

INSTRUCTION MANUAL

Portable Vibrometer: VM-7024H

IMV CORPORATION

Document Number	TVE-6-3792E
Issuance Date	December 21, 2012
V e r s i o n	1.5.0
Pages (Incl. Cover)	40

Revision History

Date	Rev	Details
May 8, 2012	1.0.0	New Issue
July 24, 2012	1.0.1	Corrected Figures and phrases.
August, 2012	1.0.2	Corrected Phrases.
Oct.15, 2012	1.0.3	Add the sampling frequency for Data Save Add the Notation for Self Check And FFT
Dec. 21, 2012	1.5.0	Add "Password Function"(4-14)

Table of Contents

1. Introduction	1
1-1. Panel Description	2
1-2. Package Contents	3
2. Outline	4
2-1. SmartVibro	4
2-2 Features	4
3. Measurement	5
3.1 Before Getting Started	6
3-2. Measurement Screen	7
3-3. Operations during Measurement	8
4. Setting	10
4-1. Mode Setting	11
4-2. Calculation Setting	11
4-3. Filter	14
4-4. Auto Range	15
4-5. Self Check	16
4-6. Averaging	17
4-7. Sensitivity Setting of AC and DC Output	18
4-8. Battery Setting	20
4-9. Auto Power OFF	20
4-10. Contrast	20
4-11. Language Setting	21
4-12. Version Information	22
4-13. Battery Indicator	23
4-14. Password Function	24
4-14-1. Password Set	24
4-14-2. Password Input	26
5. FFT and Data Dave	27
5-1. FFT	27
5-1-1. FFT Indication	27
5-1-2. FFT Setting	28
5-2 Waveform Save	29
5-2-1. Waveform Data Save	29
5-2-2. Data Save Settings	32
6. Conversion Table	33
7. Specifications	34
7-1. SmartVibro	34
7-2. Pickup	34
8. Troubleshooting	35

9. Precautions35

10. Fix the Pickup with Magnet35

11. Definitions.....36

1. Introduction

We truly appreciate your purchase.

Please read this manual carefully before use and follow the cautions below for your safety.

CAUTION

1. If the subject of the measurement could be hot, rotating, or near the movable parts, assure the safety and fix the pickup for measurement.
Do NOT hold the pickup manually in these cases to avoid any possible accidents; including burning yourself, and entangled cables.
2. Follow the instructions printed on the battery for replacement and disposal of used batteries. Pay attention to the polarity of the battery for installation.

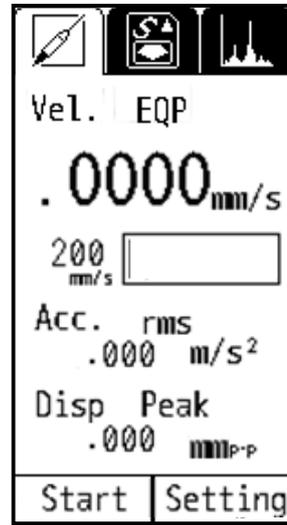
Should you have any inquiries or find a problem during use, please consult our sales office near you or IMV quality assurance department.

1-1. Panel Description

Display of the VM-7024H can be switched from Japanese to English, and vice versa. Below figures are example of a display in Japanese and English.



Japanese



English

1-2. Package Contents

Product and Accessories for the VM-7024H

(1) Basic Product and Accessories

	Products	Qty	Model	Note	Figure
Main Unit	SmartVibro	1	VM-7024H		
	Pickup	1	VP-7000L	Piezoresistive Acceleration Type	
Accessories	SmartVibro Cable	1	CP-7000	3m straight cable with metal connectors at both ends.	
	Output Cable	1	—	1.5m cable with a plug at one end. For output to a stroboscope or recorder, etc.	
	Battery	1	—	AA Alkaline batteries	
	Instruction Manual	1	—	With inspection report	
	SD Card	1	—		

(2) Optional Accessories

	Products	Qty	Model	Note
1	Long Pickup Cable	CE-7000 (10m)		To keep a distance from the subject of measurement.  (Example)
2	Magnet	MB-PB		To fix the pickup on the subject of measurement. 
3	Cover	PC-3024		Silicone jacket 
4	AC Adapter	PS-3024-S		AC100-240V 
5	Carrying Case	C-3024		To store the SmartVibro and pickup. 

Specifications and appearances of the items above are subject to change without notice.

2. Outline

2-1. SmartVibro

SmartVibro is a portable vibration meter with high-sensitivity and accuracy to measure micro vibration of super low frequency. Its application varies widely; measuring and analyzing vibrations, evaluation and maintenance of the ground and/or floor of various architectural constructions, precision machines in the laser and semiconductor industries, and low-speed machineries in energy harvesting and hydroelectric generation.

2-2 Features

■ Frequency Range

0.3 – 100Hz; Sensitivity: Full scale 0.1m/s^2 (Equivalent to 0.01G, 10Gal)

■ Simultaneous Measurement

High-speed processing CPU enabled simultaneous display of acceleration, velocity and displacement of velocity signal coming from the pickup.

■ LCD Screen

Various settings like measurement conditions are possible by a touch panel.

■ Acceleration Pickup

Square pickup can be attached to the subject of measurement in any orientation.
Durable acceleration: 300m/s^2 (30G)

■ FFT Analysis Function

Real-time FFT analysis is possible with a minimum condition setting to check vibration frequency components.

■ Waveform Data Save

Waveform can be stored.
Stored data in the SD card can be exported to a personal computer.

■ Language

SmartVibro can be operated in Japanese or English by changing the setting.

3. Measurement



Fig 3-1

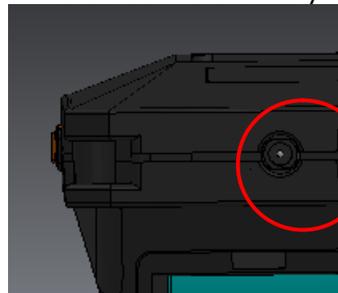
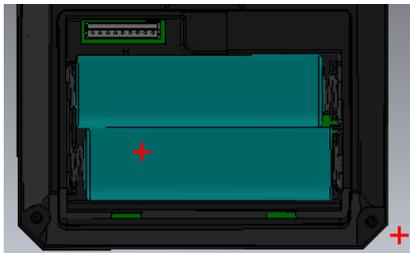
3.1 Before Getting Started

(1) You can select the computing method for velocity, acceleration, and displacement. Refer to the Chapter 4-2 for more details. Initial settings are as follows:

- Acceleration : rms
- Velocity : rms
- Displacement : EQP (Equivalent Peak)

- If you are familiar with our VM-7000L, EQP setting for the displacement is highly recommended. Since the measurement data with the VM-7000L is indicated in EQP, you may easily compare the data with the same setting.
- For measurement of the vibration severity, velocity setting needs to be “rms.”

(2) Check the polarity carefully, and set two (2) AA batteries in the battery box. (NiCd or Alkaline)



Power Connector

For the use with the AC adaptor, connect the AC adaptor cable to the power connector in the bottom of the device.

(3) Connect the pickup cable to the pickup connector.

Refer to the following chapters for measurement.

The pickup needs to touch the subject for measurement. For the method to fix the pickup, refer to the page 30.

(4) Language Setting

You can select Japanese or English to be displayed on the screen. Refer to the Chapter 4-9 for details.

3-2. Measurement Screen

Turn on the SmartVibro by sliding an orange switch on the left side of the device. Initial screen (Fig 3-2) will appear.

You can operate the device by using the touch screen and two function buttons.

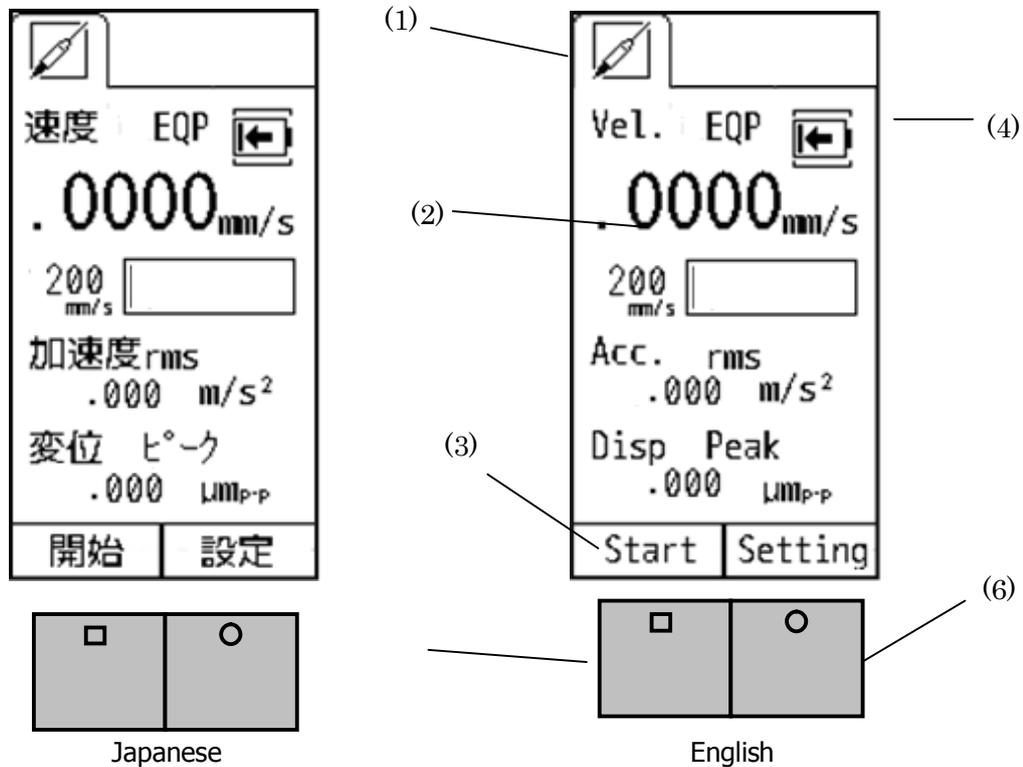


Fig 3-2 Initial Screen

- (1) Standard Measurement Mode
You can measure the OA value of acceleration in this mode.
- (2) Measurement Range Bar
This shows the level of measurement data. The data is not absolute, but rough indication.
- (3) Function Indicator
Valid functions are indicated. In the Fig 3-2, “Start” and “Setting” are operative.
- (4) Function Button (L)
In the measurement mode, you can start or hold measurement when you press this button. In the setting mode, you can check the battery level. (Chapter 4)
- (5) Function Button (R)
In the measurement mode, range display will appear when you press this button. In the FFT mode (available only with the VM-3024H), this button would switch the display from detailed to simple indication of the result, and vice versa. (Chapter 5) As for the range setting, refer to the Chapter 4.
- (6) Battery Indicator
This appears when the battery level is low.
- (7) FFT
FFT mode starts when this tab is activated. (Chapter 5-1)
- (8) Data Save
Data save mode starts when this tab is activated. Waveform will be stored in the SD card as plain text. (Chapter 5-2)

3-3. Operations during Measurement

Touching "Start" on the touch screen or press the function button L in the Figure 2 would start measurement. The screen displays measurement status. (Fig 3-3)

Once you press the same function button or touch the "Hold" on the touch screen would hold measurement and the display.

