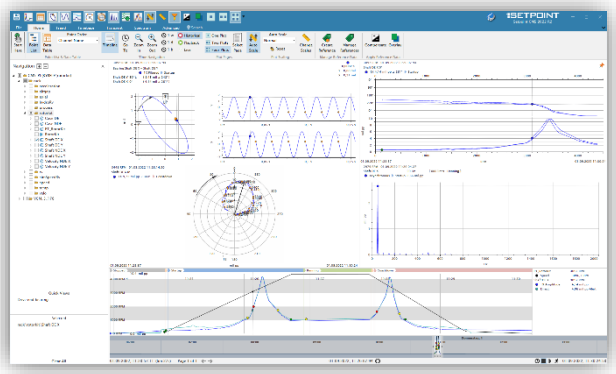
Brüel & Kjær Vibro
A member of the NSK Group

Product Specifications and Ordering Information

SETPOINT® CMS Visualization

Overview

SETPOINT® CMS client application and AVEVA™ PI Vision™ provides an easy-to-use plant-wide visualization solution for plant wide condition monitoring of rotating and reciprocating assets.



SETPOINT® CMS is used for plant wide monitoring and diagnosing machines when online monitoring with the AVEVA™ PI System™ or SETPOINT® CMS-XC, or offline monitoring with VC-8000 flight recorder data. It is a free download available at www.bkvibro.com. When used with AVEVA™ PI System™, AVEVA PI Vision serves as the primary visualization environment where the user frequently builds "dashboards" with trend and statuses. SETPOINT® CMS displays are used in these instances as a secondary "drill down" utility to examine detailed waveform data and specialized plot types used by vibration specialists. When used with CMS-XC or flight recorders, SETPOINT® CMS is the only visualization environment available. Its primary use is to allow vibration diagnosticians to visualize data and assess machinery condition details using the specialized plot types unique to vibration.

POWERED BY AVEVA

Comparison of Visualization Capabilities

		PI Vision	SETPOINT® CMS
SUPPORTED PLOTTYPES	Multivariable Trends	●	●
	Alarm Statuses / Lists	●	●
	Tabular Data	●	●
	APHT	1	1
	Polar		●
	Bode		●
	Spectrum		●
	Orbits		●
	Timebase		●
	Autocorrelation		●
	Shaft Centerline		●
	Waterfall		●
	Cascade		●
	Compressor Map		2
	Rod Position		●
	Displaced Volume		●
	Crank Angle		●
	Unrolled (Linear) Rotor Profile		●
	Unrolled (Linear) Stator Profile		●
	Circular Rotor Profile (Air Gap)		●
	Circular Magnetic Flux Profile		●
	Plant/Enterprise Diagrams	●	
	Machine Train Diagrams	●	
	X vs. Y	●	
Point Selection / Navigation		●	●
Plot overlay support		●	●
View via Web Browser		●	
Report Generation			●
Export to Microsoft Excel[3]		4	●
Export to .cms file format			5
Multi-state analysis		●	●
Bearing Fault Frequencies			●

TABLE NOTES:

1. APHT = Amplitude / PHase versus Time. Available via standard trend plot capabilities.
2. Requires Compressor Controls Corporation TrainView™ server as data source; consult factory for details.
3. Export format is comma separated variable (.csv).
4. Requires supplementary PI DataLink software from AVEVA™, an Excel toolbar add-in.
5. An open data file format allowing users to export data, share with others, and view using the free SETPOINT® CMS software.

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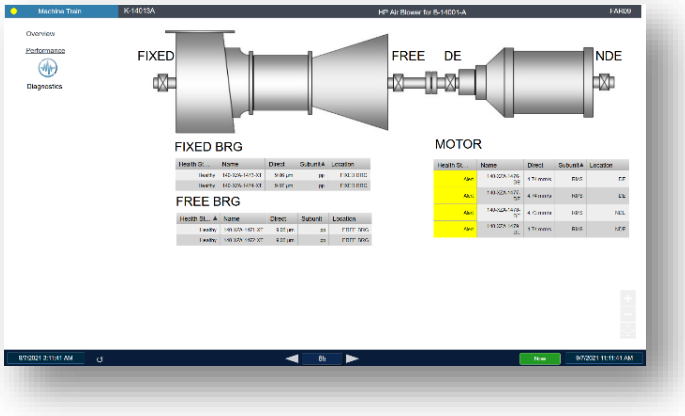
AVEVA PI Vision is used with the AVEVA PI System. It is a web server from AVEVA™ used in thousands of installations worldwide. It connects data sources (AVEVA™ PI Server™) to visualization clients (web browsers) and provides a rich suite of tools for visualizing health and trend information. When used with SETPOINT®, it serves as the platform for basic system navigation, machine train diagrams, machinery health monitoring, asset hierarchy diagrams, alarm lists, statuses, and static data trends. When the user needs to view waveform data for more detailed analysis, quick view links allow navigation to SETPIONT® CMS client launched from within AVEVA PI Vision web pages to bring up appropriate plots for the selected asset.

Simple “Traffic Light” alarm navigation quickly guides users to events enabling quick resolution with AVEVA PI Vision.



