



# Film Capacitors

## Metallized Polyester Film Capacitors (MKT)

**Series/Type:** B32572, B32573

**Date:** June 2018

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### Typical applications

- Ignition for gas, engines, generators
- Energy storage

### Climatic

- Max. operating temperature: 125 °C
- Climatic category (IEC 60068-1:2013): 55/125/56

### Features

- Special dimensions available on request
- High pulse strength
- RoHS-compatible

### Construction

- Dielectric: polyethylene terephthalate (polyester, PET)
- Stacked-film technology
- Uncoated

### Terminals

- Parallel wire leads, lead-free tinned

### Marking

Rated capacitance (coded),  
rated DC voltage

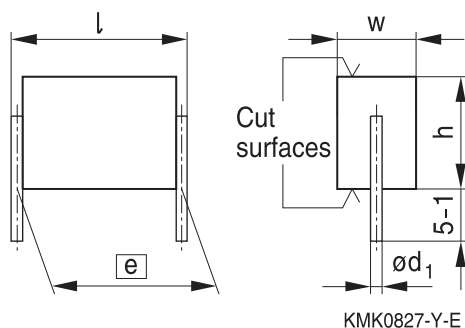
### Delivery mode

Bulk (untaped)

### Notes on mounting

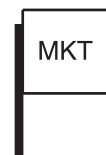
When mounting these capacitors, take into account creepage distances and clearances to adjacent live parts. The insulating strength of the cut surfaces to other live parts of the circuit is 1.5 times the capacitors rated DC voltage, but is always at least 300 V DC.

### Dimensional drawing



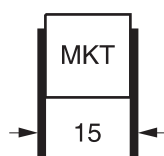
Dimensions in mm

Lead spacing	Lead diameter	Type
$e \pm 0.4$	$d_1 \pm 0.05$	
15.0	0.8	B32572
22.5	0.8	B32573



### Overview of available types

Lead spacing	15.0 mm	22.5 mm
Type	B32572	B32573
Page	4	5
$V_R$ (V DC)	250	250
$V_{RMS}$ (V AC)	160	160
$C_R$ ( $\mu$ F)		
0.68		
1.0		
1.5		
2.2		



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

$V_R$	$V_{RMS}$ $f \leq 60$ Hz	$C_R$	Max. dimensions $w \times h \times l$ mm	Ordering code (composition see below)	Untaped pcs./MOQ
V DC	V AC	$\mu F$			
250	160	0.68	$7.0 \times 11.0 \times 16.5$	B32572A3684+000	1800
		1.0	$9.1 \times 11.7 \times 16.5$	B32572A3105+000	1200
		1.5	$11.5 \times 13.5 \times 16.5$	B32572A3155+000	800
		2.2	$11.5 \times 19.8 \times 16.5$	B32572A3225+000	600

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

Special dimensions available on request.

For corresponding design rules, refer to chapter "General technical information", section 1.3.2.

**Composition of ordering code**

+ = Capacitance tolerance code:

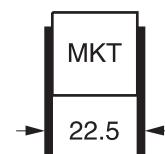
M =  $\pm 20\%$

K =  $\pm 10\%$

J =  $\pm 5\%$

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**Ordering codes and packing units (lead spacing 22.5 mm)**

$V_R$	$V_{RMS}$ $f \leq 60$ Hz	$C_R$	Max. dimensions $w \times h \times l$	Ordering code (composition see below)	Untaped
V DC	V AC	$\mu F$	mm		pcs./MOQ
250	160	0.68	$5.6 \times 9.2 \times 24.0$	B32573A3684+000	4720
		1.0	$6.4 \times 11.8 \times 24.0$	B32573A3105+000	4200
		1.5	$7.6 \times 14.3 \times 24.0$	B32573A3155+000	3720
		2.2	$8.9 \times 17.4 \times 24.0$	B32573A3225+000	2240

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

Special dimensions available on request.

For corresponding design rules, refer to chapter "General technical information", section 1.3.2.

**Composition of ordering code**

+ = Capacitance tolerance code:

M =  $\pm 20\%$

K =  $\pm 10\%$

J =  $\pm 5\%$



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### Technical data

Reference standard: IEC 60384-2:2005. All data given at T = 20 °C, unless otherwise specified.

