It is the policy of OMEGA Engineering, Inc. to comply with all worldwide safety and EMC/EMI regulations that apply. OMEGA is constantly pursuing certification of its products to the European New Approach Directives. OMEGA will add the CE mark to every appropriate device upon certification.

The information contained in this document is believed to be correct, but OMEGA accepts no liability for any errors it contains, and reserves the right to alter specifications without notice.

WARNING: These products are not designed for use in, and should not be used for, human applications.
# Table of Contents

1 Welcome .................................................................................................................................................1

2 OMEGASCOPETM overview ....................................................................................................................2

3 Introduction .............................................................................................................................................3

  1 Trademarks .........................................................................................................................................3
  2 Contact information .............................................................................................................................3
  3 How to use this manual .........................................................................................................................3
  4 System requirements ............................................................................................................................5

4 Using OMEGASCOPETM for the first time .............................................................................................6

5 OMEGASCOPETM and oscilloscope primer ............................................................................................7

  1 Oscilloscope basics ..............................................................................................................................7
  2 PC Oscilloscope basics .........................................................................................................................8
  3 OMEGASCOPETM basics .....................................................................................................................9
    1 Capture modes ................................................................................................................................10
    2 How do capture modes work with views? ......................................................................................11
  4 OMEGASCOPETM window ...................................................................................................................12
  5 Scope view .........................................................................................................................................13
  6 XY view .............................................................................................................................................14
  7 Trigger marker ....................................................................................................................................15
  8 Post-trigger arrow ..............................................................................................................................15
  9 Spectrum view ....................................................................................................................................16
 10 Persistence mode ...............................................................................................................................17
 11 Measurements table ...........................................................................................................................18
 12 Resolution enhancement ....................................................................................................................19
 13 Pointer tool tip ...................................................................................................................................20
 14 Signal rulers .......................................................................................................................................21
 15 Time rulers .........................................................................................................................................22
 16 Ruler legend .......................................................................................................................................23
 17 Frequency legend ...............................................................................................................................23
 18 Properties sheet ..................................................................................................................................24
 19 Custom probes ...................................................................................................................................24
 20 Maths channels ...................................................................................................................................25
 21 Reference waveforms .........................................................................................................................26
 22 Serial decoding ....................................................................................................................................27
 23 Mask limit testing ...............................................................................................................................28
 24 Alarms ................................................................................................................................................29
 25 Buffer Navigator ................................................................................................................................30

6 Menus .......................................................................................................................................................31

  1 File menu ...........................................................................................................................................32
    1 Save As dialog ................................................................................................................................33
# Toolbars and buttons

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 How to change to a different device</td>
<td>135</td>
</tr>
<tr>
<td>2 How to use rulers to measure a signal</td>
<td>136</td>
</tr>
<tr>
<td>3 How to measure a time difference</td>
<td>137</td>
</tr>
<tr>
<td>4 How to move a view</td>
<td>138</td>
</tr>
<tr>
<td>5 How to scale and offset a signal</td>
<td>139</td>
</tr>
<tr>
<td>6 How to set up the spectrum view</td>
<td>140</td>
</tr>
<tr>
<td>7 How to find a glitch using persistence mode</td>
<td>141</td>
</tr>
</tbody>
</table>
# Table of Contents

8 How to set up a Mask Limit Test ................................................................. 150
9 How to save on trigger ............................................................................ 153
9 Reference ..................................................................................................... 157

1 Measurement types .................................................................................. 157
   1 Scope measurements ........................................................................... 158
   2 Spectrum measurements .................................................................... 159
2 Signal generator waveform types ............................................................... 161
3 Spectrum window functions ..................................................................... 162
4 Trigger timing (part 1) ............................................................................. 163
5 Trigger timing (part 2) ............................................................................. 164
6 Serial protocols ........................................................................................ 165
   1 CAN Bus protocol .............................................................................. 166
   2 I²C Bus protocol ............................................................................... 168
   3 RS232/UART protocol ...................................................................... 169
   4 SPI Bus protocol ................................................................................ 170
7 Command-line syntax ............................................................................... 171
8 Glossary .................................................................................................... 173

10 Application Error dialog ......................................................................... 175

Index ............................................................................................................ 176
Welcome

Welcome to the OMEGASCOPE™ PC Oscilloscope software.

With an OMSP-2000/3000/4000 Series device, OMEGASCOPE™ turns your PC into a powerful PC Oscilloscope with all the features and performance of a bench-top oscilloscope at a fraction of the cost.

- How to use this manual
- What's new in this version
- Using OMEGASCOPE™ for the first time

M5064-1111 : 2012-02-27, S/W 6.6.1
2 OMEGASCOPE™ overview

Higher performance

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

Improved usability and appearance

- Clearer graphics and text
- Tool tips and help messages to explain all features
- Easy point-and-click tools for panning and zooming

Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>The latest Windows .NET technology enabling us to deliver updates more quickly</td>
<td>Multiple views of the same data, with individual zoom and pan settings for each view</td>
</tr>
<tr>
<td>Custom probes manager to make it easy for you to use your own probes and sensors with OMEGASCOPE™</td>
<td>Advanced triggering conditions including pulse, window and logic</td>
</tr>
<tr>
<td>Properties sheet displaying all settings at a glance</td>
<td>Spectrum mode with a fully optimized spectrum analyzer</td>
</tr>
<tr>
<td>Per-channel lowpass filtering</td>
<td>Math channels for creating mathematical functions of input channels</td>
</tr>
<tr>
<td>Reference waveforms for storing copies of input channels</td>
<td>Arbitrary waveform designer for oscilloscopes with a built-in arbitrary waveform generator</td>
</tr>
<tr>
<td>Rapid trigger mode to capture a sequence of waveforms with the minimum possible dead time</td>
<td>Windows Explorer integration to show files as pictures and convert to other formats</td>
</tr>
<tr>
<td>Command-line options for converting files</td>
<td>Zoom overview for rapidly adjusting the zoom to show any part of the waveform</td>
</tr>
<tr>
<td>Serial decoding for RS232, I2C and other formats, in real time</td>
<td>Mask limit testing to show when a signal goes out of bounds</td>
</tr>
<tr>
<td>Buffer navigator for searching the waveform buffer</td>
<td>Alarms to alert you when a specified event occurs</td>
</tr>
</tbody>
</table>
3 Introduction

OMEGASCOPE™ is a comprehensive software application for OMSP-2000/3000/4000 Series PC Oscilloscopes. It creates a virtual oscilloscope, spectrum analyser and multimeter on your PC.

OMEGASCOPE™ supports the following scope devices:

- OMSP-4000 Series
- OMSP-3000 Series
- OMSP-2000 Series

OMEGASCOPE™ runs on any computer with Windows XP SP2 or later, Windows Vista or Windows 7. (See System requirements for further recommendations.)

How to use OMEGASCOPE™

- Getting started: see using OMEGASCOPE™ for the first time, and OMEGASCOPE™’s Features.
- For further information: see descriptions of Menus and Toolbars, and the Reference section.
- For step-by-step tutorials, see the "How to" section.

3.1 Trademarks

Windows is a registered trade mark of Microsoft Corporation. OMEGASCOPE™ is a trademark of Omega Engineering, Inc.

3.2 Contact information

Address: Omega Engineering, Inc.
One Omega Drive
P.O. Box 4047
Stamford, CT 06907
USA

Phone: 203-359-1660
Fax: 203-359-7700

Technical support email: das@omega.com
Sales email: sales@omega.com

Web site: www.omega.com

3.3 How to use this manual

If 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:
For your first introduction to OMEGASCOPE™, we suggest that you start with these topics:

- [ ] Using OMEGASCOPE™ for the first time
- [ ] Oscilloscope basics
- [ ] PC Oscilloscope basics
- [ ] OMEGASCOPE™ basics
3.4 System requirements

To ensure that OMEGASCOPE™ operates correctly, you must have a computer with at least the minimum system requirements to run one of the supported operating systems, as shown in the following table. The performance of the oscilloscope will be better with a more powerful PC, and will benefit from a multi-core processor.

<table>
<thead>
<tr>
<th>Item</th>
<th>Absolute minimum</th>
<th>Recommended minimum</th>
<th>Recommended full specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating system</td>
<td>Windows XP SP2</td>
<td>Windows XP SP2</td>
<td>Windows XP SP2</td>
</tr>
<tr>
<td></td>
<td>Windows Vista</td>
<td>Windows Vista</td>
<td>Windows Vista</td>
</tr>
<tr>
<td></td>
<td>Windows 7</td>
<td>Windows 7</td>
<td>Windows 7</td>
</tr>
<tr>
<td>Processor</td>
<td>As required by Windows</td>
<td>300 MHz</td>
<td>1 GHz</td>
</tr>
<tr>
<td>Memory</td>
<td>256 MB</td>
<td>512 MB</td>
<td></td>
</tr>
<tr>
<td>Free disk space*</td>
<td>1.5 GB</td>
<td>2 GB</td>
<td></td>
</tr>
<tr>
<td>Ports</td>
<td>USB 1.1 compliant port</td>
<td>USB 2.0 compliant port</td>
<td></td>
</tr>
</tbody>
</table>

* The OMEGASCOPE™ software does not use all the disk space specified in the table. The free space is required to make Windows run efficiently.
4 Using OMEGASCOPE™ for the first time

We have designed OMEGASCOPE™ to be as easy as possible to use, even for newcomers to oscilloscopes. Once you have followed the introductory steps listed below, you will soon be on your way to becoming an OMEGASCOPE™ 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 prepare your computer to work with it. Wait until Windows tells you that the device is ready to use.

3. Click the new OMEGASCOPE™ icon on your Windows desktop.

4. OMEGASCOPE™ will detect your scope device and prepare to display a waveform. The green Start button will be highlighted to show that OMEGASCOPE™ is ready.

5. Connect a signal to one of the scope device's input channels and see your first waveform! To learn more about using OMEGASCOPE™, please read the OMEGASCOPE™ Primer.

Problems?

Help is at hand! Our technical support staff are always ready to answer your telephone call during office hours. At other times, please send us an email.
5 OMEGASCOPE™ and oscilloscope primer

This chapter explains the fundamental concepts that you will need to know before working with the OMEGASCOPE™ software. If you have used an oscilloscope before, then most of these ideas will be familiar to you. You can skip the Oscilloscope basics section and go straight to the OMEGASCOPE™-specific information. If you are new to oscilloscopes, please take a few minutes to read at least the Oscilloscope basics and OMEGASCOPE™ basics topics.

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 Display]

Oscilloscope displays are always read from left to right. The voltage-time characteristic of the signal is drawn as a line called the trace. In this example, the trace is blue and begins at point A. If you look to the left of this point, you will see the number "0.0" on the voltage axis, which tells you that the voltage is 0.0 V (volts). If you look below point A, you will see another number "0.0", this time on the time axis, which tells you that the time is 0.0 ms (milliseconds) at this point.

At point B, 0.25 milliseconds later, the voltage has risen to a positive peak of 0.8 volts. At point C, 0.75 milliseconds after the start, the voltage has dropped to a 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 limitless range of signal types that you will encounter.

Most oscilloscopes allow you to adjust the vertical and horizontal scales of the display. The vertical scale is called the voltage range, and is measured in units of voltage. The horizontal scale is called the timebase, and is measured in units of time.

The voltage range is typically adjustable, allowing you to set the scale to display the signal's amplitude accurately. The timebase is adjustable, allowing you to set the time scale to display the signal's time duration accurately. These adjustments are made using the vertical and horizontal controls on the oscilloscope.

In this example, the voltage range has been set to display the signal's amplitude accurately, and the timebase has been set to display the signal's time duration accurately. The signal is a sine wave, which is a common type of signal in electronic systems.
5.2 PC Oscilloscope basics

A **PC Oscilloscope** is a measuring instrument that consists of a hardware scope device and an oscilloscope program running on a PC. Oscilloscopes were originally stand-alone instruments with no signal processing or measuring abilities, and with storage only available as an expensive extra. Later oscilloscopes began to use 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 OMSP-2000/3000/4000 scope devices with the convenience of the PC that's already on your desk.
5.3 OMEGASCOPE™ basics

OMEGASCOPE™ can produce a simple display such as the example in the Oscilloscope basics 7th topic, but it also has many advanced features. The screen shot below shows the OMEGASCOPE™ window. Click on any of the underlined labels to learn more. See OMEGASCOPE™ window 12 for an explanation of these important concepts.

Note: Other buttons may appear in the OMEGASCOPE™ main window depending on the capabilities of the oscilloscope that is connected, and on the settings applied to the OMEGASCOPE™ program.
5.3.1 Capture modes

OMEGASCOPE™ can operate in three capture modes: **scope mode**, **spectrum mode** and **persistence mode**. The mode is selected by buttons in the **Capture Setup Toolbar**.

In **scope mode**, OMEGASCOPE™ displays a main **scope view**, optimises its settings for use as a PC Oscilloscope, and allows you to directly set the capture time. You can still display one or more secondary spectrum views.

In **spectrum mode**, OMEGASCOPE™ displays a main **spectrum view**, optimises its settings for spectrum analysis, and allows you to directly set the frequency range in a similar way to a dedicated spectrum analyser. You can still display one or more secondary scope views.

In **persistence mode**, OMEGASCOPE™ displays a single, modified scope view in which old waveforms remain on the screen in faded colors while new waveforms are drawn in brighter colors. See also: **How to find a glitch using persistence mode** and the **Persistence Options dialog**.

When you **save waveforms and settings**, OMEGASCOPE™ only saves data for the mode that is currently in use. If you wish to save settings for both capture modes, then you need to switch to the other mode and save your settings again.

See also: **How do capture modes work with views?**
5.3.2 How do capture modes work with views?

The **capture mode** tells OMEGASCOPE™ whether you are mainly interested in viewing waveforms (**scope mode**) or frequency plots (**spectrum mode**). When you select a capture mode, OMEGASCOPE™ sets up the hardware appropriately and then shows you a **view** that matches the capture mode (a **scope view** if you selected scope mode or **persistence mode**, or a **spectrum view** if you selected spectrum mode). The rest of this section does not apply in persistence mode, which allows only a single view.

Once OMEGASCOPE™ has shown you the first view, you can, if you wish, add more scope or spectrum views, regardless of the capture mode you are in. You can add and remove as many extra views as you wish, as long as one view remains that matches the capture mode.

![Diagram](Images)

**Examples showing how you might select the capture mode and open additional views in OMEGASCOPE™.** Top: persistence mode (one view only). Middle: scope mode. Bottom: spectrum mode.

When using a secondary view type (a spectrum view in scope mode, or a scope view in spectrum mode), you may see the data compressed horizontally rather than displayed neatly as in a primary view. You can usually overcome this by using the zoom tools.
5.4 OMEGASCOPE™ window

The OMEGASCOPE™ window shows a block of data captured from the scope device. When you first open OMEGASCOPE™ 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 the OMEGASCOPE™ window. Click on the underlined labels for more information.

To arrange the views within the OMEGASCOPE™ window

If the OMEGASCOPE™ window contains more than one view, OMEGASCOPE™ arranges them in a grid. This is arranged automatically, but you can customize it if you wish. Each rectangular space in the grid is called a viewport. You can move a view to a different viewport by dragging its name tab, but you cannot move it outside the OMEGASCOPE™ window. 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 Scope view

A scope view shows the data captured from the scope as a graph of signal amplitude against time. (See Oscilloscope basics for more on these concepts.) OMEGASCOPE™ 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 horizontal time axis, with signal level shown on one or more vertical axes. 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.

Scope views are available regardless of which mode - scope mode or spectrum mode - is active.
5.6 XY view

An **XY view**, in its simplest form, shows a graph of one channel plotted against another. XY mode is useful for showing phase relationships between periodic signals (using Lissajous figures) and for plotting I-V (current-voltage) characteristics of electronic components.

In the example above, two different periodic signals have been fed into the two input channels. The smooth curvature of the trace tells us that the inputs are roughly or exactly sine waves. The three loops in the trace show that Channel B has about three times the frequency of Channel A. We can tell that the ratio is not exactly three because the trace is slowly rotating, although you cannot see that in this static picture. Since an XY view has no time axis, it tells us nothing about the absolute frequencies of the signals. To measure frequency, we need to open a [Scope view](#).

**How to create an XY view**

There are two ways to create an XY view.

- Use the **Add View > XY** command on the [Views menu](#). This adds a new XY view to the OMEGASCOPE™ window without altering the original [scope](#) or [spectrum](#) view or views. It automatically chooses the two most suitable channels to place on the X and Y axes. Optionally, you can change the X axis channel assignment using the **X-Axis** command (see below).

- Use the **X-Axis** command on the [Views menu](#). This converts the current scope view into an XY view. It maintains the existing Y axes and allows you to choose any available channel for the X axis. With this method, you can even assign a [math channel](#) or a [reference waveform](#) to the X axis.
5.7 Trigger marker

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

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

You can move the trigger marker by dragging it with the mouse or, for more accurate control, by using the buttons on the **Triggering toolbar**.

**Other forms of trigger marker**

If the scope view is zoomed and panned so that the trigger point is off the screen, the off-screen trigger marker (shown above) appears at the side of the graticule to indicate the trigger level.

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

When some **advanced trigger types** are in use, the trigger marker changes to a window marker, which shows the upper and lower trigger thresholds.

For more information, see the section on **Trigger timing**.

5.8 Post-trigger arrow

The **post-trigger arrow** is a modified form of the **trigger marker** that appears temporarily on a **scope view** 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?**)

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*) indicates the trigger reference point.

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

5.9 **Spectrum view**

A **spectrum view** is one view of the data from a scope device. A spectrum is a diagram of signal level on a vertical axis plotted against frequency on the horizontal axis. OMEGASCOPE™ opens with a scope view, but you can add a spectrum view by using the *views menu*. Similar to the screen of a conventional spectrum analyser, a spectrum view shows you one or more spectra with a common frequency axis. Each view can have as many spectra as the scope device has channels. Click on one of the labels below to learn more about a feature.

Unlike in the scope view, in the spectrum view the data is not clipped at the limits of the range displayed on the vertical axis, so you can apply axis scaling or offset to see more data. Vertical axis labels are not provided for data outside what is considered to be the 'useful' range, but rulers will still work outside this range.

Spectrum views are available regardless of which mode - *Scope Mode* or *Spectrum Model* - is active.

For more information, see: *How to set up the spectrum view* and *Spectrum Options dialog*. 
Persistence mode

Persistence mode superimposes multiple waveforms on the same view, with more frequent data or newer waveforms drawn in brighter colors than older ones. This is useful for spotting glitches, when you need to see a rare fault event hidden in a series of repeated normal events.

Enable persistence mode by clicking the Persistence Mode button on the Capture Setup toolbar. With the persistence options set at their default values, the screen will look something like this:

The colors indicate the frequency of the data. Red is used for the highest-frequency data, with yellow for intermediate frequencies and blue for the least frequent data. In the example above, the waveform spends most of its time in the red region, but noise causes it to wander occasionally into the blue and yellow regions. These are the default colors, but you can change them using the Persistence Options dialog.

This example shows persistence mode in its most basic form. See the Persistence Options dialog for ways to modify the display to suit your application, and How to find a glitch using persistence mode for a worked example.
5.11 Measurements table

A **measurements table** displays the results of automatic measurements. Each view can have its own table, and you can add, delete or edit measurements from this table.

<table>
<thead>
<tr>
<th>Column heading</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>The name of the measurement that you selected in the Add Measurement or Edit Measurement dialog. An &quot;F&quot; after the name indicates that the statistics for this measurement are filtered.</td>
</tr>
<tr>
<td>Span</td>
<td>The section of the waveform or spectrum that you want to measure. This is 'Whole trace' by default.</td>
</tr>
<tr>
<td>Value</td>
<td>The live value of the measurement, from the latest capture</td>
</tr>
<tr>
<td>Min</td>
<td>The minimum value of the measurement since measuring began</td>
</tr>
<tr>
<td>Max</td>
<td>The maximum value of the measurement since measuring began</td>
</tr>
<tr>
<td>Average</td>
<td>The arithmetic mean of the measurements from the last $n$ captures, where $n$ is set in the General page of the Preferences dialog</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>The standard deviation of the measurements from the last $n$ captures, where $n$ is set in the General page of the Preferences dialog</td>
</tr>
<tr>
<td>Capture Count</td>
<td>The number of captures used to create the statistics above. This starts at 0 when triggering is enabled, and counts up to the number of captures specified in the General page of the Preferences dialog.</td>
</tr>
</tbody>
</table>

To add, edit or delete measurements

See: [Measurements toolbar](#).

To change the width of a measurement column

Drag the vertical separator between column headings to create the column width you need, as shown opposite.

To change the update rate of the statistics

The statistics (Min, Max, Average, Standard Deviation) are based on the number of captures shown in the Capture Count column. You can change the maximum capture count using the Capture Size control in the General page of the Preferences dialog.
Resolution enhancement

Resolution enhancement is a technique for increasing the effective vertical resolution of the scope at the expense of high-frequency detail. Selecting resolution enhancement does not change the scope's sampling rate or the number of samples available.

