

# Film Capacitors

## Metallized Polypropylene Film Capacitors (MKP)

**Series/Type:** B32671P ... B32673P

**Date:** April 2014

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**Power Factor Correction**
**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

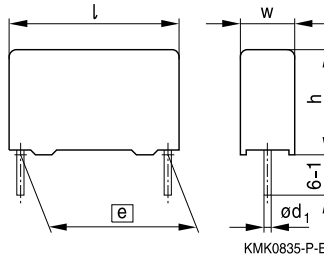
**Marking**

- Manufacturer's logo
- Lot number, series number
- Rated capacitance (coded)
- Capacitance tolerance (code letter)
- Rated DC voltage
- Date of manufacture (coded)

**Delivery mode**

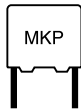
- Bulk (untaped)
- Taped (Ammo pack or reel)

For notes on taping, refer to chapter "Taping and packing".

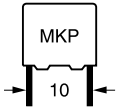
**Dimensional drawing**


Dimensions in mm

Lead spacing	Lead diameter	Type
$e \pm 0.4$	$d_1 \pm 0.05$	
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
$C_R$ ( $\mu$ F)									
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									


**B32671P**
**Power Factor Correction**
**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	Ammo pack pcs./MOQ	Reel pcs./MOQ	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

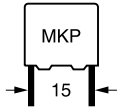
189 = Straight terminals, Reel

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	Ammo pack pcs./MOQ	Reel pcs./MOQ	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	1000
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	1000

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

Further E series, intermediate capacitance values and closer tolerance on request.

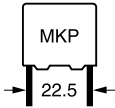
**Composition of ordering code**

+ = 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)


**B32673P**
**Power Factor Correction**
**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	Ammo pack pcs./MOQ	Reel pcs./MOQ	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	1560	1600	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	1560	1600	2160

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  $T = 20\text{ }^{\circ}\text{C}$ , otherwise is specified.

Operating temperature range	Max. operating temperature $T_{op, max}$	+125 $^{\circ}\text{C}$	
	Upper category temperature $T_{max}$	+110 $^{\circ}\text{C}$	
	Lower category temperature $T_{min}$	-55 $^{\circ}\text{C}$	
	Rated temperature $T_R$	+85 $^{\circ}\text{C}$	
Dissipation factor $\tan \delta$ (in $10^{-3}$ ) at 20 $^{\circ}\text{C}$ (upper limit values)	1 kHz	1.0	
	10 kHz	2.5	
	100 kHz	25.0	
Insulation resistance $R_{ins}$ at 100 V or time constant $\tau = C_R \cdot R_{ins}$ at 20 $^{\circ}\text{C}$ , rel. humidity $\leq 65\%$ (minimum as-delivered values)	30 G $\Omega$ ( $C_R \leq 0.33\text{ }\mu\text{F}$ )		
	10000 s ( $C_R > 0.33\text{ }\mu\text{F}$ )		
DC test voltage	$1.4 \cdot V_R$ , 2 s		
Category voltage $V_C$ (continuous operation with $V_{DC}$ or $V_{AC}$ at $f \leq 1\text{ kHz}$ )	$T_A \leq 85$	DC voltage derating	AC voltage derating
	$85 < T_A \leq 110$	$V_C = V_R$ $V_C = V_R \cdot (165 - T_{op})/80$	$V_{C, RMS} = V_{RMS}$ $V_{C, RMS} = V_{RMS} \cdot (165 - T_{op})/80$
Operating voltage $V_{op}$ for short operating periods ( $V_{DC}$ or $V_{AC}$ at $f \leq 1\text{ kHz}$ )	$T_{op} \leq 100$	DC voltage (max. hours)	AC voltage (max. hours)
	$100 < T_{op} \leq 125$	$V_{op} = 1.1 \cdot V_C$ (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 $\lambda$ Service life $t_{SL}$	24 fit ( $\leq 1 \cdot 10^{-7}/\text{h}$ ) at $0.5 \cdot V_R$ , 40 $^{\circ}\text{C}$ 200000 h at $0.5 \cdot V_R$ , 85 $^{\circ}\text{C}$ For conversion to other operating conditions and temperatures, refer to chapter "Reliability", page .		
Failure criteria: Total failure	Short circuit or open circuit		
Failure due to variation of parameters	Capacitance change $ \Delta C/C $	$> 10\%$	
	Dissipation factor $\tan \delta$	$> 4 \times$ upper limit values	
	Insulation resistance $R_{ins}$	$< 150\text{ M}\Omega$ ( $C_R \leq 0.33\text{ }\mu\text{F}$ )	
	Or time constant $\tau$	$< 50\text{ s}$ ( $C_R \geq 0.33\text{ }\mu\text{F}$ )	



**B32671P ... B32673P**

**Power Factor Correction**

**Pulse handling capability**

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

"k<sub>0</sub>" represents the maximum permissible pulse characteristic of the waveform applied to the capacitor, expressed in V<sup>2</sup>/μs.

