# Agilent N2740A Education Training Kit for 1000 Series Oscilloscopes

## Lab Manual

**Agilent Technologies**

# Notices

## Manual Part Number

N2740-97000

## Edition

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## Warranty

## Technology Licenses

## Restricted Rights Legend

## Safety Notices

**CAUTION**

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

**WARNING**

**A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.**

# Agilent 1000 Series Oscilloscopes—Big Scope Features, Little Scope Price

The Agilent 1000 Series oscilloscopes feature:

- Up to 2 GSa/s sample rate and 20 kpts memory.
- Crisp and bright 5.7″ color display with wide viewing angle and waveform viewing area—making it easy to view signals.
- Mask testing.
- Waveform recording and playback (sequence mode).
- Dedicated, color-coded vertical controls make it easy to access the most common functions.
- Built-in help, menus, front panel overlay template, and manual offered in eleven languages.
- Autoscale helps you quickly display signals, automatically setting the controls.
- Automatic measurements (23) or manual cursor measurements.
- Zoomed time base display shows big picture and zoomed in view simultaneously.
- Built-in USB ports make it easy to save your setups, data, and screen images, print to PictBridge compliant printers, and connect to your PC.
- Small, light weight portable design—easy to carry around.
- Kensington lock for added security.

# About the Training Kit Board

**Caution**

Components on the training kit board are susceptible to electrostatic discharge (ESD). Please be careful to avoid electrostatic discharge when handling the board.

## Training Kit Board Features

The N2740A education training kit board outputs 15 different types of signals, selectable via the MODE rotary dial switch.

| MODE | Output | On Channel | Notes |
|------|--------|------------|-------|
| 0 | Sine Wave | 1 | |
| 1 | Square Wave | 1 | |
| 2 | Data w/Glitch | 1 | |
| 3 | Phase Shifted Sine Waves | 1, 2 | Use POT to adjust phase shift. |
| 4 | Single Shot Data | 1 | Use SWITCH to output single shot data. |
| 5 | Burst Data | 1, 2 | Intermittent glitch on CH1 after burst data. |
| 6 | Noisy Sine Wave | 1 | |
| 7 | Ringing Pulse | 1 | |
| 8 | Triangle Wave | 1 | |
| 9 | Ramp Wave | 1 | |
| A | Square Waves w/Offset | 1, 2 | |
| B | FSK | 1 | Frequency modulated signal. |
| C | I2C | 1, 2 | Inter-Integrated Circuit serial bus, CH1 = clock, CH2 = data. |
| D | CAN | 1, 2 | Controller Area Network serial bus, CH1 = data, CH2 = drive signal. |
| E | RS-232 | 1, 2 | CH1 = Rx, CH2 = Tx. |

## USB Cable Connection



Power provided by USB connection.

Rotary MODE Signal Selection Switch

Signal Probe Points
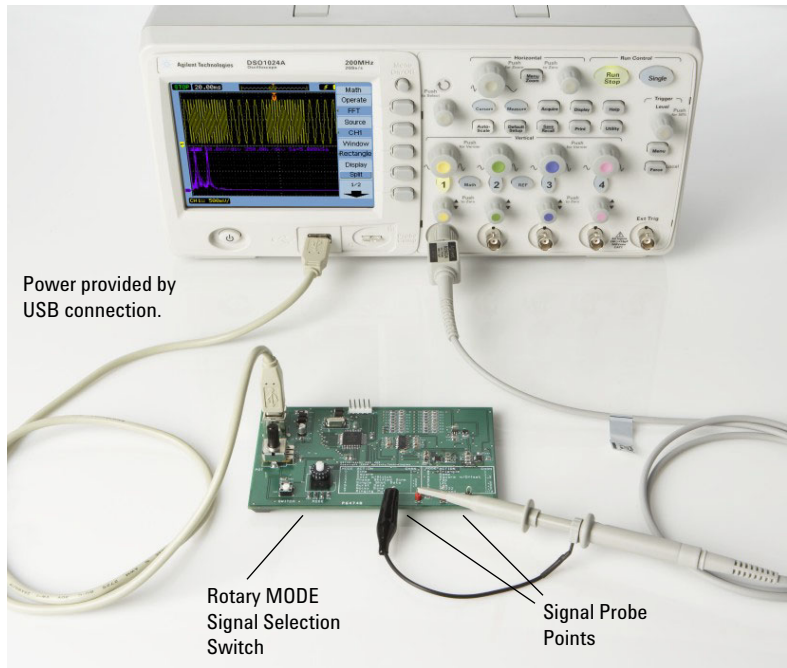
## Probes

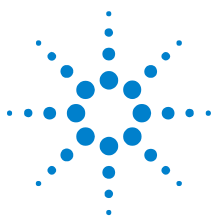Use the passive probes that are included with the oscilloscope (N2862A or N2863A).

You may need to compensate the passive probes. For more information, see the *1000 Series Oscilloscopes User's and Service Guide*.

# In This Manual

If you are experiencing the 1000 Series oscilloscope for the first time, begin with Lab 1, Using the Front Panel Controls. If you have a basic knowledge of the 1000 Series oscilloscope's front-panel controls, begin with Lab 3.

|  | Topic | Page | Time Allowance |
|---|---|---|---|
| Lab 1: | Using the Front Panel Controls | 7 | 5 min. |
| Lab 2: | Making Measurements | 15 | 5 min. |
| Lab 3: | Using Waveform Math Functions | 20 | 5 min. |
| Lab 4: | Saving and Displaying a Reference Waveform | 24 | 5 min. |
| Lab 5: | Setting Up Triggers | 26 | 10 min. |
| Lab 6: | Using Acquisition Modes | 34 | 5 min. |
| Lab 7: | Mask Testing and Recording Waveforms | 38 | 10 min. |
| Lab 8: | Saving and Printing | 43 | 5 min. |

# 1

# Using the Front Panel Controls

The Agilent 1000 Series oscilloscopes have knobs, keys, and softkeys for horizontal, vertical, run control, and trigger settings.

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Settings and status shown on screen border.



Built-in USB ports make it easy to save your work and update oscilloscope firmware.

Softkeys for selecting menu items.

Selection knob, immediate action keys and special menus
Push the knob to make a selection

Time/div and position
horizontal controls

Run Control

Trigger level
knob and
controls

Access built-in help
by pressing Help and
then the key or knob
in question

Vertical color-coded controls
for each scope channel

# Capturing and Viewing a Simple Signal

**1** Connect the USB cable from the front panel USB host port on the oscilloscope to the USB IN connector on the training kit board.

**2** Connect the channel 1 probe to the test points labeled CH1 and GND.
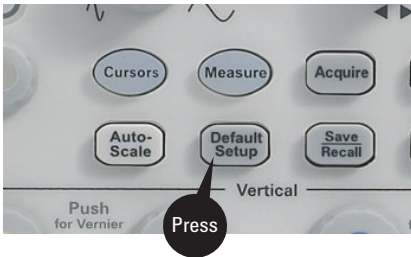
**3** Rotate the MODE dial to position **0** (Sine wave).

**4** Press the **[Default Setup]** key on the front panel. When the Default menu appears, press **[Menu On/Off]** to turn off the menu.



The oscilloscope is now set in the factory default configuration – just as it left the factory. Since the oscilloscope may have been used in a variety of applications by a variety of people, it is a good measurement procedure to put the oscilloscope in a known starting mode (Default Setup). This will make it easy to duplicate measurements as no special conditions will be set.

