Tektronix

TBS2000B Oscilloscope Demo Guide

Table of Contents

Bonus Demos

TBS2000B Series Oscilloscopes

The TBS2000B 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

◦ 200, 100, 70 MHz bandwidth models

◦ 2 and 4 analog channel models

◦ Up to 2 GS/s sampling rate

◦ 5 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 work flow assistant

About This Guide

Begin by exploring the controls and display of the TBS2000B 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 TBS2000B's connectivity and remote control capabilities, and tools for education.

Required Equipment

◦ TBS2000B Series Oscilloscope

◦ Power Cord for your region (included with instrument)

◦ Two TPP0100 or TPP0200 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 remote control)

◦ Ethernet cable (to demonstrate remote control)
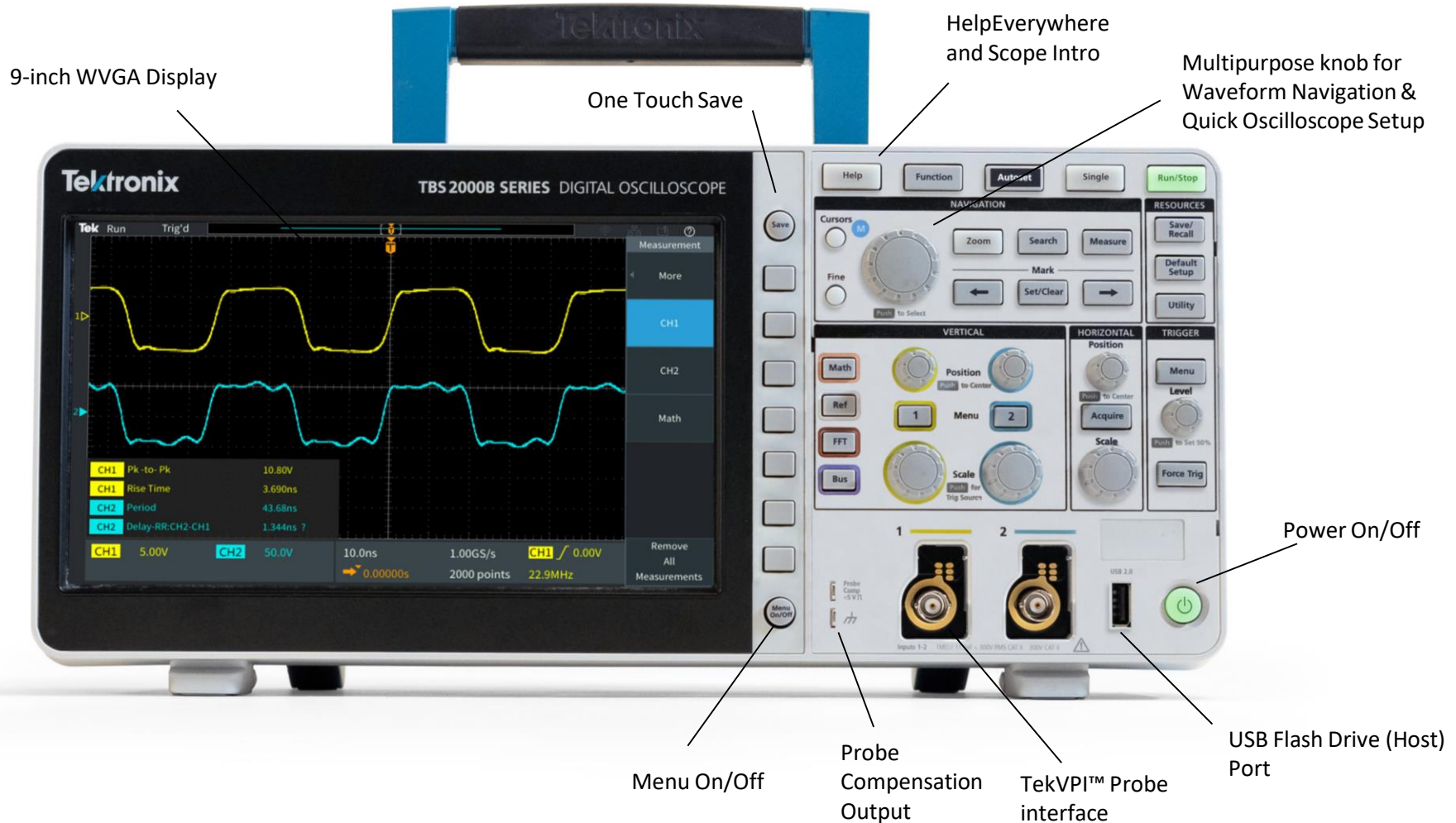
Setting up the Equipment

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 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 using 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

