Multilayer ceramic capacitors

Feedthrough chip, X7R

Series/Type: **Feedthrough chip**

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The following products presented in this data sheet are being withdrawn.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
B37872U5222S011		2009-06-26	2010-06-30	2010-12-31
B37872U5472S011		2009-06-26	2010-06-30	2010-12-31
B37872U5103S011		2009-06-26	2010-06-30	2010-12-31

Ordering Code	Substitute Product	Date of Withdrawal	Deadline Last Orders	Last Shipments
B37971U5224Z012		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.

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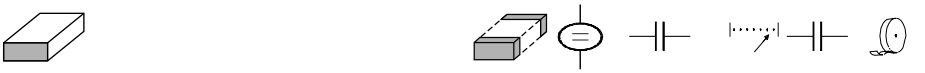
Ordering code system



B37872	U	5	222	S	0	11

Type and size
Chip size (inch/mm) = Temperature characteristic X7R
1206/3216 ≙ B37872
1806/4616 ≙ B37971

Internal coding
"U" indicates feedthrough chip capacitor

Rated voltage
5 (Code) ≙ 50 VDC
1 (Code) ≙ 100 VDC

Capacitance, coded (example)
222 ≙ 22 · 10^2 pF = 2.2 nF
472 ≙ 47 · 10^2 pF = 4.7 nF

Capacitance tolerance
S ≙ +50% / −20% (standard for 1206)
Z ≙ +80% / −20% (standard for 1806)

Internal coding

Packaging
11 ≙ cardboard tape, 180-mm reel
12 ≙ blister tape, 180-mm reel

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Features

- Excellent EMI suppression
- Low parasitic inductance and low electrical losses
- High attenuation at higher natural resonant frequency
- Space saving on the PCB
- Based on AEC-Q200 Rev-C

Applications

- EMI suppression / Decoupling and filtering
- Noise suppression and broadband I/O filtering
- Automotive brake systems (e.g. ABS)
- Hall sensors

Termination

- 4 terminations, nickel barrier terminations (Ni) for lead-free soldering

Options

- Alternative capacitance values, capacitance tolerances, C0G characteristic and feedthrough arrays available on request

Delivery mode

- Cardboard tape, 180-mm reel

Electrical data

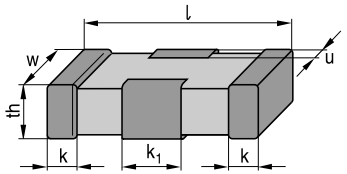
Temperature characteristic			X7R	
Max. relative capacitance change	within −55 ... +125 °C	$\Delta C/C$	±15	%
Climatic category	(IEC 60068-1)		55/125/56	
Standard			EIA	
Dielectric			Class 2	
Rated voltage[1)]		V_R	50, 100	VDC
Test voltage		V_{test}	$2.5 \cdot V_R$/5 s	VDC
Capacitance range		C_R	2.2 nF ... 10 nF; 220 nF	
Dissipation factor	(limit value)	tan δ	$< 25 \cdot 10^{-3}$	
DC resistance		R_{DC}	< 600	mΩ
Insulation resistance[2)]	(at +25 °C)	R_{ins}	$> 10^5$	MΩ
Insulation resistance[2)]	(at +125 °C)	R_{ins}	$> 10^4$	MΩ
Time constant[2)]	(at +25 °C)	τ	> 1000	s
Time constant[2)]	(at +125 °C)	τ	> 100	s
Operating temperature range		T_{op}	−55 ... +125	°C
Ageing[3)]			yes	

1) Note: No operation on AC line.
2) For C_R >10 nF the time constant $\tau = C \cdot R_{ins}$ is given.
3) Refer to chapter "General technical information", "Ageing".

Capacitance tolerances

Code letter	S (standard for 1206)	Z (standard for 1806)
Tolerance	+50/−20%	+80/−20%

Dimensional drawing



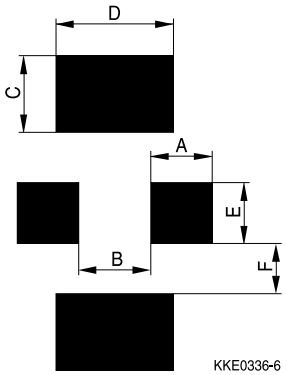
KKE0328-F

Dimensions (mm)

Case size (inch) / (mm)	1206 / 3216	1806 / 4616
l	3.20 ±0.20	4.60 ±0.20
w	1.60 ±0.15	1.60 ±0.30
th	0.90 max.	1.20 max.
k	0.40 ±0.20	0.40 ±0.30
k_1	1.00 ±0.35	1.50 ±0.30
u	0.20 +0.20/−0.10	0.30 +0.30/−0.20

