

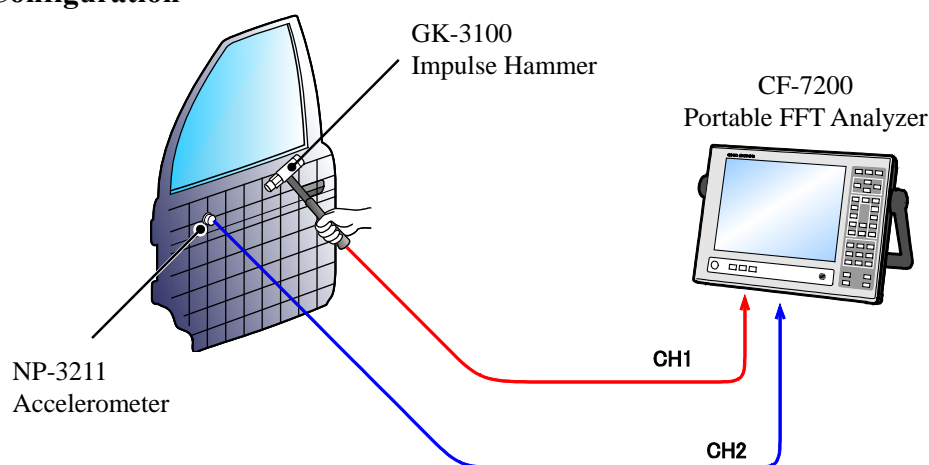
Portable FFT Analyzer Model CF-7200

Procedures to measure the frequency response function using an impact test

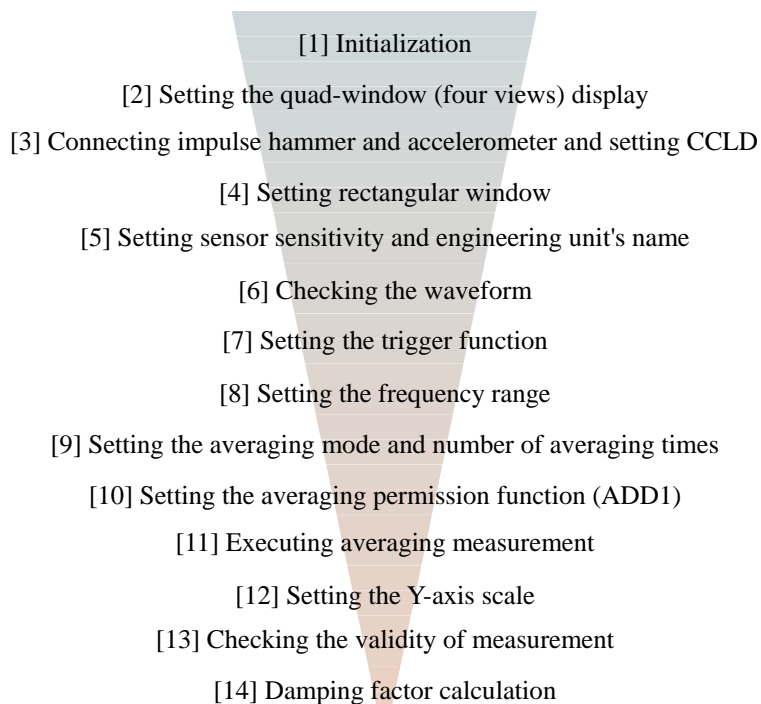
This document describes the operation procedures to obtain the frequency response function and the damping factor, using the half-power bandwidth method. In this method, the GK-3100 impulse hammer and NP-3211 accelerometer are directly connected to the CF-7200 analyzer, where the impact waveform and the response waveform are monitored using the quad-window display of the analyzer.

Throughout this document, the name of any soft key on the screen will be presented in square brackets (e.g., [MAIN]), and the name of any operation button on the panel will be enclosed by single quotation marks (e.g., 'START'). In the text, "key" means a soft key on the screen and "button" means an operation button on the panel. Note that the operation to press the 'OK' or 'CLOSE' button after setting some parameter is omitted here.

