Preditor®

Introduction

Preditor® is a system which consists of hardware, firmware and software. It's dedicated to predictive maintenance of electrical motors through electrical signature analysis (ESA).

This system can detect mechanical and electrical failures in the motor (misalignment, imbalance, broken bars, shorted turns, stator asymmetries, etc.), in the transmission system (pulleys, belts, gears) and in the attached load (fans, pumps and scroll compressors).

This product is extremely useful to monitor electrical motors located in places of difficult access and areas of risk to the employees.

Hardware

The hardware has six simultaneous input channels and is prepared to acquire current and/or voltage signals. **The same hardware can be used in a portable or remote way** as described in the item named "models". This flexibility is one of the product great potentialities.

Technical Specifications:

- Dimensions: 144 x 85 x 60 mm;
- Fireproof cover;
- Communication TCP/IP;

- Power supply: 5V DC;
- Anti-aliasing filters;
- Programmable amplifiers;
- 16 bits A/D converter.

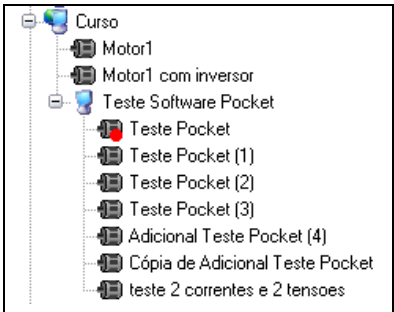
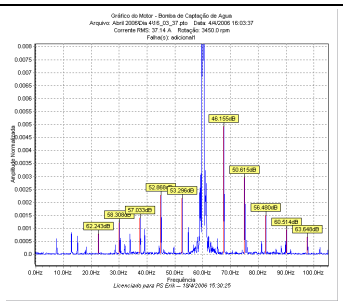
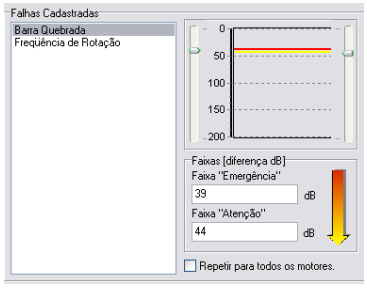
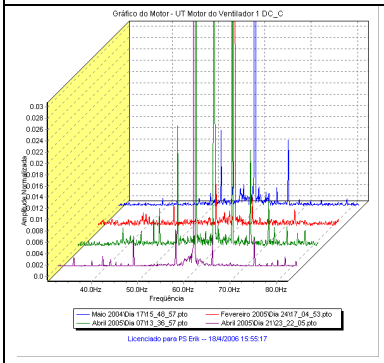
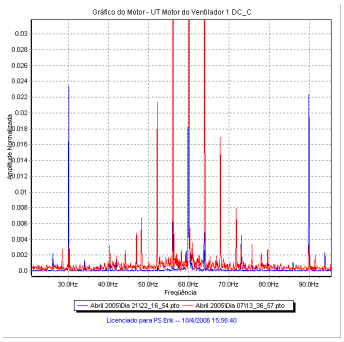
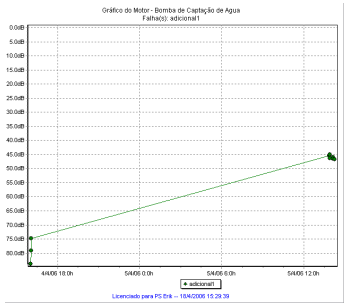
Firmware

The firmware is the hardware intelligence. Its job is to manage the communication with the central computer, run the signal acquisition and send the pre-processed data to be analyzed by the main software described below.

Software

The software is the heart of this system. In this text, one describes only its most important tools and characteristics. However, it's important to list the general aspects of the software:

- Motors organized in a hierarchical tree structure;
- Motor speed estimation through a very robust and proprietary algorithm;
- Automatic detection of failure characteristic components;
- Alarm levels set up;
- Spectra in cascade, in superimposition, etc.;
- Tendency curves of each failure type;
- Data storage configuration;
- MCSA Analyzer;
- Energy Analyzer (Electrical failures detector and power quality analyzer);
- Supervisory mode for remote acquisition;

		
hierarchical tree structure	Automatic detection of failure characteristic components	Alarm levels set up
		