9-inch WVGA Display

One Touch Save

HelpEverywhere and Scope Intro

Multipurpose knob for Waveform Navigation & Quick Oscilloscope Setup

Power On/Off

USB Flash Drive (Host) Port

TekVPI™ Probe interface

Probe Compensation Output

Menu On/Off

Front Panel Tour, Four-Channel Models

9-inch WVGA Display

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Probe Compensation Output

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TekVPI™ Probe interface
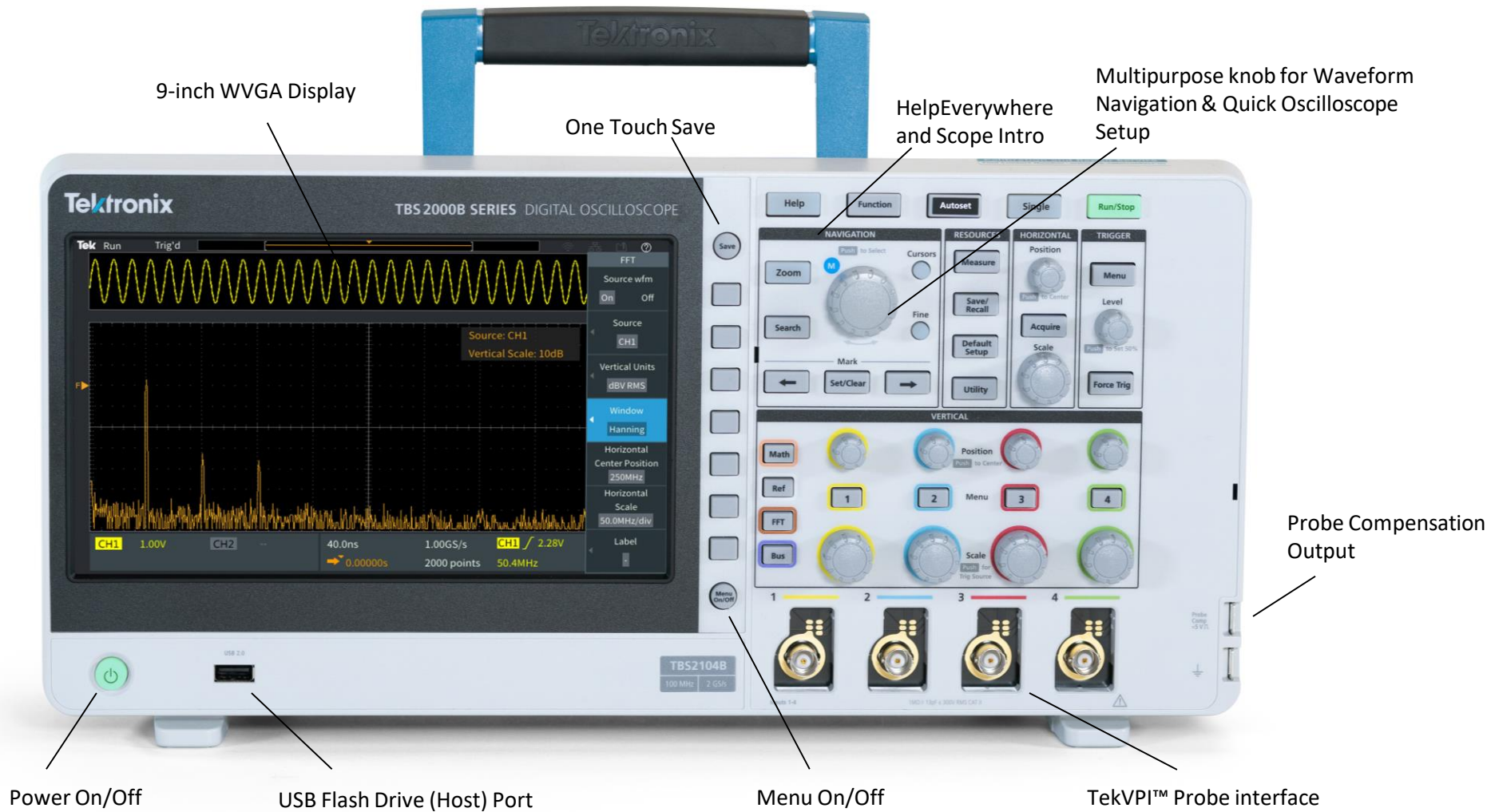
Understanding the Display

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

| 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 **Help** 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).
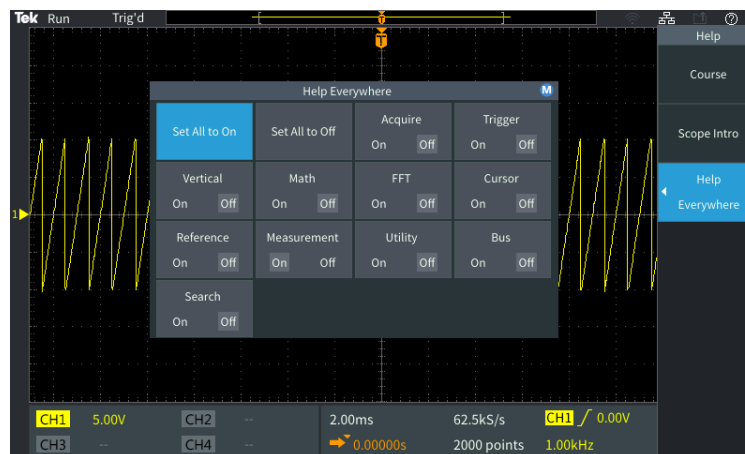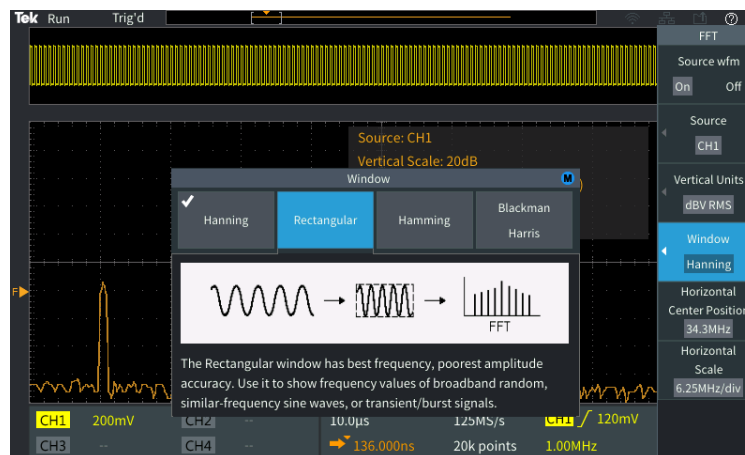

Figure 1. Turning on HelpEverywhere

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 **Help** 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 to go back to the top menu, and explore the other topics. **TBS2000B 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.
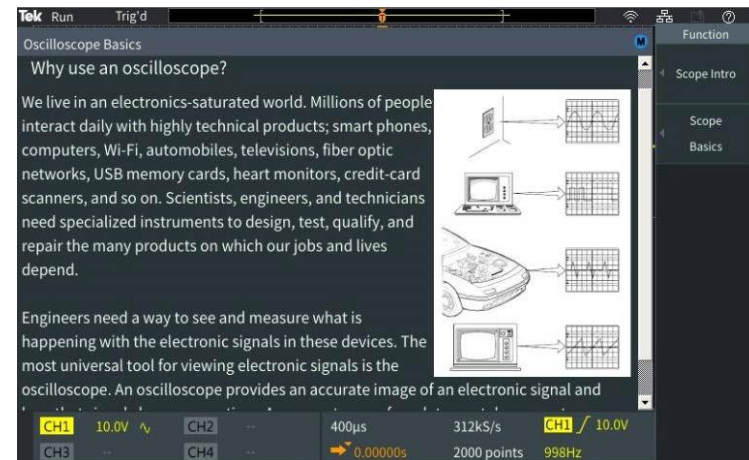

Figure 3. Selecting Oscilloscope Basics

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.

