SDA 6020/6000/5000/3000
Serial Data Analyzers Specifications

Vertical System	SDA 6020	SDA 6000	SDA 5000	SDA 3000
Analog Bandwidth @ 50 Ω (-3 dB)	6 GHz	6 GHz	5 GHz	3 GHz
Rise Time (Typical)	75 ps	75 ps	90 ps	150 ps
Input Channels	4	4	4	4
Bandwidth Limiters	25 MHz; 250 MHz; 1 GHz 3 GHz; 4 GHz			25 MHz; 250 MHz; 1 GHz
Input Impedance	50 Ω ±2.0%			
Input Coupling	DC, GND			
Maximum Input Voltage	±4 Vpeak			
Channel-Channel Isolation	≥ 100:1 at 2 GHz; ≥ 40:1 at 3 GHz; ≥ 20:1 at 4 GHz;			
Vertical Resolution	8 bits; up to 11 bits with enhanced resolution (ERES)			
Sensitivity	2 mV – 1 V/div fully variable			
DC Gain Accuracy	±1.5% of Full Scale			
Offset Range	2 mV – 194 mV/div: ±750 mV; 195 mV – 1 V/div: ±4 V			
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 clock may be applied at the auxiliary input
Time/Division Range	20 ps/div – 10 s/div
Math & Zoom Traces	4 independent zoom and 4 math/zoom traces standard; 8 math/zoom traces available with XMAP (Master Analysis package) or XMATH (Advanced Math package)
Clock Accuracy	≤ 1 ppm @ 0–40 degrees C
Time Internal Accuracy	≤ 0.06 / SR + (1 ppm * Reading) (rms)
Sample Rate & Delay Time Accuracy	±1ppm ≤ 10s interval
Jitter Noise Floor	1 ps rms (Typical)
Trigger & Interpolator Jitter	≤ 2.5 ps (Typical)
Channel-Channel Deskew Range	±4.5 ns
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

Acquisition System

Single-Shot Sample Rate/Ch	20 GS/s	10 GS/s

2 Channel Max	20 GS/s			
Random Interleaved Sampling (RIS)	200 GS/s for repetitive signals: 20 ps/div – 1 µs/div			
Maximum Trigger Rate	150,000 waveforms/second (in Sequence Mode, up to 4 channels)			
Intersegment Time	≤ 6 µs	≤ 6 µs	≤ 6 µs	≤ 6 µs
Maximum Acquisition Points/Ch	4 Ch	(2 Ch) / (4 Ch)	Duration @ 20 GS/s	Segments (Sequence Mode)
Standard Memory	8M	8M / 4M	0.4 ms	1,000 Segments
L – Memory Option	16M	16M / 8M	0.8 ms	5,000 Segments
VL – Memory Option	32M	32M / 16M	1.6 ms	10,000 Segments
XL – Memory Option	48M	48M / 24M	2.4 ms	20,000 Segments
XXL – Memory Option	N/A	100M / 50M	5.0 ms	25,000 Segments

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, roof for up to 1 million sweeps

Triggering System

Modes	Normal, Auto, Single, and Stop
Sources	Any input channel, External, Ext X10, Ext/10, or line; slope and level unique to each source (except line trigger)
Coupling Mode	DC
Pre-trigger Delay	0 – 100% of horizontal time scale
Post-trigger Delay	0 – 10,000 divisions
Hold-off by Time or Events	Up to 20 s or from 1 to 99 999 999 events
Internal Trigger Range	±5 div from center
Max Trigger Frequency	5 GHz w/Edge Trigger; 750 MHz w/SMART Trigger (8300A = 3 GHz w/Edge Trigger, 750 MHz w/SMART Trigger)
External Trigger Input Range	Aux (±0.4 V); Aux X10 (±0.04 V); Aux / 10 (±4 V)
Trigger Sensitivity (Edge)	3 Divisions @ 5 GHz, 2 Divisions @ 4 GHz, 1.2 Divisions @ 3 GHz (Typical)

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Serial Data Analyzers Specifications (continued)

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.

