Film Capacitors

Metallized Polypropylene Film Capacitors (MKP)

Series/Type: **B32671P ... B32673P**
Date: March 2017

EPCOS AG is a TDK Group Company.

Typical applications
- PFC (Power Factor Correction)

Climatic
- Max. operating temperature: 125 °C
- Climatic category (IEC 60068-1): 55/110/56

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

Features
- Very compact design
- Very small dimensions
- Very high ripple and peak current
- High frequency AC operation capability
- High voltage capability
- Excellent self-healing property
- RoHS-compatible
- Halogen-free capacitors available on request

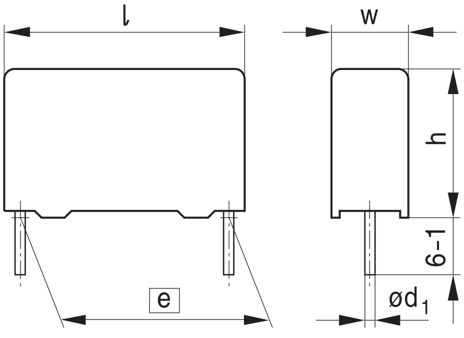
Terminals
- Parallel wire leads, lead free, tinned
- Special lead lengths available on request

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

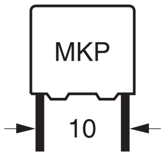


Dimensions in mm

Lead spacing e ±0.4	Lead diameter d_1 ±0.05	Type
10	0.6	B32671P
15	0.8	B32672P
22.5	0.8	B32673P

Overview of available types

Lead spacing	10 mm			15 mm			22.5 mm		
Type	B32671P			B32672P			B32673P		
Page	4			5			6		
V_{RMS} (V AC)	160	200	200	160	200	200	160	200	200
V_R (V DC)	450	520	630	450	520	630	450	520	630
C_R (µF)									
0.068									
0.082									
0.10									
0.15									
0.18									
0.22									
0.27									
0.33									
0.39									
0.47									
0.56									
0.68									
1.0									
1.5									
2.0									
2.2									



Ordering codes and packing units (lead spacing 10 mm)

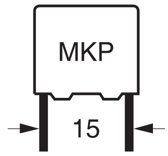
V_R V DC	V_{RMS} f ≤1 kHz V AC	C_R µF	Ordering code (composition see below)	Max. dimensions w × h × l mm	Straight terminals, Ammo pack pcs./MOQ	Straight terminals, Reel pcs./MOQ	Straight terminals, Untaped pcs./MOQ
450	160	0.10	B32671P4104+***	4.0 × 9.0 × 13.0	4000	6800	4000
		0.15	B32671P4154+***	4.0 × 9.0 × 13.0	4000	6800	4000
		0.18	B32671P4184+***	5.0 × 11.0 × 13.0	3320	5200	4000
		0.22	B32671P4224+***	5.0 × 11.0 × 13.0	3320	5200	4000
		0.27	B32671P4274+***	5.0 × 11.0 × 13.0	3320	5200	4000
		0.33	B32671P4334+***	6.0 × 12.0 × 13.0	2720	4400	4000
		0.39	B32671P4394+***	6.0 × 12.0 × 13.0	2720	4400	4000
		0.47	B32671P4474+***	6.0 × 14.0 × 13.0	2720	4400	4000
		0.68	B32671P4684+***	7.0 × 16.0 × 13.0	–	–	4000
		1.0	B32671P4105+***	8.0 × 17.5 × 13.0	–	–	4000
520	200	0.082	B32671P5823+***	4.0 × 9.0 × 13.0	4000	6800	4000
		0.10	B32671P5104+***	5.0 × 11.0 × 13.0	3320	5200	4000
		0.15	B32671P5154+***	5.0 × 11.0 × 13.0	3320	5200	4000
		0.22	B32671P5224+***	6.0 × 12.0 × 13.0	2720	4400	4000
		0.33	B32671P5334+***	7.0 × 16.0 × 13.0	–	–	4000
		0.47	B32671P5474+***	8.0 × 17.5 × 13.0	–	–	4000
630	200	0.068	B32671P6683+***	4.0 × 9.0 × 13.0	4000	6800	4000
		0.082	B32671P6823+***	5.0 × 11.0 × 13.0	3320	5200	4000
		0.10	B32671P6104+***	5.0 × 11.0 × 13.0	3320	5200	4000
		0.15	B32671P6154+***	6.0 × 12.0 × 13.0	2720	4400	4000
		0.18	B32671P6184+***	6.0 × 12.0 × 13.0	2720	4400	4000
		0.22	B32671P6224+***	6.0 × 14.0 × 13.0	2720	4400	4000
		0.33	B32671P6334+***	8.0 × 17.5 × 13.0	–	–	4000
		0.39	B32671P6394+***	8.0 × 17.5 × 13.0	–	–	4000

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

Composition of ordering code

+ = Capacitance tolerance code:
  - J = ±5%
  - K = ±10%
  - M = ±20%

*** = Packaging code:
  - 289 = Straight terminals, Ammo pack
  - 189 = Straight terminals, Reel
  - 240 = Crimped down to lead spacing 7.5 mm, Ammo pack
  - 140 = Crimped down to lead spacing 7.5 mm, Reel
  - 003 = Straight terminals, untaped (lead length 3.2 ± 0.3 mm)
  - 000 = Straight terminals, untaped (lead length 6−1 mm)



Ordering codes and packing units (lead spacing 15 mm)

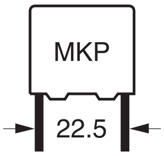
V_R V DC	V_{RMS} f ≤1 kHz V AC	C_R µF	Ordering code (composition see below)	Max. dimensions w × h × l mm	Straight terminals, Ammo pack pcs./MOQ	Straight terminals, Reel pcs./MOQ	Straight terminals, Untaped pcs./MOQ
450	160	0.10	B32672P4104+***	5.0 × 10.5 × 18.0	4680	5200	4000
		0.22	B32672P4224+***	5.0 × 10.5 × 18.0	4680	5200	4000
		0.33	B32672P4334+***	5.0 × 10.5 × 18.0	4680	5200	4000
		0.47	B32672P4474+***	5.0 × 10.5 × 18.0	4680	5200	4000
		0.56	B32672P4564+***	6.0 × 11.0 × 18.0	3840	4400	4000
		0.68	B32672P4684+***	6.0 × 12.0 × 18.0	3840	4400	4000
		1.0	B32672P4105+***	7.0 × 12.5 × 18.0	3320	3600	4000
		1.5	B32672P4155+***	9.0 × 17.5 × 18.0	2560	2800	2000
		2.0	B32672P4205+***	9.0 × 17.5 × 18.0	2560	2800	2000
		2.2	B32672P4225+***	11.0 × 18.5 × 18.0	–	2200	1200
520	200	0.15	B32672P5154+***	5.0 × 10.5 × 18.0	4680	5200	4000
		0.22	B32672P5224+***	5.0 × 10.5 × 18.0	4680	5200	4000
		0.33	B32672P5334+***	6.0 × 11.0 × 18.0	3840	4400	4000
		0.47	B32672P5474+***	7.0 × 12.5 × 18.0	3320	3600	4000
		0.68	B32672P5684+***	8.5 × 14.5 × 18.0	2720	2800	2000
		1.0	B32672P5105+***	9.0 × 17.5 × 18.0	2560	2800	2000
		1.5	B32672P5155+***	11.0 × 18.5 × 18.0	–	2200	1200
630	200	0.15	B32672P6154+***	5.0 × 10.5 × 18.0	4680	5200	4000
		0.22	B32672P6224+***	6.0 × 11.0 × 18.0	3840	4400	4000
		0.33	B32672P6334+***	7.0 × 12.5 × 18.0	3320	3600	4000
		0.47	B32672P6474+***	8.0 × 14.0 × 18.0	2920	3000	2000
		0.68	B32672P6684+***	9.0 × 17.5 × 18.0	2560	2800	2000
		1.0	B32672P6105+***	11.0 × 18.5 × 18.0	–	2200	1200