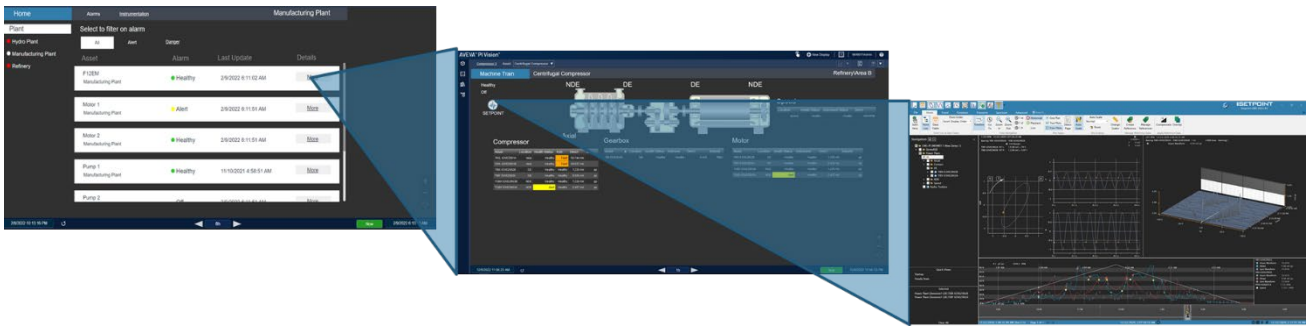


Figure 1, Drill down navigation from enterprise to asset

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Features and Benefits

Pick up where you left off
You may be an expert in rotating equipment, but you are perpetual beginner when it comes to finding your way around software. A customizable setup, domain specific menus and tooltips make options intuitive to find even if you have not used the app for weeks.

Simple, intuitive user interface
We designed the user interface by looking at popular stock trading and audio editing software, borrowing the concept of a timeline and time slider to quickly navigate to the data range of interest. Once there, you can easily zoom in and out, drop a cursor, and see data in all of the powerful plot formats you need as a machinery diagnostic professional.

Never miss important data
There's absolutely nothing worse than incurring a machinery trip, upset, or other event – only to find that the system failed to collect data when it was needed the most. This simply won't happen with SETPOINT®. With VC-8000 we blend a completely unique (and patented) method of collecting waveform snapshots with ultra-fast (80 ms "fast trend") capture of static data. We then examine the data to see if it reflects significant change from prior data, discarding data that reflects "no change" and keeping data that reflects "change". The result is a perfectly tailored data profile that retains neither too much nor too little. Tiny but meaningful excursions in machine behavior that other systems miss are caught by SETPOINT®.

Unparalleled ease of data sharing
We borrowed the concept behind the portable document format (.pdf) and extended it to vibration data for the first time. The concept is simple: customers should pay for the infrastructure that creates the data, not the application that views the data. With SETPOINT® CMS, once data has been collected, it can be saved in an innovative .cms format that preserves everything of interest: machinery hierarchy, configuration parameters, waveforms, static data, alarms – everything. Simply select the data points and data region of interest, save as a .cms file, and then share with anyone you want, anywhere in the world. To open, view, and interact with the data (including playing back recorded data), they simply download our free SETPOINT® CMS application from the web – completely analogous to using a free PDF viewer. No more cumbersome licenses to administrate when trying to share data with people inside or outside of your organization.

Easily see when waveforms have been collected
Our trend plots provide intuitive indicators showing exactly where waveforms have been collected. The trend's tic marks indicating waveform collection are color coded so you distinguish synchronous from asynchronous samples, and the height of the tic mark even captures the "interestingness" of the data – in other words, how significantly it has changed relative to surrounding data.

State Analysis
Easily identify changes in condition with color coded plot data. State based analysis enables comparison of like for like making issues pop out of the screen.

Plot overlays
Did something change? Easily compare two plots by overlaying them – such as a startup from two separate times to compare a known good baseline data set with a that from a recently refurbished rotor. Did a resonance shift? An amplification factor? The frequency content of two spectra on the same bearing months apart? Plot overlay capabilities make this activity simple and intuitive.

Replay events with playback
Want to see how an event developed over time? Simply press the play button to automatically review data. No more searching for data one plot at a time.

