pico® Technology Limited

PicoScope 6.0
PC Oscilloscope Software

User Guide

PSW044-2.0

Table of Contents

1 Welcome

Welcome to PicoScope, the PC Oscilloscope software from Pico Technology Limited.

With a scope device from Pico Technology, PicoScope 8 turns your PC into a powerful PC Oscilloscope 8 with all the features and performance of a bench-top oscilloscope 7 at a fraction of the cost.

- How to use this manual 5
- What's new in this version? 2

Software version: PicoScope 6.0 beta v0.8.0.0

2 Version 6.0 update

PicoScope 6.0 is a major new release of PicoScope, Pico Technology's software for PC Oscilloscopes.

- Higher performance
  - Faster capture rates, making it easier to see fast-moving signals
  - Faster data processing
  - Better support for the latest PicoScope USB oscilloscopes

- Improved usability and appearance
  - Clearer graphics and text
  - Tooltips and help messages to explain all features
  - Easy point-and-click tools for panning and zooming
  - User-configurable toolbars 48 - you can put all the controls where you want them

- New features
  - The latest Windows .NET technology helps us get new features to you quicker
  - New digital low-pass filtering
  - Custom probes 27 manager to make it easy for you to use your own probes and sensors with PicoScope
  - Multiple views of the same data, with individual zoom, pan and filter settings for each view

3 Introduction

PicoScope is a comprehensive software application for Pico Technology PC Oscilloscopes. Used with a scope device from Pico Technology, it creates a virtual oscilloscope, spectrum analyser and multimeter on your PC.

PicoScope 6.0 supports the following scope devices:

- PicoScope 2000 Series
- PicoScope 3000 Series
- ADC-212 variants

PicoScope 6.0 runs on any 32-bit computer with Windows 98SE, ME, 2000 or XP. (See System requirements 5 for further recommendations.)

How to use PicoScope 6.0

- Getting started: see using PicoScope for the first time 6, and PicoScope's Features. 7
- For further information: see descriptions of Menus 19 and Toolbars 44, and the Reference 63 section.
- For step-by-step tutorials, see the "How to 60" section.

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3.2 Contact information

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3.3 How to use this manual

You are using a PDF viewer to read this manual. You can turn the pages of the manual as if it were a book, using the back and forward buttons in your viewer. These buttons should look something like this:

back

forward

You can also print the entire manual for reading away from your computer. Look for a print button similar to this:

print

For your first introduction to PicoScope, we suggest that you start with these topics:

- Using PicoScope for the first time 6
- Oscilloscope basics 7
- PCO basics 8
- PicoScope basics 8

3.4 System requirements

PicoScope 6.0 runs on any Windows computer with the following specifications.

Operating system	Windows 98SE, ME, 2000 or XP
Processor	Any 32-bit Intel or Intel-compatible CPU
RAM	At least 256 MB

4 Using PicoScope for the first time

We have designed PicoScope to be as easy as possible to use, even for newcomers to oscilloscopes. Once you have followed the introductory steps listed below, we hope that you will soon become a PicoScope expert.

1. Install the software. Load the CD-ROM that is included with your scope device, then click the "Install Software" link and follow the on-screen instructions.

2. Plug in your scope device. Windows will recognise it and make the necessary changes to allow your computer to work with it. Wait until Windows tells you that the device is ready to use.

3. Click the new PicoScope icon on your Windows desktop.

4. PicoScope will detect your scope device and configure itself, ready to display a waveform. The green Start button will be highlighted to show that PicoScope is ready.

5. Connect a signal to one of the scope device's input channels and see your first waveform!

"It didn't do what I expected!"

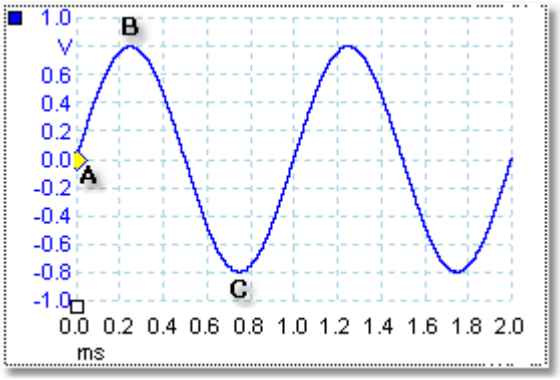
Help is at hand! Our technical support staff are always ready to answer your telephone call during office hours (see our Contact Details 5). At other times, you can contact our support forum or send us an email.

5 PicoScope and oscilloscope primer

This chapter explains the fundamental concepts that you will need to know before working with the PicoScope software. If you have used an oscilloscope before, then most of these ideas will be familiar to you. If not, please take a few minutes to read at least the "Oscilloscope basics 7" and "PicoScope basics 8" topics, and then return here to read the more detailed topics in this chapter when you need them.

5.1 Oscilloscope basics

An oscilloscope is a measuring instrument that displays a graph of voltage against time. For example, the picture below shows a typical display on an oscilloscope screen when a varying voltage is connected to one of its input channels.



Oscilloscope displays are always read from left to right. The blue line, called the "trace", begins at point A, where the voltage is 0.0 volts. At point B, 0.25 milliseconds later, the voltage has risen to its positive peak of 0.8 volts. At point C, 0.75 milliseconds after the start, the voltage has dropped to its negative peak of -0.8 volts. After 1 millisecond, the voltage has risen back to 0.0 volts and a new cycle is about to begin. This type of signal is called a sine wave, and is one of a huge number of signal types that you will encounter.

All oscilloscopes allow you to adjust the vertical and horizontal scales of the display. The vertical scale is called the voltage range (in the most common case, when the signal is measured in volts). The horizontal scale is called the time base and is measured in seconds or, as in this example, fractions of a second.

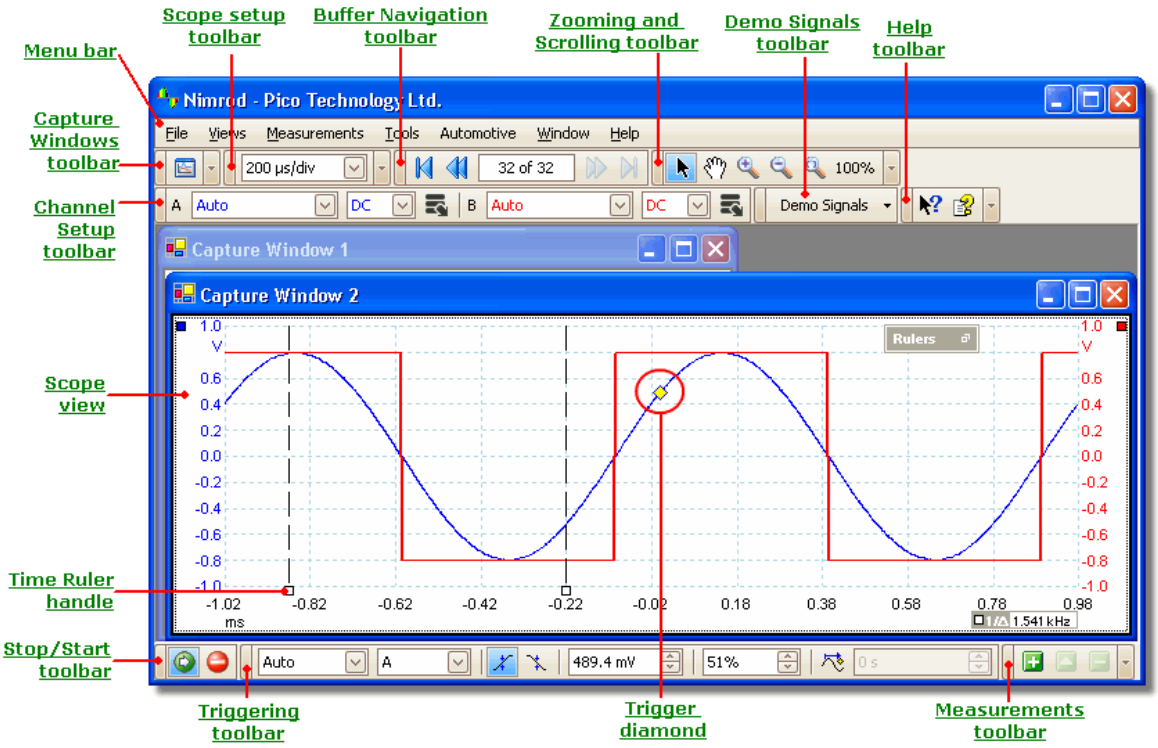
5.2 PCO basics

A PC Oscilloscope (PCO) is an oscilloscope 7 that consists of a scope device and a PC running a special software program. Oscilloscopes were introduced long before digital computers existed, and were self-contained electronic instruments with limited abilities. Later, oscilloscopes began to use the new digital technology to introduce more functions, but they remained highly specialised and expensive instruments. PC Oscilloscopes are the latest step in the evolution of oscilloscopes, combining the measuring power of Pico Technology's scope devices with the convenience of the PC that's already on your desk.

PC scope device PCO

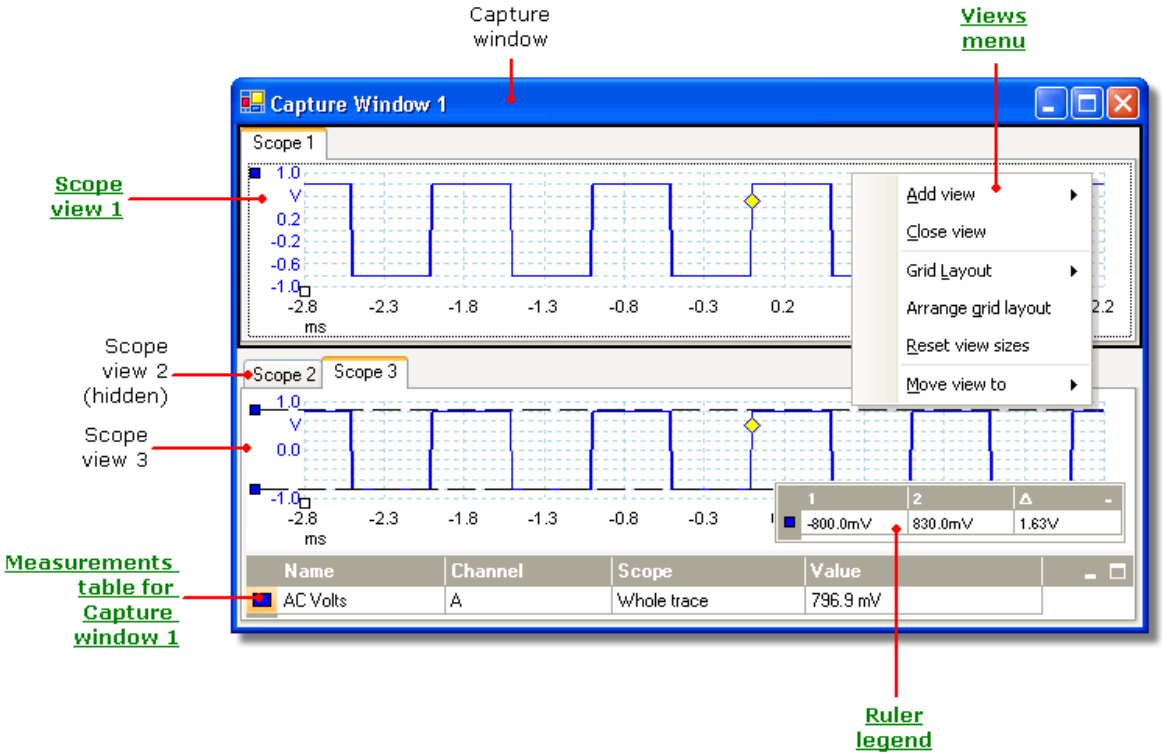
5.3 PicoScope basics

PicoScope can simple waveforms such as the example we saw in the "Oscilloscope basics 7" topic, but also has many advanced features. The screen shot below shows the main window of PicoScope, which in this case contains two capture windows 9. Click on any of the underlined labels to learn more. Also, please see "Windows, views and viewports" 18 for an explanation of these important concepts.



5.4 Capture window

A capture window shows a block of data captured from a single scope device. When you first open a capture window it contains one scope view, but you can add more views by clicking Add view in the Views menu. The screen shot below shows all the main features of a capture window. Click on the underlined labels for more information.



To open a new capture window

Click the capture window button in the capture window toolbar, or select the Create New Scope Window command in the File menu. PicoScope can display many capture windows, but only one window can be "in focus" at any time. Any commands you issue — by clicking on buttons, for example — will affect only this window. To bring a window into focus, just click on it.

To arrange the scope views within the capture window

If the capture window contains more than one scope view, then PicoScope will arrange them in a grid. This is laid out automatically, but you can customize it if you wish. Each location in the grid is called a viewport. You can move a view to a different viewport by dragging its name tab (show me), but you cannot move it outside the capture window that it belongs to. You can also put more than one view in a viewport, by dragging a view and dropping it on top of another.

For further options, right-click on a view to obtain the View menu, or select View from the Menu bar, then select one of the menu options to arrange the views.

5.5 Custom probes

A probe is any connector, transducer or measuring device that you connect to the input channel of your scope device 68. PicoScope has a built-in library of common probe types, such as the x1 and x10 voltage probes used with most oscilloscopes, but if your probe is not included in this list you can use the Custom Probes dialog 27 to define a new one. Custom probes can have any voltage range within the capabilities of the oscilloscope, display in any units, and have either linear or nonlinear characteristics.

Custom probe definitions are particularly useful when you wish to display the probe's output in units other than volts, or to apply linear or nonlinear corrections to the data.

5.6 Frequency legend

The frequency legend appears when you have placed two time rulers 15 on a scope view 14. It shows 1/Δ in hertz, where Δ is the time difference between the two rulers. You can use this to estimate the frequency of a periodic waveform, but you will get more accurate results by creating a frequency measurement using the Add Measurements button on the Measurements toolbar 52.

5.7 Measurements table

A measurements table contains the automatic measurements that you have instructed PicoScope to make on a particular view. 14 You can add, delete or edit measurements from this table.

To add a measurement

Click the Add Measurement button on the measurements toolbar 52.

To delete a measurement

Select a measurement in the table by clicking once on it, and then click the Delete Measurement button on the measurements toolbar 52. If you delete the only measurement in the table, the table will be removed.

To edit a measurement

If the measurement you wish to edit is selected, click the Edit Measurement button on the measurements toolbar 52. Otherwise, double-click on the measurement.

To change the width of a measurement column

Drag the column's border to create the column width you need. The cursor will change to a column resize symbol as shown here.

5.8 Oversampling

Oversampling is a technique of capturing samples *n* times faster than the requested sampling rate, then replacing each group of *n* adjacent samples with the average of that group. If the signal contains a small amount of noise, the result of oversampling is a waveform with increased effective resolution. The amount of oversampling available depends on how fast your scope device 68 can sample.

Procedure

- First make sure that the Oversampling control is displayed on the Scope Setup toolbar 53. If it is not, add this control to the toolbar as explained in the "Toolbars 44" topic.
- Use the Oversampling control to adjust the oversampling factor (*n*). PicoScope allows oversampling factors in the range 1 (no oversampling) to 256.

How to choose the oversampling factor

To obtain an increase in effective resolution of n bits, you should choose an oversampling factor of 4^n. Conversely, an oversampling factor of *f* will give an increase in effective resolution of log(*f*) / *n* log(4).

For example, if a scope device has a stated resolution of 8 bits, then an oversampling factor of 4 will, under ideal conditions, increase this to 9 bits. An oversampling factor of 16 will increase the effective resolution to 10 bits, and a factor of 256 will increase it to 12 bits.

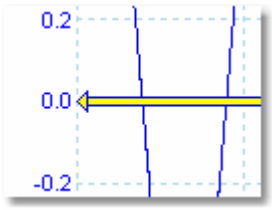
These calculations assume that the noise is Gaussian (follows a normal distribution). This is approximately true for noise from natural sources, such as thermal noise in resistors and sensors, but not be true for man-made noise such as radio interference and mains (line) hum. The scope device itself often produces enough low-amplitude noise to make oversampling successful.

The benefit of oversampling comes at the cost of having to increase the sampling rate. If your scope device is already running at its maximum sampling rate in order to capture high-frequency details in the signal, then it will not be able to oversample.

