N8813A Vertical Noise Decomposition in EZJit Complete

Data Sheet

The noise decomposition software for the 9000A, 90000A, 90000X, and 90000Q Series Infiniium oscilloscopes provides statistical analysis of high speed digital interfaces in the vertical (voltage) domain. It is complementary to the horizontal (time) analysis that the EZJit+ jitter decomposition software (N5400) has accurately provided for years.

Now for the first time, real time oscilloscopes can analyze both domains statistically with measured results that matter. Engineers who want to characterize a high speed transmitter or understand the full parameters of the waveform reaching a digital receiver will consider amplitude analysis as a new fundamental requirement in the complete consideration and evaluation of a high speed digital link.

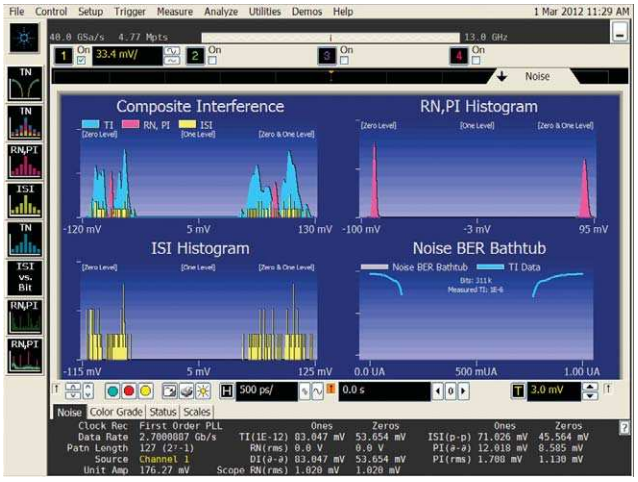

Figure 1: Vertical Noise Decomposition Graphs

Features

The EZJit Complete vertical noise decomposition software offers:

- Decomposition of Vertical Noise into constituent components:
  - Random Noise (RN)
  - Periodic Interference (PI)
  - Deterministic Interference (dual dirac model) (DI)
  - Data Dependent Interference, or Intersymbol Interference (ISI)
- Estimation of Total Interference (TI) to a specified Bit Error Ratio
- Cumulative Average of High(One) and Low(Zero) levels
- Tabular Results of all measured quantities.
- Graphical Results of:
  - InterSymbol Interference per bit
  - RN/PI Histogram
  - Total (Composite) Interference Histogram
  - BathTub curve (Measured and Extrapolated)
  - Interference Frequency Spectrum
- Settable location in the UI for vertical analysis
- Scope noise compensation, choose between:
  - Measure noise directly
  - User input value
- Arbitrary or Periodic Data patterns
- Setup Wizard for robust setup

Analyze your Eye Closure

As data rates increase, the vertical margin you have will be eroded because of channel effects (ISI) and differential noise mechanisms such as periodic interference and random noise. As a result, analysis of the complete eye with jitter measurements for the horizontal and noise measurements for the vertical is required. The results of such analysis can yield insight on debug tasks to pursue such as addressing channel loss or intra-pair skew resulting from common mode-to-differential mode conversion, and to establish system link budget/margins for your designs. Given a receiver's sensitivity, you can explore whether a transmitter's random noise component, δ_{RN}, with its BER multiplier (for instance, 14.3 for 10^{-12} BER) can be supported. With the vertical analysis complete, total confidence in the design is achieved.

