

Oscilloscope Review

Cleverscope Ltd
28 Ranfurly Rd
Epsom 1023
Auckland, New Zealand

Ph +64 9 524 7456
Fax +64 9 524 7457
www.cleverscope.com
info@cleverscope.com

v1.1 7 April 2008

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Oscilloscope Review

This Oscilloscope review compares the cleverscope CS328A with two popular stand-alone scopes (the Tek TDS2012B and the Agilent MS6012A Megazoom MSO) and four PC hosted USB scopes (Pico 3206, Link Instruments DSO-8502, Bitscope 310 and TiePie HS3-100). Some comparative information is also provided for the PicoScope 5204. Note that the Agilent MSO6012A has replaced the 54622D, which had less memory and a slower sample rate.

We compare the User Interface by showing screen shots of each instrument, and illustrating some important points.

It is our opinion that the CS328A compares well with the Agilent Megazoom scope.



Comparison with other oscilloscopes.

This comparison only looks at key differentiators. Items in **bold** are best values. Raw values only are shown (some manufacturers use averaging, filtering or repetitive processing to improve the apparent value).

| Item | Tek TDS2012B | Agilent MSO6012A | Pico 3206 | Link Instrument DSO-8502 | Bitscope USB 310 | TiePie HS3-100 | cleverscope CS328A | Note | Feature Rank |
|---|----------------------------|--|-----------------------------|------------------------------|-------------------------------|--------------------------------|--|------|--------------|
| Analog Input FSD | 20 mV – 50V | 20 mV – 50V | ±100 mV – ±20V | 50 mV – 50V | ±513mV – ±10.8V | ±100 mV – 80V | 18 mV – 80V | 1 | Important |
| Overload Protection | 300 Vrms | 300 Vrms | ±50V | ±150V | ±100V | 200V | 300 Vrms | | Mandatory |
| Analog Channel bit resolution | 8 | 8 | 8 | 8 | 8 | 8 12 at <50 MSPS | 10 optn: 12 or 14 | 2 | Important |
| Can do hardware trigger referenced averaging | Yes (10 bit) | Yes (10 bit) | - | - | - | - | Yes (14 bit) | | Important |
| Analog Input Offset | ±2V:→200mV then ±50V | ±25V:→200mV then ±100V | None | ±5 divisions | None | None | ±3.5V → 200mV then ±80V | 3 | Important |
| Number of digital channels | 0 | 16 | 0 | 0 | 8 | 0 | 8 | | Important |
| External Trigger | Yes | Yes | Yes – lose sig gen | Yes | No | On extension connector | Yes | | Important |
| External trigger sampled, stored and displayed? | No | No | No | No | No | No | Yes | | Useful |
| Samples of storage, all inputs recorded | 2.5k | 2000k Optn:8000K | 500k | 512K | 64k | 128k | 4000k or optn: 8000K | 4 | Mandatory |
| Resolution on 2V offset signal | 0.078 mV | 0.078 mV | 15.6 mV | 15.6 mV | 15.6 mV | 15.6 mV 1mV at <50Msps | 0.018 mV | | Important |
| Tracking graph with independent time base | No | No | No | No | No | No | Yes | | Important |
| Dynamic Range (raw unprocessed) | 48 dB | 48 dB | 48 dB | 48 dB | 48 dB | 48 dB 72 dB at <50Msps | 60 dB or 72 dB or 84 dB | 5 | Important |
| Sampling Rate, all channels being sampled, MSa/sec | 1000 | 2000 | 100 | 250 | 20 | 100 | 100 | | Important |
| Maximum time resolution Resolution at 20ms width Width at max sample rate | 1ns 8 us 2.5us width | 0.5ns 10 ns 1 ms width | 10ns 40 ns 5 ms width | 4ns 40 ns 320 us width | 50ns 320 ns 640us width | 10ns 200 ns 1.3 ms width | 10ns 10ns 20 ms optn: 40ms | 6 | Important |
| Self Calibration | Yes | Yes | No | No | No | No | Yes | | Mandatory |
| Separate Earthed BNC for user/PC safety | Yes | Yes | No | ? | ? | No | Yes | | Mandatory |
| User Units | No | No | Yes | No | No | Yes | Yes | | Useful |
| Glitch resolution | 12ns | 1ns | None | None | 25 ns 1 channel | None | 10 ns | | Important |
| Peak Captured to eliminate aliasing | Yes | Yes | No | No | No | No | Yes | | Mandatory |
| Anti-alias filter | Yes – 20 MHz | Yes – 20 MHz | No | No | No | No | Yes, 20 MHz | | Useful |
| Trigger delay | Yes | Yes | No | No | Yes | No | Yes | | Useful |
| Period Trigger | Yes | Yes | Yes | Yes | No | No | Yes | | Important |

