# Full Spectrum Analysis

A description of the full spectrum plot with examples.

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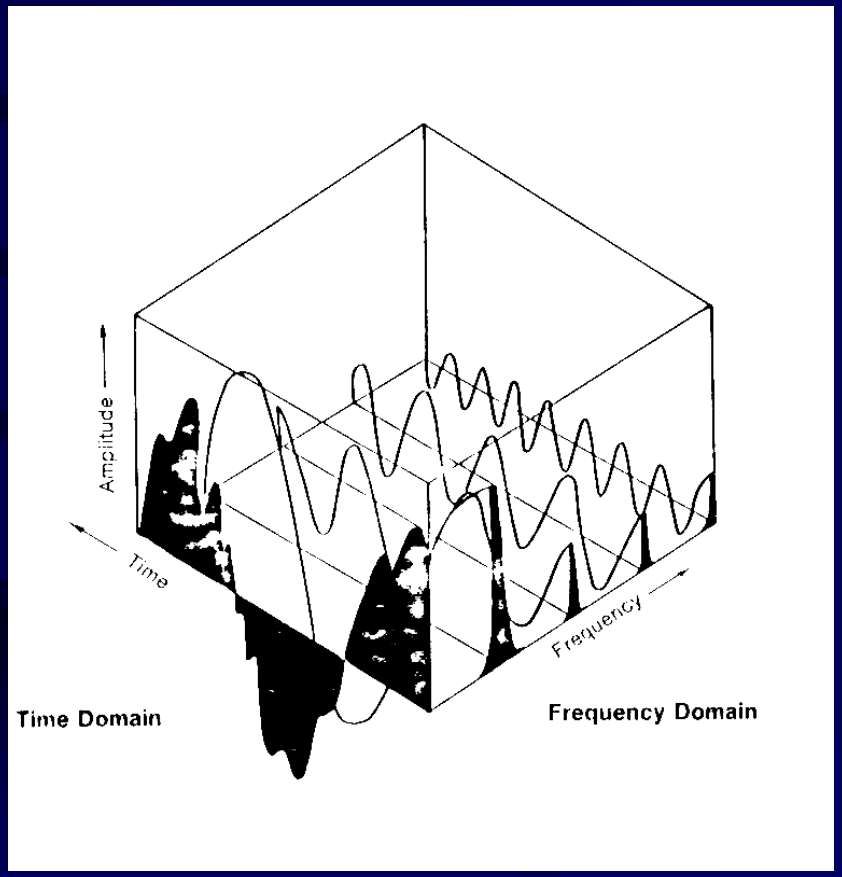
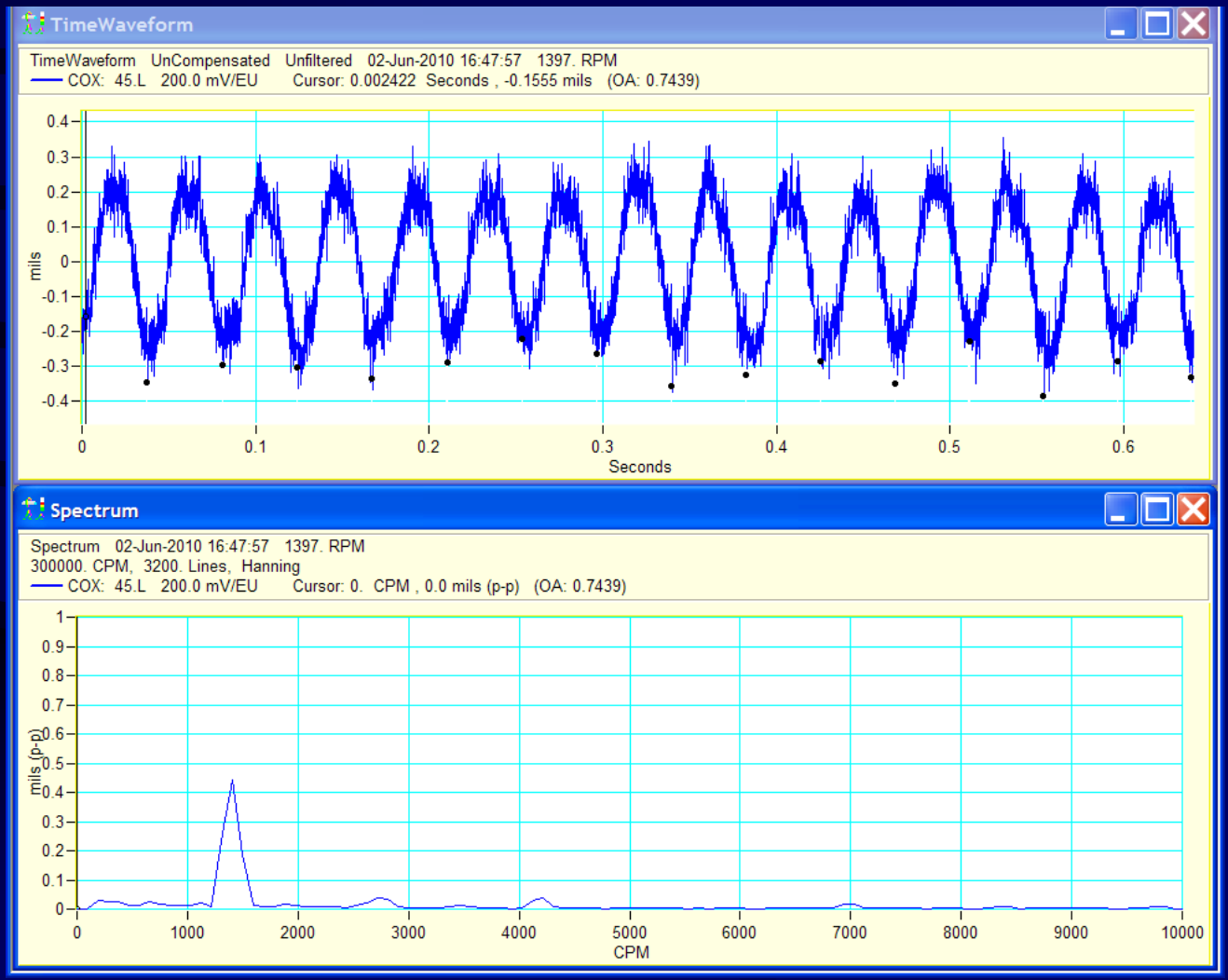
# Time and Frequency Domain



