

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.

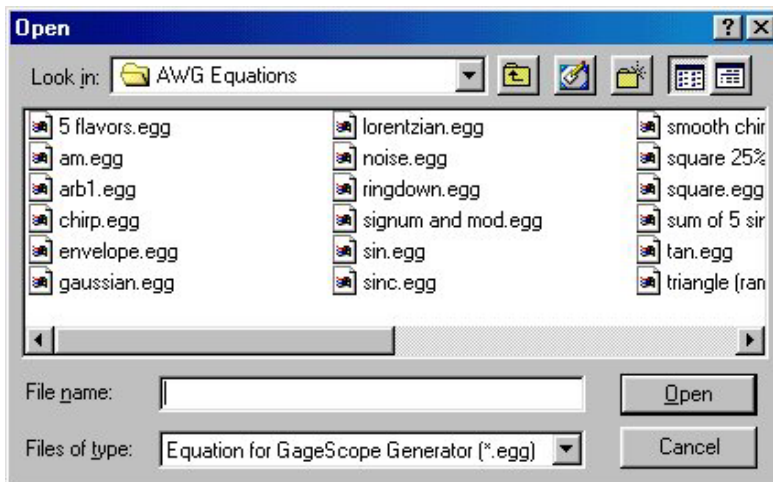
Tutorial 7: Using the Graphical Waveform Editor

The graphical waveform editor allows onscreen viewing and editing of waveforms. Complex signals can be created with relative ease using the graphics editing capabilities of GageScope® software. The complex waveforms created can then be uploaded to an arbitrary waveform generator for use in scientific applications. These features have been explained in an illustrative example below.

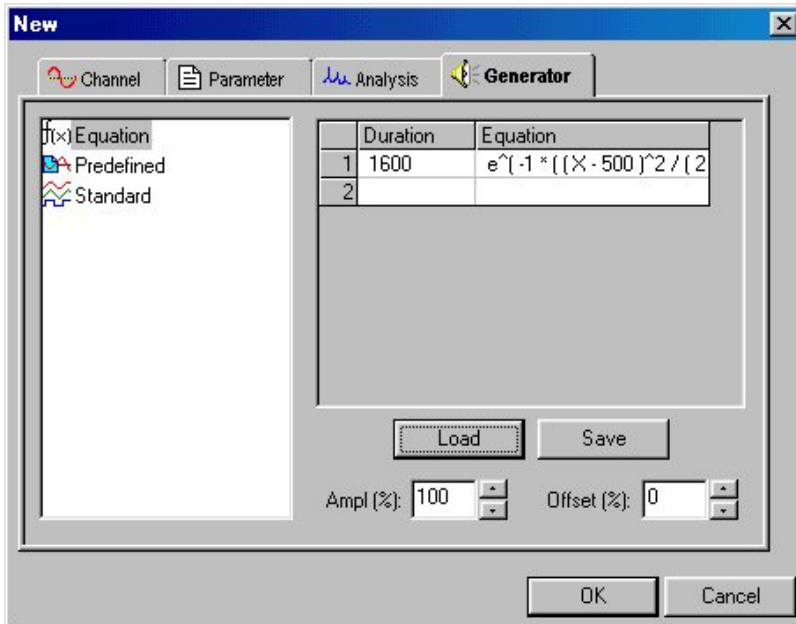
We will work on a gaussian pulse that has been created and saved as a .sig file in a local directory. The objective is to produce a non-gaussian shaped pulse using the graphical editor within GageScope. It has been assumed that GageScope® has been launched prior to following these steps:

Waveform Editing Procedure

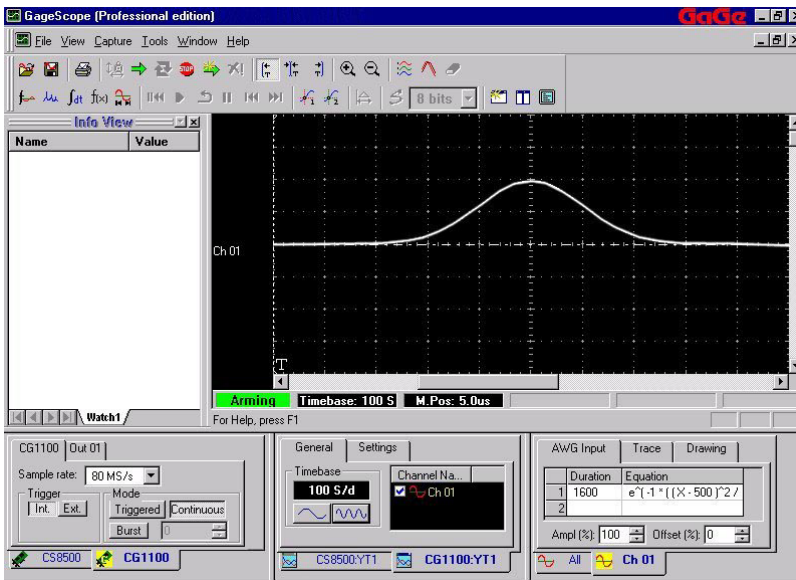
- 1 Click **File --> New --> Generator --> Equation --> Load**. The file **Open** dialog box appears:



- 2 Click **gaussian.egg** from the list in the dialog box. Gaussian.egg will appear in the **File name** text box. Click **Open**. The **New** dialog box opens as follows:



- 3 Click **OK**. GageScope® will display the gaussian pulse as follows:



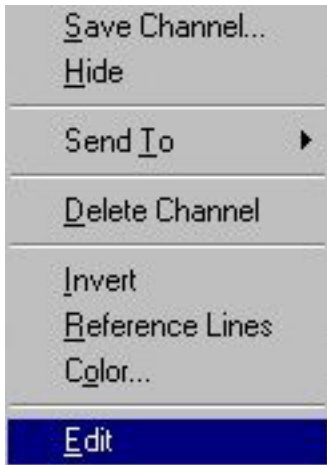
Note: The pulse has been expanded in time and displayed at the center of the display window in Gagescope. Refer to the **System** and **Display Control** sections in the

Chapter titled, **Reference**, of this manual for details on how to adjust these settings.

We have selected a gaussian pulse to be edited using the graphical editor for the purpose of demonstration. You can either select any other stored waveform or create a new waveform using the mathematical equation editor.

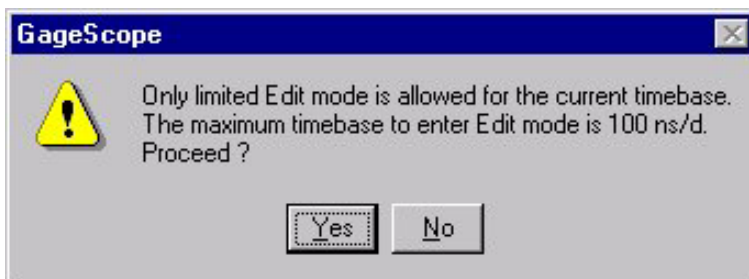
- 4 Right click on the reference line of the displayed signal. You will observe that the cursor changes shape, the waveform changes color and a menu appears at the right click position.

This menu is shown as follows:



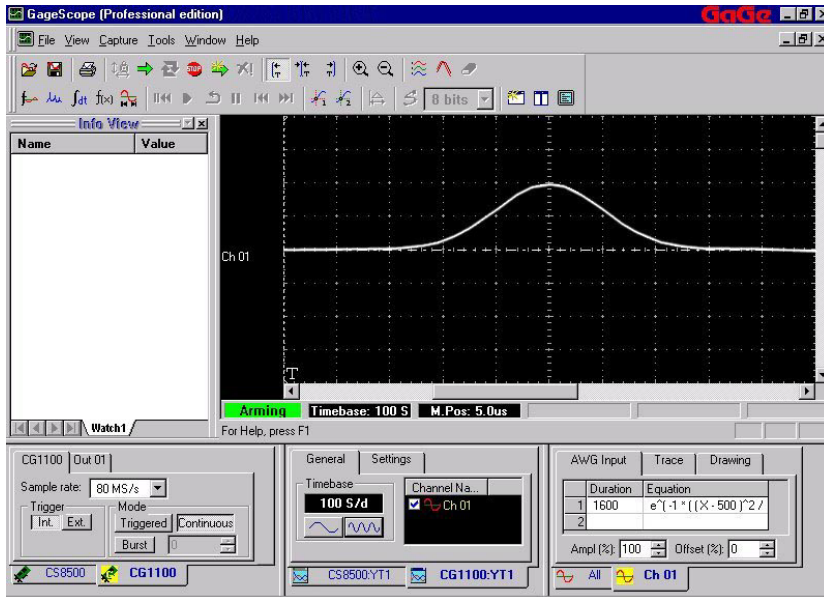
- 5 Double click on **Edit** to enter the Graphical editor. At this stage, you may be warned that for the current time base, only limited editing is available.

The warning message is displayed as follows:

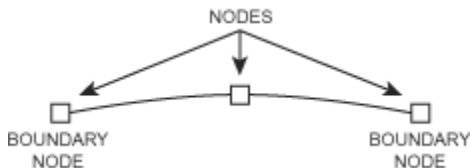


If you enter **Yes**, basic editing features like Copy, Cut, and Paste will be available. The graphical editing to change the waveform will be available only when the time base is expanded to 2 microseconds per division.

- 6 Since we are not ready for editing the waveform, click **No**. You will get back to the GageScope® display with the gaussian pulse shown on Channel 1.



- 7 At this stage, if you click **Yes**, you will enter the graphical editor but will not be able to use any of its features. You must see a few **Nodes** on the waveform to commence the editing process. A node is a point on the trace surrounded by a square.



The figure above shows a selected segment to be edited. Note that the edited segment shows three nodes. The end points of the segment are the **boundary nodes**. The middle node is the one that has been created (node creation to be explained later) or is an already existing node. The middle node is termed as the **control node**. The control node will be used to modify the selected line segment.




