TELEDYNE LECROY
Everywhere**you**look™

HDO4000
High Definition Oscilloscopes
Getting Started Guide

HD 4096

TELEDYNE LECROY
Everywhere**you**look™

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HDO4000
High Definition Oscilloscopes
Getting Started Guide

Welcome

Thank you for buying a Teledyne LeCroy product. We're certain you'll be pleased with the detailed features unique to our instruments.

This Getting Started Guide covers important safety and installation information for your oscilloscope, along with some basic operating procedures so you're quickly working with waveforms.

Contents

INTRODUCTION

About the HDO4000 Oscillosocopes

Combining Teledyne LeCroy's HD4096 high-definition technology with long memory, a compact form factor, 12.1" touch screen display, powerful debug tools, and mixed signal capability, the HDO4000 Oscilloscopes are ideal for precise measurements and quick debug. Tools such as WaveScan® Search and Find, LabNotebook Report Generator and History Mode help identify, isolate, and document problems for faster troubleshooting.

HD4096

HD4096 high-definition technology consists of high sample rate 12-bit ADCs, high signal-to-noise input amplifiers, and a low-noise system architecture. This technology enables HDO™ oscilloscopes to capture and display signals up to 1 GHz with a high sample rate and 16 times more resolution than other oscilloscopes.

Waveforms captured and displayed on the HDO4000 with HD4096 technology are cleaner and crisper. Signal details often lost in the noise are clearly visible and easy to distinguish, and measurements can be per-formed with unmatched precision for improved debug and analysis.

Mixed Signal Option

With embedded systems growing increasingly more complex, powerful mixed signal debug capabilities are an essential part of modern oscilloscopes. The 16 integrated digital channels and set of tools designed to view, measure and analyze analog and digital signals enable fast debugging of mixed signal designs. Flexible analog and digital cross-pattern triggering across all 20 channels provides the ability to quickly identify and isolate problems in an embedded system.

WaveScan Search and Find

WaveScan® Search and Find allows you to search a single acquisition using more than 20 different criteria. Or, set up a scan condition and scan for an event over hours or even days.

History Mode

Never miss a waveform. History mode lets you scroll back in time to view previous waveforms and isolate anomalies. Use cursors and measurement parameters to quickly find the source of problems. History mode is always available with a single button press, no need to enable this mode.

LabNotebook Report Generator

Save and document all your waveforms, settings and screen images through the LabNotebook report generation tool. With LabNotebook, there's no need to navigate multiple menus to save all these files independently. Returning your oscilloscope to a past state is only one button press away thanks to LabNotebook's flashback feature.

Specifications

Detailed specifications are maintained in the Datasheet on the product page at teledynelecroy.com.

Key Specifications	
Bandwidth	200 MHz – 1 GHz
Channels	2 or 4
Sample Rate (all channels)	2.5 GS/s
Memory (per channel)	12.5 Mpts/ch
Digital Channels	16
Digital Sample Rate	1.25 GS/s
Minimum Detectable Pulse Width	2 ns
Maximum Input Frequency	250 MHz

Materials List

Check that you have all the parts listed here. Contact Teledyne LeCroy immediately if any part is missing.

- 1 oscilloscope
- 2 or 4 passive probes (one for each channel)
- 1 AC power cord (rated for country)
- 1 protective front cover
- 1 Getting Started Guide
- 1 Oscilloscope Security Certificate
- 1 Oscilloscope Registration Card
- 1 Calibration Document

HDO4000-MS models also include:

- 1 digital leadset
- 5 flying ground leads
- 20 ground extenders
- 22 XL microgrippers

General Safety Information

This section contains instructions 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 precautions specified in this section. **The overall safety of any system incorporating this instrument is the responsibility of the assembler of the system.**

Symbols

These symbols appear on the instrument's front or rear panels and in its documentation to alert you to important safety considerations.

⚠ **CAUTION** of damage to instrument, or **WARNING** of hazard to health. Attend to the accompanying information to protect against personal injury or damage. Do not proceed until conditions are fully understood and met.

⚡ **WARNING.** Risk of electric shock.

⏚ Measurement ground connection.

⏛ Safety (protective) ground connection.

∿ Alternating Current.

⏻ On/Standby power.

Precautions

- **Use proper power cord.** Use only the power cord shipped with this instrument and certified for the country of use.

- **Maintain ground.** This product is grounded through the power cord grounding conductor. To avoid electric shock, connect only to a grounded mating outlet.

- **Connect and disconnect properly.** Do not connect/disconnect probes or test leads while they are connected to a voltage source.

- **Observe all terminal ratings.** Do not apply a voltage to any input (C1, C2, C3, C4, EXT or Dig) that exceeds the maximum rating of that input. Refer to the front of the oscilloscope for maximum input ratings.

- **Use only within operational environment listed.** Do not use in wet or explosive atmospheres.

- **Use indoors only.**

- **Keep product surfaces clean and dry.**

- **Do not block the cooling vents.** Leave a minimum six-inch gap between the instrument and the nearest object. Keep the underside clear of papers and other objects.

- **Do not remove the covers or inside parts.** Refer all maintenance to qualified service personnel.

- **Do not operate with suspected failures.** Inspect all parts regularly and do not use the product if any part is damaged. Cease operation immediately and sequester the instrument from inadvertent use.

Operational Environment

Temperature: 5° to 40° C
Humidity: Maximum relative humidity 90% for temperatures up to 31° C decreasing linearly to 50% relative humidity at 40° C
Altitudes: up to 3,000 m (at < 30° C)

Power and Ground Connections

The instrument operates from a single-phase, 100 to 240 Vrms (± 10%) AC power source at 50/60/400 Hz (± 10%). The instrument automatically adapts to the line voltage. Manual voltage selection is not required.

The AC inlet ground is connected directly to the frame of the instrument. For adequate protection again electric shock, connect to a mating outlet with a safety ground contact.

⚡ **WARNING.** Interrupting the protective conductor inside or outside the oscilloscope, or disconnecting the safety ground terminal, creates a hazardous situation. Intentional interruption is prohibited.

Maximum power consumption with all accessories installed (e.g., active probes, USB peripherals, digital leadsets) is 300 W (300 VA) for four-channel models and 250 W (250 VA) for two-channel models. Power consumption in standby mode is 4 W.

Cleaning

Clean only the exterior of the oscilloscope using a damp, soft cloth. Do not use harsh chemicals or abrasive elements. Under no circumstances submerge the instrument or allow moisture to penetrate it. Avoid electric shock by unplugging the power cord from the AC outlet before cleaning.

⚠ **CAUTION.** Do not attempt to clean internal parts.

Support

Online Documentation

Teledyne LeCroy publishes a free Technical Library on its website. Manuals, tutorials, application notes, white papers, and videos are available to help you get the most out of your Teledyne LeCroy products.

The *HDO4000 Oscillosocopes Operator's Manual* can be downloaded from **teledynelecroy.com/support/techlib**. This .PDF document contains more extensive procedures for operating your oscilloscope than are found here. You can also download Oscilloscope System Recovery Tools and Procedures, which contains instructions for using Acronis® True Image® Home included with the oscilloscope.

