EZJIT Plus Jitter Analysis Software for Infiniium Oscilloscopes

Data Sheet

EZJIT Plus software includes all of the basic jitter analysis features of EZJIT and adds the following advanced analysis capabilities:

- Easy-to-use jitter wizard
- Measure repetitive or arbitrary data waveforms
- Constant frequency or PLL clock recovery (requires Serial Data Analysis option)
- Available deep memory for capturing low-frequency jitter
- Separation of RJ, DJ, DDJ, ISI, BUJ, PJ, and ABUJ jitter subcomponents
- TJ estimation at low BER
- Advanced spectral and tail fit RJ extraction algorithms for the most accurate jitter decomposition in BUJ/Crosstalk signal environments
- Graphical displays of DDJ vs. bit, histograms and bathtub curve
- Fully functional with other Infiniium software such as Equalization and InfiniiSim

Figure 1. EZJIT Plus provides multiple views of jitter for maximum insight as well as quick, accurate separation of jitter subcomponents for compliance testing.

With the faster edge speeds and shrinking data valid windows in today's high-speed digital designs, insight into the causes of signal jitter is critical for ensuring the reliability of your design. Agilent's EZJIT Plus jitter analysis software for Infiniium oscilloscopes provides the advanced decomposition, analysis, and views of jitter necessary for fast and accurate insight into your signal. Decompose jitter into components, view BER bathtub curves and estimate TJ at low BER. Whether your signal is subject to channel ISI, power supply interference, or crosstalk from adjacent signal paths, EZJIT Plus enables you to accurately estimate TJ and determine the sources of jitter affecting your signal.

Choosing your Jitter Analysis Software for Infiniium Oscilloscopes

	EZJIT	EZJIT Plus	EZJIT Complete
Model number **Option number**	**E2681A** **002**	**N5400A** **004**	**N8813A** **057**
Advanced Clock Recovery	Requires Serial Data Analysis, option -003	Requires Serial Data Analysis, option -003	Requires Serial Data Analysis, option -003
Basic Jitter Views			
Jitter trend	●	●	●
Jitter histogram	●	●	●
Jitter spectrum	●	●	●
Multi-acquisition	●	●	●
Jitter Clock Measurements			
Period	●	●	●
Pulse width (+, –, both)	●	●	●
Frequency	●	●	●
Duty cycle (+, –)	●	●	●
Time-interval error	●	●	●
Cycle-cycle jitter	●	●	●
N-cycle jitter	●	●	●
Cycle-cycle +/– width	●	●	●
Cycle-cycle duty cycle	●	●	●
Jitter Data Measurements			
Time-interval error	●	●	●
Data rate	●	●	●
Unit interval	●	●	●
Delay/Edge Measurements			
Setup/hold	●	●	●
Phase	●	●	●
Rise/fall time	●	●	●
Jitter Separation			
Random jitter (RJ)		●	●
Deterministic jitter (DJ)		●	●
Data dependent jitter (DDJ)		●	●
Inter-symbol interference (ISI)		●	●
Duty cycle distortion (DCD)		●	●
Bounded uncorrelated jitter (BUJ)		●	●
Periodic jitter (PJ)		●	●
Aperiodic bounded uncorrelated jitter (ABUJ)		●	●
Total jitter (TJ) estimation		●	●
BER range		●	●
Max pattern length periodic mode		●	●
Max pattern length arbitrary mode		●	●

Choosing your Jitter Analysis Software for Infiniium Oscilloscopes *(Continued)*

	EZJIT	EZJIT Plus	EZJIT Complete
Model number **Option number**	**E2681A** **002**	**N5400A** **004**	**N8813A** **057**
Advanced Jitter Views			
Real-time Eye	Requires Serial Data Analysis, option -003	Requires Serial Data Analysis, option -003	Requires Serial Data Analysis, option -003
BER bathtub		●	●
DDJ vs bit		●	●
Composite histograms		●	●
TJ histogram		●	●
DDJ histogram		●	●
RJ/PJ histogram		●	●
RJ/PJ spectrum		●	●
Vertical Noise Analysis			
Vertical noise decomposition			●
Total interference estimation			●
Separate analysis of one and zero levels			●
Advanced noise views			●

Separate jitter on periodic and arbitrary patterns

Typically, jitter separation is performed on repetitive waveforms that are designed to stress the data transmission link and the receiver's clock recovery circuitry. However, many embedded designs using multi-vendor chipsets are limited to testing live traffic with additional align characters and packet frames that may not be repetitive. EZJIT Plus allows designers to choose between periodic and arbitrary data modes when analyzing jitter for compliance. In the arbitrary data mode, the ISI Filter shows victim-aggressor relationships between each rising and falling edge that are N-edges apart in the captured waveform. By setting the filter wide enough to capture all significant relationships, designers can quickly analyze ISI problems and accurately separate RJ/DJ parameters to provide a TJ estimation at low BER.

