



AC Film Capacitors

Installation and maintenance instruction manual for AC film capacitors

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I. Read this first

	<p>Read the following installation and maintenance instructions carefully before installing the AC capacitor into your application.</p> <p>The information stated in this manual applies to typical approved usage. Please refer to our product specifications as well as this product manual or request our approval for your own individual specifications, before installing a capacitor.</p>
	<p>Disregarding the guidelines in this manual could result in operational failure, bursting and fire. In case of doubt, contact your local EPCOS sales organization or distributor for assistance.</p>
<p>General safety notes for handling, installation and operation</p>	<p>Warnings - the equipment covered in this publication shall be used for specific applications and shall be installed, operated and maintained by qualified personnel, who are thoroughly trained and have profound understanding of all possible involved hazards.</p> <p>This manual has been written for such qualified personnel exclusively and is not intended to be a substitute for adequate training in safety procedures for this type of equipment.</p> <ul style="list-style-type: none"> ▪ These safety instructions are intended for all work on all AC film capacitors. ▪ All electrical installation and maintenance work on the AC film capacitors should be carried out by qualified electricians. Neglecting basic rules can cause physical injuries and death. ▪ Do not attempt to work on a powered AC film capacitor and handle the capacitor units carefully, as they may remain charged even after disconnection. ▪ Also, consider that the capacitor terminals, connected bus bars and cables as well as any other devices connected to them may be charged. The entire device will be electrically charged!
<p>Storage conditions</p>	<p>All capacitors covered by this document can be stored at any temperature within the permissible temperature category, i.e. -25°C to +85°C, temperature range for up to 2 years.</p> <p>For long storage periods, however, the following conditions should be observed:</p> <ul style="list-style-type: none"> ▪ Storage temperature -40°C to +40°C. ▪ Maximum relative humidity 80%, condensation shall be avoided. ▪ Maximum duration 5 years. <p>Do not use or store capacitors in an explosive atmosphere, especially where chloride gas, sulfide gas, acids, alkalis, salt or any other potentially ignitable substances are present. In a dusty environment, regular maintenance and cleaning – especially of the terminals – is required to avoid a conductive path forming between phases and/or phases and ground.</p>

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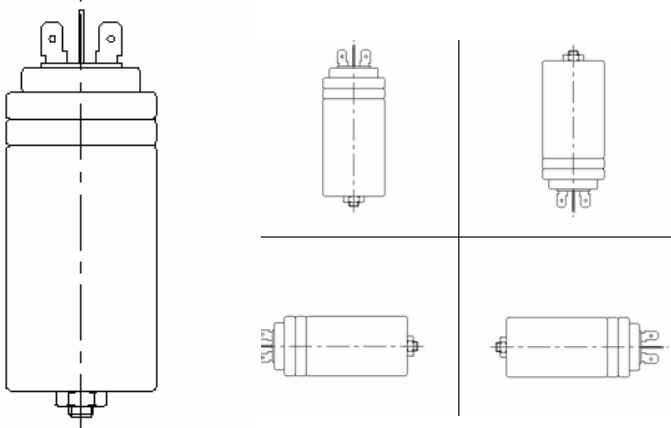
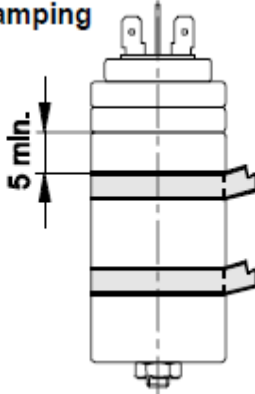
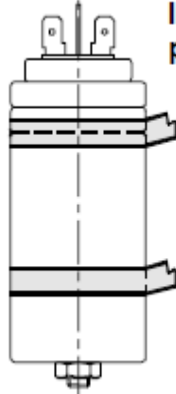
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<p>Operating conditions</p>	<p>Ambient temperature</p> <p>The capacitor shall not be allowed to overheat. The minimum and maximum permissible surrounding temperatures are specified on the capacitor as follows:</p> <p>25/70/21 = minimum permissible temperature: $-25\text{ }^{\circ}\text{C}$, maximum permissible temperature: $+70\text{ }^{\circ}\text{C}$.</p> <p>25/85/21 = minimum permissible temperature: $-25\text{ }^{\circ}\text{C}$, maximum permissible temperature: $+85\text{ }^{\circ}\text{C}$.</p> <p>40/85/21 = minimum permissible temperature: $-40\text{ }^{\circ}\text{C}$, maximum permissible temperature: $+85\text{ }^{\circ}\text{C}$.</p> <p>25/100/21 = minimum permissible temperature: $-25\text{ }^{\circ}\text{C}$, maximum permissible temperature: $+100\text{ }^{\circ}\text{C}$.</p> <p>Other classes apply in analogy to the above.</p> <p>Temperature is one of the main stress factors for polypropylene type capacitors. It has a major influence on their useful life expectancy. Please note that the useful life is considerably shorter at higher temperatures.</p>
	<p>Exceeding the maximum allowed storage or operating temperature may render the safety device inoperable.</p>

