

Overview

Sampling rate, memory depth, and bandwidth. Choose the combination you need. The LeCroy 9300 family has it all! From the low cost quad 9304A to the high bandwidth 9374, the 9300 Series continues to expand with new configurations, all sharing an easy to use panel layout, programming command set, and memory card, floppy disk storage or PCMCIA portable hard drive. Recently we have added the award winning 9362 which at 10 GS/s is the World's Fastest DSO. The new 9370/74 series offers 1 GHz bandwidth and up to 2M of memory per channel for applications ranging from disk drive testing to communications design.

THE EASIEST DSO TO USE

The 9300's knob-per function architecture is the easiest to use. You always know which knob to turn because their actions never change.

CHOOSE THE MEMORY DEPTH YOU NEED

Available from 50k to 2M, deep memory avoids aliasing, making the DSO easier to believe. LeCroy's way of managing memory makes DSOs easier to use.

FIND INTERMITTENT SIGNALS FAST WITHOUT COMPLEX TRIGGERING

Use LeCroy's 2 MByte memory and auto-trigger to capture as much data in 1 trigger as 4000 triggers that other scopes need in their 500 sample fast view mode. Or use

LeCroy's powerful Exclusion Trigger to look for anomalies. Either way, the resulting data can be saved to hard copy or into histograms that show irregular values for signal width, amplitude, timing and other characteristics. LeCroy gives you real measurements of signal anomalies. For more information refer to "Finding Intermittent Faults in Electronic Circuits (p. 149).

A DISPLAY YOU CAN WATCH ALL DAY

All 9300 scopes have a large 9" display with super sharp 810 x 696 pixel resolution. Multi-zoom provides up to 4 simultaneous views of a waveform.

MAKE THE MEASUREMENTS YOU WANT

Calculate any of 36 standard measurements on any part of the waveform. Calculate rise time or glitch energy. Pass/Fail tells if a waveform is out of spec. You can measure parameters between two traces such as propagation delays between two different signals. Built in processing converts waveforms to the most useful format. View power traces or frequency spectra - live!

ADVANCED TRIGGER

Smart Trigger circuitry allows you to lock onto the most complex signal or hard-to-find glitch or dropout.

STATISTICS

When measuring signal characteristics most users want to know the stability and worst case for risetime, propagation delay, etc. The statistics capability which is stan-

9300 Series Portable Oscilloscopes Cover the Widest Range of Applications

Main Features

- Sampling Rates
100 MS/s to
10 GS/s
- Bandwidths
200 MHz to 1.5 GHz
- Memory Lengths
500 points to 8
million points
- Large High
Resolution Display
- Advanced Triggering
- Powerful Processing
up to 64 MBytes of
RAM
- I/O to floppy, PCM-
CIA portable hard
drive, SRAM card,
GPIB, RS232 or
Centronics.
- Internal High Speed
Graphics Printer

dard in every 9300 extends the usefulness of the DSO. Observe average, minimum, maximum and standard deviation values for waveform parameters. The WPO3 option allows further parameter analysis by displaying bar charts showing histograms of parameter values.

A COMPLETE INSTRUMENT

In one mainframe, you can get 4 channels of DSO, floppy, memory card, high resolution graphics printer, spectrum analyzer, and signal processor.

Features and Benefits

TIME MEASUREMENT MADE EASY AND ACCURATE

Common applications in fields like digital electronics, computers, data communications, etc., require precise time interval measurements. The long memories in the 9370/74, 9350A/54A, 9310A/14A and 9304A allow for high sampling rate over the whole signal to give excellent time resolution. The 9362 with its 10 GS/s real time sampling rate specializes in precise capture of fast events. Scope users who have repetitive signals will benefit from the 1 GHz bandwidth and two delayed timebases in the 9320/24 to capture signals at 20 GS/s equivalent time.

LECROY PROBUS INTELLIGENT PROBE SYSTEM

The ProBus system provides a complete measurement solution from probe tip to oscilloscope display. ProBus is an intelligent interconnection between LeCroy oscilloscopes and a growing range of innovative probes. ProBus provides automatic sensing of the probe type. For LeCroy's FET probes, it also allows offset at the probe tip and coupling to be controlled from the scope front panel.

A TRIGGER FOR EVERY APPLICATION

Two levels of trigger make catching difficult signals an easy task for the 9300 user. The standard trigger functions such as pre- and post-trigger, level, slope, mode and coupling are all accessed with simple and direct controls. The touch of a button accesses further powerful trigger features (SMART trigger). Icon trigger graphics show the current setup at a glance. SMART Trigger modes allow the acquisition of complex phenomena. Trigger techniques include Fastglitch mode for triggering on glitches down to 1 nsec. The ability to trigger on pulses greater than a particular length catches missing bits, timing shifts and runts. State

and Edge qualified modes track timing problems including setup and hold violations. Catch signal interruptions with LeCroy's dropout trigger. Most 9300 scopes also include video trigger and pattern trigger. If you don't know what to trigger on, LeCroy's Exclusion trigger will find events that differ from your nominal signal shape.

AUTOMATIC MEASUREMENTS

In addition to cursor measurements, the 9300 series performs fully automatic measurements. PASS/FAIL testing allows waveforms to be continually compared with a tolerance mask. (Masks may either be generated inside the instrument, or supplied on memory cards.) In addition, the scope can test any 5 waveform parameters from a list of 36, and compare them with user-defined limits. Any failure will cause preprogrammed actions such as Hardcopy, Save or GPIB SRQ. Basic statistics (low, high, average, and standard deviation) may also be calculated on these parameters.

DOS COMPATIBLE MASS STORAGE

The 9300 series offers three options (available together or separately) for built-in mass storage. Option 93XX-FD01 provides a 3.5" 1.44 MB floppy disk drive, option 93XX-HDD provides a PCMCIA portable hard drive. Both the floppy and hard drive store waveforms and setups as DOS files. They may be used as a convenient way of transferring data to a PC. Option MC01 provides high-speed storage to industry-standard memory cards, which are also DOS compatible. Up to 4 MB of data (waveforms or setups) may be stored on a single card. Portable hard drives have >130 MByte storage capacity.

Mass storage simplifies archiving, and can also be used to ensure that measurements are always made in the same way. Golden waveforms (or tolerance masks) may also be stored, so that signals are compared with a known reference. Waveform processing is possible on live or stored waveforms.

BUILT-IN PRINTER

As well as driving most printers and plotters via GPIB (IEEE-488.2), RS-232 and optional Centronics interfaces, the 9300 series also offers an optional internal printer. This high resolution graphics printer produces full size screen dumps in approximately 10 seconds. It also has a landscape printing mode which allows up to 200x expansion on the printout to see every detail of your signal.

FLEXIBLE INTERFACING

Both GPIB and RS-232 interfaces may be used for full remote control of the instrument. All front-panel controls and internal processing functions can be controlled.

MULTIPLE-WAVEFORM ZOOM

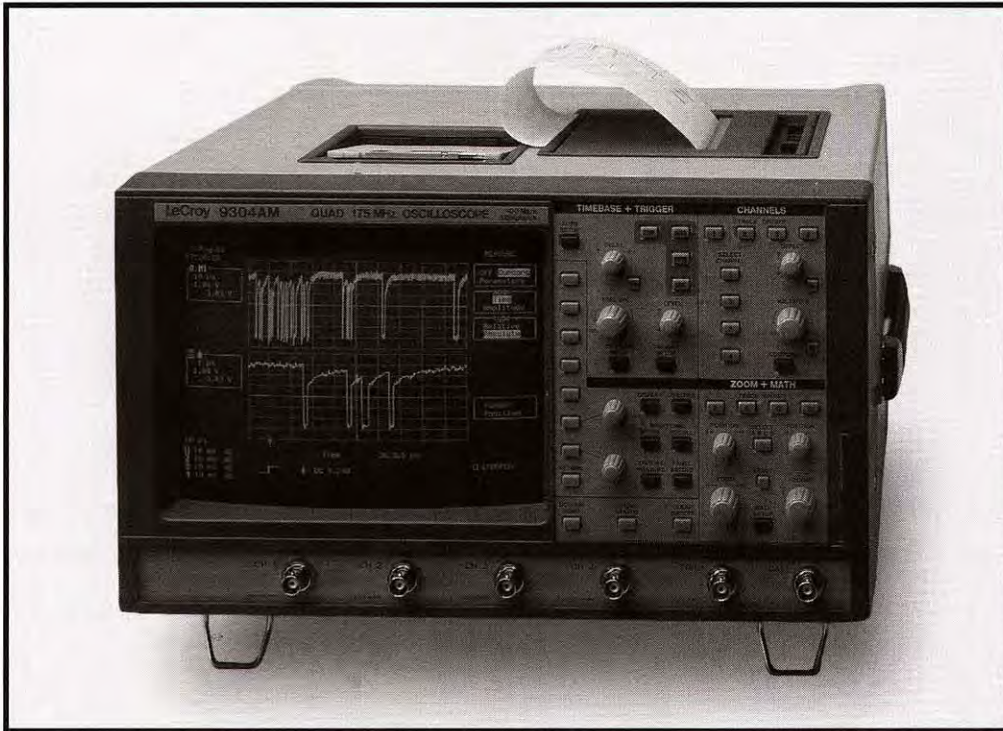
In addition to showing the complete waveform on the main timebase the 9300 series has four Zoom/Math traces which may be used for signal processing or zooming waveforms. Up to four traces (e.g., a waveform and three different expansions) may be viewed simultaneously. Alternatively, four different expansions of the same waveform may be viewed. The area to be expanded is selected by moving an intensified portion of the waveform. Cursor measurements may be made from one expanded portion to another, providing the most accurate time measurements possible. Each zoom waveform has independent vertical and horizontal expansion factors for best viewing of each signal's detail.

EXTENSIVE WAVEFORM MATH

Built-in processing includes mathematics (add, subtract, multiply and divide, negation, $\sin x/x$ and identity) and summation averaging (up to 1000 sweeps). Option WPO1 provides averaging (continuous and summed up to 1 million sweeps) and mathematics including Absolute Value, Differentiation, Identity, Integration, Log or Exp (Base e or Base 10), Negation, Reciprocal, Rescale, Square and Square Root. Also included is enhanced resolution mode (up to 11 bits) and extrema mode for storage of peak positive and negative values. More information is available in the 9300 WPO1 data sheet.

OPTIONAL FFT PACKAGE

Option WPO2 provides comprehensive spectral analysis capabilities. These permit the system designer to identify characteristics which may not be apparent in the time domain. Option WPO2 provides a wide selection of displayed projections (magnitude, phase, real, imaginary, power spectrum, power density) and windowing functions, as well as averaging in the frequency domain. For more information, see the 9300 WPO2 data sheet. LeCroy's FFT option is the most powerful in the industry. It provides superior resolution of frequency components through the ability to process up to 6 million time domain samples.



The 9304A and 9304AM are general purpose 200 MHz four channel digital oscilloscopes. They capture single-shot events at up to 100 MS/s, and repetitive signals at 10 GS/s. Record lengths up to 200k points provide excellent horizontal resolution, and allow fast digitizing of long-duration events. Memories can be segmented, for minimum dead time between acquisitions.

Live waveforms on the main timebase may be viewed simultaneously with up to 3 expansions, showing all of the signal detail. Expansions are shown as highlights on the main trace.

The LeCroy ProBus intelligent probe system allows automatic sensing of the probe type. For LeCroy's active FET probes it also provides variable offset at the probe tip. Offset and coupling are controlled from the scope's front panel.

SMART Trigger modes like Glitch, Window and Dropout allow you to capture precisely the events of interest.

A comprehensive range of signal processing functions, on live or stored waveforms, allows waveform manipulation without destroying the underlying data.

The 9304A and 9304AM feature the proven user-interface of LeCroy's portable scope family. A bright, high-resolution 9" CRT allows optimum waveform viewing on a high resolution 810 x 696 pixel screen under any conditions. Menus and text are arranged around the graticules - they never overwrite the waveforms. Each of the main control functions has a dedicated single knob, to keep the scope's performance at your fingertips.

DOS compatible floppy disk, PCMCIA portable hard drive and memory card options store waveforms and test setups, and make transferring data to a PC easier than ever. Hardcopies can be made on GPIB, RS-232-C or Centronics printers or plotters. An optional internal high resolution graphics printer is also available.

Optional packages provide extensive Waveform Processing including FFT and Enhanced Resolution to 11 bits.

9304A, 9304AM Digital Oscilloscopes 200 MHz Bandwidth, 100 MS/s

Main Features

- **Four Channels**
- **50k and 200k Point Records**
- **DOS Compatible Floppy Disk, PCMCIA portable hard drive and Memory Card Options**
- **Glitch, Window, Qualified, Interval, Dropout and Video Triggers**
- **8-bit vertical resolution, 11 with ERES option**
- **Fully Programmable via GPIB and RS-232-C**
- **Automatic PASS/FAIL testing**
- **Persistence, XY and Roll Modes**
- **Advanced Signal Processing**
- **Internal High Resolution Graphics Printer Option**

ACQUISITION SYSTEM**Bandwidth (-3 dB)**

@ 50Ω: DC to 200 MHz

@ 1 MΩ DC: DC to 200 MHz typical at the probe tip.

No. of Channels: 4

No. of Digitizers: 4

Maximum Sample Rate: 100 MS/s simultaneously on each channel.

Acquisition memories, per channel:

9304A 50k

9304AM 200k

Sensitivity: 2 mV/div to 5 V/div, fully variable.

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

Offset Range:

2.0 - 9.9 mV/div: ± 120 mV

10 - 199 mV/div: ± 1.2 V

0.2 - 5.0 V/div: ± 24 V

DC Accuracy: ≤ ± 2% full scale (8 divisions) at 0 V offset.

Vertical Resolution: 8 bits.

Bandwidth Limiter: 30 MHz.

Input Coupling: AC, DC, GND.

Input Impedance: 1 MΩ//15 pF or 50Ω ± 1%.

Max Input:

1 MΩ: 250 V (DC+peak AC@ 10 kHz)

50 Ω: ± 5 V DC (500 mW) or
5 V RMS

TIME BASE SYSTEM

Timebases: Main and up to 4 Zoom Traces.

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

Clock Accuracy: ≤ ± 0.002 %.

Interpolator Resolution: 10 ps.

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

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

External Clock: ≤ 100 MHz on EXT input with ECL, TTL or zero crossing levels.

TRIGGERING SYSTEM

Trigger Modes: Normal, Auto, Single, Stop.

Trigger Sources: CH1, CH2, CH3, CH4, Line, Ext, Ext/10. Slope, Level and Coupling for each can be set independently.

Slope: Positive, Negative, Window (BiSlope).

Coupling: AC, DC, HF (up to 500 MHz), LFREJ, HFREJ.

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

Internal Trigger Sensitivity Range: ± 5 div.

EXT Trigger Max. Input:

1 MΩ//15 pF: 250 V (DC+peak AC ≤ 10 kHz)

50Ω ± 1%: ± 5 V DC (500 mW) or 5 V RMS

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

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

SMART TRIGGER TYPES

Signal Width: Trigger on width between two limits selectable from 2.5ns to 20s.

Signal Interval: Trigger on interval between two limits selectable from 10ns to 20s.

Dropout: Trigger if the input signal drops out for longer than a time-out from 25ns to 20s.

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 5 ms/div.

Single shot: for transient and repetitive signals from 50 ns/div.

Sequence: Stores multiple events in segmented acquisition memories.

Number of segments available:

9304A 2-200

9304AM 2-500

Dead Time between segments: ≤ 150 ms

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 (50x with averaging, up to 40 mV sensitivity).

Maximum Horizontal Zoom Factors:

9304A 1,000x

9304AM 5,000x

INTERNAL MEMORY

Waveform Memory: Up to four 16-bit Memories (M1, M2, M3, M4).

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

Setup Memory: Four non-volatile memories. Optional Memory Cards, PCMCIA portable hard drive or Floppy Disks may also be used for high-capacity waveform and setup storage.

WAVEFORM PROCESSING

Up to four processing functions may be performed simultaneously. Functions available are: Add, Subtract, Multiply, Divide, Negate, Identity, Sin(x)/x and Summation Averaging.

Average: Summed averaging of up to 1,000 waveforms in the basic instrument. Up to 10⁶ averages are possible with Option WPO1.

Envelope*: Max, Min, or Max and Min values of from 1 to 10⁶ waveforms.

ERES*: Low-Pass digital filter provides up to 11 bits vertical resolution. Sampled data is always available, even when 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 Math Package WPO1, FFT is in WPO2.

AUTOMATIC MEASUREMENTS

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

amplitude	Δt at level (t=0,abs)	overshoot +
area	Δt at level (t=0%)	overshoot -
base	duty cycle	peak to peak
cmean	falltime	period
cmedian	f80-20%	rissetime
crms	f@level (abs)	r20-80%
csdev	f@level (%)	r@level (abs)
cycles	frequency	r@level (%)
delay	maximum	RMS
Δdelay	mean	std dev
Δt at level (abs)	median	top
Δt at level (%)	minimum	width

Parameters are calculated as defined by ANSI/IEEE Std 181-1977 "Standard on Pulse Measurement and Analysis by Objective Techniques". In addition, Rise and Fall times may be measured at 10 % and 90% levels, or 20% and 80% levels, or any other user-specified levels.

Δ delay provides time between mid-point transition of two sources, for making propagation delay measurements.

Δ t at level allows the same measurement to be made at any specified level.

Two cursors are used to define the region over which these parameters are calculated.

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

Relative Voltage: Two horizontal bars measure voltage differences up to $\pm 0.2\%$ of fullscale in single-grid mode.

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

Pass/Fail testing allow up to five of the listed parameters to be tested against selectable thresholds. Waveform Limit Testing is performed using templates which may be defined inside the instrument.

AUTOSETUP

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

Autosetup Time: Approximately 2 seconds.

Vertical Find: Automatically sets sensitivity and offset.

PROBES

Model:

One PP002 (10:1, 10 M Ω // 15 pF) probe supplied per channel.

The 9304A and 9304AM are fully compatible with LeCroy's range of FET Probes, which may be purchased separately.

Probe calibration: Max 1 V into 1 M Ω , 500 mV into 50 Ω , 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: Of all front-panel controls, as well as all internal functions is possible by GPIB and RS-232-C.

RS-232-C Port: Asynchronous up to 19,200 baud for computer/terminal control or printer/plotter connection.

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

Command Language complies with requirements of IEEE-488.2.

Centronics Port: Optional hardcopy parallel interface included with floppy disk and graphics printer options.

Hardcopy: Screen dumps are activated by a front-panel button or via remote control. TIFF and BMP formats are available for importing to Desktop Publishing programs. The following printers and plotters can be used to make hardcopies: HP DeskJet (color or B&W), HP ThinkJet, QuietJet, LaserJet, PaintJet and EPSON printers. HP 7400 and 7500 series, or HPGL compatible plotters. An optional internal high resolution graphics printer is also available, see page 53.

GENERAL

Auto-calibration ensures specified DC and timing accuracy.

Temperature:

5° to 40° C (41° to 104° F) rated 0° to 50° C (32° to 122° F) operating.

Humidity: < 80%.

Shock & Vibration:

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

Power: 90-250 V AC, 45-66 Hz, 150 W.

