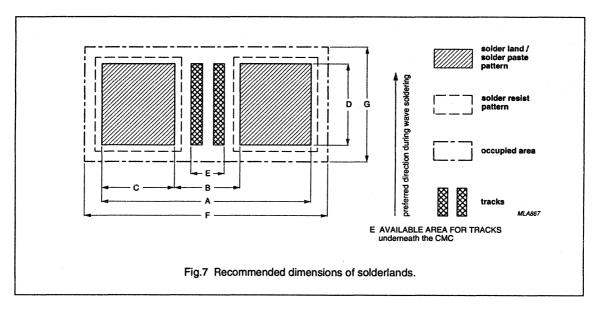


Table 5 Reflow soldering

SIZE		i	OOTPR	INT DIM (mm)	ENSION	PROCESSING PLACEMEN ACCURACY			
	Α	В	С	D	E	F	G	REMARKS	(mm)
0603	2.3	0.7	0.8	0.9	0.26	2.7	1.5	IR or hot plate soldering	±0.15
0603	2.3	0.5	0.9	0.9	0.0	2.7	1.7	IR or hot plate soldering	±0.25
0805	2.8	0.9	0.95	1.4	0.45	3.2	2.1	-	±0.25
1206	4.0	2.0	1.0	1.8	1.4	4.4	2.5	-	±0.25
1210	4.0	2.0	1.0	2.7	1.4	4.4	3.4	-	±0.25
1812	5.4	3.3	1.05	3.5	2.7	5.8	4.1	ceramic substrate only	±0.25
2220	6.6	4.5	1.05	5.3	3.9	7.0	5.9	ceramic substrate only	±0.25

Table 6 Wave soldering (no dummy tracks allowed for the high voltage series)

SIZE		F	OOTPR	INT DIM (mm)	ENSION	PROPOSED NUMBER AND DIMENSIONS OF ACCURACY			
	A	В	С	D	E	F	G	DUMMY TRACKS (mm)	(mm)
0603	2.4	1.0	0.7	0.8	0.2	3.0	1.9	1 × (0.2 × 0.8)	±0.10
0603	2.7	0.9	0.9	0.8	0.0	3.2	2.1	1 × (0.3 × 0.8)	±0.25
0805	3.2	1.4	0.9	1.3	0.36	4.1	2.5	1 × (0.3 × 1.3)	±0.15
0805	3.4	1.3	1.05	1.3	0.2	4.3	2.7	1 × (0.2 × 1.3)	±0.25
1206	4.8	2.3	1.25	1.7	1.25	5.9	3.2	3 × (0.25 × 1.7)	±0.25
1210	5.3	2.3	1.5	2.6	1.25	6.3	4.2	3 × (0.25 × 2.6)	±0.25

TEST CONDITIONS IN STATIC SOLDER BATH

Solderability:			
95% covered with smooth and bright solder coating	CECC requirement: 235 ±5 °C for 2 ±0.5 s IEC requirement: 215 ±3 °C for 3 ±0.3 s		
Resistance to leaching:	260 ±5 °C for 30 ±1 s		
10% of the metallization of the edges of the head face may be missing (inner electrodes are not visible)			
ΔC/C class 1: 0.5% or 0.5 pF			
and			
ΔC/C class 2: > –5% and ≤10%			

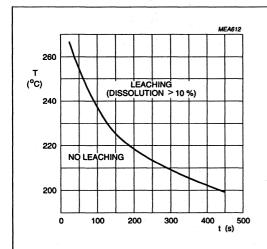


Fig.8 Resistance to leaching of Ag/Pd metallized terminations (in static solder bath) at various temperatures; for Ni/Sn metallized terminations, the leaching resistance is a factor of 10 times better than shown in the graph.

Surface mounted ceramic multilayer capacitors

General data

TESTS AND REQUIREMENTS

IEC/CECC test clause		clause			
IEC 384 10	CECC 32 100	IEC 68-2	TEST	PROCEDURE	REQUIREMENTS
PARA.		PARA.			
4.4			mounting	the capacitors may be mounted on printed-circuit boards or ceramic substrates by applying wave soldering, reflow soldering (including vapour phase soldering) or conductive adhesive	no visible damage
4.5			visual inspection and dimension check	any applicable method using × 10 magnification	in accordance with specification
4.6.1			capacitance	class 1: C ≤ 1 000 pF, f = 1 MHz; C > 1 000 pF, f = 1 kHz; measuring voltage 1 V at 20 °C	within specified tolerance
				class 2: for all capacitors f = 1 kHz	measured 1 000 hours after date of manufacture
4.6.2			tan δ	class 1: C ≤ 1 000 pF, f = 1 MHz; C > 1 000 pF, f = 1 kHz; measuring voltage 1 V at 20 °C class 2:	in accordance with specification
				for all capacitors f = 1 kHz	
4.6.3			insulation resistance	at U _R (DC) for 1 minute	in accordance with specification
4.6.4			voltage proof	2.5 × U _R for 1 minute	no breakdown or flashover
4.7.1			class 1 temperature coefficient	between minimum and maximum temperature	in accordance with specification
4.7.2			class 2 temperature characteristic	X7R, between minimum and maximum temperature	in accordance with specification
4.8			adhesion	a force of 5 N applied to the line joining the terminations and in a plane parallel to the substrate	no visible damage
4.9			bond strength of plating on end face	mounted in accordance with CECC 32 100, para 4.4 conditions: bending 1 mm at a rate of 1 mm/s	no visible damage ΔC/C: class 1; ≤1% class 2; ≤10%

Surface mounted ceramic multilayer capacitors

General data

IEC/CE	CC test o	lause			
IEC 384 10	CECC 32 100	IEC 68-2	TEST	PROCEDURE	REQUIREMENTS
PARA.		PARA.			
4.10		Tb	resistance to soldering heat	260 ±5 °C for 10 ±0.5 s	the terminations shall be well tinned after recovery ΔC/C: class 1; ≤0.5% or ±0.5 pF whichever is greater X7R; > -5% and ≤10%
			resistance to leaching	260 ±5 °C for 30 ±1 s in a static solder bath	using visual enlargement of × 10, dissolution of the terminations shall not exceed 10%
4.11	•	Ta	solderability	zero hour test, and test after storage (20 to 24 months) in original packing in normal atmosphere; unmounted chips completely immersed for 2 ±0.5 s in a solder bath at 235 ±0.5 °C	the terminations shall be well tinned
4.12		Na	rapid change of temperature	pre-conditioning: class 2 only -55/+125 °C; 5 cycles	no visible damage after 24 hours recovery: ΔC/C: class 1; ≤1% or 1 pF X7R; ≤15%
4.13			climatic sequence	pre-conditioning class 2 only	
4.13.3		Ва	dry heat	16 hours at maximum temperature	no visible damage
4.13.4		Db	damp heat accelerated, 1 cycle	24 hours at +55 °C; 100% RH	
4.13.5		Aa	cold	2 hours at minimum temperature	no visible damage

Surface mounted ceramic multilayer capacitors

General data

IEC/CECC test clause		clause			
IEC 384 10	CECC IEC 32 100 68-2		TEST	PROCEDURE	REQUIREMENTS
PARA.		PARA.			
4.13.6		Db	damp heat accelerated, remaining cycles	5 cycles of 24 hours duration at +55 °C; 100% RH	after recovery; class 1, 1 to 2 hours class 2, 24 hours
941Q5					∆C/C: class 1; ±2% or 1 pF whichever is greater X7R; ≤15%
,					tan δ: class 1; ≤2 × specified value X7R; ≤7%
					R_{INS} : class 1; 2 500 MΩ or $R_{\text{i}}C_{\text{R}} \ge 25$ s, whichever is less X7R; 1 000 MΩ or $R_{\text{i}}C_{\text{R}} \ge 25$ s, whichever is less
4.14		Ca	damp heat, steady state	pre-conditioning class 2 only 56 days at 40 °C; 90 to 95% RH; U _R applied	no visible damage; electrical checks shall comply with CECC 32 100, para 4.13.6
4.15			endurance	pre-conditioning class 2 only 1 000 hours at maximum temperature at 1.5 × U _R	no visible damage after 24 hours recovery ΔC/C: class 1; ±2% or 1 pF whichever is greater X7R; ≤20%
	·				tan δ: class 1; ≤2 × specified value X7R; ≤7%
					R_{INS} : class 1; 4 000 MΩ or $R_iC_R \ge 40$ s, whichever is less X7R; 2 000 MΩ or $R_iC_R \ge 50$ s, whichever is less
CECC 32	101 - 801		damp heat accelerated, steady state	85 °C; 85% RH; 500 hours with bias 1.5 V and U _R	R _{INS} shall not be less than 10% of the initial requirement

LEADED CERAMIC MULTILAYER CAPACITORS

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General data

PACKING

The monolithic ceramic capacitors are supplied in various packaging formats. The packaging format, product type and standard package quantity is given in Table 1.

Table 1

PRODUCT	FORMAT	FIG	AFFECTED	SMALLEST PACKAGE	STANDARD	PACKAGE DIMENSIONS (max.)		
TYPE	FORMAT	FIG.	SIZE	QUANTITY	PACKAGE QUANTITY	L (mm)	W (mm)	H (mm)
Mono-axial™	reel	5	17, 18, 26	5 000	20 000	333	333	311
	reel	5	29, 40	2 500	10 000	333	333	311
Mono-glass™	reel	5	17, 25	5 000	20 000	333	333	311
	reel	5	30	2 500	10 000	333	333	311
Mono-kap™	bulk	_	15, 20, 30	1 000	20 000	365	286	213
	bulk	_	40	500	10 000	365	286	213
	reel	4	15, 20, 30	2 500	12 500	333	333	260
	reel	4	40	2 000	10 000	333	333	260
	ammunition	3	all	2 000	10 000	338	240	210
Mono-pak™	magazine	6	26	200	20 000	537	183	152

Notes

Figures 1 and 5:

Maximum 0.1% of the total number of capacitors per reel may be missing. A maximum of 1 consecutive vacant position is followed by 6 consecutive components.

Tape begins and ends with minimum of 60 empty positions (300 mm tape).

Maximum of 5 splices per reel.

For L and D dimensions refer to Mono-axial™ and Mono-glass™ size chart.

Figures 2, 3 and 4:

Maximum 0.5% of the total number of capacitors per reel may be missing. A maximum of 2 consecutive vacant positions is followed by 6 consecutive components.

Tape begins and ends with minimum of 24 empty positions (300 mm tape).

Maximum of 5 splices per reel.

Cumulative pitch tolerance over 20 consecutive units not to exceed ±1.0 mm.

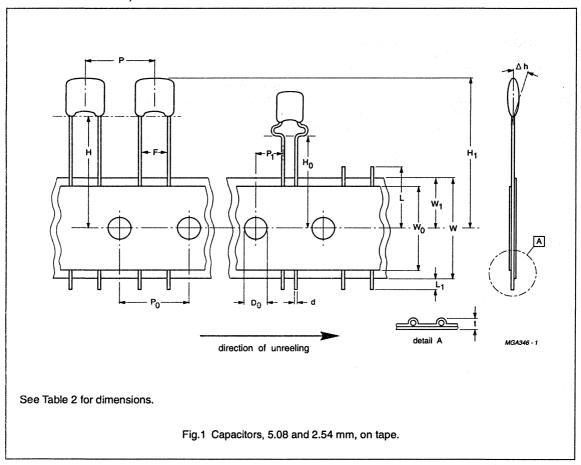
Lead space (F) shall be measured at 3.6 ±0.5 mm from the unit seating plane.

Figure 6:

Only 1 size compartment.

Tubes are treated with Anti-Static.

CAPACITORS ON TAPE, LEAD PITCH 5.08 and 2.54 mm

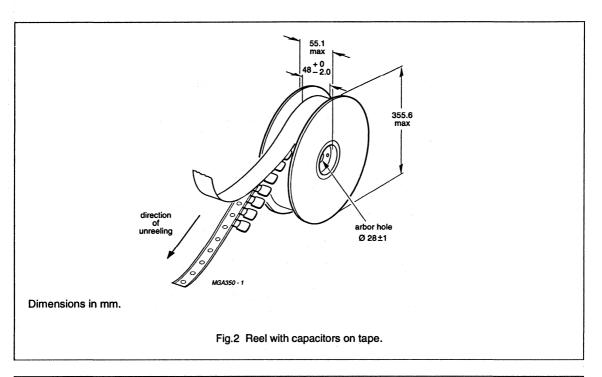


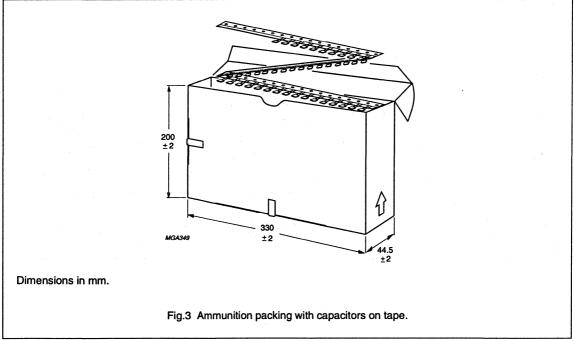
General data

Table 2

	100	DIMENSIONS			
SYMBOL	PARAMETER	METRIC (mm)	ENGLISH (inch.)		
L	cut off length	11 max.	0.443 max.		
L ₁	lead end protrusion	2 max.	0.079 max.		
Н	height to seating plane	16 min.	0.630 min.		
H _o	height to seating plane (formed leads)	16 ±0.5	0.630 ±0.020		
H ₁	top of component height	32 max.	1.260 max.		
Δh	body inclination	0.0 ±1.0 max.	0 ±0.039 max.		
W	carrier tape width	18 ^{+1.0} _{-0.5}	0.709 ^{+0.039} -0.020		
W _o	hold down tape width	15 ref.	0.591 ref.		
W _i	sprocket hole position	9 ^{+0.75} -0.5	0.354 ^{+0.030} -0.020		
F (e = 2.54 mm)	1e lead space	2.54 ^{+0.6} -0.4	0.100 ^{+0.024} -0.016		
	2e lead space	5.08 ^{+0.6} _{-0.4}	0.200 ^{+0.024} -0.016		
P _o	sprocket hole pitch	12.7 ±0.3	0.500 ±0.012		
P ₁	1e sprocket hole centre to lead centre	5.08 ±0.7	0.200 ±0.028		
	2e sprocket hole centre to lead centre	3.85 ±0.7	0.151 ±0.028		
D _o	sprocket hole diameter	4 ±0.3	0.157 ±0.012		
t	overall tape thickness	0.9 max.	0.035 max.		
d	wire lead diameter	0.5 ±0.05	0.02 ±0.002		
P	taping pitch	12.7 ref.	0.500 ref.		

General data





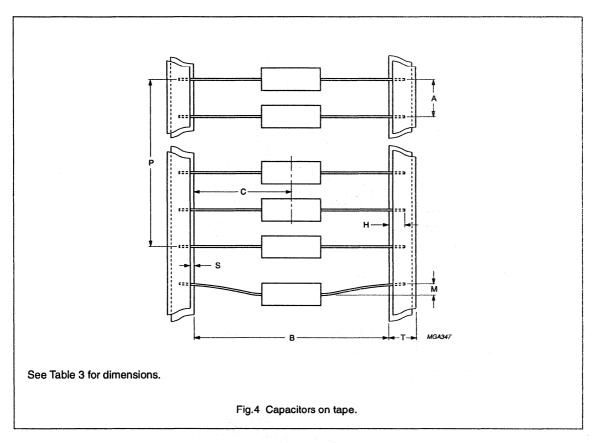
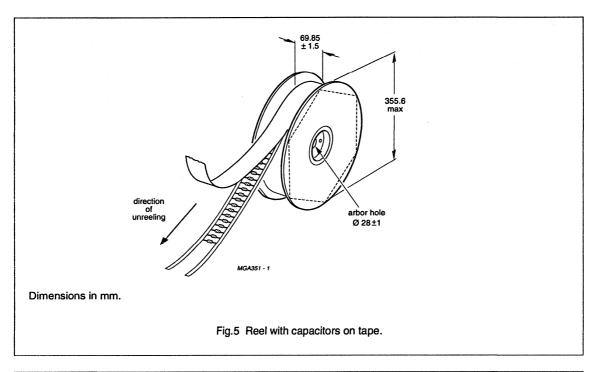
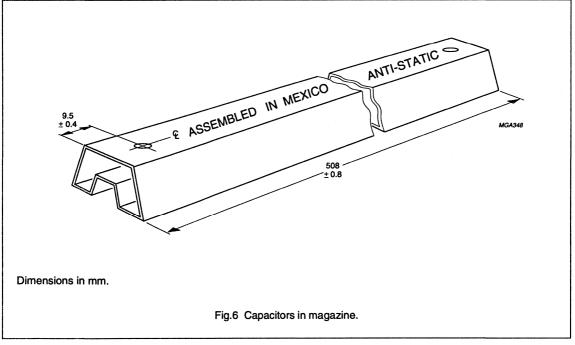


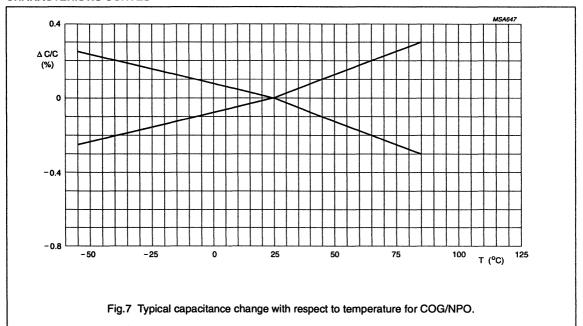
Table 3

SYMBOL		DIMENSIONS			
	PARAMETER	METRIC (mm)	ENGLISH (inch.)		
В	inside tape spacing	52.4 ±1.5	2.062 ±0.059		
С	centre	±0.8	±0.031		
Р	cumulative pitch, 6 consecutive components	±1.5	±0.059		
Α	components pitch	5 ±0.5	0.197 ±0.015		
М	lead bend	1.2 max.	0.047 max.		
S	exposed adhesive	0.8 max.	0.031 max.		
Т	tape width	6.35 nom.	0.250 nom.		
Н	lead sandwich	3.96 min.	0.156 min.		





CHARACTERISTIC CURVES



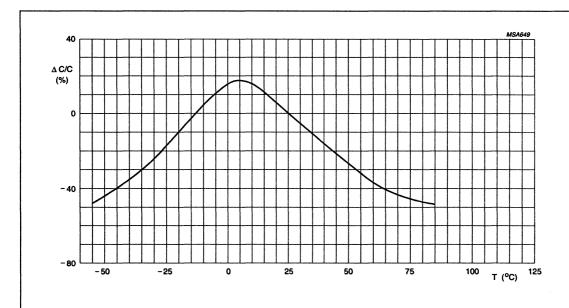
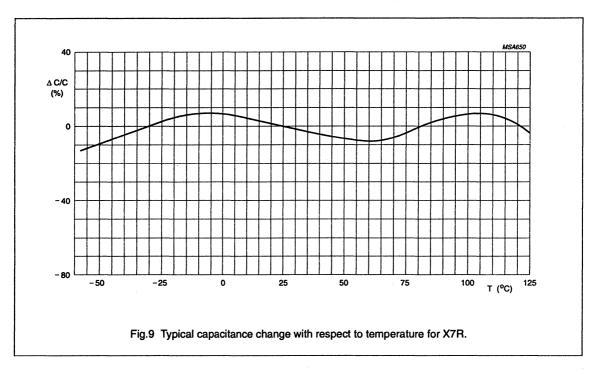
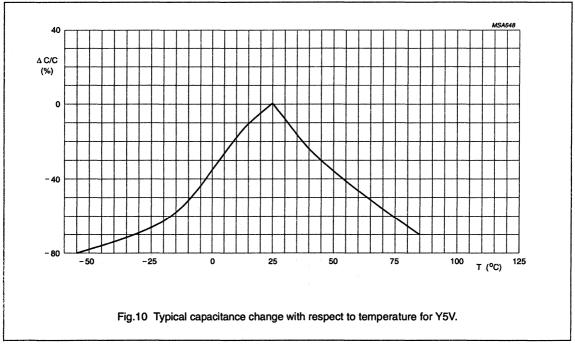
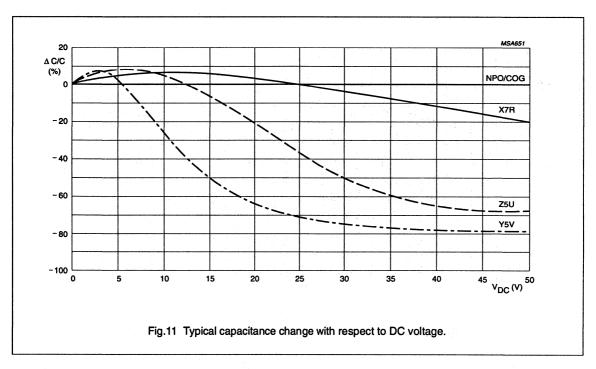
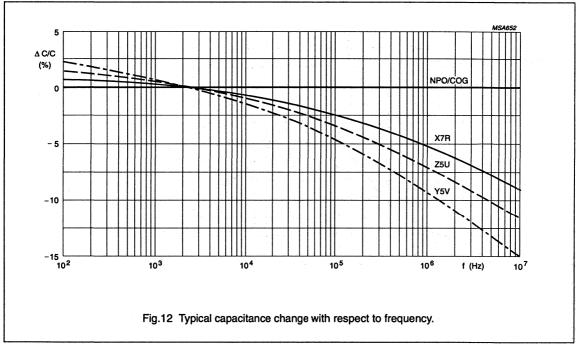


Fig.8 Typical capacitance change with respect to temperature for Z5U.









TESTS AND REQUIREMENTS

Class 1 capacitors

After manufacture, each capacitor is checked on capacitance, $\tan \delta$ and test voltage. Apart from this the following quality checks are carried out by frequent inspections.

Essentially all tests mentioned in the schedule of IEC publication 384-8, category 55/125/21 (temperature range -55/+125 °C; damp heat, long term, 21 days) are carried out along the lines of IEC publication 68.

IEC 384-8 CLAUSE	IEC 68-2 TEST METHOD	NAME OF TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
4.4		robustness of terminations		
		pull-off	pull velocity 15 cm/minute; load 5 N	no wire breakage
	Ua ₁	tensile strength	axial force 10 N	no wire breakage
	Ub	bending	load 5 N; 4 × 90°	no wire breakage
4.6	Ta method 1	solderability (solder bath)	235 °C; 2 s	good tinning
4.5	Tb method 1A	resistance to soldering heat	260 °C; 10 s	no visible damage ΔC/C: ± ≤0.5% or 0.5 pF after 1 to 2 hours
4.7	Na	rapid change of temperature	30 minutes -55 °C 30 minutes +125 °C; 5 cycles	no damage after 24 hours ΔC/C: ± ≤0.5% or 0.5 pF
4.8	Fc	vibration	10-55-10 Hz; 0.75 mm displacement; 3 directions; 6 hours	no visible damage
4.9	Eb	bump	4 000 bumps in 2 directions; 40 g; pulse time 6 ms	no visible damage
		inflammability	15 s; 35 mm above bunsen burner with flame-height 40-60 mm	self-extinguishing within 15 s after removal of bunsen burner
4.3		temperature coefficient	between +20 and -55 °C, and between +20 and +125 °C	within tolerance as specified for each particular material
4.11		climatic sequence		
4.11.2	В	dry heat	16 hours; +125 °C	no visible damage
4.11.3	Db	damp heat (accel.) 1st cycle	12 hours; +55 °C; 90 to 96% R.H. 12 hours; +25 °C; 95 to 100% R.H.	after recovery of 1-2 hours immediately followed by cold test
4.11.4	Α	cold	2 hours; -55 °C	no visible damage
4.11.5	М	low air pressure	1 hour at 8.5 kPa, last 2 minutes rated voltage	no breakdown or flashover

General data

IEC 384-8 CLAUSE	IEC 68-2 TEST METHOD	NAME OF TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
4.11.6	Db	damp heat (accel.) remaining cycle	12 hours; +55 °C 90 to 96% R.H. 12 hours; +25 °C; 95 to 100% R.H.	Δ C/C: \pm ≤1% or 1 pF tan δ : ≤2 × specified tan δ R _{ins} after 1-2 hours: >5 000 M Ω
4.12	Ca	damp heat, steady state (half number of the lot at rated voltage, other half at zero voltage)	21 days; +40 °C 90 to 95% R.H.	Δ C/C: ±≤1% or 1 pF tan δ: ≤2 × specified tan δ R _{ins} after 1-2 hours: >5 000 MΩ
4.13		endurance	1 000 hours at maximum temperature, at 1.5 × rated voltage	Δ C/C: \pm ≤1% or 1 pF tan δ : ≤1.5 × specified tan δ R _{ins} : >3 000 M Ω
		resistance to solvents	3 minutes ultrasonic washing in trichloroethylene; 1 minute drying; 30 °C; 10 brush strokes	marking and colour code must remain legible and not be discoloured; no mechanical or electrical damage or deterioration of the material

Class 2 capacitors

After manufacture, each capacitor is checked on capacitance, $\tan \delta$ and test voltage. Apart from this the following quality checks are carried out by frequent inspections.

Essentially all tests mentioned in the schedule of IEC publication 384-9, categories 55/125/21, 10/85/21 and 25/85/21 respectively for X7R-ZC1, Z5U and Y5V-2F4 (temperature ranges –55/+125 °C, +10/+85 °C and –25/+85 °C; damp heat, long term, 21 days) are carried out along the lines of IEC publication 68.

IEC 384-9 CLAUSE	IEC 68-2 TEST METHOD	NAME OF TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
4.1	, ,	pre-conditioning	1 hour; +150 °C; reference measurement after 24 hours	
4.5		robustness of terminations		
		pull-off	pull velocity 15 cm/minute; load 5 N	no wire breakage
	Ua₁	tensile strength	axial force 10 N	no wire breakage
	Ub	bending	load 5 N; 4 × 90°	no wire breakage
4.7	Ta method 1	solderability (solder bath)	235 °C; 2 s	good tinning
4.6	Tb method 1A	resistance to soldering heat	Pre-conditioning: 260 °C; 10 s	no visible damage ΔC/C after 24 hours: X7R: ±≤10% Z5U, Y5V: ±≤20%
4.8	Na	rapid change of temperature	pre-conditioning: for X7R: -55/+125 °C; 5 cycles for Z5U: +10/+85 °C; 5 cycles for Y5V: -30/+85 °C; 5 cycles	no damage Δ C/C after 24 hours: X7R: ± ≤10% Z5U, Y5V: ± ≤20%
4.9	Fb	vibration	10-55-10 Hz; 0.75 mm displacement; 3 directions; 6 hours	no visible damage
4.10	Eb	bump	4 000 bumps in 2 directions; 40 g; pulse time 6 ms	no visible damage
		inflammability	15 s; 35 mm above bunsen burner with flame-height 40-60 mm	self-extinguishing within 15 s after removal of bunsen burner
		resistance to solvents	3 minutes ultrasonic washing in trichloroethylene; 1 minute drying; 30 °C; 10 brush strokes	marking and colour code must remain legible and not be discoloured; no mechanical or electrical damage or deterioration of the material
4.12		climatic sequence		A STATE OF THE STA
4.12.1		pre-conditioning	1 hour; +150 °C	
4.12.2	Ва	dry heat	16 hours at maximum temperature	no visible damage

General data

IEC 384-9 CLAUSE	IEC 68-2 TEST METHOD	NAME OF TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
4.12.3	Db	damp heat (accel.) 1st cycle	12 hours; +55 °C; 90 to 96% R.H. 12 hours; +25 °C; 95 to 100% R.H.	no visible damage; after recovery of 1-2 hours immediately followed by cold test
4.12.4	Aa	cold	2 hours at minimum temperature	no visible damage
4.12.5	М	low air pressure	1 hour at 8.5 kPa, last 2 minutes rated voltage	no breakdown or flashover
4.12.6	Db	damp heat (accel.) remaining cycle	12 hours; +55 °C; 90 to 96% R.H. 12 hours; +25 °C; 95 to 100% R.H.	after 24 hours recovery: $\Delta C/C$: X7R: $\pm \le 15\%$ Z5U, Y5V: $\pm \le 20\%$ tan δ : $\le 7\%$ R _{ins} : $> 1~000~M\Omega$
4.13	Са	damp heat, steady state (half number of samples at rated voltage, other half of samples no voltage applied)	pre-conditioning: 21 days; +40 °C; 90 to 95% R.H. pre-conditioning	no visible damage; after 24 hours: $\Delta C/C$: X7R: $\pm \le 15\%$ Z5U, Y5V: $\pm \le 30\%$ tan δ : $\le 7\%$ R_{ins} : >1 000 M Ω
4.14		endurance	Pre-conditioning: 1 000 hours (IEC) at maximum temperature, at 1.5 × rated voltage	after 24 hours: Δ C/C: X7R: $\pm \le 20\%$ Z5U, Y5V: $\pm \le 30\%$ $\tan \delta$: \le 7% R_{ins} : $>$ 2 000 M Ω
4.4		temperature characteristic	pre-conditioning: minimum and maximum temperature	in accordance with specification

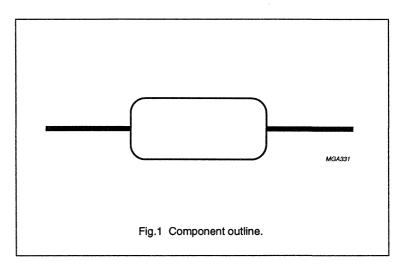
Mono-axial™ series

FEATURES

- · High capacitance per unit volume
- Low cost.

APPLICATIONS

These conformally coated radial leaded capacitors are designed for commercial and industrial applications in three dielectrics, COG (ultra-stable), X7R (stable) and Z5U (general purpose). Applications include timing, coupling/decoupling, signal comparison and biasing. Mono-axial™ capacitors are suitable for automatic insertion equipment.



DESCRIPTION

The basic capacitor construction consists of ceramic dielectric materials processed into a tape with a typical thickness range from 0.025 to 0.076 mm. Metal electrode patterns are applied using a thick film screening process. Multiple layers are stacked and

laminated in such a manner that electrodes are alternately exposed when the pattern is cut into individual chip capacitors. The capacitors are fired through a high temperature profile to mature the ceramic and metal into a homogeneous unit. Metal end

terminations are applied and fired to provide electrical connection between the individual layers. Tinned leads are attached using a solder. Encapsulation consists of a moisture resistant gold colour conformal epoxy coating that meets the flame requirements of UL94V-0.

QUICK REFERENCE DATA

Parameters	2222 740 series	2222 741 series	2222 742 series
Capacitance range	10 pF to 5 600 pF (E12 series)	220 pF to 0.33 μF (E12 series)	0.01 μF to 0.56 μF (E12 series)
Rated DC voltages	50 V, 100 V	50 V, 100 V	50 V, 100 V
Tolerance on capacitance	±5%; ±10%	±10%; ±20%	±20%; -20%/+80%
Temperature coefficients	NPO	X7R	Z5U

Philips Components Product specification

Leaded ceramic multilayer capacitors

Mono-axial™ series

MECHANICAL DATA

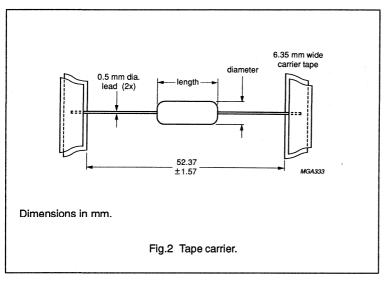


Table 1 Capacitor dimensions (note 1)

SIZE	LENGTH (max.)	DIAMETER (max.)	APPROX. MASS (g)
17	4.32 (0.170)	2.54 (0.100)	0.14
18	4.32 (0.170)	3.05 (0.120)	0.14
26	6.60 (0.260)	2.54 (0.100)	0.16
29	7.37 (0.290)	3.81 (0.150)	0.23
40	10.16 (0.400)	3.81 (0.150)	0.24

Note

1. Dimensions between brackets are in inches.

Mono-axial™ series

PACKING

Refer to the General section for Leaded Ceramic Multilayer Capacitors.

Table 2 Ordering information (note 1)

_	2222	740	2222	741	2222	742
CAPACITANCE TOLERANCE	N	PO	Х	7R	Z	5U
70111711101	50 V	100 V	50 V	100 V	50 V	100 V
±5%	09	41	-	-	_	_
±10%	10	42	10	42	_	
±20%	<u>-</u> .	_	11	43	11	43
-20/+80%	_		_	_	12	44

Note

1. Catalogue number to be completed by adding code for required series and capacitance, see Tables 3, 4 and 5.

Marking

Capacitance value (CCC T)

10 pF to 99 pf: actual value in pF (2 digits only)

100 pF and above: coded capacitance value (same as used in P/N)

Tolerance (CCC T)

Standard EIA tolerance (same as used in P/N)

Material code (M V)

Standard EIA TC code

A = COG

C = X7R

E = Z5U

Voltage code (M V)

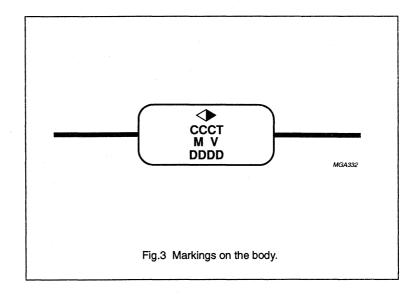
Standard EIA voltage code

1 = 100 V

5 = 50 V

Date code (DDDD)

Four digit code: first two digits denote year, last two denote week of manufacture.



Philips Components Product specification

Leaded ceramic multilayer capacitors

Mono-axial™ series

ELECTRICAL CHARACTERISTICS

Capacitors with temperature coefficient NPO. The capacitors meet the essential requirements of EIA-198. Unless stated otherwise all electrical values apply at an ambient temperature of 25 ± 3 °C, at barometric pressures of 650 to 800 mm of mercury, and relative humidity not to exceed 75%.

Capacitance range at 1 MHz, 1 V; where C ≤1 000 pF at 1 kHz, 1 V; where C >1 000 pF	10 pF to 5 600 pF
Tolerance on the capacitance	±5%, ±10%
Rated DC voltage	50 V, 100 V
DC test voltage; duration 1 minute	250% of rated voltage
Insulation resistance at rated voltage	100 GΩ or 1 000 MΩ x μF, whichever is less at 25 °C
Temperature coefficient of the capacitance	0 ppm
Tolerance on the temperature coefficient	±30 ppm
Dissipation factor at 1 MHz, 1 V; where C ≤1 000 pF at 1 kHz, 1 V; where C >1 000 pF	<15 x 10 ⁻⁴
Operating temperature range	-55 to +125 °C
Storage temperature range	−55 to +85 °C

Table 3 Range of values for 2222 740

CAPACITANCE VALUE	SIZE (see Table 1)		SUFFIX OF CATALOGUE NUMBER
(pF)	50 V	100 V	(see Table 2)
10 to 82	17	17	109 to 829
100 to 820	17	17	101 to 821
1 000	17	18	102
1 200	18	18	122
1 500	18	26	152
1 800	18	26	182
2 200	26	26	222
2 700	26	29	272
3 300	29	29	332
3 900	29	40	392
4 700	40	40	472
5 600	40	-	562

Philips Components Product specification

Leaded ceramic multilayer capacitors

Mono-axial™ series

Capacitors with temperature coefficient X7R. The capacitors meet the essential requirements of EIA-198. Unless stated otherwise all electrical values apply at an ambient temperature of 25 ± 3 °C, at barometric pressures of 650 to 800 mm of mercury, and relative humidity not to exceed 75%.

Capacitance range at 1 kHz, 1 V	220 pF to 0.33 μF
Tolerance on the capacitance	±10%, ±20%
Maximum capacitance variation with respect to capacitance value at 25 °C	±15%
Rated DC voltage	50 V, 100 V
DC test voltage; duration 1 minute	250% of rated voltage
Insulation resistance at rated voltage	100 GΩ or 1 000 MΩ x μF, whichever is less at 25 °C
Dissipation factor at 1 kHz, 1 V	≤2.5%
Operating temperature range	−55 to +125 °C
Storage temperature range	−55 to +85 °C
Ageing	typical, 1% per time decade

Table 4 Range of values for 2222 741

CAPACITANCE VALUE	_	IZE Table 1)	SUFFIX OF CATALOGUE NUMBER	
(pF)	50 V	100 V	(see Table 2)	
220 to 820	17	17	221 to 821	
1 000 to 8 200	17	17	102 to 822	
10 000 to 22 000	17	17	103 to 223	
27 000 to 56 000	17	18	273 to 563	
68 000 to 82 000	18	26	683 to 823	
100 000	18	26	104	
120 000	26	26	124	
150 000	26	29	154	
180 000	26	29	184	
220 000	29	_	224	
270 000	29	_	274	
330 000	40		334	

Mono-axial™ series

Capacitors with temperature coefficient Z5U. The capacitors meet the essential requirements of EIA-198. Unless stated otherwise all electrical values apply at an ambient temperature of 25 ±3 °C, at barometric pressures of 650 to 800 mm of mercury, and relative humidity not to exceed 75%.

