Multilayer ceramic capacitors

Chip capacitors, Advanced series, C0G and X7R

Date: October 2006

© EPCOS AG 2006. Reproduction, publication and dissemination of this data sheet and the information contained therein without EPCOS' prior express consent is prohibited.

General

Criteria for high reliability

For both OEMs and component manufacturers, high reliability is assured by consistent process control. If it is assumed that the component manufacturer supplies a defect-free product, then further correct processing by the customer forms the basis for perfect operation of the components and thus the entire application. So the precondition for high quality is not exclusively a particular “intermediate product“ (such as the ceramic capacitor) but rather the process control along the entire production chain up to its end point. This requires a high degree of mutual process understanding between the various partners (e.g. component manufacturer and placement operator) and the formulation of joint quality guidelines.

AEC-Q200 is a standard for quality requirements on components in various technologies. In view of its general character, AEC-Q200 does not apply to every component to the same extent and thus defines a minimum requirement on quality. AEC-Q200 stipulates the observance of limits that can be checked by means of a good/bad decision. It therefore permits a qualitative statement but not a quantitative one. However, it is precisely the latter that is important if we wish to approach “zero defects”. So process control moves to center stage and becomes the decisive element for ensuring and continuously improving the maximum possible reliability.

EPCOS has implemented this paradigm change and thus laid the foundation for a zero defect strategy. This concept is integrated in the “ppb level assurance system“ and is particularly realized and continuously developed further in the Advanced series.

The requirements made on the Advanced series exceed those of AEC-Q200. The criteria are clearly oriented to the aim of achieving “zero defects”. An important precondition for high component reliability is the production of the ceramic powder at our own plant. Only by knowing all the interrelationships and effects from the raw material to the completed component can the self-imposed quality criteria actually be implemented in all production steps. EPCOS has been developing and manufacturing its own ceramic powder for ceramic capacitors for many years so that the component quality can be assured from the first step of manufacture.

ppb level assurance system

The precondition for reliability at ppb level is, apart from process knowledge, a high degree of process control. To achieve this, the entire production process is subdivided systematically into subprocesses that are continuously checked with static methods on the basis of quantifiable parameters. These analysis methods are used by EPCOS within the scope of the Advanced series for all production steps from ceramic powder production and component design up to the 100% electrical testing.

In summary, the ppb level assurance system involves the following points:

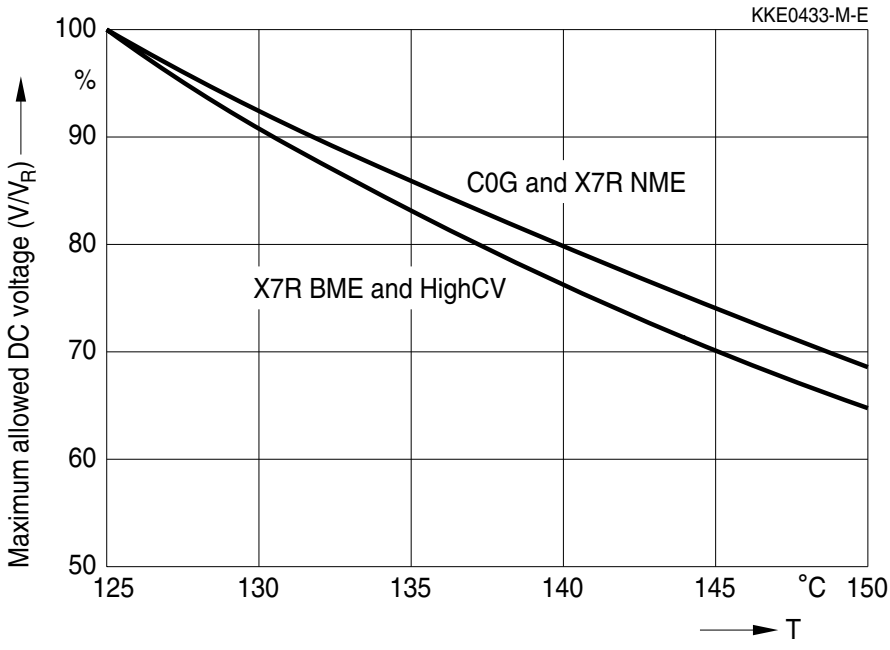
- Statistical methods for component design and process control
- Use of the Weibull method for statistical data analysis
- Introduction of quantifiable parameters (such as the failure time) to replace the previous “good” or “bad” decisions
- Dynamic test limits as a complement to fixed limits in the 100% electrical test (capacitance C, loss factor tan δ, insulation resistance R_{ins})
- Periodic check of the solder-shock resistance at 360 °C, followed by a burn-in test or HALT
- Periodic check of the bending strength by the rigorous piezoelectric method (ΔI measurement) for X7R
- A more accurate characterization of the mechanical properties by eliminating impacting factors by taking measurements on the sintered component
- 100% automatic optical inspection (AOI)
- Ultrasound analysis allowing an internal defect in the ceramic capacitor to be detected in a non-destructive way

High temperature application:

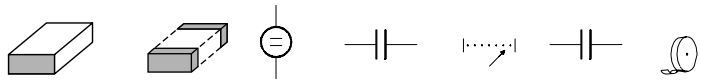
The listed Advanced series types can be used at 100% rated DC voltage up to 125 °C. Operation of Advanced capacitors at temperatures >125 °C up to 150 °C is permissible if the applied voltage is reduced according to the derating diagram below proceeding from a stress level of 100% rated voltage at 125 °C.

Note:

To achieve highest reliability levels it is generally recommended not to operate ceramic capacitors continuously at 100% rated voltage. Please see chapter “Reliability” for recommended operating voltage and calculation of failure rates.



Ordering code system



B37940 A 5 010 C 5 60

Packaging

60 ≙ cardboard tape, 180-mm reel
62 ≙ blister tape, 180-mm reel
70 ≙ cardboard tape, 330-mm reel
72 ≙ blister tape, 330-mm reel

Decimal place for cap. values <10 pF, otherwise 0

Capacitance tolerance

C_R <10 pF: **C ≙ ±0.25 pF (standard for capacitance values <10 pF)**
C_R ≥10 pF: **J ≙ ± 5% (standard)**

Capacitance, coded (example)

010 ≙ $\underline{1} \cdot 10^0$ pF = 1 pF
100 ≙ $\underline{10} \cdot 10^0$ pF = 10 pF
221 ≙ $\underline{22} \cdot 10^1$ pF = 220 pF

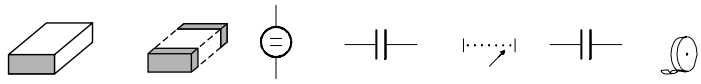
Rated voltage

Rated voltage [VDC]	50	100
Code	5	1

Internal coding "A" indicates Advanced series

Type and size	
Chip size (**inch** / mm)	Temperature characteristic C0G
0402 / 1005 **0603** / 1608 **0805** / 2012 **1206** / 3216	B37920 B37930 B37940 B37871

Ordering code system



B37941 A 5 102 K 0 60

Packaging

60 ≙ cardboard tape, 180-mm reel
62 ≙ blister tape, 180-mm reel
70 ≙ cardboard tape, 330-mm reel
72 ≙ blister tape, 330-mm reel

Internal coding

Capacitance tolerance

K ≙ ±10% (standard)

Capacitance, coded (example)

102 ≙ 10 · 10^2 pF = 1 nF
104 ≙ 10 · 10^4 pF = 100 nF
223 ≙ 22 · 10^3 pF = 22 nF

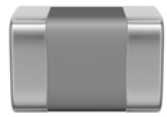
Rated voltage

Rated voltage [VDC]	25	50	100
Code	0	5	1

Internal coding "A" indicates Advanced series

Type and size	
Chip size (**inch** / mm)	Temperature characteristic X7R
0603 / 1608 **0805** / 2012 **1206** / 3216	B37931 B37941 B37872

SMD



Features

- ppb level assurance system
- Optimized bending and solder-shock strength due to simultaneous availability of BME and NME technologies
- May be used at temperatures of up to 150 °C
- Short-term use up to 175 °C without electrical stressing possible
- Marking with date code
- To AEC-Q200

Applications

- Use in safety-relevant applications, e.g. in the automotive sector:
  – ABS, ESP and airbag
- Use in applications with particularly high quality requirements, e.g. in the automotive, industrial, consumer and telecommunications industries:
  – Mobile phone base stations
  – High-end consumer electronics

Termination

- For soldering: Nickel barrier terminations (Ni)

Options

- Alternative capacitance tolerances available on request

Delivery mode

- Cardboard and blister tape (blister tape for chip thickness ≥1.2 ±0.1 mm), 180-mm and 330-mm reel available

Electrical data C0G

Temperature characteristic		C0G	
Climatic category (IEC 60068-1)		55/125/56	
Standard		EIA	
Dielectric		Class 1	
Rated voltage	V_R	50, 100	VDC
Test voltage	V_{test}	$2.5 \cdot V_R$/5 s	VDC
Capacitance range / E series	C_R	1 pF … 4.7 nF (E6)	
Temperature coefficient		$0 \pm 30 \cdot 10^{-6}$/K	
Dissipation factor (limit value)	tan δ	$<1.0 \cdot 10^{-3}$	
Insulation resistance[1)] at + 25 °C	R_{ins}	$>10^5$	MΩ
Insulation resistance[1)] at +125 °C	R_{ins}	$>10^4$	MΩ
Time constant[1)] at + 25 °C	τ	>1000	s
Time constant[1)] at +125 °C	τ	>100	s
Operating temperature range	T_{op}	–55 … +125	°C
Ageing		none	

1) For C_R >10 nF the time constant $\tau = C \cdot R_{ins}$ is given.