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.

Automatic Setup

Auto Setup	Automatically sets timebase, trigger, and sensitivity to display a wide range of repetitive signals.
Vertical Find Scale	Automatically sets the vertical sensitivity and offset for the selected channels to display a waveform with maximum dynamic range

Probes

Probes	A variety of optional passive and active probes is available.
Probe System: ProLink with Probus	Automatically detects and supports a variety of compatible probes; Supports ProLink-SMA and ProLink-BNC input adapters
Scale Factors	Automatically or manually selected depending on probe used

Color Waveform Display

Type	Color 10.4" flat-panel TFT-LCD with high resolution touch screen
Resolution	SVGA; 800 x 600 pixels
Realtime Clock	Dates, hours, minutes, seconds displayed with waveform. SNTP support to synchronize to precision internet clocks
Number of Traces	Display a maximum of 8 traces. Simultaneously display channel, zoom, memory, and math traces.
Grid Styles	Auto, Single, Dual, Quad, Octal, XY, Single + XY, Dual + XY
Waveform Styles	Sample dots joined or dots only

Analog Persistence Display

Analog & Color-Graded Persistence	Variable saturation levels; stores each trace's persistence data in memory
Persistence Selections	Select analog, color, or three-dimensional.
Trace Selection	Activate persistence on all or any combination of traces.
Persistence Aging Time	Select from 500 ms to infinity.
Sweeps Displayed	All accumulated, or all accumulated with last trace highlighted

Zoom Expansion Traces

	Display up to 4 Zoom and 4 Math/Zoom traces; 8 Math/Zoom traces available with XMAP (Master Analysis package) or XMATH (Advanced Math package).

CPU

Processor	Intel Pentium 4 @ 2.53 GHz or better with MS Windows 2000
Processing Memory	Up to 2 GBytes

Internal Waveform Memory

	M1, M2, M3, M4 Internal Waveform Memory (Store full-length waveforms with 16 bits/data point) Or store to any number of files limited only by data storage media.

Setup Storage

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

Specifications are subject to change.

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Serial Data Analyzers Specifications (continued)

Interface

Remote Control	Via Windows Automation, or via LeCroy Remote Command Set.
GPIB Port (Optional)	Supports IEEE – 488.2
Ethernet Port	10/100Base-T Ethernet interface
Floppy Drive	Internal, DOS-format, 3.5" high-density
USB Ports	4 USB ports support Windows compatible devices
External Monitor Port Standard	15-pin D-Type SVGA-compatible
Parallel Port	1 standard

Auxiliary Output

Signal Types	Select from calibrator or control signals output on front panel.
Calibrator Signal	5 Hz – 5 MHz square wave or DC Level; 0.0 to 0.5 V into 50 Ω (0–1 V into 1 MΩ), or TTL Volts (Selectable)
Control Signals	Trigger enabled, trigger out, pass/fail status

Auxiliary Input

Signal Types	Select from External Trigger or External Clock input on front panel.

General

Auto Calibration	Ensures specified DC and timing accuracy is maintained for 1 year minimum.
Power Requirements	100–120 VAC at 50/60/400 Hz; 200–240 VAC at 50/60 Hz; Automatic AC Voltage selection. Power consumption: < 800 VA

Environmental

Temperature (Operating)	+5 ˚C to +40 ˚C including floppy disk and 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)
Random Vibration (Operating)	0.31 grms 5 Hz to 500 Hz, 15 minutes in each of three orthogonal axes
Random Vibration (Non-Operating)	2.4 grms 5 Hz to 500 Hz, 15 minutes in each of three orthogonal axes
Functional Shock	20 g peak, half sine, 11 ms pulse, 3 shocks (positive and negative) in each of three orthogonal axes, 18 shocks total

Physical Dimensions

Dimensions (HWD)	264 mm x 397 mm x 491 mm; 10.4" x 15.6" x 19.3" (height excludes feet)	
	6020	**6000, 5000, 3000**
Weight	23 Kg; 49 lbs.	18 kg; 39 lbs.
Shipping Weight	29 Kg; 63 lbs.	24 kg; 53 lbs.