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

Composition of ordering code

+ = Capacitance tolerance code:
- J = ±5%
- K = ±10%
- M = ±20%

*** = Packaging code:
- 289 = Straight terminals, Ammo pack
- 189 = Straight terminals, Reel
- 255 = Crimped down to lead spacing 7.5 mm, Ammo pack
- 155 = Crimped down to lead spacing 7.5 mm, Reel
- 003 = Straight terminals, untaped (lead length 3.2 ± 0.3 mm)
- 000 = Straight terminals, untaped (lead length 6−1 mm)



Ordering codes and packing units (lead spacing 22.5 mm)

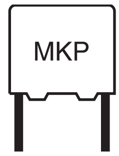
V_R V DC	V_{RMS} f ≤1 kHz V AC	C_R µF	Ordering code (composition see below)	Max. dimensions w × h × l mm	Straight terminals, Ammo pack pcs./MOQ	Straight terminals, Reel pcs./MOQ	Straight terminals, Untaped pcs./MOQ
450	160	1.0	B32673P4105+***	6.0 × 15.0 × 26.5	2720	2800	2880
		1.5	B32673P4155+***	7.0 × 16.0 × 26.5	2320	2400	2520
		2.2	B32673P4225+***	8.5 × 16.5 × 26.5	1920	2000	2040
520	200	0.47	B32673P5474+***	6.0 × 15.0 × 26.5	2720	2800	2880
		0.56	B32673P5564+***	6.0 × 15.0 × 26.5	2720	2800	2880
		0.68	B32673P5684+***	6.0 × 15.0 × 26.5	2720	2800	2880
		1.0	B32673P5105+***	7.0 × 16.0 × 26.5	2320	2400	2520
		1.5	B32673P5155+***	10.5 × 16.5 × 26.5	1560	1600	2160
		2.2	B32673P5225+***	10.5 × 20.5 × 26.5	–	–	2160
630	200	0.33	B32673P6334+***	6.0 × 15.0 × 26.5	2720	2800	2880
		0.47	B32673P6474+***	6.0 × 15.0 × 26.5	2720	2800	2880
		0.56	B32673P6564+***	6.0 × 15.0 × 26.5	2720	2800	2880
		0.68	B32673P6684+***	7.0 × 16.0 × 26.5	2320	2400	2520
		1.0	B32673P6105+***	8.5 × 16.5 × 26.5	1920	2000	2040
		1.5	B32673P6155+***	10.5 × 18.5 × 26.5	1560	1600	2160
		2.2	B32673P6225+***	12.0 × 22.0 × 26.5	–	–	1800

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

Composition of ordering code

+ = Capacitance tolerance code:
J = ±5%
K = ±10%
M = ±20%

*** = Packaging code:
289 = Straight terminals, Ammo pack
189 = Straight terminals, Reel
003 = Untaped (lead length 3.2 ± 0.3 mm)
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 $T_{op, max}$ Upper category temperature T_{max} Lower category temperature T_{min} Rated temperature T_R	+125 °C +110 °C −55 °C +85 °C	
Dissipation factor tan δ (in 10^{-3}) at 20 °C (upper limit values)	1 kHz 10 kHz 100 kHz	1.0 2.5 25.0	
Insulation resistance R_{ins} at 100 V or time constant $\tau = C_R \cdot R_{ins}$ at 20 °C, rel. humidity ≤ 65% (minimum as-delivered values)	30 GΩ ($C_R \leq 0.33$ µF) 10000 s ($C_R > 0.33$ µF)		
DC test voltage	$1.4 \cdot V_R$, 2 s		
Category voltage V_C (continuous operation with V_{DC} or V_{AC} at f ≤ 1 kHz)	T_{op} (°C)	DC voltage derating	AC voltage derating
	$T_{op} \leq 85$ $85 < T_{op} \leq 110$	$V_C = V_R$ $V_C = V_R \cdot (165 - T_{op})/80$	$V_{C,RMS} = V_{RMS}$ $V_{C,RMS} = V_{RMS} \cdot (165 - T_{op})/80$
Operating voltage V_{op} for short operating periods (V_{DC} or V_{AC} at f ≤ 1 kHz)	T_{op} (°C)	DC voltage (max. hours)	AC voltage (max. hours)
	$T_{op} \leq 100$ $100 < T_{op} \leq 125$	$V_{op} = 1.1 \cdot V_C$ (1000 h) $V_{op} = 1.0 \cdot V_C$ (1000 h)	$V_{op} = 1.0 \cdot V_{C,RMS}$ (1000 h) $V_{op} = 1.0 \cdot V_{C,RMS}$ (1000 h)
Reliability: Failure rate λ Service life t_{SL}	 24 fit (≤ $1 \cdot 10^{-7}$/h) at $0.5 \cdot V_R$, 40 °C 200000 h at $0.5 \cdot V_R$, 85 °C For conversion to other operating conditions and temperatures, refer to chapter "Reliability", page .		
Failure criteria: Total failure Failure due to variation of parameters	 Short circuit or open circuit Capacitance change |ΔC/C| Dissipation factor tan δ Insulation resistance R_{ins} Or time constant τ	 > 10% > 4 × upper limit values < 150 MΩ ($C_R \leq 0.33$ µF) < 50 s ($C_R \geq 0.33$ µF)	

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/µs.

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.

