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

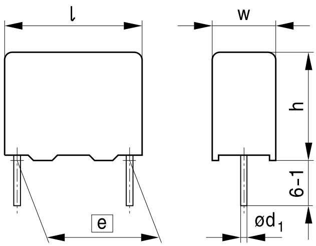
Features
- Very compact design
- High pulse strength
- High current withstand capability
- Halogen free available on request

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

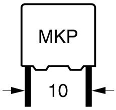


Dimensions in mm

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				



Ordering codes and packing units (lead spacing 10 mm)

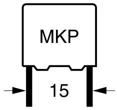
V_R V DC	V_{RMS} f ≤1 kHz V AC	C_R nF	Max. dimensions w × h × l mm	Ordering code (composition see below)	Ammo pack pcs./MOQ	Reel pcs./ MOQ	Untaped pcs./ MOQ
630	400	6.8	4.0 × 9.0 × 13.0	B32641B6682+***	4000	6800	4000
		8.2	4.0 × 9.0 × 13.0	B32641B6822+***	4000	6800	4000
		10	4.0 × 9.0 × 13.0	B32641B6103+***	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)

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 10 kHz 100 kHz	0.6 0.6 1.5
Insulation resistance R_{ins} at 20 °C, rel. humidity ≤ 65% (minimum as-delivered values)	> 100 GΩ	
Test voltage (terminal to terminal)	$1.6 \cdot V_R$, 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
	$T_A \leq 85$ $85 < T_A \leq 100$	$V_C = V_R$ $V_C = V_R \cdot (165 - T_A)/80$
Operating voltage V_{op} for short operating periods (V_{DC})	T_A (°C)	DC voltage (max. hours)
	$T_A \leq 85$ $85 < T_A \leq 100$	$V_{op} = 1.25 \cdot V_C$ (1000 h) $V_{op} = 1.25 \cdot V_C$ (1000 h)
Reliability:		
Failure rate λ	1 fit (≤ $1 \cdot 10^{-9}$/h) at $0.5 \cdot V_R$, 40 °C	
Service life t_{SL}	200 000 h at $1.0 \cdot V_R$, 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 |ΔC/C|	> 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.

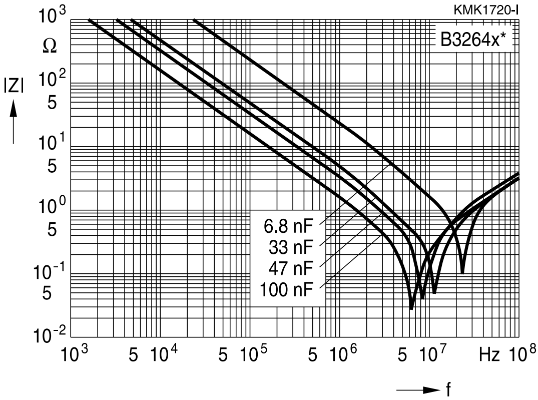
dV/dt values

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

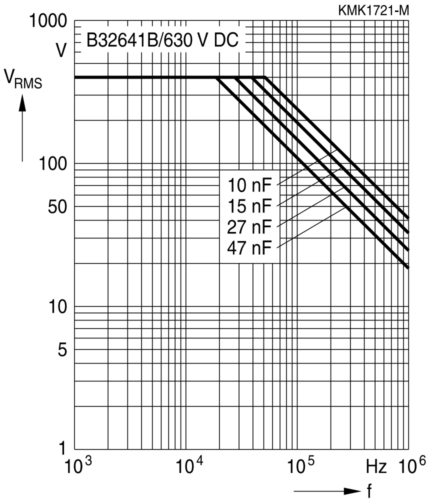
Impedance Z versus frequency f
(typical values)



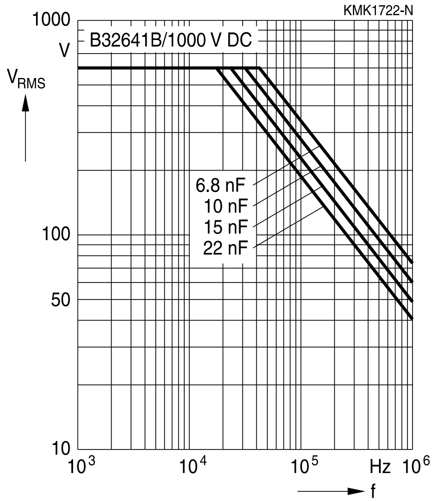
Permissible AC voltage V_{RMS} versus frequency f (for sinusoidal waveforms, $T_A \leq 85$ °C)
Self-heating $T_A \leq 10$ °C, typical values
For $T_A > 80$ °C, please refer to "General technical information", section 3.2.3.

