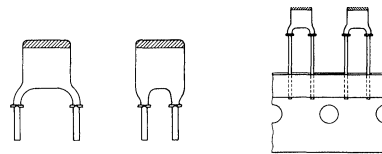


2222 678 to  
2222 683;  
2222 688; 689 ←

## MINIATURE CERAMIC PLATE CAPACITORS

class 1

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



### QUICK REFERENCE DATA

Capacitance range	0,56 to 560 pF (E12 series)
Rated d.c. voltage	100 V
Tolerance on capacitance	+ 2% or + 0,25 pF
Temperature coefficients	P100, NP0, N075, N150, N220 N330, N470, N750, N1500
Sectional specification	IEC 384-8, sub-class 1B
Climatic category (IEC 68)	55/085/21

### APPLICATION

In a wide variety of electronic equipment, e.g. as temperature compensating capacitors in tuning circuits and filters, as coupling and decoupling capacitors in high-frequency circuits where low losses and good d.c. behaviour are required.

Because of their small size and their availability with a pitch of 2,54 mm over the whole range, the capacitors are ideal for circuitry with a high component density.

### DESCRIPTION

The capacitors consist of a thin rectangular ceramic plate, both sides of which are metallized and provided with connecting leads. They are insulated by a coating that ensures a good behaviour under humid conditions. The colour of the capacitor body is grey. The capacitors distinguish themselves by small dimensions and narrow tolerances on the lead spacing. They are available with different lead shapes. The leads are provided with a flange, that guarantees leads without lacquer, making them perfectly suited for automatic insertion.

The electrical properties are characterized by low losses, a very close standard tolerance on the capacitance ( $\pm 0,25$  pF or 2%), high stability and, owing to the absence of silver, an extremely good d.c. behaviour.

(Capacitors with silver electrodes suffer from the "silver migration" effect. Silver particles move from one electrode to the other under the influence of a d.c. voltage and moisture. Capacitors with silver electrodes are considerably larger.)

2222 678 to  
2222 683;  
2222 688; 689

MECHANICAL DATA

Dimensions in mm

Outlines

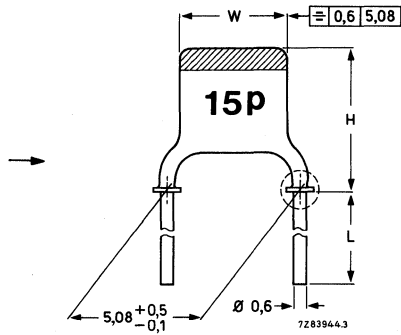


Fig. 1.

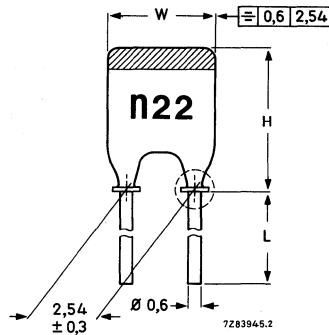
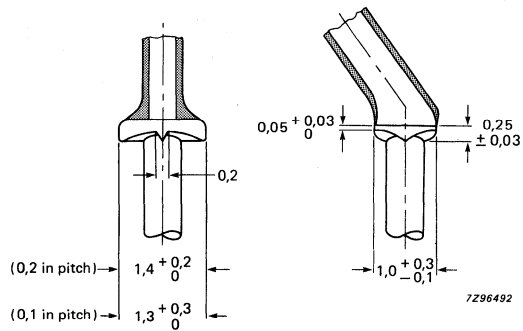


Fig. 2.

For dimensions H and W see Table 2.  
The lead length (L) is shown in Table 1 for bulk packed capacitors; for taped capacitors it can be found in section "Packing" of "General Data on Miniature ceramic plate capacitors".



DETAIL

Table 1

pitch	lead diam	Fig.	catalogue number *			
			bulk packed		on tape on reel	on tape in ammpack
			L ≥ 13 mm	L = 4 ± 0,5 mm		
5,08 mm (0,2 in)	0,6 mm (0,024 in)	1	2222 681 .....	2222 683 .....	2222 679 .....	2222 689 .....
2,54 mm (0,1 in)	0,6 mm (0,024 in)	2	2222 680 .....	2222 682 .....	2222 678 .....	2222 688 .....

