Agilent Technologies

EZJIT and EZJIT Plus Jitter Analysis Software for Infiniium Series Oscilloscopes

Data Sheet

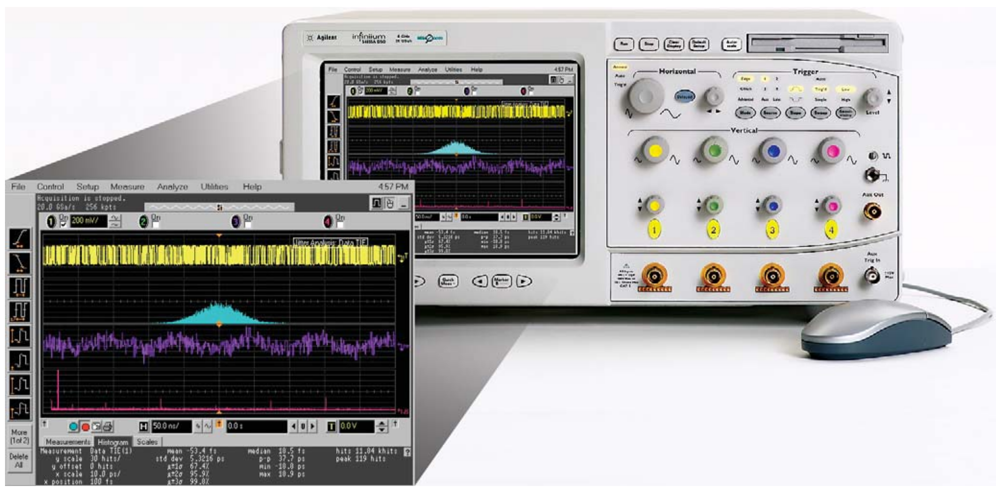


Figure 1. The N5400A provides multiple views of jitter for maximum insight as well as quick, accurate separation of jitter subcomponents for compliance testing.

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 jitter analysis software from Agilent Technologies, combined with the Infiniium 54830, 54850 and DSO80000 Series oscilloscopes, helps 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.

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

- Easy-to-use jitter measurements
- Extensive parametric analysis
- Constant frequency or PLL clock recovery
- Real-time trend, histogram, and spectrum displays
- Available deep memory for capturing low-frequency jitter
- Separation of RJ, DJ, PJ, DDJ, ISI jitter subcomponents
- TJ extimation at low BER
- Graphical displays of DDJ vs. bit histograms and bathtub curve

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.

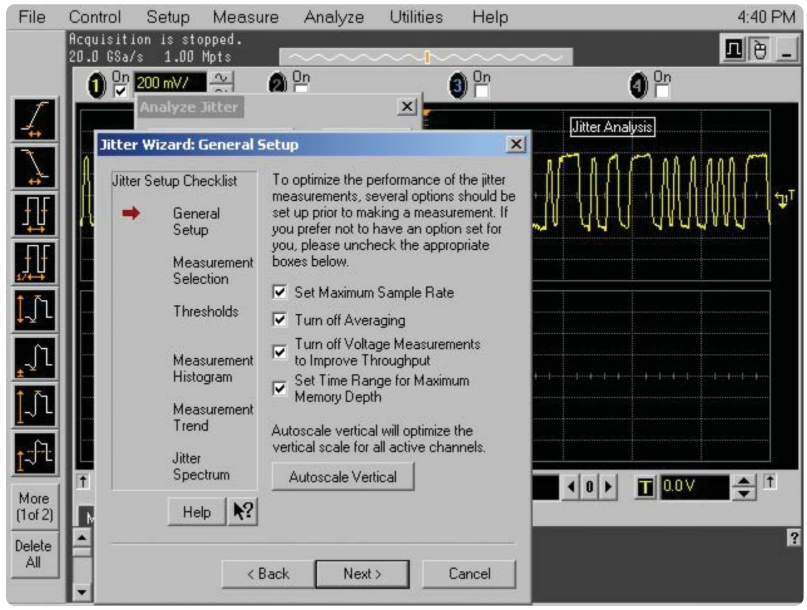


Figure 2. The EZJIT wizard simplifies jitter measurement setup.