2. Clip the **probe tip** to the **Probe Comp output**. Clip the **ground clip** to the Probe Comp **ground terminal.**

3. Press **Default Setup** in Resources section of the front panel. This will set the scope into it's default state.

4. 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 (1/2)

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 demo 3.

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
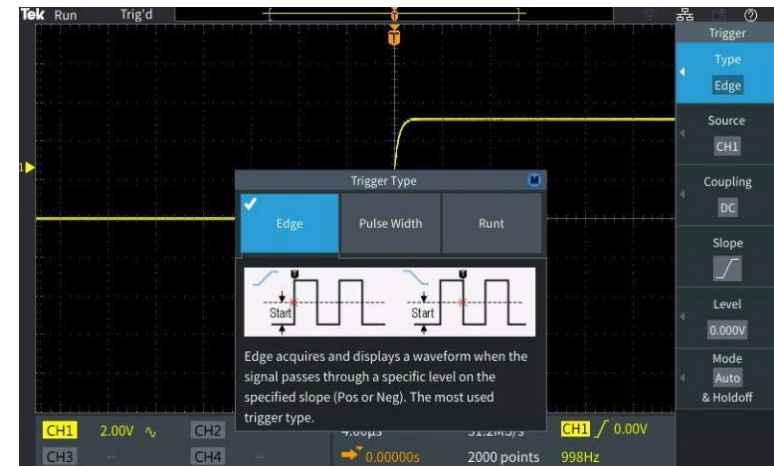

Figure 6. The M logo in the Trigger Type menu indicates that the Multipurpose Knob (MPK) should be used for selection

4. Triggering the Scope (2/2)

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

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 7. Setting pulse width trigger parameters

5. Using Pan and Zoom to Navigate through Long Records (1/2)

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 **5M** 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).
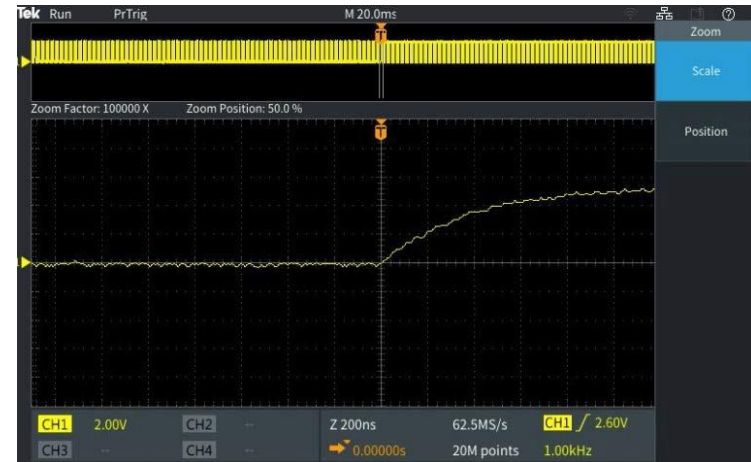

Figure 8. Zooming in on a rising edge

5. Using Pan and Zoom to Navigate through Long Records (2/2)

Especially for acquisitions of 5M points, it is important to be able to navigate through the record. Pan and zoom enable this.

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 9. Zooming in on a falling edge

6. Using Cursors to Measure Time and Amplitude(1/2)

Cursors enable quick visual measurements on the selected waveform. The TBS2000B 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.

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

6. Using Cursors to Measure Time and Amplitude(2/2)

Cursors enable quick visual measurements on the selected waveform. The TBS2000B features on-waveform readouts to make it easy to visualize measurements.

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).

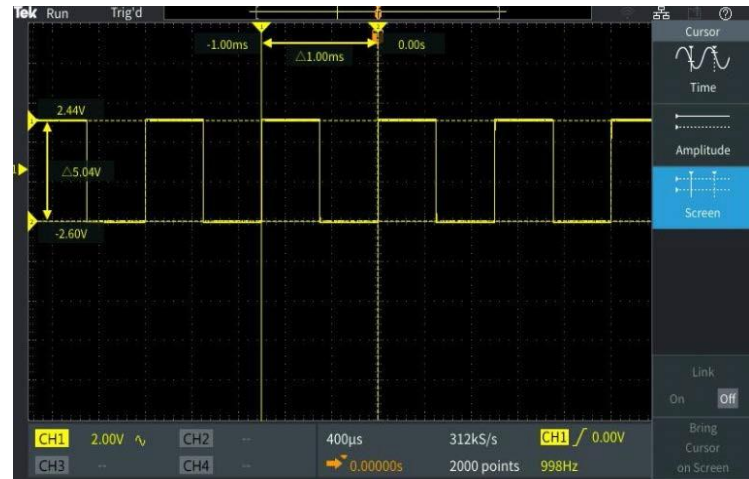*In the next section, you'll use automated measurements to get similar results.*

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

7. Making Automated Measurements (1/2)

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(Figure 12):

