LeCroy

Getting Started Manual

WaveAce

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WaveAce

Oscilloscope

Getting Started Manual
August, 2008

LeCroy Corporation

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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.

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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.

Internet: www.lecroy.com

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Welcome

Thank you for purchasing a LeCroy WaveAce product. This Getting Started Manual includes important safety and installation information for your WaveAce Series oscilloscope, along with operating procedures to get you started capturing, viewing, and analyzing your waveforms.

This WaveAce Getting Started Manual provides information in the following manner:

- ***Getting to Know WaveAce*** - First, we acquaint you with your new instrument.This section contains information on the **Hardware** (explaining the physical features of your new instrument), **Basic Controls** (demonstrating the relationship between some front panel and screen layout controls), and **Probes** (explaining Probe connections).
- ***Viewing Waveforms*** - Covers turning on traces and setting up your display. It also provides information on using the Auto Setup feature.
- ***Vertical Settings and Channel Controls*** - Provides step-by-step procedures for defining you vertical settings and channel controls, such as limiting bandwidth, adjusting sensitivity and inverting waveforms.
- ***Sampling Modes*** - Covers setting acquisition sampling modes, acquiring waveforms, and setting the timebase.
- ***Triggering*** - Provides step-by-step procedures for the five trigger types - edge, pulse, video, slope, and alternative.
- ***Analyzing Waveforms*** - Lists waveform measurements and parameter measurements. Also provides procedures for using Math functions.
- **Save and Recall** - Provides step-by-step procedures for saving and recalling scope setups, waveforms, and reference waveforms. Also provides procedures for saving data, saving and printing pictures, and recalling factory settings.
- ***Utilities*** - Covers the Utility functions, such as viewing system status.
- ***Reference*** - This section includes important safety information and specifications for the WaveAce Series Oscilloscopes.

Support

When your WaveAce Series Oscilloscope is delivered, 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.If you have any problems with your product, please refer to the Technical Support contacts at the end of this ***Getting Started Manual***. You can also refer to additional support materials at www.lecroy.com, or the Online Help files in your instrument.

Thank You

We truly hope these materials provide increased comprehension when using LeCroy's fine products.

Sincerely,

David C. Graef

LeCroy Corporation
*Vice President and Chief Technology Officer*

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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

Where the following symbols 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 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 Standby (power) switch. When it is pressed, the oscilloscope's state toggles between operating and Standby mode. This switch is not a disconnect device. The instrument can only be placed in a complete Power Off state by unplugging the power cord from the AC supply.
∼	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 with an ambient temperature within the range of +10 °C to 40 °C.

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

⚠️ **WARNING**

The oscilloscope must not be operated in explosive, dusty, or wet atmospheres.

⚠️ **CAUTION**

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

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 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.

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PLEASE NOTE THE FOLLOWING:

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

Cooling

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 rear of the oscilloscope. Ensure adequate ventilation by leaving the required 10 cm (4 inch) minimum gap around the sides and rear of the instrument.

⚠️ **CAUTION**

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

⚠️ **CAUTION**

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

AC Power Source

100 to 240 Vrms (+/-10%) AC at 50/60/400 Hz; Installation Category: 300V CAT II

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

Maximum Power Consumption: 50 VA

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

Voltage Range:	90 to 264 VAC
Frequency Range:	45 to 440 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.

WARNING - Electrical Shock Hazard

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

Intentional interruption is prohibited.

The oscilloscope should be positioned to allow easy access to the socket-outlet. Disconnect the oscilloscope from the AC supply by unplugging the instrument's power cord from the AC outlet after the oscilloscope is placed in Standby state.

CAUTION

The outer shells of the front panel BNC terminals (CH1, CH2, EXT TRIG) 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.

Avoid electrical shock hazard by unplugging the power cord from the AC outlet before cleaning.

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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 oscilloscope's protection has been impaired, disconnect the power cord and secure the instrument against any unintended operation.

The oscilloscope'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 oscilloscope 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.

Getting to Know WaveAce

Hardware

Front Panel

 The WaveAce Series oscilloscopes provide an easy-to-use front panel. The control buttons are logically grouped. The following provides an explanation of the front panel buttons and knobs.

1. Power button
2. USB port
3. Menu On/Off, Menu Option buttons and Print button
4. Front Panel Controls
5. Channel inputs, External Trigger input, Probe connect

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Back Panel

Numbered labels on this graphic correspond with descriptions in the table.

1. Pass/Fail Output
2. RS-232 Connector
3. Back USB Connector

Side Panel

The WaveAce side panel is located on the left side (facing the front of the instrument). The Power input is located on the side panel as follows:
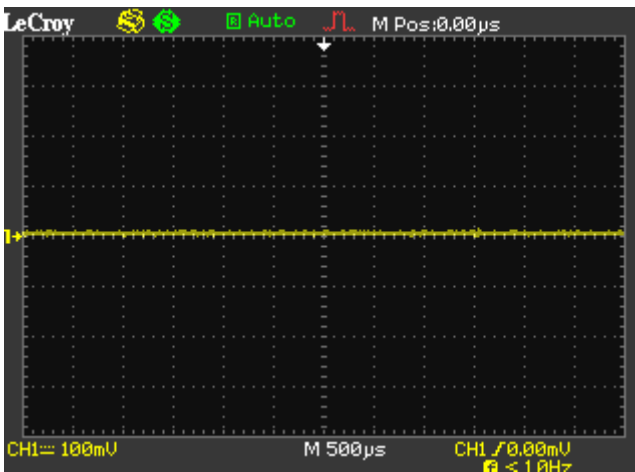
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Basic Controls

Powering Up Your WaveAce

1. Power On the oscilloscope by pressing the power button on the top left (facing) the instrument.

2. The LeCroy **Splash** screen is shown. Press any key to continue (or, after a brief period the grid display is shown).


3. The **Grid Display** is shown.

Front Panel Controls

INTENSITY/ADJUST KNOB

- **Intensity/Adjust knob** - You can use the **Adjust** knob with many functions, such as adjusting the holdoff time, moving cursors, setting the pulse width, setting the video lineage adjusting the upper and lower frequency limits, adjusting X and Y masks when using the Pass/Fail function, etc. You can also turn the **Adjust** knob to adjust the storage position of setups, waveforms, pictures when saving/recalling and to select menu options.

MENU CONTROL BUTTONS
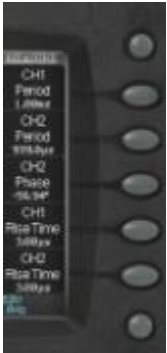
- **MENU ON/OFF** - Press to toggle the last-displayed menu On/Off.
- **Menu Option buttons (1-5)** - Press to choose menu options. Press a menu option button adjacent to your selection.
- **Print** - Press to save the current waveform to an attached USB memory device or print a picture (screen shot) to a USB-connected printer. You can set up the save/print options using the **Save/Recall → Picture** settings. For more information, refer to **Saving and Printing Waveform Pictures**.

- **CURSORS** - Press to turn on the cursors and display the **Cursor** menu. You can use the **Cursor** menu to set the Cursor Mode (**Auto**, **Off**, **Manual**, **Track**). When Cursors are on (**CURSORS** button is lit), turn the **Adjust knob** to position the cursors.
- **ACQUIRE** - Press to display **Acquire** menu. You can use the **Acquire** menu to set the acquisition Sampling Mode (**Sampling**, **Peak Detect**, **Average**). For more information on sampling modes, refer to **Acquisition Sampling Modes**.
- **SAVE/RECALL** - Press to display the **Save/Recall** menu. You can use the **Save/Recall** menu to save and recall up to 20 scope setups or waveforms in internal memory (up to 20 waveforms) or on a USB memory device (limited by memory capacity of USB device). You can also use it to recall the default factory settings, to save waveform data as a comma-delimited file (.CSV), and to save or print the displayed waveform image.
- **MEASURE** - Press to display a menu of measurement parameters. The **Display Type** must be set to **YT** mode. For more information on measurement parameters, refer to **Parameter Measurements**.
- **DISPLAY** - Press to open the **Display** menu. You can use the **Display** menu to set grid and waveform display styles, and persistence.
- **UTILITY** - Press to open the **Utility** menu. You can use the **Utility** menu to configure WaveAce features, such as sound, language, counter, etc. You can also view system status and update software.

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- **HELP** - Displays context-sensitive online help. Press Help than another front panel button and information about that button will be displayed.
- **DEFAULT SETUP** - Press to reset the oscilloscope's settings to the default factory configuration. For a list of default settings, see **Recalling Factory Settings**.
- **AUTO** - Press to have the oscilloscope automatically identify the type of waveform and adjust the controls to produce a usable display of the input signal. When you press the AUTO front panel button, the Auto Set menu opens. You can use this menu to display multiple-cycle signals, a single-cycle signal, the rising edge, the falling edge or recall the previous setup.

