



## Film Capacitors – AC Capacitors

### Metallized Polypropylene Film Capacitors (MKP)

**Series/Type:** B32354S  
**Ordering code:** B32354S3\*

**Date:** January 2019  
**Version:** 1

**Typical applications**

- Output AC filtering for power converters, UPS, motor drives

**Climatic**

- Max. operating temperature: +85 °C
- Climatic category (IEC 60068-1:2013): 40/085/21

**Construction**

- Dielectric: polypropylene (PP)
- Electrode: metallized segmented film
- Dry type capacitor
- Plastic case (UL 94 V-0)
- Epoxy resin sealing (UL 94 V-0)


**Features**

- Humidity protected: +85°C / 85% rel. humidity (RH) at 350 V<sub>RMS</sub> for 1000 hour
- THB Grade III Test B
- (Refer to IEC60384-14:2013/AMD1:2016)
- Optimized AC voltage performance
- High ripple current/frequency handling capability
- Highest safety level 10 000 AFC to UL 810<sup>1)</sup>
- For PCB mounting

**Terminals**

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

**Marking/Approval**

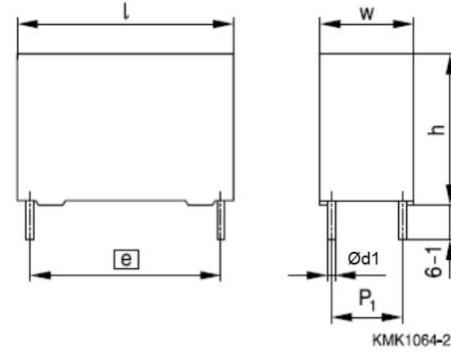
- See picture
- CE compliance to LV directive 2014/35/EU
- UL File E238746<sup>1)</sup>

**Delivery mode**

- Bulk (untapped, lead length 6-1mm)

**Dimension drawing**

4-pin version


**Dimensions (in mm)**

| Version | Lead space<br>(e±0.4) | Lead<br>diameter<br>d1±0.05 | Type    |
|---------|-----------------------|-----------------------------|---------|
| 4 pins  | 52.5                  | 1.2                         | B32354S |

1) Certification ongoing and pending acc. to UL 810: Ed. 5

**Voltage ratings**

|           |          |
|-----------|----------|
| $V_{NDC}$ | 500 V DC |
| $V_{NAC}$ | 480 V AC |
| $V_{RMS}$ | 350 V AC |

Note:  $V_{NAC}$  is maximum operating peak recurrent voltage of either polarity of a reversing type waveform, not an r.m.s value.

**Overview available types**

|                  |         |
|------------------|---------|
| Lead spacing     | 52.5 mm |
| Type             | B32354S |
| $V_{NDC}$ (V DC) | 500     |
| $V_{RMS}$ (V AC) | 350     |
| $C_R$ ( $\mu$ F) |         |
| 10               |         |
| 15               |         |
| 20               |         |
| 22               |         |
| 25               |         |
| 30               |         |
| 35               |         |
| 40               |         |

**Ordering codes and packing units (lead spacing 52.5 mm)**

| $V_{RMS}$<br>V AC | $V_{NDC}$<br>V DC | $C_R$<br>$\mu F$ | Ordering code   | Max. dimensions<br>w x h x l<br>mm | P1<br>mm | $I_{max\ RMS}^{1)}$<br>85 °C hot spot<br>80 °C case<br>10kHz<br>A | $I_{peak}$<br>A | ESR<br>(Typical)<br>10kHz<br>mΩ | Packing<br>units<br>pcs |
|-------------------|-------------------|------------------|-----------------|------------------------------------|----------|---|-----------------|---------------------------------|-------------------------|
| 350               | 500               | 10               | B32354S3106K010 | 28.0 x 35.0 x 57.5                 | 20.3     | 7   | 300             | 20                              | 33                      |
|                   |                   | 15               | B32354S3156K010 | 35.0 x 45.0 x 57.5                 | 20.3     | 11  | 450             | 14                              | 27                      |
|                   |                   | 20               | B32354S3206K010 | 35.0 x 45.0 x 57.5                 | 20.3     | 11  | 600             | 12                              | 27                      |
|                   |                   | 22               | B32354S3226K010 | 35.0 x 45.0 x 57.5                 | 20.3     | 11  | 600             | 12                              | 27                      |
|                   |                   | 25               | B32354S3256K010 | 40.0 x 50.0 x 57.5                 | 20.3     | 14  | 700             | 12                              | 24                      |
|                   |                   | 30               | B32354S3306K010 | 40.0 x 50.0 x 57.5                 | 20.3     | 14  | 900             | 10                              | 24                      |
|                   |                   | 35               | B32354S3356K010 | 50.0 x 55.0 x 57.5                 | 20.3     | 17  | 1000            | 10                              | 18                      |
|                   |                   | 40               | B32354S3406K010 | 50.0 x 55.0 x 57.5                 | 20.3     | 17  | 1100            | 9                               | 18                      |

