



## **Multilayer ceramic capacitors**

Chip capacitors, Advanced series, C0G and X7R

Date: October 2006

## 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:

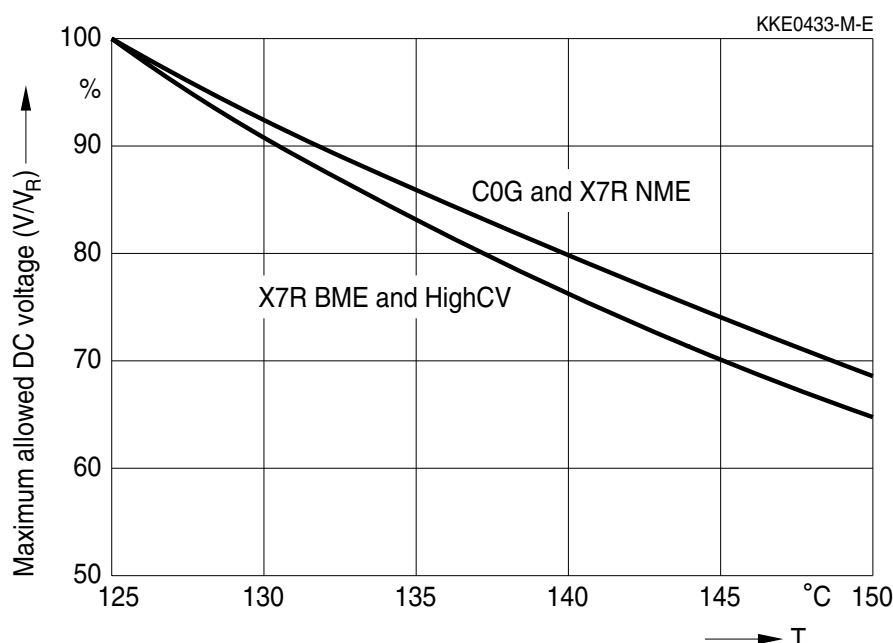
- Statistical methods for component design and process control
- Use of the Weibull method for statistical data analysis
- Introduction of quantifiable parameters (such as the failure time) to replace the previous “good” or “bad” decisions
- Dynamic test limits as a complement to fixed limits in the 100% electrical test (capacitance C, loss factor  $\tan \delta$ , 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 ( $\Delta I$  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  $\triangleq$  cardboard tape, 180-mm reel  
 62  $\triangleq$  blister tape, 180-mm reel  
 70  $\triangleq$  cardboard tape, 330-mm reel  
 72  $\triangleq$  blister tape, 330-mm reel

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

**Capacitance tolerance**  
 $C_R < 10 \text{ pF}$ : **C**  $\triangleq \pm 0.25 \text{ pF}$  (standard for capacitance values <10 pF)  
 $C_R \geq 10 \text{ pF}$ : **J**  $\triangleq \pm 5\%$  (standard)


**Capacitance, coded**  
 (example)    010  $\triangleq 1 \cdot 10^0 \text{ pF} = 1 \text{ pF}$   
                   100  $\triangleq 10 \cdot 10^0 \text{ pF} = 10 \text{ pF}$   
                   221  $\triangleq 22 \cdot 10^1 \text{ pF} = 220 \text{ pF}$


| Rated voltage | Rated voltage [VDC] | 50 | 100 |
|---------------|---------------------|----|-----|
| Code          | 5                   | 1  |     |


**Internal coding**    "A" indicates Advanced series


| Type and size            |                                   |
|--------------------------|-----------------------------------|
| Chip size<br>(inch / mm) | Temperature characteristic<br>C0G |
| <b>0402</b> / 1005       | B37920                            |
| <b>0603</b> / 1608       | B37930                            |
| <b>0805</b> / 2012       | B37940                            |
| <b>1206</b> / 3216       | B37871                            |


## Ordering code system


  
**B37941**


  
**A**

  
**5**

  
**102**

  
**K**

  
**0**

  
**60**

**Packaging**  
 60  $\triangleq$  cardboard tape, 180-mm reel  
 62  $\triangleq$  blister tape, 180-mm reel  
 70  $\triangleq$  cardboard tape, 330-mm reel  
 72  $\triangleq$  blister tape, 330-mm reel

**Internal coding**

**Capacitance tolerance**  
**K  $\triangleq$   $\pm 10\%$  (standard)**

**Capacitance, coded**    102  $\triangleq 10 \cdot 10^2$  pF = 1 nF  
 (example)                104  $\triangleq 10 \cdot 10^4$  pF = 100 nF  
                                  223  $\triangleq 22 \cdot 10^3$  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<br>(inch / mm)                                       | Temperature characteristic<br>X7R |
| <b>0603</b> / 1608<br><b>0805</b> / 2012<br><b>1206</b> / 3216 | B37931<br>B37941<br>B37872        |

## 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  $\geq 1.2 \pm 0.1$  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)               | $\tan \delta$ | $< 1.0 \cdot 10^{-3}$      |     |
| Insulation resistance <sup>1)</sup> at + 25 °C | $R_{ins}$     | $> 10^5$                   | MΩ  |
| Insulation resistance <sup>1)</sup> at +125 °C | $R_{ins}$     | $> 10^4$                   | MΩ  |
| Time constant <sup>1)</sup> at + 25 °C         | $\tau$        | $> 1000$                   | s   |
| Time constant <sup>1)</sup> at +125 °C         | $\tau$        | $> 100$                    | 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**

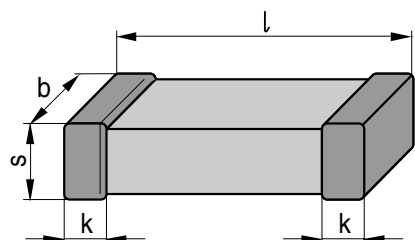
|   |                   |  |                    |
|---|-------------------|--|--------------------|
| Temperature characteristic  |                   | X7R  |                    |
| Max. relative capacitance change within $-55\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$ | $\Delta C/C$      | $\pm 15$   | %                  |
| Climatic category (IEC 60068-1)   |                   | 55/125/56  |                    |
| Standard  |                   | EIA  |                    |
| Dielectric  |                   | Class 2  |                    |
| Rated voltage <sup>1)</sup>   | $V_R$             | 25; 50; 100  | VDC                |
| Test voltage  | $V_{\text{test}}$ | $2.5 \cdot V_R/5\text{ s}$                         | VDC                |
| Capacitance range / E series  | $C_R$             | 1 nF ... 1 $\mu\text{F}$ (E6)                      |                    |
| Dissipation factor (limit value)  | $\tan \delta$     | $< 25 \cdot 10^{-3} / < 50 \cdot 10^{-3}$ for 25 V |                    |
| Insulation resistance <sup>2)</sup> at $+25\text{ }^{\circ}\text{C}$                                    | $R_{\text{ins}}$  | $> 10^5$   | M $\Omega$         |
| Insulation resistance <sup>2)</sup> at $+125\text{ }^{\circ}\text{C}$                                   | $R_{\text{ins}}$  | $> 10^4$   | M $\Omega$         |
| Time constant <sup>2)</sup> at $+25\text{ }^{\circ}\text{C}$  | $\tau$            | $> 1000$   | s                  |
| Time constant <sup>2)</sup> at $+125\text{ }^{\circ}\text{C}$   | $\tau$            | $> 100$  | s                  |
| Operating temperature range   | $T_{\text{op}}$   | $-55 \dots +125$                                   | $^{\circ}\text{C}$ |
| Ageing <sup>3)</sup>  |                   | yes  |                    |