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SETPOINT® CMS Display

Export data archive and enable pain free remote diagnostics

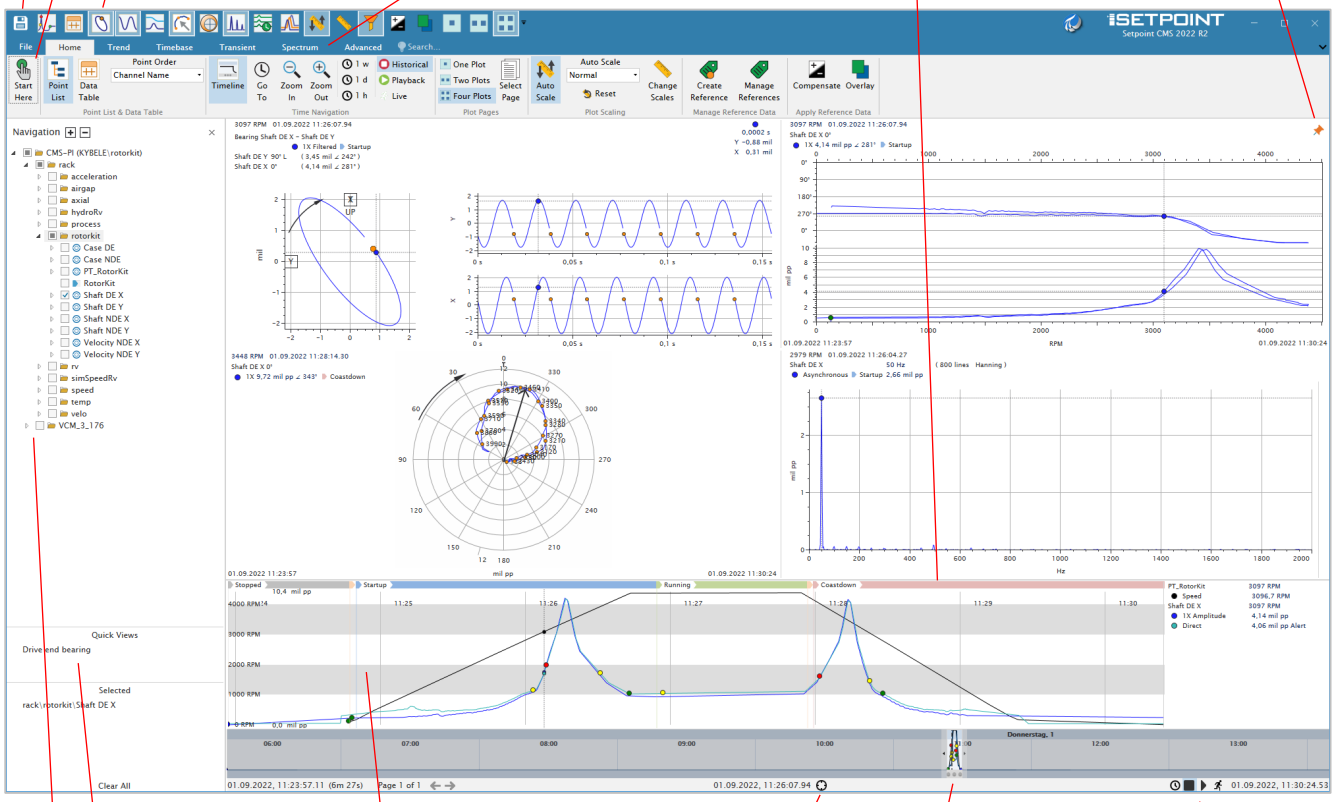
Customize the application to fit how your workflow

Bring commonly used tools to the quick access bar

Easy find settings in plot specific tabs

Color data to see states at a glance

Flag plots to keep them for later use



Synchronize cursors across the app

Data playback aids in finding anomalies

Quickly bring up previously used displays

Intuitive time slider shows full range of data at a glance; grab handles to isolate/expand

Easily identify and change selected points

Zoom into selected data range, showing more states and annotations to simplify diagnostics

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Typical PI Vision Display

Easily build / clone additional train, unit, plant, and enterprise diagrams and hierarchies using PI Vision's extensive tool set.

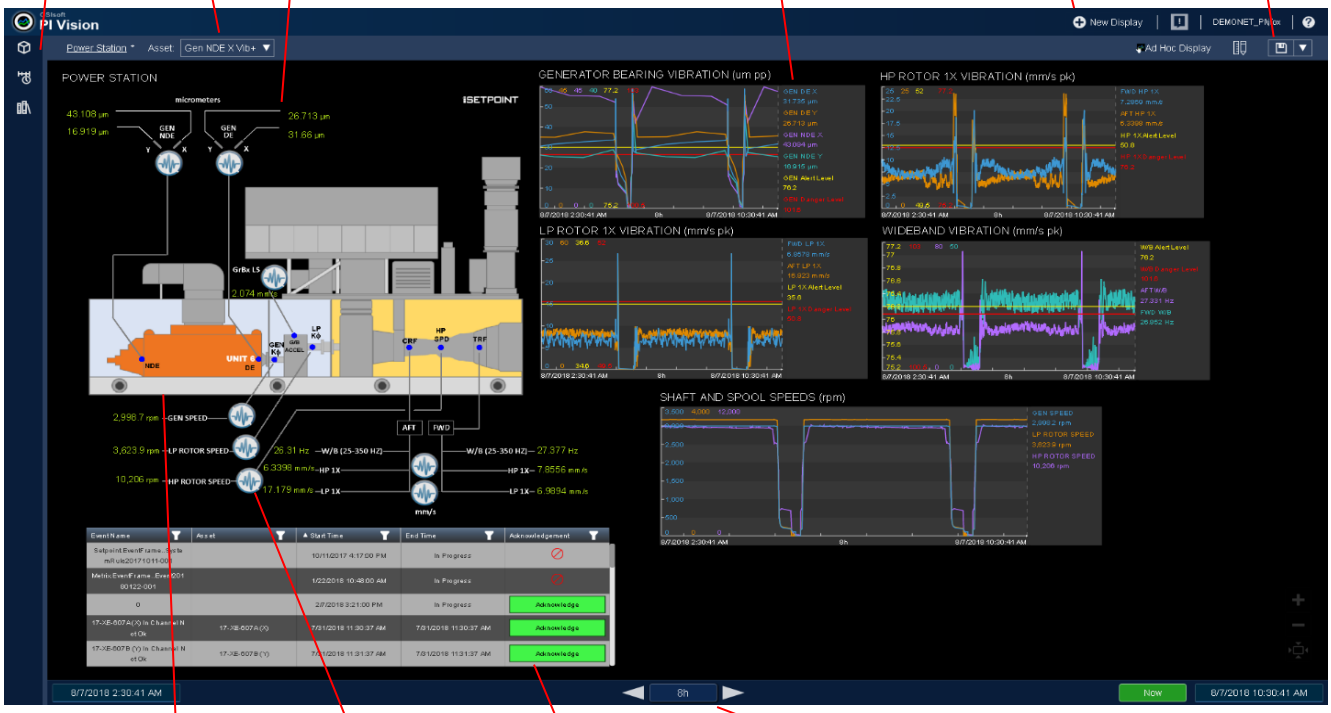
Switch displays to show related assets.

