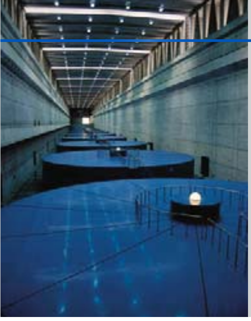


AN002

ZOOM Software Measurement and Graph Types

The ZOOM software operates under two measurement modes: Automatic and Test.

The Automatic mode records data automatically at user-defined intervals or alarm conditions for building trends, baseline and alarm analysis. The Test mode takes measurements upon user requests to provide machine insights for in-depth analysis during tests, inspections and transitory conditions, from standstill (static) to runaway speed.

In both cases, there are different types of measurements available. Each type is described below.

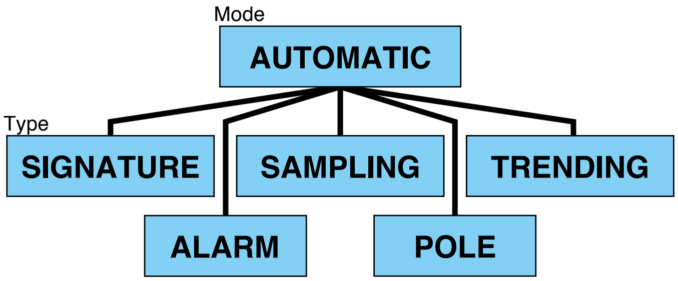


Figure 1: Measurement modes and types.

A) Measurement Section

<u>*Sampling Measurement*</u>

This is the basic type of data acquisition. Data is recorded as acquired. Channel #1 of each acquisition unit records samples at 6000 samples/sec. This traces an exact template of the pole faces (minimum 50 samples/pole for air gap on Channel #1). On additional channels per acquisition unit for air gap and other dynamic parameters[1], the lower 750 samples/sec. sampling rate is sufficient to ensure accurate results. When STATE[2] or BRIDGE[3] inputs are connected, the measurement records one value per input at the beginning of the measurement. Sampling measurement is primarily used for high speed analysis, and for system or measuring chain verification.

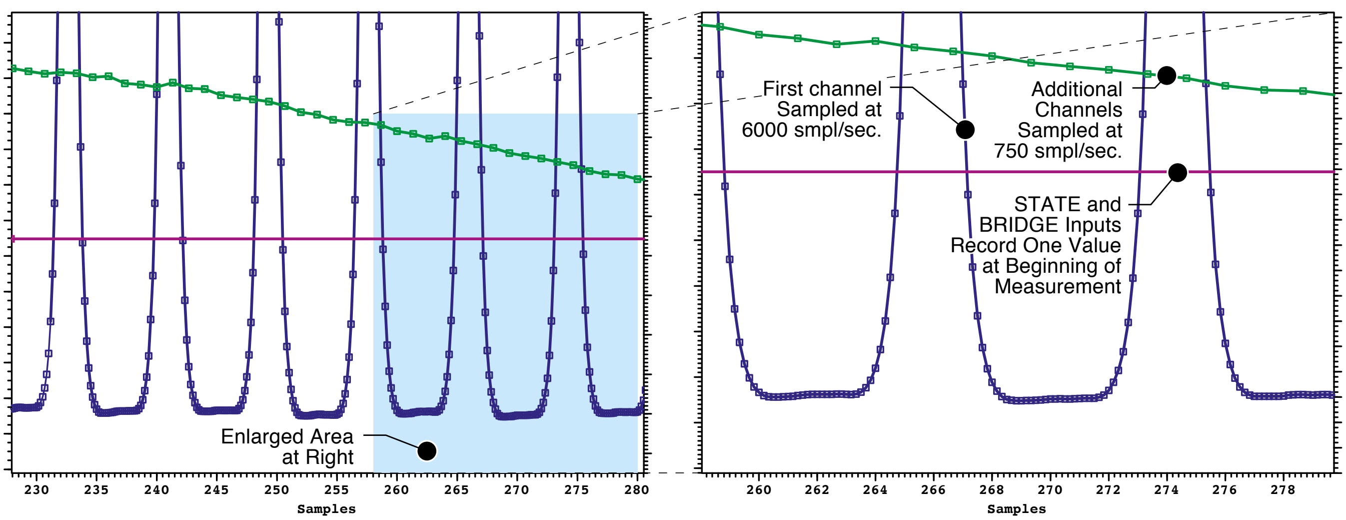


Figure 2: Graphs of Sampling measurement. Data is recorded at full sampling rate (6000 samples/sec. on Channel #1, 750 samples/sec. on additional channels, 1 value per measurement for STATE and BRIDGE inputs).