**Capacitance tolerances C0G**

|             |                      |                         |
|-------------|----------------------|-------------------------|
|             | $C_R < 10\text{ pF}$ | $C_R \geq 10\text{ pF}$ |
| Code letter | C (standard)         | J (standard)            |
| Tolerance   | $\pm 0.25\text{ pF}$ | $\pm 5\%$               |

**Capacitance tolerances X7R**

|             |              |
|-------------|--------------|
| Code letter | K (standard) |
| Tolerance   | $\pm 10\%$   |

**Dimensional drawing**


KKE0329-N

**Dimensions (mm)**

| Case size | inch / mm | 0402 / 1005    | 0603 / 1608    | 0805 / 2012     | 1206 / 3216     |
|-----------|-----------|----------------|----------------|-----------------|-----------------|
| l         |           | $1.0 \pm 0.10$ | $1.6 \pm 0.15$ | $2.00 \pm 0.20$ | $3.20 \pm 0.20$ |
| b         |           | $0.5 \pm 0.05$ | $0.8 \pm 0.10$ | $1.25 \pm 0.15$ | $1.60 \pm 0.15$ |
| s         |           | $0.5 \pm 0.05$ | $0.8 \pm 0.10$ | 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  $C_R > 10\text{ nF}$  the time constant  $\tau = C \cdot R_{\text{ins}}$  is given.

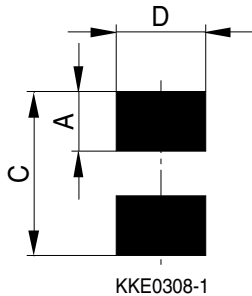
3) Refer to chapter "General technical information", "Ageing".



## Multilayer ceramic capacitors

Advanced series; C0G and X7R

### Recommended solder pad



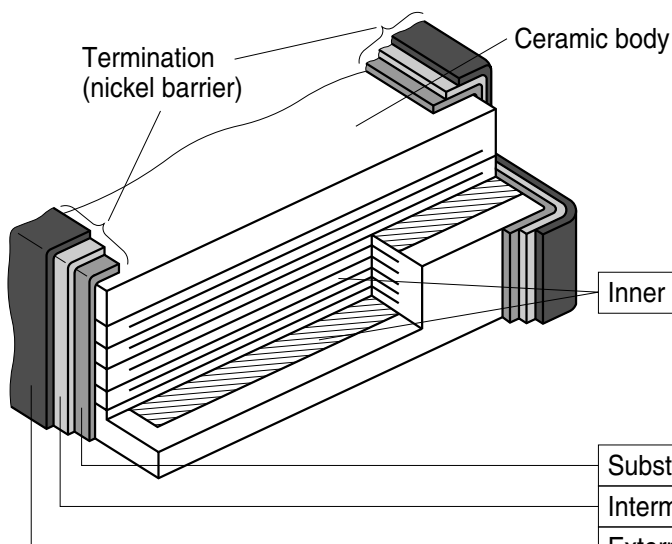
### Recommended dimensions (mm) for reflow soldering

| 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 |
|------|-----|--------|
| 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 <sup>1)</sup><br>inch<br>mm | 0402<br>1005 |  | 0603<br>1608 |     | 0805<br>2012 |     | 1206<br>3216 |     |
|----------------------------------|--------------|--|--------------|-----|--------------|-----|--------------|-----|
| Type                             | B37920       |  | B37930       |     | B37940       |     | B37871       |     |
| $V_R$ (VDC)<br>$C_R$             | 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)  $l \times b$  (inch) /  $l \times b$  (mm)



## Multilayer ceramic capacitors

### Advanced series; X7R

#### Product range for Advanced series 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)<br>$C_R$             | 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 $\mu$ F                      |              |    |     | ▲            |    |     |              |     |

▲ = HighCV

1)  $l \times b$  (inch) /  $l \times b$  (mm)

**Ordering codes and packing for C0G, 50 VDC, nickel barrier terminations**
**Case size 0402, 50 VDC**

| C <sub>R</sub> <sup>1)</sup> | Ordering code   | Chip thickness<br>mm | Cardboard tape,<br>Ø 180-mm reel | Cardboard tape,<br>Ø 330-mm reel |
|------------------------------|-----------------|----------------------|----------------------------------|----------------------------------|
|                              |                 |                      | ** $\triangleq$ 60               | ** $\triangleq$ 70               |
|                              |                 |                      | pcs/reel                         | pcs/reel                         |
| 3.3 pF                       | B37920A5030C3** | 0.5 $\pm$ 0.05       | 10000                            | 50000                            |
| 4.7 pF                       | B37920A5040C7** | 0.5 $\pm$ 0.05       | 10000                            | 50000                            |
| 6.8 pF                       | B37920A5060C8** | 0.5 $\pm$ 0.05       | 10000                            | 50000                            |
| 10 pF                        | B37920A5100J0** | 0.5 $\pm$ 0.05       | 10000                            | 50000                            |
| 15 pF                        | B37920A5150J0** | 0.5 $\pm$ 0.05       | 10000                            | 50000                            |
| 22 pF                        | B37920A5220J0** | 0.5 $\pm$ 0.05       | 10000                            | 50000                            |
| 33 pF                        | B37920A5330J0** | 0.5 $\pm$ 0.05       | 10000                            | 50000                            |
| 47 pF                        | B37920A5470J0** | 0.5 $\pm$ 0.05       | 10000                            | 50000                            |
| 68 pF                        | B37920A5680J0** | 0.5 $\pm$ 0.05       | 10000                            | 50000                            |
| 100 pF                       | B37920A5101J0** | 0.5 $\pm$ 0.05       | 10000                            | 50000                            |

1) Other capacitance values on request.



## Multilayer ceramic capacitors

Advanced series; C0G; 0603

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

#### Case size 0603, 50 VDC

| C <sub>R</sub> <sup>1)</sup> | Ordering code   | Chip thickness<br>mm | Cardboard tape,<br>Ø 180-mm reel | Cardboard tape,<br>Ø 330-mm reel |
|------------------------------|-----------------|----------------------|----------------------------------|----------------------------------|
|                              |                 |                      | ** $\triangleq$ 60               | ** $\triangleq$ 70               |
|                              |                 |                      | pcs/reel                         | pcs/reel                         |
| 1.0 pF                       | B37930A5010C0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 1.5 pF                       | B37930A5010C5** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 2.2 pF                       | B37930A5020C2** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 3.3 pF                       | B37930A5030C3** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 4.7 pF                       | B37930A5040C7** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 6.8 pF                       | B37930A5060C8** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 10 pF                        | B37930A5100J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 15 pF                        | B37930A5150J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 22 pF                        | B37930A5220J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 33 pF                        | B37930A5330J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 47 pF                        | B37930A5470J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 68 pF                        | B37930A5680J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 100 pF                       | B37930A5101J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 150 pF                       | B37930A5151J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 220 pF                       | B37930A5221J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 330 pF                       | B37930A5331J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 470 pF                       | B37930A5471J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |