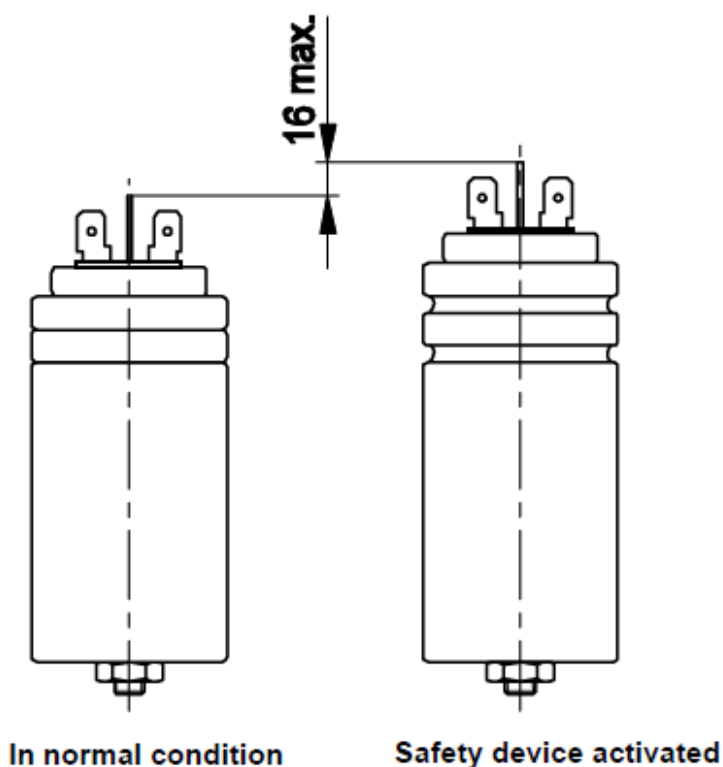
II. Products covered

Categories	Series	Product picture
Aluminum case, round	MotorCap™ B32330 - B33335	
Plastic case, round	MotorCap™ B3231x – B3235x	
Plastic case, box	B32354S	

III. Installation




<p>Mounting orientation</p>	<p>AC capacitors may be mounted in any orientation. However, the capacitor is preferentially mounted with its terminals facing upwards.</p>
	<p>In case of dents on the body deeper than 0.5 mm, do not install the capacitor.</p>
	<div style="text-align: center;">  <p>Preferential orientation</p> </div>
<p>Fixation</p>	<p>AC capacitors shall be installed in a cool and well-ventilated place away from objects radiating heat.</p> <p>The maximum torque of capacitors with an M8 bolt is 5 Nm. This bolt is used for grounding the aluminum case.</p> <p>If the capacitor is fixed with a clamp, make sure this does not block or disable its safety device.</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p>Correct clamping procedure</p>  <p>5 mm.</p> </div> <div style="text-align: center;"> <p>Incorrect clamping procedure</p>  </div> </div>

If the capacitor is fitted with an overpressure safety device (i.e. B32330 – B33335), keep a gap of at least 16 mm above the capacitor free and do not attach any mounting component at the crimp or on the top. This gap will allow the overpressure disconnecter to operate properly thanks to the longitudinal extension of the can.



