

# Portable FFT Analyzer CF-9200/9400

Frequency response measurement by impact excitation by using  
Impulse hammer



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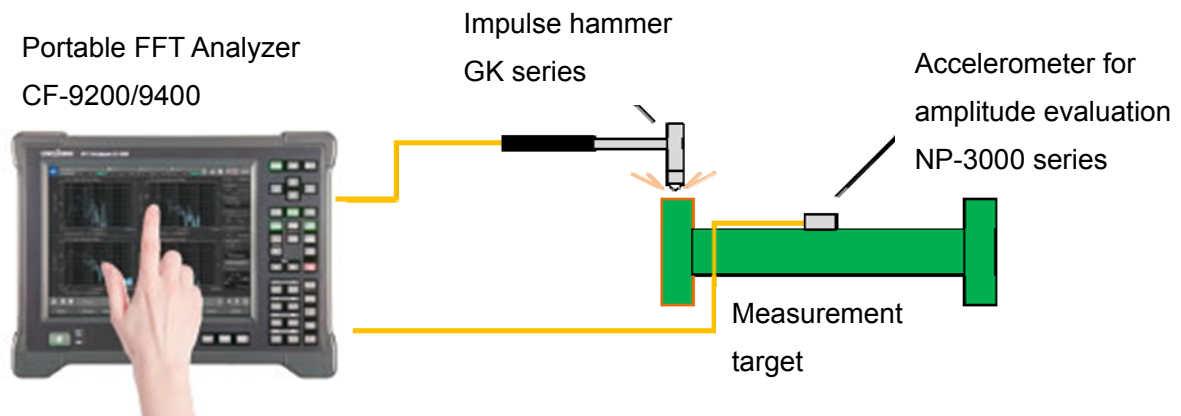
## 1. Introduction

The natural vibration frequency of the measurement target is evaluated by using the CF-9200/9400 Portable FFT Analyzer, the Impulse hammer (GK series), and the Accelerometer (NP-3000 series).

### [Frequency response measurement by impact excitation]

- ①Excite the vibration in wide band by hitting the measurement target with the impulse hammer.
- ②Detect the amplitude which is generated in the target position.
- ③Analyze the detected amplitude and excitation force of the hammer with the CF-9200/9400.
- ④Evaluate the vibration characteristics such as natural vibration frequency and amplitude of the target

This method to obtain vibration mode parameter is called experiment mode analysis.



Application example of excitation control measurement using the CF-9200/9400

## 2. Preparing equipment

### ■Portable FFT Analyzer

CF-9200/9400

\* Option is not necessary.

### ■Impulse hammer

GK series (GK-4110G10/3100/GK-2110) \* GK-3100 is used in here.

### ■Amplitude detector (acceleration, speed or displacement sensor) for target detecting

### ■Installation/ suspension system for the measurement target

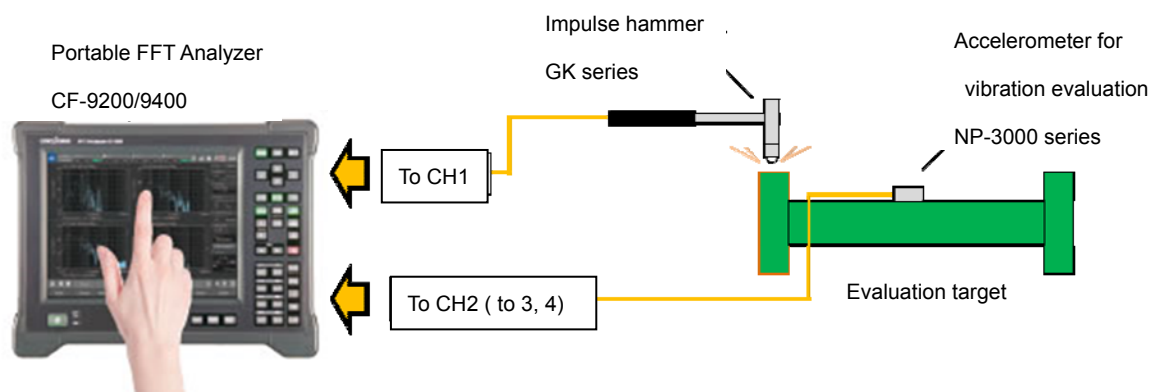
\* Described in this manual.

◇All the accelerometers used in this tutorial are "accelerometer with built-in preamplifier".

### 3. Before measurement

#### 3-1. Connection with the CF-9200/9400

- 1) Connect the impulse hammer for excitation to the signal input terminal [CH1] on the side of the CF-9200/9400.
- 2) Connect the accelerometer for amplitude evaluation to the signal input terminal [CH2 (to CH3, or 4)] on the side of the CF-9200/9400.



Connection between the CF-9200/9400 and exciter (Example)

#### 3-2. Setting the CF-9200/9400

FFT Analyzer is switched to exclusive mode in here, and performed various settings.

- 1) Starting the CF-9200/9400

Press and hold the POWER switch for 1 second or more to turn the power ON.

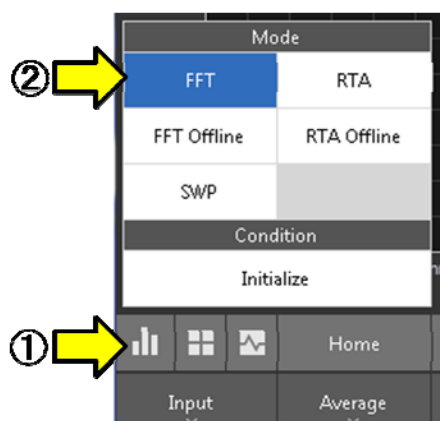
\* Press and hold the POWER switch until you hear the [Pit] sound to turn the power OFF.

(Caution) If you press the power switch too long, the power is forcibly shut down.

- 2) Selecting and starting the FFT mode

Touch the mode selection button ① and select [FFT] mode ② from the menu that pops up. FFT and FFT Offline are installed as a standard.

Touch [FFT] to start FFT.

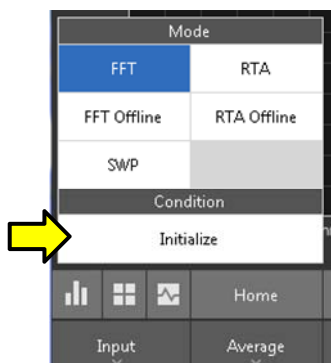


### 3) Starting and setting a new project

Start a new project to operate new measurement setting.

When a new project is started, all setting conditions of the CF-9000 series are also reset to the initial status. \* However, the data stored in memory is not deleted.

Touch [Mode switching button] in the bottom left of the screen to display a menu and touch [Initialize] in the menu. To start a new project, touch [OK] in the setting confirmation dialog box. Touch [Cancel] to stop starting a new project.



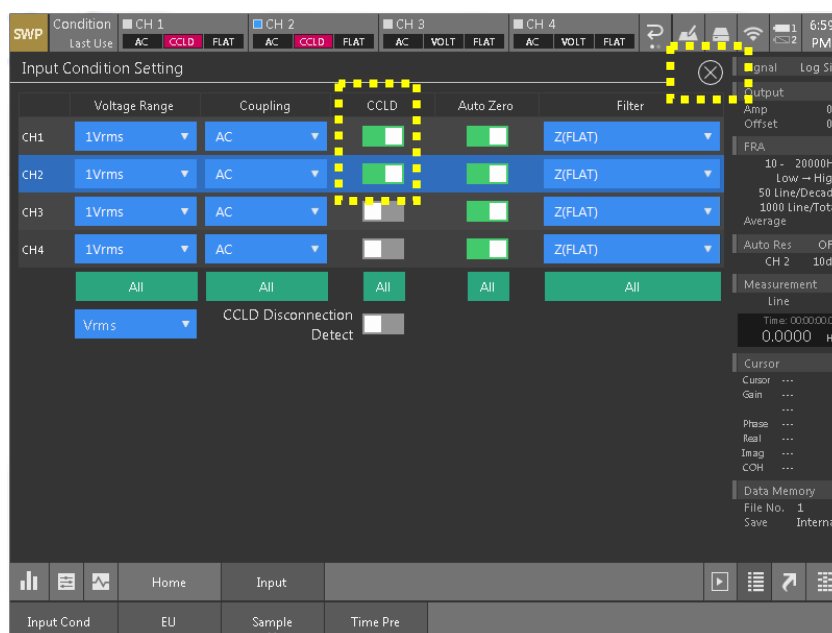
### 4) Supply power current to the impulse hammer and accelerometer which are connected to the CF-9200/9400\*.

\*This process is not necessary when a TEDS sensor is connected.

Soft key: [Home] > [Input] > [Input\_Cond]

Touch (select) [CCLD] of the channel that an impulse hammer and an accelerometer are connected, and start to activate the accelerometer by using CCLD.

\* CCLD: Constant Current Line Drive



©After this operation, close the dialog with ×.

## 5) Unit calibration of a sensor connected

Input the relationship between the physical quantity (EU) and voltage (V) of the impulse hammer and accelerometer which are connected to the CF-9200/9400.

### [Calibration method by “Calibration Chart”]

- ① .Check the sensitivities of voltage and physical value described on the “Calibration Chart” attached to the impulse hammer and accelerometer in use.

Voltage sensitivity of the impulse hammer (GK-3100)

→2.27 mV/N (Voltage output of excitation force per 1N (Newton))

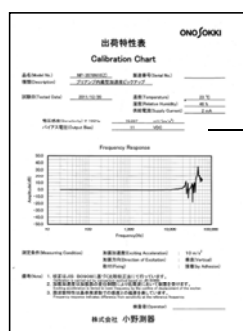
### HAMMER SENSITIVITY:

Hammer Configuration	Tip	Plastic/Vinyl	Plastic/Vinyl	
	Extender	None	Steel	
Hammer Sensitivity	mV/lb	10.08	10.65	
	(mV/N)	2.27	2.39	

Above data is valid for all supplied tips.

Voltage sensitivity of the accelerometer (NP-3000 series)

→10.097 mV/(m/s<sup>2</sup>) (Voltage output of a acceleration per 1 m/s<sup>2</sup> (meters per second))



Voltage sensitivity (Sensitivity) @ 160 Hz

10.097 mV/(m/s<sup>2</sup>)

Bias voltage (Output Bias)

11 VDC

② Input unit name and sensitivity to the CF-9200/9400

Input the voltage sensitivity to the CF-9200/9400.

Soft key: [Home] > [Input] > [EU]

When a diagram is opened, touch [EU] to turn the calibration ON, and input the unit name and sensitivity.

- CH1 **Unit\_Name** :N ⇐ Select the unit name (Newton) of the impulse hammer.
- CH1 **EU\_Valu** :0.00227 ⇐ Input voltage sensitivity of connection sensor to CH1.
- CH2 **Unit\_Name** :m/s<sup>2</sup> ⇐ Select the unit name (meter per second) of the accelerometer.
- CH2 **EU\_Value** :0.010097 ⇐ Input the voltage sensitivity of connection sensor to CH2.

\* Perform same operation when the sensor is connected to CH3, or 4.

Unit/Calib.		EU/SP					
	EU	Unit Name	EU Value	EU Type	0dB Reference	Offset	TEDS
CH1	<input checked="" type="checkbox"/>	N	0.00227 ...	V/EU	1	0dB	Execute
CH2	<input checked="" type="checkbox"/>	m/s2	0.010097 ...	V/EU	1	0dB	Execute
CH3	<input type="checkbox"/>	V	1 ...	V/EU	1	0dB	Execute
CH4	<input type="checkbox"/>	V	1 ...	V/EU	1	0dB	Execute
All		All	All	All	All	All	

©After this operation, close the dialog with ×.

### [Calibration by "TEDS"]

As the CF-9000 series is TEDS supported, reading the data from a TEDS sensor, power supply and unit calibration are automatically performed.

TEDS, abbreviations of "Transducer Electronic Data Sheet", is the data format that writes sensor-specific information complies with international standards IEEE1451.4.