**5** Press **[AutoScale]**. When the AUTO menu appears, press **[Menu On/Off]** to turn off the menu.
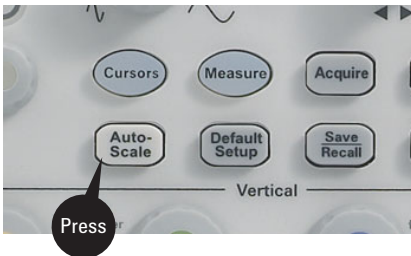


The oscilloscope analyzes all active channels, turning them on and setting the time base, V/div, and trigger conditions for an initial display.

# Horizontal Controls

**1** Turn the **large knob** in the horizontal control section clockwise and counterclockwise to control the time/div setting of the horizontal axis. Observe the changes in the displayed signal. The current time base setting is displayed at the top of the screen in the display border.

**2** Turn the **small knob** in the horizontal control section to move the waveform horizontally from the trigger point. Push this knob to return the trigger point to the center of the screen.

*Turn to control time/div*
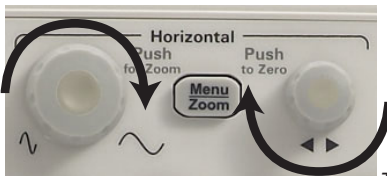


*Turn to control horizontal position*

**3** Set the time base 500 µs/div.

**4** Press the **[Menu/Zoom]** key to display the Horizontal menu. Note the Zoom setting and Time Base modes of Y-T, X-Y, and Roll.

**For instant HELP on any topic, press the [Help] key; then, press the key, softkey, or knob that you would like more information about.**

**5** Press the **Zoom** softkey and observe the split-screen – this mode shows the big picture on top and an expanded view on the bottom.

**6** Turn the large time base knob clockwise to make the window on top smaller.

**7** Press the **Zoom** softkey again to return to the original display.
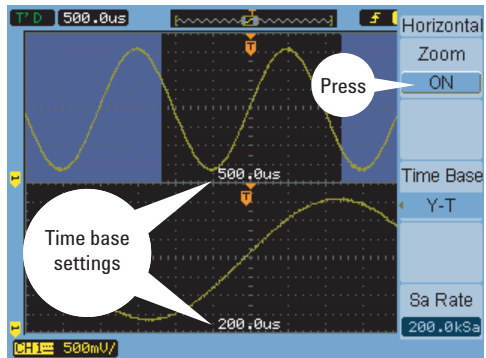


**Note: At any time, to return to the original setup, press [AutoScale].**

# Run Controls

When the oscilloscope is turned on, or if [**AutoScale**] is pressed, the acquisition will be set to [**Run**]. At any time you may [**Stop**] the acquisition process to examine a signal in detail or to save it.

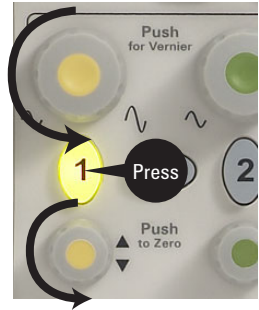**1** Press [**AutoScale**] to return to simple setup.

**2** Set time base to 2 ms/div.

**3** Press the [**Single**] key to make a single acquisition and stop the acquisition process.

**4** Use the large Horizontal knob to zoom in on the waveform.



*Capture the big picture then zoom in for detailed analysis.*
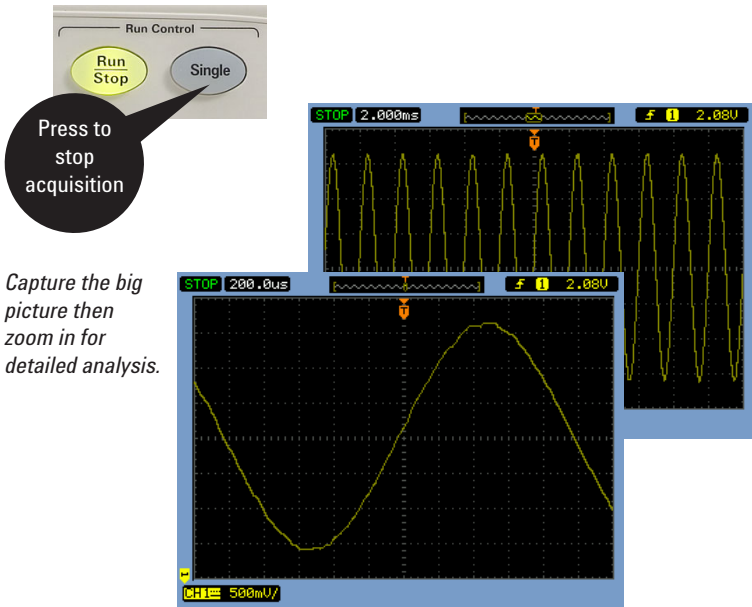
Acquisition record lengths are the same with "single" or "running" acquisitions.

# Vertical Controls

**1** Press [**AutoScale**] to return to simple setup.

**2** Turn the **large yellow knob** in the Vertical section to control the V/div setting. The V/div setting is displayed in the lower left hand corner of the screen in the display border. Knobs are color coded to match the waveform color.

**3** Press the [**1**] key to display the channel 1 menu. Press again to turn the channel off and then on.

**4** Turn the **small yellow knob** to control the vertical offset position of the waveform, moving it up or down.

# Trigger Controls

**1** Press [**AutoScale**] to return to a simple setup.

**2** Rotate the **trigger level knob** up and down. The trigger level is displayed as it is adjusted.

If the trigger level is above or below the signal, the oscilloscope will force a trigger and display a waveform when in Auto mode. Auto is a useful trigger mode to use when unsure of the exact waveform, as activity will be displayed making it easy to better configure the oscilloscope's settings and trigger level.

**3** Press the [**Menu**] key in the trigger section.

**4** Press the [**Help**] key; then press the **Sweep** softkey to read more about the Auto and Normal trigger sweep.

**5** Set the trigger sweep to **Normal**. Move the trigger level up and down.

Observe that the oscilloscope only triggers when a valid trigger condition exists – this is the trigger mode to use when you want to set a specific trigger condition and capture waveforms only when those conditions are met.
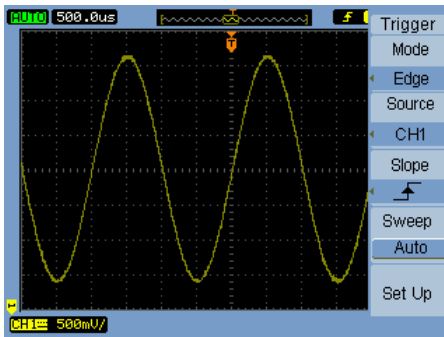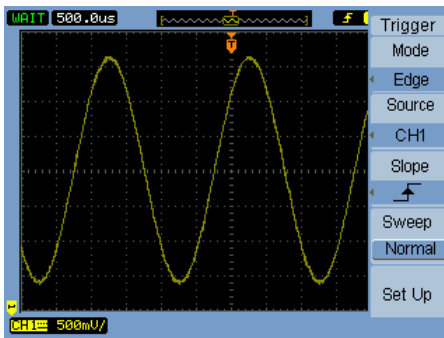
Auto sweep forces triggers if the trigger condition is not met and shows untriggered waveform activity.



Normal sweep waits for a waveform that meets the trigger conditions before displaying any activity.

# 2
# Making Measurements

With the 1000 Series oscilloscopes, you can make 23 different automatic voltage and time measurements. You can also display the hardware frequency counter. And, you can use cursors to make manual measurements.

## Automatic Voltage and Time Measurements

1  Connect the channel 1 probe to the test points labeled CH1 and GND.

2  Rotate the MODE dial to position **7** (Ringing Pulse).

3  Press **[Default Setup]**.

4  Press **[AutoScale]**.

5  Press the **[Measure]** key.



6  In the Measure menu, press **Voltage**; then, turn the selection knob to choose **Vpp**, and push the selection knob.

The peak-to-peak voltage measurement appears at the bottom of the display where up to three of the most recent measurements are shown. (The **Clear** softkey removes measurements from the display.)

