S+M COMPONENTS **Siemens Matsushita Components**

Applications with a future

We set your ideas in motion

When it comes to implementing ideas, you couldn't choose a better partner. Our flexibility turns standard products into new ones with all the right features. Whether capacitors and converter filters for wind-driven power plants, ferrite antennas for radio wrist-watches or SAW filters for the new wide-screen TV generation. If you've got the application, we've got the component.

SCS – dependable, fast and competent

Multilayer
Ceramic Capacitors

S+M COMPONENTS **Siemens Matsushita Components**

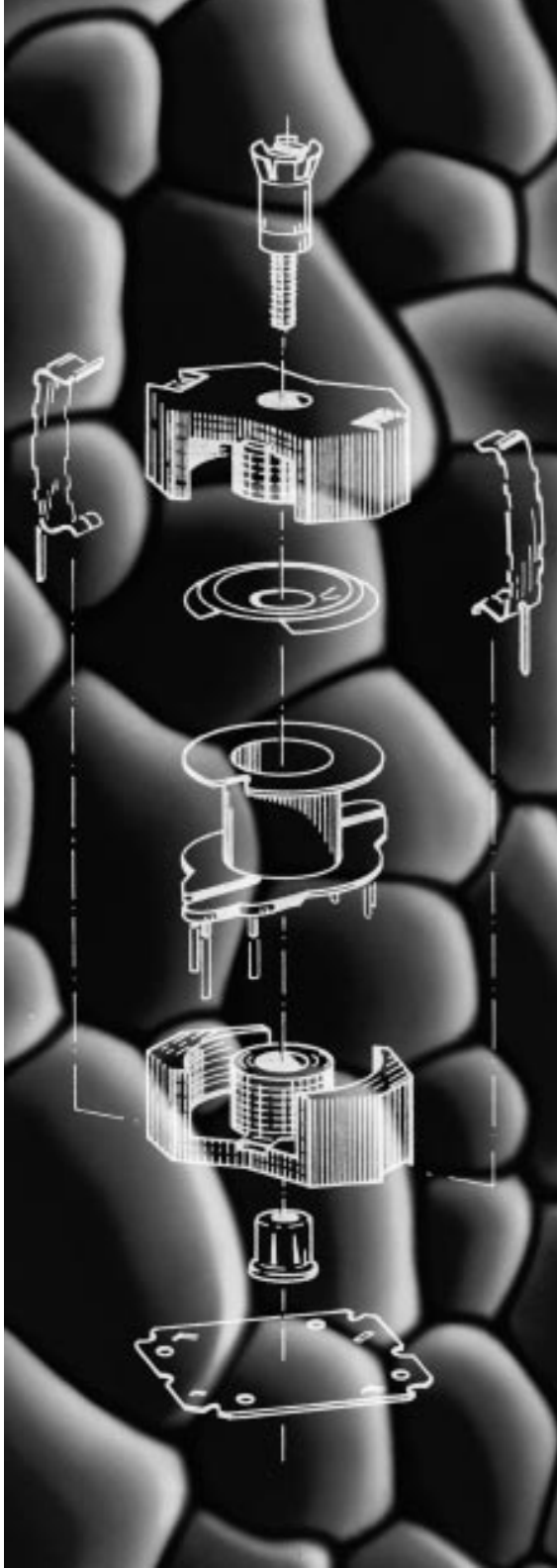
Ferrite cores and accessories

In place, in shape

With more than 4000 different ferrite cores we have the solution to tackle every application. Straight from SCS stock we can supply you 12 core shopes in as many as 26 materials, plus the matching accessories:

- **RM** for transformers with high packing density
- **PM** for power transformers
- **P** for transformers with extremely low leakage field
- **E cores**
  ETD, EC, ER with round center leg for compact transformers, EFD with flattened center leg for ultra flat transformers, wide range of standard E cores
- **U** for storage chokes, split diode and line transformers
- **Ring** for pulse, broadband and balun transformers plus chokes
- **Double-aperture** for broadband transformers up into the GHz region

SCS – dependable, fast and competent



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Ordering code	Rated voltage	Temperature characteristic	Size/ Lead spacing	Page
			Multilayer chip capacitors	
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B37550-…	50 V	X8R	1210	46
B37871-…	50 V	C0G/NP0/CH	1206	18
	50 V	C0G/NP0/CH	1206 (bulk case)	23
	100 V	C0G/NP0/CH	1206	20
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B37872-…	16 V	X7R/B char.	1206	32
	25 V	X7R/B char.	1206	33
	50 V	X7R/B char.	1206	35
	100 V	X7R/B char.	1206	37
	200/500 V	X7R/B char.	1206	39
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B37873-…	25 V	Z5U (Y5U)/F char.	1206	51
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	50 V	Z5U (Y5U)/F char.	1206 (bulk case)	53
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B37922-…	16/25 V	Z5U (Y5U)/F char.	0402	51
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	25 V	X7R/B char.	0603	33
	50 V	X7R/B char.	0603	35
	100 V	X7R/B char.	0603	37
	25/50 V	X7R/B char.	0603 (bulk case)	40
B37932-…	25 V	Z5U (Y5U)/F char.	0603	51
	50 V	Z5U (Y5U)/F char.	0603	52
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B37940-…	50 V	C0G/NP0/CH	0805	18
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B37941-…	16 V	X7R/B char.	0805	32
	25 V	X7R/B char.	0805	33
	50 V	X7R/B char.	0805	35
	100 V	X7R/B char.	0805	37
	50 V	X7R/B char.	0805 (bulk case)	40
B37942-…	25 V	Z5U (Y5U)/F char.	0805	51
	50 V	Z5U (Y5U)/F char.	0805	52
	50 V	Z5U (Y5U)/F char.	0805 (bulk case)	53

Ordering code	Rated voltage	Temperature characteristic	Size/ Lead spacing	Page
B37949-…	50 V	C0G/NP0/CH	1210	18
	100 V	C0G/NP0/CH	1210	20
	200 V	C0G/NP0/CH	1210	21
B37950-…	50 V	X7R/B char.	1210	35
	100 V	X7R/B char.	1210	37
	200/500 V	X7R/B char.	1210	39
B37951-…	50 V	Z5U (Y5U)/F char.	1210	52
B37953-…	50 V	X7R/B char.	1812	36
B37954-…	50 V	Z5U (Y5U)/F char.	1812	52
B37956-…	50 V	X7R/B char.	2220	36
B37957-…	50 V	Z5U (Y5U)/F char.	2220	52
			Multilayer leaded capacitors	
B37979-…	50 V	C0G/NP0/CH	2,5/5 mm	64
	100 V	C0G/NP0/CH	2,5/5 mm	65
B37981-…	50 V	X7R/B char.	2,5/5 mm	69
	100 V	X7R/B char.	2,5/5 mm	70
B37982-…	50 V	Z5U (Y5U)/F char.	2,5/5 mm	74
B37984-…	50 V	X7R/B char.	5 mm	69
B37985-…	50 V	Z5U (Y5U)/F char.	5 mm	74
B37986-…	50 V	C0G/NP0/CH	2,5/5 mm	64
	100 V	C0G/NP0/CH	2,5/5 mm	65
B37987-…	50 V	X7R/B char.	2,5/5 mm	69
	100 V	X7R/B char.	2,5/5 mm	70
B37988-…	50 V	Z5U (Y5U)/F char.	2,5/5 mm	74

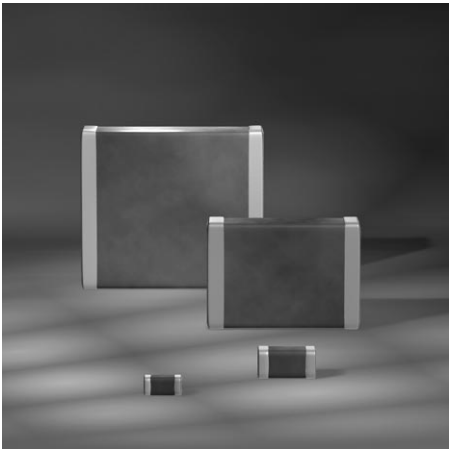
Siemens Matsushita Components

Disk varistors from stock

The choice is yours

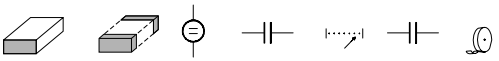
In our selection of disk varistors there's something for everything. We offer you application support and deliver models rated from 11 to 460 V straight from SCS stock. Our product certification like UL and CECC makes sure your product conforms with CE. All disk varistors are manufactured in Europe, just like our block, strap and SMD varistors.

SCS – dependable, fast and competent



Page

Ordering code system



B37940- K 5 010- D 5 60

Packaging

62 = blister tape, reel dia. 180 mm
72 = blister tape, reel dia. 330 mm
60 = cardboard tape, reel dia. 180 mm
70 = cardboard tape, reel dia. 330 mm
01 = bulk case

Decimal place for cap. values < 10 pF, otherwise not used

Capacitance tolerance
(tolerance code in acc. with IEC 62, standard values bold)

	C0G / NP0 / CH	X7R / B char. and X8R	Z5U (Y5U) / F char.
C_R < 10 pF:	B = ± 0,1 pF **C = ± 0,25 pF** D = 0,5 pF		
C_R ≥ 10 pF:	F = ± 1 % G = ± 2 % **J = ± 5 %** K = 10 %	J = ± 5 % **K = ± 10 %** M = 20 %	**M = ± 20 %**

Capacitance, coded

010 =	1 pF	101 =	100 pF	103 =	10 nF
105 =	1 µF	100 =	10 pF	102 =	1 nF
104 =	100 nF	474 =	470 nF		

Rated voltage

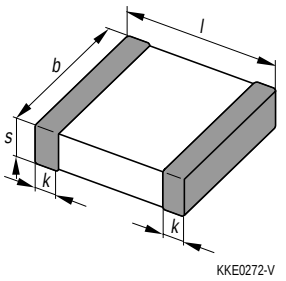
Rated voltage [Vdc]	16	25	50	100	200	500
Code	9	0	5	1	2	3

Terminations Standard: K = silver/nickel/tin for chip sizes 0402, 0603, 0805, 1206, 1210
J = silver palladium for chip sizes 1812, 2220
for conductive adhesion: all sizes

Type and size

Chip size (**inch** / mm)	Temperature characteristics C0G / NP0 / CH	X7R / B char.	X8R	Z5U (Y5U) / F char.
0402 / 1005	B37920	B37921		B37922
0603 / 1608	B37930	B37931		B37932
0805 / 2012	B37940	B37941	B37541	B37942
1206 / 3216	B37871	B37872	B37472	B37873
1210 / 3225	B37949	B37950	B37550	B37951
1812 / 4532		B37953		B37954
2220 / 5750		B37956		B37957

Dimensions and construction



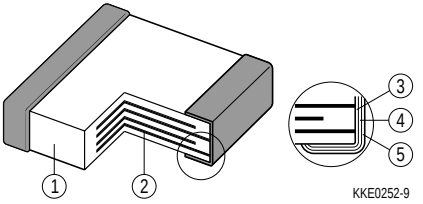
KKE0272-V

Size **inch**/mm	*l*	*b*	*s*	*k*
0402/1005	1,0 ± 0,10	0,50 ± 0,05	0,5 ± 0,05	0,2
0603/1608	1,6 ± 0,15*)	0,80 ± 0,10	0,8 ± 0,10	0,3
0805/2012	2,0 ± 0,20	1,25 ± 0,15	1,3 max.	0,5
1206/3216	3,2 ± 0,20	1,60 ± 0,15	1,3 max.	0,5
1210/3225	3,2 ± 0,30	2,50 ± 0,30	1,7 max.	0,5
1812/4532	4,5 ± 0,30	3,20 ± 0,30	1,3 max.	0,5
2220/5750	5,7 ± 0,40	5,00 ± 0,40	1,3 max	0,5

*) For bulk cases 1,6 ± 0,1

- Dimensions and tolerances in accordance with CECC 32101-801
- MLCC internal construction in accordance with EIA 469

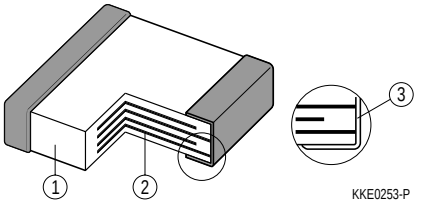
Sizes 0402 through 1210 for soldering



KKE0252-9

No.	Name	Materials
1	Dielectric	Ceramics
2	Inner electrode	Pd or AgPd
3	Substrate electrode	Ag
4	Intermediate electrode	Ni
5	External electrode	Sn

Sizes 1812, 2220 for soldering
All sizes for conductive adhesion



KKE0253-P

No.	Name	Materials
1	Dielectric	Ceramics
2	Inner electrode	Pd or AgPd
3	External electrode	AgPd

Electrical characteristics in brief

Temperature characteristic Standard	C0G/NP0/CH EIA	X7R/B char. EIA	X8R EIA	Z5U (Y5U)/ F char.[1] EIA
Dielectric	Class 1	Class 2	Class 2	Class 2
Rated voltage V_R[2] Vdc	50/100/200	16/25/50/100/ 200/500	50	16/25/50
Climatic category (IEC 68-1)	55/125/56	55/125/56	55/150/56	30/085/56
Temperature range	– 55 ... + 125 °C	– 55 ... + 125 °C	– 55 ... + 150 °C	– 30 ... + 85 °C
Available capacitance values C_R E series	1 pF … 10 nF E12	220 pF … 1 µF E12	1 nF … 150 nF E12	1 nF … 4,7 µF E6
Capacitance tolerance (standard in bold print)	C_R < 10 pF: ± 0,1 pF ± **0,25 pF** ± 0,5 pF C_R ≥10 pF: ± 1 %[2] ± 2 %[2] ± **5 %** ± 10 %	 ± 5 %[3] ± **10 %** ± 20 %	 ± 5 % ± **10 %** ± 20 %	 ± **20 %**
Temperature coefficient (tolerance)	0 ± 30 · 10^{-6}/K	–	–	–
Max. rel. capacitance change $\Delta C/C$ at V_{meas}	 –	 ± 15 %	 ± 15 %	 +22/– 56 %
Voltage test	2,5 · V_R/5 s			
Dissipation factor tan δ (limit value)	< 1,0 · 10^{-3}	< 25 · 10^{-3} < 35 · 10^{-3} (16 V)	< 25 · 10^{-3}	< 30 · 10^{-3} < 35 · 10^{-3} (25 V) < 70 · 10^{-3} (16 V)
Insulation resistance[4] at 25 °C 125 °C	 > 10^5 MΩ > 10^4 MΩ	 > 10^5 MΩ > 10^4 MΩ	 > 10^5 MΩ > 10^4 MΩ	 > 10^4 MΩ –
Time constant τ[4] at 25 °C 125 °C	 > 1000 s > 100 s	 > 1000 s > 100 s	 > 1000 s > 100 s	 > 500 s –

1) Y5U specification is also fulfilled.
2) 1 % and 2 % tolerance not for 200 V.
3) 5% tolerance not for 16 V, 200 V and 500 V.
4) For capacitance values exceeding 10 nF (C0G, X7R, X8R) and 47 nF (Z5U) the time constant $\tau = C \cdot R_{ins}$ is given.

Features

- Good thermal stability
- High insulation resistance
- Low dissipation factor
- Low inductance

Applications

- Resonant circuits
- Filter circuits
- Timing elements
- Coupling and filtering, particularly in RF circuits

Terminations

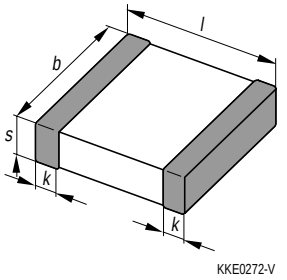
- For soldering: silver/nickel/tin
- For conductive adhesion: silver palladium

Packing

- Blister and cardboard tape, for details refer to chapter on "Taping and Packing", page 111.
- Bulk case for sizes 0603, 0805 and 1206, for details see page 114.

Maximum ratings

Climatic category
in accordance with IEC 68-1: 55/125/56



KKE0272-V

Dimensions (mm)

Size **inch**/mm	*l*	*b*	*s*	*k*
0402/1005	1,0 ± 0,10	0,50 ± 0,05	0,5 ± 0,05	0,2
0603/1608	1,6 ± 0,15*)	0,80 ± 0,10	0,8 ± 0,10	0,3
0805/2012	2,0 ± 0,20	1,25 ± 0,15	1,3 max.	0,5
1206/3216	3,2 ± 0,20	1,60 ± 0,15	1,3 max.	0,5
1210/3225	3,2 ± 0,30	2,50 ± 0,30	1,7 max.	0,5

*) For bulk cases: 1,6 ± 0,1
Tolerances in acc. with CECC 32101-801

Available capacitance tolerances

Rated capacitance C_R	Tolerance	Symbol
C_R < 10 pF:	$\Delta C_R = \pm 0{,}1$ pF	B
	$\Delta C_R = \pm 0{,}25$ pF	**C**
	$\Delta C_R = \pm 0{,}5$ pF	D
$C_R \geq 10$ pF:	$\Delta C_R/C_R = \pm 1$ %	F
	$\Delta C_R/C_R = \pm 2$ %	G
	$\Delta C_R/C_R = \pm 5$ %	**J**
	$\Delta C_R/C_R = \pm 10$ %	K

Standard tolerances in bold print

F and G tolerance not available for 200 V

Rated voltage values

V_R = 50 V, 100 V, 200 V

Product range

	C0G/NP0/CH											
Size[1)] **inch** mm	**0402** 1005		**0603** 1608		**0805** 2012			**1206** 3216			**1210** 3225	
Type	B37920		B37930		B37940			B37871			B37949	
V_R (Vdc)	50		50		50	100	200	50	100	200	50	200
1,0 pF	1,0 pF											
1,2 pF												
1,5 pF												
1,8 pF												
2,2 pF	2,0 pF[2)]											
2,7 pF	3,0 pF[2)]											
3,3 pF	4,0 pF[2)]											
3,9 pF	5,0 pF[2)]											
4,7 pF	6,0 pF[2)]											
5,6 pF	7,0 pF[2)]											
6,8 pF	8,0 pF[2)]											
8,2 pF	9,0 pF[2)]											
10 pF												
12 pF												
15 pF												
18 pF												
22 pF												
27 pF												
33 pF												
39 pF												
47 pF												
56 pF												
68 pF												
82 pF												

Chip thickness (*s*): 0,5 ± 0,1 mm | 0,6 ± 0,1 mm | 0,8 ± 0,1 mm | 1,2 ± 0,1 mm

1) l × b (inch) / l × b (mm)
2) Only listed capacitance values available
Capacitance values < 1 pF upon request

Product range

	C0G/NP0/CH												
Size[1)] **inch** mm	**0402** 1005		**0603** 1608		**0805** 2012			**1206** 3216			**1210** 3225		
Type	B37920		B37930		B37940			B37871			B37949		
V_R (Vdc)	50		50		50	100	200	50	100	200	50	100	200
100 pF													
120 pF													
150 pF													
180 pF													
220 pF													
270 pF													
330 pF													
390 pF													
470 pF													
560 pF													
680 pF													
820 pF													
1,0 nF													
1,2 nF													
1,5 nF													
1,8 nF													
2,2 nF													
2,7 nF													
3,3 nF													
3,9 nF													
4,7 nF													
5,6 nF													
6,8 nF													
8,2 nF													
10 nF													

Chip thickness (*s*): 0,5 ± 0,1 mm | 0,6 ± 0,1 mm | 0,8 ± 0,1 mm | 1,2 ± 0,1 mm | 1,6 ± 0,1 mm

1) l × b (inch) / l × b (mm)

Ordering codes for C0G/NP0/CH, 50 Vdc, AgNiSn terminations

Size	0402/1005	0603/1608	0805/2012	1206/3216	1210/3225
C_R [1]	Ordering code [2]				
	B37920-	B37930-	B37940-	B37871-	B37949-
1,0 pF	-K5010-C60 ▲	-K5010-C60 ❍	-K5010-C60 ❑	-K5010-C60 ❍	
1,2 pF		-K5010-C260 ❍	-K5010-C260 ❑	-K5010-C260 ❍	
1,5 pF		-K5010-C560 ❍	-K5010-C560 ❑	-K5010-C560 ❍	
1,8 pF		-K5010-C860 ❍	-K5010-C860 ❑	-K5010-C860 ❍	
2,2 *(2,0)* pF	*-K5020-C60* ▲	-K5020-C260 ❍	-K5020-C260 ❑	-K5020-C260 ❍	
2,7 *(3,0)* pF	*-K5030-C60* ▲	-K5020-C760 ❍	-K5020-C760 ❑	-K5020-C760 ❍	
3,3 *(4,0)* pF	*-K5040-C60* ▲	-K5030-C360 ❍	-K5030-C360 ❑	-K5030-C360 ❍	
3,9 *(5,0)* pF	*-K5050-C60* ▲	-K5030-C960 ❍	-K5030-C960 ❑	-K5030-C960 ❍	
4,7 *(6,0)* pF	*-K5060-C60* ▲	-K5040-C760 ❍	-K5040-C760 ❑	-K5040-C760 ❍	
5,6 *(7,0)* pF	*-K5070-C60* ▲	-K5050-C660 ❍	-K5050-C660 ❑	-K5050-C660 ❍	
6,8 *(8,0)* pF	*-K5080-C60* ▲	-K5060-C860 ❍	-K5060-C860 ❑	-K5060-C860 ❍	
8,2 *(9,0)* pF	*-K5090-C60* ▲	-K5080-C260 ❍	-K5080-C260 ❑	-K5080-C260 ❍	
10 pF	-K5100-J60 ▲	-K5100-J60 ❍	-K5100-J60 ❑	-K5100-J60 ❍	
12 pF	-K5120-J60 ▲	-K5120-J60 ❍	-K5120-J60 ❑	-K5120-J60 ❍	
15 pF	-K5150-J60 ▲	-K5150-J60 ❍	-K5150-J60 ❑	-K5150-J60 ❍	
18 pF	-K5180-J60 ▲	-K5180-J60 ❍	-K5180-J60 ❑	-K5180-J60 ❍	
22 pF	-K5220-J60 ▲	-K5220-J60 ❍	-K5220-J60 ❑	-K5220-J60 ❍	
27 pF	-K5270-J60 ▲	-K5270-J60 ❍	-K5270-J60 ❑	-K5270-J60 ❍	
33 pF	-K5330-J60 ▲	-K5330-J60 ❍	-K5330-J60 ❑	-K5330-J60 ❍	
39 pF	-K5390-J60 ▲	-K5390-J60 ❍	-K5390-J60 ❑	-K5390-J60 ❍	
47 pF	-K5470-J60 ▲	-K5470-J60 ❍	-K5470-J60 ❑	-K5470-J60 ❍	
56 pF	-K5560-J60 ▲	-K5560-J60 ❍	-K5560-J60 ❑	-K5560-J60 ❍	
68 pF	-K5680-J60 ▲	-K5680-J60 ❍	-K5680-J60 ❑	-K5680-J60 ❍	
82 pF	-K5820-J60 ▲	-K5820-J60 ❍	-K5820-J60 ❑	-K5820-J60 ❍	
100 pF	-K5101-J60 ▲	-K5101-J60 ❍	-K5101-J60 ❑	-K5101-J60 ❍	
120 pF	-K5121-J60 ▲	-K5121-J60 ❍	-K5121-J60 ❑	-K5121-J60 ❍	
150 pF	-K5151-J60 ▲	-K5151-J60 ❍	-K5151-J60 ❑	-K5151-J60 ❍	
180 pF	-K5181-J60 ▲	-K5181-J60 ❍	-K5181-J60 ❑	-K5181-J60 ❍	
220 pF	-K5221-J60 ▲	-K5221-J60 ❍	-K5221-J60 ❑	-K5221-J60 ❍	
270 pF		-K5271-J60 ❍	-K5271-J60 ❑	-K5271-J60 ❍	
330 pF		-K5331-J60 ❍	-K5331-J60 ❑	-K5331-J60 ❍	
390 pF		-K5391-J60 ❍	-K5391-J60 ❑	-K5339-J60 ❍	
470 pF		-K5471-J60 ❍	-K5471-J60 ❑	-K5471-J60 ❍	
560 pF			-K5561-J60 ❑	-K5561-J60 ❍	
680 pF			-K5681-J60 ❑	-K5681-J60 ❍	
820 pF			-K5821-J60 ❑	-K5821-J60 ❍	

Chip thickness: ▲: 0,5 ± 0,1 mm ❑: 0,6 ± 0,1 mm ❍: 0,8 ± 0,1 mm

1) E24 series available on request. For size 0402 only capacitance values in ( ) available; capacitance values < 1 pF on request.
2) The tables contain the ordering codes for the standard capacitance tolerance:
C = ± 0,25 pF for < 10 pF; J = ± 5 % for ≥ 10 pF. Example: B37920-K5010-**C**60
For other available capacitance tolerances see page 15

Ordering codes for C0G/NP0/CH, 50 Vdc, AgNiSn terminations (cont´d)

Size	0402/1005	0603/1606	0805/2012	1206/3216	1210/3225
C_R [1]	Ordering code [2]				
	B37920-	B37930-	B37940-	B37871-	B37949-
1,0 nF			-K5102-J60 ❑	-K5102-J60 ❍	-K5102-J62 ❍
1,2 nF			-K5122-J60 ❍	-K5122-J60 ❍	-K5122-J62 ❍
1,5 nF			-K5152-J60 ❍	-K5152-J60 ❍	-K5152-J62 ❍
1,8 nF			-K5182-J62 ◆	-K5182-J60 ❍	-K5182-J62 ❍
2,2 nF			-K5222-J62 ◆	-K5222-J60 ❍	-K5222-J62 ❍
2,7 nF				-K5272-J60 ❍	-K5272-J62 ❍
3,3 nF				-K5332-J60 ❍	-K5332-J62 ❍
3,9 nF				-K5392-J60 ❍	-K5392-J62 ❍
4,7 nF				-K5472-J62 ◆	-K5472-J62 ❍
5,6 nF				-K5562-J62 ◆	-K5562-J62 ❍
6,8 nF					-K5682-J62 ❍
8,2 nF					-K5822-J62 ◆
10 nF					-K5103-J62 ◆

Chip thickness: ❑: 0,6 ± 0,1 mm ❍: 0,8 ± 0,1 mm ◆: 1,2 ± 0,1 mm

1) E24 series available on request
2) The tables contain the ordering codes for the standard capacitance tolerance: C = ± 0,25 pF for < 10 pF; J = ± 5 % for ≥ 10 pF. Example: B37940-K5102-**J**60
For other available capacitance tolerances see page 15