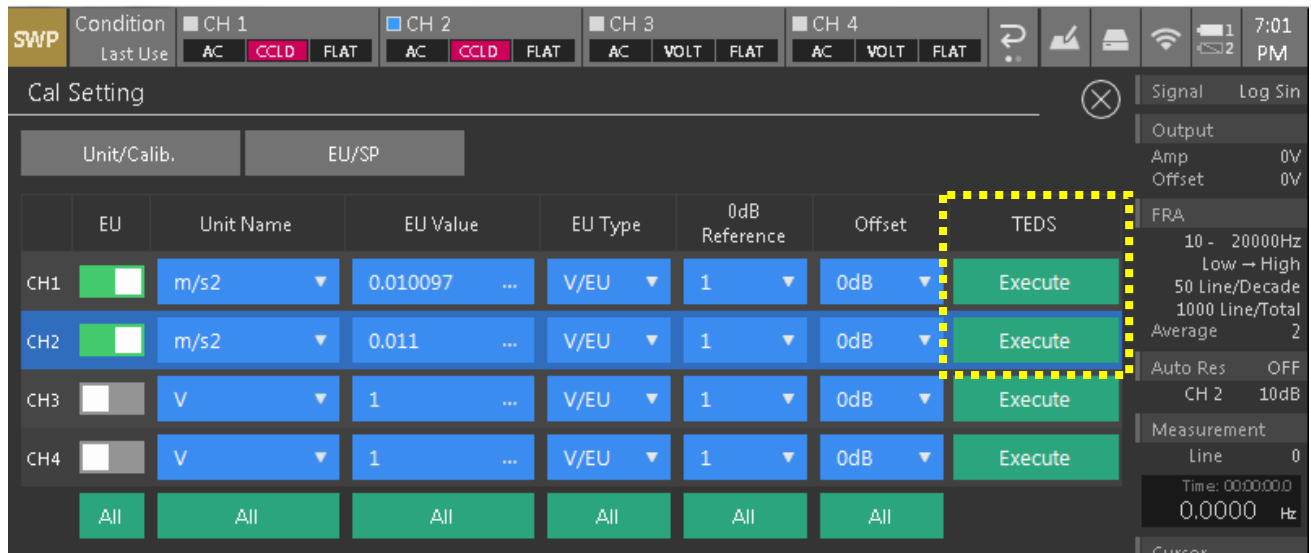
Any sensor with built-in TEDS data can send the sensitivity, weight and other data about the sensor itself to the connected the TEDS-supported FFT Analyzer. It can recognize such data and unit calibration is automatically performed.

- 1) Check that the TEDS sensor is connected to the CF-9200/9400, and touch TEDS [Execute].

Soft key: [Home] > [Input] > [EU]

Touch TEDS [Execute].

Calibration operation is completed after the data of the sensor connected is read.



ⓐAfter this operation, close the dialog with ×.

### 【 For successful measurement 】

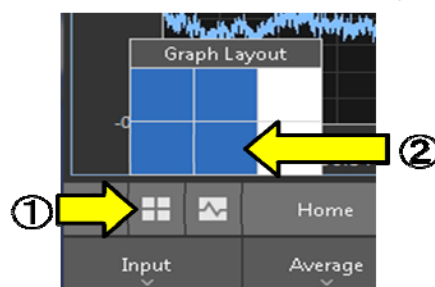
Calibrations by "Calibration Chart" and "TEDS" are not guaranteed the sensor operation and voltage sensitivity on the day of measurement. When you acquire an important data, check the movement and sensitivity of the amplitude sensor by the VX-1100, or calibrate the vibration measurement system by the VX-1100 before use.  
→Please refer to "6.Calibration procedures, etc.".

### 3-3.Simple checking of operation

Simply check the driving and calibration state of impulse hammer and accelerometer.

Set the screen view to 2 or 4 screens, and switch CH1 and CH2 to time or power spectrum waveform.

- 1) Touch the [Graph switching button] and switch the number of graphs in [Graph Layout].



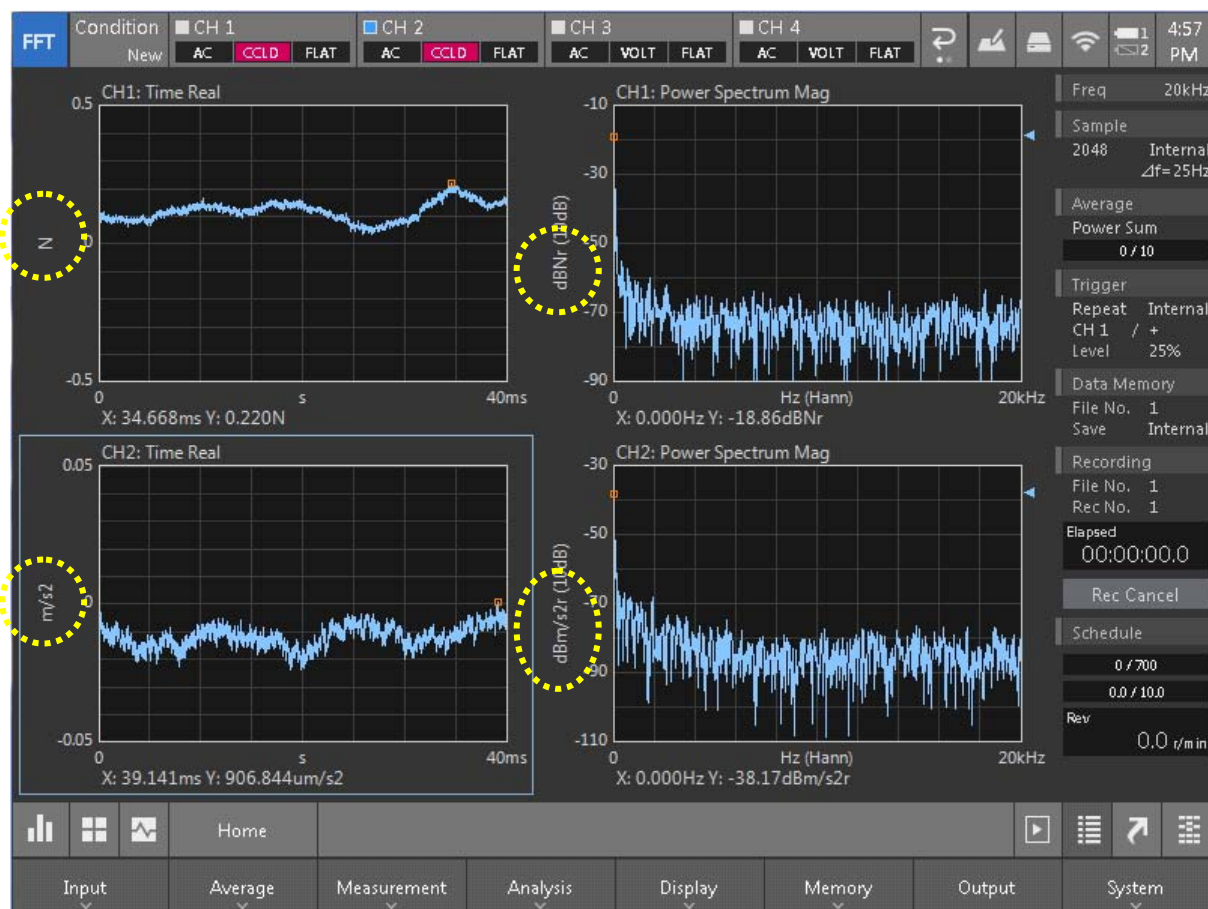
Upper figure: 4-graph display

- 2) Touch the displayed graph to select buttons of channel and waveform to be displayed.
- 3) Press [START] key on the front panel of the CF-9200/9400 to check that the unit is changed from V to N or  $\text{m/s}^2$ .





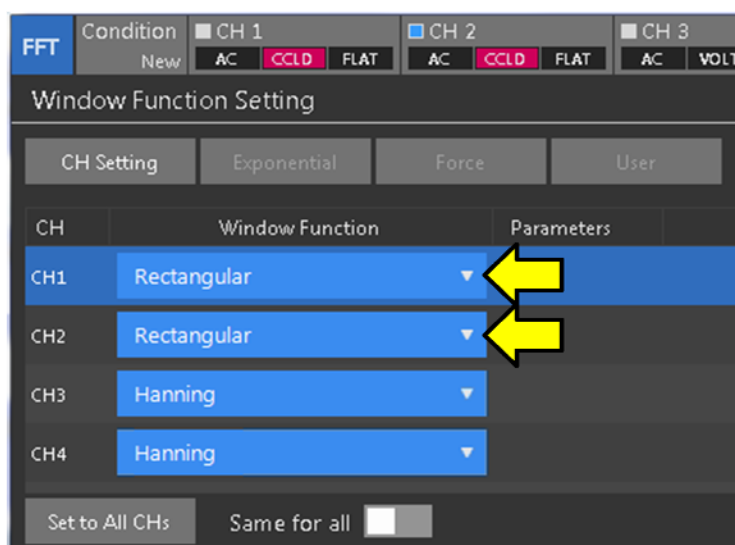
- Y-axis unit of the connected channel for the impulse hammer or the accelerometer becomes calibration unit.
- CH1:Vr → N
- CH2:Vr → m/s<sup>2</sup>



### 3-4. Setting the window function

Set the window function.

In order to handle transient signal (impulse wave), both CH1 and CH2 are switched to Rectangular (square wave) window. [Home] > [Input] > [Window]



\* Although, there are techniques to use various window functions to prevent the excitation noise or to enclose the response waveform into time window, we use original waveform in this example.

### 3-5. Checking the operation

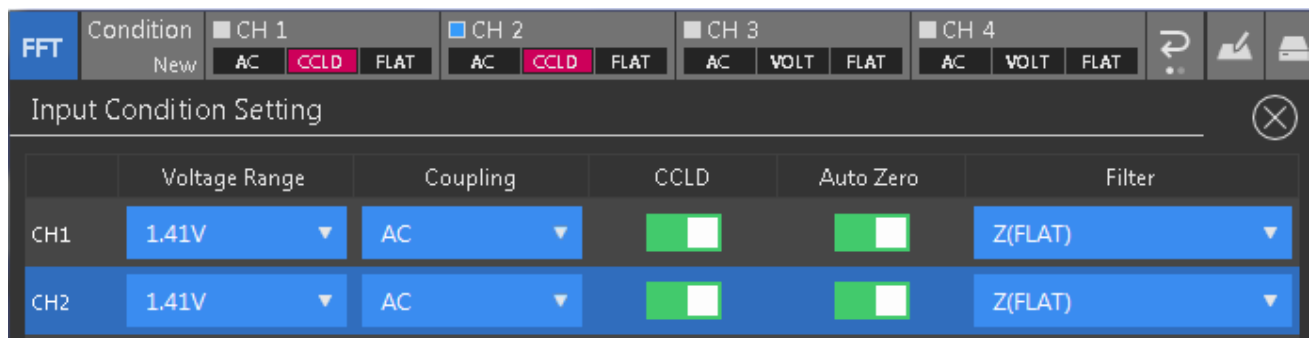
Check that the excitation force waveform and response waveform (from accelerometer) are indicated when impact test is performed by the impulse hammer with an appropriate force for several times.

#### 1) Selecting the voltage range

Select the voltage range which does not indicate A/D over.

[Home] > [Input] > [Input\_Cond]

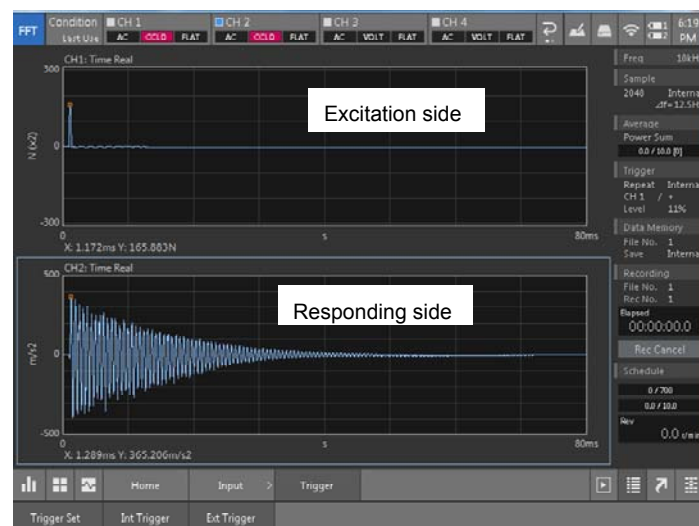
\* Check that the AD over is not indicate after hitting by 1 Vrms (default (0 dB Vrms/1.41 V)) for several times.



\* Increase the [Voltage range] of the channel when AD over is indicated. However in the CF-9000 series, AD over is rarely indicated with normal hammering, set voltage range in consideration of applying excessive force.

### 3-6. Setting the trigger function

Excitation by impulse hammer is impulse (impact) waveform. It is necessary to capture entire response waveform that occurs by the excitation to the FFT by using trigger function properly.

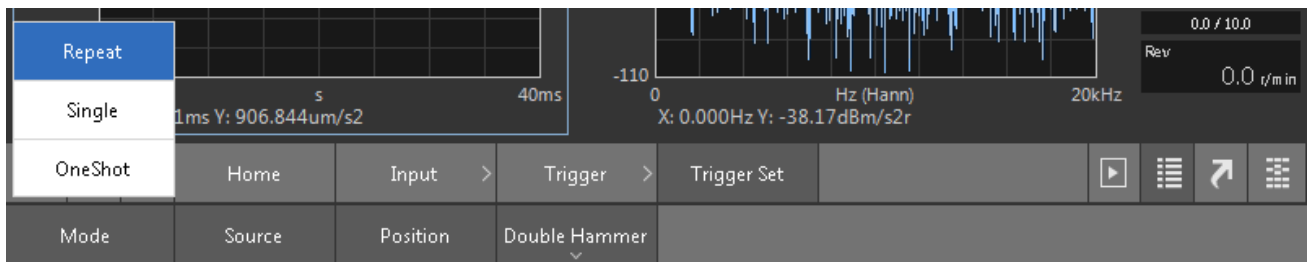


Trigger function installs the signal with an amplitude value as condition by using impulse waveform of excitation force. By using trigger function enables to install all waveforms of responding side (CH2 to 4) at the same timing.