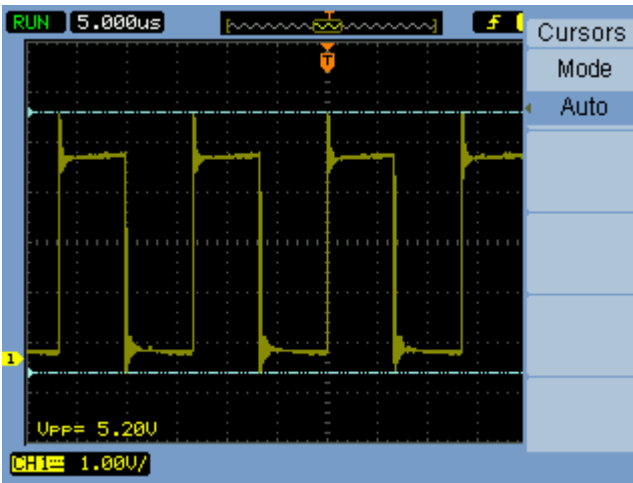Note that the **[Measure]** key is lit when measurements are displayed.

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**7** Press the **[Cursors]** key.



**8** In the Cursors menu, press **Mode**; then, turn the selection knob to choose **Auto** and push the selection knob.

Now, cursors for the latest automatic voltage or time measurement are displayed (and the **[Cursors]** key is lit).



**9** Press the **[Measure]** key.

**10** In the Measure menu, press **Time**; then, turn the selection knob to choose **Freq**, and push the selection knob.

Now, two measurements are displayed, and cursors are shown for the frequency measurement.

**11**  In the Measure menu, press **1/2** to go to the next page of menu items; then, press **Display All**.

Now, all the single-waveform measurements are displayed at once.
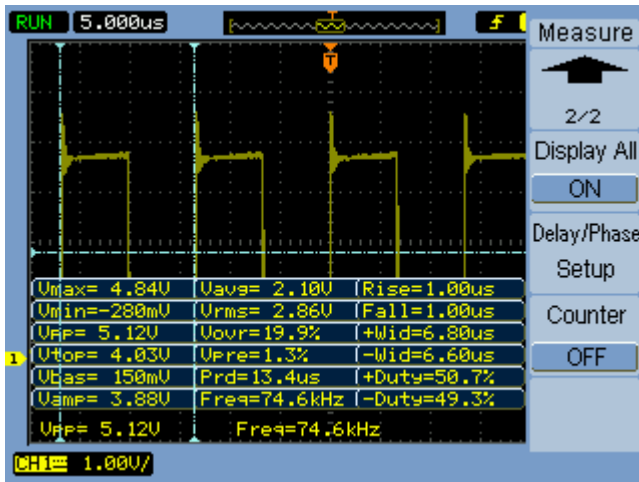


## Hardware Frequency Counter

**12**  In the Measure menu, press **Counter** to turn on the hardware frequency counter.

The 6-digit hardware frequency counter value appears at the top of the display.

The counter operates on the currently selected trigger source. It uses the trigger comparator to count the number of cycles within a period of time (known as the gate time), so the trigger level must be set correctly.

**13**  Press the **Display All** and **Counter** softkeys again to turn these measurements off and remove them from the display.

## Manual Cursor Measurements

**14** Press the **[Cursors]** key.

**15** In the Cursors menu, press **Mode**; then, turn the selection knob to choose **Manual** and push the selection knob.

**16** Press the **Type** softkey to toggle between Time (X) and Amplitude (Y) cursors.

**17** Press **CurA** to select the A cursor, and turn the selection knob to adjust it. Press **CurA** again to deselect the A cursor.

**18** Press **CurB** to select the B cursor, and turn the selection knob to adjust it.

The cursor values and difference between them are shown at the top of the display.
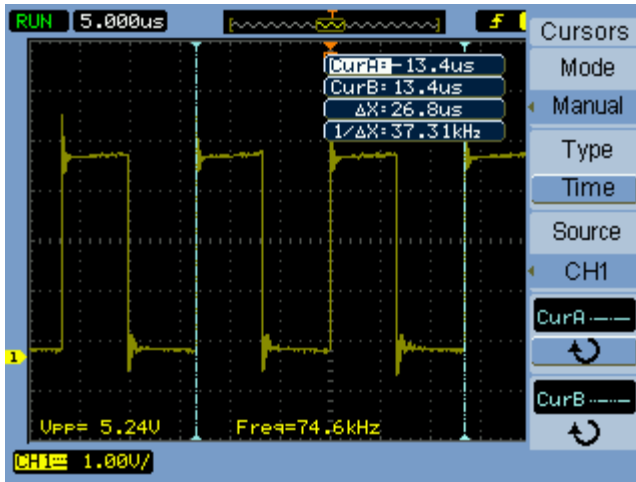


By selecting both cursors, you can adjust them at the same time by turning the selection knob.

The **Track** cursors mode gives you up to two manually adjustable, tracking cross-hair cursors that make amplitude and time measurements at different points along the selected waveform.

## Phase Measurements and the X-Y Time Base

**1** Connect the channel 2 probe to the test points labeled CH2 and GND.

**2** Rotate the MODE dial to position **3** (Phase Shifted Sine).

**3** Press **[Default Setup]**.

**4** Press **[AutoScale]**.

**5** Press the **[Measure]** key.

**6** In the Measure menu, press **Time**; then, turn the selection knob to choose **Phase A→B, rising edge**, and push the selection knob.

Watch the phase measurement value change as you turn the POT knob on the training kit board.

**7** Press the **[Menu/Zoom]** key in the horizontal controls area.

**8** In the Horizontal menu, press **Time Base**; then, turn the selection knob to choose **X-Y** and push the selection knob.

Watch the X-Y waveform change as you turn the POT knob.

# 3

# Using Waveform Math Functions
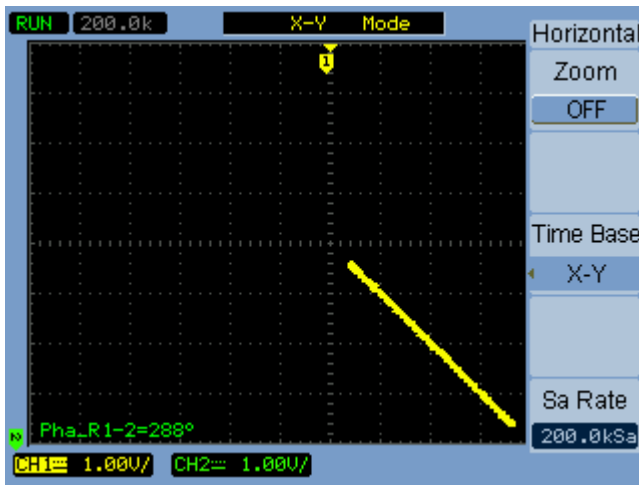
The 1000 Series oscilloscopes let you display the addition, subtraction, and multiplication of two input channel waveforms. You can also view a waveform's FFT to see its frequency components. These are known as waveform math functions.