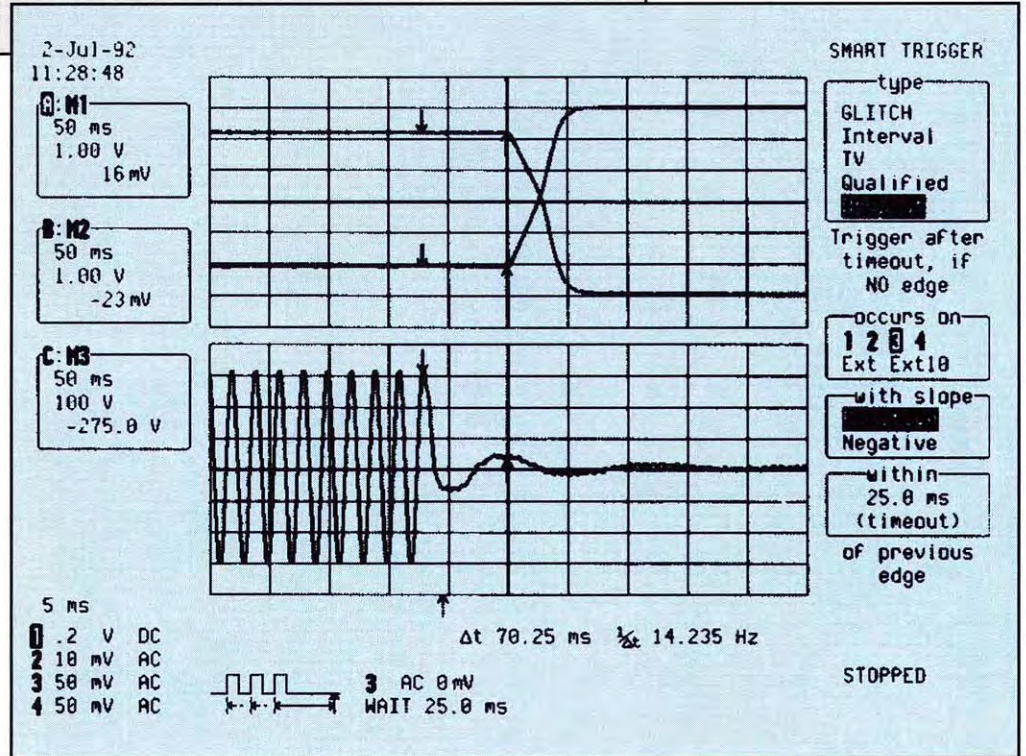
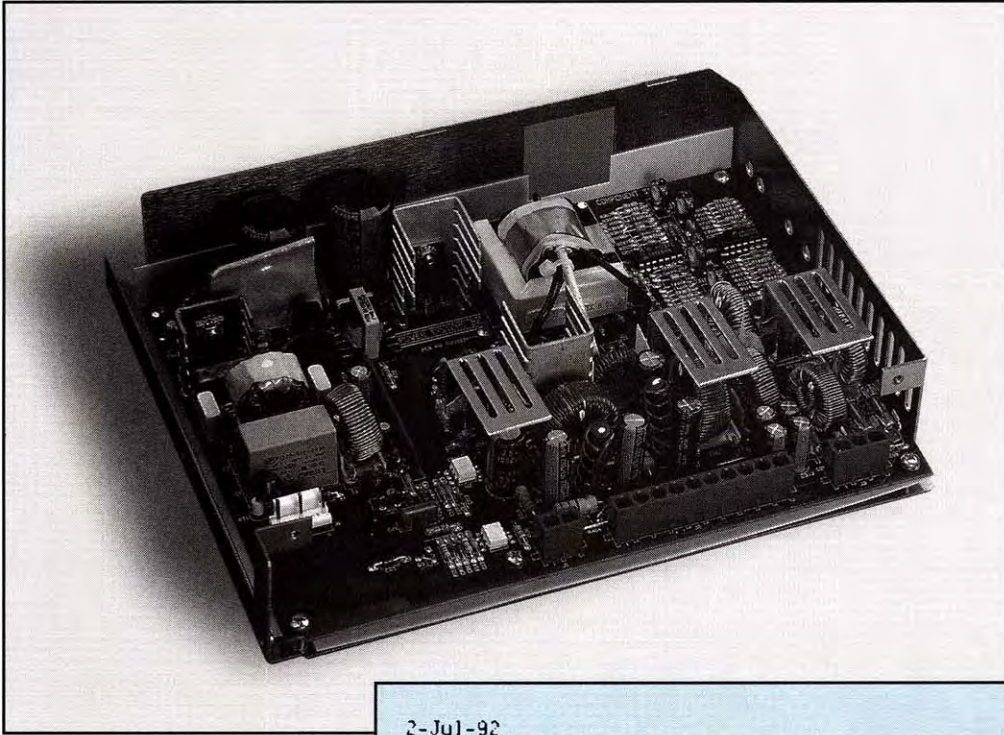
Battery Backup: Front-panel settings maintained for two years.

Dimensions:

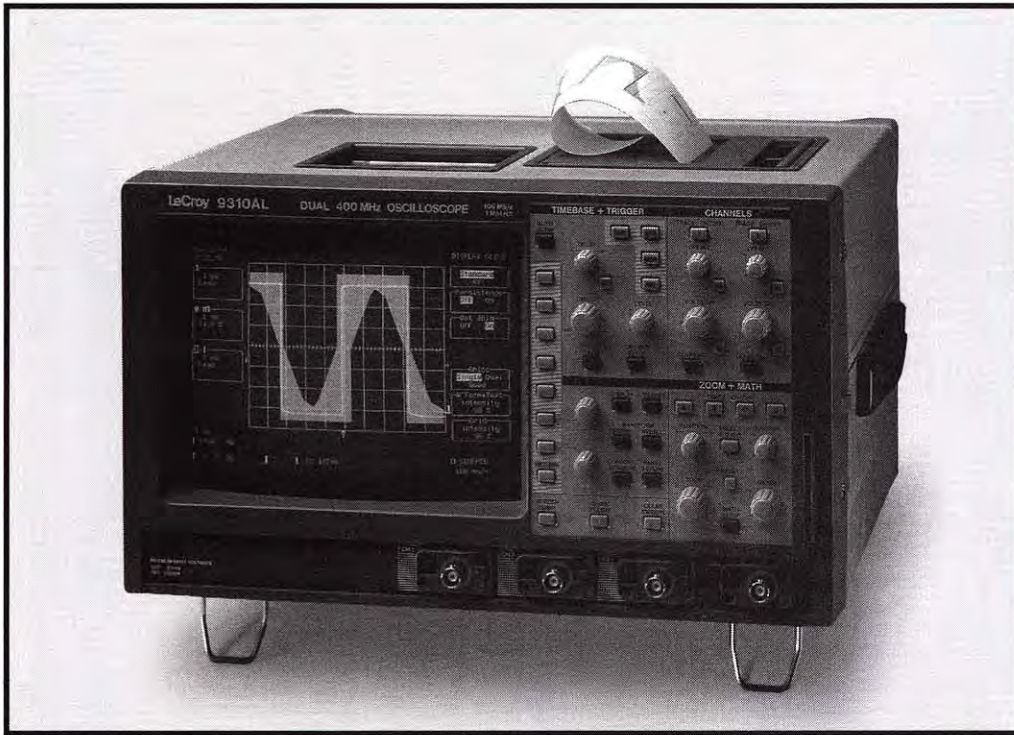
8.5"x14.5"x16.25", 210mm x 370mm x 410mm.

Weight: 12.5kg (27.5lbs) net, 18kg (40lbs) shipping.

Warranty: Three years.



Testing holdup time on a DC power supply is easy using LeCroy's dropout trigger. For more information on power supply testing, refer to the application note on page 175 of this catalog.



The 9310A family offers two channel and four channel general-purpose 400 MHz digital oscilloscopes. They capture single-shot events at up to 100 MS/s, and repetitive signals at 10 GS/s. Record lengths up to 1M points provide outstanding horizontal resolution, and allow fast digitizing of long-duration events. Memories can be segmented, for minimum dead time between acquisitions.

Live waveforms on the main timebase may be viewed simultaneously with up to 3 expansions, showing all of the signal detail. Expansions are shown as highlights on the main trace.

The LeCroy ProBus intelligent probe system allows automatic sensing of the probe type. For LeCroy's active FET probes it also provides variable offset at the probe tip. Offset and coupling are controlled from the scope front panel.

SMART Trigger modes like Glitch, Window and Dropout allow you to capture precisely the events of interest.

A comprehensive range of signal processing functions, on live or stored waveforms, allows waveform manipulation without destroying the underlying data.

The 9310A family features the proven user-interface of LeCroy's portable scope family. A bright 9" CRT allows optimum waveform viewing on a high resolution 810 x 696 pixel screen. Menus and text are arranged around the graticules - they never overwrite the waveforms. Each of the main control functions has a dedicated single knob, to keep the scope's performance at your fingertips.

DOS compatible floppy disk, PCMCIA portable hard drive and memory card options store waveforms and test setups, and make transferring data to a PC easier than ever before. Hardcopies can be made on GPIB, RS-232-C or Centronics printers or plotters. An optional internal high resolution graphics printer is also available.

Optional packages provide extensive Waveform Processing including FFT and Enhanced Resolution to 11 bits.

9310A Family Digital Oscilloscopes 400 MHz Bandwidth, 100 MS/s

Main Features

- Two and Four Channel Versions
- 50k, 200k and 1M Point Records
- DOS Compatible Floppy Disk, PCMCIA portable hard drive and Memory Card Options
- Glitch, Window, Qualified, Interval, Dropout and TV Triggers
- 8-bit vertical resolution, 11 with ERES option
- Fully Programmable via GPIB and RS-232-C
- Automatic PASS/FAIL testing
- Persistence, XY and Roll Modes
- Advanced Signal Processing
- Internal High Resolution Graphics Printer Option

ACQUISITION SYSTEM**Bandwidth (-3 dB)**

@ 50Ω: DC to 400 MHz
 Below 200 mV/div: 350 MHz
 At 2mV/div: 300 MHz
 @ 1 MΩ DC: DC to 250 MHz typical at the probe tip.

No. of Channels: 4 (9314A) or
 2 (9310A)

No. of Digitizers: 4 (9314A) or
 2 (9310A)

Maximum Sample Rate: 100 MS/s
 simultaneously on each channel.

Acquisition memories, per channel:

9310A, 9314A 50k
 9310AM, 9314AM 200k
 9310AL, 9314AL 1M

Sensitivity: 2 mV/div to 5 V/div, fully variable.

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

Offset Range:

2.0 - 9.9 mV/div: ± 120 mV
 10 - 199 mV/div: ± 1.2 V
 0.2 - 5.0 V/div: ± 24 V

DC Accuracy: ≤± 2% full scale (8 divisions) at 0 V offset.

Vertical Resolution: 8 bits.

Bandwidth Limiter: 30 MHz.

Input Coupling: AC, DC, GND.

Max Input:

1 MΩ: 250 V (DC+peak AC@ 10 kHz)
 50Ω: ± 5 V DC (500 mW) or
 5 V RMS

TIME BASE SYSTEM

Timebases: Main and up to 4 Zoom Traces.

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

Clock Accuracy: ≤±0.002 %.

Interpolator Resolution: 10 ps.

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

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

External Clock: ≤100 MHz on EXT input with ECL, TTL or zero crossing levels.

TRIGGERING SYSTEM

Trigger Modes: Normal, Auto, Single, Stop.

Trigger Sources: CH1, CH2, Line, Ext, Ext/10 (9314A: CH3, CH4). Slope, Level and Coupling for each can be set independently.

Slope: Positive, Negative, Window (BiSlope).

Coupling: AC, DC, HF (up to 500 MHz), LFREJ, HFREJ.

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

Internal Trigger Sensitivity Range:

±5 div.

EXT Trigger Max. Input:

1 MΩ//15 pF: 250 V (DC+peak AC ≤10 KHz)

50Ω ± 1%: ±5 V DC (500 mW) or 5 V RMS

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

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

SMART TRIGGER TYPES

Signal Width: Trigger on width between two limits selectable from 2.5ns to 20s.

Signal Interval: Trigger on interval between two limits selectable from 10ns to 20s.

Dropout: Trigger if the input signal drops out for longer than a time-out from 25ns to 20s.

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 10 ms/div.

Single shot: For transient and repetitive signals from 50 ns/div.

Sequence: Stores multiple events in segmented acquisition memories. Number of segments available:

9310A-9314A 2-200
 9310AM-9314AM 2-500
 9310AL-9314AL 2-2,000

Dead Time between segments: ≤150 μs

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 (50x with averaging, up to

40 mV sensitivity).

Maximum Horizontal Zoom Factors:

9310A, 9314A 1,000x
 9310AM, 9314AM 5,000x
 9310AL, 9314AL 20,000x

INTERNAL MEMORY

Waveform Memory: Up to four 16-bit Memories (M1, M2, M3, M4).

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

Setup Memory: Four non-volatile memories. Optional PCMCIA portable hard drive, Memory Cards or Floppy Disks may also be used for high-capacity waveform and setup storage.

WAVEFORM PROCESSING

Up to four processing functions may be performed simultaneously. Functions available are: Add, Subtract, Multiply, Divide, Negate, Identity, Sin(x)/x and Summation Averaging.

Average: Summed averaging of up to 1,000 waveforms in the basic instrument. Up to 10⁶ averages are possible with Option WP01.

Envelope*: Max, Min, or Max and Min values of from 1 to 10⁶ waveforms.

ERES*: Low-Pass digital filter provides up to 11 bits vertical resolution.

Sampled data is always available, even when 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 Math Package WP01. FFT is in WP02.

AUTOMATIC MEASUREMENTS

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

amplitude	Δt at level (t=0,abs)	overshoot +
area	Δt at level (t=0%)	overshoot -
base	duty cycle	peak to peak
cmean	falltime	period
cmedian	f80-20%	risetime
crms	f@level (abs)	r20-80%
csdev	f@level (%)	r@level (abs)
cycles	frequency	r@level (%)
delay	maximum	RMS
Δdelay	mean	std dev
Δt at level (abs) median		top
Δt at level (%) minimum		width

Parameters are calculated as defined by ANSI/IEEE Std 181-1977 "Standard on Pulse Measurement and Analysis by Objective Techniques". In addition, Rise and Fall times may be measured at 10

% and 90% levels, or 20% and 80% levels, or any other user-specified levels.

Δ delay provides time between mid-point transition of two sources, for making propagation delay measurements.

Δ t at level allows the same measurement to be made at any specified level.

Two cursors are used to define the region over which these parameters are calculated.

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

Relative Voltage: Two horizontal bars measure voltage differences up to $\pm 0.2\%$ of fullscale in single-grid mode.

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

Pass/Fail testing allow up to five of the listed parameters to be tested against selectable thresholds. Waveform Limit Testing is performed using templates which may be defined inside the instrument.

AUTOSETUP

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

Autosetup Time: Approximately 2 seconds.

Vertical Find: Automatically sets sensitivity and offset.

PROBES

Model: One PP002 (10:1, 10 M Ω // 15 pF) probe supplied per channel.

The 9310A family is fully compatible with LeCroy's range of FET Probes, which may be purchased separately.

Probe calibration: Max 1 V into 1 M Ω , 500 mV into 50 Ω , 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: Of all front-panel controls, as well as all internal functions is possible by GPIB and RS-232-C.

RS-232-C Port: Asynchronous up to 19,200 baud for computer/terminal control or printer/plotter connection.

GPIB Port: (IEEE-488.1) Configurable as talker/listener for computer control and fast data transfer. Command Language complies with requirements of IEEE-488.2.

Centronics Port: Optional hardcopy parallel interface included with floppy disk and graphics printer options.

Hardcopy: Screen dumps are activated by a front-panel button or via remote control. TIFF and BMP formats are available for importing to Desktop Publishing programs. The following printers and plotters can be used to make hardcopies: HP DeskJet (color or B&W), HP ThinkJet, QuietJet, LaserJet, PaintJet and EPSON printers. HP 7400 and 7500 series, or HPGL compatible plotters. An optional internal high resolution graphics printer is also available, see page 53.

GENERAL

Auto-calibration ensures specified DC and timing accuracy.

Temperature: 5° to 40° C (41° to 104° F) rated, 0° to 50° C (32° to 122° F) operating.

Humidity: <80%.

Shock & Vibration:

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

Power: 90-250 V AC, 45-66 Hz, 150W.

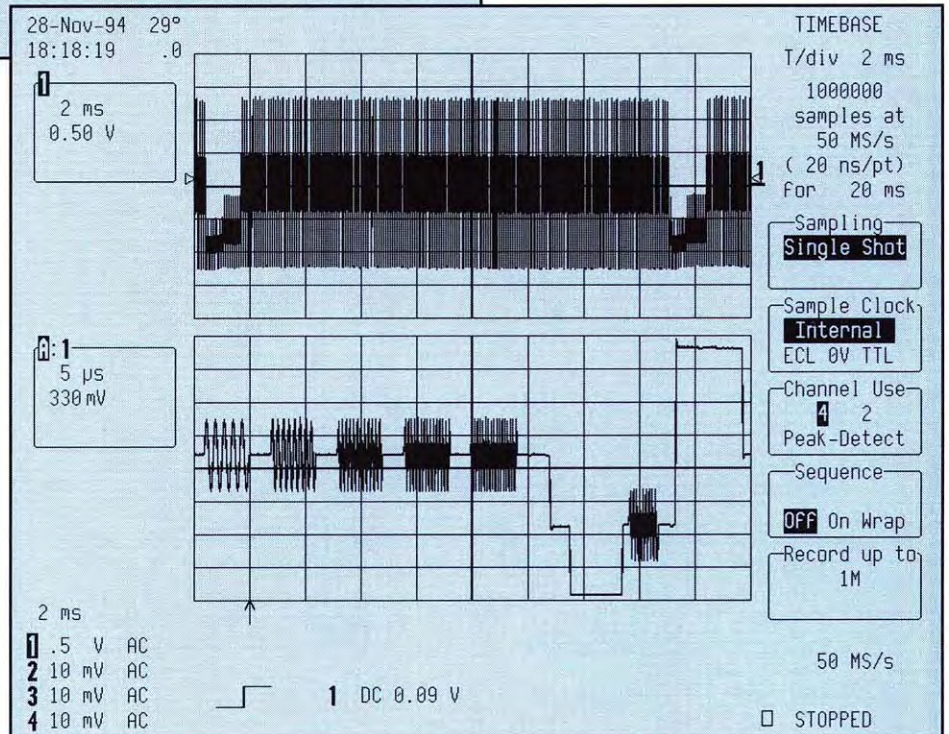
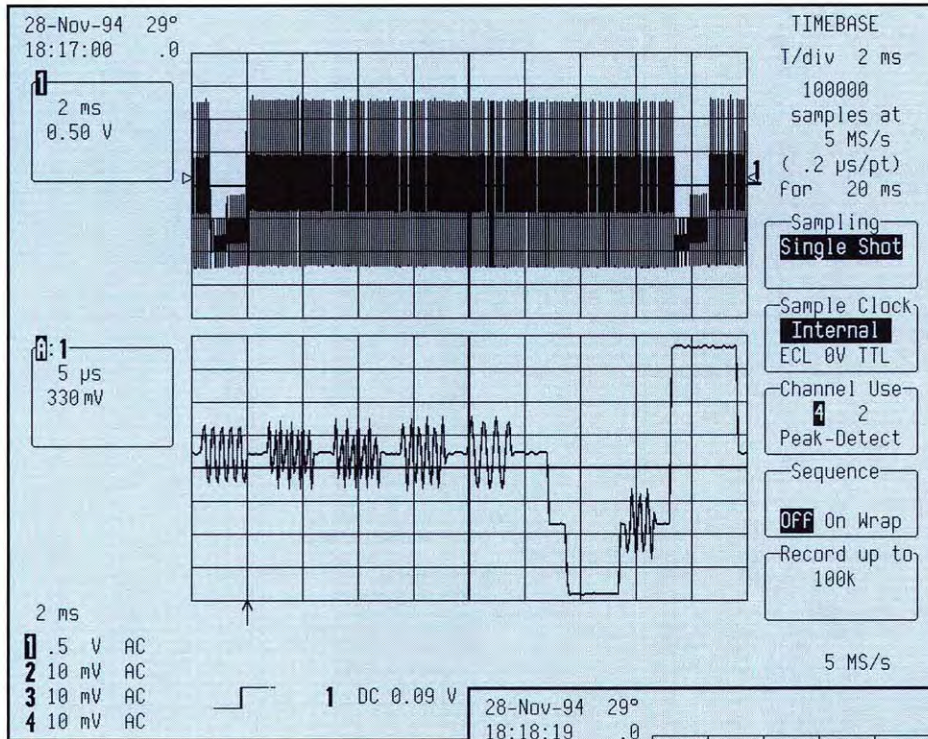
Battery Backup: Front-panel settings maintained for two years.

