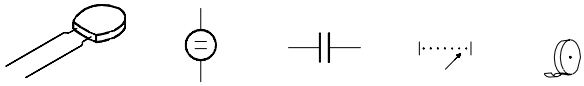
Multilayer ceramic capacitors

Leaded capacitors, Z5U (Y5U)

Date: October 2006

Ordering code system



B37979N 1 100 K 0 54

Packaging

51 ≙ cardboard tape, reel packing (360-mm reel)
54 ≙ Ammo packing (standard)
00 ≙ bulk

Internal coding

Capacitance tolerance

J ≙ ± 5% (standard for C0G)
K ≙ ±10% (standard for X7R)
M ≙ ±20% (standard for Z5U (Y5U))

Capacitance, coded (example)

101 ≙ 10 · 10^1 pF = 100 pF
222 ≙ 22 · 10^2 pF = 2.2 nF
473 ≙ 47 · 10^3 pF = 47 nF

Rated voltage

Rated voltage [VDC]	50	100
Code	5	1

Type and size			
With radial leads EIA standard	Temperature characteristic C0G	X7R	Z5U (Y5U)
Lead spacing 2.5 mm			
5.5 × 5.0 × 2.5	B37979N	B37981M	B37982N
6.5 × 5.0 × 2.5	B37986N	B37987M	B37988N
Lead spacing 5.0 mm			
5.5 × 5.0 × 2.5	B37979G	B37981F	B37982G
6.5 × 5.0 × 2.5	B37986G	B37987F	B37988G
9.0 × 7.5 × 2.5	—	B37984M	B37985N

Features

- Extremely high volumetric efficiency
- Non-linear capacitance change
- Y5U characteristic is also fulfilled

Applications

- Blocking
- Coupling
- Decoupling
- Interference suppression

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

Delivery mode

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

Electrical data

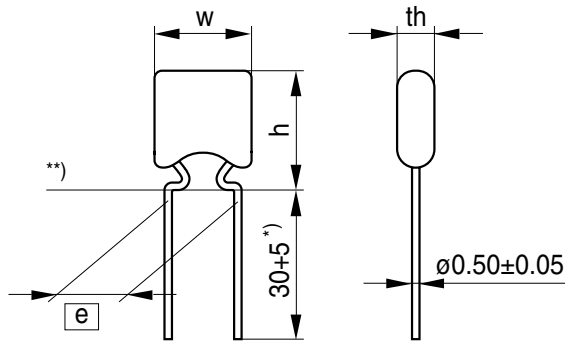
Temperature characteristic		Z5U (Y5U) [1]	
Max. relative capacitance change within –30 °C to +85 °C	$\Delta C/C$	+22/–56	%
Climatic category (IEC 60068-1)		30/85/56	
Standard		EIA	
Dielectric		Class 2	
Rated voltage [2]	V_R	50	VDC
Test voltage	V_{test}	$2.5 \cdot V_R$/5 s	VDC
Capacitance range / E series	C_R	10 nF … 4.7 µF (E6)	
Dissipation factor (limit value)	tan δ	$<50 \cdot 10^{-3}$	
Insulation resistance [3] at +25 °C	R_{ins}	$>10^4$	MΩ
Time constant [3] at +25 °C	τ	>500	s
Operating temperature range	T_{op}	–30 … +85	°C
Ageing [4]		yes	

1) Y5U specification is also fulfilled.
2) Note: No operation on AC line.
3) For C_R >10 nF the time constant $\tau = C \cdot R_{ins}$ is given.
4) Refer to chapter "General technical information", "Ageing".

Capacitance tolerances

Code letter	M
Tolerance	±20%

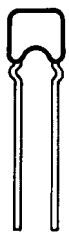
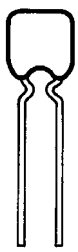
Dimensional drawing

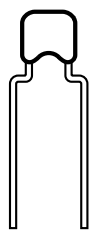
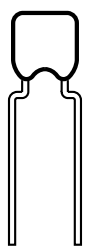
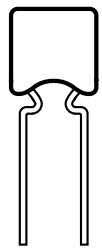


*) Lead length for bulk packaging
**) Seating plane to IEC 600717

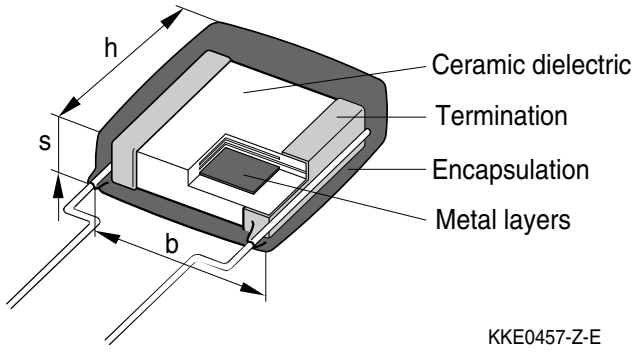
KKE0456-R-E

Dimensions (mm)