\* For catalogue number suffix see Tables 3 to 11.

Table 2

size	W (mm)	H (mm)		approx. mass g
		Fig. 1	Fig. 2	
I	3,6(-1,1)	6,3(-1,8)	5,0(-1,5)	0,14
IIA	3,9(-1,2)	6,7(-1,8)	5,3(-1,5)	0,15
IIB	4,5(-1,2)	7,3(-1,8)	6,0(-1,5)	0,15
III	5,1(-0,9)	7,9(-1,7)	6,6(-1,4)	0,17
IV	6,2(-1,0)	9,0(-1,7)	7,7(-1,4)	0,20
V	6,2(-1,0)	11,2(-2,1)	9,9(-1,8)	0,20

Note: Tolerances are given between brackets.

The thickness of the capacitors does not exceed 2,3 mm (0,08 in), except for a few types as is indicated in Tables 3 to 11.

#### Marking

The temperature coefficient is indicated by a colour code as per IEC and EIA recommendations. The capacitance value is indicated on the body by figures in a contrasting colour.

#### Mounting

When bending, cutting or flattening the leads, they should be relieved of the applied load of the capacitor body,

Soldering conditions                      max. 270 °C, max. 10 s

The capacitors are mounted on printed-wiring boards (hand mounting or automatic insertion). Due to the flange on the leads solder connections are free from lacquer. The flange is provided with a degassing groove.

#### PACKING

See "General Data on Miniature ceramic plate capacitors", section "Packing".

2222 678 to  
2222 683;  
2222 688; 689

#### ELECTRICAL DATA

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\* and tolerances,  
measured at 1 MHz,  $\leq 5$  V

see Tables 3 to 11

Rated d.c. voltage

100 V

Test voltage (d.c.) for 1 min

300 V

Test voltage (d.c.) of coating for 1 min

300 V

Insulation resistance after 1 min  
at 100 V (d.c.)

$\geq 10\,000\text{ M}\Omega$

Tan  $\delta^*$  at 1 MHz,  $\leq 5$  V  
for  $C \leq 50$  pF

$\leq 15 \left( \frac{15}{C} + 0,7 \right) \times 10^{-4}$ ; max.  $55 \times 10^{-4}$

for  $C > 50$  pF

$\leq 15 \times 10^{-4}$

Category temperature range

-55 to +85 °C

Storage temperature range

-55 to +85 °C

Climatic category, IEC 68

55/085/21

\* Including 2 mm per connecting lead.

**Capacitors with a temperature coefficient P100, rated voltage 100 V (d.c.)**

Capacitance range 0,56 to 47 pF (E12 series)

Temperature coefficient of the capacitance  $\left(\frac{\Delta C}{C \cdot \Delta T}\right)$   $+ 100 \times 10^{-6}/K$ Tolerance on the temperature coefficient  
for  $C < 20$  pF  $(-40 \text{ to } +120) \times 10^{-6}/K$  ←  
for  $C \geq 20$  pF  $\pm 40 \times 10^{-6}/K$ 

Marking colour of the temperature coefficient red/violet

Table 3

cap. pF	tolerance	size see Table 2	marking	suffix of catalogue number see Table 1
0,56*	$\pm 0,25$ pF	I	p56	03567
0,68**	$\pm 0,25$ pF	I	p68	03687
0,82***	$\pm 0,25$ pF	I	p82	03827
1,0***	$\pm 0,25$ pF	I	1p0	03108
1,2	$\pm 0,25$ pF	I	1p2	03128
1,5	$\pm 0,25$ pF	I	1p5	03158
1,8	$\pm 0,25$ pF	I	1p8	03188
2,2	$\pm 0,25$ pF	I	2p2	03228
2,7	$\pm 0,25$ pF	I	2p7	03278
3,3	$\pm 0,25$ pF	I	3p3	03338
3,9	$\pm 0,25$ pF	I	3p9	03398
4,7	$\pm 0,25$ pF	I	4p7	03478
5,6	$\pm 0,25$ pF	I	5p6	03568
6,8	$\pm 0,25$ pF	I	6p8	03688
8,2	$\pm 0,25$ pF	IIA	8p2	03828
10	$\pm 2\%$	IIA	10p	04109
12	$\pm 2\%$	IIB	12p	04129
15	$\pm 2\%$	IIB	15p	04159
18	$\pm 2\%$	III	18p	04189
22	$\pm 2\%$	III	22p	04229
27	$\pm 2\%$	IV	27p	04279
33	$\pm 2\%$	IV	33p	04339
39	$\pm 2\%$	V	39p	04399
47	$\pm 2\%$	V	47p	04479

\* Maximum thickness 3,0 mm.

