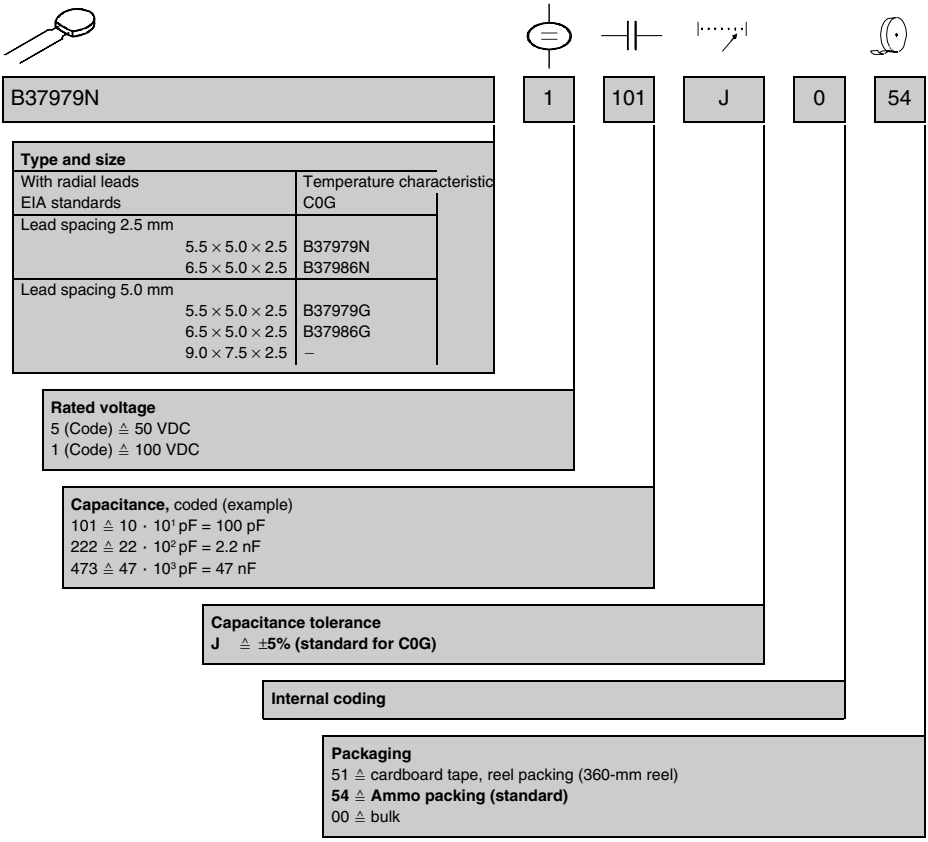
Multilayer ceramic capacitors

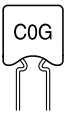
Leaded, C0G

Series/Type: **Leaded C0G**
Date: February 2009

C0G

Ordering code system





Features
- Good thermal stability
- High insulation resistance
- Low dissipation factor
- Low inductance

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

Termination
- Parallel wire leads, iron-nickel, tinned
- Crimped leads
- Non-standard lead lengths on request

Marking
- Rated capacitance, tolerance, manufacturer's logo, ceramic material, voltage

Options
- Alternative capacitance values and tolerances available on request

Delivery mode
- Cardboard tape in Ammo packing (standard)
- Cardboard tape on 360-mm reel or bulk on request

Electrical data

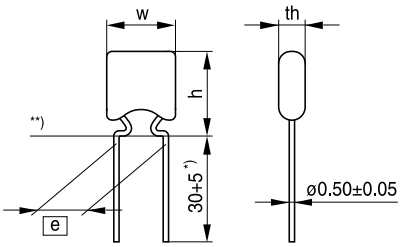
Temperature characteristic			C0G	
Climatic category	(IEC 60068-1)		55/125/56	
Standard			EIA	
Dielectric			Class 1	
Rated voltage		V_R	50, 100	VDC
Test voltage		V_{test}	$2.5 \cdot V_R$/5 s	VDC
Capacitance range		C_R	10 pF ... 10 nF (E6)	
Temperature coefficient			$0 \pm 30 \cdot 10^{-6}$/K	
Dissipation 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.