RUN CONTROL BUTTONS

- **SINGLE** - Press to acquire a single waveform. Each time you press the **SINGLE** button, the oscilloscope acquires another waveform. When the oscilloscope detects a trigger it completes the acquisition and stops.
- **RUN/STOP** - Press when you want the oscilloscope to acquire waveforms continuously. Press **RUN/STOP** again to stop the acquisition,

- **Volts/Div knobs** (CH1/CH2)- Turn to adjust the volts/division setting (vertical gain) of the corresponding channel (CH1 or CH2). Press the knob to toggle between fine (variable) and coarse (fixed) adjustments.
- **Channel buttons** (CH1/CH2) - Press a channel button (CH1 or CH2) to turn that channel ON or OFF and open the **Channel** menu for that channel. You can use the **Channel** menu to set up a channel. When the channel is ON, the channel button is lit.
- **Vertical Position knobs** (CH1/CH2) - Turn to adjust the vertical position of the corresponding channel (CH1 or CH2). Press to set the vertical position to zero.
- **REF** - Press to display the **Ref Wave** menu. You can use this menu to save and recall two reference waveforms (REFA and REFB) in internal memory.
- **MATH** - Press to display the **Math** menu. You can use the **Math** menu to use the oscilloscopes Math functions.

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- **Horizontal Position knob** - Turn to adjust the horizontal position of all channels and math waveforms (the position of the trigger relative to the center of the screen). The resolution of this control varies depending on the timebase setting. Press to set the horizontal position to zero.
- **HORI MENU** - Press to display the **Horizontal** menu. You can use the **Horizontal** menu to display the waveform and to zoom a segment of a waveform.
- **Time/Div knob** - Turn to change the horizontal time scale to magnify or compress the waveform. When Window Zone is enables, it changes the width of the Window Zone by changing the window timebase. WhenTime/Div control is set to 100 ms/div or slower and the trigger mode is set to Auto, the oscilloscope enters the scan acquisition mode. In this mode, the waveform display updates from left to right. There is no trigger or horizontal position control of waveforms during scan mode.

TRIGGER CONTROLS

- **TRIG MENU** - Press to display the **Trigger** menu. You can use the **Trigger** menu to set the trigger type (**Edge**, **Pulse**, **Video**, **Slope**, **Alternative**) and trigger settings.
- **SET TO 50%** - Press to stabilize a waveform quickly. The oscilloscope can set the Trigger Level to be halfway between the minimum and maximum voltage levels automatically. This is useful when you connect a signal to the EXT TRIG connector and set the trigger source to Ext or Ext/5.
- **FORCE** - Press to complete the current waveform acquisition whether the oscilloscope detects a trigger or not. This is useful for SINGLE acquisitions and Normal trigger mode.
- **LEVEL** - Turn to select the trigger threshold level. Press the **Level** front panel knob to set the trigger level to zero.

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Probes

LeCroy provides a passive probe for each WaveAce oscilloscope channel.

Probe Compensation

Passive probes must be compensated to flatten overshoot. This is accomplished by means of a trimmer on the probe body.

1. Attach the connector end of your probe to any channel.
2. Connect the probe end to the CAL output connector at the front of the scope.
3. Adjust the trim pot on the probe body until the square wave is as flat as possible.
4. Set the Probe option attenuation to 10X by pressing the **Channel** button and then the **Probe** menu button.
5. Set the switch to 10X on the probe.
6. Attach the probe tip to the **PROBE COMP∼3V** connector and the reference lead to the **PROBE COMP Ground** connector. Press the corresponding channel button, and then push the **AUTO** button.
7. Check the shape of the displayed waveform as follows:
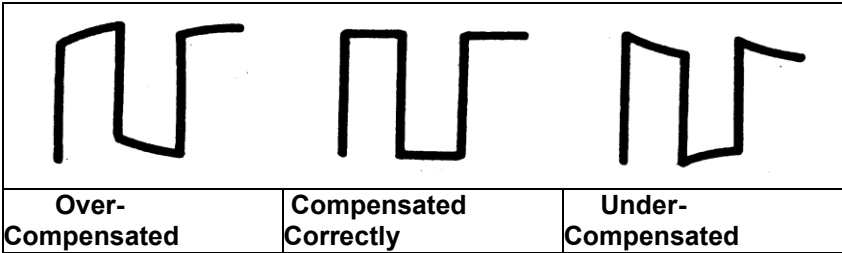
Over-Compensated	Compensated Correctly	Under-Compensated

Setting Probe Attenuation

Probes are available with various attenuation factors which affect the vertical scale of the signal. Push the **Channel** button and then the **Probe** menu option button. Attenuation options for **1X**, **10X**, **100X**, and **1000X** are available as follows:
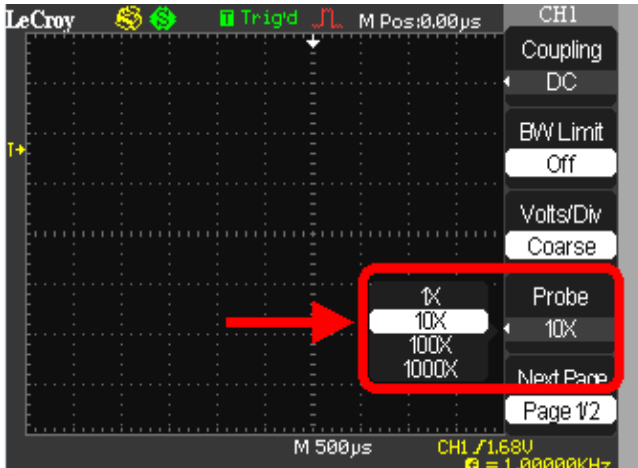
Select the attenuation that matches your probe.

PLEASE NOTE THE FOLLOWING:

- The default setting for the Probe option is 1X.
- Be sure that the Attenuation switch on the probe matches the Probe option in the oscilloscope. Switch settings are 1X and 10X.
- When the Attenuation switch on the probe is set to 1X, the system bandwidth is limited to 6MHz. To use the full bandwidth of the oscilloscope, be sure to set the switch to 10X.

Viewing Waveforms

Turning On Traces

To turn on a channel trace, simply press the channel front panel button (CH1 or CH2). When you turn on a channel, the **Channel** flyout menu opens. You can then set up the vertical settings and controls for the channel. When the channel is ON, the channel button is lit.
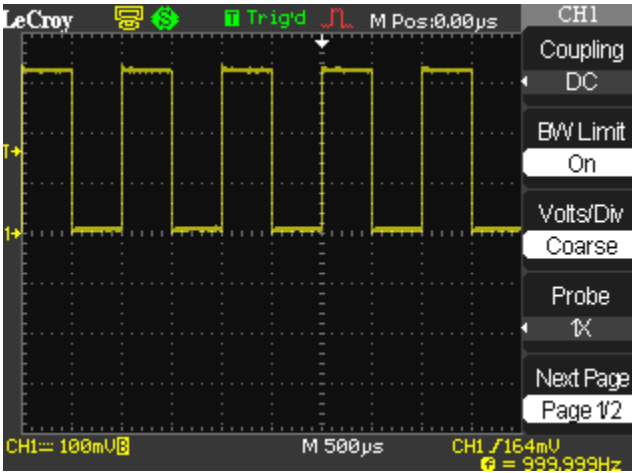
Note: To turn a trace off, press the channel front panel button again.

Setting Up the Display

You can access the Display menu pressing the **DISPLAY** front panel button.
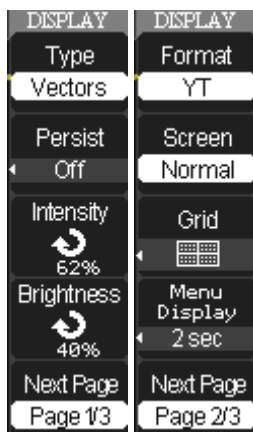
Option:	Description:
Type	**Vectors** fills the space between adjacent sample points in the display. **Dots** displays sample points directly.
Persist	Sets the length of time (1 sec, 2 sec, 5 sec, Infinite) each displayed sample point remains displayed.
Intensity	Turn the **Universal** front panel knob to set the Intensity.
Brightness	Turn the **Universal** front panel knob to set the screen brightness.
Format	Choose between **YT** format and **XY** format.
Screen	Set to Normal mode or Inverted color display mode.
Grid	Display grids and axes, turn off grids, or turn off grids and axes.
Menu Display	Set the length of time the menus will be displayed on the screen (2 seconds, 5 seconds, 10 seconds, 20 seconds, or infinite).