Capacitance range at 1 kHz, 0.5 V	0.01 μF to 0.56 μF
Tolerance on the capacitance	±20%, -20/+80%
Maximum capacitance variation with respect to capacitance value at 25 °C	-56/+22%
Rated DC voltage	50 V, 100 V
DC test voltage; duration 1 minute	250% of rated voltage
Insulation resistance at rated voltage	100 GΩ or 1 000 MΩ x μF, whichever is less at 25 °C
Dissipation factor at 1 kHz, 0.5 V	≤4%
Operating temperature range	10 to 85 °C
Storage temperature range	−55 to +85 °C
Ageing	typical, 6% per time decade

Table 5 Range of values for 2222 742

CAPACITANCE VALUE	SIZE (see Table 1)		SUFFIX OF CATALOGUE NUMBER
(pF)	50 V	100 V	(see Table 2)
0.010			103
to	17	17	to
0.027			273
0.033			333
to	17	18	to
0.082			823
0.10	17	26	104
0.12	18	26	124
0.15	18	26	154
0.18	26	26	184
0.22	26	29	224
0.27	26	29	274
0.33	29	40	334
0.39	29	40	394
0.47	40	_	474
0.56	40	-	′564

Mono-glass™ series

FEATURES

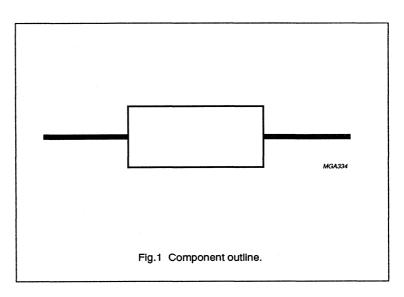
· High capacitance per unit volume

APPLICATIONS

These glass encapsulated axial leaded capacitors are designed for commercial and industrial applications in three dielectrics, COG (ultra-stable), X7R (stable) and Z5U (general purpose). Applications include timing, coupling/decoupling, signal comparison and biasing. Mono-glass™ capacitors are suitable for automatic insertion equipment.

DESCRIPTION

The basic capacitor construction consists of ceramic dielectric materials processed into a tape with a typical thickness range from 0.025 to 0.076 mm. Metal electrode patterns are applied using a thick film screening process. Multiple layers are stacked and laminated in such a manner that



electrodes are alternately exposed when the pattern is cut into individual chip capacitors. The capacitors are fired through a high temperature profile to mature the ceramic and metal into a homogeneous unit. Metal end terminations are applied and fired to provide electrical connection between the individual layers. These units are glass encapsulated, providing a hermetically sealed capacitor.

QUICK REFERENCE DATA

Parameters	2222 737 series	2222 738 series	2222 739 series
Capacitance range	10 pF to 3 300 pF (E12 series)	100 pF to 0.22 μF (E12 series)	0.01 μF to 0.33 μF (E12 series)
Rated DC voltages	50 V, 100 V	50 V, 100 V	50 V, 100 V
Tolerance on capacitance	±5%; ±10%	±10%; ±20%	±20%; –20%/+80%
Temperature coefficients	NPO	X7R	Z5U

Mono-glass™ series

MECHANICAL DATA

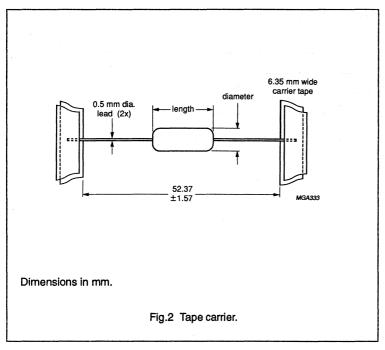


Table 1 Capacitor dimensions (note 1)

SIZE	LENGTH (max.)	DIAMETER (max.)	APPROX. MASS (g)
17	4.32 (0.170)	2.54 (0.100)	0.16
25	6.35 (0.250)	2.54 (0.100)	0.18
30	7.62 (0.300)	3.81 (0.150)	0.26

Note

1. Dimensions between the brackets are in inches.

Mono-glass™ series

PACKING

Refer to the General section for Leaded Ceramic Multilayer Capacitors.

Table 2 Ordering information (note 1)

CAPACITANCE TOLERANCE	2222	737	2222 7	738	2222	739
	NPO		X7R		Z 5U	
	50 V	100 V	50 V	100 V	50 V	100 V
±5%	09	41	-	_	_	
±10%	10	42	10	42	_	-
±20%	_	_	11	43	11	43
-20%/+80%	_	_	_	- ,	12	44

Note

1. Catalogue number to be completed by adding code for required series and capacitance, see Tables 3, 4 and 5.

Marking

Capacitance value (CCC T)

10 pF to 99 pF: actual value in

pF (2 digits only)

100 pF and above: coded capacitance value

(same as used in P/N)

Tolerance (CCC T)

Standard EIA tolerance (same as used in P/N)

Material code (M V)

Standard EIA TC code

A = COG

C = X7R

E = Z5U

Voltage code (M V)

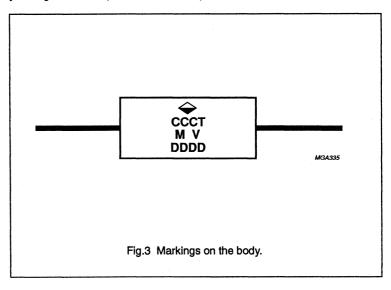
Standard EIA voltage code

1 = 100 V

5 = 50 V

Date code (DDDD)

Four digit code: first two digits denote year, last two denote week of manufacture.



Mono-glass™ series

ELECTRICAL CHARACTERISTICS

Capacitors with temperature coefficient NPO. The capacitors meet the essential requirements of EIA-198. Unless stated otherwise all electrical values apply at an ambient temperature of 25 ± 3 °C, at barometric pressures of 650 to 800 mm of mercury, and relative humidity not to exceed 75%.

Capacitance range at 1 MHz, 1 V; where C ≤1 000 pF at 1 kHz, 1 V; where C >1 000 pF	10 pF to 3 300 pF
Tolerance on the capacitance	±5%, ±10%
Rated DC voltage	50 V, 100 V
DC test voltage; duration 1 minute	250% of rated voltage
Insulation resistance at rated voltage	100 G Ω or 1 000 M Ω x μ F, whichever is less at 25 °C
Temperature coefficient of the capacitance	0 ppm
Tolerance on the temperature coefficient	±30 ppm
Dissipation factor at 1 MHz, 1 V; where C ≤1 000 pF at 1 kHz, 1 V; where C >1 000 pF	<15 x 10 ⁻⁴
Operating temperature range	-55 to +125 °C
Storage temperature range	-55 to +85 °C

Table 3 Range of values for 2222 737

CAPACITANCE VALUE	SI (see T	SUFFIX OF CATALOGUE NUMBER	
(pF)	50 V	100 V	(see Table 2)
10 to 82	17	17	109 to 829
100 to 270	17	17	101 to 271
330 to 820	17	25	331 to 821
1 000	17	25	102
1 200 to 2 700	25	30	122 to 272
3 300	25	_	332

Mono-glass™ series

Capacitors with temperature coefficient X7R. The capacitors meet the essential requirements of EIA-198. Unless stated otherwise all electrical values apply at an ambient temperature of 25 ±3 °C, at barometric pressures of 650 to 800 mm of mercury, and relative humidity not to exceed 75%.

Capacitance range at 1 kHz, 1 V	100 pF to 0.22 μF
Tolerance on the capacitance	±10%, ±20%
Maximum capacitance variation with respect to capacitance value at 25 °C	±15%
Rated DC voltage	50 V, 100 V
DC test voltage; duration 1 minute	250% of rated voltage
Insulation resistance at rated voltage	100 GΩ or 1 000 MΩ x μF, whichever is less at 25 °C
Dissipation factor at 1 kHz, 1 V	≤2.5%
Operating temperature range	-55 to +125 °C
Storage temperature range	−55 to +85 °C
Ageing	typical, 1% per time decade

Table 4 Range of values for 2222 738

CAPACITANCE VALUE	SIZ (see Ta	SUFFIX OF CATALOGUE NUMBER			
(pF)	50 V	100 V	(see Table 2)		
100			101		
to	17	. 17	to		
820			821		
1 000			102		
to	17	17	to		
8 200			822		
10 000			103		
to	17	17	to		
15 000			153		
18 000	000 17 25		183		
22 000	2 000 17 25		223		
27 000			273		
to	25	25	to		
47 000			473		
56 000			563		
to	25	30	to		
82 000			823		
100 000	000 25		100 000 25 30		104
120 000	120 000 25 -		124		
150 000			154		
to	30	-	to		
220 000			224		

Mono-glass™ series

Capacitors with temperature coefficient Z5U. The capacitors meet the essential requirements of EIA-198. Unless stated otherwise all electrical values apply at an ambient temperature of 25 ±3 °C, at barometric pressures of 650 to 800 mm of mercury, and relative humidity not to exceed 75%.

Capacitance range at 1 kHz, 0.5 V	0.01 μF to 0.33 μF
Tolerance on the capacitance	±20%, -20/+80%
Maximum capacitance variation with respect to capacitance value at 25 °C	-56%/+22%
Rated DC voltage	50 V, 100 V
DC test voltage; duration 1 minute	200% of rated voltage
Insulation resistance at rated voltage	100 G Ω or 1 000 M Ω x μF, whichever is less at 25 °C
Dissipation factor at 1 kHz, 0.5 V	≤4%
Operating temperature range	10 to 85 °C
Storage temperature range	−55 to +85 °C
Ageing	typical, 6% per time decade

Table 5 Range of values for 2222 739

CAPACITANCE VALUE	SI (see Ta	SUFFIX OF CATALOGUE NUMBER			
(μ F)	50 V	100 V	(see Table 2)		
0.010 to 0.022	17		103 to 223		
0.027 to 0.047	17	25	273 to 473		
0.056 to 0.082	17	30	563 to 823		
0.10	17	30	104		
0.12	25	30	124		
0.15	25	30	154		
0.18 to 0.33	25	-	184 to 334		

Mono-kap™ series

FEATURES

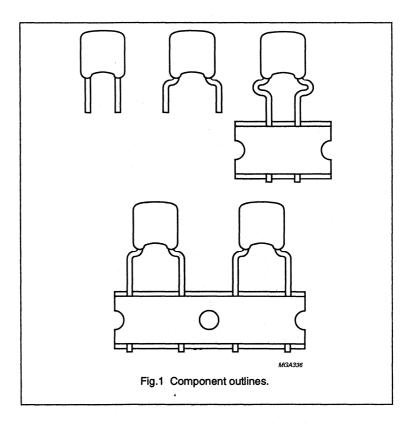
- Very high capacitance per unit volume
- · Low cost.

APPLICATIONS

These conformally coated radial leaded capacitors are designed for commercial and industrial applications in four dielectrics, COG (ultra-stable), X7R (stable), Y5V (general purpose) and Z5U (general purpose). Applications include timing, coupling/decoupling, signal comparison and biasing. Mono-kap™ capacitors are suitable for automatic insertion equipment.

DESCRIPTION

The basic capacitor construction consists of ceramic dielectric materials processed into a tape with a typical thickness range from 0.025 to 0.076 mm. Metal electrode patterns are applied using a thick film screening process. Multiple layers are stacked and laminated in such a manner that electrodes are alternately exposed when the pattern is cut into individual chip capacitors. The capacitors are fired through a high temperature profile to mature the



ceramic and metal into a homogeneous unit. Metal end terminations are applied and fired to provide electrical connection between the individual layers.

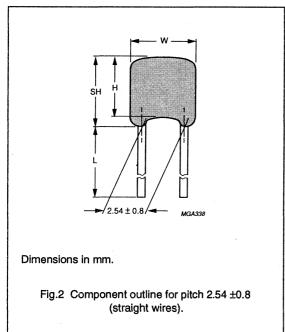
Tinned leads are attached using a solder. Encapsulation consists of a moisture resistant gold colour conformal epoxy coating that meets the flame requirements of UL94V-0.

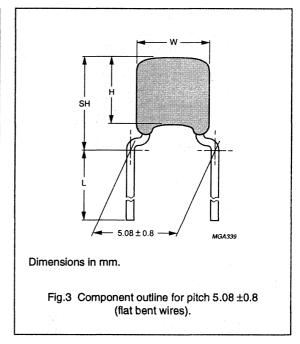
QUICK REFERENCE DATA

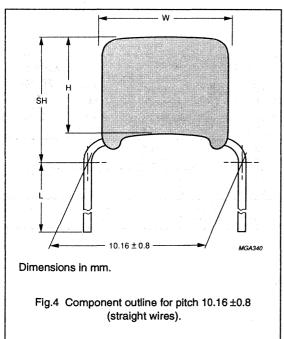
Parameters	2222 730 series	2222 731 series	2222 732 series	2222 733 series
Capacitance range	10 pF to 0.1 μF (E12 series)	100 pF to 2.2 μF (E12 series)	1 000 pF to 3.3 μF (E12 series)	1 000 pF to 3.3 μF (E12 series)
Rated DC voltages	50 V, 100 V	50 V, 100 V	50 V, 100 V	50 V, 100 V
Tolerance on capacitance	±5%; ±10%	±10%; ±20%	±20%; –20%/+80%	±20%; -20%/+80%
Temperature coefficients	NPO	X7R	Y5V	Z5U

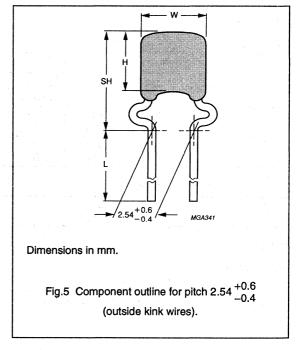
Mono-kap™ series

MECHANICAL DATA





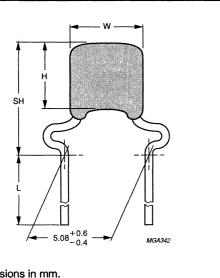




Philips Components Product specification

Leaded ceramic multilayer capacitors

Mono-kap™ series



Dimensions in mm.

Lead style available on request.

Fig.6 Component outline for pitch 5.08 $^{+0.6}_{-0.4}$ (outside kink wires).

Table 1 Capacitor dimensions (note 1)

	w	SEATING HEIGHT				APPROX.			
SIZE	(max.)	H (max.)	(max.)	FIG.2 (max.)	FIG.3 (max.)	FIG.4 (max.)	FIG.5 (max.)	FIG.6 (max.)	MASS (g)
15	3.81 (0.150)	3.81 (0.150)	2.54 (0.100)	5.38 (0.212)	6.35 (0.250)	_	6.99 (0.275)	6.99 (0.275)	0.15
20	5.08 (0.200)	5.08 (0.200)	3.18 (0.125)	6.65 (0.262)	7.62 (0.300)	_	8.26 (0.325)	8.26 (0.325)	0.16
30	7.62 (0.300)	7.62 (0.300)	3.81 (0.150)	_	10.16 (0.400)	-	_	10.80 (0.425)	0.42
40	10.16 (0.400)	10.16 (0.400)	3.81 (0.150)	_	12.70 (0.500)	12.70 (0.500)	_	13.34 (0.525)	0.94

Notes

Thickness defined as T.

Bulk packed products have a standard lead length (L) \geq 5.4 mm.

1. Dimensions between the brackets are in inches.

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Leaded ceramic multilayer capacitors

Mono-kap™ series

PACKING

Refer to the General section for Leaded Ceramic Multilayer Capacitors.

Table 2 Ordering information (notes 1 and 2)

PITCH	LEAD DIA.	CAP. TOL.	FIG.	I FIG I		LK KED	FIG.	1	TAPE REEL	FIG.	1	APE IN OPACK
	DIA.	101.		50 V	100 V		50 V	100 V		50 V	100 V	
2.54	0.4	±5%	2	01	33	_	-	-	-	-	-	
(0.1)	(0.016)	±10%	2	02	34	-	-	_	_	_	-	
(note 3)		±20%	2	03	35	-	-	_	-		-	
		-20/+80%	2	04	36	-	_	-		_	-	
2.54	0.5	±5%	2	05	37	5	09	41	5	13	45	
(0.1)	(0.020)	±10%	2	06	38	5	10	42	5	14	46	
(note 4)		±20%	2	07	39	5	11	43	5	15	47	
		-20/+80%	2	08	40	5	12	44	5	16	48	
5.08	0.5	±5%	3	17	49	3	21	53	3	25	57	
(0.2)	(0.020)	±10%	3	18	50	3	22	54	3	26	58	
(note 5)	•	±20%	3	19	51	3	23	55	3	27	59	
		-20/+80%	3	20	52	3	24	56	3	28	60	
10.16	0.635	±5%	4	29	61	_	_	-	_	-	- 1	
(0.4)	(0.025)	±10%	4	30	62	-	-	-	-	-	-	
(note 6)		±20%	4	31	63	-	-	-	-	-	-	
		-20/+80%	4	32	64	-	-	-	_	-	-	

Notes

- 1. Catalogue number to be completed by adding code for required series and capacitance, see Tables 3, 4, 5 and 6.
- 2. Dimensions between the brackets are in inches.
- 3. Only size 15.
- 4. Only sizes 15 to 20.
- 5. Only sizes 15 to 40.
- 6. Only size 40.

Mono-kap™ series

Marking

Capacitance value (CCC T)

10 pF to 99 pf: actual value in pF (2 digits only)

(2 aigits only)

100 pF and above: coded

capacitance value

(same as used in P/N)

Tolerance (CCC T)

Standard EIA tolerance (same as used in P/N)

Material code (M V)

Standard EIA TC code

A = COG

C = X7R

Y = Y5V

E = Z5U

Voltage code (M V)

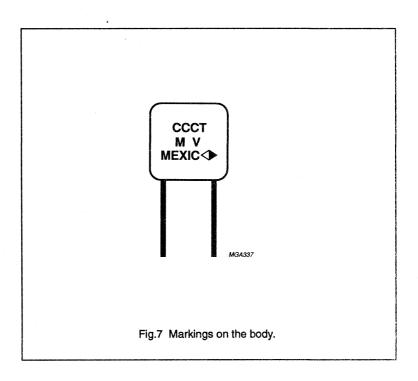
Standard EIA voltage code

1 = 100 V

5 = 50 V

Notes:

- 1. Size 15 marked with capacitance value only.
- 2. Size 20 marked with capacitance value and "MEXICO".



Mono-kap™ series

ELECTRICAL CHARACTERISTICS

Capacitors with temperature coefficient NPO. The capacitors meet the essential requirements of EIA-198. Unless stated otherwise all electrical values apply at an ambient temperature of 25 ±3 °C, at barometric pressures of 650 to 800 mm of mercury, and relative humidity not to exceed 75%.

Capacitance range at 1 MHz, 1 V; where C ≤1 000 pF at 1 kHz, 1 V; where C >1 000 pF	10 pF to 0.10 μF
Tolerance on the capacitance	±5%, ±10%
Rated DC voltage	50 V, 100 V
DC test voltage; duration 1 minute	250% of rated voltage
Insulation resistance at rated voltage	100 GΩ or 1 000 MΩ x μF, whichever is less at 25 °C
Temperature coefficient of the capacitance	0 ppm
Tolerance on the temperature coefficient	±30 ppm
Dissipation factor at 1 MHz, 1 V; where C ≤1 000 pF at 1 kHz, 1 V; where C >1 000 pF	<15 x 10 ⁻⁴
Operating temperature range	−55 to +125 °C
Storage temperature range	−55 to +85 °C

Mono-kap™ series

Table 3 Range of values for 2222 730 (NPO)

CAPACITANCE VALUE		SIZE (see Table 1)			
(pF)	50 V	100 V	(see Table 2)		
10			109		
to	15	15	to		
82			829		
100			101		
to	15	15	to		
560	green a Region		561		
680			681		
to	15	20			
820			821		
1 000	15	20	102		
1 200		20 20	122		
to	20		to		
3 300			332		
3 900	20 30		392		
4 700	20	30	472		
5 600	00		562		
to	30	30	to		
8 200			822		
10 000			103		
to	30	30	to		
22 000			223		
27 000	27 000 30 40		273		
33 000	33 000 30		333		
39 000	000 30 40		393		
47 000			473		
to	40		to		
82 000			823		
100 000	40	-	104		

Mono-kap™ series

Capacitors with temperature coefficient X7R. The capacitors meet the essential requirements of EIA-198. Unless stated otherwise all electrical values apply at an ambient temperature of 25 ±3 °C, at barometric pressures of 650 to 800 mm of mercury, and relative humidity not to exceed 75%.

Capacitance range at 1 kHz, 1 V	100 pF to 2.2 μF
Tolerance on the capacitance	±10%, ±20%
Maximum capacitance variation with respect to capacitance value at 25 °C	±15%
Rated DC voltage	50 V, 100 V
DC test voltage; duration 1 minute	250% of rated voltage
Insulation resistance at rated voltage	100 GΩ or 1 000 MΩ x μF, whichever is less at 25 °C
Dissipation factor at 1 kHz, 1 V	≤2.5%
Operating temperature range	-55 to +125 °C
Storage temperature range	-55 to +85 °C
Ageing	typical, 1% per time decade

Mono-kap™ series

Table 4 Range of values for 2222 731 (X7R)

CAPACITANCE VALUE	(s	SIZE ee Table 1)	SUFFIX OF CATALOGUE NUMBER	
(pF)	50 V	(see Table 2)		
100			101	
to	15	15	to	
820			821	
1000			102	
to	15	15	to	
8 200			822	
10 000	-		103	
to	15	15	to	
15 000			153	
18 000	15	20	183	
22 000	15	20	223	
27 000			273	
to	20	20	to	
82 000			823	
100 000	20	20	104	
120 000			124	
to	30	30	to	
470 000			474	
560 000			564	
to	30	40	to	
820 000		<u> </u>	824	
1 000 000	30	_	105	
1 200 000			125	
to	40	-	to	
2 200 000			225	

Mono-kap™ series

Capacitors with temperature coefficient Y5V. The capacitors meet the essential requirements of EIA-198. Unless stated otherwise all electrical values apply at an ambient temperature of 25 ± 3 °C, at barometric pressures of 650 to 800 mm of mercury, and relative humidity not to exceed 75%.

Capacitance range at 1 kHz, 0.5 V	0.001 μF to 3.3 μF
Tolerance on the capacitance	±20%, -20/+80%
Maximum capacitance variation with respect to capacitance value at 25 °C	-82/+22%
Rated DC voltage	50 V, 100 V
DC test voltage; duration 1 minute	250% of rated voltage
Insulation resistance at rated voltage	100 G Ω or 1 000 M Ω x μF, whichever is less at 25 °C
Dissipation factor at 1 kHz, 0.5 V	≤4%
Operating temperature range	−30 to +85 °C
Storage temperature range	–55 to +85 °C
Ageing	typical, 6% per time decade

Philips Components Product specification

Leaded ceramic multilayer capacitors

Mono-kap™ series

Table 5 Range of values for 2222 732 (Y5V)

CAPACITANCE VALUE (μF)	SIZE (see Table 1)		SUFFIX OF CATALOGUE NUMBER
	50 V	100 V	(see Table 2)
0.0010 to 0.0082	15	15	102 to 822
0.01 to 0.015	15	15	103 to 153
0.018 to 0.068	15	20	183 to 683
0.082	20	20	823
0.1 to 0.15	20	20	104 to 154
0.18 to 0.33	20	30	184 to 334
0.39 to 0.82	30	30	394 to 824
1.0	30	30	105
1.2	30	40	125
1.5	30	40	155
1.8	40	40	185
2.2	40	40	225
2.7 to 3.3	40	-	275 to 335

Mono-kap™ series

Capacitors with temperature coefficient Z5U. The capacitors meet the essential requirements of EIA-198. Unless stated otherwise all electrical values apply at an ambient temperature of 25 ±3 °C, at barometric pressures of 650 to 800 mm of mercury, and relative humidity not to exceed 75%.

Capacitance range at 1 kHz, 0.5 V	0.001 μF to 3.3 μF
Tolerance on the capacitance	±20%, -20/+80%
Maximum capacitance variation with respect to capacitance value at 25 °C	-56/+22%
Rated DC voltage	50 V, 100 V
DC test voltage; duration 1 minute	250% of rated voltage
Insulation resistance at rated voltage	100 GΩ or 1 000 MΩ x μF, whichever is less at 25 °C
Dissipation factor at 1 kHz, 0.5 V	≤4%
Operating temperature range	10 to 85 °C
Storage temperature range	–55 to +85 °C
Ageing	typical, 6% per time decade

Mono-kap™ series

Table 6 Range of values for 2222 733 (Z5U)

CAPACITANCE VALUE	SIZE (see Table 1)		SUFFIX OF CATALOGUE NUMBER
(μ F)	50 V	100 V	(see Table 2)
0.0010			102
to	15	15	to
0.0082		7 · ·	822
0.01			103
to	15	15	to
0.015			153
0.018			183
to	15	20	to
0.068			683
0.082	20	20	823
0.1			104
to	20	20	to
0.15			154
0.18			184
to	20	30	to
0.33			334
0.39			394
to	30	30	to
0.82			824
1.0	30	30	105
1.2	30	40	125
1.5	30	40	155
1.8	40	40	185
2.2	40	40	225
2.7			275
to	40	_	to
3.3			335

Mono-pak™ series

FEATURES

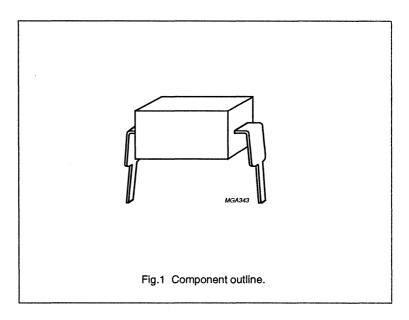
- · High capacitance per unit volume
- · Low cost.

APPLICATIONS

These moulded radial leaded capacitors are designed for commercial and industrial applications in three dielectrics, COG (ultra-stable), X7R (stable) and Z5U (general purpose). Applications include timing, coupling/decoupling, signal comparison and biasing. Mono-pak™ capacitors are suitable for automatic insertion equipment.

DESCRIPTION

The basic capacitor construction consists of ceramic dielectric materials processed into a tape with a typical thickness range from 0.025 to 0.076 mm. Metal electrode patterns are applied using a thick film screening process. Multiple layers are stacked and laminated in such a manner that electrodes are alternately exposed



when the pattern is cut into individual chip capacitors. The capacitors are fired through a high temperature profile to mature the ceramic and metal into a homogeneous unit. Metal end terminations are applied and fired to

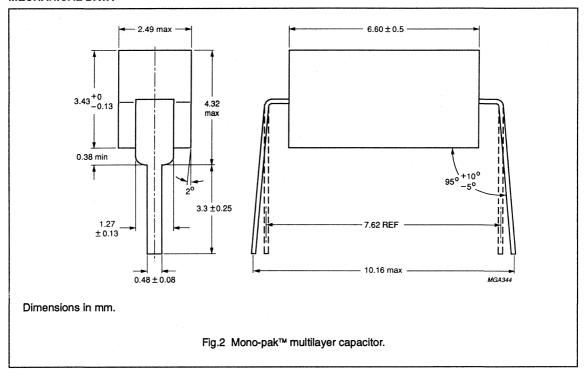
provide electrical connection between the individual layers. Tinned leads are attached using a solder. Encapsulation consists of a moisture resistant gold colour moulded epoxy coating that meets the flame requirements of UL94V-0.

QUICK REFERENCE DATA

Parameters	2222 734 series	2222 735 series	2222 736 series
Capacitance range	10 pF to 2 200 pF (E12 series)	3 300 pF to 0.22 μF (E12 series)	0.01 μF to 0.33 μF (E12 series)
Rated DC voltage	50 V	50 V	50 V
Tolerance on capacitance	±5%; ±10%	±10%; ±20%	±20%; –20%/+80%
Temperature coefficients	NPO	X7R	Z5U

Mono-pak™ series

MECHANICAL DATA



Mono-pak™ series

PACKING

Refer to the General section for Leaded Ceramic Multilayer Capacitors.

Table 1 Ordering information (note 1)

CAPACITANCE	2222 734	2222 735	2222 736
TOLERANCE	NPO	X7R	Z5U
±5%	09	-	_
±10%	10	10	_
±20%	_	11	11
<i>-</i> 20%/+80%		-	12

Notes

Approx. mass = 0.18 g.

1. Catalogue number to be completed by adding code for required series and capacitance, see Tables 2, 3 and 4.

Marking

Capacitance value (CCC T)

10 pF to 99 pf: actual value in pF (2 digits only)

100 pF and above: coded

capacitance value (same as used in P/N)

Tolerance (CCC T)

Standard EIA tolerance (same as used in P/N)

Material code (M V)

Standard EIA TC code

A = COG

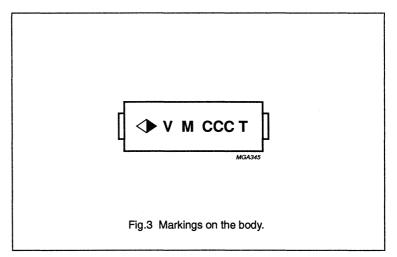
C = X7R

E = Z5U

Voltage code (M V)

Standard EIA voltage code

5 = 50 V



Philips Components Product specification

Leaded ceramic multilayer capacitors

Mono-pak™ series

ELECTRICAL CHARACTERISTICS

Capacitors with temperature coefficient NPO. The capacitors meet the essential requirements of EIA-198. Unless stated otherwise all electrical values apply at an ambient temperature of 25 ± 3 °C, at barometric pressures of 650 to 800 mm of mercury, and relative humidity not to exceed 75%.

Capacitance range at 1 MHz, 1 V; where C ≤1 000 pF at 1 kHz, 1 V; where C >1 000 pF	10 pF to 2 200 pF
Tolerance on the capacitance	±5%, ±10%
Rated DC voltage	50 V
DC test voltage; duration 1 minute	250% of rated voltage
Insulation resistance at rated voltage	100 GΩ or 1 000 MΩ x μF, whichever is less at 25 °C
Temperature coefficient of the capacitance	0 ppm
Tolerance on the temperature coefficient	±30 ppm
Dissipation factor at 1 MHz, 1 V; where C ≤1 000 pF at 1 kHz, 1 V; where C >1 000 pF	<15 x 10 ⁻⁴
Operating temperature range	-55 to +125 °C
Storage temperature range	−55 to +85 °C

Table 2 Range of values for 2222 734

CAPACITANCE VALUE (pF)	SIZE	SUFFIX OF CATALOGUE NUMBER (see Table 1)
10		109
to	26	to
82		829
100		101
to	26	to
820		821
1 000		102
to	26	to
2 200		222

Mono-pak™ series

Capacitors with temperature coefficient X7R. The capacitors meet the essential requirements of EIA-198. Unless stated otherwise all electrical values apply at an ambient temperature of 25 ± 3 °C, at barometric pressures of 650 to 800 mm of mercury, and relative humidity not to exceed 75%.

Capacitance range at 1 kHz, 1 V	3 300 pF to 0.22 μF
Tolerance on the capacitance	±10%, ±20%
Maximum capacitance variation with respect to capacitance value at 25 °C	±15%
Rated DC voltage	50 V
DC test voltage; duration 1 minute	250% of rated voltage
Insulation resistance at rated voltage	100 G Ω or 1 000 M Ω x μF, whichever is less at 25 °C
Dissipation factor at 1 kHz, 1 V	≤2.5%
Operating temperature range	-55 to +125 °C
Storage temperature range	−55 to +85 °C
Ageing	typical, 1% per time decade

Table 3 Range of values for 2222 735

CAPACITANCE VALUE (pF)	SIZE	SUFFIX OF CATALOGUE NUMBER (see Table 1)
3 300 to 8 200	26	332 to 822
10 000 to 82 000	26	103 to 823
100 000 to 220 000	26	104 to 224

Mono-pak™ series

Capacitors with temperature coefficient Z5U. The capacitors meet the essential requirements of EIA-198. Unless stated otherwise all electrical values apply at an ambient temperature of 25 ± 3 °C, at barometric pressures of 650 to 800 mm of mercury, and relative humidity not to exceed 75%.

