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Published in Dec.2023

Printed in Japan 11103E1.8-23000

CMS Condition Monitoring System

Vibration Analysis & Diagnostic System

infiSYS RV-200

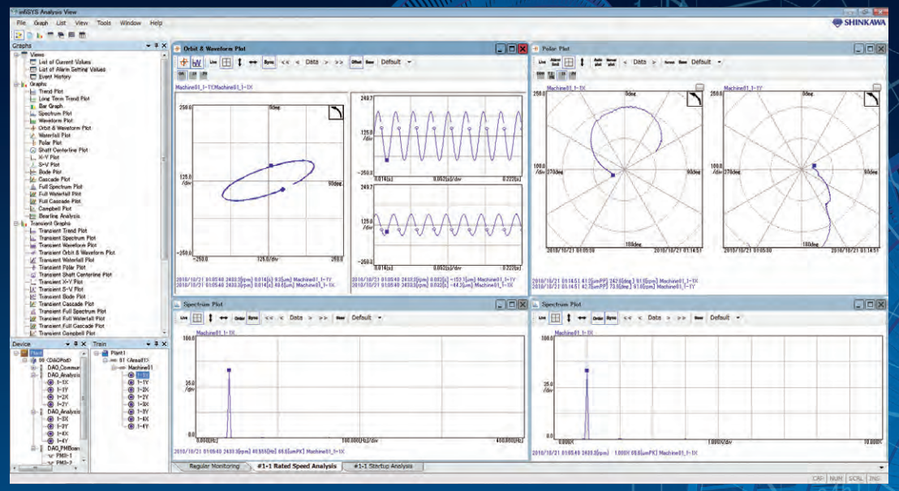
An analysis & diagnostic system for all rotating machinery

infiSYS

SHINKAWA

A vibration analysis & diagnostic system that is applicable to a variety of rotating machinery, helps safe operation and to improve operational efficiency.

infiSYS RV-200 precisely keeps track of and quickly feeds back conditions of rotating machinery which are the key production assets of plants.

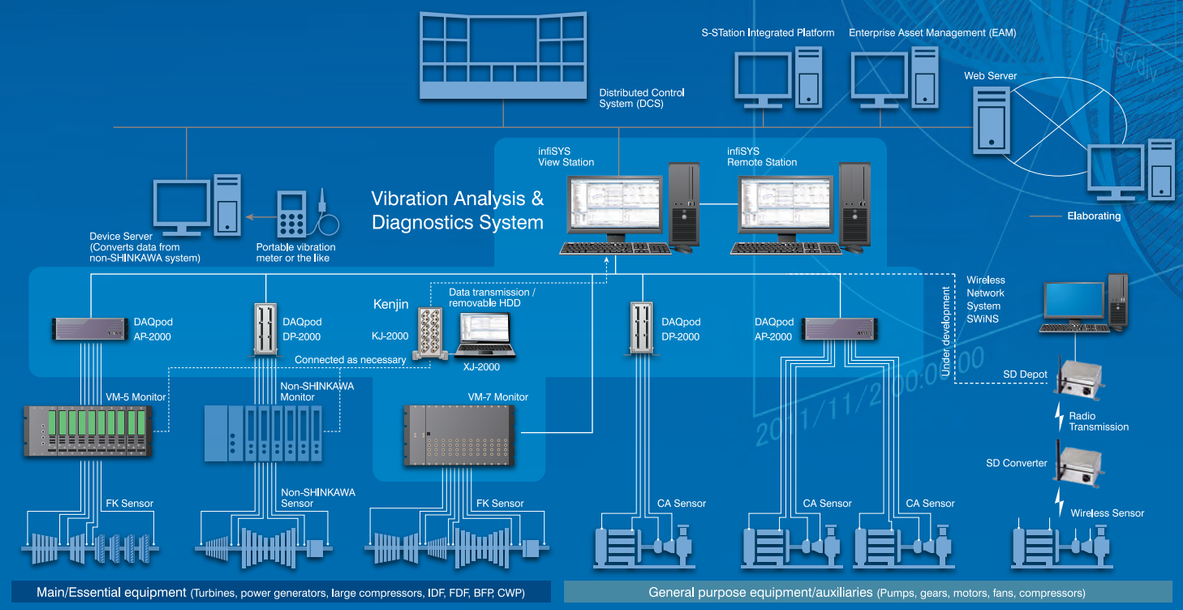


SHINKAWA CMS Overall Configuration

CMS (Condition Monitoring System)

SHINKAWA's CMS is applicable to a variety of rotating machinery condition monitoring whether it is comprehensive with shaft vibration, axial position, phase mark, rotation speed etc., for large machines, or simple with only bearing vibration for small machines.

In the CMS scheme, infiSYS RV-200 positions itself as a system which analyzes vibration for phase angle and frequency component, and displays the information in the form of various analysis graphs necessary for vibration diagnostics.



Features

1 For all rotating machinery

Applicable to a wide range from small rotating machinery supported by rolling element bearings to large rotating machinery supported by journal bearings.

2 High-speed and flexible system configuration

While achieving high-speed data acquisition, the system can be configured with various condition monitors, including non-SHINKAWA monitors.

3 Sophisticated data analysis with various graphs

The software provides a variety of analytical graphs which are optimized for the type of machinery and condition, satisfying stringent demands of vibration analysts and other plant personnel.

4 User-friendly operability and plotting functions

Intuitive software interaction with drag & drop graph display manipulation, and graph area switching tab, etc.