The Datasheet published on the product page contains the detailed product specifications.

Technical Support

Registered users can contact their regional Teledyne LeCroy service center at the number listed in this guide to make Technical Support requests by phone or email. You can also submit Technical Support requests via the website at **teledynelecroy.com/support/techhelp**.

SET UP

HDO4000 High Definition Oscilloscopes

The Front of Your Oscilloscope

A — Touch Screen Display

B — Front Panel

C — Built-in Stylus Holder

D — USB Ports

E — Ground and Calibration Terminals

F — Mixed Signal Interface

G — Channel Inputs

H — Power Button

I — Rotating / Tilting Feet

The **touch screen display** is the principal viewing and control center of the oscilloscope. See "Touch Screen Display" for an overview of its components.

The **front panel** houses buttons and knobs that control different oscilloscope settings. For the most part, you can operate the instrument using front panel hard controls, display soft controls, or a mix of both that is convenient for you.

All front panel knobs have multiple modes of operation: pressing them invokes one action and turning them another. The first label describes its "turn" action; the second label describes its "push" action.

The **built-in stylus holder** stores a stylus that can be used with the touch screen display.

Front mounted host USB ports can be used for transferring data or connecting peripherals such as a mouse or keyboard.

The **mixed signal interface** connects the digital leadset to input up-to-16 digital lines (-MS models only).

Ground and calibration output terminals are used to compensate passive probes.

Channel inputs 1–4 (or 1–2 depending on model) are signal inputs to the oscilloscope; Ext is for connecting an external trigger device.

The **Power button** turns on the oscilloscope. See "Powering On/Off" for more information.

The **rotating, tilting feet** enable four different viewing positions.

The Side of Your Oscilloscope

A **Video Output** VGA, DVI, and HDMI ports for connecting external monitors

B **USB Ports** (4) for connecting external USB devices

C **Ethernet Ports** (2) for connecting to networks

D **Audio Input/Output** Speaker, Mic, and Line-In for connecting external audio devices

E **Feet rotated back**

F **Feet rotated front and tilted**

The Back of Your Oscilloscope

A   **Built-in Carrying Handle**

B   **Aux Out** connector to send device trigger enabled, trigger out, or pass/fail output to another device

C   **Ref In/Out** connector to input an external Reference Clock, or to output a Reference Clock to another instrument

D   **USBTMC Port** for remote control

E   **AC Power Inlet** for the AC line cord

Carrying

The oscilloscope's case contains a **built-in carrying handle**. Lift the handle away from the oscilloscope body, grasp firmly and lift the instrument.

Always unplug the instrument from the power source before lifting and carrying it.

Connecting

Make the desired cable connections. All except for the power connection are optional.

After start up, configure the connection on the oscilloscope using the menu options listed below. See the *HDO4000 Oscilloscopes Operator's Manual* for more detailed instructions.

Power

Connect the line cord rated for your country to the AC power inlet on the back of the instrument, then plug it into a grounded AC power outlet. (see Power and Ground Connections in "General Safety Information").

LAN

Connect a cable from either Ethernet port on the side panel to a network access device. On the oscilloscope, use the standard Windows Network dialog to configure the network connection. Go to **Utilities > Preference Setup > Email** to configure email settings.

USB Peripherals

Connect the device to a USB port on the front or side of the instrument. Go to **Utilities > Utilities Setup > Hardcopy** to configure printer settings.

External Monitor

Connect the monitor cable to a video output on the side of the instrument (VGA, DVI, and HDMI are all supported). Go to **Display > Display Setup > Open Monitor Control Panel** to configure the display settings.

External Controller

Connect a USB-A/B cable from the USBTMC port on the back of the instrument to the controller. Go to **Utilities > Preference Setup > Remote** to configure remote control.

Other Oscilloscope (for Reference Clock)

Connect a BNC cable from Ref In/Out on the back of the instrument to the other instrument. Go to **Timebase > Horizontal Setup > Reference Clock** to configure the clock.

Other Auxiliary Device

Connect a BNC cable from Aux Out on the back of the instrument to the other device. Go to **Utilities > Utilities Setup > Aux Output** to configure the connection.

Powering On/Off

The **Power button** controls the operational state of the oscilloscope. Press the button to switch on the instrument.

⚠️ **CAUTION.** Do not change the instrument's Windows® Power Options from the default Never to System Standby or System Hibernate modes.

⚠️ **CAUTION.** Do not power on or calibrate the oscilloscope with a signal attached.

Use the **File > Shutdown** menu bar option to switch "off". Pressing the Power button again will execute a shutdown, but we do not recommend doing this because it does not allow the Windows operating system to shut down properly, and memories and setup panels will not be saved.

The Power button does not disconnect the oscilloscope from the AC power supply; some "housekeeping" circuitry continues to draw power. The only way to fully power down the instrument is to unplug the AC line cord from the outlet.

⚠️ **CAUTION**. Do not place the instrument so that it is difficult to reach the power cord in case you need to disconnect from power.

We recommend unplugging the instrument if it will remain unused for a long period of time.

Software Activation

The oscilloscope operating software (firmware and standard applications) is active upon delivery.

Software Updates
Free firmware updates are available periodically from the Teledyne LeCroy website at **teledynelecroy.com/support/softwaredownload**. Registered users will receive email notification when a new update is released. Follow the instructions on the website to download and install the software.

Demonstration Software
The oscilloscope is delivered with a 30-day trial license of the available option packages.

To try an option, go to Utilities > Utilities Setup > Options, choose the option from the list, and touch Activate Demo Key.

Purchasing Software Options
If after your trial has ended you decide to purchase an option, you'll receive another license key from Teledyne LeCroy. Refer to "Software Options" for more information. To install an option key:

1. Go to Utilities > Utilities Setup > Options.
2. Touch Add Key.
3. Enter the option key in the pop-up keyboard and touch OK.
4. Restart the XStream oscilloscope application.

Digital Leadset

Standard with all HDO4000-MS model oscilloscopes, the digital leadset enables input of up-to-16 lines of digital data. Lines can be organized into four logical groups and named appropriately.

The digital leadset features two digital banks with separate threshold and hysteresis controls, making it possible to simultaneously view data from different logic families.

Each flying lead has a signal and a ground connection. A variety of ground extenders and flying ground leads are available for different probing needs. In order to achieve optimal signal integrity, you should connect the ground at the tip of the flying lead for each channel used in your measurements. Use either the provided ground extenders or ground flying leads to make the ground connection.

To connect the leadset to the oscilloscope, push the connector into the mixed signal interface below the front panel until you hear a click.

To remove the leadset, press in and hold the buttons on each side of the connector, then pull out to release it.

