



5 Series Mixed Signal Oscilloscopes MSO54, MSO56, MSO58

Installation and Safety Manual

Supports 5 Series MSO Product Firmware V1.0 and above

www.tek.com

071-3514-00

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Contacting Tektronix

Tektronix, Inc.
14150 SW Karl Braun Drive
P.O. Box 500
Beaverton, OR 97077
USA

For product information, sales, service, and technical support:

- In North America, call 1-800-833-9200.
- Worldwide, visit www.tek.com to find contacts in your area.

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Important safety information

Safety information provides warnings and cautions that help you operate the instrument safely and keep the instrument in a safe working condition.

This manual contains information and warnings that must be followed by the user for safe operation and to keep the product in a safe condition.

To safely perform service on this product, see the *Service safety summary* that follows the *General safety summary*.

General safety summary

Use the product only as specified. Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. Carefully read all instructions. Retain these instructions for future reference.

Comply with local and national safety codes.

For correct and safe operation of the product, it is essential that you follow generally accepted safety procedures in addition to the safety precautions specified in this manual.

The product is designed to be used by trained personnel only.

Only qualified personnel who are aware of the hazards involved should remove the cover for repair, maintenance, or adjustment.

Before use, always check the product with a known source to be sure it is operating correctly.

This product is not intended for detection of hazardous voltages.

Use personal protective equipment to prevent shock and arc blast injury where hazardous live conductors are exposed.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

When incorporating this equipment into a system, the safety of that system is the responsibility of the assembler of the system.

To avoid fire or personal injury

Use proper power cord. Use only the power cord specified for this product and certified for the country of use. Do not use the provided power cord for other products.

Ground the product. This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded. Do not disable the power cord grounding connection.

Power disconnect. The power cord disconnects the product from the power source. See instructions for the location. Do not position the equipment so that it is difficult to operate the power cord; it must remain accessible to the user at all times to allow for quick disconnection if needed.

Connect and disconnect properly. Do not connect or disconnect probes or test leads while they are connected to a voltage source. Use only insulated voltage probes, test leads, and adapters supplied with the product, or indicated by Tektronix to be suitable for the product.

Observe all terminal ratings. To avoid fire or shock hazard, observe all rating and markings on the product. Consult the product manual for further ratings information before making connections to the product. Do not exceed the Measurement Category (CAT) rating and voltage or current rating of the lowest rated individual component of a product, probe, or accessory. Use caution when using 1:1 test leads because the probe tip voltage is directly transmitted to the product.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Do not float the common terminal above the rated voltage for that terminal.

Do not operate without covers. Do not operate this product with covers or panels removed, or with the case open. Hazardous voltage exposure is possible.

Avoid exposed circuitry. Do not touch exposed connections and components when power is present.

Do not operate with suspected failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Disable the product if it is damaged. Do not use the product if it is damaged or operates incorrectly. If in doubt about safety of the product, turn it off and disconnect the power cord. Clearly mark the product to prevent its further operation.

Before use, inspect voltage probes, test leads, and accessories for mechanical damage and replace when damaged. Do not use probes or test leads if they are damaged, if there is exposed metal, or if a wear indicator shows.

Examine the exterior of the product before you use it. Look for cracks or missing pieces.

Use only specified replacement parts.

Use proper fuse. Use only the fuse type and rating specified for this product.

Wear eye protection. Wear eye protection if exposure to high-intensity rays or laser radiation exists.

Do not operate in wet/damp conditions. Be aware that condensation may occur if a unit is moved from a cold to a warm environment.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry. Remove the input signals before you clean the product.

Provide proper ventilation. Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

Slots and openings are provided for ventilation and should never be covered or otherwise obstructed. Do not push objects into any of the openings.

Provide a safe working environment. Always place the product in a location convenient for viewing the display and indicators.

Avoid improper or prolonged use of keyboards, pointers, and button pads. Improper or prolonged keyboard or pointer use may result in serious injury.

Be sure your work area meets applicable ergonomic standards. Consult with an ergonomics professional to avoid stress injuries.

Use care when lifting and carrying the product. This product is provided with a handle for lifting and carrying.

Use only the Tektronix rackmount hardware specified for this product.

Probes and test leads

Before connecting probes or test leads, connect the power cord from the power connector to a properly grounded power outlet.

Keep fingers behind the finger guards on the probes.

Remove all probes, test leads and accessories that are not in use.

Use only correct Measurement Category (CAT), voltage, temperature, altitude, and amperage rated probes, test leads, and adapters for any measurement.

Beware of high voltages. Understand the voltage ratings for the probe you are using and do not exceed those ratings. Two ratings are important to know and understand:

- The maximum measurement voltage from the probe tip to the probe reference lead.
- The maximum floating voltage from the probe reference lead to earth ground.

These two voltage ratings depend on the probe and your application. Refer to the Specifications section of the manual for more information.



WARNING. To prevent electrical shock, do not exceed the maximum measurement or maximum floating voltage for the oscilloscope input BNC connector, probe tip, or probe reference lead.

Connect and disconnect properly. Connect the probe output to the measurement product before connecting the probe to the circuit under test. Connect the probe reference lead to the circuit under test before connecting the probe input. Disconnect the probe input and the probe reference lead from the circuit under test before disconnecting the probe from the measurement product.

Connect and disconnect properly. De-energize the circuit under test before connecting or disconnecting the current probe.

Connect the probe reference lead to earth ground only.

Do not connect a current probe to any wire that carries voltages above the current probe voltage rating.

Inspect the probe and accessories. Before each use, inspect probe and accessories for damage (cuts, tears, or defects in the probe body, accessories, or cable jacket). Do not use if damaged.

Service safety summary

The *Service safety summary* section contains additional information required to safely perform service on the product. Only qualified personnel should perform service procedures. Read this *Service safety summary* and the *General safety summary* before performing any service procedures.

To avoid electric shock. Do not touch exposed connections.

Do not service alone. Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

Disconnect power. To avoid electric shock, switch off the product power and disconnect the power cord from the mains power before removing any covers or panels, or opening the case for servicing.

Use care when servicing with power on. Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

Verify safety after repair. Always recheck ground continuity and mains dielectric strength after performing a repair.

Terms in the manual

These terms may appear in this manual:



WARNING. *Warning statements identify conditions or practices that could result in injury or loss of life.*



CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Terms on the product

These terms may appear on the product:

- DANGER indicates an injury hazard immediately accessible as you read the marking.
- WARNING indicates an injury hazard not immediately accessible as you read the marking.
- CAUTION indicates a hazard to property including the product.

Symbols on the product



When this symbol is marked on the product, be sure to consult the manual to find out the nature of the potential hazards and any actions which have to be taken to avoid them. (This symbol may also be used to refer the user to ratings in the manual.)

The following symbols may appear on the product:



CAUTION
Refer to Manual



Protective Ground
(Earth) Terminal



Chassis Ground



Standby

Preface

This manual provides product safety and compliance, how to connect and power on the oscilloscope, and an introduction to the instrument features, controls and basic operations. See the product Help file for more detailed information.

Key features

Welcome to the 5 Series Mixed Signal Oscilloscope. The 5 Series MSO Oscilloscopes (MSO54, MSO56, and MSO58) are 4-, 6-, and 8-channel oscilloscopes with the world's first FlexChannel™-based inputs, enabling you to efficiently and cost-effectively perform mixed signal debugging on virtually any design.

- Bandwidths from 350 MHz to 2 GHz
- 4-, 6-, and 8-channel models with FlexChannel inputs
- Each FlexChannel input supports one analog channel or eight digital channels, in any combination
- FlexChannel inputs are compatible with TekVPI® probes
- Large 15.6" HD (1920 x 1080 pixel) capacitive touch-screen display
- User interface designed to optimize touch screen use and quickly access key settings
- Stacked mode places each channel or waveform in its own horizontal 'slice' on the screen, allowing for cleaner signal viewing and measuring
- Maximum 6.25 GS/s sample rate
- 62.5 M points record length on all channels (optional 125 M record length available)
- 500,000 waveforms/second maximum waveform capture rate
- No set limit on the number of math, reference, and bus waveforms you can display ¹
- Integrated optional features include a 50 MHz arbitrary function generator (AFG), and a DVM and trigger frequency counter
- Optional advanced triggering features let you trigger and take measurements on industry serial bus data standards including I²C, SPI, USB 2.0, CAN, LIN, FlexRay, RS-232/422/485/UART, Audio (I²S, LJ, RJ, TDM), and Ethernet

Related documents

Use the related documents to access information on how to remotely program or operate the instrument, understand theory of operation, replace suspected modules, and do other tasks.

To learn about	Use this document
How to use instrument functions	<i>5 Series Mixed Signal Oscilloscope MSO54, MSO56, MSO58 Help</i> (Tektronix part number 077-1303-xx; Printable version of the instrument Help; available at www.tektronix.com/downloads)
How to remotely control the instrument	<i>5 Series Mixed Signal Oscilloscope MSO54, MSO56, MSO58 Programmer Manual</i> (Tektronix part number 077-1305-xx; available at www.tektronix.com/downloads)
Instrument specifications and procedures to verify the instrument meets specifications	<i>5 Series Mixed Signal Oscilloscope MSO54, MSO56, MSO58 Specifications and Performance Verification Technical Reference</i> (Tektronix part number 077-1306-xx; available at www.tektronix.com/downloads)

¹ Actual number of waveforms depends on available system memory.

To learn about	Use this document
Instrument theory of operation, troubleshooting, disassembly, and replaceable parts	<i>5 Series Mixed Signal Oscilloscope MSO54, MSO56, MSO58 Service Manual</i> (Tektronix part number 077-1307-xx; available at www.tektronix.com/downloads)
Installing the instrument in a rack	<i>RM5MSO Rack Mount Kit Instructions</i> (Tektronix part number 071-3523-xx; available at www.tektronix.com/downloads)
Using the TLP058 Logic Probe	<i>TLP058 FlexChannel Logic Probe Instructions</i> (Tektronix part number 071-3515-xx; available at www.tektronix.com/downloads)

Installing your instrument

Check shipped accessories

Make sure that you received everything you ordered. If anything is missing, contact Tektronix Customer Support. In North America, call 1-800-833-9200. Worldwide, visit www.tek.com to find contacts in your area.

Check the packing list that came with your instrument to verify that you have received all ordered items. Check that you received all standard accessories.

Item	Quantity	Tektronix part number
<i>5 Series Mixed Signal Oscilloscope (MSO54, MSO56, MSO58) Installation and Safety Manual</i>	1	071-3514-xx
TPP0500B Passive Voltage Probe (500 MHz bandwidth). Shipped with 350 MHz and 500 MHz models.	One per channel	TPP0500B
TPP1000 Passive Voltage Probe (1 GHz bandwidth). Shipped with 1 GHz and 2 GHz models.	One per channel	TPP1000
Front cover	1	200-5406-xx
Accessory pouch (attached to front cover)	1	016-2106-xx
Mouse (wired with USB connector)	1	119-7054-xx
Power cord	1	Depends on region
Calibration certificate	1	N/A

If you purchased factory installed options such as Advanced Serial Triggering, tap **Help > About** to confirm that the option(s) are listed in the **Installed Options** table.

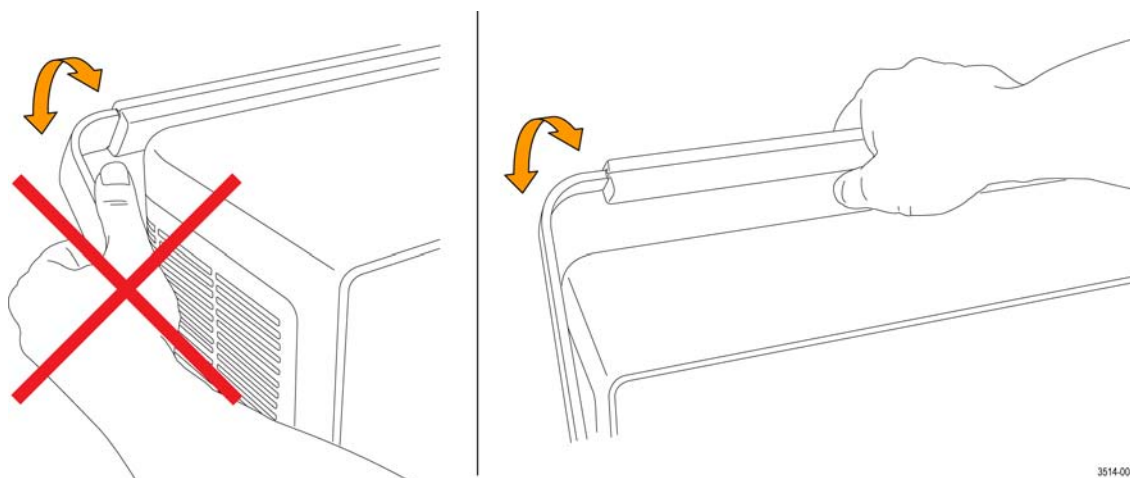
Safely rotate the handle

Use the correct process to eliminate the chance of pinching your thumb or rear-panel-connected cables while rotating the handle.



CAUTION. Hold the top of the handle to rotate the handle on the instrument. Do not hold the handle from the sides and rotate, as this can pinch the base of your thumb between the handle and the case.

If you have routed any cables between the handle and the case, be careful when rotating the handle so that you do not pinch the cables.



Operating requirements

Use the oscilloscope within the required operating temperature, power, altitude, and signal input voltage ranges to provide the most-accurate measurements and safe instrument operation.

Environment requirements

Characteristic	Description
Operating temperature	0 °C to +50 °C (+32 °F to +122 °F) For proper cooling, keep the sides and rear of the instrument clear of obstructions for 2 inches (51 mm).
Operating humidity	5% to 90% relative humidity (% RH) up to +40 °C (+104 °F) 5% to 55% RH above +40 °C up to +50 °C (+104 °F to +122 °F), Noncondensing.
Operating altitude	Up to 3000 meters (9842 feet)

Power requirements

Characteristic	Description
Power source voltage	100 V - 240 V _{AC RMS} , ±10%, single phase
Power source frequency	50/60 Hz, 100-240 V (90-264 V) 400 Hz, 115 V (103-127 V)
Power consumption	All models: 400 W maximum

Input signal requirements

Keep the input signals within allowed limits to ensure the most accurate measurements and prevent damage to the analog and digital probes or instrument.