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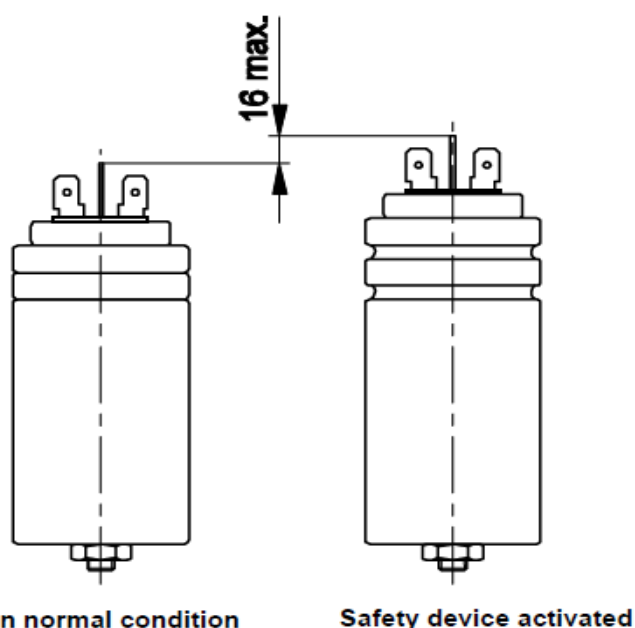
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Lighting application with ballast	<p>If the capacitor is placed next to an electro-magnetic ballast, please note that this ballast operates at the permissible temperature of the capacitor shall be regarded. The reactor and capacitor shall be far enough apart so that heat is not conducted from the reactor (via the connection cable) nor radiated from it to the capacitor. In cases where the capacitors are connected in parallel with the network, the quality of the energy shall be analyzed before, as it is responsible for most of the field failures.</p>
Connectors	<p>In case of fast-on terminals, the female connectors shall be appropriate for the terminal. A good electrical contact shall be ensured.</p> <p>Do not solder cables directly onto the fast-on terminals. The terminal may overheat, the capacitor may leak and any safety device, if available, will not operate properly.</p>
	<p>If the female connector becomes loose, the terminal may overheat, the capacitor may leak and any safety device, if available, will not operate properly.</p>
	<p>The hermetic seal of the capacitor is extremely important for a long operating life and correct functioning of the break-action mechanism of the over-pressure disconnecter. Do not damage the rubber seal and the soldering at the tab connectors.</p>
Connecting cable	<p>The cable for connecting capacitors shall be capable of carrying at least 1.5 times the rated current of the capacitor. The cable shall not exert any mechanical force on the capacitor terminals.</p>
	<p>Any mechanical force exerted on the capacitor terminals may cause leakage and prevent any safety device, if available, from operating properly.</p>
Harmonics	<p>Harmonics are sinusoidal voltages and currents whose frequencies are multiples of the 50 or 60 Hz power supply frequency. They result from the operation of electrical loads with nonlinear voltage-current characteristics. These are mainly electronic devices such as converters, electrical drives, welding machines and uninterruptible power supplies (UPS).</p>
	<p>Harmonics may cause a higher than rated current at the capacitors. The resulting overheating may damage the capacitors, leading to operational failures, bursting and fire.</p> <p>The total RMS capacitor current (incl. fundamental and harmonic currents) specified in the technical data of the specific series shall never be exceeded.</p>
Operating voltage V_B	<p>The capacitors have been designed for continuous operation at the rated voltage stated on the label. This voltage may only be exceeded within the limits permitted by the applicable standards.</p>

Overpressure disconnecter

Electrical components do not have an unlimited operating life; this also applies to self-healing capacitors. All capacitors of the B32330 to B33335 series are consequently fitted with a disconnecter that responds to overpressure. If numerous electrical breakdowns occur at the end of the capacitor's operating life or as a result of thermal or electrical overload, the formation of gas increases the pressure inside the capacitor case.

This causes the expansion head to expand. If it does so beyond a certain point, the internal wires will separate (tear-off fuses) and disconnect the capacitor from the line. This safety mechanism is irreversible. Once the safety device has operated, the capacitor will remain switched off.



Fused film capacitors

Electrical components do not have an unlimited operating life; this also applies to self-healing capacitors. All capacitors of the B3235, B32351, B32352, B32353, B32354, B32355, B32319 and B32356 series are equipped with a film containing built-in fuses. If numerous electrical breakdowns occur at the end of the capacitor's operating life or as a result of thermal or electric overload, the fuses switch off the capacitor by segments. When all the fuses have opened, the capacitor is disconnected from the line.