| Item | Tek TDS2012B | Agilent MSO6012A | Pico 3206 | Link Instrument DSO-8502 | Bitscope USB 310 | TiePie HS3-100 | cleverscope CS328A | Note | Feature Rank |
|--------------------------------------|------------------|---|--|--|---|---|---|------|-------------------|
| Can count triggers | No | Yes | No | Yes | No | No | Yes | | Useful |
| Dual Independent Triggers | No | No | No | No | No | No | Yes | 7 | Important |
| Mixed signal triggering | No | Yes (no OR) | No | No | State only | Some | Yes | | Important |
| USB rate | 2.0 | 2.0 | 2.0 | 2.0 | 1.0 | 2.0 | 2.0 | | Useful |
| Signal Generator | No | No | Yes – lose ext trig | No | Yes – lose Chan B | Yes | Yes | | Useful |
| Sig Gen Freq Range | - | - | 100 Hz – 1 MHz | - | 100 Hz – 1 Mhz | 0.01Hz – 2MHz | 0.003Hz – 10 MHz | | Useful |
| Sig Gen Voltage Range | - | - | 1V fixed sine/tri 5V fixed square | - | 0 - ±4.5V | 0- ±12V p-p | 0 – ±5V p-p | | Useful |
| Sig Gen Voltage Offset | - | - | None | - | -5.6 – +9V | 0- ±12V | ±10mV – ±4.5V | | Useful |
| Waveform type | - | - | Sine, square, tri | - | Sine, square, triangle | Sine, square, tri, noise, DC, Arbitrary | Sine, square, triangle | | Useful |
| Spectrum Analysis | Yes | Yes | Yes | Yes | Yes | Yes | Yes | | Important |
| Averaging across successive captures | Yes | Yes | No | Yes | No | Yes | Yes | 8 | Mandatory |
| Mathematical equations | No | No | No | No | No | I/O's | Yes | 9 | Important |
| Math functions | -A, -B, A-B, A+B | -A, -B, A-B, A+B, A*B, integrate, differentiate | | -A, -B, A-B, A+B, A*B | -A, -B | +, -, /, *, Integrate, differentiate, 1 st order LP filter, Gain/Offset, Sum | + - * / sqrt, log, sin, cos, tan..., integration, differentiation, filtering, multiple equations | | Important |
| User Interface | 320 x 240 LCD | 1024 x 768 LCD | Multiple MDI windows all contained in one window | Multiple MDI windows all contained in one window | One window | Multiple separate windows | Multiple separate windows with tracking function. Locate anywhere on desktop. | | Good UI Mandatory |
| Copy and paste into other document | Yes | Yes | Yes | Using Windows Alt Print Screen | Using Windows Alt Print Screen | Yes | Yes | | Mandatory |
| Subjective view of ease of use | Easy | Easy | Hard | Hard | Hard | Moderate | Easy | | Mandatory |
| Price USD | \$1,550 | \$6,774 | \$1,598 | With Intl Power Supply \$988 | B310 - \$575 Probes - \$146 Total \$721 | \$1,731 | Scope – \$1,259 Sig Gen - \$299 Total - \$1,558 | | Important |

Disclaimer: These values are correct to the best of our knowledge on 3 April 2008. Cleverscope Ltd accepts no liability for errors or omissions. If you have corrections, please send to support@cleverscope.com.

We have ranked features Mandatory for the following reasons:

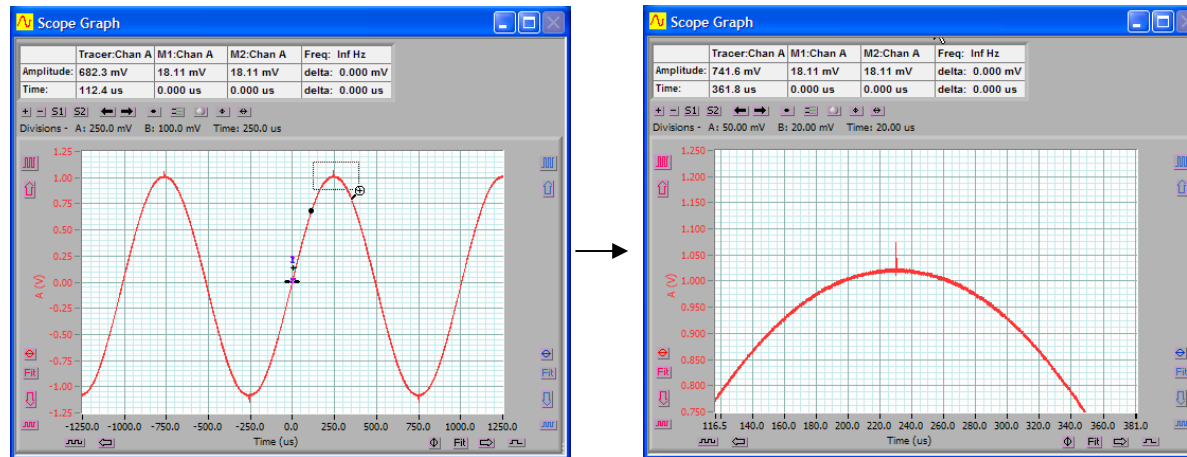
1. If the feature involves safety.
2. If the feature significantly improves versatility in many situations.
3. If the feature provides information that is essential, and can't be acquired any other way.
4. If the feature assures correct performance of the instrument.

User Interface Features

| Item | Tek TDS2012 | Agilent MSO6012A | Pico 3206 | Link Instrument DSO-8502 | Bitscope USB 310 | TiePie HS3-100 | cleverscope CS328A | Note | Feature Rank |
|--|-------------|------------------|-----------|--------------------------|------------------|----------------|--------------------|------|--------------|
| Time and amplitude axis determine capture specification (wysiwyg) | Yes | Yes | No | No | No | No | Yes | 10 | Important |
| Can examine last signal while waiting for next capture | Yes | Yes | No | No | No | No | Yes | 11 | Very useful |
| Can change axis values while waiting for a trigger | Yes | Yes | No | ? | No | ? | Yes | | Important |
| Easy control of time axis | Yes | Yes | Moderate | No | No | No | Yes | | Important |
| Axis labels are in standard intervals (0, 10, 20, 30..) | No | No | No | No | No | No | Yes | | Useful |
| Tracking cursor to show current value | No | No | No | Yes | No | No | Yes | 12 | Important |
| Place tracking markers | No | No | No | No | No | No | Yes | 13 | Important |
| Can link windows so display point tracks cursor for all displayed windows. | No | No | No | No | No | No | Yes | 14 | Important |
| Fast return to trigger point, 0V amplitude point | No | No | No | No | No | No | Yes | | Useful |
| Frequency axis can be log | No | No | No | No | No | No | Yes | | Useful |
| Bode Plots | No | No | No | Yes | No | No | Yes | | Useful |
| Expanding window size gives more divisions | No | No | No | Yes | No | No | Yes | 15 | Useful |
| Able to save data to disk | Yes | Yes | Yes | Yes | No | Yes | Yes | | Important |
| Able to log derived values (Freq, Rms etc) to disk | No | No | No | No | No | No | Yes | 16 | Useful |
| Able to select the Span and Bandwidth of the spectrum display | Yes | Yes | No | No | No | No | Yes | 17 | Useful |

