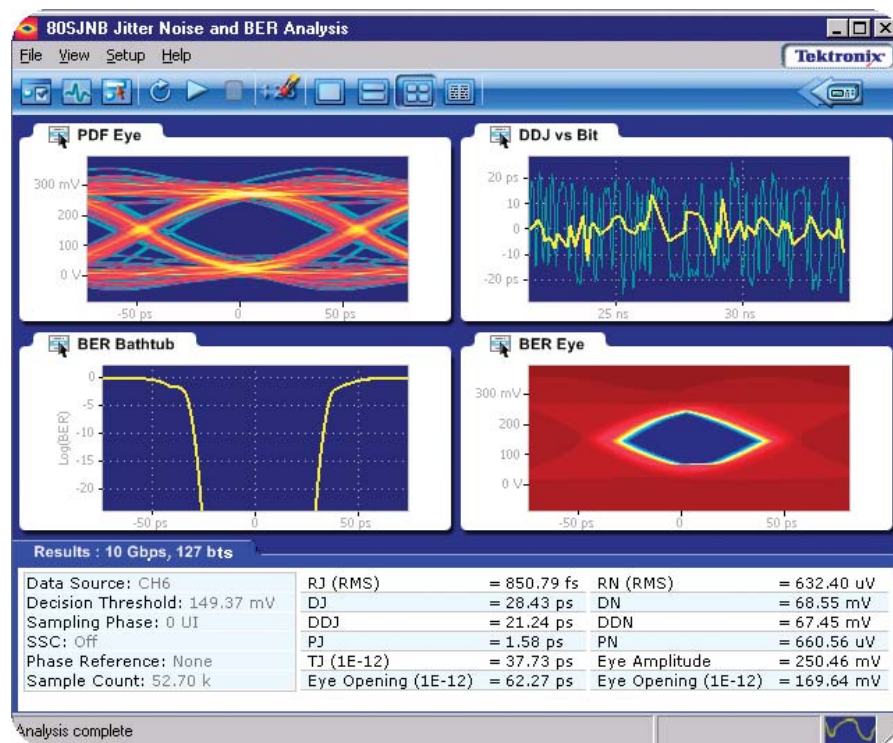


Analysis Software for Oscilloscopes

80SJNB



Jitter, Noise, BER and Serial Data Link Analysis Software for DSA8200 and 8000 Series Tektronix Sampling Oscilloscopes

80SJNB is a comprehensive software package for analysis of serial data links and related signals. The package offers industry's best jitter, noise and BER analysis, as well as a first complete solution to the Serial Data Link Analysis with channel emulation, features for de-embedding of the fixture and FFE/DFE equalizer support.

Modern Serial Data Links Designs

Acceleration of signaling speeds creates a number of challenges for design and test. The designs are evolving to address these challenges with equalization techniques in the receiver, pre-emphasis or de-emphasis in the transmitter; with dedicated fixtures for capturing the signal at test point; and with complex compliance verification procedures.

80SJNB Offers the Tools

The advanced techniques employed by the designs call for advanced tools in the measurement solutions. The concerns begin with acquisition: capturing the data signal through physical fixture distorts signal shape; 80SJNB provides you with fixture de-embedding feature which allows you to remove the effects of the fixture from the measurement. The accuracy improvement might well mean the difference between a passing design and a failing one, because the impact of the fixtures on the signal fidelity today is large.

Features & Benefits

Jitter, Noise and BER analysis of high-speed serial data rates from <1 Gb/s to 60 Gb/s provides insight into precise causes of eye closure

FFE/DFE equalization of the signal opens the eye diagram for measurements – view the signal the way the receiver comparator views it

Channel emulation from TDR waveforms or from S-parameters inserts virtual channel: observe the signal as it will look at the end of the interconnect, even while capturing the transmitter waveform only

Separation of both Jitter and Noise provides highly accurate extrapolation of BER and eye contour

Unmatched measurement system fidelity with ultra-low Jitter floor for accurate and repeatable measurement results