■ System Configuration



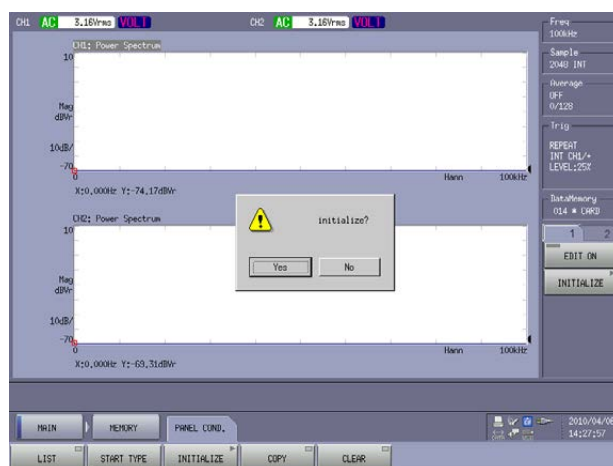
■ Operation Flow



■ Operation Procedures

1. Initialization

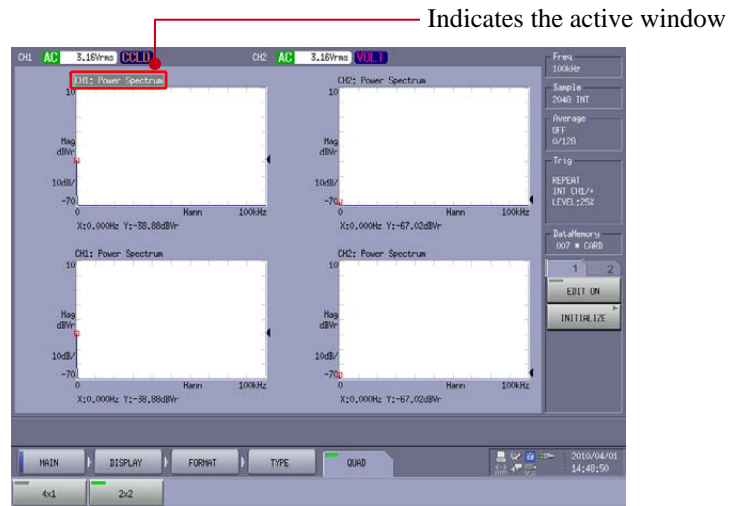
- 1. Reset the analyzer to the default conditions as it was when shipped from the factory.
Press the soft keys in the order [MAIN], [MEMORY], [PANEL COND], and [INITIALIZE].
When the "Yes No" screen is displayed, press "Yes". After a while, the screen will be set up in the default configuration and the data will be displayed.



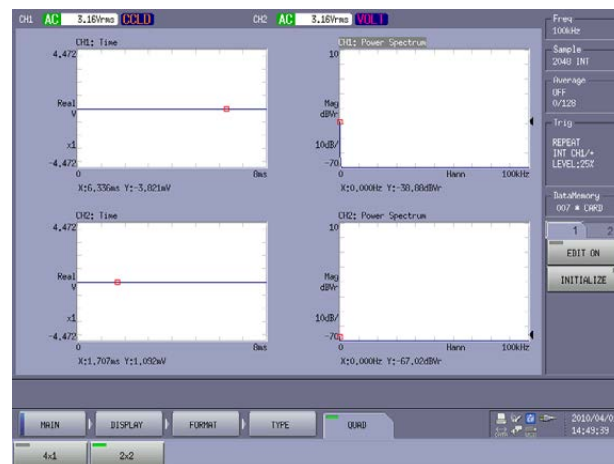
- 2. Press the 'START' button on the operation panel to set it in the measuring mode. The lamp on the button will turn on. When any setting is changed, the screen will be promptly updated, making it easier to check the results of the setting.

2. Setting the quad-window (four views) display

- 1. Press the keys in the order [MAIN]> [DISPLAY]> [FORMAT]> [TYPE]> [QUAD]> [2x2] to view the quad- window display.
- 2. Touch inside the upper left window of the screen to make it active. As shown in the figure below, the title of the window "CH1: Power Spectrum" will be shown in white characters on black background.

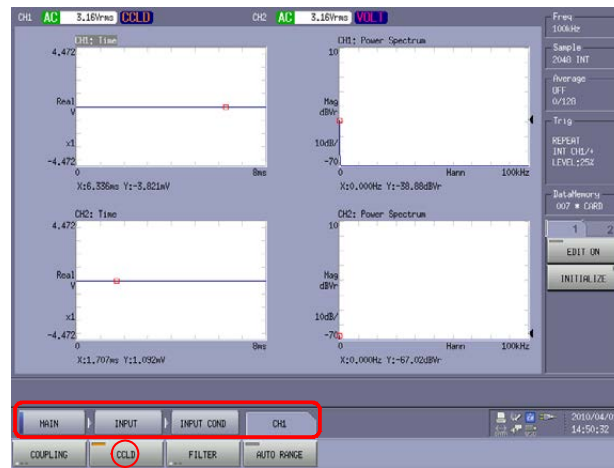


- 3. Press the 'CH1 Time' button on the operation panel. The "CH1: Time" waveform will be shown.
- 4. Similarly, set up the four windows to display "CH1: Time", "CH1: Spectrum", "CH2: Time", and "CH2: Spectrum" as shown in the figure below.