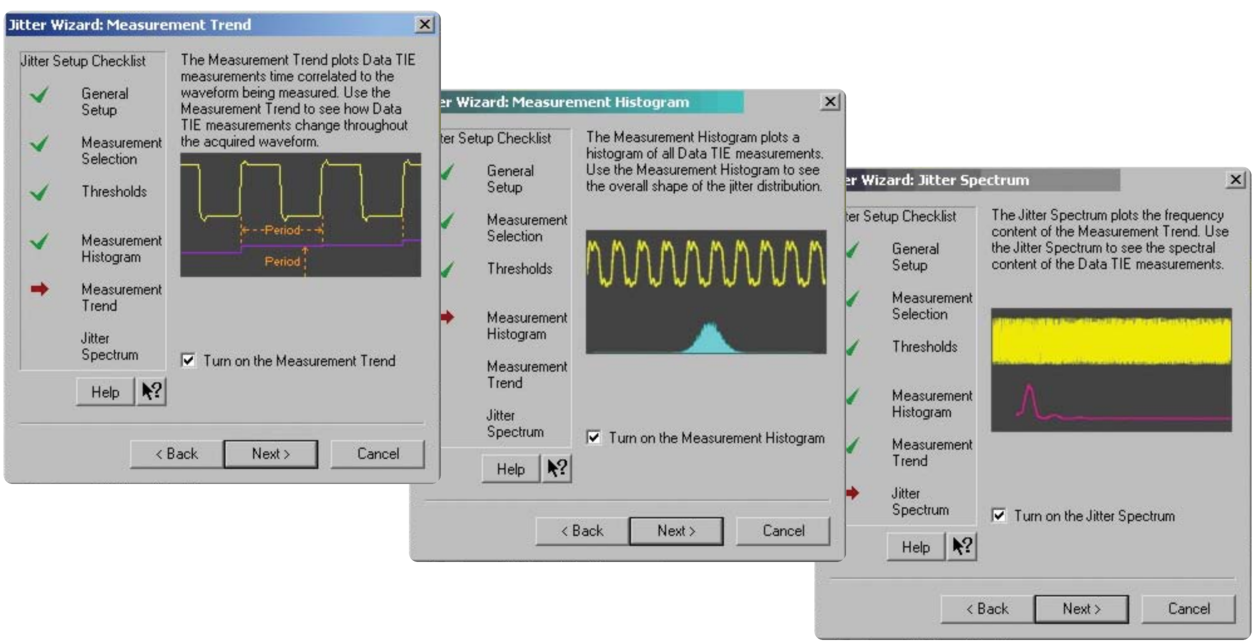


Figure 3. The setup wizard prompts you to select jitter trend, histogram, and/or spectrum displays.

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)
- Cycle-to-cycle jitter
- N-cycle jitter
- Cycle-to-cycle positive width
- Cycle-to-cycle negative width
- Cycle-to-cycle duty cycle

Data

- Time interval error (TIE)
- Data rate
- Unit interval

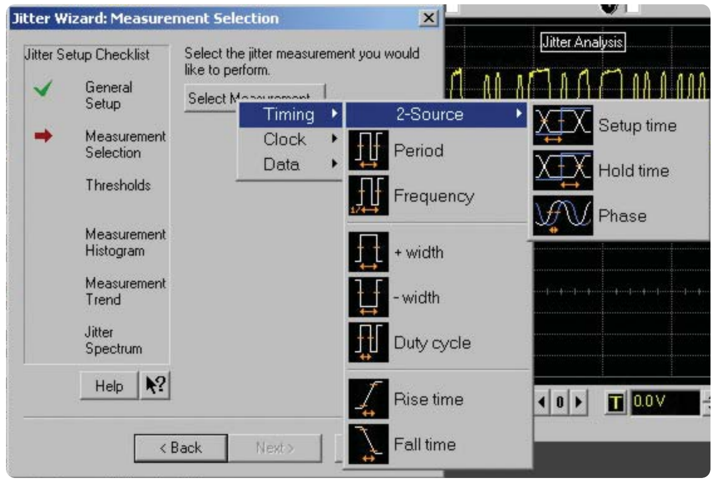


Figure 4. Extensive parametric analysis provides insight into jitter components.

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).

