Film Capacitors - Power Electronic Capacitors

General purpose applications

Series/Type: FilterCap MKP AC – Single phase
Ordering code: B3236X Series
Date: 2019-08-14
Version: 06
## Construction and general data

<table>
<thead>
<tr>
<th><strong>General data</strong></th>
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<tr>
<td><strong>Dielectric</strong></td>
<td>Metallized polypropylene film</td>
</tr>
<tr>
<td><strong>Resin filling</strong></td>
<td>Non PCB, soft polyurethane</td>
</tr>
<tr>
<td><strong>Safety device</strong></td>
<td>Overpressure disconnector, self-healing technology</td>
</tr>
<tr>
<td><strong>Mounting and grounding</strong></td>
<td>Stud on bottom of aluminum can</td>
</tr>
<tr>
<td><strong>Cooling</strong></td>
<td>Naturally air-cooled (or forced air cooling)</td>
</tr>
<tr>
<td><strong>Degree of protection</strong></td>
<td>IP00</td>
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<tr>
<td><strong>Discharge resistor</strong></td>
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<td><strong>Reference standards</strong></td>
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<td>UL approval file: E106388</td>
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<tr>
<td><strong>Terminals</strong></td>
<td>B32361 (M6) and B32362 (M10) series: Screw terminals</td>
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**Figure 1:** Capacitor MKP-AC series B32361* and B32362*
**Film Capacitors - Power Electronic Capacitors**  
**B3236X Series**  
**General purpose applications**  
**FilterCap MKP AC – Single phase**

Not for new design

**Specifications and characteristics**
Rated capacitance $C_R$: 10 … 600 μF, tolerance: ±5%

<table>
<thead>
<tr>
<th>Voltage $V_{RMS}$ (line to line)</th>
<th>Rated AC voltage $V_R$ (line to line)</th>
<th>DC voltage $V_{RDC}$</th>
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<td>350</td>
<td>675</td>
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<td>330</td>
<td>460</td>
<td>900</td>
</tr>
<tr>
<td>480</td>
<td>680</td>
<td>1200</td>
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**Test data**
- Voltage between terminals $V_{TT}$: 2.15 $\cdot$ $V_{RMS}$, 2 s
- Voltage between terminals and Case $V_{TC}$: 4000 V AC, 10 s
- Dissipation factor tan $\delta$ at 100Hz: $\leq$1.0 $\cdot$ 10$^{-3}$
- Life test: According to IEC 61071
- Life expectancy*: 100000 hours for $V_{RMS}$, $|\Delta C/C| \leq$3%

**Climatic category 40/70/21**
- Storage temperature: $T_{stg}$: $-40 \ldots +85$ °C
- Minimum temperature: $T_{min}$: $-40$ °C
- Maximum operation ambient temperature: $T_{max}$: $+70$ °C
- Maximum temperature allowed at the capacitors hot spot: $T_{ths}$: $+85$ °C
- Max. permissible humidity: 95% (test = 21 days)
- Max. permissible altitude: 2000 m above sea level

**Mechanical characteristics**
- Terminal cross section: Screw terminals - B32361 (M6): 25 mm$^2$  
  Screw terminals - B32362 (M10) series: 78 mm$^2$
- Max. torque (case): M12: 12 Nm
- Max. torque (for screw terminal): M6: 4 Nm (B32361 series)  
  M10: 10 Nm (B32362 series)

* Note that this life expectancy occurs for the worst case with a maximum temperature hot-spot of $+85$° Celsius degree. For other operation temperatures please check the life time curve for further details.

**$T_{stg}$ – Storage temperature.**

**$T_{min}$ – Minimum temperature.**

**$T_{max}$ – Maximum operation ambient temperature.**

**$T_{ths}$ – Maximum temperature allowed at the capacitors hot spot.**
Considering mounting position with terminals to the top. For other mounting positions, please request evaluation.
Film Capacitors - Power Electronic Capacitors  

B3236X Series  

General purpose applications  

FilterCap MKP AC – Single phase  

Not for new design  

<table>
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<th>Design data</th>
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<td>Dimensions (D x H)</td>
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<td>Weight approx.</td>
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<tr>
<td>Max. terminal current</td>
<td>M6: 25 A (B32361) M10: 50 A (B32362)</td>
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Design data  

