Multilayer ceramic capacitors

Chip, HQF

Series/Type: **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The following products presented in this data sheet are being withdrawn.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
B37923K5100J070		2009-06-26	2010-06-30	2010-12-31
B37923K5120J060		2009-06-26	2010-06-30	2010-12-31
B37923K5120J070		2009-06-26	2010-06-30	2010-12-31

EPCOS

Ordering Code	Substitute Product	Date of Withdrawal	Deadline Last Orders	Last Shipments
B37933K5000B460		2009-06-26	2010-06-30	2010-12-31
B37923K5150J060		2009-06-26	2010-06-30	2010-12-31
B37933K5000B470		2009-06-26	2010-06-30	2010-12-31
B37923K5150J070		2009-06-26	2010-06-30	2010-12-31
B37933K5000B560		2009-06-26	2010-06-30	2010-12-31
B37923K5180J060		2009-06-26	2010-06-30	2010-12-31
B37933K5000B570		2009-06-26	2010-06-30	2010-12-31
B37923K5180J070		2009-06-26	2010-06-30	2010-12-31
B37933K5000B660		2009-06-26	2010-06-30	2010-12-31
B37923K5220J060		2009-06-26	2010-06-30	2010-12-31
B37933K5000B670		2009-06-26	2010-06-30	2010-12-31
B37923K5220J070		2009-06-26	2010-06-30	2010-12-31
B37933K5000B760		2009-06-26	2010-06-30	2010-12-31
B37933K5000B770		2009-06-26	2010-06-30	2010-12-31
B37933K5000B860		2009-06-26	2010-06-30	2010-12-31
B37933K5000B870		2009-06-26	2010-06-30	2010-12-31
B37933K5000B960		2009-06-26	2010-06-30	2010-12-31
B37933K5000B970		2009-06-26	2010-06-30	2010-12-31
B37933K5010B060		2009-06-26	2010-06-30	2010-12-31
B37933K5010B070		2009-06-26	2010-06-30	2010-12-31
B37933K5010B260		2009-06-26	2010-06-30	2010-12-31
B37933K5010B270		2009-06-26	2010-06-30	2010-12-31
B37933K5010B560		2009-06-26	2010-06-30	2010-12-31
B37933K5010B570		2009-06-26	2010-06-30	2010-12-31
B37933K5010B860		2009-06-26	2010-06-30	2010-12-31
B37933K5010B870		2009-06-26	2010-06-30	2010-12-31
B37933K5020B260		2009-06-26	2010-06-30	2010-12-31
B37933K5020B270		2009-06-26	2010-06-30	2010-12-31
B37933K5020B760		2009-06-26	2010-06-30	2010-12-31
B37933K5020B770		2009-06-26	2010-06-30	2010-12-31
B37933K5030B360		2009-06-26	2010-06-30	2010-12-31
B37933K5030B370		2009-06-26	2010-06-30	2010-12-31
B37933K5030B960		2009-06-26	2010-06-30	2010-12-31
B37933K5030B970		2009-06-26	2010-06-30	2010-12-31
B37933K5040C760		2009-06-26	2010-06-30	2010-12-31
B37933K5040C770		2009-06-26	2010-06-30	2010-12-31
B37933K5050C660		2009-06-26	2010-06-30	2010-12-31
B37933K5050C670		2009-06-26	2010-06-30	2010-12-31