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Understanding Display Information

The grid area contains several indicators to help you understand the display. Indicators are coded to the channel colors).

|	
1	**Back USB** - Indicates whether the Back USB option is set to **Computer** or **Printer**. 🖥 **Back USB** option is set to **Computer** 🖴 **Back USB** option is set to **Printer**
2	**Print Key** - Indicates whether the **Print Key** option is set to **Print Picture** or **Save Picture**. 📇 **Print Key** option is set to **Print Picture** 📇 **Print Key** option is set to **Save Picture**
3	**USB Memory Device** - Indicates whether the USB Memory Device is inserted in the USB Port. 🖉 USB Memory Device is not inserted in the USB Port. 🖋 USB Memory Device is inserted in the USB Port.
4	**Trigger Status** ■ Armed - The oscilloscope is acquiring pre-trigger data. All triggers are ignored in this state. Ⓡ Ready - The oscilloscope is ready to trigger.

|	
	■ Trig'd - The oscilloscope has found a trigger and is acquiring the post-trigger data.
	● Stop - The oscilloscope has stopped acquiring waveform data.
	● Acq. Complete - The oscilloscope has completed a Single Sequence acquisition.
	ℝ Auto - The oscilloscope is in Auto Mode and is acquiring waveforms in the absence of triggers.
	■ Scan - The oscilloscope is acquiring and displaying waveform data continuously in Scan Mode.
5	**Acquisition Sampling Mode** ᴡᴸᴡ Sample Mode ᴡᴸᴡ Peak Detect Mode ⌐Ⴠ Average Mode
6	Horizontal Trigger Position Readout - Displays the waveform's horizontal position in time (seconds).
7	Horizontal Trigger Position Marker - Shows the horizontal trigger position.
8	Display Markers (Zero Volts Level) - Show the ground reference points of the displayed waveforms. If there is no marker, the channel is not displayed.
9	Display Signal Source
10	Signal Coupling symbol
11	Volts/Division
12	Indicates whether the bandwidth limiting filter is On or Off. The "B" icon indicates that the filter is On.
13	Main timebase setting (Note that a Window timebase setting is also displayed if applicable)
14	Trigger Source
15	Frequency Counter of Trigger Signal
16	Trigger Type and level indicator

Auto Setup

The WaveAce Series Digital Storage Oscilloscopes has an Auto Setup function that identifies the waveform type and automatically adjusts controls to produce a usable display of the input signal. Four Auto Setup waveform options are available: **Multi-Cycle**, **Single-Cycle**, **Rising Edge**, and **Falling Edge**. Press the **AUTO** front panel button, and then press the menu optoin button adjacent to the desired waveform as follows:
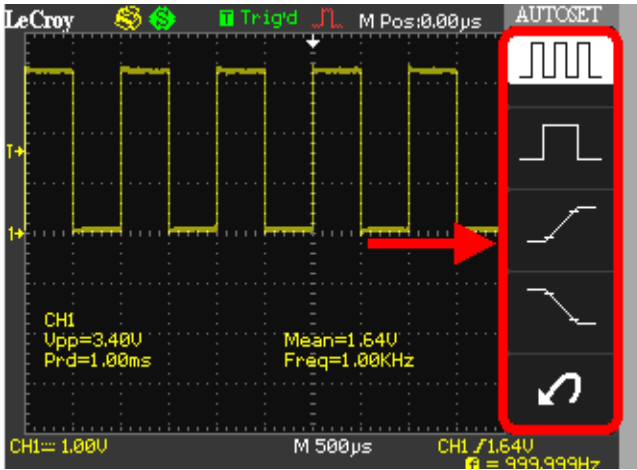
Note: Use the waveform menu button to Undo an applied Auto Setup.

Option	Description
⎍⎍⎍⎍ （Multi-cycle）	Auto set the screen and display several cycle signal.
⎍� （Single-cycle）	Set the screen and auto display single cycle signal.
╱ （Rising edge）	Auto set and show the rising time.
╲ （Falling edge）	Auto set and show the falling time.
↰ （Undo Setup）	Causes the oscilloscope to recall the previous setup.

Vertical Settings and Channel Controls

When you turn a channel trace ON, the **Channel** flyout menu opens. The **Channel** menu page shown (1/2 or 2/2) will be the one that was displayed when the trace was last turned on.

| CH1	CH1
Coupling	Invert
◄ DC	Off
BW Limit	
On	
Volts/Div	Filter
Coarse	
Probe	
◄ 1X	
Next Page	Next Page
Page 1/2	Page 2/2

Choosing Coupling

You can choose one of these input coupling modes:

- **DC** - Passes both AC and DC components of the input signal.
- **AC** - Blocks the DC component of the input signal and attenuates signals below 10 Hz.
- **GND** - Disconnects the input signal. Use GND coupling to display a zero-volt waveform. Internally, the channel input is connected to a zero-volt reference level.

PLEASE NOTE THE FOLLOWING:

- If the channel is set to DC coupling, you can quickly measure the DC component of the signal by simply noting its distance from the ground symbol.
- If the channel is set to AC coupling, the DC component of the signal is blocked allowing you to use greater sensitivity to display the AC component of the symbol.
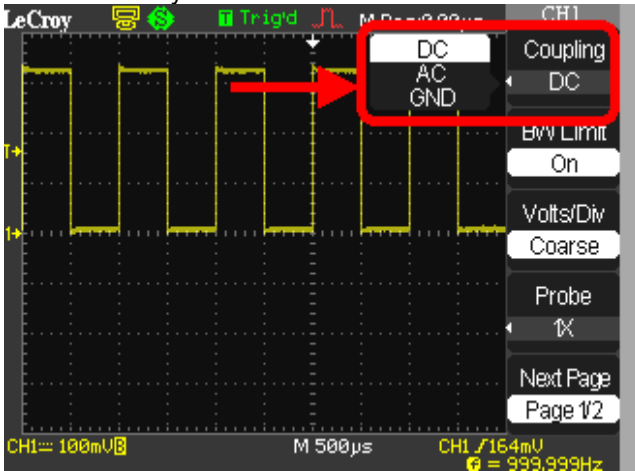

1. To choose an input coupling mode, turn on the channel whose coupling you want to change by pressing the appropriate channel button (CH1 or CH2).
2. Press the **Coupling** option button on page 1/2 of the channel menu, then select a coupling mode from the menu.

Limiting Bandwidth

You can limit the bandwidth to reduce display noise. When you turn Bandwidth Limit ON, the Bandwidth Limit value is set to 20 MHz. It also filters the signal to reduce noise and other unwanted high frequency components.

Note: The oscilloscope vertical response rolls off slowly above its bandwidth; or, above 20 MHz when the Bandwidth Limit is set to ON. Therefore, the FFT spectrum can show valid frequency information higher than the oscilloscope bandwidth. However, the magnitude information near or above the bandwidth will not be accurate.
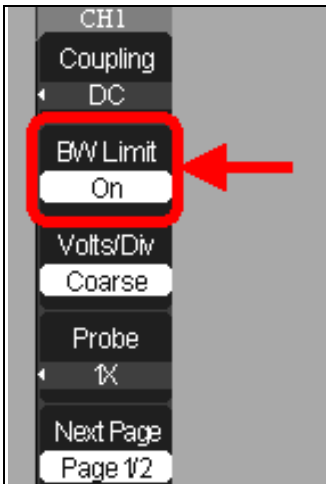
To turn the Bandwidth Limit ON, turn on the channel by pressing the appropriate channel button (CH1 or CH2).
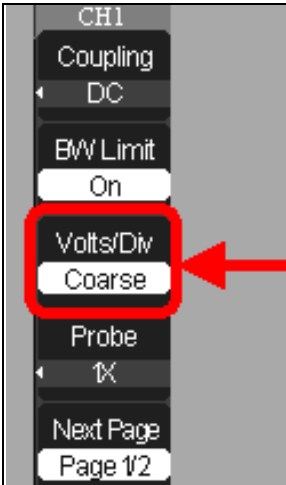
Press the **BW Limit** option button on page 1/2 of the channel menu, then select **On**.

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Adjusting Sensitivity

You can set the sensitivity of the **Volts/Div** front panel knob. When you set the sensitivity to **Coarse** (fixed - the default setting), the gain adjustment is set to 1-2-5 increments from 2 mV/div, 5 mV/div, 10 mV/div to 5 V/div. When you set the sensitivity to **Fine** (variable), it changes the resolution to small steps between the coarse settings.

Note: The vertical scale readout displays the actual **Volts/Div** setting when **Fine** (variable) is selected. Changing the setting to **Coarse** (fixed) does not change the vertical scale until the **Volts/Div** control is adjusted.


1. To set the sensitivity of the Volts/Div front panel knob, turn on the channel by pressing the appropriate channel button (CH1 or CH2).

2. Press the **Volts/Div** option button on page 1/2 of the channel menu, then select **Coarse (fixed)** or **Fine (variable)**.

Setting Probe Attenuation

Probes are available with various attenuation factors which affect the vertical scale of the signal. Select the attenuation that matches your probe. Attenuation options are **1X**, **10X**, **100X**, and **1000X.**
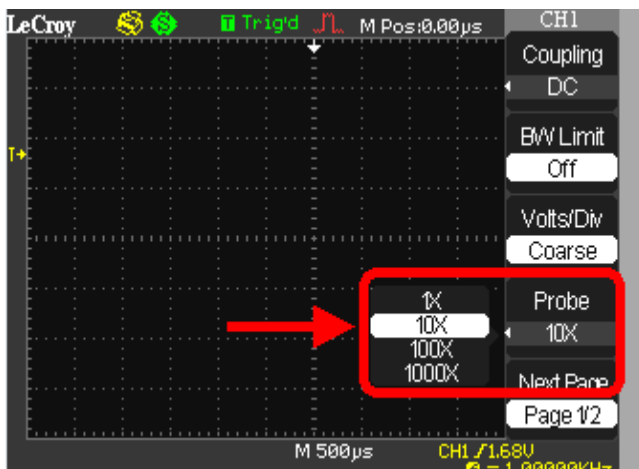
PLEASE NOTE THE FOLLOWING:

- The default setting for the Probe option is 1X.
- Be sure that the Attenuation switch on the probe matches the Probe option in the oscilloscope. Switch settings are 1X and 10X.
- When the Attenuation switch is set to 1X, the probe limits the bandwidth of the oscilloscope to 6MHz. To use the full bandwidth of the oscilloscope, be sure to set the switch to 10X.