5.9 Post-trigger arrow

The post-trigger arrow appears temporarily while you are setting up a post-trigger delay, or dragging the trigger marker after setting up a post-trigger delay. (What is a post-trigger delay? 66)

The left-hand end of the arrow indicates the trigger point, and is aligned with zero on the time axis. If zero on the time axis is outside the scope view, then the left-hand end of the post-trigger arrow appears like this:

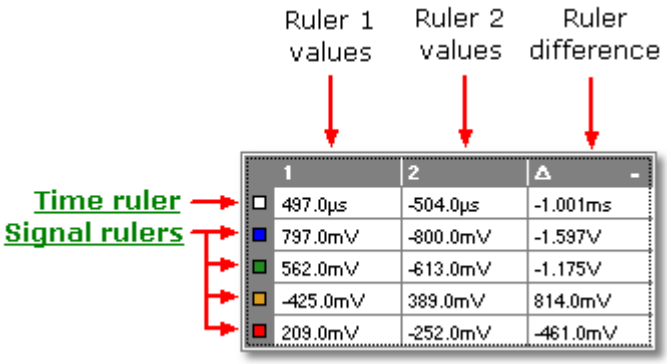


The right-hand end of the arrow (temporarily replacing the trigger marker 16) indicates the trigger reference point.

Use the buttons on the Triggering toolbar 57 to set up a post-trigger delay.

5.10 Ruler legend

The ruler legend displays the positions of all the rulers 68 you have placed on the scope view 14. It appears automatically whenever there is a ruler on the screen.



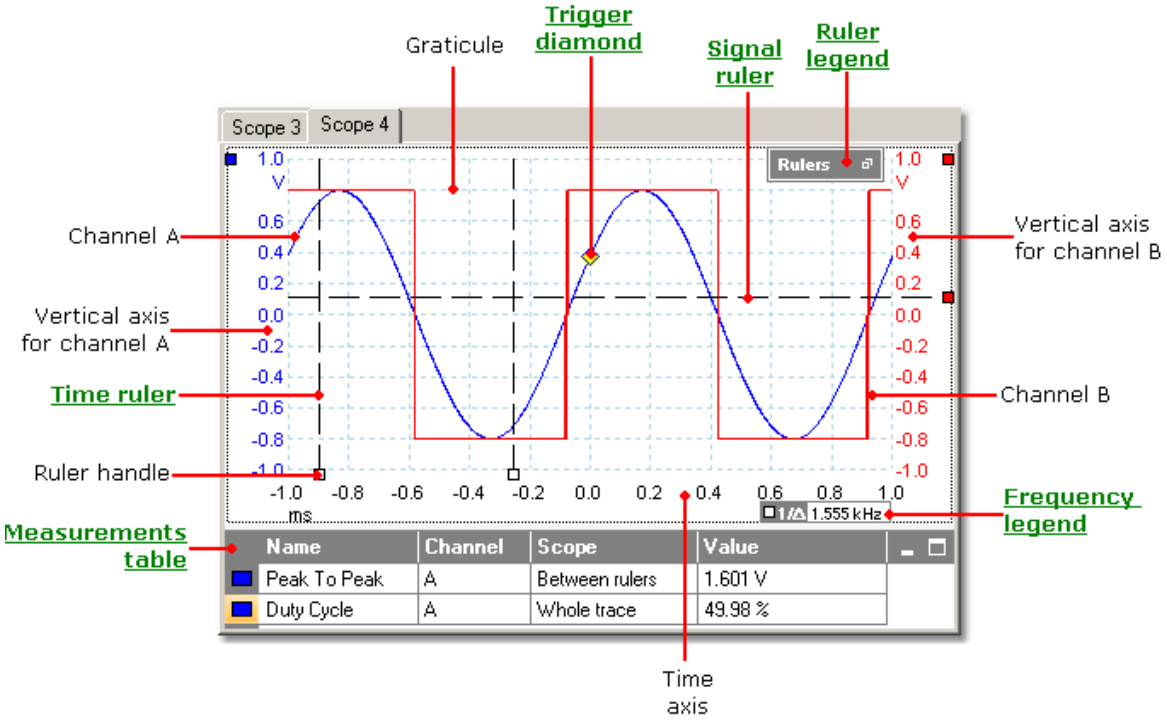
For a reminder of which row refers to which signal, point using the mouse to one of the colour-coded boxes in the left-hand margin and a label will appear, like this: Channel A.

You can drag the legend around the scope view, resize it by dragging one of its edges, or minimise it by clicking the minimise button - in the top right-hand corner.

See also: frequency legend 10 (which shows 1/Δ, where Δ is the time difference).

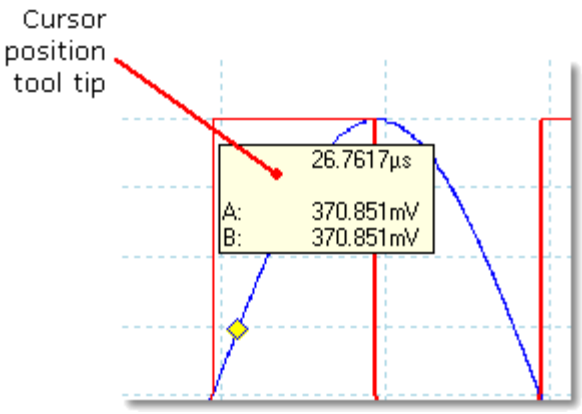
5.11 Scope view

A scope view is one view of the data belonging to a capture window [9]. Each capture window opens with a single view, but you can add more views by using the views menu. Similar to the screen of a conventional oscilloscope, a scope view shows you one or more waveforms with a common time axis. A waveform is a diagram of signal level on a vertical axis plotted against time on the horizontal axis. Each view can have as many waveforms as the scope device has channels. Click on one of the labels below to learn more about a feature.



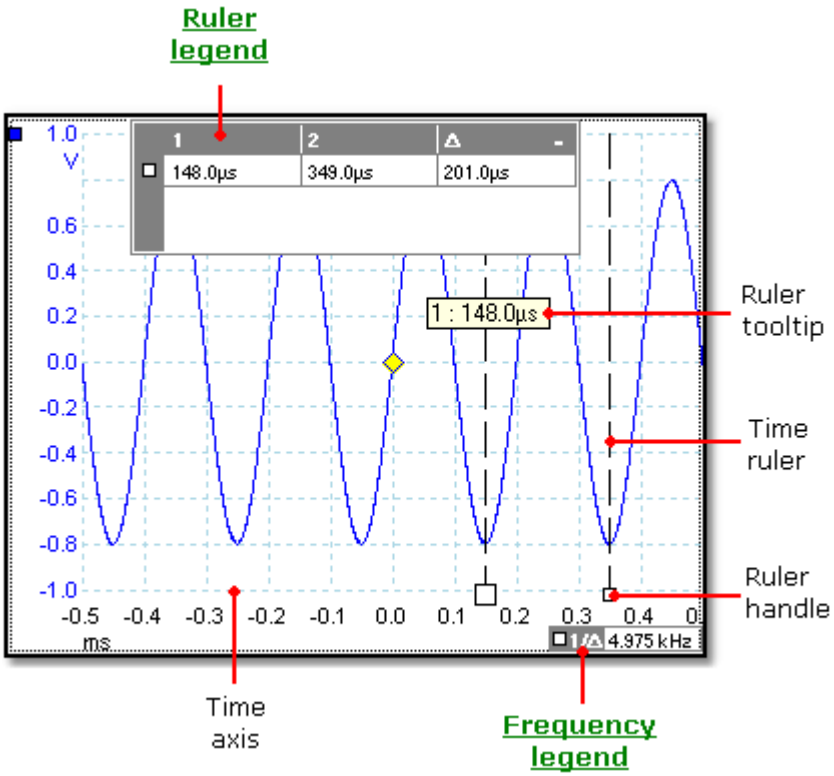
5.12 Cursor position tool tip

The cursor position tool tip is a box that displays the signal and time values at the cursor. It appears temporarily when you click the background of a scope view [14].



5.13 Time rulers

The time rulers measure time on a scope view 14 or frequency on a spectrum view (if available).



In the scope view 14 above, the two white squares on the time axis are the time ruler handles. You can drag these from the bottom left corner to the positions on the time axis you want to measure. The two vertical dashed lines are the time rulers.

Ruler tool tip

If you point to one of the rulers, as we have done in the example above, PicoScope displays a tool tip with the ruler number and the time value of the ruler.

Ruler legend

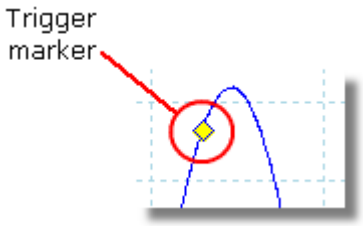
The table at the top of the view is the ruler legend. In this example, the table shows that time ruler 1 is at 148.0 microseconds, ruler 2 is at 349.0 microseconds and the difference between them is 201.0 microseconds.

Frequency legend

The frequency legend in the bottom right-hand corner shows 1/Δ, where Δ is the time difference between the two rulers. 1/Δ is 4.975 kilohertz in this example. The accuracy of this calculation depends on the accuracy with which you have positioned the time rulers. For greater accuracy with periodic signals, use the frequency measurement 63 function built in to PicoScope.

5.14 Trigger marker

The trigger marker shows the level and timing of the trigger point.



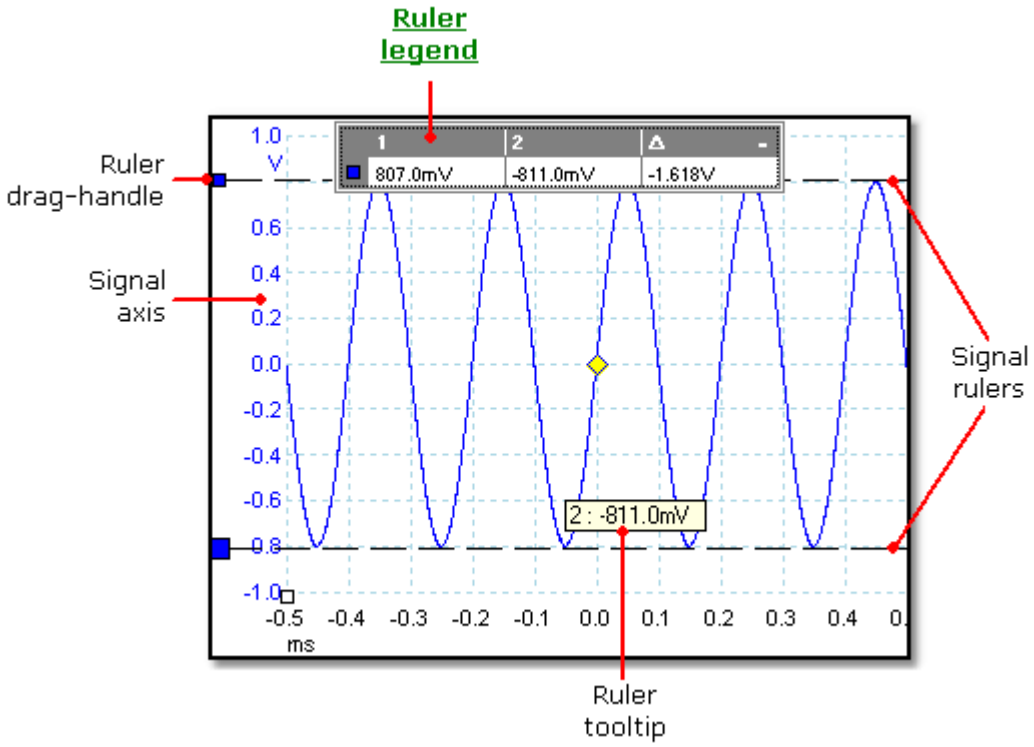
The height of the marker on the Y axis shows the level at which the trigger is set, and its position on the X axis shows the time at which it occurs.

You can move the trigger marker by dragging it with the mouse or, for numerical control, use the buttons on the Triggering toolbar 57.

In post-trigger delay mode, the trigger marker is temporarily replaced by the post-trigger arrow 13 while you adjust the post-trigger delay.

5.15 Signal rulers

The signal rulers are to help you measure signal levels with respect to ground, or signal differences, on a scope view 14.



In the scope view 14 above, the two coloured squares to the left of the vertical axis are the ruler drag-handles. You can drag these from the top-left corner to the positions you want to measure on the waveform. The two horizontal dashed lines are the signal rulers.

Ruler legend

The table at the top of the view is the ruler legend. In this example, the table shows that ruler 1 is at 807 millivolts, ruler 2 is at -811.0 millivolts and the difference between them is -1.618 volts. If you prefer to see the difference as a positive value, swap the positions of the two rulers by dragging them.

Ruler tooltip

If you move the mouse pointer over one of the rulers, PicoScope displays a tooltip 68 with the ruler number and the signal level of the ruler. You can see an example of this in the picture above.

5.16 Windows, views and viewports

PicoScope's display area contains one or more capture windows 9. Each one corresponds to a block of data captured from a scope device 68. The simplest case is a single scope device that produces a single capture, with the result shown in a single capture window.

A capture window contains one or more views 14. When you first open a capture window, it contains a single view. You can zoom and pan 58 this to show various different waveforms based on the data that the scope device captured. If you wish, you can add more views to a capture window (how?). Each view is a differently zoomed and panned section of the same capture.

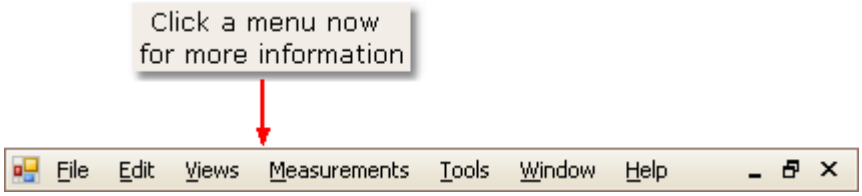
Multiple views in a capture window are always arranged in a grid. Each location in the grid is called a viewport, and can be empty or occupied by one or more views.

Upgrading from PicoScope 5

PicoScope 5 allowed you to have multiple scope views. PicoScope 6.0 retains this ability, although it calls them capture windows. 9 The views 14 feature is new to PicoScope 6.0.

6 Menus

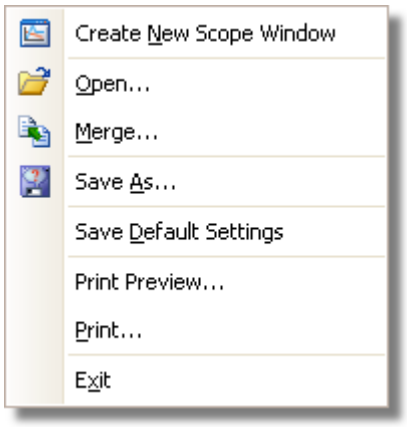
Menus are the quickest way to get to PicoScope's main features. The Menu bar is always present at the top of the PicoScope main window, just below the window's title bar. You can click any of the menu items, or press the Alt key and then navigate to the menu using the cursor keys, or press the Alt key followed by the underlined letter in one of the menu items.



The list of items in the menu bar may vary depending on the windows that you have open within PicoScope.

6.1 File menu

Click File on the Menu bar 19.



Create New Scope Window. This command is equivalent to the New Capture Window button on the Capture Windows toolbar 45. If PicoScope has not yet found a scope device, it will first open the Open Device dialog 46 to ask you which scope device 68 to use; otherwise, it will assume that you wish to use the same scope device as was used for the previous capture window. PicoScope will then open a new capture window 9 for the chosen scope device, and will fill the window with a new scope view 14. You can open up to five capture windows.

Open. Allows you to select the file you want to open. PicoScope can open `*.psdata` and `*.psd` files, which contain both waveform data and scope device settings, and `*.pssettings` and `*.pss` files, which contain only scope device settings. You can create your own files using the Save and Save As... commands, described below. If the file was saved using a different scope device from the one that is presently connected, PicoScope may need to modify the saved settings to suit the present device.

Opening a new file will close any capture windows that are currently open.

Merge. Opens a settings or waveforms file without closing any that are currently open. You cannot exceed a total of ten capture windows.

Save As. Opens the Save As dialog 21, which allows you to save the settings and waveforms for all capture windows 9 in various formats.

Save Default Settings. Saves the current settings so that they become the defaults. The new default settings will then be loaded the next time you start PicoScope.

