

**DS-0321**FFT Analysis Software

Measurement method of amplitude probability density function

## DS-0321 FFT Analysis software Measurement method of amplitude probability density function

The distribution of the signal amplitude can be checked by measuring the amplitude probability density function (PDF). For example, when random excitation is performed for a sufficient time, the excitation amplitude becomes a normal distribution.

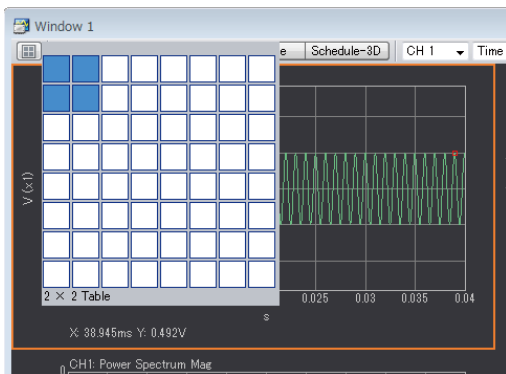
\*Strictly speaking, the histogram of amplitude is different from the probability density function, but we will explain it as the same thing.

In here, explain the example of measuring the amplitude density function by inputting the triangular wave to channel 1. The measurement of amplitude density function is averaged by 0% of overlap. Moreover, the multiple channel display of the amplitude probability density function is available. File menu operation is described in [ ], such as [Data display] > [Data input source setting] in the following explanation. The basic operation of the DS-0321 omits in here.

### ■ Operation procedure

This operation manual is how to display the time waveform and histogram (amplitude probability density function)

1. Correctly set the frequency range and voltage range of the input channel to be analyzed. Measurement channel is 1 in this manual.

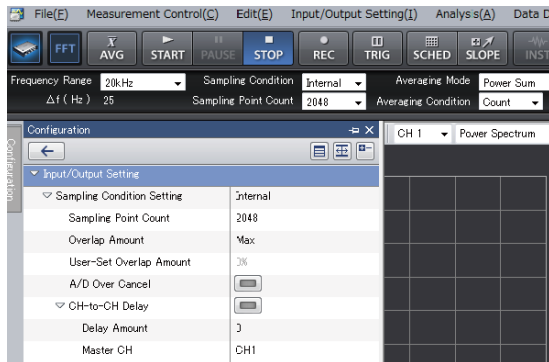


Select the display to the dual screen.

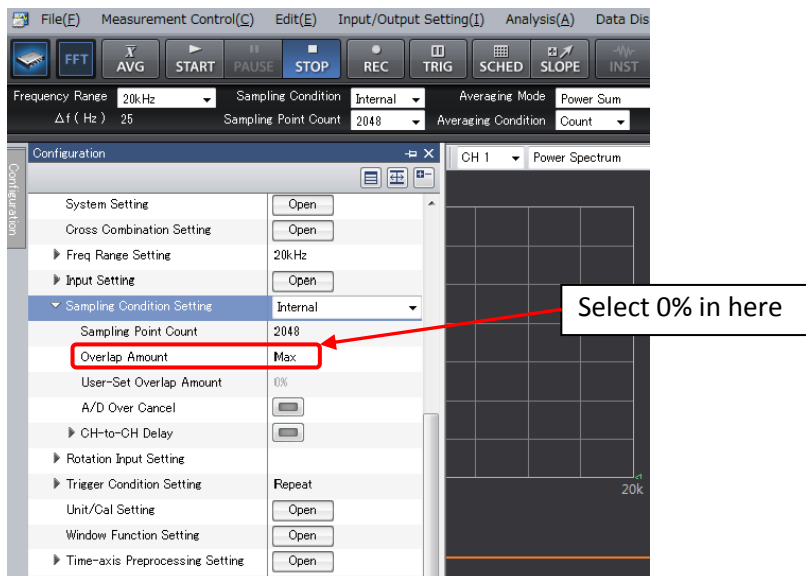
2. Set the [data type] from the data setting toolbar. Select the graph and change the data type. Select [Histogram] to the upper graph and [Time wave] to the lower graph.