Capacitance range at 1 kHz, 0.5 V	0.01 μF to 0.33 μF
Tolerance on the capacitance	±20%, -20%/+80%
Maximum capacitance variation with respect to capacitance value at 25 °C	-56%/+22%
Rated DC voltage	50 V
DC test voltage; duration 1 minute	250% of rated voltage
Insulation resistance at rated voltage	100 G Ω or 1 000 M Ω x μF, whichever is less at 25 °C
Dissipation factor at 1 kHz, 0.5 V	≤4%
Operating temperature range	10 to 85 °C
Storage temperature range	-55 to +85 °C
Ageing	typical 6% per time decade

Table 4 Range of values for 2222 736

CAPACITANCE VALUE (pF)	SIZE	SUFFIX OF CATALOGUE NUMBER (see Table 1)
0.010 to 0.082	26	103 to 823
0.10 to 0.33	26	104 to 334

Table 1 Mono-kap™ conformal radials, COG (NPO), 5% and 10% tolerance, 50 V

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	РІТСН
CN 15 C 100 J	K 100 J 15 COG F VA	2222 730 01109	2.54
CN 15 C 100 K	K 100 K 15 COG F VA	2222 730 02109	2.54
CN 15 C 120 J	K 120 J 15 COG F VA	2222 730 01129	2.54
CN 15 C 120 K	K 120 K 15 COG F VA	2222 730 02129	2.54
CN 15 C 150 J	K 150 J 15 COG F VA	2222 730 01159	2.54
CN 15 C 150 K	K 150 K 15 COG F VA	2222 730 02159	2.54
CN 15 C 180 J	K 180 J 15 COG F VA	2222 730 01189	2.54
CN 15 C 180 K	K 180 K 15 COG F VA	2222 730 02189	2.54
CN 15 C 220 J	K 220 J 15 COG F VA	2222 730 01229	2.54
CN 15 C 220 K	K 220 K 15 COG F VA	2222 730 02229	2.54
CN 15 C 270 J	K 270 J 15 COG F VA	2222 730 01279	2.54
CN 15 C 270 K	K 270 K 15 COG F VA	2222 730 02279	2.54
CN 15 C 330 J	K 330 J 15 COG F VA	2222 730 01339	2.54
CN 15 C 330 K	K 330 K 15 COG F VA	2222 730 02339	2.54
CN 15 C 390 J	K 390 J 15 COG F VA	2222 730 01399	2.54
CN 15 C 390 K	K 390 K 15 COG F VA	2222 730 02399	2.54
CN 15 C 470 J	K 470 J 15 COG F VA	2222 730 01479	2.54
CN 15 C 470 K	K 470 K 15 COG F VA	2222 730 02479	2.54
CN 15 C 560 J	K 560 J 15 COG F VA	2222 730 01569	2.54
CN 15 C 560 K	K 560 K 15 COG F VA	2222 730 02569	2.54
CN 15 C 680 J	K 680 J 15 COG F VA	2222 730 01689	2.54
CN 15 C 680 K	K 680 K 15 COG F VA	2222 730 02689	2.54
CN 15 C 820 J	K 820 J 15 COG F VA	2222 730 01829	2.54
CN 15 C 820 K	K 820 K 15 COG F VA	2222 730 02829	2.54
CN 15 C 101 J	K 101 J 15 COG F VA	2222 730 01101	2.54
CN 15 C 101 K	K 101 K 15 COG F VA	2222 730 02101	2.54
CN 15 C 121 J	K 121 J 15 COG F VA	2222 730 01121	2.54
CN 15 C 121 K	K 121 K 15 COG F VA	2222 730 02121	2.54
CN 15 C 151 J	K 151 J 15 COG F VA	2222 730 01151	2.54
CN 15 C 151 K	K 151 K 15 COG F VA	2222 730 02151	2.54
CN 15 C 181 J	K 181 J 15 COG F VA	2222 730 01181	2.54
CN 15 C 181 K	K 181 K 15 COG F VA	2222 730 02181	2.54
CN 15 C 221 J	K 221 J 15 COG F VA	2222 730 01221	2.54
CN 15 C 221 K	K 221 K 15 COG F VA	2222 730 02221	2.54
CN 15 C 271 J	K 271 J 15 COG F VA	2222 730 01271	2.54
CN 15 C 271 K	K 271 K 15 COG F VA	2222 730 02271	2.54
CN 15 C 331 J	K 331 J 15 COG F VA	2222 730 01331	2.54
CN 15 C 331 K	K 331 K 15 COG F VA	2222 730 02331	2.54

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	PITCH
CN 15 C 391 J	K 391 J 15 COG F VA	2222 730 01391	2.54
CN 15 C 391 K	K 391 K 15 COG F VA	2222 730 02391	2.54
CN 15 C 471 J	K 471 J 15 COG F VA	2222 730 01471	2.54
CN 15 C 471 K	K 471 K 15 COG F VA	2222 730 02471	2.54
CN 15 C 561 J	K 561 J 15 COG F VA	2222 730 01561	2.54
CN 15 C 561 K	K 561 K 15 COG F VA	2222 730 02561	2.54
CN 20 C 681 J	K 681 J 15 COG F VB	2222 730 05681	2.54
CN 20 C 681 K	K 681 K 15 COG F VB	2222 730 06681	2.54
CN 20 C 821 J	K 821 J 15 COG F VB	2222 730 05821	2.54
CN 20 C 821 K	K 821 K 15 COG F VB	2222 730 06821	2.54
CN 20 C 102 J	K 102 J 15 COG F VB	2222 730 05102	2.54
CN 20 C 102 K	K 102 K 15 COG F VB	2222 730 06102	2.54
CN 20 C 122 J	K 122 J 20 COG F VB	2222 730 05122	2.54
CN 20 C 122 K	K 122 K 20 COG F VB	2222 730 06122	2.54
CN 20 C 152 J	K 152 J 20 COG F VB	2222 730 05152	2.54
CN 20 C 152 K	K 152 K 20 COG F VB	2222 730 06152	2.54
CN 20 C 182 J	K 182 J 20 COG F VB	2222 730 05182	2.54
CN 20 C 182 K	K 182 K 20 COG F VB	2222 730 06182	2.54
CN 20 C 222 J	K 222 J 20 COG F VB	2222 730 05222	2.54
CN 20 C 222 K	K 222 K 20 COG F VB	2222 730 06222	2.54
CN 20 C 272 J	K 272 J 20 COG F VB	2222 730 05272	2.54
CN 20 C 272 K	K 272 K 20 COG F VB	2222 730 06272	2.54
CN 20 C 332 J	K 332 J 20 COG F VB	2222 730 05332	2.54
CN 20 C 332 K	K 332 K 20 COG F VB	2222 730 06332	2.54
CN 30 C 392 J	K 392 J 20 COG F VC	2222 730 17392	5.08
CN 30 C 392 K	K 392 K 20 COG F VC	2222 730 18392	5.08
CN 30 C 472 J	K 472 J 20 COG F VC	2222 730 17472	5.08
CN 30 C 472 K	K 472 K 20 COG F VC	2222 730 18472	5.08
CN 30 C 562 J	K 562 J 30 COG F VC	2222 730 17562	5.08
CN 30 C 562 K	K 562 K 30 COG F VC	2222 730 18562	5.08
CN 30 C 682 J	K 682 J 30 COG F VC	2222 730 17682	5.08
CN 30 C 682 K	K 682 K 30 COG F VC	2222 730 18682	5.08
CN 30 C 822 K	K 822 K 30 COG F VC	2222 730 18822	5.08
CN 30 C 103 J	K 103 J 30 COG F VC	2222 730 17103	5.08
CN 30 C 103 K	K 103 K 30 COG F VC	2222 730 18103	5.08
CN 40 C 153 J	K 153 J 30 COG F VC	2222 730 17153	5.08
CN 40 C 153 K	K 153 K 30 COG F VC	2222 730 18153	5.08
CN 40 C 223 J	K 223 J 30 COG F VC	2222 730 17223	5.08
CN 40 C 223 K	K 223 K 30 COG F VC	2222 730 18223	5.08

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	PITCH
CN 15 C 100 J DRM	K 100 J 15 COG F TT	2222 730 21109	5.08
CN 15 C 100 K DRM	K 100 K 15 COG F TT	2222 730 22109	5.08
CN 15 C 120 J DRM	K 120 J 15 COG F TT	2222 730 21129	5.08
CN 15 C 120 K DRM	K 120 K 15 COG F TT	2222 730 22129	5.08
CN 15 C 150 J DRM	K 150 J 15 COG F TT	2222 730 21159	5.08
CN 15 C 150 K DRM	K 150 K 15 COG F TT	2222 730 22159	5.08
CN 15 C 180 J DRM	K 180 J 15 COG F TT	2222 730 21189	5.08
CN 15 C 180 K DRM	K 180 K 15 COG F TT	2222 730 22189	5.08
CN 15 C 220 J DRM	K 220 J 15 COG F TT	2222 730 21229	5.08
CN 15 C 220 K DRM	K 220 K 15 COG F TT	2222 730 22229	5.08
CN 15 C 270 J DRM	K 270 J 15 COG F TT	2222 730 21279	5.08
CN 15 C 270 K DRM	K 270 K 15 COG F TT	2222 730 22279	5.08
CN 15 C 330 J DRM	K 330 J 15 COG F TT	2222 730 21339	5.08
CN 15 C 330 K DRM	K 330 K 15 COG F TT	2222 730 22339	5.08
CN 15 C 390 J DRM	K 390 J 15 COG F TT	2222 730 21399	5.08
CN 15 C 390 K DRM	K 390 K 15 COG F TT	2222 730 22399	5.08
CN 15 C 470 J DRM	K 470 J 15 COG F TT	2222 730 21479	5.08
CN 15 C 470 K DRM	K 470 K 15 COG F TT	2222 730 22479	5.08
CN 15 C 560 J DRM	K 560 J 15 COG F TT	2222 730 21569	5.08
CN 15 C 560 K DRM	K 560 K 15 COG F TT	2222 730 22569	5.08
CN 15 C 680 J DRM	K 680 J 15 COG F TT	2222 730 21689	5.08
CN 15 C 680 K DRM	K 680 K 15 COG F TT	2222 730 22689	5.08
CN 15 C 820 J DRM	K 820 J 15 COG F TT	2222 730 21829	5.08
CN 15 C 820 K DRM	K 820 K 15 COG F TT	2222 730 22829	5.08
CN 15 C 101 J DRM	K 101 J 15 COG F TT	2222 730 21101	5.08
CN 15 C 101 K DRM	K 101 K 15 COG F TT	2222 730 22101	5.08
CN 15 C 121 J DRM	K 121 J 15 COG F TT	2222 730 21121	5.08
CN 15 C 121 K DRM	K 121 K 15 COG F TT	2222 730 22121	5.08
CN 15 C 151 J DRM	K 151 J 15 COG F TT	2222 730 21151	5.08
CN 15 C 151 K DRM	K 151 K 15 COG F TT	2222 730 22151	5.08
CN 15 C 181 J DRM	K 181 J 15 COG F TT	2222 730 21181	5.08
CN 15 C 181 K DRM	K 181 K 15 COG F TT	2222 730 22181	5.08
CN 15 C 221 J DRM	K 221 J 15 COG F TT	2222 730 21221	5.08
CN 15 C 221 K DRM	K 221 K 15 COG F TT	2222 730 22221	5.08
CN 15 C 271 J DRM	K 271 J 15 COG F TT	2222 730 21271	5.08
CN 15 C 271 K DRM	K 271 K 15 COG F TT	2222 730 22271	5.08
CN 15 C 331 J DRM	K 331 J 15 COG F TT	2222 730 21331	5.08
CN 15 C 331 K DRM	K 331 K 15 COG F TT	2222 730 22331	5.08

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	PITCH
CN 15 C 391 J DRM	K 391 J 15 COG F TT	2222 730 21391	5.08
CN 15 C 391 K DRM	K 391 K 15 COG F TT	2222 730 22391	5.08
CN 15 C 471 J DRM	K 471 J 15 COG F TT	2222 730 21471	5.08
CN 15 C 471 K DRM	K 471 K 15 COG F TT	2222 730 22471	5.08
CN 15 C 561 J DRM	K 561 J 15 COG F TT	2222 730 21561	5.08
CN 15 C 561 K DRM	K 561 K 15 COG F TT	2222 730 22561	5.08
CN 20 C 681 J DRM	K 681 J 15 COG F TT	2222 730 21681	5.08
CN 20 C 681 K DRM	K 681 K 15 COG F TT	2222 730 22681	5.08
CN 20 C 821 J DRM	K 821 J 15 COG F TT	2222 730 21821	5.08
CN 20 C 821 K DRM	K 821 K 15 COG F TT	2222 730 22821	5.08
CN 20 C 102 J DRM	K 102 J 15 COG F TT	2222 730 21102	5.08
CN 20 C 102 K DRM	K 102 K 15 COG F TT	2222 730 22102	5.08
CN 20 C 122 J DRM	K 122 J 20 COG F TT	2222 730 21122	5.08
CN 20 C 122 K DRM	K 122 K 20 COG F TT	2222 730 22122	5.08
CN 20 C 152 J DRM	K 152 J 20 COG F TT	2222 730 21152	5.08
CN 20 C 152 K DRM	K 152 K 20 COG F TT	2222 730 22152	5.08
CN 20 C 182 J DRM	K 182 J 20 COG F TT	2222 730 21182	5.08
CN 20 C 182 K DRM	K 182 K 20 COG F TT	2222 730 22182	5.08
CN 20 C 222 J DRM	K 222 J 20 COG F TT	2222 730 21222	5.08
CN 20 C 222 K DRM	K 222 K 20 COG F TT	2222 730 22222	5.08
CN 20 C 272 J DRM	K 272 J 20 COG F TT	2222 730 21272	5.08
CN 20 C 272 K DRM	K 272 K 20 COG F TT	2222 730 22272	5.08
CN 20 C 332 J DRM	K 332 J 20 COG F TT	2222 730 21332	5.08
CN 20 C 332 K DRM	K 332 K 20 COG F TT	2222 730 22332	5.08
CN 30 C 392 J DRM	K 392 J 20 COG F TT	2222 730 21392	5.08
CN 30 C 392 K DRM	K 392 K 20 COG F TT	2222 730 22392	5.08
CN 30 C 472 J DRM	K 472 J 20 COG F TT	2222 730 21472	5.08
CN 30 C 472 K DRM	K 472 K 20 COG F TT	2222 730 22472	5.08
CN 30 C 562 J DRM	K 562 J 30 COG F TT	2222 730 21562	5.08
CN 30 C 562 K DRM	K 562 K 30 COG F TT	2222 730 22562	5.08
CN 30 C 682 J DRM	K 682 J 30 COG F TT	2222 730 21682	5.08
CN 30 C 682 K DRM	K 682 K 30 COG F TT	2222 730 22682	5.08
CN 30 C 822 K DRM	K 822 K 30 COG F TT	2222 730 22822	5.08
CN 30 C 103 J DRM	K 103 J 30 COG F TT	2222 730 21103	5.08
CN 30 C 103 K DRM	K 103 K 30 COG F TT	2222 730 22103	5.08

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	РІТСН
CN 40 C 153 J DRM	K 153 J 30 COG F TT	2222 730 21153	5.08
CN 40 C 153 K DRM	K 153 K 30 COG F TT	2222 730 22153	5.08
CN 40 C 223 J DRM	K 223 J 30 COG F TT	2222 730 21223	5.08
CN 40 C 223 K DRM	K 223 K 30 COG F TT	2222 730 22223	5.08

Note

1. Only the first 13 digits of the 15 digit code are significant for cross reference purposes.

Table 2 Mono-kap™ conformal radials, COG (NPO), 5% and 10% tolerance, 100 V

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	РІТСН
CN 15 A 100 J	K 100 J 15 COG H VA	2222 730 33109	2.54
CN 15 A 100 K	K 100 K 15 COG H VA	2222 730 34109	2.54
CN 15 A 120 J	K 120 J 15 COG H VA	2222 730 33129	2.54
CN 15 A 120 K	K 120 K 15 COG H VA	2222 730 34129	2.54
CN 15 A 150 J	K 150 J 15 COG H VA	2222 730 33159	2.54
CN 15 A 150 K	K 150 K 15 COG H VA	2222 730 34159	2.54
CN 15 A 180 J	K 180 J 15 COG H VA	2222 730 33189	2.54
CN 15 A 180 K	K 180 K 15 COG H VA	2222 730 34189	2.54
CN 15 A 220 J	K 220 J 15 COG H VA	2222 730 33229	2.54
CN 15 A 220 K	K 220 K 15 COG H VA	2222 730 34229	2.54
CN 15 A 270 J	K 270 J 15 COG H VA	2222 730 33279	2.54
CN 15 A 270 K	K 270 K 15 COG H VA	2222 730 34279	2.54
CN 15 A 330 J	K 330 J 15 COG H VA	2222 730 33339	2.54
CN 15 A 330 K	K 330 K 15 COG H VA	2222 730 34339	2.54
CN 15 A 390 J	K 390 J 15 COG H VA	2222 730 33399	2.54
CN 15 A 390 K	K 390 K 15 COG H VA	2222 730 34399	2.54
CN 15 A 470 J	K 470 J 15 COG H VA	2222 730 33479	2.54
CN 15 A 470 K	K 470 K 15 COG H VA	2222 730 34479	2.54
CN 15 A 560 J	K 560 J 15 COG H VA	2222 730 33569	2.54
CN 15 A 560 K	K 560 K 15 COG H VA	2222 730 34569	2.54
CN 15 A 680 J	K 680 J 15 COG H VA	2222 730 33689	2.54
CN 15 A 680 K	K 680 K 15 COG H VA	2222 730 34689	2.54
CN 15 A 820 J	K 820 J 15 COG H VA	2222 730 33829	2.54
CN 15 A 820 K	K 820 K 15 COG H VA	2222 730 34829	2.54
CN 15 A 101 J	K 101 J 15 COG H VA	2222 730 33101	2.54
CN 15 A 101 K	K 101 K 15 COG H VA	2222 730 34101	2.54
CN 15 A 121 J	K 121 J 15 COG H VA	2222 730 33121	2.54
CN 15 A 121 K	K 121 K 15 COG H VA	2222 730 34121	2.54

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	PITCH
CN 15 A 151 J	K 151 J 15 COG H VA	2222 730 33151	2.54
CN 15 A 151 K	K 151 K 15 COG H VA	2222 730 34151	2.54
CN 15 A 181 J	K 181 J 15 COG H VA	2222 730 33181	2.54
CN 15 A 181 K	K 181 K 15 COG H VA	2222 730 34181	2.54
CN 15 A 221 J	K 221 J 15 COG H VA	2222 730 33221	2.54
CN 15 A 221 K	K 221 K 15 COG H VA	2222 730 34221	2.54
CN 15 A 271 J	K 271 J 15 COG H VA	2222 730 33271	2.54
CN 15 A 271 K	K 271 K 15 COG H VA	2222 730 34271	2.54
CN 15 A 331 J	K 331 J 15 COG H VA	2222 730 33331	2.54
CN 15 A 331 K	K 331 K 15 COG H VA	2222 730 34331	2.54
CN 15 A 391 J	K 391 J 15 COG H VA	2222 730 33391	2.54
CN 15 A 391 K	K 391 K 15 COG H VA	2222 730 34391	2.54
CN 20 A 471 J	K 471 J 15 COG H VB	2222 730 37471	2.54
CN 20 A 471 K	K 471 K 15 COG H VB	2222 730 38471	2.54
CN 20 A 561 J	K 561 J 15 COG H VB	2222 730 37561	2.54
CN 20 A 561 K	K 561 K 15 COG H VB	2222 730 38561	2.54
CN 20 A 681 J	K 681 J 20 COG H VB	2222 730 37681	2.54
CN 20 A 681 K	K 681 K 20 COG H VB	2222 730 38681	2.54
CN 20 A 821 J	K 821 J 20 COG H VB	2222 730 37821	2.54
CN 20 A 821 K	K 821 K 20 COG H VB	2222 730 38821	2.54
CN 20 A 102 J	K 102 J 20 COG H VB	2222 730 37102	2.54
CN 20 A 102 K	K 102 K 20 COG H VB	2222 730 38102	2.54
CN 20 A 122 J	K 122 J 20 COG H VB	2222 730 37122	2.54
CN 20 A 152 J	K 152 J 20 COG H VB	2222 730 37152	2.54
CN 20 A 152 K	K 152 K 20 COG H VB	2222 730 38152	2.54
CN 30 A 182 J	K 182 J 20 COG H VC	2222 730 49182	5.08
CN 30 A 182 K	K 182 K 20 COG H VC	2222 730 50182	5.08
CN 30 A 222 J	K 222 J 20 COG H VC	2222 730 49222	5.08
CN 30 A 222 K	K 222 K 20 COG H VC	2222 730 50222	5.08
CN 30 A 272 J	K 272 J 20 COG H VC	2222 730 49272	5.08
CN 30 A 272 K	K 272 K 20 COG H VC	2222 730 50272	5.08
CN 30 A 332 J	K 332 J 20 COG H VC	2222 730 49332	5.08
CN 30 A 332 K	K 332 K 30 COG H VC	2222 730 50332	5.08
CN 30 A 392 J	K 392 J 30 COG H VC	2222 730 49392	5.08
CN 30 A 472 J	K 472 J 30 COG H VC	2222 730 49472	5.08
CN 30 A 472 K	K 472 K 30 COG H VC	2222 730 50472	5.08
CN 30 A 682 J	K 682 J 30 COG H VC	2222 730 49682	5.08
CN 30 A 103 J	K 103 J 30 COG H VC	2222 730 49103	5.08
CN 30 A 103 K	K 103 K 30 COG H VC	2222 730 50103	5.08

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	PITCH
CN 15 A 100 J DRM	K 100 J 15 COG H TT	2222 730 53109	5.08
CN 15 A 100 K DRM	K 100 K 15 COG H TT	2222 730 54109	5.08
CN 15 A 120 J DRM	K 120 J 15 COG H TT	2222 730 53129	5.08
CN 15 A 120 K DRM	K 120 K 15 COG H TT	2222 730 54129	5.08
CN 15 A 150 J DRM	K 150 J 15 COG H TT	2222 730 53159	5.08
CN 15 A 150 K DRM	K 150 K 15 COG H TT	2222 730 54159	5.08
CN 15 A 180 J DRM	K 180 J 15 COG H TT	2222 730 53189	5.08
CN 15 A 180 K DRM	K 180 K 15 COG H TT	2222 730 54189	5.08
CN 15 A 220 J DRM	K 220 J 15 COG H TT	2222 730 53229	5.08
CN 15 A 220 K DRM	K 220 K 15 COG H TT	2222 730 54229	5.08
CN 15 A 270 J DRM	K 270 J 15 COG H TT	2222 730 53279	5.08
CN 15 A 270 K DRM	K 270 K 15 COG H TT	2222 730 54279	5.08
CN 15 A 330 J DRM	K 330 J 15 COG H TT	2222 730 53339	5.08
CN 15 A 330 K DRM	K 330 K 15 COG H TT	2222 730 54339	5.08
CN 15 A 390 J DRM	K 390 J 15 COG H TT	2222 730 53399	5.08
CN 15 A 390 K DRM	K 390 K 15 COG H TT	2222 730 54399	5.08
CN 15 A 470 J DRM	K 470 J 15 COG H TT	2222 730 53479	5.08
CN 15 A 470 K DRM	K 470 K 15 COG H TT	2222 730 54479	5.08
CN 15 A 560 J DRM	K 560 J 15 COG H TT	2222 730 53569	5.08
CN 15 A 560 K DRM	K 560 K 15 COG H TT	2222 730 54569	5.08
CN 15 A 680 J DRM	K 680 J 15 COG H TT	2222 730 53689	5.08
CN 15 A 680 K DRM	K 680 K 15 COG H TT	2222 730 54689	5.08
CN 15 A 820 J DRM	K 820 J 15 COG H TT	2222 730 53829	5.08
CN 15 A 820 K DRM	K 820 K 15 COG H TT	2222 730 54829	5.08
CN 15 A 101 J DRM	K 101 J 15 COG H TT	2222 730 53101	5.08
CN 15 A 101 K DRM	K 101 K 15 COG H TT	2222 730 54101	5.08
CN 15 A 121 J DRM	K 121 J 15 COG H TT	2222 730 53121	5.08
CN 15 A 121 K DRM	K 121 K 15 COG H TT	2222 730 54121	5.08
CN 15 A 151 J DRM	K 151 J 15 COG H TT	2222 730 53151	5.08
CN 15 A 151 K DRM	K 151 K 15 COG H TT	2222 730 54151	5.08
CN 15 A 181 J DRM	K 181 J 15 COG H TT	2222 730 53181	5.08
CN 15 A 181 K DRM	K 181 K 15 COG H TT	2222 730 54181	5.08
CN 15 A 221 J DRM	K 221 J 15 COG H TT	2222 730 53221	5.08
CN 15 A 221 K DRM	K 221 K 15 COG H TT	2222 730 54221	5.08
CN 15 A 271 J DRM	K 271 J 15 COG H TT	2222 730 53271	5.08
CN 15 A 271 K DRM	K 271 K 15 COG H TT	2222 730 54271	5.08
CN 15 A 331 J DRM	K 331 J 15 COG H TT	2222 730 53331	5.08
CN 15 A 331 K DRM	K 331 K 15 COG H TT	2222 730 54331	5.08

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	PITCH
CN 15 A 391 J DRM	K 391 J 15 COG H TT	2222 730 53391	5.08
CN 15 A 391 K DRM	K 391 K 15 COG H TT	2222 730 54391	5.08
CN 20 A 471 J DRM	K 471 J 15 COG H TT	2222 730 53471	5.08
CN 20 A 471 K DRM	K 471 K 15 COG H TT	2222 730 54471	5.08
CN 20 A 561 J DRM	K 561 J 15 COG H TT	2222 730 53561	5.08
CN 20 A 561 K DRM	K 561 K 15 COG H TT	2222 730 54561	5.08
CN 20 A 681 J DRM	K 681 J 20 COG H TT	2222 730 53681	5.08
CN 20 A 681 K DRM	K 681 K 20 COG H TT	2222 730 54681	5.08
CN 20 A 821 J DRM	K 821 J 20 COG H TT	2222 730 53821	5.08
CN 20 A 821 K DRM	K 821 K 20 COG H TT	2222 730 54821	5.08
CN 20 A 102 J DRM	K 102 J 20 COG H TT	2222 730 53102	5.08
CN 20 A 102 K DRM	K 102 K 20 COG H TT	2222 730 54102	5.08
CN 20 A 122 J DRM	K 122 J 20 COG H TT	2222 730 53122	5.08
CN 20 A 152 J DRM	K 152 J 20 COG H TT	2222 730 53152	5.08
CN 20 A 152 K DRM	K 152 K 20 COG H TT	2222 730 54152	5.08
CN 30 A 182 J DRM	K 182 J 20 COG H TT	2222 730 53182	5.08
CN 30 A 182 K DRM	K 182 K 20 COG H TT	2222 730 54182	5.08
CN 30 A 222 J DRM	K 222 J 20 COG H TT	2222 730 53222	5.08
CN 30 A 222 K DRM	K 222 K 20 COG H TT	2222 730 54222	5.08
CN 30 A 272 J DRM	K 272 J 20 COG H TT	2222 730 53272	5.08
CN 30 A 272 K DRM	K 272 K 20 COG H TT	2222 730 54272	5.08
CN 30 A 332 J DRM	K 332 J 20 COG H TT	2222 730 53332	5.08
CN 30 A 332 K DRM	K 332 K 20 COG H TT	2222 730 54332	5.08
CN 30 A 392 J DRM	K 392 J 30 COG H TT	2222 730 53392	5.08
CN 30 A 472 J DRM	K 472 J 30 COG H TT	2222 730 53472	5.08
CN 30 A 472 K DRM	K 472 K 30 COG H TT	2222 730 54472	5.08
CN 30 A 682 J DRM	K 682 J 30 COG H TT	2222 730 53682	5.08
CN 30 A 103 J DRM	K 103 J 30 COG H TT	2222 730 53103	5.08
CN 30 A 103 K DRM	K 103 K 30 COG H TT	2222 730 54103	5.08

Note

1. Only the first 13 digits of the 15 digit code are significant for cross reference purposes.

Table 3 Mono-kap™ conformal radials X7R, 10% and 20% tolerance, 50 V

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	PITCH
CW 15 C 151 K	K 151 K 15 X7R F VA	2222 731 02151	2.54
CW 15 C 181 K	K 181 K 15 X7R F VA	2222 731 02181	2.54
CW 15 C 181 M	K 181 M 15 X7R F VA	2222 731 03181	2.54
CW 15 C 221 K	K 221 K 15 X7R F VA	2222 731 02221	2.54
CW 15 C 271 K	K 271 K 15 X7R F VA	2222 731 02271	2.54
CW 15 C 271 M	K 271 M 15 X7R F VA	2222 731 03271	2.54
CW 15 C 331 K	K 331 K 15 X7R F VA	2222 731 02331	2.54
CW 15 C 331 M	K 331 M 15 X7R F VA	2222 731 03331	2.54
CW 15 C 391 K	K 391 K 15 X7R F VA	2222 731 02391	2.54
CW 15 C 391 M	K 391 M 15 X7R F VA	2222 731 03391	2.54
CW 15 C 471 K	K 471 K 15 X7R F VA	2222 731 02471	2.54
CW 15 C 471 M	K 471 M 15 X7R F VA	2222 731 03471	2.54
CW 15 C 561 K	K 561 K 15 X7R F VA	2222 731 02561	2.54
CW 15 C 681 K	K 681 K 15 X7R F VA	2222 731 02681	2.54
CW 15 C 681 M	K 681 M 15 X7R F VA	2222 731 03681	2.54
CW 15 C 821 K	K 821 K 15 X7R F VA	2222 731 02821	2.54
CW 15 C 821 M	K 821 M 15 X7R F VA	2222 731 03821	2.54
CW 15 C 102 K	K 102 K 15 X7R F VA	2222 731 02102	2.54
CW 15 C 102 M	K 102 M 15 X7R F VA	2222 731 03102	2.54
CW 15 C 122 K	K 122 K 15 X7R F VA	2222 731 02122	2.54
CW 15 C 152 K	K 152 K 15 X7R F VA	2222 731 02152	2.54
CW 15 C 182 K	K 182 K 15 X7R F VA	2222 731 02182	2.54
CW 15 C 222 K	K 222 K 15 X7R F VA	2222 731 02222	2.54
CW 15 C 222 M	K 222 M 15 X7R F VA	2222 731 03222	2.54
CW 15 C 272 K	K 272 K 15 X7R F VA	2222 731 02272	2.54
CW 15 C 272 M	K 272 M 15 X7R F VA	2222 731 03272	2.54
CW 15 C 332 K	K 332 K 15 X7R F VA	2222 731 02332	2.54
CW 15 C 332 M	K 332 M 15 X7R F VA	2222 731 03332	2.54
CW 15 C 392 K	K 392 K 15 X7R F VA	2222 731 02392	2.54
CW 15 C 472 K	K 472 K 15 X7R F VA	2222 731 02472	2.54
CW 15 C 472 M	K 472 M 15 X7R F VA	2222 731 03472	2.54
CW 15 C 562 K	K 562 K 15 X7R F VA	2222 731 02562	2.54
CW 15 C 562 M	K 562 M 15 X7R F VA	2222 731 03562	2.54
CW 15 C 682 K	K 682 K 15 X7R F VA	2222 731 02682	2.54
CW 15 C 682 M	K 682 M 15 X7R F VA	2222 731 03682	2.54
CW 15 C 822 K	K 822 K 15 X7R F VA	2222 731 02822	2.54
CW 15 C 822 M	K 822 M 15 X7R F VA	2222 731 03822	2.54

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	РІТСН
CW 15 C 103 K	K 103 K 15 X7R F VA	2222 731 02103	2.54
CW 15 C 103 M	K 103 M 15 X7R F VA	2222 731 03103	2.54
CW 15 C 153 K	K 153 K 15 X7R F VA	2222 731 02153	2.54
CW 15 C 153 M	K 153 M 15 X7R F VA	2222 731 03153	2.54
CW 20 C 183 K	K 183 K 15 X7R F VB	2222 731 06183	2.54
CW 20 C 183 M	K 183 M 15 X7R F VB	2222 731 07183	2.54
CW 20 C 223 K	K 223 K 15 X7R F VB	2222 731 06223	2.54
CW 20 C 223 M	K 223 M 15 X7R F VB	2222 731 07223	2.54
CW 20 C 273 K	K 273 K 20 X7R F VB	2222 731 06273	2.54
CW 20 C 273 M	K 273 M 20 X7R F VB	2222 731 07273	2.54
CW 20 C 333 K	K 333 K 20 X7R F VB	2222 731 06333	2.54
CW 20 C 333 M	K 333 M 20 X7R F VB	2222 731 07333	2.54
CW 20 C 393 K	K 393 K 20 X7R F VB	2222 731 06393	2.54
CW 20 C 473 K	K 473 K 20 X7R F VB	2222 731 06473	2.54
CW 20 C 473 M	K 473 M 20 X7R F VB	2222 731 07473	2.54
CW 20 C 563 K	K 563 K 20 X7R F VB	2222 731 06563	2.54
CW 20 C 563 M	K 563 M 20 X7R F VB	2222 731 07563	2.54
CW 20 C 683 K	K 683 K 20 X7R F VB	2222 731 06683	2.54
CW 20 C 683 M	K 683 M 20 X7R F VB	2222 731 07683	2.54
CW 20 C 823 K	K 823 K 20 X7R F VB	2222 731 06823	2.54
CW 20 C 104 K	K 104 K 20 X7R F VB	2222 731 06104	2.54
CW 20 C 104 M	K 104 M 20 X7R F VB	2222 731 07104	2.54
CW 30 C 124 K	K 124 K 30 X7R F VC	2222 731 18124	5.08
CW 30 C 124 M	K 124 M 30 X7R F VC	2222 731 19124	5.08
CW 30 C 154 K	K 154 K 30 X7R F VC	2222 731 18154	5.08
CW 30 C 154 M	K 154 M 30 X7R F VC	2222 731 19154	5.08
CW 30 C 184 K	K 184 K 30 X7R F VC	2222 731 18184	5.08
CW 30 C 184 M	K 184 M 30 X7R F VC	2222 731 19184	5.08
CW 30 C 224 K	K 224 K 30 X7R F VC	2222 731 18224	5.08
CW 30 C 224 M	K 224 M 30 X7R F VC	2222 731 19224	5.08
CW 30 C 274 K	K 274 K 30 X7R F VC	2222 731 18274	5.08
CW 30 C 274 M	K 274 M 30 X7R F VC	2222 731 19274	5.08
CW 30 C 334 K	K 334 K 30 X7R F VC	2222 731 18334	5.08
CW 30 C 334 M	K 334 M 30 X7R F VC	2222 731 19334	5.08
CW 30 C 394 K	K 394 K 30 X7R F VC	2222 731 18394	5.08
CW 30 C 474 K	K 474 K 30 X7R F VC	2222 731 18474	5.08
CW 30 C 474 M	K 474 M 30 X7R F VC	2222 731 19474	5.08
CW 40 C 564 M	K 564 M 30 X7R F VC	2222 731 19561	5.08
CW 40 C 684 K	K 684 K 30 X7R F VC	2222 731 18684	5.08

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	PITCH
CW 40 C 824 M	K 824 M 30 X7R F VC	2222 731 19824	5.08
CW 40 C 105 K	K 105 K 30 X7R F VC	2222 731 18105	5.08
CW 40 C 105 M	K 105 M 30 X7R F VC	2222 731 19105	5.08
CW 15 C 151 K DRM	K 151 K 15 X7R F TT	2222 731 22151	5.08
CW 15 C 181 K DRM	K 181 K 15 X7R F TT	2222 731 22181	5.08
CW 15 C 181 M DRM	K 181 M 15 X7R F TT	2222 731 23181	5.08
CW 15 C 221 K DRM	K 221 K 15 X7R F TT	2222 731 22221	5.08
CW 15 C 271 K DRM	K 271 K 15 X7R F TT	2222 731 22271	5.08
CW 15 C 271 M DRM	K 271 M 15 X7R F TT	2222 731 23271	5.08
CW 15 C 331 K DRM	K 331 K 15 X7R F TT	2222 731 22331	5.08
CW 15 C 331 M DRM	K 331 M 15 X7R F TT	2222 731 23331	5.08
CW 15 C 391 K DRM	K 391 K 15 X7R F TT	2222 731 22391	5.08
CW 15 C 391 M DRM	K 391 M 15 X7R F TT	2222 731 23391	5.08
CW 15 C 471 K DRM	K 471 K 15 X7R F TT	2222 731 22471	5.08
CW 15 C 471 M DRM	K 471 M 15 X7R F TT	2222 731 23471	5.08
CW 15 C 561 K DRM	K 561 K 15 X7R F TT	2222 731 22561	5.08
CW 15 C 681 K DRM	K 681 K 15 X7R F TT	2222 731 22681	5.08
CW 15 C 681 M DRM	K 681 M 15 X7R F TT	2222 731 23681	5.08
CW 15 C 821 K DRM	K 821 K 15 X7R F TT	2222 731 22821	5.08
CW 15 C 821 M DRM	K 821 M 15 X7R F TT	2222 731 23821	5.08
CW 15 C 102 K DRM	K 102 K 15 X7R F TT	2222 731 22102	5.08
CW 15 C 102 M DRM	K 102 M 15 X7R F TT	2222 731 23102	5.08
CW 15 C 122 K DRM	K 122 K 15 X7R F TT	2222 731 22122	5.08
CW 15 C 152 K DRM	K 152 K 15 X7R F TT	2222 731 22152	5.08
CW 15 C 182 K DRM	K 182 K 15 X7R F TT	2222 731 22182	5.08
CW 15 C 222 K DRM	K 222 K 15 X7R F TT	2222 731 22222	5.08
CW 15 C 222 M DRM	K 222 M 15 X7R F TT	2222 731 23222	5.08
CW 15 C 272 K DRM	K 272 K 15 X7R F TT	2222 731 22272	5.08
CW 15 C 272 M DRM	K 272 M 15 X7R F TT	2222 731 23272	5.08
CW 15 C 332 K DRM	K 332 K 15 X7R F TT	2222 731 22332	5.08
CW 15 C 332 M DRM	K 332 M 15 X7R F TT	2222 731 23332	5.08
CW 15 C 392 K DRM	K 392 K 15 X7R F TT	2222 731 22392	5.08
CW 15 C 472 K DRM	K 472 K 15 X7R F TT	2222 731 22472	5.08
CW 15 C 472 M DRM	K 472 M 15 X7R F TT	2222 731 23472	5.08
CW 15 C 562 K DRM	K 562 K 15 X7R F TT	2222 731 22562	5.08
CW 15 C 562 M DRM	K 562 M 15 X7R F TT	2222 731 23562	5.08
CW 15 C 682 K DRM	K 682 K 15 X7R F TT	2222 731 22682	5.08
CW 15 C 682 M DRM	K 682 M 15 X7R F TT	2222 731 23682	5.08