*Note:*

*The values of dV/dt and k<sub>0</sub> 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.*

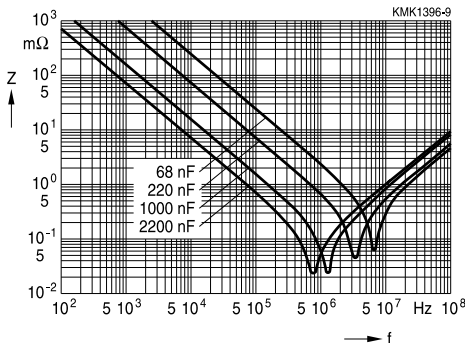
**dV/dt values**

Lead spacing		10 mm	15 mm	22.5 mm
V <sub>R</sub> V DC	V <sub>RMS</sub> V AC	dV/dt in V/μs		
450	160	140	120	100
520	200	200	160	110
630	200	250	180	130

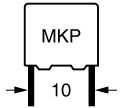
**k<sub>0</sub> values**

Lead spacing		10 mm	15 mm	22.5 mm
V <sub>R</sub> V DC	V <sub>RMS</sub> V AC	k <sub>0</sub> in V <sup>2</sup> /μs		
450	160	126000	108000	90000
520	200	208000	166000	114000
630	200	315000	226000	163000

**Impedance Z versus frequency f (typical values)**





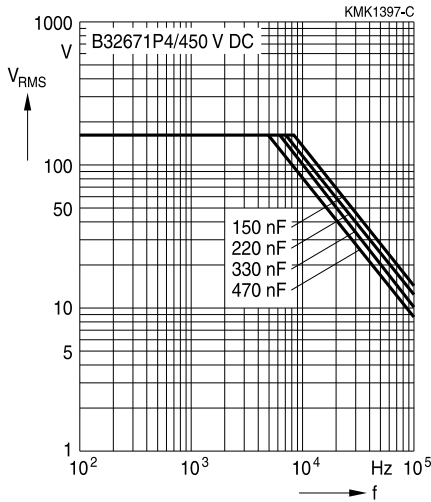


**Permissible AC voltage  $V_{RMS}$  versus frequency  $f$  (for sinusoidal waveforms  $T_A \leq 100\text{ }^\circ\text{C}$ )**

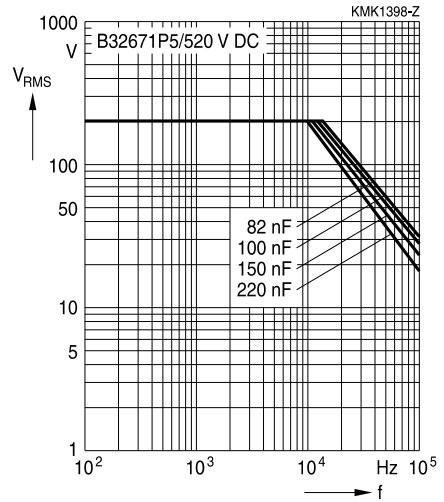
For  $T_A > 100\text{ }^\circ\text{C}$ , please use derating factor  $F_T$ .

