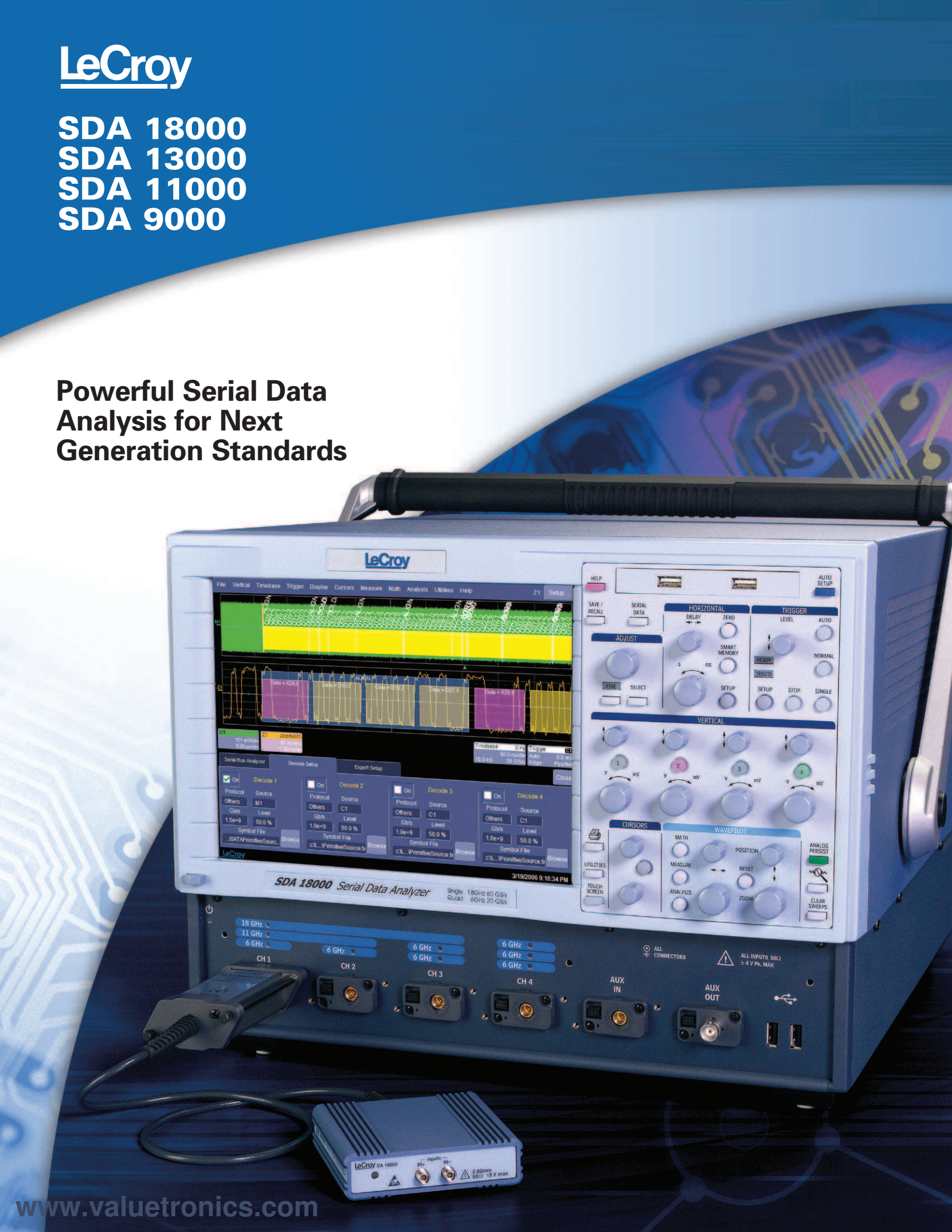
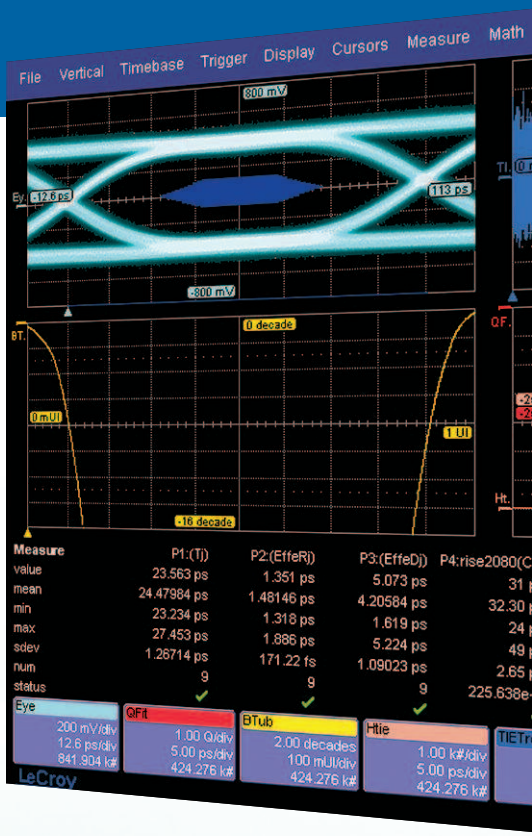
LeCroy

SDA 18000
SDA 13000
SDA 11000
SDA 9000

Powerful Serial Data Analysis for Next Generation Standards



Raising the Bar for Serial Data Analysis



The SDA 18000 serial data analyzer is a true breakthrough in signal analysis. It delivers the industry's highest true analog bandwidth—18 GHz—as well as a combined highest sampling rate of 60 GS/s and memory of up to 150 million points available in a real-time test instrument.

Based on the industry's most advanced digital oscilloscope platform, the SDA 18000 is a 4-channel real-time serial data analyzer that offers outstanding analysis capabilities that normally would require two or three different analyzers.

Put these benefits to work for you:

- **Pristine signal integrity measurements**
- **Accurate jitter analysis**
- **Powerful advanced waveform analysis**
- **Stable, repeatable results**