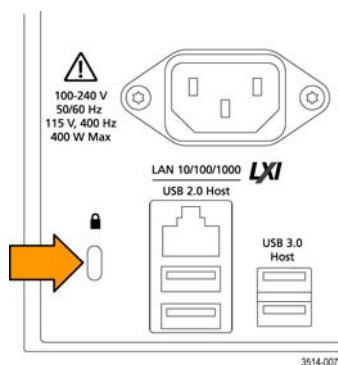
Make sure that input signals are within the following requirements.

Input	Description
Analog input channels, 1 M Ω setting, maximum input voltage at BNC	300 V _{RMS} Measurement Category II
Analog input channels, 50 Ω setting, maximum input voltage at BNC	5 V _{RMS}
Digital input channels, maximum input voltage range at digital inputs	Observe probe ratings TLP058; ± 42 V _P
Ref In maximum input voltage at BNC (rear panel)	7 V _{PP}

Secure (lock) the oscilloscope

Lock an oscilloscope to a test bench or equipment rack to prevent property loss.

Attach a standard laptop security lock to the rear panel of the oscilloscope, to secure the oscilloscope to a workbench, rack, or other location.

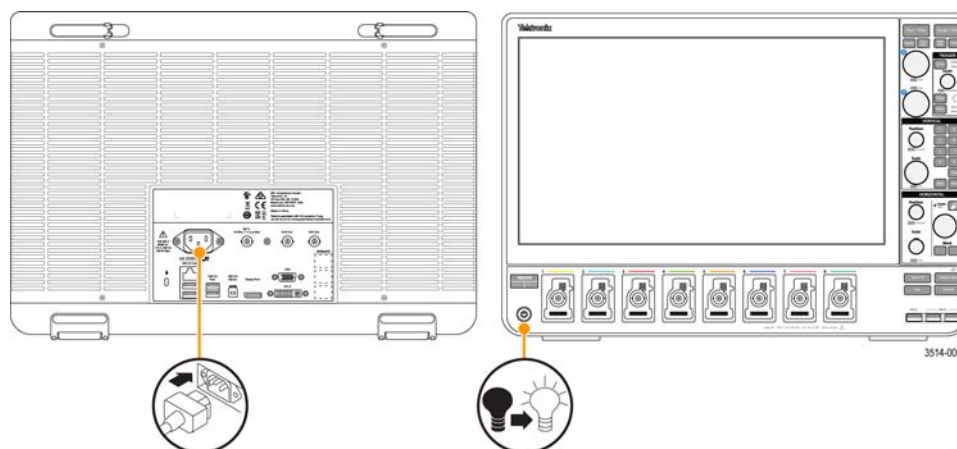


Powering the oscilloscope

Use this procedure to connect the oscilloscope to line power and power on and off the oscilloscope. Always connect the oscilloscope to AC power using the power cord that shipped with the instrument.

Prerequisite: Use the AC power cord that shipped with your oscilloscope.

1. Connect the supplied power cord to the oscilloscope power connector.



2. Connect the power cord to an appropriate AC mains source.
Power is supplied to the power supply and some other boards whenever the AC power cord is connected to a live mains circuit, putting the instrument in standby mode.
3. Push the front panel power button to power the instrument on and off.
The power button indicates instrument power states:
No light – no AC power applied
Yellow – standby mode
Blue – powered on
4. To completely remove power from the instrument, disconnect the power cord.
5. To transport the instrument with its power cord, flip out the power cord supports on the upper edge of the rear panel and wrap the power cord around the supports.

Check that oscilloscope passes power-on self tests

Power-on self tests verify that all oscilloscope modules are working correctly after power up.

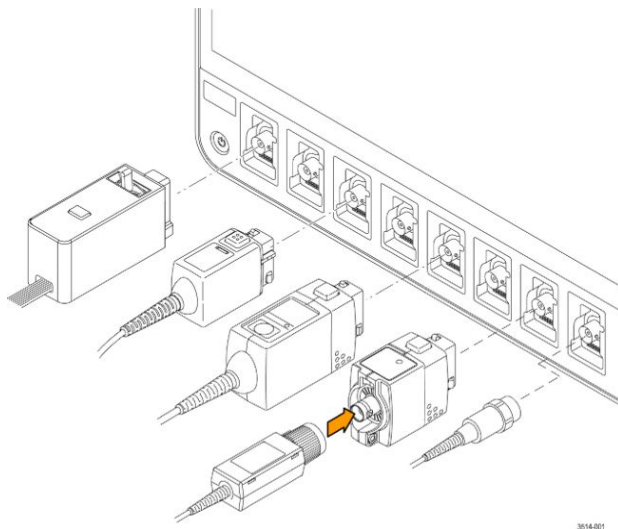
1. Power on the oscilloscope and wait until the oscilloscope screen appears.
2. Select **Utility > Self Test** from the top-edge Menu bar to open the **Self Test** configuration menu.
3. Check that the power-on self tests are **Passed**.

If the power-on self test shows **Failed**:

- a. Power cycle the oscilloscope.
- b. Tap **Utility > Self Test**. If the power-on self test still shows **Failed**, contact Tektronix Customer Support.

Connecting Probes

Probes and cables connect the oscilloscope to your device under test (DUT). Use a probe that best matches your signal measurement needs.



Connect TPP0500, TPP1000, TekVPI+®, TekVPI®, or other supported Tektronix analog probes by pushing them into a FlexChannel connector. The probe base latch locks with a 'click' when the probe is fully seated.

TekVPI probes automatically set the channel input parameters for that probe (bandwidth, attenuation, termination, and so on). If a probe has a **Menu** button, push that button to open an on-screen configuration menu. Follow instructions provided with active probes to set their parameters (auto zero, degauss, and so on).

To connect a TLP058 FlexChannel Logic Probe:

1. Move the locking lever to the unlocked position, then let go to reset locking lever to the center position.
2. Insert the probe into a FlexChannel channel until fully seated and the lock mechanism clicks.
3. Move the locking lever to the locked position. The status light should be a solid green.
4. To disconnect the TLP058 probe, move and hold the locking lever at the unlocked position and pull out the probe. Do not pull on the ribbon cable while removing the probe.

Connect a BNC probe or cable by pushing it onto a channel BNC bayonet connector and turn the lock mechanism clockwise until it locks.

Connecting a probe does not automatically display or enable that channel. Tap an Inactive Channel button to turn on that channel. Double-tap the Channel badge to open its configuration menu to verify or change probe or cable settings (bandwidth, attenuation, termination and so on).

Rackmount information

The optional RM5 Rackmount Kit lets you install the oscilloscope in standard equipment racks. The rackmount requires seven rack units (7U) of space to install.

RM5 Rackmount Kit (Option RM5).

1. Purchase or obtain the rackmount kit.
2. Follow the instructions that came with the rackmount kit (*RM5 Rackmount Kit Instructions*, Tektronix part number 071-3523-xx).
3. Make sure to allow adequate clearance on the sides and rear for air ventilation, and on the back for any cables you attach to the rear panel.

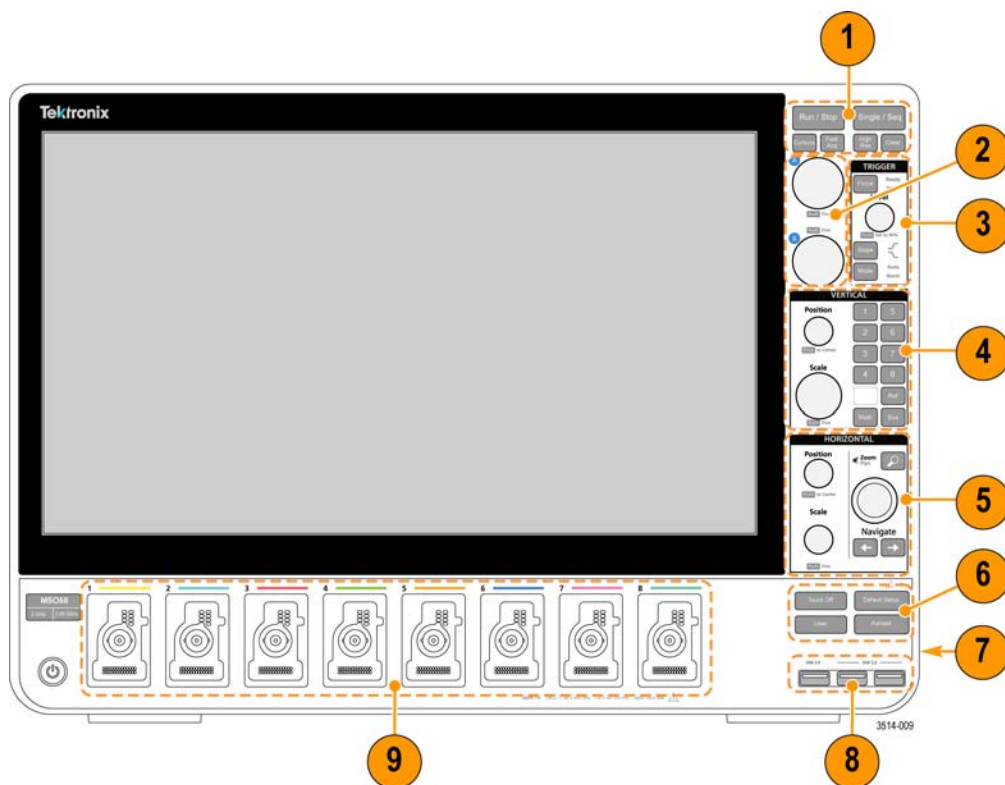
Getting acquainted with your instrument

The following content provides a high-level description of the instrument controls and user interface.

Refer to the *5 Series Mixed Signal Oscilloscope MSO54, MSO56, MSO58 Help* on the instrument for detailed information on using the controls and user interface to display waveforms and take measurements.

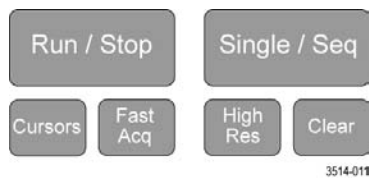
Front panel controls and connectors

The front panel controls provide direct access to key instrument settings such as vertical, horizontal, trigger, cursors, and zoom. The connectors are where you input signals with probes or cables, or insert USB devices.



1. Acquisition and Cursors controls:

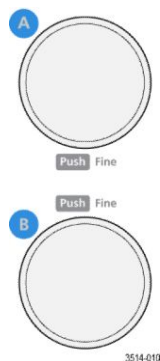
Getting acquainted with your instrument



- **Run/Stop** starts and stops waveform acquisition. The button color indicates the acquisition status (green = running and acquiring; red = stopped). When stopped, the oscilloscope shows waveforms from the last completed acquisition. The Run/Stop button on the screen also shows the acquisition status.
 - **Cursors** button turns screen cursors on or off. Use the Multipurpose knobs to move the cursors. Double-tap the cursor readouts, or on a cursor bar (line), to open the configuration menu to set cursor types and functionality. See [Display and configure cursors](#) on page 47.
 - **Fast Acq™** enables or disables the fast acquisition mode. FastAcq provides high-speed waveform capture that reduces the dead time between waveform acquisitions, enabling the capture and display of transient events such as glitches and runt pulses. It is helpful in finding elusive signal anomalies. Fast acquisition mode can also display waveform phenomena at an intensity that reflects their rate of occurrence.
 - **Single/Seq** enables making a single waveform acquisition, or a specified number of acquisitions (as set in the **Acquisition** configuration menu). Pushing **Single/Seq** turns off **Run/Stop** mode and takes a single acquisition. The button color indicates the acquisition status (quick green flash = single acquisition acquired; solid green = waiting for trigger event). Pushing **Single/Seq** again takes another single acquisition.
 - **High Res** applies unique finite impulse response (FIR) filters based on the current sample rate. This FIR filter maintains the maximum bandwidth possible for that sample rate while rejecting aliasing. The filter removes noise from the oscilloscope amplifiers and ADC above the usable bandwidth for the selected sample rate. Implementation of the filter in hardware, ahead of the trigger and storage, reduces trigger jitter and enables using **Fast Acq** mode while in **High Res** mode.
- High Res** mode also guarantees at least 12 bits of vertical resolution. The number of bits of resolution is displayed in the **Acquisition** badge at the bottom of the screen. The **Horizontal** badge also updates to show the sample rate and record length settings while in **High Res** mode.

- **Clear** deletes the current acquisitions and measurement values from memory.

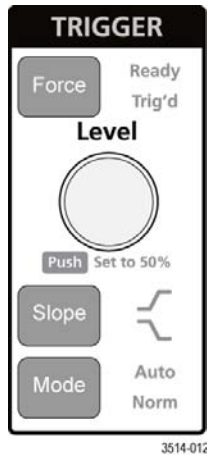
2. Multipurpose knobs:



- **Multipurpose knobs (A, B)** The Multipurpose knobs A and B move cursors and set parameter values in configuration menu input boxes. Selecting an input box that can use a Multipurpose knob assigns the indicated knob to change the value in that input box. The ring around each knob lights when you can use that knob to do an action.

Push a Multipurpose knob to enable the **Fine** mode for making smaller increment changes. Push the knob again to exit **Fine** mode.

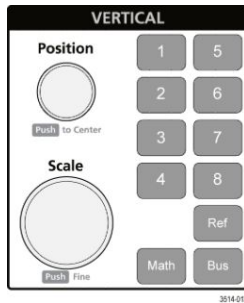
3. Trigger controls:



- **Force** forces a trigger event at a random point in the waveform and captures the acquisition.
- **Level** sets the amplitude level that the signal must pass through to be considered a valid transition. The color of the **Level** knob indicates the trigger source except for dual-level triggers. The **Level** knob is disabled when the trigger type requires two level settings or other trigger qualifiers (set from the **Trigger** configuration menu). Push the knob to set the threshold level to 50% of the peak-to-peak amplitude range of the signal.
- **Slope** sets the signal transition direction to detect (low to high, high to low, or either direction). Push the button to cycle through the selections. The **Slope** button is disabled when the trigger type requires other slope qualifiers (set from the **Trigger** configuration menu).
- **Mode** sets how the instrument behaves in the absence or presence of a trigger event.
- **Auto** trigger mode enables the instrument to acquire and display a waveform whether or not a trigger event occurs. If a trigger event occurs, the instrument displays a stable waveform. If a trigger event does not occur, the instrument forces a trigger event and acquisition and displays an unstable waveform.

