LECROY

WAVESURFER® XS SERIES

OSCILLOSCOPES

GETTING STARTED MANUAL

SEPTEMBER 2006

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Manufactured under an ISO 9000 Registered Quality Management System Visit www.lecroy.com to view the certificate.

This electronic product is subject to disposal and recycling regulations that vary by country and region. Many countries prohibit the disposal of waste electronic equipment in standard waste receptacles.
For more information about proper disposal and recycling of your LeCroy product, please visit www.lecroy.com/recycle.

WSXs-GS-E Rev B

914514-00 Rev A

WaveSurfer Xs Series

WaveSurfer Xs Series

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INTRODUCTION

This brief guide includes important safety and installation information for your WaveSurfer Xs Series oscilloscope along with brief operating procedures to get you started with the basics of operating your oscilloscope.

You can change your user interface to be in a language different from English. To do this, select **Utilities** from the menu bar at the top of the screen, then select **Preferences. Language** selection is settable in this dialog.

WaveSurfer Xs Series

SAFETY REQUIREMENTS

This section contains information and warnings that must be observed to keep the instrument operating in a correct and safe condition. You are required to follow generally accepted safety procedures in addition to the safety precautions specified in this section.

Safety Symbols and Terms

Where the following symbols or terms appear on the instrument's front or rear panels, or in this manual, they alert you to important safety considerations.

This symbol is used where caution is required. Refer to the accompanying information or documents in order to protect against personal injury or damage to the instrument.

This symbol warns of a potential risk of shock hazard.

This symbol is used to denote the measurement ground connection.

This symbol is used to denote a safety ground connection.

This symbol shows that the switch is a On/Standby switch. When it is pressed, the scope's state toggles between Operating and Standby state. This switch is not a disconnect device. To completely remove power to the scope, the power cord must be unplugged from the AC outlet after the scope is placed in Standby state.

This symbol is used to denote "Alternating Current."

CAUTION The CAUTION sign indicates a potential hazard. It calls attention to a procedure, practice or condition which, if not followed, could possibly cause damage to equipment. If a CAUTION is indicated, do not proceed until its conditions are fully understood and met.

WARNING The WARNING sign indicates a potential hazard. It calls attention to a procedure, practice or condition which, if not followed, could possibly cause bodily injury or death. If a WARNING is indicated, do not proceed until its conditions are fully understood and met.

CAT I Installation (Overvoltage) Category rating per EN 61010-1 safety standard and is applicable for the oscilloscope front panel measuring terminals. CAT I rated terminals must only be connected to source circuits in which measures are taken to limit transient voltages to an appropriately low level.

Operating Environment

The instrument is intended for indoor use and should be operated in a clean, dry environment. Before using this product, ensure that its operating environment will be maintained within these parameters:

Temperature: 5 to 40 °C

Humidity: Maximum relative humidity 80% for temperatures up to 31 °C decreasing linearly to 50% relative humidity at 40 °C.

Altitude: Up to 2,000 m

Note: Direct sunlight, radiators, and other heat sources should be taken into account when assessing the ambient temperature.

The design of the instrument has been verified to conform to EN 61010-1 safety standard per the following limits:

Installation (Overvoltage) Categories II (Mains Supply Connector) & I (Measuring Terminals)

Pollution Degree 2

Protection Class I

Note:
Installation (Overvoltage) Category II refers to local distribution level, which is applicable to equipment connected to the mains supply (AC power source).

Installation (Overvoltage) Category I refers to signal level, which is applicable to equipment measuring terminals that are connected to source circuits in which measures are taken to limit transient voltages to an appropriately low level.

Pollution Degree 2 refers to an operating environment where normally only dry non-conductive pollution occurs. Occasionally a temporary

⚠ WARNING

The DSO must not be operated in explosive, dusty, or wet/damp atmospheres.

⚠ CAUTION

Protect the DSO's display touch screen from excessive impacts with foreign objects.

⚠ CAUTION

Do not exceed the maximum specified front panel terminal (CH1, CH2, CH3, CH4, EXT) voltage levels. Refer to Specifications for more details.

⚠ CAUTION

Do not connect or disconnect probes or test leads while they are connected to a voltage source.

conductivity caused by condensation must be expected.

Protection Class 1 refers to a grounded equipment, in which protection against electric shock is achieved by Basic Insulation and by means of a connection to the protective ground conductor in the building wiring.

Cooling Requirements

The instrument relies on forced air cooling with internal fans and ventilation openings. Care must be taken to avoid restricting the airflow around the apertures (fan holes) at the sides and front of the scope. To ensure adequate ventilation it is required to leave a 15 cm (6 inch) minimum gap around the sides, front, and rear of the instrument.

⚠️ **CAUTION**

Do not block the ventilation holes located on both sides and rear of the DSO.

⚠️ **CAUTION**

Do not allow any foreign matter to enter the DSO through the ventilation holes, etc.

AC Power Source

The instrument operates from a single-phase, 100 to 240 V_{rms} (+/-10%) AC power source at 50/60 Hz (+/-5%), or single-phase 100 to 120 V_{rms} (+/-10%) AC power source at 400 Hz (+/-5%).

No manual voltage selection is required because the instrument automatically adapts to line voltage.

Depending on the accessories installed (front panel probes, PC port plug-ins, etc.), the instrument can draw up to 300 W (300 VA).

1 GHz and 2 GHz models: 340 W (340 VA)

Note:

The instrument automatically adapts itself to the AC line input within the following ranges:

Voltage Range:	90 to 264 Vrms	90 to 132 Vrms
Frequency Range:	47 to 63 Hz	380 to 420 Hz

Power and Ground Connections

The instrument is provided with a grounded cord set containing a molded three-terminal polarized plug and a standard IEC320 (Type C13) connector for making line voltage and safety ground connection. The AC inlet ground terminal is connected directly to the frame of the instrument. For adequate protection against electrical shock hazard, the power cord plug must be inserted into a mating AC outlet containing a safety ground contact. Use only the power cord specified for this instrument and certified for the country of use.

The scope should be positioned to allow easy access to the socket-outlet. To completely remove power to the scope, unplug the instrument's power cord from the AC outlet.

It is recommended that the power cord be unplugged from the AC outlet if the scope is not to be used for an extended period of time.

WARNING

Electrical Shock Hazard!

Any interruption of the protective conductor inside or outside of the DSO, or disconnection of the safety ground terminal creates a hazardous situation.

Intentional interruption is prohibited.

CAUTION

The outer shells of the front panel terminals (CH1, CH2, CH3, CH4, EXT) are connected to the instrument's chassis and therefore to the safety ground.

Calibration

The recommended calibration interval is one year. Calibration should be performed by qualified personnel only.

Cleaning

Clean only the exterior of the instrument, using a damp, soft cloth. Do not use chemicals or abrasive elements. Under no circumstances allow moisture to penetrate the instrument. To avoid electrical shock, unplug the power cord from the AC outlet before cleaning.

WARNING

Electrical Shock Hazard!

No operator serviceable parts inside. Do not remove covers.

Refer servicing to qualified personnel.

Abnormal Conditions

Operate the instrument only as intended by the manufacturer.

If you suspect the DSO's protection has been impaired, disconnect the power cord and secure the instrument against any unintended operation.

The DSO's protection is likely to be impaired if, for example, the instrument shows visible damage or has been subjected to severe transport stresses.

Proper use of the instrument depends on careful reading of all instructions and labels.

⚠ **WARNING**

Any use of the DSO in a manner not specified by the manufacturer may impair the instrument's safety protection. The instrument and related accessories should not be directly connected to human subjects or used for patient monitoring.

Virus Protection

Because your scope runs on a Windows-based PC platform, it must be protected from viruses, as with any PC on a corporate network. It is crucial that the scope be kept up to date with Windows Critical Updates, and that anti-virus software be installed and continually updated.

Visit www.lecroy.com/dsosecurity for more information regarding Windows Service Pack compatibility with LeCroy operating software, and related matters.

WHEN YOUR SCOPE IS DELIVERED

Check that You Have Everything

First, verify that all items on the packing list or invoice copy have been shipped to you. Contact your nearest LeCroy customer service center or national distributor if anything is missing or damaged. If there is something missing or damaged, and you do not contact us immediately, we cannot be responsible for replacement.

THE WARRANTY BELOW REPLACES ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS, OR ADEQUACY FOR ANY PARTICULAR PURPOSE OR USE. LECROY SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT OR OTHERWISE. THE CUSTOMER IS RESPONSIBLE FOR THE TRANSPORTATION AND INSURANCE CHARGES FOR THE RETURN OF PRODUCTS TO THE SERVICE FACILITY. LECROY WILL RETURN ALL PRODUCTS UNDER WARRANTY WITH TRANSPORT PREPAID.

Warranty

The oscilloscope is warranted for normal use and operation, within specifications, for a period of three years from shipment. LeCroy will either repair or, at our option, replace any product returned to one of our authorized service centers within this period. However, in order to do this we must first examine the product and find that it is defective due to workmanship or materials and not due to misuse, neglect, accident, or abnormal conditions or operation.

LeCroy shall not be responsible for any defect, damage, or failure caused by any of the following: a) attempted repairs or installations by personnel other than LeCroy representatives or b) improper connection to incompatible equipment, or c) for any damage or malfunction caused by the use of non-LeCroy supplies. Furthermore, LeCroy shall not be obligated to service a product that has been modified or integrated where the modification or integration increases the task duration or difficulty of servicing the oscilloscope. Spare and replacement parts, and repairs, all have a 90-day warranty.

The oscilloscope's firmware has been thoroughly tested and is presumed to be functional. Nevertheless, it is supplied without warranty of any kind covering detailed performance. Products not made by LeCroy are covered solely by the warranty of the original equipment manufacturer.

Maintenance Agreements

We offer a variety of services under the heading of Maintenance Agreements. These give extended warranty and allow you to budget maintenance costs after the initial three-year warranty has expired. Installation, training, enhancements, and on-site repairs, among other services, are available through special supplemental support agreements. Inquire at your LeCroy customer service center or national distributor.

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Windows® License Agreement

LeCroy's agreement with Microsoft prohibits users from running software on LeCroy oscilloscopes that is not relevant to measuring, analyzing, or documenting waveforms.

End-user License Agreement For LeCroy® X-Stream Software

The software in this product is made available under license from LeCroy Corporation. For full details of the End User License Agreement, please refer to the Copyright section in the on-line Help.

INSTALLATION AND POWER UP

Power Up

Press the power switch at bottom-left of the front of the scope to apply or remove power.

Software

You can find out the scope's software and hardware configuration as follows:

1. In the tool bar, touch **Utilities**.

2. In the dialog area, touch **Status**.

Adding a New Option

To add a software option you will need a code to enable the option. Call LeCroy Customer Support to place an order and receive the code.

Restoring Software

Restarting the Application

Upon initial power-up, the scope will load the instrument application software automatically.

- If you exit the application and want to reload it, touch the shortcut icon on the desktop:

- If you minimize the application, touch the appropriate task bar or desktop button to maximize it:

PROBES

The PP009 supplied with your WaveSurfer Xs scope is calibrated for the WaveSurfer XS scope's input impedance. If you use other passive probes with your WaveSurfer Xs scope, you should make sure that you calibrate them using the 1 kHz square wave signal available on the AUX OUT terminal before using them for signal measurements.

LeCroy offers a variety of other passive and active probes for use with your WaveSurfer Xs Series scope. Visit www.lecroy.com for specifications and ordering information.

Current Probes	Available from 15 A to 500 A.
Active Probes	Single-ended to >1 GHz.
Differential Probes	Differential from 15 MHz to >1 GHz.
Passive Probes	The PP009 is the passive probe that guarantees full instrument bandwidth at the probe tip. Other passive probes can be used with performance limitations.
High Voltage Probes	For measuring up to 20 kV.

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USING THE FRONT PANEL CONTROLS
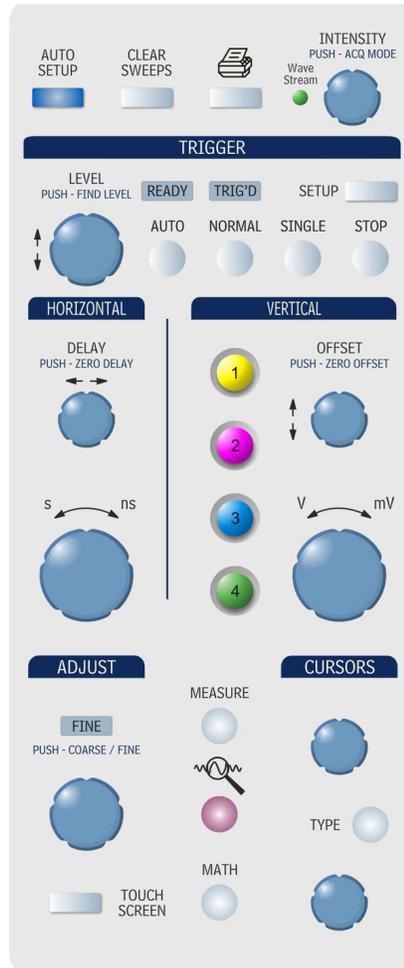
The WaveSurfer Xs scope's front panel is designed to allow you to operate basic oscilloscope functions without having to open software dialogs. Use the Horizontal and Vertical controls as you would for any other oscilloscope. The various controls are described below.

Vertical Controls
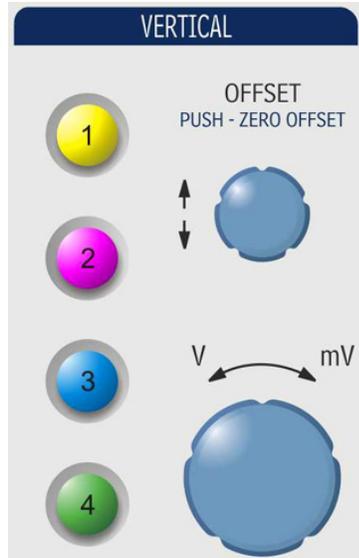
Vertical Controls are multiplexed for each channel. The lighted channel button indicates which channel the controls are *active* for.

- To turn a channel ON, simply press the channel button.

- To make a channel *active*, simply press the channel button again.

To turn a channel OFF, press the channel button to make it active, then press it again to turn it OFF

When a channel is active, its descriptor label changes appearance.
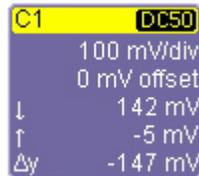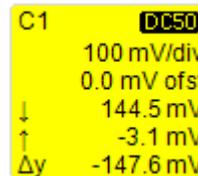
Inactive Channel   *Active Channel*

When a channel is turned OFF, the next channel in sequence becomes the active channel.

If no front panel channel buttons are lit, it means either that no channels are turned ON, or that a Math, Zoom, or Memory trace is active. In that case, the vertical offset and sensitivity knobs adjust the vertical position and vertical scale of the Math, Zoom, or Memory (Reference Waveform) trace.

