# TBS2000 Oscilloscope Demo Guide

28 JULY 2016
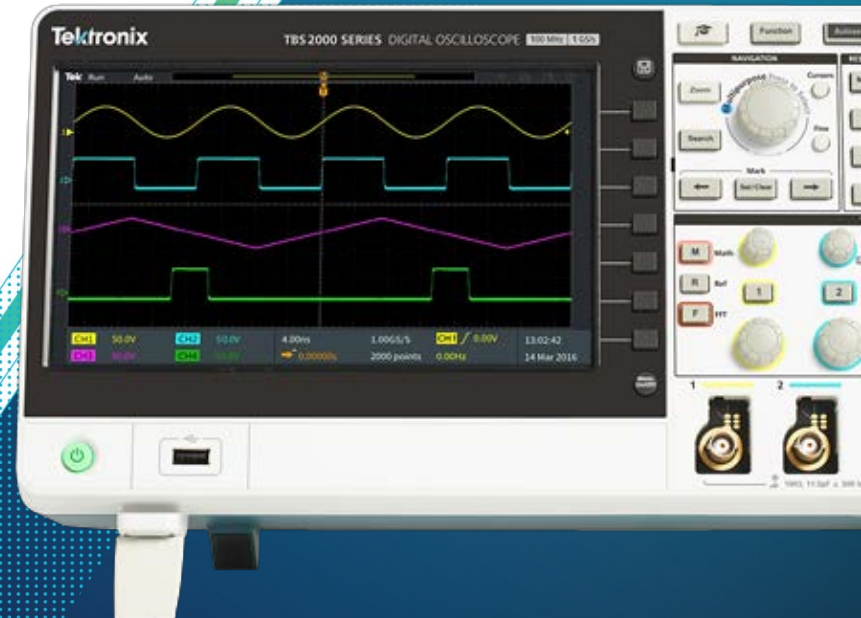
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# TBS2000 Series Oscilloscopes

The TBS2000 offers the biggest display and longest record length in its class, so you can see more of your signals.  It offers a powerful set of measurement and analysis tools with built-in tips make them easy to use.

## Key performance specifications

- 100, 70 MHz bandwidth models
- 2 and 4 analog channel models
- Up to 1 GS/s sampling rate

- 20 megapoint record length on all channels
- 5-year warranty

## Key features

- 9-inch WVGA color display
- 15 horizontal grids for 50% more signal
- TekVPI™ probe interface supports active differential, and current probes with automatic scaling and units
- Wi-Fi dongle supports wireless connectivity
- 32 automated measurements, and FFT function for thorough waveform analysis

- Configurable HelpEverywhere provides on-screen tips for specified settings
- 2-channel models are highly-portable at 2.62 kg
- Built-in Scope Intro handbook provides operating instructions and oscilloscope fundamentals
- Courseware education feature with step assistant
- TekSmartlab collaboration working flow assistant

## About This Guide

Begin by exploring the controls and display of the TBS2000 Series. Then move on to a series of hands-on exercises. Acquire waveforms, learn about triggering, take measurements, and learn how to save data. Get an introduction to the TBS2000's connectivity and remote control capabilities, and tools for education.