Electrical characteristics: Clearance and creepage distances  

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<th>Diameter</th>
<th>Terminal to terminal</th>
<th>Terminal to case</th>
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<td></td>
<td>mm</td>
<td>Min. clearance Mm</td>
<td>Min. creepage mm</td>
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<td>34</td>
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<td>B32362</td>
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<td>25</td>
<td>55</td>
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<tr>
<td>B32362</td>
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<td>25</td>
<td>63</td>
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Film Capacitors - Power Electronic Capacitors B3236X Series

General purpose applications

FilterCap MKP AC – Single phase

Not for new design

Capacitor catalog number (type or series designation)

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<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
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</table>

A. Indicates termination type
1 = M6 (2 x) screw terminals
2 = M10 (2 x) screw terminals

B. Indicates revision status (any letter), in case of S letter it means customized design

C. Indicates first number of voltage $V_{RMS}$ value (any digit)

D. Indicates first and second figure of capacitance value (any two digits)

E. Indicates exponent used as multiplier (any digit)

F. Indicates capacitor tolerance for PEC AC capacitor
$J = \pm 5\%$; $K = \pm 10\%$

G. Indicates coded capacitance value

H. Indicates second number of voltage $V_{RMS}$ value (any digit)

I. Indicates Accessories (any digit)

Label information

Date code explanation

WW Z YYYY: production weeks (e.g.: 45)
WW Z YYYY: produced in Zhuhai (China)
WW Z YYYY: production year (e.g.: 2018)

Bar code explanation

Bar code consists of batch number and serial number.

Batch number: 9 digits (e.g.: 123456789)
Serial number: 2 or 3 digits (e.g.: 01 or 001)

Note: the voltage values in the label have to be understood as for $U_{RAC}/U_{RMS}$ the value shows is the $U_{RMS}$ ($V_{RMS}$) voltage and in $U_{RDC}/U_{N}$ the value shows is the $U_{RDC}$ ($V_{RDC}$) voltage.
Film Capacitors - Power Electronic Capacitors
B3236X Series
General purpose applications FilterCap MKP AC – Single phase

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Dimensional drawings

Figure 2: Series B32361
(D = 75 mm)

Figure 3: Series B32362

Before Safety Device operation
After Safety Device operation

Max. 12 mm
19±1
12±1
3±0.5
1±0.5

35±1

DIN 6797
DIN 934

Before Safety Device operation
After Safety Device operation

Max. 12 mm
32±1
13±0.5
16±0.5

DIN 6797
DIN 934

63.5±0.5

75±0.5

M6

M10

M12

M12
Figure 4: Series B32362 (D = 85 mm)
Installation space requirements

1) A minimum distance of 20 mm between the capacitors is necessary to maintain sufficient cooling.

2) Keep at least 20 mm space above the capacitor and do not attach any mounting components at the crimp or on top. This gap will allow a longitudinal extension of the can in order to ensure that the over-pressure disconnector can fully extend.

Figure 5: Installation space requirements
### Technical data of standard products

#### B32361 series – M6 screw terminals

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<th>Rs mΩ</th>
<th>L&lt;sub&gt;self&lt;/sub&gt; nH</th>
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### Display of ordering codes for TDK Electronics products

The ordering code for one and the same product can be represented differently in data sheets, data books, other publications, on the company website, 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.tdk-electronics.tdk.com/orderingcodes](http://www.tdk-electronics.tdk.com/orderingcodes).

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|           | 80    | B32362A4806J080 | 50 | 1350 | 7.1 | 1.6 | 180 | 75 | 147 | 0.9 | 12 |
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|           | 150   | B32362A4157J080 | 50 | 2850 | 8.6 | 1.9 | 200 | 85 | 197 | 1.3 | 12 |
|           | 200   | B32362A4207J080 | 50 | 2850 | 8.5 | 2.3 | 230 | 85 | 247 | 1.7 | 12 |
|           | 250   | B32362A4257J080 | 50 | 3200 | 9.6 | 2.3 | 240 | 85 | 267 | 1.8 | 12 |
Film Capacitors - Power Electronic Capacitors B3236X Series

General purpose applications FilterCap MKP AC – Single phase

Not for new design

Terms

Design
The winding element of the MKP capacitor consists of metallized polypropylene film. This winding construction achieves low losses and a high pulse-current withstand capability. Soft PU resin is used for impregnation of the capacitor.