Probes

HDO4000 Oscilloscopes are compatible with the included passive probes and all Teledyne LeCroy ProBus active probes that are rated for the oscilloscope's bandwidth. Probe specifications and documentation are available at **teledynelecroy.com/HDO4000.**

USER INTERFACE

**HDO4000 High Definition
Oscilloscopes**

Touch Screen Display

The entire display is a touch screen. Use your finger or the stylus to touch, double-touch, touch-and-drag, touch-and-hold (right click) or draw a selection box. Many controls that display information also work as "buttons" to access other functions. If you have a mouse installed, you can click anywhere you can touch to activate a control; in fact, you can alternate between clicking and touching, whichever is convenient for you.
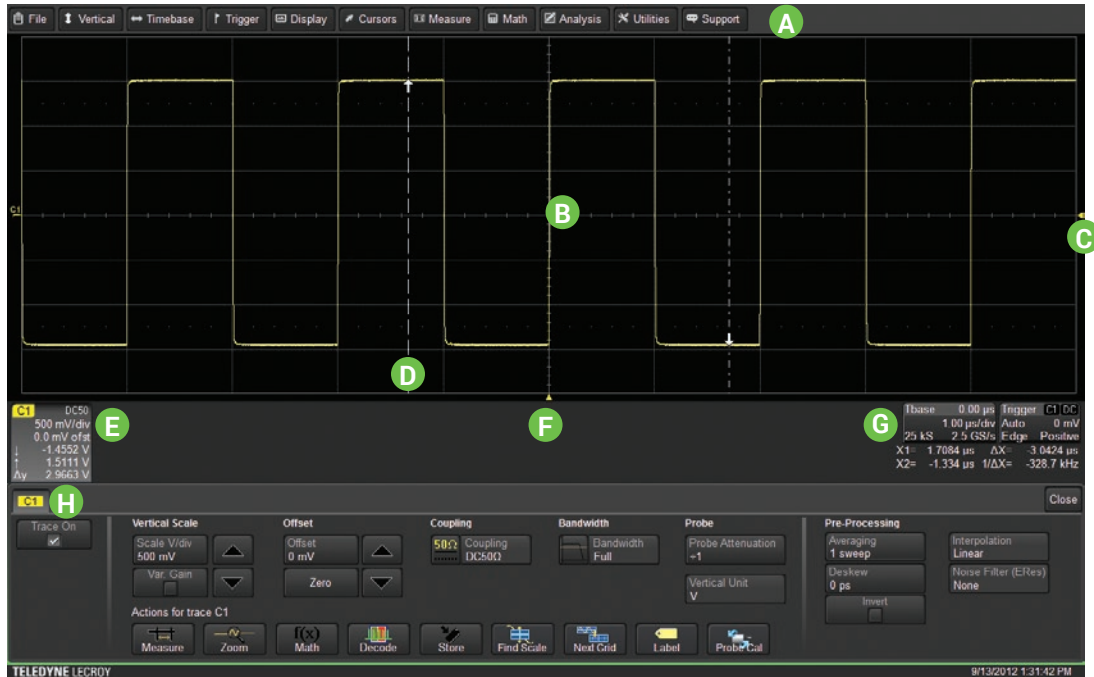
A Menu Bar

B Grid Area

C Trigger Level Indicator

D Cursor

E Channel Descriptor Box

F Trigger Position Indicator

G Timebase and Trigger Descriptor Boxes

H Dialog Tabs

A **menu bar** of drop-down menus lets you access set up dialogs and other functions. All functionality can be accessed through either the menu bar or other shortcuts.

If an action can be "undone" (such as recalling a setup), a small **Undo button** appears at the far right of the menu bar. Click this to return to the previous oscilloscope display.

The **grid area** displays the waveform traces. You can adjust the brightness of the grid lines to make other objects more visible.

Trigger level (vertical axis) and **trigger position** (horizontal axis) indicators appear on the grid when a trigger is set, color-coded to match the source.

Cursors show where measurement points have been set. Touch-and-drag cursor indicators to quickly reposition the measurement point.

Channel (C1-C4), Zoom (Z1-Z4), Math (F1-F2), Memory (M1-M4), and Digital (Digital1-Digital4, on -MS models only) **descriptor boxes** appear immediately below the grid and summarize current settings for each open trace. Touch the descriptor box once to activate the trace and again to open the corresponding setup dialog.

Timebase and Trigger descriptor boxes appear at the right of the display. Timebase and Trigger settings only apply to channel traces. Touch the descriptor boxes to open the corresponding dialogs.

Dialogs appear at the bottom of the display for entering set up data. The top dialog will be the main entry point for the selected function.
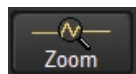
For convenience, related dialogs appear as a series of tabs behind the main dialog. Touch the tab to open the dialog.
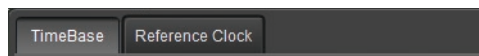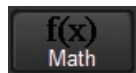
A **toolbar** on the Channel, Math, Memory and Digital dialogs offers shortcuts to common actions so you don't have to leave the underlying dialog. Actions always apply to the active (highlighted) trace.
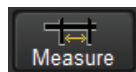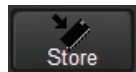
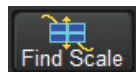Apply measurement parameters to the trace
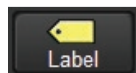
Display a zoom of the trace
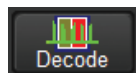
Apply math functions to the trace

Copy the trace to an internal memory (e.g., C2 to M2)

Scale the trace to fit the grid

Apply a custom label to the trace

Open serial data decoder dialogs (if options installed; else disabled)

Changing the Display

Grid Mode
To modify the touch screen grid style, choose **Display > Display Setup** from the menu bar and make your selections from the Display dialog.

By default, the oscilloscope has **Auto Grid** enabled. Auto Grid adds a grid for each new trace type (channels/memories, math, and zooms) as they open and removes the grid when no longer needed. There are options to display all traces on a single grid, an XY trace, or a single grid with an XY trace.

You can also choose to place the **Grid on Top** of traces so it remains visible, or apply **Axis Labels** to show the value currently represented by the extreme Vertical and Horizontal margins of the grid. **Grid Intensity** makes the grid lines dimmer or brighter relative to the trace.

Language Selection
To change the language that appears on the display, go to **Utilities > Preference Setup > Preferences** and make your **Language** selection. Restart the oscilloscope software after changing the language. To also change the language of the Windows operating system:

1. Choose File > Minimize to show the Windows desktop.

2. From the Windows task bar, choose Start > Control Panel > Clock, Language and Region.

3. Under Region and Language select Change Display Language.

4. Click the Install/Uninstall Languages button.

5. Select Install Language and Browse Computer or Network.

6. Click Browse and navigate to D:\Lang Packs\ to select the language. Follow the installer prompts.

7. After exiting the Control Panel, click the oscilloscope icon at the lower-right of the desktop to maximize the oscilloscope application.

NOTE: The available languages are German, Spanish, French, Italian, and Japanese. Other language packs are available from Microsoft's website.

Working With Traces

The easiest way to turn on a trace is to use the front panel **C1-C4**, **Math**, and **Zoom** buttons. A waveform appears on the grid, a new descriptor box opens at the bottom of the grid area, and the corresponding setup dialog opens. This is now the "active" trace.

