Mid-South Engineering Company

Issue No 34 Working Together **Second Quarter, 2010**

Do Your VFDs Shutdown with Over Voltage Faults?

Do You Need a Dynamic Braking Resistor?

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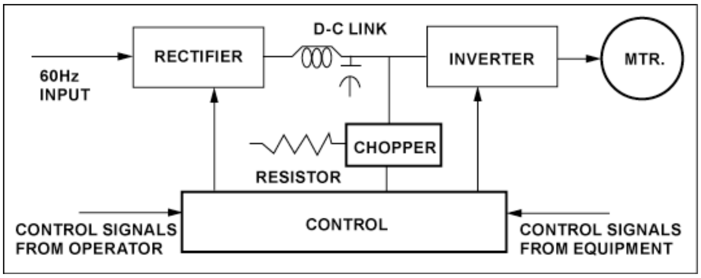
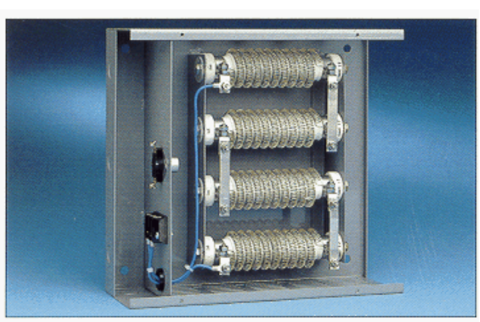


First, let us provide a brief explanation of what a VFD represents. Basically a Variable Frequency Drive (VFD) converts the incoming 50/60 Hz AC voltage to DC voltage via a Rectifier circuit. The transistors in the Controller and the Inverter circuit modify the DC voltage by converting it to a three phase waveform. This three phase waveform (output to the motor) is created via Pulse Width Modulation (PWM). The PWM output is simply a series of D.C. voltage pulses with varying pulse width. This happens for both the positive and negative half cycles of the original incoming 50/60 Hz power supply.

Second, let us provide an explanation of what a Dynamic Braking Resistor is. A Dynamic Braking Resistor (DBR) basically is a device where excess energy is dissipated, in an over voltage situation. This is done by the "Chopper" control circuit or a transistor that switches on in a *DC bus* over voltage situation to allow the excess energy to be routed to this resistor and dissipated as heat. The picture below is an example of how the components inside a DBR look.



DBRs are usually needed for Deceleration Braking loads and Overhauling loads. An example of a load that needs to Decelerate quickly would be moving material in one direction at an adjustable speed and then quickly slowing it down for it to change directions. An example of an Overhauling Load would be a load that is causing the motor to rotate faster than the motor wants to (ie load of a Crane Winch motor). To properly size the DBR you will need to have specific VFD information and duty cycle time information for your application. You will need the following information: Ohm range or minimum value, the drive's maximum braking power or continuous braking power, and the braking cycle which is usually stated as a percentage. The following calculations are examples of the calculations required to size a DBR.

> **Note:** *The calculated Braking current or Peak current must not be larger than the VFD manufacturer's specifications*

Customer information:

- Motor Horse Power: **75 HP**
- Drive Input Voltage:**3Φ 460Vac**
- Braking Torque: **150%**
- Duty Cycle
  - On Time: **3 Seconds**
  - Off Time: **15 Seconds**
- Minimum DBR Ohmic Value (Per VFD Manufacturer's Specifications): **5 Ohms**
- Maximum Braking Current Value (Per VFD Manufacturer's Specifications): **130 Amps**

Calculations:

- Regeneration Type: **Deceleration Braking**

1. Motor Wattage (MW) = 75 HP x 746 = **55950 Watts**
2. Peak Wattage (PW) = 55950 Watts x 150% Brake Torque (Use 1.5) = **83925 Watts**
3. Resistance = (750Vdc)^2 / 83925 Watts = **6.7 Ohms**

"The Barn" built in the 1930's to house Welsh ponies, serves as Mid-South's offices.

VFDs Shutdown & Dynamic Breaking Resistors Continued

4. Duty Cycle (DC) = 3 Seconds on / 15 Second off = **.2 or 20%**
5. Average DB Resistor Wattage (DBrw) = (83925 Watts x .2 Duty Cycle)/2 = **8392.5 Watts**
6. Braking Current (Bi) = Square Root (83925 Watts / 6.7 Ohms) = **112 Amps**

• Regeneration Type: **Overhauling Load**

1. Motor Wattage (MW) = 75 HP x 746 = **55950 Watts**
2. Peak Wattage (PW) = 55950 Watts x 150% Brake Torque (Use 1.5) = **83925 Watts**
3. Resistance=(750Vdc)^2 / 83925 Watts = **6.7 Ohms**
4. Duty Cycle (DC) = 3 Seconds on / 15 Second off = **.2 or 20%**
5. AverageDB Resistor Wattage (DBrw) = 83925 Watts x .2 Duty Cycle = **16785 Watts**
6. Braking Current (Bi) = Square Root (83925 Watts / 6.7 Ohms) = **112 Amps**

Note: Duty Cycle 50% or Higher/Deceleration Braking
If a Deceleration Braking load is specified with a duty cycle higher than 50%, the overhauling load form of the calculation is used. This is because the braking waveform no longer looks like a right triangle but begins to look more like the rectangular pattern of the overhauling load.

In Conclusion
DBRs are usually needed when a VFD is controlling a motor that has the need for fast Deceleration times or has the potential to be in an Overhauling load situation. Both of these cases will cause your VFDs to shutdown on Over Voltage Fault, and this problem is fixable. If you are having a problem with VFDs shutting down, let us know and we can work together to find the proper solution for your situation.

TERMS TO KNOW:
Over Voltage: Over Voltage happens when the DC voltage measured at the VFD is greater than the specifications defined by the VFD. This can happen when the motor being supplied by the VFD basically turns into a generator due to the shaft being rotated faster than the VFD wants it to. This will also take place when the voltage being supplied to the VFD increases above acceptable levels.

Adapted from:

1. http://www/postglover.com
2. http://www.drivecon.com/
3. http://www.filnor.com/
4. http://www.fortressresistors.com/dynamic_braking.htm

Thermal Oil Testing vs. Lube Oil Testing

Adapted from Paratherm Corporation

Because lubricant tests are inexpensive to run, lube-oil testing labs are sometimes used for testing thermal oils. The problem with using these labs is that the tests which include Wear and Contamination Metals and Particle Count measure properties that are important for lubrication and not heat transfer.
For example, heat-transfer oil pumps do not operate at high pressure and so do not have the close mechanical tolerances that can be affected by the presence of particles (as in machine bearings or lubricating-oil pumps). Nor is there metal wear that requires a metals analysis to prevent equipment downtime. Particles in thermal oil are more a nuisance than a threat at worst they settle out in the expansion tank.

Some lube-oil test results - Acid Number and Viscosity can be useful for thermal oils. However, one problem with relying on only viscosity to determine fluid condition is that it measures only the average of all of the components it does not detect the presence of contaminants. A Distillation Range should be included with the testing program to positively determine whether any contamination has occurred.

Where lube-oil tests become particularly deceiving is when the results are compared to lube-oil standards which are much different than thermal-oil standards. For example a low viscosity is desirable in a thermal oil because it increases the rate of heat transfer, while in lubricating oils it indicates that contamination has occurred, reducing its lubrication properties. So be cautious of accepting recommendations based on a lube-oil test report for a thermal transfer oil.

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