Notes

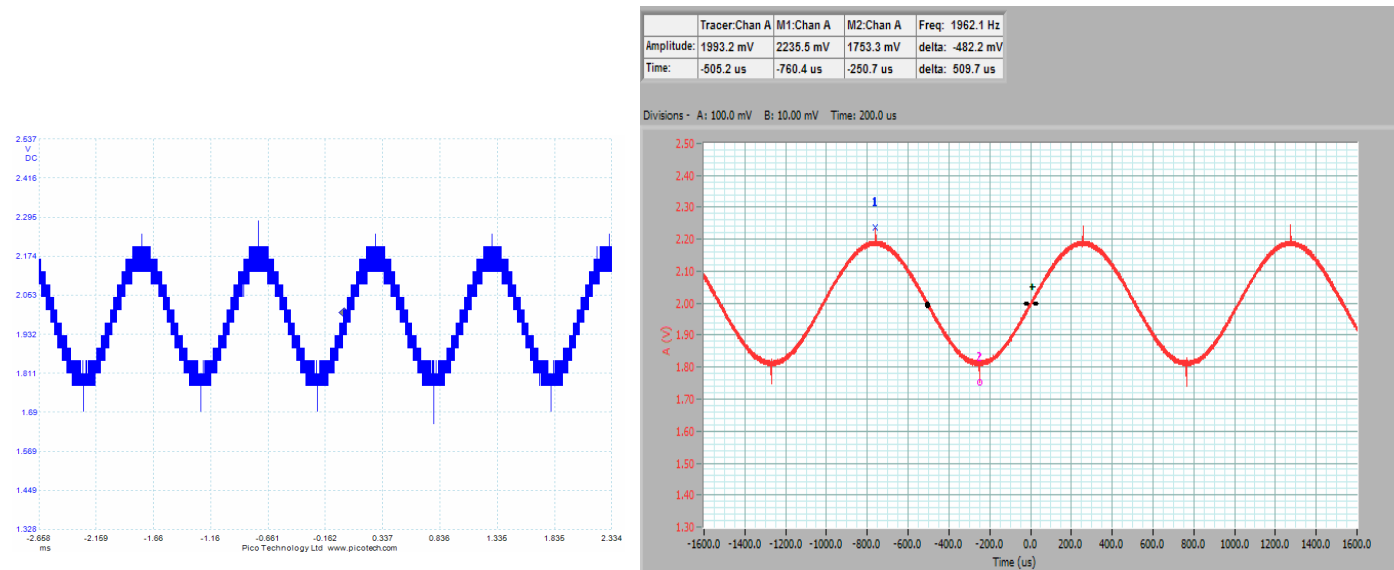
1. **Input Range.** Some CS328A systems had a maximum input range of 40V; this has now been put back to 80V. None of the other PC scopes were mains protected.
2. **Bit resolution.** The CS328A offers options to upgrade to 12 bits (CS712U) and 14 bits (CS714U) – both are dual channel 100 MSPS.
3. **Hardware offset.** Most PC scopes do not offer hardware signal offset. Here is an example of cleverscope use:



The zoom tool was used to define the area to zoom on, for a triggering graph – in this case the glitch at the top of the sine wave. The cleverscope software automatically rescaled and offset the sampler so the full bit resolution was applied across the vertical amplitude range shown. If the trigger level used is found to be off screen, it is automatically moved to be in the amplitude range newly chosen.

Note that none of the other PC scopes offered dynamic rescale if the trigger was not present.

If there is no offset system then a full range FSD that covers the desired voltage range must be used.



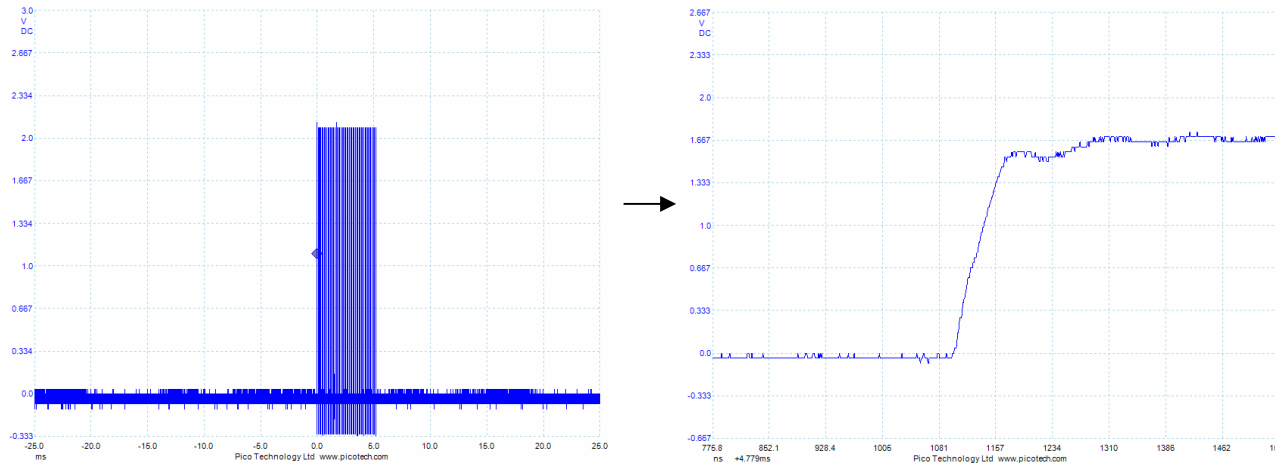
The graph on the left is a Picoscope 5204 displaying a 1kHz signal, centered at 2V, with 400 mV amplitude. This sort of signal is often found in single supply analog systems. The Picoscope has to switch to the +/-5V range to display the signal. The cleverscope graph (on the right) offsets the input range to achieve 10 (or 12, or 14) bits across the chosen amplitude range. Both graphs are displaying the same amplitude range.