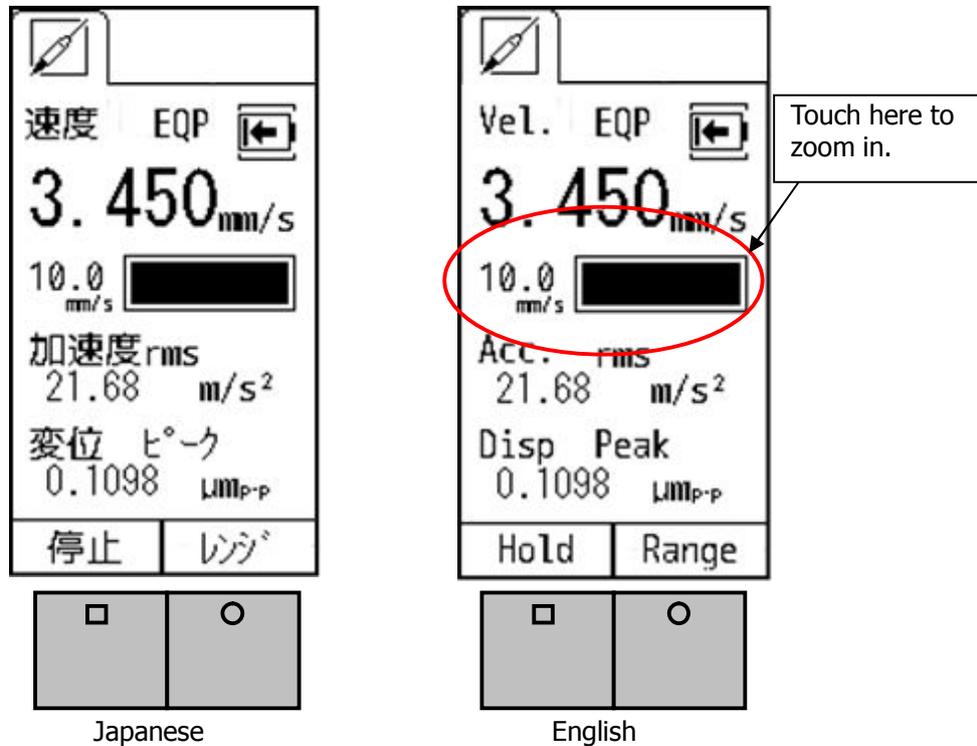


Fig 3-3 Display during Measurement

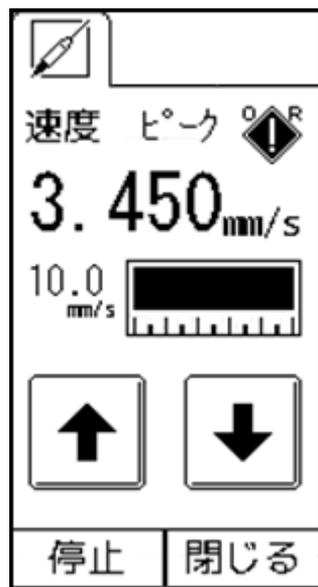
How to Change the Range

When the Auto Range function is OFF (as described in Chapter 4), the range key will be activated during measurement. (Fig 3-3) Touching "Range" on the touch screen or pressing the function button R will show the range setting display. You may adjust the range accordingly.

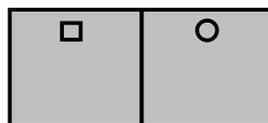
The icon, , will appear on the upper right corner of the screen when the value is over the range. (Fig 3-4)

How to Zoom In

Touch the range bar area on the screen to zoom in the image. To zoom out, touch the same area again. (Fig 3-5)

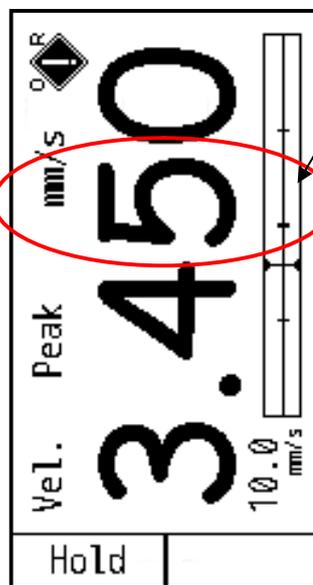
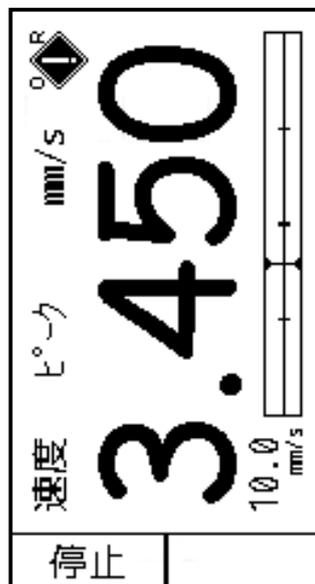


Japanese

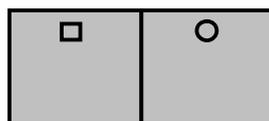


English

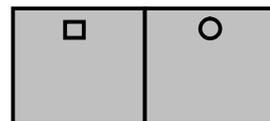
Fig 3-4 Display during Changing the Range



Touch here to zoom out.



Japanese

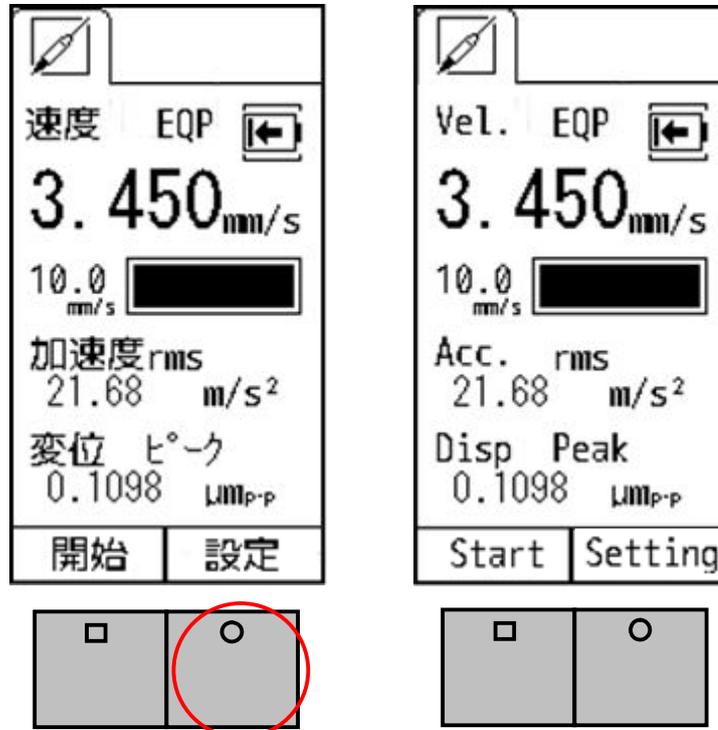


English

Fig 3-5 Enlarged

4. Setting

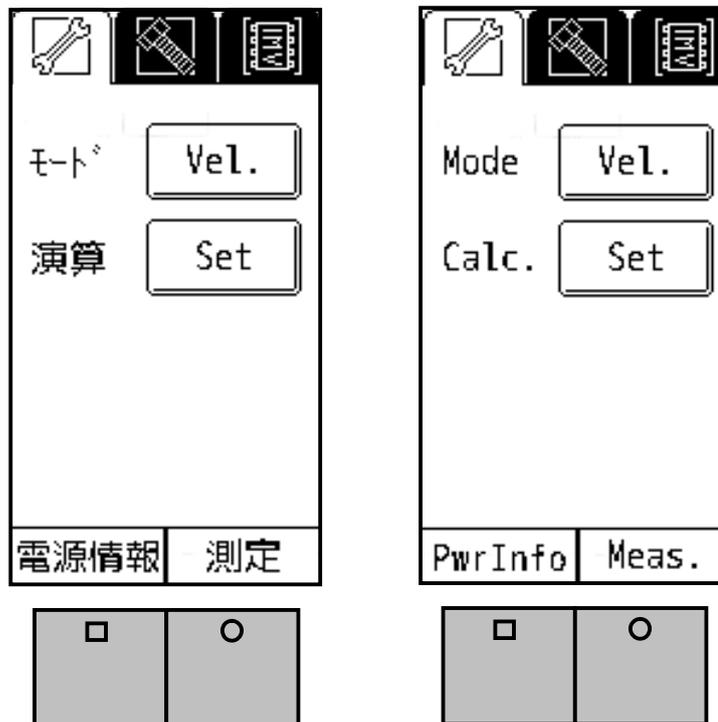
As shown in the Fig 4-1, the setting screen will appear when you press the function button R when "setting" is indicated in the function indicator. (Fig 4-2)



Japanese

English

Fig 4-1 "Setting" in the Function Indicator



Japanese

English

Fig 4-2 Mode and Calculation Setting Screen

4-1. Mode Setting

When “Vel.” Is selected for the Mode (Fig 4-2), the physical amount is shown at the top of the measurement screen. Also, the enlarged screen will show the physical amount accordingly.