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Horizontal Controls
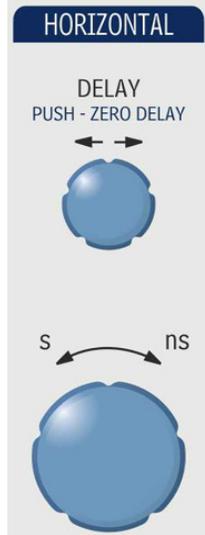
Set up the timebase by using the front panel **Horizontal** controls, just as for analog scopes. The WaveSurfer Xs scope will allocate memory as needed to maintain the highest sample rate possible for the timebase setting.

Acquisition Mode

The WaveSurfer Xs scope can acquire in either Real-Time (up to 2.5 GS/s), Random Interleaved Sampling (RIS, up to 50 GS/s), or Roll mode (up to 100 kS/s).

At certain very low time/division settings, the oscilloscope will default to RIS mode of operation to maintain the highest sample rate.

At certain very high time/division settings, the oscilloscope will default to Roll mode of operation so that display of the signal on the screen is not delayed by the long acquisition time. Maximum sample rate in Roll mode of operation is 100 kS/s.

Trigger Controls

STOP	Cancels the capture in Auto, Normal, or Single trigger mode
AUTO	Triggers the scope after a time-out, even if the trigger conditions are not met.
NORMAL	Triggers the scope each time a signal is present that meets the conditions set for the type of trigger selected.
SINGLE	Arms the scope to trigger once (single-shot acquisition) when the input signal meets the trigger conditions set for the type of trigger selected. If the scope is already armed, it will force a trigger.
SETUP	Displays the Trigger setup screen.

AutoSetup Button
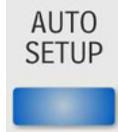
Automatically sets timebase, trigger, and sensitivity to display a wide range of repetitive signals.

Measure, Zoom, and Math Quick Buttons
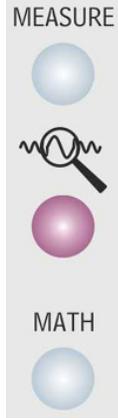
Measure – Press once to open the measure dialog. Press again to close the dialog.

QuickZoom ( ) – Press once to create zooms of all displayed channels. Press again to unzoom.

Math – Press once to turn on the Math trace, and display the Math Setup dialog. Press again to close the dialog.

Cursor Knobs and Buttons
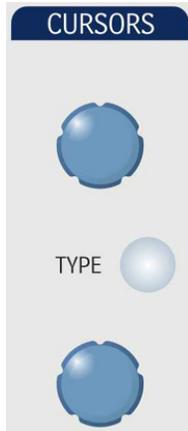
The WaveSurfer Xs scope has dedicated dual cursor knobs for cursor control. Cursors always default to a "relative" state (two cursors ON).

- Knobs – Rotate to adjust cursor position. If Cursors are OFF, rotating either knob will turn Cursors ON. Push to set to the default position.
- Type Button – Pressing the Type button once will turn Cursors ON to Horizontal (Time) measurements. Pressing again will change to Vertical (Amplitude) measurements. Pressing a third time will turn Cursors OFF.

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Adjust Knob
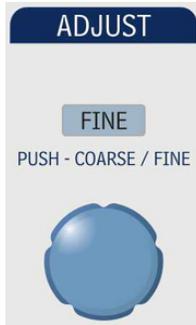
The adjust knob can be used to make adjustments to a value when a dialog is open and the selected control has a yellow highlight.

Push the knob in to toggle between coarse and fine adjustments.

Print Button

This button can be programmed to print the displayed screen to a file, a printer, or the clipboard; or to send it as an e-mail attachment. Select the device and format it in the Utilities Hardcopy dialog.

Clear Sweeps

Clears data from multiple sweeps (acquisitions) including: persistence displays, parameter (measurement) statistics, and averaged traces.

Touch Screen

The Touch Screen lighted pushbutton indicates if the oscilloscope touch screen is operational. If the button is lighted, the touch screen is ON. If the button is not lighted, the touch screen is turned OFF. The button toggles between these two states.

Intensity/Acquisition Mode

The **INTENSITY** knob adjusts the brightness of your trace. Pushing the button toggles between WaveStream fast-viewing mode (indicator lamp on) and real-time mode (lamp off).

UNDERSTANDING DISPLAY INFORMATION

The WaveSurfer Xs scope's display contains valuable information about the current settings of your Vertical (channel), Horizontal (Timebase), and Trigger controls. In addition, there are many shortcuts that are available by using the touch screen capability of your display to quickly access information or to open dialogs.
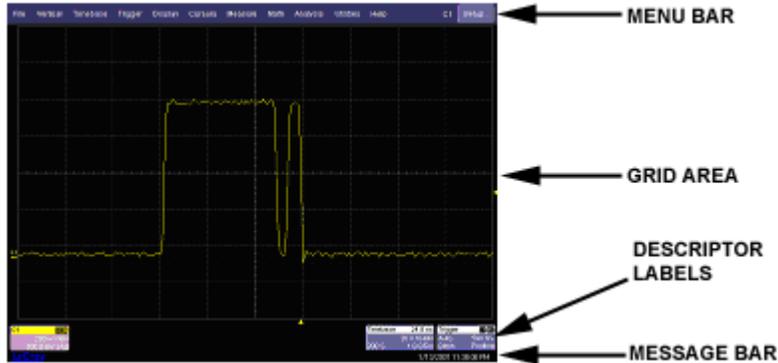
Top Menu Bar ("File" Menu)

The top menu bar provides access to various software dialogs. It is very similar to the "File" menu on any Windows program. For common oscilloscope operations, you will not need to use the top menu bar, since you can access most dialogs from the Front Panel or from the Descriptor Labels. However, it is the only way to access setup or other dialogs for the following:

- Display Setup
- Save or Recall Waveform
- Save or Recall Setups
- Print Setup
- Vertical (Channel), Horizontal, or Trigger Status
- Memory (Reference Waveform) Setup
- Pass/Fail Setup
- Utilities and Preferences Setup
- Help Access

At the right-hand end of the top menu bar is an Undo button . This button will appear after the AutoSetup front panel button is pressed, and after Zooming is performed. If you want to perform an Undo operation, it must be the very next operation after you perform the Autosetup or Zoom operation.

Grid Area

The grid area is divided into 8 vertical divisions and 10 horizontal divisions, just like any other oscilloscope. There are several indicators on the grid to help you understand the following:

- Trigger Delay setting

- Trigger Level Setting

- Trace Zero Level

These indicators are color-coded to the same color as the channel that the oscilloscope is currently set to trigger on.

Trigger Delay Indicator
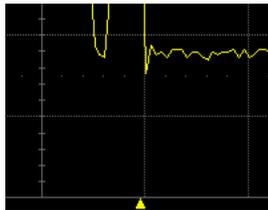
The trigger delay Indicator is a color-coded triangle that is positioned horizontally on the grid.

Trigger delay horizontally positions the scope trace on the display so you can observe the signal prior to the trigger time. It adjusts the pre- and post-trigger time.

Post-trigger delay is indicated by a color-coded arrow pointing to the left.
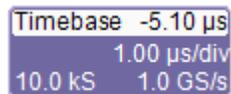
All trigger delay values (including post-trigger delay, shown here) are displayed in the timebase descriptor label.

Trigger Level Indicator

The trigger level Indicator is a color-coded triangle that is positioned vertically on the grid.

In Stop trigger mode, the solid triangle will also appear with a hollow triangle of the same color if the level is changed at that time. The hollow triangle indicates what the trigger level will be for the next valid trigger.

The trigger level indicator will not be displayed if the triggering channel is not displayed.

Zero Level Indicator
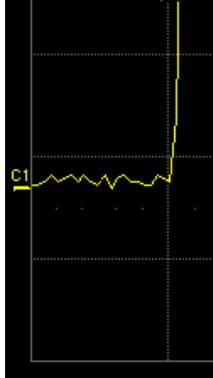
The zero volts level indicator is a color-coded label that is positioned vertically on the grid.

To change the zero level, use the front panel **OFFSET** knob in the VERTICAL control area. Rotate this knob to adjust, or push to set to zero volts. Push again to toggle back to the previous offset setting.

Descriptor Labels

Information is contained in rectangular boxes called descriptor labels. These labels contain status information, and also act as shortcuts to the full dialog when you touch them. Channel descriptor labels are displayed only for channels that are turned on. Timebase and trigger descriptor labels are always displayed.
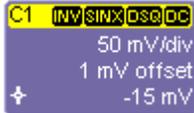
Channel trace labels show the vertical settings for the signal. The title bar (colored area) of the label shows the channel number on the far left. Other information will be indicated in the title bar, as follows:

- Coupling (AC 1MΩ, DC 1MΩ, DC 50Ω, GND)
- Deskew (DSQ) set to non-zero value
- Bandwidth Limiting (BWL) ON
- Averaging (AVG) ON
- Interpolation
- Inversion
- Probe attenuation
- Enhanced Resolution (ERES) ON

Some of these indicators may be abbreviated if several are on at one time.

Touch a channel descriptor label once to make the front panel vertical controls active for that channel. Touch it again to open the software dialog for further adjustment.

If cursors are ON, cursor information for this channel will appear in this trace label.
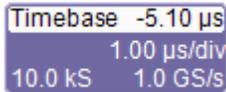
The title bar of the **TimeBase** (Horizontal) label shows the trigger delay setting at the far right. Time per division, sample rate, and number of samples are indicated below the title bar.

Touch the timebase descriptor label once to open the software dialog for further adjustment.
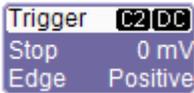
The title bar of the **Trigger** label shows the triggered channel and the trigger coupling at the far right. Trigger mode (Stopped), trigger type (Edge), level (0 mV), and slope (Positive) are indicated below the title bar.

Touch the trigger descriptor label once to open the software dialog for further adjustment.

Descriptor labels are also displayed for the math trace, zoom traces, and memory (reference waveform) traces. These descriptor labels are only displayed when their traces are turned ON.

Message Bar

At the bottom of the oscilloscope display is a narrow message bar. The current date and time are displayed at the far right. Status, error, or other messages will also be displayed in this area.

DIFFERENT WAYS TO DO THE SAME THING

The front panel and display controls provide the most common ways to access your oscilloscope's capability. However, the instrument often gives you more than one way to access dialogs and to make changes.

Top Menu Bar

If you prefer to drive the oscilloscope with the familiarity of Windows, you might prefer to access dialogs from the menu bar at the top of the display. This will open dialog boxes at the bottom of the screen where adjustments can be made.

The dialog area occupies the bottom one-third of the display. To expand the signal display area, you can minimize each dialog by touching the **Close** tab at the right of the dialog box.

In some limited cases, the menu bar is the only way to access certain functionality, but generally speaking, the most common oscilloscope functionality can be controlled from the front panel.

Mouse and Keyboard Operation

In the procedures, we focus on using the front panel for common operations, and the touch screen for making selections. But, if you have a mouse connected to the instrument, you can click on objects instead of touching them. Likewise, if you have a keyboard connected, you can use it to enter data instead of using the virtual keyboard provided by the instrument.

DISPLAYING SIGNALS -- VERTICAL SETUP

Turning a Channel On

1. Connect a signal to a channel (we'll assume you connected to channel 1 in this example, and that the channel was not already ON).

2. Press the channel 1 button on the front panel to turn on channel 1. The button lights and the descriptor label for that channel will appear.

3. If the signal is not on the grid, press the **AUTO** trigger button and adjust **Horizontal** and **Vertical** front panel controls to adjust the settings and display the signal, or simply press the **AUTOSETUP** button to quickly bring most repetitive signals onto the grid.

4. If you need to change probe attenuation, coupling, or bandwidth limiting, open the channel setup dialog for channel 1 by touching the descriptor label for channel 1
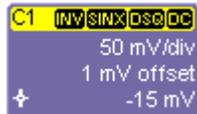
(you will need to press this twice if it is not the active trace); or use the **Vertical**, **Channel 1 Setup** selection from the menu bar to open the channel 1 setup dialog:
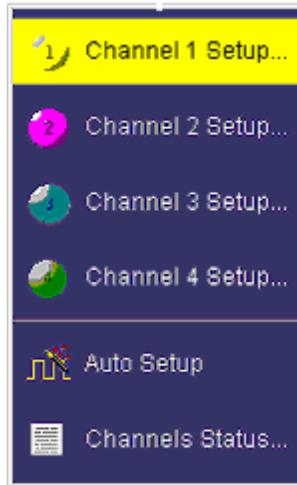
The following dialog will appear at the bottom of the display, and the grid area will shorten until this dialog is closed (by touching the **Close** button on the upper right hand corner of this dialog).
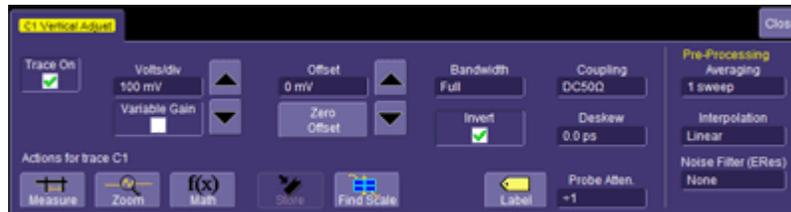
Coupling

Your choices of coupling are as follows:

- DC 50 ohm
- GROUND
- DC 1 Mohm
- AC 1 Mohm

To make a coupling selection, touch inside the **Coupling** field and select a coupling mode from the pop-up menu.

Note: The coupling choices for a channel will change if a ProBus probe is connected to a channel.

Deskew

Deskew allows you to compensate for different lengths of cables, probes, or anything else that might cause timing mismatches between signals. Connect all probes to the desired channels, then probe a common signal with each probe and adjust for timing differences using **Deskew**.

Probe Attenuation

If you use a LeCroy ProBus compatible active probe, or a probe compatible with Probe Ring, the attenuation will be set automatically by the oscilloscope. If it is not automatically set, select a value here by touching inside the **Probe Atten** field selecting a value from the pop-up menu.

Bandwidth Limiting

You may sometimes want to limit high frequency noise on a very low bandwidth input signal. If this is the case, you can limit the channel bandwidth to less than the full bandwidth of the oscilloscope. Select a different bandwidth by touching inside the **Bandwidth** field and selecting a value from the pop-up menu.

Averaging Your Signal

The WaveSurfer Xs scope allows you the opportunity to continuously average your signal to reduce signal noise and aid in signal evaluation. If you want to use averaging, select a value here by touching inside the **Averaging** field and entering a value up to 1 million sweeps on the pop-up keypad.

Interpolation Settings

Linear interpolation, which inserts a straight line between sample points, is best used to reconstruct straight-edged signals such as square waves. (Sinx)/x interpolation, on the other hand, is suitable for reconstructing curved or irregular wave shapes, especially when the sample rate is 3 to 5 times the system bandwidth.

Noise Filtering (ERES)

The instrument's enhanced resolution feature improves vertical resolution by a fixed amount for each filter. This real increase in resolution occurs whether or not the signal is noisy, or your signal is single-shot or repetitive. The signal-to-noise ratio (SNR) improvement you gain is dependent on the form of the noise in the original signal. The enhanced resolution filtering decreases the bandwidth of the signal, filtering out some of the noise.

Using Toolbar Shortcuts

These toolbar shortcuts can be used to perform specific actions for the channel corresponding to the current setup dialog.

