

Vibration Analyzer VA-12

Quick Instruction Manual

(Ver. 1.00)

RION CO., LTD.

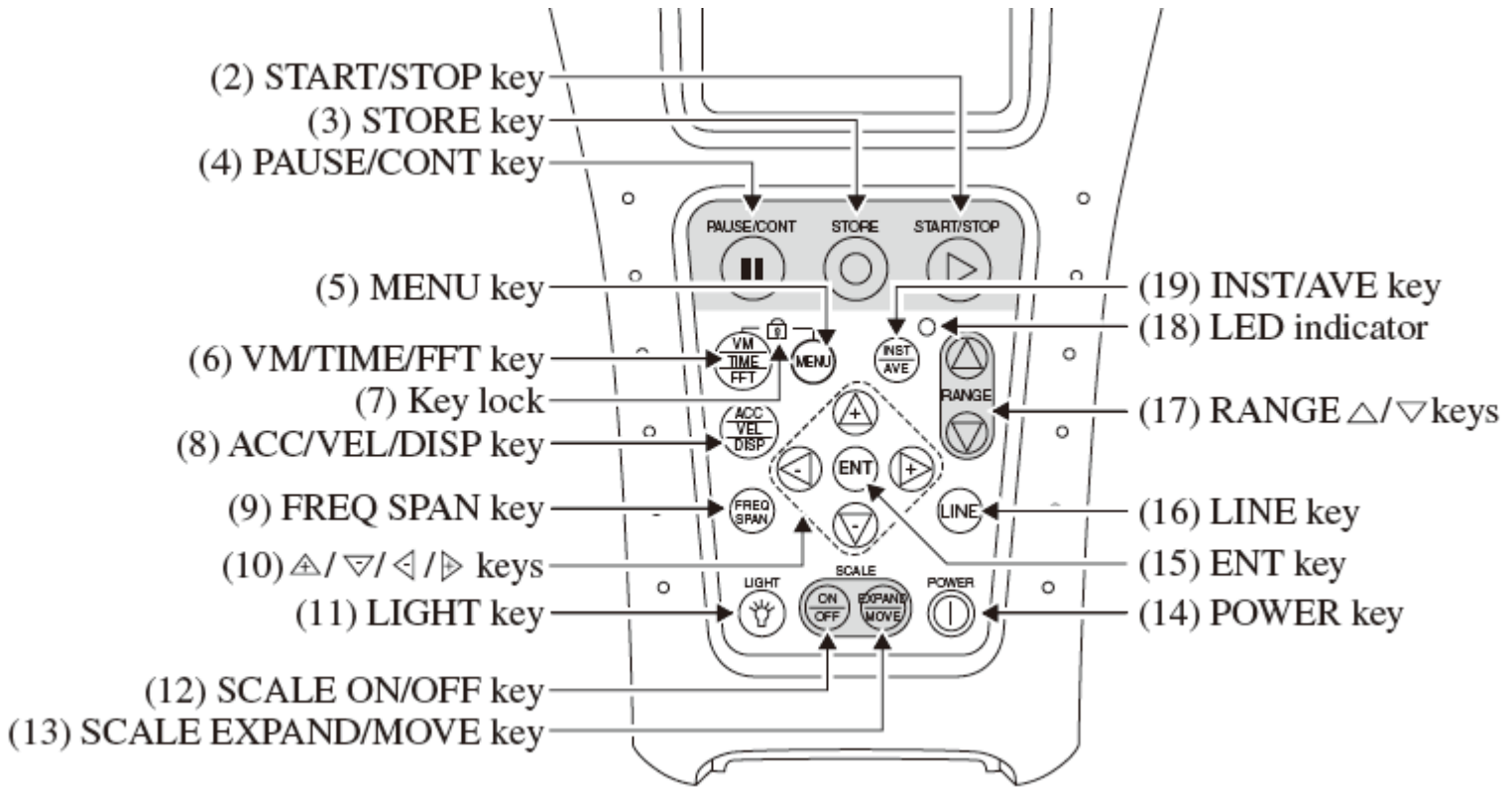
Measuring Instruments Sales and Engineering Division,
Sound and Vibration Measuring Instruments Business Department

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1. Fundamental operations

1.1 Operation key panel



1.2 Fundamental operations for preparation

VA-12 has three analysis functions: Vibration Meter Mode, Time Waveform Mode, and FFT Analyzer Mode.

The operation about common setups to each analysis function before starting measurement is explained in this section.

① Inserting the SD card

Insert the SD card into the card slot.



② Power on

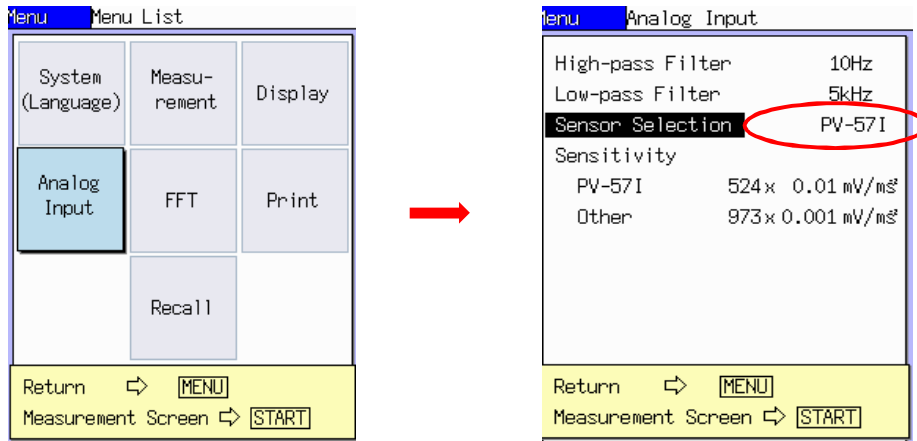
Press the POWER key for a while (longer than 1 second).

③ Sensitivity setting of the accelerometer

◆ PV-57I (Supplied accessory)

Usually it is not necessary to change the *õSensor Selectionö* since the default condition is set to PV-57I.

Press the MENU key, and go into the submenu [Analog Input] from the Menu List. Then check that *õSensor Selectionö* is set to *õPV-57Iö*. If it is set to *õOtherö*, change it to *õPV-57Iö*.

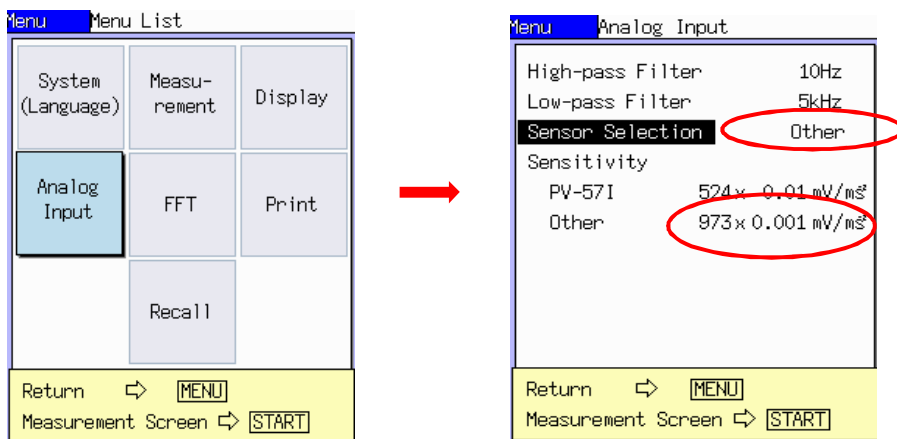


Sensor selection (PV-57I)

◆ Other accelerometers than PV-57I (Optional accessory)

When the amplitude of vibration is too small or too large, or the frequency is too high, the PV-57I cannot measure them. In that case an accelerometer suitable for the vibration characteristic should be chosen.

Press the MENU key, and go into the submenu [Analog Input] from the Menu List. Then change the *õSensor Selectionö* to *õOthersö*. Also set the *õSensitivityö* to the sensitivity value given on the calibration chart of the selected accelerometer.



Sensor selection (Other)

④ Setting the high-pass filter and low-pass filter

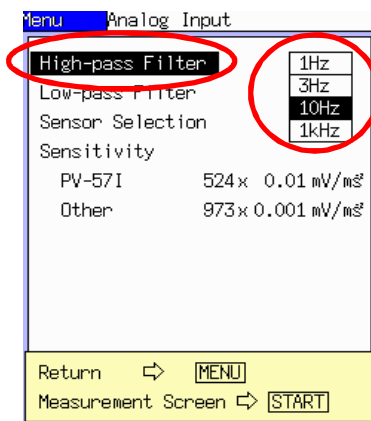
Set the High-pass filter and the Low-pass filter in the [Analog Input] submenu, according to the measurement purpose. The followings are examples of setup for typical vibration measurements.

- ◆ Setup for the unbalance or misalignment measurement

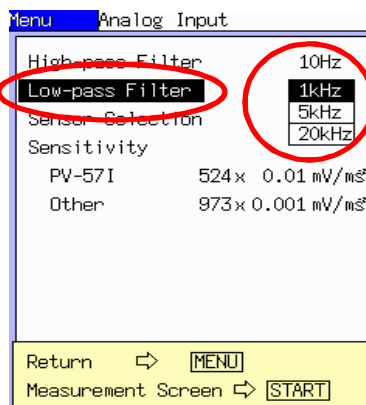
High-pass filter:10 Hz、 Low-passfilter:1 kHz

- ◆ Setup for the bearing defect measurement

High-pass filter:1 kHz、 Low-passfilter:20 kHz



Setting the High pass filter



Setting the Low pass filter

⑤ Attaching the accelerometer

Attach the accelerometer to the measuring point of the object. Since an impulsive vibration occurs when attaching the accelerometer, it is necessary to wait about 30 seconds until the influence of the impulsive vibration disappears. Moreover, it is necessary to care about the contact resonance frequency of the accelerometer which depends on the mounting method.

The desirable measuring points are as follows.

- A point near the measuring object.
- A rigid point.
- A flat and smooth point.
- A point without thick paint.

⑥ Measurement by each analysis function

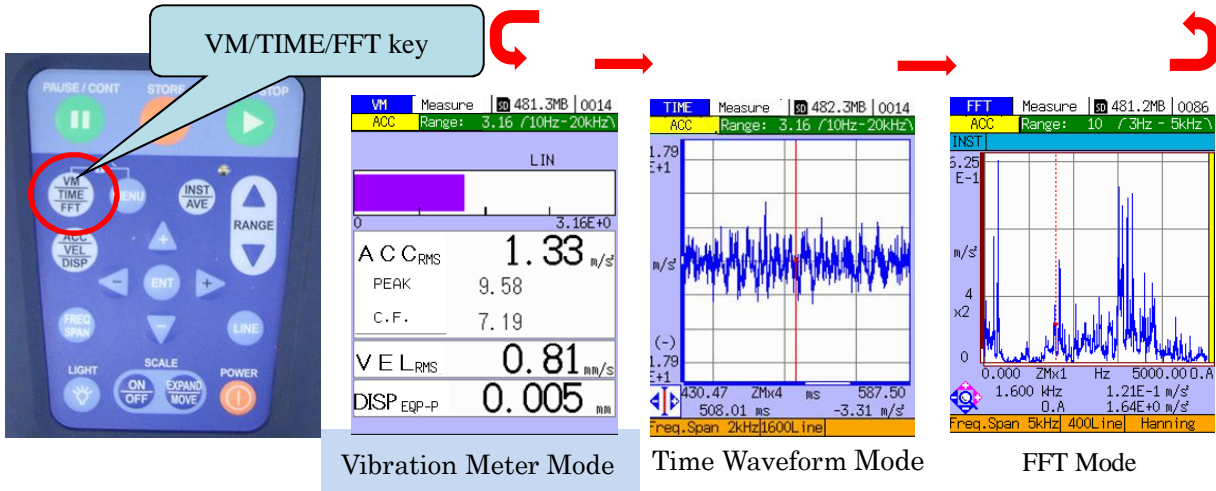
The explanations about common setups end here. Actual vibration measurement is performed by Vibration meter mode, Time waveform mode, and FFT mode.

Refer to the subsequent pages of this manual for the details of the measurement procedure for each analysis function.

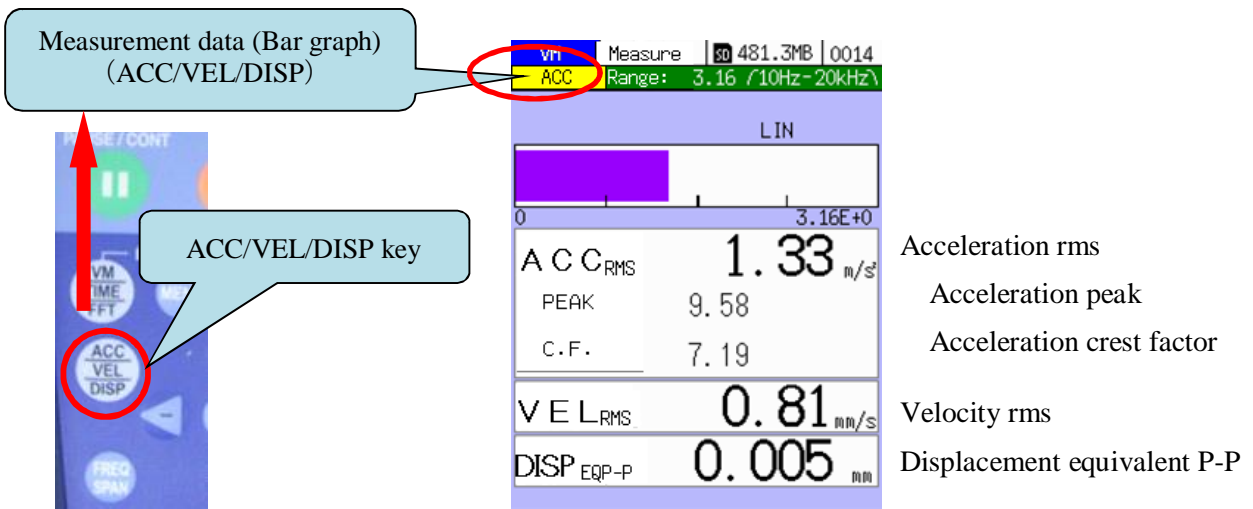
2. Measurement in Vibration Meter Mode

① Selecting the analysis function to Vibration meter mode after common setups.

