Low Pass Harmonic Filters have been optimized for AC voltage source inverters (Variable Frequency Drives), but can also be effective at improving power quality for DC Drive applications.

DC Drives Power Quality

DC drives represent a unique challenge for harmonic filtering due to their use of phase controlled rectifiers. Motor speed control is accomplished through changes in the rectifier conduction angle, and is therefore a function of the electrical degrees of rectifier conduction. So at full speed, we consider the rectifiers are in full conduction and electrically act similar to diodes (uncontrolled rectifiers). DC motor speed is reduced by phasing back the rectifiers and thereby reducing the rectifier output voltage.

The worst case, from a power quality perspective, is low speed, where the conduction angle is very low and the rectifier voltage waveform is highly distorted. This results in higher current distortion and lower power factor. Voltage can be highly distorted by the phase controlled rectifiers, creating a higher threshold of harmonic current distortion.

Typical applications of AC variable frequency drives (VFD) have very high power factor, but in DC drive applications, the harmonic filter must perform double duty. The Low Pass Harmonic Filter (LPF), serving a DC drive, must provide the reactive VARs to compensate for low power factor, as well as sufficient capacity to reduce harmonic distortion.

Harmonic Performance

In DC drive applications, harmonic performance will be different than in AC VFD applications. Whereas in AC VFD applications, it is common for the LPF to reduce THD-I to 5% or less, this is not the case for DC drives. While it may be possible to achieve this at full load, when the rectifers are phased back for low speed, the distortion may increase appreciably. The objective in DC drive cases is for the LPF to minimize full load harmonics (to approximately 5% THD-i) and to improve both power factor and harmonic distortion at the light load conditions.

Selecting LPF for DC Drives

When HP / KW is known:

Multiply DC drive (HP/KW) rating by the factor 1.33. Select (Type KS) LPF based on this HP/KW rating.

DC Drive________HP/KW x 1.33 = LPF_______HP/KW

When DC Drive AC input current is known:

Multiply DC drive (AC input current rating) by the factor 1.33. Select (Type KS) LPF based on this ampere rating.

DC Drive________Amps x 1.33 = LPF_______Amps

Normally, a Type KS filter will be used, but in cases where the DC drive has a dedicated isolation transformer or input reactor, it may be possible to use a Type KB filter in conjunction with the existing impedance, but with slightly higher residual harmonic distortion.