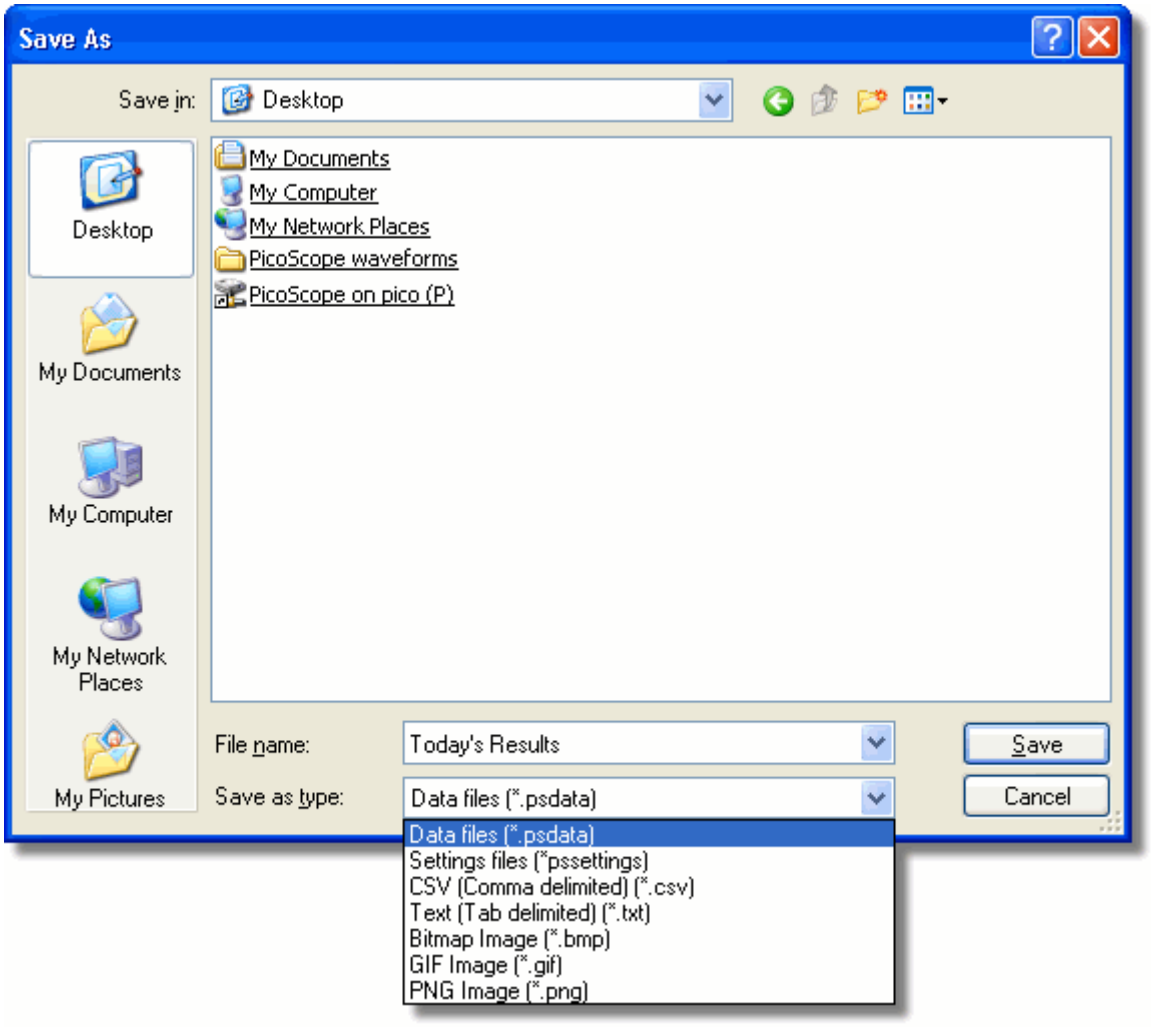
Print Preview. Opens the Print Preview window, which allows you to see how your workspace will be printed when you select the Print command.

Print. Opens a standard Windows Print dialog, which allows you to choose a printer, set printing options and then print the selected view.

Exit. Close PicoScope without saving any data.

6.1.1 Save As dialog

The Save As dialog allows you to save your waveforms and settings to a file in various formats. To open it, go to the File menu 20 and click "Save As".



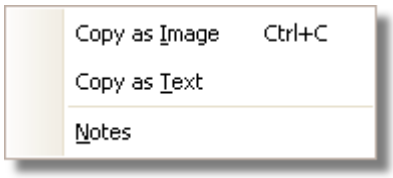
Type your chosen file name in the "File name" box, and then select a file format in the "Save as type" box. You can save data in the following formats:

Data files (*.psdata)	Stores all waveforms and settings from the current scope device. Can be opened on any computer running PicoScope.
Settings files (*.pssettings)	Stores all settings (but not waveforms) from the current scope device. Can be opened on any computer running PicoScope.
CSV (Comma delimited) (*.csv)	Stores waveforms as a text file with comma-separated values. This format is suitable for importing into spreadsheets such as Microsoft Excel. The first value on each line is the time stamp, and it is followed by one value for each active channel.

Text (Tab delimited) (*.txt)	Stores waveforms as a text file with tab-separated values. The values are the same as those in the CSV format.
Bitmap Image (*.bmp)	Stores the graticule 68, rulers 68 and waveforms in Windows bitmap format. The image is 800 pixels wide by 600 pixels high, in 16 million colours, and uncompressed. BMP files are suitable for importing into Windows desktop publishing programs.
GIF Image (*.gif)	Stores the graticule 68, rulers 68 and waveforms in Compuserve GIF format. The image is 800 pixels wide by 600 pixels high, in 256 colours, and compressed. GIF files are widely used to illustrate web pages.
PNG Image (*.png)	Stores the graticule 68, rulers 68 and waveforms in Portable Network Graphics format. The image is 800 pixels wide by 600 pixels high, in 16 million colours, and compressed.

6.2 Edit menu

Click Edit on the Menu bar 19.



Copy as Image. Copies the active view to the clipboard as a bitmap. You can then paste the image into any application that accepts bitmap images.

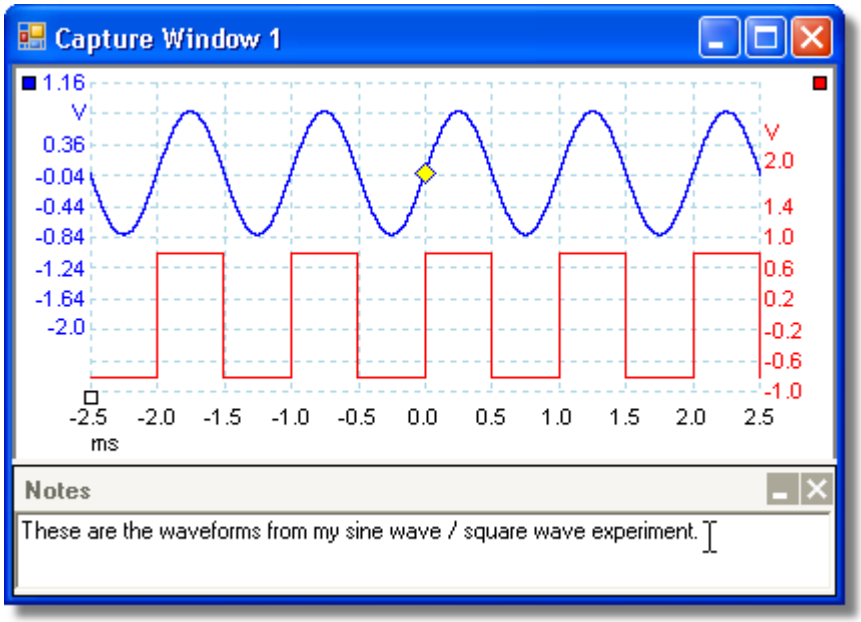
Copy as Text. Copies the data in the active view to the clipboard as text. You can paste the data into a spreadsheet or other application. The text format is the same as that used by the Save As *.txt command, and is explained in the Save As dialog 21 topic.

Notes. Opens a Notes area 23 at the bottom of the active capture window. You can enter any explanatory text that you wish to in this area.

6.2.1 Notes area

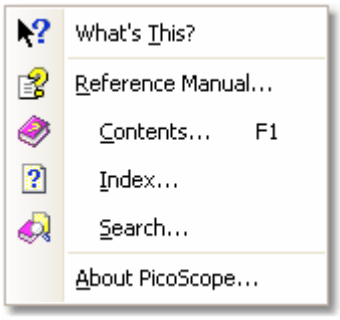
A Notes area can be displayed at the bottom of any capture window. You can enter any text you wish in this area.

To display the Notes area, click on the Edit menu, then select Notes.



6.3 Help menu

Click Help on the Menu bar 19.



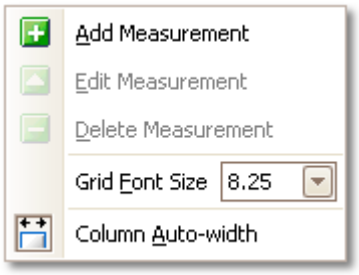
What's This? Select this item, then click on a toolbar button to see a brief help message on that button. The toolbar must be *docked* - that is, attached to the main window - to work with What's This?

Reference Manual. This is the main help manual, containing information on every menu item, button and dialog in the program.

About PicoScope... Shows information about this version of PicoScope.

6.4 Measurements menu

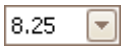
Click Measurements on the Menu bar 19.



Add measurement. Adds a row to the measurements table 11, and opens the Edit Measurement Dialog 26. You can also find this button on the Measurements toolbar 52.

Edit measurement. This takes you to the Edit Measurement Dialog 26. You can find this button on the Measurements toolbar 52, or you can edit a measurement by double-clicking on a row of the measurements Table 11.

Delete measurement. Removes the selected row from the measurements table 11. You can also find this button on the Measurements toolbar 52.

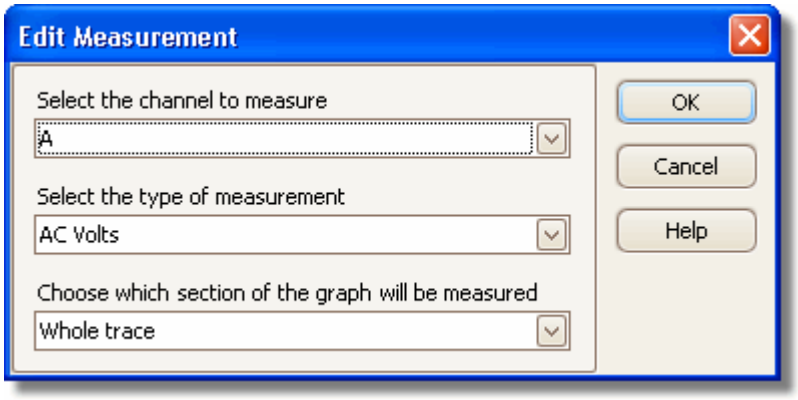


Grid font size. Sets the font size for the entries in the measurements table 11.

Column Auto-width. If this button is pressed, the columns of the measurements table 11 will continually adjust to fit the contents whenever the table changes. Click again to release the button.

6.4.1 *Add / Edit Measurement dialog*

This dialog allows you to add a measurement of a waveform to the selected capture window 9, or edit an existing measurement. PicoScope automatically refreshes the measurement every time it updates the waveform. If this is the first measurement for the capture window, PicoScope will create a new measurements table 11 to display the measurement; otherwise, it will add the new measurement to the bottom of the existing table.



Where to find it

Click the Add Measurement or Edit Measurement button on the Measurements toolbar 52 or in the Views menu, or double-click a measurement in the measurements table 11.

Channel: Select one of the scope device 68's channels to measure.

Type: PicoScope can calculate a wide range of measurements for waveforms. See Measurement Types 63 for details.

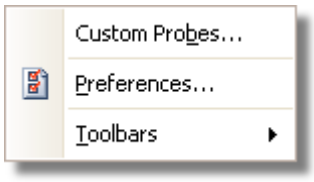
Section: You can measure the whole trace, just the section between rulers 68, or a single cycle that you point to using one of the rulers.

Where to find it

Click the Edit Measurement button on the Measurements toolbar 52 or in the Views menu,

6.5 Tools menu

Click Tools on the Menu bar 19.



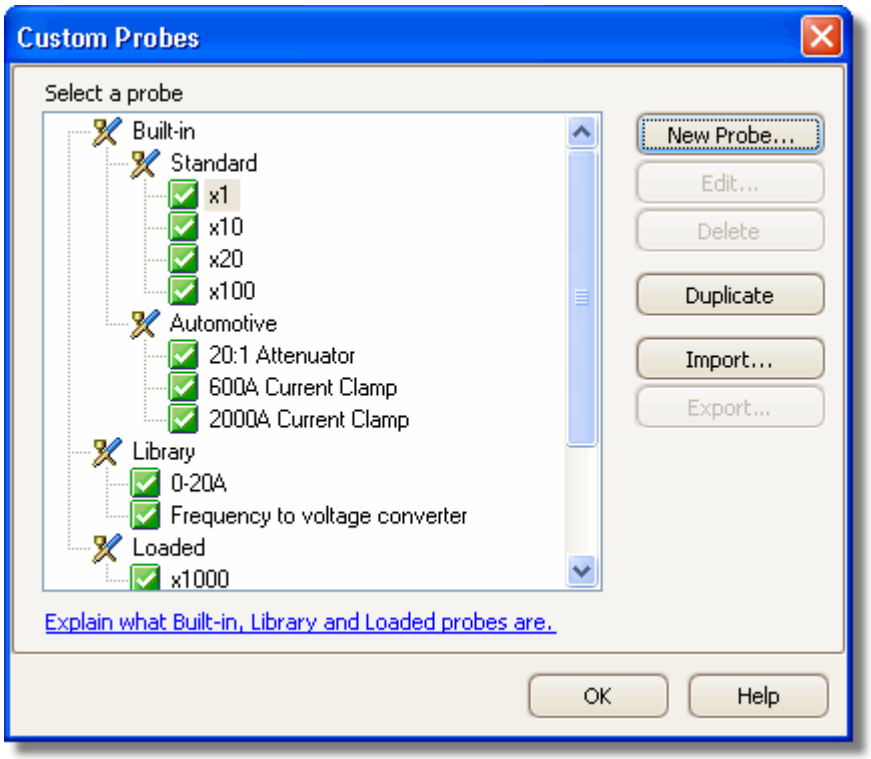
Custom Probes: Opens the Custom probes 27 dialog, which allows you to define new probes and copy, delete, move and edit existing ones.

Preferences: Opens the Preferences dialog 40, which contains various options that control PicoScope's behaviour.

Toolbars. Opens the Toolbar menu 42, which allows you to control which toolbars 44 appear and which are hidden.

6.5.1 Custom Probes dialog

This dialog allows you to define your own probes and set up custom probes 10. To open this dialog, choose Custom Probes in the Tools menu 27 or click the Channel Advanced Options button.



Understanding the probe list

All the probes that PicoScope knows about are listed under three main headings: Built-in, Library and Loaded. The probe list is preserved between sessions, so that PicoScope will never forget your custom probes unless you delete them.

- Built-in probes. The built-in probes are supplied by Pico Technology and do not change unless you download an authorised update from us. As a safeguard, PicoScope does not allow you to edit or delete these probes. If you want to modify one of them, you can copy it to your library by clicking Duplicate, and then edit the copy in your library.
- Library probes. These are the probes that you have created using any of the methods described in this topic. You can edit, delete or duplicate any of these probes by clicking the appropriate button in this dialog.
- Loaded probes. Probes in PicoScope data files (*.psdata) or settings files (*.pssettings) that you have opened appear here until you copy them to your library. You cannot edit or delete these probes directly, but you can click Duplicate to copy them to your library where you can edit them. You can also import probes from the custom ranges stored in PicoScope 5 *.psd and *.pss files, but these lack many of the features provided by PicoScope 6. (See "Upgrading from PicoScope 5 2" for more details.)

Adding a new probe to your library

There are three ways to create a new probe:

1. Create a duplicate of an existing probe as described above.

2. Click New Probe... to define a new probe.

3. Click Import to load a probe definition from a *.psprobe file and add it to your library. These files are normally supplied by Pico, but you can also create your own by defining a new probe and then clicking Export.

The second and third methods open the Custom Probe Wizard 28 to guide you through the probe definition process.

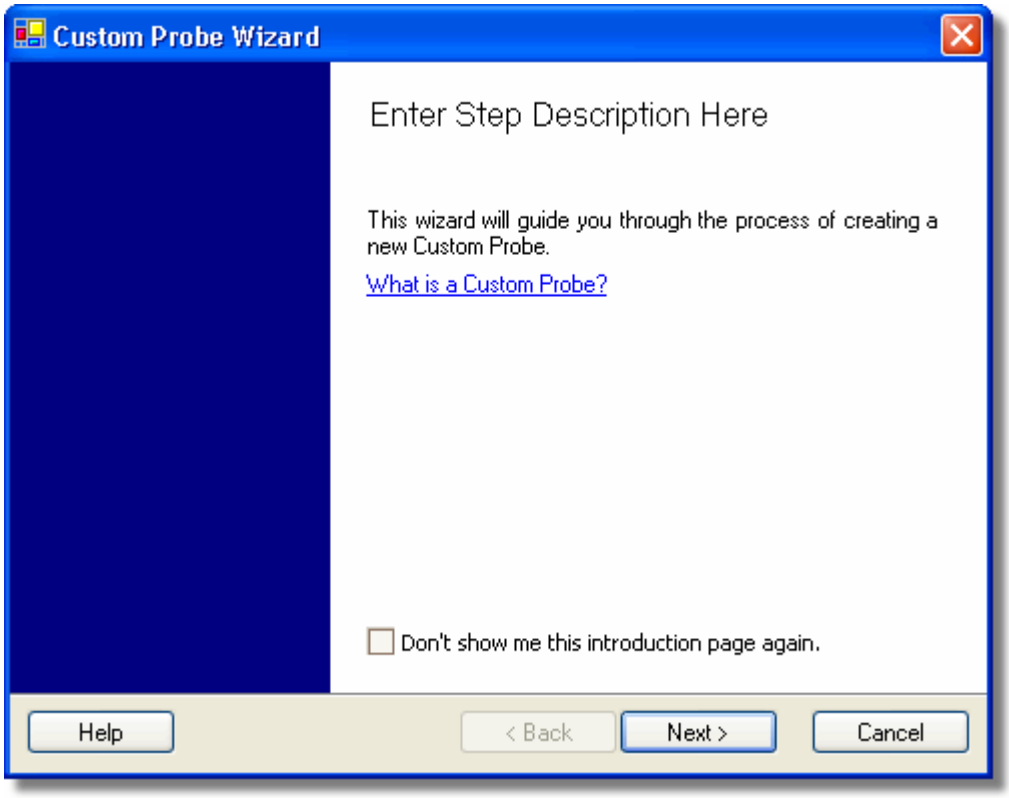
6.5.2 Custom Probe wizard

The Custom probe wizard allows you to define custom probes 10 and set up custom ranges.