\*\* Maximum thickness 2,7 mm.

\*\*\* Maximum thickness 2,5 mm.

2222 678 to  
2222 683;  
2222 688; 689

Capacitors with a temperature coefficient NPO, rated voltage 100 V (d.c.)

Capacitance range 1,8 to 120 pF (E12 series)

Temperature coefficient of the capacitance  $\left(\frac{\Delta C}{C \cdot \Delta T}\right)$   $0 \times 10^{-6}/K$

→ Tolerance on the temperature coefficient  
for  $C < 20$  pF  $(-40 \text{ to } +120) \times 10^{-6}/K$   
for  $C \geq 20$  pF  $\pm 30 \times 10^{-6}/K$

Marking colour of the temperature coefficient black

Table 4

cap. pF	tolerance	size see Table 2	marking	suffix of catalogue number see Table 1
1,8	± 0,25 pF	I	1p8	09188
2,2	± 0,25 pF	I	2p2	09228
2,7	± 0,25 pF	I	2p7	09278
3,3	± 0,25 pF	I	3p3	09338
3,9	± 0,25 pF	I	3p9	09398
4,7	± 0,25 pF	I	4p7	09478
5,6	± 0,25 pF	I	5p6	09568
6,8	± 0,25 pF	I	6p8	09688
8,2	± 0,25 pF	I	8p2	09828
10	± 2%	I	10p	10109
12	± 2%	I	12p	10129
15	± 2%	I	15p	10159
18	± 2%	I	18p	10189
22	± 2%	I	22p	10229
27	± 2%	I	27p	10279
33	± 2%	I	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%	III	n10	10101
120	± 2%	III	n12	10121

Capacitors with a temperature coefficient N075, rated voltage 100 V (d.c.)

Capacitance range 3,9 to 120 pF (E12 series)

Temperature coefficient of the capacitance  $(\frac{\Delta C}{C \cdot \Delta T})$   $-75 \times 10^{-6}/K$

Tolerance on the temperature coefficient  
for  $C < 20$  pF  $(-40 \text{ to } +60) \times 10^{-6}/K$  ←  
for  $C \geq 20$  pF  $\pm 30 \times 10^{-6}/K$

Marking colour of the temperature coefficient red

Table 5

cap. pF	tolerance	size see Table 2	marking	suffix of catalogue number see Table 1
3,9	± 0,25 pF	I	3p9	27398
4,7	± 0,25 pF	I	4p7	27478
5,6	± 0,25 pF	I	5p6	27568
6,8	± 0,25 pF	I	6p8	27688
8,2	± 0,25 pF	I	8p2	27828
10	± 2%	I	10p	28109
12	± 2%	I	12p	28129
15	± 2%	I	15p	28159
18	± 2%	I	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

2222 678 to  
2222 683;  
2222 688; 689

**Capacitors with a temperature coefficient N150, rated voltage 100 V (d.c.)**

Capacitance range 3,9 to 150 pF (E12 series)

Temperature coefficient of the capacitance  $(\frac{\Delta C}{C \cdot \Delta T})$   $-150 \times 10^{-6}/K$

→ Tolerance on the temperature coefficient  
for  $C < 20$  pF  $(-40 \text{ to } +60) \times 10^{-6}/K$   
for  $C \geq 20$  pF  $\pm 40 \times 10^{-6}/K$

Marking colour of the temperature coefficient orange

Table 6

cap. pF	tolerance	size see Table 2	marking	suffix of catalogue number see Table 1
3,9*	± 0,25 pF	I	3p9	33398
4,7	± 0,25 pF	I	4p7	33478
5,6	± 0,25 pF	I	5p6	33568
6,8	± 0,25 pF	I	6p8	33688
8,2	± 0,25 pF	I	8p2	33828
10	± 2%	I	10p	34109
12	± 2%	I	12p	34129
15	± 2%	I	15p	34159
18	± 2%	I	18p	34189
22	± 2%	I	22p	34229
27	± 2%	I	27p	34279
33	± 2%	I	33p	34339
39	± 2%	IIA	39p	34399
47	± 2%	IIA	47p	34479
56	± 2%	IIB	56p	34569
68	± 2%	IIB	68p	34689
→ 82	± 2%	IIB	82p	34829
→ 100	± 2%	III	n10	34101
→ 120	± 2%	III	n12	34121
150	± 2%	IV	n15	34151

\* Maximum thickness 2,5 mm.



