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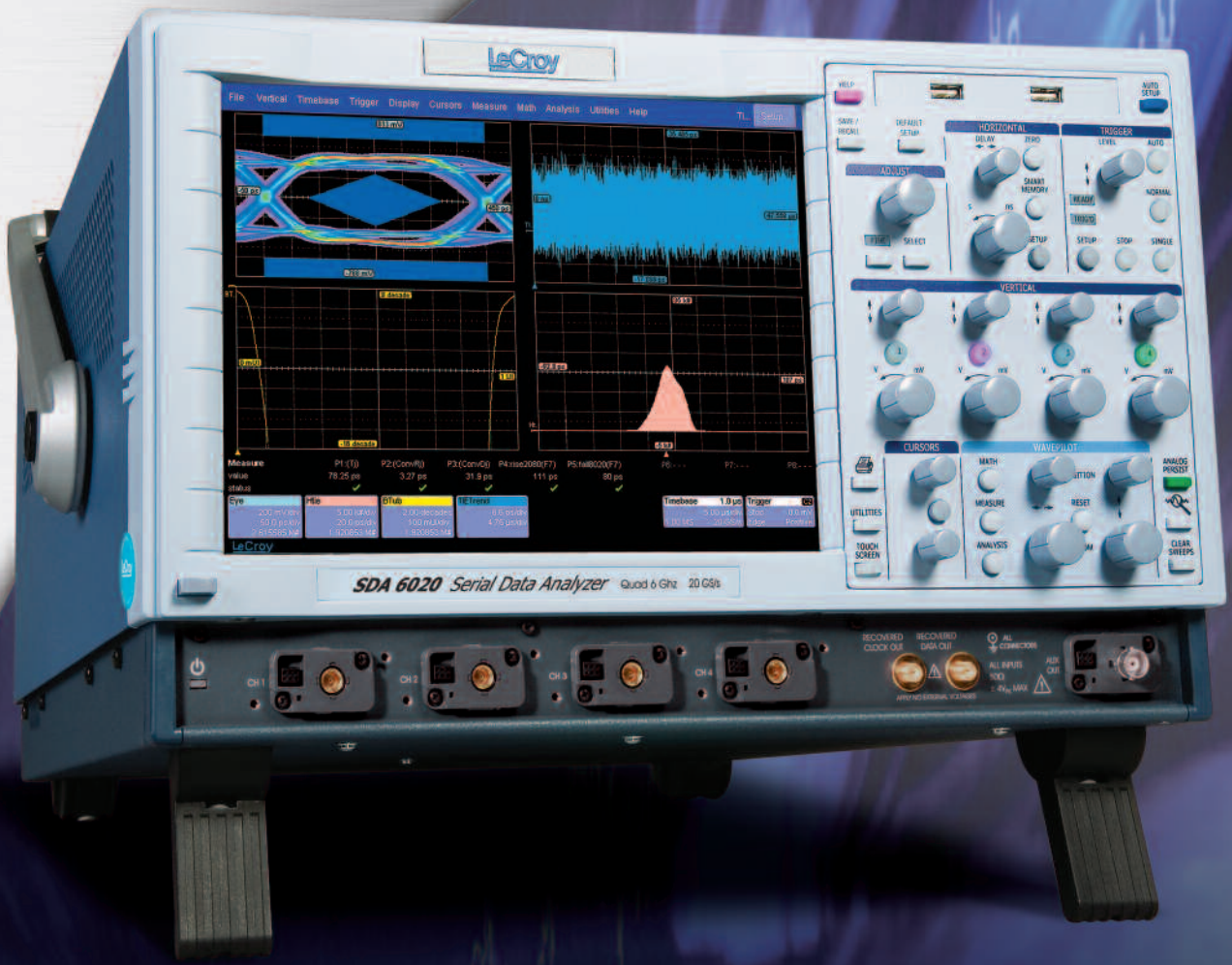
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LeCroy

# Serial Data Analyzers (3 GHz–6 GHz)

## A 360° Solution for Serial Data Analysis and Jitter





# A Total Solution for Serial Data Analysis

**With serial data—both electrical and optical—quickly becoming a dominant form of data transmission, fast and accurate analysis becomes a priority. The LeCroy SDA integrates all the key tests into one device while providing powerful standard and jitter packages. Here are a few key measurements that are part of this powerful analyzer's capabilities:**

- **Eye patterns with violation locator**
- **Accurate and repeatable jitter analysis**
- **Precision numerical clock recovery with adjustable PLL response**
- **Bit error analysis**
- **1 ps jitter noise floor**
- **Compliance testing for a broad range of standards**

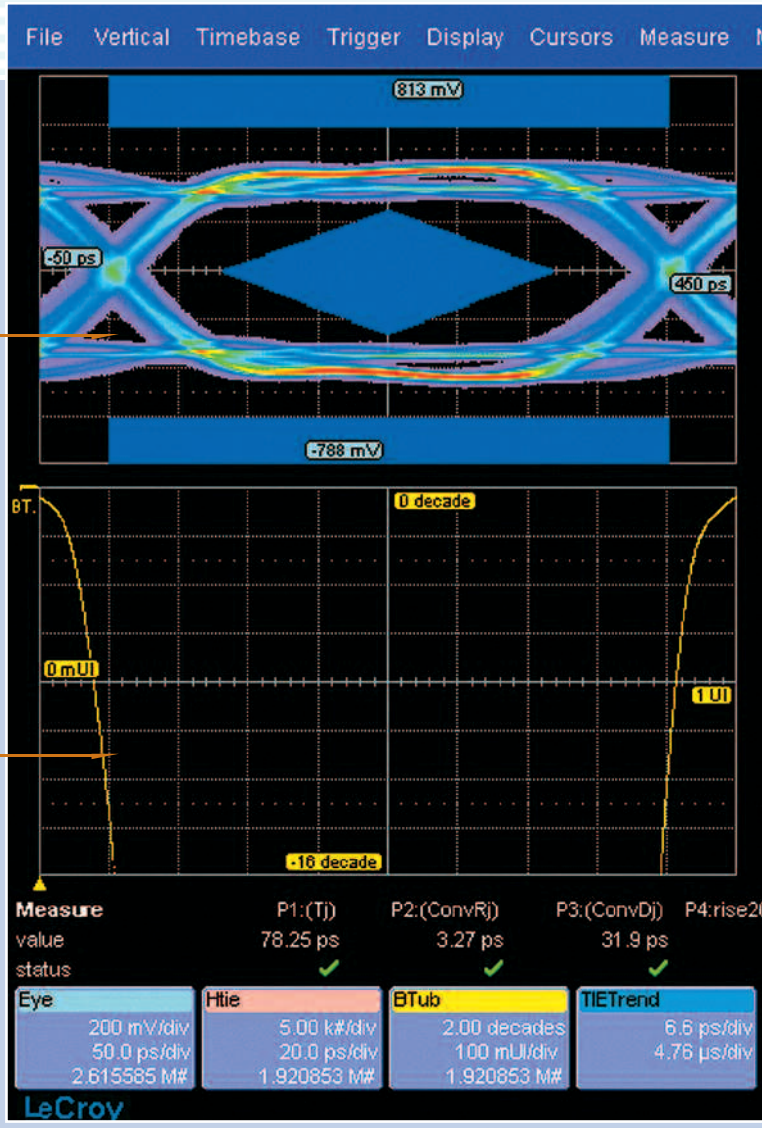
## A Four-Quadrant 360° Analysis of Your Serial Data Signal

### *Eye Patterns Show Mask Violations to the Bit*

- *Eye pattern measurement on up to 8 million consecutive bits ensures that even transient jitter and noise events are captured*
- *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 measurement jitter (typically 1 ps rms)*

