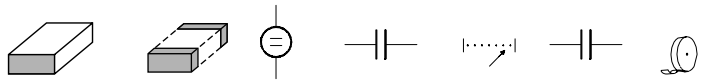
Multilayer ceramic capacitors

Chip capacitors, C0G

Date: October 2006

Ordering code system



B37940 K 5 010 C 5 60

Packaging

60 ≙ cardboard tape, 180-mm reel
62 ≙ blister tape, 180-mm reel
70 ≙ cardboard tape, 330-mm reel
72 ≙ blister tape, 330-mm reel
01 ≙ bulk case

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

Capacitance tolerance

C_R <10 pF:
B ≙ ±0.1 pF
C ≙ ±0.25 pF (standard for capacitance values ≤4.7 pF)
D ≙ ±0.5 pF (standard for capacitance values ≤8.2 pF)

C_R ≥10 pF:
F ≙ ± 1%
G ≙ ± 2%
J ≙ ± 5% (standard)
K ≙ ±10%

Capacitance, coded (example)
010 ≙ 1 · 10^0 pF = 1 pF
100 ≙ 10 · 10^0 pF = 10 pF
221 ≙ 22 · 10^1 pF = 220 pF

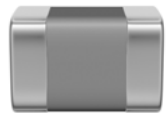
Rated voltage

Rated voltage [VDC]	50	100	200
Code	5	1	2

Termination
Standard: K ≙ nickel barrier for all case sizes
On request: J ≙ silver-palladium for conductive adhesion: all case sizes

Type and size	
Chip size (**inch** / mm)	Temperature characteristic C0G
0402 / 1005	B37920
0603 / 1608	B37930
0805 / 2012	B37940
1206 / 3216	B37871
1210 / 3225	B37949

SMD



Features

- Good thermal stability
- High insulation resistance
- Low dissipation factor
- Low inductance
- To AEC-Q200

Applications

- Resonant circuits
- Filter circuits
- Timing elements
- Coupling and filtering, particularly in RF circuits

Termination

- For soldering: Nickel barrier terminations (Ni)
- For conductive adhesion: Silver-palladium terminations (AgPd) on request

Options

- Alternative capacitance tolerances available on request

Delivery mode

- Cardboard and blister tape (blister tape for chip thickness ≥1.2 ±0.1 mm and case size 1210), 180-mm and 330-mm reel available
- Bulk case for case sizes 0402, 0603 (50 V) and 0805 (50 V) on request

Electrical data

Temperature characteristic		C0G	
Climatic category (IEC 60068-1)		55/125/56	
Standard		EIA	
Dielectric		Class 1	
Rated voltage	V_R	50, 100, 200	VDC
Test voltage	V_{test}	$2.5 \cdot V_R$/5 s	VDC
Capacitance range / E series	C_R	1 pF … 10 nF (E6/E12)	
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	

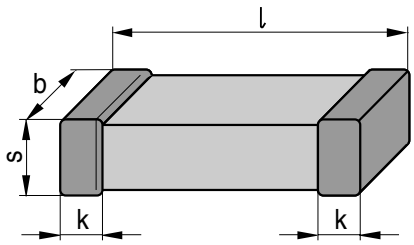
1) For C_R >10 nF the time constant $\tau = C \cdot R_{ins}$ is given.

Capacitance tolerances

	$C_R \leq 4.7$ pF			5.6 pF $\leq C_R \leq$ 8.2 pF		
Code letter	B	C (standard)	D	B	C	D (standard)
Tolerance	±0.1 pF (on request)	±0.25 pF	±0.5 pF	±0.1 pF (on request)	±0.25 pF (on request)	±0.5 pF

	$C_R \geq 10$ pF			
Code letter	F	G	J (standard)	K
Tolerance	±1% (on request for 50 V and 100 V; not available for 200 V)	±2% (on request for 50 V and 100 V; not available for 200 V)	±5%	±10%

Dimensional drawing



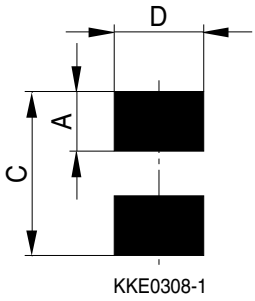
KKE0329-N

Dimensions (mm)