#### Case size 0603, 100 VDC

|        |                 |               |      |       |
|--------|-----------------|---------------|------|-------|
| 1.0 pF | B37930A1010C0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 1.5 pF | B37930A1010C5** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 2.2 pF | B37930A1020C2** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 3.3 pF | B37930A1030C3** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 4.7 pF | B37930A1040C7** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 6.8 pF | B37930A1060C8** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 10 pF  | B37930A1100J0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 15 pF  | B37930A1150J0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 22 pF  | B37930A1220J0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 33 pF  | B37930A1330J0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 47 pF  | B37930A1470J0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 68 pF  | B37930A1680J0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 100 pF | B37930A1101J0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 150 pF | B37930A1151J0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 220 pF | B37930A1221J0** | 0.8 $\pm$ 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 <sub>R</sub> <sup>1)</sup> | Ordering code   | Chip thickness<br>mm | Cardboard tape,<br>Ø 180-mm reel | Cardboard tape,<br>Ø 330-mm reel |
|------------------------------|-----------------|----------------------|----------------------------------|----------------------------------|
|                              |                 |                      | ** $\triangleq$ 60               | ** $\triangleq$ 70               |
|                              |                 |                      | pcs/reel                         | pcs/reel                         |
| 1.0 pF                       | B37940A5010C0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 1.5 pF                       | B37940A5010C5** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 2.2 pF                       | B37940A5020C2** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 3.3 pF                       | B37940A5030C3** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 4.7 pF                       | B37940A5040C7** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 6.8 pF                       | B37940A5060C8** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 10 pF                        | B37940A5100J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 15 pF                        | B37940A5150J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 22 pF                        | B37940A5220J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 33 pF                        | B37940A5330J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 47 pF                        | B37940A5470J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 68 pF                        | B37940A5680J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 100 pF                       | B37940A5101J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 150 pF                       | B37940A5151J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 220 pF                       | B37940A5221J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 330 pF                       | B37940A5331J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 470 pF                       | B37940A5471J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 680 pF                       | B37940A5681J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 1.0 nF                       | B37940A5102J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 1.5 nF                       | B37940A5152J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 2.2 nF                       | B37940A5222J0** | 1.2 $\pm$ 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

Advanced series; C0G; 0805

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

#### Case size 0805, 100 VDC

| C <sub>R</sub> <sup>1)</sup> | Ordering code   | Chip thickness<br>mm | Cardboard tape,<br>Ø 180-mm reel | Cardboard tape,<br>Ø 330-mm reel |
|------------------------------|-----------------|----------------------|----------------------------------|----------------------------------|
|                              |                 |                      | ** $\triangleq$ 60               | ** $\triangleq$ 70               |
|                              |                 |                      | pcs/reel                         | pcs/reel                         |
| 1.0 pF                       | B37940A1010C0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 1.5 pF                       | B37940A1010C5** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 2.2 pF                       | B37940A1020C2** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 3.3 pF                       | B37940A1030C3** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 4.7 pF                       | B37940A1040C7** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 6.8 pF                       | B37940A1060C8** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 10 pF                        | B37940A1100J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 15 pF                        | B37940A1150J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 22 pF                        | B37940A1220J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 33 pF                        | B37940A1330J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 47 pF                        | B37940A1470J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 68 pF                        | B37940A1680J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 100 pF                       | B37940A1101J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 150 pF                       | B37940A1151J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 220 pF                       | B37940A1221J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 330 pF                       | B37940A1331J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 470 pF                       | B37940A1471J0** | 0.6 $\pm$ 0.1        | 5000                             | 20000                            |
| 680 pF                       | B37940A1681J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 1.0 nF                       | B37940A1102J0** | 1.2 $\pm$ 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

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

## Case size 1206, 50 VDC

| C <sub>R</sub> <sup>1)</sup> | Ordering code   | Chip thickness<br>mm | Cardboard tape,<br>Ø 180-mm reel | Cardboard tape,<br>Ø 330-mm reel |
|------------------------------|-----------------|----------------------|----------------------------------|----------------------------------|
|                              |                 |                      | ** $\triangleq$ 60               | ** $\triangleq$ 70               |
|                              |                 |                      | pcs/reel                         | pcs/reel                         |
| 1.0 pF                       | B37871A5010C0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 1.5 pF                       | B37871A5010C5** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 2.2 pF                       | B37871A5020C2** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 3.3 pF                       | B37871A5030C3** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 4.7 pF                       | B37871A5040C7** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 6.8 pF                       | B37871A5060C8** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 10 pF                        | B37871A5100J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 15 pF                        | B37871A5150J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 22 pF                        | B37871A5220J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 33 pF                        | B37871A5330J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 47 pF                        | B37871A5470J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 68 pF                        | B37871A5680J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 100 pF                       | B37871A5101J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 150 pF                       | B37871A5151J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 220 pF                       | B37871A5221J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 330 pF                       | B37871A5331J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 470 pF                       | B37871A5471J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 680 pF                       | B37871A5681J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 1.0 nF                       | B37871A5102J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 1.5 nF                       | B37871A5152J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 2.2 nF                       | B37871A5222J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 3.3 nF                       | B37871A5332J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 4.7 nF                       | B37871A5472J0** | 1.2 $\pm$ 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

Advanced series; C0G; 1206

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

#### Case size 1206, 100 VDC

| C <sub>R</sub> <sup>1)</sup> | Ordering code   | Chip thickness<br>mm | Cardboard tape,<br>Ø 180-mm reel | Cardboard tape,<br>Ø 330-mm reel |
|------------------------------|-----------------|----------------------|----------------------------------|----------------------------------|
|                              |                 |                      | ** $\triangleq$ 60               | ** $\triangleq$ 70               |
|                              |                 |                      | pcs/reel                         | pcs/reel                         |
| 1.0 pF                       | B37871A1010C0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 1.5 pF                       | B37871A1010C5** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 2.2 pF                       | B37871A1020C2** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 3.3 pF                       | B37871A1030C3** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 4.7 pF                       | B37871A1040C7** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 6.8 pF                       | B37871A1060C8** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 10 pF                        | B37871A1100J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 15 pF                        | B37871A1150J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 22 pF                        | B37871A1220J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 33 pF                        | B37871A1330J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 47 pF                        | B37871A1470J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 68 pF                        | B37871A1680J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 100 pF                       | B37871A1101J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 150 pF                       | B37871A1151J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 220 pF                       | B37871A1221J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 330 pF                       | B37871A1331J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 470 pF                       | B37871A1471J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 680 pF                       | B37871A1681J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 1.0 nF                       | B37871A1102J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 1.5 nF                       | B37871A1152J0** | 0.8 $\pm$ 0.1        | 4000                             | 16000                            |
| 2.2 nF                       | B37871A1222J0** | 1.2 $\pm$ 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



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

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

**Case size 0603, 25 VDC**

|                      |                 |               |      |       |
|----------------------|-----------------|---------------|------|-------|
| 68 nF                | B37931A0683K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 100 nF               | B37931A0104K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 220 nF <sup>2)</sup> | B37931A0224K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |

**Case size 0603, 50 VDC**

|        |                 |               |      |       |
|--------|-----------------|---------------|------|-------|
| 1.0 nF | B37931A5102K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 1.5 nF | B37931A5152K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 2.2 nF | B37931A5222K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 3.3 nF | B37931A5332K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 4.7 nF | B37931A5472K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 6.8 nF | B37931A5682K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 10 nF  | B37931A5103K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 15 nF  | B37931A5153K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 22 nF  | B37931A5223K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 33 nF  | B37931A5333K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 47 nF  | B37931A5473K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |

**Case size 0603, 100 VDC**

|        |                 |               |      |       |
|--------|-----------------|---------------|------|-------|
| 1.0 nF | B37931A1102K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 1.5 nF | B37931A1152K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 2.2 nF | B37931A1222K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 3.3 nF | B37931A1332K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 4.7 nF | B37931A1472K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |

1) Other capacitance values on request.