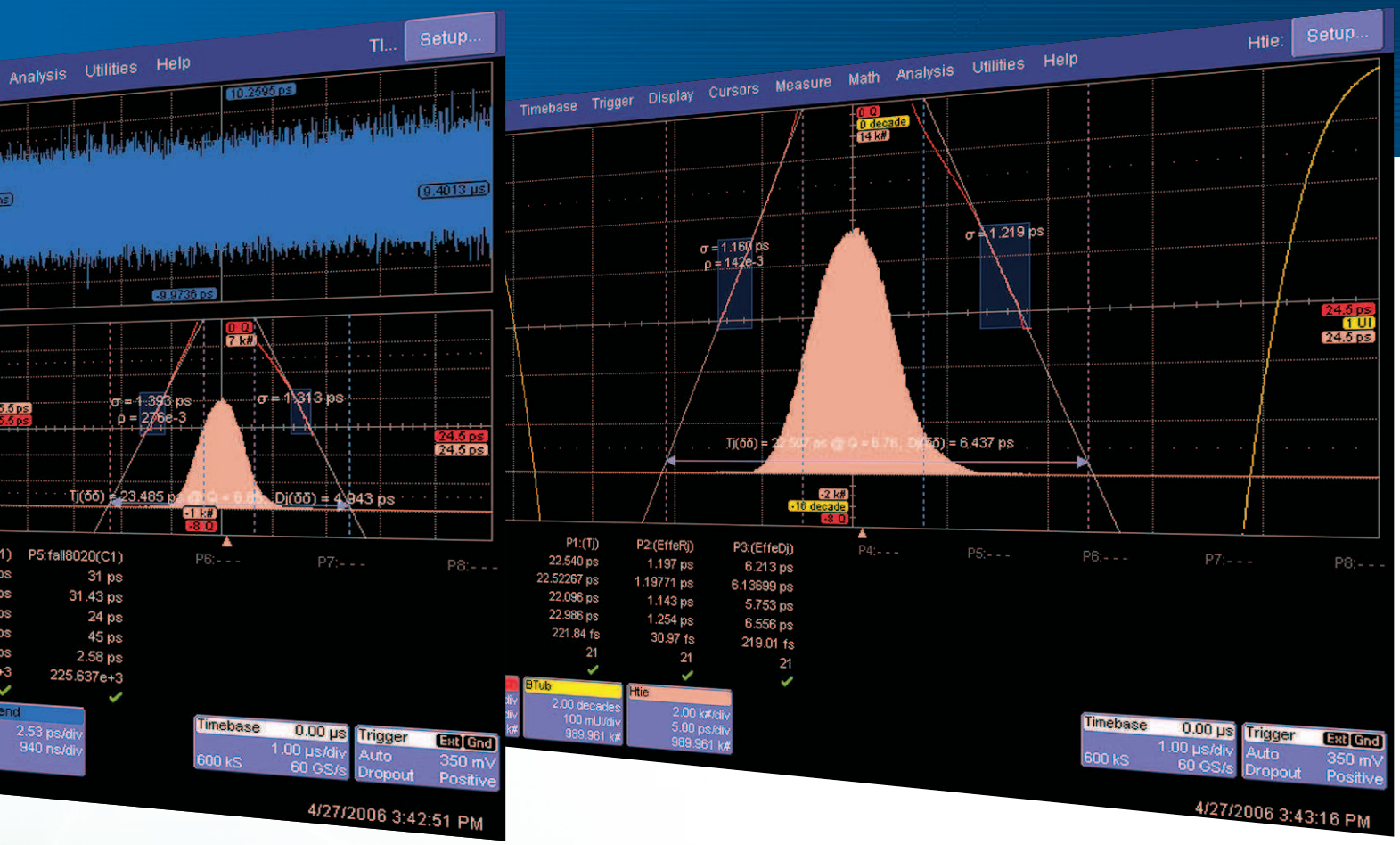
Data Rate Configuration Chart

Standard	Data Rate/ Symbol Rate	Rise Time, ps min. (20%–80%)	Minimum Bandwidth	Recommended Oscilloscope
PCI Express® Gen2	5 Gb/s	30 ps	12.5 GHz (Base Spec)	SDA 13000
SATA II/III	Gen2 3 Gb/s Gen3 6 Gb/s	100 ps (Gen1) 67 ps (Gen2)	> 10 GHz (SATA II)	SDA 11000 SDA 13000
XAUI X2	6.25 Gb/s	30 ps	≥ 11 GHz	SDA 11000
Fibre Channel 8.5	8.5 Gb/s	30 ps	18 GHz (Fibre Channel)	SDA 18000
SAS II/SAS 6G	SAS II 3 Gb/s SAS 6G 6 Gb/s	67 ps (Gen1) 33 ps (Gen2)	> 10 GHz (SAS II/SAS 6G)	SDA 18000
FB-DIMM	FBD1 4.8 Gb/s FBD2 9.6 Gb/s	30 ps	> 10 GHz (FB-DIMM) ≥ 13 GHz (FB-DIMM)	SDA 9000 or SDA 11000 SDA 13000
10 Gb Ethernet			18 GHz (10 Gb Ethernet)	SDA 18000

Sampling Oscilloscope Speed with Real Time Capabilities

The SDA 18000 has sufficient bandwidth to allow real-time measurements of the fastest serial data standards entering active development today, including 10 Gb/s Ethernet, and Fibre Channel 8.5. Previously, serial data measurements and jitter analysis of these signals could only be made with a sampling oscilloscope, a technique confined to monitoring well-behaved signals or small sequences of a repetitive bit pattern.

Capturing the data stream in real time with multiple points per transition edge with digitizing resolution as low as 16 ps per point allows the SDA 18000 to recover the embedded clock,



and phase lock to it, for precise jitter measurements. Now a complete breakdown of jitter composition is possible, even with non-repeating patterns or "live" data.

The user can instantly switch back to the individual bit pattern or the specific location where the mask violation has occurred.

Sampling at 60 GS/s assures excellent waveform capture fidelity, and the 150 million point memory depth allows the capture of long serial data patterns. This is most helpful in locating the sources of low frequency jitter modulation or tracking spread spectrum clocked (SSC) data.

SDA 13000, SDA 11000, and SDA 9000 – for Mid-speed Serial Data

The 13 GHz SDA 13000 is ideal for analysis in systems with serial data rates up to 7 Gb/s, while the 11 GHz SDA 11000 and 9 GHz SDA 9000 support rates up to 6.25 Gb/s and 5 Gb/s respectively. The three instruments feature an architecture supporting 2 channels at full BW. Each instrument shares the same advanced serial data and jitter analysis capabilities of the SDA 18000, including Q-Scale analysis. Lower bandwidth applications from 6 GHz to 4 GHz are also well served by a number of models in each bandwidth.

New Q-Scale Analysis for Unique Insight

A remarkable innovation included with the SDA Series is the Q-Scale analysis and plot view, a dramatic improvement that provides much more insight into jitter than any other method.

Q-Scale analysis uses an alternative method of breaking down jitter components. It also incorporates enhancements in extrapolating the jitter histogram tails, improving the accuracy, stability, and measurement convergence time.

The Q-Scale plot provides a visual representation of jitter breakdown, which is much more intuitive than a traditional bathtub curve.

A Total Solution for the Fastest Serial Data Rates

The LeCroy SDA 18000/13000/11000/9000 integrates all the key measurement and analysis tools into one device.

- Serial data measurements up to 10 Gb/s
- Supports testing of next generation serial data standards:
  - 10 Gb/s Ethernet
  - 8.5 Gb/s Fibre Channel
  - 6 Gb/s SATA III / 3 Gb/s SATA II
  - 6 Gb/s SAS
  - 4.8 Gb/s FB-DIMM
  - 6.25 Gb/s double XAUI
- WiMedia UWB Tx testing up through band group 5
- LeCroy 8b/10b serial decode option with powerful search capability enables captured waveforms to be searched for user-defined sequences of symbols. Multi-lane analysis decodes up to four simultaneously captured lanes.
- Capture of up to 12 million Unit Intervals (UI) in a single acquisition allows measurements of important low-frequency effects, such as spread spectrum clocking and switching power supply noise.
- LeCroy's Digital Signal Processing (DSP) technology brings uniformity in frequency and phase response, resulting in dependable eye pattern representation. LeCroy uses DSP for equalization compensation, not BW extension.
- Configurable software PLL for any standard or custom requirement.

A. Eye Patterns Show Mask Violations to the Bit

- Eye pattern measurement on up to 12 million consecutive bits captures patterns of PRBS > $2^{23}-1$.
- Consecutive-bit eye pattern analysis allows for the measurement of the wave shapes of individual bits that violate the compliance mask (violation location).
- Fast update rate.
- Very low noise floor jitter (less than 350 fs rms, typical).

B. Jitter Trend

- Time domain view of jitter displays transient jitter events that can be missed by histogram approaches.
- Clearly shows any non-stationary jitter behavior.

C. Jitter Bathtub

- The bathtub curve is extrapolated from a TIE histogram rather than from a jitter model. This produces results that correlate better with those from a bit error rate tester (BERT).
- Presents jitter as a function of bit error rate.
- Predicts maximum Bit Error Rate (BER) performance of system.

D. Histogram with Q-Scale

- Display of measured jitter histogram clearly shows any unusual jitter distributions such as bi-modal or non-Gaussian tails.
- By simply viewing the jitter breakdown (Rj, Dj), the raw data view shows jitter behavior that can be lost.
- This unprocessed display gives a high degree of confidence in the accuracy of the jitter breakdown and bathtub curve.

X-Stream Architecture

An innovative and highly efficient software architecture optimized for complex processing of large waveforms, X-Stream has these industry exclusive features:

Fastest Processing Speed: X-Stream pipelines data at 10 Gb/s into acquisition memory. It is then packetized into segments small enough to allow the remaining processing to take place in the processor cache memory—eliminating the need for constant external memory "fetches." This dramatically speeds up complex waveform processing.