   • Measurement selection indicator bar
   • Snapshot button
   • Most Used measurement list
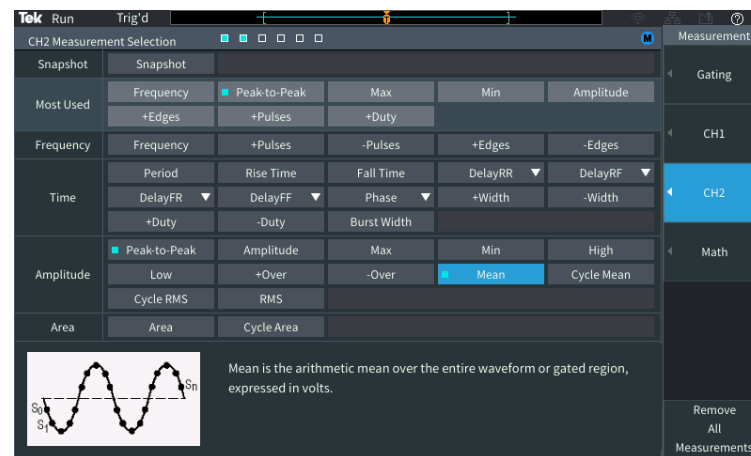   • Measurements grouped by Frequency, Time, Amplitude, Area

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.

7. Making Automated Measurements (2/2)

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

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).

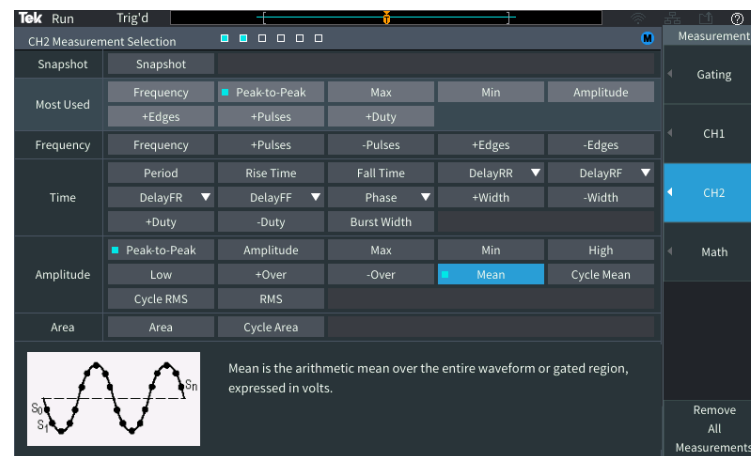9. Press **Menu On/Off** a couple of times to hide and recall the measurement readout panel .

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.
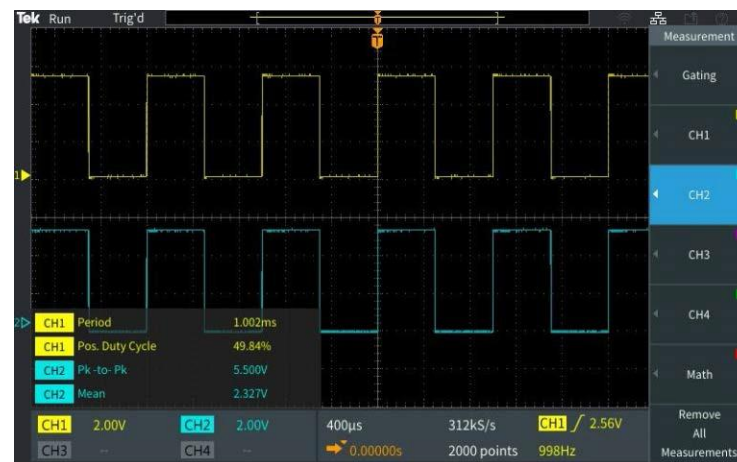

Figure 13. Transparent readouts let the signal show through.

19

8. Using an FFT to Analyze a Signal's Frequency Spectrum (1/2)

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 **FFT** 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.

Figure 14. The FFT Menu

8. Using an FFT to Analyze a Signal's Frequency Spectrum (2/2)

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

8. The default FFT window is Hanning. Use the **Window** bezel button and MPK to switch to the Rectangular window and note the result.

9. Press the Horizontal Scale bezel button and use the MPK to adjust the horizontal scale to 1.56 kHz/div.

10. Press the **Cursor** button and position the cursors on the third and fifth harmonic frequencies (Figure 15).

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

9. Saving Screen Images (1/2)

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.**

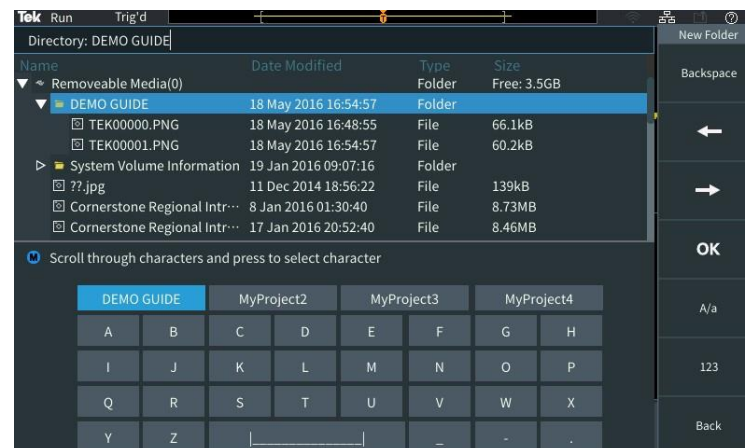9. Highlight and select the new DEMO GUIDE folder with the **MPK.**

Figure 16. Setting up a directory on a flash drive

9. Saving Screen Images (1/2)

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

10. Press the **Save** button outside the right top corner of the display(Figure 17) to save an image into the DEMO GUIDE folder on the USB thumb. The hint line should say that the image was successfully saved(Figure 18).

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 image file.

Figure 17. One Touch Save button quickly lets the user capture information form the instrument.