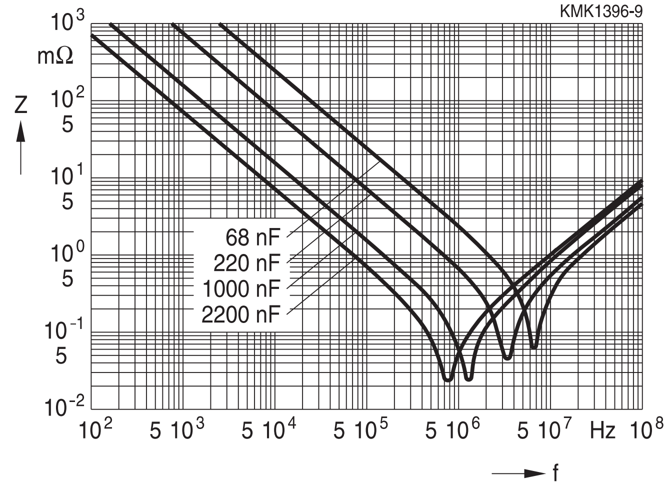
dV/dt values

Lead spacing		10 mm	15 mm	22.5 mm
V_R V DC	V_{RMS} V AC	dV/dt in V/µs		
450	160	140	120	100
520	200	200	160	110
630	200	250	180	130

k_0 values

Lead spacing		10 mm	15 mm	22.5 mm
V_R V DC	V_{RMS} V AC	k_0 in V^2/µs		
450	160	126000	108000	90000
520	200	208000	166000	114000
630	200	315000	226000	163000

Impedance Z versus frequency f (typical values)

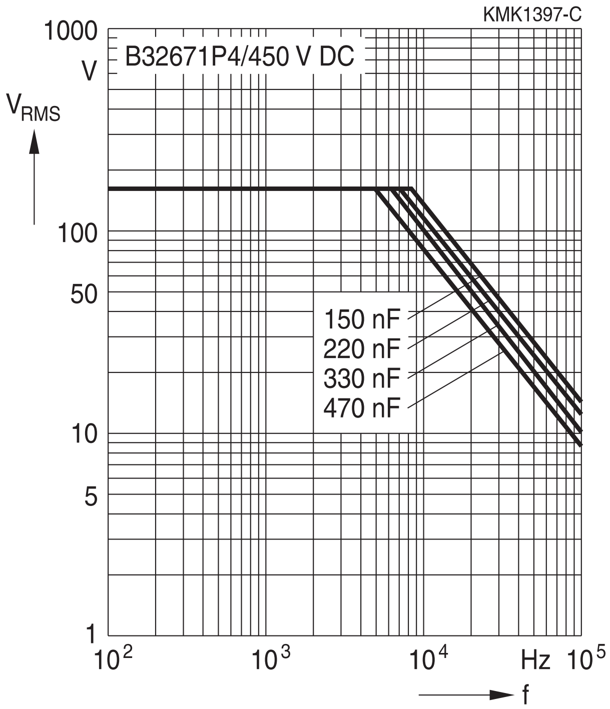


Permissible AC voltage V_{RMS} versus frequency f (for sinusoidal waveforms $T_A \leq 100$ °C)

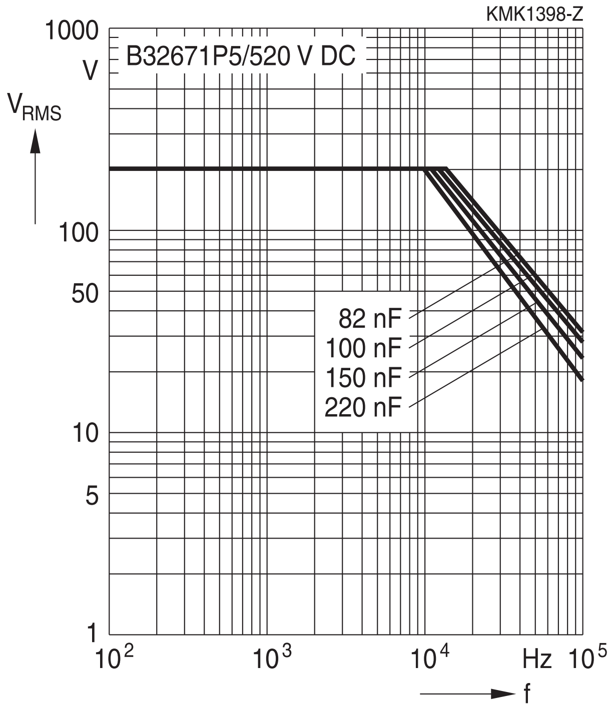
For $T_A > 100$ °C, please use derating factor F_T.

Lead spacing 10 mm

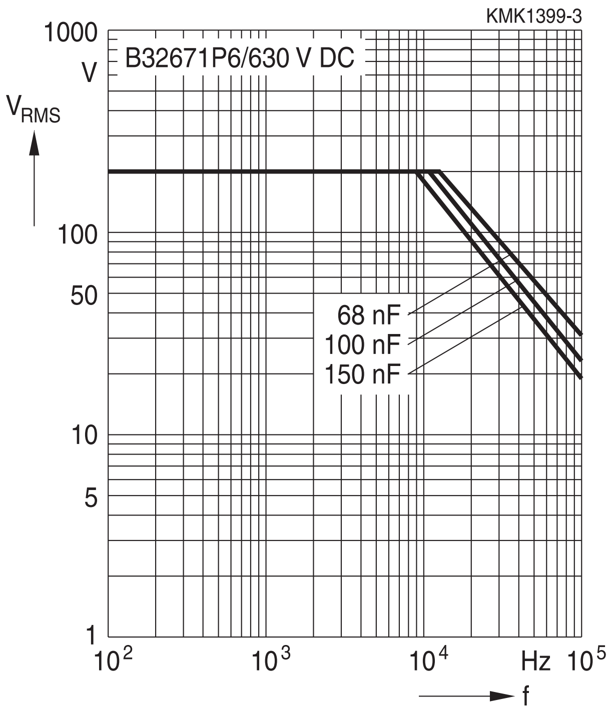
450 V DC/160 V AC



520 V DC/200 V AC



630 V DC/200 V AC

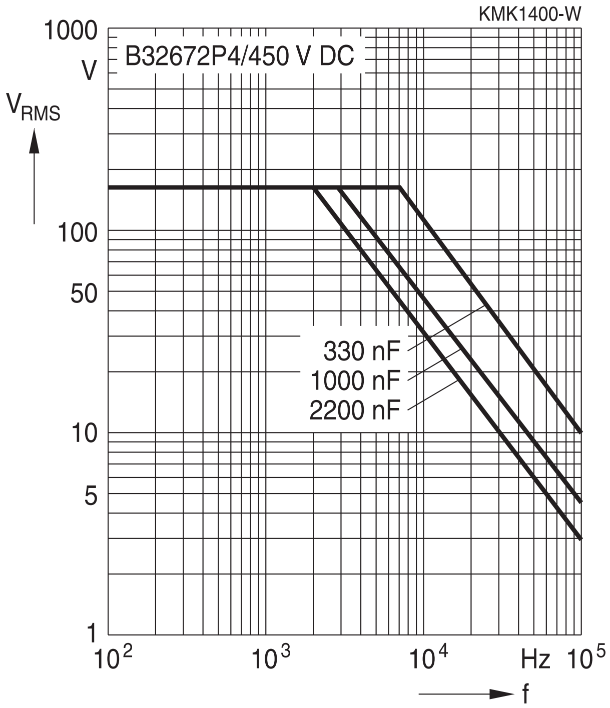


Permissible AC voltage V_{RMS} versus frequency f (for sinusoidal waveforms $T_A \leq 100$ °C)

