Technical Paper

Impact of additional AC Line Reactance on the DC Bus Voltage of a Motor Drive

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Variable speed motor drives typically have a three-phase diode rectifier input and either an AC or DC reactor. An example of a variable speed drive with an AC line reactor is shown schematically in Figure 1.

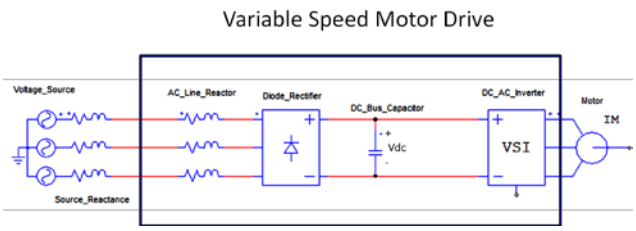

Figure 1: Variable Speed Motor Drive

Adding ac line reactance can be beneficial to the drive as it lowers the input current THD and peak diode current. Reduction in DC bus voltage due to increased AC reactance is minimal. As the diode rectifier has a near unity power factor, the voltage drop due to the 60Hz component of the current is extremely low. The dominant voltage drop attributed to the line reactance is the “commutation voltage drop”. This is the voltage it takes to ramp up the current in phase of the inductor and ramp down the current in another phase. In traditional 6-pulse (3-phase) rectifiers, this commutation occurs 6 times per fundamental ac cycle and reduces the dc bus voltage.

Figure 2 graphically shows the impact of AC line reactance on the output dc bus voltage. Consider a 100Hp drive operating at full load with a 3% internal line reactance. With a 480V, 3-phase voltage supply the drive dc bus voltage is 635Vdc. If additional line reactance is added the dc bus voltage is reduced only by approximately half the percent increase in reactance. The approximate DC voltage drop is given by:

Vdc voltage drop in % ~= (Additional line reactance in %)/2

For example, if an external 5% line reactor is added, the dc bus voltage is reduced by approximately 2.5% to 612Vdc. If a 10% line reactor is placed in front of the drive with an internal 3% line reactor, the dc bus voltage is reduced by approximately only 5% to 603Vdc (95% of 635Vdc). In this case, the dc bus voltage does not drop by 10%, which is a common misconception.

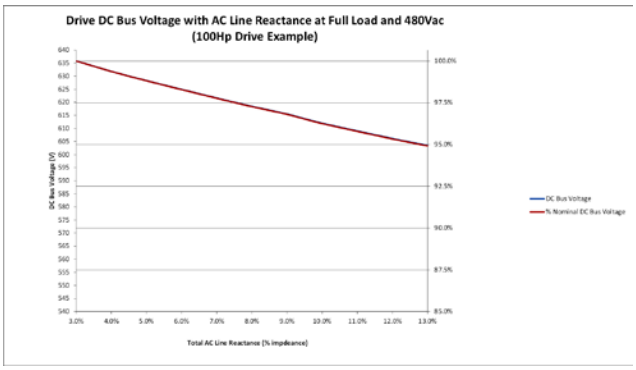

Figure 2: DC Bus voltage at full load output power

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