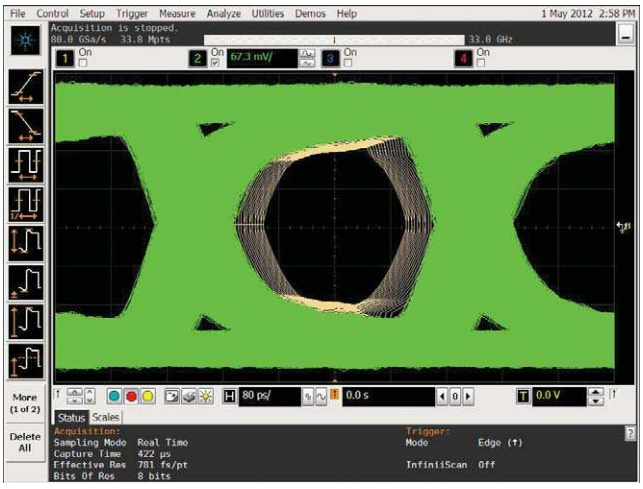

Figure 2. Eye showing BER contours from 10^{-1} to 10^{-21}

Setting Up the Oscilloscope for Vertical Noise Analysis

Vertical Noise analysis software algorithms are very similar to the jitter algorithms found in EZJit +. For this reason, and because the engineering tasks are related, the noise and jitter capabilities are merged together in one GUI and combined to constitute EZJit Complete'. It is found in both analysis and measurement tabs in the infiniium oscilloscope control graphical user interface. Selecting either of these yields the entry dialog which allows manipulation of conditions for measurement, and also presents a setup wizard. The setup wizard is the best and most carefree way to ensure good measurements and is recommended.

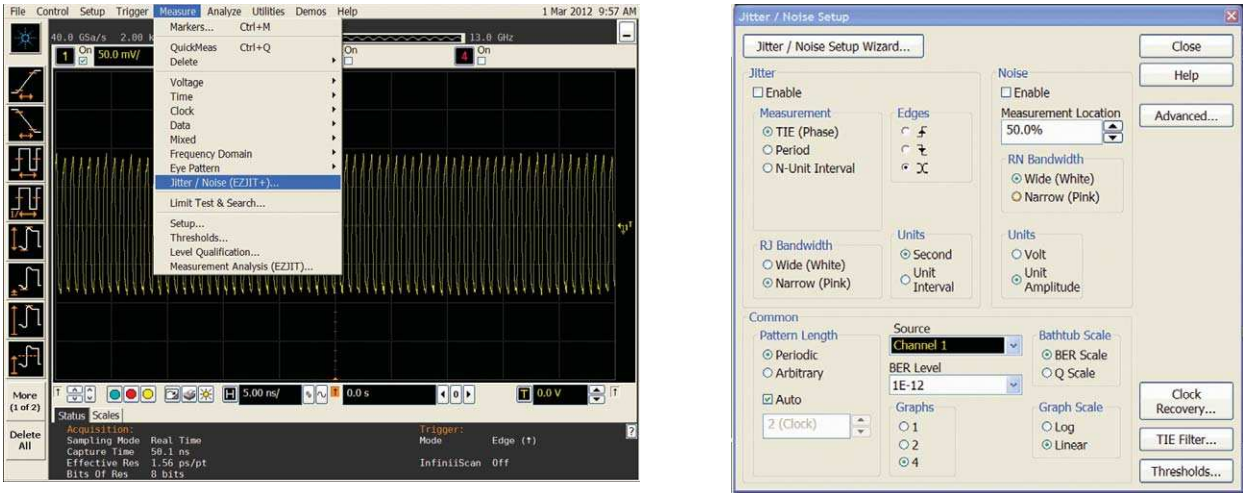

Figure 3. Jitter and Noise Measurement control dialog available from Analyze and Measurement Tabs and resulting setup control dialog

Viewing the setup dialog one can see the close relationship jitter and noise measurement have. There is a common section that addresses the channel to be measured, the pattern type, whether it should be automatically evaluated, BER level, number of graphs to present for analysis insight, and graphical controls (such as Log/Linear format and Q vs BER scales. Additionally, there are common settings in clock recovery and thresholds. One cannot be too careful about Clock Recovery and it deserves special note. While the need for clock recovery should be obvious for jitter evaluation because jitter depends on comparison against an underlying time reference, noise evaluation requirement of clock recovery may not be so obvious. It is critical the vertical noise analysis software evaluates a vertical slice in the eye diagram and must have a clock reference to do so.

Use the Setup Wizard!

In all of Infiniium's measurement software, setup wizards guide users to the quickest way to achieve results and the vertical noise analysis software in EZJit Complete is no exception. Use the Setup Wizard for bulletproof setup and results.