Inverting Waveforms
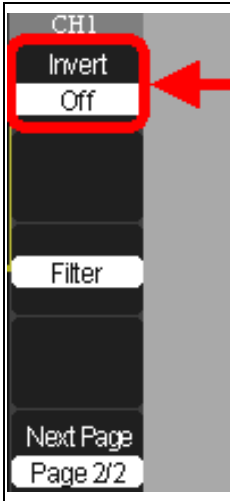
1. To invert the waveform, turn on the channel by pressing the appropriate channel button (CH1 or CH2).
2. On the channel menu, press the **Next Page** option button to go to page 2/2.
3. Press the **Invert** option button on page 2/2, then select **On**.

Using the Digital Filter

You can choose from the following digital filter types:

⌐⌐↦f Low Pass Filter (LPF)

∟⌐↦f High Pass Filter (HPF)

∟⌐↦f Band Pass Filter (BPF)

⌐⌐↦f Band Stop Filter

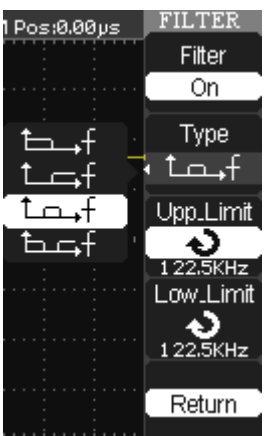|	
Pos:0.00μs FILTER **Filter** **On** **Type** **⌐⌐↦f** **Upp.Limit** **↻** **122.5KHz** **Low.Limit** **↻** **122.5KHz** **Return**	1. To turn on the digital filter, press the appropriate channel button (CH1 or CH2). 2. On the channel menu, press the **Next Page** option button to go to page 2/2. 3. Press the **Filter** option button on page 2/2. The **Filter** menu opens. 4. Press the **Filter** option button and select **On**. 5. Press the **Type** option button and select a digital filter type. 6. Press the **Upp. Limit** option button and turn the **Adjust** front panel knob to set the Upper limit. 7. Press the **Low. Limit** option button and turn the **Adjust** front panel knob to set the Lower limit.

Note: If you select the Low Pass Filter (LPF) type, you can set an Upper Limit only. If you select the High Pass Filter (HPF) type, you can set a Lower Limit only. For both Band Pass Filter (BPF) and Band Stop Filter, you can set both an Upper and Lower Limit.

Sampling Modes

Acquisition Sampling Modes

When you acquire a signal, the oscilloscope converts it into a digital form and displays a waveform. The acquisition sampling mode defines how the signal is digitized and the timebase setting affects the time span and level of detail in the acquisition. You can change the Sampling modes by pressing the ACQUIRE front panel button.

There are three basic sampling modes:

- **Sampling**- samples the signal in evenly-spaced intervals to construct the waveform.

  > **Note:** You can use this mode to reduce random noise. This mode does not acquire rapid variation in the signal that may occur between samples. This can result in narrow pulses being missed. In this case, you can use **Peak Detect** mode to acquire data.

- **Peak Detect** - captures the maximum and minimum values that occur in a signal. It finds the highest and lowest record points over many acquisitions.

  > **Note:** The oscilloscope can acquire and display narrow pulses, which may otherwise have been missed in Sampling mode. Noise will appear to be higher in this mode.

- **Average** - acquires up to 256 waveforms, averages them, and displays the resulting waveform.

  > **Note:** You can use this mode to reduce random noise.

In addition, you can also choose between **Equivalent Time Sampling** and **Real Time Sampling**.

- **Equivalent Time Sampling** can achieve up to 20 ps of horizontal resolution (equivalent to 50 GS/s). This mode is good for observing repetitive waveforms.
- **Real Time Sampling** can be used for repetitive and non-repetitive waveforms.
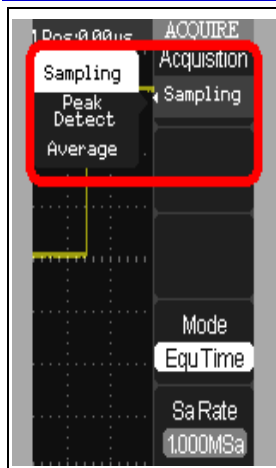
To choose a sampling mode, press the **ACQUIRE** front panel button. On the **Acquire** menu, press the **Acquisition** option button and select a sampling mode. If you select the **Average** sampling mode, press the **Averages** option button and select the number of waveforms (4, 16, 32, 64, 128, or 256).

Press the **Mode** option button and select **Equ Time** or **Real Time** sampling.

Press the **Sa Rate** option button and turn the **Time/div** front panel knob to display the sampling rate at the corresponding timebase scale.

Acquiring Waveforms

You can choose to acquire a single waveform or to acquire waveforms continuously. If you want to acquire a single waveform, press the **SINGLE** front panel button. Each time you press the **SINGLE** front panel button, the oscilloscope begins to acquire another waveform. After the oscilloscope detects a trigger, it completes the acquisition and stops. If you want to acquire waveforms continuously, press the **RUN/STOP** front panel button. Press the button again to stop the acquisition.

When you start an acquisition, the oscilloscope goes through the following steps:

1. Acquires enough data to fill the portion of the waveform record to the left of the trigger point (pre-trigger).
2. Continues to acquire data while waiting for the trigger condition to occur.
3. Detects the trigger condition.
4. Continues to acquire data until the waveform record is full.
5. Displays the waveform.

Changing the Timebase

The oscilloscope digitizes waveforms by acquiring the value of an input signal at discrete points. The timebase allows you to control how often the values are digitized. You can change the timebase using the **Time/div** front panel knob in the **Horizontal Control** group. As you turn the **Time/div** front panel knob, the value is displayed at the bottom of the screen.

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Zooming Waveforms

You can use the **Window Zone** option on the **Horizontal** menu to define a segment of a waveform to see more detail. The Window timebase setting cannot be set slower than the Main timebase setting. You can turn the **Horizontal Position** and **Time/Div** front panel knobs to zoom in/out in Window Zone.

HORIZON Main Win Zone Window	1. Press the **HORI MENU** front panel button. The **Horizon** menu opens. 2. Press the **Win Zone** option button. 3. Turn the **Time/Div** front panel knob to adjust the window size. 4. Turn the **Horizontal Position** front panel knob to adjust the window's position. 5. Press the **Window** option button. The waveform is expanded.

Triggering

Trigger Types

There are five trigger types: Edge, Video, Pulse, Slope, and Alternative. You can access trigger modes by pressing the **TRIG MENU** front panel button in the Trigger control group and selecting **Type** from the **Trigger** menu.

Edge Triggering
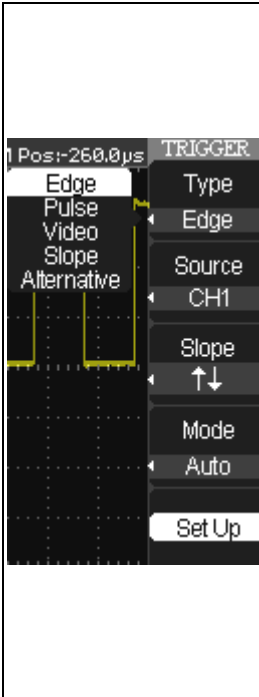
	1. Press the **Type** menu option button and select **Edge**.
	2. Press the **Source** option button to choose a channel input or external input.
	3. Use **Slope** to select a positive or negative edge for Edge Triggering (rising edge, falling edge, or both).
	4. Press the **Mode** option button to select **Auto**, **Normal**, or **Single** mode. Use **Auto** mode to let the acquisition automatically run in the absence of a trigger. Use **Normal** mode when you want to see only valid triggered waveforms (when you use this mode the oscilloscope does not display a waveform until after the first trigger). Use **Single** mode when you want the oscilloscope to acquire a single waveform.
	5. Press the **Setup** option button to display the **Trigger Setup** menu. You can use the **Trigger Setup** menu to select a coupling mode and define a **Holdoff** value. **Coupling** modes comprise **DC**, **AC**, **HF Reject**, and **LF Reject**. Turn the **Adjust** front panel knob to set the **Holdoff** value.