The difference is further exaggerated because the Picoscope has only 8 bit resolution.

The standard copy and paste supplied by each application was used to grab the graph.

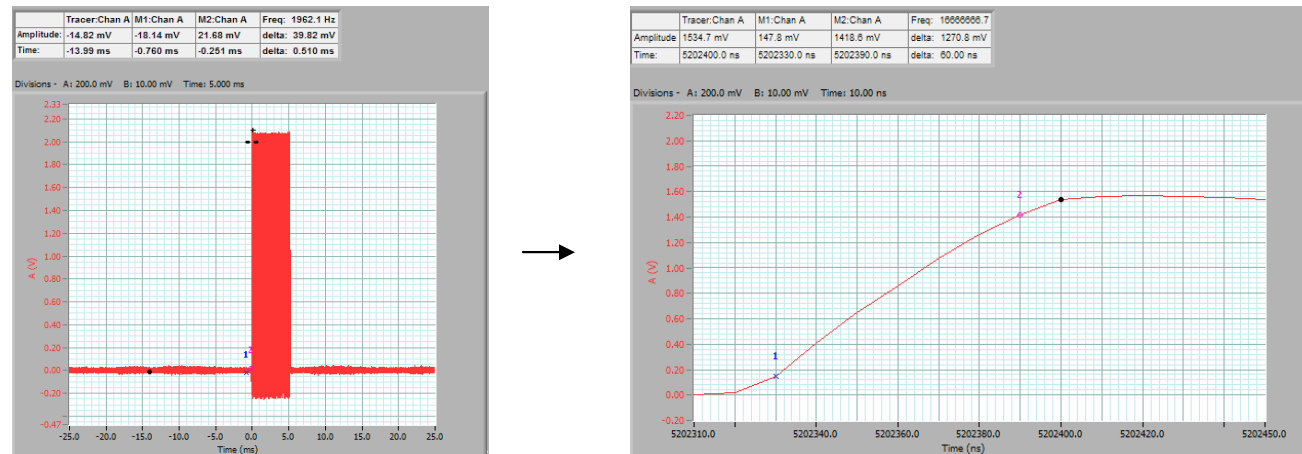
4. **Memory.** The cleverscope offers an upgrade (CS800) to achieve 8M samples for each channel. Note that the cleverscope hardware system allows full zoom on one frame, with a minimum of two frames being used. (This is so we can be waiting for a trigger while examining the last frame, something many of the PC scopes cannot do). The only other PC scope to offer larger memory is the PicoScope 5203/4, with 32/128Mbyte of memory. However, the PicoScope 5204 only allows 65536 x zoom. As an example:

PicoScope 5204 - the graph below is displayed with 5ms/div. Using maximum zoom, we get the graph below, with 76ns/div.



With a cleverscope, we can zoom to the limits of the available memory.

For example the graph below is displayed with 5ms/div. We zoom to 10ns/div:



Even though the Picoscope 5204 has 128Mbyte of memory, it cannot zoom more than 65536 times. This limits the versatility of the large memory array. Instead it would appear that the intent is to offer lots of frames for past history.

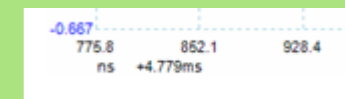
Note that the zoom is not done by changing the time scale, rather the user uses the zoom control - which is not intuitive to a standard scope user.

Also notice that the same number of divisions are displayed, no matter how wide the graph. This makes it visually harder to look at multicyle signals. Divisions are in 76.3ns/div lots.

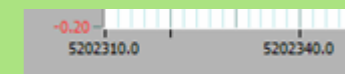
The Cleverscope can also partition it's memory into frames, but the zoom (which is not done as a zoom at all - the user just changes the time scale) can be to the limits of memory. Here we have magnified the time scale by x500,000. Divisions are in 10ns/div lots.

Note that the tracer blob and markers can be used to display the actual sample values for each sample. This is not possible with the Picoscope, or either of the bench scopes.

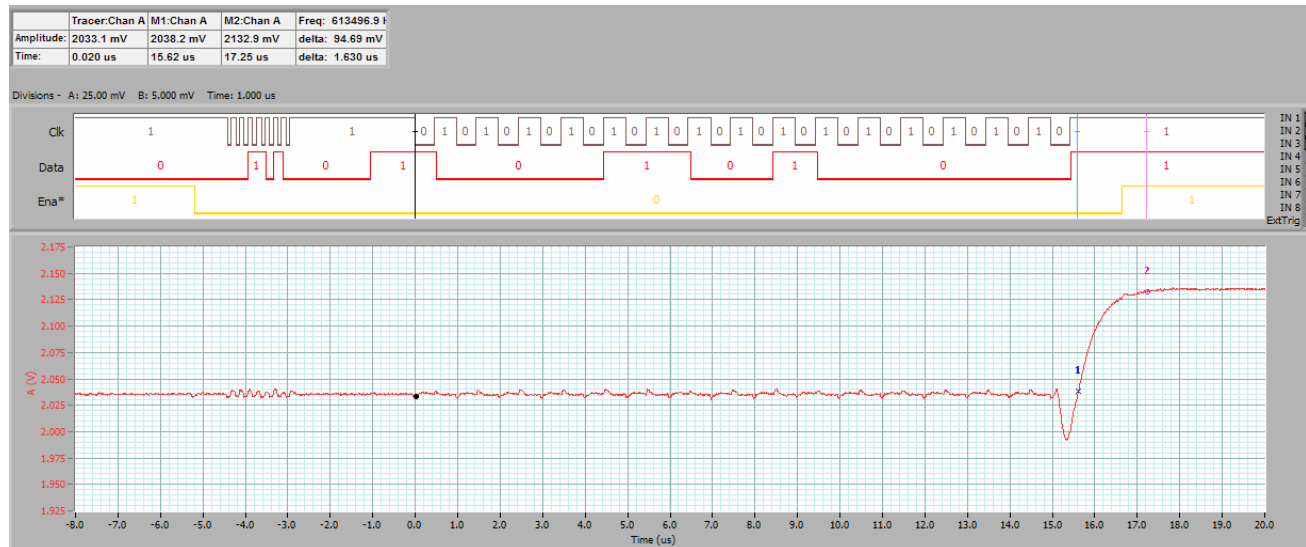
A point to note - the Picoscope displays time offsets as Base time + graph scale offset:



The Cleverscope displays the actual time, in the current division units:



5. **Dynamic range.** The standard 10 bit digitizer offers 12 dB better dynamic range than the standard 8 bit converters used by most scopes. If the optional CS712U (12 bit) or CS714U (14bit) digitizers are used, this margin improves by 24 and 36 dB respectively. See the cleverscope CS328A Performance.pdf in the Resources page.
6. **Time resolution.** For many people high time resolution is very important – and so the Tektronix and Agilent scopes are superior in this regard. But with a 3ns rise time (based on 100 MHz bandwidth) variations in the analog value on a time scale smaller than this are not very meaningful. What is important, though, is for how long time resolution is maintained when increasing the time period displayed. With the Tek's 2500 sample buffer, sampling rate starts falling when exceeding just 250ns/div. By the time you get to 2.5us/div the time resolution is no better than most PC scopes. The Agilent has a deeper memory buffer and so provides better time resolution performance. Finally when looking at long time records the cleverscope CS328A with 8M samples of memory provides the highest time resolution. The PicoScope 5204 would appear (with 32 or 128M of memory) to offer higher time resolution, but this is not the case, as maximum zoom is limited to x65536.
7. **Dual Independent Triggers.** The cleverscope is the only scope here to offer dual independent triggers. This means that the arm trigger event is defined by a first trigger definition, and the complete trigger event can be defined with a completely different second trigger. Other units assume the complete trigger is the inverse of the arm trigger. Here is an example of independence being needed:

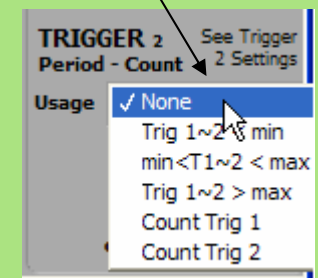
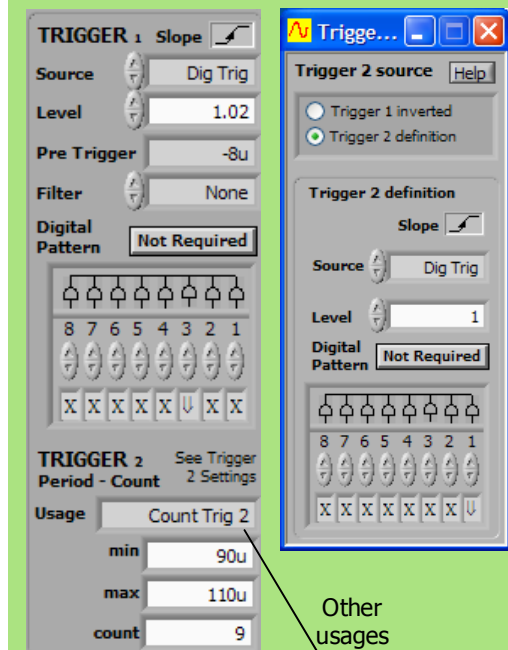


The example is an SPI DAC outputting an analog voltage change (the A channel) in response to an SPI message. The SPI system shares the clock and data with other devices, but has one enable per device. We want to start triggering when the enable goes active (low), but set the trigger position to the DAC word. Here we have a DAC address byte (8 bits) followed by the selected DAC word (16 bits). We want to trigger on the 9th clock pulse, as this is the DAC word, but only after an enable. This requires separate arm and completion triggers. In this example we used the counting triggers.

In other examples period could be used – for example to verify that after an over current is detected, that the power turn off signal happens fast enough, or that following a gate drive turnoff, miller effect current flow is not above a maximum.

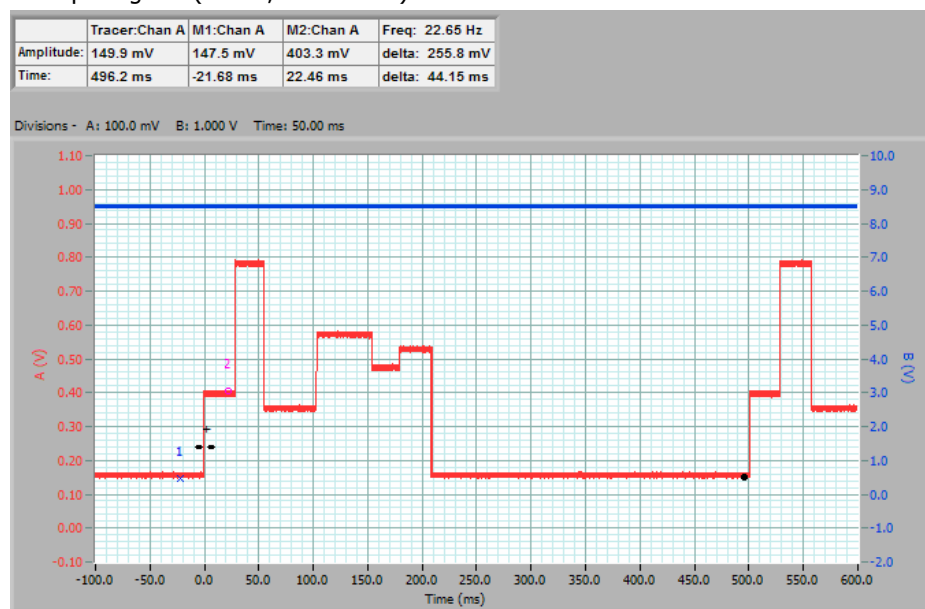
The arm trigger event is digital input 3 (Ena*) going low. This is trigger 1. Once trigger 1 is received, we count trigger 2 (the completion trigger) and trigger on the 9th Trigger 2.

