



## Film Capacitors

### Metallized Polypropylene Film Capacitors (MKP)

**Series/Type:** B32671 ... B32672

**Date:** August 2004

© EPCOS AG 2004. Reproduction, publication and dissemination of this data sheet, enclosures hereto and the information contained therein without EPCOS' prior express consent is prohibited.

Purchase orders are subject to the General Conditions for the Supply of Products and Services of the Electrical and Electronics Industry recommended by the ZVEI (German Electrical and Electronic Manufacturers' Association), unless otherwise agreed.

### Typical applications

- Electronic ballasts (resonant circuits)
- SMPS
- High-frequency AC loads
- Pulse circuits

### Climatic

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

### Construction

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

### Features

- Very high AC voltages for all frequency ranges
- Very small dimensions
- High peak voltage for short time periods
- High peak current
- High pulse withstand capability

### Terminals

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

### Marking

Manufacturer's logo, lot number, type number, rated capacitance (coded), capacitance tolerance (code letter), rated AC voltage, date of manufacture (coded)

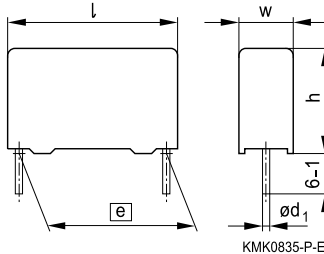
### Delivery mode

Bulk (untaped)

Taped (Ammo pack or reel)

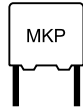
For notes on taping, refer to chapter "Taping and packing".

### Dimensional drawing



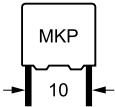
Dimensions in mm

| Lead spacing<br>$e \pm 0.4$ | Lead diameter<br>$d_1$ | Type   |
|-----------------------------|------------------------|--------|
| 10                          | 0.6                    | B32671 |
| 15                          | 0.8                    | B32672 |



# Overview of available types

| Lead spacing    | 10 mm  |      | 15 mm  |      |
|-----------------|--------|------|--------|------|
| Type            | B32671 |      | B32672 |      |
| Page            | 4      |      | 5      |      |
| $V_{rms}$ (VAC) | 500    | 600  | 600    | 700  |
| $V_R$ (VDC)     | 1000   | 1600 | 1600   | 2000 |
| $C_R$ (nF)      |        |      |        |      |
| 1.0             |        |      |        |      |
| 1.2             |        |      |        |      |
| 1.5             |        |      |        |      |
| 2.2             |        |      |        |      |
| 2.7             |        |      |        |      |
| 3.3             |        |      |        |      |
| 3.9             |        |      |        |      |
| 4.10            |        |      |        |      |
| 4.7             |        |      |        |      |
| 5.6             |        |      |        |      |
| 6.2             |        |      |        |      |
| 6.8             |        |      |        |      |
| 8.2             |        |      |        |      |
| 10              |        |      |        |      |
| 12              |        |      |        |      |
| 15              |        |      |        |      |
| 22              |        |      |        |      |
| 33              |        |      |        |      |


