

Tutorials

About the Tutorials

This chapter consists of seven tutorials. You have selected the one that is highlighted in red:

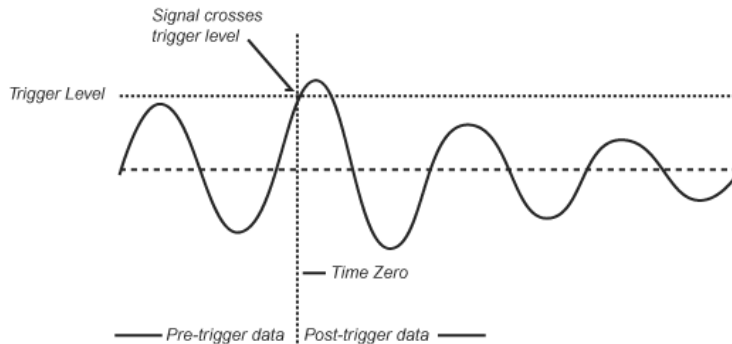
- Tutorial 1 - Fundamentals
- Tutorial 2 - Working with Channels
- **Tutorial 3 - Triggering**
- Tutorial 4 - Working with Special Modes
- Tutorial 5 - Working with Subchannels
- Tutorial 6 - Arbitrary Waveform Generator
- Tutorial 7 - Using the Graphical Waveform Editor

Each section is a self-contained tutorial. If you are new to GageScope[®], it is recommended that you do the tutorials in the order they are presented, as each section assumes you have gone through the previous material.

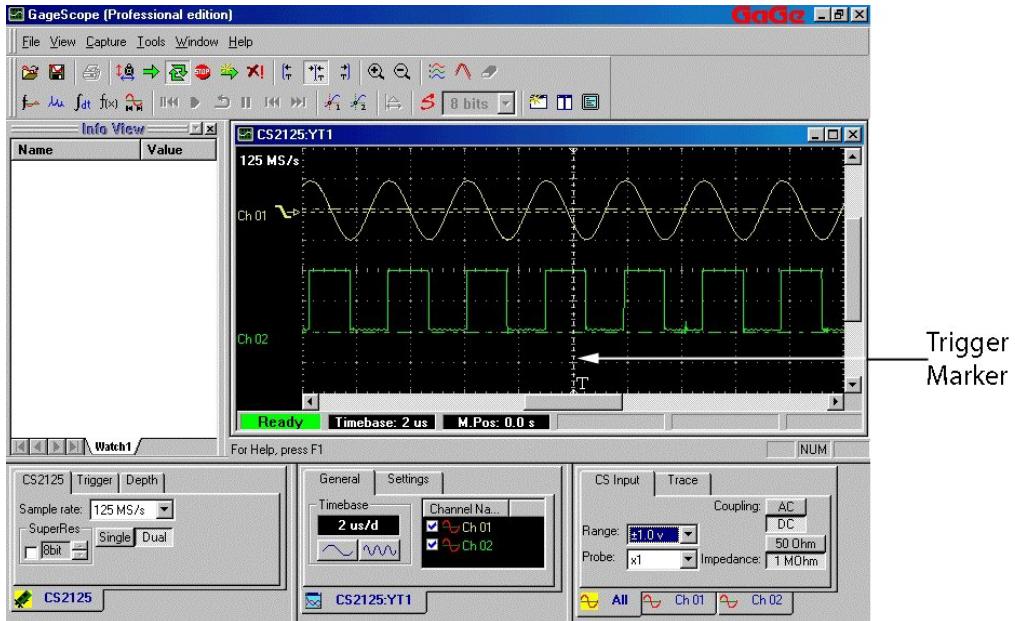
Tutorial 3: Triggering

Basic Concepts

Once GageScope® is set to Continuous or One Shot capture mode, it waits for a **trigger event**. One way for a trigger event to occur is if the voltage of an input signal crosses the **trigger level**. For example, if the trigger is set to +1V, and the signal's peaks is only at +900 mV, a trigger event does not occur. But if the signal rises to +1.1V, the trigger level will have been crossed, invoking a trigger event and subsequent data acquisition.



Once the trigger event occurs, **time zero** is established for the purposes of pre- and post-trigger data. Time zero is identified in the Display Window of GageScope® by the **trigger marker**, a vertical line with a small **T** at the bottom.



Pre- and Post-trigger Data

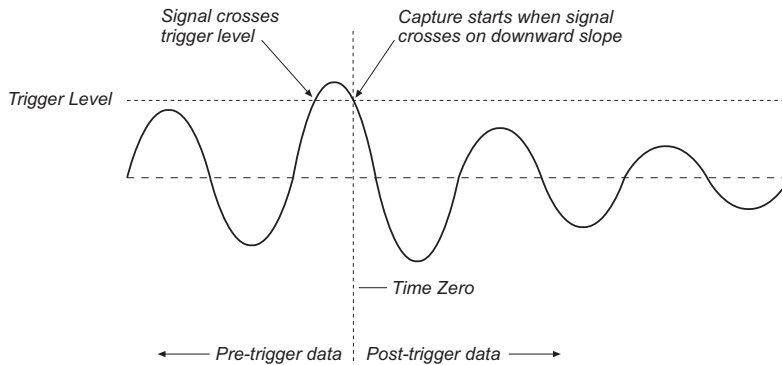
Pre-trigger data is the part of the signal acquired before the trigger event occurred, and is located to the left of the trigger marker. **Post-trigger data** is the part of the signal acquired after the trigger event occurred, and is located to the right of the trigger marker.

Once a trigger event occurs, GageScope® will ignore any new trigger events until the desired amount of signal is captured. Once the acquisition is complete, GageScope® will look for a new trigger event or stop, depending on whether the capture mode is set to Continuous or One Shot.

Trigger Events

The detection of a trigger event is affected by a variety of settings in GageScope®. For example, it is possible to change the **trigger slope**, so that the trigger occurs on the falling edge of a signal, instead of the rising edge, when the trigger level is crossed.

In the diagram below, the trigger event is occurring on the signal's falling edge.



The trigger source can also originate through the external trigger connector on the CompuScope card, if the card is so equipped, instead of an input signal.

The trigger event may not occur before a **timeout** is reached, in which case, in Continuous capture mode, GageScope® issues a **software trigger**, i.e., it triggers on its own. Or GageScope® will wait forever for a trigger to occur if timeout is disabled altogether. This useful feature allows for unattended one-shot capture.

Trigger Defaults

By default GageScope® sets up the trigger as follows:

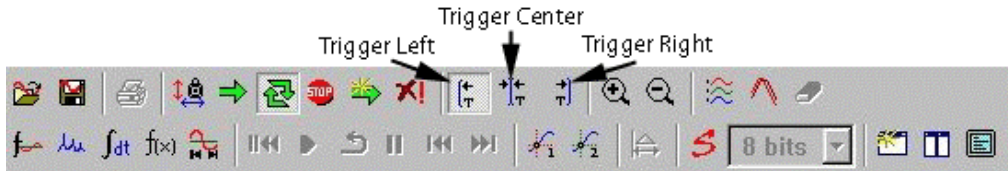
- Trigger is set to Channel 1.
- Slope is positive.
- Timeout is 10 ms.
- Trigger Level is 0 mV (zero line of channel 1).
- Pre-trigger depth is on and set to 4096 Samples.
- Post-trigger depth is set to 4096 Samples.