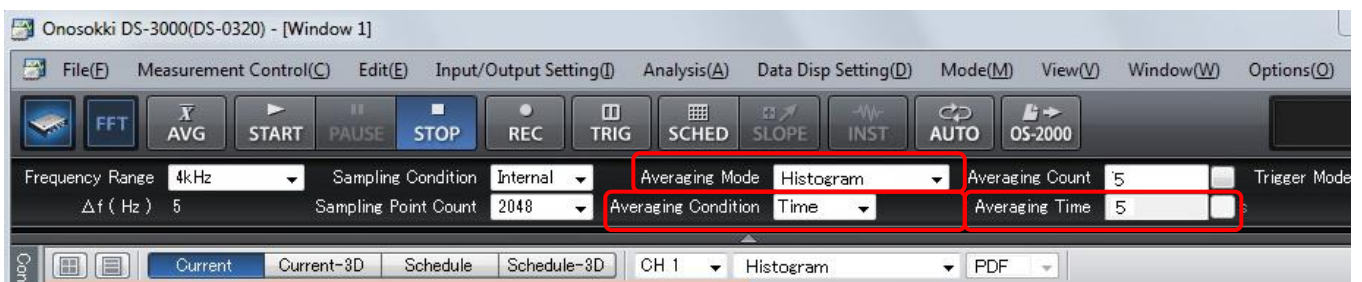
3. Select the overlap amount to 0%.  
Click [Input/ Output Setting] > [Sample Condition Setting] in this order in the Configuration menu and open the [Sample Condition Setting].



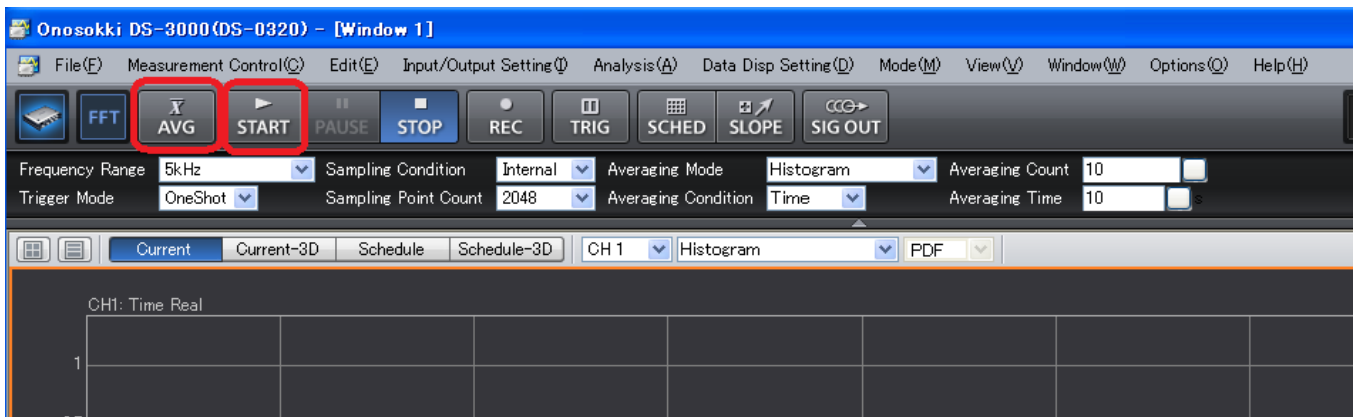
Set "Overlap Amount: 0%" from the sample condition setting.



