

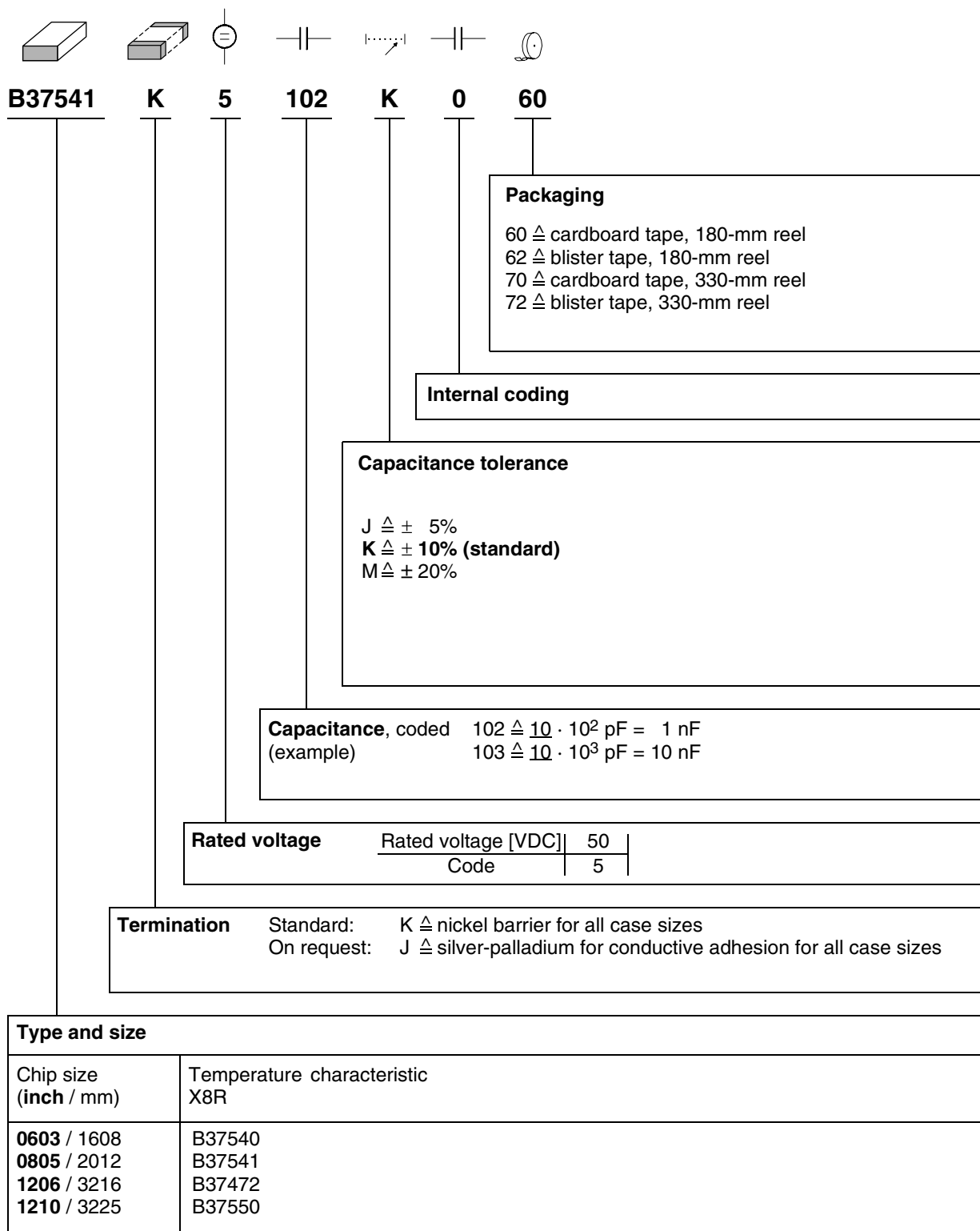


# Multilayer ceramic capacitors

Chip capacitors, X8R

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.