Single Microsoft Windows® Application: In X-Stream, all of the oscilloscope operation, acquisition, and analysis take place in one single application running under Windows XP Professional. Data transfer within this application is optimized for

The SDA 18000 Features:

1. 18 GHz analog bandwidth
2. 19 ps (typ. 20–80%) rise time
3. Up to 150 Mpts of waveform acquisition memory
4. One-touch to Serial Data Analysis
5. Sampling rates up to 60 GS/s with deepest memory
6. Wavepilot – provides easy access to powerful signal analysis capabilities.
7. Front panel USB 2.0

large waveform processing. Other oscilloscopes acquire the waveform in a basic scope application, and pass the data to other applications for serial data or jitter analysis. This less efficient design can limit the user to seeing either the eye pattern or the data waveform or the jitter analysis—but not all simultaneously.

Embedded user applications: Only X-Stream allows users to embed their own processing application within the data stream and display the results—in real time. For example, users could write a routine that emulates the receiver equalization filter and insert it within the data stream. They could then see the eye pattern as the receiver does. They could also run a complete jitter break-down analysis on the filter data—in real time with live data. Compare this with running a filter routine off-line in a laptop with static acquired waveform data. Application scripts can be written in Mathcad,® MATLAB,® VBScript, and even Excel.® An optional Processing Web Editor allows users to quickly combine their application script with built-in math functions in a simple to understand graphical object representation.

New Q-Scale—See Jitter Components Accurately

First introduced in real-time serial data analyzers by LeCroy, the new Q-Scale view shows a graphical representation of key jitter components. It is a powerful tool for the engineer troubleshooting the source of jitter in circuits.

In brief, Q-Scale analysis depicts a Gaussian distribution as a straight line.

There are two fundamental benefits of using Q-Scale:

1. When placed on top of the reference line, you can instantly judge how Gaussian the distribution is. This is much easier than trying to look at the sides of a bathtub curve.
2. Greatly improved stability of the Random Jitter (Rj) component. Because the Rj component is heavily weighted to form the Tj, the Total Jitter number is also much more repeatable.

Interpreting the Q-Scale

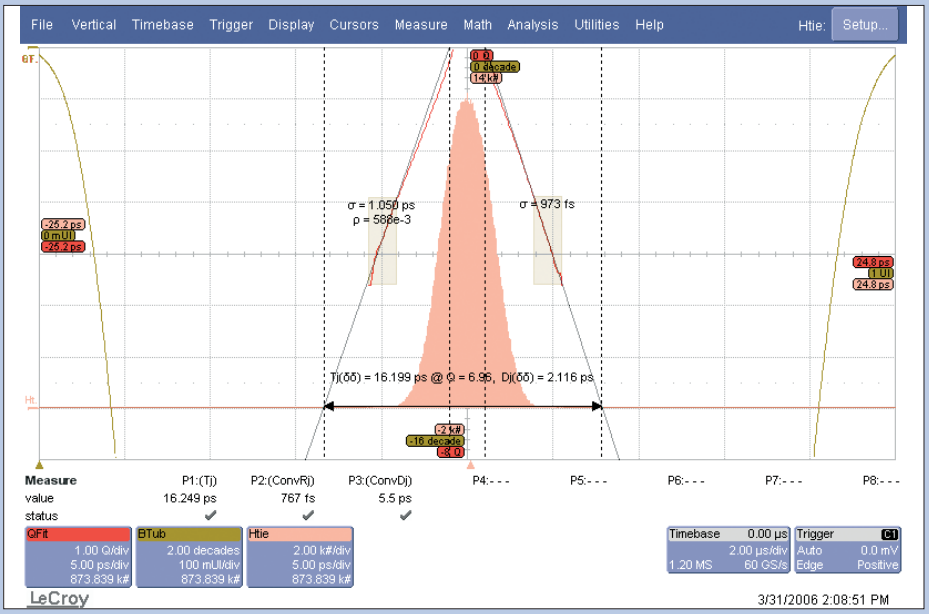
As with any jitter histogram, the width indicates the amount of jitter. The slope of the grey lines decreases with increasing random jitter.

The alignment of the red lines with the grey reference lines indicates how close to pure Gaussian the distribution on the corresponding face is. Note that it is possible and common for the two faces of the histogram to be nonsymmetrical, and even represent different amounts of jitter relative to the ideal edge placement.

The bottom tails of the red lines curve inward toward the center when there is a bounded component present. Likely sources of this jitter would be cross talk and power supply noise.

The distance between the dotted lines in the center is the deterministic (effective Dj) component, in the correct time scale. There is no separation in these lines when the Dj is zero, indicating pure random jitter.

Three parameters are used to fit the tail of the histogram—Sigma, Mean, and Population. The Rho factor indicates the closeness of the data fit to the extrapolated model necessary to extend the histogram to the selected BER. A value of 1.0 would indicate a perfect fit to a single Gaussian distribution. Rho is the amount of the distribution of the histogram fit into the extrapolated tail. Essentially, this number represents a figure of merit for the measurement quality.



1. Linearity Reveals the Source of Random Jitter

When red line lies on grey reference, the face has a Gaussian distribution.

- Bottom curves outward = more Rj
- Bottom curves inward = more bounded

2. Total Jitter Population at Your Finger Tips

Base of the histogram is total jitter interval at selected BER (shown as dotted lines).

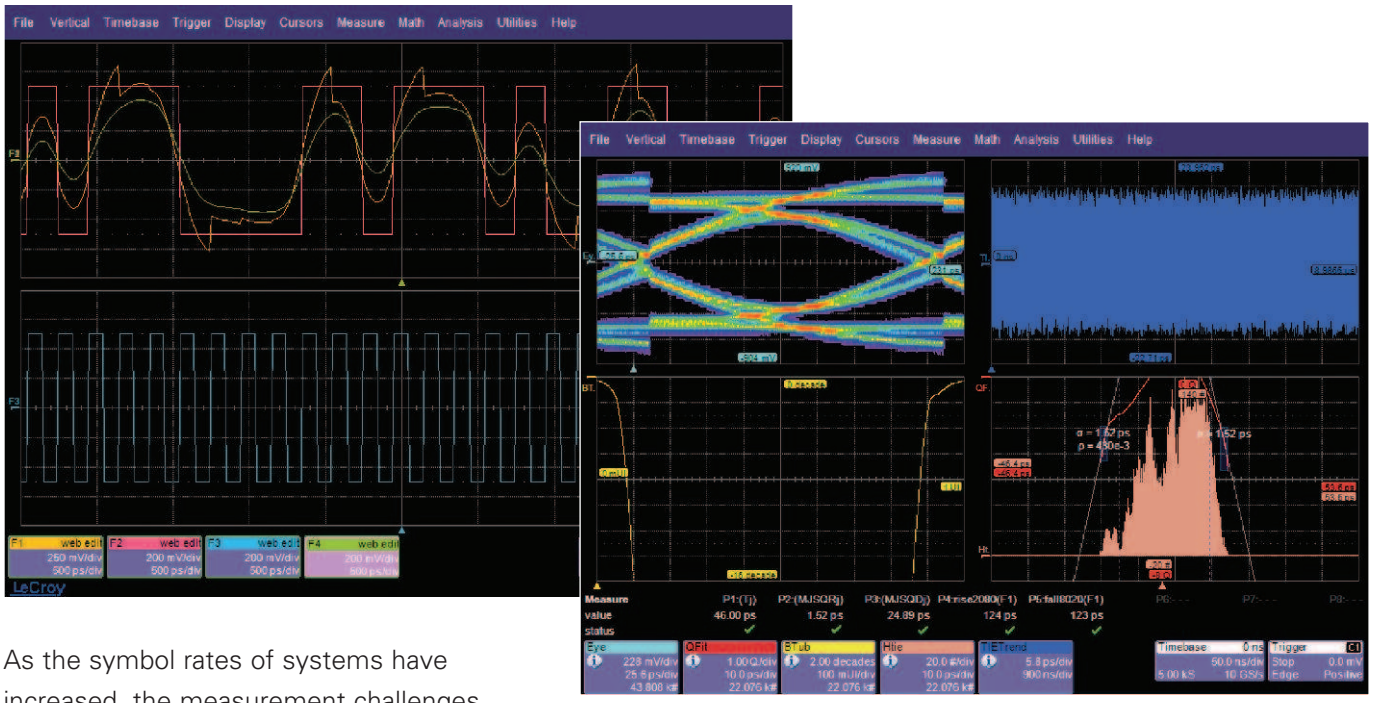
3. Precise Intuitive Calculation of Rj

Slope of grey line decreases with increasing Rj.