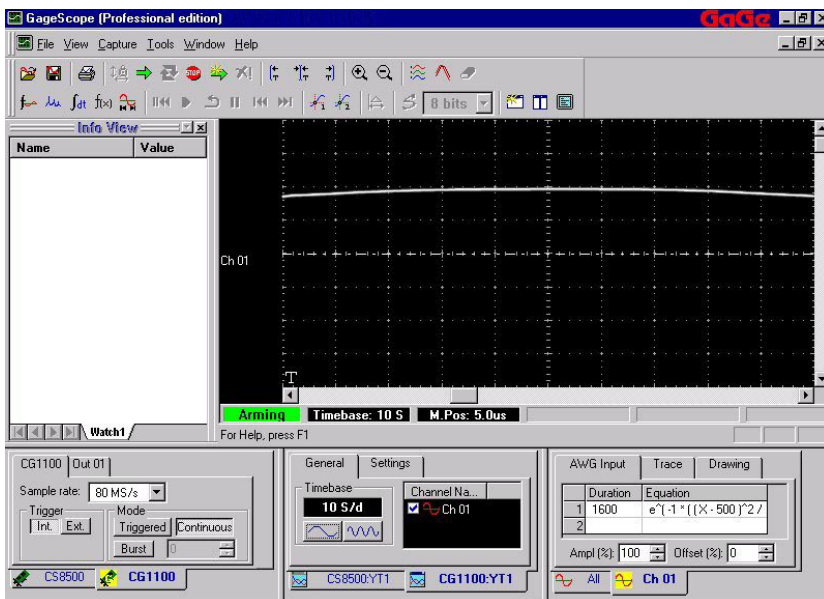
Note that the control node is shown with two orthogonal lines with arrows at the end. The mouse pointer changes shape to the one shown above when this node is selected for editing.

You can select a segment with just the boundary nodes and then create the control node anywhere within the segment OR you can select two segments with the middle node as the control node.

The important point to remember is that we must have three nodes within a selected signal segment to modify the segment.

When cursor is placed on a node to be selected for editing, it changes into a four way arrow as ➤


- 8 Expand the time base by clicking  Keep redisplaying the portion of the signal to be edited by using GageScope® display's horizontal scroll bar every time you adjust the time base. The display below shows an expanded view of the gaussian pulse:

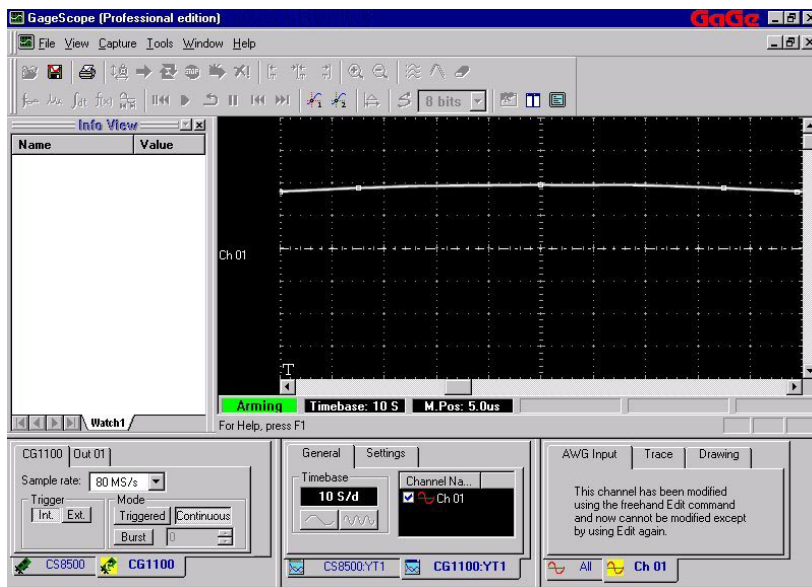


- 9 After expanding the time base and redisplaying the signal as shown above, make another attempt to launch the graphical editor.

Right click on the zero reference line. The cursor will change shape and the window

display context menu will appear. Double click on **Edit** to launch the graphical editor. One of the following will happen:

- If the trace is still too dense, the GageScope® warning window will reappear. This indicates that the time base has not been expanded enough for the editor to function.
- In such a case, click **No**. You will get back to the expanded display. Click on the time base expand button, , to expand the time base even further. Try launching the graphical editor again by right clicking on the zero reference line and selecting **Edit** from the drop down menu.
- If the time base is proper for the editor to function, you will see the following display:

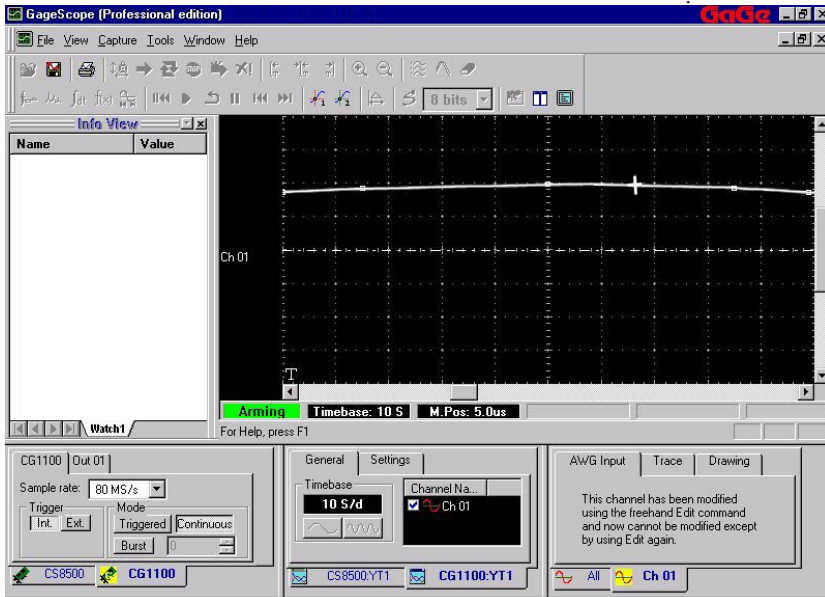


- 10** Note that the trace is now divided into four segments and hence there are five nodes shown on the trace. You can select any segment for editing purposes. Since the displayed portion of the waveform shows the nodes, it implies that we are now ready for graphical editing.

To start editing the displayed portion of the waveform, you can either use the existing Nodes or create new Nodes.

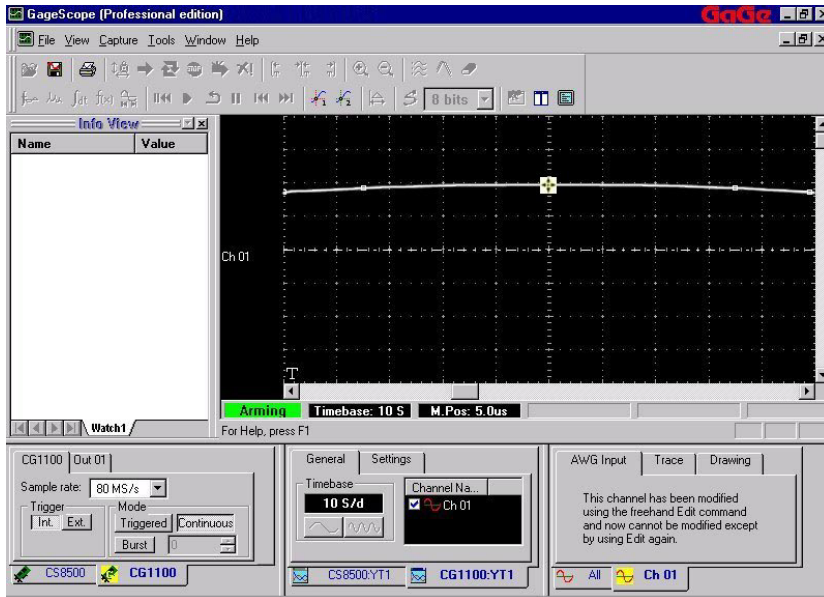
Using the Existing Nodes

- 11 Place the cursor on any portion of the waveform. The cursor changes from an arrow to be a plus sign $+$. This shows that a point on the trace has been selected, as depicted in the figure below:

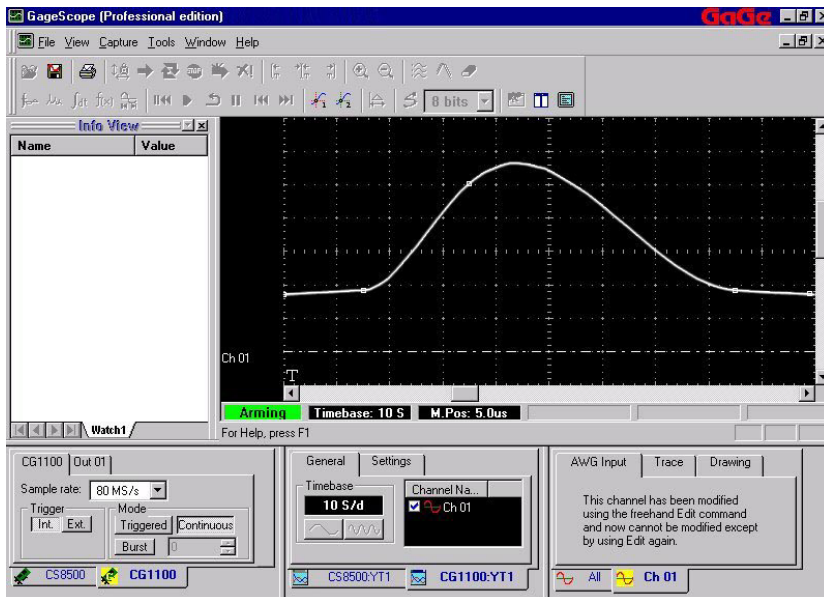


- 12 Move the hairline cursor closer to a Node. You do not have to move along the trace. You can go directly to the Node.