Notes on last page

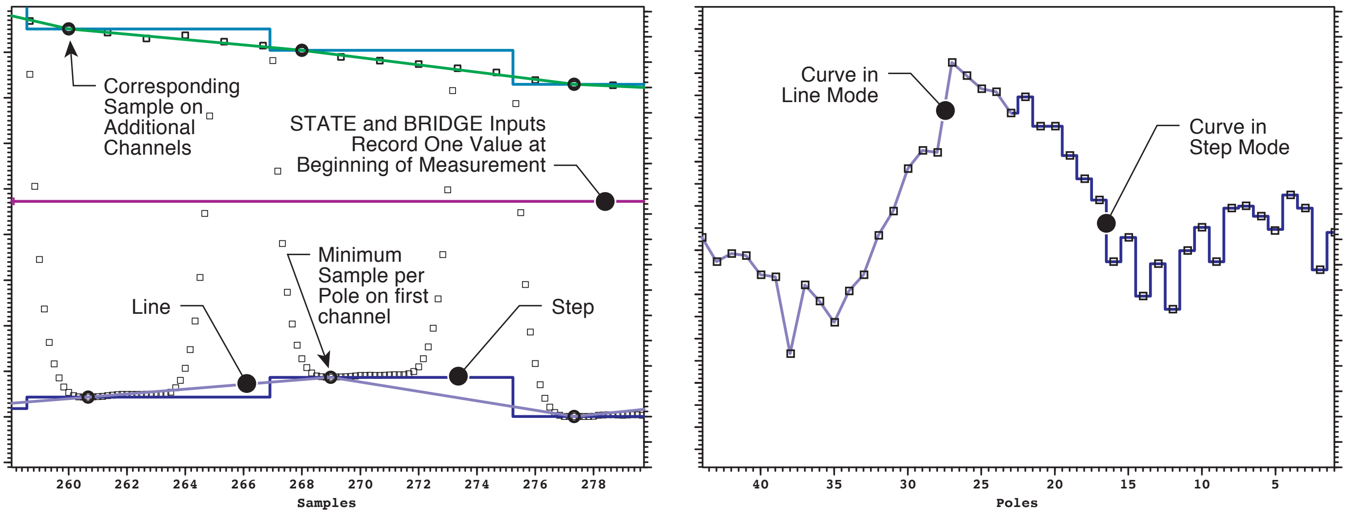


Figure 3: Graphs of Signature measurement. Each acquisition unit retains the minimum sample per pole on Channel #1 and corresponding samples for additional channels over one machine rotation. The graph at right shows the difference between curves traced in Line and Step modes.

Signature Measurement

This measurement is the result of second-level data processing. A Signature measurement is a snapshot of the machine. Each acquisition unit retains only the minimum sample per pole of Channel #1 over one machine rotation, as well as the corresponding sample for all additional channels. When a STATE module or a BRIDGE gateway is connected, the measurement records one value per input at the beginning of the measurement. This provides a number of readings per sensor equal to the number of rotor poles for any parameter input other than STATE and BRIDGE, except blade tip clearance which is equal to the number of turbine blades. Parameter correlation is referenced by the passing pole acting as physical markers on the machine. The graph can be displayed in line or step mode.

Pole Measurement

A Pole measurement is a series of consecutive Signatures over multiple machine rotations. The number of turns is user-defined and limited by the memory capacity (8192 readings) divided by the number of rotor poles. For example, 8192 readings ÷ 76 poles = 107.8 turns (approximately 68 seconds). However, most transitory conditions can be efficiently recorded with fewer turns. One value per STATE or BRIDGE input is recorded at the beginning of the measurement.

The Pole graph offers the possibility of displaying data for all poles or corresponding to a specific one. Looking at all poles over multiple rotations displays the range of variation (minimum vs. maximum, turn after turn). Focussing on data corresponding to one specific pole at a time emphasizes the stability of a parameter/input and reveals patterns and cycles.

