LeCroy 9384 Series Digital Oscilloscope 1 GHz Bandwidth, 1 - 4 GS/s

Main Features

• 1 GHz Bandwidth

• Sample rates to
4 Gigasamples/second

• Memory lengths to
8M points

• 8-bit vertical resolution,
11 with ERES option

• Four full independent
channels

• Vertical accuracy to 1%
typical

• Triggering to 1 GHz

• Innovative Peak Detect

• Glitch, Pattern, Qualified,
Interval, Dropout, TV, and
Exclusion Triggers

• Histogram and FFT
Signal Processing Options

• Floppy Disk, Internal
Printer, PCMCIA Hard
Disk and Memory Card
available

• Fully programmable via
GPIB and RS-232-C

1 GHz Bandwidth

The 9384 series digital storage oscilloscope opens up new horizons for engineers and scientists at the leading edge of technological developments. With 1 GHz bandwidth and long acquisition memories, it is now possible to reveal previously hidden waveform details. Narrow glitches are more accurately defined; risetime measurements below 1 nanosecond are more precise; and high-frequency content, filtered out in lower bandwidth systems, is retained, thereby preserving signal amplitudes and overall signal integrity. Edge Triggering to 1GHz and LeCroy's powerful Smart™ Trigger modes like: Glitch, Pattern, Dropout, Interval, Exclusion and TV enable you to capture precisely the events of interest.

4 GS/s Sample Rate

The 9384 samples simultaneously on all channels at 1 GS/s. Thus, it is ideal for demanding high speed applications. In addition, two channels can be combined to provide a sample rate of 2 GS/s or 4 GS/s in single channel mode. Finer horizontal resolution and accuracy are assured by high sample rates. This is especially critical in digital design where unpredictable circuit behavior needs to be identified and analyzed in detail to be fully understood. Together with this excellent single-shot performance the 9384 series also provides a sample rate equivalent to 10 GS/s for repetitive signals. The innovative peak-detect mode enables glitch capture even at the slowest time settings without loss of precision.

8M Points Acquisition Memory

Channel record lengths of 100k, 500k and 2M are available on the 9384. The memory power is revealed when the user seeks to sample at the highest speed over many timebase settings. DSO's with less memory may boast a high sample rate for short waveforms, but only LeCroy's long memory oscilloscope can deliver high sample rates for long waveforms. To exploit this capability to its fullest, the LeCroy 9384AL combines its channel acquisition memories to give the user up to 8 million sample points, thereby providing the waveform detail required on long and complex signals.

The combined capabilities of the 9384 place it in the forefront of DSO capability.

Precision Acquisition

1 GHz bandwidth results in greater accuracy of amplitude and risetime measurements for high frequency signals and true representation of high speed digital and analog signals.

High Sample Rate

The 9384 provides maximum sample rates of 1 GS/s, 2 GS/s, and 4 GS/s for greater waveform fidelity, excellent zoom detail, protection against aliasing, precision time resolution and wider frequency spectrum.

Channel Memory and Channel Interleaving

Capturing long time windows single-shot requires long memory. LeCroy, the company that invented long memory DSO's, provides three memory selections: 100k points per channel standard, 500k points per channel with the “M” and “TM” versions, and 2M points per channel with the “AL” version.

By interleaving the 4 channels of the 9384AL, the acquisition memory and sample rate can be increased 4X to provide up to 4 GS/s and up to 8M-points of memory. The result is that the 9384AL enables you to capture 2 millisecond of signal duration with 250 ps real time sample resolution.

Advanced Peak Detect System

The 9384 series offers an innovative peak detect capture mode. This captures fast glitches by running the ADC's at a high sampling rate even at slow time base settings thereby capturing signal details that might have been missed due to

under sampling. At the same time the scope stores the underlying data to ensure no loss of time precision - unlike other peak detect systems.

SMART Trigger System

SMART Trigger functions including Glitch, Pattern, Interval, Exclusion, TV, Dropout, and State-or-Edge Qualified triggers are available. Pre and Post-trigger delay are fully variable, Time and Events Holdoff are also included.

Automatic Parametric Measurements and Statistics

The 9384 provides more than 40 parametric measurements and their Average, Highest, Lowest values and Standard Deviation. Pass/Fail testing allows up to 5 parameters to be tested against selectable thresholds. Waveform Limit Testing can also be performed using Masks which may be defined inside the instrument. Any failure will activate preprogrammed actions such as Hardcopy, Save, Stop, Beep, GPIB SRQ, or Pulse Out.