**Technical data**

Reference standard: IEC 61071:2007, all data given at  $T = +20^\circ\text{C}$  unless otherwise specified.

|   |  |
|---|--|
| Upper category temperature $T_{\max}$   | +85 °C   |
| Rated temperature $T_R$   | +85 °C   |
| Lower category temperature $T_{\min}$   | -40 °C   |
| Dissipation factor $\tan \delta$ (in $10^{-3}$ ) at $+20^\circ\text{C}$ and 1 kHz (upper limit values)  | 1.2  |
| Insulation resistance $R_{\text{ins}}$ after 1 min, given as time constant<br>$\tau = C_R \cdot R_{\text{ins}}$ ,<br>(Minimum as-delivered values with rel. humidity $\leq 65\%$ )<br>Measuring voltage: 100VDC | 10000s   |
| AC testing voltage between terminals  | $1.65 \cdot V_{\text{NAC}}$ for 2 s  |
| Testing voltage between terminal to case  | 2000 V AC at 50/60 Hz, 60 s (typical test)   |
| Maximum peak current (A)  | $I_{P,\max} = C_R \cdot dv/dt$   |
| THB to high robustness under high humidity, refer to IEC 60384-14:2013/AMD1:2016 Grade III Test B   | Temperature $T: +85^\circ\text{C} \pm 2^\circ\text{C}$<br>Relative humidity: 85% $\pm 2\%$<br>Applied voltage: $V_{\text{RMS}}(50/60 \text{ Hz})$<br>Test duration: 1000 hrs   |
| Criteria for passing THB test   | Capacitance change $ \Delta C/C_0  \leq 10\%$<br>Dissipation factor change $\Delta \tan \delta(1 \text{ kHz}) \leq 0.005$<br>Insulation resistance $R_{\text{ins}} \geq 50\%$ specified limit  |
| Change of temperature   | In accordance with IEC 60068-2-14:2009 (Test Nb)   |
| Reliability:<br>Failure rate $\lambda$<br>Service life $t_{SL}$   | 5 fit ( $\leq 5 \times 10^{-9}/\text{h}$ ) at $0.5 \cdot V_{\text{RMS}}, +40^\circ\text{C}$<br>$\geq 100,000 \text{ h}$ at $V_{\text{RMS}}(50/60 \text{ Hz})$<br>For conversion to other operating conditions, refer to chapter "Quality, 2 Reliability"         |
| Failure criteria<br>Total failure<br>Failure due to variation of parameters   | Short circuit or open circuit<br>Capacitance change $ \Delta C/C_0  \geq 10\%$<br>Dissipation factor $\Delta \tan \delta > 4$ upper limit values<br>Insulation resistance $R_{\text{ins}}$<br>or time constant $\tau = C_R \cdot R_{\text{ins}} < 500 \text{ s}$ |

### Pulse handling capability

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

#### Note:

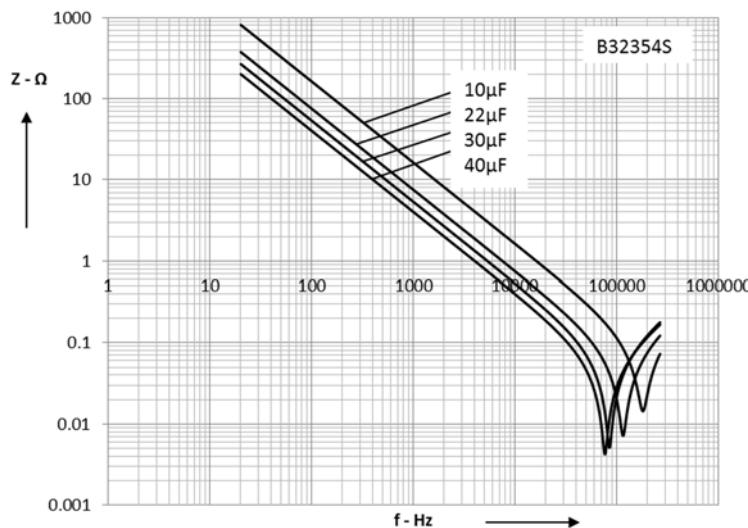
The values of dV/dt and k0 provided below must not be exceeded in order to avoid damaging the capacitor. These parameters are given for isolated pulses in such a way that the heat generated by one pulse will be completely dissipated before applying the next pulse. For a train of pulses, please refer to the curves of permissible AC voltage-current versus frequency

#### dV/dt values

|                   |                   |               |
|-------------------|-------------------|---------------|
| Lead spacing      |                   | 52.5 mm       |
| $V_{RMS}$<br>V AC | $V_{NDC}$<br>V DC | dV/dt in V/μs |
| 350               | 500               | 30            |