### 1) Setting the trigger mode

Select [Repeat].

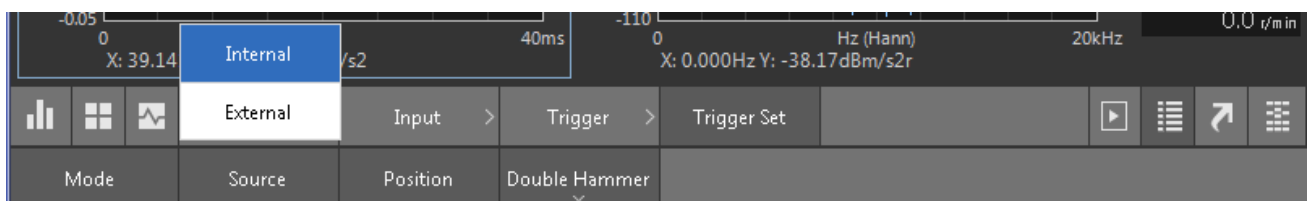
[Home] > [Input] > [Trigger] > [Trigger Set] > [Mode] > [Repeat]



### 2) Setting the trigger source

Select [Internal].

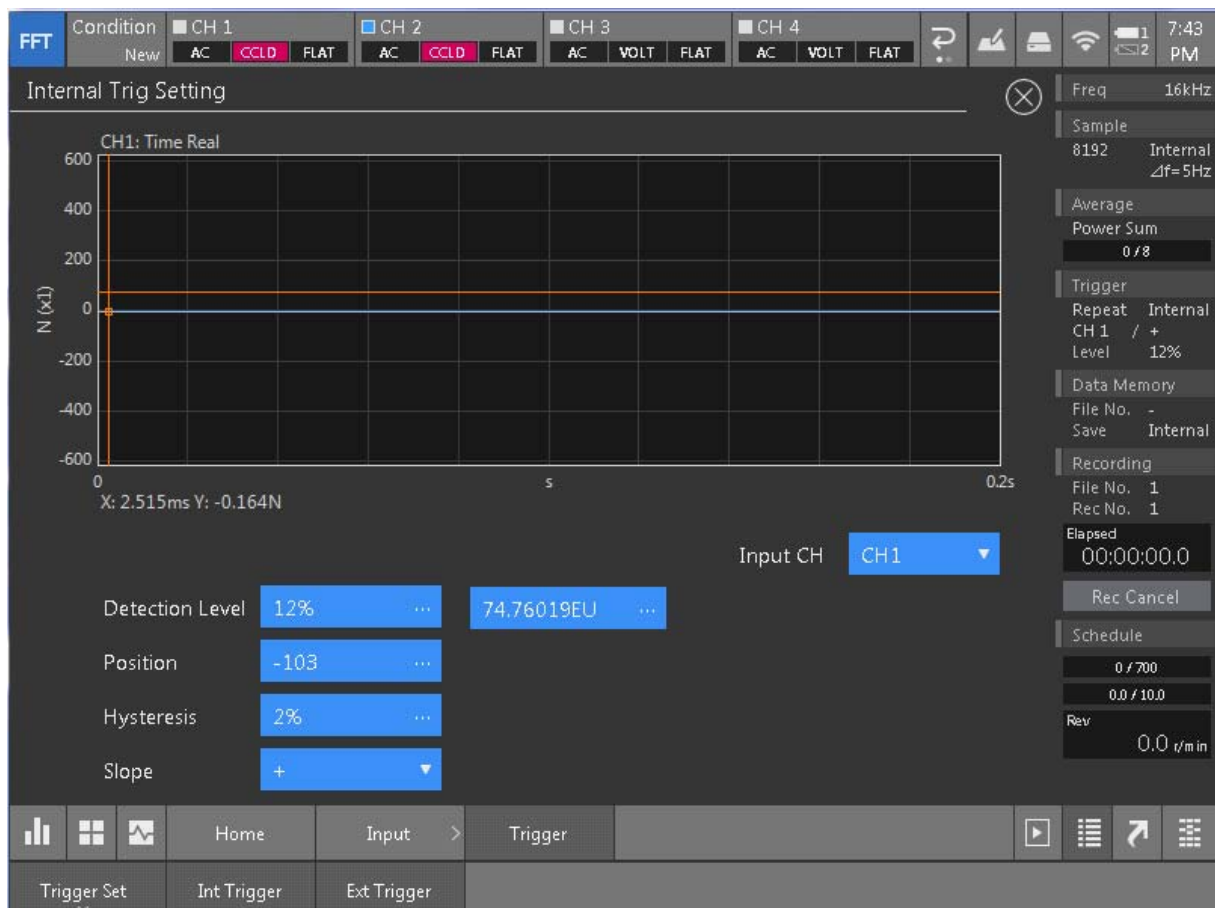
[Home] > [Input] > [Trigger] > [Trigger Set] > [Source] > [Internal]



### 3) Setting the trigger position and level (Threshold value)

Set the trigger position to the beginning of the time window (left end) to install entire waveform of CH2 (responding side) by the CH1 excitation waveform. This is called Pre.Trigger.

[Home] > [Input] > [Trigger] > [Int Trigger]



- ① Select channel (CH) that is used for [Input CH] internal trigger. \* Select [CH1] in this example.
- ② While hitting the object with the hammer, decide the appropriate position (Pre. Trigger) and level (threshold value) by touching the waveform data (light blue) while applying excitation, and cursors (orange) for trigger point and level setting.

Numerical input of the level (threshold value) is available with the ratio to input voltage (%) and physics value (EU).

When set the level in EU (N (Newton) in this example), the trigger can be applied with physical value as a rough guide.

**<When waveform by impact test is not visualized>**

Press [Y\_SCALE] key  $\Delta$  of the main unit, and adjust the display level of the signal.



**<When trigger is not applied even if level (threshold value) is set>**

Please set Hysteresis (hysteresis value). Input the numerical value (%) in the dialog box <Numeric Input> which displays when you touch the screen. \* Guideline value is from 0.001(%).

**\* Hysteresis**

The hysteresis refers to the range of the dead band to the trigger signal.

The hysteresis is useful to prevent erroneous triggering that may occur, for example, due to noise superimposed by the trigger signal.

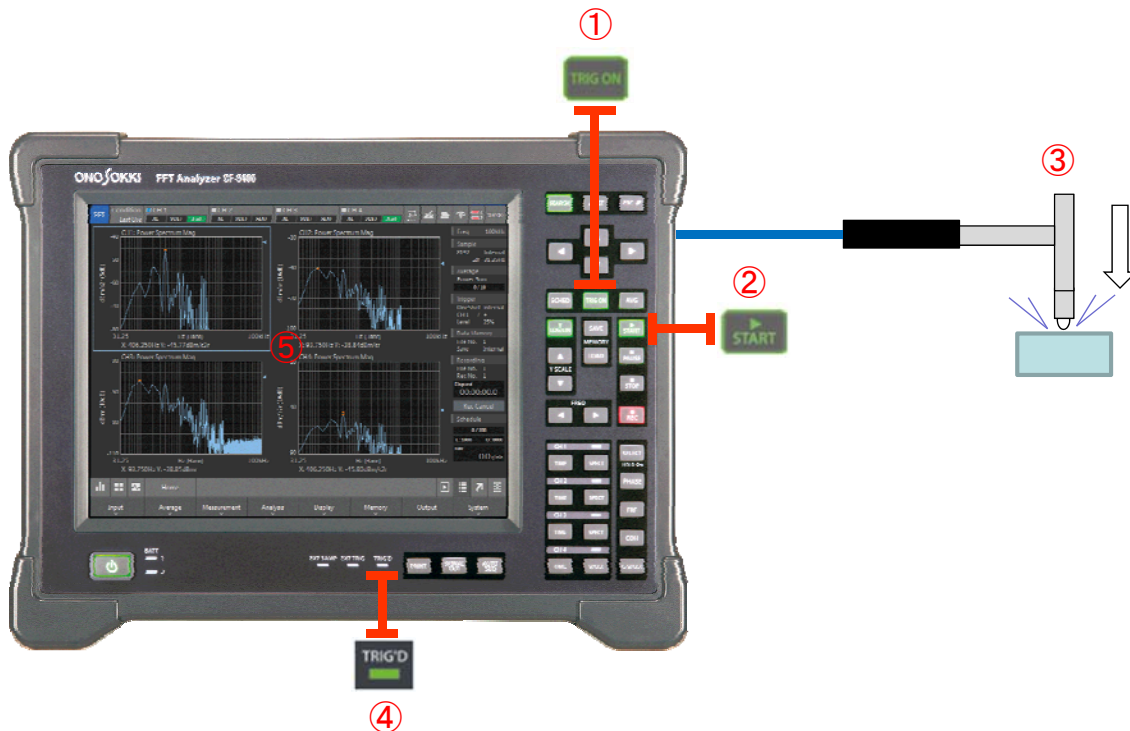
To define the range of the dead band, set the range in percentage (0 to 99 %) relative to the voltage range. This value is called the hysteresis value or level.

- ③ Switch the slope trigger polarity to either [+], [-], or [+/-].

\*Keep DEFAULT setting while hammering.

**4) Checking the trigger operation**

- ① Press [TRIG\_ON] key on the main unit of CF-9200/9400.
- ② Press [START] key. → Condition is changed to the trigger waiting mode.
- ③ Hit the object with the hammer.
- ④ [TRIG'D] LED indicator is blinked.
- ⑤ Waveform is captured for one frame.



### 3-7. Setting the frequency range and averaging

Set the rough frequency range and arithmetic averaging in accordance with impulse hammer in use.

#### 1) Setting the frequency range

Set the analysis frequency range (upper right of the screen: Freq) of the CF-9200/9400 by using the type of impulse hammer and impact tip as a rough guide.



[Guideline for impulse hammer in use and setting frequency range]

GK-3100	: 10 kHz or less
GK-2110	: 40 kHz or less
GK-4110G10	: 5 kHz or less

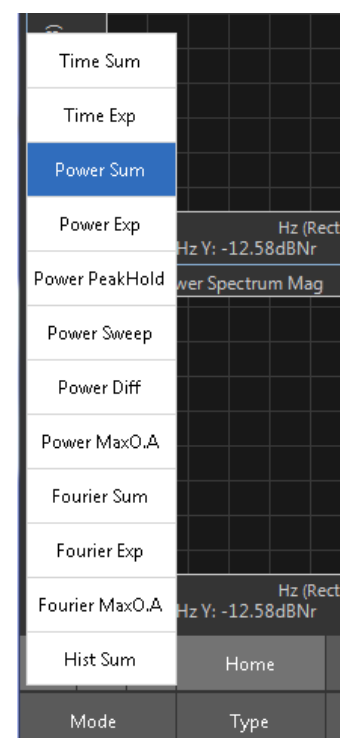
#### 2) Setting the averaging

Excitation energy of impact excitation is small, so perform hammering for several times and execute averaging (Average) process.

##### ① Checking the averaging mode

Select the power spectrum summation averaging mode (default value).

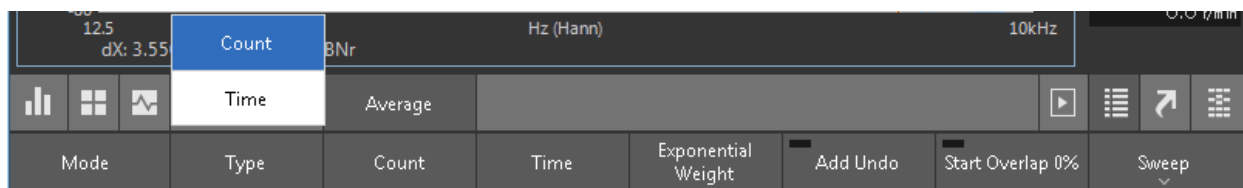
[Home] > [Average] > [Mode] > [Power Sum]



② Setting the averaging type

Set the summation averaging to count setting.

[Home] > [Average] > [Type] > [Count]

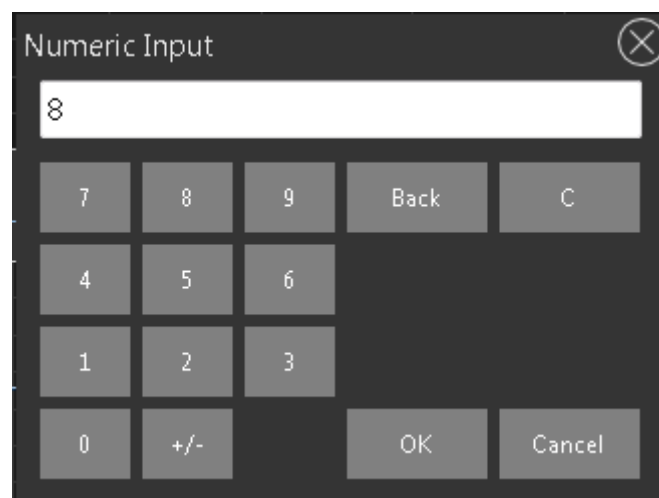


③ Setting the summation averaging and count

Set the summation averaging count by numeric input. Recommending summation averaging counts are approx.5 to 8 times.