Capacity tolerance

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

Dimensional drawing

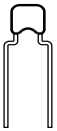
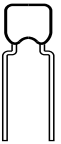


*) Lead length for bulk packaging
**) Seating plane to IEC 600717

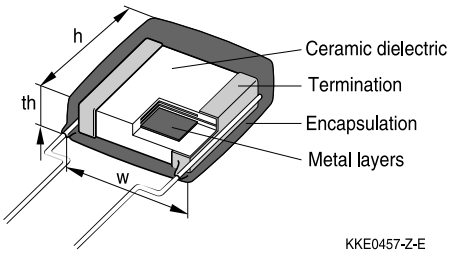
KKE0456-R-E

Dimensions (mm)

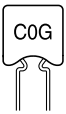
	Lead spacing e = 2.5 +0.6/−0.1 mm	
Type	B37979N	B37986N
		
h_{max}	5.5	6.0
w_{max}	5.0	5.0
th_{max}	2.5	2.5

	Lead spacing e = 5.0 +0.6/−0.1 mm	
Type	B37979G	B37986G
		
h_{max}	5.5	6.5
w_{max}	5.0	5.0
th_{max}	2.5	2.5

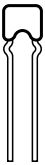
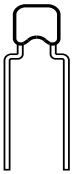
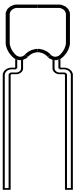
Termination



KKE0457-Z-E



Product range for leaded capacitors, C0G

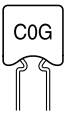
Lead spacing	2.5 mm				5.0 mm			
								
h x w x th	5.5 × 5.0 × 2.5		6.5 × 5.0 × 2.5		5.5 × 5.0 × 2.5		6.5 × 5.0 × 2.5	
Type	B37979N		B37986N		B37979G		B37986G	
C_R \ V_R (VDC)	50	100	50	100	50	100	50	100
10 pF								
15 pF								
22 pF								
33 pF								
47 pF								
68 pF								
100 pF								
150 pF								
220 pF								
330 pF								
470 pF								
680 pF								
1.0 nF								
1.5 nF								
2.2 nF								
3.3 nF								
4.7 nF								
6.8 nF								
10 nF								

Ordering codes and packing for C0G, 50 VDC, lead spacing 2.5 mm

		Ammo packing	Reel packing	Bulk
		** ≙ 54	** ≙ 51	** ≙ 00
C_R	Ordering code	pcs.	pcs./reel	pcs.
B37979N, 50 VDC				
100 pF	B37979N5101J0**	2500	2500	2000
150 pF	B37979N5151J0**	2500	2500	2000
220 pF	B37979N5221J0**	2500	2500	2000
330 pF	B37979N5331J0**	2500	2500	2000
470 pF	B37979N5471J0**	2500	2500	2000
680 pF	B37979N5681J0**	2500	2500	2000
1.0 nF	B37979N5102J0**	2500	2500	2000
1.5 nF	B37979N5152J0**	2500	2500	2000
2.2 nF	B37979N5222J0**	2500	2500	2000
B37986N, 50 VDC				
3.3 nF	B37986N5332J0**	2500	2500	2000
4.7 nF	B37986N5472J0**	2500	2500	2000
6.8 nF	B37986N5682J0**	2500	2500	2000
10 nF	B37986N5103J0**	2500	2500	2000

Ordering codes and packing for C0G, 50 VDC, lead spacing 5.0 mm

		Ammo packing	Reel packing	Bulk
		** ≙ 54	** ≙ 51	** ≙ 00
C_R	Ordering code	pcs.	pcs./reel	pcs.
B37979G, 50 VDC				
100 pF	B37979G5101J0**	2500	2500	2000
150 pF	B37979G5151J0**	2500	2500	2000
220 pF	B37979G5221J0**	2500	2500	2000
330 pF	B37979G5331J0**	2500	2500	2000
470 pF	B37979G5471J0**	2500	2500	2000
680 pF	B37979G5681J0**	2500	2500	2000
1.0 nF	B37979G5102J0**	2500	2500	2000
1.5 nF	B37979G5152J0**	2500	2500	2000
2.2 nF	B37979G5222J0**	2500	2500	2000



