

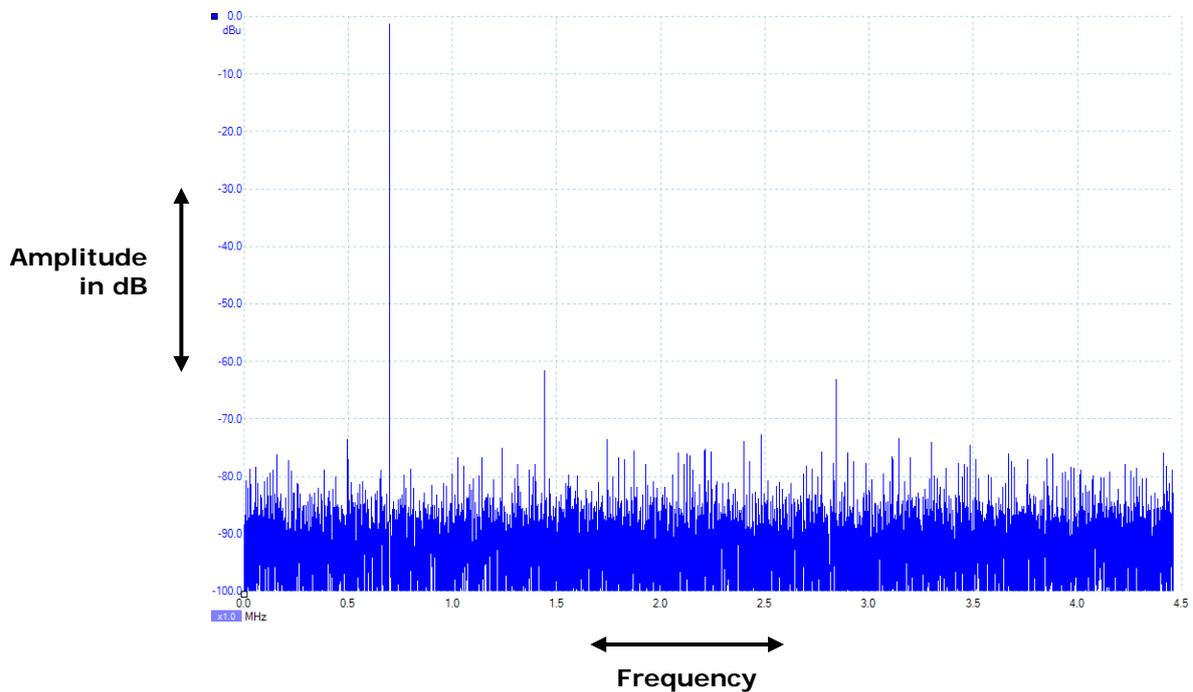
# PicoScope 6 spectrum mode



## 1 Basic controls

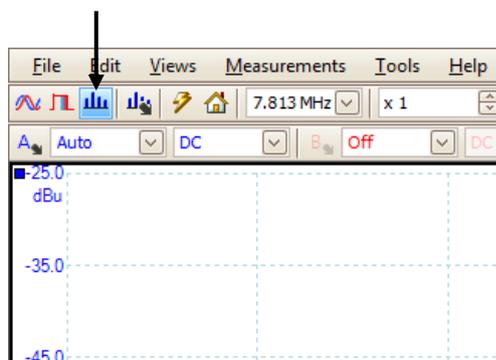
*Spectrum* mode plots amplitude on the vertical axis versus frequency on the horizontal axis. The vertical range is measured in dB (decibels) and the horizontal range in Hz (hertz). The *Spectrum* mode is useful for analysing the frequency components of a signal.

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.

**Spectrum Mode button**



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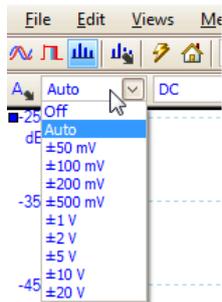


## 1.1 Voltage range

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.  $\pm 100$  mV,  $\pm 200$  mV,  $\pm 500$  mV,  $\pm 1$  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  $\pm 20$  V range is split into 10 divisions.

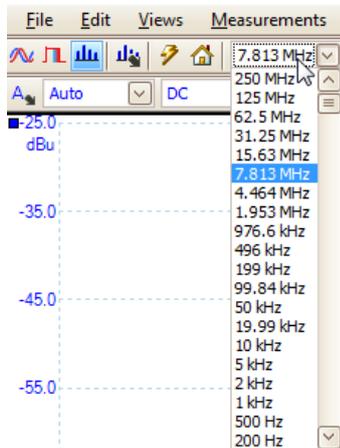
The minimum and maximum voltage range varies between products.