The first dialog in the series is either the Create a new Custom Probe dialog 29 or the Edit an existing Custom Probe dialog 30.

6.5.2.1 Create New Custom Probe dialog

This dialog introduces you to the process for creating a new custom probe. To open it, click the New Probe button in the Custom Probes dialog 27.

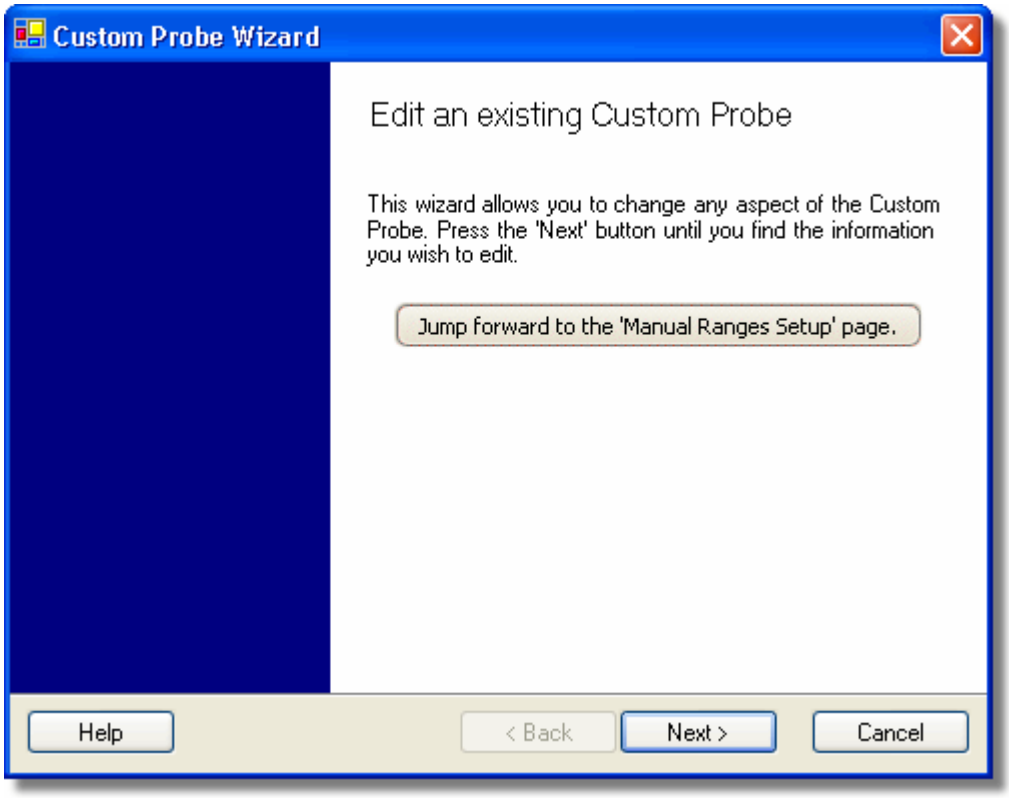


How to use the dialog

Click Next to continue to the Probe Output Units dialog 31.

6.5.2.2 *Edit Existing Custom Probe dialog*

This dialog introduces you to the process for editing an existing custom probe. Get here by clicking the Edit button in the Custom Probes dialog 27.



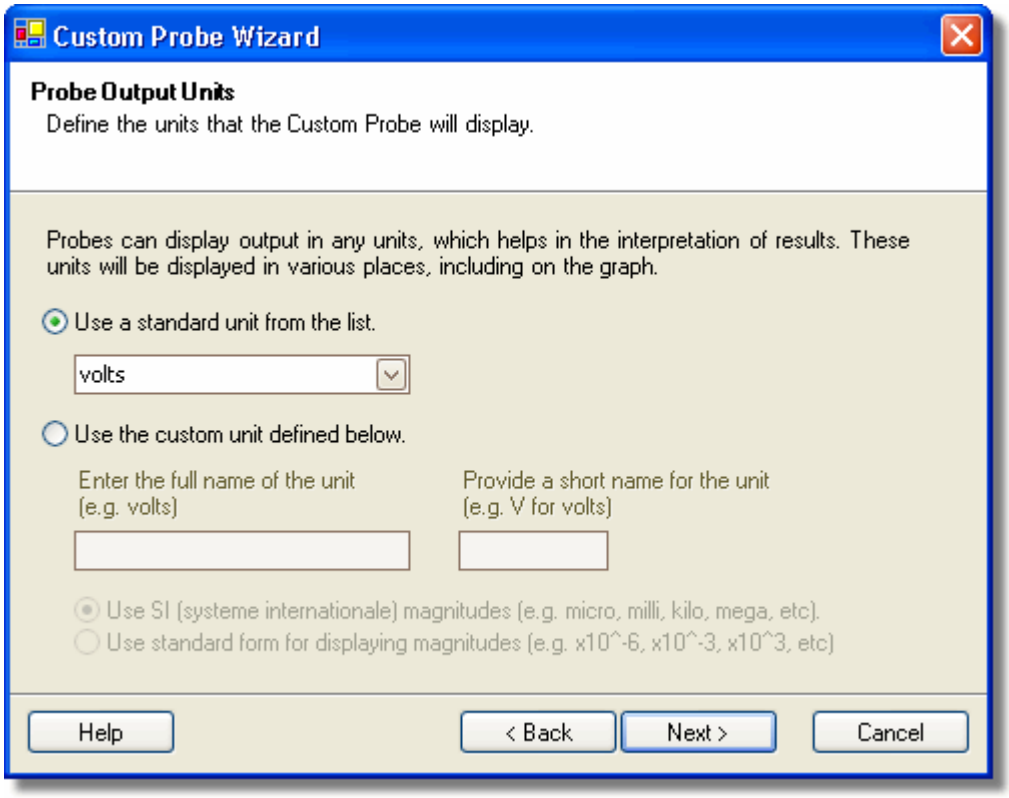
How to use the dialog

Click Next to continue to the Probe Output Units dialog 31, where you can edit the custom probe.

Click Jump forward... if you have already set up the custom probe's basic characteristics and want to add or change a custom range manually.

6.5.2.3 Probe Output Units dialog

This dialog follows the Create new Custom Probe dialog 29. It allows you to choose the units that PicoScope will use to display the output of your custom probe 68.



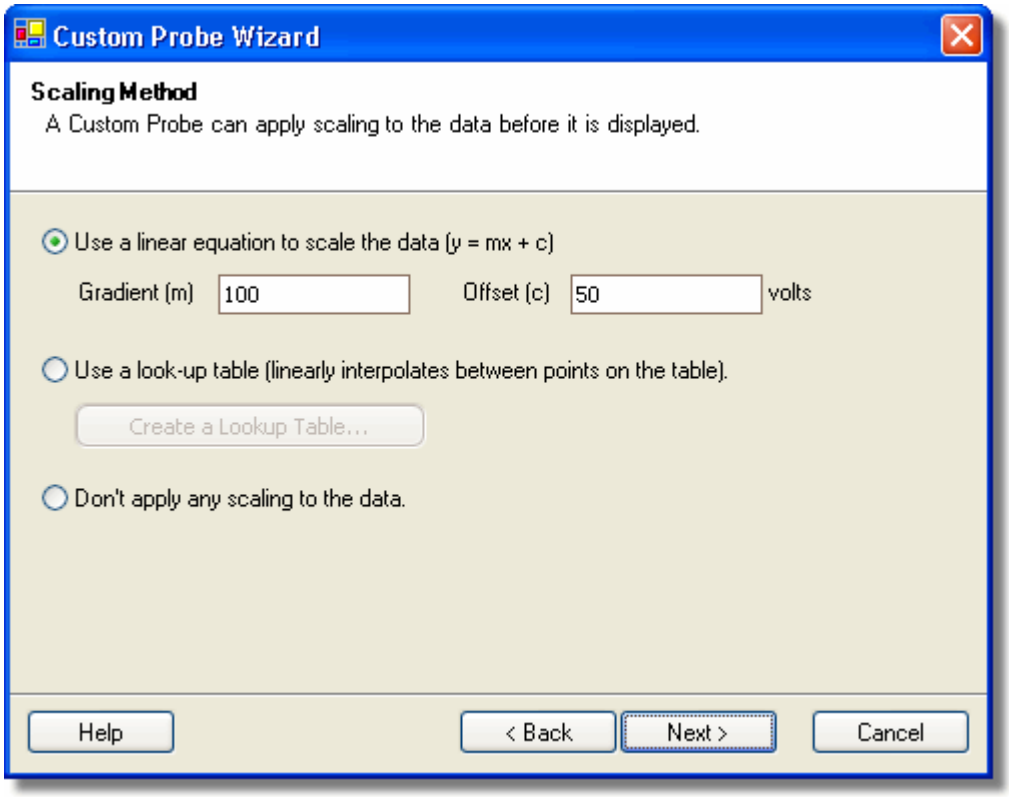
How to use the dialog

- To choose a standard SI unit, click Use a standard unit from the list and select one from the list.
- To enter a custom unit, click Use the custom unit defined below and type the unit name and symbol.

- Click Next to continue to the Scaling Method dialog 32.
- Click Back to return to the Create New Custom Probe dialog 29 if this is a new probe, or the Edit Existing Custom Probe dialog 30 if this is an existing probe.

6.5.2.4 *Scaling Method dialog*

This dialog follows the Probe Output Units dialog 31. It allows you to define the characteristic that PicoScope will use to convert the probe's voltage output to a measurement on the display.

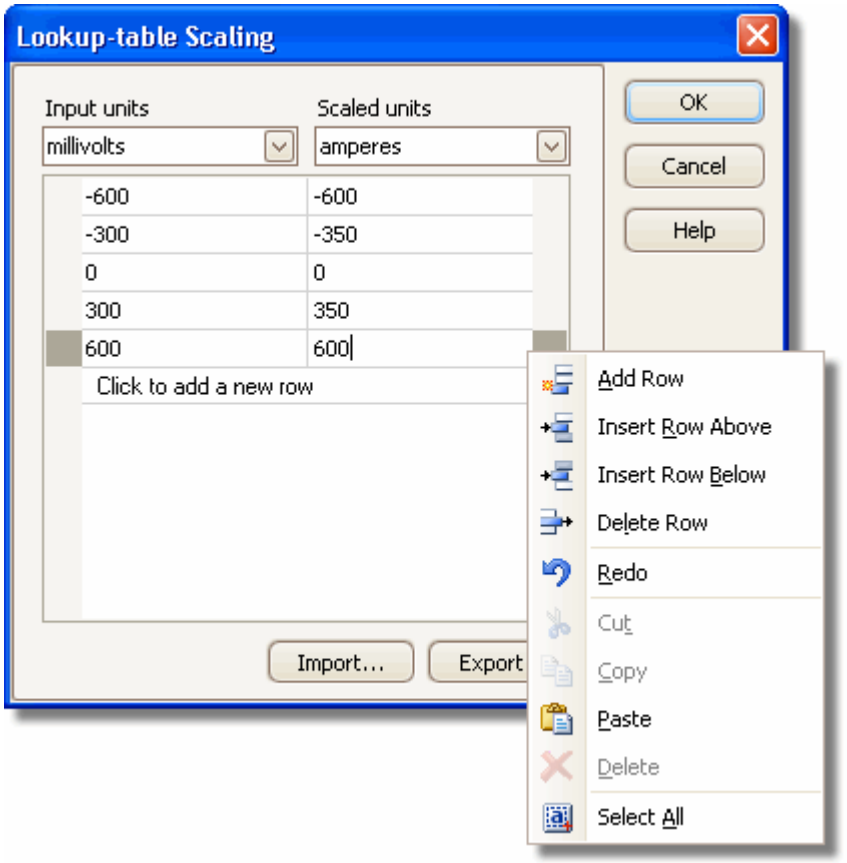


How to use the dialog

- If you do not require any scaling or offset, click the Don't apply any scaling button.
- If the probe requires linear scaling, click the Use a linear equation button and enter the gradient (or scale factor) *m* and the offset *c* in the equation $y = mx + c$, where *y* is the displayed value and *x* is the probe's voltage output.
- If you wish to apply a nonlinear function to the probe's output, choose Use a look-up table..., then click the Create a Lookup Table... button to create a new lookup table. This will take you to the Lookup-table Scaling dialog 33.
- Click Next to continue to the Range Management dialog 34.
- Click Back to return to the Probe Output Units dialog 31.

6.5.2.4.1 Lookup-table Scaling dialog

This dialog allows you to enter a look-up table to calibrate a custom probe. You can get here by clicking the Create a Look-up Table button or Edit the Lookup Table... button in the Scaling Method dialog 32.



Editing the Look-up Table

First, select suitable values in the Input units and Scaled units drop-down boxes. For example, if your probe is a current clamp that outputs one millivolt per ampere over the range -600 to +600 amperes, select Input units of millivolts and Output units of amperes.

Next, enter some data in the scaling table. Click the first empty cell at the top of the table and type "-600", then hit the Tab key and type "-600". When you are ready to enter the next pair of values, press the Tab key again to start a new row. You can also right-click on the table to obtain a more detailed menu of options, as shown in the picture. In the example above, we have entered a slightly nonlinear response; if the response had been linear then it would have been easier to use the linear option in the Scaling Method Dialog 32.

Import/Export

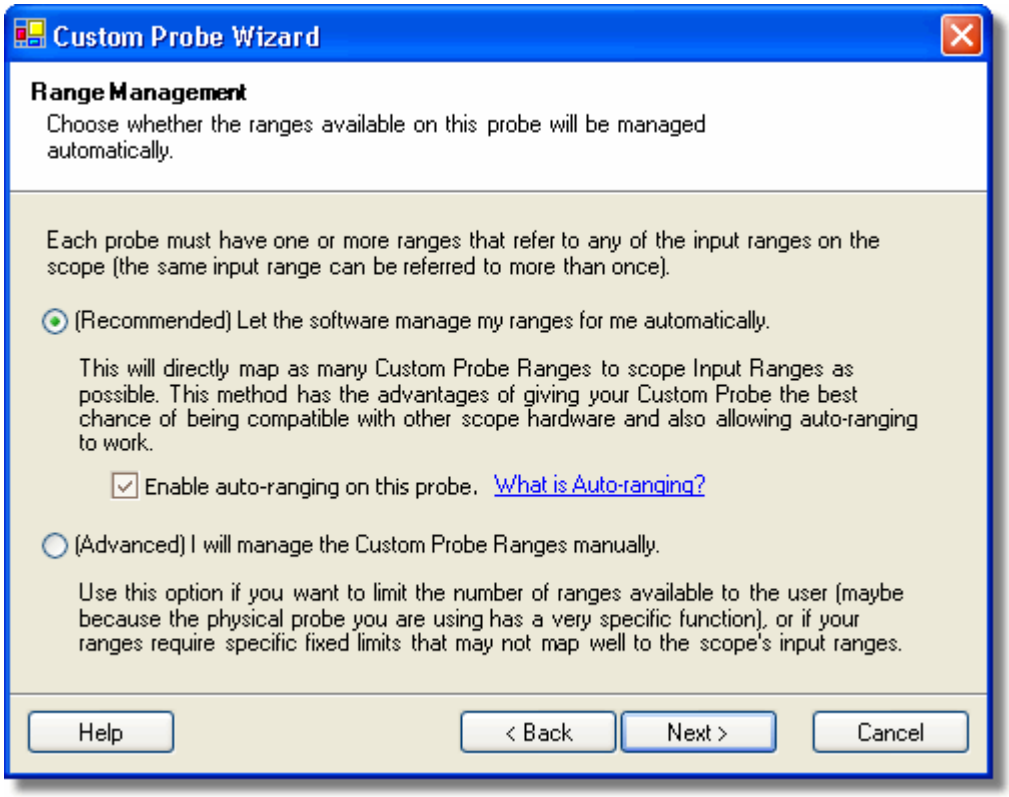
Using the Import and Export buttons, you can fill the look-up table from data in a comma-separated or tab-delimited text file, and save the look-up table to new file.