Electrical data X7R

Temperature characteristic		X7R	
Max. relative capacitance change within −55 °C to +125 °C	$\Delta C/C$	±15	%
Climatic category (IEC 60068-1)		55/125/56	
Standard		EIA	
Dielectric		Class 2	
Rated voltage[1)]	V_R	25; 50; 100	VDC
Test voltage	V_{test}	$2.5 \cdot V_R$/5 s	VDC
Capacitance range / E series	C_R	1 nF … 1 µF (E6)	
Dissipation factor (limit value)	tan δ	$<25 \cdot 10^{-3}$ / $<50 \cdot 10^{-3}$ for 25 V	
Insulation resistance[2)] at + 25 °C	R_{ins}	$>10^5$	MΩ
Insulation resistance[2)] at +125 °C	R_{ins}	$>10^4$	MΩ
Time constant[2)] at + 25 °C	τ	>1000	s
Time constant[2)] at +125 °C	τ	>100	s
Operating temperature range	T_{op}	−55 … +125	°C
Ageing[3)]		yes	

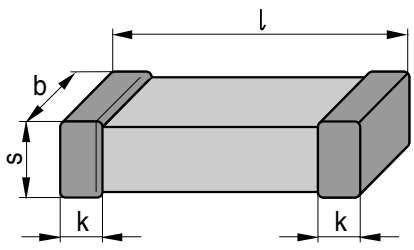
Capacitance tolerances C0G

	C_R <10 pF	C_R ≥10 pF
Code letter	C (standard)	J (standard)
Tolerance	±0.25 pF	±5%

Capacitance tolerances X7R

Code letter	K (standard)
Tolerance	±10%

Dimensional drawing



KKE0329-N

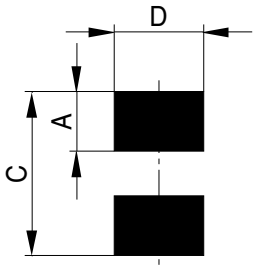
Dimensions (mm)

Case size inch / mm	0402 / 1005	0603 / 1608	0805 / 2012	1206 / 3216
l	1.0 ±0.10	1.6 ±0.15	2.00 ±0.20	3.20 ±0.20
b	0.5 ±0.05	0.8 ±0.10	1.25 ±0.15	1.60 ±0.15
s	0.5 ±0.05	0.8 ±0.10	1.30 max.	1.30 max.
k	0.1 −0.40	0.1 −0.40	0.13 −0.75	0.25 −0.75

Tolerances to CECC 32101-801

1) Note: No operation on AC line.
2) For C_R >10 nF the time constant $\tau = C \cdot R_{ins}$ is given.
3) Refer to chapter “General technical information”, “Ageing”.

Recommended solder pad



KKE0308-1

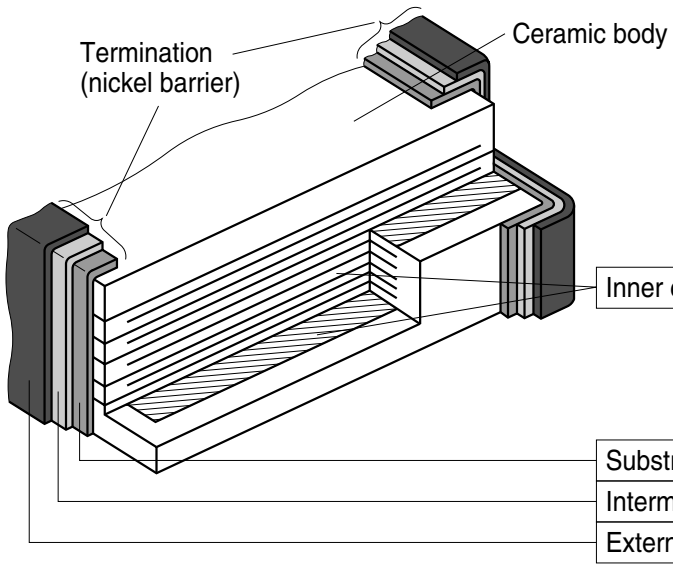
Recommended dimensions (mm) for reflow soldering

Case size	(inch/mm)	Type	A	C	D
	0402/1005	single chip	0.35 … 0.45	1.0 … 1.40	0.4 … 0.6
	0603/1608	single chip	0.60 … 0.70	1.8 … 2.20	0.6 … 0.8
	0805/2012	single chip	0.60 … 0.70	2.2 … 2.60	0.8 … 1.1
	1206/3216	single chip	0.80 … 0.90	3.8 … 4.32	1.0 … 1.4

Recommended dimensions (mm) for wave soldering

Case size	(inch/mm)	Type	A	C	D
	0603/1608	single chip	0.8 … 0.9	2.2 … 2.8	0.6 … 0.8
	0805/2012	single chip	0.9 … 1.0	2.8 … 3.2	0.8 … 1.1
	1206/3216	single chip	1.0 … 1.1	4.2 … 4.8	1.0 … 1.4

Termination



	NME	BME	HighCV
Inner electrode	AgPd	Ni	Ni

	NME	BME	HighCV
Substrate electrode	Ag	Cu	Cu
Intermediate electrode	Ni	Ni	Ni
External electrode	Sn	Sn	Sn

NME: Noble Metal Electrode
BME: Base Metal Electrode

KKE0424-N-E

Product range for Advanced series chip capacitors, C0G

Size[1)] **inch** mm	**0402** 1005		**0603** 1608		**0805** 2012		**1206** 3216	
Type	B37920		B37930		B37940		B37871	
V_R (VDC) / C_R	50		50	100	50	100	50	100
1.0 pF								
2.2 pF								
3.3 pF								
4.7 pF								
6.8 pF								
10 pF								
15 pF								
22 pF								
33 pF								
47 pF								
68 pF								
100 pF								
220 pF								
330 pF								
470 pF								
680 pF								
1.0 nF								
1.5 nF								
2.2 nF								
3.3 nF								
4.7 nF								

1) l × b (inch) / l × b (mm)

Product range for Advanced series chip capacitors, X7R

Size[1)] **inch** mm	**0603** 1608			**0805** 2012			**1206** 3216	
Type	B37931			B37941			B37872	
V_R (VDC) / C_R	25	50	100	25	50	100	50	100
1.0 nF								
2.2 nF								
3.3 nF								
4.7 nF								
6.8 nF								
10 nF								
15 nF								
22 nF								
33 nF								
47 nF								
68 nF								
100 nF								
220 nF	▲			▲				
330 nF				▲				
470 nF				▲				
1.0 µF				▲				

▲ = HighCV

1) l × b (inch) / l × b (mm)

Ordering codes and packing for C0G, 50 VDC, nickel barrier terminations

Case size 0402, 50 VDC

C_R[1)]	Ordering code	Chip thickness mm	Cardboard tape, ∅ 180-mm reel ** ≙ 60 pcs/reel	Cardboard tape, ∅ 330-mm reel ** ≙ 70 pcs/reel
3.3 pF	B37920A5030C3**	0.5 ±0.05	10000	50000
4.7 pF	B37920A5040C7**	0.5 ±0.05	10000	50000
6.8 pF	B37920A5060C8**	0.5 ±0.05	10000	50000
10 pF	B37920A5100J0**	0.5 ±0.05	10000	50000
15 pF	B37920A5150J0**	0.5 ±0.05	10000	50000
22 pF	B37920A5220J0**	0.5 ±0.05	10000	50000
33 pF	B37920A5330J0**	0.5 ±0.05	10000	50000
47 pF	B37920A5470J0**	0.5 ±0.05	10000	50000
68 pF	B37920A5680J0**	0.5 ±0.05	10000	50000
100 pF	B37920A5101J0**	0.5 ±0.05	10000	50000

1) Other capacitance values on request.