To turn off the trace, press the front panel button again.

Traces can also be turned on/off by using the **Trace On** checkbox on the Channel, Math, Zoom, and Memory setup dialogs.

Trace Context Menu
Touching a trace opens a context menu of actions that can be applied to that trace such as create math function, apply measurements, or label.
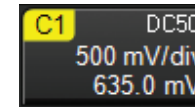
Active vs. Inactive Trace
A highlighted descriptor box indicates the active trace, and all display and front panel actions will apply to that trace until another is selected. This is true for all traces, regardless of the type. Although several traces may be open and appear on the display, only one at a time is active.

Also, the front panel buttons will light to indicate the active trace.
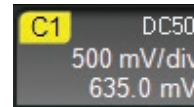
Active. *Controls will work for this trace.*

Inactive. *Controls will not work for this trace.*

Line and Intensity

The trace style can be set to a series of separate sample **Points** or a continuous vector **Line**. Go to **Display > Display Setup.**

When more data is available than can actually be displayed, **Trace Intensity** helps to visualize significant events by applying an algorithm that dims less frequently occurring samples. Press the front panel **Intensity button**, then turn the **Adjust knob** to control the Trace Intensity.
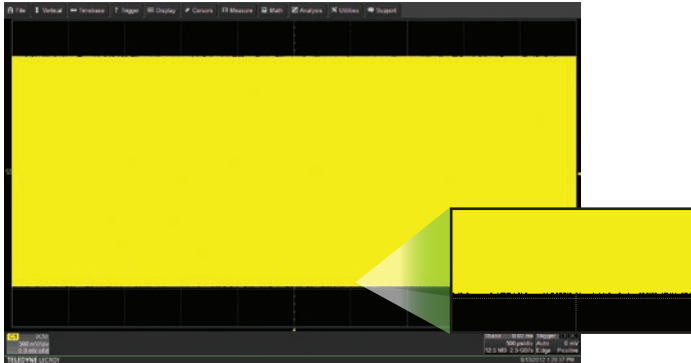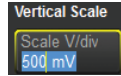

With Intensity 100%
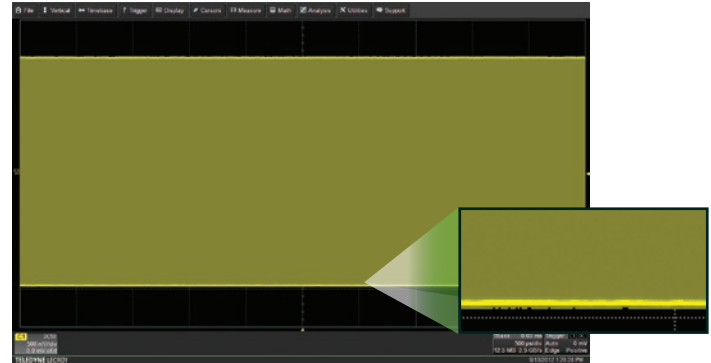
With Intensity 40%

Entering/Selecting Data

Touch & Type

Touching once activates a control. In some cases, you'll immediately see a pop-up menu of options. Touch one to select it.

In other cases, data entry fields appear highlighted on the display. When a data entry field is highlighted (as shown above), it is active and can be modified by using the front panel Adjust knob.

If you have a keyboard installed, you can type your entry in the active field. Or, you can touch again, then select your entry from the pop-up menu or keypad.

You'll see a pop-up keypad when you double-touch a numerical data entry field. Touch the soft keys to use it exactly as you would a calculator. When you touch OK, the calculated value is entered in the field.

Touch & Swipe

Touch-and-swipe the screen in an up or down direction to scroll long lists of values. You can also use scroll bars or Up/Down arrow keys to navigate to the desired value.

Touch & Drag

Touch-and-drag waveforms, cursors and trigger indicators to reposition them on the grid; this is the same as setting the values on the dialog. To quickly zoom areas of the grid, touch-and-drag to draw a selection box around a portion of the trace.

Stylus

Use the stylus when you want a more precise selection tool than your finger. It is especially helpful for selecting exact areas of the grid or values that lie close together on pop-up menus.
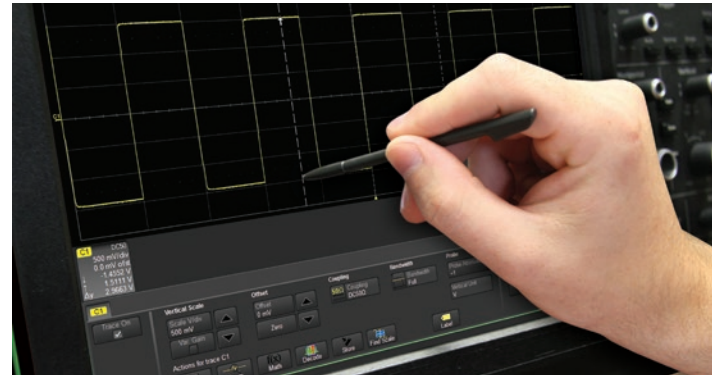
Front Panel

Most of the front panel controls duplicate functionality available through the touch screen display. They are covered in more detail in the Basics section and in the *HDO4000 Oscilloscopes Operator's Manual.* Below are a few useful front panel controls.

Shortcut buttons arranged across the top of the front panel give quick access to commonly used functions.

The **Print button** captures the entire screen and handles it according to your Hardcopy settings (e.g., print, email, or save to file), or creates a Notebook Entry in LabNotebook if configured for it.

The **Touch Screen button** enables or disables touch screen functionality.

The **Adjust knob** changes the value in any highlighted data entry field when turned. Pushing the Adjust knob toggles between coarse (large increment) or fine (small increment) adjustments. Adjust is also used to control the trace intensity value when the **Intensity button** is turned on.

Other shortcut buttons arranged across the bottom (Decode, WaveScan, etc.) open special applications.

All the knobs on the front panel function one way if turned and another if pushed like a button. The first label describes the knob's principal "turn" action; the second label describes its "push" action.

Front panel buttons light to indicate which functions and traces are active.

BASICS

HD
4096
**HDO4000 High Definition Oscilloscopes**

Vertical

These controls adjust the channel trace along the Y axis.

From the Front Panel

A Press to turn on/activate analog trace.

B Turn to raise or lower Offset (analog) or Vertical Position (digital). Push to return to zero.

C Turn to raise or lower Vertical Scale (analog) or Group Height (digital). Push to adjust with more precision.

D Press to activate digital trace (-MS models only).