## Required Equipment

- TBS2000 Series Oscilloscope
- Power Cord for your region (included with instrument)
- Two TPP0100 passive probes with hook tips attached (included with instrument)
- A USB flash drive (to demonstrate screen image capture)
- TEKUSBWIFI USB Wi-Fi dongle (to demonstrate wireless communications)
- PC with Ethernet connection (to demonstrate LXI)
- Ethernet cable (to demonstrate LXI)
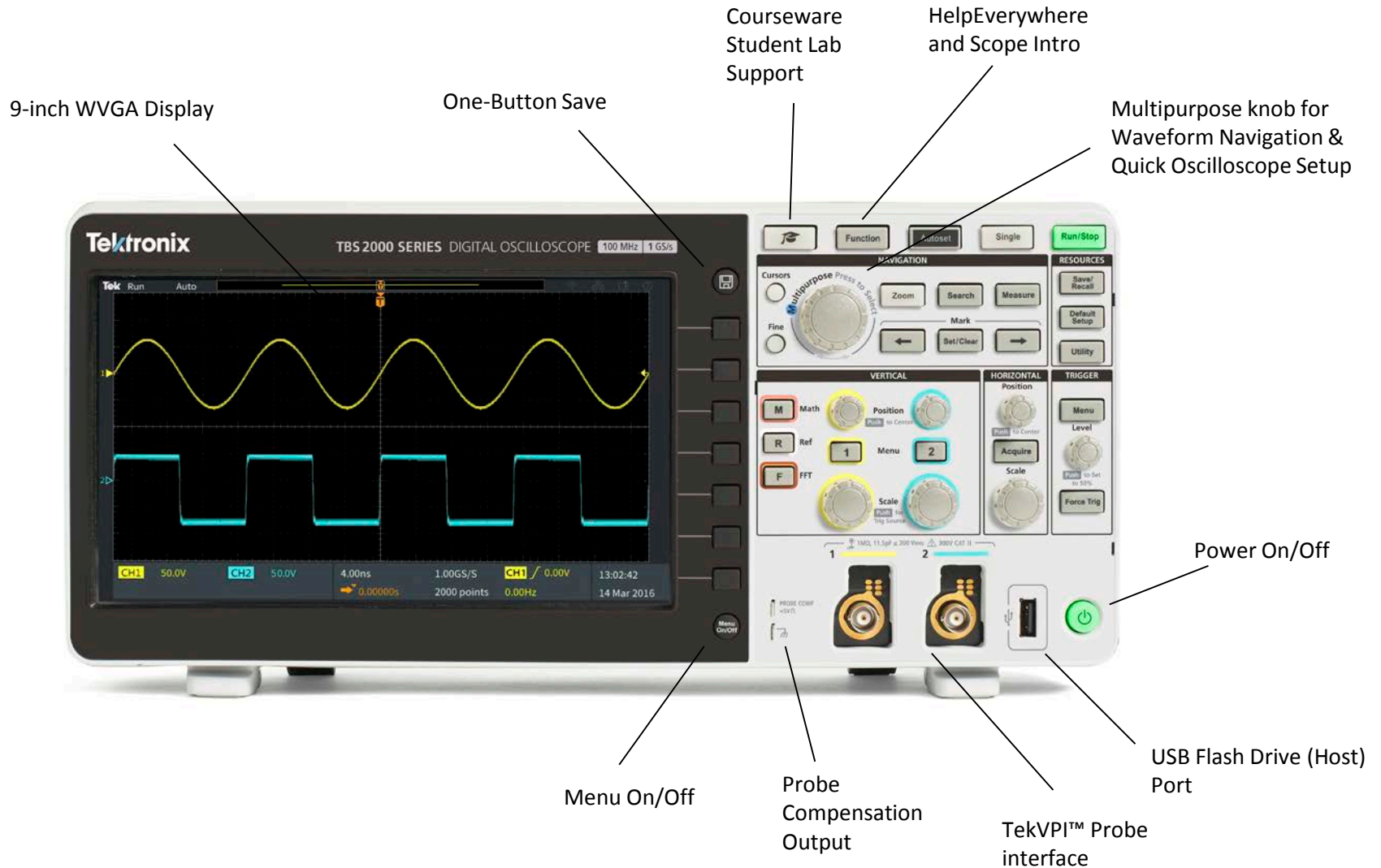
# Setting up the Equipment

**Power on the instrument**
1. Plug in the power cord for your region
2. Press the power button to turn on the instrument. Allow the instrument's power-up sequence to finish.
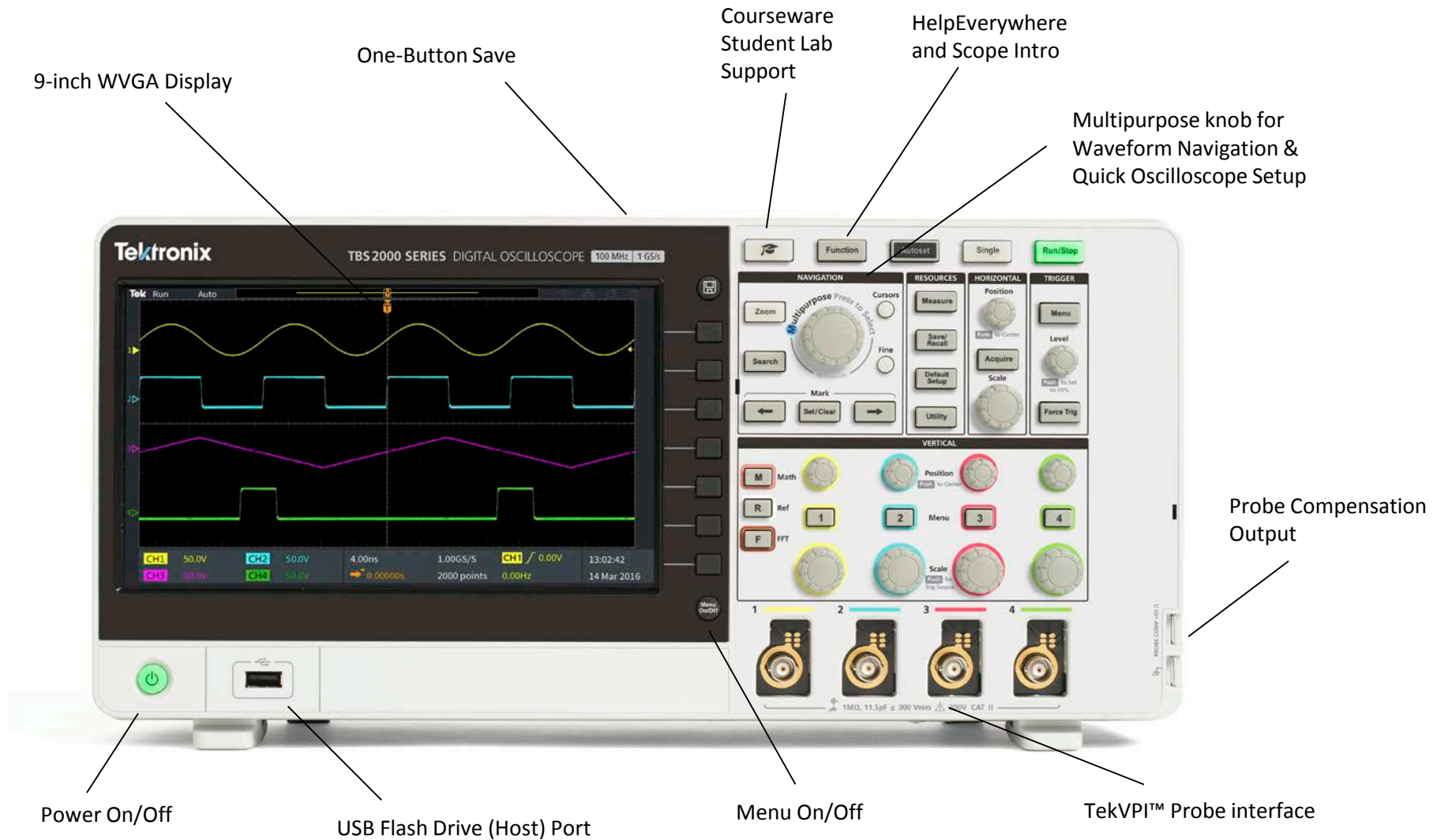3. Connect TPP0100 passive probes to Channel 1 and Channel 2