Miniature ceramic plate capacitors, class 1

2222 678 to  
2222 683;  
2222 688; 689

Capacitors with a temperature coefficient N220, rated voltage 100 V (d.c.)

Capacitance range 3,9 to 150 pF (E12 series)

Temperature coefficient of the capacitance  $(\frac{\Delta C}{C \cdot \Delta T})$   $-220 \times 10^{-6}/K$

Tolerance on the temperature coefficient  
for  $C < 20$  pF  $(-40 \text{ to } +60) \times 10^{-6}/K$  ←  
for  $C \geq 20$  pF  $\pm 40 \times 10^{-6}/K$

Marking colour of the temperature coefficient yellow

Table 7

cap. pF	tolerance	size see Table 2	marking	suffix of catalogue number see Table 1
3,9*	$\pm 0,25$ pF	I	3p9	39398
4,7	$\pm 0,25$ pF	I	4p7	39478
5,6	$\pm 0,25$ pF	I	5p6	39568
6,8	$\pm 0,25$ pF	I	6p8	39688
8,2	$\pm 0,25$ pF	I	8p2	39828
10	$\pm 2\%$	I	10p	40109
12	$\pm 2\%$	I	12p	40129
15	$\pm 2\%$	I	15p	40159
18	$\pm 2\%$	I	18p	40189
22	$\pm 2\%$	I	22p	40229
27	$\pm 2\%$	IIA	27p	40279
33	$\pm 2\%$	IIA	33p	40339
39	$\pm 2\%$	IIB	39p	40399
47	$\pm 2\%$	IIB	47p	40479
56	$\pm 2\%$	III	56p	40569
68	$\pm 2\%$	III	68p	40689
82	$\pm 2\%$	IV	82p	40829
100	$\pm 2\%$	IV	n10	40101
120	$\pm 2\%$	V	n12	40121
150	$\pm 2\%$	V	n15	40151

\* Maximum thickness 2,5 mm.

2222 678 to  
2222 683;  
2222 688; 689

Capacitors with a temperature coefficient N330, rated voltage 100 V (d.c.)

Capacitance range 4,7 to 180 pF (E12 series)

Temperature coefficient of the capacitance  $\left(\frac{\Delta C}{C \cdot \Delta T}\right)$   $-330 \times 10^{-6}/K$

Tolerance on the temperature coefficient  $\pm 60 \times 10^{-6}/K$

Marking colour of the temperature coefficient green

Table 8

cap. pF	tolerance	size see Table 2	marking	suffix of catalogue number see Table 1
4,7	$\pm 0,25$ pF	I	4p7	45478
5,6	$\pm 0,25$ pF	I	5p6	45568
6,8	$\pm 0,25$ pF	I	6p8	45688
8,2	$\pm 0,25$ pF	I	8p2	45828
10	$\pm 2\%$	I	10p	46109
12	$\pm 2\%$	I	12p	46129
15	$\pm 2\%$	I	15p	46159
18	$\pm 2\%$	I	18p	46189
22	$\pm 2\%$	I	22p	46229
27	$\pm 2\%$	I	27p	46279
33	$\pm 2\%$	IIA	33p	46339
39	$\pm 2\%$	IIA	39p	46399
47	$\pm 2\%$	IIB	47p	46479
56	$\pm 2\%$	IIB	56p	46569
68	$\pm 2\%$	III	68p	46689
82	$\pm 2\%$	III	82p	46829
100	$\pm 2\%$	IV	n10	46101
120	$\pm 2\%$	IV	n12	46121
150	$\pm 2\%$	V	n15	46151
180	$\pm 2\%$	V	n18	46181

**Capacitors with a temperature coefficient N470, rated voltage 100 V (d.c.)**

Capacitance range 6,8 to 220 pF (E12 series)

