Vibration Analysis Program
SX-A1VA

This program adds vibration measurement functions to the RIONOTE Multifunction Measurement System.

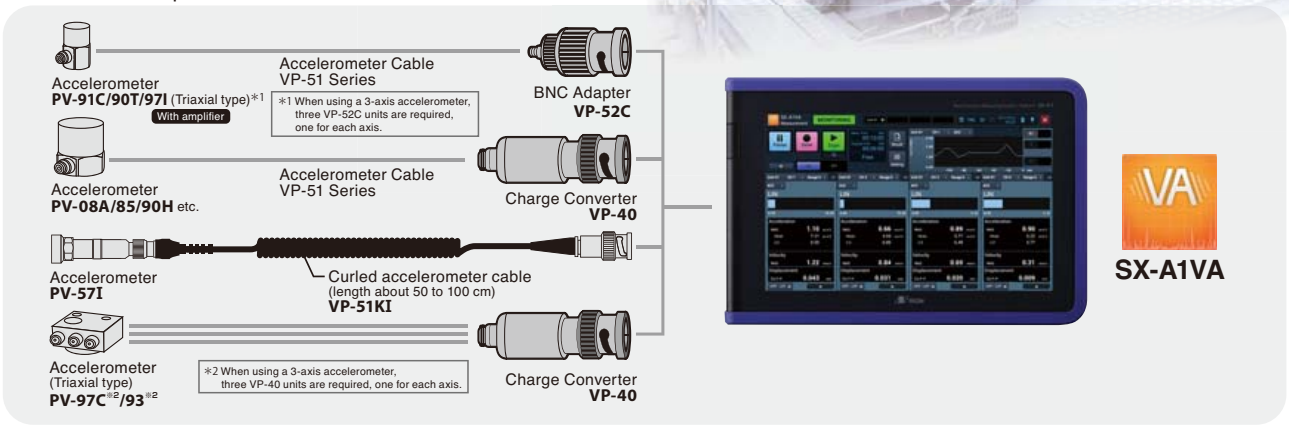
All essential vibration measurement functions are provided, enabling equipment diagnosis and trend management for industrial machinery.
The program also supports detailed diagnosis including FFT analysis and envelope processing, and ISO absolute value evaluation can also be performed. Because up to four accelerometers can be connected to the RIONOTE, simultaneous measurement in two horizontal directions and one vertical direction or other measurements of multiple planes can be easily realized.

Monitoring of vibration sound (acceleration) possible

Vibration meter mode

- Measurement simultaneously for vibration acceleration, velocity, and displacement
- Auto store function continuously records vibration values and tacho data in 100 ms intervals
- Calculation of average vibration quantity values for a specified measurement period (to facilitate reading of representative values for measurement data with considerable fluctuation)
- Separate filter settings (HPF, LPF) for acceleration, velocity, and displacement are supported

Connection examples



Simple diagnosis

By periodically measuring the vibration magnitude and comparing the results to a reference value, the equipment condition (normal or potential problem) can be diagnosed.

The example at right shows the screen in absolute measurement mode for four channels. Because the danger state is indicated by purple-red, caution by yellow, and good by green, the display of measurement results lets the operator assess the state of vibration at a glance.

Absolute value evaluation mode (absolute value evaluation function)

ISO 20816 series (Measurement and evaluation of machine vibration).

According to ISO 20816-1 : 2016, evaluation criteria for mechanical vibration over a specified range are to be decided by agreement between the supplier and the user of the machine, and boundary values for evaluation are to be determined in consideration of the measurement position and the support rigidity of the machine etc.

- Reference value
  - A: Newly installed machinery will normally be within this range.
  - B: Long-term continuous operation allowed.
  - C: Long-term continuous operation not allowed, but limited-term operation allowed.
  - D: High risk of injury. Operation not allowed.

Representative zone boundary value

Vibration velocity rms value mm/s	Range of representative zone boundary value		
0.28			
0.45			
0.71			
1.12	Zone boundary value A/B 0.71 to 4.5		
1.8			
2.8		Zone boundary value B/C 1.8 to 9.3	
4.5			
7.1			Zone boundary value C/D 4.5 to 14.7
9.3			
11.2			
14.7			
18			
28			
45			

Standard mode (evaluation function)

Two threshold values (upper and lower) each are set for acceleration, velocity, and displacement to perform evaluation.

Detailed diagnosis (FFT analysis and envelope processing)

The FFT analysis function and envelope processing function (acceleration envelope processing) can be used to determine abnormal conditions and to assess failure stage and location. Three examples for analysis using patterns to analyze vibration causes are shown below.