3. Connecting impulse hammer and accelerometer and setting CCLD

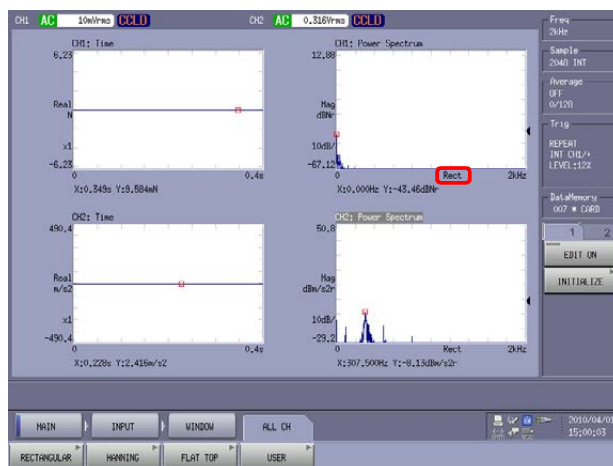
- 1. Connect the impulse hammer to CH1 and accelerometer to CH2 of CF-7200.
- 2. Press the keys in the order [MAIN]> [INPUT]> [INPUT COND]> [CH1]> [CCLD] to set the input condition for CH1 to "CCLD".



- 3. Similarly, set the input condition for CH2 to "CCLD". Press the keys in the order [MAIN], [INPUT], [INPUT COND], [CH2], and [CCLD] to turn it on.

4. Setting the rectangular window

- 1. Press the keys in the order [MAIN]> [INPUT]> [WINDOW]> [ALL CH]> [RECTANGULAR] to turn it on. On the bottom of the active window, "Rect" will be shown.



5. Setting sensor sensitivity and engineering unit's name

- 1. Setting the sensor sensitivity and engineering unit for the impulse hammer GK-3100
 - ① Find the sensor sensitivity by checking the calibration certificate attached to the impulse hammer.
 - Sensitivity of the impulse hammer GK-3100 (without an extender): 2.27 mV/N

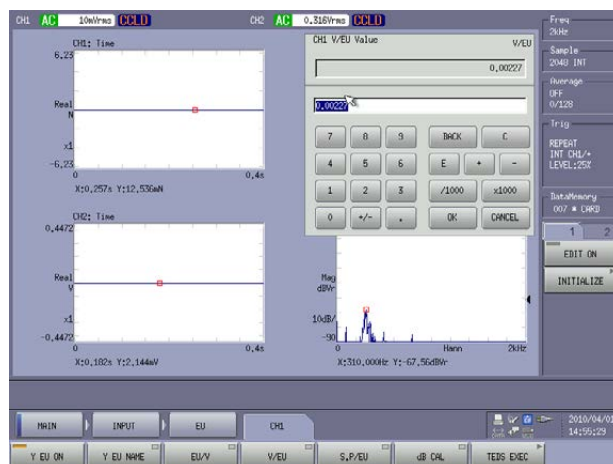
HAMMER SENSITIVITY:

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

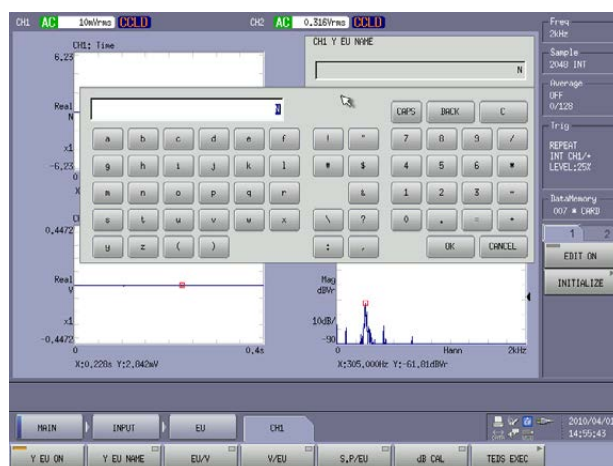
Above data is valid for all supplied tips.

- ② Press the keys in the order [MAIN]> [INPUT]> [EU]> [CH1]> [Y EU ON] to turn it on. This operation enables the engineering unit calibration function, and the values set in the following steps ③ and ④ will be reflected at once.

- ③ Press the keys in the order [MAIN]> [INPUT]> [EU]> [CH1]> [V/EU] to turn it on. In the "CH1 V/EU Value" dialog box displayed, use the keypad to enter "0.00227" as the sensitivity.