**B32671**
**High VAC, high temperature (wound)**
**Ordering codes and packing units (lead spacing 10 mm)**

| $V_{rms}$<br>$f \leq 1$ kHz<br>VAC | $V_R$<br>VDC | $C_R$<br>nF | Max. dimensions<br>$w \times h \times l$<br>mm | Ordering code<br>(composition see<br>below) | Ammo<br>pack<br>pcs./unit | Reel<br>pcs./unit | Untaped<br>pcs./unit |
|------------------------------------|--------------|-------------|------------------------------------------------|---------------------------------------------|---------------------------|-------------------|----------------------|
| 500                                | 1000         | 3.3         | $4.0 \times 9.0 \times 13.0$                   | B32671L0332+***                             | 1000                      | 1700              | 1000                 |
|                                    |              | 3.9         | $4.0 \times 9.0 \times 13.0$                   | B32671L0392+***                             | 1000                      | 1700              | 1000                 |
|                                    |              | 4.1         | $4.0 \times 9.0 \times 13.0$                   | B32671L0412+***                             | 1000                      | 1700              | 1000                 |
|                                    |              | 4.7         | $4.0 \times 9.0 \times 13.0$                   | B32671L0472+***                             | 1000                      | 1700              | 1000                 |
|                                    |              | 5.6         | $5.0 \times 11.0 \times 13.0$                  | B32671L0562+***                             | 830                       | 1300              | 1000                 |
|                                    |              | 6.2         | $5.0 \times 11.0 \times 13.0$                  | B32671L0622+***                             | 830                       | 1300              | 1000                 |
|                                    |              | 6.8         | $5.0 \times 11.0 \times 13.0$                  | B32671L0682+***                             | 830                       | 1300              | 1000                 |
|                                    |              | 8.2         | $5.0 \times 11.0 \times 13.0$                  | B32671L0822+***                             | 830                       | 1300              | 1000                 |
|                                    |              | 10          | $6.0 \times 12.0 \times 13.0$                  | B32671L0103+***                             | 680                       | 1100              | 1000                 |
|                                    |              | 12          | $6.0 \times 12.0 \times 13.0$                  | B32671L0123+***                             | 680                       | 1100              | 1000                 |
| 600                                | 1600         | 1.2         | $4.0 \times 9.0 \times 13.0$                   | B32671L1122+***                             | 1000                      | 1700              | 1000                 |
|                                    |              | 1.5         | $5.0 \times 11.0 \times 13.0$                  | B32671L1152+***                             | 830                       | 1300              | 1000                 |
|                                    |              | 2.2         | $5.0 \times 11.0 \times 13.0$                  | B32671L1222+***                             | 830                       | 1300              | 1000                 |
|                                    |              | 2.7         | $5.0 \times 11.0 \times 13.0$                  | B32671L1272+***                             | 830                       | 1300              | 1000                 |
|                                    |              | 3.3         | $6.0 \times 12.0 \times 13.0$                  | B32671L1332+***                             | 680                       | 1100              | 1000                 |
|                                    |              | 3.9         | $6.0 \times 12.0 \times 13.0$                  | B32671L1392+***                             | 680                       | 1100              | 1000                 |
|                                    |              | 4.1         | $6.0 \times 12.0 \times 13.0$                  | B32671L1412+***                             | 680                       | 1100              | 1000                 |

Further E series and intermediate capacitance values on request.

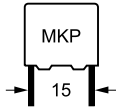
**Composition of ordering code**

+ = Capacitance tolerance code:

M =  $\pm 20\%$   
 K =  $\pm 10\%$   
 J =  $\pm 5\%$   
 A =  $\pm 3.5\%$   
 H =  $\pm 2.5\%$

\*\*\* = Packaging code:

289 = Ammo pack  
 189 = Reel  
 000 = Untaped (lead length 6 – 1 mm)