Once you are in the neighborhood of a Node, you will notice that the hairline cursor changes into a four-way arrow, $+$. This signifies that this particular node is now a control node and can be used to alter the trace. The figure below shows the trace with the control node:



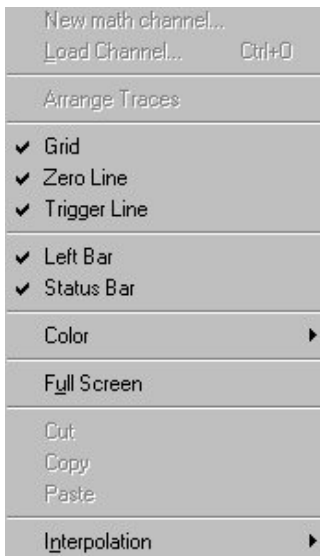
- 13** To move the control node, click the left mouse button once. This action activates the four-way arrow and now we are ready for editing. Press the left mouse button again and move the cursor as desired. Since we wish to make a gaussian pulse, non-gaussian, we will move the peak point to the left as shown in the figure below:



Observe that the peak has been shifted to the left making the pulse non-gaussian.

Note that the procedure employed in the drag and drop editing process, is the **Cubic Spline** Interpolation, which has been selected as a default. The Cubic Spline interpolation procedure works on fitting a cubic polynomial within a selected interval. In the example above, the selected interval is the interval between the two nodes: the nodes on the left and right of the control nodes define the left and right boundaries of the selected portion of the waveform. When the user moves the control node, the editor fits a cubic curve in between the two boundary nodes. This curve passes through the selected node as well as the two boundary nodes.

- 14** You can also select the straight line interpolation procedure too by selecting **Straight** from the interpolation submenu. While in the Edit mode, right click on any portion of the display. You will see following context menu:



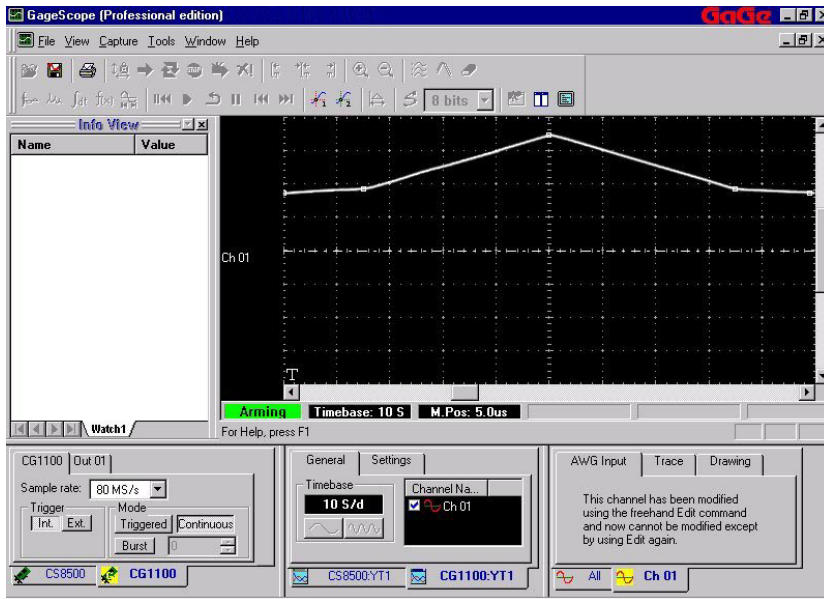
Note that **Cut**, **Copy**, and **Paste** operations are not available since the portion of the waveform to be edited for cut and paste operations has not been selected as yet. These items will be available for use whenever a portion of waveform is selected by placing the cursors on the trace for editing. The cutting, pasting and copying procedure has been outlined in the section to follow.

- 15** Select **Interpolation** to view the submenu as follows:



Spline is shown as the default interpolation option.

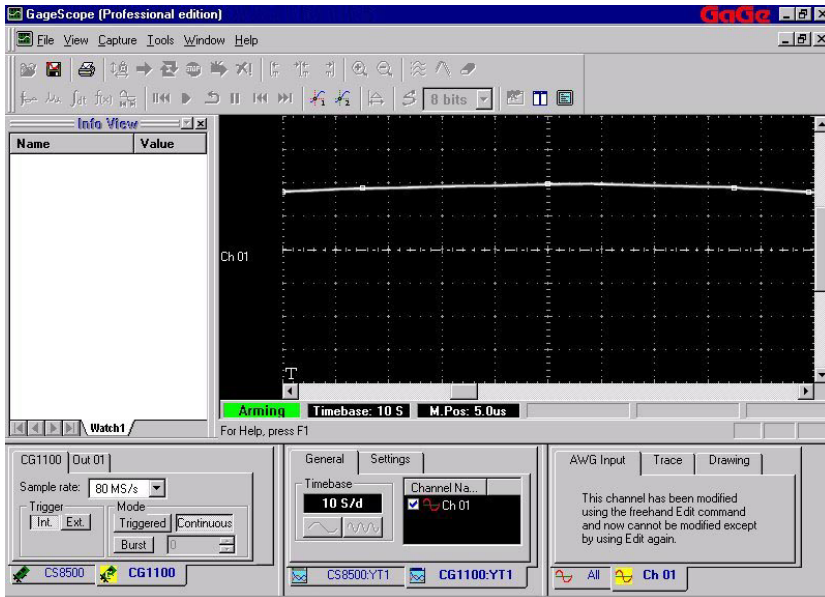
- 16 Select **Straight** option in the menu above. This option connects the three nodes, the control node, and the two boundary nodes, by straight lines as shown below:



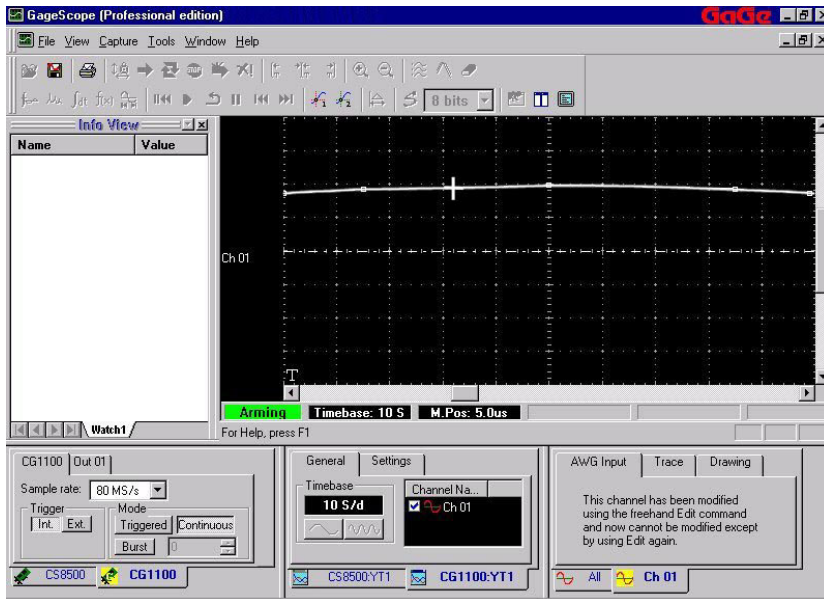
Creating New Nodes

- 17** New nodes can be created with absolute ease in the Graphical waveform editor. Newly created nodes impart user extreme flexibility to reshape the waveform arbitrarily.

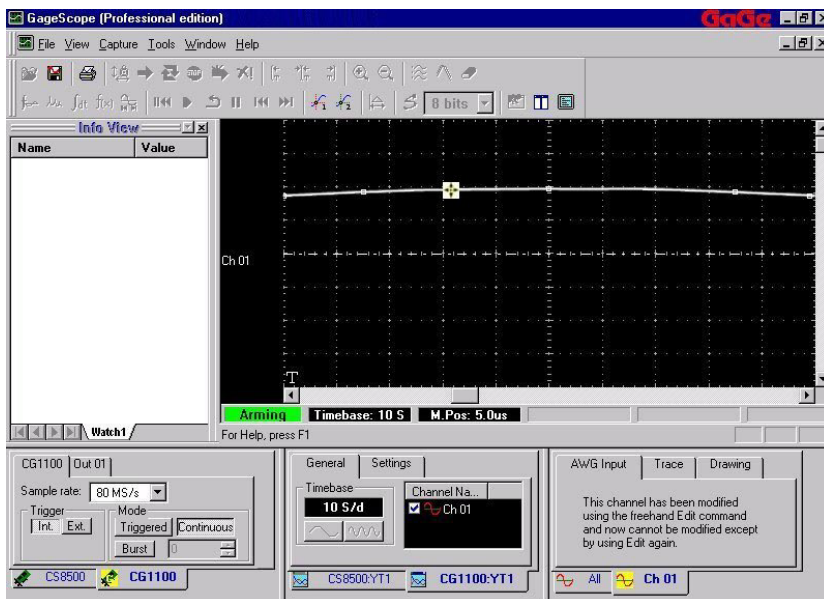
Follow the steps to get to the following displayed waveform in GageScope:



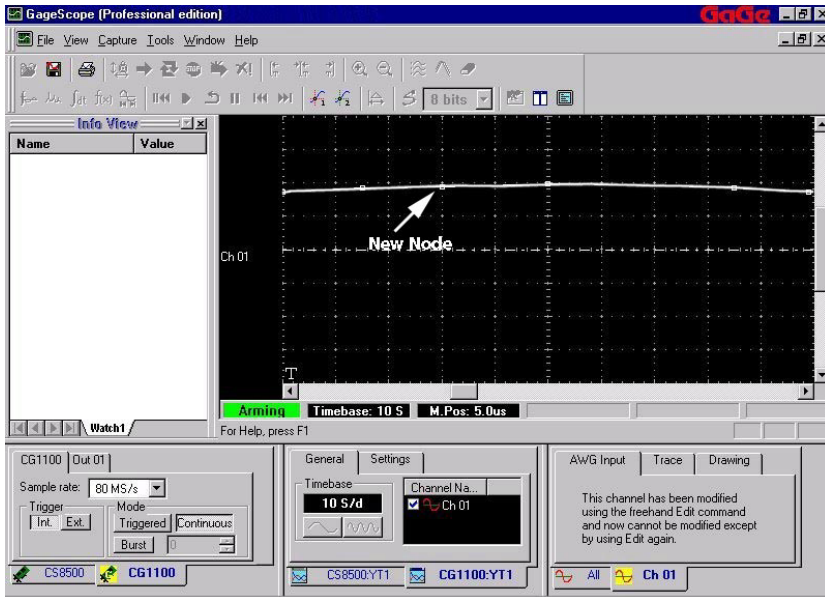
- 18** Move the cursor to the desired location on a selected portion of the waveform. This is the location where you wish to create a new node. You will note that the cursor changes shape to be a plus sign $+$.