4. Directly View Dj Magnitude

Intersection of the grey reference lines with the top of the grid represents the deterministic component in time (Effective Dj). Displayed as dotted vertical lines: Sigma value = Random Jitter Rho-fitting coefficient (quality of model fit)

Eye Doctor™ - Tools for Next Generation Serial Data Analysis

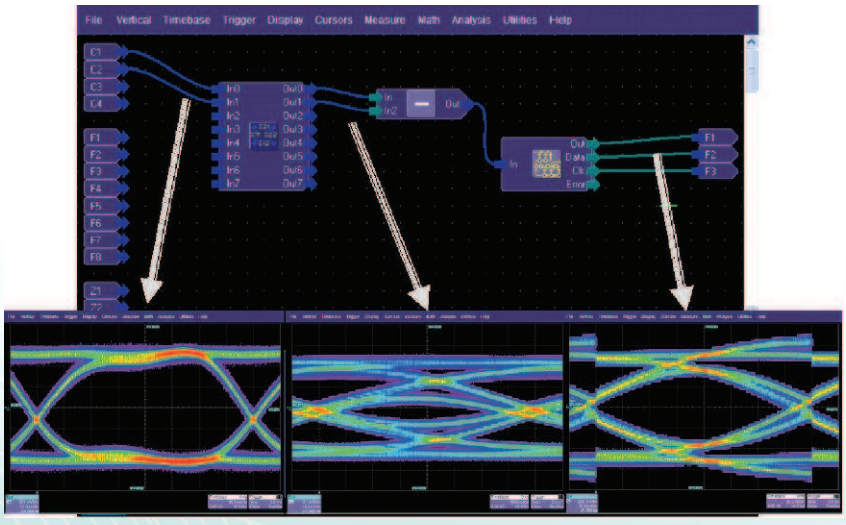


Equalizer emulation simulates the signal as viewed within the receiver. The component can automatically determine the optimum weighting coefficients for both FFE and DFE with the number of taps for each selected by the user. Coefficients can also be entered directly. The full jitter analysis capability of the SDA is available on the equalized signal.

As the symbol rates of systems have increased, the measurement challenges have also and with the adoption of receiver equalization, traditional jitter and noise measurements are becoming inadequate for determining interoperability.

Eye Doctor™ is a DSO-based instrumentation and simulation system which addresses these measurement challenges and is a dramatic leap in interoperability and compliance testing capability.

Eye Doctor provides the tools to undo or compensate many common forms of distortion thereby increasing signal to noise, opening eyes, increasing rise time, reducing jitter restoring lost bandwidth and improving waveform fidelity.



Measured Signal at Transmitter **Virtually Probed Signal at Receiver** **Equalized Signal**

Virtual Probing simulates signals from any point within the system using a single measured waveform. The virtual probe shown here is co-simulating a backplane which closes the eye. The equalizer corrects the distortion caused by the backplane which opens the eye. The Processing Web Editor is used to connect the equalizer and Virtual Probing elements in an intuitive signal flow diagram layout.

Advanced Analysis Tools
Extensive Capabilities Deliver Exceptional Performance

Although serial data compliance testing is widely available, analyzers that easily discover the reason for failing a compliance test are not. Only LeCroy SDA Series offers the class-leading serial data and jitter analysis toolset to help understand the causes behind the failure. With them, you can quickly identify the nature of the jitter and isolate the source of the problem.

To ensure your jitter measurements are comprehensive and precise, the SDA Series oscilloscope uses the standard industry breakdown for jitter, This means measurements are complete and correct. This level of jitter detail is unprecedented. By capturing jitter detail this accurately, jitter problems can be characterized and resolved quickly and efficiently.

The SDA Series contains the most analysis tools and jitter measurement methods available today. Combined with X-Stream, which provides the fastest analysis in this class of instrument, and up to 18 GHz of bandwidth, no other tool can offer more utility for the engineer designing high-speed serial data systems.

Here are just a few of the unique capabilities in the LeCroy SDA Series.

ISI Plot – Isolate Specific Bit Patterns
Averages the contribution to the eye pattern from samples with the same combination of bit values preceding and following the plotted UI.

ISI Plot

The ISI plot displays data dependent jitter contributions to the eye pattern for the second-to-last bit of a bit length, set from 3 to 10. This plot measures data dependent jitter without the need for a repeating bit pattern.

Jitter Wizard

This feature automatically selects all of the critical instrument settings, ensuring the highest accuracy and repeatability.

- Sampling rate, level, bit rate, and pattern length are automatically detected.

Edge-to-Edge Jitter

In this mode, timing is measured on data transitions relative to one another in the same way as a TIA.

- Measurements can be displayed directly or compensated to correlate with phase jitter measurements.
- Tj, Rj, and Dj measurements can be made at specific UI spacings or for all spacings in the data stream.

Filtered Jitter

The SDA Series oscilloscope offers a filtered jitter mode to support ITU-T and SONET measurements.

- Band-pass filter with selectable upper and lower cutoff frequencies supplied.

Spread Spectrum Clock

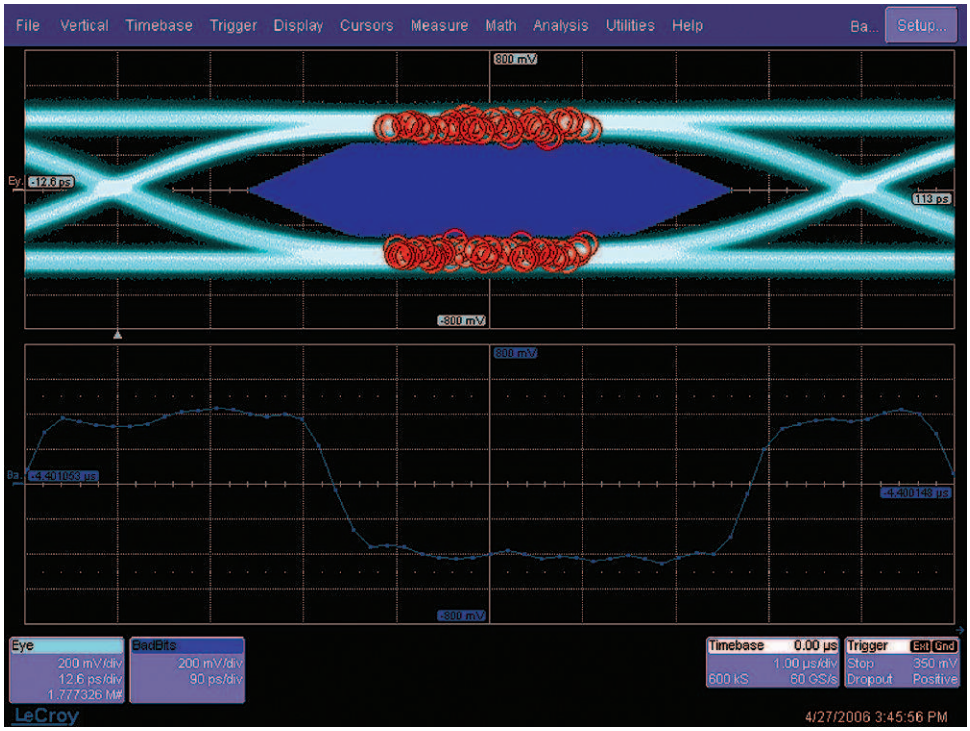
LeCroy's unique long acquisition memory and fast sample rate are ideal for seeing fine details in data transmitted with Spread Spectrum Clocks (SSC). SSC is becoming popular due to its lower noise contribution. The modulation frequency used is low, typically 33 kHz. With 150 Mpts of waveform memory, the SDA 18000 can capture over 72 entire cycles of SSC while sampling at its maximum rate of 60 GS/s.