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Ordering Code	Substitute Product	Date of Withdrawal	Deadline Last Orders	Last Shipments
B37933K5060C860		2009-06-26	2010-06-30	2010-12-31
B37933K5060C870		2009-06-26	2010-06-30	2010-12-31
B37933K5080C260		2009-06-26	2010-06-30	2010-12-31
B37933K5080C270		2009-06-26	2010-06-30	2010-12-31
B37933K5100J060		2009-06-26	2010-06-30	2010-12-31
B37933K5100J070		2009-06-26	2010-06-30	2010-12-31
B37933K5120J060		2009-06-26	2010-06-30	2010-12-31
B37933K5120J070		2009-06-26	2010-06-30	2010-12-31
B37933K5150J060		2009-06-26	2010-06-30	2010-12-31
B37933K5150J070		2009-06-26	2010-06-30	2010-12-31
B37933K5180J060		2009-06-26	2010-06-30	2010-12-31
B37933K5180J070		2009-06-26	2010-06-30	2010-12-31
B37933K5220J060		2009-06-26	2010-06-30	2010-12-31
B37933K5220J070		2009-06-26	2010-06-30	2010-12-31
B37933K5270J060		2009-06-26	2010-06-30	2010-12-31
B37933K5270J070		2009-06-26	2010-06-30	2010-12-31
B37933K5820J060		2009-06-26	2010-06-30	2010-12-31
B37933K5820J070		2009-06-26	2010-06-30	2010-12-31
B37923K5000B360		2009-06-26	2010-06-30	2010-12-31
B37923K5000B370		2009-06-26	2010-06-30	2010-12-31
B37923K5000B460		2009-06-26	2010-06-30	2010-12-31
B37923K5000B470		2009-06-26	2010-06-30	2010-12-31
B37923K5000B560		2009-06-26	2010-06-30	2010-12-31
B37923K5000B570		2009-06-26	2010-06-30	2010-12-31
B37923K5000B660		2009-06-26	2010-06-30	2010-12-31
B37923K5000B670		2009-06-26	2010-06-30	2010-12-31
B37923K5000B760		2009-06-26	2010-06-30	2010-12-31
B37923K5000B770		2009-06-26	2010-06-30	2010-12-31
B37923K5000B860		2009-06-26	2010-06-30	2010-12-31
B37923K5000B870		2009-06-26	2010-06-30	2010-12-31
B37923K5000B960		2009-06-26	2010-06-30	2010-12-31
B37923K5000B970		2009-06-26	2010-06-30	2010-12-31
B37923K5010B060		2009-06-26	2010-06-30	2010-12-31
B37923K5010B070		2009-06-26	2010-06-30	2010-12-31
B37923K5010B260		2009-06-26	2010-06-30	2010-12-31
B37923K5010B270		2009-06-26	2010-06-30	2010-12-31
B37923K5010B560		2009-06-26	2010-06-30	2010-12-31
B37923K5010B570		2009-06-26	2010-06-30	2010-12-31

Ordering Code	Substitute Product	Date of Withdrawal	Deadline Last Orders	Last Shipments
B37923K5010B860		2009-06-26	2010-06-30	2010-12-31
B37923K5010B870		2009-06-26	2010-06-30	2010-12-31
B37923K5020B260		2009-06-26	2010-06-30	2010-12-31
B37923K5020B270		2009-06-26	2010-06-30	2010-12-31
B37923K5020B760		2009-06-26	2010-06-30	2010-12-31
B37923K5020B770		2009-06-26	2010-06-30	2010-12-31
B37923K5030B360		2009-06-26	2010-06-30	2010-12-31
B37923K5030B370		2009-06-26	2010-06-30	2010-12-31
B37923K5030B960		2009-06-26	2010-06-30	2010-12-31
B37923K5030B970		2009-06-26	2010-06-30	2010-12-31
B37923K5040C760		2009-06-26	2010-06-30	2010-12-31
B37923K5040C770		2009-06-26	2010-06-30	2010-12-31
B37923K5050C660		2009-06-26	2010-06-30	2010-12-31
B37923K5050C670		2009-06-26	2010-06-30	2010-12-31
B37923K5060C860		2009-06-26	2010-06-30	2010-12-31
B37923K5060C870		2009-06-26	2010-06-30	2010-12-31
B37923K5080C260		2009-06-26	2010-06-30	2010-12-31
B37923K5080C270		2009-06-26	2010-06-30	2010-12-31
B37923K5100J060		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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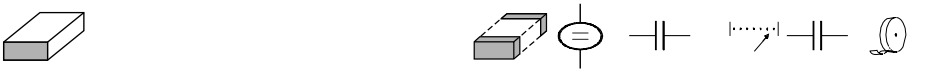
HQF

Ordering code system



B37923	K	5	100	J	0	60

Type and size
Chip size (inch/mm) = Temperature characteristic HQF
0402/1005 ≙ B37923
0603/1608 ≙ B37933