Tolerances to CECC 32101-801

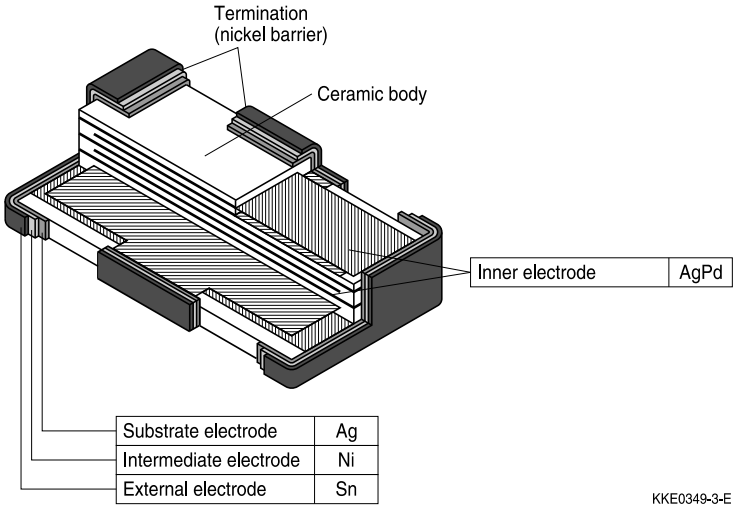
Recommended solder pad

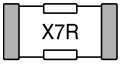


Recommended dimensions (mm) for reflow soldering

Case size	(inch/mm)	Type	A	B	C	D	E	F
	1206/3216	feedthrough chip	0.73 ... 0.83	0.93 ... 1.20	0.80 ... 0.90	1.00 ... 1.40	0.73 ... 0.83	0.74 ... 0.85
	1806/4616	feedthrough chip	1.00	0.60	1.00	2.00	1.50	1.00

Termination





Multilayer ceramic capacitors

X7R

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Product range for feedthrough capacitors, X7R

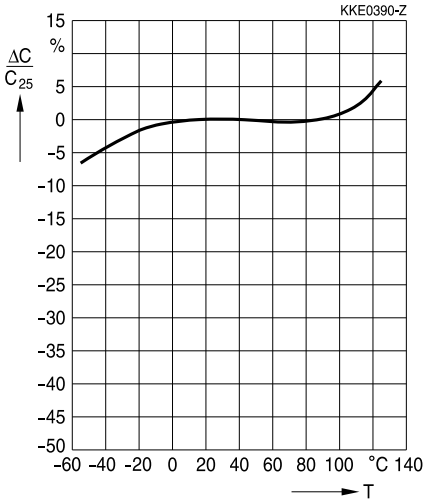
Size **inch (l x w)** mm (l x w)	**1206** 3216	**1806** 1806
Type	B37872U	B37971U
C_R \ V_R (VDC)	50	50
2.2 nF		
4.7 nF		
10 nF		
220 nF		

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

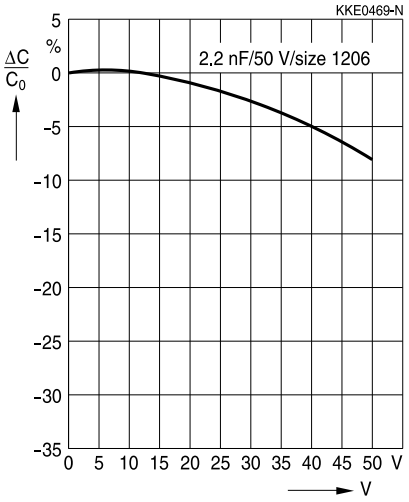
		Chip thickness	Cardboard tape, ∅180-mm reel	Blister tape, ∅180-mm reel
			** ≙ 11	** ≙ 12
C_R	Ordering code	mm	pcs./reel	pcs./reel
Case size 1206, 50 VDC				
2.2 nF	B37872U5222S0**	0.8 ±0.1	4000	-
4.7 nF	B37872U5472S0**	0.8 ±0.1	4000	-
10 nF	B37872U5103S0**	0.8 ±0.1	4000	-
Case size 1806, 50 VDC				
220 nF	B37971U5224Z0**	1.0 ±0.2	-	3000

Typical characteristics[1)]