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

| $V_{rms}$<br>$f \leq 1$ kHz<br>VAC | $V_R$<br>VDC | $C_R$<br>nF | Max. dimensions<br>$w \times h \times l$<br>mm | Ordering code<br>(composition see<br>below) | Ammo<br>pack<br>pcs./unit | Reel<br>pcs./unit | Untaped<br>pcs./unit |
|------------------------------------|--------------|-------------|------------------------------------------------|---------------------------------------------|---------------------------|-------------------|----------------------|
| 600                                | 1600         | 6.2         | $5.0 \times 10.5 \times 18.0$                  | B32672L1622+***                             | 1170                      | 1300              | 1000                 |
|                                    |              | 6.8         | $5.0 \times 10.5 \times 18.0$                  | B32672L1682+***                             | 1170                      | 1300              | 1000                 |
|                                    |              | 8.2         | $6.0 \times 11.0 \times 18.0$                  | B32672L1822+***                             | 960                       | 1100              | 1000                 |
|                                    |              | 10          | $6.0 \times 11.0 \times 18.0$                  | B32672L1103+***                             | 960                       | 1100              | 1000                 |
|                                    |              | 12          | $6.0 \times 12.0 \times 18.0$                  | B32672L1123+***                             | 960                       | 1100              | 1000                 |
|                                    |              | 15          | $7.0 \times 12.5 \times 18.0$                  | B32672L1153+***                             | 830                       | 900               | 1000                 |
|                                    |              | 22          | $8.5 \times 14.5 \times 18.0$                  | B32672L1223+***                             | 680                       | 700               | 500                  |
|                                    |              | 33          | $9.0 \times 17.5 \times 18.0$                  | B32672L1333+***                             | 640                       | 700               | 500                  |
| 700                                | 2000         | 1.0         | $5.0 \times 10.5 \times 18.0$                  | B32672L8102+***                             | 1170                      | 1300              | 1000                 |
|                                    |              | 1.2         | $5.0 \times 10.5 \times 18.0$                  | B32672L8122+***                             | 1170                      | 1300              | 1000                 |
|                                    |              | 1.5         | $5.0 \times 10.5 \times 18.0$                  | B32672L8152+***                             | 1170                      | 1300              | 1000                 |
|                                    |              | 2.2         | $5.0 \times 10.5 \times 18.0$                  | B32672L8222+***                             | 1170                      | 1300              | 1000                 |
|                                    |              | 2.7         | $5.0 \times 10.5 \times 18.0$                  | B32672L8272+***                             | 1170                      | 1300              | 1000                 |
|                                    |              | 3.3         | $5.0 \times 10.5 \times 18.0$                  | B32672L8332+***                             | 1170                      | 1300              | 1000                 |
|                                    |              | 3.9         | $5.0 \times 10.5 \times 18.0$                  | B32672L8392+***                             | 1170                      | 1300              | 1000                 |
|                                    |              | 4.1         | $5.0 \times 10.5 \times 18.0$                  | B32672L8412+***                             | 1170                      | 1300              | 1000                 |
|                                    |              | 4.7         | $5.0 \times 10.5 \times 18.0$                  | B32672L8472+***                             | 1170                      | 1300              | 1000                 |
|                                    |              | 5.6         | $6.0 \times 11.0 \times 18.0$                  | B32672L8562+***                             | 960                       | 1100              | 1000                 |
|                                    |              | 6.2         | $6.0 \times 11.0 \times 18.0$                  | B32672L8622+***                             | 960                       | 1100              | 1000                 |
|                                    |              | 6.8         | $6.0 \times 11.0 \times 18.0$                  | B32672L8682+***                             | 960                       | 1100              | 1000                 |
|                                    |              | 8.2         | $6.0 \times 12.0 \times 18.0$                  | B32672L8822+***                             | 960                       | 1100              | 1000                 |
|                                    |              | 10          | $7.0 \times 12.5 \times 18.0$                  | B32672L8103+***                             | 830                       | 900               | 1000                 |
|                                    |              | 12          | $8.5 \times 14.5 \times 18.0$                  | B32672L8123+***                             | 680                       | 700               | 500                  |
|                                    |              | 15          | $8.5 \times 14.5 \times 18.0$                  | B32672L8153+***                             | 680                       | 700               | 500                  |
|                                    |              | 22          | $9.0 \times 17.5 \times 18.0$                  | B32672L8223+***                             | 640                       | 700               | 500                  |

Further E series and intermediate capacitance values on request.