- ④ Press the keys in the order [MAIN]> [INPUT]> [CH1]> [Y EU NAME] to turn it on. In the "CH1 Y EU NAME" dialog box displayed, use the keyboard to enter "N" as the engineering unit.

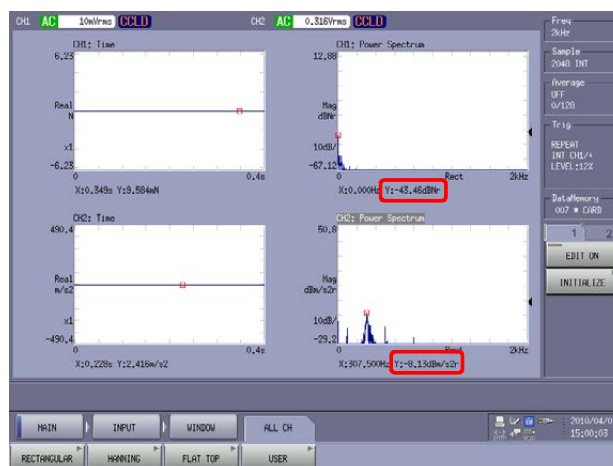


-2. Setting the sensor sensitivity and engineering unit for the accelerometer NP-3211

- ① Find the sensor sensitivity by checking the calibration certificate attached to the accelerometer.
- Sensitivity of the acceleration detector NP-3211: 0.912 mV/m/s^2

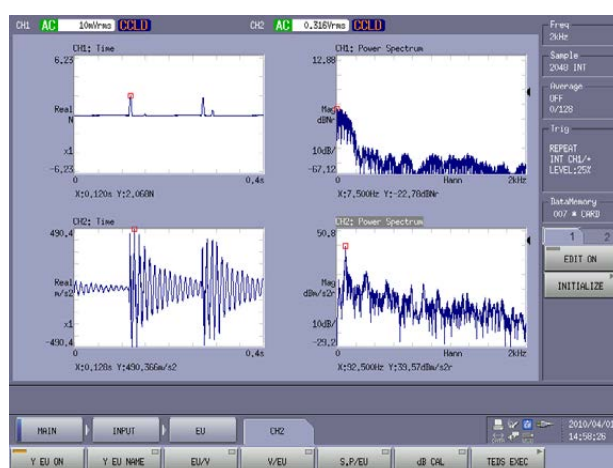
~ Calibration Certificate ~			ONO SOKKI	
			Per ISO 16063-21	
Model Number:	NP-3211			
Serial Number:	P62189			
Description:	Piezoelectric Accelerometer		Method:	Back-to-Back Comparison Calibration
Calibration Data				
Sensitivity @ 159.2 Hz	0.912	mV/ms ²	Output Bias	10.1 VDC
			Transverse Sensitivity	2.2 %

- ② Press the keys in the order [MAIN]> [INPUT]> [EU]> [CH2]> [Y EU ON] to turn it on. This operation enables the engineering unit calibration function, and the values set in the following steps ③ and ④ will be reflected at once.
- ③ Press the keys in the order [MAIN], [INPUT], [EU], [CH2], and [V/EU] to turn it on. In the "CH2 V/EU Value" dialog box displayed, use the keypad to enter "0.00912" as the sensitivity.
- ④ Press the keys in the order [MAIN], [INPUT], [CH2], and [Y EU NAME] to turn it on. In the "CH2 Y EU NAME" dialog box displayed, use the keyboard to enter "m/s²" as the engineering unit. Note that no superscript can be used such as "m/s²".



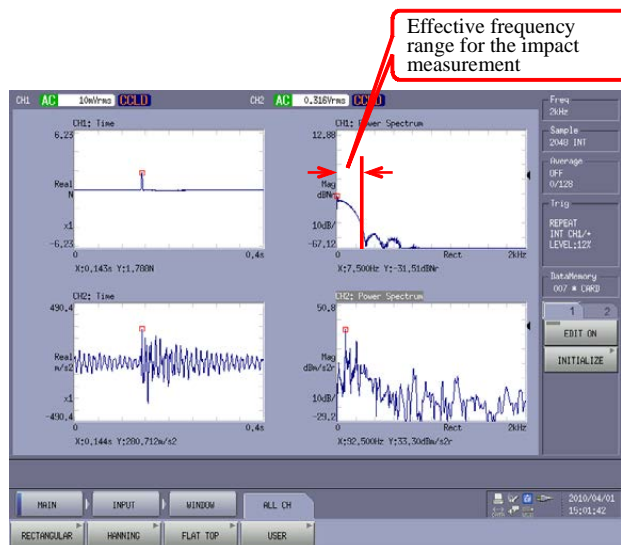
6. Checking the waveform

- 1. Temporarily set the voltage range to 10mV and frequency range to 2 kHz.
- 2. Set the voltage range properly such that the waveform voltage will not exceed the range by observing the CH 1 and CH 2 waveforms while repetitively hitting the target object using the impulse hammer GK-3100.