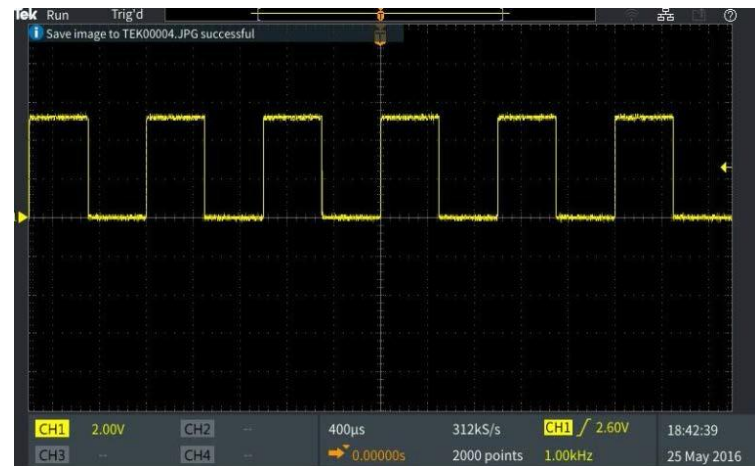
Figure 18. The hint line, in the upper left of the display, indicates a successful save.

10. Setting up a Wireless Connection

The TBS2000B 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. Plug the **TEK-USB-WIFI** adapter into the rear USB host port (Figure 19).

2. Press **Utility**, press **Config**, select **Wi-Fi Config** and press **Available Networks.** Select the wireless network that will be used for control (Figure 20).

3. Enter the network key/password if the network is secured. This is usually an encryption key/password set in the network router. (Note: The TBS2000B does not support entering a username and password for a corporate network).

4. Press **Wi-Fi Settings** menu to confirm configuration information.

5. The **Wireless Icon** in the top right corner of the display should be on, indicating that the scope is connected to Wi-Fi

Figure 19. Insert the TEK-USB-WIFI adapter to enable wireless communications

Figure 20. Configuring Wi-Fi communications via the Utility Menus

11. Remote Instrument Control (1/2)

The built-in web server in the TBS2000B 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(Figure 21).

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.)

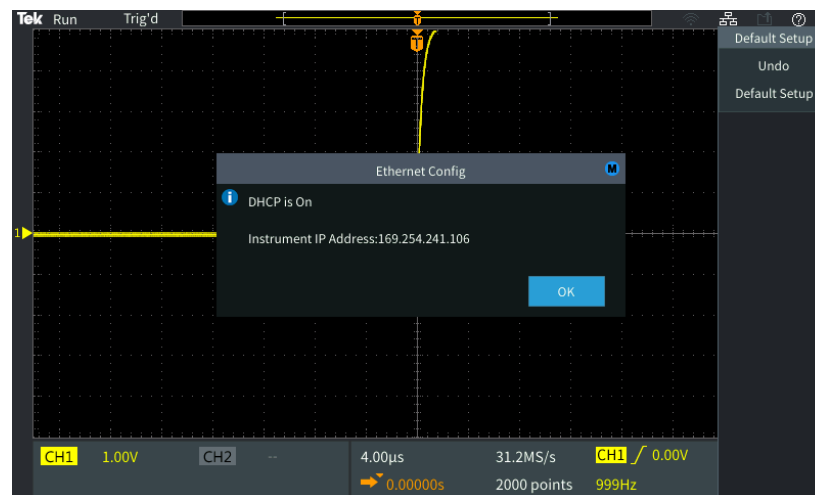7. The **Welcome Page** displays important configuration information.

Figure 21. After connecting the cable, you should see the Ethernet icon (upper right) and the scope's IP address

11. Remote Instrument Control (2/2)

The built-in web server in the TBS2000B 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.

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 (Figure 22).

10. Press **Menu Off** on the scope

11. Click **Autoset** on the PC to get a stable waveform.

Figure 22. On the PC, the IP has been entered into the address box of the browser, and autoset has been performed remotely

12. Create and load custom courseware (1/3)

The PC Courseware Editor helps you create lab descriptions and instructions on a PC and then upload the material directly onto a TBS2000B oscilloscope. You can modify existing labs with content that directly supports recent lectures or incorporates ideas discovered in class discussions. Your students can perform their lab work directly on the oscilloscope and can even automatically generate an HTML formatted lab report for submission and grading directly from the instrument.

1. After installing an opening PC Courseware Editor V2.0 on your computer click the **Create** button under the **Lab** section(Figure 23).

2. Next give your lab a name and click **OK**.

3. Select the lab you just created and select the **Edit** button (Figure 24).

Addition equipment needed:
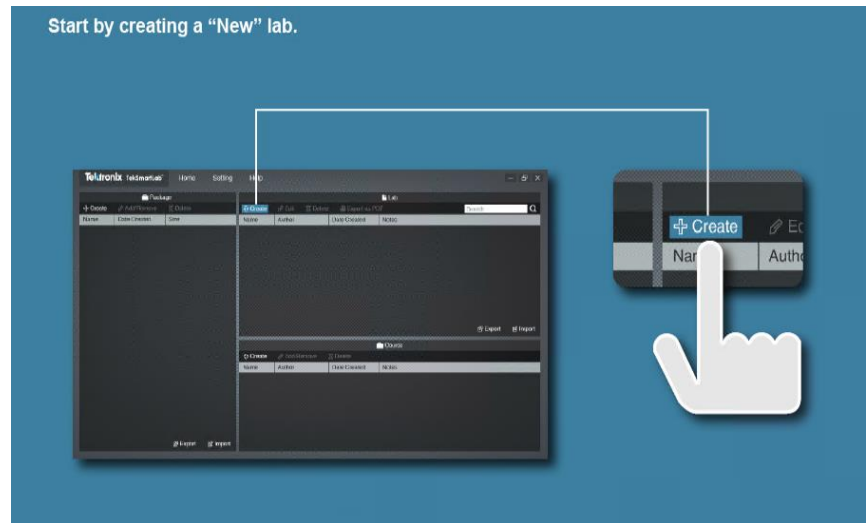- PC Courseware Editor Tool V2.0
- USB drive

Bonus Demo

Figure 23. Creating a new lab in PC Courseware Editor V2.0

Figure 24. Selecting a lab to edit in PC Courseware Editor V2.0

12. Create and load custom courseware (2/3)

The PC Courseware Editor helps you create lab descriptions and instructions on a PC and then upload the material directly onto a TBS2000B oscilloscope. You can modify existing labs with content that directly supports recent lectures or incorporates ideas discovered in class discussions. Your students can perform their lab work directly on the oscilloscope and can even automatically generate an HTML formatted lab report for submission and grading directly from the instrument.