For more information on Measure, Zoom, Math, and Memories (Reference Waveforms), refer to the section dealing with that subject.

Measure	Opens a Measurement selection pop-up menu. You can then select up to 6 parameters (measurements) for the active channel from this menu without leaving the Channel Setup dialog. The parameter automatically appears below the grid.
Zoom	Creates a zoom trace of the channel signal. The zoom trace becomes active, and you can use the Vertical and Horizontal controls to modify its scale and position.

f(x) Math	Opens a Math selection pop-up menu. You can then select a math function for the active channel from this menu without leaving the Channel Setup dialog. The Math trace is then displayed in its own grid.
Store	Copies the channel trace into its corresponding Memory (Reference Waveform) location. For instance, C1 is loaded into M1, C2 is loaded into M2, etc.
Find Scale	Automatically performs a vertical scaling that fits the waveform into the grid.
Label	Opens a Labeling pop-up menu that allows user-defined labels tied to the waveform.

TRIGGERING

Overview

The oscilloscope uses many waveform capture techniques that trigger on features and conditions that you define. These triggers fall into two major categories:

- **Edge** activated by basic waveform features or conditions such as a positive or negative slope, and hold-off
- **SMART Trigger**® sophisticated triggers that enable you to use basic or complex conditions for triggering.

Use Edge Triggers for simple signals, and the SMART Triggers for signals with rare features, like glitches.

This Getting Started Manual contains information on setting up the Edge Trigger. Reference the on-line **Help** for information on setting up and using SMART Triggers.

Trigger Terms
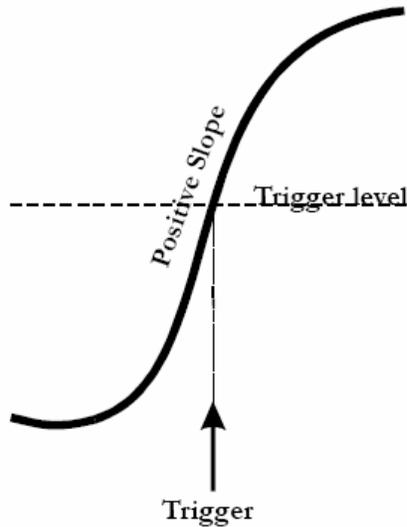
Trigger Delay - the amount of time that the oscilloscope trigger is adjusted from a zero value. You can adjust the oscilloscope's trigger position from 0-100% pre-trigger (left to right on the grid), or from 0-10,000 divisions (in time units) of post-trigger.

Coupling – the type of signal coupling at the input of the trigger source: AC, DC, LFREJ, HFREJ

Level – the threshold at which the trigger will occur, specified in volts.

Slope – the direction of the trigger voltage transition used for generating a particular trigger.

Trigger Setup

Trigger Delay

	The trigger delay Indicator is a color-coded triangle that is positioned horizontally on the grid.
	Trigger delay horizontally positions the scope trace on the display so you can observe the signal prior to the trigger time. Delay adjusts the pre- and post-trigger time. Pre-trigger delay is adjustable from 0-100%
	Post-trigger delay is indicated by a color-coded arrow pointing to the left. Post-trigger delay is adjustable from 0-10,000 divisions (calculated in time)
	All trigger delay values (including post-trigger delay, shown here) are displayed in the Timebase Descriptor Label.
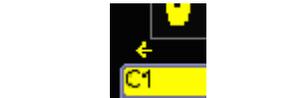
Zero delay is the horizontal center of the oscilloscope display.

To change trigger delay, use the **DELAY** front panel knob in the HORIZONTAL control area. Rotate the knob to adjust, or push to zero.

Trigger Level Indicator
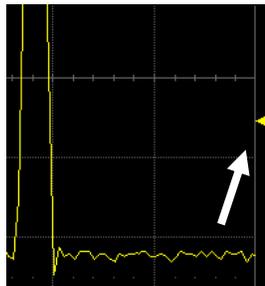
The trigger level indicator is a color-coded triangle that is positioned vertically on the grid.

In Stop trigger mode, the solid triangle will also appear with a hollow triangle of the same color if the level is changed at that time. The hollow triangle indicates what the trigger level will be for the next valid trigger.

Note: The Trigger Level indicator will not be displayed if the triggered channel is not displayed.

To change trigger level, use the front panel knob in the Trigger Control area. Rotate the knob to adjust, or push to set to 50% of the signal level.

Trigger level is specified in volts and remains unchanged when you change the vertical gain settings or offset.

The amplitude and range of the trigger level are limited as follows:

- ± 4.1 screen divisions with a channel as the trigger source

- ± 0.5 V with EXT as the trigger source

- ± 5 V with EXT/10 as the trigger source

- None with LINE as the trigger source (zero crossing is used).

To Set Up an Edge Trigger

1. Touch the trigger descriptor label at the bottom right of the display.

    Or, in the menu bar, touch **Trigger**, then select **Trigger Setup.**

    In either case, the following dialog will appear at the bottom of the display.

    Make sure that "**Edge Trigger**" is highlighted, and not "**SMART Trigger**"

2. Touch inside the **Trigger On** field and select an input from the pop-up menu:

    C1 through **C4** are abbreviations for Channel 1 through Channel 4.

    Ext and **Ext/10** allow you to trigger on the External Input of the oscilloscope. **Ext** input is +/-0.5V. **Ext/10** input is +/-5.0V.

    Line is for triggering on the Positive or Negative excursion of the AC power line (not available when using battery or DC input power).

    Pattern (Logic Pattern) can be used as a source during several of the SMART Triggers (but not for Edge Trigger).

3. Touch inside the **Coupling** field and select a trigger coupling. **Coupling** refers to the type of signal coupling at the input of the trigger circuit. You can choose from these coupling types:
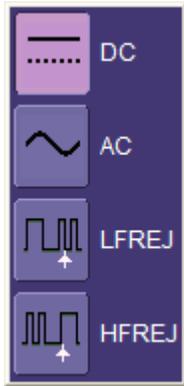
DC -- All the signal's frequency components are coupled to the trigger circuit for high frequency bursts or where the use of AC coupling would shift the effective trigger level.

AC -- The signal is capacitively coupled. DC levels are rejected, and frequencies below 50 Hz are attenuated.

LFREJ -- The signal is coupled through a capacitive high-pass filter network, DC is rejected and signal frequencies below 50 kHz are attenuated. For stable triggering on medium to high frequency signals.

HFREJ -- Signals are DC coupled to the trigger circuit, and a low-pass filter network attenuates frequencies above 50 kHz; used for triggering on low frequencies.

4. Change the trigger **Level** by adjusting the front panel trigger level knob.
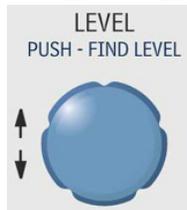
5. Touch inside the **Slope** field and select a trigger Slope:
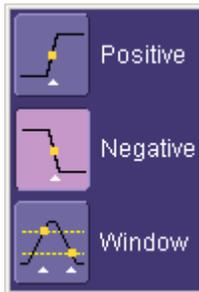
Positive and **Negative** slope refer to the direction of voltage change that you want to trigger on.

Window defines a region whose boundaries extend above and below the selected trigger level. A trigger event will occur when the signal leaves this window region in either direction and passes into the upper or lower region (see figure below). The next trigger will occur when the signal again passes into the window region.
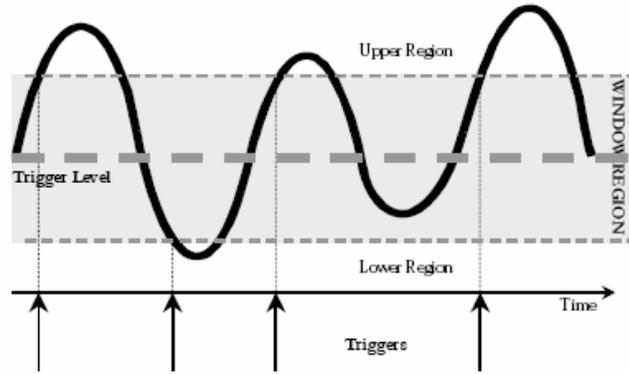
Explanation of Window trigger operation

Trigger Holdoff

Holdoff is an optional, additional condition of Edge trigger. It can be set either as a period of time or as an event count. Holdoff disables the trigger circuit for a given period of time or events after the last trigger occurred.

Events are the number of occasions on which the trigger condition is met. The trigger will again occur when the holdoff has elapsed and the edge trigger's other conditions (for level, slope, etc.) are met.

Use holdoff to obtain a stable trigger on complex, but repetitive, waveforms. For example, if there is a signal with multiple edges prior to the edge you wish to trigger on, you could set the holdoff to equal the number of edges preceding the desired triggering edge.

Refer to the on-line **Help** for more information about setup for holdoff.

WaveSurfer Xs Series

Standard Triggers

Edge	Use Edge trigger for simple, repetitive signals. This trigger is activated by basic waveform features or conditions such as a positive or negative slope, and hold-off
Width	Width trigger allows you to define a positive- or negative-going pulse width bounded by a voltage level, above or below which a trigger will occur. Or you can specify a pulse width and voltage range, within or outside of which a trigger will occur.
Qualified	The Qualified (A-B) trigger allows arming of the trigger on Event A and triggering on Event B. If the arming event is a Pattern that occurs once (Pattern) or that occurs and stays satisfied (PatState), then the triggering event can be an Edge, Width, Glitch, or Interval condition. This functionality is identical to LeCroy's previous "Qualify" and "State" triggers, but presented in a different UI.
Pattern	Pattern trigger enables triggering on a logical combination (pattern) of five inputs: CH1, CH2, CH3, CH4, EXT. You have a choice of four Boolean operators (AND, NAND, OR, NOR), and you can stipulate the high or low voltage logic level for each input independently.
TV	TV triggers provide stable triggering on standard or custom composite video signals. Use them on PAL, SECAM, or NTSC systems. Use CUSTOM setup for other standards.
Serial	Serial trigger allows a serial trigger condition to be set from within the oscilloscope, using an easy-to-understand interface.

SMART Triggers

SMART Triggers are defined as follows:

Glitch	Glitch trigger is a simpler form of Width trigger. Use Glitch trigger when you want to define a fixed pulse-width time or time range only. Glitch trigger makes no provision for voltage levels or ranges.
Interval	While Glitch trigger performs over the width of a pulse, Interval trigger performs over the width of an interval: the signal duration (the period) separating two consecutive edges of the same polarity (positive to positive or negative to negative). Use interval trigger to capture intervals that fall short of, or exceed, a given time limit. In addition, you can define a width range to capture any interval that is itself inside or outside the specified range; i.e., it can be used as an Exclusion trigger by interval.
Dropout	Used primarily in single-shot applications, and usually with a pre-trigger delay, Dropout trigger can detect lost signals. The trigger is generated at the end of the timeout period following the last trigger source transition. You can select a timeout period from 2 ns to 20 s.
Runt	The runt trigger is programmed to occur when a pulse crosses a first threshold line and fails to cross a second threshold line before recrossing the first. You can select both voltage thresholds within a time range of 100 ps to 20 s. Other defining conditions for this trigger are the edge (triggers on the slope opposite to that selected) and runt width.
Slew Rate	Slew rate trigger activates a trigger when the rising or falling edge of a pulse crosses two threshold levels: an upper level and a lower level. The pulse edge must cross the thresholds faster or slower than a selected period of time. You can select both thresholds within a range of 2 ns to 20 s.

SERIAL TRIGGER AND DECODE

A variety of Serial Data standards, such as Inter-IC (I^2C) and Serial Peripheral Interface (SPI), govern communication between microprocessors and peripherals. I2Cbus TD and SPIbus TD are unique oscilloscope tools from LeCroy that greatly enhance your ability to debug and analyze embedded controllers that use I^2C or SPI Bus communications.

The serial triggers are integrated into the oscilloscope -- no external hardware is used -- and are selected through the normal oscilloscope trigger menus. I^2C and SPI signals are input to the oscilloscope through normal passive or active probes, such as LeCroy's ZS Series of high impedance active probes. Decoding is accessed from the Analysis pull-down menu in the menu bar. The decoding is overlaid on top of the appropriate channel, and is intuitively presented and color-coded for quick understanding. Included is a Search capability for specific messages, and a table to display protocol data in summary form underneath the oscilloscope grid.

Accessing Serial Decode Triggers

Serial triggers can be accessed in two ways:
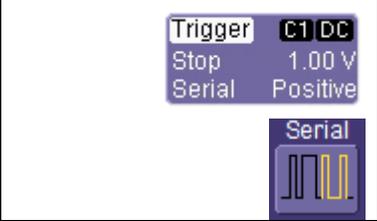
	Touch the **Trigger** descriptor label. Then select the **Serial** trigger type in the dialog box.
	Alternatively, touch **Trigger** in the menu bar, and select **Trigger Setup...** from the drop-down menu. Then select the **Serial** trigger type in the dialog box.
	Choose the appropriate serial trigger. This opens a trigger setup dialog for your choice of serial trigger.

Serial Decode and Decode Setup

These dialogs provide the ability to set the oscilloscope up for protocol decoding of serial data messages, with display of the protocol data overlaid on the signal. They also allow quick and easy access to oscilloscope zooming, searching, table display, and table export.

The serial decode and decode setup dialogs are accessed in any the following ways:

WaveScan... Serial Decode... Pass/Fail Setup... PF Testing On PF Actions On	Touch **Analysis** in the menu bar, then **Serial Decode...** in the drop-down menu. This will open the **Serial Decode** summary dialog, and provide access to Decode Setup.
C1 DC50 100 mV/div 0.0 mV ofst ↓ 144.5 mV ↑ -3.1 mV Δy -147.6 mV Decode	Touch the Channel or Memory Descriptor Box to open the respective dialog box, and touch the Decode button in the bottom toolbar.
Measure... Decode On... Decode Setup... Decode Search... Set label...	Touch a Channel, Memory, or Math trace to open a pop-up dialog that displays a shortcut to the **Decode Setup** dialog box
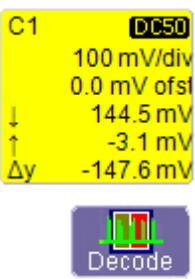
See the on-line Help on your scope for details of operation of Serial Trigger.

WaveSurfer Xs Series

MEASURING WITH CURSORS

Overview

Cursors are important tools that aid you in measuring signal values. Cursors can be moved around on the waveform to identify specific voltage and time values on the waveform. Use cursors to make fast, accurate measurements and to eliminate guesswork.

The cursor controls contain two dedicated cursor knobs and a **Type** button. The **Type** button turns cursors ON (if they are not already ON), then toggles between **Horizontal (Time)** cursors, **Vertical (Amplitude)** cursors, and **OFF**. If an FFT Math trace is ON, a **Horizontal (Frequency)** selection will be added to the toggle list.

When cursors are ON, they provide measurements for every waveform displayed. The lone exception is when a Math FFT is ON, which requires a selection of **Horizontal (Frequency)** for cursors to be placed on that waveform. To place cursors on a Zoom waveform, simply move the cursors into the zoomed part of the original channel signal.