Press the VM/TIME/FFT key to select the Vibration meter mode. The analysis function can be selected to each mode as shown in the following figure by pressing the VM/TIME/FFT key.



The five kinds of vibration values are measured and displayed simultaneously and updated in one second intervals. The bar graph indicates a selected data by the ACC/VEL/DIAP key. Acceleration, Velocity, and Displacement are selectable.

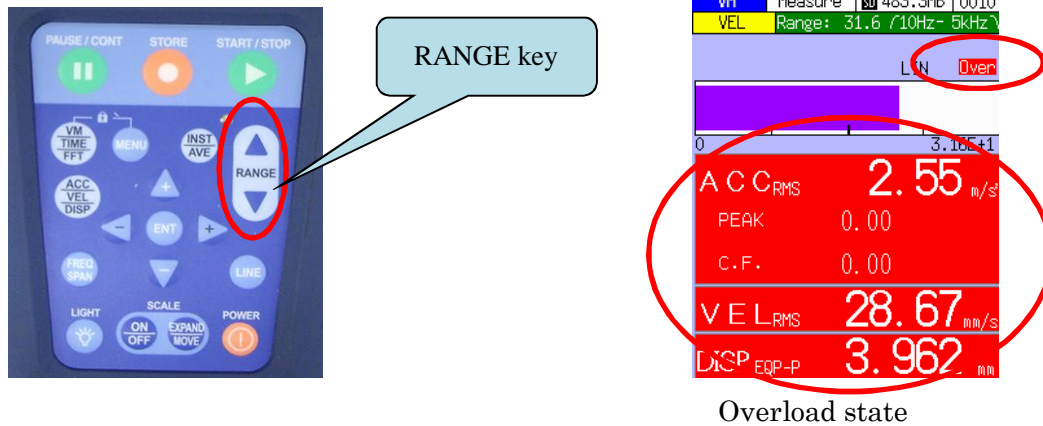


② Input range setting

Set the input range to the optimal setting. The optimal setting is to use the lowest range where an overload does not occur. The key changes to the higher range, the key changes to the lower range.

By changing input range, an electric transient noise occurs and overload may be displayed. In this case, it is not an excessive input of vibration. When an overload is displayed immediately after changing input range, please wait for a while. The overload may disappear.

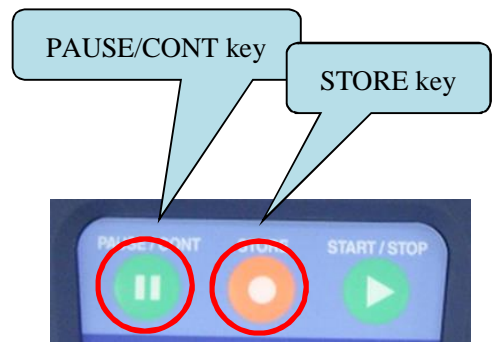
When the overload occurs, the background color of display changes to red and the δ Over δ indication appears to the upper right side.



Overload state

③ Reading the measured value

When the PAUSE/CONT key is pressed, the measurement changes to the paused state, and a measured data is fixed for reading the value. To resume the measurement, press the PAUSE/CONT key one more time.



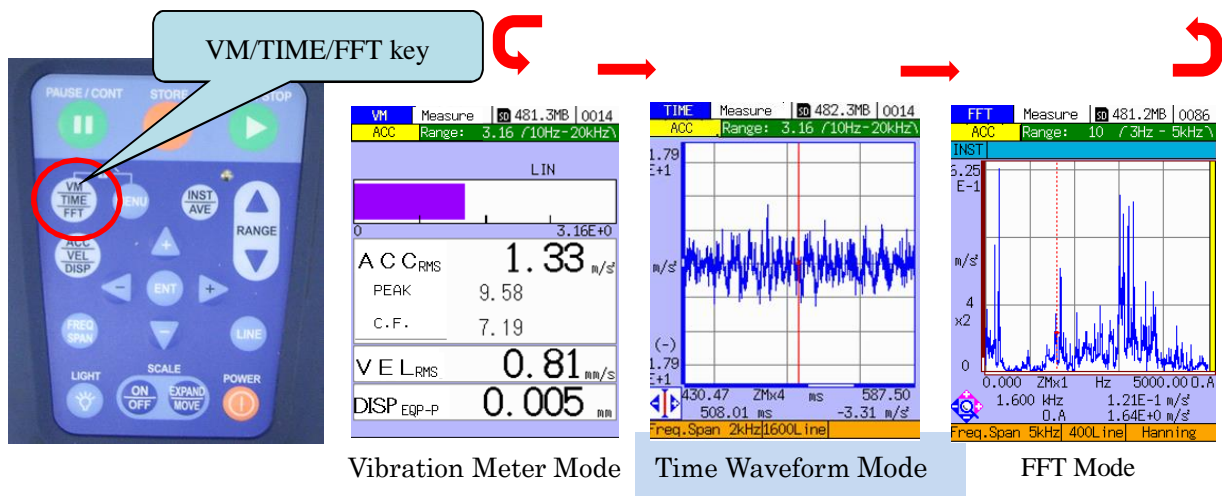
④ Storing the measured data

Store the data if necessary. When the STORE key is pressed, the data at that time is stored on SD card in VA-12. When in a paused state, the fixed data is stored.

3. Measurement in Time Waveform Mode

① Selecting the analysis function to δ Time waveform mode δ after common setups

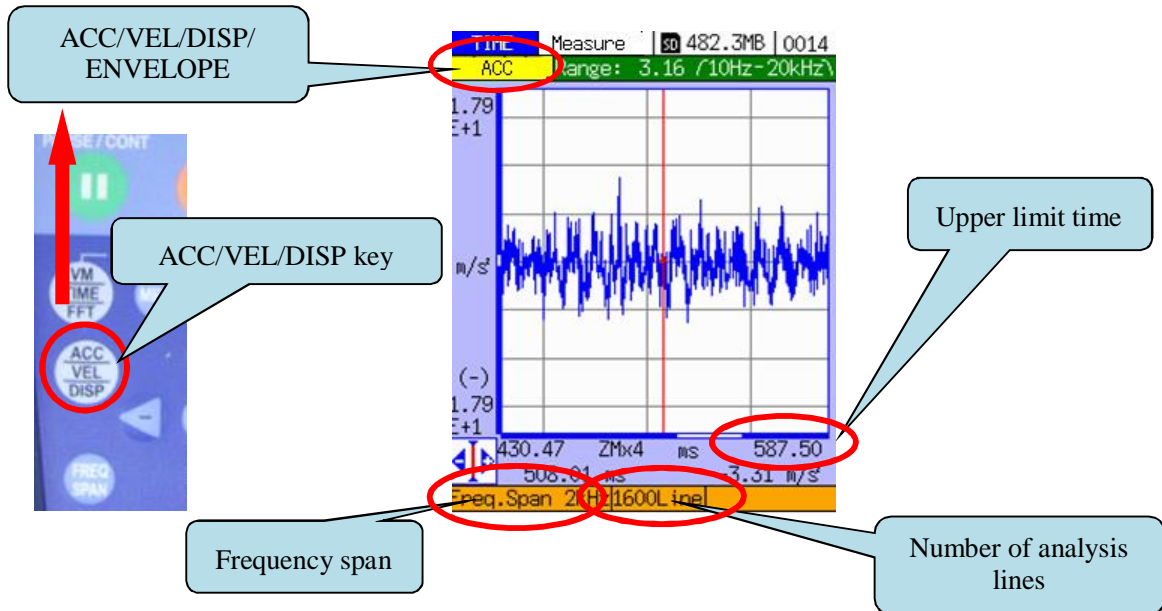
Press the VM/TIME/FFT key to select the Time waveform mode. The analysis function can be selected to each mode as shown in the following figure by pressing the VM/TIME/FFT key.



② Selecting the measurement data type

Select the measurement data type by pressing the ACC/VEL/DISP key.

Acceleration, Velocity, Displacement, and Envelope are selectable.

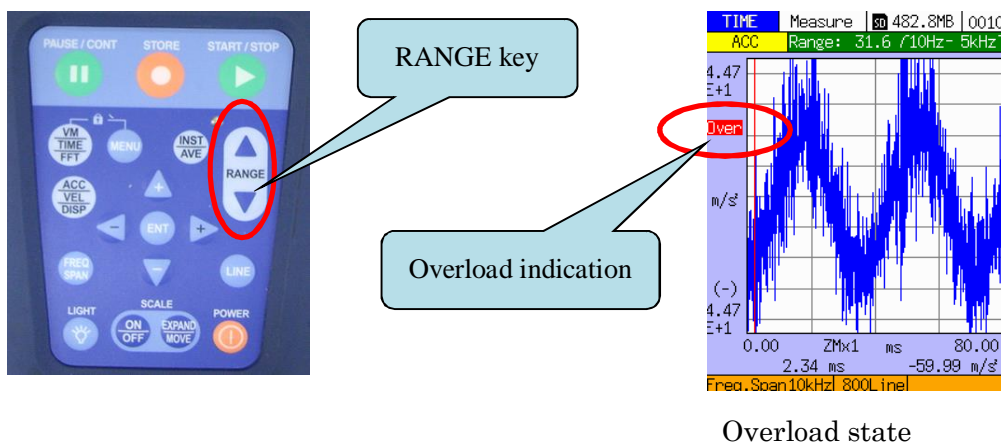


③ Input range setting

Set the input range to an optimal setting. The optimal setting is to use the lowest range where an overload does not occur. The ▲ key changes to the higher range, the ▼ key changes to the lower range.

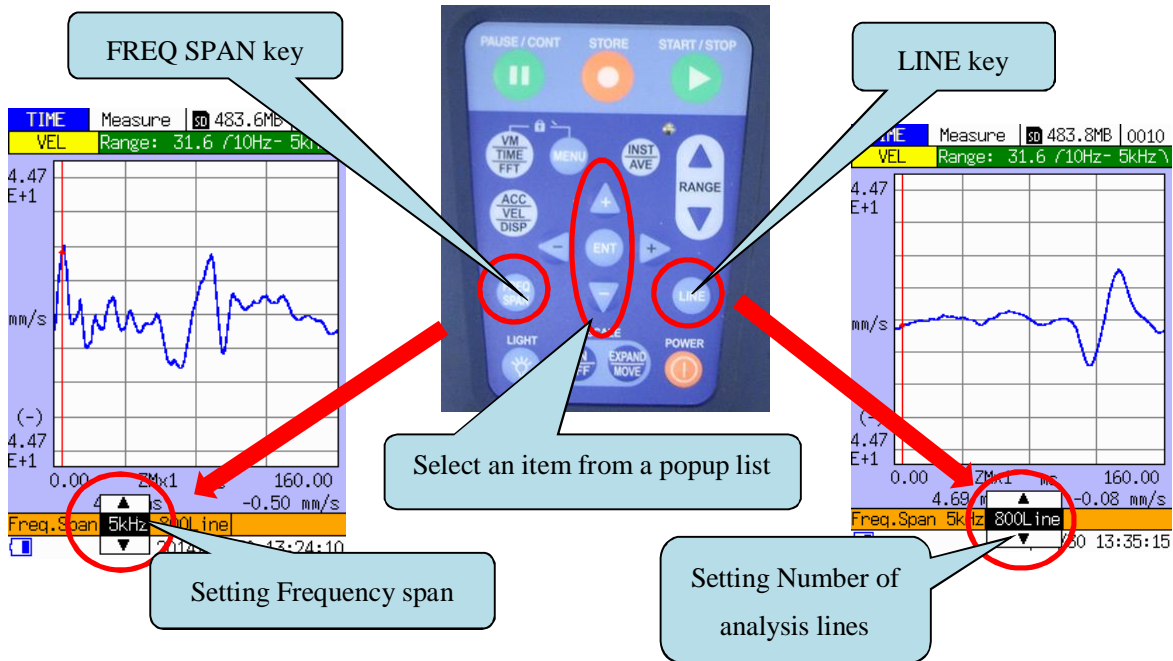
By changing input range, an electric transient noise occurs and overload may be displayed. In this case, it is not an excessive input of vibration. When an overload is displayed immediately after changing input range, please wait for a while. The overload may disappear.

When the overload occurs, the \bar{o} Over \bar{o} indication appears to the left side of display.



④ Setting the Frequency span and the Number of analysis lines

Set up the Frequency span and the number of analysis lines so that the measured time waveform can be observed clearly by the **FREQ SPAN** key and the **LINE** key. The details of a time waveform can be observed when the frequency span is set to high, but the maximum display time becomes short.





