# Film Capacitors

## Double Sided Metallized Polypropylene Film Capacitor MMKP

**Series/Type:** **B32641B ... B32642B**

Date: May 2015



EPCOS AG is a TDK Group Company.

### Typical applications
- Electronic ballasts (resonant circuits)
- LLC typology in resonant circuits
- High frequency applications with high current stress
- Switched-mode power supply

### Climatic
- Max. operating temperature: 110 °C
- Climatic category (IEC 60068-1): 55/100/56

### Construction
- Dielectric: polypropylene (PP) with polyester (PET)
- Wound capacitor technology
- Plastic case (UL 94 V-0)
- Epoxy resin sealing

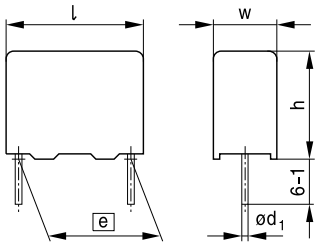
### Features
- Very compact design
- High pulse strength
- High current withstand capability
- Halogen free available on request

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

### Marking
Manufacturer's logo,
lot number, series number
rated capacitance (coded),
capacitance tolerance (code letter), rated DC voltage,
date of manufacture (coded)

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

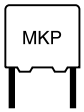
### Dimensional drawing



KMK0834-G-E

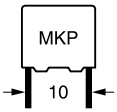
Dimensions in mm

| Lead spacing $e$ ±0.4 | Lead diameter $d_1$ ±0.05 | Type |
|---|---|---|
| 10 | 0.6 | B32641B |
| 15 | 0.8 | B32642B |




**Overview of available types**

| Lead spacing | 10 mm | | 15 mm | |
|---|---|---|---|---|
| Type | B32641B | | B32642B | |
| Page | 4 | | 5 | |
| $V_R$ (V DC) | 630 | 1000 | 630 | 1000 |
| $V_{RMS}$ (V AC) | 400 | 600 | 400 | 600 |
| $C_R$ (nF) | | | | |
| 4.7 | | | | |
| 6.8 | | | | |
| 8.2 | | | | |
| 10 | | | | |
| 15 | | | | |
| 18 | | | | |
| 22 | | | | |
| 27 | | | | |
| 33 | | | | |
| 39 | | | | |
| 47 | | | | |
| 56 | | | | |
| 68 | | | | |
| 82 | | | | |
| 100 | | | | |
| 120 | | | | |
| 150 | | | | |




**B32641B**

**High frequency**

### Ordering codes and packing units (lead spacing 10 mm)

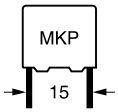
| $V_R$ V DC | $V_{RMS}$ f ≤1 kHz V AC | $C_R$ nF | Max. dimensions w × h × l mm | Ordering code (composition see below) | Ammo pack pcs./MOQ | Reel pcs./ MOQ | Untaped pcs./ MOQ |
|---|---|---|---|---|---|---|---|
| 630 | 400 | 6.8 | 4.0 × 9.0 × 13.0 | B32641B6682+*** | 4000 | 6800 | 4000 |
| | | 8.2 | 4.0 × 9.0 × 13.0 | B32641B6822+*** | 4000 | 6800 | 4000 |
| | | 10 | 4.0 × 9.0 × 13.0 | B32641B6103+*** | 4000 | 6800 | 4000 |
| | | 15 | 5.0 × 11.0 × 13.0 | B32641B6153+*** | 3320 | 5200 | 4000 |
| | | 18 | 5.0 × 11.0 × 13.0 | B32641B6183+*** | 3320 | 5200 | 4000 |
| | | 22 | 6.0 × 12.0 × 13.0 | B32641B6223+*** | 2720 | 4400 | 4000 |
| | | 27 | 6.0 × 12.0 × 13.0 | B32641B6273+*** | 2720 | 4400 | 4000 |
| | | 33 | 6.0 × 14.0 × 13.0 | B32641B6333+*** | 2720 | 4400 | 4000 |
| | | 39 | 7.0 × 16.0 × 13.0 | B32641B6393+*** | – | – | 4000 |
| | | 47 | 8.0 × 17.5 × 13.0 | B32641B6473+*** | – | – | 4000 |
| 1000 | 600 | 4.7 | 4.0 × 9.0 × 13.0 | B32641B0472+*** | 4000 | 6800 | 4000 |
| | | 6.8 | 4.0 × 9.0 × 13.0 | B32641B0682+*** | 4000 | 6800 | 4000 |
| | | 8.2 | 5.0 × 11.0 × 13.0 | B32641B0822+*** | 3320 | 5200 | 4000 |
| | | 10 | 5.0 × 11.0 × 13.0 | B32641B0103+*** | 3320 | 5200 | 4000 |
| | | 15 | 6.0 × 12.0 × 13.0 | B32641B0153+*** | 2720 | 4400 | 4000 |
| | | 18 | 6.0 × 14.0 × 13.0 | B32641B0183+*** | 2720 | 4400 | 4000 |
| | | 22 | 7.0 × 16.0 × 13.0 | B32641B0223+*** | – | – | 4000 |
| | | 27 | 8.0 × 17.5 × 13.0 | B32641B0273+*** | – | – | 4000 |
| | | 33 | 8.0 × 17.5 × 13.0 | B32641B0333+*** | – | – | 4000 |