See multiple cycles of spread spectrum clocking.

Mask Violation Locator and Multi-Eye

Mask failures are identified by contrasting color spots on the eye pattern, which appear anywhere the data intersects the mask template. Using the Mask Violation Locator tool, users can call up the actual stored bit stream waveform at the point in time of the initial failure. The actual bit sequence is also identified, pointing out any ISI problems. Cursor controls allow the user to instantly jump to the next violation, or any other that occurred in the stored pattern.

The mask violation locator works effectively on single and multiple eye masks. Multi-Eye can be used whenever two valid eye patterns occur in the same data channel, such as different transmit and receive waveforms in bi-directional channels (FSB) and transition/non-transition bit applications, as found in PCI Express. Independent measurements such as rise and fall time, eye amplitude, etc., can be made in each eye.

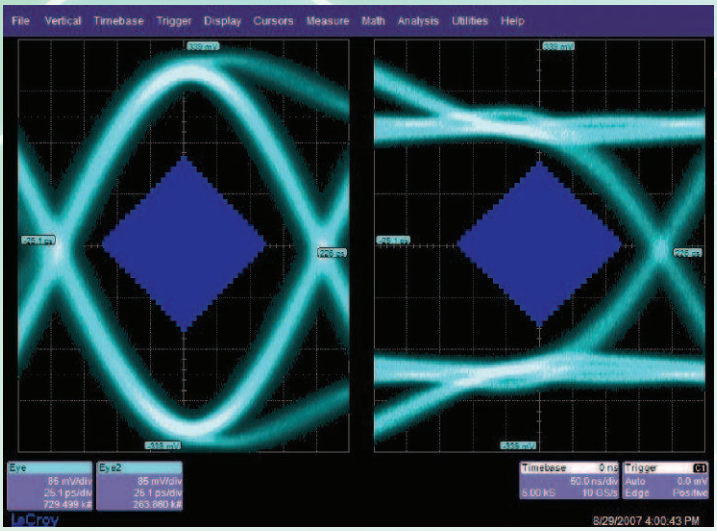


Observe bit sequences that cause mask violations.

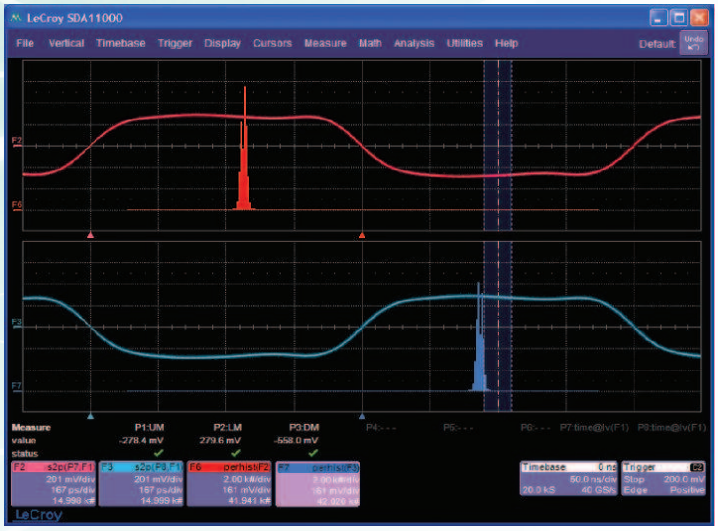
Next Generation Physical Layer Compliance Tests

Compliance Testing

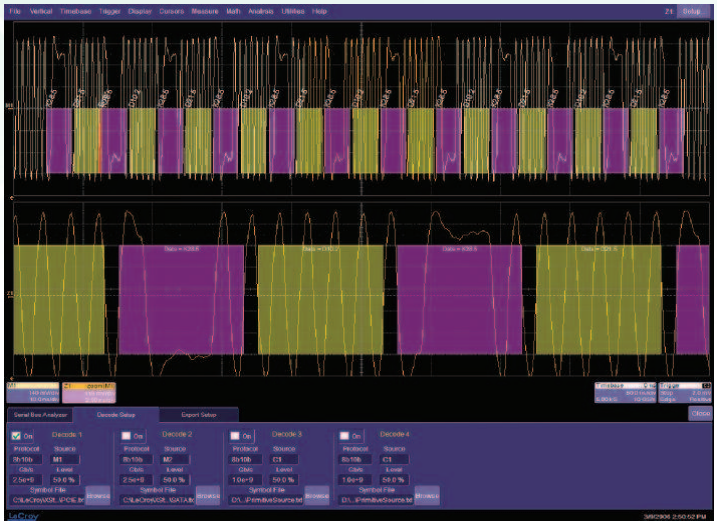
The transfer of digital data signals is increasingly moving to serial format. Serial data has several advantages over parallel such as scalability, speed and compactness. At the same time, these new serial data standards require specialized measurements and compliance testing procedures which add complexity to their design. Spanning the complete device development cycle, design engineers can focus on systematic, step-by-step functional device development tasks by selecting tests from the checklist. The use of LeCroy's compliance test software in conjunction with the deep memory and powerful analysis library of the SDA instrument family greatly simplifies the verification process.



Transition and non-transition eye diagrams for PCI Express.



SATA compliance test maximum voltage check.



Configure and decode up to 4 channels.

Spectogram of a UWB signal hopping over three frequency bands of a band group.

Differential Probing Solutions

The DA18000 Differential Amplifier

The DA18000 Differential Amplifier is a very high bandwidth DC coupled differential amplifier with a true 100 Ω balanced input. It features high common mode rejection, low noise, and is designed to be used exclusively with the SDA 18000 Serial Data Analyzer. The amplifier has unity gain, to maximize the signal to noise performance when used with the lower amplitude signal voltages common in higher data rate systems.

The DA18000 is supplied with a short pair of input cables which are matched to an electrical propagation length of 2.5 ps. Use of the DA18000 with these cables eliminates the need to deskew and calibrate input channels for differential match, a problem

encountered when acquiring differential signals with two oscilloscope channels connected with long cables.

The DA18000 differential amplifier utilizes third generation digital response equalization, the same calibration method used in LeCroy's award winning high bandwidth probes. This provides the most accurate magnitude and phase response, assuring the high fidelity eye pattern measurements.

Specification	Value
Input Configuration	True Differential, 100 Ω Balanced
Input Connector	2.92 mm
Frequency Response, System	DC–18 GHz, Typical
Rise time, 20%–80%, System	< 24 ps, Typical
Rise time, 20%-80%, Probe Only	< 19 ps
Voltage Gain	X 1
Voltage Gain Accuracy	2%, (20–30 °C)
Max. Offset Voltage, RTI	< 5 mV
Noise, System	1 mV_{rms}, Typical
Maximum Input – Differential with ÷2 Attenuators	±400 mV (800 mV_{p-p}) ±800 mV (1.6 V_{p-p})
Maximum Input – Common Mode with ÷2 Attenuators	±10 V 7 V_{rms}
Common Mode Resistance, DC	25 kΩ

Included with the DA18000:

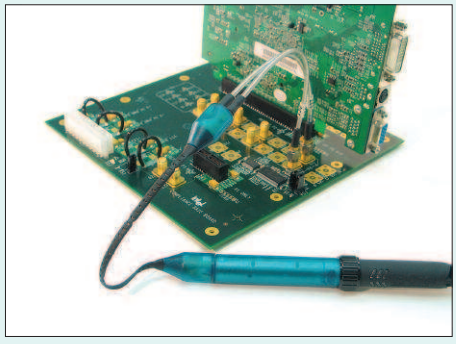
Electrically matched input cables (2), ÷2 precision attenuators (2), ESD dissipating wrist strap, Instruction Manual, certificate of traceable calibration, soft accessory case.

