

Chip capacitors, Advanced series, C0G and X7R

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#### **Advanced series**

### 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.



#### Advanced series

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

- Statistical methods for component design and process control
- Use of the Weibull method for statistical data analysis
- Introduction of quantifiable parameters (such as the failure time) to replace the previous "good" or "bad" decisions
- Dynamic test limits as a complement to fixed limits in the 100% electrical test (capacitance C, loss factor tan δ, insulation resistance R<sub>ins</sub>)
- 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 (△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 nondestructive 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.



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### Advanced series; C0G

### Ordering code system



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

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Please read *Cautions and warnings* and *Important notes* at the end of this document.



### Advanced series; X7R

### Ordering code system



#### Type and size

Chip size	Temperature characteristic
( <b>inch</b> / mm)	X7R
0603 / 1608	B37931
0805 / 2012	B37941
1206 / 3216	B37872

Please read *Cautions and warnings* and *Important notes* at the end of this document.

## Advanced series; C0G and X7R

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

Features

- 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 <sub>R</sub>	50, 100	VDC
Test voltage	V <sub>test</sub>	2.5 · V <sub>R</sub> /5 s	VDC
Capacitance range / E series	C <sub>R</sub>	1 pF … 4.7 nF (E6)	
Temperature coefficient		$0\pm30\cdot10^{-6}/K$	
Dissipation factor (limit value)	tan $\delta$	<1.0 · 10 <sup>-3</sup>	
Insulation resistance <sup>1)</sup> at + 25 °C	R <sub>ins</sub>	>10 <sup>5</sup>	MΩ
Insulation resistance <sup>1)</sup> at +125 °C	R <sub>ins</sub>	>10 <sup>4</sup>	MΩ
Time constant <sup>1)</sup> at + 25 °C	τ	>1000	S
Time constant <sup>1)</sup> at +125 °C	τ	>100	S
Operating temperature range	T <sub>op</sub>	-55 +125	°C
Ageing		none	

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







SMD

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Multilayer ceramic capacitors Advanced series; C0G and X7R

Advanced series

### **Electrical data X7R**

Temperature characteristic		X7R	
Max. relative capacitance change			
within –55 °C to +125 °C	$\Delta C/C$	±15	%
Climatic category (IEC 60068-1)		55/125/56	
Standard		EIA	
Dielectric		Class 2	
Rated voltage <sup>1)</sup>	V <sub>R</sub>	25; 50; 100	VDC
Test voltage	V <sub>test</sub>	2.5 · V <sub>R</sub> /5 s	VDC
Capacitance range / E series	C <sub>R</sub>	1 nF 1 μF (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 °C	R <sub>ins</sub>	>10 <sup>5</sup>	MΩ
Insulation resistance <sup>2)</sup> at +125 °C	<b>R</b> ins	>10 <sup>4</sup>	MΩ
Time constant <sup>2)</sup> at + 25 °C	τ	>1000	s
Time constant <sup>2)</sup> at +125 °C	τ	>100	s
Operating temperature range	T <sub>op</sub>	–55 +125	°C
Ageing <sup>3)</sup>		yes	

#### **Capacitance tolerances C0G**

	С <sub>R</sub> <10 рF	C <sub>R</sub> ≥10 pF	_
Code letter	C (standard)	J (standard)	_ (
Tolerance	±0.25 pF	±5%	

#### **Dimensional drawing**



### **Dimensions (mm)**

Case size	inch / mm	0402 / 1005	0603 / 1608	0805 / 2012	1206 / 3216
		1.0 ±0.10	1.6 ±0.15	2.00 ±0.20	3.20 ±0.20
b		$0.5\pm\!0.05$	0.8 ±0.10	1.25 ±0.15	1.60 ±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

Note: No operation on AC line.
 For C<sub>R</sub> >10 nF the time constant τ = C · R<sub>ins</sub> is given.
 Refer to chapter "General technical information", "Ageing".

Please read Cautions and warnings and Important notes at the end of this document.