Cascade	Superposition	Tendency curve

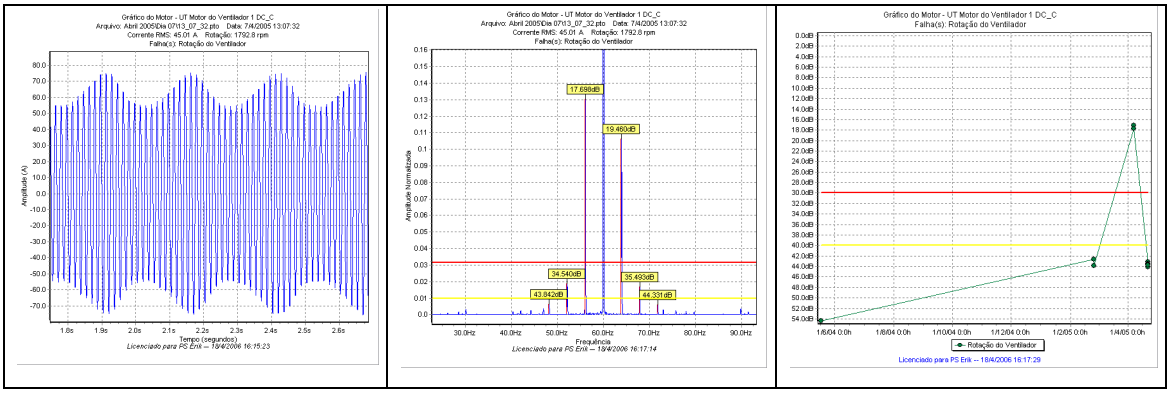
The last three items are worth describing in detail. This way:

1. MCSA Analyzer

The current signal of only one phase is acquired in order to monitor the development of failures in its spectrum which is referred to as current signature. Software Preditor® estimates the rotational speed and helps the analyst to determine the motor condition by pointing the characteristic frequencies of failure in the spectrum automatically. The system can receive constructive data of the transmission system and attached load in order to identify problems in both parts.

One can set up the alarm levels of each kind of failure for each motor specifically, and the system will monitor the motor condition by itself informing when the failure is severe and when an intervention is necessary.

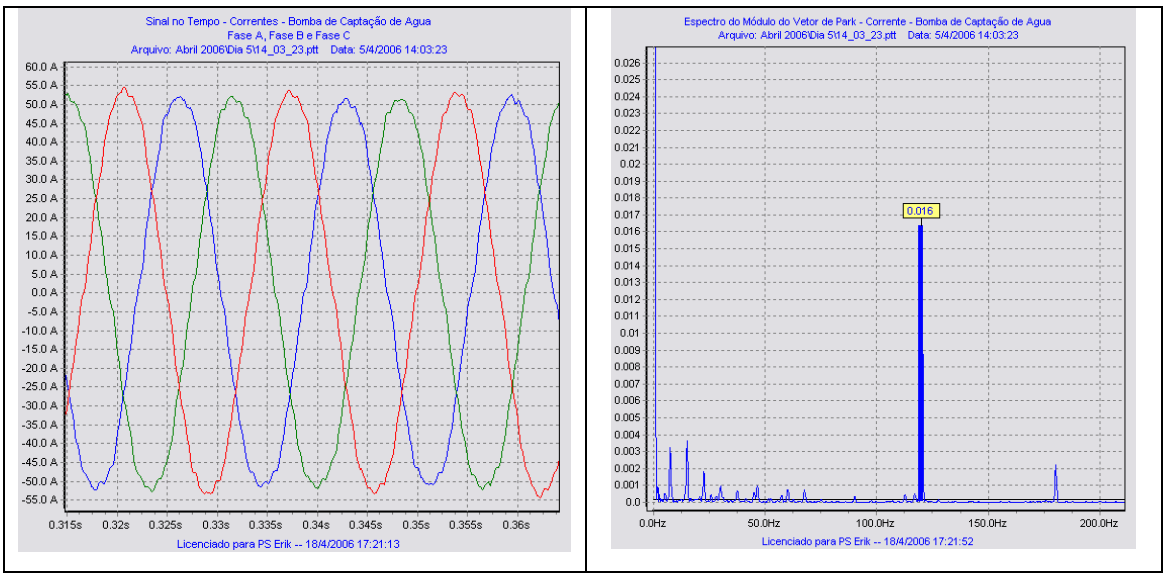
In the next figure, one can see the time domain signal, the motor signature and the tendency curve with the alarm levels:



2. Energy Analyzer

Two or three current and/or voltage signals are acquired in order to detect electrical failures. Preditor® is able to follow up stator asymmetries caused by shorted turns, hot spots, voltage imbalance, insulation deterioration, etc.