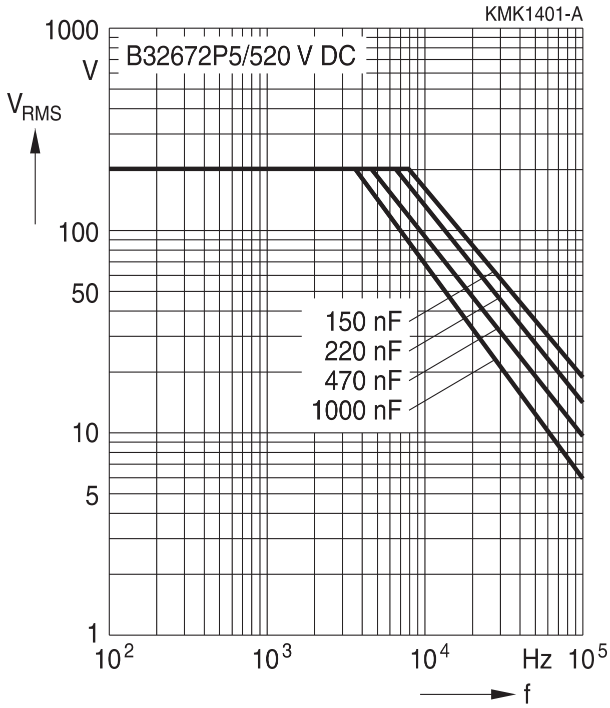
For $T_A > 100$ °C, please use derating factor F_T.

Lead spacing 15 mm

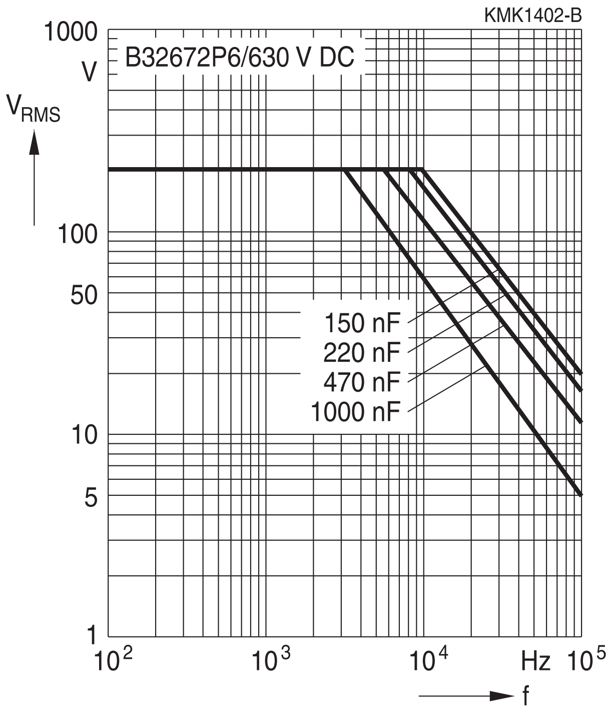
450 V DC/160 V AC



520 V DC/200 V AC



630 V DC/200 V AC

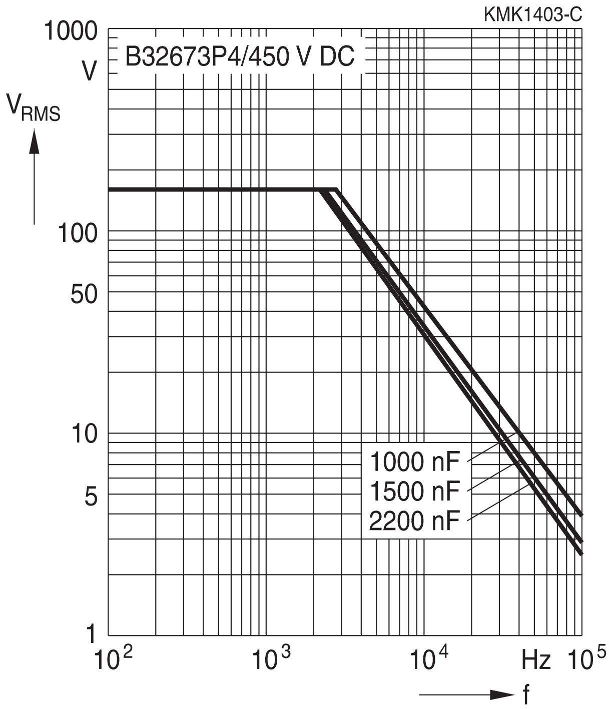


Permissible AC voltage V_{RMS} versus frequency f (for sinusoidal waveforms $T_A \leq 100$ °C)

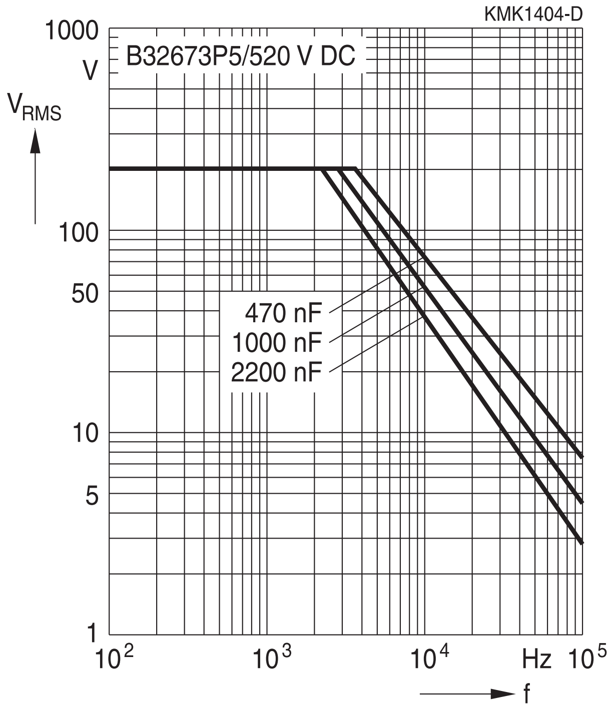
For $T_A > 100$ °C, please use derating factor F_T.