Termination
Standard:
K ≙ nickel barrier for all case sizes

Rated voltage
5 (Code) ≙ 50 VDC

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

Capacitance tolerance
C_R < 10 pF:
B ≙ ±0.1 pF (standard for capacitance values ≤ 3.9 pF)
C ≙ ±0.25 pF (standard for capacitance values ≤ 8.2 pF)
D ≙ ±0.5 pF
C_R ≥ 10 pF:
F ≙ ±1%
G ≙ ±2%
J ≙ ±5% (standard)
K ≙ ±10%

Decimal place for cap. values < 10 pF, otherwise not used

Packaging
60 ≙ cardboard tape, 180-mm reel
70 ≙ cardboard tape, 330-mm reel

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Features

- Ultra-low ESR and high Q factor
- Tight capacitance tolerances
- High stability with respect to time, temperature (T_{CC}: 0 ± 60 ppm/°C), frequency and voltage
- Class 1 characteristic with copper inner electrodes
- Excellent attenuation
- High self-resonant frequency
- Lower power dissipation / Less energy absorption
- Based on AEC-Q200 Rev-C

Applications

- High-frequency applications
- Matching circuits
- Cellular communication, Bluetooth, DECT
- Cable TV, satellite TV (LNB), GPS, satellite radio
- Filters, RF amplifiers, VCOs

Termination

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

Options

- Alternative capacitance values and tolerances available on request

Delivery mode

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

Electrical data

Temperature characteristic			C0H	
Climatic category	(IEC 60068-1)		55/125/56	
Standard			EIA	
Dielectric			Class 1	
Rated voltage		V_R	50	VDC
Test voltage		V_{test}	$2.5 \cdot V_R$/5 s	VDC
Capacitance range		C_R	0.3 pF ... 82 pF	
Temperature coefficient			$0 \pm 60 \cdot 10^{-6}$/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.

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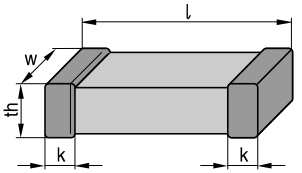
Capacitance tolerances

C_R	$C_R \leq 3.9$ pF		4.7 pF $\leq C_R \leq$ 8.2 pF		
Code letter	B (standard)	C	B	C (standard)	D
Tolerance	±0.1 pF	±0.25 pF	±0.1 pF	±0.25 pF	±0.5 pF

C_R	$C_R \geq 10$ pF			
Code letter	F	G	J (standard)	K
Tolerance	±1%	±2%	±5%	±10%

Dimensional drawing



KKE0329-N

Dimensions (mm)

Case size	(inch) (mm)	0402 1005	0603 1608
l		1.0 ±0.10	1.6 ±0.15
w		0.5 ±0.05	0.8 ±0.10
th		0.5 ±0.05	0.8 ±0.10
k		0.1 −0.40	0.1 −0.40

Tolerances to CECC 32101-801

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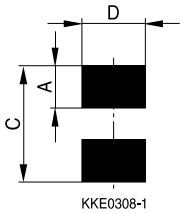
Recommended solder pad



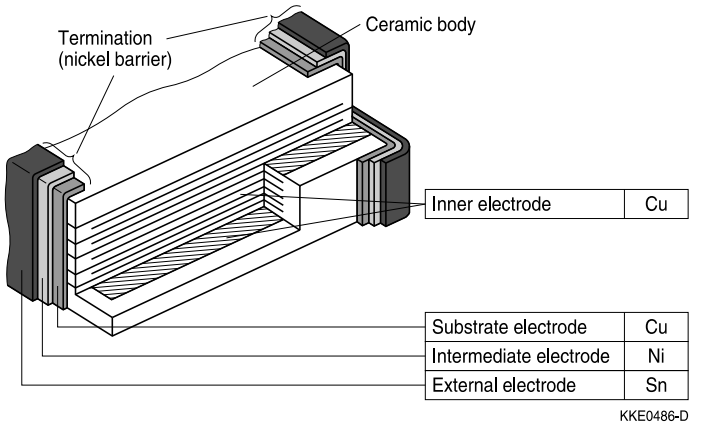
Recommended dimensions (mm) for reflow soldering

Case size	(inch/mm)	Type	A	C	D
	0402/1005	single chip	0.35 ... 0.45	1.0 ... 1.4	0.4 ... 0.6
	0603/1608	single chip	0.6 ... 0.7	1.8 ... 2.2	0.6 ... 0.8

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

Termination



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Product range for HQF chip capacitors