Internal Printer

Most printers and plotters can be driven via GPIB, RS-232-C and an optional Centronics interface. The 9384 offers an optional internal printer which can produce a 126 X 90 mm full resolution screen dump in under 10 seconds at the push of a button.

The unique `Strip-Chart' format expands the horizontal axis up to 200 cm/div per division for viewing fine waveform detail within long memory acquisitions.

Remote Interfacing

GPIB and RS-232-C interfaces may be used for full remote control of the instrument. All front panel and internal processing functions can be controlled via either interface. Optional Advanced Math Package - WP01

Option WP01 provides Summed and Continuous Averaging, Waveform Math Functions, Extrema and Enhanced Resolution Modes.

Functions can be chained together, allowing complex computations. Waveform operations can be performed on live, stored, processed or expanded waveforms without altering the original capture data.

Optional Spectral Analysis Package - WP02

Option WP02 provides comprehensive Spectral Analysis capabilities permitting the system designer to identify characteristics which may not be apparent in the time domain. WP02 provides a wide selection of windowing functions as well as averaging in the frequency domain (see page 59 of Catalog).

Spectral analysis can be performed on repetitive and single-shot waveforms, on any part or zoomed portions of a waveform up to 4M points, not just the first 10k points of the waveform.

Optional Parameter Analysis Package - WP03

Option WP03 provides extensive parameter analysis capabilities. Detailed statistical analysis can easily be performed on difficult to measure waveform phenomena such as amplitude fluctuation and timing jitter. Live histogram displays represent the statistical distribution of the user selected waveform parameter measurements. Statistical information can be extracted directly from the histograms using automatic statistical measurement including max, min, average, median, and std. deviation (see page 63).

ACQUISITION SYSTEM

Bandwidth (-3 dB):

@ 50 Ohm: DC to 1 GHz 10 mV/div and above

@ 1M Ohm DC: DC to 500 MHz typ. at probe tip, with PP005 supplied standard. 1 GHz FET probe optional.

No. of Channels: 4 - 9384

No. of Digitizers: 4 - 9384

Maximum Sample Rate: 4 GS/s

Memories: (See table)

Sensitivity: 2 mV/div to 1 V/div, 50 Ohm fully variable, 2 mV/div to 10 V/div, 1M Ohm fully variable.

Scale factors: A wide choice of probe attenuation factors are selectable.

Offset Range:

2.00 - 4.99 mV/div: ± 400 mV

5.00 - 99 mV/div: ± 1 V

0.1 - 1.0 V/div: ± 10 V

1.0 - 10 V/div: ±100 V (1M Ohm only)

± 20 V across the whole sensitivity range when using the AP 020 FET probe.

DC Accuracy: 10 mV and above, 1% typical

Vertical Resolution: 8 bits

Bandwidth Limiter: 25 MHz or 200 MHz user selectable

Input Coupling: AC, DC, GND.

Input Impedance: 1 M Ohm // 15 pF typical or 50 Ohm ±1%

Max Input:

1 M Ohm: 400 V (DC+peak AC £10 kHz)

50 Ohm: ± 5 V DC

Channels	**Maximum**	**Memory Per**				**Active**
Use	**Sample Rate**	**Channel**				**Channels**
		9384	**9384M**	**9384TM**	**9384AL**	
All Peak Detect	1 GS/s	100k	500k	500k	2M	All
OFF						
Paired Peak	2 GS/s	200k	1M	1M	4M	Ch 2 & Ch 3
Detect OFF						
Paired + PP094	4 GS/s	400k	2M	2M	8M	(PP094 input)
Peak Detect						
OFF						
All 2.5 ns Peak	100 MS/s	50k data+50k	250k data+	250k data+	1M data+	All 2.5 ns
Detect ON	data+	peak	250k peak	250k peak	1M peak	Detect

	400 MS/s peak					

TIME BASE SYSTEM

Timebases: Main and up to 4 Zoom Traces.

Time/Div Range: 1 ns/div to 1000 s/div.

Clock Accuracy: < 10 ppm

Interpolator resolution: 10 ps

Roll Mode: ranges 500 ms to 1,000 s/div.