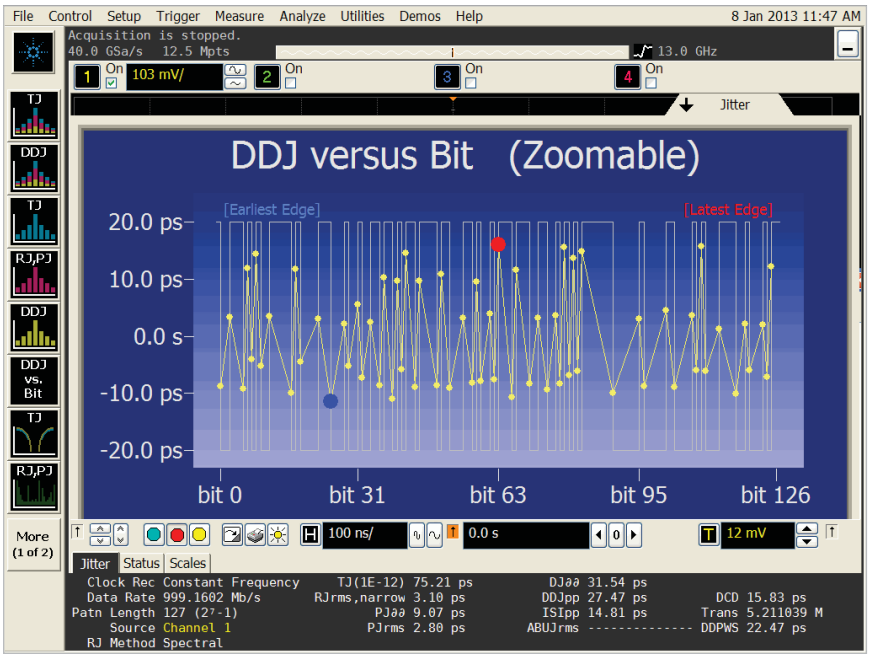


Figure 2. DDJ vs. Bit chart

Easy-to-use Jitter Separation Wizard

The easy-to-use wizard built into EZJIT Plus makes setting up advanced jitter separation simple. Walk through the measurement setup step-by-step to set critical parameters such as thresholds, vertical scaling, and clock recovery. The result: fast and accurate separation of signal jitter into components and flexible jitter views to provide critical insight.

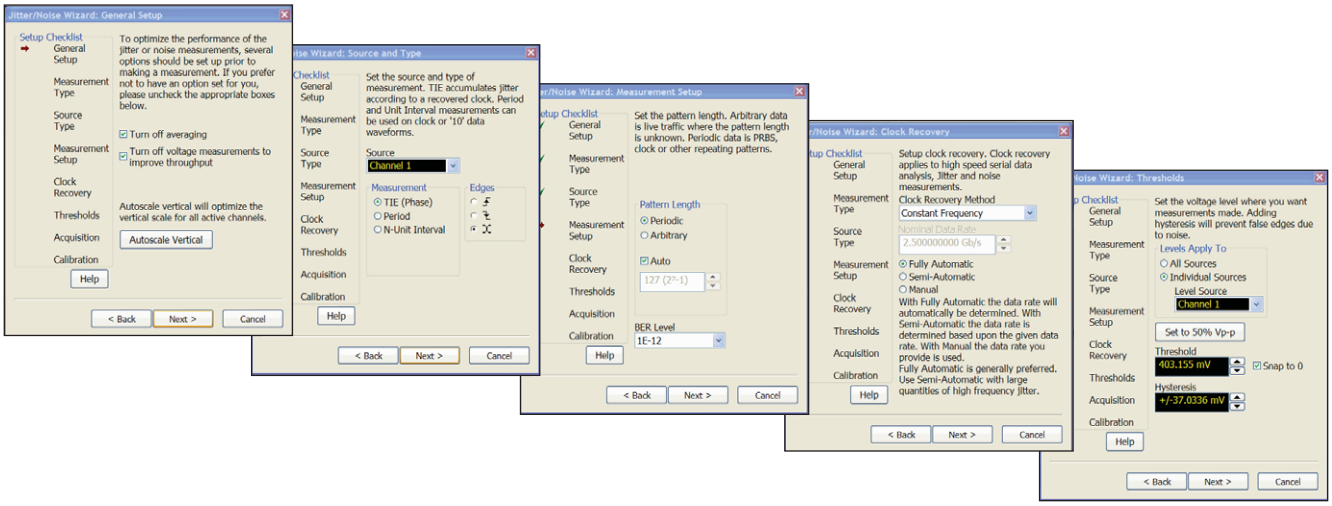


Figure 3. RJ/DJ Wizard allows user selection of data pattern type, TJ BER calculation level, clock recovery type and jitter measurement threshold.

Accurate Random Jitter Separation using Spectral and Tail Fit Algorithms

The Problem:

Common spectral algorithm for RJ extraction over-reports RJ.

Why?

Any Aperiodic Bounded Uncorrelated Jitter (ABUJ) on the signal is factored into RJ. A common source of ABUJ is crosstalk from adjacent signals.

How does this affect me?

First, the RJ measurement can be inaccurate. Second, when measuring Total Jitter (TJ) vs. BER, TJ can be dramatically overestimated due to the RJ multiplier. For example, TJ = DJ + 14*RJ for a BER of 10^-12. This means the scope will provide an unfairly negative report of the overall jitter performance of your serial data link.