Case size (inch) (mm)	0402 1005	0603 1608	0805 2012	1206 3216	1210 3225
l	1.0 ±0.10	1.6 ±0.15	2.00 ±0.20	3.20 ±0.20	3.20 ±0.30
b	0.5 ±0.05	0.8 ±0.10	1.25 ±0.15	1.60 ±0.15	2.50 ±0.30
s	0.5 ±0.05	0.8 ±0.10	1.30 max.	1.30 max.	1.70 max.
k	0.1 –0.40	0.1 –0.40	0.13 –0.75	0.25 –0.75	0.25 –0.75

Tolerances to CECC 32101-801

Recommended solder pad



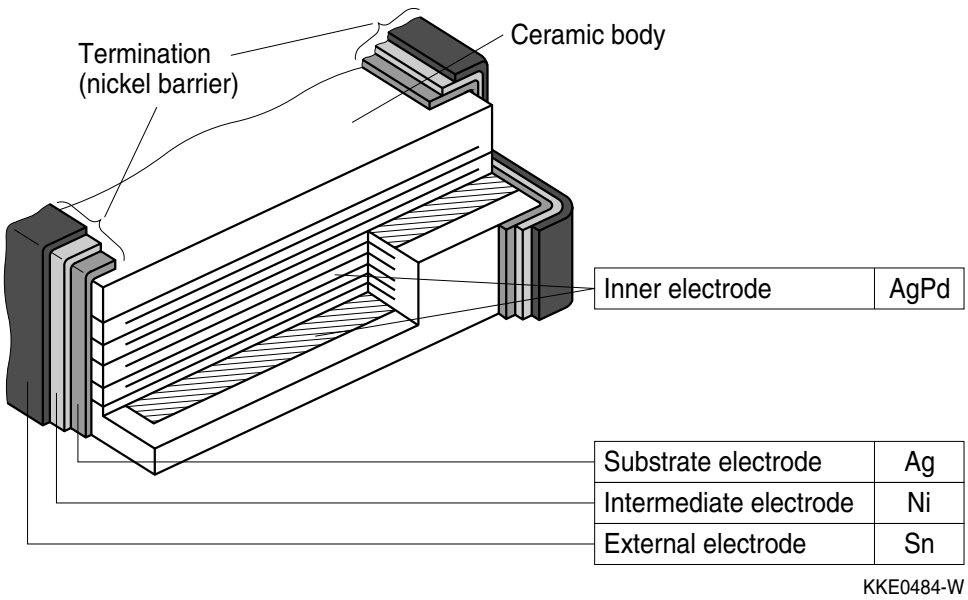
Recommended dimensions (mm) for reflow soldering

Case size	(inch/mm)	Type	A	C	D
	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
	1210/3225	single chip	1.00 … 1.20	4.0 … 4.80	1.8 … 2.3

Recommended dimensions (mm) for wave soldering

Case size	(inch/mm)	Type	A	C	D
	0603/1608	single chip	0.8 … 0.9	2.2 … 2.8	0.6 … 0.8
	0805/2012	single chip	0.9 … 1.0	2.8 … 3.2	0.8 … 1.1
	1206/3216	single chip	1.0 … 1.1	4.2 … 4.8	1.0 … 1.4

Termination



Product range chip capacitors, C0G

Size[1)] inch / mm	0402 / 1005		0603 / 1608		0805 / 2012			1206 / 3216			1210 / 3225		
Type	B37920		B37930		B37940			B37871			B37949		
V_R (VDC) / C_R	50		50	100	50	100	200	50	100		50	100	
1.0 pF			■	■	■	■		■	■				
1.2 pF			■		■	■		■					
1.5 pF			■	■	■	■		■	■				
1.8 pF			■		■	■		■					
2.2 pF			■	■	■	■	■	■	■				
2.7 pF			■		■	■		■					
3.3 pF	■		■	■	■	■	■	■	■				
3.9 pF	■		■		■	■		■					
4.7 pF	■		■	■	■	■	■	■	■				
5.6 pF	■		■		■	■		■					
6.8 pF	■		■	■	■	■	■	■	■				
8.2 pF	■		■		■	■		■					
10 pF	■		■	■	■	■	■	■	■				
12 pF	■		■		■	■		■					
15 pF	■		■	■	■	■	■	■	■				
18 pF	■		■		■	■		■					
22 pF	■		■	■	■	■	■	■	■				
27 pF	■		■		■	■		■					
33 pF	■		■	■	■	■	■	■	■				
39 pF	■		■		■	■		■					
47 pF	■		■	■	■	■	■	■	■				
56 pF	■		■		■	■		■					
68 pF	■		■	■	■	■	■	■	■				
82 pF	■		■		■	■		■					