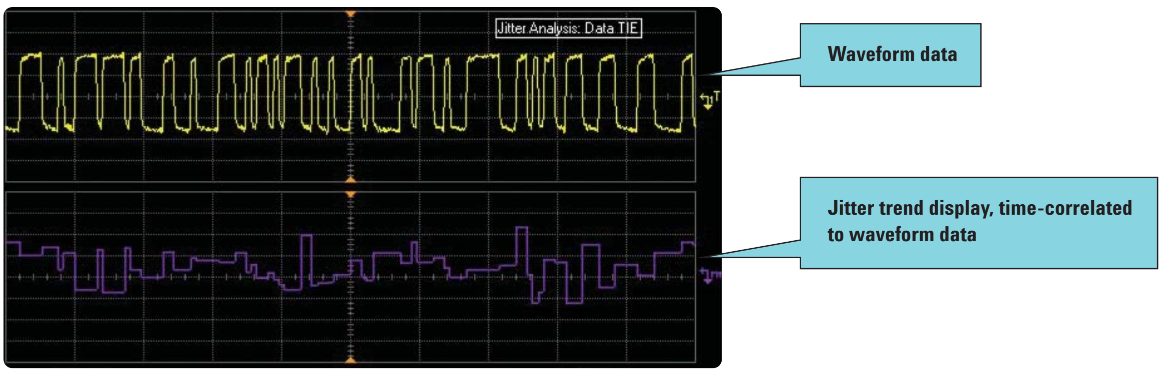


Figure 5. A trend display, showing a time plot of the measurement time-correlated with the signal waveform data, makes it easy to understand relationships between jitter and signal conditions.

The histogram display (Figure 6) 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.

The spectrum display (Figure 7) 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.

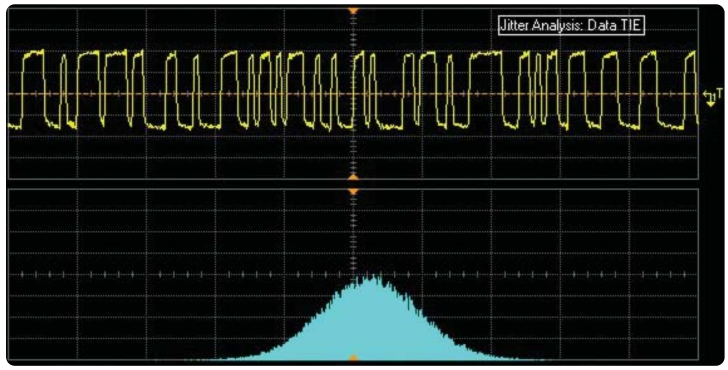


Figure 6. A histogram display plots the relative occurrence of values for the measured parameter, providing insight into the statistical nature of the jitter.

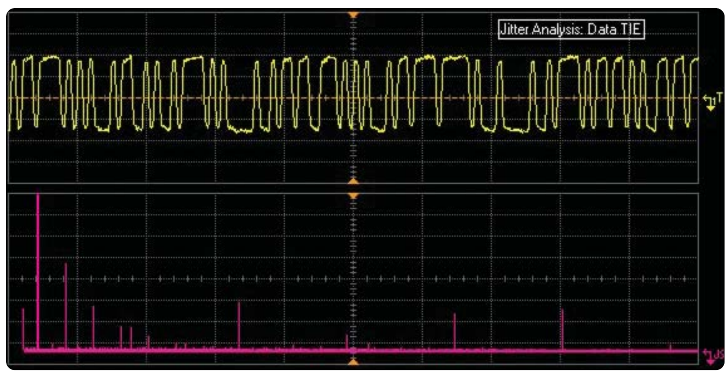


Figure 7. A spectrum display shows the spectral content of the jitter, useful for identifying sources of jitter by their frequency components.

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 rejecting faster changes.

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.