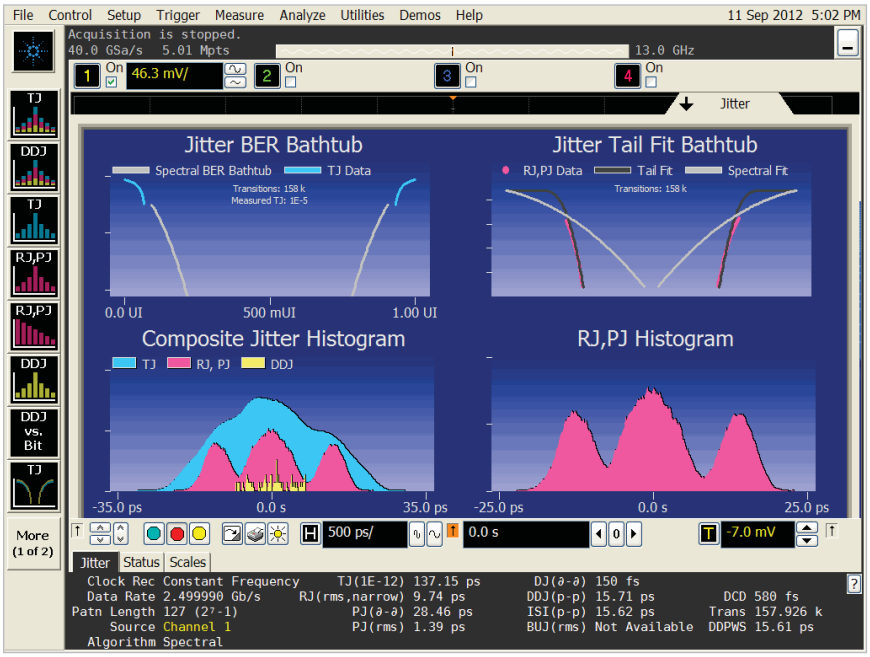


Figure 4. Jitter separation with artificially extreme crosstalk using spectral algorithm for RJ extraction. Notice the discontinuity in the BER bathtub.

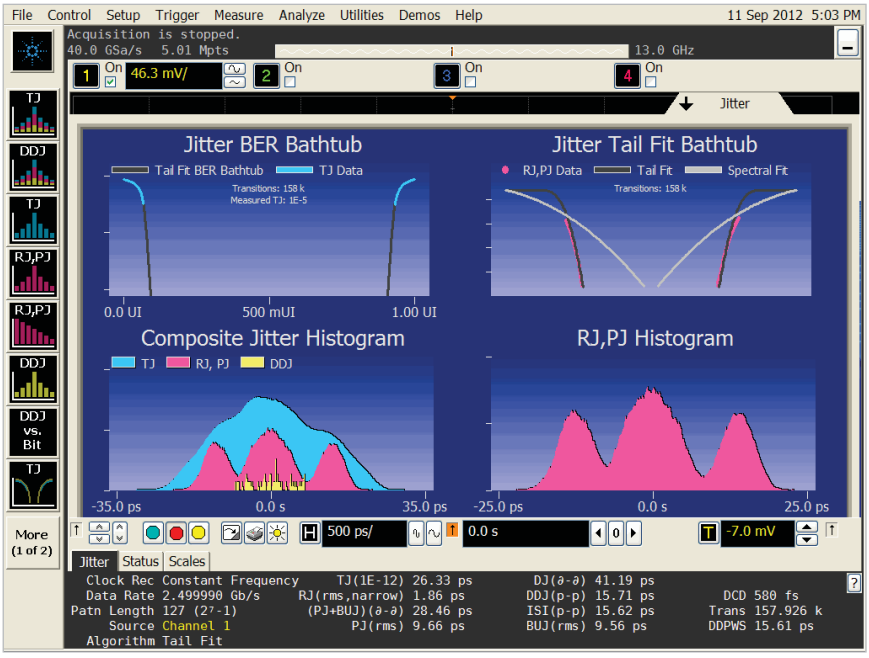


Figure 5. Jitter separation with artificially extreme crosstalk using tail fit algorithm for RJ extraction. Notice the good fit to the BER bathtub and dramatically lower RJ and TJ results.

The Solution:

EZJIT Complete provides two distinct algorithms for RJ extraction to ensure you achieve accurate measurements under all signal conditions.

The Tail Fit algorithm accurately extracts RJ, even in extreme ABUJ/crosstalk environments, by fitting directly to the tail of the RJ,PJ histogram.

Figures 4 and 5 contrast the two algorithms in a contrived jitter measurement with extreme crosstalk. You can see the tail fit algorithm in Figure 5 provides a much better fit to the BER bathtub curve in the upper left and reports significantly lower RJ and TJ.

