Film Capacitors

EMI Suppression Capacitors (MKP)

Series/Type: **B32921C/D ... B32928C/D**

Date: August 2015

EPCOS AG is a TDK Group Company.

Typical applications
- X2 class for interference suppression
- "Across the line" applications

Climatic
- Max. operating temperature: 110 °C
- Climatic category (IEC 60068-1):
  40/105/56 (ENEC10)
  40/110/56 (ENEC15)

Construction
- Dielectric: polypropylene (MKP)
- Plastic case (UL 94 V-0)
- Epoxy resin sealing (UL 94 V-0)

Features
- Very small dimensions
- Self-healing properties
- RoHS-compatible
- Halogen-free capacitors available on request

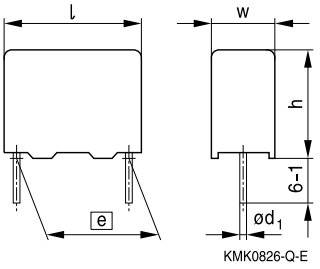
Terminals
- Parallel wire leads, lead-free tinned
- Special lead lengths available on request

Marking
Manufacturer's logo, lot number,
date code, rated capacitance (coded),
cap. tolerance (code letter),
rated AC voltage,
series number, sub-class (X2),
dielectric code (MKP), climatic category,
passive flammability category, approvals.

Delivery mode
Bulk (untaped)
Taped (Ammo pack or reel)
For taping details, refer to chapter "Taping and packing"

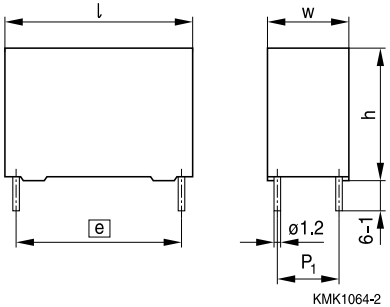
Dimensional drawings

Drawing 1



KMK0826-Q-E

Drawing 2



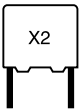
KMK1064-2

Dimensions in mm

P_1 = 20.3 mm

Lead spacing e ±0.4	Lead diameter d_1 ±0.05	Type	Drawing
10	0.6	B32921	1
15	0.8	B32922	1
22.5	0.8	B32923	1
27.5	0.8	B32924	1
37.5	1.0	B32926	1 / 2[1)]
52.5	1.2	B32928	2

1) A few individual types only



Marking Examples

C ≤ 10 µF

KMK1541-3

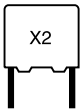
C > 10 µF

KMK1542-2

Approvals

Approval marks	Standards	Certificate
	EN 60384-14, IEC 60384-14, Ed. 3	40010694 (approved by VDE) (C ≤ 10 µF)
	EN 60384-14, IEC 60384-14, Ed. 3	E97863 (approved by UL)
	UL 1414 / UL 1283	E97863 / E157153
	CSA C22.2 No.1 / No. 8	E97863 / E157153 (approved by UL)
	CQC (GB/T 14472-1998)	CQC06001015331 / CQC06001016454 (C ≤ 10 µF)
	UL 60384-14, CSA E60384-14	E97863 (approved by UL)

Notes:	
	Effective January 2014, only for EMI supression capacitors: – UL 60384-14 certification replaces both UL 1414 and UL 1283 standards. – CSA C22.2 No. 1 and CSA C22.s No. 8 are replaced by CSA E60384-14. – References like 1414, 1283 are removed from the capacitor marking
	Capacitors under UL1414, UL1283 produced during or before 2013, are accepted under UL scope.
	Capacitors under CSA C22.2 No.1 / No. 8 produced during or before 2013, are accepted under cUL scope.

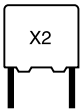


B32921C/D ... B32928C/D

X2 / 305 V AC

Overview of available types

Lead spacing	10 mm	15 mm	22.5 mm	27.5 mm	37.5 mm	52.5 mm
Type	B32921	B32922	B32923	B32924	B32926	B32928
C_R (µF)						
0.010						
0.022						
0.033						
0.047						
0.068						
0.10						
0.15						
0.22						
0.33						
0.47						
0.68						
1.0						
1.5						
2.2						
3.3						
3.9						
4.7						
5.6						
6.8						
8.2						
10						
15						
20						
25						
30						