Lead spacing 22.5 mm

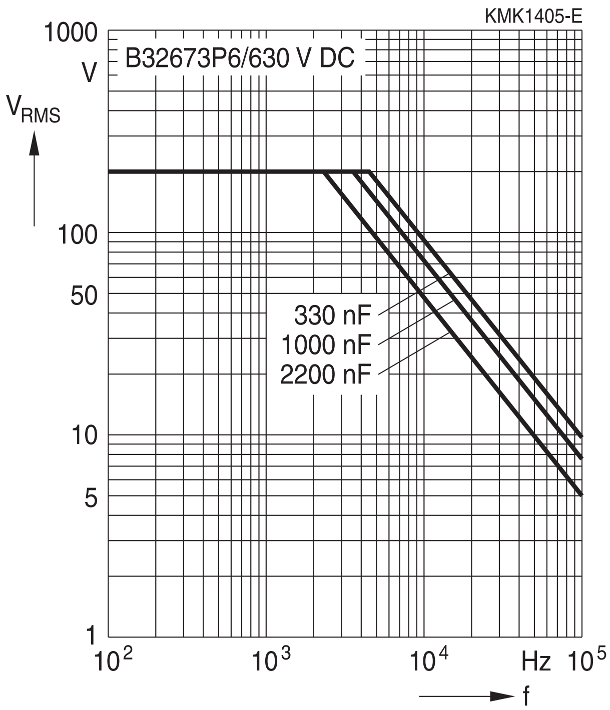
450 V DC/160 V AC

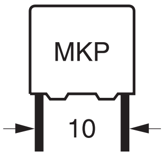


520 V DC/200 V AC



630 V DC/200 V AC



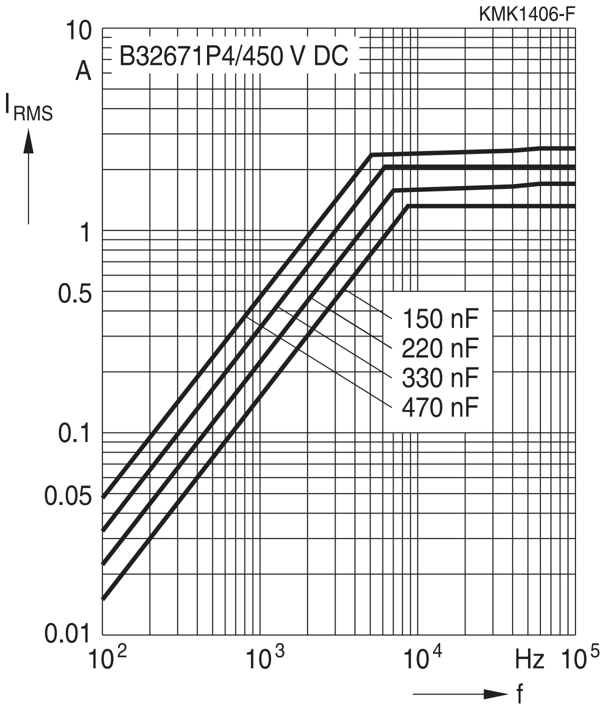


Permissible AC current I_{RMS} versus frequency f (for sinusoidal waveforms $T_A \leq 100$ °C)

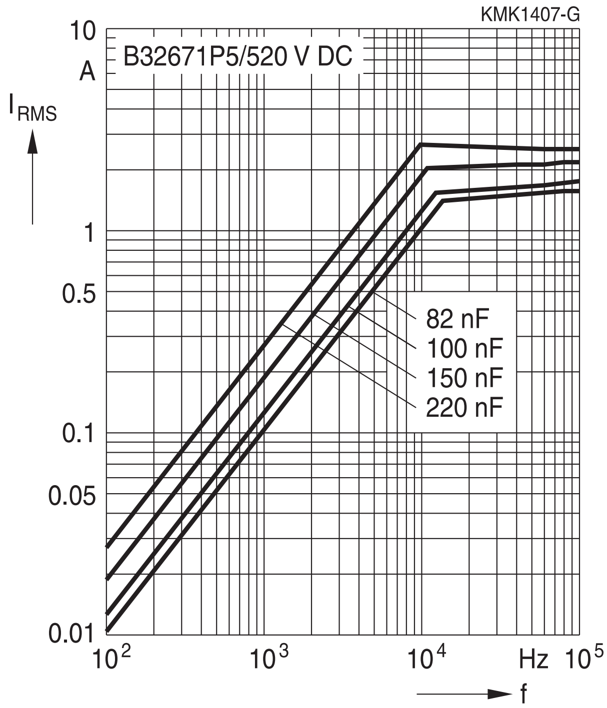
For $T_A > 100$ °C, please use derating factor F_T.

Lead spacing 10 mm

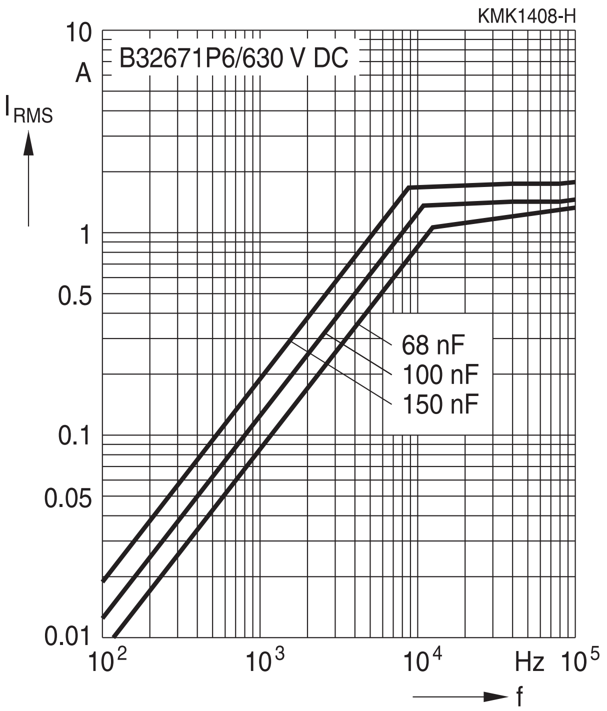
450 V DC/160 V AC



520 V DC/200 V AC



630 V DC/200 V AC

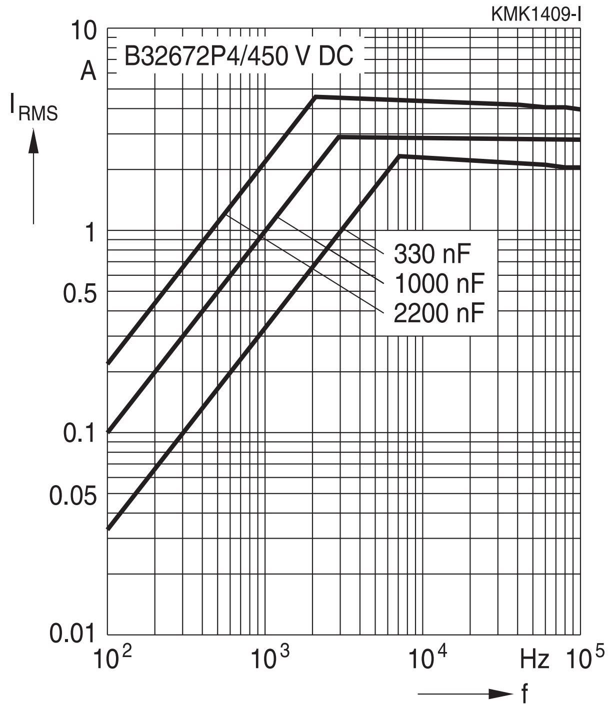


Permissible AC current I_{RMS} versus frequency f (for sinusoidal waveforms $T_A \leq 100$ °C)

