

PicoScope[®] 6 Training Program



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1 Quick guide to PicoScope 6

1.1 The PicoScope way

PicoScope 6 is designed to use as much of the screen as possible to display your signal, while still having the most commonly used functions available at the click of a button.

Traditionally the best way to control a bench-top oscilloscope was with knobs and dials. Since Pico Technology creates PC-based oscilloscopes, there are no hardware controls on the device itself. Everything is controlled by the software instead. Since moving to a PC environment, where the mouse, keyboard and touchscreen are the means of control and capture, the interface has undergone an evolutionary change.

The PicoScope 6 window has three main components:

- Menu bar
- Toolbars
- Signal view



In this chapter the most commonly used features of the **Menu** bar and toolbars will be explored, to get you up and running as quickly as possible.



1.2 Signal view

The first thing that is visible is the signal view, which is split into a fixed 10 by 10 grid. The 10 vertical divisions represent the voltage range, while the horizontal represent time. The grid is fixed but the voltage and time can be varied.



1.3 Timebase

The timebase can be varied and is set by default to seconds per division. The value goes up in multiples of 1, 2 and 5, for example 1 s/div, 2 s/div, 5 s/div. The minimum timebase varies from product to product depending on the sampling rate of the device, while the maximum timebase for all products is 5000 s/div.

There are lots of timebases, as shown below, which can be accessed by scrolling up and down.





1.4 Voltage range

The voltage ranges are selectable in increments of 1, 2 and 5, e.g. $\pm 100 \text{ mV}$, $\pm 200 \text{ mV}$, $\pm 500 \text{ mV}$, $\pm 1 \text{ V}$ While the timebase by default is defined as time per division, the voltage range is the full voltage range across all 10 divisions, so a $\pm 20 \text{ V}$ range is split into 10 divisions, each 4 V.

In each of these ranges the device maintains its full resolution, so a 12 bit device will use 12 bits in each of those ranges. Choosing the most appropriate voltage range will get the best detail out of a signal. If you use too large a range and zoom in, you will lose detail.



1.5 Coupling

Coupling sets up the input circuitry of the oscilloscope.

<u>F</u> ile	<u>E</u> dit	<u>V</u> iews	<u>M</u> easurements
^ 🦻	6	500 µs/di	v 🗸 🖌 x 1 🛛 [
A _s ±2	V	✓ DC	B Off
2.0 ₁		AC	
V		DC Erea	uency
1.6			

There are four kinds of coupling:

AC	Rejects frequencies below 1 Hz. Useful for removing DC offset from an AC signal.
DC	Accepts all frequencies from DC to the scope's maximum bandwidth.
50 Ω DC	Low-impedance option, available only on PicoScope 6000 Series oscilloscopes.
Frequency	Enables built-in hardware frequency counter. Only available on some PicoScope 4000 Series oscilloscopes.



1.6 Channel selection

Multiple channels can be selected. Each one is identified with a different colour and matching axis. For example, on a four-channel scope, the colours are as follows:

Blue	Channel A
Red	Channel B
Green	Channel C
Yellow	Channel D



1.7 Start and stop capture

The red and green buttons in the bottom left-hand corner start and stop the acquisition of data. The space bar on the keyboard can be used as a shortcut to this function. The blue highlight on either the red or the green button indicates whether the scope is capturing. In the image below the green button highlighted as the scope is capturing.





1.8 Triggering

The scope trace is displayed moving from left to right. Without a trigger the signal in question may be missed or signals would not appear to be stable on the screen.

A trigger is a threshold voltage level that, when a signal passes through it, signals the oscilloscope to capture or lock onto the waveform. The image below shows the trigger diamond.



1.8.1 Triggering toolbar

There are five key adjustments to a trigger.

- 1. Trigger Mode
- 2. Trigger Source
- 3. Rising/Falling
- 4. Trigger Threshold
- 5. Pre-Trigger

These can be adjusted using the **Trigger** toolbar:





1.8.1.1 Trigger mode The main modes are

- None No trigger condition is set and PicoScope acquires waveforms repeatedly without waiting for a signal to trigger on.
- Auto PicoScope waits for a trigger event before capturing the data. If, however, no trigger event occurs within a reasonable time, it captures the data anyway and it will keep on doing so until the capture is manually stopped.
- Repeat PicoScope waits for a trigger event before capturing the data and will keep on doing so until the capture is manually stopped.
- Single PicoScope waits for a trigger event before capturing the data and then once it acquires the waveform it stops capturing.

1.8.1.2 Trigger source

This option defines where the trigger will come from, and will vary across models. One thing that is common across all products is that their input data channels can be used as triggers. Other devices also have dedicated trigger inputs.



1.8.1.3 Rising/Falling

This is the direction to trigger on, so for example a 1 V trigger on a rising edge would only trigger if the signal goes from below 1 V to above 1 V.

Falling Edge Trigger: Signal moves from above to below the

trigger diamond



1.8.1.4 Trigger threshold

This is the voltage at which the scope triggers.





1.8.1.5 Pre trigger

This is a very useful trigger adjustment as it allows you to see what happened before the trigger diamond. The images below show an injector voltage on a 500 μ s/div timebase giving 5 ms across the screen. The first image shows a 22% pre-trigger with 1.1 ms of data before the trigger event. However, looking at the signal you cannot see what happened before this. The second image shows a 50% pre-trigger showing 2.5 ms before the trigger event, which fully shows what the signal does.



These trigger controls can be accessed by either dragging the diamond with the mouse, typing the values in the **Trigger** toolbar, or adjusting them using the **Spin** buttons.

Trigger	Auto	A 🏂 🖂	🖂 🗶 1.99 V	50 %	🕀 🏷 🕞	×.
---------	------	-------	------------	------	-------	----

1.9 Saving data

Waveforms can be saved from the **File** menu. A number of formats are available. The psdata format is the PicoScope data format, which saves an exact copy of the waveform.

			• •		S	ave	As			×
			Save in:	Nobel Prize Ap	plication	·	← 🗈 💣 📰 ◄			
			9	Name	^		Date modified	Туре	Size	
			Recent places		N	o ite	ms match your search.			
<u>F</u> ile	<u>E</u> dit <u>V</u> iews <u>M</u> easurements	Tools	Desktop							
	Co <u>n</u> nect Device	100	Libraries							
2	<u>O</u> pen	f								
	Save All Waveforms		CLARKE							
6	Save <u>A</u> ll Waveforms As									
2	Save Current Waveform As		Network							
	Save Current Waveronn As									
	Startup Settings				20140930-0001.psdata				1	Save
	Print Preview				Data files (*.psdata) Data files (*.psdata)				-	Cancel
			Options		Settings files (*.pssettings) CSV (Comma delimited) files (*.cs	sv)				
	Print			orms (count: 100)	Text (Tab delimited) files (*.bxt) Bitmap images (*.bmp) GIE images (*.cif)					
	Recent <u>F</u> iles			n numbers Eq. 2.5	Animated GIF image (*.gif)					
	Exit			e file of approximate	PNG images (*.png) MATLAB 4 files (*.mat) JPG Images (*.jpg)					
_		1			PDF (*.pdf)					

The psdata format also saves the settings, such as voltage range, timebase, triggering and so on. The pssettings format just saves the settings and not the waveform, which is useful as the file sizes can be much smaller and multiple settings files can be saved for different tests.

A **key benefit** of PicoScope 6 is that the software is licence-free and can be downloaded by anyone with or without a Pico oscilloscope. Thus, saved waveforms can be viewed by anyone in the same detail they were captured in.



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🔊 ЛГ П	ц 👍 🤌 🚮 🛛	5 ms/div 🔽 🗴	1 🗘 1	мз 🕀 📢	32 of 32 🚺 🖉) 📘 🖑 🔍 🔍 🤇	2 5 0
A _s Auto	DC	M B _M	DC DC	C Off		✓ D ₁ Off	C C M
■ 50.0 mV		Horizo	ontal Nu	l Imber of	l Buffer	Zoo	oming and
40.0		Z00	m Sa	amples	navigatio toolbar		ling toolbar
30.0					tooibai		
20.0			-				
							i de la companya de l

1.10 Number of samples

This defines the maximum number of samples across the screen: the more samples, the more detailed the signal and the larger the file. The actual number of samples is not always exactly that, but it will not be greater.

1.11 Buffer navigation toolbar

Each screen capture is called a buffer in PicoScope 6. More than one buffer can be stored in PicoScope 6 and the **Buffer Navigation** toolbar keeps a count of how many have been captured. The maximum number of buffers is 10 000.



If an interesting waveform appears and then disappears too quickly for you to study it, PicoScope gives you a second chance. You can review past waveforms either by clicking on the double arrows to move backwards and forwards or by opening the **Buffer Overview**, which gives a thumbnail view.



2 Zooming and scrolling

There are a number of ways to zoom into a signal and to scroll through the zoomed waveform. The zoom and scroll facilities are located in the **Zooming and Scrolling** toolbar, and the horizontal zoom is in the **Capture Setup** toolbar.



2.1 Zoom overview and scrolling

When the waveform is zoomed in, the **Zoom Overview** window becomes visible showing the area that has been zoomed in.



This can be adjusted, resized and moved by dragging the corners or moving the box.





Another way to move around a zoomed-in waveform is by using the hand tool $\overset{\clubsuit}{1}$, which is operated outside the zoom overview.



This works by dragging the graph around in the main view.





2.2 🤷 Window zoom

This allows you to specify an area of interest by drawing a box to be zoomed.



2.3 Coom in and out

Allows you to zoom in or out around the selected point.



2.4 👘 Horizontal zoom

This allows you to zoom in the horizontal direction by several million times, subject to the capabilities of the device.

The figure below shows a waveform from a PicoScope 6404 zoomed in 100 000 times horizontally.



2.5 🛛 2.5 Undo zoom and 🔍 zoom to full view

The **Undo** button ¹² to undo any zoom action is located next to the **Zooming and Scrolling** toolbar.

The **Zoom To Full View** button to view the full signal can also be selected from the **Zooming and Scrolling** toolbar.



3 Measurements

Measurements can be made in two ways, by using either rulers or automatic measurements.

3.1 Using rulers

The image below shows the voltage ruler handles and the time ruler handles. The voltage rulers use the same colour as the channel they are associated with, while the time ruler is white.



Ruler handle for time

Phase ruler handle



3.1.1 Voltage and time rulers

There are two rulers for time (or frequency in *Spectrum* mode), two phase rulers, and two rulers per channel for voltage. The rulers can be used by moving the mouse over the ruler handles and dragging. Time and frequency rulers can be moved left or right, and amplitude rulers can be moved up and down.



As soon as the first ruler is dragged, the ruler legend box appears showing the position of the first ruler. Once the second ruler is dragged, the time is added and the difference (delta or Δ) is displayed. For time there is a $1/\Delta$ in the bottom right-hand corner giving the frequency and also an RPM figure.

The more rulers that are added, the more the ruler legend box gets populated. The image below shows an example of a ruler legend box with two time rulers and four voltage rulers across two channels.



The **Lock** button fixes the pair of rulers so that when one ruler is moved its paired ruler moves with it with constant spacing.



In the example above the ruler legend box shows negative numbers. This is because the trigger point is set at 50% pre-trigger and both rulers are positioned to the left of this point.

The rulers are also available in Spectrum mode.





3.1.2 Phase rulers

In the example below, we have dragged the phase ruler handles (in the bottom right corner of the scope view) to the start and end positions on a cyclical waveform. By default, PicoScope labels the two rulers as 0° and 360°, but you can change these values by double-clicking and editing them.



The **Rulers** button opens the **Ruler Settings** dialog, as shown below. We have set **Phase Partition** number to 4, causing PicoScope to draw three additional rulers dividing the waveform into four phases. This feature is useful for identifying features in waveforms from rotating machinery and power semiconductors.





When phase rulers are displayed, try dragging the time rulers onto the display. An additional row appears in the **Ruler Legend** to show the phase, as well as the time, of the time rulers:

	2	Δ	- ×
138.7 µs	389.8 µs	251.2 µs	6
50.18°	140.6°	90.41°	6

Time ruler positions shown as phases

3.2 Automatic measurements

The automatic measurements can be added from three different areas; from the **Menu** bar, by right-clicking on the screen, or from the **Measurements** toolbar at the bottom:





Select **Measurements** from the **Menu** bar, and the **Add Measurements** window will appear. This works similarly in *Scope* and *Spectrum* views:



Click on the first pull-down menu to select the channel from which the measurements are to be taken:

Select the channel	to measure	ОК
A		
A		Cancel
B		
AC RMS	l	Help
Choose which sect	tion of the graph will be measured	
Whole trace	[Advanced

Spectrum mode has a similar window:

Add Measurement		×
Select the channel to measure A Select the type of measurement	~	OK Cancel
Frequency at Peak	\checkmark	Help
Choose which section of the graph will be measured		
At Peak	~	Advanced



You can then choose the type of measurement. Those below are specific to Scope mode:



Spectrum mode has its own set of measurements:



Next, select the section of the graph from which the measurements will be taken. In *Scope* mode it can be across the whole trace, between two rulers, or the cycle around each of the rulers:

-	Add Measurement	
	Select the channel to measure A	OK Cancel
	Select the type of measurement AC RMS Choose which section of the graph will be measured	Help
	Whole trace State	Advanced
	Cycle at ruler 2	/



In *Spectrum* mode the section of the graph can differ depending on the signal being measured:



or:

Select the channel to mea A	sure	\checkmark	OK
Select the type of measure	ement		Cancel
Signal to Noise Ratio (SNI	R)	\checkmark	Help
Choose which section of t	the graph will be measured		
Whole trace Whole trace			Advance



The measurements appear at the bottom of the screen. The statistics are taken from the previous 20 captures by default. This number can be adjusted in **Preferences**. Please refer to that section for more information.





Or in *Spectrum* mode:





To adjust the font size, go into the Measurements menu and select Grid Font Size:





4 Channel options

There is a **Channel Options** button for every channel; $A_{\infty} = B_{\infty} = C_{\infty} = D_{\infty}$. This includes options for accessing probes, resolution enhancement, scaling, filtering and offset adjustment.

Here are the channel options for channel A on a 3000 Series oscilloscope:

<u>File Edit Views M</u> easurements	<u>T</u> ools <u>H</u> elp						
🔼 山山 🔤 🦻 🟠 🛛 500 µs/div 🖂	x 1 🔶] 1 MS 🗧	3 📢 10	0 of 100 📡 🧭	🔥 🖑 🔍	🔍 🔍 🤄 🔍	pico
Ay Auto 🗸 DC 🖌 By Off	🖌 DC 🗸	C Off	✓ DC	D 🖌 Off	V DC		Technology
Probe x1 🗸 🖓 \cdots				1		1	
Resolution Enhancement							
Select the maximum anumber of bits.							
When should I use this feature?						_	
Lowpass Filtering							
1.954 kHz							
Activate Filtering							
Analog Options							
DC Offset 0 V							
20 MHz Bandwidth Limit							
Axis Scaling							
Scale 1.00							
Offset 0.00 % 💭 🕤							
Zero Offset							
Zero	-1.0	-0.5	0.0	0.5	1.0	1.5	2.0 2.5
Running 🙆 🕒 Trigger Auto 🖂	A	v 🗶 🗴	0V (÷ 50 % ÷	№ 0 s	Measurem	ients 🛨 🗖 🗖

Here is the reduced set of channel options for the PicoScope 2000 Series oscilloscope:

Probe	x1			~			
Resolu	Resolution Enhancement						
	Select the maximum number of bits.			; ~			
When should I use this				feature?			
Axis So	caling			43			
		Scale	1.00	\$ t			
		Offset	0.00 %	\$ +			

The options vary from product to product, but all devices allow you to change the probes, resolution and axis scaling.



4.1 Probes

The **Probes** menu allows you to use a number of built-in probes and any custom probes.

Probe x1 Resolu Select numbe Axis Sc Axis Sc				
Offset 0.00 % 💭 🕤				
Analog Options				
Offset 0 V 🕀 🕤				
25 MHz Bandwidth Limit				
Lowpass Filtering				
1 kHz				

4.2 Resolution enhancement

This is a technique for increasing the effective vertical resolution of the scope at the expense of high-frequency detail. Selecting a 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 random noise, but for many practical applications this is generally taken care of by the scope itself and the noise inherent in normal signals.

Probe x1	~ …					
Resolution Enhancement						
Select the maximum number of bits.	8.0 bits					
When should I	9.5 bits					
Axis Scaling Scale	10.0 bits 10.5 bits 11.0 bits					
Offset	11.5 bits 12.0 bits					
Analog Options						
Offset 0	/ \$ +					
25 MH:	z Bandwidth Limit					
Lowpass Filtering	Lowpass Filtering					
	Hz					



The images below show detail of a sine wave before and after resolution enhancement to 12.0 bits:



4.3 Axis scaling

This allows you to scale and offset each vertical axis individually. It is particularly useful when multiple waveforms are on the screen. Scaling is done in software.





4.4 Low pass filtering

This feature can reject high frequencies from any selected input channel, and is done in software. This option is available on most devices, but not on the 2000 Series or any data loggers.

The image below shows a square wave before any kind of filtering.





The image below shows a 1 kHz filter on the signal. This rejects the higher frequency components and so in this example the sharp rising edges of the square have been filtered.



4.5 Analog options

These are hardware features that are only available on certain products.

The analog offset is a hardware DC offset that can be adjusted on some scopes. On the PicoScope 6404, it can go up to ± 35 V depending on the voltage range.

The bandwidth limiter is a hardware filter whose cut-off frequency depends on the scope series.

Analog Options					
Offset	0 V	÷ +			
25 MHz Bandwidth Limit					



5 File menu

The **File** menu can be accessed from the **Menu** bar. It allows you to open and view saved and recent files, change start-up settings and print.

<u>F</u> ile	<u>E</u> dit <u>V</u> iews	<u>M</u> easuremen
2	<u>O</u> pen	i00 µs/dii
	<u>S</u> ave	В 🖌 О
2	Save As	
	Startup Settings	•
	Print Preview	
	<u>P</u> rint	
	Recent <u>F</u> iles	•
	E <u>x</u> it	
_		

5.1 Save

This saves all the waveforms in the buffer with the existing file name. If, for example, a data file was loaded, the **Save** command will save any updated data and overwrite the same file.

5.2 Save As

This allows you to save the waveform with a different name. It also allows you to save the data in a number of formats:

₽ ₩			Sav	e As			×
Save in:	📔 Waveforms		•	+ 🗈 💣 📰 -			
(Ha)	Name	*		Date modified	Туре	Size	
Recent places		Dus.psdata		26/09/2014 10:37 26/09/2014 12:14 14/01/2008 14:28 14/01/2008 14:27 14/01/2008 14:29	PicoScope data file PicoScope data file PicoScope data file PicoScope data file PicoScope data file	57,771 KB 136,207 KB 12,385 KB 12,385 KB 12,385 KB	
	File name:	20140929-0001.psdata				▼ Sa	ve
	Save as type:	Data files (*.psdata)				 ▼ Can	cel
C Current wa C Waveform	orms (count: 100) aveform only (numl numbers E.g., 2, 5 a file of approximat	ber: 100) 5-10	Γ	Only save zoomed reg			

There is an option to save only the current waveform in the buffer. If, for example, there were 32 buffers and the current view is on buffer 12, saving will save buffer 12 out of 32. You can also save a specified set of waveforms from the buffer.