- 19 Double click on the selected point and the cursor changes shape to look like ✚.



- 20 At this juncture, you have created a new node at this location. To view the newly created node, move the cursor away. You will see the following:

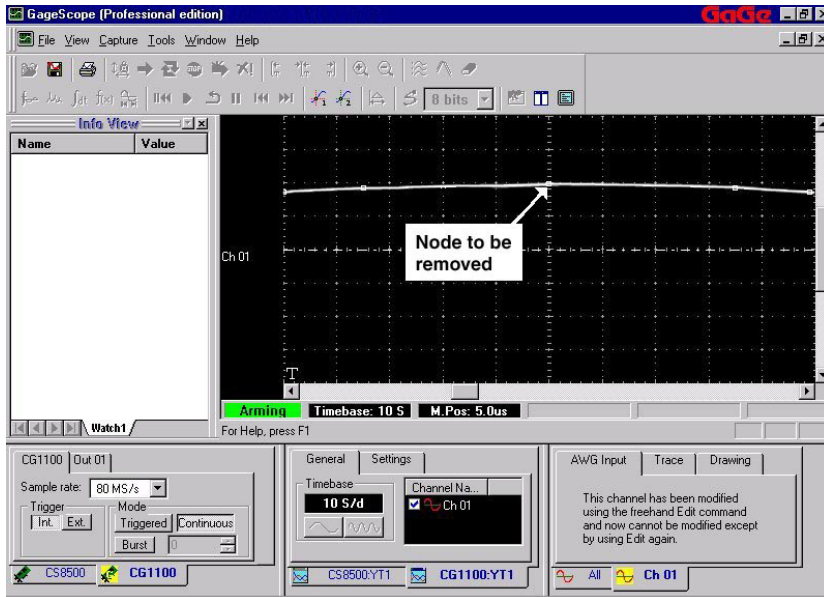


You can now use this new node to edit the selected portion of the trace.

Deleting Existing Nodes

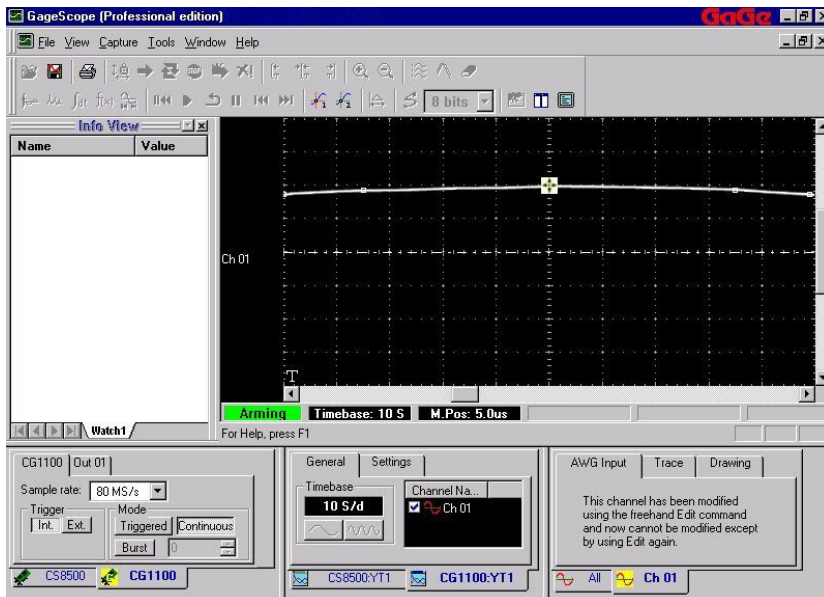
- 21** Existing nodes can be deleted by simply double clicking on the Node.

Follow the steps to get to the following displayed waveform in GageScope:

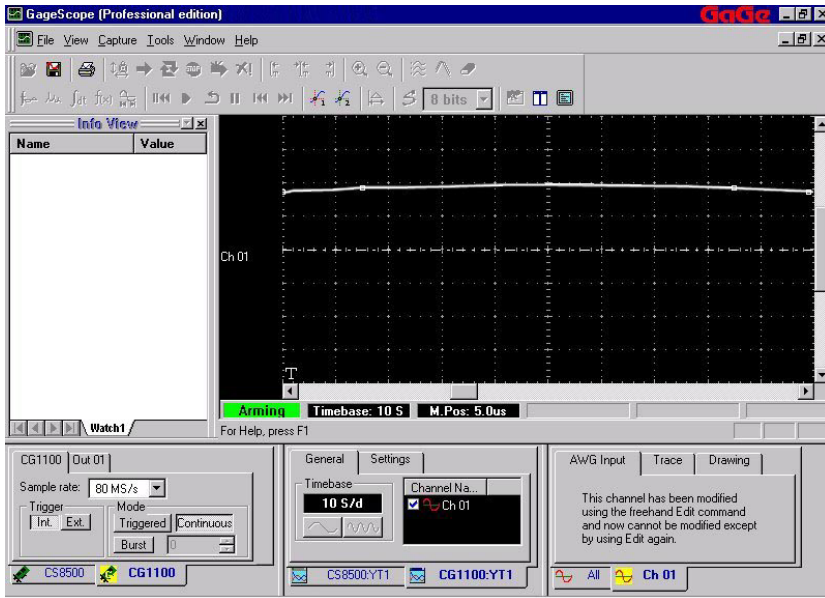


- 22** Move the cursor to the node that you wish to delete. We have selected the middle node to be deleted.

Move the cursor to the desired node. The cursor changes to be a four-way arrow.



23 Double click to remove the selected node.



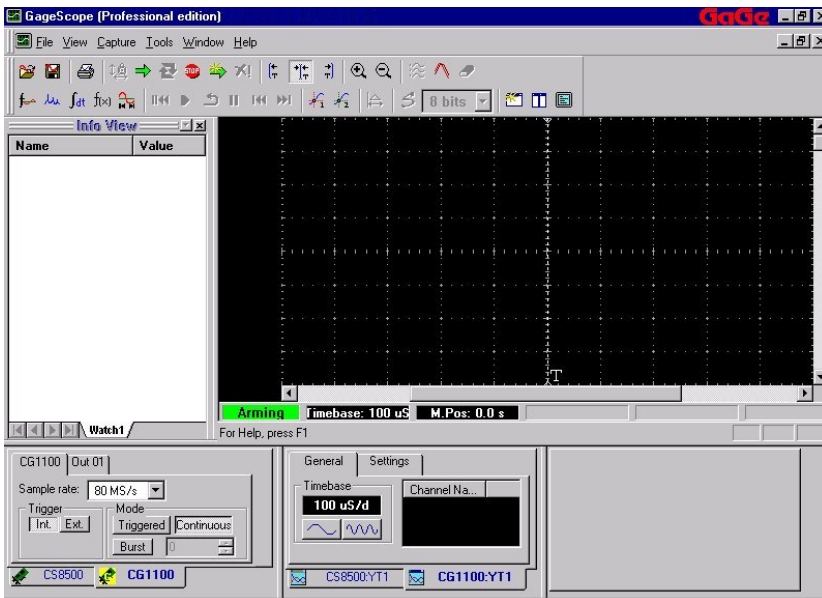
Cut, Copy and Paste Features

These features are available to the user whenever the desired portion of the waveform is selected using the cursors provided in GageScope® software.

Cut and Paste Operations

The example below illustrates how the Cut and Paste features work within the GageScope® software.

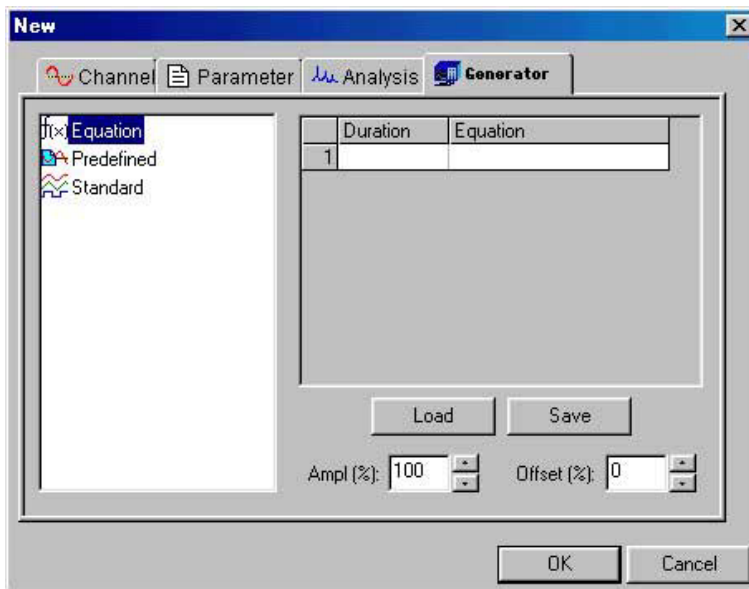
- 1 Before carrying out example below, make sure that GageScope® display is configured as follows:



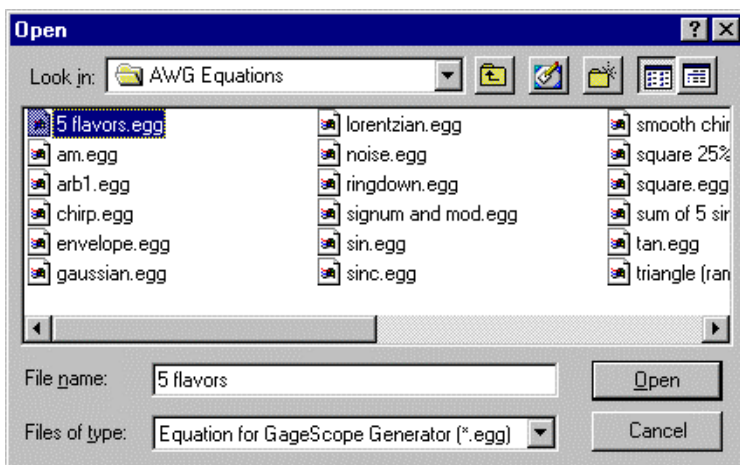
Note that the Channel control area in the lower right corner of the GageScope® display appears blank. This is because no arbitrary waveform generator related signal has yet been created or loaded. Also note that the CG1100 tabs in the System control and display controls have been selected and the CG1100 related display window is shown maximized.