Contacting
The end faces of the windings are contacted by metal spraying to ensure a reliable and low-inductance connection between the leads and layers. The leads are welded or soldered to these end faces, brought out through insulating elements (plastic) and soldered to the terminals.

Impregnation
All hollows between the windings and between the windings and the case are filled with an impregnating agent. Besides increasing dielectric strength, this improves heat dissipation from inside a capacitor. The impregnating agents that we use are free of PCB and halogens.

Self-healing
All MKP capacitors are self-healing, i.e. voltage breakdowns heal in a matter of microseconds and hence do not produce a short circuit.

Breakdowns can occur under heavy electrical load as a result of weaknesses or pores in the dielectric. The integrity of self-healing capacitors is not affected by such breakdowns.

1. Dielectric (Polypropylene)
2. Metallization
3. Material-displacing shock wave
4. Air gap with metal vapor
5,6. Plasma zone
7. Boundary layer between gas-phase dielectric and plasma zones
8. Puncture channel
9. Gas-phase dielectric
10. Zone of displaced metallization and dielectric

Figure 6: Description of Self-healing technology
When a breakdown occurs, the dielectric in a breakdown channel is broken down into its atomic components by the electric arc that forms between the electrodes. At the high temperatures of as much as 6000 K, a plasma is created that explodes out of the channel region and pushes the dielectric layers apart. The actual self-healing process starts with the continuation of the electric arc in the propagating plasma. Here the metal layers are removed from the metal edges by evaporation. Insulation areas are formed. The rapid expansion of the plasma beyond the areas of insulation and its cooling in the areas of less field strength allow the discharge to extinguish after a few microseconds.

The area of insulation that is created is highly resistive and voltage-proof for all operating requirements of the capacitor. The self-healing breakdown is limited in current and so it does not represent a short circuit. The self-healing process is so brief and low in energy that the capacitor also remains fully functional during the breakdown.

**Characteristics**

**Equivalent circuit diagram**

Any real capacitor can be modelled by the following schematic:

![Equivalent circuit diagram](image)

**Figure 7:** Equivalent circuit diagram

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$L_s$</td>
<td>series inductance</td>
<td>H</td>
</tr>
<tr>
<td>$R_s$</td>
<td>series resistance, due to contacts (leads, sprayed metal and film metallization)</td>
<td>Ω</td>
</tr>
<tr>
<td>$R_p$</td>
<td>parallel resistance, due to insulation resistance</td>
<td>Ω</td>
</tr>
<tr>
<td>$C$</td>
<td>capacitance</td>
<td>F</td>
</tr>
</tbody>
</table>

$C$, $R_s$ and $L_s$ are magnitudes that vary in the frequency domain (AC). $R_p$ is a magnitude defined in DC (insulation resistance).

**Rated capacitance $C_R$**

It is referred to a test temperature of +20 °C and a measuring frequency range of 50 Hz to 1 kHz.

**Capacitance tolerance range**

It is the range within which the actual capacitance may differ from rated capacitance. The actual capacitance is to be measured at a temperature of +20 °C. This range results from variances in materials and manufacturing processes. The standard manufacturing tolerance for PP film capacitors is ±10% or ‘K’ tolerance or ±5%, ‘J’ tolerance.
Temperature dependence of capacitance

The capacitance variation in the permissible temperature range is not linear, but it is reversible, the characteristic change in capacitance $\Delta C/C$ as a function of test temperature is shown as follows:

![Figure 8: Temperature dependence of capacitance](chart)

Capacitance drift

Capacitance is subject to irreversible in addition to reversible changes, i.e. capacitance drift, the sum of all time-dependent, irreversible changes of capacitance during operating life. This variation is stated in percent of the value at delivery. The typical figure is $+1/-3\%$.

Rated AC voltage $V_R$

The maximum operating peak recurrent voltage of either polarity of a reversing type waveform for which the capacitor has been designed. Unlike what is common in other standard (e.g. B32304* 3–phase capacitor series for PFC application) therefore, the rated voltage $V_R$ is not the RMS value, but the maximum or peak value of the capacitor voltage. The voltage at which the capacitor may be operated is dependent on other factors (especially current and frequency) besides rated voltage.

Voltage $V_{RMS}$

It is the Root Mean Square (RMS) voltage of maximum permissible value of sinusoidal AC voltage in continuous operation.