# **Capacitance tolerances X7R**

_	Code letter	K (standard)		
	Tolerance	±10%		





Multilayer ceramic capacitors Advanced series; C0G and X7R

#### **Recommended solder pad**



### Recommended dimensions (mm) for reflow soldering

Case size	(inch/mm)	Туре	А	С	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)	Туре	А	С	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: Noble Metal Electrode BME: Base Metal Electrode

KKE0424-N-E



Advanced series; C0G

Advanced series

# Product range for Advanced series chip capacitors, C0G

Size	)									
inch		04	02	06	03	08	05	12	06	
mm		10	005	16	1608		2012		3216	
Туре		B37	7920	B37	/930	B37	940	B37	871	
	V <sub>R</sub> (VDC)	50		50	100	50	100	50	100	
CR					100					
1.(	) pF									
2.2	2 pF									
3.3	3 pF									
4.7	7 pF									
6.8	3 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	5 nF									
2.2	2 nF									
3.3	3 nF									
4.7	7 nF									

<sup>1)</sup>  $l \times b$  (inch) /  $l \times b$  (mm)





Advanced series; X7R

## Product range for Advanced series chip capacitors, X7R

Size	1)								
inch			0603			0805		12	206
mm			1608			2012		32	216
Туре	•		B37931			B37941		B37	'872
C <sub>R</sub>	V <sub>R</sub> (VDC)	25	50	100	25	50	100	50	100
1.0	0 nF								
2.2	2 nF								
3.3	3 nF								
4.	7 nF								
6.8	8 nF								
10	nF								
15	nF								
22	nF								
33	nF								
47	nF								
68	nF								
100	nF								
220	nF								
330	nF								
470	nF								
1.0	0 μF								

▲ = HighCV

<sup>1)</sup>  $I \times b$  (inch) /  $I \times b$  (mm)



Advanced series; C0G; 0402

Advanced series

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

## Case size 0402, 50 VDC

		Chip thickness	Cardboard tape,	Cardboard tape,
			$\varnothing$ 180-mm reel	$\varnothing$ 330-mm reel
			** ≙ 60	** ≙ 70
C <sub>R</sub> <sup>1)</sup>	Ordering code	mm	pcs/reel	pcs/reel
3.3 pF	B37920A5030C3**	0.5 ±0.05	10000	50000
4.7 pF	B37920A5040C7**	$0.5\pm\!0.05$	10000	50000
6.8 pF	B37920A5060C8**	$0.5\pm0.05$	10000	50000
10 pF	B37920A5100J0**	$0.5\pm0.05$	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**	$0.5\pm0.05$	10000	50000
100 pF	B37920A5101J0**	$0.5\pm\!0.05$	10000	50000

<sup>1)</sup> Other capacitance values on request.





Advanced series; C0G; 0603

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

## Case size 0603, 50 VDC

		Chip thickness	Cardboard tape,	Cardboard tape,
			$\varnothing$ 180-mm reel	$\varnothing$ 330-mm reel
			** ≙ 60	** ≙ 70
C <sub>R</sub> <sup>1)</sup>	Ordering code	mm	pcs/reel	pcs/reel
1.0 pF	B37930A5010C0**	0.8 ±0.1	4000	16000
1.5 pF	B37930A5010C5**	0.8 ±0.1	4000	16000
2.2 pF	B37930A5020C2**	0.8 ±0.1	4000	16000
3.3 pF	B37930A5030C3**	0.8 ±0.1	4000	16000
4.7 pF	B37930A5040C7**	0.8 ±0.1	4000	16000
6.8 pF	B37930A5060C8**	0.8 ±0.1	4000	16000
10 pF	B37930A5100J0**	0.8 ±0.1	4000	16000
15 pF	B37930A5150J0**	0.8 ±0.1	4000	16000
22 pF	B37930A5220J0**	0.8 ±0.1	4000	16000
33 pF	B37930A5330J0**	0.8 ±0.1	4000	16000
47 pF	B37930A5470J0**	0.8 ±0.1	4000	16000
68 pF	B37930A5680J0**	0.8 ±0.1	4000	16000
100 pF	B37930A5101J0**	0.8 ±0.1	4000	16000
150 pF	B37930A5151J0**	0.8 ±0.1	4000	16000
220 pF	B37930A5221J0**	0.8 ±0.1	4000	16000
330 pF	B37930A5331J0**	0.8 ±0.1	4000	16000
470 pF	B37930A5471J0**	0.8 ±0.1	4000	16000
Case size 06	603, 100 VDC			
1.0 pF	B37930A1010C0**	0.8 ±0.1	4000	16000
1.5 pF	B37930A1010C5**	0.8 ±0.1	4000	16000
2.2 pF	B37930A1020C2**	0.8 ±0.1	4000	16000
3.3 pF	B37930A1030C3**	0.8 ±0.1	4000	16000
4.7 pF	B37930A1040C7**	0.8 ±0.1	4000	16000
6.8 pF	B37930A1060C8**	0.8 ±0.1	4000	16000
10 pF	B37930A1100J0**	0.8 ±0.1	4000	16000
15 pF	B37930A1150J0**	0.8 ±0.1	4000	16000
22 pF	B37930A1220J0**	0.8 ±0.1	4000	16000
33 pF	B37930A1330J0**	0.8 ±0.1	4000	16000
47 pF	B37930A1470J0**	0.8 ±0.1	4000	16000
68 pF	B37930A1680J0**	0.8 ±0.1	4000	16000
100 pF	B37930A1101J0**	0.8 ±0.1	4000	16000
150 pF	B37930A1151J0**	0.8 ±0.1	4000	16000
220 pF	B37930A1221J0**	0.8 ±0.1	4000	16000