Ordering codes for C0G/NP0/CH, 100 Vdc, AgNiSn terminations

Size	0805/2012	1206/3216
C_R	Ordering code [1] B37940-	B37871-
1,0 pF	-K1010-C60 ❑	-K1010-C60 ❍
1,2 pF	-K1010-C260 ❑	-K1010-C260 ❍
1,5 pF	-K1010-C560 ❑	-K1010-C560 ❍
1,8 pF	-K1010-C860 ❑	-K1010-C860 ❍
2,2 pF	-K1020-C260 ❑	-K1020-C260 ❍
2,7 pF	-K1020-C760 ❑	-K1020-C760 ❍
3,3 pF	-K1030-C360 ❑	-K1030-C360 ❍
3,9 pF	-K1030-C960 ❑	-K1030-C960 ❍
4,7 pF	-K1040-C760 ❑	-K1040-C760 ❍
5,6 pF	-K1050-C660 ❑	-K1050-C660 ❍
6,8 pF	-K1060-C860 ❑	-K1060-C860 ❍
8,2 pF	-K1080-C260 ❑	-K1080-C260 ❍
10 pF	-K1100-J60 ❑	-K1100-J60 ❍
12 pF	-K1120-J60 ❑	-K1120-J60 ❍
15 pF	-K1150-J60 ❑	-K1150-J60 ❍
18 pF	-K1180-J60 ❑	-K1180-J60 ❍
22 pF	-K1220-J60 ❑	-K1220-J60 ❍
27 pF	-K1270-J60 ❑	-K1270-J60 ❍
33 pF	-K1330-J60 ❑	-K1330-J60 ❍
39 pF	-K1390-J60 ❑	-K1390-J60 ❍
47 pF	-K1470-J60 ❑	-K1470-J60 ❍
56 pF	-K1560-J60 ❑	-K1560-J60 ❍
68 pF	-K1680-J60 ❑	-K1680-J60 ❍
82 pF	-K1820-J60 ❑	-K1820-J60 ❍
100 pF	-K1101-J60 ❑	-K1101-J60 ❍
120 pF	-K1121-J60 ❑	-K1121-J60 ❍
150 pF	-K1151-J60 ❑	-K1151-J60 ❍
180 pF	-K1181-J60 ❑	-K1181-J60 ❍
220 pF	-K1221-J60 ❑	-K1221-J60 ❍
270 pF	-K1271-J60 ❑	-K1271-J60 ❍
330 pF	-K1331-J60 ❑	-K1331-J60 ❍
390 pF	-K1391-J60 ❑	-K1391-J60 ❍
470 pF	-K1471-J60 ❑	-K1471-J60 ❍
560 pF	-K1561-J60 ❍	-K1561-J60 ❍
680 pF	-K1681-J60 ❍	-K1681-J60 ❍
820 pF	-K1821-J62 ◆	-K1821-J60 ❍
1,0 nF	-K1102-J62 ◆	-K1102-J60 ❍

Size	1206/3216	1210/3225
C_R	Ordering code [1] B37871-	B37949-
1,2 nF	-K1122-J60 ❍	-K1122-J60 ❍
1,5 nF	-K1152-J60 ❍	-K1152-J60 ❍
1,8 nF	-K1182-J60 ❍	-K1182-J60 ❍
2,2 nF	-K1222-J62 ◆	-K1222-J60 ❍
2,7 nF		-K1272-J60 ❍
3,3 nF		-K1332-J60 ❍
3,9 nF		-K1392-J60 ❍
4,7 nF		-K1472-J62 ◆
5,6 nF		-K1562-J62 ◆
6,8 nF		-K1682-J62 ◆

Chip thickness: ❑: 0,6 ± 0,1 mm ❍: 0,8 ± 0,1 mm ◆: 1,2 ± 0,1 mm

1) The tables contain the ordering codes for the standard capacitance tolerance:
C = ± 0,25 pF for < 10 pF; J = ± 5 % for ≥ 10 pF. Example: B37940-K1010-**C**60
For other available capacitance tolerances see page 15

Ordering codes for C0G/NP0/CH, 200 Vdc, AgNiSn terminations

Size	0805/2012	1206/3216	1210/3225		
C_R	Ordering code[1)]				
	B37940-	B37871-	B37949-		
1,0 pF	-K2010-C60 ❑	-K2010-C60 ❍			
1,2 pF	-K2010-C260 ❑	-K2010-C260 ❍			
1,5 pF	-K2010-C560 ❑	-K2010-C560 ❍			
1,8 pF	-K2010-C860 ❑	-K2010-C860 ❍			
2,2 pF	-K2020-C260 ❑	-K2020-C260 ❍			
2,7 pF	-K2020-C760 ❑	-K2020-C760 ❍			
3,3 pF	-K2030-C360 ❑	-K2030-C360 ❍			
3,9 pF	-K2030-C960 ❑	-K2030-C960 ❍			
4,7 pF	-K2040-C760 ❑	-K2040-C760 ❍			
5,6 pF	-K2050-C660 ❑	-K2050-C660 ❍			
6,8 pF	-K2060-C860 ❑	-K2060-C860 ❍			
8,2 pF	-K2080-C260 ❑	-K2080-C260 ❍			
10 pF	-K2100-J60 ❑	-K2100-J60 ❍			
12 pF	-K2120-J60 ❑	-K2120-J60 ❍			
15 pF	-K2150-J60 ❑	-K2150-J60 ❍			
18 pF	-K2180-J60 ❑	-K2180-J60 ❍			
22 pF	-K2220-J60 ❑	-K2220-J60 ❍			
27 pF	-K2270-J60 ❑	-K2270-J60 ❍			
33 pF	-K2330-J60 ❑	-K2330-J60 ❍			
39 pF	-K2390-J60 ❑	-K2390-J60 ❍			
47 pF	-K2470-J60 ❑	-K2470-J60 ❍			
56 pF	-K2560-J60 ❑	-K2560-J60 ❍			
68 pF	-K2680-J60 ❑	-K2680-J60 ❍			
82 pF	-K2820-J60 ❑	-K2820-J60 ❍			
100 pF	-K2101-J60 ❑	-K2101-J60 ❍	-K2101-J62 ❍		
120 pF	-K2121-J60 ❑	-K2121-J60 ❍	-K2121-J62 ❍		
150 pF	-K2151-J60 ❍	-K2151-J60 ❍	-K2151-J62 ❍		
180 pF	-K2181-J60 ❍	-K2181-J60 ❍	-K2181-J62 ❍		
220 pF	-K2221-J60 ❍	-K2221-J60 ❍	-K2221-J62 ❍		
270 pF	-K2271-J62 ◆	-K2271-J60 ❍	-K2271-J62 ❍		
330 pF	-K2331-J62 ◆	-K2331-J60 ❍	-K2331-J62 ❍		
390 pF		-K2391-J60 ❍	-K2391-J62 ❍		
470 pF		-K2471-J60 ❍	-K2471-J62 ❍		
560 pF		-K2561-J60 ❍	-K2561-J62 ❍		
680 pF		-K2681-J62 ◆	-K2681-J62 ❍		
820 pF		-K2821-J62 ◆	-K2821-J62 ❍		

Chip thickness: ❑: 0,6 ± 0,1 mm ❍: 0,8 ± 0,1 mm ◆: 1,2 ± 0,1 mm

1) The tables contain the ordering codes for the standard capacitance tolerance:
C = ± 0,25 pF for < 10 pF; J = ± 5 % for ≥ 10 pF. Example: B37940-K2010-**C**62
For other available capacitance tolerances see page 15

Ordering codes for C0G/NP0/CH, 200 Vdc, AgNiSn terminations (cont´d)

Size	0805/2012	1206/3216	1210/3225		
C_R	Ordering code[1)]				
	B37940-	B37871-	B37949-		
1,0 nF		-K2102-J62 ◆	-K2102-J62 ❍		
1,2 nF			-K2122-J62 ◆		
1,5 nF			-K2152-J62 ◆		
1,8 nF			-K2182-J62 ◆		
2,2 nF			-K2222-J62 ●		

Chip thickness: ❑: 0,6 ± 0,1 mm ❍: 0,8 ± 0,1 mm ◆: 1,2 ± 0,1 mm ●: 1,6 ± 0,1 mm

1) The tables contain the ordering codes for the standard capacitance tolerance:
C = ± 0,25 pF for < 10 pF; J = ± 5 % for ≥ 10 pF. Example: B37871-K2102-**J**62
For other available capacitance tolerances see page 15

Ordering codes for C0G/NP0/CH, 50 Vdc, AgNiSn terminations, bulk case packing

Size	0603/1608	0805/2012	1206/3216
C_R [1]	Ordering code [2] B37930-	B37940-	B37871-
1,0 pF	-K5010-C01 ❍	-K5010-C01 ❑	-K5010-C01 ❑
1,2 pF	-K5010-C201 ❍	-K5010-C201 ❑	-K5010-C201 ❑
1,5 pF	-K5010-C501 ❍	-K5010-C501 ❑	-K5010-C501 ❑
1,8 pF	-K5010-C801 ❍	-K5010-C801 ❑	-K5010-C801 ❑
2,2 pF	-K5020-C201 ❍	-K5020-C201 ❑	-K5020-C201 ❑
2,7 pF	-K5020-C701 ❍	-K5020-C701 ❑	-K5020-C701 ❑
3,3 pF	-K5030-C301 ❍	-K5030-C301 ❑	-K5030-C301 ❑
3,9 pF	-K5030-C901 ❍	-K5030-C901 ❑	-K5030-C901 ❑
4,7 pF	-K5040-C701 ❍	-K5040-C701 ❑	-K5040-C701 ❑
5,6 pF	-K5050-C601 ❍	-K5050-C601 ❑	-K5050-C601 ❑
6,8 pF	-K5060-C801 ❍	-K5060-C801 ❑	-K5060-C801 ❑
8,2 pF	-K5080-C201 ❍	-K5080-C201 ❑	-K5080-C201 ❑
10 pF	-K5100-J01 ❍	-K5100-J01 ❑	-K5100-J01 ❑
12 pF	-K5120-J01 ❍	-K5120-J01 ❑	-K5120-J01 ❑
15 pF	-K5150-J01 ❍	-K5150-J01 ❑	-K5150-J01 ❑
18 pF	-K5180-J01 ❍	-K5180-J01 ❑	-K5180-J01 ❑
22 pF	-K5220-J01 ❍	-K5220-J01 ❑	-K5220-J01 ❑
27 pF	-K5270-J01 ❍	-K5270-J01 ❑	-K5270-J01 ❑
33 pF	-K5330-J01 ❍	-K5330-J01 ❑	-K5330-J01 ❑
39 pF	-K5390-J01 ❍	-K5390-J01 ❑	-K5390-J01 ❑
47 pF	-K5470-J01 ❍	-K5470-J01 ❑	-K5470-J01 ❑
56 pF	-K5560-J01 ❍	-K5560-J01 ❑	-K5560-J01 ❑
68 pF	-K5680-J01 ❍	-K5680-J01 ❑	-K5680-J01 ❑
82 pF	-K5820-J01 ❍	-K5820-J01 ❑	-K5820-J01 ❑
100 pF	-K5101-J01 ❍	-K5101-J01 ❑	-K5101-J01 ❑
120 pF	-K5121-J01 ❍	-K5121-J01 ❑	-K5121-J01 ❑
150 pF	-K5151-J01 ❍	-K5151-J01 ❑	-K5151-J01 ❑
180 pF	-K5181-J01 ❍	-K5181-J01 ❑	-K5181-J01 ❑
220 pF	-K5221-J01 ❍	-K5221-J01 ❑	-K5221-J01 ❑
270 pF	-K5271-J01 ❍	-K5271-J01 ❑	-K5271-J01 ❑
330 pF	-K5331-J01 ❍	-K5331-J01 ❑	-K5331-J01 ❑
390 pF	-K5391-J01 ❍	-K5391-J01 ❑	-K5391-J01 ❑
470 pF	-K5471-J01 ❍	-K5471-J01 ❑	-K5471-J01 ❑
560 pF		-K5561-J01 ❑	-K5561-J01 ❑
680 pF		-K5681-J01 ❑	-K5681-J01 ❑
820 pF		-K5821-J01 ❑	-K5821-J01 ❑

Chip thickness: ❑: 0,6 ± 0,1 mm ❍: 0,8 ± 0,1 mm

1) E24 series available on request
2) The tables contain the ordering codes for the standard capacitance tolerance: C = ± 0,25 pF for < 10 pF; J = ± 5 % for ≥ 10 pF. Example: B37930-K5010-**C**01
For other available capacitance tolerances see page 15

Ordering codes for C0G/NP0/CH, 50 Vdc, AgNiSn terminations, bulk case packing (cont´d)

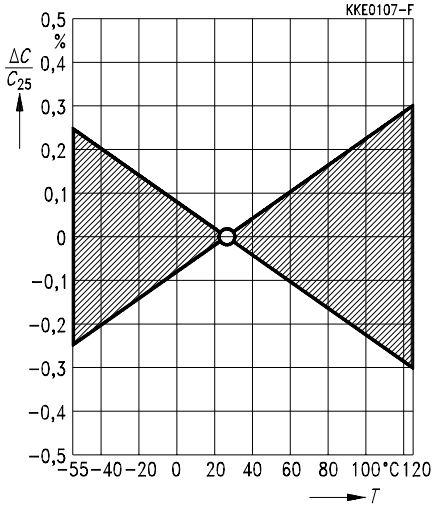
Size	0603/1608	0805/2012	1206/3216	
C_R [1]	Ordering code [2]			
	B37930-	B37940-	B37871-	
1,0 nF		-K5102-J01 ❑	-K5102-J01 ❑	
1,2 nF			-K5122-J01 ❑	
1,5 nF			-K5152-J01 ❑	
1,8 nF			-K5182-J01 ❑	
2,2 nF			-K5222-J01 ❑	

Chip thickness: ❑: 0,6 ± 0,1 mm

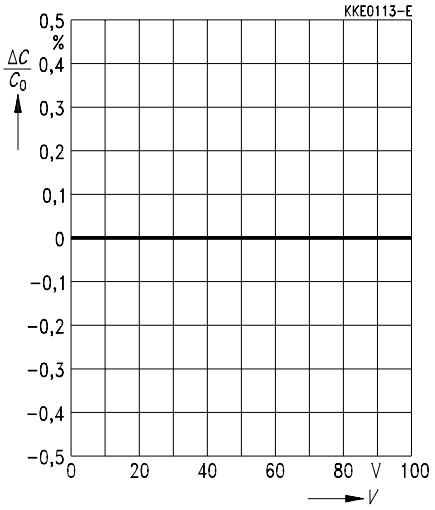
1) E24 series available on request
2) The tables contain the ordering codes for the standard capacitance tolerance:
C = ± 0,25 pF for < 10 pF; J = ± 5 % for ≥ 10 pF. Example: B37871-K5102-**J**01
For other available capacitance tolerances see page 15

Characteristics

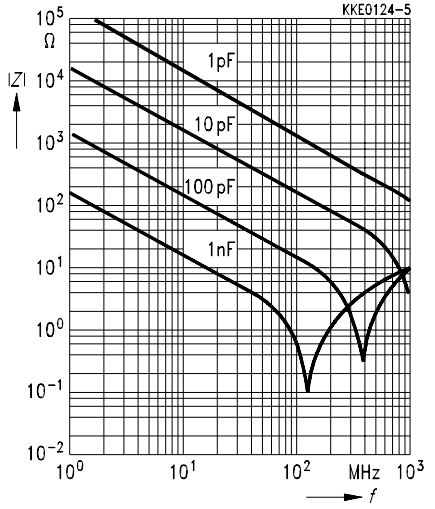
Capacitance change $\Delta C/C_{25}$ versus temperature T (tolerance range ▭)



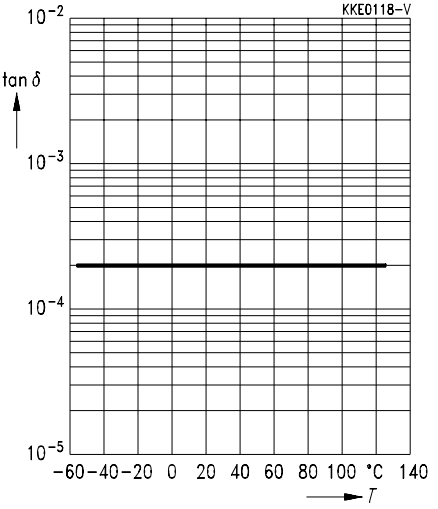
Capacitance change $\Delta C/C_0$ versus superimposed dc voltage V



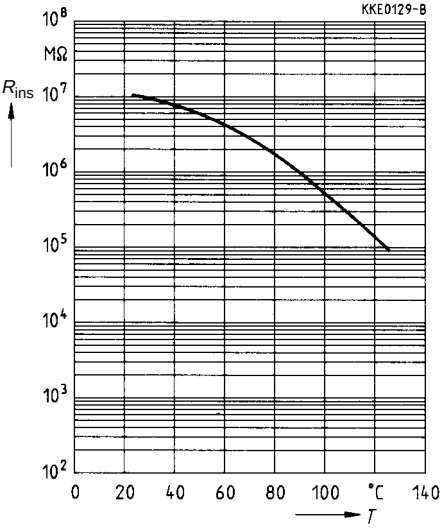
Impedance $|Z|$ versus frequency f



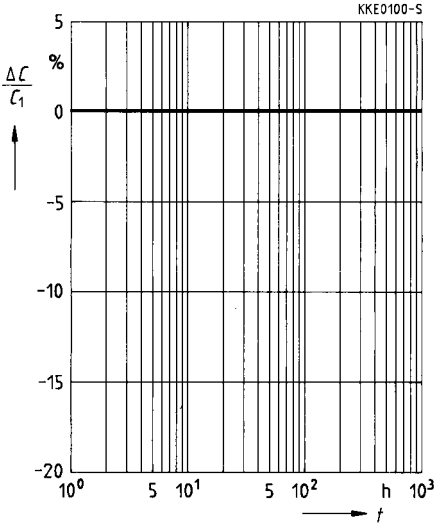
Dissipation factor tan δ versus temperature T



Insulation resistance R_{ins} versus temperature T



Capacitance change $\Delta C/C_1$ versus time t



Features

- High volumetric efficiency
- Non-linear capacitance change
- High insulation resistance
- High pulse strength

Applications

- Blocking
- Coupling
- Decoupling
- Interference suppression

Terminations

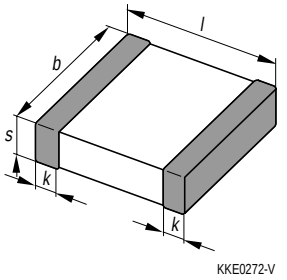
- For soldering:
  Sizes 0402 through 1210:
  silver/nickel/tin
  Sizes 1812, 2220:
  silver palladium
- For conductive adhesion:
  All sizes:
  silver palladium

Packing

- Blister and cardboard tape,
  for details refer to chapter
  “Taping and Packing”, page 111.
- Bulk case for sizes 0603, 0805
  and 1206, for details see page 114.

Maximum ratings

Climatic category
in accordance with IEC 68-1: 55/125/56



KKE0272-V

Dimensions (mm)

Size **inch**/mm	*l*	*b*	*s*	*k*
0402/1005	1,0 ± 0,10	0,50 ± 0,05	0,5 ± 0,05	0,2
0603/1608	1,6 ± 0,15*)	0,80 ± 0,10	0,8 ± 0,10	0,3
0805/2012	2,0 ± 0,20	1,25 ± 0,15	1,3 max.	0,5
1206/3216	3,2 ± 0,20	1,60 ± 0,15	1,3 max.	0,5
1210/3225	3,2 ± 0,30	2,50 ± 0,30	1,7 max.	0,5
1812/4532	4,5 ± 0,30	3,20 ± 0,30	1,3 max.	0,5
2220/5750	5,7 ± 0,40	5,00 ± 0,40	1,3 max	0,5

*) For bulk cases: 1,6 ± 0,1
Tolerances in acc. with CECC 32101-801

Available capacitance tolerances

Tolerance	Symbol
$\Delta C_R/C_R = \pm$ 5 %	J
$\Delta \boldsymbol{C_R/C_R = \pm}$ **10 %**	**K**
$\Delta C_R/C_R = \pm$ 20 %	M

Standard tolerance in bold print
J tolerance not available for 16 V, 200 V and 500 V

Rated voltage values

V_R = 16 V, 25 V, 50 V,100 V, 200 V, 500 V

Product range

	X7R/B characteristic												
Size[1)] **inch** mm	**0402** 1005		**0603** 1608				**0805** 2012				**1206** 3216		
Type	B37921		B37931				B37941				B37872		
V_R (Vdc)	16	25	16	25	50	100	16	25	50	100	16	25	50
100 pF													
120 pF													
150 pF													
180 pF													
220 pF													
270 pF													
330 pF													
390 pF													
470 pF													
560 pF													
680 pF													
820 pF													
1,0 nF													
1,2 nF													
1,5 nF													
1,8 nF													
2,2 nF													
2,7 nF													
3,3 nF													
3,9 nF													
4,7 nF													
5,6 nF													
6,8 nF													
8,2 nF													

Chip thickness (*s*): 0,5 ± 0,1 mm | 0,6 ± 0,1 mm | 0,8 ± 0,1 mm | 1,2 ± 0,1 mm

1) l × b (inch) / l × b (mm)

Product range

	X7R/B characteristic												
Size[1)] **inch** mm	**0402** 1005		**0603** 1608				**0805** 2012				**1206** 3216		
Type	B37921		B37931				B37941				B37872		
V_R (Vdc)	16	25	16	25	50	100	16	25	50	100	16	25	50
10 nF													
12 nF													
15 nF													
18 nF													
22 nF													
27 nF													
33 nF													
39 nF													
47 nF													
56 nF													
68 nF													
82 nF													
100 nF													
120 nF													
150 nF													
180 nF													
220 nF													
270 nF													
330 nF													
390 nF													
470 nF													
560 nF													
680 nF													
820 nF													
1,0 µF													

Chip thickness (*s*): 0,5 ± 0,1 mm | 0,6 ± 0,1 mm | 0,8 ± 0,1 mm | 1,2 ± 0,1 mm

1) l × b (inch) / l × b (mm)

Product range

	X7R/B characteristic										
Size[1)] **inch** mm	**1206** 3216			**1210** 3225				**1812** 4532		**2220** 5750	
Type	B37872			B37950				B37953		B37956	
V_R (Vdc)	100	200	500	50	100	200	500	50		50	
100 pF											
120 pF											
150 pF											
180 pF											
220 pF											
270 pF											
330 pF											
390 pF											
470 pF											
560 pF											
680 pF											
820 pF											
1,0 nF											
1,2 nF											
1,5 nF											
1,8 nF											
2,2 nF											
2,7 nF											
3,3 nF											
3,9 nF											
4,7 nF											
5,6 nF											
6,8 nF											
8,2 nF											

Chip thickness (*s*): 0,5 ± 0,1 mm | 0,6 ± 0,1 mm | 0,8 ± 0,1 mm | 1,2 ± 0,1 mm | 1,6 ± 0,1 mm

1) l × b (inch) / l × b (mm)

Product range

	X7R/B characteristic										
Size[1)] **inch** mm	**1206** 3216			**1210** 3225				**1812** 4532		**2220** 5750	
Type	B37872			B37950				B37953		B37956	
V_R (Vdc)	100	200	500	50	100	200	500	50		50	
10 nF											
12 nF											
15 nF											
18 nF											
22 nF											
27 nF											
33 nF											
39 nF											
47 nF											
56 nF											
68 nF											
82 nF											
100 nF											
120 nF											
150 nF											
180 nF											
220 nF											
270 nF											
330 nF											
390 nF											
470 nF											
560 nF											
680 nF											
820 nF											
1,0 µF											

Chip thickness (*s*): 0,5 ± 0,1 mm | 0,6 ± 0,1 mm | 0,8 ± 0,1 mm | 1,2 ± 0,1 mm | 1,6 ± 0,1 mm

1) l × b (inch) / l × b (mm)

Ordering codes for X7R/B characteristic, 16 Vdc, AgNiSn terminations

Size	0402/1005	0603/1608	0805/2012	1206/3216	
C_R	Ordering code [1]				
	B37921-	B37931-	B37941-	B37872-	
470 pF	-K9471-K60 ▲				
560 pF	-K9561-K60 ▲				
680 pF	-K9681-K60 ▲				
820 pF	-K9821-K60 ▲				
1,0 nF	-K9102-K60 ▲				
1,2 nF	-K9122-K60 ▲				
1,5 nF	-K9152-K60 ▲				
1,8 nF	-K9182-K60 ▲				
2,2 nF	-K9222-K60 ▲				
2,7 nF	-K9272-K60 ▲				
3,3 nF	-K9332-K60 ▲				
3,9 nF	-K9392-K60 ▲				
4,7 nF	-K9472-K60 ▲	-K9472-K60 ❍			
5,6 nF	-K9562-K60 ▲	-K9562-K60 ❍			
6,8 nF	-K9682-K60 ▲	-K9682-K60 ❍			
8,2 nF	-K9822-K60 ▲	-K9822-K60 ❍			
10 nF	-K9103-K60 ▲	-K9103-K60 ❍	-K9103-K60 ❑		
12 nF	-K9123-K60 ▲	-K9123-K60 ❍	-K9123-K60 ❑		
15 nF	-K9153-K60 ▲	-K9153-K60 ❍	-K9153-K60 ❑		
18 nF		-K9183-K60 ❍	-K9183-K60 ❑		
22 nF		-K9223-K60 ❍	-K9223-K60 ❑	-K9223-K60 ❍	
27 nF		-K9273-K60 ❍	-K9273-K60 ❑	-K9273-K60 ❍	
33 nF		-K9333-K60 ❍	-K9333-K60 ❑	-K9333-K60 ❍	
39 nF		-K9393-K60 ❍	-K9393-K60 ❑	-K9393-K60 ❍	
47 nF		-K9473-K60 ❍	-K9473-K60 ❑	-K9473-K60 ❍	
56 nF		-K9563-K60 ❍	-K9563-K60 ❑	-K9563-K60 ❍	
68 nF		-K9683-K60 ❍	-K9683-K60 ❑	-K9683-K60 ❍	
82 nF			-K9823-K60 ❑	-K9823-K60 ❍	
100 nF			-K9104-K60 ❍	-K9104-K60 ❍	
120 nF			-K9124-K60 ❍	-K9124-K60 ❍	
150 nF			-K9154-K62 ◆	-K9154-K60 ❍	
180 nF			-K9184-K62 ◆	-K9184-K60 ❍	
220 nF			-K9224-K62 ◆	-K9220-K60 ❍	
270 nF				-K9274-K60 ❍	
330 nF				-K9334-K60 ❍	
390 nF				-K9394-K62 ◆	
470 nF				-K9474-K62 ◆	

Chip thickness: ▲: 0,5 ± 0,1 mm ❑: 0,6 ± 0,1 mm ❍: 0,8 ± 0,1 mm ◆: 1,2 ± 0,1 mm

1) The tables contain the ordering codes for the standard capacitance tolerance:
K = ± 10 %. Example: B37921-K9471-**K**60
For other available capacitance tolerances see page 27