**Ordering code system**


**Features**

- Max. relative capacitance change up to 150 °C is  $\pm 15\%$
- Non-linear capacitance change
- High insulation resistance
- High pulse strength
- To AEC-Q200


**Applications**

- Automotive
- Blocking
- Coupling
- Decoupling
- Interference suppression

**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  $\geq 1.2 \pm 0.1$  mm and case size 1210) 180-mm and 330-mm reel available

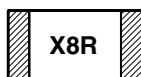
**Electrical data**

Temperature characteristic		X8R	
Max. relative capacitance change within $-55\text{ °C}$ to $+150\text{ °C}$	$\Delta C/C$	$\pm 15$	%
Climatic category (IEC 60068-1)		55/150/56	
Standard		EIA	
Dielectric		Class 2	
Rated voltage <sup>1)</sup>	$V_R$	50	VDC
Test voltage	$V_{\text{test}}$	$2.5 \cdot V_R/5\text{ s}$	VDC
Capacitance range / E series	$C_R$	100 pF ... 150 nF (E6)	
Dissipation factor (limit value)	$\tan \delta$	$< 25 \cdot 10^{-3}$	
Insulation resistance <sup>2)</sup> at $+25\text{ °C}$	$R_{\text{ins}}$	$> 10^5$	M $\Omega$
Insulation resistance <sup>2)</sup> at $+125\text{ °C}$	$R_{\text{ins}}$	$> 10^4$	M $\Omega$
Time constant <sup>2)</sup> at $+25\text{ °C}$	$\tau$	$> 1000$	s
Time constant <sup>2)</sup> at $+125\text{ °C}$	$\tau$	$> 100$	s
Operating temperature range	$T_{\text{op}}$	$-55 \dots +150$	$^{\circ}\text{C}$
Ageing <sup>3)</sup>		yes	

1) Note: No operation on AC line.

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

3) Refer to chapter "General technical information", "Ageing".



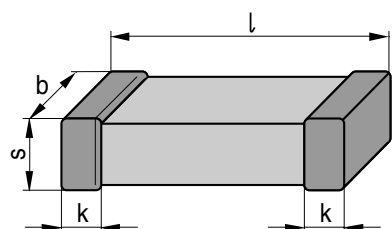
## Multilayer ceramic capacitors

### X8R

### Capacitance tolerances

Code letter	J	K (standard)	M
Tolerance	±5%	±10%	±20%

### Dimensional drawing

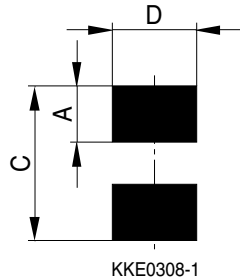


KKE0329-N

### Dimensions (mm)

Case size	(inch)	0603	0805	1206	1210
	(mm)	1608	2012	3216	3225
l		1.6 ±0.15	2.00 ±0.20	3.2 ±0.20	3.2 ±0.30
b		0.8 ±0.10	1.25 ±0.15	1.6 ±0.15	2.5 ±0.30
s		0.8 ±0.10	1.30 max.	1.30 max.	1.30 max.
k		0.1 –0.40	0.13 –0.75	0.25 –0.75	0.25 –0.75