**Composition of ordering code**

+ = Capacitance tolerance code:

M =  $\pm 20\%$

K =  $\pm 10\%$

J =  $\pm 5\%$

A =  $\pm 3.5\%$

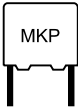
H =  $\pm 2.5\%$

\*\*\* = Packaging code:

289 = Ammo pack

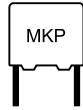
189 = Reel

000 = Untaped (lead length 6 – 1 mm)


**B32671 ... B32672**
**High VAC, high temperature (wound)**

## Technical data

|                                                                                                                       |                                                                                                                |                                                            |                                                                 |
|-----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|-----------------------------------------------------------------|
| Operating temperature range                                                                                           | Max. operating temperature T <sub>op,max</sub>                                                                 |                                                            | +125 °C                                                         |
|                                                                                                                       | Upper category temperature T <sub>max</sub>                                                                    |                                                            | +110 °C                                                         |
|                                                                                                                       | Lower category temperature T <sub>min</sub>                                                                    |                                                            | −55 °C                                                          |
|                                                                                                                       | Rated temperature T <sub>R</sub>                                                                               |                                                            | +85 °C                                                          |
| Dissipation factor tan δ (in 10 <sup>−3</sup> )<br>at 20 °C<br>(upper limit values)                                   | at                                                                                                             | Typical                                                    | Upper limit                                                     |
|                                                                                                                       | 10 kHz                                                                                                         | 0.3                                                        | 0.6                                                             |
|                                                                                                                       | 100 kHz                                                                                                        | 0.3                                                        | 1.0                                                             |
| Insulation resistance R <sub>ins</sub><br>at 20 °C, rel. humidity ≤ 65%<br>(minimum as-delivered values)              | > 100 GΩ                                                                                                       |                                                            |                                                                 |
| DC test voltage                                                                                                       | 1.6 · V <sub>R</sub> , 2 s                                                                                     |                                                            |                                                                 |
| Category voltage V <sub>C</sub><br>(continuous operation with V <sub>DC</sub><br>or V <sub>AC</sub> at f ≤ 1 kHz)     | T <sub>A</sub> (°C)                                                                                            | DC voltage derating                                        | AC voltage derating                                             |
|                                                                                                                       | T <sub>A</sub> ≤ 85                                                                                            | V <sub>C</sub> = V <sub>R</sub>                            | V <sub>C,rms</sub> = V <sub>rms</sub>                           |
|                                                                                                                       | 85<T <sub>A</sub> ≤110                                                                                         | V <sub>C</sub> = V <sub>R</sub> · (165−T <sub>A</sub> )/80 | V <sub>C,rms</sub> =V <sub>rms</sub> · (165−T <sub>A</sub> )/80 |
| Operating voltage V <sub>op</sub> for<br>short operating periods<br>(V <sub>DC</sub> or V <sub>AC</sub> at f ≤ 1 kHz) | T <sub>A</sub> (°C)                                                                                            | DC voltage (max. hours)                                    | AC voltage (max. hours)                                         |
|                                                                                                                       | T <sub>A</sub> ≤ 100                                                                                           | V <sub>op</sub> = 1.25 · V <sub>C</sub> (2000 h)           | V <sub>op</sub> = 1.0 · V <sub>C,rms</sub> (2000 h)             |
|                                                                                                                       | 100<T <sub>A</sub> ≤125                                                                                        | V <sub>op</sub> = 1.25 · V <sub>C</sub> (1000 h)           | V <sub>op</sub> = 1.0 · V <sub>C,rms</sub> (1000 h)             |
| Damp heat test                                                                                                        | 56 days/40 °C/93% relative humidity                                                                            |                                                            |                                                                 |
| Limit values after damp<br>heat test                                                                                  | Capacitance change  ΔC/C                                                                                       |                                                            | ≤ 2%                                                            |
|                                                                                                                       | Dissipation factor change Δ tan δ                                                                              |                                                            | ≤ 1.0 · 10 <sup>−3</sup> (at 1 kHz)                             |
|                                                                                                                       | Insulation resistance R <sub>ins</sub>                                                                         |                                                            | ≥ 50 GΩ                                                         |
| Reliability:                                                                                                          |                                                                                                                |                                                            |                                                                 |
| Failure rate λ                                                                                                        | 1 fit (≤ 1 · 10 <sup>−9</sup> /h) at 0.5 · V <sub>R</sub> , 40 °C                                              |                                                            |                                                                 |
| Service life t <sub>sL</sub>                                                                                          | 200 000 h at 1.0 · V <sub>R</sub> , 40 °C                                                                      |                                                            |                                                                 |
|                                                                                                                       | For conversion to other operating conditions and temperatures,<br>refer to chapter "Quality assurance", page . |                                                            |                                                                 |
| Failure criteria:                                                                                                     |                                                                                                                |                                                            |                                                                 |
| Total failure                                                                                                         | Short circuit or open circuit                                                                                  |                                                            |                                                                 |
| Failure due to variation<br>of parameters                                                                             | Capacitance change  ΔC/C                                                                                       |                                                            | > 10%                                                           |
|                                                                                                                       | Dissipation factor tan δ                                                                                       |                                                            | > 4 · upper limit values                                        |
|                                                                                                                       | Insulation resistance R <sub>ins</sub>                                                                         |                                                            | < 1500 MΩ                                                       |