5 Functions that conform to the ISO standards

The software have functions that is applied to ISO standards of machine condition monitoring and analysis (ISO10816-3, ISO7919-3, ISO18436-2).

Advantages

Helps customers improve productivity and reliability by optimizing plant operation.

- Detects abnormal symptoms from vibration characteristics or subtle changes in vibration. Reduces risks of unplanned production shutdown by taking a proactive approach.
- Advanced diagnostics reveal the causes and areas of anomalies and detailed analysis helps users practice optimal, efficient maintenance.

Applications



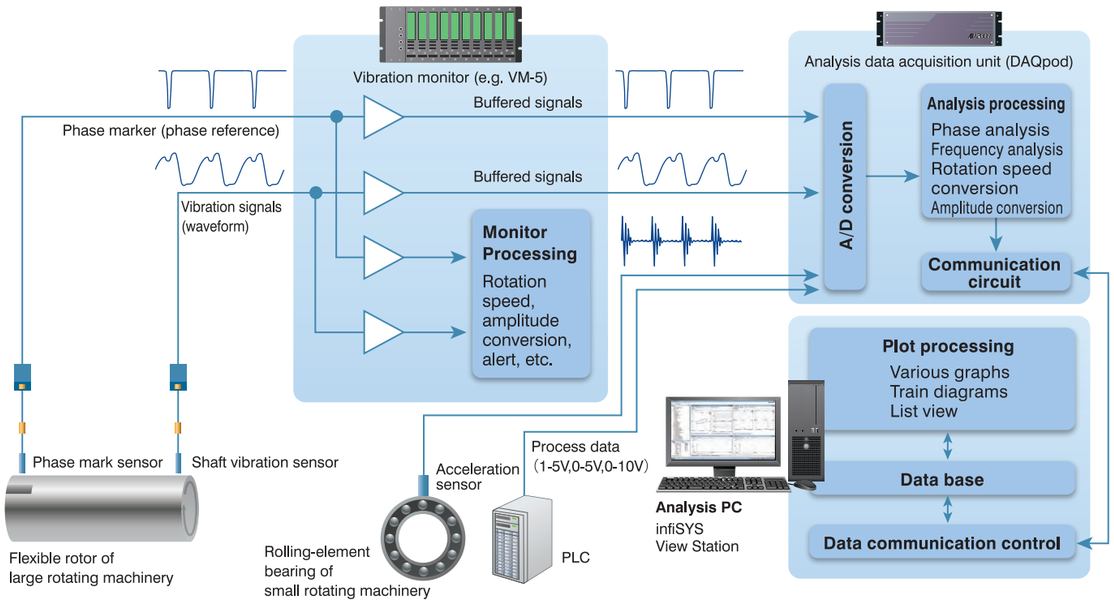

- Steam turbines
- Gas turbines
- Electric generators
- Feed pumps
- Fans
- Blowers
- Compressors
- BOP machinery
- Rotating equipment critical to your facility

Features 1

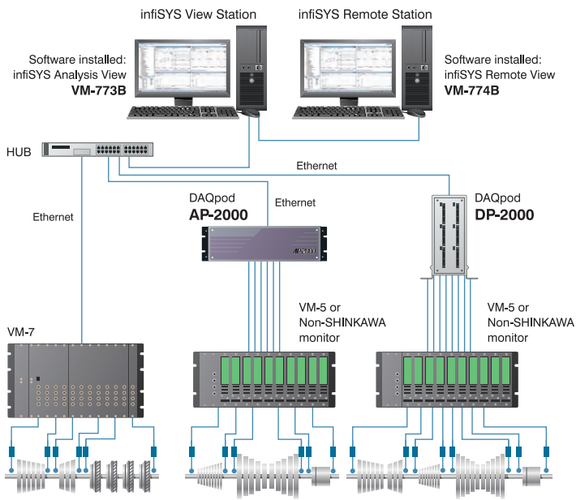
For all rotating machinery

infiSYS RV-200 Basic System

When used for large rotating machinery, it acquires phase mark signals and shaft vibration waveforms, processes phase analysis and frequency analysis, and then displays the information in various graphs for further analysis.
For small rotating machinery, infiSYS acquires acceleration vibration waveform of casing and the information is displayed with graphs based on the frequency analysis.

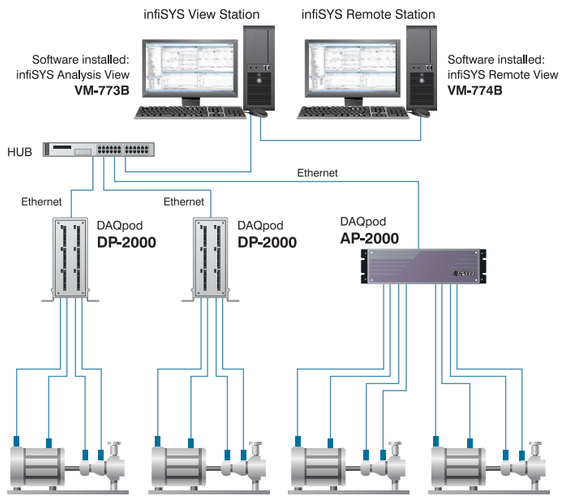


infiSYS RV-200 Configuration Example (for Large Rotating Machinery)



Based on the vibration waveform detected by shaft vibration sensors, the system provides vibration monitoring and anomaly analysis for rated-speed operation, and shaft behavior analysis for critical startup/shutdown.

infiSYS RV-200 Configuration Example (for Small Rotating Machinery)



Based on the vibration detected by acceleration sensors installed on the bearing housings, the system provides trend management and abnormality diagnostics not only on overall vibration but also on vibration of each fault frequency resulting from bearing failure.