Dimensions: (HWD)

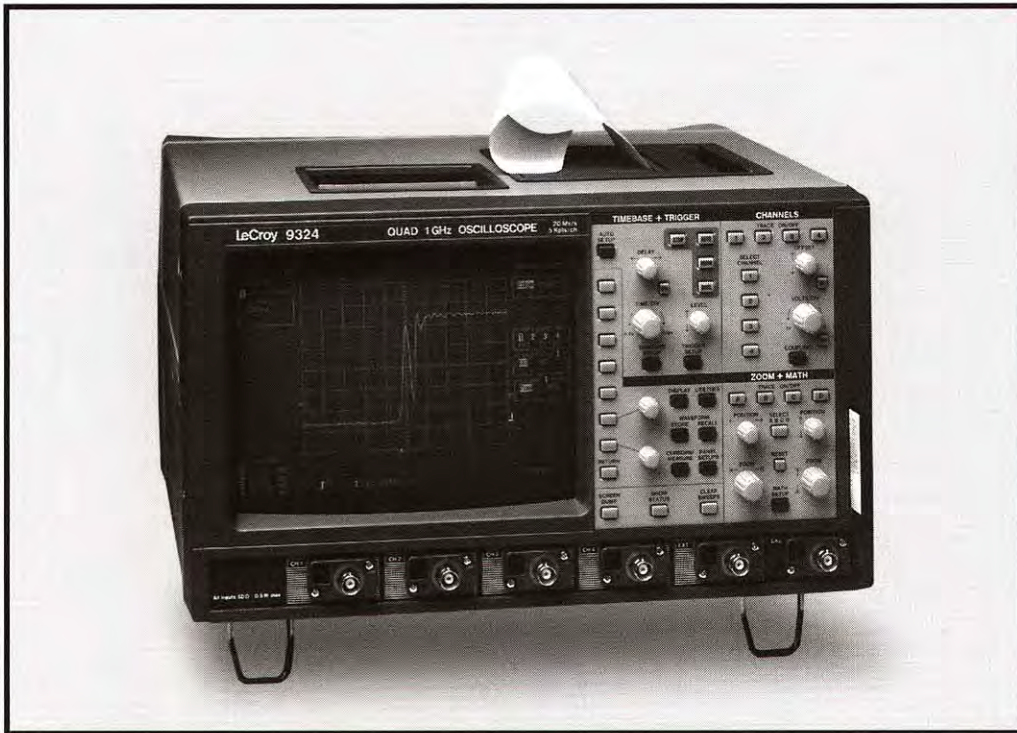
8.5"x14.5"x16.25", 210mm x 370mm x 410mm.

Weight: 12.5kg (27.5lbs) net, 18kg (40lbs) shipping.

Warranty: Three years.



Long Memory allows a scope to capture long duration signals at a high sample rate. Note the difference in detail in the zoom sections shown on the lower traces of the two scope screens above. A 1 megapoint scope puts 20 times more points on the waveform than a 50k point scope. For further discussion refer to "How to use the Benefits of Long Memory in DSOs" on Page 147 of this catalog.



The 9320/24 are two and four channel instruments extending the power of digital oscilloscopes up to 1 GHz bandwidth. The oscilloscope is primarily intended for repetitive waveforms, which are sampled with an equivalent sampling rate of up to 20 GS/sec. Single shot events up to a few MHz may also be acquired with a single shot sampling rate of up to 20 MS/sec.

The digital technology used provides standard DSO features like pre-trigger view, hardcopy, full programmability, etc. The proven user interface of the 9300 oscilloscope family ensures ease of use and user efficiency.

The LeCroy ProBus intelligent probe system allows automatic sensing of the probe type. For LeCroy's active FET probes it also provides variable offset at the probe tip. Offset and coupling are controlled from the scope front panel.

Up to two delayed timebases can be positioned on the main trace and displayed giving excellent resolution and precision in time measurements.

Advanced triggering capabilities, which include glitch, pattern and state/edge qualified triggers simplify the testing and debugging of electronics systems.

DOS compatible floppy disk, PCMCIA portable hard drive and memory card options store waveforms and test setups, and make transferring data to a PC easier than ever before. Hardcopies may be made on GPIB, RS-232 or Centronics printers or plotters. An optional built-in high resolution graphics printer is also available. Additional firmware packages extend the oscilloscope's processing capabilities in both time and frequency domains.

Analog oscilloscope users who have been using 350 - 400 MHz scopes to look at signals will find the higher bandwidth and digital measurement power of the 9320/24 gives them outstanding performance at a comparable price.

Communications engineers who require 1 GHz bandwidth scopes to look at 155 Mbps data will find the combination of the 9320/24 and AP082/83 trigger pickoffs very powerful for testing SDH and SONET signals. Refer to Page 171 for more information.

9320 and 9324, 1GHz Bandwidth Portable Digital Oscilloscopes

Main Features

- **1 GHz Bandwidth**
- **Two or Four Channels**
- **Main and two delayed timebases for accurate time measurements**
- **Glitch, pattern, state and edge qualified triggers**
- **Automatic pass/fail testing**
- **Optional built-in high resolution graphics printer**
- **DOS-compatible floppy disk, PCMCIA portable hard drive and memory card options**
- **Fully programmable via GPIB and RS-232**

ACQUISITION SYSTEM

No. of channels: 2 (9320) and 4 (9324).

Bandwidth (-3 dB): DC to 1 GHz.

Rise time: < 350 psec.

Input impedance: 50Ω ±1%.

Maximum input voltage: ±5 V DC (500 mW) or 5 V RMS.

Maximum Input Voltage: ± 5 V DC (500mW) or 5 V RMS.

Sensitivity range: 5 mV/div to 2 V/div in 1, 2, 5 sequence and continuously variable.

Random noise: < 500 μV RMS at 5 mV/div.

Probe calibrator: BNC connector, 250 mV into 50Ω, generates rectangular pulses with 50% duty cycle; rise/fall times < 500 psec; flatness < 1%; zero offset; programmable frequency. The calibrator output can alternatively provide, under menu control, a trigger output or a PASS/FAIL output.

No. of digitizers: 2 or 4, one per channel.

Vertical resolution: 8 bits, all on screen (up to 12 bits with processing).

Sample rate: Up to 20 MS/sec for transients, up to 20 GS/sec for repetitive signals, simultaneously on all channels.

DC accuracy: ≤ ±2% full scale.

Vertical expansion: up to 5x normally, up to 50x with averaging.

Offset: 5 - 24.5 mV/div; ±0.8 V

25.0 - 124.9 mV/div; ±4.0 V

125 mV/div - 2 V/div; ±10.0 V

TIMEBASE SYSTEM

Timebases: Three, main and two delayed.

Main timebase range: 100 psec/div to 200 msec/div in 1, 2, 5 sequence.

Delayed timebase range: 100 psec/div to main timebase setting.

Clock accuracy: ≤ 0.002%.

Interpolator resolution: 10 psec.

Interpolator accuracy: < 15 psec.

Maximum record length: 5000 samples per channel.

Acquisition modes: Random interleaved sampling from 100 psec/div to 10 msec/div. Single shot from 0.1 msec/div to 200 msec/div. trigger system

Pre-trigger time: Adjustable in 1% increments up to 100% full scale (grid width).

Post-trigger delay: Adjustable in 0.1 division increments up to 10,000 divisions.

Timing: Trigger date and time stored with each waveform.

External trigger input: 50 Ω ±1%.

External trigger voltage range: ±0.5 V in EXT, ±5 V in EXT/10.

Trigger rate: Up to 1.5 GHz on one channel only, (CH2 in 9320, CH4 in

9324) when HF coupling selected; 750 MHz for all other inputs.

Trigger jitter: < 10 psec RMS.

Trigger holdoff range: By time 12.5 nsec to 20 sec in steps of 12.5 nsec, by events.

1 to 106, 100 MHz maximum rate.

STANDARD TRIGGER

Trigger sources: CH1, CH2, (CH1 to CH4 in 9324), Ext, Ext/10. CH1 to CH4 and EXT have independent trigger circuits allowing individual setting of slope, level and coupling.

Slope: Positive, negative.

Coupling: DC, AC-AUTOLEVEL, and HF (for one channel only).

Modes: Stop, auto, normal, single.

SMART TRIGGER™

Single source on any of CH1 to CH4 and EXT.

Pulse or pattern width < or >:

1 nsec to

1 msec in steps variable from 500 psec to 20 nsec.

Pattern: Trigger on the logic AND of the input channels (CH1 to CH4 in 9324, CH1 and CH2 in 9320), where each source can be defined as high (H), low (L) or don't care (X). The trigger can be selected at the beginning (entered) or at the end (exited) of the specified pattern. The pattern width can also be specified as above.

State/edge qualified: Triggers on any source (CH1 to CH4 + EXT) after the entering of a qualifying condition, edge or state, that can be defined on a single source or on a pattern of the input channels. The trigger can take place after (or within) a programmable delay ranging from 2 nsec to 1 msec in steps variable from 500 psec to 20 nsec. The state qualified trigger requires the continuing presence of the enabling pattern to trigger, while the edge qualified trigger does not.

DISPLAY

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

Resolution: 810 x 696 pixels.

Graticules: Internally generated, separate intensity control for graticule and waveforms; single, dual and quad graticules.

Display modes: Normal, variable and infinite persistence, XY.

AUTOMATIC MEASUREMENTS

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

amplitude	Δt at level (t=0,abs) overshoot +
area	Δt at level (t=0%) overshoot -

base	duty cycle	peak to peak
cmean	falltime	period
cmedian	f80-20%	risetime
crms	f@level (abs)	r20-80%
csdev	f@level (%)	r@level (abs)
cycles	frequency	r@level (%)
delay	maximum	RMS
Δdelay	mean	std dev
Δt at level (abs) median		top
Δt at level (%) minimum		width

Parameters are calculated as defined by ANSI/IEEE Std 181-1977 "Standard on Pulse Measurement and Analysis by Objective Techniques". In addition, Rise and Fall times may be measured at 10 % and 90% levels, or 20% and 80% levels, or any other user-specified levels.

Δdelay provides time between midpoint transition of two sources, for making propagation delay measurements.

Δt at level allows the same measurement to be made at any specified level.

Two cursors are used to define the region over which these parameters are calculated.

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 also displayed.

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

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

Pass/Fail testing allow up to five of the listed parameters to be tested against selectable thresholds. Waveform Limit Testing is performed using templates which may be defined inside the instrument.

WAVEFORM PROCESSING

Waveform processing routines, up to four simultaneously, are called and set up via menus. These include arithmetic functions (add, subtract, multiply, divide, negate, identity), Sin(x)/x and summation averaging (up to 1000 sweeps).

Function memories: 4 x 5000 points, 16 bit.

Optional processing: Extra processing power can be added by installing LeCroy's waveform processing options, see page 41, 43 or 47.

Option WP01: Provides averaging, summation (to 1,000,000 sweeps) and continuous, extended mathematics including integration, differentiation, log, exp, absolute value, square, square root, etc; high resolution mode, up to 11 bits; extrema mode for storage of extreme positive and negative values.

Option WP02: Provides FFT spectral analysis with a wide selection of displayed parameters.

AUTO-SETUP

Front panel button. Automatically scales timebase, trigger and sensitivity settings to correctly display repetitive signals with amplitudes between 10 mV and 5 V.

Auto-setup time: Approximately 2 sec, frequency above 50 Hz; duty cycle greater than 0.1%.

Vertical find: Individual per channel, automatically scales sensitivity and offset.

INTERFACING

Remote control: Of all front-panel controls, as well as all internal functions is possible by GPIB and RS-232.

RS-232 port: Asynchronous up to 19,200 baud for computer/terminal control or printer/plotter connection.

GPIB port: (IEEE-488.1) Configurable as talker/listener for computer control and fast data transfer. Command language complies with requirements of IEEE-488.2.

Centronics: Optional parallel interface. Included with floppy disk and graphics printer options.

Hardcopy: Screen dumps are activated by a front-panel button or via remote control. TIFF format is available for importing to DTP programs. The following printers and plotters can be used to make hardcopies: HP ThinkJet, QuietJet, LaserJet, PaintJet (color), DeskJet (color) and EPSON printers. HP 7400 and 7500 series, or HPGL compatible plotters.

STORAGE

Reference memories: 4 x 5000 points, 16 bits, usable to store acquired and processed waveforms.

Setups: Up to four stored in battery backed-up memories. Front-panel settings are maintained for two years. Three DOS-compatible mass storage options: 1.44 MB, 3.5" floppy disk, PCMCIA portable hard drive and/or up to 8 MB fast storage memory card, provide non-volatile mass storage of waveforms and/or front-panel setups.

SELF TESTS

Auto-calibration ensures specified DC and timing accuracy.

GENERAL

Temperature: 5°C to 40°C (41° to 104°F) rated, 0°C to 50°C (32° to 122°F) operating.

Humidity: < 80%.

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

Power: 90-250 V AC, 45-66 Hz, 150W.

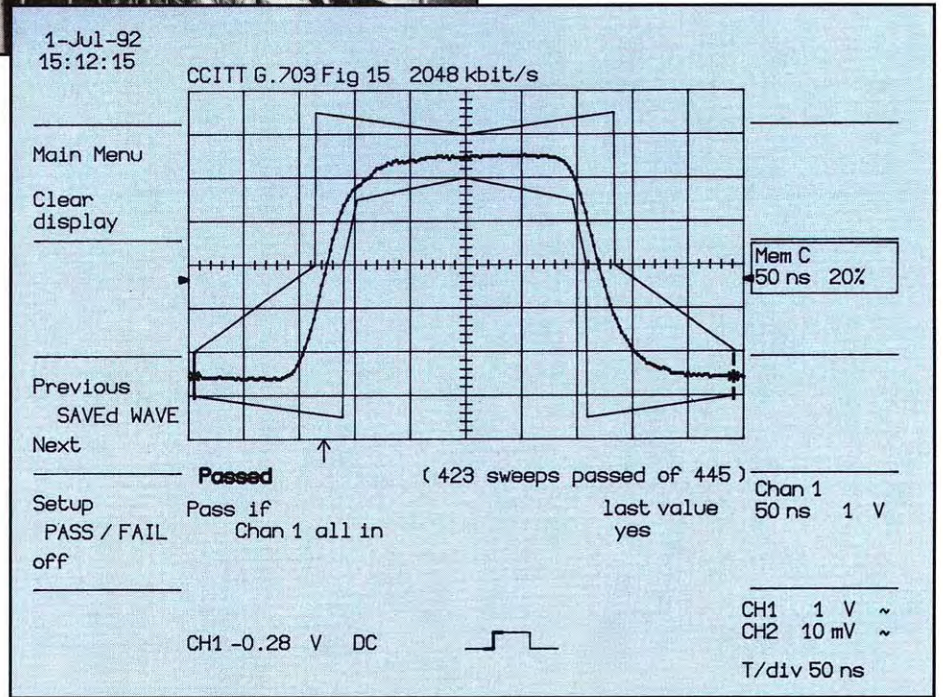
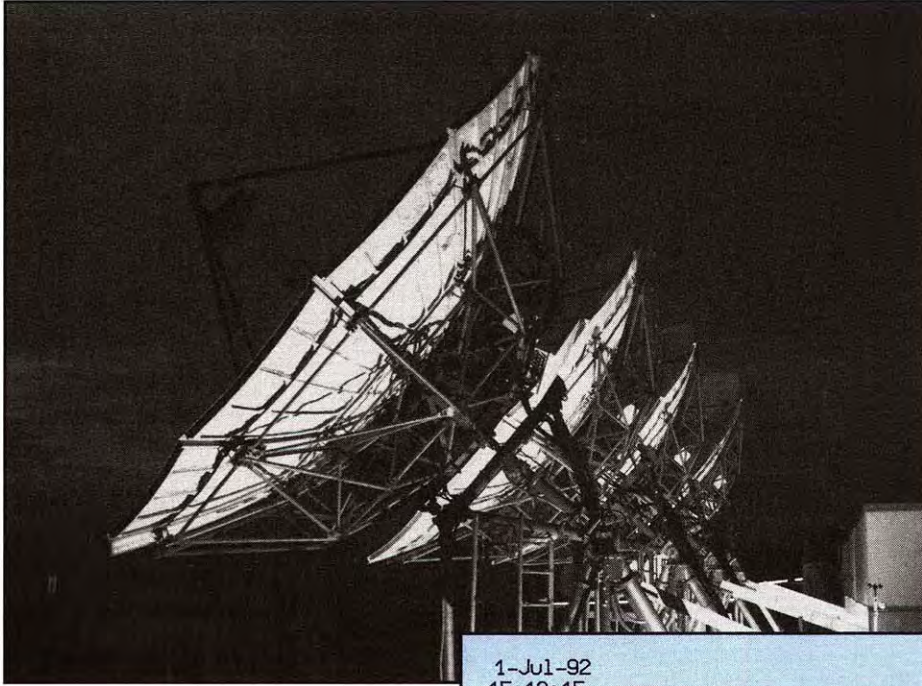
Battery backup: Front-panel settings maintained for two years.

Dimensions:

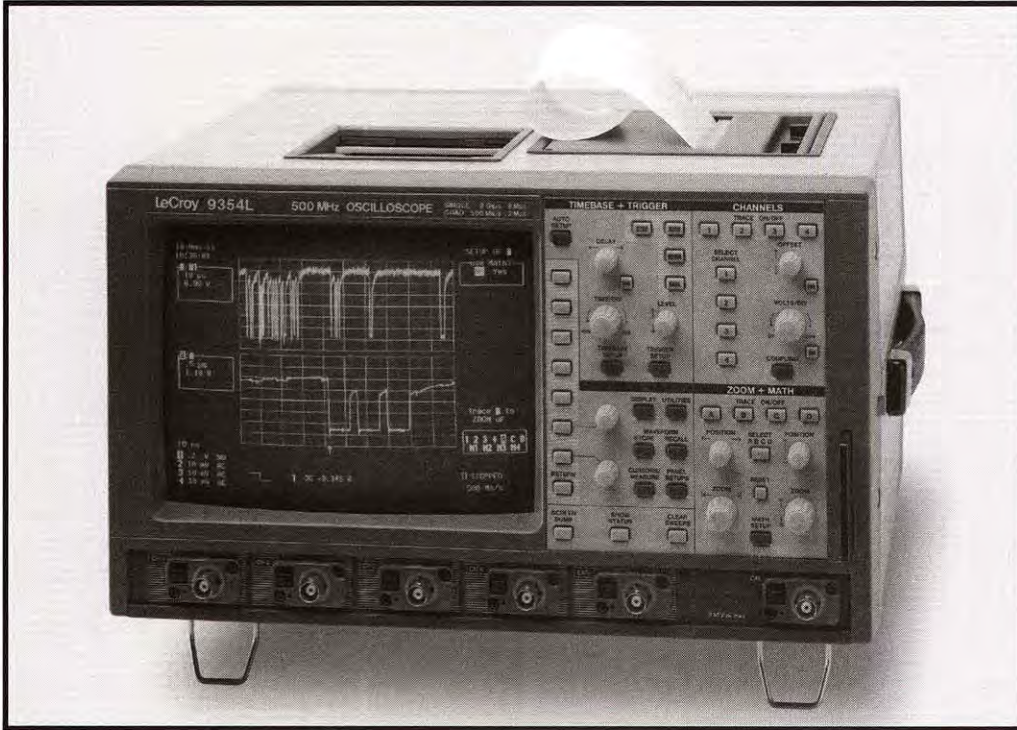
(HWD) 8.5" x 14.5" x 16.25",
210 mm x 370 mm x 410 mm.

Weight: 10 kg (22 lbs) net, 15.5 kg (34 lbs) shipping.

Warranty: 3 years.



The 1 GHz bandwidth of the 9320 & 9324 combined with the trigger capabilities of the optional AP082 and AP083 are ideal for testing SONET/SDH 155 Mbps signals. Refer to Page 171 for more information.