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	PITCH
CW 15 C 822 K DRM	K 822 K 15 X7R F TT	2222 731 22822	5.08
CW 15 C 822 M DRM	K 822 M 15 X7R F TT	2222 731 23822	5.08
CW 15 C 103 K DRM	K 103 K 15 X7R F TT	2222 731 22103	5.08
CW 15 C 103 M DRM	K 103 M 15 X7R F TT	2222 731 23103	5.08
CW 15 C 153 K DRM	K 153 K 15 X7R F TT	2222 731 22153	5.08
CW 15 C 153 M DRM	K 153 M 15 X7R F TT	2222 731 23153	5.08
CW 20 C 183 K DRM	K 183 K 15 X7R F TT	2222 731 22183	5.08
CW 20 C 183 M DRM	K 183 M 15 X7R F TT	2222 731 23183	5.08
CW 20 C 223 K DRM	K 223 K 15 X7R F TT	2222 731 22223	5.08
CW 20 C 223 M DRM	K 223 M 15 X7R F TT	2222 731 23223	5.08
CW 20 C 273 K DRM	K 273 K 20 X7R F TT	2222 731 22273	5.08
CW 20 C 273 M DRM	K 273 M 20 X7R F TT	2222 731 23273	5.08
CW 20 C 333 K DRM	K 333 K 20 X7R F TT	2222 731 22333	5.08
CW 20 C 333 M DRM	K 333 M 20 X7R F TT	2222 731 23333	5.08
CW 20 C 393 K DRM	K 393 K 20 X7R F TT	2222 731 22393	5.08
CW 20 C 473 K DRM	K 473 K 20 X7R F TT	2222 731 22473	5.08
CW 20 C 473 M DRM	K 473 M 20 X7R F TT	2222 731 23473	5.08
CW 20 C 563 K DRM	K 563 K 20 X7R F TT	2222 731 22563	5.08
CW 20 C 563 M DRM	K 563 M 20 X7R F TT	2222 731 23563	5.08
CW 20 C 683 K DRM	K 683 K 20 X7R F TT	2222 731 22683	5.08
CW 20 C 683 M DRM	K 683 M 20 X7R F TT	2222 731 23683	5.08
CW 20 C 823 K DRM	K 823 K 20 X7R F TT	2222 731 22823	5.08
CW 20 C 104 K DRM	K 104 K 20 X7R F TT	2222 731 22104	5.08
CW 20 C 104 M DRM	K 104 M 20 X7R F TT	2222 731 23104	5.08
CW 30 C 124 K DRM	K 124 K 30 X7R F TT	2222 731 22124	5.08
CW 30 C 124 M DRM	K 124 M 30 X7R F TT	2222 731 23124	5.08
CW 30 C 154 K DRM	K 154 K 30 X7R F TT	2222 731 22154	5.08
CW 30 C 154 M DRM	K 154 M 30 X7R F TT	2222 731 23154	5.08
CW 30 C 184 K DRM	K 184 K 30 X7R F TT	2222 731 22184	5.08
CW 30 C 184 M DRM	K 184 M 30 X7R F TT	2222 731 23184	5.08
CW 30 C 224 K DRM	K 224 K 30 X7R F TT	2222 731 22224	5.08
CW 30 C 224 M DRM	K 224 M 30 X7R F TT	2222 731 23224	5.08
CW 30 C 274 K DRM	K 274 K 30 X7R F TT	2222 731 22274	5.08
CW 30 C 274 M DRM	K 274 M 30 X7R F TT	2222 731 23274	5.08
CW 30 C 334 K DRM	K 334 K 30 X7R F TT	2222 731 22334	5.08
CW 30 C 334 M DRM	K 334 M 30 X7R F TT	2222 731 23334	5.08
CW 30 C 394 K DRM	K 394 K 30 X7R F TT	2222 731 22394	5.08
CW 30 C 474 K DRM	K 474 K 30 X7R F TT	2222 731 22474	5.08
CW 30 C 474 M DRM	K 474 M 30 X7R F TT	2222 731 23474	5.08

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	РІТСН
CW 40 C 564 M DRM	K 564 M 40 X7R F TT	2222 731 23561	5.08
CW 40 C 684 K DRM	K 684 K 40 X7R F TT	2222 731 22684	5.08
CW 40 C 824 M DRM	K 824 M 40 X7R F TT	2222 731 23824	5.08
CW 40 C 105 K DRM	K 105 K 40 X7R F TT	2222 731 22105	5.08
CW 40 C 105 M DRM	K 105 M 40 X7R F TT	2222 731 23105	5.08

Note

1. Only the first 13 digits of the 15 digit code are significant for cross reference purposes.

Table 4 Mono-kap™ conformal radials X7R, 10% and 20% tolerance, 100 V

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	PITCH
CW 15 A 151 K	K 151 K 15 X7R H VA	2222 731 34151	2.54
CW 15 A 151 M	K 151 M 15 X7R H VA	2222 731 35151	2.54
CW 15 A 181 K	K 181 K 15 X7R H VA	2222 731 34181	2.54
CW 15 A 221 K	K 221 K 15 X7R H VA	2222 731 34221	2.54
CW 15 A 221 M	K 221 M 15 X7R H VA	2222 731 35221	2.54
CW 15 A 271 K	K 271 K 15 X7R H VA	2222 731 34271	2.54
CW 15 A 331 K	K 331 K 15 X7R H VA	2222 731 34331	2.54
CW 15 A 331 M	K 331 M 15 X7R H VA	2222 731 35331	2.54
CW 15 A 391 K	K 391 K 15 X7R H VA	2222 731 34391	2.54
CW 15 A 391 M	K 391 M 15 X7R H VA	2222 731 35391	2.54
CW 15 A 471 K	K 471 K 15 X7R H VA	2222 731 34471	2.54
CW 15 A 471 M	K 471 M 15 X7R H VA	2222 731 35471	2.54
CW 15 A 561 K	K 561 K 15 X7R H VA	2222 731 34561	2.54
CW 15 A 561 M	K 561 M 15 X7R H VA	2222 731 35561	2.54
CW 15 A 681 K	K 681 K 15 X7R H VA	2222 731 34681	2.54
CW 15 A 821 K	K 821 K 15 X7R H VA	2222 731 34821	2.54
CW 15 A 102 K	K 102 K 15 X7R H VA	2222 731 34102	2.54
CW 15 A 102 M	K 102 M 15 X7R H VA	2222 731 35102	2.54
CW 15 A 122 K	K 122 K 15 X7R H VA	2222 731 34122	2.54
CW 15 A 122 M	K 122 M 15 X7R H VA	2222 731 35122	2.54
CW 15 A 152 K	K 152 K 15 X7R H VA	2222 731 34152	2.54
CW 15 A 182 K	K 182 K 15 X7R H VA	2222 731 34182	2.54
CW 15 A 222 K	K 222 K 15 X7R H VA	2222 731 34222	2.54
CW 15 A 222 M	K 222 M 15 X7R H VA	2222 731 35222	2.54
CW 15 A 272 K	K 272 K 15 X7R H VA	2222 731 34272	2.54
CW 15 A 332 K	K 332 K 15 X7R H VA	2222 731 34332	2.54
CW 15 A 332 M	K 332 M 15 X7R H VA	2222 731 35332	2.54

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	РІТСН
CW 15 A 392 K	K 392 K 15 X7R H VA	2222 731 34392	2.54
CW 15 A 472 K	K 472 K 15 X7R H VA	2222 731 34472	2.54
CW 15 A 472 M	K 472 M 15 X7R H VA	2222 731 35472	2.54
CW 15 A 562 K	K 562 K 15 X7R H VA	2222 731 34562	2.54
CW 15 A 682 K	K 682 K 15 X7R H VA	2222 731 34682	2.54
CW 15 A 682 M	K 682 M 15 X7R H VA	2222 731 35682	2.54
CW 15 A 822 K	K 822 K 15 X7R H VA	2222 731 34822	2.54
CW 15 A 103 K	K 103 K 15 X7R H VA	2222 731 34103	2.54
CW 15 A 103 M	K 103 M 15 X7R H VA	2222 731 35103	2.54
CW 15 A 123 K	K 123 K 15 X7R H VA	2222 731 34123	2.54
CW 20 A 153 K	K 153 K 15 X7R H VB	2222 731 38153	2.54
CW 20 A 153 M	K 153 M 15 X7R H VB	2222 731 39153	2.54
CW 20 A 183 K	K 183 K 20 X7R H VB	2222 731 38183	2.54
CW 20 A 223 K	K 223 K 20 X7R H VB	2222 731 38223	2.54
CW 20 A 223 M	K 223 M 20 X7R H VB	2222 731 39223	2.54
CW 20 A 273 K	K 273 K 20 X7R H VB	2222 731 38273	2.54
CW 20 A 273 M	K 273 M 20 X7R H VB	2222 731 39273	2.54
CW 20 A 333 K	K 333 K 20 X7R H VB	2222 731 38333	2.54
CW 20 A 333 M	K 333 M 20 X7R H VB	2222 731 39333	2.54
CW 20 A 393 M	K 393 M 20 X7R H VB	2222 731 39393	2.54
CW 20 A 473 K	K 473 K 20 X7R H VB	2222 731 38473	2.54
CW 20 A 473 M	K 473 M 20 X7R H VB	2222 731 39473	2.54
CW 20 A 563 K	K 563 K 20 X7R H VB	2222 731 38563	2.54
CW 20 A 683 K	K 683 K 20 X7R H VB	2222 731 38683	2.54
CW 20 A 683 M	K 683 M 20 X7R H VB	2222 731 39683	2.54
CW 20 A 823 M	K 823 M 20 X7R H VB	2222 731 39823	2.54
CW 20 A 104 K	K 104 K 20 X7R H VB	2222 731 38104	2.54
CW 20 A 104 M	K 104 M 20 X7R H VB	2222 731 39104	2.54
CW 30 A 124 K	K 124 K 30 X7R H VC	2222 731 50124	5.08
CW 30 A 124 M	K 124 M 30 X7R H VC	2222 731 51124	5.08
CW 30 A 224 K	K 224 K 30 X7R H VC	2222 731 50224	5.08
CW 30 A 224 M	K 224 M 30 X7R H VC	2222 731 51224	5.08
CW 30 A 334 K	K 334 K 30 X7R H VC	2222 731 50334	5.08
CW 15 A 151 K DRM	K 151 K 15 X7R H TT	2222 731 54151	5.08
CW 15 A 151 M DRM	K 151 M 15 X7R H TT	2222 731 55151	5.08
CW 15 A 181 K DRM	K 181 K 15 X7R H TT	2222 731 54181	5.08
CW 15 A 221 K DRM	K 221 K 15 X7R H TT	2222 731 54221	5.08
CW 15 A 221 M DRM	K 221 M 15 X7R H TT	2222 731 55221	5.08
CW 15 A 271 K DRM	K 271 K 15 X7R H TT	2222 731 54271	5.08

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	PITCH
CW 15 A 331 K DRM	K 331 K 15 X7R H TT	2222 731 54331	5.08
CW 15 A 331 M DRM	K 331 M 15 X7R H TT	2222 731 55331	5.08
CW 15 A 391 K DRM	K 391 K 15 X7R H TT	2222 731 54391	5.08
CW 15 A 391 M DRM	K 391 M 15 X7R H TT	2222 731 55391	5.08
CW 15 A 471 K DRM	K 471 K 15 X7R H TT	2222 731 54471	5.08
CW 15 A 471 M DRM	K 471 M 15 X7R H TT	2222 731 55471	5.08
CW 15 A 561 K DRM	K 561 K 15 X7R H TT	2222 731 54561	5.08
CW 15 A 561 M DRM	K 561 M 15 X7R H TT	2222 731 55561	5.08
CW 15 A 681 K DRM	K 681 K 15 X7R H TT	2222 731 54681	5.08
CW 15 A 821 K DRM	K 821 K 15 X7R H TT	2222 731 54821	5.08
CW 15 A 102 K DRM	K 102 K 15 X7R H TT	2222 731 54102	5.08
CW 15 A 102 M DRM	K 102 M 15 X7R H TT	2222 731 55102	5.08
CW 15 A 122 K DRM	K 122 K 15 X7R H TT	2222 731 54122	5.08
CW 15 A 122 M DRM	K 122 M 15 X7R H TT	2222 731 55122	5.08
CW 15 A 152 K DRM	K 152 K 15 X7R H TT	2222 731 54152	5.08
CW 15 A 182 K DRM	K 182 K 15 X7R H TT	2222 731 54182	5.08
CW 15 A 222 K DRM	K 222 K 15 X7R H TT	2222 731 54222	5.08
CW 15 A 222 M DRM	K 222 M 15 X7R H TT	2222 731 55222	5.08
CW 15 A 272 K DRM	K 272 K 15 X7R H TT	2222 731 54272	5.08
CW 15 A 332 K DRM	K 332 K 15 X7R H TT	2222 731 54332	5.08
CW 15 A 332 M DRM	K 332 M 15 X7R H TT	2222 731 55332	5.08
CW 15 A 392 K DRM	K 392 K 15 X7R H TT	2222 731 54392	5.08
CW 15 A 472 K DRM	K 472 K 15 X7R H TT	2222 731 54472	5.08
CW 15 A 472 M DRM	K 472 M 15 X7R H TT	2222 731 55472	5.08
CW 15 A 562 K DRM	K 562 K 15 X7R H TT	2222 731 54562	5.08
CW 15 A 682 K DRM	K 682 K 15 X7R H TT	2222 731 54682	5.08
CW 15 A 682 M DRM	K 682 M 15 X7R H TT	2222 731 55682	5.08
CW 15 A 822 K DRM	K 822 K 15 X7R H TT	2222 731 54822	5.08
CW 15 A 103 K DRM	K 103 K 15 X7R H TT	2222 731 54103	5.08
CW 15 A 103 M DRM	K 103 M 15 X7R H TT	2222 731 55103	5.08
CW 15 A 123 K DRM	K 123 K 15 X7R H TT	2222 731 54123	5.08
CW 20 A 153 K DRM	K 153 K 15 X7R H TT	2222 731 54153	5.08
CW 20 A 153 M DRM	K 153 M 15 X7R H TT	2222 731 55153	5.08
CW 20 A 183 K DRM	K 183 K 20 X7R H TT	2222 731 54183	5.08
CW 20 A 223 K DRM	K 223 K 20 X7R H TT	2222 731 54223	5.08
CW 20 A 223 M DRM	K 223 M 20 X7R H TT	2222 731 55223	5.08
CW 20 A 273 K DRM	K 273 K 20 X7R H TT	2222 731 54273	5.08
CW 20 A 273 M DRM	K 273 M 20 X7R H TT	2222 731 55273	5.08

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	PITCH
CW 20 A 333 K DRM	K 333 K 20 X7R H TT	2222 731 54333	5.08
CW 20 A 333 M DRM	K 333 M 20 X7R H TT	2222 731 55333	5.08
CW 20 A 393 M DRM	K 393 M 20 X7R H TT	2222 731 55393	5.08
CW 20 A 473 K DRM	K 473 K 20 X7R H TT	2222 731 54473	5.08
CW 20 A 473 M DRM	K 473 M 20 X7R H TT	2222 731 55473	5.08
CW 20 A 563 K DRM	K 563 K 20 X7R H TT	2222 731 54563	5.08
CW 20 A 683 K DRM	K 683 K 20 X7R H TT	2222 731 54683	5.08
CW 20 A 683 M DRM	K 683 M 20 X7R H TT	2222 731 55683	5.08
CW 20 A 823 M DRM	K 823 M 20 X7R H TT	2222 731 55823	5.08
CW 20 A 104 K DRM	K 104 K 20 X7R H TT	2222 731 54104	5.08
CW 20 A 104 M DRM	K 104 M 20 X7R H TT	2222 731 55104	5.08
CW 30 A 124 K DRM	K 124 K 30 X7R H TT	2222 731 54124	5.08
CW 30 A 124 M DRM	K 124 M 30 X7R H TT	2222 731 55124	5.08
CW 30 A 224 K DRM	K 224 K 30 X7R H TT	2222 731 54224	5.08
CW 30 A 224 M DRM	K 224 M 30 X7R H TT	2222 731 55224	5.08
CW 30 A 334 K DRM	K 334 K 30 X7R H TT	2222 731 54334	5.08

Note

1. Only the first 13 digits of the 15 digit code are significant for cross reference purposes.

Table 5 Mono-kap™ conformal radials Z5U, ±20%; -20%/+80% tolerance, 50 V

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	PITCH
CZ 15 C 102 M	K 102 M 15 Z5U F VA	2222 733 03102	2.54
CZ 15 C 152 M	K 152 M 15 Z5U F VA	2222 733 03152	2.54
CZ 15 C 182 Z	K 182 Z 15 Z5U F VA	2222 733 04182	2.54
CZ 15 C 222 M	K 222 M 15 Z5U F VA	2222 733 03222	2.54
CZ 15 C 332 Z	K 332 Z 15 Z5U F VA	2222 733 04332	2.54
CZ 15 C 392 M	K 392 M 15 Z5U F VA	2222 733 03392	2.54
CZ 15 C 472 Z	K 472 Z 15 Z5U F VA	2222 733 04472	2.54
CZ 15 C 682 M	K 682 M 15 Z5U F VA	2222 733 03682	2.54
CZ 15 C 682 Z	K 682 Z 15 Z5U F VA	2222 733 04682	2.54
CZ 15 C 822 M	K 822 M 15 Z5U F VA	2222 733 03822	2.54
CZ 15 C 103 M	K 103 M 15 Z5U F VA	2222 733 03103	2.54
CZ 15 C 103 Z	K 103 Z 15 Z5U F VA	2222 733 04103	2.54
CZ 15 C 123 M	K 123 M 15 Z5U F VA	2222 733 03123	2.54
CZ 15 C 123 Z	K 123 Z 15 Z5U F VA	2222 733 04123	2.54
CZ 15 C 183 M	K 183 M 15 Z5U F VA	2222 733 03183	2.54

Table 5 Mono-kap™ conformal radials Z5U, ±20%; -20%/+80% tolerance, 50 V

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	PITCH
CZ 15 C 223 M	K 223 M 15 Z5U F VA	2222 733 03223	2.54
CZ 15 C 223 Z	K 223 Z 15 Z5U F VA	2222 733 04223	2.54
CZ 15 C 273 M	K 273 M 15 Z5U F VA	2222 733 03273	2.54
CZ 15 C 333 M	K 333 M 15 Z5U F VA	2222 733 03333	2.54
CZ 15 C 333 Z	K 333 Z 15 Z5U F VA	2222 733 04333	2.54
CZ 20 C 473 M	K 473 M 15 Z5U F VB	2222 733 07473	2.54
CZ 20 C 473 Z	K 473 Z 15 Z5U F VB	2222 733 08473	2.54
CZ 20 C 683 M	K 683 M 15 Z5U F VB	2222 733 07683	2.54
CZ 20 C 683 Z	K 683 Z 15 Z5U F VB	2222 733 08683	2.54
CZ 20 C 104 M	K 104 M 20 Z5U F VB	2222 733 07104	2.54
CZ 20 C 104 Z	K 104 Z 20 Z5U F VB	2222 733 08104	2.54
CZ 20 C 124 M	K 124 M 20 Z5U F VB	2222 733 07124	2.54
CZ 20 C 154 M	K 154 M 20 Z5U F VB	2222 733 07154	2.54
CZ 20 C 154 Z	K 154 Z 20 Z5U F VB	2222 733 08154	2.54
CZ 20 C 184 M	K 184 M 20 Z5U F VB	2222 733 07184	2.54
CZ 20 C 224 M	K 224 M 20 Z5U F VB	2222 733 07224	2.54
CZ 20 C 224 Z	K 224 Z 20 Z5U F VB	2222 733 08224	2.54
CZ 20 C 334 M	K 334 M 20 Z5U F VB	2222 733 07334	2.54
CZ 30 C 474 M	K 474 M 30 Z5U F VC	2222 733 19474	5.08
CZ 30 C 474 Z	K 474 Z 30 Z5U F VC	2222 733 20474	5.08
CZ 30 C 684 M	K 684 M 30 Z5U F VC	2222 733 19684	5.08
CZ 30 C 824 M	K 824 M 30 Z5U F VC	2222 733 19824	5.08
CZ 30 C 105 M	K 105 M 30 Z5U F VC	2222 733 19105	5.08
CZ 30 C 105 Z	K 105 Z 30 Z5U F VC	2222 733 20105	5.08
CZ 40 C 155 M	K 155 M 30 Z5U F VC	2222 733 19155	5.08
CZ 40 C 185 M	K 185 M 40 Z5U F VC	2222 733 19185	5.08
CZ 40 C 225 M	K 225 M 40 Z5U F VC	2222 733 19225	5.08
CZ 40 C 225 Z	K 225 Z 40 Z5U F VC	2222 733 20225	5.08
CZ 15 C 102 M DRM	K 102 M 15 Z5U F TT	2222 733 23102	5.08
CZ 15 C 152 M DRM	K 152 M 15 Z5U F TT	2222 733 23152	5.08
CZ 15 C 182 Z DRM	K 182 Z 15 Z5U F TT	2222 733 24182	5.08
CZ 15 C 222 M DRM	K 222 M 15 Z5U F TT	2222 733 23222	5.08
CZ 15 C 332 Z DRM	K 332 Z 15 Z5U F TT	2222 733 24332	5.08
CZ 15 C 392 M DRM	K 392 M 15 Z5U F TT	2222 733 23392	5.08
CZ 15 C 472 Z DRM	K 472 Z 15 Z5U F TT	2222 733 24472	5.08
CZ 15 C 682 M DRM	K 682 M 15 Z5U F TT	2222 733 23682	5.08
CZ 15 C 682 Z DRM	K 682 Z 15 Z5U F TT	2222 733 24682	5.08
CZ 15 C 822 M DRM	K 822 M 15 Z5U F TT	2222 733 23822	5.08

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	PITCH
CZ 15 C 103 M DRM	K 103 M 15 Z5U F TT	2222 733 23103	5.08
CZ 15 C 103 Z DRM	K 103 Z 15 Z5U F TT	2222 733 24103	5.08
CZ 15 C 123 M DRM	K 123 M 15 Z5U F TT	2222 733 23123	5.08
CZ 15 C 123 Z DRM	K 123 Z 15 Z5U F TT	2222 733 24123	5.08
CZ 15 C 183 M DRM	K 183 M 15 Z5U F TT	2222 733 23183	5.08
CZ 15 C 223 M DRM	K 223 M 15 Z5U F TT	2222 733 23223	5.08
CZ 15 C 223 Z DRM	K 223 Z 15 Z5U F TT	2222 733 24223	5.08
CZ 15 C 273 M DRM	K 273 M 15 Z5U F TT	2222 733 23273	5.08
CZ 15 C 333 M DRM	K 333 M 15 Z5U F TT	2222 733 23333	5.08
CZ 15 C 333 Z DRM	K 333 Z 15 Z5U F TT	2222 733 24333	5.08
CZ 20 C 473 M DRM	K 473 M 15 Z5U F TT	2222 733 23473	5.08
CZ 20 C 473 Z DRM	K 473 Z 15 Z5U F TT	2222 733 24473	5.08
CZ 20 C 683 M DRM	K 683 M 15 Z5U F TT	2222 733 23683	5.08
CZ 20 C 683 Z DRM	K 683 Z 15 Z5U F TT	2222 733 24683	5.08
CZ 20 C 104 M DRM	K 104 M 20 Z5U F TT	2222 733 23104	5.08
CZ 20 C 104 Z DRM	K 104 Z 20 Z5U F TT	2222 733 24104	5.08
CZ 20 C 124 M DRM	K 124 M 20 Z5U F TT	2222 733 23124	5.08
CZ 20 C 154 M DRM	K 154 M 20 Z5U F TT	2222 733 23154	5.08
CZ 20 C 154 Z DRM	K 154 Z 20 Z5U F TT	2222 733 24154	5.08
CZ 20 C 184 M DRM	K 184 M 20 Z5U F TT	2222 733 23184	5.08
CZ 20 C 224 M DRM	K 224 M 20 Z5U F TT	2222 733 23224	5.08
CZ 20 C 224 Z DRM	K 224 Z 20 Z5U F TT	2222 733 24224	5.08
CZ 20 C 334 M DRM	K 334 M 20 Z5U F TT	2222 733 23334	5.08
CZ 30 C 474 M DRM	K 474 M 30 Z5U F TT	2222 733 23474	5.08
CZ 30 C 474 Z DRM	K 474 Z 30 Z5U F TT	2222 733 24474	5.08
CZ 30 C 684 M DRM	K 684 M 30 Z5U F TT	2222 733 23684	5.08
CZ 30 C 824 M DRM	K 824 M 30 Z5U F TT	2222 733 23824	5.08
CZ 30 C 105 M DRM	K 105 M 30 Z5U F TT	2222 733 23105	5.08
CZ 30 C 105 Z DRM	K 105 Z 30 Z5U F TT	2222 733 24105	5.08
CZ 40 C 155 M DRM	K 155 M 30 Z5U F TT	2222 733 23155	5.08
CZ 40 C 185 M DRM	K 185 M 40 Z5U F TT	2222 733 23185	5.08
CZ 40 C 225 M DRM	K 225 M 40 Z5U F TT	2222 733 23225	5.08
CZ 40 C 225 Z DRM	K 225 Z 40 Z5U F TT	2222 733 24225	5.08

Note

1. Only the first 13 digits of the 15 digit code are significant for cross reference purposes.

Table 6 Mono-kap™ conformal radials Z5U, ±20%; -20%/+80% tolerance, 100 V

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	РІТСН
CZ 15 A 102 M	K 102 M 15 Z5U H VA	2222 733 35102	2.54
CZ 15 A 102 Z	K 102 Z 15 Z5U H VA	2222 733 36102	2.54
CZ 15 A 222 M	K 222 M 15 Z5U H VA	2222 733 35222	2.54
CZ 15 A 332 Z	K 332 Z 15 Z5U H VA	2222 733 36332	2.54
CZ 15 A 392 M	K 392 M 15 Z5U H VA	2222 733 35392	2.54
CZ 15 A 472 M	K 472 M 15 Z5U H VA	2222 733 35472	2.54
CZ 15 A 472 Z	K 472 Z 15 Z5U H VA	2222 733 36472	2.54
CZ 15 A 822 M	K 822 M 15 Z5U H VA	2222 733 35822	2.54
CZ 15 A 103 M	K 103 M 15 Z5U H VA	2222 733 35103	2.54
CZ 15 A 103 Z	K 103 Z 15 Z5U H VA	2222 733 36103	2.54
CZ 15 A 123 M	K 123 M 15 Z5U H VA	2222 733 35123	2.54
CZ 20 A 223 M	K 223 M 20 Z5U H VB	2222 733 39223	2.54
CZ 20 A 223 Z	K 223 Z 20 Z5U H VB	2222 733 40223	2.54
CZ 20 A 333 M	K 333 M 20 Z5U H VB	2222 733 39333	2.54
CZ 20 A 393 M	K 393 M 20 Z5U H VB	2222 733 39393	2.54
CZ 20 A 473 M	K 473 M 20 Z5U H VB	2222 733 39473	2.54
CZ 20 A 683 M	K 683 M 20 Z5U H VB	2222 733 39683	2.54
CZ 20 A 104 M	K 104 M 20 Z5U H VB	2222 733 39104	2.54
CZ 20 A 104 Z	K 104 Z 20 Z5U H VB	2222 733 40104	2.54
CZ 20 A 124 M	K 124 M 20 Z5U H VB	2222 733 39124	2.54
CZ 20 A 154 M	K 154 M 20 Z5U H VB	2222 733 39154	2.54
CZ 30 A 224 M	K 224 M 30 Z5U H VC	2222 733 51224	5.08
CZ 30 A 334 M	K 334 M 30 Z5U H VC	2222 733 51334	5.08
CZ 30 A 474 M	K 474 M 30 Z5U H VC	2222 733 51474	5.08
CZ 30 A 474 Z	K 474 Z 30 Z5U H VC	2222 733 52474	5.08
CZ 40 A 105 M	K 105 M 30 Z5U H VC	2222 733 51105	5.08
CZ 15 A 102 M DRM	K 102 M 15 Z5U H TT	2222 733 55102	5.08
CZ 15 A 102 Z DRM	K 102 Z 15 Z5U H TT	2222 733 56102	5.08
CZ 15 A 222 M DRM	K 222 M 15 Z5U H TT	2222 733 55222	5.08
CZ 15 A 332 Z DRM	K 332 Z 15 Z5U H TT	2222 733 56332	5.08
CZ 15 A 392 M DRM	K 392 M 15 Z5U H TT	2222 733 55392	5.08
CZ 15 A 472 M DRM	K 472 M 15 Z5U H TT	2222 733 55472	5.08
CZ 15 A 472 Z DRM	K 472 Z 15 Z5U H TT	2222 733 56472	5.08
CZ 15 A 822 M DRM	K 822 M 15 Z5U H TT	2222 733 55822	5.08
CZ 15 A 103 M DRM	K 103 M 15 Z5U H TT	2222 733 55103	5.08
CZ 15 A 103 Z DRM	K 103 Z 15 Z5U H TT	2222 733 56103	5.08
CZ 15 A 123 M DRM	K 123 M 15 Z5U H TT	2222 733 55123	5.08

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE	PITCH
CZ 20 A 223 M DRM	K 223 M 20 Z5U H TT	2222 733 55223	5.08
CZ 20 A 223 Z DRM	K 223 Z 20 Z5U H TT	2222 733 56223	5.08
CZ 20 A 333 M DRM	K 333 M 20 Z5U H TT	2222 733 55333	5.08
CZ 20 A 393 M DRM	K 393 M 20 Z5U H TT	2222 733 55393	5.08
CZ 20 A 473 M DRM	K 473 M 20 Z5U H TT	2222 733 55473	5.08
CZ 20 A 683 M DRM	K 683 M 20 Z5U H TT	2222 733 55683	5.08
CZ 20 A 104 M DRM	K 104 M 20 Z5U H TT	2222 733 55104	5.08
CZ 20 A 104 Z DRM	K 104 Z 20 Z5U H TT	2222 733 56104	5.08
CZ 20 A 124 M DRM	K 124 M 20 Z5U H TT	2222 733 55124	5.08
CZ 20 A 154 M DRM	K 154 M 20 Z5U H TT	2222 733 55154	5.08
CZ 30 A 224 M DRM	K 224 M 30 Z5U H TT	2222 733 55224	5.08
CZ 30 A 334 M DRM	K 334 M 30 Z5U H TT	2222 733 55334	5.08
CZ 30 A 474 M DRM	K 474 M 30 Z5U H TT	2222 733 55474	5.08
CZ 30 A 474 Z DRM	K 474 Z 30 Z5U H TT	2222 733 56474	5.08
CZ 40 A 105 M DRM	K 105 M 30 Z5U H TT	2222 733 55105	5.08

Note

1. Only the first 13 digits of the 15 digit code are significant for cross reference purposes.

Table 7 Mono-axial™ conformal axials COG/NPO, 5% tolerance, 50 V

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE
A 40 C 101 J DRM	A 101 J 17 COG F VV	2222 740 09101
A 40 C 151 J DRM	A 151 J 17 COG F VV	2222 740 09151
A 40 C 181 J DRM	A 181 J 17 COG F VV	2222 740 09181
A 40 C 221 J DRM	A 221 J 17 COG F VV	2222 740 09221
A 40 C 331 J DRM	A 331 J 17 COG F VV	2222 740 09331
A 40 C 391 J DRM	A 391 J 17 COG F VV	2222 740 09391
A 40 C 471 J DRM	A 471 J 17 COG F VV	2222 740 09471
A 40 C 561 J DRM	A 561 J 17 COG F VV	2222 740 09561
A 40 C 681 J DRM	A 681 J 17 COG F VV	2222 740 09681
A 40 C 102 J DRM	A 102 J 17 COG F VV	2222 740 09102

Note

1. Only the first 13 digits of the 15 digit code are significant for cross reference purposes.

Table 8 Mono-axial™ conformal axials COG/NPO, 5% tolerance, 100 V

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE
A 40 A 100 J DRM	A 100 J 17 COG H VV	2222 740 41109
A 40 A 150 J DRM	A 150 J 17 COG H VV	2222 740 41159
A 40 A 180 J DRM	A 180 J 17 COG H VV	2222 740 41189
A 40 A 220 J DRM	A 220 J 17 COG H VV	2222 740 41229
A 40 A 270 J DRM	A 270 J 17 COG H VV	2222 740 41279
A 40 A 330 J DRM	A 330 J 17 COG H VV	2222 740 41339
A 40 A 470 J DRM	A 470 J 17 COG H VV	2222 740 41479
A 40 A 680 J DRM	A 680 J 17 COG H VV	2222 740 41689
A 40 A 820 J DRM	A 820 J 17 COG H VV	2222 740 41829

Note

1. Only the first 13 digits of the 15 digit code are significant for cross reference purposes.

Table 9 Mono-axial™ conformal axials X7R, 10% tolerance, 50 V

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE
A 41 C 332 K DRM	A 332 K 17 X7R F VV	2222 741 10332
A 41 C 472 K DRM	A 472 K 17 X7R F VV	2222 741 10472
A 41 C 103 K DRM	A 103 K 17 X7R F VV	2222 741 10103
A 41 C 153 K DRM	A 153 K 17 X7R F VV	2222 741 10153
A 41 C 223 K DRM	A 223 K 17 X7R F VV	2222 741 10223
A 41 C 333 K DRM	A 333 K 17 X7R F VV	2222 741 10333
A 41 C 473 K DRM	A 473 K 17 X7R F VV	2222 741 10473
A 41 C 563 K DRM	A 563 K 17 X7R F VV	2222 741 10563
A 41 C 104 K DRM	A 104 K 18 X7R F VV	2222 741 10104

Note

1. Only the first 13 digits of the 15 digit code are significant for cross reference purposes.

Table 10 Mono-axial™ conformal axials X7R, 10% tolerance, 100 V

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE
A 41 A 221 K DRM	A 221 K 17 X7R H VV	2222 741 42221
A 41 A 271 K DRM	A 271 K 17 X7R H VV	2222 741 42271
A 41 A 331 K DRM	A 331 K 17 X7R H VV	2222 741 42331
A 41 A 471 K DRM	A 471 K 17 X7R H VV	2222 741 42471
A 41 A 681 K DRM	A 681 K 17 X7R H VV	2222 741 42681
A 41 A 821 K DRM	A 821 K 17 X7R H VV	2222 741 42821
A 41 A 102 K DRM	A 102 K 17 X7R H VV	2222 741 42102
A 41 A 122 K DRM	A 122 K 17 X7R H VV	2222 741 42122
A 41 A 152 K DRM	A 152 K 17 X7R H VV	2222 741 42152
A 41 A 222 K DRM	A 222 K 17 X7R H VV	2222 741 42222

Note

1. Only the first 13 digits of the 15 digit code are significant for cross reference purposes.

Table 11 Mono-axial* conformal axials Z5U, M and Z tolerance codes, 50 V

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE
A 43 C 103 M DRM	A 103 M 17 Z5U F VV	2222 742 11103
A 43 C 103 Z DRM	A 103 Z 17 Z5U F VV	2222 742 12103
A 43 C 223 M DRM	A 223 M 17 Z5U F VV	2222 742 11223
A 43 C 333 M DRM	A 333 M 17 Z5U F VV	2222 742 11333
A 43 C 473 M DRM	A 473 M 17 Z5U F VV	2222 742 11473
A 43 C 473 Z DRM	A 473 Z 17 Z5U F VV	2222 742 12473
A 43 C 104 M DRM	A 104 M 17 Z5U F VV	2222 742 11104
A 43 C 104 Z DRM	A 104 Z 17 Z5U F VV	2222 742 12104
A 43 C 224 M DRM	A 224 M 26 Z5U F VV	2222 742 11224
A 43 C 224 Z DRM	A 224 Z 26 Z5U F VV	2222 742 12224
A 43 C 274 Z DRM	A 274 Z 26 Z5U F VV	2222 742 12274
A 43 C 334 M DRM	A 334 M 29 Z5U F VV	2222 742 11334
A 43 C 334 Z DRM	A 334 Z 29 Z5U F VV	2222 742 12334
A 43 C 474 Z DRM	A 474 Z 40 Z5U F VV	2222 742 12474
A 43 C 564 M DRM	A 564 M 40 Z5U F VV	2222 742 11564

Note

1. Only the first 13 digits of the 15 digit code are significant for cross reference purposes.

Table 12 Mono-pak™ molded dip COG/NPO, 5% and 10% tolerance, 50 V

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE
CN 80 C 100 K	P 100 K 26 COG F VP	2222 734 10109
CN 80 C 220 K	P 220 K 26 COG F VP	2222 734 10229
CN 80 C 330 K	P 330 K 26 COG F VP	2222 734 10339
CN 80 C 470 K	P 470 K 26 COG F VP	2222 734 10479
CN 80 C 560 K	P 560 K 26 COG F VP	2222 734 10569
CN 80 C 680 K	P 680 K 26 COG F VP	2222 734 10689
CN 80 C 820 K	P 820 K 26 COG F VP	2222 734 10829
CN 80 C 101 K	P 101 K 26 COG F VP	2222 734 10101
CN 80 C 151 K	P 151 K 26 COG F VP	2222 734 10151
CN 80 C 221 J	P 221 J 26 COG F VP	2222 734 09221
CN 80 C 221 K	P 221 K 26 COG F VP	2222 734 10221
CN 80 C 331 K	P 331 K 26 COG F VP	2222 734 10331
CN 80 C 471 K	P 471 K 26 COG F VP	2222 734 10471
CN 80 C 102 J	P 102 J 26 COG F VP	2222 734 09102
CN 80 C 102 K	P 102 K 26 COG F VP	2222 734 10102
CN 80 C 222 K	P 222 K 26 COG F VP	2222 734 10222

Note

1. Only the first 13 digits of the 15 digit code are significant for cross reference purposes.

Table 13 Mono-pak™ molded dip X7R, 10% and 20% tolerance, 50 V

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE
CW 80 C 332 K	P 332 K 26 X7R F VP	2222 735 10332
CW 80 C 472 K	P 472 K 26 X7R F VP	2222 735 10472
CW 80 C 103 K	P 103 K 26 X7R F VP	2222 735 10103
CW 80 C 103 M	P 103 M 26 X7R F VP	2222 735 11103
CW 80 C 223 K	P 223 K 26 X7R F VP	2222 735 10223
CW 80 C 223 M	P 223 M 26 X7R F VP	2222 735 11223
CW 80 C 473 K	P 473 K 26 X7R F VP	2222 735 10473
CW 80 C 473 M	P 473 M 26 X7R F VP	2222 735 11473
CW 80 C 104 K	P 104 K 26 X7R F VP	2222 735 10104
CW 80 C 104 M	P 104 M 26 X7R F VP	2222 735 11104
CW 80 C 224 K	P 224 K 26 X7R F VP	2222 735 10224
CW 80 C 224 M	P 224 M 26 X7R F VP	2222 735 11224

Note

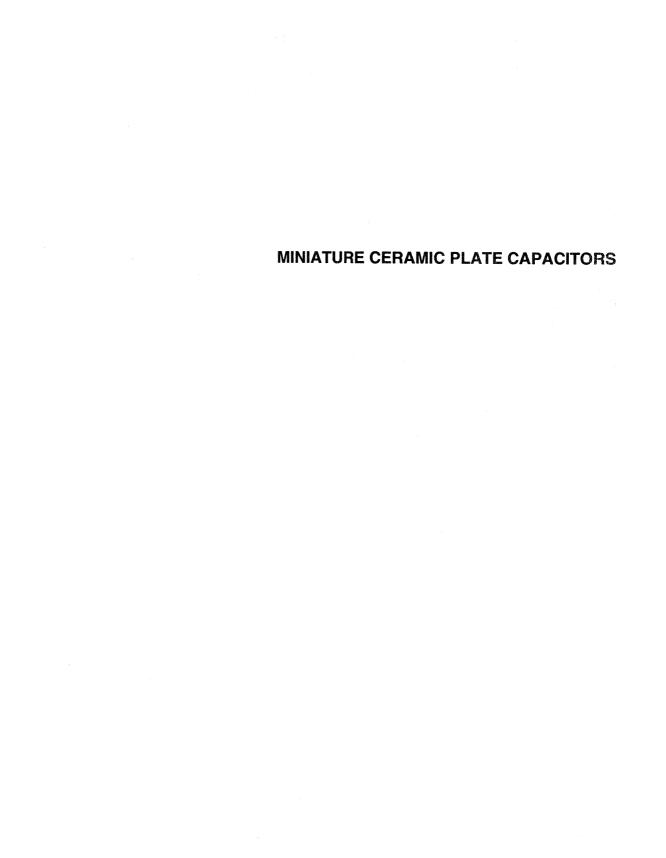
1. Only the first 13 digits of the 15 digit code are significant for cross reference purposes.