[Home] > [Average] > [Count] > [5 to 8 times]

Ten-key pad (Numeric\_Input) is opened so input the summation count in number.



Make sure to touch [OK] to close the ten-key pad.

### 3-8. Setting the excitation band

Perform the hammer hitting to check if excitation reaches to the desired band or not, and adjust it.

\* Impulse hammer has an upper limit of frequency for excitation, and it varies depending on hardness of the target, type and impact tip material of the hammer. The width of excitation band and magnitude of excitation force are in the relation of trade-off.

#### 1) Preparing and checking the excitation band

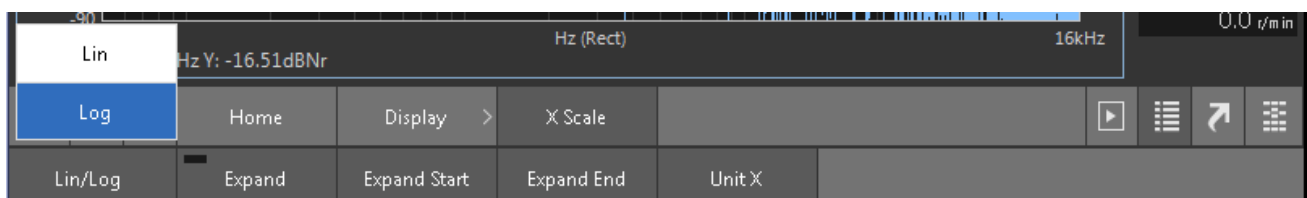
Actually hit the evaluation target to identify the upper limit of excitation, and set the appropriate frequency range.

[Setting and screen display]

- ① Changing to vertical dual window display.
- ② Set the upper screen to time waveform. → Touch the upper screen and press [Time] key on CH1 of the main unit.
- ③ Set the lower screen to power spectrum. → Touch the lower screen and press [SPECT] key on CH1 of the main unit.

\* After above settings, the upper screen displays time waveform of CH1 and lower screen displays power spectrum of CH1.

- ④ Select display of the power spectrum of CH1.
- ⑤ Change the X-axis (frequency) of the power spectrum of CH1 to Log display.  
Select [Home] > [Display] > [X Scale] > [Lin/Log] > Log in this order.





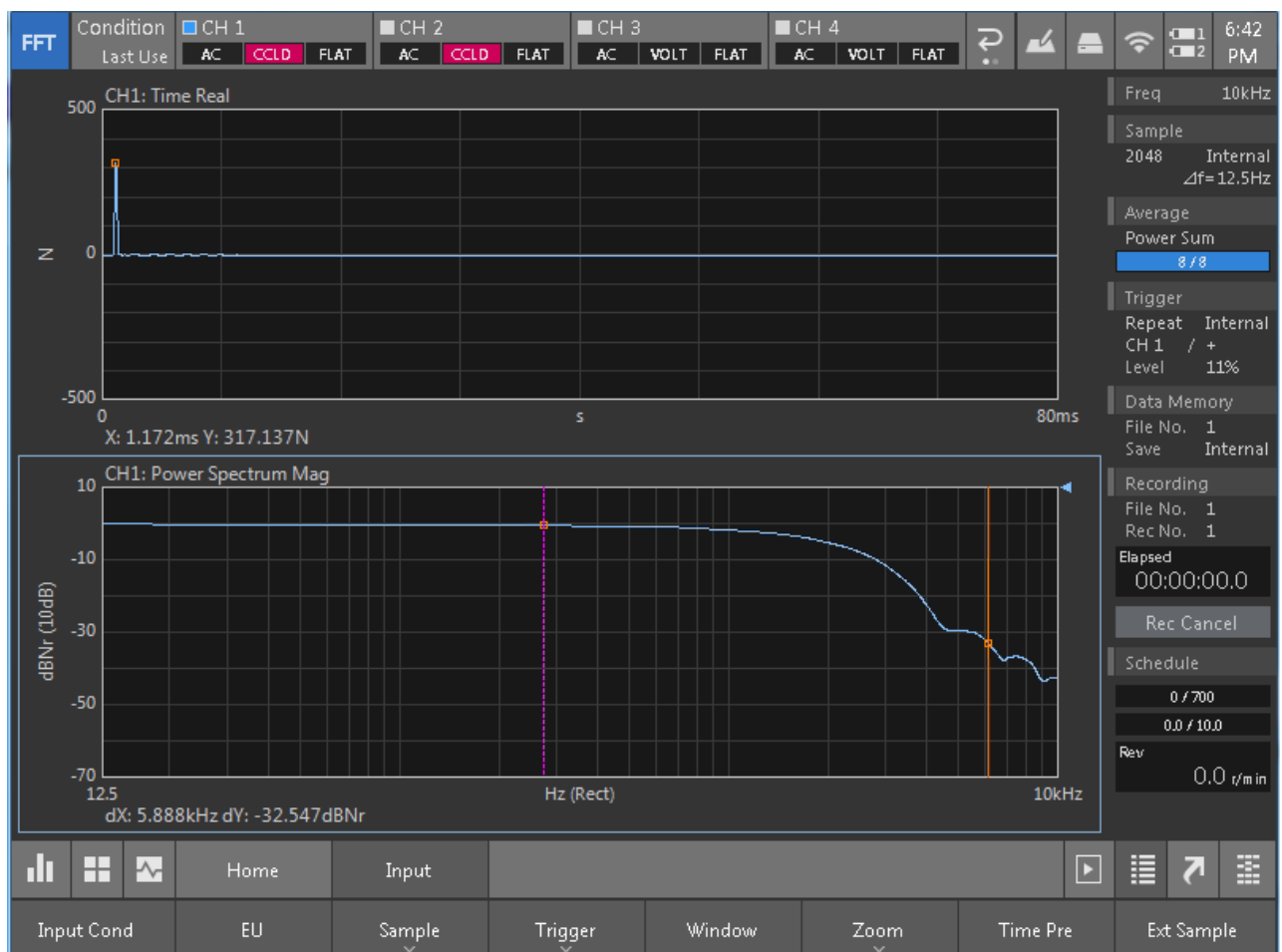
## [Impact test]

- ① Press [TRIG\_ON] key on main unit of CF-9200/9400.
- ② Turn the Average [AVG] ON.
- ③ Press [START] key. → Condition is changed to the trigger waiting mode.
- ④ Hit the object with the hammer.
- ⑤ [TRIG'D] LED indicator is blinked.

\* When the setting count of hammering excitation is terminated, [START] LED indicator is turned off.

## 2) Checking the excitation band

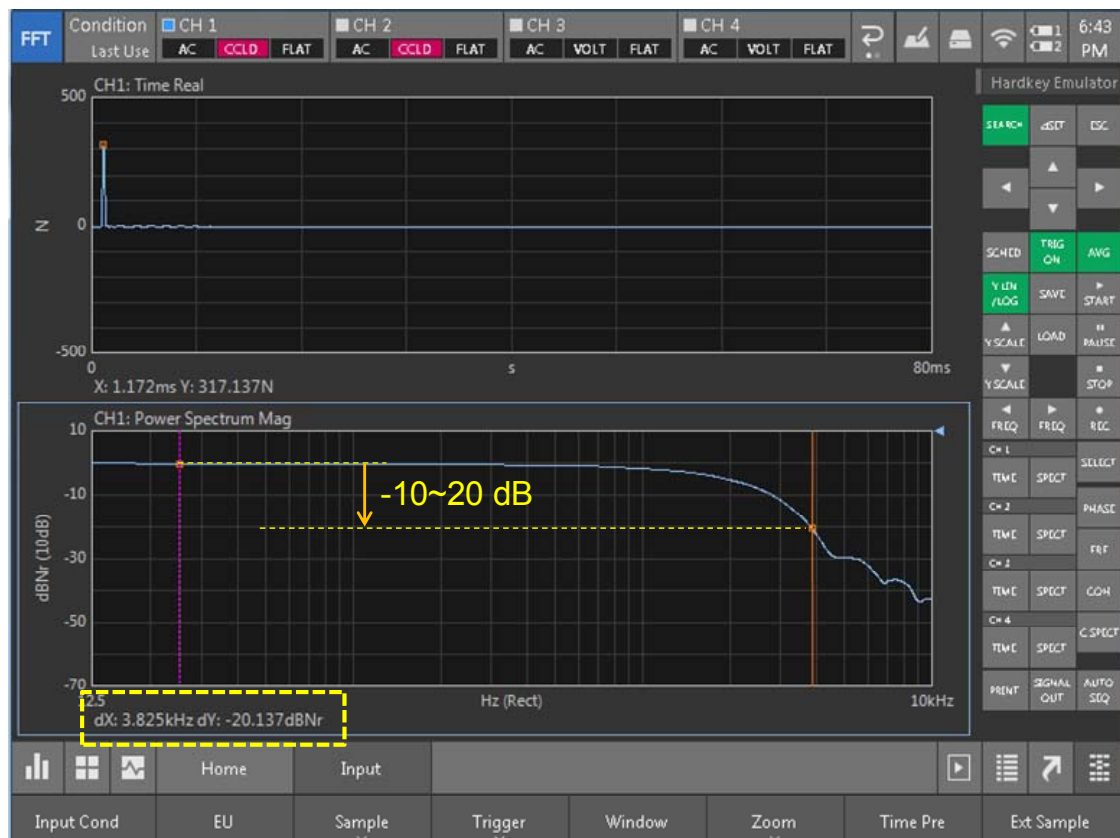
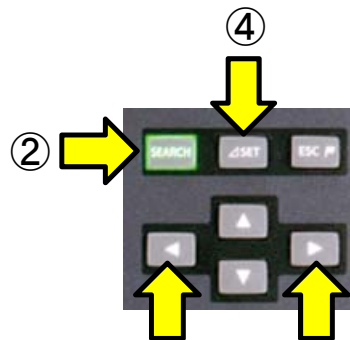
Check the band that is capable of excitation with the hammer and impact tip in use by measuring the damping of power spectrum waveform of CH1. Upper limit of the band capable of excitation are -10 to -20 dB lower than the flat band.





# [Setting and screen display]

- ① Select the power spectrum of CH1 on the lower screen by touching it.
- ② Press the panel key [SEARCH] to display the cursor.
- ③ Touch the screen or press the panel key to move the cursor to the flat part of the excitation force on the graph.
- ④ Press [↵SET] key to display another cursor on the screen.
- ⑤ Touch the screen or press the panel key to move the cursor to -10 to -20 dB lower amplitude frequency than the flat band.
- ⑥ dX is the upper limit of the frequency (Hz) capable of excitation.



\* In the above figure, dX: 3.825 kHz dY: -20.137 dB → The upper limit of frequency capable of excitation is approx. 3.8 kHz.

\* Attach Medium Tip to the hammer.

[Checking and changing]

If it is unnecessary to increase or decrease the excitation band, checking of the impulse hammer has been completed.

If it is necessary to increase the excitation band, replace the impact tip or the hammer itself.

If it is necessary to decrease the excitation band, replace the impact tip. It enables to increase the excitation force and SN ratio.

\* For further details, please refer to the [Appendix] in the end.

## 4. Impact test

Perform actual impact test and obtain the data.

Procedure is same as the checking of excitation band.