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Pulse Triggering

Use Pulse width triggering to trigger on aberrant pulses. You can select how to compare the trigger pulse relative to the pulse width as follows:

⎍⎡ Positive pulse width less than pulse width setting

⎍⎍ Positive pulse width larger than pulse width setting

⎍⎍ Positive pulse width equal to pulse width setting

⎤⎦ Negative pulse width less than pulse width setting

⎣⎦ Negative pulse width larger than pulse width setting

⎣⎦ Negative pulse width equal to pulse width setting

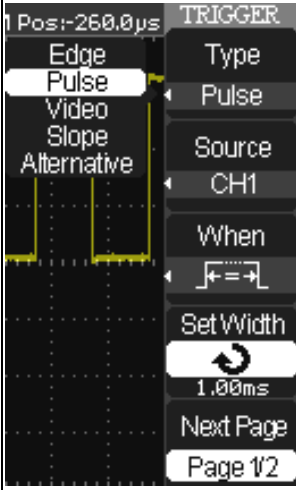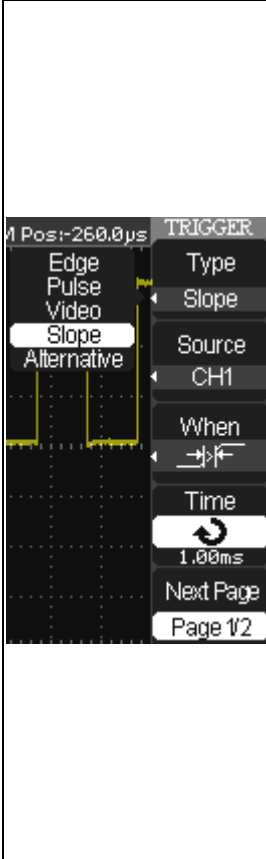|	

1 Pos:-260.0µs **TRIGGER**
Edge   Type
Pulse
Video   ◄ Pulse
Slope
Alternative Source
                    ◄ CH1
 	
                    When
                    ◄ ⌐⊏=⊐⌐
 	
                    Set Width
                    ↻
                    1.00ms
                    Next Page
                    Page 1/2
	1. Press the **Type** option button and select **Pulse**.
	2. Press the **Source** option button to choose a channel input or external input.
	3. Press the **When** option button to select how to compare the trigger pulse relative to the value selected in the Set Width option.
	4. Press the **Set Width** option button and then turn the **Adjust** front panel knob to set the pulse width.
	5. Press the **Next Page** option button.
	6. Press the **Mode** option button to select **Auto**, **Normal**, or **Single** mode. Use **Auto** mode to let the acquisition automatically run in the absence of a trigger. Use **Normal** mode when you want to see only valid triggered waveforms (when you use this mode the oscilloscope does not display a waveform until after the first trigger). Use **Single** mode when you want the oscilloscope to acquire a single waveform.
	7. Press the **Setup** option button to display the **Trigger Setup** menu.

Video Triggering

Use Video Triggering to trigger on fields or lines of standard video signals.

|	
	1. Press the **Type** option button and select **Video**.
	2. Press the **Source** option button to choose a channel input or external input.
	3. Press the **Polarity** option button and select ⊓ (Normal) or ⊔ (Inverted). Normal triggers on the negative edge of the sync pulse. Inverted triggers on the positive edge of the sync pulse.
TRIGGER Type ◄ Video Source ◄ CH1 Polarity ⊓ Sync ◄ All Lines Next Page Page 1/2	4. Press the **Sync** option button and select a video sync (**Line Num**, **All Lines**, **Odd Field**, **Even Field**). If you select **Line Num**, you can turn the **Adjust** front panel knob to set the appointed line number. 5. Press the **Next Page** option button. 6. Press the **Standard** option button and select the video standard for sync and line number count (NTSC or Pal/Secam). 7. Press the **Mode** option button to select **Auto**, **Normal**, or **Single** mode. Use **Auto** mode to let the acquisition automatically run in the absence of a trigger. Use **Normal** mode when you want to see only valid triggered waveforms (when you use this mode the oscilloscope does not display a waveform until after the first trigger). Use **Single** mode when you want the oscilloscope to acquire a single waveform. 8. Press the **Setup** option button to display the **Trigger Setup** menu. You can use the **Trigger Setup** menu to select a coupling mode and define a **Holdoff** value. **Coupling** modes comprise **DC**, **AC**, **HF Reject**, and **LF Reject**. Turn the **Adjust** front panel knob to set the **Holdoff** value.

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Slope Triggering

Use Slope Triggering to trigger on the positive slope or negative slope depending on the trigger conditions and time you set.

M Pos:-260.0µs TRIGGER Edge Pulse Video **Slope** Alternative Type Slope Source CH1 When ⇥⊩⊢ Time ↻ 1.00ms Next Page Page 1/2	1. Press the **Type** option button and select **Slope**. 2. Press the **Source** option button to choose a channel input or external input. 3. Press the **When** option button to select the trigger condition. 4. Press the **Time** option button and then turn the **Adjust** front panel knob to set the slope time. 5. Press the **Next Page** option button. 6. Press the **Vertical** option button and select the trigger level that can be adjusted using the **Level** front panel knob. You can adjust Level A, Level B, or adjust both at the same time. 7. Press the **Mode** option button to select **Auto**, **Normal**, or **Single** mode. Use **Auto** mode to let the acquisition automatically run in the absence of a trigger. Use **Normal** mode when you want to see only valid triggered waveforms (when you use this mode the oscilloscope does not display a waveform until after the first trigger). Use **Single** mode when you want the oscilloscope to acquire a single waveform. 8. Press the **Setup** option button to display the **Trigger Setup** menu. You can use the **Trigger Setup** menu to select a coupling mode and define a **Holdoff** value. **Coupling** modes comprise **DC**, **AC**, **HF Reject**, and **LF Reject**. Turn the **Adjust** front panel knob to set the **Holdoff** value.

Alternative Triggering

The trigger signal comes from two vertical channels when you use Alternative Triggering. Using this type of trigger, you can observe two unrelated signals at the same time. For each signal, you can select different trigger types, such as Edge, Pulse, Slope, or Video. Trigger information for the two channels is displayed at the bottom right side of the display.
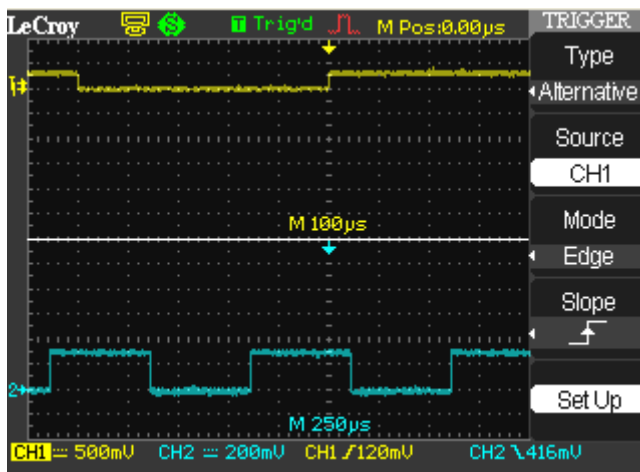

1. Press the **Type** option button and select **Alternative**.
2. To set up both triggers, press the **Source** option button and select a Source (**CH1**, **CH2**).
3. For the selected Source, press the **Mode** option button and select a Trigger Type (**Edge**, **Pulse**, **Slope**, or **Video**).
4. For the selected trigger type, set the trigger options.
5. Press the **Setup** option button to display the **Trigger Setup** menu. You can use the **Trigger Setup** menu to select a coupling mode and define a **Holdoff** value. Coupling modes comprise **DC**, **AC**, **HF Reject**, and **LF Reject**. Turn the **Adjust** front panel knob to set the Holdoff value.

Analyzing Waveforms

Waveform Measurements

Measuring with Cursors

Cursors are important tools that aid you in measuring signal values. Cursors are boundary markers that you can move across the grid. Use cursors to make fast, accurate measurements and to eliminate guesswork.
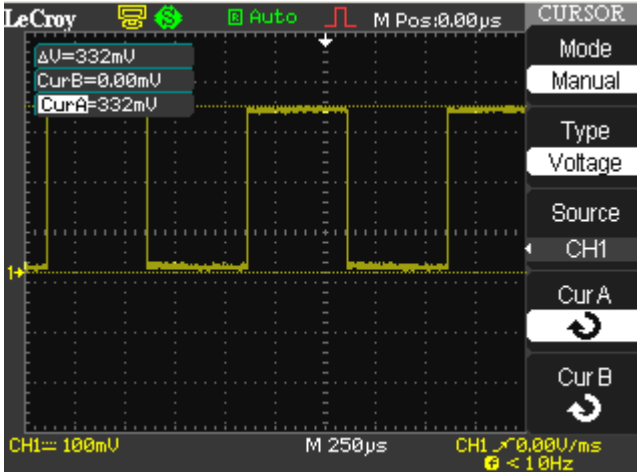

There are three cursor measurement modes:

- **Manual** - displays two horizontal parallel cursors or vertical parallel cursors to measure voltage or time. Voltage cursors appear as horizontal lines on the display and measure the vertical parameters. Time cursors appear as vertical lines on the display and measure the horizontal parameters. You can move the cursor by turning the **Adjust** front panel knob. Before using cursors, you should make sure that you have set the signal source as the channel for measuring.
- **Track** - displays two cross-cursors. The cross-cursors set the position on the waveform automatically. You can adjust the cursor position on the waveform by turning the **Adjust** front panel knob. The values are displayed on the top of the grid display.
- **Auto** - Automatically places markers of what is being measured on the waveform. These markers clarify parameter measurements by displaying cursors and a visual representation of what is being measured. When in Auto cursor mode, as you select measurement parameters the markers will be displayed for the measurements.