Alarm Measurement

Like Pole measurement, Alarm measurement is a set of consecutive Signatures automatically triggered by an alarm occurrence. When readings breach one of the user-set thresholds per input (Hi, Hi-Hi, Lo, Lo-Lo) for at least three consecutive rotations, the measurement is triggered and recorded on all dynamic parameters. The number of recorded turns is also defined by the user – minimum 9 turns prior to alarm + turn of alarm occurrence + 10 turns after. This time, the STATE or BRIDGE inputs are recorded for the turn of the alarm occurrence only.

This measurement is valuable for analysis of data leading to the event and shortly after.

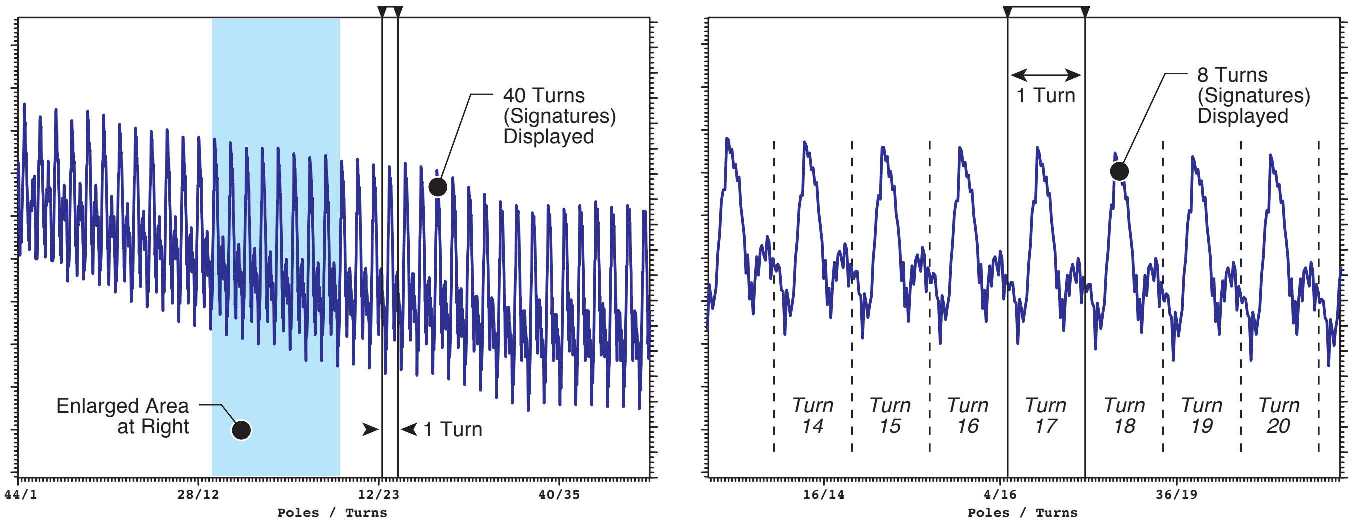
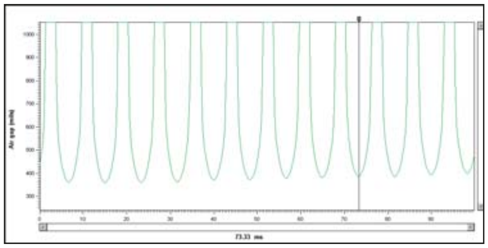


Figure 4: Graphs of Pole measurement showing parameter evolution over multiple turns. One can see the variation of rotor circularity, vibration amplitude, and patterns.

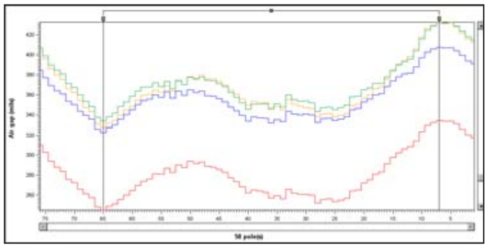
Trending Measurement

This measurement is an average calculation recorded on all dynamic, STATE and BRIDGE inputs at user-defined intervals as frequent as every 15 minutes down to once a month. The system continuously calculates an average for each turn (***t***) where the sum is: A) a value for turn [***t***] + B) the calculated sum of the previous turn [***t***-1], then C) divided by 2. It calculates three values per input: minimum, maximum and average. For minimum and maximum trend values, part A) uses the actual minimum and maximum readings of turn [***t***]. For average trend value, part A) is the sum of all readings for turn [***t***] divided by the number of readings (poles).