Channel Descriptor Box
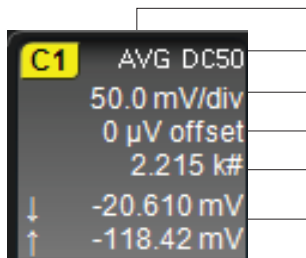
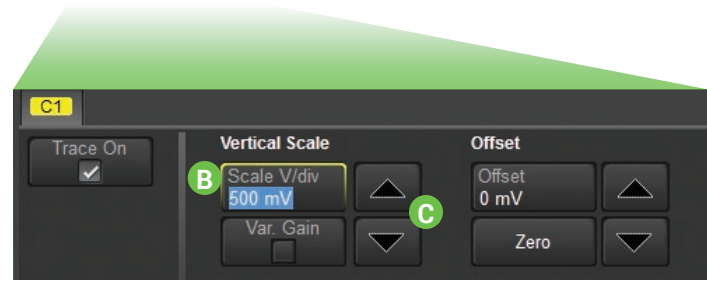Pre-Processing Summary List (changes from default state)

Coupling

Gain Setting

Offset Setting

Averaging # Sweeps

Vertical Cursor Positions

Analog Traces From the Display
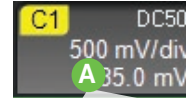
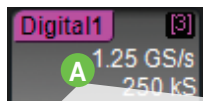**A** Touch channel descriptor once to activate the trace and again to open the Channel setup dialog.
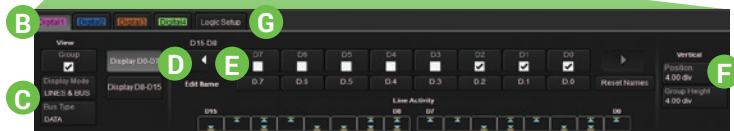

B Touch any control to change the value.

C Use the Up/Down buttons to change Vertical Scale or Offset.

Digital Traces From the Display

A Touch Digital descriptor once to activate the digital trace and again to open the Digital dialog.


B Touch tab to choose digital group (1-4).

C Choose to display individual digital lines, bus trace or both.

D Touch arrows to switch between banks 0-7 and 8-15.

E Touch checkboxes to select the lines in the group.

F Enter Vertical Position (top of lowest bit relative to center) and Group Height (vertical space occupied by group) in divisions.

G Touch to open Logic Setup dialog.

Digital Descriptor Box

Digital Lines in Group

Digital Sample Rate

Digital Memory
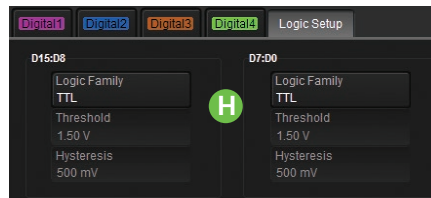
H Choose a standard Logic Family, or enter custom Threshold and Hysteresis. Separate controls allow you to set different values for each bank.
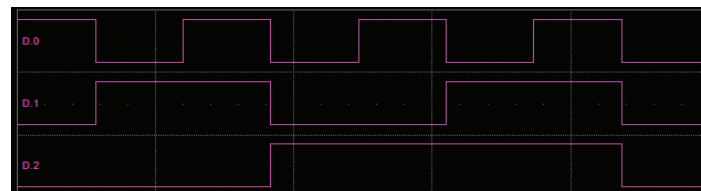
Line trace shows high, low and transition points for each line.

Bus trace collapses lines into hex values.

Line Activity Indicators

High

Low

Transitioning

Watch Line Activity Indicators instead of line traces to quickly see the state of each digital line.

Horizontal (Timebase)

These controls adjust the trace along the X axis.

From the Front Panel

A Turn to raise or lower trigger Delay. Push to return Delay to zero.

B Turn to raise or lower Horizontal Scale (Time/div). Push to adjust scale with more precision on math, memory, or zoom traces.

Timebase Descriptor Box

Trigger Delay (Position)

Sampling Mode (blank in real-time)

Time/div

Samples

Sample Rate
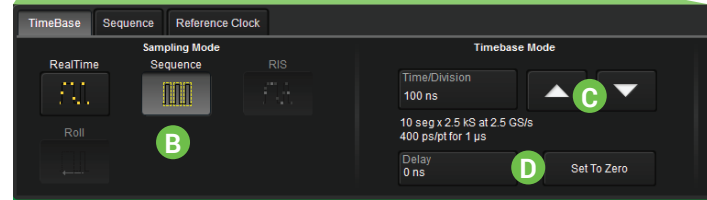
From the Display

A Touch Timebase descriptor to open the Timebase dialog.

B Touch to select a Sampling Mode.

C Use the Up/Down buttons to change Time/Division.

**D** Enter a Delay or use the button to Set To Zero.

Triggers

Triggers tell the oscilloscope when to perform an acquisition. Trigger types and modes are described at more length in the *HDO4000 Oscilloscopes Operator's Manual.*

From the Front Panel

A Press to open the Trigger setup dialog.

B Press to control acquisition processing:
Auto – trigger after a preset period if there is no valid trigger.
Normal – trigger repeatedly whenever all conditions are met.
Single – trigger once when all conditions are met.
Stop – stop acquisition.

C Turn to raise or lower trigger voltage Level. Push to find a level.

D READY lights when trigger armed; TRIG'D lights when trigger fired.

Trigger Descriptor Box

Trigger Source
Trigger Coupling
Trigger Level
Trigger Slope

Trigger Mode
Trigger Type
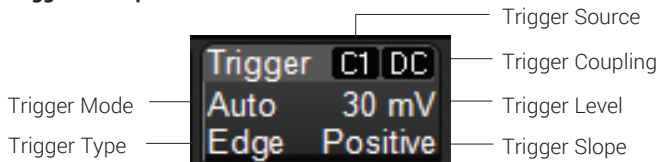
From the Display
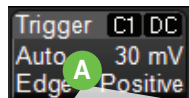
A Touch Trigger descriptor to open the Trigger setup dialog.

B Touch to choose trigger Type.

C Choose trigger Source channel.

D Set trigger voltage Level, or let the software Find Level based on the input signal.

E Choose trigger Coupling and enter other conditions.

Trigger Indicators

Level *Position* *Pre/Post-Trigger* – appears at corner of grid when trigger point is no longer visible.

Zoom

Zoom traces display a magnified portion of another trace.

From the Front Panel

Press the Zoom button.

Zoom trace opens for every channel trace. The zoomed portion of the original trace is highlighted.
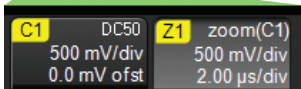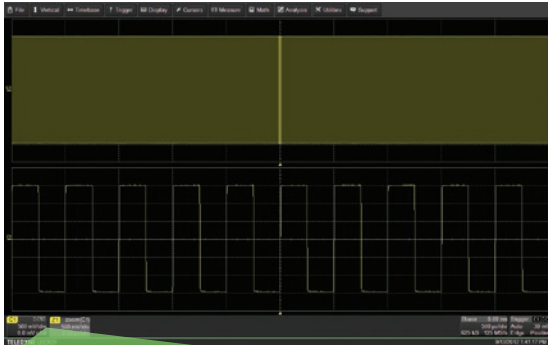
Use Vertical knobs to adjust V/div.

Use Horizontal knobs to adjust Time/div.