Finishing

Clicking OK or Cancel will return you to the Scaling Method dialog 32.

6.5.2.5 *Range Management dialog*

This dialog follows the Scaling Method dialog 32. It allows you to override PicoScope's automatic range-creation feature for custom probes. In most cases, the automatic procedure will be ideal.



How to use the dialog

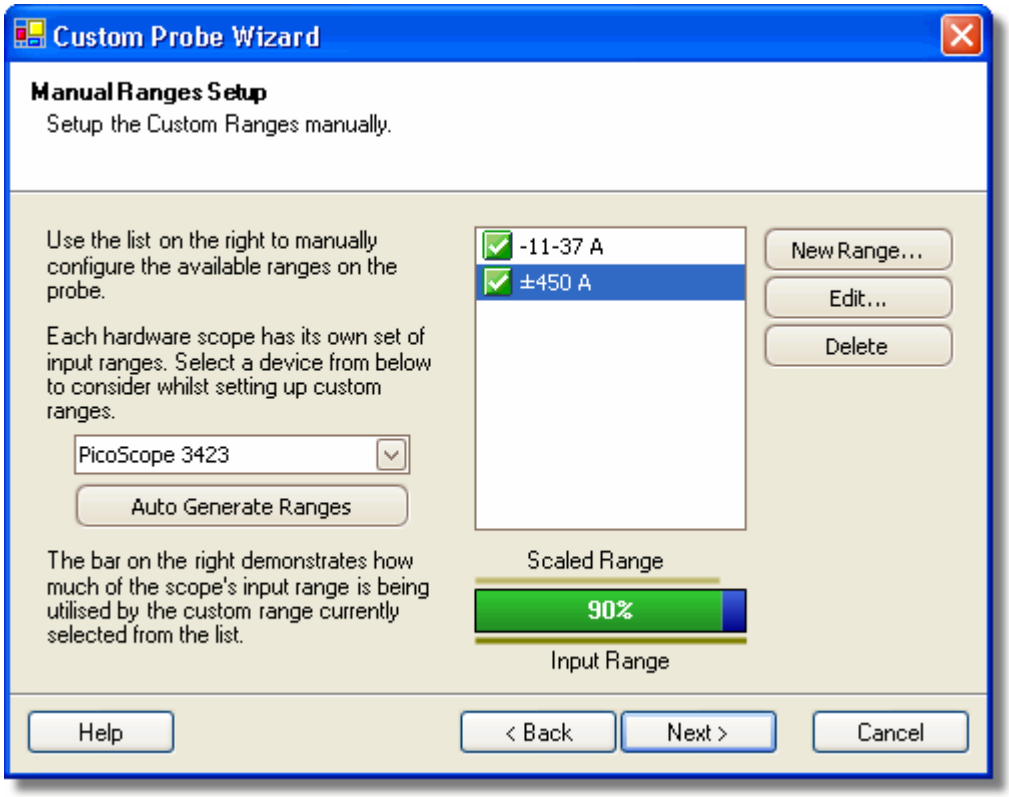
- If you select Let the software manage my ranges for me automatically, then clicking Next will take you to the Custom Probe Identification dialog 38. PicoScope's automatic ranges should be ideal for most applications.
- If you select I will manage the Custom Probe Ranges manually, clicking Next will take you to the Manual Ranges Setup dialog 35.
- Click Back to return to the Scaling Method dialog 32.

What is Auto-ranging?

When the Auto-ranging function is selected, PicoScope continually monitors the input signal and adjusts the range when necessary to allow it to display the signal with maximum resolution. This function is available on all standard ranges, and can be used with custom ranges only if you select Let the software manage my ranges for me automatically in this dialog.

6.5.2.6 *Manual Ranges Setup dialog*

This dialog appears when you select the Advanced option in the Range Management dialog 34 and then click Next >. It allows you to create ranges manually for your custom probe.



How to use the dialog

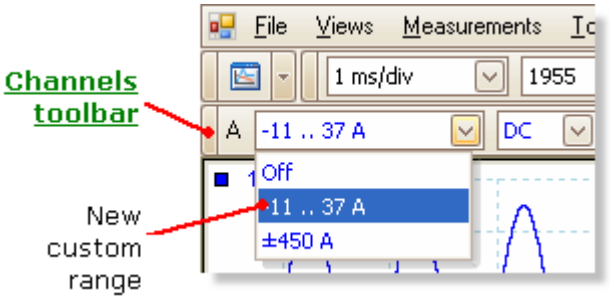
If you wish, you can click Auto Generate Ranges and the program will create a number of ranges for the selected device. This will create the same list of ranges that you would have obtained by selecting Let the software manage my ranges for me automatically in the previous dialog. When you select a range, a diagram below the list will show its relationship to the scope device's input range — this is explained further under Edit range dialog 36. You can then edit the ranges by clicking Edit, or you can also add a new range by clicking New Range. Both of these buttons take you to the Edit Range dialog 36.

Click Next to continue to the Custom Probe Identification dialog 38.

Click Back to return to the Range Management dialog 34.

How to use a new custom range

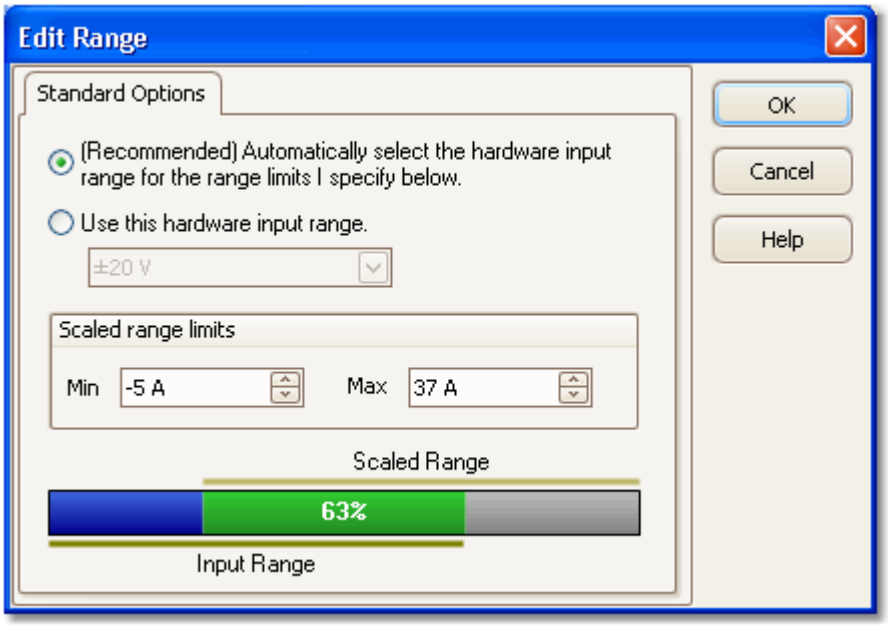
After you have created a custom range, it will appear in the drop-down list of ranges in the channels toolbar, 47 like this:



6.5.2.6.1 Edit Range dialog

This dialog allows you to edit a manual range for a custom probe.

You can get here by clicking the Edit or New Range buttons in the Manual Ranges Setup dialog 35.



Automatic mode

If you leave the "Automatic" radio button pressed, the program will automatically determine the best hardware input range for the device as you change the Scaled range limits. This is the best mode to use for almost all ranges. You should set the Scaled range limits to the maximum and minimum values you wish to see on the vertical axis of the scope display.

Fixed range mode

If you press the "Hardware input range" radio button and select a hardware input range from the drop-down box, PicoScope will then use that hardware input range whatever scaled range limits you choose. Set the upper and lower scaled range limits to the limits you wish to appear at the top and bottom of the vertical axis in PicoScope's scope view.

What is an input range?

An input range is the signal range, usually in volts, on the input channel of the scope device 68. Your scaled range should match this as closely as possible to make the most of the scope's resolution.

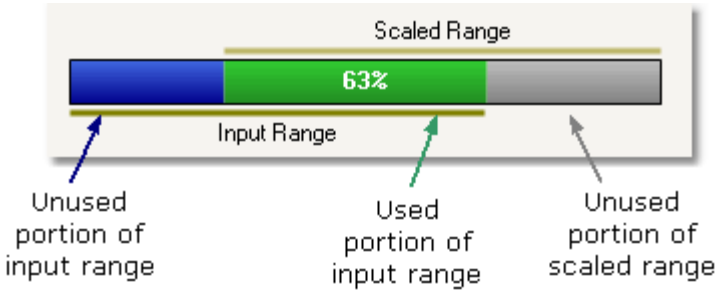
What is a scaled range?

The scaled range is the range that will appear on the vertical axis of the scope display when the probe is selected.

The scaling that you chose on the Scaling Method 32 page defines the relationship between the input range and the scaled range. This dialog enables you to set up ranges to display the scaled data on the scope view.

The range utilisation bar

This diagram at the bottom of the dialog represents the relationship between the scaling and the hardware input range of the scope device.



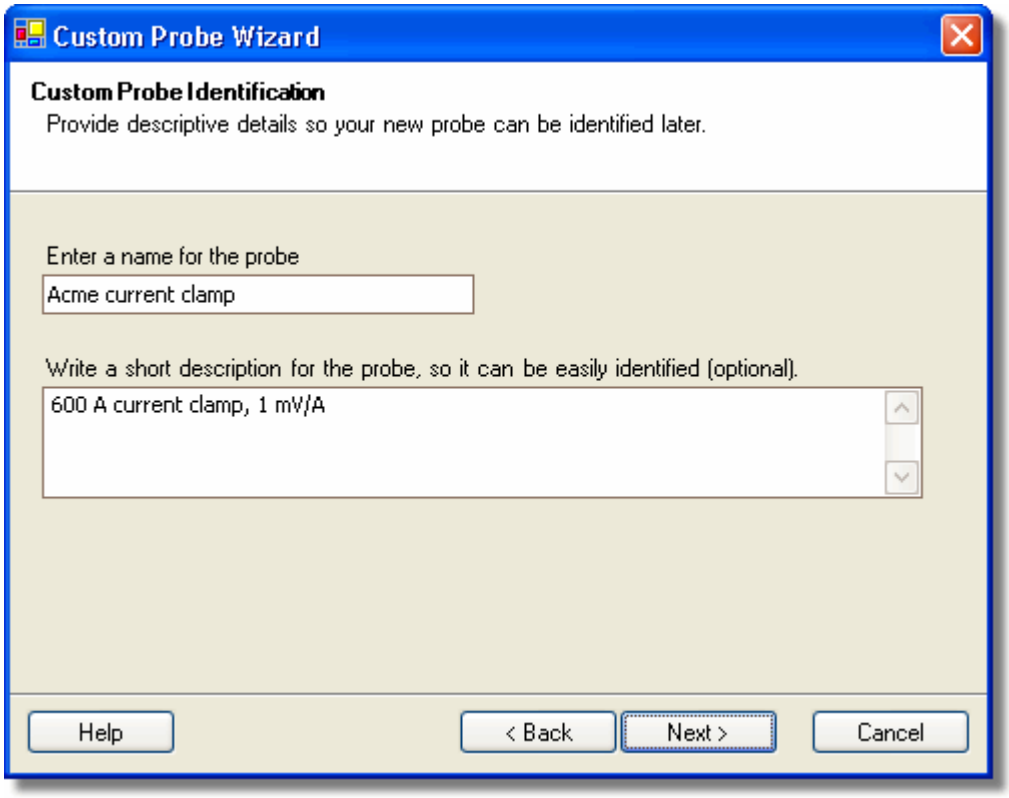
- Green - The section of the input range that is used by the scaled range. This should be as large as possible, to maximise the use of the scope device's resolution.
- Blue - Areas of the input range that are not being used. These indicate wasted resolution.
- Grey - Parts of the scaled range that are not covered by the input range. These will result in wasted space on the graph. The range utilisation bar may not represent these areas accurately when non-linear scaling is being used, so you should always test the scaled range limits on the scope view.

Finishing

Clicking OK or Cancel will return you to the Manual Ranges Setup dialog 35.

6.5.2.7 *Custom Probe Identification dialog*

This dialog follows the Range Management dialog 34. It allows you to enter text to identify the custom probe.



How to use the dialog

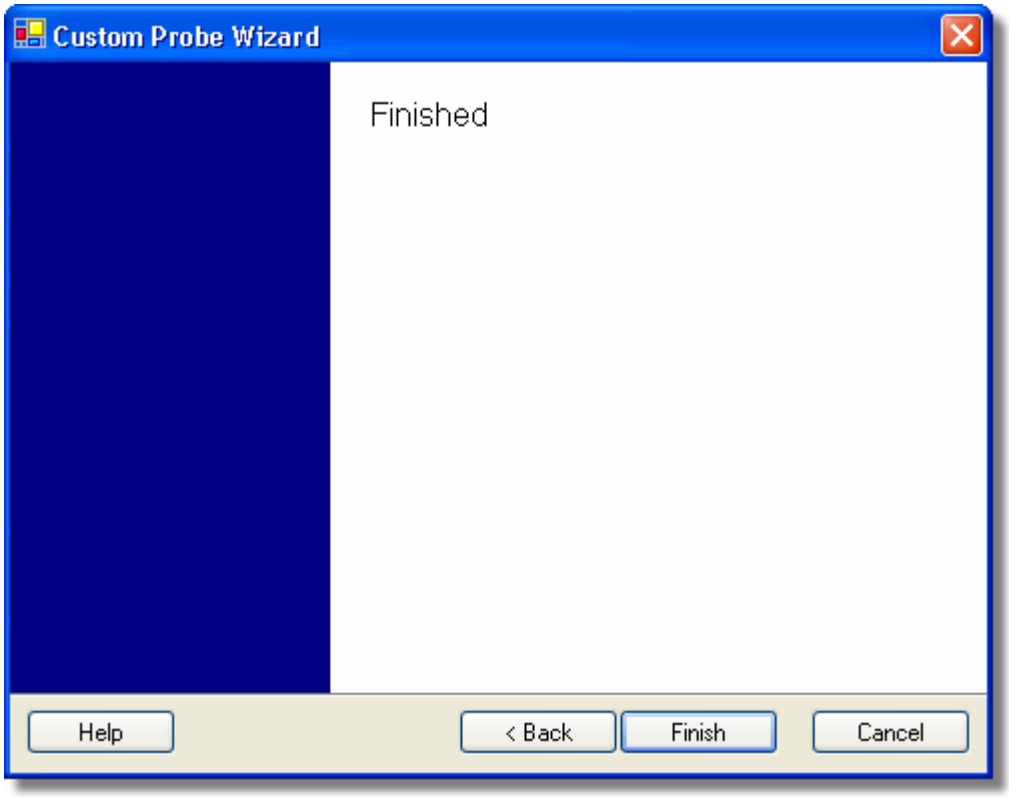
Click Back to return to the Range Management dialog 34 (or the Manual Ranges Setup dialog 35 if you chose manual setup).

- The probe name will appear in the probe list.
- The description is not used in the present version of the software.

Fill in the text fields and click Next to continue to the Custom Probe Finished dialog 39 .

6.5.2.8 *Custom Probe Finished dialog*

This dialog follows the Custom Probe Identification dialog 38. It displays a summary of the custom probe that you have just set up.



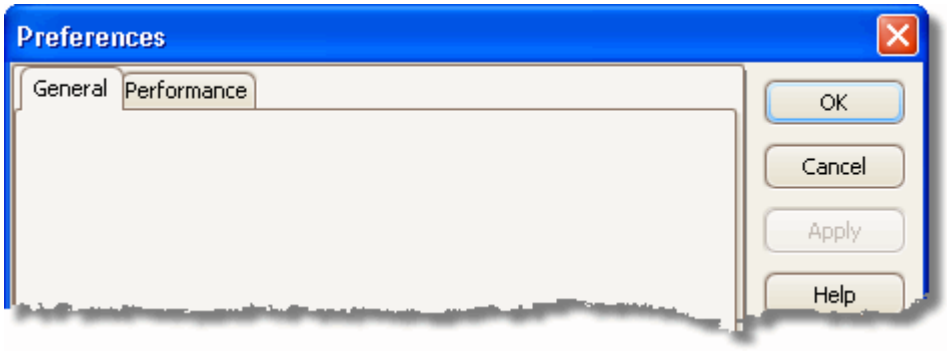
How to use the dialog

Click Back to return to the Custom Probe Identification dialog 38.

Click Finish to accept your custom probe settings and return to the Custom Probes dialog 27.