SSC support: analysis of systems with spread spectrum clocking, with profile and frequency

Channel emulation recalculation: with just one transmitter acquisition view the link performance for a number of emulated channels

DDPWS – Data Dependent Pulse width shrinkage measurement and plot available

Support for TWDP with Tektronix' free utility U80TWDP_LRM for compliance test on IEEE 802.3aqTM LRM devices; Analysis of the LRM result is also supported (80SJNB V2.1 opt. 01 – Advanced Version only)

Over 30 dB of channel loss is now handled and equalized, supporting advanced backplane standards

Applications

Characterize Jitter, Noise and BER performance of high-speed serial designs from 1 Gb/s to 60 Gb/s data rates

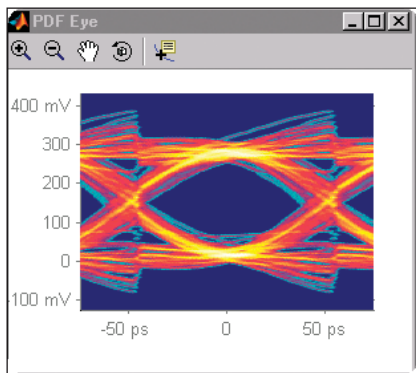
Characterize advanced links using FFE/DFE equalization and with TWDP and DDPWS measurements

Link budgeting and "What-if" analysis with emulation of a range of channels with just-one transmitter measurement

Acquire precise waveform shape for simulations or other processing; rely on acquisition with state-of-the-art resolution, Jitter, Noise and with fixture de-embedding support

Characterize Jitter, Noise and BER performance of multigigabit standards

Design validation and characterization of next generation high-speed serial data computer and communications components and systems



And what is the transmitter signal shape you are capturing? The signal from the transmitter is no longer a simple NRZ square-wave pattern. Designers alleviate high frequency loss in the media with transmitter equalization features, that is, with pre-emphasis or de-emphasis of the transmitter waveform. Correspondingly, transmitter signal today needs to be evaluated for this transmitter equalization; your 80SJNB quickly provides equalizing tap weight results to give you insight into the quality of your transmitter for both single and multi-tap transmitter equalization designs.

Beyond Measurements at Transmitter

An important part of today's evaluation of serial data links is the complicated interaction between the shape of the measured waveform and the complex behavior of the interconnect channel. It is no longer possible to assume that if transmitter output meets the eye diagram mask it will work against all channels up to a given loss. Instead, advanced link test methods acquire the true transmitter waveform shape and test against several corner-case channels.

Is the solution of emulating the channels based on their network description, for example, S-parameters? Such compliance tests are becoming a part of new standards. Now the measurement suite on your transmitter under test simply involves acquisition of the transmitter signal. Then you connect the captured signal to all required channels, one channel at a time – in emulation, rather than physically. This methodology is supported by 80SJNB; the candidate channels can be viewed without the need to re-acquire the transmitter waveform. And unlike bare-bones evaluation scripts often used for pass/fail decision the 80SJNB offers rich set of views of the signal, starting with complete waveform, oversampled for high signal fidelity. And of course the complete set of 80SJNB jitter and noise measurements is available to support your analysis of what problems, if any, your device might have. At the same time the BER eye offers a view of the link performance that matters most to the end user – in terms of BER performance and its margins. At the end of the test, save the waveform description dataset for evidence or for future experiments; then recall and re-analyze whenever is needed without the need to re-acquire.