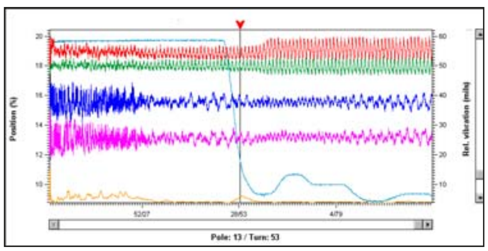
It shows the evolution of a parameter over an extended period of time ranging from days to months. This time, both dynamic, STATE and BRIDGE inputs can be correlated on a graph.



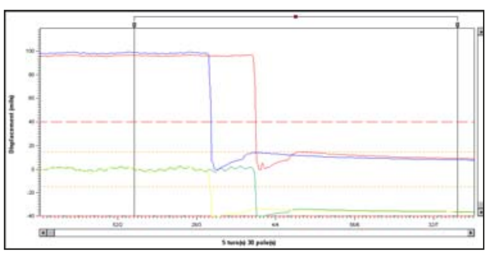
Sampling Graph



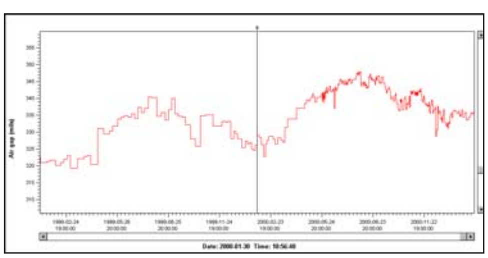
Signature Graph



Pole Graph



Alarm Graph



Trend Graph

B) Graph Section

Stored data can be processed and displayed in four types of graphs: X-Y rectangular, polar views, and spectrums.

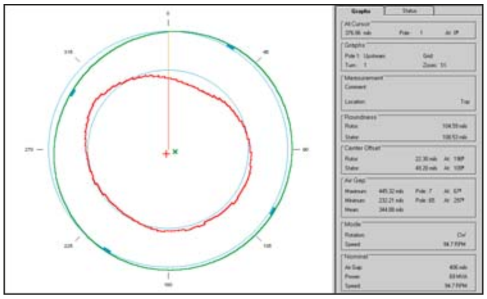
<u>*Rectangular graphs*</u>

These graphs are used to display Sampling, Signature, Pole, Alarm and Trend measurements. In this form, the Y axis is the parameter value while the X axis varies according to the measurement type: Sampling graph is relative to samples, Signature graph is relative to rotor poles for one machine rotation, Pole and Alarm graphs are relative to turns subdivided into rotor poles, and Trend graph is relative to time subdivided into dates and hours.

Up to 15 color-coded curves can be displayed simultaneously. A series of features and options allow to: enlarge areas, position cursors that can be combined over multiple graphs, use delta to display variations between two points, view alarm levels, view all poles or a specific one, alternate between top and bottom air gap sensors, display curves in dot, line or step modes, etc.

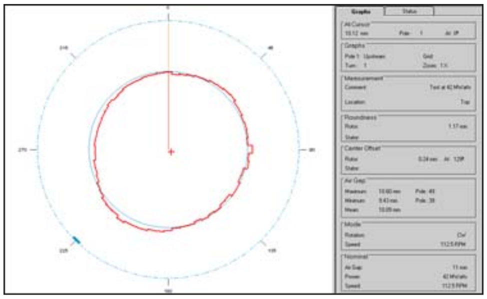
Polar Graphs

The uniqueness of the ZOOM software is its ability to represent critical parameters in a polar fashion. The polar graphs are used to display generator air gap, rotor shape only, turbine blade tip clearance (Kaplan/propeller), and shaft orbit.



Generator Air Gap Polar Graph

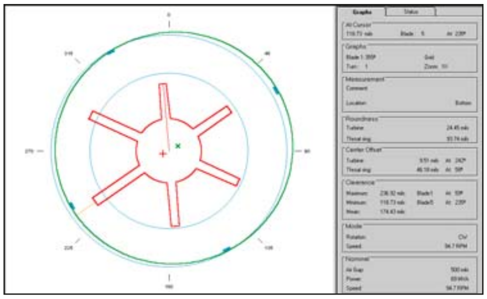
The generator air gap and rotor shape graphs can be plotted from Signature and Pole measurements. The Polar graph of generator air gap shows the rotor inside the stator where the stator shape is calculated from all sensor information. The Polar graph of rotor shape traces the shape as seen by any user-selected sensor.