## Addition/Subtraction/Multiplication Math Functions

1   Connect the channel 1 probe to the test points labeled CH1 and GND.

2   Connect the channel 2 probe to the test points labeled CH2 and GND.

3   Rotate the MODE dial to position **3** (Phase Shifted Sine).

4   Press **[Default Setup]**.

5   Press **[AutoScale]**.

6   Press the **[Math]** key.

7   In the Math menu, press **Operate**; then, turn the selection knob to choose **A - B**, and push the selection knob.

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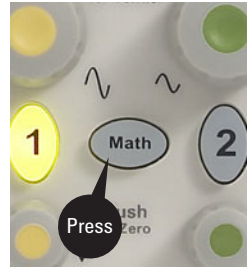
Watch the subtraction waveform change as you turn the POT knob on the training kit board.
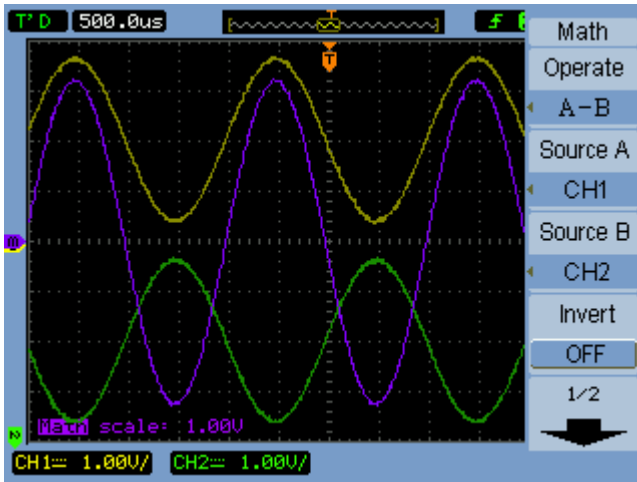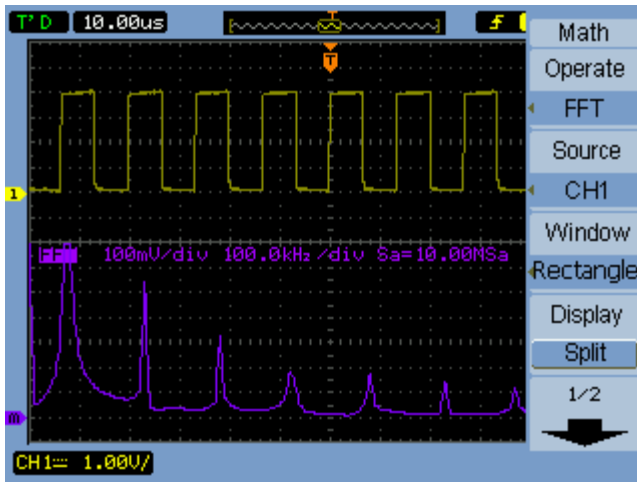


The Math menu also lets you:

• Select any two input channels for the A and B waveform sources.

• Invert the voltage values of the math waveform.

• Vertically position the math waveform using the selection knob.

• Vertically scale the math waveform using the selection knob.

# FFT Math Function

**1** Rotate the MODE dial to position **1** (Square wave, 75 kHz).

**2** Press **[Default Setup]**.

**3** Press **[AutoScale]**.

**4** Adjust the horizontal scale to 10.0 μs/div.

**5** Press the **[Math]** key.

**6** In the Math menu, press **Operate**; then, turn the selection knob to choose **FFT**, and push the selection knob.

**7** Turn the horizontal scale knob to adjust the horizontal scale to 100 kHz/div.

You can see the square wave's frequency components are at the fundamental frequency and the odd harmonics.



In FFT mode, the Math menu also lets you:

- Select the input source channel.
- Choose the FFT window type from: Rectangle, Hanning, Hamming, and Blackman.
- Switch between a split-screen display and a full-screen display.
- Vertically position the FFT waveform using the selection knob.
- Vertically scale the FFT waveform using the selection knob.
- Switch between Vrms and dBVrms scale.

You can also use the FFT waveform math function on the training kit board's FSK signal (MODE dial position **B**) to see the frequencies in the frequency modulated waveform.

# 4

# Saving and Displaying a Reference Waveform

The 1000 Series oscilloscopes let you save and display a reference waveform in order to compare it with other captured waveforms.

**1** Connect the channel 1 probe to the test points labeled CH1 and GND.

**2** Rotate the MODE dial to position **1** (Square wave, 75 kHz).

**3** Press [**Default Setup**].

**4** Press [**AutoScale**].

**5** Press the [**REF**] key.

**6** In the REF menu, press **Save**.

The reference waveform is displayed.

**7** Press **1/2** to go to the next page of menu items; press the softkey, and turn the selection knob to adjust the reference waveform's vertical position.

The horizontal scale and position knobs operate on the reference waveform when it is displayed.

**8** Rotate the MODE dial to position **7** (Ringing Pulse).

Now, you can compare the square waveform and the ringing pulse waveform.

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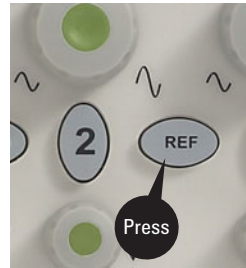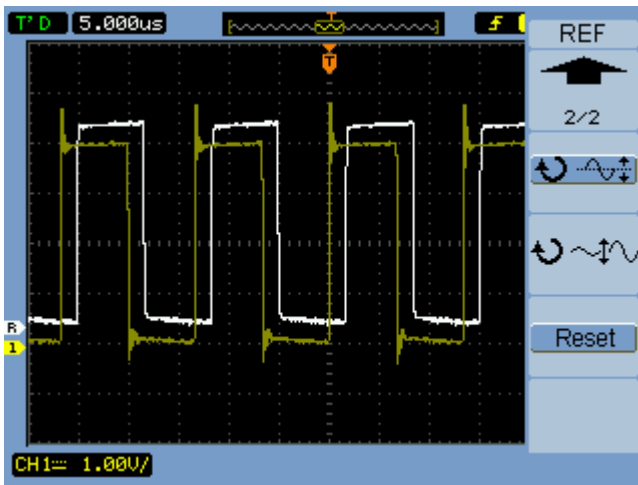
The REF menu also lets you:

• Select the source when saving a reference waveform.

• Select an internal or external (USB drive) location when saving a reference waveform.

• Import or export reference waveforms to an external USB drive location.

• Vertically position the reference waveform using the selection knob.

• Vertically scale the reference waveform using the selection knob.

• Reset the reference waveform to its scale and position when originally saved.

# 5

# Setting Up Triggers

The 1000 Series oscilloscopes provide many triggering options for capturing waveforms. You can specify trigger sweep, coupling, sensitivity, and holdoff, and you can use these triggering modes:

- Edge — occurs when the input passes through a specified voltage level with the specified slope.

- Pulse — used to find pulses with certain widths.

- Video — used to trigger on fields or lines for standard video waveforms.

- Pattern — used to trigger on patterns from all input channels.

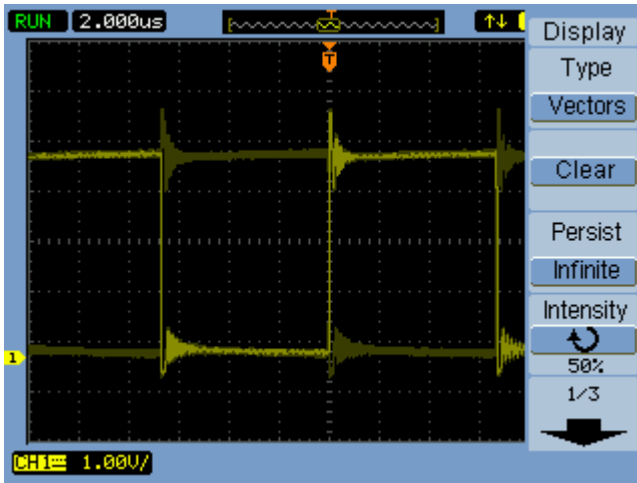- Alternate — used to trigger on non-synchronized signals.