⑤ Fixing a measured time waveform

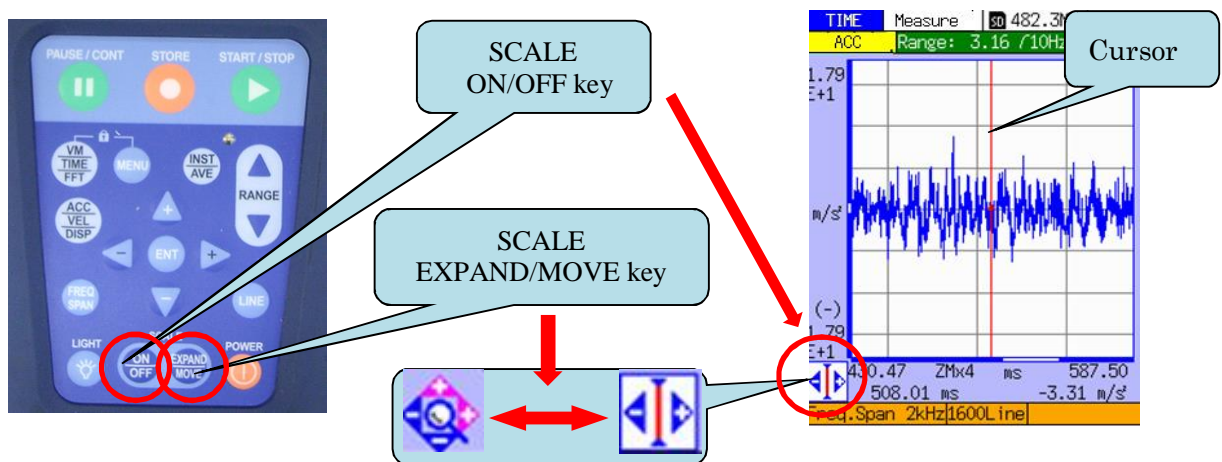
When you read the amplitude of time waveform with cursor, press the **PAUSE/CONT** key. The measurement changes to the paused state, and a measured time waveform is fixed.

To resume the measurement, press the **PAUSE/CONT** key one more time.

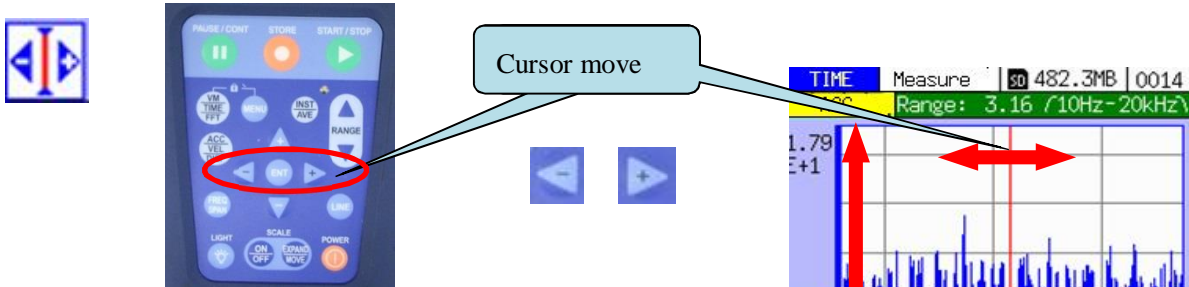
⑥ Zooming the X-axis and the Y-axis of the graph display

When the **SCALE ON/OFF** key is pressed, the display scaling function becomes operational. In this case, the graph zoom symbol  or the cursor move symbol  is shown at the bottom left corner of the display.

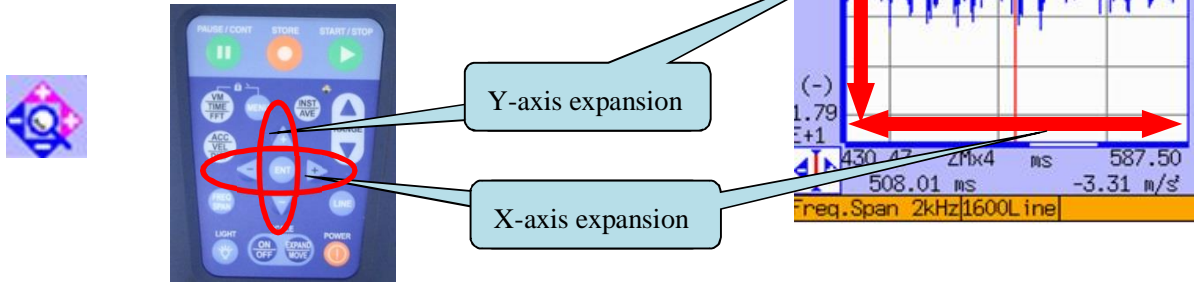
The graph zoom symbol and the cursor move symbol can be selected by the **SCALE EXPAND/MOVE** key.



◆ Cursor move symbol : Move mode



◆ Graph zoom symbol : Zoom mode



The keys for zoom operation are as follows.

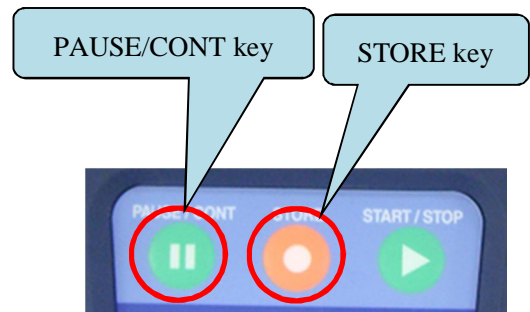
Expand Y-axis  , Shrink Y-axis  , Expand X-axis  , Shrink X-axis  .

Expansion of the X-axis is performed so that the present cursor position locates at the center.

⑦ Storing the measured data

Store the data if necessary. When the STORE key is pressed, the data at that time is stored on SD card in VA-12.

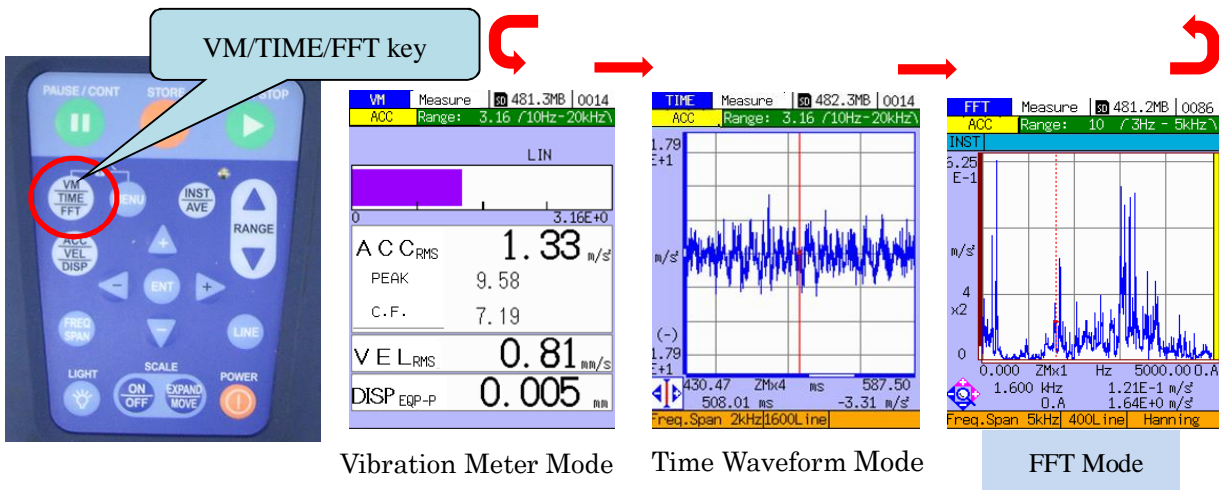
When in a paused state, the fixed data is stored.



4. Measurement in FFT Mode

① Selecting the analysis function to δ FFT mode after common setups

Press the VM/TIME/FFT key to select the FFT mode. The analysis function can be selected to each mode as shown in the following figure by pressing the VM/TIME/FFT key.



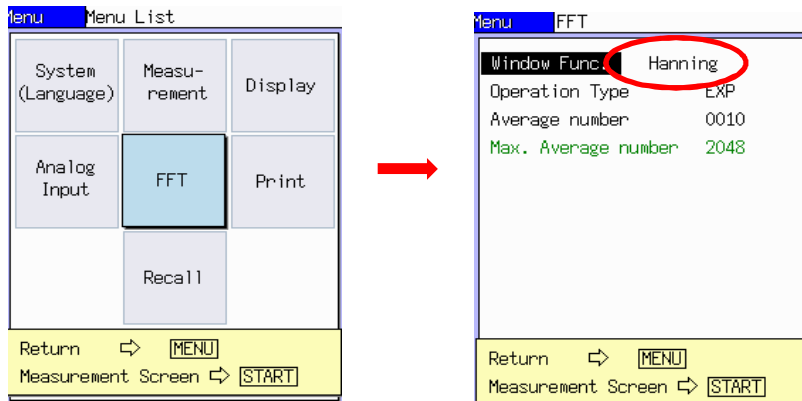
Vibration Meter Mode

Time Waveform Mode

FFT Mode

② Setting the Window function

Press the MENU key, and go into the submenu [FFT] from the Menu List. Then select the Window function to a suitable setting.



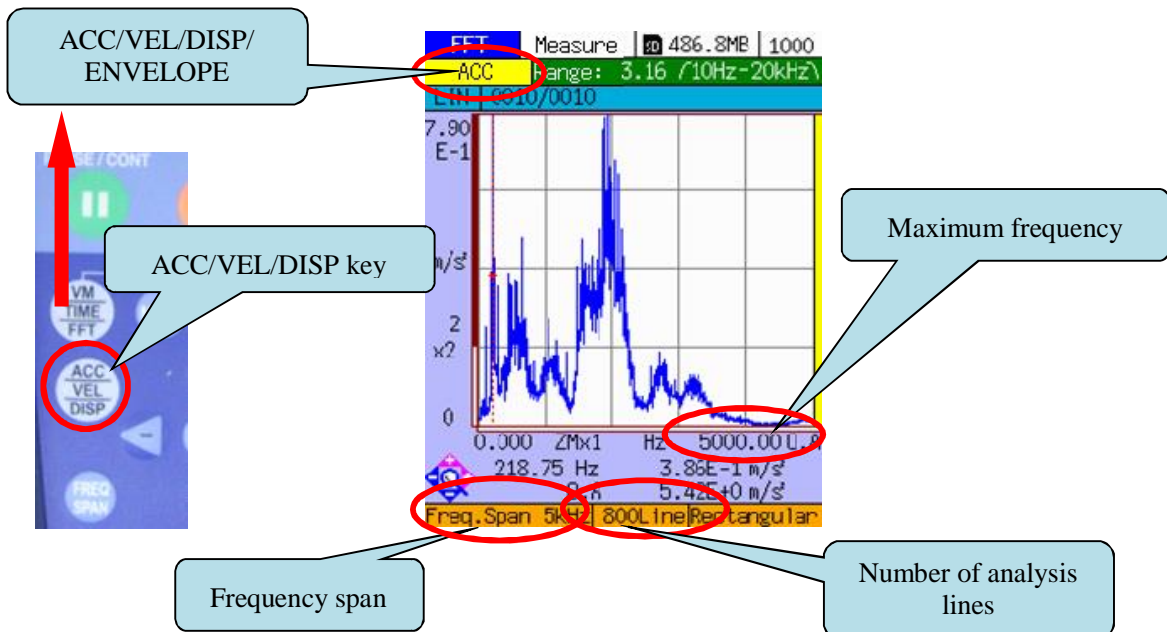
Setting the Window function

The window function is chosen as follows according to the measurement purpose.



- ◆ Rectangular : It is used for the phenomena without repetition like a single pulse.
- ◆ Hanning : It is used for the usual measurement.
- ◆ Flattop : It is used for reading the amplitude correctly, although the frequency resolution may be worse.

③ Selecting the measurement data type

Select the measurement data type by pressing the ACC/VEL/DISP key. Acceleration, Velocity, Displacement, and Envelope are selectable.

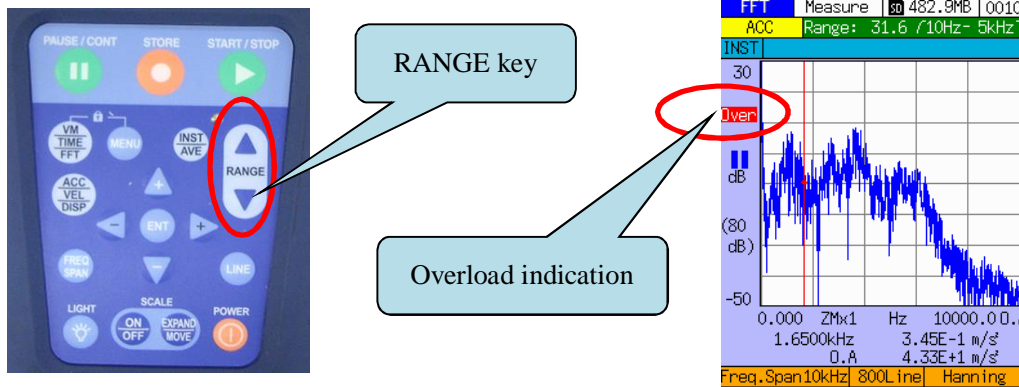


④ Input range setting

Set the input range to an optimal setting. The optimal setting is to use the lowest range where an overload does not occur. The  key changes to the higher range, the  key changes to the lower range.