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- Time cursors are vertical lines that you move horizontally to measure the difference in time or frequency values between the cursors.
- Voltage cursors appear as horizontal lines on the display and measure the vertical parameters.
- The measurement values listed on the top of the grid display are as follows:

  A→T - the horizontal position of Cursor A (Time cursor centered around the midpoint of the screen)

  A→V - the vertical position of Cursor A (Voltage cursor centered around the channel ground level)

  B→T - the horizontal position of Cursor B (Time cursor centered around the midpoint of the screen)

  B→V - the vertical position of Cursor B (Voltage cursor centered around the channel ground level)

  ▲T - Horizontal space between Cursor A and Cursor B (Time value between the two cursors)

  1/▲T - the reciprocal of the horizontal space between Cursor A and Cursor B

  ▲V - the vertical space between Cursor A and Cursor B (Voltage value between the two cursors)

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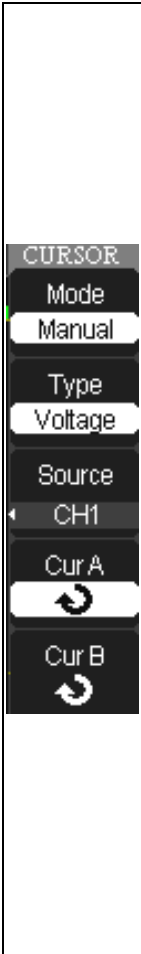
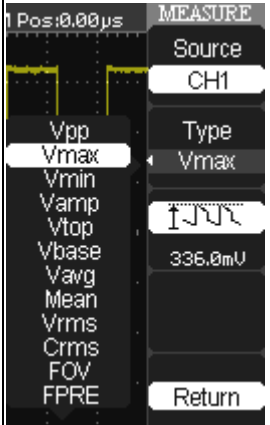|	
CURSOR Mode Manual Type Voltage Source CH1 Cur A ↺ Cur B ↺	1. Press the **CURSORS** front panel button. The **Cursor** menu opens. 2. If you want to set the mode to Manual, press the **Mode** option button and select **Manual**. Press the **Type** option button and select **Voltage** or **Time**. Press the **Source** option button and select a source (**CH1**, **CH2**, **MATH**, **REFA**, or **REFB**). Press the **CurA** or **CurB** option button and turn the **Adjust** front panel knob to adjust the cursors. *OR* If you want to set the mode to Track, press the **Mode** option button and select **Track**. Press the **Cursor A** or **Cursor B** option button and select a source. Press the **CurA** or **CurB** option button and turn the **Adjust** front panel knob to adjust the cursors. If Track is selected, both cursors move in unison and both appear brighter in the grid. *OR* If you want to set the mode to Auto, press the **Mode** option button and select **Auto**. When you select measurement parameters using the **MEASURE** front panel button, the cursors are automatically displayed. The measurement values are displayed on the top right corner. The cursor selected for placement is indicated by a highlighted fine grain icon in the menu and the cursor itself has a higher brightness in the grid.

Parameter Measurements

Waveform analysis typically begins with the measurement of parameters. Parameter measurement tools determine a wide range of waveform properties. Use them to automatically calculate many attributes of your waveform, like rise time, rms voltage, and peak-to-peak voltage, for example.

You can access the parameter measurements by pressing the **MEASURE** front panel button and then pressing an option button for **Voltage**, **Time**, **Delay** or **All Measurements** for each channel. Parameter values are displayed on the **Measure** flyout menu.

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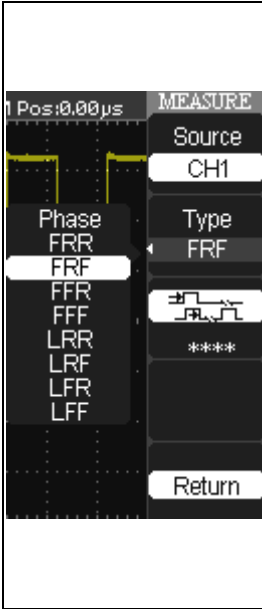
- **Vpp** - Difference between highest and lowest points in the waveform.
- **Vmax** - Measures highest point in waveform. Unlike top, it does not assume the waveform has two levels.
- **Vmin** - Measures the lowest point in a waveform. Unlike base, it does not assume the waveform has two levels.
- **Mean** - Average of the data for a time domain waveform. Computed as centroid of distribution for a histogram.
- **Vrms** - Root Mean Square of data between the cursors -- about the same as sdev for a zero-mean waveform.
- **Crms** - Cyclic root mean square: Computes the square root of the sum of squares of data values divided by number of points. Contrary to rms, calculation is performed over an integer number of cycles, eliminating bias caused by fractional intervals.
- **Vtop** - Higher of two most probable states, the lower being base; it is characteristic of rectangular waveforms and represents the higher most probable state determined from the statistical distribution of data point values in the waveform.
- **Vbase** - Lower of two most probable states (higher is top). Measures lower level in two-level signals. Differs from min in that noise, overshoot, undershoot, and ringing do not affect measurement.
- **Vavg** - Arithmetic mean over the first cycle in the waveform.
- **Vamp** - Voltage between Vtop and Vbase of a waveform.
- **ROVShoot** - (Vmax-Vtop)/Vamp after the waveform rising transition.
- **FOVShoot** - (Vmin-Vbase)/Vamp after the waveform falling transition.
- **RPREShoot** - (Vmin-Vbase)/Vamp before the waveform rising transition.
- **FPREShoot** - (Vmax-Vtop)/Vamp before the waveform falling transition.

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TIME MEASUREMENT PARAMETERS

(measurement menu image)	• **Period** ⊔ ⊓ - Period of a cyclic signal measured as time between every other pair of 50% crossings. Starting with first transition after left cursor, period is measured for each transition pair, with values averaged to give final result. • **+Wid** ⊓ - Time between the first rising edge and the next rising edge at the waveform 50% level. • -**Wid** ⊔ - Time between the first falling edge and the next rising edge at the waveform 50% level. • **Rise Time** ⌐ - Duration of pulse waveform's rising transition from 10% to 90%, averaged for all rising transitions between the cursors. • **Fall Time** ⌐ - Duration of pulse waveform's falling transition from 90% to 10%, averaged for all falling transitions between the cursors. • **BWid** ⊓⊔⊓ - Duration of a burst measured over the entire waveform. • **+Dut** ⊓⊔ - Ratio between positive pulse width and period. • **-Dut** ⊔⊓ - Ratio between negative pulse width and period.

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1 Pos:0.00µs MEASURE Source CH1 Phase FRR FRF FFR FFF LRR LRF LFR LFF Type FRF **** Return	• **Phase** - Amount one waveform leads or lags another in time expressed in degrees, where 360 degrees comprise one waveform cycle. • **FRR** - Time between the first rising edge of Source 1 and the first rising edge of Source 2. • **FRF** - Time between the first rising edge of Source 1 and the first falling edge of Source 2. • **FFR** - Time between the first falling edge of Source 1 and the first rising edge of Source 2. • **FFF** - Time between the first falling edge of Source 1 and the first falling edge of Source 2. • **LRR** - Time between the first rising edge of Source 1 and the last rising edge of Source 2. • **LRF** - Time between the first rising edge of Source 1 and the last falling edge of Source 2. • **LFR** - Time between the first falling edge of Source 1 and the last rising edge of Source 2. • **LFF** - Time between the first falling edge of Source 1 and the last falling edge of Source 2.

Waveform Math

Standard math functions include addition, subtraction, multiplication, division, and FFT. For more information on FFT, see the **FFT** section. Press the **MATH** front panel button in the **Vertical Control** group to display the **Math** menu.

MATH Operation - CH1-CH2 CH2-CH1 CH1 Invert Off CH2 Invert Off	1. Press the **Operation** option button and select a math operator **+**, **-**, *****, **/**, or **FFT**. 2. The **Source** can be any channel, but not another math trace. If you choose subtraction, you can choose **CH1-CH2** or **CH2-CH1**. If you choose division, you can choose **CH1/CH2** or **CH2/CH1**. 3. If you want to invert a waveform, press the **CH1Invert** or **CH2Invert** option button and select **On**.

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FFT

The FFT process mathematically converts a time-domain signal into its frequency components. You can display only one FFT waveform at a time. You can choose to display the FFT waveform and the channel waveform on the screen (split screen) or to display the FFT waveform full screen. You can choose from four Window types:

Window Type	Description	Test Content
Rectangular	Best frequency resolution, worst magnitude resolution. This is essentially the same as no window.	Symmetric transients or bursts. Equal-amplitude sine waves with fixed frequencies. Broadband random noise with a relatively slowly varying spectrum.
Hanning	Better frequency, poorer magnitude accuracy than Rectangular.	Sine, periodic, and narrow-band random noise. Asymmetric transients or bursts.
Hamming	Better frequency, poorer magnitude accuracy than Rectangular. Hamming has slightly better frequency resolution than Hanning.	Sine, periodic, and narrow-band random noise. Asymmetric transients or bursts.
Blackman	Best magnitude, worst frequency resolution.	Single frequency waveforms to find higher order harmonics.

1. To set up an FFT math function, press the **MATH** front panel button. The **Math** menu is displayed.
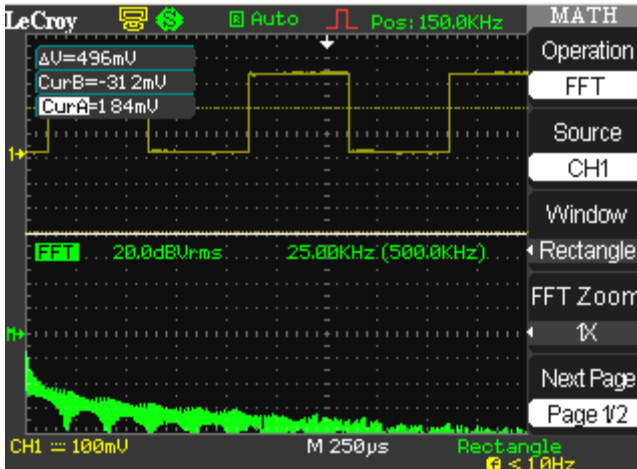
2. Press the **Operation** menu option button and select **FFT**.
3. Press the **Source** menu option button and select a source (**CH1**, **CH2**) for the FFT waveform.
4. Press the **Window** menu option button and select a type of window (**Rectangle**, **Hanning**, **Hamming**, or **Blackman**).
5. Press the **FFT Zoom** menu option button and select a zoom factor (**1X**, **2X**, **5X**, or **10X**).
6. Press the **Next Page** menu option button to go to page 2/2.
7. Press the **Scale** menu option button and select **Vrms** or **dBVrms**.
8. Press the **Display** menu option button and select **Split** to display the FFT waveform on the bottom half of the screen or **Full** screen to display the FFT waveform on the full screen.

