Multilayer ceramic capacitors

Array, C0G

Series/Type: **Array**

Date: February 2009

The following products presented in this data sheet are being withdrawn.

Substitute Products: See www.epcos.com/withdrawal_mlcc

Ordering Code	Substitute Product	Date of Withdrawal	Deadline Last Orders	Last Shipments
B37940R5220K041		2009-06-26	2010-06-30	2010-12-31
B37940R5220K043		2009-06-26	2010-06-30	2010-12-31
B37940R5330K041		2009-06-26	2010-06-30	2010-12-31

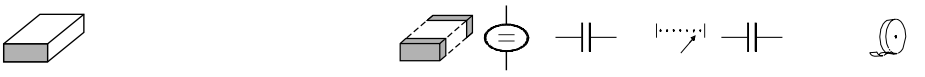
EPCOS

Ordering Code	Substitute Product	Date of Withdrawal	Deadline Last Orders	Last Shipments
B37940R5330K043		2009-06-26	2010-06-30	2010-12-31
B37940R5470K041		2009-06-26	2010-06-30	2010-12-31
B37940R5470K043		2009-06-26	2010-06-30	2010-12-31
B37940R5101K041		2009-06-26	2010-06-30	2010-12-31
B37940R5101K043		2009-06-26	2010-06-30	2010-12-31
B37940R5221K041		2009-06-26	2010-06-30	2010-12-31
B37940R5221K043		2009-06-26	2010-06-30	2010-12-31
B37871R5100K041		2009-06-26	2010-06-30	2010-12-31
B37871R5100K043		2009-06-26	2010-06-30	2010-12-31
B37871R5150K041		2009-06-26	2010-06-30	2010-12-31
B37871R5150K043		2009-06-26	2010-06-30	2010-12-31
B37871R5220K041		2009-06-26	2010-06-30	2010-12-31
B37871R5220K043		2009-06-26	2010-06-30	2010-12-31
B37871R5330K041		2009-06-26	2010-06-30	2010-12-31
B37871R5330K043		2009-06-26	2010-06-30	2010-12-31
B37871R5470K041		2009-06-26	2010-06-30	2010-12-31
B37871R5470K043		2009-06-26	2010-06-30	2010-12-31
B37871R5101K041		2009-06-26	2010-06-30	2010-12-31
B37871R5101K043		2009-06-26	2010-06-30	2010-12-31
B37871R5221K041		2009-06-26	2010-06-30	2010-12-31
B37871R5221K043		2009-06-26	2010-06-30	2010-12-31
B37871R5331K041		2009-06-26	2010-06-30	2010-12-31
B37871R5331K043		2009-06-26	2010-06-30	2010-12-31
B37871R5471K041		2009-06-26	2010-06-30	2010-12-31
B37871R5471K043		2009-06-26	2010-06-30	2010-12-31
B37830R0100K021		2009-06-26	2010-06-30	2010-12-31
B37830R0100K023		2009-06-26	2010-06-30	2010-12-31
B37830R0150K021		2009-06-26	2010-06-30	2010-12-31
B37830R0150K023		2009-06-26	2010-06-30	2010-12-31
B37830R0220K021		2009-06-26	2010-06-30	2010-12-31
B37830R0220K023		2009-06-26	2010-06-30	2010-12-31
B37830R0330K021		2009-06-26	2010-06-30	2010-12-31
B37830R0330K023		2009-06-26	2010-06-30	2010-12-31
B37940R5100K041		2009-06-26	2010-06-30	2010-12-31
B37940R5100K043		2009-06-26	2010-06-30	2010-12-31
B37940R5150K041		2009-06-26	2010-06-30	2010-12-31
B37940R5150K043		2009-06-26	2010-06-30	2010-12-31

For further information please contact your nearest EPCOS sales office, which will also support you in selecting a suitable substitute. The addresses of our worldwide sales network are presented at www.epcos.com/sales.