Equalize, then Equalize Again

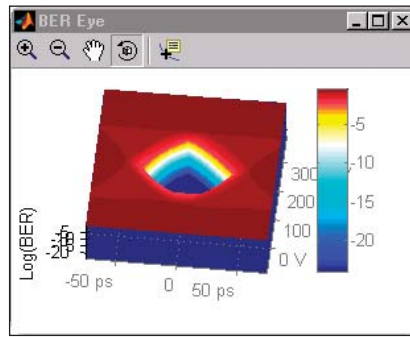
The equalization in the transmitter is one tool in the arsenal of tricks fighting the loss and dispersion in the interconnect: another one is the equalization at the receiver. Receiver equalization in most modern NRZ systems falls under either FFE (Feed Forward Equalization; also known as LFE – Linear Feedback Equalization) or DFE – Decision Feedback Equalization. A receiver equipped with equalization is capable of decoding signals which when viewed as an eye diagram are completely closed. How to measure such signals? The equalization tools in the 80SJNB can open even a completely closed eye, with your own equalizer tap values or, at a push of a button, equalization tap values on a PRBS pattern will be found for you, for either FFE or DFE equalizer. The speed of recalculation and the ease of use allows you to easily modify system parameters, such as the number and weight of taps or the amount of pre- or de-emphasis; you can verify the optimization of the design or develop “what-if” scenarios.

Measure Jitter and Noise

The jitter and noise measurements in the 80SJNB add several improvements to the algorithms for extraction of waveform and its vertical and horizontal impairment parameters. The measurements are faster, accept more distorted waveforms and the analysis converges with higher reliability.

If you design or measure devices intended for the high-volume PC market you will appreciate the addition of operation on the SSC (Spread Spectrum Clocking) – another first in the sampling oscilloscope measurements. Using the DSA8200 or TDS/CSA8200 mainframes, plus the 82A04 Phase Reference module the 80SJNB not only measures your signals under the presence of SSC, it also measures the SSC parameters.

Beyond just analysis, the 80SJNB presents the unmatched utility of separating the jitter caused by noise impairments versus its jitter-based component.



80SJNB BER

Perhaps the single most important result of serial data link test is the BER; uniquely, the 80SJNB brings you the BER Eye plot. While measurements on narrow parts of the signal are now common (jitter at the crossing, noise at the cursor), 80SJNB captures the whole signal and then truthfully presents the accumulation of all impairments. Measurement results at a different decision threshold or timing point are just a click away, as the 80SJNB always keeps the whole 3-D shape and all waveforms behind it.

Serial Data Link Analysis

Transmitter Equalization Measurements

Serial Data transmitters employing pre-emphasis/de-emphasis can be evaluated and measured using the FFE equalization feature. The package can autoselect the tap values on the received PRBS pattern, enabling evaluation of the value of taps that counter-equalize the transmitter pre-emphasis/de-emphasis.

Fixture Removal, Arbitrary Filter

At high speeds the test fixture often significantly distorts the acquired signal. The Advanced package supports a filter block which can be used for the fixture removal. But the processing block is flexible – not dedicated; it can perform as an arbitrary filter instead, for example for simulation of pre-emphasis/de-emphasis schemes.

Channel Emulation

The interaction between the true transmitter signal shape and the channel (interconnect) parameters is complex and not easily predictable from separate measurements. A reliable way to observe the performance of the whole serial link is by connecting the true transmitter waveform to the channel. The channel doesn't have to be physically present: the Advanced 80SJNB package offers channel emulation based on network measurements of the channel. In this situation a transmitter signal with or without pre-emphasis/de-emphasis can be captured; the channel can be emulated through its S-parameters or time-domain network description, such as the TDR/TDT traces and the signal at the end of the emulated channel can be measured.

The Platform

The 80SJNB Jitter, Noise, BER and Serial Data Link Analysis runs on the Tektronix 8000 Series sampling oscilloscopes. This combination of state of the art analysis software with the advantages of the Tektronix sampling oscilloscope mainframe, such as modular flexibility, uncompromised performance and unmatched signal fidelity provide you with the ideal solution for next generation high-speed serial data design validation and compliance testing.

Network Description Tool

The 80SJNB Jitter, Noise, BER and Data Link Analysis software in some cases uses network description information, such as S-parameters in the Touchstone format. We recommend Tektronix TDR hardware and Tektronix IConnect application software for high quality Touchstone network description data. Amongst the advantages of using Tek TDR and IConnect is the preservation of the DC values in the Touchstone matrix, which is typically lost with other measurement methods. 80SJNB will work with network description based on other measurement methods, such as VNA data; the DC measurement results will then typically have to be extrapolated in the 80SJNB.