Jitter Separation and Total Jitter Estimation at Low BER

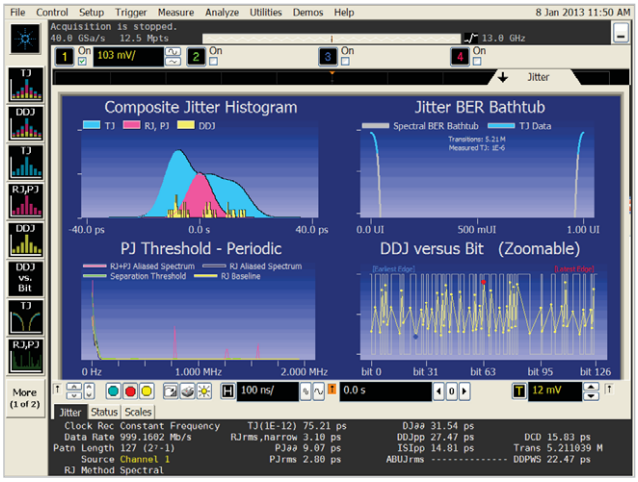


Figure 6.

4-in-1 jitter measurement results display allow for multiple views of jitter populations and distributions, data-dependent jitter versus bit in repetitive patterns, as well as the bathtub curve plot, which measures eye-opening vs. bit error rate.

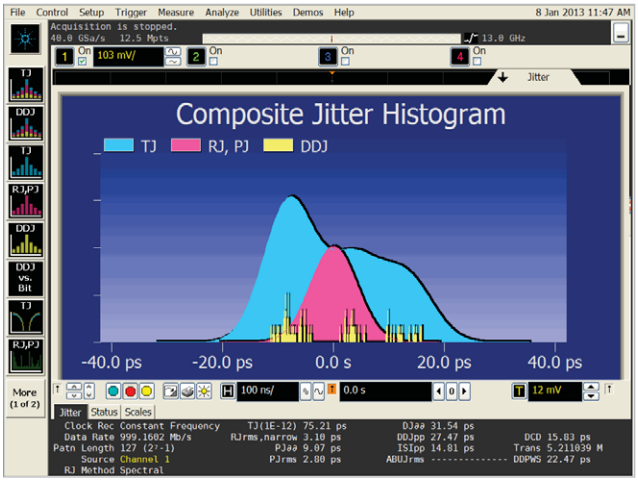


Figure 7.

Composite histogram displays relative contributions of data-dependent jitter, total jitter as well as random and periodic jitter. Total jitter is a convolution of the data-dependent jitter probability density function (PDF) and the random/periodic jitter PDF.

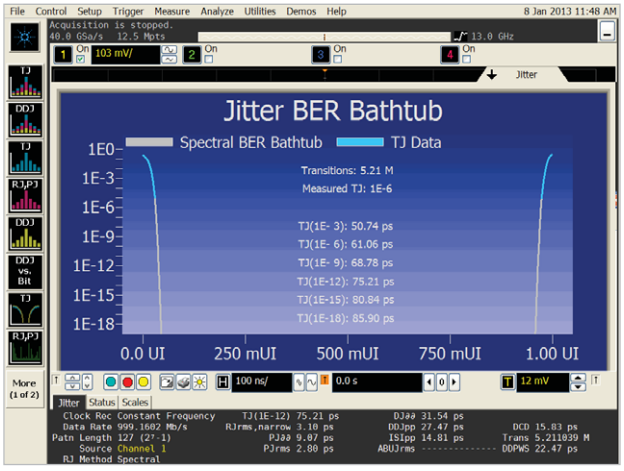


Figure 8.

Simplified display leverages existing measurement results tabs and measurement toolbars, integrating the EZJIT Plus measurement capability into the Infiniium display window. When the RJ/DJ graphical display window is minimized to view the voltage vs. time waveform under test, the jitter separation results are still visible in the jitter measurement results tab.