Ordering codes and packing units

Lead spacing mm	C_R µF	Max. dimensions w × h × l mm	Ordering code (composition see below)	Straight terminals, Ammo pack pcs./ MOQ	Straight terminals, Reel pcs./ MOQ	Straight terminals, Untaped pcs./ MOQ	Pins
10	0.010	4.0 × 9.0 × 13.0	B32921C3103+*** ◆	4000	6800	4000	2
	0.022	4.0 × 9.0 × 13.0	B32921C3223+*** ◆	4000	6800	4000	2
	0.033	4.0 × 9.0 × 13.0	B32921C3333+*** ◆	4000	6800	4000	2
	0.047	5.0 × 11.0 × 13.0	B32921C3473+*** ◆	3320	5200	4000	2
	0.068	6.0 × 12.0 × 13.0	B32921C3683+***	2720	4400	4000	2
	0.10	6.0 × 12.0 × 13.0	B32921C3104M***	2720	4400	4000	2
15	0.033	5.0 × 10.5 × 18.0	B32922C3333K***	4680	5200	4000	2
	0.047	5.0 × 10.5 × 18.0	B32922C3473K***	4680	5200	4000	2
	0.068	5.0 × 10.5 × 18.0	B32922C3683K*** ◆	4680	5200	4000	2
	0.10	5.0 × 10.5 × 18.0	B32922C3104+*** ◆	4680	5200	4000	2
	0.15	6.0 × 12.0 × 18.0	B32922C3154+*** ◆	3840	4400	4000	2
	0.22	7.0 × 12.5 × 18.0	B32922C3224+*** ◆	3320	3600	4000	2
	0.33	8.0 × 14.0 × 18.0	B32922C3334M*** ◆	2920	3000	2000	2
	0.33	8.5 × 14.5 × 18.0	B32922D3334K***	2720	2800	2000	2
	0.47	9.0 × 17.5 × 18.0	B32922C3474+*** ◆	2560	2800	2000	2
	0.68	11.0 × 18.5 × 18.0	B32922C3684+*** ◆	–	2200	1000	2

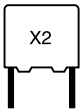
◆ Preferred type

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:
- M = ±20%
- K = ±10%
- = (Closer tolerances on request)

*** = Packaging code:
- 289 = Straight terminals, Ammo pack
- 189 = Straight terminals, Reel
- 240 = Crimped down from lead spacing 10 mm to 7.5 mm, Ammo pack
- 140 = Crimped down from lead spacing 10 mm to 7.5 mm, Reel
- 255 = Crimped down from lead spacing 15 mm to 7.5 mm, Ammo pack
- 155 = Crimped down from lead spacing 15 mm to 7.5 mm, Reel
- 003 = Straight terminals, untaped (lead length 3.2 ±0.3 mm)
- 000 = Straight terminals, untaped (lead length 6 - 1 mm)



B32921C/D ... B32928C/D

X2 / 305 V AC

Ordering codes and packing units

Lead spacing mm	C_R µF	Max. dimensions w × h × l mm	Ordering code (composition see below)	Straight terminals, Ammo pack pcs./ MOQ	Straight terminals, Reel pcs./ MOQ	Straight terminals, Untaped pcs./ MOQ	Pins
22.5	0.22	6.0 × 15.0 × 26.5	B32923C3224+***	2720	2800	2880	2
	0.33	6.0 × 15.0 × 26.5	B32923C3334M***	2720	2800	2880	2
	0.33	7.0 × 16.0 × 26.5	B32923D3334K***	2320	2400	2520	2
	0.47	8.5 × 16.5 × 26.5	B32923C3474+***	1920	2000	2040	2
	0.68	10.5 × 16.5 × 26.5	B32923C3684+***	1560	1600	2160	2
	1.0	11.0 × 20.5 × 26.5	B32923C3105+*** ◆	1480	1400	2040	2
	1.5	12.0 × 22.0 × 26.5	B32923C3155M***	–	–	1800	2
	2.2	14.5 × 29.5 × 26.5	B32923C3225+***	–	–	1040	2
27.5	0.68	11.0 × 19.0 × 31.5	B32924C3684+***	–	1400	1280	2
	1.0	11.0 × 19.0 × 31.5	B32924C3105+***	–	1400	1280	2
	1.5	12.5 × 21.5 × 31.5	B32924C3155+*** ◆	–	1200	1120	2
	2.2	14.0 × 24.5 × 31.5	B32924C3225+***	–	–	1040	2
	3.3	16.0 × 32.0 × 31.5	B32924D3335K***	–	–	880	2
	3.3	18.0 × 27.5 × 31.5	B32924C3335M***	–	–	800	2
	4.7	18.0 × 33.0 × 31.5	B32924C3475M***	–	–	800	2
	4.7	21.0 × 31.0 × 31.5	B32924D3475K***	–	–	720	2
	5.6	22.0 × 36.5 × 31.5	B32924C3565+***	–	–	784	2

◆ Preferred type

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further intermediate capacitance values on request.