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%

*** = Packaging code:
289 = Ammo pack
189 = Reel
000 = Untaped (lead length 6 −1 mm)




**Ordering codes and packing units (lead spacing 15 mm)**

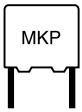
| $V_R$ V DC | $V_{RMS}$ f ≤1 kHz V AC | $C_R$ nF | Max. dimensions w × h × l mm | Ordering code (composition see below) | Ammo pack pcs./MOQ | Reel pcs./ MOQ | Untaped pcs./ MOQ |
|---|---|---|---|---|---|---|---|
| 630 | 400 | 15 | 5.0 × 10.5 × 18.0 | B32642B6153+*** | 4680 | 5200 | 4000 |
| | | 18 | 5.0 × 10.5 × 18.0 | B32642B6183+*** | 4680 | 5200 | 4000 |
| | | 22 | 5.0 × 10.5 × 18.0 | B32642B6223+*** | 4680 | 5200 | 4000 |
| | | 27 | 5.0 × 10.5 × 18.0 | B32642B6273+*** | 4680 | 5200 | 4000 |
| | | 33 | 5.0 × 10.5 × 18.0 | B32642B6333+*** | 4680 | 5200 | 4000 |
| | | 39 | 6.0 × 11.0 × 18.0 | B32642B6393+*** | 3840 | 4400 | 4000 |
| | | 47 | 6.0 × 12.0 × 18.0 | B32642B6473+*** | 3840 | 4400 | 4000 |
| | | 56 | 7.0 × 12.5 × 18.0 | B32642B6563+*** | 3320 | 3600 | 4000 |
| | | 68 | 8.0 × 14.0 × 18.0 | B32642B6683+*** | 2920 | 3000 | 2000 |
| | | 82 | 8.5 × 14.5 × 18.0 | B32642B6823+*** | 2720 | 2800 | 2000 |
| | | 100 | 8.5 × 14.5 × 18.0 | B32642B6104+*** | 2720 | 2800 | 2000 |
| | | 120 | 9.0 × 17.5 × 18.0 | B32642B6124+*** | 2560 | 2800 | 2000 |
| | | 150 | 11.0 × 18.5 × 18.0 | B32642B6154+*** | – | 2200 | 1200 |
| 1000 | 600 | 10 | 5.0 × 10.5 × 18.0 | B32642B0103+*** | 4680 | 5200 | 4000 |
| | | 15 | 5.0 × 10.5 × 18.0 | B32642B0153+*** | 4680 | 5200 | 4000 |
| | | 18 | 5.0 × 10.5 × 18.0 | B32642B0183+*** | 4680 | 5200 | 4000 |
| | | 22 | 6.0 × 11.0 × 18.0 | B32642B0223+*** | 3840 | 4400 | 4000 |
| | | 27 | 6.0 × 12.0 × 18.0 | B32642B0273+*** | 3840 | 4400 | 4000 |
| | | 33 | 7.0 × 12.5 × 18.0 | B32642B0333+*** | 3320 | 3600 | 4000 |
| | | 39 | 8.0 × 14.0 × 18.0 | B32642B0393+*** | 2920 | 3000 | 2000 |
| | | 47 | 8.0 × 14.0 × 18.0 | B32642B0473+*** | 2920 | 3000 | 2000 |
| | | 56 | 8.5 × 14.5 × 18.0 | B32642B0563+*** | 2720 | 2800 | 2000 |
| | | 68 | 9.0 × 17.5 × 18.0 | B32642B0683+*** | 2560 | 2800 | 2000 |
| | | 82 | 11.0 × 18.5 × 18.0 | B32642B0823+*** | – | 2200 | 1200 |
| | | 100 | 11.0 × 18.5 × 18.0 | B32642B0104K*** | – | 2200 | 1200 |

