APPLICATION NOTE

# Advanced Spectral Analysis Current Demodulation

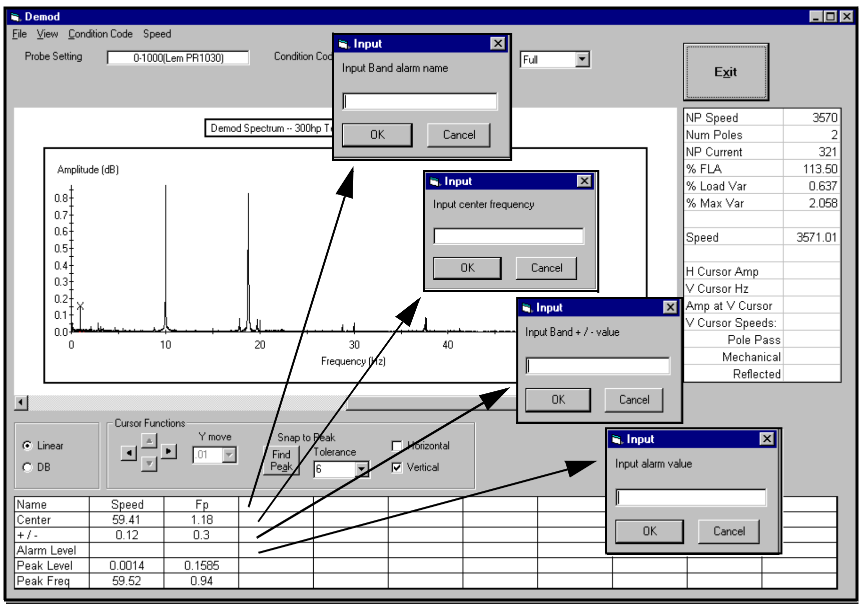
Note 0302

## Description

The demodulation process filters out the 60 Hz carrier frequency of the motor's running current and reveals the hidden signals representing repetitive load variations. These load variations are reflected back from items such as belts, gears, and rotor speed, into the motor current through the air gap flux affecting the counter electomotive force (CEMF). Removing the 60 Hz signal enhances the ability of the software to analyze load variations and detect motor speed, pole-pass, mechanical pass-through, and reflected frequencies. Advanced spectral analysis is the process of determining what those load variations mean and allows you to identify potential faults with belts, gears, pumps, compressor stages, and other mechanical related anomalies.

Accurate speed assessment is critical for accurate identification of rotor related defect frequencies. Rotor bar degradation can lead to reduced torque, motor trips, and even stator damage. Mechanical defects such as belt tension or damage, compressor or pump damage, and imbalance can lead to physical damage of the mechanical components. Identifying and correlating the impact of the mechanical defects on the motor current and power will increase the understanding of the fault severity and impact on operations. Each of these problems could lead to reduced operating efficiency and productivity. Speed detection is also valuable to the technician when evaluating other EMAX tests such as High/Low Resolution and Eccentricity current signature analysis (CSA).

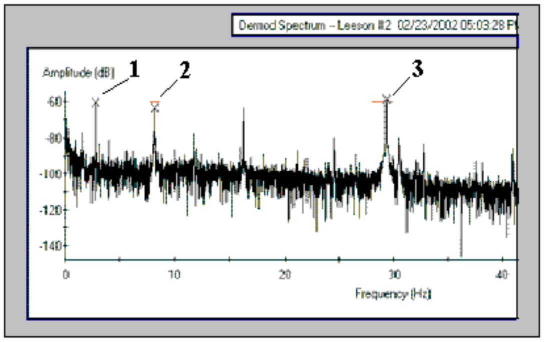
## Procedure




- *Establish a baseline.* When using demodulation to evaluate motor condition, it is important to have an established baseline for comparison purposes taken when the motor is in a satisfactory condition.
- *Establish band alarms.* The band alarm name, center, width (+/-), and height (alarm level) must all be entered to establish a band alarm. Band alarms should be 1.5 to 2 times the baseline peak on a healthy motor.
- *Identify frequencies*. Identify frequencies related to specific components and conditions such as belts, gears, pumps, compressor stages, and other mechanical related anomalies. Ten frequency envelopes can be listed on the demodulation screen. The first two are designated for Speed and pole pass frequency (Fp), the remaining eight are user defined.
- *Monitor changes*. Monitor changes in identified frequencies so that any significant increases in amplitude can be investigated. Using current demodulation, the speed of the motor can be identified by a peak in the spectrum and monitored for changes in amplitude.

## Analysis

- If any peak within the band alarm exceeds the predetermined setpoint, the software will identify an alarm in the band alarm table and demodulation history chart.
- Increasing amplitudes of identified peaks indicate a changing condition of the system associated with that peak.




- Increasing Fp indicates possible rotor degradation, such as cracked or broken rotor bars or end rings. Fp is also used for speed acquisition. (See point 1)
- Increasing frequencies related to belts indicate possible belt or pulley damage, angular offset of the pulleys, or a loose belt. (See point 2)
- Increasing speed peaks indicate possible imbalance related anomalies (the motor is out of balance or misaligned). A properly balanced and aligned motor will result in a lower speed frequency amplitude. The speed frequency is also used for speed acquisition. By removing the 60 Hz signal, the technician can identify the motor's speed by comparing Fp and the mechanical frequency associated with its estimated speed. The estimated speed used to set envelopes for both Fp and speed are based on the motor's nameplate speed and the percentage of full load running current. (See point 3)

## Case Study - Belts

When transmitting power to the load via a belt attached to the motor, changes in alignment can be evaluated using the demodulated current spectrum. Evaluation of the current spectrum is similar to alignment in that increases in the amplitude of the belt frequency and the development of multiples of the belt frequency indicate a problem. The operator must know the diameter of the pulley mounted on the motor and the length of the belt to calculate belt frequency. Belt Frequency = 3.142 (D/L) X (RPM/60) Where D is the diameter of the motor mounted pulley, L is the length of the belt, and RPM is the motor speed.

In the example below you can see the dramatic change in the demodulated current spectrum after proper tensioning and alignment was performed on a drive belt. In the figure on the left, the belt frequency is 8.188 Hz and there are elevated peaks at multiples of the belt frequency. Notice in the figure on the right how the multiples of the belt frequency have disappeared and how much lower the amplitude of the belt frequency is after the work was completed. These frequencies can now be easily monitored to detect future problems developing in the belt drive of this system.