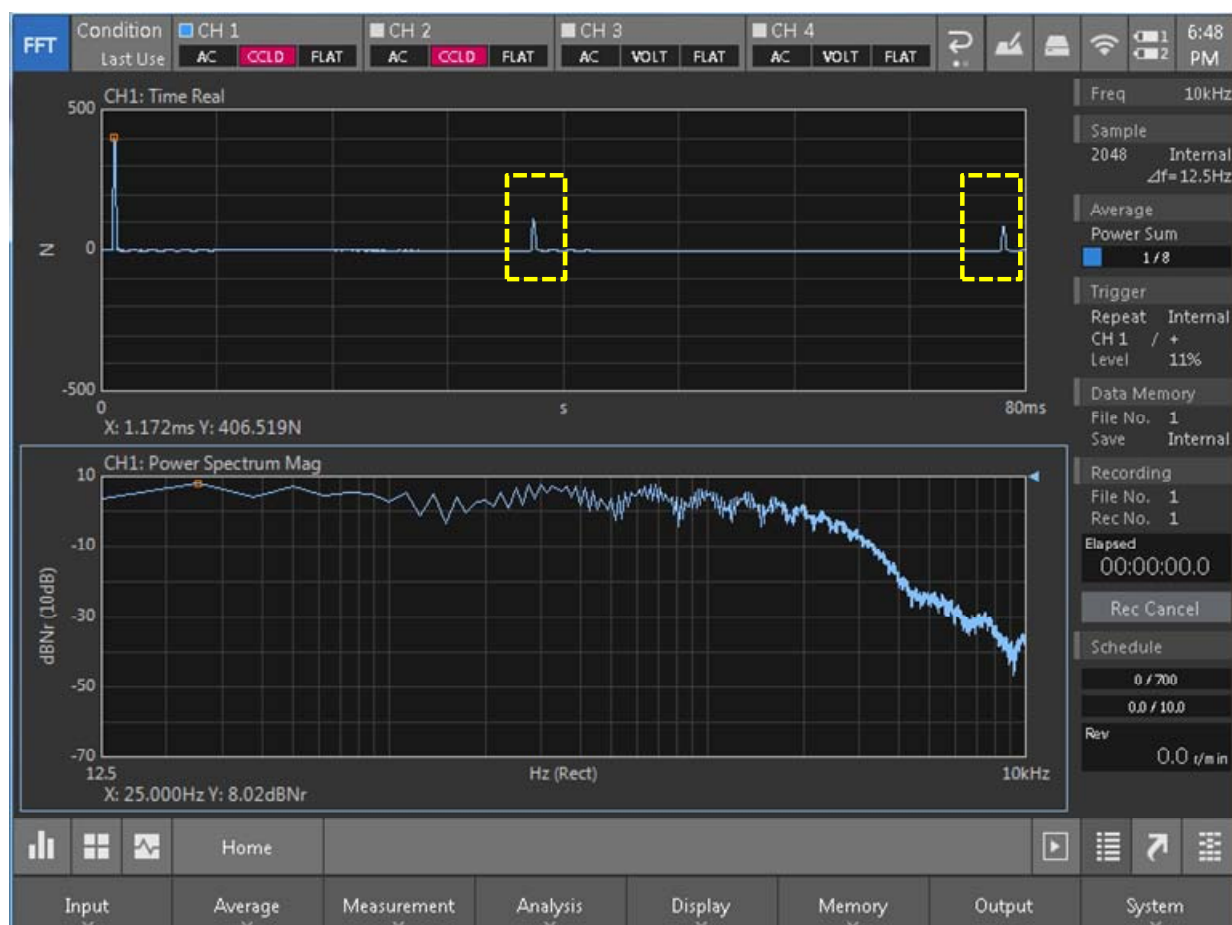
### 4-1. Number of screens and display contents

There is no restriction on the number of screens and display contents while hammering, but the TIME (time waveform) of CH1 observation is necessary to check double hammering (twice hitting)\*.

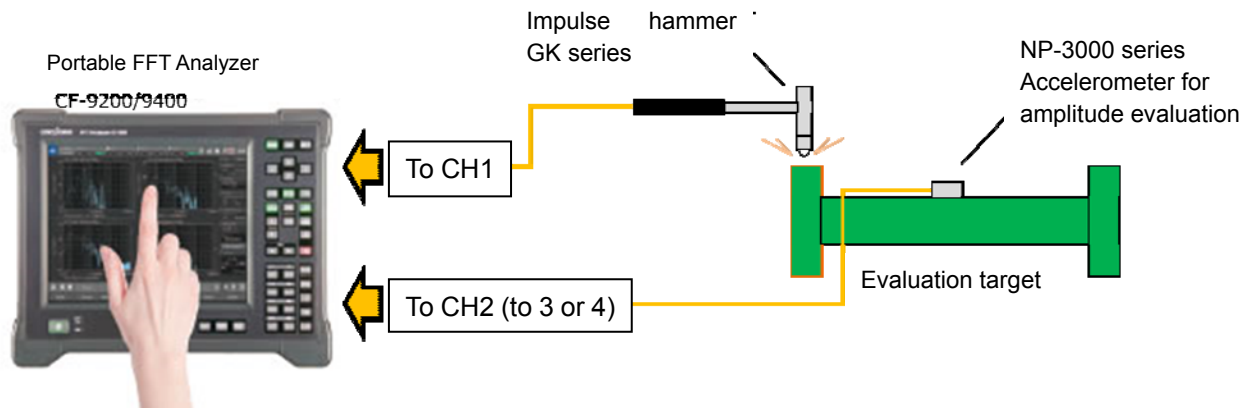
Other analysis waveform can be displayed after hammering.

\* Double hammering (twice hitting) is an operation error that hits target twice or more among identical time frame. The CF-9200/9400 can be automatically cancelled to capture the data if the double hammering is occurred. For further details, please refer to the "Reference guide (P. 94)".

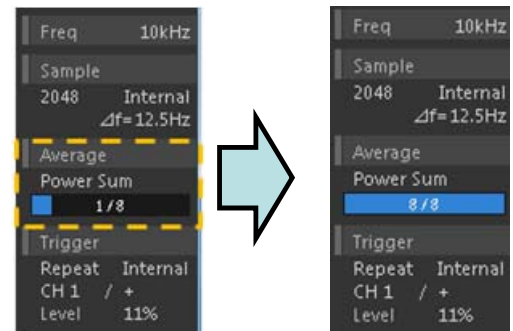
[Occurring of the double hammering]



## 4-2. Actual impact test



- ① Check the equipment connection.
- ② Press [TRIG\_ON] key on the main unit of CF-9200/9400.
- ③ Press [AVG] key to turn ON average.
- ④ When you press [START] key, the condition is changed to trigger wait state.
- ⑤ When you start hammering, [TRIG'D] LED indicator is blinked.
- ⑥ When the excitation is progressed, the number of averaging is increased and indication bar is extended.
- ⑦ When the setting count of hammering excitation is terminated, [START] LED indicator is turned off.



The excitation operation has been completed.

### [Caution]

Hereafter, do not touch [START] key before completing the analysis, displaying, and saving data.

## 5. Analysis

Display the frequency response function (FRF).

### 5-1. Checking the coherence function (COH)

Coherence function indicates the degree of the casual relationship between the input and output of the measurement system in range of 0 to 1. When the coherence is 1 (MAX), the output of the system entirely arise from the input. When the coherence is 0, the output of the system has no relation with the input. In this manual, input = excitation force by hammering, and output = amplitude (vibration by the excitation). Therefore, coherence function helps to determine if the amplitude value detected by the accelerometer is from the hammering excitation or not, and to decide reoperation of excitation, or reconsideration of excitation method.

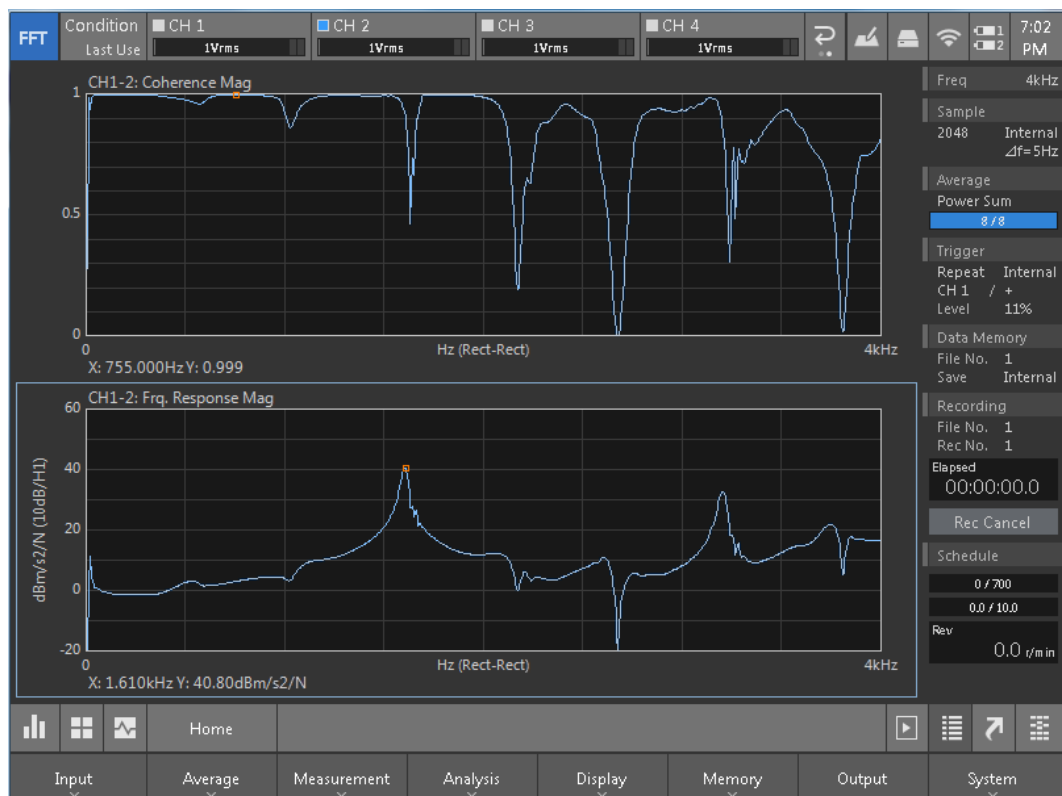
#### (Cautions while observing the coherence function)

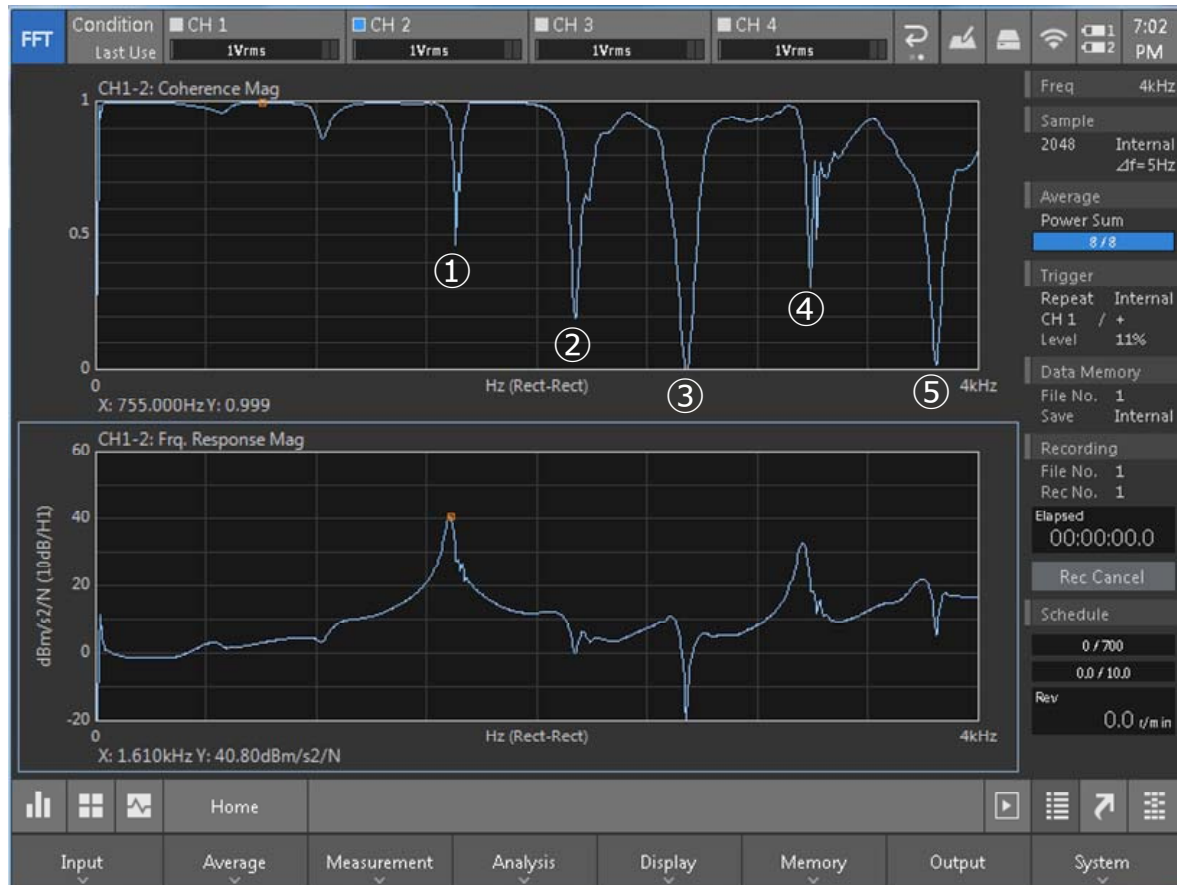
The followings are deteriorating factor of coherence function by hammering.

- (1) Even if excitation is applied to the evaluation target, vibration is not generated or hard to generate at the detection part in the specific frequency,.
- (2) Poor SN ratio (Small excitation force/ Many disturbance vibrations/ Poor sensitivity detector)
- (3) Output response is longer than time window, and leakage error is occurred.
- (4) Response to the excitation of evaluation target is nonlinear.

Coherence and frequency response function are displayed in 2 windows screen and compared.

- 1) Touch the screen to be displayed coherence and press [COH] key.
- 2) Touch the screen to be displayed frequency response function and press [FRF] key.