1) l × b (inch) / l × b (mm)

Product range chip capacitors, C0G

Size[1)] inch / mm	0402 / 1005		0603 / 1608		0805 / 2012			1206 / 3216			1210 / 3225		
Type	B37920		B37930		B37940			B37871			B37949		
V_R (VDC) / C_R	50		50	100	50	100	200	50	100		50	100	
100 pF	■		■	■	■	■	■	■	■				
120 pF			■		■	■		■					
150 pF			■	■	■	■	■	■	■				
180 pF			■		■	■		■					
220 pF			■	■	■	■	■	■	■				
270 pF			■		■	■		■					
330 pF			■		■	■	■	■	■				
390 pF			■		■	■		■					
470 pF			■		■	■		■	■				
560 pF					■	■		■					
680 pF					■	■		■	■				
820 pF					■	■		■					
1.0 nF					■	■		■	■		■	■	
1.2 nF					■			■					
1.5 nF					■			■	■		■	■	
1.8 nF					■			■					
2.2 nF					■			■	■		■	■	
2.7 nF								■					
3.3 nF								■			■	■	
3.9 nF								■					
4.7 nF								■			■	■	
5.6 nF								■					
6.8 nF											■	■	
8.2 nF													
10 nF											■		

1) l × b (inch) / l × b (mm)