**To see the firmware version**
1. Press the **Utility** button
2. Press the **Configuration** bezel button
3. Scroll the **Multipurpose** knob to highlight **System Status**, and press the **Multipurpose** knob to enter the System Status menu
4. Review the firmware version at the bottom. Visit www.tek.com for the latest firmware.

# Front Panel Tour, Two-Channel Models



Courseware Student Lab Support

HelpEverywhere and Scope Intro

9-inch WVGA Display

One-Button Save

Multipurpose knob for Waveform Navigation & Quick Oscilloscope Setup

Power On/Off

USB Flash Drive (Host) Port

Menu On/Off

Probe Compensation Output

TekVPI™ Probe interface

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# Understanding the Display



Acquisition Status

Trigger Status

Waveform Record View

Wireless Connectivity Indicator

LAN Connectivity Indicator

Data Transfer in process

HelpEverywhere Enabled

Active Channel

Channel Indicator

Vertical Scale

Horizontal Scale Trigger Delay

Sample Rate and Record Length

Hardware based Counter

Time/Date

Run   Auto

1
2
3
4

-7μs  -6μs  -5μs  -4μs  -3μs  -2μs  -1μs   0   +1μs  +2μs  +3μs  +4μs  +5μs  +6μs  +7μs

CH1  50.0mV    CH2  50.0mV    1.00μs         2.00GS/S      Ch1  0.00 V     11:42 AM
CH3  50.0mV    CH4  50.0mV    T  0.000000s   20k points    59.816 kHz     20 Nov  2014

# 1. Activating HelpEverywhere Tips

While you're learning your way around the scope, HelpEverywhere provides helpful tips.  Once you become proficient, you can turn the tips off if you wish.

1. Press **Function** button on the front panel
2. Press **HelpEverywhere** bezel button (Figure 1).
3. Select **Set All to On** by pressing the **Multipurpose Knob** (**MPK)**
4. When you use the Trigger, Measure, and Cursor function later on, you'll see HelpEverywhere tips that explain trigger modes, measurements, and cursor types (Figure 2).
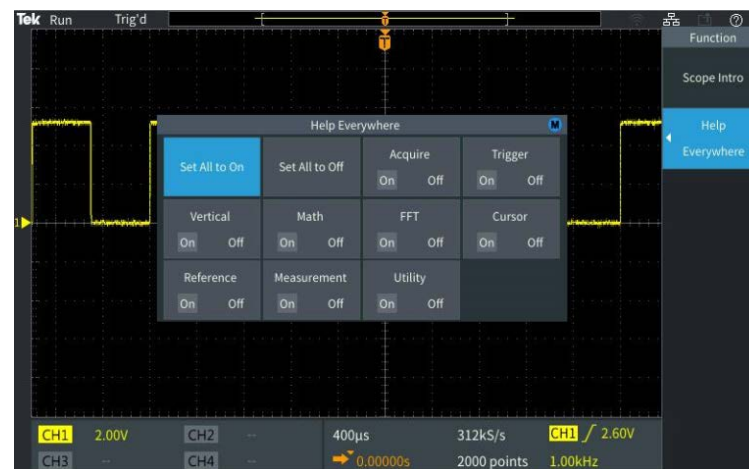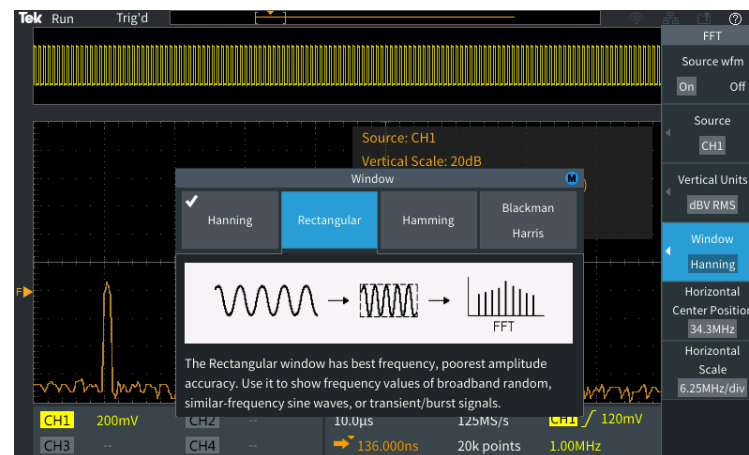


Figure 1. Turning on HelpEverywhere



Figure 2. A HelpEverwhere tip helps with FFT setup. You'll see more tips  as you work through the rest of this booklet.