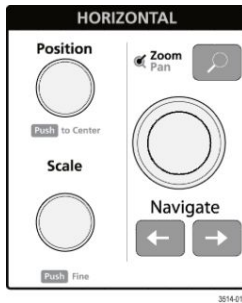
Normal trigger mode sets the instrument to acquire and display a waveform only when there is a valid trigger event. If no trigger occurs, the last waveform record acquired remains on the display. If no last waveform exists, no waveform is displayed.

4. Vertical controls:



- **Position** moves the selected waveform (Channel, Math, Reference, Bus) and its graticule up or down on the screen. The color of the **Position** knob indicates which waveform the knob is controlling. Push the knob to set the threshold level to 50% of the peak-to-peak amplitude range of the signal.
- **Scale** sets the amplitude units per vertical graticule division of the selected waveform. The scale values are shown on the right edge of the horizontal graticule lines, and are specific to the selected waveform in both **Stacked** or **Overlay** modes (in other words, each waveform has its own unique vertical graticule settings regardless of display mode). The color of the **Scale** knob indicates which waveform the knob is controlling.
- **Channel** buttons (1-4 for MSO54, 1-6 for MSO56, 1-8 for MSO58) turns on (displays), selects, or turns off a channel, as follows:
 - If the channel is not displayed, pushing a Channel button turns on that channel to the Waveform view.
 - If the channel is on the screen and is not selected, pushing that channel's button selects that channel.
 - If the channel is on the screen and is also selected, pushing that channel's button turns that channel off (removes it from Waveform view).
- The **Math** button adds or selects a Math waveform on the Waveform view, as follows:
 - If no Math waveform exists, pushing the **Math** button adds a Math waveform to the Waveform view and opens the Math configuration menu.
 - If only one Math waveform is displayed, pushing the button turns off the Math waveform (removes it from Waveform view). Push the button again to display the waveform.
 - If two or more Math waveforms are displayed, pushing the button cycles through selecting each math waveform.
- The **Ref** button adds or selects a Reference (saved) waveform on the Waveform view, as follows:
 - If no Reference waveform exists, pushing the **Ref** button opens the **Browse Waveform Files** configuration menu. Navigate to and select a waveform file (*.wfm) and tap **Recall** to load and display the reference waveform.
 - If only one Reference waveform is displayed, pushing the button turns off the Reference waveform (removes it from the Waveform View). Push the button again to display the waveform.
 - If two or more Reference waveforms are displayed, pushing the button cycles through selecting each Reference waveform.
- The **Bus** button adds or selects a bus waveform on the Waveform view, as follows:
 - If no Bus waveform exists, pushing the **Bus** button adds a Bus waveform to the Waveform view and opens the Bus configuration menu.
 - If only one Bus waveform is displayed, pushing the button turns off the Bus waveform (removes it from Waveform view).
 - If two or more Bus waveforms are displayed, pushing the button cycles through selecting each Bus waveform.

5. Horizontal controls:



- **Position** moves the waveform and graticule side to side on the screen (changing the trigger point position in the waveform record). Push the knob to center the trigger event to the center graticule on the Waveform view.
- **Scale** sets the time per major horizontal graticule division and samples/second parameters for the oscilloscope. Scale applies to all waveforms. Push the knob to enable the Fine mode for making smaller increment changes. Push the knob again to exit Fine mode.
- **Zoom** opens the Zoom mode. Push **Zoom** again to exit zoom mode. See [The Zoom user interface elements](#) on page 26.
- **Zoom** knob (center knob) increases or decreases the area of the zoom box in the Zoom Waveform Overview, which in turn controls the zoom amount of the waveforms shown in the main Zoom view.
- **Pan** knob (outer knob) moves the Zoom box left or right in the **Zoom Waveform Overview**, which in turn controls the part of the waveform shown in the main Zoom view.
- **Navigate** (left and right arrow) buttons puts the oscilloscope in Zoom mode and positions the previous or next search point in the waveform record to the center graticule of the Waveform view. There must be a **Search** badge present in the Results bar before the **Navigate** function will operate. See [Badges](#) on page 19.

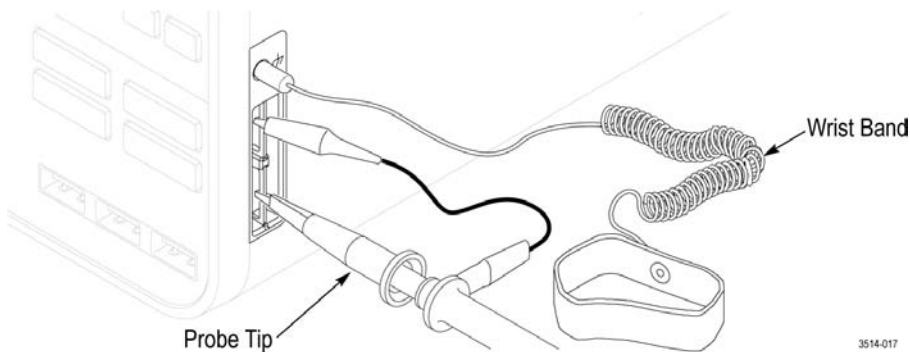
The front panel **Navigate** buttons can also be used for the **Previous** and **Next** button functions on measurement badges.

6. Miscellaneous controls:



- **Touch Off** turns touch screen capability off. The **Touch Off** button is lighted when the touch screen is turned off.
- **User** is a one-push save operation that uses the current menu bar **File > Save As** settings to save screen shots (including open menus and dialog boxes), waveform files, instrument settings, and so on, as follows:
 - If a **File > Save** or **File > Save As** operation has occurred since the last instrument startup, pushing **User** saves the file types to the location last set in the **Save As** configuration menu.
 - If no file save operation has occurred since the last instrument startup, pushing **User** opens the **Save As** configuration menu. Select a tab to select what type of file to save (Screen Capture, Waveform, and so on), set any associated parameters, and where to save it, and select **OK**. The specified file or files are saved. The next time you push **User**, the specified files are saved.
 - Screen Captures capture the entire screen, including most displayed configuration menus and dialog boxes.
- **Default Setup** restores the oscilloscope settings (horizontal, vertical, scale, position, and so on) to the factory default settings.
- **Autoset** automatically displays a stable waveform. See [Quickly display a waveform \(Autoset\)](#) on page 35.

7. Ground and Probe Compensation connectors:



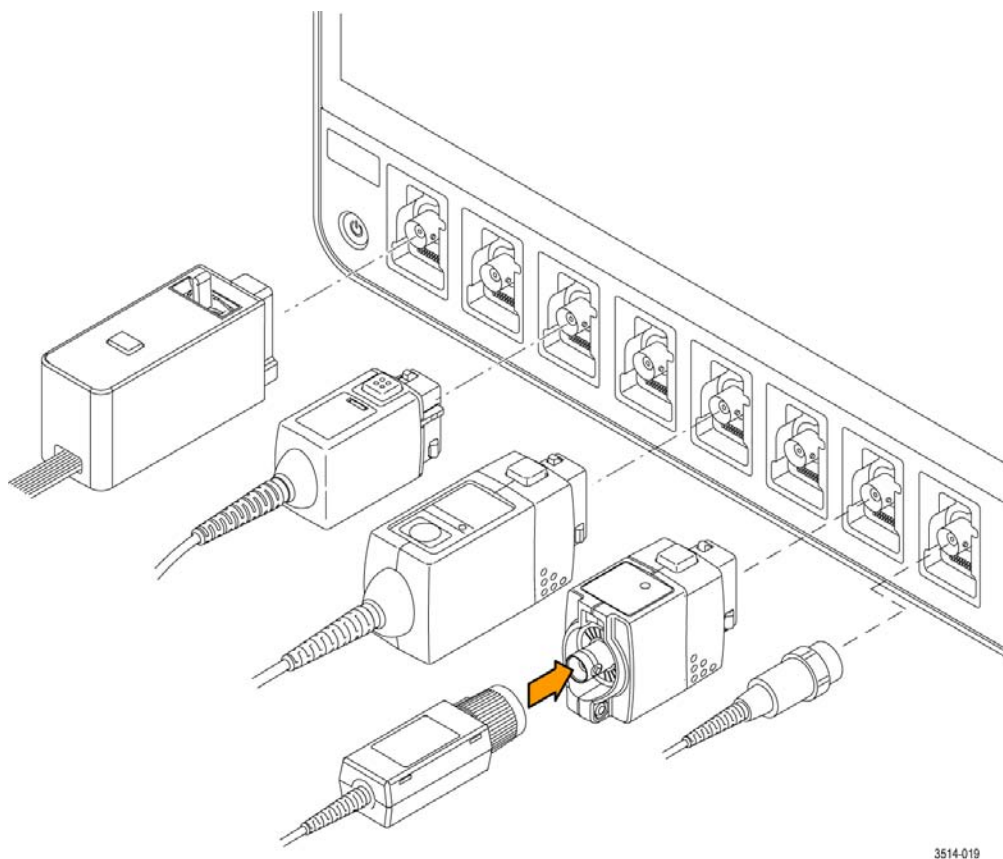
- The Ground and Probe Compensation connectors are located at the lower right side of the instrument, near the front panel. The Ground connector (the small hole in the case) provides an electrically grounded (through a resistor) connection point to attach an anti-static wrist strap, to reduce electrostatic damage (ESD) while you handle or probe the DUT.
- The Probe Compensation connections provide a ground connector (upper tab) and 1 kHz square wave source (lower tab) for adjusting the high-frequency response of a passive probe (probe compensation). The oscilloscope uses this signal to automatically compensate supported probes, including the ones that ship with the product. See [Compensate the TPP0500B or TPP1000 probes](#) on page 30.

8. USB Host ports (USB 3.0 and 2.0):



- USB ports are located at the lower right corner of the front panel, and on the rear panel. Connect USB flash drives to which you can save or recall data (such as instrument software updates, waveforms, settings, and screen captures), or connect peripheral devices such as a mouse or keyboard.

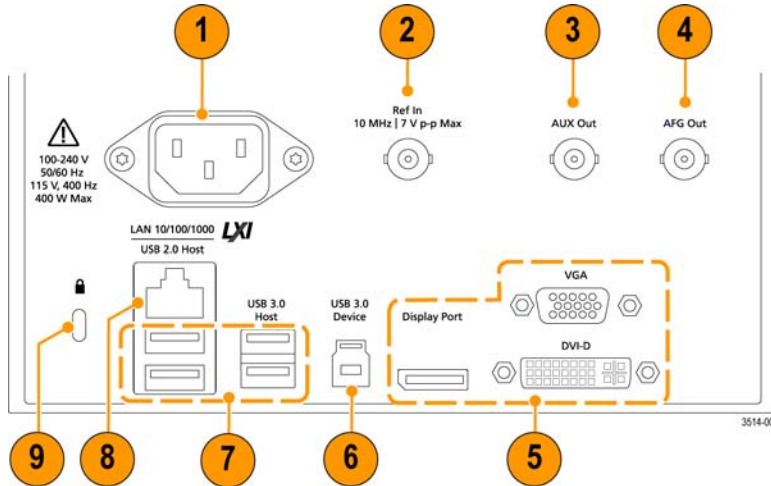
9. FlexChannel probe connectors:



- FlexChannel connectors support all TekVPI+ and TekVPI measurement probes, BNC passive probes, the TPL058 FlexChannel Logic Probe, and BNC cables. You connect most probes simply by pushing them into the connector until the probe seats with a click. See [Connecting Probes](#) on page 5.

Rear panel connections

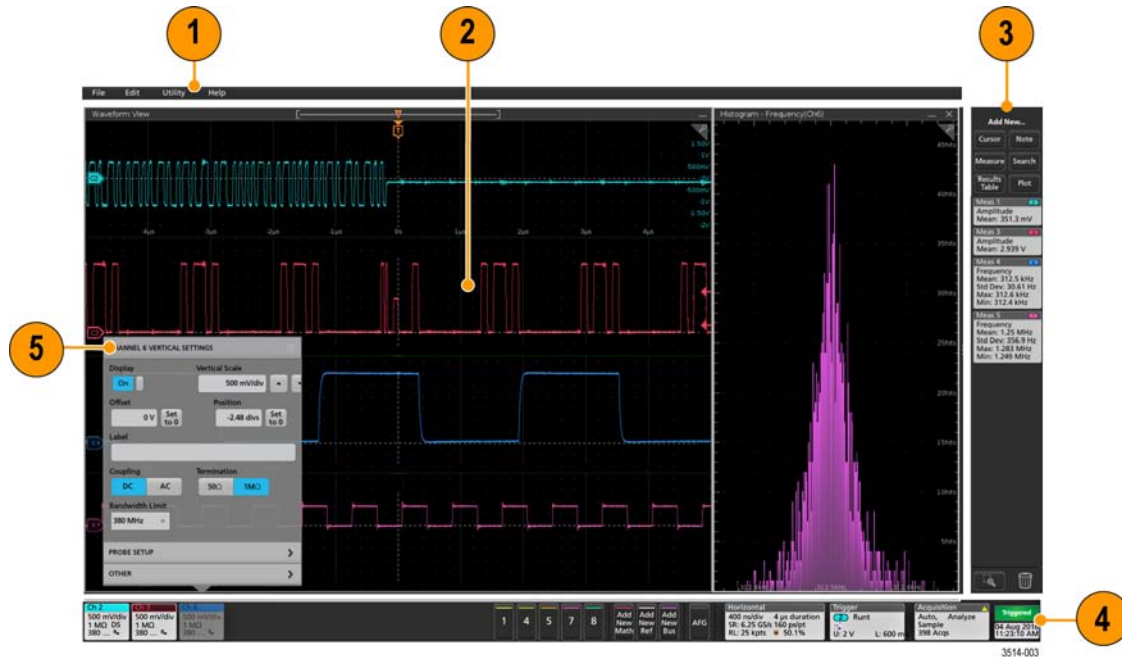
The rear panel connections supply power to the oscilloscope and provide connectors for network, USB devices, video, reference signals, and the AFG output.



1. **Power cord** connector. Use only the power cord specified for this product and certified for the country of use.
2. **Ref In** lets you connect a high-precision 10 MHz reference signal to the oscilloscope for more accurate measurements.
3. **AUX Out** generates a signal transition on a trigger event, outputs a 10 MHz reference signal, or outputs a synchronization signal from the AFG.
4. **AFG Out** is the signal output for the Arbitrary Function Generator (AFG).
5. **Video outputs** (Display Port, VGA, and DVI-D) let you connect an external monitor or projector to show the oscilloscope screen.
6. **USB Device** port lets you connect to a PC to remotely control the oscilloscope using USBTMC protocol.
7. **USB Host** ports let you connect a USB memory device, keyboard, or mouse.
8. **LAN** connector (RJ-45) connects the oscilloscope to a 10/100/1000 Base-T local area network.
9. **Security** lock connector lets you use a standard PC/laptop lock cable to secure the oscilloscope to a work bench or other location.