6.5.3 Preferences dialog

This dialog allows you to set miscellaneous options for the PicoScope software. Click one of the tabs on the screen shot below to learn more.

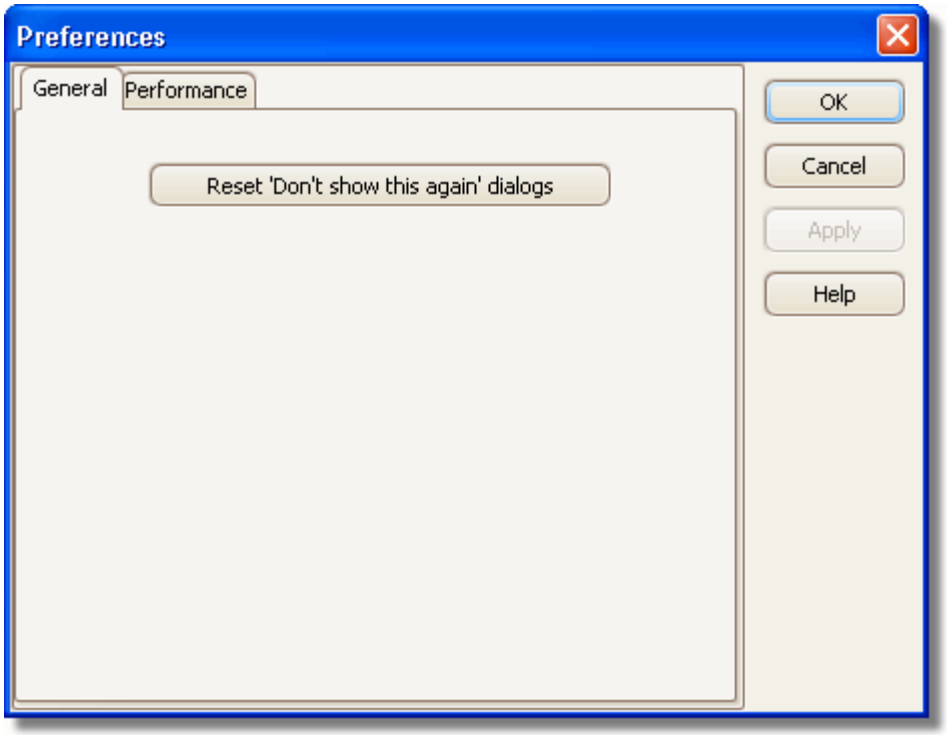


Where to find it

Click the Preferences command in the Tools menu 27 on the Menu bar 19.

6.5.3.1 General dialog

This dialog contains general controls for PicoScope.



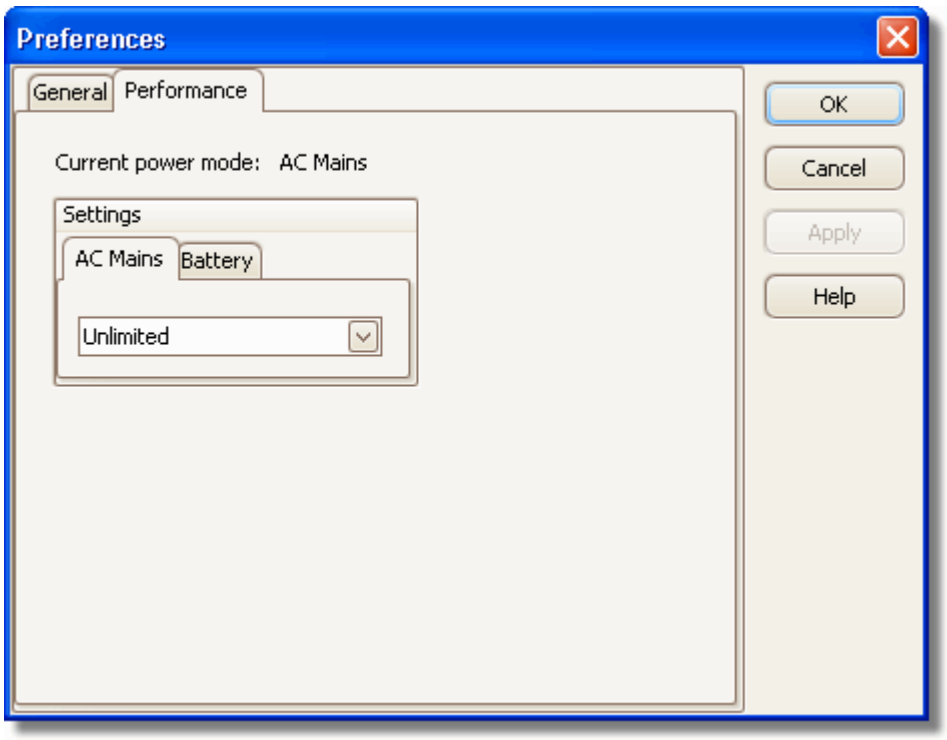
Reset: Click this button to restore any missing dialogs that you asked PicoScope not to show again.

Where to find it

Click the Preferences command in the Tools menu 27 on the Menu bar 19.

6.5.3.2 Performance dialog

The performance settings limit the speed at which PicoScope captures data from the scope device. The other PicoScope settings, the type of scope device [68] and the speed of the computer will all affect whether this limit can actually be reached. PicoScope automatically selects the appropriate limit according to whether your computer is running on batteries or on mains (line) power.



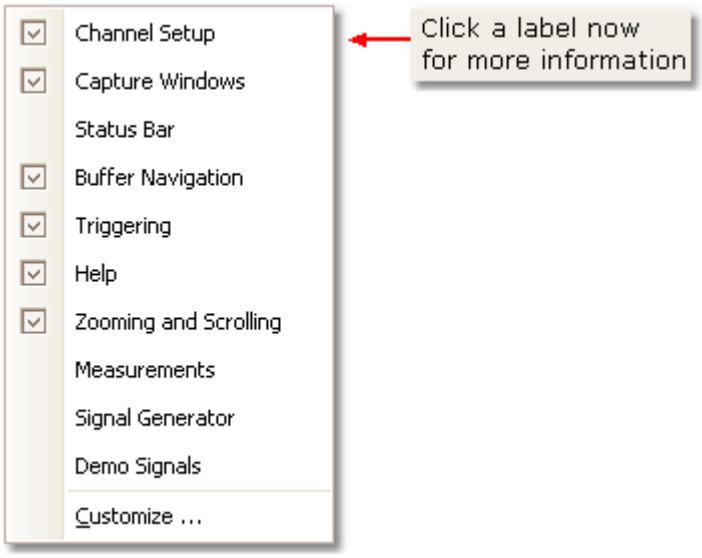
The settings are in captures per second. By default, the capture rate is set to "Unlimited" when your computer is running on AC Mains power, for maximum performance. If other applications run too slowly on your PC whilst PicoScope is capturing, then reduce the capture rate limit. When your computer is running on Battery power, PicoScope imposes a performance limit to save the battery. You can increase this limit manually, but this will cause the battery power to drain very quickly.

Where to find it

Click the Preferences command in the Tools menu [27] on the Menu bar [19].

6.6 Toolbar menu

This menu lists the toolbars 44 and allows you to display or hide each one.



Where to find it

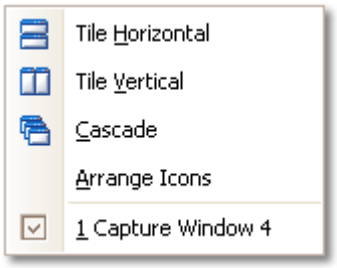
Right-click on any toolbar 44 or on the background of the toolbar area. The Customization dialog 48 has a similar menu on its Toolbars page 49.

How to use it

Click one of the ticks ☑ to remove a toolbar, or click in the empty margin next to a toolbar name to add that toolbar.

6.7 Window menu

Click Window on the Menu bar 19.



The commands in this menu instruct PicoScope to arrange the capture windows 9 within its main window.

Tile Horizontal: Arranges the capture windows in a grid that fills the main window, making the capture windows as wide as possible.

Tile Vertical: Arranges the capture windows in a grid that fills the main window, making the capture windows as tall as possible.

Cascade: Sets all capture windows to a standard size and arranges them in an overlapping pattern.

Arrange Icons: Arranges any minimised capture windows in a row at the bottom of the main window.

7 Toolbars

A toolbar is a collection of buttons and controls with related functions. The Measurements toolbar 52, for example, looks like this:

Toolbars are normally stored, or docked, in rows at the top and bottom edges of the window, but you can drag them to new locations if you wish. If you drop them on any of the four edges of the main window, they attach themselves to the edge. (They are then said to be "docked".) If you drop them anywhere else, they become individual "undocked" windows with their own close button, like this:

If you have closed a toolbar and want to reopen it, right-click anywhere in the toolbar area to open the Toolbar menu 42, then select the desired toolbar from the list.

Customizing

You can customize some of the toolbars by clicking their menu button (or) to open the Customization dialog 48. You can also right-click on any of the toolbars or the toolbar background to open the Toolbar menu 42.

7.1 Buffer Navigation toolbar

The Buffer Navigation toolbar allows you to select one waveform from the buffer of stored waveforms.

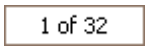
The waveform buffer

When you click the Start button 56, PicoScope clears the waveform buffer and then adds a new waveform every time the scope device captures data, until the buffer is full or you click the Stop button 56.

You can review the waveforms stored in the buffer using these buttons:

First waveform button. Displays waveform 1.

Previous waveform button. Displays the previous waveform in the buffer.



Waveform number indicator. Shows which waveform is currently displayed, and how many waveforms the buffer holds. You can edit the number in the box and press Enter, and PicoScope will jump to the specified waveform.

Next waveform button. Displays the next waveform in the buffer.

Last waveform button. Displays the last waveform in the buffer.

7.2 Capture Windows toolbar

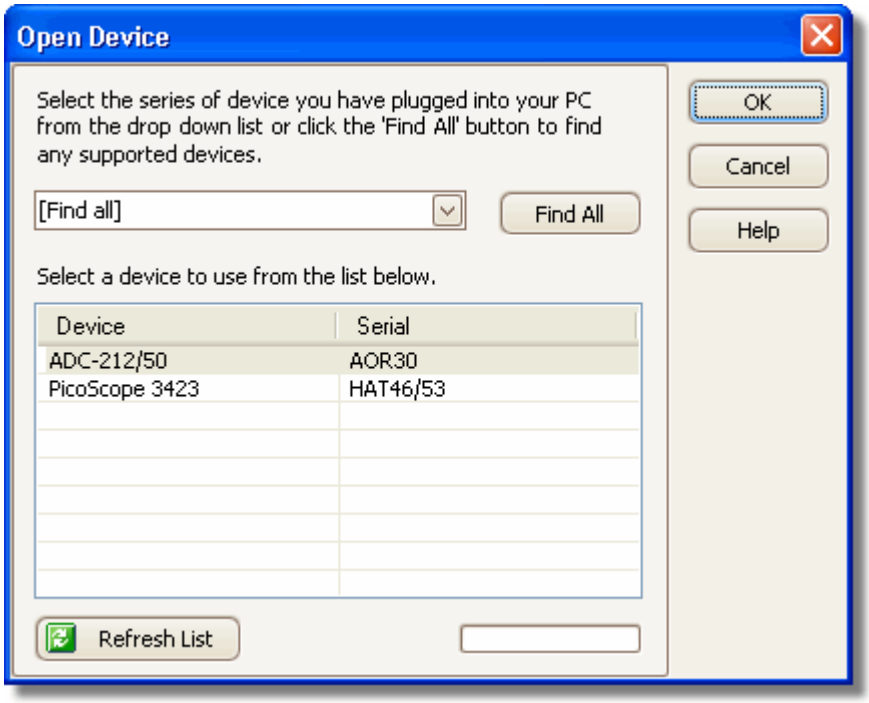
The Capture Window toolbar allows you to open a capture window 9.

The toolbar contains the following button:

New Capture Window button. If PicoScope has not yet found a scope device, clicking this button first opens the Open Device dialog 46 to allow you to select a scope device 68, then opens a new capture window 9 for the selected scope device. If a capture window is already open, this button simply opens another capture window for the same scope device. To switch scope devices, you must close and then restart PicoScope.

7.2.1 Open Device dialog

When PicoScope is not sure which scope device 68 to use, it displays a list of all the units attached to your computer and allows you to select which one to use.



Where to find it

PicoScope always tries to locate the correct scope device to use without asking you. This dialog appears only there is no suitable scope, or when there is more than one scope and you have not yet specified which one to use.

See "How to change to a different scope device 61" if you wish to switch to a different scope device later.

You will also see this dialog if you click the New Capture Window button 45 when no scope device is connected.

Procedure

- To restrict the selection to a particular series of devices, click on the device drop-down box and select a device series; otherwise, click the Find All button.
- Wait for a list of devices to appear in the grid.
- Select one device and click the OK button.
- PicoScope will open a new capture window 9 and scope view 14 for the selected scope device.
- Use the toolbars 44 to set up the scope device 68 and the scope view 14 to display your signals.

Demo mode

To experiment with PicoScope with no scope device 68 connected, choose one of the Demo devices from the drop-down list. The Demo Signals dialog 59 will then appear, allowing you to set up one or more test signals.

7.3 Channel Setup toolbar

The Channel Setup toolbar controls the settings for each vertical input channel 68. The screen shot below shows the toolbar for a four-channel scope device 68, but different scope devices may have different numbers of channels.

Each channel has its own set of buttons:

Scale Control. Determines the maximum and minimum signal levels at the top and bottom of the Y axis for this channel. The number of options depends on the selected scope device 68 and probe 68. If you select Auto, PicoScope will continually adjust the vertical scale so that the height of the waveform fills as much of the view as possible.

Coupling Control. Selects AC coupling 68 or DC coupling 68.

Advanced Options button. Opens the Probe drop-down menu 47 to allow you to select a probe 68 for this channel.

7.3.1 Probe Drop-Down menu

The Probe drop-down menu appears when you click the  Advanced Options button on the Channels toolbar 47. Use it to tell PicoScope what type of probe is connected to a channel. By default, the probe is assumed to be x1, which means that a one-volt signal at the input to the probe will appear as one volt on the display.

 Expand probe list. Click this to select from a list of probes.

 Open Custom Probes dialog. The Custom Probes dialog 27 allows you to edit your library of custom probes.

7.4 Customization dialog

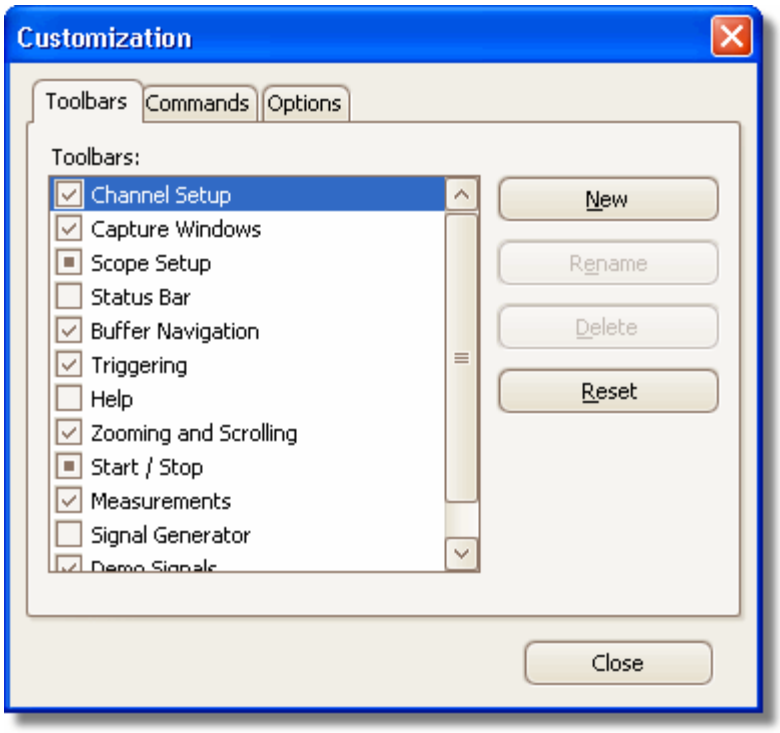
The Customization dialog allows you to customize the toolbars. Click on one of the tabs in the screen shot below for more information on the relevant page of the dialog.

Where to find it

Right-click on any toolbar or on the toolbar background area, or click the menu button (or) on any toolbar, then select the Customize command.

7.4.1 Customization Toolbars page

The Toolbars page of the Customization dialog 48 allows you to make the toolbars 44 visible or invisible.



Checkboxes: Tick or clear the checkboxes to make each toolbar 44 appear or disappear.

New: Create an empty toolbar, with your choice of name, which you can populate with buttons and controls using the Commands tab of this dialog box.