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%

*** = Packaging code:
289 = Ammo pack
189 = Reel
000 = Untaped (lead length 6 −1 mm)




**B32641B ... B32642B**

**High frequency**

## Technical data

Reference standard: IEC-60384-16. All data given at T = 20 °C, otherwise is specified.

| | | |
|---|---|---|
| Operating temperature range | Max. operating temperature $T_{op,max}$ | +110 °C |
| | Upper category temperature $T_{max}$ | +100 °C |
| | Lower category temperature $T_{min}$ | −55 °C |
| | Rated temperature $T_R$ | +85 °C |
| Dissipation factor tan δ (in $10^{-3}$) at 20 °C (upper limit values) | 1 kHz | 0.6 |
| | 10 kHz | 0.6 |
| | 100 kHz | 1.5 |
| Insulation resistance $R_{ins}$ at 20 °C, rel. humidity ≤ 65% (minimum as-delivered values) | > 100 GΩ | |
| Test voltage (terminal to terminal) | 1.6 · $V_R$, 2 s | |
| Test voltage (terminal to case) | 2000 V AC, 60s | |
| Category voltage $V_C$ (continuous operation with $V_{DC}$) | $T_A$ (°C) | DC voltage derating |
| | $T_A \leq 85$ | $V_C = V_R$ |
| | $85<T_A\leq100$ | $V_C = V_R \cdot (165-T_A)/80$ |
| Operating voltage $V_{op}$ for short operating periods ($V_{DC}$) | $T_A$ (°C) | DC voltage (max. hours) |
| | $T_A \leq 85$ | $V_{op} = 1.25 \cdot V_C$ (1000 h) |
| | $85<T_A\leq100$ | $V_{op} = 1.25 \cdot V_C$ (1000 h) |
| Reliability: | | |
| Failure rate λ | 1 fit (≤ 1 · $10^{-9}$/h) at 0.5 · $V_R$, 40 °C | |
| Service life $t_{SL}$ | 200 000 h at 1.0 · $V_R$, 85 °C | |
| | For conversion to other operating conditions and temperatures, refer to chapter "Quality, 2 Reliability". | |
| Failure criteria: | | |
| Total failure | Short circuit or open circuit | |
| Failure due to variation of parameters | Capacitance change $\lvert\Delta C/C\rvert$ | > 10% |
| | Dissipation factor tan δ | > 4 · upper limit value |
| | Insulation resistance $R_{ins}$ | < 1500 MΩ |

**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. These parameters are given for isolated pulses in such a way that the heat generated by one pulse will be completely dissipated before applying the next pulse. For a train of pulses, please refer to the curves of permissible AC voltage-current versus frequency.*

**dV/dt values**

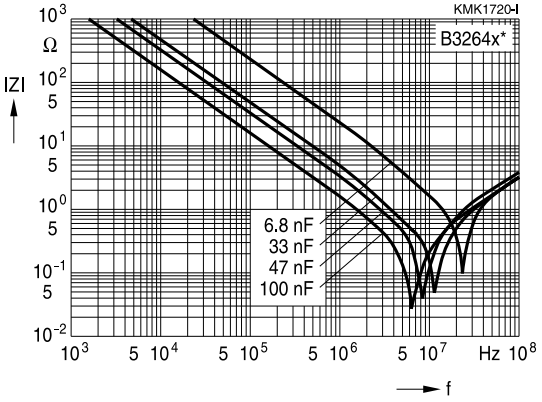
| Lead spacing | | 10 mm | 15 mm |
|---|---|---|---|
| $V_R$ V DC | $V_{RMS}$ V AC | dV/dt in V/µs | |
| 630 | 400 | 4000 | 2700 |
| 1000 | 600 | 6200 | 3500 |