The user interface screen

The touch screen user interface contains waveforms and plots, measurement readouts, and touch-based controls to access all oscilloscope functions.



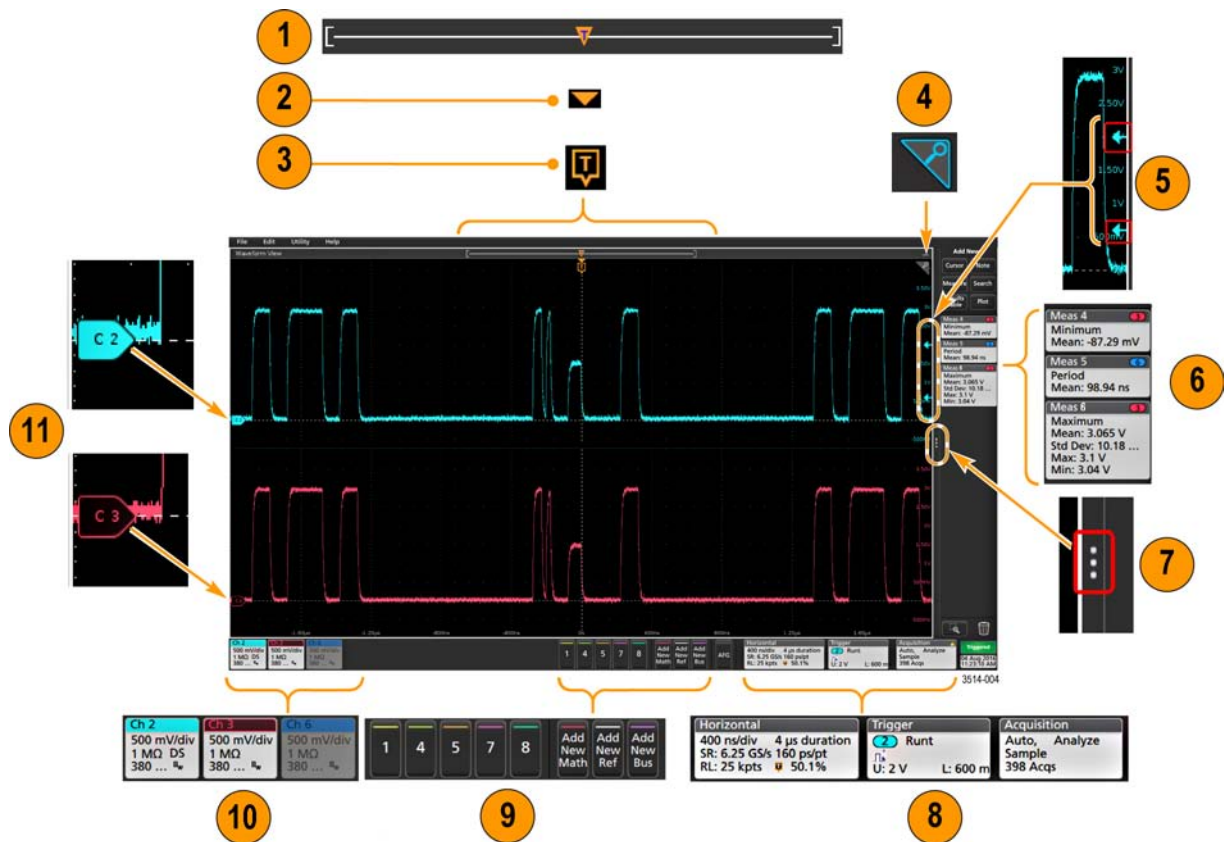
1. The **Menu bar** provides menus for typical operations including:
 - Saving, loading, and accessing files
 - Undoing or redoing an action
 - Setting oscilloscope display and measurement preferences
 - Configuring network access
 - Running self tests
 - Erasing measurement and settings memory (TekSecure™)
 - Loading option licenses
 - Opening a Help viewer.
2. The **Waveform View** area displays analog, digital, math, reference, bus, and trend waveforms. The waveforms include waveform handles (identifiers), individual vertical graticule scale labels, and trigger position and level(s) indicators. You can set the Waveform View to stack each waveform vertically in separate graticules, called 'slices' (the default mode, as shown in the previous image), or overlay all the waveforms on the screen (traditional waveform view). See [The user interface elements](#) on page 16.

You can also add Histogram, Spectral, Eye, and Measurement Results views (plots) for individual measurements. These plot views are separate view windows that you can move on the screen by dragging their title bar to a new position.

3. The **Results Bar** contains controls for displaying cursors, adding notes, plots, and result tables to the screen, and add measurements to the Results bar. The controls are:
 - The **Cursors** button displays on-screen cursors in the selected view. Touch and drag, or use the Multipurpose knobs, to move the cursors. Double-tap on a cursor, or on the cursor readouts, to open a configuration menu to set cursor types and related functions.
 - The **Measure** button opens a configuration menu from which to select and add measurements to the Results bar. Each measurement you add has a separate badge. Double-tap a measurement badge to open its configuration menu.
 - The **Results Table** button adds a Measurement or Bus Results table to the screen. The Measurement Results table displays all measurements present in the Results bar. The Bus Results table displays bus decode information for displayed bus waveforms. Each table is contained within its own view window, which can be moved within the display area.
 - The **Note** button adds a note object to the selected view. Double-tap the note text to open a configuration menu to change the text and font characteristics. Drag the note to any location on the view. Notes cannot be added to a **Results Table** view.
 - The **Search** button lets you detect and mark a waveform where specified events occur. Tap **Search** to open a Search configuration menu and set the search conditions for analog and digital channels. You can add any number of searches to the same waveform or to different waveforms. Search badges are added to the **Results** bar.
 - The **Plot** button adds an XY, XYZ, or Eye Diagram plot to the display. These plots are contained within their own window and can be moved within the overall display area.
 - The **Measurement** and **Search** badges show measurement and search results, and are displayed in the middle area of the **Results** bar. See [Badges](#) on page 19. See [Add a measurement](#) on page 40. See [Add a Search](#) on page 45.
 - The **Draw-a-Box** button at the bottom of the Results Bar lets you draw a box on the screen to zoom in on an area of interest.
 - The **Trash Can** icon lets you drag Channel, Waveform, Measurement, and Search badges to the **Trash Can** to delete them.
4. The **Settings Bar** displays System badges for setting Horizontal, Trigger, Acquisition, and Date/Time parameters; **Inactive Channel** buttons to turn on channels; **Add New Waveform** buttons to add math, reference, and bus waveforms to the display; and Channel and Waveform badges that let you configure the individual waveform parameters. Tap a channel or waveform button to add it to the screen and display a badge. Double-tap any type badge to open its configuration menu. See [Badges](#) on page 19.
5. **Configuration Menus** let you quickly change the parameters of the selected user interface item. You can open configuration menus by double-tapping on badges, screen objects, or screen areas. See [Configuration menus](#) on page 24.

The user interface elements

Each area of the user interface has a specific function that helps manage information or controls. This topic shows and describes the key user interface elements.



1. The **Waveform Record View** is a graphical high-level view of the overall waveform record length, how much of the record is on the screen (shown in brackets), the location of key time events including the trigger event, and the current position of waveforms cursors.



If you are displaying a reference waveform that is shorter than the current acquisition record length, or you are changing the horizontal time scale while the oscilloscope acquisition is stopped, the brackets change position to show the part of the waveform record that is being viewed relative to the current acquisition record length.



If cursors are active on a waveform, the Waveform record view shows the relative cursor positions as small vertical dashed lines.



When in Zoom mode, the Waveform Record View is replaced with the Zoom Overview. See [The Zoom user interface elements](#) on page 26.

2. The **Expansion Point** icon on the waveform view shows the center point around which the waveform expands and compresses when changing horizontal settings.



3. The **Trigger Position Indicator** shows where the trigger event occurred in the waveform record. The trigger icon is displayed in the waveform slice that is the trigger source.



4. The **Zoom** icon (in upper right corner of Waveform and Plot views) toggles zoom on and off. The front panel **Zoom** button and knobs also turn on zoom mode and change the position and horizontal size of the Zoom Box.



5. The **Trigger Level Indicator** icon(s) shows the trigger level on the trigger source waveform. Some trigger types require two trigger levels.
6. **Measurement** and **Search** badges show measurement and search results. See [Badges](#) on page 19. See [Add a measurement](#) on page 40.
7. The **Results Bar Handle** opens or closes the Results Bar, to maximize waveform screen viewing when needed. To reopen the Results bar, either tap the handle icon or swipe left from the right side of the display.
8. The **System** badges show global instrument settings (Horizontal, Trigger, Acquisition, Run/Stop status, and Date/Time). See [Badges](#) on page 19.
9. The **Inactive Channel** buttons add channel waveforms to the Waveform view and add an associated Channel badge to the Settings bar.

The **Add New** buttons add Math, Reference, and Bus waveforms to the Waveform view, and add an associated Waveform badge to the Settings bar. You can add any number of Math, Reference, and Bus waveforms, limited only by system memory.

The optional **AFG** button opens the AFG configuration menu to set and enable the AFG output. This button is only present if the AFG option is installed.

The optional **DVM** button lets you use an analog probe to take DC, AC RMS, or DC+AC RMS voltage measurements on your DUT. Tap the button to add a **DVM** badge to the Results Bar and open a configuration menu. The DVM option also enables a trigger frequency counter, accessible from the **Mode & Holdoff** panel in the **Trigger** badge menu. This button is only present if the DVM option is installed.

10. **Channel** and **Waveform** badges (Math, Reference, Bus) show active channel and waveform settings and their status (selected, unselected, inactive). Double-tap a badge to open its associated configuration menu. See [Badges](#) on page 19. See [Configuration menus](#) on page 24.

If you add more Channel or Waveform badges than can fit in the waveform badge area, use the scroll buttons at each end of the waveform badge area to let you scroll through all badges.

11. The **Waveform Handles** identify the channel or source waveform (C1-C8 for channels, Mx for Math waveforms, Rx for Reference waveforms, Bx for bus waveforms). The waveform handles are at the zero-volt level of the waveform. The currently selected waveform handle is a solid color; unselected waveform handles are outlined.

Double-tapping a waveform handle opens the configuration menu for that waveform.

For digital channels, the waveform handle shows the channel number, with the individual digital signal handles marked D0–D7. The colors follow a color code similar to that used on resistors. The D0 indicator is white, the D1 indicator is brown, the D2 indicator is red, and so on.



Double-tapping a digital waveform handle opens the digital channel configuration menu.

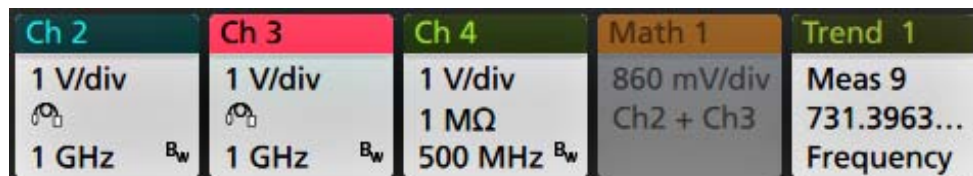
Dragging a digital signal handle over another handle swaps those two signals on the waveform.

Badges

Badges are rectangular icons that show waveform, measurement, and instrument settings or readouts. Badges also provide fast access to configuration menus. The badge types are Channel, Waveform, Measurement, Search, and System.

Channel and Waveform badges

Channel and **Waveform** badges are located in the Settings Bar, located along the bottom left of the screen. These badges show settings for each displayed channel or waveform. Each waveform (channel, math, reference, bus, and trend) has its own badge. Double-tap a badge to open its configuration menu.



Most Channel and Waveform badges also have Scale buttons, shown by single-tapping the badge. Use the Scale buttons to increase or decrease the vertical scale setting for that waveform.

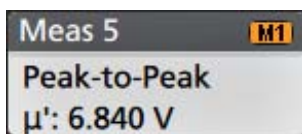


Channel badges are listed in the channel order. You cannot move **Channel** badges other than to drag them into the **Trash Can** icon to turn them off.

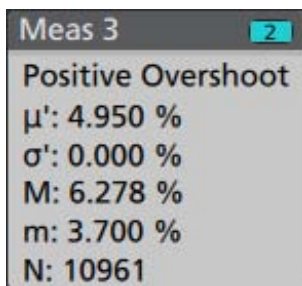
Waveform badges (Math, Ref, Bus, Trend) are listed in the order created, and are grouped together by type. Deleting a **Waveform** badge does not change the order or names of the remaining badges. You cannot move **Waveform** badges other than to drag them to the **Trash Can** icon to delete them.

Measurement badges

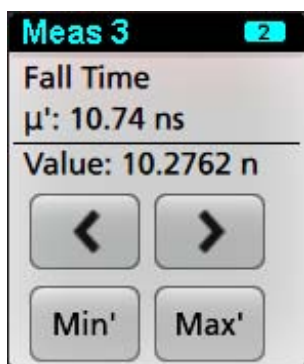
Measurement badges are located in the Results Bar. They show measurements or search results. The badge title also shows the measurement source or sources. To add a Measurement badge, tap the **Add New Measurement** button and select a measurement. Double-tap a Measurement badge to open its configuration menu to change or refine settings. The default measurement badge readout shows the measurement's mean (μ) value.



To add statistical readouts to individual measurement badges, double-tap a measurement badge to open its configuration menu and select **Show Statistics in Badge**.



Some Measurement badges also have Navigation buttons, shown by single-tapping the badge.



The < (Previous) and > (Next) buttons center the waveform in the display at the position of the previous or next measurement point in the record (for measurements that take more than one measurement per acquisition).

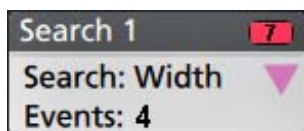
The **Min'** and **Max'** navigation buttons center the waveform in the display at the minimum or maximum value for that measurement in the current acquisition.

The prime symbol (') shown on measurement readings and Min/Max buttons indicates that the value shown (or moved to in the case of **Min/Max** and waveforms) is from the current acquisition. Lack of a prime symbol means the value is from all acquisitions.