Setting up for the Examples

In order to continue this tutorial, make sure you have at least one input signal originating from a signal generator connected to channel A of your CompuScope card. For the examples used here, a 200 kHz sine wave signal with an amplitude of approximately 1.8V was connected to channel A of a CompuScope 2125.

Trigger Marker Align




The Trigger Align buttons allow you to quickly position the trigger marker to the left, center, or right of the display window.



The trigger marker indicates where the trigger occurred in the data acquisition. The data to the left of the “T” is pre-trigger data, and data to the right of the “T” is post-trigger data.

By default GageScope® centers the trigger marker in the Display Window.

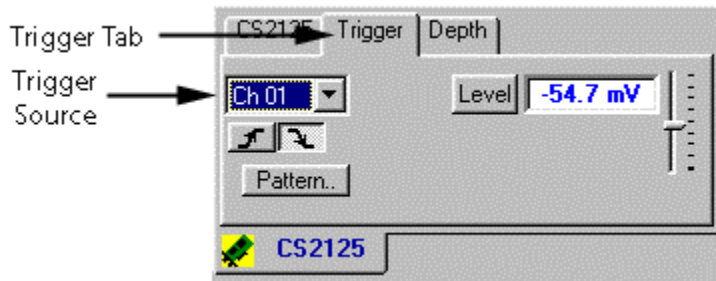
Using the Trigger Align Buttons

- 1 Click the **Trigger Left Align** button  in the toolbar to position the trigger to the left of the display.
- 2 Click the **Trigger Right Align** button  in the toolbar to position the trigger to the right of the display.
- 3 Click the **Trigger Center Align** button  in the toolbar to position the trigger in the center of the display.

These buttons have the same effect as scrolling toward the trigger using the horizontal scroll bar.

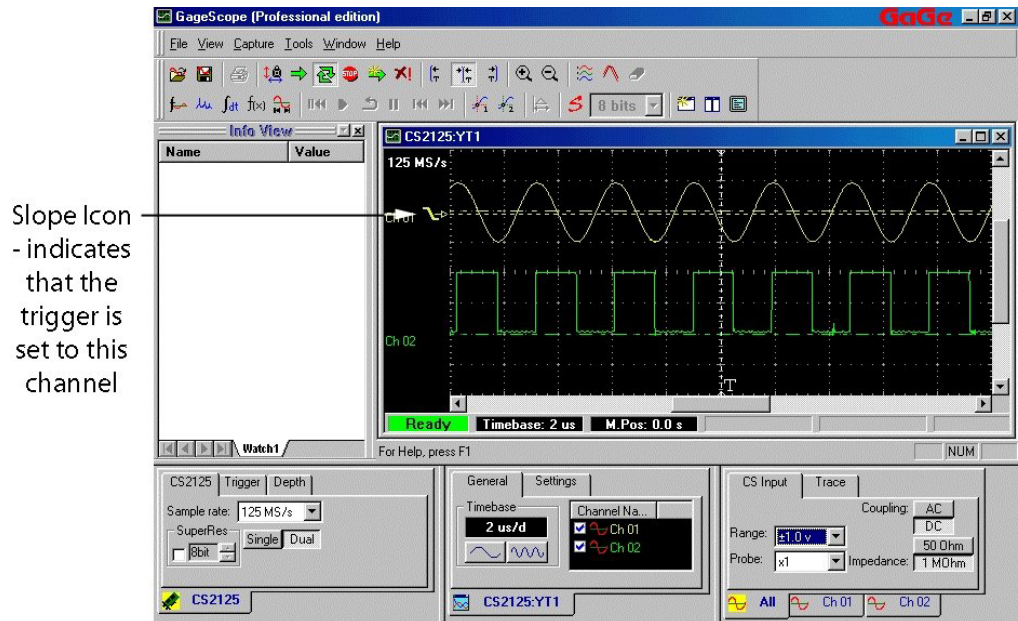
Trigger Source

The trigger source is located in the **Trigger** tab of the System Control.



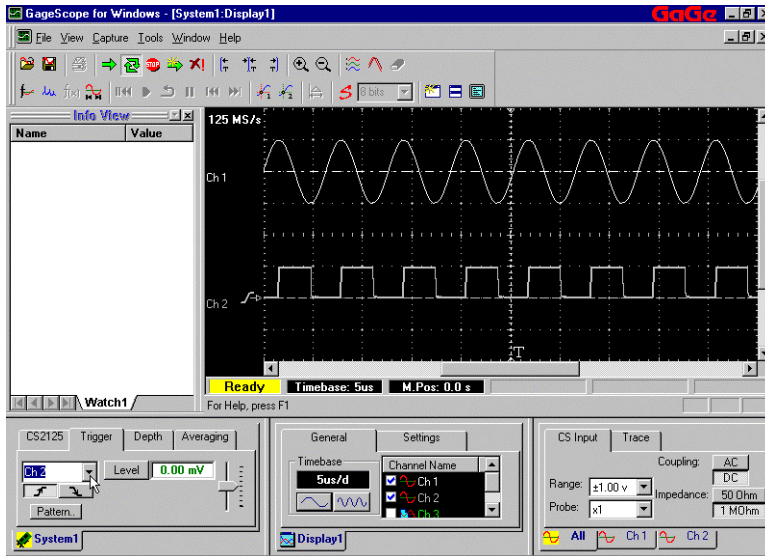
The trigger source options are input signals (“Ch 1” and “Ch 2,” etc.), “External,” and “Disabled.” By default, the trigger source is set to **Ch 1** (input channel 1, which corresponds to channel A of the CompuScope card). Note that on the CompuScope 1016, the trigger source options are External or Disabled only.

This is also indicated by the slope icon to the left of channel 1, as shown below.



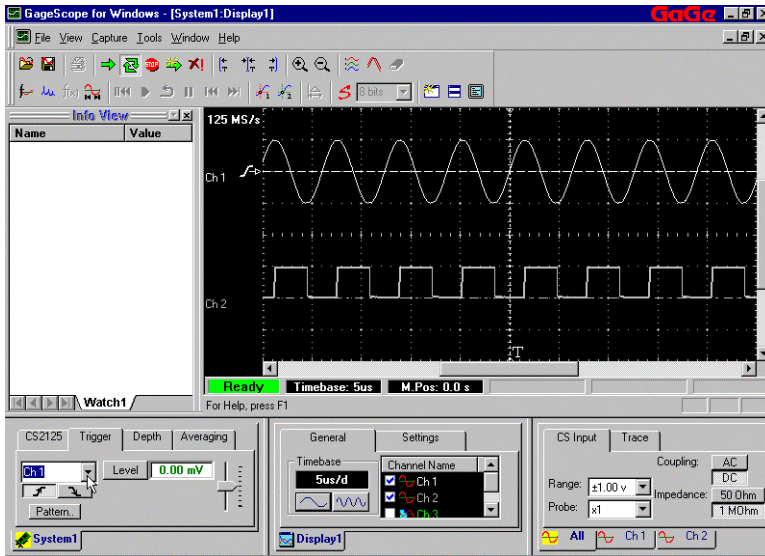
Changing the Trigger Source

- 1 Click on the **Trigger** tab.
- 2 Choose **Ch 2** from the Trigger Source drop-down list. Notice that the slope icon in the Display Window has moved next to channel 2.