### *Jitter Bathtub*

- *Bathtub curve extrapolated directly from the time interval error (TIE) histogram gives an accurate total jitter measurement.*
- *Presents jitter as a function of bit error rate.*
- *Predicts maximum BER performance of system.*



## Serial Data Analysis

One-button access that covers the following serial data measurements:

- Eye patterns
- Jitter analysis (including total, random and deterministic)
- Signal rise/fall and overshoot
- Extinction ratio and Q factor
- Standards compliance

## New Advanced Serial Data and Jitter Analysis (Standard)

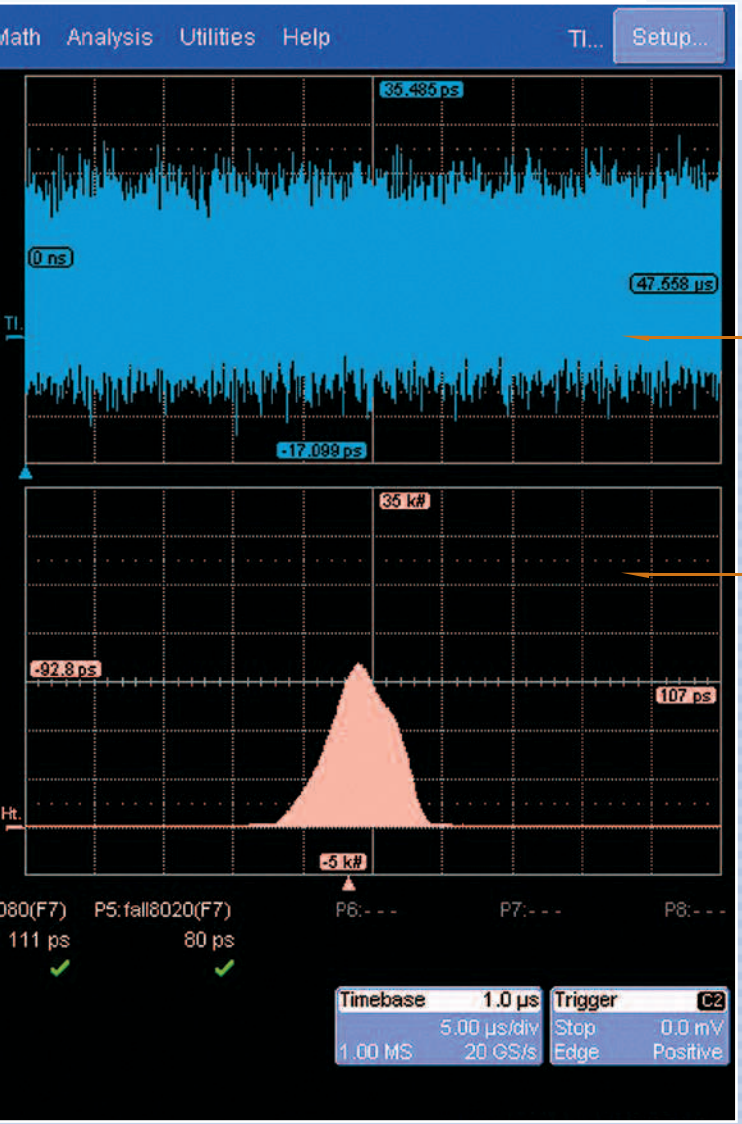
With this analysis software, the SDA resolves the most challenging measurements like:

- Edge-to-edge jitter
- Clock jitter
- Filtered jitter
- Effective and MJSQ jitter
- ISI plot of data dependent jitter
- N-cycle jitter plot
- Bit error rate analysis
- Mask violation

## Serial Data Standards

The SDA supports a wide range of standards, including:

- Serial Attached SCSI (SAS 1.5 Gb/s, 3.0 Gb/s, and 6 Gb/s)
- PCI Express® Gen1 and Gen2 (2.5 Gb/s and 5 Gb/s)
- UWB – Wimedia Alliance
- Serial ATA (1.5 Gb/s and 3.0 Gb/s)
- Fully Buffered DIMM (FB-DIMM) AMB Point-to-Point (3.2 Gb/s to 4.8 Gb/s)
- Fibre Channel (133 Mb/s to 8.5 Gb/s)
- USB 2.0 (HS signal quality)
- IEEE 802.3 (10Base-T, 100Base-T, 1000Base-T)
- High Definition Multimedia Interface (HDMI)
- 1000Base-LX4 (XAUI)




### *Jitter Trend*

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

### *Histogram*

- *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.*



# Thorough Jitter Analysis

**Jitter is the most critical measurement in serial data signal analysis, and LeCroy has the ultimate solution for you. The SDA can measure a full set of clock and timing jitter parameters as well as time interval error (TIE) measurements for data signals. With the included ASDA-J measurement package (see below), you get the most effective jitter analysis tool available today.**

- **TIE measurements are performed using a precise software clock recovery.**
- **Data bit deviation is measured from their ideal locations in time.**
- **Processed data is displayed in several different views, including bathtub, histogram, time trend, and data dependent jitter vs. bit.**
- **Measurements include total, random, and deterministic, with the latter broken down into periodic and data dependent parts.**

# Turbocharge Your Jitter Measurements

**ASDA-J Software**

**Many different instruments such as sampling oscilloscopes, time interval analyzers (TIA's), and bit error rate test sets are used to evaluate the jitter in serial data streams. The LeCroy ASDA-J package (included), is the first software to implement all of these standard methods. With a single instrument, the slight differences among methods can be viewed and understood. ASDA-J provides specific jitter measurements to meet all serial data standards.**

## Jitter Wizard

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

- Prompts the user about the signal under test.
- Sampling rate, level, bit rate, and pattern length are automatically detected.




## Edge-to-Edge Jitter

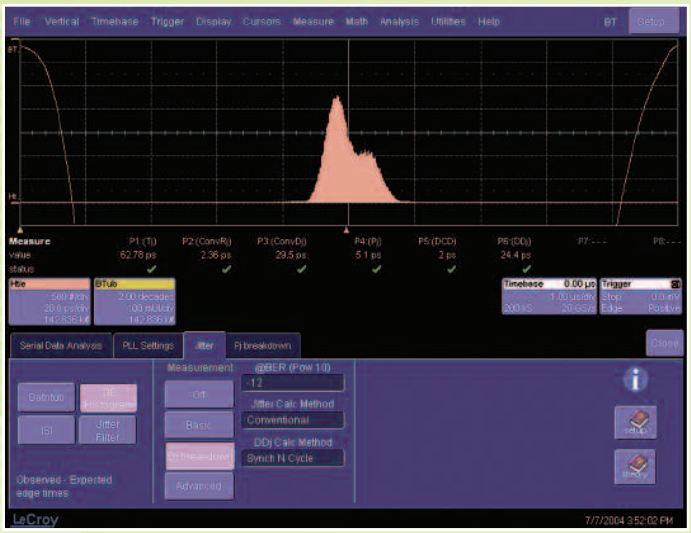
In this mode, timing is measured on data transitions relative to one another in the same way as a timing interval analyzer (TIA).

