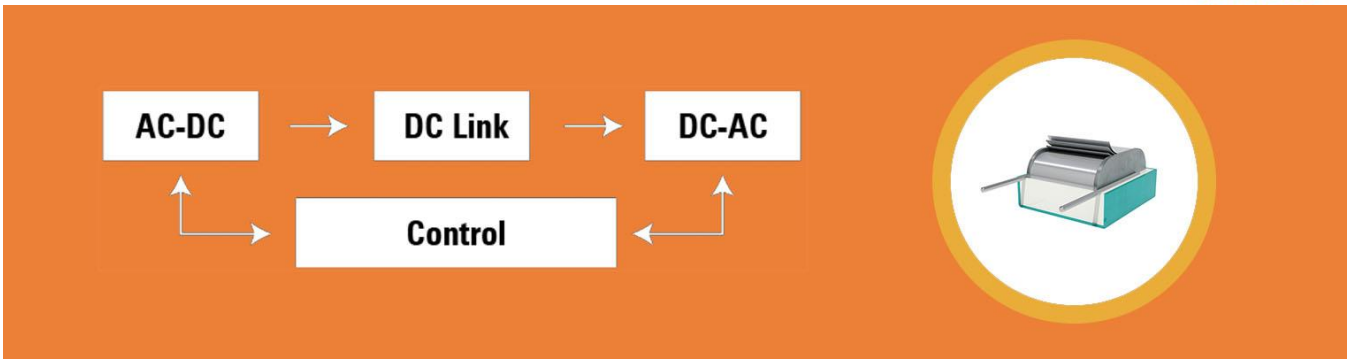
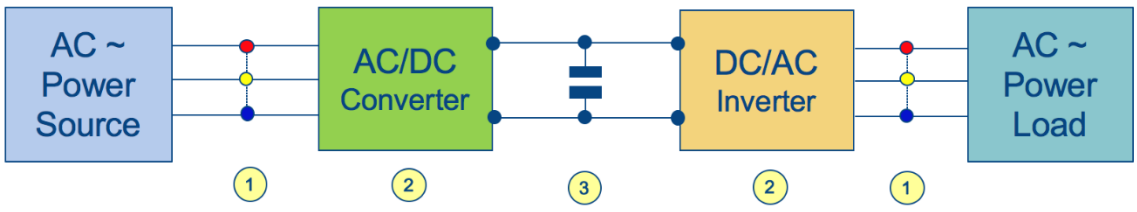


The demand for energy savings and alternative energy sources has called for a rapid advancement in products such as solar converters and wind generators. A DC-to-AC inverter is a critical subsystem needed to operate these devices. Inverters use a power film capacitor in three different functions. In the AC sections, capacitors are used to reduce harmonic content. Snubbers for the MOSFETs or IGBTs dampen (potentially) dangerous voltage spikes. DC link capacitors support the DC network's high currents while filtering AC ripple.

Today's operating frequencies are in the range of 30 kHz. These frequencies drive the need for low inductance and low ESR to limit the switching transient voltages. End application requirements drive the need for wide operating temperatures, long operational lifetimes, mechanical strength, form factor flexibility, and of course, low total cost of ownership.

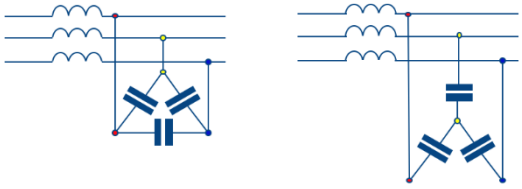
The self-healing and unique over-voltage capabilities of power film capacitors render them a first consideration in industrial markets such as windmill generators, solar converters, drivers for welders, and UPS systems, to name just a few.