The following table shows the file formats that can be saved or opened in PicoScope 6:

Format	Description
psdata	PicoScope 6 format contains full waveform data and settings
psd PicoScope 5 format contains full waveform data and settings	
	opened but not saved)
pssettings	PicoScope 6 format contains settings
pss	PicoScope 5 format contains settings (this can be opened but not saved)
CSV	Stores up to 1 million samples
txt	Stores up to 1 million samples
bmp	Image format
png	Image format
gif	Image format
Animated	Image format over a number of buffers, showing an animation of all the
gif	buffers in a continuous loop (only available when saving all buffers)
MATLAB	MATLAB 4 .mat binary format: an open source format with no limitation on
	the number of samples.

5.3 Startup Settings

The startup settings can be changed from the **File** menu.

<u>F</u> ile	Edit <u>V</u> iews <u>M</u> easurements	<u>T</u> ools <u>H</u> elp			
2	<u>O</u> pen) x 1 🔷 9 kS 🐳 🗸			
	Save All Waveforms	uto 🗸 DC 🗸 📈			
6	Save <u>All</u> Waveforms As				
2	Save Current Waveform As				
	Startup Settings	Save Startup Settings			
	Print Pre <u>v</u> iew	Load Startup Settings			
	Print	Reset Startup Settings			
	Recent <u>Fi</u> les				
	E <u>x</u> it				
0.4					

This does two things; it saves the current settings as the default startup setting but also assigns them to the **Home** button and the **Load Startup Setting** option. **Reset Start-up Settings** loads the factory default settings.


5.4 Print and Print Preview

The **Print** and **Print Preview** options can also be accessed from the **File** menu.





5.5 Recent files

This shows a list of the most recently viewed waveforms, which appear as thumbnails for quick and easy viewing.





6 Edit menu

The Edit menu is located on the Menu bar:

Eile Edit	<u>Views</u> <u>M</u> easurements <u>T</u> ools	Help			
мл Ч	Copy as <u>I</u> mage	🗘 16 kS 🕀 📢 32 of 32 🕅			
A AL	Copy as <u>T</u> ext				
2.0	Copy Entire <u>W</u> indow as Image	1 2 Δ - ×			
V	Notes	-2.0 ms -1.003 ms 997.0 μs Ε			
1.6		1			
1.2					
	<u>+</u>	i			
0.8					
0.4					



6.1 Copy as image

This allows you to copy only the signal view, excluding measurements and the ruler legend box, to the Windows clipboard:



6.2 Copy as text

This copies the raw data in text format to the clipboard. It can copy up to 1 million samples per channel, which can then be pasted into an Excel file.

	А	В
1	Time	Channel A
2	(ms)	(V)
3		
4	-2.50087	0.990936
5	-2.50055	0.97293
6	-2.50023	0.648274
7	-2.49991	0.143254
8	-2.49959	-0.32557
9	-2.49927	-0.65023
10	-2.49895	-0.81252
11	-2.49863	-0.90274
12	-2.49831	-0.93881



6.3 Copy Entire Window as Image

This copies the entire PicoScope 6 window to the clipboard:





6.4 Notes

This adds a **Notes** box at the bottom of the page. The notes are visible when printed and are preserved when the file is saved.

<u>Eile E</u> di	t <u>V</u> iews	<u>M</u> easurements	<u>T</u> ools <u>H</u>	elp						
🔊 🖵 тр	. Ц _Ш 🦻 -	🚮 🛛 500 μs/div	✓ x 1	16	ks 🕀 📢	32 of 32	🗌 🕪 🧭 📘	s 🖑 🔍 🔍 🤆	🔍 🔊 🔍	
A Auto	✓ DC	✓ B ₃	Off	DC DC	✓ M¥					
■ 2.0 V				1 -2.0 ms	2 s -1.003 ms	Δ – 3 997.0 μs	X			
1.6				-2.0 11		557.0 µs				
1.2										
					_		-	· · · · ·	_	
0.8										
0.4										
0.0										
0.0					Ť					
-0.4										
-0.8										
-1.2										
-1.6										
-2.0	-2.0		-1.0							
-2.5 x1.0 ms	-2.0	-1.5	-1.0	-0.5	0.0	0.5	1.0		2.0 1/A 1.003 kHz , 60	2.5 181 RPM
Channel	Name	Span Va	alue Min	Max	Average	σ Ca	apture Count			
A	Frequenc	y Whole trace 1	kHz 999.9	9 Hz 1 kHz	1 kHz	338.2 mHz 20				
Notes										_ ×
Square Wav	e 1kHzwith m	neasurements			R.					÷
🙄 🥥 Tr	igger Auto		A 🗸) 🗶 🗶 🛛	V 🕀 !	50 % 🕀)	🏷 🛛 s 🗧	-		



7 Views menu

The **Views** menu primarily allows you to split the PicoScope 6 screen into multiple viewports. Each viewport can have a *Scope*, *Spectrum* or *XY* view. The trace that appears in each viewport is called a view.



Multiple views can be placed in one viewport. The example below shows 1 viewport and three views; Scope1, XY 1 and Spectrum 1. These appear as separate tabs.



The **Views** menu additionally allows you to automatically arrange waveforms, hide/unhide waveforms and look at the **Properties** window.

The **Views** menu is accessible in *Scope*, *Spectrum* and *Persistence* modes.



7.1 Accessing views menu

Access the Views menu either via the Menu bar or by right-clicking in the signal view.



At first, the **Views** menu does not appear to have all the options available, but this is because no views have been added yet. Some features are greyed out when you access the **Views** menu from the **Menu** bar, and they are not shown at all if you right-click on the signal view.

Once a view is added, the **Views** menu in both methods shows and enables all the other options. The first image below shows the **Views** menu being accessed from the toolbar, while the image on the right is the result of right-clicking.



When right-clicking, two additional commands appear. One is to add a **Reference Waveform** (see section) and the other is to **Add Measurements** (see section).



7.2 Adding multiple views

To add multiple views, go to the **Views** menu, select **Add View**, and choose a type of view. The view modes available are *Scope*, *Spectrum* and *XY*.

<u>V</u> ie	ws <u>M</u> easurements	<u>T</u> ools	<u>H</u> elp
	<u>A</u> dd View		Score
-	Re <u>n</u> ame View		Spectrum
	<u>C</u> lose View		XY
	Channels	• [
	X-Axis	- •	
1	Grid <u>L</u> ayout	•	
	Arrange <u>G</u> rid Layout		
-	<u>R</u> eset View Sizes		
	Move View To		
	Arrange <u>V</u> iews		
1	Auto-arrange axes		
	R <u>e</u> set View Layout		
	View Properties	\	x

The image below shows 3 additional views being added, each of a different type.





7.3 Closing a view

To close a view, go to the appropriate view and select $\ensuremath{\textbf{Close View}}$ from the $\ensuremath{\textbf{Views}}$ menu.

Add View
Re <u>n</u> ame View
Close View
Channels +
X-Axis
Grid Layout
Arrange <u>G</u> rid Layout
Reset View Sizes
Move View To
Arrange <u>V</u> iews
Auto-arrange axes
Reset View Layout
View <u>P</u> roperties

When a view is closed the software automatically rearranges the viewports:





7.4 Arranging waveforms

You can arrange the waveforms in *Scope*, *Spectrum* and *Persistence* modes.

When multiple channels are enabled (or reference waveforms and math channels) it can be difficult to distinguish one waveform from another.



Each of the waveforms can be resized and moved up or down. While this is very flexible in certain situations, it can be time-consuming. An alternative is to use the **Auto-arrange axes** command:



To return the layout to default, select **Reset View Layout**.



7.5 Hiding channels

Channels can be hidden or unhidden from view. This is available in *Scope* and *Spectrum* modes.

First, left-click on the required viewport to select it. In the example below, the middle viewport is selected.



Next go the **Views** menu (either from the **Menu** bar or by right-clicking), select **Channels** and then click on a channel to disable it.







The tick box next to the channel disappears and the channel is hidden from view.

To re-enable the channel go back into the **Views** menu, select **Channels**, and click on the disabled channel.



8 Tools menu

8.1 Custom probes

PicoScope 6 allows you to adjust the scaling of your input signal using custom probes. There are a number of predefined probes. By default PicoScope 6 has probes set up for x10, x20, and x100. The automotive software has an additional set of predefined probes (please refer to the **Automotive** section for more information).

To access custom probes, click **Channel Options** And then click **Probe**:

Probe x1 Resolu Select numbe Axis S Axis S						
Offset 0.00 % 💭						
Analog Options						
Offset 0 V						
None None						
Lowpass Filtering						
1 kHz						

Here are the voltage ranges when a x100 probe has been selected:

E	ile <u>E</u> dit <u>V</u> i	ews	<u>M</u> easurements	<u>T</u> ools	Help
N	յու մա կեր	1	🚮 🛛 50 μs/div	✓ × 1	
	±20 V 🔽	DC	🗸 🖌	Off	$\overline{}$
2	Off				
	Auto				
	±5 V				
1	±10 V				
· ·	±20 V				
	±50 V				
-	±100 V				
· ·	±200 V				
	±500 V				
	±1 kV				
	±2 kV	11111			1111
I	4 በ፡	2			



You also have the flexibility to create your own custom probes with their own units of measurement. You can achieve this using the **Custom Probe** wizard. This can be accessed by selecting **Tools > Custom Probes** from the menu:

Eile	<u>E</u> dit	⊻iews	<u>M</u> easurements	Tool	ls <u>H</u> elp
л 🔊	ш	ц 🌮	🚮 50 μs/div	2	Custom Pro <u>b</u> es
A Aut	:0			Σ	Maths Channels
50.0 ₇				2	Reference Waveforms
mV				XX 0101	Serial Decoding
					<u>A</u> larms
				Æ	Mas <u>k</u> s ▶
40.0				T	Macro Recorder
				8	Preferences

Alternatively, you can click **Channel Options** and then the 🔤 button:

Eile	<u>E</u> dit	⊻iews	Measurements	<u>T</u> ools	Help
л 🔊	ш	ц 🌖 🤌	🚮 🛛 50 μs/div	✓ X 1	😌 🛛 16 kS 🕀
A 🖌 Aut	0	✓ DC	V B 👷	Off	DC V
Probe	×1		~	R	
Reso	lution E	Inhanceme	nt	Probes	;
	t the n ber of b	naximum bits.	8.0 bits 🔽	Create	, Select and Edit Probes
	Whe	n should I	use this feature?		
Axis	Scaling				
		Scale	1.00		
		Offset	0.00 % 😂 🕤		

The **Custom Probes** window appears with a list of built-in probes. You can create new probes from scratch, copy and edit existing probes, or import and export probes:

Custom Probes	×
Select a probe Select a probe Built-in Sult - 2 x1 Sult - 2 x10 WPS600 60 bar Range WPS600 600 bar Range WPS500X Range 1 WPS500X Range 2 WPS500X Range 3 Ubrary Loaded	New Probe Edit Delete Duplicate Import Export
Explain what Built-in, Library and Loaded probes are.	
0	Help



When you click **New Probe**, the **Custom Probe** wizard runs through the steps to create a custom probe. To give an example we will create a DC current clamp that takes 10 mV per amp and can measure a maximum current of 100 A.

•∿	Custom Probe Wizard	×
	Create a New Custom Probe	
	This wizard will guide you through the process of creating a new Custom Probe. <u>What is a Custom Probe?</u>	
	Don't show me this introduction page again.	
Help	< Back Next > Cance	

Click **Next** to move on to the next window, which allows you to either select standard units from the list or create your own. In this case, amperes can be chosen from the list as it is already defined:

👆 Custom Probe Wizard	×
Probe Output Units Define the units that the Custom Probe will display.	
Probes can display output in any units, which helps in the interpretation of results. These units will be displayed in various places, including on the graph. Cuse a standard unit from the list. Volts amperes hertz ohns seconds decibels degrees baud seconds/division bytes	
Help < Back Next > Cance	9



4	Custom Probe Wizard	×
	utput Units he units that the Custom Probe will display.	
These un	an display output in any units, which helps in the interpretation of results. its will be displayed in various places, including on the graph. I standard unit from the list.	
	s	
	e full name of the unit (e.g. volts) Provide a short name for the unit (e.g. V for volts)	
Help	< Back Next > Canc	el

The next step defines the scaling method. Either an equation, or a lookup table, or no scaling can be applied. No scaling is useful if just the units need changing or for limiting the view of a range e.g. showing only positive voltages. More information on this is available in the **Advanced** section.

and a second sec		Cu	stom Probe \	Vizard	I	×
Scaling Method A Custom Probe can apply scaling to the data before it is displayed.						
⊙ Use	a linear equation	n to scale t	he data (y = mx	+ c)		
y =	1.0	x +	0.0	an	nperes	
	Gradient (m)		Offset (c)			
O Use	a look-up table	(linearly in	terpolates betwe	en poin	its on the table).	
	Create a Looku	p Table	1			
O Doi	n't apply any scali	ng to the	data.			
Hel	p		< B	ack	Next >	Cancel

Both the linear equation and lookup table methods are covered in this section to highlight the differences.



8.1.1 Linear equation

The image below shows the equation y = mx + c, where m is the gradient and c is the offset.

The gradient is the multiplication factor and in this case is 100, since the probe is 10 mV per 1 A.

The offset is used to zero the effects of a DC offset on a signal. In this case it is 0.

• •	Custom Probe Wizard	×			
-	Scaling Method A Custom Probe can apply scaling to the data before it is displayed.				
-					
Help	< Back Next > Cance	21			

The next screen defines how the ranges will be managed. The **Recommended** option lets the software manage these ranges automatically. When **Enable auto-ranging on this probe** is selected, PicoScope continually monitors the input signal and adjusts the range when necessary to allow it to display the signal with maximum resolution. The **Advanced** option allows you to customise the ranges. This is covered in the **Advanced Custom Probes** section. In this example **Recommended** is selected.



👈 Custom Probe Wizard 🗙
Range Management Choose whether the ranges available on this probe will be managed automatically.
Each probe must have one or more ranges that refer to any of the input ranges on the scope (the same input range can be referred to more than once).
Recommended) Let the software manage my ranges for me automatically.
This will directly map as many Custom Probe Ranges to scope Input Ranges as possible. This method has the advantages of giving your Custom Probe the best chance of being compatible with other scope hardware and also allowing auto-ranging to work.
Enable auto-ranging on this probe. <u>What is auto-ranging?</u>
O (Advanced) I will manage the Custom Probe Ranges manually.
Use this option if you want to limit the number of ranges available to the user (maybe because the physical probe you are using has a very specific function), or if your ranges require specific fixed limits that may not map well to the scope's input ranges.
Help <a> Back Next > Cancel

The next screen shows the **Filter Method**, which allows you to enable filtering. This is a software feature that applies a low pass filter. Setting the filter frequency only allows frequencies up to this value to be viewed, while any higher frequency components are removed. This is useful for removing high frequency noise or interference on a signal.

👆 Custom Probe Wizard	×
Filter Method A Custom Probe can configure low-pass filtering.	
Filter the data before applying scaling. This will automatically set and enable low-pass filtering for this p	obe.
Filter Frequency 1 Hz 🛕 🔽 Enabled	
Help < Back I	ext > Cancel



The next screen is where you can define the name of the custom probe, with the option to also add extra information:

₽ <mark>v</mark>	Custom Probe Wizard	×
Custom Probe Iden Provide descriptive	tification details so your new probe can be identified later.	
	e probe ption for the probe, so it can be easily identified (optional). ccaling using equation y=100x	
Help	< Back Next > Cance	·

On the final screen in the **Custom Probe** wizard, click **Finish** to confirm your changes. Click **Cancel** to erase any changes made, or **Back** to make modifications:

•	Custom Probe Wizard	
	Finished	
Help	< Back Finish Cancel	1



The **Custom Probes** list now shows the newly created probe under the *Library* section:

Custom Probes	×
Select a probe Select a probe Built-in All All All Built-in All All All Built-in All All All Built-in All All All All All All All Al	X New Probe Edit Delete Duplicate Import Export
Explain what Built-in, Library and Loaded probes are.	K Help

The newly created probe can now be accessed from the **Channel Options** button under **Probe** on any channel. The probe will appear under *Library*:





Selecting this probe reveals a new set of ranges:

<u>Eile E</u> dit	⊻iews	Measurements	<u>T</u> ools I
🔊 🔟 🔟	la 🦻	🚮 🛛 50 μs/div	✓ × 1
A ±100 A	✓ DC	M B	Off
■ 00 Off Auto ±5 A			
80 ±10 A ±20 A			
±50 A 60 ±100 A ±200 A	-		
±500 A 40 ±1 kA ±2 kA			
	-		
20.0	1		

Lots of ranges appear and half of them will be of no use as the probe only goes up to 100 A. Also, the ranges that are useful show negative and positive values, but for a DC current clamp only the positive values are required.

8.1.2 Duplicating and editing a probe

The previous section covered the DC current clamp using the equation method. To highlight the differences we will create another probe. The first probe is duplicated and edited to use a lookup table instead of an equation. To do this, open the **Custom Probes** window, highlight the newly created probe, and then click **Duplicate**:

Custom Probes	×
Select a probe Built-in X1 X1 X10 X20 WPS600 60 bar Range WPS600 60 bar Range WPS500X Range 1 WPS500X Range 2 WPS500X Range 3 Library DC Current Clamp DC Current Clamp Courrent Clamp Courrent Clamp DC Current Clamp Courrent Clamp DC Current Clamp DC Current Clamp DC Current Clamp Courrent Clamp DC Current Clamp	New Probe Edit Delete Duplicate Import Export
ОК	Help



This creates an identical probe with a number (2) at the end of the name to indicate the copy number. To edit the copied probe, highlight it and click **Edit**:

•	Custom Probe Wizard
	Edit an Existing Custom Probe
	This wizard allows you to change any aspect of the Custom Probe. Press the 'Next' button until you find the information you wish to edit.
Help	< Back Next > Cancel

The **Custom Probe** wizard appears with the same options as a newly created probe. The only difference is that the settings for the copied probe will appear.

8.1.3 Look-up table

The image below shows the previously created linear equation.

₽ v		Custom Probe Wizard	×
	g Method om Probe can app	ly scaling to the data before it is displayed.	
Use	e a linear equatior	n to scale the data (y = mx + c)	
y =	100	x + 0.0 amperes	
	Gradient (m)	Offset (c)	
O Use	e a look-up table (linearly interpolates between points on the table).	
	Create a Lookuj	o Table	
C Do	n't apply any scali	ng to the data.	
Hel	p	< Back Next >	Cancel



Select Use a look-up table to enable the Create a Lookup Table... button:

A.	Custom Probe Wizard	×			
Scaling Method A Custom Probe can apply scaling to the data before it is displayed.					
y = ⓒ Use a	a linear equation to scale the data (y = mx + c) 100 x + 0.0 amperes Gradient (m) Offset (c) a look-up table (linearly interpolates between points on the table). Create a Lookup Table 't apply any scaling to the data.				
Help	< Back Next > Can	cel			

If you click **Next** without selecting **Create a look-up table**... you will be prompted to do so:

	Lookup Table Missing
?	No lookup table has been defined. Do you want to define one now?
	Yes No

Select **Yes** or **Create a Lookup Table** to open a blank table, allowing you to create a customised lookup table. Click **Import** to save the scaling file as a CSV or text file, or **Export** to export preconfigured CSV or text files:

Looki	up-table Scaling	×
	Scaled units amperes	OK Cancel Help
Im	port Export	



Alternatively the probe can be defined within the table provided. This can be populated with the raw input readings and then scaled readings as the table below shows. The first things that have to be selected are the units for the *Input* and *Scaled* readings. A range of input and scaled units is available:

	Lookup-table Scaling	×
Input units volts millivolts volts kilovolts	Scaled units	OK Cancel Help
	Import Export	

In the DC current clamp example, the maximum current to be measured is 100 A and at 10 mv/A this equates to 1 V maximum. Therefore the input units are in volts. The scaled units will remain in amperes.