- 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

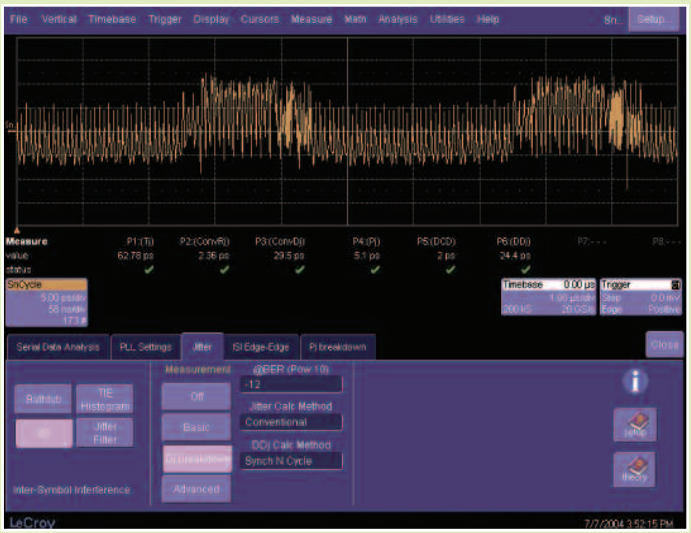
ASDA-J offers a filtered jitter mode to support ITU-T and SONET measurements.

- Band-pass filter with selectable upper and lower cutoff frequencies supplied.
- Peak-to-peak and rms value, plus the jitter waveform, are displayed in this mode.



## Bathtub Curve

*The bathtub curve shows the overall jitter distribution over a unit interval and serves as the basis for bit error rate estimation.*



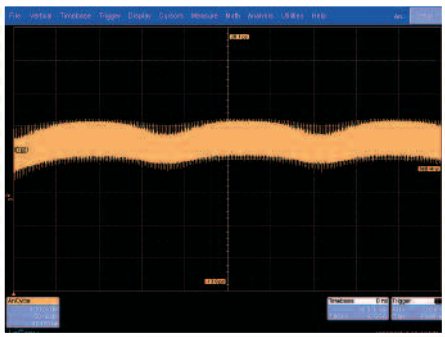
## Synchronous N-cycle Plot

*This display shows the data dependent jitter for each data transition in a repeating data pattern. The pattern is automatically detected from the data stream.*

## N-cycle vs. N Jitter Plot

This display shows the rms jitter as a function of the UI spacing. This display provides a very sensitive way of viewing periodic jitter effects.

The minimum value of this plot gives the rms value of the random jitter.



*The horizontal axis is the number of UI, N, over which the jitter is measured and the vertical dimension shows the rms jitter for that spacing. The plot above shows a signal with low frequency periodic jitter.*

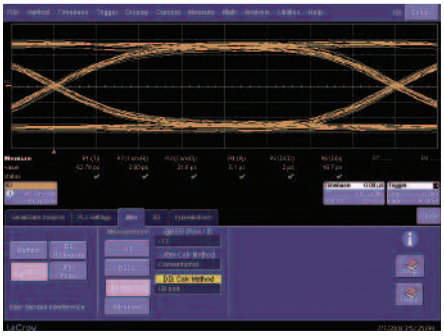
## Jitter Analysis: Rj, Dj, Tj

The SDA measures total jitter by extrapolating the histogram of jitter measurements. The ASDA-J option includes the following three methods for determining the random and deterministic components to support all existing standards:

- *Conventional.* Deterministic jitter is measured directly and Rj is the difference between the total and deterministic parts.
- *Effective.* BERT-scan method using the bathtub curve to fit a "dual dirac" jitter model.
- *MJSQ.* Fibre Channel method using two Gaussian curves to fit the extremes of the measured distribution.

## 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.





# The Cleanest Eye Patterns Possible

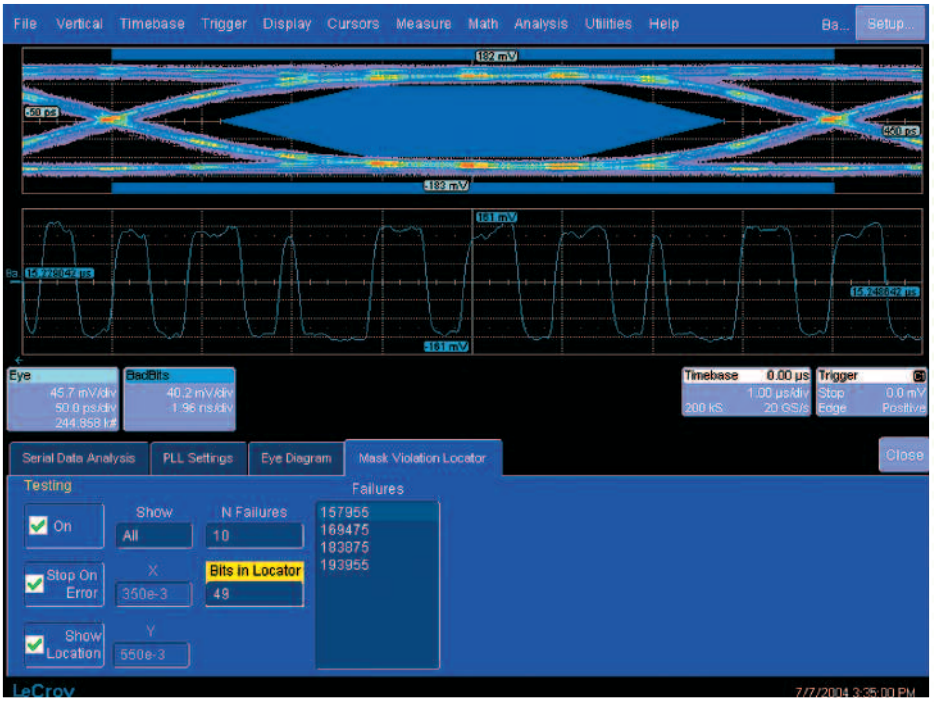
**Eye pattern analysis is a widely used tool for assessing the signal integrity of serial data streams. The SDA measures eye patterns on a continuous record of up to 8M consecutive unit intervals (UI). A software-defined clock recovery algorithm is used to separate the record into segments that are one UI in length, and the segments are then overlaid to form the eye pattern. Subsequent acquisitions are accumulated with the previous ones.**

- **Consecutive UI ensures the capture of transient events on any single bit.**
- **Eye pattern measurement compliant for PCI Express, Serial ATA, USB 2.0, and Serial Attached SCSI.**
- **Trigger jitter is eliminated, giving a measurement of jitter that is 7x lower than traditional methods of measuring eye patterns.**

## A Sharp Focus for Eye Patterns

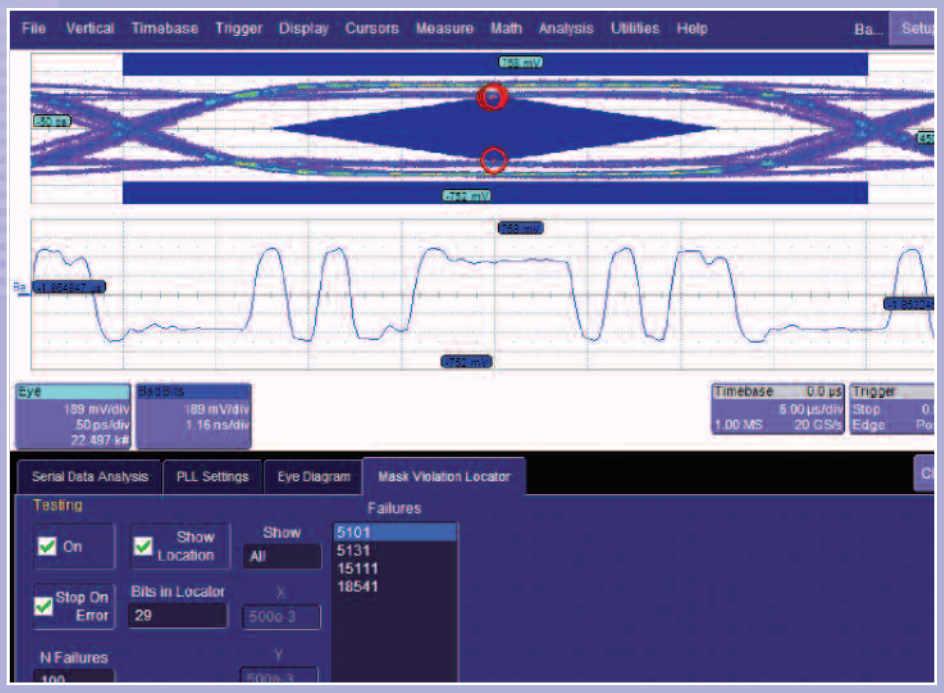
Eye violation location displays individual bits that violate the eye mask boundaries. The SDA measures eye patterns on consecutive unit intervals of the data stream under test. The original waveform is indexed by the software so that the parts of the overall waveform that violate the mask boundaries, when formed into an eye pattern, can be identified by the particular bit that caused them. The signal waveform around the failed bit is displayed, and relationships between the failure and adjacent bits can be easily seen. A second channel from the instrument can also be displayed, and time-aligned with the signal under test, to locate relationships between failures and other signals in the system under test.