Table 14 Mono-pak™ molded dip Z5U, M and Z tolerance codes, 50 V

DISTRIBUTION PART NUMBER	15 DIGIT CODE (note 1)	12NC CODE
CZ 80 C 103 M	P 103 M 26 Z5U F VP	2222 736 11103
CZ 80 C 103 Z	P 103 Z 26 Z5U F VP	2222 736 12103
CZ 80 C 223 M	P 223 M 26 Z5U F VP	2222 736 11223
CZ 80 C 223 Z	P 223 Z 26 Z5U F VP	2222 736 12223
CZ 80 C 473 M	P 473 M 26 Z5U F VP	2222 736 11473
CZ 80 C 473 Z	P 473 Z 26 Z5U F VP	2222 736 12473
CZ 80 C 104 M	P 104 M 26 Z5U F VP	2222 736 11104
CZ 80 C 104 Z	P 104 Z 26 Z5U F VP	2222 736 12104
CZ 80 C 224 M	P 224 M 26 Z5U F VP	2222 736 11224
CZ 80 C 224 Z	P 224 Z 26 Z5U F VP	2222 736 12224
CZ 80 C 334 Z	P 334 Z 26 Z5U F VP	2222 736 12334

Note

^{1.} Only the first 13 digits of the 15 digit code are significant for cross reference purposes.



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General data

CURRENT AND MAINTENANCE TYPES

Current ceramic plate capacitors have leads provided with a flange. They are available in a wide variety of executions. The flange ensures excellent solderability and component height definition on the printed-circuit boards. These capacitors are suitable for both hand mounting and automatic insertion.

Ceramic plate capacitors **without flanged leads** are not for design-in. They are for maintenance purposes only. They are not available on tape.

The electrical properties of capacitors with flanged leads are the same as the electrical properties of capacitors with straight leads.

COMPOSITION, COLOUR CODING AND MARKING

Table 1 shows the composition of the materials used in ceramic plate capacitors. Colour coding indicating the temperature coefficient or temperature dependence is given.

The capacitance is marked on the body of the plate capacitors in a three digit code: two numbers corresponding with the numerical capacitance value and one letter indicating the multiplier and the decimal point. For example: 1pO = 1.0 pF, 22n = 22 nF.

Table 1 Composition of the materials

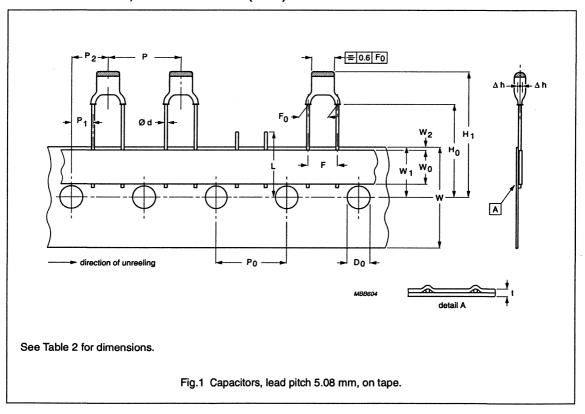
CLASS		COLOUR	COLOUR CODE	
Class 1: $\epsilon_r = 6$ up to 250; T.	C. types			
P100 (+100 × 10 ⁻⁶ /K)	MgTiO ₃ , Mg₂SiO₄	red-violet	T. C. value	grey
NPO (0×10-6/K)	MgTiO ₃	black		
N075 (-75×10 ⁻⁶ /K)	BaNd ₂ (Bi ₂)Ti ₅ O _x + TiO ₂	red		
N150 (-150 × 10 ⁻⁶ /K)	BaNd ₂ (Bi ₂)Ti ₅ O _× + TiO ₂	orange		
N220 (-220 × 10 ⁻⁶ /K)	BaNd ₂ (Bi ₂)Ti ₅ O _x + TiO ₂	yellow		
N330 (-330 × 10 ⁻⁶ /K)	BaNd ₂ (Bi ₂)Ti ₅ O _× + TiO ₂	green		
N470 (-470 × 10 ⁻⁶ /K)	BaNd ₂ (Bi ₂)Ti ₅ O _× + TiO ₂	blue		
N750 (-750 × 10-6/K)	TiO ₂ + additions	violet	\$.	
N1 500 (-1 500 × 10 ⁻⁶ /K)	CaTiO ₃ + additions	orange/orange		
Class 2: ε, >250; high-K typ	es			
$\varepsilon_r = 2000$	Ba(Bi)TiO ₃	yellow	K-value	tan
$\varepsilon_{\rm r} = 5000$	(Ba, Ca) (Ti, Zr) O ₃ + add.	blue		
$\varepsilon_{\rm r} = 14~000$	(Ba, Ca) (Ti, Zr) O ₃ + add.	green		

PACKING

The miniature ceramic plate capacitors are supplied in bulk packing (cardboard boxes), in tape on reels or in ammunition packing. The number of capacitors per box, per reel and per ammunition pack are listed below.

SIZE		NUMBER OF CAPACITORS		
SIZE	вох	REEL	AMMUNITION PACKING	
I, IIA, IIB	1 000	4 000	4 000	
III, IV, V (with wire length ≤6 mm)	1 000	-	ayan tarah da kabana	
III, IV, V (with wire length >6 mm)	500	4 000	4 000	
III (500 V with wire length >6 mm)	500	4 000	4 000	
IV, V (500 V with wire length >6 mm)	500	4 000	2 000	
I, IIA, IIB, III, IV, V (1 000 V with wire length >6 mm)	500	2 000	2 000	
I, IIA, IIB, III, IV (1 000 V with wire length ≤6 mm)	1 000	-	-	
V (1 000 V with wire length ≤6 mm)	500	-	_	

CAPACITORS ON TAPE, LEAD PITCH 5.08 mm (0.2 in.)



General data

Table 2

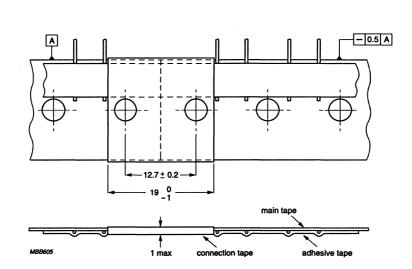
SYMBOL	PARAMETER	DIMENSIONS (mm)		
		NOMINAL	TOLERANCE	
d	lead diameter	0.6	+0.06 -0.05	
Р	pitch between capacitors	12.7	±1.0	
Po	feed-hole pitch	12.7	±0.2 (note 1)	
P ₁	feed-hole centre to lead centre	3.85	±0.5 (note 2)	
P ₂	feed-hole centre to component centre	6.35	±1.0 (note 2)	
F	lead-to-lead distance	5.0	+0.6 -0.2	
F _o		5.08	+0.5 -0.1	
Δh	component alignment	0	±1.0	
W	tape width	18.0	±0.5	
W _o	hold-down tape width	6.0	±0.5	
W ₁	hole position	9.0	±0.5	
W ₂	hold-down tape position	0	+2	
H _o	flange to tape centre	18.25 (16.0) (note 3)	±0.5	
H₁	component height	31 (28.75) (note 4)	max.	
		22 (18.75) (note 4)	min.	
L	length of snipped lead	11	max.	
D _o	feed-hole diameter	4.0	±0.2	
t	total tape thickness	0.65	±0.2	

Notes

- 1. Cumulative pitch error: ±≤1 mm/20 pitches.
- 2. Obliquity maximum 3°.
- 3. $H_0 = 16$ mm also available.
- 4. Values between brackets are referred to component height when $H_{\rm 0}$ = 16 mm.

General data

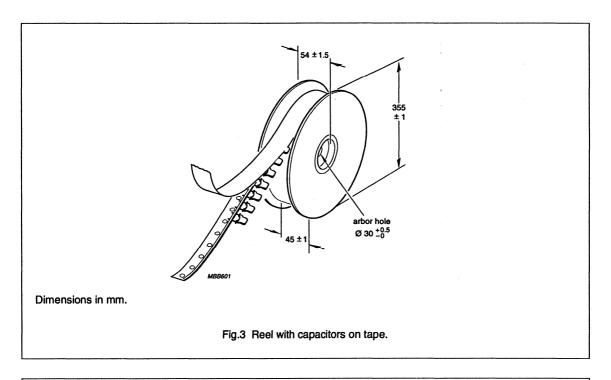
PARAMETER	MIN.	MAX.
Extraction force for component in the tape plane, vertically to direction of unreeling	5 N	-
Break force of tape	15 N	-
Pull-off force main tape - reel		2.5 N

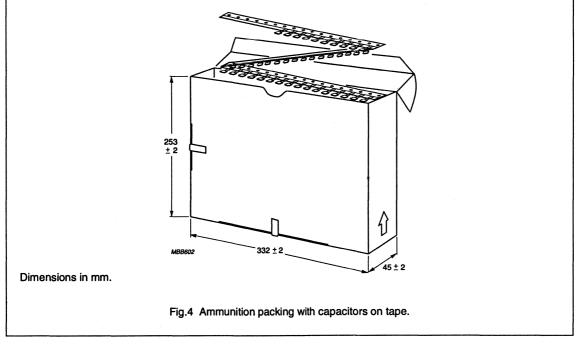


Dimensions in mm.

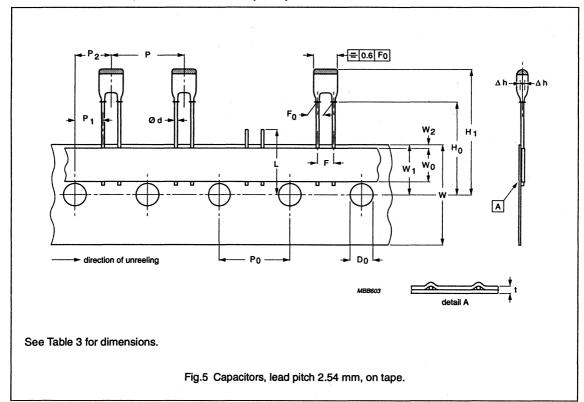
Maximum 0.5% of the total number of capacitors per reel may be missing. A maximum of 3 consecutive vacant positions is followed by at least 6 consecutive components. The tape begins and ends with 5 empty positions.

Fig.2 Connection of tapes, lead pitch 5.08 mm.





CAPACITORS ON TAPE, LEAD PITCH 2.54 mm (0.1 in.)



General data

Table 3

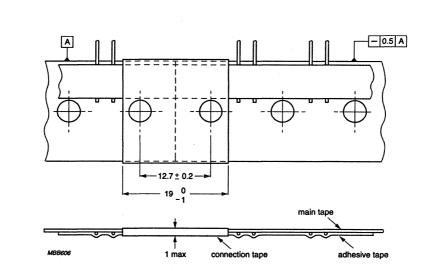
SYMBOL	PARAMETER	DIMENSIONS (mm)	
		NOMINAL	TOLERANCE
d	lead diameter	0.6	+0.06 -0.05
Р	pitch between capacitors	12.7	±1.0
P _o	feed-hole pitch	12.7	±0.2 (note 1)
P ₁	feed-hole centre to lead centre	5.1	±0.5 (note 2)
P ₂	feed-hole centre to component centre	6.35	±1.0 (note 2)
F	lead-to-lead distance	2.54	±0.3
F ₀	The second secon	2.54	±0.3
Δh	component alignment	0	±1.0
w	tape width	18.0	±0.5
W _o	hold-down tape width	6.0	±0.5
W ₁	hole position	9.0	±0.5
W ₂	hold-down tape position	0	+2
H _o	flange to tape centre	18.25 (16.0) (note 3)	0.5
H ₁	component height	30 (27.75) (note 4)	max.
		21 (18.75) (note 4)	min.
L	length of snipped lead	11	max.
D _o	feed-hole diameter	4.0	±0.2
t	total tape thickness	0.65	±0.2

Notes

- 1. Cumulative pitch error: ±≤1 mm/20 pitches.
- 2. Obliquity maximum 3°.
- 3. $H_0 = 16$ mm also available.
- 4. Values between brackets are referred to component height when H_0 = 16 mm.

General data

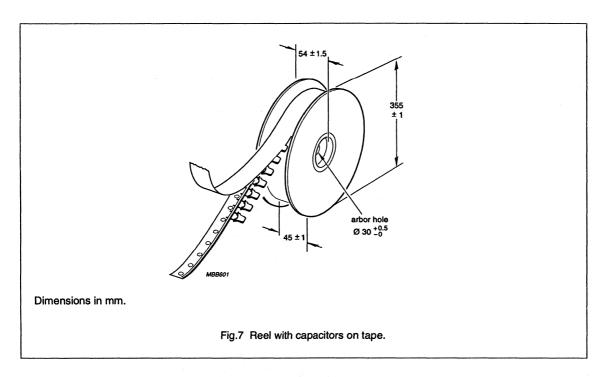
PARAMETER	MIN.	MAX.
Extraction force for component in the tape plane, vertically to direction of unreeling	5 N	-
Break force of tape	15 N	-
Pull-off force main tape - reel	_	2.5 N

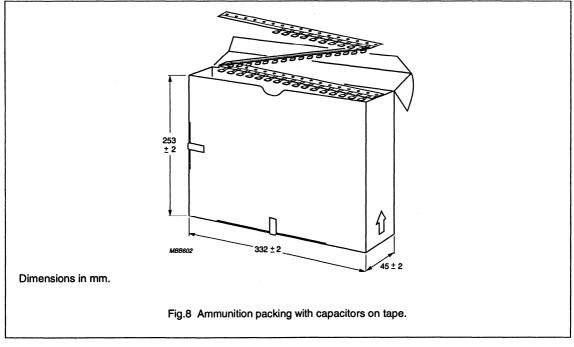


Dimensions in mm.

Maximum 0.5% of the total number of capacitors per reel may be missing. A maximum of 3 consecutive vacant positions is followed by at least 6 consecutive components. The tape begins and ends with 5 empty positions.

Fig.6 Connection of tapes, lead pitch 2.54 mm.





General data

TEST AND REQUIREMENTS

Class 1 capacitors

After manufacture, each capacitor is checked on capacitance, $\tan \delta$ and test voltage. Apart from this the following quality checks are carried out by frequent inspections.

Essentially all tests mentioned in the schedule of IEC publication 384-8, category 55/085/21 (temperature range -55/+85 °C; damp heat, long term, 21 days) are carried out along the lines of IEC publication 68.

IEC 384-8 CLAUSE	IEC 68-2 TEST METHOD	NAME OF TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
4.4		robustness of terminations		
		pull-off	pull velocity 15 cm/minute; load 5 N	no wire breakage
	Ua₁	tensile strength	axial force 10 N	no wire breakage
	Ub	bending	load 5 N; 4 × 90°	no wire breakage
4.6	Ta method 1	solderability (solder bath)	235 °C; 2 s	good tinning
4.5	Tb method 1A	resistance to soldering heat	260 °C; 10 s	no visible damage ΔC/C: ±≤0.5% or 0.5 pF after 1 to 2 hours
4.7	Na	rapid change of temperature	30 minutes -55 °C 30 minutes +85 °C; 5 cycles	no damage, after 24 hours ΔC/C: ±≤0.5% or 0.5 pF
4.8	Fc	vibration	10-55-10 Hz; 0.75 mm displacement; 3 directions; 6 hours	no visible damage
4.9	Eb	bump	4 000 bumps in 2 directions; 40 g; pulse time 6 ms	no visible damage
		inflammability	15 s; 35 mm above bunsen burner with flame-height 40-60 mm	self-extinguishing within 15 seconds after removal of bunsen burner
4.3		temperature coefficient	between +20 and -55 °C, and between +20 and +85 °C	within tolerance as specified for each particular material
4.11		climatic sequence		
4.11.2	В	dry heat	16 hours; +85 °C	no visible damage
4.11.3	Db	damp heat (accel.) 1st cycle	12 hours; +55 °C; 90 to 96% R.H. 12 hours; +25 °C; 95 to 100% R.H.	after recovery of 1-2 hours immediately followed by cold test
4.11.4	Α	cold	2 hours; -55 °C	no visible damage
4.11.5	М	low air pressure	1 hour; 8.5 kPa, last 2 minutes rated voltage	no breakdown or flashover

General data

IEC 384-8 CLAUSE	IEC 68-2 TEST METHOD	NAME OF TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
4.11.6	Db	damp heat (accel.) remaining cycle	12 hours; +55 °C; 90 to 96% R.H. 12 hours; +25 °C; 95 to 100% R.H.	Δ C/C: \pm 1% or 1 pF tan δ: \leq 2 × specified tan δ R _{ins} after 1-2 hours: >5 000 M Ω for 2222 650 to 654, 691, 692 >100 M Ω for other types
4.12	Ca	damp heat, steady state (half number of the lot at rated voltage, other half at zero voltage)	21 days; +40 °C; 90 to 95% R.H.	Δ C/C: \pm 1% or 1 pF tan δ: \leq 2 × specified tan δ R _{ins} after 1-2 hours: >5 000 M Ω for 2222 650 to 654, 691, 692 >100 M Ω for other types
4.13		endurance	1 000 hours at +85 °C; 2222 650 to 654, 691, 692:: 750 V (DC) other types: 150 V (DC)	Δ C/C: \pm <1% or 1 pF tan δ: \leq 1.5 × specified tan δ R _{ins} : >3 000 M Ω for 2222 650 to 654, 691, 692 >300 M Ω for other types
		resistance to solvents	3 minutes ultrasonic washing in trichloroethylene; 1 minute drying; 30 °C; 10 brush strokes	marking and colour code must remain legible and not be discoloured; no mechanical or electrical damage or deterioration of the material

Class 1 precision capacitors NPO

After manufacture, each capacitor is checked on capacitance, $\tan \delta$ and test voltage. Apart from this the following quality checks are carried out by frequent inspections.

Essentially all tests mentioned in the schedule of IEC publication 384-8, category 55/125/56 (temperature range -55/+125 °C; damp heat, long term, 56 days) are carried out along the lines of IEC publication 68.

IEC 384-8 CLAUSE IEC 68-2 TEST METHOD		NAME OF TEST	CONDITIONS	PERFORMANCE REQUIREMENTS	
4.4		robustness of terminations		-	
		pull-off	pull velocity 15 cm/minute; load 5 N	no wire breakage	
	Ua₁	tensile strength	axial force 10 N	no wire breakage	
	Ub	bending	load 5 N; 4 × 90°	no wire breakage	
4.6	Ta method 1	solderability (solder bath)	235 °C; 2 s	good tinning	
4.5	Tb method 1A	resistance to soldering heat	260 °C; 10 s	no visible damage ΔC/C: ±≤0.5% or 0.5 pF after 1 to 2 hours	
4.7	Na	rapid change of temperature	30 minutes -55 °C 30 minutes +125 °C; 5 cycles	no damage, after 24 hours ΔC/C: ±≤0.5% or 0.5 pF	
4.8	Fc	vibration	10-55-10 Hz; 0.75 mm displacement; 3 directions; 6 hours	no visible damage	
4.9	Eb	bump	4 000 bumps in 2 directions; 40 g; pulse time 6 ms	no visible damage	
		inflammability	15 s; 35 mm above bunsen burner with flame-height 40-60 mm	self-extinguishing within 15 seconds after removal of bunsen burner	
4.3		temperature coefficient	between +20 and -55 °C, and between +20 and +125 °C	within tolerance as specified	
4.11		climatic sequence			
4.11.2	В	dry heat	16 hours; +125 °C	no visible damage	
4.11.3	Db	damp heat (accel.) 1st cycle	12 hours; +55 °C; 90 to 96% R.H. 12 hours; +25 °C; 95 to 100% R.H.	after recovery of 1-2 hours immediately followed by cold test	
4.11.4	Α	cold	2 hours; -55 °C	no visible damage	
4.11.5	М	low air pressure	1 hour; 8.5 kPa, last 2 minutes rated voltage	no breakdown or flashover	

General data

IEC 384-8 CLAUSE	IEC 68-2 TEST METHOD	NAME OF TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
4.11.6	Db	damp heat (accel.) remaining cycles	12 hours; +55 °C; 90 to 96% R.H. 12 hours; +25 °C; 95 to 100% R.H.	ΔC/C: ±≤1% or 1 pF whichever is greater tan δ: ≤2 × specified tan δ R _{ins} after 1-2 hours: >1 000 MΩ
4.12	Ca	damp heat, steady state (half number of the lot at rated voltage, other half at zero voltage)	56 days; +40 °C; 90 to 95% R.H.	ΔC/C: ±≤1% or 1 pF whichever is greater tan δ: ≤2 × specified tan δ R _{ins} after 1-2 hours: >1 000 MΩ
4.13		endurance	1 000 hours at +125 °C; 150 V (DC)	Δ C/C: \pm ≤1% or 1 pF whichever is greater tan δ : ≤1.5 × specified tan δ R _{ins} : >3 000 M Ω
		resistance to solvents	3 minutes ultrasonic washing in trichloroethylene; 1 minute drying; 30 °C; 10 brush strokes	marking and colour code must remain legible and not be discoloured; no mechanical or electrical damage or deterioration of the material

General data

Class 2 capacitors

After manufacture, each capacitor is checked on capacitance, $\tan \delta$ and test voltage. Apart from this the following quality checks are carried out by frequent inspections.

Essentially all tests mentioned in the schedule of IEC publication 384-9, category 55/085/21 (temperature range --55/+85 °C; damp heat, long term, 21 days) are carried out along the lines of IEC publication 68.

IEC 384-9 CLAUSE	TEST		CONDITIONS	PERFORMANCE REQUIREMENTS
4.1		pre-conditioning	1 hour; +150 °C; reference measurement after 24 hours	
4.5		robustness of terminations		
		pull-off	pull velocity 15 cm/minute; load 5 N	no wire breakage
	Ua₁	tensile strength	axial force 10 N	no wire breakage
	Ub	bending	load 5 N; 4 × 90°	no wire breakage
4.7	Ta method 1	solderability (solder bath)	235 °C; 2 s	good tinning
4.6	Tb method 1A	resistance to soldering heat	Pre-conditioning: 260 °C; 10 s	no visible damage ΔC/C after 24 hours: 2222 630: ±≤10% 2222 629 and 640: ±≤20% 2222 655 and 693: ±10%
4.8	Na	rapid change of temperature	pre-conditioning: 2222 630/640/655 and 693: 30 minutes; -55 °C 30 minutes; +85 °C 2222 629: 30 minutes; -10 °C 30 minutes; +55 °C; 5 cycles	no damage ΔC/C after 24 hours: 2222 630/655 and 693: ±≤10% 2222 629 and 640: ±≤20%
4.9	Fb	vibration	10-55-10 Hz; 0.75 mm displacement; 3 directions; 6 hours	no visible damage

General data

METHOD	NAME OF TEST	CONDITIONS	PERFORMANCE REQUIREMENTS	
Eb	bump	4 000 bumps in 2 directions; 40 g; pulse time 6 ms	no visible damage	
	inflammability	15 s; 35 mm above bunsen burner with flame-height 40-60 mm	self-extinguishing within 15 s after removal of bunsen burner	
	resistance to solvents	3 minutes ultrasonic washing in trichloroethylene; 1 minute drying, 30 °C; 10 brush strokes	marking and colour code must remain legible and not be discoloured; no mechanical or electrical damage or deterioration of the material	
	climatic sequence			
	pre-conditioning	1 hour; +150 °C		
Ва	dry heat	16 hours at +85 °C and +55 °C respectively for 2222 630/640/655/693 and 629	no visible damage	
Db	damp heat (accel.) 1st cycle	12 hours; +55 °C; 90 to 96% R.H. 12 hours; +25 °C; 95 to 100% R.H.	no visible damage; after recovery of 1-2 hours immediately followed by cold test	
Aa	cold	2222 630/640/655 and 693: 2 hours; –55 °C; 2222 629: 2 hours; –10 °C	no visible damage	
М	low air pressure	1 hour at 8.5 kPa, last 2 minutes rated voltage	no breakdown or flashover	
Db	damp heat (accel.) remaining cycle	12 hours; +55 °C; 90 to 96% R.H. 12 hours; +25 °C; 95 to 100% R.H.	after 24 hours recovery: ΔC/C: 2222 630/655 and 693: ±≤10% 2222 629 and 640: ±≤20% tan δ: ≤7% R _{ins} : 2222 629/630 and 640: >100 MΩ 2222 655 and 693:	
	Db Aa M	resistance to solvents climatic sequence pre-conditioning Ba dry heat Db damp heat (accel.) 1st cycle Aa cold M low air pressure Db damp heat (accel.)	inflammability 15 s; 35 mm above bunsen burner with flame-height 40-60 mm resistance to solvents 3 minutes ultrasonic washing in trichloroethylene; 1 minute drying, 30 °C; 10 brush strokes climatic sequence pre-conditioning 1 hour; +150 °C 16 hours at +85 °C and +55 °C respectively for 2222 630/640/655/693 and 629 Db damp heat (accel.) 12 hours; +55 °C; 90 to 96% R.H. 12 hours; +25 °C; 95 to 100% R.H. Aa cold 2222 630/640/655 and 693: 2 hours; -55 °C; 2222 629: 2 hours; -10 °C M low air pressure 1 hour at 8.5 kPa, last 2 minutes rated voltage Db damp heat (accel.) 12 hours; +55 °C; 90 to 96% R.H. 12 hours; +25 °C;	

General data

IEC 384-9 CLAUSE	IEC 68-2 TEST METHOD	NAME OF TEST	CONDITIONS	PERFORMANCE REQUIREMENTS
4.13	Са	damp heat, steady state (half number of samples at rated voltage, other half of samples no voltage applied)	pre-conditioning 21 days; +40 °C; 90 to 95% R.H.	no visible damage; after 24 hours: $\Delta C/C$: 2222 630/655 and 693: $\pm \le 10\%$ 2222 629 and 640: $\pm \le 20\%$ tan $\delta \le \le 7\%$ R_{ins} : 2222 629/630 and 640: $\ge 100 \ M\Omega$ 2222 655 and 693: $\ge 1000 \ M\Omega$
4.14		endurance	pre-conditioning 1 000 hours (IEC) pre-conditioning: 2222 630 and 640: +85 °C; 150 V (DC) 2222 629: +55 °C; 100 V (DC) 2222 655: +85 °C; 750 V (DC) 2222 693: +85 °C; 1 500 V (DC)	after 24 hours: Δ C/C: 2222 630/655 and 693: $\pm \le 10\%$ 2222 629 and 640: $\pm \le 20\%$ tan δ: $\le 5\%$ (2222 629: $\le 6.5\%$) R_{ins} : 2222 629/630 and 640: >300 MΩ 2222 655 and 693: >1 000 MΩ
4.4		temperature characteristic	pre-conditioning minimum and maximum temperature	in accordance with specification

Precision capacitors NPO

FEATURES

- · High-frequency circuits
- · High reliability
- · High stability
- · Space saving.

APPLICATIONS

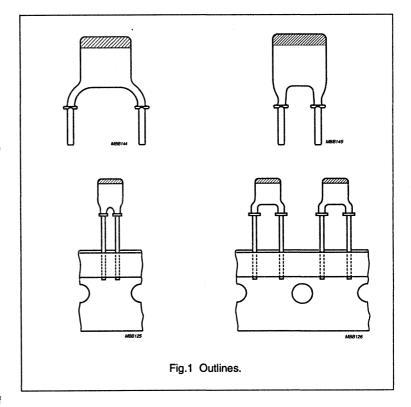
In a great variety of electronic circuits, e.g. in filters, tuning circuits and other professional applications where high stability, precision, reliability and low losses are a requirement. Because of their small size the capacitors are suitable for use in circuitry with high component density. The high reliability even in most demanding environmental conditions make the product suitable for automotive, telecommunications and other electronic circuits used at high temperatures.

DESCRIPTION

The capacitors consist of a thin rectangular ceramic plate, both sides of which are metallized, and tinned connecting leads are secured using a high melting point solder. The capacitors are encapsulated in epoxy lacquer, which is resistant to all commonly used cleaning solvents. They have small dimensions and narrow tolerances on the lead spacing. The leads are provided with a flange, which guarantees that the leads are free of lacquer, and its shape allows soldering gasses to escape freely. ensuring excellent solderability. This makes the capacitors suitable for both hand mounting and automatic insertion. The electrical properties are characterized by low losses, a very narrow tolerance on capacitance (±0.1 pF or 1%), high stability and, owing to the absence of silver, an extremely good DC behaviour.

QUICK REFERENCE DATA

Capacitance range	1 to 240 pF (E24 series)
Rated DC voltage	100 V
Tolerance on capacitance	C ≤ 10 pF: ±0.1 pF C > 10 pF: ±1%
Sectional specification	IEC 384-8
Climatic category (IEC 68)	55/125/56

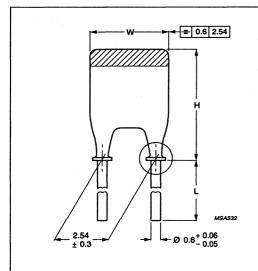


Philips Components Product specification

Miniature ceramic plate capacitors

Precision capacitors NPO

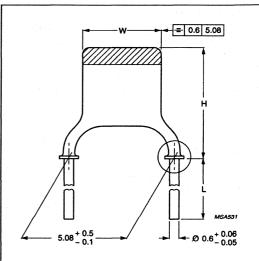
MECHANICAL DATA



Dimensions in mm.

For dimensions H, L and W see Tables 1 and 2.

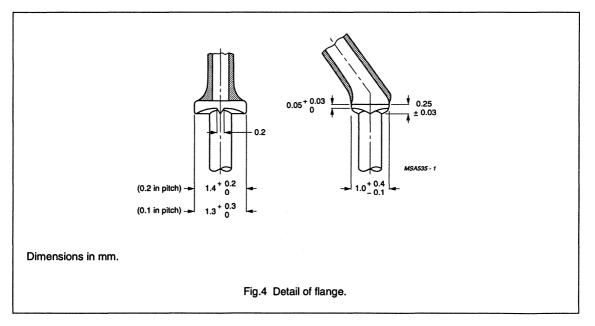
Fig.2 Component outline style 1.



Dimensions in mm.

For dimensions H, L and W see Tables 1 and 2.

Fig.3 Component outline style 2.



Precision capacitors NPO

Marking

The temperature coefficient is indicated by a colour code in accordance with IEC and EIA recommendations. Capacitance value and voltage are indicated by a marking code in a contrasting colour on the body. Refer to Table 3, for marking codes.

Mounting

When bending, cutting or flattening, the leads should be relieved of the applied load by supporting them at the capacitor body.

Soldering conditions: max. 265 °C, max. 10 s.

The capacitors are suitable for mounting on printed-circuit boards (hand mounting or automatic insertion).

Table 1 Capacitor dimensions

SIZE (note 1)	W (note 2)	H (note 2) (mm)		APPROX.	
	(mm)	Style 1	Style 2	(g)	
ı	3.6 (-1.1)	5.0 (-1.5)	6.3 (-1.8)	0.14	
IIA	3.9 (-1.4)	5.3 (-1.7)	6.7 (-2.0)	0.15	
IIB	4.5 (-1.8)	6.0 (–2.1)	7.3 (-2.4)	0.15	
· III	5.1 (-1.8)	6.6 (-2.3)	7.9 (-2.6)	0.17	
IV	6.2 (-2.0)	7.7 (-2.4)	9.0 (–2.7)	0.20	
V	6.2 (-2.0)	10.3 (-2.8)	11.2 (-3.1)	0.23	

Notes

- Unless indicated in Table 3, the thickness of the capacitors does not exceed 2.3 mm.
- 2. Tolerances are given between brackets.

Philips Components Product specification

Miniature ceramic plate capacitors

Precision capacitors NPO

PACKING

Refer to the General section for Miniature Ceramic Plate Capacitors.

Table 2 Ordering information

	:		CATALOGUE NUMBERS (note 1)				
DITOU	LEAD	CTVI E	BULK	PACKED	ON TAPE	ON TAPE	ON TAPE
PITCH	DIAMETER	STYLE	L ≥13 mm	L = 4 ±0.5 mm	(note 3) (REEL)	(note 2) (AMMUNITION PACK)	(note 3) (AMMUNITION PACK)
2.54 mm (0.1 in)	0.6 mm (0.024 in)	1	2222 680	2222 682	2222 678	2222 686	2222 688
5.08 mm (0.2 in)	0.6 mm (0.024 in)	2	2222 681	2222 683	2222 679	2222 687	2222 689

Notes

- 1. Catalogue number to be completed by adding code for required capacitance value, see Table 3.
- 2. $H_0 = 16 \text{ mm}$.
- 3. $H_0 = 18.25$ mm.

ELECTRICAL CHARACTERISTICS

The capacitors meet the essential requirements of IEC 384-8. Unless stated otherwise 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%.

