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EZJIT and EZJIT Plus Jitter Analysis Software for Infiniium Series Oscilloscopes

Data Sheet

Features of the EZJIT Plus software that optimize jitter analysis include:

- Easy-to-use jitter wizard
- Measure repetitive or arbitrary data waveforms
- Constant frequency or PLL clock recovery
- Real-time measurement trend, histogram, and spectrum displays
- Available deep memory for capturing low-frequency jitter
- Separation of RJ, DJ, PJ, DDJ, ISI jitter subcomponents
- TJ estimation at low BER
- Graphical displays of DDJ vs. bit, histograms and bathtub curve
- Fully functional with other Infiniium software such as Equalization and InfiniiSim

Figure 1. The N5400A 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. EZJIT and EZJIT Plus jitter analysis software from Agilent Technologies, combined with the Infiniium Series oscilloscopes, help to identify and quantify jitter components.Time correlation of jitter to the real-time signal makes it easy to trace jitter components to their sources. Deep jitter separation algorithms (up to PBS23) identify low frequency jitter components, that are easy to miss.

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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.

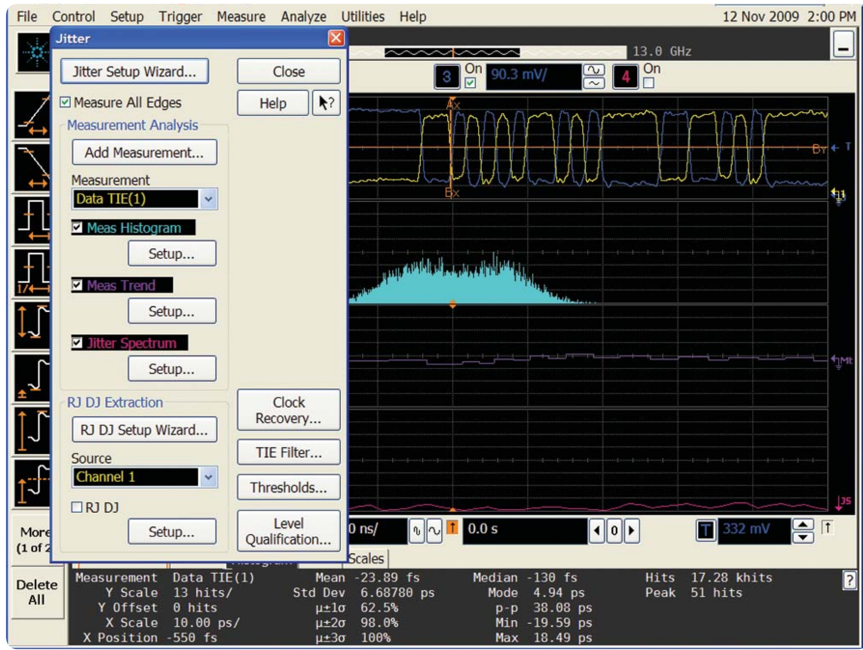


Figure 2. The setup wizard prompts you to select measurement thresholds, histogram, jitter trend, and/or spectrum displays.