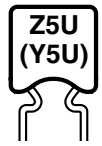
	Lead spacing e = 2.5 +0.6/−0.1 mm	
Type	B37982N	B37988N
		
h_{max}	5.5	6.5
w_{max}	5.0	5.0
th_{max}	2.5	2.5

	Lead spacing e = 5.0 +0.6/−0.1 mm		
Type	B37982G	B37988G	B37985N
			
h_{max}	5.5	6.5	9.0
w_{max}	5.0	5.0	7.5
th_{max}	2.5	2.5	2.5

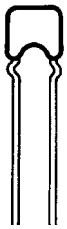
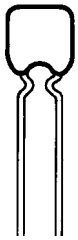
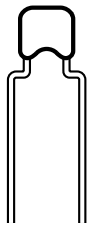
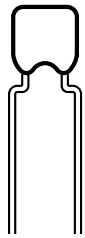
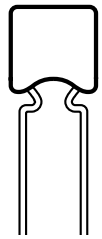
Termination



KKE0457-Z-E



Product range leaded capacitors, Z5U (Y5U)

Lead spacing	2.5 mm				5.0 mm					
										
h × b × s (mm)	5.5 × 5.0 × 2.5		6.5 × 5.0 × 2.5		5.5 × 5.0 × 2.5		6.5 × 5.0 × 2.5		9.0 × 7.5 × 2.5	
Type	B37982N		B37988N		B37982G		B37988G		B37985N	
V_R (VDC) / C_R	50		50		50		50		50	
10 nF	■				■					
15 nF	■				■					
22 nF	■				■					
33 nF	■				■					
47 nF	■				■					
68 nF	■				■					
100 nF	■				■					
150 nF	■				■					
220 nF			■				■			
330 nF			■				■			
470 nF			■				■			
680 nF			■				■			
1.0 µF			■				■			
1.5 µF									■	
2.2 µF									■	
3.3 µF									■	
4.7 µF									■	

Ordering codes and packing for Z5U (Y5U), 50 VDC, lead spacing 2.5 mm

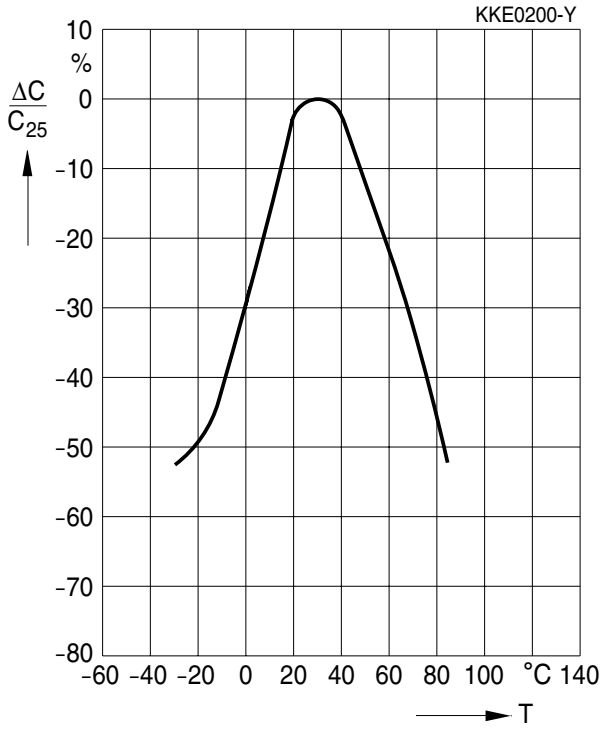
C_R	Ordering code	Ammo packing ** ≙ 54 pcs	Reel packing ** ≙ 51 pcs/reel	Bulk ** ≙ 00 pcs
B37982, 50 VDC				
10 nF	B37982N5103M0**	2500	2500	2000
15 nF	B37982N5153M0**	2500	2500	2000
22 nF	B37982N5223M0**	2500	2500	2000
33 nF	B37982N5333M0**	2500	2500	2000
47 nF	B37982N5473M0**	2500	2500	2000
68 nF	B37982N5683M0**	2500	2500	2000
100 nF	B37982N5104M0**	2500	2500	2000
150 nF	B37982N5154M0**	2500	2500	2000
B37988, 50 VDC				
220 nF	B37988N5224M0**	2500	2500	2000
330 nF	B37988N5334M0**	2500	2500	2000
470 nF	B37988N5474M0**	2500	2500	2000
680 nF	B37988N5684M0**	2500	2500	2000
1.0 µF	B37988N5105M0**	2500	2500	2000