# 2. Using the Scope Intro Built-in Handbook

If you get stuck, or want to know more about a particular control, Scope Intro provides a built-in, handy reference.

1. Press **Function** button on the front panel
2. Press **Scope Intro** bezel button (Figure 3)
3. Select **Oscilloscope Basic** with the **Multipurpose Knob** (**MPK)**
4. Select **Why use an oscilloscope**
5. Use the MPK to scroll through the content (Figure 4)
6. Press **Scope Intro** again back to the top menu, and explore the other topics. **TBS2000 Overview** gives good explanation of the instrument's controls and menus.
7. Press **Menu On/Off** to exit Scope Intro when you are finished exploring.



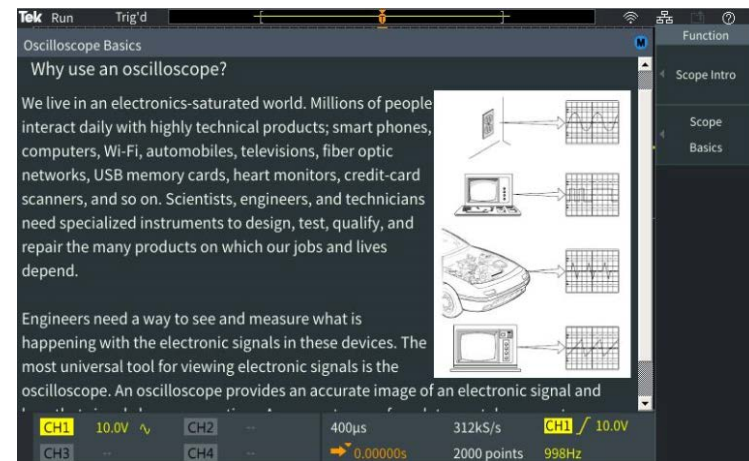Figure 3. Selecting Oscilloscope Basics



Figure 4.  Using the Multipurpose Knob to scroll through the handbook

# 3. Using Autoset to Acquire a Waveform

Autoset can often provide a stable signal display, automatically.

1. Attach a TPP0100 passive probe to the Channel 1 BNC connector. Clip the probe tip to the Probe Comp output. Clip the ground clip to the Probe Comp ground terminal.
2. Press **Default Setup** in Resources section of the front panel. This will set the scope into it's default state.
3. Press **Autoset** at the top of the front panel to automatically acquire and display the 5 Vpp, 1 kHz waveform from the probe compensation output
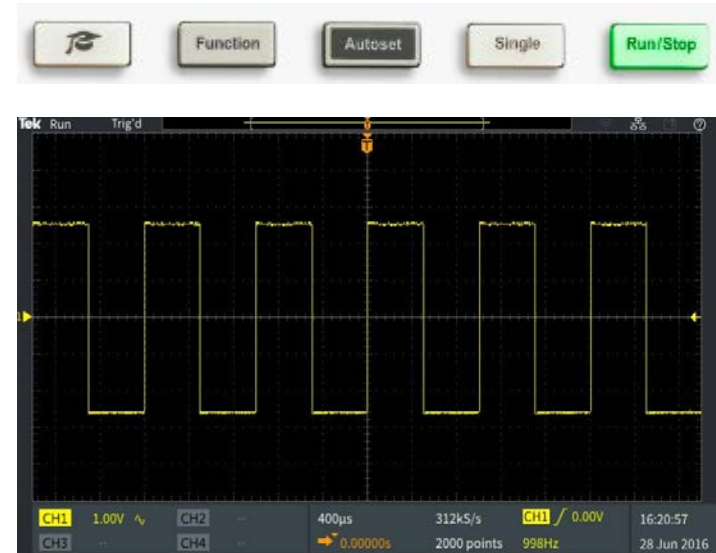


Figure 5. Autoset button and display after pressing autoset

# 4. Triggering the Scope

Although the square wave signal of the probe compensation does not require pulse width triggering, we will set it up for demonstration purposes.