**$k_0$ values**

| Lead spacing | | 10 mm | 15 mm |
|---|---|---|---|
| $V_R$ V DC | $V_{RMS}$ V AC | $k_0$ in $V^2/\mu s$ | |
| 630 | 400 | 5 040 000 | 3 402 000 |
| 1000 | 600 | 12 400 000 | 7 000 000 |

**Impedance Z versus frequency f**

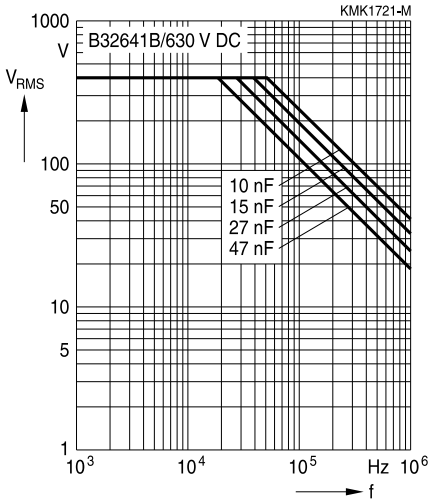
(typical values)



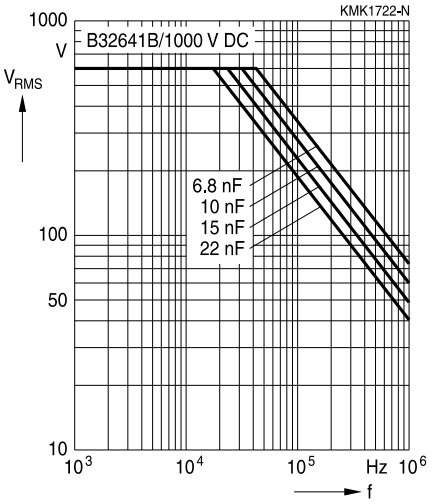
**Permissible AC voltage $V_{RMS}$ versus frequency f (for sinusoidal waveforms, $T_A \leq 85$ °C)**
Self-heating $T_A \leq 10$ °C, typical values
For $T_A > 80$ °C, please refer to "General technical information", section 3.2.3.

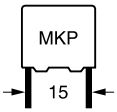
**Lead spacing 10 mm**

630 V DC/400 V AC




1000 V DC/600 V AC





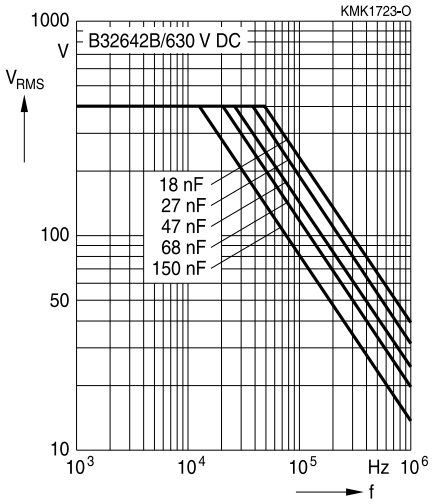

**B32642B**

**High frequency**

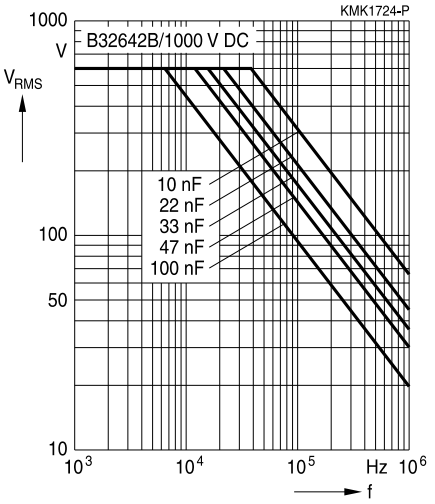
**Permissible AC voltage $V_{RMS}$ versus frequency f (for sinusoidal waveforms, $T_A \leq 85$ °C)**
Self-heating $T_A \leq 10$ °C, typical values
For $T_A > 80$ °C, please refer to "General technical information", section 3.2.3.