- 2 Open the file titled **5 Flavors.egg** by carrying out the steps as follows:

Click **File --> New --> Generator --> Equation**. The New dialog box opens:

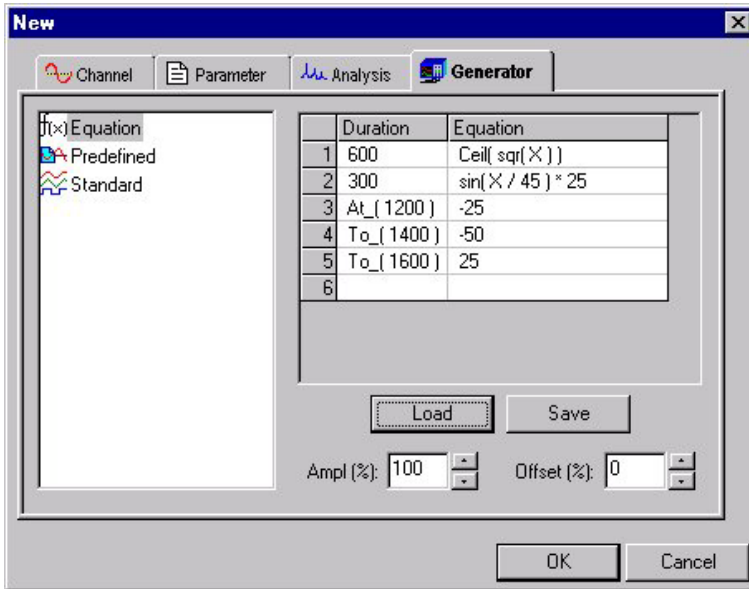


- 3 Click **Load**. The file **Open** dialog box appears:



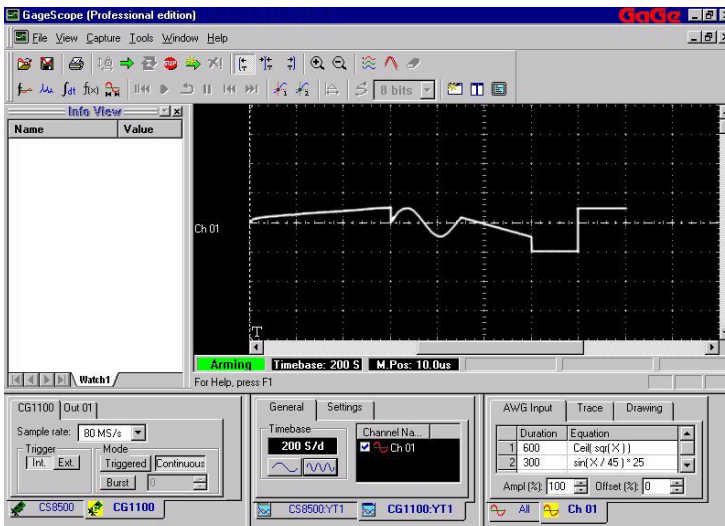
- 4 By default, the contents of the **AWG Equations** folder appear in the file **Open** dialog box as shown in the above.

Select the file named **5 flavors.egg**. The name of the selected file appears in the File name text box. Click **Open**. The **New** dialog box appears again:






Note that the right hand portion of the **New** dialog box shows the exact composition of the signal to be displayed in GageScope. The signal certainly contains 5 types of waveforms.

- Click **OK** to load the signal. GageScope® will display the signal as follows:



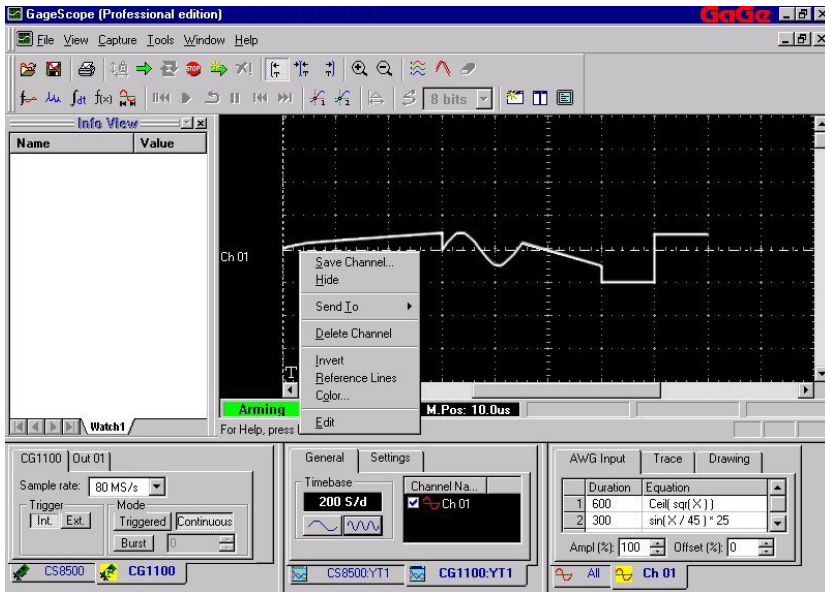
In case the signal does not appear exactly the same as in the figure above, you may have to align the trigger to the left and compress the timebase to make the signal match the

one shown above.

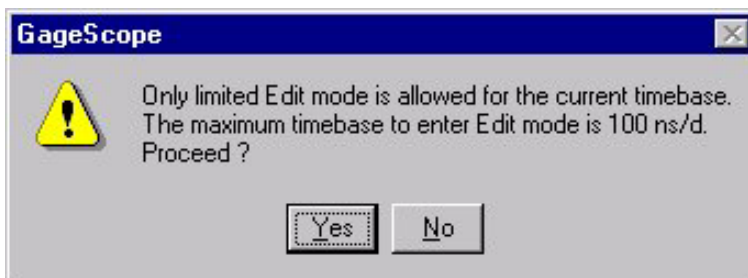
Click the left trigger align Icon  to align the trigger to the left. Click on the timebase expansion  or compression  buttons in the display control area to adjust to the timebase to exactly match the display settings as shown in the figure above.

- The next step is to invoke the Edit Mode. In order to achieve this end, place the cursor on the signal zero reference line. The cursor will turn into a move pointer.


Right click to view the context menu:





- Note that **Edit** is the last option in the context menu. Click **Edit** to enter the graphical editing mode. The following dialog box appears:

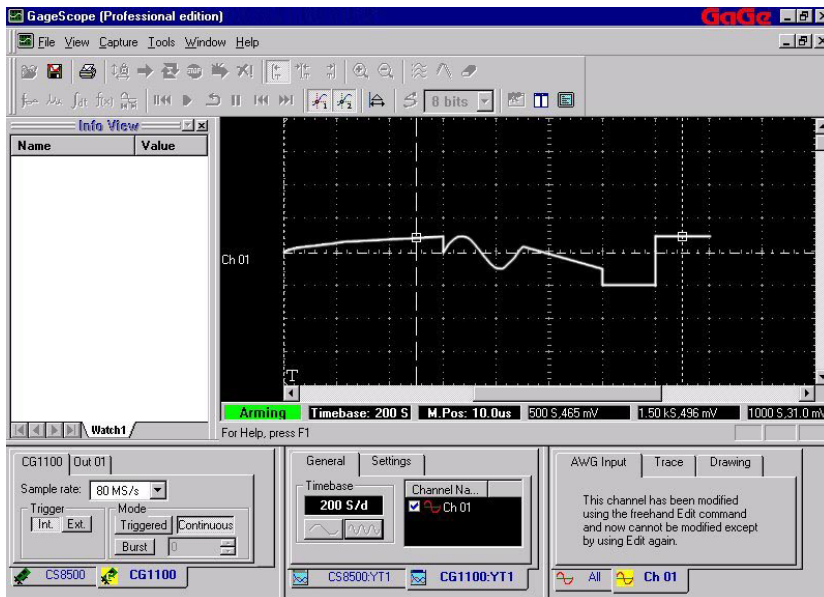


This message informs you that the current timebase settings allow limited editing features. This means that you may have to expand the timebase to be able to utilize full

editing capabilities. Since the timebase settings are frozen in the Edit mode, you will have to click **No** to go back to the non-edit mode and expand the timebase by clicking on  button in the display control. After having expanded the timebase, you can again attempt to launch the graphical editor by clicking Edit in the windows context menu. This is an iterative procedure and we do not want to embark on this route.

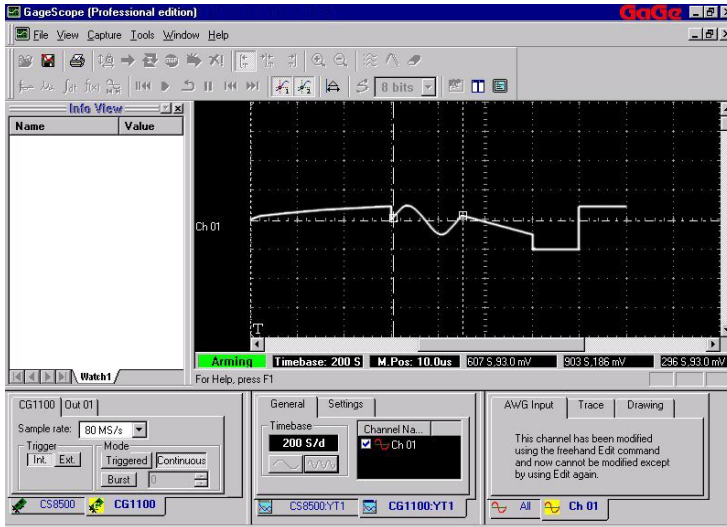
- 8 We have opted to select **Yes**. The waveform graphical editing mode is now invoked. You will view the original waveform.