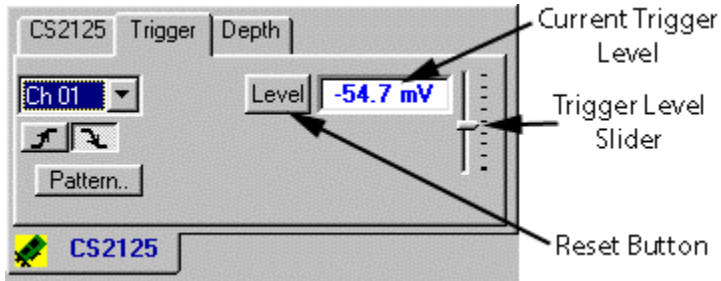
- 3 Click on the trigger list once more.

- 4 Click on **Ch 1**. The slope icon has moved back to channel 1.



Trigger Level

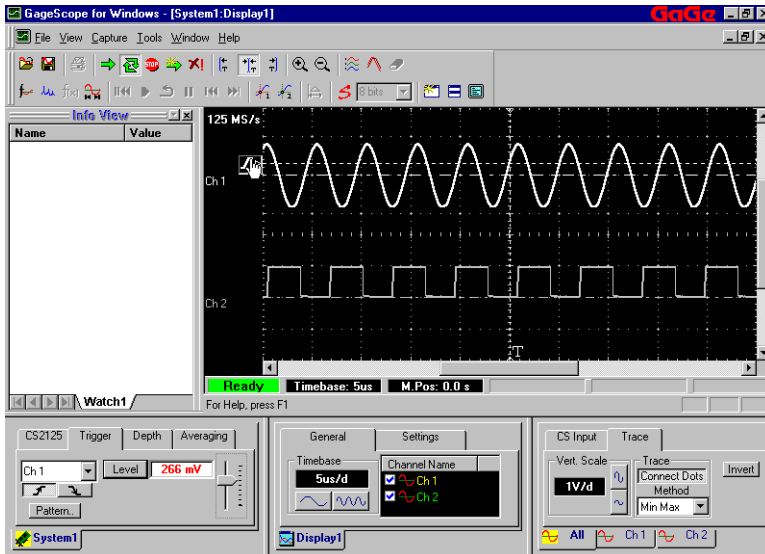
By default the trigger level is set to 0mV (the zero line of channel 1).



Change the Trigger Level by Dragging the Slope Icon

- 1 Position the mouse pointer over the slope icon at the far left of the signal.
- 2 Hold down the left mouse button.

3 Drag the mouse up or down to change the trigger level.

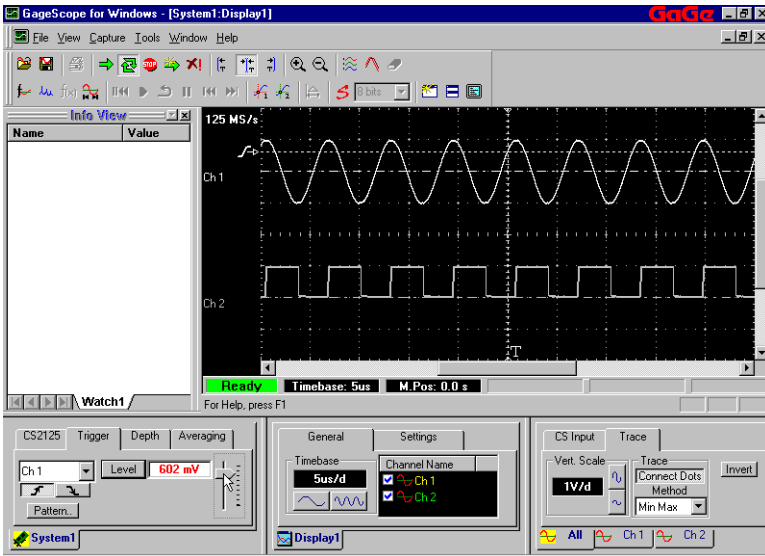


Note that if you raise or lower the trigger level so that it is higher or lower than the signal peaks, trigger events will stop occurring. This is because the signal voltage is not reaching the trigger level in order to start a capture.

Also note that the changes you make to the trigger level are reflected in the trigger level field in Trigger tab of the System Control (lower left of the screen).

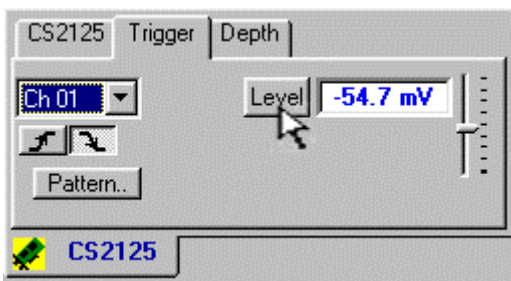
Change the Trigger Level by Dragging the Slider

- 1 Click on the **Trigger** tab in the **System Control**.
- 2 Using the trigger level slider, raise the trigger level to approximately 600 mV.



Reset the Trigger Level to Zero

- 1 Click on the **Level** button to quickly reset the trigger level to 0.



Trigger Slope

The slope icon in the Display Window reflects the current trigger slope.

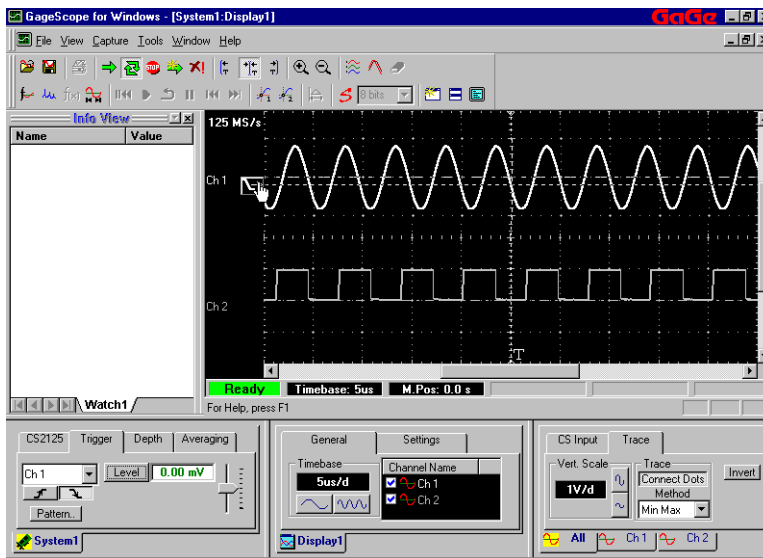


indicates positive slope, i.e. the trigger occurs on the signal's rising edge.

indicates negative slope, i.e. the trigger occurs on the signal's falling edge.