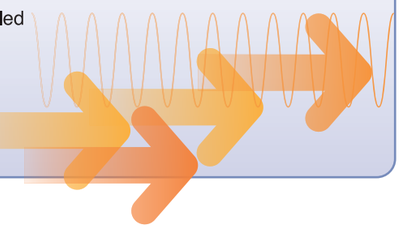
Features 2

High-speed and flexible system configuration

High-speed data acquisition

- Trend data every 1 sec
- Waveform data every 10 sec

The data during not only machine's rated speed operation but also startup/shutdown (transient data)can be acquired for detailed analysis graph plotting.



Various system configurations

- Various monitors (VM-7, VM-5, VM-25)
- Non-SHINKAWA monitors
- Modbus server

The system can be configured independently of a condition monitor that is already deployed on large rotating machinery. Whether an existing SHINKAWA monitor or non-SHINKAWA monitor, data can be acquired and analyzed via DAQpod, upgrading the customer's existing system to a current analysis-capable system.

* If the monitor is VM-7, DAQpod is not required.

Multi channel

- Maximum number of inputs 480 ch

Integrating, monitoring, and analyzing vibration data of machinery in a plant in one analysis system, the system contributes to a plant's stable operation with early detection, analysis/diagnostics of abnormality.

Analysis data acquisition unit DAQpod

Analyzes vibration waveform signals received from a condition monitor on large rotating machinery and sends analysis data to the infiSYS View Station. When it is used for bearing vibration analysis on small rotating machinery, acceleration sensors can be directly connected for data collection.

DAQpod AP-2000


DAQpod DP-2000

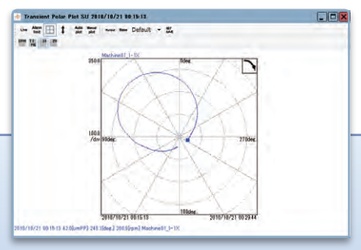
Features 3 Sophisticated data analysis with various graphs

infiSYS RV-200 offers a variety of analysis and plotting functions.

Provides analysis and plotting functions required by vibration analysts certified in accordance with ISO 18436-2.

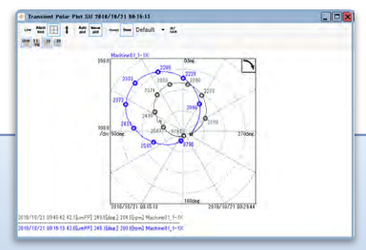
* ISO18436-2: Condition monitoring and diagnostics of machines - Requirements for training and certification of personnel - Part 2 : Vibration condition monitoring and diagnostics

Data display examples



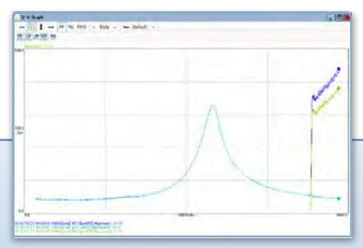
Polar Plot

This shows the vibration vector at the time of critical startup/shutdown of the machine. From this plot, the user can observe the balancing condition, vibration levels and critical speed during the startup/shutdown of the machine.
Displayed data (Switchable display): 1X, 2X
This allows over-lay of current data on top of past data.



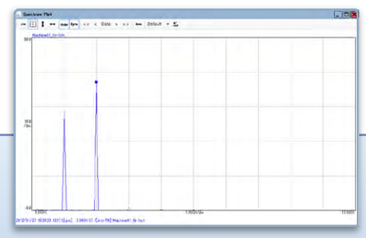
Polar Plot (reference superimposition and speed indication)

For easy comparison, the data set as the base line is plotted over the current or selected data. The rotation speed of multiple clicked points can be labeled on the field while the RPM (speed) button is active. At other times, the speed is displayed while the cursor is over the point.



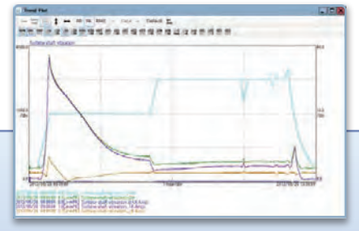
S-V Plot

A Speed - Vibration (S-V) trend plot shows the change in the vibration amplitude with rotation speed. The user can select multiple amplitude types from overall (OA), 0.5X, 1X, 2X, to display in the same field for understanding the critical speed or vibration condition during startup and shutdown of the rotating machinery.



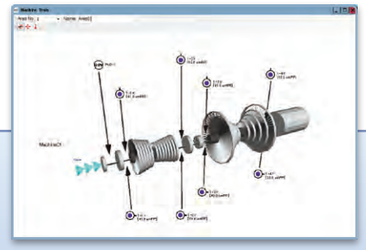
Spectrum Plot

This plot shows the frequency analysis of the vibration data. The X-axis represents the frequency or the order; the Y-axis shows the amplitude of each frequency component. The graph identifies the frequencies and the orders to help determine the cause of the abnormal condition of the rotating machinery.



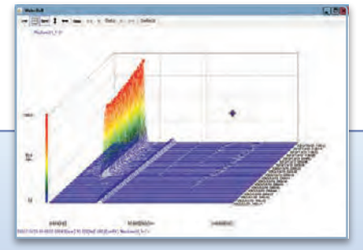
Trend Plot

This plot displays short term and long term chronological changes using a line chart.
Displayed data (multiple selections are allowed): Rotation speed, GAP, OA, 0.5 X amplitude, 0.5 X phase, 1X amplitude, 1X phase, 2X amplitude, 2X phase, Not-1X amplitude, nX1 to nX4 amplitude and phase, Smax amplitude, various alarm setting values.