1) Other capacitance values on request.



Advanced series; C0G; 0805

Advanced series

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

#### Case size 0805, 50 VDC

		Chip thickness	Cardboard tape, $\alpha$ 180-mm real	Cardboard tape, $\emptyset$ 330-mm reel
			± 100-mm reer	± 530-mm reer
C <sub>B</sub> <sup>1)</sup>	Ordering code	mm	pcs/reel	pcs/reel
1.0 pF	B37940A5010C0**	0.6 ±0.1	5000	20000
1.5 pF	B37940A5010C5**	0.6 ±0.1	5000	20000
2.2 pF	B37940A5020C2**	0.6 ±0.1	5000	20000
3.3 pF	B37940A5030C3**	0.6 ±0.1	5000	20000
4.7 pF	B37940A5040C7**	0.6 ±0.1	5000	20000
6.8 pF	B37940A5060C8**	0.6 ±0.1	5000	20000
10 pF	B37940A5100J0**	0.6 ±0.1	5000	20000
15 pF	B37940A5150J0**	0.6 ±0.1	5000	20000
22 pF	B37940A5220J0**	0.6 ±0.1	5000	20000
33 pF	B37940A5330J0**	0.6 ±0.1	5000	20000
47 pF	B37940A5470J0**	0.6 ±0.1	5000	20000
68 pF	B37940A5680J0**	0.6 ±0.1	5000	20000
100 pF	B37940A5101J0**	0.6 ±0.1	5000	20000
150 pF	B37940A5151J0**	0.6 ±0.1	5000	20000
220 pF	B37940A5221J0**	0.6 ±0.1	5000	20000
330 pF	B37940A5331J0**	0.6 ±0.1	5000	20000
470 pF	B37940A5471J0**	0.6 ±0.1	5000	20000
680 pF	B37940A5681J0**	0.6 ±0.1	5000	20000
1.0 nF	B37940A5102J0**	0.6 ±0.1	5000	20000
1.5 nF	B37940A5152J0**	0.8 ±0.1	4000	16000
2.2 nF	B37940A5222J0**	1.2 ±0.1	3000 <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

Please read Cautions and warnings and Important notes at the end of this document.





Advanced series; C0G; 0805

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

#### Case size 0805, 100 VDC

			Chip thickness	Cardboard tape,	Cardboard tape,
				$\varnothing$ 180-mm reel	$\varnothing$ 330-mm reel
				** ≙ 60	** ≙ 70
C <sub>R</sub> <sup>1)</sup>		Ordering code	mm	pcs/reel	pcs/reel
1.0	) pF	B37940A1010C0**	0.6 ±0.1	5000	20000
1.5	5 pF	B37940A1010C5**	0.6 ±0.1	5000	20000
2.2	2 pF	B37940A1020C2**	0.6 ±0.1	5000	20000
3.3	3 pF	B37940A1030C3**	0.6 ±0.1	5000	20000
4.7	′ pF	B37940A1040C7**	0.6 ±0.1	5000	20000
6.8	3 pF	B37940A1060C8**	0.6 ±0.1	5000	20000
10	pF	B37940A1100J0**	0.6 ±0.1	5000	20000
15	pF	B37940A1150J0**	0.6 ±0.1	5000	20000
22	pF	B37940A1220J0**	0.6 ±0.1	5000	20000
33	pF	B37940A1330J0**	0.6 ±0.1	5000	20000
47	pF	B37940A1470J0**	0.6 ±0.1	5000	20000
68	pF	B37940A1680J0**	0.6 ±0.1	5000	20000
100	pF	B37940A1101J0**	0.6 ±0.1	5000	20000
150	pF	B37940A1151J0**	0.6 ±0.1	5000	20000
220	pF	B37940A1221J0**	0.6 ±0.1	5000	20000
330	pF	B37940A1331J0**	0.6 ±0.1	5000	20000
470	pF	B37940A1471J0**	0.6 ±0.1	5000	20000
680	pF	B37940A1681J0**	0.8 ±0.1	4000	16000
1.0	) nF	B37940A1102J0**	1.2 ±0.1	3000 <sup>2)</sup>	12000 <sup>3)</sup>

