Siemens Matsushita Components

SilverCap Capacitors
Right on the Spot

Questions and Answers

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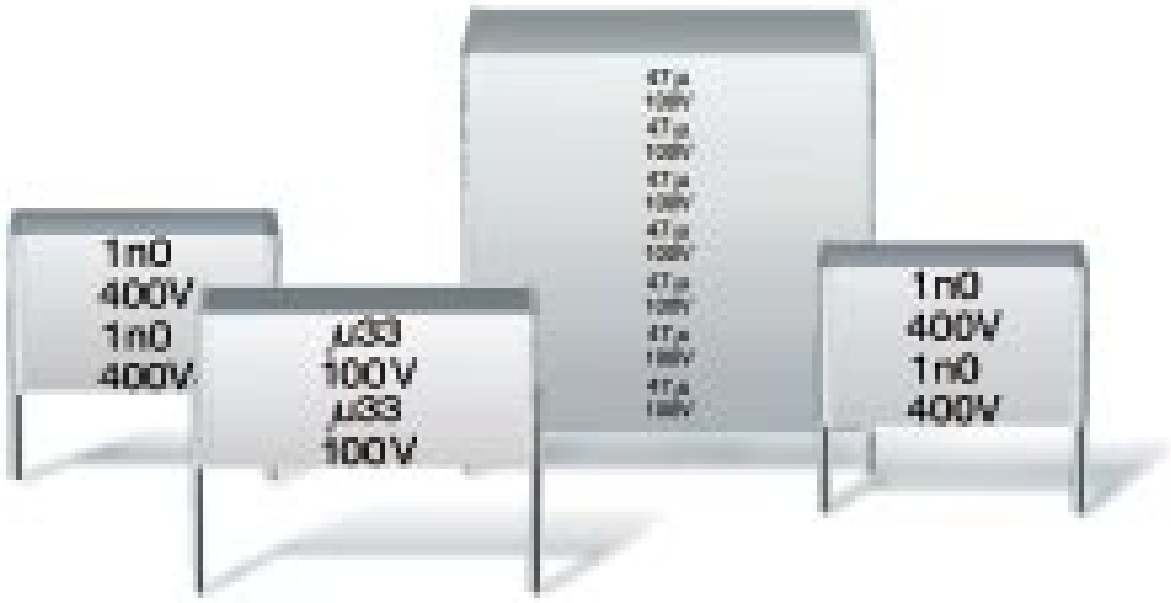
The most common questions regarding SilverCap capacitors and the answers



The uncoated MKT capacitor series B32560 to B32564 (SilverCap) is the cheapest film capacitor with respect to fabrication costs, which is manufactured by S+M Components and is available with lead spaces 7.5 mm, 10 mm, 15 mm, 22.5 mm and 27.5 mm. It only consists of the basic elements of any film capacitor, which are the metallized film and the two leads. The absence of any boxing or encapsulation does not only minimize the cost of the component, it also makes the SilverCap capacitor the most ecological capacitor on the market. This is obvious during the fabrication process, where no waste like epoxy resin or lacquer occurs. But it is also valid for the disposal of electric goods after their lifetime, where the SilverCap capacitors will never do harm to the environment.

The absence of any encapsulation additionally makes our SilverCap capacitor the most volume efficient film capacitor on the market. Furthermore we can design the capacitor's geometry according to your special demands by varying the thickness and height of the capacitor body in a wide range. Only the volume of the capacitor is determined by the desired capacitance. This makes the Silver Cap ideal for applications in PC board designs with space constraints.

The SilverCap capacitor is a stacked capacitor constructed with a metallized polyethylene terephthalate film and shows all the benefits of this film capacitor technology which are known from our boxed MKT capacitor series .

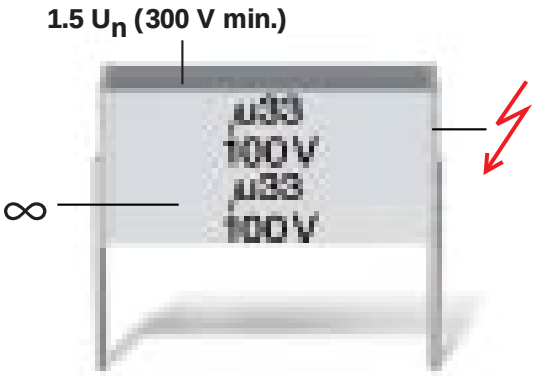
Nevertheless you will only benefit from the cost advantage of this capacitor series in your application, if you respect the specific properties of the SilverCap capacitors. These properties as well as some proposals to a successful application shall be given in the following sections.