![Figure 9: Voltage $V_{RMS}$](chart)
Not for new design

**Rated DC voltage** $V_{RDC}$

It is the maximum operating peak voltage of either polarity but of non-reversing type waveform, for which the capacitor has been designed, for continuous operation.

**Non-recurrent surge voltage** $V_S$

A peak voltage induced by a switching or any other disturbance of the system which is allowed for a limited number of times and for durations shorter than the basic period.

![Figure 10: Non-recurrent surge voltage $V_S$](image)

Maximum duration: 50 ms/pulse
Maximum number of occurrences: 1000 (during load)

**Max. Recurrent peak voltage** $\hat{u}$

This is the permissible, max. Recurrent peak voltage that may appear for max. 1% of the period.

![Figure 11: Max. Recurrent peak voltage $\hat{u}$](image)

**Symmetric alternating voltage** $\hat{u}_{ac}$

The peak values of a symmetrical alternating voltage applied to the capacitor is a decisive factor for the dielectric losses.

\[ \hat{u}_{ac} = V_R \]

**Insulation voltage** $V_i$

It is the rms rated value of the insulation voltage of capacitive elements and terminals to case or earth.

If not specified, the rms value of the insulating voltage is equivalent to the rated voltage divided by $\sqrt{2}$.

**Maximum current** $I_{max}$

It is the maximum rms current for continuous operation, but could not be higher than maximum terminal current. A higher current than proposal $I_{max}$ value could be possible in lower ambient temperature.

CAP PW PD 2019-08-14
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Maximum peak current $I_p$

It is the maximum current amplitude which occurs instantaneously during continuous operation. The maximum peak current and the maximum rate of voltage rise $(dV/dt)_{max}$ on a capacitor are related as follows:

$$I_p = C_R \cdot \left(\frac{dV}{dt}\right)_{max}$$

Maximum surge current $I_s$

It is the peak non-repetitive current induced by switching or any other disturbance of the system permitted for a limited number of times, at durations shorter than the basic period.

$$I_s = C_R \cdot \left(\frac{dV}{dt}\right)_s$$

Maximum duration: 50 ms/pulse
Maximum number of occurrences: 1000 (during load)

Self-inductance $L_{self}$

The self-inductance is produced by the inductance of the terminals and the windings. Because of the special kind of contacting in self-healing capacitors (large area metal spraying covering all windings), the self-inductance is particularly low. It allows the resonance frequency to be determined:

$$f = \frac{1}{2\pi \sqrt{L_{self} \cdot C_R}}$$

The resonance frequency is high for all capacitors accordingly.

Insulation Resistance ($R_{ins}$)

The dielectric of a capacitor has a large area and a short length. Even if the material is a good isolator there always flows a certain current between the charged electrodes (the current increases exponentially with the temperature). This leakage can be described as a parallel resistance with a high value, an Insulation Resistance.

![Insulation Resistance (R_{ins})](image)

Figure 12: Insulation Resistance ($R_{ins}$)
Insulation resistance and self-discharge time constant

The insulation values for the individual components according to the capacitance are stated as an insulation resistance $R_{\text{ins}}$ in MΩ or a self-discharge time constant $\tau$ in seconds.

$$\tau = R_{\text{ins}} \cdot C_R$$

Series resistance $R_S$

Resistive losses occur in the electrodes in the contacting and in the inner wiring. These are comprised in the series resistance $R_S$ of a capacitor.

The series resistance $R_S$ generates the ohmic losses ($I^2 \times R_S$) in a capacitor. It is largely independent of frequency. The figures stated in selection charts apply to $+20°C$ capacitor temperature.

Dissipation factor $\tan \delta$

The equivalent circuit diagram used for the losses in a capacitor can be shown as follows:

![Simplified equivalent circuit diagram of a capacitor](image)

The self-inductance and capacitance of a capacitor produce its resonance frequency (natural frequency).

$$\tan \delta(f) = \tan \delta_0 + R_S \cdot \omega \cdot C$$

From the frequency dependence of the equivalent series resistance can be derived:

$$\text{ESR} = \frac{\tan \delta}{\omega \cdot C} = R_S + \frac{\tan \delta_0}{\omega \cdot C}$$