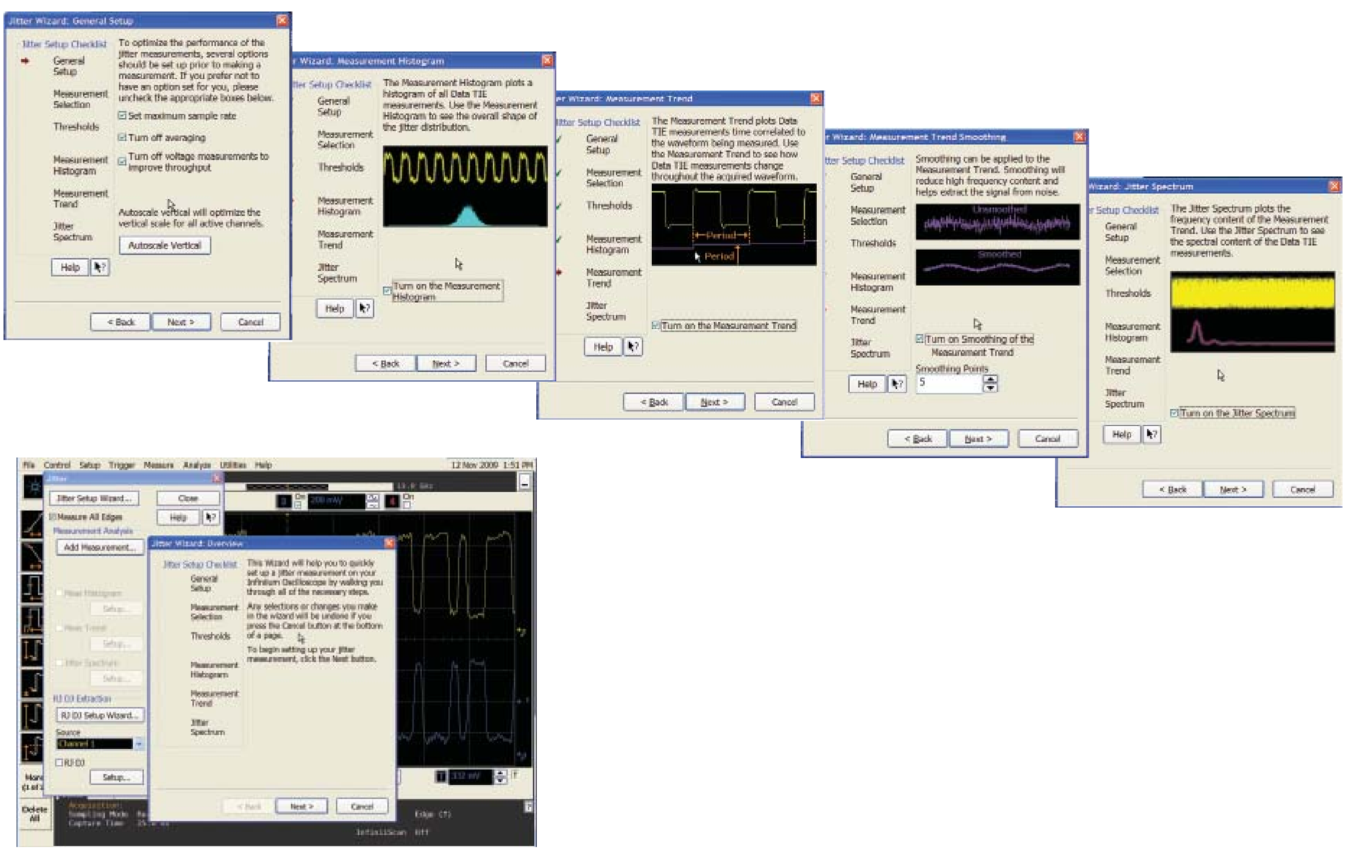


Figure 3. The EZJIT wizard simplifies jitter measurement setup.

Extensive parametric analysis

The 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

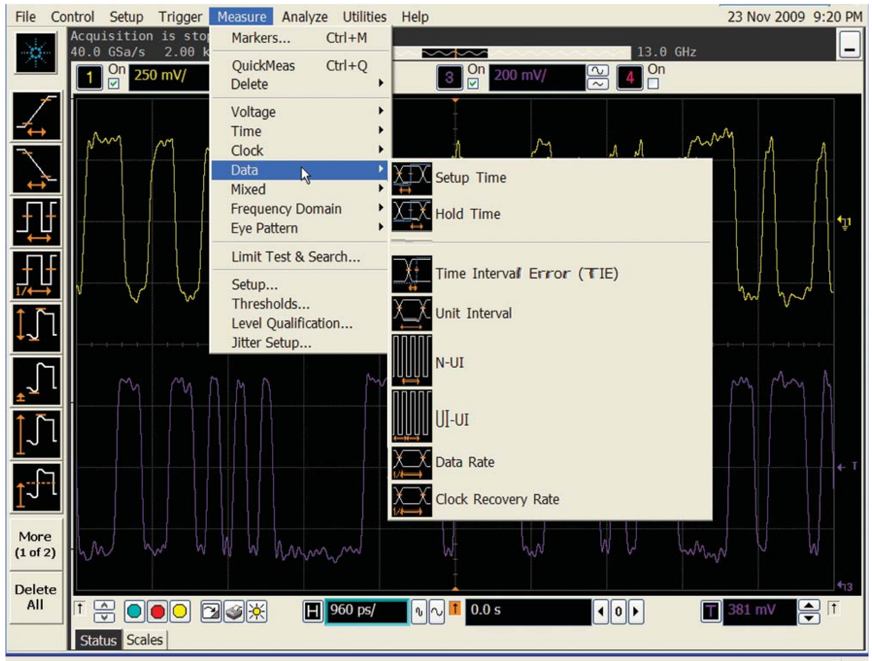


Figure 4. Extensive parametric analysis provides insight into data jitter components.