### Pulse handling capability

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

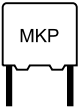
"k<sub>0</sub>" represents the maximum permissible pulse characteristic of the waveform applied to the capacitor, expressed in V<sup>2</sup>/ $\mu$ s.

Note:

The values of dV/dt and k<sub>0</sub> provided below must not be exceeded in order to avoid damaging the capacitor.

### dV/dt and k<sub>0</sub> values

| Lead spacing           | 10 mm               |                                            |                     |                                            | 15 mm               |                                            |                     |                                            |
|------------------------|---------------------|--------------------------------------------|---------------------|--------------------------------------------|---------------------|--------------------------------------------|---------------------|--------------------------------------------|
| Type                   | B32671              |                                            |                     |                                            | B32672              |                                            |                     |                                            |
| V <sub>rms</sub> (VAC) | 500                 |                                            | 600                 |                                            | 600                 |                                            | 700                 |                                            |
| V <sub>R</sub> (VDC)   | 1000                |                                            | 1600                |                                            | 1600                |                                            | 2000                |                                            |
| C <sub>R</sub><br>nF   | dV/dt<br>V/ $\mu$ s | k <sub>0</sub><br>V <sup>2</sup> / $\mu$ s | dV/dt<br>V/ $\mu$ s | k <sub>0</sub><br>V <sup>2</sup> / $\mu$ s | dV/dt<br>V/ $\mu$ s | k <sub>0</sub><br>V <sup>2</sup> / $\mu$ s | dV/dt<br>V/ $\mu$ s | k <sub>0</sub><br>V <sup>2</sup> / $\mu$ s |
| 1.0                    | —                   | —                                          | —                   | —                                          | —                   | —                                          | 6 500               | 10 000 000                                 |
| 1.2                    | —                   | —                                          | 6 000               | 14 400 000                                 | —                   | —                                          | 6 250               | 9 700 000                                  |
| 1.5                    | —                   | —                                          | 5 600               | 14 000 000                                 | —                   | —                                          | 6 000               | 9 500 000                                  |
| 2.2                    | —                   | —                                          | 5 200               | 13 800 000                                 | —                   | —                                          | 5 000               | 9 200 000                                  |
| 2.7                    | —                   | —                                          | 5 000               | 13 600 000                                 | —                   | —                                          | 4 750               | 9 000 000                                  |
| 3.3                    | 4 700               | 16 000 000                                 | 4 700               | 13 300 000                                 | —                   | —                                          | 4 500               | 8 900 000                                  |
| 3.9                    | 4 300               | 13 600 000                                 | 4 500               | 13 100 000                                 | —                   | —                                          | 4 000               | 8 300 000                                  |
| 4.1                    | 4 100               | 12 300 000                                 | 4 400               | 13 000 000                                 | —                   | —                                          | 3 800               | 8 000 000                                  |
| 4.7                    | 3 800               | 9 900 000                                  | —                   | —                                          | —                   | —                                          | 3 600               | 7 800 000                                  |
| 5.6                    | 3 400               | 8 400 000                                  | —                   | —                                          | —                   | —                                          | 3 300               | 7 400 000                                  |
| 6.2                    | 3 200               | 7 700 000                                  | —                   | —                                          | 3 600               | 18 600 000                                 | 3 100               | 7 200 000                                  |
| 6.8                    | 3 100               | 7 400 000                                  | —                   | —                                          | 3 500               | 17 400 000                                 | 3 000               | 7 000 000                                  |
| 8.2                    | 2 700               | 7 200 000                                  | —                   | —                                          | 3 100               | 15 400 000                                 | 2 800               | 6 700 000                                  |
| 10                     | 2 500               | 7 000 000                                  | —                   | —                                          | 2 800               | 13 800 000                                 | 2 600               | 6 300 000                                  |
| 12                     | 2 300               | 6 400 000                                  | —                   | —                                          | 2 600               | 12 600 000                                 | 2 400               | 6 000 000                                  |
| 15                     | —                   | —                                          | —                   | —                                          | 2 300               | 12 300 000                                 | 2 200               | 5 900 000                                  |
| 22                     | —                   | —                                          | —                   | —                                          | 2 000               | 11 800 000                                 | 1 900               | 5 300 000                                  |
| 33                     | —                   | —                                          | —                   | —                                          | 1 700               | 11 000 000                                 | —                   | —                                          |