At least 2 pairs are needed to produce a scaling file assuming the relationship is linear. If the relationship is not linear then multiple points are required. In this case it is a linear relationship and 2 points are chosen. The first set of values is 0 V = 0 A and the next will be 1 V = 100 A:

l	ookup-table Scaling	×
Input units volts 0 1 Start typing here	ookup-table Scaling Scaled units Compares Compar	Cancel Help
	Import Export)



Once the scaling is set, you can adjust the ranges in the **Range Management** screen. As before, the **Recommended** option is selected:

👈 Custom Probe Wizard					
Range Management Choose whether the ranges available on this probe will be managed automatically.					
Each probe must have one or more ranges that refer to any of the input ranges on the scope (the same input range can be referred to more than once).					
Recommended) Let the software manage my ranges for me automatically.					
This will directly map as many Custom Probe Ranges to scope Input Ranges as possible. This method has the advantages of giving your Custom Probe the best chance of being compatible with other scope hardware and also allowing auto-ranging to work.					
Enable auto-ranging on this probe.					
C (Advanced) I will manage the Custom Probe Ranges manually.					
Use this option if you want to limit the number of ranges available to the user (maybe because the physical probe you are using has a very specific function), or if your ranges require specific fixed limits that may not map well to the scope's input ranges.					
Help < Back Next > Cancel]				

Filtering can also be enabled:

Custom Probe Wizard	×
Filter Method A Custom Probe can configure low-pass filtering.	
Filter the data before applying scaling. This will automatically set and enable low-pass filtering for this probe.	
Filter Frequency 1 Hz 😴 🗹 Enabled	
Help < Back Next > Car	ncel



The name and description can now be edited:

👈 Custom Probe Wizard	×
Custom Probe Identification Provide descriptive details so your new probe can be identified later.	
Enter a name for the probe DC Current Clamp Look-Up Write a short description for the probe, so it can be easily identified (optional).	
2 point look-up table for DC current clamp 0 V = 0 A and 1 V = 100 A	
Help < Back Next > Can	cel

Once completed, the modifications made to the probe will appear in the library list:

Custom Probes	×
Select a probe Built-in X1 X10 X20 WP5600 60 bar Range WP5600 60 bar Range WP5500X Range 1 WP5500X Range 2 WP5500X Range 3 Library DC Current Clamp DC Current Clamp Loaded Explain what Built-in, Library and Loaded probes are.	New Probe Edit Delete Duplicate Import Export
0	K Help



Accessing the probe from the **Channel Options** button shows the newly added probe in the list:



Select the new probe. The list of ranges now has a maximum current of 100 A and only shows positive values:



8.1.4 Importing and exporting a probe

To save a probe, highlight the required probe and then click **Export**:

Custom Probes	×			
Custom Probes Select a probe Image: Select a probe	New Probe Edit Delete Duplicate Import Export			
ОК Неір				



The default location is under the **Probes** folder which is located in the **Waveforms** folder under **My Documents**, but the file can be saved anywhere. The file extension of the probe is *.psprobe*:

			Export Custom	Probe				×
€ ∋ - ↑]	« Documer	nts∍	→ Waveforms → Probes	~ ¢	Searc	h Probes		Q,
Organise 🔻 Ne	w folder						•== •	0
CLARKE Desktop Documents Downloads Music Pictures Videos Local Disk (C: Pif(\\filesrv2)		^	Name	No items match	n your se	Date mod	ified	Туре
🖵 library (\\libm	iail) (J:)	۷	<					>
File <u>n</u> ame:	DC Current C	Clam	p Look-Up.psprobe					~
Save as <u>t</u> ype:	Custom Prob	e file	es (*.psprobe)					~
Hide Folders						<u>S</u> ave	Can	cel

To import a probe, simply click **Import** and locate the destination folder. Any probes with the *.psprobe* extension will appear in the list:

	Import Custom Probe		×
) 🔄 👻 ↑ 🕌 « Documents → Wave	forms → Probes v C S	earch Probes	P
Organise 🔻 New folder			(?)
	Name	Date modified	
Desktop	DC Current Clamp Look-Up.ps	probe 30/09/2014 10:16	I
Documents			
🚺 Downloads			
2			
Music			
Pictures			
J Videos			
Local Disk (C:)			
🖵 jeff (\\filesrv2) (H:)			
🖵 library (\\libmail) (J:)			
🕎 market (\\filesrv2) (K:)			
🚽 admin (\\filesrv2) (M:) 🗸 🗸	<		>
File <u>n</u> ame: DC Current C	lamp Look-Up.psprobe 🗸 🗸	Custom Probe files (*.psprobe)	¥
		<u>O</u> pen Cancel	



8.2 Math channels

Math channels are found under the **Tools** menu:

<u>File Edit Views Measurements</u>	Tool	s <u>H</u> elp
ณ Л. Ш. 🖳 🥕 🚮 🛛 50 µs/div	2	Custom Pro <u>b</u> es
A. Auto V DC V B.	Σ	Maths Channels
■ 50.0 · · · · · · · · · · · · · · · · · ·	⊳	Reference Waveforms
mV	XX 0101	Serial Decoding
40.0		<u>A</u> larms
	Æ	Mas <u>k</u> s ►
30.0	T	Macro Recorder
	8	Preferences
10.00	_	1

To select one of the built-in math channels, click the appropriate check box:

Maths Channels	×
Select a Maths Channel Built-in Invert A Invert B	OK Help
A + B A - B Library Loaded	Create Edit
	Duplicate
Explain what Built-in, Library and Loaded Maths Channels are.	Export

Select **Invert A** and then **OK** to show both waveforms, as in the image below. The new math channel now has its own axis appearing on the right-hand side:



The math channel is treated like a normal channel. Anything that can be done on a real channel also applies to a Math channel, like measurements and reference waveforms.

8.3 Reference waveforms

A reference waveform creates a copy of an input signal which can be used as a reference point consisting of a known good signal. The incoming signal can be visually checked to see how closely it matches the reference waveform. This is available in both *Scope* and *Spectrum* modes.





There are two ways to access reference waveforms. The quick method is to right-click on the screen and select **Reference Waveforms** and the channel. This will immediately create a reference waveform.



The second method is to go to the **Tools** menu and select **Reference Waveforms**.



The next step is to highlight the required channel and then click **Duplicate**:

Reference Waveforms	×
Select a Reference Channel Available B Library Loaded	OK Help Edit Delete Duplicate
Explain what Available, Library and Loaded Reference Channels are.	Import Export



The reference waveform will appear in a fainter colour in the Library section:

Reference Waveforms	×
Select a Reference Channel	OK Help
Loaded	Edit Delete Duplicate
Explain what Available, Library and Loaded Reference Channels are.	Import Export

Highlight the reference waveform and select **Edit** to rename it and change the colour:



Once these modifications are done, click **OK**:





To enable the reference waveform, click the check box next to its name:

Reference Waveforms	×
Select a Reference Channel	OK Help
Loaded	Edit Delete Duplicate
Explain what Available, Library and Loaded Reference Channels are.	Import Export

To see the waveform, click **OK**. The reference waveform will now appear with the defined colour and a new axis:





As the reference waveform created is the same as the incoming signal, it is difficult to see. The image below shows the input signal changed to a sine wave, so the square wave reference waveform is easier to see:



Reference waveforms are most useful on the timebases they were created in. If a longer timebase is selected after a reference waveform is created, the reference waveform will only appear in part of the view, as shown here:





The pre-trigger percentage is also important to consider, as a reference waveform taken at 50% is best suited to a waveform that has also 50% pre-trigger on the same timebase. If you choose the incorrect timebase, part of the reference waveform will be out of sight, as the example below shows.






8.3.1 Saving and loading

Return to **Reference Waveforms** and click **Import** and **Export** to load and save waveforms:



The file extension is *.psreference*. The default location is in the **References** folder, which resides in the **Waveforms** folder under **My Documents**:



Saved psdata waveforms can be converted to reference waveforms by simply loading the psdata file and doing the same procedure again.



8.4 Serial decoding

The serial data protocols are decoded in software. The protocols available are:

- I²C
- RS232/UART
- SPI
- 1²S
- CAN
- LIN
- FlexRay

The data decoded is represented as hexadecimal numbers by default, with data bits, address bits, error bits and parity bits shown separately.

The **Serial Decoding** option can be accessed from the **Tools** menu in *Scope* mode.

Too	ols <u>H</u> elp
2	Custom Pro <u>b</u> es
Σ	Maths Channels
- 🔁	Reference Waveforms
X 0101	Serial Decoding
. 🕘	Alarms
я	Mas <u>k</u> s •
T	Macro Recorder
8	Preferences

Once serial decoding is selected, you are presented with a dialog where the channel and the protocol can be chosen. In the example below, the CAN Low protocol is selected and the threshold and baud rate are set. The **In graph** option displays the decoded data below the actual waveform, while the **In table** option stores all the data on a table.

Serial Decoding	×	Serial Decoding	×
CAN Low	Chai Data Chai Display Settings Name CAN Le Show Decoded Data	CAN Low Image: Canadity of the second section of the second section of the second section of the second s	OK Cancel Help



8.4.1 In graph

The screen below shows the **In graph** data beneath the actual signal and the **In table** data in a table:



Zooming into this signal reveals the frame and field information:





8.4.2 In table

Select the **In table** option to display all of the data from the current buffer in a table:

lo. 1		cumulate	V	iew l	ink:	<no< th=""><th>ne 🗸</th><th>)+</th><th>Start from Filter</th><th>Statistics</th><th>1</th><th>Search</th><th>Refi</th><th>resh Clear</th><th></th><th></th></no<>	ne 🗸)+	Start from Filter	Statistics	1	Search	Refi	resh Clear		
		Frame	RTR	SRR	IDE	R0	R1	DLC	Data bytes	CRC Sequence	CRC Delimiter	ACK Slot	ACK Delimiter	Error	Start Time	End Time
		Unknown	-	-	-	-	-	0	-	-	-	-	-	-	0 s	163.6 µs
		Data	1	-	1	1	-	8	FC B1 38 00 00 44 9F 13	7895	0	Yes	0	-	202.5 µs	433.9 µs
	588	Data	1	-	1	1	-	8	0A 00 7E 80 00 81 0C 7F	41EF	0	Yes	0	-	664.9 µs	904.1 µs
		Data	1	-	1	1	-	8	18 80 00 96 00 00 00 00	4233	0	Yes	0	-	1.741 ms	1.976 ms
5	5C0	Data	1	-	1	1	-	8	42 11 82 A6 20 00 01 56	3EBB	0	Yes	0	-	4.045 ms	4.275 ms
1 0	50	Data	1	-	1	1	-	4	00 A0 A0 00	6E71	0	Yes	0	-	6.042 ms	6.207 ms
3 3	394	Data	1	-	1	1	-	4	00 00 00 00	1F4C	0	Yes	0	-	6.706 ms	6.875 ms
5 1	A0	Data	1	-	1	1	-	8	00 00 00 00 FE FE 00 1A	1F55	0	Yes	0	-	7.218 ms	7.46 ms
7 5	5A0	Data	1	-	1	1	-	8	81 00 00 71 F9 00 00 F0	75B1	0	Yes	0	-	8.191 ms	8.424 ms
9 5	540	Data	1	-	1	1	-	8	20 49 FF 00 FF 00 00 26	7D64	0	Yes	0	-	9.253 ms	9.488 ms
1 2	280	Data	1	-	1	1	-	8	01 21 8E 0A 20 00 20 20	3D3A	0	Yes	0	-	9.975 ms	10.21 ms
3 2	288	Data	1	-	1	1	-	8	FC B1 38 00 00 44 9F 13	7895	0	Yes	0	-	10.25 ms	10.48 ms
5 4	180	Data	1	-	1	1	-	8	63 00 00 D5 4A 00 06 FA	1371	0	Yes	0	-	10.7 ms	10.93 ms
7 2	2C2	Data	1	-	1	1	-	4	00 05 00 40	0EFB	0	Yes	0	-	11.74 ms	11.91 ms
93	20	Data	1	-	1	1	-	8	04 00 10 00 00 21 00 01	154E	0	Yes	0	-	17.75 ms	17.99 ms
1 5	540	Data	1	-	1	1	-	8	30 49 FF 00 FF 00 00 0F	5E78	0	Yes	0	-	19.11 ms	19.35 ms
3 -		Unknown	-	-	-	-	-	0	-	-	-	-	-	-	19.94 ms	20 ms

8.4.2.1 Export

The **Export** button allows you to export the **In table** data to an Excel worksheet. This will export the channel that has been highlighted. Click **Export** and select the Excel (xls) format from the **Save As** window:

۳			Save A	١S					×
€ ∋ - ↑ 🎍	Ocumen	ts	Waveforms →	1	~ ¢	Searc	h Wavefor	ms	Q
Organise 🔻 New	folder								0
퉬 Weekly Reports		^	Name	^			Date mo	dified	Туре
🤣 Homegroup			Probes References				30/09/20 30/09/20		File folder File folder
🖳 CLARKE									
膧 Desktop									
Documents									
🚺 Downloads									
P									
🚺 Music									
📄 Pictures									
📔 Videos		¥	<						>
File <u>n</u> ame:	CANSignal.xl	s							~
Save as <u>t</u> ype: X	LS (Microsof	ft Ex	cel) files (*.xls)						¥
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			7 - (* -)	Ŧ						CANSIGNAL - Micros	oft Excel				_ = x
C	2	Hom	ie Inser	t	Page	Layou	ut	F	ormula	as Data Review	v View A	dd-Ins		@ –	⇒ x
	ste	∦ ≧⊒ ∛	Arial B <u>I</u> U S Fon	- <u>A</u>	A A			≣ 3	■ E ■ E ≫r ent	1	Conditional Format as Tabl	e ▼ 📑	□ Insert ▼ Delete ▼ Format ▼ Cells	Sort &	Select *
		A1		- ()		ţ	e se	Expo	orted	CAN Low data for Ch	nannel A				×
	А	В	С	D	E	F	G	Н	1	J	К	L	М	N	0
1	Exp	orted	CAN Low da	ata foi	r Char	nnel	A		-		-	·		-	
2	No.	ID	Frame	RTR	SRR	IDE	R0	R1		Data bytes	CRC Sequence	CRC Delimiter	ACK Slot	ACK Delimiter	Error
3	1	1	Unknown	1	-	-	1	-	0	-	-	-	-	-	-
4	3	288	Data	1	-	1	1	-	8	FCB1380000449F13	7895	0	Yes	0	-
5	5	588	Data	1	-	1	1	-	8	0A007E8000810C7F	41EF	0	Yes	0	-
6	7	5E7	Data	1	-	1	1	-	8	1880009600000000	4233	0	Yes	0	-
7	9	5C0	Data	1	-	1	1	-	8	421182A620000156	3EBB	0 Yes		0	-
8	11	050	Data	1	-	1	1	-	4	00A0A000	6E71	0	Yes	0	-
9	13	394	Data	1	-	1	1	-	4	0000000	1F4C	0	Yes	0	-
10	15	1A0	Data	1	-	1	1	-	8	00000000FEFE001A	1F55	0	Yes	0	- =
11	17	5A0	Data	1	-	1	1	-	8	81000071F90000F0	75B1	0	Yes	0	-
12	19	540	Data	1	-	1	1	-	8	2049FF00FF000026	7D64	0	Yes	0	-
13	21	280	Data	1	-	1	1	-	8	01218E0A20002020	3D3A	0	Yes	0	-
14	23	288	Data	1	-	1	1	-	8	FCB1380000449F13	7895	0	Yes	0	-
15	25	480	Data	1	-	1	1	-	8	630000D54A0006FA	1371	0	Yes	0	-
16	27	2C2	Data	1	-	1	1	-	4	00050040	0EFB	0	Yes	0	-
17	29	320	Data	1	-	1	1	-	8	0400100000210001	154E	0	Yes	0	-
18	31	540	Data	1	-	1	1	-	8	3049FF00FF00000F	5E78	0	Yes	0	-
19	33	-	Unknown	-	-	-	-	-	0	-	-	-	-	-	-
20															
21															-
14 4	++	CA	NSIGNAL	۰. 🕫	/				_		1 4	1111			▶ [
Rea	dy												100% (9	

Here is the Excel file just created with the In table data:

8.4.2.2 Accumulate

The **In table** serial data that is presented on the screen is only for the current buffer. Click **Accumulate** to keep on adding the new buffer data at the top of the table, while keeping previous buffer data as well.



8.4.2.3 View

The **View** option allows you to customise what is displayed and how the table is shown on the screen. Frames and fields can be removed from view, as in the example below where only the data frames are selected.