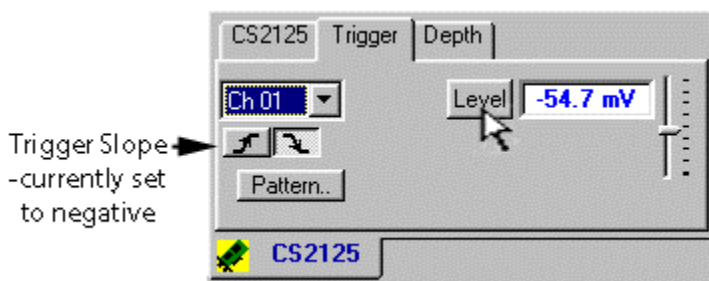
Change the Trigger Slope

- 1 Double-click on the slope icon in the Display Window to change the slope of the trigger. In response, the slope icon changes to a negative slope.



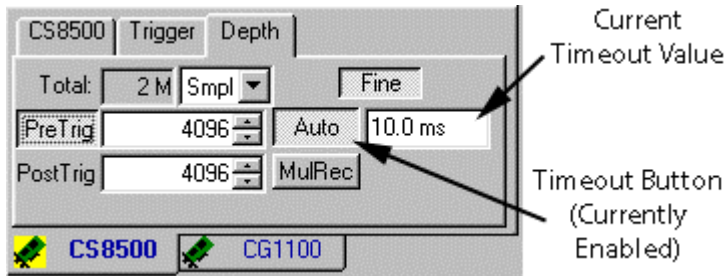
- 2 Double-click on the slope icon once again to change the slope back to positive.

The slope is also available through the Trigger tab.



Trigger Timeout

The timeout setting is the amount of time GageScope® waits for a trigger event. As there is one timeout setting for all available triggers, timeout is located in the Depth tab. The default is **10 ms**.

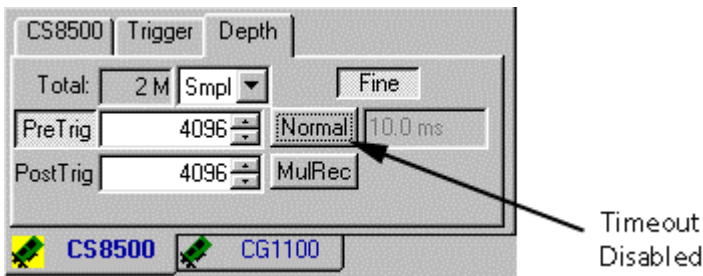


You can completely disable timeout by clicking on the **Auto** button. If you click on the **One Shot** capture button, timeout is automatically disabled.

In the following exercise, you will disable the timeout, then prevent a trigger event from occurring.

Disabling the Timeout

- 1 Make sure you are in continuous mode (click on the **Continuous** mode button).
- 2 Click on the **Depth** tab in the System Control.
- 3 Click on the **Auto** button to disable it (it should now read **Normal** and not be “pressed in”).



- 4 Click on the **Trigger** tab in the System Control.
- 5 Make sure the Trigger is set to **Ch 1**.

- 6 Click on the **Level** button to reset the Trigger level to 0.
- 7 The Status bar at the bottom left of the Display Window should state “Ready” on a green background. This indicates a trigger event is occurring properly.



Absence of a Trigger Event with Timeout Disabled

- 1 Raise the trigger level to higher than Channel 1's peaks. Remember you can drag the trigger level (the slope icon) in the Display Window.

By moving the trigger level above the signal, you are preventing a trigger event from occurring.

- 2 The Status bar at the bottom left of the Display Window should now state “Waiting” on a magenta background. This indicates that GageScope® is waiting for a trigger event to occur.



Since you disabled the timeout, GageScope® will wait forever for a trigger event to occur.

- 3 Drag the trigger level back down to cause a trigger event and subsequent capture. The status bar should report “Ready” once more.

◆ Setting a Timeout of 5 Seconds

In the following exercise, you will set the timeout to five seconds, then prevent a trigger event from occurring. A value of five seconds is used so that you may have a bit of lead time before GageScope® issues a timeout.

- 1 Make sure you are in **Continuous** mode and that the trigger is set to channel 1.
- 2 Click on the **Depth** tab in the System Control.
- 3 Click on the **Timeout** button to enable it (it should be pressed in).
- 4 Click in the **Timeout** field.
- 5 Press **Backspace** or **Delete** to erase what's in the field.

- 6 Type in **5 s** and press **Enter**. Be sure to use a lowercase ‘s.’

The letter ‘**s**’ stands for “seconds.” Other abbreviations, such as **ms** for milliseconds, and **us** for microseconds, are also valid units.

Five seconds is an extremely long time for data acquisition purposes, and in this case is used only for demonstration.

- 7 Click on the **Trigger** tab in the System Control.
- 8 Click on the **Level** button to reset the Trigger level.
- 9 The Status bar at the bottom left of the Display Window should state “Ready” on a green background. This means a trigger is occurring properly.



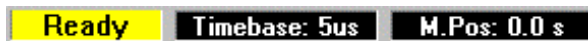
Absence of a Trigger Event with a Timeout of 5 Seconds

- 1 Raise the trigger level so that it is higher than Channel 1’s positive peaks.
- 2 The Status bar at the bottom left of the Display Window now states “Waiting” with a magenta background.



This indicates that GageScope® is waiting for a trigger event.

- 3 If you watch closely, a “Ready” message with a yellow background should appear in the status bar every 5 seconds.



- 4 Once a timeout is issued, GageScope® issues a software trigger (it triggers on its own) and performs a capture. It then re-arms the card for another trigger event—the status bar states “Waiting” again. Note that this is only true for continuous mode.

Change to One Shot Mode

- 1 Click on the **One Shot** icon. You may very briefly see “Stop” on the status bar with a blue background.



Thereafter, the status bar should report “Waiting” with a magenta background.



When you change to **One Shot** mode, GageScope[®] automatically disables the timeout. With timeout disabled, GageScope[®] will wait forever until a trigger event occurs (or until you press the **Stop** button). This allows for unattended one-shot capture.