**Lead spacing 15 mm**

630 V DC/400 V AC



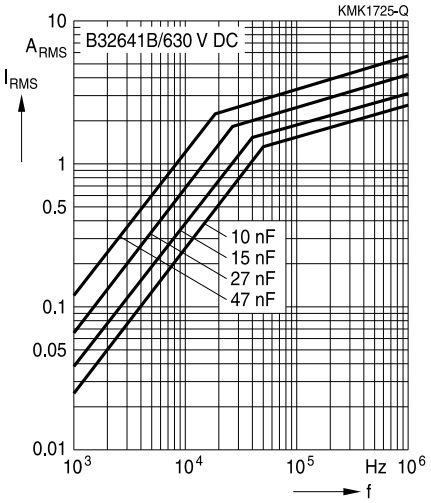

1000 V DC/600 V AC



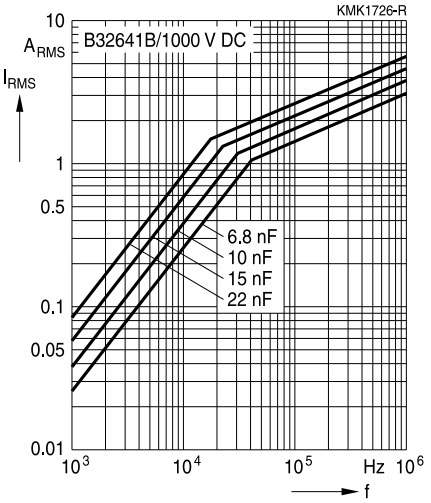
**Permissible current $I_{RMS}$ versus frequency f (for sinusoidal waveforms, $T_A \leq 85$ °C)**
Self-heating $T_A \leq 10$ °C, typical values

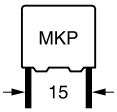
**Lead spacing 10 mm**

630 V DC/400 V AC




1000 V DC/600 V AC



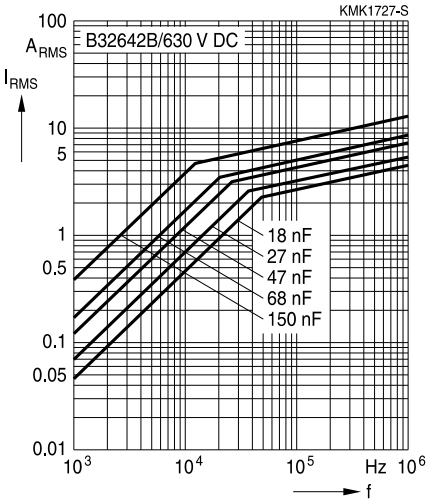




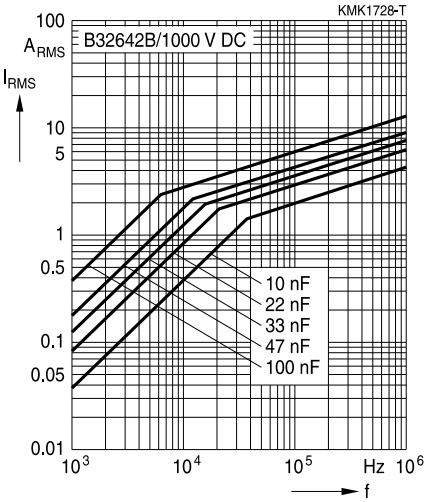

**Permissible current $I_{RMS}$ versus frequency f (for sinusoidal waveforms, $T_A \leq 85$ °C)**
Self-heating $T_A \leq 10$ °C, typical values