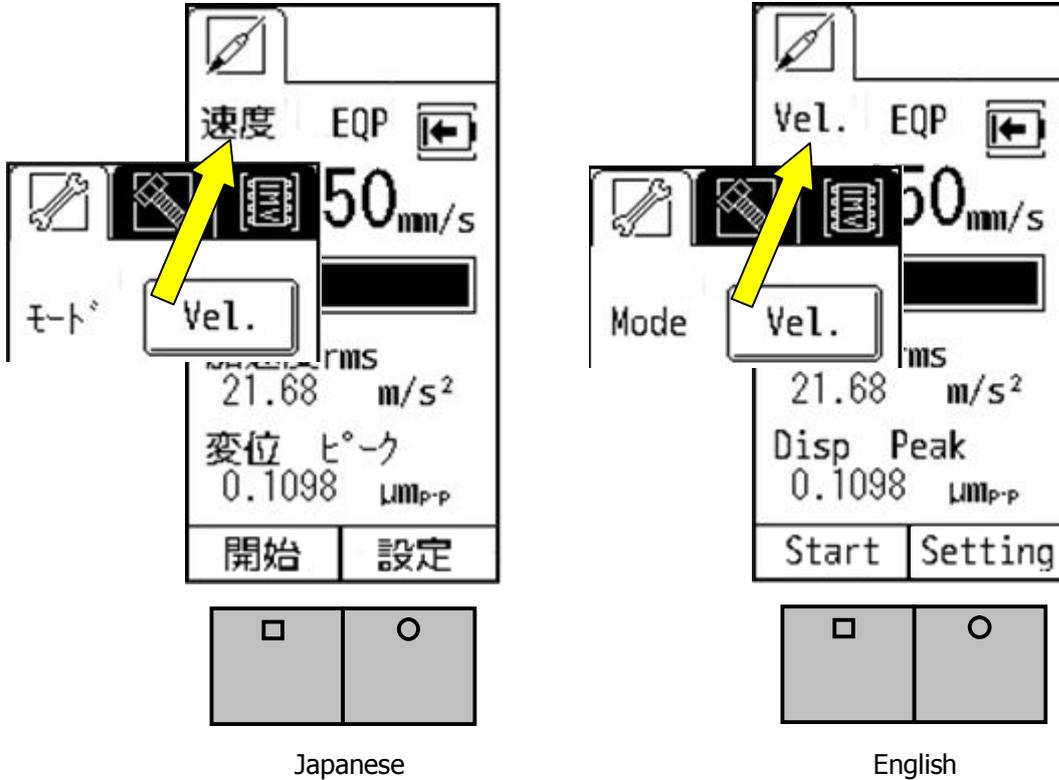
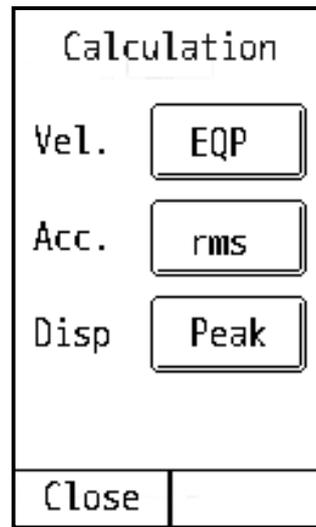


Fig 4-3 Mode Setting

As you touch the button (Vel.) by “Mode” on the screen, the subject of setting will change from velocity, to acceleration, and then to displacement in the mode setting.

4-2. Calculation Setting

You can set how to indicate the physical amount of measurement results in calculation setting. As you touch “Set” in the Fig 4-2, the Fig 9 will appear.



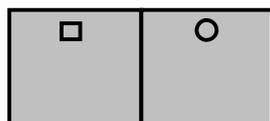
Japanese



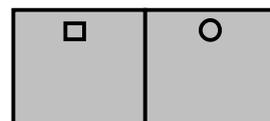
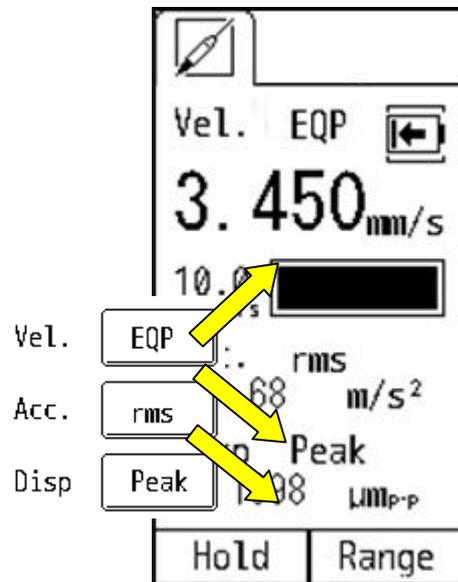
English

Fig 4-4 Calculation Setting

The calculation method selected in the Fig 4-4 will be displayed on the screen.



Japanese



English

Fig 4-5 Example of the Setting Screen

The calculation method also will be changed as you touch the button on the screen in the following order:

Velocity: "rms" "EQP" "Peak"

Acceleration: "rms" "EQP" "Peak"

Displacement: "EQP" "Peak"

Below is a brief description of each calculation method.

rms: Root mean square. This is the square root of the mean of the squares of the time-series data gathered from measurement. ISO standard sets RMS as evaluation criteria of the vibration velocity, which is also known as vibration severity.

EQP: EQP is a value gained by "rms" times root 2 ($\sqrt{2}$). This formula is suitable to use for measurement of sine vibration generated by rotational machines, for example.

Peak: The maximum value of the time-series data.

[Note] Refer to the Chapter 11 for more detailed definitions.

[Note] Settings of the VM-7000L

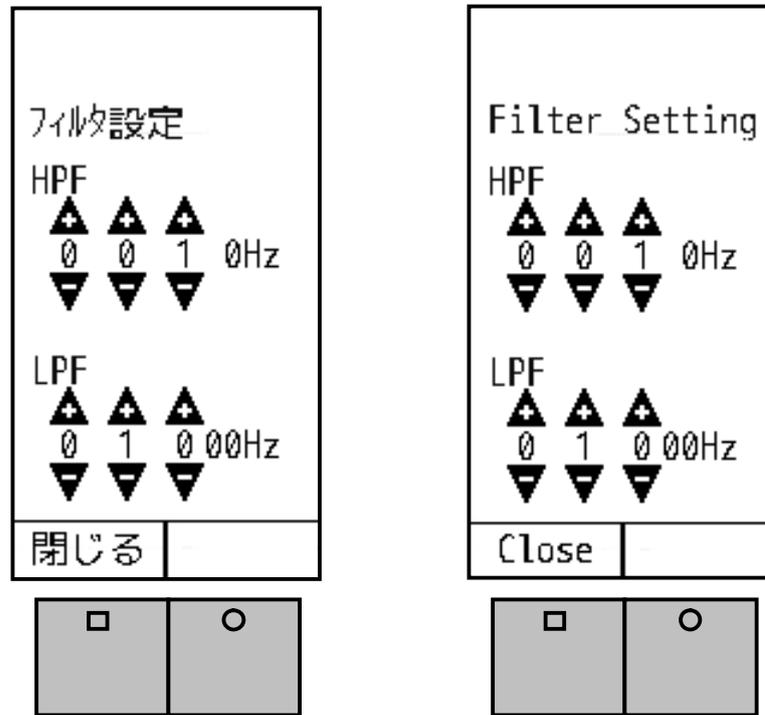
For the users of the VM-7000L, using the same setting with the VM-7000L is recommended instead of "Peak" setting. Below is the recommended setting of the VM-3024.

Model	VM-7000L	VM-7024H
Velocity	rms	←
	EQP	←
Acceleration	rms	←
	EQP	←
Displacement	EQP	←
	—	—

4-3. Filter

You can change the settings of high-pass (HPF) and low-pass filters (LPF).

Pressing “Set” would bring you to the screen indicated in Fig 4-6. By touching the triangles on the screen, you can change the frequency of each filter.



Japanese

English

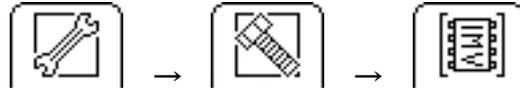
Fig 4-6 Example of the Filter Setting

The range of the filter setting is as follows:

- HPF: 0.3Hz – 55Hz
- LPF: 10Hz – 100Hz

4-4. Auto Range

In the setting section, the menu will be switched in the following order as you touch the icon:



Pressing "Next Page" will lead you to the data save and FFT function setting menu in the page 2. For more details, refer to the Chapter 5.

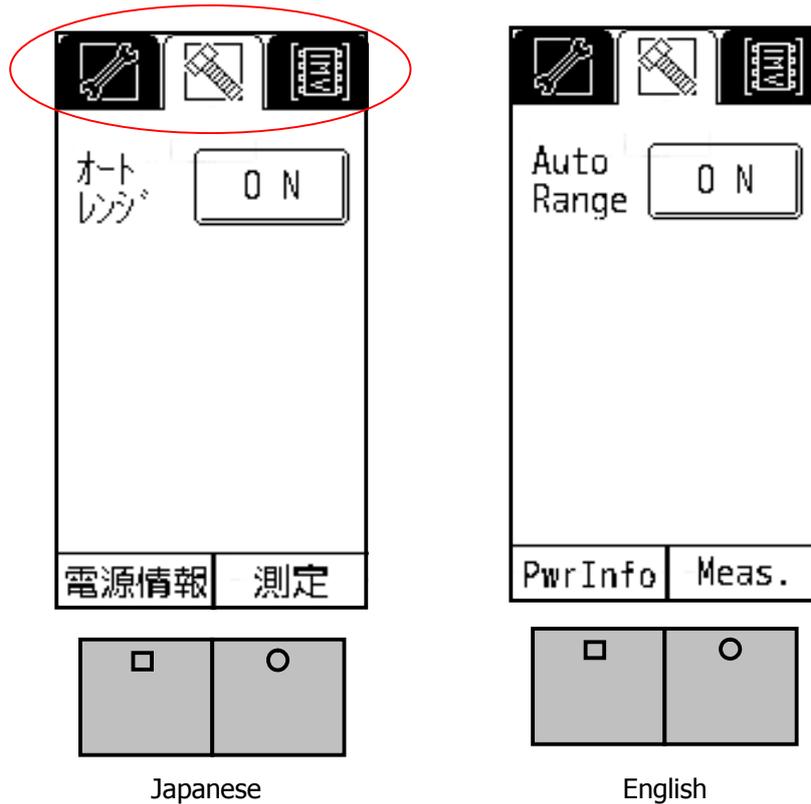


Fig 4-7 Auto Range Setting Page

Auto Range ON: Range will be adjusted automatically during measurement. "Range" will not be indicated on the measurement display, namely in this case the function button R is not effective.

You can switch between ON and OFF by touching the Auto Range button on the screen.

4-5. Self Check

You can check the behavior of the pickup by using the Self Check shown in Fig 4-8.