Size **inch (l x w)** mm (l x w)	**0402** 1005	**0603** 1608
Type	B37923	B37933
C_R \ V_R (VDC)	50	50
0.3 pF		
0.4 pF		
0.5 pF		
0.6 pF		
0.7 pF		
0.8 pF		
0.9 pF		
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		
82 pF		

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

C_R	Ordering code	Chip thickness mm	Cardboard tape, ∅180-mm reel ** ≙ 60 pcs./reel	Cardboard tape, ∅330-mm reel ** ≙ 70 pcs./reel
Case size 0402, 50 VDC				
0.3 pF	B37923K5000B3**	0.5 ±0.05	10000	50000
0.4 pF	B37923K5000B4**	0.5 ±0.05	10000	50000
0.5 pF	B37923K5000B5**	0.5 ±0.05	10000	50000
0.6 pF	B37923K5000B6**	0.5 ±0.05	10000	50000
0.7 pF	B37923K5000B7**	0.5 ±0.05	10000	50000
0.8 pF	B37923K5000B8**	0.5 ±0.05	10000	50000
0.9 pF	B37923K5000B9**	0.5 ±0.05	10000	50000
1.0 pF	B37923K5010B0**	0.5 ±0.05	10000	50000
1.2 pF	B37923K5010B2**	0.5 ±0.05	10000	50000
1.5 pF	B37923K5010B5**	0.5 ±0.05	10000	50000
1.8 pF	B37923K5010B8**	0.5 ±0.05	10000	50000
2.2 pF	B37923K5020B2**	0.5 ±0.05	10000	50000
2.7 pF	B37923K5020B7**	0.5 ±0.05	10000	50000
3.3 pF	B37923K5030B3**	0.5 ±0.05	10000	50000
3.9 pF	B37923K5030B9**	0.5 ±0.05	10000	50000
4.7 pF	B37923K5040C7**	0.5 ±0.05	10000	50000
5.6 pF	B37923K5050C6**	0.5 ±0.05	10000	50000
6.8 pF	B37923K5060C8**	0.5 ±0.05	10000	50000
8.2 pF	B37923K5080C2**	0.5 ±0.05	10000	50000
10 pF	B37923K5100J0**	0.5 ±0.05	10000	50000
12 pF	B37923K5120J0**	0.5 ±0.05	10000	50000
15 pF	B37923K5150J0**	0.5 ±0.05	10000	50000
18 pF	B37923K5180J0**	0.5 ±0.05	10000	50000
22 pF	B37923K5220J0**	0.5 ±0.05	10000	50000

SMD

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

C_R	Ordering code	Chip thickness mm	Cardboard tape, ∅180-mm reel ** ≙ 60 pcs./reel	Cardboard tape, ∅330-mm reel ** ≙ 70 pcs./reel
Case size 0603, 50 VDC				
0.4 pF	B37933K5000B4**	0.8 ±0.1	4000	16000
0.5 pF	B37933K5000B5**	0.8 ±0.1	4000	16000
0.6 pF	B37933K5000B6**	0.8 ±0.1	4000	16000
0.7 pF	B37933K5000B7**	0.8 ±0.1	4000	16000
0.8 pF	B37933K5000B8**	0.8 ±0.1	4000	16000
0.9 pF	B37933K5000B9**	0.8 ±0.1	4000	16000
1.0 pF	B37933K5010B0**	0.8 ±0.1	4000	16000
1.2 pF	B37933K5010B2**	0.8 ±0.1	4000	16000
1.5 pF	B37933K5010B5**	0.8 ±0.1	4000	16000
1.8 pF	B37933K5010B8**	0.8 ±0.1	4000	16000
2.2 pF	B37933K5020B2**	0.8 ±0.1	4000	16000
2.7 pF	B37933K5020B7**	0.8 ±0.1	4000	16000
3.3 pF	B37933K5030B3**	0.8 ±0.1	4000	16000
3.9 pF	B37933K5030B9**	0.8 ±0.1	4000	16000
4.7 pF	B37933K5040C7**	0.8 ±0.1	4000	16000
5.6 pF	B37933K5050C6**	0.8 ±0.1	4000	16000
6.8 pF	B37933K5060C8**	0.8 ±0.1	4000	16000
8.2 pF	B37933K5080C2**	0.8 ±0.1	4000	16000
10 pF	B37933K5100J0**	0.8 ±0.1	4000	16000
12 pF	B37933K5120J0**	0.8 ±0.1	4000	16000
15 pF	B37933K5150J0**	0.8 ±0.1	4000	16000
18 pF	B37933K5180J0**	0.8 ±0.1	4000	16000
22 pF	B37933K5220J0**	0.8 ±0.1	4000	16000
27 pF	B37933K5270J0**	0.8 ±0.1	4000	16000
82 pF	B37933K5820J0**	0.8 ±0.1	4000	16000

