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DS-0321 FFT Analysis Software

DS-0371(DS-0372, DS-0373)
Sine sweep frequency measurement using signal output

Operation Manual

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Sine sweep frequency measurement using signal output

The general method to measure the natural oscillation frequency is to perform sine sweep excitation by the exciter and measure the frequency response function. Also, the sine sweep signal is used as the input signal for frequency character measurement of the filter circuit. The same operation is used for both measurements.

Power SP sweep function of the averaging function is used for the sine sweep measurement. When the DS-0371 (DS-0372, DS-0373) signal output (option) is used, the sine sweep is output synchronously with analysis. It becomes appropriate measurement and enables data averaging.

This manual explains the operation procedure of CR circuit low-pass filter measurement as an example using the signal output (DS-0371 (DS-0372, DS-0373)).

In this manual, file menu operation is mentioned in [ ] as [File] > [New Project] in the following explanation. OK button operation is omitted in here for the DS-0321 standard operation.
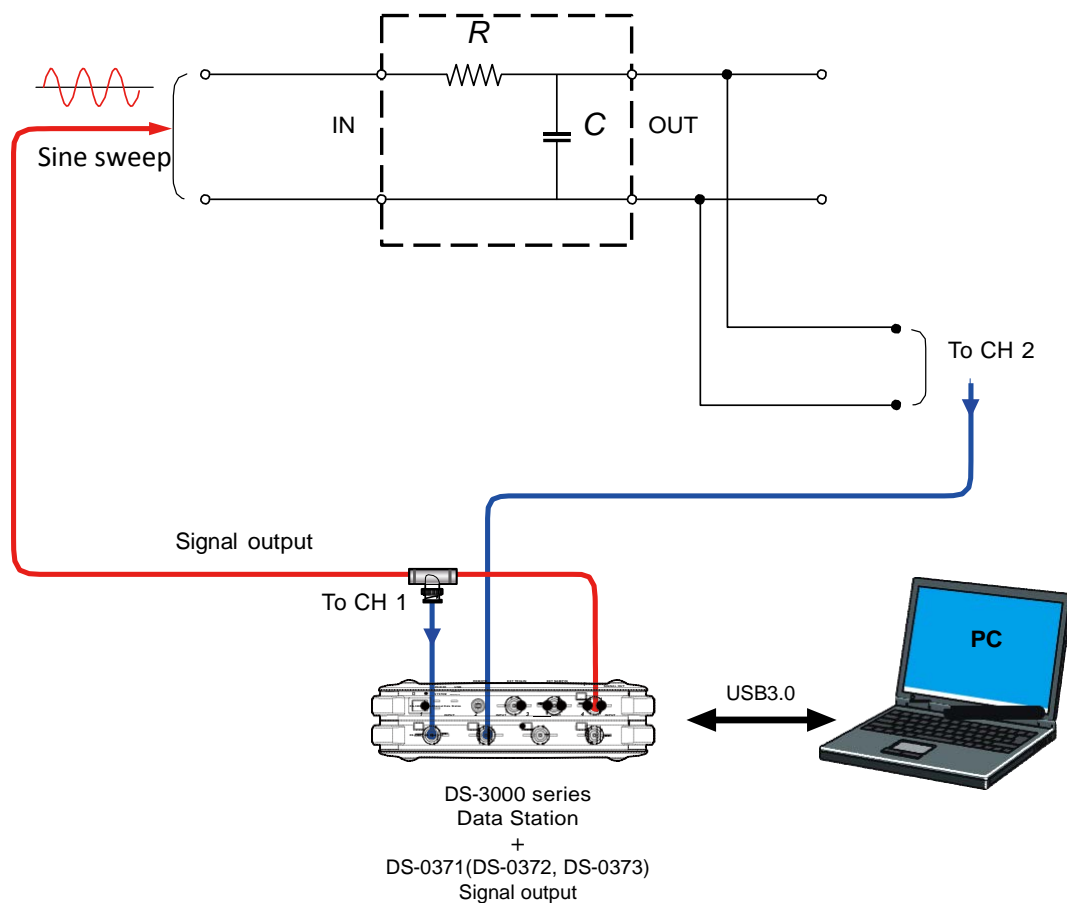
■ Connecting example 1

Figure1： Connecting example of low pass filter characteristic measurement of CR circuit