A Trigger Event Exercise

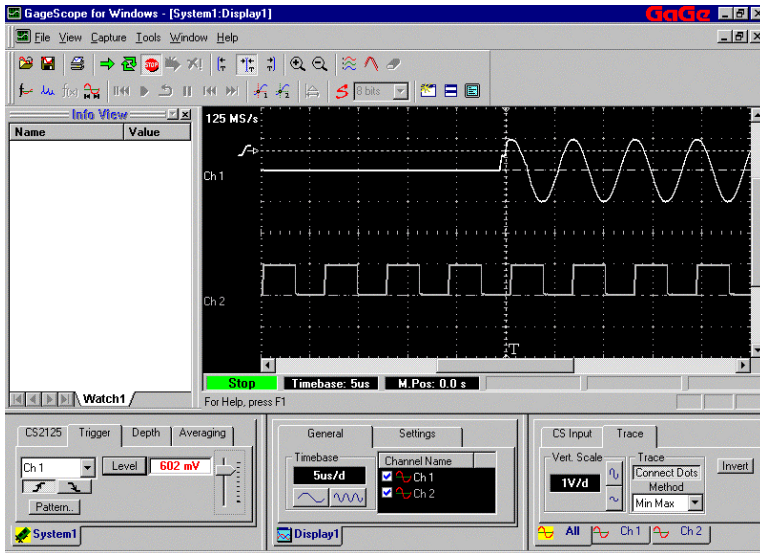
In the following exercise, you will use your signal generator to create a trigger event. The data will be captured by GageScope® in One Shot mode.

If you have a signal generator that has a “one shot” button, you can use it to create the trigger event. If your generator does not have a “one shot” button, instructions are provided for simulating a trigger by removing and reconnecting the cables attached to your generator.

- 1 Click on the **Trigger Center Align** button.
- 2 Reset the trigger level to 0 (click the **Level** button in the **Trigger** tab).
- 3 Switch to **Continuous** mode.
- 4
 - If your generator does not have a “one shot” button, unplug the cable from the signal generator that is connected to Channel A of the CompuScope card. Your sine wave should turn to a flat line.
- 5 Raise the trigger level of channel 1 to above channel 1’s zero line.
- 6 Set up a one shot capture by clicking on the **One Shot** button in the toolbar. Timeout will automatically be disabled, and the Status Bar should state “Waiting.”
- 7
 - If your generator has a “one shot” button, press it now.
 - Otherwise, plug the cable back into the signal generator as cleanly and quickly as possible.

- 8 The resulting pre-trigger signal should amount to a mostly flat line with some activity near the Trigger Marker.

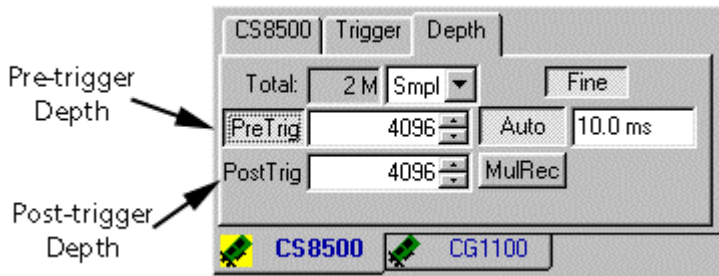
The post-trigger signal should show an uneven signal turning into a sine wave soon after the signal passed the trigger marker.



Notice how the post-trigger data did not begin until the signal measured at least as high as the trigger level. When the signal reached the point of the trigger level, the trigger event occurred and the capture began.

Introduction to Trigger Depths

Click on the **Depth** tab in the System Control to see the trigger depth settings.

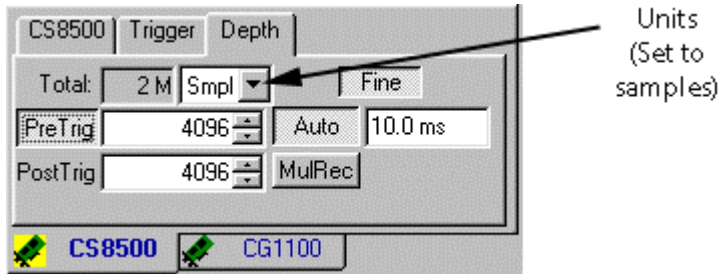


By default both pre- and post-trigger depth are set to 4096 samples. The trigger depths are limited by the amount of memory on-board your CompuScope card.

You can turn off pre-trigger acquisition by clicking on the **Pre Trig** button.

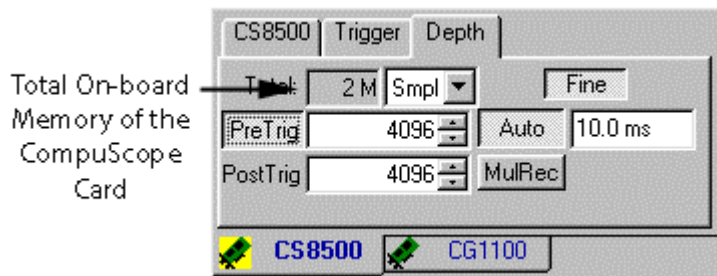
About Trigger Depth Units

Trigger depths are shown in number of **samples** (or points). This is displayed in the Units value in the **Depth** tab. This field cannot be changed.





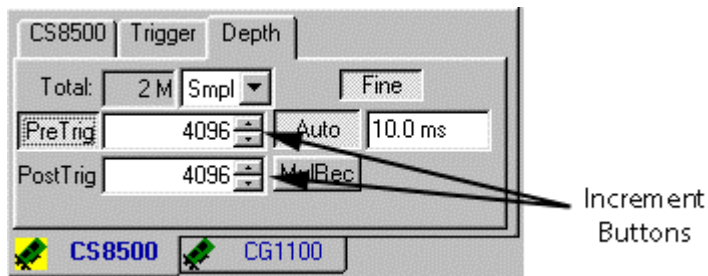
About the Trigger Total

The **Total** field reports the total amount of data that can be stored in the on-board memory of the CompuScope card. The total is shown in samples.



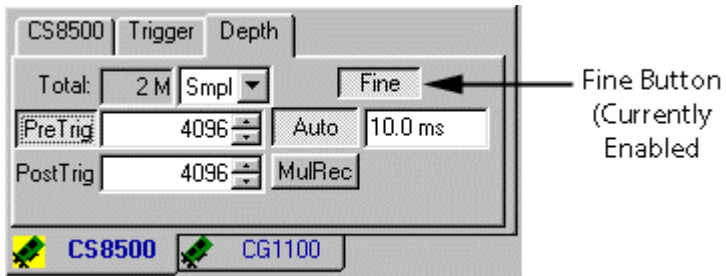
About Increment Buttons

The **Increment Up**  and **Increment Down**  buttons are located to the right of the pre- and post-trigger fields and are used to make changes to these settings.



About Fine Mode

Fine Mode is enabled by default.