Measurement badges are listed in the order created, starting at the top of the Results bar. Deleting a **Measurement** badge does not change the order or names of the remaining badges. You cannot move **Measurement** badges other than to drag them into the **Trash Can** icon to delete them.

Search badges

Search badges are also located in the Results Bar, below the Measurement badges. A search badge defines the search source, type, and the number of search criteria events (occurrences) in the current acquisition, and marks the waveform where those events occur with small down-pointing triangles along the top of the waveform graticule. Double-tap a search badge to open its configuration menu to change or refine search settings.



Search badges are created by tapping the **Add New... Search** button. Use the displayed configuration menu to set the search criteria.

Search badges have < (Previous) and > (Next) Navigation buttons that open the Zoom mode and center the waveform in the display at the position of the previous or next search mark in the waveform record. Search badge Navigation buttons are only usable when the oscilloscope is in single acquisition mode. Single-tap a badge to close the Navigation buttons.



Some searches also provide **Min** and **Max** navigation buttons that open the Zoom mode and center the waveform in the display at the minimum or maximum value for that search event in the current acquisition.

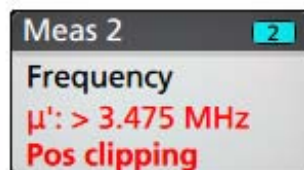
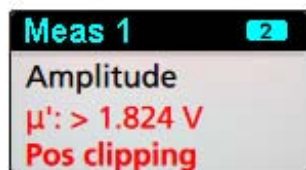
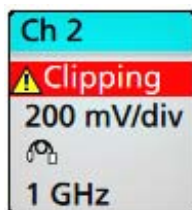
Search badges are listed in the order created. Deleting a **Search** badge does not change the order or names of the remaining badges. You cannot move **Search** badges other than to drag them into the **Trash Can** icon to delete them.

Signal Clipping and Badges



WARNING. Clipping is caused by excessive or dangerous voltage at the probe tip, and/or a vertical scale setting that is not adequate to display the entire vertical range of the waveform. Excessive voltage at the probe tip can injure the operator and cause damage to the probe and/or instrument.

This instrument shows a warning triangle symbol and the words **Clipping** in a Channel badge when a vertical clipping condition exists. Any measurement badges associated with that channel also indicate a clipping condition by turning the measurement text red and listing the type of clipping (positive or negative).



To close the clipping message, change the vertical scale to show the entire waveform, disconnect the probe tip from the excessive voltage source, and check that you are probing the correct signal using the correct probe.

Clipping causes inaccurate amplitude-related measurement results. Clipping also causes inaccurate amplitude values in saved waveform files. If a math waveform is clipped, it will not affect amplitude measurements on that math waveform.

System badges



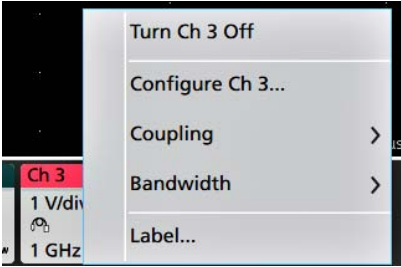
System badges (in the Settings bar) display the main Horizontal, Trigger, and Acquisition settings. You cannot delete System badges.



Double-tap a System badge to open its configuration menu.

The Horizontal badge also has Scale buttons, shown by single-tapping the badge. Use the Horizontal Scale buttons to increase or decrease the horizontal time setting.

Common badge actions

Action	Result	Example
Single tap	Immediate access controls (Scale, Navigation).	
Double tap	Configuration menu with access to all settings for the badge.	
Touch and hold	Right-click menu with single tap access to common actions. Typical actions include turning off a channel and deleting a measurement or search badge.	

Badge selection status

The appearance of a badge indicates its selection status (selected or unselected), or if a measurement needs to be deleted to close a channel or waveform badge.

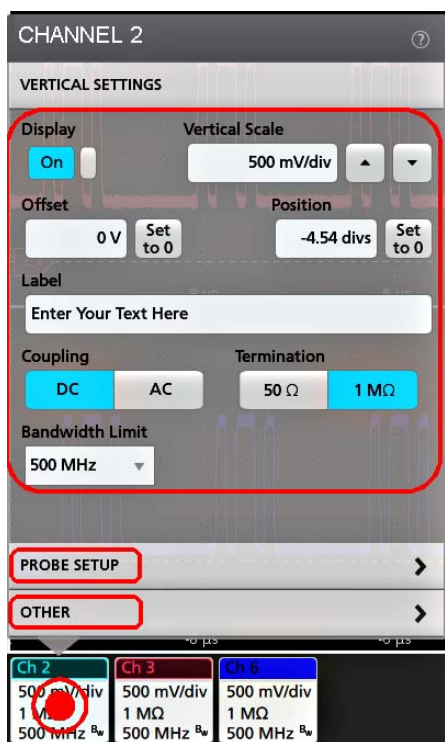
Badge type	Selected	Unselected	Turned off or in use ¹
Channel or Waveform			
Measurement			N/A

Configuration menus

Configuration menus let you quickly set the parameters for channels, system settings (Horizontal, Trigger, Acquisition), measurements, cursor readouts, Waveform and Plot views, note text, and so on.

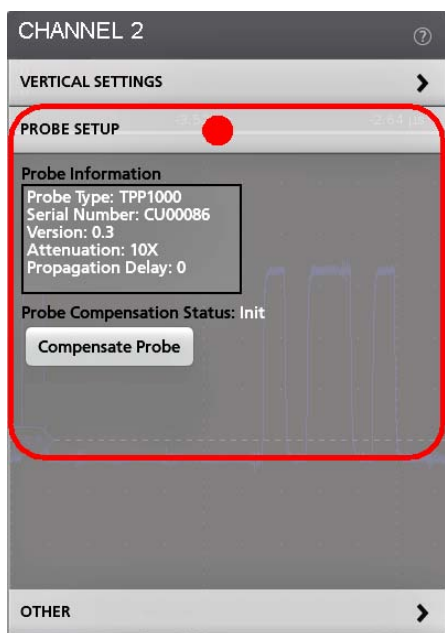
Double-tap an item (badge, Waveform or Plot view, cursor readouts, note text, and so on) to open its configuration menu. For example, double-tap a Channel badge in the Settings bar to open its configuration menu.

¹ A dimmed Channel badge means the screen waveform is turned off (but not deleted). A dimmed Waveform badge means that the waveform display is turned off, or it is being used as a source by a measurement and cannot be deleted until the measurement is deleted.



Selections or values that you enter take effect immediately. Menu contents are dynamic, and can change depending on your selections.

Related settings are grouped into 'panels.' Tap the panel name to show those settings. Changes to panel settings can change the values and/or fields shown in that panel and other panels.

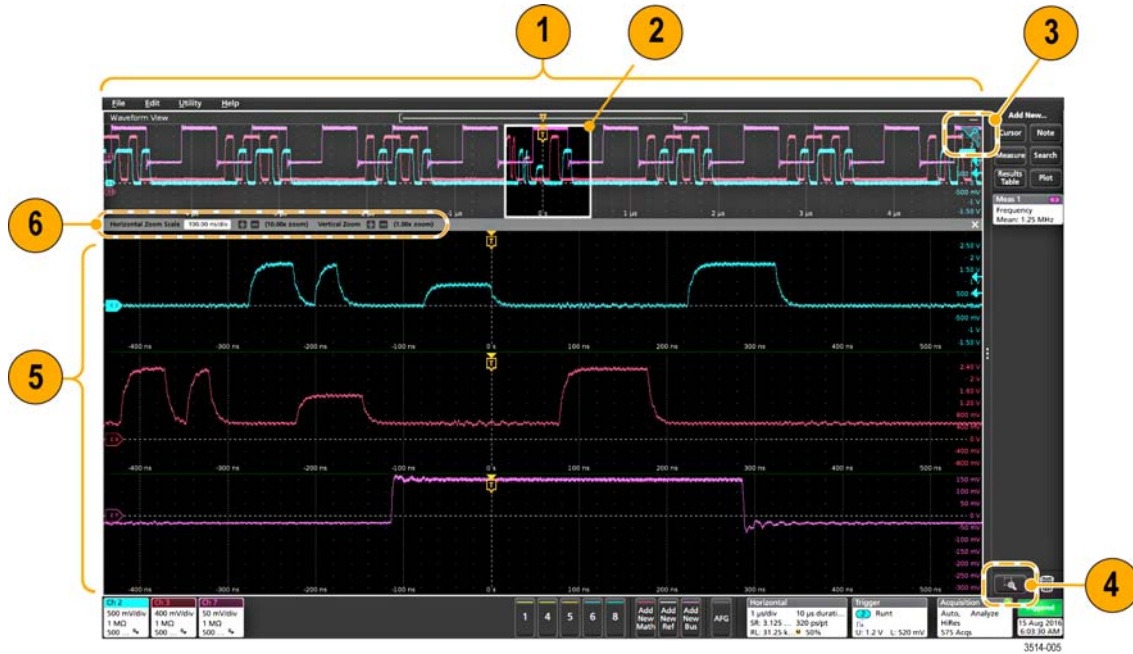


Tap anywhere outside a configuration menu to close it.

To open Help content for a configuration menu, tap the question mark Help icon in the upper right corner of the menu.

The Zoom user interface elements

Use the zoom tools to magnify waveforms to view signal details.



1. The **Zoom Overview** shows the entire waveform record. All waveforms are shown in Overlay mode in the Zoom Overview area.

NOTE. Using pinch and expand gestures on the Zoom Overview waveforms changes the horizontal time base settings.

2. The **Zoom Box** shows the area of the Zoom Overview to display in the Zoom View. You can touch and drag the box to move the area to view. You can also use the zoom **Pan** knob to move the Zoom Box left or right.

NOTE. Moving the Zoom Box, or changing its position, does not change the horizontal time base settings.

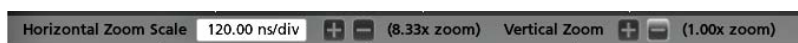
3. The **Zoom** icon (in the upper right corner of the Waveform View) switches zoom mode on and off.
4. The **Draw-a-Box** button lets you quickly draw a box around an area of interest in the Waveform or Zoom Overview on which to zoom. Drawing a box immediately puts the oscilloscope into zoom mode. The button is located at the bottom of the Results bar. Tap the button, then touch and drag on the waveform to draw a box on the area of interest.

To keep the Draw-a-Box button enabled, double-tap the Draw-a-Box button. Keeping the Draw-a-Box function enabled lets you update your Zoom display by drawing new boxes in either the Waveform Slice or Zoom Overview window.

5. The **Zoom View** shows the zoomed waveforms as marked by the Zoom Box in the Zoom Waveform Record View. Use pinch and/or drag options in the zoom view to change the zoomed area of interest.

NOTE. Pinch, expand, and drag gestures in the Zoom View only change zoom magnification settings and Zoom Box position.

6. Use the **Zoom Title Bar** controls to adjust the vertical and horizontal size of the zoom area. Click or tap the + or - buttons.



Using the touch screen interface for common tasks

Use standard touch screen actions, similar to those found on smart phones and tablets, to interact with most screen objects. You can also use a mouse to interact with the UI. The equivalent mouse operation is shown for each touch operation.

The oscilloscope has a user interface tutorial. Tap Help > User Interface Tutorial to quickly learn the fundamental touch operations.

Table 1: Common touchscreen UI tasks (with mouse equivalents)

Task	Touchscreen UI action	Mouse action
Add a channel, math, reference, or bus waveform to the screen.	Tap an inactive channel button, Add New Math, Add New Reference, or Add New Bus button.	Click an inactive channel button, Add New Math, Add New Reference, or Add New Bus button.
Select a channel, math, reference, or bus waveform to make it active	Stacked or Overlay mode: Tap the Channel or Waveform badge. Stacked mode: Tap the channel, math, reference, or bus waveform slice or handle. Overlay mode: Tap the channel or waveform handle.	Stacked or Overlay mode: Left-click the Channel or Waveform badge. Stacked mode: Left-click the channel, math, reference, or bus waveform slice or handle. Overlay mode: Left-click the channel or waveform handle.
Display scale or navigation buttons on a badge (waveform, measurement ¹ , search, horizontal).	Tap the badge.	Click the badge.
Open a configuration menu on any item (all badges, views, cursor readouts, labels, and so on).	Double-tap the badge, view, or other object.	Double-click the badge, view, or other object.
Open a right-click menu (badges, views).	Touch and hold on the badge, Waveform View, Plot view, or other screen item until a menu opens.	Right-click the object.
Close a configuration menu ² .	Tap anywhere outside the menu or dialog.	Click anywhere outside the menu or dialog.
Move a menu.	Touch and hold the menu title bar or a blank area in the menu, then drag the menu to new position.	Click and hold the right mouse button on title or blank area, drag to new position.
Move a note ³ .	Touch and hold on a note and quickly ⁴ start to drag, then move to new position.	Click and hold the right mouse button on the note and quickly start to drag, then move to the new position.

¹ Not all measurement or search badges display navigation buttons.

² Some dialog boxes will not close until you click an OK, Close, or other button in the dialog.

³ Notes are screen objects and are not associated with any particular waveform channel or slice.

⁴ Start to move the note as soon as selected (highlighted), otherwise the UI opens the right-click menu.

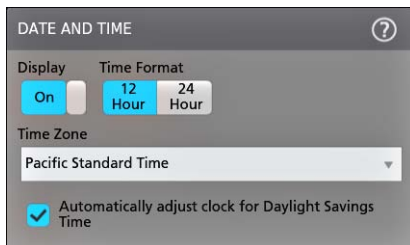
Task	Touchscreen UI action	Mouse action
Change horizontal or vertical settings directly on a waveform. Vertical changes only apply to the selected channel or waveform; horizontal changes apply to all channels and waveforms.	Tap a badge and use the Scale buttons. Pinch or expand two fingertips on the waveform view, move them together or apart vertically or horizontally, lift from screen; repeat.	Left-click a channel, waveform, or Horizontal badge and click on the Scale buttons.
Increase or decrease the zoom area (while in Zoom mode)	Pinch or expand two fingertips on the waveform view, move them together or apart vertically or horizontally, lift from screen; repeat.	Click the + or - buttons on the Zoom Title bar. Click the Draw-a-Box button, draw a box around the waveform area of interest.
Quickly scroll or pan a waveform or list.	Touch and drag in the waveform or list.	Click and drag in the waveform or list.
Close or open the Results Bar to increase the Waveform view area.	Tap on the Results Bar Handle (three vertical dots) or anywhere in the divider between the Waveform View and the Results Bar.	Click the Results Bar Handle (three vertical dots) or anywhere in the divider between the Waveform View and the Results Bar. Click and drag the Results Bar divider.