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Typical RF performance for HQF capacitors, case size 0402, 50 VDC

Capacitance pF	f_{res} [1] MHz	ESR @ 1 GHz [2] mΩ	Q @ 1 GHz [2]	ESR @ f_{res} [2] mΩ
0.3	23400	560	920	710
0.4	20350	490	805	605
0.5	19700	440	720	535
0.6	17400	405	650	485
0.7	15100	375	600	445
0.8	14450	355	560	415
0.9	12600	335	520	385
1.0	12000	320	490	365
1.2	10600	295	440	330
1.5	8900	265	390	290
1.8	7100	245	350	265
2.2	6400	225	310	235
2.7	6000	205	275	210
3.3	5500	185	245	190
3.9	5350	170	225	175
4.7	4650	155	200	155
5.6	3950	145	175	140
6.8	4100	130	155	125
8.2	3650	120	140	115
10	3350	110	120	105
12	3350	102	104	94
15	2600	92	88	82
18	2300	84	70	74
22	2200	78	56	66

1) Measured with impedance analyser E4991 A, parts not soldered.
2) Measured with network analyser HP 8753D, parts soldered.

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Typical RF performance for HQF capacitors, case size 0603, 50 VDC

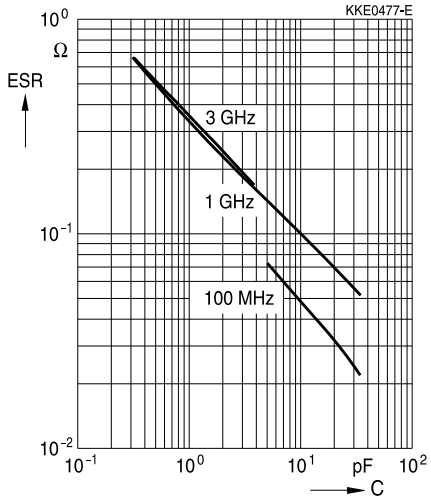
Capacitance pF	f_{res} [3] MHz	ESR @ 1 GHz [4] mΩ	Q @ 1 GHz [4]	ESR @ f_{res} [4] mΩ
0.4	17800	445	860	595
0.5	17100	400	805	540
0.6	13600	385	755	510
0.7	12200	345	635	440
0.8	11400	325	595	410
0.9	10600	315	560	390
1.0	9600	300	525	365
1.2	8800	275	455	335
1.5	7900	250	395	300
1.8	6900	240	360	285
2.2	5750	215	305	250
2.7	5100	200	270	235
3.3	4700	185	235	210
3.9	4150	175	210	200
4.7	3550	165	185	185
5.6	3130	150	160	170
6.8	2850	140	135	155
8.2	2730	130	115	140
10	2580	120	96	130
12	2400	110	76	118
15	2150	102	62	108
18	2050	96	50	100
22	1870	88	34	90
27	1780	80	26	82

Capacitance pF	f_{res} [3] MHz	ESR @ 1 GHz [4] mΩ	Q @ 1 GHz [4]	ESR @ f_{res} [4] mΩ
82	930	52	105	52

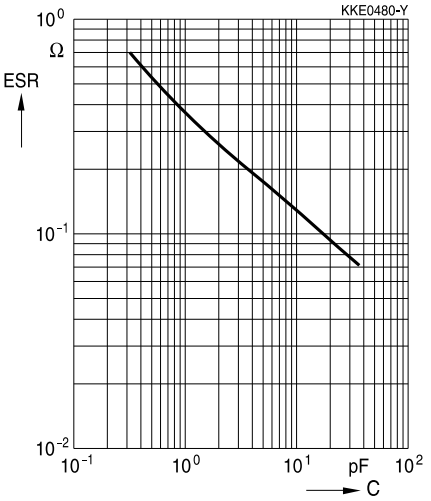
3) Measured with impedance analyser E4991 A, parts not soldered.
4) Measured with network analyser HP 8753D, parts soldered.