Fields Display Grid Fo - 1 - 1		_	5	•	V	Data Remo Error	ote		Ye Ye Ye	lot 25 25 25	Delimiter 0 0 0	- -	Time 202.5 μs 664.9 μs 1.741 ms	Time 433.9 μs 904.1 μs
Grid Fo - 1 - 1 - 1	nt Siz	_	-				hte ite		Y		-	-		
Grid Fo - 1 - 1 - 1	nt Siz	_	-				ile i			25	0	-	1.741 ms	
- 1 - 1 - 1	1	e 6.	-			Error							1.741.002	1.976 ms
- 1 - 1		-	4	00.00.0000					Ye	25	0	-	4.045 ms	4.275 ms
- 1	1			00 A0 A0 00		Over	oad		Y	25	0	-	6.042 ms	6.207 ms
		-	4	00 00 00 00					Y	25	0	-	6.706 ms	6.875 ms
	1	-	8	00 00 00 00 FI		Unkn	own		Y	25	0	-	7.218 ms	7.46 ms
- 1	1	-	8	81 00 00 71 F9	00 00	F0	75B1	0	Y	25	0	-	8.191 ms	8.424 ms
- 1	1	-	8	20 49 FF 00 F	F 00 00	26	7D64	0	Y	25	0	-	9.253 ms	9.488 ms
- 1	1	-	8	01 21 8E 0A 2	0 00 20	20	3D3A	0	Y	25	0	-	9.975 ms	10.21 ms
- 1	1	-	8	FC B1 38 00 0	0 44 9F	13	7895	0	Y	25	0	-	10.25 ms	10.48 ms
- 1	1	-	8	63 00 00 D5 4/	A 00 06	FA	1371	0	Y	25	0	-	10.7 ms	10.93 ms
- 1	1	-	4	00 05 00 40			0EFB	0	Y	25	0	-	11.74 ms	11.91 ms
- 1	1	-	8	04 00 10 00 00	21 00	01	154E	0	Y	25	0	-	17.75 ms	17.99 ms
- 1	1	-	8	30 49 FF 00 F	F 00 00) 0F	5E78	0	Y	25	0	-	19.11 ms	19.35 ms
-	1	1 1 1 1 1 1	1 1 - 1 1 - 1 1 - 1 1 -	1 1 - 8 1 1 - 4 1 1 - 8	1 1 - 8 63 00 00 D5 4) 1 1 - 4 00 05 00 40 1 1 - 8 04 00 10 00 00	1 1 - 8 63 00 00 D5 4A 00 00 1 1 - 4 00 05 00 40 1 1 - 8 04 00 10 00 00 21 00	1 1 - 8 63 00 00 D5 4A 00 06 FA 1 1 - 4 00 05 00 40 1 1 - 8 04 00 10 00 00 21 00 01	1 1 - 8 63 00 00 D5 4A 00 06 FA 1371 1 1 - 4 00 05 00 40 0EFB 1 1 - 8 04 00 10 00 00 21 00 01 154E	1 1 - 8 63 00 00 D5 4A 00 06 FA 1371 0 1 1 - 4 00 05 00 40 0EFB 0 1 1 - 8 04 00 10 00 021 00 01 154E 0	1 1 - 8 63 00 00 D5 4A 00 06 FA 1371 0 Yy 1 1 - 4 00 05 00 40 0EFB 0 Yy 1 1 - 8 04 00 10 00 021 00 01 154E 0 Yy	1 1 - 8 63 00 00 D5 4A 00 06 FA 1371 0 Yes 1 1 - 4 00 05 00 40 0EFB 0 Yes 1 1 - 8 04 00 10 00 00 21 00 01 154E 0 Yes	1 1 - 8 63 00 00 D5 4A 00 06 FA 1371 0 Yes 0 1 1 - 4 00 05 00 40 0EFB 0 Yes 0 1 1 - 8 04 00 10 00 00 21 00 01 154E 0 Yes 0	1 1 - 8 63 00 00 D5 4A 00 06 FA 1371 0 Yes 0 - 1 1 - 4 00 05 00 40 0EFB 0 Yes 0 - 1 1 - 8 04 00 10 00 00 21 00 01 154E 0 Yes 0 -	1 1 - 8 63 00 00 D5 4A 00 06 FA 1371 0 Yes 0 - 10.7 ms 1 1 - 4 00 05 00 40 0EFB 0 Yes 0 - 11.74 ms 1 1 - 8 04 00 10 00 00 21 00 01 154E 0 Yes 0 - 17.75 ms

The same can also be done with the actual fields.

Seria	l Decod	ing			~	No.	- a 💌
E	cport	Accumulate	View Link: <none +="" fro<="" start="" th=""><th>om 🗄</th><th>~</th><th>ID</th><th>Search 🕨 Refresh Clear</th></none>	om 🗄	~	ID	Search 🕨 Refresh Clear
No.	ID 288	Frame Data	D: Frames	► E	_	Frame	
3 5	288 588	Data	0A Fields	•		RT	
7	5E7	Data				SRR	
9	5C0	Data	10			IDE	
11	050	Data	Grid Font Size 6.5	_			
13	394	Data	00 00 00 00			R0	
15	1A0	Data	00 00 00 00 FE FE 00 1A			R1	
17	5A0	Data	81 00 00 71 F9 00 00 F0			DLC	
19	540	Data	20 49 FF 00 FF 00 00 26	E	~	Data bytes	
21	280	Data	01 21 8E 0A 20 00 20 20		_		
23	288	Data	FC B1 38 00 00 44 9F 13	_		CRC Sequence	
25	480	Data	63 00 00 D5 4A 00 06 FA	_		CRC Delimiter	
27	2C2	Data	00 05 00 40	_		ACK Slot	
29	320	Data	04 00 10 00 00 21 00 01	_			
31	540	Data	30 49 FF 00 FF 00 00 0F	_		ACK Delimiter	
						Error	
1						Stuffed Bits	
						Baud Rate	
						Start Time	
						End Time	
						Frame Time	
						Min Voltage	
	A-CAN	Low				Max Voltage	



The example below shows the removal of a number of fields.

Serial	Decod	ing										_ J
Ex	port	Accumulate	View	Link:	<none +<="" th="" 🗸=""><th>Start from</th><th>Filter</th><th>Statistics</th><th>Search</th><th>Refresh</th><th>Clear</th><th></th></none>	Start from	Filter	Statistics	Search	Refresh	Clear	
No.	ID	Frame	Data bytes	5								
3	288	Data	FC B1 38 0	0 00 44 9F	= 13							
5	588	Data	0A 00 7E 80	00 81 00	C7F							
7	5E7	Data	18 80 00 96	00 00 00	00							
9	5C0	Data	42 11 82 A6	20 00 01	56				Ν			
11	050	Data	00 A0 A0 0	D					6			
13	394	Data	00 00 00 00									
15	1A0	Data	00 00 00 00	FE FE 00) 1A							
17	5A0	Data	81 00 00 71	F9 00 00	F0							
19	540	Data	20 49 FF 00	FF 00 00	0.26							
21	280	Data	01 21 8E 0A	20 00 20	20							
23	288	Data	FC B1 38 0	0 00 44 9F	F 13							
25	480	Data	63 00 00 D5	5 4A 00 06	5 FA							
27	2C2	Data	00 05 00 40									
29	320	Data	04 00 10 00	00 21 00	01							
31	540	Data	30 49 FF 00	FF 00 00) 0F							
A	- CAN	Low										

The data is presented in Hex by default. It can be changed to Binary, Decimal or ASCII.

	Viev	v Link:	<no< th=""><th>ne</th><th>v+</th><th>Start from</th><th>. F</th><th>ilter</th><th>Statistics</th></no<>	ne	v +	Start from	. F	ilter	Statistics
R1		Frames				•			CRC Sequence
		Fields		0 44 9F	- 13	7895			
-		Display	Form	\checkmark	Hex				
Н		Grid Fo	nt Siz	e 6	5.5	~√∑		Binar	y i
	-	1	1	-	4	00 A0 A0 00		ASCI	I
	-	1	1	-	4	00 00 00 00		Decin	
L	-	1	1	-	8	00 00 00 00 FI	_	Decin	nai

An example of a binary display format is shown below.

No.	ID	Frame	Data bytes
3	01010	Data	111111001011001001110000000000000000000
5	10110	Data	000010100000000011111101000000000000000
7	10111	Data	000110001000000000000001001011000000000
9	10111	Data	0100001000010001100000101010011000100000
11	00001	Data	000000010100000101000000000000000000000
13	01110	Data	000000000000000000000000000000000000000
15	00110	Data	000000000000000000000000000000000000000
17	10110	Data	100000010000000000000001110001111110010000
19	10101	Data	001000000100100111111111000000001111111
21	01010	Data	0000000100100001100011100000101000100000
23	01010	Data	111111001011000100111000000000000000000
25	10010	Data	011000110000000000000011010101010000000
27	01011	Data	000000000010100000001000000
29	01100	Data	000001000000000000000000000000000000000
31	10101	Data	001100000100100111111111000000001111111



Font size can also be adjusted. Here is font size 6.5:

Seria	l Decoding							
E	kport A	ccumulate		Viev	v Link:	<none< th=""><th>~+</th><th>Start from</th></none<>	~ +	Start from
No.	ID	Frame	D		Frames			
3	01010	Data	11					1001
5	10110	Data	00		Fields			P 0010
7	10111	Data	00		Display	Format		D000
9	10111	Data	01		Grid Fo	nt Size	6.5	0000
11	00001	Data	00		Gildro	Int Dize	6.5	
13	01110	Data	00	000000	000000000	0000000		
15	00110	Data	00	000000	000000000	0000000	8.25	0111111100
17	10110	Data	10	000001	000000000	0000000		100000000
19	10101	Data	00	100000	010010011	1111111	12 14	100000000
21	01010	Data	00	000001	1001000011	0001110	16	000000000
23	01010	Data			0101100010			0010001001
25	10010	Data	01	100011	00000000	0000000		000000000
27	01011	Data	00	000000	000001010	0000000	22	
29	01100	Data	00	000100	000000000	0010000	24	0001000010
31	10101	Data	00	110000	0010010011	1111111	00000001	111111100000000

and here is size 16:

Serial	Decoding			۵ X
Exp	port A	ccumulate	View Link: None + Start from Filter Statistics Search Refresh Clear	
No.	ID	Frame	Data bytes	
3	0	D	111111001011000100111000000000000000000	Ĥ
5	1	D	0000101000000001111110100000000000000	=
7	1	D	00011000100000000000010010110000000000	
9	1	D	01000010000100011000001010100110001000	
1	0	D	000000010100000101000000000000000000000	
1	0	D	000000000000000000000000000000000000000	
1	0	D	0000000000000000000000000000011111101111	
1	1	D	100000010000000000000011100011111100100	
1	1	D	00100000100100111111110000000011111111	
2	0	D	0000001001000011000111000001010001000000	
2	0	D	1111110010110001001110000000000000000	
2	1	D	011000110000000000000110101010100000000	
2	0	D	000000000010100000001000000	\checkmark
A	- CAN L	w		

8.4.2.4

This drop-down list selects or opens a spreadsheet file that maps numbers to strings.

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

8.4.2.5 Start from filter

Link

Use the **Start from filter** button to enter a condition that PicoScope will wait for before collecting data. When PicoScope 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.



8.4.2.6 Statistics

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

Serial Decoding _ 하고 Export Accumulate View Link: <none>> + Start from Filter Statistics · Search >> Refresh Clear</none>										
E	ort	Accumulate	View Link: <ivo< th=""><th></th><th></th><th>n Hilti</th><th>er Statis</th><th></th><th>Search 🕨 Refresh Clear</th><th></th></ivo<>			n Hilti	er Statis		Search 🕨 Refresh Clear	
	ID	Frame	Data bytes	Stuffed Bits	Baud Rate	Frame Time	Min Voltage	Max Voltage	Voltage Delta	
1	-	Unknown	-	0	-	163.6 µs	0 V	0 V	0 V	Ē
2	-	Interframe	-	0	-	38 µs	0 V	0 V	0 V	
3	288	Data	FC B1 38 00 00 44 9F 13	8	500 kbaud	231.4 µs	1.183 V	3.293 V	2.11 V	
4	-	Interframe	-	0	-	230 µs	0 V	0 V	0V	
5	588	Data	0A 00 7E 80 00 81 0C 7F	12	500 kbaud	239.2 µs	1.119 V	3.297 V	2.178 V	
8	-	Interframe	-	0	-	836 µs	0 V	0 V	0 V	
7	5E7	Data	18 80 00 96 00 00 00 00	10	500 kbaud	235.2 µs	1.03 V	3.126 V	2.096 V	
8	-	Interframe	-	0	-	2.068 ms	0 V	0 V	0V	
9	5C0	Data	42 11 82 A6 20 00 01 56	7	500 kbaud	229.2 µs	1.105 V	2.65 V	1.545 V	
10	-	Interframe	-	0	-	1.766 ms	0 V	0 V	ov k	
11	050	Data	00 A0 A0 00	7	500 kbaud	165.4 µs	1.566 V	3.063 V	1.496 V	
12	-	Interframe	-	0	-	498 µs	0 V	0 V	0V	
13	394	Data	00 00 00 00	9	500 kbaud	169.2 µs	990.7 mV	3.233 V	2.242 V	
14	-	Interframe	-	0	-	342 µs	0 V	0 V	0V	
15	1A0	Data	00 00 00 00 FE FE 00 1A	13	500 kbaud	241.2 µs	1.069 V	3.286 V	2.217 V	
16	-	Interframe	-	0	-	730 µs	0 V	0 V	0V	
17	5A0	Data	81 00 00 71 F9 00 00 F0	9	500 kbaud	233.2 µs	894.9 mV	3.247 V	2.352 V	
18	-	Interframe	-	0	-	828 µs	0 V	0 V	0V	
19	540	Data	20 49 FF 00 FF 00 00 26	10	500 kbaud	235.2 µs	994.4 mV	3.009 V	2.014 V	
20	-	Interframe	-	0	-	486 µs	0 V	0 V	0V	
21	280	Data	01 21 8E 0A 20 00 20 20	10	500 kbaud	235.4 µs	1.027 V	3.297 V	2.27 V	
22	-	Interframe	-	0	-	34 µs	0 V	0 V	0V	
23	288	Data	FC B1 38 00 00 44 9F 13	8	500 kbaud	231.1 µs	930.3 mV	2.735 V	1.805 V	
24		Interframe		0		226 me	01/	01/	0.V	

8.4.2.7 Search

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

8.4.2.8 Refresh

Refresh instructs PicoScope to decode the raw data again. This is necessary if the **Start from...** condition has been changed, for example.

8.4.2.9 Clear

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

For more information please refer to the PicoScope 6 User's Guide.



8.5 Alarms

Alarms are *actions* that can be programmed to execute when certain *events* occur.

Events

There are three types of events that can trigger an alarm:

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.

Actions

PicoScope can execute a number of actions when an event occurs:

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

Alarms are available in *Scope*, *Persistence* and *Spectrum* modes and are accessed from the **Tools** menu on the **Menu** bar.

	<u>T</u> ools <u>H</u> elp					
]	2	Custom Pro <u>b</u> es				
5	Σ	Maths Channels				
-	2	Reference Waveforms				
	XX 0101	Serial Decoding				
		Alarms				
	Æ	Mas <u>k</u> s 😼 🕨				
	Ŧ	Macro Recorder				
_	8	Preferences				

The default action is to *Beep*. Click **Edit** to change the action:

Alarms	×
Event Capture	ОК
🕑 Веер	Cancel
	Apply
	Help
	Add
	Edit
	Remove
	Move Up
	Move Down

Alarms			×
Event	Capture	~	ОК
P Beep)		Cancel
			Apply
			Help
			Add
			Edit
			Remove
			Move Up
			Move Down



A number of actions are now available:

Alarms ×	Alarms ×
Event Capture V	Event Capture 🕑 OK
Beep Cancel	Beep Cancel
Apply	Apply
Alarm Action	Alarm Action
Action Beep	Action Beep File Play Sound Stop Capture Restart Capture Run Executable Save Current Buffer Save All Buffers Trigger Signal Generator Move Down
Enable external code execution	Enable external code execution

Select **Save Current Buffer** and choose a file name and location, as in the example below. The default location is the **Waveforms** folder in **My Documents**.

larms		23
Event Cap	ture 🕑	OK Cancel
Alarm Ac	tion	
Action File	Save Current Buff	fer V Cancel
		Remove Move Up
		Move Down

Alarm Action								
Action	Save Current Buffer							
File	aveforms\Example.psdata 🚥							
	OK Cancel							



Save As	Search Waveforms	×
Organize New folder		• 0
	Date modified 02/08/2011 16:05	Type File folder
File name: SaveOnTrigger		-
Save as type: Data files (*,psdata)	Save	▼ Cancel

Before the alarm is activated, you must select the tick box to enable it:

Alarms					
Event Capture	ОК				
Sav Buffers F &	Cancel				
	Apply				
	Help				
	Add				
	Edit				
	Remove				
	Move Up				
	Move Down				

Once this has been done the device is ready to start capturing:





To disable the alarm, stop the device from capturing or click Cancel each time a waveform is saved. The waveforms are now stored automatically in the specified location, with the number of the capture in brackets. The example opposite shows that 53 waveforms were captured as 53 events occurred.

Organize 🔻 Share w	ith 🕶 Burn New	folder			• • • • • • • • • • • • • • • • •
Favorites Desktop	Documents I Waveforms	brary		A	range by: Folder 🔻
Downloads Recent Places					
Libraries		-		-	-
Documents	References	Example (53)	Example (51)	Example (52)	Example (49)
Pictures	Neicences	example (55)	example (31)	Example (32)	example («3)
Videos		i j	1	1	
V Computer	-	-	-	-	-
🏭 OS (C:)	Example (50)	Example (47)	Example (48)	Example (45)	Example (46)
Vetwork			<u> </u>	1	
	A.,	A.	A.	A.,	A.
	Example (43)	Example (44)	Example (41)	Example (42)	Example (39)
	Sector Sector	1	1	E. considered	

Add additional events by clicking Add:

Alarms	×	Alarms	23
Event Capture	ОК	Event Capture	ОК
Save Current Buffer [SaveC	Cancel	Save Current Buffer [SaveC	Cancel
	Apply		Apply
	Help		Help
2	Add Edit Remove Move Up Move Down		Edit Edit Move Up Move Down

If, for example, you want the computer or laptop to beep when all the buffers are full, tick the **Buffer Full** event. Each event, when selected, will show its own set of actions in a list, very much like having a new page for every event.

Alarms	×
Event Buffers Full Capture Bee Buffers Full Caffars Full Caffars Full	OK Cancel Apply Help
	Add Edit
	Remove Move Up Move Down



Now when the buffer is full the PC will make a beeping sound. When multiple actions are available under one event, move them up or down the priority list by highlighting the action and clicking **Move Up** or **Move Down**:

Alarms	×
Event Buffers Full	✓ ОК
 Beep Stop Capture 	Cancel
 Restart Capture 	Apply
	Help
	5
	Add
	Edit
	Remove
	Move Up
	Move Down

8.6 Mask limit testing

Mask limit testing is a feature that indicates if a signal goes outside a specified area, called a mask, drawn on the <u>scope view</u> or <u>spectrum view</u>. PicoScope can draw the mask automatically by tracing a captured signal. Mask limit testing is useful for spotting intermittent errors during debugging, and for finding faulty units during production testing. It is good for doing Pass/Fail tests. Mask testing is available in both *Scope* and *Spectrum* mode.





To create a new mask, select Masks > Add Mask from the Tools menu.



The next screen that appears is the **Mask Library**. First select the appropriate channel and then click **Generate**:

OK Cancel Apply
Apply
Connecto
Generate
Import

	Mask Library	×
Channel 🗖 A	\checkmark	ОК
Available Masks		Cancel
Library Loaded		Apply
		Generate
		Import

This will bring up a window where the name of the mask can be defined and how much clearance in the X and Y directions is required by using the up and down arrows or typing in a specific value. The units will vary in *Scope* and *Spectrum* modes:



	Mask Library ×
Channel	■ A ✓ OK
Availab	× _{ncel}
Libra	
Load	Name Spectrum Mask of A ply
	X Offset 781.3 kH 🗢 SI 🕤
	Y Offset 100 mV 😌 SI 🕤 erate
	Generate Cancel
	Import
	Export

The adjustments can also be made in % by clicking **SI** and can be changed back to SI units by clicking **%**.



Once the appropriate offsets are defined, click **Generate**. The mask will appear in the list under **Library**. In *Scope* and *Spectrum* modes the icons will differ:

Mask Library ×	Mask Library	Mask Library
Channel A CK Availab Cel Libra Load Name Mask of A OV X Offset 10% 20% 5 erate Generate Cancel Import	Channel A C Available Masks Library Loaded Generate Delete Import Export	Channel A OK Available Masks Library Juli Spectrum Mask of A Loaded Generate Delete Import Export

Highlight the mask and click **Apply** to apply the mask to the view. The image below is of a mask in *Scope* mode:





Click **OK** to display the full mask. The measurements appear at the bottom giving the number of mask failures along with some other statistics. In the example below, 2 waveforms out of 44 have failed.