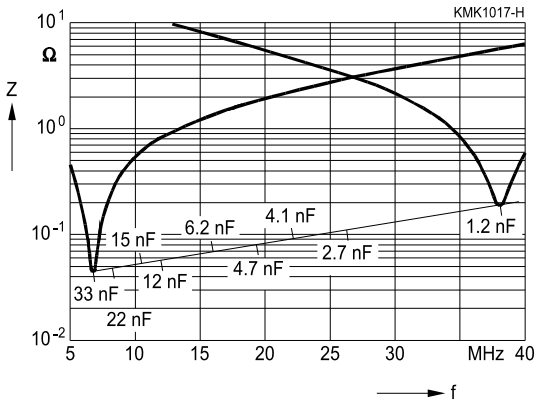


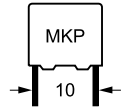
B32671 ... B32672

High VAC, high temperature (wound)

## Impedance $Z$ versus frequency $f$

(typical values)



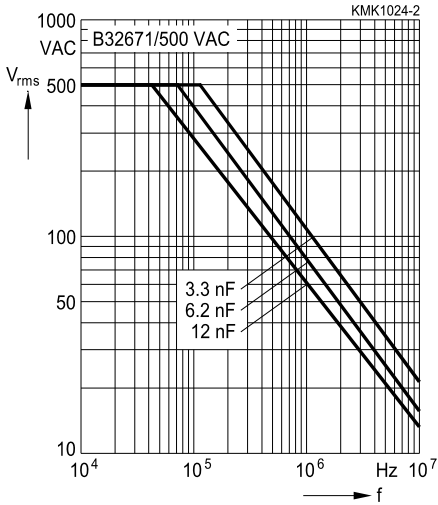


Permissible AC voltage  $V_{rms}$  versus frequency  $f$  (for sinusoidal waveforms  $T_A \leq 100\text{ °C}$ )

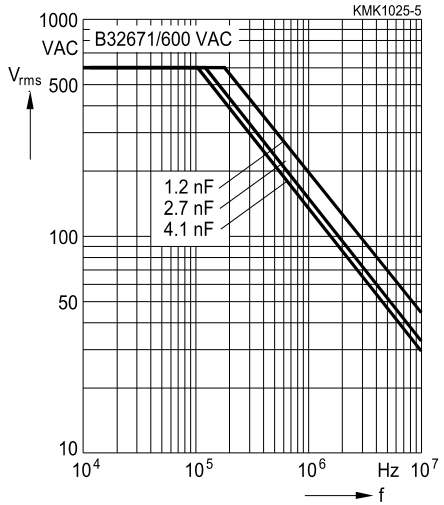
For  $T_A > 100\text{ °C}$ , please refer to "General technical information", section 3.2.3.