Typical characteristics for case size 0402[1)]

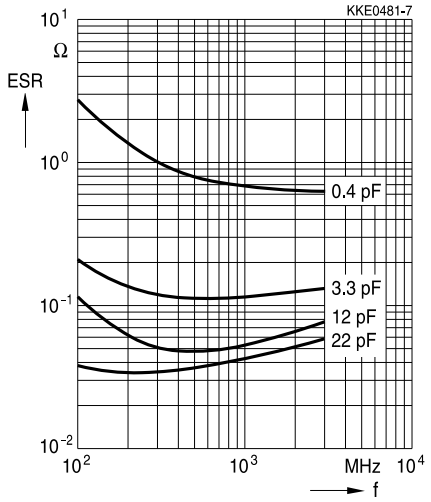
ESR versus capacitance C
(for not soldered parts)



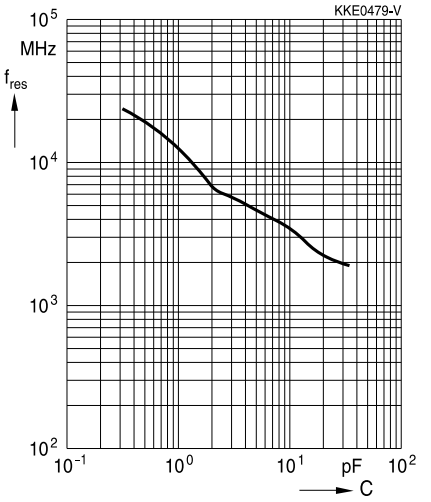
ESR versus capacitance C
at self-resonant frequency (for soldered parts)



ESR versus frequency f



Self-resonant frequency f_{res} versus
capacitance C

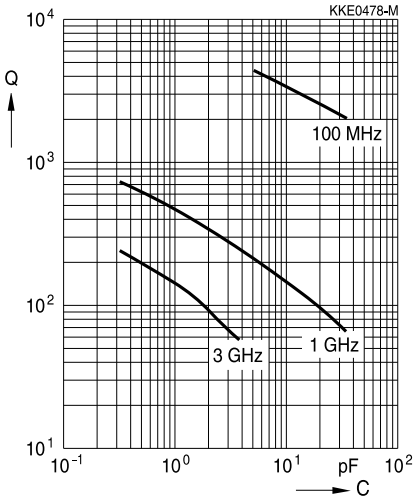


1) For more detailed information on frequency behavior and characteristics see www.epcos.com/mlcc_impedance.

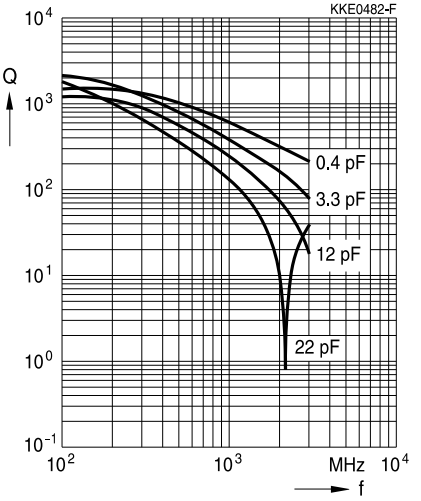
SMD

Typical characteristics for case size 0402[1)]

Q factor versus capacitance C



Q factor versus frequency f

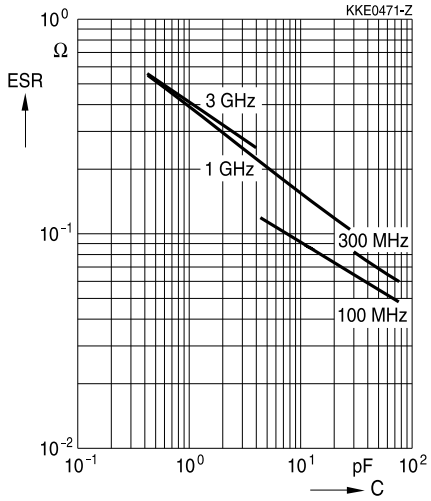


1) For more detailed information on frequency behavior and characteristics see www.epcos.com/mlcc_impedance.

