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# Multilayer Ceramic Capacitors

## Series/Type: B37931

The following products presented in this data sheet are being withdrawn.

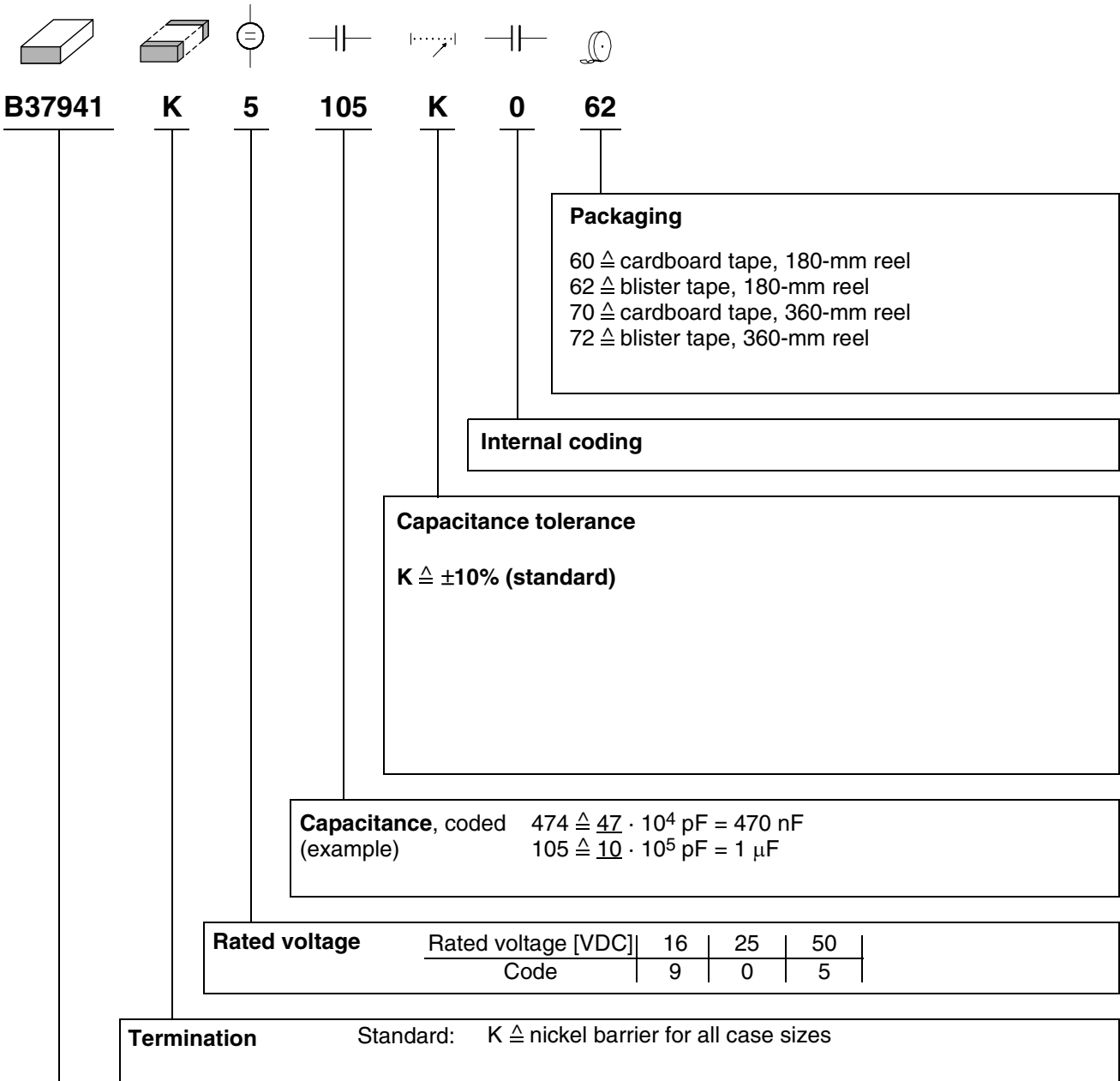
| Ordering Code   | Substitute Product | Date of Withdrawal | Deadline Last Orders | Last Shipments |
|-----------------|--------------------|--------------------|----------------------|----------------|
| B37931K9224K060 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37931K9224K070 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37931K0224K060 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |



| Ordering Code   | Substitute Product | Date of Withdrawal | Deadline Last Orders | Last Shipments |
|-----------------|--------------------|--------------------|----------------------|----------------|
| B37931K0224K070 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37931K5104K060 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37931K5104K070 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37941K9224K060 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37941K9224K070 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37941K9334K060 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37941K9334K070 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37941K9474K060 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37941K9474K070 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37941K9105K062 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37941K9105K072 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37941K0224K060 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37941K0224K070 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37941K0334K060 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37941K0334K070 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37941K0474K060 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37941K0474K070 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37941K0105K062 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37941K0105K072 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
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| B37941K5224K070 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37941K5334K062 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37941K5334K072 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37941K5474K062 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37941K5474K072 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37941K5105K062 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37941K5105K072 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37872K9105K062 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37872K9105K072 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37872K9225K062 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37872K9225K072 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
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| B37872K0105K072 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37872K0225K062 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37872K0225K072 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37872K5105K062 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |
| B37872K5105K072 |                    | 2008-08-01         | 2009-07-31           | 2009-10-31     |

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Ordering code system



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


**Features**

- Characteristic of class 2 dielectric
- Highest possible capacitance to rated voltage ratio
- High capacitance values up to 2.2  $\mu\text{F}$
- Voltage rating from 16 V to 50 V
- To AEC-Q200


**Applications**

- Coupling and bypass filters

**Termination**

- For soldering: Nickel barrier terminations (Ni)

**Options**

- Other capacitance values on request

**Delivery mode**

- Cardboard and blister tape (blister tape for chip thickness  $\geq 1.2 \pm 0.1$  mm)

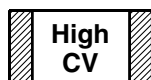
**Electrical data**

|   |                   |   |                    |
|---|-------------------|---|--------------------|
| Temperature characteristic  |                   | X7R   |                    |
| Max. relative capacitance change within $-55\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | $\Delta C/C$      | $\pm 15$  | %                  |
| Climatic category (IEC 60068-1)   |                   | 55/125/56   |                    |
| Standard  |                   | EIA   |                    |
| Dielectric  |                   | Class 2   |                    |
| Rated voltage <sup>1)</sup>   | $V_R$             | 16; 25; 50  | VDC                |
| Test voltage  | $V_{\text{test}}$ | $2.5 \cdot V_R/5$ s   | VDC                |
| Capacitance range   | $C_R$             | 100 nF ... 2.2 $\mu\text{F}$  |                    |
| Dissipation factor (limit value)  | $\tan \delta$     | $< 50 \cdot 10^{-3}$ for $\leq 25$ V<br>$< 25 \cdot 10^{-3}$ for 50 V |                    |
| Insulation resistance <sup>2)</sup> at $+25\text{ }^{\circ}\text{C}$                                    | $R_{\text{ins}}$  | $> 10^4$  | $\text{M}\Omega$   |
| Time constant <sup>2)</sup> at $+25\text{ }^{\circ}\text{C}$  | $\tau$            | $> 500$   | s                  |
| Operating temperature range   | $T_{\text{op}}$   | $-55 \dots +125$  | $^{\circ}\text{C}$ |
| 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".

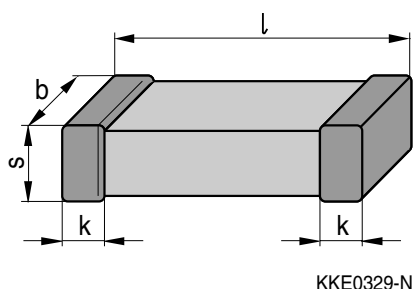


**Multilayer ceramic capacitors**  
**HighCV; X7R**

**Capacitance tolerances**

|             |                 |
|-------------|-----------------|
| Code letter | K<br>(standard) |
| Tolerance   | ±10%            |