2) HighCV type



## Multilayer ceramic capacitors

Advanced series; X7R; 0805

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

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

#### Case size 0805, 25 VDC

|                           |                 |                |                    |                     |
|---------------------------|-----------------|----------------|--------------------|---------------------|
| 220 nF <sup>2)</sup>      | B37941A0224K0** | 0.8 $\pm$ 0.1  | 4000               | 16000               |
| 330 nF <sup>2)</sup>      | B37941A0334K0** | 0.8 $\pm$ 0.1  | 4000               | 16000               |
| 470 nF <sup>2)</sup>      | B37941A0474K0** | 0.8 $\pm$ 0.1  | 4000               | 16000               |
| 1.0 $\mu$ F <sup>2)</sup> | B37941A0105K0** | 1.25 $\pm$ 0.1 | 3000 <sup>3)</sup> | 12000 <sup>4)</sup> |

#### Case size 0805, 50 VDC

|        |                 |               |      |       |
|--------|-----------------|---------------|------|-------|
| 1.0 nF | B37941A5102K0** | 0.6 $\pm$ 0.1 | 5000 | 20000 |
| 1.5 nF | B37941A5152K0** | 0.6 $\pm$ 0.1 | 5000 | 20000 |
| 2.2 nF | B37941A5222K0** | 0.6 $\pm$ 0.1 | 5000 | 20000 |
| 3.3 nF | B37941A5332K0** | 0.6 $\pm$ 0.1 | 5000 | 20000 |
| 4.7 nF | B37941A5472K0** | 0.6 $\pm$ 0.1 | 5000 | 20000 |
| 6.8 nF | B37941A5682K0** | 0.6 $\pm$ 0.1 | 5000 | 20000 |
| 10 nF  | B37941A5103K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 15 nF  | B37941A5153K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 22 nF  | B37941A5223K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 33 nF  | B37941A5333K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 47 nF  | B37941A5473K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 68 nF  | B37941A5683K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |
| 100 nF | B37941A5104K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |

#### Case size 0805, 100 VDC

|        |                 |               |      |       |
|--------|-----------------|---------------|------|-------|
| 1.0 nF | B37941A1102K0** | 0.6 $\pm$ 0.1 | 5000 | 20000 |
| 1.5 nF | B37941A1152K0** | 0.6 $\pm$ 0.1 | 5000 | 20000 |
| 2.2 nF | B37941A1222K0** | 0.6 $\pm$ 0.1 | 5000 | 20000 |
| 3.3 nF | B37941A1332K0** | 0.6 $\pm$ 0.1 | 5000 | 20000 |
| 4.7 nF | B37941A1472K0** | 0.6 $\pm$ 0.1 | 5000 | 20000 |
| 6.8 nF | B37941A1682K0** | 0.6 $\pm$ 0.1 | 5000 | 20000 |
| 10 nF  | B37941A1103K0** | 0.6 $\pm$ 0.1 | 5000 | 20000 |
| 15 nF  | B37941A1153K0** | 0.6 $\pm$ 0.1 | 5000 | 20000 |
| 22 nF  | B37941A1223K0** | 0.8 $\pm$ 0.1 | 4000 | 16000 |

1) Other capacitance values on request.

2) HighCV type.

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

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

**Ordering codes and packing for X7R, 50 and 100 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 330-mm reel |
|------------------------------|---------------|----------------------|----------------------------------|----------------------------------|
|                              |               |                      | ** $\triangleq$ 60               | ** $\triangleq$ 70               |
|                              |               |                      | pcs/reel                         | pcs/reel                         |

**Case size 1206, 50 VDC**

|        |                 |               |                    |                     |
|--------|-----------------|---------------|--------------------|---------------------|
| 1.0 nF | B37872A5102K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 1.5 nF | B37872A5152K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 2.2 nF | B37872A5222K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 3.3 nF | B37872A5332K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 4.7 nF | B37872A5472K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 6.8 nF | B37872A5682K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 10 nF  | B37872A5103K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 15 nF  | B37872A5153K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 22 nF  | B37872A5223K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 33 nF  | B37872A5333K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 47 nF  | B37872A5473K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 68 nF  | B37872A5683K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 100 nF | B37872A5104K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 220 nF | B37872A5224K0** | 1.2 $\pm$ 0.1 | 3000 <sup>2)</sup> | 12000 <sup>3)</sup> |
| 330 nF | B37872A5334K0** | 1.2 $\pm$ 0.1 | 3000 <sup>2)</sup> | 12000 <sup>3)</sup> |
| 470 nF | B37872A5474K0** | 1.2 $\pm$ 0.1 | 3000 <sup>2)</sup> | 12000 <sup>3)</sup> |

**Case size 1206, 100 VDC**

|        |                 |               |                    |                     |
|--------|-----------------|---------------|--------------------|---------------------|
| 1.0 nF | B37872A1102K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 1.5 nF | B37872A1152K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 2.2 nF | B37872A1222K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 3.3 nF | B37872A1332K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 4.7 nF | B37872A1472K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 6.8 nF | B37872A1682K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 10 nF  | B37872A1103K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 15 nF  | B37872A1153K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 22 nF  | B37872A1223K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 33 nF  | B37872A1333K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 47 nF  | B37872A1473K0** | 0.8 $\pm$ 0.1 | 4000               | 16000               |
| 68 nF  | B37872A1683K0** | 1.2 $\pm$ 0.1 | 3000 <sup>2)</sup> | 12000 <sup>3)</sup> |
| 100 nF | B37872A1104K0** | 1.2 $\pm$ 0.1 | 3000 <sup>2)</sup> | 12000 <sup>3)</sup> |

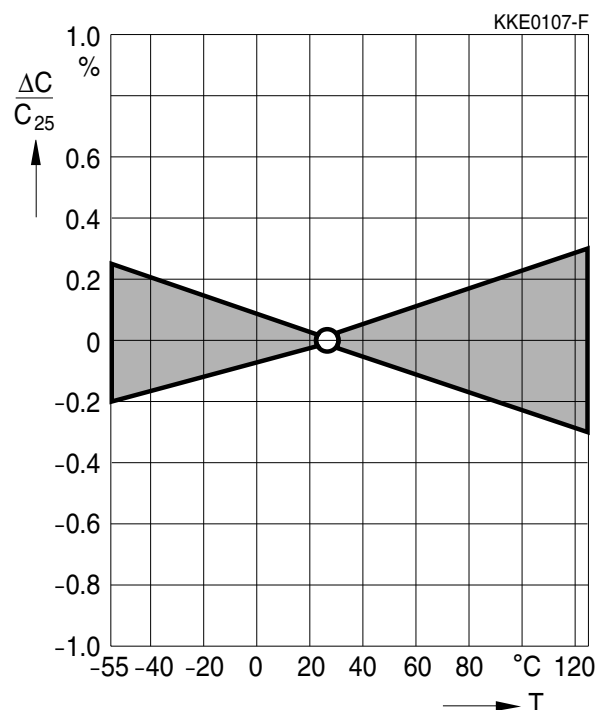
1) Other capacitance values on request.