### Impedance Z versus frequency f

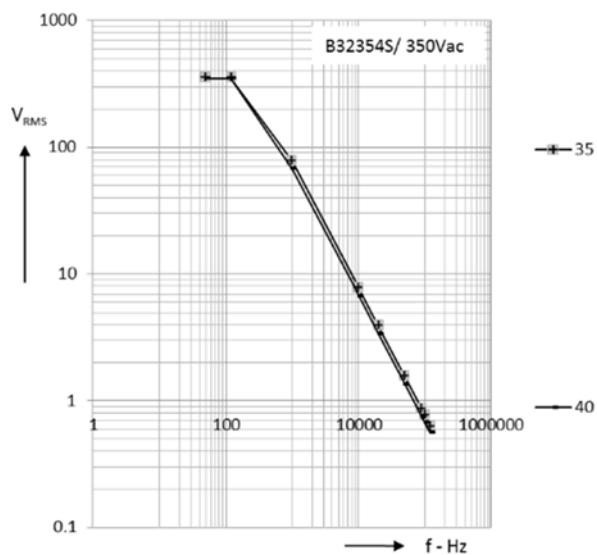
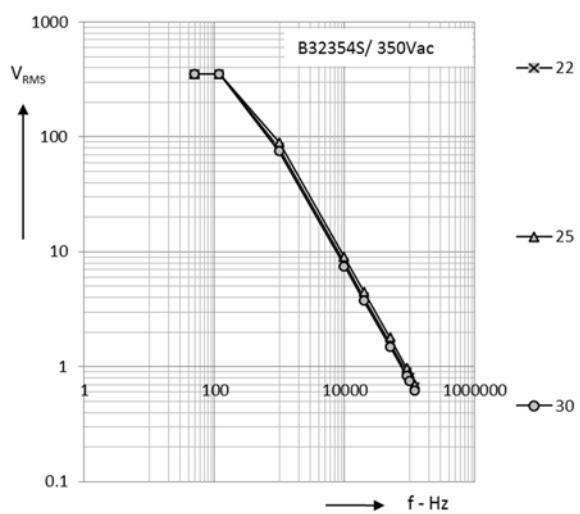
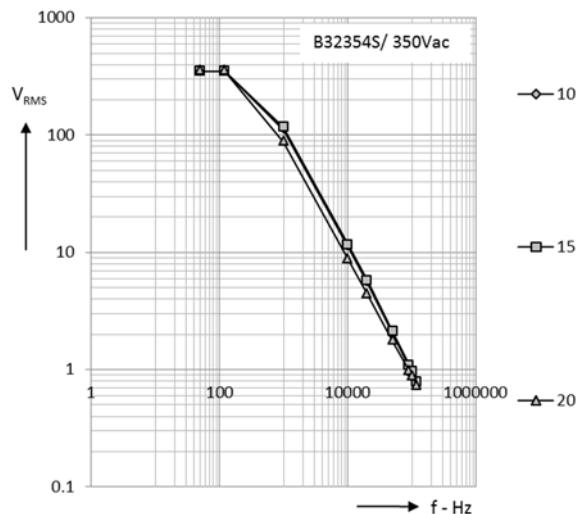
(typical values)



**Permissible AC voltage  $V_{RMS}$  versus frequency  $f$  (for sinusoidal waveforms,  $T_{case} \leq +80^{\circ}\text{C}$ )**

For  $T_{case} > +80^{\circ}\text{C}$ , please refer to de-rating factor  $F_T$ .

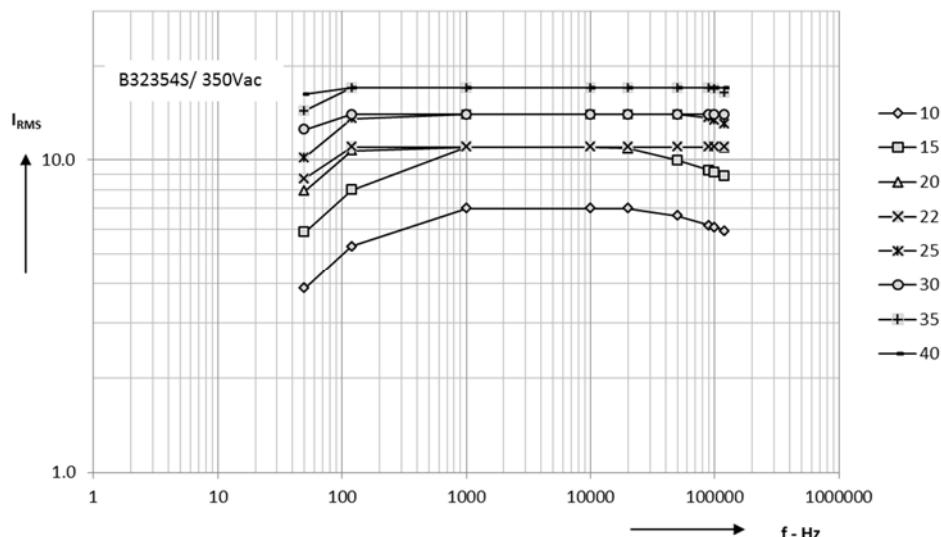
**Lead spacing 52.5 mm**



**Permissible current  $I_{RMS}$  versus frequency  $f$  (for sinusoidal waveforms,  $T_{case} \leq +80^{\circ}C$ )**

For  $T_{case} > +80^{\circ}C$ , please refer to de-rating curve.