D13000PS/D11000PS Differential Probe System

The D13000PS/D11000PS extends the full signal acquisition performance of the SDA 13000, SDA 11000 and SDA 9000 to the probe tips. With 13/11 GHz system bandwidth, the probe enables direct measurement of high-speed serial data streams up to 6.25 Gb/s.

When used to acquire input signals for the SDA 13000, SDA 11000, SDA 9000, or SDA 18000, the D13000PS/D11000PS provides unprecedented waveform fidelity, even with signals at higher serial data rates. Each probe utilizes third generation response compensation calibration, the most advanced in use today, to provide optimal system response.

The D13000PS/D11000PS provides both direct Solder-In and cabled SMA-connector interconnect lead assemblies. The D13000PS also provides SMP cables for additional cabling options. Each interconnect lead comes with a dedicated probe amplifier module that has calibration data optimized for the respective lead. This eliminates the performance compromise of using a single calibration for multiple lead types.



Specifications

Vertical System	SDA 18000 18 GHz/Ch Mode	SDA 18000 11 GHz/Ch Mode	SDA 18000 6 GHz/Ch Mode	SDA 13000 13 GHz/Ch Mode	SDA 13000 6 GHz/Ch Mode	SDA 11000 11 GHz/Ch Mode	SDA 11000 6 GHz/Ch Mode	SDA 9000 9 GHz/Ch Mode	SDA 9000 6 GHz/Ch Mode
Analog Bandwidth @ 50 Ω (-3 dB)	18 GHz	11 GHz	6 GHz	13 GHz	6 GHz	11 GHz	6 GHz	9 GHz	6 GHz
Rise Time (Typical, 10–90%)	27 ps	40 ps	75 ps	35 ps	75 ps	40 ps	75 ps	49 ps	75 ps
Rise Time (Typical, 20–80%)	19 ps	28 ps		25 ps		28 ps			
Input Channels	1	1	4, 2, or 1	2 or 1	4 or 2	2 or 1	4 or 2	2 or 1	4 or 2
Bandwidth Limiters	Full BW only		20 MHz, 200 MHz, 1 GHz, 3 GHz, 4 GHz	Full BW only	20 MHz, 200 MHz, 1GHz, 3 GHz, 4 GHz	Full BW only	20 MHz, 200 MHz, 1 GHz, 3 GHz, 4 GHz	Full BW only	20 MHz, 200 MHz, 1 GHz, 3 GHz, 4 GHz
Input Impedance	50 Ω ±2.0%								
Input Coupling	DC, GND								
Maximum Input Voltage	±4 V_{peak}								
Vertical Resolution	8 bits; up to 11 bits with enhanced resolution (ERES)								
Sensitivity	2 mV–1 V/div (< 10 mV/div through zoom)		2 mV–1 V/div (fully variable, < 10 mV/div through zoom)	2 mV–1 V/div (< 10 mV/div through zoom)	2 mV–1 V/div (fully variable, < 10 mV/div through zoom)	2 mV–1 V/div (< 10 mV/div through zoom)	2 mV–1 V/div (fully variable, < 10 mV/div through zoom)	2 mV–1 V/div (< 10 mV/div through zoom)	2 mV–1 V/div (fully variable, < 10 mV/div through zoom)
DC Gain Accuracy	±1.5% of full scale								
Offset Range	±750 mV @ 2 mV–141 mV/div ±4 V @ 141 mV–1 V/div		±750 mV @ 2 mV–195 mV/div ±4 V @ 195 mV–1 V/div	±750 mV @ 2 mV–159 mV/div ±4 V @ 159 mV–1 V/div	±750 mV @ 2 mV–195 mV/div ±4 V @ 195 mV–1 V/div	±750 mV @ 2 mV–195 mV/div ±4 V @ 195 mV–1 V/div	±750 mV @ 2 mV–195 mV/div ±4 V @ 195 mV–1 V/div	±750 mV @ 2 mV–141 mV/div ±4 V @ 141 mV–1 V/div	±750 mV @ 2 mV–195 mV/div ±4 V @ 195 mV–1 V/div
Offset Accuracy	±(1.5% of full scale +1.5% of offset value +2 mV)								

Horizontal System									
Timebases	Internal timebase common to 4 input channels; an external 100 MHz reference may be applied on the rear panel			Internal timebase common to 4 input channels					
Time/Division Range, Real Time	10 ps/div–100 µs/div (standard memory) 10 ps/div–500 µs/div (-XL memory)		20 ps/div–10 s/div	10 ps/div–100 µs/div (standard memory) 10 ps/div–500 µs/div (-XL memory)	20 ps/div–10 s/div	10 ps/div–100 µs/div (standard memory) 10 ps/div–500 µs/div (-XL memory)	20 ps/div–10 s/div	10 ps/div–100 µs/div (standard memory) 10 ps/div–500 µs/div (-XL memory)	20 ps/div–10 s/div
Time/Division Range, Random Interleave sampling (RIS)	N/A		to 20 ps/div (upper time/div limit function of sample rate and memory length settings)	N/A	to 20 ps/div (upper time/div limit function of sample rate and memory length settings)	N/A	to 20 ps/div (upper time/div limit function of sample rate and memory length settings)	N/A	to 20 ps/div (upper time/div limit function of sample rate and memory length settings)
Math and Zoom Traces	8 independent zoom and 8 math or zoom traces								
Sample Rate and Delay Time Accuracy	±1 ppm, aging < 1 ppm/year @ 25°C								
Time Interval Accuracy	≤ 0.06/SR + (1 ppm, aging < 1 ppm/year * Reading) (rms)								
Jitter Noise Floor	< 350 fs rms measured with 35 ps rise time (typical)		1 ps rms (typical)	< 350 fs rms measured with 35 ps rise time (typical)	1 ps rms (typical)	< 350 fs rms measured with 35 ps rise time (typical)	1 ps rms (typical)	< 350 fs rms measured with 35 ps rise time (typical)	1 ps rms (typical)
Trigger and Interpolator Jitter	< 2.5 ps rms (typical)								
Channel-Channel Deskew Range	±9 x time/div. setting, or 25 ns, whichever is larger								
External Timebase Reference In	100 MHz; 50 Ω impedance, applied at the rear input					N/A		NA	

Acquisition System	SDA 18000			SDA 13000		SDA 11000		SDA 9000	
	18 GHz/Ch Mode	11 GHz/Ch Mode	6 GHz/Ch Mode	13 GHz/Ch Mode	6 GHz/Ch Mode	11 GHz/Ch Mode	6 GHz/Ch Mode	9 GHz/Ch Mode	6 GHz/Ch Mode
Single-Shot Sample Rate/Ch	60 GS/s on 1 Ch	40 GS/s on 1 Ch	20 GS/s on 4, 2, or 1 Ch	40 GS/s on 2 or 1 Ch	20 GS/s on 4 or 2 Ch	40 GS/s on 2 or 1 Ch	20 GS/s on 4 or 2 Ch	40 GS/s on 2 or 1 Ch	20 GS/s on 4 or 2 Ch
Random Interleaved Sampling (RIS)	N/A		200 GS/s for repetitive signals, to 20 ps /div.	N/A	200 GS/s for repetitive signals, to 20 ps /div.	N/A	200 GS/s for repetitive signals, to 20 ps /div.	N/A	200 GS/s for repetitive signals, to 20 ps /div.
Maximum Trigger Rate	150,000 waveforms / second								
Intersegment Time	6 µs								
Maximum Acquisition Memory Points/Ch	1 Ch	1 Ch	4 Ch	2 Ch	4 Ch	2 Ch	4 Ch	2 Ch	4 Ch
Standard Memory	60 M	40 M	20 M	40 M	20 M	40 M	20 M	40 M	20 M
XL – Memory Option	150 M	100 M	50 M	100 M	50 M	100 M	50 M	100 M	50 M