You can search through the mask failures in the waveform buffer, but this can be difficult if there are a large number of waveforms.





A more useful way to search through these waveforms is to only show mask failures:

38	
Ç3	
Buffers to show	Mask fails on Channel A

Using this method the failed waveforms can be viewed immediately.



8.6.1 Saving and clearing masks

Once you have created a mask it is saved automatically in the PicoScope settings; the next time PicoScope is loaded the mask will appear in the library. Masks can also be saved for use on other machines by going to **Tools** > **Masks** > **Save Mask**:





The file format is .mask and by default the location is selected is the **Waveforms** document under **My Documents**:

		Export M	vlask				×
🛞 🏵 🔻 🕇 퉬 « Docu	iments → W	/aveforms →	~ ¢	Searc	h Waveforr	ns	<i>م</i>
Organise 🔻 New folder							0
膧 Desktop	^ N	lame	*		Date mod	ified	Туре
Documents		Probes			30/09/201	4 10:26	File folder
🗼 Downloads		References			30/09/201		File folder
<u>.</u>		References			30/03/201	4 10.25	The folder
🔰 Music							
📔 Pictures							
📔 Videos							
🃥 Local Disk (C:)							
🚍 jeff (\\filesrv2) (H:)							
🖵 library (\\libmail) (J:)							
🖵 market (\\filesrv2) (K:)							
🚽 admin (\\filesrv2) (M:)	v «						>
File <u>n</u> ame: Mask of	A.mask						~
Save as type: Mask file	es (*.mask)						~
Alide Folders					<u>S</u> ave	Can	cel

To clear a mask, click on **Tools** > **Masks** > **Clear Mask**:

Too	Tools Help							
2	Custom Pro <u>b</u> es 375 of 375 💓 🧭							
Σ	Maths Channels							
2	Reference Waveforms							
XX 0101	Serial Decoding							
	Alarms							
Я	Mas <u>k</u> s 🕨	Add Masks						
T	Macro Recorder	Clear Mask						
8	Preferences	Save Mask						



9 Help menu

Access the Help menu from the Menu bar:

м <mark>и</mark>		PicoScope 6	
<u>File Edit Views Measurements Tools</u>	<u>H</u> el	p	
🔼 🏨 🎝 🚮 500 µs/div 🗸 1	8	<u>U</u> ser's Guide	of 0
A Auto V DC V B Off V		Online Documentation	710
2.0		Online <u>F</u> orum	
v		Send Feedback	1.0 ms
1.6		Check for Updates	
		About PicoScope 6	
1.2	-		

9.1 User's Guide

The User's Guide's contains detailed instructions on PicoScope:



9.2 Online Documentation

If you have internet access, this takes you to the documentation library on the Pico website.

9.3 Online Forum

This is the discussion forum on our website. Visit regularly to find out about the latest software releases, product announcements, and hints and tips from our technical specialists.



9.4 Send Feedback

If you have comments about PicoScope, please let us know by filling in this form. You can recommend new features that you would like to see, or report bugs or documentation errors.

9.5 Check for Updates

If you have an active internet connection, click **Check for Updates...** to see if you have the latest version of the software. PicoScope regularly checks for updates unless you have disabled the feature in **Tools > Preferences > Updates**.



9.6 About PicoScope 6

Click **About PicoScope 6** to view information about the product and the software currently being used:





10 Function generator and arbitrary waveform generator (AWG)

A function generator has one or more predefined waveforms that can be selected from a list. Many models also have an AWG that allows you to customise and specify the waveform.

10.1 Function generator

To access the function generator from the *Scope*, *Persistence* and *Spectrum* modes, click on the **Signal Generator** button and then ticking the **Signal On** box.



. 2.0

From the pull-down menu a number of predefined waveforms can be chosen. This will vary slightly from product to product.







The frequency, amplitude and offset can also be adjusted. Changing the offset to 1 V will move the signal up.



10.1.1 Sweep mode

The signal can be swept by ticking the **Enabled** box in the **Sweep** section. You can select the direction of the sweep, the stop frequency, how much the frequency will increment by, and how long between each increment.

Signal On	Sine 🗸
Import	Arbitrary
Start Frequency	1 kHz
Amplitude	1 V
Offset	0 V
Sweep Mode	Active
SweepType	Up 🔽
Stop Frequency	Up Down
Concernant Incoment	UpDown
Frequency Increment	DownUp 6
Increment Time Interval	DownUp 나? 1 ms



10.2 Arbitrary waveform generator (AWG)

For devices that support it, the Arbitrary Waveform Generator allows you to customise your own waveform. This can be achieved in a number of ways.

10.2.1 Importing a waveform

Import The Import button allows you to import a CSV file that contains a set of values between -1 and 1. The example below shows a CSV containing the following points.



The graph above shows the result of importing the CSV file.

The amplitude, frequency and sweep options can also be altered from the main signal generator controls.



11 Persistence mode

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



The colours 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.

То	access	persistence,	click	the	Persistence	Mode	button	on	the	Capture	Setup
too	lbar.										

Persistence Mode button



Mode	Advanced	~
Decay Time (ms)	5000	×
Saturation (%)		
Decayed Intensity		4
Custom		
Line Drawing	Constant Density	\checkmark
Color Scheme	Color	\checkmark
Background	Black	\checkmark
Data Hold	Decay Timeout	\sim
Persistence Mode	Frequency	\checkmark



The **Persistence Options** button gives the full range of controls available:

<u>F</u> ile <u>E</u> dit	<u>V</u> iews <u>T</u> ools	<u>H</u> elp
🔊 🔟 🔟	🐧 🤌 🏠 🛽 5 µs	s/div 🖌 🗴 1 🗘
A ±1V	13	
1.0	Mode	Digital Color
V	Decay Time (ms)	1
	Saturation (%)	
0.8		
	Decayed Intensity	(%) 0 🗘
0.6		
	•	

Four modes are available:



Digital Color

Uses a range of colours 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

Uses colour 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.

Fast

Uses a simplified drawing method for faster screen updates, of the order of 100 000 waveforms per second with faster scopes. Data hold and line drawing are not available in this mode.

Advanced

Opens up a **Custom Options** section at the bottom of the dialog that let you customise the display in *Persistence* mode. For more information please refer to the PicoScope 6 User's Guide, section 7.5.2.



12 Spectrum mode

Spectrum mode plots amplitude on the vertical axis versus frequency on the horizontal axis. The vertical range is measured in dB (decibels) and the horizontal range in Hz (hertz). The *Spectrum* mode is useful for analysing the frequency components of a signal.

The image below shows a 700 kHz sine wave which should have just one component, but since it is not a perfect sine wave some higher frequency components appear with lower amplitude.



To access *Spectrum* mode, click the **Spectrum Mode** button on the **Capture Setup** toolbar.





12.1.1 Voltage range

In exactly the same way as *Scope* mode, the voltage ranges are selectable and go up in multiples of 1, 2 and 5, e.g. $\pm 100 \text{ mV}$, $\pm 200 \text{ mV}$, $\pm 500 \text{ mV}$, $\pm 1 \text{ V}$... While timebase by default is defined in time per division, the voltage range is the full voltage range across all 10 divisions, so a $\pm 20 \text{ V}$ range is split into 10 divisions.

The minimum and maximum voltage range varies between products.

In each of these ranges, the device maintains its full resolution, so a 12-bit device will be 12 bits in each of those ranges. Choosing the most appropriate voltage range will give you the best detail out of your signal.



12.1.2 Frequency range

Multiple frequency ranges are available, from a few hertz up to the full bandwidth of the scope.





12.1.3 Spectrum options

This contains controls that determine how PicoScope converts the source waveform in the current scope view to a spectrum view:



12.1.3.1 Spectrum bins

This is 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. The example below shows a frequency range of 199 kHz and 8192 bins across this range:





If the source waveform contains fewer samples than required (that is, fewer than twice the number of frequency bins), PicoScope 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 PicoScope 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 8192 frequency bins, not the 16 384 requested.

If the source waveform contains more samples than required, PicoScope 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, PicoScope needs only $2 \times 16,384 = 32,768$ 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.

12.1.3.2 Window function

A number standard window functions are available.

Window	Main peak width (bins @ -3 dB)	Highest side lobe (dB)	Side lobe roll-off (dB/octave)	Notes
Blackman	1.68	-58	18	Often used for audio work.
Gaussian	1.33 to 1.79	-42 to -69	6	Gives minimal time and frequency errors.
Triangular	1.28	-27	12	Also called Bartlett window.
Hamming	1.30	-41.9	6	Also called Raised sine-squared. Used in speech analysis.
Hann	1.20 to 1.86	-23 to -47	12 to 30	Also called sine-squared. Used for audio & vibration.
Blackman-Harris	1.90	-92	6	General-purpose.
Flat-top	2.94	-44	6	Negligible pass-band ripple. Used mainly for calibration.
Rectangular	0.89	-13.2	6	No fading. Maximal sharpness. Used for short transients.

12.1.3.3 Display mode

Three display modes are available; 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 a rolling average of spectra calculated from all the waveforms in the waveform. 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. The image below shows the noise floor being averaged.



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. The image below shows the effects of peak hold on a waveform that is sweeping up and down in frequency from 1 kHz to 100 kHz.



12.1.3.4 Scale

This specifies the labelling and scaling of the vertical (signal) axis from these options.

Linear Logarithmic	The vertical axis is scaled in volts. 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. 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.

Spectrum Bins	16384	Spe	ctrum Bins	16384 🗸
Window Function	Blackman 🖂	Win	dow Function	Blackman 🔽
Display Mode	Magnitude 🔽	Disp	olay Mode	Magnitude 🛛 🖂
Scale	 Logarithmic Linear 	Scal	le	⊙ Logarithmic ○ Linear
Logarithmic unit	dBm 🕑	Log	jarithmic unit	Arbitrary dB 🔽 774.6 mV
OK Apply Cancel			ОК А	pply Cancel
dBm			Arbiti	ary dB



12.1.3.5 X Axis The x axis can be set to either linear or log_{10} :





13 Advanced custom probes

Previously when the **Range Management** section was encountered the automatic settings were chosen. This section covers the manual customisation of probe ranging. To describe how this works a custom probe will be created that only shows positive voltages in ranges from 0 V–1 V to 0 V–20 V.

ч ъ	Custom Probe Wizard	×
Range Management Choose whether the range automatically.	es available on this probe will be managed	
	e or more ranges that refer to any of the input ranges on the nge can be referred to more than once).	
C (Recommended) Let the commended of	ne software manage my ranges for me automatically.	
possible. This method	as many Custom Probe Ranges to scope Input Ranges as has the advantages of giving your Custom Probe the best atible with other scope hardware and also allowing auto-rangin	ng
🔽 Enable auto-ran	ging on this probe. What is auto-ranging?	
(Advanced) I will mana	age the Custom Probe Ranges manually.	
because the physical p	want to limit the number of ranges available to the user (maybe robe you are using has a very specific function), or if your range imits that may not map well to the scope's input ranges.	
Help	< Back Next > Cance	el

Going through the process of a custom probe:





The units will be the same since only the negative voltages will be removed from view:

* v	Custom Probe Wizard	×
Probe Output U Define the unit	Units ts that the Custom Probe will display.	
These units wil Use a stand volts	play output in any units, which helps in the interpretation of results. Il be displayed in various places, including on the graph. dard unit from the list.	
Enter the full n	name of the unit (e.g. volts) Provide a short name for the unit (e.g. V for volts)	
Help	< Back Next > Cancel	

No scaling will be applied:

•	Custom Probe Wizard	×
Scaling A Custo	Method om Probe can apply scaling to the data before it is displayed.	
y = C Use	a linear equation to scale the data (y = mx + c) 1.0 x + 0.0 volts Gradient (m) Offset (c) a look-up table (linearly interpolates between points on the table). Create a Lookup Table n't apply any scaling to the data.	
Help	o < Back Next > Cance	



The advanced range management can now be selected:

👈 Custom Probe Wizard	×
Range Management Choose whether the ranges available on this probe will be managed automatically.	
Each probe must have one or more ranges that refer to any of the input ranges on the scope (the same input range can be referred to more than once).	
$\ensuremath{\mathbb{C}}$ (Recommended) Let the software manage my ranges for me automatically.	
This will directly map as many Custom Probe Ranges to scope Input Ranges as possible. This method has the advantages of giving your Custom Probe the best chance of being compatible with other scope hardware and also allowing auto-ranging to work.	
Enable auto-ranging on this probe. What is auto-ranging?	
Advanced) will manage the Custom Probe Ranges manually.	
Use this option if you want to limit the number of ranges available to the user (maybe because the physical probe you are using has a very specific function), or if your ranges require specific fixed limits that may not map well to the scope's input ranges.	
Help < Back Next > Cancel	

The Manual Ranges Setup shows a blank canvas:

•	Custom Probe Wizard	×
	nual Ranges Setup tup the Custom Ranges manually.	
	Use the list on the right to manually configure the available ranges on the probe. Each hardware scope has its own set of input ranges. Select a device from below to consider whilst setting up custom ranges. PicoScope 3206B V Auto Generate Ranges The bar on the right demonstrates how much of the scope's input range is being utilised by the custom range currently selected from the list. Range not valid	
	Help < Back Next > Cancel	


You can run the Auto Generate Ranges process for any product:

ч Сс	ustom Probe Wizard	×
Manual Ranges Setup Setup the Custom Ranges manual	ly.	
Use the list on the right to man configure the available ranges of probe. Each hardware scope has its ow of input ranges. Select a device below to consider whilst setting custom ranges. <u>PicoScope 32068</u> <u>PicoScope 4424/06</u> PicoLog 1012 PicoLog 1012 PicoLog 1216 USB DTDAQ PicoScope 4224 IEPE PicoScope 3205A PicoScope 3205A PicoScope 3205B <u>PicoScope 3205B</u> <u>PicoScope 6404</u> PicoScope 6404 PicoScope 6407 PicoScope 6408 PicoScope 4262 PicoScope 4205 PicoScope 2205 MSO PicoScope 2206	on the ± 50 mV Edit in set ± 100 mV Edit from ± 200 mV Delete g up ± 1 V ± 2 V ± 5 V ✓ s nge 100%	
PicoScope 2207 PicoScope 2208 PicoScope 6402A	< Back Next > Cance	

Choose the PicoScope 3206B and click **Auto Generate Ranges** to automatically create a list of suitable scaled ranges for each of the hardware ranges. In this example there is no scaling and the full set of hardware ranges is presented:

👆 Custon	n Probe Wizard	x
Manual Ranges Setup Setup the Custom Ranges manually.		
Use the list on the right to manually configure the available ranges on the probe. Each hardware scope has its own set of input ranges. Select a device from below to consider whilst setting up custom ranges. PicoScope 3206B Auto Generate Ranges The bar on the right demonstrates how much of the scope's input range is being utilised by the custom range currently selected from the list.	± 50 mV ^ ± 100 mV Edit ± 200 mV Edit ± 500 mV E ± 1 V E ± 2 V E ± 5 V E ± 10 V V Range not valid	
Help	< Back Next > Cance	1



In this example only voltages greater or equal to 1 V are used. The remaining ranges can be deleted; select a range and click **Delete**:

•	Custom	Probe Wizard	×
Set	tup the Custom Ranges manually.		
	Use the list on the right to manually configure the available ranges on the probe. Each hardware scope has its own set of input ranges. Select a device from below to consider whilst setting up custom ranges. PicoScope 3206B Auto Generate Ranges The bar on the right demonstrates how much of the scope's input range is being utilised by the custom range currently selected from the list.	<pre> ±500 mV ±1 V ±2 V ±5 V ±10 V ±20 V Scaled Range 100% Input Range </pre>	New Range Edit Delete
	Help	< Back Next :	Cancel

Once complete, the negative component of each of these ranges can be removed. To modify the existing ranges, select the required range and click **Edit**:

No. Custom	Probe Wizard	t		×
Manual Ranges Setup Setup the Custom Ranges manually.				
Use the list on the right to manually configure the available ranges on the probe. Each hardware scope has its own set of input ranges. Select a device from below to consider whilst setting up custom ranges. PicoScope 3206B v Auto Generate Ranges The bar on the right demonstrates how much of the scope's input range is being utilised by the custom range currently selected from the list.			New Range Edit Delete	
Help	< Back	Next >	Cancel	



Double-click ± 1 V to bring up the **Edit Range** window. You can use the recommended values or manually adjust the hardware range:

Edit Range	×
Standard Options Advanced	ОК
 (Recommended) Automatically select the hardware input range for the range limits I specify below. 	Cancel
O Use this hardware input range.	Apply
Scaled range limits	Help
Scaled Range	
100%	
Input Range (±1 V)	

Edit Range	×
Standard Options Advanced	ОК
C (Recommended) Automatically select the hardware input range for the range limits I specify below.	Cancel
 Ise this hardware input range. [±]1V [∨] [±]20 mV [±]20 mV [±]100 mV [±]100 mV [±]200 mV [±]500 mV [±]10V [±]200 mV [±]10V [±]20V [±]50V [±]10V [±]20V [±]20V	Apply Help
Input Range (±1 V)	

In this case the recommended range is suitable as this will give the greatest voltage and resolution for this range.



To remove the negative component of this range, put 0 as **Min** in the **Scaled range limits**. Once this is selected the range utilisation bar will show that 50% of this range is being used, as below. As this is a software option the hardware resolution will not change:

Edit Range	×
Standard Options Advanced	ОК
 Recommended) Automatically select the hardware input range for the range limits I specify below. 	Cancel
O Use this hardware input range.	Apply
Scaled range limits	Help
Min OV Max 1V	
Scaled Range	
50 <mark>%</mark>	
Input Range (±1 V)	

The image below shows a more detailed description of the range utilisation bar.



Green The section of the input range that is used by the scaled range. This should be as large as possible, to maximize the use of the scope's resolution.

Blue Areas of the input range that are not being used. These indicate wasted resolution.

Grey Part of the scaled range that is not covered by the input range. This will result in wasted space on the graph. The range utilisation bar may not represent this area accurately when non-linear scaling is being used, so testing the scaled range limits on the scope view is advised.



The **Advanced** tab allows you to invert a waveform, but this is not necessary in this example:

Edit Range	×
Standard Options Advanced For advanced users only. It is strongly recommended that you do not change these settings. Waveform Inversion (Recommended) Do not Invert Always Invert Invert when negative Invert when positive 	OK Cancel Apply Help

Once completed, the same process can be done for each of the other ranges. The new set of ranges will now be shown from 0 V:

₽	Custom	Probe Wizard	×
	I Ranges Setup the Custom Ranges manually.		
con pro Eac of i bel cus Pic The hov is b	e the list on the right to manually digure the available ranges on the ibe. h hardware scope has its own set nput ranges. Select a device from ow to consider whilst setting up tom ranges. oScope 3206B Auto Generate Ranges e bar on the right demonstrates v much of the scope's input range reing utilised by the custom range rently selected from the list.	0 1 V 0 2 V 0 5 V 0 10 V 0 20 V Scaled Range 50 % Input Range	New Range Edit Delete
He	lp	< Back Next >	Cancel



All that is left is to name the sensor and add a short description:

Custom Probe Wizard	x
Custom Probe Identification Provide descriptive details so your new probe can be identified later.	
Enter a name for the probe Unipolar Ranges Write a short description for the probe, so it can be easily identified (optional).	
Unipolar voltage ranges set from 1 V to 20 V.	
Help < Back Next > Cance	el

Once completed, the new unipolar Ranges will appear in the **Library** section of **Custom Probes**:

Custom Probes	×
Select a probe	
Built-in	A New Probe
x20	Edit
x100	Delete
WPS000 000 bar Range	Duplicate
WPS500X Range 2	Import
WPS500X Range 3	
DC Current Clamp	Export
DC Current Clamp Look-Up	
Unipolar Ranges	¥
Explain what Built-in, Library and Loaded probes are	4
	OK Help



The range will now appear in channel options under **Probe**.