1. Keep Channel 1 connected to the Probe Comp output, as in the last demonstration.
2. Press **Default Setup** in Resources section of the front panel
3. Adjust the Vertical Scale on Channel 1 to 2.00V
4. The default trigger type is Edge with a rising slope. The default level is 0V. This is shown in yellow in the lower right of the display.
5. Adjust the **Trigger Level** toward the center of the waveform. The trigger level indicator appears during the adjustment.
6. Press **Menu** in the Trigger section. Press the **Type** side-bezel button (Figure 6). Note that the LED under the multipurpose knob (MPK) is lighted, prompting for a selection.
7. Scroll the **MPK** to highlight the **Pulse Width** trigger type, and press the **MPK** to select it
8. Note that the **Source** is CH1 and the **Polarity** is Positive
9. Press **Trigger When**, and use the MPK to select **Pulse Width >**.  Change the pulse duration to > 10ns.  Since the pulse width is much greater than 10 ns, the waveform triggers (Figure 7).
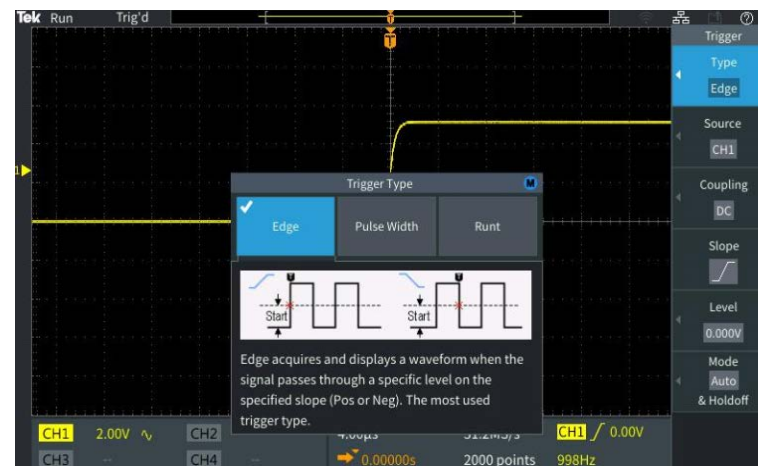10. Press Menu On/Off button below the display to exit the menu



Figure 6.  The M logo in the Trigger Type menu indicates that the Multipurpose Knob (MPK) should be used for selection
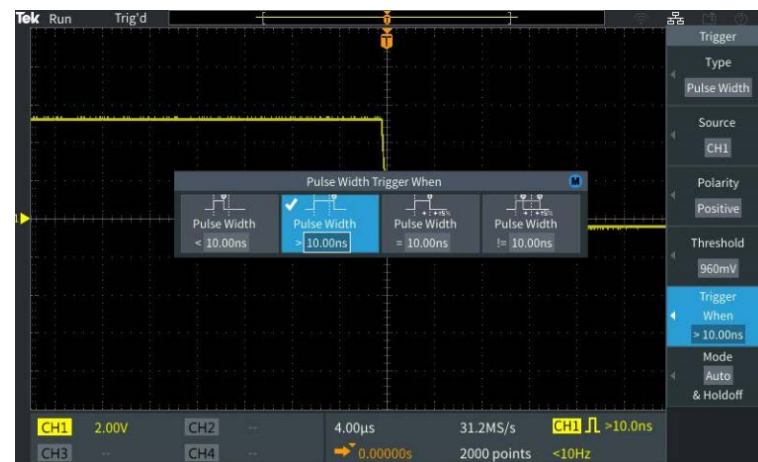


Figure 7. Setting pulse width trigger parameters

# 5. Using Pan and Zoom to Navigate through Long Records

Especially for acquisitions of 20M points, it is important to be able to navigate through the record. Pan and zoom enable this.

1. Press the **Acquire** button on the front panel. Notice that the Multipurpose Knob LED is on, which means it can be used to make a selection.
2. Set **Record Length** to **20M** by turning the **Multipurpose Knob (MPK)** and press the knob to make the selection.
3. Change the horizontal scale to 10ms/div with the **Horizontal Scale** knob
4. Press the **Zoom** button. The button lights to show that Zoom is active.
5. Turn the **MPK** to change the zoom scale factor from **1X** to **100000X.** See the details of the trigger edge (Figure 8).
6. Set the zoom factor back to 100X. Press the **Position** bezel button. Turn the **MPK** to position a falling edge in the center of the zoom area.
7. Press the **Scale** bezel button, and use the **MPK** to zoom in on the falling edge detail. Adjust position if needed (Figure 9).
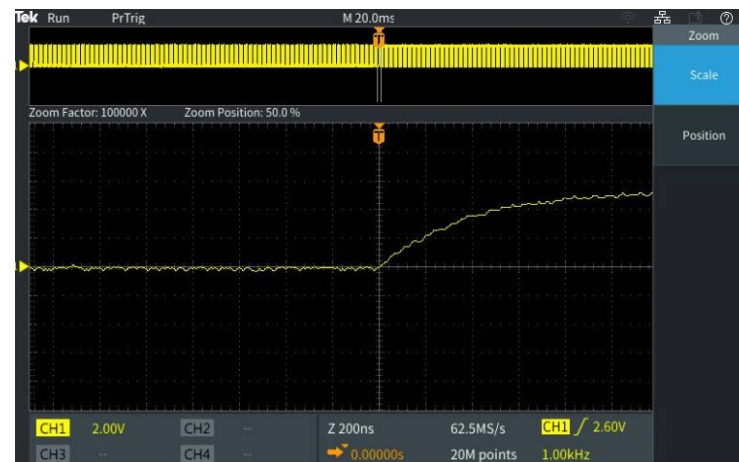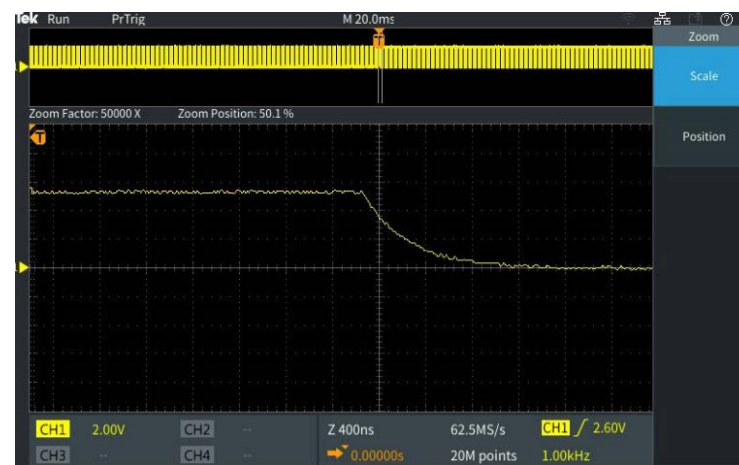


Figure 8. Zooming in on a rising edge



Figure 9. Zooming in on a falling edge

# 6. Using Cursors to Measure Time and Amplitude

Cursors enable quick visual measurements on the selected waveform. The TBS2000 features on-waveform readouts to make it easy to visualize measurements.