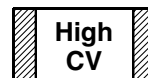
**Dimensional drawing**



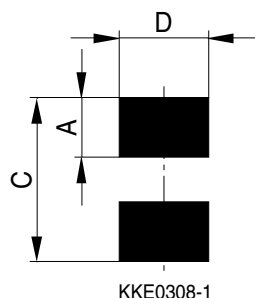
**Dimensions (mm)**

| Case size | (inch) | 0603      | 0805       | 1206       |
|-----------|--------|-----------|------------|------------|
|           | (mm)   | 1608      | 2012       | 3216       |
| l         |        | 1.6 ±0.15 | 2.00 ±0.20 | 3.2 ±0.20  |
| b         |        | 0.8 ±0.10 | 1.25 ±0.15 | 1.6 ±0.15  |
| s         |        | 0.8 ±0.10 | 1.35 max.  | 1.80 max.  |
| k         |        | 0.1 –0.4  | 0.13 –0.75 | 0.25 –0.75 |

Tolerances to CECC 32101-801



**Recommended solder pad**



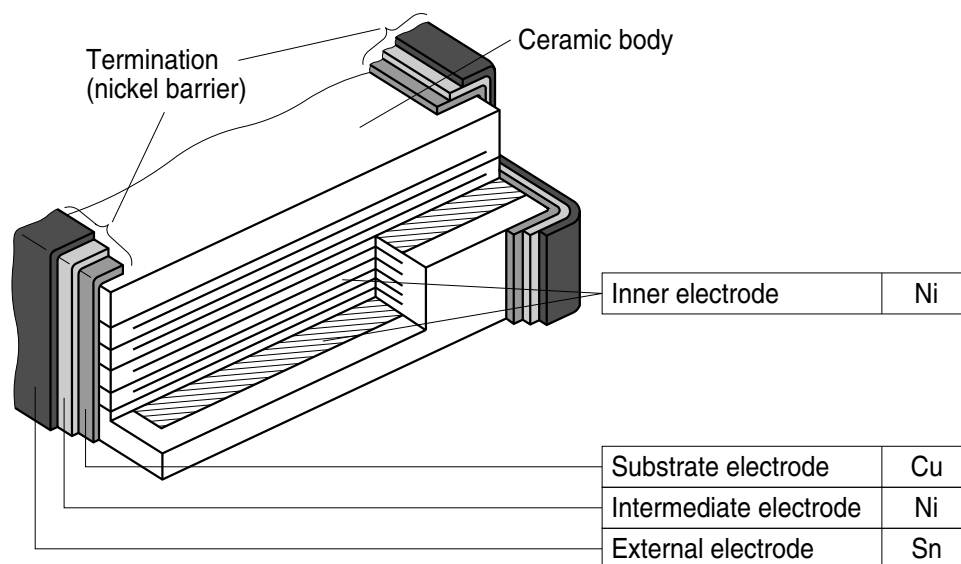
**Recommended dimensions (mm) for reflow soldering**

| 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 |

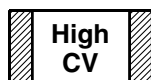
**Recommended dimensions (mm) for wave soldering**

| 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**



KKE0342-F


**Multilayer ceramic capacitors**
**HighCV; X7R**
**Product range for HighCV chip capacitors, X7R**

| Size <sup>1)</sup><br>inch<br>mm | 0603<br>1608 |    |    | 0805<br>2012 |    |    | 1206<br>3216 |    |    |
|----------------------------------|--------------|----|----|--------------|----|----|--------------|----|----|
| Type                             | B37931       |    |    | B37941       |    |    | B37872       |    |    |
| $V_R$ (VDC)                      | 16           | 25 | 50 | 16           | 25 | 50 | 16           | 25 | 50 |
| $C_R$<br>100 nF                  |              |    |    |              |    |    |              |    |    |
| 220 nF                           |              |    |    |              |    |    |              |    |    |
| 330 nF                           |              |    |    |              |    |    |              |    |    |
| 470 nF                           |              |    |    |              |    |    |              |    |    |
| 1.0 $\mu$ F                      |              |    |    |              |    |    |              |    |    |
| 2.2 $\mu$ F                      |              |    |    |              |    |    |              |    |    |

1) l × b (inch) / l × b (mm)