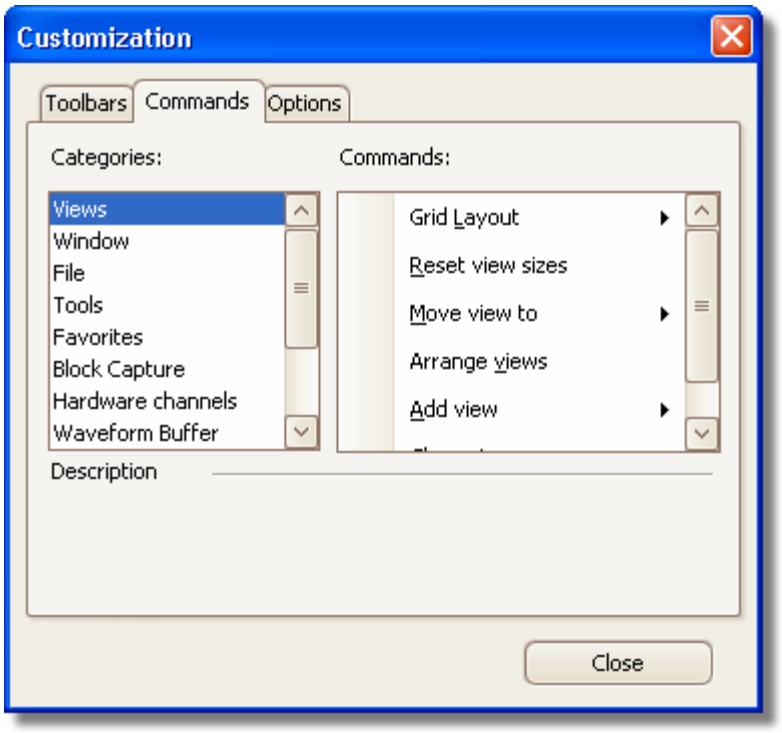
Rename: Change the name of a toolbar that you have created. You cannot rename the standard toolbars.

Delete: Remove the selected toolbar. You cannot delete the standard toolbars.

Reset: Restore the selected toolbar to its default state.

7.4.2 Customization Commands page

The Commands tab of the Customization dialog 48 allows you to add commands to, or remove them from, the toolbars 44.

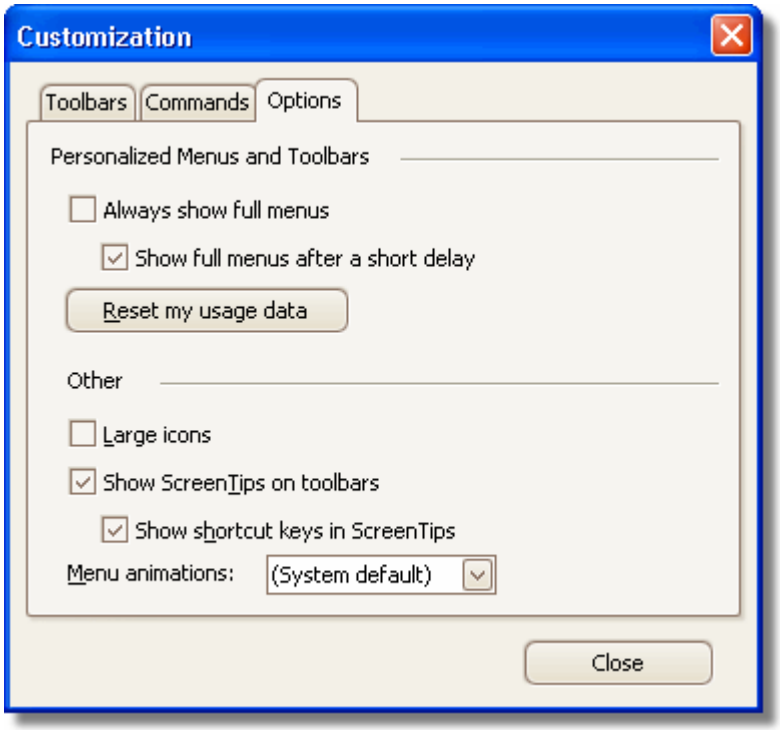


To add a command, select its category from the Categories list, then drag it from the Commands list to the appropriate toolbar.

To remove a command, drag it from its toolbar and drop it anywhere on the Customization dialog.

7.4.3 Customization Options page

The Options tab of the Customization dialog [48] controls the appearance of the Toolbars [44].



Always show full menus. PicoScope can hide the least-used commands in its menus to save space. Tick this box if you do not want it to do this.

Show full menus after a short delay. If this box is ticked, PicoScope first shows abbreviated menus, then after a short delay changes to the full menu.

Reset my usage data. If you are using abbreviated menus and some of the commands you want to use have disappeared, click this button to restore all the hidden commands.

Large icons. Increase the size of all the toolbar icons.

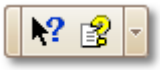
Show ScreenTips on toolbars. If this box is ticked, PicoScope displays tool tips (short explanatory messages) whenever you point to a toolbar [44] control or button.

Show shortcut keys in ScreenTips. Some toolbar controls and buttons have shortcut keys (combinations of keys that you can press to achieve the same effect). You can choose whether or not to be reminded of these shortcuts whenever a ScreenTip appears.

Menu animations. This option lets you choose what happens when you click on a menu title in the menu bar [19]. You can make the menu appear instantly, or you can experiment with other animation effects.

7.5 Help toolbar

The Help toolbar gives you access to "What's This?" help and the reference manual that you are now reading.



 What's This? Help. Click this button, then click a toolbar control or button to see a short description. Use it only on toolbars that are attached to the edge of the PicoScope window.

 Reference Manual. Opens this reference manual, which has information on every menu, dialog and control.

7.6 Measurements toolbar

The Measurements toolbar controls the measurements table 11.

It contains the following buttons:

 Add Measurement.	Adds a row to the table, and then opens the Add Measurement dialog. 26
 Edit Measurement.	Opens the Edit Measurement dialog 26 for the currently selected measurement. You can also edit a measurement by double-clicking on a row of the measurements table. 11
 Delete Measurement.	Deletes the currently selected row from the measurements table 11. If you delete the last measurement, the table disappears.

7.7 Scope Setup toolbar

The Scope Setup toolbar controls the time-related settings of your oscilloscope. It normally looks like this:

Standard controls

Timebase control. When the active view is a scope view, this sets the time represented by a single division of the horizontal axis when the zoom 58 factor is 100%. The timebases available depend on the type of scope device 68 you are using.

Choosing a timebase of 200 ms/div or slower causes PicoScope to switch to roll mode. Instead of redrawing the whole waveform many times every second, roll mode causes the waveform to move continuously from right to left, with old data disappearing off the left-hand side and new data being added on the right-hand side. This mode is more convenient for viewing slowly changing data.

Additional controls

You can customize the Scope Setup toolbar to include the following additional controls. See Toolbars 44 for instructions on customizing.

Samples control. Sets the number of samples that fit across the width of the Scope view 14. Increasing this number increases the time resolution of the display. If PicoScope will not let you select as many samples as you would like, try:

1. Reducing the oversampling factor
2. Selecting a slower timebase.

Oversampling control. This is set to 1 by default, so that oversampling is disabled. See Oversampling 12 for more information.

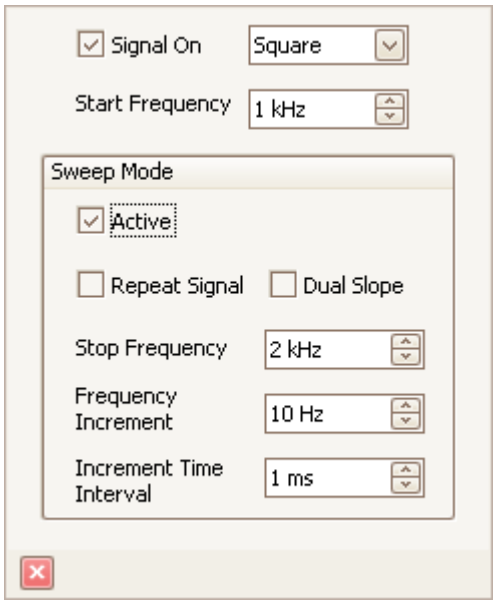
7.8 Signal Generator toolbar

The Signal Generator toolbar allows you to set up your scope device 68's test signal output. If the scope device has no test signal output, this toolbar will not appear.

Signal Generator. The "E" on this control stands for "External", and refers to the "E" label on the scope device's test signal output. Clicking the control opens the Signal Generator dialog 54.

7.8.1 Signal Generator dialog

This dialog controls the scope device 68's built-in signal generator. It is not available if the selected scope device does not have a signal generator. The number of controls in the dialog may vary according to the type of scope device in use.



Left:

Signal generator dialog for the PicoScope 3206

How to use it

Signal On: Tick this box to enable the signal generator.

Frequency: Type in this box or use the spin buttons to select the frequency. If the scope device has a frequency sweep generator, then this box will set the start frequency of the sweep.

Sweep Mode Active. Tick this box to enable sweep mode. Otherwise, the generator will operate at a fixed frequency set by the Start Frequency box.

Repeat Signal. Tick this box to generate a repetitive sweep. Otherwise, the generator will reach Stop Frequency and then remain there.

Dual Slope. In normal mode, the generator will increase the frequency linearly from Start Frequency to Stop Frequency, and then immediately begin again at Start Frequency. In Dual Slope mode, it will reach Stop Frequency and then decrease the frequency linearly to Start Frequency before beginning again.

Stop Frequency. In Sweep Mode, the generator will stop increasing the frequency when it reaches Stop Frequency.

Frequency Increment. In Sweep Mode, the generator will increase or decrease the frequency by this amount every Increment Time Interval.

Increment Time Interval. In Sweep Mode, the generator will increase or decrease the frequency by Frequency Increment once every time interval of this duration.

Where to find it

Click the  menu button on the Signal Generator toolbar 54.

7.9 Start / Stop toolbar

The Start / Stop toolbar allows you to start and stop the selected scope device (the scope device whose scope view is currently in focus). The Start button is highlighted if the selected scope device is sampling; otherwise, the Stop button is highlighted.

Start button. Start sampling on the selected scope device.

Stop button. Click to stop sampling on the selected scope device. Shift-click to stop sampling only in the active capture window.

You can also use the space bar to start and stop sampling.

7.10 Triggering toolbar

The Triggering toolbar tells the scope device in the selected capture window when to start capturing data.

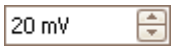
Trigger Mode.

None: PicoScope acquires waveforms repeatedly without waiting for specific events.
Auto: PicoScope tries to wait for a trigger event before displaying data. If there is no trigger event within a specified time, it displays data anyway. It repeats this process until you click the Stop button 56. "Auto" mode does not set up the trigger level automatically; you still need to do this yourself.
Repeat: PicoScope waits for a trigger event before displaying data; but if there is no trigger event, it displays nothing. It repeats this process until you click the Stop button 56.
Single: PicoScope waits once for a trigger event, then stops sampling. To repeat a single trigger, click the Start button 56.

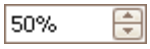
Trigger Source. This is the channel that PicoScope monitors for the trigger 68 condition.

Rising Edge. Click to trigger on the rising edge of the waveform.

Falling Edge. Click to trigger on the falling edge of the waveform.



Trigger Level. Sets the trigger 68 level. You can also set the trigger level by dragging the trigger marker 16 up or down on the screen.



Pre-trigger Time (0% to 100%). This parameter controls how much of the waveform appears before the trigger point. It defaults to 50%, which puts the trigger marker 16 is in the middle of the screen. You can also control this parameter by dragging the trigger marker 16 to the left or right.

Post-trigger Delay. Click this button to toggle the Post-trigger Delay control (see next item).

Post-trigger Delay. The post-trigger delay is the time that PicoScope waits after the trigger point before sampling. You can also modify this parameter by dragging the trigger marker 16 while the Post-trigger Delay button is enabled. As you drag the marker, you will see the post-trigger arrow 13 displayed briefly. For this control to have an effect, you must first make sure that the Post-trigger Delay button is enabled.

Technical Note

See the reference topic "Trigger Timing 65" for information on how the Pre-trigger Time and Post-trigger Delay controls interact.

7.11 Zooming and Scrolling toolbar

The Zooming and Scrolling toolbar allows you to move around a scope view[14]. There is a keyboard shortcut for each button.

Normal Selection tool (Ctrl+S or Escape). This button turns the pointer into a standard arrow that you can use to click buttons, drag rulers[68] and operate any other controls that appear in the PicoScope window.

Hand tool (panning) (Ctrl+D). This button turns the pointer into a hand tool that you can use to click and drag the scope view[14] to pan it vertically and horizontally when you are zoomed in. You can also pan using the scroll bars. Press the Escape key to return to the Normal Selection tool.

Zoom In tool (Ctrl+I). This button turns the pointer into a zoom-in tool. Click the tool on the scope view[14] to double the magnification of the horizontal and vertical axes. Scroll bars will appear, which you can drag to pan around the view, or you can pan by using the Hand tool (see above). Press the Escape key to return to the Normal Selection tool.

Zoom Out tool (Ctrl+O). This button turns the pointer into a zoom-out tool. Click the tool on the scope view[14] to zoom out both horizontally and vertically by a factor of two. You cannot zoom out beyond 100% (normal size). Press the Escape key to return to the Normal Selection tool.

Marquee Zoom tool (Ctrl+M). This button turns the pointer into a marquee zoom tool. Use it to draw a box called a marquee on the scope view[14] and PicoScope will magnify that box to fill the view. Scroll bars will appear, which you can drag to pan around in the view, or you can pan by using the Hand tool (see above). Press the Escape key to return to the Normal Selection tool.

100% (Ctrl+U). Resets the scope view[14] to normal size. The view will no longer have scroll bars, and panning will no longer be possible.

7.12 Demo Signals toolbar

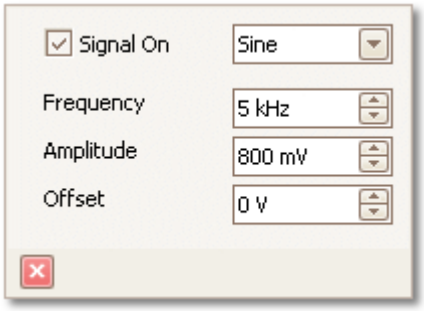
The Demo Signals toolbar allows you to set up test signals, so that you can experiment with PicoScope when no scope device is connected. To use this feature, close PicoScope, unplug all scope devices and then restart PicoScope. The program will prompt you to select a Demo device using the Open Device dialog 46.

The toolbar contains the following buttons.

When you click this button, you will see a drop-down list of all the available channels. Click one of the channels to open the Demo Signals dialog 59, which will allow you to set up that channel.

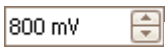
7.12.1 Demo Signals dialog

This dialog controls one channel of the demo signal generator, a feature of PicoScope that creates a variety of test signals to simulate a scope device. Open it by clicking the Demo Signals button on the Demo Signals toolbar 59 and then selecting a channel. It is available only when you start PicoScope without having a scope device 68 connected to your computer, and then select a scope device type of "Demo" in the Open Device dialog 46.



Signal On: Tick this box to enable the demo signal generator.

Frequency: Type your desired frequency in hertz here, or use the spin buttons.



Amplitude: Type your desired amplitude in millivolts here, or use the spin buttons.

Offset: Enter a number here to add a d.c. offset to the demo signal. By default, the demo signals have a mean value of zero volts.

Where to find it

Click the Demo Signals button on the Demo Signals toolbar 59. You must have previously selected a "Demo" scope device 68 type in the Open Device dialog 46.

8 How to...

This chapter explains how to achieve some common tasks.

How to...

8.1 How to change to a different scope device

- Close PicoScope
- Unplug the old scope device 68
- Plug in the new scope device
- Restart PicoScope

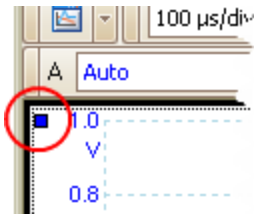
PicoScope will detect that the scope device has changed and will immediately start using the new scope device. If there is more than one scope device connected, the Open Device dialog 46 will appear to let you choose a scope.

8.2 How to use rulers to measure a signal

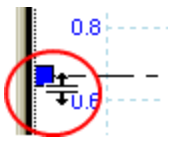
Using a single ruler for signal-to-ground measurements

- Look at the Channels toolbar 47 to find the colour code for the channel 68 you wish to measure:

- Find the ruler handle (the small coloured square in the top-left or top-right corner of the scope view 14) of this colour:



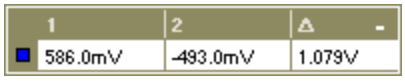
- Drag the ruler handle downwards. A signal ruler 17 (horizontal broken line) will appear across the scope view. Release the ruler handle when the ruler is where you want it.