1. Press **Default Setup**. Press **Autoset.**
2. Press the **Cursors** button beside the MPK (Figure 10).
3. Press the **Screen** bezel button to select independent control of both amplitude and time cursors
4. Turn the **MPK** to move the left time cursor close to the position you would like to measure
5. To position the cursor more precisely, press the **Fine** button. Now turn the **MPK** to left cursor exactly on a rising edge of the signal.
6. Press the **MPK** to change control to the right time cursor. Turn the **MPK** and use **Fine** to position the cursor on the next rising edge.
7. Note the delta time readout between the cursors and the time position for each bar
8. Press **MPK** again to change control to the upper cursor for amplitude measurements. Move the cursor to the top of the signal and note the delta readout (Figure 11).
9. In the next section, you'll use automated measurements to get similar results.



Figure 10. Location of the **Cursors** and **Fine** buttons (two-channel model shown)
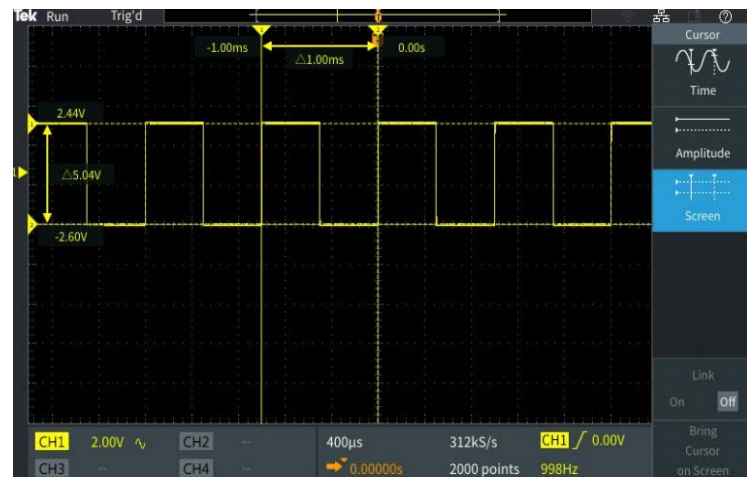


Figure 11. Using the cursors to measure period and amplitude of the Probe Comp signal

# 7. Making Automated Measurements

Automated measurements use the processing power of the scope to provide a frequency, time, amplitude, and area measurements.

1. Connect passive probes to Channel 1 and Channel 2. Connect both probe tips to Probe Comp and both ground clips to Probe Comp ground.
2. Press **Autoset.**
3. Press the **Measure** button in the resource section of the front panel.
4. Notice, from top to bottom:
   - Measurement selection indicator bar
   - Snapshot button
   - Most Used measurement list
   - Measurements grouped by Frequency, Time, Amplitude, Area
5. Press the **CH1 bezel button.** Scroll and press **MPK** to select **Frequency** and **+Duty** for Channel 1.
6. Press the **CH2 bezel button.** Scroll and press **MPK** to select **Peak-Peak** and **Mean** for Channel 2 (Figure 12).
7. Press **Menu On/Off** to return to the waveform window.
8. Note the measurement readout (Figure 13).
9. Press **Menu On/Off** a couple of times to hide and recall the measurement readout panel .
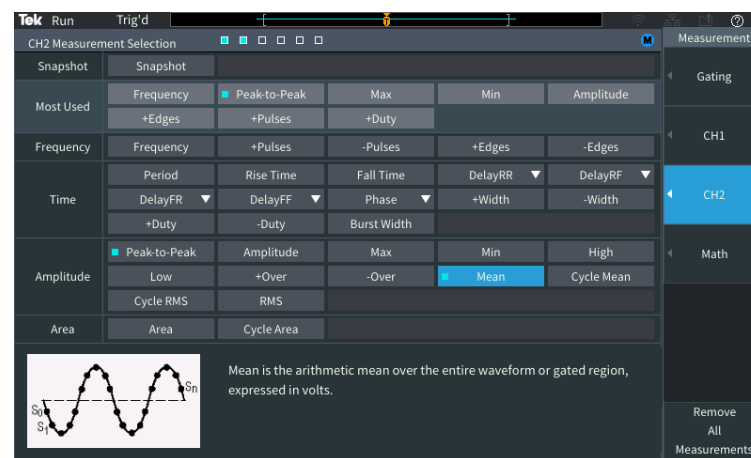