Capacitance values (note 1) measured at 1 MHz, ≤5 V	see Table 3
Rated DC voltage	100 V
DC test voltage; duration 1 minute	300 V
DC test voltage of coating; duration 1 minute	300 V
Insulation resistance at 100 V (DC) after 1 minute	≥10 000 MΩ
Tan δ (note1) measured at 1 MHz, ≤5 V	
C ≤50 pF	$\leq 10 \left(\frac{15}{C} + 0.7\right) \times 10^{-4}$; max. 20×10^{-4}
C >50 pF	≤10 × 10 ⁻⁴
Category temperature range	-55 to +125 °C
Climatic category (IEC 68)	55/125/56

Note

1. Including 2 mm per connecting lead.

Precision capacitors NPO

Precision capacitors with temperature coefficient NPO, rated voltage 100 V (DC)

Capacitance range	1 to 240 pF (E24 series)
Temperature coefficient of the capacitance ($\frac{\Delta C}{C.\Delta T}$)	0 × 10 ⁻⁸ /K
Tolerance on the temperature coefficient	±30 × 10 ⁻⁶ /K
Marking colour of the temperature coefficient	black

Table 3 Precision capacitance range, temperature coefficient NPO

CAPACITANCE VALUE (note 1) (pF)	TOLERANCE	SIZE (see Table 1)	MARKING	SUFFIX OF CATALOGUE NUMBER (see Table 2)
1.0 (note 2)	±0.1 pF	I	1p0	90108
1.1	±0.1 pF	1	1p1	90118
1.2	±0.1 pF	1	1p2	90128
1.3	±0.1 pF	1	1p3	90138
1.5	±0.1 pF	1	1p5	90158
1.6	±0.1 pF	1	1p6	90168
1.8	±0.1 pF	1	1p8	90188
2.0	±0.1 pF	1	2p0	90208
2.2	±0.1 pF	1	2p2	90228
2.4	±0.1 pF	1	2p4	90248
2.7	±0.1 pF	1	2p7	90278
3.0	±0.1 pF	1	3p0	90308
3.3	±0.1 pF	1.	3p3	90338
3.6	±0.1 pF	· 1	3p6	90368
3.9	±0.1 pF	1	3p9	90398
4.3	±0.1 pF	1	4p3	90438
4.7	±0.1 pF	1	4p7	90478
5.1	±0.1 pF	1	5p1	90518
5.6	±0.1 pF	1	5p6	90568
6.2	±0.1 pF	1	6p2	90628
6.8	±0.1 pF	1	6p8	90688
7.5	±0.1 pF	1	7p5	90758
8.2	±0.1 pF	E.	8p2	90828
10	±0.1 pF	1.	10p	90109
11	±1%	I"	11p	90119
12	±1%	1	12p	90129
13	±1%	ı	13p	90139
15	±1%	1	15p	90159
16	±1%	<u> </u>	16p	90169

Precision capacitors NPO

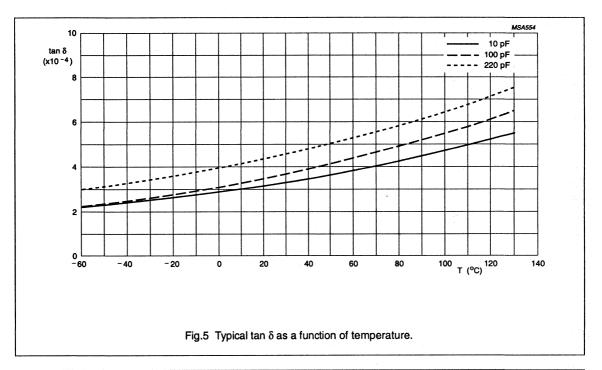
CAPACITANCE VALUE (note 1) (pF)	TOLERANCE	SIZE (see Table 1)	MARKING	SUFFIX OF CATALOGUE NUMBER (see Table 2)
18	±1%	1	18p	90189
20	±1%	the second	20p	90209
22	±1%		22p	90229
24	±1%		24p	90249
27	±1%	1	27p	90279
30	±1%		30p	90309
33	±1%		33p	90339
36	±1%	IIA	36p	90369
39	±1%	IIA	39p	90399
43	±1%	IIA I	43p	90439
47	±1%	IIA	47p	90479
51	±1%	IIA	51p	90519
56	±1%	IIA	56p	90569
62	±1%	IIB	62p	90629
68	±1%	IIB	68p	90689
75	±1%	IIB	75p	90759
82	±1%	IIB	82p	90829
100	±1%	111	n10	90101
110	±1%	lii .	n11	90111
120	±1%	lii v	n12	90121
130	±1%	IV	n13	90131
150	±1%	IV	n15	90151
160	±1%	IV	n16	90161
180	±1%	IV	n18	90181
200	±1%	V	n20	90201
220	±1%	V	n22	90221
240	±1%	V	n24	90241

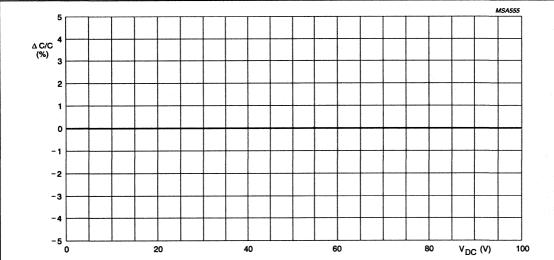
Notes

- 1. Other capacitance values and tolerances are available on request.
- 2. Maximum thickness 2.5 mm.

Miniature ceramic plate capacitors

Precision capacitors NPO



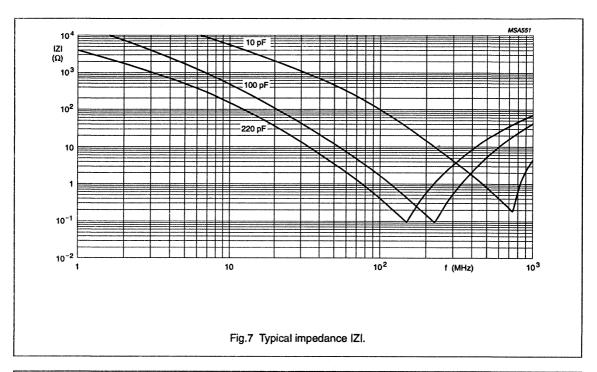


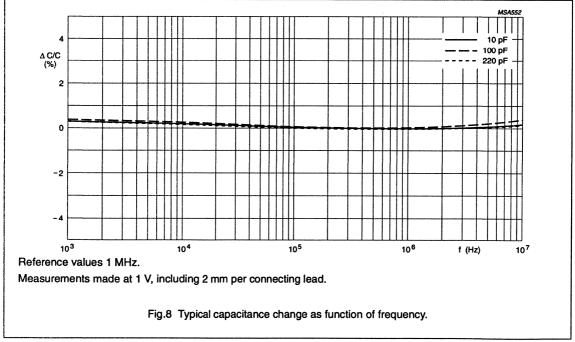
Reference values 1 MHz.

Measurements made at 1 V, including 2 mm per connecting lead.

Fig.6 Typical capacitance change as function of DC voltage.

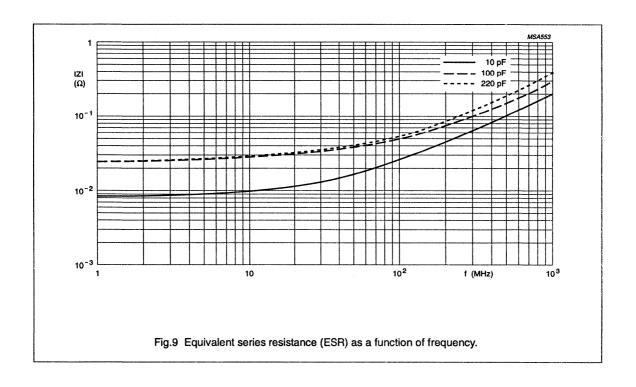
Precision capacitors NPO





Miniature ceramic plate capacitors

Precision capacitors NPO



Class 1 (flanged types)

FEATURES

- · High-frequency circuits
- · Temperature compensating
- · High stability
- Space saving.

APPLICATIONS

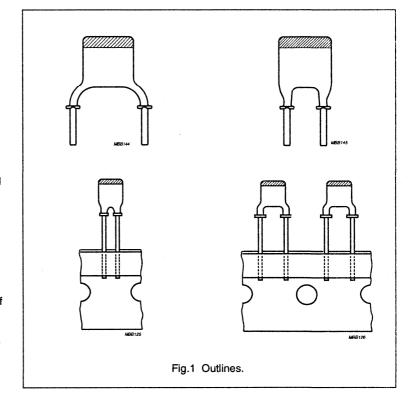
In a great variety of electronic circuits, e.g. in filters and tuning circuits where high stability and/or temperature compensation are a requirement. Because of their small size the capacitors are suitable for use in circuitry with high component density.

DESCRIPTION

The capacitors consist of a thin rectangular ceramic plate, both sides of which are metallized, and tinned connecting leads are secured using a high melting point solder. The capacitors are encapsulated in epoxy lacquer, which is resistant to all commonly used cleaning solvents. They have small dimensions and narrow tolerances on the lead spacing. The leads are provided with a flange, which guarantees that the leads are free of lacquer, and its shape allows soldering gasses to escape freely, ensuring excellent solderability. This makes the capacitors suitable for both hand mounting and automatic insertion. The electrical properties are characterized by low losses, a narrow tolerance on capacitance (±0.25 pF or 2%), high stability and, owing to the absence of silver, an extremely good DC behaviour.

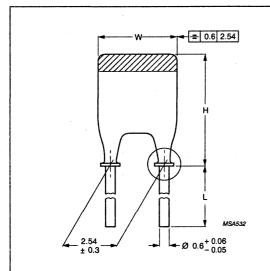
QUICK REFERENCE DATA

Capacitance range	0.56 to 560 pF (E12 series)
Rated DC voltage	100 V
Tolerance on capacitance	±2% or ±0.25 pF
Temperature coefficients	P100, NP0, N075, N150, N220, N330, N470, N750 and N1500
Sectional specification	IEC 384-8
Climatic category (IEC 68)	55/085/21



Class 1 (flanged types)

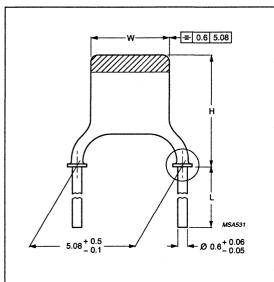
MECHANICAL DATA



Dimensions in mm.

For dimensions H, L and W see Tables 1 and 2.

Fig.2 Component outline style 1.



Dimensions in mm.

For dimensions H, L and W see Tables 1 and 2.

Fig.3 Component outline style 2.

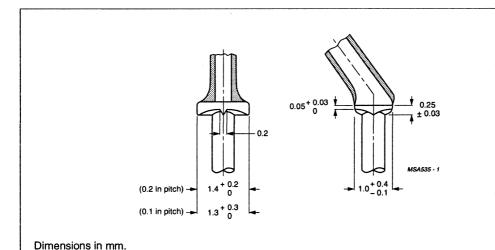


Fig.4 Detail of flange.

Class 1 (flanged types)

Marking

The temperature coefficient is indicated by a colour code in accordance with IEC and EIA recommendations. Capacitance value and voltage are indicated by a marking code in a contrasting colour on the body. Refer to Tables 3 to 11, for marking codes.

Mounting

When bending, cutting or flattening, the leads should be relieved of the applied load by supporting them at the capacitor body.

Soldering conditions: max. 265 °C, max. 10 s.

The capacitors are suitable for mounting on printed-circuit boards (hand mounting or automatic insertion).

Table 1 Capacitor dimensions

SIZE (note 1)	W (note 2)	H (note 2) (mm)		(note 2)		APPROX. MASS
	(mm)	Style 1	Style 2	(g)		
I	3.6 (-1.1)	5.0 (-1.5)	6.3 (–1.8)	0.14		
IIA	3.9 (-1.4)	5.3 (–1.7)	6.7 (–2.0)	0.15		
IIB	4.5 (–1.8)	6.0 (-2.1)	7.3 (–2.4)	0.15		
III	5.1 (-1.8)	6.6 (–2.3)	7.9 (–2.6)	0.17		
. IV	6.2 (-2.0)	7.7 (-2.4)	9.0 (–2.7)	0.20		
V	6.2 (–2.0)	10.3 (–2.8)	11.2 (-3.1)	0.23		

Notes

- Unless indicated in Tables 3 to 11, the thickness of the capacitors does not exceed 2.3 mm.
- 2. Tolerances are given between brackets.

Class 1 (flanged types)

PACKING

Refer to the General section for Miniature Ceramic Plate Capacitors.

Table 2 Ordering information

			CATALOGUE NUMBERS (note 1)					
DETOLL	CH LEAD STYLE BULK PACKED ON TAPE		LEAD	077/15			ON TAPE	ON TAPE
PITCH	DIAMETER	SITLE	L≥13 mm	L = 4 ±0.5 mm	(note 3) (REEL)	(note 2) (AMMUNITION PACK)	(note 3) (AMMUNITION PACK)	
2.54 mm (0.1 in)	0.6 mm (0.024 in)	1	2222 680	2222 682	2222 678	2222 686	2222 688	
5.08 mm (0.2 in)	0.6 mm (0.024 in)	2	2222 681	2222 683	2222 679	2222 687	2222 689	

Notes

- 1. Catalogue number to be completed by adding code for required capacitance value, see Tables 3 to 11.
- 2. $H_0 = 16 \text{ mm}$.
- 3. $H_0 = 18.25 \text{ mm}$.

ELECTRICAL CHARACTERISTICS

The capacitors meet the essential requirements of IEC 384-8. Unless stated otherwise all electrical values apply at an ambient temperature of 20 \pm 1 °C, an atmospheric pressure of 86 to 106 kPa and a relative humidity of 63 to 67%.

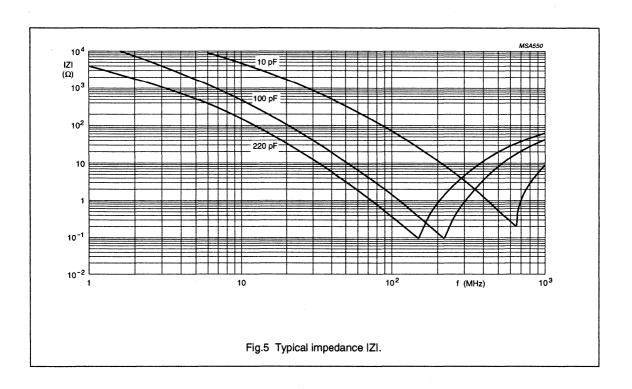
Capacitance values (note 1) measured at 1 MHz, ≤5 V	see Tables 3 to 11.
Rated DC voltage	100 V
DC test voltage; duration 1 minute	300 V
DC test voltage of coating; duration 1 minute	300 V
Insulation resistance at 100 V (DC) after 1 minute	≥10 000 MΩ
Tan δ (note1) measured at 1 MHz, ≤5 V	
C ≤50 pF	$\leq 15 \left(\frac{15}{C} + 0.7\right) \times 10^{-4}$; max. 55×10^{-4}
C >50 pF	≤15 × 10 ⁻⁴
Category temperature range	−55 to +85 °C
Storage temperature range	−55 to +85 °C
Climatic category (IEC 68)	55/085/21

Note

1. Including 2 mm per connecting lead

Miniature ceramic plate capacitors

Class 1 (flanged types)



Miniature ceramic plate capacitors

Class 1 (flanged types)

Capacitors with temperature coefficient P100, rated voltage 100 V (DC)

Capacitance range	0.56 to 47 pF (E12 series)
Temperature coefficient of the capacitance ($\frac{\Delta C}{C.\Delta T}$)	+100 × 10 ⁻⁶ /K
Tolerance on the temperature coefficient	±30 × 10 ⁻⁶ /K
Marking colour of the temperature coefficient	red/violet

Table 3 Capacitance range, temperature coefficient P100

CAPACITANCE VALUE (note 1) (pF)	TOLERANCE	SIZE (see Table 1)	MARKING	SUFFIX OF CATALOGUE NUMBER (see Table 2)
0.56 (note 2)	±0.25 pF	· I	p56	03567
0.68 (note 3)	±0.25 pF	!	p68	03687
0.82 (note 4)	±0.25 pF	1	p82	03827
1.0 (note 4)	±0.25 pF	1	1p0	03108
1.2	±0.25 pF	ı	1p2	03128
1.5	±0.25 pF	1	1p5	03158
1.8	±0.25 pF	1	1p8	03188
2.2	±0.25 pF	I	2p2	03228
2.7	±0.25 pF	1	2p7	03278
3.3	±0.25 pF	1	3p3	03338
3.9	±0.25 pF	ł	3p9	03398
4.7	±0.25 pF	ı	4p7	03478
5.6	±0.25 pF	. 1	5p6	03568
6.8	±0.25 pF	1	6p8	03688
8.2	±0.25 pF	IIA	8p2	03828
10	±2%	IIA	10p	04109
12	±2%	IIB	12p	04129
15	±2%	IIB	15p	04159
18	±2%	III	18p	04189
22	±2%	111	22p	04229
27	±2%	IV	27p	04279
33	±2%	IV .	33p	04339
39	±2%	V	39p	04399
47	±2%	v	47p	04479

Notes

- 1. Other capacitance values and tolerances are available on request.
- 2. Maximum thickness 3.0 mm.
- 3. Maximum thickness 2.7 mm.
- 4. Maximum thickness 2.5 mm.

Miniature ceramic plate capacitors

Class 1 (flanged types)

Capacitors with temperature coefficient NPO, rated voltage 100 V (DC)

Capacitance range	1.8 to 220 pF (E12 series)	
Temperature coefficient of the capacitance ($\frac{\Delta C}{C.\Delta T}$)	0 × 10 ⁻⁶ /K	
Tolerance on the temperature coefficient	±30 × 10 ⁻⁶ /K	
Marking colour of the temperature coefficient	black	

Table 4 Capacitance range, temperature coefficient NP0

CAPACITANCE VALUE (note 1) (pF)	TOLERANCE	SIZE (see Table 1)	MARKING	SUFFIX OF CATALOGUE NUMBER (see Table 2)
1.8	±0.25 pF	I	1p8	09188
2.2	±0.25 pF	ı	2p2	09228
2.7	±0.25 pF	I	2p7	09278
3.3	±0.25 pF	1 .	3p3	09338
3.9	±0.25 pF	ı	3p9	09398
4.7	±0.25 pF	1	4p7	09478
5.6	±0.25 pF	1	5p6	09568
6.8	±0.25 pF	ı	6p8	09688
8.2	±0.25 pF	1	8p2	09828
10	±2%	1	10p	10109
12	±2%	1	12p	10129
15	±2%	l I	15p	10159
18	±2%	I	18p	10189
22	±2%	1	22p	10229
27	±2%	1	27p	10279
33	±2%	1	33p	10339
39	±2%	IIA	39p	10399
47	±2%	·IIA	47p	10479
56	±2%	IIA	56p	10569
68	±2%	IIB	68p	10689
82	±2%	IIB	82p	10829
100	±2%	111	n10	10101
120	±2%	111	n12	10121
150	±2%	IV	n15	10151
180	±2%	IV	n18	10181
220	±2%	V	n22	10221

Note

1. Other capacitance values and tolerances are available on request.

Miniature ceramic plate capacitors

Class 1 (flanged types)

Capacitors with temperature coefficient N075, rated voltage 100 V (DC)

Capacitance range	3.9 to 120 pF (E12 series)
Temperature coefficient of the capacitance ($\frac{\Delta C}{C.\Delta T}$)	−75 × 10 ⁻⁶ /K
Tolerance on the temperature coefficient	$\pm 30 \times 10^{-6}$ /K
Marking colour of the temperature coefficient	red

Table 5 Capacitance range, temperature coefficient N075

CAPACITANCE VALUE (note 1) (pF)	TOLERANCE	SIZE (see Table 1)	MARKING	SUFFIX OF CATALOGUE NUMBER (see Table 2)
3.9	±0.25 pF	ı	3p9	27398
4.7	±0.25 pF	l I	4p7	27478
5.6	±0.25 pF	l I	5p6	27568
6.8	±0.25 pF	!	6p8	27688
8.2	±0.25 pF	l l	8p2	27828
10	±2%	l l	10p	28109
12	±2%	1	12p	28129
15	±2%	1	15p	28159
18	±2%	1	18p	28189
22	±2%	IIA	22p	28229
27	±2%	IIA	27p	28279
33	±2%	IIB	33p	28339
39	±2%	IIB	39p	28399
47	±2%	III	47p	28479
56	±2%	III	56p	28569
68	±2%	IV	68p	28689
82	±2%	IV	82p	28829
100	±2%	v	n10	28101
120	±2%	V	n12	28121

Note

1. Other capacitance values and tolerances are available on request.

Class 1 (flanged types)

Capacitors with temperature coefficient N150, rated voltage 100 V (DC)

Capacitance range	3.9 to 220 pF (E12 series)
Temperature coefficient of the capacitance ($\frac{\Delta C}{C \Delta T}$)	–150 × 10 ⁻⁶ /K
Tolerance on the temperature coefficient	±30 × 10 ⁻⁶ /K
Marking colour of the temperature coefficient	orange

Table 6 Capacitance range, temperature coefficient N150

CAPACITANCE VALUE (note 1) (pF)	TOLERANCE	SIZE (see Table 1)	MARKING	SUFFIX OF CATALOGUE NUMBER (see Table 2)
3.9 (note 2)	±0.25 pF	I	3p9	33398
4.7	±0.25 pF	1	4p7	33478
5.6	±0.25 pF	I	5p6	33568
6.8	±0.25 pF	1	6p8	33688
8.2	±0.25 pF	1	8p2	33828
10	±2%	1	10p	34109
12	±2%	1	12p	34129
15	±2%	ı	15p	34159
18	±2%	ı	18p	34189
22	±2%		22p	34229
27	±2%	- 1	27p	34279
33	±2%	1	33p	34339
39	±2%	IIA	39p	34399
47	±2%	IIA	47p	34479
56	±2%	IIB	56p	34569
68	±2%	IIB	68p	34689
82	±2%	101	82p	34829
100	±2%	111	n10	34101
120	±2%	III	n12	34121
150	±2%	IV	n15	34151
180	±2%	IV	n18	34181
220	±2%	V	n22	34221

Notes

- 1. Other capacitance values and tolerances are available on request.
- 2. Maximum thickness 2.5 mm.

Miniature ceramic plate capacitors

Class 1 (flanged types)

Capacitors with temperature coefficient N220, rated voltage 100 V (DC)

Capacitance range	3.9 to 150 pF (E12 series)
Temperature coefficient of the capacitance ($\frac{\Delta C}{C.\Delta T}$)	-220 × 10 ⁻⁶ /K
Tolerance on the temperature coefficient	±30 × 10 ⁻⁶ /K
Marking colour of the temperature coefficient	yellow

Table 7 Capacitance range, temperature coefficient N220

CAPACITANCE VALUE (note 1) (pF)	TOLERANCE	SIZE (see Table 1)	MARKING	SUFFIX OF CATALOGUE NUMBER (see Table 2)
3.9 (note 2)	±0.25 pF	ı	3p9	39398
4.7	±0.25 pF	1	4p7	39478
5.6	±0.25 pF	1	5p6	39568
6.8	±0.25 pF	1	6p8	39688
8.2	±0.25 pF		8p2	39828
10	±2%		10p	40109
12	±2%	1	12p	40129
15	±2%	,1	15p	40159
18	±2%	1	18p	40189
22	±2%	1	22p	40229
27	±2%	IIA	27p	40279
33	±2%	IIA	33p	40339
39	±2%	IIB	39p	40399
47	±2%	IIB	47p	40479
56	±2%	III	56p	40569
68	±2%	III	68p	40689
82	±2%	IV	82p	40829
100	±2%	IV	n10	40101
120	±2%	V	n12	40121
150	±2%	V	n15	40151

Notes

- 1. Other capacitance values and tolerances are available on request.
- 2. Maximum thickness 2.5 mm.

Class 1 (flanged types)

Capacitors with temperature coefficient N330, rated voltage 100 V (DC)

Capacitance range	4.7 to 180 pF (E12 series)
Temperature coefficient of the capacitance ($\frac{\Delta C}{C \cdot \Delta T}$)	–330 × 10 ⁻⁶ /K
Tolerance on the temperature coefficient	±60 × 10 ⁻⁶ /K
Marking colour of the temperature coefficient	green

Table 8 Capacitance range, temperature coefficient N330

CAPACITANCE VALUE (note 1) (pF)	TOLERANCE	SIZE (see Table 1)	MARKING	SUFFIX OF CATALOGUE NUMBER (see Table 2)
4.7	±0.25 pF	I	4p7	45478
5.6	±0.25 pF	I	5p6	45568
6.8	±0.25 pF	ı	6p8	45688
8.2	±0.25 pF	1.	8p2	45828
10	±2%	1	10p	46109
12	±2%	ı	12p	46129
15	±2%	* .	15p	46159
18	±2%	1	18p	46189
22	±2%	ı	22p	46229
27	±2%	1	27p	46279
33	±2%	IIA	33p	46339
39	±2%	IIA	39p	46399
47	±2%	IIB	47p	46479
56	±2%	IIB	56p	46569
68	±2%	III	68p	46689
82	±2%	111	82p	46829
100	±2%	IV	n10	46101
120	±2%	IV	n12	46121
150	±2%	v	n15	46151
180	±2%	V	n18	46181

Note

1. Other capacitance values and tolerances are available on request.

Class 1 (flanged types)

Capacitors with temperature coefficient N470, rated voltage 100 V (DC)

Capacitance range	6.8 to 220 pF (E12 series)
Temperature coefficient of the capacitance ($\frac{\Delta C}{C.\Delta T}$)	-470 × 10 ⁻⁶ /K
Tolerance on the temperature coefficient	±60 × 10 ⁻⁶ /K
Marking colour of the temperature coefficient	blue (330) and a construction of the construct

Table 9 Capacitance range, temperature coefficient N470

CAPACITANCE VALUE (note 1) (pF)	TOLERANCE	SIZE (see Table 1)	MARKING	SUFFIX OF CATALOGUE NUMBER (see Table 2)
6.8	±0.25 pF	l ·	6p8	51688
8.2	±0.25 pF	ı	8p2	51828
10	±2%	41	10p	52109
12	±2%		12p	52129
15	±2%	. 1	15p	52159
18	±2%	1	18p	52189
22	±2%	1	22p	52229
27	±2%	1	27p	52279
33	±2%		33p	52339
39	±2%	IIA	39p	52399
47	±2%	IIA	47p	52479
56	±2%	IIB	56p	52569
68	±2%	IIB	68p	52689
82	±2%	III ·	82p	52829
100	±2%	111	n10	52101
120	±2%	IV	n12	52121
150	±2%	IV	n15	52151
180	±2%	V	n18	52181
220	±2%	·V	n22	52221

Note

1. Other capacitance values and tolerances are available on request.

Miniature ceramic plate capacitors

Class 1 (flanged types)

Capacitors with temperature coefficient N750, rated voltage 100 V (DC)

Capacitance range	3.9 to 330 pF (E12 series)
Temperature coefficient of the capacitance ($\frac{\Delta C}{C.\Delta T}$)	−750 × 10 ⁻⁶ /K
Tolerance on the temperature coefficient	±120 × 10 ⁻⁶ /K
Marking colour of the temperature coefficient	violet

Table 10 Capacitance range, temperature coefficient N750

CAPACITANCE VALUE (note 1) (pF)	TOLERANCE	SIZE (see Table 1)	MARKING	SUFFIX OF CATALOGUE NUMBER (see Table 2)
3.9	±0.25 pF	I	3p9	57398
4.7	±0.25 pF	1	4p7	57478
5.6	±0.25 pF	1	5p6	57568
6.8	±0.25 pF	1	6p8	57688
8.2	±0.25 pF	1	8p2	57828
10	±2%	I	10p	58109
12	±2%	, 1	12p	58129
15	±2%	1.	15p	58159
18	±2%	1	18p	58189
22	±2%	1	22p	58229
27	±2%	l	27p	58279
33	±2%	l	33p	58339
39	±2%	:1.	39p	58399
47	±2%	A .	47p	58479
56	±2%	IIA	56p	58569
68	±2%	IIA	68p	58689
82	±2%	IIB	82p	58829
100	±2%	IIB	n10	58101
120	±2%	III	n12	58121
150	±2%	III	n15	58151
180	±2%	IV	n18	58181
220	±2%	IV	n22	58221
270	±2%	V	n27	58271
330	±2%	V	n33	58331

Note

1. Other capacitance values and tolerances are available on request.

Miniature ceramic plate capacitors

Class 1 (flanged types)

Capacitors with temperature coefficient N1500, rated voltage 100 V (DC)

Capacitance range	18 to 560 pF (E12 series)
Temperature coefficient of the capacitance ($\frac{\Delta C}{C.\Delta ext{T}}$)	−1 500 × 10 ⁻⁶ /K
Tolerance on the temperature coefficient	(0 to +500) × 10 ⁻⁶ /K
Marking colour of the temperature coefficient	orange/orange

Table 11 Capacitance range, temperature coefficient N1500

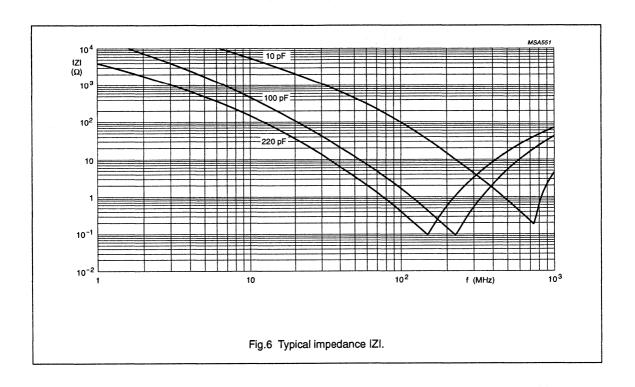
CAPACITANCE VALUE (note 1) (pF)	TOLERANCE	SIZE (see Table 1)	MARKING	SUFFIX OF CATALOGUE NUMBER (see Table 2)
18 (note 2)	±2%	ļ.	18p	70189
22	±2%	1	22p	70229
27	±2%	1	27p	70279
33	±2%	1	33p	70339
39	±2%	I	39p	70399
47	±2%	1	47p	70479
56	±2%	1	56p	70569
68	±2%	1	68p	70689
82	±2%	1, ,	82p	70829
100	±2%	IIA	n10	70101
120	±2%	IIA	n12	70121
150	±2%	IIB	n15	70151
180	±2%	IIB	n18	70181
220	±2%	ĬII	n22	70221
270	±2%	III	n27	70271
330	±2%	IV	n33	70331
390	±2%	IV	n39	70391
470	±2%	. V	n47	70471
560	±2%	V	n56	70561

Notes

- 1. Other capacitance values and tolerances are available on request.
- 2. Maximum thickness 2.5 mm.

Miniature ceramic plate capacitors

Class 1 (flanged types)





Class 2 (flanged types)

FEATURES

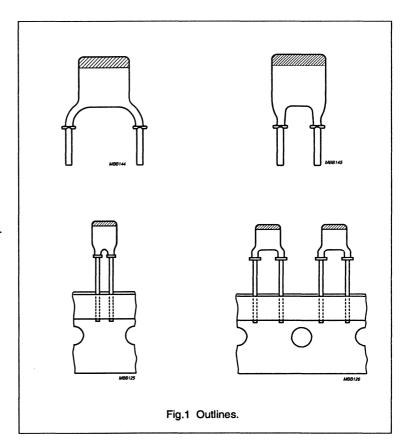
- · General purpose
- · Coupling and decoupling
- · Space saving.

APPLICATIONS

In electronic circuits where non-linear change of capacitance with temperature is permissible and low losses are not essential, i.e. coupling and decoupling. Because of their small size the capacitors are suitable for use in circuitry with high component density.

DESCRIPTION

The capacitors consist of a thin rectangular ceramic plate, both sides of which are metallized. The tinned connecting leads are secured using a high melting point solder. The capacitors are encapsulated in epoxy lacquer, which is resistant to all commonly used cleaning solvents. They have small dimensions and narrow tolerances on the lead spacing. The leads are provided with a flange, which guarantees that the leads are free of lacquer, and its shape allows soldering gasses to escape freely, ensuring excellent solderability. This makes the capacitors suitable for both hand mounting and automatic insertion.

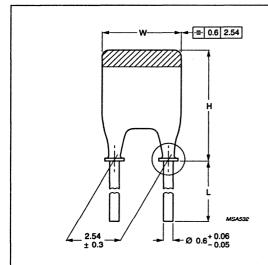


QUICK REFERENCE DATA

Parameters	2222 630 series	2222 640 series	2222 629 series
Capacitance range	180 to 6 800 pF (E12 series)	1 000 to 15 000 pF (E6 series)	1 000 to 47 000 pF (E3 series)
Dielectric material	K2000	K5000	K14000
Rated DC voltage	100 V	100 V	63 V
Tolerance on capacitance	±10%	-20/+50%	-20/+80%
Sectional specification	IEC 384-9 (2C2)	IEC 384-9 (2E2)	IEC 384-9
Climatic category (IEC 68)	55/085/21	55/085/21	10/055/21

Class 2 (flanged types)

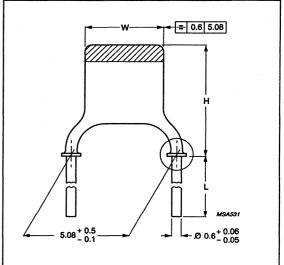
MECHANICAL DATA



Dimensions in mm.

For dimensions H, L and W see Tables 1 and 2.

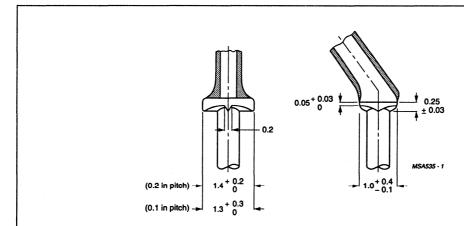
Fig.2 Component outline style 1.



Dimensions in mm.

For dimensions H, L and W see Tables 1 and 2.

Fig.3 Component outline style 2.



Dimensions in mm.

Fig.4 Detail of flange.

Miniature ceramic plate capacitors

Class 2 (flanged types)

Marking

The body of the capacitors is tan coloured. The capacitors also have a colour mark on top indicating the temperature dependence of the capacitance;

yellow for type 2222 630 blue for type 2222 640 green for type 2222 629.

The capacitance value is indicated by a marking code in a contrasting colour on the body. Refer to Tables 3, 4, and 5 for marking codes.

Mounting

When bending, cutting or flattening, the leads should be relieved of the applied load by supporting them at the capacitor body.

Soldering conditions: max. 265 °C, max. 10 s.

The capacitors are suitable for mounting on printed-circuit boards (hand mounting or automatic insertion).

Table 1 Capacitor dimensions

SIZE (note 1)	W (note 2)	H (note 2) (mm)		(note 2) APPROX (e 2) (mm) MASS	
	(mm)	Style 1	Style 2	(g)	
1	3.6 (-1.1)	5.0 (-1.5)	6.3 (-1.8)	0.14	
IIA	3.9 (-1.4)	5.3 (-1.7)	6.7 (–2.0)	0.15	
IIB	4.5 (-1.8)	6.0 (–2.1)	7.3 (–2.4)	0.15	
ļ ļiii	5.1 (-1.8)	6.6 (-2.3)	7.9 (–2.6)	0.17	
IV	6.2 (-2.0)	7.7 (-2.4)	9.0 (–2.7)	0.20	
V	6.2 (-2.0)	10.3 (–2.8)	11.2 (-3.1)	0.23	

Notes

- Unless indicated in Tables 3, 4, and 5 the thickness of the capacitors does not exceed 2.3 mm.
- 2. Tolerances are given between brackets.

Class 2 (flanged types)

PACKING

Refer to the General section for Miniature Ceramic Plate Capacitors.

Table 2 Ordering information

PITCH	LEAD DIAMETER	STYLE	CATALOGUE NUMBERS (note 1)				
			BULK PACKED		ON TAPE	ON TAPE	ON TAPE
			L ≥13 mm	L = 4 ±0.5 mm	(note 3) (REEL)	(note 2) (AMMUNITION PACK)	(note 3) (AMMUNITION PACK)
2.54 mm	0.6 mm	1	2222 630 08	2222 630 18	2222 630 51	2222 630 62	2222 630 61
(0.1 in)	(0.024 in)		2222 640 08	2222 640 18	2222 640 51	2222 640 62	2222 640 61
			2222 629 08	2222 629 18	2222 629 51	2222 629 62	2222 629 61
5.08 mm	0.6 mm	0.6 mm 2	2222 630 09	2222 630 19	2222 630 53	2222 630 64	2222 630 63
(0.2 in)	(0.024 in)		2222 640 09	2222 640 19	2222 640 53	2222 640 64	2222 640 63
			2222 629 09	2222 629 19	2222 629 53	2222 629 64	2222 629 63

Notes

- 1. Catalogue number to be completed by adding code for required capacitance value, see Tables 3, 4 and 5.
- 2. $H_0 = 16 \text{ mm}$.
- 3. $H_0 = 18.25 \text{ mm}$.

