



# Understanding ZOOM's Shaft Orbit Graph

The Orbit graph from the ZOOM ANALYST software provides a unique view of the shaft position relative to the actual position of the rotor poles. This is possible because of our Pole-reference method<sup>1</sup>, in which the rotor poles measured with air gap sensors serve as physical markers around the machine rotational axis, as opposed to traditional Time-reference method, which uses a simple key phasor probe to provide an angle estimate. The method makes it very easy to find the exact location of the rotor imbalance (heavy spot) of any point of the shaft orbit. This information can be correlated to the rotor circularity and geometric center offset as provided by the air gap polar graph. This allows comprehensive shaft behavior analysis and quicker rotor balancing, which translates into shorter downtime and increased machine availability.

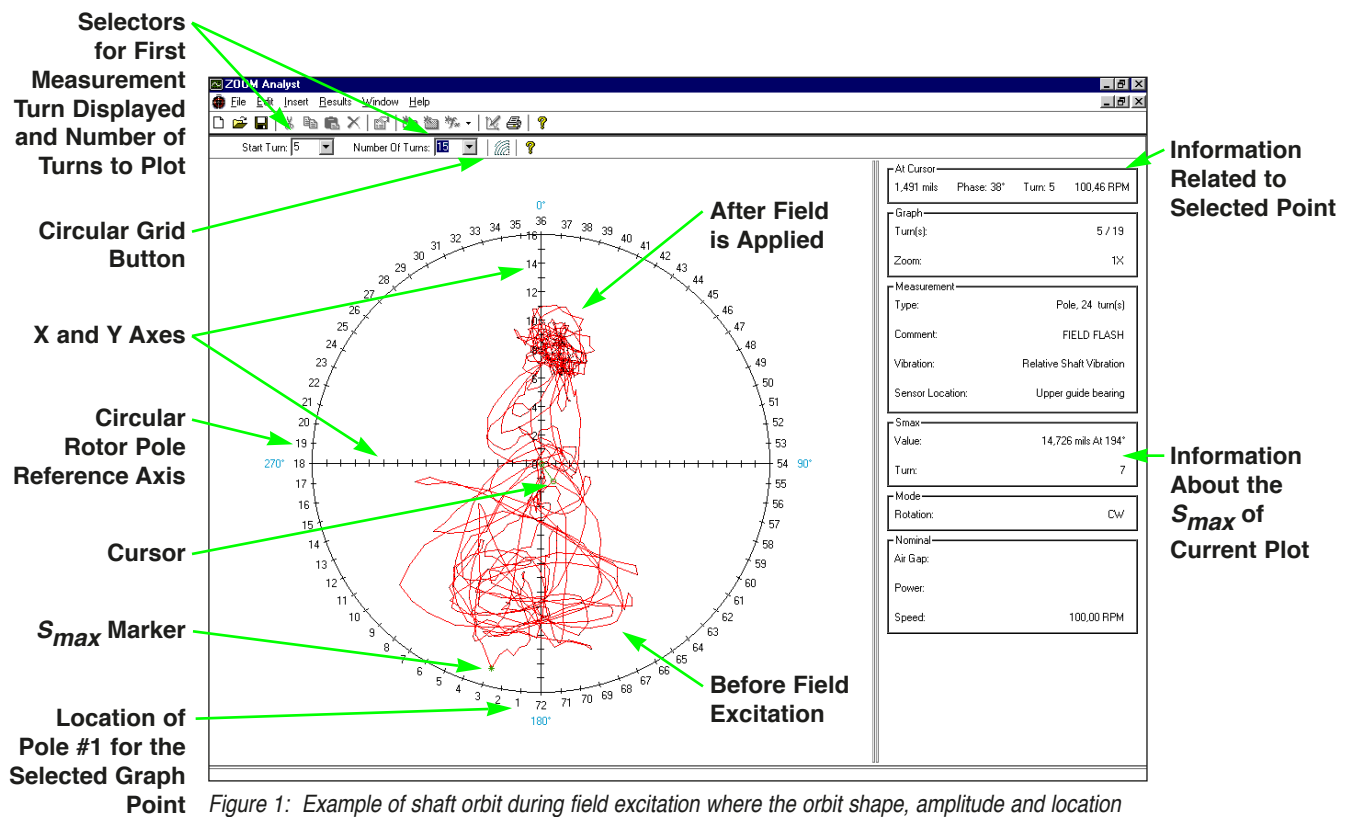


Figure 1: Example of shaft orbit during field excitation where the orbit shape, amplitude and location changes.

The orbit is traced by calculating the resultant vector ( $S$ )<sup>2</sup> summation from the X and Y proximity probes located at the guide bearings. As ZOOM synchronizes data acquisition of vibration inputs to the passage of each rotor pole during a machine turn, it provides a number of samples per rotation equal to the number of rotor poles. Therefore, the resultant vector is relative to rotor poles instead of degrees.

The graph presents the shaft orbit plot over two grids in the background: the X and Y axes, and the circular rotor pole axis. The center corresponds to the geometric average of all the orbit points displayed. The X and Y axes intersecting at the center of the graph are automatically scaled to provide the best and largest view of the orbit. The outer circular axis is incremented by the number of rotor poles and the numbering rotates according to the selected orbit point. In the process, not only does it tell the position of each rotor pole at the time of the selected

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orbit point, it also shows the pole in the angle of the imbalance. Optionally, the user can display a grid of concentric circles related to the X and Y axis increments.

The orbit graph is traced using data from Signature and Pole measurements<sup>3</sup>. When tracing an orbit from a Pole measurement, the software plots by default all turns comprised in the measurement, but the user can specify the first turn to be displayed and the number of turns to plot. This can be useful to emphasize specific moments of the measurement, especially during transitory phases such as start-up, field excitation or load rejection. In the case of a Signature measurement, only one machine rotation is plotted.

For each plot, a marker indicates the  $S_{MAX}$  location of the displayed orbit and a cursor indicates by default the first point of the plotted orbit. By selecting any point on the orbit, the rotor pole numbering will rotate and the user will be provided with the numerical information of the selected point appearing on the right hand side of the screen.

The first box at the top displays “At Cursor” information for the selected point comprised of: the position relative to the geometric center of the plot, the phase which corresponds to the angle relative to Pole #1 rotation-wise, the measurement turn of the selected point, and the machine rotational speed for that turn. The fourth box provides the “ $S_{MAX}$ ” information for the current plot indicating: the value from the geometric center of the plot, the angle from the upstream  $0^\circ$  reference, and the measurement turn of the data. If one changes any parameter of the plot (i.e. start turn or number of turns plotted), the display is refreshed and the values for “At Cursor” and “ $S_{MAX}$ ” are automatically updated to the new geometric center of the refreshed plot.

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