Eile	<u>E</u> dit	⊻iews	Measurements	Tools
л.	ш	d <u>ia</u> 📝	🚮 5 ms/div	✓ × 1
A 🖌 ±50) mV	V DC	✓ B ₁	Off
Probe	×1		\checkmark	
Resolu Select numbe		▼ Built-in ✓ x1 ✓ x10 ✓ x20)	
Axis So		- 🔽 DC	Current Clamp Current Clamp Lo iPolar Ranges	ookUp

Click Input Range to see the newly created set of ranges.



The example below shows a signal that is now unipolar on the 0 to 2 V range.





14 Advanced views menu

14.1 Naming views

To modify the view names, go to the Views menu and select Rename View.

Add View	•	
Re <u>n</u> ame View		
Close View		
Channels	•	
X-Axis	•	
Grid <u>L</u> ayout	•	
Arrange <u>G</u> rid Layout		
Reset View Sizes		
Move View To	•	Rename View
Arrange <u>V</u> iews		
Auto-arrange axes		View name
Reset View Layout		Scope Channel A
		OK Cancel
View Properties		

The image below shows all four views after they have been renamed.





14.2 Arranging views

To modify the way the views are arranged, go to the **Views** menu and select **Grid Layout**. By default this is set to *Automatic*.

Views Measurements	Tool	s <u>I</u>	lelp	
Add View	+		🗘 16 kS 🗘 🔇	32
Rename View				
<u>C</u> lose View				
Channels	•			
X-Axis	•			
Grid <u>L</u> ayout	•		Automațic	
Arrange <u>G</u> rid Layout			1 Viewport	={
Reset View Sizes			2 Viewports	
Move View To	•		3 Viewports	
Arrange <u>V</u> iews			4 Viewports	0
Auto-arrange axes			6 Viewports	
Reset View Layout			<u>9</u> Viewports	
View <u>P</u> roperties		_	Custom layout	

You can choose up to nine viewports, as in the example below, even if some are empty.

Elle Edit Views Iools Help		Sec. 14
ณ 🕅 da da 🤌 🦉 🕼 188/80 🕑 💷 👘 🗄	16 k5 🔠 📢 32 of 32 🕼 🕢 🛝 🖓 🔍 🔍 🔍	1 (12)
As Auto V DC V By Auto V DC		
Oxernel A 2.0	Channel B	Spectrum View Channel A
V	• • • • • • • • • • • • • • • • • • •	- 10u
	0.8	-25.0
		-50.0
	-00	-740
16 20-	15	-56.0 -110.0 00 50.0 1000 150.0 2000 250.0 300.0 350.0
-50 -40 -30 -20 -10 00 10 20 30 40 50	200 50 40 30 20 10 00 10 20 30 40 50	65 50.0 100.0 150.0 200.0 250.0 300.0 350.0
Tripper Auto C 12 A C	ov 🗄 50% 🗄 🖄 👘 🗄 🛄 🛄 🖬	

The example below shows one viewport, with the additional views appearing as tabs.





14.3 Custom layout

Select **Custom Layout** to define the number of rows and columns.

	Automatic		
	<u>1</u> Viewport		
	<u>2</u> Viewports		
	<u>3</u> Viewports	Custom grid layout	23
	4 Viewports		
	<u>6</u> Viewports	Rows Columns	ОК
	<u>9</u> Viewports	3 🗸 X 1 🗸	
~	Custom ayout		Cancel

You can alter this to have three columns instead of three rows:





14.4 Resizing and resetting views

To resize each view, point at the border of the viewport where a double arrow appears (either \clubsuit or \clubsuit) and drag the window to size.



To undo these size changes, go to the Views menu and select Reset View Sizes.

Add View	•
Re <u>n</u> ame View	
<u>C</u> lose View	
Channels	•
X-Axis	•
Grid <u>L</u> ayout	•
Arrange <u>G</u> rid Layout	
Reset View Sizes	
Move View To	•
Arrange <u>V</u> iews	
Auto-arrange axes	
Reset View Layout	
View Properties	
	Re <u>n</u> ame View <u>C</u> lose View Channels X-Axis Grid Layout Arrange <u>G</u> rid Layout <u>Reset View Sizes</u> <u>Move View To</u> Arrange <u>Views</u> Auto-arrange axes <u>Re</u> set View Layout

14.5 Moving views

Move each view between viewports using the Views menu.





After selecting the appropriate view, click **Move View To**. Viewport 3 is chosen in this example.



This will move the view in viewport 1 to viewport 3. A tab will appear at the top of viewport 3 as it now has two views.



You can also choose to simply move views to the next or previous viewports, or drag views around by clicking on the label tab.



14.6 XY mode

You can view Lissajous figures in *XY* mode, and plot two channels against each other instead of having voltage versus time. This is particularly useful when looking at phase relationships between channels. It can also be done on math and reference waveforms.

To enable XY mode go to the **Views** menu, select **Add View**, and choose XY mode. The two most suitable channels will automatically be placed on the X and Y axes. To change the X axis select **Views** > **X-Axis**.

t <u>V</u> ie	ws <u>M</u> easurements	Tool	s <u>H</u> elp
L	<u>A</u> dd View	•	Scope
-	Re <u>n</u> ame View		Spectrum 🔐
	<u>C</u> lose View		XY
	Channels	•	
	X-Axis	•	
5	Grid <u>L</u> ayout	•	
	Arrange <u>G</u> rid Layout		
	Reset View Sizes		
	Move View To	•	
	Arrange <u>V</u> iews		-1.0 -0.5
_	Auto-arrange axes		
	R <u>e</u> set View Layout		
	View <u>P</u> roperties		
			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~



To access *XY* mode from *Scope* mode, go to the **Views** menu, select **X-Axis**, and change it from **Time** to the appropriate channel.



Due to the number of divisions and the fact that you may be using a wide screen monitor, the shapes may not appear as you would expect. This can be easily rectified by changing the scaling for each channel.



### 14.7 Properties

Select View Properties from the Views menu.

Add View
Re <u>n</u> ame View
<u>C</u> lose View
Channels •
X-Axis 🕨
Grid Layout
Arrange <u>G</u> rid Layout
Reset View Sizes
Move View To ►
Arrange <u>V</u> iews
Auto-arrange axes
Reset View Layout
View Properties

The **Properties** window will be shown on the right-hand side, giving you information on the sample interval, sample rate, number of samples used, the signal being generated if using a device equipped with a signal generator, and about each channel. There is also a time stamp which is particularly useful when viewing data at a later date. The **Properties** window gives the exact time and date the buffer was captured.





Additional information will be shown in *Spectrum* mode, such as the window function used, the number of bins, the bin width, and the time gate. The number of bins defines the frequency resolution, the bin width is the frequency interval for each bin, and the time gate is the reciprocal of the bin width. The example below shows a frequency range of 500 kHz, and the number of bins is 2048. The bin width is calculated by dividing the frequency range by the number of bins, so 500 000/2048 = 244.1 Hz, and the time gate is 1/244.1 = 4.096 ms.





## 15 Triggering in depth

### 15.1 Post triggering

The post-trigger delay is the time that PicoScope waits after the trigger point before sampling. To enable the post triggering, select the **Post Trigger Enable** button  $\stackrel{\sim}{\sim}$ . When selected, the button will turn blue and the post trigger time controls can now be adjusted  $\stackrel{\sim}{\sim}$ .

The image below shows a 1 MHz square wave with the post-trigger delay disabled.



The image below shows the post-trigger delay enabled with a delay of 500 ns.



The maximum post trigger time varies depending on the product and timebase selected.



### 15.2 Advanced trigger modes

### 15.2.1 ETS

Equivalent-time sampling (ETS) allows a digital oscilloscope to capture high-frequency signals with an effective sampling rate much higher than the real-time sampling rate. Most digital storage oscilloscopes (DSOs), including Pico PC oscilloscopes, feature ETS.

ETS constructs a picture of the input signal by accumulating the samples over many wave cycles. As multiple cycles are needed, ETS can only be used to measure signals that are repetitive; single-shot or non-repetitive signals cannot be used.

The figure below shows an 8 MHz sine wave that was captured using a <u>Pico handheld</u> <u>oscilloscope</u>, using a real-time sampling rate of 40 MS/s. The second figure shows the same 8 MHz sine wave sampled using digital ETS. From these waveforms you can see that the real-time sampling gives a wave shape so distorted as to be nearly useless, while ETS gives a much more accurate representation of the input signal.

On repetitive waveforms, a Pico oscilloscope with ETS can provide the same accuracy as more expensive oscilloscopes with higher real-time sampling rates.





### 15.2.2 Rapid block mode

*Rapid block* mode reduces the time delay between waveform buffers from milliseconds to as little as 1 microsecond (device-dependent). This is a hardware feature and is available on most current Pico USB oscilloscopes (excluding the PicoScope 2000 Series).

The way the data is captured changes to achieve this reduction in time delay. In *Normal block* mode, the device captures data in the memory of the device and then transfers it to the PC. After each buffer the device then re-arms itself for another capture. In *Rapid block* mode, the data is not transferred to the PC after each buffer is captured, but instead the next buffer is captured. This is repeated until the desired number of captures



is reached, and only then is the data transferred to the PC.

The number of buffers can be controlled using the **Rapid Captures** (hare) control. The maximum number is set in PicoScope 6 to 10,000. The actual number that is achievable will depend on the number of samples per buffer and the buffer memory of a device. Rapid triggering is only available on quicker timebases.



### 15.3 A guide to advanced triggering

Advanced trigger types enable you to capture a stable waveform even with complex signals. Oscilloscopes capable of advanced triggering are ideal for troubleshooting glitches, timing violations, overvoltages and dropouts in analog and digital circuits.

In this guide to advanced triggering we will review basic edge-triggering and its limitations, and then we will explore the possibilities that advanced triggering offers. Finally we will explain in detail how to set up advanced triggers in PicoScope 6.

# 15.3.1 Why do I need advanced triggering?

As a scope user, you will be familiar with the standard type of triggering used on oscilloscopes. It is called edge-triggering, and on simple scopes it is the only type available. A trigger circuit monitors the incoming signal and waits for the voltage to rise above (or fall below) a set threshold, then causes the scope to capture and display the waveform. This method is adequate when the signal consists of pulses or cycles that are all similar to one another, as they are in a pure sine or square wave. Basic edge-triggering is enabled by default when you start PicoScope 6.

In the first image opposite, the trigger point is shown by the diamond shape. The threshold is set to 0.0 V,





in Repeat mode

and the scope starts to capture as soon as the signal rises above this voltage. This method gives a stable display if all the pulses are of the same shape and equally spaced.

This square wave represents only one type of signal found in electronic circuits. Most signals are more complex than this, as in the more realistic example in the second image.

In this waveform, the pulses are of unequal widths. If you use a simple edge trigger in *single trigger* mode, the scope will pick the first rising edge it sees. The rising edge of the shortest pulse was luckily caught in this case, but the scope could just as easily have started capturing on any of the other rising edges. If you were looking for a narrow pulse



that only occurred once in every million normal pulses, you would be very lucky to find it using this hit-and-miss method.

In *auto* or *repeat trigger* mode, the scope will continue to capture many times each second. The third image shows a number of waveforms superimposed, as you might see if the refresh rate is fast enough. This type of display is of little use if we want to see the data contained in the pulse train.

This brief view of edge-triggering shows that if you want to reliably find a rare event, such as a narrow pulse buried within a string of wider pulses, you need a more powerful type of trigger.



The advanced edge trigger provides the standard rising and falling edge conditions, and an additional condition called dual-edge triggering. This triggers on both edges, allowing you to check the widths and voltages of positive and negative pulses as the same time, as in the image above. It is useful for rapidly spotting jitter and noise problems.

The advanced trigger types also include *hysteresis* to reduce false triggering on noisy signals. When *hysteresis* is enabled, a second trigger threshold voltage is used in addition to the main 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. The following example illustrates how this works.



Consider the very noisy signal on the right. 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 example, several times in one cycle. If we zoom in on the highlighted parts of the signal, we will see how hysteresis can help.

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.





Noisy signal with hysteresis threshold

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, despite the noise on the signal.



The window trigger detects the moment when the waveform enters or leaves a voltage range. This allows you to search for overvoltages and undervoltages at the same time. In the image above, a 5 volt power supply is monitored with thresholds of 4.5 and 5.5 volts. The window trigger would detect both the positive and negative excursions outside this range.



Pulse-width triggering enables you to trigger exclusively on pulses of a specified width. This can be useful for finding rare events in synchronous control signals such as writeenables, or for finding extreme values in pulse-width modulated signals.

In the image above, the trigger was set to *pulse width*, *positive*, *greater than 70 ns*. This found a 100 ns pulse in a stream of 50 ns pulses.





The interval trigger helps you find missing or mistimed edges.

The image above shows two examples of a 4 MHz clock waveform with a missing pulse. You could use a pulse width trigger to search for the extended high pulse in the top example or the extended low pulse in the bottom example, but the interval trigger lets you find both errors without having to change the trigger type. Setting an interval trigger of *rising*, *greater than 300 ns* will detect both cases. The trigger point is set to the first rising edge after the long interval.



The windowed dwell trigger 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. In the image above, a nominally  $\pm$ 700 mV signal has occasional overvoltages and undervoltages, but we have set the dwell time to *greater than 100 ns* so that only abnormally wide pulses that go outside this range are detected.



The level dropout trigger detects an edge followed by a specified time with no edges. This is useful for triggering on the end of a pulse train. The image above shows the end of a pulse train in which rising edges regularly occur every 133 ns. The dropout trigger has detected that no rising edges have occurred within 500 ns.





The window dropout trigger 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. In the image above, the window dropout trigger was set to a 300 ns delay with a 600 mV to 800 mV window. It ignored the first pulse, which entered the window briefly, and the first dropout, when the signal remained below the window, but detected when the signal remained within the window for more than 300 ns.



This trigger detects a pulse that crosses the first threshold and then returns below it without crossing the second threshold. Pulses like this can cause problems in logic circuits if they violate the receiver's minimum high level specification.



The logic trigger 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 level-qualified or window-qualified, whereas Ext is level-qualified with a variable threshold, and AuxIO is level-qualified with a fixed TTL threshold. In the image above the trigger was set to *Channel A, level, above O V, Channel B, level, below O V, AND*. The trigger condition became true in the middle of the trace, at time = 0, when Channel A was above 0 V at the same time that Channel B was below 0 V.

Instead of the AND function, you can choose to combine the channels with other logic functions such as OR, NOR, XOR and XNOR.



### 15.3.3 How do I use the advanced trigger types?

PicoScope 6 lets you avoid the complexity of advanced triggers unless you really need to use them. We will first look at the trigger mode control and the simple edge trigger types, before moving on to advanced triggers.



15.3.3.1 Trigger mode control

The trigger mode control specifies whether the scope waits for a trigger condition, and if so, how it behaves afterwards. *None* and *ETS* modes are not compatible with advanced trigger types. If you select one of these, the **Advanced Triggers** button will not be available. *Single, Repeat* and *Auto* modes work as in any other oscilloscope. They instruct the scope to trigger on the conditions you have set, whether these are simple edge triggers or advanced triggers. You can find a full description of these trigger modes in the PicoScope 6 User's Guide.



The **Channel**, **Rising edge**, **Falling edge** and **Threshold** controls allow you to set up simple edge-triggering without having to open the advanced triggers dialog. If you are an experienced scope user you will find these controls familiar, even if you have not used PicoScope before. Full details can be found in the User's Guide. The corresponding controls for advanced trigger types are found in the **Advanced Triggers** dialog, which we will come to soon.



The **Advanced Triggers** button is the key control that lets you set up the conditions for advanced triggering.

Click this button to open the **Advanced Triggers** dialog. If the button is greyed out, then you are using a trigger mode that is not compatible with advanced triggering. Change the trigger mode to *Auto*, *Repeat* or *Single*.



#### 15.3.3.4 Advanced triggers dialog

This dialog appears when you click the **Advanced Triggers** button in the **Triggering** toolbar. It allows you to set up the simple edge trigger as well as all the advanced types:

🚽 Simple Edge	Source	A		Threshold	403.9 mV	A V
🥤 Advanced Edge	Direction	Rising				
UT Window		rusing		Hysteresis	1.50 %	\$ t
🖵 Pulse Width				riysteresis	1.50 %	
1 Interval						
😈 Window Pulse Width						
ML Level Dropout						
Window Dropout						
Runt			[			
💒 Logic			4	1		
	Dising					
	Rising					
				0		
					Help	Close

### 15.3.3.5 The trigger types list

Select one of trigger types in this list to show a number of options, a diagram and a description on the right of the **Advanced Triggers** dialog.

### 15.3.3.6 The advanced trigger options

The options on the right-hand side of the dialog vary according to the trigger type selected from the list. In the following section it is explained which options apply to which trigger types. To save space, the appearance of the dialog for every possible trigger type and combination of options is not shown.

### 15.4 Advanced trigger types

15.4.1

Simple edge

This trigger type is equivalent to using the basic trigger settings on the **Triggering** toolbar, as described earlier. The simple edge trigger can be used in conjunction with any trigger mode, including *None* and *ETS*.

The source control lets you select which signal the scope should use as the trigger. Set it to either **A**, **B**, **Ext** or **AuxIO**. These names correspond to the BNC input connectors on the scope device. **A** and **B** are the main measurement channels, and have variable thresholds and voltage windows. **Ext** is the external trigger input, which has a single variable threshold. **AuxIO** is the auxiliary input on the back of the scope, and has a fixed TTL threshold voltage.

The **Direction** control specifies the edge that will activate the trigger, and is equivalent to the **Rising edge** and **Falling edge** buttons on the **Triggering** toolbar.

The **Threshold** control sets the voltage at which the trigger operates.



# 15.4.2 • Advanced edge

This trigger type includes the standard rising and falling edge triggers, but also includes the rising or falling edge trigger that was mentioned earlier in this article. The edge type is selected by the **Direction** control. The **Hysteresis** control sets the distance between the two trigger thresholds to improve noise rejection.

The other controls are the same as those for the simple edge trigger.

This and all the following trigger types are not compatible with *ETS* mode.

### 15.4.3



This trigger type detects a signal entering or exiting a range of voltages, called the *window*.

The **Direction** control specifies whether the trigger operates when the signal enters the window, exits it, or both.

The **Threshold 1** and **Threshold 2** controls define the upper and lower limits of the voltage window that activates the trigger. You can enter the upper and lower thresholds in either order in the two boxes, and PicoScope 6 will work out which one is the lower threshold and which one is the upper.