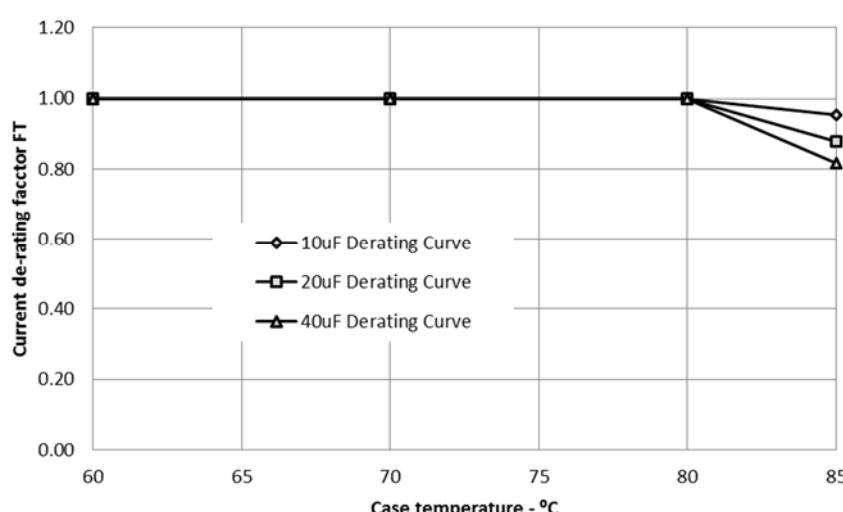
**Lead spacing 52.5 mm**


**Maximum AC current ( $I_{RMS}$ ) vs. temperature for  $T_{case} > +80^{\circ}C$** 

The graphs described in the previous section for the permissible AC voltage ( $V_{RMS}$ ) or current ( $I_{RMS}$ ) vs. frequency ( $f > 50/60$  Hz) are given for a maximum case temperature  $T_{case} \leq +80^{\circ}C$ . In case of higher capacitor surface temperatures ( $T_{case}$ ), to avoid the temperature of the hottest spot above maximum operating temperature, the de-rating factor  $F_T$  shall be applied in the following way:

$$I_{RMS}(T_{case}) = I_{RMS,T_{case} \leq 80^{\circ}C} * F_T(T_{case})$$

And  $F_T$  is given by the following curve:



**Typical test**

| Test description   | Reference                   | Test conditions  | Performance requirements  |         |               |                               |                      |      |                                |                      |      |               |         |               |                               |                      |      |                                |                      |      |                         |
|--|-----------------------------|--|---|---------|---------------|-------------------------------|----------------------|------|--------------------------------|----------------------|------|---------------|---------|---------------|-------------------------------|----------------------|------|--------------------------------|----------------------|------|-------------------------|
| Electricity parameters   | IEC 61071: 2007             | Voltage between terminals: 1.5 V <sub>NAC</sub> , 60 s;<br>Terminals and enclosure: 2000 V AC, 60 s;<br>Insulation resistance R <sub>INS</sub><br>Capacitance C <sub>R</sub><br>Dissipation factor tanδ  | Within specified limits<br>No visible damage<br>No flashover  |         |               |                               |                      |      |                                |                      |      |               |         |               |                               |                      |      |                                |                      |      |                         |
| 1 – Robustness of terminations                                       | IEC 60068-2-21:2006         | <p>Tensile strength (test V<sub>a1</sub>)</p> <table border="1"> <thead> <tr> <th>Wire diameter</th> <th>Section</th> <th>Tensile force</th> </tr> </thead> <tbody> <tr> <td>0.5 &lt; d<sub>1</sub> ≤ 0.8 mm</td> <td>≤ 0.5 m<sup>2</sup></td> <td>10 N</td> </tr> <tr> <td>0.8 &lt; d<sub>1</sub> ≤ 1.25 mm</td> <td>≤ 1.2 m<sup>2</sup></td> <td>20 N</td> </tr> </tbody> </table> <p>Duration 10 s +/-1 s</p> <p>Bending V<sub>b</sub> method 1</p> <table border="1"> <thead> <tr> <th>Wire diameter</th> <th>Section</th> <th>Tensile force</th> </tr> </thead> <tbody> <tr> <td>0.5 &lt; d<sub>1</sub> ≤ 0.8 mm</td> <td>≤ 0.5 m<sup>2</sup></td> <td>10 N</td> </tr> <tr> <td>0.8 &lt; d<sub>1</sub> ≤ 1.25 mm</td> <td>≤ 1.2 m<sup>2</sup></td> <td>20 N</td> </tr> </tbody> </table> <p>4 • 90 °C, Duration 2 s to 3 s/bend</p> | Wire diameter   | Section | Tensile force | 0.5 < d <sub>1</sub> ≤ 0.8 mm | ≤ 0.5 m <sup>2</sup> | 10 N | 0.8 < d <sub>1</sub> ≤ 1.25 mm | ≤ 1.2 m <sup>2</sup> | 20 N | Wire diameter | Section | Tensile force | 0.5 < d <sub>1</sub> ≤ 0.8 mm | ≤ 0.5 m <sup>2</sup> | 10 N | 0.8 < d <sub>1</sub> ≤ 1.25 mm | ≤ 1.2 m <sup>2</sup> | 20 N | Within specified limits |
| Wire diameter  | Section                     | Tensile force  |   |         |               |                               |                      |      |                                |                      |      |               |         |               |                               |                      |      |                                |                      |      |                         |
| 0.5 < d <sub>1</sub> ≤ 0.8 mm  | ≤ 0.5 m <sup>2</sup>        | 10 N   |   |         |               |                               |                      |      |                                |                      |      |               |         |               |                               |                      |      |                                |                      |      |                         |
| 0.8 < d <sub>1</sub> ≤ 1.25 mm                                       | ≤ 1.2 m <sup>2</sup>        | 20 N   |   |         |               |                               |                      |      |                                |                      |      |               |         |               |                               |                      |      |                                |                      |      |                         |
| Wire diameter  | Section                     | Tensile force  |   |         |               |                               |                      |      |                                |                      |      |               |         |               |                               |                      |      |                                |                      |      |                         |
| 0.5 < d <sub>1</sub> ≤ 0.8 mm  | ≤ 0.5 m <sup>2</sup>        | 10 N   |   |         |               |                               |                      |      |                                |                      |      |               |         |               |                               |                      |      |                                |                      |      |                         |
| 0.8 < d <sub>1</sub> ≤ 1.25 mm                                       | ≤ 1.2 m <sup>2</sup>        | 20 N   |   |         |               |                               |                      |      |                                |                      |      |               |         |               |                               |                      |      |                                |                      |      |                         |
| 2 – Resistance to soldering heat                                     | IEC 60068-2-20:2008         | Solder bath temperature at 260 ± 5 °C, immersion for 10 seconds  | ΔC/C <sub>0</sub> I ≤ 0.5%<br>Increase of tanδ (10 kHz) ≤ 0.005 compared to initial value                         |         |               |                               |                      |      |                                |                      |      |               |         |               |                               |                      |      |                                |                      |      |                         |
| 3 - Vibration  | IEC 60068-2-6:2007          | 10 Hz to 55 Hz<br>Amplitude ± 0.35mm or acceleration 98 m/s <sup>2</sup><br>Test duration: 10 frequency cycles, 3 axes offset from each other by 90°<br>1 octave/min<br>Visual examination   | No visible damage   |         |               |                               |                      |      |                                |                      |      |               |         |               |                               |                      |      |                                |                      |      |                         |
| 4 – Shocks or impact   | IEC 60068-2-6:2007          | Pulse shape: half sine<br>Acceleration: 490 m/s <sup>2</sup><br>Duration of pulse: 11 ms<br>Visual examination   | No visible damage<br>ΔC/C <sub>0</sub> I ≤ 0.5%<br>Increase of tanδ (10kHz)≤0.005 compared to initial value       |         |               |                               |                      |      |                                |                      |      |               |         |               |                               |                      |      |                                |                      |      |                         |
| 5 – THB test (Grade III Test B, high robustness under high humidity) | IEC 60384-14:2013/AMD1:2016 | 85 °C/85% relative humidity/V <sub>RMS</sub> /1000 h   | No visible damage<br>ΔC/C <sub>0</sub> I ≤ 10%<br>Δtanδ (1 kHz) ≤ 0.005<br>R <sub>INS</sub> ≥ 50% specified limit |         |               |                               |                      |      |                                |                      |      |               |         |               |                               |                      |      |                                |                      |      |                         |