Temperature coefficient of the capacitance  $(\frac{\Delta C}{C \cdot \Delta T})$   $-470 \times 10^{-6}/K$

Tolerance on the temperature coefficient  
for  $C < 20$  pF  $(-90 \text{ to } +250) \times 10^{-6}/K$  ←  
for  $C \geq 20$  pF  $\pm 60 \times 10^{-6}/K$

Marking colour of the temperature coefficient blue

Table 9

cap. pF	tolerance	size see Table 2	marking	suffix of catalogue number see Table 1
6,8	± 0,25 pF	I	6p8	51688
8,2	± 0,25 pF	I	8p2	51828
10	± 2%	I	10p	52109
12	± 2%	I	12p	52129
15	± 2%	I	15p	52159
18	± 2%	I	18p	52189
22	± 2%	I	22p	52229
27	± 2%	I	27p	52279
33	± 2%	I	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%	III	n10	52101
120	± 2%	IV	n12	52121
150	± 2%	IV	n15	52151
180	± 2%	V	n18	52181
220	± 2%	V	n22	52221

2222 678 to  
2222 683;  
2222 688; 689

Capacitors with a temperature coefficient N750, rated voltage 100 V (d.c.)

Capacitance range 3,9 to 330 pF (E12 series)

Temperature coefficient of the capacitance  $(\frac{\Delta C}{C \cdot \Delta T})$   $-750 \times 10^{-6}/K$

→ Tolerance on the temperature coefficient  
for  $C < 20$  pF  $(-120 \text{ to } +250) \times 10^{-6}/K$   
for  $C \geq 20$  pF  $\pm 120 \times 10^{-6}/K$

Marking colour of the temperature coefficient violet

Table 10

cap. pF	tolerance	size see Table 2	marking	suffix of catalogue number see Table 1
3,9	$\pm 0,25$ pF	I	3p9	57398
4,7	$\pm 0,25$ pF	I	4p7	57478
5,6	$\pm 0,25$ pF	I	5p6	57568
6,8	$\pm 0,25$ pF	I	6p8	57688
8,2	$\pm 0,25$ pF	I	8p2	57828
10	$\pm 2\%$	I	10p	58109
12	$\pm 2\%$	I	12p	58129
15	$\pm 2\%$	I	15p	58159
18	$\pm 2\%$	I	18p	58189
22	$\pm 2\%$	I	22p	58229
27	$\pm 2\%$	I	27p	58279
33	$\pm 2\%$	I	33p	58339
39	$\pm 2\%$	I	39p	58399
47	$\pm 2\%$	I	47p	58479
56	$\pm 2\%$	IIA	56p	58569
68	$\pm 2\%$	IIA	68p	58689
82	$\pm 2\%$	IIB	82p	58829
100	$\pm 2\%$	IIB	n10	58101
120	$\pm 2\%$	III	n12	58121
150	$\pm 2\%$	III	n15	58151
180	$\pm 2\%$	IV	n18	58181
220	$\pm 2\%$	IV	n22	58221
270	$\pm 2\%$	V	n27	58271
330	$\pm 2\%$	V	n33	58331

Miniature ceramic plate capacitors, class 1

2222 678 to  
2222 683;  
2222 688; 689

Capacitors with a temperature coefficient N1500, rated voltage 100 V (d.c.)

Capacitance range 18 to 560 pF (E12 series)

Temperature coefficient of the capacitance  $(\frac{\Delta C}{C \cdot \Delta T})$   $-1500 \times 10^{-6}/K$

Tolerance on the temperature coefficient  $(0 \text{ to } +500) \times 10^{-6}/K$

Marking colour of the temperature coefficient orange/orange

Table 11

cap. pF	tolerance	size see Table 2	marking	suffix of catalogue number see Table 1
18*	± 2%	I	18p	70189
22	± 2%	I	22p	70229
27	± 2%	I	27p	70279
33	± 2%	I	33p	70339
39	± 2%	I	39p	70399
47	± 2%	I	47p	70479
56	± 2%	I	56p	70569
68	± 2%	I	68p	70689
82	± 2%	I	82p	70829
100	± 2%	IIA	n10	70101
120	± 2%	IIA	n12	70121
150	± 2%	IIB	n15	70151
180	± 2%	IIB	n18	70181
220	± 2%	III	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

\* Maximum thickness 2,5 mm.