■ Operation procedure

1. Open [File] > [New project] from the menu.

2. Press the [START] button to change the condition to measurement in progress state.

3. Set the voltage range and frequency range according to the signal. Setting in here: Voltage range= 1Vrms, Frequency range= 20 kHz (Changing setting is required according to the target object)

4. Select [Input/ Output setting] > [Window function setting] in the menu to open the "Window (window function) setting" dialog box and set CH1 and CH2 to "Rectangular".
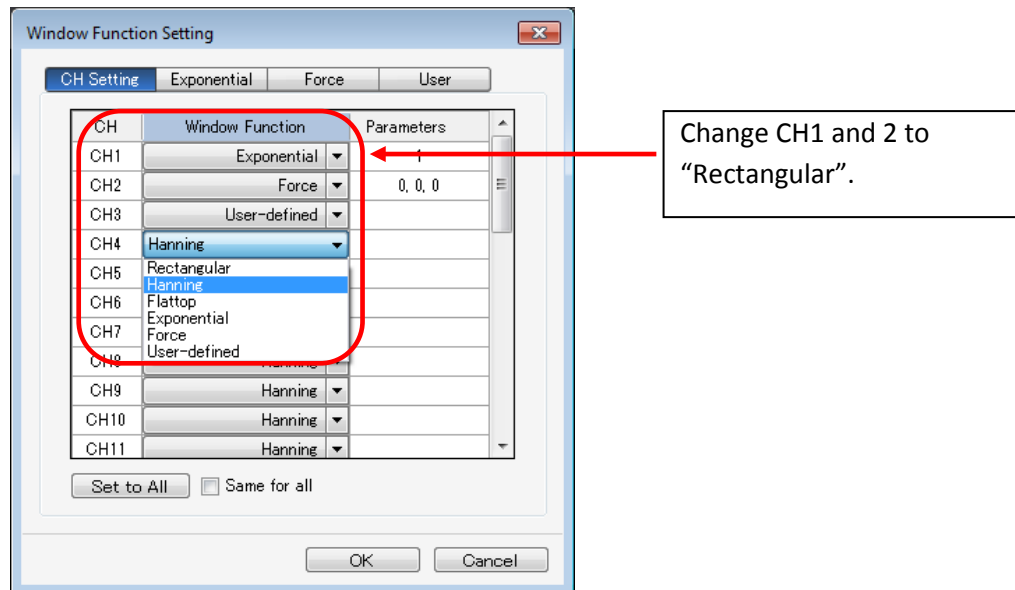

Figure 3：Window Function Setting

5. Stop the measurement by pressing the [STOP] button.

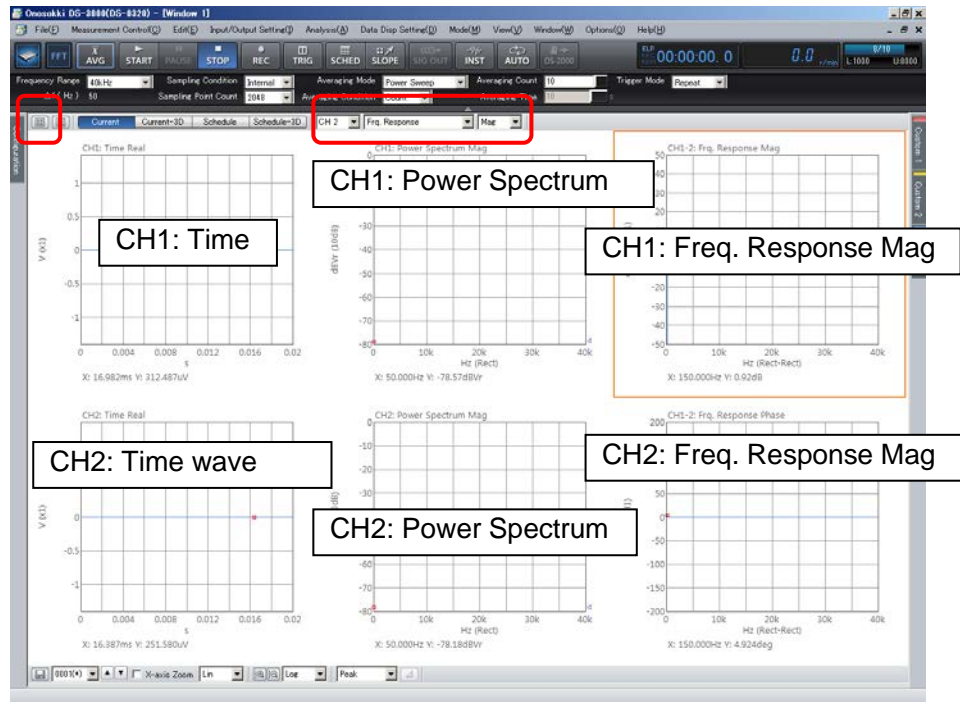6. Change the screen layout to 2 x 3. Select the CH and data type to be displayed.