Save and Recall

Saving and Recalling Scope Setups

You can quickly save and recall up to 20 scope panel settings and 20 waveforms in internal memory. Waveforms and panel settings can also be save to a USB memory device.

Saving the Current Settings

SAVE/REC
Type
Setups
Save To
Device
Setup
◄ No.2
Save
Recall
	1. Press the **Save/Recall** front panel button. The **SAVE/REC** flyout menu opens.
	2. Press the **Type** option button and select **Setups**.
	3. If you want to save the setup to internal memory, press the **Save To** option button to select **Device**. Press the **Setup** option button or turn the **Adjust** front panel knob to assign a number (No. 1 - No. 20) to the setup.
	
	  OR
	
	  If you want to save the setup to a USB memory device, insert the USB memory device and press the **Save To** option button to select **File**. Press the **Setup** option button or turn the **Adjust** front panel knob to select a file number (for example, No.00002).
	4. Press the **Save** option button to save the current setup.

Recalling Setups

1. Press the **Save/Recall** front panel button. The **SAVE/REC** flyout menu opens.
2. Press the **Type** option button and select **Setups**.
3. If you want to recall the setup from internal memory, press the **Save To** option button to select **Device**. Press the **Setup** option button or turn the **Adjust** front panel knob to select the number assigned to the setup you want to recall.

    OR

    If you want to recall the setup from a USB memory device, insert the USB memory device and press the **Save To** option button to select **File**. Press the **Setup** option button or turn the **Adjust** front panel knob to select the number assigned to the file you want to recall.
4. Press the **Recall** option button to recall the setup.

Saving and Recalling Waveforms

You can quickly save waveforms in internal memory (up to 20 waveforms) or on a USB memory device (limited by memory capacity of USB device). You can display up to three waveforms at the same time. You can easily recall these saved waveforms later.

Saving Waveforms

SAVE/REC
Type
Waveforms
Save To
Device
Waveform
◄ No.1
 	
Save
 	
Recall
	1. Display the waveform(s) you want to save and press the **Save/Recall** front panel button. The **SAVE/REC** flyout menu opens.
	2. Press the **Type** option button and select **Waveforms**.
	3. If you want to save the waveform to internal memory, press the **Save To** option button to select **Device**. Press the **Waveform** option button or turn the **Universal** front panel knob to assign a number (No. 1 - No. 20) to the waveform.
	
	    OR
	
	    If you want to save the waveform to a USB memory device, insert the USB memory device and press the **Save To** option button to select **File**. Press the **Waveform** option button or turn the **Universal** front panel knob to select a file number (for example, No.00002).
	4. Press the **Save** option button to save the waveform.

Recalling Waveforms

1. Press the **Save/Recall** front panel button. The **SAVE/REC** flyout menu opens.
2. Press the **Type** option button and select **Waveforms**.
3. If you want to recall the waveform from internal memory, press the **Save To** option button to select **Device**. Press the **Waveform** option button or turn the **Universal** front panel knob to select the number assigned to the waveform you want to recall.

    OR

    If you want to recall the waveform from a USB memory device, insert the USB memory device and press the **Save To** option button to select **File**. Press the **Waveform** option button or turn the **Universal** front panel knob to select the number assigned to the file you want to recall.
4. Press the **Recall** option button to recall the waveform.

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Saving and Recalling Reference Waveforms

You can save two reference waveforms (REFA and REFB) in internal memory. You can easily recall these saved reference waveforms later. You cannot adjust the horizontal position and scale of the reference waveform, but the oscilloscope does display the horizontal and vertical scales at the bottom of the display.

Note: X-Y mode waveforms are not stored as reference waveforms.

Saving Reference Waveforms

REF WAV Source CH1 REF A Save REF A Off	1. Press the **REF** front panel button. The **REF WAV** flyout menu opens. 2. Press the **Source** option button to select the input signal channel. 3. Press the **REFA/REFB** option button to set the storage location (REFA or REFB). 4. Press the **Save** option button to save the reference waveform. Once you have saved a reference waveform, it becomes available for display.

Recalling Reference Waveforms

1. Press the **REF** front panel button. The **REF WAV** flyout menu opens.
2. Press the **REFA/REFB** option button to choose which reference waveform (REFA or REFB) you want to recall.
3. Press the **REFA/REFB On/Off** option button to select **REFA On** or **REFB On**.

Saving Data (.CSV)

You can save waveform data as a comma-delimited (.CSV) file. You can then use this information in other applications, such as Microsoft Excel. The .CSV file contains the data points (horizontal and vertical information) of the displayed waveform. You can also choose to save these parameters to the .CSV file:

- Record Length
- Sample Interval
- Trigger Point
- Vertical Units
- Vertical Scale
- Vertical Offset
- Horizontal Units
- Horizontal Scale
- Model Number
- Serial Number
- Software Version

Saving the .CSV file

SAVE/REC Type CSV Data Depth Maximum Para Save Off CSV No.00001 Save	1. Press the **Save/Recall** front panel button. The **SAVE/REC** flyout menu opens. 2. Press the **Type** option button and select **CSV**. 3. Press the **Data Depth** option button and select **Maximum** or **Displayed**. 4. Press the **Para Save** option button and select **On** or **Off**. 5. Press the **CSV** option button or turn the **Adjust** front panel knob to select the file number assigned to the .CSV file you want to save. 6. Press the **Save** option button to save the current setup.

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Saving and Printing Waveform Pictures

You can save a waveform image (.BMP) file to a USB memory device or print a waveform image to a USB-connected printer. Once you have set up your print options and connected the device to the USB port, you can press the Print front panel button to save or print the image.

SAVE/REC Type Picture Print Key Save Picture Picture No.00015 Save	1. Press the **Save/Recall** front panel button. The **SAVE/REC** flyout menu opens. 2. Press the **Type** option button and select **Picture**. 3. If you want to print the displayed waveform, press the **Print Key** option button and select **Print Picture**. Be sure a printer is connected to your WaveAce. *OR* If you want to save the displayed waveform, press the **Print** Key option button and select **Save Picture**. Be sure a USB memory device is connected before saving the image. Press the **Picture** option button or turn the Universal front panel knob to select the number for the .BMP file you want to save. Press the **Save** option button to save the displayed waveform.

PLEASE NOTE THE FOLLOWING:

- Once you have set up your save and/or print options, press the **Print** front panel button to save or print the displayed waveform.
- You have to set the **Back USB** option on the **Utility** menu to **Computer** if you want to save bitmap pictures or **Printer** if you want to print the pictures.

Recalling Factory Settings

The oscilloscope is set up for normal operation when it is shipped from the factory. The default settings are as follows:

Menu	Option	Default
CH1/CH2	Coupling	DC
	BW Limit	Off
	Volts/div adjust	Coarse (fixed)
	Probe	1X
	Invert	Off
	Volts/div	1.00V
MATH	Operation	CH1-CH2
	CH1 Invert	Off
	CH2 Invert	Off
	FFt operation:	
	Source	CH1
	Window	Hanning
	FFT Zoom	1X
	Scale	dBVrms
HORIZONTAL	Window	Main
	Position	0.00μs
	Sec/div	500μs
	Window Zone	50.0μs
	Trigger Knob	level
CURSOR	Type	Off
	Source	CH1
	Horizontal (voltage)	+/-3.2divs
	Vertical (time)	+/-5divs
MEASURE	Source	CH1
	Type	average
ACQUIRE	Mode	Sampling
	Averages	16
DISPLAY	Type	Vectors
	Persist	Off
	Grid	
	Menu Display	2 secs
REF	Type	Waveform
	Source	CH1
TRIGGER (Edge)	Type	Edge
	Source	CH1
	Slope	Rising

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Menu	Option	Default
	Mode	Auto
	Coupling	DC
	Level	0.00V
TRIGGER (Pulse)	Type	Pulse
	Source	CH1
	When	=
	Set Pulse Width	1.00ms
	Mode	Auto
	Coupling	DC
TRIGGER (Video)	Type	Video
	Source	CH1
	Polarity	Normal
	Sync	All Lines
	Standard	NTSC
TRIGGER (Slope)	Type	Slope
	Source	CH1
	Mode	Auto
TRIGGER (Alternative)	Type	Alternative
	Source	CH1

The DEFAULT SETUP button does not reset the following settings:

- Language option
- Saved reference waveform files
- Saved setup files
- Display contrast
- Calibration data

There are two ways to recall the factory settings:

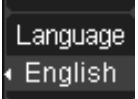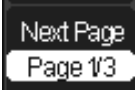1. Press the **Default Setup** front panel button.