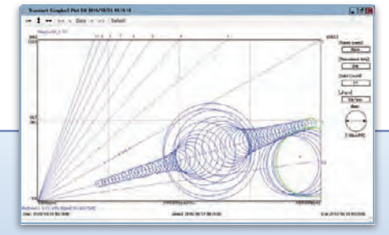
Machine Train Diagram

The 3D illustration of rotating machinery diagram displays the rotation speed as well as the location and the vibration amplitude of each measuring point.
For each machine, current values can be displayed in a list view.



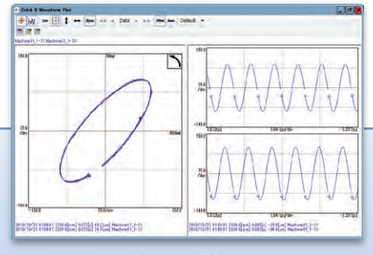
Waterfall Plot

This plot is used to analyze changes in frequency components that occur over time.
Cascade plot can also be displayed with width (z-axis) as rotation speed to analyze changes in frequency components in relation to changes in rotation speed.



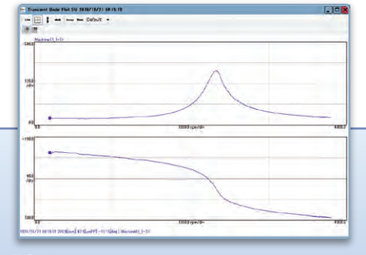
Campbell Plot (Optional)

The X-axis shows the rotation speed; the Y-axis expresses the vibration frequency; the radial lines indicate each order; the size of the circle represents the vibration amplitude. This shows the vibration level relative to the change in the rotation speed. Whether or not a sequence of vibration is accompanying a specific order or it is of a certain frequency component can be seen visually.



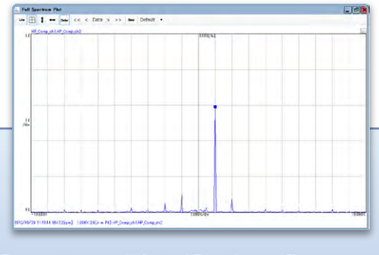
Orbit and Waveform Plot

This plot composes signals from each X and Y sensor and displays the dynamic motion of the center of a rotating shaft.
The Orbit plot helps to identify any abnormal status including imbalance, misalignment, oil whirl and oil whip.



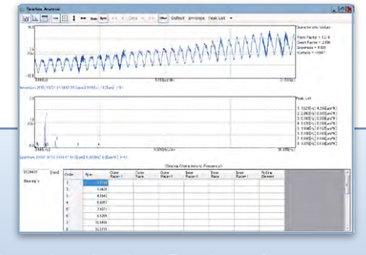
Bode Plot

This plot displays the amplitude and phase in separate graphs with rotation speed used as the horizontal axis.
From this plot, the user can see the vibration status and critical speed during the startup/shutdown of the machine.
Displayed data (Switchable display): 1X, 2X
This allows over lay of current data on top of past data.



Full Spectrum Plot (Optional)

A spectrum plot that separately depicts the forward whirling motion and backward whirling motion of the rotating machine rotor. The X-axis is the frequency of the whirling motion (positive for forward, negative for backward), and the Y-axis is the amplitude of each frequency component or order.



Bearing Analysis (Optional)

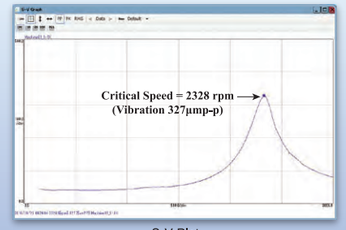
This window collectively displays the plots necessary for rolling bearing diagnosis. The following analysis functions are available per additional specification code, “/RB1” and “/RB2”.
/RB1 … Peak value analysis, order analysis, sideband analysis
/RB2 … Crest factor, form factor, kurtosis, skewness, envelope.

Sophisticated data analysis with various graphs

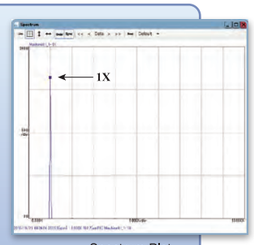
Case Studies

Unbalanced Vibration

The most common abnormal vibration is due to the mismatch between shaft center and mass center, due to manufacturing error or machine components missing.
The characteristic of the vibration generates the rotation synchronous component (1X), which is sine wave or similar. Vibration becomes largest at critical speed.



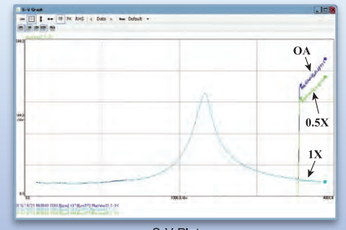
S-V Plot



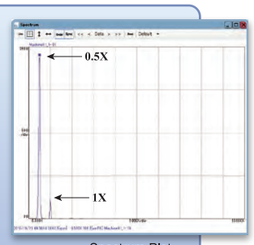
Spectrum Plot

Oil Whirl Vibration

Self-excited, unstable vibration typical for sleeve bearing supported rotating machinery. Possible causes include effects from the shape of the sleeve bearing, oil film characteristics, etc. Normally, this vibration appears at two or less times lower than the critical speed, and the frequency is around half the rotation synchronous frequency (0.5X).