Ordering codes and packing for C0G, 50 and 100 VDC, nickel barrier terminations

Case size 0603, 50 VDC

C_R[1)]	Ordering code	Chip thickness mm	Cardboard tape, ∅ 180-mm reel ** ≙ 60 pcs/reel	Cardboard tape, ∅ 330-mm reel ** ≙ 70 pcs/reel
1.0 pF	B37930A5010C0**	0.8 ±0.1	4000	16000
1.5 pF	B37930A5010C5**	0.8 ±0.1	4000	16000
2.2 pF	B37930A5020C2**	0.8 ±0.1	4000	16000
3.3 pF	B37930A5030C3**	0.8 ±0.1	4000	16000
4.7 pF	B37930A5040C7**	0.8 ±0.1	4000	16000
6.8 pF	B37930A5060C8**	0.8 ±0.1	4000	16000
10 pF	B37930A5100J0**	0.8 ±0.1	4000	16000
15 pF	B37930A5150J0**	0.8 ±0.1	4000	16000
22 pF	B37930A5220J0**	0.8 ±0.1	4000	16000
33 pF	B37930A5330J0**	0.8 ±0.1	4000	16000
47 pF	B37930A5470J0**	0.8 ±0.1	4000	16000
68 pF	B37930A5680J0**	0.8 ±0.1	4000	16000
100 pF	B37930A5101J0**	0.8 ±0.1	4000	16000
150 pF	B37930A5151J0**	0.8 ±0.1	4000	16000
220 pF	B37930A5221J0**	0.8 ±0.1	4000	16000
330 pF	B37930A5331J0**	0.8 ±0.1	4000	16000
470 pF	B37930A5471J0**	0.8 ±0.1	4000	16000

Case size 0603, 100 VDC

1.0 pF	B37930A1010C0**	0.8 ±0.1	4000	16000
1.5 pF	B37930A1010C5**	0.8 ±0.1	4000	16000
2.2 pF	B37930A1020C2**	0.8 ±0.1	4000	16000
3.3 pF	B37930A1030C3**	0.8 ±0.1	4000	16000
4.7 pF	B37930A1040C7**	0.8 ±0.1	4000	16000
6.8 pF	B37930A1060C8**	0.8 ±0.1	4000	16000
10 pF	B37930A1100J0**	0.8 ±0.1	4000	16000
15 pF	B37930A1150J0**	0.8 ±0.1	4000	16000
22 pF	B37930A1220J0**	0.8 ±0.1	4000	16000
33 pF	B37930A1330J0**	0.8 ±0.1	4000	16000
47 pF	B37930A1470J0**	0.8 ±0.1	4000	16000
68 pF	B37930A1680J0**	0.8 ±0.1	4000	16000
100 pF	B37930A1101J0**	0.8 ±0.1	4000	16000
150 pF	B37930A1151J0**	0.8 ±0.1	4000	16000
220 pF	B37930A1221J0**	0.8 ±0.1	4000	16000

1) Other capacitance values on request.

Ordering codes and packing for C0G, 50 VDC, nickel barrier terminations

Case size 0805, 50 VDC

C_R[1]	Ordering code	Chip thickness mm	Cardboard tape, ∅ 180-mm reel ** ≙ 60 pcs/reel	Cardboard tape, ∅ 330-mm reel ** ≙ 70 pcs/reel
1.0 pF	B37940A5010C0**	0.6 ±0.1	5000	20000
1.5 pF	B37940A5010C5**	0.6 ±0.1	5000	20000
2.2 pF	B37940A5020C2**	0.6 ±0.1	5000	20000
3.3 pF	B37940A5030C3**	0.6 ±0.1	5000	20000
4.7 pF	B37940A5040C7**	0.6 ±0.1	5000	20000
6.8 pF	B37940A5060C8**	0.6 ±0.1	5000	20000
10 pF	B37940A5100J0**	0.6 ±0.1	5000	20000
15 pF	B37940A5150J0**	0.6 ±0.1	5000	20000
22 pF	B37940A5220J0**	0.6 ±0.1	5000	20000
33 pF	B37940A5330J0**	0.6 ±0.1	5000	20000
47 pF	B37940A5470J0**	0.6 ±0.1	5000	20000
68 pF	B37940A5680J0**	0.6 ±0.1	5000	20000
100 pF	B37940A5101J0**	0.6 ±0.1	5000	20000
150 pF	B37940A5151J0**	0.6 ±0.1	5000	20000
220 pF	B37940A5221J0**	0.6 ±0.1	5000	20000
330 pF	B37940A5331J0**	0.6 ±0.1	5000	20000
470 pF	B37940A5471J0**	0.6 ±0.1	5000	20000
680 pF	B37940A5681J0**	0.6 ±0.1	5000	20000
1.0 nF	B37940A5102J0**	0.6 ±0.1	5000	20000
1.5 nF	B37940A5152J0**	0.8 ±0.1	4000	16000
2.2 nF	B37940A5222J0**	1.2 ±0.1	3000[2]	12000[3]

1) Other capacitance values on request.
2) Blister tape, 180-mm reel, ordering code ** ≙ 62
3) Blister tape, 330-mm reel, ordering code ** ≙ 72

Ordering codes and packing for C0G, 100 VDC, nickel barrier terminations

Case size 0805, 100 VDC

C_R[1)]	Ordering code	Chip thickness mm	Cardboard tape, ∅ 180-mm reel ** ≙ 60 pcs/reel	Cardboard tape, ∅ 330-mm reel ** ≙ 70 pcs/reel
1.0 pF	B37940A1010C0**	0.6 ±0.1	5000	20000
1.5 pF	B37940A1010C5**	0.6 ±0.1	5000	20000
2.2 pF	B37940A1020C2**	0.6 ±0.1	5000	20000
3.3 pF	B37940A1030C3**	0.6 ±0.1	5000	20000
4.7 pF	B37940A1040C7**	0.6 ±0.1	5000	20000
6.8 pF	B37940A1060C8**	0.6 ±0.1	5000	20000
10 pF	B37940A1100J0**	0.6 ±0.1	5000	20000
15 pF	B37940A1150J0**	0.6 ±0.1	5000	20000
22 pF	B37940A1220J0**	0.6 ±0.1	5000	20000
33 pF	B37940A1330J0**	0.6 ±0.1	5000	20000
47 pF	B37940A1470J0**	0.6 ±0.1	5000	20000
68 pF	B37940A1680J0**	0.6 ±0.1	5000	20000
100 pF	B37940A1101J0**	0.6 ±0.1	5000	20000
150 pF	B37940A1151J0**	0.6 ±0.1	5000	20000
220 pF	B37940A1221J0**	0.6 ±0.1	5000	20000
330 pF	B37940A1331J0**	0.6 ±0.1	5000	20000
470 pF	B37940A1471J0**	0.6 ±0.1	5000	20000
680 pF	B37940A1681J0**	0.8 ±0.1	4000	16000
1.0 nF	B37940A1102J0**	1.2 ±0.1	3000[2)]	12000[3)]

1) Other capacitance values on request.
2) Blister tape, 180-mm reel, ordering code ** ≙ 62
3) Blister tape, 330-mm reel, ordering code ** ≙ 72

Ordering codes and packing for C0G, 50 VDC, nickel barrier terminations

Case size 1206, 50 VDC

C_R[1]	Ordering code	Chip thickness mm	Cardboard tape, ∅ 180-mm reel ** ≙ 60 pcs/reel	Cardboard tape, ∅ 330-mm reel ** ≙ 70 pcs/reel
1.0 pF	B37871A5010C0**	0.8 ±0.1	4000	16000
1.5 pF	B37871A5010C5**	0.8 ±0.1	4000	16000
2.2 pF	B37871A5020C2**	0.8 ±0.1	4000	16000
3.3 pF	B37871A5030C3**	0.8 ±0.1	4000	16000
4.7 pF	B37871A5040C7**	0.8 ±0.1	4000	16000
6.8 pF	B37871A5060C8**	0.8 ±0.1	4000	16000
10 pF	B37871A5100J0**	0.8 ±0.1	4000	16000
15 pF	B37871A5150J0**	0.8 ±0.1	4000	16000
22 pF	B37871A5220J0**	0.8 ±0.1	4000	16000
33 pF	B37871A5330J0**	0.8 ±0.1	4000	16000
47 pF	B37871A5470J0**	0.8 ±0.1	4000	16000
68 pF	B37871A5680J0**	0.8 ±0.1	4000	16000
100 pF	B37871A5101J0**	0.8 ±0.1	4000	16000
150 pF	B37871A5151J0**	0.8 ±0.1	4000	16000
220 pF	B37871A5221J0**	0.8 ±0.1	4000	16000
330 pF	B37871A5331J0**	0.8 ±0.1	4000	16000
470 pF	B37871A5471J0**	0.8 ±0.1	4000	16000
680 pF	B37871A5681J0**	0.8 ±0.1	4000	16000
1.0 nF	B37871A5102J0**	0.8 ±0.1	4000	16000
1.5 nF	B37871A5152J0**	0.8 ±0.1	4000	16000
2.2 nF	B37871A5222J0**	0.8 ±0.1	4000	16000
3.3 nF	B37871A5332J0**	0.8 ±0.1	4000	16000
4.7 nF	B37871A5472J0**	1.2 ±0.1	3000[2]	12000[3]

1) Other capacitance values on request.
2) Blister tape, 180-mm reel, ordering code ** ≙ 62
3) Blister tape, 330-mm reel, ordering code ** ≙ 72