Turning Cursors On
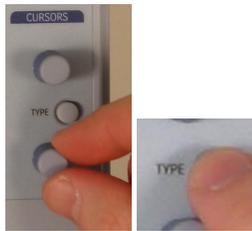
Cursors will automatically turn on when you rotate either of the two cursor knobs. Or, you can press the **TYPE** button to turn cursors ON, then toggle through the various cursor types.

Cursor Types

Horizontal (Time)
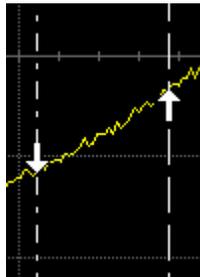
Horizontal (Time) cursors are moved left and right along the waveform. Place them at a desired location along the time axis to read the signal's time and amplitude information at the selected location.

Vertical (Amplitude)
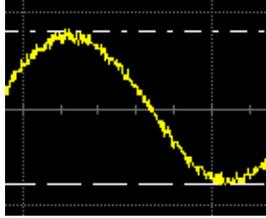
Vertical cursors are lines that you move up and down on the grid to measure the amplitude of a signal.

Horizontal (Frequency)
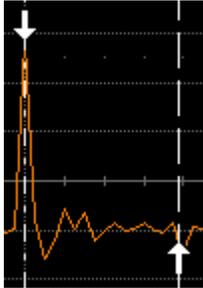
Horizontal (Frequency) cursors are moved left and right along the FFT Math trace. Place them at a desired location along the frequency axis to read the signal's frequency and amplitude at the selected location.

Changing Cursor Type

Pressing the **Type** button between the cursor knobs will toggle the Cursors from one type to another, and ultimately to **OFF**, without requiring a cursor setup dialog to be opened.

Tracking Cursors
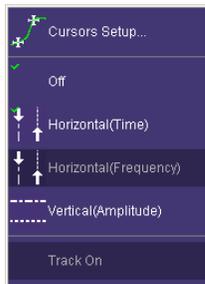
If you want cursors to move in unison when you adjust their position, select **Cursors** from the menu bar, then **Cursor Setup…** from the drop-down menu. Check the **Track** checkbox in the **Cursors** dialog to enable cursor tracking.

Reading Cursor Information

Cursor information is displayed in two different places on the WaveSurfer Xs scope display.

Descriptor Labels
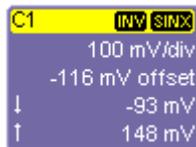
The Descriptor Labels for Channels, Math, Zoom, and Memory traces contain both absolute and relative amplitude (voltage) cursor information.

Cursor Table

The cursor table underneath the Timebase and Trigger descriptor labels appears when **Horizontal (Time)** or **Horizontal (Frequency)** cursors are turned on. This table contains the common absolute and relative information for the two cursors, and frequency information (if Horizontal cursors are selected).

If the display is in XY Mode, XY cursor information will be located underneath the XY display.

MEASURING WITH PARAMETERS

Overview

Parameters are pre-programmed measurements that eliminate the need to set up cursors for standardized measurements, like rise time, fall time, peak-peak amplitude, etc. Use them to automatically calculate many attributes of your waveform. You can make common measurements on one or more waveforms, and display up to six parameter measurements at one time. You can also display statistics for your measurements, or apply "gating" to the measurement area.

The WaveSurfer Xs scope uses pre-defined algorithms to determine the top, base, 10% level, etc. of the waveform in order to make automatic measurements. These algorithms are in accordance with IEEE standards.

If, for some reason, a parameter is unable to be calculated correctly, a warning symbol will be shown underneath the measurement so that you know to proceed with caution.

In the WaveSurfer Xs scope, some parameter measurements (like Mean) produce a single value for all the data between the measure gates. Others (like Rise Time) are always calculated for every value in an acquisition. However, the **value** displayed is always the last value in the acquisition. Use statistics if you desire more information about the distribution of measurements in the acquisition.

Setting Up Parameter(s)

1. Press the Measure front panel button

   Or, in the top menu bar, touch **Measure**, then select **Measure Setup.**

   In either case, the following dialog will appear at the bottom of the display.
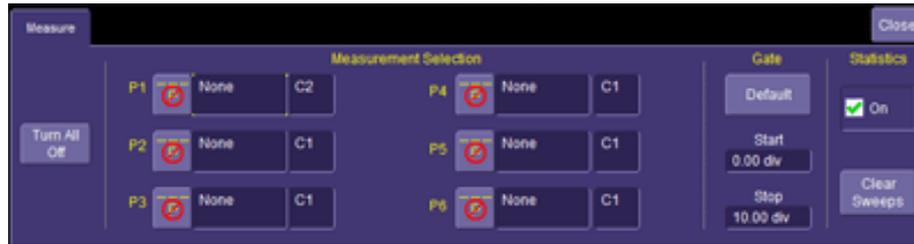
2. The default status is that parameters are OFF, and all are undefined ("None"). Touch either the **icon** or touch in the **None** area to bring up the **Select Measurement** dialog:

   Touch any of the icons to select the measurement that you desire. Scroll down through the list using the slider bar on the right side of the pop-up menu.

3. Once the parameter is selected, it will appear on the display underneath the grid, as shown below:

4. The channel source will default to C1. Touch inside the **Source** field to select a different source (either a channel, a math function, a memory, or a zoom).
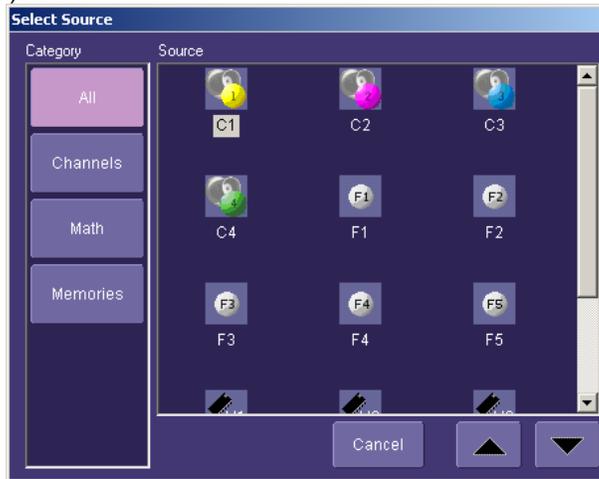
5. Add additional parameter measurements to the display by selecting other parameters (labeled as P1 through P6) as described above.
6. Close the measure dialog by either pressing the front panel **Measure** button again, or touching **Close** on the on-screen dialog.

Understanding Parameter Displays

The Parameter Display Format

Understanding the information in the parameter displays is easy. The table below explains what each abbreviation means, following the parameter display from left to right, and top to bottom.

The format is **Px:Name(source)** with value and status contained below:

P1, P2, P3, P4, P5, P6	The number of the parameter measurement. "P" means Parameter. Each parameter is uniquely identified.
Name	In the example in step 3 (above), **max** is the parameter name, short for maximum. A brief definition of each parameter is included in the measurement selection dialog box.
(source)	The source can be a channel (Cx), a zoom trace (Zx), a math trace (Math), or a memory (reference waveform) (Mx)
value	The last measured value in the acquisition.
status	An indication of whether the parameter was calculated correctly. A ✓ means that the measurement was performed correctly. Reference the table below for information on other status symbols.

Status Symbols

Below each parameter appears a symbol that indicates the status of the parameter, as follows:

✓	A green check mark means that the scope is returning a valid value.
✗	A crossed-out pulse means that the scope is unable to determine top and base; however, the measurement could still be valid.
✗⇓	A downward pointing arrow indicates an underflow condition (signal below the grid area).
✗⇑	An upward pointing arrow indicates an overflow condition (signal above the grid area).
✗⇕	An upward-and-downward pointing arrow indicates an underflow and overflow condition (signal below and above the grid area).

Parameter Gates (Windows)

Sometimes you might want to have a parameter measurement on a specific portion of your signal, and ignore all other portions. When this is the case, you can use Measure **Gate.** Measure **Gate** is controlled in the Measure dialog, and is set in grid divisions.

To set the gate, touch the **Start** field to highlight the control yellow, and then use the adjust knob to adjust the location of the start gate. Repeat for the **Stop** gate. Measure gates will remain on the display as long as the **Start** gate is not equal to 0 divisions, and the **Stop** gate is not equal to 10 divisions.

Measurement Statistics

After you add a parameter measurement, you can look at statistics of that parameter measurement, and acquire an understanding of how that measurement changes with time.

WaveSurfer Xs Series
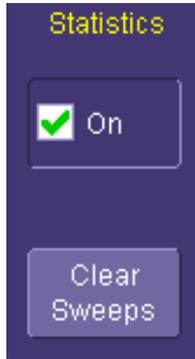
To view measurement statistics, check the box next to **On** under **Statistics** in the **Measure** dialog. If a measurement is displayed, statistics will now also be displayed (as shown below).

Measure	P1:freq(C1)
value	3.00300 MHz
mean	3.0000024 MHz
min	2.97619 MHz
max	3.02480 MHz
sdev	6.1486 kHz
num	21.830e+3
status	✔

Statistics will continue to accumulate with each additional trigger until **Clear Sweeps** (either on the front panel or in the Measure dialog) is pressed, or a control (e.g. Volts/Div) is changed.

Most statistical values (mean, minimum, max, standard deviation) are self-explanatory. **Num** is the number of measurements in the statistical sample. **Value** and **Status** are defined in Understanding Parameter Displays (above).

Turning Off Parameters

You can turn all parameters OFF by touching the **Turn All Off** button in the Measure dialog. This will also redefine all the parameter definitions to NONE.

WAVESCAN™ ADVANCED SEARCH AND ANALYSIS

LeCroy's WaveScan Advanced Search and Analysis tool can be used in the following ways:

- **Capture and Search** -- Take a single acquisition, set a search mode, and apply a filter (i.e., create a search condition).
- **Scan** -- Set a search mode, apply a filter, and take multiple acquisitions to scan for unusual events (i.e., create a software condition for a hardware trigger).

You can select from more than 20 search modes (frequency, rise time, runt, duty cycle, etc.), apply a search condition (slope, level, threshold, hysteresis), and begin scanning in a post-acquisition environment. Since the scanning modes are not simply copies of the hardware triggers, but "software triggers," the capability is much greater.

For instance, there is no "frequency" trigger in any oscilloscope, yet WaveScan allows frequency to be quickly scanned for. You can accumulate a data set of unusual events that are separated by hours or days, enabling faster debugging. The events are time stamped and indexed in a table from which you can select them for viewing individually.

You can also set actions to occur automatically when unusual events are found: stop the acquisition, emit an audible beep, output a pulse, print the screen, or save the waveform.

Refer to your scope's on-line Help for more information about WaveScan.

WaveScan Signal Views

WaveScan provides distinct views of your signal:

- **Source** view highlights all occurrences of edges that meet your criteria.
- **Zoom** view allows you to expand a waveform feature vertically and horizontally; to apply further processing; to store it, or apply a descriptive label to the feature.

WaveScan Search Modes

Search modes are used to locate anomalies during acquisition.

- **Edge** -- for detecting the occurrence of edges; selectable slope and level
- **Non-monotonic** -- for detecting threshold re-crosses; selectable slope, hysteresis, and level
- **Runt** -- for detecting pulses that fail to cross a threshold; selectable polarity and thresholds
- **Measurement** -- for defining a measurement with a filtering (search or scan) criteria

WaveSurfer Xs Series

ZOOMING YOUR CHANNELS

Overview

LeCroy offers extremely powerful, yet simple to use, zooming capability in the WaveSurfer Xs scope. The large, bright 10.4" display with touch screen lends itself very well to quickly creating zooms, and being able to see how they relate to the original channels.

There are a number of different ways to zoom in a WaveSurfer Xs scope:

- **Drawing a box** around the area to be zoomed, using either your finger or a mouse/pointing device.
- Using the front panel **QuickZoom** button.
- Using the software toolbar **Zoom** button that is in the Channel dialog.

The operating behavior for all three methods is basically the same, with some minor differences.

In all cases, the zoomed channels are displayed in a separate half-height grid at the bottom of the display (separate from the channels). If you also have a Math trace displayed when you zoom, there will be three grids on the display, each one-third height.

The zoomed traces are nearly the same color as the original channel traces to make comparison easy. The zoomed area is shown in white on the original channel trace. All zooms share a common horizontal zoom scale and position. Each zoom has an independent vertical zoom capability. All zooms are calculated to 16-bit vertical resolution. Therefore, you can vertically scale the zoom traces and still maintain very high resolution when viewing signal detail.

Creating Zooms

There are three ways to create zooms of your channels.

Touch Screen Zooming
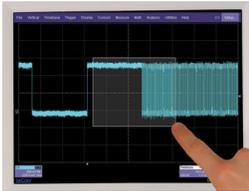
You can "draw a box" around the area that you wish to zoom simply by dragging your finger, stylus, or mouse pointer around the area of the waveform or waveforms that you want to zoom. Zoom traces are created instantly in a separate grid.

To UNDO your zoom, touch the **UNDO** button in the upper right corner of the display.

You can also use touch screen zoom to change the zoom scale of an existing Zoom, Math, or Memory (reference waveform) trace.

When you zoom a waveform by this method, a representation of the zoomed area will appear in a thumbnail Preview in the **Zx** dialog.

Front Panel QuickZoom Button

MEASURE
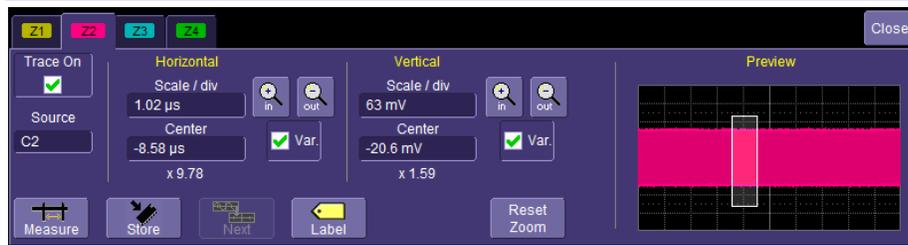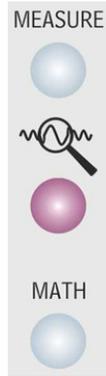
Press the front panel QuickZoom button.

Zoom traces will be created for all of the channels currently displayed.

To turn off a Zoom trace individually, touch the Zoom descriptor label to open the Zoom trace dialog, then uncheck the ON checkbox.

To UNDO your zoom at any time, simply press the front panel QuickZoom button again.

Note: If you turn a channel ON while the QuickZoom is displayed, the new channel will not be zoomed.

MATH
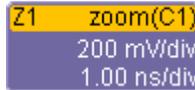
Toolbar Zoom

Press the toolbar **Zoom** button in the **Cx Vertical Adjust** dialog for the channel trace you want to zoom. A Zoom trace will be created for that channel only.

To UNDO your zoom, press the **Undo** button in the upper right corner of the display, or press the front panel QuickZoom button.

Zoom Descriptor Label

When a Zoom trace is ON, there is a descriptor label on the display for it, much like for the channels, math trace, and memories (reference waveforms).
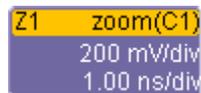
- The top line contains information about the Zoom trace (in this case, it's a Zoom of Channel 1).