SMD

Ordering code system



B37830	R	0	101	K	0	2	1

Type and size
Chip size (inch/mm) = Temperature characteristic
C0G:
0405/1012 ≙ B37830
0508/1220 ≙ B37940
0612/1632 ≙ B37871
X7R:
0405/1012 ≙ B37831
0508/1220 ≙ B37941
0612/1632 ≙ B37872

Internal coding
"R" indicates array capacitor

Rated voltage
9 (Code) ≙ 16 VDC
0 (Code) ≙ 25 VDC
5 (Code) ≙ 50 VDC

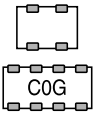
Capacitance, coded (example)
100 ≙ $10 \cdot 10^0$ pF = 10 pF
101 ≙ $10 \cdot 10^1$ pF = 100 pF
220 ≙ $22 \cdot 10^0$ pF = 22 pF

Capacitance tolerance
J ≙ ±5%
K ≙ ±10% (standard for C0G)
M ≙ ±20% (standard for X7R)

Internal coding: 0
or decimal place for cap. value <10 pF

2 ≙ 2-fold array
4 ≙ 4-fold array

Packaging
1 ≙ cardboard tape, 180-mm reel
3 ≙ cardboard tape, 330-mm reel



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Features

- Reduction of mounting time and mounting costs
- Space saving on the PCB
- Based on AEC-Q200 Rev-C

Applications

- Suitable for electronic circuits with parallel line layout
- Coupling and filtering, particularly in RF circuits
- Resonant circuits
- Filter circuits

Termination

- Nickel barrier terminations (Ni) for lead-free soldering

Options

- Alternative capacitance values and tolerances available on request

Delivery mode

- Cardboard and blister tape, 180-mm and 330-mm reel available

Electrical data

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

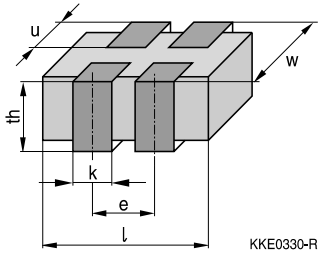
1) For C_R >10 nF the time constant $\tau = C \cdot R_{ins}$ is given.

Capacitance tolerances

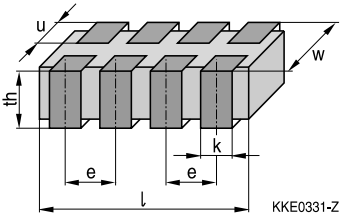
Code letter	J	K (standard)
Tolerance	±5%	±10%

Dimensional drawing

2-fold array (case size 0405)



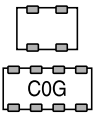
4-fold array (case sizes 0508 and 0612)



Dimensions (mm)

		2-fold array	4-fold array	
Case size	(inch)	0405	0508	0612
	(mm)	1012	1220	1632
l		1.37 ±0.15	2.00 ±0.20	3.20 ±0.20
w		1.00 +0/−0.15	1.25 ±0.15	1.60 ±0.20
th		0.70 max.	0.85 ±0.10	0.85 ±0.10
k		0.36 ±0.10	0.30 ±0.10	0.40 ±0.15
e		0.64	0.50 ±0.10	0.80 ±0.15
u		0.20 ±0.10	0.20 +0.3/−0.10	0.20 +0.3/−0.10

Tolerances to CECC 32101-801



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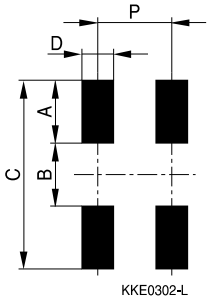
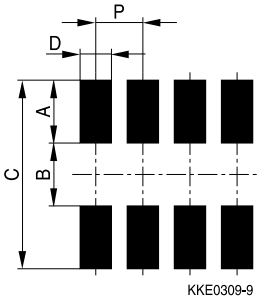
Recommended solder pad