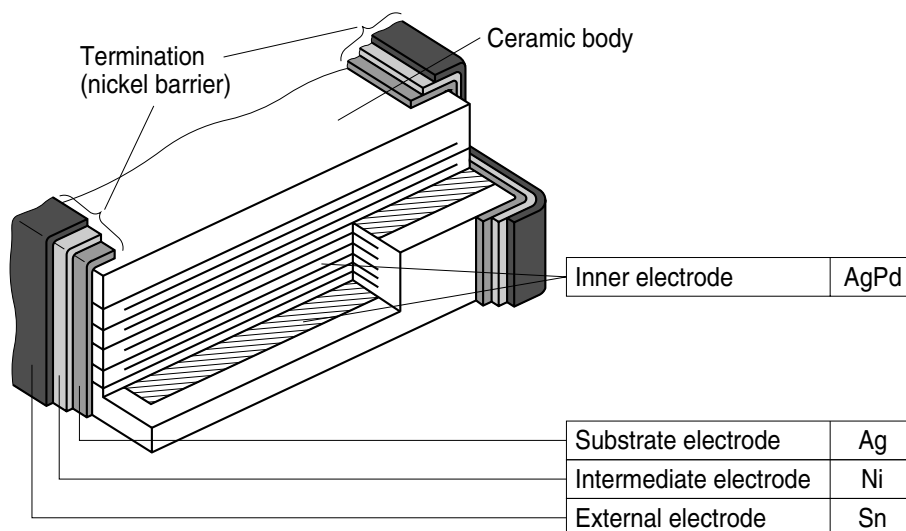
Tolerances to CECC 32101-801

**Recommended solder pad**

**Recommended dimensions (mm) for reflow soldering**

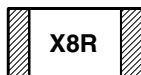
Case size (inch/mm)	Type	A	C	D
0603/1608	single chip	0.6 ... 0.7	1.8 ... 2.20	0.6 ... 0.8
0805/2012	single chip	0.6 ... 0.7	2.2 ... 2.60	0.8 ... 1.1
1206/3216	single chip	0.8 ... 0.9	3.8 ... 4.32	1.0 ... 1.4
1210/3225	single chip	1.0 ... 1.2	4.0 ... 4.80	1.8 ... 2.3

**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**


KKE0484-W


**Multilayer ceramic capacitors**
**X8R**
**Product range chip capacitors, X8R**

Size <sup>1)</sup> inch mm	<b>0603</b> 1608		<b>0805</b> 2012		<b>1206</b> 3216		<b>1210</b> 3225	
Type	B37540		B37541		B37472		B37550	
$V_R$ (VDC)	50		50		50		50	
$C_R$								
100 pF								
150 pF								
220 pF								
330 pF								
470 pF								
680 pF								
1.0 nF								
1.5 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								
150 nF								

1) l × b (inch) / l × b (mm)

**Ordering codes and packing for X8R, 50 VDC, nickel barrier terminations**

$C_R$ <sup>1)</sup>	Ordering code <sup>2)</sup>	Chip thickness mm	Cardboard tape, Ø 180-mm reel	Cardboard tape, Ø 330-mm reel
			** $\triangleq$ 60	** $\triangleq$ 70
			pcs/reel	pcs/reel

**Case size 0603, 50 VDC**

100 pF	B37540K5101K0**	0.8 ± 0.1	4000	16000
150 pF	B37540K5151K0**	0.8 ± 0.1	4000	16000
220 pF	B37540K5221K0**	0.8 ± 0.1	4000	16000
330 pF	B37540K5331K0**	0.8 ± 0.1	4000	16000
470 pF	B37540K5471K0**	0.8 ± 0.1	4000	16000
680 pF	B37540K5681K0**	0.8 ± 0.1	4000	16000
1.0 nF	B37540K5102K0**	0.8 ± 0.1	4000	16000
1.5 nF	B37540K5152K0**	0.8 ± 0.1	4000	16000
2.2 nF	B37540K5222K0**	0.8 ± 0.1	4000	16000
3.3 nF	B37540K5332K0**	0.8 ± 0.1	4000	16000
4.7 nF	B37540K5472K0**	0.8 ± 0.1	4000	16000

**Case size 0805, 50 VDC**

470 pF	B37541K5471K0**	0.6 ± 0.1	5000	20000
680 pF	B37541K5681K0**	0.6 ± 0.1	5000	20000
1.0 nF	B37541K5102K0**	0.6 ± 0.1	5000	20000
1.5 nF	B37541K5152K0**	0.6 ± 0.1	5000	20000
2.2 nF	B37541K5222K0**	0.6 ± 0.1	5000	20000
3.3 nF	B37541K5332K0**	0.6 ± 0.1	5000	20000
4.7 nF	B37541K5472K0**	0.6 ± 0.1	5000	20000
6.8 nF	B37541K5682K0**	0.6 ± 0.1	5000	20000
10 nF	B37541K5103K0**	0.6 ± 0.1	5000	20000
15 nF	B37541K5153K0**	0.6 ± 0.1	5000	20000
22 nF	B37541K5223K0**	0.6 ± 0.1	5000	20000

1) Other capacitance values on request.