The completion trigger is given by Trigger 2, and it is the falling edge of digital input 1, the clk signal:

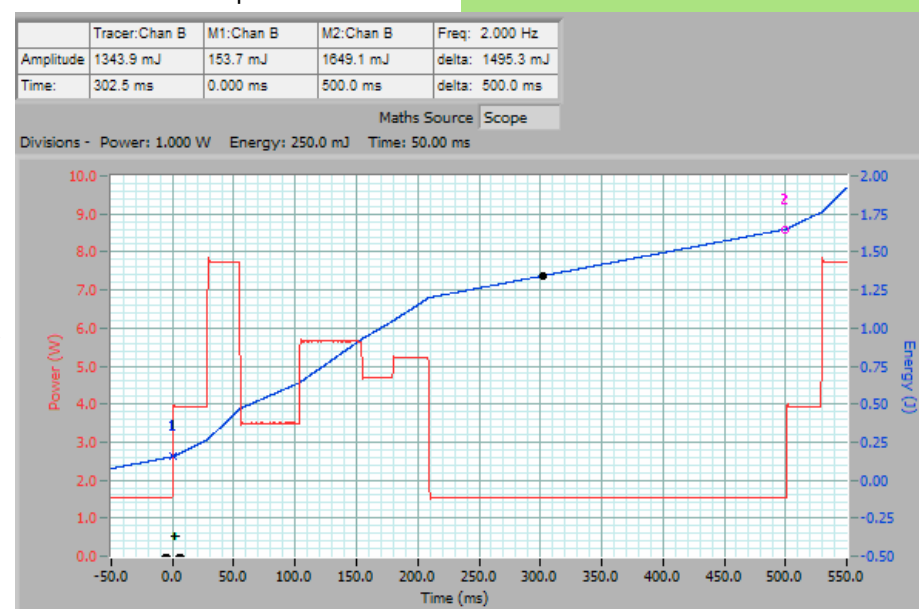


8. **Averaging.** There are many situations where the noise on the signal obscures the signal, and the signal is of the same shape each time a trigger occurs. In this situation averaging coherently with the trigger will maintain the signal, but average out the noise, resulting in better signal to noise ratio, with no loss of bandwidth. Some of the PC oscilloscopes do not offer this option.
9. **Maths equations.** Many scopes offer simple arithmetic (+ - / *) to process the signal. This is useful, but greater power in deriving information from the signal can be had providing arbitrary mathematical equations - and this is what cleverscope does. As an example, a common problem is to estimate the battery life of some equipment that does not draw continuous power. Below is the time graph of a transmitting device that activates twice per second. An 0.86 ohm resistor made a handy current probe. The current is thus $V_i/0.86$. We can estimate the power when using a supply voltage of Vs as $\text{Power} = V_s V_i/0.86$. The total energy will be $\int V_s V_i/0.86$. In many situations filtering is also useful - here our measurement is polluted with some switch mode power supply noise. To eliminate this, we used a 1KHz Bessel filter (linear phase) to reduce the noise.

The input signals (A is V_i , and B is V_s) – note the noise.



This is the Maths Graph:



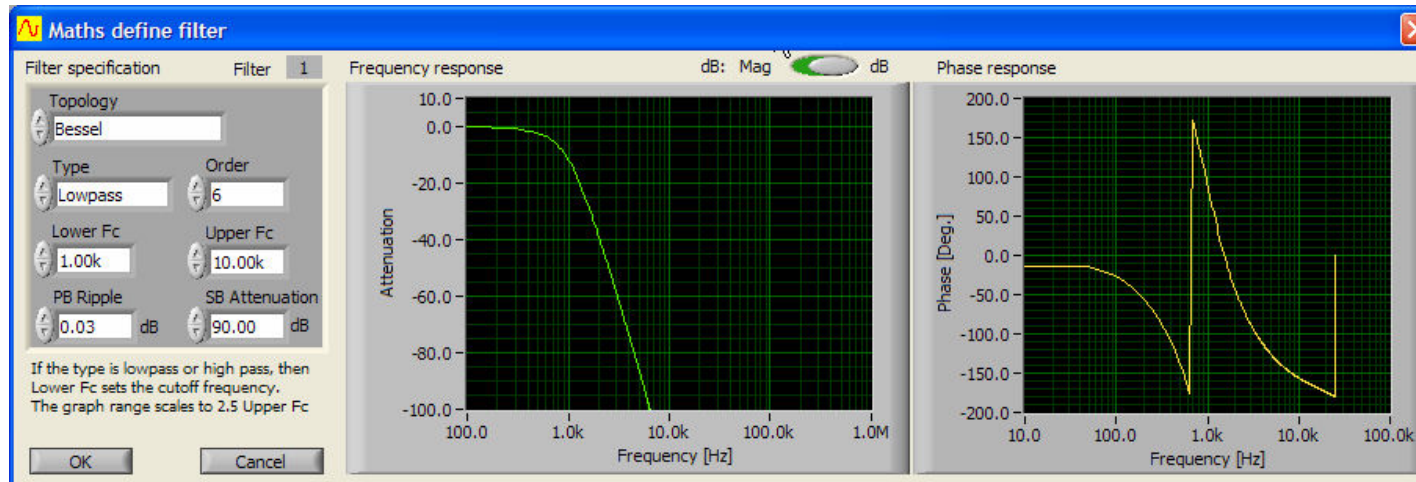
Note that the Maths graph has reduced noise, because of the filter, and it is also using custom units – displaying values in power and energy. The total energy used for a 500msec period was 1.495Joule (or Js) (the difference between Markers 1 and 2).