Points labeled clearly and intuitively.

Best in class trend plots.

Each user can make displays to meet their needs

Share displays with other users



Quickly navigate time with time controls.

Attractive, professional graphics depicting machines, bearings, valves, meters, and any other asset can be easily imported or selected from AVEVA PI Vision's extensive library.

Event list with acknowledgements, and reason code to manage events directly on the display

Double-click on CMS "Quick View" icons to launch CMS Display and view waveforms and measurement plots for selected point(s).

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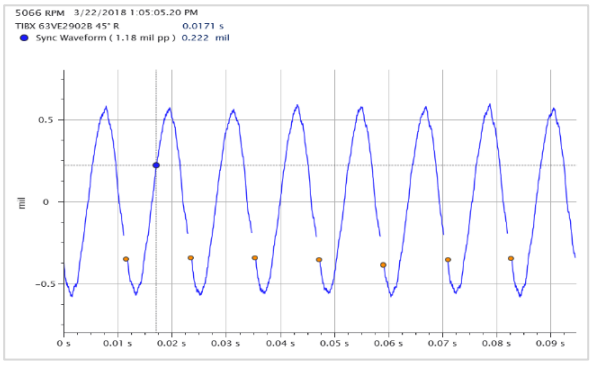
Supported Plot Types

Timebase and Autocorrelation

The Timebase plot shows the amplitude of the signal along the y-axis and time along the x-axis. Synchronous and asynchronous waveforms can be displayed, and waveforms may be unfiltered or filtered to 1X, 2X and a user-configurable nX value. Synchronous waveforms provide a phase trigger indicator.

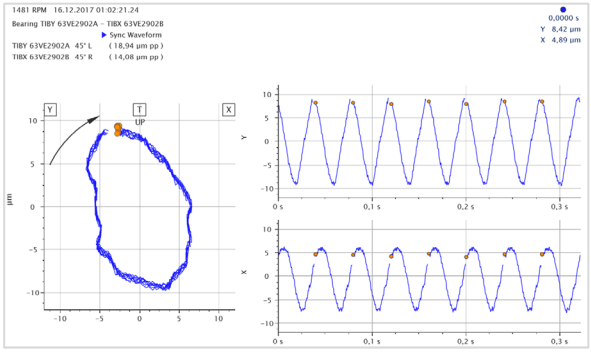
Similarly, the Autocorrelation plot displays the normalized autocorrelation factor as a function of the time lag. Autocorrelation measures the correlation of a signal with a time-shifted copy of itself. This helps revealing periodic patterns with low energy and/or low frequency, which is especially useful for detecting synchronous and non-synchronous impacts on rolling element bearings and gears.



Orbit and Orbit with Timebase

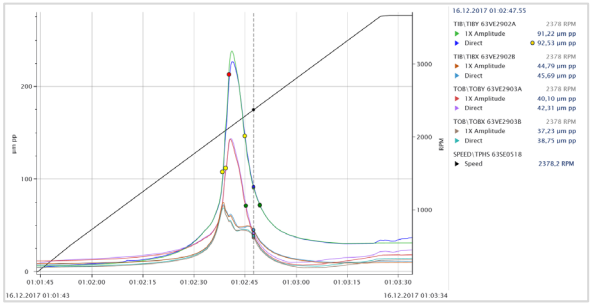
This plot is essentially a Lissajou figure that combines the timebase signals from orthogonal (X-Y) transducers to show the orbital shape of shaft or casing deflection. It visually conveys the shape of the vibration and is highly useful for identifying many types of malfunctions. Orbits are provided for synchronous and asynchronous data. Unfiltered and filtered (1X, 2X, nX) orbits are available for synchronous data only.

Combines the orbit and timebase presentations into an integrated plot for X and Y transducers. This plot type is available for synchronous and asynchronous data and may be unfiltered or filtered (1X, 2X, nX) for sychronous data. X and Y timebase plots are arranged vertically with matching time scales and cursor movements.



Trend

In addition to the single- and multi-variable trend capabilities in the CMS display application, users can easily switch back and forth between CMS and PI Vision displays, leveraging the powerful native capabilities of the PI System. This is particularly useful for showing both CMS and non-CMS data side-by-side in the same trend plots. Trend resolution is 80ms, allowing outstanding correlation of cause-effect relationships and powerful zooming capabilities to see sub-second activity with acute clarity.