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

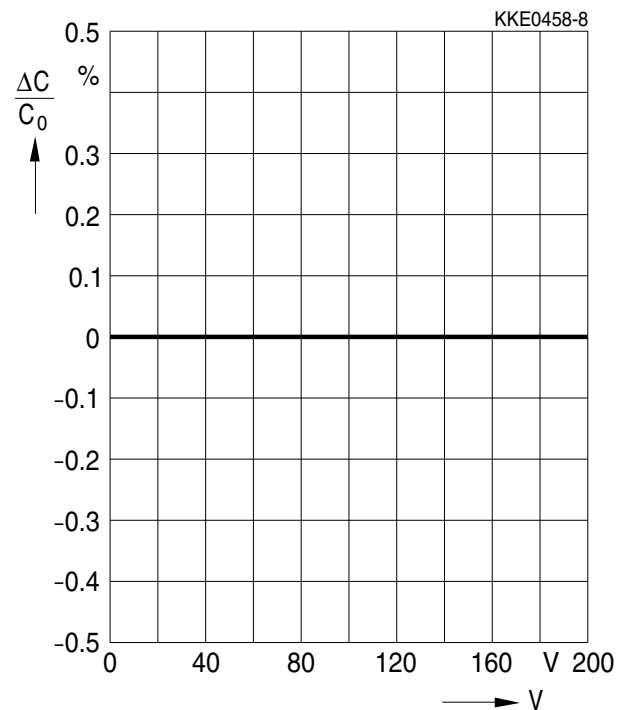
3) Blister tape, 330-mm reel, ordering code \*\*  $\triangleq$  72

### Typical characteristics for C0G<sup>1)</sup>

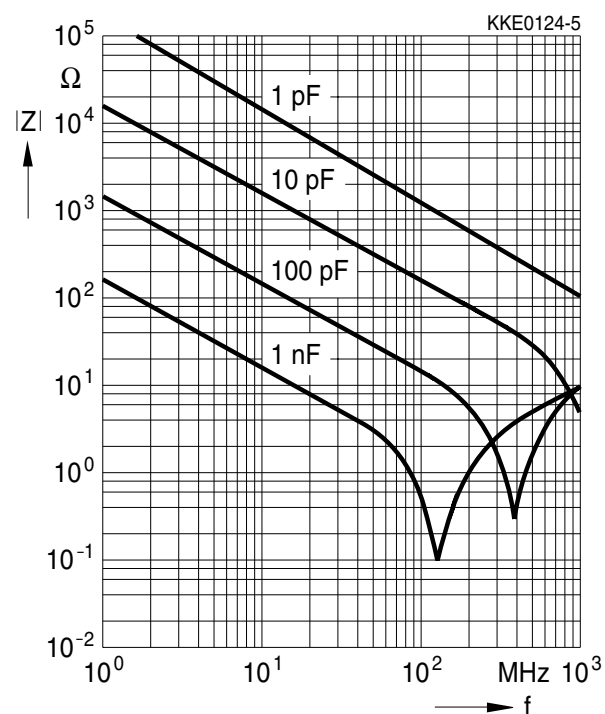
Capacitance change  $\Delta C/C_{25}$  versus temperature T (tolerance range  $\pm 0.2\%$ )



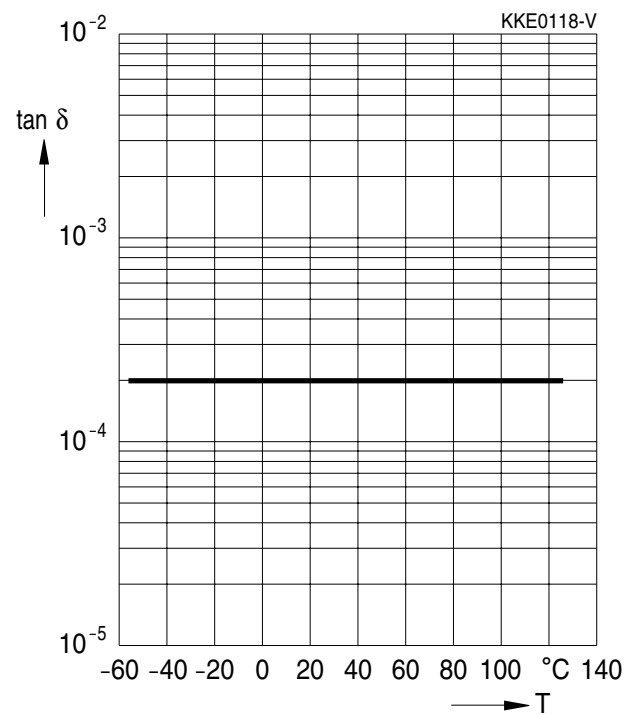
Capacitance change  $\Delta C/C_0$  versus superimposed DC voltage V



Impedance |Z| versus frequency f



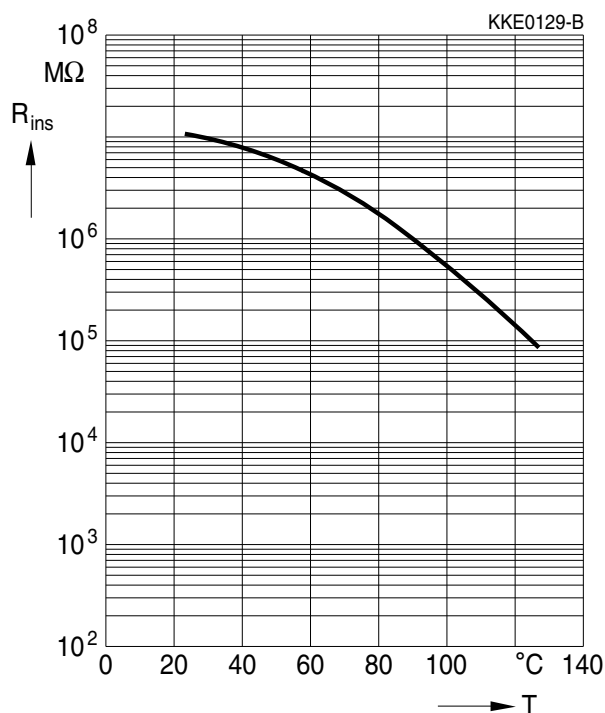
Dissipation factor  $\tan \delta$  versus temperature T



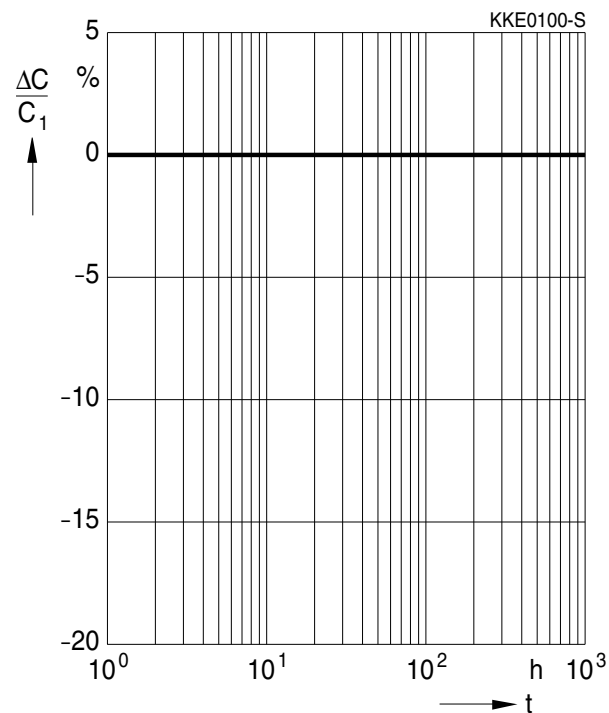
1) For more detailed information on frequency behavior and characteristics see [www.epcos.com/mlcc\\_impedance](http://www.epcos.com/mlcc_impedance).