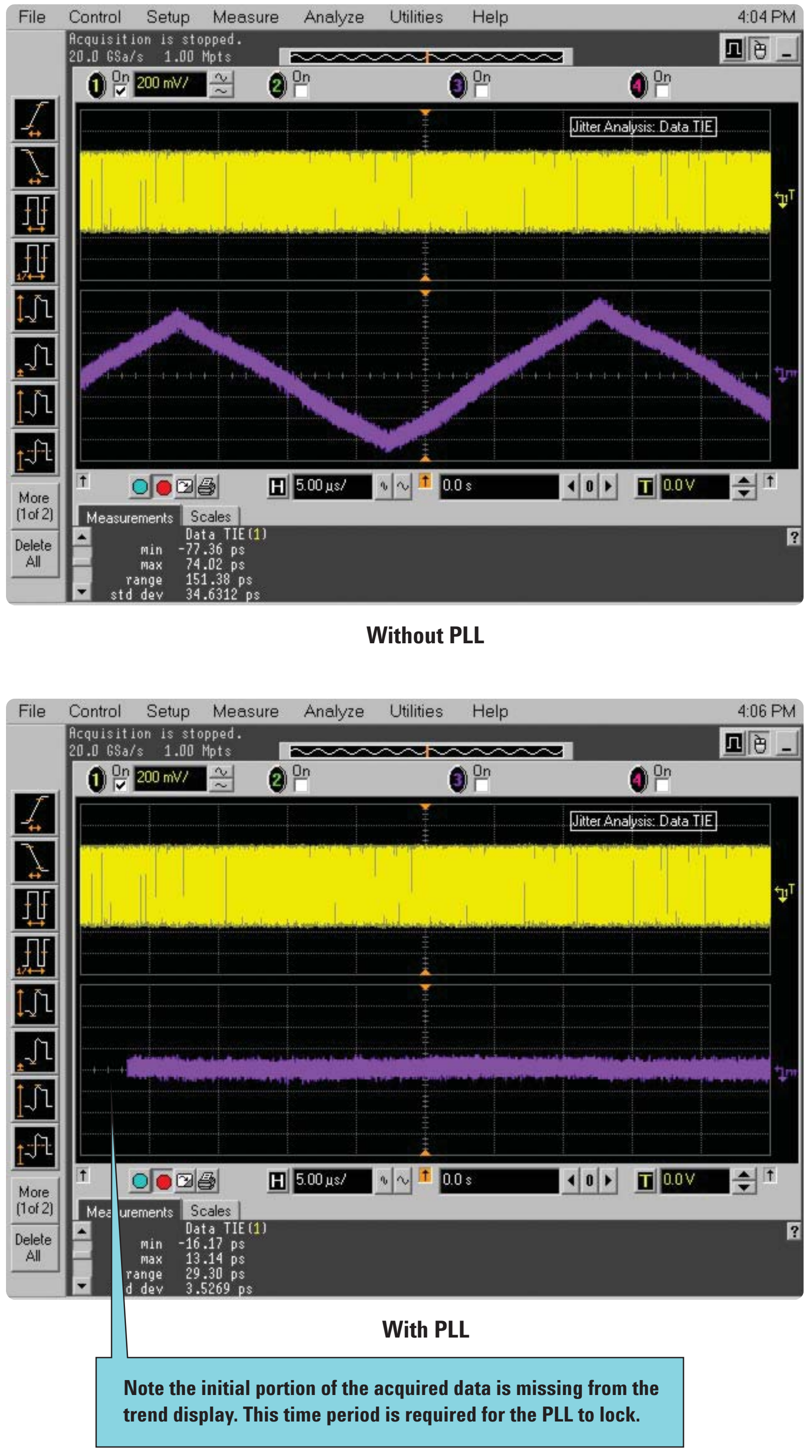
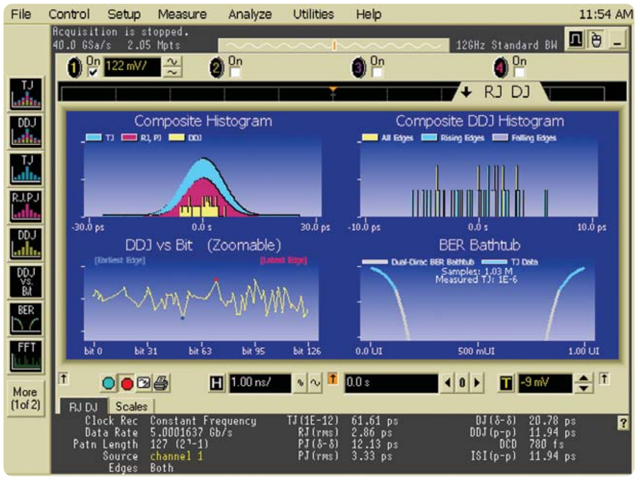
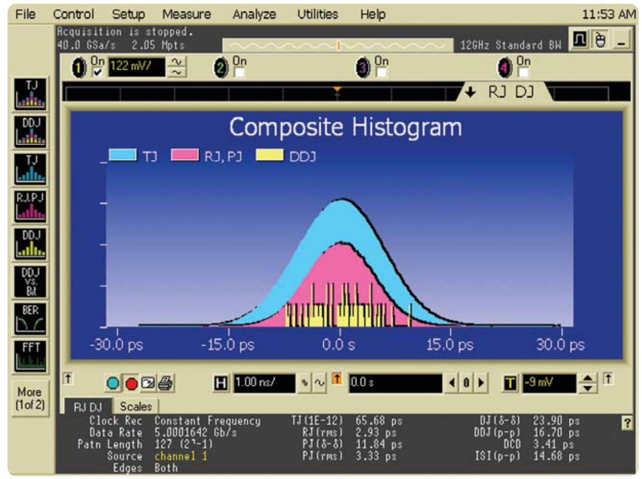