When you observe the coherence function, you may concern about five frequencies of ① to ⑤ which are lower than 0.5. It is possible to estimate the factor by observing FRF at the same time and determine re-impact test or restriction of observing bandwidth.

- ① ,④: Suspected of leakage error in the resonance point vicinity.
- ② ,③: Anti-resonant points. These observation points are not vibrated with these frequencies.
- ⑤: SN ratio is poor in the excitation limitation area vicinity of the hammer.

With the consideration of above;

- 1) Limit the observation band to 3 kHz.
- 2) Extend the time window (sample length: 2048 → 4096) to resolve the leakage error.

\* In this example, re-impact test can be considered from the above conditions.

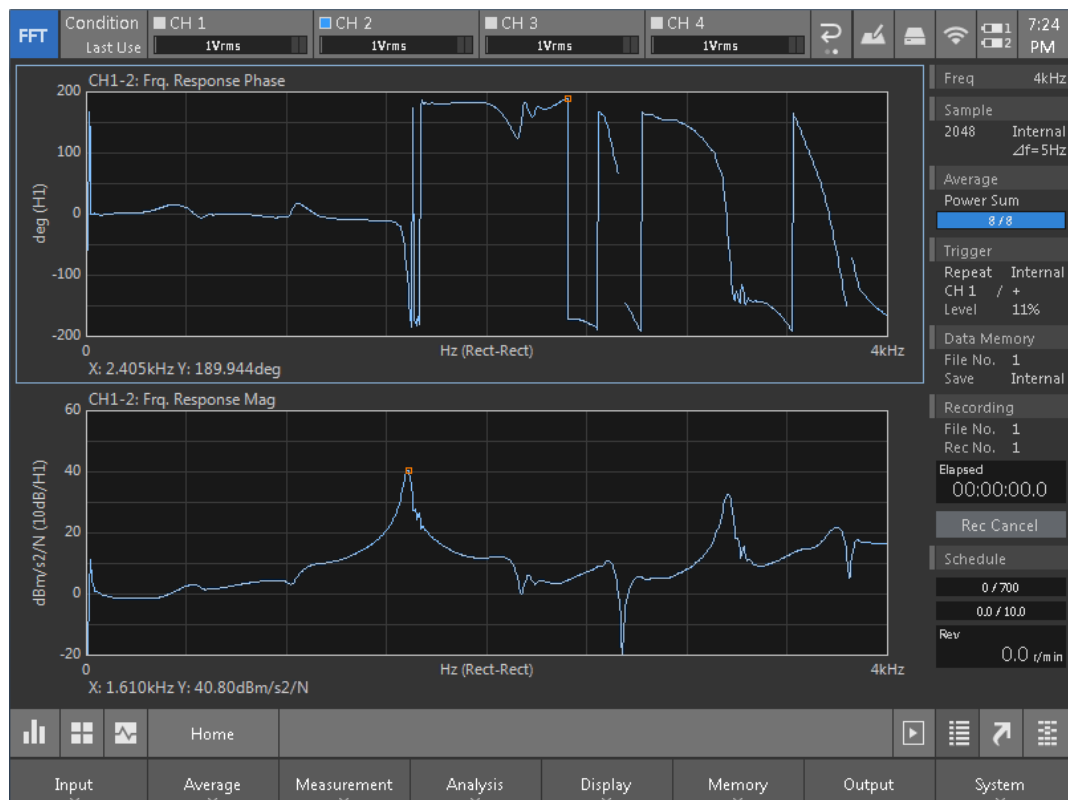
## 5-2. Bode plot display 1

When you display the phase to the position where the coherence function is displayed, it becomes bode plot which displays gain and phase.

Bode plot makes frequency in X-axis as common, and vertically arrange amplitude and phase in Y-axis. Bode plot enables to check the resonance point and amplitude of frequency easily. Also, distinguish view of amplitude and phase is possible, so it is highly used as a diagram which displays frequency response function.

(Set as vertical dual window display.)

- 1) Touch the upper screen and press [PHASE] key.
- 2) Touch the lower screen and press [FRF] key.

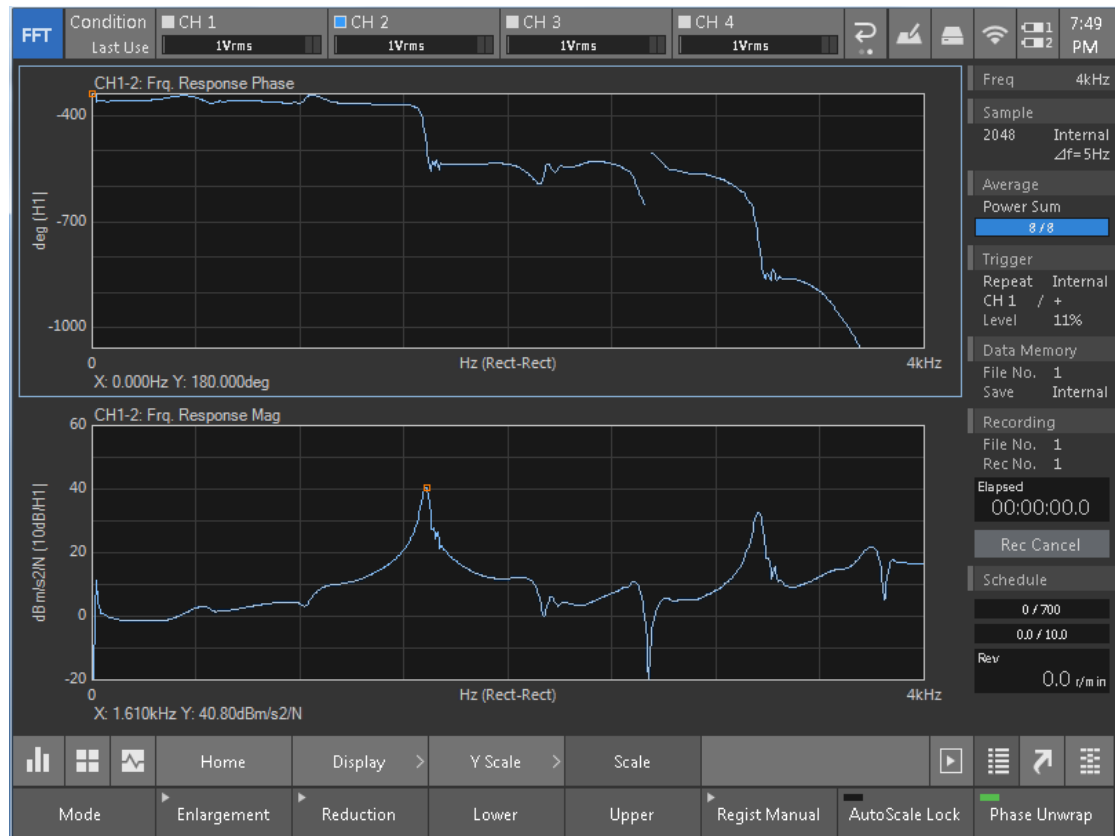


### 5-3. Bode plot display 2

Standard phase display is  $\pm 180^\circ$  wrap around display.

[Phase Unwrap] is the mode which cancels  $\pm 180^\circ$  wrap around display and displays continuous connecting phase characteristics.

[Home] > [Display] > [Y Scale] > [Scale] > [Phase Unwrap]

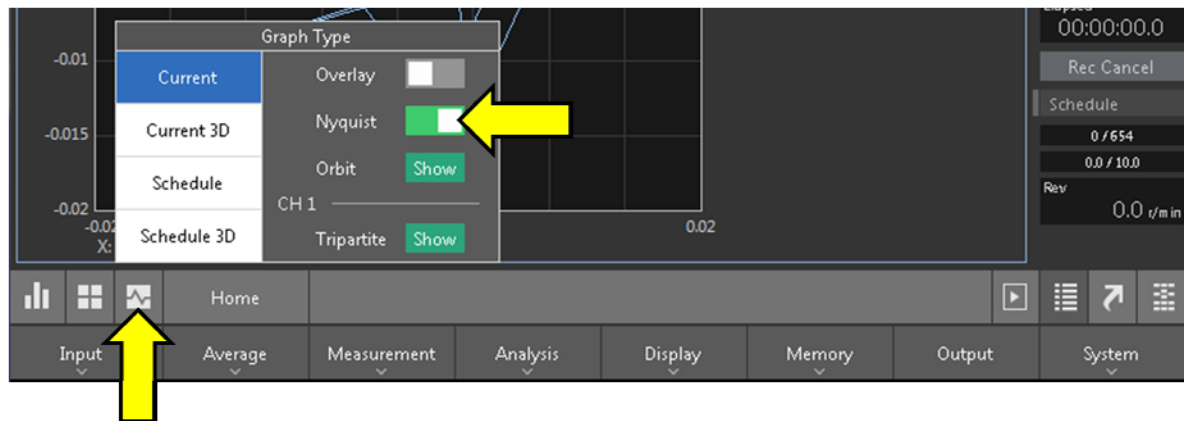




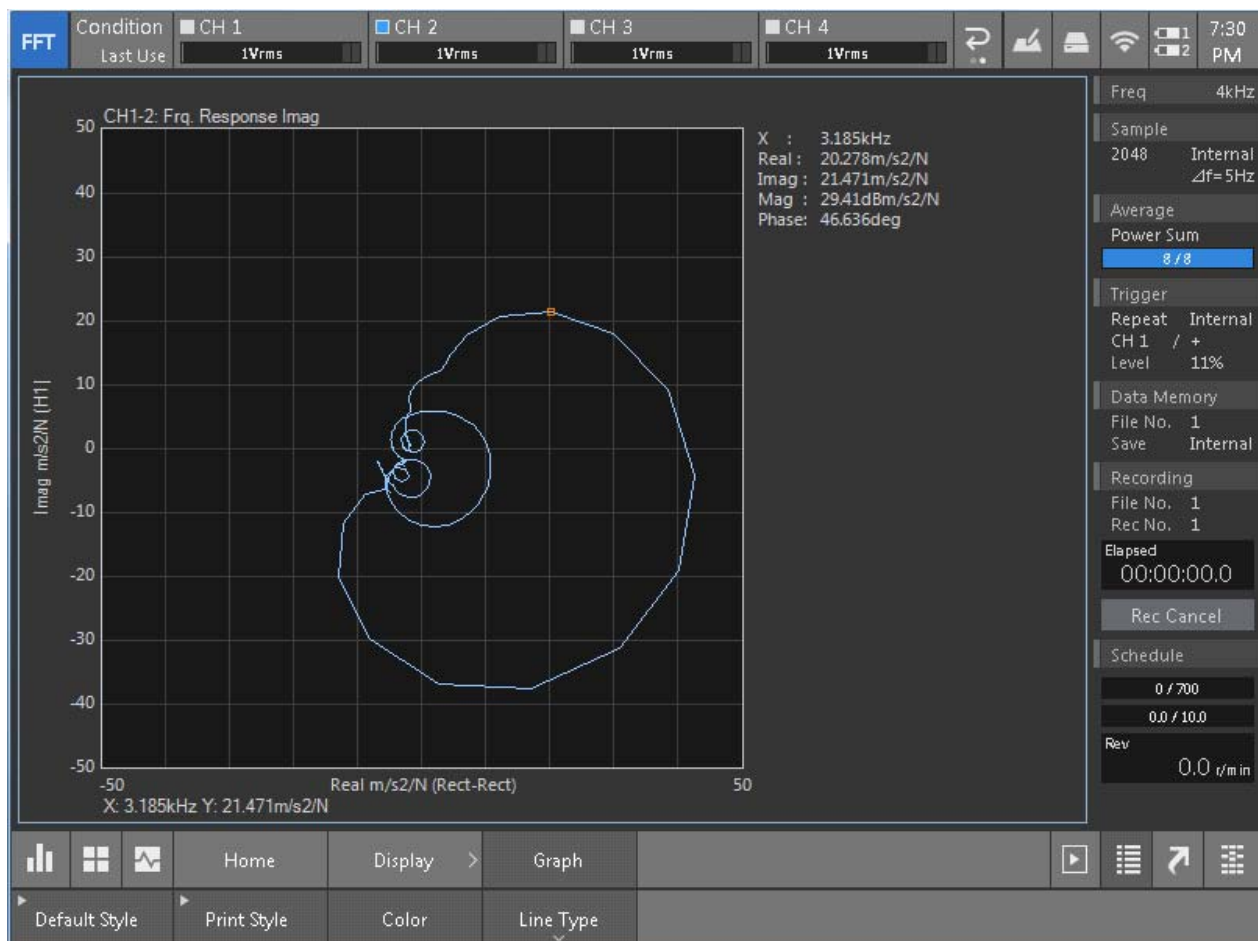
## 5-4. Nyquist plot display

The plot which is arranged the real part and imaginary part of the frequency response function to horizontal axis and vertical axis, and drew the moving trace which changes each frequency  $\omega$  from 0 to infinity is called Nyquist plot.

- 1) Select the FRF graph to be displayed by touching it.
- 2) Touch [Graph Type] > [Nyquist] in this order to turn ON [Nyquist] display.



