

Film Capacitors

Metallized Polypropylene Film Capacitors (MKP)

Series/Type: B32794 ... B32798

Date: August 2014

© EPCOS AG 2015. Reproduction, publication and dissemination of this publication, enclosures hereto and the information contained therein without EPCOS' prior express consent is prohibited.

EPCOS AG is a TDK Group Company.

MKP AC filtering
Typical applications

- Output AC filtering for power converters
UPS, solar inverters, motor drives

Climatic

- Max. operating temperature: 105 °C
- Climatic category (IEC 60068-1): 40/85/56

Construction

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

Features

- Optimized AC voltage performance
- High ripple current/frequency capability
- Small dimensions
- For PCB mounting
- RoHS-compatible

Terminals

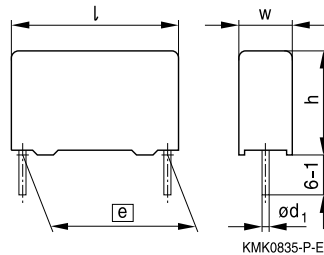
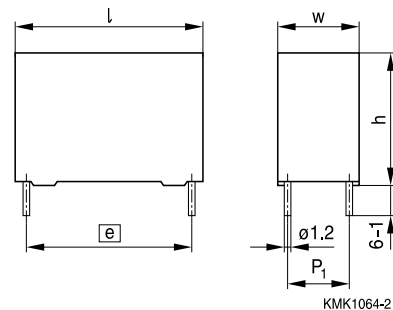
- Parallel wire leads, lead-free tinned
- 2-pin and 4-pin versions
- Standard lead lengths: 6 – 1 mm
- Special lead lengths available on request

Marking

Manufacturer's logo, date code, rated capacitance (coded), capacitance tolerance (code letter), rated AC voltage

Delivery mode

Bulk (untaped, lead length 6 – 1 mm)

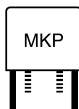
Dimensional drawings
2-pin version

4-pin version


Dimensions in mm

| Version | Lead spacing $[e] \pm 0.4$ | Lead diameter d_1 | Type |
|---------|-------------------------------|------------------------|-----------|
| 2-pin | 27.5 | 0.8 | B32794D |
| 2-pin | 37.5 | 1.0 | B32796E/T |
| 4-pin | 37.5 | 1.2 | B32796G |
| 4-pin | 52.5 | 1.2 | B32798G |

Overview of available types

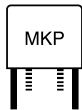
| | | | | |
|------------------|---------|-----|-----|-----|
| Lead spacing | 27.5 mm | | | |
| Type | B32794 | | | |
| Page | 6 | | | |
| V_{RMS} (V AC) | 250 | 300 | 350 | 400 |
| C_R (μ F) | | | | |
| 0.82 | | | | |
| 1.2 | | | | |
| 1.5 | | | | |
| 2.0 | | | | |
| 2.2 | | | | |
| 2.5 | | | | |
| 3.3 | | | | |
| 3.5 | | | | |
| 4.0 | | | | |
| 5.0 | | | | |
| 6.3 | | | | |
| 7.5 | | | | |
| 8.0 | | | | |
| 10 | | | | |
| 12 | | | | |
| 15 | | | | |



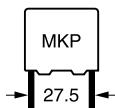
B32794 ... B32798

MKP AC filtering

| | | | | |
|------------------|---------|-----|-----|-----|
| Lead spacing | 37.5 mm | | | |
| Type | B32796 | | | |
| Page | 7 | | | |
| V_{RMS} (V AC) | 250 | 300 | 350 | 400 |
| C_R (μ F) | | | | |
| 2.7 | | | | |
| 3.5 | | | | |
| 4.0 | | | | |
| 5.0 | | | | |
| 5.6 | | | | |
| 7.5 | | | | |
| 8.0 | | | | |
| 10 | | | | |
| 11 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 20 | | | | |
| 22 | | | | |
| 24 | | | | |
| 25 | | | | |
| 30 | | | | |
| 34 | | | | |
| 40 | | | | |
| 45 | | | | |



| | | | | |
|------------------|---------|-----|-----|-----|
| Lead spacing | 52.5 mm | | | |
| Type | B32798 | | | |
| Page | 9 | | | |
| V_{RMS} (V AC) | 250 | 300 | 350 | 400 |
| C_R (μ F) | | | | |
| 18 | | | | |
| 20 | | | | |
| 25 | | | | |
| 26 | | | | |
| 30 | | | | |
| 35 | | | | |
| 40 | | | | |
| 55 | | | | |
| 75 | | | | |