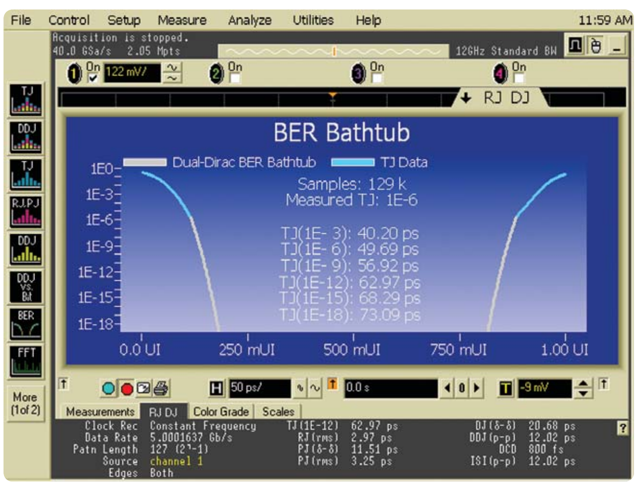
Figure 8. You can choose constant-frequency or phase-locked loop (PLL) clock recovery. With PLL clock recovery, the data rate and loop bandwidth are adjustable.



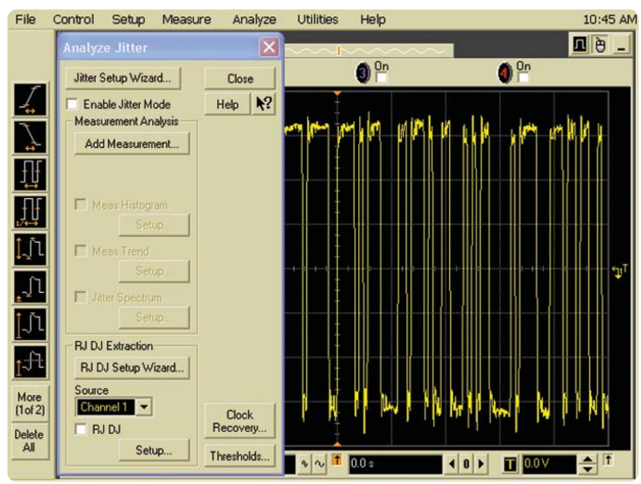
4-in-1 jitter measurement results display allow for multiple views of jitter populations and distributions, data-dependent jitter versus bit in repetitive patterns, as well as the bathtub curve plot, which measures eye-opening vs. bit error rate.



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 1 M memory (32 M at rates of 2 GSamples/second or slower) in the Agilent 54850 Series oscilloscopes is recommended for jitter analysis. At a sampling rate of 20 GSa/s and an incoming data rate of 2.5 Gb/s, 1 M memory allows you to capture jitter frequency components down to 20 KHz. In the 54830 Series, the optional 16 M memory allows you to capture jitter frequency components as low as 312 Hz, at a sampling rate of 4 GSa/s.

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 9. 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, aggressor 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.