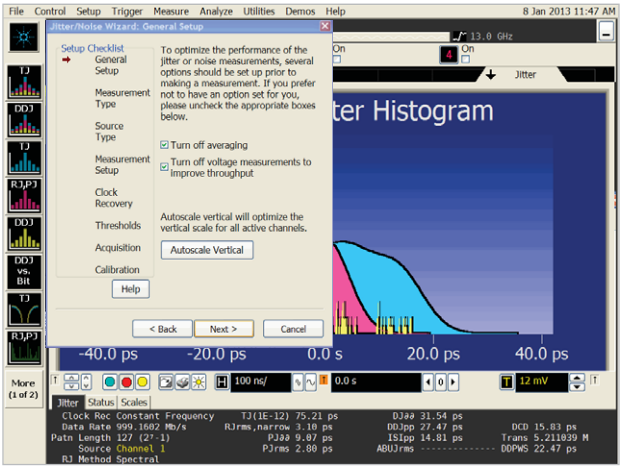
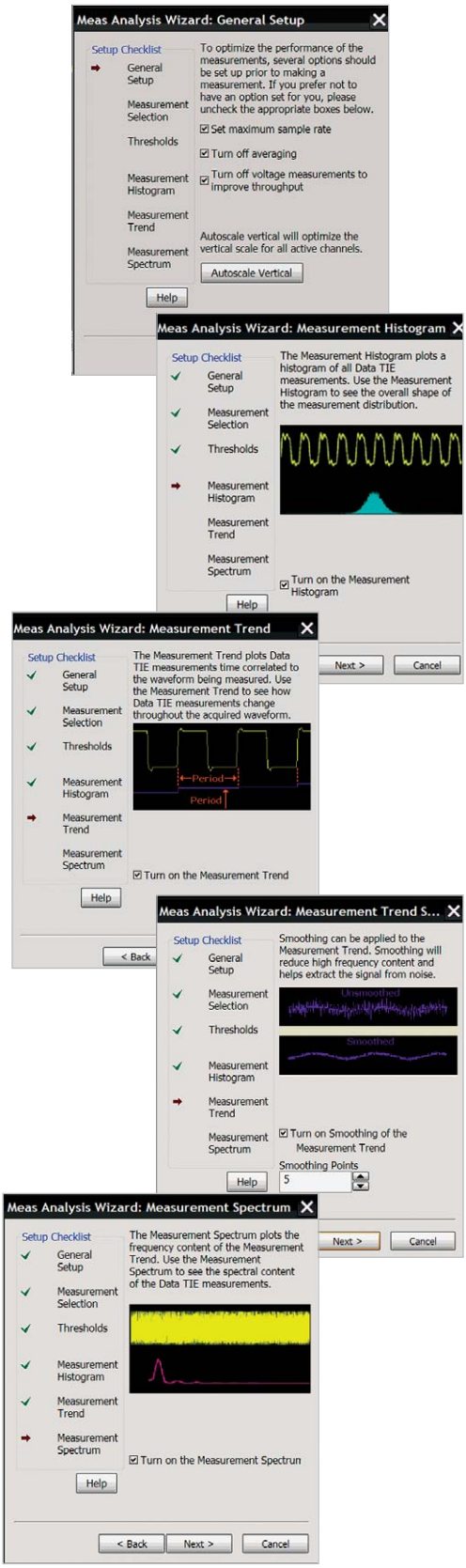


Figure 9.

A step-by-step wizard simplifies complex jitter measurement setups and allows for complete user control over important parameters such as the measurement threshold voltage and clock recovery method.

EZJIT: Essential Jitter Analysis Tools

Included with EZJIT Plus



Jitter analysis made easy

A wizard in the EZJIT jitter analysis software helps you quickly set up the Infiniium oscilloscopes and begin taking measurements. With time-correlated jitter trend and signal waveform displays, the relationships between jitter and signal conditions are more clearly visible. Intuitive displays and clear labeling of information make it easy to comprehend measurement results.

Figure 10. The setup wizard prompts you to select measurement thresholds, histogram, jitter trend, and/or spectrum displays.

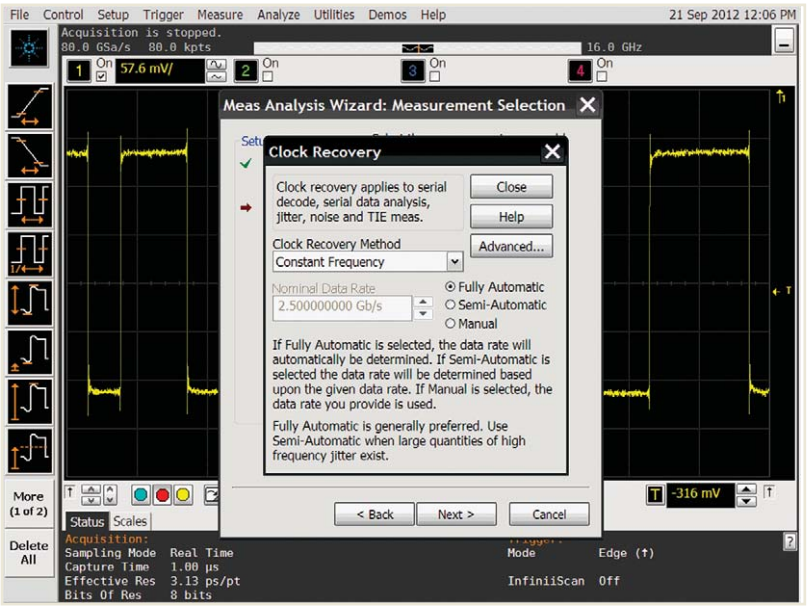


Figure 11. The EZJIT wizard simplifies jitter measurement setup, such as advanced clock recovery, shown here.