At this stage, click one after the other on the left , and right cursor , icons in the toolbar. The GageScope® display will show both the cursors at default locations:



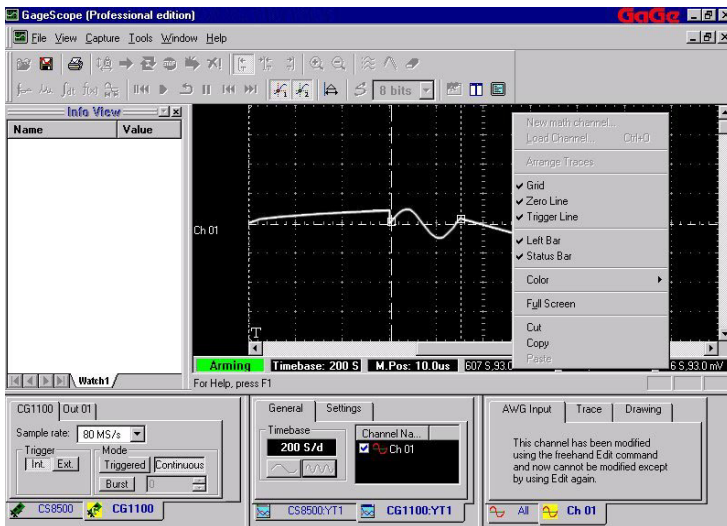
- 9 Place the mouse pointer anywhere on the left cursor. The mouse pointer will change shape to a move pointer. Hold down the left mouse button and drag the move pointer. The cursor will drag with the pointer. Release the left mouse button at the starting location of the waveform to be edited. Follow the same procedure for the right cursor.

In this example, we have decided to cut out the sine portion of the trace. This portion will be inserted in between the last part of the trace.



You can observe that the sine portion of the signal has been selected.

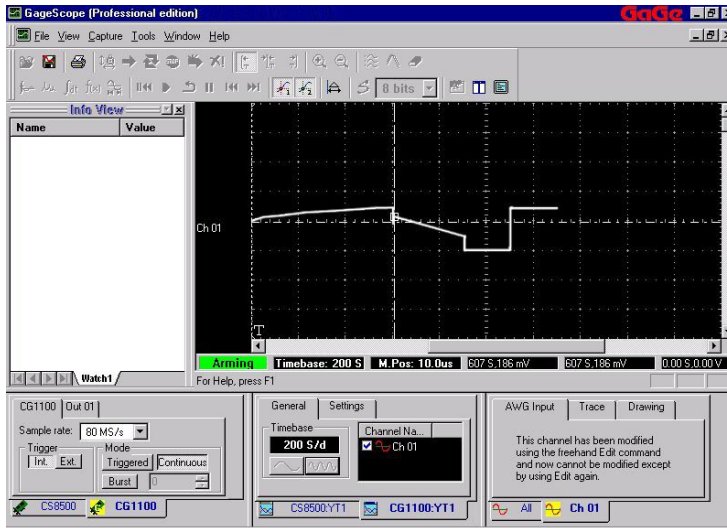
- 10 Right click anywhere on the display (except the zero reference line). You will see the display context menu as follows:




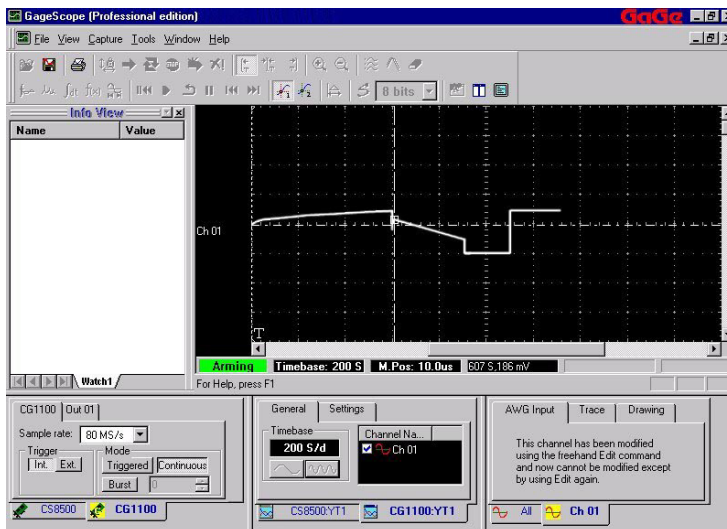
The **Cut** and **Copy** commands are grouped together at the bottom of this window.

- 11 Double click on **Cut** to select and execute the command. You will see that the selected portion of the signal has been removed from the display and both left and right cursors collapsed to show a single cursor. You must understand that both cursors exist as

separate entities. It's just that they seem to be one.



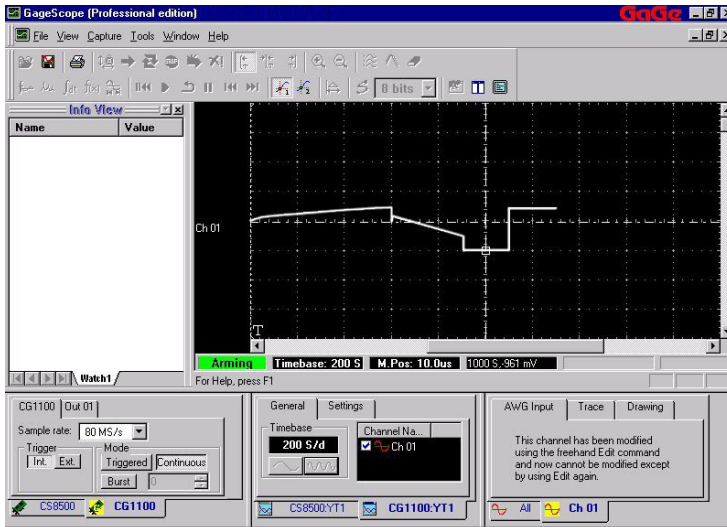
- 12 Hide the right cursor by clicking on the respective icon  in the toolbar.



Observe that the sine portion of the signal has been removed. The portion to the right of the cut part has moved to the left to glue with the left part of the signal.

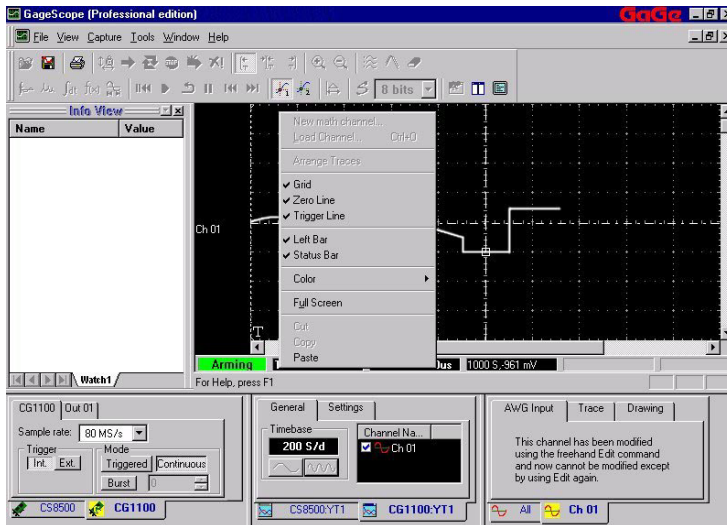
Note that the right cursor icon appears enabled in the toolbar.

- 13 Place the mouse pointer on the left cursor, hold down the left mouse button, and drag the cursor to the desired insertion point on the displayed waveform. Release the left mouse button. You will see the following display with the left cursor positioned at the desired insertion point:



Note that the insertion point has been arbitrarily selected. If you wish, you can select any other paste location.

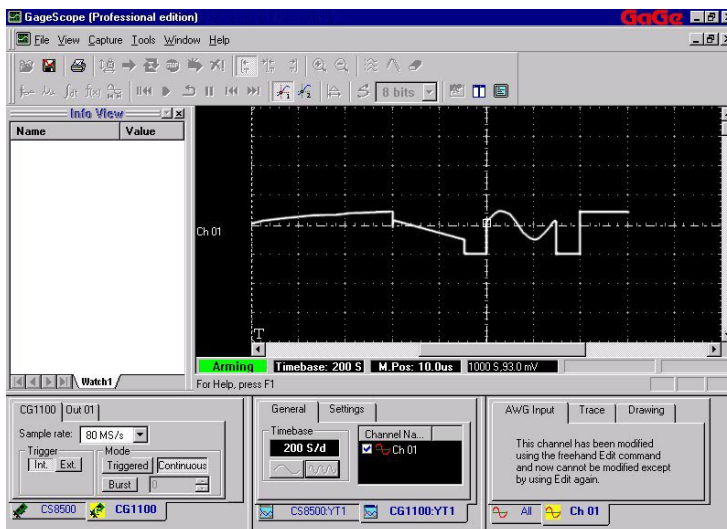
- 14 Right click anywhere within the display window. The display context window will appear again as shown below:




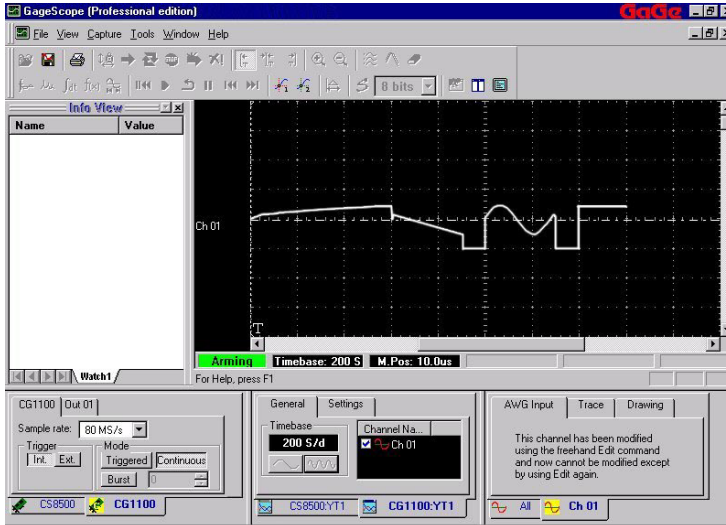
Make sure that you do not right click on the zero reference line. Right clicking on the zero reference line brings up the channel context menu.