Ordering codes for X7R/B characteristic, 25 Vdc, AgNiSn terminations

Size	0402/1005	0603/1608	0805/2012	1206/3216	
C_R	Ordering code[1)] B37921-	B37931-	B37941-	B37872-	
100 pF	-K0101-K60 ▲				
120 pF	-K0121-K60 ▲				
150 pF	-K0151-K60 ▲				
180 pF	-K0181-K60 ▲				
220 pF	-K0221-K60 ▲				
270 pF	-K0271-K60 ▲				
330 pF	-K0331-K60 ▲				
390 pF	-K0391-K60 ▲				
470 pF	-K0471-K60 ▲				
560 pF	-K0561-K60 ▲				
680 pF	-K0681-K60 ▲				
820 pF	-K0821-K60 ▲				
1,0 nF	-K0102-K60 ▲				
1,2 nF	-K0122-K60 ▲				
1,5 nF	-K0152-K60 ▲				
1,8 nF	-K0182-K60 ▲				
2,2 nF	-K0222-K60 ▲				
2,7 nF	-K0272-K60 ▲				
3,3 nF	-K0332-K60 ▲				
3,9 nF	-K0392-K60 ▲				
4,7 nF	-K0472-K60 ▲	-K0472-K60 ❍			
5,6 nF		-K0562-K60 ❍			
6,8 nF		-K0682-K60 ❍			
8,2 nF		-K0822-K60 ❍			
10 nF		-K0103-K60 ❍	-K0103-K60 ❑		
12 nF		-K0123-K60 ❍	-K0123-K60 ❑		
15 nF		-K0153-K60 ❍	-K0153-K60 ❑		
18 nF		-K0183-K60 ❍	-K0183-K60 ❑		
22 nF		-K0223-K60 ❍	-K0223-K60 ❑	-K0223-K60 ❍	
27 nF			-K0273-K60 ❑	-K0273-K60 ❍	
33 nF			-K0333-K60 ❑	-K0333-K60 ❍	
39 nF			-K0393-K60 ❑	-K0393-K60 ❍	
47 nF			-K0473-K60 ❑	-K0473-K60 ❍	
56 nF			-K0563-K60 ❍	-K0563-K60 ❍	
68 nF			-K0683-K60 ❍	-K0683-K60 ❍	

Chip thickness: ▲: 0,5 ± 0,1 mm ❑: 0,6 ± 0,1 mm ❍: 0,8 ± 0,1 mm

1) The tables contain the ordering codes for the standard capacitance tolerance: K = ± 10 %. Example: B37921-K0101-**K**60
For other available capacitance tolerances see page 27

Ordering codes for X7R/B characteristic, 25 Vdc, AgNiSn terminations (cont´d)

Size	0402/1005	0603/1608	0805/2012	1206/3216	
C_R	Ordering code [1]				
	B37921-	B37931-	B37941-	B37872-	
82 nF			-K0823-K62 ◆	-K0823-K62 ❍	
100 nF			-K0104-K62 ◆	-K0104-K62 ❍	
120 nF				-K0124-K62 ❍	
150 nF				-K0154-K62 ❍	
180 nF				-K0184-K62 ◆	
220 nF				-K0224-K62 ◆	

Chip thickness: ❍: 0,8 ± 0,1 mm ◆: 1,2 ± 0,1 mm

1) The tables contain the ordering codes for the standard capacitance tolerance: K = ± 10 %. Example: B37941-K0823-**K**62
For other available capacitance tolerances see page 27

Ordering codes for X7R/B characteristic, 50 Vdc, AgNiSn terminations

Size	0603/1608	0805/2012	1206/3216	1210/3225
C_R	Ordering code [1] B37931-	B37941-	B37872-	B37950-
220 pF	-K5221-K60 ❍			
270 pF	-K5271-K60 ❍			
330 pF	-K5331-K60 ❍			
390 pF	-K5391-K60 ❍			
470 pF	-K5471-K60 ❍	-K5471-K60 ❑		
560 pF	-K5561-K60 ❍	-K5561-K60 ❑		
680 pF	-K5681-K60 ❍	-K5681-K60 ❑		
820 pF	-K5821-K60 ❍	-K5821-K60 ❑		
1,0 nF	-K5102-K60 ❍	-K5102-K60 ❑	-K5102-K60 ❍	
1,2 nF	-K5122-K60 ❍	-K5122-K60 ❑	-K5122-K60 ❍	
1,5 nF	-K5152-K60 ❍	-K5152-K60 ❑	-K5152-K60 ❍	
1,8 nF	-K5182-K60 ❍	-K5182-K60 ❑	-K5182-K60 ❍	
2,2 nF	-K5222-K60 ❍	-K5222-K60 ❑	-K5222-K60 ❍	
2,7 nF	-K5272-K60 ❍	-K5272-K60 ❑	-K5272-K60 ❍	
3,3 nF	-K5332-K60 ❍	-K5332-K60 ❑	-K5332-K60 ❍	
3,9 nF	-K5392-K60 ❍	-K5392-K60 ❑	-K5392-K60 ❍	
4,7 nF	-K5472-K60 ❍	-K5472-K60 ❑	-K5472-K60 ❍	
5,6 nF	-K5562-K60 ❍	-K5562-K60 ❑	-K5562-K60 ❍	
6,8 nF	-K5682-K60 ❍	-K5682-K60 ❑	-K5682-K60 ❍	
8,2 nF	-K5822-K60 ❍	-K5822-K60 ❑	-K5822-K60 ❍	
10 nF	-K5103-K60 ❍	-K5103-K60 ❑	-K5103-K60 ❍	-K5103-K62 ❍
12 nF		-K5123-K60 ❑	-K5123-K60 ❍	-K5123-K62 ❍
15 nF		-K5153-K60 ❑	-K5153-K60 ❍	-K5153-K62 ❍
18 nF		-K5183-K60 ❑	-K5183-K60 ❍	-K5183-K62 ❍
22 nF		-K5223-K60 ❑	-K5223-K60 ❍	-K5223-K62 ❍
27 nF		-K5273-K60 ❑	-K5273-K60 ❍	-K5273-K62 ❍
33 nF		-K5333-K60 ❑	-K5333-K60 ❍	-K5333-K62 ❍
39 nF		-K5393-K60 ❑	-K5393-K60 ❍	-K5393-K62 ❍
47 nF		-K5473-K60 ❑	-K5473-K60 ❍	-K5473-K62 ❍
56 nF		-K5563-K62 ◆	-K5563-K60 ❍	-K5563-K62 ❍
68 nF		-K5683-K62 ◆	-K5683-K60 ❍	-K5683-K62 ❍
82 nF		-K5823-K62 ◆	-K5823-K60 ❍	-K5823-K62 ❍
100 nF		-K5104-K62 ◆	-K5104-K60 ❍	-K5104-K62 ❍
120 nF				-K5124-K62 ❍
150 nF				-K5154-K62 ❍
180 nF				-K5184-K62 ◆
220 nF				-K5224-K62 ◆

Chip thickness: ❑: 0,6 ± 0,1 mm ❍: 0,8 ± 0,1 mm ◆: 1,2 ± 0,1 mm

1) The tables contain the ordering codes for the standard capacitance tolerance: K = ± 10 %. Example: B37931-K5221-**K**60
For other available capacitance tolerances see page 27

Ordering codes for X7R/B characteristic, 50 Vdc, AgPd terminations (cont´d)

Size	1812/4532	2220/5750		
C_R	Ordering code[1)] B37953-	B37956-		
100 nF	-J5104-K62 ◆			
120 nF	-J5124-K62 ◆			
150 nF	-J5154-K62 ◆			
180 nF	-J5184-K62 ◆			
220 nF	-J5224-K62 ◆			
270 nF	-J5274-K62 ◆			
330 nF	-J5334-K62 ◆			
390 nF	-J5394-K62 ◆			
470 nF	-J5474-K62 ◆	-J5474-K62 ◆		
560 nF		-J5564-K62 ◆		
680 nF		-J5684-K62 ◆		
820 nF		-J5824-K62 ◆		
1,0 µF		-J5105-K62 ◆		

Chip thickness: ◆: 1,2 ± 0,1 mm

1) The tables contain the ordering codes for the standard capacitance tolerance:
K = ± 10 %. Example: B37953-J5104-**K**62
For other available capacitance tolerances see page 27

Ordering codes for X7R/B characteristic, 100 Vdc, AgNiSn terminations

Size	0603/1608	0805/2012	1206/3216	1210/3225	
C_R	Ordering code [1)] B37931-	B37941-	B37872-	B37950-	
100 pF	-K1101-K60 ❍				
120 pF	-K1121-K60 ❍				
150 pF	-K1151-k60 ❍				
180 pF	-K1181-K60 ❍				
220 pF	-K1221-K60 ❍				
270 pF	-K1271-K60 ❍				
330 pF	-K1331-K60 ❍				
390 pF	-K1391-K60 ❍				
470 pF	-K1471-K60 ❍	-K1471-K60 ❑			
560 pF	-K1561-K60 ❍	-K1561-K60 ❑			
680 pF	-K1681-K60 ❍	-K1681-K60 ❑			
820 pF	-K1821-K60 ❍	-K1821-K60 ❑			
1,0 nF	-K1102-K60 ❍	-K1102-K60 ❑	-K1102-K60 ❍		
1,2 nF	-K1122-K60 ❍	-K1122-K60 ❑	-K1122-K60 ❍		
1,5 nF	-K1152-K60 ❍	-K1152-K60 ❑	-K1152-K60 ❍		
1,8 nF	-K1182-K60 ❍	-K1182-K60 ❑	-K1182-K60 ❍		
2,2 nF	-K1222-K60 ❍	-K1222-K60 ❑	-K1222-K60 ❍		
2,7 nF	-K1272-K60 ❍	-K1272-K60 ❑	-K1272-K60 ❍		
3,3 nF	-K1332-K60 ❍	-K1332-K60 ❑	-K1332-K60 ❍		
3,9 nF	-K1392-K60 ❍	-K1392-K60 ❑	-K1392-K60 ❍		
4,7 nF	-K1472-K60 ❍	-K1472-K60 ❑	-K1472-K60 ❍		
5,6 nF		-K1562-K60 ❑	-K1562-K60 ❍		
6,8 nF		-K1682-K60 ❑	-K1682-K60 ❍		
8,2 nF		-K1822-K60 ❑	-K1822-K60 ❍		
10 nF		-K1103-K60 ❑	-K1103-K60 ❍	-K1103-K62 ❍	
12 nF		-K1123-K60 ❑	-K1123-K60 ❍	-K1123-K62 ❍	
15 nF		-K1153-K60 ❑	-K1153-K60 ❍	-K1153-K62 ❍	
18 nF			-K1183-K60 ❍	-K1183-K62 ❍	
22 nF			-K1223-K60 ❍	-K1223-K62 ❍	
27 nF			-K1273-K60 ❍	-K1273-K62 ❍	
33 nF			-K1333-K60 ❍	-K1333-K62 ❍	
39 nF			-K1393-K60 ❍	-K1393-K62 ❍	
47 nF			-K1473-K60 ❍	-K1473-K62 ❍	

Chip thickness: ❑: 0,6 ± 0,1 mm ❍: 0,8 ± 0,1 mm ◆: 1,2 ± 0,1 mm

1) The tables contain the ordering codes for the standard capacitance tolerance:
K = ± 10 %. Example: B37931-K1101-**K**60
For other available capacitance tolerances see page 27

Ordering codes for X7R/B characteristic, 100 Vdc, AgNiSn terminations (cont´d)

Size	0603/1608	0805/2012	1206/3216	1210/3225	
C_R	Ordering code [1]				
	B37931-	B37941-	B37872-	B37950-	
56 nF			-K1563-K62 ◆	-K1563-K62 ❍	
68 nF			-K1683-K62 ◆	-K1683-K62 ❍	
82 nF			-K1823-K62 ◆	-K1823-K62 ❍	
100 nF			-K1104-K62 ◆	-K1104-K62 ❍	
120 nF				-K1124-K62 ◆	
150 nF				-K1154-K62 ◆	

Chip thickness: ❍: 0,8 ± 0,1 mm ◆: 1,2 ± 0,1 mm

1) The tables contain the ordering codes for the standard capacitance tolerance:
K = ± 10 %. Example: B37872-K1563-**K**62
For other available capacitance tolerances see page 27

Ordering codes for X7R/B characteristic, 200/500 Vdc, AgNiSn terminations

Size	1206/3216	1206/3216	1210/3225	1210/3225
V_R	200	500	200	500
C_R	Ordering code[1)] B37872-	B37872-	B37950-	B37950
470 pF	-K2471-K60 ❍	-K3471-K60 ❍		
560 pF	-K2561-K60 ❍	-K3561-K60 ❍		
680 pF	-K2681-K60 ❍	-K3681-K60 ❍		
820 pF	-K2821-K60 ❍	-K3821-K60 ❍		
1,0 nF	-K2102-K60 ❍	-K3102-K60 ❍	-K2102-K62 ❍	-K3102-K62 ❍
1,2 nF	-K2122-K60 ❍	-K3122-K60 ❍	-K2122-K62 ❍	-K3122-K62 ❍
1,5 nF	-K2152-K60 ❍	-K3152-K60 ❍	-K2152-K62 ❍	-K3152-K62 ❍
1,8 nF	-K2182-K60 ❍	-K3182-K60 ❍	-K2182-K62 ❍	-K3182-K62 ❍
2,2 nF	-K2222-K60 ❍	-K3222-K60 ❍	-K2222-K62 ❍	-K3222-K62 ❍
2,7 nF	-K2272-K60 ❍	-K3272-K62 ◆	-K2272-K62 ❍	-K3272-K62 ❍
3,3 nF	-K2332-K60 ❍	-K3332-K62 ◆	-K2332-K62 ❍	-K3332-K62 ❍
3,9 nF	-K2392-K60 ❍	-K3392-K62 ◆	-K2392-K62 ❍	-K3392-K62 ◆
4,7 nF	-K2472-K60 ❍	-K3472-K62 ◆	-K2472-K62 ❍	-K3472-K62 ◆
5,6 nF	-K2562-K60 ❍		-K2562-K62 ❍	-K3562-K62 ◆
6,8 nF	-K2682-K60 ❍		-K2682-K62 ❍	-K3682-K62 ◆
8,2 nF	-K2822-K60 ❍		-K2822-K62 ❍	-K3822-K62 ●
10 nF	-K2103-K60 ❍		-K2103-K62 ❍	-K3103-K62 ●
12 nF	-K2123-K62 ◆		-K2123-K62 ❍	
15 nF	-K2153-K62 ◆		-K2153-K62 ❍	
18 nF	-K2183-K62 ◆		-K2183-K62 ❍	
22 nF	-K2223-K62 ◆		-K2223-K62 ◆	
27 nF			-K2273-K62 ◆	
33 nF			-K2333-K62 ◆	
39 nF			-K2393-K62 ●	
47 nF			-K2473-K62 ●	

Chip thickness: ❍: 0,8 ± 0,1 mm ◆: 1,2 ± 0,1 mm ●: 1,6 ± 0,1 mm

1) The tables contain the ordering codes for the standard capacitance tolerance: K = ± 10 %. Example: B37872-K2471-**K**60
For other available capacitance tolerances see page 27

Ordering codes for X7R/B characteristic, 25 V/50 Vdc, AgNiSn terminations, bulk case packing

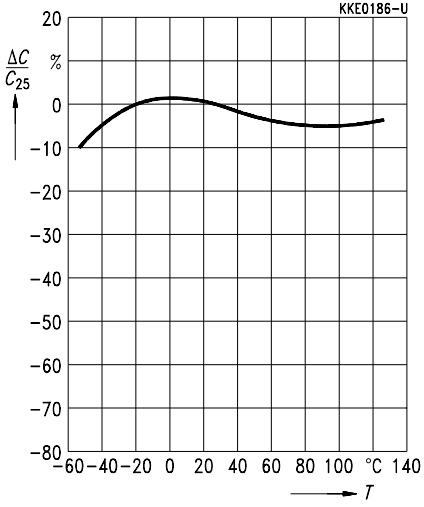
Size	0603	0603	0805	1206	
V_R	25 V	50 V	50 V	50 V	
C_R	Ordering code [1]				
	B37931-	B37931-	B37941-	B37872-	
220 pF		-K5221-K01 ❍			
270 pF		-K5271-K01 ❍			
330 pF		-K5331-K01 ❍			
390 pF		-K5391-K01 ❍			
470 pF		-K5471-K01 ❍	-K5471-K01 ❑		
560 pF		-K5561-K01 ❍	-K5561-K01 ❑		
680 pF		-K5681-K01 ❍	-K5681-K01 ❑		
820 pF		-K5821-K01 ❍	-K5821-K01 ❑		
1,0 nF		-K5102-K01 ❍	-K5102-K01 ❑	-K5102-K01 ❑	
1,2 nF		-K5122-K01 ❍	-K5122-K01 ❑	-K5122-K01 ❑	
1,5 nF		-K5152-K01 ❍	-K5152-K01 ❑	-K5152-K01 ❑	
1,8 nF		-K5182-K01 ❍	-K5182-K01 ❑	-K5182-K01 ❑	
2,2 nF		-K5222-K01 ❍	-K5222-K01 ❑	-K5222-K01 ❑	
2,7 nF		-K5272-K01 ❍	-K5272-K01 ❑	-K5272-K01 ❑	
3,3 nF		-K5332-K01 ❍	-K5332-K01 ❑	-K5332-K01 ❑	
3,9 nF		-K5392-K01 ❍	-K5392-K01 ❑	-K5392-K01 ❑	
4,7 nF	-K0472-K01 ❍	-K5472-K01 ❍	-K5472-K01 ❑	-K5472-K01 ❑	
5,6 nF	-K0562-K01 ❍	-K5562-K01 ❍	-K5562-K01 ❑	-K5562-K01 ❑	
6,8 nF	-K0682-K01 ❍	-K5682-K01 ❍	-K5682-K01 ❑	-K5682-K01 ❑	
8,2 nF	-K0822-K01 ❍	-K5822-K01 ❍	-K5822-K01 ❑	-K5822-K01 ❑	
10 nF	-K0103-K01 ❍	-K5103-K01 ❍	-K5103-K01 ❑	-K5103-K01 ❑	
12 nF	-K0123-K01 ❍		-K5123-K01 ❑	-K5123-K01 ❑	
15 nF	-K0153-K01 ❍		-K5153-K01 ❑	-K5153-K01 ❑	
18 nF	-K0183-K01 ❍		-K5183-K01 ❑	-K5183-K01 ❑	
22 nF	-K0223-K01 ❍			-K5223-K01 ❑	
27 nF				-K5273-K01 ❑	
33 nF				-K5333-K01 ❑	
39 nF				-K5393-K01 ❑	
47 nF				-K5473-K01 ❑	

Chip thickness: ❑: 0,6 ± 0,1 mm ❍: 0,8 ± 0,1 mm

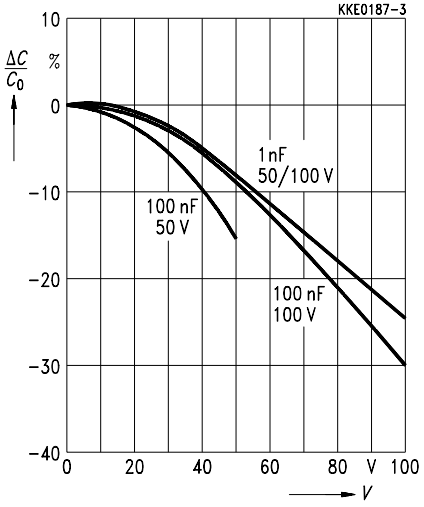
1) The tables contain the ordering codes for the standard capacitance tolerance: K = ± 10 %. Example: B37931-K0472-**K**01
For other available capacitance tolerances see page 27

Characteristics

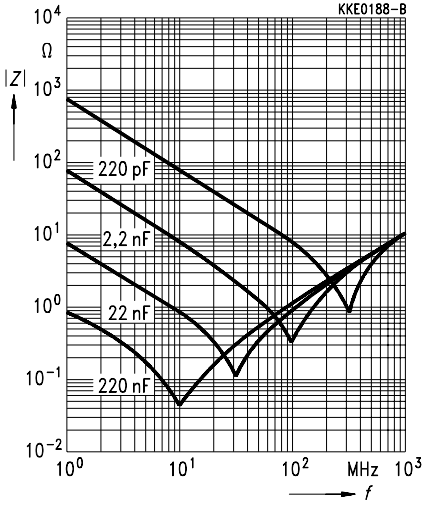
Capacitance change $\Delta C/C_{25}$ versus temperature T



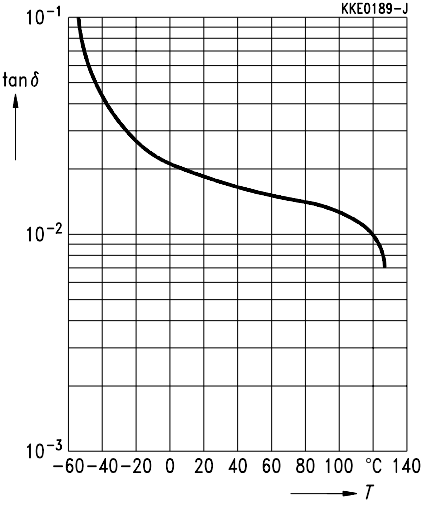
Capacitance change $\Delta C/C_0$ versus superimposed dc voltage V



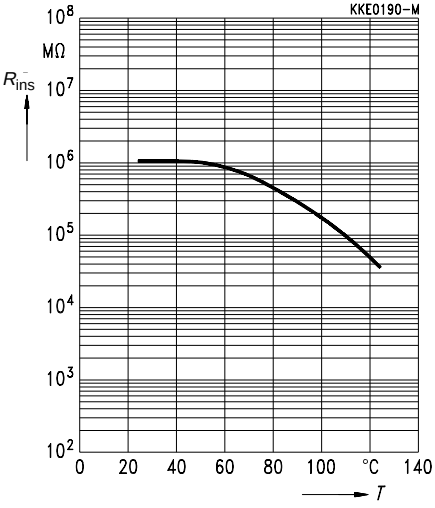
Impedance $|Z|$ versus frequency f



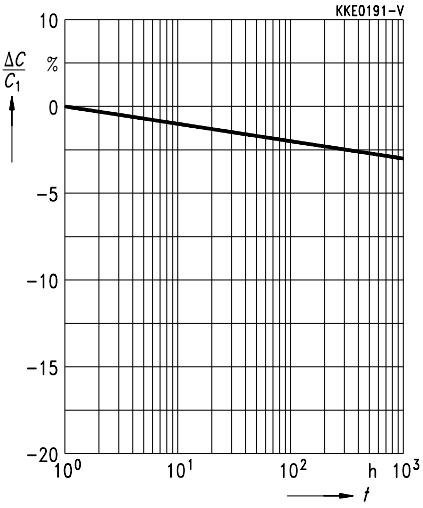
Dissipation factor tan δ versus temperature T



Insulation resistance R_{ins} versus temperature T



Capacitance change $\Delta C/C_1$ versus time t



Features

- High volumetric efficiency
- Non-linear capacitance change
- High insulation resistance
- High pulse strength
- Wide temperature range

Applications

- Blocking
- Coupling
- Decoupling
- Interference suppression

Terminations

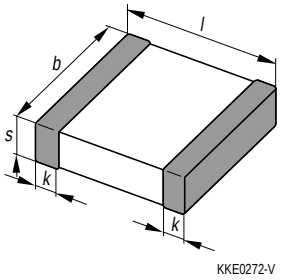
- For soldering:
  silver/nickel/tin
- For conductive adhesion:
  silver palladium

Packing

- Blister and cardboard tape,
  for details refer to chapter
  “Taping and Packing”, page 111.
- Bulk case on request

Maximum ratings

Climatic category
in accordance with IEC 68-1: 55/150/56



KKE0272-V

Dimensions (mm)

Size **inch**/mm	*l*	*b*	*s*	*k*
0805/2012	2,0 ± 0,20	1,25 ± 0,15	1,3 max.	0,5
1206/3216	3,2 ± 0,20	1,60 ± 0,15	1,3 max.	0,5
1210/3225	3,2 ± 0,30	2,50 ± 0,30	1,3 max.	0,5

Tolerances in acc. with CECC 32101-801

Available capacitance tolerances

Tolerance	Symbol
$\Delta C_R/C_R = \pm$ 5 %	J
$\Delta \boldsymbol{C_R}/\boldsymbol{C_R} = \pm$ **10 %**	**K**
$\Delta C_R/C_R = \pm$ 20 %	M

Standard tolerance in bold print

Rated voltage values

V_R = 50 V

Product range

	X8R					
Size[1)] **inch** mm	**0805** 2012		**1206** 3216		**1210** 3225	
Type	B37541		B37472		B37550	
V_R (Vdc)	50		50		50	
470 pF						
560 pF						
680 pF						
820 pF						
1,0 nF						
1,2 nF						
1,5 nF						
1,8 nF						
2,2 nF						
2,7 nF						
3,3 nF						
3,9 nF						
4,7 nF						
5,6 nF						
6,8 nF						
8,2 nF						

Chip thickness (s): 0,6 ± 0,1 mm | 0,8 ± 0,1 mm

1) l × b (inch) / l × b (mm)

Product range

	X8R					
Size[1)] **inch** mm	**0805** 2012		**1206** 3216		**1210** 3225	
Type	B37541		B37472		B37550	
V_R (Vdc)	50		50		50	
10 nF						
12 nF						
15 nF						
18 nF						
22 nF						
27 nF						
33 nF						
39 nF						
47 nF						
56 nF						
68 nF						
82 nF						
100 nF						
120 nF						
150 nF						

Chip thickness (*s*): 0,6 ± 0,1 mm | 0,8 ± 0,1 mm | 1,2 ± 0,1 mm

1) l × b (inch) / l × b (mm)