High speed and long memory make this family the ideal 500 MHz general-purpose Digital Storage Oscilloscopes. Two and four channel simultaneous sampling at 500 MS/s meets demanding high-speed design applications. Even faster sampling may be achieved by combining channels, up to a maximum of 2 GS/s. Acquisition memories may also be combined, providing up to 8 M points of continuous or segmented waveform recording. Repetitive signals are digitized at up to 10 GS/s.

A unique peak detect scheme triggers on glitches down to 1ns and keeps the ADC sampling at 2.5 ns - even at slow time bases - without destroying the underlying data. This provides circuit designers with the benefits of peak detection without any loss of precision.

Live waveforms on the main timebase may be viewed simultaneously with up to 3 expansions, showing all of the signal detail. Expansions are shown as highlights on the main trace. Each zoomed detail may be expanded horizontally and vertically as required.

SMART Trigger modes like Glitch, Pattern, Dropout and TV allow you to capture precisely the events of interest. Pre- and Post-Trigger delay, and Time and Events Holdoff are also standard. The 9350A family features the proven user-interface of LeCroy's portable scopes. A bright 9" CRT allows optimum waveform viewing on a high resolution 810 x 696 pixel screen. Menus and text are arranged around the graticules - they never overwrite the waveforms. Dedicated control knobs keep the scope's performance at your fingertips.

A comprehensive range of signal processing functions including FFT and Math on live or stored waveforms, allows extensive waveform manipulation. Up to 16 MBytes of RAM are standard allowing advanced processing including FFT's up to 1 Mpoint. For the most powerful processing in the industry, a 64 MByte RAM option is available, see Page 57. DOS compatible floppy disk, PCMCIA portable hard drive and memory card options store waveforms and test setups, and simplify data transfer to any PC. An optional high resolution graphics printer is also available.

9350A Family Digital Oscilloscopes 500 MHz Bandwidth, 2 GS/s

Main Features

- **Two and Four Channel versions**
- **Up to 8M Point record length**
- **DOS Compatible Floppy Disk, PCMCIA portable hard drive and Memory Card options**
- **Innovative Peak Detect Mode**
- **Glitch, Pattern, Qualified, Interval, Dropout and Video Triggers**
- **8-bit vertical resolution, 11 with ERES option**
- **Fully programmable via GPIB and RS-232-C**
- **Automatic PASS/FAIL testing**
- **Advanced Signal Processing**
- **Internal High Resolution Graphics**

ACQUISITION SYSTEM**Bandwidth (-3 dB):** DC to 500 MHz**No. of Channels:**

4 (9354A) or 2 (9350A)

No. of Digitizers:

4 (9354A) or 2 (9350A)

Maximum Sample Rate:

2 GS/s (9354A) or 1 GS/s (9350A)

Acquisition Memory: Up to 8 M (see table below).**Sensitivity:** 2 mV/div to 5 V/div, fully variable.**Scale factors:** A wide choice of over 12 probe attenuation factors are selectable.**Offset Range:** 2.0 - 9.9 mV/div:
± 120 mV

10.0 - 199 mV/div: ± 1.2 V

0.2 - 5.0 V/div: ± 24 V

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

DC Accuracy: ≤±2% full scale.**Vertical Resolution:** 8 bits.**Bandwidth Limiter:** 30 MHz**Input Coupling:** AC, DC, GND.**Input Impedance:** 1 MΩ//15 pF or 50 Ω ± 1%.**Max Input:**

1 MΩ: 250 V (DC+peak AC ≤ 10 kHz)

50 Ω: ± 5 V DC (500 mW) or 5 V RMS

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.**External Clock:** ≤ 100 MHz on EXT input with ECL, TTL or zero crossing levels up to 500 MHz with option 935XA-CKTRIG.**TRIGGERING SYSTEM****Trigger Modes:** Normal, Auto, Single.**Trigger Sources:** CH1, CH2, Line, Ext, Ext/10 (9354: CH3, CH4), Slope, Level and Coupling for each can be set independently.**Slope:** Positive, Negative.**Coupling:** AC, DC, HF, LFREJ, HFREJ.

Pre-trigger recording: 0 to 100% of full scale (adjustable in 0.1 div increments).

Post-trigger delay: 0 to 10,000 divisions (adjustable in 0.01% increments).**Holdoff by time:** 10 ns to 20 s.**Holdoff by events:** 0 to 99,999,999 events.**Trigger Bandwidth:** Up to 500 MHz using HF coupling.**Internal Trigger Sensitivity Range:**

± 5 div.

EXT Trigger Max Input:

1 MΩ//15 pF: 250 V (DC+peak AC ≤ 10 kHz)

50 Ω ± 1%: ± 5 V DC (500 mW) or 5 V RMS

EXT Trigger Range: ±0.5 V (±5 V with Ext/10)**Trigger Timing:** Trigger Date and Time are listed in the Memory Status Menu.**SMART TRIGGER TYPES****Pattern:** Trigger on the logic AND of 5 inputs - CH1, CH2, CH3, CH4, and EXT Trigger, (9350: 3 inputs - CH1, CH2, EXT) 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 as short as 1 nsec or on pulse widths between two limits selectable from < 2.5ns to 20s.**Signal or Pattern Interval:** Trigger on an interval between two limits selectable from 10ns to 20s.**Dropout:** Trigger if the input signal drops out for longer than a time-out from 25ns to 20s.**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 μs/div (M,L versions: from 1 ns/div to 5 μs/div).**Single shot:** for transient and repetitive signals from 10 ns/div (all channels active).**Peak detect:** captures and displays 2.5 ns glitches or other high-speed events.**Sequence:** Stores multiple events - each of them time stamped - in segmented acquisition memories.

Number of segments available:

9350A-9354A 2-50

9350AM-9354AM-9354TM 2-500

9350AL-9354AL 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 (50x with averaging, up to 40 μV sensitivity).**Horizontal Zoom Factors:**9350A-9354A 500x
9350AM-9354AM-9354TM 2,000x
9350AL-9354AL 40,000x**INTERNAL MEMORY****Waveform Memory:** Up to four 16-bit Memories (M1,M2,M3,M4).**Processing Memory:** Up to four 16-bit Waveform Processing Memories (A,B,C,D).**Setup Memory:** Four non-volatile memories. Optional Cards or Disks may also be used for high-capacity waveform and setup storage.**AUTOMATIC MEASUREMENTS**

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

amplitude	Δt at level (t=0,abs)	overshoot +
area	Δt at level (t=0%)	overshoot -
base	duty cycle	peak to peak
cmean	falltime	period
cmedian	f80-20%	risetime
crms	f@level (abs)	r20-80%
csdev	f@level (%)	r@level (abs)
cycles	frequency	r@level (%)
delay	maximum	RMS
Δdelay	mean	std dev
Δt at level (abs) median		top
Δt at level (%) minimum		width

Parameters are calculated as defined by ANSI/IEEE Std 181-1977 "Standard on Pulse Measurement and Analysis by Objective Techniques". In addition, Rise and Fall times may be measured at 10 % and 90% levels, or 20% and 80% levels, or any other user-specified levels.

Δdelay provides time between midpoint transition of two sources, for making propagation delay measurements.

Δt at level allows the same measurement to be made at any specified level.

Two cursors are used to define the region over which these parameters are calculated.

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

Relative Voltage: Two horizontal bars measure voltage differences up to $\pm 0.2\%$ of fullscale in single-grid mode.

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

Pass/Fail testing allow up to five of the listed parameters to be tested against selectable thresholds. Waveform Limit Testing is performed using templates which may be defined inside the instrument.

WAVEFORM PROCESSING

Up to four processing functions may be performed simultaneously. Functions available are: Add, Subtract, Multiply, Divide, Negate, Identity, Sin (x)/x 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 WPO1.

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 Math Package WPO1, FFT is in WPO2.

AUTOSETUP

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

Autosetup Time: Approximately 2 seconds.

Vertical Find: Automatically sets sensitivity and offset.

PROBES

Model: One PP002 (X10, 10 M Ω // 15 pF) probe supplied per channel. The 9350 family is fully compatible with LeCroy's range of FET Probes, which may be purchased separately.

Probe calibration: Max 1 V into 1 M Ω , 500 mV into 50 Ω , 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 trans-

fer. Command Language complies with requirements of IEEE-488.2.

Centronics Port: Optional hardcopy parallel interface included with floppy disk and graphics printer option.

Hardcopy: Screen dumps are activated by a front-panel button or via remote control. TIFF format is available for importing into Desktop Publishing programs. The following printers and plotters can be used to make hardcopies: HP DeskJet (color or B&W), HP ThinkJet, QuietJet, LaserJet, PaintJet and EPSON printers. HP 7400 and 7500 series, or HPGL compatible plotters.

An optional internal high resolution graphics printer is also available, see Page 53.

GENERAL

Auto-calibration ensures specified DC and timing accuracy.

Temperature: 5° to 40° C (41° to 104° F) rated, 0° to 50° C (32° to 122° F) operating.

Humidity: < 80%.

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

Power: 90-250 V AC, 45-66 Hz, 230 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.

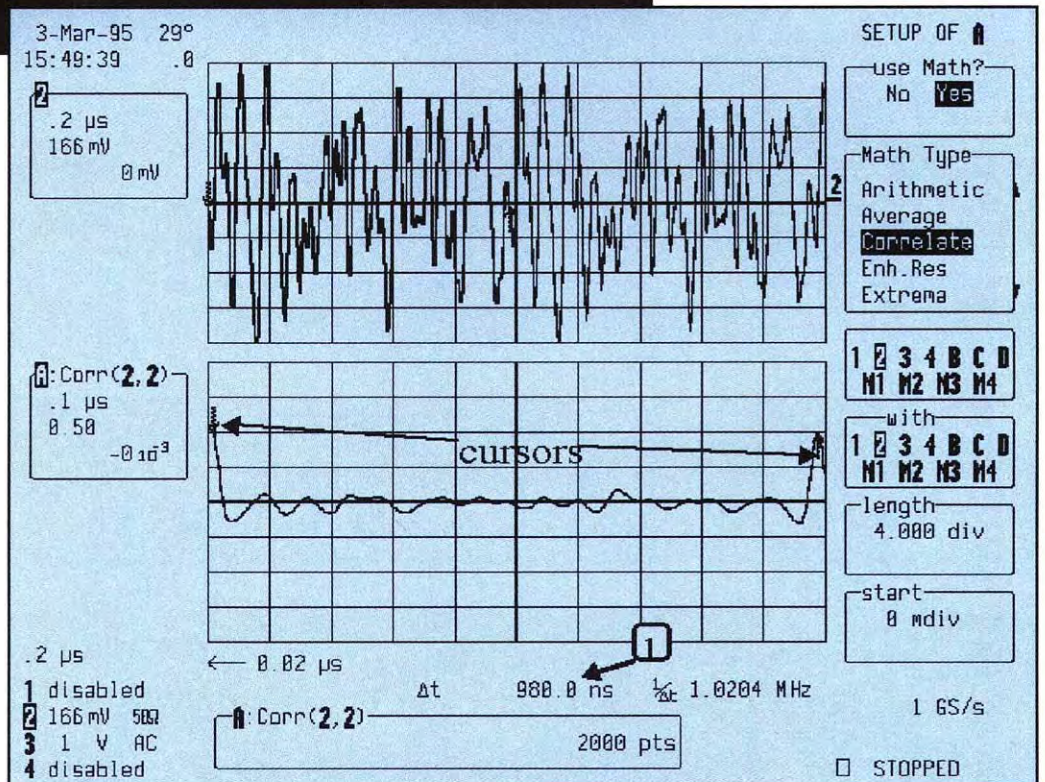
Weight: 13 kg (28.6 lbs) net, 18.5 kg (40.7 lbs) shipping.

Warranty: 3 years.

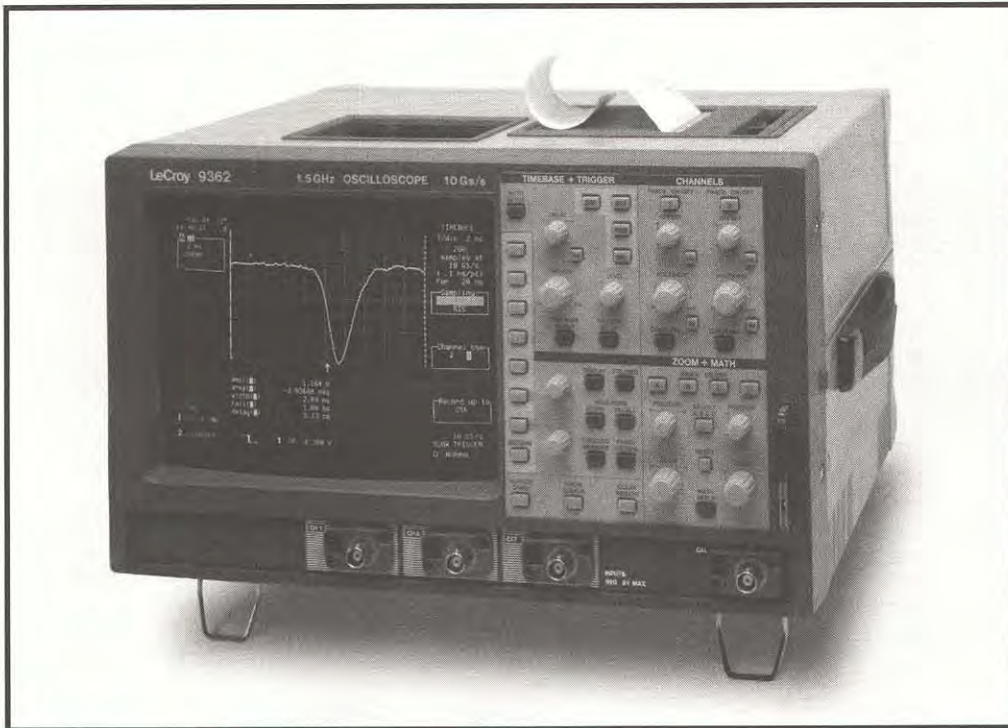
Memory Per Channel

Channels Used	Maximum Sample Rate	9350A 9354A	9350AM 9354AM	9354TM	9350AL 9354AL	Notes
All, Peak Detect OFF	500 MS/s	50k	250k	500k	2M	All channels active
All, Peak Detect ON	100 MS/s data 400 MS/s peak	25k data+ 25k peaks	100k data + 100k peaks	250k data + 250k peaks	1M data + 1M peaks	All channels active 2.5 ns peak detect
Paired Peak Detect OFF	1 GS/s	100k	500k	1M	4M	9350A; CH1 9354A; Ch2 + Ch3
Paired + PP092 Peak Detect OFF	2 GS/s	200k	1M	2M	8M	9354A Models Only

For Ordering Information See Page 62



The 93XX-DDM and 93XX-PRML packages allow 9350A series scopes to make powerful measurements on magnetic media. Above is an autocorrelation measurement. Refer to the DDM/PRML technical data on Page 49 and "Making PRML Measurements with DSO's on Page 157 for more information.



The 9362's 10 GS/s sample rate makes it the fastest single shot digital scope available. It is ideal for applications like digital design, which require high bandwidth single-shot acquisition. Its two independent digitizers are clocked simultaneously to make precise timing measurements. Fast single-shot pulses can be characterized with 100 psec resolution in single channel mode or 200 psec resolution using both channels.

With 1.5 GHz bandwidth, the 9362 is also ideal for characterizing high-speed repetitive signals. Optional FET probes ensure low loading and high bandwidth.

The 9361 is an excellent oscilloscope for looking at single shot events with slower risetimes. It samples on 2 channels simultaneously at 2.5 GS/s sampling rate with 300 MHz bandwidth.

SMART Trigger modes like Glitch, Window and Dropout allow you to capture precisely the events of interest. Once signals are triggered, a range of signal processing functions, on live or stored waveforms, allows

waveform manipulation without destroying the underlying data.

Menus and text are arranged around the waveform graticules - they never overwrite the waveforms. Each of the main control functions is dedicated to a single knob, to keep the scope's performance at your fingertips.

The 9360 series features the proven user-interface of LeCroy's portable scope family. A bright 9" CRT allows optimum waveform viewing on a high resolution 810 x 696 pixel screen.

Optional packages for FFT and extensive Waveform Processing (including Enhanced Resolution processing to 11 bits) are available.

DOS compatible memory card, PCMCIA portable hard drive and floppy disk options store waveforms and test setups, and make transferring data to your PC easier than ever before. An optional high resolution graphics printer is also available.

9361, 9362 Fast Digitizing Oscilloscopes

Main Features

- 10 GS/s max single shot sampling on 9362, 2.5 GS/s on 9361
- Repetitive sampling mode with 1.5 GHz bandwidth on 9362
- 750 MHz single-shot bandwidth on 9362, 300 MHz on 9361
- Single-shot acquisition available on all timebases
- 8-bit vertical resolution; 11 with ERES option
- Glitch, Interval, Dropout, Video and State-Qualified Triggers
- Advanced signal processing
- Record length to 25,000 points
- Automatic PASS/FAIL testing
- 36 Automatic measurements
- Internal 3.5" floppy disk and PCMCIA portable hard drive storage options
- Internal high resolution graphics printer option

ACQUISITION**No. of Channels:** 2**No. of Digitizers:** 2**Maximum Sample Rate:** 10 GS/s in single channel mode, 5 GS/s simultaneously on each channel for 9362, 2.5 GS/s for 9361.**Bandwidth (-3 dB):** 1.5 GHz (repetitive) 750 MHz (single shot) for 9362, 300 MHz for 9361.**Sensitivity:** 2 mV/div to 5 V/div (9361), to 1 V (9362), fully variable.**Offset Range:** ± 8 divisions.**DC Accuracy:** $\pm(3\% \text{ FS} + 3\% \text{ offset} + 1\text{mV})$.**Vertical Resolution:** 8 bits.**Analog Bandwidth Selections:** 30 MHz (9361 only) and full.**Input Coupling:** AC, DC, GND.**Input Impedance:** 1 M Ω ||15 pF 50 Ω $\pm 1\%$ or 1 M Ω ||15 pF (9361 only).**Max Input:** 1 M Ω :250V (DC+peak AC<10KHz) 50 Ω : $\pm 5\text{V}$ DC (500 mW) or 5VRMS.**Scale Factors:** Probe attenuation is sensed automatically.**WAVEFORM PROCESSING**

Up to four processing functions may be performed simultaneously. Available functions are: Add, Subtract, Multiply, Divide, Negate, Identity, Sin (x)/x and the following:

Average: Summed averaging of up to 1,000 waveforms in the basic instrument. Up to 10⁶ averages are possible with Option WP01.**Envelope*:** Max, Min, or Max and Min values of from 1 to 10⁶ waveforms are displayed.**ERES*:** Low-Pass digital filter provides up to 11 bits vertical resolution.**Sample:** Sample data is always available, even when trace is turned off. Any of the above modes can be invoked without destroying the sample data.

*Envelope and ERES modes are provided in Optional Math Package WP01.