- 3. Similarly, by changing the frequency range from 20 kHz to 1 kHz, i.e., from higher to lower frequencies, determine the approximate natural frequency and the frequency range in which the spectrum of the impact is effectively covered. After that, set the optimum frequency range. In the case of the figure below, the range up to the first dip of the CH1 spectrum is considered the effective frequency range of the impact. The excitation force at and above this frequency is

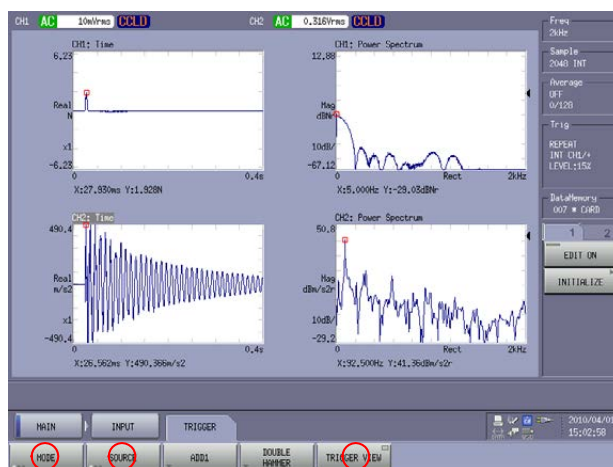
relatively low, and is considered insufficient. This range (bandwidth) is determined by the steepness of the impact waveform. If the target object is harder, the waveform can be steeper, and thus up to a higher frequency can be used.



7. Setting the trigger function

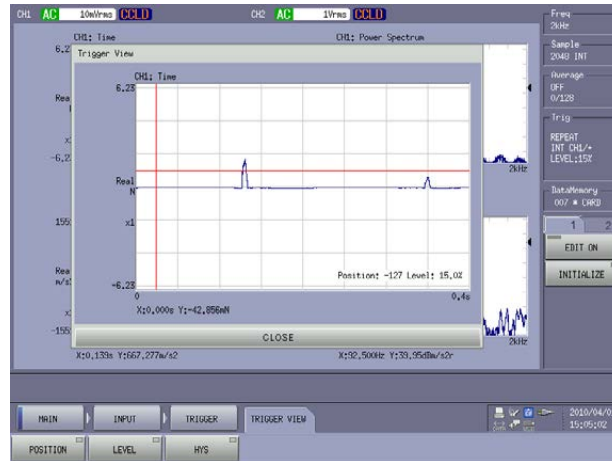
Here, it is set to use the CH1 waveform as the trigger signal for the display of the impact waveform.

- 1. Press the 'STOP' button on the operation panel at a proper timing to show the impact waveform on the screen.
- 2. Press the keys in the order [MAIN]> [INPUT]> [TRIGGER] to set various parameters of the trigger function.

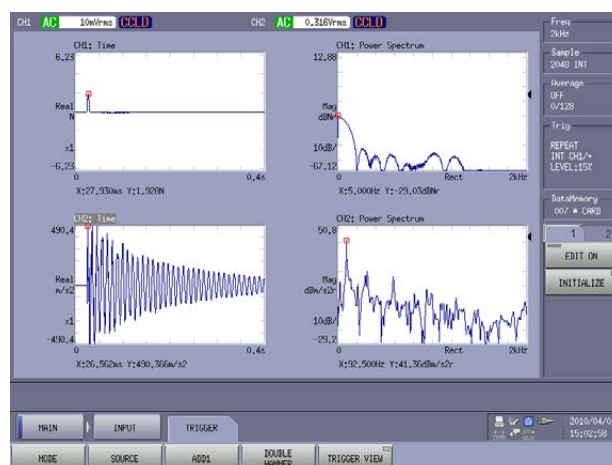


- ① Press the keys in the order [MAIN]> [INPUT]> [TRIGGER]> [SOURCE]> [MODE]> [REPEAT] to enable the "repeat trigger" function. (Note that the "REPEAT" function is enabled in the default setting, and thus this operation is unnecessary.)