Ordering codes and packing for Z5U (Y5U), 50 VDC, lead spacing 5.0 mm

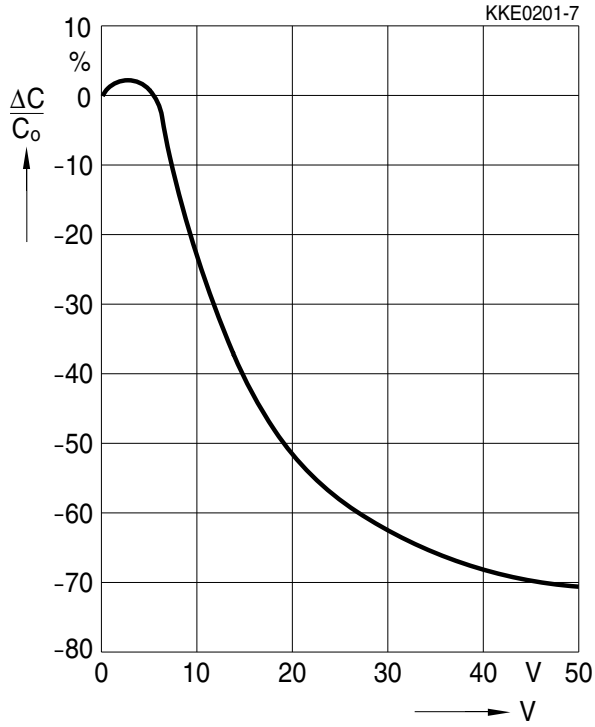
C_R	Ordering code	Ammo packing ** ≙ 54 pcs	Reel packing ** ≙ 51 pcs/reel	Bulk ** ≙ 00 pcs
B37982, 50 VDC				
10 nF	B37982G5103M0**	2500	2500	2000
15 nF	B37982G5153M0**	2500	2500	2000
22 nF	B37982G5223M0**	2500	2500	2000
33 nF	B37982G5333M0**	2500	2500	2000
47 nF	B37982G5473M0**	2500	2500	2000
68 nF	B37982G5683M0**	2500	2500	2000
100 nF	B37982G5104M0**	2500	2500	2000
150 nF	B37982G5154M0**	2500	2500	2000
B37988, 50 VDC				
220 nF	B37988G5224M0**	2500	2500	2000
330 nF	B37988G5334M0**	2500	2500	2000
470 nF	B37988G5474M0**	2500	2500	2000
680 nF	B37988G5684M0**	2500	2500	2000
1.0 µF	B37988G5105M0**	2500	2500	2000
B37985, 50 VDC				
1.5 µF	B37985N5155M0**	2000	2000	1000
2.2 µF	B37985N5225M0**	2000	2000	1000
3.3 µF	B37985N5335M0**	2000	2000	1000
4.7 µF	B37985N5475M0**	2000	2000	1000

Typical characteristics

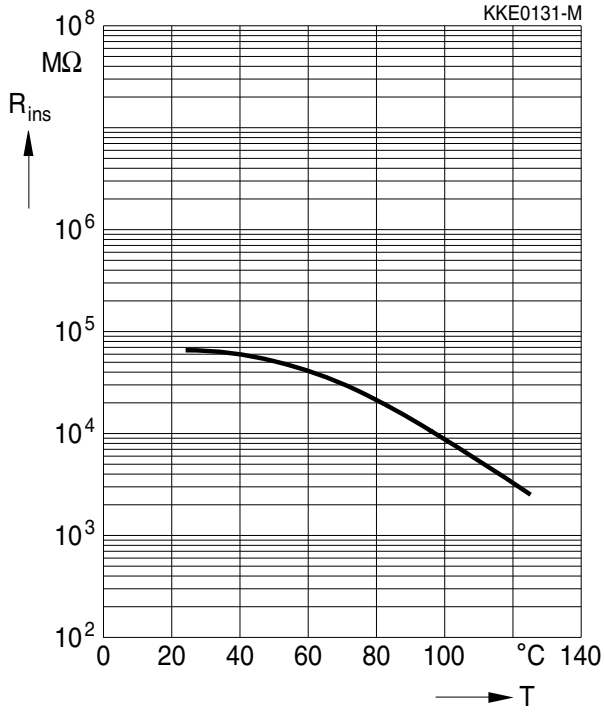
Capacitance change $\Delta C/C_{25}$ versus temperature T