## Triggering on Both Edges, Displaying Infinite Persistence

**1** Connect the channel 1 probe to the test points labeled CH1 and GND.

**2** Rotate the MODE dial to position **7** (Ringing Pulse).

**3** Press **[Default Setup]**.

**4** Press **[AutoScale]**.

**5** Adjust the horizontal scale to 2 µs/div.

**6** Press the **[Menu]** key.

**7** In the Trigger menu, press **Slope** three times to select both edges.

**8** Press the **[Display]** key.

**9** In the Display menu, press **Persist** to turn on "Infinite" persistence.



Move trigger level up and down on signal

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Being able to trigger on both edges of a waveform and use infinite persistence gives you a display similar to an eye diagram.

## Triggering on Single Shot Pulses

**1**  Connect the channel 1 probe to the test points labeled CH1 and GND.

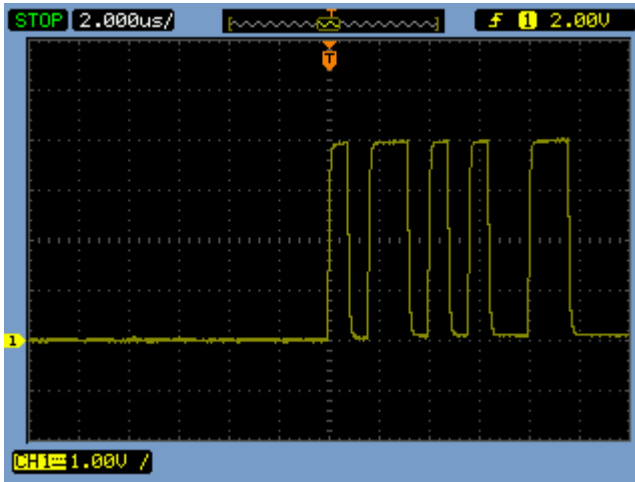**2**  Rotate the MODE dial to position **4** (Single Shot Data).

In the single shot mode, the training kit board outputs single shot data when its SWITCH button is pressed.

**3**  Press [**Default Setup**].

**4**  Press [**AutoScale**].

**5**  Adjust the trigger level to 2.0 V.

**6**  Adjust the channel 1 vertical position to -2.0 V.

**7**  Adjust the horizontal scale to 2.0 µs/div.

**8**  Press the [**Single**] key.

Notice that "WAIT" appears in the upper left corner of the display because the oscilloscope is waiting to find the trigger condition.

**9**  Press the training kit board's SWITCH button.

The desired single shot data is now captured.

Note that "STOP" appears in the upper left corner of the display after the single acquisition has completed.

## Adjusting Trigger Sensitivity

1 Connect the channel 1 probe to the test points labeled CH1 and GND.

2 Rotate the MODE dial to position **6** (Noisy Sine).

3 Press **[Default Setup]**.

4 Press **[AutoScale]**.

   Notice the oscilloscope appears to be triggering on both edges of the waveform when it should be triggering on the rising edge only. Actually, the noise in the waveform has a rising edge that is also triggering the oscilloscope.
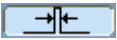
5 Press the **[Menu]** key.

6 In the Trigger menu, press **Set Up**.

7 In the Set Up menu, press **Sensitivity**; then, turn the selection knob to enter 0.7 div.

   Now, it takes more of a change in the waveform to trigger the oscilloscope, and only the rising edge of the sine wave (not the noise) triggers the oscilloscope.
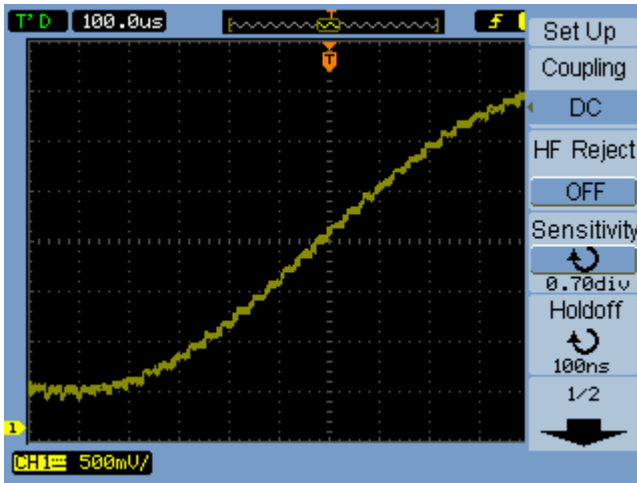
With the training kit board's noisy sine waveform, you can also turn on **HF Reject** to attenuate frequencies above 100 kHz. With the higher frequencies attenuated, the oscilloscope will trigger on the rising edge of the sine wave at the default sensitivity of 0.3 div.

## Finding Glitches with a Pulse Trigger, Displaying Zoomed Time Base

**1** Connect the channel 1 probe to the test points labeled CH1 and GND.

**2** Rotate the MODE dial to position **2** (Data w/Glitch).

**3** Press [**Default Setup**].

**4** Press [**AutoScale**].

**5** Press the [**Menu**] key.

**6** In the Trigger menu, press **Mode**; then, turn the selection knob to choose **Pulse**, and push the selection knob.

**7** Push the trigger [**Level**] knob to set the trigger level to 50% of the captured waveform.

**8** Press **When**; then, turn the selection knob to choose ⎡ ‾⫞⊢ ⎤ "less than positive pulse" and push the selection knob.

**9** Push the horizontal scale knob to turn on the zoomed time base display.

**10** Turn the horizontal scale knob to select the zoomed time base of 200 ns/div.
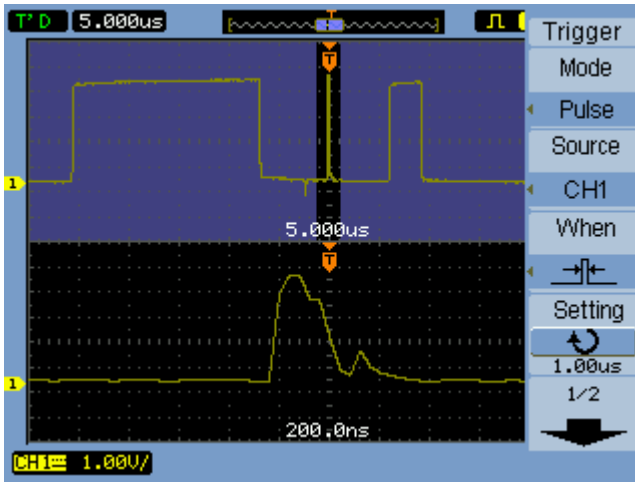


## Triggering on a Pattern

**1** Connect the channel 1 probe to the test points labeled CH1 and GND.

**2** Connect the channel 2 probe to the test points labeled CH2 and GND.

**3** Rotate the MODE dial to position **C** (I2C, Inter-Integrated Circuit).

**4** Press [**Default Setup**].

**5** Press [**AutoScale**].

**6** Press [**2**] to display the signal on channel 2.

**7** Adjust the vertical scale on both channels to 2 V/div.

**8** Vertically position channel 1 on the upper half of the display and channel 2 on the lower half.

**9** Press the [**Menu**] key.

**10** In the Trigger menu, press **Mode**; then, turn the selection knob to choose **Pattern**, and push the selection knob.