Figure 12. Peak-Peak and Mean measurements selected for Channel 2. Note the two blue boxes in the measurement selection indicator at the top of the display.
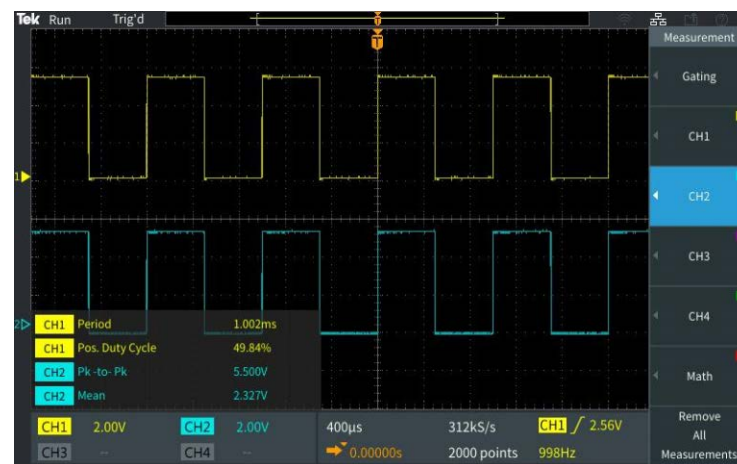


Figure 13. Transparent readouts let the signal show through.

# 8. Using an FFT to Analyze a Signal's Frequency Spectrum

The FFT function calculates the frequency input of the source waveform.  Cursors make it easy to measure frequency and amplitude in the spectrum.

1. Keep the TPP0100 passive probe connected to Channel 1 and the Probe Comp output.
2. Press **Default Setup.** Press **Autoset**.
3. Press the **F** button for FFT function on the front panel (Figure 14).
4. By default, the source waveform is on. Turn it off by pressing the **Source wfm**  bezel button.
5. Source Channel, Vertical Units, Window Type , Horizontal Center Position and Scale may be adjusted by selecting the corresponding **bezel button** and adjusting with the **MPK** .
6. The FFT readout panel in the top right corner of the waveform display shows important settings.
7. The default FFT window is Hanning. Use the **Window** bezel button and MPK to switch to the Rectangular window and note the result.
8. Press the Horizontal Scale bezel button and use the MPK to adjust the horizontal scale to 1.56 kHz/div,
9. Press the **Cursor** button and position the cursors on the third and fifth harmonic frequencies (Figure 15).
10. The delta between third harmonic and fifth harmonic frequency should be 2 kHz, which is consistent with the 1 kHz fundamental frequency of the Probe Comp output.
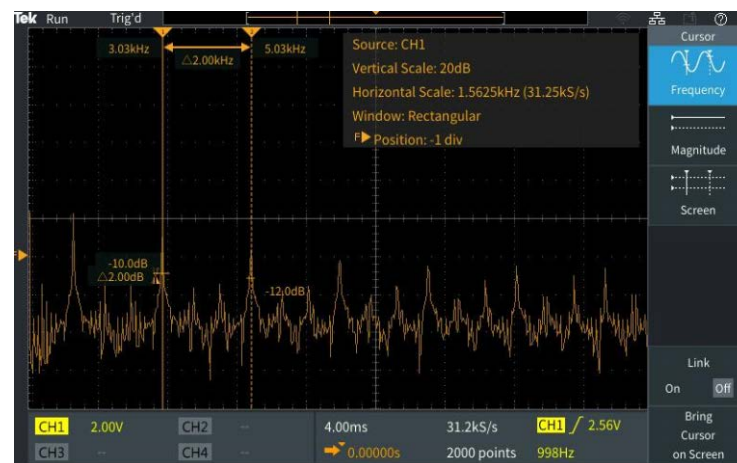


Figure 14.  The FFT Menu



Figure 15.  Cursors positioned on the 3 kHz and 5 kHz harmonics of the 1 kHz probe comp output .

# 9. Saving Screen Images

You can save screen images, waveform data, and setups to a USB flash drive.  This demonstration shows how to save a screen image.

1. Press **Default Setup**. Press **Autoset**.
2. Plug a USB flash drive into the USB host port  on the oscilloscope's front panel
3. Press **Save/Recall** in the Resource section of the front panel
4. Use the side bezel button to set the **Action** to **Save Image**
5. Set the **Format** to JPG
6. Assign the button with the  floppy disk icon to "Assign to Image". Now each time you press the button above the side bezel buttons, a screen will be saved.
7. Press **File Utility**, press **New Folder**, and use the **MPK** to set up a new folder named "DEMO GUIDE" (Figure 16).
8. Press **Back**
9. Highlight and select the new DEMO GUIDE folder with the **MPK**
10. Press the **Floppy Disk** button outside the right top corner of the display to save an image into the DEMO GUIDE folder on the USB thumb. The hint line should say that the image was successfully saved.
11. Take the flash drive to a PC equipped with a USB host port. You can now open the screenshot image as you would any .jpg file.
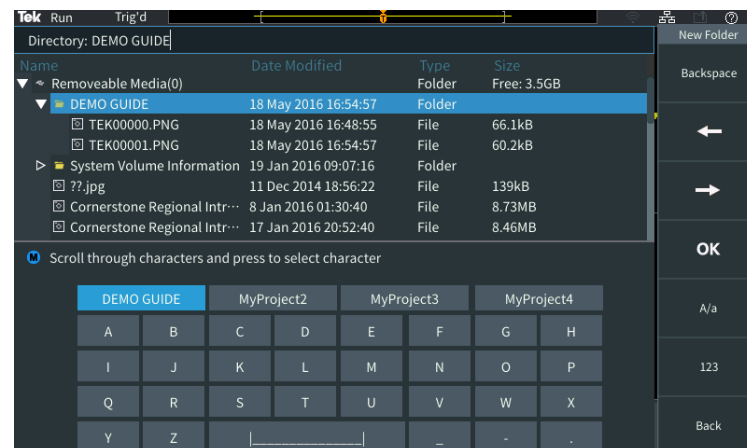