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C$</td>
<td>Capacitor</td>
<td>F</td>
</tr>
<tr>
<td>$L_{\text{self}}$</td>
<td>Self-inductance</td>
<td>H</td>
</tr>
<tr>
<td>ESR</td>
<td>Equivalent series resistance, representing the entire active power in capacitor</td>
<td>Ω</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\tan \delta$</td>
<td>Dissipation factor of capacitor</td>
<td>-</td>
</tr>
<tr>
<td>$\tan \delta_0$</td>
<td>Dissipation factor of dielectric</td>
<td>-</td>
</tr>
<tr>
<td>$R_S$</td>
<td>Series resistance</td>
<td>Ω</td>
</tr>
</tbody>
</table>
Dielectric dissipation factor tan δ₀

The dissipation factor tan δ₀ of the dielectric is assumed to be constant for all capacitors in their frequency range of use. The figures stated in data sheets apply to rated operation.

Expected Fit rate λ

The FIT (Failure In Time) of a component is defined as the number of expected failures in $10^9$ hours of operation.

The FIT rate is calculated on the basis of the number of components operating in the field and the estimated hours of operation. All the reports of failures are taken into consideration for this calculation, which is updated every year. The other values in the graph are given as indication and calculated based on acceleration factors.

The failure criterion is capacitance drop higher than 3%.

**Figure 14:** Expected Fit rate λ

Thermal design

In order to scale a capacitor correctly for a particular application, the permissible ambient temperature has to be determined. This can be taken from the diagram “Permissible ambient temperature TA vs total power dissipation P” after calculating the power dissipation (for further details please check individual data sheets).
Calculation of power dissipation $P$

The total power dissipation $P$ is composed of the dielectric losses ($P_D$) and the resistive losses ($P_R$):

$$P = P_D + P_R$$

$$P_D = \hat{u}_{ac}^2 \cdot \frac{\pi}{f_0} \cdot C \cdot \tan \delta_0$$

$$P_R = I^2 \cdot R_S$$

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\hat{u}_{ac}$</td>
<td>Peak value of symmetrical AC voltage applied to capacitor</td>
<td>V</td>
</tr>
<tr>
<td>$f_0$</td>
<td>Fundamental frequency</td>
<td>Hz</td>
</tr>
<tr>
<td>$C$</td>
<td>Capacitance</td>
<td>F</td>
</tr>
<tr>
<td>$\tan \delta_0$</td>
<td>Dissipation factor of dielectric</td>
<td></td>
</tr>
</tbody>
</table>

The $R_S$ figure at maximum hot-spot temperature is used to calculate the resistive losses. In selection charts and data sheets the figure is stated for $20^\circ C$ capacitor temperature. The conversion factor is as follows:

$$R_{S85^\circ} = 1.25 \cdot R_{S20^\circ}$$

Thermal resistance $R_{th}$

The thermal resistance is defined as the ratio of a temperature difference and the power dissipation produced in a capacitor. The decisive factor here is $\Delta T_{cap}$ where the temperature difference between an external reference point of the coolant (e.g. air) surrounding the capacitor and the hot spot (zone with highest temperature occurring in the component). In a steady state:

$$R_{th} = \frac{\Delta T_{cap}}{P}$$

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{th}$</td>
<td>Thermal resistance</td>
<td>K/W</td>
</tr>
<tr>
<td>$\Delta T_{cap}$</td>
<td>Temperature difference between hot-spot and ambient</td>
<td>K</td>
</tr>
<tr>
<td>$P$</td>
<td>Power dissipation</td>
<td>W</td>
</tr>
</tbody>
</table>
The temperature difference depends on a large number of different factors. The thermal resistance is a function of several parameters such as the working temperature and the power dissipation of the capacitor.

After installation of the capacitor, it is necessary to verify that maximum hot-spot temperature is not exceeded at extreme service conditions. For detail calculations, please refer to single datasheet part number for further details.

**Life expectancy \( t_{LD} \)**

The life expectancy \( t_{LD} \) is based on the exclusive effect of Voltage and Temperature (hot-spot \( T_{hs} \)) applied to the capacitor dielectric and electrodes (other factors are not considered in the model such as environmental or mechanical effects).

Hot Spot Temperature (\( T_{hs} \)): as the sum of ambient temperature plus the heating induced by the current (\( I_{RMS} \)) in the dielectric which is measured inside of capacitor. Current is an indirect parameter under consideration which affects the temperature \( T_{hs} \).