Acquisition Processing

Averaging	Summed averaging to 1 million sweeps; continuous averaging to 1 million sweeps
Enhanced Resolution (ERES)	From 8.5 to 11 bits vertical resolution
Envelope (Extrema)	Envelope, floor, or roof for up to 1 million sweeps

Triggering System

Modes	Normal, Auto, Single, and Stop
Sources*	Any input channel, External, Ext X 10, Ext ÷10, or line; slope and level unique to each source (except line trigger)
Coupling Mode	DC
Pre-trigger Delay	0–100% of memory size (adjustable in 1% increments)
Post-trigger Delay	the smaller of 0–10,000 divisions or 86400 seconds
Hold-off by Time or Events	From 2 ns up to 20 s or from 1 to 99,999,999 events
Internal Trigger Range	±5 div from center
Trigger Sensitivity with Edge Trigger (Ch 1–4)	3 div @ ≤ 5 GHz, 2 div @ < 4 GHz, 1.2 div @ < 3 GHz (typical)
External Trigger Sensitivity, (Edge Trigger)	300 V @ ≤ 5 GHz, 200 mV @ < 4 GHz, 120 mV < 3 GHz (typical)
Max. Trigger Frequency, SMART Trigger™	750 MHz @ ≤ 10 mV
External Trigger Input Range	Aux (±0.4 V); Aux X10 (±0.04 V); Aux/10 (±4 V)

Basic Triggers

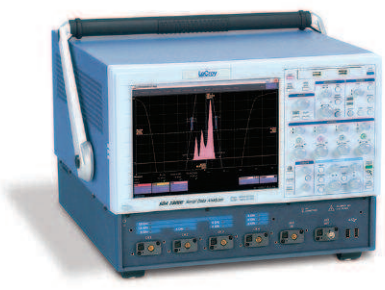
Edge/Slope/Line	Triggers when signal meets slope and level condition.

SMART Triggers

State or Edge Qualified	Triggers on any input source only if a defined state or edge occurred on another input source.
	Delay between sources is selectable by time or events.
Dropout	Triggers if signal drops out for longer than selected time between 2 ns and 20 s.
Pattern	Logic combination (AND, NAND, OR, NOR) of 5 inputs* – 4 channels and external trigger input. Each source can be high, low, or don't care. The High and Low level can be selected independently. Triggers at start or end of the pattern.

*Non-active channels are not available as trigger sources when operating in high bandwidth modes (9 GHz, 13 GHz, 11 GHz, or 18 GHz)

Specifications



SDA 18000

SDA 13000

SDA 11000

SDA 9000

SMART Triggers with Exclusion Technology

Glitch	Triggers on positive or negative glitches with widths selectable from 600 ps to 20 s, or on intermittent faults
Signal or Pattern Width	Triggers on positive or negative pulse widths selectable from 600 ps to 20 s, or on intermittent faults
Signal or Pattern Interval	Triggers on intervals selectable between 2 ns and 20 s.

Setup Storage

Front Panel and Instrument Status	Store to the internal hard drive or to a USB-connected peripheral device.

Power Requirements

Voltage	100–120 VAC ±10% at 50/60/400 Hz; 200–240 VAC ±10% at 50/60 Hz; Automatic AC Voltage Selection
Max. Power Consumption	800 VA (800 W)

Environmental

Temperature (Operating)	+5 °C to +40 °C including CD-ROM drives
Temperature (Non-Operating)	–20 °C to +60 °C
Humidity (Operating)	5% to 80% relative humidity (non-condensing) up to +30 °C. Upper limit derates to 25% relative humidity (non-condensing) at +40 °C.
Humidity (Non-Operating)	5% to 95% relative humidity (non-condensing) as tested per MIL-PRF-28800F

Physical Dimensions

Dimensions (HWD)	310 mm x 447 mm x 500 mm; 12.2" x 17.6" x 19.7" (height excludes feet)
Weight	27 kg; 59 lbs.
Shipping Weight	36 kg; 80 lbs.

Certifications

	CE Compliant; UL and cUL listed; Conforms to EN 61326 (for EMC); EN 61010, UL 61010B-1 and CSA C22.2 No. 1010.1 (for safety)

Warranty and Service

	2-year warranty; calibration recommended annually. Optional service programs include extended warranty, upgrades, and calibration services.

Standard

Advanced Serial Data Analysis Tools

Eye Diagram

bit rate
pattern detect
Tx density
mask test with violation locator
eye amplitude
eye timing
eye crossing
extinction ratio
average power

Clock Recovery

standard PLL settings
(FC GOLDEN, PCI Express, DVI, Custom)
custom filter settings
number of poles
natural frequency
damping factor

Jitter Analysis

jitter wizard
edge to reference (data to clock)
edge to edge (data to data)
conventional
effective
MJSQ
basic (Tj, Rj, Dj)
Dj breakdown (DDj, Pj, DCD)
advanced (peak-peak and rms)
TIE jitter
ISI plot with bit sequence tracking
synchronous N-cycle with bit pattern display
bathtub curve
jitter histogram
filtered jitter
periodic jitter (Pj) with peak frequency listing
TIE clock jitter
period jitter
half-period jitter
cycle-cycle jitter

Math Tools

Display up to four math function traces (F1 – F4). The easy-to-use graphical interface simplifies setup of up to two operations on each function trace, and function traces can be chained together to perform math-on-math.

absolute value
Auto-correlation function
average (summed)
average (continuous)
cubic interpolation function
derivative
deskew (resample)
difference (–)
enhanced resolution (to 11 bits vertical)
envelope
exp (base e)
exp (base 10)
fft (power spectrum, magnitude, phase, up to 25 Mpts)
floor
histogram of 2 billion events
integral
invert (negate)
log (base e)
log (base 10)
parameter math (+,-,*,/ of two different parameters)
product (x)
ratio (/)
reciprocal
rescale (with units)
roof
(sinx)/x
sparse function
square
square root
sum (+)
track graphs
trend (datalog) of 1 million events
zoom (identity)

Measure Tools

Displays any 8 parameters together with statistics, including their average, high, low, and standard deviations. Histicons provide a fast, dynamic view of parameters and wave shape characteristics.

amplitude
area
base
cycles
delay
Δ delay
duty cycle
duration
falltime (90–10%, 80–20% @level)
frequency
first
histogram parameters
last
level@ x
maximum
mean
median
minimum
narrowband power measurements
number of points
+overshoot
–overshoot
peak-to-peak
period
phase
risetime (10–90%, 20–80% @level)
rms
std. deviation
top
width
time@minimum (min.)
time@maximum (max.)
Δ time@level
Δ time@level from trigger
x@max
x@min

Pass/Fail Testing

Simultaneously test multiple parameters against selectable parameter limits or pre-defined masks. Pass or fail conditions can initiate actions, including document to local or networked files, e-mail the image of the failure, save waveforms, output a pulse via the the front panel auxiliary BNC output, or (with the GPIB option) send a GPIB SRQ.

8B/10B Protocol Decoding

Simultaneously translates up to 4 lanes of 8B/10B encoded Serial Data waveforms into symbol views to allow easier troubleshooting. This allows the user to quickly correlate protocol events with the physical serial data waveform. The decoder operates with 8B/10B encoded data at rates up to 6.25 Gb/s.