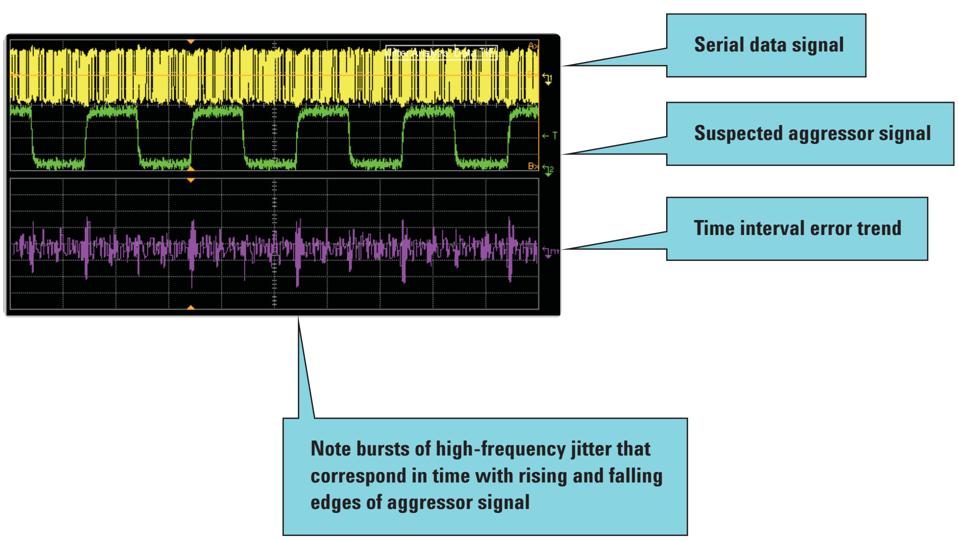


Figure 9. The clock recovery PLL in most serial data receivers can reject jitter at low frequencies. However, sometimes events occurring at low frequencies (middle green trace) can cause bursts of jitter that contain higher frequencies that the PLL cannot reject (lower purple trace).

Oscilloscope compatibility

The EZJIT and EZJIT Plus jitter analysis software are compatible with Agilent 54850 and DSO80000 Series oscilloscopes with operating software version A.03.90 or higher. The E2681A EZJIT jitter analysis software is also compatible with Agilent 54830 Series oscilloscopes with operating software version A.03.15 or higher.

The following table indicates the optimal oscilloscope choice for various commonly used data rates.

Data rate	Technology	Recommended oscilloscopes	Oscilloscope bandwidth	Maximum acquisition memory available	Time interval error jitter measurement noise floor
250 Mb/s	GbE (4x250 Mb/s)	54830B 54831B 54830D 54831D	600 MHz	16 M samples	7 ps RMS
333 Mb/s	DDR	54830B 54831B 54830D 54831D	600 MHz	16 M samples	7 ps RMS
533 Mb/s	DDR	54832D	1 GHz	16 M samples	5 ps RMS
1 Gb/s	Fibre Channel 1063 RapidIO	54854A	4 GHz	1 M samples	1.8 ps RMS
1.5 Gb/s	Serial ATA	54855A	6 GHz	1 M samples	1.4 ps RMS
2 Gb/s	Fibre Channel 2125	54855A	6 GHz	1 M samples	1.4 ps RMS
2.5 Gb/s	PCI Express RapidIO	54855A	6 GHz	1 M samples	1.4 ps RMS
3 Gb/s	SATA II SAS	DSO81004A	10 GHz	2 M samples	1 ps RMS
3.125 Gb/s	XAUI (4x3.125 Gb/s)	DSO81004A	10 GHz	2 M samples	
4.0 Gb/s	Fibre Channel 4250	DSO81204A DSO81304A	12 GHz 13 GHz	2 M samples	0.8 ps RMS
4.8 Gb/s	Fully Buffered DIMM	DSO81304A	13 GHz	2 M samples	0.8 ps RMS
5.0 Gb/s	PCI Express II	DSO81304A	13 GHz	2 M samples	0.8 ps RMS

Ordering information

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

Oscilloscope	Option number EZJIT	EZJIT Plus	Description
DSO80000 Series	002	004	EZJIT and EZJIT Plus jitter analysis software for Infiniium DSO80000 oscilloscopes (installed at the factory)
54850 Series	002	004	EZJIT and EZJIT Plus jitter analysis software for Infiniium 5485XA oscilloscopes (installed at the factory)
54830 Series	015	N/A	EZJIT jitter analysis software for Infiniium 5483XA 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 anlaysis software for Infiniium 5485XA and DSO80000 series oscilloscopes
N5401A	After-purchase EZJIT Plus upgrade from existing EZJIT installation for Infiniium 5485XA and DSO80000 series oscilloscopes
E2681A	After-purchase EZJIT jitter anlaysis software for Infiniium 5483XA, 5485XA and DSO80000 series oscilloscopes

Related Literature

Publication Title	Publication Type	Publication Number
Infiniium 54850 Series Oscilloscopes and InfiniiMax 1130 Series Probes	Data Sheet	5988-7976EN
Infiniium 54830 Series Oscilloscopes	Data Sheet	5988-3788EN
E2690A Time Interval and Jitter Analysis	Data Sheet	5988-9723EN
Finding Sources of Jitter with Real-Time Jitter Analysis	Application Note 1448-2	5988-9740EN

Viewing tools	E2681A EZJIT	N5400A EZJIT Plus	E2690A Advanced
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	E2690A Advanced
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	E2690A Advanced
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}	10^{-20}
Pattern length limitation		2^{12} **	

* 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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