**Multilayer ceramic capacitors**
**HighCV; X7R; 0603 to 1206**

**Ordering codes and packing for HighCV, X7R, 16, 25 and 50 VDC, nickel barrier terminations**

| C <sub>R</sub> <sup>1)</sup>  | Ordering code   | Chip thickness<br>mm | Cardboard tape,<br>Ø 180-mm reel | Cardboard tape,<br>Ø 360-mm reel |
|-------------------------------|-----------------|----------------------|----------------------------------|----------------------------------|
|                               |                 |                      | ** $\triangleq$ 60               | ** $\triangleq$ 70               |
|                               |                 |                      | pcs/reel                         | pcs/reel                         |
| <b>Case size 0603, 16 VDC</b> |                 |                      |                                  |                                  |
| 220 nF                        | B37931K9224K0** | 0.8 ±0.1             | 4000                             | 16000                            |
| <b>Case size 0603, 25 VDC</b> |                 |                      |                                  |                                  |
| 220 nF                        | B37931K0224K0** | 0.8 ±0.1             | 4000                             | 16000                            |
| <b>Case size 0603, 50 VDC</b> |                 |                      |                                  |                                  |
| 100 nF                        | B37931K5104K0** | 0.8 ±0.1             | 4000                             | 16000                            |
| <b>Case size 0805, 16 VDC</b> |                 |                      |                                  |                                  |
| 220 nF                        | B37941K9224K0** | 0.8 ±0.1             | 4000                             | 16000                            |
| 330 nF                        | B37941K9334K0** | 0.8 ±0.1             | 4000                             | 16000                            |
| 470 nF                        | B37941K9474K0** | 0.8 ±0.1             | 4000                             | 16000                            |
| 1.0 µF                        | B37941K9105K0** | 1.2 ±0.1             | 3000 <sup>2)</sup>               | 12000 <sup>3)</sup>              |
| <b>Case size 0805, 25 VDC</b> |                 |                      |                                  |                                  |
| 220 nF                        | B37941K0224K0** | 0.8 ±0.1             | 4000                             | 16000                            |
| 330 nF                        | B37941K0334K0** | 0.8 ±0.1             | 4000                             | 16000                            |
| 470 nF                        | B37941K0474K0** | 0.8 ±0.1             | 4000                             | 16000                            |
| 1.0 µF                        | B37941K0105K0** | 1.2 ±0.1             | 3000 <sup>2)</sup>               | 12000 <sup>3)</sup>              |
| <b>Case size 0805, 50 VDC</b> |                 |                      |                                  |                                  |
| 220 nF                        | B37941K5224K0** | 0.8 ±0.1             | 4000                             | 16000                            |
| 330 nF                        | B37941K5334K0** | 1.2 ±0.1             | 3000 <sup>2)</sup>               | 12000 <sup>3)</sup>              |
| 470 nF                        | B37941K5474K0** | 1.2 ±0.1             | 3000 <sup>2)</sup>               | 12000 <sup>3)</sup>              |
| 1.0 µF                        | B37941K5105K0** | 1.2 ±0.1             | 3000 <sup>2)</sup>               | 12000 <sup>3)</sup>              |
| <b>Case size 1206, 16 VDC</b> |                 |                      |                                  |                                  |
| 1.0 µF                        | B37872K9105K0** | 1.2 ±0.1             | 3000 <sup>2)</sup>               | 12000 <sup>3)</sup>              |
| 2.2 µF                        | B37872K9225K0** | 1.2 ±0.1             | 3000 <sup>2)</sup>               | 12000 <sup>3)</sup>              |
| <b>Case size 1206, 25 VDC</b> |                 |                      |                                  |                                  |
| 1.0 µF                        | B37872K0105K0** | 1.2 ±0.1             | 3000 <sup>2)</sup>               | 12000 <sup>3)</sup>              |
| 2.2 µF                        | B37872K0225K0** | 1.2 ±0.1             | 3000 <sup>2)</sup>               | 12000 <sup>3)</sup>              |
| <b>Case size 1206, 50 VDC</b> |                 |                      |                                  |                                  |
| 1.0 µF                        | B37872K5105K0** | 1.2 ±0.1             | 3000 <sup>2)</sup>               | 12000 <sup>3)</sup>              |

1) Other capacitance values on request.