Ordering codes and packing for C0G, 100 VDC, nickel barrier terminations

Case size 1206, 100 VDC

C_R[1]	Ordering code	Chip thickness mm	Cardboard tape, ∅ 180-mm reel ** ≙ 60 pcs/reel	Cardboard tape, ∅ 330-mm reel ** ≙ 70 pcs/reel
1.0 pF	B37871A1010C0**	0.8 ±0.1	4000	16000
1.5 pF	B37871A1010C5**	0.8 ±0.1	4000	16000
2.2 pF	B37871A1020C2**	0.8 ±0.1	4000	16000
3.3 pF	B37871A1030C3**	0.8 ±0.1	4000	16000
4.7 pF	B37871A1040C7**	0.8 ±0.1	4000	16000
6.8 pF	B37871A1060C8**	0.8 ±0.1	4000	16000
10 pF	B37871A1100J0**	0.8 ±0.1	4000	16000
15 pF	B37871A1150J0**	0.8 ±0.1	4000	16000
22 pF	B37871A1220J0**	0.8 ±0.1	4000	16000
33 pF	B37871A1330J0**	0.8 ±0.1	4000	16000
47 pF	B37871A1470J0**	0.8 ±0.1	4000	16000
68 pF	B37871A1680J0**	0.8 ±0.1	4000	16000
100 pF	B37871A1101J0**	0.8 ±0.1	4000	16000
150 pF	B37871A1151J0**	0.8 ±0.1	4000	16000
220 pF	B37871A1221J0**	0.8 ±0.1	4000	16000
330 pF	B37871A1331J0**	0.8 ±0.1	4000	16000
470 pF	B37871A1471J0**	0.8 ±0.1	4000	16000
680 pF	B37871A1681J0**	0.8 ±0.1	4000	16000
1.0 nF	B37871A1102J0**	0.8 ±0.1	4000	16000
1.5 nF	B37871A1152J0**	0.8 ±0.1	4000	16000
2.2 nF	B37871A1222J0**	1.2 ±0.1	3000[2]	12000[3]

1) Other capacitance values on request.
2) Blister tape, 180-mm reel, ordering code ** ≙ 62
3) Blister tape, 330-mm reel, ordering code ** ≙ 72

Ordering codes and packing for X7R, 25, 50 and 100 VDC, nickel barrier terminations

C_R[1]	Ordering code	Chip thickness	Cardboard tape, ∅ 180-mm reel	Cardboard tape, ∅ 330-mm reel
			** ≙ 60	** ≙ 70
		mm	pcs/reel	pcs/reel
Case size 0603, 25 VDC				
68 nF	B37931A0683K0**	0.8 ±0.1	4000	16000
100 nF	B37931A0104K0**	0.8 ±0.1	4000	16000
220 nF[2]	B37931A0224K0**	0.8 ±0.1	4000	16000
Case size 0603, 50 VDC				
1.0 nF	B37931A5102K0**	0.8 ±0.1	4000	16000
1.5 nF	B37931A5152K0**	0.8 ±0.1	4000	16000
2.2 nF	B37931A5222K0**	0.8 ±0.1	4000	16000
3.3 nF	B37931A5332K0**	0.8 ±0.1	4000	16000
4.7 nF	B37931A5472K0**	0.8 ±0.1	4000	16000
6.8 nF	B37931A5682K0**	0.8 ±0.1	4000	16000
10 nF	B37931A5103K0**	0.8 ±0.1	4000	16000
15 nF	B37931A5153K0**	0.8 ±0.1	4000	16000
22 nF	B37931A5223K0**	0.8 ±0.1	4000	16000
33 nF	B37931A5333K0**	0.8 ±0.1	4000	16000
47 nF	B37931A5473K0**	0.8 ±0.1	4000	16000
Case size 0603, 100 VDC				
1.0 nF	B37931A1102K0**	0.8 ±0.1	4000	16000
1.5 nF	B37931A1152K0**	0.8 ±0.1	4000	16000
2.2 nF	B37931A1222K0**	0.8 ±0.1	4000	16000
3.3 nF	B37931A1332K0**	0.8 ±0.1	4000	16000
4.7 nF	B37931A1472K0**	0.8 ±0.1	4000	16000

1) Other capacitance values on request.
2) HighCV type

Ordering codes and packing for X7R, 25, 50 and 100 VDC, nickel barrier terminations

C_R[1]	Ordering code	Chip thickness	Cardboard tape, ∅ 180-mm reel	Cardboard tape, ∅ 330-mm reel
			** ≙ 60	** ≙ 70
		mm	pcs/reel	pcs/reel
Case size 0805, 25 VDC				
220 nF[2]	B37941A0224K0**	0.8 ±0.1	4000	16000
330 nF[2]	B37941A0334K0**	0.8 ±0.1	4000	16000
470 nF[2]	B37941A0474K0**	0.8 ±0.1	4000	16000
1.0 µF[2]	B37941A0105K0**	1.25 ±0.1	3000[3]	12000[4]
Case size 0805, 50 VDC				
1.0 nF	B37941A5102K0**	0.6 ±0.1	5000	20000
1.5 nF	B37941A5152K0**	0.6 ±0.1	5000	20000
2.2 nF	B37941A5222K0**	0.6 ±0.1	5000	20000
3.3 nF	B37941A5332K0**	0.6 ±0.1	5000	20000
4.7 nF	B37941A5472K0**	0.6 ±0.1	5000	20000
6.8 nF	B37941A5682K0**	0.6 ±0.1	5000	20000
10 nF	B37941A5103K0**	0.8 ±0.1	4000	16000
15 nF	B37941A5153K0**	0.8 ±0.1	4000	16000
22 nF	B37941A5223K0**	0.8 ±0.1	4000	16000
33 nF	B37941A5333K0**	0.8 ±0.1	4000	16000
47 nF	B37941A5473K0**	0.8 ±0.1	4000	16000
68 nF	B37941A5683K0**	0.8 ±0.1	4000	16000
100 nF	B37941A5104K0**	0.8 ±0.1	4000	16000
Case size 0805, 100 VDC				
1.0 nF	B37941A1102K0**	0.6 ±0.1	5000	20000
1.5 nF	B37941A1152K0**	0.6 ±0.1	5000	20000
2.2 nF	B37941A1222K0**	0.6 ±0.1	5000	20000
3.3 nF	B37941A1332K0**	0.6 ±0.1	5000	20000
4.7 nF	B37941A1472K0**	0.6 ±0.1	5000	20000
6.8 nF	B37941A1682K0**	0.6 ±0.1	5000	20000
10 nF	B37941A1103K0**	0.6 ±0.1	5000	20000
15 nF	B37941A1153K0**	0.6 ±0.1	5000	20000
22 nF	B37941A1223K0**	0.8 ±0.1	4000	16000

1) Other capacitance values on request.
2) HighCV type.
3) Blister tape, 180-mm reel, ordering code ** ≙ 62
4) Blister tape, 330-mm reel, ordering code ** ≙ 72

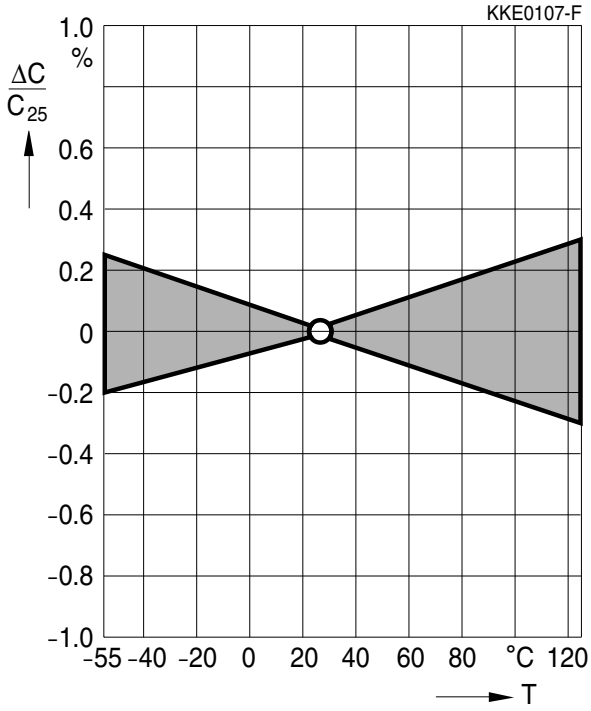
Ordering codes and packing for X7R, 50 and 100 VDC, nickel barrier terminations

C_R[1]	Ordering code	Chip thickness mm	Cardboard tape, ∅ 180-mm reel ** ≙ 60 pcs/reel	Cardboard tape, ∅ 330-mm reel ** ≙ 70 pcs/reel
Case size 1206, 50 VDC				
1.0 nF	B37872A5102K0**	0.8 ±0.1	4000	16000
1.5 nF	B37872A5152K0**	0.8 ±0.1	4000	16000
2.2 nF	B37872A5222K0**	0.8 ±0.1	4000	16000
3.3 nF	B37872A5332K0**	0.8 ±0.1	4000	16000
4.7 nF	B37872A5472K0**	0.8 ±0.1	4000	16000
6.8 nF	B37872A5682K0**	0.8 ±0.1	4000	16000
10 nF	B37872A5103K0**	0.8 ±0.1	4000	16000
15 nF	B37872A5153K0**	0.8 ±0.1	4000	16000
22 nF	B37872A5223K0**	0.8 ±0.1	4000	16000
33 nF	B37872A5333K0**	0.8 ±0.1	4000	16000
47 nF	B37872A5473K0**	0.8 ±0.1	4000	16000
68 nF	B37872A5683K0**	0.8 ±0.1	4000	16000
100 nF	B37872A5104K0**	0.8 ±0.1	4000	16000
220 nF	B37872A5224K0**	1.2 ±0.1	3000[2]	12000[3]
330 nF	B37872A5334K0**	1.2 ±0.1	3000[2]	12000[3]
470 nF	B37872A5474K0**	1.2 ±0.1	3000[2]	12000[3]
Case size 1206, 100 VDC				
1.0 nF	B37872A1102K0**	0.8 ±0.1	4000	16000
1.5 nF	B37872A1152K0**	0.8 ±0.1	4000	16000
2.2 nF	B37872A1222K0**	0.8 ±0.1	4000	16000
3.3 nF	B37872A1332K0**	0.8 ±0.1	4000	16000
4.7 nF	B37872A1472K0**	0.8 ±0.1	4000	16000
6.8 nF	B37872A1682K0**	0.8 ±0.1	4000	16000
10 nF	B37872A1103K0**	0.8 ±0.1	4000	16000
15 nF	B37872A1153K0**	0.8 ±0.1	4000	16000
22 nF	B37872A1223K0**	0.8 ±0.1	4000	16000
33 nF	B37872A1333K0**	0.8 ±0.1	4000	16000
47 nF	B37872A1473K0**	0.8 ±0.1	4000	16000
68 nF	B37872A1683K0**	1.2 ±0.1	3000[2]	12000[3]
100 nF	B37872A1104K0**	1.2 ±0.1	3000[2]	12000[3]