For this technique to work, the signal must contain a very small amount of Gaussian noise, but for many practical applications this is generally taken care of by the scope itself and the noise inherent in normal signals.

The resolution enhancement feature uses a flat moving-average filter. This acts as a low-pass filter with good step response characteristics and a very slow roll-off from the pass-band to the stop-band.

Some side-effects will be observed when using resolution enhancement. These are normal and can be counteracted by reducing the amount of enhancement used, increasing the number of samples captured or changing the timebase. Trial and error is usually the best way to find the optimum resolution enhancement for your application. The side-effects include:

- Widened and flattened impulses (spikes)
- Vertical edges (such as those of square waves) turned into straight-line slopes
- Inversion of the signal (sometimes making it look as if the trigger point is on the wrong edge)
- A flat line (when there are not enough samples in the waveform)

Procedure

1. Click the Channel Options button in the Channel Setup toolbar to select the effective number of bits, which can be equal to or greater than the vertical resolution of your scope device.
Quantifying Resolution Enhancement

The table below shows the size of the moving-average filter for each resolution enhancement setting. A bigger filter size requires a higher sampling rate to represent a given signal without significant side-effects (as detailed above).

<table>
<thead>
<tr>
<th>Resolution enhancement e (bits)</th>
<th>Number of values n</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>1.0</td>
<td>4</td>
</tr>
<tr>
<td>1.5</td>
<td>8</td>
</tr>
<tr>
<td>2.0</td>
<td>16</td>
</tr>
<tr>
<td>2.5</td>
<td>32</td>
</tr>
<tr>
<td>3.0</td>
<td>64</td>
</tr>
<tr>
<td>3.5</td>
<td>128</td>
</tr>
<tr>
<td>4.0</td>
<td>256</td>
</tr>
</tbody>
</table>

**Example.** Your scope device is an OMSP-2205 (resolution = 8 bits). You have selected an effective resolution of 9.5 bits. The resolution enhancement is therefore:

\[ e = 9.5 - 8.0 = 1.5 \text{ bits}. \]

The table shows that this is achieved using a moving average of:

\[ n = 8 \text{ samples}. \]

This number gives a guide to what sort of filtering effect the resolution enhancement will have on the signal. The best way of seeing the actual low-pass filter effect is to add a spectrum view and look at the shape of the noise floor (try dragging the y-axis upwards to see the noise more clearly).

5.13 **Pointer tool tip**

The **pointer tool tip** is a box that displays the horizontal and vertical axis values at the mouse pointer location. It appears temporarily when you click the background of a view.

![Pointer tool tip in a scope view](image-url)
5.14 Signal rulers

The **signal rulers** (sometimes called **cursors**) help you measure absolute and relative signal levels on a **scope**, **XY** or **spectrum view**.

In the **scope view** above, the two colored squares to the left of the vertical axis are the **ruler drag-handles** for channel A. Drag one of these downwards from its resting position in the top left corner, and a **signal ruler** (a horizontal dashed line) will extend from it.

Whenever one or more signal rulers is in use, the **ruler legend** appears. This is a table showing all of the signal ruler values. If you close the ruler legend using the **Close** button, all the rulers are deleted.

Signal rulers also work in **spectrum** and **XY** views.

**Ruler tool tip**

If you move the mouse pointer over one of the rulers, OMEGASCOPE™ displays a **tool tip** with the ruler number and the signal level of the ruler. You can see an example of this in the picture above.
5.15 Time rulers

The **time rulers** (sometimes called **cursors**) measure time on a **scope view** or frequency on a **spectrum view**.

**Ruler tool tip**

If you hold the mouse pointer over one of the rulers, as we did in the example above, OMEGASCOPE™ 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. Clicking the **Close** button on the ruler legend also deletes all the rulers.

**Frequency legend**

The **frequency legend** in the bottom right-hand corner of a scope view shows $1/\Delta$, where $\Delta$ is the difference between the two time rulers. The accuracy of this calculation depends on the accuracy with which you have positioned the rulers. For greater accuracy with periodic signals, use the **frequency measurement** function built in to OMEGASCOPE™.
5.16 Ruler legend

The **ruler legend** is a box that displays the positions of all the rulers you have placed on the view. It appears automatically whenever you position a ruler on the view:

![Ruler legend diagram]

Editing

You can adjust the position of a ruler by editing any value in the first two columns. To insert a Greek µ (the *micro* symbol, meaning one millionth or \( \times 10^{-6} \)), type the letter 'u'.

Tracking rulers

When two rulers have been positioned on one channel, the **Lock button** appears next to that ruler in the ruler legend. Clicking this button causes the two rulers to track each other: dragging one causes the other one to follow it, maintaining a fixed separation. The button changes to \( \hat{\text{b}} \) when the rulers are locked.

**TIP:** To set up a pair of tracking rulers with a known distance between them, first click the Lock button, then edit the two values in the ruler legend so that the rulers are the desired distance apart.

See also: frequency legend.

5.17 Frequency legend

The **frequency legend** appears when you have placed two time rulers on a scope view. It shows \( 1/\Delta \) in hertz (the SI unit of frequency, equal to cycles per second), where \( \Delta \) 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.

For frequencies up to 1.666 kHz, the frequency legend can also show the frequency in RPM (revolutions per minute). The RPM display can be enabled or disabled in the Preferences > Options dialog.
5.18 Properties sheet

The **Properties sheet** is a summary of the settings that OMEGASCOPE™ is using. It is enabled using the **Views > View Properties** menu command, and appears to the right of the waveforms in the OMEGASCOPE™ window.

```
<table>
<thead>
<tr>
<th>Settings</th>
<th>Description</th>
</tr>
</thead>
</table>
| **Sampling settings** | Sample interval: 800 ns  
Sample rate: 1.25 MS/s  
No. samples: 6,255  |
| **Spectrum settings** | Window: Blackman  
No. bins: 4096  
Bin width: 152.6 Hz  
Time gate: 5 ms  |
| **Signal generator settings** | Signal type: Sine  
Frequency: 1 kHz  
Amplitude: 1 V  
Offset: 0 V  |
| **Channel settings** | Channel A  
Range: ±2 V  
Coupling: DC  |
| **Time stamp** | Channel B  
Range: ±50 mV  
Coupling: DC  |
| Capture Date | 2009/09/10  |
| Capture Time | 17:08:35  |
```

**Window.** The **window function** is applied to the data before computing the spectrum. This is selected in the **Spectrum options dialog.**

**Time gate.** The number of samples that OMEGASCOPE™ uses to compute a spectrum is equal to twice the number of bins. This number of samples is expressed as a time interval called the time gate. It is measured from the start of the capture.

5.19 Custom probes

A **probe** is any connector, transducer or measuring device that you connect to an input channel of your **scope device.** OMEGASCOPE™ 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** 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.
5.20 Maths channels

A maths channel is a mathematical function of one or more input signals. The function can be as simple as "Invert A", replacing the Invert button on a conventional oscilloscope, or a complex function that you define. It can be displayed in a scope, XY or spectrum view in the same way as an input signal, and like an input signal it has its own measurement axis, scaling and offset button and color.

OMEGASCOPE™ has a set of built-in math channels for the most important functions, including "A+B" (the sum of channels A and B) and "A-B" (the difference between channels A and B). You can also define your own functions using the equation editor, or load predefined maths channels from files.

The picture below is a three-step guide to using maths channels:

1. **Tools > Maths Channels command.** Click this to open the Maths Channels dialog, shown at top right in the picture above.

2. **Maths Channels dialog.** This lists all the available maths channels. In the example above, only the built-in functions are listed.

3. **Maths channel.** Once enabled, a maths channel appears in the selected scope or spectrum view. You can change its scale and offset as with any other channel. In the example above, the new maths channel (bottom) is defined as A-B, the difference between input channels A (top) and B (middle).

You may occasionally see a flashing warning symbol like this - ! - at the bottom of the maths channel axis. This means that the channel cannot be displayed because an input source is missing. For example, this occurs if you enable the A+B function while channel B is set to Off.
5.21 Reference waveforms

A **reference waveform** is a stored copy of an input signal. You can create one by right-clicking on the view, selecting the **Reference Waveforms** command and selecting which channel to copy. It can be displayed in a scope or spectrum view in the same way as an input signal, and like an input signal it has its own measurement axis, **scaling and offset button** and **color**.

For more control over Reference Waveforms, use the **Reference Waveforms dialog** as shown below.

1. **Reference Waveforms button**. Click this to open the **Reference Waveforms dialog**, shown on the right in the picture above.

2. **Reference Waveforms dialog**. This lists all the available input channels and reference waveforms. In the example above, input channels A and B are switched on, so they appear in the **Available** section. The **Library** section is empty to begin with.

3. **Duplicate button**. When you select an input channel or reference waveform and click this button, the selected item is copied to the **Library** section.

4. **Library section**. This shows all your reference waveforms. Each one has a check box that controls whether or not the waveform appears on the display.

5. **Reference waveform**. Once enabled, a reference waveform appears in the selected **scope** or **spectrum** view. You can **change its scale and offset** as with any other channel. In the example above, the new reference waveform (bottom) is a copy of channel A.

6. **Axis control button**. Opens an **axis scaling dialog** allowing you to adjust scale, offset and delay for this waveform.
5.22 Serial decoding

You can use OMEGASCOPE™ to decode data from a serial bus such as I²C or CAN Bus. Unlike a conventional bus analyzer, OMEGASCOPE™ lets you see the high-resolution electrical waveform at the same time as the data. The data is integrated into the scope view, so there’s no need to learn a new screen layout.

How to use Serial Decoding

1. Select the **Tools** > **Serial Decoding** menu command.

2. Complete the **Serial Decoding dialog**.

3. Choose to display the data in **View**, **In Window**, or both.

4. You can decode multiple channels in different formats simultaneously. Use the **Decoding tab** below the "In Window" data table (shown in the picture above) to select which channel of data to display in the table.
5.23 Mask limit testing

**Mask limit testing** is a feature that tells you when a waveform or spectrum goes outside a specified area, called a **mask**, drawn on the **scope view** or **spectrum view**. OMEGASCOPE™ can draw the mask automatically by tracing a captured waveform, or you can draw it manually. Mask limit testing is useful for spotting intermittent errors during debugging, and for finding faulty units during production testing.

To begin, go to the main OMEGASCOPE™ menu and select **Tools > Masks > Add Masks**. This opens the **Mask Library dialog**. When you have selected, loaded or created a mask, the scope view will appear as follows:

(A) **Mask**

Shows the allowed area (in white) and the disallowed area (in blue). Right-clicking the mask area and selecting the **Edit Mask** command takes you to the **Edit Mask dialog**. You can change the mask colors with the **Tools > Preferences > Colors** dialog; add, remove and save masks using the **Masks menu**; and hide and display masks using the **Views > Masks menu**.

(B) **Failed waveforms**

If the waveform enters the disallowed area, it is counted as a failure. The part of the waveform that caused the failure is highlighted, and persists on the display until the capture is restarted.

(C) **Measurements table**

The number of failures since the start of the current scope run is shown in the **Measurements table**. You can clear the failure count by stopping and restarting the capture using the **Start/Stop button**. The measurements table can display other measurements at the same time as the mask failure count.
5.24 Alarms

Alarms are actions that OMEGASCOPE™ can be programmed to execute when certain events occur. Use the Tools > Alarms command to open the Alarms dialog, which configures this function.

The events that can trigger an alarm are:

- Capture - when the oscilloscope has captured a complete waveform or block of waveforms.
- Buffers Full - when the waveform buffer becomes full.
- Mask(s) Fail - when a waveform fails a mask limit test.

The actions that OMEGASCOPE™ can execute are:

- Beep
- Play Sound
- Stop Capture
- Restart Capture
- Run Executable
- Save Current Buffer
- Save All Buffers

See Alarms dialog for more details.
5.25 Buffer Navigator

The OMEGASCOPE™ waveform buffer can hold up to 10,000 waveforms, subject to the amount of available memory in the oscilloscope. The Buffer Navigator helps you to scroll through the buffer quickly to find the waveform you want.

To begin, click the Buffer Navigator button in the Buffer Navigation toolbar. This opens the Buffer Navigator window:

Click on any one of the visible waveforms to bring it to the front of the navigator for closer inspection, or use the controls:

- **Buffers to show**: If any of the channels has a mask applied, then you can select the channel from this list. The Buffer Navigator will then show only the waveforms that failed the mask test on that channel.
- **Start**: Scroll to waveform number 1.
- **Backward**: Scroll to the next waveform on the left.
- **Zoom in**: Change the scale of the waveforms in the Buffer Navigator view. There are three zoom levels: Large: default view. One waveform fills the height of the window. Medium: a medium-sized waveform above a row of small waveforms. Small: a grid of small waveforms. Click on the top or bottom row of images to scroll the grid up or down.
- **Zoom out**: Forward: Scroll to the next waveform on the right. End: Scroll to the last waveform in the buffer. (The number of waveforms depends on the Tools > Preferences > General > Maximum Waveforms setting and on the type of scope connected.)

Click anywhere on the main OMEGASCOPE™ window to close the Buffer Navigator window.
6 Menus

Menus are the quickest way to get to OMEGASCOPE™'s main features. The Menu bar is always present at the top of the OMEGASCOPE™ 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 arrow 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 in OMEGASCOPE™.
6.1 File menu
Location: Menu bar > File
Purpose: gives access to file input and output operations

---

Connect Device. This command appears only when there is no scope device connected. It opens the Connect Device dialog, which allows you to select the scope device you wish to use.

Open. Allows you to select the file you want to open. OMEGASCOPE™ 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, OMEGASCOPE™ may need to modify the saved settings to suit the present device.

Hint: Use the Page Up and Page Down keys to cycle through all the waveform files in the same directory.

Save All Waveforms. Saves all waveforms using the filename shown in the title bar.

Save All Waveforms As. Opens the Save As dialog, which allows you to save the settings, waveforms, custom probes and math channels for all views in various formats. Only the waveforms for the mode currently in use (Scope Mode or Spectrum Mode) will be saved.

Save Current Waveform As. Opens the Save As dialog, which allows you to save the settings, waveforms, custom probes and math channels for all views in various formats. Only the waveforms for the mode currently in use (Scope Mode or Spectrum Mode) will be saved.

In persistence mode, this command is called Save Persistence As and saves only the data for this mode.

Startup Settings. Opens the Startup Settings menu.

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.

Recent Files. A list of recently opened or saved files. This list is compiled automatically, but you can clear it using the Files page of the Preferences dialog.

Exit. Close OMEGASCOPE™ without saving any data.

6.1.1 Save As dialog
Location:  **Menu bar > File > Save All Waveforms As** or **Save Current Waveform As**

Purpose:  allows you to save your waveforms and settings (including custom probes and active math channels) to a file in various formats.

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 waveforms and settings from the current scope device. Can be opened on any computer running OMEGASCOPE™.

**Settings files (.pssettings)**
Stores all settings (but not waveforms) from the current scope device. Can be opened on any computer running OMEGASCOPE™.
<table>
<thead>
<tr>
<th>File Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSV (Comma delimited) files (.csv)</td>
<td>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, including currently displayed math channels. (Details)</td>
</tr>
<tr>
<td>Text (Tab delimited) files (.txt)</td>
<td>Stores waveforms as a text file with tab-separated values. The values are the same as those in the CSV format. (Details)</td>
</tr>
<tr>
<td>Bitmap images (.bmp)</td>
<td>Stores a picture of the waveforms, graticule and rulers in Windows BMP format. The image is 800 pixels wide by 600 pixels high, in 16 million colors, and uncompressed. BMP files are suitable for importing into Windows desktop-publishing programs.</td>
</tr>
<tr>
<td>GIF images (.gif)</td>
<td>Stores the waveforms, graticule and rulers in Compuserve GIF format. The image is 800 pixels wide by 600 pixels high, in 256 colors, and compressed. GIF files are widely used to illustrate web pages.</td>
</tr>
<tr>
<td>Animated GIF image (*.gif)</td>
<td>Creates an animated GIF that displays all of the waveforms in the buffer in sequence. Each waveform is formatted as in the single GIF format described above.</td>
</tr>
<tr>
<td>PNG images (.png)</td>
<td>Stores the graticule, rulers and waveforms in Portable Network Graphics format. The image is 800 pixels wide by 600 pixels high, in 16 million colors, and compressed.</td>
</tr>
<tr>
<td>Matlab 4 files (.mat)</td>
<td>Stores the waveform data in Matlab 4 format.</td>
</tr>
</tbody>
</table>
6.1.1.1 File formats for exported data

OMEGASCOPE™ can export raw data in either text or binary format:

**Text-based file formats**

- Easy to read without special tools
- Can be imported into standard spreadsheet applications
- Files are very large if there are many samples in the data (so files are limited to about 1 million values per channel)

**Text file format details**

**Binary file format**

- Files remain relatively small and can even be compressed in some situations (this means that the amount of saved data is unlimited)
- Either a special application is required to read the files or the user must write a program to read the data from the file

If you need to save more than 64 K values per channel, then you must use a binary file format such as the Matlab® MAT-file format.

**Binary file format details**

**Data types for storing OMEGASCOPE™ data**

Regardless of whether the data types were loaded from a binary file or from a text-based file, we recommend the following data formats for storing the values loaded from an OMEGASCOPE™ data file:

- Sampled data (such as voltages) should use 32-bit single-precision floating-point data types.
- Times should use 64-bit double-precision floating-point data types.

6.1.1.1.1 Text formats

Text-format files exported by OMEGASCOPE™ are encoded in UTF-8 format by default. This is a popular format which is capable of representing a huge range of characters, whilst still retaining some compatibility with the ASCII character set if only standard Western European characters and numbers are used in the file.

**CSV (comma-separated values)**

CSV files store data in the following format:

```
Time, Channel A, Channel B
(µs), (V), (V)
-500.004, 5.511, 1.215
-500.002, 4.724, 2.130
-500, 5.552, 2.212
...
```

There is a comma after each value on a line to represent a column of data and a carriage return at the end of the line to represent a new row of data. The 1 million values per channel limit prevents excessively large files being created.
Note. CSV files are not the best choice of format if you are working in a language that uses the comma character as the decimal point. Instead, try using the tab-delimited format which works in almost the same way.

Tab-delimited

Tab-delimited files store data in the following format:

<table>
<thead>
<tr>
<th>Time (µs)</th>
<th>Channel A (V)</th>
<th>Channel B (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500.004</td>
<td>5.511</td>
<td>1.215</td>
</tr>
<tr>
<td>-500.002</td>
<td>4.724</td>
<td>2.130</td>
</tr>
<tr>
<td>-500</td>
<td>5.552</td>
<td>2.212</td>
</tr>
</tbody>
</table>

The files have a tab character after each value on a line to represent a column of data and a carriage return at the end of the line to represent a new row of data. These files work in any language and are a good choice for sharing data internationally. The 1 million values per channel limit prevents excessively large files being created.

6.1.1.1.2 Binary formats

OMEGASCOPE™ can export data in version 4 of the .mat binary file format. This is an open format and the full specification is freely available from the www.mathworks.com website. OMEGASCOPE™ saves data into the MAT-File format in a specific way, which is detailed below.

Importing into Matlab

Load the file into your workspace using this syntax:

```
load myfile
```

Each channel’s data is stored in an array variable named by the channel. So, the sampled data for channels A to D would be in four arrays named A, B, C and D.

There is only one set of time data for all channels and this is loaded in one of two possible formats:

1. A start time, an interval and a length. The variables are named Tstart, Tinterval and Length.
2. An array of times (sometimes used for ETS data). The time array is named T.

If the times are loaded in as Tstart, Tinterval and Length then you can use the following command to create the equivalent array of times:

```
T = [Tstart : Tinterval : Tstart + (Length - 1) * Tinterval];
```

Exploring the file format

The full file specification, available from www.mathworks.com, is comprehensive so this guide does not describe the entire format. Instead, this guide describes enough of the format to allow you to get data from the file and use it in your own program.

The variables described above (under Importing into Matlab) are stored in a series of data blocks, each preceded by a header. Each variable has its own header and data block and the corresponding variable names are stored with them (such as A, B, Tstart). The following sections describe how to read each variable from the file.
The order of the data blocks is not specified, so programs should look at the variable names to decide which variable is currently being loaded.

**The header**
The file consists of a number of data blocks preceded by 20-byte headers. Each header contains five 32-bit integers (as described in the table below).

<table>
<thead>
<tr>
<th>Bytes</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 3</td>
<td>Data format (0, 10 or 20)</td>
</tr>
<tr>
<td>4 – 7</td>
<td>Number of values</td>
</tr>
<tr>
<td>8 – 11</td>
<td>1</td>
</tr>
<tr>
<td>12 – 15</td>
<td>0</td>
</tr>
<tr>
<td>16 – 19</td>
<td>Name length</td>
</tr>
</tbody>
</table>

**Data format**
The ‘Data format’ in the first 4-bytes describes the type of numerical data in the array.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Double (64-bit floating point)</td>
</tr>
<tr>
<td>10</td>
<td>Single (32-bit floating point)</td>
</tr>
<tr>
<td>20</td>
<td>Integer (32-bit)</td>
</tr>
</tbody>
</table>

**Number of values**
The ‘Number of values’ is a 32-bit integer describing the number of numerical values in the array. This value may be 1 for variables that only describe one value; but for arrays of samples or times, expect this to be a large number.