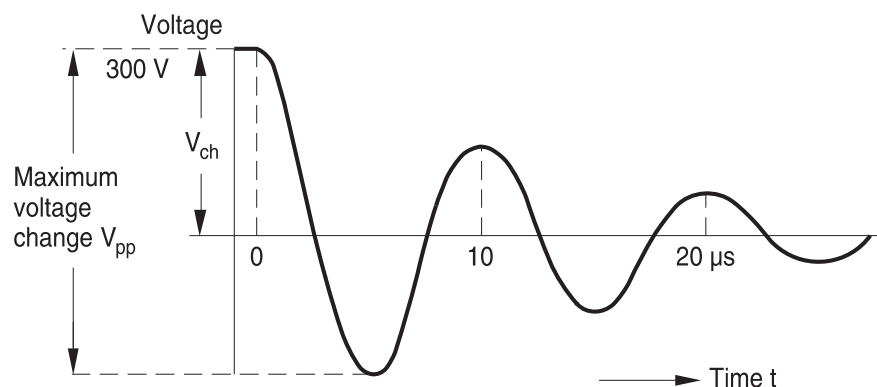
Operating temperature range	Max. operating temperature $T_{op,max}$		+125 °C
	Upper category temperature $T_{max}$		+125 °C
	Lower category temperature $T_{min}$		-55 °C
	Rated temperature $T_R$		+85 °C
Dissipation factor $\tan \delta$ (in $10^{-3}$ ) at 20 °C (upper limit values)	at	$C_R \leq 1 \mu F$	$C_R > 1 \mu F$
	1 kHz	8	10
	10 kHz	15	—
Time constant $\tau = C_R \cdot R_{ins}$ at 20 °C, rel. humidity $\leq 65\%$ (minimum as-delivered values)	2500 s		
DC test voltage	$1.6 \cdot V_R, 2 s$		
Category voltage $V_C$ (continuous operation with $V_{DC}$ or $V_{AC}$ at $f \leq 60$ Hz)	$T_{op}$ (°C)	DC voltage derating	AC voltage derating
	$T_{op} \leq 85$	$V_C = V_R$	$V_{C,RMS} = V_{RMS}$
	$85 < T_{op} \leq 125$	$V_C = V_R \cdot (165 - T_{op})/80$	$V_{C,RMS} = V_{RMS} \cdot (165 - T_{op})/80$
Max. charging voltage $C_{ch}$	$1.2 \cdot V_R$ for $\leq 1 s$		
Reliability:			
Failure rate $\lambda$	2 fit ( $\leq 2 \cdot 10^{-9}/h$ ) at $0.5 \cdot V_R, 40$ °C		
Service life $t_{SL}$	100 000 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 $ \Delta C/C $		> 10%
	Dissipation factor $\tan \delta$		> 2 · upper limit value
	Time constant $\tau = C_R \cdot R_{ins}$		< 50 s



### Pulse handling capability

The capacitors are especially manufactured and tested to suit their intended applications.

Typical permissible load:



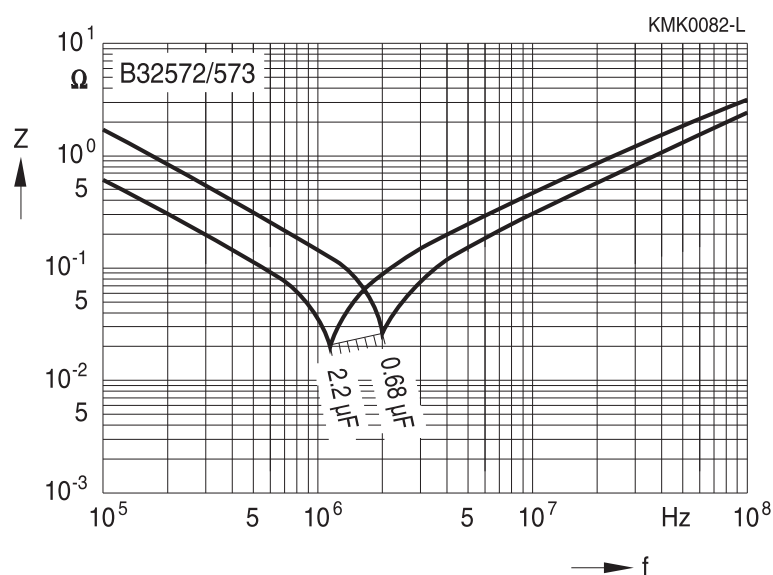
KMK0083-U-E

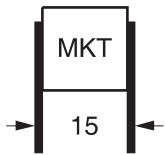
Lead spacing		15 and 22.5 mm
Max. rate of voltage rise $V_{pp}/\tau$	(at $V_{pp} = 500$ V)	200 V/ $\mu$ s
Pulse characteristic $k_0$	(at $V_{pp} \leq 500$ V)	200 000 V <sup>2</sup> / $\mu$ s
Max. charging voltage $V_{ch}$	( $\leq 1$ s)	300 V DC
Max. voltage change $V_{pp}$	( at $f = 100$ kHz)	500 V

Unlimited number of pulses permitted.

### Impedance Z versus frequency f

(typical values)





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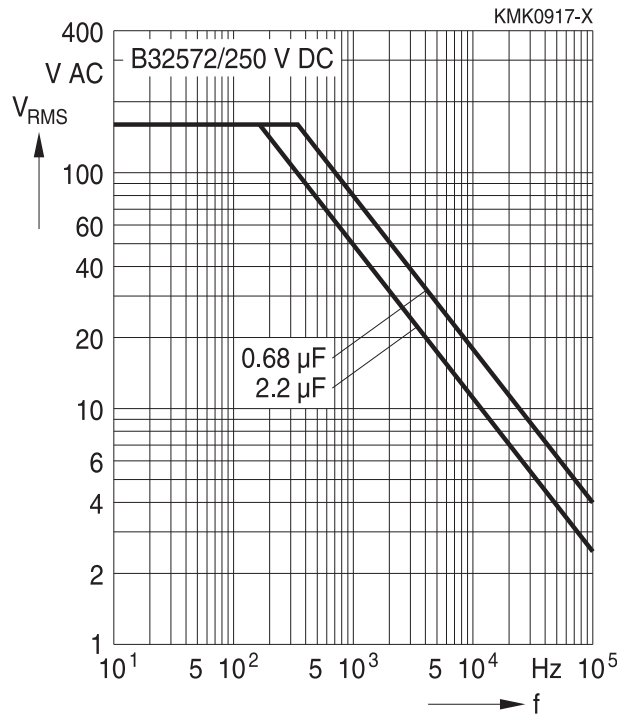
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**Permissible AC voltage  $V_{RMS}$  versus frequency  $f$  (for sinusoidal waveforms,  $T_A \leq 55\text{ °C}$ )**

For  $T_A > 55\text{ °C}$ , please refer to "General technical information", section 3.2.3.

**Lead spacing 15 mm**

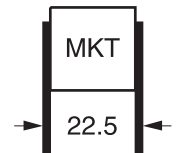
250 V DV/160 V AC





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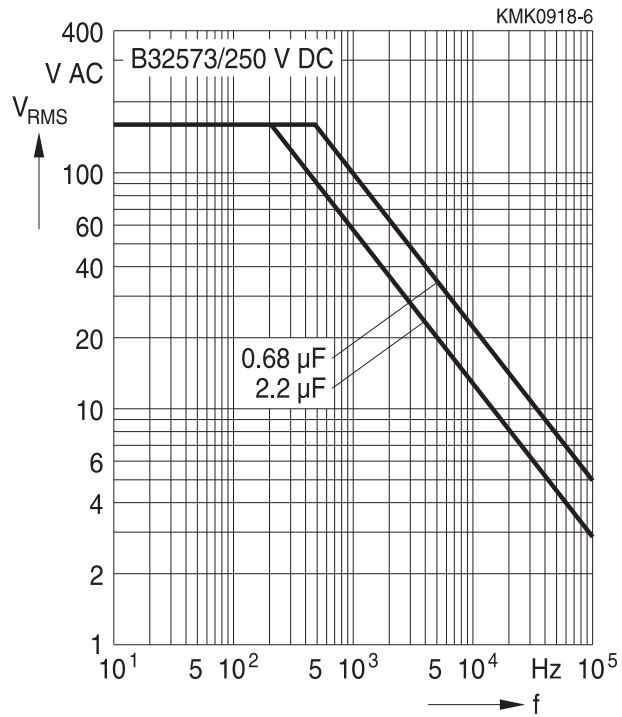


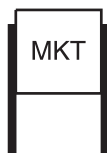
**Permissible AC voltage  $V_{RMS}$  versus frequency  $f$  (for sinusoidal waveforms,  $T_A \leq 55\text{ }^\circ\text{C}$ )**

For  $T_A > 55\text{ }^\circ\text{C}$ , please refer to "General technical information", section 3.2.3.