ELECTRICAL CHARACTERISTICS

Capacitors 2222 630 (colour mark yellow). The capacitors meet the essential requirements of IEC 384-8 (2C2). Unless stated otherwise 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%.

Capacitance values measured at 1 kHz, 1 V	180 to 6 800 pF; E12 series (see Table 3)		
Dielectric material	K2000		
Tolerance on capacitance, after 1 000 hours	±10%		
Maximum capacitance variation with respect to capacitance value at 20 °C	+20 to -20% (see Fig.5)		
Rated DC voltage	100 V		
DC test voltage; duration 1 minute	300 V		
DC test voltage of coating; duration 1 minute	300 V		
Insulation resistance at 100 V (DC) after 1 minute	≥4 000 MΩ		
Tan δ measured at 1 kHz, 1 V	≤3.5%		
Maximum voltage dependence of the capacitance between 0 and 40 V	-5%		
Category temperature range	-55 to +85 °C		
Storage temperature range	−55 to +85 °C		
Ageing	typical, 1.5% per time decade		
Climatic category (IEC 68)	55/085/21		

Miniature ceramic plate capacitors

Class 2 (flanged types)

Table 3 Capacitance range, for 2222 630

CAPACITANCE VALUE (pF)	SIZE (see Table 1)	MARKING	SUFFIX OF CATALOGUE NUMBER (see Table 2)
180 (note 1)		n18	181
220	1	n22	221
270	1	n27	271
330	1	n33	331
390	1	n39	391
470	1	n47	471
560		n56	561
680		n68	681
820	1	n82	821
1 000	1	1n0	102
1 200	IIA	1n2	122
1 500	IIA	1n5	152
1 800	IIB	1n8	182
2 200	IIB	2n2	222
2 700	III	2n7	272
3 300	III	3n3	332
3 900	IV	3n9	392
4 700	IV.	4n7	472
5 600	v	5n6	562
6 800	V	6n8	682

Note

1. Maximum thickness 2.5 mm.

Class 2 (flanged types)

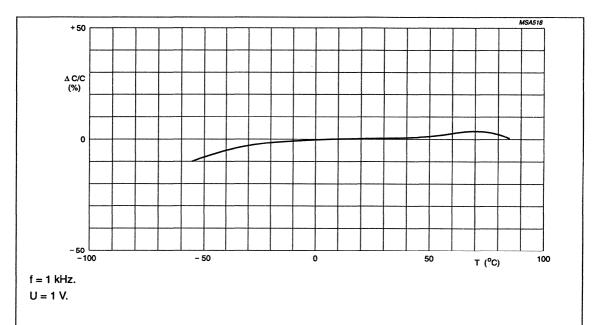


Fig.5 Typical capacitance change with respect to capacitance value as a function of temperature.

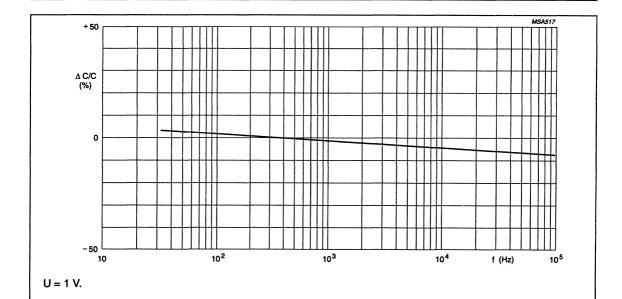


Fig.6 Typical capacitance change with respect to the capacitance value at capacitance value at 300 Hz as a function of frequency.

Miniature ceramic plate capacitors

Class 2 (flanged types)

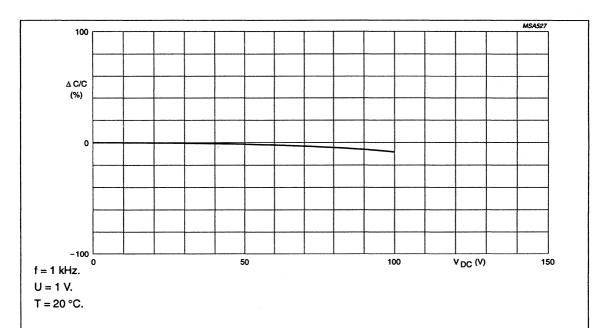


Fig.7 Typical capacitance change with respect to the capacitance value at 0 V as a function of DC voltage.

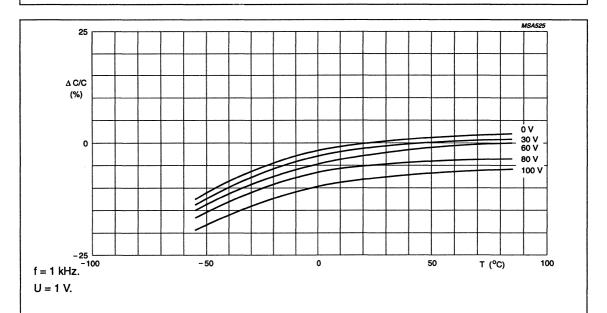
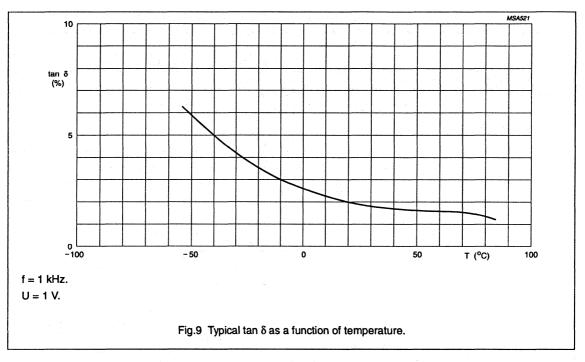
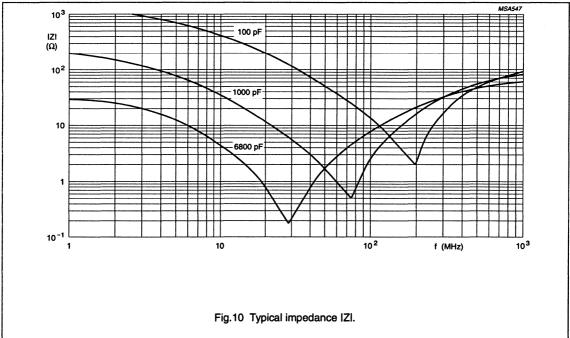


Fig.8 Typical capacitance change with respect to the capacitance value at 0 V and 20 °C as a function of temperature at different DC voltages.

Miniature ceramic plate capacitors

Class 2 (flanged types)





Miniature ceramic plate capacitors

Class 2 (flanged types)

Capacitors 2222 640 (colour mark blue). The capacitors meet the essential requirements of IEC 384-9 (2E2). Unless stated otherwise 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%.

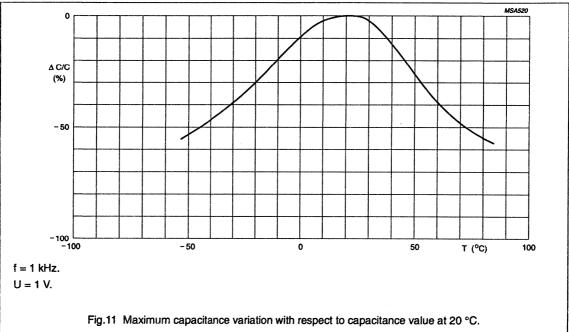
Capacitance values measured at 1 kHz, 1 V	1 000 to 15 000 pF; E6 series (see Table 4)			
Tolerance on capacitance, after 1 000 hours	-20 to +50%			
Dielectric material	K5000			
Maximum capacitance variation with respect to capacitance value at 20 °C	+20 to -55% (see Fig.11)			
Rated DC voltage	100 V			
DC test voltage; duration 1 minute	300 V			
DC test voltage of coating; duration 1 minute	300 V			
Insulation resistance at 100 V (DC) after 1 minute	≥4 000 MΩ			
Tan δ measured at 1 kHz, 1 V	≤3.5%			
Category temperature range	-55 to +85 °C			
Storage temperature range	−55 to +85 °C			
Ageing	typical, 5% per time decade			
Climatic category (IEC 68)	55/085/21			

Table 4 Capacitance range, for 2222 640

CAPACITANCE VALUE (pF)	SIZE (see Table 1)	MARKING	SUFFIX OF CATALOGUE NUMBER (see Table 2)
1 000	1	1n0	102
1 500	1	1n5	152
2 200	1	2n2	222
3 300	IIA	3n3	332
4 700	IIB	4n7	472
6 800	· · · · · · · · · · · · · · · · · · ·	6n8	682
10 000	IV	10n	103
15 000	V	15n	153

Miniature ceramic plate capacitors

Class 2 (flanged types)



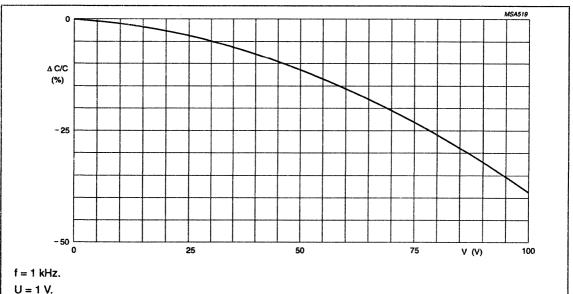


Fig.12 Typical capacitance variation with respect to capacitance value at 20 °C as a function of DC voltage.

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Miniature ceramic plate capacitors

Class 2 (flanged types)

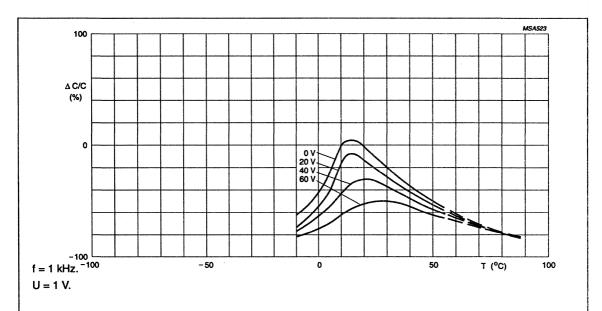
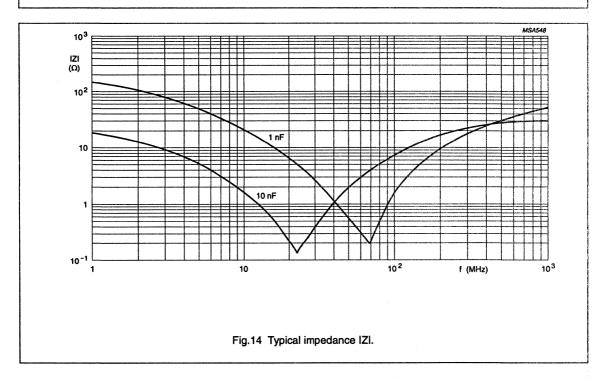


Fig.13 Typical capacitance variation with respect to the capacitance value at 0 V and 20 °C as a function of temperature at different voltages.



Class 2 (flanged types)

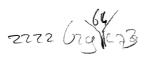
Capacitors 2222 629 (colour mark green). The capacitors meet the essential requirements of IEC 384-9. Unless stated otherwise all electrical values apply at an ambient temperature of 20 ±1 °C, an atmospheric pressure of 86 to 106 kPa and a relative humidity of 63 to 67%.

Capacitance values measured at 1 kHz, 1 V	1 000 to 47 000 pF; E3 series (see Table 5)		
Tolerance on capacitance, after 1 000 hours	-20 to +80%		
Dielectric material	K14000		
Maximum capacitance variation with respect to capacitance value at 20 °C	+20 to -75% (see Fig.16)		
Rated DC voltage at 55 °C	63 V		
Derated DC voltage at 85 °C	40 V		
DC test voltage; duration 1 minute	200 V		
DC test voltage of coating; duration 1 minute	200 V		
Insulation resistance at 100 V (DC) after 1 minute	≥4 000 MΩ		
Tan δ measured at 1 kHz, 1 V	≤3.5%		
Category temperature range	−10 to +55 °C		
Storage temperature range	−55 to +85 °C		
Ageing	typical, 5% per time decade		
Climatic category (IEC 68)	10/055/21		

Table 5 Capacitance range, for 2222 629

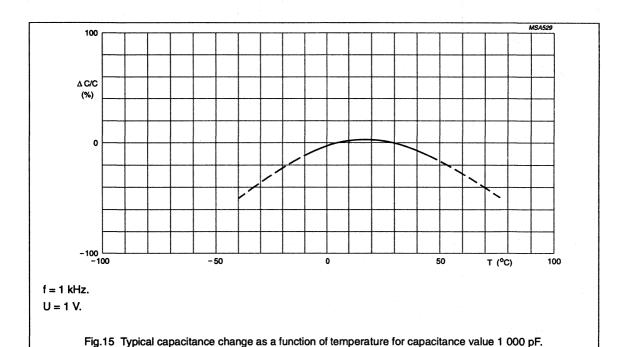
CAPACITANCE VALUE (pF)	SIZE (see Table 1)	MARKING	SUFFIX OF CATALOGUE NUMBER (see Table 2)
1 000		1n0	102
2 200		2n2	222
4 700	1	4n7	472
10 000	IIB	10n	103
22 000	IV	22n	223
47 000	V	47n	473





Miniature ceramic plate capacitors

Class 2 (flanged types)



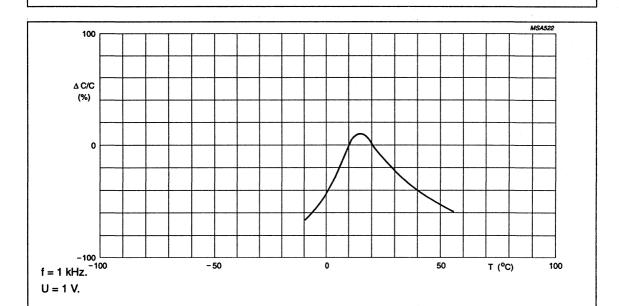


Fig.16 Typical capacitance change as a function of temperature for capacitance values 2 200 pF to $47\,000$ pF.

Miniature ceramic plate capacitors

Class 2 (flanged types)

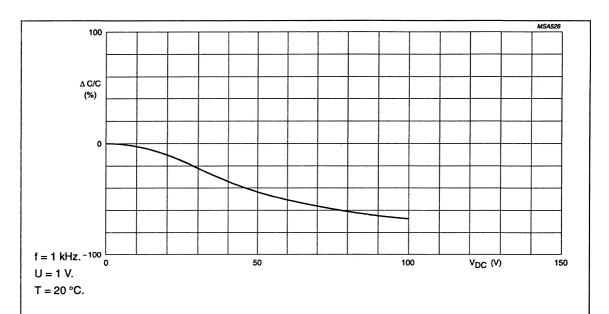


Fig.17 Typical capacitance change with respect to the capacitance value at 0 V, as a function of DC voltage, for capacitance values 2 200 to 47 000 pF.

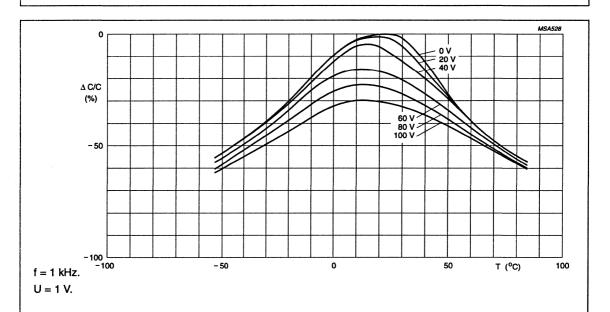
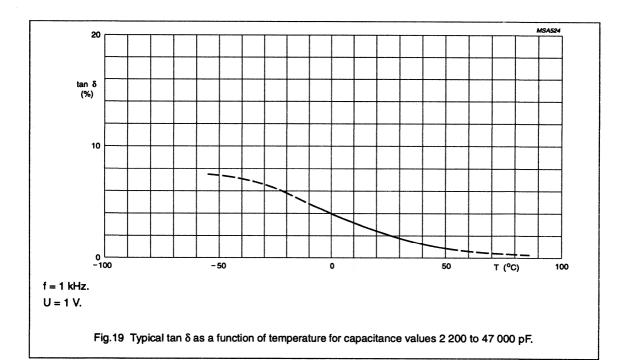
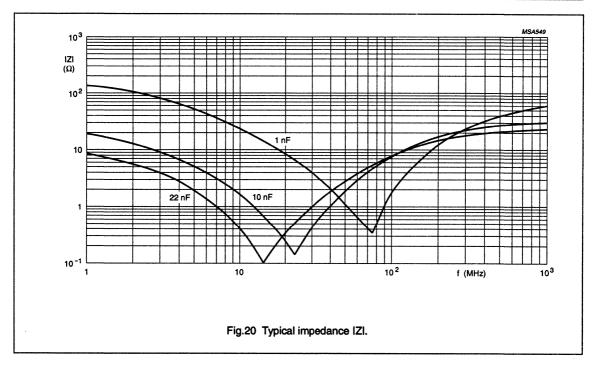


Fig.18 Typical capacitance change with respect to the capacitance value at 0 V and 20 °C, as a function of temperature at different DC voltages, for capacitance values 2 200 to 47 000 pF.

Class 2 (flanged types)





Class 1 (non-flanged types)

FEATURES

- · High-frequency circuits
- · Temperature compensating
- · High stability
- · Space saving.

APPLICATIONS

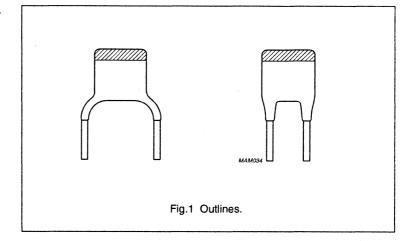
Ceramic plate capacitors without flange are not for current design projects. They are recommended for maintenance purposes only. The electrical properties are identical to capacitors with flanged leads.

DESCRIPTION

The capacitors consist of a thin rectangular ceramic plate, both sides of which are metallized. The tinned connecting leads are secured using a high melting point solder. The capacitors are encapsulated in epoxy lacquer, which is resistant to all commonly used cleaning solvents. They have small dimensions and narrow tolerances on the lead spacing. The electrical properties are characterized by low losses, a narrow tolerance on capacitance (±0.25 pF or 2%), high stability and, owing to the absence of silver, an extremely good DC behaviour.

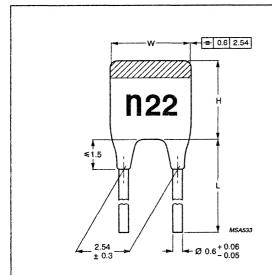
QUICK REFERENCE DATA

Capacitance range	0.56 to 560 pF (E12 series)
Rated DC voltage	100 V
Tolerance on capacitance	±2% or ±0.25 pF
Temperature coefficients	P100, NP0, N075, N150, N220, N330, N470, N750 and N1500
Sectional specification	IEC 384-8
Climatic category (IEC 68)	55/085/21



Class 1 (non-flanged types)

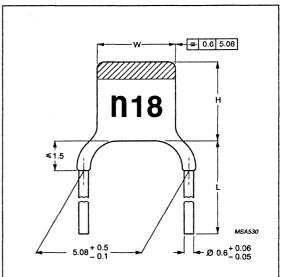
MECHANICAL DATA



Dimensions in mm.

For dimensions H, L and W see Tables 1 and 2.

Fig.2 Component outline style 1.



Dimensions in mm.

For dimensions H, L and W see Tables 1 and 2.

Fig.3 Component outline style 2.

Marking

The temperature coefficient is indicated by a colour code in accordance with IEC and EIA recommendations. Capacitance value and voltage are indicated by a marking code in a contrasting colour on the body. Refer to the Tables of Data Sheet Class 1 (flanged types) for marking codes.

Mounting

When bending, cutting or flattening, the leads should be relieved of the applied load by supporting them at the capacitor body.

Soldering conditions: max. 265 °C, max. 10 s.

Table 1 Capacitor dimensions

SIZE (note 1)	W (note 2) (mm)	H (note 2) (mm)	APPROX. MASS (g)
1	3.6 (-1.1)	3.7 (-1.2)	0.14
IIA	3.9 (–1.4)	4.0 (–1.5)	0.15
IIB	4.5 (–1.8)	4.7 (–2.0)	0.16
III	5.1 (–1.8)	5.3 (-2.0)	0.17
IV .	6.2 (-2.0)	6.4 (-2.2)	0.20
V	6.2 (–2.0)	8.6 (–2.6)	0.23

Notes

- Unless indicated in the Tables of Data Sheet Class 1 (flanged types) the thickness of the capacitors does not exceed 2.3 mm. Capacitors exceeding this thickness also have H_{max} = 4.5 mm.
- 2. Tolerances are given between brackets.

Class 1 (non-flanged types)

Lacquer on the leads

When the capacitors shown in Figs 2 and 3 are mounted on printed-circuit boards with a thickness of 1.5 mm and with holes of 1.3 mm diameter or on printed-circuit boards with a thickness of 1 mm and with holes of 0.8 mm diameter there will be no lacquer on the leads at the lower side of the board. For capacitors with maximum thickness greater than 2.3 mm and lead pitch of 5.08 mm, the lacquer on the leads extends less than 2 mm.

PACKING

Refer to the General section for Miniature Ceramic Plate Capacitors.

Table 2 Ordering information

			CATALOGUE NUMBERS (note 1)		
PITCH	LEAD DIAMETER	STYLE	L ≥15 mm	$L = 6^{+0}_{-2} \text{ mm}$	
2.54 mm (0.1 in)	0.6 mm (0.024 in)	1	2222 631	2222 641	
5.08 mm (0.2 in)	0.6 mm (0.024 in)	2	2222 638	2222 642	

Note

 Catalogue number to be completed by adding code for required capacitance value. Refer to the Tables of Data Sheet Class 1 (flanged types) for catalogue numbers.



Class 2 (non-flanged types)

FEATURES

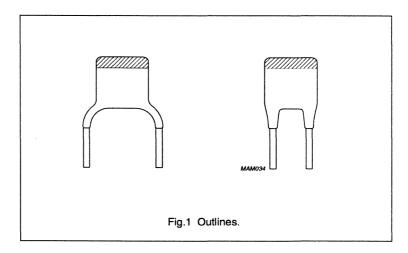
- General purpose
- · Coupling and decoupling
- · Space saving.

APPLICATIONS

Ceramic plate capacitors without flange are not for current design projects. They are recommended for maintenance purposes only. The electrical properties are identical to capacitors with flanged leads.

DESCRIPTION

The capacitors consist of a thin rectangular ceramic plate, both sides of which are metallized. The tinned connecting leads are secured using a high melting point solder. The capacitors are encapsulated in epoxy lacquer, which is resistant to all commonly used cleaning solvents. They have small dimensions and narrow tolerances on the lead spacing.



QUICK REFERENCE DATA

Parameter	2222 630 series	2222 640 series	2222 629 series	
Capacitance range	180 to 6 800 pF (E12 series)	1 000 to 15 000 pF (E6 series)	1 000 to 47 000 pF (E3 series)	
Dielectric material	K2000	K5000	K14000	
Rated DC voltage	100 V	100 V	63 V	
Tolerance on capacitance	±10%	-20/+50%	-20/+80%	
Sectional specification	IEC 384-9 (2C2)	IEC 384-9 (2E2)	IEC 384-9	
Climatic category (IEC 68)	55/085/21	55/085/21	10/055/21	

Miniature ceramic plate capacitors

Class 2 (non-flanged types)

MECHANICAL DATA

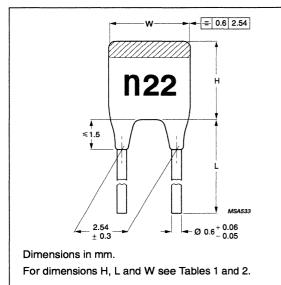
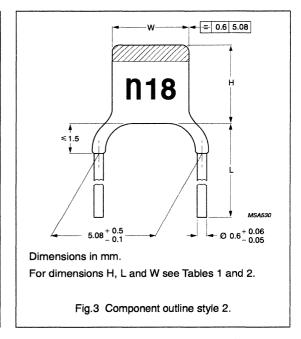


Fig.2 Component outline style 1.



Marking

The body of the capacitors is tan coloured. The capacitors also have a colour mark on top indicating the temperature dependence of the capacitance;

yellow for type 2222 630 blue for type 2222 640 green for type 2222 629.

The capacitance value is indicated by a marking code in a contrasting colour on the body. Refer to the Tables of Data Sheet Class 2 (flanged type)

Mounting

for marking codes.

When bending, cutting or flattening, the leads should be relieved of the applied load by supporting them at the capacitor body.

Soldering conditions: max. 265 °C, max. 10 s.

Table 1 Capacitor dimensions

SIZE (note 1)	(note 2) (note 2)		APPROX. MASS (g)	
1	3.6 (-1.1)	3.7 (-1.2)	0.14	
IIA	3.9 (–1.4)	4.0 (–1.5)	0.15	
IIB	4.5 (-1.8)	4.7 (-2.0)	0.16	
III	5.1 (-1.8)	5.3 (-2.0)	0.17	
IV	6.2 (-2.0)	6.4 (-2.2)	0.20	
V	6.2 (–2.0)	8.6 (-2.6)	0.23	

Notes

- The thickness of the capacitors does not exceed 2.3 mm with the exception of 2222 630 ...181 (maximum thickness 2.5 mm).
- 2. Tolerances are given between brackets.

Miniature ceramic plate capacitors

Class 2 (non-flanged types)

Lacquer on the leads

When the capacitors shown in Figs 2 and 3 are mounted on printed-circuit boards with a thickness of 1.5 mm and with holes of 1.3 mm diameter or on printed-circuit boards with a thickness of 1 mm and with holes of 0.8 mm diameter there will be no lacquer on the leads at the lower side of the board. For capacitors with maximum thickness greater than 2.3 mm and lead pitch of 5.08 mm, the lacquer on the leads extends less than 2 mm.

PACKING

Refer to the General section for Miniature Ceramic Plate Capacitors.

Table 2 Ordering information

			CATALOGUE N	CATALOGUE NUMBERS (note 1)		
PITCH	LEAD DIAMETER STYLE	L ≥15 mm	$L = 6^{+0}_{-2} \text{ mm}$			
2.54 mm	0.6 mm	1	2222 630 01	2222 630 05		
(0.1 in)	(0.1 in) (0.024 in)	·	2222 640 01	2222 640 05		
	·		2222 629 01	2222 629 05		
5.08 mm	0.6 mm	2	2222 630 03	2222 630 06		
(0.2 in)	(0.2 in) (0.024 in)		2222 640 03	2222 640 06		
			2222 629 03	2222 629 06		

Note

 Catalogue number to be completed by adding code for required capacitance values. Refer to the Tables of Data Sheet Class 2 (flanged type).

Class 1, 500 V (DC) (flanged types)

FEATURES

- · High-frequency circuits
- Temperature compensating
- · High stability
- · Space saving.

APPLICATIONS

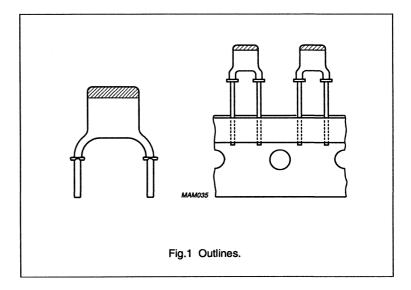
In a great variety of electronic circuits, e.g. in filters and tuning circuits where high stability and/or temperature compensation are a requirement. Because of their small size the capacitors are suitable for use in circuitry with high component density.

DESCRIPTION

The capacitors consist of a thin rectangular ceramic plate, both sides of which are metallized, and tinned connecting leads are secured using a high melting point solder. The capacitors are encapsulated in epoxy lacquer, which is resistant to all commonly used cleaning solvents. They have small dimensions and narrow tolerances on the lead spacing. The leads are provided with a flange, which guarantees that the leads are free of lacquer, and its shape allows soldering gasses to escape freely, ensuring excellent solderability. This makes the capacitors suitable for both hand mounting and automatic insertion. The electrical properties are characterized by low losses, a narrow tolerance on capacitance (±0.25 pF or 2%), high stability and, owing to the absence of silver, an extremely good DC behaviour.

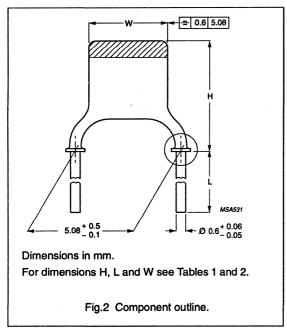
QUICK REFERENCE DATA

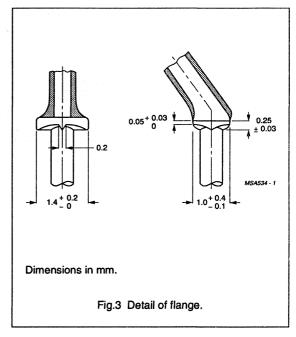
Capacitance range	0.47 to 270 pF (E12 series)
Rated DC voltage	500 V
Tolerance on capacitance	±2% or ±0.25 pF
Temperature coefficients	P100, NP0, N150, N750 and N1500
Sectional specification	IEC 384-8
Climatic category (IEC 68)	55/085/21



Class 1, 500 V (DC) (flanged types)

MECHANICAL DATA





Marking

The body of the capacitors is coloured grey. The temperature coefficient is indicated by a colour code in accordance with IEC and EIA recommendations. Capacitance value and voltage are indicated by a marking code in a contrasting colour on the body. Refer to Tables 3 to 7, for marking codes.

Mounting

When bending, cutting or flattening, the leads should be relieved of the applied load by supporting them at the capacitor body.

Soldering conditions: max. 265 °C, max. 10 s.

The capacitors are suitable for mounting on printed-circuit boards (hand mounting or automatic insertion).

Table 1 Capacitor dimensions

SIZE (note 1)	(note 2) (note 2)		APPROX. MASS (g)
ı	3.6 (–1.1)	6.3 (-1.8)	0.14
IIA	3.9 (–1.4)	6.7 (–2.0)	0.15
IIВ	4.5 (–1.8)	7.3 (–2.4)	0.15
JII	5.1 (–1.8)	7.9 (–2.6)	0.17
IV	6.2 (–2.0)	9.0 (–2.7)	0.20
V	6.2 (-2.0)	11.2 (-3.1)	0.23

Notes

- Unless indicated in Tables 3 to 7, the thickness of the capacitors does not exceed 2.3 mm.
- 2. Tolerances are given between brackets.

Class 1, 500 V (DC) (flanged types)

PACKING

Refer to the General section for Miniature Ceramic Plate Capacitors.

Table 2 Ordering information

		CATALOGUE NUMBERS (note 1)				
PITCH	LEAD	BULK PACKED			ON TAPE	ON TAPE
PITCH	DIAMETER	L≥13 mm	13 mm L = 4 ±0.5 mm (REEL)	(note 2) (AMMUNITION PACK)	(note 3) (AMMUNITION PACK)	
5.08 mm (0.2 in)	0.6 mm (0.024 in)	2222 652	2222 653	2222 654	2222 692	2222 691

Notes

- 1. Catalogue numbers to be completed by adding code for required capacitance value, see Tables 3 to 7.
- 2. $H_0 = 16 \text{ mm}$.
- 3. $H_0 = 18.25 \text{ mm}$.

ELECTRICAL CHARACTERISTICS

The capacitors meet the essential requirements of IEC 384-8. Unless stated otherwise 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%.

Capacitance values (note 1) E12 series (see Tables 3 to 7) measured at 1 MHz, ≤5 V	0.47 to 270 pF
Rated DC voltage	500 V
DC test voltage; duration 1 minute	1 250 V
DC test voltage of coating; duration 1 minute	1 250 V
Insulation resistance at 500 V (DC) after 1 minute	>10 000 MΩ
Tan δ (note1) measured at 1 MHz, ≤5 V;	
C <50 pF	$\leq 15 \left(\frac{15}{C} + 0.7 \right) \times 10^{-4}$
C >50 pF	≤15 × 10 ⁻⁴
Category temperature range	−55 to +85 °C
Storage temperature range	−55 to +85 °C
Climatic category (IEC 68)	55/085/21

Note

1. Including 2 mm per connecting lead.

Class 1, 500 V (DC) (flanged types)

Capacitors with temperature coefficient P100

Capacitance range	0.47 to 33 pF (E12 series)
Temperature coefficient of the capacitance ($\frac{\Delta C}{C.\Delta T}$)	+100 × 10 ⁻⁶ /K
Tolerance on the temperature coefficient	±30 × 10 ⁻⁶ /K
Marking colour of the temperature coefficient	red/violet

Table 3 Capacitance range, temperature coefficient P100

CAPACITANCE			MARKII	NG CODE	SUFFIX OF
VALUE (note 1) (pF)	TOLERANCE	SIZE (see Table 1)	VALUE	VOLTAGE	CATALOGUE NUMBER (see Table 2)
0.47 (note 2)	±0.25 pF	1	p47	500	03477
0.56	±0.25 pF	1	p56	500	03567
0.68	±0.25 pF	1	p68	500	03687
0.82	±0.25 pF	1	p82	500	03827
1.0	±0.25 pF	ı	1p0	500	03108
1.2	±0.25 pF	- I	1p2	500	03128
1.5 (note 2)	±0.25 pF	1	1p5	500	03158
1.8	±0.25 pF	1	1p8	500	03188
2.2	±0.25 pF	I I	2p2	500	03228
2.7	±0.25 pF	1	2p7	500	03278
3.3	±0.25 pF	1	3p3	500	03338
3.9	±0.25 pF	1	3p9	500	03398
4.7	±0.25 pF	IIA	4p7	500	03478
5.6	±0.25 pF	IIA	5p6	500	03568
6.8	±0.25 pF	IIB	6p8	500	03688
8.2	±0.25 pF	IIB	8p2	500	03828
10	±2%	111	10p	500	04109
12	±2%	111	12p	500	04129
15	±2%	111	15p	500	04159
18	±2%	IV	18p	500	04189
22	±2%	IV	22p	500	04229
27	±2%	v	27p	500	04279
33	±2%	v	33p	500	04339

Notes

- 1. Other capacitance values and tolerances are available on request.
- 2. Maximum thickness 2.5 mm.

Miniature ceramic plate capacitors

Class 1, 500 V (DC) (flanged types)

Capacitors with temperature coefficient NP0

Capacitance range	0.82 to 150 pF (E12 series)
Temperature coefficient of the capacitance ($\frac{\Delta C}{C.\Delta T}$)	0 × 10 ⁻⁹ /K
Tolerance on the temperature coefficient	±30 × 10 ⁻⁶ /K
Marking colour of the temperature coefficient	black

Table 4 Capacitance range, temperature coefficient NP0

CAPACITANCE			MARKIN	IG CODE	SUFFIX OF
VALUE (note 1) (pF)	TOLERANCE	SIZE (see Table 1)	VALUE	VOLTAGE	CATALOGUE NUMBER (see Table 3)
0.82 (note 2)	±0.25 pF	ı	p82	500	09827
1.0 (note 2)	±0.25 pF	1	1p0	500	09108
1.2	±0.25 pF	· 1	1p2	500	09128
1.5	±0.25 pF	1	1p5	500	09158
1.8	±0.25 pF	1	1p8	500	09188
2.2	±0.25 pF	ı	2p2	500	09228
2.7	±0.25 pF	1	2p7	500	09278
3.3	±0.25 pF	· 1	3p3	500	09338
3.9	±0.25 pF	1	3p9	500	09398
4.7	±0.25 pF	1	4p7	500	09478
5.6	±0.25 pF	1	5p6	500	09568
6.8	±0.25 pF	ı	6p8	500	09688
8.2	±0.25 pF	1	8p2	500	09828

Class 1, 500 V (DC) (flanged types)

CAPACITANCE			MARKIN	IG CODE	SUFFIX OF
VALUE (note 1) (pF)	TOLERANCE	SIZE (see Table 1)	VALUE	VOLTAGE	CATALOGUE NUMBER (see Table 3)
10	±2%	1,	10p	500	10109
12	±2%	Lagrani	12p	500	10129
15	±2%	IIA	15p	500	10159
18	±2%	IIA	18p	500	10189
22	±2%	IIA	22p	500	10229
27	±2%	IIB	27p	500	10279
33	±2%	IIB	33p	500	10339
39	±2%	IIB	39p	500	10399
47	±2%	111	47p	500	10479
56	±2%	111	56p	500	10569
68	±2%	IV	68p	500	10689
82	±2%	IV	82p	500	10829
100	±2%	IV	n10	500	10101
120	±2%	V	n12	500	10121
150	±2%	V	n15	500	10151

Notes

- 1. Other capacitance values and tolerances are available on request.
- 2. Maximum thickness 2.5 mm.