Ordering codes for X8R, 50 Vdc, AgNiSn terminations

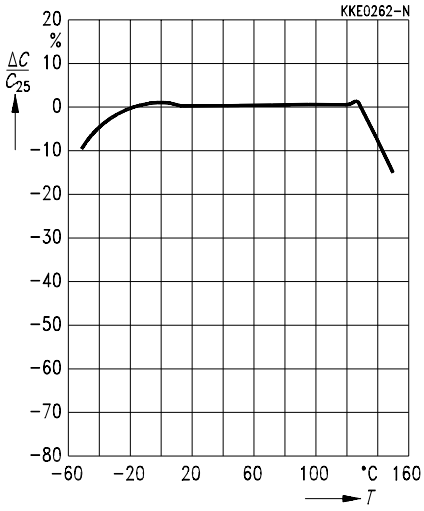
Size	0805/2012	1206/3216	1210/3225	
C_R	Ordering code [1] B37541-	B37472-	B37550-	
470 pF	-K5471-K60 ❑			
560 pF	-K5561-K60 ❑			
680 pF	-K5681-K60 ❑			
820 pF	-K5821-K60 ❑			
1,0 nF	-K5102-K60 ❑	-K5102-K60 ❍		
1,2 nF	-K5122-K60 ❑	-K5122-K60 ❍		
1,5 nF	-K5152-K60 ❑	-K5152-K60 ❍		
1,8 nF	-K5182-K60 ❑	-K5182-K60 ❍		
2,2 nF	-K5222-K60 ❑	-K5222-K60 ❍		
2,7 nF	-K5272-K60 ❑	-K5272-K60 ❍		
3,3 nF	-K5332-K60 ❑	-K5332-K60 ❍		
3,9 nF	-K5392-K60 ❑	-K5392-K60 ❍		
4,7 nF	-K5472-K60 ❑	-K5472-K60 ❍		
5,6 nF	-K5562-K60 ❑	-K5562-K60 ❍		
6,8 nF	-K5682-K60 ❑	-K5682-K60 ❍		
8,2 nF	-K5822-K60 ❑	-K5822-K60 ❍		
10 nF	-K5103-K60 ❑	-K5103-K60 ❍	-K5103-K62 ❍	
12 nF	-K5123-K60 ❑	-K5123-K60 ❍	-K5123-K62 ❍	
15 nF	-K5153-K60 ❑	-K5153-K60 ❍	-K5153-K62 ❍	
18 nF		-K5183-K60 ❍	-K5183-K62 ❍	
22 nF		-K5223-K60 ❍	-K5223-K62 ❍	
27 nF		-K5273-K60 ❍	-K5273-K62 ❍	
33 nF		-K5333-K60 ❍	-K5333-K62 ❍	
39 nF		-K5393-K60 ❍	-K5393-K62 ❍	
47 nF		-K5473-K60 ❍	-K5473-K62 ❍	
56 nF		-K5563-K62 ◆	-K5563-K62 ❍	
68 nF		-K5683-K62 ◆	-K5683-K62 ❍	
82 nF		-K5823-K62 ◆	-K5823-K62 ❍	
100 nF		-K5104-K62 ◆	-K5104-K62 ❍	
120 nF			-K5124-K62 ◆	
150 nF			-K5154-K62 ◆	

Chip thickness: ❑: 0,6 ± 0,1 mm ❍: 0,8 ± 0,1 mm ◆: 1,2 ± 0,1 mm

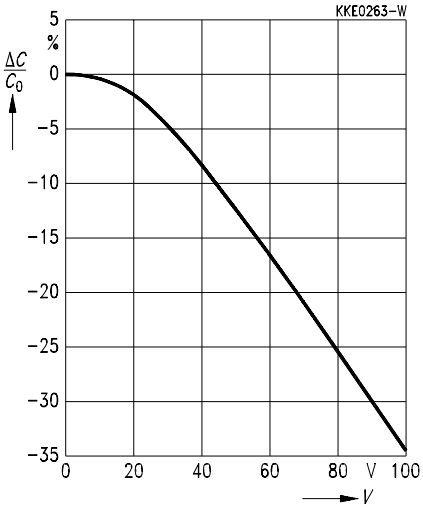
1) The tables contain the ordering codes for the standard capacitance tolerance: K = ± 10%. Example: B37541-K5471-**K**60
For other available capacitance tolerances see page 43

Characteristics

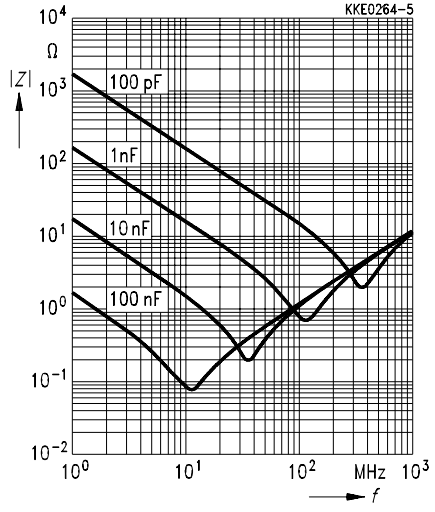
Capacitance change $\Delta C/C_{25}$ versus temperature T



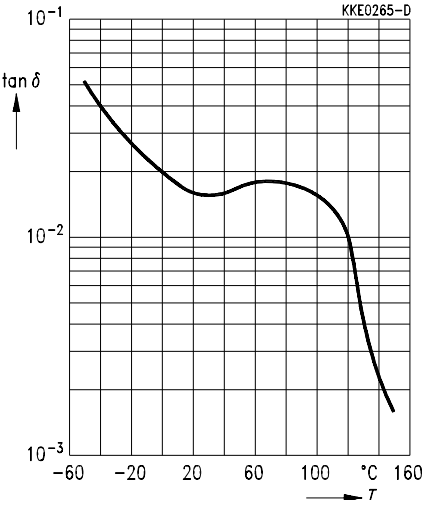
Capacitance change $\Delta C/C_0$ versus superimposed dc voltage V



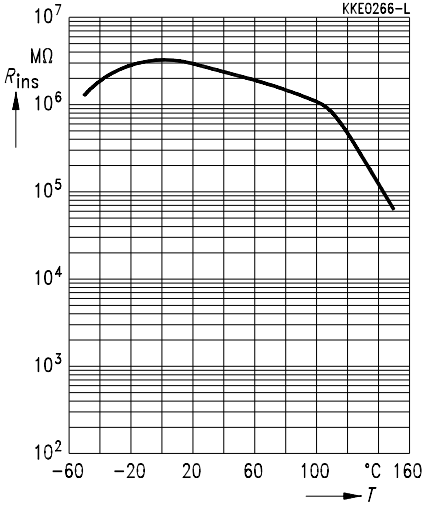
Impedance $|Z|$ versus frequency f



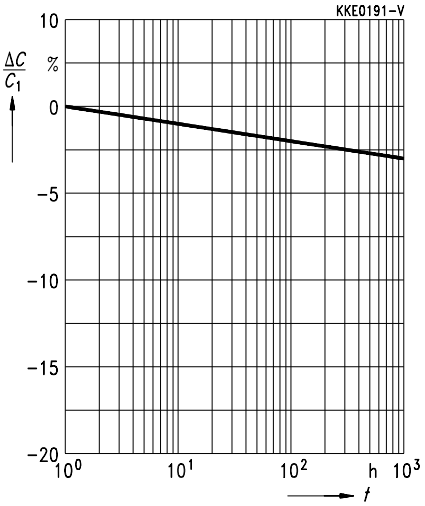
Dissipation factor tan δ versus temperature T



Insulation resistance R_{ins} versus temperature T



Capacitance change $\Delta C/C_1$ versus time t



Features

- Extremely high volumetric efficiency
- Non-linear capacitance change
- Y5U characteristic is also fulfilled

Applications

- Blocking
- Coupling
- Decoupling
- Interference suppression

Terminations

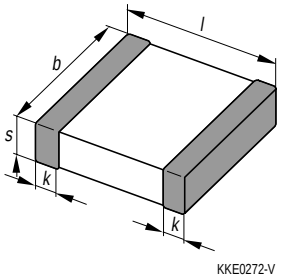
- For soldering:
  Sizes 0402 through 1210:
  silver/nickel/tin
  Sizes 1812, 2220:
  silver palladium
- For conductive adhesion:
  All sizes:
  silver palladium

Packing

- Blister and cardboard tape,
  for details refer to chapter
  “Taping and Packing”, page 111.
- Bulk case for sizes 0603, 0805
  and 1206, for details see page 114.

Maximum ratings

Climatic category
in accordance with IEC 68-1: 30/85/56



KKE0272-V

Dimensions (mm)

Size **inch**/mm	*l*	*b*	*s*	*k*
0402/1005	1,0 ± 0,10	0,50 ± 0,05	0,5 ± 0,05	0,2
0603/1608	1,6 ± 0,15*)	0,80 ± 0,10	0,8 ± 0,10	0,3
0805/2012	2,0 ± 0,20	1,25 ± 0,15	1,3 max.	0,5
1206/3216	3,2 ± 0,20	1,60 ± 0,15	1,3 max.	0,5
1210/3225	3,2 ± 0,30	2,50 ± 0,30	1,3 max.	0,5
1812/4532	4,5 ± 0,30	3,20 ± 0,30	1,3 max.	0,5
2220/5750	5,7 ± 0,40	5,00 ± 0,40	1,3 max	0,5

*) For bulk cases: 1,6 ± 0,1
Tolerances in acc. with CECC 32101-801

Available capacitance tolerances

Tolerance	Symbol
$\Delta C_R/C_R$ = ± **20 %**	**M**

Standard tolerance in bold print

Rated voltage values

V_R = 16 V, 25 V, 50 V

Product range

	Z5U (Y5U) / F characteristic													
Size[1)] **inch** mm	**0402** 1005		**0603** 1608		**0805** 2012		**1206** 3216		**1210** 3225		**1812** 4532		**2220** 5750	
Type	B37922		B37932		B37942		B37873		B37951		B37954		B37957	
V_R (Vdc)	16	25	25	50	25	50	25	50		50		50		50
1,0 nF														
2,2 nF														
4,7 nF														
10 nF														
15 nF														
22 nF														
33 nF														
47 nF														
68 nF														
100 nF														
150 nF														
220 nF														
330 nF														
470 nF														
680 nF														
1,0 µF														
1,5 µF														
2,2 µF														
3,3 µF														
4,7 µF														

Chip thickness (*s*): 0,5 ± 0,1 mm | 0,6 ± 0,1 mm | 0,8 ± 0,1 mm | 1,2 ± 0,1 mm

1) l × b (inch) / l × b (mm)

Ordering codes for Z5U (Y5U) / F characteristic, 16/25 Vdc, AgNiSn terminations

Size	0402/1005	0402/1005	0603/1608	0805/2012	1206/3216
V_R	16 V	25 V	25 V	25 V	25 V
C_R	Ordering code [1]				
	B37922-	B37922-	B37932-	B37942-	B37873-
1,0 nF		-K0102-M60 ▲			
2,2 nF		-K0222-M60 ▲			
3,3 nF		-K0332-M60 ▲			
4,7 nF		-K0472-M60 ▲			
6,8 nF		-K0682-M60 ▲			
10 nF		-K0103-M60 ▲			
15 nF					
22 nF	-K9223-M60 ▲		-K0223-M60 ❍		
33 nF			-K0333-M60 ❍		
47 nF	-K9473-M60 ▲		-K0473-M60 ❍	-K0473-M60 ❑	
68 nF			-K0683-M60 ❍	-K0683-M60 ❑	
100 nF	-K9104-M60 ▲		-K0104-M60 ❍	-K0104-M60 ❑	
150 nF				-K0154-M60 ❍	-K0154-M60 ❍
220 nF				-K0224-M62 ◆	-K0224-M60 ❍
330 nF				-K0334-M62 ◆	-K0334-M60 ❍
470 nF					-K0474-M62 ◆
680 nF					-K0684-M62 ◆
1,0 µF					-K0105-M62 ◆

Chip thickness: ▲: 0,5 ± 0,1 mm ❑: 0,6 ± 0,1 mm ❍: 0,8 ± 0,1 mm ◆: 1,2 ± 0,1 mm

1) The tables contain the ordering codes for the standard capacitance tolerance: M = ± 20%. Example: B37922-K9223-**M**60

Ordering codes for Z5U (Y5U) / F characteristic, 50 Vdc, AgNiSn terminations

Size	0603/1608	0805/2012	1206/3216	1210/3225
C_R	Ordering code [1]			
	B37932-	B37942-	B37873-	B37951-
10 nF	-K5103-M60 ❍	-K5103-M60 ❑		
15 nF	-K5153-M60 ❍	-K5153-M60 ❑		
22 nF	-K5223-M60 ❍	-K5223-M60 ❑		
33 nF	-K5333-M60 ❍	-K5333-M60 ❑		
47 nF	-K5473-M60 ❍	-K5473-M60 ❑	-K5473-M60 ❍	
68 nF		-K5683-M60 ❑	-K5683-M60 ❍	
100 nF		-K5104-M60 ❍	-K5104-M60 ❍	
150 nF		-K5154-M62 ◆	-K5154-M60 ❍	
220 nF			-K5224-M60 ❍	-K5224-M62 ❍
330 nF			-K5334-M62 ◆	-K5334-M62 ❍
470 nF			-K5474-M62 ◆	-K5474-M62 ❍
680 nF				-K5684-M62 ◆
1 µF				-K5105-M62 ◆

Ordering codes for Z5U (Y5U) / F characteristic, 50 Vdc, AgPd terminations

Size	1812/4532	2220/5750
C_R	Ordering code [1]	
	B37954-	B37957-
470 nF	-J5474-M62 ◆	
680 nF	-J5684-M62 ◆	
1 µF	-J5105-M62 ◆	-J5105-M62 ◆
1,5 µF	-J5155-M62 ◆	-J5155-M62 ◆
2,2 µF		-J5225-M62 ◆
3,3 µF		-J5335-M62 ◆
4,7 µF		-J5475-M62 ◆

Chip thickness: ❑: 0,6 ± 0,1 mm ❍: 0,8 ± 0,1 mm ◆: 1,2 ± 0,1 mm

1) The tables contain the ordering codes for the standard capacitance tolerance: M = ± 20%. Example: B37932-K5103-**M**60

Ordering codes for chip capacitors, Z5U (Y5U) / F characteristic, 25 V/50 Vdc, AgNiSn terminations, bulk case packing

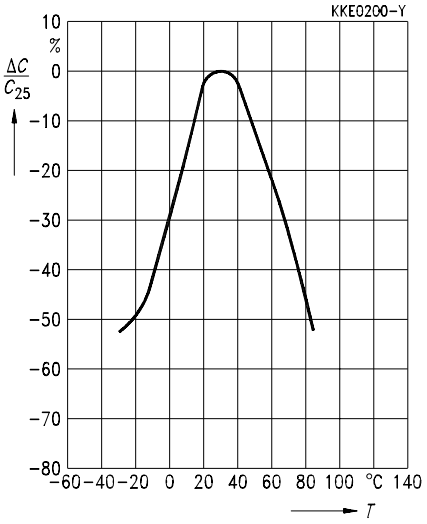
Size	0603	0603	0805	1206	
V_R	25 V	50 V	50 V	50 V	
C_R	Ordering code [1]				
	B37932-	B37932-	B37942-	B37873-	
10 nF		-K5103-M01 ❍	-K5103-M01 ❑		
15 nF		-K5153-M01 ❍	-K5153-M01 ❑		
22 nF	-K0223-M01 ❍	-K5223-M01 ❍	-K5223-M01 ❑		
33 nF	-K0333-M01 ❍	-K5333-M01 ❍	-K5333-M01 ❑		
47 nF	-K0473-M01 ❍	-K5473-M01 ❍	-K5473-M01 ❑	-K5473-M01 ❑	
68 nF	-K0683-M01 ❍		-K5683-M01 ❑	-K5683-M01 ❑	
100 nF	-K0104-M01 ❍			-K5104-M01 ❑	
150 nF				-K5154-M01 ❑	

Chip thickness: ❑: 0,6 ± 0,1 mm ❍: 0,8 ± 0,1 mm

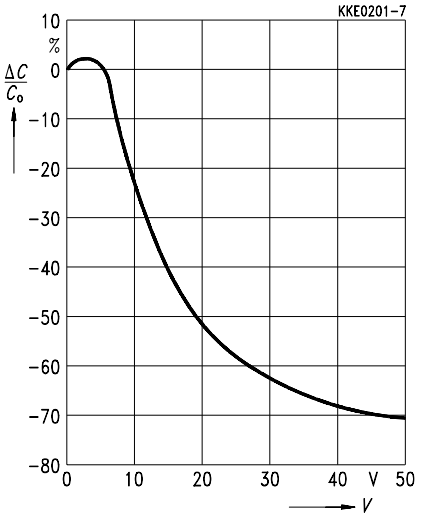
1) The tables contain the ordering codes for the standard capacitance tolerance: M = ± 20%. Example: B37932-K0223-**M**01

Characteristics

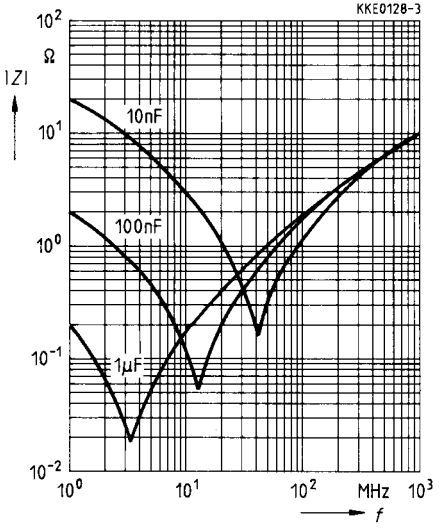
Capacitance change $\Delta C/C_{25}$ versus temperature T



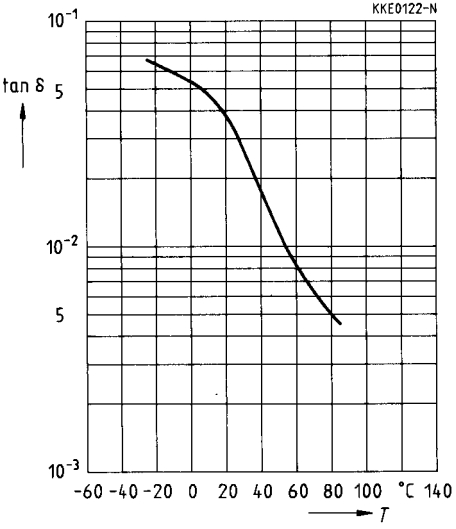
Capacitance change $\Delta C/C_0$ versus superimposed dc voltage V



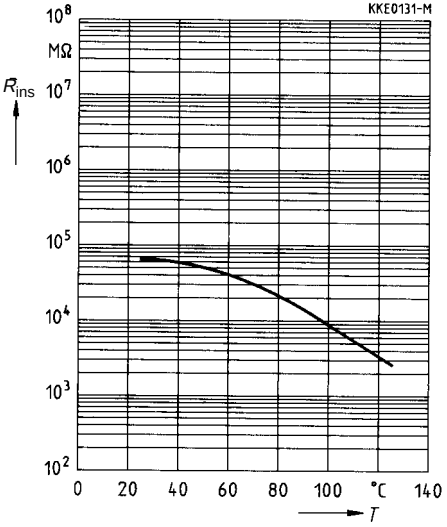
Impedance $|Z|$ versus frequency f



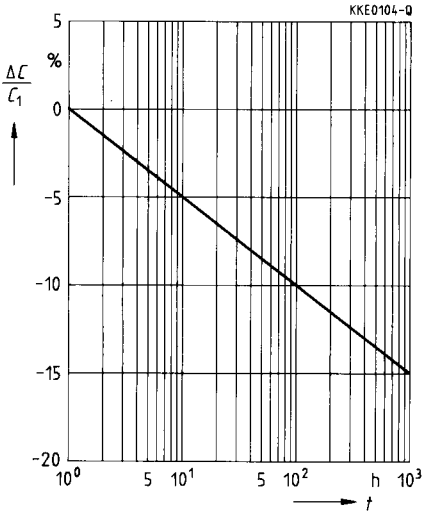
Dissipation factor tan δ versus temperature T



Insulation resistance R_{ins} versus temperature T



Capacitance change $\Delta C/C_1$ versus time t



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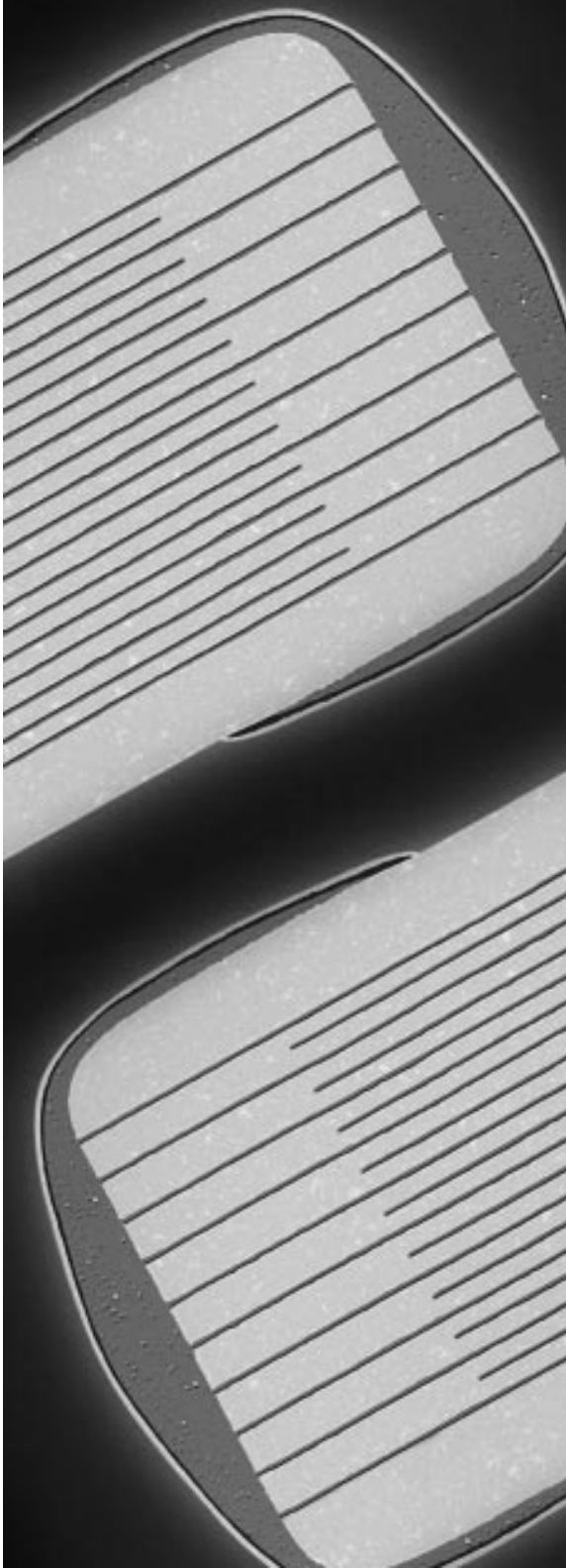
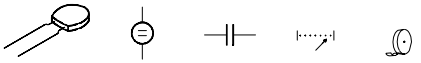


Page

Ordering code system



B37979-N 1 100 K 54

Packaging (standard value bold)

51 = reel dia. 360 mm
54 = Ammo pack
00 = bulk

Capacitance tolerance

(tolerance code in acc. with IEC 62, standard values bold)

C0G / NP0 / CH	X7R / B characteristic	Z5U (Y5U) / F characteristic
J = ± 5 % **K = ± 10 %**	K = ± 10 % **M = ± 20 %**	**M = ± 20 %**

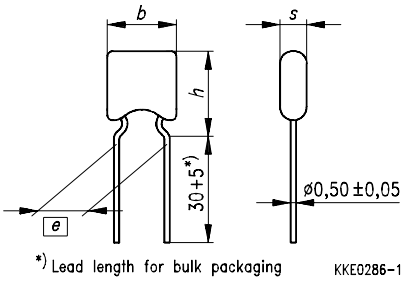
Capacitance, coded 100 = 10 pF 102 = 1 nF 104 = 100 nF 223 = 22 nF
101 = 100 pF 103 = 10 nF 105 = 1 µF 474 = 470 nF

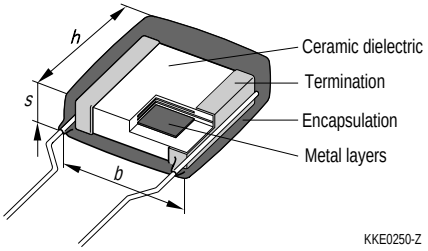
Rated voltage 5 = 50 Vdc, 1 = 100 Vdc

Type and size

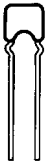
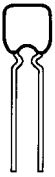
With radial leads EIA standard	Temperature characteristics C0G / NP0 / CH	X7R / B char.	Z5U (Y5U) / F char.
Lead spacing 2,5 mm			
5,5 × 5,0 × 2,5	B37979-N	B37981-M	B37982-N
6,5 × 5,0 × 2,5	B37986-N	B37987-M	B37988-N
Lead spacing 5,0 mm			
5,5 × 5,0 × 2,5	B37979-G	B37981-F	B37982-G
6,5 × 5,0 × 2,5	B37986-G	B37987-F	B37988-G
9,0 × 7,5 × 2,5		B37984-M	B37985-N

Dimensions, construction and lead styles

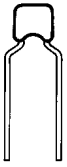
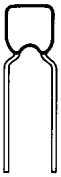
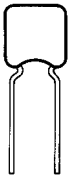




Lead spacing $e = 2{,}5^{+0{,}6}_{-0{,}1}$ mm

h_{max} b_{max} s_{max}	5,5 mm 5,0 mm 2,5 mm	6,5 mm 5,0 mm 2,5 mm	Dielectric
			
Types	B37979-N	B37986-N	C0G/NP0/CH
	B37981-M	B37987-M	X7R/B char.
	B37982-N	B37988-N	Z5U (Y5U) / F char.

Lead spacing $e = 5{,}0^{+0{,}6}_{-0{,}1}$ mm

h_{max} b_{max} s_{max}	5,5 mm 5,0 mm 2,5 mm	6,5 mm 5,0 mm 2,5 mm	9,0 mm 7,5 mm 2,5 mm	Dielectric
				
Types	B37979-G	B37986-G		C0G/NP0/CH
	B37981-F	B37987-F	B37984-M	X7R/B char.
	B37982-G	B37988-G	B37985-N	Z5U (Y5U) / F char.

Electrical characteristics in brief

Temperature characteristic Standard	C0G/NP0/CH EIA	X7R/B char. EIA	Z5U (Y5U)/F char.[1] EIA
Dielectric	Class 1	Class 2	Class 2
Rated voltage V_R Vdc	50/100	50/100	50
Climatic category (IEC 68-1)	 55/125/56	 55/125/56	 30/085/56
Temperature range	– 55 … + 125 °C	– 55 … + 125 °C	– 30 … + 85 °C
Available capacitance values C_R E series	 10 pF … 10 nF E12	 470 pF … 1 µF E12	 10 nF … 4,7 µF E6
Capacitance tolerance (standard in bold print)	 ± 5 % ± **10 %**	 ± 10 % ± **20 %**	 ± **20 %**
Temperature coefficient (tolerance)	$0 \pm 30 \cdot 10^{-6}$/K	–	–
Max. rel. capacitance change $\Delta C/C$ at V_{meas}	 –	 ± 15 %	 +22/– 56 %
Voltage test	$2{,}5 \cdot V_R$/5 s		
Dissipation factor tan δ (limit value)	$< 1{,}0 \cdot 10^{-3}$	$< 25 \cdot 10^{-3}$	$< 30 \cdot 10^{-3}$
Insulation resistance [2] at 25 °C 125 °C Time constant τ [2] at 25 °C 125 °C	 $> 10^5$ MΩ $> 10^4$ MΩ > 1000 s > 100 s	 $> 10^5$ MΩ $> 10^4$ MΩ > 1000 s > 100 s	 $> 10^4$ MΩ – > 500 s –

1) Y5U specification is also fulfilled.
2) For capacitance values exceeding 10 nF (C0G, X7R) and 47 nF (Z5U) the time constant $\tau = C \cdot R_{ins}$ is given.