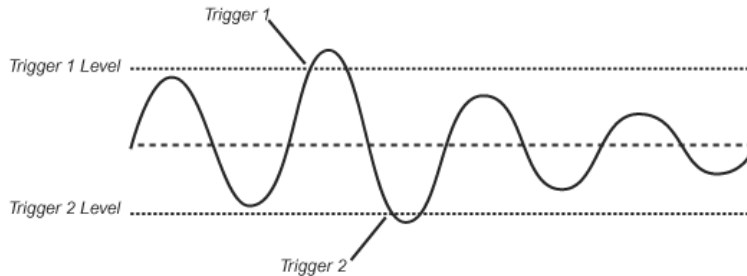
When **Fine Mode** is enabled, the increment buttons increase or decrease pre- and post-trigger data settings by 64 sample points. When **Fine Mode** is disabled, the changes are made in increments of 640 sample points.

Creating Multiple Independent Trigger Sources

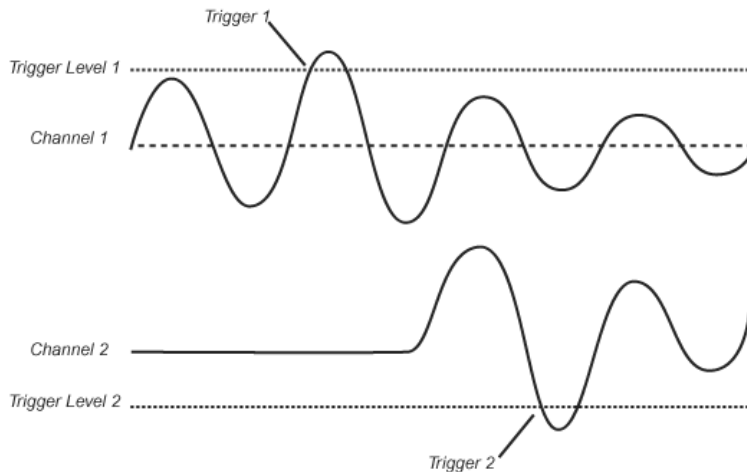
About Windowed Triggering

Certain CompuScope cards support “Windowed Triggering,” meaning that you can set two independent trigger conditions which are OR’ed together. Windowed triggering allows you to:

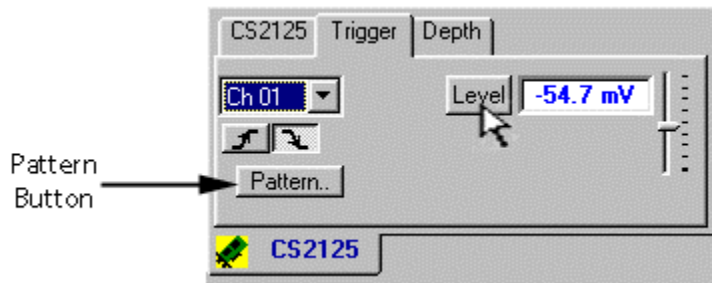
- Set two different triggers on the same channel



- Or set one trigger condition on each input of a CompuScope



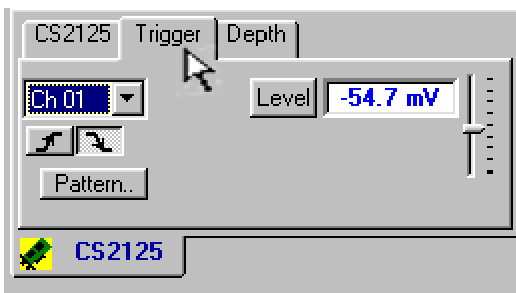
These triggers are set via the **Pattern** setting in the **Trigger** tab of the System Control.



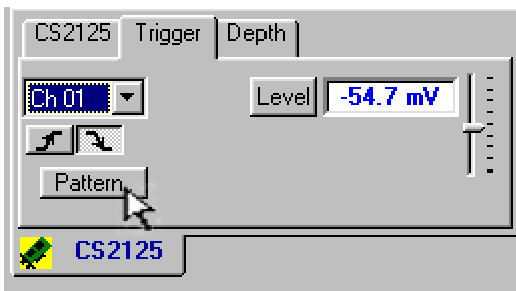
The Trigger Pattern dialog allows configuration of multiple independent triggers. Trigger source, slope and level can be modified, and trigger sources may be added and removed. Multiple triggers are not available for all CompuScope models.

Open the Advanced Trigger Configuration Dialog

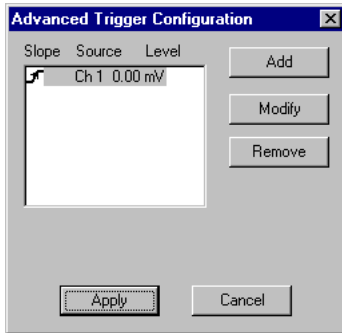
- 1 Click on the **Trigger** tab of the System Control if it is not already in front.



- 2 Click on the **Pattern** button.

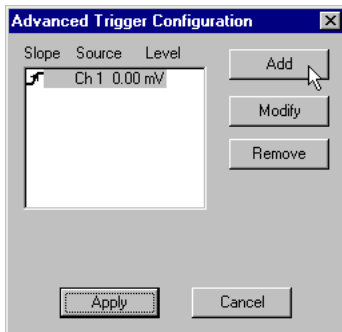


- This brings up the Advanced Trigger Configuration dialog, listing all of the currently specified trigger sources. Currently only the default trigger source is listed.

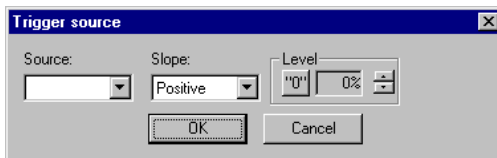


Create Two Different Trigger Sources on Channel 1

- In the Advanced Trigger Configuration dialog, click **Add**.



- This brings up the **Trigger Source** dialog with a blank Source field.



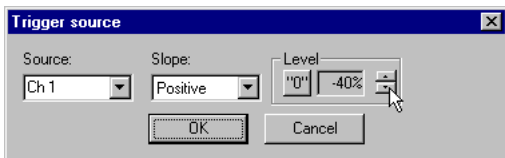
- 3 Click on the **Source** drop-down list to select Ch 1.



- Note that on CompuScope 1016, the trigger source can be External only.
 - Note also that if you have a Multi-Card system installed, you will see one trigger source for each channel available in your system. For example, for a three-card CS8012A system, there will be six input channel trigger sources available (since each CS8012A has two input channels). If you do not see the right number of trigger sources, go to **Preferences** in the Tools menu. Make sure the **Independent Trigger** item is checked.
- 4 To change the Trigger Level, use the increment/decrement buttons to set a percentage of the current input range of the selected trigger source.

For instance, since our Trigger Source is set to Ch 1, and the current input range for Ch 1 is $\pm 1\text{V}$, if we select 50%, the trigger level will be set to +500 mV. If we select -10%, the trigger level will be set to -100 mV. The maximum positive setting is 100% and the maximum negative setting is -100%.

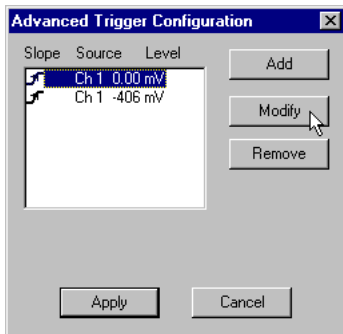
Set the Trigger Level to about **-40%**, or about -400 mV. You can click and hold the Down Increment button until it reaches the desired level.