Display Nyquist plot.



## 6. Saving data

Pressing [SAVE] button on the main unit saves the acquired data.

1) Set the saving condition of data memory.

① Set the number of the data memory to be saved.

[Home] > [Memory] > [Data]

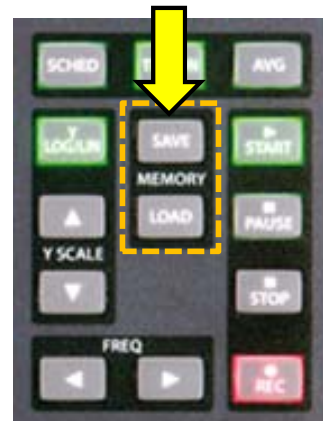
Touch (move the selection cursor) the number (No. 1 in this example) of target data memory in memory management screen. The setting data memory number can be checked at File No. which is displayed in the Data Memory on the Status screen.

Please note when you select the number which has already been saved data, existing data is overwritten by new data.

② Set the type of saving data.

[Home] > [Memory] > [Data] > [Save Type]

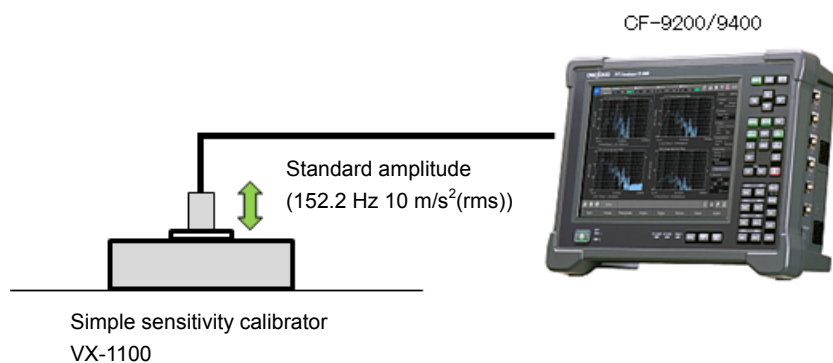
The save data type setting key is sequentially displayed by touching [Save Type] key, and touch the type of data to be saved to set it to ON (enable) or OFF (disable). After completion of the setting, touch  $\times$  or press the hardware key [ESC] to close the dialog box.



## 7. Calibration procedures, etc.

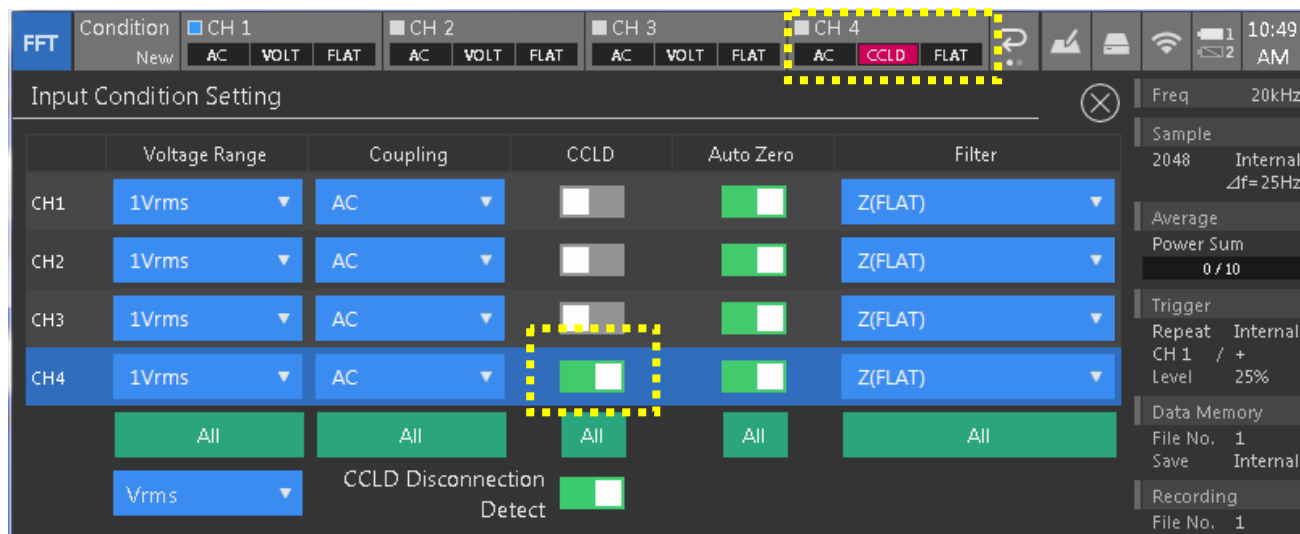
[Calibration of vibration measurement system by the VX-1100]

Apply the standard acceleration ( $152.2 \text{ Hz } 10 \text{ m/s}^2(\text{rms})$ ) to the accelerometer by using the VX-1100, and perform calibration with measurement system of the accelerometer and the CF-9200/9400.



- 1) Connect the accelerometer to the CF-9200/9400, and turn ON the CCLD of the channel which connected the sensor.

Software key: [Home] > [Input] > [Input\_Cond]



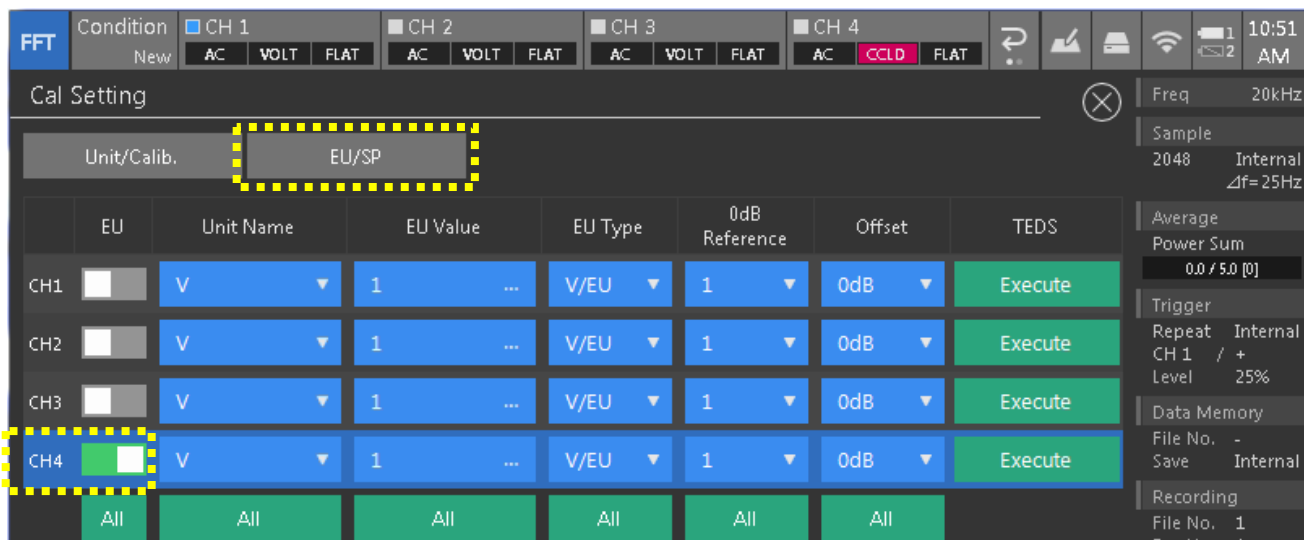
Turn ON the CCLD by touching the [CCLD] of the channel which connected the accelerometer.

\* Turn ON the CCLD of CH4 in this example.

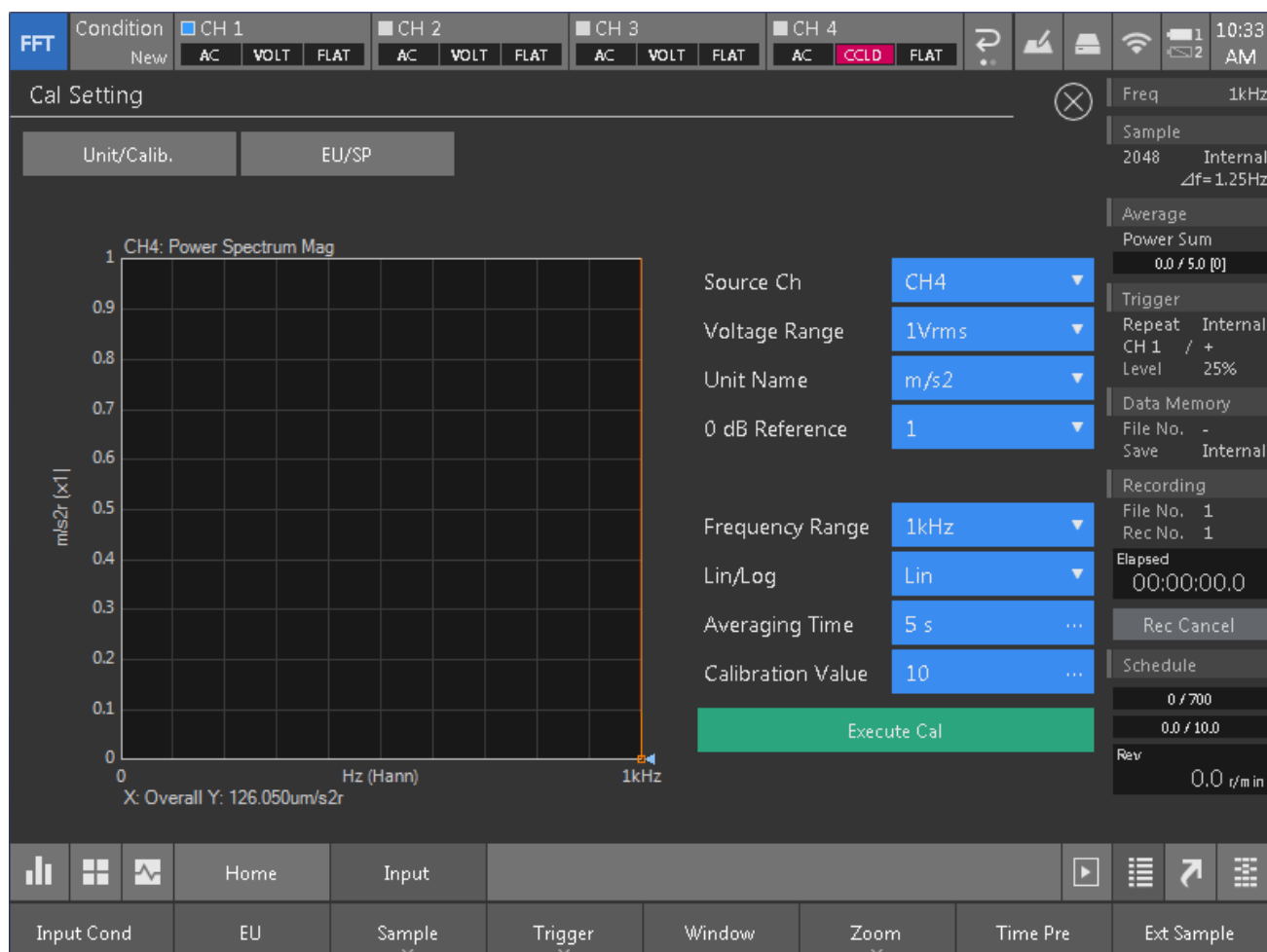
- 2) Enter to the calibration menu.

Software key: [Home] > [Input] > [EU]

- ① Touch [EU] of the channel to be calibrated to turn it ON.
- ②. Select [EU/SP].



The [Cal Setting] dialog box is displayed.



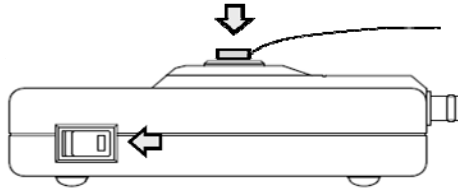
- [Source Ch] : Select the CH to be calibrated (CH4 in this example).
- [Voltage Range] : Input voltage range (1 Vrms (DEFAULT))
- [Unit Name] : Select the unit to be calibrated ( $\text{m/s}^2$  in this example)
- [0 dB Reference] : Input 0 dB reference value (1 DEFAULT)
- [Frequency Range] : 1 kHz
- [Lin/Log] : Lin
- [Averaging Time] : 5 (sec)

-[Calibration Value] : Input the amplitude value to be calibrated( $10 \text{ m/s}^2$  in this example)

After the input process, move the search cursor to 1 kHz (right end of the screen) and check that "Overall" is displayed.

