

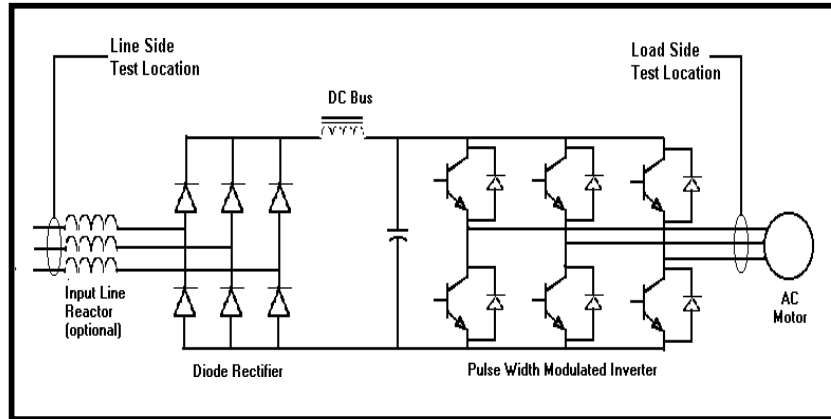
VFD Testing and Analysis

Note 0301

Description

Motors powered by variable frequency (VFD) or variable speed (VSD) drives require additional testing and analysis to ensure the high voltage stresses are not weakening the motor's insulation system or the drive components. This application note is designed to give a quick review of the techniques for testing and analyzing VFD's and VFD driven motor data using the MCEMAX.

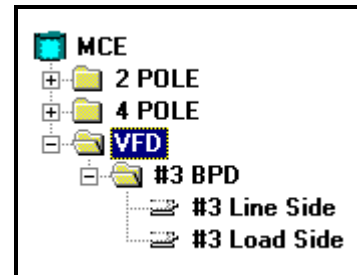
VFDs are made up of three components, the rectifier, storage, and inverter sections. Most VFD failures are the result of misapplication. Failures usually occur in the power sections, in either the rectifier or inverter.



Procedure

Voltage					
	Fund RMS	Tot RMS	C.F	THD	
Voltage 1-2	371.43	478.86	1.38	7.89	
Voltage 2-3	363.15	473.97	1.35	11.22	
Voltage 1-3	371.04	479.49	1.37	9.23	
Average	368.54	477.44			
% Imbalance	1.46	0.73			HVF 0.01
%NEMA Derating	98.12		%NEMA Derating		100.00
Voltage 1	215.88	309.00	1.55	11.32	
Voltage 2	211.58	306.35	1.60	11.15	
Voltage 3	210.87	308.42	1.60	11.51	
Average	212.78	307.92			
% Imbalance	1.46	0.51			
Current					
Current 1	142.90	171.64	1.75	5.36	
Current 2	148.88	175.82	1.77	3.49	
Current 3	153.04	185.15	1.75	6.00	
Average	148.27	177.54			
% Imbalance	3.62	4.29			
% FLA	62.04	74.28			
Impedance					
	Real	Magnitude	Angle		
Phase 1	1.25	1.51	34.22		
Phase 2	1.14	1.42	36.86		
Phase 3	1.11	1.38	36.54		
% Imbalance	7.28				

- Establish two motors in the database for each drive motor combination. One will be used for EMAX testing on the line side of the VFD. The other will be used for MCE and EMAX testing on the load side of the VFD.
- Disconnect the VFD from the motor when performing MCE (deenergized) testing.
- Remove warning level set points which are not applicable to VFD signals. These include Current THD, HVF, F_L , and $Z_{\text{imbalance}}$ for line side and V_{L-L} , V_{THD} , HVF, and F_L for load side.
- Refer to IEEE 519-1992 for standards on power quality.
- Perform the following tests:



Line Side

EMAX Power Analysis

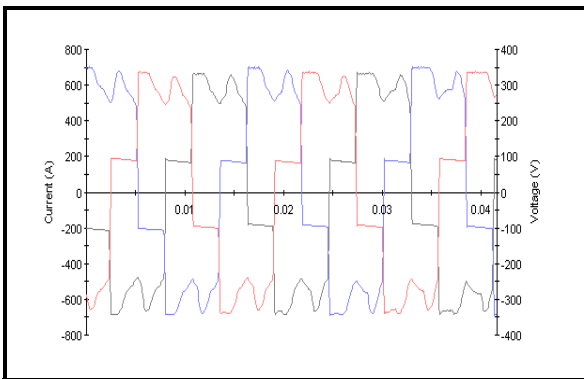
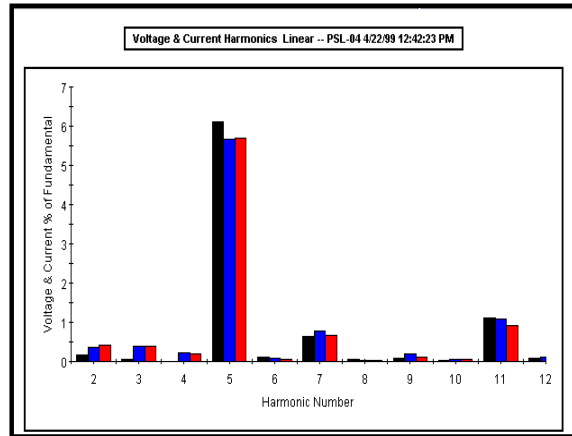
Load Side

All MCE Tests
All EMAX Tests

Line Side Analysis

Line Side Analysis focuses on the health of the VFD components, specifically the transistors.

- Monitor the voltage THD.
- Look for excessive harmonics of voltage on the voltage and current harmonics graph.
- High 5th and 7th harmonics indicate the presence of a 6 pulse drive influence on the distribution system. Each of the individual voltage harmonics should be <3% of the fundamental as per IEEE 519-1992. The figure to the right shows an example of unacceptable levels of voltage distortion.



- IEEE 519-1992 is the Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems. It recommends for voltages greater than 600 VAC and less than 69k VAC, the overall voltage THD limit is 5%.
- Look for erratic zero crossings of voltage and current based on expected values and comparative values. The figure to the left indicates a defective inverter section on the VFD.

Load Side Analysis

- IEEE 519-1992 power quality standards do not apply on the load side of a VFD.
- MCE testing analysis is identical for drive motors and non-drive motors.
- The voltage and current time domain is different, but still balanced, as shown below.
- The EMAX Demod test for auto speed acquisition requires manual speed selection.
- EMAX Low Res, High Res, and Eccentricity test have a built in line frequency modifier so that the “Select Speed” and “Estimate Bars” algorithms are correct for different line frequencies. Spectrum peak caution and alarm values are the same for drive motors and non-drive motors. Verify speed to confirm rotor defects.