By changing input range, an electric transient noise occurs and overload may be displayed. In this case, it is not an excessive input of vibration. When an overload is displayed immediately after changing input range, please wait for a while. The overload may disappear.

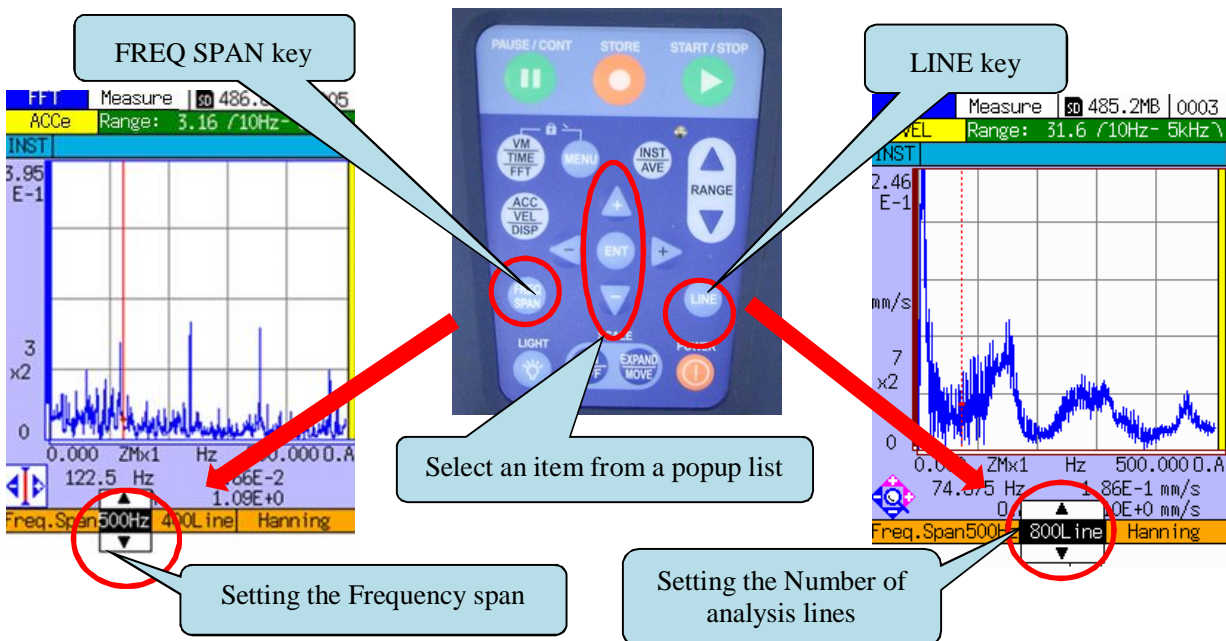
When the overload occurs, the $\bar{o}Over\bar{o}$ indication appears to the left side of display.



Overload state

⑤ Setting the Frequency span and the Number of analysis lines

In order to determine the maximum frequency to analyze and the frequency resolution, the frequency span and the number of analysis lines are set up. The frequency span can be selected by the 'FREQ SPAN' key, and the number of analysis lines can be selected by the 'LINE' key.



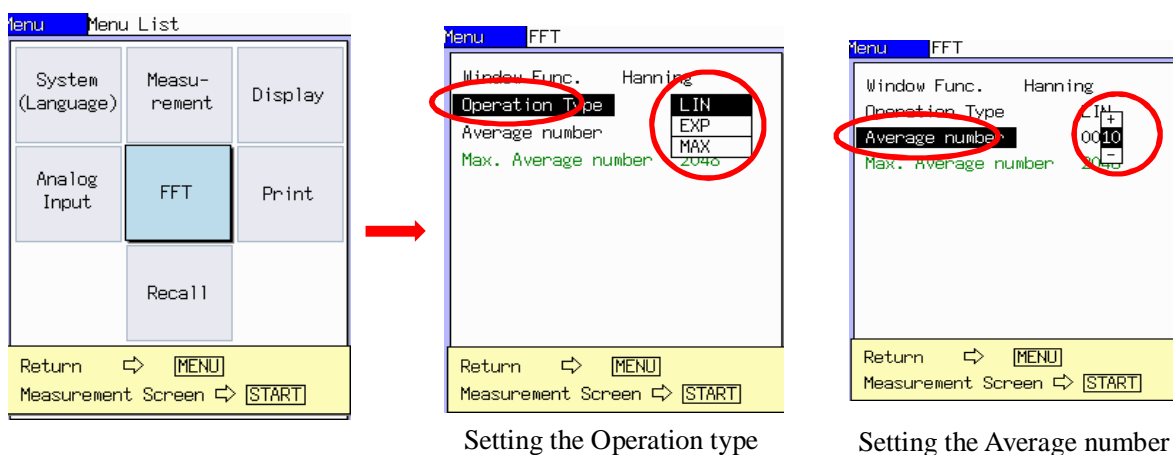
Set the frequency span about three times larger than the fundamental frequency if the frequency can be predicted like a rotating machine. Also set the number of analysis lines so that the frequency resolution becomes narrower than 1 Hz. The frequency resolution is obtained by the frequency span divided by the

number of analysis lines. If the generated frequency cannot be predicted, measure the frequency roughly with high frequency span at first, then set the frequency span and the number of analysis lines so that the frequency resolution becomes narrower than 1 Hz.

⑥ Setting the Operation type

In the Instantaneous measurement, it is not necessary to set the operation type. In the measurement with operation function, it is necessary to select the operation type. Then press the INST/AVE key, and press the START/STOP key.

In order to select the operation type, presses the MENU key, then go into the submenu [FFT] from the Menu List, and set the Operation type and the Average number.



◆ Instantaneous measurement

FFT spectra are continuously displayed without averaging. It is used when grasping the characteristics of phenomenon by observing the time variation of the spectrum, or when the average is not necessary since the vibration is steady.

The operation type is chosen as follows according to the measurement purpose.

◆ Linear average

It is a popular averaging type, and is used to obtain the arithmetic averaged result. The operation stops when the number of measured data reaches to the Average number set in the submenu [FFT].

◆ Exponential average

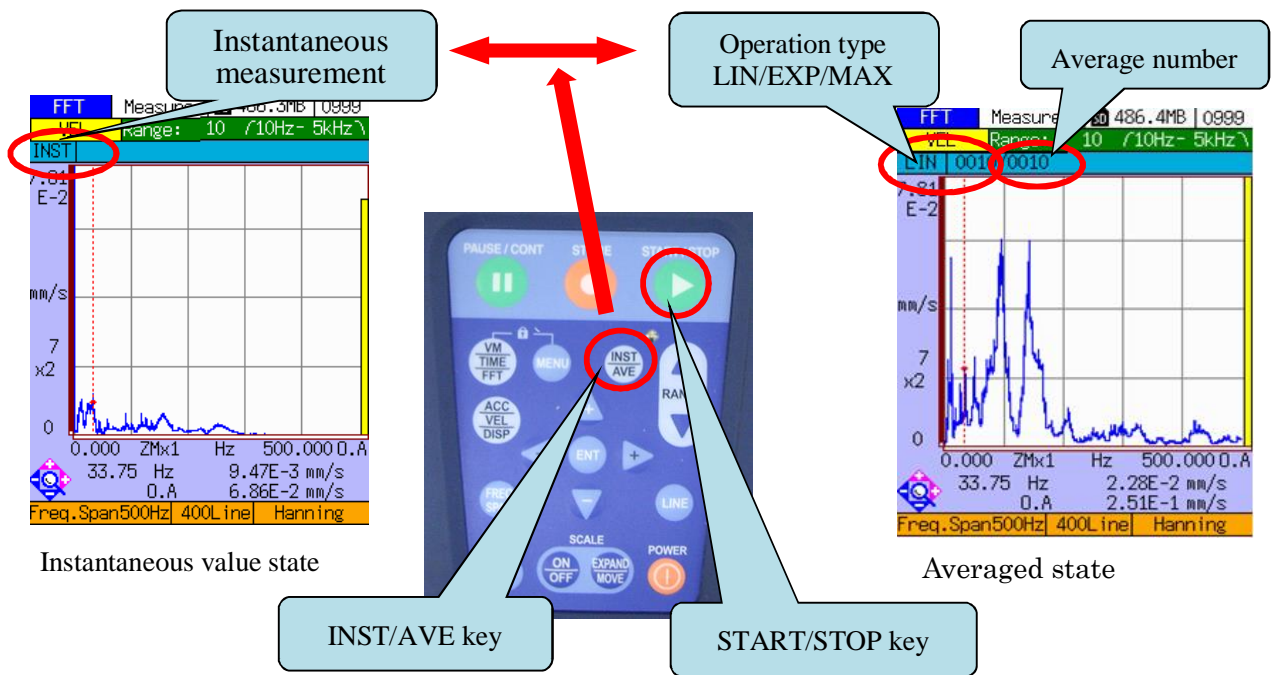
FFT spectra are continuously displayed with a time constant. When amplitude of vibration changes violently, the averaged amplitude becomes smooth. It is used when grasping the characteristics of phenomenon by observing the time variation of the spectrum. If an impulsive vibration occurs, you may miss it in Instantaneous measurement. However you will not miss it in exponential average, since the time constant keeps the influence of the impulsive vibration for a while.

◆ Maximum hold

It is used when obtaining the maximum value of each frequency component. The operation stops when the number of measured data reaches to the Average number set in the submenu [FFT].

In order to start the operation function, press the INST/AVE key. In that case, an operation type is displayed at the upper left part of display. In Linear average, [LIN] is shown, in Exponential average, [EXP] is shown, and in Maximum hold, [MAX] is shown. The average number is also displayed. If the INST/AVE key is pressed again, it will change to the Instantaneous measurement and [INST] is shown.

If the START/STOP key is pressed where the operation type is LIN, EXP, or MAX, the average will start and the counter of the average number will go up. If the START/STOP key is pressed again during the average operation, the average will stop at the time. If the START/STOP key is pressed in the Instantaneous measurement, the average will not start.





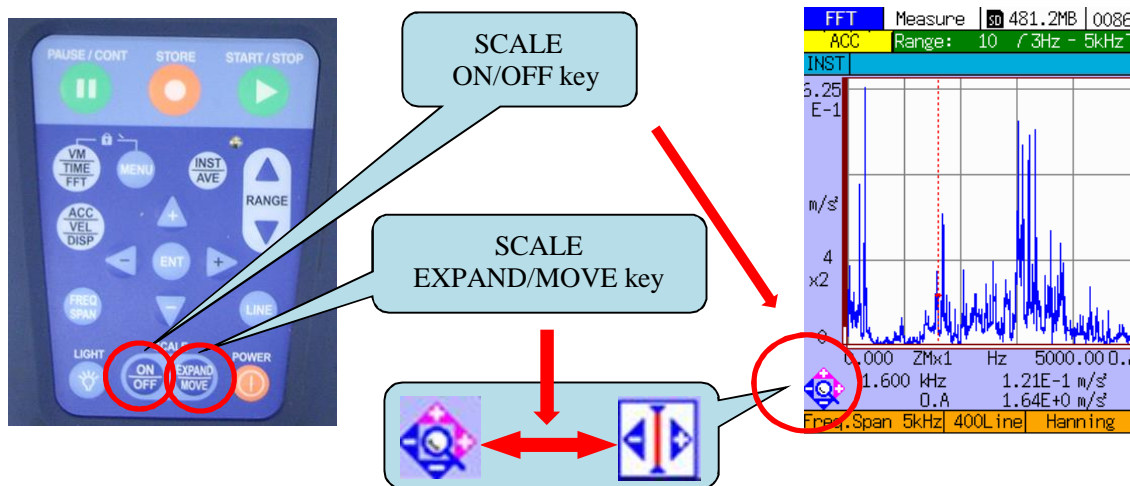
⑦ Fixing a FFT spectrum

In Linear average or Maximum hold, the operation stops when the average counter reaches to the average number, and the FFT spectrum is fixed.

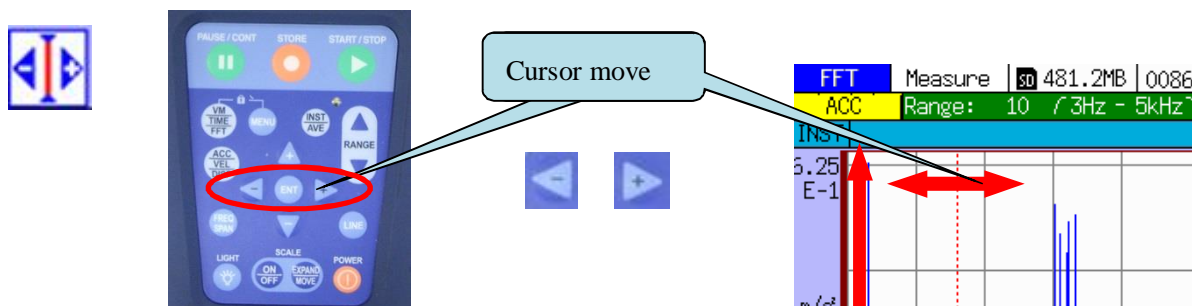
In Instantaneous measurement or Exponential average, the operation continues. When you read the frequency or the amplitude of spectrum with cursor, press the PAUSE/CONT key. The measurement changes to the paused state, and a measured FFT spectrum is fixed. To resume the measurement state, press the PAUSE/CONT key one more time.