Ordering codes and packing for C0G, 50 VDC, lead spacing 5.0 mm

		Ammo packing	Reel packing	Bulk
		** ≙ 54	** ≙ 51	** ≙ 00
C_R	Ordering code	pcs.	pcs./reel	pcs.
B37986G, 50 VDC				
3.3 nF	B37986G5332J0**	2500	2500	2000
4.7 nF	B37986G5472J0**	2500	2500	2000
6.8 nF	B37986G5682J0**	2500	2500	2000
10 nF	B37986G5103J0**	2500	2500	2000

Ordering codes and packing for C0G, 100 VDC, lead spacing 2.5 mm

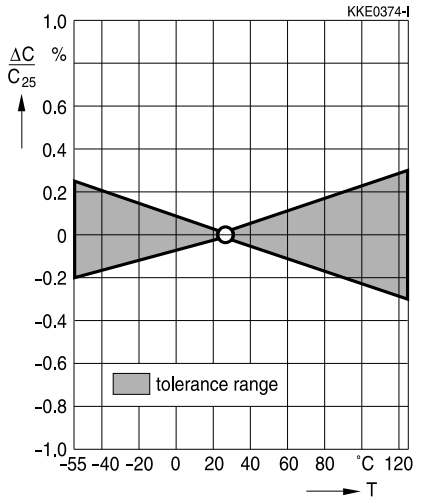
		Ammo packing	Reel packing	Bulk
		** ≙ 54	** ≙ 51	** ≙ 00
C_R	Ordering code	pcs.	pcs./reel	pcs.
B37979N, 100 VDC				
10 pF	B37979N1100J0**	2500	2500	2000
15 pF	B37979N1150J0**	2500	2500	2000
22 pF	B37979N1220J0**	2500	2500	2000
33 pF	B37979N1330J0**	2500	2500	2000
47 pF	B37979N1470J0**	2500	2500	2000
68 pF	B37979N1680J0**	2500	2500	2000
100 pF	B37979N1101J0**	2500	2500	2000
150 pF	B37979N1151J0**	2500	2500	2000
220 pF	B37979N1221J0**	2500	2500	2000
330 pF	B37979N1331J0**	2500	2500	2000
470 pF	B37979N1471J0**	2500	2500	2000
680 pF	B37979N1681J0**	2500	2500	2000
1.0 nF	B37979N1102J0**	2500	2500	2000
B37986N, 100 VDC				
1.5 nF	B37986N1152J0**	2500	2500	2000
2.2 nF	B37986N1222J0**	2500	2500	2000

Ordering codes and packing for C0G, 100 VDC, lead spacing 5.0 mm

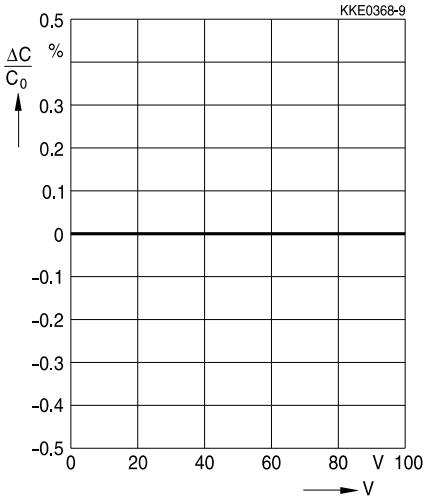
		Ammo packing	Reel packing	Bulk
		** ≙ 54	** ≙ 51	** ≙ 00
C_R	Ordering code	pcs.	pcs./reel	pcs.
B37979G, 100 VDC				
10 pF	B37979G1100J0**	2500	2500	2000
15 pF	B37979G1150J0**	2500	2500	2000
22 pF	B37979G1220J0**	2500	2500	2000
33 pF	B37979G1330J0**	2500	2500	2000
47 pF	B37979G1470J0**	2500	2500	2000
68 pF	B37979G1680J0**	2500	2500	2000
100 pF	B37979G1101J0**	2500	2500	2000
150 pF	B37979G1151J0**	2500	2500	2000
220 pF	B37979G1221J0**	2500	2500	2000
330 pF	B37979G1331J0**	2500	2500	2000
470 pF	B37979G1471J0**	2500	2500	2000
680 pF	B37979G1681J0**	2500	2500	2000
1.0 nF	B37979G1102J0**	2500	2500	2000
B37986G, 100 VDC				
1.5 nF	B37986G1152J0**	2500	2500	2000
2.2 nF	B37986G1222J0**	2500	2500	2000