15.4.4

Pulse width

This trigger type detects pulses within a specified range of widths.

The **Pulse direction** control specifies whether you want to trigger on either positive or negative pulses.

The **Threshold** control operates as for the simple edge trigger type.

The **Condition** control specifies whether you are looking for pulses wider or narrower than a specified width. You can also specify two pulse widths and trigger on pulses whose widths are either inside or outside those two values.

- **Greater than** triggers on pulses wider than the specified time.
- Less than triggers on pulses which are narrower than the specified time. This is useful for finding glitches.

The **Time** control specifies the pulse width for the *Greater than* and *Less than* conditions.

- **Inside time range** triggers on pulses that are wider than **Time 1** but no wider than **Time 2**. This is useful for finding pulses that meet maximum and minimum width specifications.
- **Outside time range** does the opposite; it triggers on pulses that are either narrower than **Time 1** or wider than **Time 2**. This is useful for finding pulses that violate a width specification.

The **Time 1** and **Time 2** controls specify the minimum and maximum pulse widths for the *Inside time range* and *Outside time range* trigger types.



# 15.4.5 Interval

This mode lets you search for two successive edges of the same polarity that are separated by a specified interval of time.

The **Source** and **Threshold** controls operate as for the **Simple Edge** trigger type.

Set the **Starting edge** control to either *rising* or *falling* according to the polarity of the edges you are interested in.

Next, set the **Condition** control to one of these options:

- Greater than triggers when the second edge occurs later than Time after the first edge. This is useful for detecting missing events or interruptions in a clock waveform.
- Less than triggers when the second edge occurs earlier than **Time** after the first edge. This is 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**. This is useful for finding edges within a narrow timing range.
- **Outside time range** triggers when the second edge is earlier than **Time 1** after the first edge or later than **Time 2**. This is useful for finding spurious edges that fail to meet the timing specification.

Finally, set up **Time** (or **Time 1** and **Time 2**) to define the time interval or range of time intervals.

15.4.6 Window pulse width

This trigger type is a combination of the window trigger and the pulse width trigger. It detects when the signal enters a voltage window for a specified time or range of times.

The **Source** control operates as for the simple edge trigger type.

The **Dwell Location** control specifies whether the signal needs to dwell inside or dwell outside the window for the specified time.

The **Time**, **Time 1** and **Time 2** controls operate as for the *Pulse Width* trigger type.

The **Threshold 1** and **Threshold 2** controls operate as for the *Window* trigger type.

15.4.7 Level dropout

This trigger type is activated when the signal remains on one side of a threshold voltage for a specified period of time.

The **Source** and **Threshold** controls operate as for the simple edge trigger type.

The **Dropout** control specifies whether to trigger when the signal remains **High** or **Low**, or in **Either** state relative to the threshold.

The **Time** control specifies the time to wait after the last detected edge before triggering.



# 15.4.8 Window dropout

This trigger type is a combination of the **Level dropout trigger** and the **Window trigger**. It is activated when the signal remains inside or outside a voltage window for a specified period of time.

The **Source**, **Threshold 1** and **Threshold 2** controls operate as for the **Window** trigger type.

The Dropout and Time controls operate as for the Level dropout trigger type.

### 15.4.9 Runt trigger

As mentioned before, the above article was written after the 5000 Series oscilloscope was released and so does not cover the *Runt* trigger mode. A runt trigger has two adjustable threshold levels with hysteresis, and detects pulses that are either too low or too high depending on the pulse direction.

With a positive pulse, if a signal rises past threshold 2 and then falls past the same threshold without going through threshold 1, the trigger will be activated. The image below shows an example of a setup for runt trigger settings to capture a runt signal.

<ul> <li>∮ Simple Edge</li> <li>∮ Advanced Edge</li> </ul>	Source Pulse Direction	A V Positive Pulse V	Threshold 1 Threshold 2	850 mV 🔷 200 mV 🗢
U Window			Hysteresis	1.50 % 💭 🕤
11 Interval				
💶 Window Pulse Width				
ML Level Dropout				
ML_ Window Dropout				
<mark>ी ह्य</mark> ी Runt			[	
差 Logic				
		e that enters the window and the second threshold.	and then exits via	the same threshold
				Help Close

The example below shows a positive pulse being captured by the runt trigger. The signal enters threshold 2 on a rising edge, never goes through threshold 1 and leaves threshold 2 on a negative edge. The opposite is true for a runt trigger on negative pulse.





In summary, a runt trigger on a positive pulse will trigger the signal on a negative edge, while a runt trigger on a negative pulse will trigger the signal on a positive edge.

15.4.10



This trigger type monitors all four scope inputs, **A**, **B**, **Ext** and **AuxIO**. At the same time it compares each one to its own threshold or voltage window, and activates when some combination of the inputs meet their respective conditions. This trigger type does not support edge-triggering. All channels are either level-qualified or window-qualified, so the trigger does not wait for an edge but operates as soon as it sees a valid voltage.

-	O Level	🖲 Window
Above 🔛	Direction	Inside
Above	Threshold 1	Inside
Below	Threshold 2	Outside 600 mV
		Above Threshold 1 Below

(a) Level-qualified

(b)	Window-qualified

### Channel A or B setup for logic trigger

The **Channel A** and **Channel B** settings have the most options. Each one has a dialog to select either level-qualified or window-qualified operation.

• With level-qualification selected, the channel is active when above or below the threshold. The **Direction** and **Threshold** controls operate as for the *Simple Edge* trigger type.



• With window-qualification selected, the channel is active when inside or outside the specified voltage window. The **Direction**, **Threshold 1** and **Threshold 2** controls operate as for the *Window* trigger type.

The **Ext** and **AuxIO** settings controls have only the level-qualified options.

Each channel has a **Use** checkbox to the right of its settings control. Setting this box causes the channel to be included in the logic trigger, and clearing it causes the channel to be ignored.

The **Logic** control specifies how the four inputs are combined to produce a trigger condition. The six most common Boolean functions are provided: *AND*, *NAND*, *OR*, *NOR*, *XOR* and *XNOR*. For example, to trigger when all of the channel conditions are being met choose AND, or to trigger on none of them being met select *NOR*.

xex →□ Digital trigger

PicoScope provides a further advanced trigger type for mixed-signal oscilloscopes (MSOs). The digital trigger detects a combination of edges and states on the digital inputs of the MSO. The Digital trigger dialog gives two options for setting up the trigger: a set of buttons for selecting levels and edges, and a text box for specifying the entire pattern in one string of characters:

두 Simple Edge	
	Set Trigger Pattern
🚽 Advanced Edge	
UIII Window	
니 Pulse Width	
니 Interval	
💶 Window Pulse Width	
ML_ Level Dropout	
Window Dropout	
Runt	
전전 Digital 뉴근 Logic	Binary 🖌 100000000000000000000000000000000000
Logic	D15 D0
	Trigger when the channel levels of all the selected channels agree with the
	chosen pattern at the same time.
	Help Close

The button area has a row for each enabled digital input:

Set	Set Trigger Pattern					
	D15			₽	Ł	
	D14			₽	Ł	=
	D13			₽	L	
	D12			₽	Ł	
	D11			₽	Ł	
	D10			₽	L	
	D9			▲	Ł	
	D8			F	7	$\sim$



You can select each input to be either high or low. If neither level button is pressed, the input level will be ignored.

You can optionally select one of the digital inputs to be edge-sensitive using the rising edge and falling edge buttons. Only one input can be made edge-sensitive.

If you prefer to use the text entry box, the following text string will have the same effect:

Binary	$\sim$	F00001111XXXXXXXX	
		D15	D0

The text string consists of the following codes, one for each input:

- F falling edge (on no more than one input)
- R rising edge (on no more than one input)
- 0 low level
- 1 high level
- X don't care



# 16 Advanced math channels

This feature can be found by going into **Tools** > **Math Channels**:

Maths Channels	×
Select a Maths Channel  Built-in  Invert A  Invert B	OK Help
	Create
Loaded	Delete Duplicate
Explain what Built-in, Library and Loaded Maths Channels are,	Import Export

Click Create and the Math Channel wizard will appear:

•∿	Math Channel Wizard		
	Create a New Maths Channel		
	This wizard will guide you through the process of creating a new Maths Channel. What is a Maths Channel?		
	Don't show me this introduction page again.		
Help	< Back Next > Cancel		



Click **Next** to enter basic equations:

•	Math Channel Wizard	×
Enter the eq	uation for this Maths Channel.	
•	<pre>CEC . X / A B C D V . Advanced &gt;&gt;</pre>	
Help	< Back Next > Cancel	

Click **Advanced** to reveal further buttons. Here is the default set of advanced buttons (under the **Main** heading):

Enter the equation for this	Enter the equation for this Maths Channel.					
+ - × ( ) Ad Main Trigonometric Buffered Filters						
Help < Back Next > Cancel						



The min, max,  $\bar{x}$  (average) and peak (also known as envelope) are grouped in the **Buffered** section because they can work on multiple waveforms in the buffer. Here,  $\bar{x}$  is chosen on channel A:

<b>ч</b> М	ath Channel Wizard	×
Enter the equation for this Maths	Channel.	
( ) Advanced Main Trigonometric	$(A + B)/(C + D) CE C$ / A B C D \(\neq \) <<< inin max $\bar{x}$ 7 8 9 eak 4 5 6 1 2 3 0 . E	
Help	< Back Next > Cancel	

After clicking **Next**, the channel name and colour can be defined:

<b>*</b> ъ	Math Channel Wizard	×
Edit the channel name and ch	annel color.	
Name	ChA Waveform Averaging	
Color	Magenta V Custom	
Help	< Back Next > Cance	



To define the units and ranges, click **Next**. The range can be left as automatic, or you can select the **Override** box to customise it:

<b>A</b>	Math Channel Wizard	×
Select the ran	ge and units for your Maths Channel.	
	Units Long Name volts Short Name V Range V Override automatic range selection. Min -2 Max 2	
Help	< Back Next > Cance	

The next screen summarises the actions taken. Select the **Finish** button here to save the settings:

<b>Ф</b>	Math Channel Wizard	×
	Finished.	
	The Maths Channel creation process is complete. Press Finish to continue.	
	ChA Waveform Averaging Formula, average(A) Color, Magenta Custom range scale: -2 to 2 Automatic unit selection.	
Help	< Back Finish Cance	1



When finished, the newly created **Math** channel appears in the **Library**:

Maths Channels	×
Select a Maths Channel          Built-in       Invert A         Invert B       Invert B         A + B       A - B         A + B       A - B         A + B       A / B         Library       ChA Waveform Averaging         Loaded       A	OK Help Create Edit Delete Duplicate
Explain what Built-in, Library and Loaded Maths Channels are.	Export

Click the tick box and select **OK** to enable the newly created channel:

Maths Channels	×
Select a Maths Channel          Built-in <ul> <li>Invert A</li> <li>Invert B</li> <li>A + B</li> <li>A - B</li> <li>A + B</li> <li>Cha Waveform Averaging</li> <li>Loaded</li> </ul>	OK Help Create Edit Delete Duplicate
Explain what Built-in, Library and Loaded Maths Channels are.	Import Export


The signal below shows a very noisy sine wave. Averaging the signal over a number of buffers cleans up the signal dramatically.



The image below shows the peak (also called envelope) taken from a signal that is sweeping up and down in frequency. This takes the min and max pairs and draws a line between them.





The peak measurement is the same as drawing a line between the min and max measurements. The image below illustrates this more clearly. This mode is useful for analysing jitter on a signal.



#### 16.1.1 Frequency

The frequency measurement is useful for detecting anomalies in a signal. The example below is of a crank sensor in a car on a long timebase of 1 s/div.





# Applying a frequency to the math channel:

۰	Math Channel Wizard	×
Enter the equation for this	s Maths Channel.	
+ - ×	freq(A! CE C	
<ul> <li>Main</li> <li>Trigonometric</li> <li>Buffered</li> <li>Filters</li> </ul>	x^y     In     e^xx     7     8     9       freq     duty     log     4     5     6       d/dx     ſ     sqrt     1     2     3       norm     abs     0     .     E	
Help	< Back Next > Cance	

You can now choose an automatic range or manually enter a range:

<b>b</b>	Math Channel Wizard	×
Select the ran	ige and units for your Maths Channel.	
	Units Long Name hertz Short Name Hz	
	Range     Image: Override automatic range selection.       Min     0       Max     6.25E+07	
Help	< Back Next > Cance	



Choosing the automatic range and then enabling the math channel seems to have no effect apart from creating a new axis on the right-hand side. This is because the automatic frequency range when selected defaults to a much higher frequency and so any low frequencies are invisible.



Going back to the math channel and editing the ranges to be manually configured, and then setting the upper limit to 5000 Hz like in the image below, results in a much clearer image of the frequency changes across the time axis:

<b>₽</b> v	Math Channel Wizard	×
Select the ran	ge and units for your Maths Channel.	
	Units Long Name hertz Short Name Hz Range Override automatic range selection. Min 0 Max 5000	
Help	< Back Next > Cancel	



Zoom can be used for a closer look at areas where frequency is changing.





The result shows a more detailed view of the signal where the missing tooth on a crank sensor is detected.





# 17 Advanced mask testing

# 17.1 Editing masks

Once a mask has been created it can be modified, and polygons can be added or removed. Right-click on the screen to access the **Views** menu and select **Edit Mask**.



A table and a number of points now become available. The table represents the points of the polygon giving their X and Y coordinates.





Each of the points in the polygon can be dragged.



Alternatively a whole polygon can be removed.





A new polygon can also be added.



Once the polygon is added it can be moved around. The various points can be adjusted either by using the mouse to add points or by using the table provided.







Once the mask modifications are complete, select Exit Mask Edit in the Views menu.





To save a mask, right-click on the screen to open the Views menu and select Mask > Save Mask.





# 18 Advanced arbitrary waveform generator (AWG)

Changing the frequency of an AWG signal is different to changing the frequency of a standard signal. The standard signal generator frequency represents one cycle from a waveform, while an AWG waveform can contain multiple cycles.

The example below shows a 1 kHz sine wave created from the standard signal generator.



Accessing the AWG and creating a sine wave with 5 cycles.





Applying this will produce a 5 kHz sine wave, even though the frequency is set at 1 kHz.



pico



# 18.1 Using the editor

Arbitrary...

The arbitrary waveform editor allows a greater degree of flexibility in creating a custom waveform. With the AWG the minimum values are defined between -1 and +1. These have no units, so the actual output level will depend on what amplitude has been selected in the software. For example, 1 V amplitude will give  $\pm 1$  V, and 2 V amplitude will give  $\pm 2$  V. The amplitude is adjusted in the main signal generator controls.

Arbitrary Waveform Generator		2				
🏹 🐺 🐺 🥖 🥖 🛄 Samples 128	Ý	🚬 🕅 🄊 🤊 🥝				
$\Box \land \land \land \land \land \land \land$ Cycles 1	🕀 Min -0.50	Max 0.50	Duty Cycl	e 50 %		
+1						
0						128
0						120
-1						
(						
Cursor at:				ОК	Cancel Apply	Help

#### 18.1.1 Importing and exporting from within the editor

The editor includes some additional import and export functions.





Importing from a channel is a particularly useful feature that allows captured waveforms to be imported into the editor. The example below shows a crank sensor signal. The area between the rulers is the area of interest as it shows one complete cycle of the crankshaft.



Go into the editor and select the **Import From Channel** button to show a number of options, such as which channel and section of the waveform channel are be imported:

Import from a Channel	×
Select Channel	ОК
Select Samples	Cancel
• between samples 1 1 16384 1	Help
O between Time rulers	
Number of samples on channel A : 625004	
Details	
Samples being imported: 16383	
AWG limit: 32768	



Two options are available between samples or between time rulers. In this example time rulers are required:

Import from a Channel	×
Select Channel	ОК
Select Samples	Cancel Help
between Time rulers	
Number of samples on channel A : 9925 Details	
Samples being imported: 9921 AWG limit: 32768	

Click **OK** to show the imported data from channel A between the two rulers:





The waveform can now be applied. The image below shows the waveform at a much higher frequency and a lower voltage than the original:



This can be altered by going into the main **Signal Generator** controls and dropping the frequency to a more appropriate number, then increasing the voltage level.





# 18.1.2 Smooth drawing mode

Using the drawing icons, a waveform can be drawn. The *Smooth drawing* mode *lacts* like a paintbrush.



### 18.1.3 Line drawing mode

The *Line drawing* mode *law* draws straight lines.



18.1.4 Clearing

The **Clear All** button **Clears** the screen and leaves a line going through zero.

+1				
0				1024
-1				



# 18.1.5 🤊 약 Undo/Redo

The waveform editor keeps track of any adjustments made to a waveform. If a mistake is made, the **Undo** button can go back to the first step taken. This does not include zooming as this has separate controls, but every other operation can be undone. If the **Undo** button is pressed by mistake, the **Redo** button can go forward one step at a time, all the way to the latest modification made.

# 18.1.6 🔍 🤍 Zoom

The **Zoom** buttons zoom horizontally in or out around a chosen point. The **Soom To Full View** button cancels all zoom and displays the whole waveform.

# 18.1.7 Waveform settings

A number of predefined shapes can be selected. The number of cycles can be adjusted, the minimum and maximum values can be adjusted, and the duty cycle can be varied.



For example, the image below is produced by a square wave that has 10 cycles, with the minimum amplitude set to 0 and the max set at 0.9, with a duty cycle of 75%.



#### 18.1.8 Normalise

The **Normalise** button 4 expands the waveform vertically by bringing the biggest peak to either +1 or -1. For example, for a square wave that has a minimum value of -0.5 and maximum of +0.7, the **Normalise** button will bring the 0.7 to 1 and the -0.5 will increase in amplitude by the same ratio.

More specifically, the ratio of the increase is 1/0.7 = 1.4286, so multiplying this by -0.5 gives -0.7143. Therefore the normalised waveform will range from -0.7143 to 1.



The image below shows the original waveform.



The image below shows after normalising the waveform.



#### 18.1.9 Bit stream mode

In Bit stream mode you can define a pulse train in hex or binary, and set the logic levels.

Create bina	ry stream - Available Samples : 128	×
Binary	10101010101010101111	]
Hex	AAAAF	
Logic High	1.00 V	
Logic Low	0.00 🔍 V	
	OK Cancel	



Arbitrary Waveform Generator	11	MA MA	
🏹 🐺 🐺 🥖 🥖 🛄 Samples 128	🕀 🎦 🚻 🤊 🥐 🤄		
	Min 0.00 Max 1.00	Duty Cycle 50 %	
+1			
0	]		128
-1			
Cursor at: -0.152 , 71		ОК	Cancel Apply Help

# 18.1.10 Number of samples

In the image above the pulses do not look very steep. This is because the number of samples is only 128. Increase this to produce better pulses. The maximum number of samples varies between products.