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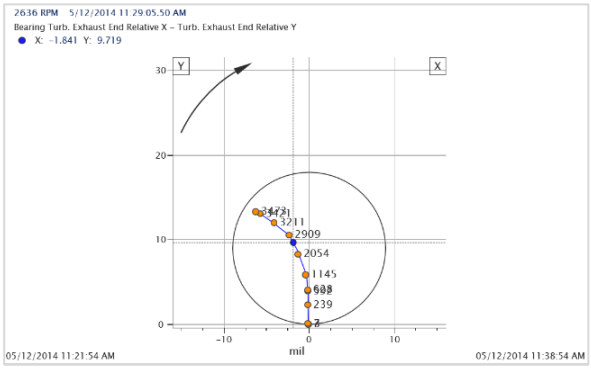
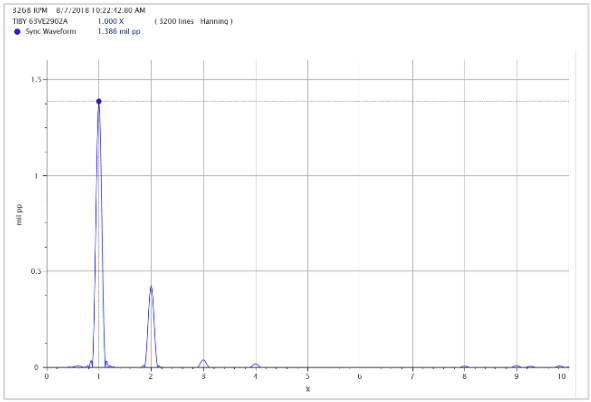
Shaft Centerline

This plot is a specialized trend showing movement of the shaft's average position over time and with speed tags affixed. It is highly useful during startup and shutdown conditions to ensure a proper oil wedge is forming in the bearing, allowing the shaft to assume its expected attitude angle. The shaft centerline plot is useful for a number of other purposes, such as ensuring that no abnormal pre-loads exist, such as misalignment.



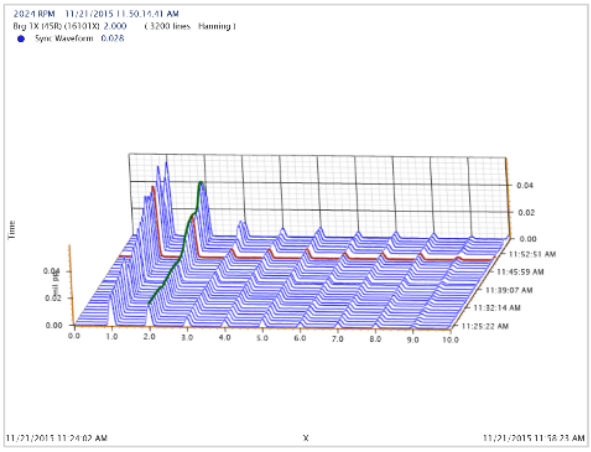
Spectrum and Full Spectrum

This plot uses the same data as for timebase presentations, but uses a Fourier transform to generate a frequency-domain view. It is particularly useful for identifying sub- and super-synchronous components that may correlate to machine geometries such as blade pass, gear mesh, or rolling element bearings (which can also be visually identified on the plot). Both synchronous and asynchronous spectra are available, each with powerful zooming and cursor capabilities.



Waterfall & Cascade

The waterfall plot is a 3D trend of spectra with frequency on the x-axis, time on the y-axis, and amplitude on the z-axis. It allows spectral changes over time to be easily visualized. The cascade plot is similar, but the y-axis is machine rotative speed, allowing spectral changes during startup or shutdown conditions to be identified. 500 spectra can be presented in a single plot, and advanced features such as 3D surface contours, amplitude color coding, crosshair-type cursor movement and display, and 3D rotation enhance the ability to isolate data of interest. Using the cursor, a single spectrum can be selected and displayed in a separate window for even more powerful diagnostic capabilities.



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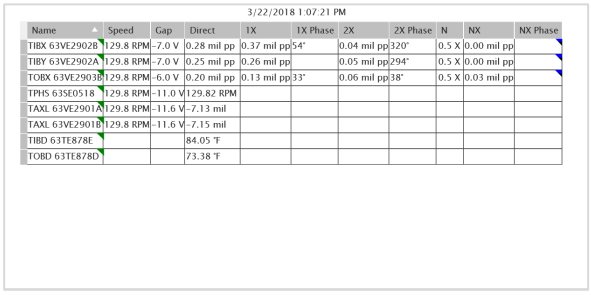
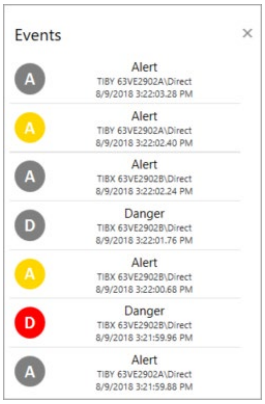
Tabular

This plot arranges data numeric values in row/column format, convenient for identifying a sample that will be used for compensation or other purposes. Data is also color-coded to indicate alarm status for easy identification of precise rpm or other conditions at which a channel entered or left an alarm status. Data can be sorted in ascending or descending order by simply clicking on a column header, similar to typical spreadsheet functionality.



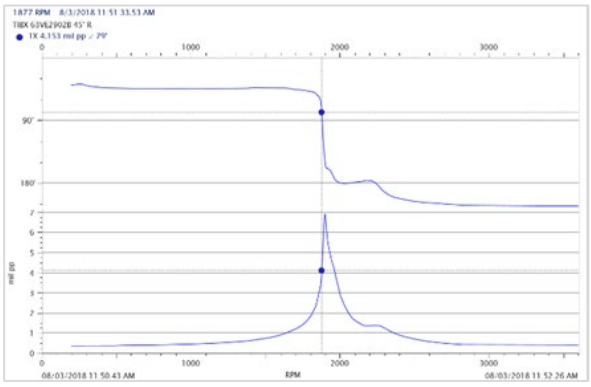
Alarms and Events

A sequence of events may be determined by using the event list in the SETPOINT® CMS client or AVEVA PI Vision display. In CMS click on the event time stamp to center the data on that event. In AVEVA PI Vision use the event list directly on displays to more easily manage events.



