Film capacitors – MKP DC link

High density series up to 110 µF (450 V DC ... 1300 V DC)

Series/Type: **B32774, B32776, B32778**

Date: June 2008
Version: 2

Typical applications

For compact design of:

- Frequency converters
- Industrial and high-end power supplies
- Solar inverters

Climatic

- Maximum operating temperature 85 °C (case)
- Climatic category (IEC 60068-1): 40/85/56

Construction

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

Features

- Capacitance values up to 110 µF
- High CV product, compact
- Excellent self-healing properties
- Overvoltage capability
- Low losses with high current capability
- High reliability
- Long useful life

Terminals

- Parallel wire leads, lead-free tinned
- 2-pin and 4-pin versions
- Standard lead lengths: 6–1mm
- Special lead lengths are available on request

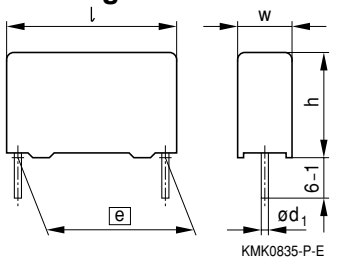
Marking

- Manufacturer's logo and lot number, date code, rated capacitance (coded), capacitance tolerance (code letter), rated DC voltage.

Delivery mode

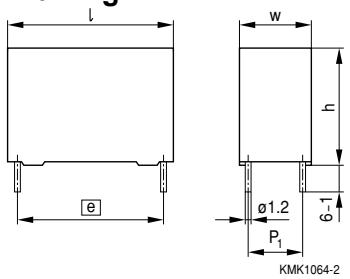
- Bulk (untaped, lead length 6–1mm)

Drawing A



KMK0835-P-E

Drawing B



KMK1064-2

Dimensions in mm

Dimensions

Number of wires	Lead spacing e ±0.4 mm	Lead diameter d_1 mm	Type	Drawing
2-pin	27.5	0.8	B32774D	A
2-pin	37.5	1.0	B32776E	A
4-pin	37.5	1.2	B32776G	B
4-pin	52.5	1.2	B32778G	B

Ordering codes and packing units for V_R = 450 V DC

C_R	dV/dt	P_1	Max. dimensions w × h × l	Ordering code	$I_{P,max}$	ESL	$I_{RMS,\ max}$ 70 °C, 0.1 ... 0.3 kHz	$I_{RMS,\ max}$ 70 °C, 10 kHz	$I_{RMS,\ max}$ 70 °C, 20 kHz	ESR_{typ} 70 °C, 10 kHz	PU
µF	V/µs	mm	mm		A	nH	A	A	A	mΩ	pcs.
5	30	–	11.0 × 21.0 × 31.5	B32774D4505+000	150	25	0.5 ... 1.5	5.0	4.5	8.5	588
10	30	–	15.0 × 24.5 × 31.5	B32774D4106+000	300	25	1.0 ... 3.0	6.5	6.0	7.5	420
22	30	–	22.0 × 36.5 × 31.5	B32774D4226+000	660	25	2.2 ... 6.6	10.0	9.0	5.0	196
30	21	–	20.0 × 39.5 × 41.5	B32776E4306+000	630	10	3.0 ... 9.0	11.5	10.5	9.0	160
30	21	10.2	20.0 × 39.5 × 41.5	B32776G4306+000	630	15	3.0 ... 9.0	12.5	11.5	8.0	160
35	21	–	28.0 × 37.0 × 42.0	B32776E4356+000	735	10	3.5 ... 10.0	12.5	11.5	9.0	110
35	21	10.2	28.0 × 37.0 × 42.0	B32776G4356+000	735	15	3.5 ... 10.0	13.5	12.5	8.0	110
40	21	–	28.0 × 37.0 × 42.0	B32776E4406+000	840	10	4.0 ... 12.0	13.5	12.5	5.5	110
40	21	10.2	28.0 × 37.0 × 42.0	B32776G4406+000	840	15	4.0 ... 12.0	14.5	13.5	5.0	110
50	21	–	28.0 × 42.5 × 41.5	B32776E4506+000	1050	10	5.0 ... 15.0	15.0	14.0	4.0	110
50	21	20.3	28.0 × 42.5 × 41.5	B32776G4506+000	1050	15	5.0 ... 15.0	16.0	15.0	4.0	110
60	21	–	30.0 × 45.0 × 42.0	B32776E4606+000	1260	10	6.0 ... 18.0	16.5	15.0	3.0	100
75	14	20.3	30.0 × 45.0 × 57.5	B32778G4756+000	1050	15	7.5 ... 22.0	16.0	15.5	5.5	70
80	14	20.3	30.0 × 45.0 × 57.5	B32778G4806+000	1120	15	8.0 ... 24.0	16.5	16.0	5.0	70
100	14	20.3	35.0 × 50.0 × 57.5	B32778G4107+000	1400	15	10.0 ... 30.0	18.0	18.0	4.0	27
110	14	20.3	35.0 × 50.0 × 57.5	B32778G4117K000	1540	15	11.0 ... 33.2	19.0	19.0	4.0	27