For > 50k points: 10 s to 1,000 s/div.

TRIGGERING SYSTEM

Trigger Modes: Normal, Auto, Single.

Trigger Sources: CH1, CH2, CH3 and CH4, External and Line, Slope, Level and Coupling for each source can be set independently.

Slope: Positive, Negative.

Coupling: AC, DC, HF, LFREJ, HFREJ.

Pre-trigger recording: 0 to 100% of full scale (adjustable in 1% increments).

Post-trigger delay: 0 to 10,000 divisions (adjustable in 0.1 div. increments).

Holdoff by time: 10 ns to 20 s.

Holdoff by events: 0 to 99,999,999 events.

Width Trigger Sensitivity:

<10% of full scale > 1 ns;

<20% of full scale 500 ps to 1 ns

Internal Trigger Sensitivity Range: ± 5 div.

EXT Trigger Max Input:

1 M Ohm // 15 pF: 400 V (DC+peak AC<10 kHz)

50 Ohm± 1%:

± 5 V DC (500 mW) or 5V RMS

EXT Trigger Range: ± 0.5 V (± 5 V with Ext/10)

Trigger Timing: Trigger Date and Time are listed in the Waveform Status Menu.

SMART TRIGGER TYPES

Pattern: Trigger on the logic AND of 5 inputs - CH1, CH2, CH3, CH4, and EXT

Trigger, where each source can be defined as High, Low or Don’t Care. The Trigger can be defined as the beginning or end of the specified pattern.
Signal or Pattern Width: Trigger on glitches <2.5 ns (1 ns typical) or on pulse widths between two limits selectable from <2.5 ns to 20s exclusive.
Exclusion Trigger: Trigger on a signal or period outside two limits selectable from <2.5 ns to 20s.
Signal or Pattern Interval: Trigger on an interval between two limits selectable from 10 ns to 20 s.
Dropout: Trigger if the input signal drops out for longer than a time-out from 25 ns to 20 s.
State/Edge Qualified: Trigger on any source only if a given state (or transition) has occurred on another source. The delay between these events can be defined as a number of events on the trigger channel or as a time interval.
TV: Allows selection of both line (up to 1500) and field number (up to 8) for PAL, SECAM, NTSC or non-standard video.
ACQUISITION MODES
Random Interleaved Sampling (RIS): for repetitive signals from 1 ns/div to 2 ms/div.
Random Interleaved Sampling Rate:
10 GS/s
Single shot: for transient and repetitive signals from 2 ns/div (all channels active).
Peak detect: captures and displays 2.5 ns glitches (1 ns typical) or other high-speed events.
Sequence: Stores multiple events - each of them time stamped - in segmented acquisition memories.
Number of segments available:
9384 2-500
9384M 2-2,000
9384TM 2-2,000
9384AL 2-2,000

DISPLAY

Waveform style: Vectors connect the individual sample points, which are highlighted as dots. Vectors may be switched off.

CRT: 12.5 x 17.5 cm (9" diagonal) raster.

Resolution: 810 x 696 points.

Modes: Normal, X-Y, Variable or Infinite Persistence.

Real-time Clock: Date, hours, minutes, seconds.

Graticules: Internally generated; separate intensity control for grids and waveforms.

Grids: 1, 2 or 4 grids.

Formats: YT, XY, and both together.

Vertical Zoom: Up to 5x Vertical Expansion (25x with averaging, up to 80 µV sensitivity with Advanced Math option WP01).

Horizontal Zoom Factors up to:

9384 20,000x

9384M 100,000x

9384TM 100,000x

9384AL 200,000x

Waveforms can be expanded to give .4-.5 points/division. Zoom factors up to 800,000x for the 9384L with all channels combined.

INTERNAL MEMORY

Waveform Memory: Up to four 16-bit Memories (M1,M2,M3,M4). The length of each memory is equal to the data acquisition memory.

Processing Memory: Up to four 16-bit Waveform Processing Memories (A,B,C,D).

Setup Memory: Four non-volatile memories. Optional IC Memory Cards, floppy disk or PCMCIA hard drives may also be used for high-capacity waveform and setup storage.

CURSOR MEASUREMENTS

Relative Time: Two cursors provide time measurements with resolution of ±0.05% full-scale for unexpanded traces; up to 10% of the sampling interval for expanded traces. The corresponding frequency value is displayed.