Figure 4: Measurement screen

7. Select [Input/ Output Setting] > [Sig Output Setting] in the menu to open the "Sig Output Setting" dialog, then set the [Sig Output Mode Setting] to [Sweep Ave Sig Output].Set the start frequency, stop frequency, amplitude, and DC offset. Set the frequency range to 40 kHz, Start frequency to 0 Hz, Stop frequency to 40,000 Hz and Amplitude to 1V. (Sample frequency is determined by the frequency resolution which is decided by the sample point. In here, the sample point is set as 2048 points, so start frequency is 50 Hz. Calculate with ⌀f 50 Hz.)
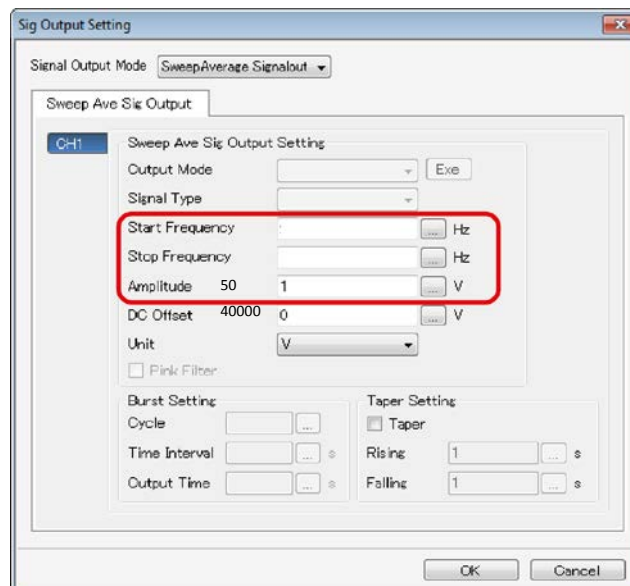

Figure 5：Setting screen of the signal output

8. Set the sweep channel and number of averaging processing.
   ① Select [Input/ Output Setting] > [Averaging Setting] from the menu and set [Averaging setting: Power SP Sweep], [Averaging Count: 2] and [Sweep CH: CH1].

Figure 6: Averaging Setting screen

Click the [AVG] button to start the measurement. At this time, the signal output is started as well. When the sweep is reached to the selected upper limit, the measurement is automatically stopped. Measurement is able to stop manually by clicking [STOP] button.
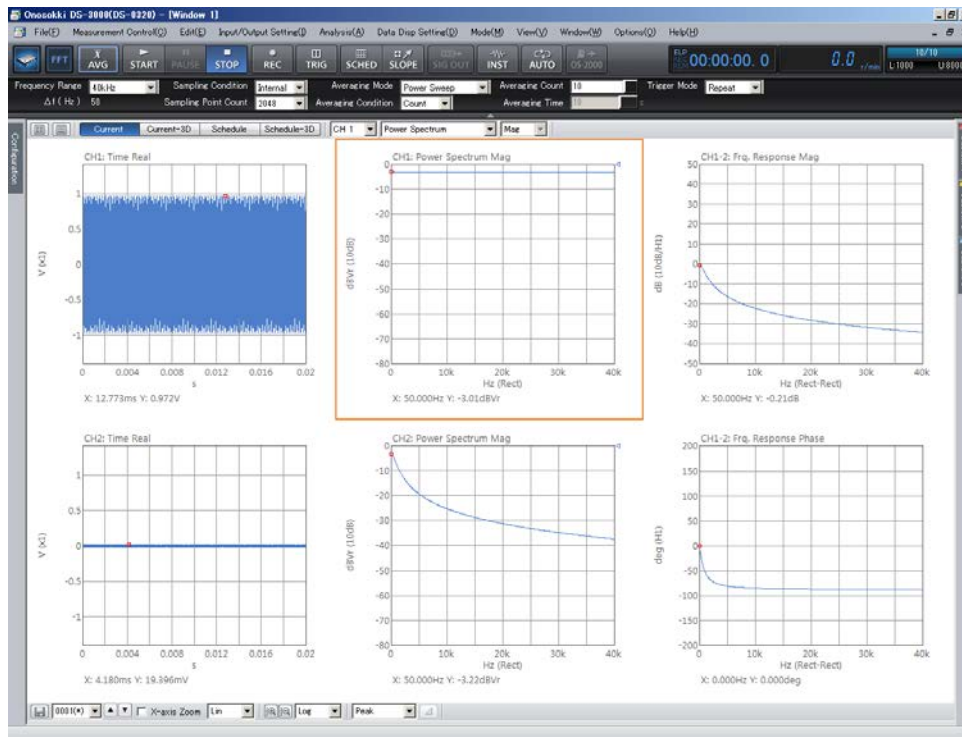
<Measurement result screen (measurement in progress)>