Please also read ZVEI – General safety data sheet for power capacitors on the Internet at <https://en.tdk.eu/tdk-en/529468/products/product-catalog/film-capacitors/ac-film-capacitors>.

IV. Mounting guidelines for boxed type B32354S

This section provides guidelines in soldering, cleaning and embedding for boxed type AC.

1. Soldering

1.1. Solderability of leads

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

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

Solder bath temperature	235 ±5 °C
Soldering time	2.0 ±0.5 s
Immersion depth	2.0 +0/-0.5 mm from capacitor body or seating plane
Evaluation criteria: Visual inspection	Wetting of wire surface by new solder ≥90%, free-flowing solder

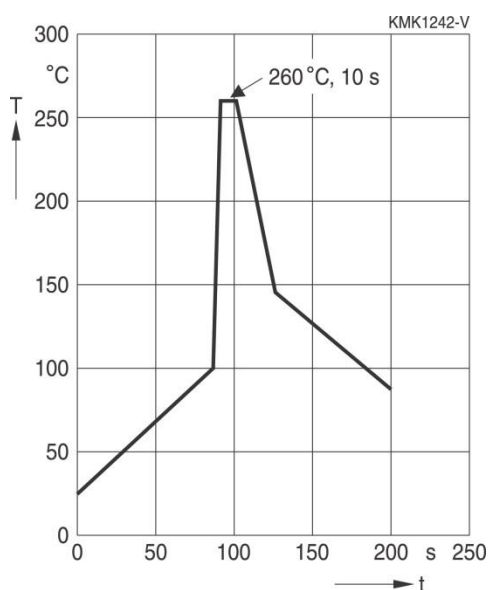
1.2. Resistance to soldering heat

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

Solder bath temperature	260 ±5 °C
Soldering time	10.0 ±1.0 s

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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 MKP
$\tan \delta$	As specified in sectional specification

1.3. General notes on soldering

Permissible heat exposure loads on AC 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

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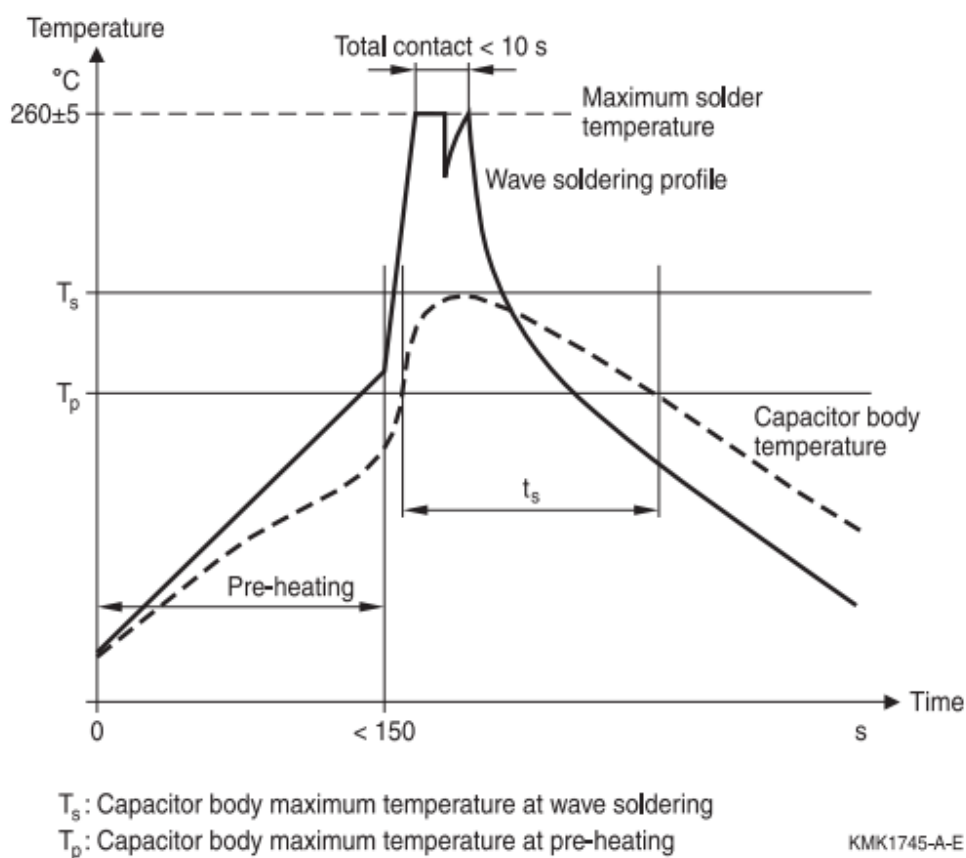
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- Additional heating due to heat dissipation by neighboring components
- Use of solder-resist coatings