Features

- Good thermal stability
- High insulation resistance
- Low dissipation factor
- Low inductance

Applications

- Resonant circuits
- Filter circuits
- Timing elements
- Coupling and filtering, particularly in RF circuits

Terminals

- Parallel wire leads, iron-nickel, tinned
- Crimped leads
- Non-standard lead lengths on request

Marking

- Rated capacitance, tolerance, manufacturer's logo, ceramic material, voltage

Packing

Optionally	Last 2 digits of ordering code
Tape & reel	-51
AMMO pack	**-54**
Bulk	-00

Standard packing in bold print

Maximum ratings

- Climatic category in accordance with IEC 68-1: 55/125/56

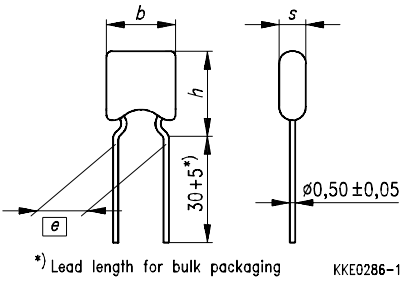
Available capacitance tolerances

Tolerance	Symbol
$\Delta C_R/C_R = \pm$ 5 %	J
$\Delta C_R/C_R = \pm$ 10 %	**K**

Standard tolerance in bold print

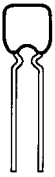
Rated voltage values

V_R = 50 V, 100 V

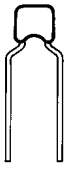
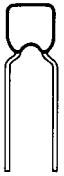


Dimensions (mm)

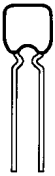
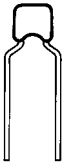
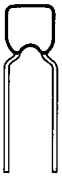
Lead spacing $e = 2{,}5\ ^{+0,6}_{-0,1}$ mm

h_{max}	5,5	6,5
b_{max}	5,0	5,0
s_{max}	2,5	2,5
		
Type	B37979-N	B37986-N

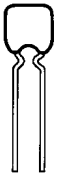
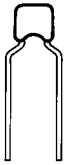
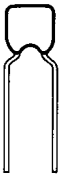
Lead spacing $e = 5{,}0\ ^{+0,6}_{-0,1}$ mm

h_{max}	5,5	6,5
b_{max}	5,0	5,0
s_{max}	2,5	2,5
		
Type	B37979-G	B37986-G

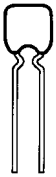
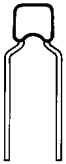
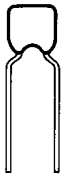
Product range

	C0G/NP0/CH							
Lead spacing	2,5 mm				5,0 mm			
								
$h \times b \times s$ (mm)	$5,5 \times 5,0 \times 2,5$		$6,5 \times 5,0 \times 2,5$		$5,5 \times 5,0 \times 2,5$		$6,5 \times 5,0 \times 2,5$	
Type	B37979-N		B37986-N		B37979-G		B37986-G	
V_R (Vdc)	50	100	50	100	50	100	50	100
10 pF		■				■		
12 pF		■				■		
15 pF		■				■		
18 pF		■				■		
22 pF		■				■		
27 pF		■				■		
33 pF		■				■		
39 pF		■				■		
47 pF		■				■		
56 pF		■				■		
68 pF		■				■		
82 pF		■				■		
100 pF	■	■			■	■		
120 pF	■	■			■	■		
150 pF	■	■			■	■		
180 pF	■	■			■	■		
220 pF	■	■			■	■		
270 pF	■	■			■	■		
330 pF	■	■			■	■		
390 pF	■	■			■	■		
470 pF	■	■			■	■		
560 pF	■	■			■	■		
680 pF	■	■			■	■		
820 pF	■	■			■	■		

Product range

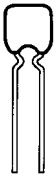
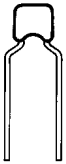
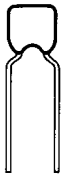
	C0G/NP0/CH							
Lead spacing	2,5 mm				5,0 mm			
								
$h \times b \times s$ (mm)	$5{,}5 \times 5{,}0 \times 2{,}5$		$6{,}5 \times 5{,}0 \times 2{,}5$		$5{,}5 \times 5{,}0 \times 2{,}5$		$6{,}5 \times 5{,}0 \times 2{,}5$	
Type	B37979-N		B37986-N		B37979-G		B37986-G	
V_R (Vdc)	50	100	50	100	50	100	50	100
1,0 nF	■	■			■	■		
1,2 nF	■			■	■			■
1,5 nF	■			■	■			■
1,8 nF	■			■	■			■
2,2 nF	■			■	■			■
2,7 nF			■				■	
3,3 nF			■				■	
3,9 nF			■				■	
4,7 nF			■				■	
5,6 nF			■				■	
6,8 nF			■				■	
8,2 nF			■				■	
10 nF			■				■	

Ordering codes for C0G/NP0/CH, 50 Vdc

Lead spacing	2,5 mm		5,0 mm	
				
$h \times b \times s$ (mm)	5,5 × 5,0 × 2,5	6,5 × 5,0 × 2,5	5,5 × 5,0 × 2,5	6,5 × 5,0 × 2,5
C_R	Ordering code[1)]			
	B37979-	B37986-	B37979-	B37986-
100 pF	-N5101-K54		-G5101-K54	
120 pF	-N5121-K54		-G5121-K54	
150 pF	-N5151-K54		-G5151-K54	
180 pF	-N5181-K54		-G5181-K54	
220 pF	-N5221-K54		-G5221-K54	
270 pF	-N5271-K54		-G5271-K54	
330 pF	-N5331-K54		-G5331-K54	
390 pF	-N5391-K54		-G5391-K54	
470 pF	-N5471-K54		-G5471-K54	
560 pF	-N5561-K54		-G5561-K54	
680 pF	-N5681-K54		-G5681-K54	
820 pF	-N5821-K54		-G5821-K54	
1,0 nF	-N5102-K54		-G5102-K54	
1,2 nF	-N5122-K54		-G5122-K54	
1,5 nF	-N5152-K54		-G5152-K54	
1,8 nF	-N5182-K54		-G5182-K54	
2,2 nF	-N5222-K54		-G5222-K54	
2,7 nF		-N5272-K54		-G5272-K54
3,3 nF		-N5332-K54		-G5332-K54
3,9 nF		-N5392-K54		-G5392-K54
4,7 nF		-N5472-K54		-G5472-K54
5,6 nF		-N5562-K54		-G5562-K54
6,8 nF		-N5682-K54		-G5682-K54
8,2 nF		-N5822-K54		-G5822-K54
10 nF		-N5103-K54		-G5103-K54

1) The tables contain the ordering codes for
– standard capacitance tolerance: K = ± 10%. Example: B37979-K5101-**K**54
Other available capacitance tolerances: see page 61
– standard packing: 54 = AMMO pack. Example: B37979-K5101-K**54**
Other packing modes: see page 61

Ordering codes for C0G/NP0/CH, 100 Vdc

Lead spacing	2,5 mm		5,0 mm	
				
$h \times b \times s$ (mm)	5,5 × 5,0 × 2,5	6,5 × 5,0 × 2,5	5,5 × 5,0 × 2,5	6,5 × 5,0 × 2,5
C_R	Ordering code[1)]			
	B37979-	B37986-	B37979-	B37986-
10 pF	-N1100-K54		-G1100-K54	
12 pF	-N1120-K54		-G1120-K54	
15 pF	-N1150-K54		-G1150-K54	
18 pF	-N1180-K54		-G1180-K54	
22 pF	-N1220-K54		-G1220-K54	
27 pF	-N1270-K54		-G1270-K54	
33 pF	-N1330-K54		-G1330-K54	
39 pF	-N1390-K54		-G1390-K54	
47 pF	-N1470-K54		-G1470-K54	
56 pF	-N1560-K54		-G1560-K54	
68 pF	-N1680-K54		-G1680-K54	
82 pF	-N1820-K54		-G1820-K54	
100 pF	-N1101-K54		-G1101-K54	
120 pF	-N1121-K54		-G1121-K54	
150 pF	-N1151-K54		-G1151-K54	
180 pF	-N1181-K54		-G1181-K54	
220 pF	-N1221-K54		-G1221-K54	
270 pF	-N1271-K54		-G1271-K54	
330 pF	-N1331-K54		-G1331-K54	
390 pF	-N1391-K54		-G1391-K54	
470 pF	-N1471-K54		-G1471-K54	
560 pF	-N1561-K54		-G1561-K54	
680 pF	-N1681-K54		-G1681-K54	
820 pF	-N1821-K54		-G1821-K54	
1,0 nF	-N1102-K54		-G1102-K54	
1,2 nF		-N1122-K54		-G1122-K54
1,5 nF		-N1152-K54		-G1152-K54
1,8 nF		-N1182-K54		-G1182-K54
2,2 nF		-N1222-K54		-G1222-K54

1) The tables contain the ordering codes for
– standard capacitance tolerance: K = ± 10 %. Example: B37979-K5101-**K**54
Other available capacitance tolerances: see page 61
– standard packing: 54 = AMMO pack. Example: B37979-K5101-K**54.** Other packing modes: see page 61

Features

- High volumetric efficiency
- Non-linear capacitance change
- High insulation resistance
- High pulse strength

Applications

- Blocking
- Coupling
- Decoupling
- Interference suppression

Terminals

- Parallel wire leads
  iron-nickel, tinned
- Crimped leads
- Non-standard lead lengths on request

Marking

- Rated capacitance, tolerance, manufacturer's logo, ceramic material, voltage

Packing

Optionally	Last 2 digits of ordering code
Tape & reel	-51
AMMO pack	**-54**
Bulk	-00

Standard packing in bold print

Maximum ratings

- Climatic category
  in accordance with IEC 68-1: 55/125/56

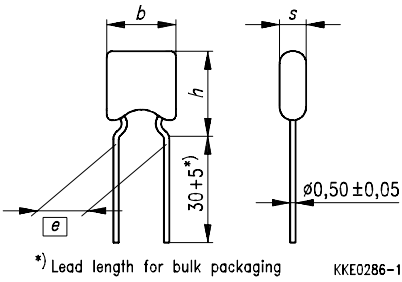
Available capacitance tolerances

Tolerance	Symbol
$\Delta C_R/C_R = \pm 10$ %	K
$\Delta C_R/C_R = \pm 20$ %	**M**

Standard tolerance in bold print

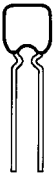
Rated voltage values

V_R = 50 V, 100 V

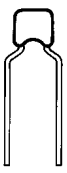
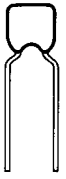
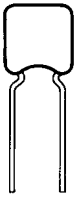


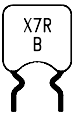
Dimensions (mm)

Lead spacing $e = 2{,}5\ ^{+0,6}_{-0,1}$ mm

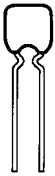
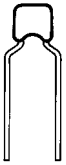
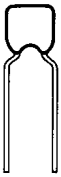
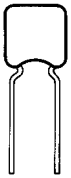
h_{max}	5,5	6,5
b_{max}	5,0	5,0
s_{max}	2,5	2,5
		
Type	B37981-M	B37987-M

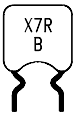
Lead spacing $e = 5{,}0\ ^{+0,6}_{-0,1}$ mm

h_{max}	5,5	6,5	9,0
b_{max}	5,0	5,0	7,5
s_{max}	2,5	2,5	2,5
			
Type	B37981-F	B37987-F	B37984-M

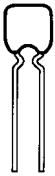
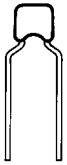
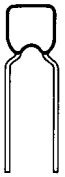
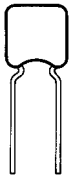


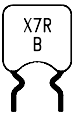
Product range

	X7R/B characteristic									
Lead spacing	2,5 mm				5,0 mm					
										
$h \times b \times s$ (mm)	5,5 × 5,0 × 2,5		6,5 × 5,0 × 2,5		5,5 × 5,0 × 2,5		6,5 × 5,0 × 2,5		9,0 × 7,5 × 2,5	
Type	B37981-M		B37987-M		B37981-F		B37987-F		B37984-M	
V_R (Vdc)	50	100	50	100	50	100	50	100	50	
470 pF		■				■				
560 pF		■				■				
680 pF		■				■				
820 pF		■				■				
1,0 nF		■				■				
1,2 nF		■				■				
1,5 nF		■				■				
1,8 nF		■				■				
2,2 nF		■				■				
2,7 nF		■				■				
3,3 nF	■	■			■	■				
3,9 nF	■	■			■	■				
4,7 nF	■	■			■	■				
5,6 nF	■	■			■	■				
6,8 nF	■	■			■	■				
8,2 nF	■	■			■	■				
10 nF	■	■			■	■				
12 nF	■	■			■	■				
15 nF	■	■			■	■				
18 nF	■			■	■			■		
22 nF	■			■	■			■		

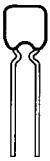
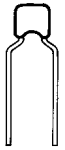
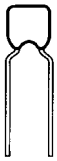
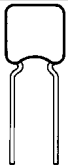


Product range

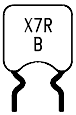
	X7R/B characteristic									
Lead spacing	2,5 mm				5,0 mm					
										
$h \times b \times s$ (mm)	5,5 × 5,0 × 2,5		6,5 × 5,0 × 2,5		5,5 × 5,0 × 2,5		6,5 × 5,0 × 2,5		9,0 × 7,5 × 2,5	
Type	B37981-M		B37987-M		B37981-F		B37987-F		B37984-M	
V_R (Vdc)	50	100	50	100	50	100	50	100	50	
27 nF	■			■	■			■		
33 nF	■			■	■			■		
39 nF	■			■	■			■		
47 nF	■			■	■			■		
56 nF			■	■			■	■		
68 nF			■	■			■	■		
82 nF			■	■			■	■		
100 nF			■	■			■	■		
120 nF			■	■			■	■		
150 nF			■	■			■	■		
180 nF			■				■			
220 nF			■				■			
270 nF									■	
330 nF									■	
390 nF									■	
470 nF									■	
560 nF									■	
680 nF									■	
820 nF									■	
1,0 µF									■	



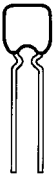
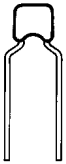
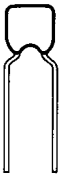
Ordering codes for X7R/B characteristic, 50 Vdc

Lead spacing	2,5 mm		5,0 mm		
					
$h \times b \times s$ (mm)	5,5 × 5,0 × 2,5	6,5 × 5,0 × 2,5	5,5 × 5,0 × 2,5	6,5 × 5,0 × 2,5	9,0 × 7,5 × 2,5
C_R	Ordering code[1)] B37981-	B37987-	B37981-	B37987-	B37984-
3,3 nF	-M5332-M54		-F5332-M54		
3,9 nF	-M5392-M54		-F5392-M54		
4,7 nF	-M5472-M54		-F5472-M54		
5,6 nF	-M5562-M54		-F5562-M54		
6,8 nF	-M5682-M54		-F5682-M54		
8,2 nF	-M5822-M54		-F5822-M54		
10 nF	-M5103-M54		-F5103-M54		
12 nF	-M5123-M54		-F5123-M54		
15 nF	-M5153-M54		-F5153-M54		
18 nF	-M5183-M54		-F5183-M54		
22 nF	-M5223-M54		-F5223-M54		
27 nF	-M5273-M54		-F5273-M54		
33 nF	-M5333-M54		-F5333-M54		
39 nF	-M5393-M54		-F5393-M54		
47 nF	-M5473-M54		-F5473-M54		
56 nF		-M5563-M54		-F5563-M54	
68 nF		-M5683-M54		-F5683-M54	
82 nF		-M5823-M54		-F5823-M54	
100 nF		-M5104-M54		-F5104-M54	
120 nF		-M5124-M54		-F5124-M54	
150 nF		-M5154-M54		-F5154-M54	
180 nF		-M5184-M54		-F5184-M54	
220 nF		-M5224-M54		-F5224-M54	
270 nF					-M5274-M54
330 nF					-M5334-M54
390 nF					-M5394-M54
470 nF					-M5474-M54
560 nF					-M5564-M54
680 nF					-M5684-M54
820 nF					-M5824-M54
1,0 µF					-M5105-M54

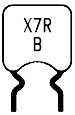
1) The tables contain the ordering codes for
– standard capacitance tolerance: M = ± 20 %. Example: B37981-M5332-**M**54.Other available capacitance tolerances: see p. 66
– standard packing: 54 = AMMO pack. Example: B37981-M5332-M**54.** Other packing modes: see page 66



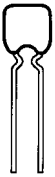
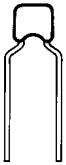
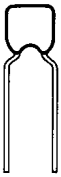
Ordering codes for X7R/Bcharacteristic, 100 Vdc

Lead spacing	2,5 mm		5,0 mm	
				
$h \times b \times s$ (mm)	5,5 × 5,0 × 2,5	6,5 × 5,0 × 2,5	5,5 × 5,0 × 2,5	6,5 × 5,0 × 2,5
C_R	Ordering code [1]			
	B37981-	B37987-	B37981-	B37987-
470 pF	-M1471-M54		-F1471-M54	
560 pF	-M1561-M54		-F1561-M54	
680 pF	-M1681-M54		-F1681-M54	
820 pF	-M1821-M54		-F1821-M54	
1,0 nF	-M1102-M54		-F1102-M54	
1,2 nF	-M1122-M54		-F1122-M54	
1,5 nF	-M1152-M54		-F1152-M54	
1,8 nF	-M1182-M54		-F1182-M54	
2,2 nF	-M1222-M54		-F1222-M54	
2,7 nF	-M1272-M54		-F1272-M54	
3,3 nF	-M1332-M54		-F1332-M54	
3,9 nF	-M1392-M54		-F1392-M54	
4,7 nF	-M1472-M54		-F1472-M54	
5,6 nF	-M1562-M54		-F1562-M54	
6,8 nF	-M1682-M54		-F1682-M54	
8,2 nF	-M1822-M54		-F1822-M54	
10 nF	-M1103-M54		-F1103-M54	
12 nF	-M1123-M54		-F1123-M54	
15 nF	-M1153-M54		-F1153-M54	
18 nF		-M1183-M54		-F1183-M54
22 nF		-M1223-M54		-F1223-M54
27 nF		-M1273-M54		-F1273-M54
33 nF		-M1333-M54		-F1333-M54
39 nF		-M1393-M54		-F1393-M54
47 nF		-M1473-M54		-F1473-M54
56 nF		-M1563-M54		-F1563-M54
68 nF		-M1683-M54		-F1683-M54
82 nF		-M1823-M54		-F1823-M54

1) The tables contain the ordering codes for
– standard capacitance tolerance: M = ± 20 %. Example: B37981-M1471-**M**54.
Other available capacitance tolerances: see page 66
– standard packing: 54 = AMMO pack. Example: B37981-M1471-M**54.**
Other packing modes: see page 66



Ordering codes for X7R/B characteristic, 100 Vdc (cont´d)

Lead spacing	2,5 mm		5,0 mm	
				
$h \times b \times s$ (mm)	5,5 × 5,0 × 2,5	6,5 × 5,0 × 2,5	5,5 × 5,0 × 2,5	6,5 × 5,0 × 2,5
C_R	Ordering code [1]			
	B37981-	B37987-	B37981-	B37987-
100 nF		-M1104-M54		-F1104-M54
120 nF		-M1124-M54		-F1124-M54
150 nF		-M1154-M54		-F1154-M54

1) The tables contain the ordering codes for
– standard capacitance tolerance: M = ± 20 %. Example: B37987-M1104-**M**54.
Other available capacitance tolerances: see page 66
– standard packing: 54 = AMMO pack. Example: B37987-M1104-M**54.**
Other packing modes: see page 66

Features

- Extremely high volumetric efficiency
- Non-linear capacitance change
- Y5U characteristic is also fulfilled

Applications

- Blocking
- Coupling
- Decoupling
- Interference suppression

Terminals

- Parallel wire leads
  iron-nickel, tinned
- Crimped leads
- Non-standard lead lengths on request

Marking

- Rated capacitance, tolerance, manufacturer's logo, ceramic material, voltage

Packing

Optionally	Last 2 digits of ordering code
Tape & reel	-51
AMMO pack	**-54**
Bulk	-00

Standard packing in bold print

Maximum ratings

- Climatic category
  in accordance with IEC 68-1: 30/085/56

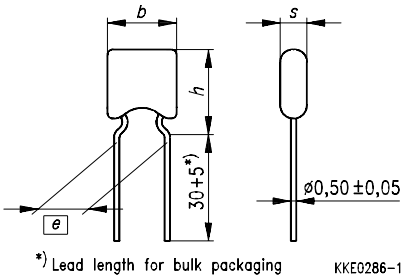
Available capacitance tolerances

Tolerance	Symbol
$\Delta C_R/C_R = \pm$ **20 %**	**M**

Standard tolerance in bold print

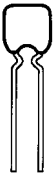
Rated voltage values

V_R = 50 V

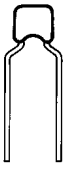
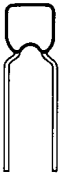


Dimensions (mm)

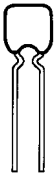
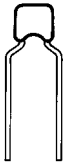
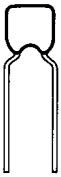
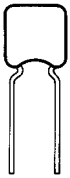
Lead spacing $e = 2{,}5\ ^{+0,6}_{-0,1}$ mm

h_{max}	5,5	6,5
b_{max}	5,0	5,0
s_{max}	2,5	2,5
		
Type	B37982-N	B37988-N

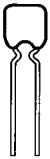
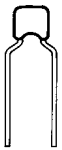
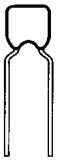
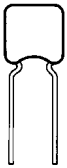
Lead spacing $e = 5{,}0\ ^{+0,6}_{-0,1}$ mm

h_{max}	5,5	6,5	9,0
b_{max}	5,0	5,0	7,5
s_{max}	2,5	2,5	2,5
			
Type	B37982-G	B37988-G	B37985-N

Product range

	Z5U (Y5U)/F characteristic									
Lead spacing	2,5 mm				5,0 mm					
										
$h \times b \times s$ (mm)	5,5 × 5,0 × 2,5		6,5 × 5,0 × 2,5		5,5 × 5,0 × 2,5		6,5 × 5,0 × 2,5		9,0 × 7,5 × 2,5	
Type	B37982-N		B37988-N		B37982-G		B37988-G		B37985-N	
V_R (Vdc)	50		50		50		50		50	
10 nF	■				■					
15 nF	■				■					
22 nF	■				■					
33 nF	■				■					
47 nF	■				■					
68 nF	■				■					
100 nF	■				■					
150 nF	■				■					
220 nF			■				■			
330 nF			■				■			
470 nF			■				■			
680 nF			■				■			
1,0 µF			■				■			
1,5 µF									■	
2,2 µF									■	
3,3 µF									■	
4,7 µF									■	

Ordering codes for Z5U (Y5U) / F characteristic, 50 Vdc

Lead spacing	2,5 mm		5,0 mm		
					
$h \times b \times s$ (mm)	5,5 × 5,0 × 2,5	6,5 × 5,0 × 2,5	5,5 × 5,0 × 2,5	6,5 × 5,0 × 2,5	9,0 × 7,5 × 2,5
C_R	Ordering code [1]				
	B37982-	B37988-	B37982-	B37988-	B37985-
10 nF	-N5103-M54		-G5103-M54		
15 nF	-N5153-M54		-G5153-M54		
22 nF	-N5223-M54		-G5223-M54		
33 nF	-N5333-M54		-G5333-M54		
47 nF	-N5473-M54		-G5473-M54		
68 nF	-N5683-M54		-G5683-M54		
100 nF	-N5104-M54		-G5104-M54		
150 nF	-N5154-M54		-G5154-M54		
220 nF		-N5224-M54		-G5224-M54	
330 nF		-N5334-M54		-G5334-M54	
470 nF		-N5474-M54		-G5474-M54	
680 nF		-N5684-M54		-G5684-M54	
1,0 µF		-N5105-M54		-G5105-M54	
1,5 µF					-N5155-M54
2,2 µF					-N5225-M54
3,3 µF					-N5335-M54
4,7 µF					-N5475-M54

1) The tables contain the ordering codes for
- standard capacitance tolerance: M = ± 20%. Example: B37982-N5103-**M**54
- standard packing: 54 = AMMO pack. Example: B37982-N5103-M**54**
  Other packing modes: see page 72

1 Definition and construction

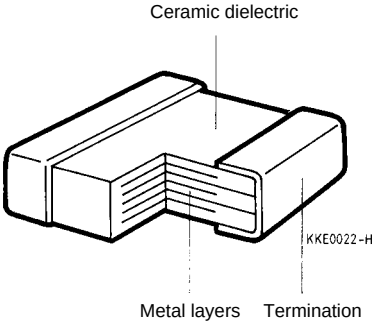
1.1 Introduction

The term ceramic capacitors covers a large group of capacitors. Their properties may be quite different, but they all have the oxide ceramic dielectric in common.

Ceramic generally means that an inorganic polycrystalline body is formed by sintering at high temperatures. By means of special production methods, extremely thin layers of ceramic materials can be obtained. These layers are stacked to construct capacitors whose electrical and mechanical properties meet stringent requirements.

The multilayer capacitors consist of a monolithic ceramic block with comb-like sintered electrodes. These electrodes come to the surface at the face ends of the ceramic block where an electrical contact is made by burnt-in metallic layers.