**Lead spacing 10 mm**

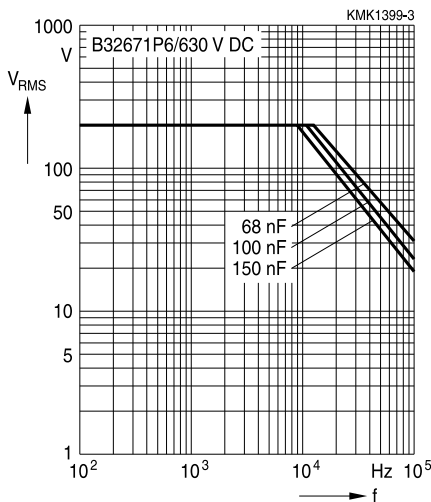
**450 V DC/160 V AC**

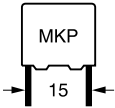


**520 V DC/200 V AC**



**630 V DC/200 V AC**





**B32672P**

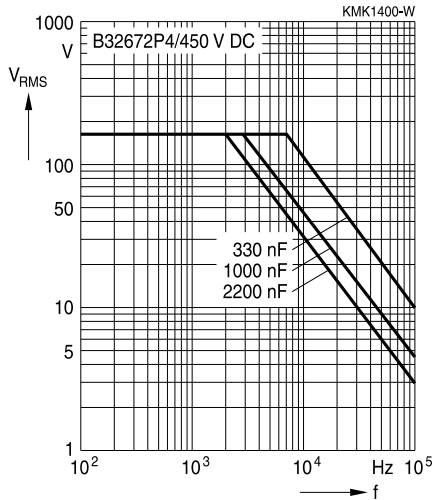
**Power Factor Correction**

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

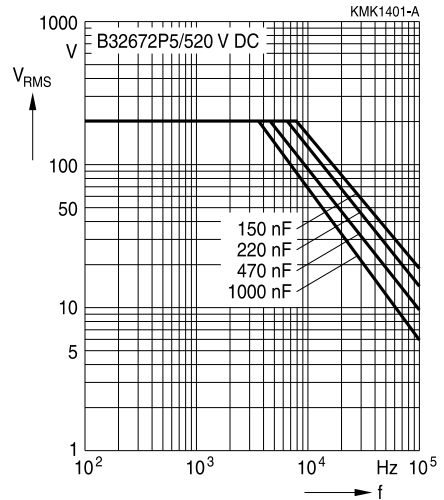
For  $T_A > 100\text{ }^\circ\text{C}$ , please use derating factor  $F_T$ .

**Lead spacing 15 mm**

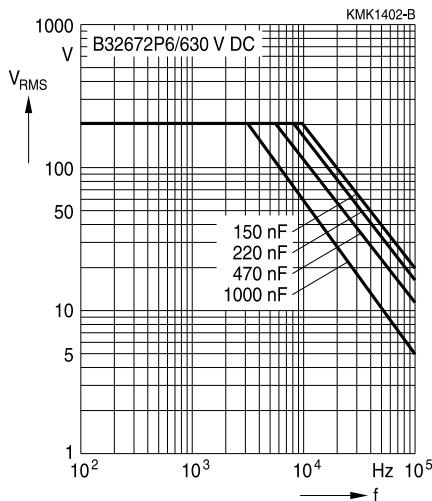
**450 V DC/160 V AC**

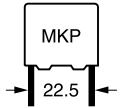


**520 V DC/200 V AC**



**630 V DC/200 V AC**



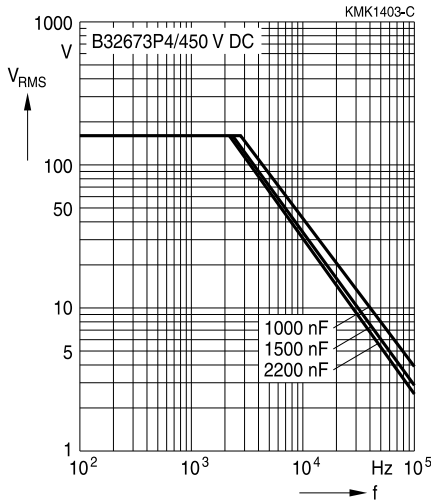


**Permissible AC voltage  $V_{RMS}$  versus frequency  $f$  (for sinusoidal waveforms  $T_A \leq 100\text{ }^\circ\text{C}$ )**

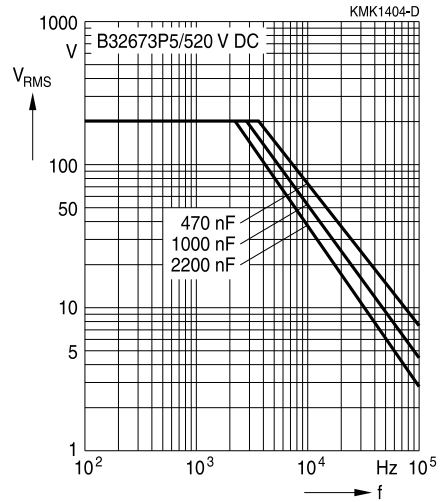
For  $T_A > 100\text{ }^\circ\text{C}$ , please use derating factor  $F_T$ .