## Typical characteristics for C0G<sup>1)</sup>

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



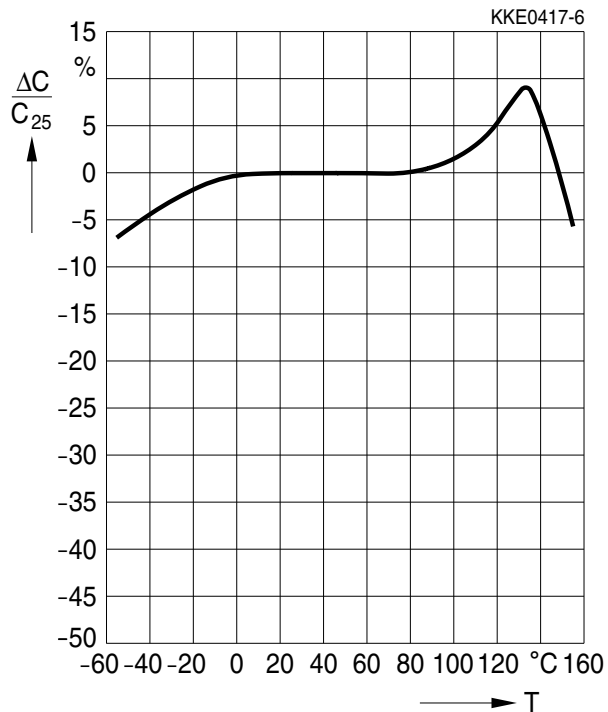
Capacitance change  $\Delta C/C_1$  versus time  $t$



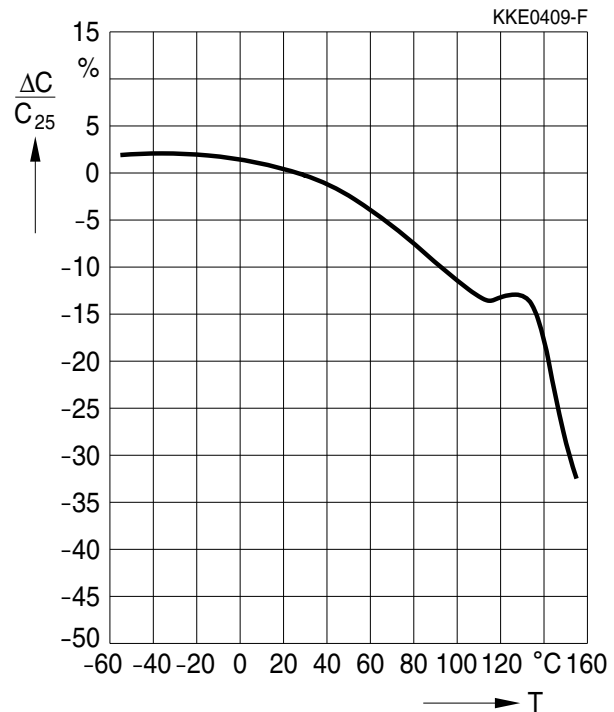
1) For more detailed information on frequency behavior and characteristics see [www.epcos.com/mlcc\\_impedance](http://www.epcos.com/mlcc_impedance).

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

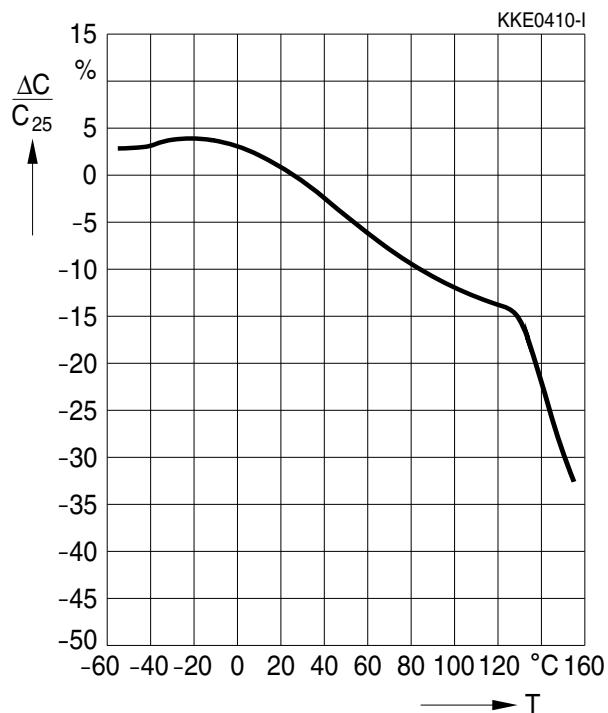
Capacitance change  $\Delta C/C_{25}$  versus temperature T for NME



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



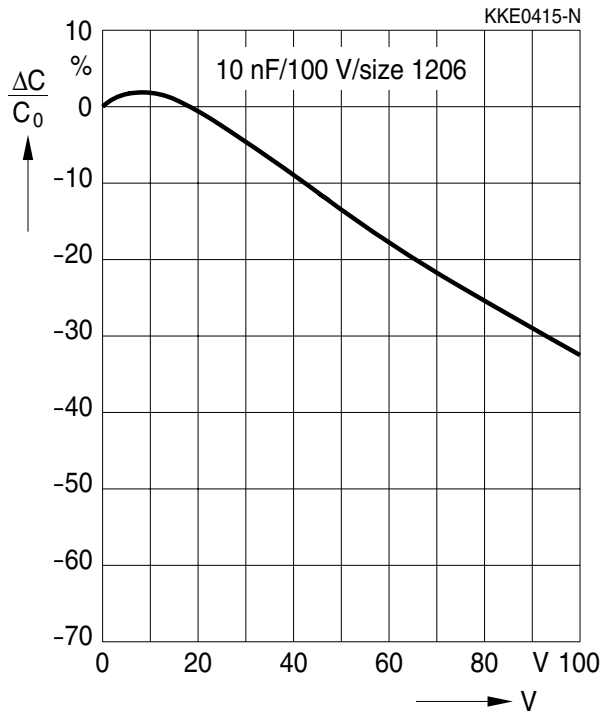
Capacitance change  $\Delta C/C_{25}$  versus temperature T for HighCV



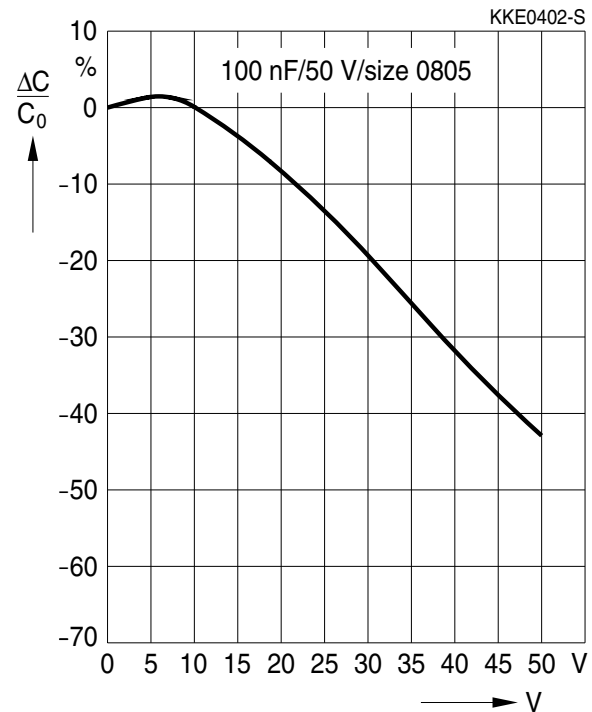
1) For more detailed information on frequency behavior and characteristics see [www.epcos.com/mlcc\\_impedance](http://www.epcos.com/mlcc_impedance).