**ASDA-J Software**




*The original bit sequence is stored along with the eye pattern, allowing the user to locate the exact bit or bits that caused a mask failure. This type of analysis pinpoints the source of mask failures, speeding up the debugging process. The display can be set to show any number of bits around a specific violation up to the total acquisition so specific bit patterns can be recognized. A table of violations and bit locations is also available.*

- **Fully programmable clock recovery algorithm, including first- and second-order PLL models, provides compliance to all existing standards and allows the modeling of specific receiver types.**
- **Clock recovery modes for PCI Express, DVI/HDMI, and "GOLDEN" PLL.**
- **Fast update rate for both electrical and optical signals with reference receiver.**

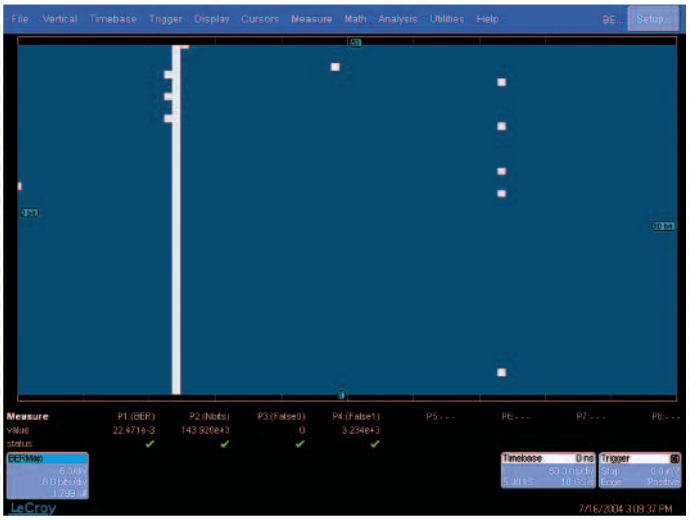



*Eye patterns are measured on a continuous record of up to 8M consecutive UI, giving low jitter, high update rates, and the ability to capture single-bit anomalies.*

## Bit Error Rate Analysis

While bit error rate performance can be predicted through signal quality tests on the transmitter, jitter tolerance testing of receivers can only be evaluated through bit error rate analysis. The SDA converts the captured record of consecutive bits to generate a bit stream, using its software clock recovery and a threshold detector. The bit stream is compared to the expected pattern to determine the number of bit errors and the error ratio. Bit error locations can be displayed in a 3-dimensional map that shows the error locations relative to their position within a frame or pattern. This type of display shows the root causes of bit errors by clearly indicating pattern or frame related issues.

- Measures total errors, 1's errors, 0's errors, and error rate.
- Up to 1e-7 BER on a single capture.
- Error map shows locations of bit errors accumulated over multiple signal acquisitions to measure lower bit error rates.
- Reference patterns can be PRBS5 to PRBS23, and arbitrary patterns can be entered into the instrument or stored in a file.




*The bit error map displays the location of bit errors (shown as bright squares) relative to their location in a frame or pattern. Each frame is displayed as a row in the plot. Frames can be of fixed length, delimited by a specific bit pattern, or both. The bit error rate, along with the number of bit errors, is displayed below the map.*

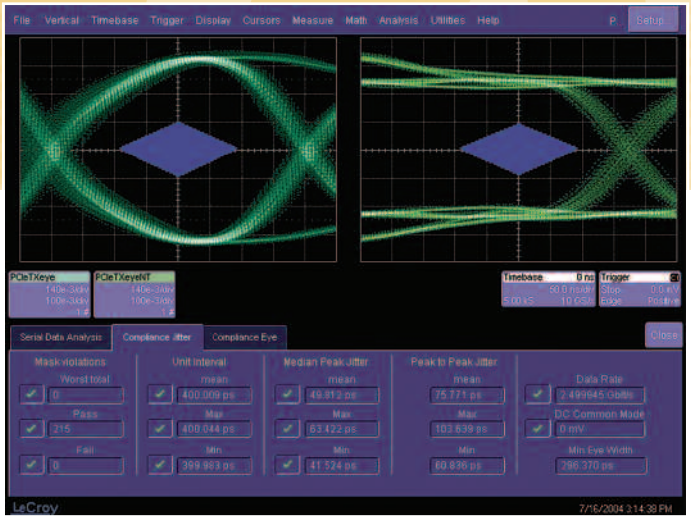
## 8B/10B Protocol Decoding

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.

# Serial Pattern Trigger

**The SDA 6000A XXL and SDA 4000A XXL include a serial pattern trigger that enables signal acquisition to be synchronized with a specific bit sequence in the serial data stream under test. This trigger can be combined with the powerful jitter and eye pattern analysis features of the SDA to measure specific parts of a data stream, such as unscrambled header bytes or specific channels, in a multiplexed data stream. The SDA can also:**

- **Trigger on pattern lengths up to 32 bits**
- **Support data rates from 50 Mb/s to 2.7 Gb/s**
- **Provide recovered clock and data signals to external measurement equipment**



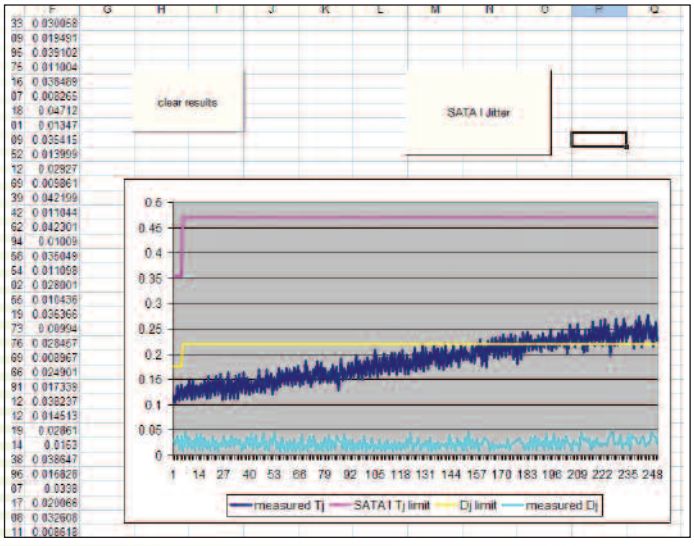

*The SDA-PCIE-G2 software option for the SDA implements PCI-SIG® compliant eye pattern and jitter measurements. The software measures both systems and add-in cards.*

## Standards Compliance

The SDA Series offers a growing list of compliance packages to support everything from USB 2.0 to PCI Express. These optional packages enhance the basic analysis and debug capabilities of the SDA by adding specific compliance measurements and displays. Simple single-button operation can be invoked to perform an entire set of measurements and to display all results, including a pass/fail indicator. LeCroy continues to add new measurements to the SDA to support current and emerging serial data standards.