Bode

A trend of vibration amplitude and phase versus shaft rotative speed, using cartesian coordinates, and highly useful for identifying critical speeds (resonances), amplification factors, and damping. 1X, 2X, and nX filtered bode plots are available and utilize data collected at 80ms resolution. Like trend plots, multiple channels can be overlaid on one another, useful for identifying differences in rotor system response in horizontal and vertical planes, or at different ends of the machine. Also, like trend plots, color-coded markers identify when the measurement entered or left an alarm condition.



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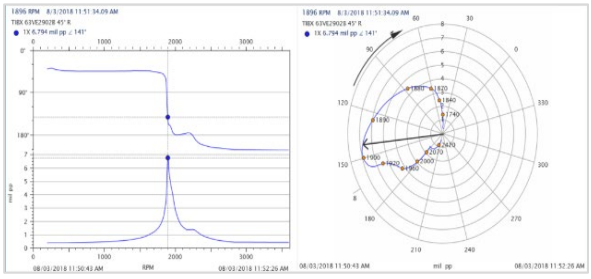
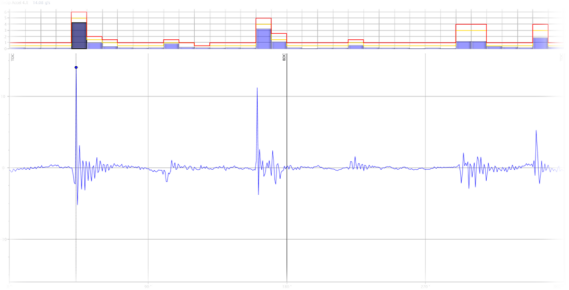
Polar

Although the polar plot uses the same underlying data as the Bode, it presents the data using polar coordinates instead of Cartesian. The two plot formats complement one another, as certain characteristics are easier to identify in polar coordinates than in Cartesian, and vice versa. The screen capture at right, for example, contrasts the same data used for Bode plot representations (left) with their corresponding polar plot representations (right).



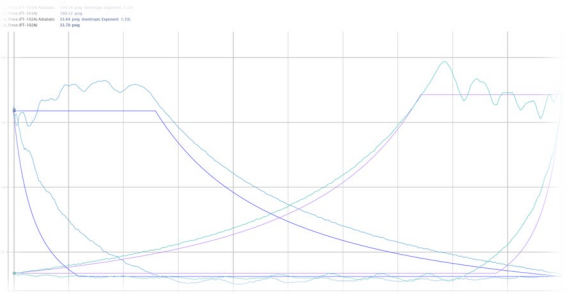
Crank Angle

This specialized plot displays any dynamic measurement associated with the reciprocating machine as a function of the shaft crank angle. In addition, segment bar graphs and alarm limits are provided to see at a glance what segments are close to or exceeding alarm limits.



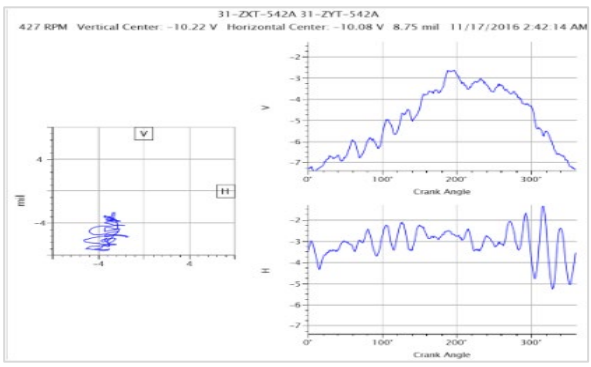
Displaced Volume

This plot is a pressure-volume (P-V) diagram showing dynamic pressure data against the changing cylinder volume caused by the machinery's reciprocating motion. Overlaying an adiabatic curve provides a theoretical reference, assisting with diagnostic analysis.



Rod Position

This plot displays the position of the recipicating machine to help identify rider wear and other defects.



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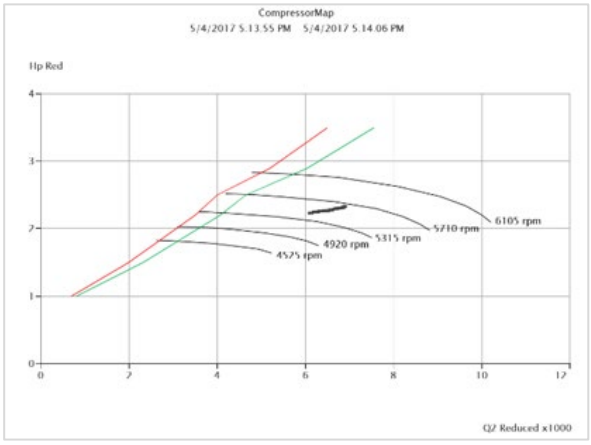
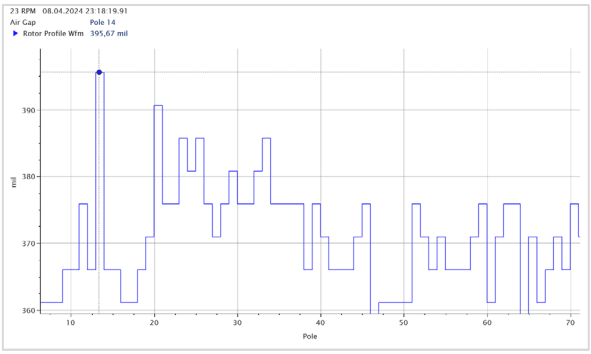
Compressor Map

This plot is useful for monitoring incipient surge and comparing with other data available in CSM to dialog a root cause.