Like in MCSA, here one can set up alarm levels and monitor the development of the failures above. The next figure presents an example including the current signal in time domain and the electrical failure pattern in motor signature after manipulation of the three current signals:



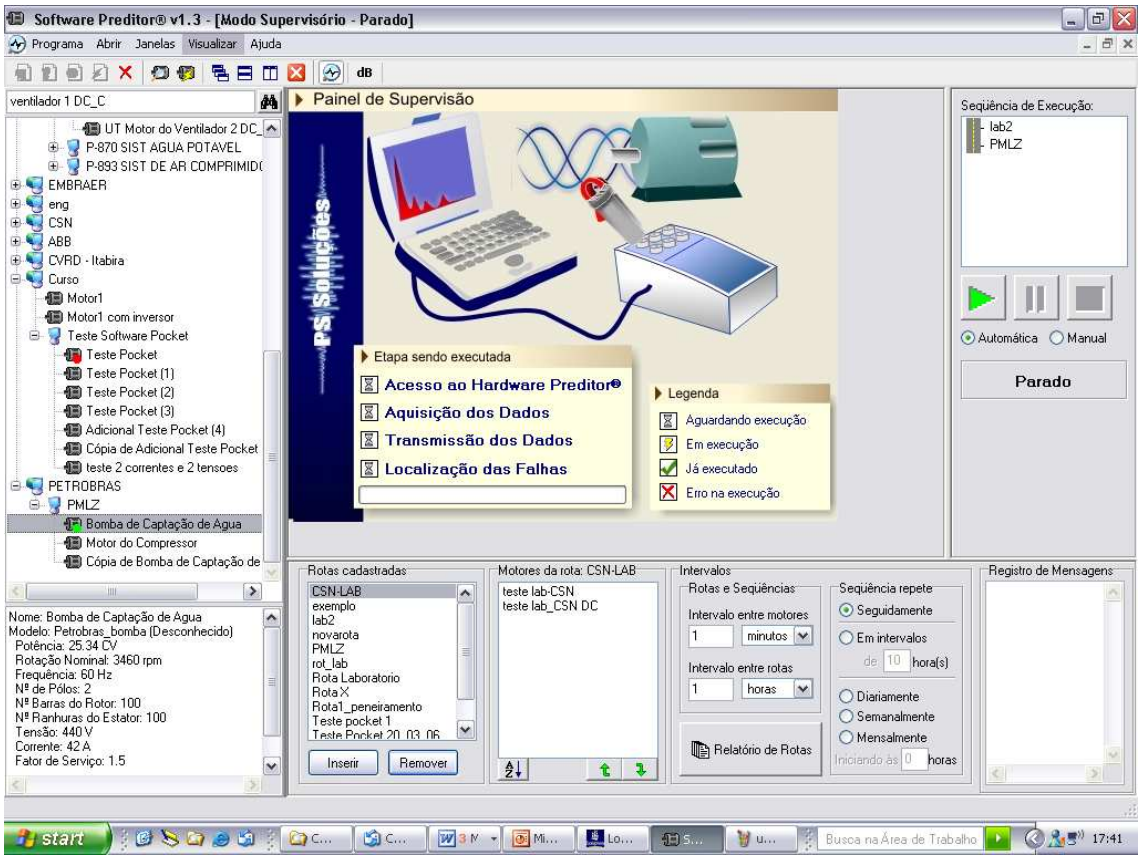
It's still possible to analyze the power quality in order to avoid reducing the motor life span as a result of poor feeding conditions. This way one can monitor the harmonic content, power factor, distortion factor, displacement

factor, reactive power, harmonic power, active power, apparent power, RMS currents and voltages, Total Harmonic Distortion (THD), etc.

3. Supervisory Mode

When the system is connected in a network (as explained in the following item), the Supervisory Mode is the tool to be used. In this mode, the user can create maintenance routes and run these routes automatically. The number of motors to be monitored is unlimited and the user defines the time between the acquisitions.

The system automatically estimates the rotational speed and calculates the failures patterns, refreshing the motor condition status according to the alarm levels set up previously. Reports about the routes execution and about the motors condition are made.