- The 2nd line contains vertical scaling information.

- The 3rd line contains horizontal scaling information.

If the descriptor label is a solid color (as shown below), then the Zoom trace is ACTIVE, which means that the Horizontal and Vertical front panel controls are set to adjust that specific zoom trace, and not any of the channels. In this case, the scale and position of the Zoom trace can be changed by adjusting the horizontal and vertical controls on the front panel.

Note that the Horizontal scales and position is the same for all Zoom traces, but Vertical scale and position can be adjusted individually.

If the Zoom trace is inactive, and you wish to make it active, simply touch the descriptor label once and it will become active. This will also open the Zoom trace dialog.

> **Note:** When a Zoom trace is active, no channel buttons will be lighted, which tells you that a Zoom trace may be currently active.

Adjusting Zoom Scale and Position

Using Front Panel Controls

It is easy to adjust your Zoom trace's scale and position. The WaveSurfer Xs scope multiplexes the Vertical and Horizontal Front Panel controls to control the zoom scale and position. This is done automatically after you have created the zoom trace, and remains this way until you make a Channel, Math trace, or Memory (reference waveform) active.

	If the Zoom trace you wish to adjust is not active, touch the descriptor label once to make it active.
	Then use the front panel horizontal and vertical controls to adjust position and scale. The operation of the knobs will feel natural. Use the table below as a guide.
	Note: When a Zoom trace is active, no channel buttons will be lighted, which tells you that a Zoom trace may be currently active.

Panel Control	Zoom Control Action
Delay	Zooms horizontal position
Timebase	Zooms horizontal scale
Offset	Zooms vertical position
Gain / Sensitivity	Zooms vertical scale
Push – Zero Delay	Resets horizontal zoom to 10:1 scale, and resets to default horizontal position
Push – Zero Offset	Resets vertical zoom to 1:1 scale, and resets to default vertical position

Using Zoom Dialog Controls

You can also use the Zoom dialog controls to adjust zoom.
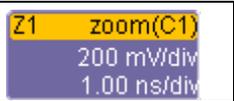
Z1 zoom(C1) 200 mV/div 1.00 ns/div	Touch the descriptor label to open the Zoom dialog.

Then use the on-screen zoom controls to change the horizontal and vertical position and scale.

Horizontal scale adjustments always apply to all waveforms.
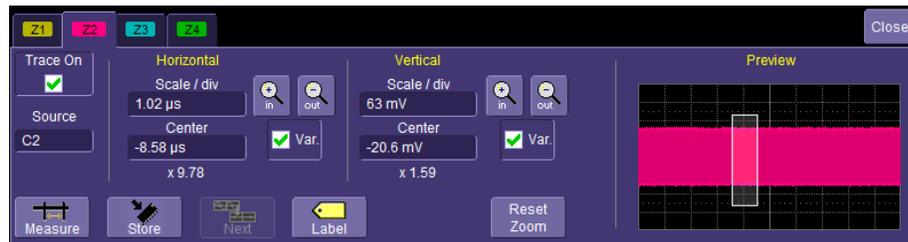
Using Toolbar Shortcuts

These toolbar shortcuts can be used to perform specific actions for each Zoom trace.

Measure	Opens a Measurement selection pop-up menu. You can then select a parameter (measurement) for the Zoom trace from this menu without leaving the Zoom Setup dialog. The parameter automatically appears below the grid.
Store	Loads the Zoom trace into its corresponding Memory (Reference Waveform) location (for instance, Z1 is stored into M1, Z2 is stored into M2, etc.).
Label	Opens a Labeling pop-up menu that allows you to create labels tied into the waveform.

WaveSurfer Xs Series

USING THE MATH TRACE

Overview

Math allows you to perform simple and complex mathematical calculations on your signal, or on a zoom or memory (reference waveform). The oscilloscope can be operating in any acquisition mode (Real-Time, RIS, or Roll Mode) when Math is created.

Math traces are defined with an Operator and a Source. Examples of Operators include Add, Subtract, Multiply, Divide, and FFT. Sources are channels, zoom traces, or memories (reference waveforms). Some Operators require two sources, and some only one source. The oscilloscope shows how many sources you need to define when you choose the Operator.

Math is always displayed in a separate half-height grid at the bottom of the display, separate from your other traces. This makes it easier to interpret Math information if the math scale is different from the channel scales. If you also have Zoom traces displayed when you turn the Math trace ON, there will be three grids on the display, each one-third height.

Each Math trace can also be zoomed without setting up a separate zoom trace. This reduces a step, and gives you more capability to understand the exact feature of interest without having to create another trace. Simply use the zoom controls in the Math dialog, or use the Vertical and Horizontal controls for position and scale change in both axes when the Math trace is active.

One powerful feature about WaveSurfer Xs Math traces is that they are calculated to 16-bit vertical resolution. Therefore, you can vertically zoom the Math trace and still maintain very high resolution when viewing the zoomed trace.

Description of math functions

The WaveSurfer Xs scope contains several Math operators as standard, plus an FFT function. Additional Math functions are available in the MathSurfer Advanced Math option. Descriptions are provided below:

Standard Math

−	**Difference** (Subtract) – Subtracts two waveforms
×	**Product** (Multiply) – Multiplies two waveforms.
÷	**Ratio** (Divide) – Calculates the ratio of two waveforms
+	**Sum** (Add) – Adds two waveforms
	Fast Fourier Transform (FFT) – computes a power frequency spectrum of an FFT up to 25 kpts. Contains Rectangular, Von Hann, and Flat Top windows.

MathSurfer Advanced Math

$\lvert y \rvert$	**Absolute Value** – calculates the absolute value of a waveform.
$\langle y \rangle_n$	**Average** – calculates either a summed or continuous average up to 1 million sweeps (user selectable)
dy/dx	**Derivative –** calculates the derivative of adjacent samples
	Envelope – calculates highest and lowest vertical values of a waveform at each horizontal value for a given number of acquisitions (sweeps)
	Enhanced Resolution (ERES) – noise reduction and smoothing filter specified by number of additional bits
	Fast Fourier Transform (FFT) – Adds Hamming, Blackman-Harris, and Hanning windows, and capability to calculate up to 1 Mpts. Also allows FFT Averaging through use of 2nd Math Operator.
	Floor - calculates the lowest vertical values of a waveform at each horizontal value for a given number of acquisitions (sweeps)
$\int ydx$	**Integral** – calculates the linearly rescaled integral (with multiplier and adder) of a waveform input
$-(y)$	**Invert** – inverts the waveform
$1/y$	**Reciprocal** – calculates the reciprocal of the waveform
$y=ax+b$	**Rescale** – allows user-defined rescaling, including user defined units.
	Roof - calculates the highest vertical values of a waveform at each horizontal value for a given number of acquisitions (sweeps)
y^2	**Square** – calculates the square of the waveform
$\sqrt{y}$	**Square Root** – calculates the square root of the waveform

Setting up a Math Trace

1. Press the Math front panel button
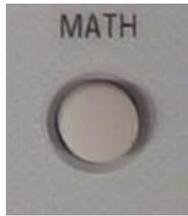
    Or, in the Top Menu Bar, touch **Math**, then select **Math Setup…**

    In either case, the following dialog will appear at the bottom of the display, the Math trace will turn ON, and the last selected Math Operator will be chosen as the current operator.

2. To change the currently defined Operator, touch either the icon or touch in the **Operator** area to bring up the following pop-up menu (if you ordered the MathSurfer Advanced Math option, you would have more selections than those shown):
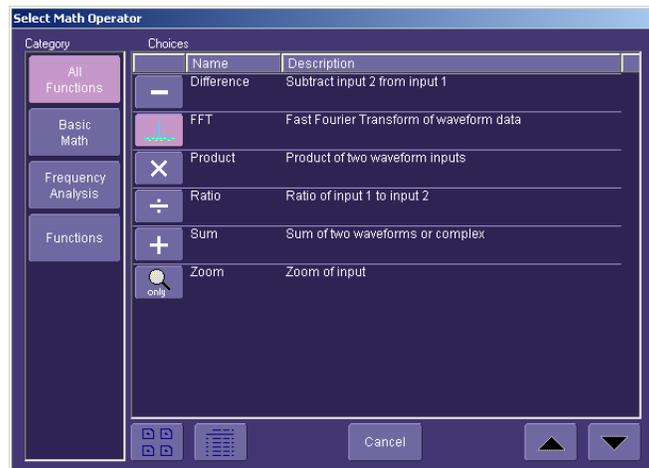
    Touch any of the icons to select the math operator (function) that you desire. Scroll down through the list using the scroll bar on the rights side of the pop-

up menu.

3. Once the **Operator** is selected, the pop-up menu will close and the Math trace will be re-defined.

4. If you have purchased the MathSurfer Advanced Math option, you will also be able to select a second **Operator.** To do this, select Dual from the **Single/Dual** button selection.

 A second **Operator** will appear. It can be changed like the first.

 Two Operators can be helpful in some situations. For instance, you can compute an FFT, then Average the FFT result over many computations by making the first Operator an FFT and the second operator an Average function. Or, you can make the second Operator a Rescale function to change units and rescale information for a non-standard calculation.

5. The channel source will default to C1. Touch inside the source field to select a different source (either a channel, a memory, or a zoom).
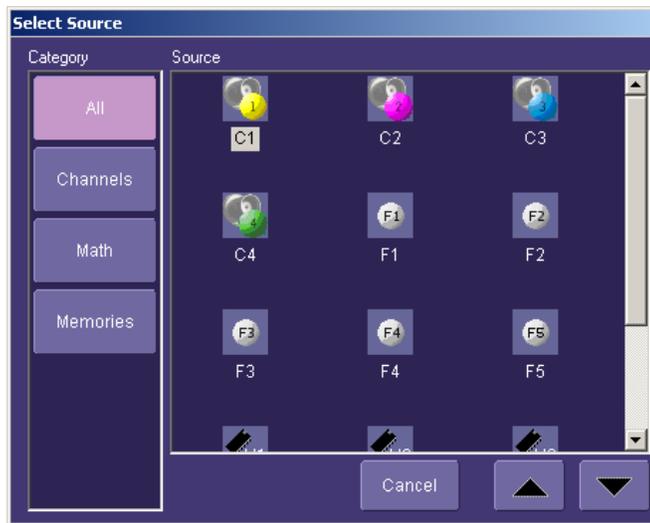
6. Close the Math dialog by either pressing the front panel **Math** button again, or touching **Close** on the on-screen dialog.

Math Descriptor Label

When a Math trace is ON, there is a descriptor label on the display for it, much like for the channels, zooms, and memories (reference waveforms).

- The top line contains information about how the Math trace is defined (in this case, it's an FFT of Channel 1).

- The 2nd line contains vertical scaling information.

- The 3rd line contains horizontal scaling information.

If the descriptor label is a solid color (as shown below), then the Math trace is ACTIVE, which means that the Horizontal and Vertical front panel controls are set to adjust the Math trace, and not any of the channels. In this case, the scale and position of the Math trace can be changed by adjusting the horizontal and vertical controls on the front panel.
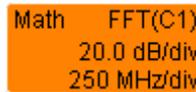
If the Math trace is not ACTIVE, and you wish to make it ACTIVE, simply touch the descriptor label once and it will become active and the Math dialog will open.

Zooming Math

Math traces have zoom capability built in, so it is easy to change the scale and position of the Math trace, as required. You can zoom in one of two ways:

	Touch the descriptor label to make it active.
	Then use the front panel horizontal and vertical controls to adjust position and scale. The operation of the knobs will feel natural. Use the table below as a guide.
	Note: When Math trace is active, no channel buttons will be lighted, which tells you that the Math trace may be currently active.

Panel Control	Zoom Control Action
Delay	Zooms horizontal position
Timebase	Zooms horizontal scale
Offset	Zooms vertical position
Gain / Sensitivity	Zooms vertical scale
Push – Zero Delay	Resets horizontal zoom to 10:1 scale, and resets to default horizontal position
Push – Zero Offset	Resets vertical zoom to 1:1 scale, and resets to default vertical position

Using Math Dialog Zoom Controls

Math FFT(C1) 20.0 dB/div 250 MHz/div	Touch the descriptor label twice to open the Math dialog.
Zoom	Touch the Zoom button in the Math dialog toolbar.
FFT Zoom Close / Horizontal Center 250.0 MHz / Scale / div 50.0 MHz / x 1.00 / Vertical Center -64.0 dBm / Scale / div 20.0 dB / x 1.00 / in out in out Reset Zoom	Then use the software zoom controls to change the horizontal and vertical position and scale.

Toolbar Shortcuts

These toolbar shortcuts can be used to perform specific actions for the Math Trace.

Measure	Opens a Measurement selection pop-up menu. You can then select a parameter (measurement) for the Math trace from this menu without leaving the Math Setup dialog. The parameter automatically appears below the grid.
Store	Loads the Math trace into its corresponding Memory (Reference Waveform) location (Memory 1, or abbreviated as M1).
Label	Opens a Labeling pop-up menu that allows you to create labels tied to the waveform.
Zoom	Opens the zoom control tab in the Math dialog.

WaveSurfer Xs Series

USING WAVESTREAM FAST VIEWING MODE

Adjusting Trace Intensity

INTENSITY PUSH - ACQ MODE Wave Stream	WaveStream fast viewing mode provides brightness-graded intensity with a decay time similar to the action of phosphor on an analog screen. WaveStream mode operates at up to 2.5 GS/s with an update rate up to 8000 waveforms/second for better capture of higher frequency abnormal events. The **INTENSITY** knob adjusts the brightness of your trace. Pushing the button toggles between WaveStream fast-viewing mode and real-time mode.

SAVING AND RECALLING SETUPS

Overview

You can save or recall scope settings to or from hard disk, USB key, or LAN location. This can be very helpful if you repeat the same types of tasks over and over again, or if you share the scope with many people.

To Save Scope Settings as a Setup File
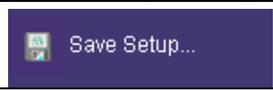
Save Setup...	Choose **Save Setup** from the **File** top menu bar.
Save Now!	Choose to save the Waveform Data as an **Internal Setup** temporary location in RAM or to a **File** on the hard drive or external storage device. Touch **Save Now** to save the file.

To Recall Scope Settings from a Setup File

Recall Setup...	Choose **Recall Setup** from the **File** top menu bar.
Recall Now!	Choose to recall the Setup from an **Internal Setup** temporary location in RAM or from a **File** on the hard drive or external storage device. Touch **Recall Now** to save the file.

To Recall Default Scope Settings

Recall Setup...	Choose **Recall Setup** from the **File** top menu bar.
Recall Default	Touch the button under **Recall Default Setup.**

WaveSurfer Xs Series

SAVING AND RECALLING WAVEFORMS

Overview

There are several ways to save and recall your signals:

- Save your Channel signal, Math trace, or Zoom trace to a Memory location (Reference Waveform).

- Save your Channel signal, Math trace, or Zoom trace as Data.

- Save your Channel signal, Math trace, or Zoom trace as a Screen Image.

Memories (Reference Waveforms)

Memories are saved in non-volatile RAM on the WaveSurfer Xs scope. Saving to a memory is quick and easy. It is the ideal way to save data for quick comparison with another waveform.