Schematic construction of a multilayer capacitor:



$$C = \frac{\varepsilon_0 \cdot \varepsilon_r \cdot (n-1) \cdot A}{d}$$

C: Capacitance of capacitor [As/V = F]
$\varepsilon_0 \approx 8{,}85 \cdot 10^{-12}$ As/Vm: absolute dielectric constant
ε_r: relative dielectric constant (material dependent)
A: effective electrode area per electrode [m^2]
n: number of electrodes (metal layers)
d: electrode spacing [m]

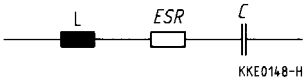
1.2 Capacitance

The unit of capacitance is the farad. One farad is the capacitance of a capacitor in which a charge of one coulumb produces one volt potential difference between the terminals.

$$C = \frac{Q_{el}}{V}$$

Q_{el}: charge stored in the capacitor [C = As]
V: voltage applied to the capacitor [V]

Practical equivalent circuit diagram for a real capacitor



L: inductance [H = Vs/A]
C: capacitance [F = As/V]
ESR: equivalent series resistance [Ω]

The magnitude of the impedance for this configuration can be calculated as follows:

$$|Z| = \sqrt{ESR^2 + (1/(2\pi fC) - 2\pi fL)^2}$$

Z: impedance (ac resistance) [Ω]
f: frequency of applied voltage [Hz]

1.3 Type classification and application

Depending on the chemical composition of their ceramic dielectrics, which determine the main electric properties, ceramic capacitors are classified as follows:

Class-1 capacitors

- The dielectric ($\varepsilon < 200$) primarily consists of a mixture of metal oxides and titanates.
- Defined linear temperature coefficient with reversible temperature dependence
- Capacitance does not vary with voltage.
- Low losses at frequencies up to the UHF range
- High insulation resistance

Applications: resonant circuits, filters, timing elements

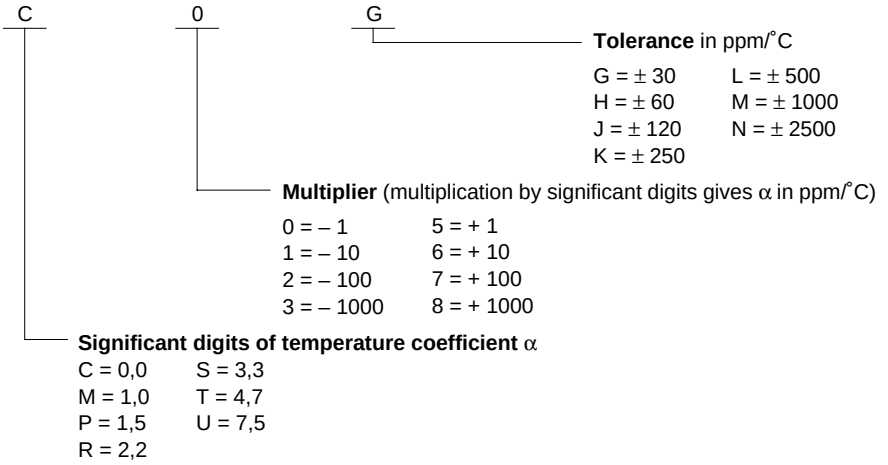
Class-2 capacitors

- The dielectric ($\varepsilon \approx 200$ to 10000) primarily consists of titanates (barium, calcium, strontium) and zirconates.
- Non-linear dependence of capacitance on temperature and voltage
- Somewhat higher losses and lower insulation resistance than class-1 capacitors
- Capacitance decreases according to a logarithmic function (ageing).
- Relatively high capacitance values even with small-size capacitors

Applications: coupling, blocking, filtering.

2 Temperature characteristics of capacitance for class-1 ceramics

In accordance with EIA-198-D



Temperature characteristic "NP0" covers "C0G".

In accordance with CECC standard 32100 / IEC standard 384-8

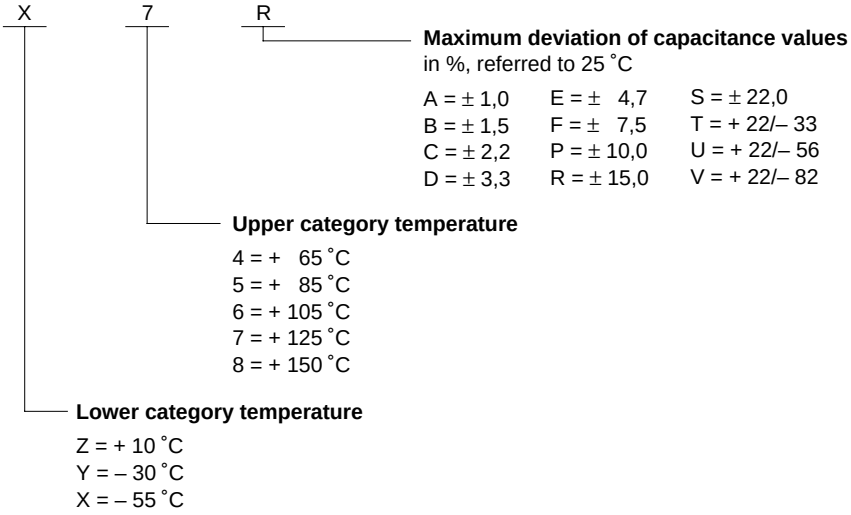
Rated temperature coefficient α (10^{-6}/°C)	Limit deviations for temperature coefficient (10^{-6}/°C)	Class	Code letters for	
			α	Limit deviations
+ 100	± 30	1B	A	G
0	± 30	1B	C	G
– 33	± 30	1B	H	G
– 75	± 30	1B	L	G
– 150	± 30	1B	P	G
– 220	± 30	1B	R	G
– 330	± 60	1B	S	H
– 470	± 60	1B	T	H
– 750	± 120	1B	U	J
– 1000	± 250	1F	Q	K
– 1500	± 250	1F	V	K
– 1000 ≤ α ≤ + 140		1C	SL	–
– 1750 ≤ α ≤ + 250		1D	UM	–

Notes:

- The rated values of the temperature coefficient α and the accompanying limit deviations are defined using the capacitance change between the temperatures 20 °C and 85 °C.
- A capacitor having a temperature coefficient of zero and a limit deviation of $\pm 30 \cdot 10^{-6}$/°C is given the code letters CG (class 1B).

3 Temperature characteristics of capacitance for class-2 ceramics

In accordance with EIA-198-D



Temperature characteristic "B" (JIS) covers "X7R" (EIA).
Temperature characteristic "F" (JIS) covers "Y5U" (EIA).

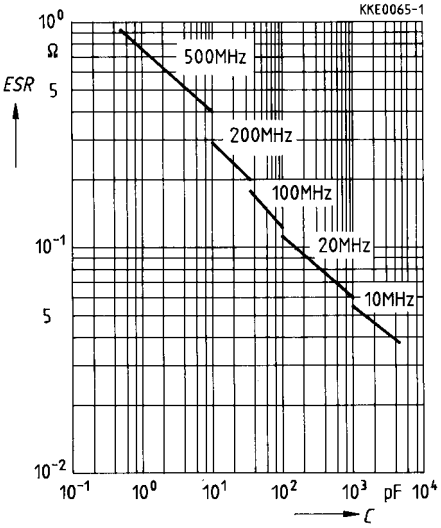
In accordance with CECC standard 32100 / IEC standard 384-10

Code letter for sub-class	Max. capacitance change in % over specified temperature range		Symbol for specified temperature range (˚C)				
			– 55/+ 125	– 55/+ 85	– 40/+ 85	– 25/+ 85	+ 10/+ 85
	without dc voltage	with dc voltage	1	2	3	4	6
2B	± 10 %	+ 10/– 15 %	–	×	×	×	–
2C	± 20 %	+ 20/– 30 %	×	×	×	–	–
2D	+ 20/– 30 %	+ 20/– 40 %	–	–	–	×	–
2E	+ 22/– 56 %	+ 22/– 70 %	–	×	×	×	×
2F	+ 30/– 80 %	+ 30/– 90 %	–	×	×	×	×
2R	± 15 %		×	–	–	–	–
2X	± 15 %	+ 15/– 25 %	×	–	–	–	–

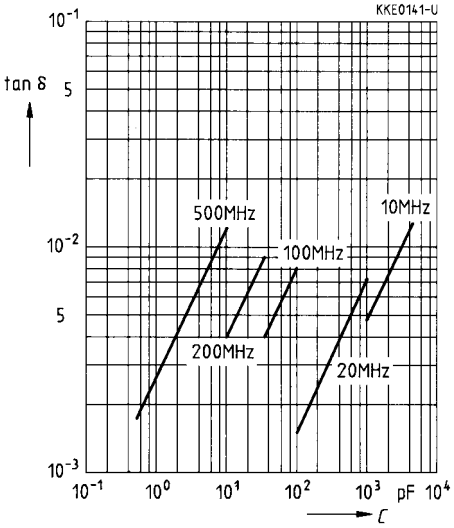
4 Important terms

4.1 Frequency response

Equivalent series resistance versus capacitance for C0G capacitors (typical values)



Dissipation factor versus capacitance for C0G capacitors (typical values)

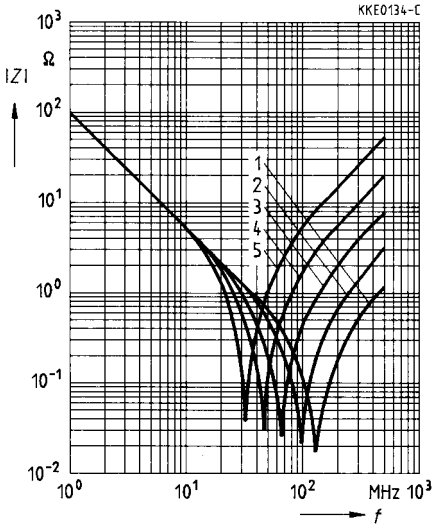


The type-related impedance characteristics of chip capacitors are to be found in the data sheet section (pages 15 to 55) .

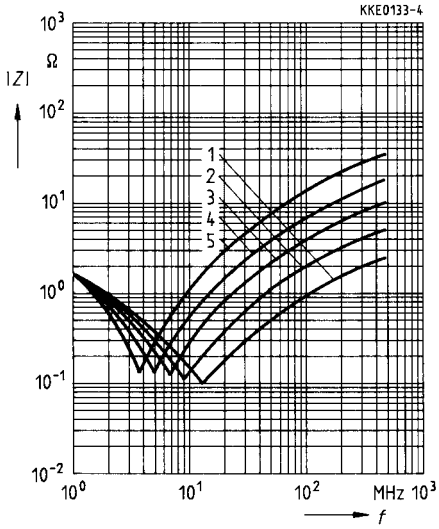
The relationship between capacitance of capacitors with wire leads and frequency is also affected by the lead lengths and mounting conditions.

The following graphs show a comparison between chip capacitors and leaded capacitors, providing an idea of the typical frequency response of leaded ceramic capacitors.

Example: C0G capacitor, C_R = 1 nF

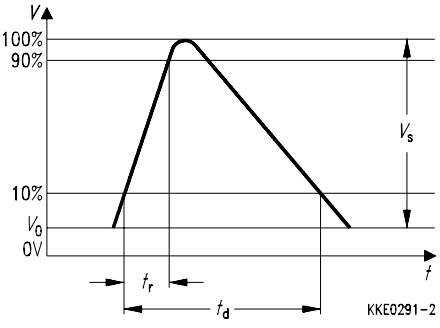


Example: X7R capacitor, C_R = 100 nF



1: Chip
2: 1,5 mm lead length
3: 5,0 mm lead length
4: 10,0 mm lead length
5: 20,0 mm lead length

4.2 Pulse handling capability



Pulse definition in accordance with DIN 40 839
Rate of voltage rise: $S_V = 0{,}8 \cdot V_S / t_r$
Max. permissible rate S_V = 1000 V/µs
Max. voltage amplitude: $V_S + V_0 = 2{,}5 \cdot V_R$

4.3 Thermal characteristic and electrical ratings

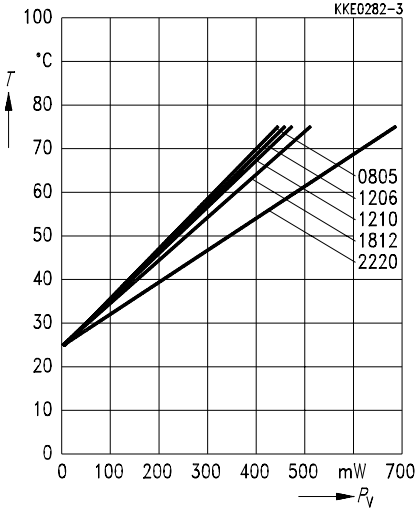
Ceramic capacitors change their capacitance more (class 2) or less (class 1) with temperature. Graphs in the data sheet section show the respective characteristic curves.

Basically, ceramic multilayer capacitors may also be operated at higher temperatures than specified by the upper category temperature. But in such cases some specific features of the ceramic material systems must be taken into account.

Due to a change in the crystalline structure, the capacitance value of high K materials (with a high dielectric constant, e.g. X7R, Z5U) drastically decreases above the Curie point (order of magnitude approximately 50 % at 150 ˚C). With low K materials (with a low dielectric constant, e.g. C0G) the dissipation factor increases considerably at high temperatures.

Owing to the high temperature, moreover, an acceleration of failure mechanisms and thus a shorter service life of the capacitor is to be expected. As the activation energy, necessary for calculating the service life, is subject to some uncertainty, the numerical estimation may be incorrect. In the most favorable case (E_a = 0,5 eV) it can be assumed that the failure rate at 150 ˚C is approximately 125 times higher than under standard conditions T = 40 ˚C.

In addition to the high ambient temperature, the high electrical energy exchange contributes to heating the capacitor.



Heating of capacitors as a function of power dissipation (Parameter: size)

4.4 Ageing

The capacitance of class-2 capacitors decreases with time. This process, known as ageing , follows a logarithmic law, which is expressed in terms of an ageing constant. The ageing constant is defined as the percentage loss of capacitance during a “time decade”, i.e. during a period of time, in which the capacitor is subject to a tenfold increase in age (e.g. from 1 h to 10 h).

The law of capacitance ageing is expressed by the following equation:

$C_t = C_1 \cdot (1 - k \cdot \log_{10} t)$

C_t: capacitance, t hours after start of ageing [F]
C_1: capacitance, 1 hour after start of ageing [F]
k: ageing constant (capacitance decrease per decade)
t: time in hours from start of ageing [h]

Because of ageing, it is necessary to specify an age for reference measurements at which the capacitance shall be within the prescribed tolerances.

Since the capacitance significantly decreases during the first hours after production, all capacitors shipped are guaranteed a capacitance value for 1000 hours (t = 1000 h).

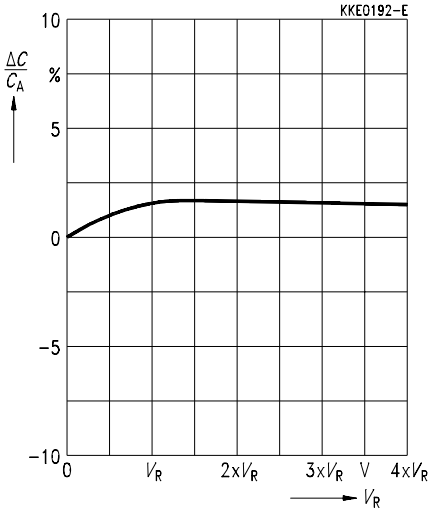
By heating the capacitors above the Curie temperature (approximately 130 – 150 ˚C) the capacitance decrease can be reversed. Ageing then starts anew.

Surface-mount devices will be completely de-aged by each soldering process; subsequently a new ageing process begins.

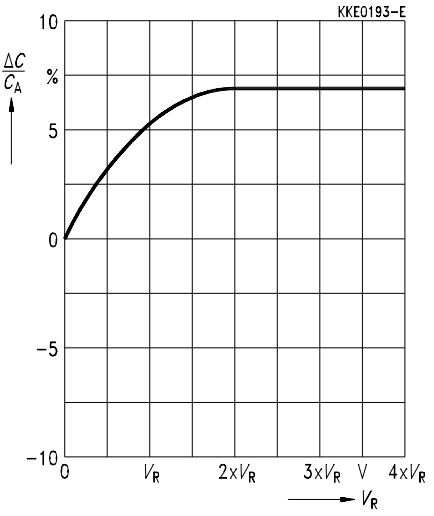
4.5 Influence of measuring conditions and preconditioning

High dc voltages applied to class-2 capacitors also result in capacitance changes (depending on the material system used):

Capacitance change after
dc voltage appplied to
X7R capacitors (typical values)



Capacitance change after
dc voltage appplied to
Z5U capacitors (typical values)

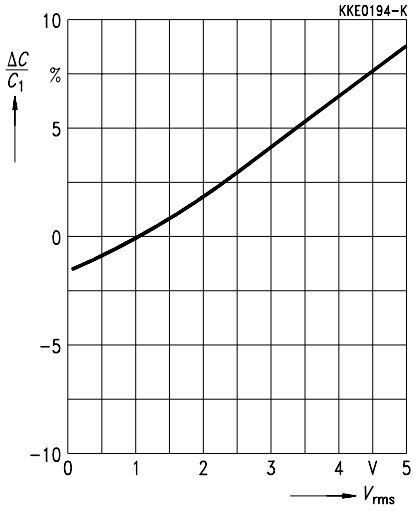


These voltage effects can only be reversed by de-ageing.

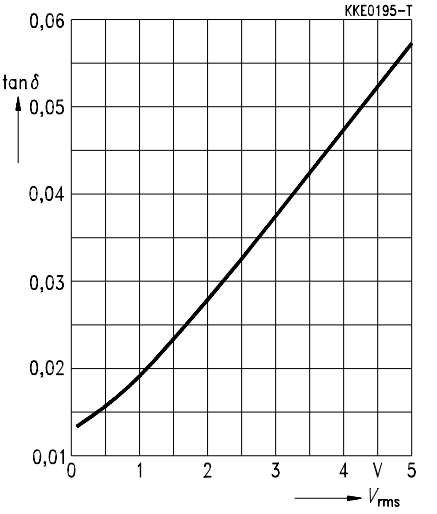
The capacitance of class-2 capacitors changes with voltage and/or temperature load. If measurements are made immediately after a voltage test, an insulation test or a test under thermal stress, the capacitance may be exceeded.

The following curves show the effects of deviations from the standard measurement conditions (V_{rms}, f_{meas}, T_{meas} according to measuring and test conditions, page 99), taking an X7R capacitor as an example.

Capacitance change $\Delta C/C_1$ versus measuring ac voltage V_{rms}



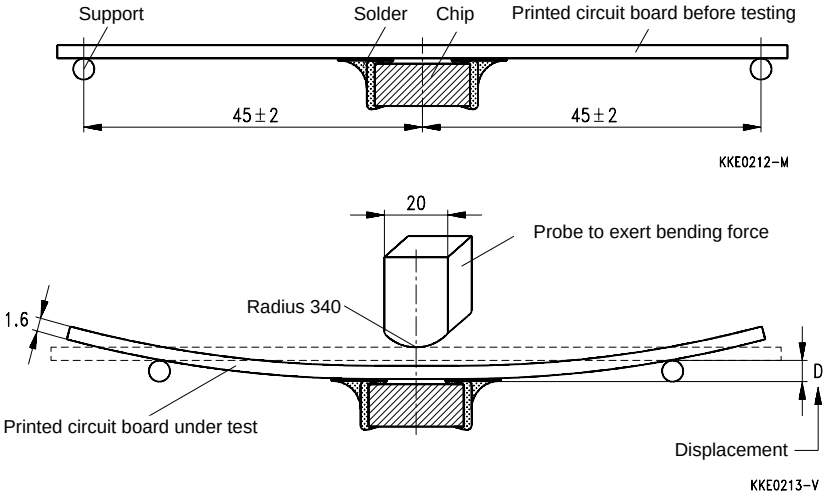
Dissipation factor tan δ versus measuring ac voltage V_{rms}



4.6 Effect of mechanical stress

In practical applications, two types of mechanical stress play the main roles: forces exerted during component mounting and forces that result when the printed circuit boards are subjected to bending strain.

a) Bending strength



Units: mm

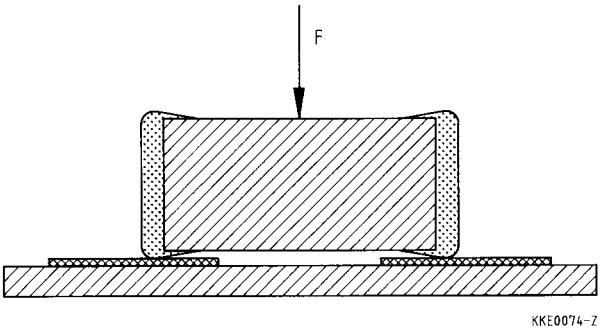
Size	Thickness	Class 1	Class 2
0603	0,8		
0805	0,6		
	0,8		
1206	0,6		
	0,8		
1210	0,6		
	0,8		
1812	1,2		
2220	1,2		

0 1 2 3 4 5 6/0 1 2 3 4 5 6

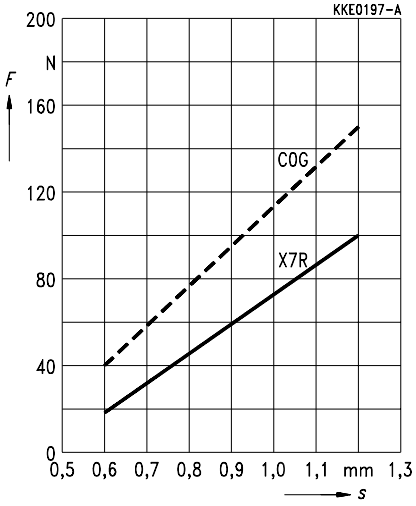
Displacement due to bending

Failure criterion:
$\Delta C/C_0 \geq 5\%$ for C0G
$\Delta C/C_0 \geq 10\%$ for X7R
or visible damage

b) Breaking strength



Breaking strength *F* versus chip thickness *s* for size 0805



c) Mechanical robustness of leads

Leads may not be bent within a length of 1 mm from the point where they leave the capacitor body.
Bending conditions specified by IEC 68-2-21:
Tensile strength: 10 N
Bending strength: 2 bending cycles through 90° with a force of 5 N

5 Climatic categories

The test class or climatic category in accordance with IEC 68-1 is indicated by 3 groups of figures, e.g.: 55/125/56

1st group of figures:
corresponds to lower category temperature (test for resistance to cold)

2nd group of figures:
corresponds to upper category temperature (test for resistance to dry heat)

3rd group of figures:
number of days denoting duration of damp heat test at 93 % relative humidity and 40 ˚C

Storage of chip capacitors

Solderability is guaranteed for one year from date of delivery (half a year for chips with AgPd terminations), provided that the components are stored in the original packages.

Storage temperature:– 25 … + 45 ˚C
Relative humidity: ≤ 75 % annual average, ≤ 95 % on 30 days in a year

6 Standards and specifications

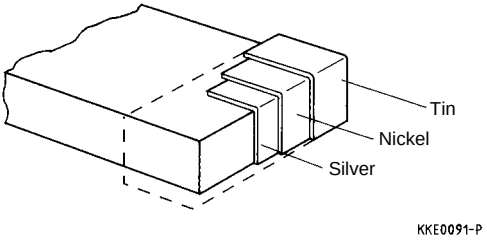
CECC 00 802	Guideline: CECC standard method for the specification of surface-mount devices (SMDs) of assessed quality
CECC 30 000	Generic specification: Fixed capacitors
CECC 30 600	Sectional specification: Fixed ceramic capacitors, type 1
CECC 30 700	Sectional specification: Fixed capacitors with ceramic dielectric, class 2
CECC 32 100	Sectional specification: Multilayer ceramic chip capacitors
EN ISO 9000-1	Quality management and quality assurance standards Part 1: Guidelines for selection and use
EN ISO 9001	Quality systems Model for quality assurance in design/development, production, installation and servicing
EN ISO 9002	Quality systems Model for quality assurance in production, installation and servicing
EN ISO 9004-1	Quality management and quality system elements Part 1: Guidelines
IEC 63	Preferred number series of resistors and capacitors (identical to DIN-IEC 63)
IEC 68	Electrical engineering Basic environmental testing procedures (identical to DIN-IEC 68)
IEC 384-1	Fixed capacitors for use in electronic equipment Part 1: Generic specification (identical to DIN IEC 384, Teil 1)

IEC 384-8	Fixed capacitors for use in electronic equipment Part 8: Sectional specification: Fixed capacitors of ceramic dielectric, class 1 (identical to DIN IEC 384, Teil 8)
IEC 384-8-1	Fixed capacitors for use in electronic equipment Part 8-1: Blank detail specification: Fixed capacitors of ceramic dielectric, class 1. Quality assessment level E (identical to DIN IEC 384, Teil 8-1)
IEC 384-9	Fixed capacitors for use in electronic equipment Part 9: Sectional specification: Fixed capacitors of ceramic dielectric, class 2 (identical to DIN IEC 384, Teil 9)
IEC 384-9-1	Fixed capacitors for use in electronic equipment Part 9-1: Blank detail specification: Fixed capacitors of ceramic dielectric, class 2. Quality assessment level E (identical to DIN IEC 384, Teil 9-1)
IEC 384-10	Fixed capacitors for use in electronic equipment Part 10: Sectional specification: Fixed multilayer ceramic chip capacitors (identical to DIN IEC 384, Teil 10)
IEC 384-10-1	Fixed capacitors for use in electronic equipment Part 10-1: Blank detail specification: Fixed multilayer ceramic chip capacitors. Quality assessment level E (identical to DIN IEC 384, Teil 10-1)
ISO 2859-1	Sampling procedure for inspection by attributes Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection (identical to DIN ISO 2859, Teil 1)
DIN 40 839	Electromagnetic compatibility in motor vehicles
EIA-198-D	Ceramic dielectric capacitors Class I, II, III and IV
QS-9000	Quality System Requirements (including supporting documents)
VDA	VDA (Verband der Automobilindustrie e.V.) Quality management in the automotive industry

1 Terminations

1.1 Silver/nickel/tin terminations

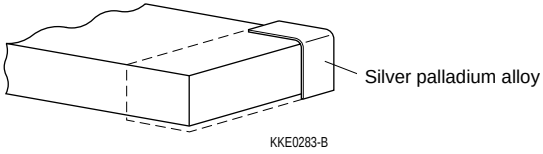
(Sizes 0402, 0603, 0805, 1206, 1210)



As shown in the diagram above, the terminations consist of three metallic layers. A primary silver layer with high conductivity provides for good electrical contact. “Leaching” of the silver is prevented by a nickel barrier layer. The outer tin coating prevents corrosion of the nickel and ensures good component solderability.

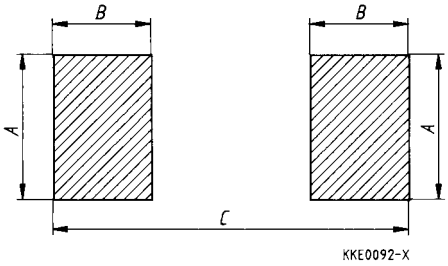
1.2 Silver palladium terminations

(Sizes 1812, 2220)



Silver palladium terminations are used for the large sizes 1812 and 2220 and for chips intended for conductive adhesion. This metallization improves the resistance of large chips to thermal shock. In case of conductive adhesion, the silver palladium metallization reduces susceptibility to corrosion.