2-fold array (case size 0405)



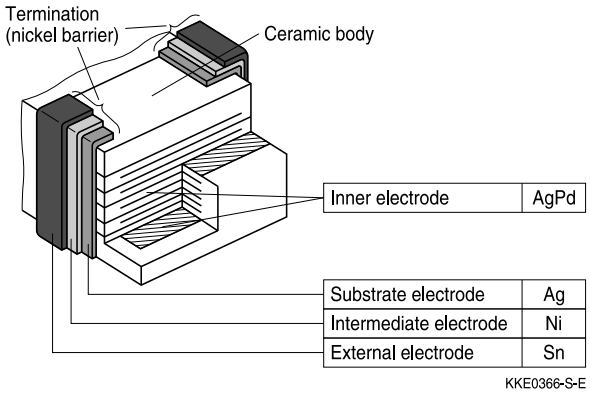
4-fold array (case sizes 0508 and 0612)



Recommended dimensions (mm) for reflow soldering

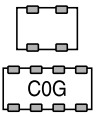
Case size	(inch/mm)	Type	A	B	C	D	P
	0405/1012	2-fold array	0.50 ... 0.55	0.45 ... 0.50	1.45 ... 1.60	0.30 ... 0.35	0.64 ±0.10
	0508/1220	4-fold array	0.50 ... 0.70	0.60 ... 0.70	1.60 ... 2.10	0.25 ... 0.35	0.50 ±0.005
	0612/1632	4-fold array	0.70 ... 0.90	0.80 ... 1.00	2.20 ... 2.80	0.30 ... 0.40	0.80 ±0.005

Termination



Product range for array capacitors, C0G

	2-fold arrays	4-fold arrays	
Size **inch (l x w)** mm (l x w)	**0405** 1012	**0508** 1220	**0612** 1632
Type	B37830R	B37940R	B37871R
$C_R \setminus V_R$ (VDC)	25	50	50
10 pF			
15 pF			
22 pF			
33 pF			
47 pF			
100 pF			
220 pF			
330 pF			
470 pF			



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Ordering codes and packing for C0G, 25 VDC, nickel barrier terminations

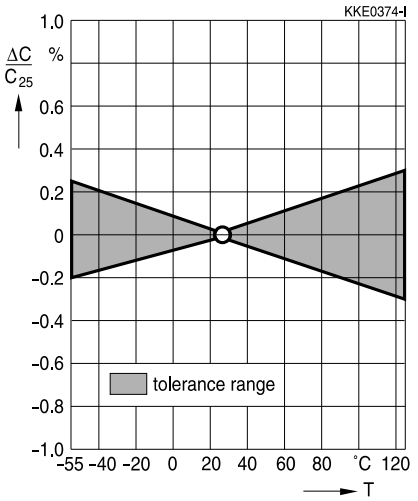
		Chip thickness	Cardboard tape, ∅180-mm reel	Cardboard tape, ∅330-mm reel
			* ≙ 1	* ≙ 3
C_R	Ordering code	mm	pcs./reel	pcs./reel
Case size 0405, 25 VDC, 2-fold arrays				
10 pF	B37830R0100K02*	0.6 ±0.1	5000	20000
15 pF	B37830R0150K02*	0.6 ±0.1	5000	20000
22 pF	B37830R0220K02*	0.6 ±0.1	5000	20000
33 pF	B37830R0330K02*	0.6 ±0.1	5000	20000