Extensive parametric analysis

EZJIT jitter analysis software can analyze the time variability of any of the following fundamental parametric measurements:

Single-source
- Period
- Frequency
- Positive pulse width
- Negative pulse width
- Duty cycle
- Rise time
- Fall time

Dual-source
- Setup time
- Hold time
- Phase

Clock
- Time-interval error (TIE)
- N - Period Jitter
- Period to Period Jitter
- Pos width to Pos width jitter
- Neg width to Neg width jitter
- Cycle-to-cycle duty cycle

Data
- Time interval error (TIE)
- Data rate
- Unit interval
- n - UI jitter
- UI - UI jitter
- Clock Recovery Rate

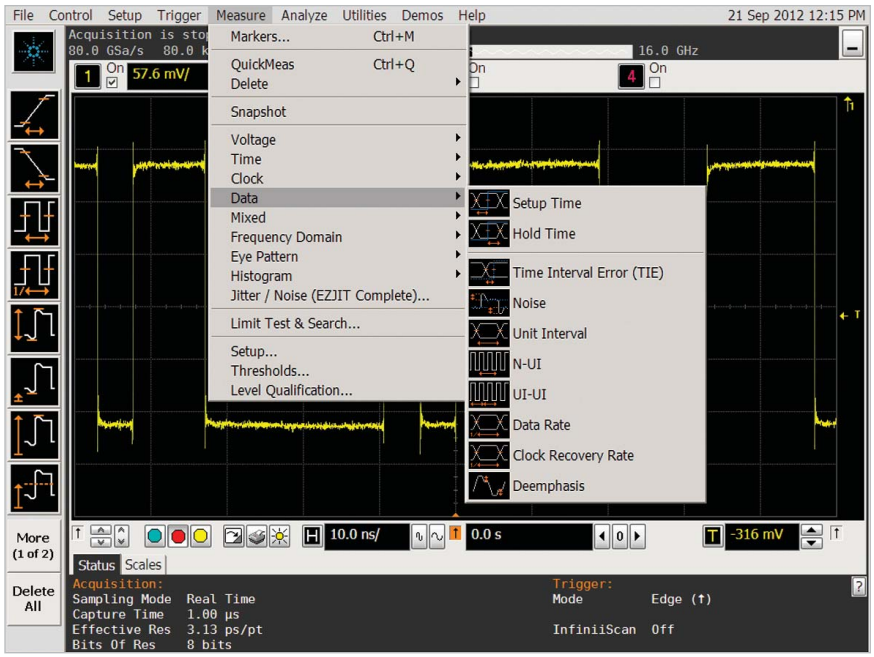


Figure 12. Extensive parametric analysis provides insight into data jitter components.

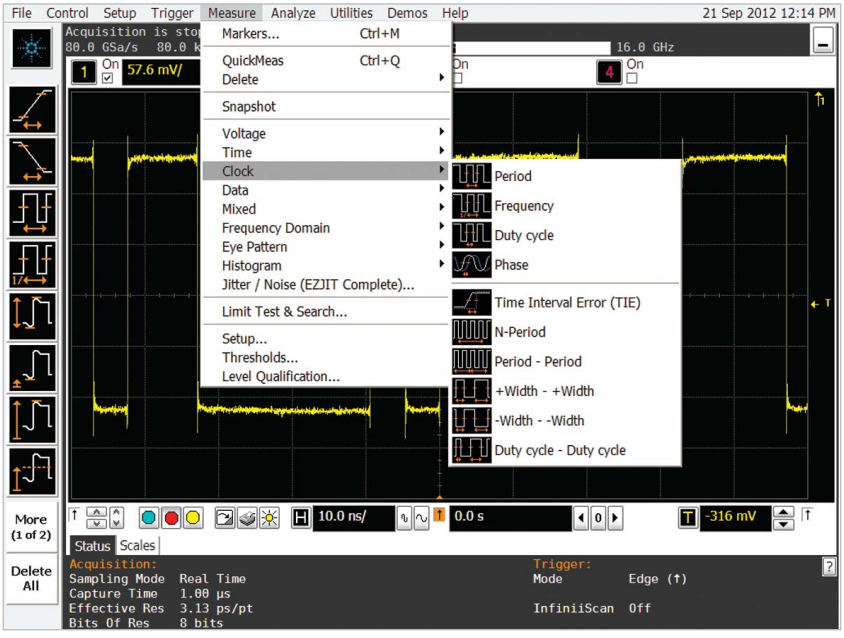


Figure 13. Clock jitter measurements provides insight into clock jitter components.

Real-time trend, histogram, and spectrum displays

Measurement data can be viewed as a trend display (Figure 14), showing a time plot of the measurement time-correlated with the signal waveform data. This makes it easy to understand relationships between jitter and signal conditions, such as intersymbol interference (ISI).

Figure 14. A trend display, showing a time plot of the measurement time-correlated with the signal waveform data, makes it easy to understand relationships between jitter and signal conditions.

The histogram display (Figure 15) plots the relative occurrence of values for the measured parameter. The histogram provides insight into the statistical nature of the jitter.

For example, the histogram shown in Figure 15 appears as two gaussian distributions. The peak-to-peak jitter between the gaussians indicates significant deterministic jitter in the signal, while the gaussians show the spread of random jitter.