B32794
MKP AC filtering
Ordering codes and packing units (lead spacing 27.5 mm)

| V_{RMS} | V_R | C_R | Max. dimensions $w \times h \times l$ | P_1 | Ordering code (composition see below) | I_{RMS} 60 °C 10 kHz A | ESL nH | ESR 10 kHz mΩ | Untaped pcs./ MOQ |
|-----------|-------|-------|--|-------|---|-----------------------------------|-----------|---------------------|-------------------------|
| V AC | V DC | μF | mm | mm | | | | | |
| 250 | 630 | 2.5 | 11.0 × 19.0 × 31.5 | – | B32794D2255+000 | 4 | 24 | 14.1 | 2352 |
| | | 4.0 | 11.0 × 21.0 × 31.5 | – | B32794D2405+000 | 6 | 25 | 9.1 | 2352 |
| | | 6.3 | 15.0 × 24.5 × 31.5 | – | B32794D2635+000 | 8 | 26 | 6.1 | 1680 |
| | | 10 | 16.0 × 32.0 × 31.5 | – | B32794D2106+000 | 11 | 27 | 4.2 | 1064 |
| | | 15 | 22.0 × 36.5 × 31.5 | – | B32794D2156+000 | 13 | 28 | 3.1 | 784 |
| 300 | 700 | 2.0 | 11.0 × 19.0 × 31.5 | – | B32794D3205+000 | 4 | 24 | 15.6 | 2352 |
| | | 3.3 | 13.5 × 23.0 × 31.5 | – | B32794D3335+000 | 6 | 25 | 9.7 | 1932 |
| | | 5.0 | 14.0 × 24.5 × 31.5 | – | B32794D3505+000 | 7 | 26 | 6.7 | 1848 |
| | | 8.0 | 18.0 × 33.0 × 31.5 | – | B32794D3805+000 | 9 | 27 | 4.6 | 952 |
| | | 12 | 22.0 × 36.5 × 31.5 | – | B32794D3126+000 | 11 | 28 | 3.5 | 784 |
| 350 | 875 | 1.2 | 11.0 × 19.0 × 31.5 | – | B32794D8125+000 | 3 | 24 | 21.2 | 2352 |
| | | 2.2 | 12.5 × 21.5 × 31.5 | – | B32794D8225+000 | 5 | 25 | 11.9 | 2100 |
| | | 3.3 | 15.0 × 24.5 × 31.5 | – | B32794D8335+000 | 7 | 26 | 8.2 | 1680 |
| | | 5.0 | 18.0 × 33.0 × 31.5 | – | B32794D8505+000 | 9 | 27 | 5.8 | 952 |
| | | 7.5 | 22.0 × 36.5 × 31.5 | – | B32794D8755+000 | 12 | 28 | 4.5 | 784 |
| 400 | 1050 | 0.82 | 11.0 × 19.0 × 31.5 | – | B32794D4824+000 | 3 | 24 | 26.5 | 2352 |
| | | 1.5 | 13.5 × 23.0 × 31.5 | – | B32794D4155+000 | 4 | 25 | 14.8 | 1932 |
| | | 2.2 | 14.0 × 24.5 × 31.5 | – | B32794D4225+000 | 6 | 26 | 10.4 | 1848 |
| | | 3.5 | 18.0 × 33.0 × 31.5 | – | B32794D4355+000 | 8 | 27 | 6.9 | 952 |
| | | 5.0 | 22.0 × 36.5 × 31.5 | – | B32794D4505+000 | 11 | 28 | 5.5 | 784 |

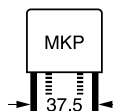
MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:

K = ±10%

J = ±5%


Ordering codes and packing units (lead spacing 37.5 mm)

| V_{RMS} | V_R | C_R | Max. dimensions w × h × l | P_1 | Ordering code (composition see below) | I_{RMS} 60 °C 10 kHz A | ESL nH | ESR 10 kHz mΩ | Untaped pcs./ MOQ |
|-----------|--------------------|-------|------------------------------|-------|---|-----------------------------------|-----------------|---------------------|-------------------------|
| V AC | V DC | μF | mm | mm | | | | | |
| 250 | 630 | 8 | 24.0 × 15.0 × 41.5 | – | B32796T2805+000 | 8 | 21 | 9 | 1040 |
| | | 11 | 24.0 × 19.0 × 41.5 | – | B32796T2116+000 | 10 | 23 | 8 | 780 |
| | | 22 | 20.0 × 39.5 × 42.0 | 10.2 | B32796G2226+000 | 15 | 30 | 3.2 | 640 |
| | | 22 | 20.0 × 39.5 × 42.0 | – | B32796E2226+000 | 14 | 30 | 3.2 | 640 |
| | | 25 | 28.0 × 37.0 × 42.0 | 10.2 | B32796G2256+000 | 17 | 30 | 2.9 | 440 |
| | | 25 | 28.0 × 37.0 × 42.0 | – | B32796E2256+000 | 16 | 30 | 2.9 | 440 |
| | | 40 | 30.0 × 45.0 × 42.0 | 20.3 | B32796G2406+000 | 21 | 33 | 2.3 | 400 |
| | | 40 | 30.0 × 45.0 × 42.0 | – | B32796E2406+000 | 20 | 33 | 2.3 | 400 |
| | | 45 | 33.0 × 48.0 × 42.5 | 20.3 | B32796G2456+000 | 23 | 33 | 1.9 | 180 |
| | | 300 | 700 | 5.6 | 24.0 × 15.0 × 41.5 | – | B32796T3565+000 | 7 | 21 |
| 7.5 | 24.0 × 19.0 × 41.5 | | | – | B32796T3755+000 | 9 | 23 | 10 | 780 |
| 16 | 20.0 × 39.5 × 42.0 | | | 10.2 | B32796G3166+000 | 14 | 30 | 3.9 | 640 |
| 16 | 20.0 × 39.5 × 42.0 | | | – | B32796E3166+000 | 13 | 30 | 3.9 | 640 |
| 20 | 28.0 × 37.0 × 42.0 | | | 10.2 | B32796G3206+000 | 15 | 30 | 3.1 | 440 |
| 20 | 28.0 × 37.0 × 42.0 | | | – | B32796E3206+000 | 14 | 30 | 3.1 | 440 |
| 30 | 30.0 × 45.0 × 42.0 | | | 20.3 | B32796G3306+000 | 19 | 33 | 2.2 | 400 |
| 30 | 30.0 × 45.0 × 42.0 | | | – | B32796E3306+000 | 18 | 33 | 2.2 | 400 |
| 34 | 33.0 × 48.0 × 42.5 | | | 20.3 | B32796E3346+000 | 20 | 33 | 1.9 | 180 |
| 350 | 875 | | | 4 | 24.0 × 15.0 × 41.5 | – | B32796T8405+000 | 7 | 21 |
| | | 5 | 24.0 × 19.0 × 41.5 | – | B32796T8505+000 | 9 | 23 | 11 | 780 |
| | | 10 | 20.0 × 39.5 × 42.0 | 10.2 | B32796G8106+000 | 12 | 30 | 4.9 | 640 |
| | | 10 | 20.0 × 39.5 × 42.0 | – | B32796E8106+000 | 11 | 30 | 4.9 | 640 |
| | | 14 | 28.0 × 37.0 × 42.0 | 10.2 | B32796G8146+000 | 15 | 30 | 3.6 | 440 |
| | | 14 | 28.0 × 37.0 × 42.0 | – | B32796E8146+000 | 14 | 30 | 3.6 | 440 |
| | | 15 | 30.0 × 45.0 × 42.0 | 20.3 | B32796G8156+000 | 15 | 30 | 3.0 | 400 |
| | | 20 | 30.0 × 45.0 × 42.0 | 20.3 | B32796G8206+000 | 19 | 30 | 2.6 | 400 |
| | | 20 | 30.0 × 45.0 × 42.0 | – | B32796E8206+000 | 18 | 30 | 2.6 | 400 |
| | | 24 | 33.0 × 48.0 × 42.5 | 20.3 | B32796G8246+000 | 20 | 30 | 2.5 | 180 |