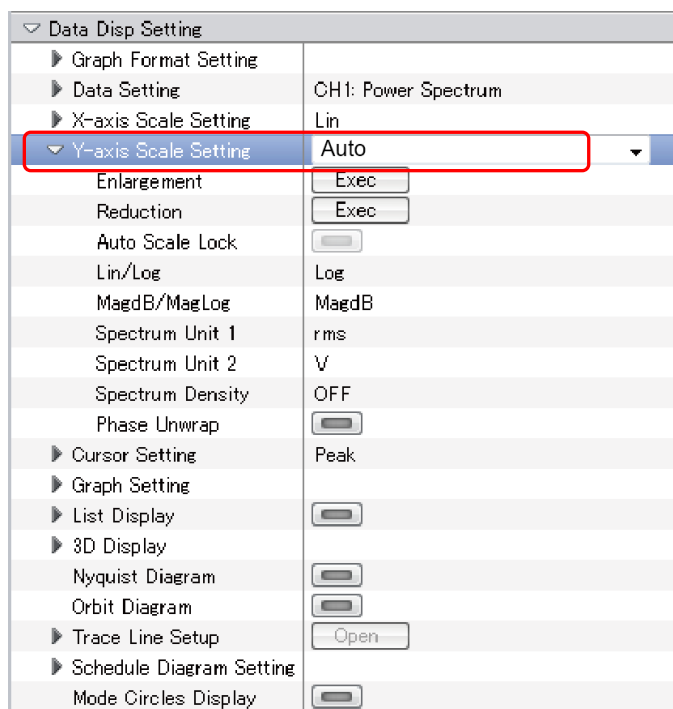
4. Select "Histogram" to the Averaging Mode and "Time" to the Averaging Condition.  
The averaging Time is 5 seconds in here.



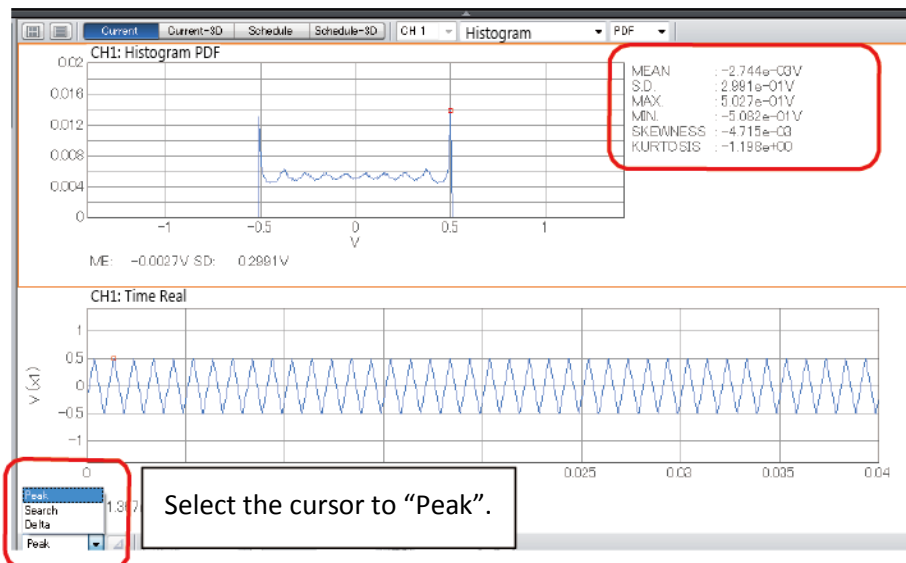
- The measurement starts when the AVG button and START button is pressed after inputting the signal.



- Set Y-axis scale to Auto to make the graph easy to see. Select Histogram PDF graph and right click it. Select the [Y-axis Scale Select] from the displayed menu. Select [Auto] from the [Y-axis Scale Setting] on the configuration.