Certifications

	CE Approved, 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

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

Specifications are subject to change.

SDA 6020/6000/5000/3000

Serial Data Analyzers Specifications (continued)

Optical Reference Receiver (with OE425/OE455)	SDA 3000	SDA 5000 / SDA 6000 / SDA 6020
4th order Bessel-Thompson filter response at the following data rates:		
SONET/SDH	OC-1/STM0 (51.84 Mb/s) OC-3/STM1 (155.52 Mb/s) OC-12/STM4 (622.08 Mb/s)	OC-1/STM0 (51.84 Mb/s) OC-3/STM1 (155.52 Mb/s) OC-12/STM4 (622.08 Mb/s) OC-48/STM16 (2488.3 Mb/s)
Fibrechannel	FC133 (132.7 Mb/s) FC266 (265.6 Mb/s) FC531 (531.2 Mb/s) FC1063 (1063.5 Mb/s)	FC133 (132.7 Mb/s) FC266 (265.6 Mb/s) FC531 (531.2 Mb/s) FC1063 (1063.5 Mb/s) FC2125 (2127 Mb/s)
Gigabit Ethernet	1.25 Gb/s	1.25 Gb/s
InfiniBand		2.25 Gb/s (2127 Mb/s)
User Defined	Any rate up to 2 Gb/s	Any rate up to 3.5 Gb/s

Clock Recover System

Channel	Software-based clock recovery using golden PLL for data rates up to 2.5 Gb/s	Software-based clock recovery using golden PLL for data rates up to 3.5 Gb/s
PLL Bandwidth	Single pole w/ adjustable cut-off frequency	Single pole w/ adjustable cut-off frequency
Jitter		Same as time base: 1 ps RMS typical

Communications Mask Testing

SONET/SDH	OC-1/STM0 OC-3/STM1 OC-12/STM4	OC-1/STM0 OC-3/STM1 OC-12/STM4 OC-48/STM16
Ethernet IEEE Std 802.3 and	1000 Base-SX Short Wave Optical	1000 Base-SX Short Wave Optical
ANSI X3.263-1995	1000 Base-LX Long Wave Optical	1000 Base-LX Long Wave Optical
Fibre Channel Electrical	FC133E, FC266E, FC531E, FC1063E	FC133E, FC266E, FC531E, FC1063E, FC2125
(ANSI X3.303-1997) IEEE 1394b (draft)	S400 Optical S400b T1 S400b T2 S800 Optical S800b T1 S800b T2	S400 Optical S400b T1 S400b T2 S800 Optical S800b T1 S800b T2 S1600 Optical S1600b T1 S1600b T2
Serial Data ATA (draft)	G1, G1 Rx, G1 Tx G2, G2 Rx, G2 Tx	G1, G1 Rx, G1 Tx G2, G2 Rx, G2 Tx
DVI (rev.1.0)	Transmit normalized, Receiver Low/high	
InfiniBand (draft)		2.5 Gb/s Optical 2.5 Gb/s Electrical
PCI-Express		TX transition TX de-emphasized RX
XAUI		TX near end TX far end

Jitter Testing

Data Measurements	Period, Frequency, TIE, N-Cycle
Clock Measurements	Frequency, Period, Half Period, Cycle-Cycle, N-Cycle, Positive Cy-Cy Duty, Negative Cy-Cy Duty, Clock TIE
Analysis	Tj, Rj, Dj, DCD, DDj, Pj

Bit Error Rate

Data Rate		< = 2 Gb/s	< = 3.5 Gb/s
Maximum capture buffer size (bits)		20 Gs/s at 1.25 Gb/s data rate (16 samples/bit)	20 Gs/s at 2.5 Gb/s data rate (8 samples/bit)
Capture size in bits:	Std.	500k	1M
	L (16M)	1M	2M
	VL (32M)	2M	4M
	XL (50M)	3M	6M
	XXL (100M)	6.25M	12.5M (except 6020 unit)