From the Display
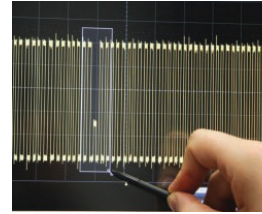
Draw a zoom box on a portion of a Channel trace.

Repeat on another section to open a new zoom trace.

OR
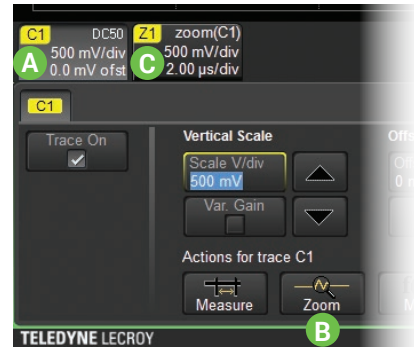
Ⓐ Touch Channel descriptor box to activate the trace.

Ⓑ Touch the Zoom shortcut button.

Ⓒ Touch Zoom descriptor to open the Zoom dialog and adjust scale.

Cursors

Cursors set measurement points on a trace. There are five preset cursor types, each with a unique appearance on the display: Horizontal (Time), Horizontal + Vertical, Vertical (Amplitude), Horizontal (Frequency), and Horizontal (Event). These are described in more detail in the *HDO4000 Oscilloscopes Operator's Manual*.

From the Front Panel
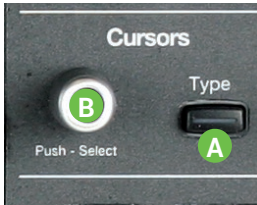
A Press to apply cursor. Continue pressing to cycle through all cursor types.

B Turn to adjust cursor position. Push to select different cursor lines to adjust.

From the Display

A Choose Cursor > Cursor Setup to open the Cursor dialog.

B Touch to choose Cursor Type.

C Touch-and-drag cursor line to reposition cursor.

D Vertical Cursor readout appears on descriptor boxes.

E Horizontal Cursor readout appears below Timebase.

Measurements & Statistics

Measurements are waveform parameters that can be expressed as numerical values, such as amplitude or frequency. You can set up-to-eight simultaneous measurements on one or more traces and view the active readout in a table. Statistics can be added to the readout along with histicons, a miniature histogram of the statistical distribution. You can also gate measurements to limit them to a specific portion of the trace or plot the trend of the measurement over time. Some measurements can be made at a specified level.

A Choose Measure > Measure Setup to open the Measure dialog.

B Touch to re-open Measure dialog if closed.

C These statistics can be added to the readout.

D Measurement readout table.

E Select to show measurement table; clear to hide.

F Touch to choose parameter.

G Touch to choose source trace.

H Touch to plot trend of measurement.

I Touch to set level(s) used for @level parameters.

J Touch to set measurement gates.

K Select to display histicons.

L Select to display statistics.

Math

Math traces display the result of applying a mathematical function (e.g., FFT) to another waveform trace. One important distinction between math functions and measurement parameters is that the result of math is always another waveform, whereas the result of measurement is a number.

A Choose Math > Math Setup or press front panel Math button to open Math dialog.

B Touch Function tab (F*x*) and select Trace On. (Deselect Trace On to close trace.)

C Math trace (F1-F2) opens in separate grid.

D Choose Source trace and math Operator.

E Use Operator subdialog to configure the math function.

F Open Zoom subdialog to rescale math trace.

G Math descriptor box shows math trace scale. Touch it to re-open the Function tab if closed.

Memories (Reference Waveforms)

Memories are traces stored for reference. They can be recalled to the display for comparison with other traces. A memory can be zoomed or measured for better analysis of historical data. You can store up-to-four internal memories (M1-M4). After that, new memories will overwrite previously stored data.

Internal memories only persist until the oscilloscope is rebooted. To store memories indefinitely, save them to an external file by choosing File > Save Waveform. The file can then be recalled into one of the four internal memories for viewing by choosing File > Recall Waveform. Only memory files saved with the extension .trc can be recalled.

Press the front panel Mem(ory) button to open the Memory dialog.

A To turn on stored memory, check On next to M1-M4.

B To store new memory, touch M1-M4 button or tab.
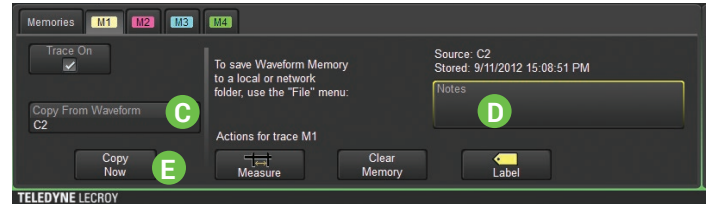
C Select source trace in Copy From Waveform.

D Add notes describing contents of memory.

E Touch to copy to internal memory.

Documenting

HDO4000 Oscilloscopes offer several ways to preserve and share data—such as print, save to file, email, or save as Notebook Entry— any of which can be associated with the front panel Print button.

Go to Utilities > Utilities Setup > Hardcopy to configure how the oscilloscope handles the Print command. To make Print create a new Notebook Entry, go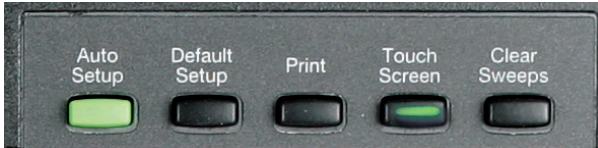 to File > LabNotebook > Preferences and select Create Entry when Hardcopy Pressed. Pressing Print captures an image of the display, which will then be handled according to your chosen Print method.

Sending Data

If you have email set up on the oscilloscope, LabNotebook reports and other saved files can be sent directly from the instrument. They can also be transferred to a USB drive through any of the host USB ports on the instrument. Use the Windows Explorer to transfer files from your save folder.

LabNotebook

The integrated LabNotebook tool lets you build reports containing waveform images and custom annotations right on the oscilloscope. You create individual Notebook Entries as you work, which are saved to a resident database. When you choose File > LabNotebook, the LabNotebook dialog opens showing all your Notebook entries. Choose which entries to export, the report file format and the output location. You can also use the LabNotebook Flashback feature to put the oscilloscope back to the exact state it was in when the Notebook Entry was saved. See the *HDO4000 Oscilloscopes Operator's Manual* for more information on using LabNotebook.
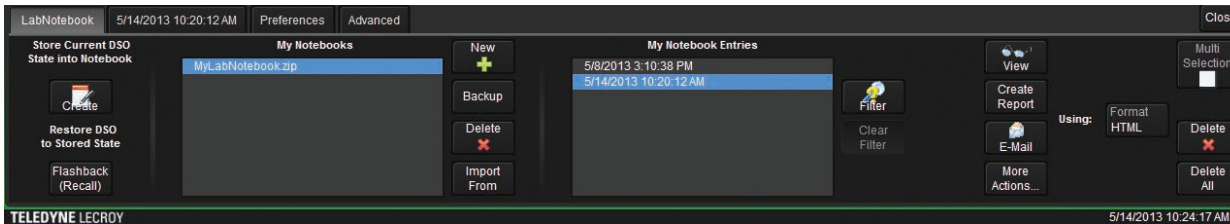
Temperature Dependent Calibration

The HDO4000 is calibrated at the factory prior to being shipped. This calibration is run at 23° C (± 2° C) and is valid for temperatures ± 5° C of the original calibration temperature. Within this temperature range the HDO4000 will meet all of the specifications. When the oscilloscope is used outside of this temperature range a temperature dependent calibration is recommended. There are two options for this calibration: Calibrate All or Calibrate Current Setting.