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

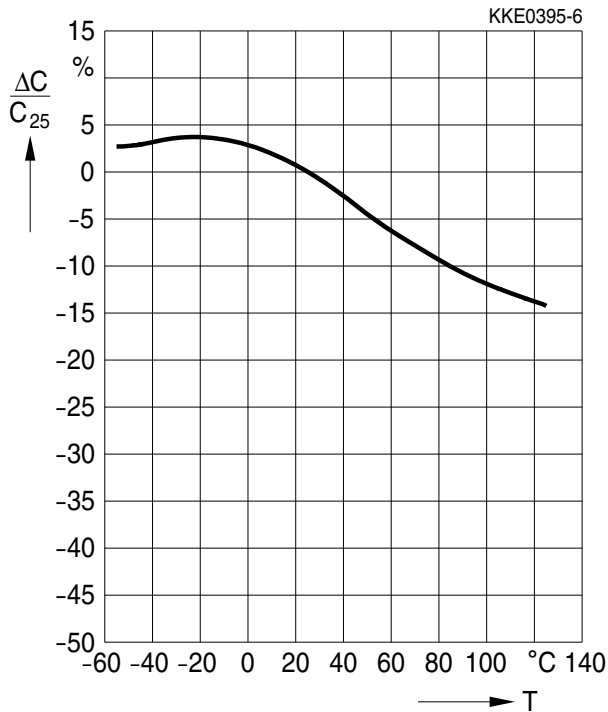
3) Blister tape, 330-mm reel, ordering code \*\*  $\triangleq$  72



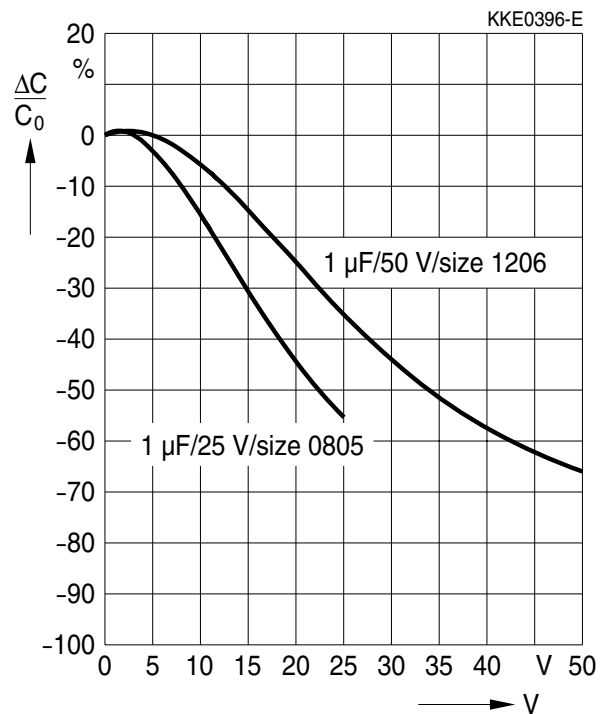
Multilayer ceramic capacitors  
HighCV; X7R

Typical characteristics for HighCV X7R<sup>1)</sup>

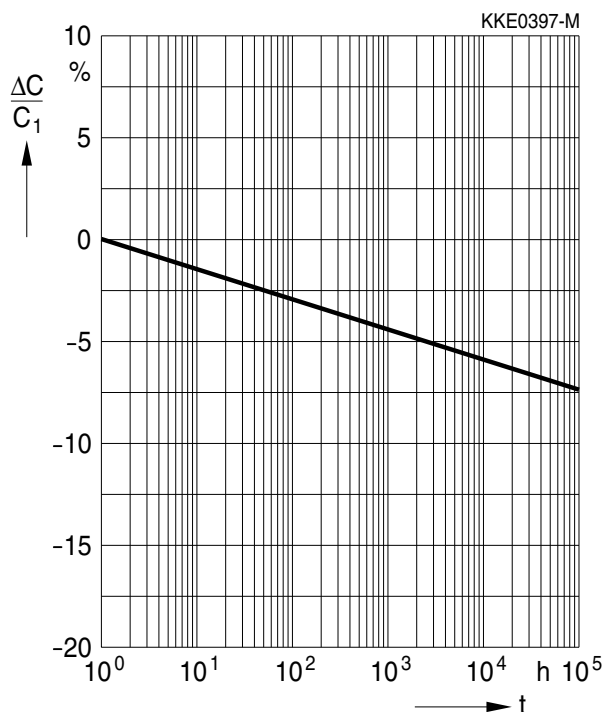
Capacitance change  $\Delta C/C_{25}$  versus temperature T