Prerequisites

The software package is designed for use on 8000 Series Sampling Oscilloscopes, including the DSA8200 Digital Serial Analyzer Sampling Oscilloscopes and the older TDS8200, 8000B and 8000 Digital Sampling Oscilloscopes and CSA8200, 8000B and 8000 Communications Signal Analyzers.

The SSC (Spread Spectrum Clocking) support requires the use of 82A04 Phase Reference module, which can only be used on the 8200 series instruments.

When clock recovery of SSC (Spread Spectrum Clocking) signal is needed the 80A07 Clock Recovery Unit is recommended; 80A05 Clock Recovery unit does not support SSC.

Measurements

Advanced Jitter Analysis

Measurements	Description
TJ@BER	Total jitter at specified BER
RJ	Random jitter
RJ (h)	Horizontal component of random jitter
RJ (v)	Vertical component of random jitter
RJ (δ - δ)	Random jitter according to the Dual Dirac model
DJ	Deterministic jitter
DDJ	Data dependent jitter
DDPWS	Data Dependent Pulse Width Shrinkage
DCD	Duty cycle distortion
DJ (δ - δ)	Deterministic jitter computed in the Dual Dirac model
PJ	Periodic jitter
PJ (h)	Horizontal component of periodic jitter
PJ (v)	Vertical component of periodic jitter
EO@BER	Horizontal eye opening at specified BER

Advanced Noise Analysis

Measurements	Description
RN	Random noise
RN (v)	Vertical component of random noise
RN (h)	Horizontal component of random noise
DN	Deterministic noise
DDN1	Data dependent noise on logical level 1
DDN0	Data dependent noise on logical level 0
PN	Periodic noise
PN (v)	Vertical component of periodic noise
PN (h)	Horizontal component of periodic noise
EO@BER	Vertical eye opening at specified BER
SSC Magnitude	Magnitude of SSC modulation in ppm
SSC Frequency	Frequency of SSC modulation in ppm

- **Plots:** Jitter and Noise Components Probability Distributions, Spectral Distributions, Data Dependent Jitter and Noise vs. Bit, Data Pattern Waveform, Bathtub Curves for Jitter and Noise, BER Probability Map, BER Contour Diagrams, Q-Eye, Probability Distribution Eye Diagrams (Data Pattern can be Plotted after Every Signal Path (SP) Processing Step), SSC (Spread Spectrum Clocking) Profile
- **Data Logging:** Query and Export of all Numeric Results. Export of Waveforms: Raw Acquired Pattern Waveform, Correlated Pattern Waveform, Correlated Pattern Waveform after Every Signal Path Processing Step. Probability Distribution Eyes Diagrams and Bathtub Curves

Characteristics

TDS/CSA8200, TDS/CSA8000B, TDS/CSA8000

Jitter Floor	With 82A04: ≤ 200 fs rms* ¹ , without: ≤ 800 fs (DSA8200)
Noise Measurement Accuracy	Matches underlying hardware capability, see sampling module data sheet for specifications. Acquired waveform must be live. Acquired waveform must be a fixed repetitive pattern of maximum pattern length: 215 Uls Network description in either Touchstone S-parameters (one, two or four-port supported; single-ended and differential entry supported) or in time-domain "reference, waveform" format (time-domain format *.wfm of DSA8200 supported; time-domain format *.wfm of IConnect [®] supported)
Export Waveforms	Raw (acquired) waveform, correlated filtered waveform after every step of the Signal Path
Equalization Autoset Patterns	PRBS 3 through PRBS 15 (any pattern that can be analyzed can be also equalized)
Maximum SSC (spread spectrum clocking)	>5000 ppm Equalization schemes supported: FFE and DFE
Maximum Number of Taps, FFE/DFE	100/40; 1, 2 or 10 FFE taps/UI
Arbitrary Filter Description	Finite Impulse response Arbitrary Filter Description Contact your Tektronix Technical Support Center (http://www.tek.com/service/) for other formats/format convertors