Lead spacing 10 mm

630 V DC/400 V AC



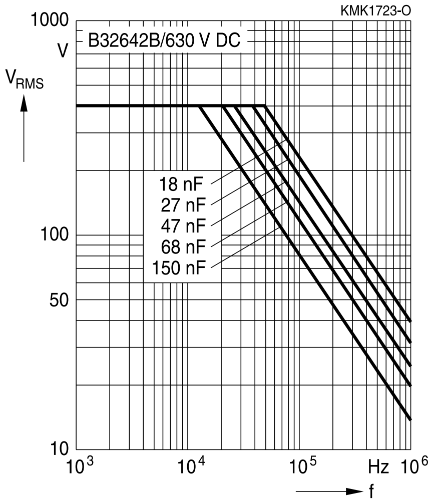
1000 V DC/600 V AC



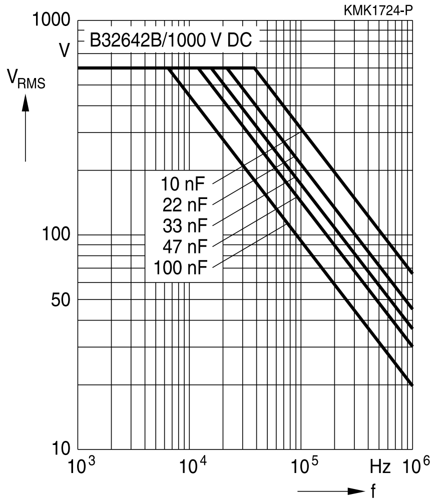
Permissible AC voltage V_{RMS} versus frequency f (for sinusoidal waveforms, $T_A \leq 85$ °C)
Self-heating $T_A \leq 10$ °C, typical values
For $T_A > 80$ °C, please refer to "General technical information", section 3.2.3.

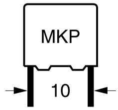
Lead spacing 15 mm

630 V DC/400 V AC



1000 V DC/600 V AC

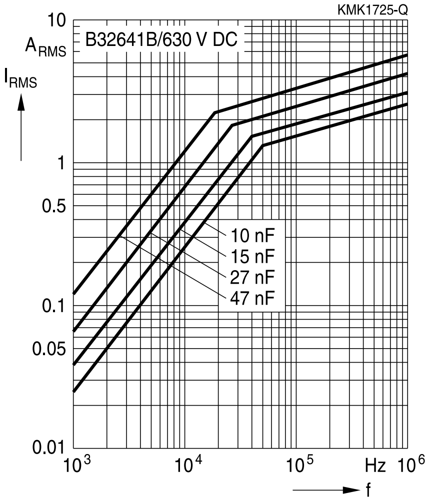




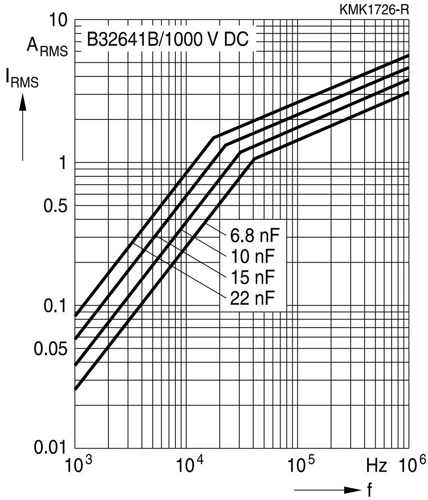
Permissible current I_{RMS} versus frequency f (for sinusoidal waveforms, $T_A \leq 85$ °C)
Self-heating $T_A \leq 10$ °C, typical values