   OR
2. Press the **Save/Recall** front panel button. The **SAVE/REC** flyout menu opens. Press the Type option button and select Factory.

Utilities
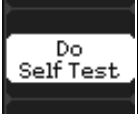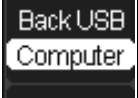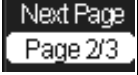
Utility Menu

You can use the **Utility** menu to configure your oscilloscope. Press the **UTILITY** front panel button to display the **Utility** menu.

Utility Menu - Page 1/3

UTILITY **System Status**	Press the **System Status** option button to display a summary of the oscilloscope settings. For more information, see the **System Status** section.
Sound ◁◊<	Press the **Sound** to turn ON/OFF sound when you press a key.
Counter On	Turn the Frequency **Counter** ON/OFF.
Language ◂ English	**Language** lets you choose a UI local language.
Next Page Page 1/3	Press the **Next Page** option button to display page 2/3.

Utility Menu - Page 2/3

UTILITY **Do Self Cal**	Press the **Do Self Cal** option button to perform a self-calibration. When you start a self-calibration, you should disconnect everything from all inputs.
Do Self Test	Press the **Do Self Test** option button to perform a screen test, keyboard test, and/or an LED test.
Print Setup	Press the **Print Setup** option button to set up your print options.
Back USB Computer	Press **Back USB** and select **Computer** if you are connecting to a computer using the USB connector or **Printer** if you are connecting to a printer using the USB connector.
Next Page Page 2/3	Press the **Next Page** option button to display page 3/3.

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UTILITY Update Firmware Pass/Fail Record IO Setting Next Page Page 3/3	Press the **Update Firmware** option button to update the oscilloscope using the USB memory device. For more information, see the **Updating the System Software** section.
	Press the **Pass/Fail** option button to monitor changes of signals and output pass or fail signals by judging whether the input signal is within the predefined mask.
	Press the **Record** option button to record the input waveform from CH1 and CH2, with a maximum record length of 2500 frames. You can record the pass/fail test output, which is especially useful when capturing abnormal signals over a long period of time without having to watch the signal. You set the source, the time interval between record frames, and the maximum number of record frames.
	Press the **IO Setting** option button to set up the band rate (300, 2400, 4800, 9600, 19200, 38400).
	Press the **Next Page** option button to display page 1/3.

System Status

View the oscilloscope's hardware and software configuration as follows:

1. Press the **Utility** front panel button.
2. On the **Utility** flyout menu, press the **System Status** menu option button as follows:
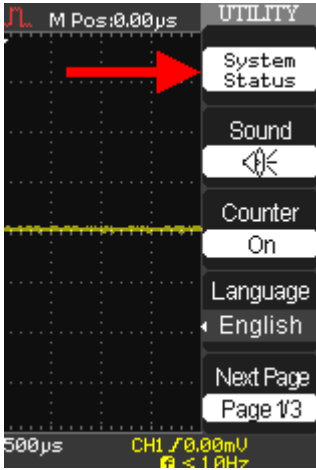
3. The System **Status Information** screen is then shown. Press the **SINGLE** front panel button to exit the **Status Information** screen.

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Updating the System Software

System software updates are downloaded through the USB memory port in the front of the oscilloscope.

1. Insert the USB memory device containing the software update in the USB port on the front of the scope.
2. Press the front panel **Utility** button.
3. Press the **Next Page** menu option button to navigate to menu page **3/3**. Select the **Update Firmware** menu option button as follows:

> **Note**: WaveAce reminds you to verify the firmware product type matches the instrument. Also, to verify the firmware update file is stored in the root directory of the USB memory device.

Now, press the **SINGLE** front panel button to begin updating the firmware or the **RUN/STOP** front panel button to exit.

Reference

Specifications

Vertical System	WA102	WA112	WA202	WA212	WA222	WA232
Bandwidth	60 MHz	100 MHz	60 MHz	100 MHz	200 MHz	300 MHz
Rise Time (Typical)	<5.8 ns	<3.5 ns	<5.8 ns	<3.5 ns	<1.7 ns	<1.1 ns
Input Channels	2					
Bandwidth Limiters	20 MHz					
Input Impedance	1 MΩ ∥ 13 pF				50 Ω, 1 MΩ ∥ 13 pF	
Input Coupling	AC, DC, GND					
Max Input Voltage	400 V Pk				1 MΩ - 400 V Pk, 50 Ω - ≤ 5 Vrms	
Vertical Resolution	8 bits					
Sensitivity	2 mV-5 V/div (1-2-5 order)					
Offset Range	±2 V @ 2–100 mV/div ±40 V @ 200 mV–5 V/div		±40 V @ 200 mV–5 V/div ±800 mV @ 2 mV–100 mV/div			
Offset Accuracy	±3.0%					

Horizontal System	WA102	WA112	WA202	WA212	WA222	WA232
Timebase Range	2.5 ns/div-50 s/div (Roll mode: 100 ms/div ~50 s/div)		1.0 ns/div-50 s/div (Roll mode: 100 ms/div ~50 s/div)			

Acquisition	WA102	WA112	WA202	WA212	WA222	WA232
Acquisition Memory	4 kpts		9 kpts			
Interleaved Memory	N/A		18 kpts			
Averaging	4, 16, 32, 64, 128, 256					
Peak Detect	10 ns		1 ns			
Real Time Sampling Rate	250 MS/s		1 GS/s			
Interleaved Sampling Rate	500 MS/s		N/A		2 GS/s	
Equivalent Sampling Rate	50 GS/s					

Triggering	WA102	WA112	WA202	WA212	WA222	WA232
Trigger Modes	Auto, Normal, Single					

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Triggering	WA102	WA112	WA202	WA212	WA222	WA232
Trigger Types	Edge, Pulse, Video, Slope, Alternative					
Trigger Coupling	AC, DC, LF Reject, HF Reject					
Trigger Slope	Positive, Negative					
Holdoff Range	100 ns - 1.5 s					
External Trigger Range	CH1, CH2, ±6 div from center of screen EXT: ±1.2 V EXT/5: ±6 V		CH1, CH2, ±5 div from center of screen EXT: ±0.6 V EXT/5: ±3 V			

Basic Triggers

Edge Trigger: Edge Types - Rising, Falling, Rising and Falling

Pulse Trigger: Trigger Modes - Positive Pulse Width (>, <, =), Negative Pulse Width(<, >, =)

Video Trigger: Support Signal Formats: PAL/SECAM, NTSC; Trigger Condition - odd field, even field, all lines, line Num

Slope Trigger: Positive Slope (>, <, =) ,Negative Slope (>, <, =) , Time: 20 ns - 10 s

Alternative Trigger: CH1/CH2 Trigger Types - Edge, Pulse, Video, Slope

Documentation and Connectivity

Waveform File Data: Save waveform data to internal reference traces or USB memory. Waveforms saved to USB memory can be binary or CSV

Screen Images: Save screen images to USB memory in bitmap format

USB: 1 front panel mounted USB port, 1 rear panel USB port

RS-232: 1 rear panel RS-232 port

Display

Type: Color TFT 5.7 in diagonal Liquid Crystal Display

Resolution: 320 X 234 pixels

Grid Styles: XY, YT

Waveform Display Mode: Point, Vector

Persistence

Persistence Selections: Off, 1 s, 2 s, 5 s, Infinite

Setup Storage

Store up to 20 setups to internal memory or save to a USB memory device for recall later

Math Tools

1 Math Trace; choose between Sum, Difference, Product, Quotient, FFT (Rectangular, Hamming, Hanning, Blackman with 1024 points)

General

POWER SUPPLY:

Input Voltage: 100-240 VAC, Automatic AC Voltage Selection

Frequency: 50/60/400 Hz

Power: 50 VA max.

Physical Dimensions (HxWxD): 154 mm (6.06") x 133 mm (5.23") x 305 mm (12")

Weight: 2.3 kg (approx.)

Warranty and Service: 3 year warranty, calibration recommended yearly

Environmental:

Temperature (operating): +10 °C to +40 °C

Temperature (non-operating): -20 °C to +60 °C

Humidity (operating): 5 to 80% RH (non-condensing)

Humidity (non-operating): 5 to 95% RH (non-condensing as tested per MIL-PRF-28800F

Altitude (operating): up to 3000 m

Altitude (non-operating): up to 15,000 m

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Technical Support

For assistance with installation, calibration, and a full range of software applications contact the customer service center nearest you. You can also find contact information for the following offices on the LeCroy Web site at http://www.lecroy.com/tm/ServiceSupport.

Contact Your Local LeCroy Technical Support Office for Help	
United States and Canada **Phone Sales**: 800-553-2769 or 845-425-2000 **Fax (Sales&Service)**: 845-578-5985 **Email Sales**: contact.corp@lecroy.com **Web Site**: http://www.lecroy.com/	*Europe* **Phone Sales**: + 41 22 719 2228 **Fax Sales**: + 41 22 719 2230 **Email Sales**: contact.sa@lecroy.com **Web Site**: http://www.lecroy.com/europe
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Korea - Seoul **Phone Sales**: ++ 82 2 3452 0400 **Fax Sales**: ++ 82 2 3452 0490 **Web Site**: http://www.lecroy.co.kr	

Thank you for purchasing a WaveAce Oscilloscope

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