Calibrate All - All possible combinations of vertical and horizontal settings are calibrated at the current temperature. This calibration is valid for the current temperature ± 5° C. This calibration takes about 50 minutes.

Calibrate Current Setting - The oscilloscope is calibrated at the current vertical and horizontal setting. This calibration is valid for this setting for the current temperature ± 5° C. This calibration takes under 30 seconds.

It is recommended that the HDO4000 be calibrated when the temperature range is outside of the ± 5° C of the original calibration temperature or when it has been more than 1 month since the previous calibration.

It is recommended that the HDO4000 be warmed up for at least 20 minutes prior to use. During the HDO4000 warm-up period, the oscilloscope will automatically initiate calibrations to ensure that the HDO4000 is always calibrated.

It is required that all inputs be removed from the oscilloscope prior to performing calibration.

Software Options

Optional software packages are available to enhance the operation of an HDO4000 Oscilloscope.

Spectrum Analyzer Option (HDO4K-SPECTRUM) simplifies setup and use of the oscilloscope for analyzing frequency-dependent effects. It allows users who are familiar with RF spectrum analyzers to start using the FFT with little or no concern about the details of setting up an FFT.

Power Analysis Option (HDO4K-PWR) provides exceptional ability to measure and analyze the operating characteristics of power conversion devices and circuits. The Power Analysis option is used with Teledyne LeCroy oscilloscopes to make critical power switching device measurements, perform control loop modulation analysis, and measure line power harmonics.

Electrical Telecom Mask Test Package (HDO4K-ET-PMT) performs automated compliance mask tests on a wide range of electrical telecom standards.

Many **Serial Trigger and Decoder Options** (see table at right) provide added insight when debugging particular serial data standards. For the most current list, go to teledynelecroy.com/serialdata.

Part Number	Description
HDO4K-1553 TD	MIL-STD-1553 Trigger and Decoder
HDO4K-ARINC429bus Dsymbolic	ARINC 429 Symbolic Decoder
HDO4K-Audiobus TD	Audiobus Trigger and Decoder
HDO4K-AUTO	CAN, LIN and FlexRay Trigger and Decoder
HDO4K-CANbus TD	CAN Trigger and Decoder
HDO4K-CAN FDbus TD	CAN FD Trigger and Decoder
HDO4K-DigRF3Gbus D	DigRF 3G Decoder
HDO4K-DigRFv4bus D	DigRF v4 Decoder
HDO4K-DPHYbus D	MIPI D-PHY/CSI/DSI Decoder
HDO4K-EMB	I^2C, SPI, UART and RS-232 Trigger and Decoder
HDO4K-ENETbus D	10M and 100M ENET Decoder
HDO4K-FlexRaybus TD	FlexRay Trigger and Decoder
HDO4K-I2Cbus TD	I^2C Trigger and Decoder
HDO4K-LINbus TD	LIN Trigger and Decoder
HDO4K-Manchester D	Manchester Decoder
HDO4K-NRZ D	NRZ Decoder
HDO4K-SENTbus D	SENT Decoder
HDO4K-SpaceWirebus D	SpaceWire Decoder
HDO4K-SPIbus TD	SPI Trigger and Decoder
HDO4K-UART-RS232bus TD	UART and RS232 Trigger and Decoder
HDO4K-USB2bus D	USB 2.0 Decoder
HDO4K-USB2-HSICbus D	USB-HSIC Decoder

REFERENCE

HD
4096

HDO4000 High Definition Oscilloscopes

Service

Contact your local Teledyne LeCroy service center for calibration or other service.

Returning a Product

If the product cannot be serviced on location, the service center will give you a **Return Material Authorization (RMA)** code and instruct you where to ship the product. All products returned to the factory must have an RMA.

Return shipments must be prepaid. Teledyne LeCroy cannot accept COD or Collect shipments. We recommend air-freighting. Insure the item you're returning for at least the replacement cost.

 Follow these steps for a smooth product return.

1. Remove all accessories from the device. Do not include the manual.

2. Pack the product in its case, surrounded by the original packing material (or equivalent).

3. Label the case with a tag containing:
   • The RMA
   • Name and address of the owner
   • Product model and serial number
   • Description of failure or requisite service

4. Pack the product case in a cardboard shipping box with adequate padding to avoid damage in transit.

5. Mark the outside of the box with the shipping address given to you by Teledyne LeCroy; be sure to add the following:
   • ATTN: <RMA code assigned by Teledyne LeCroy>
   • FRAGILE

6. **If returning a product to a different country:**
   • Mark the shipment as a **Return of US manufactured goods for warranty repair/recalibration**.
   • If there is a cost for the service, list the cost in the Value column and the original purchase price **For insurance purposes** only.
   • Be very specific about the reason for shipment. Duties may have to be paid on the value of the service.

Service Plans

Extended warranty, calibration, and upgrade plans are available for purchase. Contact your Teledyne LeCroy sales representative or your regional service center to purchase a service plan.

Teledyne LeCroy Service Centers

For a complete list of Teledyne LeCroy offices by country, including our sales and distribution partners, visit: teledynelecroy.com/support/contact

World Wide Corporate Office	**US Protocol Solutions Group**	**Europe**
Teledyne LeCroy 700 Chestnut Ridge Road Chestnut Ridge, NY, 10977, USA teledynelecroy.com **Sales and Service:** Ph: 800-553-2769 / 845-425-2000 FAX: 845-578-5985 contact.corp@teledynelecroy.com **Support:** Ph: 800-553-2769 support@teledynelecroy.com	Teledyne LeCroy 3385 Scott Boulevard Santa Clara, CA, 95054, USA teledynelecroy.com **Sales and Service:** Ph: 800-909-7211 / 408-727-6600 FAX: 408-727-0800 protocolsales@teledynelecroy.com **Support:** Ph: 800-909-7112 / 408-653-1260 psgsupport@teledynelecroy.com	Teledyne LeCroy SA 4, Rue Moïse Marcinhes Case postale 341 1217 Meyrin 1 Geneva, Switzerland teledynelecroy.com/europe **Sales and Service:** Ph: + 41 22 719 2228 / 2323 / 2277 FAX: + 41 22 719 2233 contact.sa@teledynelecroy.com **Support:** applications.indirect@teledynelecroy.com
China LeCroy Corporation Beijing Rm. 2001, Unit A, Horizon Plaza No. 6 Zhichun Rd., Haidian Dist. Beijing 100088, China www.lecroy.com.cn **Sales:** Ph: 86-10-82800318 / 0319 / 0320 FAX: 86-10-82800316 Marketing.China@teledynelecroy.com **Service:** Rm. 2002 Ph: 86-10-82800245 Service.China@teledynelecroy.com	**Korea** Teledyne LeCroy Korea 10th fl. 333 Yeongdong-daero Gangnam-gu Seoul 135-280, Korea teledynelecroy.com/korea Ph: ++ 82 2 3452 0400 FAX: ++ 82 2 3452 0490	**Japan** Teledyne LeCroy Japan 3F, Houbunshafuchu Bldg. 3-11-5, Midori-cho, Fuchu-Shi Tokyo, 183-0006 Japan teledynelecroy.com/japan Ph: + 81-42-402-9400 FAX: + 81-42-402-9586