2) Blister tape, 180-mm reel, ordering code \*\*  $\triangleq$  62 3) Blister tape, 330-mm reel, ordering code \*\*  $\triangleq$  72

<sup>1)</sup> Other capacitance values on request.



Advanced series; C0G; 1206

Advanced series

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

#### Case size 1206, 50 VDC

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

Please read Cautions and warnings and Important notes at the end of this document.



Advanced series

**Multilayer ceramic capacitors** 

Advanced series; C0G; 1206

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

## Case size 1206, 100 VDC

			Chip thickness	Cardboard tape,	Cardboard tape,
				$\varnothing$ 180-mm reel	$\varnothing$ 330-mm reel
				** ≙ 60	** ≙ 70
C <sub>R</sub> <sup>1)</sup>		Ordering code	mm	pcs/reel	pcs/reel
1.0	pF	B37871A1010C0**	0.8 ±0.1	4000	16000
1.5	pF	B37871A1010C5**	0.8 ±0.1	4000	16000
2.2	pF	B37871A1020C2**	0.8 ±0.1	4000	16000
3.3	pF	B37871A1030C3**	0.8 ±0.1	4000	16000
4.7	pF	B37871A1040C7**	0.8 ±0.1	4000	16000
6.8	pF	B37871A1060C8**	0.8 ±0.1	4000	16000
10	pF	B37871A1100J0**	0.8 ±0.1	4000	16000
15	pF	B37871A1150J0**	0.8 ±0.1	4000	16000
22	pF	B37871A1220J0**	0.8 ±0.1	4000	16000
33	pF	B37871A1330J0**	0.8 ±0.1	4000	16000
47	pF	B37871A1470J0**	0.8 ±0.1	4000	16000
68	pF	B37871A1680J0**	0.8 ±0.1	4000	16000
100	pF	B37871A1101J0**	0.8 ±0.1	4000	16000
150	pF	B37871A1151J0**	0.8 ±0.1	4000	16000
220	pF	B37871A1221J0**	0.8 ±0.1	4000	16000
330	pF	B37871A1331J0**	0.8 ±0.1	4000	16000
470	pF	B37871A1471J0**	0.8 ±0.1	4000	16000
680	pF	B37871A1681J0**	0.8 ±0.1	4000	16000
1.0	nF	B37871A1102J0**	0.8 ±0.1	4000	16000
1.5	nF	B37871A1152J0**	0.8 ±0.1	4000	16000
2.2	nF	B37871A1222J0**	1.2 ±0.1	3000 <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

Please read Cautions and warnings and Important notes at the end of this document.



Advanced series; X7R; 0603

Advanced series

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

			Chip thickness	Cardboard tape,	Cardboard tape,
				$\varnothing$ 180-mm reel	$\varnothing$ 330-mm reel
				** ≙ 60	** ≙ 70
$C_R^{(1)}$		Ordering code	mm	pcs/reel	pcs/reel
Case	e size 06	03, 25 VDC			
68	nF	B37931A0683K0**	0.8 ±0.1	4000	16000
100	nF	B37931A0104K0**	0.8 ±0.1	4000	16000
220	nF <sup>2)</sup>	B37931A0224K0**	$0.8\pm\!0.1$	4000	16000
Case	e size 06	03, 50 VDC			
1.0	) nF	B37931A5102K0**	0.8 ±0.1	4000	16000
1.5	5 nF	B37931A5152K0**	0.8 ±0.1	4000	16000
2.2	2 nF	B37931A5222K0**	0.8 ±0.1	4000	16000
3.3	3 nF	B37931A5332K0**	0.8 ±0.1	4000	16000
4.7	7 nF	B37931A5472K0**	0.8 ±0.1	4000	16000
6.8	3 nF	B37931A5682K0**	$0.8\pm\!0.1$	4000	16000
10	nF	B37931A5103K0**	0.8 ±0.1	4000	16000
15	nF	B37931A5153K0**	0.8 ±0.1	4000	16000
22	nF	B37931A5223K0**	0.8 ±0.1	4000	16000
33	nF	B37931A5333K0**	0.8 ±0.1	4000	16000
47	nF	B37931A5473K0**	0.8 ±0.1	4000	16000
Case	e size 06	03, 100 VDC			
1.0	) nF	B37931A1102K0**	0.8 ±0.1	4000	16000
1.5	5 nF	B37931A1152K0**	0.8 ±0.1	4000	16000
2.2	2 nF	B37931A1222K0**	0.8 ±0.1	4000	16000
3.3	3 nF	B37931A1332K0**	$0.8\pm\!0.1$	4000	16000
4.7	7 nF	B37931A1472K0**	0.8 ±0.1	4000	16000