|   |                 |   |   |
|---|-----------------|---|---|
| 6 – Surge test  | IEC 61071: 2007 | 1.1 • $V_{NDC}$ or $\hat{I}_{test} = 1.1 \hat{I}_{max}$<br>Number of discharges: 5<br>Time lapse: every 2 min (10 min total)<br>Within 5 min after the surge discharge test<br>Duration 10 s, $1.5 \bullet V_{NAC}$ at $T_{amb}$ .  | No visible damage<br>$ \Delta C/C_0  \leq 1.0\%$<br>$\tan\delta (10 \text{ kHz}) \leq 1.2$<br>initial $\tan\delta + 0.0001$   |
| 9- Self-healing                                       | IEC 61071: 2007 | 1.5 • $V_{NAC}$<br>Duration 10 s<br>Number of clearings $\leq 5$<br>Increase the voltage at 100 V/s till 5 clearings occur<br>with a max. of $2.5 \bullet V_{NAC}$ for a duration of 10 s   | $ \Delta C/C_0  \leq 0.5\%$<br>$\tan\delta (10 \text{ kHz}) \leq 1.2$<br>initial $\tan\delta + 0.0001$  |
| 10 – Environmental                                    | IEC 61071: 2007 | Change of temperature acc. to IEC 60068-2-14<br>Test $N_b$<br>$T_{max} = +105 \text{ }^{\circ}\text{C}$<br>$T_{min.} = -40 \text{ }^{\circ}\text{C}$<br>Transition time: 1 h, equivalent to $1 \text{ }^{\circ}\text{C}/\text{min}$<br>5 cycles<br>Damp heat steady state acc. to IEC 60068-2-78<br>Test $C_a$<br>$T = 40 \text{ }^{\circ}\text{C} \pm 2 \text{ }^{\circ}\text{C}$<br>$RH = 93\% \pm 3 \%$<br>Duration 56 days<br>High voltage between terminal:<br>$1.5 \bullet V_{NDC}$ at ambient temperature<br>Duration 10 s | No puncturing or flashover<br>Self-healing punctures permitted<br>$ \Delta C/C_0  \leq 2\%$<br>Increase of $\tan\delta (10 \text{ kHz}) \leq 0.015$                     |
| 11 – Thermal stability test under overload conditions | IEC 61071: 2007 | Natural cooling $T_{amb} \pm 5 \text{ }^{\circ}\text{C}$<br>$1.21 \bullet P_{max.} = (U_2/2) \bullet W_2 \bullet C \bullet \tan\delta = 1.21 \bullet (I_{2max.}/W_2 \bullet C) \bullet \tan\delta_2$<br>$W_2 = 2 \times \pi \bullet f_2$<br>Imax. (see specific reference data)<br>$f_2 = 10 \text{ kHz}$<br>$\tan\delta_2 = \tan\delta$ at $10 \text{ kHz}$<br>Duration 48 h<br>Measure the temperature every 1.5 h during the last 6 h  | Temperature rise $< 1^{\circ}\text{C}$<br>$ \Delta C/C_0  \leq 2\%$<br>Increase of $\tan\delta (10 \text{ kHz}) \leq 1.2$ initial $\tan\delta (10 \text{ kHz}) + 0.015$ |

|                                      |                 |   |  |
|--------------------------------------|-----------------|---|--|
| 12 – Endurance test between terminal | IEC 61071: 2007 | Sequence 1.25 • $V_{RMS}$ at $T_{case} = 85^\circ\text{C}$<br>Duration 500 h<br>1000 x discharge cycles at $1.4 \cdot I$ (maximum repetitive peak current in continuous operation)<br>1.25 • $V_{RMS}$ at $T_{case} = 85^\circ\text{C}$<br>Duration 500 h | $ \Delta C/C_0  \leq 3\%$<br>Increase of $\tan\delta$ (10kHz) $\leq 0.015$ compared to initial value |
|--------------------------------------|-----------------|---|--|

## Mounting guidelines

### 1. Soldering

#### 1.1 Solderability of leads

The solderability of terminal leads is tested to IEC 60068-2-20:2008, test Ta, method 1.

Before a solderability test is carried out, terminals are subjected to accelerated ageing (to IEC 60068-2-2:2007, test Ba: 4 h exposure to dry heat at  $155^\circ\text{C}$ ). Since the ageing temperature is far higher than the upper category temperature of the capacitors, the terminal wires should be cut off from the capacitor before the ageing procedure to prevent the solderability being impaired by the products of any capacitor decomposition that might occur.

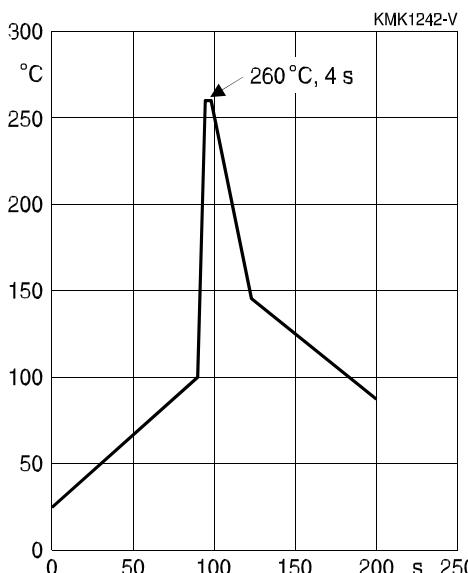
|                         |   |
|-------------------------|---|
| Solder bath temperature | $235 \pm 5^\circ\text{C}$   |
| Soldering time          | $2.0 \pm 0.5\text{ s}$  |
| Immersion depth         | $2.0 +0/-0.5\text{ mm}$ from capacitor body or seating plane            |
| Evaluation criteria:    |   |
| Visual inspection       | Wetting of wire surface by new solder $\geq 90\%$ , free-flowing solder |

#### 1.2 Resistance to soldering heat

Resistance to soldering heat is tested to IEC 60068-2-20:2008, test Tb, method 1A.