Configure the instrument

Set the time zone and clock readout format

Set the time zone to your region so that saved files are marked with the correct date and time information. You can also set the time format (12 or 24 hour clock).

1. Double-tap the Date/Time badge (bottom-right of screen) to open the configuration menu.



2. Select your local time zone and the time format (12 or 24 hour). Settings take place immediately.
3. To turn off showing the date and time on the screen, tap the **Display** button to **Off**.
To turn on date/time display again, double-tap in the blank area where the date/time badge was displayed to open the configuration menu, and set the **Display** button to **On**.
4. Tap anywhere outside of the menu to close it.

Download and install the latest firmware

Loading the latest firmware helps ensure that your oscilloscope is taking the most accurate measurements. You can check for the latest updates from network-connected oscilloscopes, or download the update file to a USB drive and install from there.

Prerequisite: Save any important on-instrument files (waveforms, screen captures, oscilloscope setups, and so on) to a USB drive or network.

Update oscilloscope firmware from USB drive

Prerequisite: Determine the current version of firmware installed on the oscilloscope (**Help > About**)

1. Open up a Web browser on a PC and go to www.tektronix.com/software.
2. Enter **MSO5** in the search field and click **Search**.
3. Select **Software** in the **Filter by type** list.
4. If the listed available firmware version is newer than what is on your oscilloscope, select and download that file to your PC.
5. Follow the installation instructions that came with the downloaded firmware to create a firmware install file.
6. Copy the firmware install file to a USB drive.
7. Insert the USB drive into any oscilloscope USB Host port. The oscilloscope detects the USB drive with the firmware file and starts the installation process.

8. Follow instructions to install the firmware.

NOTE. Do not power off the oscilloscope or remove the USB flash drive until the oscilloscope finishes installing the firmware. The oscilloscope displays a message when it is OK to turn off the oscilloscope.

9. When the firmware install is finished, remove the USB drive and restart the oscilloscope.

To confirm the firmware installation:

1. Tap **Help > About** in the Menu bar.
2. Verify that the firmware version number listed on the screen is the same version that you downloaded.

Run Signal Path Compensation (SPC)

Run SPC at regular intervals for best measurement accuracy. You should run SPC whenever the ambient (room) temperature has changed by more than 5 °C (41 °F), or once a week if you use vertical scale settings of 5 mV per division or less.

Signal Path Compensation (SPC) corrects for DC level inaccuracies in the internal signal path, caused by temperature variations and/or long-term signal path drift. Failure to run SPC on a regular basis may result in the oscilloscope not meeting warranted performance levels at low volts per division settings.

Prerequisite: Disconnect all probes and cables from the front-panel channel inputs and rear-panel signal connectors.

1. Power on and warm up the oscilloscope for at least 20 minutes.
2. Tap **Utility > Calibration**.
3. Tap **Run SPC**. The **SPC Status** readout shows **Running** while SPC is running. SPC can take several minutes per channel to run, so wait until the SPC Status message changes to Pass before reconnecting probes and using the oscilloscope.



CAUTION. You can abort the SPC calibration by tapping **Abort SPC**. This may leave some channels uncompensated, resulting in possible inaccurate measurements. If you do abort the SPC, make sure to run the SPC procedure completely before using the instrument to take measurements.

4. Close the Calibration configuration dialog when SPC has completed.
5. If the SPC fails, write down any error message text. Make sure that all probes and cables are disconnected and run the SPC again. If the SPC still fails, contact Tektronix Customer Support.

Compensate the TPP0500B or TPP1000 probes

Probe compensation adjusts the high frequency response of a probe for best waveform capture and measurement accuracy. The oscilloscope can automatically test and store compensation values for an unlimited number of probe/channel combinations.

The oscilloscope stores the compensation values for each probe/channel combination, and automatically recalls the compensation values when you plug in the probe. Probe compensation status is shown in the Probe Setup panel of the Channel configuration menu.

- If the Probe Compensation Status field displays **Pass**, the probe is compensated and ready for use.
- If the Probe Compensation Status field displays **Default**, the attached probe has not been compensated and needs to have this probe compensation procedure run.

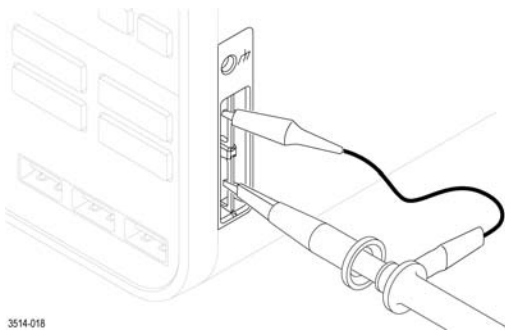
- If the Probe Compensation Status field displays **Fail**, the attached probe has failed the probe compensation procedure. Reconnect the probe and run probe compensation again.
- If there is no probe compensation status field shown in the panel, the oscilloscope cannot store compensation values for that probe. See the oscilloscope Help for how to manually compensate passive probes not supported by the probe compensation function.

Use this procedure to compensate a TPP0500B, TPP1000, or other supported TPP-family probe that shows a Default status when connected to the oscilloscope.

NOTE. A **Default Setup** does not delete probe compensation values. A factory calibration deletes all stored probe compensation values.

Prerequisite: The oscilloscope must be powered on for at least 20 minutes before compensating a probe.

1. Connect a supported probe to an input channel. The probes shipped with the oscilloscope support this probe compensation process.
2. Connect the probe tip and ground lead of the probe to the PROBE COMP terminals on the lower right side of the oscilloscope (near the Default Setup and Autoset front panel buttons).



Connect the probe tip to the 1 kHz source (lower connector), and the ground clip to the ground (upper connector). For best results, remove any probe tip accessories and hold the probe tip directly onto the 1 kHz connector.

NOTE. Connect only one probe at a time to the PROBE COMP terminals.

3. Turn off all channels.
4. Turn on the channel to which the probe is connected.
5. Push the front-panel **Autoset** button. The screen displays a square wave.
6. Double-tap the badge of the channel you want to compensate.
7. Tap the **Probe Setup** panel.

If the Probe Compensation Status says **Pass**, the probe is already compensated for this channel. You can move the probe to another channel and start again from step 1, or connect a different probe to this channel and start from step 1.

If the Probe Compensation Status says **Default**, continue with this procedure.

8. Tap **Compensate Probe** to open the **Probe Compensation** dialog.
9. Tap **Compensate Probe** to run the probe compensation.
10. The probe compensation is finished when the Probe Compensation Status displays **Pass**. Disconnect the probe tip and ground from the PROBE COMP terminals.

11. Repeat these steps for each supported passive probe that you want to compensate for this channel.
12. Repeat these steps to compensate supported probes on other channels of the oscilloscope.

NOTE. For most accurate measurements, open the **Probe Setup** panel and verify the Probe Compensation Status is **Pass** whenever you attach a probe to a channel.

Connect to a network (LAN)

Connecting to a network allows you to remotely access the instrument.

Work with your network administrator to obtain the required information to connect to your network (IP address, Gateway IP address, Subnet Mask, DNS IP address, and so on).

1. Connect a CAT5 cable from the oscilloscope LAN connector to your network.
2. Select **Utility > I/O** on the menu bar to open the I/O configuration menu.
3. Obtain or enter the network address information:
 - If your network is DHCP-enabled, tap **Auto** to obtain the IP address information from the network. DHCP mode is the default mode.
 - If your network is not DHCP-enabled, or you need a permanent (non-changing) IP address for this instrument; tap **Manual** and enter the IP address and other values provided by your IT or system administrator resource.
4. Tap **Test Connection** to verify that the connections is working. The LAN Status icon turns green when the instrument successfully connects to your network. If you have problems connecting to your network, contact your system administration resource for help.

Operating basics

These procedures are an introduction to using the interface to do common tasks. See the Help information in the application for detailed information on menu and field settings.

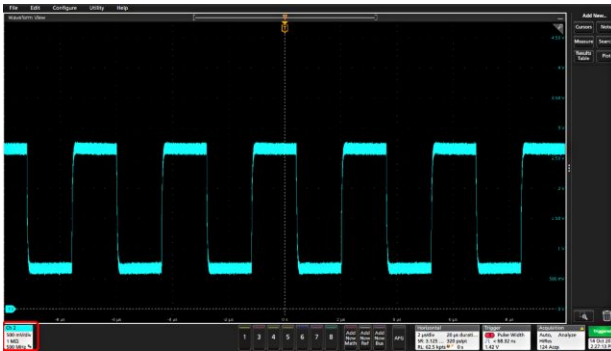
Add a channel waveform to the display

Use this procedure to add a channel signal to the Waveform View.

1. Connect signal(s) to the channel input(s).
2. Tap an Inactive Channel button (in the Settings bar) of a connected channel.



The selected channel is added to the Waveform View and a Channel badge is added to the Settings bar.



3. Continue tapping Inactive Channel buttons to add more channels (digital or analog). Channels are displayed from lowest-numbered channel at the top, to highest-numbered channel at the bottom of the view, regardless of the order they were added (in stacked mode).



4. Double-tap a channel badge to open that channel's configuration menu to check or change settings. See [Configure channel or waveform settings](#) on page 34.

Configure channel or waveform settings

Use the channel and waveform configuration menus to set parameters such as vertical scale and offset, coupling, bandwidth, probe settings, deskew values, external attenuation values, and other settings.

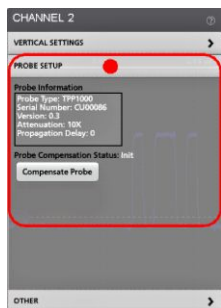
Prerequisite: There is a channel or waveform badge in the Settings bar.

1. Double-tap a **Channel** or **Waveform** badge to open a configuration menu for that item.

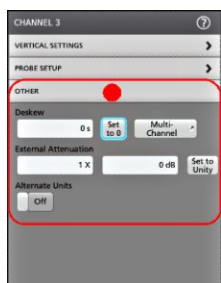
For example, in a Channel menu, use the **Vertical Settings** panel to set basic probe parameters such as vertical scale and position, offset, coupling, termination, and bandwidth limit.



2. Tap the **Probe Setup** panel to confirm probe settings and run configuration or compensation on supported probes.



3. Tap the **Other** panel to set probe deskew, external attenuation, and alternate units parameters.

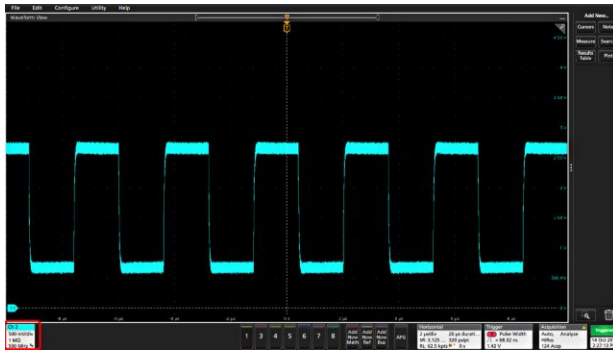


4. Tap the Help icon on the menu title to open the help topic for more information.
5. Tap outside the menu to close the menu.

Quickly display a waveform (Autoset)

The Autoset function analyzes the signal characteristics and changes the instrument Horizontal, Vertical, and Trigger settings to automatically display a triggered waveform. You can then make further changes to trigger and horizontal settings to view the waveform point of interest.

1. Connect the probe with the signal of interest to the lowest-numbered channel. The signal can be analog or digital.
2. Connect any other associated signal(s) to available channel input(s).
3. Add the channel waveforms to the Waveform view. [Add a channel waveform to the display](#) on page 33
4. Push the front-panel **Autoset** button. When using the Stacked Display mode, the instrument analyzes the signal characteristics of the lowest-numbered displayed channel (analog or digital) and adjusts the horizontal, vertical, and trigger settings accordingly to display a triggered waveform for that channel. Vertical scale is adjusted for all other active waveforms to maximize ADC utilization.



When using the Overlay Display mode, the instrument adjusts the horizontal and trigger settings of the lowest-numbered displayed channel to display a triggered waveform for that channel, and adjusts the vertical settings and position of all active waveforms such that they are uniformly spaced on screen.

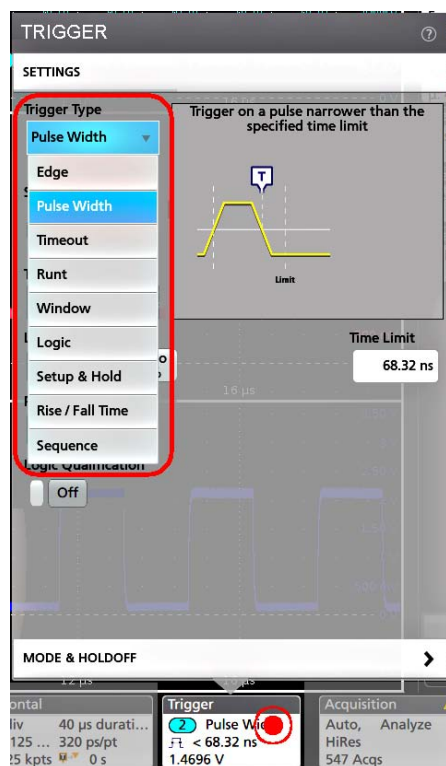
Autoset guidelines:

- Autoset displays two or three cycles (depending on the detected signal) with the trigger level near the midlevel of the signal.
- The trigger is set to type Edge, rising slope, DC coupling.
- If no channels are displayed before pushing **Autoset**, the oscilloscope adds Ch 1 to the view whether it has a signal or not.
- For digital signals, the oscilloscope analyzes and triggers on the lowest (LSB) digital channel with an active signal.
- Autoset ignores math, reference, and bus waveforms.
- A channel or waveform with a frequency less than 40 Hz is classified as no signal.

How to trigger on a signal

Use this procedure to open the Trigger menu to select and configure the trigger event type and conditions.