Bearing fault

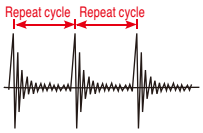
The bearing fault manifests itself by large acceleration. Envelope analysis reveals peaks at regular intervals, as shown in the illustration. When the dimensions of the bearing parts, number of rolling elements, number of shaft revolutions etc. are known, the faulty part can be determined from the primary frequency of the series of peaks.

Time waveform

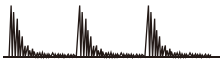
FFT spectrum

Envelope processing

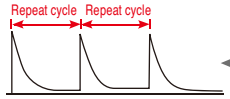
① Shock waveform due to bearing fault



② Absolute waveform value



③ Envelope processing using envelope filter



④ FFT analysis

For failure diagnosis of bearings, envelope processing is used because it is necessary to know the repetition period of the shock waveform.

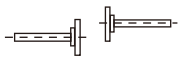
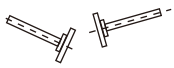
Misalignment

In the case of misalignment, a large frequency component that is an integer multiple of the number of revolutions appears in the axial direction. The multiplication factor of the vibration component depends on the type of bearing.

FFT spectrum

What is misalignment?

Misalignment refers to a state where the rotation center line of two rotary axes that are joined by a coupling is not in a straight line. This can be due to core deviation, face shift or a combination of these or similar conditions. When misalignment occurs, face runout can cause an increase in the thrust load acting on the bearing, which shortens the service life of the bearing.

Core deviation	
Face runout	
Core deviation and face runout	

Unbalance

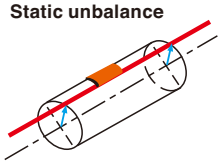
Unbalance is a condition that occurs in the rotary direction. It is characterized by an increase only in the vibration component that is equal to the number of revolutions. Other vibration frequency components will show almost no change. The vibration amplitude is proportional to the degree of unbalance. When the rotation frequency increases, the amplitude increases by the square of the number of revolutions.

FFT spectrum

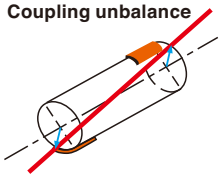
What is unbalance?

Unbalance occurs when the center of gravity of a rotating body is displaced from the center. Different types of unbalance include static unbalance, coupling unbalance, and dynamic unbalance. When unbalance occurs, the load acting on the bearing in the circumferential direction increases, which shortens the service life of the bearing.

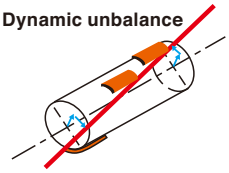
Static unbalance



Coupling unbalance



Dynamic unbalance



Trend management (relative value evaluation)

SX-A1VA program can store the data tagged with information of the measurement point and can output the data all together for each measuring object. By using spreadsheet software such as Excel enables trend management of the machinery condition. In order to assess changes in the vibration of rotating machinery or similar which can indicate problems and possible causes, it is necessary to effectively accumulate and manage measurement data. Reference values can then be determined based on these data for example to set caution and danger threshold values.

When a caution threshold is exceeded, monitoring should be strengthened, and when the danger threshold is reached, detailed diagnosis will normally be performed. With many common types of vibration acceleration, values that are about 2 to 3 times above normal are considered caution indicators and a further increase by a factor of 2 to 3 will indicate a danger state. For a given piece of machinery, vibration measurement location, measurement direction, and measurement period are determined, and a graph in which measured values are entered in a time series is created (trend management graph).