1

What about the electrical insulation?

The face areas of the SilverCap capacitors, where the leads are welded, are also called Schoop areas. They are under the same electrical potential as the corresponding leads and are not insulated. The side areas are fully insulated by cover films.

The top and bottom sides are insulated with a minimum of 1.5 U_n, always exceeding a minimum insulation voltage of 300 V.



During the insertion of single-sided PC boards a direct contact of the Schoop areas to adjacent conducting parts and to the case has to be avoided. The minimum clearance as demanded by IEC 664-1 for peak voltages under 1000 V is 0.2 mm, which can easily be handled during hand insertion. We propose a minimum distance of ≈ 1 mm in order to take into account mechanical tolerances during the insertion of the PC boards.

When you use double-sided PC boards attention has also to be paid to the distance of the Schoop areas to adjacent printed wires on the insertion side of the PC board when the SilverCap body is placed directly on the PC board. The minimum creepage distances according to IEC 664-1 are

400 V	**:**	**2**	**mm**
300 V	**:**	**1.6**	**mm**
250 V	**:**	**1**	**mm**
100 V	**:**	**0.16**	**mm**
63 V	**:**	**0.063**	**mm**

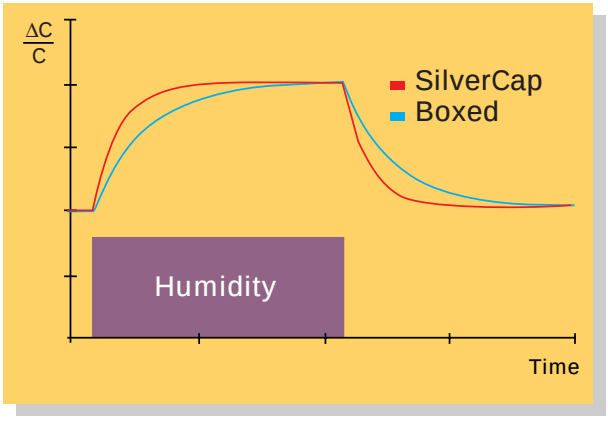
This has to be considered during the layout of the PC board. For our smallest SilverCap capacitor series B32560 with lead space 7.5 mm we propose to avoid printed wires between the two leads of the capacitor on the insertion side of the board, so that **you will not have trouble** with creepage distances directly under the relatively small component body. You may also order a crimped version of the SilverCap capacitor, which ensures a well defined distance to the PC board on the insertion side. In this case you can also place printed wires below the capacitor body.

2

Can a SilverCap capacitor be used under humide conditions?

If the influence of humidity on the SilverCap capacitor is considered, a distinction between reversible and irreversible effects has to be done. The reversible changes of capacitance, insulation-resistance and the tanδ, as defined by the humidity test according to IEC 68-1, occur for relative humidities less than 93 % applied for a limited time. The SilverCap capacitors exhibit the same equilibrium data as boxed capacitors with shorter time constants of the reversible changes.

That means that the humidity penetrates faster into the component as well as it diffuses faster out of the component. All reversible influences on the SilverCap capacitor can be reversed by a drying process.



An unlimited contact of the SilverCap capacitor with water may destroy the contact between the metallization and the Schoop area and thus destroy the capacitor. For this reason wet surroundings must be avoided strictly. The microclimate, defined by IEC 721-3-9 in the interior of any electrical apparatus, must be according to these constraints in order to guarantee a successful application of the SilverCap capacitor.

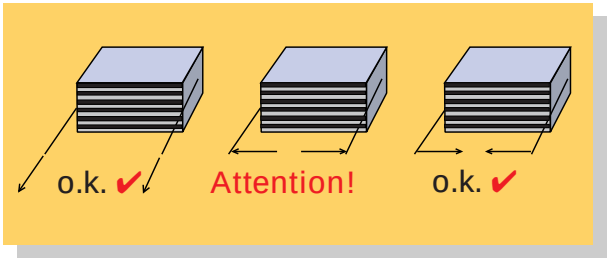
The irreversible influence of the humidity has also some consequences for the manufacturing of the PC boards. The boards suited for SilverCap capacitors **must not be cleaned with waterbased solvents**. Suitable cleaning

solvents are the technical alcohols ethanol, isopropanol and n-propanol. We propose to use a resin-based welding flux, which might also be applied without an additional cleaning process.