4. Now use the editor page on the **Objective tab** to describe the main objective of the lab. Feel free to use pictures, graphs, and tables. (Figure 25).

5. Now click on the **Procedure tab** describe the main procedure of the lab.

6. Click **Save** and **Quit** once finished figure (Figure 26).
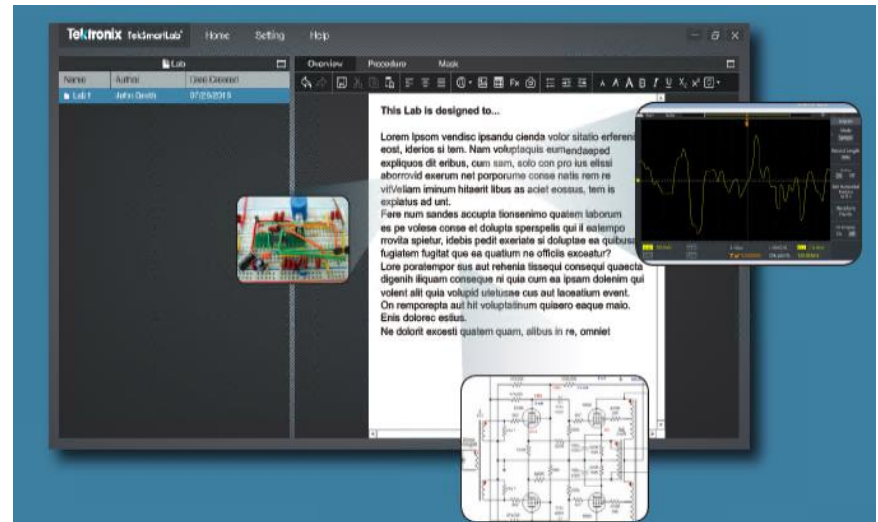
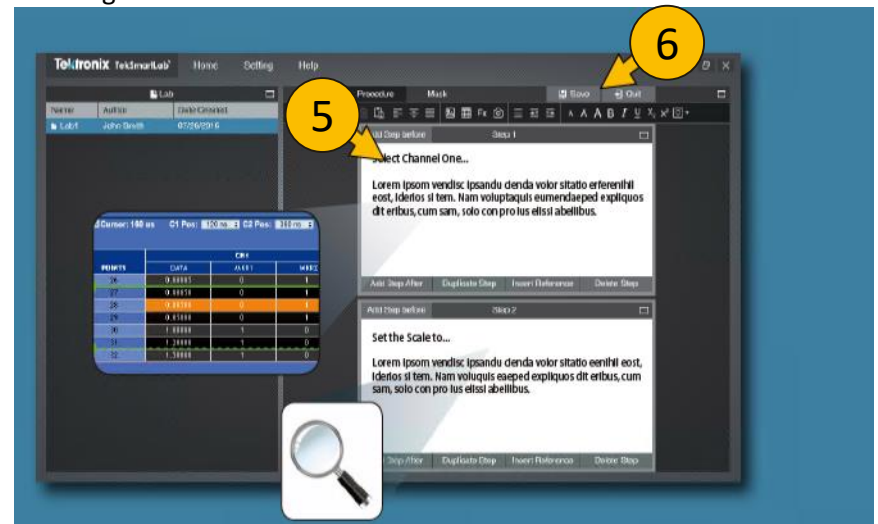Figure 25. Creating a lab objective for students to read before starting the lab

Figure 26. Creating a lab procedure for students to follow

12. Create and load custom courseware (3/3)

7. Follow the steps in **Figure 27** to create a package that can be loaded on the TBS2000B

8. Select the package and **export** it to a **USB** thumbdrive.

9. Click **Save** and **Quit** once finished figure (Figure 26).

10. Plug the USB drive into the scope and press the **Utility** button.

11. Press the **Update Course** button to upload the course the instrument (Figure 28).

12. Confirm that the course is loaded by pressing the **Help** button and then pressing **Courses**.

Figure 27. Creating a lab objective for students to read before starting the lab
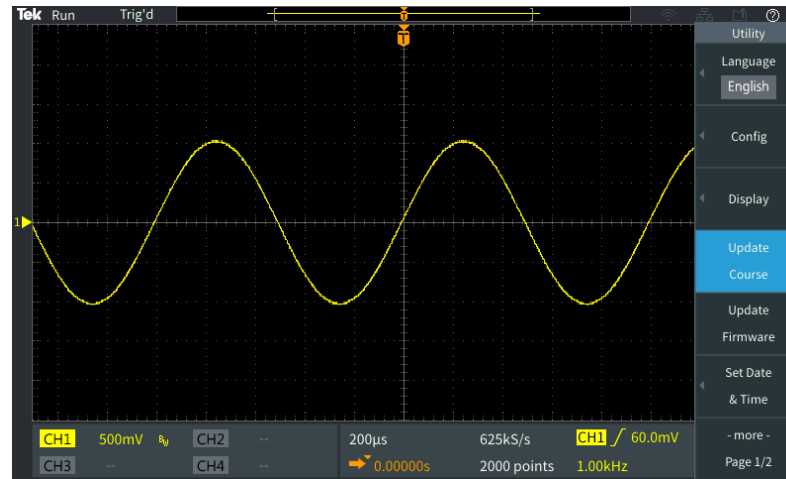
Figure 28. Creating a lab objective for students to read before starting the lab

13. *Configure a lab of instruments with TekSmartLab software* (1/3)

TekSmartLab is the industry's first network-based lab instrument management solution for quickly setting up and efficiently managing basic Instrumentation in engineering laboratories at colleges and universities. The centralized control of instruments enabled by the TekSmartLab solution dramatically improves the classroom and lab experience for students, instructors and lab managers. In this Demo we will be setting up a lab and pushing settings to all connected instruments.