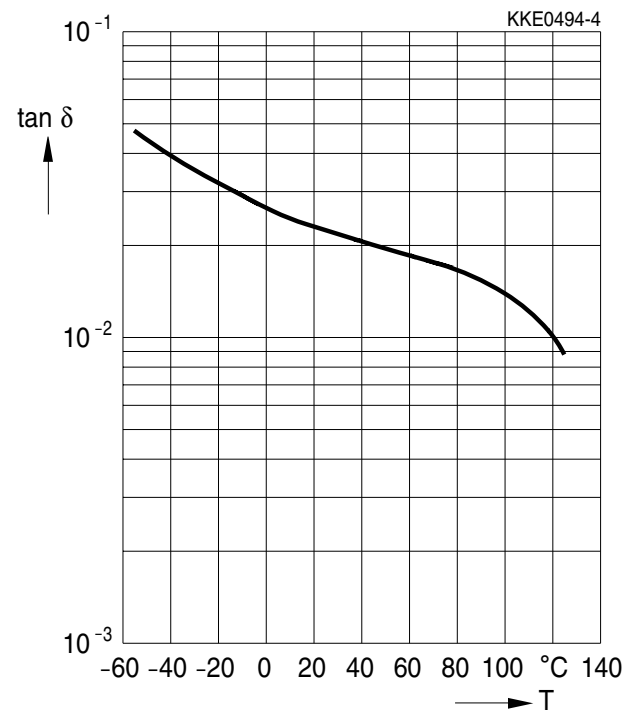
Capacitance change  $\Delta C/C_0$  versus superimposed DC voltage V



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



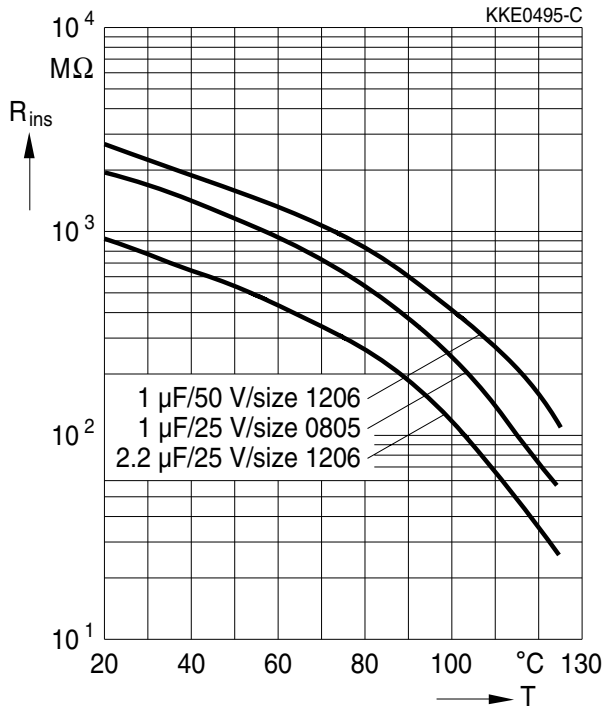
Dissipation factor  $\tan \delta$  versus temperature T



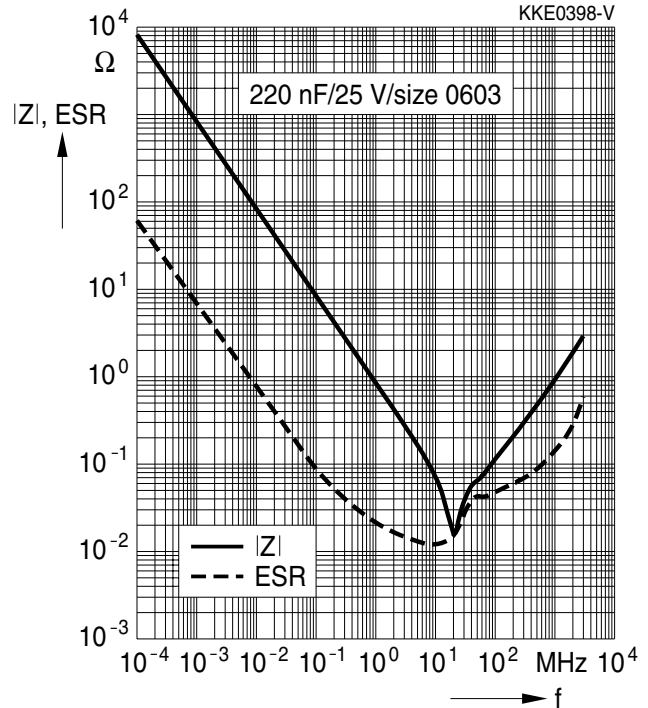
1) For more detailed information on frequency behavior and characteristics see [www.epcos.com/mlcc\\_impedance](http://www.epcos.com/mlcc_impedance).