**Lead spacing 22.5 mm**

250 V DC/160 V AC





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## Testing and Standards

Test	Reference	Conditions of test	Performance requirements
Electrical parameters	IEC 60384-2:2005	Voltage proof, $1.4 V_R$ , 1 minute Insulation resistance, $R_{ins}$ Capacitance, C Dissipation factor, $\tan \delta$	Within specified limits
Robustness of terminations	IEC 60068-2-21:2006	Tensile strength (test Ua1)	No visible damage Capacitance and $\tan \delta$ within specified limits
		Wire diameter   Tensile force $0.5 < d_1 \leq 0.8$ mm   10 N	
Resistance to soldering heat	IEC 60068-2-20:2008, test Tb, method 1A	Solder bath temperature at $260 \pm 5$ °C, immersion for 4 seconds (lead spacing $\leq 10$ mm) 10 seconds (lead spacing $> 10$ mm)	$\Delta C/C_0 \leq 2\%$ $ \Delta \tan \delta  \leq 0.003$ for $C \leq 1 \mu F$ $ \Delta \tan \delta  \leq 0.002$ for $C > 1 \mu F$
Rapid change of temperature	IEC 60384-2:2005	$T_A$ = lower category temperature $T_B$ = upper category temperature Five cycles, duration $t = 30$ min.	$\Delta C/C_0 \leq 5\%$ $ \Delta \tan \delta  \leq 0.003$ for $C \leq 1 \mu F$ $ \Delta \tan \delta  \leq 0.002$ for $C > 1 \mu F$ $R_{ins} \geq 50\%$ of initial limit
Vibration	IEC 60384-2:2005	Test Fc: vibration sinusoidal Displacement: 0.75 mm Acceleration: $98 \text{ m/s}^2$ Frequency: 10 Hz ... 500 Hz Test duration: 3 orthogonal axes, 2 hours each axe	No visible damage
Bump	IEC 60384-2:2005	Test Eb: Total 4000 bumps with $390 \text{ m/s}^2$ mounted on PCB Duration: 6 ms	$\Delta C/C_0 \leq 5\%$ $ \Delta \tan \delta  \leq 0.003$ for $C \leq 1 \mu F$ $ \Delta \tan \delta  \leq 0.002$ for $C > 1 \mu F$ $R_{ins} \geq 50\%$ of initial limit
Climatic sequence	IEC 60384-2:2005	Dry heat Tb / 16 h Damp heat cyclic, 1 <sup>st</sup> cycle $+55$ °C / 24 h / 95% ... 100% RH Cold Ta / 2 h Damp heat cyclic, 5 cycles $+55$ °C / 24 h / 95% ... 100% RH	$\Delta C/C_0 \leq 5\%$ $ \Delta \tan \delta  \leq 0.005$ for $C \leq 1 \mu F$ $ \Delta \tan \delta  \leq 0.003$ for $C > 1 \mu F$ $R_{ins} \geq 50\%$ of initial limit
Damp heat, steady state	IEC 60384-2:2005	Test Ca $40$ °C / 93% RH / 56 days	No visible damage $ \Delta C/C_0  \leq 5\%$ $ \Delta \tan \delta  \leq 0.005$ $R_{ins} \geq 50\%$ of initial limit

Test	Reference	Conditions of test	Performance requirements
Endurance A	IEC 60384-2:2005	85 °C / 1.25 V <sub>R</sub> / 2000 hours	No visible damage  ΔC/C <sub>0</sub>   ≤ 5%  Δ tan δ  ≤ 0.003 for C ≤ 1 μF  Δ tan δ  ≤ 0.002 for C > 1 μF R <sub>ins</sub> ≥ 50% of initial limit
Endurance B	IEC 60384-2:2005	125 °C / 1.25 V <sub>C</sub> / 2000 hours	No visible damage  ΔC/C <sub>0</sub>   ≤ 5%  Δ tan δ  ≤ 0.003 for C ≤ 1 μF  Δ tan δ  ≤ 0.002 for C > 1 μF R <sub>ins</sub> ≥ 50% of initial limit