<sup>1)</sup> Other capacitance values on request.

<sup>2)</sup> HighCV type





Advanced series; X7R; 0805

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

			Chip thickness	Cardboard tape,	Cardboard tape,
				$\varnothing$ 180-mm reel	$\varnothing$ 330-mm reel
				** ≙ 60	** ≙ 70
$C_R^{(1)}$		Ordering code	mm	pcs/reel	pcs/reel
Case	size 08	05, 25 VDC			
220	nF <sup>2)</sup>	B37941A0224K0**	0.8 ±0.1	4000	16000
330	nF <sup>2)</sup>	B37941A0334K0**	0.8 ±0.1	4000	16000
470	nF <sup>2)</sup>	B37941A0474K0**	0.8 ±0.1	4000	16000
1.0	) μF <sup>2)</sup>	B37941A0105K0**	1.25 ±0.1	3000 <sup>3)</sup>	12000 <sup>4)</sup>
Case	size 08	05, 50 VDC	•		
1.0	) nF	B37941A5102K0**	0.6 ±0.1	5000	20000
1.5	5 nF	B37941A5152K0**	0.6 ±0.1	5000	20000
2.2	2 nF	B37941A5222K0**	0.6 ±0.1	5000	20000
3.3	3 nF	B37941A5332K0**	0.6 ±0.1	5000	20000
4.7	′ nF	B37941A5472K0**	0.6 ±0.1	5000	20000
6.8	3 nF	B37941A5682K0**	0.6 ±0.1	5000	20000
10	nF	B37941A5103K0**	0.8 ±0.1	4000	16000
15	nF	B37941A5153K0**	0.8 ±0.1	4000	16000
22	nF	B37941A5223K0**	0.8 ±0.1	4000	16000
33	nF	B37941A5333K0**	0.8 ±0.1	4000	16000
47	nF	B37941A5473K0**	0.8 ±0.1	4000	16000
68	nF	B37941A5683K0**	0.8 ±0.1	4000	16000
100	nF	B37941A5104K0**	0.8 ±0.1	4000	16000
Case	size 08	05, 100 VDC			
1.0	) nF	B37941A1102K0**	0.6 ±0.1	5000	20000
1.5	5 nF	B37941A1152K0**	0.6 ±0.1	5000	20000
2.2	2 nF	B37941A1222K0**	0.6 ±0.1	5000	20000
3.3	3 nF	B37941A1332K0**	0.6 ±0.1	5000	20000
4.7	′ nF	B37941A1472K0**	0.6 ±0.1	5000	20000
6.8	8 nF	B37941A1682K0**	0.6 ±0.1	5000	20000
10	nF	B37941A1103K0**	0.6 ±0.1	5000	20000
15	nF	B37941A1153K0**	0.6 ±0.1	5000	20000
22	nF	B37941A1223K0**	0.8 ±0.1	4000	16000

- 2) HighCV type.
- a) Blister tape, 180-mm reel, ordering code \*\* ≙ 62
  b) Blister tape, 330-mm reel, ordering code \*\* ≙ 72

Please read Cautions and warnings and Important notes at the end of this document.

<sup>1)</sup> Other capacitance values on request.