- Look at the ruler legend 13 (the small table that appears on the scope view). It should have a row marked by a small coloured square matching the colour of your ruler handle. The first column shows the signal level of the ruler.

Using two rulers for differential measurements

- Follow the steps above for "using a single ruler".
- Drag the second ruler handle of the same colour downwards until its ruler is at the signal level to be measured.
- Look at the ruler legend 13 again. The second column now shows the signal level of the second ruler, and the third column shows the difference between the two rulers.



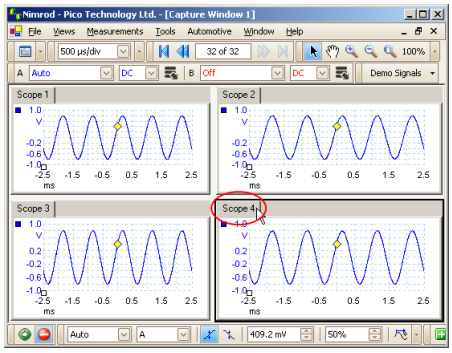
8.3 How to measure a time difference

- Find the time ruler handle (the small white square in the bottom left corner of the scope view 14).
- Drag the ruler handle to the right. A time ruler 15 (vertical broken line) will appear on the scope view. Release the ruler handle when the ruler is at the time you wish to use as the reference.
- Drag the second white ruler handle to the right until its ruler is at the time to be measured.
- Look at the ruler legend 13 (the small table that appears on the scope view). It should have a row marked by a small white square. The first two columns show the times of the two rulers, and the third column shows the time difference.
- The frequency legend 10 shows 1/Δ, where Δ is the time difference.

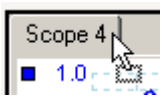
You can use the same method to measure a frequency difference on a spectrum view, if this is available.

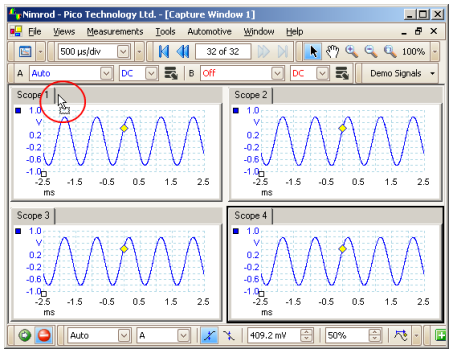
8.4 How to move a view

You can easily drag a view 18 from one viewport 68 to another in a capture window 9. This example shows a capture window with four viewports. The viewports contain scope views called "Scope 1" to "Scope 4". Suppose you wish to move the "Scope 4" view to the top left viewport.

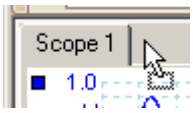


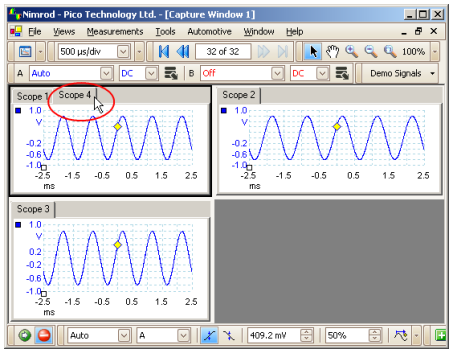
1. Click on the name tab of the "Scope 4" view and hold the mouse button down.



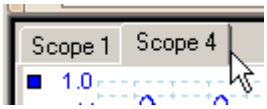


2. Drag the mouse pointer to the new location next to the name tab of the "Scope 1" view.





3. Release the mouse button, and the view will move to the new location.



9 Reference

This is where you can find detailed information on the workings of PicoScope.

9.1 Measurement types

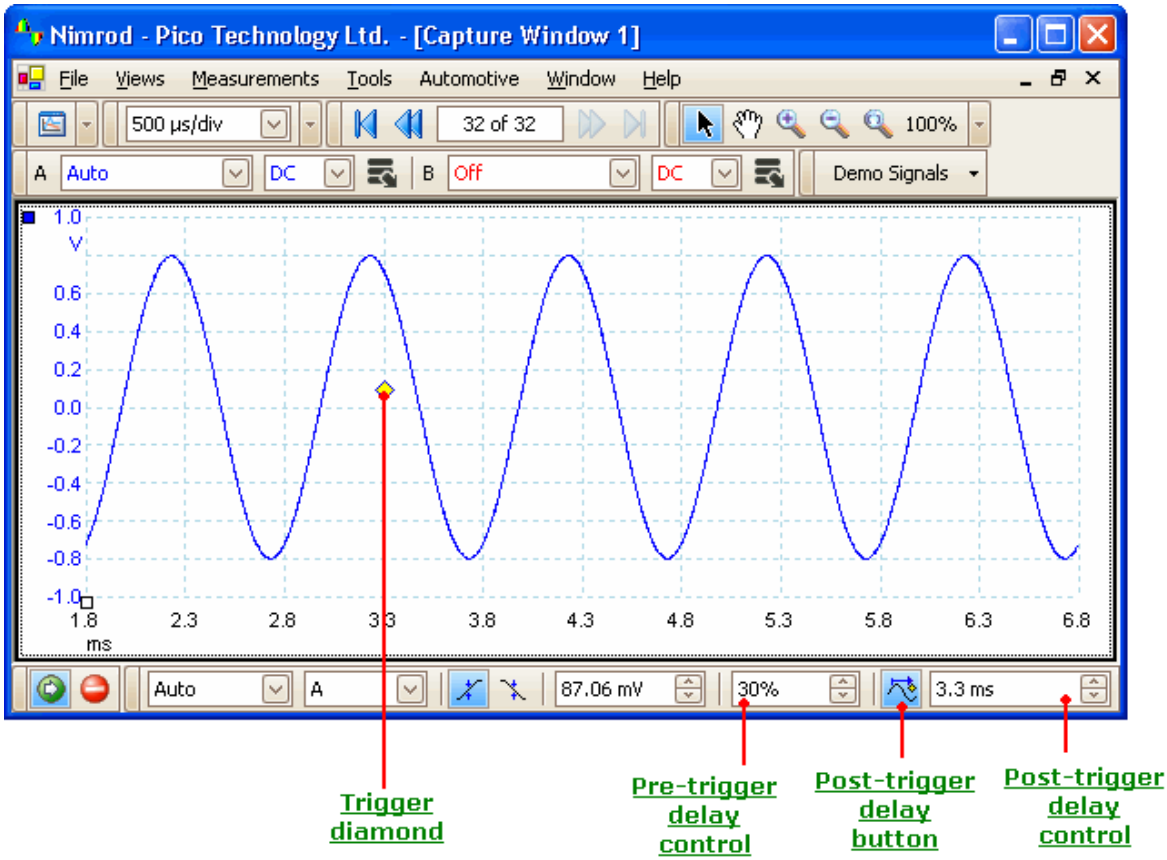
The Edit Measurement dialog 26 allows you to select one of a range of measurements that PicoScope can calculate for the selected waveform. Here is a list of the available measurements:

AC Volts:	The root mean square (RMS) value of the AC component of the waveform. This measurement subtracts any DC offset from the waveform. It is equivalent to a *ripple* measurement.
Burn Time:	For a secondary ignition waveform, the duration of the spark.
Burn Voltage:	For a secondary ignition waveform, the voltage across the spark gap during the burn time.
Crank RPM:	The turning rate of the crankshaft, as measured by the crankshaft sensor. Expressed in revolutions per minute.
Cycle Time:	PicoScope will attempt to find a repeated pattern in the waveform and measure the duration of one cycle.
DC Volts:	The mean value of the waveform.
Duty Cycle:	The amount of time that a signal spends above its mean value, expressed as a percentage of the signal period. A duty cycle of 50% means that the high time is equal to the low time.
Dwell Angle:	In a primary ignition waveform, dwell time converted to an angle, using the formula: dwell angle = (dwell time * crankshaft RPM / 60) * 360 degrees.
Dwell Time:	In a primary ignition waveform, the time during which battery current flows in the ignition coil, as the magnetic field builds up in its winding.
Fall Time:	The time the signal takes to fall from 80% to 20% of its peak values.
Falling Rate:	The rate at which the signal voltage falls, in signal units per second. Measured between 80% and 20% of its peak-to-peak value.
Frequency:	The number of cycles of the waveform per second.
High Pulse Width:	The amount of time that the signal spends above its mean value.

Injector Duration:	The duration of the fuel injector pulse, as battery current flows through the injector coil.
Low Pulse Width:	The amount of time that the signal spends below its mean value.
Maximum:	The highest level reached by the signal.
Minimum:	The lowest level reached by the signal.
Peak Burn Voltage:	For a secondary ignition waveform, the voltage of the initial peak as the spark begins.
Peak To Peak:	The difference between maximum and minimum.
Rise Time:	The time the signal takes to rise from 20% to 80% of its peak-to-peak value.
Rising Rate:	The rate at which the signal rises, in signal units per second. Measured between 20% and 80% of its peak-to-peak value.

9.2 Trigger timing (part 1)

The pre-trigger time control and post-trigger delay control functions are described individually under "Triggering toolbar 57", but the interaction between the two controls is also important to understand. Here is a screen shot of a capture window 9 with post-trigger delay enabled:



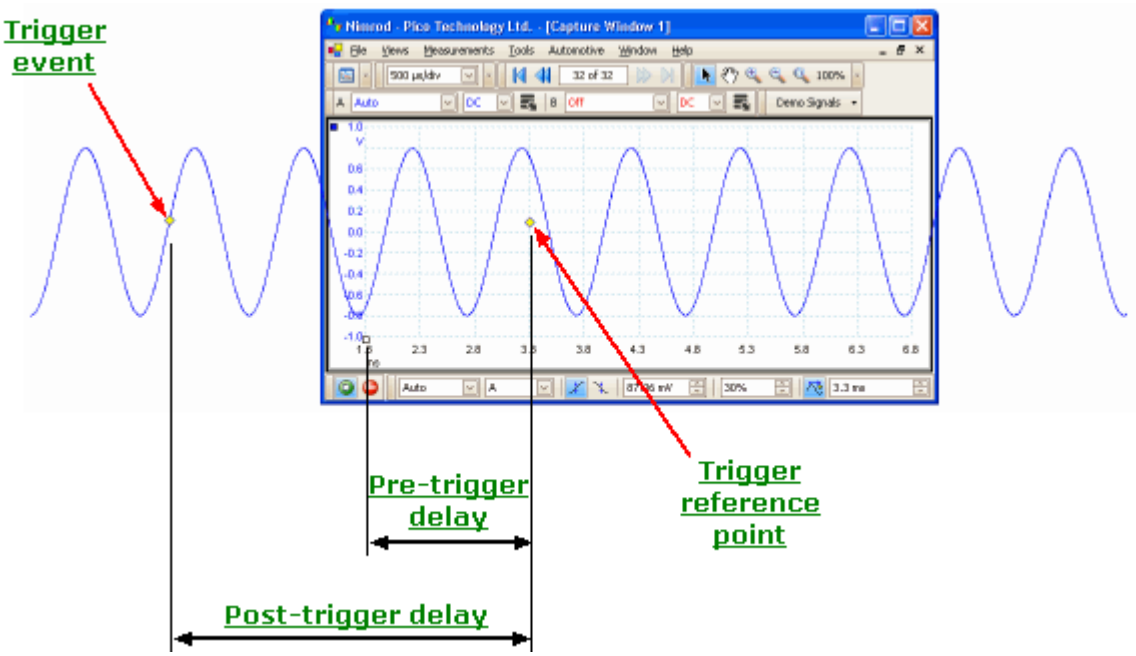
First, notice that the trigger reference point (◇) does not lie on the waveform. This is because the post-trigger delay is set to 3.3 ms, which means that the trigger occurred 3.3 ms before the reference point, somewhere off the left-hand edge of the scope view. 14 The time axis is aligned so that the trigger reference point is at 3.3 ms.

Second, the pre-trigger delay is set to 30%, which forces the trigger reference point to appear 30% of the way across the scope view, measured from the left-hand edge.

Third, PicoScope often limits the trigger-to-reference-point delay to the total capture time. Once you have reached this limit, the program will not let you increase the pre-trigger delay, and if you increase the post-trigger delay, PicoScope will reduce the pre-trigger delay to stop the total exceeding the limit.

9.3 Trigger timing (part 2)

"Trigger timing (part 1)[65]" introduced the concepts of pre-trigger delay[57] and the post-trigger delay[57]. This diagram below shows how they are related.



The pre-trigger delay positions the capture window[9] in relation to the trigger reference point so that you can choose how much of the waveform should be before the reference point, and how much after it.

The post-trigger delay is like the delayed trigger of a conventional oscilloscope. PicoScope waits for this time, minus the pre-trigger delay, before capturing data. scope devices have a limit to the number of sampling intervals that can pass between the trigger event and the end of the capture window, so the software may adjust the pre-trigger delay to keep within this limit.

Tip

If you have set up a post-trigger delay, you can click the post-trigger delay button while the scope is running whenever you want to switch between viewing the trigger event and the trigger reference point.

9.4 Keyboard shortcuts

You can activate all of PicoScope's functions using the menu system, but some functions also have keyboard shortcuts. These can save time on tasks that you repeat often.

Ctrl-C	Copy the current view to the Windows clipboard. You can then switch to another application and paste the contents of the clipboard as a picture. The method for doing this varies, but many applications use the Ctrl-V key or a "Paste" button.
Ctrl-D	Hand tool. Use to pan the waveform when zoomed in. Equivalent to the "Hand tool" button on the Zooming and Scrolling toolbar. 58
Ctrl-I	Zoom-in tool. Click on the waveform to zoom in. Equivalent to the "Zoom-in tool" button on the Zooming and Scrolling toolbar. 58
Ctrl-M	Marquee zoom tool. Click on the waveform and drag to draw a box (a marquee), and PicoScope will zoom in to make the box fill the view. Equivalent to the "Marquee zoom tool" button on the Zooming and Scrolling toolbar. 58
Ctrl-O	Zoom-out tool. Click on the waveform to zoom out. Equivalent to the "Zoom-out tool" button on the Zooming and Scrolling toolbar. 58
Ctrl-S or Escape	Cancels a zoom or pan mode and restores the pointer to a standard selection tool. Equivalent to the "Normal selection tool" button on the Zooming and Scrolling toolbar. 58
Ctrl-U	Zoom to 100% scale. Restores a view to its normal state. Equivalent to the "Zoom to 100% scale" button on the Zooming and Scrolling toolbar. 58
Space bar	Starts and stops the active capture window.

9.5 Glossary

AC coupling. In this mode, the scope device very low signal frequencies below a few hertz. This allows you to use the full resolution of the scope to measure a.c. signals accurately, ignoring any d.c. offset. You cannot measure the signal level with respect to ground in this mode.

Channel. A scope device has one or more channels, each of which can sample one signal. High-speed scope devices typically have one BNC connector per channel.

DC coupling. In this mode, the scope device measures the signal level relative to signal ground. This shows maximum information about the signal, including d.c. and a.c. components.

Graticule. The pattern of broken grey lines in every scope view window. These help you estimate the amplitude and time of features on the waveform.

Grid. The arrangement of viewports 68 in a capture window. The number of grid rows and the number of grid columns can each be either 1, 2, 3 or 4.

In focus. PicoScope can display several capture windows, but one window is drawn in stronger colours than the others. This is the window that is in focus. When you click a toolbar button, it will usually affect only the window that is in focus. To bring a window into focus, click on it.

Oversampling. Collecting samples at a faster rate than requested, then combining the excess samples by averaging. This technique can increase the effective resolution of a scope device when there is a small amount of noise on the signal.

Probe. An accessory that attaches to your oscilloscope and picks up a signal to be measured. A probe can pick up any form of signal, but it always delivers a voltage signal to the oscilloscope. PicoScope knows about standard probes, but also allows you to define custom probes.

Roll mode. Normally, PicoScope redraws the waveform in a scope view many times every second. At timebases slower than 200 ms/div, however, it switches to roll mode. This causes the waveform to move continuously from right to left, with old data disappearing off the left-hand side and new data being added on the right-hand side. This mode is more convenient for viewing slowly changing data.

Ruler. A vertical or horizontal dashed line that can be dragged into place on a waveform in a Scope View. PicoScope displays the signal level, time value or frequency value of all rulers in a Ruler Legend box.

Scope device. A box of electronics that, with the help of the PicoScope software, turns your computer into a PC Oscilloscope.

Tooltip. A label that appears when you move the mouse pointer over some parts of the PicoScope screen, such as buttons, controls and rulers.

Trigger. A device that detects when the waveform rises or falls past a preset signal level. When this event occurs, the program may begin to acquire data.

View. A presentation of data from a particular scope device. Each scope device may have zero, one or more views, all of which are displayed inside the capture window for that scope device. The only type of view currently available is the scope view.

Viewport. A rectangular space in a capture window that can contain one or more views, or can be empty.

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