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

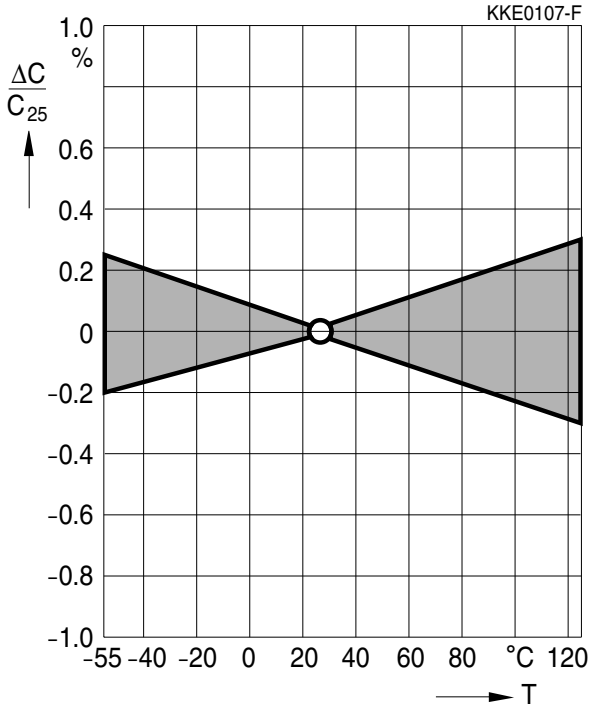
Case size 1206, 100 VDC

C_R	Ordering code[1)]	Chip thickness mm	Cardboard tape, ∅ 180-mm reel ** ≙ 60 pcs/reel	Cardboard tape, ∅ 330-mm reel ** ≙ 70 pcs/reel
1.0 pF	B37871K1010C0**	0.8 ±0.1	4000	16000
1.5 pF	B37871K1010C5**	0.8 ±0.1	4000	16000
2.2 pF	B37871K1020C2**	0.8 ±0.1	4000	16000
3.3 pF	B37871K1030C3**	0.8 ±0.1	4000	16000
4.7 pF	B37871K1040C7**	0.8 ±0.1	4000	16000
6.8 pF	B37871K1060D8**	0.8 ±0.1	4000	16000
10 pF	B37871K1100J0**	0.8 ±0.1	4000	16000
15 pF	B37871K1150J0**	0.8 ±0.1	4000	16000
22 pF	B37871K1220J0**	0.8 ±0.1	4000	16000
33 pF	B37871K1330J0**	0.8 ±0.1	4000	16000
47 pF	B37871K1470J0**	0.8 ±0.1	4000	16000
68 pF	B37871K1680J0**	0.8 ±0.1	4000	16000
100 pF	B37871K1101J0**	0.8 ±0.1	4000	16000
150 pF	B37871K1151J0**	0.8 ±0.1	4000	16000
220 pF	B37871K1221J0**	0.8 ±0.1	4000	16000
330 pF	B37871K1331J0**	0.8 ±0.1	4000	16000
470 pF	B37871K1471J0**	0.8 ±0.1	4000	16000
680 pF	B37871K1681J0**	0.8 ±0.1	4000	16000
1.0 nF	B37871K1102J0**	0.8 ±0.1	4000	16000
1.5 nF	B37871K1152J0**	0.8 ±0.1	4000	16000
2.2 nF	B37871K1222J0**	1.2 ±0.1	3000[2)]	12000[3)]

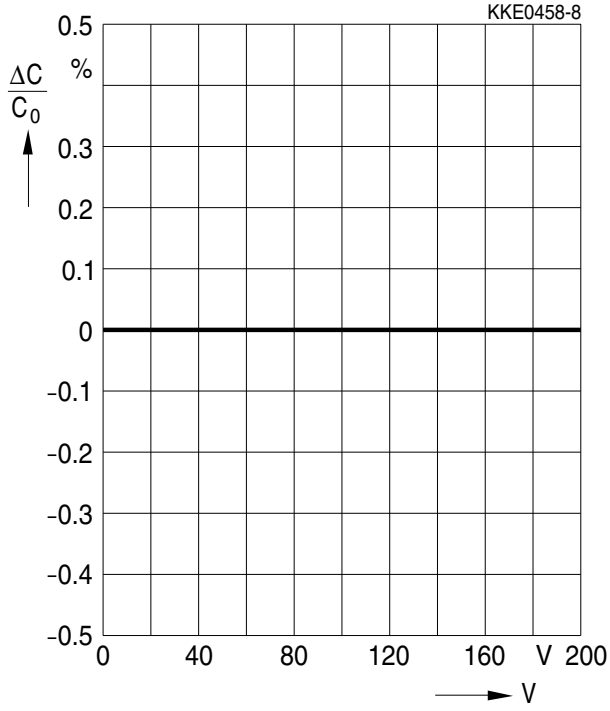
1) The table contains the ordering codes for the standard capacitance tolerance. For other available capacitance tolerances see page 4.
2) Blister tape, 180-mm reel, ordering code ** ≙ 62
3) Blister tape, 330-mm reel, ordering code ** ≙ 72

Typical characteristics[1)]

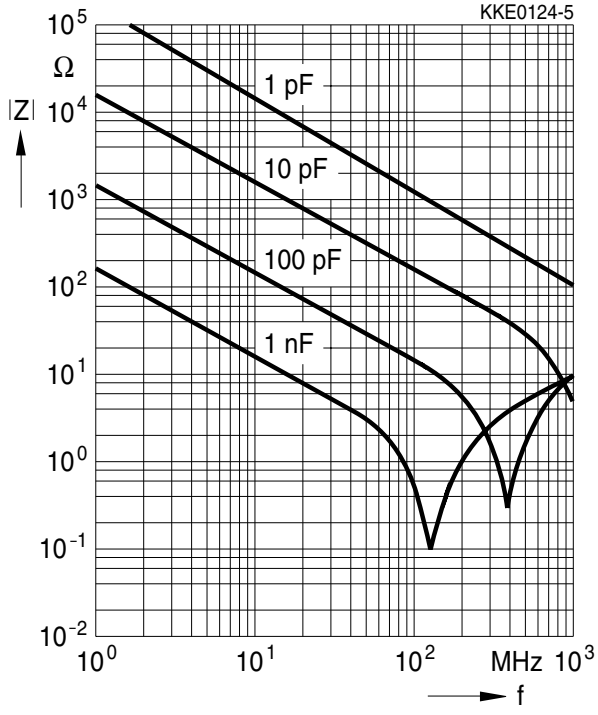
Capacitance change $\Delta C/C_{25}$ versus temperature T (tolerance range ▭)