Models

In industry, Preditor® can be used in two different ways: portable or remote in an Ethernet network.

a) Portable Version

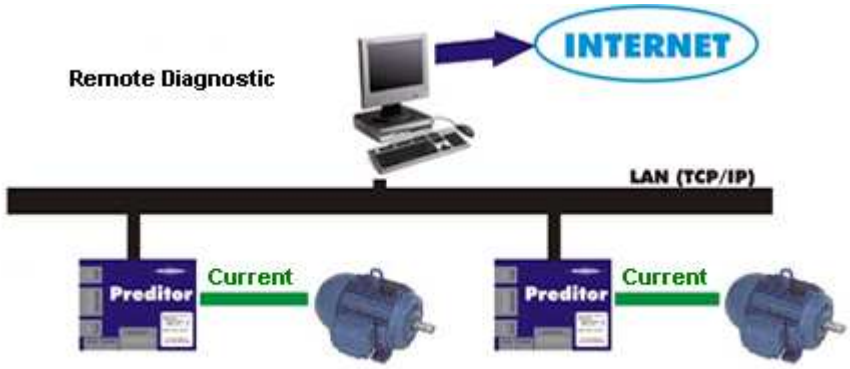
The portable version consists of a hardware Preditor® communicating with a Pocket PC through a portable wireless access point. All this together with the transducers comes in an appropriate transport bag designed for Preditor®.

This configuration is appropriate to collect data of motors out of the maintenance route. The main characteristics are:

- Simple use and very interactive;
- Routes are created in the supervisory mode and uploaded to the pocket PC;
- It's possible to include motors in field;
- It's possible to visualize the time domain signal, phasorial diagram and spectra through pocket PC;
- The embedded software helps the user to connect the transducers in the appropriate way;
- At the end the signals acquired are downloaded to the central computer for the whole analysis.

b) Remote Version

In the remote version, the communication is based on Ethernet network. Each hardware plugged in this network has an IP address and through the motor configuration the software knows exactly where each signal comes from. This way:



This way it is possible to monitor the motors conditions from a remote office with a group of expert analysts.

The hardware is installed in the electrical panel on the DIN trail.

Other Characteristics

- In Brazil, the main customers are mining, aluminum, steel and Oil companies.
- The selling policy involves a hands-on course on ESA, software customizations to satisfy the client specific needs, consulting during the period of the system implementation, analysis and diagnostic services.

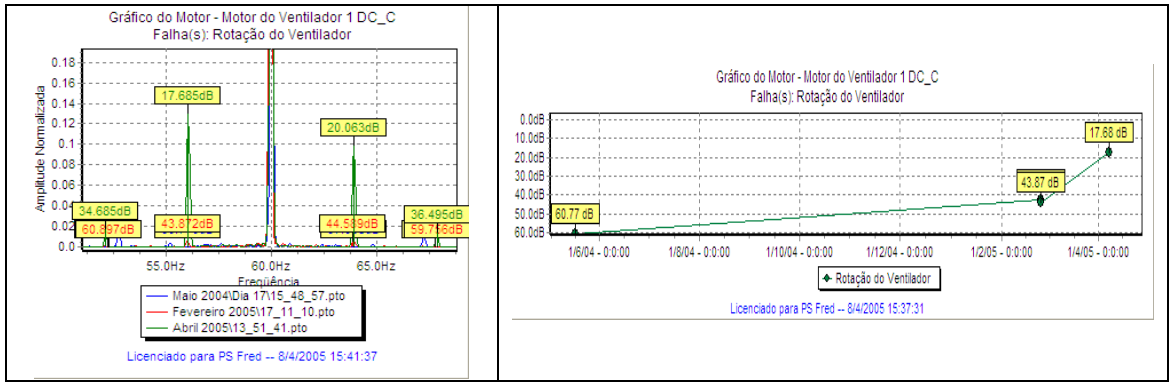
Industrial Cases (examples)

In order to exemplify the product potentiality, one presents two industrial cases:

1) Gearbox/centrifugal fan

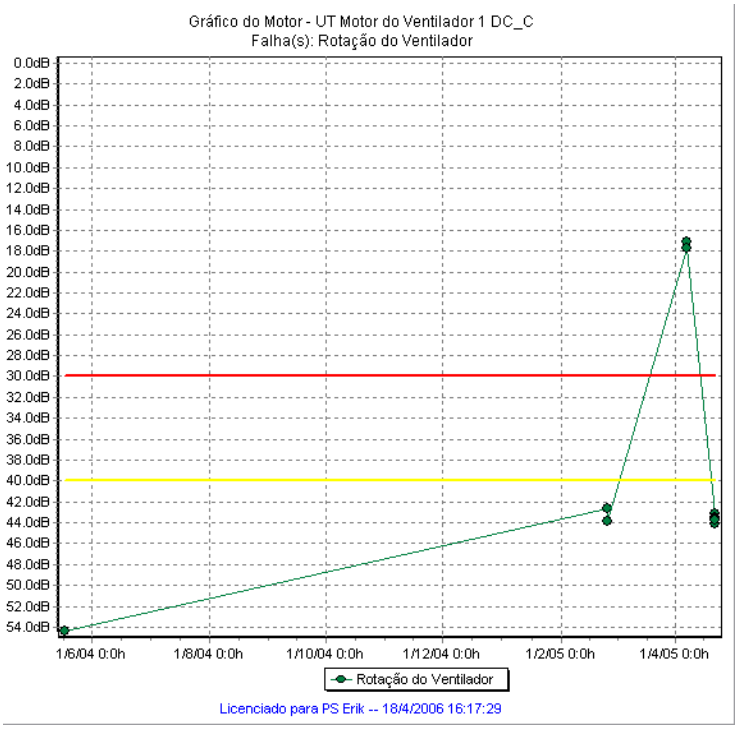
This industrial case has also happened in an aluminum company in Brazil. The motor constructive characteristics are: 60Hz, 4 poles, 72 A, 440 V, single-squirrel-cage-type rotor with 58 bars, rate speed 1780 RPM. The fan has 8 blades and the speed relation is 1:7.7.

The next figure shows the frequency components related to the fan rotational speed before (blue and red spectra) and after the failure (green spectrum). It is quite clear in the spectrum that the magnitude of these components has increased substantially (43.09 dB). The motor behavior had been followed up for one year and the tendency curve is also presented.



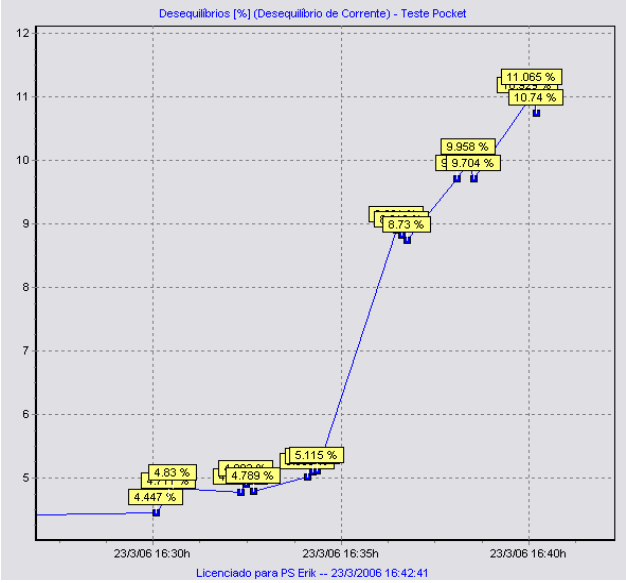
The diagnosis for this motor was: "presence of imbalance, misalignment or looseness in the fan set (including the gearbox)". The driven train was analyzed and, in fact, there was looseness in the gearbox.

After repair:

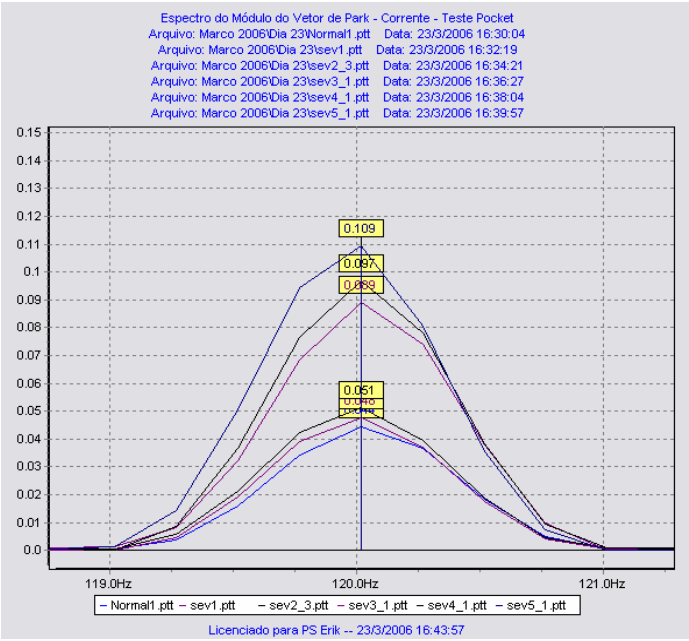


2) Shorted turns

In this case, a shorted turns fault was present and there were five levels of severity. The tendency curve shows exactly each level of severity from the normal condition to the worst condition (or most severe condition):



The components which have pointed the percentage of imbalance can be found in the spectrum:



Preditor® is an effective tool to diagnose electrical failures including insulation faults.