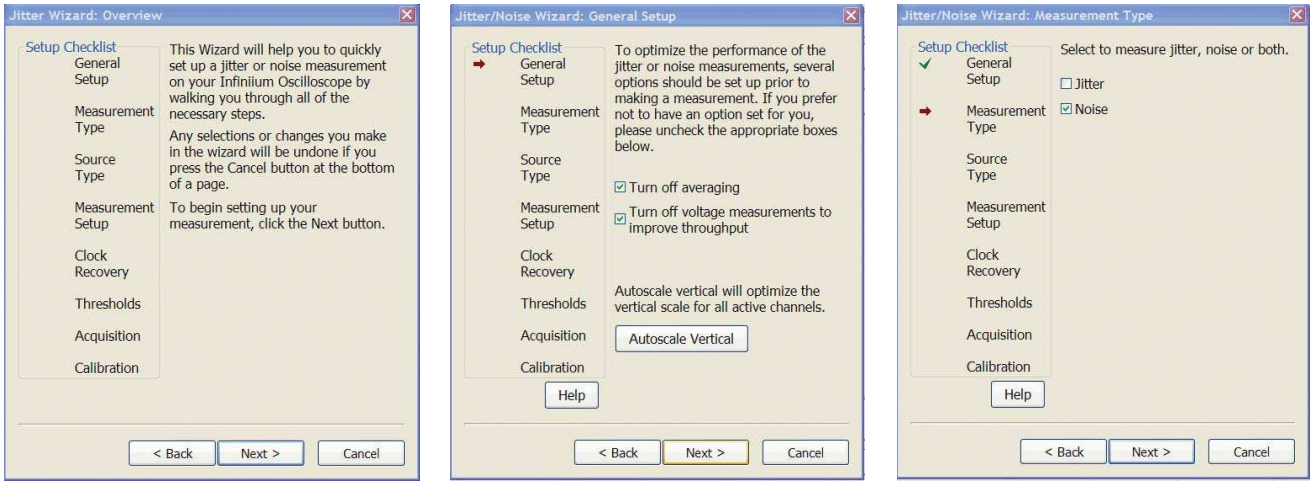

Figure 4. Jitter and Noise Wizard. The setup checklist is presented in the first wizard screen and the user can see where in the process they are every step of the way.

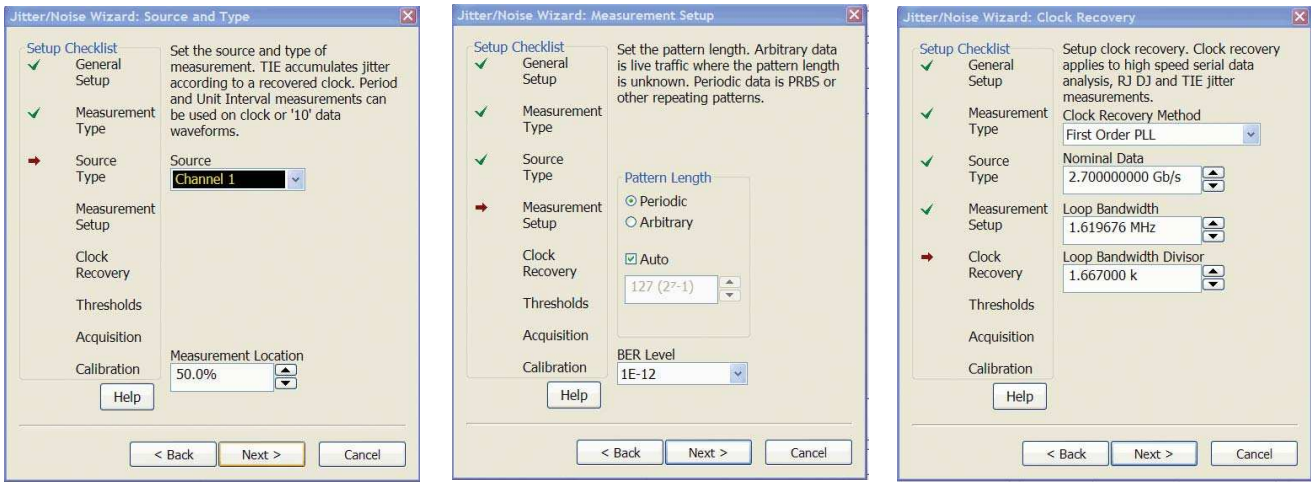

Figure 5. Jitter and Noise Wizard. Key parameters are selected. From the target and location in the unit interval, to whether periodic or arbitrary patterns are being analyzed, to clock recovery.