**Lead spacing 15 mm**

630 V DC/400 V AC



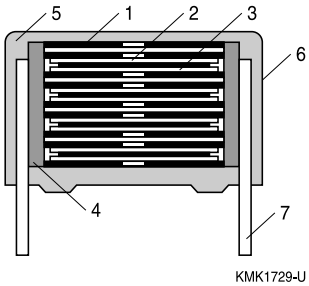

1000 V DC/600 V AC



**Reliability Tests**

| Test and IEC reference | Conditions of test | Failure criteria | | | |
|---|---|---|---|---|---|
| | | Visible damages | \|ΔC/C\| | tan δ (100kHz) | $R_{ins}$ |
| Electrical parameters IEC 60384-16 | Capacitance: 1 KHz, 1.0 V<br>Loss factor: 1 KHz, 1.0 V<br>100 KHz, 1.0V<br>Voltage proof: 1.6 $V_R$, 1 min<br>Insulation resistance: 500 V, 1 min | Yes | Within specified limits | | <100 GΩ |
| Rapid change of temperature IEC 60384-16 | $T_A$ = Lower category temperature<br>$T_B$ = Upper category temperature<br>Five cycles, duration t = 30 min | Yes | – | – | – |
| Vibration IEC 60384-16 | 10 Hz ~ 500 Hz<br>0.75 mm<br>6 hours per axe | Yes | – | – | – |
| Bump IEC 60384-16 | 390 m/s²<br>6 ms<br>3 axes, total number of bumps: 4000 | Yes | > 2% | > upper limit value | < 50% of min. as-delivered value |
| Climatic sequence IEC 60384-1 | Dry heat: 16 hours<br>Damp heat, one cycle<br>Test Aa 2 hours | Yes | > 2% | > 1.5 × upper limit value | < 50% of min. as-delivered value |
| Damp heat, steady state IEC 60384-16 | 40 °C/93% relative humidity/56 days | Yes | > 3% | > 1.5 × upper limit value | < 50% of min. as-delivered value |
| Damp heat, steady state – | 60 °C/95% relative humidity/ $V_R$ DC/1000 hours | Yes | > 5% | > 1.5 × upper limit value | < 50% of min. as-delivered value |
| Resistance to soldering heat IEC 60068-2-20 | Solder bath at +260 °C ±5°C | Yes | > 2% | > upper limit value | < 50% of min. as-delivered value |
| Endurance IEC 60384-16 | 110 °C/1.25 $V_C$/1000 hours | Yes | > 5% | > 1.5 × upper limit value | < 50% of min. as-delivered value |
| Charge and discharge IEC 60384-16 | 10000 pulses and with 2 times dV/dt according to detail specification | Yes | > 3% | > 1.5 × upper limit value | < 50% of min. as-delivered value |

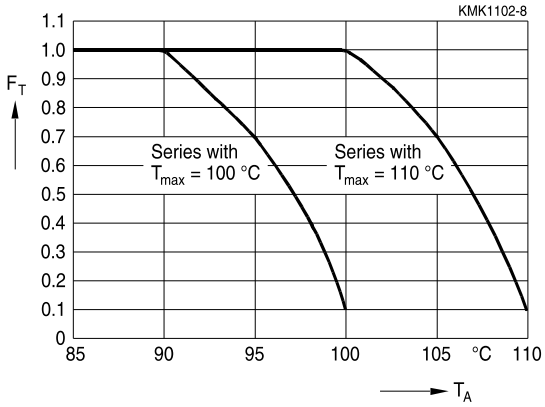
**Construction MMKP**




1 Dielectric film: Metallized polyethylene terephthalate (polyester, PET)
2 Dielectric film: Polypropylene (PP)
3 Dielectric film: Metallized polypropylene (PP)
4 Metal spray: Lead free alloy
5 Sealing: Epoxy resin sealing
6 Case: PBT, according to UL 94-0
7 Terminal: Lead free tinned wire

**Important note**

The operating temperature, which is the sum of ambient temperature and self-heating, shall not exceed the upper category temperature (110 °C). To assure this, a derating in the Irms shall be applied as follows:



## 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.

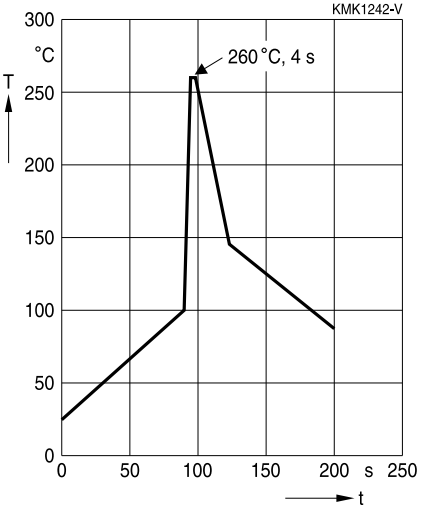
Before a solderability test is carried out, terminals are subjected to accelerated ageing (to IEC 60068-2-2, test Ba: 4 h exposure to dry heat at 155 °C). Since the ageing temperature is far higher than the upper category temperature of the capacitors, the terminal wires should be cut off from the capacitor 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:<br>Visual inspection | <br>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)<br>coated<br>uncoated (lead spacing > 10 mm) | 260 ±5 °C | 10 ±1 s |
| MFP<br>MKP | <br>(lead spacing > 7.5 mm) | | |
| MKT | boxed (case 2.5 × 6.5 × 7.2 mm) | | 5 ±1 s |
| MKP<br>MKT | (lead spacing ≤ 7.5 mm)<br>uncoated (lead spacing ≤ 10 mm)<br>insulated (B32559) | | < 4 s<br>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<br>5% for EMI suppression capacitors |
| tan $\delta$ | As specified in sectional specification |

### 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.

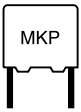
EPCOS recommends the following conditions:

- 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" |

| Topic | Safety information | Reference chapter "Mounting guidelines" |
|---|---|---|
| Resistance to vibration | Do not exceed the tested ability to withstand vibration. The capacitors are tested to IEC 60068-2-6.<br>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" |
| 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.<br>Caution: Consult us first, if you also wish to embed other uncoated component types! | 3 "Embedding of capacitors in finished assemblies" |

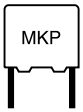
**Display of ordering codes for EPCOS products**

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 |
|---|---|---|
| $\alpha$ | Heat transfer coefficient | Wärmeübergangszahl |
| $\alpha_C$ | Temperature coefficient of capacitance | Temperaturkoeffizient der Kapazität |
| A | Capacitor surface area | Kondensatoroberfläche |
| $\beta_C$ | Humidity coefficient of capacitance | Feuchtekoeffizient der Kapazität |
| C | Capacitance | Kapazität |
| $C_R$ | Rated capacitance | Nennkapazität |
| $\Delta C$ | 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 |
| $\Delta t$ | Time interval | Zeitintervall |
| $\Delta T$ | Absolute temperature change (self-heating) | Absolute Temperaturänderung (Selbsterwärmung) |
| $\Delta \tan \delta$ | Absolute change of dissipation factor | Absolute Änderung des Verlustfaktors |
| $\Delta V$ | 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) |

| 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 | Impulskennwert |
| $L_S$ | Series inductance | Serieninduktivität |
| $\lambda$ | Failure rate | Ausfallrate |
| $\lambda_0$ | Constant failure rate during useful service life | Konstante Ausfallrate in der Nutzungsphase |
| $\lambda_{test}$ | Failure rate, determined by tests | Experimentell ermittelte Ausfallrate |
| $P_{diss}$ | Dissipated power | Abgegebene Verlustleistung |
| $P_{gen}$ | Generated power | Erzeugte Verlustleistung |
| Q | Heat energy | Wärmeenergie |
| $\rho$ | 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 (Feuchtetest) |
| t | Time | Zeit |
| T | Temperature | Temperatur |
| $\tau$ | 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 Verlfustfaktors |
| 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 | Beriebstemperatur |
| $T_R$ | Rated temperature | Nenntemperatur |
| $T_{ref}$ | Reference temperature | Referenztemperatur |
| $t_{SL}$ | Reference service life | Referenz-Lebensdauer |




**B32641B ... B32642B**

**High frequency**

| 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.**
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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)**.

## Important notes

7. The trade names EPCOS, Alu-X, CeraDiode, CeraLink, CeraPad, CeraPlas, CSMP, CSSP, CTVS, DeltaCap, DigiSiMic, DSSP, ExoCore, FilterCap, FormFit, LeaXield, MiniBlue, MiniCell, MKD, MKK, 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.