# Basic FFT Plot



# Basic FFT Characteristics

- 1024 time waveform points used with 400 line spectrum
- 1024 time waveform numbers produces 1024 FFT numbers
  - 512 cosine terms
  - 512 sine terms
- FFT has both amplitude and phase content

# Basic FFT Characteristics, cont

- Most FFT plots display 400 lines (for 1024 waveform points)
  - Units are magnitude (phase characteristics are hidden)
  - Lines 401 to 512 are truncated to reduce the risk of aliasing and based on history

# Basic FFT Characteristics, cont

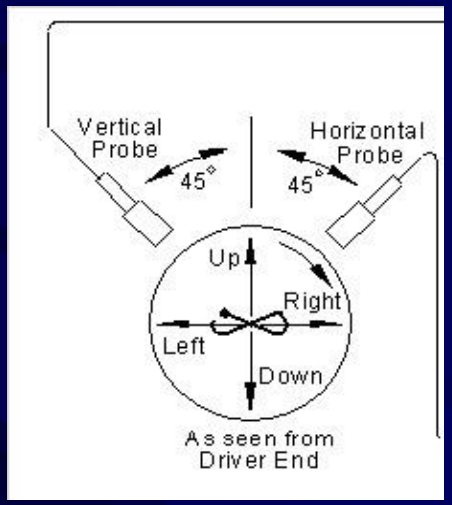
- Referred to as a “half” spectrum
- Displays a limited amount of data from the waveform
- Is fully reversible if phase content is preserved