- ② Press the keys in the order [MAIN]> [INPUT]> [TRIGGER]> [SOURCE]> [INT]> [SOURCE]> [CH1] to turn it on.
- ③ Press the keys in the order [MAIN]> [INPUT]> [TRIGGER]> [TRIGGER VIEW]. The "Trigger View" window will open.



- ④ Touching on the "Trigger View" window shows vertical and horizontal red lines. Repeat applying the impact and adjust the lines such that the peak waveform exceeds the horizontal red line and the vertical line is placed approximately at the left side position shown in the figure.
- 3. Turn on the 'TRIG ON' button.
 - 4. Turn on the 'START' button (The lamp turns on).
 - 5. Run GK-3100 to give the impact once. Check that the trigger is activated and the waveform is displayed as shown below. After waiting for a while, give the next impact to check the result again. Repeat this operation for several times.



In the case of the above shown data, judging from the CH1 power spectrum, the effective frequency range for the measurement is considered up to 200 Hz, which is the first dip frequency in the spectrum. The frequency components higher than this point are at the noise level due the insufficient excitation force. Note that the peak power spectrum of CH2 is a candidate for the resonant frequency.

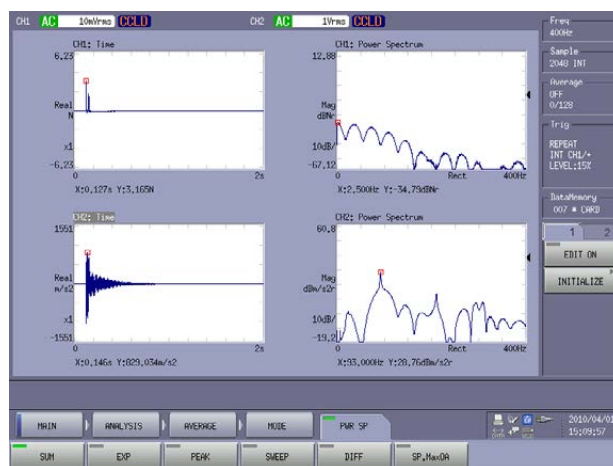
8. Setting the frequency range

Here, the analysis frequency range is set by referring to the effective frequency range determined from the CH1 power spectrum in Step 7. At this time, check that the CH2 decay waveform over time is sufficiently attenuated in the right end area of the waveform window. The analysis frequency range is set to 400 Hz here, because setting a too narrow analysis range might excessively reduce the CH2 power spectrum.

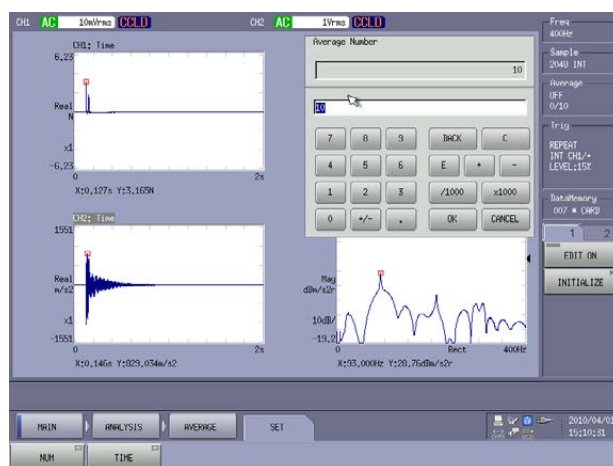
Changing the frequency range automatically changes the cut off frequency of the low pass filter accordingly. Due to this effect, the amplitude of the impulse waveform may be reduced, and thus it may be required to adjust the trigger level again (Step 9).

9. Setting the averaging mode and number of averaging times

- 1. Select the keys in the order [MAIN]> [ANALYSIS]> [AVERAGE]> [MODE]> [PWR SP]> [SUM]. The averaging mode is enabled.



- 2. Select the keys in the order [MAIN]> [ANALYSIS]> [AVERAGE]> [SET]> [NUM]. The "Average Number" dialog box appears. Here, set "10" as the number of averaging times.



Note: Double hammering

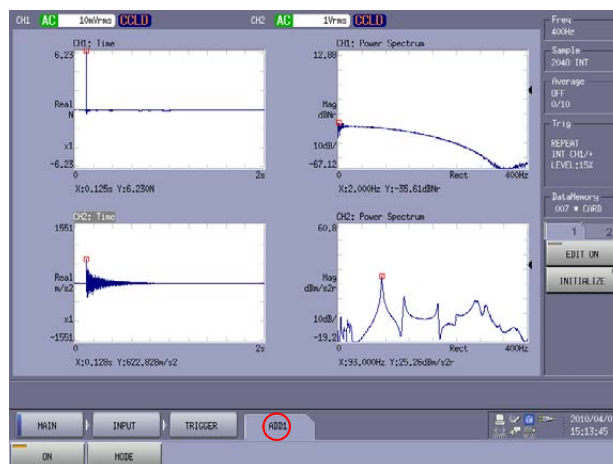
When an impulse hammer is used, any occurrence of double hammering as shown in the figure below can reduce the accuracy of the measurement. Be careful not to cause double hammering. To avoid double hammering, it is necessary for the operator to become accustomed to the hitting operation.