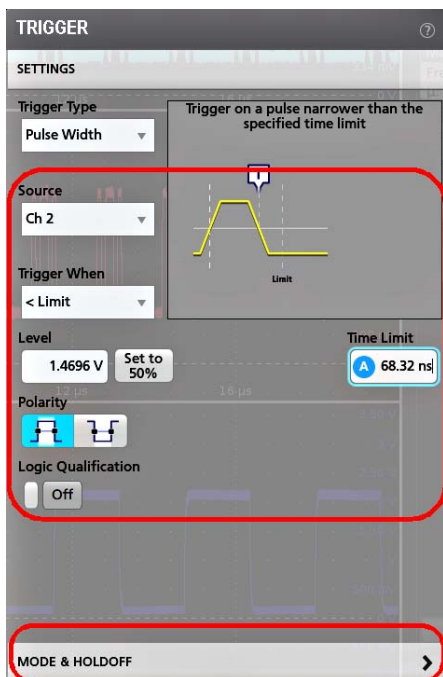
1. Double-tap the **Trigger** badge on the Settings bar to open the Trigger configuration menu.
2. Select a trigger from the **Trigger Type** list. The trigger type sets what fields are available in the menu and also updates the illustration to show a graphic of the trigger type.



NOTE. To trigger on a bus, you must first add the bus to the Waveform view. See [Add a math, reference, or bus waveform](#) on page 38

NOTE. Triggering on buses other than Parallel requires purchasing and installing serial trigger and analysis options. See the Tektronix Web site for available serial trigger and analysis options.

3. Select the other fields and panels to refine the trigger conditions. The menu fields and trigger graphic update as you make changes to the trigger settings. Displayed fields depend on the selected trigger type. Selection changes take effect immediately.

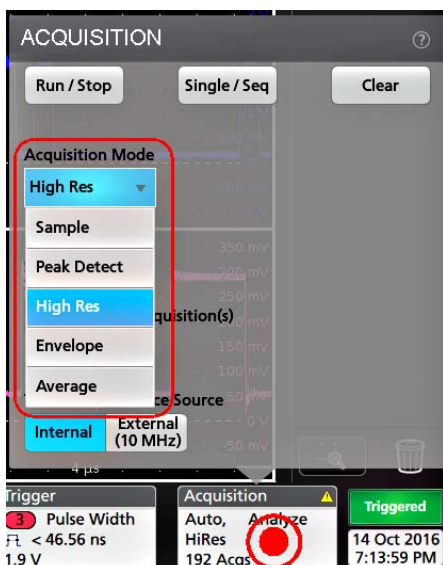


4. Tap the Help icon on the menu title for more information on these settings.
5. Tap outside the menu to close the menu.

Set the acquisition mode

Use this procedure to set the method the instrument uses to acquire and display the signal.

1. Double-tap the **Acquisition** badge on the Settings bar to open the Acquisition configuration menu.
2. Select the acquisition method from the **Acquisition Mode** list. Set any other parameters associated with the selected acquisition type.

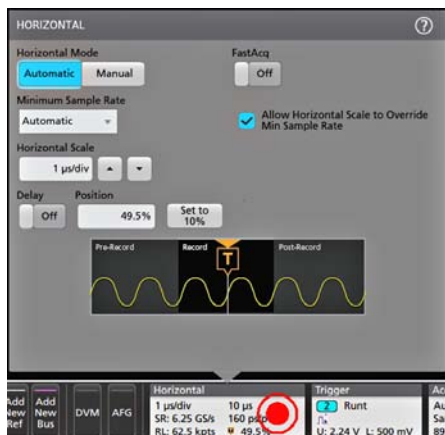


3. Tap the Help icon on the menu title for more information on these settings.
4. Tap outside the menu to close the menu.

Set Horizontal parameters

Use this procedure to set the horizontal time base parameters such as mode, minimum sample rate, horizontal scale, delay, and trigger delay time (relative to the center of the waveform record).

1. Double-tap the **Horizontal** badge on the Settings bar to open the Horizontal configuration menu.



2. Use the menu selections to set horizontal parameters.
3. Tap the Help icon on the menu title for more information on these settings.

Add a math, reference, or bus waveform

Math waveforms let you create new waveforms based on operations between two or more waveforms or by applying equations to waveform data. A reference waveform is a static waveform record displayed for comparison. Bus waveforms let you view and analyze serial or parallel data.

There is no set limit to the number of Math, Reference, or Bus waveforms you can add to the Waveform View, other than system physical memory constraints.

1. Tap the **Add New Math**, **Add New Ref**, or **Add New Bus** button in the Settings bar.

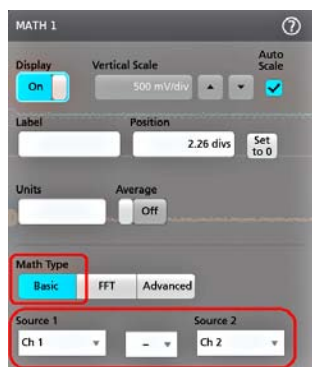


2. The instrument adds the waveform to the Waveform view, adds a Waveform badge to the Settings bar, and opens a configuration menu. This example shows adding a Math waveform.



3. Use the configuration menus to refine the waveform parameters. Displayed fields depend on the waveform and selections made in the menu. Selection changes take effect immediately.

This example shows adding a Math waveform, using the Math **Source** fields to select Ch 1 and Ch 2 as the waveform sources, and set the math type to **Basic** math operation, and subtracting channel 2 from channel 1.



4. When adding a Reference waveform, the instrument presents a **Recall** configuration menu. Navigate to and select the reference waveform file (*.wfm) to recall, then tap the **Recall** button. The instrument displays the Reference waveform and opens the configuration menu.
5. Double-tap a math, reference, or bus badge to check or change that waveform's settings. See [Configure channel or waveform settings](#) on page 34.
6. Tap the Help icon on a configuration menu title for more information on math, reference, and bus waveform settings.
7. Tap outside the menu to close the menu.

Add a measurement

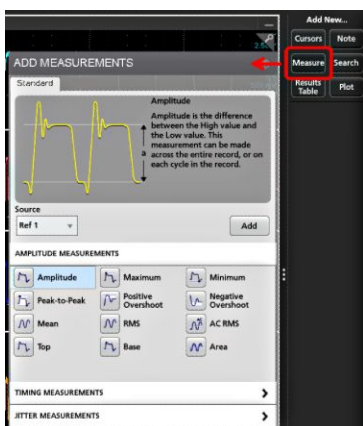
Use this procedure to select and add measurements.

1. Acquire the channel(s) and/or waveform(s) on which you want to take measurements.

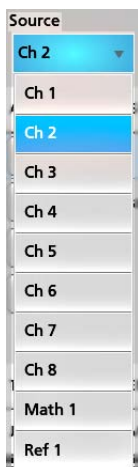


NOTE. Waveforms do not need to be displayed to be used for measurements, as long as the channel or waveform badge is on the Settings bar and is acquiring the signal to measure.

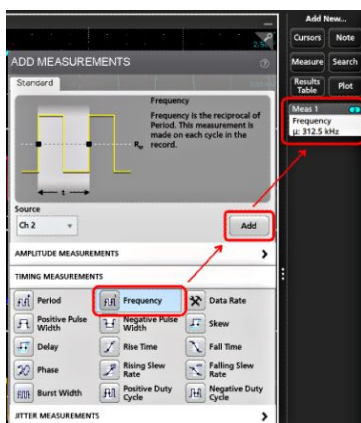
2. Tap the **Add New...Measure** button to open the **Add Measurements** configuration menu.



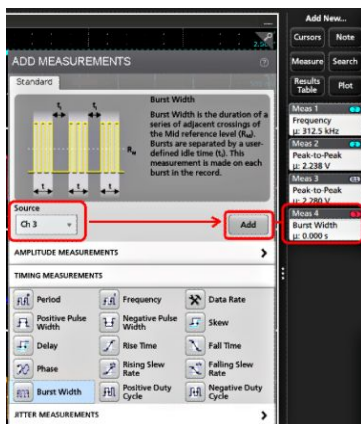
3. Tap the **Source** field and select the measurement source. All available sources that are valid for the measurement are listed.



4. Select from the configuration menu panels, such as Amplitude, Timing, and Jitter, to display measurements for those categories.
5. Select a measurement and tap **Add** (or double-tap the measurement) to add the measurement to the Results bar. The measurement badge is added immediately.



6. Select and add other measurements for the current source. Tap the measurement category panels to display and select other measurements to add.
7. To add measurements for other sources, select a different source, select a measurement, and add the measurement.



8. Tap outside the **Add Measurements** menu to close the menu.
9. To further adjust a measurement's settings, double-tap a measurement badge to open a configuration menu for that measurement. See [Configure a measurement](#) on page 42.
10. Tap the Help icon on the menu title for more information on settings.

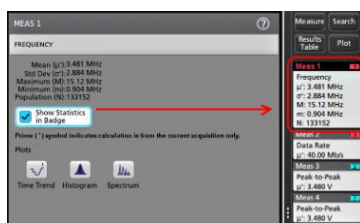
Configure a measurement

Use this procedure to add statistical readouts to the measurement badge, display plots for the measurement, and refine measurement parameters (configuration, global versus local scope of settings, gating, filtering, and so on).

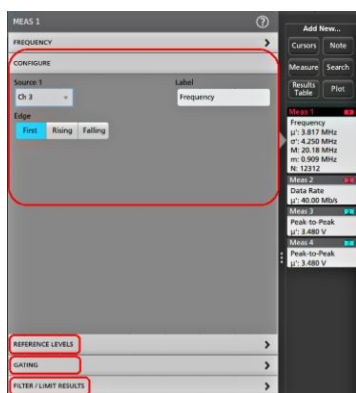
1. Double-tap a measurement badge to open its **Measurement** configuration menu.



2. Tap **Show Statistics in Badge** to add statistical readouts to the measurement badge.



3. Tap available panel titles to make changes for those categories.

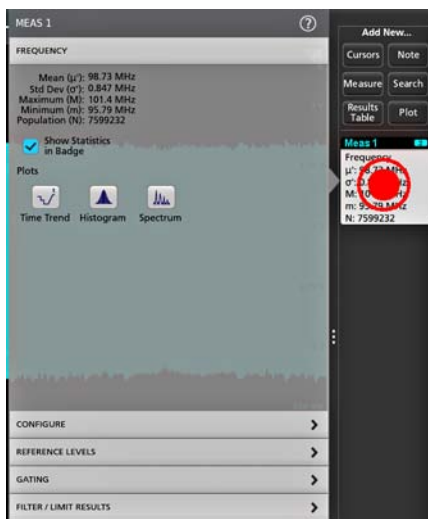


4. Use the available fields to refine the measurement conditions. Displayed fields depend on the measurement. Selection changes take effect immediately. Selection changes can also change fields in other panels.
5. Tap the Help button on the menu title for more information on this menu's settings.
6. Tap outside the menu to close the menu.

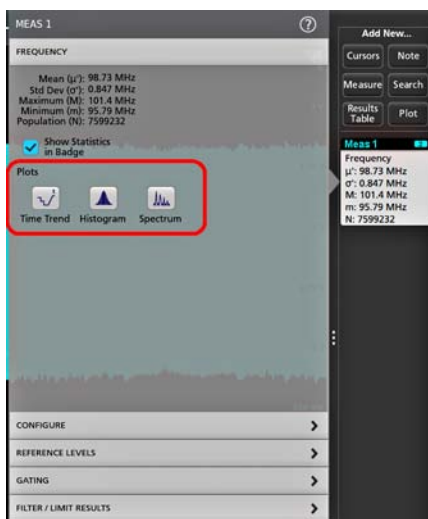
Add a plot of a measurement

Measurement plots let you graph the distribution of waveform datapoint occurrences (histogram), plot the frequency components (spectrum) of a waveform, show the time trend of a measurement, display an eye diagram, and other supported plots depending on the measurement. Available plots depend on the measurement.

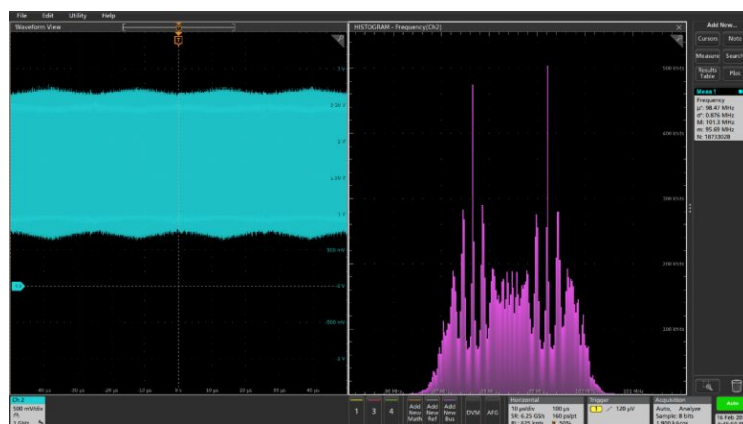
1. Double-tap a Measurement badge to open the **Meas** configuration menu.



2. Tap a **Plots** button to add that plot for the measurement to the screen.

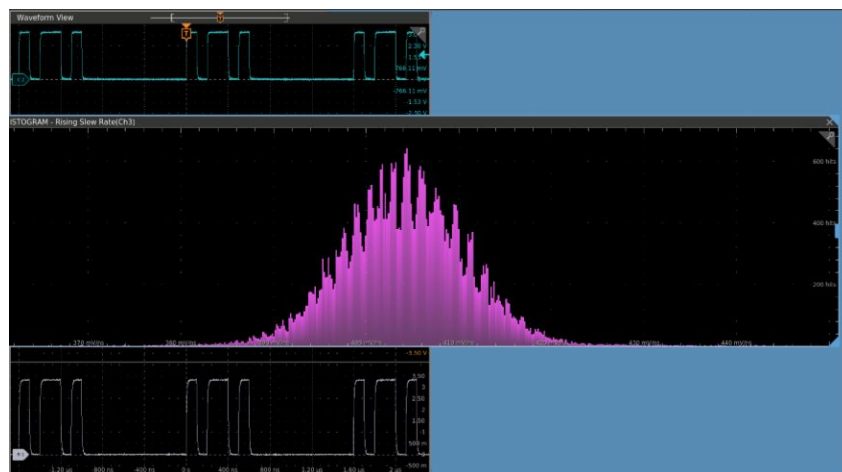


The following shows adding a Histogram plot.



You can add more than one plot to measurements (to different measurements or the same measurement). For example, you can add two histogram plots for the same measurement, set one to display the X-Axis with a Logarithmic scale, and the other plot to display the X-Axis with a Linear scale.