# FFT Summary

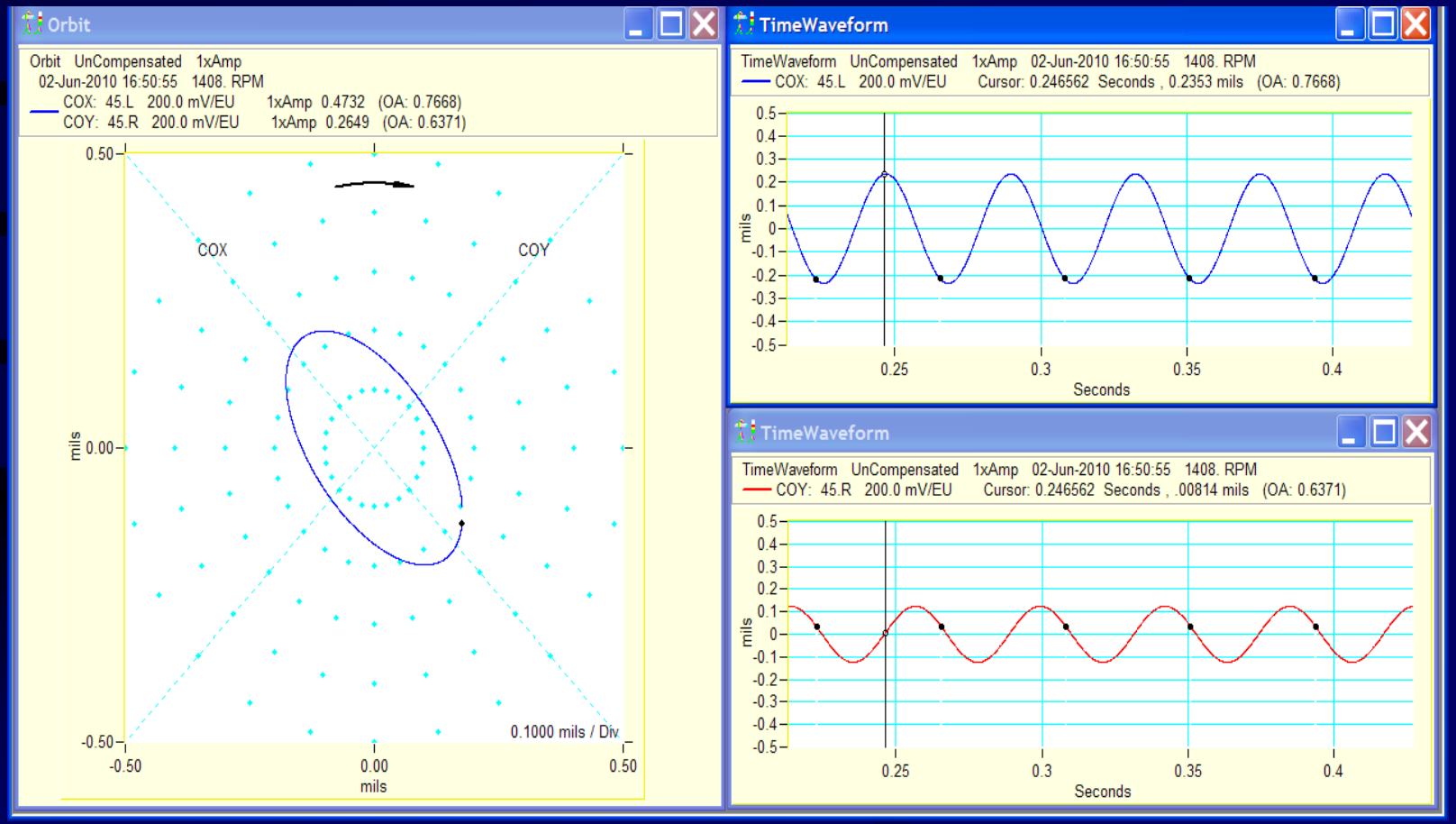
**Magnitude FFT plots display 400 lines of data for a 1024 sample waveform. Internally, the FFT routine calculates 1024 frequency values including 512 sine and 512 cosine terms. The data is presented as magnitude $\{(\text{sine}^2+\text{cosine}^2)^{1/2}\}$ and truncated from 512 frequency points to 400 to reduce the risk of viewing aliased data.**