Conditions:

| Series  | Solder bath temperature   | Soldering time   |
|---|---------------------------|--|
| MKT boxed (except $2.5 \times 6.5 \times 7.2\text{ mm}$ )<br>coated,<br>uncoated (lead spacing $> 10\text{ mm}$ ) | $260 \pm 5^\circ\text{C}$ | $10 \pm 1\text{ s}$  |
| MFP   |                           |  |
| MKP (lead spacing $> 7.5\text{ mm}$ )   |                           |  |
| MKT boxed (case $2.5 \times 6.5 \times 7.2\text{ mm}$ )   |                           | $5 \pm 1\text{ s}$   |
| MKP (lead spacing $\leq 7.5\text{ mm}$ )  |                           | $< 4\text{ s}$   |
| MKT uncoated (lead spacing $\leq 10\text{ mm}$ )<br>insulated (B32559)  |                           | recommended soldering profile for<br>MKT uncoated (lead spacing $\leq 10\text{ mm}$ ) and insulated (B32559) |



|                      |   |
|----------------------|---|
| Immersion depth      | 2.0 +0/-0.5 mm from capacitor body or seating plane                               |
| Shield               | Heat-absorbing board, 1.5 ±0.5 mm thick, between capacitor body and liquid solder |
| Evaluation criteria: |   |
| Visual inspection    | No visible damage   |
| $\Delta C/C_0$       | 2% for MKT/MKP/MFP<br>5% for EMI suppression capacitors                           |
| $\tan \delta$        | As specified in sectional specification   |

### 1.3 General notes on soldering

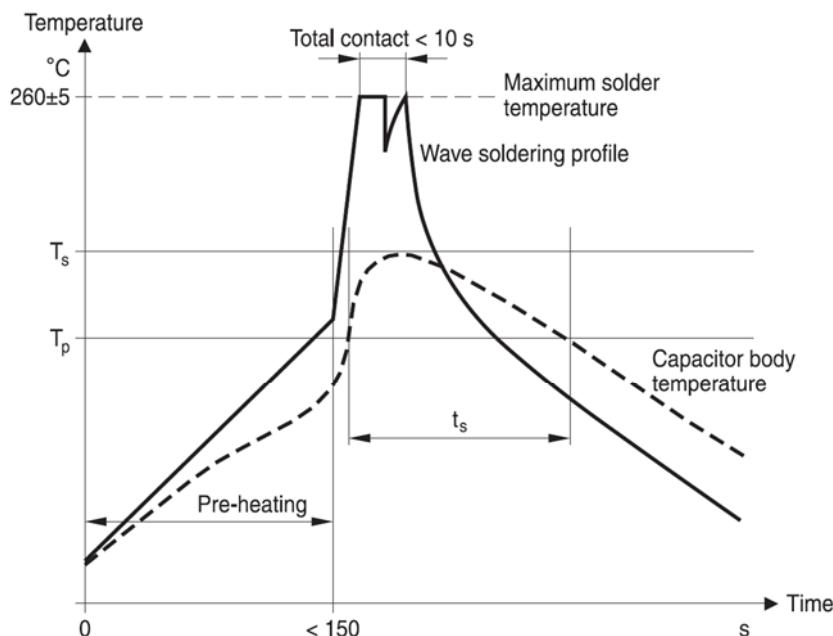
Permissible heat exposure loads on film capacitors are primarily characterized by the upper category temperature  $T_{max}$ . Long exposure to temperatures above this type-related temperature limit can lead to changes in the plastic dielectric and thus change irreversibly a capacitor's electrical characteristics. For short exposures (as in practical soldering processes) the heat load (and thus the possible effects on a capacitor) will also depend on other factors like:

- Pre-heating temperature and time
- Forced cooling immediately after soldering Terminal characteristics:
- diameter, length, thermal resistance, special configurations (e.g. crimping) Height of capacitor above solder bath
- Shadowing by neighboring components
- Additional heating due to heat dissipation by neighboring components Use of solder-resist coatings

The overheating associated with some of these factors can usually be reduced by suitable countermeasures. For example, if a pre-heating step can't be avoided, an additional or reinforced cooling process may possibly have to be included.

### Recommends

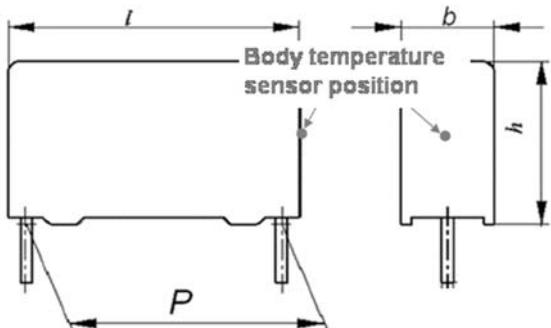
As a reference, the recommended wave soldering profile for our film capacitors is as follows:



$T_s$ : Capacitor body maximum temperature at wave soldering

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

KMK1745-A-E



Body temperature should follow the description below:

■ MKP capacitor:

During pre-heating:  $T_p \leq 110 \text{ }^\circ\text{C}$

During soldering:  $T_s \leq 120 \text{ }^\circ\text{C}$ ,  $t_s \leq 45 \text{ s}$

■ MKT capacitor:

During preheating:  $T_p \leq 125 \text{ }^\circ\text{C}$

During soldering:  $T_s \leq 160 \text{ }^\circ\text{C}$ ,  $t_s \leq 45 \text{ s}$

When SMD components are used together with leaded ones, the film capacitors should not pass into the SMD adhesive curing oven. The leaded components should be assembled after the SMD curing step.