Intermediate capacitance values are available on request.

Composition of ordering code

+ = Capacitance tolerance code
K = ±10%
J = ±5%

Ordering codes and packing units for V_R = 800 V DC

C_R	dV/dt	P_1	Max. dimensions w × h × l	Ordering code	$I_{P,max}$	ESL	$I_{RMS,\ max}$ 70 °C, 0.1 ... 0.3 kHz	$I_{RMS,\ max}$ 70 °C, 10 kHz	$I_{RMS\ max}$ 70 °C, 20 kHz	ESR_{typ} 70 °C, 10 kHz	PU
µF	V/µs	mm	mm		A	nH	A	A	A	mΩ	pcs.
3	40	–	11.0 × 21.0 × 31.5	B32774D8305+000	120	25	0.4 ... 1.1	5.0	4.5	7.0	588
5	40	–	14.0 × 24.5 × 31.5	B32774D8505+000	120	25	0.4 ... 1.1	5.0	4.5	7.0	462
12	40	–	22.0 × 36.5 × 31.5	B32774D8126+000	200	25	0.6 ... 1.9	6.	5.5	6.5	196
14	22	–	18.0 × 32.5 × 41.5	B32776E8146+000	480	10	1.5 ... 4.5	10.0	9.0	4.5	180
15	22	10.2	20.0 × 39.5 × 41.5	B32776G8156+000	310	15	1.8 ... 5.3	10.5	9.5	7.0	160
20	22	–	28.0 × 37.0 × 42.0	B32776E8206+000	330	10	1.9 ... 5.7	11.5	10.5	6.5	110
20	22	10.2	28.0 × 37.0 × 42.0	B32776G8206+000	440	15	2.5 ... 7.5	12.0	11.0	5.5	110
22	22	10.2	28.0 × 37.0 × 42.0	B32776G8226+000	440	15	2.5 ... 7.5	13.0	12.0	5.0	110
25	22	–	28.0 × 42.5 × 41.5	B32776E8256+000	485	10	2.8 ... 8.3	13.5	12.5	4.5	110
30	22	–	30.0 × 45.0 × 42.0	B32776E8306+000	550	10	3.1 ... 9.4	14.0	13.0	5.0	100
30	22	20.3	30.0 × 45.0 × 42.0	B32776G8306+000	660	15	3.8 ... 11.0	15.0	14.0	3.5	100
45	15	20.3	30.0 × 45.0 × 57.5	B32778G8456+000	660	15	3.8 ... 11.0	16.0	15.0	3.0	70
55	15	20.3	35.0 × 50.0 × 57.5	B32778G8556+000	675	15	5.7 ... 17.0	17.0	16.0	3.5	27
60	15	20.3	35.0 × 50.0 × 57.5	B32778G8606+000	825	15	6.9 ... 20.0	21.0	18.0	3.0	27

Intermediate capacitance values are available on request.