SDA 6020/6000/5000/3000
Serial Data Analyzers Specifications (continued)

Standard

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
average (summed)
average (continuous)
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 kpts)
floor
histogram of 1000 events
integral
invert (negate)
log (base e)
log (base 10)
product (x)
ratio (/)
reciprocal
rescale (with units)
roof
(sinx)/x
square
square root
sum (+)
trend (datalog) of 1000 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
last
level @ x
maximum
mean
median
minimum
number of points
+overshoot
–overshoot
peak-to-peak
period
phase
risetime (10–90%, 20–80%, @ level)
rms
std. deviation
top
width
median
phase
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, email 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.

Advanced Math Package (XMATH)

This package provides a comprehensive set of signal WaveShape Analysis Tools providing insight into the wave shapes of complex signals. Additional capability provided by XMATH includes:

- Intuitive, Graphical Math Setup (Processing Web) with unlimited chaining of functions
- 8 math traces total (4 additional)
- Parameter math – add, subtract, multiply, or divide two different parameters
- Histograms expanded with 19 histogram parameters and up to 2 billion events
- Trend (datalog) of up to 1 million events
- Track graphs of any measurement parameter
- FFT capability added to include: power averaging, power density, real and imaginary components, frequency domain parameters, and FFT on up to 25 Mpts.
- Narrow band power measurements
- Auto-correlation function
- Sparse function
- Cubic and Quadratic Interpolation function

Jitter and Timing Analysis Package (JTA2)

This package provides jitter timing and analysis using time, frequency, and statistical views for common timing parameters, and also includes other useful tools. JTA2 includes:

- Jitter and timing parameters, with "Track" graphs of
  - Cycle-Cycle Jitter
  - N-Cycle
  - N-Cycle with start selection
  - Frequency
  - Period
  - Half Period
  - Width
  - Time Interval Error
  - Setup
  - Hold
  - Skew
  - Duty Cycle
  - Duty Cycle Error
- Edge@lv parameter (counts edges)
- Histograms expanded with 19 histogram parameters and up to 2 billion events
- Trend (datalog) of up to 1 million events
- Track graphs of all parameters
- Persistence histogram, persistence trace (mean, range, sigma)

Optional

Advanced Serial Data Analysis (ASDA)

This package includes advanced serial data analysis tools which enable the SDA to perform detailed analysis o ter, eye patterns and bit errors. The package includes

- Mask violation locator
- N-Cycle vs. N jitter plot
- Bit error analysis with error map
- ISI plot
- Filtered jitter analysis

LeCroy M1 Timing Tools

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

LeCroy M1 Timing Tool (Advanced, 1 scope)	LeCROY M1 / ADV-1
LeCroy M1 Timing Tool (Advanced, 4 scopes)	LeCROY M1 / ADV-4
LeCroy M1 Timing Tool (Basic)	LeCROY M1 / BASIC

Advanced Customization Package (XDEV)

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

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

Disk Drive Measurements Package (DDM2)

This package provides disk drive parameter measurements and related mathematical functions for performing disk drive WaveShape Analysis.

- Disk Drive Parameters are as follows:

amplitude assymetry
local base
local baseline separation
local maximum
local minimum
local number
local peak-peak
local time between events
local time between peaks
local time between troughs
local time at minimum
local time at maximum
local time peak-trough
local time over threshold
local time trough-peak
local time under threshold
narrow band phase
narrow band power
overwrite
pulse width 50
pulse width 50–
pulse width 50+
resolution
track average amplitude
track average amplitude–
track average amplitude+
auto-correlation s/n
non-linear transition shift

- Correlation function
- Trend (datalog) of up to 1 million events
- Histograms expanded with 18 histogram parameters and up to 2 billion events