2) The table contains the ordering codes for the standard capacitance tolerance.  
For other available capacitance tolerances see page 4.


**Multilayer ceramic capacitors**
**X8R; 1206 and 1210**
**Ordering codes and packing for X8R, 50 VDC, nickel barrier terminations**

$C_R^{1)}$	Ordering code <sup>2)</sup>	Chip thickness mm	Cardboard tape, Ø 180-mm reel	Cardboard tape, Ø 330-mm reel
			** $\triangleq$ 60	** $\triangleq$ 70
			pcs/reel	pcs/reel

**Case size 1206, 50 VDC**

1.0 nF	B37472K5102K0**	$0.8 \pm 0.1$	4000	16000
1.5 nF	B37472K5152K0**	$0.8 \pm 0.1$	4000	16000
2.2 nF	B37472K5222K0**	$0.8 \pm 0.1$	4000	16000
3.3 nF	B37472K5332K0**	$0.8 \pm 0.1$	4000	16000
4.7 nF	B37472K5472K0**	$0.8 \pm 0.1$	4000	16000
6.8 nF	B37472K5682K0**	$0.8 \pm 0.1$	4000	16000
10 nF	B37472K5103K0**	$0.8 \pm 0.1$	4000	16000
15 nF	B37472K5153K0**	$0.8 \pm 0.1$	4000	16000
22 nF	B37472K5223K0**	$0.8 \pm 0.1$	4000	16000
33 nF	B37472K5333K0**	$0.8 \pm 0.1$	4000	16000
47 nF	B37472K5473K0**	$0.8 \pm 0.1$	4000	16000
68 nF	B37472K5683K0**	$1.2 \pm 0.1$	3000 <sup>3)</sup>	12000 <sup>4)</sup>
100 nF	B37472K5104K0**	$1.2 \pm 0.1$	3000 <sup>3)</sup>	12000 <sup>4)</sup>
			Blister tape, Ø 180-mm reel	Blister tape, Ø 330-mm reel
			** $\triangleq$ 62	** $\triangleq$ 72
			pcs/reel	pcs/reel

**Case size 1210, 50 VDC**

10 nF	B37550K5103K0**	$0.8 \pm 0.1$	4000	16000
15 nF	B37550K5153K0**	$0.8 \pm 0.1$	4000	16000
22 nF	B37550K5223K0**	$0.8 \pm 0.1$	4000	16000
33 nF	B37550K5333K0**	$0.8 \pm 0.1$	4000	16000
47 nF	B37550K5473K0**	$0.8 \pm 0.1$	4000	16000
68 nF	B37550K5683K0**	$0.8 \pm 0.1$	4000	16000
100 nF	B37550K5104K0**	$0.8 \pm 0.1$	4000	16000
150 nF	B37550K5154K0**	$1.2 \pm 0.1$	3000	12000

1) Other capacitance values on request.

2) The table contains the ordering codes for the standard capacitance tolerance.

For other available capacitance tolerances see page 4.