Composition of ordering code

+ = Capacitance tolerance code
K = ±10%
J = ±5%

Ordering codes and packing units for V_R = 1100 V DC

C_R	dV/dt	P_1	Max. dimensions w × h × l	Ordering code	$I_{P,max}$	ESL	$I_{AC,max}$ 70 °C, 0.1 ... 0.3 kHz	$I_{AC,max}$ 70 °C, 10 kHz	$I_{AC,max}$ 70 °C, 20 kHz	ESR_{typ} 70 °C, 10 kHz	PU
µF	V/µs	mm	mm		A	nH	A	A	A	mΩ	pcs.
2	75	–	12.5 × 21.5 × 31.5	B32774D0205+000	150	25	0.3 ... 1.0	4.0	3.5	7.0	525
5	75	–	19.0 × 30.0 × 31.5	B32774D0505+000	375	25	0.9 ... 2.6	6.5	6.0	6.0	224
7	75	–	22.0 × 36.5 × 31.5	B32774D0705+000	525	25	1.2 ... 3.6	7.5	7.0	5.5	196
12	54	–	20.0 × 39.5 × 41.5	B32776E0126+000	648	10	2.1 ... 6.2	10.0	9.0	7.0	160
12	54	10.2	20.0 × 39.5 × 41.5	B32776G0126+000	648	15	2.1 ... 6.2	11.0	10.0	6.5	160
14	54	–	28.0 × 37.0 × 42.0	B32776E0146+000	756	10	2.4 ... 7.3	12.0	11.0	6.0	110
14	54	10.2	28.0 × 37.0 × 42.0	B32776G0146+000	756	15	2.4 ... 7.3	13.0	12.0	5.5	110
16	54	–	28.0 × 42.5 × 41.5	B32776E0166+000	864	10	2.8 ... 8.3	12.0	11.0	5.5	110
16	54	10.2	28.0 × 42.5 × 41.5	B32776G0166+000	864	15	2.8 ... 8.3	13.0	12.0	5.0	110
20	54	–	30.0 × 45.0 × 42.0	B32776E0206+000	1080	10	3.5 ... 10.0	13.0	12.0	3.5	100
20	54	20.3	30.0 × 45.0 × 42.0	B32776G0206+000	1080	15	3.5 ... 10.0	15.0	13.0	3.0	100
30	35	20.3	30.0 × 45.0 × 57.5	B32778G0306+000	1050	15	5.2 ... 15.0	16.0	14.0	4.0	70
40	35	20.3	35.0 × 50.0 × 57.5	B32778G0406+000	1400	15	6.9 ... 20.0	20.0	20.0	3.5	27

Intermediate capacitance values are available on request.

Composition of ordering code

+ = Capacitance tolerance code
K = ±10%
J = ±5%

Ordering codes and packing units for V_R = 1300 V DC

C_R	dV/dt	P_1	Max. dimensions w × h × l	Ordering code	$I_{P,max}$	ESL	$I_{AC,\ max}$ 70 °C, 0.1 ... 0.3 kHz	$I_{AC,\ max}$ 70 °C, 10 kHz	$I_{AC,\ max}$ 70 °C, 20 kHz	ESR_{typ} 70 °C, 10 kHz	PU
µF	V/µs	mm	mm		A	nH	A	A	A	mΩ	pcs.
1.5	100	–	12.5 × 21.5 × 31.5	B32774D1155K000	150	25	0.3 ... 0.9	4.5	4.0	7.5	525
3	100	–	18 × 27.5 × 31.5	B32774D1305K000	300	25	0.6 ... 1.7	6.0	5.5	6.5	357
5	100	–	22.0 × 36.5 × 31.5	B32774D1505K000	500	25	1.0 ... 2.9	8.0	7.0	6.0	196
8	73	10.2	20.0 × 39.5 × 41.5	B32776G1805K000	584	15	1.5 ... 4.6	9.0	8.0	8.0	160
10	73	–	28.0 × 37.0 × 42.0	B32776E1106K000	730	10	1.9 ... 5.7	11.0	10.0	7.0	110
10	73	10.2	28.0 × 37.0 × 42.0	B32776G1106K000	730	15	1.9 ... 5.7	12.0	11.0	6.5	110
12	73	20.3	28.0 × 42.5 × 41.5	B32776G1126K000	876	15	2.3 ... 6.9	13.0	12.0	5.5	110
14	73	–	30.0 × 45.0 × 42.0	B32776E1146K000	1022	10	2.7 ... 8.0	13.0	12.0	5.0	100
20	50	20.3	30.0 × 45.0 × 57.5	B32778G1206K000	1000	15	3.8 ... 11.0	14.0	13.0	5.5	70
25	50	20.3	35.0 × 50.0 × 57.5	B32778G1256K000	1250	15	4.8 ... 14.0	17.0	16.0	4.5	27
27	50	20.3	35.0 × 50.0 × 57.5	B32778G1276K000	1350	15	5.2 ... 15.0	17.5	16.0	4.0	27