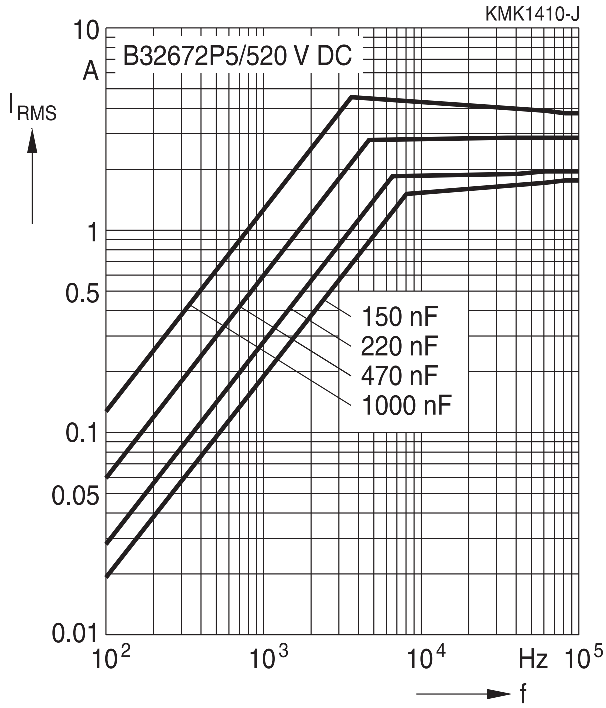
For $T_A > 100$ °C, please use derating factor F_T.

Lead spacing 15 mm

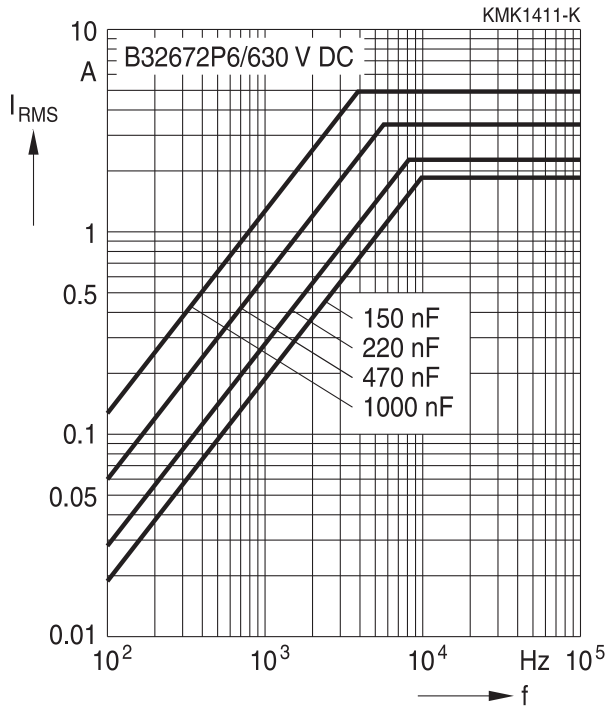
450 V DC/160 V AC



520 V DC/200 V AC



630 V DC/200 V AC

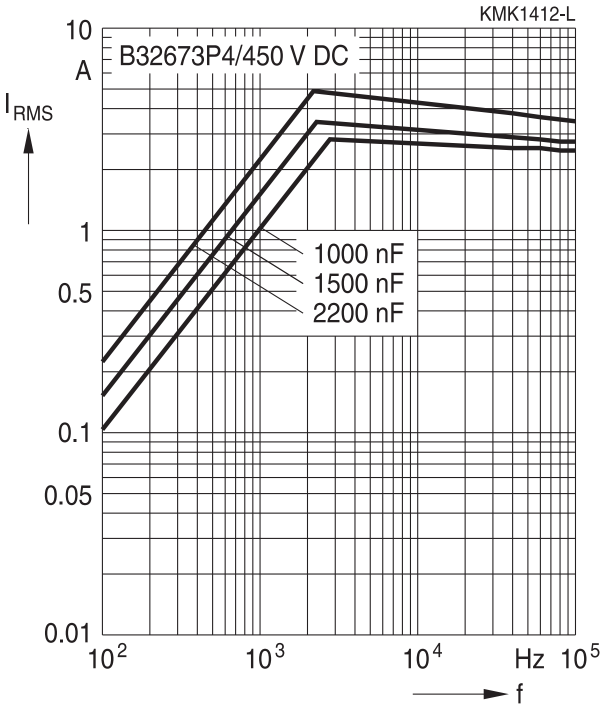


Permissible AC current I_{RMS} versus frequency f (for sinusoidal waveforms $T_A \leq 100$ °C)

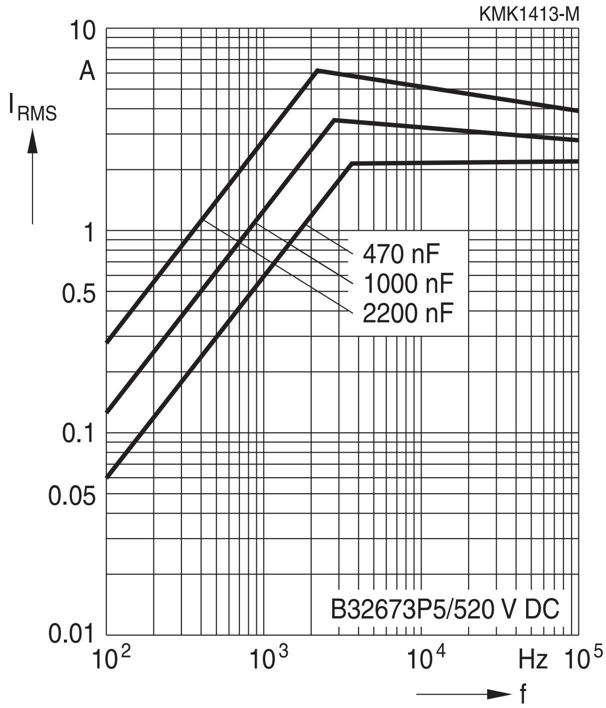
For $T_A > 100$ °C, please use derating factor F_T.