3) Blister tape, 180-mm reel, ordering code \*\*  $\triangleq$  62

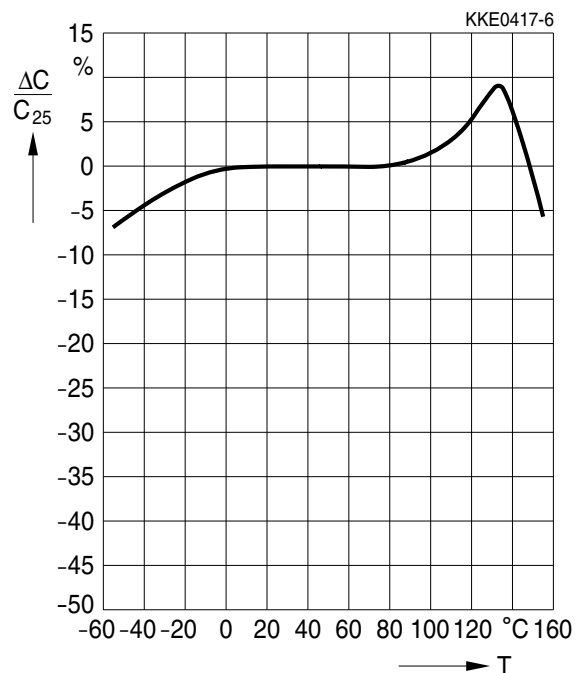
4) Blister tape, 330-mm reel, ordering code \*\*  $\triangleq$  72



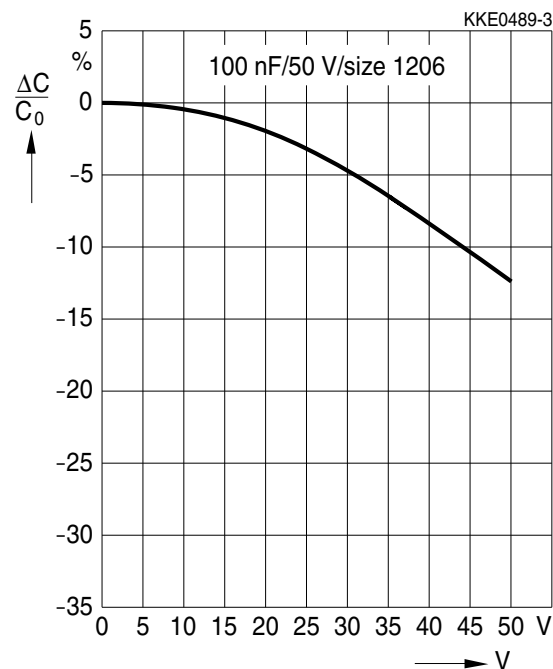


**Typical characteristics<sup>1)</sup>**

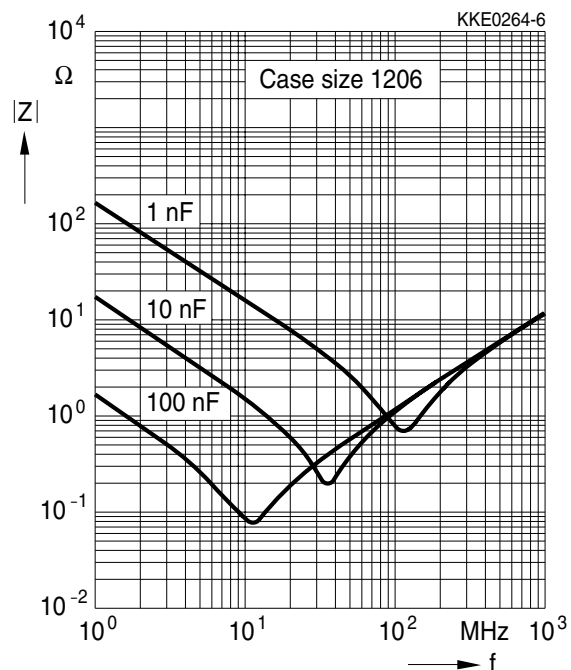
Capacitance change  $\Delta C/C_{25}$  versus temperature T