Use the Setup Wizard! (continued)

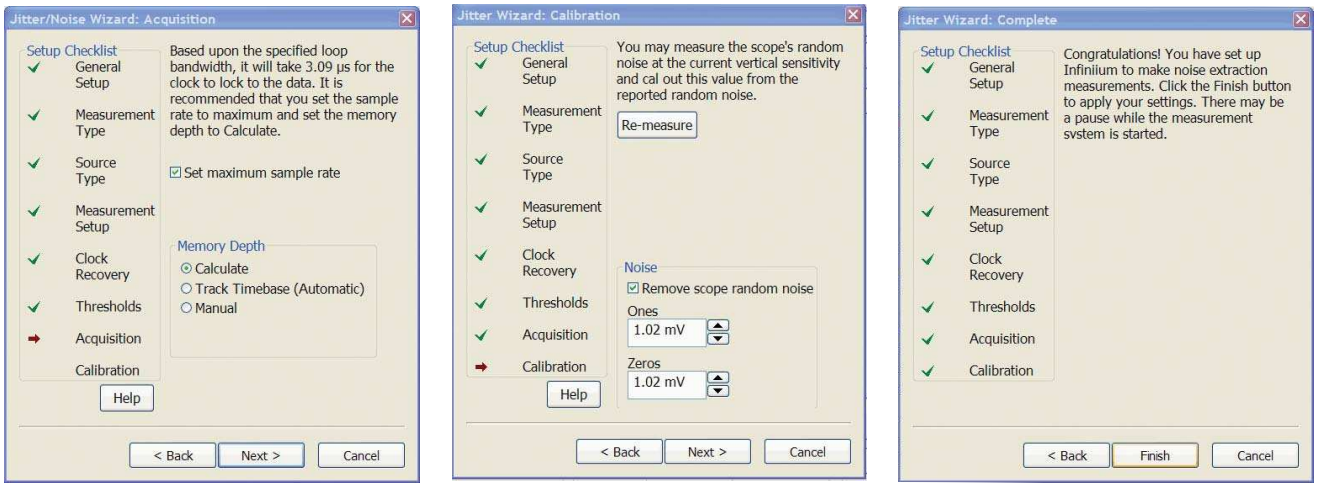

Figure 6. Jitter and Noise Wizard. Selecting 'Calculate' memory depth assures appropriate acquisition depth (memory) for highest accuracy. The Calibration tab will activate scope to measure its own noise and the check box selection of 'Remove scope random noise' will perform a root sum square subtraction of the scope's random noise from all subsequent calculations of random noise.

The jitter wizard guides you through the setup process, from General Setup to the Calibration where the oscilloscope's contribution to noise is subtracted. The default values in the wizard the optimize accuracy and robustness of the measurement.

Viewing and Analyzing Vertical Noise

Analysis of your signal is portrayed in graphical and tabular forms. The graphical portrayals provide the most immediate insight while the tabular provide the numeric evaluation you need for evaluating your target.

When analyzing vertical noise, four graphs will be presented as the standard configuration. These are shown below. These are considered to provide the most insight immediately, but the user also has more options available.