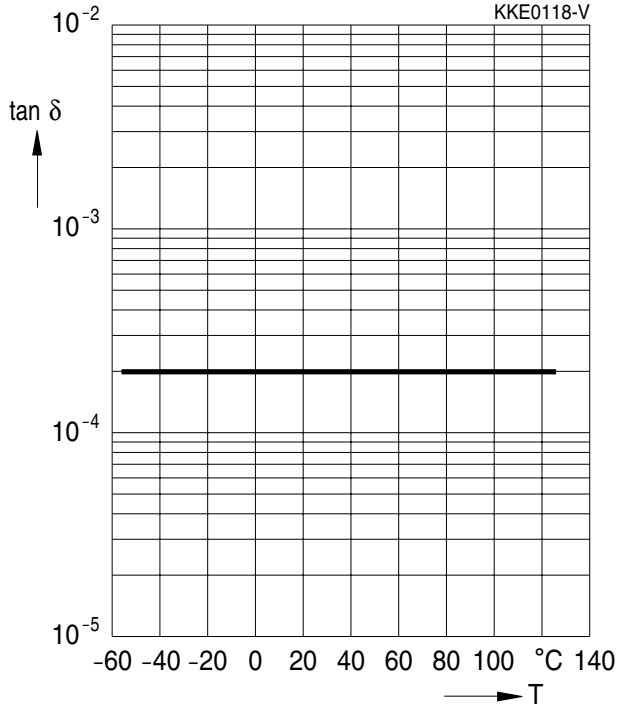
Capacitance change $\Delta C/C_0$ versus superimposed DC voltage V



Impedance |Z| versus frequency f



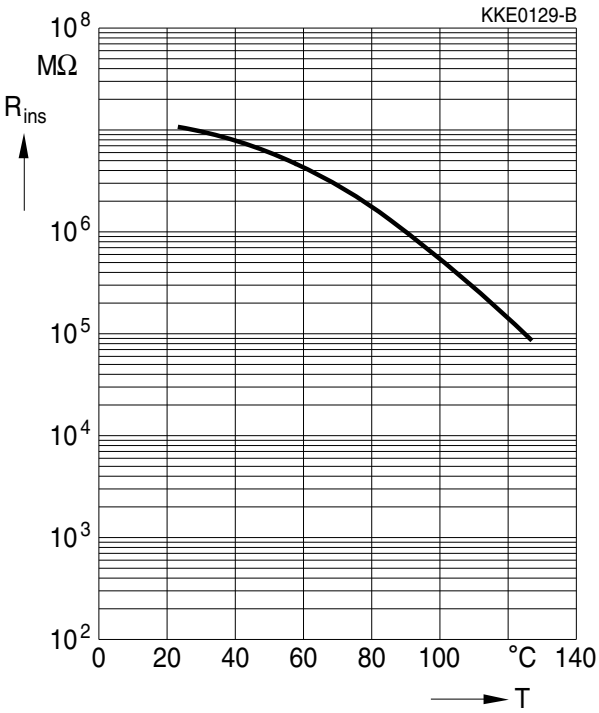
Dissipation factor tan δ versus temperature T