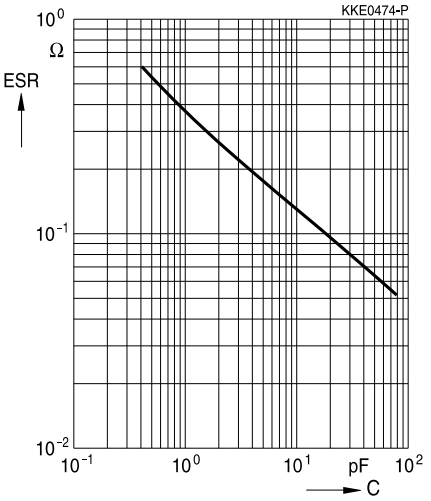
SMD

Typical characteristics for case size 0603[1)]

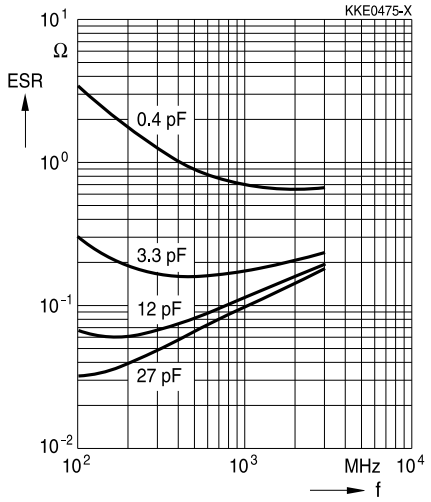
ESR versus capacitance C
(for not soldered parts)



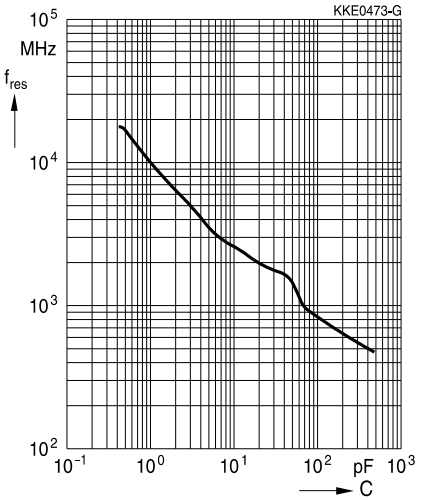
ESR versus capacitance C
at self-resonant frequency (for soldered parts)



ESR versus frequency f



Self-resonant frequency f_{res} versus
capacitance C

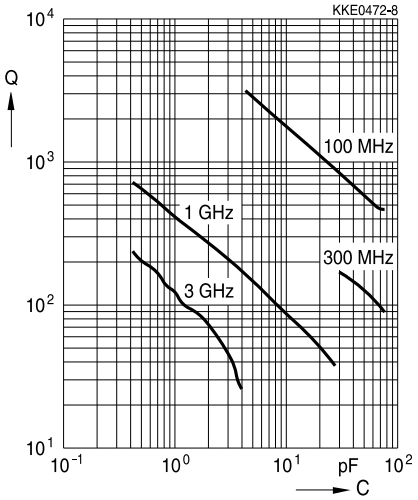


1) For more detailed information on frequency behavior and characteristics see www.epcos.com/mlcc_impedance.

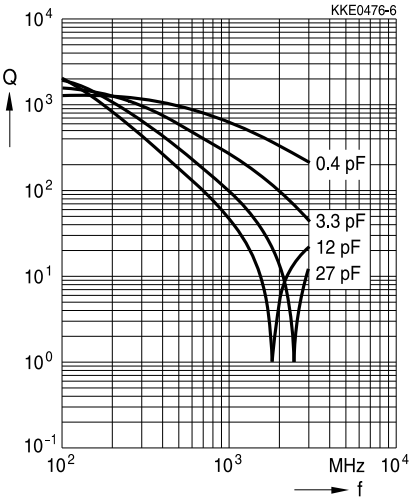
SMD

Typical characteristics for case size 0603[1)]

Q factor versus capacitance C



Q factor versus frequency f



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

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:

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.
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