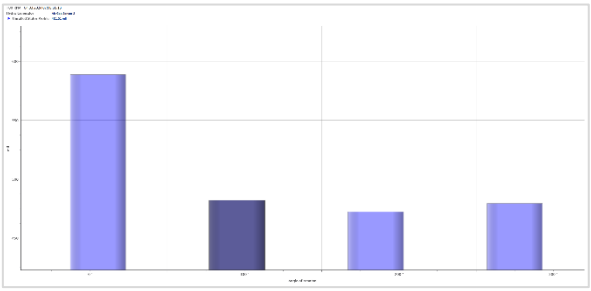
Unrolled Rotor Profile

The Unrolled (or Linear) Rotor Profile plot displays the profile of the Rotor based on the data from a single Air Gap sensor. Measurements are evaluated by the distance (gap) between the Rotor and Stator and are plotted versus pole numbers. The shape and location are influenced by operation forces. Air gap problems can be identified, and corrective action taken long before a failure occurs.



Unrolled Stator Profile

Visualizes deviations of the Stator from a perfectly circular shape. To this end, the Unrolled (or Linear) Stator Profile plot displays the distance (gap) of multiple Air Gap sensors to a reference Rotor pole. Changes in the Stator shape can thus be detected, monitored, and corrected at early stages.



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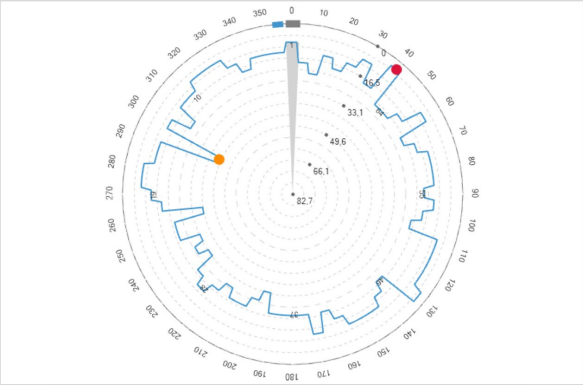
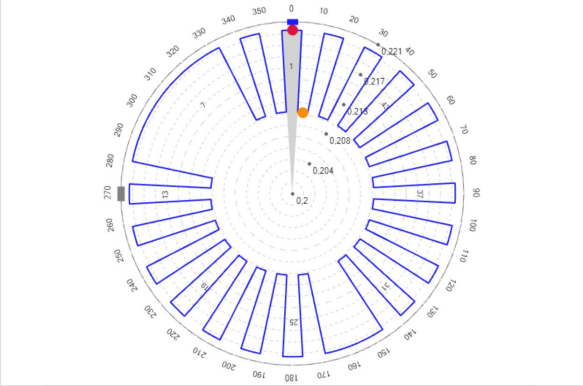
Circular Rotor Profile

Displays the same data as the Unrolled Rotor Profile plot but on a polar canvas. Additionally, data from multiple connected Air Gap sensors can be compared. In combination, this helps correlating measurement values to geometric features of Rotor and Stator.



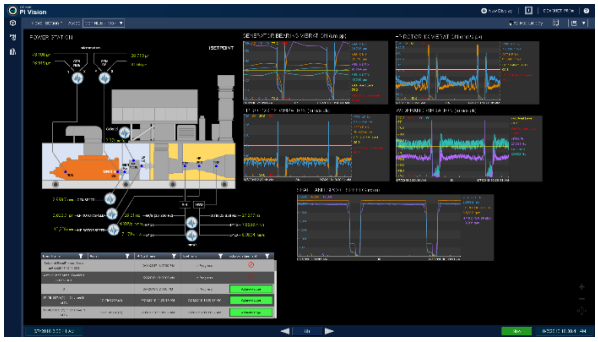
Circular Magnetic Flux Profile

Visualizes the magnetic flux between the rotor and the stator on a polar canvas. Data from Magnetic Flux sensors can thus be used to detect, monitor, and correct electrical faults at early stages.



Machine Train Diagrams and Trends

These diagrams are built in PI Vision and can be customized using the full suite of tools provided by the PI System. Bar graphs, numeric displays, trends, statuses, and many other features can be combined as required to develop screens that are intuitive for personnel and even mimic your DCS or other screens used by operators.



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Specifications

For additional information refer to the following companion documents:

Components	Document
SETPOINT® CMS Overview Specifications	S000029
SETPOINT® CMS Instructions	S1176125

Computer Requirements	
SETPOINT® CMS Client Application	• Dual-core CPU or better • 8 GB RAM recommended • 300 MB hard drive space • Microsoft .NET Framework 4.8 • Display resolution: SXGA (1280 x 1024) or better • PI AF Client 2012 or higher* • Supported Microsoft Windows Operating System (64-bit) - Windows 10 Pro - Windows 11 Pro - Windows Server 2019 - Windows Server 2022 * The SETPOINT® CMS uses PI AF (PI Asset Framework) when connecting to a PI System.
PI Vision 2022 (Server)	• Processor speed: 2 GHz or faster • 6 GB RAM or more • Processor cores: 4 or more • Windows Server 2016 or newer, including Server Core versions • 200 MB + 5 MB per user • Microsoft SQL Server 2012 64-bit or later • Microsoft IIS 8.0 or later