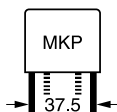
MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:

K = ±10%

J = ±5%


B32796
MKP AC filtering
Ordering codes and packing units (lead spacing 37.5 mm)

| V_{RMS} | V_R | C_R | Max. dimensions $w \times h \times l$ | P_1 | Ordering code (composition see below) | I_{RMS} 60 °C 10 kHz A | ESL nH | ESR 10 kHz mΩ | Untaped pcs./ MOQ |
|-----------|-------|-------|--|-------|---|-----------------------------------|-----------|---------------------|-------------------------|
| V AC | V DC | μF | mm | mm | | | | | |
| 400 | 1050 | 2.7 | 24.0 × 15.0 × 41.5 | – | B32796T4275+000 | 7 | 21 | 15 | 1040 |
| | | 3.5 | 24.0 × 19.0 × 41.5 | – | B32796T4355+000 | 8 | 23 | 13 | 780 |
| | | 7.5 | 20.0 × 39.5 × 42.0 | 10.2 | B32796G4755+000 | 11 | 30 | 5.5 | 640 |
| | | 7.5 | 20.0 × 39.5 × 42.0 | – | B32796E4755+000 | 10 | 30 | 5.5 | 640 |
| | | 10 | 28.0 × 37.0 × 42.0 | 10.2 | B32796G4106+000 | 14 | 30 | 4.5 | 440 |
| | | 10 | 28.0 × 37.0 × 42.0 | – | B32796E4106+000 | 13 | 30 | 4.5 | 440 |
| | | 13 | 30.0 × 45.0 × 42.0 | 20.3 | B32796G4136+000 | 17 | 33 | 3.5 | 400 |
| | | 13 | 30.0 × 45.0 × 42.0 | – | B32796E4136+000 | 16 | 33 | 3.5 | 400 |
| | | 16 | 33.0 × 48.0 × 42.5 | 20.3 | B32796G4166+000 | 18 | 33 | 3.5 | 180 |

MOQ = Minimum Order Quantity, consisting of 4 packing units.

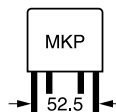
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:

K = ±10%

J = ±5%


Ordering codes and packing units (lead spacing 52.5 mm)

| V_{RMS} | V_R | C_R | Max. dimensions $w \times h \times l$ | P_1 | Ordering code (composition see below) | I_{RMS} 60 °C 10 kHz A | ESL nH | ESR 10 kHz mΩ | Untaped pcs./ MOQ |
|-----------|-------|-------|--|-------|---|-----------------------------------|-----------|---------------------|-------------------------|
| V AC | V DC | μF | mm | mm | | | | | |
| 250 | 630 | 55 | 30.0 × 45.0 × 57.5 | 20.3 | B32798G2556+000 | 21 | 35 | 2.7 | 280 |
| | | 75 | 35.0 × 50.0 × 57.5 | 20.3 | B32798G2756+000 | 25 | 38 | 2.1 | 108 |
| 300 | 700 | 40 | 30.0 × 45.0 × 57.5 | 20.3 | B32798G3406+000 | 19 | 35 | 3.2 | 280 |
| | | 55 | 35.0 × 50.0 × 57.5 | 20.3 | B32798G3556+000 | 24 | 38 | 2.5 | 108 |
| 350 | 875 | 26 | 30.0 × 45.0 × 57.5 | 20.3 | B32798G8266+000 | 18 | 35 | 4.5 | 280 |
| | | 30 | 30.0 × 45.0 × 57.5 | 20.3 | B32798G8306K000 | 20 | 37 | 4.0 | 108 |
| | | 30 | 35.0 × 50.0 × 57.5 | 20.3 | B32798G8306J000 | 20 | 37 | 4.0 | 108 |
| | | 35 | 35.0 × 50.0 × 57.5 | 20.3 | B32798G8356+000 | 22 | 38 | 3.0 | 108 |
| | | 40 | 35.0 × 50.0 × 57.5 | 20.3 | B32798G8406K000 | 22 | 38 | 3.0 | 108 |
| 400 | 1050 | 18 | 30.0 × 45.0 × 57.5 | 20.3 | B32798G4186+000 | 16 | 35 | 4.7 | 280 |
| | | 20 | 35.0 × 50.0 × 57.5 | 20.3 | B32798G4206+000 | 17 | 37 | 4.5 | 108 |
| | | 25 | 35.0 × 50.0 × 57.5 | 20.3 | B32798G4256+000 | 20 | 38 | 3.5 | 108 |