Intermediate capacitance values are available on request.

Composition of ordering code

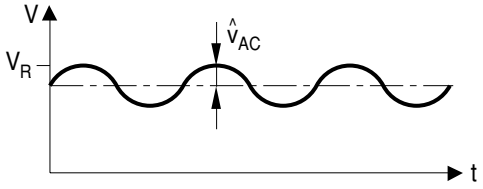
+ = Capacitance tolerance code
K = ±10%
J = ±5%

Technical data

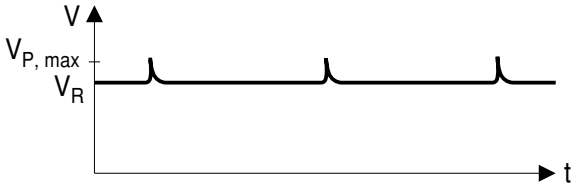
Reference standard: IEC 61071. All data given at T = 20 ºC, unless otherwise specified.

Operating temperature range (case)		Max. operating temperature, $T_{op,max}$			+105 ºC
		Upper category temperature			+85ºC
		Lower category temperature			–40ºC
ESR (@ 10 kHz)	LS 27.5	< 3.0 · ESR_{typ}			
	LS 37.5	< 2.5 · ESR_{typ}			
	LS 52.5	< 1.5 · ESR_{typ}			
Insulation resistance R_{ins} given as time constant $\tau=C_R \cdot R_{ins}$, rel. humidity ≤ 65% (minimum as-delivered values)		30 000 s			
DC test voltage between terminals (10 s)		1.5 · V_R			
DC test voltage terminal to case (10 s)		2110 V AC, 50 Hz			
Pulse handling capability (V/µs)		I_P (A) / C (µF)			
Damp heat test		56 days / 40 °C / 93% R.H.			
Limit values after damp heat test		Capacitance change $\lvert \Delta C/C \rvert$			≤ 5%
		Dissipation factor change $\Delta \tan \delta$			≤ $1.5 \cdot 10^{-3}$ (@ 1 kHz)
		Insulation resistance R_{ins}			≥ 50% of minimum as-delivered values
Reliability:	Failure rate λ	1 fit (≤ $1 \cdot 10^{-9}$) at 0.5 · V_R, 40 °C			
	Service life t_{SL}	200.000 h @ V_R and 40 °C			
		For conversion to other operating conditions, refer to chapter "Quality assurance", data book 2005 "Film capacitors", page 390			
V_R (V DC)		450	800	1100	1300
Continuous operation voltage V_{op} (V DC) at 70 °C		450	800	1100	1300
Continuous operation voltage V_{op} (V DC) at 85 °C		450	700	920	1100
For temperatures between 70ºC and 85ºC		1%/ºC of derating respect V_{op} at 70ºC (no derating at 450 DC series)			

Typical waveforms:



KLK1635-E



KLK1267-S

Restrictions:

V_R: Maximum operating peak voltage of either polarity but of a non-reversing waveform, for which the capacitor has been designed for continuous operation.

$\hat{u}_{AC} \leq 0.2 \cdot V_R$

$V_{P, max}$: Maximum permissible recurrent voltage that may appear for 2% of the period.

Cautions and warnings

- Do not exceed the upper category temperature (UCT).
- Do not apply any mechanical stress to the capacitor terminals.
- Avoid any compressive, tensile or flexural stress.
- Do not move the capacitor after it has been soldered to the PC board.
- Do not pick up the PC board by the soldered capacitor.
- Do not place the capacitor on a PC board whose hole space differs from the specified lead space.
- Do not exceed the specified time or temperature limits during soldering.
- Avoid external energy inputs, such as fire or electricity.
- Avoid overload of the capacitors.