**Lead spacing 22.5 mm**

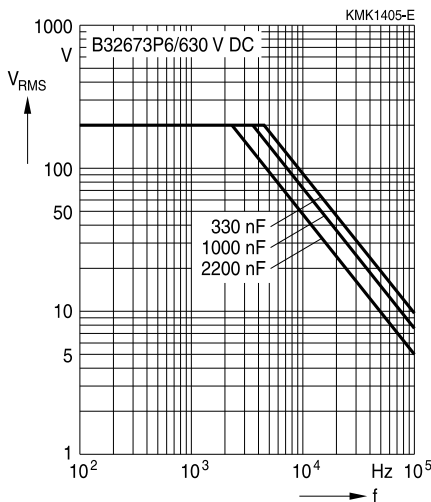
**450 V DC/160 V AC**

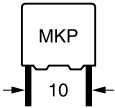


**520 V DC/200 V AC**



**630 V DC/200 V AC**





B32671P

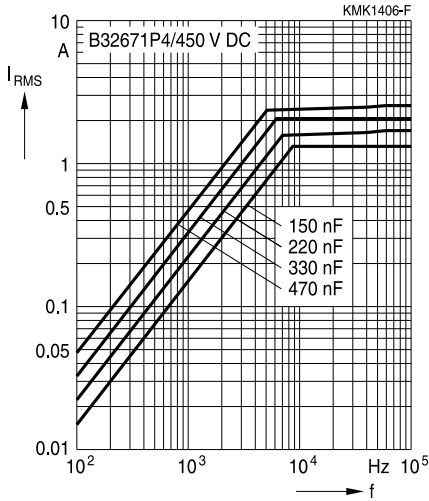
Power Factor Correction

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

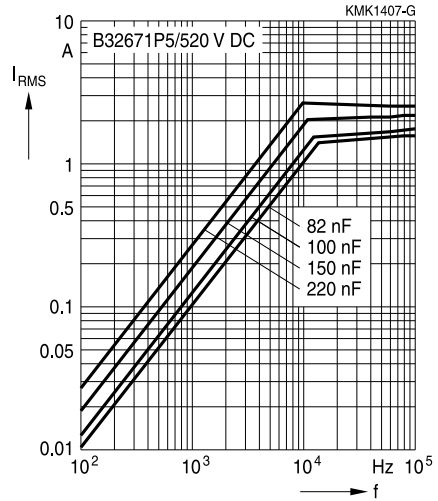
For  $T_A > 100\text{ }^\circ\text{C}$ , please use derating factor  $F_T$ .

Lead spacing 10 mm

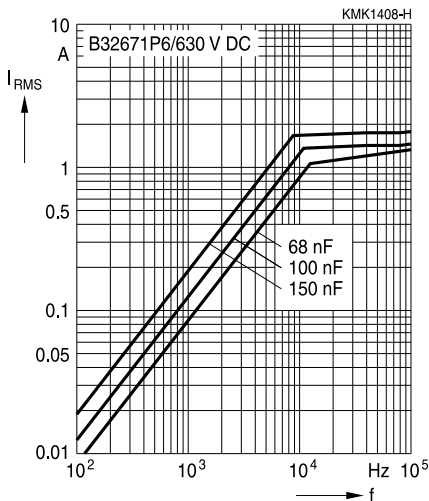
450 V DC/160 V AC

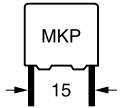


520 V DC/200 V AC



630 V DC/200 V AC



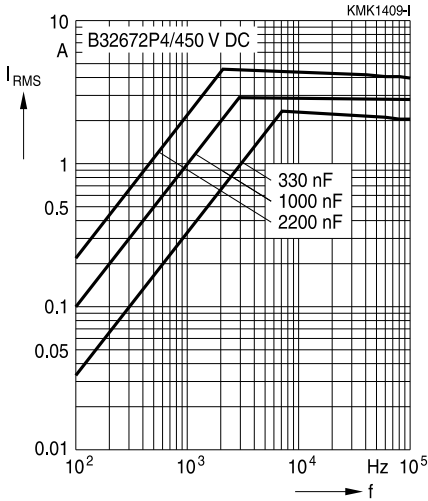


**Permissible AC current  $I_{RMS}$  versus frequency  $f$  (for sinusoidal waveforms  $T_A \leq 100\text{ }^\circ\text{C}$ )**

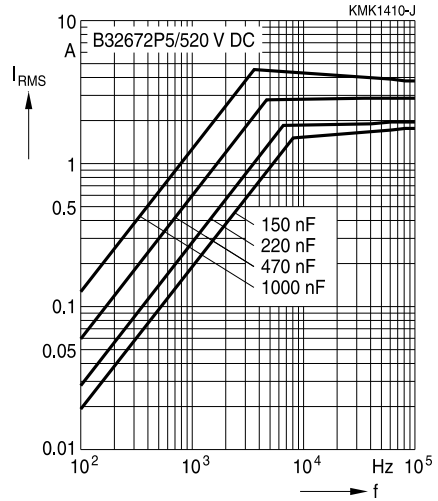
For  $T_A > 100\text{ }^\circ\text{C}$ , please use derating factor  $F_T$ .