2 Geometry of solder pads



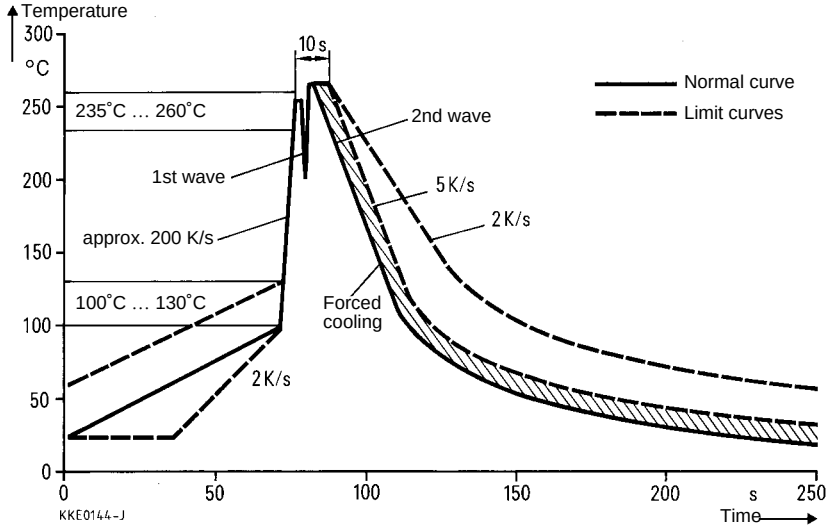
Recommended maximum dimensions (mm)

Size inch/mm	*A*	*B*	*C*
0402/1005	0,6	0,6	1,7
0603/1608	1,0	1,0	3,0
0805/2012	1,3	1,2	3,4
1206/3216	1,8	1,2	4,5
1210/3225	2,8	1,2	4,5
1812/4532	3,6	1,5	6,0
2220/5750	5,5	1,5	7,2

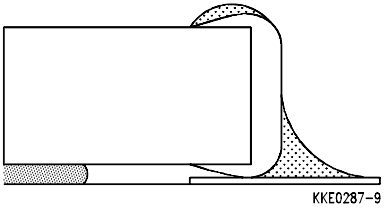
3 Wave soldering

3.1 Soldering temperature profile

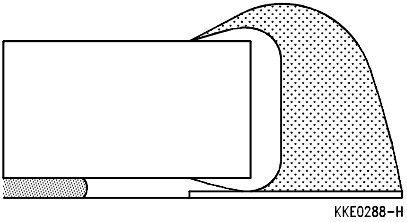
Temperature characteristic at component terminal with dual wave soldering



3.2 Solder joint profiles for silver/nickel/tin terminations



Good solder joint

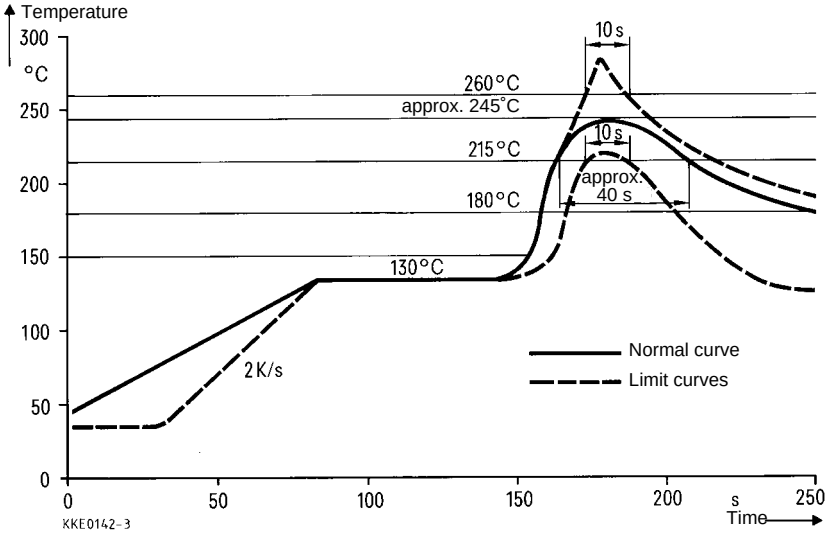


Too much solder
Pad geometry too large, not soldered in preferred direction

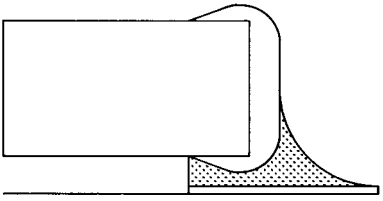
4 Infrared-reflow soldering

4.1 Soldering temperature profile

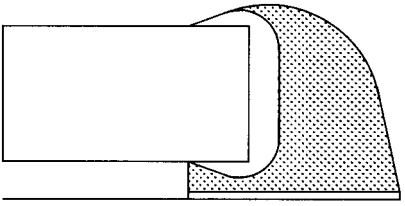
Temperature characterictic at component terminal with infrared soldering



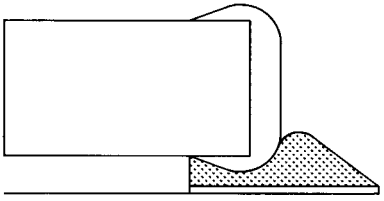
4.2 Solder joint profiles for silver/nickel/tin terminations



Good solder joint KKE0070-2



Too much solder
Pad geometry too large KKE0071-A

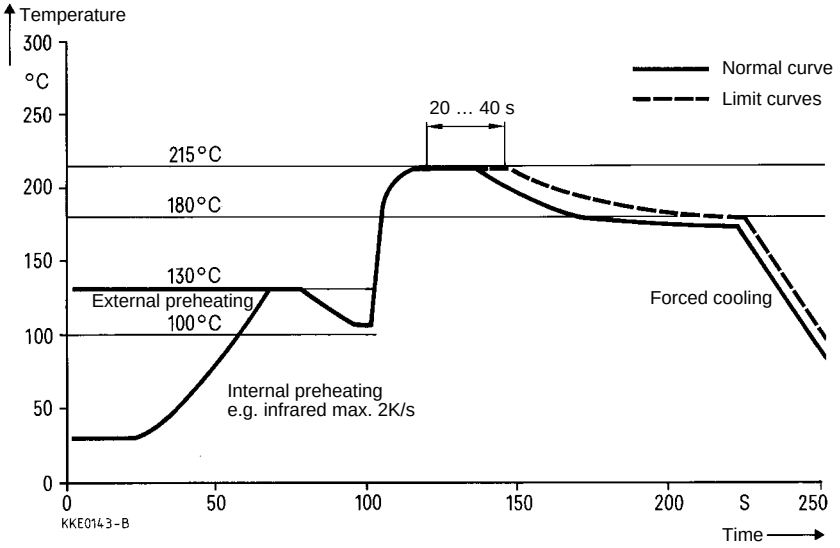


Poor wetting KKE0072-I

5 Vapor phase soldering

5.1 Soldering temperature profile

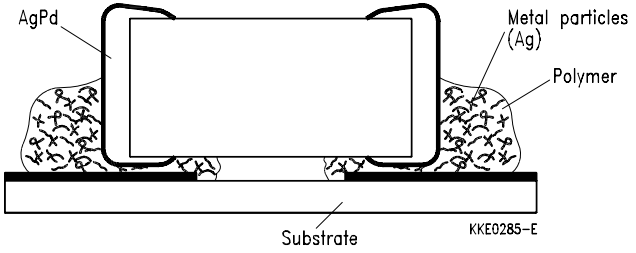
Temperature-time graph of continuous-type vapor-phase soldering with preheating. The temperature at the component terminal applies.



6 Conductive adhesion

Attaching surface-mount devices (SMDs) with electrically conductive adhesives is a commercially attractive component connection method to supplement or even replace conventional soldering methods.

Electrically conductive adhesives consist of a non-conductive plastic (epoxy resin, polyimide or silicon) in which electrically conductive metal particles (gold, silver, palladium, nickel etc.) are embedded. Electrical conduction is effected by the metal particles being in contact with each other.



Adhesion is particularly suitable for meeting the demands of hybrid technology. The adhesives can be deposited ready for production requirements by screen printing, stamping or by dispensers. As shown in the following table, conductive adhesion involves two work operations less than soldering.

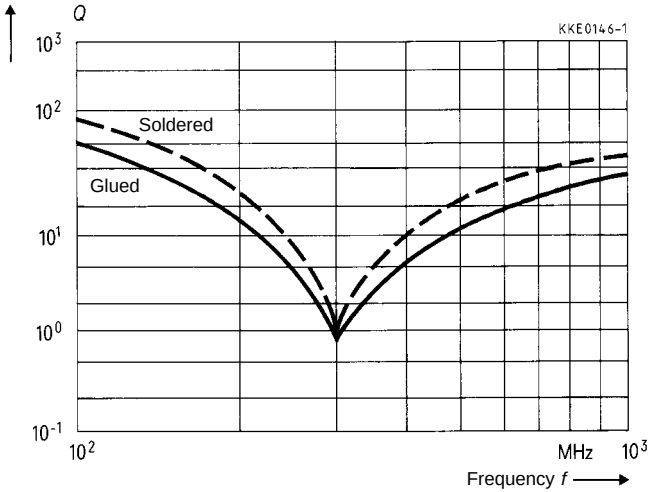
Reflow soldering	Wave soldering	Conductive adhesion
Screen-print solder paste	Apply glue dot	Screen-print conductive adhesive
Mount SMD	Mount SMD	Mount SMD
Predry solder paste	Cure glue	Cure adhesive
Reflow soldering	Wave soldering	Inspect
Wash	Wash	
Inspect	Inspect	

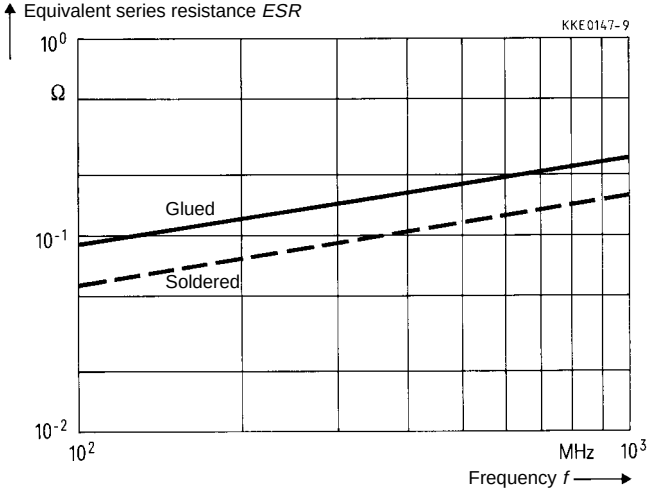
A further advantage of adhesion is that the components are subjected to virtually no temperature shock at all. (The curing temperatures of the adhesives are between120 and 180 ˚C, typical curing times are between 30 minutes and one hour).

The bending strength of glued chips is, in comparison with that of soldered chips, higher by a factor of at least 2, as is to be expected due to the elasticity of the glued joints.

The electrical characteristics at 1 kHz (for C0G, $C_R \leq 1000$ pF) meet the limiting values specified for each particular ceramic material. As the conductivity of adhesives is lower than that of soft solder, the use of this method for RF applications is restricted.

Comparison (soldered-glued) of quality factor *Q* and equivalent series resistance *ESR* for a C0G capacitor, size 0805 with a capacitance of 220 pF:





7 Wettability test in accordance with IEC 68-2-58

Preconditioning: immersion in F-SW 32 flux.
Evaluation criterion: wetting of pads ≥ 95 %.

Terminals	Solder	Bath temperature (˚C)	Immersion time (s)
AgNiSn	SnPb 60/40	215 ± 3	3 ± 0,3
AgPd	SnPb 60/40	235 ± 5	2 ± 0,2

8 Solder heat resistance test in accordance with IEC 68-2-58

Capacitance change

C0G/NP0/CH	≤ 1 % or 0,5 pF (whichever is higher)
X7R/B characteristic, X8R	≤ – 5/+ 10 %
Z5U (Y5U) / F characteristic	≤ + 20 %

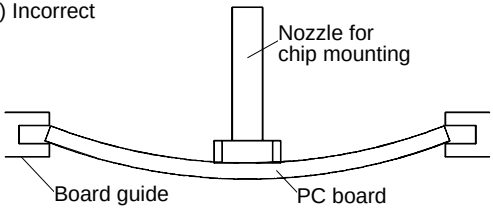
9 Leaching resistance in accordance with IEC 68-2-58

Preconditioning: immersion in F-SW 32 flux.
Evaluation criterion: no leaching of contacts.

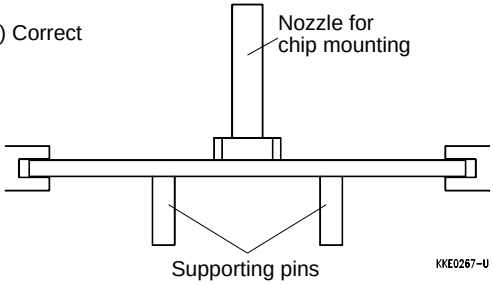
Terminals	Solder	Bath temperature (˚C)	Immersion time (s)
AgNiSn	SnPb 60/40	260 ± 5	30 ± 1
AgPd	SnPb 60/40	260 ± 5	10 ± 1

10 Placement and orientation of chips on PCB

a) Incorrect



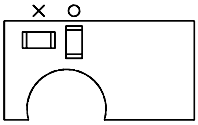
b) Correct



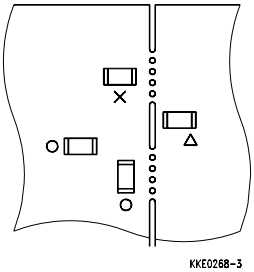
It is recommended that the PC board should be held by means of some adequate supporting pins such as shown in fig. b to prevent the SMDs from being damaged or cracked.

c) Cracks

SMDs located near an easily warped area



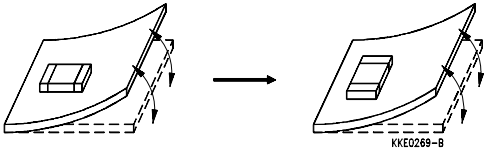
SMD breakage probability due to stress at a breakaway



When placing a component near an area which is apt to bend or a grid groove on the PC board, it is advisable to have both electrodes subjected to uniform stress, or to position the component's electrodes at right angles to the grid groove or bending line (fig. c).

d) Component orientation

Locate chip horizontal to the direction in which stress acts



Incorrect orientation

Correct orientation

Choose a mounting position that minimizes the stress imposed on the chip during flexing or bending of the board.

11 Important notes

The following is a summary of the most important facts and conditions that have to be observed when processing ceramic capacitors.

11.1 Soldering

– When larger component sizes (≥ 1210) are used, care should be taken that the temperature difference between preheating and solder wave does not exceed 100 K. Reflow soldering is recommended.
– When small component sizes (≤ 1206) are used, preheating at 130 °C and a maximum soldering temperature of 260 °C is recommended according to the soldering temperature profiles.
– Manual soldering with a soldering iron is to be avoided, hot-air methods are recommended for making repairs.

11.2 Cleaning

All environmentally compatible agents are suitable for cleaning. Ultrasonic cleaning should be carried out with the utmost caution. Too high ultrasonic power can impair the adhesive strength of the metallized surfaces.

11.3 Electrical measurements

Voltage and temperature dependence of capacitance

The capacitance of class-2 capacitors changes with voltage and/or temperature load. If measurements are made immediately after a voltage test, an insulation test or a test under thermal stress, the capacitance may be exceeded.

For details refer to section 4.5 under General Technical Information.

Ageing

The capacitance of class-2 capacitors decreases with time. By heating the capacitors above the Curie temperature (approximately 130 – 150 °C) the capacitance decrease can be reversed.

Because of ageing, it is necessary to specify an age for reference measurements at which the capacitance shall be within the prescribed tolerances. Since the capacitance significantly decreases during the first hours after production, all capacitors shipped are guaranteed a capacitance value for 1000 hours (t = 1000 h).

For details refer to section 4.4 under General Technical Information.

Leaded capacitors

The relation between capacitance and frequency is influenced by lead length and mounting conditions.

For details refer to section 4.1 under General Technical Information.

11.4 Storage of chip capacitors

Solderability is guaranteed for one year from date of delivery (half a year for chips with AgPd terminations), provided that the components are stored in the original packages.

Storage temperature: – 25 … + 45 °C
Relative humidity: ≤ 75 % annual average, ≤ 95 % on 30 days in a year

The solderability of the external electrodes may be deteriorated if SMDs are stored where they are exposed to high humidity, dust or harmful gas (hydrogen chloride, sulfurous acid gas or hydrogen sulfide).

Do not store SMDs where they are exposed to heat or direct sunlight. Otherwise, the packing material may be deformed or SMDs may stick together, causing problems during mounting.

After opening the factory seals, such as polyvinyl-sealed packages, it is recommended to use the SMDs as soon as possible.

1 Temperature conditions

1.1 Standard atmospheric conditions

Unless otherwise specified, the standard range of atmospheric conditions for measuring and testing is as follows:

Ambient temperature	5 °C … 35 °C
Relative humidity	45% … 85%
Air pressure	86 Kpa … 106 Kpa

If there may be any doubt on the results, measurements shall be made within the following limits:

Ambient temperature	20 °C ± 2 °C
Relative humidity	60% … 70%
Air pressure	86 Kpa … 106 Kpa

1.2 Operating temperature range

The operating temperature range is the range of ambient temperatures at which the capacitor can be operated continuously at rated voltage.

Temperature compensation use:

C0G/NP0/CH, X7R/B char.	– 55 °C … + 125 °C
X8R	– 55 °C … + 150 °C
Z5U (Y5U) / F char.	– 30 °C … + 85 °C

1.3 Preconditioning

Prior to measuring the capacitance or the dissipation factor (tan δ) or the Q values of high-permittivity ceramic capacitors or barrier layer capacitors, the capacitor shall be subjected to the following preconditioning:

1 hour at 125 °C ± 3 °C followed by 48 ± 4 hours at standard atmospheric conditions.

2 Capacitance measurements

Measuring conditions in accordance with CECC 30 000 (IEC 384-1)

Measuring frequency f_{meas}

C0G/NP0/CH ≤ 1 nF	1 MHz ± 0,2 MHz
C0G/NP0/CH > 1 nF	1 kHz ± 0,2 kHz
X7R/B char., X8R,	1 kHz ± 0,2 kHz
Z5U (Y5U) / F char.	1 kHz ± 0,2 kHz

Measuring voltage V_{rms}

C0G/NP0/CH, X7R/B char., X8R	1 Vac ± 0,2 V
Z5U (Y5U) / F char.	0,3 Vac ± 0,1 V

Reference temperature T_{ref} 25 °C ± 1 K (EIA)

Refer to page 97 for important notes on electrical measurements.

3 Dissipation factor measurements

The measuring conditions for the dissipation factor are the same as for the capacitance.

C0G/NP0/CH	$\tan\delta < 1 \cdot 10^{-3}$
X7R/B char., X8R	$\tan\delta < 25 \cdot 10^{-3}$
16 V version	$\tan\delta < 35 \cdot 10^{-3}$
Z5U (Y5U) F char.	$\tan\delta < 30 \cdot 10^{-3}$
25 V version	$\tan\delta < 35 \cdot 10^{-3}$
16 V version	$\tan\delta < 70 \cdot 10^{-3}$

4 Insulation resistance measurements

Measuring conditions in accordance with CECC 30 000 (IEC 384-1)

The measuring voltage is equal to the rated voltage. The charging current may not exceed 50 mA, the charging period is 1 minute.

C0G/NP0/CH	R_{ins}	25 °C/125 °C	10^5 MΩ/10^4 MΩ
	τ	25 °C/125 °C	1000 s/100 s
X7R/B char., X8R	R_{ins}	25 °C/125 °C	10^5 MΩ/10^4 MΩ
	τ	25 °C/125 °C	1000 s/100 s
Z5U (Y5U) F char.	R_{ins}	25 °C/—	10^4 MΩ/—
	τ	25 °C/—	500 s/—

For capacitance values exceeding 10 nF (C0G, X7R, X8R)and 47 nF (Z5U) the time constant $\tau = C \cdot R_{ins}$ is indicated.

5 Voltage tests

Test conditions in accordance with CECC 30 000 (IEC 384-1); MIL-STD-202F (method 301)

Test voltage: 2,5 · rated voltage.

The charging current may not exceed 50 mA. Duration of test: 5 seconds.

6 Capacitance tolerance / temperature range

Conditions in accordance with CECC 32 100 (IEC 384-10)

C0G/NP0/CH	– 55 °C … + 125 °C	± 30 ppm/K
X7R/B char.	– 55 °C … + 125 °C	± 15 %
X8R	– 55 °C … + 150 °C	± 15%
Z5U (Y5U) / F char.	– 30 °C … + 85 °C	+ 22/–56%

7 Dry heat tests

According to IEC and CECC specification the test is performed without voltage treatment prior to the test. Before and after the test the capacitors are heat-treated and subjected to the standard test conditions.

Mounting	see mounting instructions
Test duration	1000 + 48/– 0 h
Test temperature	125 °C (± 3 °C)
Test voltage	2 · rated voltage
Test current	surge current ≤ 50 mA

Permissible capacitance changes

C0G/NP0/CH	≤ 2 % or 1 pF (whichever is higher)
X7R/B char., X8R	≤ ± 10 %
Z5U (Y5U)/F char.	≤ ± 20 %

tan δ

C0G/NP0/CH	$\leq 3 \cdot 10^{-3}$
X7R/B char., X8R	$\leq 50 \cdot 10^{-3}$
Z5U (Y5U)/F char.	$\leq 70 \cdot 10^{-3}$

Insulation resistance

C0G/NP0/CH	$\geq 10^4$ MΩ
X7R/B char., X8R	$>10^3$ MΩ or time constant $\tau \geq 50$ s
Z5U (Y5U)/F char.	$>10^3$ MΩ or time constant $\tau \geq 50$ s For capacitance values exceeding 47 nF the time constant $\tau = C \cdot R_{ins}$ is indicated.

8 Damp heat tests

Conditions in accordance with IEC 68-2-3

Mounting	see mounting instructions
Test duration	56 days
Test temperature	40 °C (± 2 °C)
Relative humidity	93 + 2 /– 3 %
Test voltage	rated voltage
Test current	surge current ≤ 50 mA

Permissible capacitance changes

C0G/NP0/CH	≤ 2 % or 1 pF (whichever is higher)
X7R/B char., X8R	≤ ± 10 %
Z5U (Y5U)/F char.	≤ ± 20 %

tan δ

C0G/NP0/CH	$\leq 3 \cdot 10^{-3}$
X7R/B char., X8R	$\leq 50 \cdot 10^{-3}$
Z5U (Y5U)/F char.	$\leq 70 \cdot 10^{-3}$

Insulation resistance

C0G/NP0/CH	$\geq 5 \cdot 10^3$ MΩ
X7R/B char., X8R	$> 10^3$ MΩ or time constant $\tau \geq 25$ s
Z5U (Y5U)/F char.	$> 10^3$ MΩ or time constant $\tau \geq 25$ s For capacitance values exceeding 22 nF the time constant $\tau = C \cdot R_{ins}$ is indicated.

9 Tests for resistance to soldering heat

Chip capacitors:
Test conditions in accordance with IEC 68-2-58

Capacitance change

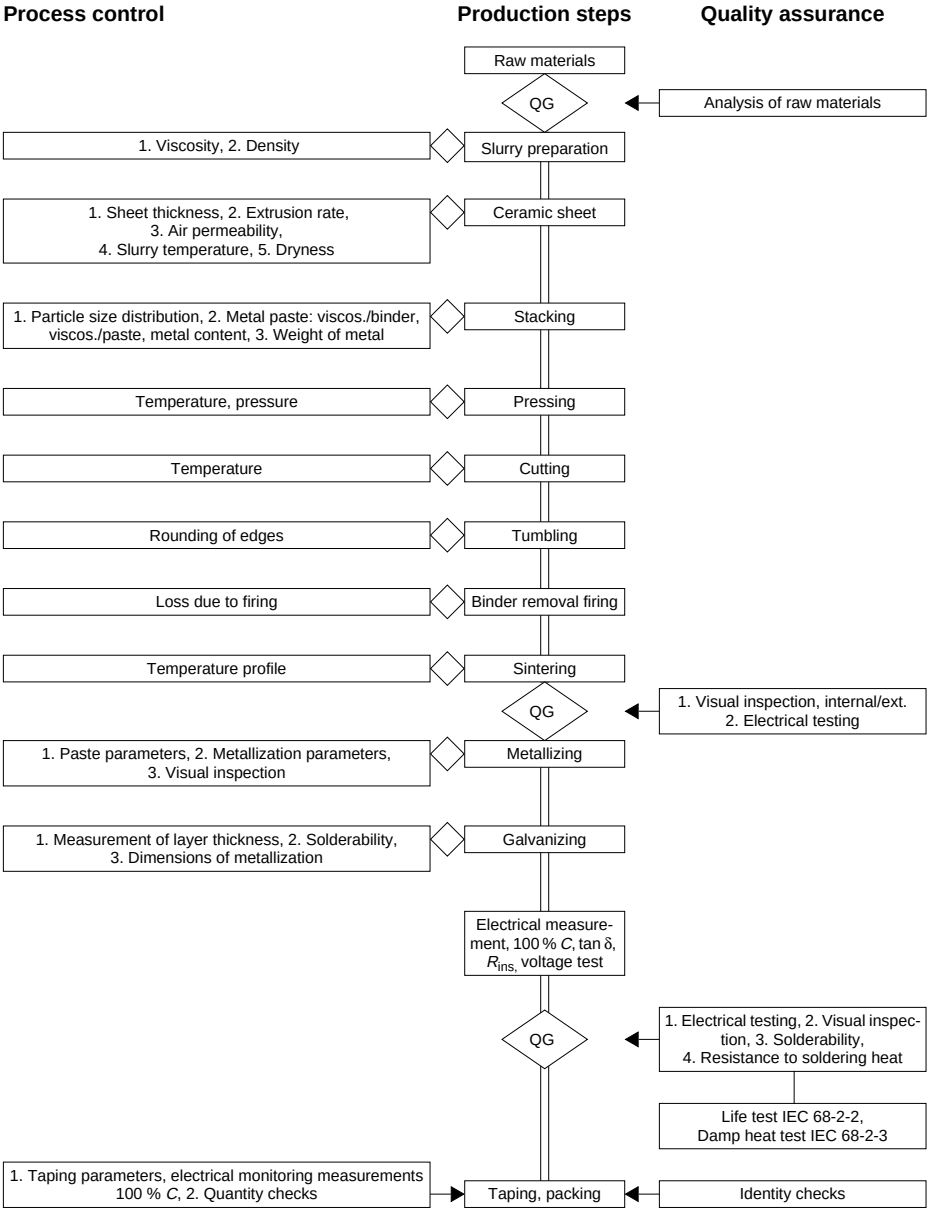
C0G/NP0/CH	≤ 1 % or 0,5 pF (whichever is higher)
X7R/B char., X8R	≤ – 5/+ 10 %
Z5U (Y5U)/F char.	≤ + 20 %

Capacitors with radial leads:
Test conditions in accordance with IEC 68-2-20

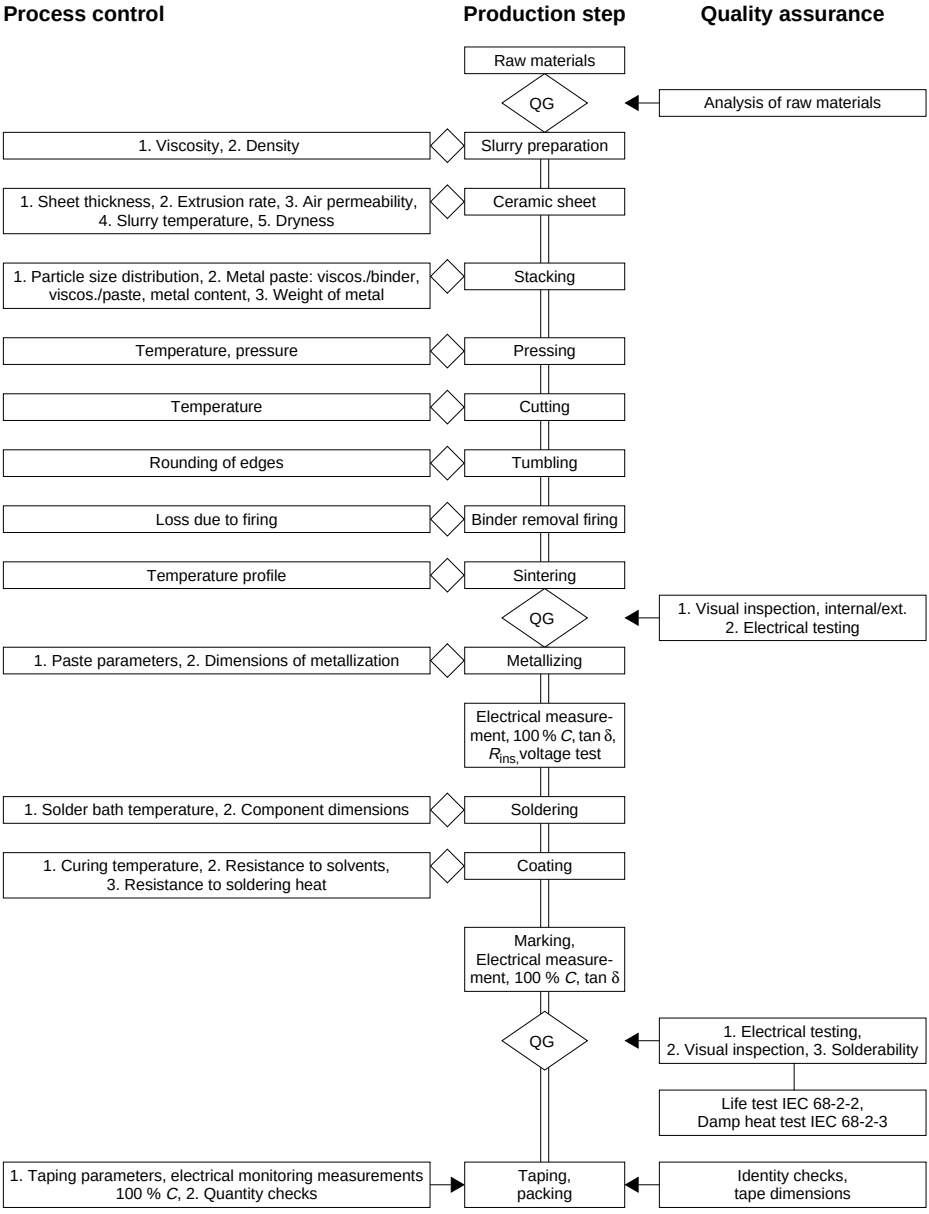
Capacitance change

C0G/NP0/CH	≤ 1 % or 0,5 pF (whichever is higher)
X7R/B char., X8R	≤ – 5/+ 10 %
Z5U (Y5U)/F char.	≤ + 20 %

1 Manufacturing process and quality assurance of chip capacitors



2 Manufacturing process and quality assurance of leaded capacitors



3 Introduction

In order to meet the high technical demands of a free world market, the S + M Ceramic Components Division has established a sophisticated quality assurance system. This is based on the standards QS-9000/VDA 6.1, ISO 9001 and CECC as well as on customer requirements. Certification to QS-9000/VDA 6.1 was obtained in October 1997, certification to ISO 9001 in September 1991.