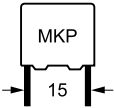
Lead spacing 10 mm

500 VAC/1000 VDC



600 VAC/1600 VDC





**B32672**

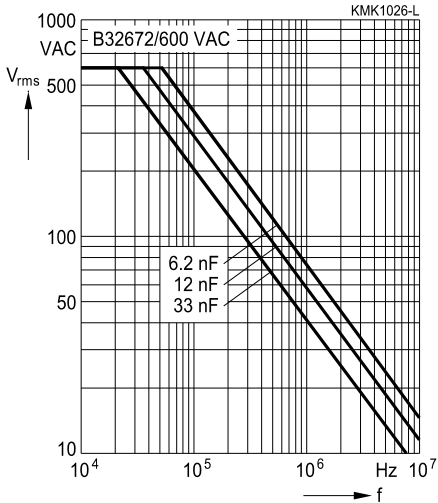
**High VAC, high temperature (wound)**

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

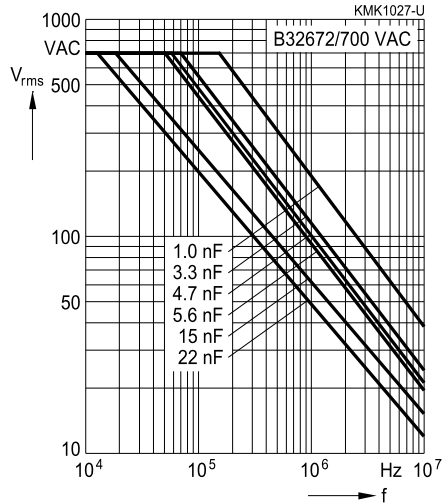
For  $T_A > 100^\circ\text{C}$ , please refer to "General technical information", section 3.2.3.

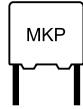
**Lead spacing 15 mm**

**600 VAC/1600 VDC**



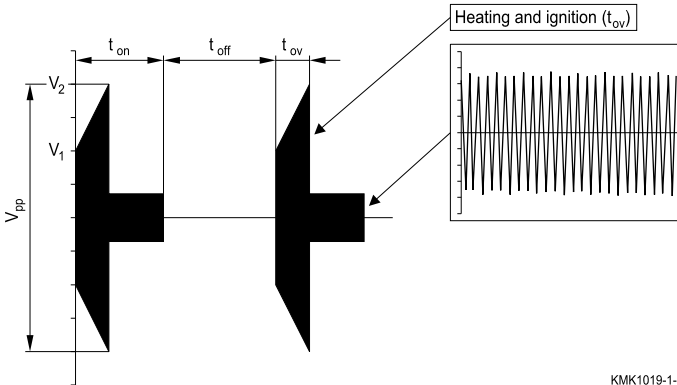
**700 VAC/2000 VDC**





### Operation at overvoltages during heating and ignition of lamps ( $T_A \leq 40^\circ\text{C}$ )

In lighting applications, the capacitors can be subjected to overvoltages during the heating and ignition periods. An overvoltage occurs when the operation voltage exceeds the permissible AC voltage at the resonant frequency  $f_r$ .