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

EPCOS recommendations

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



Body temperature should follow the description below:

- MKP capacitor
 During pre-heating: $T_p \leq 110 \text{ }^\circ\text{C}$
 During soldering: $T_s \leq 120 \text{ }^\circ\text{C}$, $t_s \leq 45 \text{ s}$

Leaded film capacitors are not suitable for reflow soldering.

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

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

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2. Cleaning

To determine whether the following solvents, often used to remove flux residues and other substances, are suitable for the capacitors described, refer to the table below:

Type	Ethanol, isopropanol, n-propanol	n-propanol-water mixtures, water with surface tension-reducing tensides (neutral)	Solvent from table A (see next page)	Solvent from table B (see next page)
MKP (coated/boxed)	Suitable	Suitable	Suitable	Unsuitable

Even when suitable solvents are used, a reversible change of the electrical characteristics may occur in uncoated capacitors immediately after they are washed. Thus it is always recommended to dry the components (e.g. 4 h at 70 °C) before they are subjected to subsequent electrical testing.

Table A

Manufacturers' designations for trifluoro-trichloro-ethane-based cleaning solvents (selection).

Trifluoro-trichloro-ethane	Mixtures of trifluoro-trichloro-ethane with ethanol and isopropanol	Manufacturer
Freon TF	Freon TE 35; Freon TP 35; Freon TES	Du Pont
Frigen 113 TR	Frigen 113 TR-E; Frigen 113 TR-P; Frigen TR-E 35	Hoechst
Arklone P	Arklone A; Arklone L; Arklone K	ICI
Kaltron 113 MDR	Kaltron 113 MDA; Kaltron 113 MDI; Kaltron 113 MDI 35	Kali-Chemie
Flugene 113	Flugene 113 E; Flugene 113 IPA	Rhone-Progil

Table B (worldwide banned substances)

Manufacturers' designations for unsuitable cleaning solvents (selection).

Mixtures of chlorinated hydrocarbons and ketones with fluorated hydrocarbons	Manufacturer
Freon TMC, Freon TA; Freon TC	Du Pont
Arklone E	ICI
Kaltron 113 MDD; Kaltron 113 MDK	Kali-Chemie
Flugene 113 CM	Rhone-Progil

3. Embedding of capacitors in finished assemblies



In many applications, finished circuit assemblies are embedded in plastic resins. In this case, both chemical and thermal influences of the embedding ("potting") and curing processes shall be taken into account.

Our experience has shown that the following potting materials can be recommended: non-flexible epoxy resins with acid-anhydride hardeners; chemically inert, non-conducting fillers; maximum curing temperature of 100 °C.



Before embedding uncoated types, should users consult us regarding of proper technical installation guidelines.

V. Maintenance

	There are no serviceable or repairable parts inside the capacitor. Please refrain from opening the capacitor.
	Any opening or attempt to open or maintain the capacitor will void warranty and void liability of EPCOS.
General safety notes for installation and operation	<p>Discharge and short-circuit the capacitor before handling. Do not apply excess vibration, mechanical shock (drop) or pressure to the capacitor.</p> <p>Motor-run and lightning capacitors are classified as S0 or S2/S3 to IEC 60252 or the related national regulations.</p> <p>S0 capacitors have no specific failure mode. In case of overload, they may burst or catch fire.</p> <p>S2/S3 capacitors have a built-in safety device; in case of overload, they go into open circuit mode (S2) or with a small residual capacitance (S3).</p>
	Disregarding the guidelines in this manual could result in operational failure, bursting or fire for all types of capacitors.

This listing does not claim to be complete, but merely reflects the experience of EPCOS AG.

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Warning 3 in the next page (it is blocked): **The warnings, cautions and product-specific notes shall be observed.**

Important notes

The following applies to all products named in this publication:

1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application**. As a rule, EPCOS is either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether an EPCOS product with the properties described in the product specification is suitable for use in a particular customer application.
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