Optional

Advanced Customization Package (XDEV)

This package provides a set of tools to modify the oscilloscope and customize it to meet your unique needs. Additional capability provided by XDEV includes:

- Creation of your own measurement parameter or math function, using third party software packages, and display of the result in the oscilloscope. Supported third party software packages include:
  - VBScript
  - MATLAB
  - Excel
  - Mathcad
- CustomDSO – create your own user interface in a oscilloscope dialog box.
- Adding macro of keys to run VBScript files
- Support of plug-ins

Serial Data Compliance Packages

- QPHY-ENET – Ethernet Application Software Package
- QPHY-USB – USB Application Software Package
- SDA-SATA – SATA Gen1/Gen2 Solution Analysis Software Package
- SDA-FBDIMM – FB-DIMM Solution Analysis Software Package
- SDA-HDMI – HDMI Compliance Test Software Package
- SDA-PCIE-G2 – PCI Express Development and Compliance Software for Gen1 and Gen2
- SDA-SAS – SAS I/II Solution Analysis Compliance Software Package
- SDA-UWB – UWB Test Solution Software Package

Ordering Information

Description	Product Code
Serial Data Analyzers	
4 Ch; 18 GHz Serial Data Analyzer; 18 GHz, 60 GS/s 60 Mpts on 1 Ch, 6 GHz, 20 GS/s 20 Mpts/Ch on 4 Ch	SDA 18000
4 Ch; 13/6 GHz Serial Data Analyzer; 11 GHz, 40 GS/s 40 Mpts on 2 Ch; 6 GHz, 20 GS/s 20 Mpts on 4 Ch	SDA 13000
4 Ch; 11/6 GHz Serial Data Analyzer; 11 GHz, 40 GS/s 40 Mpts on 2 Ch; 6 GHz, 20 GS/s 20 Mpts on 4 Ch	SDA 11000
4 Ch; 9 GHz Serial Data Analyzer; 9 GHz 40 GS/s 40 Mpts/Ch on 2 Ch; 6 GHz, 20 GS/s 20 Mpts/Ch on 4 Ch	SDA 9000
Included with Standard Configuration	
ProLink Adapter, Type K; 1 each **(SDA 18000 only)**	LPA-K
ProLink Adapter, SMA; 4 each **(3 each with SDA 18000)**	LPA-SMA
ProLink Adapter BNC; 2 each	LPA-BNC
Printed Getting Started Manual, Operator's Manual	
CD-ROMs containing Operator's Manual, Remote Control Manual, Automation Manual, and Software Options Manual	
CD-ROMs containing Utility Software and Norton Antivirus Software (1 year subscription)	
CD-ROM Drive	
Optical 3-button Wheel Mouse-USB	
Standard Ports; 10/100Base-T Ethernet, Parallel, SVGA Video Output, PowerMac G4/QS USB 2.0	
Power Cable (for the country ordered from)	
Protective Front Cover	
Standard Commercial Calibration and Performance Certificate	
2-Year Warranty	
Memory Options	
For SDA 18000:	
150 Mpts/18 GHz, 100 Mpts/11 GHz, 50 Mpts/4 Ch	SDA18-XL
For SDA 13000:	
100 Mpts/13 GHz, 50 Mpts/4 Ch	SDA13-XL
For SDA 11000:	
100 Mpts/11 GHz, 50 Mpts/4 Ch	SDA11-XL
For SDA 9000:	
100 Mpts/9 GHz, 50 Mpts/4 Ch	SDA9-XL
Software Options	
Compliance Software Options	
QualiPHY Automated Test and Reporting Software Package	QPHY
Ethernet Application Software Package	QPHY-ENET*
USB Application Software Package	QPHY-USB**
FB-DIMM Solution Analysis Compliance Software Package **(SDA 13000/SDA 11000/SDA 9000 only)**	SDA-FBDIMM
HDMI Compliance Test Software Package	SDA-HDMI
PCI Express Development and Compliance Software for Gen1 and Gen2	SDA-PCIE-G2
SAS Compliance Software Package	SDA-SAS
SATA Gen1/Gen2 Solution Analysis Software Package	SDA-SATA
UWB Test Solution Software Package	SDA-UWB
Application Specific Test and Analysis Software Options	
Advanced Optical Recording Measurement Software Package	AORM
Disk Drive Measurements Software Package	DDM2

*TF-ENET-B required. **TF-USB-B required.

Description	Product Code
Software Options (cont'd)	
Advanced Math and WaveShape Analysis Software Options	
Digital Filter Software Package	DFP2
Advanced Customization Software Package	XDEV
Processing Web Editor Software Package	XWEB
Eye Doctor (Virtual probe and equalizer emulation bundle)	EYEDR
Virtual Probe	EYEDR-VP
Equalizer Emulation	EYEDR-EQ
Hardware and Software Option	
32 Digital Oscilloscope Mixed Signal Option	MS-32-DSA
Hardware Options and Accessories	
2 x 36 inch SMA to SMA Cable	ENET-2CAB-SMA036
2 x 18 inch SMA to SMA Cable	ENET-2CAB-SMA018
2 x BNC to SMA Adapter	ENET-2ADA-BNCSMA
38 GHz Trigger Prescaler	SDA-TPS
1 MΩ Adapter includes PP005A Passive Probe	AP-1M
IEEE-488 GPIB Control Interface	GPIB-1
Dual Monitor Display	DMD-1
Keyboard, USB	KYBD-1
ProLink-to-BNC Adapter; 1 each	LPA-BNC
Kit of 4 ProLink BNC Adapters with Case	LPA-BNC-KIT
ProLink-to-SMA Adapter	LPA-SMA
Kit of 4 SMA ProLink Adapters with Case	LPA-SMA-KIT
ProLink-to-Type 'K' adapter; 1 each	LPA-K
Oscilloscope Cart with Additional Shelf and Drawer	OC1024
Oscilloscope Cart	OC1021
Removable Hard Drive Package	WM-RHD
Additional Removable Hard Drive	WM-RHD-02
Hard Shell Transit Case	SDA11-TC1
Compliance Test Fixtures	
HDMI Test Fixture Set (TPA-P-SE, TPA-P-DI)	TF-HDMI
10/100/1000Base-T Compliance Test Fixture	TF-ENET-B
USB 2.0 Testing Compliance Test Fixture	TF-USB-B
Telecom Adapter Kit 100 Ω Bal., 120 Ω Bal., 75 Ω Unbal.	TF-ET
Serial ATA Test Fixture (Includes Pair of SMA Cables)	TF-SATA
Probe Options and Probe Accessories	
18 GHz Differential Amplifier **(SDA 18000 only)**	DA18000
13 GHz Differential Probe System	D13000PS
11 GHz Differential Probe System	D11000PS
WaveLink 7.5 GHz, Differential Probe Adjustable Tip Module	D600A-AT*
WaveLink 7 GHz, Differential Probe Small Tip Module	D600ST*
WaveLink 4 GHz, 5 V Differential Probe Small Tip Module	D350ST*
WaveLink 6 GHz, Differential Positioner Mounted Tip Probe Module	D500PT*
WaveLink ProLink Probe Body	WL600
1 GHz Active Differential Probe (÷1, ÷10, ÷20)	AP034
7.5 GHz Low Capacitance Passive Probe (÷10, 1 kΩ; ÷20, 500 Ω)	PP066
2.5 GHz 0.7 pF Active Probe (÷10), Small Form Factor	HFP2500
Probe Deskew and Calibration Test Fixture	TF-DSQ
Cascade Microtech EZ-Probe Positioner	EZ PROBE

*For a complete probe, order a WL600 Probe Body with the Probe Tip Module.

Customer Service

LeCroy oscilloscopes are designed, built, and tested to ensure high reliability. In the unlikely event you experience difficulties, our digital oscilloscopes are fully warranted for two years, and LeCroy probes are warranted for one year.

This warranty includes: • No charge for return shipping • Long-term 7-year support • Upgrade to latest software at no charge

LeCroy 1-800-5-LeCroy
www.lecroy.com

Local sales offices are located throughout the world.
To find the most convenient one visit www.lecroy.com