## Mounting guidelines

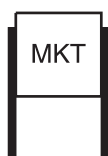
### 1 Soldering

#### 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



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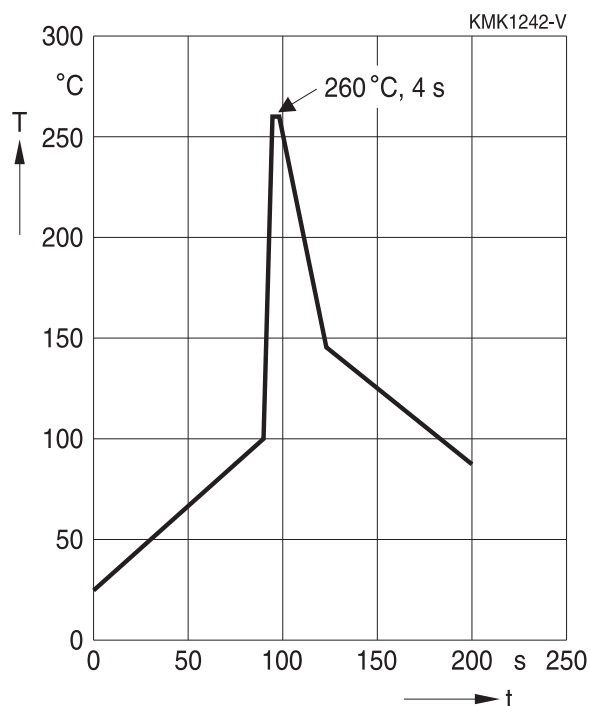
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## 1.2 Resistance to soldering heat

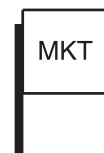
Resistance to soldering heat is tested to IEC 60068-2-20, test Tb, method 1.

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



### 1.3 General notes on soldering

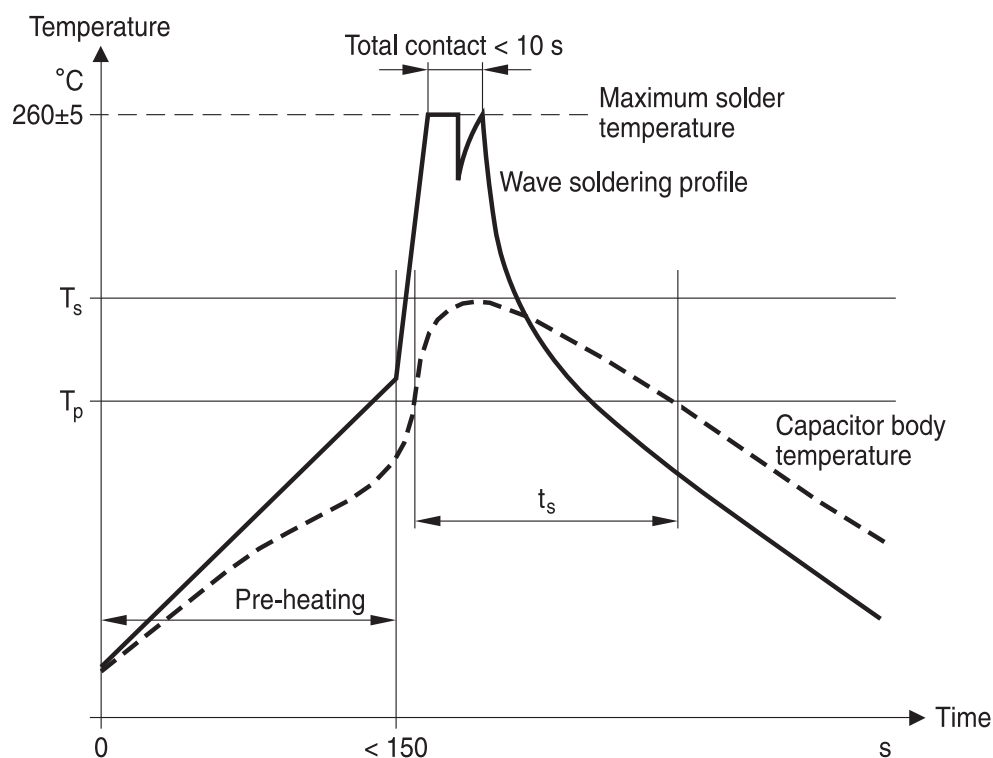
Permissible heat exposure loads on film capacitors are primarily characterized by the upper category temperature  $T_{max}$ . Long exposure to temperatures above this type-related temperature limit can lead to changes in the plastic dielectric and thus change irreversibly a capacitor's electrical characteristics. 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 recommendations