1. Click **Setting -> Bench/Lab Layout Config** and choose the **Bench Layout Configuration** tab.

2. Choose the **four-instrument layout** by using the dropdown arrow in each instruments selection box (Figure 30).

3. Click **Apply**.

4. Click **Yes** to confirm the setting.

Addition equipment needed:
- TekSmartLab TSL3000B V3.0[*]
- TBX3000A with 4 instruments connected via usb[*]

Bonus Demo

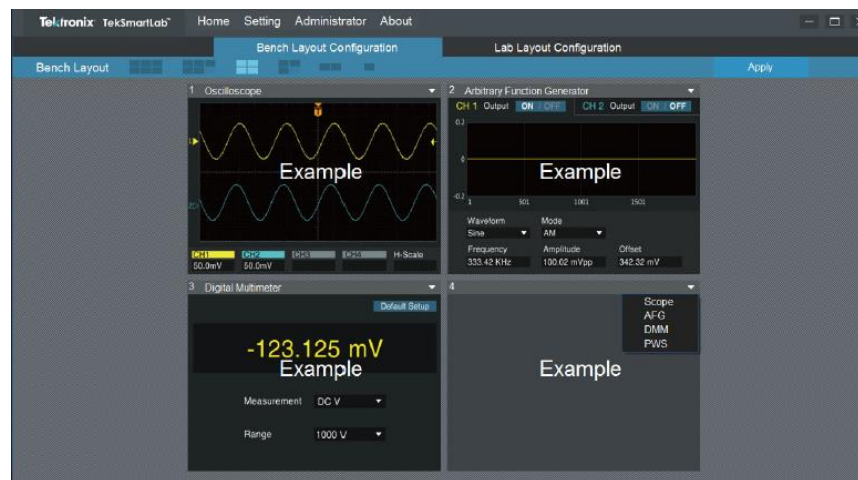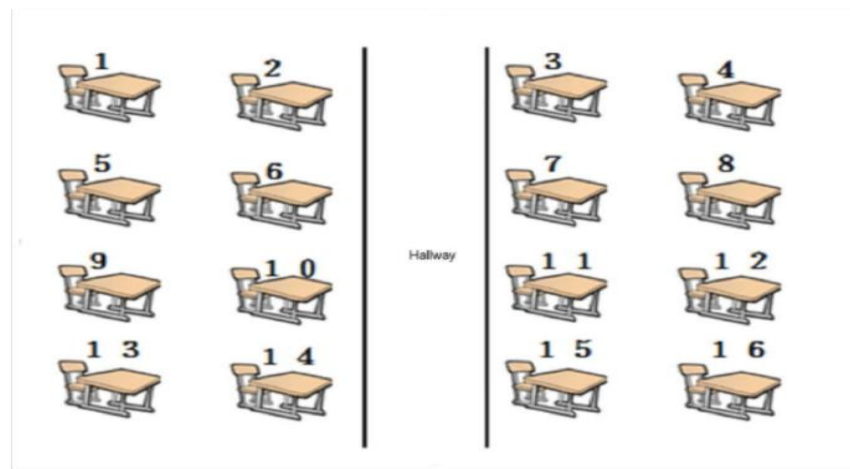Figure 29. TekSmartLab supports up to 6 instruments at each bench.

Figure 30. Tektronix and Keithley oscilloscopes, power supplies, digital multimeters and arbitrary function generators can all be added and managed from the TekSmartLab TSL300B software.

[*]See TekSmartLab user manual for setup instructions

13. *Configure a lab of instruments with TekSmartLab software* (2/3)

TekSmartLab is the industry's first network-based lab instrument management solution for quickly setting up and efficiently managing basic Instrumentation in engineering laboratories at colleges and universities. The centralized control of instruments enabled by the TekSmartLab solution dramatically improves the classroom and lab experience for students, instructors and lab managers. In this Demo we will be setting up a lab and pushing settings to all connected instruments.

4. Choose a lab grid that matches the physical layout of the teaching lab.

5. Choose the **Lab Layout Configuration** tab.

6. Choose **By Row** next to **Number**.

7. For this example **Input 4** next to **Row**.

8. Input **5** next to **Column**.

9. Clear the middle column by **double-clicking** the benches you want to remove (Figure 32).

10. Click **Apply** to complete the setting.

Figure 31. Example of a student bench layout

Figure 32. TekSmartLab allows you to set up your lab/classroom grid to match your actual classroom/lab layout

13. *Configure a lab of instruments with TekSmartLab software* (3/3)

TekSmartLab is the industry's first network-based lab instrument management solution for quickly setting up and efficiently managing basic Instrumentation in engineering laboratories at colleges and universities. The centralized control of instruments enabled by the TekSmartLab solution dramatically improves the classroom and lab experience for students, instructors and lab managers. In this Demo we will be setting up a lab and pushing settings to all connected instruments.

4. To centrally configure all the instruments in your lab, Click **Configure Instrument** from the home page (Figure 33).

5. Choose **Scope** in the left pane, the oscilloscope configuration page is displayed on the right.

6. Click the **White Arrow** in the **Instrument Panel** to hide the icons of the instruments.

7. You can easily **Default Setup** the instruments after each ;ab and disable the **Autoset** feature so that students learn how to make measurements (Figure 34).