S-V Plot

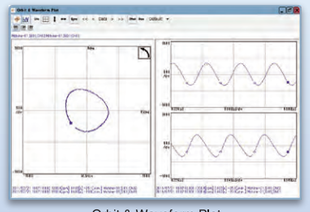


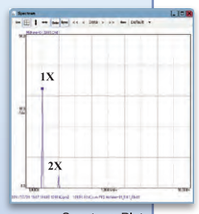
Spectrum Plot

Misalignment Vibration

Vibration that occurs when the shaft centers of driving rotating machinery and its associated driven rotating machinery are not properly aligned. Typically the vibration includes rotation synchronous frequency component (1X) and harmonic components (2X, 3X).

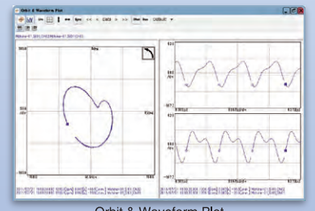
[Normal condition]

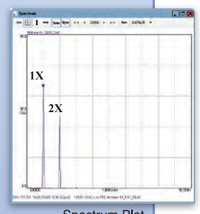

Orbit & Waveform Plot



Spectrum Plot

[Misalignment occured]

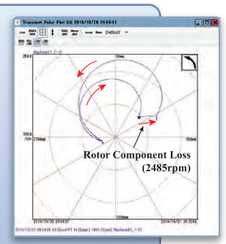

Orbit & Waveform Plot



Spectrum Plot

Loss of Rotor Component

When a rotor component is lost or flies off, the vibration conditions suddenly change. The typical phenomenon includes sudden changes in the amplitude and phase angle (vibration vector) of the rotation synchronous frequency component (1X).

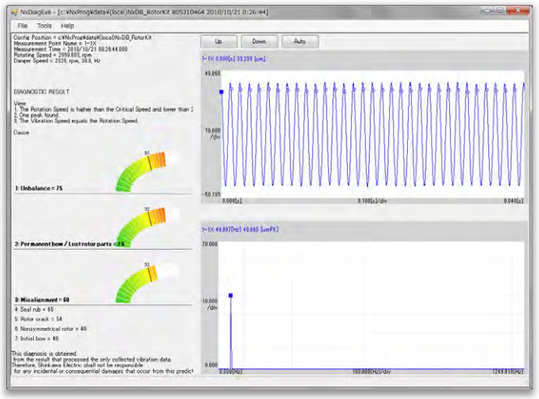


Polar Plot

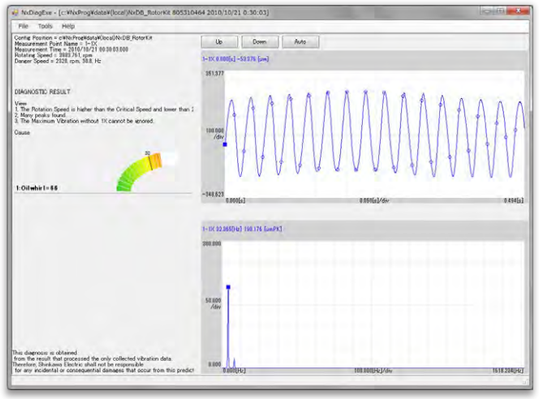
Diagnosis Screens

Installing VM-781B infiSYS Diagnostic Software adds a diagnostic function to VM-773B infiSYS Analysis View Software or VM-774B infiSYS Remote View Software. The top 3 possible causes of the the abnormal vibration are diagnosed and listed to support technical engineers with their diagnostics.

Example (rotor unbalance)



Example (oil whirl)



Applications

The diagnostics are applicable to the following rotating machinery with rolling-element bearings or journal bearings.

● Turbines ● Electric generators ● Motors ● Blowers ● Pumps ● Compressors

Failure modes to be determined

Diagnostics with Journal Bearing

Unbalance	Permanent bow / Lost rotor parts
Seal rub	Misalignment
Friction induced whirl	Critical speed
Rotor crack	Cavitation
Gear inaccuracy	Vane vibration
Nonsymmetrical rotor	Draft core
Steam whirl / Seal whirl	Surging
Oil whip	Oil whirl
Partial rub	

Diagnostics with Rolling Bearings

Bearing damage	Insufficient bearing lube due to grease deterioration
Lubricating trouble	Insufficient tightness - Bearing
Unequal bearing stiffness	Unbalance
Vane unbalance	Cooling fin unbalance
Coupling inaccuracy of damage	Misalignment
Seal or rotor rub	Inaccurate tooth contact
Tooth surface wear	Electrically excited vibration
Insufficient tightness - Casing	Vane rub

Note: The diagnostic results are derived from collected vibration data. No responsibility can be accepted for any loss or damage that might arise from the use of the information.

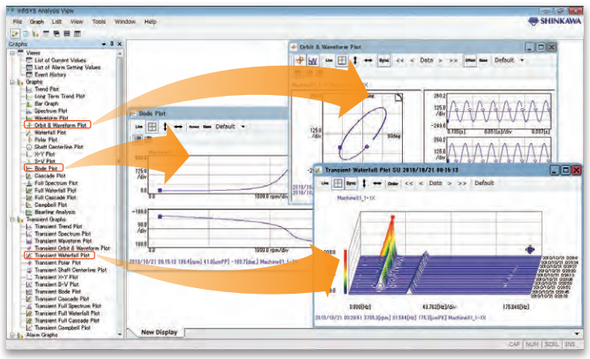
infiSYS RV-200 (hardware & software) has a simple user interface, that is easy and instinctively operated by most plant personnel.