As a reference, the recommended wave soldering profile for our film capacitors is as follows:



$T_s$ : Capacitor body maximum temperature at wave soldering

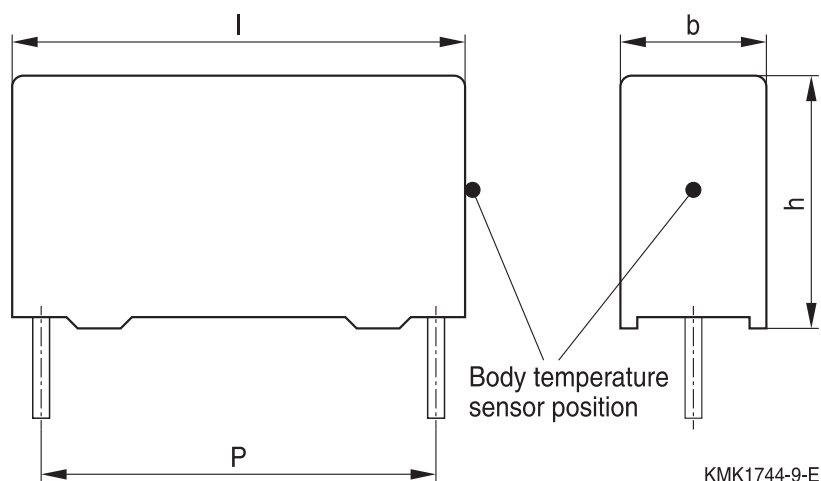
$T_p$ : Capacitor body maximum temperature at pre-heating

KMK1745-A-E



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Body temperature should follow the description below:

- MKP capacitor
  - During pre-heating:  $T_p \leq 110 \text{ }^\circ\text{C}$
  - During soldering:  $T_s \leq 120 \text{ }^\circ\text{C}$ ,  $t_s \leq 45 \text{ s}$
- MKT capacitor
  - During pre-heating:  $T_p \leq 125 \text{ }^\circ\text{C}$
  - During soldering:  $T_s \leq 160 \text{ }^\circ\text{C}$ ,  $t_s \leq 45 \text{ s}$

When SMD components are used together with leaded ones, the 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.

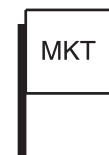
In order to ensure proper conditions for manual or selective soldering, the body temperature of the capacitor ( $T_s$ ) must be  $\leq 120 \text{ }^\circ\text{C}$ .

One recommended condition for manual soldering is that the tip of the soldering iron should be  $< 360 \text{ }^\circ\text{C}$  and the soldering contact time should be no longer than 3 seconds.

For uncoated MKT capacitors with lead spacings  $\leq 10 \text{ mm}$  (B32560/B32561) the following measures are recommended:

- pre-heating to not more than  $110 \text{ }^\circ\text{C}$  in the preheater phase
- rapid cooling after soldering

Please refer to EPCOS Film Capacitor Data Book in case more details are needed.



## 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.
- Consult us if application is with severe temperature and humidity condition.
- There are no serviceable or repairable parts inside the capacitor. Opening the capacitor or any attempts to open or repair the capacitor will void the warranty and liability of EPCOS.
- Please note that the standards referred to in this publication may have been revised in the meantime.

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 60068-2-6:2007. 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"

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"



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Topic	Safety information	Reference chapter "Mounting guidelines"
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"

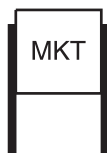
### Display of ordering codes for EPCOS products

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](http://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)



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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
$\lambda$	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 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, $T_A + \Delta T$	Betriebstemperatur, $T_A + \Delta T$
$T_R$	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	Kategorie <span>spannung</span>
$V_{C,RMS}$	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	Ausgangsspannung
$V_{op}$	Operating voltage	Betriebsspannung
$V_p$	Peak pulse voltage	Impuls-Spitzen <span>spannung</span>
$V_{pp}$	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

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## Important notes

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