## Future-proof Customization

As new standards are being developed, specialized measurements are often needed. Using the powerful customization features of the SDA, specialized parameters and functions can be implemented using MATLAB,® Mathcad,® Excel, Visual Basic, or any other programming language. These functions can then be embedded into the instrument, creating custom measurements that can be accessed in the same manner as any of the standard features of the instrument.




*Customization and Automation can be used to create special measurements for new standards. The plot above shows an implementation of the Serial ATA Generation I jitter test in an Excel spreadsheet.*

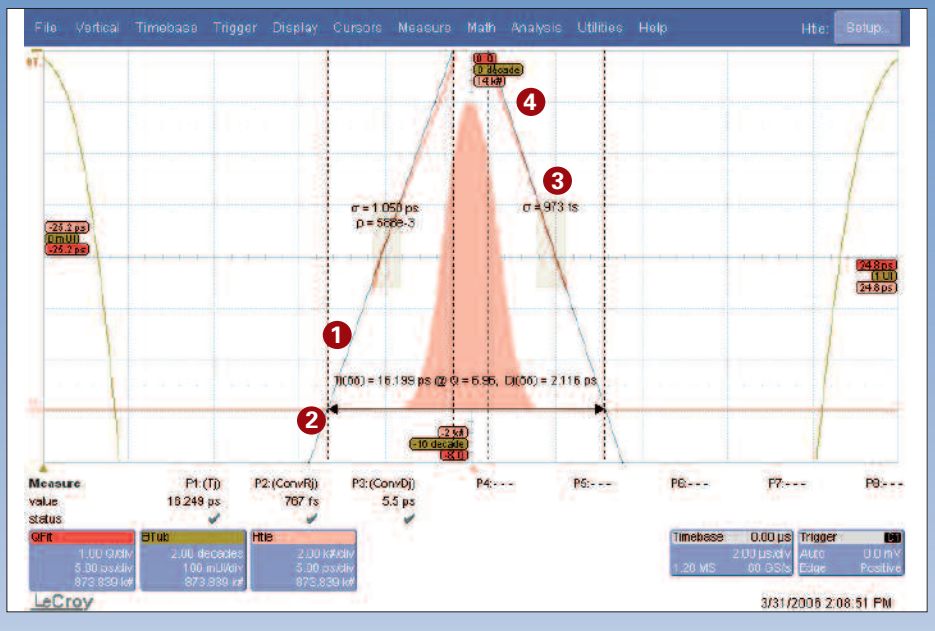
# New Q-Scale–See Jitter Components Accurately

**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.




### 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)

## Interpreting the Q-Scale

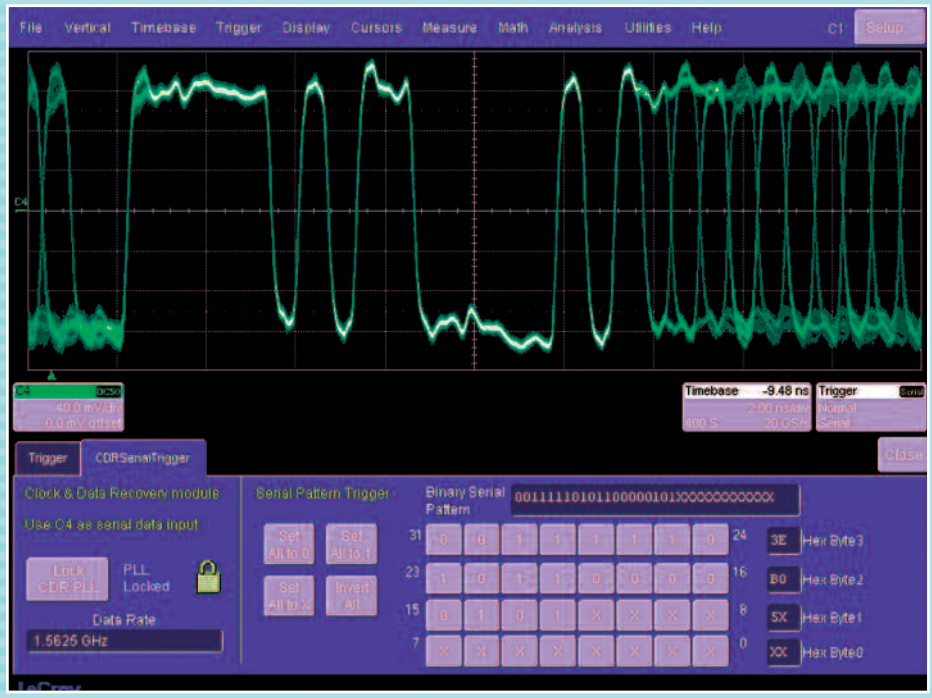
As with any jitter histogram, the width indicates the amount of jitter. The slope of the grey lines decreases with increasing random jitter.

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.




*The SDA serial pattern trigger can be used to acquire specific bit patterns for processing.*

## Optical-to-Electrical Converters

The OE525 and OE555 O/E converters feature 4.5 GHz optical bandwidth and multi-mode optical fiber inputs, and operate over the 500–870 nm and 950–1630 nm wavelength ranges, respectively. The O/E converters feature DSP-based reference receivers that give precise response for any data rate and on any channel.




## LabNotebook™ – A Comprehensive Report Documentation and Setup Archival Tool

Now you can efficiently create complete and detailed waveform reports directly in the serial data analyzer. An all-in-one solution for annotating and sharing information, LabNotebook simplifies results recording and report generation by eliminating the multi-step processes that often involve several pieces of equipment.




*Freehand notes can be written on the screen with a stylus right on the waveform and then saved in the report file. Simple and very efficient.*

## Makes Reports the Way You Want

LabNotebook enables you to focus on results rather than the process, so you can now:

- Save all displayed waveforms
- Save the relevant setups with the saved waveform
- Add freehand notes with a stylus or as text
- Convert the complete report to pdf, rtf, or html
- Print or e-mail reports

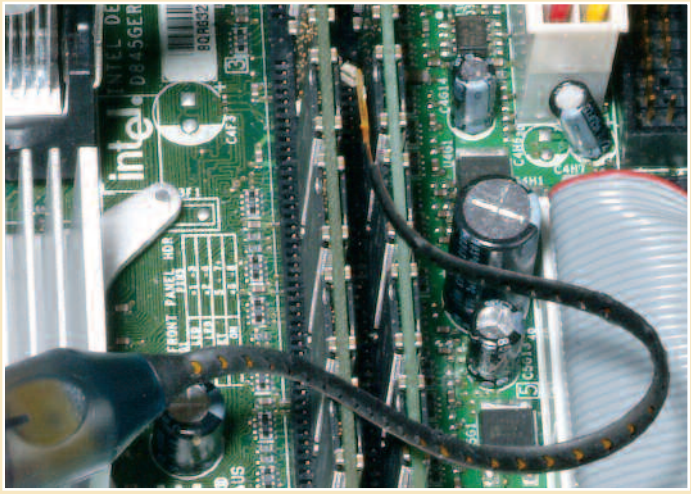
## WaveLink® D600ST

*Mechanical Performance Without Rival*

Best-in-class mechanical design for optimum utility:

- Small-tip, high-bandwidth differential probe
- Three interconnect configurations for flexibility
- Very small form factor for accessing tight spaces

Each of the interchangeable leads is a thin, highly flexible 145 mm (5.7") long lead connecting the tip and the D600ST probe tip module.