Quick learning of graphic display.

Examples of easy operation

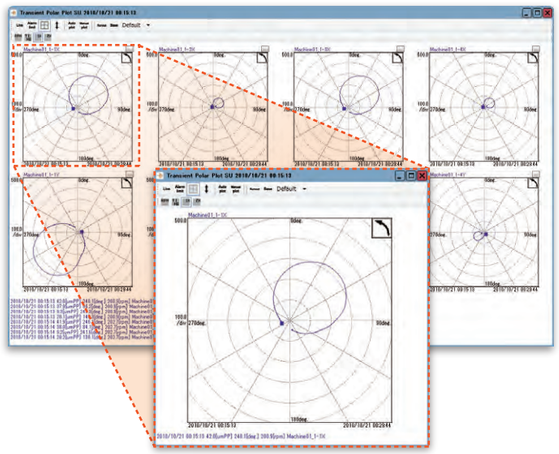
Drag & drop

From tree at left to display area at right, desired plots can be displayed anywhere you want.



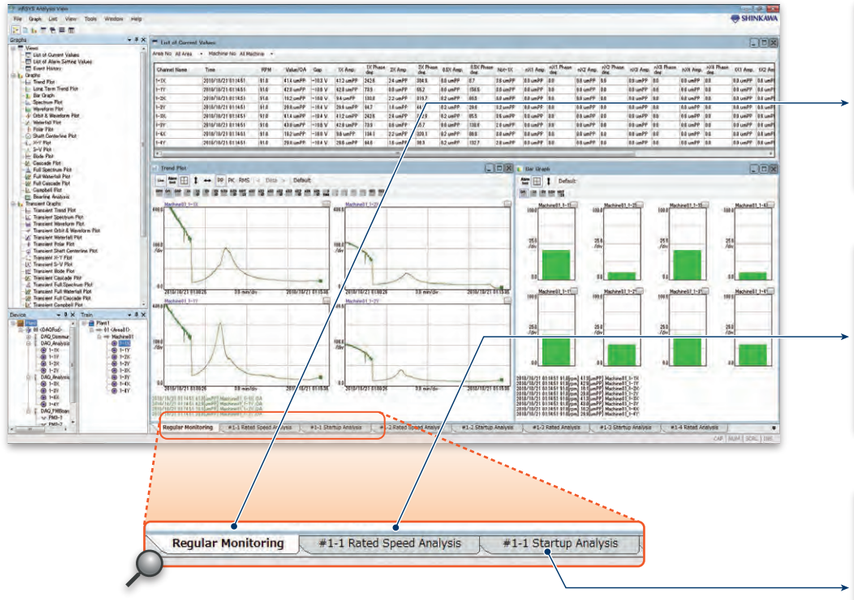
Tile display

The desired channel plot can be picked up instantly from the display window. The desired plot window opens with one click.

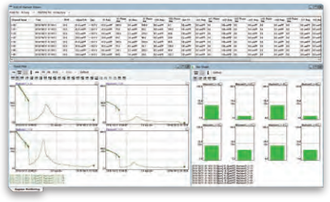


Page switching tab

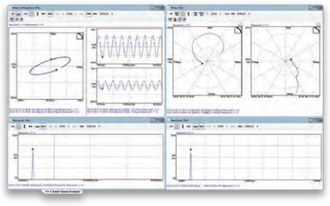
Desired plot page can be displayed simply by switching the tabs.
The step to create a new page is also simple. (Up to 20 pages.)



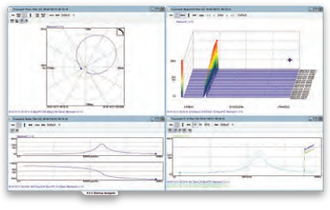
Regular Monitoring Data sample page



Rated Analysis sample page



Startup Analysis sample page



Up to 20 pages can be created.

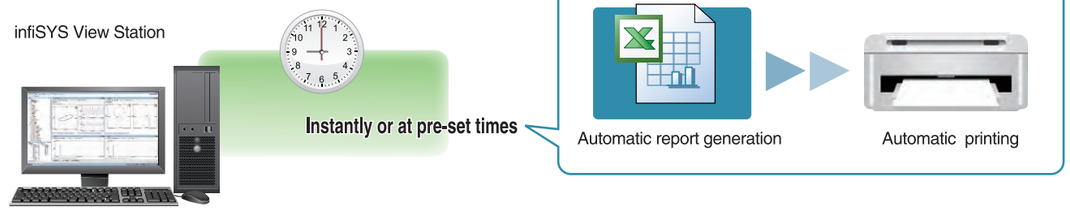
Pages with desired plots in desired arrangement can be created with specified tab name. Users can lock the displays as well, this allows uniformity and protection on your custom view settings.

For more efficient trend management and vibration analysis/diagnostic reporting

infiSYS Report Software VM-783B

By installing this software to the infiSYS View Station or Remote Station, the user will be able to output the event history, trend data and analysis graph images into report files.

Example



Easier, faster Report generation using a format template

Using a preinstalled or customized template, the user can quickly create a report in a desired format.
If it is pre-set, the system can create and print out reports at defined intervals or at the time of alarm activation.