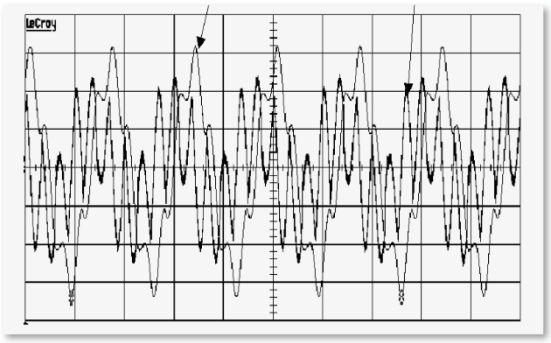
Power Film Capacitor Types



Key for windmill example: 1) AC Filters, 2) Snubbers, and 3) DC Link

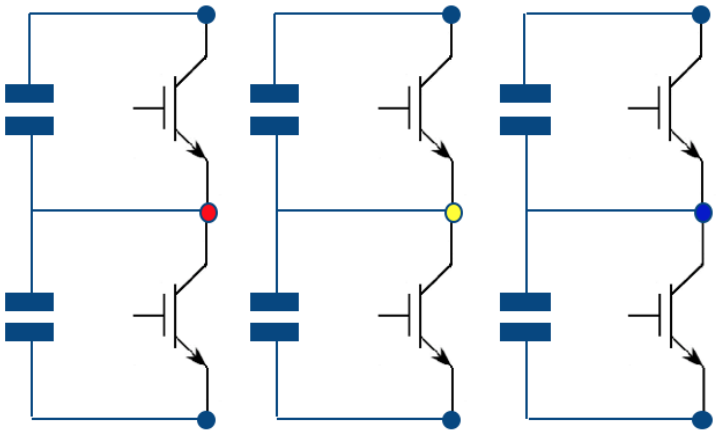
(1) AC Filtering





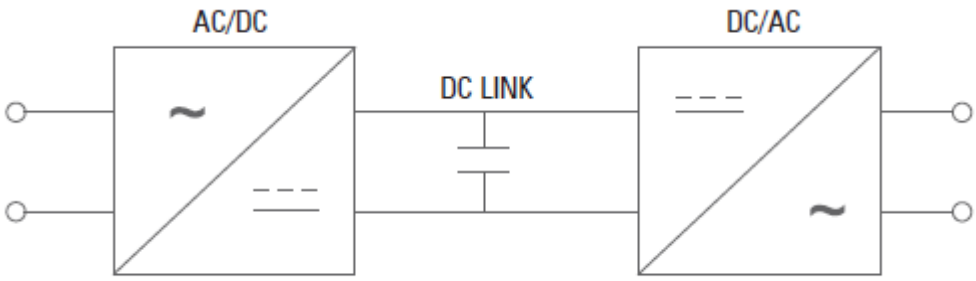
AC filtering capacitors reduce the high frequencies that contribute to the fundamental frequency e.g., 50 – 60 Hz. Output filtering uses both delta and star configurations. For this function, circuit designers select components featuring wound metallized polypropylene film. The C44P is an example capacitor for AC filtering.

(2) Snubber



When the semiconductor device switches, high peak currents are generated. These transients can cause voltages as high as 4,000 V_{PK}. Snubber capacitors reduce these high voltages and high peak currents. Depending on the semiconductor device, different form factors are available for mounting. For example, the KEMET C4B series is designed to bolt directly onto an IGBT package.

(3) DC Link



A DC link connects two AC systems with different voltages and frequencies using an intermediate DC stage. The DC link capacitor temporarily stores the energy until conversion back to AC. The DC link capacitor has a relatively high voltage rating, low dissipation factor, and low inductance.

The DC bus voltage is usually between 450 – 1,700 VDC depending on the particular application. Compared to the AC filtering stages, a DC link capacitor's operating temperature tends to be higher (>85°C). The increased temperatures are due to the DC link capacitor's proximity to the switching semiconductors.

The capacitor's mechanical dimensions depend on the maximum operating voltage, maximum transient voltage, maximum ripple current, ripple current frequency, ambient temperature, and operational lifetime requirements.

Conclusion

For power applications, we have a Power Film Capacitor Selection Matrix to help identify which series works in each converter's function.

For detailed help in choosing the right capacitor for the functional areas of AC filtering, snubbers, and DC link, use the contact form below to speak to a KEMET FAE. Our application experts can help choose the right capacitor technology, considering your application's high voltage, high temperature, and high ripple currents. We can contribute to making the design decision between the various capacitor technologies available for each stage of a power inverter.