Relative Voltage: Two horizontal bars measure voltage differences up to ±0.2% of full-scale in single-grid mode.

Absolute Time: A cross-hair marker measures time relative to the trigger and voltage with respect to ground.

Absolute Voltage: A reference bar measures voltage with respect to ground.

AUTOMATIC MEASUREMENTS

The following Parametric measurements are available, together with their Average, Highest, Lowest values and Standard Deviation:

amplitude	falltime	peak to peak
area	f 80-20%	period
base	f@level (abs)	risetime
cycles	f@level (%)	r 20-80%
delay	frequency	r@level (abs)
delta delay	maximum	r@level (%)
delta t at level (abs)	mean	RMS
delta t at level (%)	median	std dev
delta t at level (t=0,abs)	minimum	top

Pass/Fail testing allows any 5 items (parameters and/or masks) to be tested against selectable thresholds. Waveform Limit Testing is performed using Masks which may be defined inside the instrument. Any failure can initiate preprogrammed actions such as Hardcopy, Save to internal memory, Save to mass storage device (card or disk), GPIB SRQ or Pulse Out.

DC2D+ and DC2D- measure setup and hold times.

WAVEFORM PROCESSING

Up to four processing functions may be performed simultaneously. Functions

available are: Add, Subtract, Multiply, Divide, Negate, Identity and Summation Averaging.
Average: Summed averaging of up to 1,000 waveforms in the basic instrument. Up to a million sweeps are possible with Option WP01.
Envelope*: Max, Min, or Max and Min values of up to one million sweeps.
ERES*: Low-Pass digital filter provides up to 11 bits vertical resolution.

Sampled data is always available, even when a trace is turned off. Any of the above modes can be invoked without destroying the data.
FFT*: Spectral Analysis with four windowing functions and FFT averaging.
*Envelope and ERES modes are provided in Advanced Math Package WP01, FFT is in Package WP02.

AUTOSETUP

Pressing Autosetup sets timebase, trigger and sensitivity to display a wide range of repetitive signals. (Amplitude 2 mV to 40 V; frequency above 50Hz; Duty cycle greater than 0.1%).
Autosetup Time: Approximately 2 seconds.
Vertical Find: Automatically sets sensitivity and offset.

PROBES

Model: One PP005 (X10, 10 M Ohm // 11 pF) probe supplied per channel.
The 9384 family is fully compatible with LeCroy’s range of FET Probes, which may be purchased separately.
Probe calibration: Max 1 V into 1 M Ohm, 500 mV into 50 Ohm, frequency and amplitude programmable, pulse or square wave selectable, rise and fall time 1 ns typical.
Alternatively, the Calibrator output can provide a trigger output or a PASS/FAIL test output.

INTERFACING

Remote Control: All front-panel controls, as well as all internal functions are possible by GPIB and RS-232-C.

RS-232-C Port (Standard): Asynchronous up to 19200 baud for computer/terminal control or printer/plotter connection.

GPIB Port (Standard): (IEEE-488.1) Configurable as talker/listener for computer control and fast data transfer

Centronics port: Hardcopy parallel interface are available as part of either floppy disk or internal printer options.

Hardcopy: Screen dumps are activated by a front panel button or via remote control. TIFF format is available for importing to Desktop Publishing programs. The following printers and plotters can be used to make hardcopies: HPThinkJet, QuietJet, LaserJet, PaintJet, and EPSON printers, HP7400 and 7500 series, or HPGL compatible plotters.

An optional internal high resolution graphics printer is also available, see p. 73.

GENERAL

Auto-calibration ensures specified DC and timing accuracy.

Temperature: 5° to 40° C rated accuracy. 0° to 50° C operating. Derate @ 1°C/1000 ft of altitude to 10,000 ft.

Humidity: <80%

Shock and Vibration: Meets MIL-STD-810C modified to LeCroy design specifications and MIL-T-28800C.

Power: 90-250 VAC, 45-66 Hz, 350 W.

Battery Backup: Front panel settings maintained for two years.

Dimensions: (HWD) 8.5" x 14.5" x 16.25", (210mm x 370mm x 410mm).

Weight: 13 kg (28.6 lbs) net, 18.5 kg (40.7 lbs) shipping.

Warranty: Three years

Compliance: Complies with the EU - EMCDirective