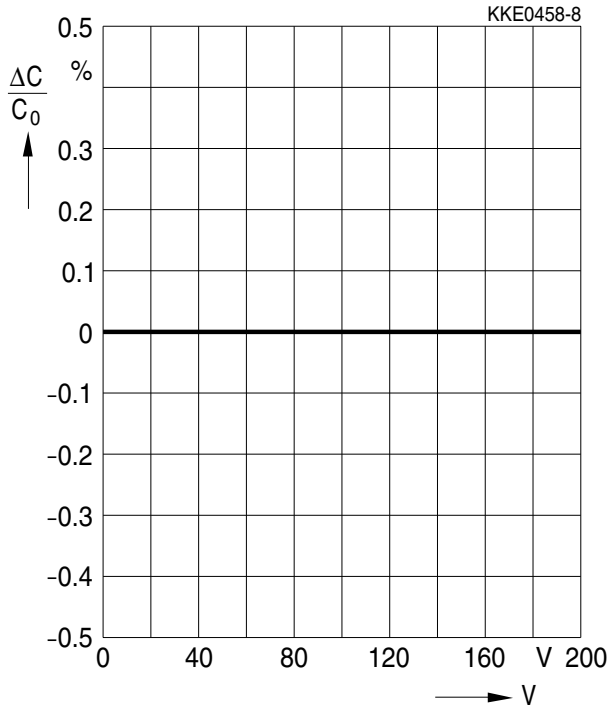
1) Other capacitance values on request.
2) Blister tape, 180-mm reel, ordering code ** ≙ 62
3) Blister tape, 330-mm reel, ordering code ** ≙ 72

Typical characteristics for C0G[1)]

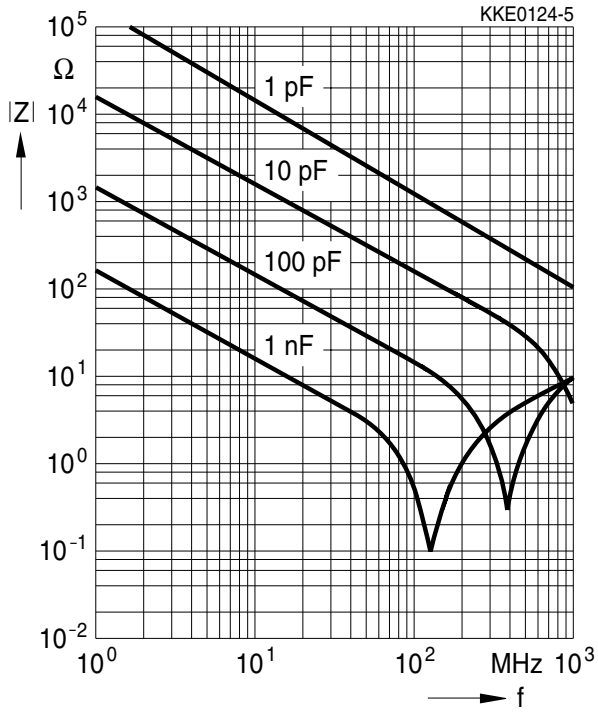
Capacitance change $\Delta C/C_{25}$ versus temperature T (tolerance range ▭)



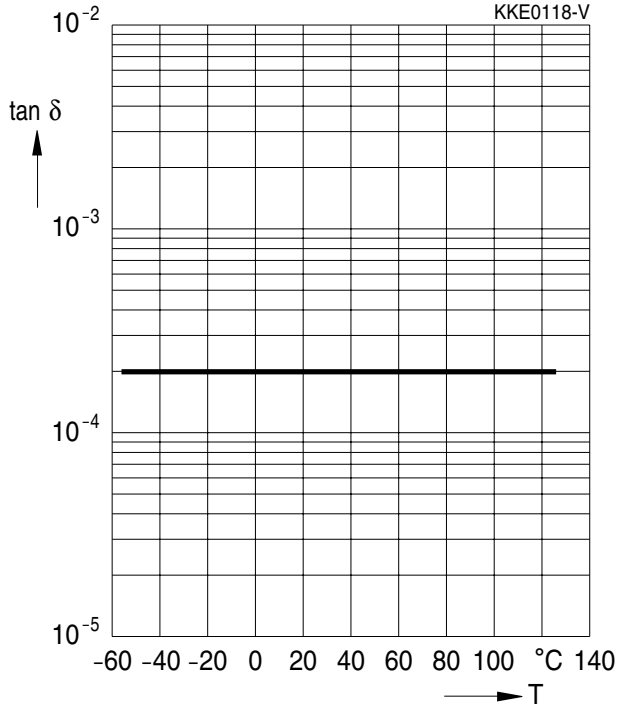
Capacitance change $\Delta C/C_0$ versus superimposed DC voltage V



Impedance |Z| versus frequency f



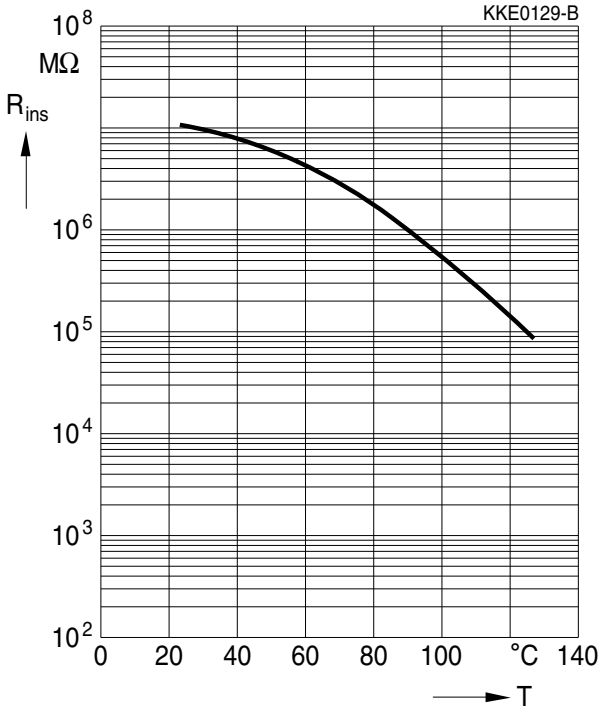
Dissipation factor tan δ versus temperature T



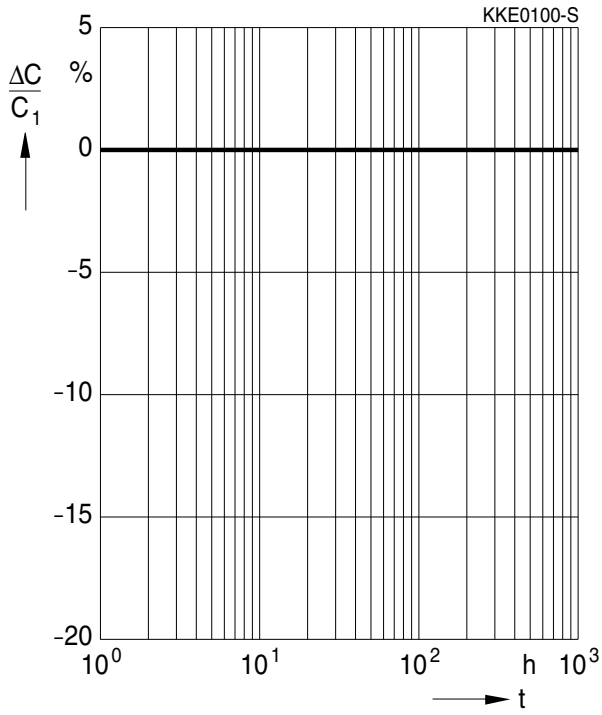
1) For more detailed information on frequency behavior and characteristics see www.epcos.com/mlcc_impedance.