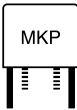
MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:

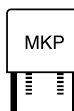
K = ±10%

J = ±5%


B32794 ... B32798
MKP AC filtering
Technical data

Reference standard: IEC 61071, EN 61071, VDE 0560-120

| | |
|--|--|
| Operating temperature range (case) | Max. operating temperature, $T_{op,max}$ +105 °C Upper category temperature T_{max} +85 °C Lower category temperature T_{min} -40 °C Note: At $T > 85$ °C de-rating for V_{RMS} (V AC) should be 1.5%/°C |
| Capacitance drift in range (-40 °C, -85 °C) | 2% respect the value measured at reference conditions |
| Insulation Resistance R_{ins} given as time constant $\tau = C_R \cdot R_{ins}$, rel. humidity $\leq 65\%$ (minimum as-delivered values) | 30 000 s |
| Test voltage between terminals | $1.5 \cdot V_R$ for 10 s $1.65 \cdot V_R$ for 2 s |
| Test voltage terminal case (10 s) | $2 \cdot V_{RMS} + 1000$ V AC (min. 2000 V AC) at 50 Hz |
| Maximum permissible overvoltage for short operating periods (max 1 min/day) | $1.3 \cdot V_{RMS}$ |
| Maximum peak current (A) | $I_{P,max} = C_R \cdot \frac{dV}{dt}$ |
| Damp heat test Limit values after damp heat test | 56 days/40 °C/93% relative humidity Capacitance change $ \Delta C/C \leq 5\%$ Dissipation factor change $\Delta \tan \delta \leq 1.5 \cdot 10^{-3}$ (at 1 kHz) Insulation resistance $R_{ins} \geq 50\%$ of minimum as-delivered values |
| Change of temperature | In accordance with IEC 60068-2-14 (Test Nb) |
| Reliability: | Failure rate λ 300 fit Service life t_{SL} > 60 000 h at V_{RMS} , 60 °C For conversion to other operating conditions, refer to chapter "Reliability" on page 439 from Data Book 2009. Failure criteria: Total failure Short/open circuit Failure due to variation of parameters Capacitance change $ \Delta C/C \geq 10\%$ Dissipation factor change $\Delta \tan \delta > 4 \cdot$ upper limit value Insulation resistance $R_{ins} < 1500$ M Ω ($C_R \leq 0.33\mu F$) or time constant $\tau = C_R \cdot R_{ins} < 500$ s ($C_R > 0.33\mu F$) |



Pulse handling capability

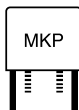
"dV/dt" represents the maximum permissible voltage change per unit of time for non-sinusoidal voltages, expressed in V/μs.

Note:

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

| Lead spacing | 27.5 mm | | | | 37.5 mm | | | | 52.5 mm | | | |
|-------------------------|---------------|-----|-----|-----|---------|-----|-----|-----|---------|-----|-----|-----|
| Type | B32794 | | | | B32796 | | | | B32798 | | | |
| V _{RMS} (V AC) | 250 | 300 | 350 | 400 | 250 | 300 | 350 | 400 | 250 | 300 | 350 | 400 |
| | dV/dt in V/μs | | | | | | | | | | | |
| | 27 | 31 | 39 | 47 | 19 | 21 | 26 | 32 | 12 | 14 | 18 | 21 |

Notes: Please take all additional data not mentioned above from our Data Book 2009



B32794 ... B32798

MKP AC filtering

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.