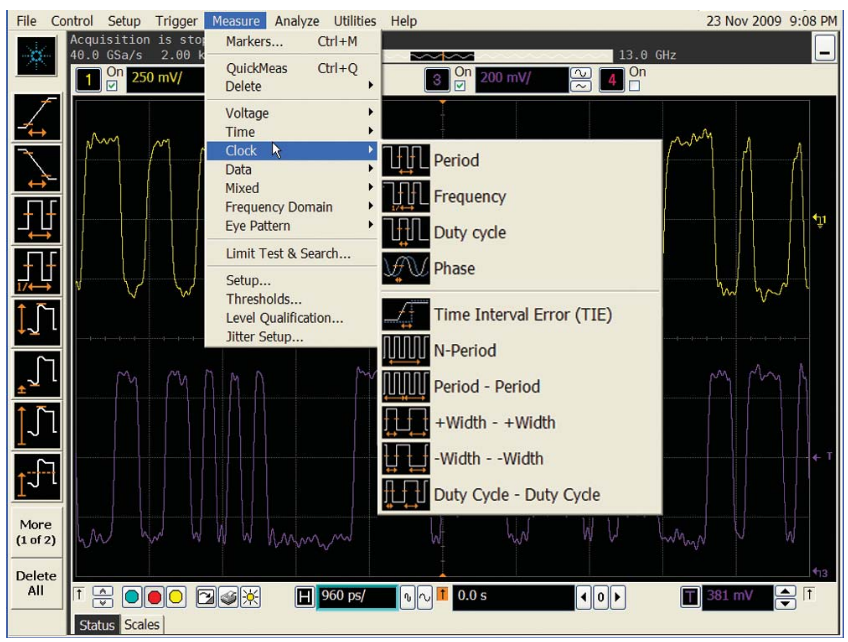


Figure 5. Clock jitter measurements provides insight into clock jitter components.

Real-time trend, histogram, and spectrum displays

Measurement data can be viewed as a trend display (Figure 5), 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).

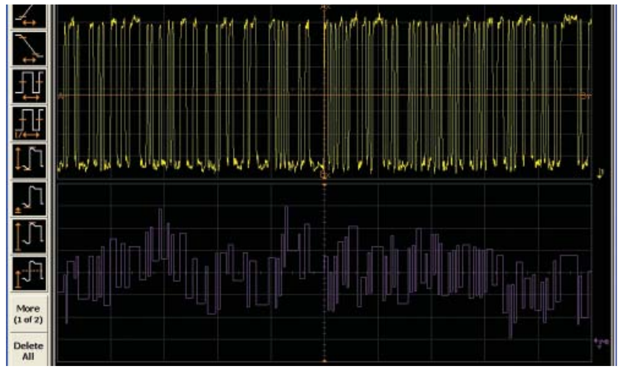


Figure 6. A trend display, showing a time plot of the measurement time-correlated with the signal waveform data, makes it easy to understand relationships between jitter and signal conditions.

The histogram display (Figure 7) 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 6 has a Gaussian appearance, which indicates that random noise is the dominant cause of the jitter.

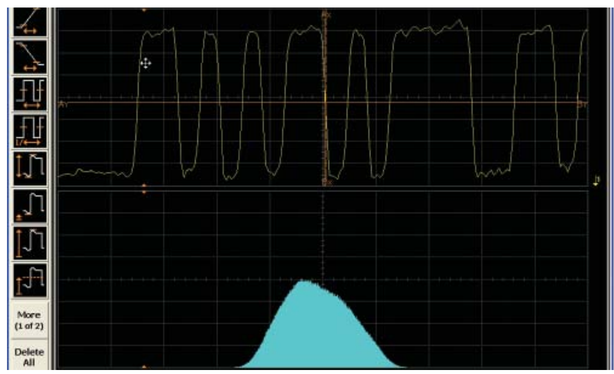


Figure 7. A histogram display plots the relative occurrence of values for the measured parameter, providing insight into the statistical nature of the jitter.