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

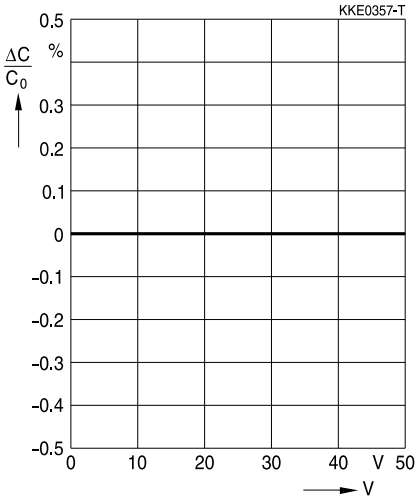
C_R	Ordering code	Chip thickness mm	Cardboard tape, ∅180-mm reel * ≙ 1 pcs./reel	Cardboard tape, ∅330-mm reel * ≙ 3 pcs./reel
Case size 0508, 50 VDC, 4-fold arrays				
10 pF	B37940R5100K04*	0.85 ±0.1	4000	16000
15 pF	B37940R5150K04*	0.85 ±0.1	4000	16000
22 pF	B37940R5220K04*	0.85 ±0.1	4000	16000
33 pF	B37940R5330K04*	0.85 ±0.1	4000	16000
47 pF	B37940R5470K04*	0.85 ±0.1	4000	16000
100 pF	B37940R5101K04*	0.85 ±0.1	4000	16000
220 pF	B37940R5221K04*	0.85 ±0.1	4000	16000
Case size 0612, 50 VDC, 4-fold arrays				
10 pF	B37871R5100K04*	0.85 ±0.1	4000	16000
15 pF	B37871R5150K04*	0.85 ±0.1	4000	16000
22 pF	B37871R5220K04*	0.85 ±0.1	4000	16000
33 pF	B37871R5330K04*	0.85 ±0.1	4000	16000
47 pF	B37871R5470K04*	0.85 ±0.1	4000	16000
100 pF	B37871R5101K04*	0.85 ±0.1	4000	16000
220 pF	B37871R5221K04*	0.85 ±0.1	4000	16000
330 pF	B37871R5331K04*	0.85 ±0.1	4000	16000
470 pF	B37871R5471K04*	0.85 ±0.1	4000	16000

Typical characteristics[1)]

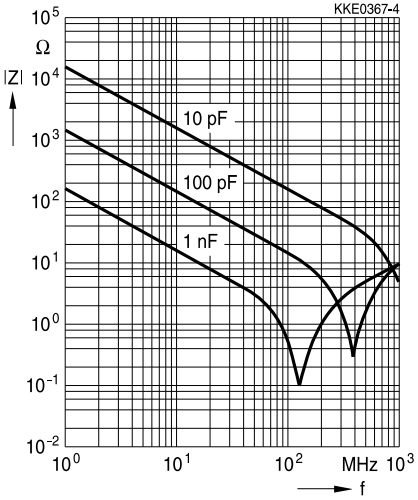
Capacitance change $\Delta C/C_{25}$ versus temperature T



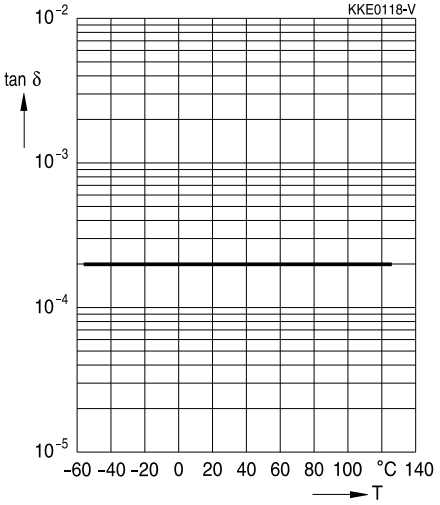
Capacitance change $\Delta C/C_0$ versus superimposed DC voltage V