Typical characteristics

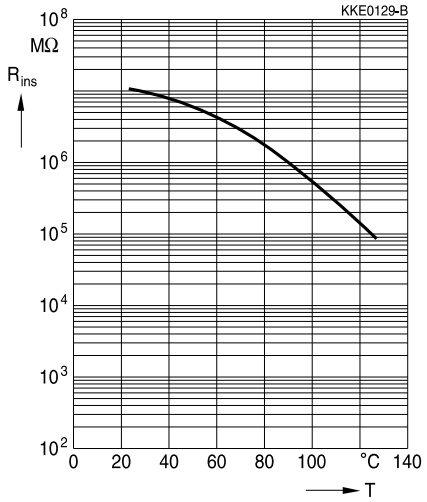
Capacitance change $\Delta C/C_{25}$ versus temperature T



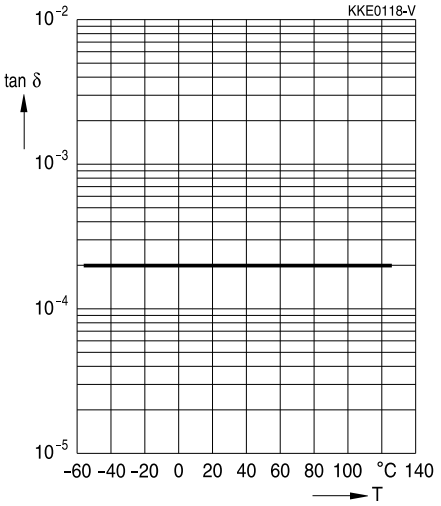
Capacitance change $\Delta C/C_0$ versus superimposed DC voltage V



Insulation resistance R_{ins} versus temperature T

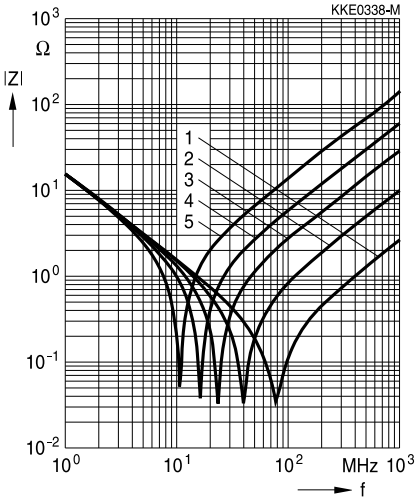


Dissipation factor tan δ versus temperature T

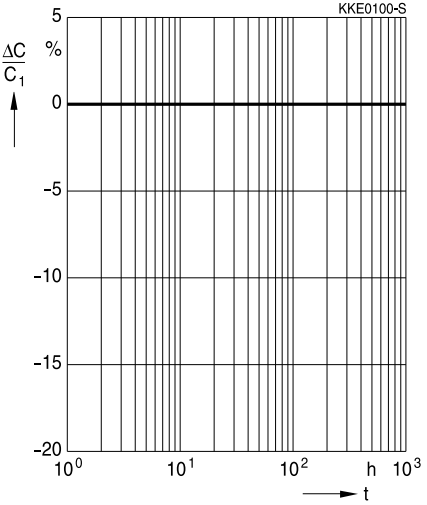


Typical characteristics

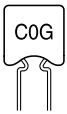
Impedance |Z| versus frequency f



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



1: SMD chip capacitor
2: 1.5 mm lead length
3: 5.0 mm lead length
4: 10.0 mm lead length
5: 20.0 mm lead length



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”).

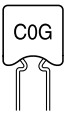
Recommendations for the circuit board design

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.
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. The aforementioned does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.
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)**.
7. The trade names EPCOS, BAOKE, Alu-X, CeraDiode, CSMP, CSSP, CTVS, DSSP, MiniBlue, MKK, MLSC, MotorCap, PCC, PhaseCap, PhaseCube, PhaseMod, SIFERRIT, SIFI, SIKOREL, SilverCap, SIMDAD, SIMID, SineFormer, SIOV, SIP5D, SIP5K, ThermoFuse, WindCap are **trademarks registered or pending** in Europe and in other countries. Further information will be found on the Internet at www.epcos.com/trademarks.