Leaded film capacitors are not suitable for reflow soldering.

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

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

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

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

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

**Cautions and warnings**

- Do not exceed the upper category temperature (UCT).
- Do not apply any mechanical stress to the capacitor terminals.
- Avoid any compressive, tensile or flexural stress.
- Do not move the capacitor after it has been soldered to the PC board. Do not pick up the PC board by the soldered capacitor.
- Do not place the capacitor on a PC board whose PTH hole spacing differs from the specified lead spacing.
- Do not exceed the specified time or temperature limits during soldering. Avoid external energy inputs, such as fire or electricity.
- Avoid overload of the capacitors.
- Component is non-serviceable/non-repairable.

The table below summarizes the safety instructions that must always be observed. A detailed description can be found in the relevant sections of the chapters "General technical information" and "Mounting guidelines".

| Topic                   | Safety information  | Reference chapter "General technical information" |
|-------------------------|---|---|
| Storage conditions      | Make sure that capacitors are stored within the specified range of time, temperature and humidity conditions.   | 4.5<br>"Storage conditions"                       |
| Flammability            | Avoid external energy, such as fire or electricity (passive flammability), avoid overload of the capacitors (active flammability) and consider the flammability of materials.   | 5.3<br>"Flammability"                             |
| Resistance to vibration | Do not exceed the tested ability to withstand vibration. The capacitors are tested to IEC 60068-2-6.<br><br>We offer film capacitors specially designed for operation under more severe vibration regimes such as those found in automotive applications. Consult our catalog "Film Capacitors for Automotive Electronics". | 5.2<br>"Resistance to vibration"                  |

| Topic  | Safety information  | Reference chapter "Mounting guidelines"            |
|--|---|--|
| Soldering                                      | Do not exceed the specified time or temperature limits during soldering.  | 1 "Soldering"                                      |
| Cleaning                                       | Use only suitable solvents for cleaning capacitors.   | 2 "Cleaning"                                       |
| Embedding of capacitors in finished assemblies | When embedding finished circuit assemblies in plastic resins, chemical and thermal influences must be taken into account.<br>Caution: Consult us first, if you also wish to embed other uncoated component types! | 3 "Embedding of capacitors in finished assemblies" |

### Display of ordering codes for 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).

## Important notes

The following applies to all products named in this publication:

1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application**. As a rule 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](http://www.tdk-electronics.tdk.com/material)). Should you have any more detailed questions, please contact our sales offices.
5. We constantly strive to improve our products. Consequently, **the products described in this publication may change from time to time**. The same is true of the corresponding product specifications. Please check therefore to what extent product descriptions and specifications contained in this publication are still applicable before or when you place an order.

We also **reserve the right to discontinue production and delivery of products**. Consequently, we cannot guarantee that all products named in this publication will always be available. The aforementioned does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.

6. Unless otherwise agreed in individual contracts, **all orders are subject to our General Terms and Conditions of Supply**.
7. **Our manufacturing sites serving the automotive business apply the IATF 16949 standard**. The IATF certifications confirm our compliance with requirements regarding the quality management system in the automotive industry. Referring to customer requirements and customer specific requirements ("CSR") TDK always has and will continue to have the policy of respecting individual agreements. Even if IATF 16949 may appear to support the acceptance of unilateral requirements, we hereby like to emphasize that **only requirements mutually agreed upon can and will be implemented in our Quality Management System**. For clarification purposes we like to point out that obligations from IATF 16949 shall only become legally binding if individually agreed upon.

## Important notes

8. The trade names EPCOS, CeraCharge, CeraDiode, CeraLink, CeraPad, CeraPlas, CSMP, CTVS, DeltaCap, DigiSiMic, ExoCore, FilterCap, FormFit, LeaXield, MiniBlue, MiniCell, MKD, MKK, MotorCap, PCC, PhaseCap, PhaseCube, PhaseMod, PhiCap, PowerHap, PQSine, PQvar, SIFERRIT, SIFI, SIKOREL, SilverCap, SIMDAD, SiMic, SIMID, SineFormer, SIOV, ThermoFuse, WindCap are **trademarks registered or pending** in Europe and in other countries. Further information will be found on the Internet at [www.tdk-electronics.tdk.com/trademarks](http://www.tdk-electronics.tdk.com/trademarks).

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