TIME BASE SYSTEM**Timebases:** Main and up to 4 Zoom Traces. Any 4 viewed simultaneously.**Time/Div Range:** 1 ns/div to 1000 s/div.**Timebase Accuracy:** $\pm 0.07\%$.**Record Length:** 500 to 25,000 points (500 points for timebase settings from 500 ns/div to 1 ns/div).**Roll Mode:** on ranges 500 ms to 1000 s/div.**TRIGGERING SYSTEM****Trigger Modes:** Normal, Auto, Single, Stop.**Trigger Sources:** CH1, CH2, Line, Ext, Ext/10 (Slope, Level and Coupling for each can be set independently.)**Slope:** Positive, Negative, Window (BiSlope).**Coupling:** AC, DC, LFREJ, HFREJ, HF.**Pre-trigger recording:** 0 to 100% of full scale (0 to 75% at 10ns/div) adjustable in 1% steps.**Post-trigger delay:** 0 to 10,000 divisions (adjustable in 0.1 div increments).**Holdoff by time:** 25 ns to 20s.**Holdoff by events:** 0 to 109 events.**Trigger Bandwidth:** Up to 500 MHz using HF coupling.**Ext Trigger Input:** 1 M Ω ||15pF, 250V Max.**Ext Trigger Range:** $\pm 500\text{mV}$, $\pm 5\text{V}$ with Ext/10**Trigger Timing:** Trigger Date and Time are listed in the Waveform Status Menu.**SMART TRIGGER TYPES****Pulse Width:** Trigger on pulse width between two limits selectable from less than 2.5ns to 20s. Typically triggers on glitches down to 1 ns.**Interval Width:** Trigger on pulse spacing between two limits selectable from 2.5ns to 20s.**Dropout:** Trigger if the input signal drops out for longer than a timeout from 25ns to 20s.**State/Edge Qualified:** Trigger on any source only if a given state (or transition) has occurred on one of the other possible sources. The delay between these events can be defined as a number of events on the trigger channel.**TV:** Allows selection of both line (up to 1500) and field number (up to 8) for PAL, SECAM, NTSC or non-standard video.**DISPLAY****Waveform style:** Vectors connect the individual sample points, which are highlighted as dots.**CRT:** 12.5x17.5 cm (9" diagonal) raster.**Resolution:** 810x696 points.**Modes:** Normal, X-Y, Persistence.**Real-time Clock:** Date, hours, minutes, sec.**Graticules:** Internally generated; separate intensity control for grids and waveforms.**Grids:** 1, 2 or 4 grids.**Formats:** YT, XY, and both together.**Persistence:** Normal or Infinite.**Zoom:** Up to 200x Horizontal and up to 5x Vertical Expansion (50x with averaging, up to 40 mV sensitivity).**AUTOMATIC MEASUREMENTS**

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

amplitude	Δt at level (t=0,abs)	overshoot +
area	Δt at level (t=0%)	overshoot -
base	duty cycle	peak to peak
cmean	falltime	period
cmedian	f80-20%	risetime
crms	f@level (abs)	r20-80%
csdev	f@level (%)	r@level (abs)
cycles	frequency	r@level (%)
delay	maximum	RMS
Δ delay	mean	std dev
Δt at level (abs)	median	top
Δt at level (%)	minimum	width

Parameters are calculated as defined by ANSI/IEEE Std 181-1977 "Standard on Pulse Measurement and Analysis by Objective Techniques". In addition, Rise and Fall times may be measured at 10 % and 90% levels, or 20% and 80% levels, or any other user-specified levels.

 Δ delay provides time between midpoint transition of two sources, for making propagation delay measurements. Δt at level allows the same measurement to be made at any specified level.

Two cursors are used to define the region over which these parameters are calculated.

Relative Time: Two cursors provide time measurements with resolution of $\pm 0.05\%$ full scale for unexpanded traces; up to 10 % of the sampling interval for expanded traces. The corresponding frequency value is also displayed.**Relative Voltage:** Two horizontal bars measure voltage differences up to $\pm 0.2\%$ of fullscale in single-grid mode.**Absolute Time:** A cross hair marker measures time relative to the trigger, and voltage with respect to ground.**Pass/Fail** testing allow up to five of the listed parameters to be tested against selectable thresholds. Waveform Limit Testing is performed using templates which may be defined inside the instrument.**INTERNAL MEMORY****Waveform Memory:** Four 16-bit Reference Memories (M1,M2,M3,M4) for full 25k records.**Processing Memory:** Four 16-bit Waveform Processing Memories (A,B,C,D) 25k each.

Setup Memory: Four non-volatile panel memories.

AUTOSETUP

Sets timebase, trigger and sensitivity to display a wide range of repetitive signals. (Amplitude 2mV to 40V; frequency above 50Hz; Duty Cycle > 0.1%).

Autosetup Time: Approximately 2 seconds.

Vertical Find: Automatically sets sensitivity & offset.

INTERFACING

Remote Control of all front-panel controls, as well as all internal functions, is possible by GPIB and RS-232.

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

GPIB Port: (IEEE-488.2) Talker/listener for computer control and fast data transfer.

Hardcopy: Screendumps are activated by a front-panel button or via remote control. TIFF format is available for importing to DTP programs. The following printers and plotters can be used to make hardcopies:

HP ThinkJet, QuietJet, LaserJet, PaintJet and EPSON compatible printers. HP 7400 and 7500 series, Phillips 8151, Graphtek FP5301 and compatible plotters. An internal high resolution graphics printer is also available.

MASS STORAGE OPTIONS

Optional 3.5" Floppy Disk drive and PCMCIA standard portable hard drive and memory cards allow storage of traces, screen graphics, setups and Pass/Fail templates.

GENERAL

Temperature:

10° to 35° C (50° to 95° F) rated, 0° to 45° C (32° to 113° F) operating

Humidity: <80%

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

Power: 90-250 V AC, 45-66 Hz, 150W

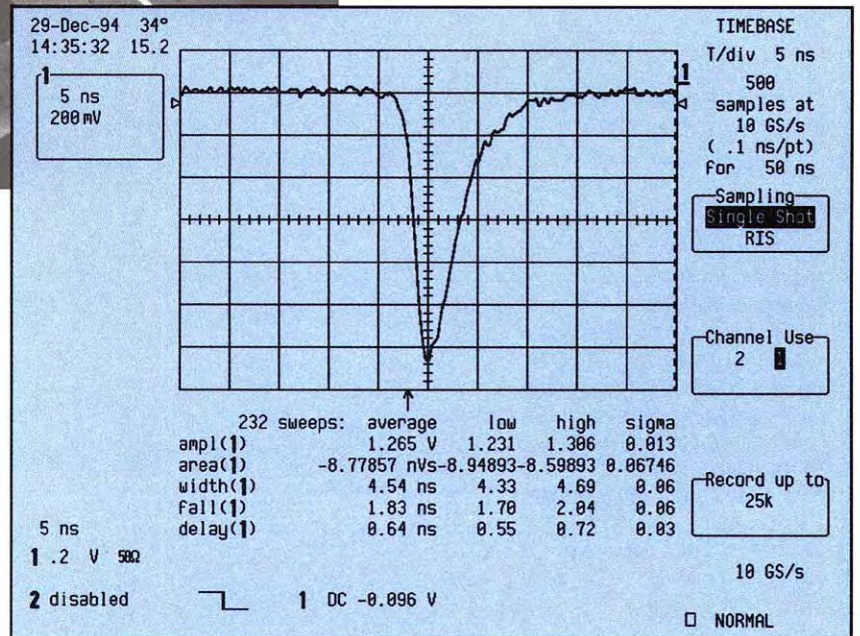
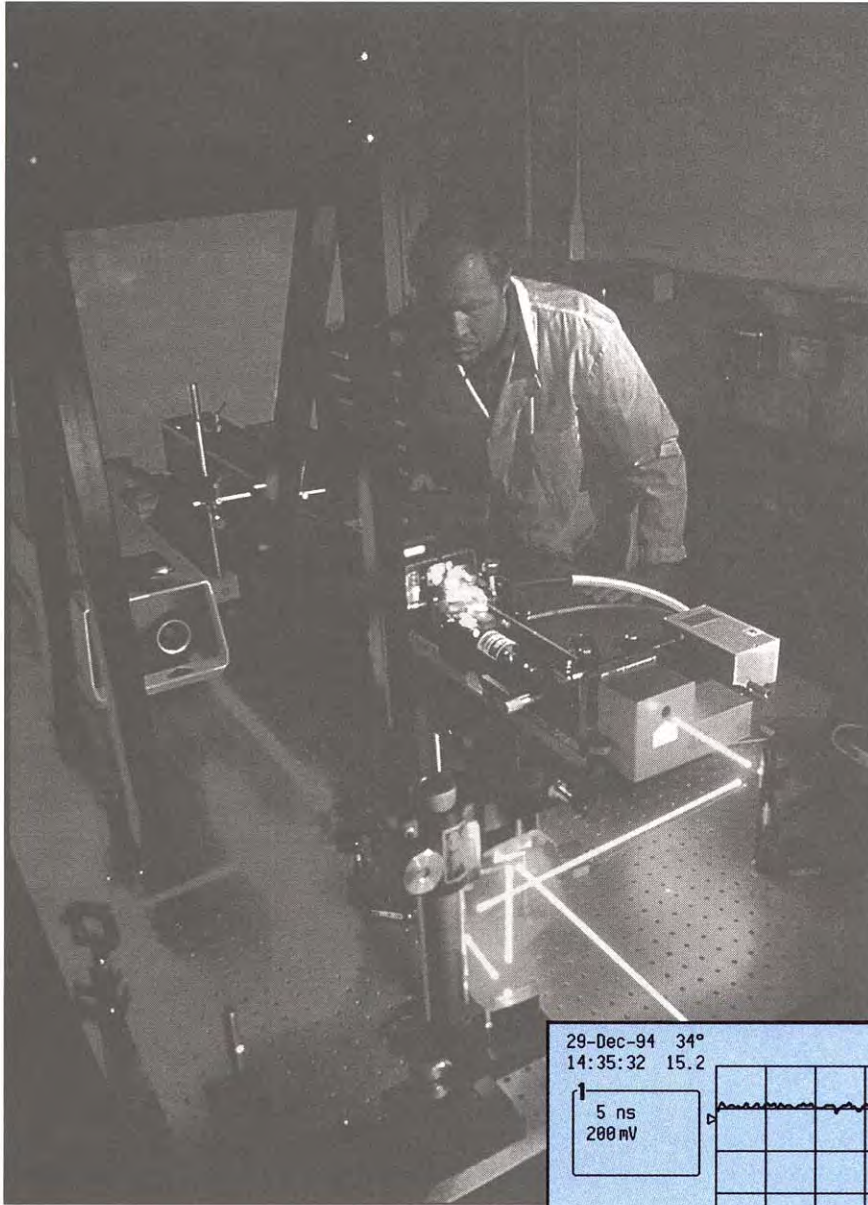
Battery Backup: Front-panel settings maintained for two years

Dimensions: (HWD)

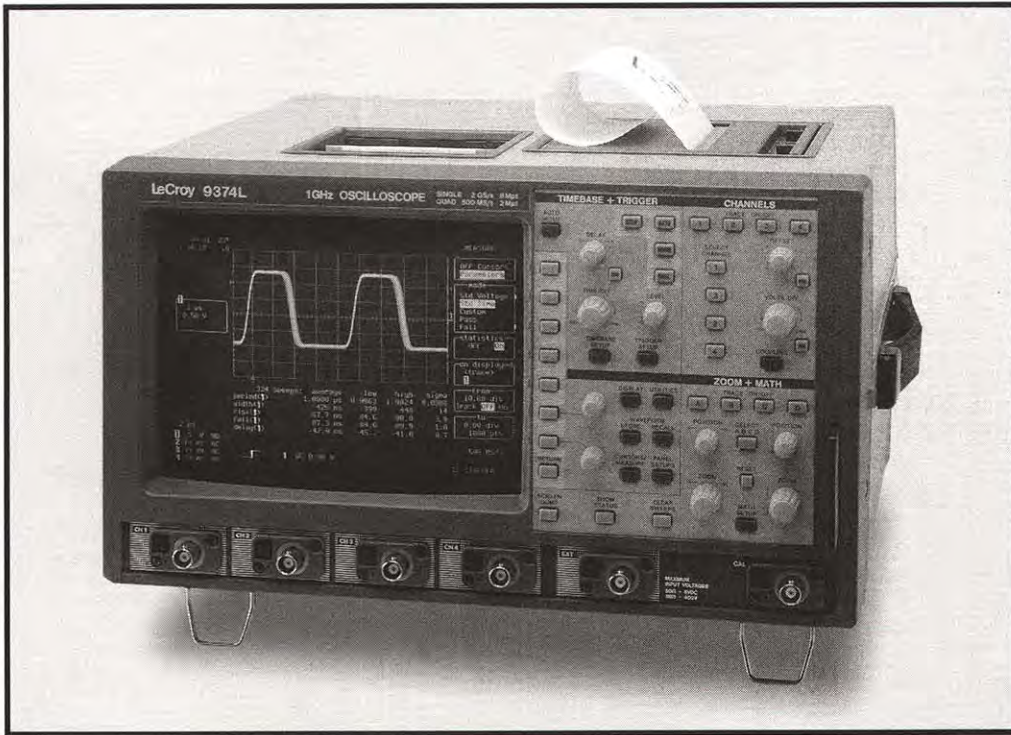
8.5"x14.5"x16.25" 210mm x 370mm x 410mm

Weight: 10kg (22lbs) net 15.5kg (34lbs) shipping

Warranty: 3 years



Here the 9362 captures a laser pulse 232 times and measures the amplitude, area, falltime of the fast leading edge, width and delay (jitter) of the pulse relative to a timing reference. The average, maximum, minimum and standard deviation of all the values is displayed.



1 GHz BANDWIDTH

The 9370 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.

2 GS/S SAMPLE RATE

The two and four channel models of the 9370 series sample simultaneously on all channels at 500 MS/s. Thus, they are ideal for demanding high speed applications. In addition, two channels can be combined to provide a sample rate of 1 GS/s. The 9374 provides 2 GS/s in single channel mode. Finer horizontal resolution and accuracy are guaranteed by high sample rates. This is especially critical in digital design where unpredictable circuit

behavior has to be identified and analyzed in detail to be fully understood. Together with this excellent single-shot performance the 9370 series also provides a sample rate equivalent to 10 GS/s for repetitive signals.

8M POINTS ACQUISITION MEMORY

Channel memory lengths of 50k, 250k and 2M are available on the two and four channel 9370 DSOs. The memory power is revealed when the user seeks to sample at the highest speed over many timebase settings. Short memory DSOs may boast a high sample rate for short waveforms, but only a long memory oscilloscope can deliver high sample rates for long waveforms. To exploit this capability to its fullest the LeCroy 9370 series 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 9370 series place it in the forefront of DSO capability.

9370 Series Digital Oscilloscopes 1 GHz Bandwidth, 2 GS/s

Main Features

- Up to 8M Point record length
- 8-bit vertical resolution, 11 with ERES option
- Two and Four Channel versions
- Portable Hard Disk (PCMCIA III), Memory Card and DOS Compatible Floppy Disk options
- Innovative Peak Detect
- Glitch, Pattern, Qualified, Interval, Dropout and TV Triggers
- Fully programmable via GPIB and RS-232-C
- Internal Graphics Printer Option
- Automatic PASS/FAIL testing
- Advanced Signal Processing

ACQUISITION SYSTEM**Bandwidth (-3 dB):**

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

@ 1 MΩ DC: DC to 500 MHz typ. at probe tip, with PP004 supplied standard. 1 GHz FET probe optional.

No. of Channels: 4 (9374) or 2 (9370)

No. of Digitizers: 4 (9374) or 2 (9370)

Maximum Sample Rate and Acquisition

Memories: See table below.

Sensitivity:

2 mV/div to 1 V/div, 50Ω, fully variable

2 mV/div to 10 V/div, 1MΩ, 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 - 10V/div: ± 100 V (1MΩ only)

DC Accuracy: Typically 1% for DC gain and offset at 0V.

Vertical Resolution: 8 bits.

Bandwidth Limiter: 20 MHz, 200 MHz.

Input Coupling: AC, DC, GND.

Input Impedance: 1MΩ//15 pF or 50 Ω ±1%.

Max Input:

1 MΩ: 400 V (DC+peak AC @10 kHz)

50Ω: ±5 V DC (500 mW) or 5 V RMS

TIME BASE SYSTEM

Timebases: Main and up to 4 Zoom Traces.

Time/Div Range: 1 ns/div to 1,000 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.

External Clock: ≤100 MHz on EXT input with ECL, TTL or zero crossing levels.

Optional 50 MHz to 500 MHz rear panel fixed frequency clock input.

External Reference: Optional 10 MHz rear-panel input.

TRIGGERING SYSTEM

Trigger Modes: Normal, Auto, Single, Stop.

Trigger Sources: CH1, CH2, Line, Ext, Ext/10 (9374: CH3, CH4). 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.

Internal Trigger Range: ±5 div.

EXT Trigger Max Input:

1 MΩ//15 pF: 250 V (DC + peak AC ≤10 kHz)

50Ω ±1%: ±5 V DC (500 mW) or 5 V RMS

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

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

Trigger Comparator: Optional ECL rear panel output.

SMART TRIGGER TYPES

Pattern: Trigger on the logic AND of 5 inputs - CH1, CH2, CH3, CH4, and EXT Trigger, (9370: 3 inputs - CH1, CH2, EXT) 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 width between two limits selectable from 2.5ns to 20s. Will typically trigger on glitches 1ns wide.

Signal or Pattern Interval: Trigger on interval between two limits selectable from 10ns to 20s

Dropout: Trigger if the input signal drops out for longer than a time-out from 25ns to 20s.

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 nonstandard video.

ACQUISITION MODES**Random Interleaved Sampling (RIS):**

For repetitive signals from 1 ns/div to 5 ms/div.

Single shot: For transient and repetitive signals from 10 ns/div (all channels active).

Peak detect: Captures and displays 2.5 ns glitches or other high-speed events.

Sequence: Stores multiple events in segmented acquisition memories.

Number of segments available:

9370-9374 2-200

9370M-9374M 2-500

9370L-9374L 2-2,000

Max. Dead Time between segments:

100 μs

DISPLAY

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

CRT: 12.5x17.5 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 (50x with averaging, up to 40 mV sensitivity, only with WPO1).

Maximum Horizontal Zoom Factors:

9370-9374 2,000x

9370M-9374M 10,000x

9370L-9374L 80,000x

Waveforms can be expanded to give 2-2.5 points/division. This provides zoom factors up to 400,000x for the 9374L when channels are combined.

AUTOMATIC MEASUREMENTS

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

amplitude	Δt at level (t=0,abs)	overshoot + area
area	Δt at level (t=0%)	overshoot - peak to peak
base	duty cycle	period
cmean	falltime	risetime
cmedian	f80-20%	r20-80%
crms	f@level (abs)	r@level (abs)
csdev	f@level (%)	r@level (%)
cycles	frequency	RMS
delay	maximum	std dev
Δdelay	mean	top
Δt at level (abs) median	minimum	width
Δt at level (%)		

Parameters are calculated as defined by ANSI/IEEE Std 181-1977 "Standard on Pulse Measurement and Analysis by Objective Techniques". In addition, Rise and Fall times may be measured at 10 % and 90% levels, or 20% and 80% levels, or any other user-specified levels.

Δdelay provides time between midpoint transition of two sources, for making propagation delay measurements.

Δt at level allows the same measurement to be made at any specified level.

Two cursors are used to define the region over which these parameters are calculated.

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 also displayed.

Relative Voltage: Two horizontal bars measure voltage differences up to $\pm 0.2\%$ of fullscale in single-grid mode.

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

Pass/Fail testing allow up to five of the listed parameters to be tested against selectable thresholds. Waveform Limit Testing is performed using templates which may be defined inside the instrument.

INTERNAL MEMORY

Waveform Memory: Up to four 16-bit Memories (M1, M2, M3, M4).

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

Setup Memory: Four non-volatile memories. Optional Cards or Disks may also be used for high-capacity waveform and setup storage.

WAVEFORM PROCESSING

Up to four processing functions may be performed simultaneously.

Functions available are: Add, Subtract, Multiply, Divide, Negate, Identity, Summation Averaging and Sin (x)/x.

Average: Summed averaging of up to 1,000 waveforms in the basic instrument. Up to 10^6 averages are possible with Option WPO1.

Extrema*: Roof, Floor, or Envelope values from 1 to 10^6 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 five windowing functions and FFT averaging.

*Extrema and ERES modes are provided in Math Package WPO1. FFT is in WPO2.

AUTOSETUP

Pressing Autsetup sets timebase, trigger and sensitivity to display a wide range of repetitive signals. (Frequency above 50Hz; Duty cycle greater than 0.1%).

Autosetup Time: Approximately 2 seconds.

Vertical Find: Automatically sets sensitivity and offset.

PROBES

Model:

One PP004 (10:1, 10 M Ω // 10 pF) probe supplied per channel. 200 V max input.

The 9370 series is fully compatible with LeCroy's range of FET Probes, which may be purchased separately.

Probe calibration: Max 1 V into 1 MW, 500 mV into 50 W, 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: Possible by GPIB and RS-232-C for all front-panel controls, as well as all internal functions.