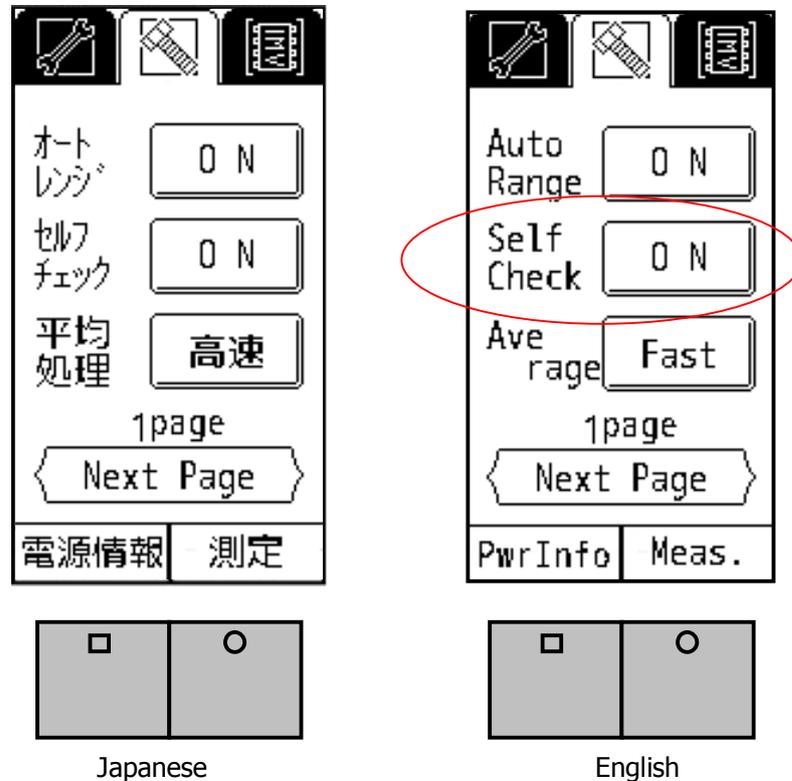


Fig 4-8 Setting Page of the Self Check

As the pickup has a sensitivity to DC acceleration, You can check the behavior of the pickup by output of waveform through AC OUT. If you flip the pickup vertically, the value of response will change at the level of $\pm 9.8\text{m/s}^2$ ($\pm 1\text{G}$), namely gravity acceleration. In addition, the indicator of acceleration is fixed to rms value, including the DC value.

When you connect the AC OUT to the oscilloscope or digital voltage meter, and flip the pickup vertically, $\pm 0.327\text{V}$ output should be observed, theoretically. Because the output level of AC OUT is $\pm 1\text{V}$. But we have some errors while measuring, so we suggest it is good to indicate that the value is $0.654 \pm 5\%$. which is the sum of the two case(upside and downside), absolutely.

And the value of acceleration is about 9.8m/s^2 . You can observe about 0V and 0m/s^2 , when you place the pickup horizontally.

Note: On this mode using, the mode setting is not effective. Namely, if you select any mode, the mode is fixed to “Acc.”.

4-6. Averaging

You can select the conditions of Averaging of the measurement results from Fast, Slow, or Normal. This setting specifies the quantity of data to be used in Averaging. The quantity with the Slow setting will be larger than the Fast setting. Slow setting is recommended to minimize fluctuation of measurement results for the case that low-frequency components dominate the results. Setting should be specified by the Average button indicated in the Figure 4-9.

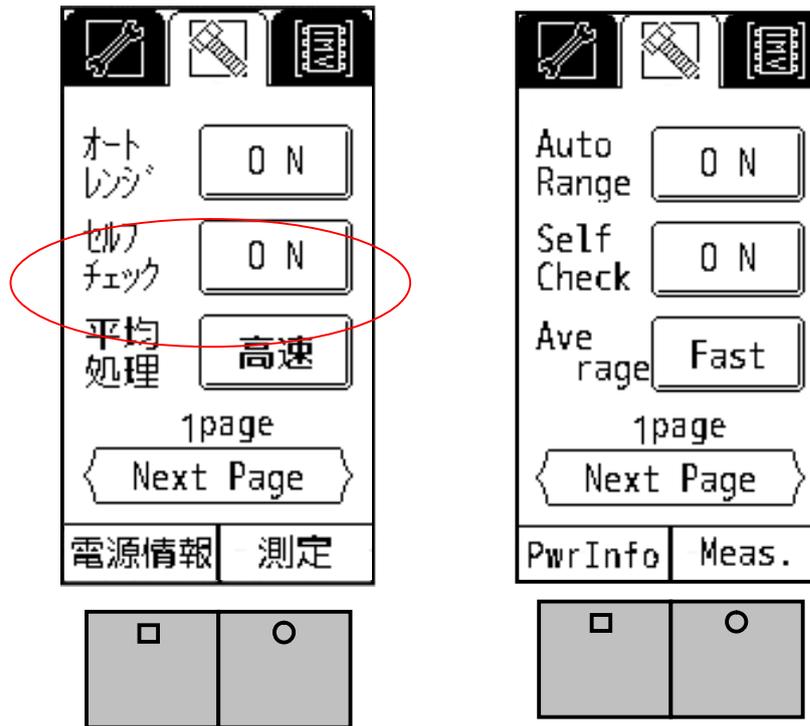
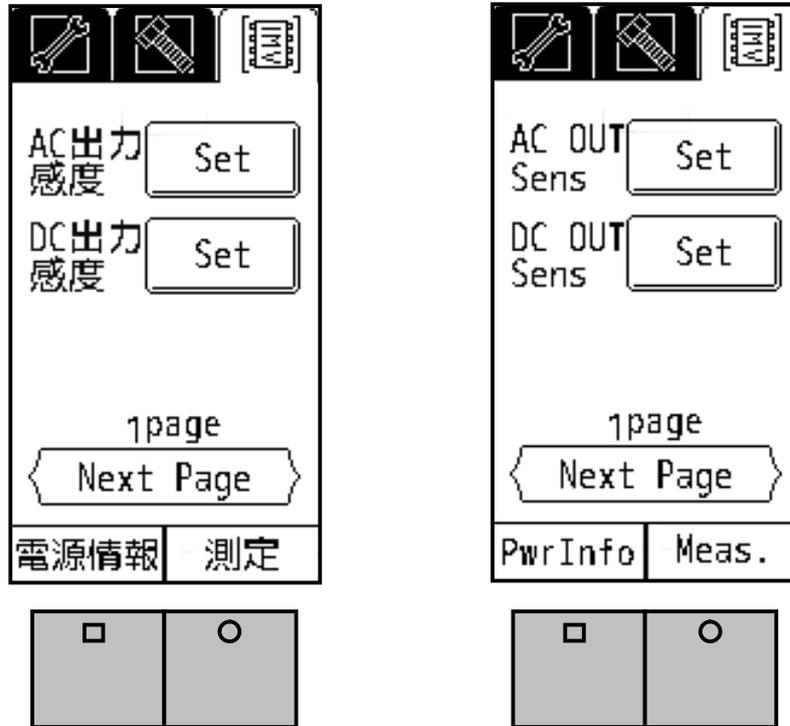


Fig 4-9 Setting Page of the Averaging

4-7. Sensitivity Setting of AC and DC Output



Fig 4-10 will appear as this icon is selected.



Japanese

English

Fig 4-10 AC and DC Output Sensitivity Setting Page

This function set the full-scale value to the AC Output Voltage(1V). Display in the Fig 4-11 will appear once you press "Set."

You can set the level of velocity, acceleration, and displacement per 1V. In the Fig 4-11, each level is set as follows:

- Velocity: 1V is equivalent to 1.5mm/s.
- Acceleration: 1V is equivalent to 30m/s².
- Displacement: 1V is equivalent to 7.5mm.

The physical amount of output signal of AC OUT is equivalent to the physical amount designated in the mode setting. You can select the value by pressing the button. The value will be switched as follows:

- Velocity: 1500 → 150 → 15 → 1.5
- Acceleration: 30 → 3 → 0.3
- Displacement: 75 → 7.5 → 0.75 → 0.075

AC出力感度	
速度 mm/s	1.5
加速度 m/s ²	30
変位 mm	7.5
単位/V	
閉じる	



Japanese

AC OUT Sens	
Vel. mm/s	1.5
Acc. m/s ²	30
Disp mm	7.5
unit/V	
Close	

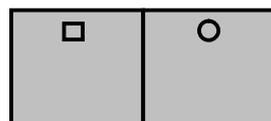


English

Fig 4-11 AC Output Sensitivity Setting Page

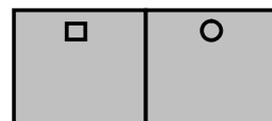
This function set the full-scale value to the DC Output Voltage(1V). Display in the Fig 16 will appear once you press "Set."

DC出力感度	
速度 mm/s	1.5
加速度 m/s ²	30
変位 mmP-P	1.5
単位/V	
閉じる	



Japanese

DC OUT Sens	
Vel. mm/s	1.5
Acc. m/s ²	30
Disp mmP-P	1.5
unit/V	
Close	



English

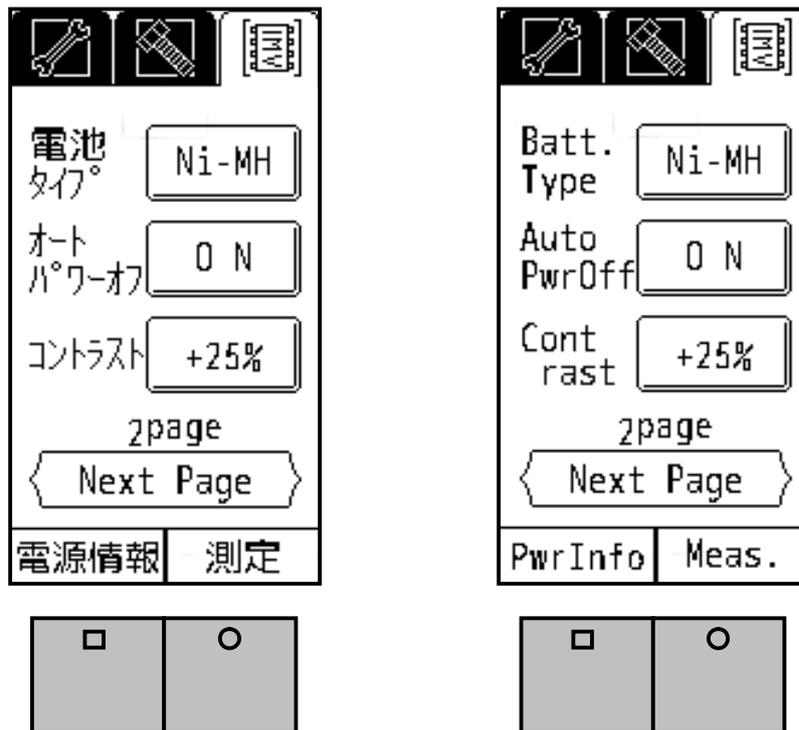
Fig 4-12 DC Output Sensitivity Setting Page

Setting method is the same as AC sensitivity setting. Refer to the next page for the values you can set.

Velocity: 1500 → 150 → 15 → 1.5
Acceleration: 30 → 3 → 0.3
Displacement: 150 → 15 → 1.5

4-8. Battery Setting

You can go to the next page by touching the "Next Page" indication on the screen. You can go back to page 1 by touching "Next Page" in page 3. Fig 4-13 shows page 2.



