

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

ONO SOKKI CO., LTD.

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The distribution of the signal amplitude can be check 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.

🚰 Onosokki DS-3	000(DS-0	320) - [Wir	ndow 1]										L
🔁 File(E) M	easuremer	nt Control(C) Edit(E) Input	Output Se	tting(I)	Analysis(<u>A</u>)	Data Dis	p Setting(<u>D</u>)	Mode(<u>N</u>	1) View(<u>V</u>)	Window(<u>W</u>)	Options(O)
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S BB	Current	Curr	ent-3D	Schedule	Schedu	ile-3D	СН 1 👻	▲ Histogran	n	▼ PDI	-		

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

🗃 Onosokki DS-3000(DS-0320) - [Window 1]							
📑 File(E) M	easurement Control	© Edit(<u>E</u>) Input/O	itput Setting \oplus Analysis($\underline{\ell}$) Data Disp Setting(<u>D</u>)	Mode(<u>M</u>) View(<u>V</u>) ′	Window(<u>W</u>) Options(<u>O</u>)	Help(<u>H</u>)
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CH1: Time Real							
<u>CH1: T</u>	ime Real						
	ime Real						

6. 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.

▽ Data Disp Setting					
Graph Format Setting					
🕨 Data Setting	CH1: Power Spectrum				
▶ X-axis Scale Setting	Lin				
🗢 Y-axis Scale Setting	Auto 🗸				
Enlargement	Exec				
Reduction	Exec				
Auto Scale Lock					
Lin/Log	Log				
MagdB/MagLog	MagdB				
Spectrum Unit 1	rms				
Spectrum Unit 2	V				
Spectrum Density	OFF				
Phase Unwrap					
Cursor Setting	Peak				
Graph Setting					
🕨 List Display					
🕨 3D Display					
Nyquist Diagram					
Orbit Diagram					
Trace Line Setup	Open				
Schedule Diagram Setting					
Mode Circles Display					

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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	The average value μ can be obtained by the following formula. P(x) is probability density function. $\mu = \sum_{k=-256}^{255} x_k P(x_k)$
S.D.	Standard deviation	The second moment around the mean is variance, and the square root of the variance is the standard deviation σ . The effective value and the standard deviation of the signal excluding the DC component are the same. $\sigma = \sqrt{\sum_{k=-256}^{255} (x_k - \mu)^2 P(x_k)}$
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	SKEWNESS indicates the third order moment with respect to the mean value normalized by σ^3 and is used as an index for indicating the asymmetry with respect to the mean value. SKEWNESS is calculated by the following formula. $S = \frac{1}{\sigma^3} \left(\sum_{k=-256}^{255} (x_k - \mu)^3 P(x_k) \right)$
KURTOSIS	Kurtosis	The kurtosis K is a value obtained by normalizing the 4 th order moment around the mean value with σ^4 and is an index showing the acuteness of the waveform. It can be obtained by the following formula $K = \frac{1}{\sigma^4} \left(\sum_{k=-256}^{255} (x_k - \mu)^4 P(x_k) \right)$ (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.

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

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Title:

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