Say we have a 6Ahr 9V battery, this has a capacity of about $6 \times 9 \times 3600 = 194.4$ kJ. Thus this battery could run the device for $194.4 \text{ kJ} / 1.495 = 130,033$ cycles, or 65,016 seconds – about 18 hours.

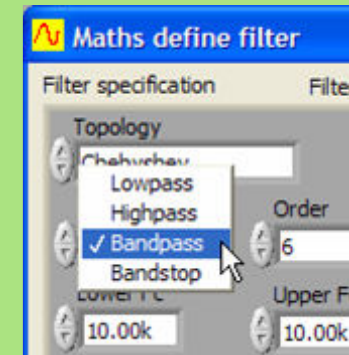
These were the Maths equations used:

| Maths Equation Builder | | | Help |
|--|-------------------------------------|----------|-------------|
| Check Equations | Used? | Process | Destination |
| <input checked="" type="checkbox"/> $(a/0.86)*b$ | <input checked="" type="checkbox"/> | Filter 1 | a |
| <input checked="" type="checkbox"/> a | <input checked="" type="checkbox"/> | Integral | b |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | -----> | b |

Here is the filter definition used:

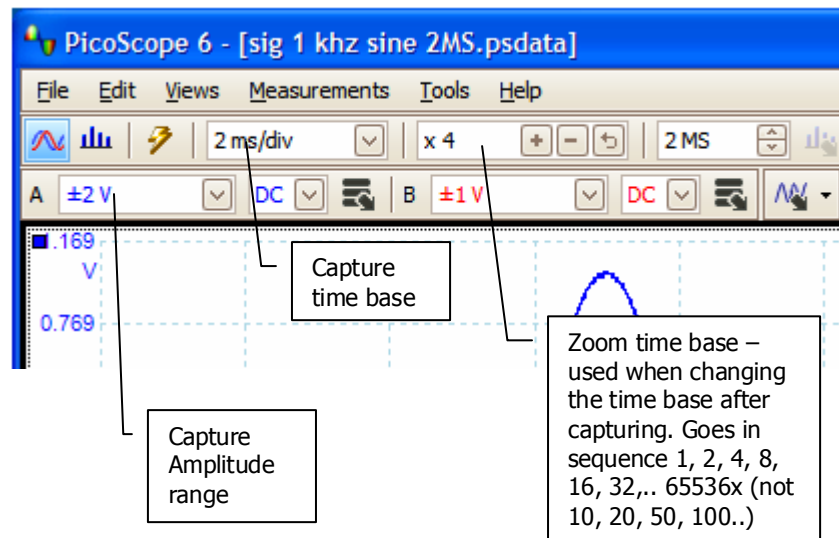


Filtering is a useful tool when extracting information from the signal. The Cleverscope filtering system allows you define the filter parametrically – either low pass, bandpass, high pass or bandstop (notch).



The bandstop filter is useful for removing mains borne noise for example.

- WYSIWYG.** The bench top scopes, and cleverscope, use the 'What you see is what you get' principle – adjust the time and amplitude axis, and that is what is captured. For the amplitude axis, it helps to have scale and offset to achieve this. Once the signal is captured (while waiting for the next trigger or not), the user can examine the signal – zooming time or amplitude. The cleverscope tracking graph, which is linked to the main scope graph tracing cursor position makes this especially easy.

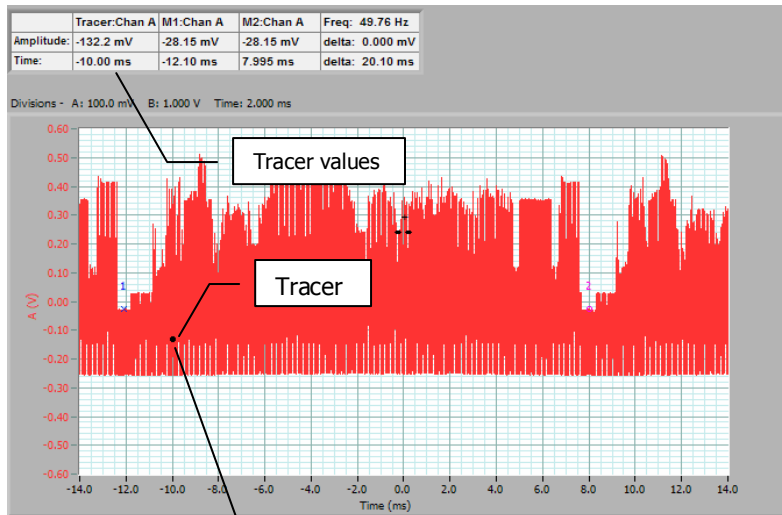


However the other PC scopes have independent control of the capture specification and the display specification. This means in many cases you have to adjust two setups to achieve what you want. Further they do not allow adjustments while waiting for a trigger – you have to stop triggering, adjust, and then re-trigger. Some of the PC scopes have distinctly non- friendly methods of adjusting the time axis.