Communication between infiSYS Analysis View and the Host system via OPC server

OPC Client Software VM-784B

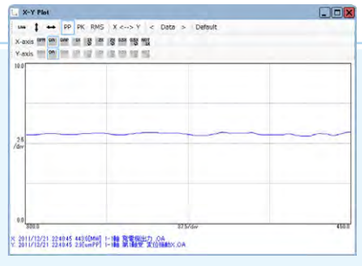
By adding to infiSYS Analysis View (version 1.2.0.0 or later), interactive data communication with the host system, such as DCS and PLC, will be available through an OPC server.
The infiSYS RV-200 system acquires process data, such as temperature, pressure, generating power, etc. along with vibration data, and performs a variety of analysis with the information linked together.
Likewise, the host system can utilize the analysis data of infiSYS Analysis View.

Example

infiSYS View Station

Creating a generating power (load) - vibration correlation plot (L-V plot)

An X-Y plot displays selected pairs of data acquired by infiSYS which are set as the x-axis and the y-axis. This is useful to check the relationship between the vibration and the process data, i.e., load, temperature, pressure, etc.

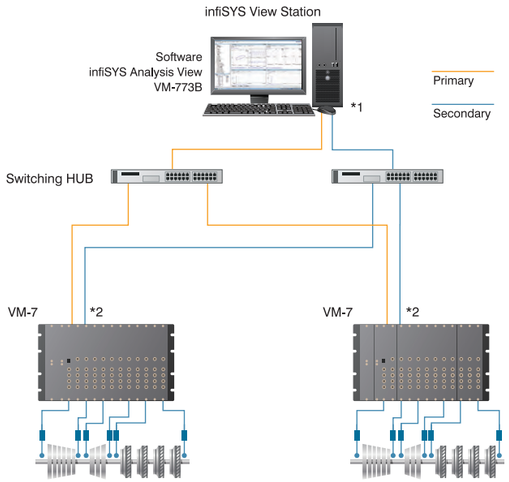


Also, a display of process data in a bar graph or a trand plot will become available.

Extension Features for Even Better Operation and Reliability

Support for Analysis Communication Redundancy

Communication between the infiSYS View Station and VM-7 can be provided with redundancy.
This prevents loss of data due to disconnection, hub failure or communication failure due to noise on the primary line.
When communication failure is detected, inifiSYS Analysis View automatically switches to the secondary line
and continues communicating with the VM-7 monitor.

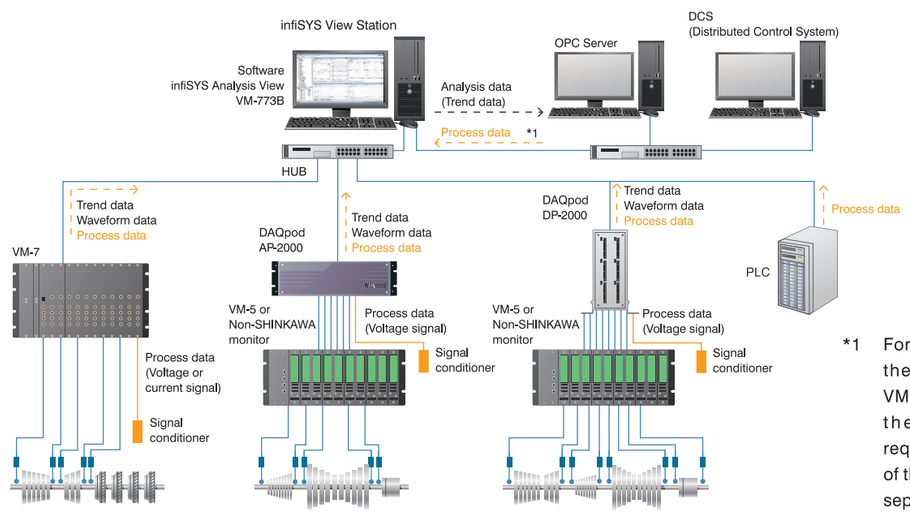


*1 Two LAN cards must be installed on the infisys view station.

*2 VM-742B Network Communication Modules, both with analysis function and of supported versions, must be installed in Slot C1 and Slot C2.

Process Data Input Function

To incorporate process data such as temperature, pressure, power, etc., into the infiSYS View Station, the user can provide analog signals to DAQpod, and/or digitally communicate with DCS or PLC via the OPC server or Modbus/TCP.
With VM-7, analog signal types are voltage and current; with DAQpod, analog signals are limited to voltage.
For digital communication, refer to page 10, “OPC Client Software”.



*1 For data interaction with DCS via the OPC server, installation of VM-784B OPC Client Software to the infiSYS View Station is required. (For the support version of this function, please refer to the separate “Updated Information”.)

The SHINKAWA Network

SHINKAWA is employing global thinking to create a business with a worldwide network currently comprising over 50 bases around the world.

Please refer to our website to find the information such as addresses and phone numbers of our subsidiaries.
URL: https://www.shinkawa.co.jp/eng/