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.



## 1.2 Frequency range

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

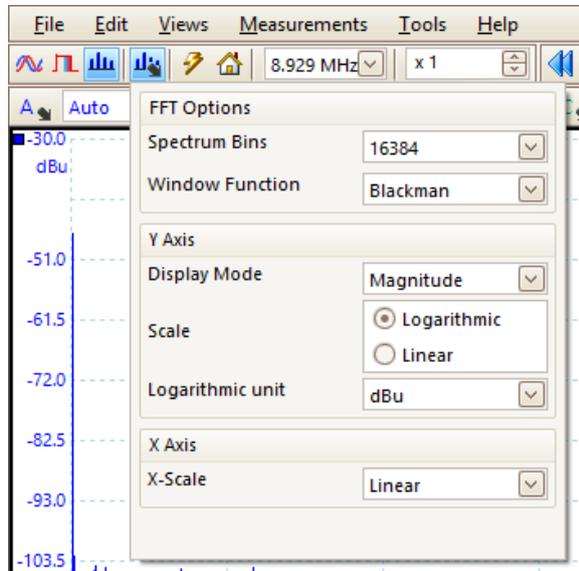


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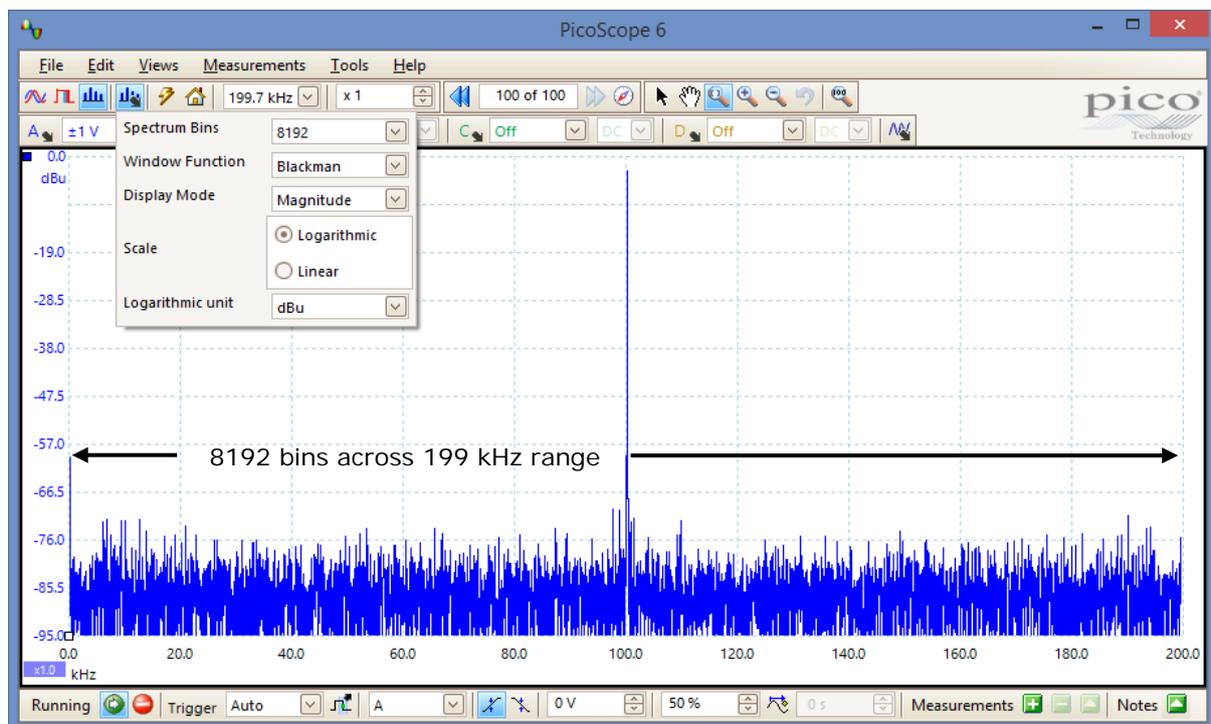
## 2 Spectrum options

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



### 2.1 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:



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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.

## 2.2 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
<b>Blackman</b>	1.68	-58	18	Often used for audio work.
<b>Gaussian</b>	1.33 to 1.79	-42 to -69	6	Gives minimal time and frequency errors.
<b>Triangular</b>	1.28	-27	12	Also called Bartlett window.
<b>Hamming</b>	1.30	-41.9	6	Also called Raised sine-squared. Used in speech analysis.
<b>Hann</b>	1.20 to 1.86	-23 to -47	12 to 30	Also called sine-squared. Used for audio & vibration.
<b>Blackman-Harris</b>	1.90	-92	6	General-purpose.
<b>Flat-top</b>	2.94	-44	6	Negligible pass-band ripple. Used mainly for calibration.
<b>Rectangular</b>	0.89	-13.2	6	No fading. Maximal sharpness. Used for short transients.