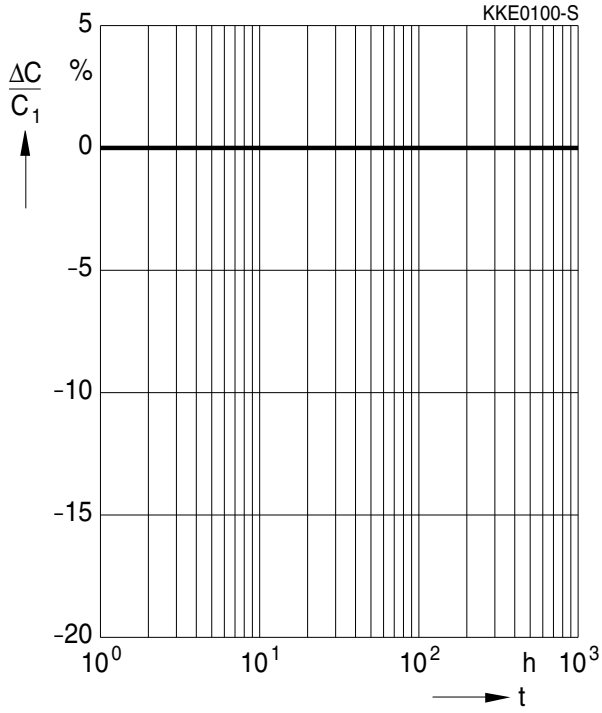
1) For more detailed information on frequency behavior and characteristics see www.epcos.com/mlcc_impedance.

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.

Notes on the selection of ceramic capacitors

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

1. Depending on the application, ceramic capacitors used to meet high quality requirements should at least satisfy the specifications to AEC-Q200. They must meet quality requirements going beyond this level in terms of ruggedness (e.g. mechanical, thermal or electrical) in the case of critical circuit configurations and applications (e.g. in safety-relevant applications such as ABS and airbag equipment or durable industrial goods).
2. At the connection to the battery or power supply (e.g. clamp 15 or 30 in the automobile) and at positions with stranding potential, to reduce the probability of short circuits following a fracture, two ceramic capacitors must be connected in series and/or a ceramic capacitor with integrated series circuit should be used. The MLSC from EPCOS contains such a series circuit in a single component.
3. Ceramic capacitors with the temperature characteristics Z5U and Y5V do not satisfy the requirements to AEC-Q200 and are mechanically and electrically less rugged than C0G or X7R/X8R ceramic capacitors. In applications that must satisfy high quality requirements, therefore, these capacitors should not be used as discrete components (see the chapter “Effects on mechanical, thermal and electrical stress”, point 1.4).
4. For ESD protection, preference should be given to the use of multilayer varistors (MLV) (see the chapter “Effects on mechanical, thermal and electrical stress”, point 1.4).
5. An application-specific derating or continuous operating voltage must be considered in order to cushion (unexpected) additional stresses (see the chapter “Reliability”).

The following should be considered in circuit board design

1. If technically feasible in the application, preference should be given to components having an optimal geometrical design.
2. At least FR4 circuit board material should be used.
3. Geometrically optimal circuit boards should be used, ideally those that cannot be deformed.
4. Ceramic capacitors must always be placed a sufficient minimum distance from the edge of the circuit board. High bending forces may be exerted there when the panels are separated and during further processing of the board (such as when incorporating it into a housing).
5. Ceramic capacitors should always be placed parallel to the possible bending axis of the circuit board.
6. No screw connections should be used to fix the board or to connect several boards. Components should not be placed near screw holes. If screw connections are unavoidable, they must be cushioned (for instance by rubber pads).

The following should be considered in the placement process

1. Ensure correct positioning of the ceramic capacitor on the solder pad.
2. Caution when using casting, injection-molded and molding compounds and cleaning agents, as these may damage the capacitor.
3. Support the circuit board and reduce the placement forces.
4. A board should not be straightened (manually) if it has been distorted by soldering.
5. Separate panels with a peripheral saw, or better with a milling head (no dicing or breaking).
6. Caution in the subsequent placement of heavy or leaded components (e.g. transformers or snap-in components): danger of bending and fracture.
7. When testing, transporting, packing or incorporating the board, avoid any deformation of the board not to damage the components.
8. Avoid the use of excessive force when plugging a connector into a device soldered onto the board.
9. Ceramic capacitors must be soldered only by the mode (reflow or wave soldering) permissible for them (see the chapter “Soldering directions”).
10. When soldering the most gentle solder profile feasible should be selected (heating time, peak temperature, cooling time) in order to avoid thermal stresses and damage.
11. Ensure the correct solder meniscus height and solder quantity.
12. Ensure correct dosing of the cement quantity.
13. Ceramic capacitors with an AgPd external termination are not suited for the lead-free solder process: they were developed only for conductive adhesion technology.

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

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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.
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