Typical characteristics for C0G[1)]

Insulation resistance R_{ins} versus temperature T



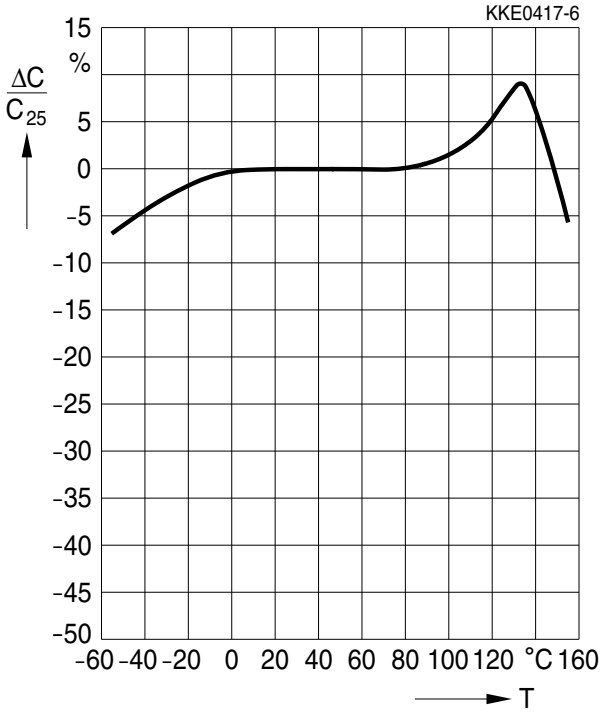
Capacitance change $\Delta C/C_1$ versus time t



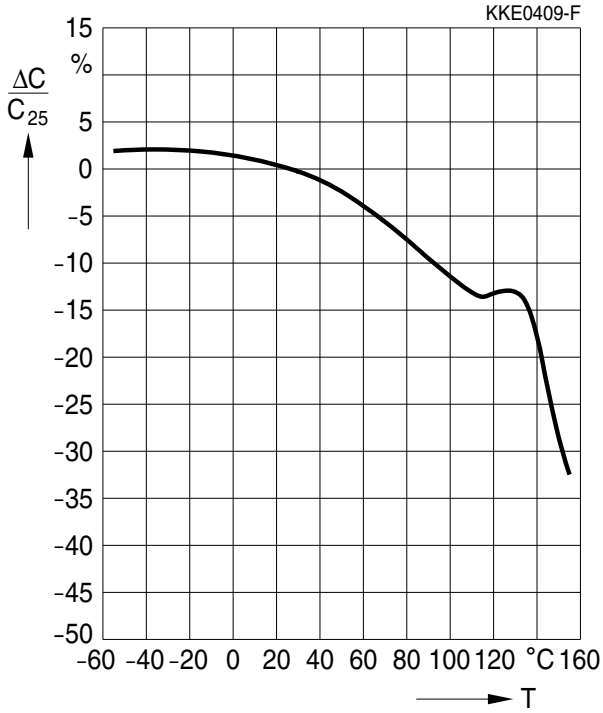
1) For more detailed information on frequency behavior and characteristics see www.epcos.com/mlcc_impedance.

Typical characteristics for X7R[1)]

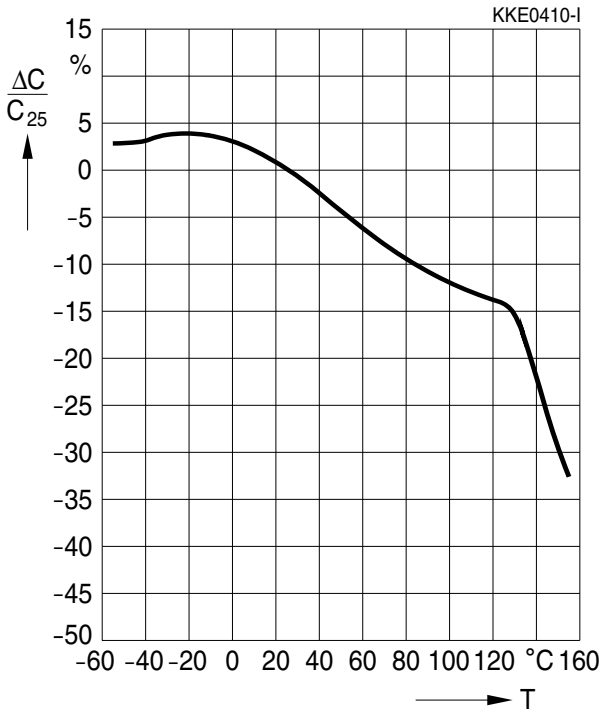
Capacitance change $\Delta C/C_{25}$ versus temperature T for NME



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



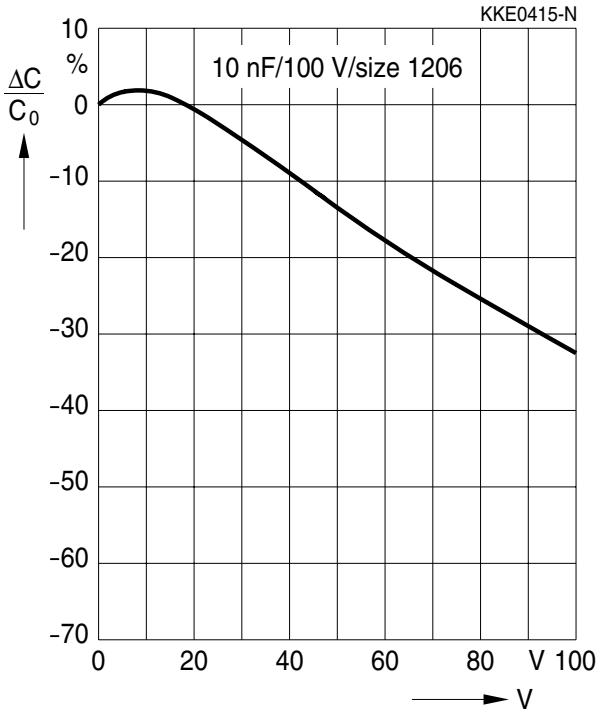
Capacitance change $\Delta C/C_{25}$ versus temperature T for HighCV



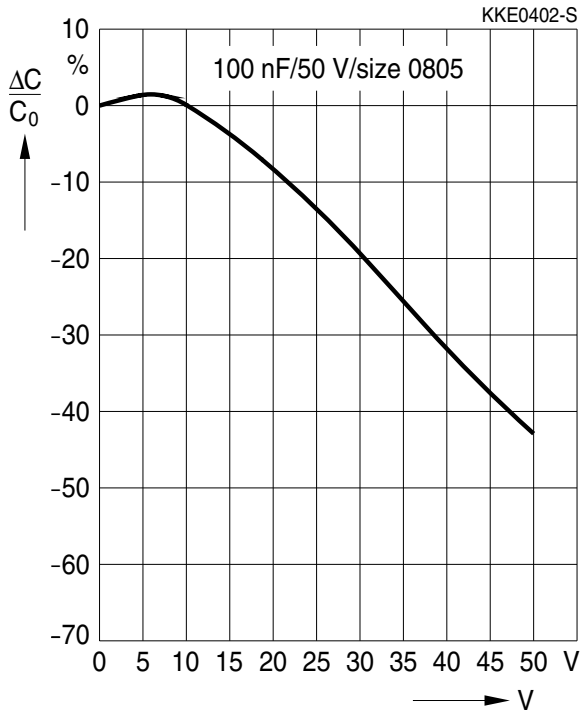
1) For more detailed information on frequency behavior and characteristics see www.epcos.com/mlcc_impedance.

Typical characteristics for X7R[1)]

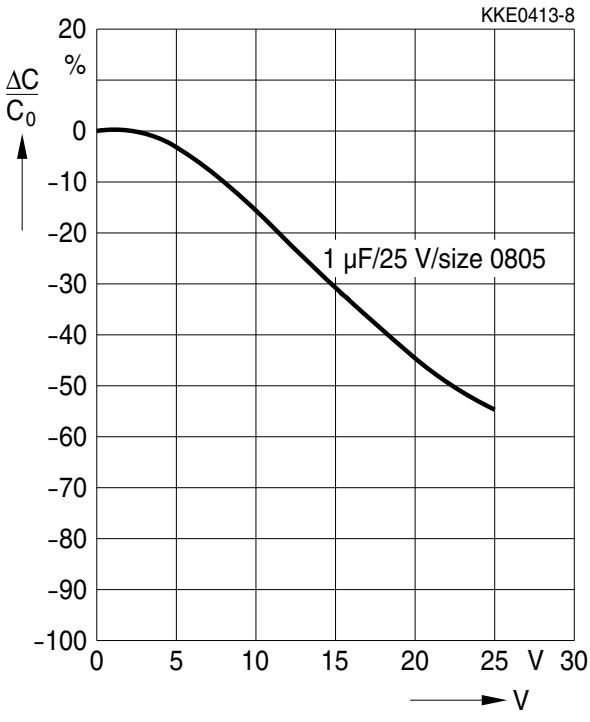
Capacitance change $\Delta C/C_0$ versus superimposed DC voltage V for NME