The spectrum display (Figure 8) 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.

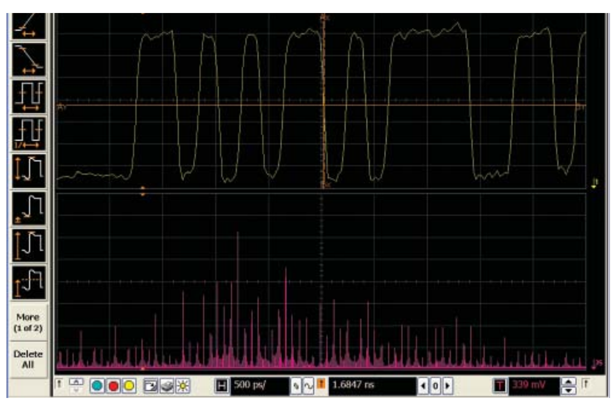


Figure 8. A spectrum display shows the spectral content of the jitter, useful for identifying sources of jitter by their frequency components.

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.

The oscilloscope's clock recovery software needs to emulate the behavior of the PLL in the clock recovery circuit in order to show the jitter that the receiver experiences. At the top in Figure 8, you see a 2.5 Gb/s signal modulated at 33 KHz (upper yellow trace). The lower purple trace is the jitter trend, in which you can clearly see the 33 KHz sawtooth modulation.

With the oscilloscope's clock recovery software set to emulate a PLL with the appropriate bandwidth, the scope now shows what the receiver sees. The 33 KHz modulation is removed from the jitter trend, as seen in the lower screen in Figure 8.

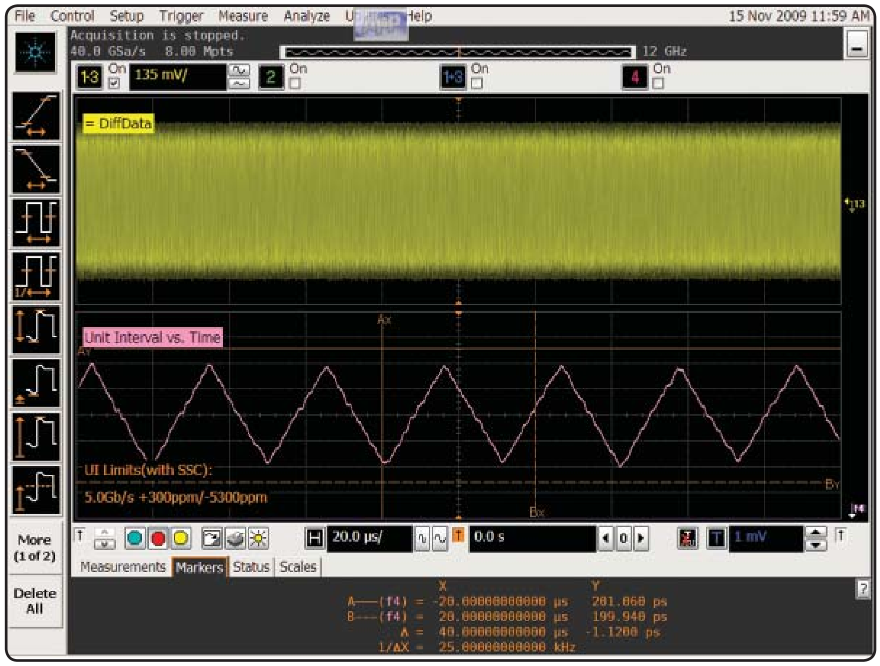


Figure 9. You can choose constant-frequency or phase-locked loop (PLL) clock recovery. With PLL clock recovery, the data rate, loop bandwidth and damping factor are adjustable.

RJ/DJ separation for jitter compliance

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.