**Name length**
The ‘Name length’ is the length of the name of the variable as a null-terminated 1-byte per character ASCII string. The last null terminating character (‘\0’) is included in the ‘Name length’ so if the variable name is “TStart” (same as ‘TStart\0’) then the name length will be 7.

**The data block**
The data block begins with the name of the variable (such as A, Tinterval) and you should read in the number of bytes described by the ‘Name length’ part of the header (not forgetting that the last byte in the string is ‘\0’ if your programming language needs to take account of this).

The remaining part of the data block is the actual data itself, so read in the number of values described in the ‘Number of values’ part of the header. Remember to take account of the size of each value as described in the ‘Data format’ part of the header.

Channel data such as voltages, in variables such as A and B, are stored as 32-bit single-precision floating-point data types. Times such as Tstart, Tinterval and T are stored as 64-bit double-precision floating-point data types. Length is stored as a 32-bit integer.
6.1.2 Start up Settings menu
Location:  Menu bar > File > Startup Settings
Purpose:  allows you to load, save and restore the OMEGASCOPE™ startup settings

- **Save Startup Settings.** Saves your current settings ready for when you next select **Load Startup Settings.** These settings are remembered from one session of OMEGASCOPE™ to the next.

- **Load Startup Settings.** Returns to the settings you created with the **Save Startup Settings** command.

- **Reset Startup Settings.** Deletes the startup settings you created with the **Save Startup Settings** command, and restores the installation default settings.

6.2 Edit menu
Location:  Menu bar > Edit
Purpose:  gives access to the clipboard-related and note editing functions

- **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 dialog** when you select the .txt format.

- **Copy Entire Window as Image.** This copies a picture of the OMEGASCOPE™ window to the clipboard, and is equivalent to pressing Alt-PrtScn on a full-size keyboard. You can then paste the picture into any application that can display pictures, such as a word processor or desktop publishing program.

- **Notes.** Opens a **Notes area** at the bottom of the OMEGASCOPE™ window. You can type or paste your own notes in this area.
6.2.1 Notes area

Location:  Menu bar > Edit > Notes

Purpose: a text box for typing your own notes

A Notes area can be displayed at the bottom of the OMEGASCOPE™ window. You can enter any text you wish in this area. You can also copy text from another program and paste it here.
6.3 Views menu

Location: **Menu bar > Views**, or right-click on a **view**.

Purpose: controls the layout of the current **view**, which is a rectangular area of the OMEGASCOPE™ window that display scope, spectrum or other kinds of data.

The contents of the **Views menu** may vary depending on where you click and how many views are open. If the current view contains a **Measurements table**, a combined **Measurements menu** and **Views menu** will appear.

**Add View:** Add a view of the selected type (scope, XY or spectrum). In automatic grid layout mode (the default), OMEGASCOPE™ rearranges the grid to make room for the new view, up to a limit of four views. Any further views will be added as tabs in existing **viewports**. If you have selected a fixed grid layout, OMEGASCOPE™ will not change it.

**Rename View:** Change the standard 'Scope' or 'Spectrum' label to a title of your choice.

**Close View:** Remove a view from the OMEGASCOPE™ window. In automatic grid layout mode (the default), OMEGASCOPE™ rearranges the grid to make the best use of the remaining space. In fixed grid layout mode (if you have selected a grid fixed layout), OMEGASCOPE™ will not change the grid.

**Channels:** Select which channels are visible in the current view. Each view, when created, shows all the input channels, but you can switch them on and off using this command. Only the input channels that are enabled (not set to “Off” in the **Channel Setup Toolbar**) are available for viewing. The **Channels menu** also list **math channels**. You can select up to 8 channels in any view.
**X-Axis:** Select any suitable channel to drive the X axis. By default, the X axis represents time. If you select an input channel instead, the scope view will become an XY view that plots one input against another. A quicker way to create an XY view is to use the Add View command (see above).

**Grid Layout:** The grid layout defaults to "Automatic" mode, in which OMEGASCOPE™ automatically arranges views in a grid. You can also select one of the standard grid layouts or create a custom layout, which OMEGASCOPE™ will preserve as you add or remove views.

**Arrange Grid Layout:** Adjust the grid layout to fit the number of views. Moves any tabbed views to empty viewports. Overrides any previous choice of grid layout.

**Reset View Sizes:** If you have resized any of the views by dragging the vertical or horizontal separator bars between viewports, this option resets all the viewports to their original sizes.

**Move View To:** Move a view to a specified viewport. You can achieve the same effect by dragging the view by its name tab and dropping it in a new viewport. See How to move a view.

**Auto-arrange Axes:** Scale and offsets all traces to fill the view and avoid overlaps.

**Reset View Layout:** Reset the scale factor and offset of the selected view to their default values.

**Arrange views:** If multiple views are stacked in the same viewport, move them into their own viewports.

**View Properties:** Show the Properties sheet, which lists scope settings that are normally hidden.

**Reference Waveforms:** Create a new Reference Waveform by copying one of the available channels, and add it to the view. To edit or remove a waveform, use the Tools > Reference Waveforms menu command.

**Masks:** Select which masks (see Mask Limit Testing) are visible.
6.3.1 Custom grid layout dialog

Location: right-click on view > Views menu > Grid Layout > Custom layout...

Menu bar > View

Purpose: if the Grid Layout section of the Views menu does not contain the layout you want, this dialog gives further options.

You can lay out the view grid with any number of rows and columns up to 4 by 4. You can then drag the views to different locations in the grid.
6.4 Measurements menu

Location: Menu bar > Measurements

Purpose: controls the Measurements table

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

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

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

- **Grid font size.** Sets the font size for the entries in the measurements table.

- **Column Auto-width.** If this button is pressed, the columns of the measurements table will continually adjust to fit the contents whenever the table changes. Click again to release the button.
6.4.1 Add / Edit Measurement dialog

Location: Measurements toolbar > Add Measurement or Edit Measurement button
Views menu > Add Measurement or Edit Measurement button
Double-click a measurement in the measurements table

Purpose: allows you to add a measurement of a waveform to the selected view, or edit an existing measurement

OMEGASCOPE™ automatically refreshes the measurement every time it updates the waveform. If this is the first measurement for the view, OMEGASCOPE™ will create a new measurements table to display the measurement; otherwise, it will add the new measurement to the bottom of the existing table.

Channel Which of the scope device's channels to measure.
Type OMEGASCOPE™ can calculate a wide range of measurements for waveforms. See Measurement Types for details.
Section Measure the whole trace, just the section between rulers, or, where appropriate, a single cycle marked by one of the rulers.
Advanced Gives access to advanced measurement settings.
6.4.2 Advanced measurement settings

**Location:** Add Measurement or Edit Measurement dialog > Advanced

**Purpose:** adjust parameters of certain measurements such as filtering and spectrum analysis

**Threshold**

Some measurements, such as **Rise Time** and **Fall Time**, can be made using different thresholds. Select the appropriate ones here. When comparing rise and fall times with manufacturers' specifications, it is important to use the same thresholds for all measurements.

**Spectrum Span**

When measuring peak-related parameters such as 'Frequency at Peak' in a spectrum view, OMEGASCOPE™ can search for a peak near to the specified ruler location. This option tells OMEGASCOPE™ how many frequency bins to search. The default is 5, which tell OMEGASCOPE™ to search from 2 bins below to 2 bins above the ruler frequency, giving a total range of 5 bins including the ruler frequency.
**Filter control**

OMEGASCOPE™ can low-pass filter the statistics to produce more stable and more accurate numbers. Filtering is not available on all measurement types.

**Enable Filter** - check to enable low-pass filtering, if available. An "F" will appear after the measurement name in the measurements table.

**Automatic** - check to set the low-pass filter characteristics automatically

**Cutoff Frequency**

The filter cut-off frequency normalised to the measurement rate. Range: 0 to 0.5.

**Filter Size**

The number of samples used to construct the filter

---

**Harmonic Control**

These options apply to distortion measurements in spectrum views. You can specify which harmonics OMEGASCOPE™ uses for these measurements.

**Highest Harmonic**

The highest harmonic to include when calculating distortion power

**Search Range [bins]**

The number of frequency bins to search, centred on the expected frequency, when looking for a harmonic peak

**Harmonic Noise Floor [dB]**

The level in dB above which signal peaks will be counted as harmonics
6.5 Tools menu

Location:  Menu bar > Tools

Purpose: gives access to assorted tools for signal analysis

- **Custom Probes**: Define new probes and copy, delete, move and edit existing ones.
- **Maths Channels**: Add or edit a channel that is a mathematical function of one or more other channels.
- **Reference Waveforms**: Create, load or save a channel as a copy of an existing channel.
- **Serial Decoding**: Decode and display the contents of serial data stream such as CAN bus.
- **Alarms**: Specify actions to be taken on certain events.
- **Masks**: Perform mask limit testing on a waveform. This detect when the waveform departs from a specified shape.
- **Macro Recorder**: Save a frequently-used sequence of operations.
- **Preferences**: Set various options that control OMEGASCOPE™'s behaviour.
6.5.1 Custom Probes dialog
Location: Tools > Custom Probes, or click the Channel Options button ( ).

Purpose: allows you to select predefined probes and set up custom probes.

The selection of probes shown may vary depending on the version of the OMEGASCOPE™ software that you are using.

Understanding the probe list

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

- **Built-in probes.** The built-in probes are supplied by Omega Engineering, Inc. and do not change unless you download an authorized update from us. As a safeguard, OMEGASCOPE™ 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 Duplicate in this dialog.

- **Loaded probes.** Probes in OMEGASCOPE™ 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.
Adding a new probe to your library

There are three ways to create a new probe:

1. Use the Duplicate button 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, but you can also create your own by defining a new probe and then clicking Export.

Methods 2 and 3 open the Custom Probe Wizard to guide you through the probe definition process.
6.5.1.1 Custom Probe wizard

Location: Custom Probes dialog > New Probe

Purpose: allows you to define custom probes and set up custom ranges

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

6.5.1.1.1 Create New Custom Probe dialog

Location: Custom Probes dialog > New Probe

Purpose: introduces you to the process for creating a new custom probe

![Custom Probe Wizard](image)

**How to use the dialog**

Click **Next** to continue to the Probe Output Units dialog.
6.5.1.1.2 Edit Existing Custom Probe dialog

Location: **Custom Probes dialog** > **Edit**

Purpose: introduces you to the process for editing an existing **custom probe**

How to use the dialog

Click **Next** to continue to the **Probe Output Units dialog**, 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.
6.5.1.1.3 Probe Output Units dialog

Location:  Create new Custom Probe dialog > Next

Purpose: allows you to choose the units that OMEGASCOPE™ will use to display the output of your custom probe.

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

Location: **Probe Output Units dialog** > **Next**

Purpose: allows you to define the characteristic that OMEGASCOPE™ will use to convert the custom 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**.
- Click **Next** to continue to the **Range Management dialog**.
- Click **Back** to return to the **Probe Output Units dialog**.

![Scaling Method dialog](image-url)
6.5.1.4.1 Lookup-table Scaling dialog

Location: Scaling Method dialog > Create a Look-up Table or Edit the Lookup Table...

Purpose: creates a look-up table to calibrate a custom probe.

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.

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.
6.5.1.1.5 Range Management dialog

**Location:** Scaling Method dialog > Next

**Purpose:** allows you to override OMEGASCOPETM's automatic range-creation feature for custom probes. In most cases, the automatic procedure will be sufficient.

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. OMEGASCOPETM'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.

- Click **Back** to return to the Scaling Method dialog.

**What is Auto-ranging?**

When the **Auto-ranging** function is selected, OMEGASCOPETM 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.
6.5.1.1.6 Manual Ranges Setup dialog

Location: **Range Management dialog** > **Advanced** > **Next**

Purpose: creates 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**. 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**.

Click **Next** to continue to the **Filter Method dialog**.

Click **Back** to return to the **Range Management dialog**.

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**, like this:
6.5.1.6.1 Edit Range dialog

Location:  **Manual Ranges Setup dialog** > Edit or New Range

Purpose: editing a manual range for a [custom probe](#)

**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, OMEGASCOPE™ 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 OMEGASCOPE™’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. 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](#) 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 shows how well the input range of the device is matched to the scaled range.

- **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.

**Advanced tab**

**Finishing**
Clicking **OK** or **Cancel** will return you to the Manual Ranges Setup dialog.
6.5.1.1.6.2 Edit Range dialog (Advanced tab)

Location: Manual Ranges Setup dialog > Edit or New Range > Advanced tab

Purpose: configuring advanced options for custom probes.

These options are for factory use and we recommend that you do not change them.

**Finishing**

Clicking **OK** or **Cancel** will return you to the Manual Ranges Setup dialog.
6.5.1.1.7 Filter Method dialog

Location:  Manual Ranges Setup dialog > Next

Purpose:  sets up lowpass filtering for this custom probe

This dialog has the same effect as manually enabling the Lowpass Filtering option in the Channel Options dialog. Filtering will only occur if the attached scope device supports filtering.

Back:  Go to the Manual Range Setup dialog

Next:  Go to the Custom Probe Identification dialog
6.5.1.1.8 Custom Probe Identification dialog

Location:  **Range Management dialog**  >  **Next**

Purpose:  entering text to identify the **custom probe**

![Custom Probe Identification dialog](image)

**How to use the dialog**

Click **Back** to return to the **Filter Method dialog**.

- 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**.
6.5.1.9 Custom Probe Finished dialog

Location:  **Custom Probe Identification dialog** > **Next**

Purpose:  signals the end of the **custom probe** setup procedure

![Custom Probe Wizard](image)

**How to use the dialog**

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

Click **Finish** to accept your custom probe settings and return to the **Custom Probes dialog**.
6.5.2 Maths Channels dialog

Location: Menu bar > Tools > Maths Channels

Purpose: creating, editing and controlling maths channels, which are virtual channels generated by mathematical functions of input channels.

Maths Channel list

The main area of the Maths Channels dialog is the Maths Channel list, which shows all the built-in, library and loaded maths channels. To choose whether or not a channel appears in the main OMEGASCOPE™ window, click the appropriate check box and then OK. You can have up to 8 channels in any view, including input channels and maths channels. If you try to enable a 9th channel, OMEGASCOPE™ will open a new view.

Built In: these maths channels are defined by OMEGASCOPE™ and cannot be changed.

Library: these are the maths channels that you define using the Create or Duplicate button, Edit, or load with the Import button.

Loaded: these are the maths channels present in any OMEGASCOPE™ settings or data files that you have loaded.

Create: Opens the Maths Channel Wizard, which guides you through the process of creating or editing a maths channel. The new channel will appear under "Library" in the Maths Channel list.
<table>
<thead>
<tr>
<th>Menu</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edit</td>
<td>Opens the <a href="#">Maths Channel Wizard</a> to allow you to edit the selected maths channel. You must first select a channel in the <strong>Library</strong> section of the <strong>Maths Channel list</strong>. If the channel you want to edit is in the <strong>Built In</strong> or <strong>Loaded</strong> section, first copy it to the <strong>Library</strong> section by clicking <strong>Duplicate</strong>, then select it and click <strong>Edit</strong>.</td>
</tr>
<tr>
<td>Delete</td>
<td>Permanently deletes the selected maths channel. Only maths channels in the <strong>Library</strong> section can be deleted.</td>
</tr>
<tr>
<td>Duplicate</td>
<td>Creates a copy of the selected maths channel. The copy is placed in the <strong>Library</strong> section, from where you can edit it by clicking <strong>Edit</strong>.</td>
</tr>
<tr>
<td>Import</td>
<td>Opens a <code>.psmaths</code> math channel file and places the maths channels it contains in the <strong>Library</strong> section.</td>
</tr>
<tr>
<td>Export</td>
<td>Saves all maths channels from the <strong>Library</strong> section to a new <code>.psmaths</code> file.</td>
</tr>
</tbody>
</table>
6.5.2.1 Maths Channel Wizard

**Location:** Channel Setup toolbar > Maths Channels button

**Purpose:** creating, editing and controlling maths channels, which are virtual channels generated by mathematical functions of input channels

1. **Introduction**

2. **Equation**

3. **Channel name**

4. **Units and range**

5. **Finished**
6.5.2.1.1 Maths Channel Wizard Introduction dialog

Location: Maths Channels dialog > Create (if you have not ticked the "Don't show me this introduction page again" check box)

Purpose: introduces the Maths Channel Wizard
6.5.2.1.2 Maths Channel Wizard Equation dialog

**Location:** Maths Channel Wizard

**Purpose:** allows you to enter or edit the equation for a maths channel. You can type directly into the equation box, or click the calculator buttons and let the program insert the symbols for you. A red error indicator X will appear to the right of the equation box if the equation contains a syntax error.

**Basic view**

![Maths Channel Wizard Equation dialog, basic view](image)

**Basic buttons**

<table>
<thead>
<tr>
<th>Button</th>
<th>Equation text</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE</td>
<td></td>
<td>Clear equation. Clears the entire contents of the equation box.</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>Clear. Clears the single character to the left of the cursor.</td>
</tr>
<tr>
<td>+</td>
<td>+</td>
<td>Addition</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>Subtraction or negation</td>
</tr>
<tr>
<td>*</td>
<td>*</td>
<td>Multiplication</td>
</tr>
<tr>
<td>/</td>
<td>/</td>
<td>Division</td>
</tr>
<tr>
<td>A...D</td>
<td>A...D</td>
<td>Channel A, B, C or D. If your scope has fewer than 4 channels then the available channels are named sequentially starting from A.</td>
</tr>
<tr>
<td>v</td>
<td></td>
<td>Reference channels. Shows a drop-down list of available reference channels to insert into the equation.</td>
</tr>
<tr>
<td>T</td>
<td>T</td>
<td>Time, in seconds</td>
</tr>
<tr>
<td>(...)</td>
<td>(...)</td>
<td>Parentheses. Expressions within parentheses will be evaluated before the expressions to either side.</td>
</tr>
</tbody>
</table>
**Advanced view**

Clicking the **Advanced** button reveals more function buttons, including trigonometric functions and logarithms.

**Advanced buttons**

<table>
<thead>
<tr>
<th>Button</th>
<th>Equation text</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>sqrt</td>
<td>sqrt()</td>
<td>Square root</td>
</tr>
<tr>
<td>x^y</td>
<td>^</td>
<td>Raise $x$ to the power of $y$</td>
</tr>
<tr>
<td>ln</td>
<td>ln()</td>
<td>Natural logarithm</td>
</tr>
<tr>
<td>abs</td>
<td>abs()</td>
<td>Absolute value</td>
</tr>
<tr>
<td>norm</td>
<td>norm()</td>
<td>Normalised value. OMEGASCOPE™ calculates the maximum and minimum values of the argument over the period of the timebase, and then scales and offsets the argument so that it exactly fits the range $[0, +1]$ units.</td>
</tr>
<tr>
<td>e^x</td>
<td>exp()</td>
<td>Exponentiation. Raise $e$, the base of the natural logarithm, to the power of $x$.</td>
</tr>
<tr>
<td>log</td>
<td>log()</td>
<td>Base-10 logarithm</td>
</tr>
<tr>
<td>Pi</td>
<td>Pi</td>
<td>$\pi$, the ratio of a circle's circumference to its diameter</td>
</tr>
<tr>
<td>inv</td>
<td></td>
<td>Inverse. Modifies the <strong>sin</strong>, <strong>cos</strong> and <strong>tan</strong> buttons to <strong>asin</strong>, <strong>acos</strong> and <strong>atan</strong> respectively.</td>
</tr>
<tr>
<td>sin</td>
<td>sin()</td>
<td>Sine of the argument in radians</td>
</tr>
<tr>
<td>cos</td>
<td>cos()</td>
<td>Cosine of the argument in radians</td>
</tr>
<tr>
<td>tan</td>
<td>tan()</td>
<td>Tangent of the argument in radians</td>
</tr>
<tr>
<td>0...9</td>
<td>0..9</td>
<td>The decimal digits</td>
</tr>
<tr>
<td>.</td>
<td>.</td>
<td>Decimal point</td>
</tr>
<tr>
<td>E</td>
<td>E</td>
<td>Exponential notation. The number preceding the <strong>E</strong> is multiplied by 10 raised to the power of the number following the <strong>E</strong>.</td>
</tr>
</tbody>
</table>
Advanced equation features

There are a few equation features that can be accessed only by editing the equation using the keyboard.

**Hyperbolic functions.** You can enter the `sinh()`, `cosh()` and `tanh()` operators to obtain hyperbolic functions.

**Reference waveforms.** You can use a reference waveform as an input to an equation by typing its name in curly braces. For example, `A - {A (2)}` subtracts the reference waveform `A (2)` from channel `A`. The name of the reference waveform must be typed exactly as it appears in the Reference Waveforms dialog, including any spaces.