Rotor Shape Polar Graph

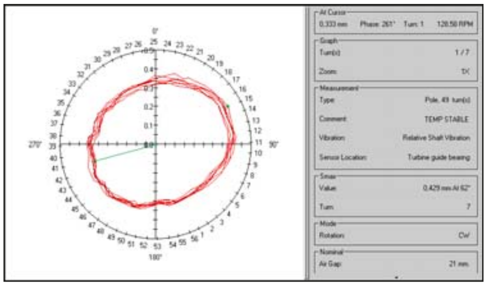
Both graphs are displayed with various valuable numerical information. The default upstream position of the rotor can be changed to minimum gap and maximum gap positions to emphasize critical angles. Other features include: enlarging rotor and stator shapes, displaying reference circles as well as circular grids in the background, and alternating between top and bottom sensors to plot respective rotor rim layers. Plotting from a Pole measurement allows to visualize dynamic variations by displaying one turn at a time during transitory conditions such as start-up, field excitation, shutdown, load rejection and overspeed.

The Polar graph of the turbine blade tip clearance, for Kaplan and propeller-type turbines, shows turbine blades inside the discharge ring. It is also plotted from Signature and Pole measurements, and offers the same features such as enlargement, rotation, grid, and numerical values.

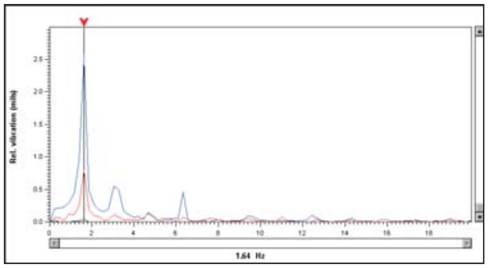


Turbine Blade Tip Clearance Polar Graph

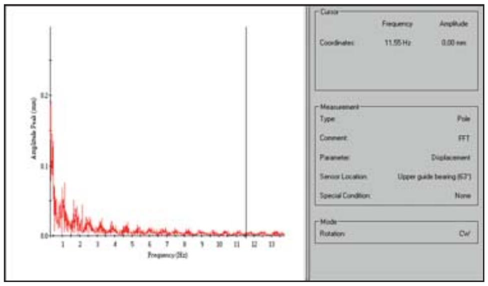
The shaft orbit graph from our ZOOM ANALYST³ software is unique in the way that it presents the shaft displacement relative to the rotor poles. This permits quick balancing of the machine as each point indicates the pole in the angle of the imbalance. It can be plotted using guide bearing data from Signature and Pole measurements. It can display any number of rotations starting from any turn and trace a grid in the background. A marker indicates the maximum point of each plot. It also comes with various numerical values.



Shaft Orbit Graph



Spectrum Graph from ZOOM Application software



Spectrum Graph from ZOOM Analyst software

Spectrum Graphs

Low and high frequency spectrum (FFT) graphs can be traced by the ZOOM Application[3] or ZOOM Analyst[3] software, using data from Sampling, Pole and Alarm measurements (at least 256 data registers). The low frequency FFT graph of the ZOOM Application software uses Pole or Alarm measurements of any parameters, while the high frequency FFT graph uses Sampling measurements of any parameters. The amplitude is displayed relative to the frequency (Hz) component.

The spectrum graph from the ZOOM Analyst software uses displacement and vibration data from the same types of measurements. More powerful and user-friendly, it boasts greater functionality, displays curves by frequency or order, indicates the highest peak, and provides many numerical values.

1. *Dynamic Parameters: fast evolving parameters for correlation and behavior analysis.*
2. *STATE Inputs: slow evolving parameters (quasi static, do not change significantly over the duration of a measurement) for complementary information and trending purposes.*
3. *BRIDGE Inputs: slow evolving parameters acquired from the PLC/SCADA network for complementary information and trending purposes.*
4. *ZOOM Application and ZOOM Analyst: graphic user interface (GUI) modules for data analysis offering various tools and graphic features.*

For more information, contact VibroSystM at:
2727 East Jacques-Cartier Blvd
Longueuil (Quebec) J4N 1L7 CANADA
Tel.: +1 450 646-2157 • +1 800 663-8379 (US only)
Fax: +1 450 646-2164
Email: sales@vibrosystm.com
www.vibrosystm.com