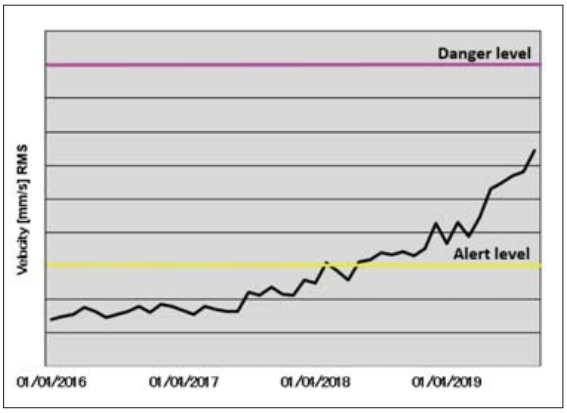
Measurement point

Measurement value

Time series

	A	B	Q	R	S	T	U	V
1	Saved Time	1/6/2020 11:42:57.4						
2								
3	Area	Area A						
4	Machine	Machine 001						
5	Point	Point A-1						
6								
7								
8	ACC Unit	m/s^2						
9	ACC RMS/EQ	RMS						
10	VEL Unit	mm/s						
11	VEL RMS/EQ	RMS						
12	DISP Unit	μm						
13	DISP RMS/EQ	EQ P-P						
14								
15	DateTime	Project Name	CH1 ACC	CH1 ACC PEAK	CH1 ACC C.F.	CH1 VEL	CH1 DISP	CH1 Evaluation
16	8/4/2017 12:56:05.9	project_0000	0.311622734	2.147816388	6.89236103	0.163034283	25.99104903	Favorable
17	9/4/2017 12:57:40.0	project_0001	0.34286847	2.000216633	5.833772449	0.163027499	30.31537769	Favorable
18	10/4/2017 12:58:46.2	project_0002	0.354303728	2.493594877	7.038014791	0.220096474	25.5043605	Favorable
19	11/4/2017 12:59:53.5	project_0003	0.35794955	2.194137827	6.129740419	0.21329033	21.97810112	Favorable
20	12/4/2017 13:01:07.0	project_0004	0.36931514	2.393820994	6.481784072	0.237535333	21.87149994	Favorable
21	1/4/2018 13:02:12.9	project_0005	0.379803513	3.077126167	8.101889687	0.214571178	25.71060653	Favorable
22	2/4/2018 13:02:49.0	project_0006	0.432314572	3.678793376	8.509528965	0.21192415	23.00814064	Favorable
23	3/4/2018 13:03:40.0	project_0007	0.466482974	3.957233521	8.483125308	0.257591261	31.44753308	Favorable

Evaluation

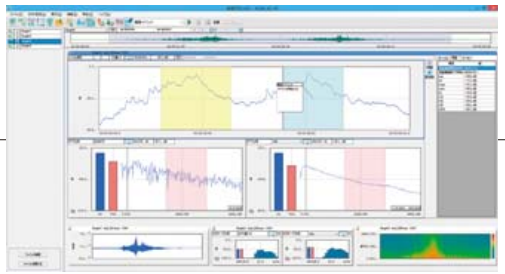


Trend management graph

Specifications

Number of input channels		Max. 2 (with SA-A1B2) Max. 4 (with SA-A1B4) (Number of logical channels: Using one signal input, settings for analysis of multiple vibration quantities such as acceleration, velocity, displacement, acceleration envelope etc. can be made.)
Vibration frequency range (using PV-57I)		Acceleration: 0.02 to 141.4 m/s² (rms)
		Velocity: 0.2 to 141.4 mm/s (rms, at 159.15 Hz)
		Displacement: 0.02 to 40.0 mm (EQ peak-peak, at 15.915 Hz)
Measurement frequency range (Electrical characteristics)		Acceleration: 1 Hz to 20 kHz
		Velocity: 3 Hz to 3 kHz
		Displacement: 3 Hz to 500 Hz
		Acceleration envelope: 1 kHz to 20 kHz
Filters		
	High-pass filter	1 Hz, 3 Hz, 5 Hz, 10 Hz, 1 kHz
	Low-pass filter	500 Hz, 1 kHz, 5 kHz, 10 kHz, 20 kHz
Vibration meter mode		Acceleration: rms, EQ 0-peak, Waveform peak, Crest factor
		Velocity: rms, EQ 0-peak
		Displacement: rms, EQ 0-peak, EQ peak-peak
	Sampling frequency	51.2 kHz
	Store functions	Instantaneous value store, Auto store, Average value store
	Threshold evaluation function	Allows setting a threshold value for a vibration quantity, with on-screen indication when the vibration quantity exceeds the threshold during measurement
	ISO absolute value evaluation function	Evaluation of instantaneous value or average value can be performed based on ISO 20816-1: 2016

FFT analysis mode		Power spectrum Time waveform of 1 frame
	Frequency range	100 Hz, 200 Hz, 500 Hz, 1 kHz, 2 kHz, 5 kHz, 10 kHz, 20 kHz
	Number of analysis lines	200, 400, 800, 1600, 3200 (Number of sampling points: 512, 1024, 2048, 4096, 8192)
	Time window functions	Rectangular, Hanning, Flat-top
	Average processing functions	Linear average, Exponential average, Maximum value hold (MAX)
Display functions		
	Display units	Acceleration: m/s², G, in/s², Velocity: mm/s, in/s, Displacement: mm, μm, mil
Waveform recording		Recording of vibration waveform during measurement
	Sampling frequency	Vibration meter mode: 51.2 kHz (fixed)
		FFT analysis mode: Frequency range x 2.56
	Quantization bit rate	24 bit (fixed)
Trigger measurement		
	Trigger modes	Free, Single, Repeat
	Trigger source	Vibration meter mode: Vibration quantity, Time, External, Tacho pulse
		FFT analysis mode: Waveform, Time, External, Tacho pulse



Option

Waveform Analysis Software

AS-70

Waveform processing software for display and analysis of waveform data collected with SX-A1VA

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