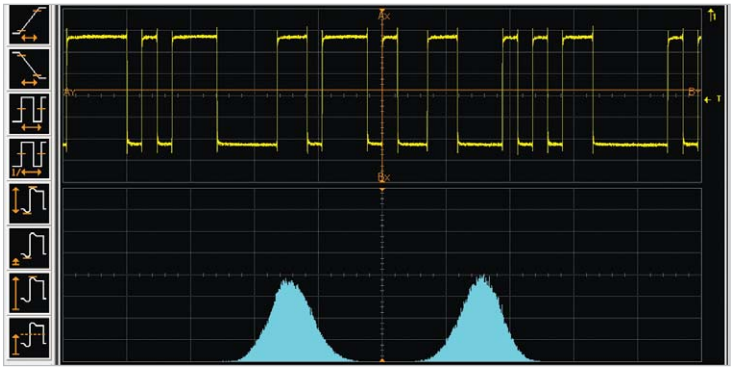


Figure 15. A histogram display plots the relative occurrence of values for the measured parameter, providing insight into the statistical nature of the jitter.

The spectrum display (Figure 16) shows the spectral content of the jitter. The spectrum display can be useful for identifying sources of jitter by their frequency components. For example, if you suspect a switching power supply with a switching frequency of 33-KHz is injecting jitter, you can test your theory by examining the jitter spectrum for a peak at 33-KHz.

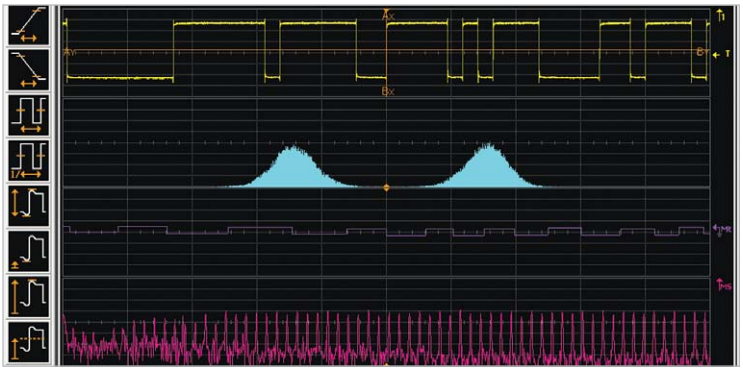


Figure 16. A spectrum display shows the spectral content of the jitter, useful for identifying sources of jitter by their frequency components.

Flexible clock recovery

You can choose constant-frequency or phase-locked loop (PLL) clock recovery as well as use an explicit clock on another input channel to time the data transition. With PLL clock recovery, the data rate and loop bandwidth are adjustable.

Many standards allow the use of spread-spectrum clocking to avoid concentrating EMI and RFI at specific frequencies. Spread-spectrum clocking is simply FM modulation of the clock frequency, usually at some frequency well below the clock frequency. The bandwidth of the PLL in the receiver hardware allows it to track the slow change in the clock frequency while allowing faster changes to be measured.

Figure 17. You can choose constant-frequency or phase-locked loop (PLL) clock recovery. With PLL clock recovery, the data rate, loop bandwidth and damping factor are adjustable.

Deep memory captures low-frequency jitter

Deep memory is especially valuable for jitter analysis. The optional 2 Gpts memory on the Agilent 90000 X-Series and 90000 Q-Series is helpful in measuring low frequency jitter. At a sample rate of 80 GSa/s and incoming data rate of 2.5 Gb/s, 2 Gpts allows you to capture jitter frequency components down to 40Hz. Comparably in the 90000A, 9000A, and 9000 H-Series, the 40 GSa/s sample rate and optional 1 Gpts memory allows you to capture jitter frequency components as low as 40 Hz.

In some cases, measuring low-frequency jitter is not required; for example, the clock recovery PLL in most serial data receivers can reject jitter very effectively at moderately low frequencies. But sometimes an event occurring at a low repetition rate can cause bursts of jitter or noise with higher frequencies that the PLL cannot reject.

An example is shown in Figure 18. The upper yellow trace is a serial data signal. The middle green trace shows an uncorrelated aggressor signal that is causing short-term bursts of jitter in the data signal. The lower purple trace, showing a jitter trend signal derived from the serial data signal, plots the timing of each edge in the data stream compared to the "ideal" recovered clock. You can see a burst of timing errors that coincides with each transition in the middle green signal.

Further jitter analysis support

For additional jitter analysis features, including Rj/Dj separation, bathtub curve generation, and ABUJ extraction, Agilent offers the N5400A EZJIT Plus jitter analysis software.

For even deeper insight, apply the same deep analysis and component separation to the vertical noise affecting your signal using Agilent's N8813A EZJIT Complete software.