**Lead spacing 15 mm**

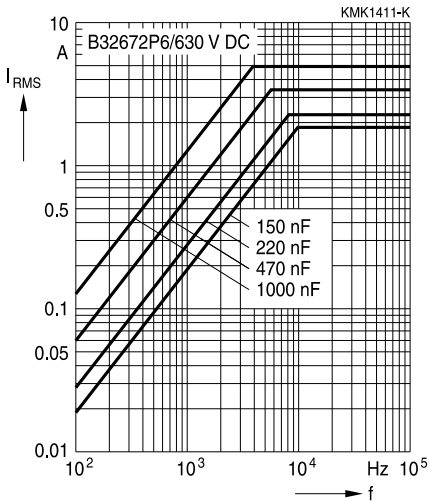
450 V DC/160 V AC

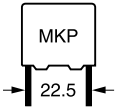


520 V DC/200 V AC



630 V DC/200 V AC





**B32673P**

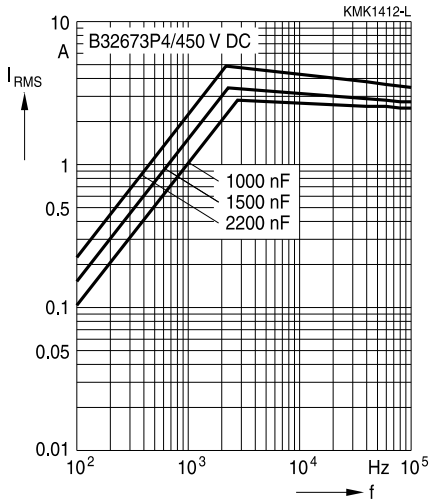
**Power Factor Correction**

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

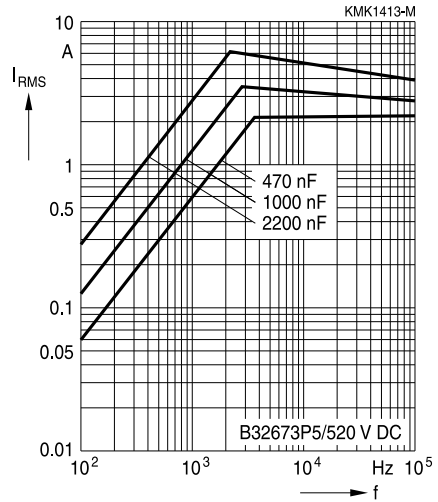
For  $T_A > 100\text{ }^\circ\text{C}$ , please use derating factor  $F_T$ .

**Lead spacing 22.5 mm**

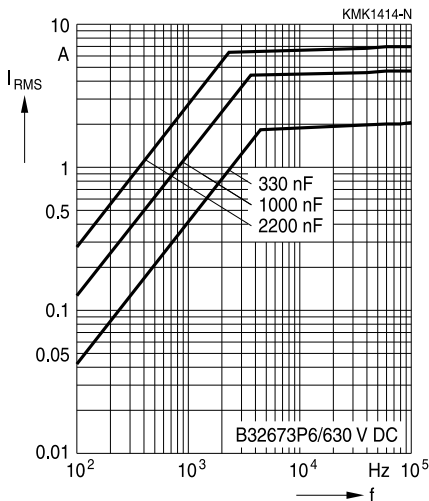
450 V DC/160 V AC

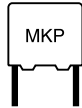


520 V DC/200 V AC



630 V DC/200 V AC





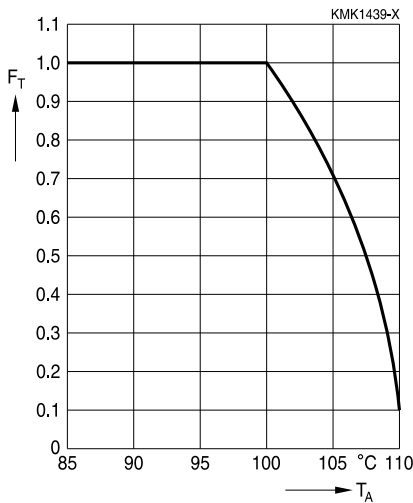
**Maximum AC voltage ( $V_{RMS}$ ), current ( $I_{RMS}$ ) vs. frequency and temperature for  $T_A > 100\text{ }^\circ\text{C}$**