System Capabilities			
SETPOINT® CMS software cannot be used to make changes to machinery protection system configuration			
Network Firewall Port Access	**Protocol**	**Port**	**Direction (Unidirectional)**
	AF	5457	To AF
	PI	5450	To PI

Plot Types and Plot Features	
CMS Display	• Filtered and unfiltered Timebase • Filtered and unfiltered Orbit • Filtered and unfiltered Orbit/Timebase • Spectrum • Shaft Centerline • Bode • Polar • Waterfall • Cascade • Tabular • Multi-variable trend & states • Compressor Map • Crank Angle • Displaced Volume • Rod Position • Unrolled Rotor Profile • Unrolled Stator Profile • Circular Rotor Profile • Circular Magnetic Flux Profile
AVEVA PI Vision	• Single- and multi-variable trend • Asset Hierarchies • Alarm Lists (PI Vision only) • Event Lists (PI Vision only) • Machine Train Diagrams
Plot Header	• Asset and point names shown • Probe orientation shown • Date/time shown • Rotational speed shown • Direction of rotation shown • Pk-Pk (or 0-Pk) value shown
Data Validity	• Indicates non-valid data • Indicated NOT OK transducers or points • Indicates if data is in alarm
Data origin	Both live and historical data display supported
Plot Scaling	• Auto per Plot • Compare Plots • Manual
Units	Imperial and Metric supported

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Plot Types and Plot Features	
Pre-defined plot groupings	• Yes, using flag plot feature • Bookmark groups of plots for later reuse • Quick views associated to assets
Overlay	Use custom events to overlay historical data on top of current context
Full Screen	Expand plot to view on a second screen
Cursors	• Right arrow advances in time, left arrow goes back in time • Clicking on a curve advances cursor to that position • Clicking on curve activates cursor if not already shown • Numerical readout of time, speed, state, amplitude, and phase at cursor position • Difference cursor allows comparison of two different features • Harmonic cursor • Sideband cursor • Bearing frequency markers
Orbit / Timebase	• Collects and displays both synchronous and asynchronous orbits for X-Y transducer pairs • Shows direction of rotation • Shows shaft precession via blank/bright phase trigger dot • Zooming supported • Timebase plots scale as orbit plot is scaled • Time and amplitude shown on cursor position • Cursors linked between orbit and timebase plots

Plot Types and Plot Features	

Spectrum	• Half or full spectrum
	• Selectable for 200, 400, 800, 1600, 3200, 6400, or 12800 lines
	• Windowing Supported
	  - Hanning
	  - Hamming
	  - Flat top
	  - Blackman
	• Frequency Cursor
	• Amplitude Cursor
	• Difference Cursor
	• Harmonic Cursor
	• Sideband Cursor
	• Linear Y-axis scaling
	• X-axis scaling in frequency or orders of running speed
	• 500 spectra available simultaneously in waterfall and cascade plot types
	• Spectral overlapping supported when contiguous waveform data is available

Shaft Centerline	• Set Initial Gap with reference • Set in volts and convert to mils • Set bearing clearances • Select data by time • Display speed or time markers
Timeline	• Visually navigate data to easily zoom out to months of data or zoom into a few seconds • Visually find past events
Crank Angle vs Vibration	• Multi-variable scale • Optional gas force, inertial load, and rod load • Optional pressure
Displaced Volume	• Optional adiabatic curve • Adjustable theoretical attributes

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General Features	
Local Time Support	Yes
Supports Data exchange with Excel	Yes
Access Rights	• User-Based • Role-Based • View-Only • Administrator • Changes to access rights logged by user, date, and change
Hardware Alarms	• Superimposed on trend plots and time slider • Shown in Alarm list
Software Alarms	Supported in PI AF
Data playback controls	Supported for both live and historical data
Portable Data	Export CMS data to a file and share it with remote experts
Word Export	Publish plots to a word document to share analysis results
Export Archive Data	From CMS-XC or flight recorder databases export large amounts of data to archive it for future use
Document Management	Available via PI Server
(Machine) State	• User added • Automated (VC-8000 Rack based) State displays
Quick View	Navigation link from PI Vision to SETPOINT® CMS

* Only applicable for Channel Type Recip Impact, Recip Cylinder Press and Recip Rod Position

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Ordering Information

Download SETPOINT® CMS
SETPOINT® CMS can be downloaded directly from www.bkvibro.com or, alternatively, is delivered with a SETPOINT® solution. For information on ordering a complete server installation of SETPOINT® refer to the SETPOINT® CMS Overview Specifications (S000029).

Order additional software as required.
AVEVA PI Vision is an optional component that is not strictly required for using CMS. However, it is strongly recommended, as PI Vision provides essential features for most users, such as the ability to create machine train diagrams, asset hierarchies, alarm list shortcuts, and event list shortcuts. It also provides powerful trending and analysis tools for static data types.

AVEVA PI Vision can be ordered directly from AVEVA; customers with existing copies of AVEVA PI Vision can use those as well.

C106808.003
PI Vision (per named user) - PI Visualization Software

AVEVA PI DataLink provides a way to query PI data directly from Microsoft Excel and gives an easy way to do additional add-hock analysis.

C106808.002
PI DataLink (per named user) - PI Visualization Software

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AVEVA

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Subject to technical changes