# Specifications

| Vertical System | SDA 6020 | SDA 6000A XXL | SDA 4020 | SDA 4000A XXL | SDA 3010 |
|---|---|---|---|---|---|
| Analog Bandwidth @ 50 Ω (-3 dB) | 6 GHz | 6 GHz | 4 GHz | 4 GHz | 3 GHz |
| Rise Time (Typical) | 75 ps | 75 ps | 105 ps | 105 ps | 150 ps |
| Input Channels | 4 | | | | |
| Bandwidth Limiters | 20 MHz, 200 MHz, 1 GHz, 3 GHz, 4 GHz (1 and 3 GHz for SDA 4xxx model only. 4 GHz for SDA 6xxx model only) | | | | |
| Input Impedance | 50 Ω ±2.0% | | | | 50 Ω ±1.5%, 1 MΩ ‖ 15 pF |
| Input Coupling | DC, GND | | | | 1 MΩ: AC, DC, GND; 50 Ω: DC |
| Maximum Input Voltage | ±4 $V_{peak}$ | | | | 50 Ω: 5 $V_{rms}$, 1 MΩ: 100 V max. (peak AC: ≤ 5 kHz + DC) |
| Channel-Channel Isolation | ≥ 100:1 at 2 GHz; ≥ 40:1 at 3 GHz; ≥ 20:1 at 4 GHz | | | | 250:1 at same V/div setting, 40:1 at 3 GHz |
| Vertical Resolution | 8 bits; up to 11 bits with enhanced resolution (ERES) | | | | |
| Sensitivity | 2 mV–1 V/div (fully variable, < 10 mV/div through zoom) | | | | 50 Ω: 2 mV–1 V/div (fully variable); 1 MΩ: 2 mV–2 V/div (fully variable) |
| DC Gain Accuracy | ±1.5% of full scale | | | | ±1.5% of full scale |
| Offset Range | ±750 mV @ 2 mV–194 mV/div<br>±4 V @ 196 mV–1 V/div | | | | 50 Ω: ±700 mV @ 2–4.95 mV/div<br>±1.5 V @ 5–100 mV/div<br>±10 V @ 0.102-1 V/div<br>1 MΩ: ±700 mV @ 2–4.95 mV/div<br>±1.5 V @ 5–100 mV/div<br>±20 V @ 0.102–2 V/div |
| Offset Accuracy | ±(1.5% of full scale +1.5% of offset value +2 mV) | | | | ±(1.5% of full scale + 0.5% of offset value + 2 mV) |

| Horizontal System | | | | | |
|---|---|---|---|---|---|
| Timebases | Internal timebase common to 4 input channels; an external clock may be applied at the auxiliary input | | | | |
| Time/Division Range | Real Time: 20 ps/div–10 s/div<br>Random Interleave Sampling: to 20 ps/div | | | | Real Time: 200 ps/div–10 s/div;<br>RIS mode: to 20 ps/div;<br>Roll mode: up to 1000 s/div |
| Math and Zoom Traces | 8 independent zoom and 8 math or zoom traces | | | | |
| Sample Rate and Delay Time Accuracy | ±1 ppm ≤ 10 s interval | | | | ±5 ppm ≤ 10 s interval |
| Time Interval Accuracy | ≤ 0.06 / SR + (1 ppm * Reading) (rms) | | | | |
| Jitter Noise Floor | 1 ps rms (typical) | | | | |
| Trigger and Interpolator Jitter | < 2 ps rms (typical) | | | | 3 ps rms (typical) |
| Channel-Channel Deskew Range | ±9 x time/div. setting, or 25 ns, whichever is larger | | | | ±9 x time/div. setting, or 100 ms, whichever is larger |
| External Timebase Reference | 100 MHz; 50 Ω impedance, applied at the rear input | | | | |
| External Clock | 30 MHz–2 GHz 50 Ω impedance applied at the auxiliary input | N/A | 30 MHz–2 GHz 50 Ω impedance applied at the auxiliary input | N/A | 30 MHz–1 GHz 50 Ω impedance applied at the auxiliary input |

| Acquisition System | | | | | | |
|---|---|---|---|---|---|---|
| Single-Shot Sample Rate/Ch | 20 GS/s on 4 Ch | 20 GS/s on 2 Ch; 10 GS/s on 4 Ch | 20 GS/s on 4 Ch | 20 GS/s on 2 Ch; 10 GS/s on 4 Ch | 20 GS/s on 2 Ch; 10 GS/s on 4 Ch | |
| Random Interleaved Sampling (RIS) | 200 GS/s for repetitive signals, to 20 ps /div. Upper time/div limit function of sample rate and memory length settings | | | | | |
| Maximum Trigger Rate | 150,000 waveforms/second (in Sequence Mode, up to 4 channels) | | | | | |
| Intersegment Time | ≤ 6 µs | | | | | |
| Maximum Acquisition Memory Points/Ch | 4 Ch | (2 Ch) / (4 Ch) | 4 Ch | (2 Ch) / (4 Ch) | (4 Ch / 2 Ch) | Max. Segments (Sequence Mode) |
| Standard Memory | 20M | 100M / 50M | 20M | 100M / 50M | 10M / 20M | 5000 |
| VL – Memory Option | 32M | N/A | 32M | N/A | N/A | 10,000 |
| XL – Memory Option | 50M | N/A | 50M | N/A | 25M / 50M | 20,000 |

| 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 |
| Interpolation | Linear or Sin x/x |

| 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 86,400 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 |

*External trigger not available on the SDA 6000A XXL or SDA 4000A XXL.

# Specifications

| Triggering System | SDA 6020 | SDA 6000A XXL | SDA 4020 | SDA 4000A XXL | SDA 3010 |
|---|---|---|---|---|---|
| Trigger Sensitivity with Edge Trigger (Ch 1-4) | 3 div @ ≤ 5 GHz<br>2 div @ < 4 GHz<br>1.2 div @ < 3 GHz (typical) | | 2 div @ ≤ 4 GHz<br>1.2 div @ < 3 GHz (typical) | | 2 div < 3 GHz<br>1 div < 2 GHz |
| External Trigger Sensitivity (Edge Trigger) | 1.2 V @ ≤ 5 GHz<br>800 mV @ < 4 GHz<br>480 mV < 3 GHz (typical) | | 800 mV @ ≤ 4 GHz,<br>480 mV < 3 GHz (typical) | | 2 div < 3 GHz<br>1 div < 2 GHz |
| Max. Trigger Frequency, SMART Trigger™ | 750 MHz @ ≤ 10 mV | | | | |
| External Trigger Input Range | Aux (±0.4 V);<br>Aux X10 (±0.04 V);<br>Aux/10 (±4 V) | N/A | Aux (±0.4 V);<br>Aux X10 (±0.04 V);<br>Aux/10 (±4 V) | N/A | Aux (±0.4 V);<br>Aux X10 (±0.04 V);<br>Aux/10 (±4 V) |
| **Basic Triggers** | | | | | |
| Edge/Slope/Line | Triggers when signal meets slope (positive or negative) 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. | | | | |
| **Serial Trigger†** | | | | | |
| Data Rates | N/A | 50 Mb/s to 2.7 Gb/s | N/A | 50 Mb/s to 2.7 Gb/s | N/A |
| Pattern Length | N/A | Up to 32 bits | N/A | Up to 32 bits | N/A |
| Clock and Data Outputs | N/A | 1/2 amplitude AC coupled LVPCL, 400 $mV_{p-p}$ into 50 Ω | N/A | 1/2 amplitude AC coupled LVPCL, 400 $mV_{p-p}$ into 50 Ω | N/A |
| **SMART Triggers with Exclusion Technology** | | | | | |
| Glitch and Pulse Width | 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 | 100–240 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) | 650 W/650 VA | 800 VA (800 W) | 650 W/650 VA | 650 W/650 VA |
| **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 | | | | |
| Altitude (Operating) | Up to 10,000 ft. (3048 m) at or below +25 °C | | | | |
| Altitude (Non-Operating) | Up to 40,000 ft. (12,192 m) | | | | |
| **Physical Dimensions** | | | | | |
| Dimensions (HWD) | 264 mm x 397 mm x 491 mm; 10.4" x 15.6" x 19.3" (height excludes feet) | | | | |
| Weight | 23 kg; 50 lbs. | 18 kg; 39 lbs. | 23 kg; 50 lbs. | 18 kg; 39 lbs. | 18 kg; 39 lbs. |
| Shipping Weight | 29 kg; 63 lbs. | 24 kg; 53 lbs. | 29 kg; 63 lbs. | 24 kg; 53 lbs. | 24 kg; 53 lbs. |
| **Certifications** | | | | | |
| | CE Compliant, UL and cUL listed; conforms to EN 61326-1, EN 61010-1, UL 3111-1, and CSA C22.2 No. 1010.1 | | | | |
| **Warranty and Service** | | | | | |
| | 3-year warranty; calibration recommended annually. Optional service programs include extended warranty, upgrades, and calibration services. | | | | |