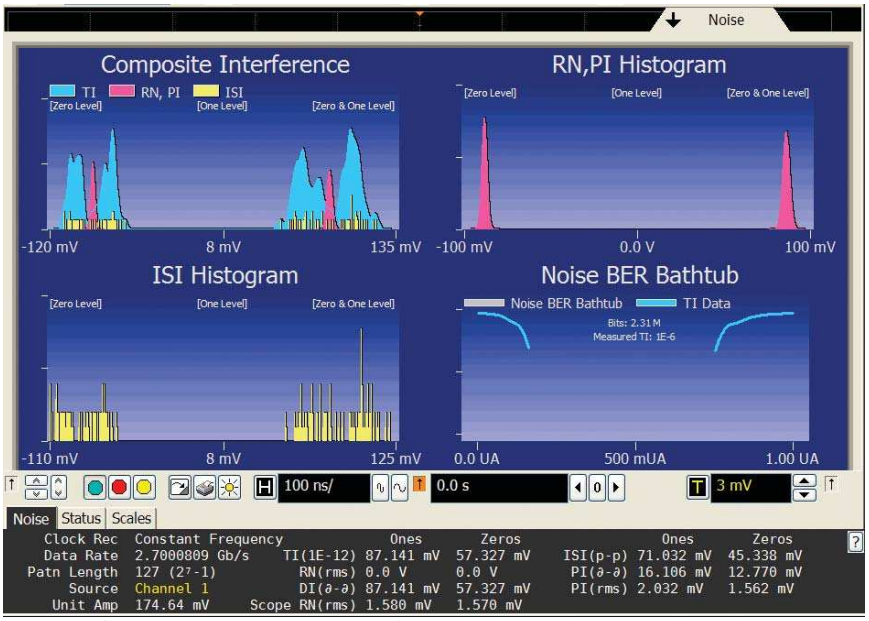

Figure 7. Standard graphical portrayal of vertical noise decomposition. From top to right: composite interference histogram, random and periodic histogram, intersymbol interference histogram, and bathtub plot.

Other Views

In addition to the vertical noise histograms and bathtub plots are other graphical portrayals that can give you the information you need to act. These are noise spectrum, threshold spectrum and ISI vs Bit. The noise spectrum and threshold spectrum will show periodic and random components vs frequency. The advantage of viewing the noise spectrum plot is to understand the noise contribution frequencies. For instance, if there is power supply radiation source or grounding issue on one side of a differential pair it will show up as common and differential noise and will be immediately clear on the plot. The threshold plot (not shown) shows the calculated threshold vs frequency that the vertical noise decomposition software uses to discern between a periodic noise component and random noise.

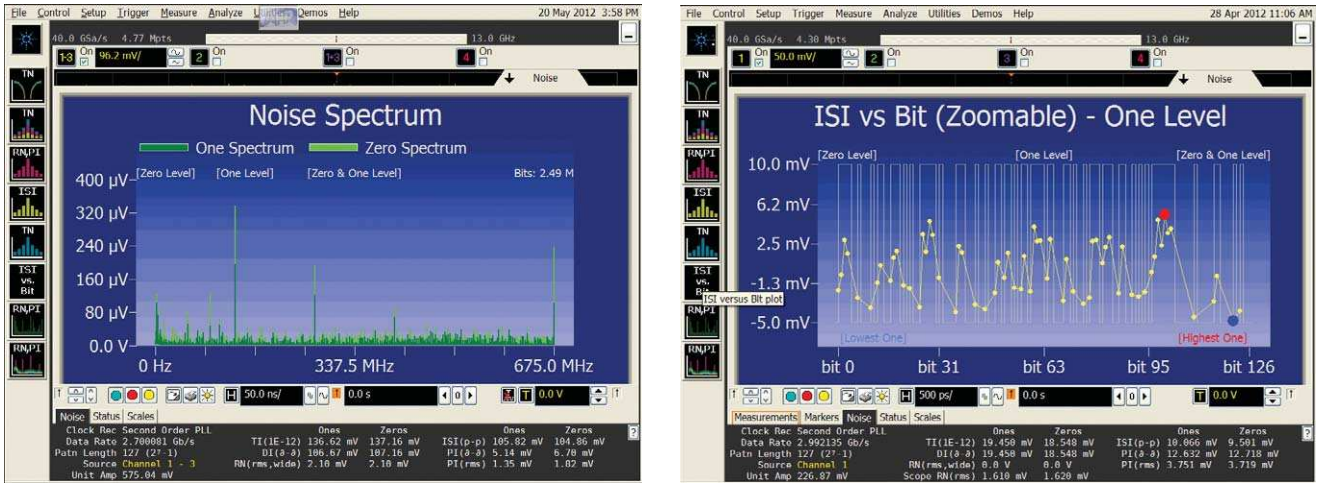

Figure 8. Spectrum portrayal of the vertical noise and pattern dependent noise (ISI) in ISI vs Bit plots. By selecting on the plot labels, the user can select between analyzing zeroes, ones, or both simultaneously.