⑧ Zooming the X-axis and the Y-axis of the graph display

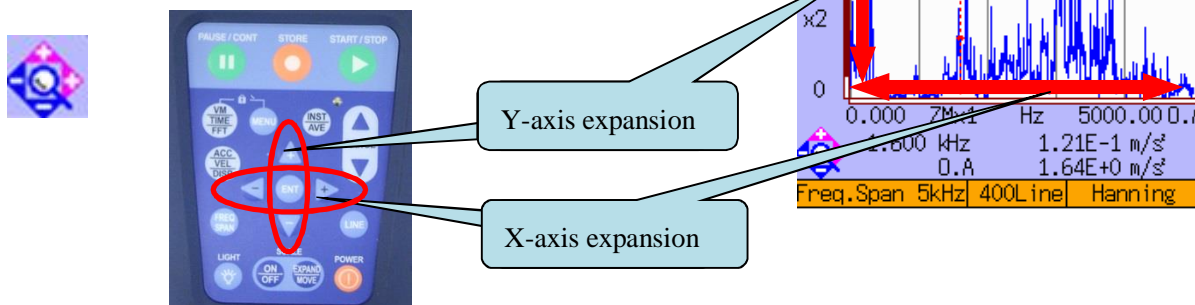
When the SCALE ON/OFF key is pressed, the display scaling function becomes operational. In this case, the graph zoom symbol  or the cursor move symbol  is shown at the bottom left corner of the display. The graph zoom symbol and the cursor move symbol can be changed by the SCALE EXPAND/MOVE key.







◆ Cursor move symbol : Move mode



◆ Graph zoom symbol : Zoom mode





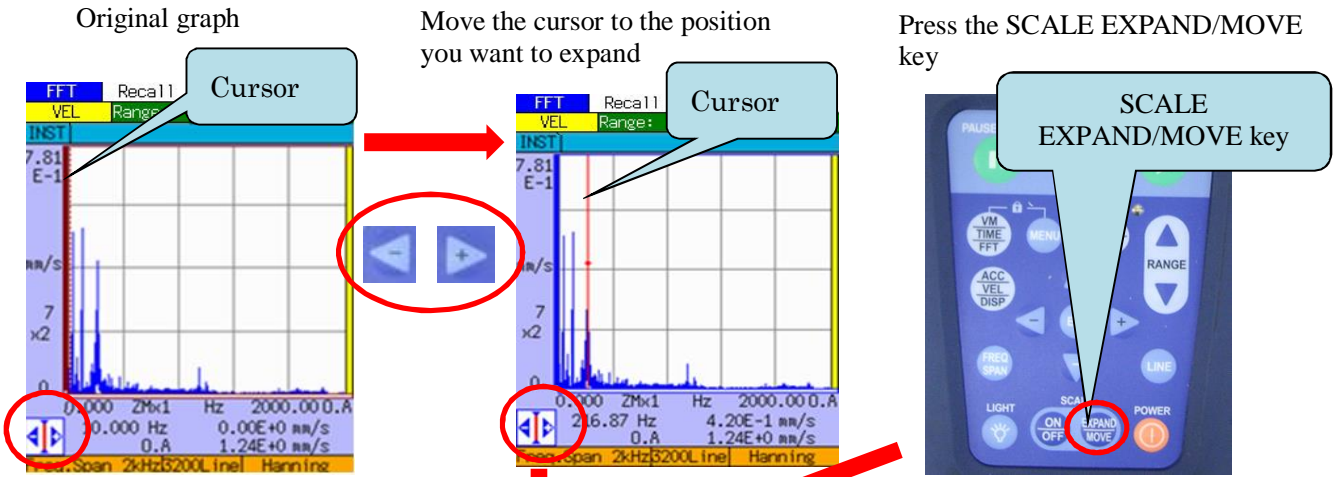
The keys for zoom operation are as follows.

Expand Y-axis  , Shrink Y-axis  , Expand X-axis  , Shrink X-axis  .

Expansion of the X axis is performed so that the present cursor position locates at the center.

The example of operation to expand the X-axis is as follows. It is assumed that the cursor move symbol is displayed at first. If the Graph zoom symbol is displayed at first, press the SCALE EXPAND/MOVE key to change the zoom mode.

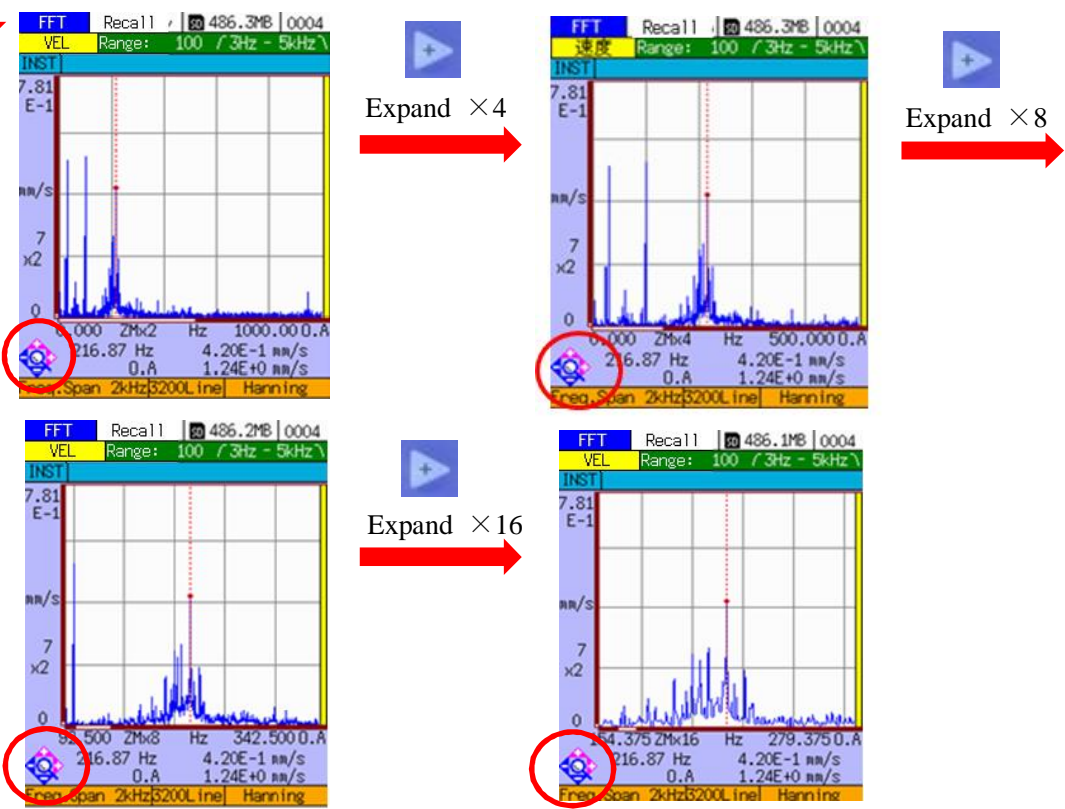
Move the cursor to the position where you want to expand. Press the SCALE EXPAND/MOVE key, then Cursor move symbol is displayed. Press the  key. The X-axis is expanded twice on the basis of the cursor position. When you press the  key once, the X-axis is expanded twice.



Press the  key

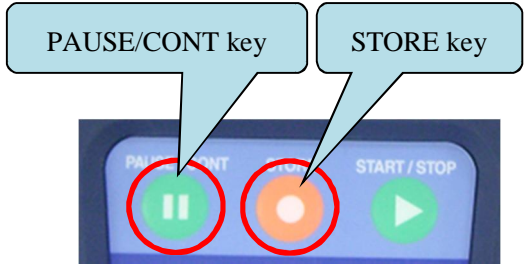
Graph zoom symbol is displayed

The X-axis is expanded twice on the basis of the cursor position



⑨ Storing the measured data

Store the data if necessary. When the STORE key is pressed, the data at that time is stored on SD card in VA-12. When in a paused state, the fixed data is stored.



5. Examples of typical vibration measurement

The followings are the examples of VA-12 settings for some typical vibration measurements. The minimum settings for the measurement are described. The input range should be set up according to the amplitude of vibration so that an overload may not occur.

5.1 Diagnosis of unbalance and misalignment

The vibration velocity is measured to diagnose the structural defects like unbalance or misalignment. The measurements in three directions (horizontal, vertical, and axial) are necessary to diagnosis. And the biggest value in them is used for diagnosis.

In survey diagnosis, the root mean square values of the vibration velocity are measured by Vibration Meter Mode. If the measured value exceeds the criterion and the judgment is abnormal, the precise diagnosis is carried out. In this case, the defect part and the cause are investigated by Time Waveform Mode or FFT Analyzer Mode. In unbalance condition, only a shaft rotational frequency appears, but in misalignment condition, a shaft rotational frequency and its harmonics appear. Since the vibration velocity relates to the vibration severity which indicates the violence of total vibration, if the vibration velocity increases, there may be some abnormalities.

Fundamental settings

High-pass filter : 10 Hz

Low-pass filter : 1 kHz

◆ Survey diagnosis

Analysis function : Vibration Meter Mode

Measurement data type : Velocity

◆ Precise diagnosis by time waveform

Analysis function : Time Waveform Mode

Measurement data type : Velocity

Frequency span, Number of analysis lines : Set up so that the time waveform can be observed

◆ Precise diagnosis by FFT analysis

Analysis function : FFT Analyzer Mode

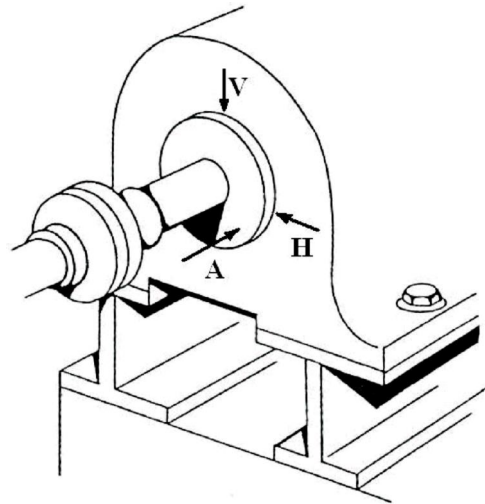
Measurement data type : Velocity

Window function : Hanning window

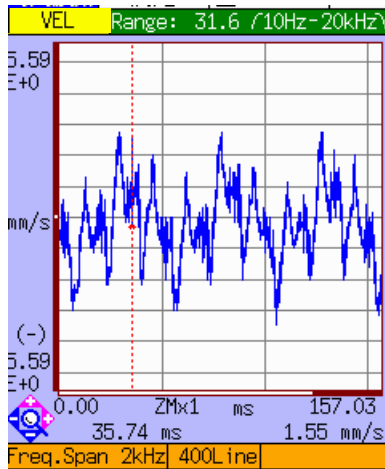
Frequency span : 200Hz (unbalance)、 200Hz or 500Hz (Misalignment)

Number of analysis lines : Set up so that the frequency resolution becomes narrower than 1Hz

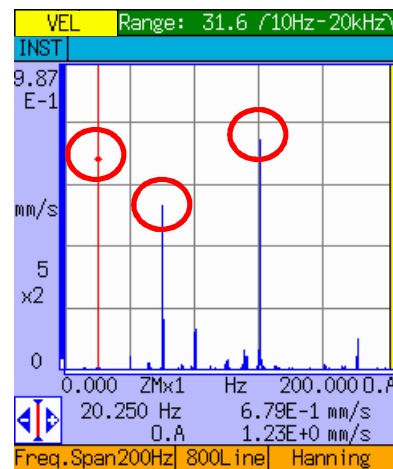
Operation type : It is used if necessary



An example of misalignment : The shaft rotational frequency (20.25Hz), the third harmonics (60.75Hz) and the 6th harmonics (121.5Hz) can be observed.



Time waveform (velocity)



FFT (velocity)

5.2 Diagnosis of rolling element bearings

Since the acceleration increases if a bearing defect becomes large, vibration acceleration is measured to diagnose bearings. Attach the accelerometer to the bearing as near as possible. The measurement direction is available in any directions among horizontal, vertical, and axial direction.

In survey diagnosis, the root mean square values and the crest factor of the vibration acceleration are measured by Vibration Meter Mode. If the vibration acceleration exceeds the criterion and the judgment is abnormal, the precise diagnosis is carried out. In precise diagnosis, the defected part can be predicted by FFT analysis of acceleration envelope, if the information about the bearing to diagnosis is known, for examples, rotating speed, diameter of ball, number of balls, pitch diameter, and contact angle.