- 15 You can see that the **Cut** and **Copy** commands have been disabled. Only the **Paste** command is shown enabled at the bottom of the display context menu.

Double click on Paste to insert the cut portion of the trace. The modified signal will be shown as follows:



- 16 Hide the cursor by clicking on the left cursor button  in the toolbar:



- 17 You will note that while in the edit mode, most of the functionality in GageScope® remains disabled.

Click on the channel 1 tab in the bottom of the Channel Control. Click on the **AWG Input** tab to bring it to front. The AWG Input property page will appear and is shown as follows:



Channel 1 (**Ch 01**) contains the signal you have just modified. In order to get back to the normal functionality, you will have to leave the Edit Mode.

- 18 Click on the **File** menu in the menu bar. The File menu will be displayed:



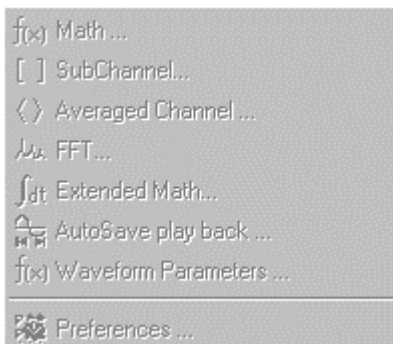
Note that the Save Setup, Load Setup, New, and Load Channel commands have been disabled. These will be re-enabled once you leave the Edit mode.

- 19 Click on **Capture** in the main menu. The Capture menu will appear:



Note that the entire Capture menu has been disabled. These features are not needed while editing of signals is in progress.

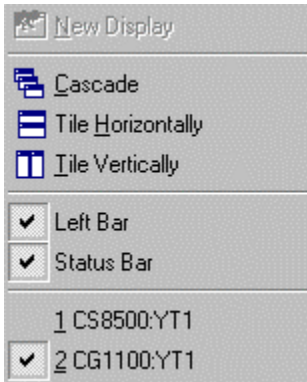
- 20 Click on **Tools** in the main menu bar. The Tools menu will appear:



Note once again that the entire menu has been disabled since these functions are not

required when editing of a waveform is in progress.

- 21** Click on **Windows** in the main menu bar. The Windows menu will appear:



You can see that the New Display command is disabled. While in the edit mode, you are not allowed to create another signal. In other words, only one signal can be modified at a time.

- 22** We have finished editing the waveform and now must exit the Edit Mode. In order to do so, move the mouse pointer to the zero reference line. The mouse pointer will turn into a move pointer. Right click on the zero reference line of the waveform. The zero reference context window will appear as follows:



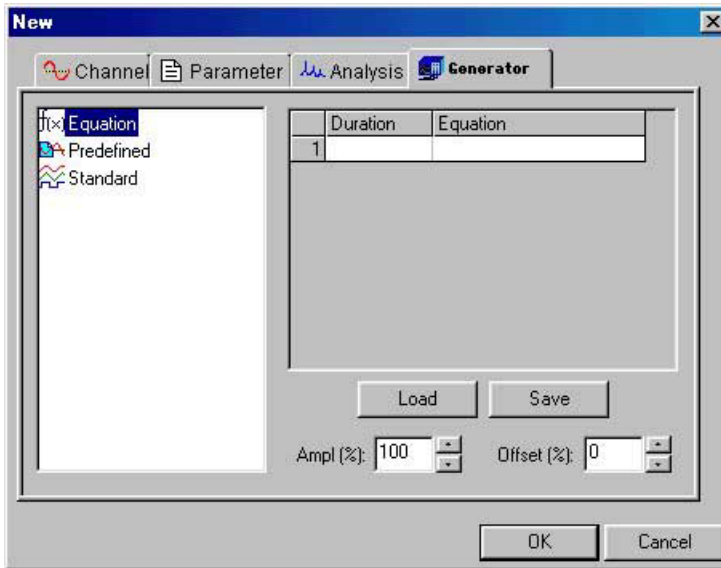
The check mark indicates that the Edit Mode is in force. Double click on Edit. This will take GageScope® out of the Edit Mode. You will note that the functions that were disabled will now be restored to their original settings.

Copy and Paste Operations

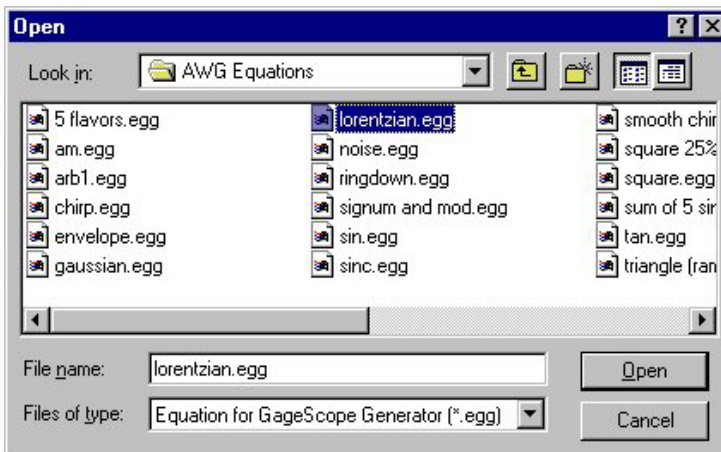
The example below illustrates how the Copy and Paste features work within the GageScope® software.

- 1 Open the file titled **Lorentzian.egg** by carrying out the steps as follows:

Click **File --> New --> Generator --> Equation**. The **New** dialog box opens:

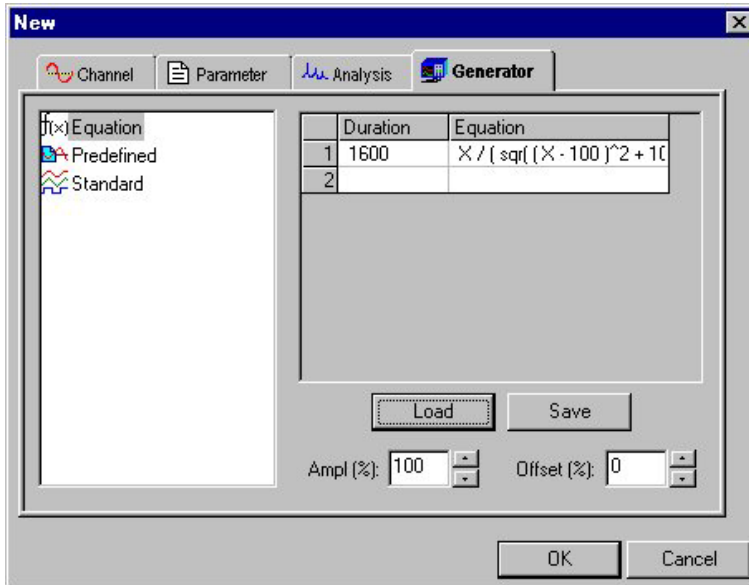


- 2 Click **Load**. The file **Open** dialog box appears:



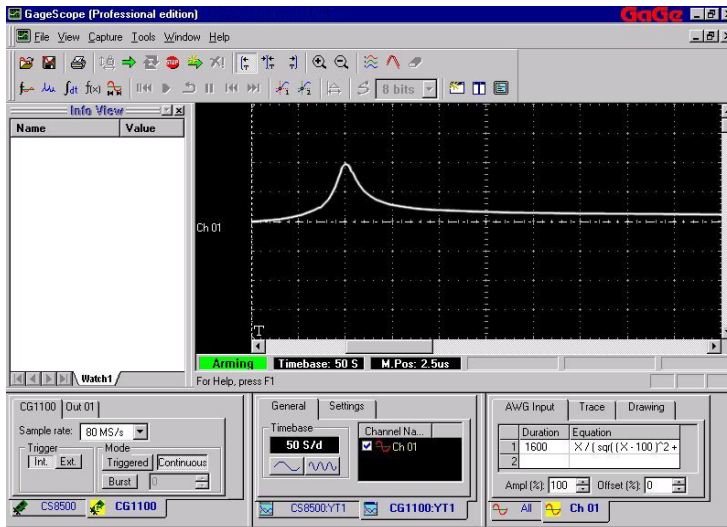
- 3 By default, the contents of the **AWG Equations** folder appear in the file **Open** dialog box as shown above.

Select the file named **Lorentzian.egg**. The name of the selected file appears in the File name text box. Click **Open**. The **New** dialog box appears again:






Note that the right hand portion of the **New** dialog box shows the exact composition of the signal to be displayed in GageScope.

- 4 Click **OK** to load the signal. GageScope® will display the signal as follows:

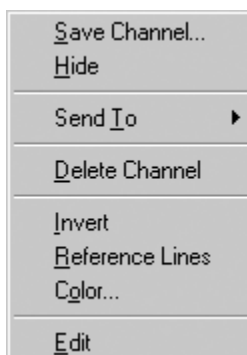


In case the signal does not appear exactly the same as in the figure above, you may have to align the trigger to the left and compress the timebase to make the signal match the one shown above.

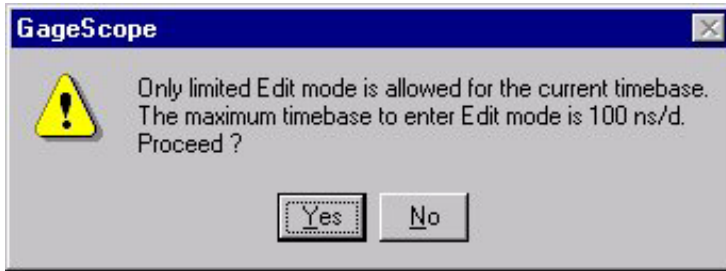
Click the left trigger align Icon  to align the trigger to the left. Click on the timebase expansion  or compression  buttons in the display control area to adjust to the timebase to exactly match the display settings as shown in the figure above.

- 5 The next step is to invoke the Edit Mode. In order to achieve this end, place the cursor on the signal zero reference line. The cursor will turn into a move pointer.