<After measurement>
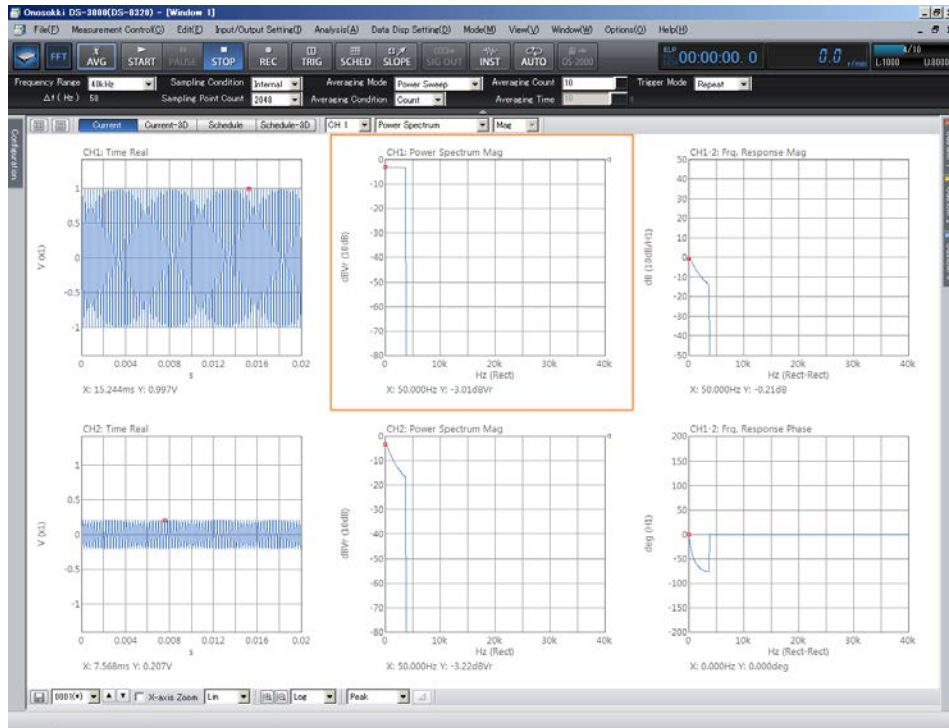
Figure 7: Measurement screen

9. Set the X-axis to Log scale.

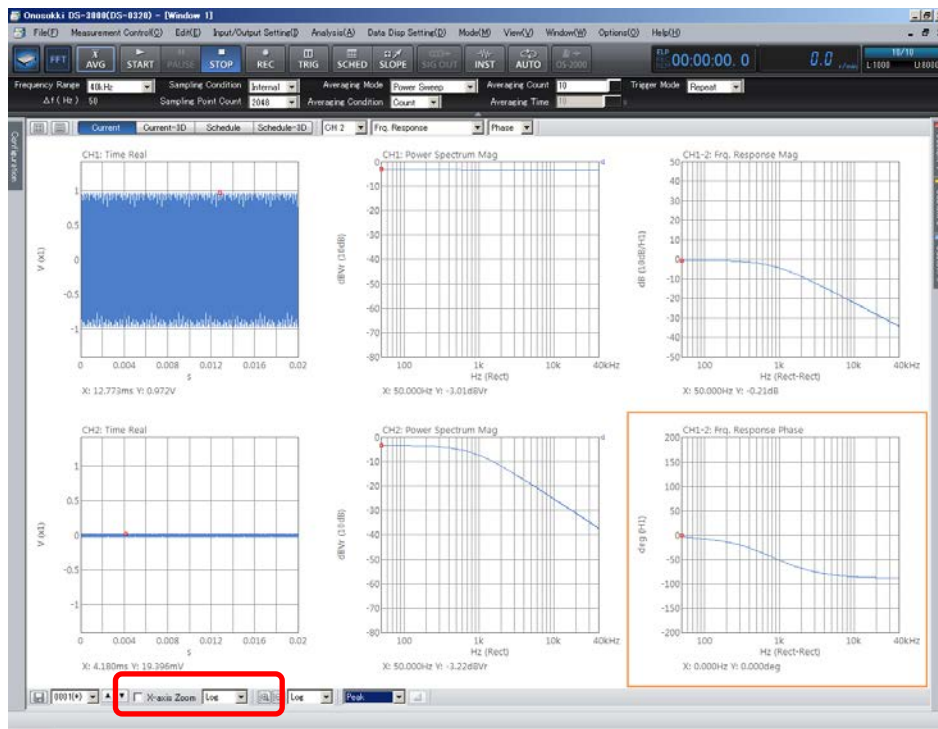   ①   Change the X-axis setting in the lower part of the screen, from [Lin] to [Log].