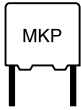
The graphs described in the previous section for the permissible AC voltage ( $V_{RMS}$ ) or current ( $I_{RMS}$ ) vs. frequency are given for a maximum ambient temperature  $T_A \leq 100\text{ }^\circ\text{C}$ . In case of higher ambient temperatures ( $T_A$ ), the self-heating ( $\Delta T$ ) of the 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:

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

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

And  $F_T$  is given by the following curve:





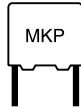
B32671P ... B32673P

**Power Factor Correction**

**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, $\tan \delta$	Within specified limits
Robustness of terminations	IEC 60068-2-21	Tensile strength (test Ua1) Wire diameter	Capacitance and $\tan \delta$ within specified limits
		Tensile force $0.5 < d_1 \leq 0.8 \text{ mm}$	
Resistance to soldering heat	IEC 60068-2-20, test Tb, method 1A	Solder bath temperature at $260 \pm 5 \text{ }^\circ\text{C}$ , immersion for 10 seconds	$\Delta C/C_0 \leq 2\%$ $\Delta \tan \delta \leq 0.001$
Rapid change of temperature	IEC 60384-16	$T_A$ = lower category temperature $T_B$ = upper category temperature Five cycles, duration $t = 30 \text{ min.}$	$\Delta C/C_0 \leq 2\%$ $\Delta \tan \delta \leq 0.002$ $R_{INS} \geq 50\%$ of initial limit
Vibration	IEC 60384-16	Test F <sub>c</sub> : 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 60384-16	Test Eb: Total 4000 bumps with $390 \text{ m/s}^2$ mounted on PCB 6 ms duration	No visible damage $\Delta C/C_0 \leq 2\%$ $\Delta \tan \delta \leq 0.001$ $R_{INS} \geq 50\%$ of initial limit
Climatic sequence	IEC 60384-16	Dry heat Tb / 16 h. Damp heat cyclic, 1st cycle + $55 \text{ }^\circ\text{C} / 24\text{h} / 95\% \dots 100\% \text{ RH}$ Cold Ta / 2h Damp heat cyclic, 5 cycles + $55 \text{ }^\circ\text{C} / 24\text{h} / 95\% \dots 100\% \text{ rh}$	No visible damage $\Delta C/C_0 \leq 2\%$ $\Delta \tan \delta \leq 0.001$ $R_{INS} \geq 50\%$ of initial limit
Damp Heat Steady State	IEC 60384-16	Test Ca $40 \text{ }^\circ\text{C} / 93\% \text{ RH} / 56 \text{ days}$	No visible damage $\Delta C/C_0 \leq 3\%$ $\Delta \tan \delta \leq 0.003$ $R_{INS} \geq 50\%$ of initial limit
High temperature high humidity with load		$60 \text{ }^\circ\text{C} / 95\% \text{ RH} / 1000 \text{ hours}$ with $V_{R,DC}$	No visible damage $\Delta C/C_0 \leq 10\%$ $\Delta \tan \delta \leq 0.004$ $R_{INS} \geq 50\%$ of initial limit





Endurance A		85 °C/ 1.1 V <sub>R</sub> / 1000 hours	No visible damage  ΔC/C <sub>0</sub>   ≤ 5%  Δ tan δ  ≤ 0.004 R <sub>INS</sub> ≥ 50% of initial limit
Endurance B		110 °C/ 1.1 V <sub>C</sub> / 1000 hours	No visible damage  ΔC/C <sub>0</sub>   ≤ 10%  Δ tan δ  ≤ 0.004 R <sub>INS</sub> ≥ 50% of initial limit
Endurance C		125 °C/ 1.1 V <sub>C</sub> / 1000 hours	No visible damage  ΔC/C <sub>0</sub>   ≤ 10%  Δ tan δ  ≤ 0.004 R <sub>INS</sub> ≥ 50% of initial limit
Endurance D		85 °C/ V <sub>R</sub> + 4 A <sub>RMS,1000 KHz</sub> / 1000 hours	No visible damage  ΔC/C <sub>0</sub>   ≤ 10%  Δ tan δ  ≤ 0.004 R <sub>INS</sub> ≥ 50% of initial limit

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