**11** Set up the channel 1 trigger value:

   **a** Press **Channel**; then, turn the selection knob to choose **CH1**, and push the selection knob.

   **b** Press **Code**; then, turn the selection knob to choose **L**, and push the selection knob.

   **c** Adjust the trigger level to 2 V.

**12** Set up the channel 2 trigger value:

   **a** Press **Channel**; then, turn the selection knob to choose **CH2**, and push the selection knob.

   **b** Press **Code**; then, turn the selection knob to choose **H**, and push the selection knob.

   **c** Adjust the trigger level to 2 V.

**13** Leave all the remaining channel trigger values as don't cares (**X**).

**14** Press **Sweep** to select "Normal".

**15** Adjust the horizontal scale knob to view the pattern that triggers the oscilloscope.
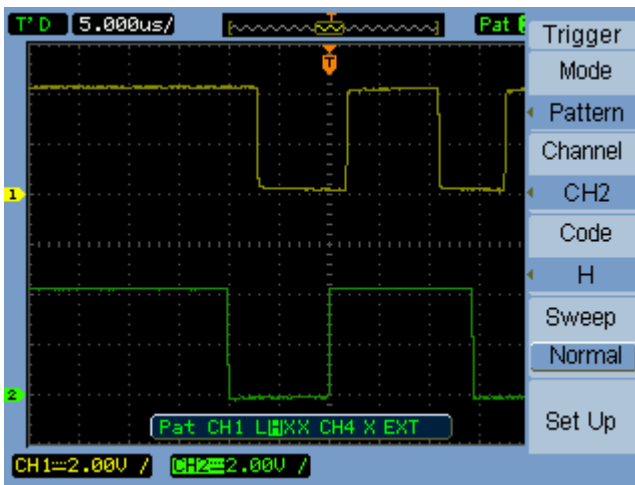
# Triggering on Non-Synchronized Signals in Alternate Mode

**1** Connect the channel 1 probe to the test points labeled CH1 and GND.

**2** Connect the channel 2 probe to the test points labeled CH2 and GND.

**3** Rotate the MODE dial to position **C** (I2C, Inter-Integrated Circuit).

**4** Press [**Default Setup**].

**5** Press [**AutoScale**].

**6** Press [**2**] to display the signal on channel 2.

**7** Press the [**Menu**] key.

**8** In the Trigger menu, press **Mode**; then, turn the selection knob to choose **Alternate**, and push the selection knob.

**9** Set up the channel 1 trigger and horizontal scale:

   **a** Press **Select** to select **CH1**.

   **b** Press **Type**; then, turn the selection knob to choose **Edge**, and push the selection knob.

   **c** Press **1/2** to go to the next page of menu items.

   **d** Press **Slope** twice to choose "falling edge".

   **e** Adjust the trigger level to 2 V.

   **f** Adjust the horizontal scale to 20 μs/div.

**10** Set up the channel 2 trigger and horizontal scale:

   **a** Press **2/2** to go to the previous page of menu items.

   **a** Press **Select** to select **CH2**.

   **b** Press **Type**; then, turn the selection knob to choose **Pulse**, and push the selection knob.

   **c** Press **1/2** to go to the next page of menu items.

   **d** Press **When**; then, turn the selection knob to choose  "negative pulse greater than", and push the selection knob.

   **e** Press **Setting**; then, turn the selection knob to enter 100 μs.

   **f** Adjust the trigger level to 2 V.

   **g** Adjust the horizontal scale to 100 μs/div.
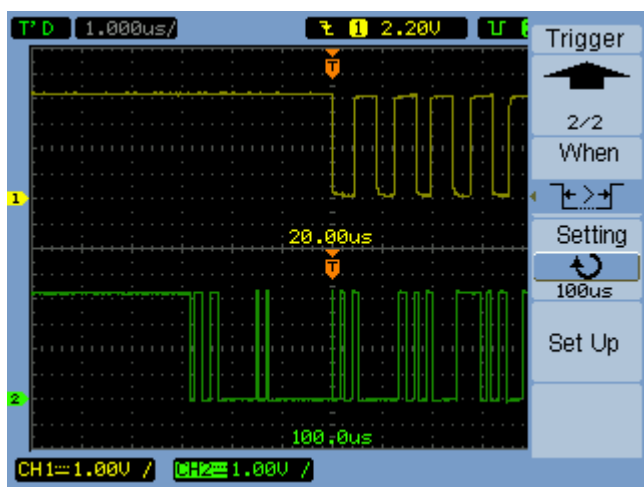
The channel 1 and channel 2 signals are captured using different triggers and displayed in different horizontal scales.

# 6

# Using Acquisition Modes

The previous exercises in this manual use the "Normal" acquisition mode, where acquisitions are made and displayed one after the other. The 1000 Series oscilloscopes also have these acquisition modes:

- **Average** — acquisitions are made, and the running average over the specified number of acquisitions is displayed. This lets you remove random noise from the waveform and improve measurement accuracy.

  In Normal or Average acquisition modes, at longer horizontal time/div settings, the oscilloscope's analog-to-digital converter samples at a rate that yields more samples than can be stored in a limited amount of oscilloscope memory. Consequently, samples are thrown away (decimated), and you can miss narrow excursions on a signal.

- **Peak Detect** — acquisitions are made at the fastest sample rate, and the minimum and maximum values for the period associated with the memory and time/div setting are stored. This way, you can capture narrow excursions on a signal at longer horizontal time/div settings.

## Averaging to Reduce Noise on Repetitive Waveforms

1  Connect the channel 1 probe to the test points labeled CH1 and GND.

2  Rotate the MODE dial to position **F** (Unused).

3  Press [**Default Setup**].

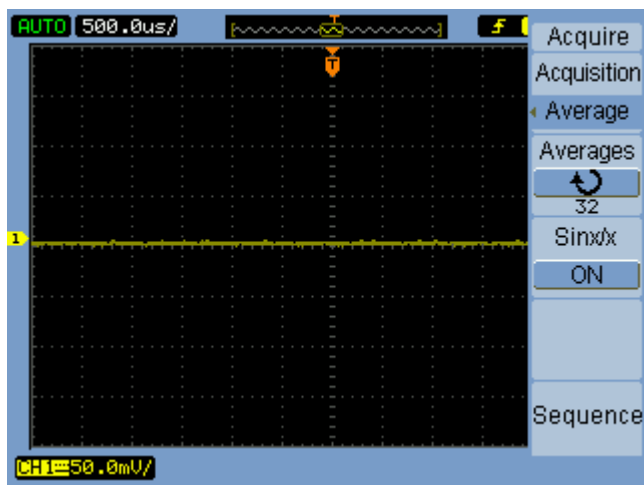4  Press [**AutoScale**].

5  Adjust the vertical scale to 50 mV/div.

  You can see random noise on the input.

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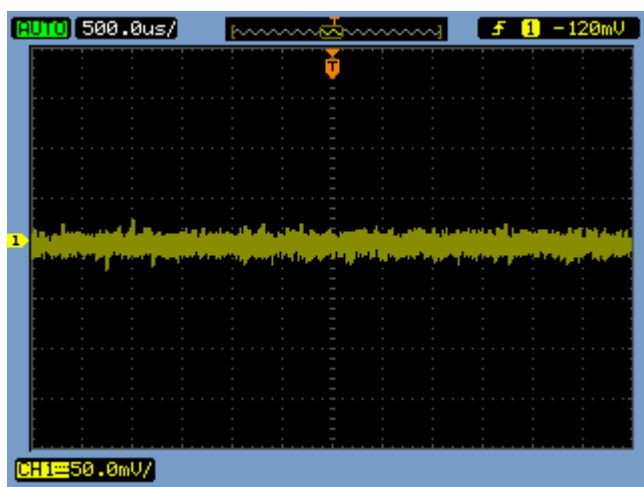
6 Press **[Acquire]**.

7 In the Acquire menu, press **Acquisition**; then, turn the selection knob to choose **Average**, and push the selection knob.