8. Choose selected benches displayed in blue, or click **All** to choose all benches.

9. Click **Apply** to distribute the configuration to the chosen benches. The configured benches will be displayed in **green**.
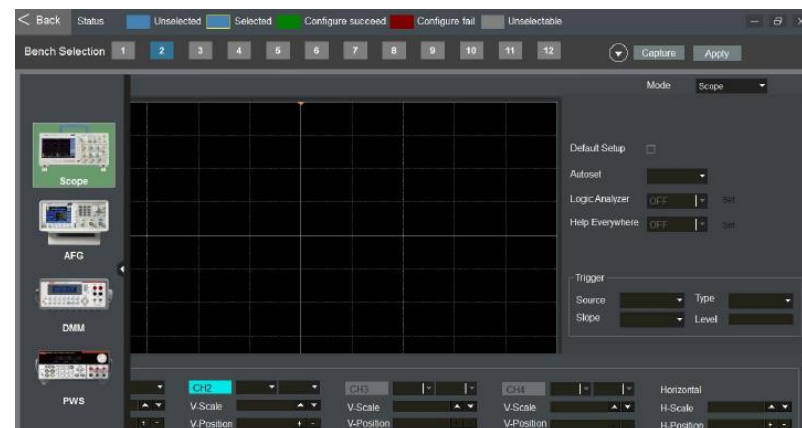

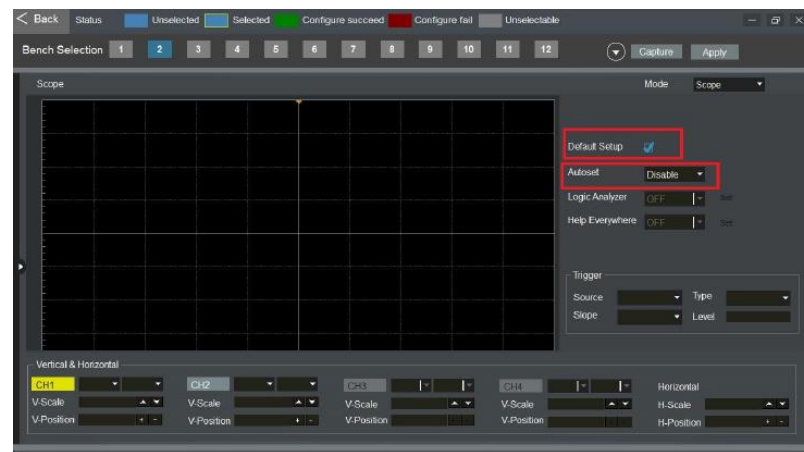Figure 33. TekSmartLabs centralized instrument configuration panel

Figure 34. TekSmartLab has setup features tom make your job as an instructor easier like centralized instrument configuration..

14. *Create trend plots using TekBench software* (1/2)

TekBench™ is PC software that controls Tektronix oscilloscopes and arbitrary function generators. It offers intuitive instrument control, automated measurement data logging, automated frequency response measurements[*], and easy waveform exporting to eliminate extra time and effort. It allow users to focus on their experiment rather than learning the instrument.

1. Connect a USB cable from the instrument to your computer

2. Connect the **Channel 1** AFG31000 output to the **Channel 1** input of the TBS200B

3. Choose the **Datalog** tab and select the measurements& channels to be logged in the upper left of the screen (Figure 36).

4. Choose the **start and stop conditions** for your test. For this demo choose the **Click Start Button** condition for start and the **Click Stop Button** for the stop condition.

Addition equipment needed:
- TekBench software
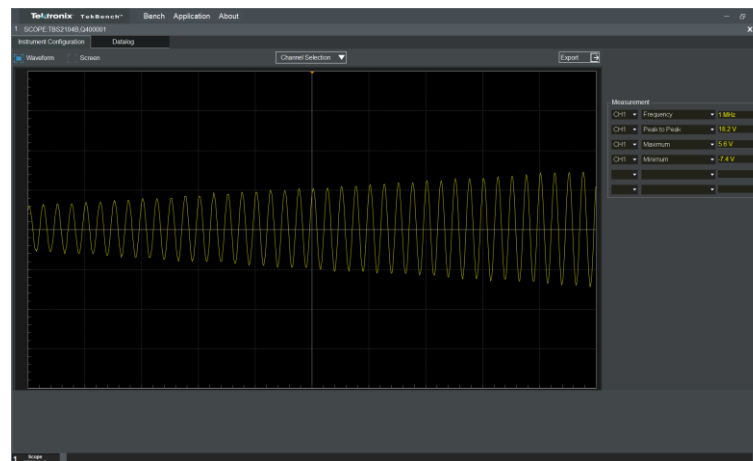- USB cable
- AFG31000

Bonus Demo

Figure 35. The main instrument control screen allows you to see either the waveform data on its own or a picture of the instruments screen with all open menus displayed
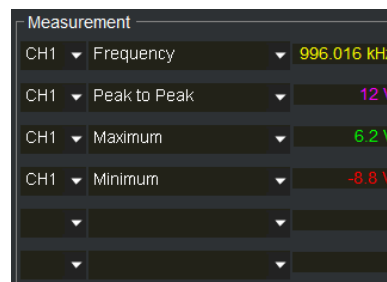
Figure 36. Choose Channels & measurements to log

[*]*with supported instruments*

14. *Create trend plots using TekBench software* (2/2)

TekBench™ is PC software that controls Tektronix oscilloscopes and arbitrary function generators. It offers intuitive instrument control, automated measurement data logging, automated frequency response measurements[*], and easy waveform exporting to eliminate extra time and effort. It allow users to focus on their experiment rather than learning the instrument.

Figure 37. Choose logging interval and start and stop conditions

5. Choose the **logging interval** for your test. For this demo enter **3 Seconds** (Figure 37).

6. Press the green **start** button on the bottom left to start logging

7. Turn the output of the AFG31000 on.

8. Slowly **change the output parameters** of the AFG31000 i.e. (Amplitude, frequency, offset) and watch the measurements change on the software (Figure 38).

9. When you are done recording **press stop** in the lower left corner.

10. To save the logging data as a csv file press the **Export** button in the lower right.
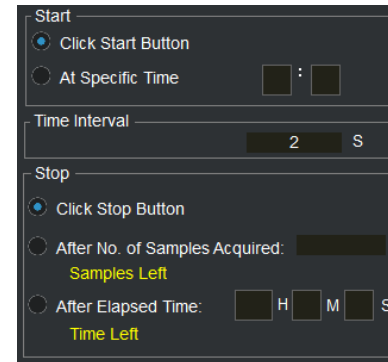
Figure 38. TekBench datalogging can track multiple measurements

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