(Example) Time waveform and spectrum in the case of double hammering



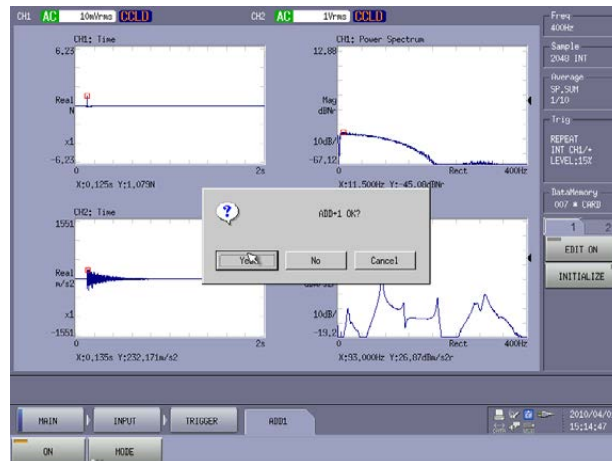
10. Setting the averaging permission function (ADD1)

To enable the averaging permission function (ADD+1) which performs the averaging by checking the waveform, press the keys in the order [MAIN]> [INPUT]> [TRIGGER]> [ADD1] to turn it on.

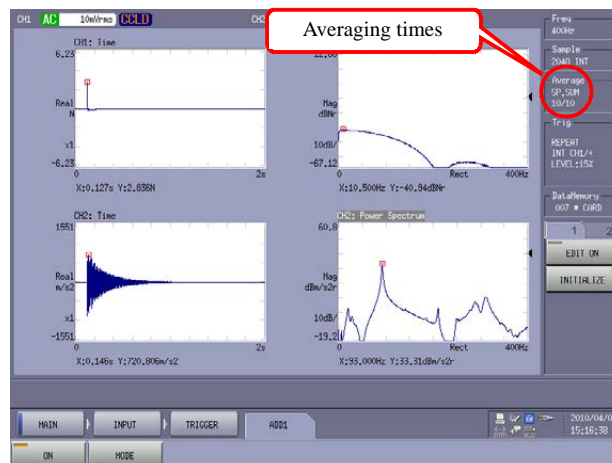


11. Executing averaging measurement

- 1. After pressing the 'STOP' button on the operation panel to stop the measurement, press and turn on the 'AVR' button.
- 2. Press the 'START' button on the operation panel.
- 3. Use the impulse hammer to produce an impact. When the trigger is invoked, measurement is made, and the display is updated, the "ADD+1 OK?" message will appear.

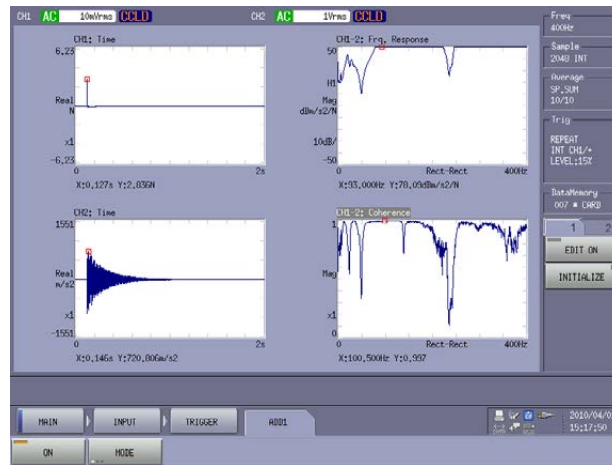


- 4. If the measured data is not suitable due to any double hammering, press the "Cancel" key. If the data is fine, press the "Yes" key. Then, averaging is performed and the resulting data is displayed. When it reaches the number of averaging times set (10 times in the following example), the process will stop automatically. You can also stop the averaging process by pressing the 'STOP' button if it is determined that the data will not significantly change after some averaging has been done.