Japanese

English

Fig 4-13 Battery, Auto Power, Contrast Setting Page

You can select the battery type, Ni-MH (rechargeable Ni-Cd battery) or LR6/R6 (alkaline battery). Since battery life indication depends on this battery type setting, the correct battery type needs to be selected. If other types of battery are used, the battery life may not be indicated correctly.

4-9. Auto Power OFF

Auto Pwr OFF: ON

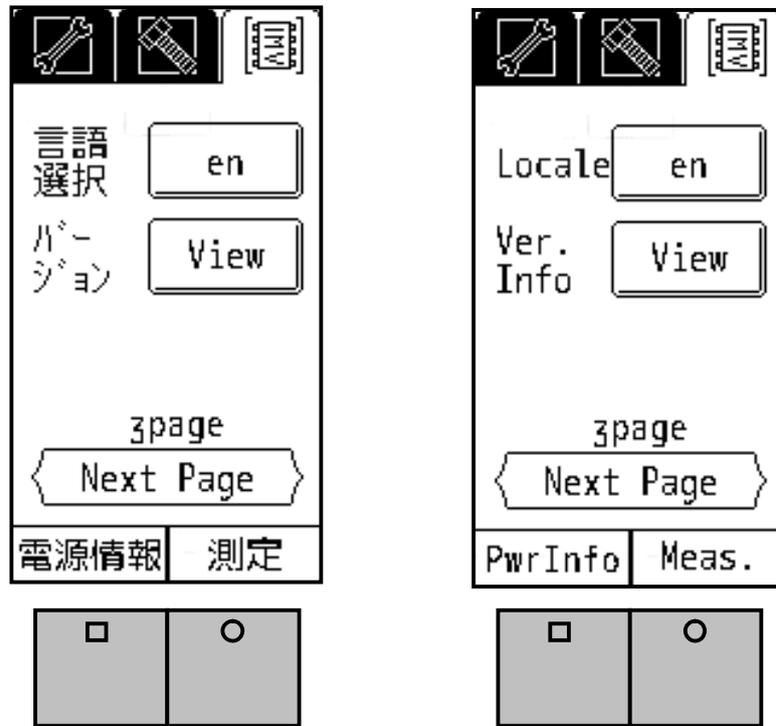
The device will be turned off automatically in 30 minutes.

4-10. Contrast

You can adjust the contrast of the screen from -50% to +50% at +25% intervals.

4-11. Language Setting

On page 3, you can select language and check the version.



Japanese English
Fig 4-14 Language Setting and Version Information

Select "en" for English. Once you restart the device, the display will be changed into English. To choose Japanese, select "jp" and restart the device.

4-12. Version Information

Firmware version will be displayed as you press the View button in the Fig 4-14.

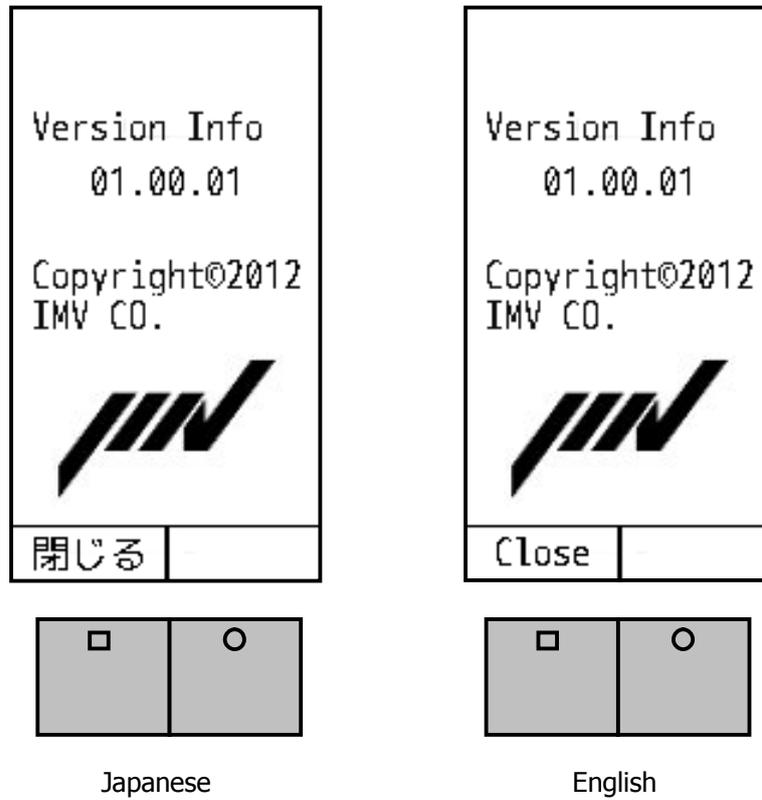


Fig 4-15 Version Information

4-13. Battery Indicator

Battery indicator will appear when you press the function button L below "Pwr Info" indication.

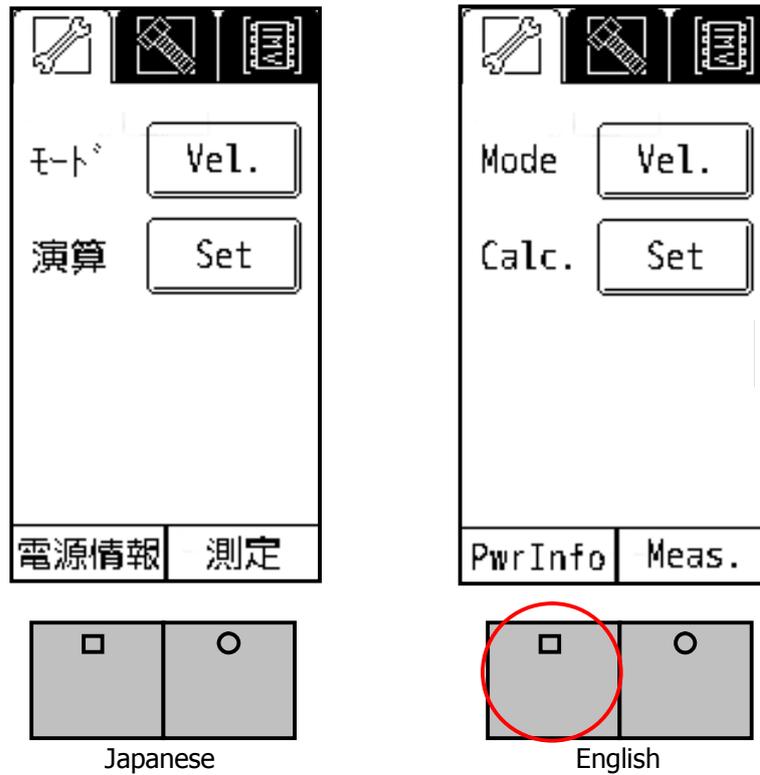


Fig 4-16 Pwr Info Indication

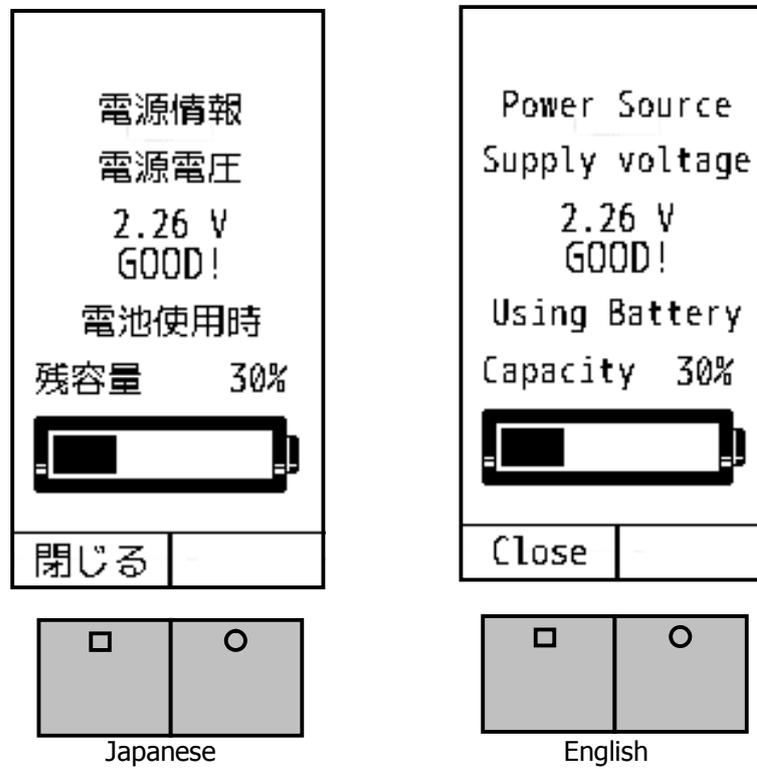


Fig 4-17 Battery Information

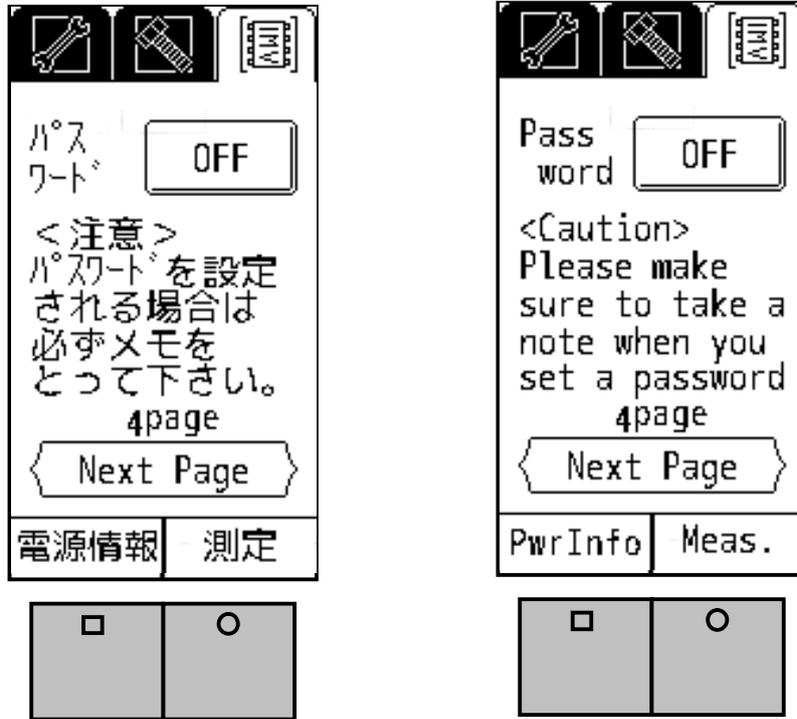
4-14. Password Function

4-14-1. Password Set

You can set the password not to change the setting parameters. Default password is not set.



tab's 4th page shows "Password setting".