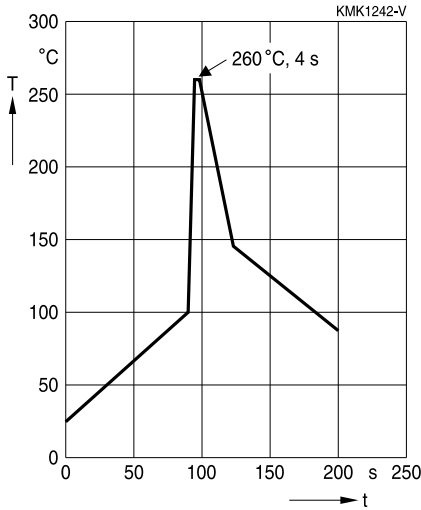
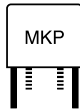
| | |
|-------------------------|---|
| Solder bath temperature | 235 ±5 °C |
| Soldering time | 2.0 ±0.5 s |
| Immersion depth | 2.0 +0/−0.5 mm from capacitor body or seating plane |
| Evaluation criteria: | |
| Visual inspection | Wetting of wire surface by new solder ≥90%, free-flowing solder |

1.2 Resistance to soldering heat

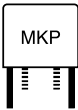
Resistance to soldering heat is tested to IEC 60068-2-20, test Tb, method 1A.

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 (lead spacing ≤ 7.5 mm) | | < 4 s |
| MKT uncoated (lead spacing ≤ 10 mm) insulated (B32559) | | recommended soldering profile for MKT uncoated (lead spacing ≤ 10 mm) and insulated (B32559) |



| | |
|----------------------|---|
| Immersion depth | 2.0 +0/−0.5 mm from capacitor body or seating plane |
| Shield | Heat-absorbing board, (1.5 ±0.5) mm thick, between capacitor body and liquid solder |
| Evaluation criteria: | |
| Visual inspection | No visible damage |
| $\Delta C/C_0$ | 2% for MKT/MKP/MFP 5% for EMI suppression capacitors |
| $\tan \delta$ | As specified in sectional specification |



B32794 ... B32798

MKP AC filtering

1.3 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 change irreversibly a capacitor's electrical characteristics. For short exposures (as in practical soldering processes) the heat load (and thus the possible effects on a capacitor) will also depend on other factors like:

- Pre-heating temperature and time
- Forced cooling immediately after soldering
- Terminal characteristics:
 - diameter, length, thermal resistance, special configurations (e.g. crimping)
- Height of capacitor above solder bath
- Shadowing by neighboring components
- Additional heating due to heat dissipation by neighboring components
- Use of solder-resist 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 possibly have to be included.

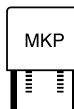
EPCOS recommends the following conditions:

- Pre-heating with a maximum temperature of 110 °C
- Temperature inside the capacitor should not exceed the following limits:
 - MKP/MFP 110 °C
 - MKT 160 °C
- When SMD components are used together with leaded ones, the leaded film capacitors should not pass into the SMD adhesive curing oven. The leaded components should be assembled after the SMD curing step.
- Leaded film capacitors are not suitable for reflow soldering.

Uncoated capacitors

For uncoated MKT capacitors with lead spacings ≤ 10 mm (B32560/B32561) the following measures are recommended:

- pre-heating to not more than 110 °C in the preheater phase
- rapid cooling after soldering

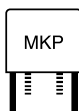


Cautions and warnings

- 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 PTH hole spacing differs from the specified lead spacing.
- 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.

The table below summarizes the safety instructions that must always be observed. A detailed description can be found in the relevant sections of the chapters "General technical information" and "Mounting guidelines".

| Topic | Safety information | Reference chapter "General technical information" |
|-------------------------|---|---|
| Storage conditions | Make sure that capacitors are stored within the specified range of time, temperature and humidity conditions. | 4.5 "Storage conditions" |
| Flammability | Avoid external energy, such as fire or electricity (passive flammability), avoid overload of the capacitors (active flammability) and consider the flammability of materials. | 5.3 "Flammability" |
| Resistance to vibration | Do not exceed the tested ability to withstand vibration. The capacitors are tested to IEC 60068-2-6. 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". | 5.2 "Resistance to vibration" |



B32794 ... B32798

MKP AC filtering

| Topic | Safety information | Reference chapter "Mounting guidelines" |
|--|---|--|
| Soldering | Do not exceed the specified time or temperature limits during soldering. | 1 "Soldering" |
| Cleaning | Use only suitable solvents for cleaning capacitors. | 2 "Cleaning" |
| Embedding of capacitors in finished assemblies | When embedding finished circuit assemblies in plastic resins, chemical and thermal influences must be taken into account. Caution: Consult us first, if you also wish to embed other uncoated component types! | 3 "Embedding of capacitors in finished assemblies" |

Effect of humidity on capacitance stability

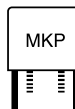
Long contact of a film capacitor with humidity can produce irreversible effects. Direct contact with liquid water or excess exposure to high ambient humidity or dew will eventually remove the film metallization and thus destroy the capacitor. Plastic boxed capacitors must be properly tested in the final application at the worst expected conditions of temperature and humidity in order to check if any parameter drift may provoke a circuit malfunction.