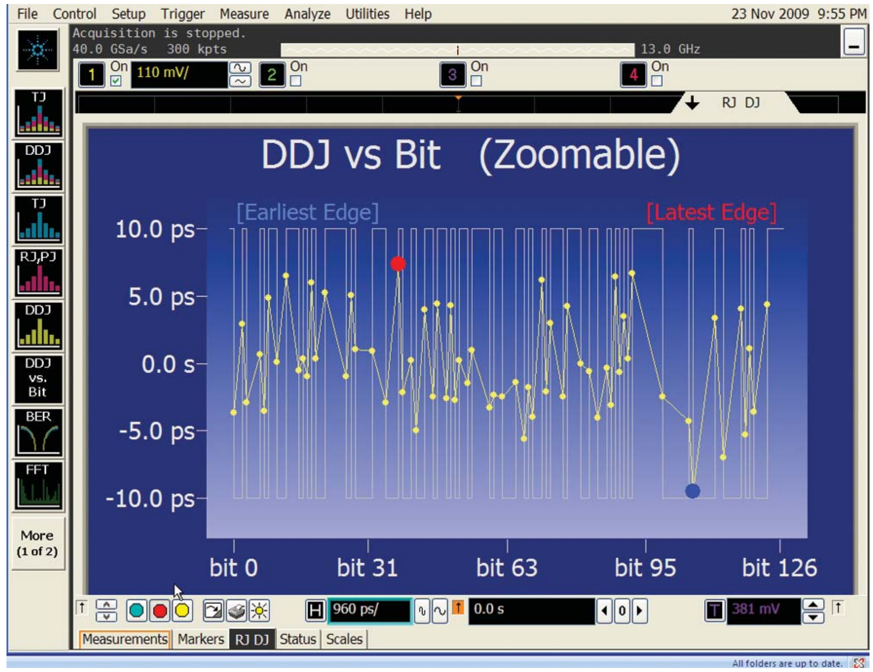


Figure 10. DDJ vs. Bit chart

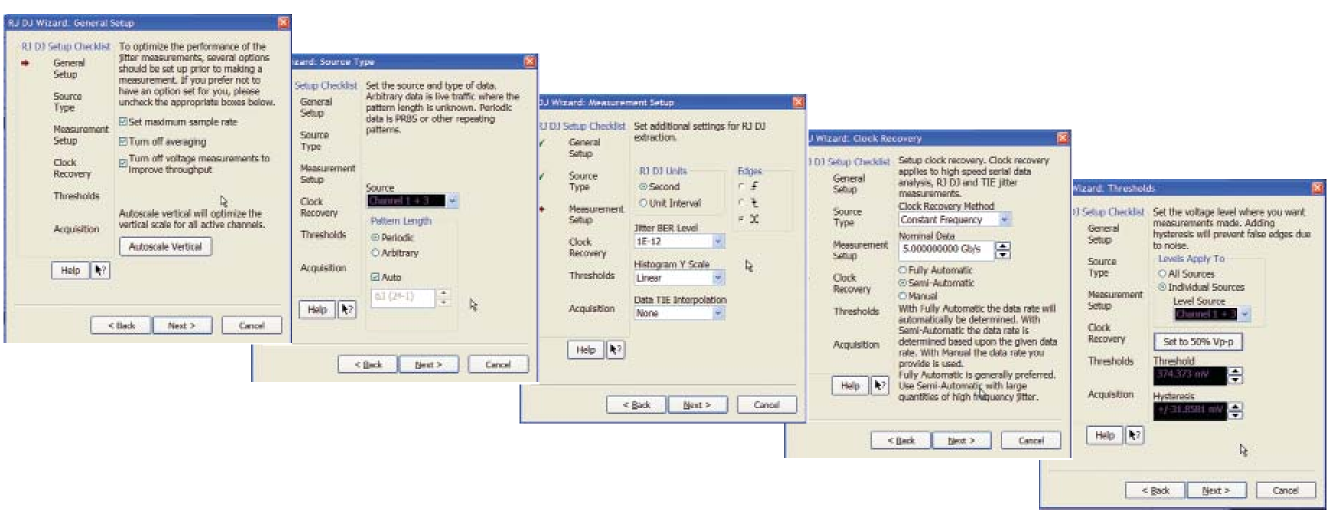
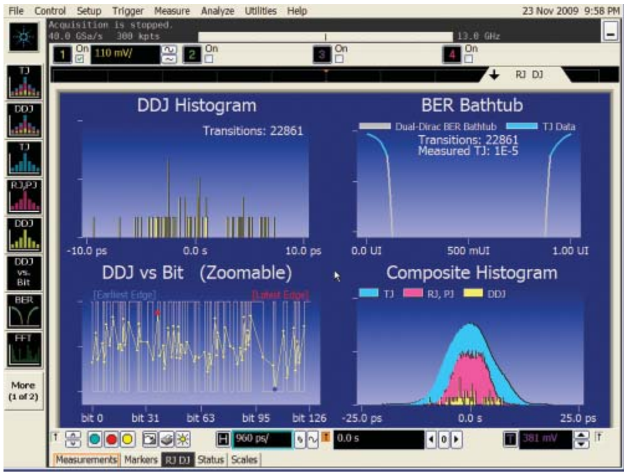
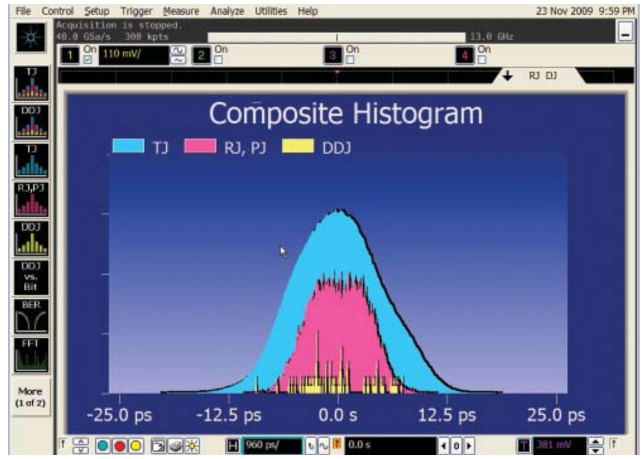