-Analysis of Ones, Zeroes, or both Ones and Zeroes

The vertical noise decomposition software will default to the four-graph view seen in Figure 7, however two other choices are available to you. These are two-graph and one-graph formats for better focused viewing. The selection is available in the entry screen shown in Figure 3.

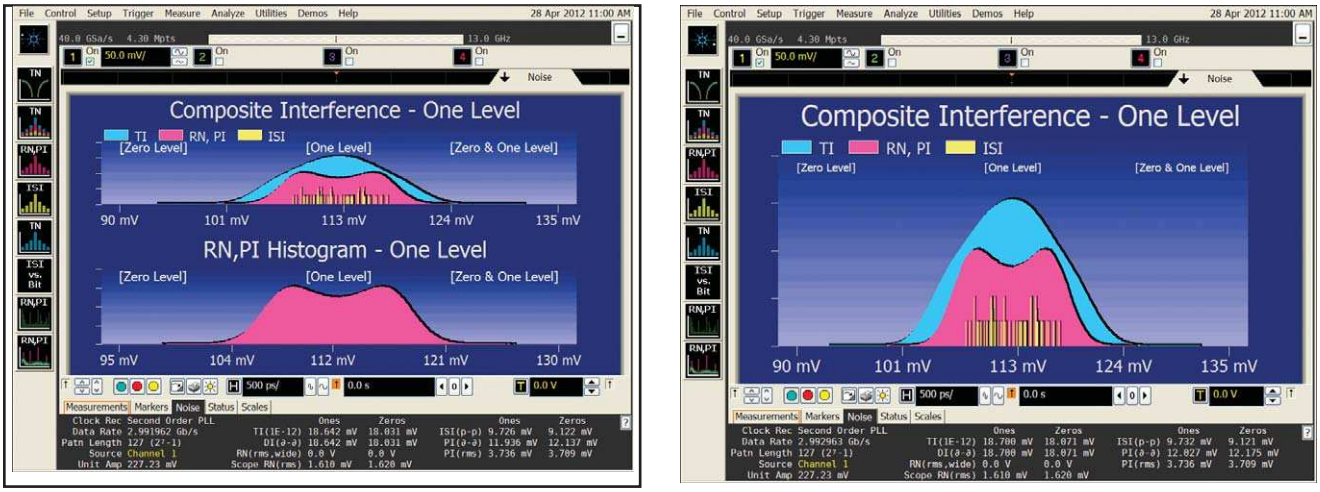

Figure 9. The EZJit Complete entry screen allows selection of 4, 2 or 1 graph formats.

-Analysis of Ones, Zeroes, or both Ones and Zeroes

Close analysis of the the four-graph view seen in Figure 7, will reveal that the plot is rendering both One and Zero analysis on each of the graphs shown. In those graphs, if you should want to examine the 'One' histograms or 'Zero' histograms in greater detail, you can click on the '[One Level]' or '[Zero Level]' labels. When you do so, the graph will rescale and show the side selected (One or Zero). This is depicted in Figure 10.

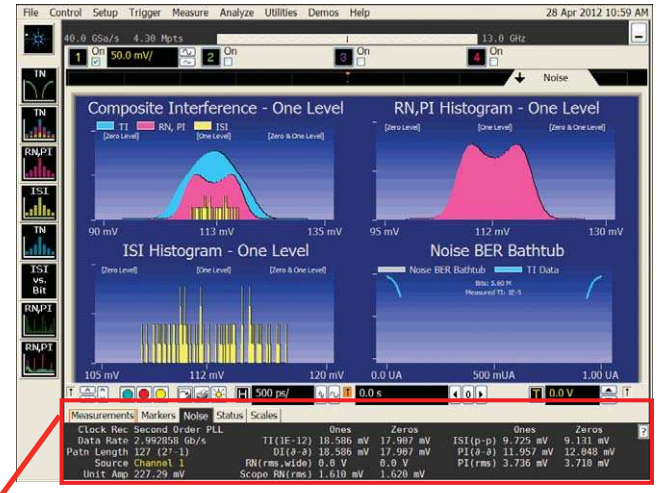

Figure 10. Focus on just the Ones, or the Zeroes or both: Analysis for Ones is shown here.