# Orbit Plot Development

- Using two orthogonal probes



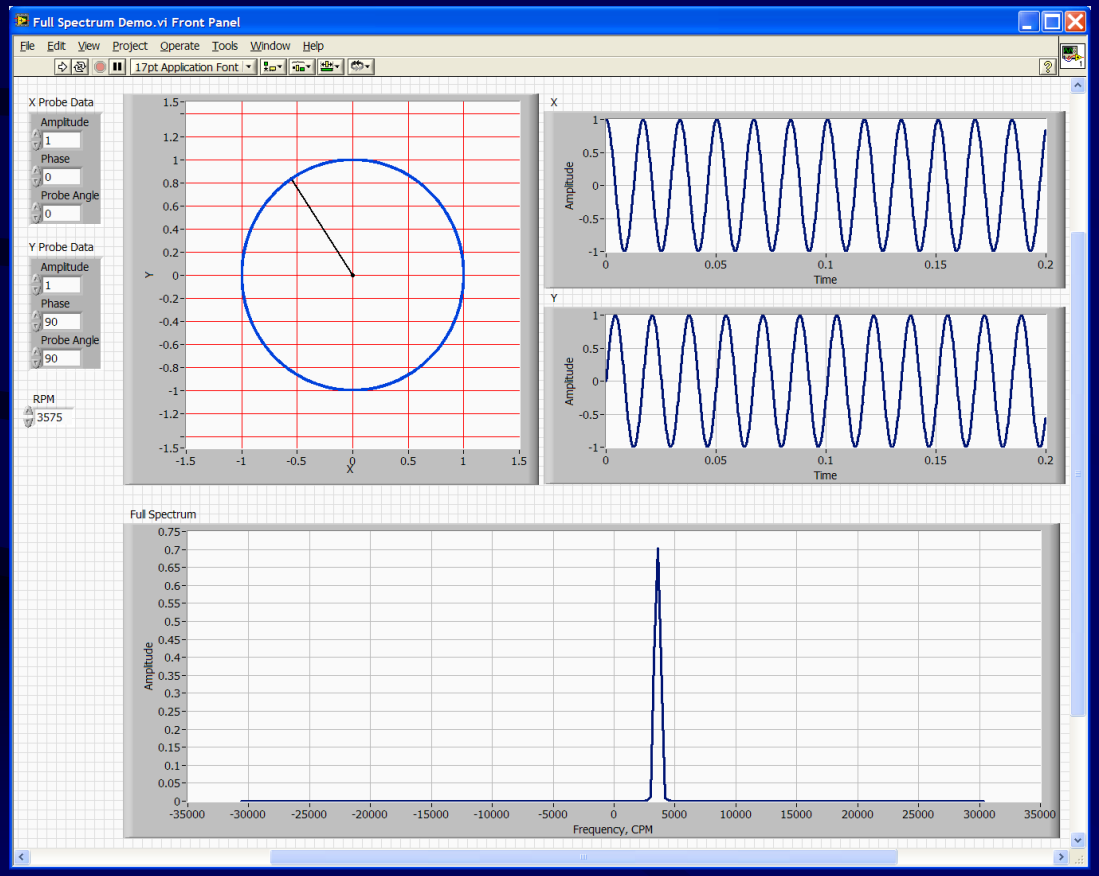
# Orbit Example



# Full Spectrum Introduction

- Full Spectrum plot is a sort of FFT display that is used to separate data from orthogonal pairs into “forward” and “reverse” precession