Figure 11. RJ/DJ Wizard allows user selection of data pattern type, TJ BER calculation level, clock recovery type and jitter measurement threshold.

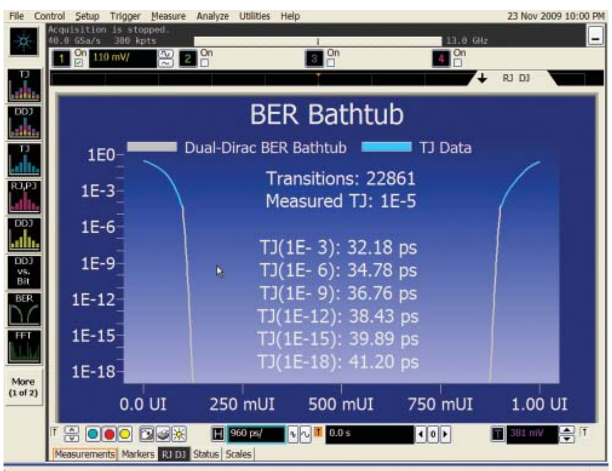
Jitter separation and total jitter estimation at low BER



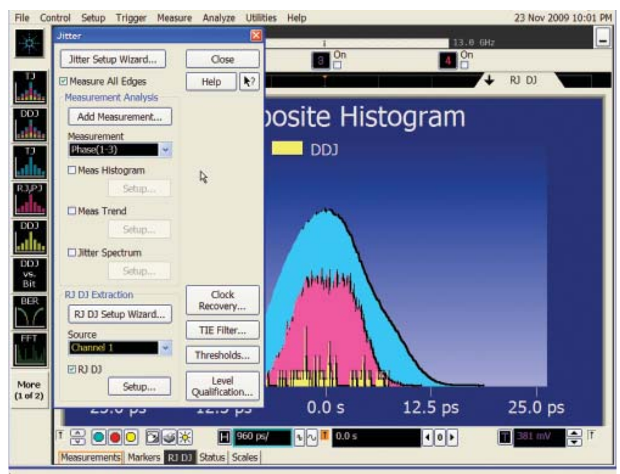
4-in-1 jitter measurement results display allow for multiple views of jitter populations and distributions, data-dependent jitter versus bit in repetitive patterns, as well as the bathtub curve plot, which measures eye-opening vs. bit error rate.