Composition of ordering code

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- = (Closer tolerances on request)

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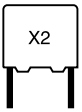
- 255 = Crimped down from lead spacing 15 mm to 7.5 mm, Ammo pack
- 155 = Crimped down from lead spacing 15 mm to 7.5 mm, Reel
- 003 = Straight terminals, untaped (lead length 3.2 ±0.3 mm)
- 000 = Straight terminals, untaped (lead length 6 - 1 mm)



Ordering codes and packing units

Lead spacing mm	C_R µF	Max. dimensions w × h × l mm	Ordering code (composition see below)	Straight terminals, Ammo pack pcs./ MOQ	Straight terminals, Reel pcs./ MOQ	Straight terminals, Untaped pcs./ MOQ	Pins
37.5	2.2	14.0 × 25.0 × 41.5	B32926C3225+***	–	–	1380	2
	3.3	16.0 × 28.5 × 41.5	B32926C3335+***	–	–	800	2
	3.9	16.0 × 28.5 × 41.5	B32926C3395+***	–	–	800	2
	4.7	18.0 × 32.5 × 41.5	B32926C3475+***	–	–	720	2
	5.6	18.0 × 32.5 × 41.5	B32926C3565+***	–	–	720	2
	6.8	20.0 × 39.5 × 41.5	B32926C3685+***	–	–	640	2
	8.2	20.0 × 39.5 × 41.5	B32926C3825+***	–	–	640	2
	10	28.0 × 42.5 × 41.5	B32926C3106+***	–	–	440	2
	15	30.0 × 45.0 × 42.0	B32926C3156M***	–	–	400	2
	15	33.0 × 48.0 × 42.0	B32926D3156+***	–	–	180	4
52.5	20	30.0 × 45.0 × 57.5	B32928C3206+***	–	–	280	4
	25	35.0 × 50.0 × 57.5	B32928C3256+***	–	–	108	4
	30	35.0 × 50.0 × 57.5	B32928C3306M***	–	–	108	4

◆ Preferred type

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further intermediate capacitance values on request.

Composition of ordering code

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- M = ±20%
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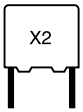


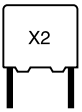
B32921C/D ... B32928C/D

X2 / 305 V AC

Technical data

Reference standard: IEC / UL 60384-14. All data given at T = 20 °C unless otherwise specified.

Max. operating temperature $T_{op,max}$	+110 °C			
Dissipation factor tan δ (in 10^{-3}) at 20 °C (upper limit values)		$C_R \leq 0.1$ µF	0.1µF$< C_R \leq$2.2 µF	$C_R >$2.2 µF
	at 1 kHz	1.0	1.0	2.0
	100 kHz	5.0	–	–
Insulation resistance R_{ins} or time constant $\tau = C_R \cdot R_{ins}$ at 20 °C, rel. humidity ≤ 65% (minimum as-delivered values)	$C_R \leq 0.33$ µF	$C_R > 0.33$ µF		
	100 000 MΩ	30 000 s		
DC test voltage	2121 V, 2 s (C ≤ 10 µF) / 1312 V, 2 s (C > 10 µF)			
The repetition of this DC voltage test may damage the capacitor. Special care must be taken in case of use several capacitors in a parallel configuration.				
Passive flammability category	B			
Maximum continuous DC voltage V_{DC}	630 V			
Maximum continuous AC voltage V_{AC}	310 V (50/60 Hz)			
Rated AC voltage (IEC 60384-14)	305 V (50/60 Hz)			
Operating AC voltage V_{op} at high temperature	$T_A \leq 110$ °C	$V_{op} = V_{AC}$	(continuously)	
	$T_A \leq 110$ °C	$V_{op} = 1.25 \cdot V_{AC}$	(1000 h)	
Damp heat test Limit values after damp heat test	56 days / 40 °C / 93% relative humidity Capacitance change $\lvert\Delta C/C\rvert$ ≤ 5% Dissipation factor change $\Delta \tan \delta \leq 0.5 \cdot 10^{-3}$ (at 1 kHz) Insulation resistance $R_{ins} \leq 1.0 \cdot 10^{-3}$ (at 10 kHz) or time constant $\tau = C_R \cdot R_{ins}$ ≥ 50% of minimum as-delivered values			



Pulse handling capability

"dV/dt" represents the maximum permissible voltage change per unit of time for non-sinusoidal voltages, expressed in V/µs.

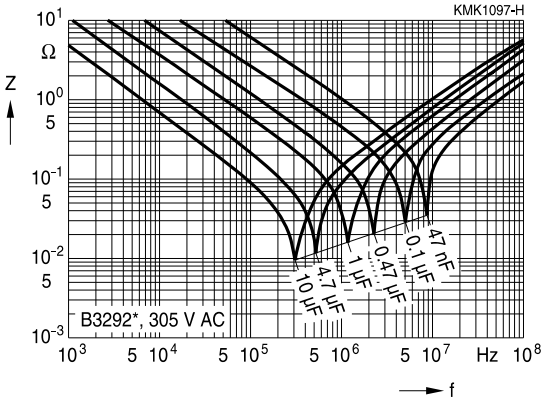
"k_0" represents the maximum permissible pulse characteristic of the waveform applied to the capacitor, expressed in $V^2/\mu s$.