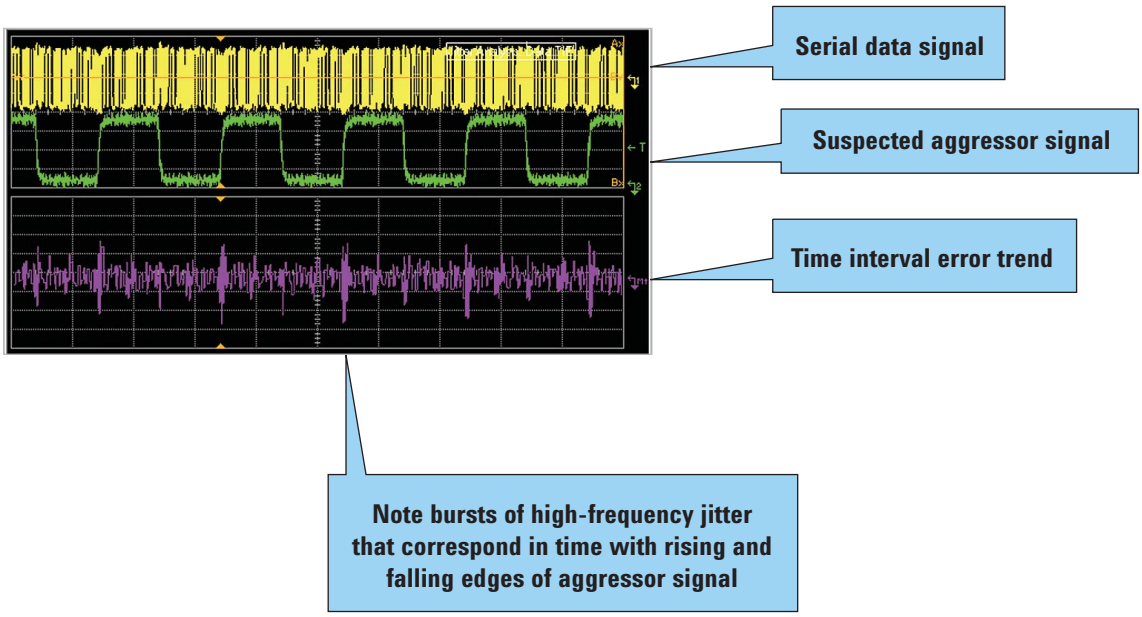


Figure 18. The clock recovery PLL in most serial data receivers can reject jitter at low frequencies. However, sometimes events occurring at low frequencies (middle green trace) can cause bursts of jitter that contain higher frequencies that the PLL cannot reject (lower purple trace).

Oscilloscope compatibility

Oscilloscopes	Software revision
90000 Q-Series	3.5 or higher
90000 X-Series	3.0 or higher
90000 Series	2.1 or higher
9000 Series	2.0 or higher
9000 H-Series	4.20 or higher
90008 Series Oscilloscopes/Digitizers	All

Ordering information

To order the EZJIT jitter analysis software with an oscilloscope, please order the option indicated in the table:

	Option number			
Oscilloscope	EZJIT	EZJIT Plus	EZJIT Complete	Description
DSO9000 Series DSO9000 H-Series DSO90000 Series DSO90000 X-Series DSO90000 Q-Series	002	004	057	EZJIT, EZJIT Plus, and EZJIT Complete jitter analysis software for Infiniium DSO90000 oscilloscopes (installed)

To order the EZJIT jitter analysis software for an existing oscilloscope, please order the following:

Model number	Description
E2681A	After-purchase EZJIT jitter analysis software for Infiniium oscilloscopes
N5400A	After-purchase EZJIT Plus jitter analysis software for Infiniium oscilloscopes
N5401A	After-purchase EZJIT Plus upgrade from existing EZJIT installation for oscilloscopes
N8813A	After-purchase EZJIT Complete upgrade from existing EZJIT Plus installation for oscilloscopes

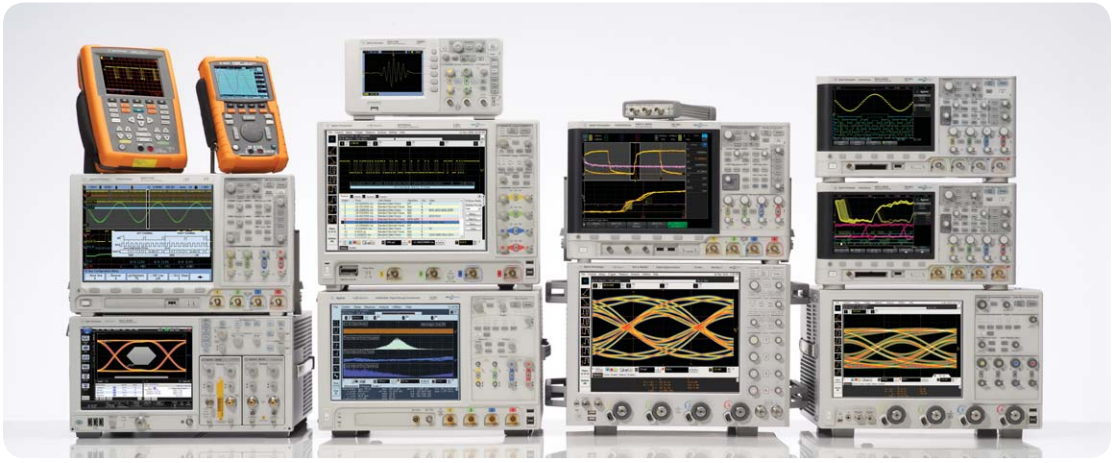
Other Measurement Software for High Speed Digital Data Analysis

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 Plus	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	Data Sheet	5990-6541EN
EZJIT Complete	Data Sheet	5991-0523EN
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

For copies of this literature, contact your Agilent representative or visit www.agilent.com/find/scope-apps.



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