Certifications
EMC Compliance

EC DECLARATION OF CONFORMITY - EMC
The oscilloscope meets intent of EC Directive 2004/108/EC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications listed in the Official Journal of the European Communities:

EN 61326-1:2013, EN 61326-2-1:2013 EMC requirements for electrical equipment for measurement, control, and laboratory use. [1]

Electromagnetic Emissions:
EN 55011:2010, Radiated and Conducted Emissions Group 1, Class A [2][3]

EN 61000-3-2/A2:2009 Harmonic Current Emissions, Class A

EN 61000-3-3:2008 Voltage Fluctuations and Flickers, Pst = 1

Electromagnetic Immunity:
EN 61000-4-2:2009 Electrostatic Discharge, 4 kV contact, 8 kV air, 4 kV vertical/horizontal coupling planes [4]

EN 61000-4-3/A2:2010 RF Radiated Electromagnetic Field, 3 V/m, 80-1000 MHz; 3 V/m, 1400 MHz - 2 GHz; 1 V/m, 2 GHz - 2.7 GHz

EN 61000-4-4/A1:2010 Electrical Fast Transient/Burst, 1 kV on power supply lines, 0.5 kV on I/O signal data and control lines [4]

EN 61000-4-5:2006 Power Line Surge, 1 kV AC Mains, L-N, L-PE, N-PE [4]

EN 61000-4-6:2009 RF Conducted Electromagnetic Field, 3 Vrms, 0.15 MHz - 80 MHz

EN 61000-4-11:2004 Mains Dips and Interruptions, 0%/1 cycle, 70%/25 cycles, 0%/250 cycles [4][5]

[1] To ensure compliance with all applicable EMC standards, use high quality shielded interface cables.

[2] Emissions which exceed the levels required by this standard may occur when the oscilloscope is connected to a test object.

[3] This product is intended for use in nonresidential areas only. Use in residential areas may cause electromagnetic interference.

[4] Meets Performance Criteria "B" limits of the respective standard: during the disturbance, product undergoes a temporary degradation or loss of function or performance which is self-recoverable.

[5] Performance Criteria "C" applied for 70%/25 cycle voltage dips and for 0%/250 cycle voltage interruption test levels per EN61000-4-11.

European Contact:*
Teledyne LeCroy Europe GmbH
Im Breitspiel 11c
D-69126 Heidelberg
Germany
Tel: + 49 6221 82700

AUSTRALIA & NEW ZEALAND DECLARATION OF CONFORMITY – EMC
Oscilloscope complies with the EMC provision of the Radio Communications Act per the following standards, in accordance with requirements imposed by Australian Communication and Media Authority (ACMA):

AS/NZS CISPR 11:2011 Radiated and Conducted Emissions, Group 1, Class A.

Australia / New Zealand Contacts:*

RS Components Pty Ltd.	RS Components Ltd.
Suite 326 The Parade West	Units 30 & 31 Warehouse World
Kent Town, South Australia 5067	761 Great South Road
	Penrose, Auckland, New Zealand

* Visit teledynelecroy.com/support/contact for the latest contact information.

Safety Compliance

EC DECLARATION OF CONFORMITY – LOW VOLTAGE
The oscilloscope meets intent of EC Directive 2006/95/EC for Product Safety. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:

EN 61010-1:2010 Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements

EN 61010-2:030:2010 Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-030: Particular requirements for testing and measuring circuits

The design of the instrument has been verified to conform to the following limits put forth by these standards:

- Mains Supply Connector: Overvoltage Category II, instrument intended to be supplied from the building wiring at utilization points (socket outlets and similar).
- Measuring Circuit Terminals: No rated measurement category. Terminals not intended to be connected directly to the mains supply.
- Unit: Pollution Degree 2, operating environment where normally only dry, non-conductive pollution occurs. Temporary conductivity caused by condensation should be expected.

U.S. NATIONALLY RECOGNIZED AGENCY CERTIFICATION
The oscilloscope has been certified by Underwriters Laboratories (UL) to conform to the following safety standard and bears UL Listing Mark:

UL 61010-1 Third Edition – Safety standard for electrical measuring and test equipment.

CANADIAN CERTIFICATION
The oscilloscope has been certified by Underwriters Laboratories (UL) to conform to the following safety standard and bears cUL Listing Mark:

CAN/CSA-C22.2 No. 61010-1-12. Safety requirements for electrical equipment for measurement, control and laboratory use.

Environmental Compliance

END-OF-LIFE HANDLING
The instrument is marked with this symbol to indicate that it complies with the applicable European Union requirements to Directives 2002/96/EC and 2006/66/EC on Waste Electrical and Electronic Equipment (WEEE) and Batteries.

The instrument 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 Teledyne LeCroy product, please visit teledynelecroy.com/recycle.

RESTRICTION OF HAZARDOUS SUBSTANCES (RoHS)
This instrument and its accessories conform to the 2011/65/EU RoHS2 Directive, as it has been classified as Industrial Monitoring and Control Equipment (per Article 3, Paragraph 24) and is exempt from RoHS compliance until 22 July 2017 (per Article 4, Paragraph 3).

ISO Certification

Manufactured under an ISO 9000 Registered Quality Management System.

Warranty

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. TELEDYNE 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. TELEDYNE LECROY WILL RETURN ALL PRODUCTS UNDER WARRANTY WITH TRANSPORT PREPAID.

The oscilloscope is warranted for normal use and operation, within specifications, for a period of three years from shipment. Teledyne 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.

Teledyne 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 Teledyne LeCroy representatives or b) improper connection to incompatible equipment, or c) for any damage or malfunction caused by the use of non-Teledyne LeCroy supplies. Furthermore, Teledyne 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 Teledyne LeCroy are covered solely by the warranty of the original equipment manufacturer.

Windows License Agreement

The HDO4000 series oscilloscope software runs on the Windows operating system. Teledyne LeCroy's agreement with Microsoft prohibits users from installing third-party software on HDO4000s that is not relevant to measuring, analyzing, or documenting waveforms.

TELEDYNE LECROY
Everywhere**you**look™