Lead spacing 22.5 mm

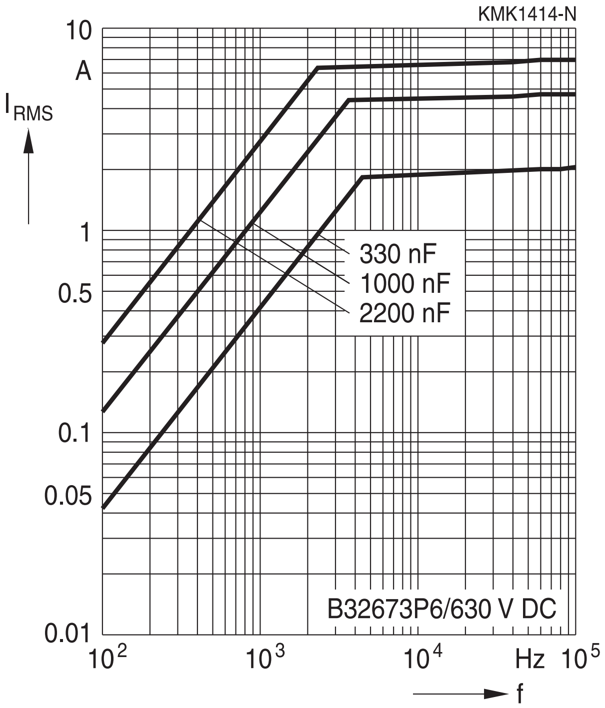
450 V DC/160 V AC



520 V DC/200 V AC



630 V DC/200 V AC



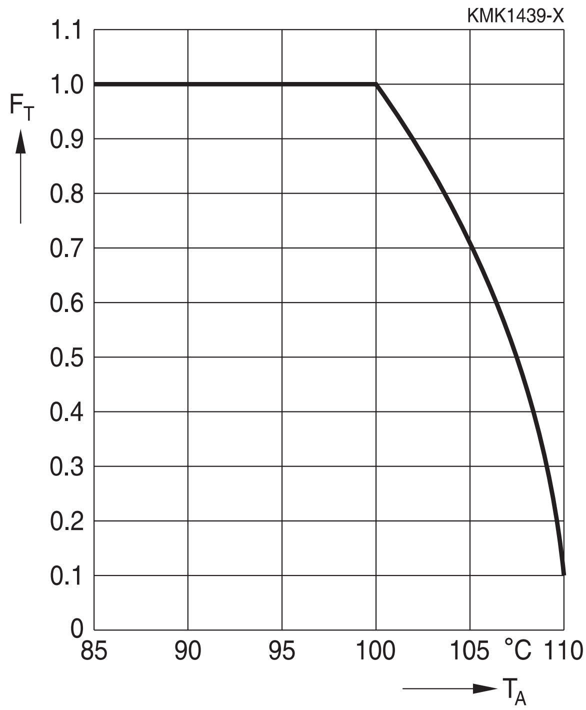
Maximum AC voltage (V_{RMS}), current (I_{RMS}) vs. frequency and temperature for T_A > 100 ºC

The graphs described in the previous section for the permissible AC voltage (V_{RMS}) or current (I_{RMS}) vs. frequency are given for a maximum ambient temperature $T_A \leq 100$ ºC. In case of higher ambient temperatures (T_A), the self-heating (ΔT) of the component must be reduced to avoid that temperature of the component ($T_{op} = T_A + \Delta T$) reaches values above maximum operating temperature.The factor F_T shall be applied in the following way:

$$I_{RMS}(T_A) = I_{RMS,T_A \leq 100\,^{\circ}C} \cdot F_T(T_A)$$

$$V_{RMS}(T_A) = V_{RMS,T_A \leq 100\,^{\circ}C} \cdot F_T(T_A)$$

And F_T is given by the following curve:



Testing and Standards

Test	Reference	Conditions of test	Performance requirements
Electrical Parameters	IEC 60384-16	Voltage proof, 1.4 V_R, 1 minute Insulation resistance, R_{INS} Capacitance, C Dissipation factor, tan δ	Within specified limits
Robustness of terminations	IEC 60068-2-21	Tensile strength (test Ua1) Wire diameter: $0.5 < d_1 \leq 0.8$ mm — Tensile force: 10 N	Capacitance and tan δ within specified limits
Resistance to soldering heat	IEC 60068-2-20, test Tb, method 1A	Solder bath temperature at 260 ± 5 °C, immersion for 10 seconds	$\Delta C/C_0 \leq 2\%$ $\lvert\Delta \tan \delta\rvert \leq 0.001$
Rapid change of temperature	IEC 60384-16	T_A = lower category temperature T_B = upper category temperature Five cycles, duration t = 30 min.	$\lvert\Delta C/C_0\rvert \leq 2\%$ $\lvert\Delta \tan \delta\rvert \leq 0.002$ $R_{INS} \geq 50\%$ of initial limit
Vibration	IEC 60384-16	Test F_C: vibration sinusoidal Displacement: 0.75 mm Accleration: 98 m/s^2 Frequency: 10 Hz ... 500 Hz Test duration: 3 orthogonal axes, 2 hours each axe	No visible damage
Bump	IEC 60384-16	Test Eb: Total 4000 bumps with 390 m/s^2 mounted on PCB 6 ms duration	No visible damage $\lvert\Delta C/C_0\rvert \leq 2\%$ $\lvert\Delta \tan \delta\rvert \leq 0.001$ $R_{INS} \geq 50\%$ of initial limit
Climatic sequence	IEC 60384-16	Dry heat Tb / 16 h. Damp heat cyclic, 1st cycle + 55 °C / 24h / 95% ... 100% RH Cold Ta / 2h Damp heat cyclic, 5 cycles + 55 °C / 24h / 95% ... 100% rh	No visible damage $\lvert\Delta C/C_0\rvert \leq 2\%$ $\lvert\Delta \tan \delta\rvert \leq 0.001$ $R_{INS} \geq 50\%$ of initial limit
Damp Heat Steady State	IEC 60384-16	Test Ca 40 °C / 93% RH / 56 days	No visible damage $\lvert\Delta C/C_0\rvert \leq 3\%$ $\lvert\Delta \tan \delta\rvert \leq 0.003$ $R_{INS} \geq 50\%$ of initial limit
High temperature high humidity with load		60 °C / 95% RH / 1000 hours with $V_{R, DC}$	No visible damage $\lvert\Delta C/C_0\rvert \leq 10\%$ $\lvert\Delta \tan \delta\rvert \leq 0.004$ $R_{INS} \geq 50\%$ of initial limit

Test	Reference	Conditions of test	Performance requirements
Endurance A		85 °C/ 1.1 V_R / 1000 hours	No visible damage $\lvert\Delta C/C_0\rvert \leq 5\%$ $\lvert\Delta \tan \delta\rvert \leq 0.004$ $R_{INS} \geq 50\%$ of initial limit
Endurance B		110 °C/ 1.1 V_C / 1000 hours	No visible damage $\lvert\Delta C/C_0\rvert \leq 10\%$ $\lvert\Delta \tan \delta\rvert \leq 0.004$ $R_{INS} \geq 50\%$ of initial limit
Endurance C		125 °C/ 1.1 V_C / 1000 hours	No visible damage $\lvert\Delta C/C_0\rvert \leq 10\%$ $\lvert\Delta \tan \delta\rvert \leq 0.004$ $R_{INS} \geq 50\%$ of initial limit
Endurance D		85 °C/ V_R + 4 $A_{RMS,1000\ KHz}$/ 1000 hours	No visible damage $\lvert\Delta C/C_0\rvert \leq 10\%$ $\lvert\Delta \tan \delta\rvert \leq 0.004$ $R_{INS} \geq 50\%$ 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.