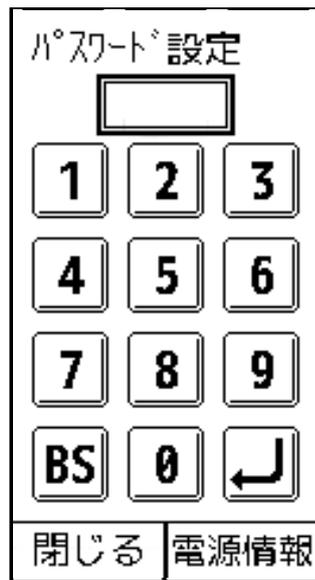


Japanese

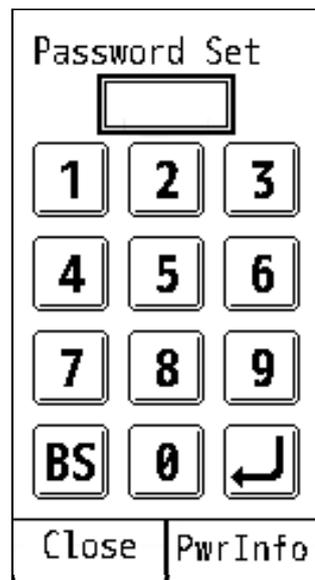
English

Fig 4-18 Password setting (password off)

Push the "OFF" button on Fig 4-18, then Fig 4-19 is showed to input 4 digits password number. Input 4 digits number, and push the "Return" button, then the password number is set. In case of " password is being set ", "OFF" becomes to "ON" in Fig 4-18 (see Fig 4-20).

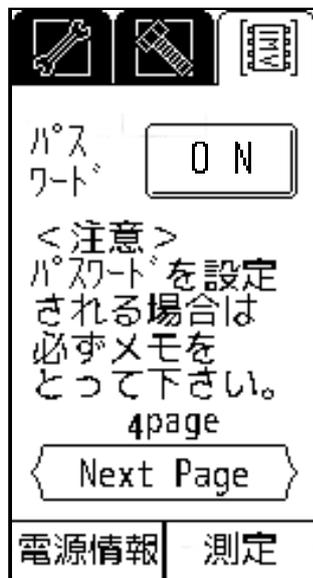


Japanese

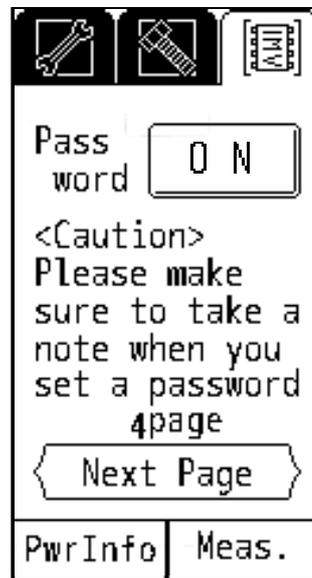


English

Fig 4-19 Password input



Japanese



English

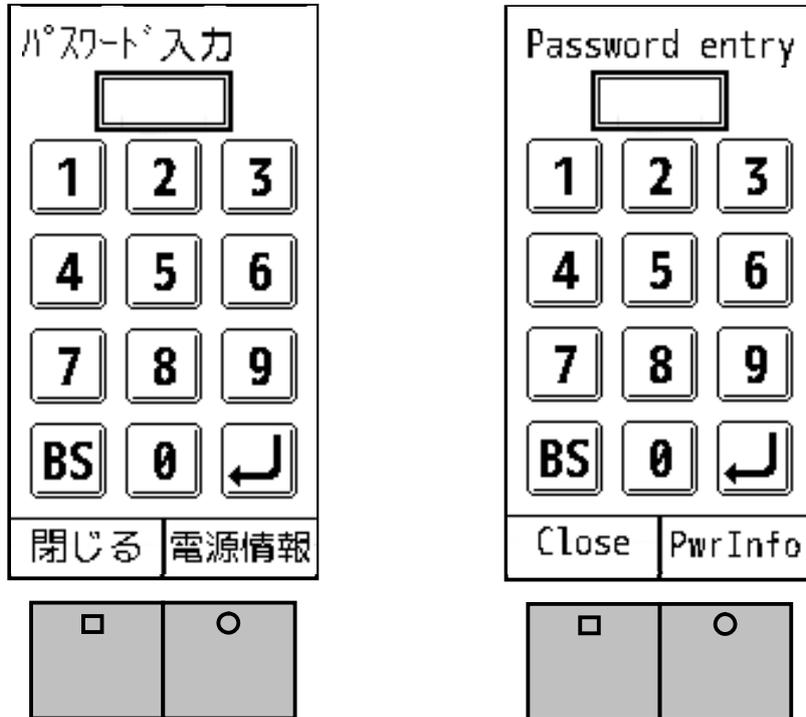
Fig 4-20 Password setting (password on)

4-14-2. Password Input

While password is set, if you press the "Setting" button, Fig 4-21 will show "Password entry". Please input 4 digits number, and press the "return" button.

If password is correct, then the setting page will be displayed, and if not correct, then the "Password entry" is required again.

In such a case, please confirm your password and input it correctly.



Japanese

English

Fig 4-21 Password Input

**Note) Please make sure to take a note when you set a password.
If you have forgotten your password,
you would not change the setting parameters.**

5. FFT and Data Save

VM-7024H is equipped with the FFT and waveform saving functions.



FFT: FFT Mode is activated when this tab is selected.



Data Save: Data Save Mode

Waveform data will be stored in the SD card as plain text.

5-1.FFT

5-1-1.FFT Indication



Selecting the <FFT> tab will show the screen shown in Fig 5-1.

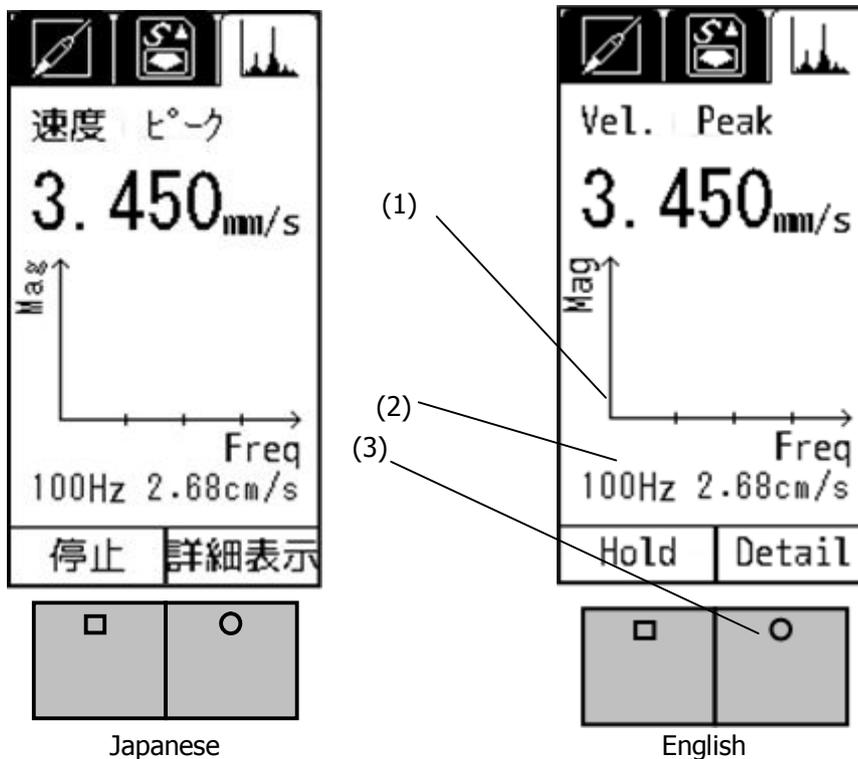


Fig 5-1 FFT Menu

(1) FFT Graph

Y-axis shows the physical amount of the measurement result indicated above the graph.

(Velocity in Fig 5-1)

X-axis indicates frequency.

(2) Maximum frequency and its value.

(3) Details will appear as you press the function button R. (Fig 5-2)

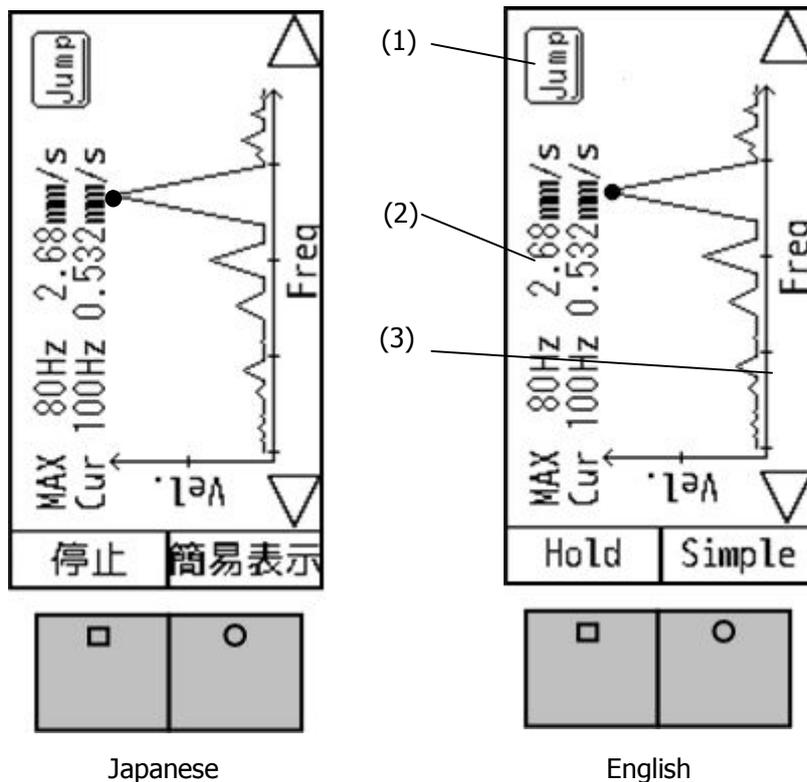


Fig 5-2 Details of the FFT

- (1) The cursor, indicated as a black dot on the screen, will move from one peak to another peak.
 - (2) MAX: Maximum value of the gathered data.
Cur: Value pointed by the cursor.
 - (3) Slide the cursor.
- Frequency range of the FFT is 0.25Hz – 100Hz.

5-1-2. FFT Setting

Fig 5-3 is the FFT setting page. FFT Line shows a frequency resolution. You can select from 1Hz, 0.5Hz, and 0.25Hz.

Note: At FFT mode, it may take much time to execute FFT calculation. For sake of time, You can set some parameters as following.