Figure 8: Measurement screen
Set the X-axis to Log scale

10.   Set the cursor to frequency response function -3 dB (Attenuated point in 1/√2 times with voltage value) to see the cutoff frequency. When the frequency response function is -3 dB, the phase becomes -45 degrees.
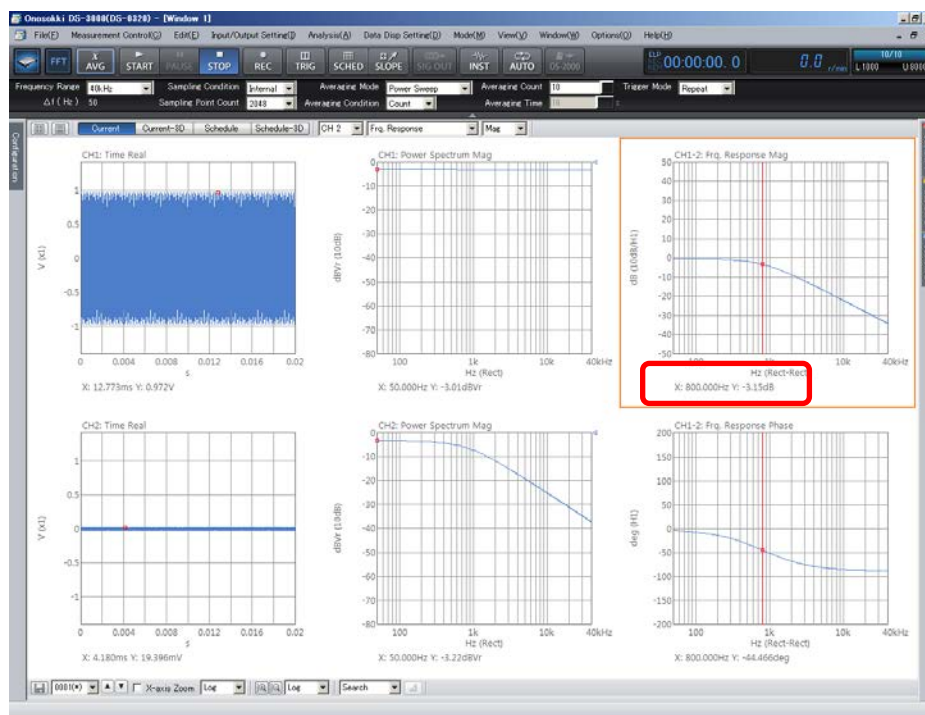

Figure 9: Measurement screen
Set a cursor on the -3 dB

To increase the frequency resolution (Zoom function)

The increase of the frequency resolution is required when you measure the range which is close to cutoff frequency or resonance frequency. There are two methods to increase the frequency resolution.

- Change the sampling frequency into large value (example: 2048 →4096).

- Sweep measurement using the zoom function

Either way, you need more time for measurement. A measure such as reducing the measurement range is required.

In here, we are using zoom measurement of ±1,000 Hz centered at 1,200 Hz as an example. When the sample number is 2048, it is expected that the frequency resolution will be swept at 1,200 Hz ± 1,000 Hz with 800 equal divisions, but there are restrictions on the setting.