Arbitrary Waveform Generator			
🏹 🐺 🐺 🥖 🥖 🕅 Samples 16384	🗢 🕐 🚻 🔄		
$\Box \land \land \land \land \land \land \land \land$	➡ Min 0.00 ➡ Max 1.0	Duty Cycle 50 %	
+1			
			16384
-1			
Cursor at: 0.97 , 10		ОК	Cancel Apply Help



# 19 Preferences

The **Preferences** section allows you to set options for the PicoScope software. This can be accessed from the **Tools** menu by selecting **Preferences**:

Eile	Edit	⊻iews	Measurements	<u>T</u> oo	ls <u>H</u> elp	
л 🔊	ш	Ц 🖗	🚮 50 μs/div	2	Custom Pro <u>b</u> es	
A Aut	0	V DC		Σ	Maths Channels	
<b>50.0</b>				2	<u>R</u> eference Waveforms	
mV				XX 0101	Serial Decoding	
					<u>A</u> larms	
40.0				Я	Mas <u>k</u> s	• .
				Ŧ	Macro Recorder	
					Preferences	
30.0						

The section is organized under tabs:

Regional	& Language	Printing	Colors	Options
General	Power Mana	agement	Sampling	Keyboard
	Reset 'Do	on't show this aga	ain' dialogs	
		Reset preference	es	
Waveform Bu	ffer			
	ximum number of v actual number will orm.			
Maximum W	aveforms 32	×		
Collection Tim	e Units	_		
<ul> <li>Times p</li> </ul>	er Division			
O Total c	ollection time			
Measurement	Statistics			
Sets the nur calculated	mber of captures o	over which measu	urements statistic	s are
	[000] ntures		20 🌩	
Statistics Ca	puires [2 - 1000]			

# 19.1 General

# 19.1.1 Resetting

The **Reset Preferences** button resets anything that has been changed in the preferences back to default settings.

Reset 'Don't show this again' dialogs	
Reset preferences	



19.1.2	Waveform buffer
Waveform Bu	fer
	cimum number of waveforms that can be stored in the waveform actual number will depend on how many samples are collected in rm.
Maximum W	aveforms 32

By default this is set to 32, but it can be increased to be up to 10,000. The actual number of buffers may vary due to a number of factors; the device that is being used, whether the device is in *Block* or *Streaming* mode, the number of samples per buffer, and the type of triggering used.

# Example

On a device in *Block* mode with external memory modules, the total number of buffers can be calculated approximately. For example, the PicoScope 3206B has 128 MS of memory. If PicoScope 6 is set to have a maximum of 32 buffers, each buffer must be no larger than 4 MS if all buffers are to be utilised. If the number of samples is increased further then the number of buffers will decrease.

In *Streaming* mode things get a little less straightforward. In PicoScope 6 the streaming rate is limited to 1 MS/s, or less with longer timebases. Since the device is streaming to the PC, the number of samples does not depend on the scope's buffer size, so different rules apply. Using the 3206 as an example, at 10 s/div the device can stream at 1 MS/s, giving a total of 100 MS, so only 1 buffer can be used. If 2 s/div is chosen, this equates to 20 MS per buffer, but as 12 buffers can be collected this gives a total of 240 MS.

#### **Collection time units**

By default, the timebase of the scope is given in seconds per division. The total collection time, on the other hand, represents the time across the whole screen. For example, a 10 ms/div timebase when changed to total collection time would become 100 ms.

Collection Time Units	
<ul> <li>Times per Division</li> <li>Total collection time</li> </ul>	

<u>F</u> ile <u>E</u> dit	<u>V</u> iews	<u>M</u> easurements
🔊 🖵 🔟	us 🦻 📓	10 ms/div 🖂
A 🛓 ±5 V	Mac	S B S Off
5.0		
v		

<u>F</u> ile <u>E</u> dit	<u>V</u> iews <u>N</u>	<u>d</u> easurements
🔼 ЦТ	uls 🦻 🖓	100 ms 🖂
A 🖌 ±5 V	AC N	🕗 🛛 B 🖕 Off
<b>5.0</b>		
V:		



#### 19.1.3 Measurement statistics

Measurement Statistics		
Sets the number of captures over which measurem calculated	ients st	tatistics are
Statistics Captures [2 - 1000]	20	

By default this is set at 20 and can be increased to 1000. These are the statistics over a number of captures that are presented when a measurement is added. The image below shows the min, max, average and standard deviation over 20 captures.

Cha	annel	Name	Span	Value	Min	Max	Average	σ	Capture Count	
A		Frequency	Whole trace	1 kHz	1 kHz	1 kHz	1 kHz	324.4 mHz	20	

#### 19.2 Power management

Regional & Language Printing Colors Options	ОК
General Power Management Sampling Keyboard	
Select the power mode to configure Mains	Cancel
Capture Rate	Apply
Reduce the number of waveforms per second that the scope will capture to extend battery life or allow other applications to run faster. 30 Captures per second	Help
Current power mode: Mains	

This control limits the speed at which PicoScope captures data from the scope. The other PicoScope settings, the type of scope and the speed of the computer will all affect whether this limit can actually be reached. PicoScope automatically selects the appropriate limit according to whether the 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 the computer is running on mains (line) power for maximum performance. If other applications run too slowly on the PC while PicoScope is capturing, then reduce the capture rate limit. When the computer is running on battery power, PicoScope imposes a performance limit to save the battery. This can be increased manually, but this will cause the battery power to drain very quickly.



# 19.3 Sampling

19.3.1	Adjusting waveform buffers.
--------	-----------------------------

_	& Language	Printing	Colors	Options	ОК
General	Power Mana	gement	Sampling	Keyboard	
					Cancel
Slow Sampling	Transition			2	( Annhy
	ection time at which				( Apply
	s the mode where P on time has expired		late the screen b	efore the	Help
Collection Tir	ne 200 ms/div	$\bigtriangledown$			
	n device specificati				
	g mode at the requi le possible will be us		ne, in which case	the nearest	
	npling transition for		ice: 200 ms/div		
			,		
Slow Sampling	Display				
Display p	previous Waveform	Buffer			
Display p	previous Waveform	Buffer			
		Buffer			
		Buffer			
	plation	Buffer			
Sin(x)/x Interpo	plation	On Off	activates when o	perating at	
Sin(x)/x Interpo		On Off		perating at	
Sin(x)/x Interpo	olation	On Off ch interpolation ble only in scope		perating at	

#### 19.3.2 Slow sampling transition

This alters the timebase at which the device changes from *Block* mode to *Streaming* mode. By default this is set at 200 ms/div.

There are two modes of operation: *Block* mode and *Streaming* mode. In *Block* mode the device captures data to the device's memory and then transfers it to the PC, so the trace will appear on the screen once the buffer is complete. In *Streaming* mode the device can continuously stream data to the PC, so the trace will be drawn in real time. The timebase at which the device changes from *Block* mode to *Streaming* mode can be altered from 100 ms/div to 500 s/div.



# 19.3.3 Slow sampling display

This displays the previous buffer as the new one is being drawn. The image below gives a clearer view of this.



#### 19.3.4 Sin(x)/x interpolation

PicoScope 6 uses sin(x)/x interpolation to draw the waveform on the screen. This means that fewer samples are required to draw a waveform accurately than with linear interpolation. A waveform using linear interpolation draws a line from one sample to the other, while sin(x)/x interpolation uses an algorithm that requires fewer samples to draw a waveform. To get a good representation of a signal when using linear interpolation, the sample rate has to be at least 5 or even 10 times higher than the highest frequency in the signal, while with sin(x)/x it only needs to be 2.5 times higher.



# 19.4 Colors

In this section the traces, background, masks and a number of other aspects of the software can be have the colour changed. The line thickness of the trace and the grid can also be altered. The example below shows the default colours changed to look like an old phosphor oscilloscope:





# 19.5 Keyboard shortcuts

PicoScope 6 now allows the use of shortcuts to the vast majority of the features. These can be accessed from the **Preferences** section under the **Keyboard** tab.

Regional & Language Printing Colors	Options	ОК
General Power Management Sampling	Keyboa	
		Cancel
Keyboard Shortcuts		
⊡ AutoSetup	A	Apply
AutoSetup		
	=	Help
Buffer.Filtered		
First		
Last		
Next		
Previous		
Filter.Next		
Filter.Previous		
···· Next		
Previous		
AnalogOffset.Decrement AnalogOffset.Increment		
	-	
Press shortcut Keys:		
Press shortcut keys.		
	Assign	
	Clear	

Sections where the shortcuts apply:

🕀 Buffer	
🗄 Channel	
Collection Time	
Config	
···· Notes	
NumberOf Samples	
• Peristence	
Run	Space



The example below will be used to create a shortcut for the signal generator.

Persistence		
E Print		
Run	Space	
E Settings		
Siggen		=
Amplitude.Decrement		
Amplitude.Increment		
Enabled.Clear		
···· Enabled.Set		
Enabled.Toggle		
Frequency.Decrement		
Frequency.Increment		
··· Offset.Decrement		
···· Offset.Increment		
• Siggen.Sweep		
WaveType.Next		
····· WaveType.Previous		
Spectrum		
Tools		
	Press shortcut Keys:	
		Assign
		roaigin

To assign a shortcut the desired action must first be selected. In the example below it is *Enabled.Set*, which enables the signal generator.

Run	Space	
+ Settings		ſ
Siggen		
Amplitude.Decrement		
Amplitude.Increment		
Enabled.Clear		
Enabled.Set		
Enabled.Tbggle		
Frequency.Decrement		
Frequency.Increment		
···· Offset.Decrement		
··· Offset.Increment		
Siggen.Sweep		
WaveType.Next		
WaveType.Previous		
Spectrum		
Tools		
	Press shortcut Keys:	
		Assign
		Assign
		Clear



Then the **Assign** button is pressed and the shortcut can be typed in.

Persistence		
Print		
Run	Space	
Settings		
Siggen		:
Amplitude.Decrement		
- Amplitude.Increment		
Enabled Clear		
- Enabled.Set	Ctrl + E	
Enabled.Toggle		
Frequency.Decrement		
- Frequency.Increment		
Offset.Decrement		
- Offset.Increment		
Siggen.Sweep		
WaveType.Next WaveType.Previous		
	Press shortcut Keys:	
	Ctrl + E	Assign
	Ctrl + E	Assign

A total of 4 keys can be used including 3 modifiers (Ctrl, Alt and Shift) as the example below shows.

Regional	& Language	Printing	Colors	Options
General	Power Mana	gement	Sampling	Keyboard
Keyboard Sho	rtcuts			
	lDefaults etDefaults eDefaults		Space Ctrl + E Ctrl + Alt + Shift + Ctrl + Alt + Shift +	
		Press shortcut K Ctrl + Alt + Shi		Assign Clear

Click **OK** and these shortcuts can now be used.



# 19.5.1 Keyboard maps

A drop-down menu at the foot of the **Keyboard** dialog allows you to save and load collections of keyboard shortcuts called **keyboard maps**. Pico provides a number of standard maps, but you can also create your own:

Preferences	×
Regional & Language         Printing         Colors         Options         Updates           General         Power Management         Sampling         Keyboard	ОК
Keyboard Shortcuts	Cancel
Show Full Key List	Apply
Auto Setup Auto Setup Buffer Next Previous Channel Ch	Help
Advanced (QWERTV) Advanced (DVORAK) User Import	

To create your own map, change the keyboard shortcuts as explained above and then click **Export**. This creates a *.pskeys* file containing your settings. To retrieve these settings later, select **Import** from the drop-down list.



# 19.6 Regional & language

In this section the language of the software can be changed and metric or U.S. units can be selected. Simply select the language or units and click **OK**:



You will then be shown a prompt asking whether you want to restart the software now. Click **Yes** to automatically exit and restart the software with the language and units that have just been selected:

Preferences	>
General Power Management Sampling Keyboard Regional & Language Printing Colors Options Updates	ОК
Language Mode Selection	Cancel
Language German (Deutsch)	Apply
Measurement System Specify which measurement Syste Restart Now	
Yes No	



# 19.7 Options

In this section a number of advanced features can be hidden from view. The software can also be set up to remember the last device connected, so that next time PicoScope is loaded it will automatically search for the last device connected. This is particularly useful when multiple devices are connected:

Preferences	×
General     Power Management     Sampling     Keyboard       Regional & Language     Printing     Colors     Options     Updates       Device Startup Settings     Remember the last device connected and attempt to connect by default     Remember Last Device	OK Cancel Apply Help
Advanced Features Enable PicoScope 6 advanced features.  Spectrum Persistence Recent Files  Advanced Features.  Move Trigger toolbar to top Recent Files  Recent Files  Reset recent files list	



The recent file list is the history of the files that have been opened. This can be modified to show up to 32 items. The image below shows 3 thumbnail views in the **Recent Files** list.



# 19.8 Printing

When printing a waveform some default text appears.

General Po	wer Management	Sampling	Keyboard
Regional & Langua	ge Printing	Colors	Options
Default Print Settings			
Set the default contac	ct information for printing		
Company Name	Pico Technology		
Company Website	www.picotech.com		
Telephone Number	+44-1480-396395		
Company Logo			
		Browse Clear	
	Reset	)	



This can be modified by editing the appropriate fields:

Preferences	×
General Power Management Sampling Keyboard Regional & Language Printing Colors Options Updates	ОК
Default Print Settings	Cancel
Set the default contact information for printing	Apply
Company Name Stahlgruber	Help
Company Website http://www.stahlgruber.de/	
Telephone Number	
Company Logo	

File > Print Preview reveals the changed information:





# 20 The automotive software

The automotive software includes the same features as the test and measurement software, with some additional automotive-specific functions.

# 20.1 Automotive menu

The **Automotive** menu includes a number of tests that can be performed on the vehicle:



When you select an automotive test, a help file appears containing instructions and information for the test.

A saved example waveform is also shown. This will contain all the relevant settings to carry out your test, which includes correct timebase, voltage range, custom probe and triggering. You can then start the test by clicking **Go** and **Stop**.

The settings may need to be adjusted a little, as the waveform will vary depending on the vehicle, but they provide a good starting point.

The example below runs through a *Primary Voltage Ignition* test. First, select **Ignition > Distributor > Primary Voltage** from the **Automotive** menu:





The help file will appear with the relevant information and instructions.

	pico
	How to connect the oscilloscope     Example waveform and notes     Technical information
	Close this window Main menu
	How to connect the oscilloscope when testing:- a primary ignition circuit
black crocodile c the red moulding (p	nuator into channel A on the PicoScope and plug a BNC test lead into the attenuator. Placing a large lip on the test lead with the black moulding (negative) and a small red crocodile clip onto the test lead with positive). Place the black crocodile clip onto the battery negative terminal and probe the coil's negative (or I with the small red crocodile clip as illustrated in Figure 44.1.

Close or move the help file to view the example waveform, which shows the appropriate settings:



Check or uncheck the **Show Web Help** option in the **Automotive** menu to enable or disable the help file:

Charging and Starting	•
Sensors	•
Actuators	•
Ignition	•
Communication Networks	•
Advanced Tests	•
Advanced Accessories	•
Motorcycle-Specific	•
Show Web Help	



# 20.2 Waveform library

The waveform library is a major innovation in PicoScope that links your personal copy of the software to the community of PicoScope users around the world. To participate, all you need is an internet connection and an account on the *picoauto.com* forum.

Once you have these prerequisites, run PicoScope and go to **File > Waveform Library**. This opens the **Waveform Library Browser**. Log in with your forum credentials, and the browser will show a selection of waveforms from the library.

<b>4</b>	Waveform Library – 🗖 🗙
7 Search Options	Found 4 out of 743 waveforms. Showing 1 to 4 jeff Home My Waveforms Log Out
Vehicle details ViN / ID Code Make Nissan Vin Model [Select Model] Vin Generation Year <yyy-yyy> Transmission Year Conditions Engine details Engine Code Primary Fuel Petrol (4) V</yyy-yyy>	Open Waveform 12.44 (MB)       Car Details         Make/Model: Nissan / Pulsar         Year: 2000         Transmission: Manual         Engine code: QR15DE         Primary fuel: Petrol         Cylinders: 4         Configuration: Inline         Engine code: QP15DE         Primary fuel: Petrol         Cylinders: 4         Configuration: Inline         Engine capacity: 1.5 L         ECU make/model: Denso /         Test conditions: Key on Engine Running Idle         Notes: Test of crank Vs cam sensors for         compartision of vehicle with streached         timming chain         Uploaded by: AESwai
Secondary Fuel Cylinders Configuration Capacity (L) Capacity(cu in) ECU Make [Select Make]	A     Crankshaft sensor       Status: Good       B     Camshaft sensor       Load     Status: Good       C     COP ignition trigger signal
ECU Model Channel details	Load
Add channel Select Good/Bad/Unknown Uist view Grid view	Car Details Make/Model: Nissan / X-Trail Year: 2004 Transmission: Manual Engine code: QR25 Primary fuel: Petrol Test conditions: Key on Engine Running Idle Uploaded by: hijakd

Use the data fields on the left to narrow down the selection to waveforms relevant to your diagnostic problem. If you find a waveform that you would like to display on your own PicoScope screen, click *Open Waveform* to load the file into PicoScope. This replaces all of your settings and waveforms with those from the library. Alternatively, click *Load* to copy the waveform to PicoScope as a reference waveform. Using this method, any waveforms that you have already captured remain on the display, with the library waveform displayed in a paler color.

If you wish, you can share the results of your investigation with the PicoScope community. This option is presented when you save the waveform using **File > Save**. Waveforms created by Pico Technology's automotive specialists carry the "Verified by Pico Technology" mark.



# 20.3 Custom probes

The automotive software has a range of additional default custom probes available:



# 20.4 Hidden features

Some of the features available in the test and measurement software may be hidden here as they are not commonly used, for example *Spectrum* and *Persistence* modes. To enable these, select **Preferences** from the **Tools** menu:



Select the **Options** tab to see the advanced features that have been hidden. The image below shows that *Spectrum*, *Persistence* and some triggering options aren't selected:

Preferences	×
General Power Management Sampling Keyboard Regional & Language Printing Colors Options	ОК
Device Startup Settings Remembers the last device connected and attempt to connect by default	Cancel
Remember Last Device	Help
Advanced Features Enable PicoScope advanced features.	
Spectrum Trigger Delay Persistence Rapid Trigger	
I Zoom Overview I RPM	
Recent Files	
Reset recent files list	



Tick these boxes to re-enable the features:

Preferences	
General       Power Management       Sampling       Keyboard         Regional & Language       Printing       Colors       Options         Device Startup Settings       Remembers the last device connected and attempt to connect by default       Image: Remember Last Device         Advanced Features       Enable PicoScope advanced features.	OK Cancel Apply Help
Image: Spectrum     Image: Trigger Delay       Image: Persistence     Image: Rapid Trigger       Image: Total Action Delay     Image: Rapid Trigger	
Recent Files	
Trigger Auto V 🖍 A V 😓 50	
🗿 🎒 Trigger 🗛 💽 🔏 🔍 🖉 50	) % 🕀 🕫 🕞 🔚 🖬

# The Triggering toolbar before and after enabling *Spectrum* and *Persistence* modes

-50.0	-40.0 -50.0 -10.0 x10 µs Rapid Mone Auto Single Rapid Auto Trigger Auto Trigger
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A ₁ Auto ♥ DC ♥ B ₁ Off	

# The toolbars before and after enabling *Spectrum* and *Persistence* modes

# 20.5 Rotation rulers

The <u>phase rulers</u> mentioned earlier are called "rotation rulers" in the automotive version of PicoScope. They can be used to mark the four phases of a four-stroke engine. You can change the default 360 label on the second ruler to 720 to show the correct camshaft angle. To do this, double-click the "360" label and type "720".



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