## 2.3 Display mode

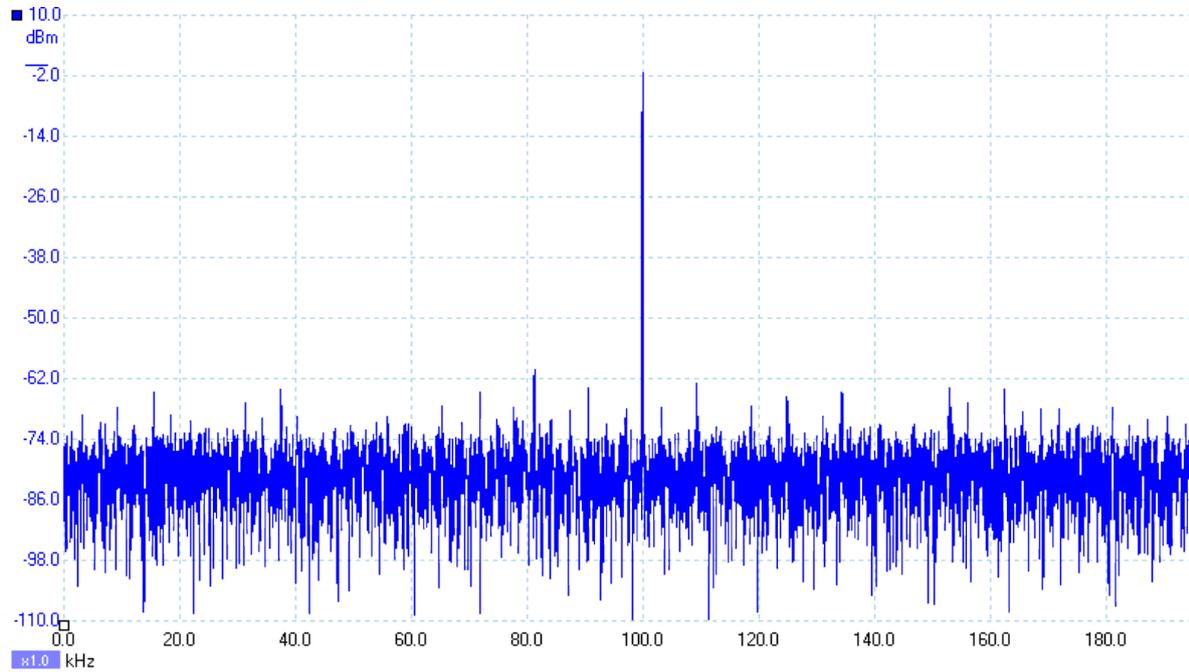
Three display modes are available; *Magnitude*, *Average* or *Peak Hold*.

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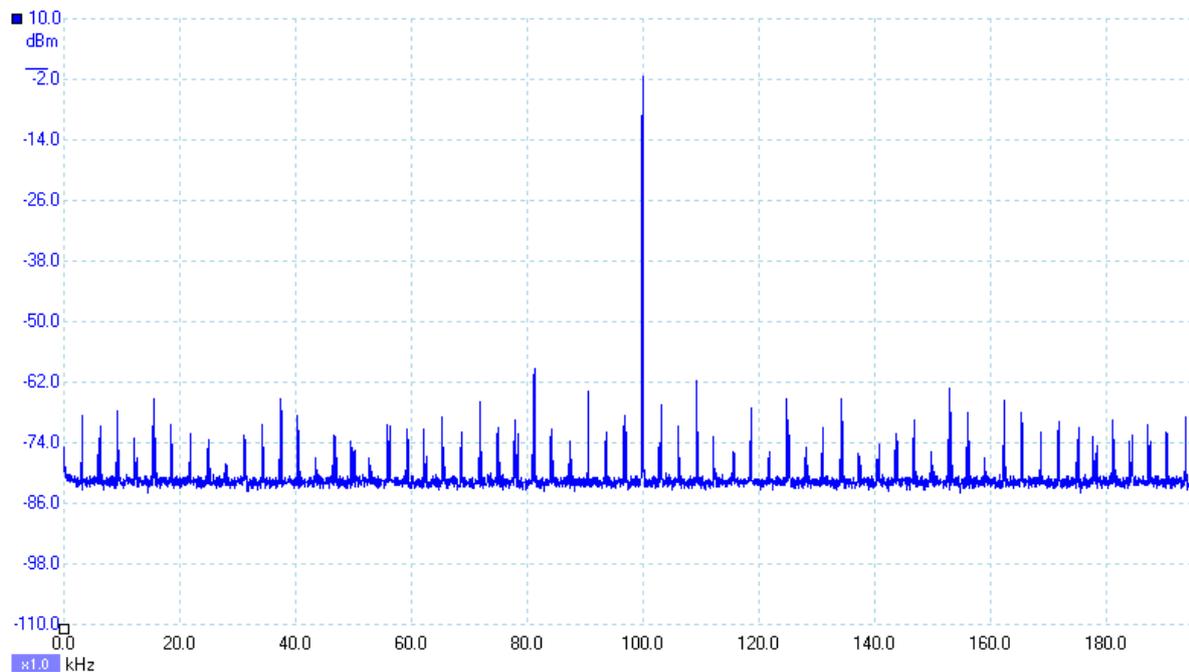
## Magnitude