① Select [Input/ Output Setting] > [Frequency Range Setting] from the menu and set the zoom setting in the configuration. Set [Frequency Span: 2 kHz (±1,000 Hz)] at first and then input [Center Frequency: 1,200 Hz]. This is because the zoom magnification is determined by the setting of the center frequency and frequency span, and because there is a constraint on the frequency resolution after zooming, the value is automatically changed and set close to the inputted value.
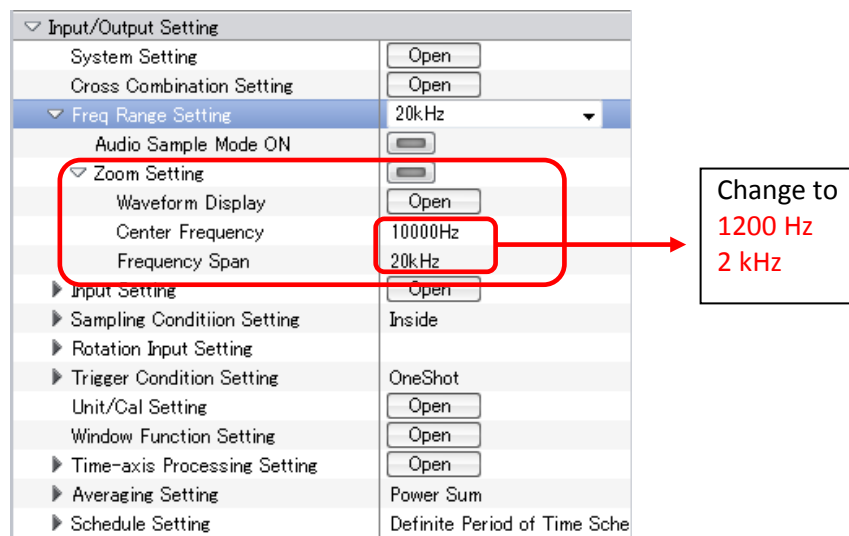

Figure 10: Zoom setting screen

② Select [Input/ Output Setting] > [Signal Output setting] from the menu and select the output mode to [Sweep Average Signal Output]. The setting of the Start Frequency is 220 Hz and Stop frequency is 2,200 Hz. The value is automatically reflected.
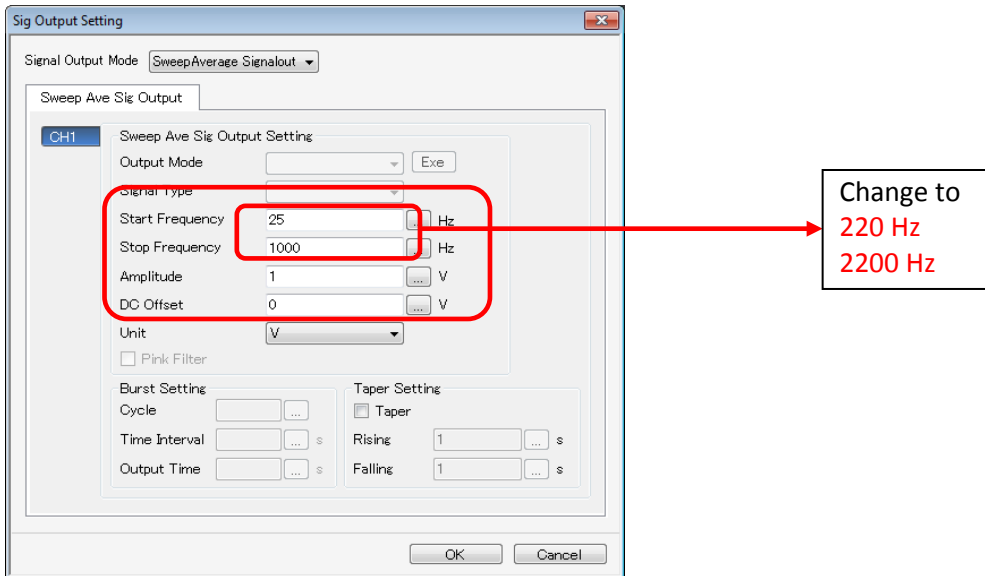