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.



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.



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.

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 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 and 9000A, the optional 1 Gpts memory allows you to capture jitter frequency components as low as 40Hz.

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 12. 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 and bathtub curve generation, Agilent offers the N5400A EZJIT Plus jitter analysis and E2690A time interval and jitter analysis software packages.

For more information on the E2690A, please see "Related Literature" at the end of this document.

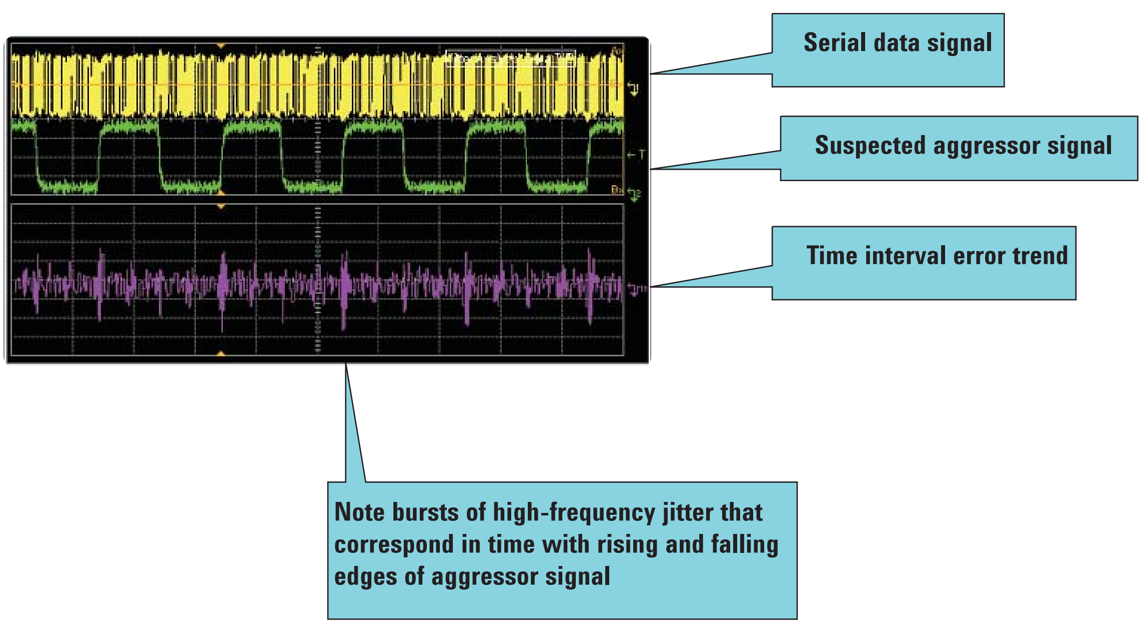


Figure 12. The clock recovery PLL in most serial data receivers can reject jitter at low frequencies. However, sometimes events occurring at low frequencies (middle green trace) can cause bursts of jitter that contain higher frequencies that the PLL cannot reject (lower purple trace).

Oscilloscope compatibility

Oscilloscopes	Software revision
8000 Series	A.04.90 or higher
90000 X-Series	3.0 or higher
90000 Series	2.1 or higher
9000 Series	2.0 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	Description
DSO90000 Series DSO90000 X-Series	002	004	EZJIT and EZJIT Plus jitter analysis software for Infiniium DSO90000 oscilloscopes (installed)
9000 Series	002	004	EZJIT and EZJIT Plus jitter analysis software for Infiniium DSO9000 oscilloscopes
8000 Series	002	N/A	EZJIT jitter analysis software for Infiniium 8000A oscilloscopes (installed at the factory)

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

Model number	Description
N5400A	After-purchase EZJIT Plus jitter analysis software for Infiniium 5485XA and DSO90000 series oscilloscopes
N5401A	After-purchase EZJIT Plus upgrade from existing EZJIT installation for DSO90000 series oscilloscopes
E2681A	After-purchase EZJIT jitter analysis software for Infiniium DSO90000 series oscilloscopes