# Precession Demo



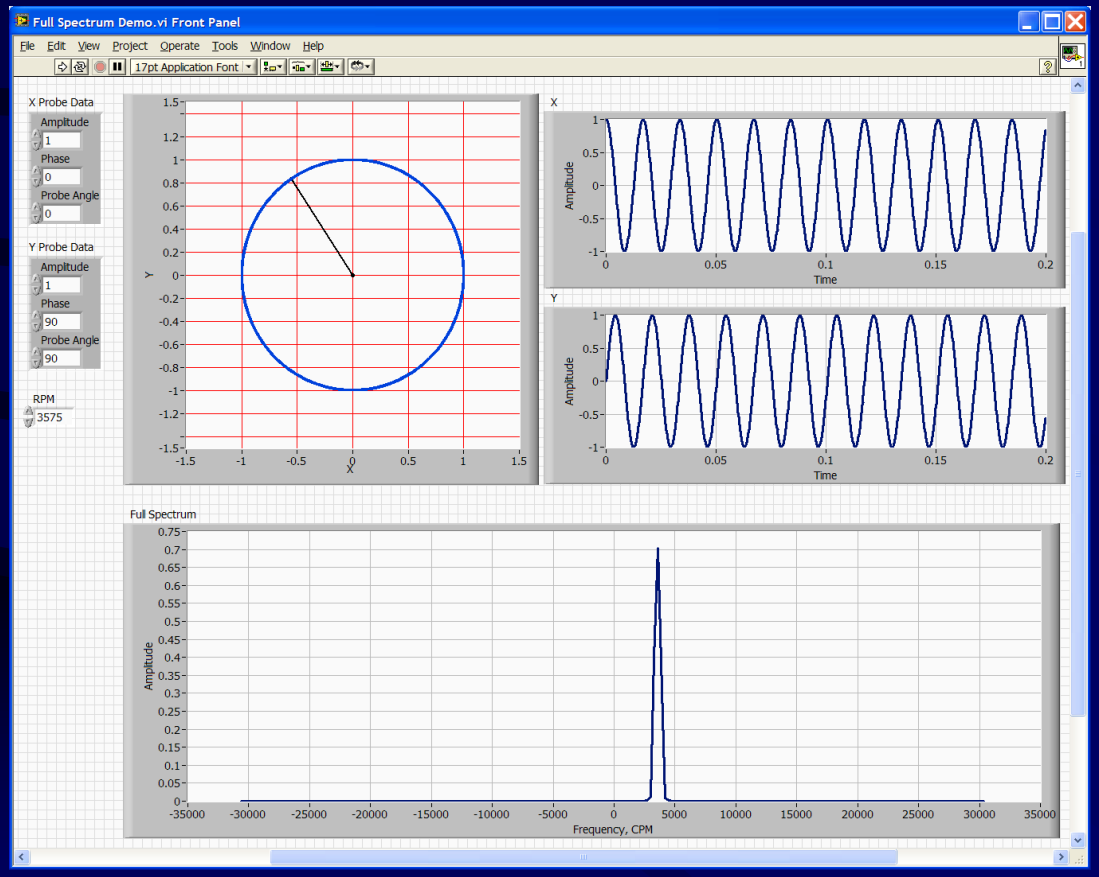
# Forward/Reverse Calculation

$$Forward\ Component = \frac{1}{2}\left[X^2 + Y^2 + 2XYsin\left(\emptyset_x - \emptyset_y\right)\right]^{0.5}$$