Fundamental settings

High-pass filter : 1 kHz

Low-pass filter : 20 kHz

◆ Survey diagnosis

Analysis function : Vibration Meter Mode

Measurement data type : Acceleration rms value and Acceleration crest factor

◆ Precise diagnosis by time waveform

Analysis function : Time Waveform Mode

Measurement data type : Acceleration and Envelope

Frequency span, Number of analysis lines : Set up so that the time waveform can be observed

◆ Precise diagnosis by FFT analysis

Analysis function : FFT Analyzer Mode

Measurement data type : Acceleration and Envelope

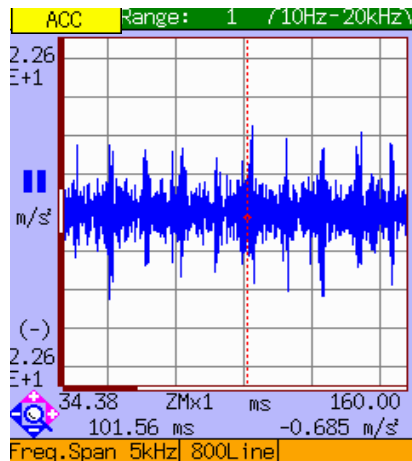
Window function : Hanning window

Frequency span : 20kHz (Acceleration),200Hz or 500Hz (Envelope)

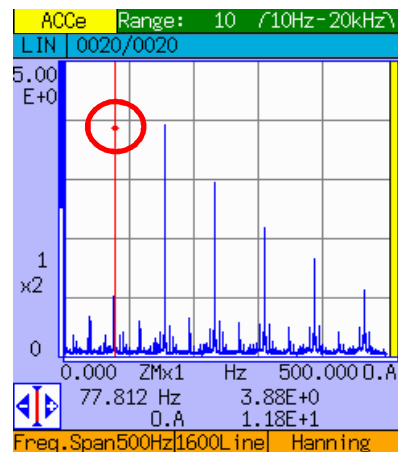
Number of analysis lines : Set up so that the frequency resolution becomes narrower than 1Hz

Operation type : It is used if necessary

An example of outer race defect of a bearing : The Ball Pass Frequency of Outer race can be observed at 77.8Hz.



Time waveform (acceleration)



FFT (envelope)

5.3 Measurement of natural frequency

The natural frequencies of a structure can be measured by exciting the object. Attach an accelerometer to the object, and excite it with an impulse hammer. In measurement, it is necessary to use the trigger function and the linear average. Refer to the instruction manual of VA-12 about the details of the trigger function. When an exciting point and an attached point of the accelerometer changes to the other position, the measured frequencies may change. In this case, all the measured frequencies are considered as natural frequencies.

Fundamental settings

Sensor selection : PV-57I (in usual case),

A lighter accelerometer for example PV-91C (when the object is very small and light)

High-pass filter : 10 Hz

Low-pass filter : 20 kHz

Analysis function : FFT Analyzer Mode

Measurement data type : Acceleration

Window function : Rectangular window

Frequency span : 5 kHz (Set up so that the whole natural frequencies are included)

Number of analysis lines : 3200 (Set up so that the whole decay process of a time waveform can be observed)

Operation type : Linear average、 Average number : about 5

FFT Scale : Log (The display range becomes wide when the FFT scale is set to Log. It is often used in impact excitation measurement.)

Trigger operation mode : Repeat

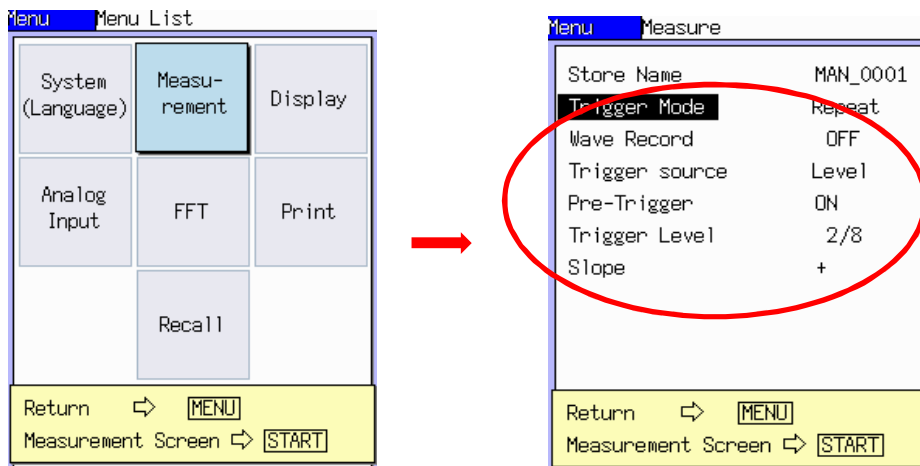
Trigger source : Level

Pre-trigger : ON

Trigger level : 1/8 ~ 2/8

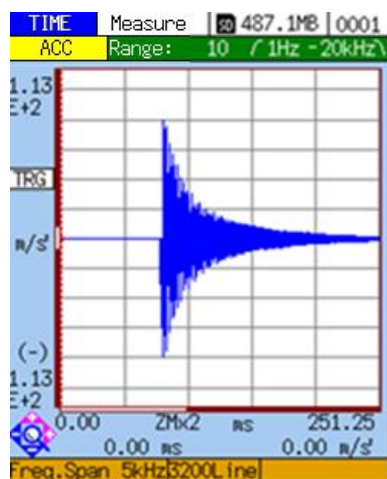
Slope : +

The trigger conditions are set in the submenu [Measurement]. Press the MENU key, and go into the submenu [Measurement] from the Menu List.



Setting the trigger conditions

A measurement example of natural frequencies of a stainless plate (200mm×100mm×20mm) :
The 2.54 kHz and the 2.89 kHz are natural frequencies.



Time waveform (acceleration)



FFT (acceleration)

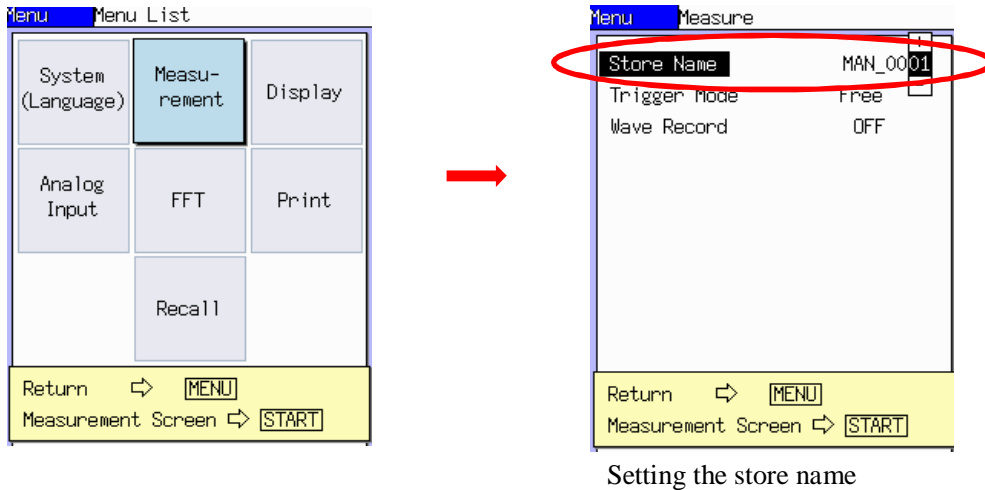
6. Data store and recall

6.1 Store and recall operations of measurement data

① Setting the Store Name

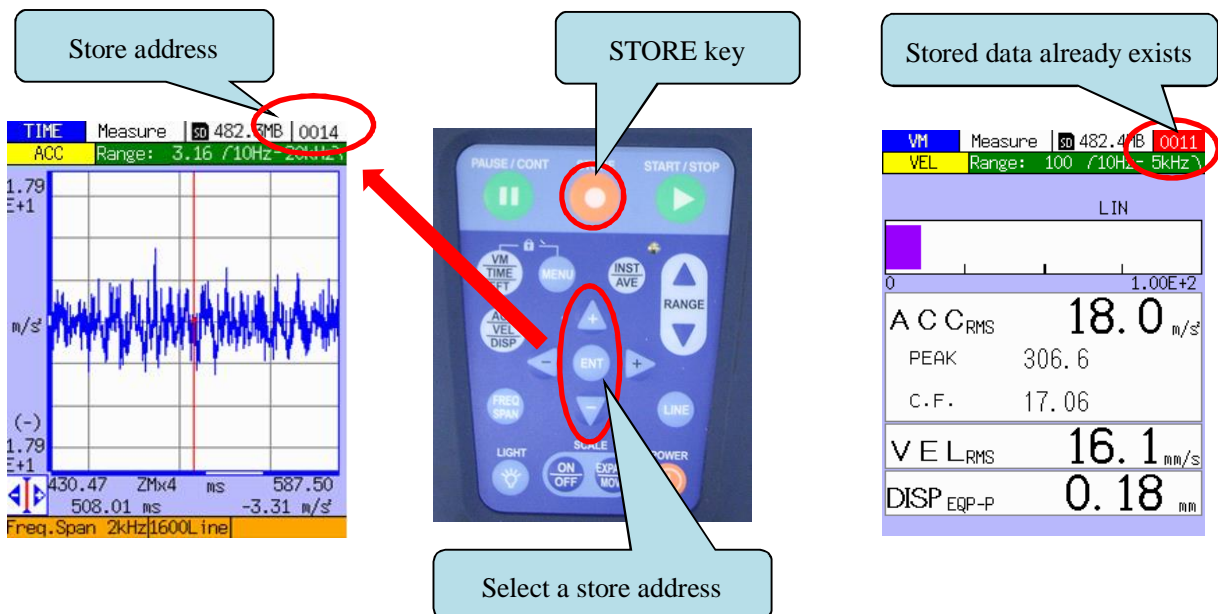
Press the MENU key, and go into the submenu [Measurement] from the Menu List. Then set the Store Name. Specify the number which follows MAN_ like 0001 to any value.

Up to 1000 data can be stored in one Store Name.



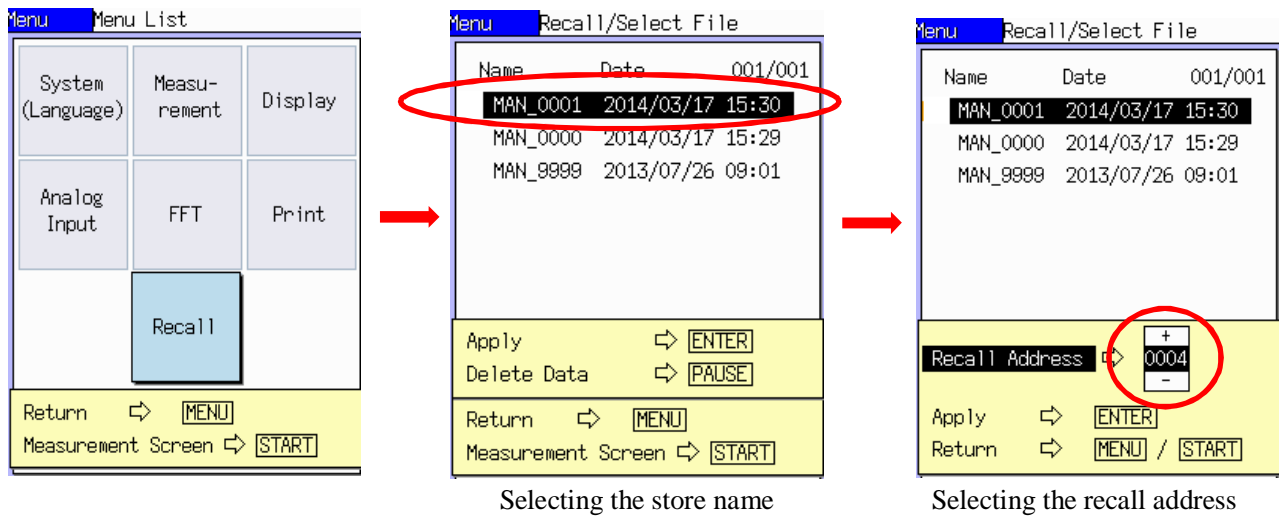
② Selecting store address and data storing

The store address is indicated at the upper right corner of display. This store address means the address contained in a Store Name which was set up at the previous step. The measured data can be stored in the indicated store address by pressing the STORE key. The store address can be selected by keys. When the data already exists in the selected address, the background color of the address is displayed to red. Data will be overwritten if the STORE key is pressed in this state.



③ Recalling a stored data

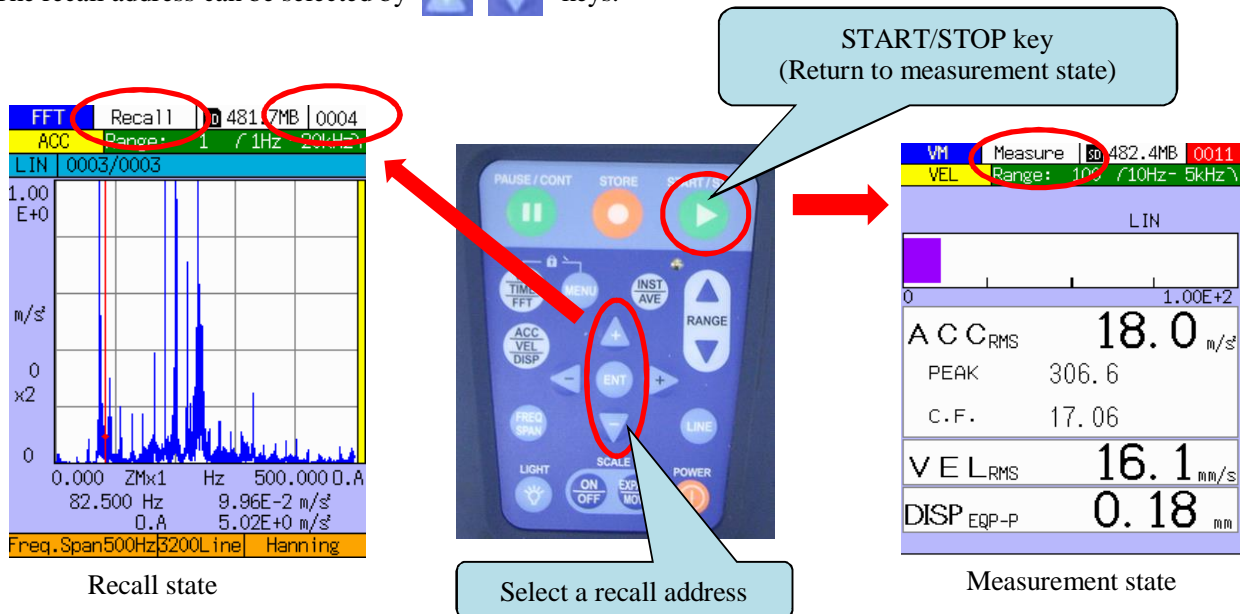
Press the MENU key, and go into the submenu [Recall] from the Menu List. Then select the "Store Name" and the Recall address. The data stored in the selected address is displayed by pressing the ENTER key.