System Specifications

Maximum number of connections	20 units* (VM-7, DAQpod, Modbus Server) * DP-2000H is composed of 2 systems, therefore counted as two units in this calculation.	
Maximum number of measuring points	480 points* * Actual number of points measurable may be limited due to system configuration.	
Number of FFT lines	VM-7 : 800 lines DAQpod : 400 / 800 / 1600 lines	
Short Term / Long Term data saving feature	Short Term data saving period	Can be set to any length between 1 day and 31 days.
	Short Term data saving interval	Trend data : 1 sec (critical mode), 10 sec (BOP mode) Waveform data : 10 sec / 20 sec / 30 sec / 1 min / 2 min / 3 min / 5 min / 10 min
	Long Term data saving period	1 yr / 2 yrs / 3 yrs / 4 yrs / 5 yrs
	Long Term data saving interval	Trend data : 10 min/20 min/60 min/120 min Waveform data : 1 hour/2 hour/6 hour/8 hour/12 hour/24 hour
Alarm data saving feature (Applicable to critical mode only)	Time range of the data to be saved	Trend data : Up to 24 hours of data before and after the alarm occurred. Waveform data : Up to 24 hours of data before and after the alarm occurred.
	Data saving interval	Trend data : Every 1 sec Waveform data : Based on the normal waveform data saving interval.
	Type of alarm	OA amplitude, 1X amplitude / phase, 2X amplitude / phase, rotation speed, process data
	High speed acquisition	Trend data : Taken at intervals of 0.1 sec from 20 sec before the alarm until 10 sec after the alarm. Waveform data : Taken at the selected intervals (minimum 10 sec) from 60 sec before the alarm until 60 sec after the alarm.
Transient data saving function	Data saving period	
	Startup period	: Time when reached the starting speed − m min to Time when reached the end speed + n min (E.g : 5 min + 100 rpm to 2,900 rpm + 15 min)
	Shutdown period	: Time when reached the starting speed − m min to Time when reached the end speed + m min (E.g : 5 min + 2,900 rpm to 100 rpm + 10 min) (m : 0 to 60 min, n : 0 to 180 min)
	Data saving interval	Trend data : 1 sec (critical mode), 10 sec (BOP mode) Waveform data : Based on the Δt setting or Δrpm setting
Number of histories	Number of transient histories per measuring point 100 to 1,000 Number of alarm histories per measuring point 100 to 1,000 Number of event histories per hardware item 1,000 to 10,000	
Data display function	Displayable graphs : Trend Plot, Long Term Trend Plot, Bar Graph, Spectrum Plot, Waveform Plot, Orbit & Waveform Plot, Waterfall Plot, Polar Plot, Shaft Centerline Plot, X-Y Plot, S-V Plot, Bode Plot (Optional plots : Cascade Plot, Full Spectrum Plot, Full Waterfall Plot, Full Cascade Plot, Campbell Plot) Analysis (Optional) : Peak analysis, order analysis, side band analysis, crest factor, form factor, kurtosis, skewness, envelope, runout (slow roll vector), spectrum alarm List view : List of Current Values, List of Alarm Setting Values, Event History, Machine Train (maximum 24)	

Note: The system and hardware specifications in this document are just overviews. For details, please refer to the specification sheets of the infiSYS RV-200 System and other related products.

Hardware Specifications

For DAQpod

Number of inputs (number of channels)	AP-2000H* (19" rack)	: Maximum number of vibration channels = [48 ch - (number of phase marker channels)] Number of phase marker channels = [0, 4, 8, 12, 16 ch] ×2 systems
	AP-2000D* (19" rack)	: Maximum number of vibration channels = 48 ch - (number of phase marker channels) Number of phase marker channels = 0, 4, 8, 12, 16 ch
	DP-2000 (24 ch box)	: Maximum number of vibration channels = 24 ch - (number of phase marker channels) Number of phase marker channels = 0, 4, 8 ch
Number of frequency analysis lines	400 / 800 / 1600 lines	
Trend data	Rotation speed, OA amplitude, GAP, 0.5X amplitude / phase, 1X amplitude / phase, 2X amplitude / phase, Not-1X amplitude, nX1 to nX4 amplitude/phase, Smax amplitude, Σ8X or higher amplitude, IR / OR / BS vibration, Process data.	
Data collection interval	Trend data collection interval Every 1 sec (every 0.1 sec during alarm high speed acquisition mode) Waveform data collection interval During normal operation : Every 10 / 20 / 30 sec, 1 / 2 / 3 / 5 / 10 min During transient : Δt setting : Trend every 1 sec (fixed) : Waveform every 10 sec (fixed) : Δrpm setting : From Δ1 rpm to Δ100 rpm (1 rpm increments) The actual intervals that can be used to collect data will be limited depending on the number of channels and system requirements.	
Network Interface	Ethernet 100 Base-TX	
Power supply voltage	AP-2000H / D (19" rack)	: Rated voltage 100-240VAC
	DP-2000 (24 ch box)	: Rated voltage 24 VDC
Dimensions	AP-2000H / D (19" rack)	: 482 (W) x 132.5 (H) x 444 (D) mm
	DP-2000 (24 ch box)	: 96 (W) x 224 (H) x 165 (D) mm

For VM-7 (Analysis board installed)

Number of inputs (number of channels)	Phase marker channels : Rack common 4ch, vibration module specific 1 ch/module vibration channels : 44 ch
Number of frequency analysis lines	800 lines
Trend data	Rotation speed, OA amplitude, GAP, 0.5X amplitude / phase, 1X amplitude / phase, 2X amplitude / phase, Not-1X amplitude. nX1 to nX4 amplitude / phase, Smax amplitude, Process data.
Data collection interval	Trend data collection interval Every 1 sec (Process data : Every 10 sec) Waveform data collection interval During normal operation : Every 10 / 20 / 30 sec, 1 / 2 / 3 / 5 / 10 min During transient : Δt setting : Trend every 1 sec (fixed) : Waveform every 10 sec (fixed) : Δrpm setting : From Δ1 rpm to Δ100 rpm (1 rpm increments) The actual intervals that can be used to collect data will be limited depending on the number of channels and the system requirements.
Network Interface	Ethernet 100 Base-TX
Power supply voltage	Supports power supply redundancy with VM-75□B Power Supply Module Rated voltage 100-240 VAC / 50-60 Hz, 24 VDC, 110-220 VDC