Impedance |Z| versus frequency f



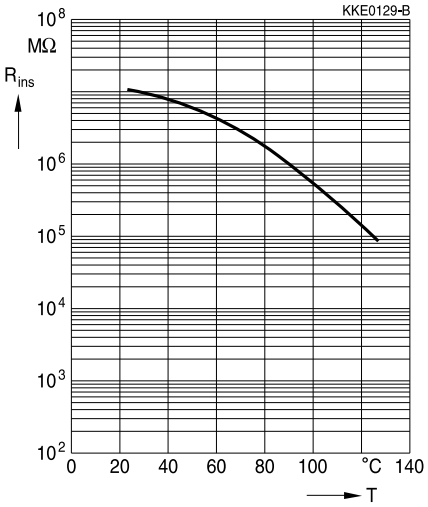
Dissipation factor tan δ versus temperature T



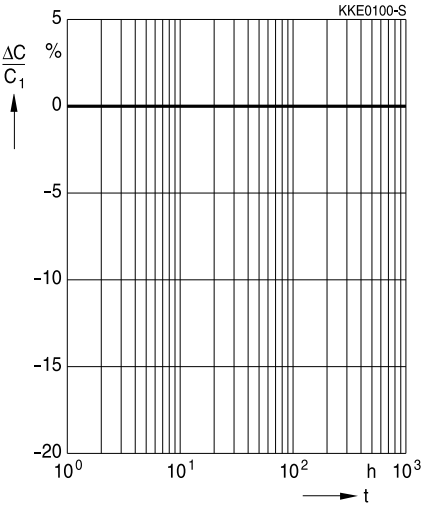
1) For more detailed information on frequency behavior and characteristics see www.epcos.com/mlcc_impedance.

Typical characteristics[1)]

Insulation resistance R_{ins} versus temperature T



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



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

Cautions and warnings

How to select ceramic capacitors

Remember the following when selecting ceramic capacitors:

1. Ceramic capacitors that must fulfill high quality requirements must be qualified based on AEC-Q200 Rev-C.
2. When ceramic capacitors are used at the connection to a battery or power supply (e.g. clamp 15 or 30 in an automobile) or for safety-relevant applications, two single ceramic capacitors should be connected in series. Alternatively a ceramic capacitor with integrated series circuits should be used in order to reduce the possibility of a short circuit caused by a fracture. The MLSC from EPCOS contains such a series circuit in a single component.
3. The use of multilayer varistors (MLVs) is recommended for ESD protection (see chapter “Effects on mechanical, thermal and electrical stress”, section 1.4).
4. Additional stress factors such as continuous operating voltage or application-specific derating must be taken into account in the selection of components (refer to chapter “Reliability”).

Recommendations for the circuit board design

1. Components with an optimized geometrical design are preferable where permitted by the application.
2. Use at least FR4 circuit board material.
3. Geometrically optimized circuit boards are preferable, especially those that cannot be deformed.
4. Ceramic capacitors should be placed with a sufficient minimum distance from the edge of a circuit board. High bending forces may be exerted there when boards are separated and during further processing of a board (e.g. when incorporating it in a housing).
5. Ceramic capacitors should always be placed parallel to the possible bending axis of a circuit board.
6. Screw connections should not be used to fix a board or connect several boards. Components should not be placed near screw holes. If screw connections are unavoidable, they should be cushioned, for instance using rubber pads.

Recommendations for processing

1. Ensure correct positioning of a ceramic capacitor on the solder pad.
2. Be careful when using casting, injection-molded and molding compounds and cleaning agents. They can damage a capacitor.
3. Support a circuit board and reduce placement forces.
4. Do not straighten a board (manually) if it is distorted by soldering.
5. Separate boards with a peripheral saw, or preferably with a milling head (no dicing or breaking).
6. Be careful when subsequently placing heavy or leaded components (e.g. transformers or snap-in components) because of the danger of bending and fracture.
7. When testing, transporting, packing or inserting a board, avoid any deformation of it so that components are not damaged.
8. Avoid excessive force when plugging a connector into a device soldered onto a board.
9. Only mount ceramic capacitors using the soldering process (reflow or wave) that is permissible for them (see chapter “Soldering directions”).
10. When soldering, select the softest solder profile possible (heating time, peak temperature, cooling time) to avoid thermal stress and damage.
11. Ensure the correct solder meniscus height and solder quantity.
12. Ensure correct dosing of the cement.
13. Ceramic capacitors with external silver-palladium terminations are intended for conductive adhesion - they are not suited for lead-free soldering processes.