Capacitance change $\Delta C/C_0$ versus superimposed DC voltage V for BME



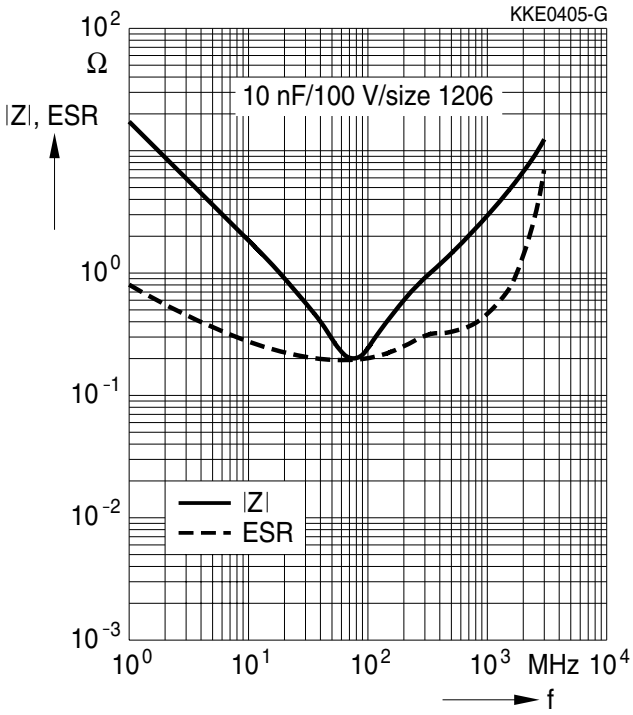
Capacitance change $\Delta C/C_0$ versus superimposed DC voltage V for HighCV



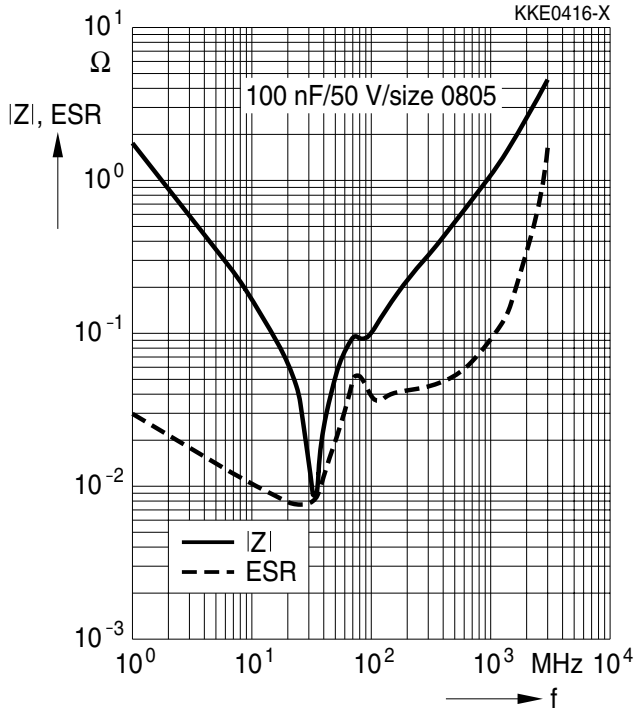
1) For more detailed information on frequency behavior and characteristics see www.epcos.com/mlcc_impedance.

Typical characteristics for X7R[1)]

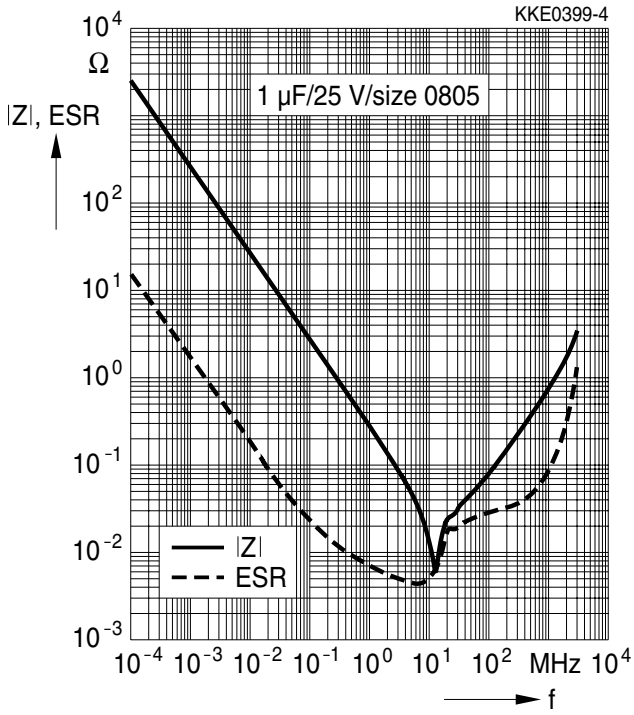
Impedance |Z| versus frequency f for NME



Impedance |Z| versus frequency f for BME



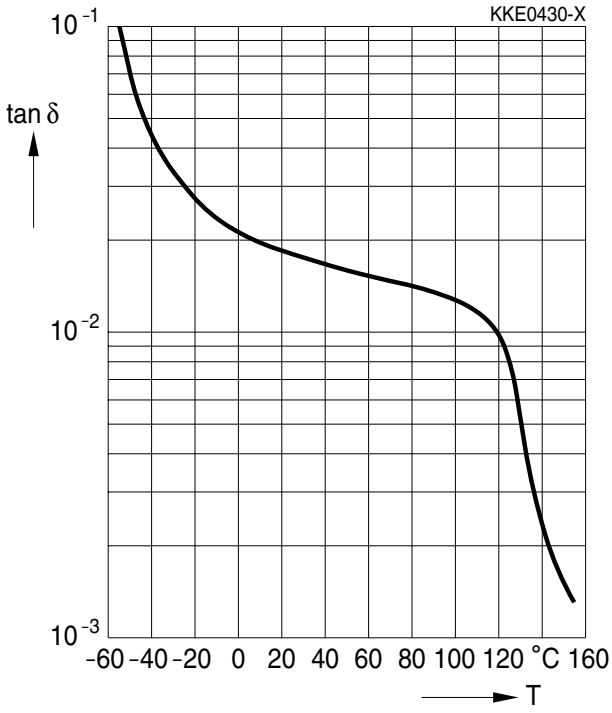
Impedance |Z| versus frequency f for HighCV



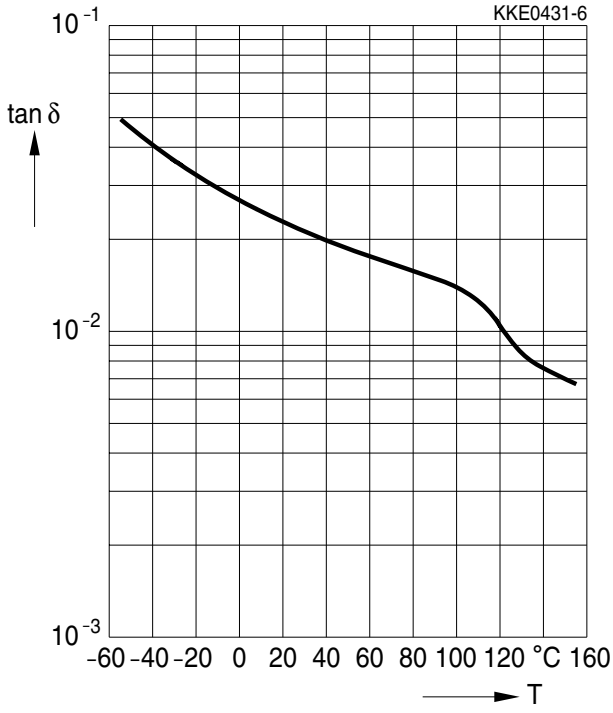
1) For more detailed information on frequency behavior and characteristics see www.epcos.com/mlcc_impedance.

Typical characteristics for X7R[1)]

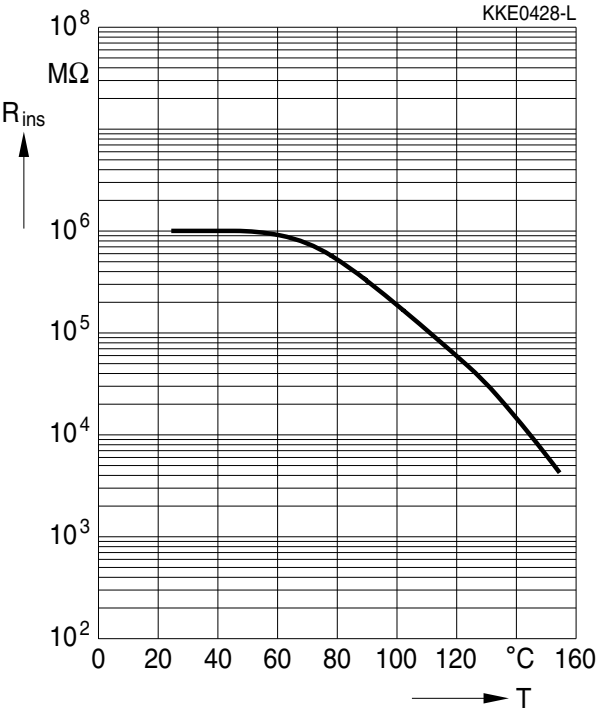
Dissipation factor tan δ versus temperature T for NME/BME