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

GPIB Port: (IEEE-488.1) Configurable as talker/listener for computer control and fast data transfer. Command Language complies with requirements of IEEE-488.2.

Centronics Port: Optional hardcopy parallel interface is provided with floppy and graphics printer options.

Hardcopy: Screen dumps are activated by a front-panel button or via remote control. TIFF and BMP formats are available for importing to Desktop Publishing programs. The following printers and plotters can be used to make hardcopies: HP DeskJet (color or BW), HP ThinkJet, QuietJet, LaserJet, PaintJet and EPSON printers; HP 7470 and 7550 plotters, or similar, and HPGL compatible plotters. An optional internal high resolution graphics printer is also available.

GENERAL

Auto-calibration ensures specified DC and timing accuracy.

Temperature:

5° to 40° C (41° to 104° F) rated 0° to 50° C (32° to 122° F) operating.

Humidity: <80%.

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

Power: 90-250 V AC, 45-66 Hz, 230 W.

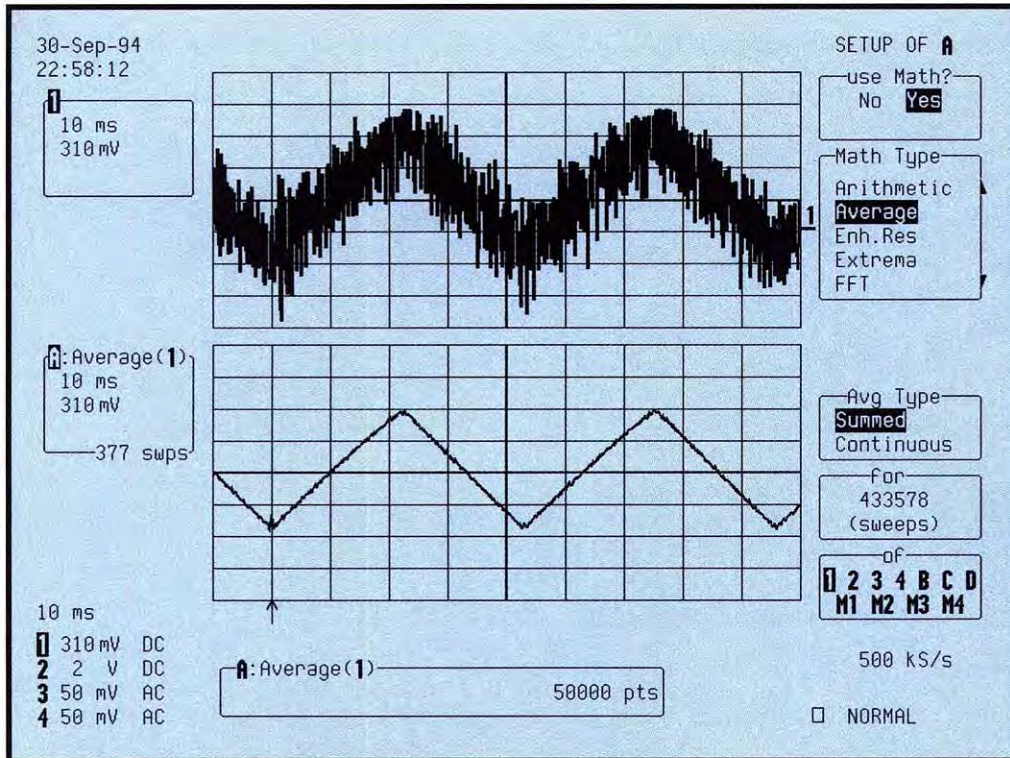
Battery Backup: Front-panel settings maintained for two years.

Dimensions: (HWD)

8.5"x14.5"x16.25", 210mm x 370mm x 410mm.

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

Warranty: Three years.



Summed Averaging is applied to the signal in Channel 1, to remove random noise. Trace A shows the result after 377 sweeps: the noise has practically disappeared.

The LeCroy WP01 Waveform Processing package features a powerful toolset that extends the processing power inside the 9300 oscilloscope, well beyond the capabilities of a traditional instrument. In fact, all the processing is built-in to eliminate the need for external computers and controllers. High-speed microprocessors and up to 64 MBytes of RAM are used to ensure real-time updates of computed waveforms on the screen. The package is fully programmable over GPIB or RS-232-C interfaces, and hard copies can be made directly on to a wide range of printers (including the optional internal printer), plotters or graphic formats. Data can also be saved to optional floppy disk and PCMCIA portable hard drive.

Features and Benefits

EXTENSIVE SIGNAL AVERAGING

WP01 offers two powerful, high-speed averaging modes that can be used to reduce noise and improve the signal-to-noise ratio. Vertical resolution can be extended by several bits to improve dynamic range and increase the overall input sensitivity to as much as 50 mV/div.

Summed averaging, where up to 1,000,000 sweeps are repeatedly summed, with equal weight, in a 32-bit

accumulation buffer for improved accuracy. The accumulated result is then divided by the number of sweeps.

Continuous/exponential averaging where a weighted addition of successive waveforms can be performed with weighting factors from 1:1 to 1:1023. The averaging goes on indefinitely with the contribution of "older" sweeps gradually decreasing. The method is particularly appropriate to reduce noise on signals drifting very slowly in time or amplitude.

ENHANCED RESOLUTION BY DIGITAL FILTERING

Allows low-pass F.I.R. filtering of the digitized signals, with 6 different cutoff frequencies per sampling rate setting. As a result, the vertical resolution of the captured signals – single-shot or repetitive – increases from 8 bits to 11 bits in 0.5-bit steps. This feature is ideal to strip off unwanted high-frequency noise on transient events.

RESCALING

Allows an input signal to be rescaled using a $(ax + b)$ correction factor to compensate for gain and offset. This is very useful when dealing with various types of transducers, to read the correct temperature or pressure value directly from the scope's cursor.

WP01 Waveform Processing Package for the 9300 Family of Digital Oscilloscopes

Main Features

- High-precision averaging up to 1 million sweeps
- Extended digital filtering capabilities
- Rescale function, with $(ax + b)$ correction factor
- Envelope mode
- Integration
- Differentiation
- Log(e) and Log(10)
- Exp(e) and Exp(10)
- Absolute Value, Reciprocal
- Square, Square root
- Powerful function chaining feature

ENVELOPE MODE

Shows the signal envelope by retaining only the highest and lowest amplitudes for every sampling interval, over a user-definable number of sweeps. Ideal to visualize the time or amplitude jitter in a signal.

POWERFUL MATH TOOLSET

In addition to the basic arithmetic functions found in the standard models (+, -, \leftrightarrow , \cdot , \div), WPO1 adds an impressive set of functions such as integration, differentiation, logarithms and exponential – in both bases 10 and e – square, square root, reciprocal and absolute value. All these functions are updated automatically each time a new waveform is acquired, showing a “live” representation of a computed trace. This would be impossible to achieve on a separate computer.

FUNCTION CHAINING

When more than one math function is needed in the equation, WPO1 supports function chaining, and allows the user to multiply, for instance, the “Voltage” and the “Current” channel and to integrate the result to get an instantaneous energy curve.

REMOTE CONTROL

All of the waveform processing can be controlled via GPIB or RS-232-C remote control. And the function traces do not even need to be called up on screen to be updated, an important feature that speeds up the computation.

GENERAL

Max. number data points: Up to 8 million. Only limited by the available amount of system memory (indicated in the “memory used” status menu).

Min. number data points: Data points can be reduced down to 50 in the processing function to improve update rate.

Vertical Zoom: supported, 50^x maximum.

Horizontal Zoom: supported, maximum zooming to a point where 50 samples of the source trace occupy the full screen.

Maximum Sensitivity: 50 mV/div after vertical expansion.

SUMMATION AVERAGING

Number of Sweeps: 1 to 1,000,000.

Speed: up to 200,000 points/s.

CONTINUOUS AVERAGING

Possible Weighting Factors: 1:1, 1:3, 1:7, 1:15, 1:31, 1:63, 1:127, 1:255, 1:511 and 1:1023.

ENHANCED RESOLUTION

Choice of six low-pass filters to improve vertical resolution improvement from 8 to 11 bits in 0.5-bit steps.

Resulting bandwidth:

0.5 bit 0.5 \leftrightarrow Nyquist BW

1 bit 0.241 \leftrightarrow Nyquist BW

1.5 bit 0.058 \leftrightarrow Nyquist BW

2 bit 0.029 \leftrightarrow Nyquist BW

2.5 bit 0.016 \leftrightarrow Nyquist BW

Nyquist BW = 1/2 \leftrightarrow sample frequency.

Rescale ax + b rescaling with a and b

ranging from ± 0.00001 E-15 to

± 9.99999 E+15

ARITHMETIC

Addition, subtraction, multiplication and ratio on any two waveforms.

FUNCTIONS

Identity, negation, integration (including additive constant), differentiation, square, square root, logarithm and exponential (base e and 10), sin x/x, reciprocal and absolute value of any waveform.

EXTREMA

Shows the signal envelope by retaining only the highest and lowest amplitudes for every sampling interval. Logs all extreme values of a waveform over a programmable number of sweeps. Maxima and minima can be displayed together, or separately by choosing roof or floor traces.

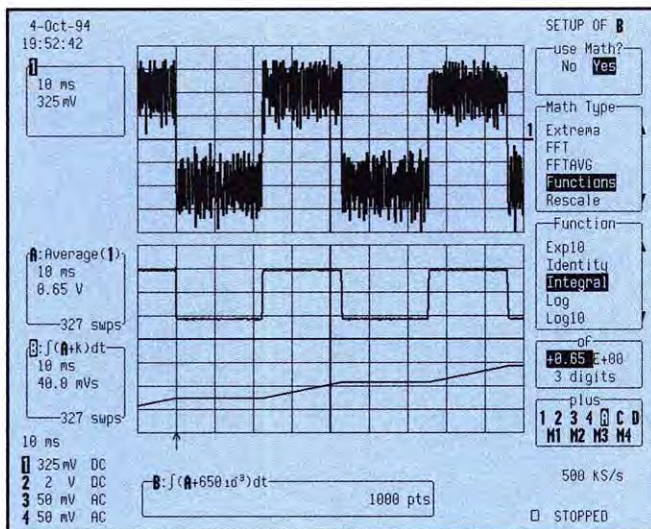
Number of Sweeps: 1 to 1,000,000.

FUNCTION CHAINING

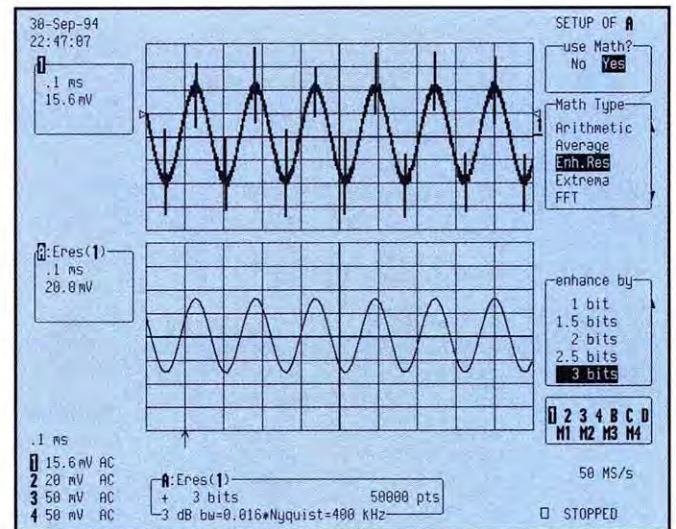
Up to four functions can be automatically chained using traces A, B, C and D. Using memories M1 to M4 for intermediate results, any number of operations can be chained manually or via remote control.

REMOTE CONTROL

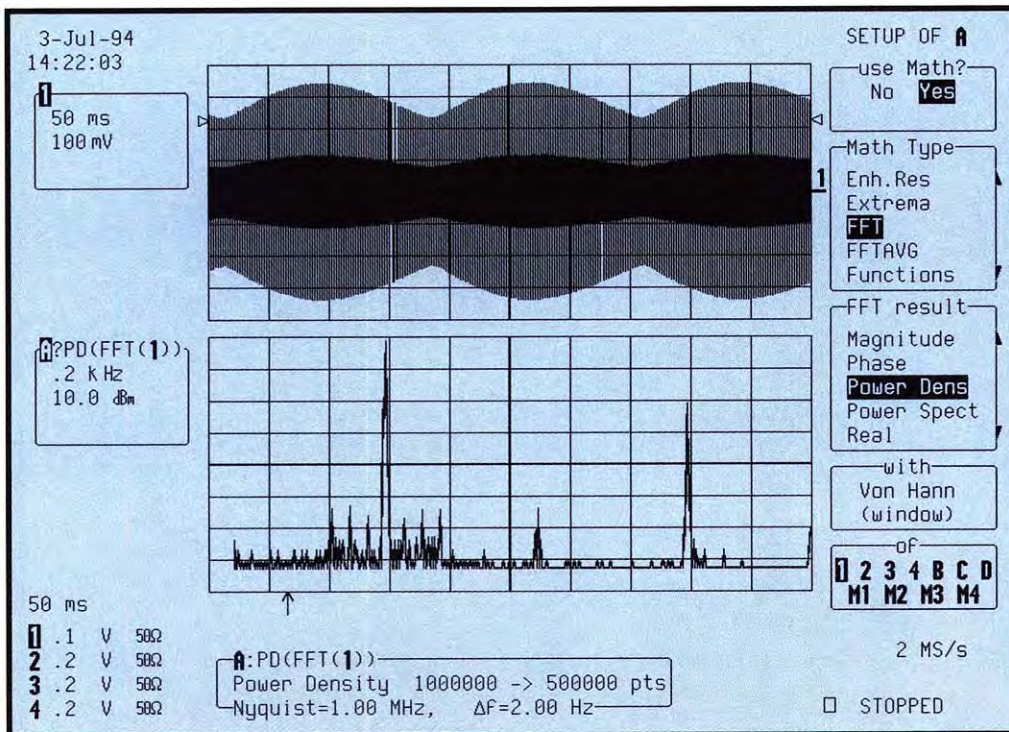
All controls and waveform processing functions are fully programmable using simple commands over the oscilloscope's GPIB or RS-232-C interfaces.



To illustrate WPO1's function chaining ability, the noisy signal in Channel 1 has been averaged in Trace A to remove undesired noise, and the result integrated in trace B.



High-frequency glitches in Channel 1 have been dramatically reduced in Trace A by using the low-pass filtering properties of the Enhanced Resolution Function.



The WP02 Spectrum Analysis package provides the 9300 oscilloscope with a powerful frequency-domain toolset that extends its processing capabilities, well beyond the realm of a standard instrument. In fact, all the processing is built-in to eliminate the need for external computers and controllers.

High-speed microprocessors and up to 64 MBytes of RAM are used to perform computations. Fast Fourier Transforms (FFTs) convert time domain waveforms into frequency domain records to reveal valuable spectral information such as phase, magnitude and power. The package is fully programmable over GPIB and RS-232-C interfaces, and hardcopies can be made directly on to a wide range of printers (including the optional internal printer), plotters or graphic formats. Data can also be saved to optional floppy disk or PCMCIA portable hard drive.

Features and Benefits

WHY FFT IN A SCOPE?

The FFT package on a LeCroy 9300 has at least four clear advantages over common swept spectrum analyzers:

- It can show the spectrum of a **transient signal**.
- Both **time and frequency** information can be monitored **simultaneously**.
- Phase information is **available**.
- The price is **attractive**.

It has two definite advantages over FFT analyzers:

- It can show higher-frequency components.
- Both **time and frequency** information can be monitored **simultaneously**.
- The price is **attractive**.

BROAD SPECTRUM COVERAGE

The frequency spectrum ranges from DC to the full bandwidth of the oscilloscope for repetitive signals, and to one half of the maximum sampling frequency for transients.

MULTI-CHANNEL ANALYSIS

All input channels can be analyzed simultaneously to look for common frequency-domain characteristics in independent signals.

VERSATILE SCALING FORMATS

Frequency-domain data may be presented as magnitude, phase, real, imaginary, complex, log-power and log-PSD (Power Spectral Density).

STANDARD WINDOW FUNCTIONS

Use rectangular for transient signals; von Hann (Hanning) and Hamming for continuous waveform data; Flattop for accurate amplitude measurements; Blackman-Harris for maximum frequency resolution.

FREQUENCY DOMAIN AVERAGING

Up to 50,000 FFT sweeps may be averaged to reduce base-line noise, enable analysis of phase-incoherent signals or signals which cannot be triggered on.

WP02 Spectrum Analysis Package for the 9300 Family of Digital Oscilloscopes

Main Features

- Frequency range from DC up to the instrument's full bandwidth
- Simultaneous FFTs on up to 4 channels
- Perform FFT on up to 6 million time domain samples
- Frequency resolution down to 100 μ Hz
- Frequency domain averaging
- Wide selection of scaling formats and window functions
- 5 window functions
- Up to 5 1000-point FFTs per second
- Full support of cursors and automatic waveform parameters
- Full PASS/FAIL testing support

FREQUENCY CURSORS AND WAVEFORM PARAMETERS

Cursors can be set on the FFT trace to show up to 0.004% frequency resolution (up to 0.002% for 10,000 point memory) and measure power or voltage differences to 0.2% of full scale. Automatic waveform parameters can also be applied to FFT traces.

PASS/FAIL TESTING ON FFT TRACES

PASS/FAIL testing is fully supported on FFT traces. The instrument can be setup to test incoming spectra against tolerance masks. In case the signal "fails", the instrument can be programmed to perform a choice of actions (screen dump, waveform storage, pulse out, etc.)

RESCALING

Allows an input signal to be rescaled using a $(ax + b)$ correction factor to compensate for gain and offset. This is very useful when dealing with various types of transducers, to read the correct temperature or pressure value directly from the scope's cursor.

FUNCTION CHAINING

When more than one math function is needed in the equation, WPO2 supports function chaining, and allows the user to multiply, for instance, the "Voltage" and the "Current" channel and to integrate the result to get an instantaneous energy curve.

REMOTE CONTROL

All of the waveform processing can be controlled via GPIB or RS-232-C remote control. And the function traces do not even need to be called up on screen to

FOURIER PROCESSING

Fourier processing is a mathematical technique which enables a time-domain waveform to be described in terms of frequency-domain magnitude and phase, or real and imaginary spectra. It is used, for example, in spectral analysis where a waveform is sampled and digitized, then transformed by a Discrete Fourier Transform (DFT). Fast Fourier Transforms (FFT) are a set of algorithms used to reduce the computation time (by better than a factor of 100 for a 1000 point FFT) needed to evaluate a DFT.

be updated, an important feature that speeds up the computation.

GENERAL

Max. number data points: only limited by the available amount of system memory (indicated in the "memory used" status menu). Up to 6 million data points can be handled in scopes equipped with the 930X-64 RAM option of 64 MBytes of RAM.

Min. number data points: Data points can be reduced down to 50 in the processing function to improve update rate.

Vertical Zoom: supported, 50 \leftrightarrow maximum.

Horizontal Zoom: supported, maximum zooming to a point where 50 samples of the source trace occupy the full screen.

Maximum Sensitivity: 50 mV/div after vertical expansion.

Frequency Range:

Repetitive signals: DC to instrument bandwidth.

Transient signals: DC to 1/2 maximum single-shot sampling frequency

Frequency Scale Factors: 0.05 Hz/div to 0.2 GHz/div in a 1-2-5 sequence.

Frequency Accuracy: 0.01%.

AMPLITUDE AND PHASE

Amplitude Accuracy: Better than 2%. Amplitude accuracy may be modified by the window function (see the window functions table).

Signal Overflow: A warning is provided at the top of the display when the input signal exceeds the ADC range.

Number of Traces: Time domain and frequency domain data can be displayed simultaneously (up to 4 waveforms).

Phase Range: -180° to +180°.

Phase Accuracy: $\pm 5^\circ$ (for amplitudes > 1.4 div).