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

Symbols and terms

Symbol	English	German
A	Area	Fläche
C	Capacitance	Kapazität
C_0	Initial (original) capacitance	Anfangskapazität
C_1	Capacitance value after one hour's use	Kapazitätswert nach einer Stunde
C_R	Rated capacitance	Nennkapazität
C_{20}	Capacitance at 20 °C	Kapazität bei 20 °C
C_{25}	Capacitance at 25 °C	Kapazität bei 25 °C
ΔC	Capacitance change	Kapazitätsänderung
D	Bending displacement	Durchbiegung
E_a	Activation energy	Aktivierungsenergie
ESR	Equivalent series resistance	Ersatzserienwiderstand
F	Force	Kraft
f	Frequency	Frequenz
f_{meas}	Measuring frequency	Messfrequenz
f_{res}	Self-resonant frequency	Eigenresonanzfrequenz
I_{test}	Test current	Prüfstrom
k	Ageing constant	Alterungskonstante
L	Inductance	Induktivität
N	Quantity (integer values)	Anzahl (ganzzahliger Wert)
P_{loss}	Power dissipation or loss	Verlustleistung
Q_{el}	Electrical charge	Elektrische Ladung
Q	Quality	Güte
R_{ins}	Insulation resistance	Isolationswiderstand
R_P	Parallel resistance	Parallelwiderstand
R_S	Series resistance (circuit resistance)	Serienwiderstand
S_V	Rate of rise of a voltage pulse	Flankensteilheit eines Spannungsimpulses
T	Temperature	Temperatur
T_{meas}	Measuring temperature	Messtemperatur
T_{op}	Operating temperature	Betriebstemperatur
T_{ref}	Reference temperature	Bezugstemperatur
T_{test}	Test temperature	Prüftemperatur
t	Time	Zeit
t_r	Rise time of a voltage pulse	Anstiegszeit eines Spannungsimpulses
t_{test}	Test duration	Prüfdauer
tan δ	Dissipation factor	Verlustfaktor

Symbol	English	German
V	Voltage	Spannung
V_0	Initial (original) voltage (basic voltage level)	Anfangsspannung (Spannungsgrundpegel)
V_{meas}	Measuring voltage	Messspannung
V_R	Rated voltage	Nennspannung
V_S	Amplitude of a voltage pulse	Hub des Spannungsimpulses
V_{RMS}	Measuring (root-mean-square or effective) AC voltage	Effektivspannung
V_{test}	Test voltage	Prüfspannung
|Z|	Magnitude of impedance (AC resistance)	Betrag der Impedanz (Wechselstromwiderstand)
α	Temperature coefficient	Temperaturkoeffizient
ε_0	Absolute dielectric constant	Absolute Dielektrizitätskonstante
ε_r	Relative dielectric constant	Relative Dielektrizitätskonstante
λ	Failure rate	Ausfallrate
τ	Time constant	Zeitkonstante

Abbreviations / Notes

Symbol	English	German
e	Lead spacing (in mm)	Rastermaß (in mm)
SMD	Surface-mounted devices	Oberflächenmontierbares Bauelement
*	To be replaced by a number in ordering codes, type designations etc.	Platzhalter für Zahl im Bestellnummern-code oder für die Typenbezeichnung.
+	To be replaced by a letter.	Platzhalter für einen Buchstaben.
	All dimensions are given in mm.	Alle Maße sind in mm angegeben.
	The commas used in numerical values denote decimal points.	Verwendete Kommas in Zahlenwerten bezeichnen Dezimalpunkte.

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 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 an electronic component could endanger human life or health (e.g. in accident prevention or lifesaving 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 an 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.
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