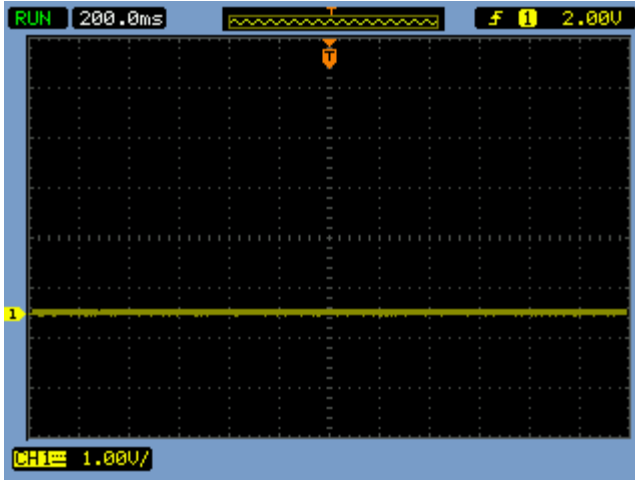8 Press **Averages**; then, turn the selection knob to choose 32.

   You can see how the random noise is removed from the input.
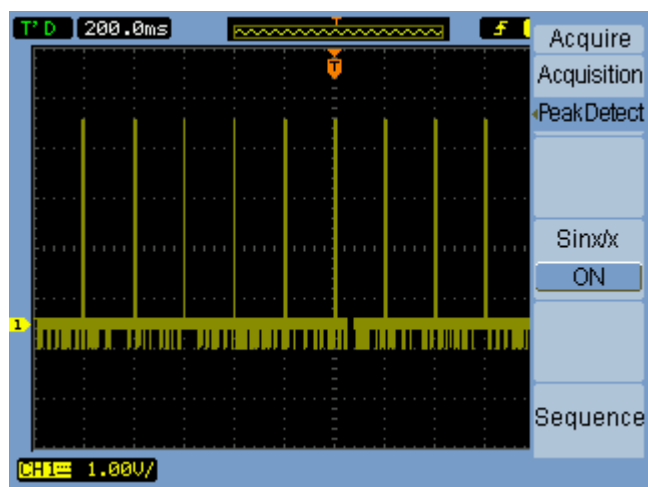
# Peak Detect to Capture Narrow Excursions

**1** Connect the channel 1 probe to the test points labeled CH1 and GND.

**2** Rotate the MODE dial to position **5** (Burst Data).

**3** Press [**Default Setup**].

**4** Press [**AutoScale**].

**5** Adjust the trigger level to 2.0 V.

**6** Adjust the channel 1 vertical position to -1.5 V.

**7** Adjust the horizontal scale to 200 ms/div.

Because the burst data is relatively narrow compared to the time/div setting (and effective sample rate), few of the bursts are displayed.



**8** Press [**Acquire**].

**9** In the Acquire menu, press **Acquisition**; then, turn the selection knob to choose **Peak Detect**, and push the selection knob.

Now, the bursts and other narrow excursions are displayed.

# 7

# Mask Testing and Recording Waveforms

The 1000 Series oscilloscope features include mask testing and recording waveforms. You can combine these features to record only waveforms that fail a mask test.

## Creating Masks

**1** Connect the channel 1 probe to the test points labeled CH1 and GND.

**2** Rotate the MODE dial to position **5** (Burst Data).

**3** Press [**Default Setup**].

**4** Press [**AutoScale**].

**5** Adjust the trigger level to 2.0 V.

**6** Adjust the channel 1 vertical position to -1.5 V.

**7** Adjust the horizontal scale to 2.0 $\mu$s/div.

**8** Adjust the horizontal position to 6.0 $\mu$s.

**9** Press [**Utility**].

**10** In the Utilities menu, press **1/2** to go to the next page of menu items.

**11** Press **Mask Test**.

**12** In the Mask Test menu, press **Enable Test** to turn on the mask test feature.

**13** Press **1/2** to go to the next page of menu items.

**14** Press **Mask Setting**.

**15** In the Mask menu, press **Create Mask** to create the mask.

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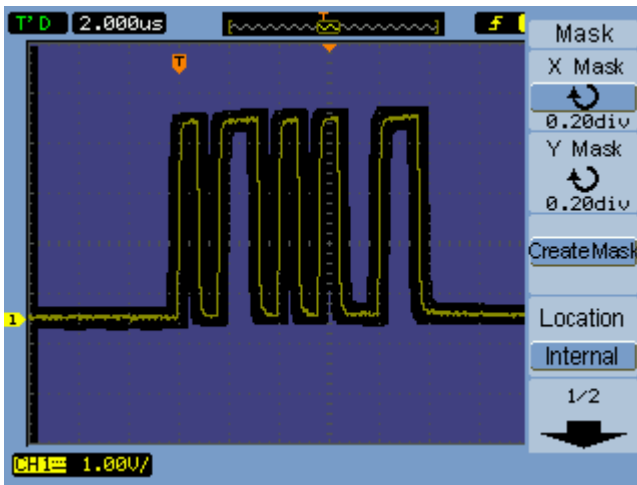
## Running the Mask Test

**16** Press **1/2** to go to the next page of menu items.

**17** Press the return softkey at the bottom of the menu to return to the Mask Test menu.

**18** Press **StopOnOutput** to turn off stopping on a mask failure.

Note that the output condition is set to **Fail**. In addition to stopping on the output condition, you can use the output condition when recording waveforms (using Sequence in the Acquire menu). This lets you record over an extended period only waveforms matching the output condition.

**19** Press **2/2** to go to the previous page of menu items.

**20** Press **Msg Display** to turn on the display of failing, passing, and total waveforms.

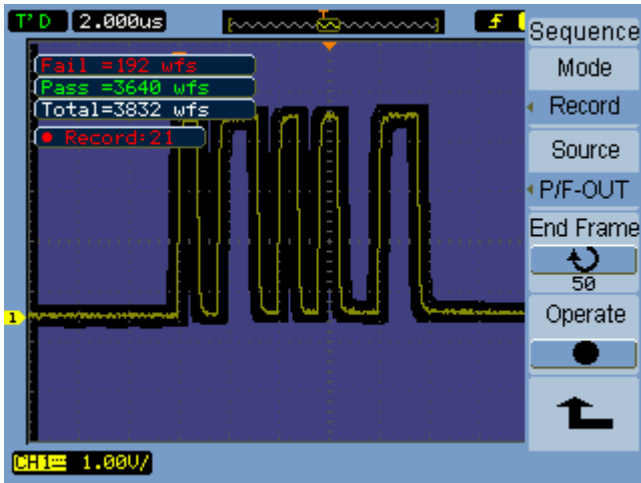**21** Press **Operate** to begin the mask test.
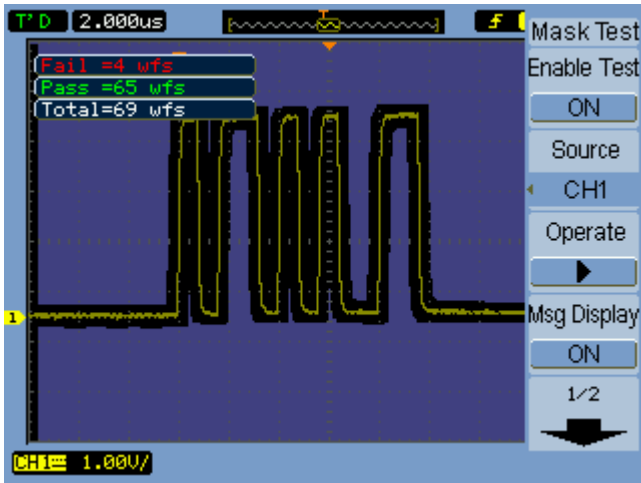
## Recording Waveforms

**22** Press [**Acquire**].

**23** In the Acquire menu, press **Sequence**.

**24** In the Sequence menu, press **Mode**; then, turn the selection knob to choose **Record**, and push the selection knob.

**25** Press **Source**; then, turn the selection knob to choose **P/F-OUT**, and push the selection knob.

This selects the mask test's output condition as the source for waveform recording.