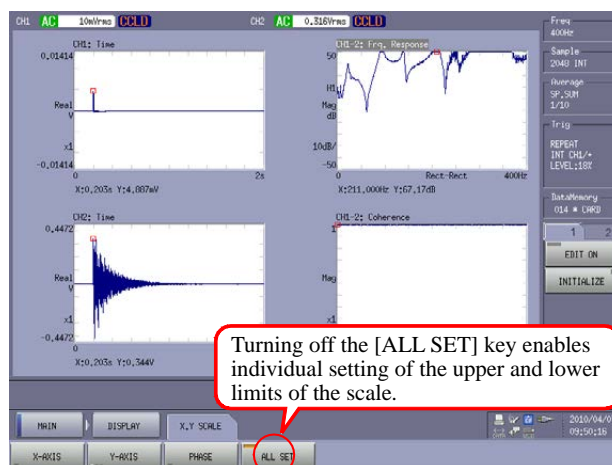
- 5. Touch on the top right window to make it active, and press the 'FRF' button on the operation panel. The frequency response function will be displayed.

- 6. Similarly, touch on the bottom right window to make it active, and press the 'COH' button on the operation panel. The coherence function will be displayed.



12. Setting the Y-axis scale

- 1. Press the keys in the order [MAIN]> [DISPLAY]> [X.Y SCALE]> [ALL SET] to turn off the [ALL SET] key. By turning off the [ALL SET] key, individual setting of the windows becomes possible.

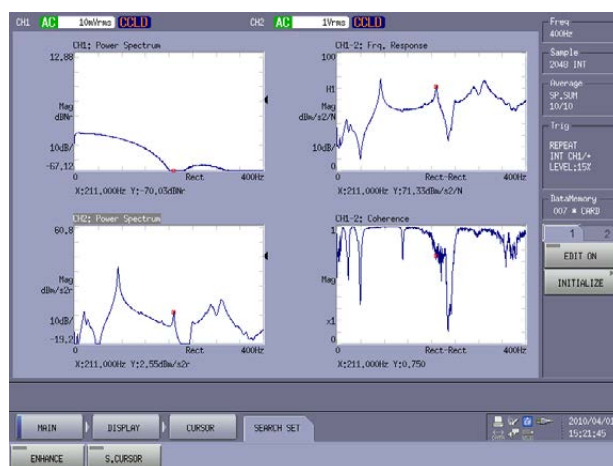


- 2. Select the keys in the order [MAIN]> [DISPLAY]> [X.Y SCALE]> [Y-AXIS]> [MANUAL]> [UP SCALE] (or [LOW SCALE]). You can freely set the upper and lower limit values for the Y-axis of the active window.

Note that in Step 12-1, the frequency response function shown in the top right window is saturated at the top as shown. Accordingly, the FRF scale is changed to the range of 0 to 100 taking into account the peak value. (Refer to the Y-axis scale values of the top right window for the frequency response function in Step 13.) Also note that the setting has been changed to show the spectrum of CH1 and CH2 on the right side windows.

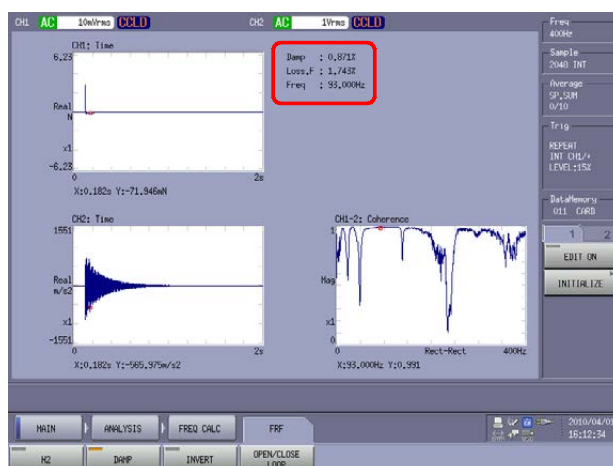
13. Checking the validity of measurement

The data is valid for the first peak frequency of the frequency response function as COH is 0.995 and the CH1 spectrum is within the effective frequency range. However, as the frequency range from the second peak and the above has very low CH1 spectrum level and the spectrum is near the noise floor, the data cannot be determined to be valid for the measurement environment. If it is desired to extend the measurement to higher frequencies, other measurement methods such as the use of a vibration generator will be required.



14. Damping factor calculation

- 1. Place the search cursor at the peak frequency. It is convenient to turn off the 'SEARCH' button as it will then show the peak automatically.
- 2. Press the keys in the order [MAIN]> [ANALYSIS]> [FREQ CALC]> [FRF]> [DAMP]. The calculation results, i.e., the damping factor (Damp, in %), loss factor (Loss F), and resonant frequency (Freq) will be shown on the right side of the window.



<End>
(2009/04/19)