Waveform Data

Waveform Data is usually saved in a binary or ASCII format (though other formats are available). The data can be recalled on the same oscilloscope, or transferred to another oscilloscope or other program (like Excel, MATLAB, or Mathcad) for further processing. If recalled on an oscilloscope, it would be recalled in a Memory (reference waveform) trace.

Screen Image

Screen images can be saved in a number of different image formats, and saved to a filename, printed, or sent as an e-mail attachment. Screen images are not actual oscilloscope data, and cannot be recalled into the oscilloscope.

Saving and Recalling Memories

Fastest Way to Store and Display

Being able to compare a current acquisition with a reference trace is a very fundamental oscilloscope need. The WaveSurfer Xs scope has made it easy to save a channel, math trace, or zoom trace to a memory location.
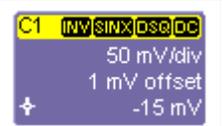
	Touch the Channel, Math, or Zoom descriptor label twice to open the dialog for the trace that you desire to save to a reference location.
	Touch the **Store** button in the toolbar at the bottom of the dialog.

The trace will be saved to its corresponding Memory trace (C1 to M1, C2 to M2, etc., Z1 to M1, Z2 to M2, etc., Math to M1) and displayed on the grid. The memory trace will have a descriptor label, a dialog, etc. like all other traces. It can even be zoomed and repositioned on the grid.

M Memory Setup...	Choose **Memory Setup** from the **Math** top menu bar.
M1	Choose a Memory location from the **Memory Setup** dialog. In this example, we'll choose M1.
Copy From Waveform / C1 / Copy Now / M1 / 200 mV/div / 10.0 ns/div	Choose a waveform to copy into this memory. In this example, we'll choose to copy C1 into this M1 memory location. After you've selected the waveform to copy into memory, touch **Copy Now**. The M1 memory trace will contain the C1 waveform present at the time of copy, the M1 trace will be turned ON, and the descriptor label will be active. The position and scale can be changed with the front panel controls, just like a zoom trace.
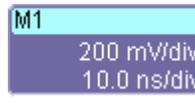
Using Memory Toolbar Shortcuts

These toolbar shortcuts can be used to perform specific actions for the Memory Traces.

Measure	Opens a Measurement selection pop-up menu. You can then select a parameter (measurement) for the Memory trace from this menu without leaving the Memory Setup dialog. The parameter automatically appears below the grid.
Clear Memory	Clears the memory of the stored trace.
Label	Opens a Labeling pop-up menu that allows you to create labels tied to the memory.
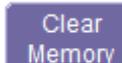
WaveSurfer Xs Series

Saving and Recalling Waveform Data

To Save Waveform Data

Save Waveform...	Choose **Save Waveform** from the **File** top menu bar.
File	Choose to save the Waveform Data to a **File**
Source / C1 / Trace Title / Trace / Binary ASCII Excel Matlab MathCad / Save Now!	Choose a source of the data that you want to save, and choose a file name for the data file. ⚠ **CAUTION** **If you use a name that ends in a number instead of a letter, the instrument may truncate the number. This is because, by design, the first waveform is automatically numbered 0, the second 1, etc.** Choose a data format. If you select **ASCII** or **Excel**, also touch the **SubFormat** field and select either **Time Data** or **Time & Ampl**. Then touch the **Delimiter** field and select a delimiter character from the pop-up menu: comma, space, semicolon, or tab. Then choose a directory and file name to store the file to (this could be a USB memory storage device, or the oscilloscope internal hard drive: Save files in directory c:\LeCroy\XStream\Waveforms Browse Next file will be saved to C1Trace00000.trc Then touch the **Save Now** button in the dialog.
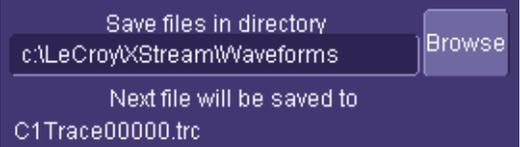
To Recall Waveform Data

Recall Waveform...	Choose **Recall Waveform** from the **File** top menu bar.
File / Recall files from directory c:\LeCroy\XStream\Waveforms / Browse / Recall Now!	Choose to recall the Waveform Data from a **File** Touch inside the **Destination** field and select a memory location to store the file into. If you wish, check the **Show on Recall** box to turn the memory ON and display the waveform instantly. Touch inside the **Recall files from directory** data entry field and enter the path, using the pop-up keyboard. Or touch the **Browse** button to navigate to the file. Touch the **Recall Now** button to recall the waveform data file.
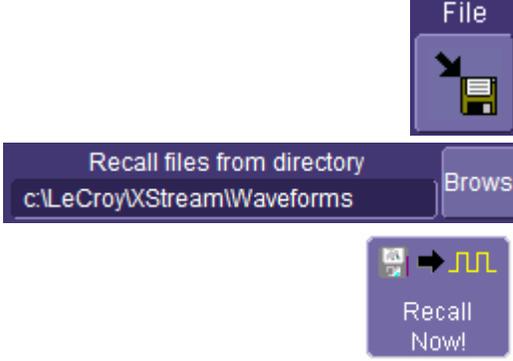
Saving Screen Images

Printer Clipboard File E-Mail	You can send images to a hard copy printer, to storage media (like the internal hard drive or a USB memory stick), as an e-mail attachment, or as a clipboard file for copying into other programs.
(printer icon) (Label icon)	You can define the front panel **Print** button to automatically save, print, or e-mail the file with just one button push You can also annotate (add labels) to your screen images before saving them so as to make your documentation job easier. Use the toolbar Label button to create and add labels independently to each Waveform.

WaveSurfer Xs Series

Saving the Screen Image to a File

 Choose File if you want to save the screen image to storage media, such as a USB memory stick or the internal hard drive.

1. In the menu bar touch **Utilities**, then **Utilities Setup...** in the drop-down menu.
2. Touch the **Hardcopy** tab, then the **File** icon.
3. Touch inside the **File Format** data entry field and select a graphic file format from the pop-up menu.
4. Under **Colors**, touch the **Use Print Colors** checkbox if you want the traces printed on a white background. A white background saves printer toner.
5. Touch inside the **Directory** data entry field and type the path to the folder you want to print to, using the pop-up keyboard. Or touch the **Browse** button and navigate to the folder.
6. Touch inside the **File Name** data entry field and enter a name for the display image, using the pop-up keyboard.
7. Touch the **Grid Area Only** checkbox if you do not need to print the dialog area and you only want to show the waveforms and grids.
8. Touch the **Print Now** button, or use the front panel Print button to save the file.

Sending the Screen Image as an E-mail Attachment

The instrument also gives you the option to e-mail your screen images, using either the MAPI or SMTP protocols. Before you send an e-mail, you must first be connected to an e-mail server and must set up the e-mail server and recipient address in **Preference Setup**.

To Send E-mail

1. In the menu bar touch **Utilities**, then **Utilities Setup...** in the drop-down menu.
2. Touch the **Hardcopy** tab, then the **E-mail** button.
3. Touch inside the **File Format** data entry field and select a graphic file format from the pop-up menu.
4. Under **Colors**, touch the **Use Print Colors** checkbox if you want the traces printed on a white background. A white background saves printer toner.
5. Touch the **Prompt for message to send with mail** checkbox if you want to include remarks with the image.
6. Touch the **Grid Area Only** checkbox if you do not need to print the dialog area and you only want to show the waveforms and grids.
7. Touch the **Print Now** button.

Printing the Screen Image to a Printer

Choose Printer if you want to print the screen image to an external printer

To Print the Screen Image to a Printer

1. In the menu bar, touch **File**, then **Print Setup...** in the drop-down menu. The Utilities **Hardcopy** dialog opens.

2. In the dialog area, touch the **Printer** icon .
3. Under **Colors**, touch the **Use Print Colors** checkbox if you want the traces printed on a white background. A white background saves printer toner. (You can change the printer colors in the **Preferences -- Color** dialog).
4. Touch inside the **Select Printer** field. From the touch pad pop-up choose the printer you want to print to. Touch the **Properties** button to see your printer setup.
5. Touch the icon for the layout **Orientation** you want: portrait or landscape.
6. Touch the **Grid Area Only** checkbox if you do not need to print the dialog area and you only want to show the waveforms and grids.
7. Touch the **Print Now** button, or use the front panel Print button to print the file.

WaveSurfer Xs Series

Saving the Screen Image to a Clipboard

Choose Clipboard if you want to save the screen image to the clipboard so you can paste a file into another application (like MS Word, for example).

To Save the Screen Image to the Clipboard

1. In the menu bar touch **Utilities**, then **Utilities Setup...** in the drop-down menu.
2. Touch the **Hardcopy** tab.
3. Under **Colors**, touch the **Use Print Colors** checkbox if you want the traces printed on a white background. A white background saves printer toner.
4. Touch the **Grid Area Only** checkbox if you do not need to print the dialog area and you only want to show the waveforms and grids.
5. Touch the **Print Now** button, or use the front panel Print button to save the file.

SHARING YOUR DATA & COMMUNICATING WITH OTHERS

Overview

The WaveSurfer Xs scope provides you with many powerful tools to communicate your results to others and to increase your productivity. Some examples are listed below:

- E-mail images to co-workers or customers directly from the oscilloscope.
- Allow annotation of image files directly on the oscilloscope.
- Save images and data files to the oscilloscope hard drive or network drive.
- Download images and files quickly to a USB memory stick.
- Create an archive of "perfect" signals for comparison to during board validation (using traces stored on the hard drive).
- Print to any printer.
- Be controlled or viewed from a remote location using off-the-shelf software tools.

The WaveSurfer Xs scope uses WindowsXP embedded, so you are probably aware of the basic philosophy of minimizing the program, saving to directories, and opening other programs on the oscilloscope. This will make it easier for you to intuitively operate the WaveSurfer Xs scope.

Standard outputs

- The WaveSurfer Xs scope is standard with the following:
- 100BaseT Ethernet
- Front-Mounted USB port
- Side-mounted USB ports (qty. 4)
- 9-pin serial port
- SVGA output

Connecting to a Network

The WaveSurfer Xs scope's standard 10/100 Base-T Ethernet port allows quick and easy connection to a network. DHCP (Dynamic Host Configuration Protocol) means that, provided your network doesn't have a firewall, you only need to plug in your network cable to the WaveSurfer Xs scope's Ethernet port, and a network address will be self-assigned.

If your network has a firewall, your IT department can assist you in connecting to the network using familiar Windows setup routines.

Because your scope runs on a Windows-based PC platform, it is wise to protect it from viruses, as with any PC on a corporate network. It is crucial that the scope be kept up to date with Windows Critical Updates, and that anti-virus software be installed and continually updated.

WaveSurfer Xs Series

Visit www.lecroy.com/dsosecurity for more information regarding Windows Service Pack compatibility with LeCroy operating software, and related matters.

Accessing the Desktop

Print Setup... Print Minimize Windowed	You can access the WaveSurfer Xs scope's (Windows) desktop by opening the **File** top menu bar and then choosing **Minimize**. This will minimize the oscilloscope and allow you to open other Windows programs, such as Windows Explorer, Paint, Internet Explorer, etc.
	When minimized, the oscilloscope program appears as a follows in the lower right hand corner of the display. Touch on the icon to maximize the program to full screen size.

Sending E-mail from the Oscilloscope

It is very easy to send an e-mail of an image directly from the oscilloscope by pressing a single front panel button. Reference the previous section *Sending the Screen Image as an Email Attachment.*

Annotating Image Files

Any channel, math trace, zoom trace, or memory (reference waveform) can be "annotated", or labeled. These labels are attached to the waveform and can be positioned anywhere on the waveform. Note the following:

- Label placement adjusts depending on vertical and horizontal adjustments to the trace.

- When a screen image is saved to disk, these labels are part of the screen image.

- By using labels, you eliminate extra work in a separate program.

- Labels contribute to your co-worker's or customer's understanding of your work.

To Create a Label on a Waveform
1. Open the dialog for the channel, math, zoom, or memory that you want to label.
2. Touch the **Label** button in the toolbar.

Label

3. Touch the **Add Label** button in the pop-up menu.

Math: Trace Annotation

Label position may either be specified in the control below, or by dragging the label using the touchscreen/mouse.

Labels

Add label

View labels

Remove label

Label Text

Text of label

Horizontal Pos.

0

Close
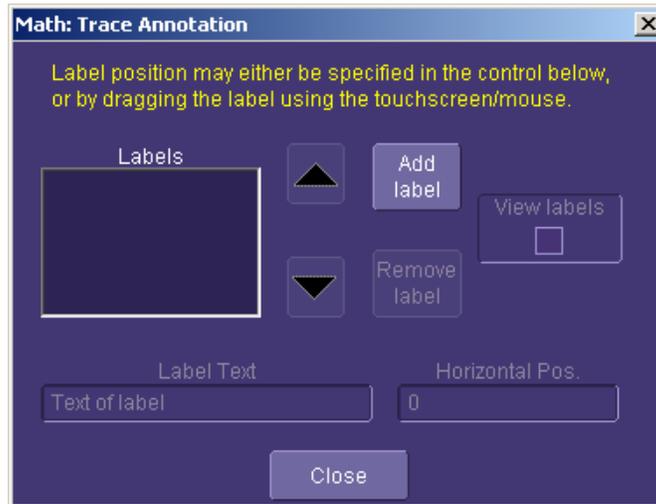
4. Create **Label Text** by using the pop-up keyboard. You may also change **Horizontal Position** of each label, **Remove Label**, and turn labels on/off by checking or unchecking the **View Labels** checkbox.

Saving Data Files and Images

You can save raw data files by **Choosing File**, **Save Waveform** and choosing data format, locations, etc. before choosing **Save Now**.

Images can be saved by choosing **File** in **Utilities, Hardcopy**, selecting a **File Format**, **File Name**, **Directory** location, etc.), and then pressing the **Print** icon in the dialog or on the front panel. Reference *Saving the Screen Image to a File* for more information.

Once saved (on a USB memory stick, USB storage device, or oscilloscope hard drive), the image file can be easily cut and paste into other programs, like Word, Excel, Paint, etc.

Creating Reference Waveforms (Memories)

If you wish to compare a waveform to another waveform, you can save them into **Memories**. Up to 4 memories can be stored in non-volatile RAM at a time. You can display all 4 memories at once, if desired.

If you wish to store more than 4 waveforms at a time, you can **Save Waveform** Data (accessed from the **File** menu), and then **Recall Waveform** Data (also accessed from the File menu) into a **Memory** trace.

Reference the chapter on **Saving and Recalling Signals** for more information.

Printing

Since the WaveSurfer Xs scope runs on a WindowsXP platform, you can connect any WindowsXP compatible printer to the oscilloscope, following standard Windows setup routines for installing a new printer.

Reference the chapter on **Print Management** for more detailed information. In addition, there is information on setting the front panel **Print** button in the chapter **Saving and Recalling Signals** section *Printing the Screen Image to a Printer.*

Controlling and Viewing Remotely

Use Windows NetMeeting, VNC, pcAnywhere, or a similar program to control the oscilloscope remotely or share screen information in real-time with others located anywhere in the world, or just down the hallway.