-Tabular results

Finally, the measured results are available in tabular form or over remote user interface. The results are available now in their own results tab at the bottom of the infiniium screen under 'Noise'.

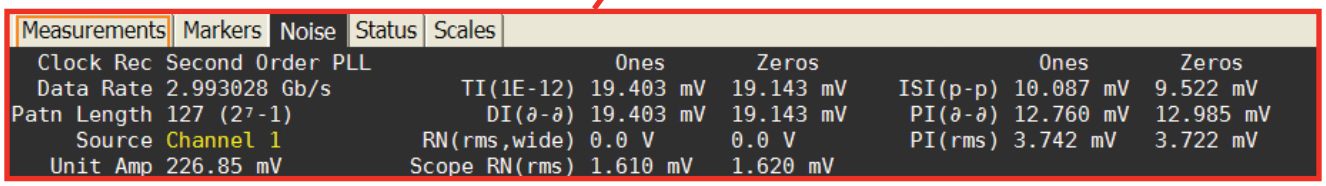

Figure 11. New Noise tab displaying all the values associated with vertical decomposition.

Other Analyses Enabled

Fixed Level Analysis: if your device is fixed at a high or a low, you can still analyze the system noise. In this case, you do not have a signal to perform first or second order recovery from data, so you can use an explicit clock and adjust threshold and hysteresis settings in the wizard.

Sweep the Eye: To comprehend vertical performance throughout the eye, the user can sweep the measurement location in the eye and performing noise analysis at each vertical solutions. With similar measurements of jitter at different horizontal thresholds the results can be processed externally to render a complete contour around the eye opening. This would be done to evaluate the statistical eye contour, or to measure over a specific range given assumptions of the behavior of the system receiver. An example of this is shown in Figure 2.

Ordering information

The N8813A EZJit Complete software is compatible with all 90000 Infiniium oscilloscopes. Firmware Revision 3.5 or greater. (Windows XP Pro or Win7). To purchase Vertical Noise Analysis software on new or existing Infiniium 90000 or 90000 X-Series or Q-Series Oscilloscopes, order the following:

Model number	Description	Quality
DSO/DSA 90000A Series	Infiniium Oscilloscope	1
DSO90000-057	EZJit Complete. Includes EZJit + and Noise Analysis	Select 1
Existing	N8813A Noise Decomposition (Requires EZJit+)	
Server Based License	N5435A-055 EZJit Complete Jitter Analysis	
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Server Based License	N5435A-055 EZJit Complete Jitter Analysi	

Other Measurement software for High Speed Digital Data Analysis.

Realtime Oscilloscopes: DSO/DSA90000A Series, 90000X Series, 90000Q Series		
Model Number	**Title**	**Description**
E2681A	EZJit	Trending of Measurements, clock recovery, and fundamental jitter measurements such as total jitter and N cycle jitter.
N5400A	EZJit +	Jitter Decomposition using dual dirac technique. Predict total jitter to low BERs
N5461A	Equalization	Select from CTLE, FFE and DFE equalization types and various clock topologies to understand what equalization will do to a signal, or to model voltage eye internal to receiver device.
N2809A & N2807A	Precision Probe Software and Hardware Kit	Measure and remove effects of cable and switch paths in front of the oscilloscope, measure and ac calibrate probes for greatest accuracy and bandwidth.
N5465A	InfiniiSim Waveform Transformation Toolset	Creates transfer functions for implementing De-Embedding of Fixtures and cables, Embedding, general simulation, removing probe loading and changing observation point of measurement.
E2688A	Serial Data Analysis	Create eye diagrams of total captured waveform or of particular filtered portions of it (i.e bit sequence dependence). Includes standard masks and 8b/10b protocol analysis.
Sampling Oscilloscopes: 86100D Series Digital Communication Analyzer		
86100D-300	Advanced Amplitude Analysis	Infiniium DCA software option that performs the highest accuracy amplitude analysis available.
86100D-200	Advanced Jitter Analysis	Jitter Decomposition using dual dirac technique. Predict total jitter to low BERs
86100D-201	Advanced Jitter Analysis	Equalize signals using software CTLE and FFE/LFE models.
86100D-202	Enhanced Impedance and S-Parameter SW	Single-ended and differential S-parameter measurements.
86100D-300	Advanced Amplitude Analysis	Infiniium DCA software option that performs the highest accuracy amplitude analysis available.
86100DU-401	Advanced Eye Analysis	Jitter and amplitude/noise analysis on long patterns such as PRBS31. Eye contour and eye/mask testing.
86100D-SIM	InfiniiSim-DCA	Creates transfer functions used to de-embed/embed fixtures and cables, general simulation, removing probe loading and changing observation point of measurement.