Phase Scale Factor: 50° /division.

spectrum scaling formats

Horizontal Scale: Linear, in Hz

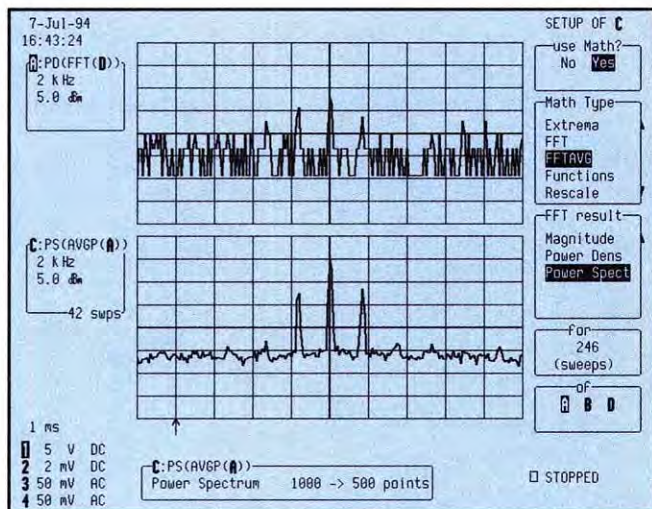
Vertical Scales:

Power Spectrum in dBm (1 mW into 50 W).

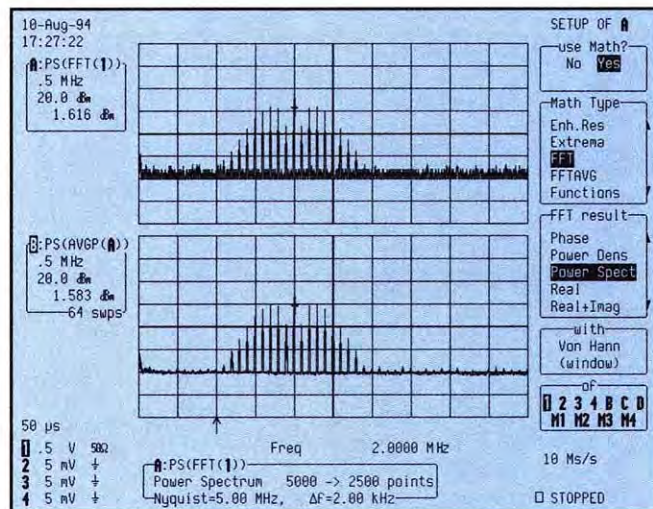
Power Spectral Density (PSD) in dBm.

Magnitude, Real, Imaginary: Linear, in V/div

Phase Display: Linear, in degrees.



An FFT (top trace) with spectral components buried in noise. By applying the power averaging function (lower trace), all the baseline noise is removed, and the spectral components of an AM signal are clearly visible.



Frequency modulated signal, 2 MHz carrier with 99 kHz modulation frequency, 4:1 frequency deviation, FFT shows modulation sidebands, FFT power average used to improve s/n ratio.

WINDOW FUNCTIONS

Rectangular, von Hann (Hanning), Hamming, Flattop and Blackman-Harris (see table below).

fft execution times*

100 points in less than 0.03 s.

1000 points in less than 0.3 s.

10000 points in less than 3 s.

* Only valid for 9350, 9360, 9370 and 9304/10 with MWP option. Other models, add 50%

FREQUENCY DOMAIN POWER AVERAGING

Summation averaging of power, PSD or magnitude for up to 50,000 sweeps.

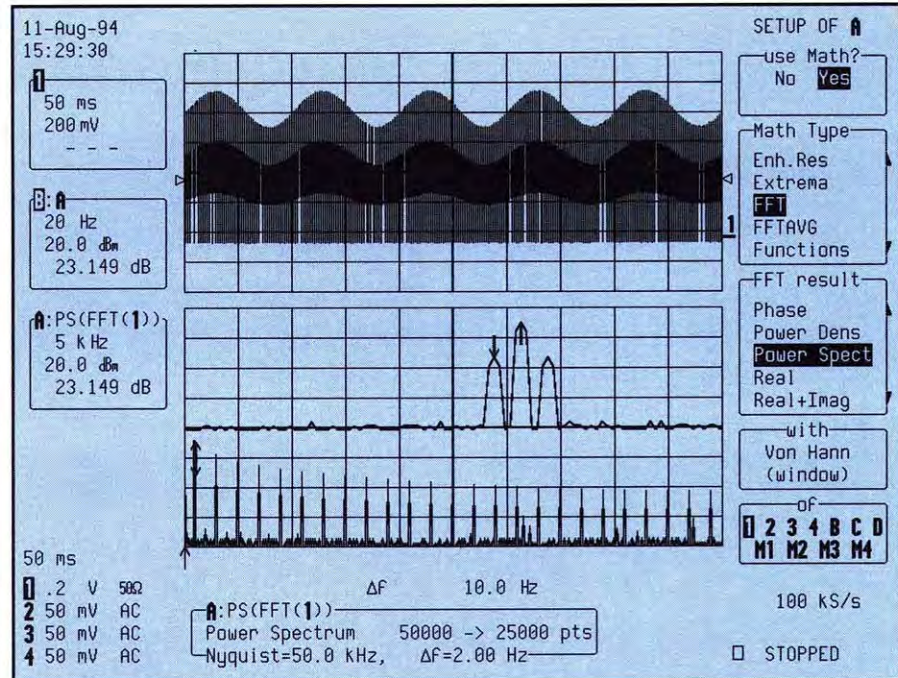
FUNCTION CHAINING

Up to four functions can be automatically chained using traces A, B, C and D. Using memories M1 to M4 for intermediate results, any number of operations can be chained manually or via remote control.

REMOTE CONTROL

All controls and waveform processing functions are fully programmable using simple commands over the oscilloscope's GPIB or RS-232-C interfaces.

Adding the WP02 Spectrum Analysis Package to the 9300 family of digital oscilloscopes provides a fast and economical solution to frequency domain applications.



FFT analysis of a 1 kHz square wave with 25% pulse amplitude modulation at 10 Hz. Long memory and 50 kpoint FFT show up to 51st harmonic, while expansion shows 10 Hz modulation sidebands.

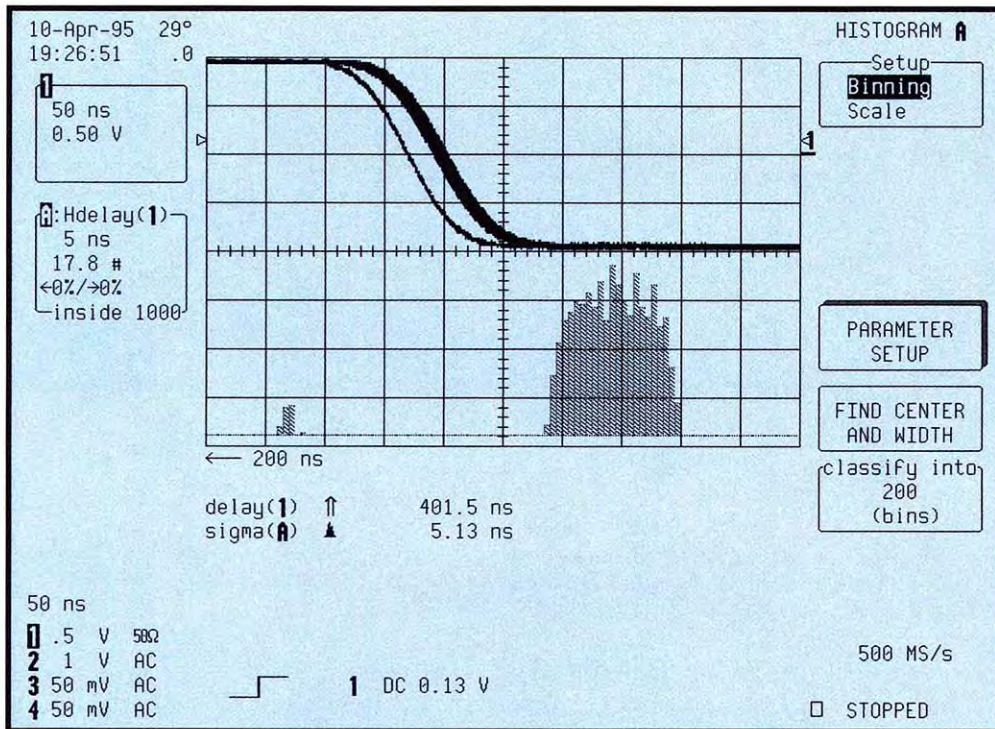
Filter Pass Band and Resolution

Window Type	Filter bandwidth at -6dB [freq. bins]	Highest side lobe [dB]	Scallop loss [dB]	Noise bandwidth [freq. bins]
Rectangular	1.21	-13	3.92	1
von Hann	2	-32	1.42	1.5
Hamming	1.81	-43	1.78	1.36
Flattop	1.78	-44	0.01	2.96
Blackman-Harris	1.81	-67	1.13	1.71

Filter Bandwidth at -6dB characterizes the frequency resolution of the filter.

Highest Side Lobe indicates the reduction in leakage of signal components into neighboring frequency bins.

Scallop Loss is the loss associated with picket fence effect.



The LeCroy WPO3 Waveform Processing package extends the measurement capability of the 9300 oscilloscope by providing a new processing function – built into the oscilloscope – to perform in-depth analysis on waveform parameters – a task that was formerly carried out either manually, with a notepad, or by means of an external computer, in a spreadsheet program.

The new function provides **histogramming** of any waveform parameter measurement, and can be conveniently **autoscaled** to display the center and width of the distribution. In addition, an already wide range of automated measurements are extended to provide a new category of statistical measurements specifically designed to analyze histogram distributions.

The package is fully programmable over GPIB and RS-232-C interfaces, and hardcopies can be made directly to a wide range of printers (including the optional internal printer), plotters or graphic formats.

WAVEFORM PARAMETER ANALYSIS

WPO3 adds a powerful dimension to waveform analysis by recording and analyzing

the properties of a series of waveform parameter measurements. This is accomplished by a function that records the parameter values and presents the data in a statistical form – the Histogram.

The Histogram function produces a waveform consisting of one point for each histogram bin, where the value of each point is equal to the number of parameter values which fall into the corresponding bin.

Analysis of histogram distributions is supported by a wide range of automated statistical parameters, which provide insight and quantitative analysis into difficult-to-measure phenomena such as jitter and amplitude fluctuation. This function is also invaluable in establishing production test limits.

A DATABASE IN THE OSCILLOSCOPE

The Histogram function performs calculations on a stored history database of waveform parameters. This allows detailed analysis to be performed on parameter data without the need to reacquire the source waveforms. Having the parameter database available also allows automatic scaling of histogram and graph displays.

WPO3 Parameter Analysis Package for the 9300 Family of Digital Oscilloscopes

Main Features

- Histogram function for over 40 different parameters
- Up to 2000 bins
- Population of up to 2,000,000,000
- 18 histogram parameters
- Autoscale on Histogram
- Histograms of all or individual segments in sequence waveforms

WAVEFORM PARAMETER MEASUREMENTS

The LeCroy 9300 series has the capability to perform a wide range of automated waveform parameter measurements which make interpretation of waveform data easy, accurate and repeatable. The distribution of these parameter measurements can be analyzed by histogramming their values. Some of the waveform parameters available include:

amplitude	Δt at level (abs)	overshoot+
area	Δt at level (%)	overshoot -
base	duty cycle	peak to peak
cmean	falltime	period
cmedian	f80-20%	risetime
crms	f@level (abs)	r20-80%
csdev	f@level (%)	r@level (abs)
cycles	frequency	r@level (%)
delay	maximum	RMS
Δ delay	mean	std dev
median	top	minimum
width		

HISTOGRAM FEATURES

Provided below are just some of the histogramming capabilities.

Vertical:

Autoscaling, choice of "Linear", "Log" or "Constant maximum" (linear) scales. Up to 50x expansion.

Horizontal:

20 to 2000 bins in a 1-2-5 sequence. Autosetup of center and width.

Population:

20 to 2,000,000,000 selectable in a 1-2-5 sequence.

Data Source: Any waveform parameter.

Value:

The number of events binned, as well as the percent of overflow/underflow events are automatically displayed.

Measurements: 18 Statistical parame-

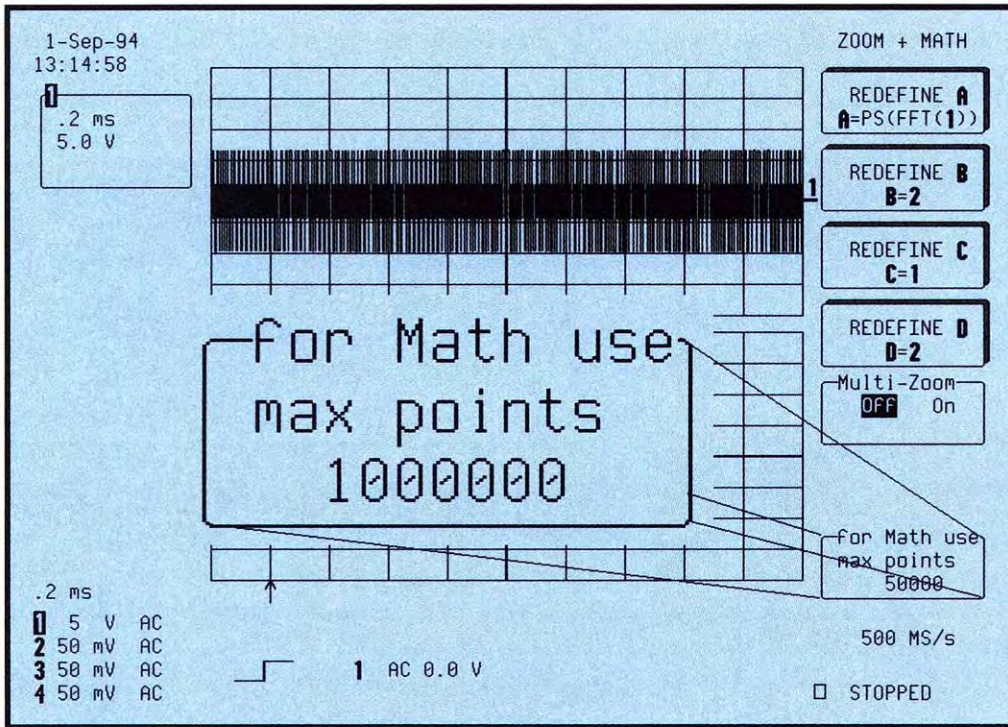
ters operate directly on the histogram. Cursor measurements can also be made directly on histograms.

HISTOGRAM PARAMETERS

The standard 9300 series offers basic parameter statistics (maximum, minimum, average and standard deviation). WPO3 adds 18 Parameters for use directly on the histogram displays. These additional measurements allow detailed analysis of the parameter distributions and can be monitored by the pass/fail system to provide go/no-go testing based on parameter statistics.

Histogram Parameters

Parameter	Abbreviation	Explanation
histogram base	hbase	Horizontal position of left-most statistically significant bin.
histogram top	htop	Horizontal position of right-most statistically significant bin.
histogram amplitude	hampl	Horizontal difference between the htop and hbase values.
histogram rms value	hrms	Root Mean Square value of histogram distribution
sigma	sigma	Standard Deviation of histogram distribution
low	low	Horizontal position of left-most non-zero bin.
high	high	Horizontal position of right-most non-zero bin.
range	range	Horizontal difference between the high and low values.
total population	totp	Total population in the histogram.
maximum population	maxp	Maximum population in any histogram bin (i.e. vertical value at the mode).
peaks	pks	Number of peaks in the distribution.
mode	mode	Horizontal position of the bin with the maximum population.
average	avg	Horizontal mean of the distribution.
median	median	Horizontal median of distribution. The value of the mid-point of the distribution.
full width at half max	fwhm	The width of the distribution around the maximum population bin, including bins which contain at least one half of the maximum population.
full width at x% of max	fwxx	The width of the distribution around the maximum population bin, including bins which are at least x% of the maximum population.
x position at peak	xapk	Horizontal position of the nth largest peak by area.
percentile	pctl	Value in histograms for which % of population is smaller.



EXTENDED PROCESSING

The "No Math on Large Waveforms" message has been consigned to the archives. The MWP option stretches the math processing frontier for the 9300 series. You can now upgrade a 9314AL to average a 1 million point "mega" trace or you can upgrade a 9374L to perform a 6 Mpoint FFT. MWP also extends the capacity of the oscilloscope's internal memories.

SMART MEMORY ALLOCATION

With up to 64MB of system memory, the MWP option dramatically improves the processing power of the machine. And with the smart memory allocation, all of this memory can be dynamically dedicated to one demanding task, an FFT for example, freeing up the memory unused by other traces.

FASTER UPDATE

The high speed processor used in MWP upgrades is the same one installed in the 9350, 9360 and 9370 series. It enhances the processing speed of 9304A, 9310A, 9314A and 9320 scopes to yield an essential improvement in the overall DSO response. The trace update rate is amazingly fast. Also, the data processing functions have never looked so "live", providing the instantaneous response needed when fine-tuning a critical circuit under test.

WHY MORE MEMORY?

The example illustrated in the screenshots on the next page clearly demonstrates the advantage of processing memory for the FFT computation. For a given time window and a given acquired record length, more processing memory dramatically expands the frequency spectrum of an FFT.

"Mega" Waveform Processing (MWP)

Main Features

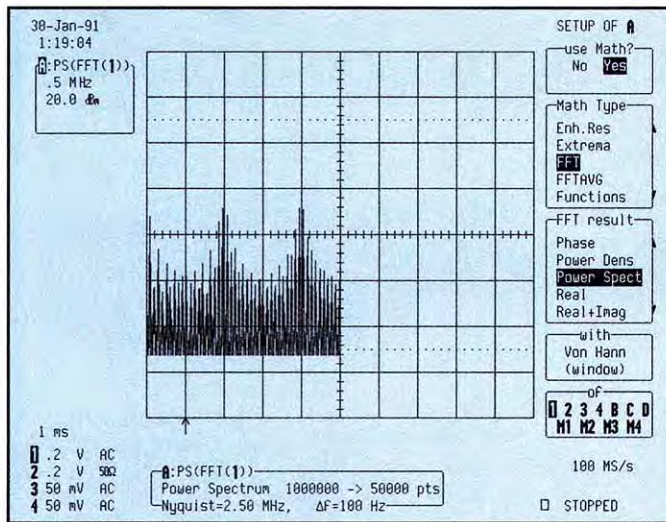
- Up to 64 MBytes of Processing RAM
- High speed processor/coprocessor
- Larger system memory extends math processing capacity on long waveforms.
- Waveforms up to 8 MBytes can be read back into the oscilloscope.
- Improved processing speed.
- System memory is dynamically allocated to traces.

SYSTEM MEMORY

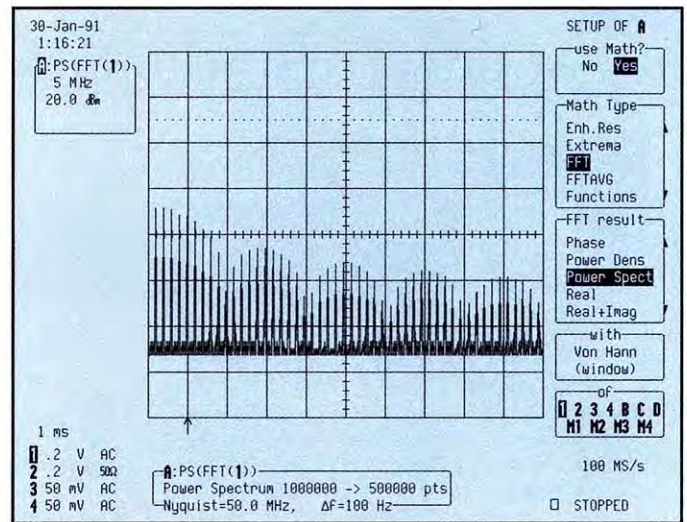
The MWP option increases the standard system memory to 8 MBytes for MWPM and to 16 MBytes for MWPL. Model 930X-64 upgrades memory length to 64 MBytes.