In case of penetration of humidity through the film, the layer of Zinc can be degraded, specially under AC operation (change of polarity), accelerated by the temperature, provoking an increment of the serial resistance of the electrode and eventually a reduction of the capacitance value. For DC operation, the parameter drift is much less.

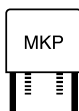
Plastic boxes and resins can not protect 100% against humidity. Metal enclosures, resin potting or coatings or similar measures by customers in their applications will offer additional protection against humidity penetration.

Display of ordering codes for EPCOS products

The ordering code for one and the same product can be represented differently in data sheets, data books, other publications and the website of EPCOS, or in order-related documents such as shipping notes, order confirmations and product labels. **The varying representations of the ordering codes are due to different processes employed and do not affect the specifications of the respective products.** Detailed information can be found on the Internet under www.epcos.com/orderingcodes.


Symbols and terms

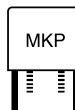
| Symbol | English | German |
|----------------------|---|---|
| α | Heat transfer coefficient | Wärmeübergangszahl |
| α_C | Temperature coefficient of capacitance | Temperaturkoeffizient der Kapazität |
| A | Capacitor surface area | Kondensatoroberfläche |
| β_C | Humidity coefficient of capacitance | Feuchtekoeffizient der Kapazität |
| C | Capacitance | Kapazität |
| C_R | Rated capacitance | Nennkapazität |
| ΔC | Absolute capacitance change | Absolute Kapazitätsänderung |
| $\Delta C/C$ | Relative capacitance change (relative deviation of actual value) | Relative Kapazitätsänderung (relative Abweichung vom Ist-Wert) |
| $\Delta C/C_R$ | Capacitance tolerance (relative deviation from rated capacitance) | Kapazitätstoleranz (relative Abweichung vom Nennwert) |
| dt | Time differential | Differentielle Zeit |
| Δt | Time interval | Zeitintervall |
| ΔT | Absolute temperature change (self-heating) | Absolute Temperaturänderung (Selbsterwärmung) |
| $\Delta \tan \delta$ | Absolute change of dissipation factor | Absolute Änderung des Verlustfaktors |
| ΔV | Absolute voltage change | Absolute Spannungsänderung |
| dV/dt | Time differential of voltage function (rate of voltage rise) | Differentielle Spannungsänderung (Spannungsflankensteilheit) |
| $\Delta V/\Delta t$ | Voltage change per time interval | Spannungsänderung pro Zeitintervall |
| E | Activation energy for diffusion | Aktivierungsenergie zur Diffusion |
| ESL | Self-inductance | Eigeninduktivität |
| ESR | Equivalent series resistance | Ersatz-Serienwiderstand |
| f | Frequency | Frequenz |
| f_1 | Frequency limit for reducing permissible AC voltage due to thermal limits | Grenzfrequenz für thermisch bedingte Reduzierung der zulässigen Wechselspannung |
| f_2 | Frequency limit for reducing permissible AC voltage due to current limit | Grenzfrequenz für strombedingte Reduzierung der zulässigen Wechselspannung |
| f_r | Resonant frequency | Resonanzfrequenz |
| F_D | Thermal acceleration factor for diffusion | Therm. Beschleunigungsfaktor zur Diffusion |
| F_T | Derating factor | Deratingfaktor |
| i | Current (peak) | Stromspitze |
| I_C | Category current (max. continuous current) | Kategoriestrom (max. Dauerstrom) |