**Signum function.** The `sign()` operator returns the sign of its input. The result is +1 when the input is positive, -1 when the input is negative, and 0 when the input is 0.
6.5.2.1.3 Maths Channel Wizard Name dialog

Location: **Maths Channel Wizard**

Purpose: allows you to enter or edit the name and color of a **maths channel**

OMEGASCOPE™ initially sets the name to the text of the equation, but you can edit it to anything you like. The name will appear in the channel list in the **Maths Channels dialog**. You can set the color of the trace to one of the standard colors in the dropdown-list, or click **Custom** to choose any possible color allowed by Windows.
6.5.2.1.4 Maths Channel Wizard Units and Range dialog

Location:  **Maths Channel Wizard**

Purpose:  allows you to specify the measurement units and the range of values to display for a maths channel.

**Units, Long Name:** This is for your reference only.

**Units, Short Name:** This will be displayed on the measurement axis in scope and spectrum views, in the ruler legend and in the measurements table.

**Range:** If you leave the check box empty, OMEGASCOPE™ will choose the most appropriate range for the measurement axis. If you prefer to set your own values for the minimum and maximum extremes of the measurement axis, tick the check box and enter them in the Min and Max boxes.
6.5.2.1.5  Maths Channel Wizard Finished dialog

Location:  **Maths Channel Wizard**

Purpose:  shows you the settings for the **maths channel** that you have just created or edited

**Back.** Click this button to return to previous dialogs in the **Maths Channel Wizard** if you wish to change any of the settings.

**Finish.** Click this button to accept the settings shown and return to the **Maths Channels dialog**. If you want the new or edited channel to appear on the scope or spectrum display, remember to tick the appropriate check box in the channel list. You can change them later by clicking the **Maths Channels button** in the **Channel Setup toolbar**.
6.5.3 Reference Waveforms dialog

Location: **Tools > Reference Waveforms**

Purpose: enables you to create, edit and control reference waveforms, which are stored copies of input channels.

The main area of the Reference Waveforms dialog is the Reference Waveforms list, which shows all the available input channels and the library and loaded reference waveforms. To choose whether or not a waveform appears in the main OMEGASCOPÉ™ window, click the appropriate check box and then OK. You can have up to 8 channels in any view, including input channels, math channels and reference waveforms. If you try to enable a 9th channel, OMEGASCOPÉ™ will open a new view.

Available: these input channels are suitable as sources for reference waveforms

Library: these are the reference waveforms that you have defined using the Duplicate button or loaded with the Import button

Loaded: these are the reference waveforms present in any OMEGASCOPÉ™ settings or data files that you have loaded

Edit: Opens the Edit Reference Waveform dialog to allow you to edit the selected reference waveform. You must first select a waveform in the Library section of the Reference Waveforms list. If the waveform you want to edit is in the Loaded section, first copy it to the Library section by clicking Duplicate, then select it and click Edit.
**Delete**
Permanently deletes the selected reference waveform. Only reference waveforms in the Library section can be deleted.

**Duplicate**
Creates a copy of the selected input channel or reference waveform. The copy is placed in the Library section, from where you can edit it by clicking Edit. A quicker way to do the same thing is to right-click on the view, select Reference Waveforms and then click the channel that you wish to copy.

**Import**
Opens a .psreference reference waveform file and places the waveforms it contains in the Library section.

**Export**
Saves all reference waveforms from the Library section to a new .psreference or Matlab 4 .mat file.

6.5.3.1 Edit Reference Waveform dialog

Location: [Reference Waveforms dialog] > Edit

Purpose: allows you to edit the name and color of a reference waveform.

**Name.** OMEGASCOPE™ initially names the waveform after the input channel used as its source, but you can edit it to anything you like. Here we have named it "sine". The name will appear in the waveform list in the Reference Waveforms dialog.

**Color:** You can set the color of the trace to one of the standard colors in the drop-down-list, or click Custom to choose any color allowed by Windows.
6.5.4 Serial Decoding dialog

Location: **Tools > Serial Decoding**

Purpose: lets you choose which channels to use for serial decoding and set other options.

The following formats are supported:

- **I2C**
- **CAN Bus**
- **RS232 (UART)**
- **SPI**

This is where you select which channels to decode, and what serial protocol to use for each channel. All the available channels are listed in the **Channels** column.

- If the channel you want to use is not listed, enable it first by using the **Channels toolbar**.
- For each channel that you want to decode, click in the **Protocols** column. A drop-down list will appear, containing all the protocols that OMEGASCOPE™ understands. The list may vary depending on which version of OMEGASCOPE™ you are using. For multi-channel protocols like I2C and SPI, select the data channel. Any other channels will be specified later.
Select the protocol you wish to use. A **Settings** panel for the selected channel will then appear below the table in the dialog.

**Settings panel**

The settings panel shows all the adjustable settings for the selected channel. The options available depend on the protocol selected.

**Information panel**

You do not need to take action on the messages in this panel. If the number of samples is too small then OMEGASCOPE™ will automatically adjust the capture settings to improve the signal quality. If the number of samples is larger than necessary, this is harmless and no adjustment will be made.

**Common settings**

These apply to all serial data formats.

- **Refresh.** When you have entered the necessary information, OMEGASCOPE™ analyzes the incoming signal and chooses the best settings for serial decoding. If OMEGASCOPE™ is unable to decode the data, try improving the signal quality and then click the **Refresh** button to analyze the signal again. For best results, click the **Auto Setup button** in the **Capture Setup toolbar** in the main OMEGASCOPE™ window before entering serial decoding mode. This will ensure that the signal is captured with enough detail for accurate decoding.

- **Display.** Choose where you want to display the data: **In View**, **In Window**, or both.

  - **In View** shows the data in logic-analyzer style, on the same time axis as the analog waveform.
  - Hover the mouse pointer over any decoded packet to display its contents.
  - Click-and-drag the decoded data up or down the scope view.
  - If the **In Window** display is visible, double-click on any packet to highlight it in the table.

  - **In Window** displays the decoded data in a table in the **serial data window**, with advanced search and filtering functions.

**CAN Bus** settings

OMEGASCOPE™ can decode either the CAN H or the CAN L signal. Select which one you are using in the **Protocols table**.

- **Threshold.** A voltage halfway between the high and low logic levels. If you are not sure, set this to halfway between the maximum and minimum voltages that you see on the waveform.

- **Baud Rate.** The speed of data transmission in symbols per second. Set this to match the speed of the data bus.

**I2C** settings

- **Clock Channel.** Which channel is connected to the SCL signal.
Clock Threshold. The threshold voltage to use for the SCL signal.

Data Threshold. The threshold voltage to use for the SDA signal.

Settings. Opens the I2C Settings dialog.

RS232/UART Settings

Threshold. A voltage halfway between the high and low logic levels. If you are not sure, set this to halfway between the maximum and minimum voltages that you see on the waveform.

Baud Rate. The speed of data transmission in symbols per second. Set this to match the speed of the data bus.

Bit Definitions. Opens the Bit Definitions dialog for setting up RS232 format parameters.

SPI Settings

Clock Channel. Which channel is connected to the clock signal (SCLK or CLK).

Clock Threshold. The threshold voltage to use for the clock signal.

Data Threshold. The threshold voltage to use for the data signal (SDI, DI, SI, SDO, DO or SO).

CS Channel. Which channel to use for the chip select (CS, SS or STE) signal, if present.

CS Threshold. The threshold voltage to use for the chip select signal.

Settings. Opens the Settings dialog.
6.5.4.1 Serial Data window

Location: **Channels toolbar** > **Serial Decoding button** > select **In Window** in the **Serial Decoding dialog**.

Purpose: shows decoded serial data in alphanumeric format and allows advanced filtering and searching.

For more information on the format of the table for each serial protocol, see Serial protocols.

If you also selected **In View** in the **Serial Decoding dialog**, the data will also appear in graphical form on the scope view. You can click on one of the data packets in the scope view to go to the corresponding row in the table, or you can double-click a row in the table to zoom to the corresponding frame in the scope view.

**Control bar**

The controls in the control bar are as follows:

**Export**

Save the decoded data to a Microsoft Excel spreadsheet.

**Accumulate**

By default, OMEGASCOPE™ clears the table each time the scope captures a new buffer full of data. Click this button to enter Accumulate mode, which continues adding serial frames to the end of the table until you click the button again.

**View**

Controls which details of the data appear in the table. The sub-menus are as follows:

- **View > Frames/Packets:** which types of frames or packets are displayed
- **View > Fields:** which columns appear in the data table
- **View > Display Format:** hexadecimal, binary, ASCII or decimal format
- **View > Font Size:** the character size used in the table

![Serial Data window](image)
**Link**

This drop-down list selects or opens a spreadsheet file that maps numbers to strings. For example, if you wish to display a CAN packet of type 41 (hex) as "Headlights On", then enter "41" in the first column of the file and "Headlights On" in the second.

This button creates a sample spreadsheet file to which you can add your own list of number-string pairs.

**Start from...**

Use this button to enter a condition that OMEGASCOPE™ will wait for before collecting data. When OMEGASCOPE™ detects a packet that matches this condition, it will collect all subsequent data (subject to filtering, if used - see above) and display it in the table.

**Filter**

Click to show the filter bar, which allows you to enter arbitrary data above each column in the table. The table will display only those packets that match the data you have entered. For example, entering "6C7" in the filter box at the top of the **ID** column will cause only frames with an ID of 6C7 to be displayed.

**Statistics**

Toggle the statistics columns that list measurements such as packet start and end times, and signal voltages.

**Search**

Search for any data value in a specified column of the table.

**Refresh**

Instructs OMEGASCOPE™ to decode the raw data again. This is necessary if you have changed the **Start from...** condition, for example.

**Clear**

Clear all data and settings in the table. New data will appear the next time that the scope captures a waveform.
6.5.4.2  Bit Definitions dialog

Location:  Serial Decoding dialog > RS232/UART format > Bit Definitions

Purpose:  sets up parameters of your RS232 data format so OMEGASCOPE™ can decode the data

Signal Idle State:

Data bits:  The state, low or high, of the signal when no data present.

Data bits:  The number of bits in the word.

Parity:  The type of error-correction bit, if any, added to each word.

Stop bits:  The number of extra bits used to indicate the end of a word.

Bit Order:  Whether the least-significant or the most-significant bit occurs first.
6.5.4.3 Settings dialog

**Location:** Serial Decoding dialog > select SPI format > Settings

**Purpose:** sets up parameters of your SPI data format so OMEGASCOPE™ can decode the data

**Sample Clock on:** Which edge of the clock to use.

**Chip Select State:** The polarity of the chip select (CS) signal, if used.

**Data bits:** The number of bits in the word. Choose from the drop-down list or type a number directly into the box.

**Bit Order:** Whether the least-significant or the most-significant bit occurs first.
6.5.4.4 I2C Settings dialog

Location: Serial Decoding dialog > select I2C format > Settings

Purpose: sets up parameters of your I2C data format so OMEGASCOPE™ can decode the data

Display Address as: 7 bit Slave Address: displays as an 8-bit number by adding leading zeroes to the 7-bit address.
8 bit Read/Write Address: displays as an 8-bit number considering the Read/Write~ bit.
6.5.5 Alarms dialog

**Location:**  **Tools > Alarms**

**Purpose:** gives access to the alarms feature, which specifies actions to be taken on various events

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**Event:** Select the event that will trigger the alarm:

- **Capture:** when a waveform is captured. If triggering is enabled, this option corresponds to a trigger event. You can therefore use this function to save a file on each trigger event.

- **Buffers Full:** when the number of waveforms in the waveform buffer reaches the maximum waveform count.

- **Mask(s) Fail:** when any channel fails a mask test.

**(Actions list):** Add an action to this list by clicking **Add**. Whenever the specified event occurs, OMEGASCOPE™ will execute the all the actions in the list from top to bottom.

*NOTE: For an action to execute, its check box must be set.*

**Apply:** Set up the scope according to the settings in this dialog.

**Add:** Add an event to the Actions list. Possible events are:

- **Beep:** activate the computer's built-in sounder. 64-bit PCs redirect this sound to the headphone output.

- **Play Sound:** specify the name of a .wav sound file to play.
**Stop Capture:** equivalent to pressing the red **Stop** button.

**Restart Capture:** equivalent to pressing the green **Start** button. Use only if the **Stop Capture** action was used earlier in the list.

**Run Executable:** run the specified EXE, COM or BAT program file. You can type the `%file%` variable after the program name to pass the name of the last file saved as an argument to the program. OMEGASCOPE™ will stop capturing while the program runs, and resume after the program terminates.

**Save Current Buffer:** save the current waveform from the buffer as a `.psdata`, `.pssettings`, `.csv` or `.mat` file. You can use the `%buffer%` variable to insert the buffer index number into the filename, or the `%time%` variable to insert the time of capture.

**Save All Buffers:** save the entire waveform buffer as a `.psdata`, `.pssettings`, `.csv` or `.mat` file.
6.5.6 Masks menu
Location: **Tools** > **Masks**

Purpose: gives control over **Mask Limit Testing**

**Add Masks:** Add a mask to the display using the **Mask Library dialog**.

**Clear Mask:** Remove the mask from the display.

**Save Mask:** Save the displayed mask to disk as a .mask file.

6.5.6.1 Mask Library dialog
Location: **Menu bar** > **Tools** > **Masks**

Purpose: allows you to create, export and import masks for **Mask Limit Testing**

**Channel:** Select the channel to which you want to apply the mask.

**Available masks:** The **Library** section shows all the masks that you have saved in the past and not deleted. The **Loaded** section shows all the masks currently in use.

**Generate:** Create a new mask based on the last waveform captured from the selected channel. Opens the **Generate Mask dialog**.

**Import:** Load a mask that has previously been saved as a .mask file.

**Export:** Save a mask as a .mask file for future import.
Apply: Use the selected mask on the selected channel but remain in the **Mask Library** dialog.

OK: Use the selected mask on the selected channel and return to the **scope view**.

6.5.6.2 Editing a mask

To edit a mask in **Mask Limit Testing** mode, first note that a mask is made up of one or more shapes called **polygons**. Choose the polygon that you wish to edit, then right-click on it and select **Edit Mask**:

OMEGASCOPETM will then draw edit handles on the selected mask polygon and display the mask edit box. If you drag any of the handles to edit the polygon, the statistical results will be updated immediately.

The mask edit box looks like this:

If the edit box is not immediately visible, it may have been minimized; in which case, click the restore button. If you edit the coordinates of a vertex, the statistical results will be updated immediately. You can also export the mask to a **.mask** file with the export button. Use the + and - buttons to add or remove vertices. The minimize button has its usual function. To leave mask editing mode, close the mask edit box with the close (X) button.
To add or remove an entire polygon, right-click the mask and select either the Add Mask Polygon or the Remove Mask Polygon command:

6.5.6.3 Generate Mask Dialog
Location: Mask Library dialog > Generate
Purpose: allows you to set parameters for the automatically generated mask. OMEGASCOPE™ will then create a new mask based on the last captured waveform

Name: OMEGASCOPE™ automatically chooses a name for the new mask, but you can change it to anything you like here.

X Offset: The horizontal distance between the waveform and the mask.

Y Offset: The vertical distance between the waveform and the mask.
6.5.7 Macro Recorder
Location:  Tools > Macro Recorder
Purpose: records a sequence of commands to be replayed later

The Macro Recorder helps when you wish to execute a series of commands repeatedly. It saves all commands to a .psmacro file, which can be modified using an XML editor.

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*Execute in real time:* Play back the macro at the same speed as when recorded. Without this option, playback will be as fast as possible.
6.5.8 Preferences dialog

Location:  

Menu bar > Tools > Preferences

Purpose: Allows you to set options for the OMEGASCOPE™ software. Click one of the tabs in the picture below to learn more.
6.5.8.1 General page

Location: Preferences dialog

Purpose: contains general controls for OMEGASCOPE™

- **Reset 'Don't show this again' dialogs**
  Restore any missing dialogs that you asked OMEGASCOPE™ not to show again.

- **Reset preferences**
  Set all preferences back to their default values.

- **Waveform Buffer**
  - **Maximum Waveforms**: This is the maximum number of waveforms that OMEGASCOPE™ will store in the waveform buffer. You can select a number from 1 to the maximum allowed by the oscilloscope that is connected: see the scope specifications for details. The actual number of waveforms stored depends on the available memory and the number of samples in each waveform.

- **Collection Time Units**
  Change the mode of the Timebase control in the Capture Setup toolbar.

  - **Times per division**: the Timebase control displays time units per division - for example, '5 ns /div'. Most laboratory oscilloscopes display timebase settings in this way.

  - **Total collection time**: the Timebase control displays time units for the entire width of the scope view - for example, '50 ns'.

- **Measurement Statistics**
  - **Capture Size**: the number of successive captures that OMEGASCOPE™ uses to calculate the statistics in the Measurements Table. A larger number produces more accurate statistics but causes them to be updated less frequently.
6.5.8.2 Power management page

Location: Preferences dialog

Purpose: controls features of the oscilloscope that affect its power consumption

Capture Rate

This control limits the speed at which OMEGASCOPE™ captures data from the scope device. The other OMEGASCOPE™ settings, the type of scope device and the speed of the computer will all affect whether this limit can actually be reached. OMEGASCOPE™ 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 Mains (line) power, for maximum performance. If other applications run too slowly on your PC while OMEGASCOPE™ is capturing, then reduce the capture rate limit. When your computer is running on Battery power, OMEGASCOPE™ 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.
6.5.8.3 Sampling page

Location: Preferences dialog

Purpose: controls the sampling behaviour of the oscilloscope

**Slow Sampling Transition**

In normal (fast) sampling mode, OMEGASCOPE™ collects enough data to fill the screen and then redraws the whole view at once. This method is suitable for fast timebases, when the screen is redrawn many times each second, but with slow timebases it can cause an unacceptable delay before the data appears on the screen. To avoid this delay, OMEGASCOPE™ automatically switches to slow sampling mode, in which the scope trace advances gradually across the screen as the scope captures data.

The **Collection Time** control lets you select the timebase at which OMEGASCOPE™ switches to slow sampling mode.

**Slow Sampling Display**

When this box is checked, OMEGASCOPE™ displays the previous waveform in the buffer while gradually redrawing the new waveform over the top of it. Thus, at any time, the left-hand side of the view shows the beginning of the new waveform, while the right-hand side shows the end of the previous waveform. A vertical bar separates the two waveforms.
**Sin(x)/x Interpolation**

When the number of pixels across the scope view is greater than the number of samples in the waveform buffer, OMEGASCOPE™ interpolates - that is, it fills the space between the samples with estimated data. It can either draw straight lines between the samples (linear interpolation) or connect them with smooth curves (sin(x)/x interpolation). Linear interpolation makes it easier to see where the samples are, which is useful for high-accuracy measurements, but results in a jagged waveform. Sin(x)/x interpolation gives a smoother waveform but disguises the true locations of the samples, so should be used with care when the number of samples on the screen is low.

You can adjust the number of samples below which sin(x)/x interpolation is switched on. Sin(x)/x interpolation is used only on the scope's fastest timebase.
6.5.8.4 Keyboard page

Location: part of the Preferences dialog

Purpose: displays, and allows you to edit, keyboard shortcuts

A keyboard shortcut is a combination of keys that can be pressed on the keyboard to activate an OMEGASCOPE™ function.

**Keyboard Shortcuts**

All available OMEGASCOPE™ operations and their associated keyboard shortcuts (if defined) are listed. To edit or add a keyboard shortcut:

- Scroll the list of OMEGASCOPE™ commands until the required command is visible.
- Select the required command.
- Select the 'Press shortcut keys:' box.
- Press the required key combination on the keyboard.
- Click Assign.
6.5.8.5 Regional & Language page

Location: part of the Preferences dialog

Purpose: lets you select the language and other location-dependent settings for OMEGASCOPE™'s user interface

- **Language**
  - Select, from the drop-down box, the language you wish to use for the OMEGASCOPE™ user interface. OMEGASCOPE™ will ask you to restart the program before switching to the new language.

- **Measurement System**
  - Select metric or U.S. units.
6.5.8.6 Printing page

Location: part of the Preferences dialog

Purpose: lets you enter the details that will appear at the bottom of printed output

![Preferences dialog](image)

**Default Print Settings** When you print a view from the File menu, these details will be added to the bottom of the page.
6.5.8.7 Colors page

Location: part of the Preferences dialog

Purpose: lets you set the colors for various parts of the user interface

Custom Colors

These controls let you specify the colors for various parts of the OMEGASCOPE™ screen:

Channels
the trace color for each scope channel.

Masks
the mask areas in Mask Limit Testing.

Misc
miscellaneous items:

Grid lines
the horizontal and vertical lines on the graticule.

Background
the area behind the waveforms and graticule. (In persistence mode this setting can be overridden by the Persistence Options dialog.)