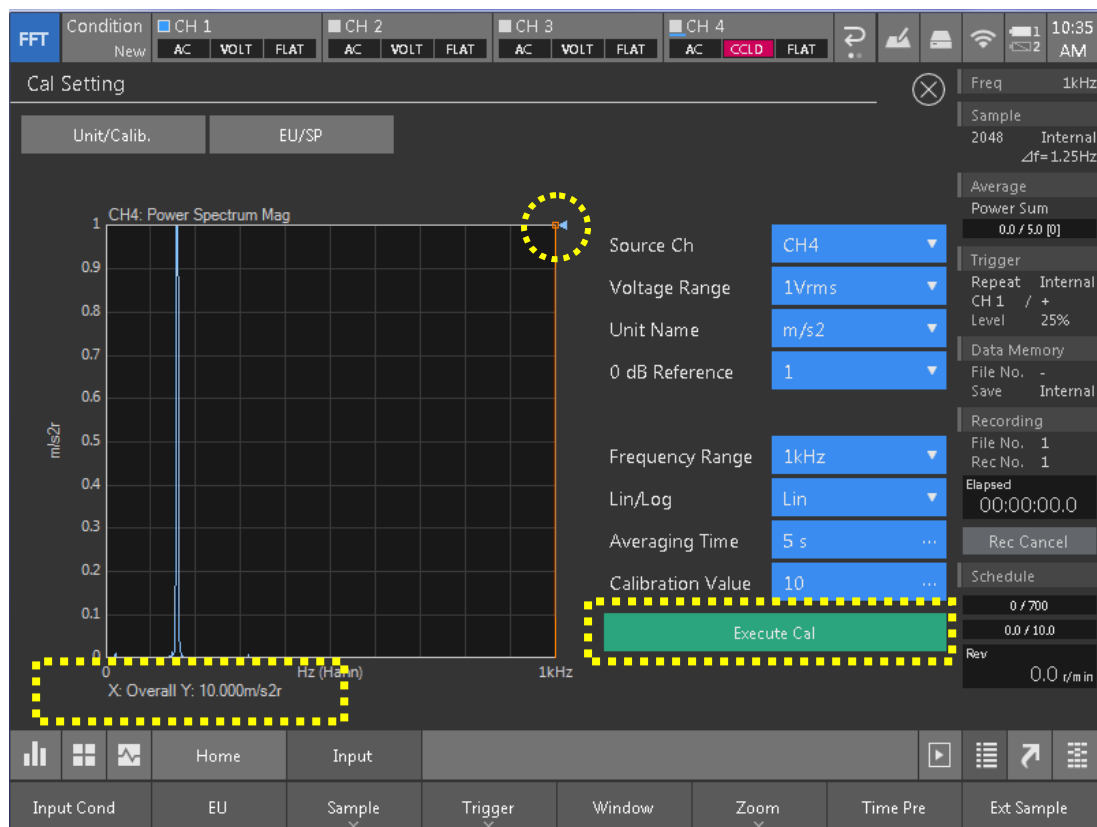
3) Mount an accelerometer on the "Accelerometer mount table" of the VX-1100.

4) Turn ON the power and start excitation.



5) When the power spectrum appears in the screen, touch [Execute Cal] to execute the calibration.

After the calibration, check that the value of Overall is displayed as " $10 \text{ m/s}^2$ " and exit.



【 for successful measurement 】

Amplitude of the VX-1100 contains the following errors.

Excitation acceleration :  $10 \text{ m/s}^2$  (rams)  $\pm 3 \%$

Excitation speed :  $10 \text{ mm/s}$  (rms)  $\pm 4 \%$

Excitation displacement :  $10 \mu\text{m}$  (rms)  $\pm 5 \%$

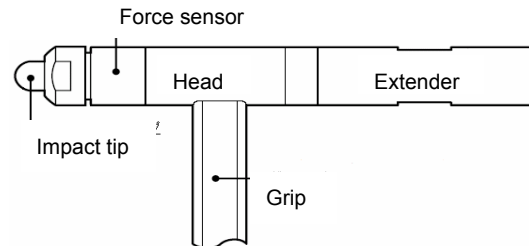
## [Appendix]

### 1. Structure and system of impulse hammer

Impulse hammer is the most simple excitation equipment. Excitation can be applied just simply hitting the target. It is used for multi-vibration analysis field from simple structure and easy-to-use. Vibration analysis by the impulse hammer is called "hammering test" or "impact test".

#### Force sensor is driven by constant current.

Force sensor is equipped to the hammer tip to detect the excitation force, and the excitation force (N (newton)) generated by impact is voltage outputted from the BNC connector in the grip end part.



Impact part (**impact tip**) is selectable according to the target.

**Extender** is the removable spindle (weight) to stabilize the excitation force by adding weight to impulse hammer head.

### 2. Impact tip

The preamplifier and force sensor are incorporated to the impulse hammer and the sensor is attached to the hammer head impact edge.

Various type of **impact tip** is available to be attached to the hammer impact edge. The tip gives an impact force to the sensor surface and protects the sensor from damage. **Excitation force and excitation band** can be adjusted by replacing a tip to that of the different rigidity.

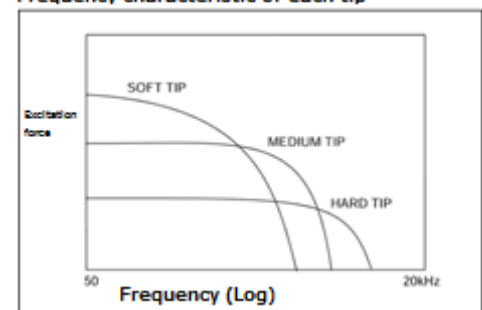


### 3. Characteristics and selection of the impact tip

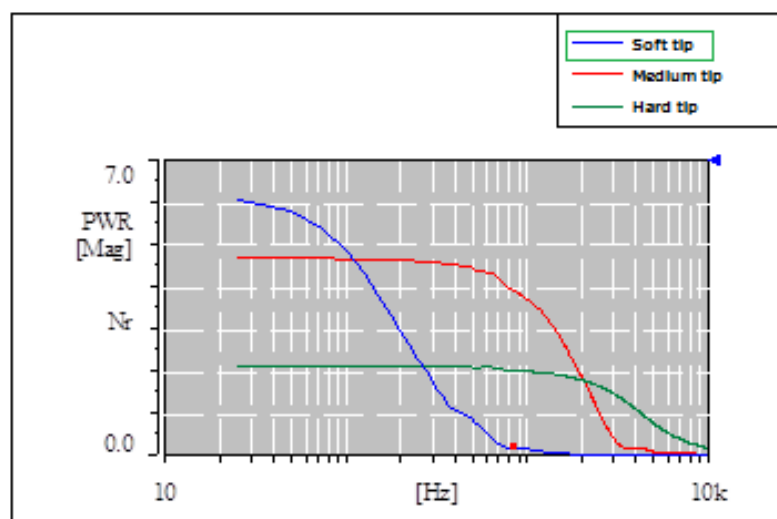
Adjustment of excitation force of impulse hammer is mainly operated by changing the tip.

Tip affects the frequency range of hammer impact. To perform high accuracy measurement, determine the frequency band you want to apply excitation, and select appropriate tip.

Frequency characteristic of each tip



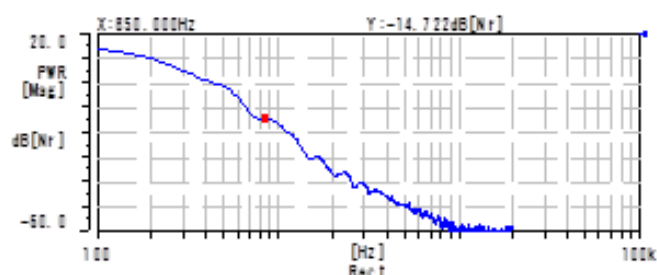
Actual measurement characteristics of accessory tip for the GK-3100 (reference value).



Soft tip

Approx. 620 Hz\*

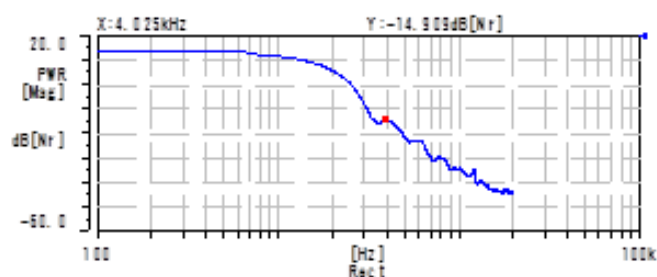
Soft tip 002.dat FILE(FFT)



Medium tip

Approx. 3 kHz\*

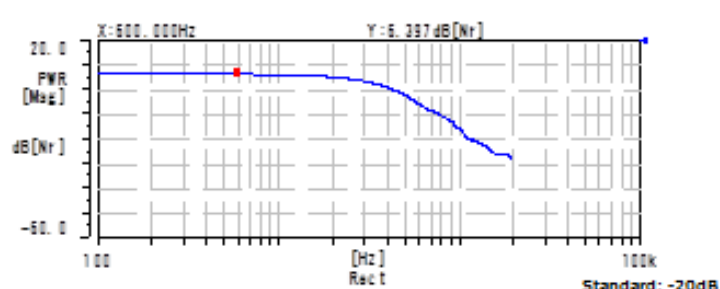
Medium tip 002.dat FILE(FFT)



Hard tip

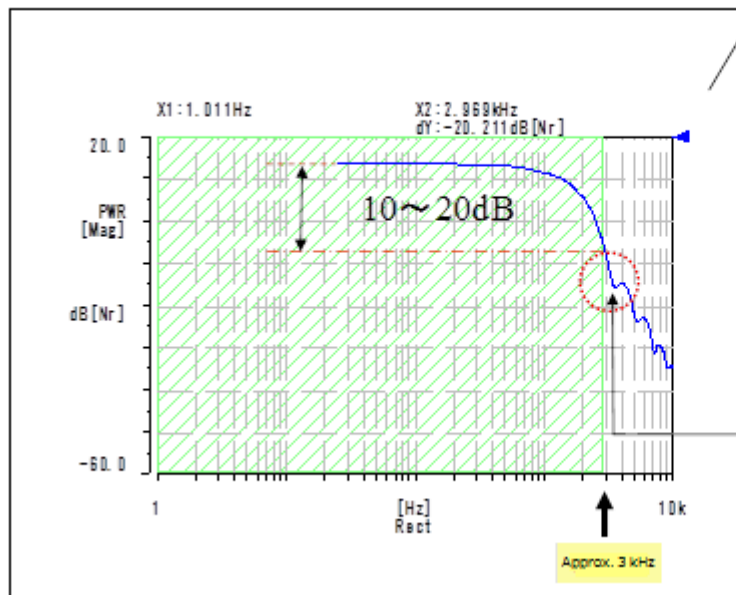
Approx. 9 kHz\*

Hard tip 002.dat FILE(FFT)



## Identify the effective excitation frequency.

Guideline of the effective excitation frequency is -10 to -20 dB from the maximum excitation force. Select the tip with the same guideline.



When medium tip is attached to the GK-3100, approx. 3 kHz is the upper limit of the excitation frequency.

Good SN ratio measurement is possible with the medium tip when the upper limit of excitation is approx. 3 kHz.

Zero-cross point:  
The point where the amplitude shows zero in general. Therefore, if the band is in close to this point, vibration excitation cannot be operated.

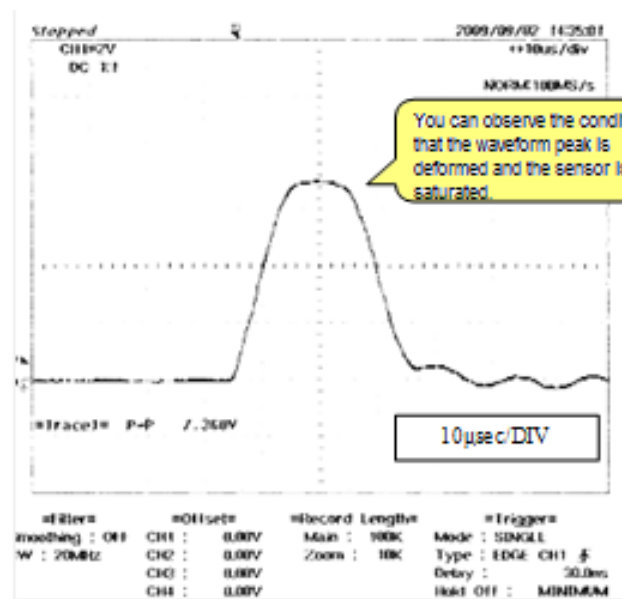
You can distinguish as the groove of the spectrum (dip)

## 4. Saturation of force sensor

When you operate hammering by giving an intentional force, the excitation force is increased and the enabled excitation band is extended. However, there is a possibility of the saturation of force sensor.

**The saturation of force sensor cannot be seen in the time-axis waveform** by the influence of the low sampling frequency of the FFT analyzer and internal filter. **When the force sensor is saturated, correct excitation force cannot be received.**

Please note that bad results can be obtained if you **operate hammering by giving an intentional force** to earn SN ratio.



Observing the sampling of 100 MHz by digital oscilloscope



## References

Akio Nagamatsu (1993) Introduction of mode analysis, CORONA PUBLISHING CO.,LTD

Makoto Kurabe (1998) Illustration introduction of mode analysis, Taiga publishing

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