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.

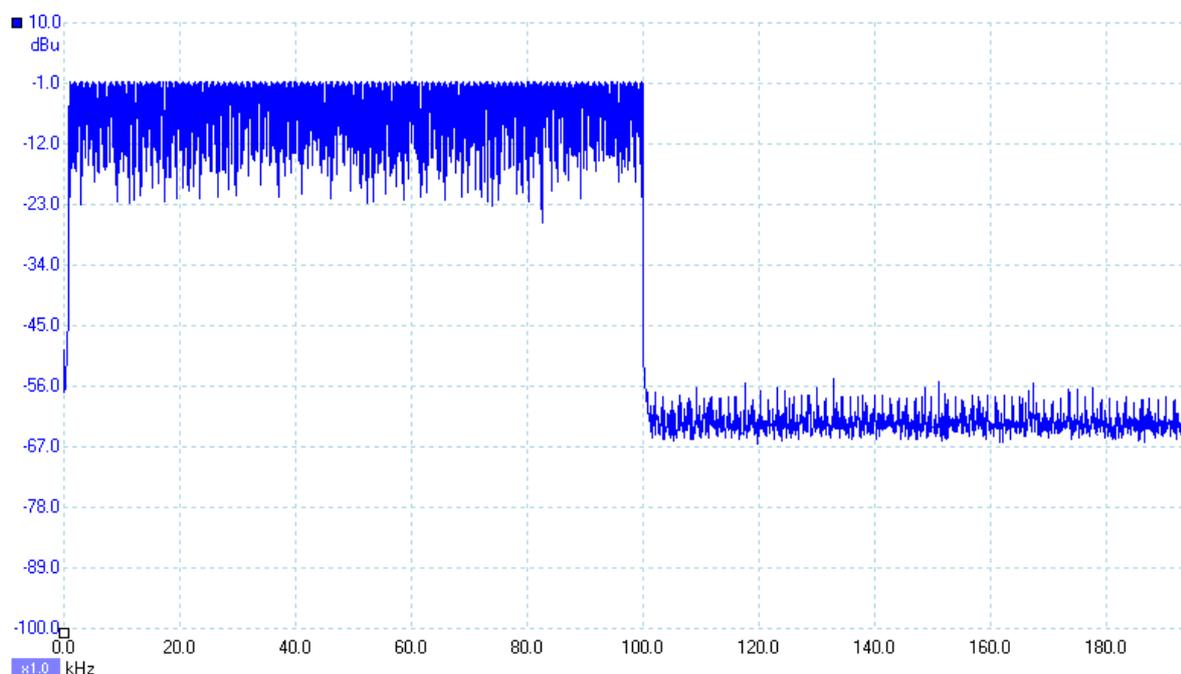


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## Peak Hold

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.



## 2.4 Scale

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

- Linear** The vertical axis is scaled in volts.
- Logarithmic** The vertical axis is scaled in decibels, referred to the level selected below in the **Logarithmic unit** control.
- dBV** Reference level is 1 volt.
- dBu** Reference level is 1 milliwatt with a load resistance of 600 ohms. This corresponds to a voltage of about 775 mV.
- dBm** Reference level is one milliwatt into the specified load impedance. 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.

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Spectrum Bins: 16384  
Window Function: Blackman  
Display Mode: Magnitude  
Scale:  Logarithmic  Linear  
Logarithmic unit: dBm  
600  $\Omega$   
OK Apply Cancel

Spectrum Bins: 16384  
Window Function: Blackman  
Display Mode: Magnitude  
Scale:  Logarithmic  Linear  
Logarithmic unit: Arbitrary dB  
774.6 mV  
OK Apply Cancel

## 2.5 X Axis

The x axis can be set to either linear or  $\log_{10}$ :