Related literature

Publication title	Publication type	Publication number
Infiniium DSO90000 and DSA90000 Series Oscilloscopes	Data Sheet	5989-7819EN
Infiniium 90000 X Series	Data Sheet	5990-5271EN
Infiniium 90000 Q Series	Data Sheet	5990-5299EN
EZJit Plus Jitter	Data Sheet	5990-6541EN
EZJit	Data Sheet	5989-5483EN
Information on Jitter Measurement	White Paper	5989-5483EN
86100D Wide-Bandwidth Oscilloscop Mainframe and Modules	Data Sheet	5990-5822EN
86100C Jitter/ Amplitude	Product Note	5989-1146EN

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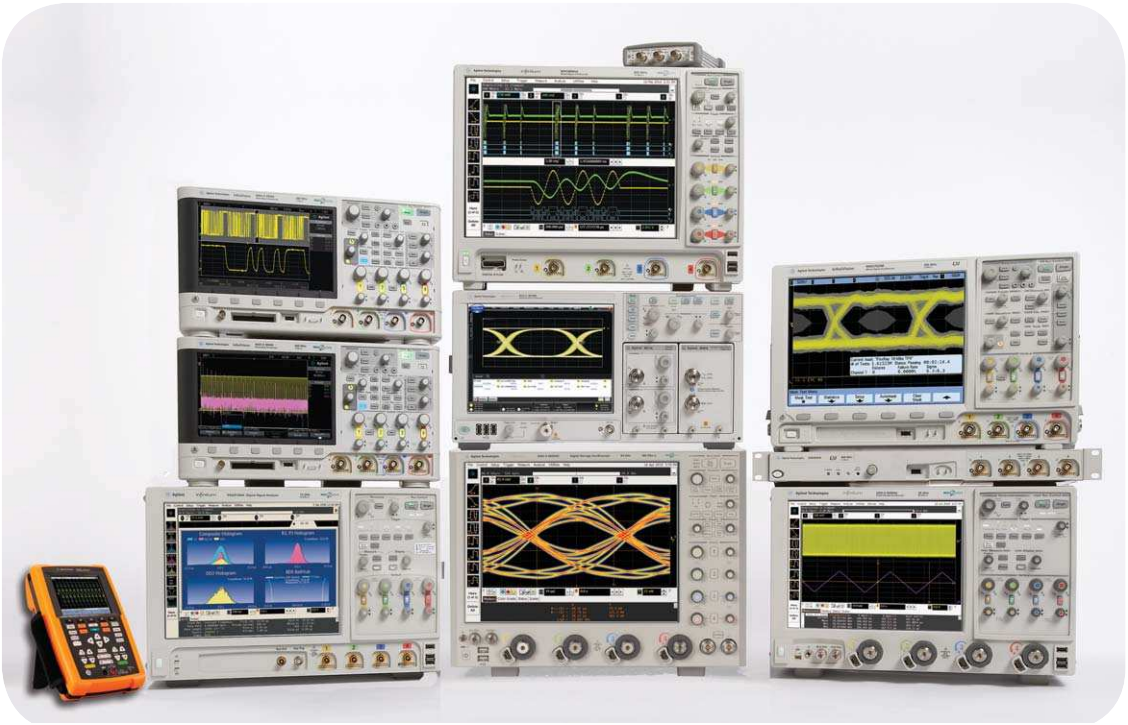

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