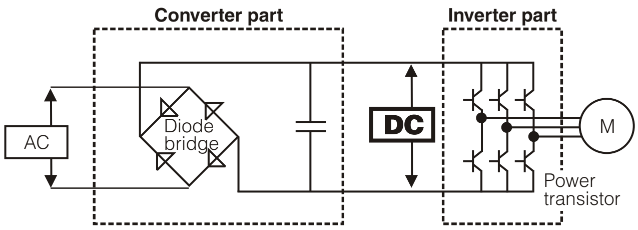
Application Notes

DC Link Capacitors
Technological Perspective and Applications

'Inverter' has become the most common term associated with the white goods electronics industry. But before we discuss on the advantages associated with this technology let us first get an understanding of the technology.

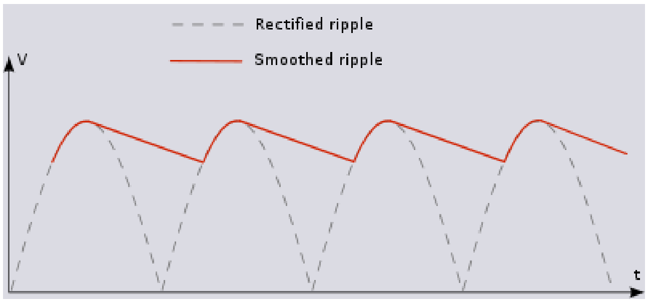
An inverter is a device that supplies variable frequency power to equipment. This function gives the freedom of motor revolution speed control which in turn reduces the power consumption. A reduction in power consumption implies better efficiency of the appliance and longer service life.

The inverter consists of basic two parts: A Converter and an Inverter.



The AC input is first converted to DC by the "Converter "section. Further this DC is then inverted to AC by the "Inverter "Section to supply the desired variable frequency.

As shown in the figure, a capacitor is used which provides the smoothing of the DC bus voltage. This can be seen in the figure shown below.



This capacitor is known as DC Link capacitor and it functions as a short-term current source and sink to limit transient voltages seen by power conversion semiconductor switches and the input DC bus. The most commonly used DC Link capacitors are of two types:

1. Electrolytic Capacitors
2. Film Capacitors

Mostly Electrolytic capacitors are used as DC link capacitors. The aluminum electrolytic capacitors have a high energy density which makes them the primary choice to be used as DC link capacitor.

In the subsequent discussion we shall try to understand the calculation of DC link capacitance and the advantages which film capacitors offer over the electrolytic capacitors. A point worth noting here it that the main criterion for DC link application is the device's RMS current withstanding capability.

Let us take an example as discussed below:

Working voltage for DC bus: $120V_{DC}$

Ripple voltage (Uripple) allowed: $4V_{RMS}$

RMS current (Irms): 80Arms @ 20 kHz

The minimum capacitance value is determined from the equation:

$C = Irms/(Uripple \times 2\pi f) = 159\ \mu F$

For the same application if we consider using an electrolytic capacitor then we must take into account that a $1\mu F$ capacitor can to handle 20mA, so in this example, in order to handle 80 Arms the minimum capacitance value would be:

$C = 80/0.02 = 4000\ \mu F$.

The amount of capacitance needed for an inverter bus link capacitor is much less for a film capacitor than an electrolytic capacitor. This is because the film capacitors are rated for much higher ripple current than the electrolytic capacitors.

Applications where the voltage handling requirement exceeds 500 VDC , then in such cases film capacitors shall prove to be a better choice because electrolytic capacitors can be designed with a maximum voltage rating of 500 Volts only. However this kind of design limitation does not exist for film capacitors.

Let us take a case where the designer requires 900 VDC handling capability. Then he will have to use two electrolytic capacitors in series. But if a film capacitor is chosen then same purpose can be accomplished by using single film capacitor. Therefore, we can see that film capacitor offers an advantage when compare to electrolytic capacitor for DC Link application. In addition, there is no wet electrolyte that dries up with time.