④ Selecting recall address in the recall state

In the recall state, the selected data is recalled and the character "Recall" is displayed at the upside center.

The recall address can be selected by keys.



⑤ Returning to the measurement state

The START/STOP key is pressed to return to the measurement state from the recall state.

In the measurement state, the character "Measure" is displayed at the upside center.

6.2 Store and recall operations of screen bitmap image

The VA-12 allows storing the current screen image as a BMP file in a specified folder on the SD card. Since the stored BMP file can be treated by computer, it is useful for making a report.

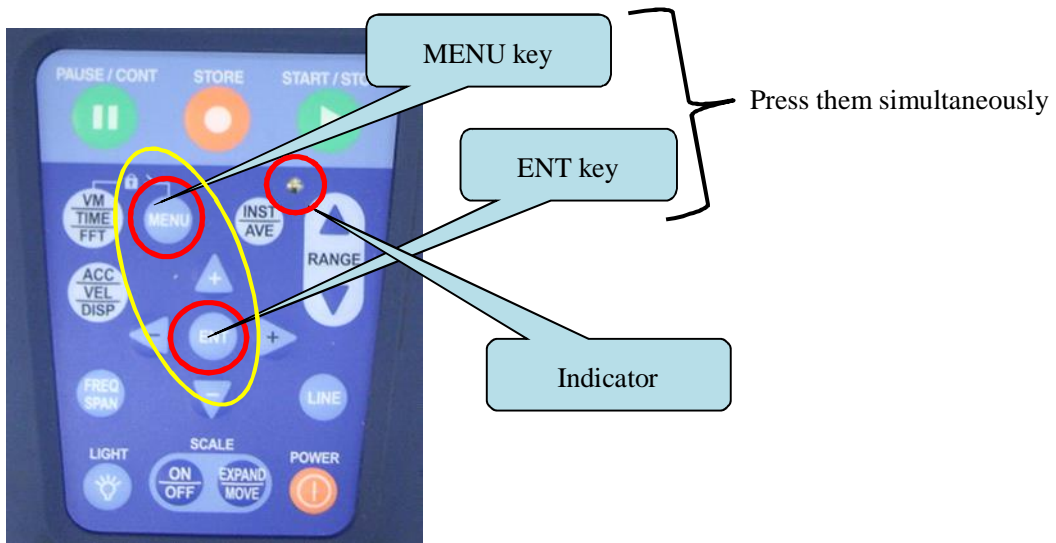
① Displaying the measurement data

Display the measurement data to store as BMP file.


② Storing the screen bitmap image



Press both the MENU key and the ENT key simultaneously.

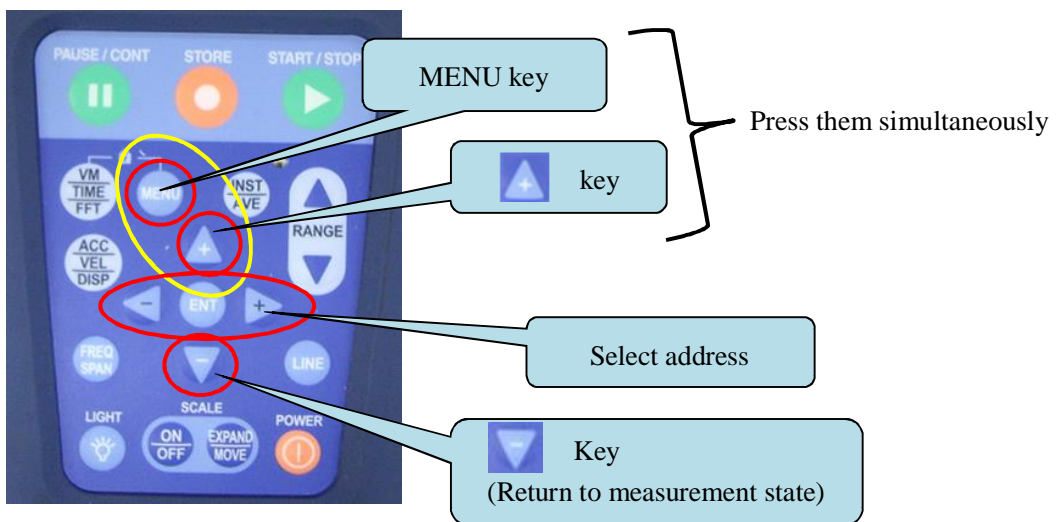
When the storing is started, the indicator blinks red. It disappears after completed.




③ Recalling the screen bitmap image

Press both the MENU key and  key simultaneously. The stored bitmap image is displayed.

The recall address can be selected by   keys.



④ Returning to the measurement state

 key is pressed to return to the measurement state.

6.3 Data transfer to a computer via USB

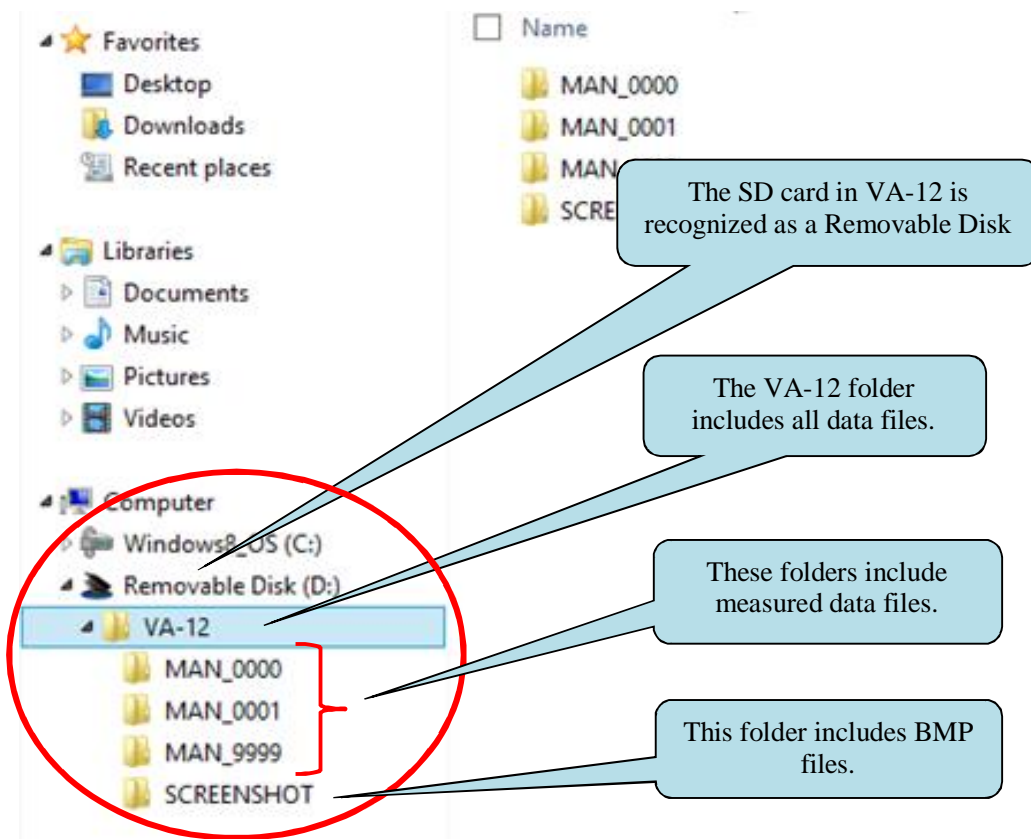
① Connection between VA-12 and a computer

Turn on the power supply of VA-12. Connect the USB connector of VA-12 and a computer with a USB cable.



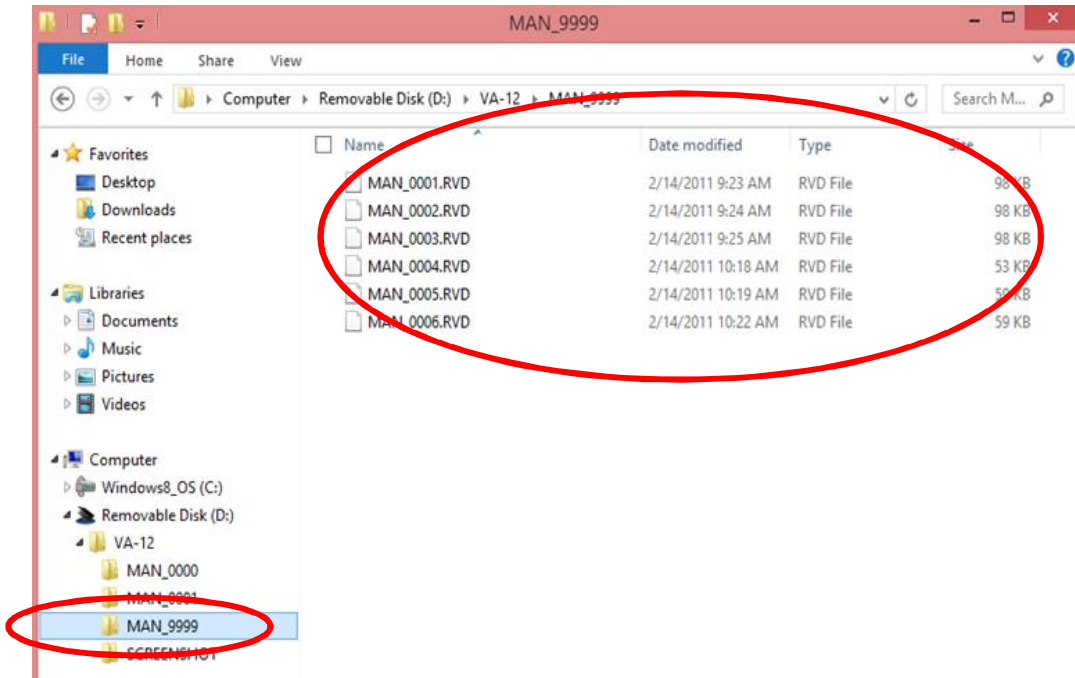
② Referring to data folders on SD card by a computer

A computer recognizes the SD card in VA-12 as a removable disk. All stored files exist in the 'VA-12' folder. The folders 'MAN_****' include measured data files. '****' means 4 digits number. The folder name 'MAN_****' is same as the 'Store Name' set in the submenu [Measurement]. The 'SCREENSHOT' folder includes BMP files.



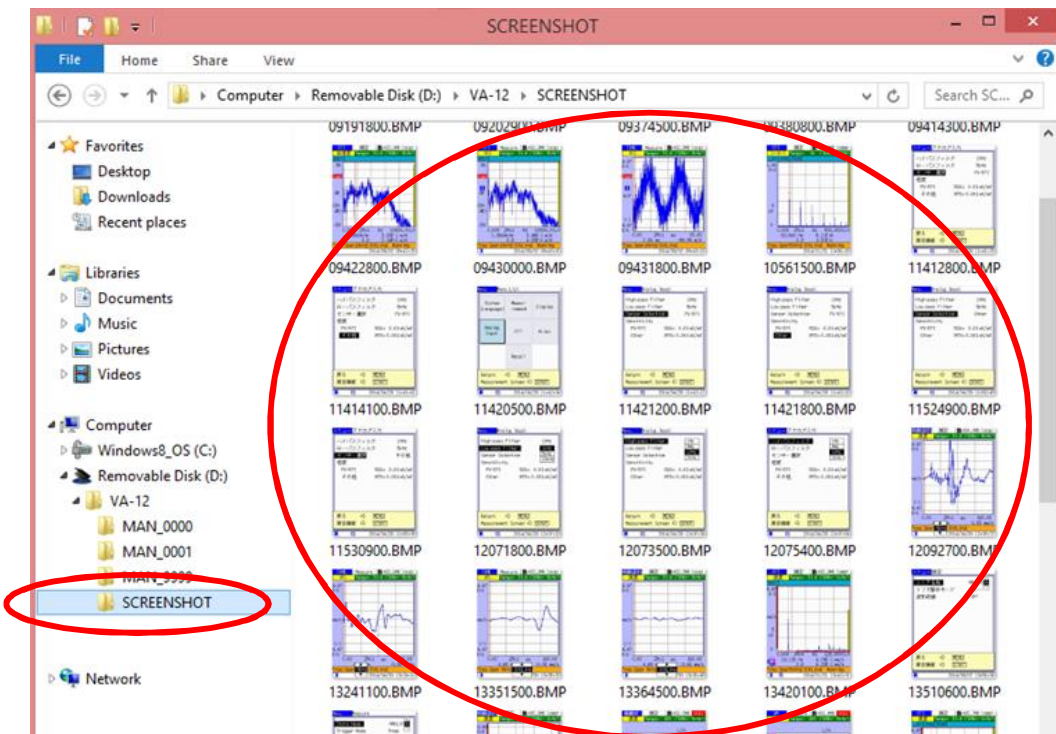
③ Copying data files

The measured data files exist in a folder named MAN_****. In an example shown in the following figure, there are six data files in the folder MAN_9999. The extension names of the data files are RVD. Copy required data files to another folder in a computer.