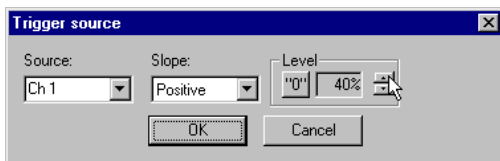
- 5 Click **OK** to accept the new trigger source.

- 6 We will now modify our initial trigger source.

Click on the first item in the list to highlight it and then click **Modify**.

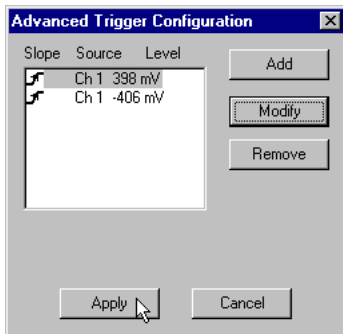


- 7 Change the trigger level from its current value, 0.00 mV, to **+40%**, equivalent to about +400 mV.

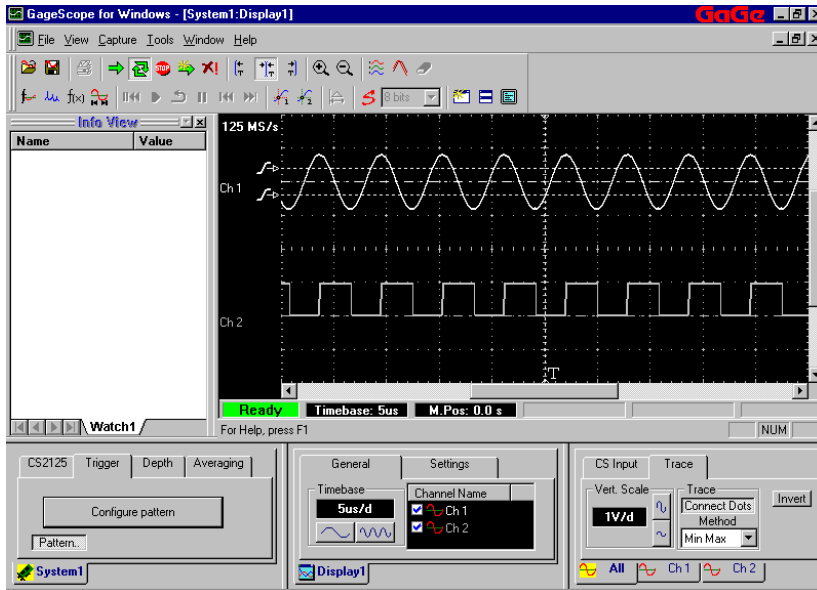


Click **OK** when finished.

- 8 Now click **Apply** in the Advanced Trigger Configuration dialog to apply the changes. Your changes will be updated in the Display Window.



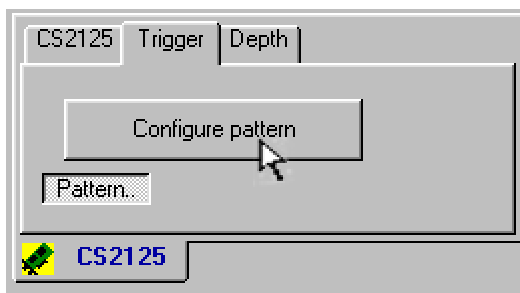
- 9 You will now see the signals in the Display Window moving somewhat jerkily to the left and right. This is because the signals are being triggered off the first trigger source and then the second, as the trigger level is constantly shifting from +400 mV to -400 mV.



Create a Trigger Source on each Input Channel

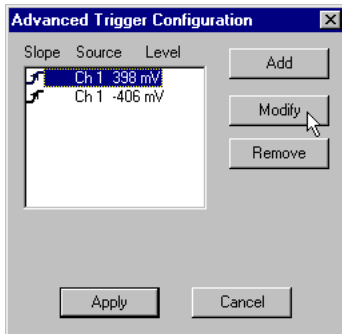
- 1 We have just created two trigger conditions on Ch 1. We will now create one trigger condition on Ch 1 and one on Ch 2.

Click the **Configure Pattern** button in the Trigger tab.

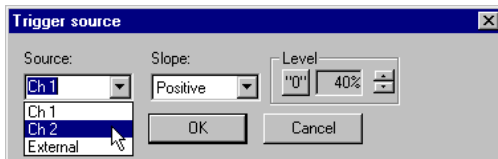


- 2 The Advanced Trigger Configuration dialog appears displaying our two trigger sources set to Ch 1.

Select the item in the list with the positive trigger level to highlight it, and click **Modify**.

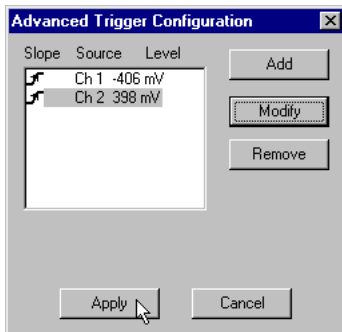


- 3 Change the Trigger Source to **Ch 2** by clicking the **Source** drop-down menu.

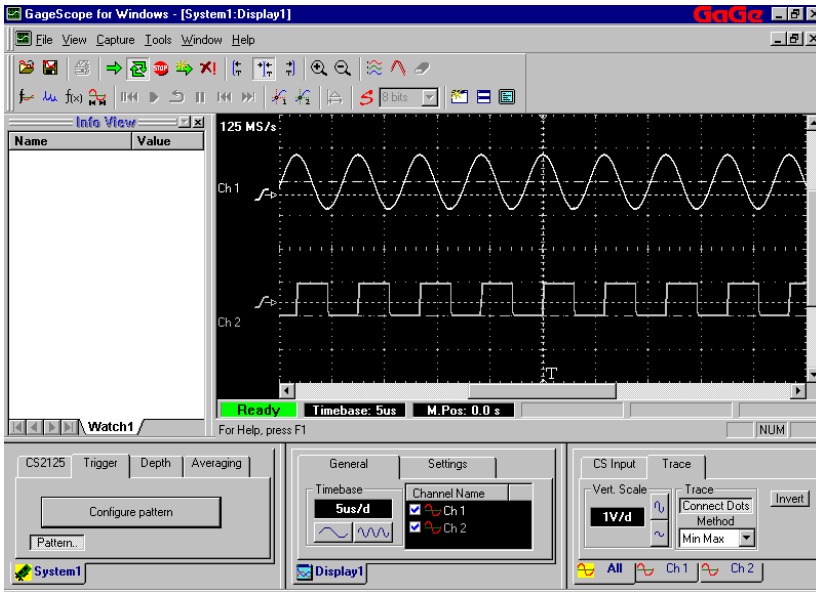


Click **OK** to accept the changes.