PROCESSOR

The MWP option also upgrades the standard 16 MHz 68020/68881 processor system of a 9304A, 9310A, 9314A or 9320, to a 32 MHz 68EC030/68882 system.



Without MWP option: The FFT processing of a 1 M point record length is limited to 50k; as a result the spectrum is limited to 2.5 MHz.



With MWP option: The same signal processed with a 500kpoint FFT shows a full spectrum of 50 MHz.

Mega Waveform Processing Option		
Task Example	Without MWP	With MWP
Retrieve a 1M waveform saved on a floppy, to the scope	Impossible: requires more than 2MByte of memory	Possible.
Perform an FFT on a 200k waveform	Possible, by limiting the input points, which also limits the resulting FFT bandwidth	Possible without reducing the input points. The FFT spectrum will cover the full bandwidth.
Average 1000-point waveforms at a 100 Hz sweep rate	Impossible for 9304A, 9310A, 9314A or 9320 scopes, the maximum rate is 80 Hz: some events will be missed.	Possible, the maximum rate can actually reach 125 Hz, a 56% improvement!



EXTERNAL CLOCK

This feature allows the 9350A and 9370 series DSOs to be externally clocked at a fixed rate from 50 MS/s to 500 MS/s, enabling full phase control over the acquired signal. The sample rate can be fine-tuned to the exact speed required by the application.

EXTERNAL REFERENCE

The external reference allows the scope to be phase-synchronized to an external 10 MHz reference, either to match the stability of the external source or to phase lock the acquired signal. Several DSOs can then be synchronized using a simple source as reference.

TRIGGER COMPARATOR

The trigger comparator signal outputs a pulse for each valid edge-trigger condition

on the trigger signal. This is an invaluable feature for event-counting and throughput applications.

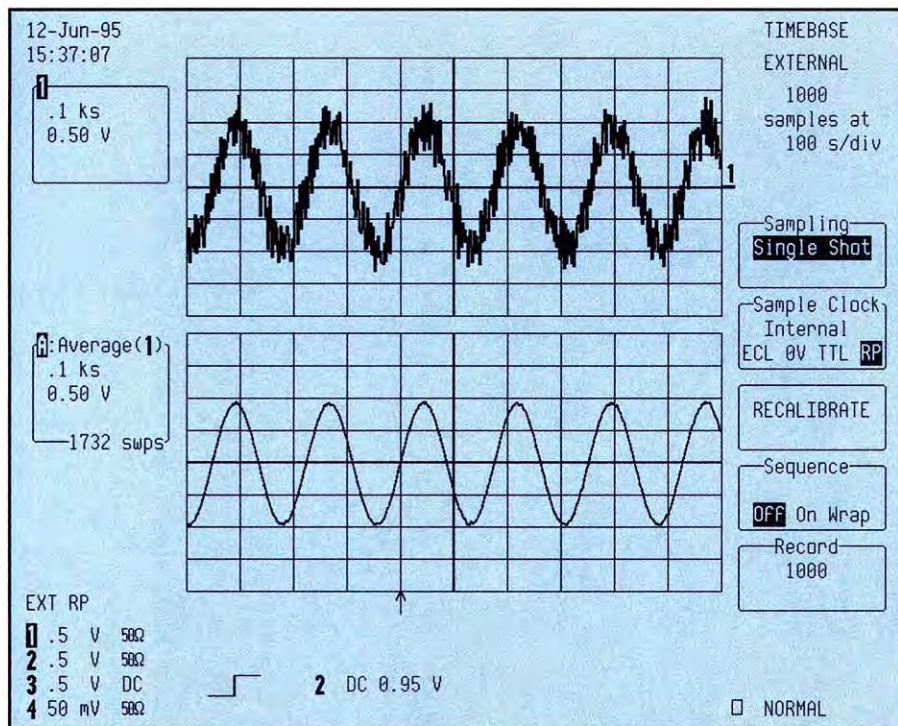
In applications as diverse as capturing radar signals and making advanced measurements on magnetic media using PRML methods, there can be requirements to sample the data at defined frequencies.

The 9350A and 9370 series scopes have the ability to accept a data sampling clock through the front panel at frequencies up to 100 MS/s. This is applied through the BNC connector that is normally used for the external trigger. The CKTRIG option is for those applications requiring a higher speed sample clock (up to 500 MS/s) or where the external trigger input is required for triggering the scope.

CKTRIG Hardware Option for the 9350A and 9370 Series Oscilloscopes

Main Features

- High speed 500 MHz external clock input.
- 10 MHz external clock reference input.
- Edge trigger comparator output.
- BNC, rear-panel mounted connectors.



This figure shows how synchronous sampling can eliminate interfering signals. In the picture above a 455 kHz communications signal with interference and noise is sampled using the Rear Panel ("RP") external sampling clock input available in the CKTRIG option. The top trace shows a single shot of the signal. The interference source has a frequency very near the carrier of the desired signal. The sample clock has been set to be synchronous with the known frequency of the underlying signal. The effects of the noise and interference have been eliminated in the lower trace which is an average of 1732 acquisitions. The measurement is successful because the user was able to set the sampling at a frequency where both the noise and interference would average to zero while the underlying data remained constant.

EXTERNAL CLOCK INPUT

Input signal requirements:

Amplitude: 800 mV p-p

Frequency range: 50 MHz to 500 MHz

Offset: 0 V

Input impedance: 50Ω.

Calibration must be initiated for each external clock change.

The negative pulse width must be less than 5ns. (2ns recommended)

Swept Clock: Only a fixed frequency external clock is supported. Swept clocks will cause substantial offset errors (10% worst-case).

External Clock Reference Input

Signal Requirements:

Amplitude: 800 mV p-p

Frequency range: 10 MHz \pm 5%

Offset: 0 V

Input impedance: 50Ω.

TRIGGER COMPARATOR OUTPUT

The comparator operates in a 'time-over-threshold' mode and generates a pulse edge of the same polarity as the polarity of the selected triggering edge each time a valid EDGE TRIGGER condition is met on the trigger signal. The duration of the pulse will be equal to the time the trigger signal is above/below the trigger level.

Note: This feature does not operate in SMART TRIGGER mode.

Output signal characteristics: ECL, 50Ω, series-terminated.

LeCroy DSO Model Number	Max Transient Sample Rate	Max Repetitive Sample Rate	Analog BW (Minimum)	Number of Channels	Memory per Channel	Processing RAM	See Page #
Medium Performance Scopes							
9304A	100 MS/s	10 GS/s	200 MHz	4	50k	2M	15
9304AM	100 MS/s	10 GS/s	200 MHz	4	200k	2M	15
9310A	100 MS/s	10 GS/s	400 MHz	2	50k	2M	19
9310AM	100 MS/s	10 GS/s	400 MHz	2	200k	2M	19
9310AL	100 MS/s	10 GS/s	400 MHz	2	1M	2M	19
9314A	100 MS/s	10 GS/s	400 MHz	4	50k	2M	19
9314AM	100 MS/s	10 GS/s	400 MHz	4	200k	2M	19
9314AL	100 MS/s	10 GS/s	400 MHz	4	1M	2M	19
High Performance Scopes							
9350A	1 GS/s	10 GS/s	500 MHz	2	25k/2 Ch 50k/1 Ch	4M	27
9350AM	1 GS/s	10 GS/s	500 MHz	2	100k/2 Ch 250k/1 Ch	8M	27
9350AL	1 GS/s	10 GS/s	500 MHz	2	2M/2 Ch 4M/1 Ch	16M	27
9354A	2 GS/s	10 GS/s	500 MHz	4	25k/4 Ch 50k/2 Ch 100k/1 Ch	4M	27
9354AM	2 GS/s	10 GS/s	500 MHz	4	100k/4 Ch 250k/2 Ch 500k/1 Ch	8M	27
9354TM	2 GS/s	10 GS/s	500 MHz	4	500k/4 Ch 1M/2 Ch 2M/1 Ch	8M	27
9354AL	2 GS/s	10 GS/s	500 MHz	4	2M/4 Ch 4M/2 Ch 8M/1 Ch	16M	27
9370	2 GS/s	10 GS/s	1 GHz	2	25k/2 Ch 50k/1 Ch	4M	35
9370M	2 GS/s	10 GS/s	1 GHz	2	100k/2 Ch 250k/1 Ch	8M	35
9370L	2 GS/s	10 GS/s	1 GHz	2	2M/2 Ch 4M/1 Ch	16M	35
9374	2 GS/s	10 GS/s	1 GHz	4	25k/4 Ch 50k/2 Ch 100k/1 Ch	4M	35
9374M	2 GS/s	10 GS/s	1 GHz	4	100k/4 Ch 250k/2 Ch 500k/1 Ch	8M	35
9374L	2 GS/s	10 GS/s	1 GHz	4	2M/4 Ch 4M/2 Ch 8M/1 Ch	16M	35
Specialty Application Scopes							
9320	20 MS/s	20 GS/s	1 GHz	2	5k	2M	23
9324	20 MS/s	20 GS/s	1 GHz	4	5k	2M	23
9361	2.5 GS/s	N/A	300 MHz	2	500 - 25k	100k	31
9362	10 GS/s	10 GS/s	1.5 GHz	2	500 - 25k	100k	31

9300 Series

Model #	9300 Series Digital Oscilloscopes	U.S. \$
9304A	4 Ch 200 MHz 100 MS/s Scope 50k Memory/Ch	5,990
9304AM	4 Ch 200 MHz 100 MS/s Scope 200k Memory/Ch	6,990
9310A	2 Ch 400 MHz 100 MS/s Scope 50k Memory/Ch	4,990
9310AM	2 Ch 400 MHz 100 MS/s Scope 200k Memory/Ch	5,990
9310AL	2 Ch 400 MHz 100 MS/s Scope 1Meg Memory/Ch	10,490
9314A	4 Ch 400 MHz 100 MS/s Scope 50k Memory/Ch	7,860
9314AM	4 Ch 400 MHz 100 MS/s Scope 200k Memory/Ch	9,440
9314AL	4 Ch 400 MHz 100 MS/s Scope 1Meg Memory/Ch	15,740
9320	2 Ch 1 GHz 20 GS/s Scope Sampling Scope	7,490
9324	4 Ch 1 GHz 20 GS/s Scope Sampling Scope	11,490
9350A	2 Ch 500 MHz 500 MS/s 50k Memory/Ch Scope 1 GS/s 100k Memory/1Ch	9,990
9350AM	2 Ch 500 MHz 500 MS/s 250k Memory/Ch Scope 1 GS/s 500k Memory/1 Ch	11,490
9350AL	2 Ch 500 MHz 500 MS/s 2 Meg Memory/Ch Scope 1 GS/s 4Meg Memory/1 Ch	16,490
9354A	4 Ch 500 MHz 500 MS/s 50k Memory/Ch Scope 2 GS/s 200k Memory/1 Ch	13,490
9354AM	4 Ch 500 MHz 500 MS/s 250k Memory/Ch Scope 2 GS/s 1Meg Memory/1 Ch	16,490
9354AL	4 Ch 500 MHz 500 MS/s 2 Meg Memory/Ch Scope 2 GS/s 8Meg Memory/1 Ch	24,490
9354TM	4 Ch 500 MHz 500 MS/s 500k Memory/Ch Scope 2 GS/s 2Meg Memory/1 Ch includes WP01/02/FDGP	19,990
9361	2 Ch 300 MHz 2.5 GS/s Scope 500 to 25k Memory/Ch	8,990
9362	2 Ch 1.5 GHz 10 GS/s Scope 500 to 25k Memory/Ch	14,990
9370	2 Ch 1 GHz 500 MS/s 50k Memory/Ch Scope 1 GS/s 100k Memory/1 Ch	11,490
9370M	2 Ch 1 GHz 500 MS/s 250k Memory/Ch Scope 1 GS/s 500k Memory/1 Ch	12,990
9370L	2 Ch 1 GHz 500 MS/s 2 Meg Memory/Ch Scope 1 GS/s 4 Meg Memory/1 Ch	17,990
9374	4 Ch 1 GHz 500 MS/s 50k Memory/Ch Scope 2 GS/s 200k Memory/1 Ch	16,490
9374M	4 Ch 1 GHz 500 MS/s 250k Memory/Ch Scope 2 GS/s 1 Meg Memory/1 Ch	19,490
9374L	4 Ch 1 GHz 500 MS/s 2 Meg Memory/Ch Scope 2 GS/s 8 Meg Memory/1 Ch	27,490

VISA AND MASTER CARD ACCEPTED

9300 Series

Options

		U.S. \$
9304-SM	9304 Service Manual, Covers 9304 and 9304M	125
9304A-SM	9304A Service Manual Covers 9304A and 9304AM	125
9300-OEMKIT	OEM Kits are available for 9300 series scopes	consult factory
9310-SM	9310 Service Manual, Covers 9310/M/L	125
9310A-SM	9310 Service Manual, Covers 9310A/M/L	125
9314-SM	9314 Service Manual, Covers 9314/M/L	125
9314A-SM	9314A Service Manual Covers 9314A/M/L	125
931X-OM	Operator's and Programmer's Manual Included with 9304/9310/9314	85
932X-OM	9320 & 9324 Operator's Manual Included with 9320 and 9324	85
9320-SM	9320 Service Manual	125
9324-SM	9324 Service Manual	125
9350-SM	Service Manual, Covers 9350/M/L	125
9354-SM	Service Manual, Covers 9354/M/L	125
935X-OM	9350 Series Operator's Manual, Included with 9350/9354	85
935XA-CKTRIG	935XA Series External Clock, Ref Clock Includes trigger comparator output	490
9360-OM	9360 Operator's Manual, Included with 9360 and 9361	85
9360-SM	9360 Service Manual, Covers 9360 and 9361	125
93XXC2	Choice of any two of WP01, WP02, WP03 or PRML	1,875
93XXC3	Choice of any three of WP01, WP02, WP03 or PRML	2,490
93XX-DA01	Type III Adapter for Computer	360
93XX-DDM	Disk Drive Measurement Package	3,000
93XX-FD01	Floppy Disk Option	590
93XX-FDGP	Graphic Printer & Floppy Disk Options	1,190
93XX-GP01	Graphic Printer Option	890
93XX-HDD	Type III PCMCIA Slot w/130 MByte Hard Drive	990
93XX-HD01	Type III PCMCIA Slot	590
93XX-HD02	130 MByte PCMCIA Hard Drive	499
93XX-MC01/04	Memory Card Reader w/512k Card, For 9300 Series	500
93XX-MWPL	32 MHz 68030/68882 w/16 MByte RAM	1,490
93XX-MWPM	32 MHz 68030/68882 w/8 MByte RAM	990
93XX-PRML	PRML Analysis Package	1,250
93XX-TP	Total Performance Package for 9300 Series Includes WP01/02 and FD01	2,000
93XX-VP1	Includes WP01/02 and DDM Analysis	3,850
93XX-VP2	Includes WP01/02, DDM and PRML Analysis	4,725
93XX-VP3	Includes DDM Package and PRML Analysis	3,187
93XXWP01	9300 Series Waveform Processing, Advanced Math Option	1,250
93XXWP01/02	9300 Series Waveform Math/FFT	1,875
93XXWP02	9300 Series Spectrum Analysis, FFT Option	1,250
93XXWP03	9300 Series Histogram Analysis, Parameter Analysis Option	1,250

1-800-5-LECROY

9300 Series Ordering Information

1-800-5-LECROY

9300 Series

		U.S. \$
Accessories		
93XX-FC	Protective Front Cover 9300 Series	50
93XX-FD-TC1	Telecom Templates On 3.5" Floppy Disk	350
93XX-GPR10	Graphic Printer Paper/10 Rolls	100
93XX-MC02	128k Memory Card for 9300 Series	175
93XX-MC04	512k Memory Card for 9300 Series	330
93XX-MC-TC1	Telecom Templates On 512k SRAM card	700
93XX-RM01	Rackmount Adaptor for 9300 Series Scope	100
93XX-TC1	Hard Carrying Case for 9300 Series Scope	570
93XX-TC2	Soft Carrying Case for 9300 Series Scope	225
94XX-MC02	128k Memory Card	175
94XX-MC04	512k Memory Card	330
94XX-MC-TC1	Memory Card Telecom Template	700
LS-RM	Rackmount Adapter for LS140	340
LS-RS232/PLOT	RS232 Cable LS140 to Printer/Plotter Connects LS140 to DTE device	50
LS-RS232/REM	RS232 Cable LS140 to IBM AT Computer 9 Pin Female to 9 Pin Female Connector	80
LS-SOFT	Soft Carrying Case for an LS140	199
LS-TRANS	Transit Case for LS140	570
OC9002	Oscilloscope Cart for 9300, 9400 and LS140 Series Compatible with FD/GP Option for 9300	555
OC9003	Oscilloscope Cart with Drawer and Printer Shelf	795
RM9400-SERIES	Scope Rackmount Adapter 9400 Series - with front panel switch	690
SG9001	Overload Protector for High Voltage	120
TC9001	Hard Carrying Case for 9400 Series Scope	660
TC9002	Soft Carrying Case for 9400 Series Scope	270
9300 Series Portable Digital Scope Probes		
AP020	1 GHz Active FET Probe (10:1) With ProBus connector	990*
AP021	800 MHz Active FET Probe (5:1) With ProBus connector	990*
AP030	15 MHz Differential Probe (10x, 100x)	300*
AP082	SDH:STM-1E Trigger Pickoff Includes 93XX-FD-TC1	990*
AP083	SONNET:STS-3 Trigger Pickoff Includes 93XX-FD-TC1	990*
AP1143A	Probe Offset/Power for AP54701A	1,701**
AP54701A	2.5 GHz Active FET Probe (10:1) Requires AP1143A Power Supply	3,194**
D9010	10:1 High Impedance Divider	160
D9011	10:1/1:1 High Impedance Divider	160
D9012	Divider 1:10 1 M Ω	165
D9013	Divider 1:10 1 M Ω	165
P9010	10:1 Scope Probe Coline Probe	65
P9010/2	10:1 Scope Probe Length 2 m Coline Probe	80
P9011	10:1/1:1 Probe for 9400 Series Coline Probe	80
P9100	100:1 Probe for 9400 Series Coline Probe	80

VISA AND MASTER CARD ACCEPTED

* 30% discount when purchased with an oscilloscope

** 28% discount when purchased with an oscilloscope

9300 Series

		U.S. \$
PMM502	Passive Probe 500 MHz fine pitch MiniProbe x10 with sense ring	300
PP002	10:1 350 MHz 1 MΩ Passive Probe	80
PP012	100:1 300 MHz 1MΩ Passive Probe	95
PP062	10:1 1 GHz 500Ω Passive Probe	95
PP064	100:1 1 GHz 500Ω Passive Probe	95
SI9000	15 MHz Differential Probe x20/x200	300
SI9000A	15 MHz Differential Probe x50/x500	300

Warranties & Calibrations

93XX-C5	5 NIST Calibrations on any 9300 Series Scope	650
93XX-CC	NIST Calibration Certificate on any 9300 Series Scope At time of purchase	175
93XX-CM5	5 MILSTD Calibrations on any 9300 Series Scope MILSTD 45662A Calibration	1050
93XX-EW	1 Year Extended Warranty on any 9300 Series Scope Includes NIST Calibration	550
93XX-MIL	MILSTD 45662A Calibration on any 9300 Series Scope	275
93XX-T5	5 Year Warranty & NIST Cal on any 9300 Series Scope	975
93XX-W5	5 Year Repair Warranty on any 9300 Series Scope	545
94XX-CC	NIST Calibration on any 9400 Series Scope At time of purchase	275
94XXC5	5 NIST Calibrations on any 9400 Series Scope	795
94XXCM5	5 MILSTD Calibrations on any 9400 Series Scope MILSTD 45662A Calibration	1,295
94XX-EW	1 Year Extended Warranty Includes NIST Calibration	550

1-800-5-LECROY

9300 Series Ordering Information

Ordering Information

9300 Series Upgrade Path

If you own an older 9300 series scope than the ones shown on earlier pages of this catalog you can upgrade it to the newest performance levels. LeCroy is the only scope company that lets you upgrade your scope to keep up with technology.