System Requirements

- 80A06 PatternSync Module (plugged into the oscilloscope or on a SlotSaver cable)
- DSA8200 or TDS/CSA8200 or TDS/CSA8000B or TDS/DSA8000 Series mainframe with software release V5.* Windows XP (please contact the Tektronix field office for information on upgrading your mainframe if necessary)
- Contact your local Tektronix sales office for details on configuring your existing TDS/CSA8200, TDS/CSA8000B or TDS/CSA8000 to be compatible with 80SJNB

*¹ See 82A04 Data sheet for details; 82A04 only supported in the 8200 series mainframes.

Ordering Information

The 80SJNB is offered in two versions, Essentials and Advanced:

80SJNB Versions

Essentials	For jitter, noise and BER analysis. The Essentials builds on the features of the original 80SJNB and adds several new export waveforms, algorithmic improvements and analysis of signals with SSC (Spread Spectrum Clocking)
Advanced	Adds the following features to the Essentials package:
	Filter for support of fixture de-embedding/ arbitrary linear filter
	Channel emulation (based on time-domain or frequency-domain measurements of the channel)
	FFE/DFE Equalizer support

The 80SJNB Essentials or Advanced version can be preinstalled on a new DSA8200 Series oscilloscopes, as follows:

80SJNB Jitter, Noise, BER and Serial Data Link Analysis:

Oscilloscope	Option	Description
DSA8200	Opt JNB	Add 80SJNB Essentials to DSA8200
	Opt JNB01	Add 80SJNB Advanced to DSA8200

Note: For users of the original (80SJNB V1.*) package: The 80SJNB Essentials (V2.*) is a free update. Download the free update from www.tek.com.

Existing Oscilloscope Ordering Options

For users with existing oscilloscopes, the following table lists ordering options:

Oscilloscopes	Option	Description
DSA82UP	Opt JNB	Add 80SJNB Essentials to DSA8200
	Opt JNB01	Add 80SJNB Advanced to DSA8200
	Opt JNBADD01	Upgrade from JNB* ² to JNB Advanced
CSA82UP	Opt JNB	Add 80SJNB Essentials to CSA8200
	Opt JNB01	Add 80SJNB Advanced to CSA8200
	Opt JNBADD01	Upgrade from JNB* ² to JNB Advanced
TDS82UP	Opt JNB	Add 80SJNB Essentials to TDS8200
	Opt JNB01	Add 80SJNB Advanced to TDS8200
	Opt JNBADD01	Upgrade from JNB* ² to JNB Advanced
CSA8BUP	Opt JNB	Add 80SJNB Essentials to CSA8000B
	Opt JNB01	Add 80SJNB Advanced to CSA8000B
	Opt JNBADD01	Upgrade from JNB* ² to JNB Advanced
TDS8BUP	Opt JNB	Add 80SJNB Essentials to TDS8000B
	Opt JNB01	Add 80SJNB Advanced to TDS8000B
	Opt JNBADD01	Upgrade from JNB* ² to JNB Advanced
CSA8UP	Opt JNB	Add 80SJNB Essentials to CSA8000
	Opt JNB01	Add 80SJNB Advanced to CSA8000
	Opt JNBADD01	Upgrade from JNB* ¹ to JNB Advanced
TDS82UP	Opt JNB	Add 80SJNB Essentials to TDS8000
	Opt JNB01	Add 80SJNB Advanced to TDS8000
	Opt JNBADD01	Upgrade from JNB* ² to JNB Advanced

*1 See 82A04 Data sheet for details; 82A04 only supported in the 8200 series mainframes.

*2 The upgrade path from JNB to JNB Advanced also applies to JNB Essentials to JNB Advanced.

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For Further Information

Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit www.tektronix.com



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Product(s) complies with IEEE Standard 488.1-1987, RS-232-C and with Tektronix Standard Codes and Formats.

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