Live trigger
the trigger marker for the current trigger position

Trigger
secondary trigger marker (appears when the live trigger has moved since the last waveform capture)

Horizontal axis
the numbers across the bottom of each view, which usually indicate time measurements

Rulers
the horizontal and vertical rulers that you can drag into position to help measure features on the waveform

Persistence
the three colors to use for each channel in digital color persistence mode. The top color is used for the most frequently hit pixels, the middle and bottom colors for the less and least frequently hit pixels.
Line Thickness

These controls let you specify the thickness of the lines drawn on the scope and spectrum views:

**Channel**
the waveforms and spectrum traces for all scope channels

**Grid Lines**
the horizontal and vertical lines on the graticule

**Markers**
the horizontal and vertical rulers that you can drag into position to help measure features on the waveform

Reset Colors to Default

Resets all of the color and line thickness settings to their default values.
6.5.8.8 Options page

**Location:** part of the Preferences dialog

**Purpose:** lets you set various options that control the way that OMEGASCOPE™ works

### Device Startup Settings

**Remember Last Device.** This option is used when OMEGASCOPE™ finds more than one scope device connected to the computer. If the check box is ticked, OMEGASCOPE™ will attempt to use the same device that was used last time. Otherwise it will use the first device available.

### Advanced Features

The advanced capture modes are enabled by default. You can enable or disable these features using the following options:

- **Spectrum**
  - Spectrum view and spectrum analyser features
- **Persistence**
  - Digital Color, Analog Intensity and custom persistence display modes
- **Zoom Overview**
  - A window that appears when you zoom in to help to move around large waveforms with the minimum of mouse clicks
- **RPM**
  - Revolutions per minute, displayed alongside hertz in the frequency legend
- **Trigger Delay**
  - The time-delay control in the Triggering toolbar
- **Rapid Trigger**
  - The 'Rapid' entry in the Trigger mode control in the Triggering toolbar

### Recent Files

The maximum number of files listed in the File > Recent Files menu. Click the button to clear the list.
6.6 Help menu
Location: Menu bar > Help
Purpose: gives access to the OMEGASCOPE™ User’s Guide and related information

User’s Guide This is the main help manual, containing complete information on the program. Contents, Index and Search are shortcuts to various functions of the help viewer.

Check for Updates Connect to the Omega Engineering, Inc. website and look for a newer version of the OMEGASCOPE™ software. Requires an internet connection.

About OMEGASCOPE™ Show version numbers of the OMEGASCOPE™ software and any oscilloscope that is connected.
6.7 Connect Device dialog

Location: **Menu bar > File > Connect Device**
or plug in a new device

Purpose: when OMEGASCOPE™ finds more than one available **scope device**, this dialog allows you to select which one to use.

![Connect Device dialog](image)

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

**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.
- OMEGASCOPE™ will open a **scope view** for the selected scope device.
- Use the **toolbars** to set up the device and the **scope view** to display your signals.

**Demonstration mode**

If you start OMEGASCOPE™ with no device connected, or with more than one device connected, the **Connect Device dialog** automatically appears with a list of 'DEMO' (demonstration) devices for you to choose from. These are virtual devices that you can use to experiment with the features of OMEGASCOPE™. Once you have selected a demonstration device and clicked OK, OMEGASCOPE™ adds a **Demo Signal Generator button** to the toolbar. Use this button to set up the test signals from your demonstration device.
6.8 Converting files in Windows Explorer

You can convert OMEGASCOPE™ data files to other formats for use in other applications, or to different forms of data for use with OMEGASCOPE™.

The easiest way to do this conversion is through the context menu in **Windows Explorer**. The context menu is the menu that pops up when you right-click it with the mouse or activate it with the "menu" button on a Windows keyboard. When you install OMEGASCOPE™, a "Convert" entry is added to the context menu to enable you to convert OMEGASCOPE™ data files.

Converting to OMEGASCOPE™ 6.2.4 format

The example above shows four pre-existing OMEGASCOPE™ data files represented by standard OMEGASCOPE™ icons. OMEGASCOPE™ 6.2.4 introduced a new feature that allows OMEGASCOPE™ data files to appear as waveforms instead of icons. To enable this feature for old data files, you need to convert them to the new format using the context menu of Windows Explorer.

- If OMEGASCOPE™ is running, close it.
- In Windows Explorer, right-click a OMEGASCOPE™ data file.
- Select **Convert > All waveforms > .psdata**. A OMEGASCOPE™ icon will appear in the Windows notification area while the conversion is in progress.
- OMEGASCOPE™ will ask you to confirm that you wish to overwrite the .psdata file with a new version. Click **Yes**.
- Wait for Windows Explorer to update the display.
- Repeat for all .psdata files.
The `.psdata` files should now appear as in this picture:

![Image of OMEGASCOPE™ data file explorer](image)

### Converting to other formats

For all of these conversions, you can choose either "All waveforms" or "Current waveform". A `.psdata` file can contain either a single waveform or the entire contents of the waveform buffer, which can hold a number of waveforms from successive trigger events. If the `.psdata` file contains more than one waveform, then you can choose to convert all of them or just the one that was last viewed in OMEGASCOPE™.

- Right-click an OMEGASCOPE™ data file.
- To convert all waveforms in the file, select **Convert > All waveforms** or **Convert > Current waveform** and then the file format that you require. An OMEGASCOPE™ icon ![OMEGASCOPE™ icon](image) will appear in the Windows notification area while the conversion is in progress.

### Complex operations

For more complex operations, such as converting all files in a directory, you can run OMEGASCOPE™ in a command window (see Command-line syntax).
Toolbars and buttons

A toolbar is a collection of buttons and controls with related functions. OMEGASCOPE™ contains the following toolbars:

- Buffer Navigation toolbar
- Channel Setup toolbar
- Measurements toolbar
- Capture Setup toolbar
- Start / Stop toolbar
- Triggering Toolbar
- Zooming and Scrolling toolbar
- Signal Generator button
7.1 Buffer Navigation toolbar

The Buffer Navigation toolbar allows you to select a waveform from the waveform buffer.

What is the waveform buffer?

Depending on the settings you have chosen, OMEGASCOPE™ may store more than one waveform in its waveform buffer. When you click the Start button or change a capture setting, OMEGASCOPE™ clears the buffer and then adds a new waveform to it each time the scope device captures data. This continues until the buffer is full or you click the Stop button. You can limit the number of waveforms in the buffer to a number between 1 and 10,000 using the General preferences page.

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

First waveform button. Display waveform 1.

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

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

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

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

Buffer Navigator button. Open the Buffer Navigator window for quick selection of buffer waveforms.
7.2 Channel Setup toolbar

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

![Channel Setup toolbar screenshot]

Each channel has its own set of buttons:

- **Channel Options button.** Opens the Channel Options menu with options for probes, resolution enhancement, scaling, and filtering.

- **Range control.** Sets up the scope device to capture signals over the specified range of values. The list of options depends on the selected scope device and probe. A red warning symbol appears if the input signal exceeds the selected range. If you select Auto, OMEGASCOPE™ will continually adjust the vertical scale so that the height of the waveform fills as much of the view as possible.

- **Coupling Control.** Sets up the input circuitry. AC coupling rejects frequencies below about 1 Hz. DC coupling accepts all frequencies from DC to the scope's maximum bandwidth.

- **Frequency.** enable the built-in frequency counter if available. Only one channel at a time can be operated in this mode. Supported devices include the OMSP-4000 Series 12-bit scopes.
7.2.1 Channel Options menu

The **Channel Options menu** appears when you click the **Channel Options button** (for example: ![button]) on the **Channel Setup toolbar**.

**Probe list.** Indicates the probe currently in use and allows you to select a different one. Use it to tell OMEGASCOPE™ 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** allows you to edit your library of custom probes.

**Resolution enhance.** Allows you to increase the effective resolution of your scope device using **Resolution enhancement**. The number in this box is a target value that the software will attempt to use whenever possible.

**Axis Scaling.** These are the **axis scaling controls** that allow you to set the scale and offset for each vertical axis individually.
**Analog Options.** Options that can be applied to the oscilloscope input hardware, if the oscilloscope hardware supports them.

**Offset:** an offset voltage added to the analog input before digitization. OMSP-3000 Series only.

**Lowpass Filtering.** An independent digital lowpass filter for each input channel, with programmable cut-off frequency. This can be useful for removing noise from your signal to make more accurate measurements. Not all scopes support this feature.
7.2.1.1 Axis scaling controls

The **axis scaling controls** are control boxes that let you change the scale and offset of each vertical axis individually. If the axis belongs to a **reference waveform**, then you can also adjust its delay relative to the live waveforms.

There are two ways to open the axis scaling control:

- For any channel displayed in a view: click the coloured scaling button at the bottom of the vertical axis.
- For any input channel: Click the **Channel Options button** in the **Channel Setup toolbar**.

**Scale control.** Increase to magnify the waveform, decrease to reduce it. The vertical axis rescales accordingly so that you can always read the correct voltage from the axis. Click the reset button to return to a scale of 1.0. The scaling button always shows the selected scale.

**Offset control.** Increase to move the waveform up the display, decrease to move it down. The vertical axis shifts accordingly so that you can always read the correct voltage from the axis. Adjusting this control is equivalent to clicking and dragging the vertical axis. Click the reset button to return to an offset of 0.00%.

**Delay control (for reference waveforms only).** Increase to move the waveform to the left relative to the timing reference point, decrease to move it to the right. Click the reset button to return to a delay of 0 s.

The location of the timing reference point depends on which **trigger mode** OMEGASCOPE™ is in. If the trigger mode is **None** then the delay is measured relative to the left-hand edge of the display. In all other trigger modes, the delay is measured relative to the **trigger marker**.
7.2.1.2 Lowpass filtering

The **lowpass filtering** feature can reject high frequencies from any selected input channel. The filtering control is found in the Advanced Channel Options dialog, which is opened by clicking the **Channel Options button** for the relevant channel on the Channel Setup toolbar. The control determines the cut-off frequency of the filter, which must be below half the sampling rate shown in the Properties sheet.

The following devices support lowpass filtering:

- OMSP-3000 Series
- OMSP-4000 Series

Lowpass filtering is useful for rejecting noise. The split screenshot below shows the effect of applying a 1 kHz lowpass filter on a noisy signal. The underlying shape of the signal is preserved but the high-frequency noise is eliminated:

![Split screenshot showing the effect of lowpass filtering](image)

*Left: before lowpass filtering. Right: after 1 kHz lowpass filtering.*
Filter details

The lowpass filtering algorithm is chosen according to the relationship between the selected cut-off frequency ($f_C$) and the sampling rate ($f_S$), as follows:

<table>
<thead>
<tr>
<th>$f_C / f_S$</th>
<th>Filter type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 to 0.1</td>
<td>Moving average</td>
<td>A moving average filter is used for low cut-off frequencies. The length of the filter is adjusted to achieve the selected cut-off frequency, which is defined as the first minimum in the frequency response. There is significant signal leakage above the cut-off frequency. This filter changes a vertical edge into a linear slope.</td>
</tr>
<tr>
<td>0.1 to &lt; 0.5</td>
<td>FIR</td>
<td>A finite impulse response filter is used for medium to high cut-off frequencies. This has a monotonic roll-off above the cut-off frequency and therefore suffers from less leakage than the moving average filter.</td>
</tr>
</tbody>
</table>

You can force OMEGASCOPE™ to use one or other of the filter types by adjusting the Samples control in the Capture Setup toolbar to make the ratio $f_C/f_S$ fall into one of the two ranges shown in the table. As the table shows, the cut-off frequency must be below half the sampling frequency.
7.3 Capture Setup toolbar

The **Capture Setup toolbar** controls the time-related or frequency-related settings of your oscilloscope.

**Scope Mode**

In **scope mode**, the toolbar looks like this:

![Capture Setup toolbar in scope mode](image)

(See below for different versions of the toolbar in **spectrum mode** and **persistence mode**.)

- **Scope Mode.** Sets up OMEGASCOPE™ to operate as an **oscilloscope**. Use the **Auto Setup button** to optimise the settings. If you wish, you can add a secondary **spectrum view** from the context menu (by right-clicking on the scope view).

- **Persistence Mode.** Toggles **persistence mode**, which allows old traces to remain on the screen in faded colors while new traces are drawn on top in brighter colors. The use of colors is controlled by the **Persistence Options dialog**. OMEGASCOPE™ will remember any views that were open, so that you can return to them by clicking the **Persistence Mode** button again.

- **Spectrum Mode.** Sets up OMEGASCOPE™ to operate as a **spectrum analyser**. Use the **Auto Setup button** to optimise the settings. If you wish, you can add a secondary **scope view** from the context menu (by right-clicking on the scope view).

- **Auto Setup.** Searches for a signal on one of the enabled input channels, then sets up the timebase and signal range to display the signal correctly.

- **Home.** Restores OMEGASCOPE™ to its default settings. Equivalent to the **File > Startup Settings > Load Startup Settings** command.

**Timebase control.** Sets the time represented by a single division of the horizontal axis when the **horizontal zoom control** is set to x1. The timebases available depend on the type of **scope device** you are using.

Choosing a timebase of 200 ms/div or slower causes OMEGASCOPE™ to switch to a different mode of data transfer. The internal details of this are taken care of by OMEGASCOPE™, but the slow mode limits the sampling rate to a maximum of 1 million samples per second.

You can change this control to display the total time across the scope view, rather than the time per division, using the **Collection Time Units** control in the **General** page of the **Preferences dialog**.
**Horizontal zoom control.** Zooms the view, in the horizontal direction only, by the specified amount. Click the + and − buttons to adjust the zoom factor, or the reset button to reset.

**Samples control.** Sets the maximum number of samples that will be captured for each channel. If this is larger than the number of pixels across the scope view then you can zoom in to see more detail. The actual number of samples captured is displayed on the Properties sheet, and may be different from the number requested here, depending on which timebase is selected and which scope device is in use.

**Spectrum Mode**

In **spectrum mode**, the **Capture Setup toolbar** looks like this:

**Frequency range control.** Sets the frequency range across the horizontal axis of the spectrum analyser when the horizontal zoom control is set to x1.

**Spectrum Options.** Appears if a spectrum view is open, regardless of whether scope mode or spectrum mode is selected. It opens the **Spectrum Options dialog**.

**Persistence Mode**

In **persistence mode**, the **Capture Setup toolbar** looks like this:

**Persistence Options.** Opens the **Persistence Options dialog**, which controls several parameters affecting the way that OMEGASCOPE™ represents old and new data in persistence mode.
7.3.1 Spectrum Options dialog

This dialog appears when you click the **Spectrum Options button** in the **Capture Setup toolbar**. It is available only when a **spectrum view** is open. It contains controls that determine how OMEGASCOPE™ converts the source waveform in the current scope view to a spectrum view.

| Spectrum Bins | The number of frequency bins into which the spectrum is divided. This control sets the maximum number of frequency bins, which the software may or may not be able to provide depending on other settings. The main constraint is that the number of bins cannot greatly exceed half the number of samples in the source waveform.

If the source waveform contains fewer samples than required (that is, fewer than twice the number of frequency bins), then OMEGASCOPE™ zero-pads the waveform up to the next power of two. For example, if the scope view contains 10,000 samples, and you set Spectrum Bins to 16384, then OMEGASCOPE™ zero-pads the waveform to 16,384 samples, which is the nearest power of two above 10,000. It then uses these 16,384 samples to provide 8,192 frequency bins, not the 16,384 requested.

If the source waveform contains more samples than required, then OMEGASCOPE™ uses as many samples as necessary, starting from the beginning of the waveform buffer. For example, if the source waveform contains 100,000 samples and you request 16,384 frequency bins, OMEGASCOPE™ needs only 2 x 16,384 = 32,768 samples, so it uses the first 32,768 samples from the waveform buffer and ignores the rest. The amount of data actually used is displayed as the **Time Gate** setting in the **Properties sheet**.

**Window Function**

Allows you to choose one of the standard window functions to reduce the effect of operating on a time-limited waveform. See [Window functions](#).

**Display Mode**

You can choose **Magnitude**, **Average** or **Peak Hold**.

**Magnitude**: the spectrum view shows the frequency spectrum of the last waveform captured, whether live or stored in the **waveform buffer**.
**Average:** the spectrum view shows an rolling average of spectra calculated from all the waveforms in the waveform buffer. This has the effect of reducing the noise visible in the spectrum view. To clear the averaged data, click Stop and then Start, or change from Average mode to Magnitude mode.

**Peak Hold:** the spectrum view shows a rolling maximum of the spectra calculated from all the waveforms in the buffer. In this mode, the amplitude of any frequency band in the spectrum view will either stay the same or increase, but never decrease, over time. To clear the peak hold data, click Stop and then Start, or change from Peak Hold mode to Magnitude mode.

Note: when you switch to Average or Peak Hold mode, there may be a noticeable delay while OMEGASCOPE™ processes the entire contents of the waveform buffer, which may contain many waveforms, to build up the initial display. If this occurs, a progress bar appears at the bottom of the window to show that OMEGASCOPE™ is busy:

**Scale**

Specifies the labelling and scaling of the vertical (signal) axis. This can be one of the following:

**Linear:** The vertical axis is scaled in volts.

**Logarithmic:**

The vertical axis is scaled in decibels, referred to the level selected below in the Logarithmic unit control.

- **dBV:** Reference level is 1 volt.
- **dBu:** Reference level is 1 milliwatt with a load resistance of 600 ohms. This corresponds to a voltage of about 775 mV.
- **dBm:** Reference level is one milliwatt into the specified load impedance. You can enter the load impedance in the box below the Logarithmic unit control.

**Arbitrary dB:** Reference level is an arbitrary voltage, which you can specify in the box below the Logarithmic unit control.
7.3.2 Persistence Options dialog

This dialog appears when you click the Persistence Options button in the Capture Setup toolbar. It is available only when persistence mode is selected. It controls the colors and fading algorithm used to distinguish new or frequent data from old or intermittent data in the persistence view.

Mode

**Digital Color.** This mode uses a range of colors to indicate the frequency of waveform data. Red is used for the most frequent data, and less frequent data is represented successively by yellow and blue.

**Analog Intensity.** This mode uses color intensity to indicate the age of waveform data. The latest data is drawn at full intensity in the selected color for that channel, with older data being represented by paler shades of the same color.

**Advanced.** This mode opens up a Custom Options section at the bottom of the dialog that let you customise the persistence mode display.

Decay Time

The time, in milliseconds, taken for waveform data to fade from maximum intensity to minimum intensity or from red to blue. The longer the decay time, the longer the older waveforms will remain on the screen.

Saturation

The intensity or color with which new waveforms are drawn.

Decayed Intensity

The intensity or color to which the oldest waveforms decay when the decay time expires. If the decayed intensity is zero, then older waveforms will be completely erased from the display after the decay time. For non-zero values of decayed intensity, old waveforms will remain indefinitely on the screen at that intensity unless overwritten by new ones.
Custom Options

**Line Drawing** The type of line drawn between samples that are adjacent in time.
- **Phosphor Emulation.** Joins each pair of sample points with a line whose intensity varies inversely with the slew rate.
- **Constant Density.** Joins each pair of sample points with a line of uniform color.
- **Scatter.** Draws sample points as unconnected dots.

**Color Scheme**
- **Phosphor.** Uses a single hue for each channel, with varying intensity.
- **Color.** Uses a color from red to blue to represent the age of each waveform.

**Background**
- **Black.** Overrides the Color Preferences dialog. This is the default.
- **White.** Overrides the Color Preferences dialog.
- **User Preference.** Sets the background color to the preference set in the Colors page of the Preferences dialog.

**Data Hold** This option is enabled only when **Persistence Mode** (see below) is set to **Time Delay**.
- **Decay Timeout.** Old waveforms fade until they reach **Decayed Intensity** and then disappear.
- **Infinite.** Old waveforms fade until they reach **Decayed Intensity** and then remain indefinitely unless overwritten by new waveforms.

**Persistence Mode**
- **Frequency.** Points on the display are drawn with a color or intensity that depends on the frequency with which they are hit by waveforms.
- **Time Delay.** Points on the display are drawn at full intensity when hit by a waveform, and are then allowed to decay to **Decayed Intensity**.
  The behaviour after this depends on the **Data Hold** setting (see above).
7.4 Measurements toolbar

The **Measurements toolbar** controls the **measurements table**.

It contains the following buttons:

- **Add Measurement** - Adds a row to the table, and then opens the **Add Measurement dialog**.

- **Edit Measurement** - Opens the **Edit Measurement dialog** for the currently selected measurement. You can also edit a measurement by double-clicking on a row of the **measurements table**.

- **Delete Measurement** - Deletes the currently selected row from the **measurements table**.
7.5 Signal Generator button

The **Signal Generator button** allows you to set up your scope device's test signal generator, if it has one, or the demo signal settings if OMEGASCOPE™ is in demo mode.

If your scope has a built-in signal generator then clicking the **Signal Generator button** opens the **Signal Generator dialog**.

If OMEGASCOPE™ is in demo mode then clicking the **Signal Generator button** opens the **Demo Signals menu**.

7.5.1 Signal Generator dialog

**Location:** click the **Signal Generator button** on the toolbar

**Purpose:** controls the scope device's built-in signal generator

![Signal generator dialog for the OMEGASCOPE™ 3206](image)

Not all scope devices have a signal generator, and those that do have a varying range of controls in the signal generator dialog.

**Basic controls**

- **Signal On.** Tick this box to enable the signal generator.