4 Quality assurance procedure

The multilayer ceramic capacitors described in this data book qualified and were released for production according to the following criteria: compliance with type specification and capability of production, measuring and test equpiment.

The following tests are carried out in order to ensure a consistently high quality:

4.1 Incoming goods inspection

The properties of the parts and materials required for production are defined in close cooperation with qualified suppliers. Quality is ensured by quality assurance measures at the supplier as well as by quality assurance agreements (QSV) and defined inspection procedures for incoming goods.

4.2 Process control

A variety of measures is implemented - wherever possible at the source - in order to achieve the objective of eliminating defects as efficiently as possible. Already at the preliminary stage, FMEA (Failure Mode and Effects Analysis) is applied: *potential* errors are given a risk priority figure corresponding to their significance and the probability of their occurrence and detection. If the risk priority figure is high, remedial measures are introduced right from the start. During production, the processes are monitored using SPC (Statistical Process Control) methods: on-the-spot action is taken immediately if a process starts to deviate from the desired results. All important manufacturing processes are continuously monitored, parallel to the production process.

4.3 Product assurance

So-called “QC gates” are planned into the manufacturing process, i.e. an inspection takes place at the end of each step before the products are passed on to the next step. Continuous monitoring and evaluation of the test results are used to assess procedures and to determine how well the processes are mastered (cf. 4.2).

4.4 Final inspection

Before packing the capacitors, the electrical parameters are checked in a 100%-inspection. In addition, each production lot undergoes random sampling for electrical parameters, solderability and finish. If the capacitors are taped, a further 100%-measurement of *capacitance* is performed at the taping machine.

5 Incoming goods inspection by the customer

The quality of our products is ensured by the procedures shown at the beginning of this section (page 103 and 104). If the customer wishes to carry out an incoming goods inspection all the same, we recommend the use of the sampling inspection plan for normal inspection, inspection level II, in accordance with ISO 2859-1. The inspection methods employed should be agreed upon by the customer and the supplier. Often stricter inspection criteria are agreed upon, whereby the size of the sample lot corresponds to the plan, but in which “zero defects” are required. i.e. the lot will only be accepted if it is entirely free of defects. Independent of such agreements, all random sample inspections made by S + M Components are subjected to such stricter criteria (zero defects).

The following details are required for judging any possible claims: test circuit, sample size, number of defectives found, sample defectives, lot number.

6 Classification of defects

A component is defective if it does not meet the specifications given in the data sheet or another agreed delivery specification. A distinction is made between inoperatives, which usually exclude the functional use of the component, and less significant defects.

Inoperative ceramic capacitors are capacitors with:

– short circuit or open circuit and/or exceeded tolerances excluding functional use
– broken component, terminals or encapsulation
– wrong or missing identification

Other defects of ceramic capacitors are:

– defects in electrical characteristics (electrical characteristics outside of specified limits)
– defects in mechanical properties (e. g. wrong dimensions, illegible marking, bent terminals).

7 Reliability

Data on reliability (in terms of time) under severe or moderate operating conditions are obtained from endurance tests which are carried out continuously. The data are based on the failures registered for capacitors under a defined load. The reliability of the individual types tested is based on confidence levels of 60 % and 90 %. Our reliability data result from a large number of component operating hours and are continuously updated. The latest figures are available upon request.

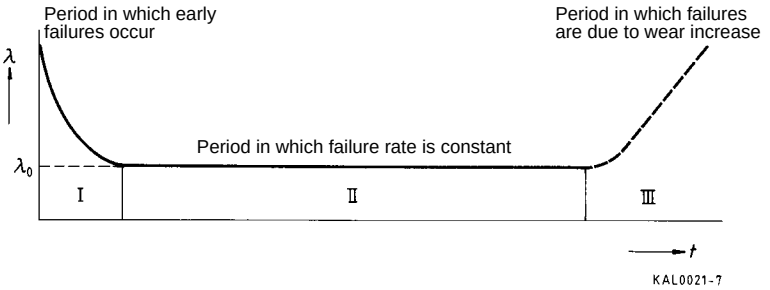
7.1 Failure rate

Information on component failure rates provide the manufacturer with a basis for reliability forecasts and allow him to estimate future service requirements.

If the fraction ΔN of a large number, N, of identical components fails during the time Δt, the failure rate (averaged over Δt) is indicated by $\lambda = \Delta N / (N \cdot \Delta t)$. The failure rate depends on the failure criteria, the load and the operating time.

The dimension of the failure rate is the reciprocal of time and the unit used is 10^{-9} / h = 1 fit (failure in time).

7.2 Failure periods



Region II is assumed to be the “service period” of components. It is thus considered to be sufficient to state the (virtually) constant failure rate λ_0 .

7.3 Reference conditions

Unless otherwise agreed upon, the failure rates of ceramic capacitors are based on the following conditions:

ambient temperature 40 °C, operation at 50 % of rated voltage V_R.

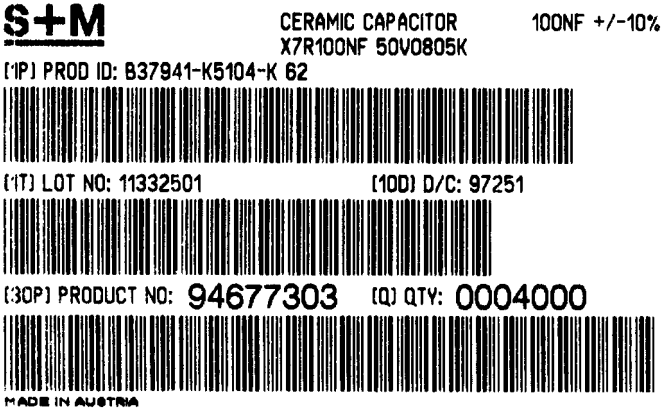
8 Identification and traceability

The packing of all delivered ceramic multilayer capacitors has a barcode label with details of type, ordering code, quantity, manufacturing date and lot number. This information is required in order to process complaints quickly and efficiently.

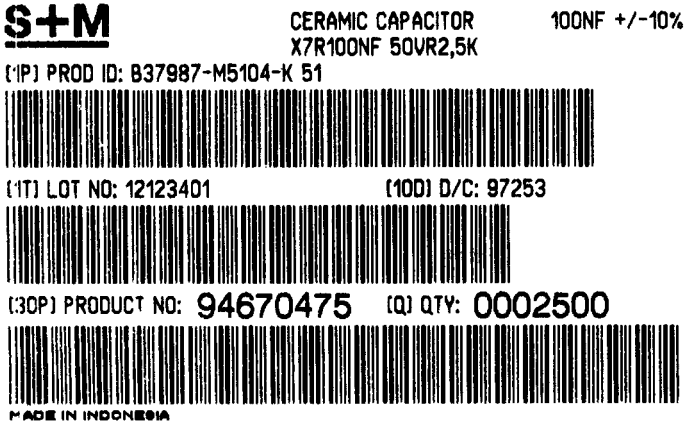
Due to our systematic, unambiguous identification system, each component *and* inspection report can be allocated to a specific production lot. If we know the lot number, we can retrace the component back through the entire production process, right back to purchasing.

Example of a label with production ID (1P), lot numer (1T), date code (10D), production number (30P) and quantity (Q) as a barcode.

Chip capacitors



Leaded capacitors



9 Corrective and preventive measures

Quality issues are handled by interdisciplinary Q teams using the 8D (8 disciplines) method. This method is also applied for handling customer complaints. The focus is on eliminating quality problems from the very start. If a problem has occurred nevertheless, the target is quick response and effective elimination.

10 Supplementary information

Multilayer ceramic capacitors may only be used in line with the corresponding specifications, mounting instructions and state of the art. If there is any issue you are not sure about, do not hesitate to consult our specialists, who will be pleaed to give you support. Non-observance of limit specifications, operating conditions or processing instructions may lead to circuit malfunction (and further consequences) or at least to increased failure rates.

The specification of quality data – which always refer to a fairly large number of components – does not constitute a guarantee of characteristics or properties in the legal sense. However, agreement on these specifications does not mean that the customer may not claim for replacement of individual defective capacitors within the terms of delivery. S+M Components cannot, however, assume any further liability beyond the replacement of defective components. This applies in particular to any further consequences of component failure.

Furthermore, it must be taken into consideration that failure rate figures refer to the average production status and are therefore to be understood as mean values (statistical expectations) for a large number of delivery lots of identical capacitors. These figures are based on application experience and on data obtained from preceding tests under normal conditions, or – for purposes of accelerated aging – more severe conditions.

S+M COMPONENTS **Siemens Matsushita Components**

SMDs from stock

Focus on surface mounting

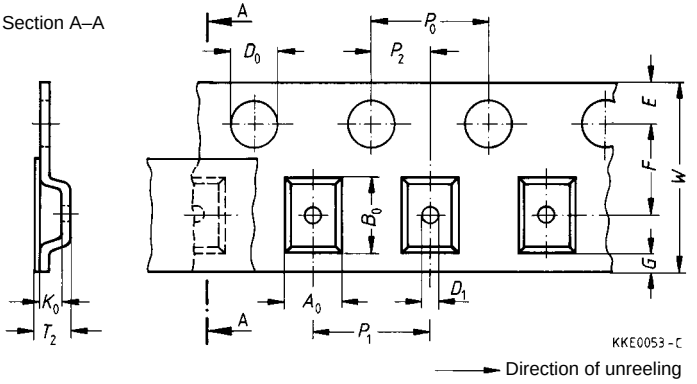
SCS also offers you an extensive range of components for surface mounting. For example you can have HF chokes SIMID 01 through SIMID 04, thermistor chips for temperature compensation, tantalum chips in sizes A, B, C and D plus surface-mount transformers and laboratory assortments of ceramic chip capacitors.

Ask for our SMD product survey!

SCS – dependable, fast and competent

1 Taping of chip capacitors

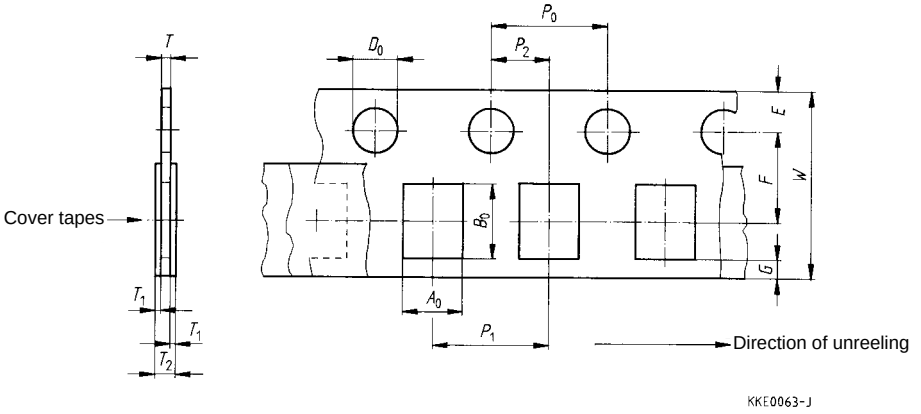
1.1 **Blister tape** (taping in accordance with IEC 286-3)



Dimensions (mm)	Size (8-mm tape)			Size (12-mm tape)		Tolerance
	0805/2012	1206/3216	1210/3225	1812/4532	2220/5150	
$A_0 \times B_0$	1,6 × 2,4	1,9 × 3,5	2,8 × 3,5	3,5 × 4,8	5,1 × 6,0	± 0,2
K_0	0,7 ; 0,9; 1,3 (standard)			1,3		max.
T_2	2,5			4,5		max.
D_0	1,5			1,5		+ 0,1/ – 0
D_1	1,0			1,5		min.
P_0	4,0			4,0		± 0,1[1)]
P_2	2,0			2,0		± 0,05
P_1	4,0			8,0		± 0,1
W	8,0			12,0		± 0,3
E	1,75			1,75		± 0,1
F	3,5			5,5		± 0,05
G	0,75			0,75		min.

1) ≤ 0,2 mm over 10 hole spaces

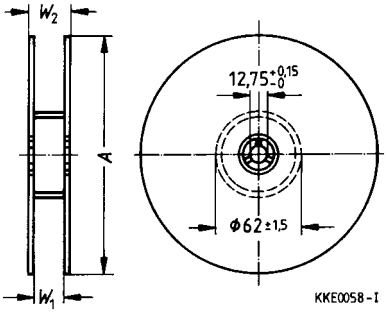
1.2 **Cardboard tape** (taping in accordance with IEC 286-3)

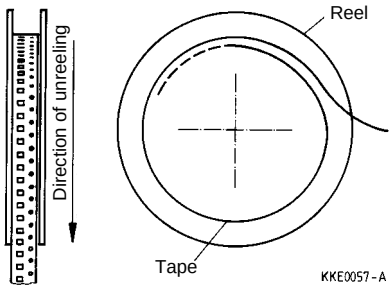


Dimensions (mm)	Size (8-mm tape) 0402/1005	0603/1608	0805/2012	1206/3216	Tolerance
$A_0 \times B_0$	1,15 × 0,6	0,95 × 1,8	1,50 × 2,30	2,0 × 3,6	± 0,2
T	0,6	0,7; 0,9 (standard)			max.
T_2	0,7	0,9	1,1		max.
D_0	1,5	1,5			± 0,1
P_0	4,0	4,0			± 0,1[1)]
P_2	2,0	2,0			± 0,05
P_1	2,0	4,0			± 0,1
W	8,0	8,0			± 0,3
E	1,75	1,75			± 0,1
F	3,5	3,5			± 0,05
G	0,75	0,75			min.

1) ≤ 0,2 mm over 10 hole spaces

1.3 Reel packaging



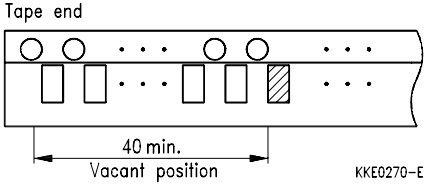


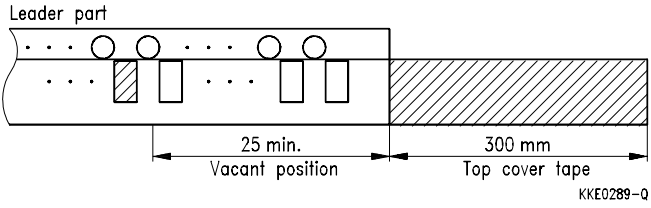
8-mm tape

Dimensions	180-mm tape reel	330-mm tape reel
A	180 – 2/+ 0	330 ± 2,0
W_1	8,4 + 1,5/– 0	8,4 + 1,5/– 0
W_2	14,4 max.	14,4 max.

12-mm tape

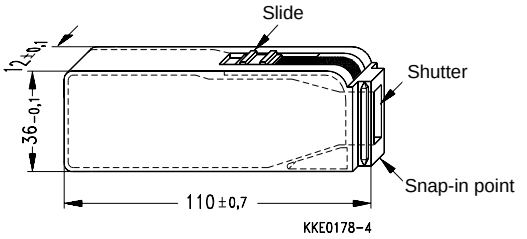
Dimensions	180-mm tape reel	330-mm tape reel
A	180 – 2/+ 0	330 ± 2,0
W_1	12,4 + 1,5/– 0	12,4 + 1,5/– 0
W_2	18,4 max.	18,4 max.





1.4 Bulk case packing

Part of our standard chip range is also available in bulk cases. (See data sheets for ordering codes.)



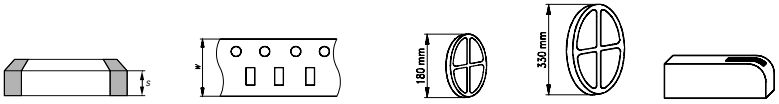
Packing units:

Case size	pcs
0603	15000
0805	10000
1206	5000

Advantages of bulk case packaging:

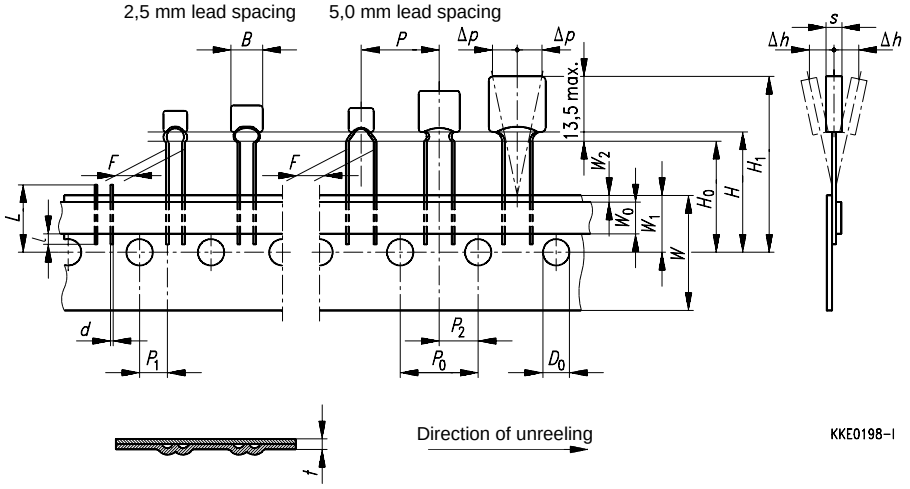
- Environmentally compatible material; considerably less packaging material (1/30 of blister packing)
- Small package sizes (110 × 36 × 12) mm with appropriately low storage requirements
- Can be used several times (less waste)
- No standstill-times during production, since packages can be refilled or replaced while component mounting is in progress
- High component placement reliability if the bulk feeder is used

1.5 Packing units for chip capacitors



Size inch/mm	Thickness *s*	Tape		Packing units (in 1000 pcs)		
				Reel		Bulk case
		Cardboard Width *W*	Blister Width *W*	180 mm dia.	330 mm dia.	
0402/1005	0,5	8 mm	–	10,0	–	–
0603/1608	0,8	8 mm	–	4,0	16,0	15,0
0805/2012	0,6	8 mm	–	5,0	20,0	10,0
	0,8	8 mm	–	4,0	16,0	–
	1,2	–	8 mm	3,0	12,0	–
1206/3216	0,6	8 mm	–	4,0	16,0	5,0
	0,8	8 mm	–	4,0	16,0	–
	1,2	–	8 mm	3,0	12,0	–
1210/3225	0,6	–	8 mm	4,0	16,0	–
	0,8	–	8 mm	4,0	16,0	–
	1,2	–	8 mm	3,0	12,0	–
	1,6	–	8 mm	2,0	8,0	–
1812/4532	1,2	–	12 mm	1,5	5,0	–
2220/5750	1,2	–	12 mm	1,5	5,0	–

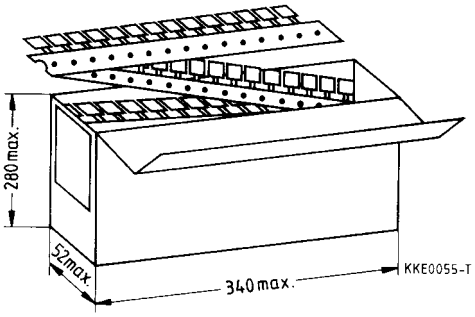
2 **Taping of leaded capacitors** (in accordance with IEC 286-2)



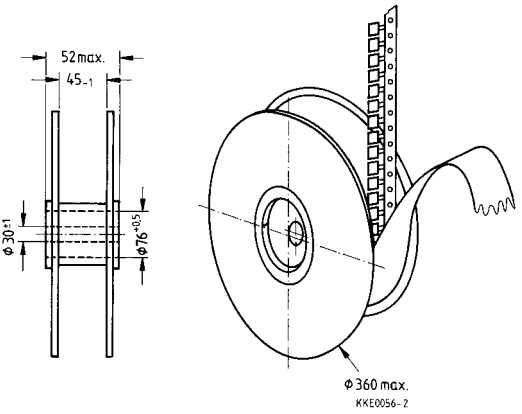
Dimen-sions(mm)	Lead spacing 2,5 mm	5,0 mm	Tolerance	Comments
B	11,0	11,0	max.	
s	2,5	2,5	max.	
d	0,55	0,55	± 0,05	
P	12,7	12,7	± 1,0	
P_0	12,7	12,7	± 0,2	± 1 mm / 20 hole spaces
P_1	5,1	3,85	± 0,7	
P_2	6,35	6,35	± 1,3	
F	2,5	5,0	+ 0,6/ – 0,1	
Δh	0	0	± 2,0	Measured at top of component body
Δp	0	0	± 1,3	
W	18,0	18,0	± 0,5	
W_0	5,5	5,5	min.	Peel force ≥ 5 N
W_1	9,0	9,0	± 0,5	
W_2	1,0	1,0	– 0,5	
H	18,0	18,0	+ 2,0/ – 0	
H_0	16,0	16,0	± 0,5	
H_1	32,2	32,2	max.	
D_0	4,0	4,0	± 0,2	
t	0,7	0,7	+ 0,2	
L	11,0	11,0	max.	
l	1,0	1,0	max.	

3 Types of packing

Ammo packing



Reel packing



S+M COMPONENTS **Siemens Matsushita Components**

Ferrite inductors from SCS stock

Transformation at its best

Not just one-off solutions but complete ones designed precisely to a requirements profile are more in demand than ever. So we are offering surface-mount transformers for power and broadband applications straight from SCS stock:

- **E 6,3** with small dimensions, low leakage inductance and high electric strength
- **ER 11** flat and with low leakage inductance
- **RM 4 LP** for high DC biasing
- **S interface transformer RM 5** for precise pulse transmission in ISDN terminals
- **U interface transformer RM 6** for ISDN applications
- **Planar inductor RM 7** with high power density and extremely flat for DC/DC applications

SCS – dependable, fast and competent

A	Area
C	Capacitance of capacitor
C_0	Initial (original) capacitance
C_1	Capacitance value after one hour's use
C_R	Rated capacitance
C_{20}	Capacitance at 20 ˚C
C_{25}	Capacitance at 25 ˚C
D	Bending displacement
E_a	Activation energy
ESR	Equivalent series resistance
F	Force
f	Frequency
f_{meas}	Measuring frequency
k	Ageing constant
L	Inductance
N	Quantity (integer values)
P_V	Power dissipation or loss
Q_{el}	Electrical charge
Q	Quality
R_{ins}	Insulation resistance
R_P	Parallel resistance
R_S	Series resistance
S_V	Rate of rise of a voltage pulse
T	Temperature
T_{meas}	Measuring temperature
t	Time
t_R	Rise time of a voltage pulse
tan δ	Dissipation factor
V	Voltage
V_0	Initial (original) voltage (basic voltage level)
V_{meas}	Measuring voltage
V_R	Rated voltage
V_S	Amplitude of a voltage pulse
V_{rms}	Measuring (root-mean-square or effective) ac voltage
$\|Z\|$	Magnitude of impedance (ac resistance)
α	Temperature coefficient
Δ	Tolerance, change
ε_0	Absolute dielectric constant
ε_r	Relative dielectric constant
λ	Failure rate
τ	Time constant

Surface-mount devices

Decimal points are indicated by commas.

S

T

U

V

W

Z