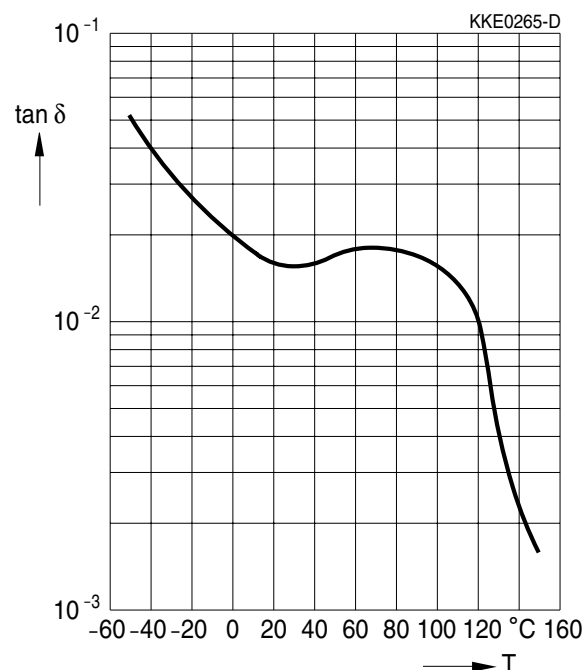
Capacitance change  $\Delta C/C_0$  versus superimposed DC voltage V



Impedance |Z| versus frequency f



Dissipation factor  $\tan \delta$  versus temperature T

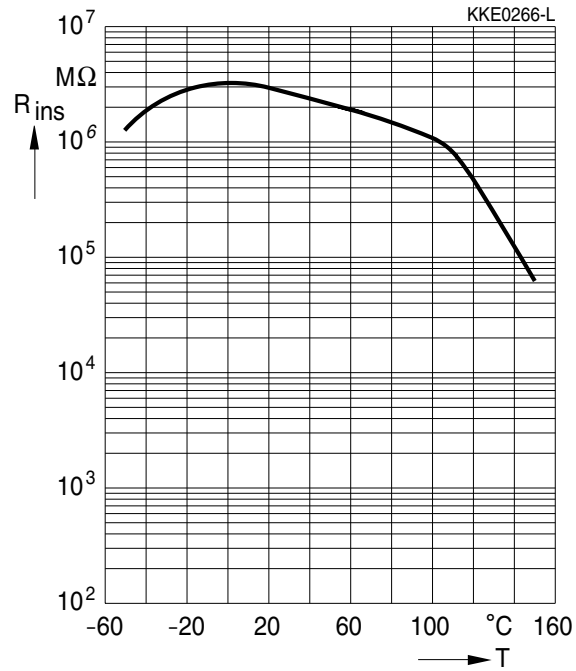


1) For more detailed information on frequency behavior and characteristics see [www.epcos.com/mlcc\\_impedance](http://www.epcos.com/mlcc_impedance).

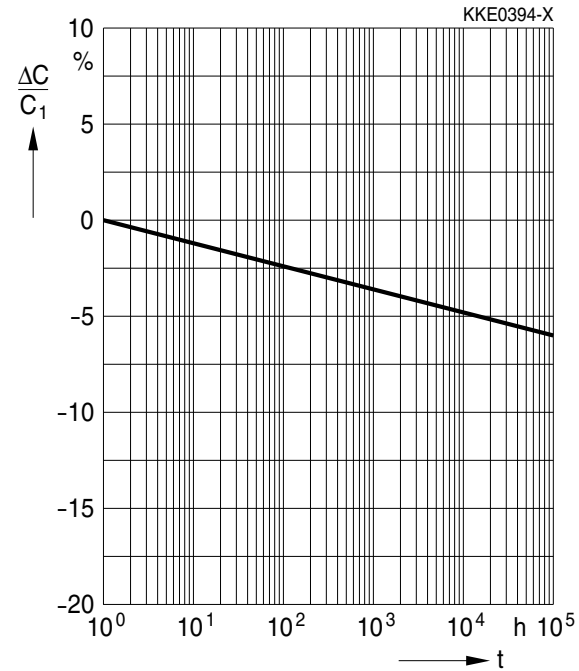


Typical characteristics<sup>1)</sup>

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](http://www.epcos.com/mlcc_impedance).

## Multilayer ceramic capacitors

### Cautions and warnings

#### 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.

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](http://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](http://www.epcos.com/trademarks).