- **Signal Type.** Select the type of signal to be generated. The list of signal types depends on the capabilities of the scope device.
**Import.** Opens a file selection dialog that allows you to import an arbitrary waveform file. The file will be loaded into the arbitrary waveform generator and the generator switched on. This button is available only if your scope has an arbitrary waveform generator.

**Arbitrary.** Opens the Arbitrary Waveform window. This button is available only if your scope has an arbitrary waveform generator.

**Start 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 sets the start frequency of the sweep.

**Amplitude.** The amplitude of the waveform measured from peak to peak. For example, if Amplitude is 1 V and Offset is 0 V, the output will have a negative peak of -0.5 V and a positive peak of +0.5 V.

**Offset.** The mean value of the signal. For example, when Offset is 0 V, a sine or square wave will have equal positive and negative peak voltages.

**Sweep mode controls**

- **Active.** Tick this box to enable sweep mode. If the box is not ticked, the generator will operate at a fixed frequency set by the Start Frequency control.

- **Sweep Type.** Specifies the direction in which the frequency is swept.

- **Stop Frequency.** In sweep mode, the generator stops increasing the frequency when it reaches the Stop Frequency.

- **Frequency Increment.** In sweep mode, the generator increases or decreases the frequency by this amount every Increment Time Interval.

- **Increment Time Interval.** In sweep mode, the generator increases or decreases the frequency by Frequency Increment each time this interval ends.
7.5.2 Arbitrary waveform files

Some OMEGASCOPE™ PC Oscilloscopes have an arbitrary waveform generator (AWG), which is enabled using the Signal Generator dialog. OMEGASCOPE™ can program the AWG with a standard waveform, such as a sine or square wave, or an arbitrary waveform that you create or import from a text file.

A text file for OMEGASCOPE™ is a list of decimal floating-point values, as in this example:

```
0.0 0.3 0.9 0.6 0.6 0.0 -0.3 0.0 0.0 0.0
```

The file may have between 10 and 8,192 values, as many it needs to define the waveform. Each line may have more than one value, in which case the values must be separated by tabs or commas.

The values are samples between -1.0 and +1.0 and must be equally spaced in time. The output is scaled to the amplitude selected in the Signal Generator dialog, and the selected offset is added if necessary. For example, if the signal generator amplitude is set to "1 V" and the offset to "0 V", then a sample value of -1.0 corresponds to an output of -1.0 V and a sample of +1.0 corresponds to an output of +1.0 V.

The file should contain exactly one cycle of the waveform, which will then be played back at the speed specified in the Signal Generator dialog. In the example above, the signal generator was set to 1 kHz, so one cycle of the waveform lasts for 1 ms. There are 10 samples in the waveform, so each sample lasts for 0.1 ms.

**Using files saved from OMEGASCOPE™**

As OMEGASCOPE™ can export CSV and TXT files, you can capture a waveform and then play it back using the arbitrary waveform generator. You must first modify the file by removing the header rows and time values so that its format matches the example above.
7.5.3 Arbitrary Waveform Generator window

Location:  
**Signal Generator dialog** > **Arbitrary**

Purpose:  
allows you to import, edit, draw and export arbitrary waveforms to load into your scope’s **arbitrary waveform generator**. You can also import and export the data in **CSV format** for use in other applications.

Once the desired waveform appears in the window, click **OK** or **Apply** to start using it.

**Toolbar buttons**

- **Import from channel.** Opens the **Import from Channel dialog**, which lets you copy a waveform from the scope into the arbitrary waveform window.

- **Import.** Displays an **Open** dialog to allow you to import an arbitrary waveform from a **text file**.

- **Export.** Displays a **Save As** dialog to allow you to save the arbitrary waveform as a **text file**.

- **Freehand drawing.** Enters freehand drawing mode, in which you can draw any waveform shape using the mouse.

- **Straight-line drawing.** Enters straight line mode, in which you can click on the waveform to draw a straight line from the previous point. To start a new series of lines, click the button again.

- **Samples.** The number of samples in the arbitrary waveform. Each sample represents the signal value at a given instant in time, and the samples are equally spaced in time. For example, if there are 1024 samples and the **arbitrary waveform generator** is set to play back at 1 kHz, then each sample represents \((1/1 \text{ kHz} \div 1024)\) or about 0.98 microseconds.
**Bit stream.** Draws a sequence of bits according to binary or hex data that you specify. The logic high and low levels are adjustable.

**Clear.** Deletes the arbitrary waveform.

**Normalize.** Adjusts the waveform vertically so that it occupies the full [-1,+1] range.

**Undo and Redo.** The *Undo button* reverses the last change made to the arbitrary waveform. The *Redo button* reverses the last action of the *Undo button*.

**Zoom tools.** To zoom the time axis in or out, click the "+" or "-" zoom button and then click on the waveform area. Click the "100%" button to restore the time axis to its original scale.

### Waveform settings

**Standard waveform shapes.** Draw a standard waveform with the settings specified in the numerical controls below the toolbar. The current waveform will be erased.

**Cycles.** The number of cycles to draw. This control is used in conjunction with the *Standard waveform shapes buttons*. Select one of the standard waveform shapes and then enter the number of cycles, and OMEGASCOPE™ will draw the requested number of cycles of the waveform.

**Minimum.** When one of the *Standard waveform shapes buttons* is pressed, this control sets the minimum signal level.

**Maximum.** When one of the *Standard waveform shapes buttons* is pressed, this control sets the maximum signal level.

**Duty cycle.** When a square, triangular or ramp waveform is selected using one of the *Standard waveform shapes buttons*, this control sets the duty cycle of the signal. Duty cycle is defined as the time that the signal spends above zero volts divided by the total cycle time. Thus, a symmetrical square or triangular wave has a duty cycle of 50%. Reducing the duty cycle shortens the positive part of the cycle and lengthens the negative part, and increasing the duty cycle does the opposite.

### Other buttons

**OK**
Copies the waveform from the graphical editor into the arbitrary waveform generator and returns to the main OMEGASCOPE™ window.

**Apply**
Copies the waveform from the graphical editor into the arbitrary waveform generator and remains in the Arbitrary Waveform Generator window.
7.5.3.1 Import from a Channel dialog

Location: Arbitrary Waveform window > Import from a Channel button

Purpose: allows you to copy captured data from a scope channel to the Arbitrary Waveform window.

Select Channel: You can import the latest waveform from any available channel.

Select Samples: By default, the entire capture is imported. This control allows you to specify a subset of the capture, either between specified sample numbers or between rulers. The subset will be scaled to fit the number of samples specified in the Samples control in the Arbitrary Waveform window.
7.5.4 Demo Signals dialog

Location: start OMEGASCOPE™ with no scope device plugged in > Connect Device dialog [ ] > select "DEMO" device > Signal Generator button [ ] > select channel

Purpose: controls one channel of the "demo" signal source, a feature of OMEGASCOPE™ that creates a variety of test signals to simulate a scope device

- **Signal On**: Tick this box to enable the demo signal source.
- **Frequency**: Type your desired frequency in hertz, or use the spin buttons.
- **Amplitude**: Type your desired amplitude in volts, or use the spin buttons.
- **Offset**: Enter a number to add a d.c. offset to the demo signal. By default, the demo signals have a mean value of zero volts.

7.5.5 Demo Signals menu

Location: start OMEGASCOPE™ with no scope connected > Connect Device dialog [ ] > select "demo device" [ ] > Signal Generator button [ ]

Purpose: allows you to set up test signals so that you can experiment with OMEGASCOPE™ when no scope device is connected

When you click the Signal Generator button [ ], a drop-down list of all the available channels in your demo device appears, like this:

<table>
<thead>
<tr>
<th>Channel</th>
<th>Signal Type</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Sine</td>
<td>1 kHz</td>
</tr>
<tr>
<td>B</td>
<td>Square</td>
<td>1 kHz</td>
</tr>
</tbody>
</table>

Click one of the channels to open the Demo Signals dialog [ ], which will allow you to set up a signal from that channel.
7.6 Start / Stop toolbar

The **Start / Stop toolbar** allows you to start and stop the *scope device*. Click anywhere on the toolbar, or press the space bar, to start or stop sampling.

- **Start icon.** Highlighted if the oscilloscope is sampling.
- **Stop icon.** Highlighted if the oscilloscope is stopped.
7.7 Triggering toolbar

The **Triggering toolbar** tells the scope device when to start capturing data. See also: **Trigger**.

**Trigger Mode**. The list of available modes varies depending on the type of **scope device** in use.

**None**: OMEGASCOPE™ acquires waveforms repeatedly without waiting for a signal to trigger on.

**Auto**: OMEGASCOPE™ waits for a trigger event before capturing data. If there is no trigger event within a reasonable time, it captures data anyway. It repeats this process until you click the **Stop button**. "Auto" mode does not set the trigger level automatically.

**Repeat**: OMEGASCOPE™ waits indefinitely for a trigger event before displaying data. It repeats this process until you click the **Stop button**. If there is no trigger event, OMEGASCOPE™ displays nothing.

**Single**: OMEGASCOPE™ waits once for a trigger event, then stops sampling. To make OMEGASCOPE™ repeat this process, click the **Start** button.

**Rapid**: OMEGASCOPE™ instructs the **scope device** to acquire a sequence of waveforms with the minimum possible delay between them. The display is not updated until the last waveform in the sequence has been captured. When the operation is finished, you can step through the waveforms using the **Buffer Navigation toolbar**.

**ETS**: **Equivalent Time Sampling**. OMEGASCOPE™ captures many cycles of a repetitive signal, then combines the results to produce a single waveform with higher time-resolution than is possible with a single capture. For accurate results, the signal must be perfectly repetitive and the trigger must be stable.

If you select ETS when an **Advanced Trigger** type is enabled, the trigger type will revert to **Simple Edge** and the **Advanced Triggering** button will be disabled.

**Advanced Triggering**. Click to open the **Advanced Triggering dialog**, which gives you extra trigger types beyond the simple edge trigger. If this button is disabled, it is because either **None** or **ETS** is selected in the trigger mode control, or your scope device does not support this mode. To enable the **Advanced Triggering** button, set the control to another trigger mode, such as **Auto**, **Repeat** or **Single**.

**Trigger Source**. This is the channel that OMEGASCOPE™ monitors for the **trigger** 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 level. You can also set the trigger level by dragging the trigger marker 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 in the middle of the screen. You can also control this parameter by dragging the trigger marker to the left or right.

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

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

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

Rapid Captures. In Rapid trigger mode, this is the number of waveforms to capture in a sequence. They will be captured with the minimum possible dead time between them.
7.7.1 Advanced Triggering dialog

**Location:** Triggering toolbar > Advanced Triggering button

**Purpose:** allows you to set up more complex trigger types than simple edge-triggering

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**Advanced trigger types list.** This control lists all the available advanced trigger types. Click on the condition you require, and a diagram and description will appear on the right of the dialog.

If ETS triggering is enabled in the triggering toolbar, then selecting any trigger type except Simple Edge switches off ETS mode.

**Advanced triggering options.** The options available depend on the trigger type selected. See Advanced trigger types. Instructions and diagrams also appear in the dialog.
7.7.2 Advanced trigger types

The advanced trigger types can be switched on in the Advanced Triggering dialog. For all trigger types, the first step is to select which signal the scope should use as the trigger; so set Source to either A, B, Ext or AuxIO. These names correspond to the BNC input connectors on the scope device. Then choose one of the trigger types below.

- **Simple Edge.** This type provides the same Rising and Falling edge triggers that are available from the Triggering toolbar. It is included in this dialog as an alternative method of setting up the Simple Edge trigger.
  
  You can set the trigger Threshold while in the advanced triggering dialog, or alternatively you can drag the Trigger marker on the scope view.
  
  This is the only trigger type that is compatible with ETS mode.

- **Advanced Edge.** This trigger type adds an extra Rising or Falling edge trigger, and Hysteresis, to the Simple Edge trigger. The Rising or Falling option triggers on both edges of a waveform, and is useful for monitoring pulses of both polarities at once. Hysteresis is described in a separate topic.

- **Window.** This trigger type detects when the signal enters or leaves a specified voltage window. The Direction control specifies whether the trigger should detect the signal entering the window, leaving it, or both. Threshold 1 and Threshold 2 are the upper and lower voltage limits of the window. The order in which you specify the two voltages does not matter. Hysteresis can be set to reduce the number of false triggers on a noisy signal, and is described in a separate topic.

- **Pulse Width.** This trigger type detects pulses of a specified width.
  
  First set the Pulse Direction to either Positive or Negative according to the polarity of the pulse you are interested in.

  Next, set one of the four Condition options:

  - **Greater than** triggers on pulses wider than the specified time.
  
  - **Less than** triggers on pulses that are narrower (useful for finding glitches).
  
  - **Inside time range** triggers on pulses that are wider than Time 1 but no wider than Time 2 (useful for finding pulses that meet a specification).
  
  - **Outside time range** does the opposite: it triggers on pulses that are either narrower than Time 1 or wider than Time 2 (useful for finding pulses that violate a specification).

  Next, set the trigger Threshold in volts or other units, or drag the Trigger marker on the scope view.

  Finally, set up Time 1 (and Time 2 if present) to define the pulse width.
**Interval.** This type lets you search for two successive edges of the same polarity that are separated by a specified interval of time.

First, set the **Starting edge** to either **Rising** or **Falling** according to the polarity of the edges you are interested in.

Next, select one of the four **Condition** options:

- **Greater than** triggers when the second edge occurs later than **Time 1** after the first edge (useful for detecting missing events).

- **Less than** triggers when the second edge occurs earlier than **Time 1** after the first edge (useful for detecting timing violations and spurious edges).

- **Inside time range** triggers when the second edge is later than **Time 1** after the first edge and earlier than **Time 2** (useful for finding valid edges).

- **Outside time range** triggers when the second edge is earlier than **Time 1** after the first edge or later than **Time 2** (useful for finding spurious edges).

Finally, set up **Time 1** (and **Time 2** if present) to define the time interval.

**Window pulse width.** This is a combination of the window trigger and the pulse width trigger. It detects when the signal enters or leaves a voltage range for a specified period of time.

**Level dropout.** This detects an edge followed by a specified time with no edges. It is useful for triggering on the end of a pulse train.

**Window dropout.** This is a combination of the window trigger and the dropout trigger. It detects when the signal enters a specified voltage range and stays there for a specified time. This is useful for detecting when a signal gets stuck at a particular voltage.

**Runt.** Detects a pulse that crosses one threshold and then falls below the same threshold, without crossing the second threshold. This is typically used for finding pulses that fail to reach a valid logic level.

**Logic.** This can detect a number of logical combinations of the scope’s four inputs: A, B, Ext and AUXIO. The conditions that can be applied to each input vary: A and B can be edge-, level- or window-qualified; Ext is level-qualified with a variable threshold; and AUXIO is level-qualified with a fixed TTL threshold.

You can choose to combine the channels with an AND, NAND, OR, NOR, XOR or XNOR function.
7.7.2.1 Hysteresis

**Hysteresis** is a feature of the advanced trigger types in OMEGASCOPE™ that reduces false triggering on noisy signals. When hysteresis is enabled, a second trigger threshold voltage is used in addition to the main trigger threshold. The trigger fires only when the signal crosses the two thresholds in the correct order. The first threshold arms the trigger, and the second causes it to fire. An example will help to illustrate how this works.

**Noisy signal with a single threshold**

Consider the very noisy signal above. It is difficult to trigger reliably on this signal with a normal rising edge trigger because it crosses the trigger threshold, the red line in this picture, several times in one cycle. If we zoom in on the highlighted parts of the signal, we will see how hysteresis can help.

**Noisy signal with hysteresis threshold**

In these zoomed-in views, the original threshold is the lower red line. The upper red line is the second threshold used by the hysteresis trigger.

The signal rises across the lower threshold at (1) and (2), arming the trigger but not firing it. At (3) the signal finally crosses the upper threshold, firing the trigger. On the falling edge of the signal, at (4) and (5), rising edges of noise pulses cause the signal to cross the upper and lower thresholds, but in the wrong order, so the trigger is not armed and does not fire. Thus the trigger occurs at only one well-defined point in the cycle (3), despite the noise on the signal.

Hysteresis is enabled by default for all the advanced trigger types. The **Hysteresis** controls in the **Advanced triggering dialog** let you change the hysteresis voltage as a percentage of full scale. The trigger marker shows the size of the hysteresis window.
7.8 Zooming and Scrolling toolbar

The **Zooming and Scrolling toolbar** allows you to move around a **scope view** or **spectrum view**. Each button has a keyboard shortcut, as listed below.

- **Ctrl+S** or **Esc** **Normal Selection tool.** Restores the pointer to its normal appearance. You can use this pointer to click buttons, drag **rulers** and operate any other controls in the OMEGASCOPE™ window.

- **Ctrl+D** **Hand tool.** Turns the pointer into a hand (Navigate) that you can use to click and drag the view to pan it vertically and horizontally when you are zoomed in. You can also pan using the scroll bars. Press the **Esc** key to return to the **Normal Selection tool**.

- **Ctrl+M** **Marquee Zoom tool.** This button turns the pointer into a marquee zoom tool. Use it to draw a box (called a marquee) on the view and OMEGASCOPE™ 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). Zooming in also opens the **Zoom Overview** window. Press the **Esc** key to return to the **Normal Selection tool**.

  If you point to the time axis, the pointer changes into the horizontal marquee zoom tool, which restricts zooming to the horizontal axis. This lets you zoom in by an arbitrary amount without disturbing the vertical zoom factor.

- **Ctrl+I** **Zoom-in tool.** Turns the pointer into a zoom-in tool. Click on the view with this tool to zoom in to the specified location. Zooming in also opens the **Zoom Overview** window.

  If you point to the time axis, the pointer changes into the horizontal zoom-in tool, which restricts zooming to the horizontal axis. This lets you zoom in without disturbing the vertical zoom factor.

- **Ctrl+O** **Zoom-out tool.** Turns the pointer into a zoom-out tool. Click on the view with this tool to zoom out around the specified location.

  If you point to the time axis, the pointer changes into the horizontal zoom-out tool, which restricts zooming to the horizontal axis. This lets you zoom out without disturbing the vertical zoom factor.

- **Undo zoom.** Returns the view to the previous zoom and pan settings.

- **Ctrl+U** **Zoom to full view.** Resets the view to normal size. The view will no longer have scroll bars, and panning will no longer be possible.
7.8.1  Zoom Overview
Whenever you zoom in using the Zooming and Scrolling toolbar, the Zoom Overview window should appear*:

The Zoom Overview shows the full waveforms on all enabled channels. The rectangle indicates the area that is visible in the current view.

You can move around the waveform by dragging the rectangle.

You can also adjust the zoom factor by dragging the edges of the rectangle to resize it.

Minimize button: reduce the Zoom Overview window in size without affecting the zoom settings.

Close button: close the Zoom Overview window and return the zoom factor to 100%.

*Note: if the Zoom Overview does not appear, the feature may have been switched off. Check the Zoom Overview option in Tools > Preferences > Options.
8 How to...

This chapter explains how to perform some common tasks.

- Change to a different scope device
- Use rulers to measure a signal
- Measure a time difference
- Move a view
- How to scale and offset a signal
- How to set up the spectrum view
- Find a glitch using persistence mode
- Set up a Mask Limit Test
- Save on trigger
8.1 How to change to a different device

Unplug the old device
Plug in the new device

OMEGASCOPE™ detects that the device has changed and immediately starts using the new one.

If more than one device is connected then you will see the Connect Device dialog, which allows you to select a device to use.
8.2 How to use rulers to measure a signal

**Using a single ruler for signal-to-ground measurements**

- Look at the [Channels toolbar](#) to find the color code for the channel you wish to measure:

  ![Channels toolbar](#)

- Find the ruler handle (the small colored square in the top-left or top-right corner of the [scope view](#) or [spectrum view](#) of this color):

  ![Ruler handle](#)

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

  ![Signal ruler](#)

- Look at the [ruler legend](#) (the small table that appears on the view). It should have a row marked by a small colored square matching the color of your ruler handle. The first column shows the signal level of the ruler.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>△</th>
</tr>
</thead>
<tbody>
<tr>
<td>586.0mV</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Using two rulers for differential measurements**

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

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>△</th>
</tr>
</thead>
<tbody>
<tr>
<td>586.0mV</td>
<td>-483.0mV</td>
<td>1.079V</td>
</tr>
</tbody>
</table>
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).

- Drag the ruler handle to the right. A time ruler (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 (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 shows $1/\Delta$, where $\Delta$ is the time difference.

You can use a similar method to measure a frequency difference on a spectrum view.
8.4 How to move a view

You can easily drag a view from one viewport to another. This example shows four viewports, which contain scope views called "Scope 1" to "Scope 4". Suppose that 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.
8.5 How to scale and offset a signal

OMEGASCOPE™ offers two ways to change the size and position of a signal during or after capture. These methods apply equally to scope views and spectrum views. They do not change the stored data, only the way in which it is displayed. These options are provided in addition to the analog offset capability of the OMSP-3000 Series scopes.

**Global zooming and scrolling**

This is usually the quickest way to get a closer look at the fine detail on your signals. The global zooming and scrolling tools move all the signals at once and are found on the zooming and scrolling toolbar.