Set the FFT resolution to 1Hz
Set the Averaging mode to Fast

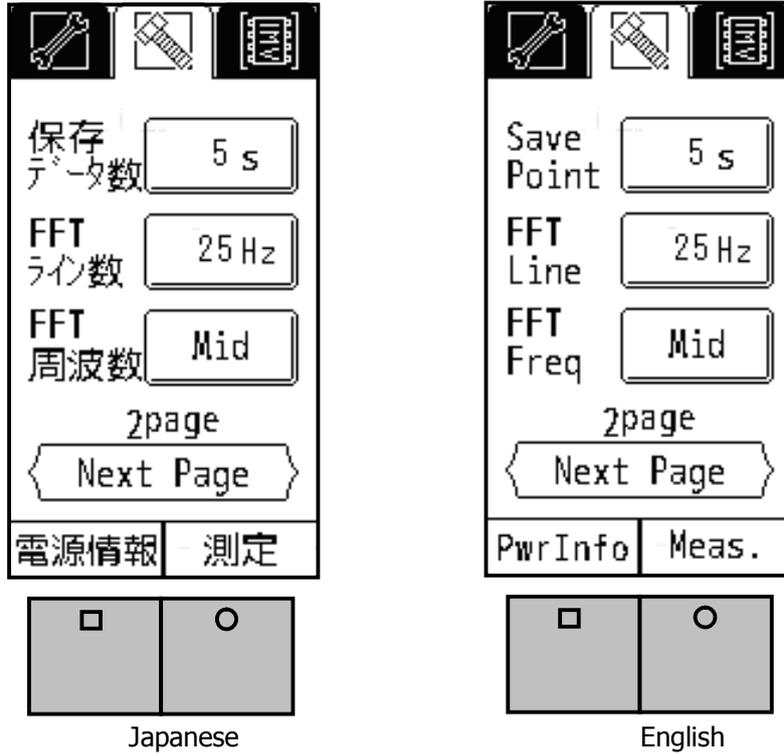


Fig 5-3 FFT Parameter Setting

5-2 Waveform Save
5-2-1. Waveform Data Save

Fig 5-4 is shown when you select <Waveform Save> icon  in the measurement mode.

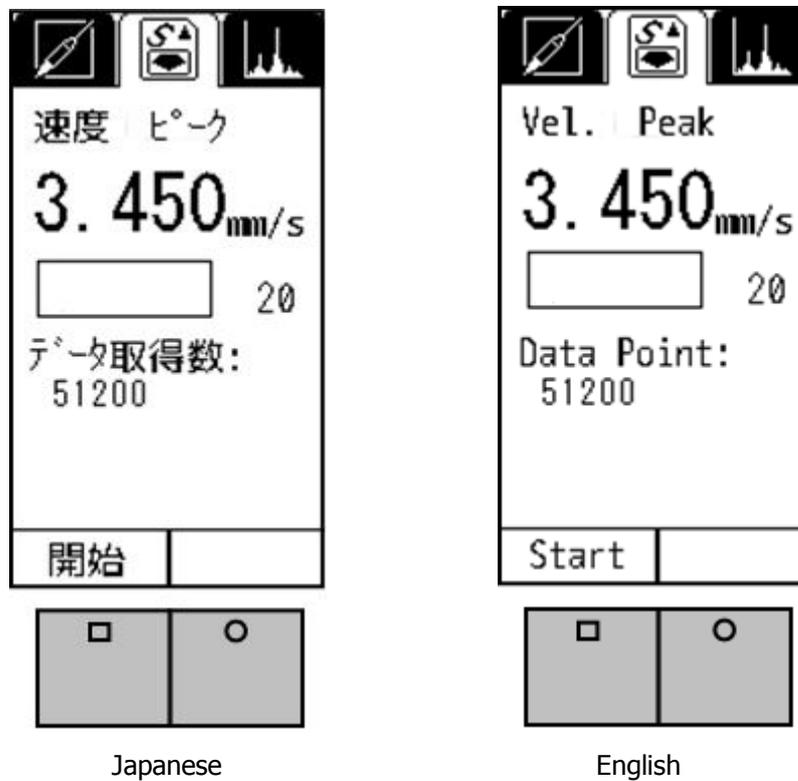


Fig 5-4 Data Gathering Start

Once you press "Start" on the screen or button in Fig 5-4, Fig 5-5 will appear.

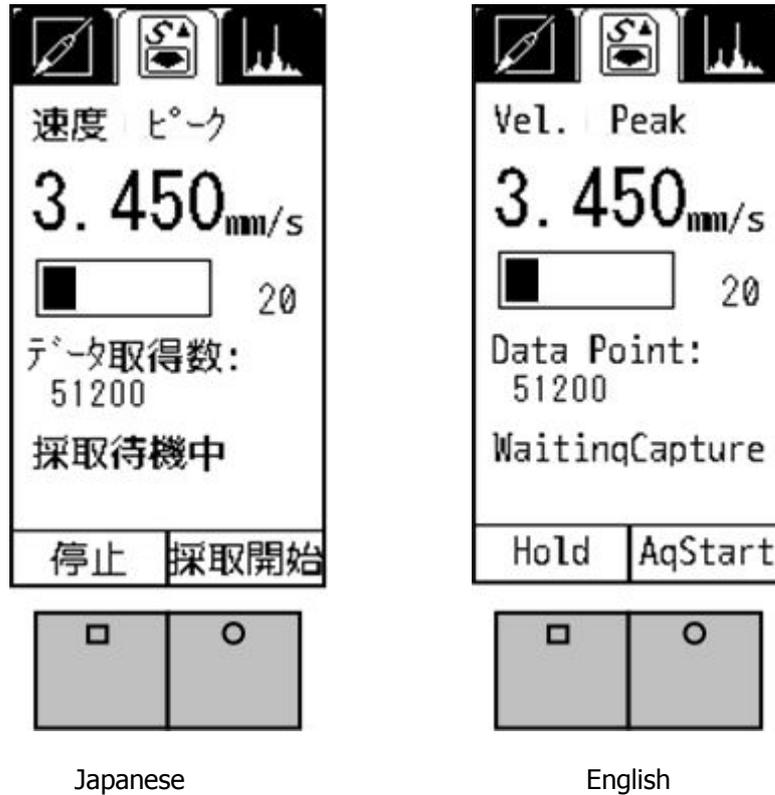
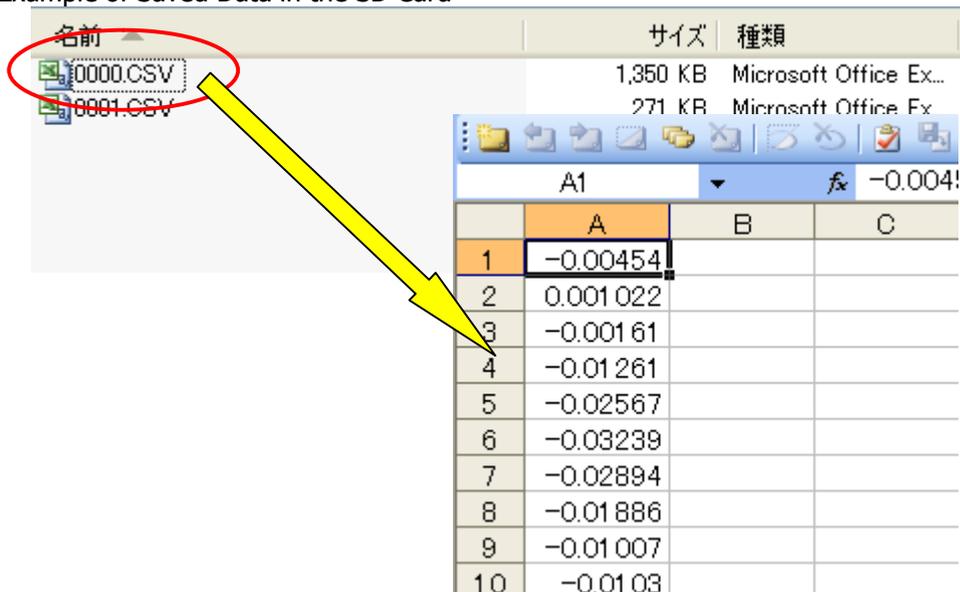


Fig 5-5 Data Gathering

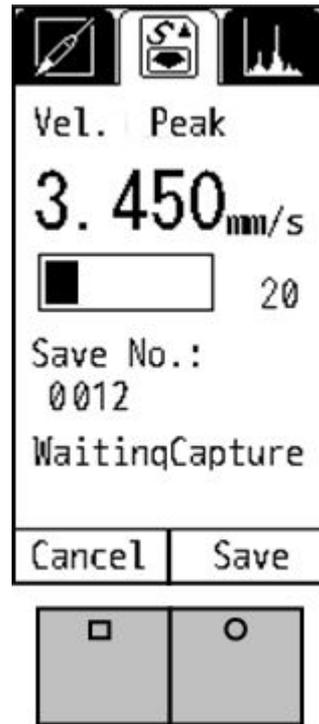
Pressing/Touching "Aq Start" in Fig 5-5 starts gathering the data. Once it is completed, Fig 5-6 appears. Press/Touch "Save" to save the data in a SD card. Data will be numbered automatically in series starting from 0000.

Example of Saved Data in the SD Card





Japanese



English

Fig 5-6 Completed Data Gathering

At the data storing, the sampling frequency is set to 2048Hz (not 4096Hz).

5-2-2. Data Save Settings



Fig 5-7 is the display of data save setting. Select this icon:
Go to page 2, and set the save points.