3. You can move plot windows by dragging the Plot view title bar to a new position. The blue background area moves to show where the plot will be located when you remove your finger from the title bar. You can also resize plot windows by selecting and dragging the Plot view border. You should use a mouse to do these operations, as it is easier to select and drag plots with a mouse.



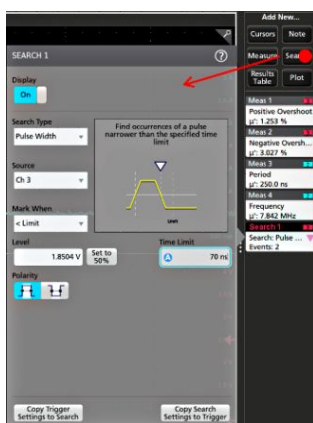
4. Double-tap within a Plot view to open a configuration menu to set display characteristics. Tap the Help icon on the configuration menu title for more information on that menu's settings. Tap outside the menu to close the menu.

Add a Search

Use this procedure to set search criteria and mark a waveform where those events occur.

You can search on analog and digital signals, math waveforms, and reference waveforms. You can add searches to different waveforms and multiple searches to the same waveform. Prerequisite: Display the channel or waveform signal on which to search. The waveform must be displayed to create a search for it.

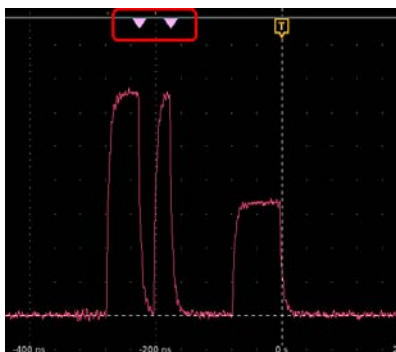
1. Display the channel or waveform signal on which to search. The waveform must be displayed to create a search for it.
2. Tap the **Add New...Search** button to open the Search configuration menu.



3. Use the configuration menu fields to set the search criteria in the same way that you would set for a trigger condition (select the **Search Type**, **Source**, and conditions on which to search).

NOTE. You cannot search for sequential events (there is no Sequence search type).

4. The searched waveform is marked with one or more triangles as soon as the search criteria becomes true. Each search uses a different color for its markers. The example image shows search criteria set to find positive pulse widths that are less than 70 ns wide.



5. To stop showing marks on a waveform, double-tap the **Search** badge and tap **Display** to **Off**.
6. To move the waveform to center marks on the display, push the **Run/Stop** front panel button to stop acquisition, single-tap a **Search** badge, and tap the < or > Navigation button.



NOTE. Navigation buttons are only functional when the oscilloscope acquisition mode is set to **Stop**.

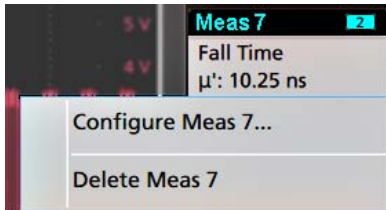
This opens the **Zoom** mode and moves the waveform to the previous or next event mark on the waveform.

7. If available for a search, tap the **Min** or **Max** button to center the waveform in the display at the minimum or maximum value of the search events in the waveform record.
8. To return the instrument to normal acquisition mode, tap the **Zoom** icon in the upper right corner of the Waveform View to turn off **Zoom** mode, and push the **Run/Stop** front-panel button to set it to Run mode.

Delete a Measurement or Search badge

Use this procedure to remove a Measurement or Search badge from the Results bar.

1. Touch and hold the Measurement or Search badge that you want to delete. The instrument opens a right-click menu.
2. Select **Delete Meas** to delete that badge from the Results bar.



3. You can also delete a Measurement or Search badge by dragging it to the **Trash Can** icon, located at the bottom of the **Results** bar. When the Trash can icon and the badge turns red, lift your finger to delete the badge. You can use the mouse to drag and delete a badge.

NOTE. You can undo a measurement delete.

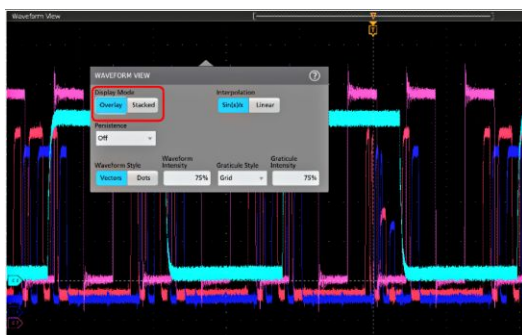
Change waveform view settings

Use this procedure to change the waveform display mode (Stacked or Overlay), waveform trace interpolation algorithm, waveform persistence, style and intensity, and graticule style and intensity.

1. Double-tap on an open graticule area to open the **Waveform View** configuration menu.



2. Tap the buttons in the **Display Mode** to toggle between **Overlay** and **Stacked** modes.



3. Use the other controls to set the waveform interpolation algorithm, waveform point persistence, style, and intensity, and graticule style and intensity.
4. Tap the **Help** icon on the menu title to open the Waveform View menu help topic for more information on the waveform view parameters.
5. Tap outside the menu to close the menu.

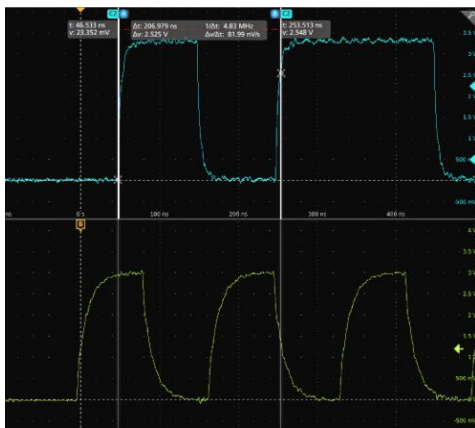
Display and configure cursors

Cursors are on-screen lines that you can move to take measurements on specific parts of a waveform or plot, or between two different waveforms. Cursor readouts show both current position values and the difference (delta) between cursors.

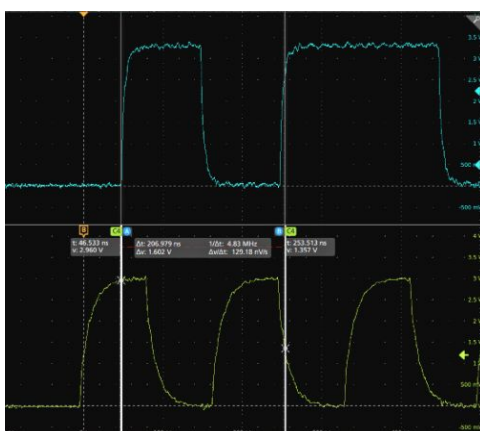
1. Tap the waveform slice (in Stacked mode), or the channel or waveform badge (in Overlay mode) to which you want to add cursors.
2. Tap the **Add New...Cursors** button, or push the front-panel **Cursors** button.

The cursors are added to the display.

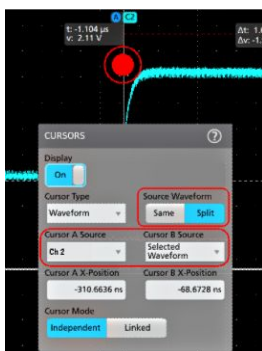
Operating basics



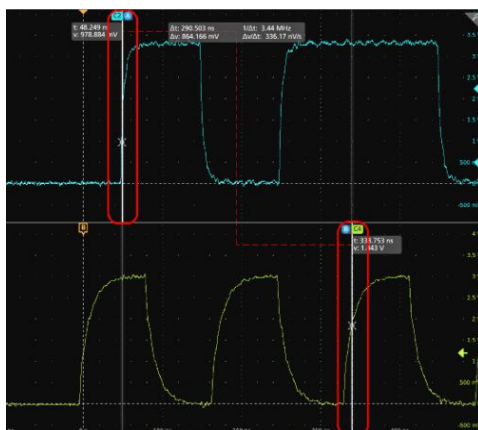
3. Use Multipurpose Knobs **A** and **B** to move the cursors, or touch and drag a cursor. Cursors show readouts that show position and difference measurements between the cursors.
4. To move the cursors to a different channel or waveform, just tap in that waveform graticule.



5. To further configure cursors, double-tap on either cursor line or the cursor readouts to open the **Cursors** configuration menu. For example, tap the Cursor type to select the cursors to display, such as Waveform, V Bars, H Bars, and V&H Bars.



6. To split the cursors between two waveforms, tap the **Source** field and select **Split** and select the source for each cursor.



The cursors are moved to the specified waveforms.

7. Tap the Help icon on the menu title for more information on the menu settings.
8. To stop showing cursors, push the front panel **Cursor** button, press and hold to open the right-click menu and turn cursors off, or open the Cursors configuration menu and set Display to **Off**.

Remote access from a Web browser

You can remotely control your oscilloscope from a browser. Enter the IP address into your Web browser to display the oscilloscope screen and use a mouse to access all screen-based controls and items on the oscilloscope.

Prerequisites:

- The IP address of the oscilloscope that you want to access. To determine an oscilloscope's IP address, select **Utility > IO** in the oscilloscope menu bar and view the network settings in the **LAN** panel.
 - The oscilloscope must be connected to, and accessible from, the network to which the PC is connected. See [Connect to a network \(LAN\)](#) on page 32
1. Open a Web browser on a PC connected to the same network as the oscilloscope.
 2. Enter just the oscilloscope IP address on the URL line of the browser and press **Enter**. For example: 135.62.88.157.

The browser searches for and opens the Web page for the oscilloscope.

3. Select **Instrument Control (e*Scope®)**.

The browser displays the instrument screen.

4. Use a mouse to select and interact with the oscilloscope controls shown in the Web browser.

Connect the oscilloscope to a PC using a USB cable

Use a USB cable to connect the oscilloscope directly to a PC for remote instrument control.

1. On the oscilloscope, select **Utility > I/O** from the menu bar.
2. Tap **USB Device Port Settings**.
3. Confirm that the USB Device Port control is **On** (default setting).
4. Connect a USB cable from the PC to the USB **Device** port on the rear of the instrument.
5. If using the USB connection to remotely control the oscilloscope using GPIB commands, set the **GPIB Talk/Listen Address** for your configuration (0 - 30).

Cleaning the instrument

Cleaning

Use a dry, soft cotton cloth to clean the outside of the unit. Do not use any liquid cleaning agents or chemicals that could damage the touch screen, case, controls, screen, markings or labels, or possibly infiltrate the case.

Cleaning the instrument

EMC, safety and environmental compliance

Compliance Information

This section lists the EMC (electromagnetic compliance), safety, and environmental standards with which the instrument complies.

EMC compliance

EU EMC directive

Meets intent of Directive 2014/30/EU for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:

EN 61326-1, EN 61326-2-1. EMC requirements for electrical equipment for measurement, control, and laboratory use. ^{1 2 3 4}

- CISPR 11; IEC 61000-4-2; IEC 61000-4-3 ⁵; IEC 61000-4-4; IEC 61000-4-5; IEC 61000-4-6⁵; IEC 61000-4-11

EN 61000-3-2. AC power line harmonic emissions

EN 61000-3-3. Voltage changes, fluctuations, and flicker

European contact.

Tektronix, Inc. PO Box 500, MS 19-045

Beaverton, OR 97077, USA

www.tek.com

Australia / New Zealand EMC

Complies with the EMC provision of the Radiocommunications Act per the following standard, in accordance with ACMA:

- EN 61326-1 and EN 61326-2-1. Radiated and Conducted Emissions, Group 1, Class A

¹ This product is intended for use in nonresidential areas only. Use in residential areas may cause electromagnetic interference.

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

³ Equipment may not meet the immunity requirements of applicable listed standards when test leads and/or test probes are connected due to coupling of electromagnetic interference onto those leads/probes. To minimize the influence of electromagnetic interference, minimize the loop area between the unshielded portions of signal and associated return leads, and keep leads as far away as possible from electromagnetic disturbance sources. Twisting unshielded test leads together is an effective way to reduce loop area. For probes, keep the ground return lead as short as possible and close to the probe body. Some probes have accessory probe tip adapters to accomplish this most effectively. In all cases, observe all safety instructions for the probes or leads used.

⁴ For compliance with the EMC standards listed here, high quality shielded interface cables should be used.

⁵ ± 1.0 division waveform displacement or ≤ 2.0 division increase in peak-to-peak noise is allowed when the instrument is subjected to fields and signals as defined in the IEC 61000-4-3 and IEC 61000-4-6 tests.

Safety compliance

This section lists the safety standards with which the product complies and other safety compliance information.

EU low voltage directive

Compliance was demonstrated to the following specification as listed in the Official Journal of the European Union:

Low Voltage Directive 2014/35/EU.

- EN 61010-1; EN 61010-2-030

U.S. nationally recognized testing laboratory listing

- UL 61010-1; UL 61010-2-030

Canadian certification

- CAN/CSA-C22.2 No. 61010-1; 61010-2-030

Additional compliances

- IEC 61010-1; IEC 61010-2-030

Equipment type

Test and measuring equipment.

Safety class

Class 1 – grounded product.

Pollution degree rating

Pollution Degree 2 (as defined in IEC 61010-1). Rated for indoor, dry location use only.

Measurement and overvoltage category description

Measurement terminals on this product may be rated for measuring mains voltages from the following category (see specific ratings marked on the product and in the manual).

- Category II. Circuits directly connected to the building wiring at utilization points (socket outlets and similar points).

NOTE. Only mains power supply circuits have an overvoltage category rating. Only measurement circuits have a measurement category rating. Other circuits within the product do not have either rating.

Mains overvoltage category rating

The mains power supply circuit for this product is rated for overvoltage category II (as defined in IEC 61010-1).

Environmental compliance

This section provides information about the environmental impact of the product.

Product end-of-life handling

Observe the following guidelines when recycling an instrument or component:

Equipment recycling. Production of this equipment required the extraction and use of natural resources. The equipment may contain substances that could be harmful to the environment or human health if improperly handled at the product's end of life. To avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle this product in an appropriate system that will ensure that most of the materials are reused or recycled appropriately.



This symbol indicates that this product complies with the applicable European Union requirements according to Directives 2012/19/EU and 2006/66/EC on waste electrical and electronic equipment (WEEE) and batteries. For information about recycling options, check the Tektronix Web site (www.tek.com/productrecycling).

Perchlorate materials. This product contains one or more type CR lithium batteries. According to the state of California, CR lithium batteries are classified as perchlorate materials and require special handling. See www.dtsc.ca.gov/hazardouswaste/perchlorate for additional information.

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