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

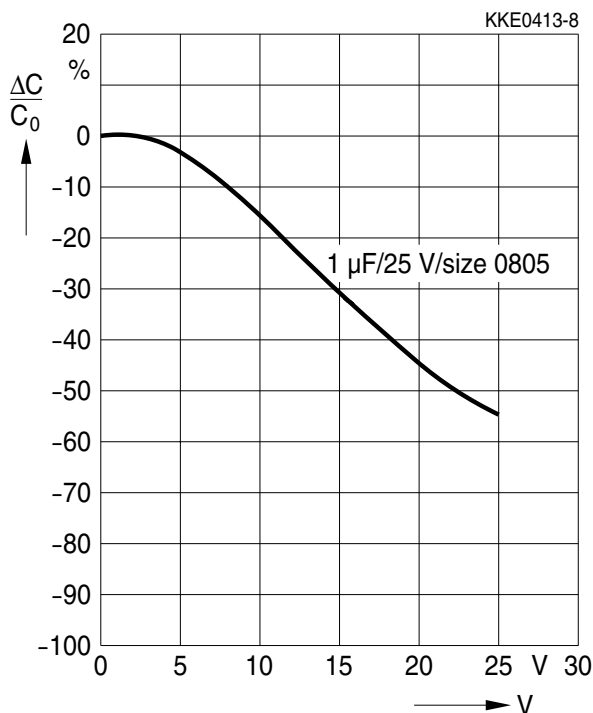
Capacitance change  $\Delta C/C_0$  versus  
superimposed DC voltage V for NME



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



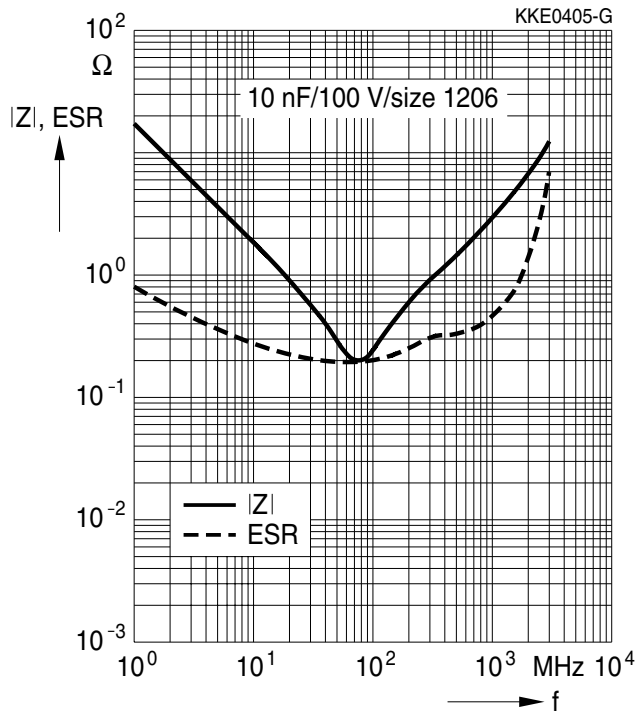
Capacitance change  $\Delta C/C_0$  versus  
superimposed DC voltage V for HighCV



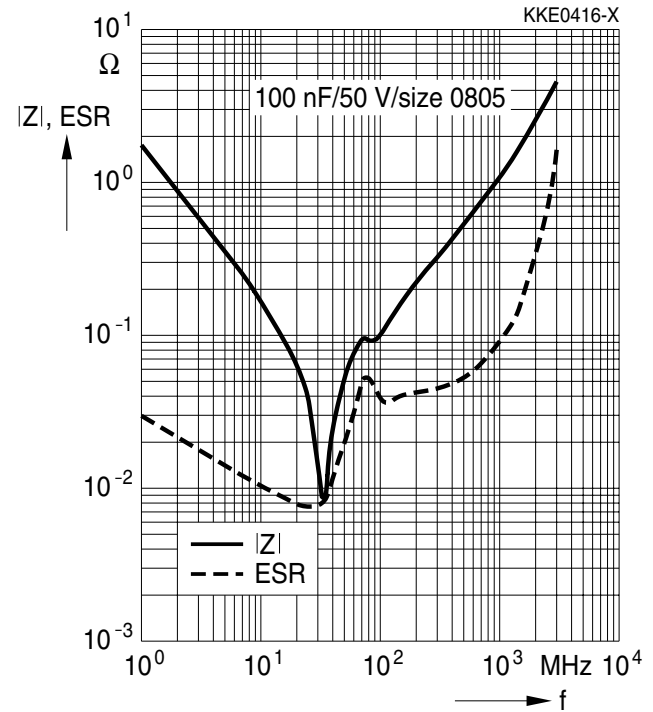
1) For more detailed information on frequency behavior and characteristics see [www.epcos.com/mlcc\\_impedance](http://www.epcos.com/mlcc_impedance).

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

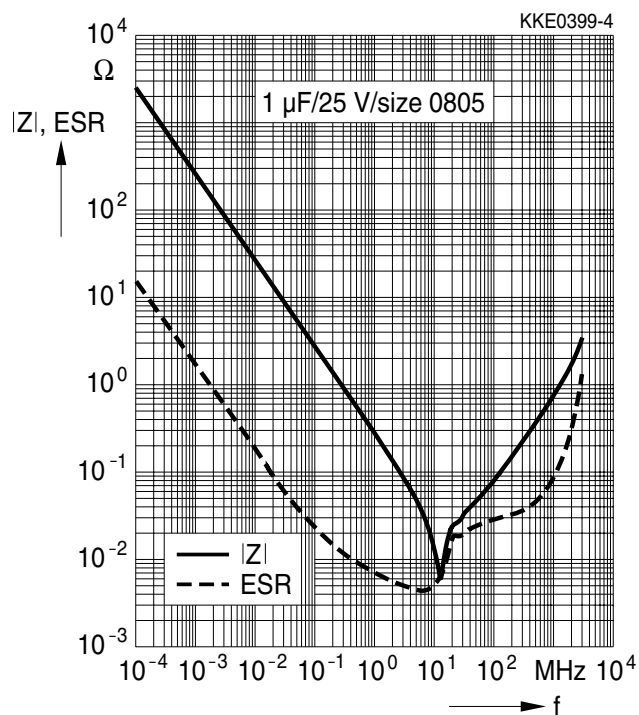
Impedance  $|Z|$  versus frequency  $f$  for NME



Impedance  $|Z|$  versus frequency  $f$  for BME



Impedance  $|Z|$  versus frequency  $f$  for HighCV

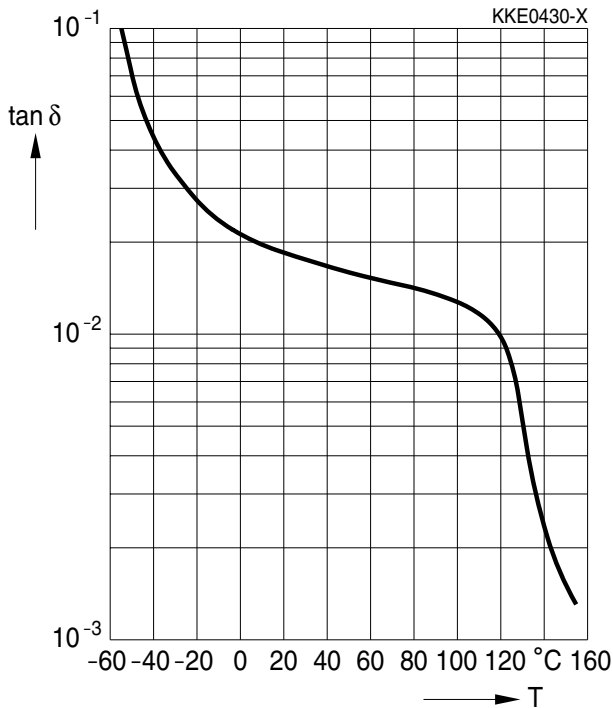


1) For more detailed information on frequency behavior and characteristics see [www.epcos.com/mlcc\\_impedance](http://www.epcos.com/mlcc_impedance).