Figure 11: Signal Output Setting screen

③ Start measurement by turning ON the [AVG] button. The following figure shows the result of zoom measurement. The cutoff frequency can be read properly. ⊿f is 2.5 Hz.
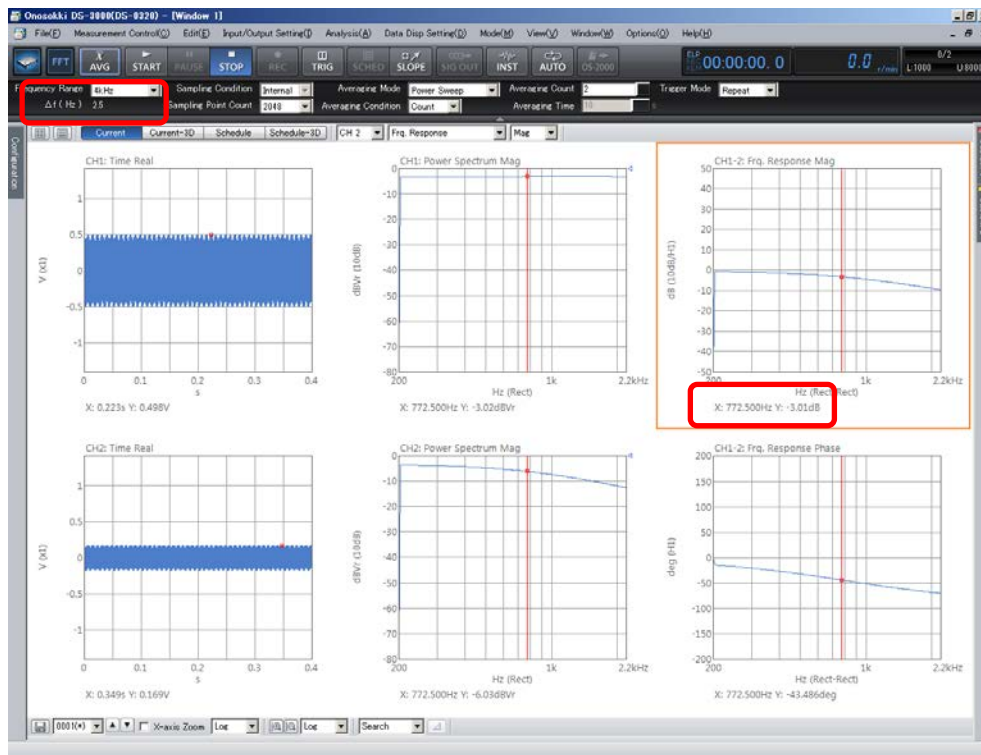

Figure12: Measurement screen / Zoom measurement result

■Supplement

1. Sine sweep frequency

The sine sweep frequency is swept by the frequency which is according to the frequency resolution of the FFT.

In this example, the range is 20 kHz, and number of samples is 2048;

Frequency resolution: $\Delta f = 20$ kHz $\div (2048 \div 2.56) = 25$ Hz

So, the swept frequency is determined as 25 Hz interval, such as 25 Hz > 50Hz > 75 Hz ….> 20 kHz.

Also, the frequency is maintained up to 2048 times of sampling points. Furthermore, the frequency is maintained until the averaging is processed twice when the number of averaging is set to two times. (The averaging setting has a connection to the [Overlap amount] setting which can be set by pressing in the order [Input] > [Sampling condition set] > [Overlap amount] on the menu.) When the sweep signal is not connected to the analysis, the frequency is changed while measuring up to 2048 sampling points. However, there is the advantage of making an appropriate measurement using the signal output of DS-0371 (DS-0372, DS-0373), and the frequency is maintained according to the analysis.

2. Power SP sweep function (Averaging processing setting)

There are two types of power SP sweep function (Averaging processing setting) on the DS-0321.

Measurement method for the internal synchronization

> How to use the signal which outputs from the FFT Analyzer (DS-3000 series)
> The measurement method using the input CH which is connected to the signal output of the FFT Analyzer as a reference. The frequency which is outputted by the FFT Analyzer is known value, so FRF (frequency response value) of this point is measured. It is not necessary to set the sweep CH in this point. Set the signal output mode as [Sweep average signal output].
> (Point)・The rectangular window function is recommended.

Measurement method by the external signal

> How to use the signal from the external equipment such as exciter or the sensor as a sweep signal
> The method of not using the signal output of the FFT Analyzer. (Connection example is shown in the following.)
> The FFT Analyzer is not able to recognize which frequency is swept or not, so it is necessary to select the swept channel in the external mode. The FFT Analyzer measures the FRF of the search point which is the max. value of power spectrum at the selected CH. Set the signal output mode as [Waveform output].
> (Point)・The signal from the swept channel must be outputted continuously in the measurement frequency range. If the signal is smaller than the noise component, the appropriate sweep cannot be performed.
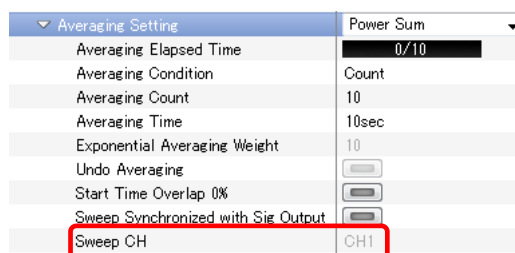> ・Set the window function as the hanning.