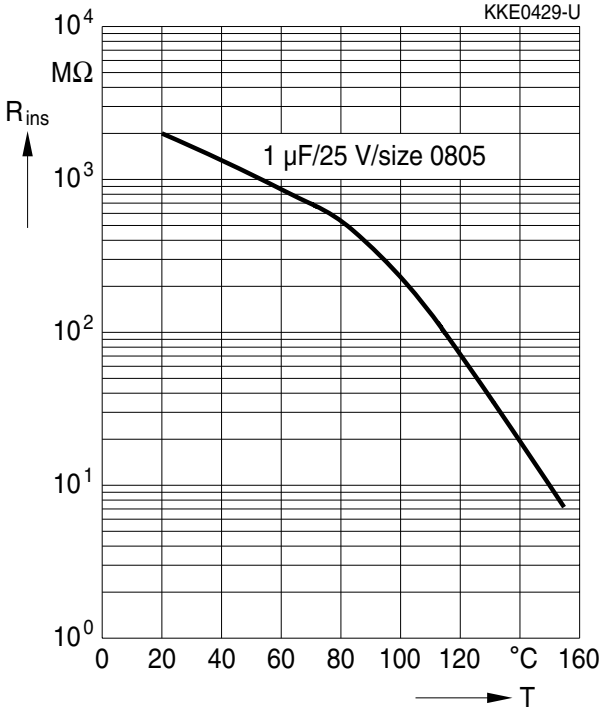
Dissipation factor tan δ versus temperature T for HighCV



Insulation resistance R_{ins} versus temperature T for NME/BME



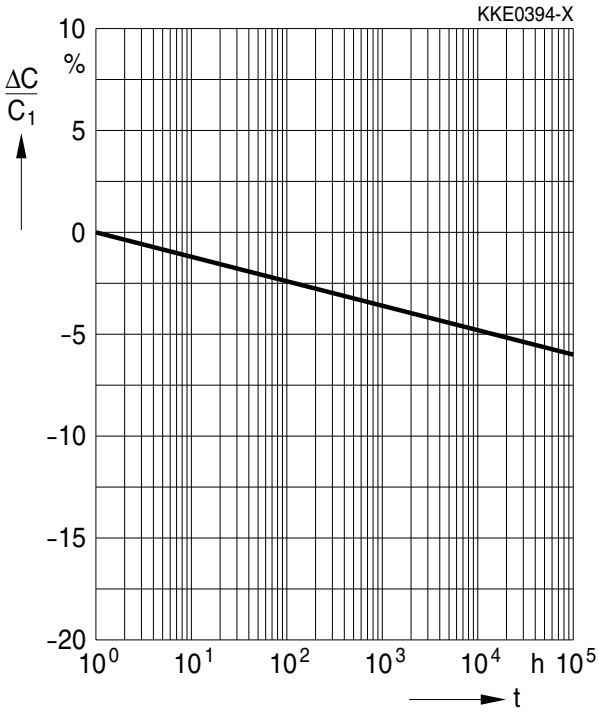
Insulation resistance R_{ins} versus temperature T for HighCV



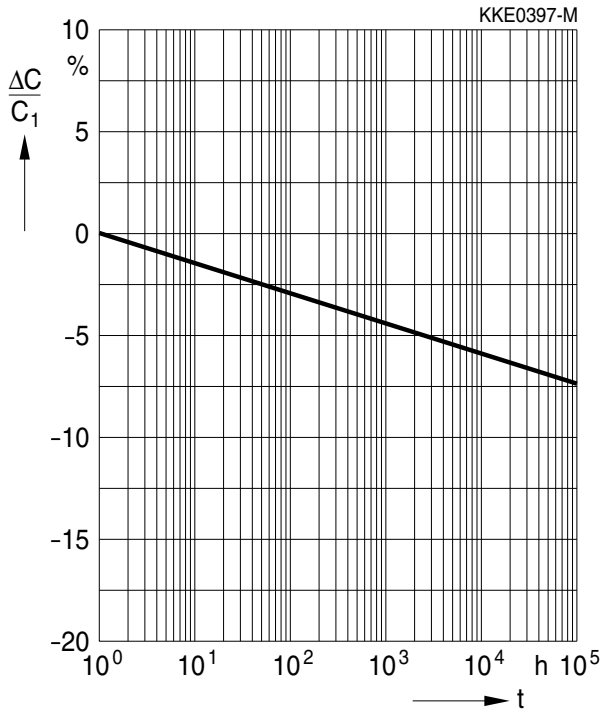
1) For more detailed information on frequency behavior and characteristics see www.epcos.com/mlcc_impedance.

Typical characteristics for X7R[1)]

Capacitance change $\Delta C/C_1$ versus time t for NME/BME



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



1) For more detailed information on frequency behavior and characteristics see www.epcos.com/mlcc_impedance.

Notes on the selection of ceramic capacitors

In the selection of ceramic capacitors, the following criteria must be considered:

1. Depending on the application, ceramic capacitors used to meet high quality requirements should at least satisfy the specifications to AEC-Q200. They must meet quality requirements going beyond this level in terms of ruggedness (e.g. mechanical, thermal or electrical) in the case of critical circuit configurations and applications (e.g. in safety-relevant applications such as ABS and airbag equipment or durable industrial goods).
2. At the connection to the battery or power supply (e.g. clamp 15 or 30 in the automobile) and at positions with stranding potential, to reduce the probability of short circuits following a fracture, two ceramic capacitors must be connected in series and/or a ceramic capacitor with integrated series circuit should be used. The MLSC from EPCOS contains such a series circuit in a single component.
3. Ceramic capacitors with the temperature characteristics Z5U and Y5V do not satisfy the requirements to AEC-Q200 and are mechanically and electrically less rugged than C0G or X7R/X8R ceramic capacitors. In applications that must satisfy high quality requirements, therefore, these capacitors should not be used as discrete components (see the chapter “Effects on mechanical, thermal and electrical stress”, point 1.4).
4. For ESD protection, preference should be given to the use of multilayer varistors (MLV) (see the chapter “Effects on mechanical, thermal and electrical stress”, point 1.4).
5. An application-specific derating or continuous operating voltage must be considered in order to cushion (unexpected) additional stresses (see the chapter “Reliability”).

The following should be considered in circuit board design

1. If technically feasible in the application, preference should be given to components having an optimal geometrical design.
2. At least FR4 circuit board material should be used.
3. Geometrically optimal circuit boards should be used, ideally those that cannot be deformed.
4. Ceramic capacitors must always be placed a sufficient minimum distance from the edge of the circuit board. High bending forces may be exerted there when the panels are separated and during further processing of the board (such as when incorporating it into a housing).
5. Ceramic capacitors should always be placed parallel to the possible bending axis of the circuit board.
6. No screw connections should be used to fix the board or to connect several boards. Components should not be placed near screw holes. If screw connections are unavoidable, they must be cushioned (for instance by rubber pads).

The following should be considered in the placement process

1. Ensure correct positioning of the ceramic capacitor on the solder pad.
2. Caution when using casting, injection-molded and molding compounds and cleaning agents, as these may damage the capacitor.
3. Support the circuit board and reduce the placement forces.
4. A board should not be straightened (manually) if it has been distorted by soldering.
5. Separate panels with a peripheral saw, or better with a milling head (no dicing or breaking).
6. Caution in the subsequent placement of heavy or leaded components (e.g. transformers or snap-in components): danger of bending and fracture.
7. When testing, transporting, packing or incorporating the board, avoid any deformation of the board not to damage the components.
8. Avoid the use of excessive force when plugging a connector into a device soldered onto the board.
9. Ceramic capacitors must be soldered only by the mode (reflow or wave soldering) permissible for them (see the chapter “Soldering directions”).
10. When soldering the most gentle solder profile feasible should be selected (heating time, peak temperature, cooling time) in order to avoid thermal stresses and damage.
11. Ensure the correct solder meniscus height and solder quantity.
12. Ensure correct dosing of the cement quantity.
13. Ceramic capacitors with an AgPd external termination are not suited for the lead-free solder process: they were developed only for conductive adhesion technology.

This listing does not claim to be complete, but merely reflects the experience of EPCOS AG.

Important notes

The following applies to all products named in this publication:

1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application.** As a rule, EPCOS is either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether an EPCOS product with the properties described in the product specification is suitable for use in a particular customer application.
2. We also point out that **in individual cases, a malfunction of passive electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified.** In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of a passive electronic component could endanger human life or health (e.g. in accident prevention or life-saving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of a passive electronic component.
3. **The warnings, cautions and product-specific notes must be observed**.
4. In order to satisfy certain technical requirements, **some of the products described in this publication may contain substances subject to restrictions in certain jurisdictions (e.g. because they are classed as "hazardous")**. Useful information on this will be found in our Material Data Sheets on the Internet (www.epcos.com/material). Should you have any more detailed questions, please contact our sales offices.
5. We constantly strive to improve our products. Consequently, **the products described in this publication may change from time to time**. The same is true of the corresponding product specifications. Please check therefore to what extent product descriptions and specifications contained in this publication are still applicable before or when you place an order.

   We also **reserve the right to discontinue production and delivery of products**. Consequently, we cannot guarantee that all products named in this publication will always be available.
6. Unless otherwise agreed in individual contracts, **all orders are subject to the current version of the "General Terms of Delivery for Products and Services in the Electrical Industry" published by the German Electrical and Electronics Industry Association (ZVEI)**.
7. The trade names EPCOS, EPCOS-JONES, Baoke, CeraDiode, CSSP, MLSC, PhaseCap, PhaseMod, SIFERRIT, SIFI, SIKOREL, SilverCap, SIMID, SIOV, SIP5D, SIP5K, UltraCap, WindCap are **trademarks registered or pending** in Europe and in other countries. Further information will be found on the Internet at www.epcos.com/trademarks.