All of these programs may be loaded and configured on the WaveSurfer Xs scope as if the WaveSurfer Xs scope were a standard PC.

PRINT MANAGEMENT

The instrument gives you the ability to output files to a printer or plotter, to print to file, or to e-mail your files. Any Windows XP supported printer is supported by your instrument.

Setting Up the Printer

1. In the menu bar, touch **File**, then **Print Setup...** in the drop-down menu. The Utilities **Hardcopy** dialog opens.

2. In the dialog area, touch the **Printer** icon .
3. Under **Colors**, touch the **Use Print Colors** checkbox if you want the traces printed on a white background. A white background saves printer toner. (You can change the printer colors in the Preference dialog;)
4. Touch inside the **Select Printer** field. From the touch pad pop-up choose the printer you want to print to. Touch the **Properties** button to see your printer setup.
5. Touch the icon for the layout **Orientation** you want: portrait or landscape.
6. Touch the **Grid Area Only** checkbox if you do not need to print the dialog area and you only want to show the waveforms and grids.

To Print

You can print in one of three ways:

*   Press the printer button on the front panel.
*   In the menu bar, touch **File**, then **Print** in the drop-down menu.
*   Touch the **Print Now** button in the "Hardcopy" dialog

Adding Printers and Drivers

Note: If you want to add a printer driver, the driver must first be loaded on the scope.

1. In the menu bar, touch **File**, then **Print Setup...** in the drop-down menu. The Utilities **Hardcopy** dialog opens.

2. In the dialog area, touch the **Printer** icon .

3. Touch the **Add Printer** button. An MS Windows® window with which to add a printer will open.

4. Touch the Properties button to change printer properties such as number of copies.

Changing the Default Printer

1. If you want to change the default printer, minimize the instrument application by touching **File** in the menu bar, then **Minimize** in the drop-down menu.

2. Touch the **Start** button in the task bar at the bottom of the screen.

3. Select **Settings**, then **Printers**.

4. Touch the printer you want to set as the default printer, then touch **File, Set as Default Printer**.

PASS/FAIL TESTING

Overview

The WaveSurfer Xs scope's pass/fail testing is designed for basic determination of whether a signal is within an industry-standard or user-defined mask. Several unique views are provided to make it easy to understand when the signal is falling outside of its desired range.

Mask Tests

You have the choice to do mask testing by using an existing mask, or by using a mask created from your actual waveform, with vertical and horizontal tolerances that you define. Existing masks can be loaded from a floppy disk or from a network.

You can set your mask test to be True for waveforms All In, All Out, Any In, or Any Out. For example, if you select All In, the test will be False if even a single waveform falls outside the mask.

Masks that you create from your waveform can be confined to just a portion of the trace by use of a measure gate. (See Measure Gate for an explanation of how this feature works.)

Actions

You can decide the actions to occur upon your waveform's passing or failing, by selecting one or all of the following:
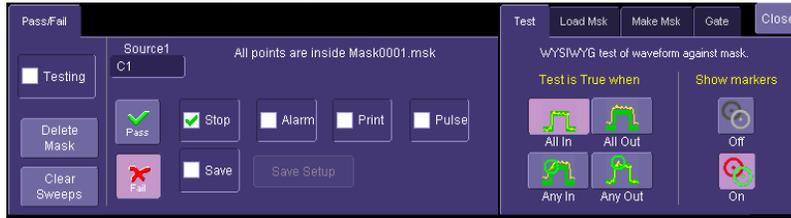
*   stop
*   audible alarm
*   print image of display
*   emit pulse
*   save waveform

The selection **Pulse** causes a pulse to be output through the Aux Out connector. This pulse can be used to trigger another scope. You can set the amplitude and width of the pulse as described in Auxiliary Output Signals.

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Setting Up Pass/Fail Testing

1. Touch the **Analysis** top menu bar item, then touch **Pass/Fail Analysis**. The following dialog will appear at the bottom of the display.

2. Select a Source for the mask test.

3. Touch either the **Pass** or **Fail** button to set the actions to occur upon your waveform's passing or failing the test.

4. Touch the actions you want to occur: stop test, sound alarm, print result, emit pulse, or save the waveform. If you want to have the results printed, be sure that the oscilloscope is connected to a local or network printer. See Printing.

5. If you want to save your waveform automatically, touch the **Save Setup**. This will take you out of the current dialog and will open the "Save Waveform" dialog. See Saving and Recalling Signals.

Setting Up Mask Testing

1. From the "Test" dialog on the right-hand side, make a selection in the **Test is True when** group of buttons:

This selection means, for example, that if you select **All In** the test will be False if even a single waveform falls outside the mask.

2. From **Show Markers**, choose whether or not to have mask violations displayed.

3. If you are loading a pre-existing mask, touch the **Load Mask** tab, then the **File** button. You can then enter the file name or browse to its location.

4. If you want to make a mask from your waveform, touch the **Make Mask** tab.

5. Touch inside the **Ver Delta** and **Hor Delta** fields and enter boundary values, using the pop-up numeric keypad.

6. Touch the **Browse** button to create a file name and location for the mask if you want to save it.

7. Touch the **Gate** tab, then enter values in the **Start** and **Stop** fields to constrain the mask to a portion of the waveform. Or, you can simply touch and drag the Gate posts, which initially are placed at the extreme left and right ends of the grid.

UTILITIES AND PREFERENCES

Overview

The Utilities and Preferences dialogs are accessed from the top menu bar **Utilities** selection. Utilities and Preferences contain setup and other information that doesn't need to be changed or accessed frequently.

Other items are located in the various top menu bar drop-downs.

Most of the following entries correspond to labeled tabs on the **Utilities** dialog.

Status

The status read-only dialog displays system information including serial number, firmware version, and installed software and hardware options.

To Access Status Dialog

1. In the menu bar, touch **Utilities**.
2. Touch the **Status** tab.

Remote communication

The Remote dialog is where you can select a network communication protocol, establish network connections, and configure the Remote Control Assistant log. The choice of communication protocols is currently limited to TCPIP.

> **Note:** The instrument uses Dynamic Host Configuration Protocol (DHCP) as its addressing protocol. Therefore, it is not necessary to set up an IP address if your network supports DHCP. If it does not, you can assign a static address in the standard Windows network setup dialog. Consult with your IT department. The local firewall may make it difficult for you to do this on your own.

The Remote Control Assistant monitors communication between your PC and scope when you are operating the instrument remotely. You can log all events, or errors only. This log can be invaluable when you are creating and debugging remote control applications.

To Set Up Remote Communication.

If you are connecting the scope to a network, first contact your Information Systems administrator. If you are connecting the scope directly to your PC, connect an Ethernet cable between them.

1. In the menu bar touch **Utilities**, then **Utilities Setup...** in the drop-down menu.
2. Touch the **Remote** tab.
3. Make a **Port** selection:**TCPIP** (transmission control protocol/Internet protocol) is the only supported port at this time.

4. Press the **Net Connections** button; the Windows **Network and Dial-up Connections** window appears.

5. Touch **Make New Connection** and use the Windows Network Connection Wizard to make a new connection; or, touch Local Area Connection to reconfigure the scope's connection if it is already connected to the network.

To Configure the Remote Control Assistant Event Log

1. In the menu bar touch **Utilities**, then **Utilities Setup...** in the drop-down menu.

2. Touch the **Remote** tab.

3. Touch inside the **Log Mode** data entry field.

4. Select **Off**, **Errors Only**, or **Full Dialog** from the pop-up menu.

5. To export the contents of the event log to an ASCII text file, touch the **Show Remote Control Log** button: the "Event Logs" popup window appears. Touch inside the **DestFilename** data entry field and enter a file name, using the pop-up keyboard. Then touch the **Export to Text File** button.

Aux Output

The following signals can be output through the AUX OUTPUT coaxial connector on the back of the WaveSurfer Xs scope (this coaxial connector is not labeled).

🔘	Aux Output Off -- turns off the auxiliary output signal
⎍	Trigger Out -- can be used to trigger another scope
⎍	Trigger Enabled -- can be used as a gating function to trigger another instrument when the scope is ready
🛑	Pass/Fail -- allows you to set a pulse duration from 1 ms to 500 ms; generates a pulse when pass/fail testing is active and conditions are met.

To Set Up Auxiliary Output

1. In the menu bar, touch **Utilities**, then **Utilities Setup...** in the drop-down menu.

2. Touch the **Aux Output** tab.

3. Touch one of the buttons under **Use Auxiliary Output For**.

4. If you selected Pass/Fail, touch inside the **Pulse Duration** field and enter a value from 1 ms to 500 ms, using the pop-up numeric keypad.

Note: The CAL output on the front of the WaveSurfer Xs scope is always set to a 1V / 1 kHz square wave.

Date & Time

The instrument gives you the choice of manually setting the time and date or getting it from the Internet. If you elect to get the time and date from the Internet, you need to have the scope connected to the Internet through the LAN connector on the rear panel. You can also set time zones and daylight savings time.

To Set Time and Date Manually

1. In the menu bar touch **Utilities**, then **Utilities Setup...** in the drop-down menu.
2. Touch the **Date/Time** tab.
3. Touch inside each of the **Hour**, **Minute**, **Second**, **Day**, **Month**, and **Year** data entry fields and enter a value, using the pop-up numeric keypad.
4. Touch the **Validate Changes** button.

To Set Time and Date from the Internet

The Simple Network Time Protocol (SNTP) is used.

1. Ensure that the scope is connected to the Internet through the LAN connector at the rear of the scope.
2. In the menu bar touch **Utilities**, then **Utilities Setup...** in the drop-down menu.
3. Touch the **Date/Time** tab.
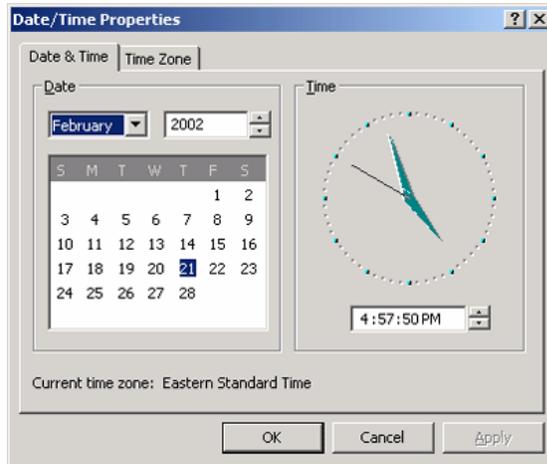4. Touch the **Set from Internet** button.

To Set Time and Date from Windows

1. In the menu bar touch **Utilities**, then **Utilities Setup...** in the drop-down menu.
2. Touch the **Date/Time** tab.
3. Touch the **Windows Date/Time** button .

4. Use the **Time & Date Properties** window to configure the time, including time zone.

Options

Use this dialog to add or remove software options. For information about software options, contact your local LeCroy Sales and Service office, or visit our Web site at http://www.lecroy.com/options.

Options that you purchase, such as **MathSurfer**, add performance to you instrument. This added performance is seen in the new math functions you can choose from when setting up the Math trace.

Service

This button provides access to service dialogs, which are for the sole use of LeCroy service personnel. A security code is required to gain access.

Show Windows Desktop

Touching the **Show Windows Desktop** button in the main "Utilities" dialog minimizes the instrument application to reveal the underlying desktop. To maximize the application, touch the shortcut icon:
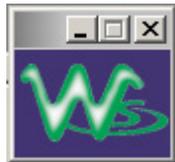
Touch Screen Calibration

Touching the **Touch-Screen Calibration** button starts the calibration procedure. During the procedure, you will be prompted to touch the center of a small cross in 5 key locations on the touch screen. Because sufficient accuracy cannot be achieved using your finger, use a stylus instead for this procedure. The calibration has a ten-second timeout in case no cross is touched.

To avoid parallax errors, be sure to place your line of sight directly in front of each cross before touching it.

Preferences

Audible Feedback

You can elect to have audible confirmation each time you touch a screen or front panel control.

1. In the menu bar touch **Utilities**; then touch **Preferences** in the drop-down menu.
2. Touch the "Audible Feedback" **Enable** checkbox so that the scope emits a beep with each touch of the screen or front panel control.

Auto-calibration

You can choose to have your instrument automatically recalibrate itself whenever there is a significant change in ambient temperature. If you do not enable this option, the scope will only recalibrate at startup and whenever you make a change to certain operating conditions.

1. In the menu bar touch **Utilities**; then touch **Preferences** in the drop-down menu.
2. Touch the "Automatic Calibration" **Enable** checkbox.

Offset Control

As you change the gain, this control allows you to either keep the vertical offset level indicator stationary (when **Div** is selected) or to have it move with the actual voltage level (when **Volts** is selected). The advantage of selecting **Div** is that the waveform will remain on the grid as you increase the gain; whereas, if **Volts** is selected, the waveform could move off the grid.

> **Note:** Regardless of whether you select **Volts** or **Div**, the "Offset" shown in the channel setup dialog always indicates volts. However, when **Div** is selected for the Offset Control, the offset in volts is scaled proportional to the change in gain, thereby keeping the division on the grid constant.

1. In the menu bar touch **Utilities**; then touch **Preferences** in the drop-down menu.
2. Touch the **Offset/Delay** tab.
3. Under **Offset Setting constant in:**, touch either the **Div** or **Volts** button.

WaveSurfer Xs Series

Local Language

The WaveSurfer Xs scope can be selected to display a user interface in a wide variety of languages. Make a selection and the WaveSurfer Xs scope will change language dynamically.

Offset/Delay Control

As you change the timebase, this control allows you to either keep the horizontal offset indicator stationary (when **Div** is selected) or to have it move with the trigger point (when **Time** is selected). The advantage of selecting **Div** is that the trigger point will remain on the grid as you increase the timebase; whereas, if **Time** is selected, the trigger point could move off the grid.

> **Note:** Regardless of whether you select **Time** or **Div**, the "Delay" shown in the timebase setup dialog always indicates time. However, when **Div** is selected for Delay In, the delay in time is scaled proportional to the change in timebase, thereby keeping the division on the grid constant.

1. In the menu bar touch **Utilities**; then touch **Preferences** in the drop-down menu.
2. Touch the **Offset/Delay** tab.
3. Under **Offset Setting constant in:**, touch either the **Volts** or **Div** button.
4. Under **Delay Setting constant in:**, touch either the **Time** or **Div** button.

E-mail

Before you can send e-mail from the scope, it must first be configured.

1. In the menu bar touch **Utilities**, then **Preference Setup...** in the drop-down menu.
2. Touch the **E-mail** tab.
3. Choose an e-mail server protocol: **MAPI** (Messaging Application Programming Interface) is the Microsoft interface specification that allows different messaging and workgroup applications (including e-mail, voice mail, and fax) to work through a single client, such as the Exchange client included with Windows 95 and Windows NT. MAPI uses the default Windows e-mail application (usually Outlook Express). **SMTP** (Simple Mail Transfer Protocol) is a TCP/IP protocol for sending messages from one computer to another through a network. This protocol is used on the Internet to route e-mail. In many cases no account is needed.
4. If you chose MAPI, touch inside the **Originator Address (From:)** data entry field and use the pop-up keyboard to type in the instrument's e-mail address. Then touch inside the **Default Recipient Address (To:)** data entry field and use the pop-up keyboard to enter the recipient's e-mail address.
5. If you chose SMTP, touch inside the **SMTP Server** data entry field and use the pop-up keyboard to enter the name of your server. Touch inside the **Originator Address (From:)** data entry field and use the pop-up keyboard to type in the instrument's e-mail address. Then touch inside the **Default Recipient Address (To:)** data entry field and use the pop-up keyboard to enter the recipient's e-mail address.
6. You can send a test e-mail text message by touching the **Send Test Mail** button. The test message reads "Test mail from [name of scope's e-mail address]."