*Maximum of 4 channels (no External) on the SDA 6000A XXL and SDA 4000A XXL.

†Serial Trigger is available in SDA 6000A XXL and SDA 4000A XXL.

# Specifications

| Standard | Fixtures | Measurements | Software Options | Web Site |
|---|---|---|---|---|
| InfiniBand | | Rj, Dj, Tj, Eye pattern | | www.infinibandta.org |
| PCI Express | CLB, CBB (available through PCI-SIG) | jitter, eye patterns | SDA-PCIE-G2 | www.pci-sig.org |
| Fibre Channel (133 to 4.25 Gb/s) | OE525 (optical standards) | jitter, Rj, Dj, Tj, eye pattern | | www.fibrechannel.org |
| USB 2.0 (HS signal quality) | TF-USB | HS signal quality (eye pattern) | USB2 | www.usb.org |
| IEEE 1394b (jitter and eye pattern) | QP-SIB, QP-SIG (available from Quantum Parametrics) | eye pattern, Rj, Tj, Dj | | www.1394TA.com |
| SONET/SDH (optical, up to OC48/STM16) | OE555 | eye pattern, filtered jitter | | telecom-info.telcordia.com |
| Ethernet 10/100 1000Base-ST, 1000Base-LX | TF-ET TF-ENET TF-10BT | eye pattern, Rj, Tj, Dj | ENET | www.IEEE.org |
| RapidIO (Parallel/Serial) | | eye pattern, Tj, Rj, Dj | | www.rapidio.org |
| Serial Attached SCSI | | eye pattern, jitter: Tj, Dj | SDA-SAS | www.T10.org |
| 100Base-LX4 (XAUI) | | eye pattern, jitter: Tj, Dj | | www.10gea.org |
| DVI | TPA-R, TPA-P (available through DDWG) | eye pattern with software clock recovery PLL, rise/fall | | www.DDWG.org |
| HDMI | TPA-R, TPA-P (available through DDWG) | eye pattern with software clock recovery PLL, rise/fall | SDA-HDMI | www.HDMI.org |
| FB-DIMM | contact LeCroy | all PHY compliance measurements | SDA-FB-DIMM | www.jedec.org |
| Serial ATA | TF-SATA | eye pattern, jitter Gen1 (edge to edge), Gen2 (2nd order PLL) | SDA-SATA | www.sata-io.org |
| WiMedia UWB | | PSD, EVM, Magnitude, Phase QPSK, DCM, Constellation | SDA-UWB* | www.wimedia.org |

*Compatible with SDA 6000A XXL and SDA 6020 only

## 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

#### 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, send a pulse out at 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.

#### Math Tools

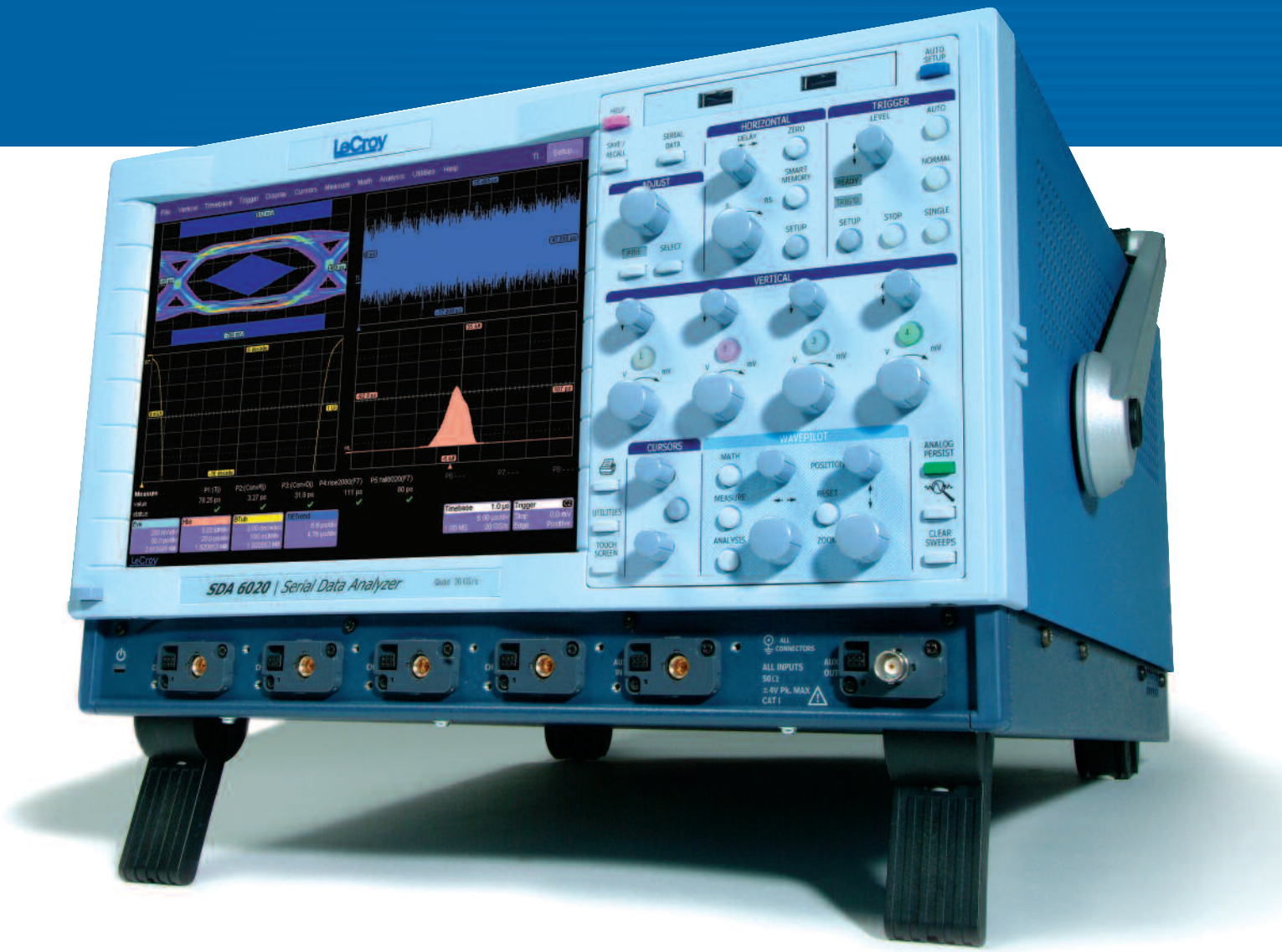
Display up to four math function traces (F1 – F4). The easy-to-use graphical interface simplifies setup of up to two operations on each function trace, and function traces can be chained together to perform math-on-math.