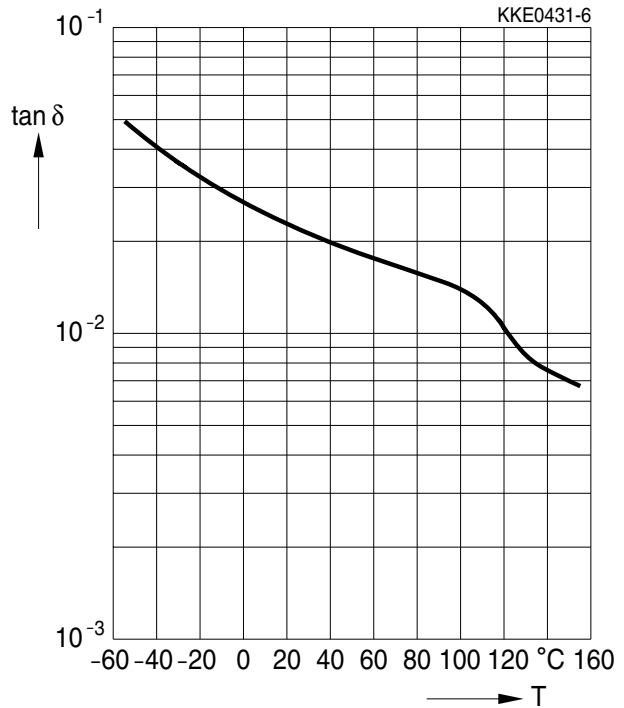


### Typical characteristics for X7R<sup>1)</sup>

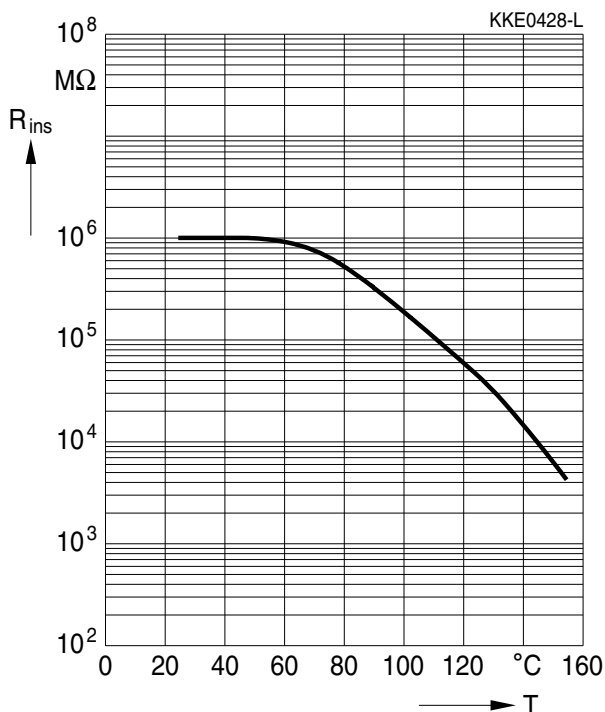
Dissipation factor  $\tan \delta$  versus temperature T for NME/BME



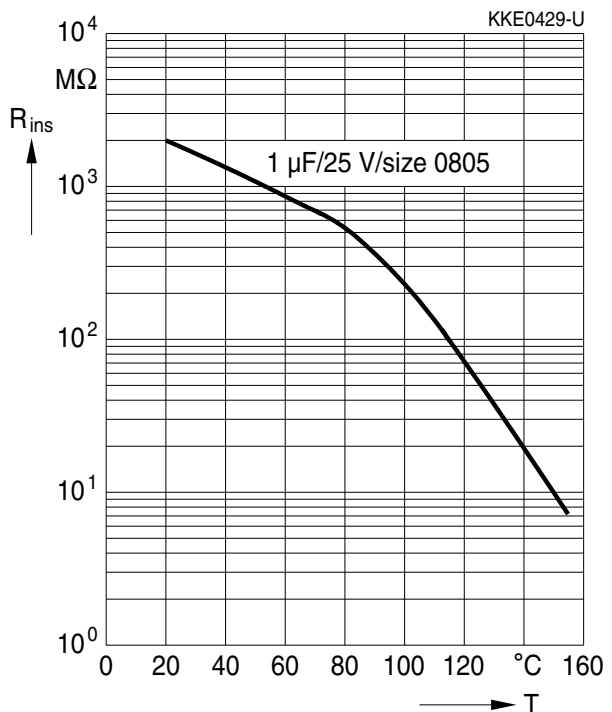
Dissipation factor  $\tan \delta$  versus temperature T for HighCV



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



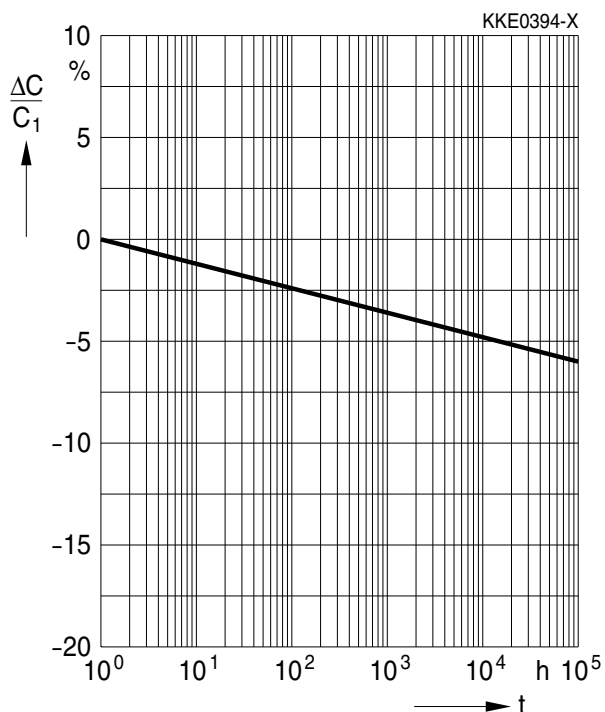
Insulation resistance  $R_{ins}$  versus temperature T for HighCV



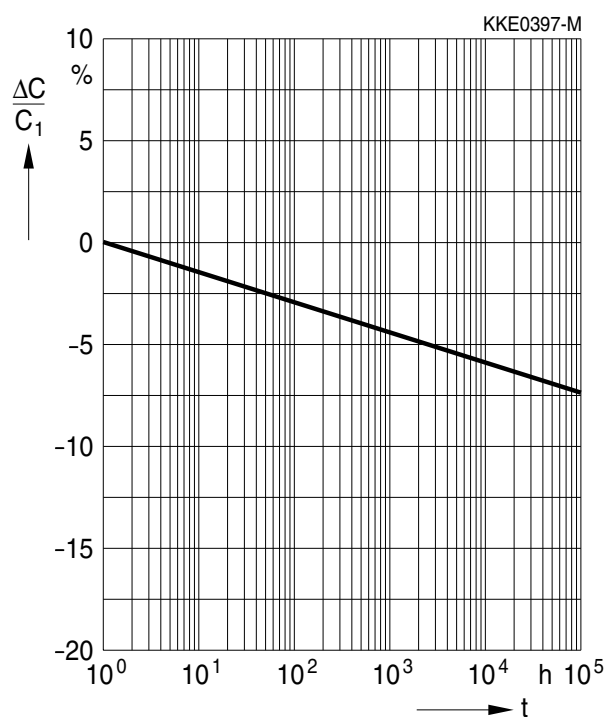
1) For more detailed information on frequency behavior and characteristics see [www.epcos.com/mlcc\\_impedance](http://www.epcos.com/mlcc_impedance).

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

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](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.

## Multilayer ceramic capacitors

### 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](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)**.
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