When a view is zoomed in, it has vertical and horizontal scroll bars that let you move the signals around as a group. You can also use the hand tool to scroll around the graph.

**Axis scaling and offset**

Use these tools to position individual signals on the graph (unlike the global zooming and scrolling tools, which are applied to all of the signals at the same time). Axis scaling and offset tools are ideal when a signal on one channel is smaller than on another or when you just want to make the best use of available screen space. Common uses are:

- Aligning signals that have different amplitudes or offsets, for an overlay comparison:
Arranging the signals in their own rows for side-by-side comparison:

Click the scaling button at the bottom of the axis you wish to modify, and the axis scaling controls will appear. To adjust the offset without using the axis scaling controls, click on the vertical axis and drag it up or down.

How to use these tools together

These global and axis-specific tools work smoothly together and make it easy to move around your data once you know how. We will take a look at a common example of usage to explain how the tools can be used together.

Consider this common setup where all 4 channels are being displayed on the centreline of the graph.
Step 1. Arrange the signals into rows using the axis offset tool, so we can clearly see them all side by side.

Step 2. Scale the signals so that they have roughly equal amplitudes. This eliminates the overlap and makes the smaller signal easier to read.
Step 3. Now we want to take a closer look at a specific time range of the signal in greater detail. We don’t want to mess around with the neat axis scaling and offset that we have spent time creating, so instead we use the global windowed-zoom tool to select a specific section of the entire graph to zoom.

We can of course use the scrollbars or the hand tool to navigate around this zoomed view without ever changing our carefully arranged signals. Clicking the Zoom 100% button will take us back to the full view of our data; and again, this happens without affecting our axis scaling and offset set-up.
How is this different from scaling my data with a Custom Probe?

You can create a Custom Probe to apply scaling to the raw data. A Custom Probe may change the scale and position of data on the graph but it has a few important differences from the other scaling methods.

- Custom Probe scaling is a permanent transformation. The scaling is applied when the data is captured and cannot be changed afterwards.
- The actual data values themselves are changed so the graph axes may no longer display the voltage range of the device.
- Custom Probe scaling can be nonlinear and so may alter the shape of the signal.

Custom Probes are useful when you want to represent the characteristics of a physical probe or transducer that you plug into your scope device. All of the zooming, scrolling, scaling and offset tools still apply to data that has been scaled with a Custom Probe in exactly the same way that they would apply to the raw data.
8.6 How to set up the spectrum view

Creating a spectrum view

First, ensure that the trigger mode is not set to ETS, as it is not possible to open a spectrum view in ETS trigger mode.

There are three ways to open a spectrum view:

1. Click the Spectrum Mode button in the Capture Setup toolbar. We recommend using this method to get the best spectrum analysis performance from your scope. Once in Spectrum Mode, you can still open a scope view to see your data in the time domain, but OMEGASCOPE optimizes the settings for the spectrum view.

2. Go to the Views menu and select Add view, then select Spectrum.

3. Right-click on any view, select Add view, then select Spectrum. The menu is similar to the Views menu shown above.

Configuring the spectrum view

See Spectrum Settings dialog.

Selecting the source data

OMEGASCOPE can produce a spectrum view based on either live or stored data. If OMEGASCOPE is running (the Start button is pressed in), the spectrum view represents live data. Otherwise, with OMEGASCOPE stopped (the Stop button pressed in), the view represents data stored in the currently selected page of the waveform buffer. When OMEGASCOPE is stopped, you can use the buffer controls to scroll through the buffer and the spectrum view will be recalculated from the waveform currently selected.
8.7 How to find a glitch using persistence mode

Persistence mode helps you find rare events hidden in otherwise repetitive waveforms. In normal scope mode, such an event may appear on the display for a fraction of a second, too quickly for you to press the space bar to freeze it on the screen. Persistence mode keeps the event on the display for a predetermined time, allowing you to set up the trigger options to capture it more reliably.

**Step-by-step guide**

Set up the scope to trigger on a repetitive waveform like the one below. We suspect that there are occasional glitches but we can see nothing wrong yet, so we shall use persistence mode to investigate. Click the Persistence Mode button to continue.
Our original scope view is replaced by a persistence view, as shown below. Immediately, we can see three pulses with different shapes. At this point we have the **Saturation** control in **Persistence Options** turned up to maximum to help us spot the various waveforms easily.
Now that we have found some glitches, we will turn the Saturation control down to minimum. Click the Persistence options button to open the Persistence Options dialog, and then use the slider to adjust the saturation. The display then appears as below.

The waveforms are now darker but have a wider range of colors and shades. The most frequently occurring waveform is shown in red, and is the normal shape of the pulse. A second waveform is drawn in light blue to shows that it occurs less frequently, and it shows us that there is an occasional jitter of about 10 ns in the pulse width. The third waveform is drawn in dark blue because it occurs less frequently than the other two, and indicates that there is an occasional runt pulse about 300 mV lower in amplitude than normal.
Persistence mode has done its job. We have found our glitches, and now we want to examine them in more detail. The best way to do this is to switch back to normal **scope mode**, so that we can use the **advanced triggering** and **automatic measurement** functions built in to OMEGASCOPE™.

Click the **Scope Mode button**. Set up an advanced pulse-width trigger to look for a pulse wider than 60 ns. OMEGASCOPE™ then finds the runt pulse straight away.

We can now add automatic measurements or drag the rulers into place to analyse the runt pulse in detail.
How to set up a Mask Limit Test

For full information on this feature, see:  Mask Limit Testing.

1. Display a stable waveform in a scope view. Adjust the voltage range and timebase so that the feature of interest fills most of the view. In this example, we are viewing a repetitive pulse as might be found on a data bus.

2. Select the Tools > Masks > Add Masks command.
3. You should now be in the **Mask Library dialog**:

Channel A is selected by default. You can change this if you want to apply the mask to a different channel.

4. Click the **Generate** button to open the **Generate Mask dialog**:
5. For now, accept the default settings and click **Generate**. Then click **OK** in the **Mask Library dialog** to return to the scope view:

![Image of Mask Library dialog](image1)

You now have a mask drawn around the original waveform.

6. OMEGASCOPE™ stops capturing when you enter the **Mask Library dialog**, so press the space bar to restart. If any captured waveform fails to fit inside the mask, the offending parts are drawn in a contrasting color. The **Measurements table** shows the number of failures:

![Image of Measurements table](image2)

7. You now have a functioning mask limit test. Please read the **Mask Limit Test** topic for information on editing, importing and exporting masks. It is also possible to set up a Mask Limit Test on a **spectrum** or **XY** view.
8.9 How to save on trigger

Save-on-trigger is just one of a number of functions that are possible with the Alarms feature.

1. Set up OMEGASCOPE™ to display your waveform, and enable triggering:

![Waveform Image]

2. Select the **Tools > Alarms** command:
3. You should now be in the **Alarms dialog**:

4. Set **Event** to **Capture**:
5. Select the first item in the Actions list, click Edit, and change Action to Save Current Buffer:

6. Click the button to the right of the File box and enter the name and location of the file to save:
7. Ensure that both the **Save Current Buffer** check box and the **Enable Alarm** check box are set:

![Alarms dialog box]

8. Click OK. OMEGASCOPE™ will now save a file on every trigger event.

9. Switch off the alarm when you have finished using it, to avoid creating unwanted files.
9 Reference

This is where you can find detailed information on the operation of OMEGASCOPE™.

- Measurement types
- Spectrum window functions
- Serial protocols
- Trigger timing
- Command-line syntax
- Glossary

9.1 Measurement types

The Edit Measurement dialog allows you to select one of a range of measurements that OMEGASCOPE™ can calculate for the selected view. The list of measurements available depends on whether the view is a scope view (see scope measurements) or a spectrum view (see spectrum measurements).
9.1.1 Scope measurements

**AC RMS.** The root mean square (RMS) value of the waveform minus the **DC Average.** It is equivalent to a ripple measurement.

**Cycle Time.** OMEGASCOPE™ will attempt to find a repeated pattern in the waveform and measure the duration of one cycle.

**DC Average.** 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.

**Falling Rate.** The rate at which the signal level falls, in signal units per second. Click the Advanced button in the Add Measurement or Edit Measurement dialog to specify the signal level thresholds for the measurement.

**Frequency.** The number of cycles of the waveform per second.

**Fall Time.** The time the signal takes to fall from the upper threshold to the lower threshold. Click the Advanced button in the Add Measurement or Edit Measurement dialog to specify the signal level thresholds for the measurement.

**High Pulse Width.** The amount of time that the signal spends above its mean value.

**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 To Peak.** The difference between maximum and minimum.

**Rise Time.** The time the signal takes to rise from the lower threshold to the upper threshold. Click the Advanced button in the Add Measurement or Edit Measurement dialog to specify the signal level thresholds for the measurement.

**Rising Rate.** The rate at which the signal level rises, in signal units per second. Click the Advanced button in the Add Measurement or Edit Measurement dialog to specify the signal level thresholds for the measurement.

**True RMS.** The root mean square (RMS) value of the waveform, including the DC component.

**Mask Failures.** A special measurement that counts the number of failed waveforms in Mask Limit Testing mode. This measurement is added to the table automatically when you use Mask Limit Testing, so there is usually no need to select it manually.
9.1.2 Spectrum measurements

To add a spectrum measurement, open a spectrum view and then click the Add Measurement button. You can use these measurements in either scope mode or spectrum mode.

**Frequency at peak.** The frequency at which the peak signal value appears.

**Amplitude at peak.** The amplitude of the peak signal value.

**Average amplitude at peak.** The amplitude of the peak signal value averaged over a number of captures.

**Total power.** The power of the whole signal captured in the spectrum view, calculated by adding the powers in all of the spectrum bins.

**Total Harmonic Distortion (THD).** The ratio of the sum of harmonic powers to the power at the fundamental frequency.

\[
THD = 20 \log_{10} \left( \frac{\sqrt{V_2^2 + V_3^2 + V_4^2 + V_5^2 + V_6^2 + V_7^2}}{V_f} \right)
\]

**Total Harmonic Distortion plus Noise (THD+N).** The ratio of the harmonic power plus noise to the fundamental power. THD+N values are always greater than the THD values for the same signal.

\[
THD + N = 20 \log_{10} \left( \frac{\sqrt{\text{sum of squares of RMS values excluding datum}}}{\text{RMS value of datum}} \right)
\]

**Spurious-free Dynamic Range (SFDR).** This is the ratio of the amplitude of the specified point (normally the peak frequency component) and the frequency component with the second largest amplitude (call it "SFDR frequency"). The component at the "SFDR frequency" is not necessarily a harmonic of the fundamental frequency component. For example, it might be a strong, independent noise signal.

**Signal+Noise+Distortion to Signal+Noise Ratio (SINAD).** The ratio, in decibels, of the signal-plus-noise-plus-distortion to noise-plus-distortion.

\[
SINAD = 20 \log_{10} \left( \frac{\text{RMS value of datum}}{\sqrt{\text{sum of squares of all RMS components except datum}}} \right)
\]

**Signal to Noise Ratio (SNR).** The ratio, in decibels, of the mean signal power to the mean noise power. Hanning or Blackman windows are recommended because of their low noise.

\[
SNR = 20 \log_{10} \left( \frac{\text{RMS value of datum}}{\sqrt{\text{sum of squares of all values excluding datum and harmonics}}} \right)
\]
Intermodulation Distortion (IMD). A measure of the distortion caused by the nonlinear mixing of two tones. When multiple signals are injected into a device, modulation or nonlinear mixing of these two signals can occur. For input signals at frequencies f1 and f2, the two second-order distortion signals will be found at frequencies: f3 = (f1 + f2) and f4 = (f1 - f2).

IMD is expressed as the dB ratio of the RMS sum of the distortion terms to the RMS sum of the two input tones. IMD can be measured for distortion terms of any order, but the second-order terms are most commonly used. In the second-order case, the intermodulation distortion is given by:

\[
\text{IMD} = 20 \log_{10} \sqrt{\frac{F_3^2 + F_4^2}{F_1^2 + F_2^2}}
\]

where

F3 and F4 are the amplitudes of the two second-order distortion terms (at frequencies f3 and f4 defined above)

and

F1 and F2 are the amplitudes of the input tones (at frequencies f1 and f2, as marked by the frequency rulers in the spectrum window).

For reference, the third-order terms are at frequencies (2F1 + F2), (2F1 - F2), (F1 + 2F2) and (F1 - 2F2).

Note: Hanning or Blackman windows are recommended because of their low noise. An FFT size of 4096 or greater is recommended in order to provide adequate spectral resolution for the IMD measurements.

Mask Failures. See Mask Limit Testing[^2].
9.2 Signal generator waveform types

The list of waveform types available in the **Signal Generator dialog** varies according to the type of oscilloscope connected. The full list is as follows:

- **Sine**
- **Square**
- **Triangle**
- **RampUp**
- **RampDown**
- **Sinc**
- **Gaussian**
- **HalfSine**
- **WhiteNoise**
- **PRBS**
- **DCVoltage**
- **Arbitrary**

---

**Sine**

**Square**

**Triangle**

**RampUp**

**RampDown**

**Sinc**

**Gaussian**

**HalfSine**

**WhiteNoise**

**PRBS**

**DCVoltage**

**Arbitrary**
9.3 Spectrum window functions

To create a spectrum view, OMEGASCOPETM captures a block of sampled data over a finite time interval and then uses a Fast Fourier Transform to compute its spectrum. The algorithm assumes a signal level of zero at all times outside the captured time interval. Typically, this assumption causes sharp transitions to zero at either end of the data, and these transitions have an effect on the computed spectrum, creating unwanted artefacts such as ripple and gain errors. To reduce these artefacts, the signal can be faded in and out at the start and end of the block. There are several commonly used "window functions" that can be convolved with the data to effect this fading, and which are chosen according to the type of signal and the purpose of the measurement.

The **Window Functions control** in the Spectrum Options dialog lets you select one of the standard window functions for spectrum analysis. The following table shows some of the figures of merit used to compare the functions.

<table>
<thead>
<tr>
<th>Window</th>
<th>Main peak width (bins @ -3 dB)</th>
<th>Highest side lobe (dB)</th>
<th>Side lobe roll-off (dB/octave)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackman</td>
<td>1.68</td>
<td>-58</td>
<td>18</td>
<td>often used for audio work</td>
</tr>
<tr>
<td>Gaussian</td>
<td>1.33 to 1.79</td>
<td>-42 to -69</td>
<td>6</td>
<td>gives minimal time and frequency errors</td>
</tr>
<tr>
<td>Triangular</td>
<td>1.28</td>
<td>-27</td>
<td>12</td>
<td>also called Bartlett window</td>
</tr>
<tr>
<td>Hamming</td>
<td>1.30</td>
<td>-41.9</td>
<td>6</td>
<td>also called raised sine-squared; used in speech analysis</td>
</tr>
<tr>
<td>Hann</td>
<td>1.20 to 1.86</td>
<td>-23 to -47</td>
<td>12 to 30</td>
<td>also called sine-squared; used for audio &amp; vibration</td>
</tr>
<tr>
<td>Blackman-Harris</td>
<td>1.90</td>
<td>-92</td>
<td>6</td>
<td>general-purpose</td>
</tr>
<tr>
<td>Flat-top</td>
<td>2.94</td>
<td>-44</td>
<td>6</td>
<td>negligible pass-band ripple; used mainly for calibration</td>
</tr>
<tr>
<td>Rectangular</td>
<td>0.89</td>
<td>-13.2</td>
<td>6</td>
<td>no fading; maximal sharpness; used for short transients</td>
</tr>
</tbody>
</table>
9.4 Trigger timing (part 1)

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

![Scope View with Post-Trigger Delay](image)

**Note 1.** The trigger reference point (Diamond) does not lie on the waveform. This is because the post-trigger delay is set to 200 µs, which means that the trigger occurred 200 µs before the reference point, somewhere off the left-hand edge of the scope view. The time axis is aligned so that the trigger reference point is at 200 µs.

**Note 2.** The pre-trigger delay is set to 25%, which makes the trigger reference point appear 25% of the way across the scope view from the left-hand edge.

**Note 3.** OMEGASCOPE™ limits the trigger-to-reference-point delay to a multiple of 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, OMEGASCOPE™ will reduce the pre-trigger delay to stop the total exceeding the limit. The multiple is typically 100 in most trigger modes, and 1 in **ETS** mode.
9.5 Trigger timing (part 2)

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

The pre-trigger delay positions the scope view 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. OMEGASCOPE™ waits for this time after the trigger event before drawing the trigger reference point. Scope devices have a limit to the number of sampling intervals that can elapse between the trigger event and the end of the capture, 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.
Serial protocols

The **serial decoding** function can decode the following serial protocols:

- **CAN Bus**
- **I2C Bus**
- **RS-232 (UART)**
- **SPI Bus**
9.6.1 CAN Bus protocol

You can decode CAN Bus data using the serial decoding feature built into OMEGASCOPE™.

**About CAN Bus**

CAN (Controller Area Network) Bus is a serial protocol used in automotive and industrial machinery to allow microcontrollers to communicate with each other. The standard was originally developed in 1983 by Robert Bosch GmbH. It typically uses differential signalling (with signals named CAN H and CAN L) to increase noise immunity. OMEGASCOPE™ supports CAN Bus bit rates from 10 kbit/s to 1 Mbit/s.

The in-window view of the data looks like this:

![CAN Bus Data Table]

The columns in the data table are as follows:

<table>
<thead>
<tr>
<th>Column No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No.</strong></td>
<td>Serial number of the frame (decimal). If Accumulate mode is off, this counts from the start of the selected waveform. If Accumulate mode is on, this counts from the start of the first waveform in the waveform buffer.</td>
</tr>
<tr>
<td><strong>ID</strong></td>
<td>Identifier (hexadecimal). Should be unique for a specified data type. Base frames have an 11-bit identifier, and extended frames have a 29-bit identifier.</td>
</tr>
<tr>
<td><strong>Frame</strong></td>
<td>CAN Bus data is divided into frames, each consisting of a number of bits. A frame can be any of the following types:</td>
</tr>
<tr>
<td></td>
<td><strong>Data</strong>: contains data destined for a node</td>
</tr>
<tr>
<td></td>
<td><strong>Remote</strong>: a request for the transmission of a specific identifier</td>
</tr>
<tr>
<td></td>
<td><strong>Error</strong>: transmitted by a node that detects an error</td>
</tr>
<tr>
<td></td>
<td><strong>Overload</strong>: inserted to add a delay between frames</td>
</tr>
<tr>
<td></td>
<td><strong>Interframe</strong>: time interval preceding data frames and remote frames</td>
</tr>
<tr>
<td><strong>RTR</strong></td>
<td>Remote transmission request</td>
</tr>
<tr>
<td><strong>SRR</strong></td>
<td>Used only in extended frames</td>
</tr>
<tr>
<td><strong>IDE</strong></td>
<td>Identifier extension bit</td>
</tr>
<tr>
<td><strong>R0</strong></td>
<td>Reserved bit</td>
</tr>
</tbody>
</table>
R1 Reserved bit, extended frames only
DLC Data length code. Indicates the number of bytes of data.
Data bytes The data content of the message, DLC bytes long (hexadecimal)
CRC Sequence A cyclic redundancy check of the data (hexadecimal)
CRC Delimiter A fixed bit following the CRC Sequence field
Ack Slot Node asserts this bit to acknowledge receipt
Ack Delimiter A fixed bit following the Ack Slot field
Error Set if OMEGASCOPE™ detects an error
Start Time Value of OMEGASCOPE™ timebase at start of frame
End Time Value of OMEGASCOPE™ timebase at end of frame
9.6.2 I²C Bus protocol
You can decode I²C Bus data using the serial decoding feature built into OMEGASCOPE™.

**About I²C Bus**

I²C (Inter-Integrated Circuit) Bus is a serial protocol used mainly in consumer electronics for communications between devices on the same circuit board, and between computers and displays. The standard was originally developed in the 1980s by Philips. It uses two signals: clock (SCL) and data (SDA). Speeds up to 3.4 Mbit/s are possible.

The in-window view of the data looks like this:

![I²C Bus Data](image)

The columns in the data table are as follows:

<table>
<thead>
<tr>
<th>Column No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>Serial number of the packet (decimal). If <strong>Accumulate</strong> mode is off, this counts from the start of the selected waveform. If <strong>Accumulate</strong> mode is on, this counts from the start of the first waveform in the waveform buffer.</td>
</tr>
<tr>
<td>Packet</td>
<td>Packet type: <strong>Start</strong>, <strong>Stop</strong>, <strong>Address</strong>, <strong>Data</strong> or <strong>Unknown</strong>.</td>
</tr>
<tr>
<td>Address</td>
<td>Shown for address packets.</td>
</tr>
<tr>
<td>Read/Write</td>
<td>Polarity of the Read/Write flag.</td>
</tr>
<tr>
<td>Data bytes</td>
<td>Contents of data packets.</td>
</tr>
<tr>
<td>Acknowledge</td>
<td>Whether the destination acknowledged the packet.</td>
</tr>
<tr>
<td>Baud Rate</td>
<td>The signalling rate detected for this packet.</td>
</tr>
<tr>
<td>Start Time</td>
<td>Time according to OMEGASCOPE™ timebase at start of frame.</td>
</tr>
<tr>
<td>End Time</td>
<td>Time according to OMEGASCOPE™ timebase at end of frame.</td>
</tr>
</tbody>
</table>
9.6.3 RS232/UART protocol
You can decode **RS232 (UART)** data using the **serial decoding** feature built into **OMEGASCOPE™**.