④ Copying BMP files

The stored BMP files exist in the folder named SCREENSHOT. Copy required BMP files to another folder in a computer.

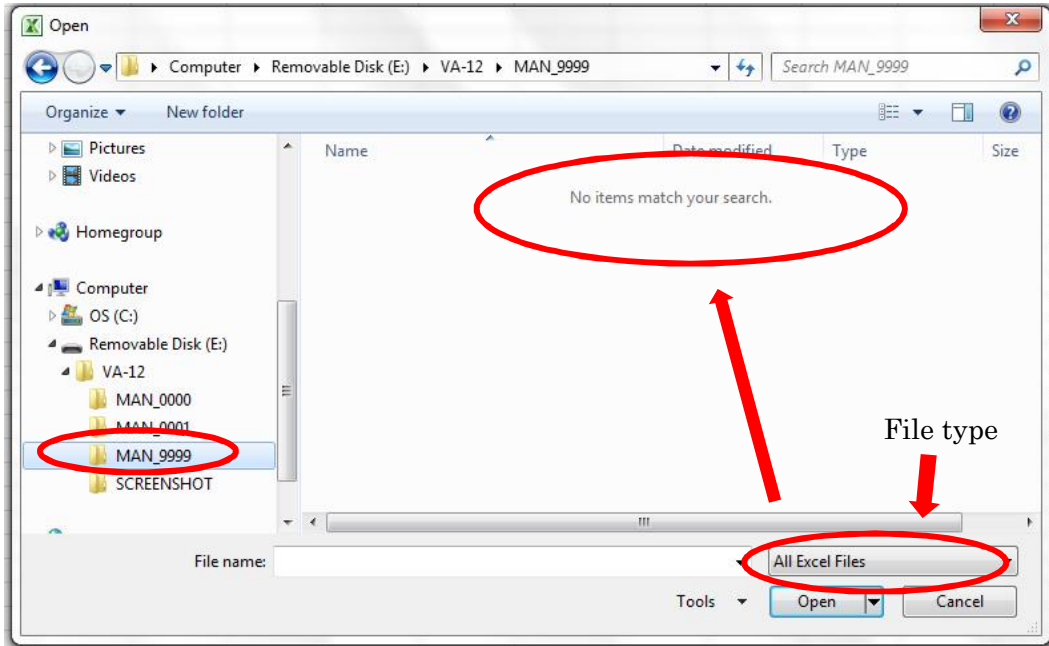


6.4 Data import to Microsoft Excel

Since a measurement data file is written by CSV format, the data can be imported into Microsoft Excel.

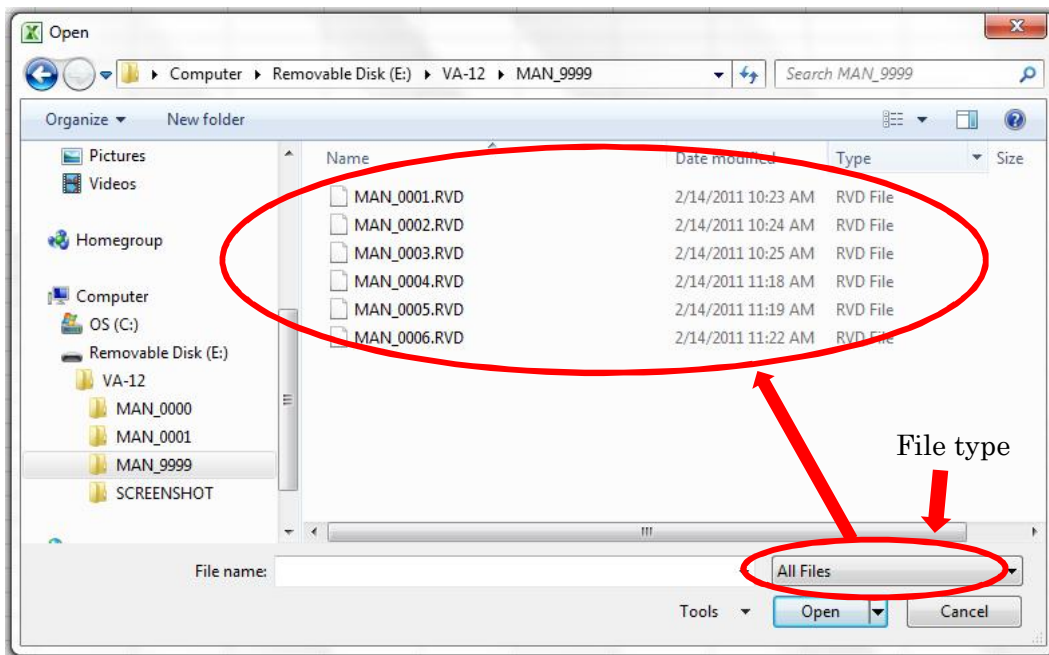
① Starting Microsoft Excel

Start Microsoft Excel and execute file open. The file open window appears as shown in the following figure. In this window, select the folder to import for example MAN_9999. In this stage, since the file type is set to All Excel Files, "No items match your search" is displayed and data files are not displayed.



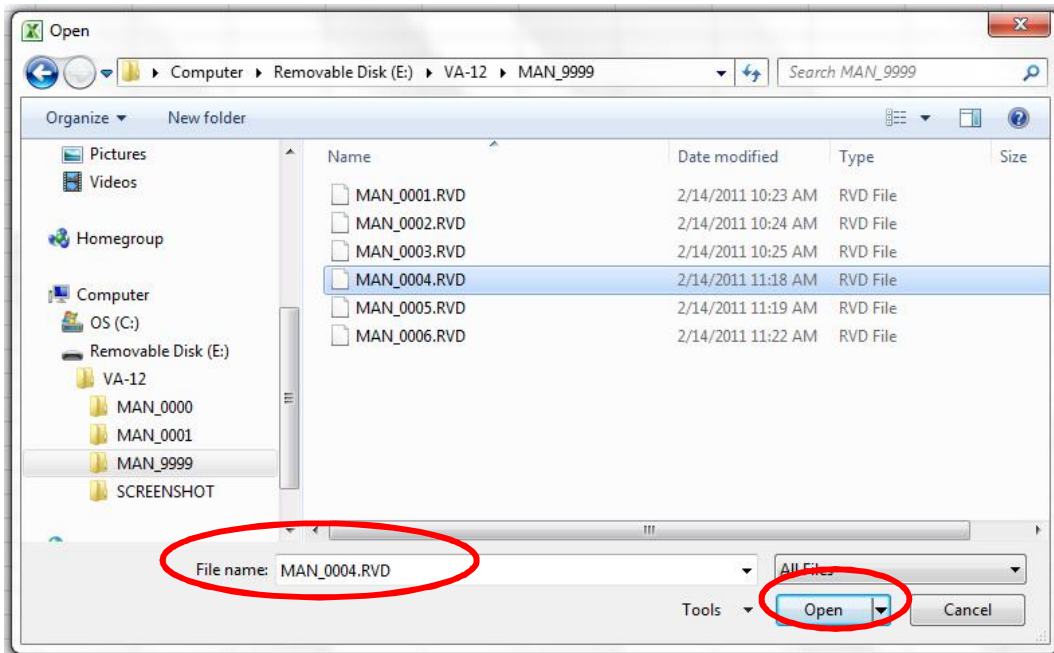
② Selecting the file type to All Files

Select the file type to All Files. Then the data files with extension name RVD are displayed.



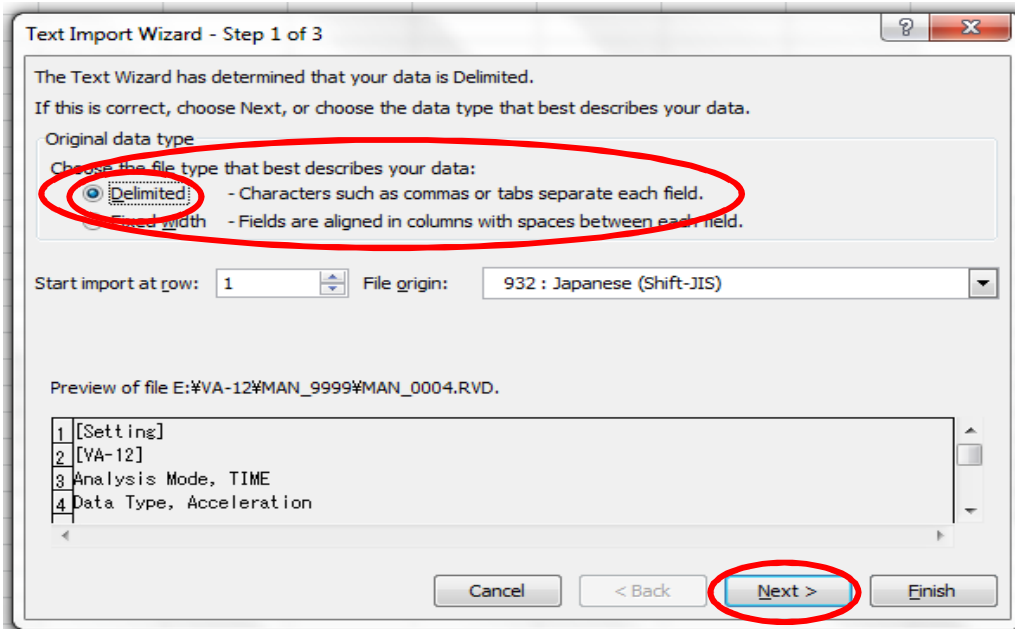
③ Opening the selected file

Select the data file to open for example MAN_0004.RVD, and click the "Open".



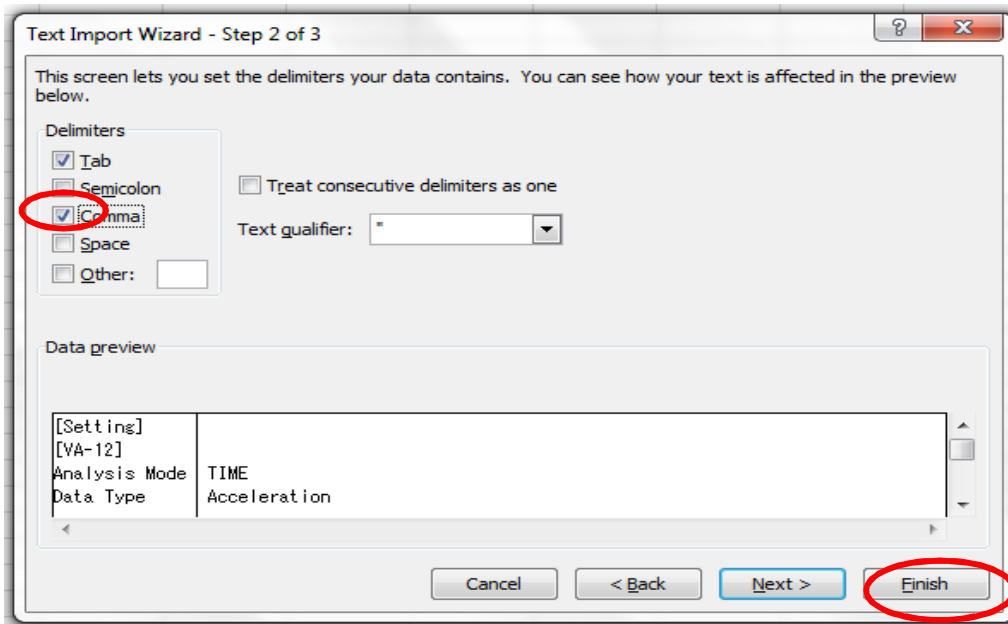
④ Determining that the selected file is delimited

After clicking the "Open", the "Text Import Wizard-Step 1 of 3" appears as shown in the following figure. In this wizard, select the "Choose the file type that best describes your data" to "Delimited" characters such as commas of tables separate each field. Then click the "Next"



⑤ Setting the delimiters contained in the selected file

After clicking the **Next**, the **Text Import Wizard-Step 2 of 3** appears. Check the checkbox of the **Comma**. Then click the **Finish**.



⑥ Importing the data to Microsoft Excel

After clicking the **Finish**, the data are imported to Excel as shown in the following figure.

The screenshot shows the Microsoft Excel interface with the file 'MAN_0004.RVD' open. The data is imported into a table with columns A, B, and C. The data is as follows:

	A	B	C
16	Frequency	10kHz	
17	Analysis Li	3200	
18	Average Di	Ave	
19	Average Ty	Linear	
20	Average Co	12	
21	Average Co	12	
22	Window Fu	Hanning	
23	Actual Sen	549	
24	Actual Sen	x0.01	
25	Sensor Ty	PV-57I	
26	Start Time	2011/02/14 11:18:02	
27	Trigger Mo	Free	
28	Trigger So	Level Trigger	
29	Trigger Lev	1	
30	Trigger Slo	+	
31	Pretrigger	None	
32	Store Nam	9999	
33	Store Addn	4	
34	Store Num	1	
35	Store Inter	1 min	
36	Store Start	2011/02/14 00:00:00	
37			
38	[Data]		
39		-1.76	
40		-1.2	
41		-0.55	
42		0.09	
43		0.79	
44		1.39	
45		1.89	