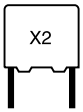
Note:
The values of dV/dt and k_0 provided below must not be exceeded in order to avoid damaging the capacitor.

dV/dt and k_0 values

Lead spacing	10 mm	15 mm	22.5 mm	27.5 mm	37.5 mm	52.5 mm
dV/dt in V/µs	475	340	170	120	80	50
k_0 in $V^2/\mu s$	408500	292400	146200	103200	68800	43200

Impedance Z versus frequency f
(typical values)



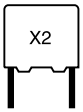


B32921C/D ... B32928C/D

X2 / 305 V AC

Testing and Standards

Test	Reference	Conditions of test	Performance requirements
Electrical Parameters	IEC 60384-14	Voltage Proof: Between terminals: 4.3 × V_R (DC), 1 min Terminals and enclosure: 2 V_R + 1500 V AC Insulation resistance, R_{INS} Capacitance, C Dissipation factor, tan δ	Within specified limits
Robustness of terminations	IEC 60068-2-21	Tensile strength (test Ua1) Wire diameter: Tensile force 0.5 < d_1 ≤ 0.8 mm: 10 N 0.8 < d_1 ≤ 1.25 mm: 20 N	Capacitance and tan δ within specified limits
Resistance to soldering heat	IEC 60068-2-20, test Tb, method 1A	Solder bath temperature at 260 ± 5 °C, immersion for 10 seconds	$\Delta C/C_0 \leq 5\%$ tan δ within specified limits
Rapid change of temperature	IEC 60384-16	T_A = lower category temperature T_B = upper category temperature Five cycles, duration t = 30 min.	No visible damage $\lvert\Delta C/C_0\rvert \leq 5\%$ tan δ within specified limits
Damp Heat Steady State	IEC 60384-14	Test Ca 40 °C / 93% RH / 56 days	No visible damage $\lvert\Delta C/C_0\rvert \leq 5\%$ $\lvert\Delta$ tan δ$\rvert \leq 0.008$, C ≤ 1 µF $\lvert\Delta$ tan δ$\rvert > 0.005$, C > 1 µF Voltage proof $R_{INS} \geq 50\%$ of initial limit
Impulse test Endurance	IEC 60384-14	3 impulses T_B / 1.25 V_R / 1000 hours, 1000 V_{rms} for 0.1 s every hour	No visible damage $\lvert\Delta C/C_0\rvert \leq 10\%$ $\lvert\Delta$ tan δ$\rvert \leq 0.008$, C ≤ 1 µF $\lvert\Delta$ tan δ$\rvert > 0.005$, C > 1 µF Voltage proof $R_{INS} \geq 50\%$ of initial limit
Passive flammability	IEC 60384-14	Flame applied for a period of time depending on capacitor volume	B
Active flammability	IEC 60384-14	20 discharges at 2.5 kV + V_R	The cheesecloth shall not burn with a flame



Mounting guidelines

1 Soldering

1.1 Solderability of leads

The solderability of terminal leads is tested to IEC 60068-2-20, test Ta, method 1.

Before a solderability test is carried out, terminals are subjected to accelerated ageing (to IEC 60068-2-2, test Ba: 4 h exposure to dry heat at 155 °C). Since the ageing temperature is far higher than the upper category temperature of the capacitors, the terminal wires should be cut off from the capacitor before the ageing procedure to prevent the solderability being impaired by the products of any capacitor decomposition that might occur.

Solder bath temperature	235 ±5 °C
Soldering time	2.0 ±0.5 s
Immersion depth	2.0 +0/−0.5 mm from capacitor body or seating plane
Evaluation criteria: Visual inspection	 Wetting of wire surface by new solder ≥90%, free-flowing solder

1.2 Resistance to soldering heat

Resistance to soldering heat is tested to IEC 60068-2-20, test Tb, method 1A.
Conditions:

Series		Solder bath temperature	Soldering time
MKT	boxed (except 2.5 × 6.5 × 7.2 mm) coated uncoated (lead spacing > 10 mm)	260 ±5 °C	10 ±1 s
MFP MKP	 (lead spacing > 7.5 mm)		
MKT	boxed (case 2.5 × 6.5 × 7.2 mm)		5 ±1 s
MKP MKT	(lead spacing ≤ 7.5 mm) uncoated (lead spacing ≤ 10 mm) insulated (B32559)		< 4 s recommended soldering profile for MKT uncoated (lead spacing ≤ 10 mm) and insulated (B32559)