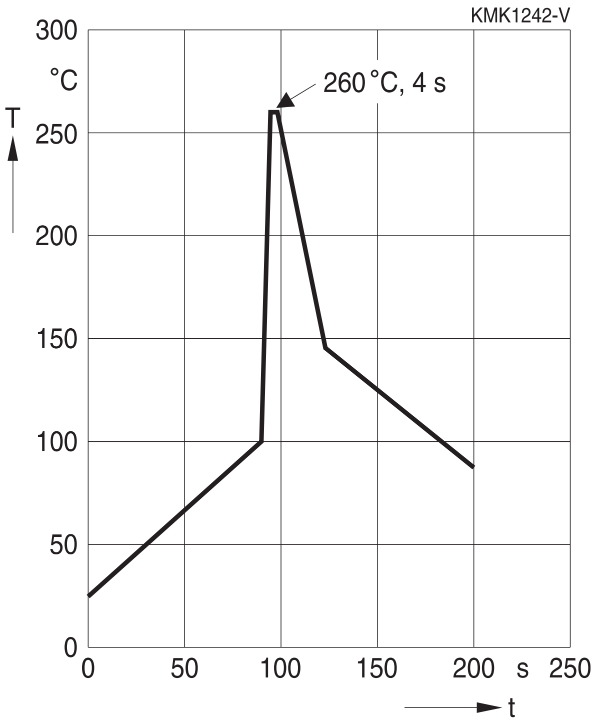
Before a solderability test is carried out, terminals are subjected to accelerated ageing (to IEC 60068-2-2, test Ba: 4 h exposure to dry heat at 155 °C). Since the ageing temperature is far higher than the upper category temperature of the capacitors, the terminal wires should be cut off from the capacitor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

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

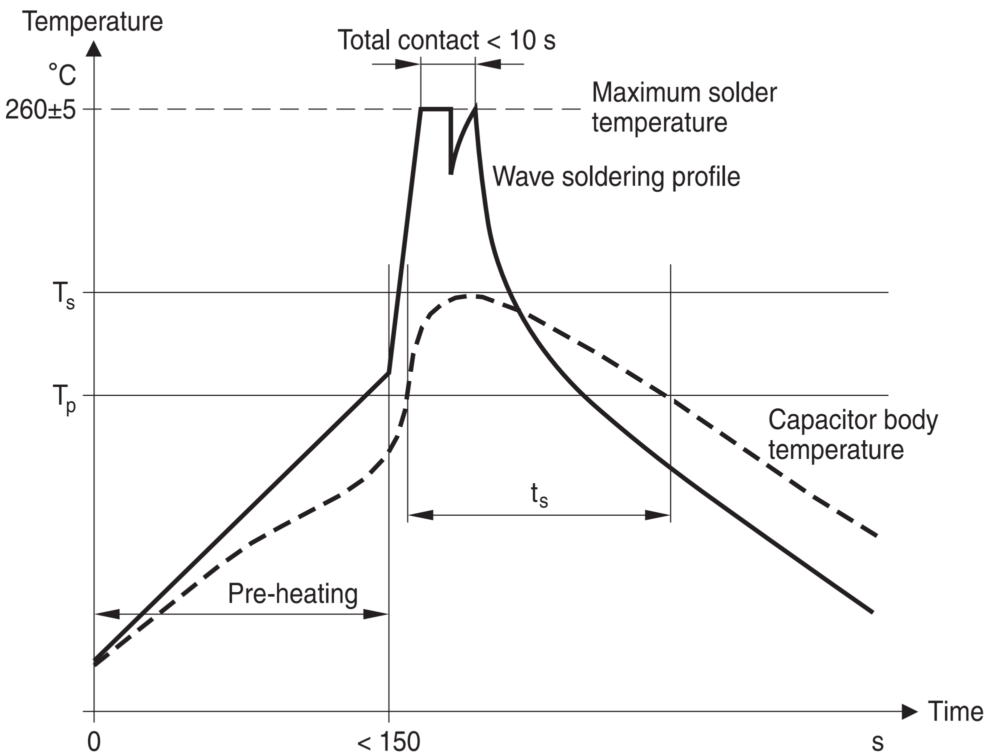
Permissible heat exposure loads on film capacitors are primarily characterized by the upper category temperature T_{max}. Long exposure to temperatures above this type-related temperature limit can lead to changes in the plastic dielectric and thus change irreversibly a capacitor's electrical characteristics.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

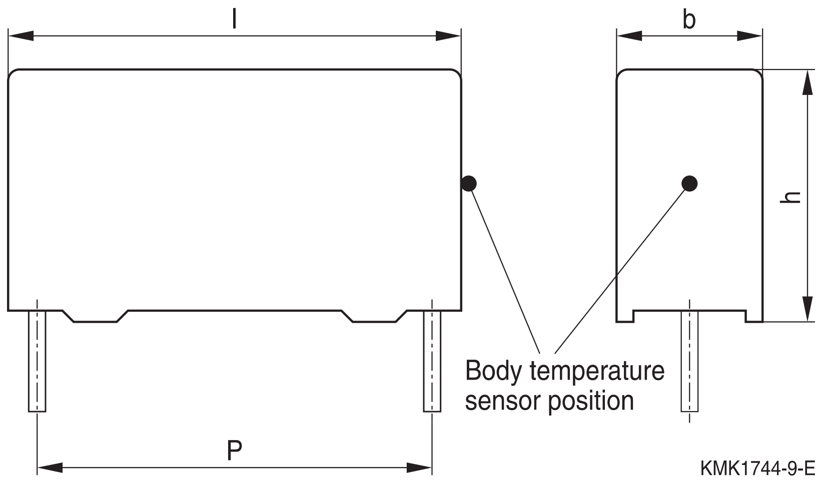
EPCOS recommendations

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



Body temperature should follow the description below:

- MKP capacitor
  During pre-heating: $T_p \leq 110$ °C
  During soldering: $T_s \leq 120$ °C, $t_s \leq 45$ s
- MKT capacitor
  During pre-heating: $T_p \leq 125$ °C
  During soldering: $T_s \leq 160$ °C, $t_s \leq 45$ 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 ≤ 120 °C.

One recommended condition for manual soldering is that the tip of the soldering iron should be < 360 °C and the soldering contact time should be no longer than 3 seconds.

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

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.

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"

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"

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, $T_A + \Delta T$	Beriebstemperatur, $T_A + \Delta T$
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	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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Important notes

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