Resistance to soldering heat

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

Series	Solder bath temp.	Soldering time
MKT boxed (except 2.5 x 6.5 x 7.2 mm); coated; MKP/MFP	260 ±5 °C	10 ±1 s
MKT boxed (case 2.5 x 6.5 x 7.2 mm)	260 ±5 °C	5 ±1 s

General notes on soldering

Permissible heat-exposure loads on film capacitors are primarily characterized by the upper category temperature T_{max}. Long exposure to temperatures above this type-related temperature limit can lead to changes in the plastic dielectric and thus irreversibly change a capacitor's electrical characteristics. For short exposure times (as in practical soldering processes), the heat load (and thus the possible effects on the capacitor) will also depend on other factors such as:

- The pre-heating temperature and time.
- The forced cooling immediately after soldering.
- The terminal characteristics: diameter, length, thermal resistance, special configurations (e.g. crimping).
- The height of the capacitor above the solder bath.
- Shadowing by neighboring components.
- Additional heating due to heat dissipation by neighboring components.
- Use of solder-resistant coatings.

The overheating associated with some of these factors can usually be reduced by suitable countermeasures. For example, if a pre-heating step cannot be avoided, an additional or reinforced cooling process may have to be included.

Cleaning

To determine whether a particular solvent, often used to remove flux residues and other substances, is suitable for the capacitors described, please refer to data book 2005 "Film Capacitors", in which this information is available. Even when suitable solvents are used, a reversible change of the electrical characteristics may occur in uncoated capacitors immediately after they have been washed. Thus it is always recommended to dry the components (e.g. 4 h at 70 °C) before they are subjected to subsequent electrical testing.

Embedding of capacitors in finished assemblies

In many applications, finished circuit assemblies are embedded in plastic resins. In this case, both chemical and thermal influences of the embedding ("potting") and curing processes must be taken into account. Our experience has shown that the following potting materials can be recommended considering maximum curing temperature 100 °C:

- Non-flexible epoxy resins with acid-anhydride hardeners
- Chemically inert, non-conducting fillers

Caution: Consult us first if you also wish to embed other uncoated component types!

Storage conditions

All capacitors listed in this product profile can be stored for short periods at any temperature within the entire range of category temperatures . For long storage periods, however, the following conditions should be observed:

- Storage temperature –40 to +40 °C
- Maximum relative humidity 80%, no dew allowed on the capacitor
- Maximum duration 24 months (12 months for taped components)

Resistance to vibration

A capacitor's ability to withstand vibration (e.g. such as that occurring in applications involving rotating machinery) is tested to IEC 60068-2-6. The test procedure used here involves continuous sinusoidal vibration along three orthogonal axes, with a continuously varying frequency (10 … 500 Hz), an acceleration amplitude of 10 *g*, a displacement amplitude of 0.75 mm and a duration of 360 minutes for each axis. EPCOS offers film capacitors specially designed for operation under more severe vibration regimes such as those found in automotive applications. Consult our catalog "Film Capacitors for Automotive Electronics".

Passive flammability

The passive flammability test is applied to ensure that components bearing the corresponding qualification contribute less energy to the combustion behavior of their immediate vicinity than is required to ignite them. This measure is designed to contain any localized fire that may occur. In the respective tests, the capacitors are subjected to a standardized flame to evaluate their combustion behavior by checking whether the flame persists for longer than a maximum permissible period or not. The severity of the test is determined essentially by the test flame and exposure time in accordance with various international standards (IEC 60040 CO 752 (amendment to IEC 60384-1), IEC 60695-2-2 and UL 1414). Unless the detail specifications stipulate otherwise, EMI suppression capacitors are tested to IEC 60384-14, section 4.17, test severity categories B and C.

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 life-saving 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, CSSP, CTVS, DSSP, MiniBlue, MKK, MLSC, MotorCap, PCC, PhaseCap, 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.