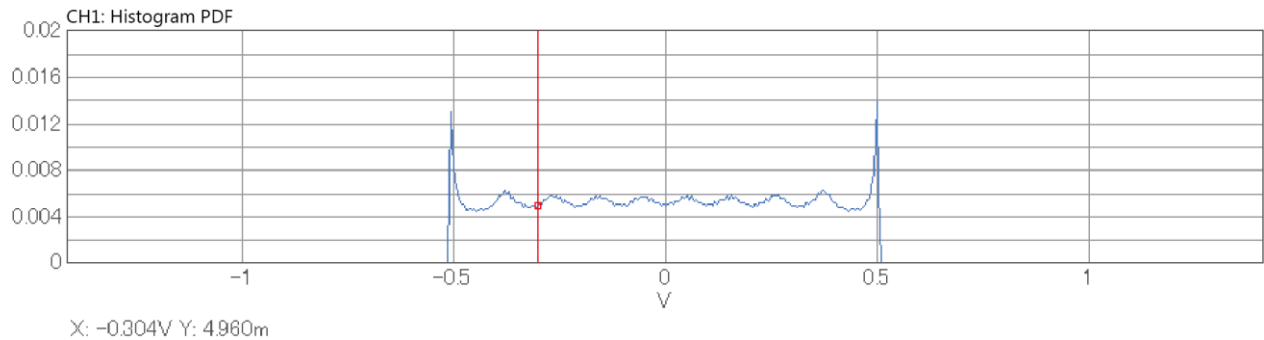


7. Display of the Histogram PDF. Select [Peak] from the cursor setting. 6 types of value are displayed on the right side of the graph as follows.



Display	Name	Overview
MEAN	Mean value	<p>The average value <math>\mu</math> can be obtained by the following formula. <math>P(x)</math> is probability density function.</p> $\mu = \sum_{k=-256}^{255} x_k P(x_k)$
S.D.	Standard deviation	<p>The second moment around the mean is variance, and the square root of the variance is the standard deviation <math>\sigma</math>. The effective value and the standard deviation of the signal excluding the DC component are the same.</p> $\sigma = \sqrt{\sum_{k=-256}^{255} (x_k - \mu)^2 P(x_k)}$
MAX.	Maximum value	MAX indicates the maximum value of one frame of the time-axis waveform or time record memory data.
MIN.	Minimum value	MIN indicates the minimum value of one frame of the time-axis waveform or time record memory data.
SKEWNESS	Skewness	<p>SKEWNESS indicates the third order moment with respect to the mean value normalized by <math>\sigma^3</math> and is used as an index for indicating the asymmetry with respect to the mean value. SKEWNESS is calculated by the following formula.</p> $S = \frac{1}{\sigma^3} \left( \sum_{k=-256}^{255} (x_k - \mu)^3 P(x_k) \right)$
KURTOSIS	Kurtosis	<p>The kurtosis <math>K</math> is a value obtained by normalizing the 4<sup>th</sup> order moment around the mean value with <math>\sigma^4</math> and is an index showing the acuteness of the waveform. It can be obtained by the following formula</p> $K = \frac{1}{\sigma^4} \left( \sum_{k=-256}^{255} (x_k - \mu)^4 P(x_k) \right)$ <p>(Caution) The normal random noise of KURTOSIS is 3, so the value obtained by subtracting 3 from the above value is displayed in this software.</p>

When setting the cursor to “Search”, 6 items are not displayed.



Y-value is amplitude probability density. Total summation of Y-axis is 1.

Other term description

### **Amplitude Probability Density Function: PDF**

The amplitude probability density function obtains the probability that a varying signal exists at a specific amplitude value. The horizontal axis denotes the amplitude (V) and the vertical axis is normalized from 0 to 1. With this software, the amplitude is decomposed to 1/512 times the voltage range. The amplitude probability density function makes it possible to analyze how the input signal varies near what portion of the amplitude, and can be used for the PASS/FAIL test by shape.

\*In this manual, the Probability Density Function is amplitude histogram. Therefore, it changes depending on the voltage range even analyze with the same signal.

### **Cumulative Distribution function: CDF**

The cumulative distribution function represents the probability that the instantaneous value of fluctuating time-axis signal is lower than a certain amplitude level. The amplitude probability distribution function is obtained by integrating the amplitude probability density function. The attribute of the display function “Histogram” can be changed from PDF to CDF.

End

Title: DS-0321 FFT Analysis software  
Measurement method of amplitude probability density function

Date issued: 27<sup>th</sup> December, 2017

Publisher: ONO SOKKI. CO.,. LTD

Contact details: **Yokohama Technical Center**  
1-16-1 Hakusan, Midori-ku, Yokohama 226-8507, Japan  
PHONE: +81-45-935-3918  
FAX: +81-45-930-1808 (Overseas sales department)  
E-Mail: [overseas@onosokki.co.jp](mailto:overseas@onosokki.co.jp)