Typical characteristics for HighCV X7R<sup>1)</sup>

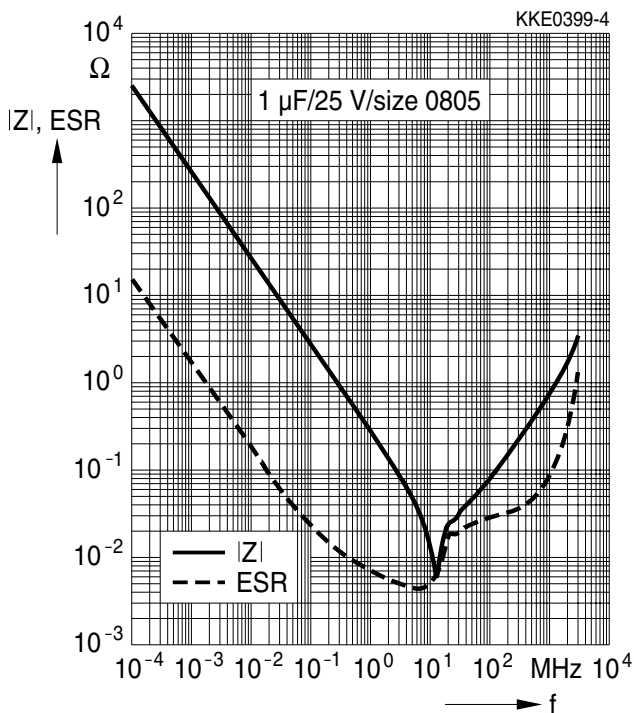
Insulation resistance  $R_{ins}$  versus temperature  $T$



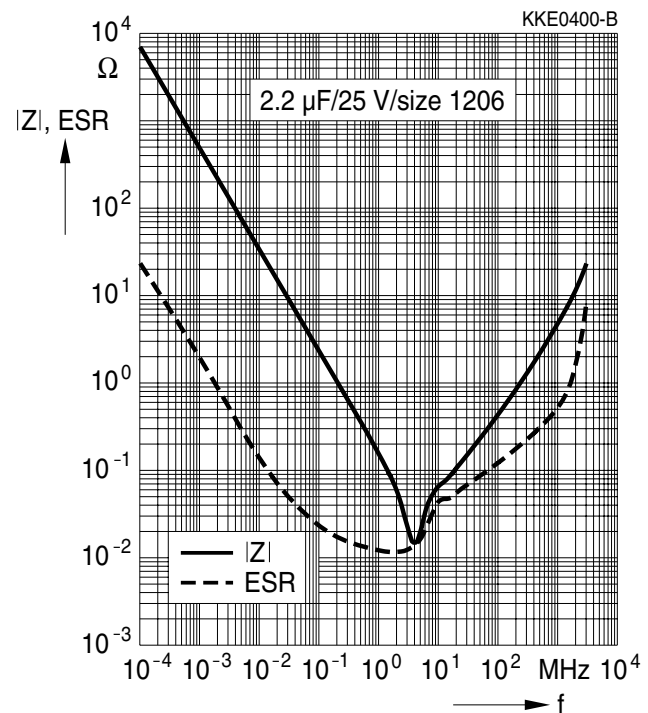
Impedance  $|Z|$  and ESR versus frequency  $f$



Impedance  $|Z|$  and ESR versus frequency  $f$



Impedance  $|Z|$  and ESR versus frequency  $f$



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).

## Multilayer ceramic capacitors

### Cautions and warnings

#### 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:

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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.
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