Right click to view the context menu:



- 6 Note that **Edit** is the last option in the context menu. Click **Edit** to enter the graphical editing mode. The following dialog box appears:

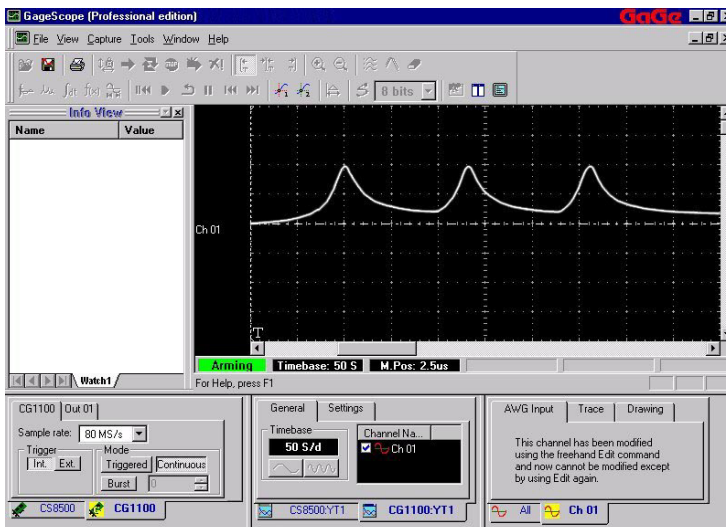


Choosing Yes will invoke the graphical editor.

We have already discussed the implications of limited Edit mode capabilities in the previous section.

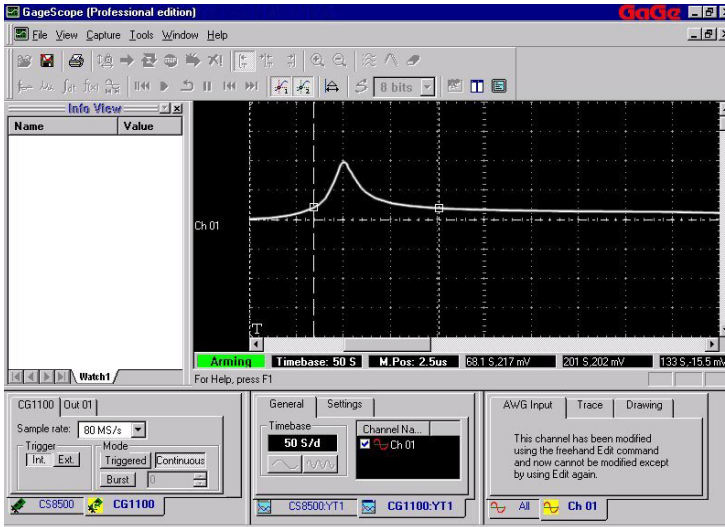
- 7 Click **Yes**. The waveform graphical editing mode is now invoked.


Following the procedure given in the previous section, select the portion of the trace to be copied. This is achieved by positioning the cursors at the desired locations on the trace. The display below shows one such selection:



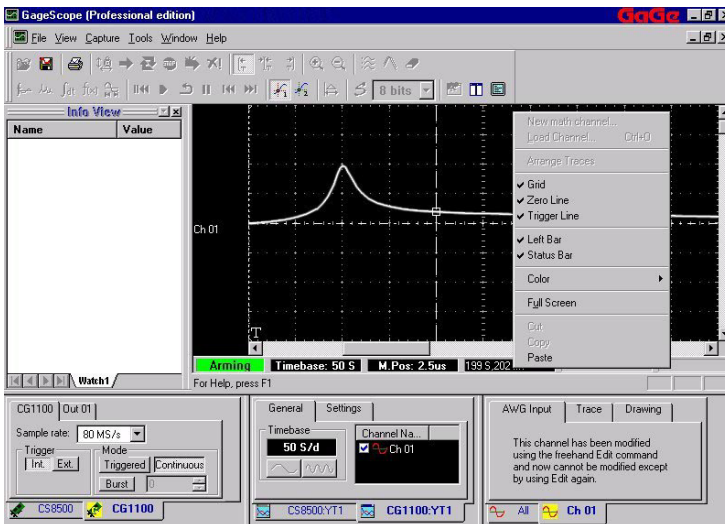
Observe that we have selected the middle portion of the signal to be copied.

- 8 Right click anywhere on the display (except the zero reference line). You will see the display context menu. Click on **Copy**. The screen will appear the same but the selected portion of the trace will be copied to the memory buffer:



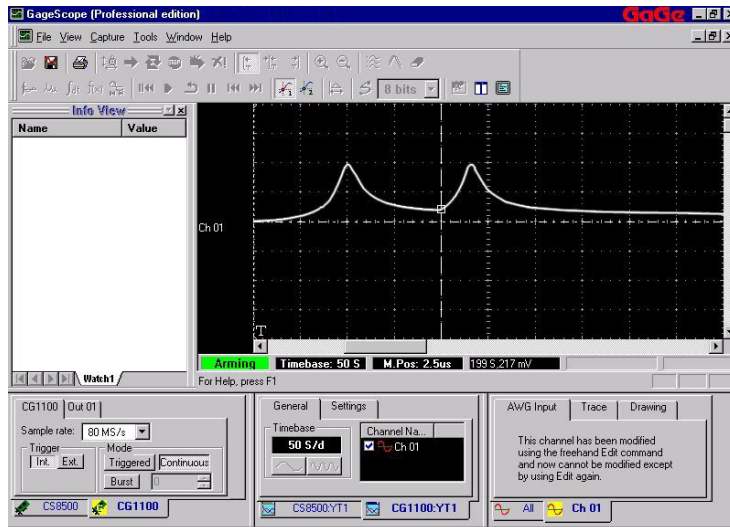
- 9 Hide the right cursor by clicking on the respective icon  in the toolbar. After hiding the right cursor, drag the left cursor to place it at the insertion point on the trace.

Next, right click anywhere on the display except the zero reference line. The reference context menu will appear:

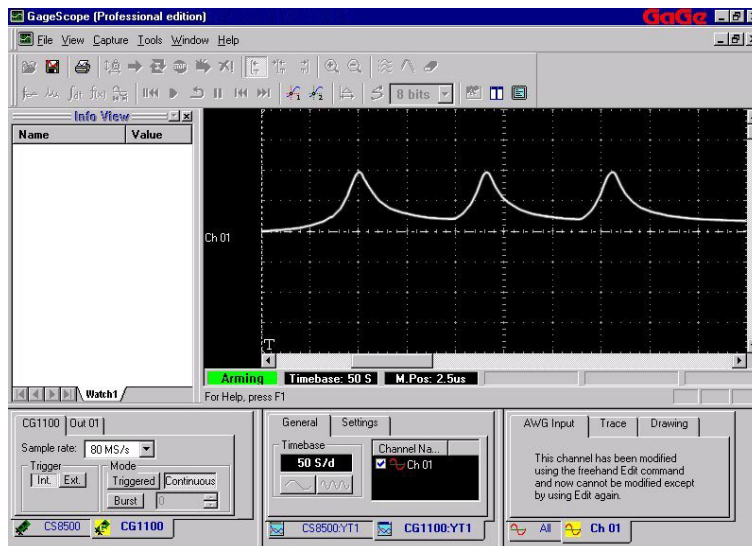


- 10 You can see that the **Cut** and **Copy** commands have been disabled. Only the **Paste** command is shown enabled at the bottom of the display context menu.

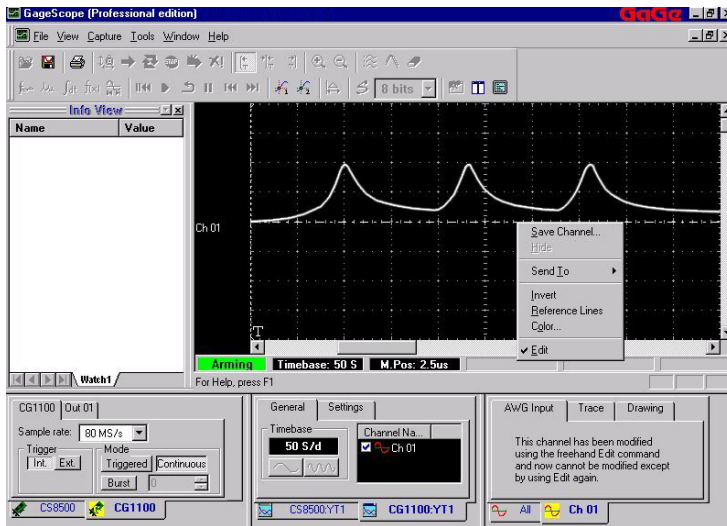
Double click on **Paste**. The copied portion of the trace will be pasted at the cursor location as shown below:



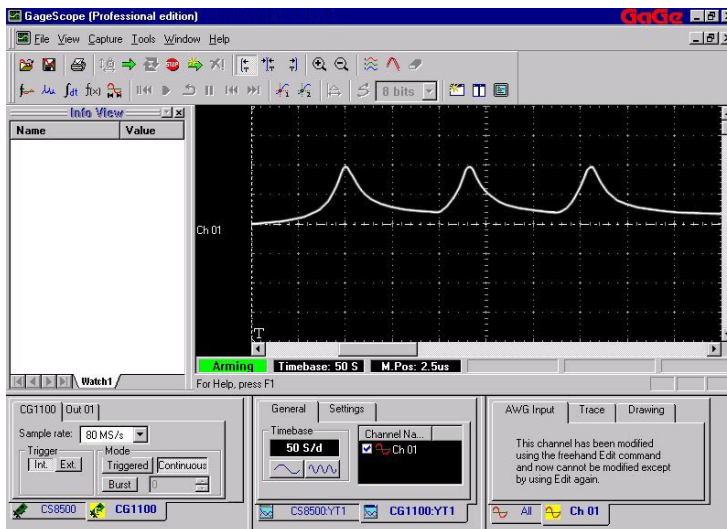
- 11 The part of the trace copied is again pasted at the end of the signal. Hide the left cursor by clicking on the left cursor button in the toolbar. The GageScope® display will show as follows:



- 12 When finished, you must exit the Edit mode. Right click on the zero reference line. The reference context menu will appear. The check mark besides **Edit** command shows that the Edit mode is currently active.



- 13 Click on **Edit** to deactivate the Edit Mode. The GageScope[®] window will appear as follows:



Observe that the normal operation has commenced since all disabled controls have been enabled.