Miniature ceramic plate capacitors

Class 1, 500 V (DC) (flanged types)

Capacitors with temperature coefficient N150

Capacitance range	2.2 to 150 pF (E12 series)
Temperature coefficient of the capacitance ($\frac{\Delta C}{C.\Delta T}$)	–150 × 10 ⁻⁶ /K
Tolerance on the temperature coefficient	±30 × 10 ⁻⁶ /K
Marking colour of the temperature coefficient	orange

Table 5 Capacitance range, temperature coefficient N150

CAPACITANCE			MARKIN	G CODE	SUFFIX OF
VALUE (note 1) (pF)	TOLERANCE	SIZE (see Table 1)	VALUE	VOLTAGE	CATALOGUE NUMBER (see Table 3)
2.2 (note 2)	±0.25 pF	1	2p2	500	33228
2.7 (note 2)	±0.25 pF	1	2p7	500	33278
3.3	±0.25 pF	1	3p3	500	33338
3.9	±0.25 pF	1	3p9	500	33398
4.7	±0.25 pF	1	4p7	500	33478
5.6	±0.25 pF	. 1	5p6	500	33568
6.8	±0.25 pF	1	6p8	500	33688
8.2	±0.25 pF	1	8p2	500	33828
10	±2%	l	10p	500	34109
12	±2%	. 1	12p	500	34129
15	±2%	IIA	15p	500	34159
18	±2%	IIA	18p	500	34189
22	±2%	IIA	22p	500	34229
27	±2%	IIB	27p	500	34279
33	±2%	IIB	33p	500	34339
39	±2%	IIB	39p	500	34399
47	±2%	111	47p	500	34479
56	±2%	·III	56p	500	34569
68	±2%	IV	68p	500	34689
82	±2%	IV	82p	500	34829
100	±2%	IV	n10	500	34101
120	±2%	v	n12	500	34121
150	±2%	V	n15	500	34151

Notes

- 1. Other capacitance values and tolerances are available on request.
- 2. Maximum thickness 2.5 mm.

Miniature ceramic plate capacitors

Class 1, 500 V (DC) (flanged types)

Capacitors with temperature coefficient N750

Capacitance range	1.8 to 120 pF (E12 series)
Temperature coefficient of the capacitance ($\frac{\Delta C}{C.\Delta T}$)	−750 × 10 ⁻⁶ /K
Tolerance on the temperature coefficient	±120 × 10 ⁻⁶ /K
Marking colour of the temperature coefficient	violet

Table 6 Capacitance range, temperature coefficient N750

CAPACITANCE			MARKIN	IG CODE	SUFFIX OF
VALUE (note 1) (pF)	TOLERANCE	SIZE (see Table 1)	VALUE	VOLTAGE	CATALOGUE NUMBER (see Table 3)
1.8 (note 2)	±0.25 pF	ı	1p8	500	57188
2.2 (note 3)	±0.25 pF	ı	2p2	500	57228
2.7	±0.25 pF	1	2p7	500	57278
3.3	±0.25 pF	ı	3p3	500	57338
3.9	±0.25 pF	1	3p9	500	57398
4.7 (note 3)	±0.25 pF	ı	4p7	500	57478
5.6	±0.25 pF	ı	5p6	500	57568
6.8	±0.25 pF	1	6p8	500	57688
8.2	±0.25 pF	1	8p2	500	57828
10	±2%	ı	10p	500	58109
12	±2%	ı	12p	500	58129
15	±2%	1	15p	500	58159
18	±2%	IIA	18p	500	58189
22	±2%	IIA	22p	500	58229
27	±2%	IIB	27p	500	58279
33	±2%	IIB	33p	500	58339
39	±2%	IIB	39p	500	58399
47	±2%	111	47p	500	58479
56	±2%	- 111	56p	500	58569
68	±2%	IV	68p	500	58689
82	±2%	IV	82p	500	58829
100	±2%	IV 1	n10	500	58101
120	±2%	V	n12	500	58121

Notes

- 1. Other capacitance values and tolerances are available on request.
- 2. Maximum thickness 2.7 mm.
- 3. Maximum thickness 2.5 mm.

Miniature ceramic plate capacitors

Class 1, 500 V (DC) (flanged types)

Capacitors with temperature coefficient N1500

Capacitance range	8.2 to 270 pF (E12 series)
Temperature coefficient of the capacitance ($\frac{\Delta C}{C.\Delta T}$)	–1500 × 10 ⁻⁶ /K
Tolerance on the temperature coefficient	(-0 + 500) × 10 ⁻⁶ /K
Marking colour of the temperature coefficient	orange/orange

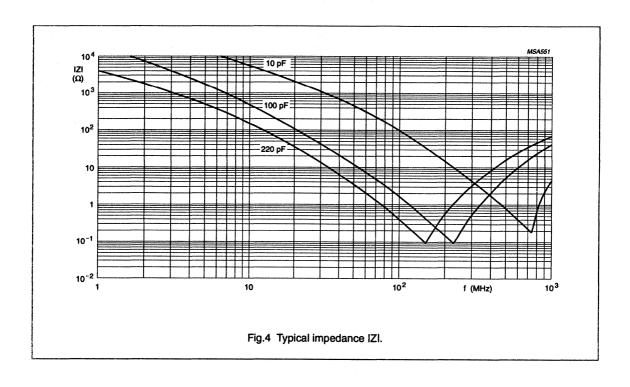
Table 7 Capacitance range, temperature coefficient N1500

CAPACITANCE				G CODE	SUFFIX OF
VALUE (note 1) (pF)	TOLERANCE	SIZE (see Table 1)	VALUE	VOLTAGE	CATALOGUE NUMBER (see Table 3)
8.2 (note 2)	±0.25 pF	1	8p2	500	69828
10 (note 3)	±2%	. 1	10p	500	70109
12 (note 3)	±2%	1	12p	500	70129
15	±2%	1	15p	500	70159
18	±2%	- 1	18p	500	70189
22	±2%	1	22p	500	70229
27	±2%	1	27p	500	70279
33	±2%	IIA	33p	500	70339
39	±2%	IIA	39p	500	70399
47	±2%	IIA	47p	500	70479
56	±2%	IIB	56p	500	70569
68	±2%	IIB	68p	500	70689
82	±2%	IIB	82p	500	70829
100	±2%	· III	n10	500	70101
120	±2%		n12	500	70121
150	±2%	IV	n15	500	70151
180	±2%	IV	n18	500	70181
220	±2%	IV	n22	500	70221
270	±2%	V	n27	500	70271

Notes

- 1. Other capacitance values and tolerances are available on request.
- 2. Maximum thickness 3.0 mm.
- 3. Maximum thickness 2.5 mm.

Class 1, 500 V (DC) (flanged types)



Class 2, 500 V (DC) (flanged type)

FEATURES

- · General purpose
- · Coupling and decoupling
- · Space saving.

APPLICATIONS

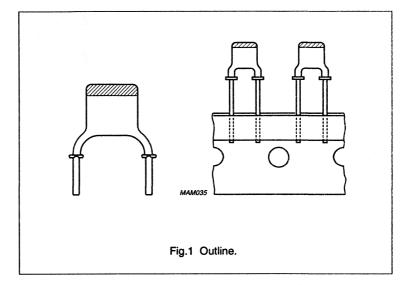
In electronic circuits where non-linear change of capacitance with temperature is permissible and low losses are not essential, e.g. coupling and decoupling. Because of their small size, the capacitors are ideal for circuitry with high component density.

DESCRIPTION

The capacitors consist of a thin rectangular ceramic plate, both sides of which are metallized. The tinned connecting leads are secured using a high melting point solder. The capacitors are encapsulated in epoxy lacquer, which is resistant to all commonly used cleaning solvents. They have small dimensions and narrow tolerances on the lead spacing. The leads are provided with a flange. The flange guarantees that the leads are free of lacquer, and its shape allows soldering gasses to escape freely, ensuring excellent solderability. This makes the capacitors suitable for both hand mounting and automatic insertion.

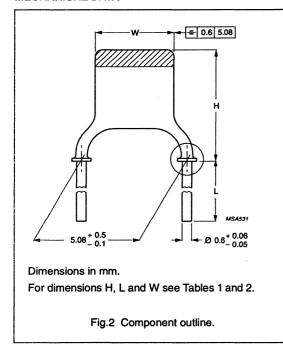
QUICK REFERENCE DATA

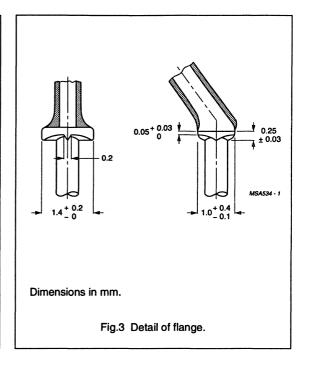
Capacitance range	100 to 4 700 pF (E12 series)
Dielectric material	K2000
Rated DC voltage	500 V
Tolerance on capacitance	±10%
Sectional specification	IEC 384-9 (2C2)
Climatic category (IEC 68)	55/085/21



Class 2, 500 V (DC) (flanged type)

MECHANICAL DATA





Marking

The body of the capacitors is tan coloured. The temperature dependence is indicated by a yellow colour cap. Capacitance value and voltage are indicated by a marking code in a contrasting colour on the body. Refer to Table 3 for marking codes.

Mounting

When bending, cutting or flattening, the leads should be relieved of the applied load by supporting them at the capacitor body.

Soldering conditions: max. 265 °C, max. 10 s.

The capacitors are suitable for mounting on printed-circuit boards (hand mounting or automatic insertion).

Table 1 Capacitor dimensions

SIZE (note 1)	W (note 2) (mm)	H (note 2) (mm)	APPROX. MASS
ı	3.6 (-1.1)	6.3 (-1.8)	0.14
IIA	3.9 (-1.4)	6.7 (-2.0)	0.15
IIB	4.5 (-1.8)	7.3 (–2.4)	0.15
lii ii	5.1 (-1.8)	7.9 (-2.6)	0.17
IV	6.2 (-2.0)	9.0 (-2.7)	0.20
V	6.2 (-2.0)	11.2 (-3.1)	0.23

Notes

- Unless indicated in Table 3, the thickness of the capacitors does not exceed 2.3 mm.
- 2. Tolerances are given between brackets.

Miniature ceramic plate capacitors

Class 2, 500 V (DC) (flanged type)

PACKING

Refer to the General section for Miniature Ceramic Plate Capacitors.

Table 2 Ordering information

		CATALOGUE NUMBERS (note 1)					
PITCH	LEAD	BULK PACKED			ON TAPE	ON TAPE	
PITON	DIAMETER	L ≥13 mm	L = 4 ±0.5 mm	ON TAPE (REEL)	(note 2) (AMMUNITION PACK)	(note 3) (AMMUNITION PACK)	
5.08 mm (0.2 in)	0.6 mm (0.024 in)	2222 655 09	2222 655 19	2222 655 53	2222 655 64	2222 655 63	

Notes

- 1. Catalogue numbers to be completed by adding code for required capacitance value, see Table 3.
- 2. $H_0 = 16 \text{ mm}$.
- 3. $H_0 = 18.25 \text{ mm}$.

ELECTRICAL CHARACTERISTICS

The capacitors meet the essential requirements of IEC 384-9. Unless stated otherwise 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%.

Capacitance values measured at 1 kHz, 1 V	100 to 4 700 pF (E12 series)
Tolerance on the capacitance, after 1 000 hours	±10%
Dielectric material	K2000
Rated DC voltage	500 V
DC test voltage; duration 1 minute	1 250 V
DC test voltage of coating; duration 1 minute	1 250 V
Insulation resistance at 500 V (DC) after 1 minute	>4 000 MΩ
Tan δ measured at 1 kHz, 1 V	<3.5%
Category temperature range	-55 to +85 °C
Storage temperature range	−55 to +85 °C
Capacitance change versus temperature	see Fig.4
Capacitance change versus frequency	see Fig.5
Climatic category (IEC 68)	55/085/21
Ageing	typical, 1.5% per time decade

Miniature ceramic plate capacitors

Class 2, 500 V (DC) (flanged type)

Table 3 Range of values

CAPACITANCE VALUE (pF)	SIZE (see Table 1)	MARKING	SUFFIX OF CATALOGUE NUMBERS (see Table 2)
100 (note 1)	<u> </u>	n10 500	101
120 (note 2)	l	n12 500	121
150	1	n15 500	151
180	l	n18 500	181
220		n22 500	221
270	l	n27 500	271
330		n33 500	331
390	l	n39 500	391
470	IIA	n47 500	471
560	IIA	n56 500	561
680	IIB	n68 500	681
820	IIB	n82 500	821
1 000	IIB	1n0 500	102
1 200	IIB	1n2 500	122
1 500	III	1n5 500	152
1 800	III	1n8 500	182
2 200	IV	2n2 500	222
2 700	IV	2n7 500	272
3 300	٧	3n3 500	332
3 900	٧	3n9 500	392
4 700	٧	4n7 500	472

Notes

- 1. Maximum thickness 2.7 mm.
- 2. Maximum thickness 2.5 mm.

Class 2, 500 V (DC) (flanged type)

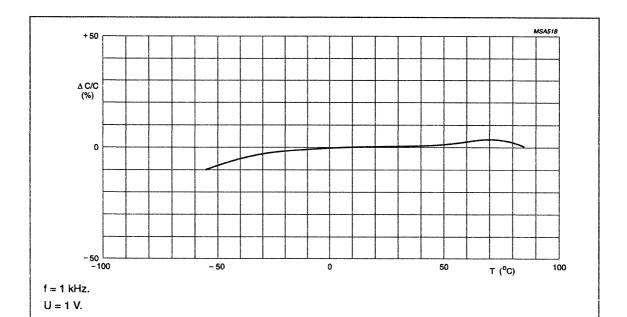
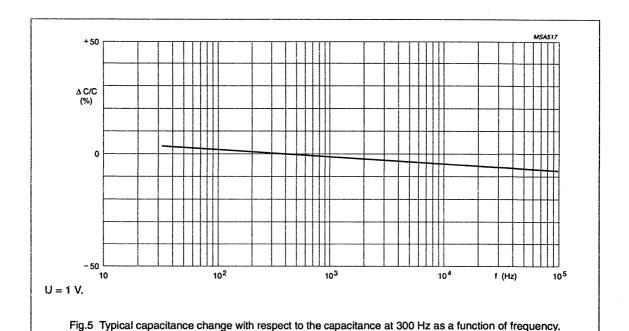
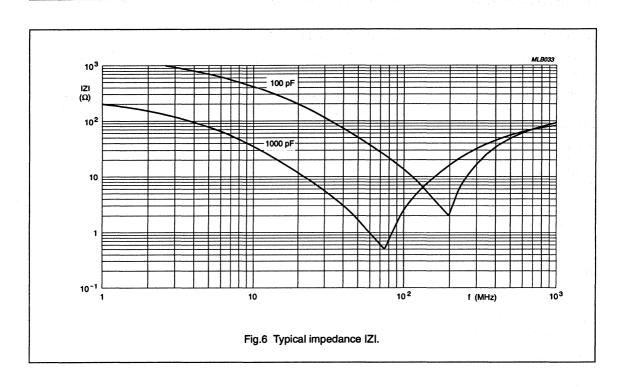


Fig.4 Typical capacitance change with respect to the capacitance at 20 °C as a function of temperature.



Class 2, 500 V (DC) (flanged type)



Class 2, 1 000 V (DC) (flanged type)

FEATURES

- General purpose
- · Coupling and decoupling
- · Space saving.

APPLICATIONS

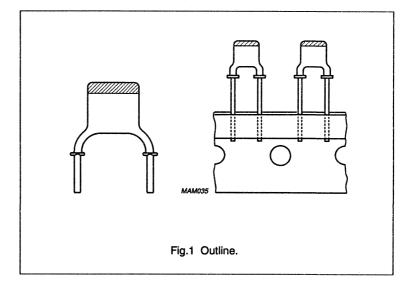
In electronic circuits where non-linear change of capacitance with temperature is permissible and low losses are not essential, e.g. coupling and decoupling. Because of their small size, the capacitors are ideal for circuitry with high component density.

DESCRIPTION

The capacitors consist of a thin rectangular ceramic plate, both sides of which are metallized. The tinned connecting leads are secured using a high melting point solder. The capacitors are encapsulated in epoxy lacquer, which is resistant to all commonly used cleaning solvents. They have small dimensions and narrow tolerances on the lead spacing. The leads are provided with a flange. The flange guarantees that the leads are free of lacquer, and its shape allows soldering gasses to escape freely, ensuring excellent solderability. This makes the capacitors suitable for both hand mounting and automatic insertion.

QUICK REFERENCE DATA

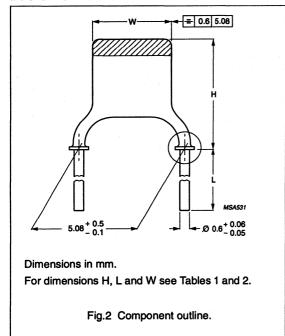
Capacitance range	100 to 1 200 pF (E12 series)
Rated DC voltage	1 000 V
Tolerance on capacitance	±10%
Sectional specification	IEC 384-9 (2C2)
Climatic category (IEC 68)	55/085/21

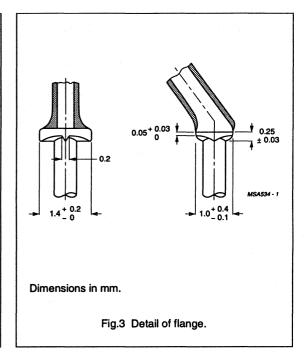


Miniature ceramic plate capacitors

Class 2, 1 000 V (DC) (flanged type)

MECHANICAL DATA





Marking

The body of the capacitors is tan coloured. The temperature dependence is indicated by a yellow colour cap. Capacitance value and voltage are indicated by a marking code in a red colour on the body. Refer to Table 3 for marking codes.

Mounting

When bending, cutting or flattening, the leads should be relieved of the applied load by supporting them at the capacitor body.

Soldering conditions: max. 260 °C, max. 10 s.

The capacitors are suitable for mounting on printed-circuit boards (hand mounting or automatic insertion).

Table 1 Capacitor dimensions

SIZE (note 1)	W (note 2) (mm)	H (note 2) (mm)	APPROX. MASS (g)
I	3.6 (-1.1)	6.3 (-1.8)	0.15
IIA	3.9 (-1.4)	6.7 (-2.0)	0.15
IIB	4.5 (-1.8)	7.3 (-2.4)	0.18
l m	5.1 (-1.8)	7.9 (-2.6)	0.22
IV	6.2 (-2.0)	9.0 (-2.7)	0.33
V	6.2 (-2.0)	11.2 (-3.1)	0.47

Notes

- Unless indicated in Table 3, the thickness of the capacitors does not exceed 2.7 mm.
- 2. Tolerances are given between brackets.

Class 2, 1 000 V (DC) (flanged type)

PACKING

Refer to the General section for Miniature Ceramic Plate Capacitors.

Table 2 Ordering information

		CATALOGUE NUMBERS (note 1)				
PITCH LEAD		BULK PACKED		ON TAPE	ON TAPE	ON TAPE
FIICH	DIAMETER	L ≥13 mm	L = 4 ±0.5 mm	(note 3) (REEL)	(note 2) (AMMUNITION PACK)	(note 3) (AMMUNITION PACK)
5.08 mm (0.2 in)	0.6 mm (0.024 in)	2222 693 09	2222 693 19	2222 693 53	2222 693 64	2222 693 63

Notes

- 1. Catalogue numbers to be completed by adding code for required capacitance value, see Table 3.
- 2. $H_0 = 16 \text{ mm}$.
- 3. $H_0 = 18.25 \text{ mm}$.

ELECTRICAL CHARACTERISTICS

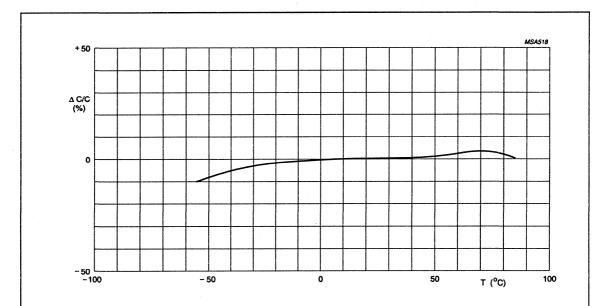
The capacitors meet the essential requirements of IEC 384-9. Unless stated otherwise all electrical values apply at an ambient temperature of 20 ±1 °C, an atmospheric pressure of 86 to 106 kPa and a relative humidity of 63 to 67%.

Capacitance values measured at 1 kHz, 1 V	100 to 1 200 pF (E12 series)
Tolerance on the capacitance, after 1 000 hours	±10%
Rated DC voltage	1 000 V
DC test voltage; duration 1 minute	2 000 V
DC test voltage of coating; duration 1 minute	2 000 V
Insulation resistance at 1 000 V (DC) after 1 minute	>6 000 MΩ
Tan δ measured at 1 kHz, 1 V	<3.5%
Category temperature range	−55 to +85 °C
Storage temperature range	−55 to +85 °C
Capacitance change versus temperature	see Fig.4
Capacitance change versus frequency	see Fig.5
Climatic category (IEC 68)	55/085/21
Ageing	typical, 1.5% per time decade

Class 2, 1 000 V (DC) (flanged type)

Table 3 Range of values

CAPACITANCE VALUE (pF)	SIZE (see Table 1)	MARKING	SUFFIX OF CATALOGUE NUMBERS (see Table 2)
100		n10	101
120	i a sa li	n12	121
150	IIA	n15	151
180	IIA	n18	181
220	IIB	n22	221
270	IIB	n27	271
330	IIB	n33	331
390	111	n39	391
470	III	n47	471
560	IV	n56	561
680	IV	n68	681
820	IV	n82	821
1 000	V	1n0	102
1 200	V	1n2	122



f = 1 kHz. U = 1 V.

Fig.4 Typical capacitance change with respect to the capacitance at 20 °C as a function of temperature.

Class 2, 1 000 V (DC) (flanged type)

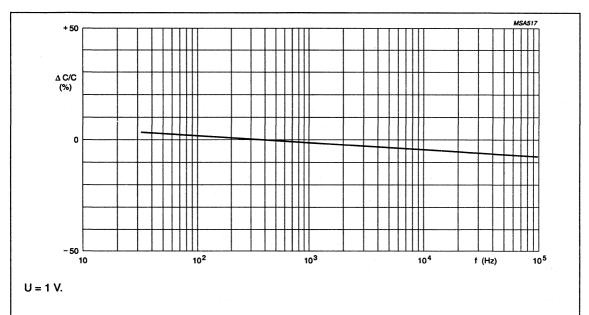
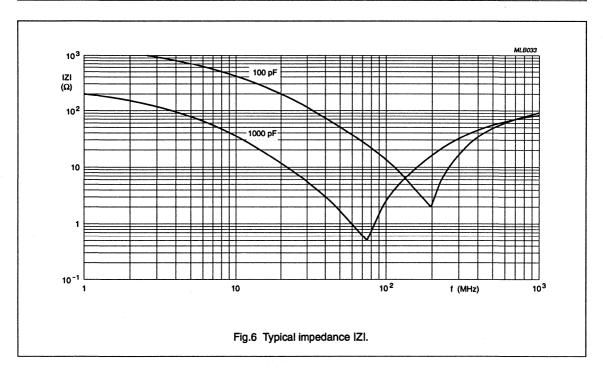


Fig.5 Typical capacitance change with respect to the capacitance at 300 Hz as a function of frequency.



Class 1, 500 V (DC) (non-flanged types)

FEATURES

- High-frequency circuits
- · Temperature compensating
- · High stability
- · Space saving.

APPLICATIONS

Ceramic plate capacitors without flange are not for current design projects. They are recommended for maintenance purposes only. The electrical properties are identical to capacitors with flanged leads.

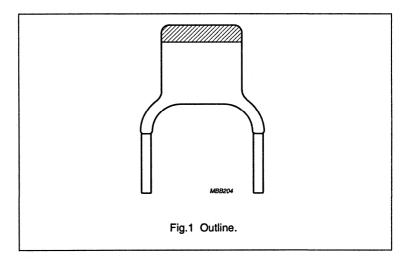
DESCRIPTION

April 1993

The capacitors consist of a thin rectangular ceramic plate, both sides of which are metallized. The tinned connecting leads are secured using a high melting point solder. The capacitors are encapsulated in epoxy lacquer, which is resistant to all commonly used cleaning solvents. They have small dimensions and narrow tolerances on the lead spacing. The electrical properties are characterized by low losses, a narrow tolerance on capacitance (±0.25 pF or 2%), high stability and, owing to the absence of silver, an extremely good DC behaviour.

QUICK REFERENCE DATA

Capacitance range	0.47 to 270 pF (E12 series)
Rated DC voltage	500 V
Tolerance on capacitance	±2% or ±0.25 pF
Temperature coefficients	P100, NP0, N150, N750 and N1500
Sectional specification	IEC 384-8
Climatic category (IEC 68)	55/085/21



Class 1, 500 V (DC) (non-flanged types)

MECHANICAL DATA

Marking

The temperature coefficient is indicated by a colour code in accordance with IEC and EIA recommendations. Capacitance value and voltage are indicated by a marking code in a contrasting colour on the body. Refer to the Tables of Data Sheet Class 1, 500 V (DC) (flanged types) for marking codes.

Mounting

When bending, cutting or flattening, the leads should be relieved of the applied load by supporting them at the capacitor body.

Soldering conditions: max. 265 °C, max. 10 s.

The capacitors are suitable for mounting on printed-circuit boards (hand mounting or automatic insertion).

Lacquer on the leads

When the capacitors are mounted on printed-circuit boards with a thickness of 1.5 mm and with holes of 1.3 mm diameter or on printed-circuit boards with a thickness of 1 mm and with holes of 0.8 mm diameter there will be no lacquer on the leads at the lower side of the board. For capacitors with maximum thickness greater than 2.3 mm and lead pitch of 5.08 mm, the lacquer on the leads extends less than 2 mm.

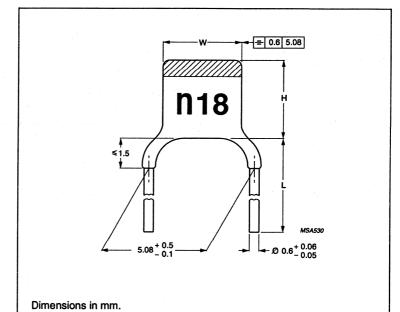


Table 1 Capacitor dimensions

SIZE (note 1)	W (note 2) (mm)	H (notes 2 and 3) (mm)	APPROX. MASS (g)
I	3.6 (-1.1)	3.7 (-1.2)	0.14
IIA	3.9 (-1.4)	4.0 (–1.5)	0.15
IIB	4.5 (-1.8)	4.7 (-2.0)	0.16
111	5.1 (-1.8)	5.3 (-2.0)	0.17
IV	6.2 (-2.0)	6.4 (-2.2)	0.20
V	6.2 (-2.0)	8.6 (-2.6)	0.23

Fig.2 Component outline.

Notes

- Unless indicated in the Tables of Data Sheet Class 1 (flanged types) the thickness of the capacitors does not exceed 2.3 mm.
- 2. Tolerances are given between brackets.
- 3. The H_{max} of the indicated capacitors is 4.5 mm.

For dimensions H, L and W see Tables 1 and 2.

Class 1, 500 V (DC) (non-flanged types)

PACKING

Refer to the General section for Miniature Ceramic Plate Capacitors.

Table 2 Ordering information

		CATALOGUE NUMBERS (note 1)	
PITCH	LEAD DIAMETER	L ≥15 mm	$L = 6^{+0}_{-2} \text{ mm}$
5.08 mm (0.2 in)	0.6 mm (0.024 in)	2222 650	2222 651

Note

 Catalogue number to be completed by adding code for required capacitance value. Refer to the Tables of Data Sheet Class 1 (flanged types) for catalogue numbers.

Class 2, 500 V (DC) (non-flanged type)

FEATURES

- Coupling and decoupling
- · Space saving.

APPLICATIONS

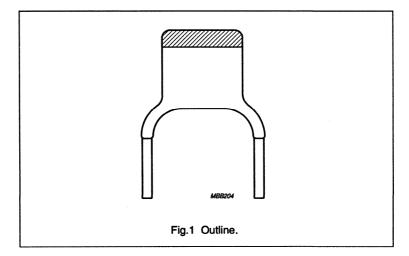
Ceramic plate capacitors without flanges are not intended for current design projects. They are recommended for maintenance purposes only. The electrical properties are identical to capacitors with flanged leads.

DESCRIPTION

The capacitors consist of a thin rectangular ceramic plate, both sides of which are metallized. The tinned connecting leads are secured using a high melting point solder. The capacitors are encapsulated in epoxy lacquer, which is resistant to all commonly used cleaning solvents. They have small dimensions and narrow tolerances on the lead spacing.

QUICK REFERENCE DATA

Capacitance range	100 to 4 700 pF (E12 series)
Tolerance on capacitance	±10%
Dielectric material	K2000
Rated DC voltage	500 V
Sectional specification	IEC 384-9 (2C2)
Climatic category (IEC 68)	55/085/21



Class 2, 500 V (DC) (non-flanged type)

MECHANICAL DATA

Marking

The body of the capacitors is tan coloured. The temperature dependence is indicated by a yellow colour cap. Capacitance value and voltage are indicated by a marking code in a contrasting colour on the body.

Refer to Table 3 for marking codes.

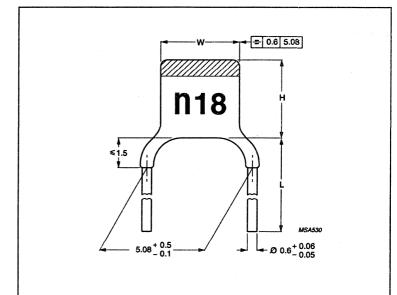
Mounting

When bending, cutting or flattening, the leads should be relieved of the applied load by supporting them at the capacitor body.

Soldering conditions: max. 265 °C, max. 10 s.

Lacquer on the leads

When the capacitors are mounted on printed-circuit boards with a thickness of 1.5 mm and with holes of 1.3 mm diameter or on printed-circuit boards with a thickness of 1 mm and with holes of 0.8 mm diameter there will be no lacquer on the leads at the lower side of the board. For the capacitance value indicated by note 1 in Table 3, the lacquer on the leads is less than 2 mm.



Dimensions in mm.

For dimensions H, L and W see Tables 1 and 2.

Fig.2 Component outline.

Table 1 Capacitor dimensions

SIZE (note 1)	W (note 2) (mm)	H (note 2) (mm)	APPROX. MASS (g)
ı	3.6 (-1.1)	3.7 (-1.2)	0.14
IIA	3.9 (-1.4)	4.0 (–1.5)	0.15
IIB	4.5 (-1.8)	4.7 (-2.0)	0.16
III	5.1 (-1.8)	5.3 (-2.0)	0.17
IV	6.2 (-2.0)	6.4 (-2.2)	0.20
V	6.2 (–2.0)	8.6 (–2.6)	0.23

Notes

- Unless indicated in Table 3, the thickness of the capacitors does not exceed 2.3 mm.
- 2. Tolerances are given between brackets.

Class 2, 500 V (DC) (non-flanged type)

PACKING

Refer to the General section for Miniature Ceramic Plate Capacitors.

Table 2 Ordering information

		CATALOGUE NUMBERS (note 1)		
PITCH	LEAD DIAMETER	L ≥15 mm	$L = 6^{+0}_{-2} \text{ mm}$	
5.08 mm (0.2 in)	0.6 mm (0.024 in)	2222 655 03	2222 655 06	

Note

1. Catalogue numbers to be completed by adding code for required capacitance value, see Table 3.

ELECTRICAL CHARACTERISTICS

The capacitors meet the essential requirements of IEC 384-9. Unless stated otherwise 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%.

Capacitance values measured at 1 kHz, 1 V	100 to 4 700 pF (E12 series)		
Tolerance on the capacitance, after 1 000 h	±10%		
Dielectric material	K2000		
Rated DC voltage	500 V		
DC test voltage; duration 1 minute	1 250 V		
DC test voltage of coating; duration 1 minute	1 250 V		
Insulation resistance at 500 V (DC) after 1 minute	>4 000 MΩ		
Tan δ measured at 1 kHz, 1 V	<3.5%		
Category temperature range	-55 to +85 °C		
Storage temperature range	−55 to +85 °C		
Capacitance change versus temperature	see Fig.3		
Capacitance change versus frequency	see Fig.4		
Climatic category (IEC 68)	55/085/21		
Ageing	typical, 1.5% per time decade		

Class 2, 500 V (DC) (non-flanged type)

Table 3 Range of values

CAPACITANCE VALUE (pF)	SIZE (see Table 1)	MARKING	SUFFIX OF CATALOGUE NUMBERS (see Table 2)	
100 (note 1)		n10 500	101	
120 (note 2)		n12 500	121	
150	l	n15 500	151	
180		n18 500	181	
220	1	n22 500	221	
270	1	n27 500	271	
330	l	n33 500	331	
390	1	n39 500	391	
470	IIA	n47 500	471	
560	IIA	n56 500	561	
680	IIB	n68 500	681	
820	IIB	n82 500	821	
1 000	IIB	1n0 500	102	
1 200	IIB	1n2 500	122	
1 500	III	1n5 500	152	
1 800	III	1n8 500	182	
2 200	IV	2n2 500	222	
2 700	IV	2n7 500	272	
3 300	V	3n3 500	332	
3 900	V	3n9 500	392	
4 700	V	4n7 500	472	

Notes

- 1. Maximum thickness 2.7 mm.
- 2. Maximum thickness 2.5 mm.

Miniature ceramic plate capacitors

Class 2, 500 V (DC) (non-flanged type)

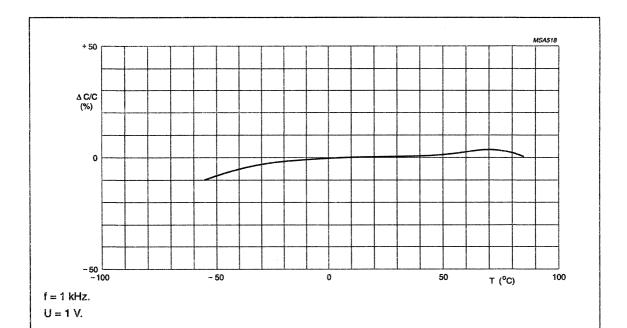


Fig.3 Typical capacitance change with respect to the capacitance at 20 °C as a function of temperature.

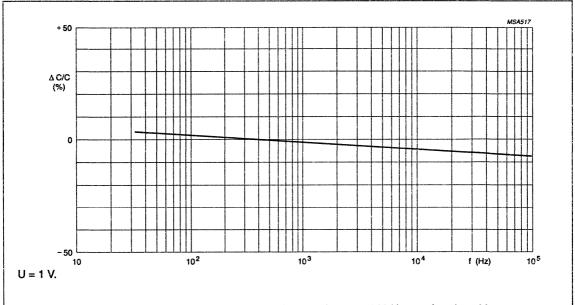
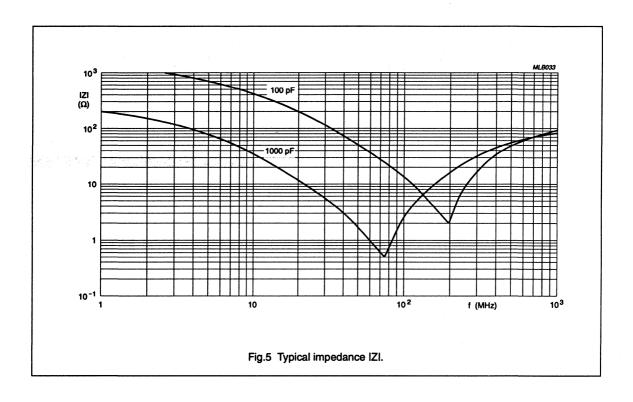


Fig.4 Typical capacitance change with respect to the capacitance at 300 Hz as a function of frequency.



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Data handbook system

DATA HANDBOOK SYSTEM

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