KMK1019-1-E

For a repetitive application of on/off switching pulses (as for example in the life tests applied by electronic ballast manufacturers), limits have to be imposed on the time periods under overvoltage and on the duty cycle, in order to keep the capacitance value within the required margins:

- The overvoltage time  $t_{OV}$  should be less than 1 sec.
- The maximum duty cycle of the overvoltage is given by

$$\frac{t_{OV}}{t_{on} + t_{off}} \leq \left( \frac{V_{rms}}{V_{rms,OV}} \right)^2 \cdot 0.5$$

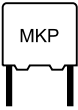
where  $V_{rms,OV}$  is the RMS voltage during period  $t_{OV}$ .

$$V_{rms,OV} = \sqrt{\frac{V_1^2 + V_1 \cdot V_2 + V_2^2}{6}}$$

and  $V_{rms}$  is the permissible AC voltage for continuous operation at the resonant frequency  $f_r$  (given by the "permissible AC voltage versus frequency  $f$ " graphics in the previous pages).

- The drift of capacitance depends on the  $V_{pp}$  attained, and the total time under overvoltage, which is calculated in hours as follows:  
 $(N_i \cdot t_{OV}) / 3600$   
 where  $N_i$  is the number of overvoltage impulses and  $t_{OV}$  is expressed in seconds.

The maximum drift of capacitance as a function of both parameters is provided graphically in the following pages.



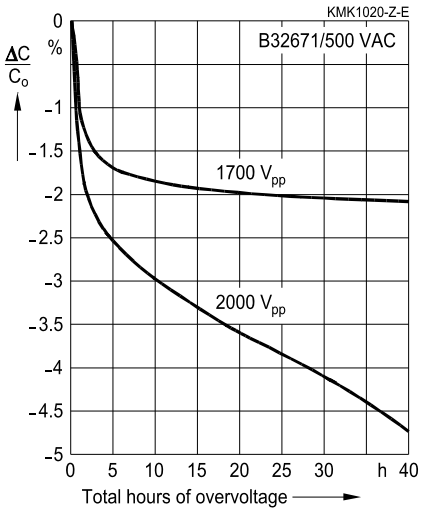
**B32671 ... B32672**

**High VAC, high temperature (wound)**

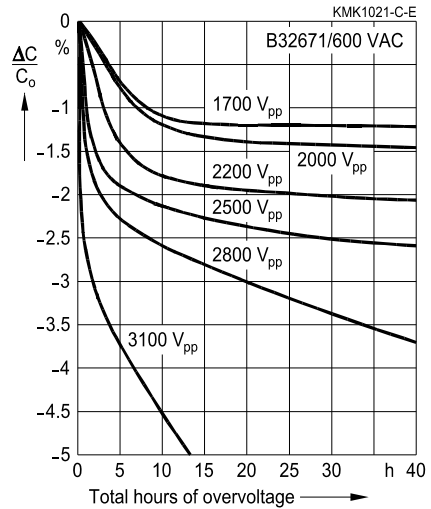
**Estimation of the maximum drift of capacitance value in function of the number of total hours overvoltage**

**Lead spacing 10 mm**

**500 VAC/1000 VDC**



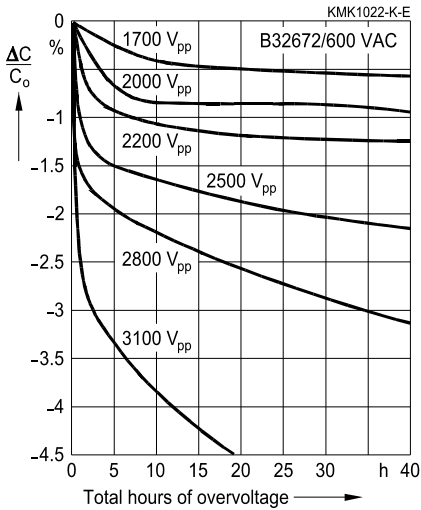
**600 VAC/1600 VDC**



Estimation of the maximum drift of capacitance value in function of the number of total hours overvoltage

Lead spacing 15 mm

600 VAC/1600 VDC



700 VAC/2000 VDC