**About RS232**

RS232 is the serial data standard used by UARTs (Universal Asynchronous Receiver/Transmitters) in the "serial" or "COM" ports once commonly found on computers. It was developed in the 1960s for connecting modems to terminals. The full standard uses a voltage swing of ±12 V, larger than most other standards. Data rates of 115 kbit/s are possible. The simplest RS232 connection consists of two signals: Rx (receive) and Tx (transmit).

The in-window view of the data looks like this:

![Serial Decoding Window](image)

The columns in the data table are as follows:

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>Serial number of the packet (decimal). If <strong>Accumulate</strong> mode is off, this counts from the start of the selected waveform. If <strong>Accumulate</strong> mode is on, this counts from the start of the first waveform in the waveform buffer.</td>
</tr>
<tr>
<td>Packet</td>
<td>Packet type: all packets in this format are classified as <strong>Data</strong>.</td>
</tr>
<tr>
<td>Start Bit</td>
<td>If present, this is the fixed &quot;1&quot; bit at the start of the word.</td>
</tr>
<tr>
<td>Data bytes</td>
<td>Contents of data packets.</td>
</tr>
<tr>
<td>Parity Bit</td>
<td>The error-correction bit, if present, at the end of the word.</td>
</tr>
<tr>
<td>Stop Bit</td>
<td>If present, this is the fixed &quot;1&quot; bit at the end of the word.</td>
</tr>
<tr>
<td>Error</td>
<td>Indicates whether there was a data error.</td>
</tr>
<tr>
<td>Start Time</td>
<td>Time according to OMEGASCOPE™ timebase at start of frame.</td>
</tr>
<tr>
<td>End Time</td>
<td>Time according to OMEGASCOPE™ timebase at end of frame.</td>
</tr>
</tbody>
</table>
9.6.4 SPI Bus protocol

You can decode SPI Bus data using the serial decoding feature built into OMEGASCOPE™.

About SPI Bus

SPI (Serial Peripheral Interface) Bus is a serial data standard used for communication between microprocessors and peripheral devices. It was developed by Motorola. The original standard uses a 4-wire link, although 3-wire and 2-wire versions are also used.

The in-window view of the data looks like this:

![Data Table](image)

The columns in the data table are as follows:

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>Serial number of the packet (decimal). If Accumulate mode is off, this counts from the start of the selected waveform. If Accumulate mode is on, this counts from the start of the first waveform in the waveform buffer.</td>
</tr>
<tr>
<td>Packet</td>
<td>Packet type: Start, Stop, Address, Data or Unknown.</td>
</tr>
<tr>
<td>Data bytes</td>
<td>Contents of data packets.</td>
</tr>
<tr>
<td>Start Time</td>
<td>Time according to OMEGASCOPE™ timebase at start of frame.</td>
</tr>
<tr>
<td>End Time</td>
<td>Time according to OMEGASCOPE™ timebase at end of frame.</td>
</tr>
</tbody>
</table>
9.7 Command-line syntax

To display the GUI

OMEGASCOPE <filename>

<filename> Specifies a single .psdata or .pssettings file.

Example: OMEGASCOPE C:\Temp\source.psdata

To display help

OMEGASCOPE /?

Shows help on all command line options.

To convert psdata files

OMEGASCOPE /C,/c

Converts a psdata file from one format to another. Cannot be used with /p[rint].

Syntax:

OMEGASCOPE /c[onvert] <names> [/d <names>] /f <format> [/q]
[/b [<n>[::<m>]] | [all]] [/v <viewportname>]

<names> Specifies a list of one or more directories or psdata files. Wildcards may be used to specify multiple files. If a directory is specified, all psdata files within that directory will be specified. This is a mandatory argument.

/d <names> Destination. Default is input filename with new extension.

/f <format> Destination format: csv, txt, png, bmp, gif, a[nimated] gif, psdata, pssettings, matlab. This is a mandatory argument.

/q Quiet mode. Do not ask before overwriting files. The default is to prompt.

/b [<n>[::<m>]]|all Waveform number n, waveform range n to m or all waveforms. The default is the current waveform.

/v <viewportname> View to convert. Default is current view.

Example:

OMEGASCOPE /c C:\Temp\source.psdata /f png /b 5:9 /v Scope2
To print a view

**OMEGASCOPE /p**, /p

Prints a view in the psdata file. Cannot be used with /c[onvert].

Syntax:

```
OMEGASCOPE /p[rint] <names> [/b [<n>[:<m>]] | all] [/v <viewportname>]
```

- `<names>`: Specifies a list of one or more directories or .psdata files. Wildcards may be used to specify multiple files. If a directory is specified, all .psdata files within that directory will be specified. This is a mandatory argument.

- `/b [<n>[:<m>]] | all`: Waveform number n, waveform range n to m or all buffers. Default is current waveform.

- `/v <viewportname>`: View to convert. Default is current view.

Example:

```
OMEGASCOPE /p C:\Temp\source.psdata /b 5:9 /v Scope2
```
9.8 Glossary

**AC coupling.** In this mode, the scope device rejects very low signal frequencies below about 1 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.

**AWG.** An arbitrary waveform generator (AWG) is a circuit that can generate a waveform of almost any shape. It is programmed with a data file, supplied by the user, which defines the output voltage at a number of equally spaced points in time. The circuit uses this data to reconstruct the waveform with a specified amplitude and frequency.

**Axis.** A line marked with measurements. OMEGASCOPE™ shows one vertical axis for each channel that is enabled in a view, giving measurements in volts or other units. Each view also has a single horizontal axis, which is marked in units of time for a scope view, or units of frequency for a spectrum view.

**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.

**CSV.** Comma-separated values. A form of text file containing a list of values separated by commas and line-breaks. CSV format is used for importing and exporting OMEGASCOPE™ arbitrary waveform files. You can also export OMEGASCOPE™ waveforms in CSV format. CSV files can be imported into spreadsheets and other programs.

**DC coupling.** In this mode, the scope device measures the signal level relative to signal ground. This shows both d.c. and a.c. components.

**Dead time.** The time between the end of one capture and the start of the next. To obtain the minimum possible dead time, use Rapid trigger mode.

**Demo mode.** If OMEGASCOPE™ is started when no scope device is plugged in, it allows you to select a "demo device", a virtual scope unit that you can use to test the software. The program is then in "demo" (short for "demonstration") mode. This mode provides a simulated, configurable signal source for each input channel of the demo device.

**ETS.** Equivalent Time Sampling. A method of increasing the effective sampling rate of the scope. In a scope view, the program captures several cycles of a repetitive signal, then combines the results to produce a single waveform with higher time-resolution than a single capture. For accurate results, the signal must be perfectly repetitive and the trigger must be stable.

**Graticule.** The horizontal and vertical dashed lines in every view. These help you estimate the amplitude and time or frequency of features on the waveform.

**Grid.** The arrangement of viewports. The number of grid rows and the number of grid columns can each be either 1, 2, 3 or 4.

**In focus.** OMEGASCOPE™ can display several views, but only one view is in focus at any time. When you click a toolbar button, it will usually affect only the view that is in focus. To bring a view into focus, click on it.
PC Oscilloscope. A measuring instrument consisting of a scope device and the OMEGASCOPE™ software running on a PC. A PC Oscilloscope has the same functions as a traditional bench-top oscilloscope but is more flexible and cost-effective. You can improve its performance by upgrading the PC using standard parts from any computer shop, or by purchasing a new scope device, and you can upgrade the software by downloading an update from Omega Engineering, Inc.

Probe. An accessory that attaches to your oscilloscope and picks up a signal to be measured. Probes are available to pick up any form of signal, but they always deliver a voltage signal to the oscilloscope. OMEGASCOPE™ has built-in definitions of standard probes, but also allows you to define custom probes.

Progressive mode. Normally, OMEGASCOPE™ redraws the waveform in a scope view many times every second. At timebases slower than 200 ms/div, however, it switches to progressive mode. In this mode, OMEGASCOPE™ updates the scope view continuously as each capture progresses, rather than waiting for a complete capture before updating the view.

Resolution enhancement. 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. (More details.)

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

Scope device. The oscilloscope that you plug into the USB or parallel port of your computer. With the help of the OMEGASCOPE™ software, the scope device turns your computer into a PC Oscilloscope.

Standard deviation. A statistical measure of the spread of a set of samples. The standard deviation of the set $y_1 \cdots y_n$ is defined as:

$$SD = \sqrt{\frac{1}{n-1} \sum_{i=1}^{n} (y_i - \bar{y})^2},$$

where $\bar{y}$ is the arithmetic mean of all the samples. The units of the standard deviation value are the same as those of the original samples.

Tool tip. A label that appears when you move the mouse pointer over some parts of the OMEGASCOPE™ screen, such as buttons, controls and rulers.

Trigger. The part of an oscilloscope that monitors an incoming signal and decides when to begin a capture. Depending on the trigger condition that you set, the scope may trigger when the signal crosses a threshold, or may wait until a more complex condition is satisfied.

Vertical resolution. The number of bits that the scope device uses to represent the signal level. This number is fixed by the design of the device, but a greater effective number can be obtained in some cases by using resolution enhancement.

View. A presentation of data from a scope device. A view may be a scope view, an XY view or a spectrum view.

Viewport. The views in the OMEGASCOPE™ window are arranged in a grid and each rectangular area in the grid is called a viewport.
10 Application Error dialog

If there is a problem with OMEGASCOPE™ and the program needs to close, the Application Error dialog appears:

It would be very helpful to us if you could send us a report of the problem. All you need to do is click the Send Report button, then save the .zip file in a place where you can easily find it again, such as on your desktop. Then, email the .zip file to us at das@omega.com, and we will do the rest. Don't worry if you can't think of a comment to enter in the text box: just leave it empty and send the report to us anyway.
Index

% 83
%buffer% variable 83
%file% variable 83
%time% variable 83
.bmp files, saving 33
csv files, saving 33
gif files, saving 33
.mask files 85
.png files, saving 33
.psd files
converting 102, 171
saving 33
.psmaths files 63, 67, 70
.preference files 73
.psettings files, saving 33
txt files, saving 33

A
AC coupling 173
AC power 91
Accelerometer inputs 106
Add Measurement dialog 44
Adding a measurement 44
Address of company 3
Advanced measurement settings 45
Advanced triggering 127, 129
types 130
Alarms 29, 83
Save on trigger 153
Analog intensity 116
Analog offset 107
Animated GIF 33
Arbitrary waveform generator 119
ing editing window 122
files 121
importing from channel 124
Average (statistics) 18
AWG 173
Axis 13, 14, 16, 173
auto-arrange 40
horizontal 13, 14, 16
offset 140
scaling 140
scaling controls 109
vertical 13, 14, 16
B
Bandwidth limiter 107
Battery power 91
Beep 83
Binary files, exporting 36
Bit Definitions dialog 80
Bit stream 122
Buffer Navigation toolbar 105
Buffer Navigator 30
C
CAN Bus protocol 166
Capture count 18
Capture modes 10, 11
Capture rate preference 91
Capture Setup toolbar 112
Capture size preference 90
Channel 173
selecting in a view 40
Channel Options
button 106
menu 107
Channel settings
in Properties sheet 24
Channel Setup toolbar
standard 106
Channel warning symbol 25
Clipboard 38
Close file 32
Collection time units 90
Color preferences 97
Column auto-width 43
Command line syntax 171
Connect Device dialog 32, 101
Contact information 3
Converter, how to change 136
Converting data files 102, 171
Copy
as image 38
as text 38
Coupling control 106
Create New Custom Probe dialog 50
CSV files, exporting 35
Cursors (see Rulers) 21, 22, 23
Custom grid layout dialog 42
Custom Probe Manager 47
Custom Probe wizard 50
Create New Custom Probe dialog 50
Custom Probe wizard 50
  Edit Existing Custom Probe dialog 51
  Edit Range dialog 57
  Edit Range dialog (Advanced tab) 59
  Finished dialog 62
  Lookup-table Scaling dialog 54
  Manual Ranges Setup dialog 56
  Probe ID dialog 61
  Probe Output Units dialog 52
  Range Management dialog 55
  Scaling Method dialog 53

Custom probes 24
dialog 48
  saving 32

D

Data files
  converting 102
DC coupling 173
Dead time 173
Decoding tab 27
Default Print Settings 96
Demo device 125
Demo mode 125, 173
Demo Signals
dialog 125
toolbar 125
Digital color 116
Dropout trigger 130

E

Edge trigger 130
Edit Existing Custom Probe dialog 51
Edit menu 38
Edit Range dialog 57
Edit Range dialog (Advanced tab) 59
Edit Reference Waveform dialog 74
Effective resolution 19
Email addresses 3
Equation dialog 67
Equivalent-time sampling 127
ETS 127, 173
  and Advanced Triggering 129
Exit 32
Exporting data 35
  binary format 36
  text format 35

F

Fall time
  threshold 45
Falling edge button 127
Fax number 3
File conversion 102
File menu 32
Filter Method dialog 60
Filtering 107
  channels 110
  measurements 18
  statistics 45
Focus 173
Frequency counter 106
Frequency difference, measuring 138
Frequency legend 22, 23
Frequency rulers 22
Functions, mathematical 67

G

General preferences 90
Generate mask 85
Generate Mask dialog 87
Glitches, finding 130
Glossary 173
Graticule 13, 14, 16, 173
Grid 173
  layout 40, 42

H

Hand tool 133
Harmonic control for measurements 45
Help menu 100
Horizontal axis 13, 14, 16
House current 91
Hysteresis 132

I

I²C Bus protocol 168
I²C settings 82
I²C Settings dialog 82
Image, saving as 33
Import from a Channel dialog 124
Input impedance 106
Interpolation
  linear 92
  sin(x)/x 92
Interval trigger 129, 130
Introduction 3
Invert button 25
K
Keyboard shortcuts 94, 133

L
Language preferences 95
Line thicknesses 97
Lissajous figures 14
Logic trigger 130
Lookup-Table Scaling dialog 54
Lowpass filtering 60, 107, 110

M
Macro Recorder 88
Mains power 91
Manual Ranges Setup dialog 56
Marquee Zoom tool 133
Mask Limit Testing 28, 47
How To 150
Masks
  colors 28, 97
  displaying 40
  editing 86
  export 85
  generate 85
  import 85
  in Buffer Navigator 30
  library dialog 85
  menu 85
  polygons 86
  selection dialog 28
Math channels 47
  button 106
  saving 32
Maths Channel Wizard
  Equation dialog 67
  Finished dialog 72
  Introduction dialog 66
  Name and Color dialog 70
  overview 65
  Units and Range dialog 71
Maths channels 63
  Built In 63
  dialog 63
  Library 63
  Loaded 63
  overview 25
Matlab 4 files
  exporting 36, 73
Max (statistics) 18
Maximum Waveforms preference 90
Measurement statistics
  capture size 90
Measurement system
  selecting 95
Measurements
  adding 18, 43, 44
  advanced settings 45
  deleting 18, 43
  editing 18, 43
  filtering 18
  font size 43
  list of types 157
  menu 43
  scope 158
  spectrum 159
  statistics 18
  table 18
  toolbar 118
Menus 31
Metric measurements 95
Min (statistics) 18
Missing events, finding 130

N
Normal Selection tool 133
Notes area 38, 39

O
Offset 140
  analog 107
OMEGASCOPE™ 1, 2, 9
  how to use 3, 6, 7
  main window 12
Open file 32
Oscilloscope 7
Overrange indicator 13, 106

P
Page Down key 32
Page Up key 32
Panning 134
PC Oscilloscope 8
Persistence mode
  button 112
  enabling and disabling 99
  options 116
Pointer tool tip 20
Polygon 86
Post-trigger delay 163
Post-trigger delay 163
    arrow 15
    control 127, 163
Power Management preferences 91
   Preferences 47
       capture rate 91
       colours 97
       Default Print Settings 96
       device selection 99
       dialog 89
       general 90
       keyboard 94
       language 95
       persistence modes 99
       power management 91
       sampling 92
       spectrum modes 99
Pre-trigger delay 163
    control 127, 163
Printing 32
    from command line 171
    from menu 32
    preferences 96
    preview 32
Probe 173
    custom 24
Probe ID dialog 61
Probe Output Units dialog 52
Progress bar 114
Progressive mode 173
Properties sheet 24
    displaying 40
Pulse width trigger 129, 130

R
   Range control 106
   Range Management dialog 55
   Rapid trigger mode 127
   Reference manual 100
   Reference waveforms 47
       adding 40
       delay 109
       dialog 73
       Library 73
       Loaded 73
       overview 26
       using in equations 67
Reset 'Don't show this again' dialogs 90
Resolution enhancement 19, 107, 173
Revolutions per minute 23
   Rise time threshold 45
   Rising edge button 127
   RPM 23, 99
RS232
    protocol 169
    settings 80
Rulers 13, 14, 16
    definition 173
    deleting 21, 22
    handles 13, 14, 16
    legend 23
    lock button 23
    time 13, 16
    voltage 13, 14, 16
   Runt pulse trigger 130

S
   Sampling preferences 92
   Sampling rate 112
   Save As 32
       dialog 33
   Save file 32
   Save on trigger 83, 153
   Scaling 9, 140
       button 109
   Scaling Method dialog 53
   Scope device 173
   Scope measurements
       AC volts 158
       Cycle time 158
       DC volts 158
       Duty cycle 158
       Fall time 158
       Falling rate 158
       Frequency 158
       High pulse width 158
       Low pulse width 158
       Maximum 158
       Minimum 158
       Peak to peak 158
       Rise time 158
       Rising rate 158
   Scope mode 10
       button 112
   Scope view 11, 13
   Scrolling 140
   Selection tool, normal 133
   Serial decoding 27, 47
       data window 78
       dialog 75
       protocols 165
Serial number
   of oscilloscope 100
Settings
   saving 32
Settings dialog 81
Signal difference, how to measure 137
Signal generator
   button 119
   dialog 119
   Waveform types 161
Signal rulers 13, 14, 16, 21
Slow sampling transition 92
Smoothing 92
Software version 1
Sound file 83
Space bar 126
Spectrum measurements
   Amplitude at peak 159
   Frequency at peak 159
   Intermodulation Distortion (IMD) 159
   Signal to Noise Ratio (SNR) 159
   Spurious-free Dynamic Range (SFDR) 159
   Total Harmonic Distortion (THD) 159
   Total Harmonic Distortion plus Noise (THD+N) 159
   Total power 159
Spectrum mode 10
   button 112
   enabling and disabling 99
Spectrum options
   bins 114
   dialog 114
   display mode 114
   scale 114
Spectrum view 11, 16
   how to set up 145
SPI Bus protocol 170
SPI settings 81
Spreadsheet, exporting to 33
Spurious edges, finding 130
Standard deviation 18, 173
Start/Stop toolbar 126
Startup Settings menu 38
Statistics 18
   filtering 45
Symbols
   red warning 13
   yellow warning 25
System requirements 5

T
   Telephone number 3
   Text files, exporting 33, 35
   Threshold for measurements 45
   Time difference, how to measure 138
   Time gate 24
   Time rulers 13, 16, 22
   Timebase controls 112
   Tool tip 173
   Toolbars 104
   Tools menu 47
   Trace 7
   Tracking rulers 23
   Trademarks 3
   Trigger 127, 163, 173
      advanced 127, 129
      dropout 130
      dual-edge 129
      edge 130
      glitches 130
      interval 129, 130
      logic 130
      marker 15
      missing events 130
      mode control 127
      pulse width 129, 130
      reference point 163
      runt pulse 130
      timing 163
      toolbar 127
      window 130

U
   U.S. measurements 95
   UART protocol 169
       settings 80
   Undo zoom 133

V
   Valid edges, finding 130
   Version 1
   Version number
       hardware 100
       software 100
   Vertical axis 13, 14, 16
   Vertical resolution 173
   View 173
       how to move 139
View 173
  menu 40
  scope 13
  selecting channels 40
  spectrum 16
  XY 14
Viewport 173

W
  Warning symbol 106
    red 13
    yellow 25
  Waveform 7, 13
    saving 32
  Waveform buffers
    number of 90
  Window functions 114, 162
  Window trigger 130

X
  X axis, configuring 40
  X-Axis command 14
  XY view 14

Z
  Zooming 140
    undo 133
    Zoom overview 134
    Zooming and Scrolling toolbar 133
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- Cartridge & Strip Heaters
- Immersion & Band Heaters
- Flexible Heaters
- Laboratory Heaters

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- Refractometers
- Pumps & Tubing
- Air, Soil & Water Monitors
- Industrial Water & Wastewater Treatment
- pH, Conductivity & Dissolved Oxygen Instruments