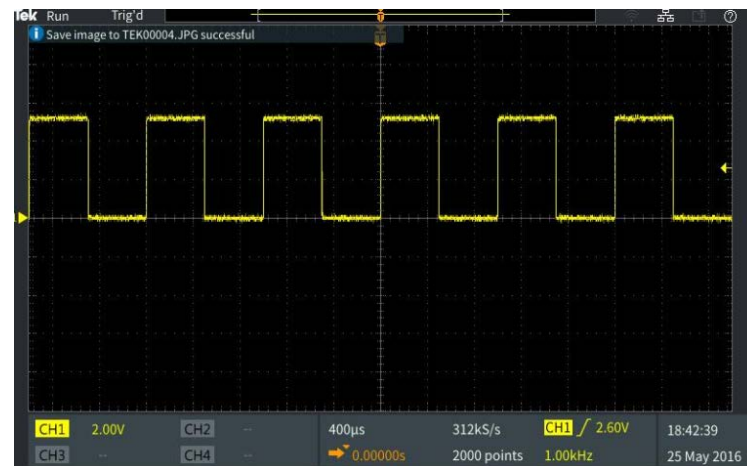Figure 16. Setting up a directory on a flash drive



Figure 17. The hint line, in the upper left of the display, indicates a successful save.

# 10. Setting up a Wireless Connection

The TBS2000 Series supports wireless communication through a USB to Wi-Fi adapter. To remotely control the scope, a PC, tablet or cell phone must be available and on the same network as the instrument.

1. Press **Default Setup**. Press **Autoset.**
2. Plug the **TEK-USB-WIFI** adapter into the rear USB host port (Figure 18)
3. Press **Utility**, press **Config**, select **Wi-Fi Config** and press **Available Networks.** Select the wireless network that will be used for control (Figure 19)
4. Enter the network key/password if the network is secured. This is usually an encryption key/password set in the network router. (Note: The TBS2000 does not support entering a username and password for a corporate network)
5. Press **Wi-Fi Settings** menu to confirm configuration information
6. The **Wireless Icon** in the top right corner of the display should be on, indicating that the scope is connected to Wi-Fi



Figure 18. Insert the TEK-USB-WIFI adapter to enable wireless communications



Figure 19. Configuring Wi-Fi communications via the Utility Menus

# 11. Using LXI for Remote Control

The built-in web server in the TBS2000 enables remote control from any device with an Ethernet connection and web browser. This demonstration requires a PC and an Ethernet cable. *Note: If you established a wireless connection in the previous exercise, you can also use that connection.*

1. With the probe connected to the Probe Comp output, press **Default Setup** in the Resource section of the front panel
2. Connect an Ethernet cable from the PC to the LAN port on the rear of the instrument.
3. Verify that the Ethernet connection icon is on in the upper right corner of the display
4. In a few seconds a window will pop up on the scope display, saying "DHCP On  Instrument IP Address: XXX.XX.XXX.XXX." (If not, go to Utility->Config->Ethernet Config-> DHCP to set DHCP on, and repeat)
5. Open a web browser on the PC.
6. Type the IP address of the instrument into the address box of the web browser. (Refer to the scope's LAN settings menu if you missed the pop up dialog window.)
7. The **Welcome Page** displays important configuration information
8. Before you can control the scope, you will be asked for a password. The default password is blank.
9. Click the **Control Panel** button on the top of the PC screen, to access the control panel.
10. Press **Menu Off** on the scope
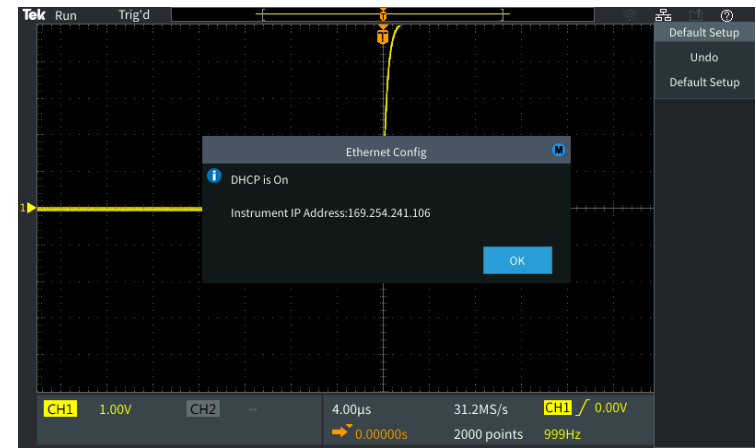11. Click **Autoset** on the PC to get a stable waveform.



Figure 20. After connecting the cable, you should see the Ethernet icon (upper right) and the scope's IP address



Figure 21. On the PC, the IP has been entered into the address box of the browser, and autoset has been performed remotely