Advanced series; X7R; 1206

Advanced series

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

			Chip thickness	Cardboard tape,	Cardboard tape,
				$\varnothing$ 180-mm reel	$\varnothing$ 330-mm reel
				** ≙ 60	** ≙ 70
$C_R^{(1)}$		Ordering code	mm	pcs/reel	pcs/reel
Case	size 12	06, 50 VDC			
1.0	) nF	B37872A5102K0**	0.8 ±0.1	4000	16000
1.5	5 nF	B37872A5152K0**	0.8 ±0.1	4000	16000
2.2	2 nF	B37872A5222K0**	0.8 ±0.1	4000	16000
3.3	8 nF	B37872A5332K0**	0.8 ±0.1	4000	16000
4.7	′ nF	B37872A5472K0**	0.8 ±0.1	4000	16000
6.8	8 nF	B37872A5682K0**	0.8 ±0.1	4000	16000
10	nF	B37872A5103K0**	0.8 ±0.1	4000	16000
15	nF	B37872A5153K0**	0.8 ±0.1	4000	16000
22	nF	B37872A5223K0**	0.8 ±0.1	4000	16000
33	nF	B37872A5333K0**	0.8 ±0.1	4000	16000
47	nF	B37872A5473K0**	0.8 ±0.1	4000	16000
68	nF	B37872A5683K0**	0.8 ±0.1	4000	16000
100	nF	B37872A5104K0**	0.8 ±0.1	4000	16000
220	nF	B37872A5224K0**	1.2 ±0.1	3000 <sup>2)</sup>	12000 <sup>3)</sup>
330	nF	B37872A5334K0**	1.2 ±0.1	3000 <sup>2)</sup>	12000 <sup>3)</sup>
470	nF	B37872A5474K0**	1.2 ±0.1	3000 <sup>2)</sup>	12000 <sup>3)</sup>
Case	size 12	06, 100 VDC			
1.0	) nF	B37872A1102K0**	0.8 ±0.1	4000	16000
1.5	5 nF	B37872A1152K0**	0.8 ±0.1	4000	16000
2.2	2 nF	B37872A1222K0**	0.8 ±0.1	4000	16000
3.3	8 nF	B37872A1332K0**	0.8 ±0.1	4000	16000
4.7	' nF	B37872A1472K0**	0.8 ±0.1	4000	16000
6.8	8 nF	B37872A1682K0**	0.8 ±0.1	4000	16000
10	nF	B37872A1103K0**	0.8 ±0.1	4000	16000
15	nF	B37872A1153K0**	0.8 ±0.1	4000	16000
22	nF	B37872A1223K0**	0.8 ±0.1	4000	16000
33	nF	B37872A1333K0**	0.8 ±0.1	4000	16000
47	nF	B37872A1473K0**	0.8 ±0.1	4000	16000
68	nF	B37872A1683K0**	1.2 ±0.1	3000 <sup>2)</sup>	12000 <sup>3)</sup>
100	nF	B37872A1104K0**	1.2 ±0.1	3000 <sup>2)</sup>	12000 <sup>3)</sup>

2) Blister tape, 180-mm reel, ordering code \*\*  $\triangleq$  62 3) Blister tape, 330-mm reel, ordering code \*\*  $\triangleq$  72

Please read Cautions and warnings and Important notes at the end of this document.

<sup>1)</sup> Other capacitance values on request.





Advanced series; C0G

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

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



# Impedance |Z| versus frequency f



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



# Dissipation factor tan $\delta$ versus temperature T



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

Please read *Cautions and warnings* and *Important notes* at the end of this document.

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Multilayer ceramic capacitors Advanced series; C0G

Advanced	
series	

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

Insulation resistance  $R_{\text{ins}}$  versus temperature  $\mathsf{T}$ 



Capacitance change  ${\bigtriangleup C/C_1}$  versus time t



<sup>1)</sup> For more detailed information on frequency behavior and characteristics see www.epcos.com/mlcc\_impedance.





Advanced series; X7R

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

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



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



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



<sup>1)</sup> For more detailed information on frequency behavior and characteristics see www.epcos.com/mlcc\_impedance.



Multilayer ceramic capacitors Advanced series; X7R

Advanced series

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

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



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



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



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

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Advanced series; X7R

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

Impedance |Z| versus frequency f for NME



Impedance |Z| versus frequency f for HighCV



Impedance |Z| versus frequency f for BME



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





Multilayer ceramic capacitors Advanced series; X7R

Advanced series

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

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



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



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



Insulation resistance R<sub>ins</sub> versus temperature T for HighCV



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

Please read *Cautions and warnings* and *Important notes* at the end of this document.

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Advanced series; X7R

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

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



Capacitance change  ${\bigtriangleup C/C_1}$  versus time t for HighCV



<sup>1)</sup> For more detailed information on frequency behavior and characteristics see www.epcos.com/mlcc\_impedance.



#### **Cautions and warnings**

#### Notes on the selection of ceramic capacitors

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

- 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).



#### 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.



#### Important notes

The following applies to all products named in this publication:

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

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