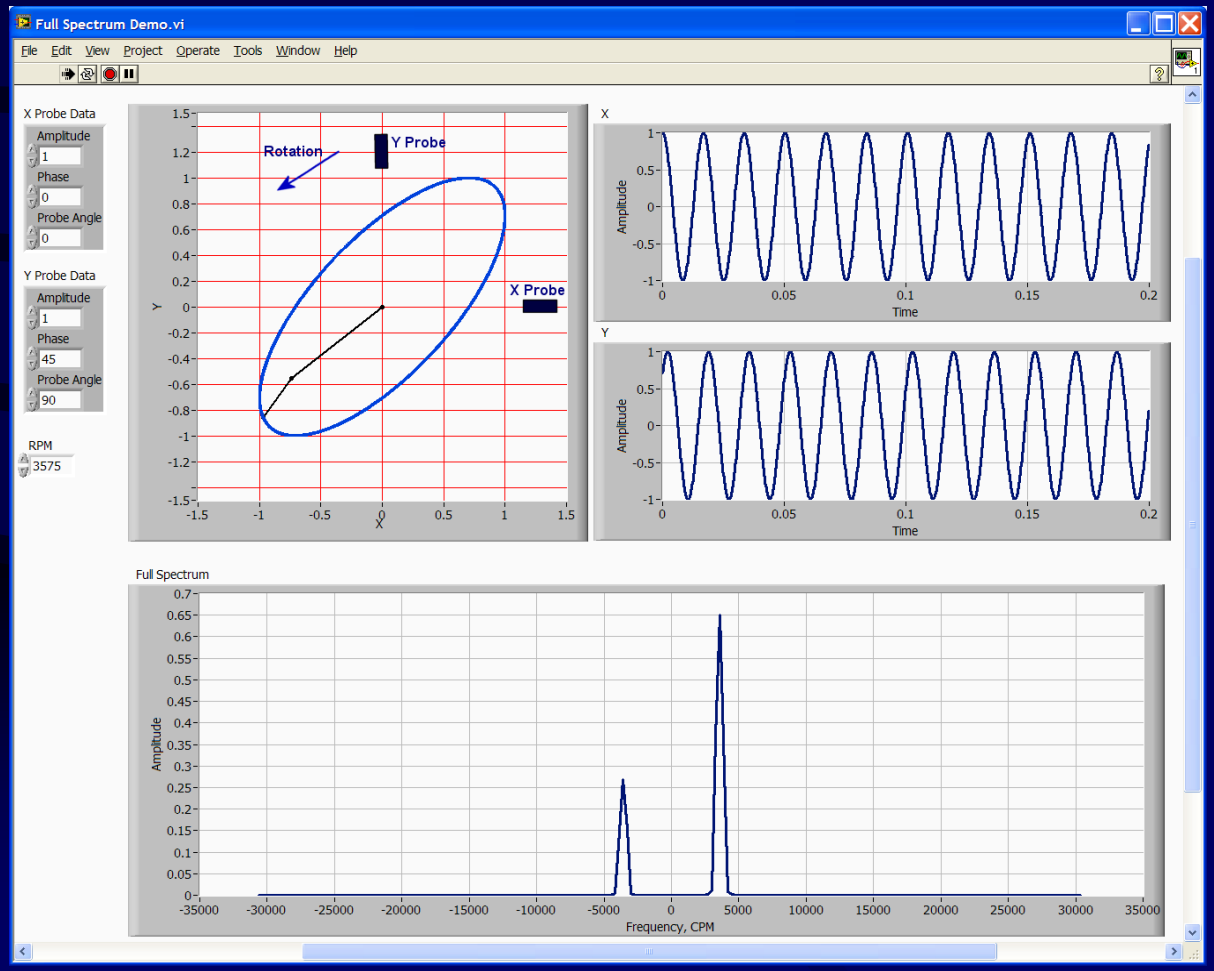
$$Backwards\ Component = \frac{1}{2}\left[X^2 + Y^2 - 2XYsin\left(\emptyset_x - \emptyset_y\right)\right]^{0.5}$$

| Description | Conditions | Comments |
|---|---|---|
| All forward amplitude | Circular orbit (figure 5) | Rare perfect orbit likely due to unbalance with symmetrical bearings/supports |
| Forward amplitude with some backward component | Elliptical orbit (figure 7) | Normal rotor response with non-symmetric vertical/horizontal bearing and/or support stiffness |
| Forward and backward components equal | Orbit is a straight line (same amplitude but with both probes either in phase or 180° out of phase) (figure 8) | Can be caused by misalignment type loading of a bearing |

# Circular Orbit – Pure Forward



# Elliptical Orbit – Forward/Reverse Mix



# Straight Line Orbit – Forward/Reverse Equal