- 4 Click **Apply** to exit the Advanced Trigger Configuration dialog.

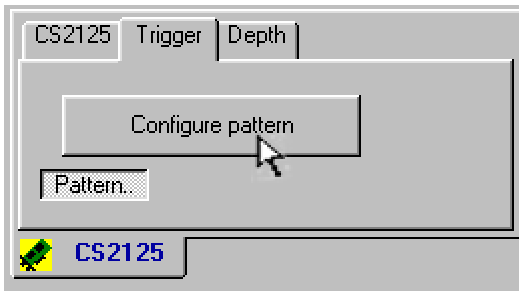


- 5 Note first that the second trigger has moved down to Channel 2. The signals are again moving jerkily to the left and right, this time because they are repeatedly triggering off Ch 1 and then Ch 2.

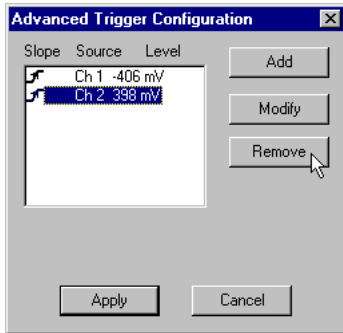


Remove the Second Trigger Source

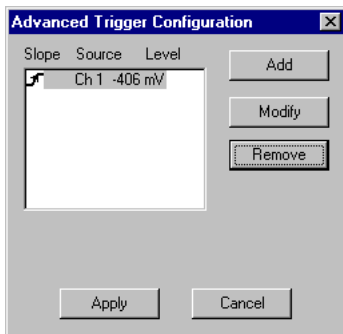
- 1 Click the **Configure Pattern** button in the Trigger tab.



- 2 In the Advanced Trigger Configuration Dialog, highlight the Ch 2 trigger source and click **Remove**.

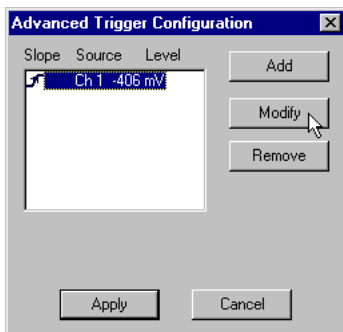


- 3 The trigger source will disappear from the list.

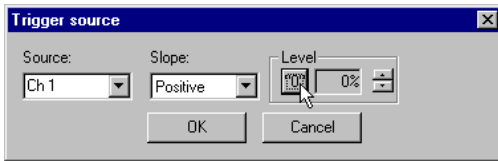


Change the Trigger Level Back to 0 mV

- 1 Click on the remaining trigger source and click **Modify**.

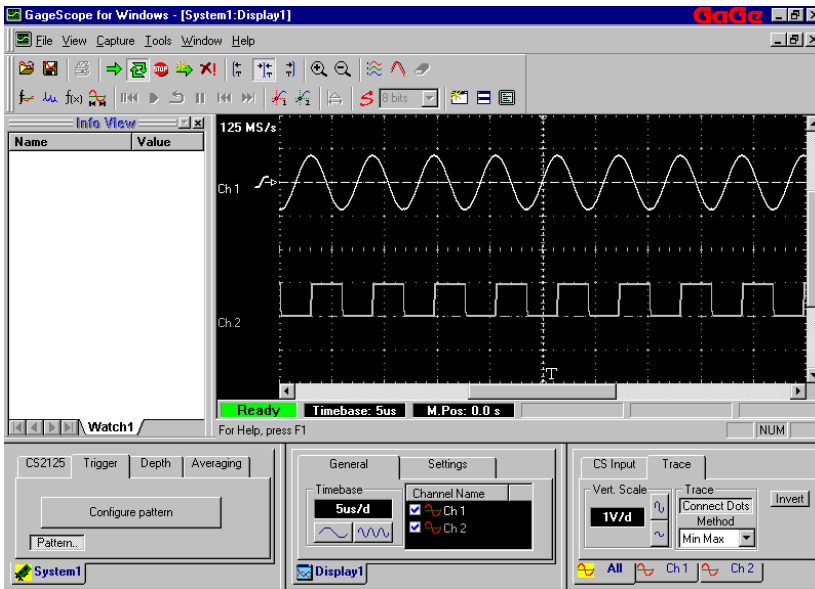


- Click the **Level** button to change the trigger level back to **0 mV**.



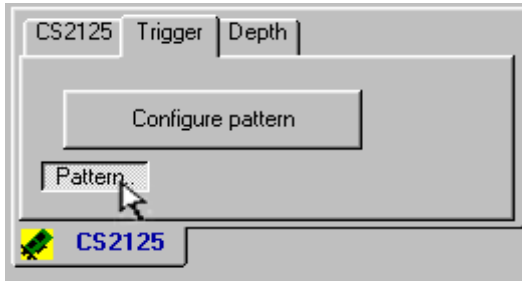
Click **OK** to accept the change.

- Click **Apply** to exit the Advanced Trigger Configuration dialog. Our display shows that we are triggering off Ch 1 at 0 mV.



Exit the Trigger Pattern Configuration

- 1 To return to the regular Trigger Tab, click on the **Pattern** button so that it is no longer pressed in.



Notes

If you have already created two independent triggers and you attempt to add a third, you will not be able to select a Trigger Source—the drop-down menu will be blank. On CompuScope cards that support multiple independent triggers, you cannot set more than two trigger sources.

Triggering Summary

- System triggers are set in the Trigger Tab of the System Control as well as in the Pattern dialog. Not all CompuScope cards support multiple triggers.
- The **Trigger Align** buttons can be used to automatically center, left-align or right-align the trigger marker.
- A trigger is selected in the Trigger Tab of the System Control or in the Pattern dialog. Triggers can be set to channel 1, channel 2, or external, and can also be disabled.
- The trigger level can be changed by dragging the trigger level line in the Display Window, or by dragging the trigger level slider in the Trigger tab of the System Control.
- Trigger slope can be changed by double-clicking the trigger slope icon in the Display Window, or by right-clicking to bring up the Slope context menu and then left-clicking on the desired slope.
- Trigger timeout is set in the Depth Tab of the System Control. You can disable the timeout by clicking **Auto** so that it reads **Normal** and is not “pressed in.” When a timeout is reached, GageScope® issues a software trigger, i.e., it triggers at the moment of timeout.
- Timeout is automatically disabled when you click on the **One Shot** button. It is automatically re-enabled when you click on the **Continuous** button.
- The amount of captured data is set in the Depth tab of the System Control. The unit of measurement can be set in samples, percent of on-board memory, and time. The Total field reflects the total amount of data that can be stored in the on-board memory of the CompuScope card.
- Both pre- and post-trigger depths are set to 4096 by default.
- When the **Fine** button (Depth tab) is enabled, pre- and post-trigger depths are increased or decreased in increments of 64 sample points. With Fine Mode disabled, the changes are made in increments of 640 sample points.