**26** Press **End Frame**; then, turn the selection knob to choose 50.

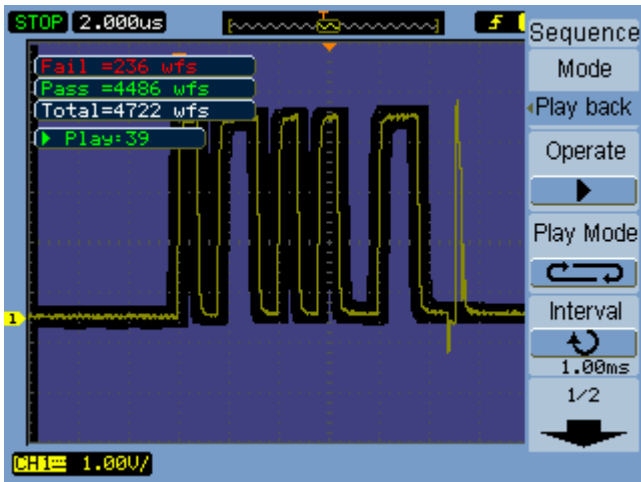**27** Press **Operate** to begin recording waveforms.

**28** Press **Operate** again to stop recording waveforms.

## Playing-Back Waveforms

**29** Press **Mode**; then, turn the selection knob to choose **Play back**, and push
the selection knob.

**30** Press **Operate** to begin playing-back the recorded waveforms.

**31** Press **Operate** again to stop the play-back.

Note that you can:

- Play-back in continuous and one-time modes.
- Change the interval between waveforms as they are played-back.
- Look at recorded waveforms individually using the **Current Frame** menu item (after pressing **1/2** to go to the next page of menu items).
- Save and recall recorded waveforms using the **Storage** mode.

# 8
# Saving and Printing

With the 1000 Series oscilloscopes, you can:

- Save/recall oscilloscope waveforms and setups to/from internal storage locations or external USB drive locations.

- Save screen images and CSV format (comma-separated value) waveform data to external USB drive locations.

- Print screen images to PictBridge compatible printers.
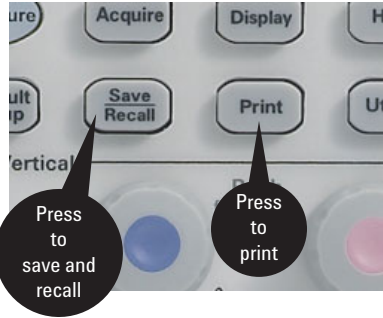
## Saving and Recalling Waveforms and Setups

**1** Press **[Save/Recall]**.

**2** In the Save/Recall menu, press **Storage**; then, turn the selection knob to choose **Waveform** or **Setups** and push the selection knob.
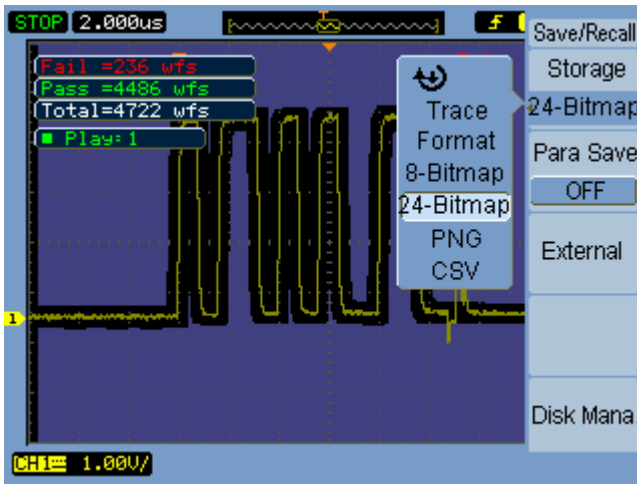


**3** Press **Internal** to save to (or load from) one of the 10 internal storage locations, or press **External** to save to (or load from) a location on a USB drive.

## Saving Screen Images and CSV Format Data

**1** Press **[Save/Recall]**.

**2** In the Save/Recall menu, press **Storage**; then, turn the selection knob to choose **8-Bitmap**, **24-Bitmap**, **PNG**, or **CSV** and push the selection knob.

**3** Press **External** to save to a location on a USB drive.

Note that:

- You can turn on **Para Save** to oscilloscope parameters in an accompanying ASCII test file.

- With CSV (comma-separated value) format, you can choose "Displayed" or "Maximum" **Data Depth**.

# Printing Screen Images

PictBridge compliant printers are connected to the square USB device port on the back panel.

**1** Press [**Print**].

**2** In the Print menu, select the printing options.
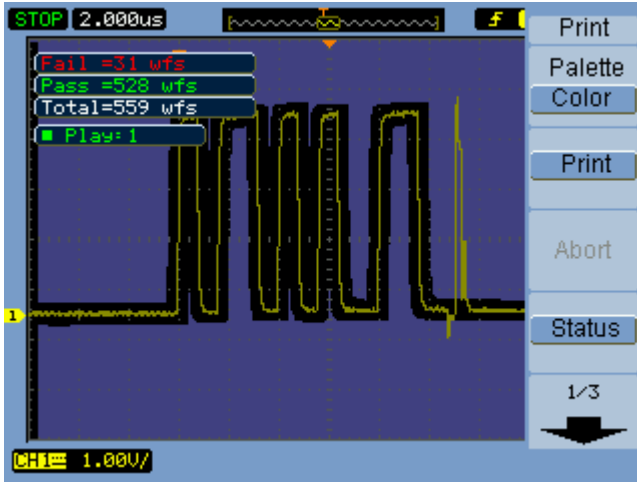


**3** Press **Print** to start the print.

## Recommended Probes and Accessories

Optional accessories:

- N2738A – Soft carrying case for 1000 Series.
- N2739A – Rackmount kit for 1000 Series.
- N2740A – Education training kit for 1000 Series.
- U3000A – Electronic instrument training kit.

Recommended probes:

- N2862A – 150 MHz 10:1 passive probe (standard with 60 MHz/100 MHz models).
- N2863A – 300 MHz 10:1 passive probe (standard with 200 MHz models).
- 10070C – 20 MHz 1:1 passive probe.
- 10076A – 250 MHz, 100:1, 4 kV passive probe.
- N2771A – 50 MHz, 1000:1, 30 kV passive probe.
- N2772A – 20 MHz, 1.2 kV differential probe (requires 9V battery or N2773A power adapter).
- 1146A – 100 kHz, 100A AC/DC current probe (requires 9V battery).

Software and drivers:

- IntuiLink toolbar connectivity – downloadable free from: www.agilent.com/find/intuilink
- National Instruments LabView Plug & Play driver downloadable free from: xxx

For more information about the Agilent 1000 Series oscilloscopes, check out:
www.agilent.com/find/DSO1000

# Agilent 1000 Series Oscilloscopes

| Model | Channels | Bandwidth | Max. sample rate | Memory | Other standard features |
|-------|----------|-----------|------------------|--------|------------------------|
| DSO1002A | 2 | 60 MHz | 2 GSa/s half channel*, 1 GSa/s each channel | 20 kpts half channel*, 10 kpts each channel | • Dedicated controls for each channel.<br>• AutoScale.<br>• Automatic and cursor measurements.<br>• Front and back panel USB ports.<br>• Built-in help. |
| DSO1004A | 4 | 60 MHz | | | |
| DSO1012A | 2 | 100 MHz | | | |
| DSO1014A | 4 | 100 MHz | | | |
| DSO1022A | 2 | 200 MHz | | | |
| DSO1024A | 4 | 200 MHz | | | |

* Half channel is when only one channel of channel pair 1-2 is turned on, or one channel of channel pair 3-4 is turned on.

N2740-97000

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