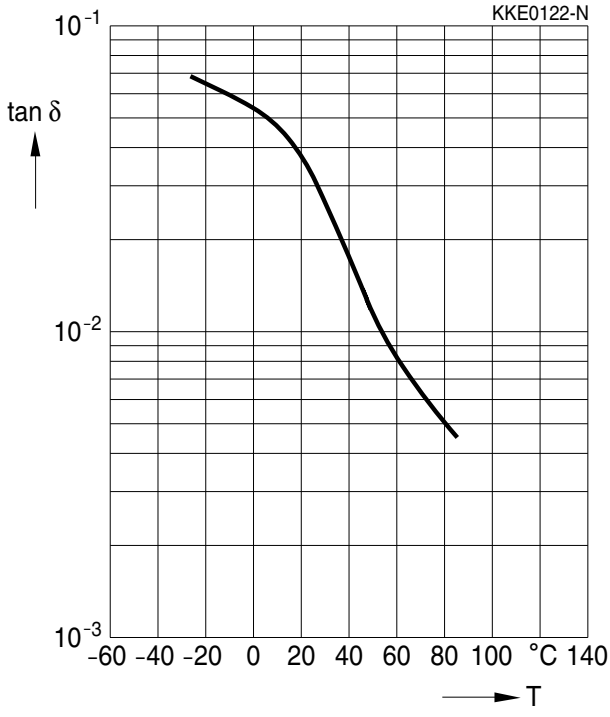
Capacitance change $\Delta C/C_0$ versus superimposed DC voltage V



Insulation resistance R_{ins} versus temperature T

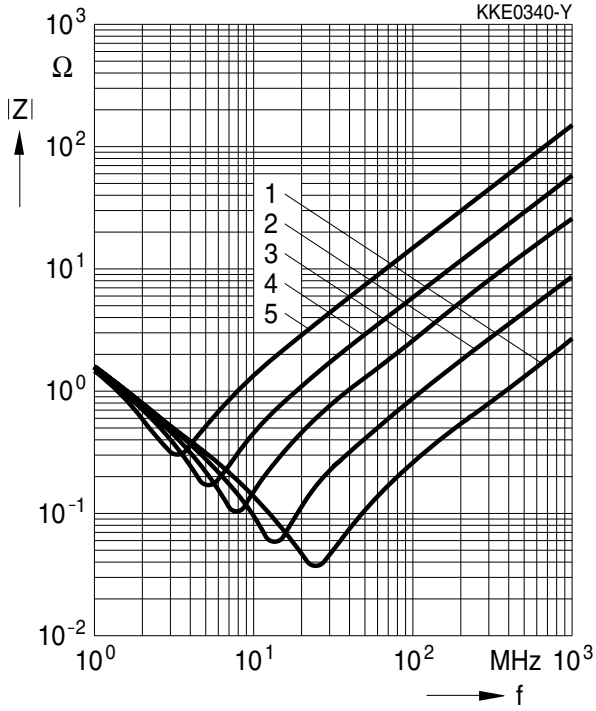


Dissipation factor tan δ versus temperature T

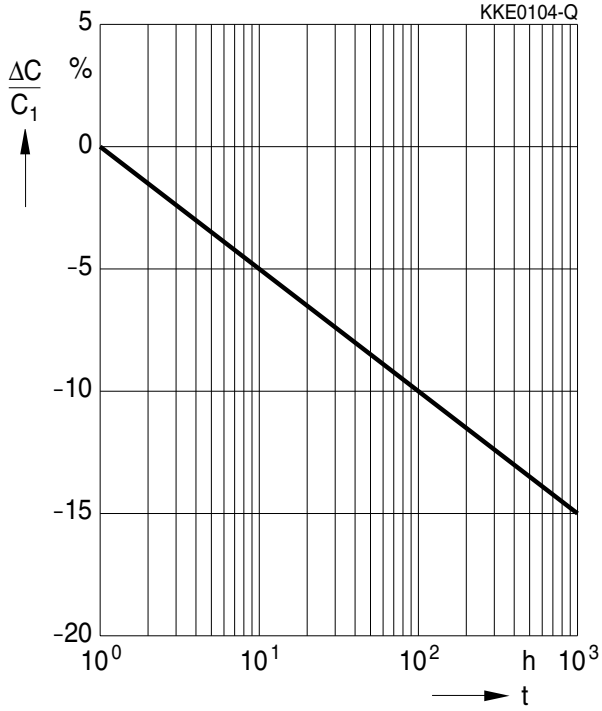


Typical characteristics

Impedance |Z| versus frequency f



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



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

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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