Acquisition Status

For each general category of scope operation, you can view a summary of your setups. These dialogs are not accessible through the Utilities dialog, but are instead accessed from the menu bar drop-down menus. The categories are as follows:

- Vertical -- select **Channels Status . . .** from drop-down menu
- Timebase -- select **Acquisition Status . . .** from drop-down menu
- Trigger -- select **Acquisition Status . . .** from drop-down menu
- Math -- select **Math Status . . .** from drop-down menu

In addition to these dialogs, summaries are also provided for XY setups, memory (M1-M4) setups, and time stamps for sequence mode sampling.

REMOTE CONTROL OPERATION

Refer to the *Remote Control Manual* supplied on CD with your scope for more information.

You can fully control your instrument remotely. The only actions for which you must use the front panel controls are the powering up of the scope and the setting of remote control addresses.
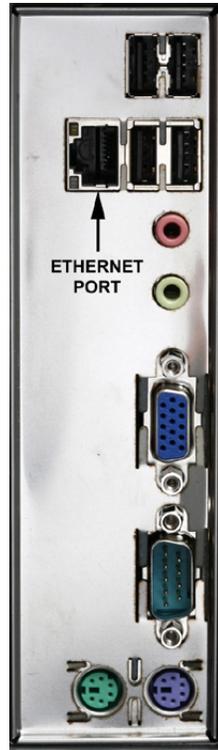
Standards

LeCroy remote control commands conform to the GPIB IEEE 488.2[1] standard. This may be considered an extension of the IEEE 488.1 standard.

Program Messages

You control the oscilloscope remotely using program messages that consist of one or more commands or queries. The program messages you send from the external controller to the WaveSurfer Xs scope oscilloscope must conform to precise format structures. The oscilloscope will execute all program messages sent in the correct form, but will ignore those with errors.

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[1]*ANSI/IEEE Std. 488.2–1987,* IEEE Standard Codes, Formats, Protocols, and Common Commands. *The Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, NY 10017 USA*

AUTOMATION

Refer to the *Automation Manual* supplied on CD with your scope for more information.

In addition to supporting the familiar ASCII-based "GPIB" remote commands, the WaveSurfer Xs scope instruments fully support control by Automation interfaces based on Microsoft's Component Object Model (COM). Using COM, the controlling application can run directly on the instrument without requiring an external controller; or, alternatively, it can run using Microsoft's distributed COM standard (DCOM) on a networked computer.

Standards

Automation is a Microsoft technology, formerly referred to as "OLE Automation," that has primarily been used to enable cross-application macro programming. It is based upon the Component Object Model (COM).

An application that "exposes Automation Objects" is referred to as an "Automation Server." Automation Objects expose "Automation Interfaces" to the controlling "Automation Client." The manual describes these Automation objects and interfaces in detail.

It is important to note that Automation itself is not software language dependent; it can be used from any programming language that supports COM. LeCroy's usage, however, concentrates mainly on the use of Automation from the Visual Basic Script (VBScript) language, primarily because it is easy to use, it is the language that the WaveSurfer Xs scope uses for setup files, and VBScript interpreter is installed by default on all WaveSurfer Xs scope instruments and, therefore, is available without your having to purchase any additional software.

SYSTEM RECOVERY

Your WaveRunner Xi series oscilloscope was designed to operate very reliably for many years. However, the application software that operates the instrument runs on a Windows platform. The loading or incomplete removal of additional Windows applications may eventually cause problems in the stability of the operating system. In severe cases, it may be necessary to reload the base operating system and oscilloscope application. This can be done by using a recovery routine to restore a clean copy of the image originally installed on the C: drive. Any user data and calibration data located within the D: partition will not be affected by the recovery process.

LeCroy has provided a recovery application, along with a backup image, in an extra partition on the instrument's hard drive. The recovery process is easy to perform, using the instructions provided below.

After the recovery procedure is done, you must activate Windows, either by internet connection to Microsoft's Web site or by telephone. For this you will need to supply the Windows Product Key number, which is affixed to the bottom of the scope.

Note: The recovery process will produce a replica of the operating system and oscilloscope application software at the revision levels that were current when the oscilloscope was manufactured. Any later revisions of the application software, Windows operating system, and virus scan definition files will not be loaded automatically. After completion of the disk image recovery, it is highly recommended that you search the vendors' Web sites to upgrade the individual components to their current revision level. The current oscilloscope application software can be downloaded directly from the LeCroy Web site at www.lecroy.com.

Since the calibration data for the oscilloscope is stored in the D: drive, the current calibration constants will be preserved during the recovery process.

Recovery Procedure

1. Connect an network cable to the LAN port at the rear of the scope if you intend to activate windows through the internet.
2. Connect a keyboard and a mouse to the scope.
3. Apply power to the scope.
4. As soon as the LeCroy logo appears on the screen, press and hold down the **F4** key until the recovery software logo appears momentarily:
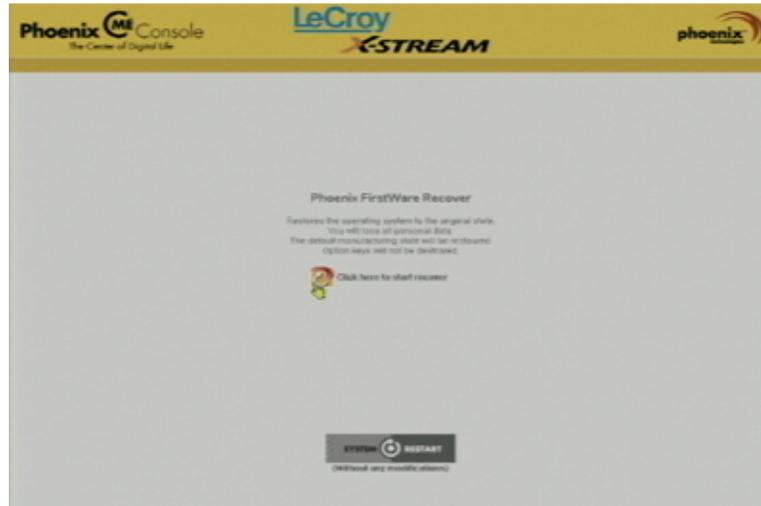
5. Then the cME console End User License Agreement is displayed. Read the agreement, and click **Accept**:

6. The Phoenix cME Console main page is displayed. Click **Click here to start recover**:
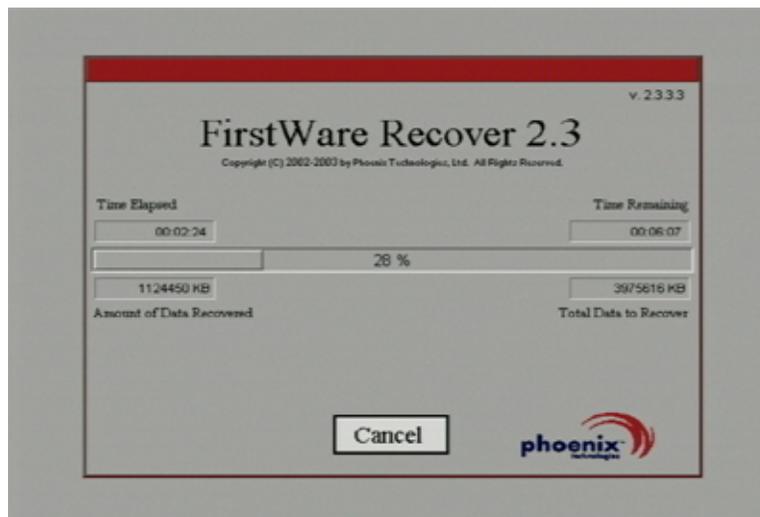
7. The FirstWare Recover splash screen is displayed momentarily:

8. The recovery starts, and the FirstWare Progress screen is displayed. No further selections are required. The recovery takes about 10 minutes.

Note: The screen will blank on occasion for prolonged periods. This is normal and is not an indication of any malfunctioning of the recovery process.

9. After the recovery is completed, the X-Stream software installer screen appears. Click **Next** to continue:
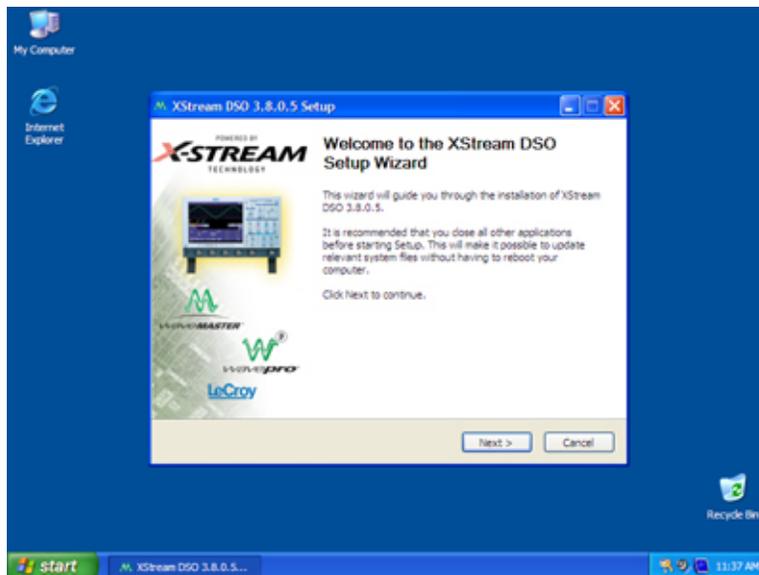
10. When the X-Stream installation is completed, reboot the scope.

Now you must activate Windows by internet connection to Microsoft's Web site or by telephone. For this you will need to supply the Windows Product Key number, which is affixed to the bottom of the scope.

Windows Activation

1. Click **Start** in the task bar, then select **All Programs → Activate Windows**.

Note: After Windows Activation is completed, this selection will no longer appear in the All Programs menu.
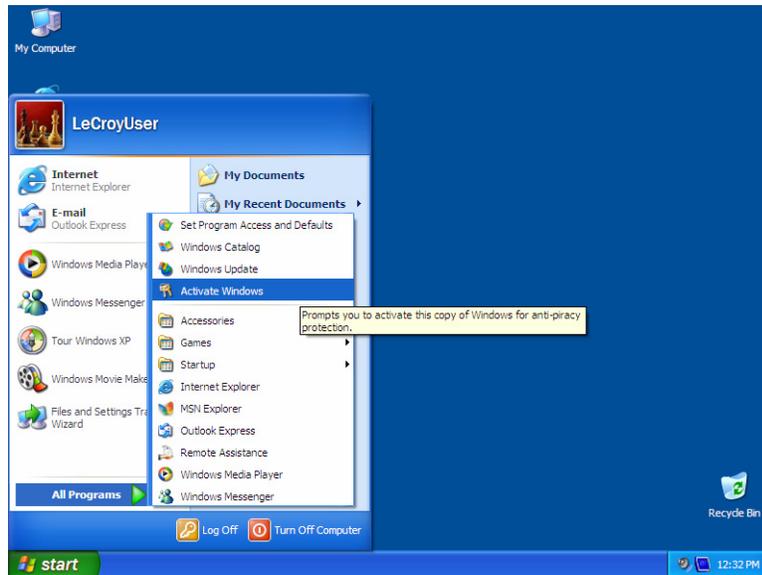
2. Select an activation method: internet or phone. Then click **Next**.
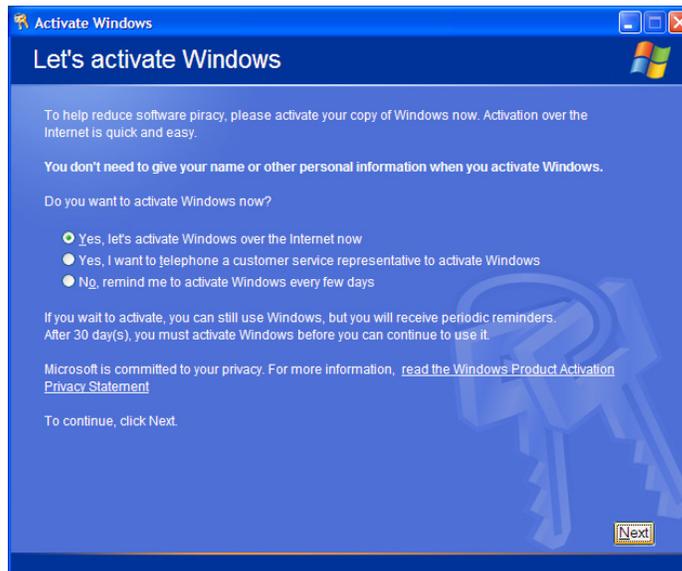
3. If you elected to activate by internet, enter the Activation ID (Product Key number on the bottom of the scope) number when prompted to do so, then click **Next**. Windows Activation will begin.

4. If you elected to activate by phone, select the country the scope is located in. Then dial the number provided. You will be asked to repeat over the phone the installation ID listed on the screen; then a 7-part number will be provided to you to enter in the empty boxes at the bottom of the screen. Click **Next** when you are done.

5. When activation is completed, an acknowledgement screen will appear. Click **OK**.
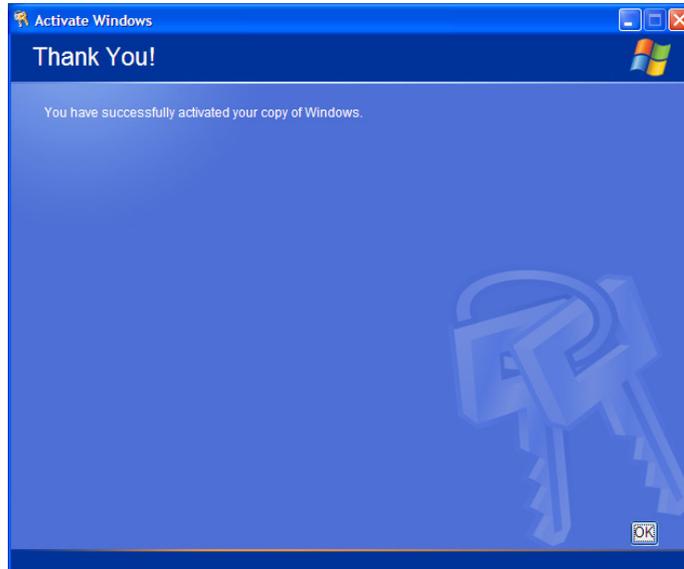
6. Check the revision levels of the X-Stream software, virus definitions, and Windows updates. Visit the vendors' Web sites and download all necessary updates.

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