Lifetime estimation formula as follows:

\[
t_2 = t_1 \cdot e^{(T_1 - T_2)/A} \left(\frac{V_1}{V_2}\right)^n
\]

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t_2 )</td>
<td>Estimated lifetime at temperature ( T_2 ) and Voltage ( V_2 )</td>
<td>hour</td>
</tr>
<tr>
<td>( t_1 )</td>
<td>Reference life expectancy (e.g. 100,000 hours for ( V_R ) (</td>
<td>\Delta C/C</td>
</tr>
<tr>
<td>( V_2 )</td>
<td>Variable Voltage (Rated AC voltage)</td>
<td>VAC</td>
</tr>
<tr>
<td>( V_1 )</td>
<td>Reference Voltage (Rated AC voltage)</td>
<td>VAC</td>
</tr>
<tr>
<td>( T_1 )</td>
<td>Reference temperature (e.g. 70°C)</td>
<td>°C</td>
</tr>
<tr>
<td>( T_2 )</td>
<td>Variable temperature</td>
<td>°C</td>
</tr>
<tr>
<td>( A )</td>
<td>Acceleration factor of temperature</td>
<td>-</td>
</tr>
<tr>
<td>( n )</td>
<td>Acceleration factor of voltage</td>
<td>-</td>
</tr>
</tbody>
</table>
Lifetime Expectancy Graphs

The lifetime estimations below shows the standard expected lifetime of 100,000 hours (at +85 °C hot-spot) are only theoretical calculations based on endurance test results performed according to IEC61071 standard.

**Figure 15:** Service life $t_{LD}$ at different hot-spot temperature ($T_{hs}$) and voltage $V_{RMS}$
Cautions and warnings
- Capacitors with dents of more than 1 mm depth or any other mechanical damage must not be used.
- Check the tightness of the connections / terminals periodically.
- The energy stored in capacitors may be lethal. To prevent any risk of shock, the capacitors must be discharged and short-circuited before handling.
- Failure to follow cautions may result in the worst case in premature failure, bursting and fire.

Safety
- Electrical or mechanical misapplication of capacitors may be hazardous. Personal injury or property damage may result from bursting of the capacitor or expulsion of molten material due to mechanical disruption of the capacitor.
- Ensure good, effective grounding for capacitor enclosures.
- Observe appropriate safety precautions during operation (self-recharging phenomena and the high energy stored in capacitors).
- Handle capacitors carefully, as they may still be charged even after disconnection.
- The terminals of capacitors, connected busbars and cables as well as other devices may also be energized.
- Follow good engineering practice.
- The maximum permissible fault current (AFC) of 10 kA in accordance with the UL 810 standard must be assured by the application.

Thermal load
- After installing the capacitor, verify that the maximum hot-spot temperature is not exceeded under extreme operating conditions.

Mechanical protection
- The capacitor has to be installed to assure that no mechanical damage or dents in the case occur.

Storage and operating conditions
- Do not use or store capacitors in corrosive atmospheres, especially where chloride gas, sulfide gas, acid, alkali, salt or the like are present. In dusty environments, regular maintenance and cleaning, especially of the terminals, is required to avoid creating a conductive path between phases and/or phases and ground.

Overpressure disconnector
- To ensure full functionality of an overpressure safety disconnector, the following points must be observed:
  1. The elastic elements must not be hindered, i.e.
     - Connecting lines must be flexible leads (cables)
     - There must be sufficient space (min.15 mm) for expansion above the connections
     - The metal cover must not be retained by rigid parts such as busbars.
  2. The stress parameters of the capacitor must be within the IEC 61071 specification.

Service life expectancy
- Electrical components do not have an unlimited service life expectancy: this also applies to self-healing capacitors. The maximum service life expectancy may vary depending on the application in which the capacitor is used.
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 we are 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 a 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 life-saving 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.**

4. In order to satisfy certain technical requirements, **some of the products described in this publication may contain substances subject to restrictions in certain jurisdictions (e.g. because they are classed as hazardous).** Useful information on this will be found in our Material Data Sheets on the Internet (www.tdk-electronics.tdk.com/material). Should you have any more detailed questions, please contact our sales offices.

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6. Unless otherwise agreed in individual contracts, **all orders are subject to our General Terms and Conditions of Supply.**

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