Lead spacing 10 mm

630 V DC/400 V AC



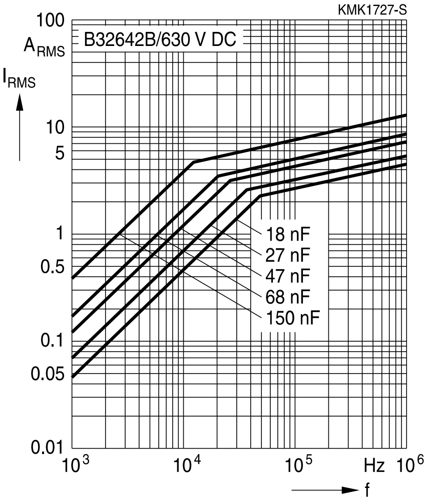
1000 V DC/600 V AC



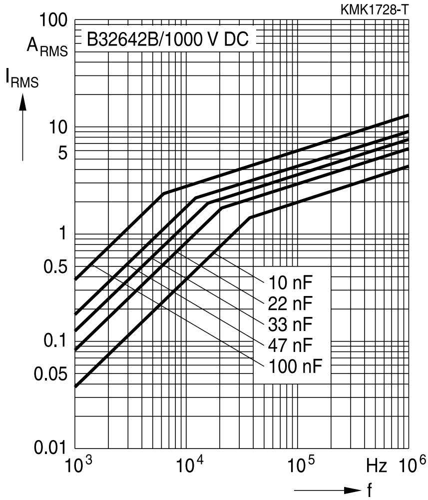
Permissible current I_{RMS} versus frequency f (for sinusoidal waveforms, $T_A \leq 85$ °C)
Self-heating $T_A \leq 10$ °C, typical values

Lead spacing 15 mm

630 V DC/400 V AC



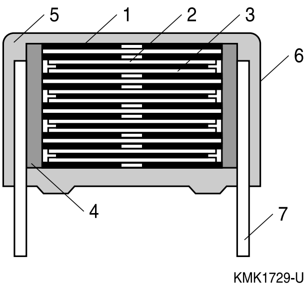
1000 V DC/600 V AC



Reliability Tests

Test and IEC reference	Conditions of test	Failure criteria			
		Visible dama-ges	|ΔC/C|	tan δ (100kHz)	R_{ins}
Electrical parameters IEC 60384-16	Capacitance: 1 KHz, 1.0 V Loss factor: 1 KHz, 1.0 V; 100 KHz, 1.0V Voltage proof: 1.6 V_R, 1 min Insulation resistance: 500 V, 1 min	Yes	Within specified limits		<100 GΩ
Rapid change of temperature IEC 60384-16	T_A = Lower category temperature T_B = Upper category temperature Five cycles, duration t = 30 min	Yes	–	–	–
Vibration IEC 60384-16	10 Hz ~ 500 Hz 0.75 mm 6 hours per axe	Yes	–	–	–
Bump IEC 60384-16	390 m/s^2 6 ms 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 Damp heat, one cycle 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

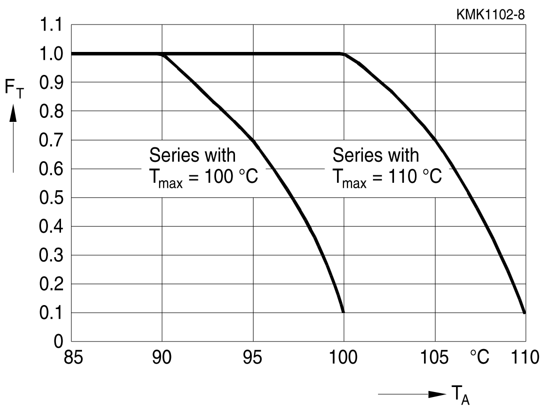
Construction MMKP



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.

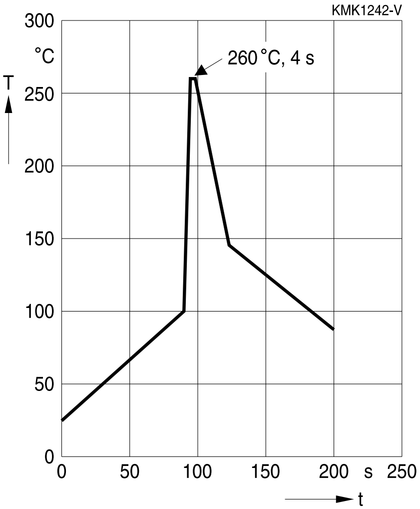
Before a solderability test is carried out, terminals are subjected to accelerated ageing (to IEC 60068-2-2, test Ba: 4 h exposure to dry heat at 155 °C). Since the ageing temperature is far higher than the upper category temperature of the capacitors, the terminal wires should be cut off from the capacitor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



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 δ	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. 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. 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
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)

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
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 (Feuchtetest)
t	Time	Zeit
T	Temperature	Temperatur
τ	Time constant	Zeitkonstante
tan δ	Dissipation factor	Verlustfaktor
tan δ_D	Dielectric component of dissipation factor	Dielektrischer Anteil des Verlustfaktors
tan δ_P	Parallel component of dissipation factor	Parallelanteil des Verlfustfaktors
tan δ_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

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
$\boxed{e}$	Lead spacing	Rastermaß

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