3 Is the mechanical robustness of the leads sufficient?

The resistance of the leads towards external forces is uncritical for boxed or dipped capacitors due to the strength of the sealing. In case of SilverCap capacitors the welding between the leads and the Schoop area is responsible for the mechanical strength of the leads. The IEC 68-2-21 demands a minimum lead strength of 10 N towards axial forces in the direction of the leads for all passive components.

This is easily fulfilled by our SilverCap capacitors so that an axial stress must be regarded as uncritical. The most severe strain for a SilverCap capacitor is a torsional bending of the leads away from the capacitor body. Performing stress analysis with shearing forces directly applied to the leads at the capacitor body, the SilverCap capacitors also withstand much higher forces than 10 N. This is due to the improvement of the welding quality in our actual SilverCap capacitor series ('J' in the middle



block of the ordering code). A torsional bending towards the centre of the capacitor is as uncritical as the axial stress mentioned above.

4 What about taping of SilverCap capacitors?

Due to the above mentioned improvements of the component a taped version of our SilverCap capacitors is available now for automatic insertion. It is available with straight leads in lead spaces 7.5 mm, 10 mm and 15 mm or in kinked versions with leads bended down to lead spaces 5 mm and 7.5 mm.

The most severe mechanical stress in this process is the bending of the leads directly before the capacitors are attached to the tape, which is necessary to fulfill the narrow tolerance of the lead's distance demanded by IEC 286-1. We do the 100 % final tests of our taped Silver Cap capacitors after this taping process so that you can be sure to receive a good capacitor quality. The mechanical stress for the component during the automatic insertion is much lower than during the fabrication process. This has been tested on all important insertion systems and is already applied at large quantities with more than a million pieces.

5 Can SilverCaps be soldered easily?

The best soldering conditions for SilverCap capacitors are proved to be relatively low soldering temperatures (approx. 250 °C) and short soldering times (approx. 2 sec). A strong improvement of the soldering heat resistance has been achieved for our actual SilverCap capacitor series ('J' in the middle block of the ordering code) with the reduction of the lead diameters compared to older versions.

After the completed soldering the inherent heat which is stored in the component has to be transferred to the surrounding as fast as possible in order to avoid the destruction of the polyethylene terephthalate film, which starts to shrink at higher temperatures. The first hint for an overheating of the component is the beginning detachment of the cover films from the side areas, which originates from the shrinking of them under the influence of the heat. The capacitor body appears to be blown up in these cases.

A reduction of the soldering temperature or at least a further re-cooling of the component, for instance by using additional ventilators, is recommended. If possible in your application, this can also be achieved by using our Silver Cap capacitors with crimped leads in order to improve the cooling by a good air surrounding of the capacitor body.

6

Can the SilverCap capacitors be used at high operating temperatures?

SilverCap capacitors are well suited for applications at high surrounding temperatures, because the dissipation power generated inside the capacitor body diffuses faster into the surrounding. Approaching a temperature of 125 °C, the SilverCap capacitors are even better suited than boxed capacitors because of an irreversible decay of the box sealing. This reduces the capability of self-healing of the boxed capacitors.

7

What about the temporary occurence of visible cracks on the bottom areas?

During the fabrication process of stacked capacitors the single-layers of metallized film are faced with mechanical strains during the winding, the tempering, the schooping and the sawing of the capacitor. Furthermore humidity may be stored between the film layers, which also causes a strain during the strong local heating-up at the welding process. All these mechanical strains may be reduced by cracks, which mainly occur at the bottom side of the capacitors between the leads.

Intense endurance tests of such components prove that these cracks have no influence on the electrical properties of the SilverCaps so that the occurrence of such cracks is not dangerous for the application. The probability of the occurrence of these cracks is the same for SilverCap capacitors as for boxed capacitors, where these cracks are covered by the sealing of the box. **Even here no influence on the electrical parameters is known.**

Conclusion

Due to the permanent improvement of the quality of the winding process and especially the contact quality of the leads to the Schoop area, one can consider the handling of the SilverCap capacitors as easy and safe, as long as the above mentioned hints are considered.

The advantages of the SilverCap capacitors like
- flexible design of the dimensions
- excellent self-healing capability
- best temperature behaviour
- low-cost construction

are convincing in all cases, where you have highest demands on cost sensitive designs and space optimized PC board layouts.