Averaging Setting	Power Sum ▼
Averaging Elapsed Time	0/10
Averaging Condition	Count
Averaging Count	10
Averaging Time	10sec
Exponential Averaging Weight	10
Undo Averaging	
Start Time Overlap 0%	
Sweep Synchronized with Sig Output	
Sweep CH	CH1

Figure 13: Averaging processing setting screen

Connection example： Measuring the vibration frequency characteristics by using the exciter

Select the CH1 signal as [Sweep signal] to perform sweep averaging processing.

The sweep may not perform very well if the CH1 is in the following conditions.

"Vibration is very small", "Drown out by noise" or "Several frequency components are generated"
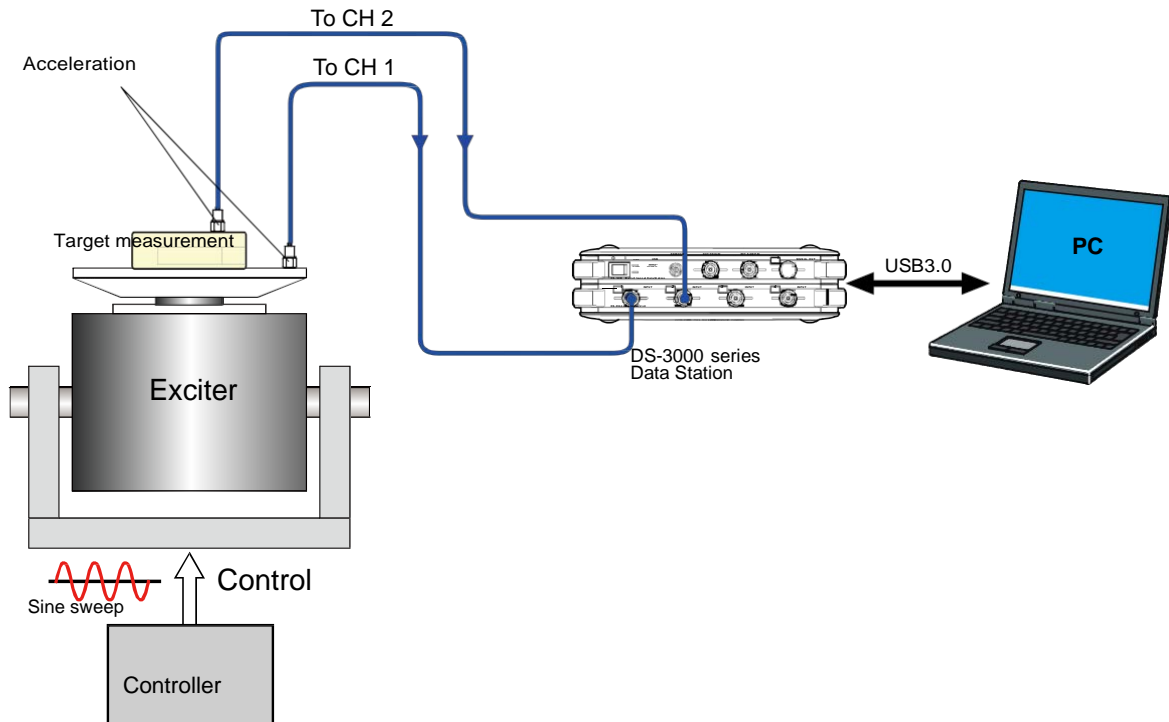
3. Overlap while averaging

When performing sweep averaging, we recommend you to set the overlap as 0% or 50%. The initial setting of overlap is "Max". In this manual, set twice averaging in 1 point. The averaging has almost no effect on results when the overlap is selected as "Max", because it is in a state of performing averaging using almost the same data. When performing the sweep averaging, we recommend you to set the overlap as 0% or 66.7%. When selects the window function as hanning, set the overlap to 66.7%.

Figure 14: Setting screen of overlap