Viewing tools	E2681A EZJIT	N5400A EZJIT Plus
Jitter debug views		
Measurement trend	√	√
Histogram	√	√
Text		
Jitter modulation spectrum	√	√
Multi-acquisition	√	√
Jitter compliance views		
Real-time eye	*	*
Bathtub curve		√
DDJ vs. bit plot		√
Composite histograms		√
TJ histogram		√
RJ/PJ histogram		√
RJ/PJ spectrum (DDJ removed)		√

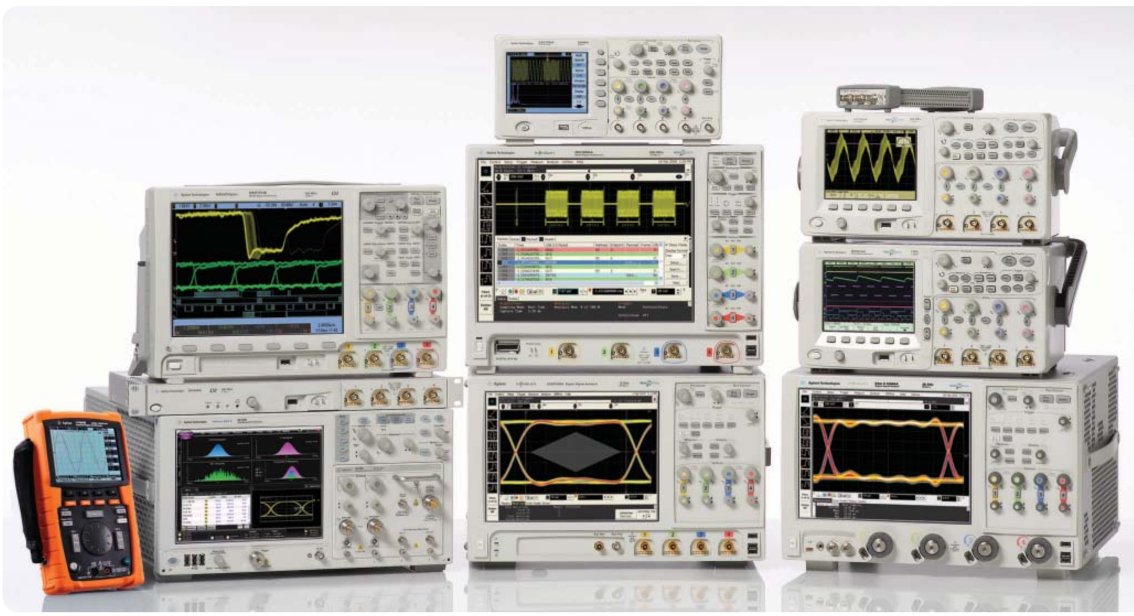
Jitter/timing measurements	E2681A EZJIT	N5400A EZJIT Plus
Clock measurements		
Period	√	√
Pulse width (+, –, both)	√	√
Frequency	√	√
Duty cycle (+, –)	√	√
Differential crossing voltage (+, –, both)		
Time-interval error	√	√
Cycle-cycle jitter	√	√
N-cycle jitter	√	√
Cycle-cycle +/– width	√	√
Cycle-cycle duty cycle	√	√
Data measurements		
Time-interval error	√	√
Data rate	√	√
Unit interval	√	√
By event #		
By size		
Pulse width jitter		
Delay measurements		
Setup/hold	√	√
Phase	√	√
User defined		
Edge rate measurements		
Rise/fall time	√	√
Differential rise time analysis		

Compliance test measurements	E2681A EZJIT	N5400A EZJIT Plus
Total jitter separation components		
Random jitter (RJ)		√
Deterministic jitter (DJ)		√
Periodic jitter (PJ)		√
Data dependent jitter (DDJ)		√
Inter-symbol interference (ISI)		√
Duty cycle distortion (DCD)		√
Total jitter estimation		√
BER range		10^{-18}
Pattern length limitation		
Periodic mode		2^{12}
Arbitrary mode		none

* Requires E2688A serial data analysis software

** 32 pattern repeats per acquisition are recommended for greater accuracy of measured PJ, 128 repeats will provide maximum accuracy.

*** These items are not calculated directly, but derived from other values.



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