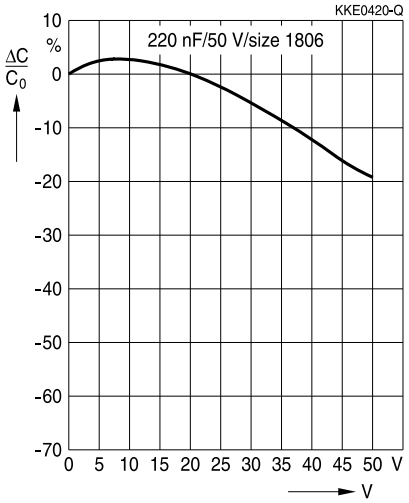
Capacitance change $\Delta C/C_{25}$ versus temperature T



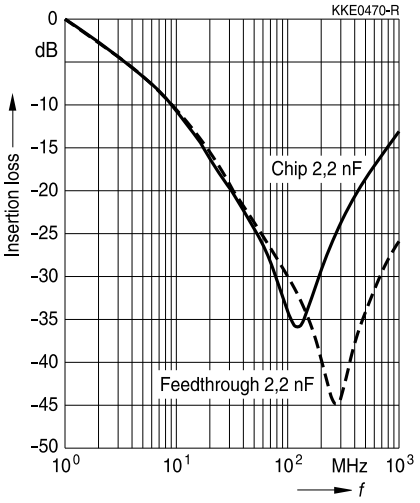
Capacitance change $\Delta C/C_0$ versus superimposed DC voltage V



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



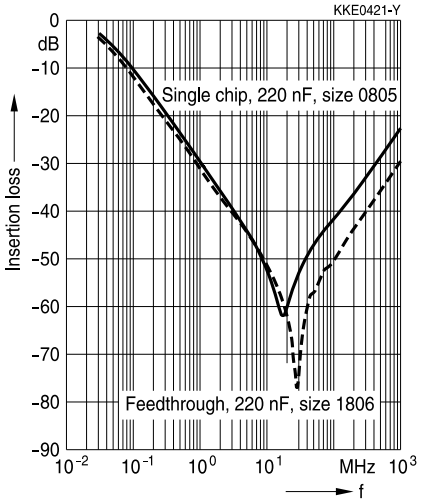
Insertion loss dB versus frequency f



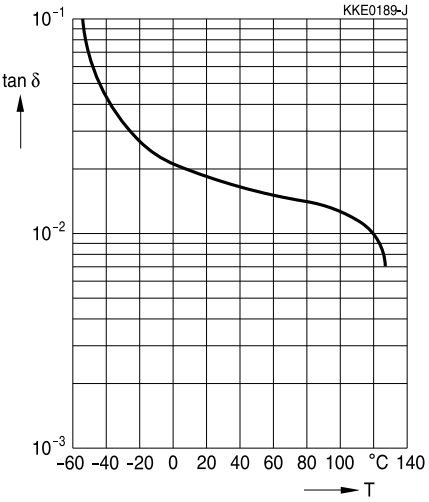
1) For more detailed information on frequency behavior and characteristics see www.epcos.com/mlcc_impedance.

Typical characteristics[1)]

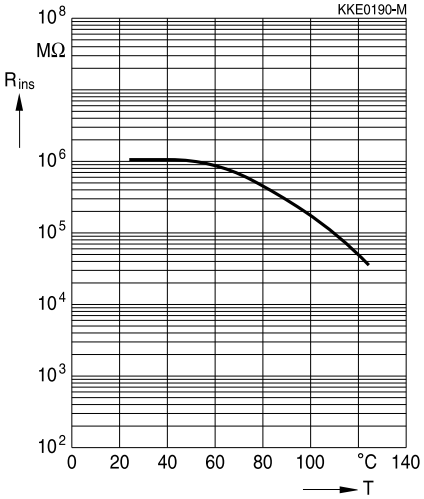
Insertion loss dB versus frequency f



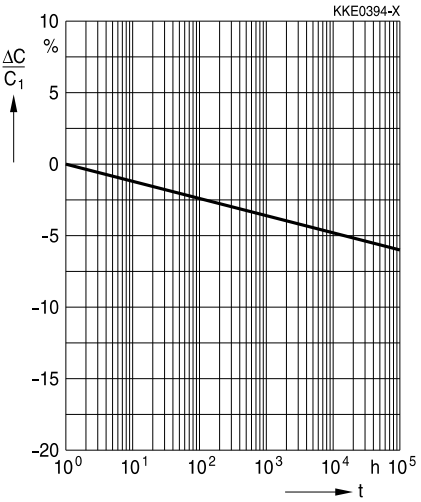
Dissipation factor tan δ versus temperature T



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.

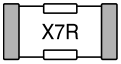
Recommendations for processing

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



Multilayer ceramic capacitors

X7R

SMD

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:

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