B32794 ... B32798

MKP AC filtering

| Symbol | English | German |
|------------------|--|---|
| I_{RMS} | (Sinusoidal) alternating current, root-mean-square value | (Sinusförmiger) Wechselstrom |
| i_z | Capacitance drift | Inkonstanz der Kapazität |
| k_0 | Pulse characteristic | Impuls Kennwert |
| L_S | Series inductance | Serieninduktivität |
| λ | Failure rate | Ausfallrate |
| λ_0 | Constant failure rate during useful service life | Konstante Ausfallrate in der Nutzungsphase |
| λ_{test} | Failure rate, determined by tests | Experimentell ermittelte Ausfallrate |
| P_{diss} | Dissipated power | Abgegebene Verlustleistung |
| P_{gen} | Generated power | Erzeugte Verlustleistung |
| Q | Heat energy | Wärmeenergie |
| ρ | Density of water vapor in air | Dichte von Wasserdampf in Luft |
| R | Universal molar constant for gases | Allg. Molarkonstante für Gas |
| R | Ohmic resistance of discharge circuit | Ohmscher Widerstand des Entladekreises |
| R_i | Internal resistance | Innenwiderstand |
| R_{ins} | Insulation resistance | Isolationswiderstand |
| R_P | Parallel resistance | Parallelwiderstand |
| R_S | Series resistance | Serienwiderstand |
| S | severity (humidity test) | Schärfegrad (Feuchtest) |
| t | Time | Zeit |
| T | Temperature | Temperatur |
| τ | Time constant | Zeitkonstante |
| $\tan \delta$ | Dissipation factor | Verlustfaktor |
| $\tan \delta_D$ | Dielectric component of dissipation factor | Dielektrischer Anteil des Verlustfaktors |
| $\tan \delta_P$ | Parallel component of dissipation factor | Parallelanteil des Verlustfaktors |
| $\tan \delta_S$ | Series component of dissipation factor | Serienanteil des Verlustfaktors |
| T_A | Temperature of the air surrounding the component | Temperatur der Luft, die das Bauteil umgibt |
| T_{max} | Upper category temperature | Obere Kategorietemperatur |
| T_{min} | Lower category temperature | Untere Kategorietemperatur |
| t_{OL} | Operating life at operating temperature and voltage | Betriebszeit bei Betriebstemperatur und -spannung |
| T_{op} | Operating temperature | Betriebstemperatur |
| T_R | Rated temperature | Nenntemperatur |
| T_{ref} | Reference temperature | Referenztemperatur |
| t_{SL} | Reference service life | Referenz-Lebensdauer |



| Symbol | English | German |
|-------------|---|---|
| V_{AC} | AC voltage | Wechselspannung |
| V_C | Category voltage | Kategoriespannung |
| $V_{C,RMS}$ | Category AC voltage | (Sinusförmige) Kategorie-Wechselspannung |
| V_{CD} | Corona-discharge onset voltage | Teilentlade-Einsatzspannung |
| V_{ch} | Charging voltage | Ladespannung |
| V_{DC} | DC voltage | Gleichspannung |
| V_{FB} | Fly-back capacitor voltage | Spannung (Flyback) |
| V_i | Input voltage | Eingangsspannung |
| V_o | Output voltage | Ausgangssspannung |
| V_{op} | Operating voltage | Betriebsspannung |
| V_p | Peak pulse voltage | Impuls-Spitzenspannung |
| V_{pp} | Peak-to-peak voltage Impedance | Spannungshub |
| V_R | Rated voltage | Nennspannung |
| \hat{V}_R | Amplitude of rated AC voltage | Amplitude der Nenn-Wechselspannung |
| V_{RMS} | (Sinusoidal) alternating voltage, root-mean-square value | (Sinusförmige) Wechselspannung |
| V_{SC} | S-correction voltage | Spannung bei Anwendung "S-correction" |
| V_{sn} | Snubber capacitor voltage | Spannung bei Anwendung "Beschaltung" |
| Z | Impedance | Scheinwiderstand |
| e | Lead spacing | Rastermaß |

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.
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, Alu-X, CeraDiode, CeraLink, CeraPlas, CSMP, CSSP, CTVS, DeltaCap, DigiSiMic, DSSP, FilterCap, FormFit, MiniBlue, MiniCell, MKD, MKK, MLSC, MotorCap, PCC, PhaseCap, PhaseCube, PhaseMod, PhiCap, PQSine, SIFERRIT, SIFI, SIKOREL, SilverCap, SIMDAD, SiMic, SIMID, SineFormer, SIOV, SIP5D, SIP5K, TFAP, 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.