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
∅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.)
∅time@level
∅time@level from trigger
x@max
x@min




# 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

## Compliance Packages

- ENET – Ethernet Test 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
- SATA – SATA Gen1/Gen2 Solution Analysis Software Package
- USB – USB 2.0 Compliance Test Software Package

## LeCroy M1 Timing Tools

The SDA acquires data, calculates, displays, and analyzes jitter in clock and serial data. A wide variety of measurement tools is available including differential crossing point measurements. Jitter viewing tools include line graph, histogram, jitter spectrum, text, and eye diagram. Available in an advanced or basic version.

| | |
|---|---|
| LeCroy M1 Timing Tool (Advanced, 1 oscilloscope) | LeCROY M1/ADV-1 |
| LeCroy M1 Timing Tool (Advanced, 4 oscilloscopes) | LeCROY M1/ADV-4 |
| LeCroy M1 Timing Tool (Basic) | LeCROY M1/BASIC |

# Ordering Information

| Description | Product Code |
|---|---|
| 4 Ch; 6 GHz Serial Data Analyzer; 20 GS/s; 20 Mpts/Ch | SDA 6020 |
| 4 Ch; 6 GHz Serial Data Analyzer; 10 GS/s; 50 Mpts/Ch; 20 GS/s, 100 Mpts in 2 or 1 Ch | SDA 6000A XXL |
| 4 Ch; 4 GHz Serial Data Analyzer; 20 GS/s; 20 Mpts/Ch | SDA 4020 |
| 4 Ch; 4 GHz Serial Data Analyzer; 10 GS/s; 50 Mpts/Ch; 20 GS/s, 100 Mpts in 2 or 1 Ch | SDA 4000A XXL |
| 4 Ch; 3 GHz Serial Data Analyzer; 10 GS/s, 10 Mpts/Ch; 20 GS/s, 20 Mpts/Ch in 2 or 1 Ch | SDA 3010 |

## Memory Options SDA 6020 / SDA 4020/SDA 3010

| | |
|---|---|
| 16 Mpts/Ch (32 Mpts/Ch interleaved) | SDA-VL* |
| 25 Mpts/Ch (50 Mpts/Ch interleaved) | SDA-XL |

*SDA-VL memory option is not available for the SDA 3010.

## Included with Standard Configurations

| | |
|---|---|
| ProLink Adapter SMA; 4 each **(not included with SDA 3010)** | LPA-SMA |
| ProLink Adapter BNC; 2 each **(not included with SDA 3010)** | LPA-BNC |
| Getting Started Manual | |
| CD-ROM containing Operator's Manual, Remote Control Manual, and Automation 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, USB 2.0 | |
| Protective Front Cover | |
| Standard Commercial Calibration and Performance Certificate | |
| 3-Year Warranty | |

## Software Options

### Application Specific Test and Analysis Software Options

| | |
|---|---|
| Advanced Optical Recording Measurement | AORM |
| Disk Drive Measurement Software Package | DDM2 |

### Advanced Math and WaveShape Analysis Software Options

| | |
|---|---|
| Digital Filter Software Package | DFP2 |
| Advanced M1 Software Package for Jitter and Timing Measurements (1 seat) | LECROYM1/ADV-1 |
| Advanced M1 Software Package for Jitter and Timing Measurements (4 seats) | LECROYM1/ADV-4 |
| Basic M1 Software Package for Jitter and Timing Measurements | LECROYM1/BASIC |
| Advanced Customization Software Package | XDEV |
| Processing Web Editor Software Package for Functions and Parameters | XWEB |

### Standards Compliance Software Options

| | |
|---|---|
| Ethernet Test Software Package | ENET |
| HDMI Compliance Test Software Package | SDA-HDMI |
| PCI Express Development and Compliance Software for Gen1 and Gen2 | SDA-PCIE-G2 |
| SAS I/II Solution Analysis Compliance Software Package | SDA-SAS |
| SATA Gen1/Gen2 Solution Analysis Software Package | SDA-SATA |
| UWB Test Solution Software Package | SDA-UWB* |
| USB 2.0 Compliance Test Software Package | USB2 |

*Compatible with SDA 6000A XXL and SDA 6020 only.

| Description | Product Code |
|---|---|

## Hardware and Software Option

| | |
|---|---|
| 32 Digital Oscilloscope Mixed Signal Option | MS-32-DSA |

## Hardware Options and Accessories

| | |
|---|---|
| 1 MΩ Adapter includes PP005A Passive Probe | AP-1M |
| Dual Monitor Display | DMD-1 |
| IEEE-488 GPIB Control Interface | GPIB-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* |
| Oscilloscope Cart with Additional Shelf and Drawer | OC1024 |
| Oscilloscope Cart | OC1021 |
| Rackmount Adapter with 25" (64 cm) Slides | RMA-25 |
| Rackmount Adapter with 30" (76 cm) Slides | RMA-30 |
| Internal Graphics Printer | WM-GP02 |
| Removable Hard Drive Package (includes USB, CD-ROM, removable hard drive, and spare hard drive) | WM-RHD |
| Additional Removable Hard Drive | WM-RHD-02 |
| Soft Carrying Case | WM-SCC |
| Hard Transit Case | WM-TC1 |

*Not available with the SDA 3010.

## Compliance Test Fixtures

| | |
|---|---|
| Ethernet Compliance Test Fixture for 10Base-T | TF-10BT |
| Ethernet Compliance Test Fixture for 100Base-T/1000Base-T [Includes a Set of 2 Test Fixtures Signals on Twisted Pair Cables (UTP)] | TF-ENET |
| Telecom Adapter Kit 100 Ω Bal., 120 Ω Bal., 75 Ω Unbal. | TF-ET |
| HDMI Test Fixture Set (TPA-P-SE, TPA-P-DI) | TF-HDMI |
| Serial ATA Test Fixture (includes pair of SMA cables) | TF-SATA |
| USB 2.0 Testing Compliance Test Fixture | TF-USB |

## Probes Options and Probe Accessories

| | |
|---|---|
| 1 GHz, Active Differential Probe (÷1, ÷10, ÷20) | AP034 |
| 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 |
| 2.5 GHz, 0.7 pF Active Probe (÷10), Small Form Factor | HFP2500 |
| (Qty. 4) 1.5 GHz, 0.9 pF, 1 MΩ High Impedance Active Probe | ZS1500-QUADPAK |
| (Qty. 4) 1 GHz, 0.9 pF, 1 MΩ High Impedance Active Probe | ZS1000-QUADPAK |
| Optical-to-Electrical Converter, 500–870 nm ProLink BMA Connector | OE525 |
| Optical-to-Electrical Converter, 950–1630 nm ProLink BMA Connector | OE555 |
| 7.5 GHz, Low Capacitance Passive Probe 500/1000 Ω | PP066 |
| Probe Deskew and Calibration Test Fixture | TF-DSQ |

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

## Customer Service

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

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