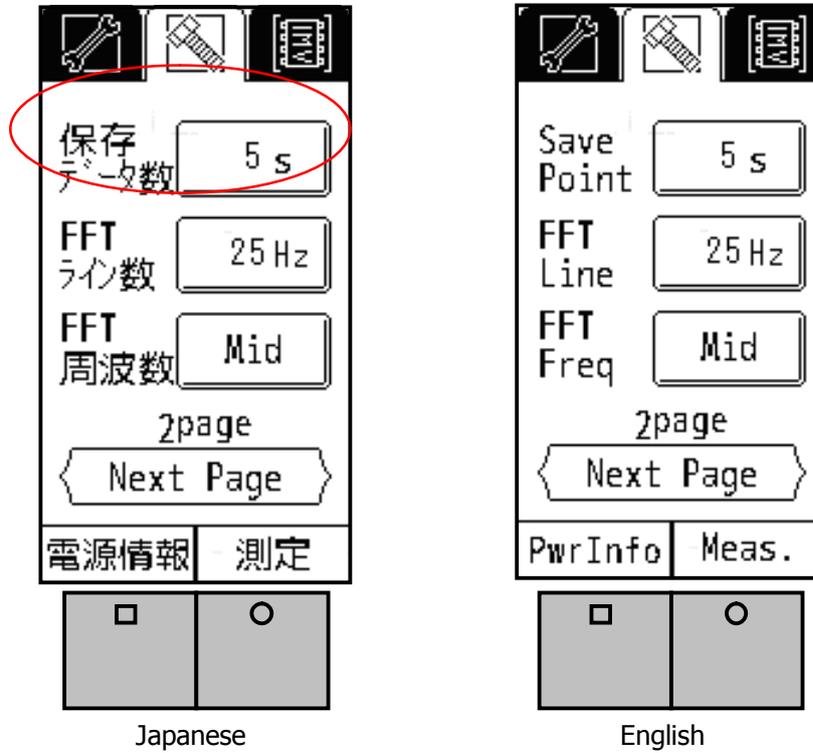
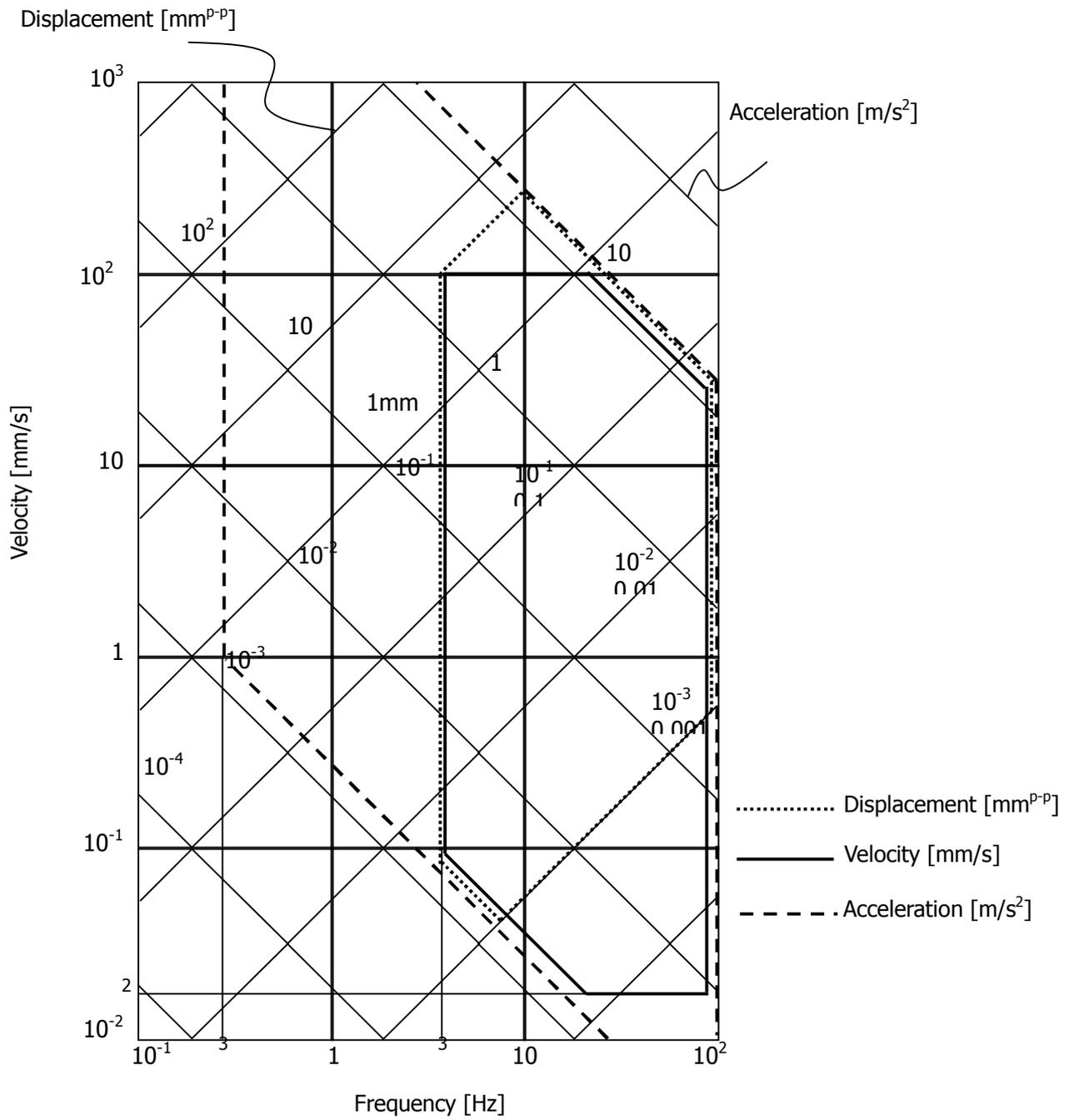


Fig 5-7 Parameter Setting of Data Save

Select the time to save the data. You can select from 5s, 10s, 25s, or 50s.

6. Conversion Table



7. Specifications
7-1. SmartVibro

Sampling Frequency	4096Hz (2048Hz for Data Save)
Frequency Range	Acceleration: 0.3Hz – 100Hz Velocity: 0.3Hz – 100Hz Displacement: 0.3Hz – 100Hz Note) Max Frequency of Velocity and Displacement is restricted by acceleration limit “20m/s² .
Frequency Characteristics	±5% (16Hz)
Full Scale	Acceleration: 6-range (20, 6, 2, 0.6, 0.2, 0.06m/s ²), Auto Velocity: 6-range (100, 30, 10, 3, 1, 0.3mm/s), Auto Displacement: 6-range (10, 3, 1, 0.3, 0.1, 0.03mmp-p), Auto
Indication	EQP: Acceleration, Velocity, Displacement PEAK: Acceleration, Velocity, Displacement rms: Acceleration, Velocity
Accuracy	Sensitivity Error: +/-5% (16Hz) Range Changeover Error: +/-2% (16Hz) Linearity: +/- 0.5% (Full Scale)
Output	AC OUT: 0 to +/-1V with a load over 10kΩ DC OUT: 0 to +1V with a load over 10kΩ
FFT	Δf: 2.5Hz, 5Hz, 10Hz
Data Save	SD Card Data Saving: 5s, 10s, 25s, 50s
Language	Japanese and English
Power	AA x 2pcs (Approx. 20hrs in continuous run) Alarm: Icon in the screen
Ambient Conditions	Use: 0 to +50C; 95%RH or less, without condensation Accuracy Assured: +5 to +35C; 85%RH or less, without condensation Save: -10 to +60C; 95%RH or less, without condensation
Dimensions & Weight	74(W) x 32.5(D) x 148(H)mm 230g (with batteries)

7-2. Pickup

Detection Method	Piezoresistive Acceleration Type
Detection Direction	1 direction
Sensitivity	102 [mV/(m/s ²)]
Natural Frequency	>450Hz
Cross-Sectional Sensitivity	< 3[mV/(m/s ²)]
Max Tolerable Accel.	300 m/s ²
Ambient Conditions	Use: -10 to +70C, without frost or condensation; drip-proof
Cable Connection	6P
Dimensions & Weight	W45 × H45 × D45mm 200g

8. Troubleshooting

(1) Over range

When the over range icon, , appeared during use, modify the range setting as explained in Figure 3-4. Over range will be adjusted automatically in the auto range setting.

(2) No display

Possible causes are following:

(A) Battery voltage is below 2.0V.

(B) Polarity of the battery is wrong.

(C) Pickup cable is not properly connected to the equipment.

(D) AC adaptor is broken (if AC adapter is used), or not properly connected to the equipment.

When no problem was found in the 4 items above, (A) to (D), turn off and restart the machine.

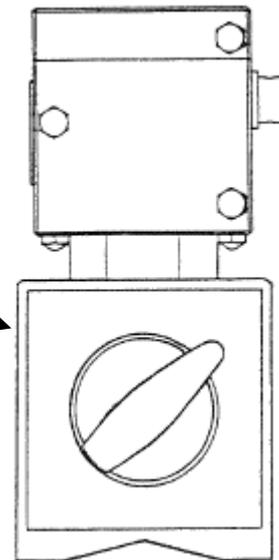
9. Precautions

1. Turn off and remove batteries when not in use for long period of time.
2. Keep the machine away from organic solvent like ketone or thinner to protect the body made of ABS resin. For cleaning, use soft clothes. You may use a small amount of alcohol.
3. Do not disassemble the equipment. You can open only the battery box cover.
4. Avoid strong shock. The screen is made of glass.
5. Avoid high temperature or humidity to protect LCD screen. Store the equipment in dry place under 35C. Do not leave the machine under direct sunlight or in a car.

10. Fix the Pickup with Magnet

It is useful to measure vibration with a magnet, if you can not mount a pickup on a machine(iron material) stable. In case of large vibration, please confirm not to rattle and fall the pickup

Magnet Chuck

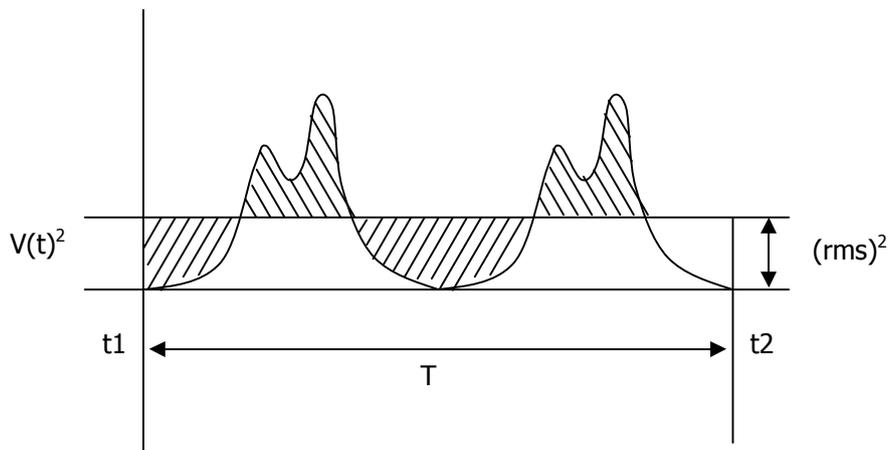


11. Definitions

rms : Root mean square. This is the square root of mean of the values x_i^2 , for a set of measuring data x_1, x_2, \dots, x_n , namely

$$rms = \sqrt{\frac{x_1^2 + x_2^2 + \dots + x_n^2}{n}}$$

ISO standard sets RMS of vibration velocity as evaluation criteria of the vibration velocity, which is also known as vibration severity.



EQP: Equivalent peak. Giving that a measuring data set is sinusoidal, EQP is calculated Peak by following formula.

$(rms) \times \sqrt{2}$ is the formula with SmartVibro since the peak would be $rms \times \sqrt{2}$ in sine wave.

Peak: Maximum value in the time-domain data.