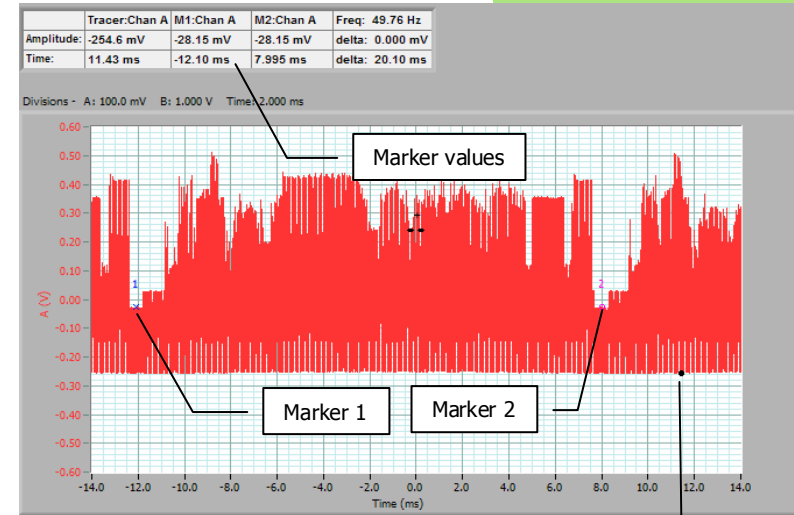
Further, the axis values are often in non-decimal intervals.

On the Picoscope, and TiePie scopes it was very hard to set the time axis to the range wanted. (You can set the range directly with the TiePie, but this requires opening a dialog box, setting the values, and closing the dialog box again). On the Picoscope it was impossible to set the values to the desired range, and with the desired intervals needed. The Link Instruments software allows changes to the time scale, but the axes are not labelled.

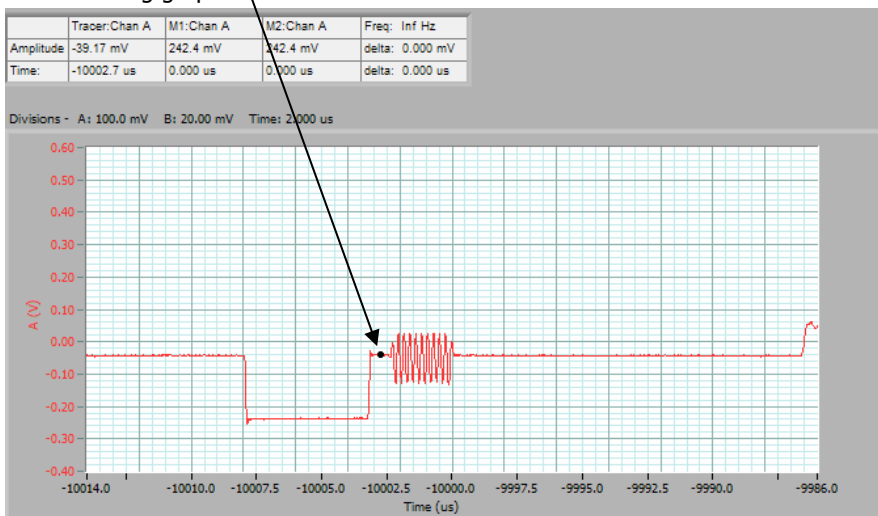
11. **Adjust view while waiting for trigger.** In many situations, you set the scope triggering, and then look at the scope, adjusting the view, before generating the next trigger event. The bench top scopes and cleverscope allow you to do this. Using the PC scopes, if the scope was waiting for a trigger, you could not adjust. Instead you need to stop triggering, adjust the capture definition, and then start retriggering. This seems hard.
12. **Tracking cursor and graph.** The cleverscope tracer shows the current point of interest. The tracking and maths graphs can track this point. Further changes in the tracking or maths graphs tracers, are reflected in changes to the tracer in the other graphs. As an example, a complete video picture is captured below. Here is the scope graph - which defines the capture spec:



Move the
tracer to
the right



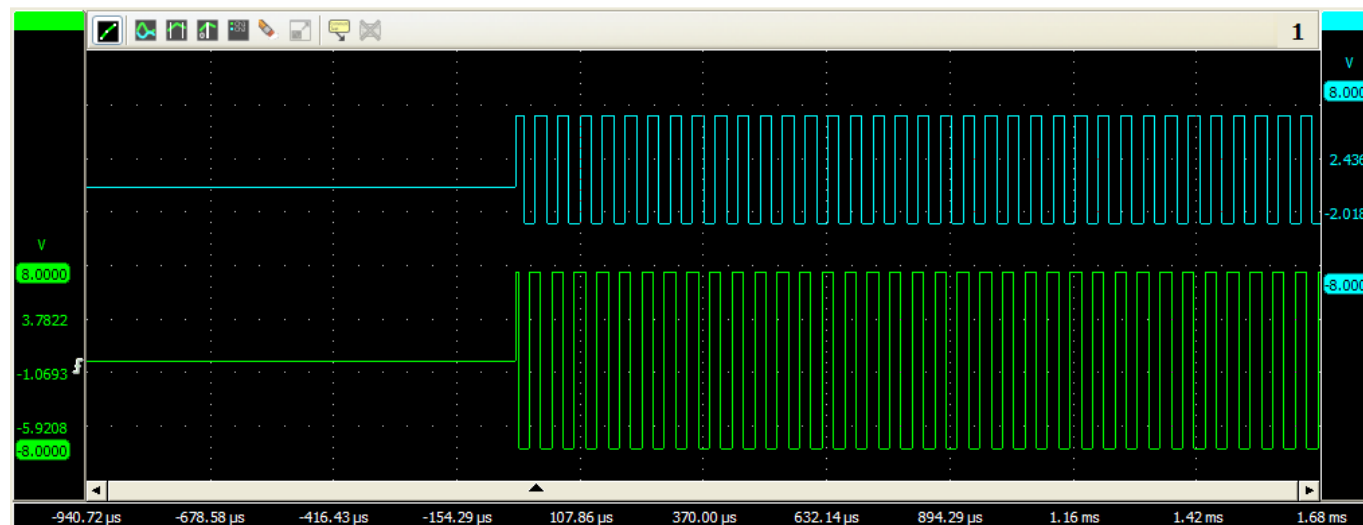
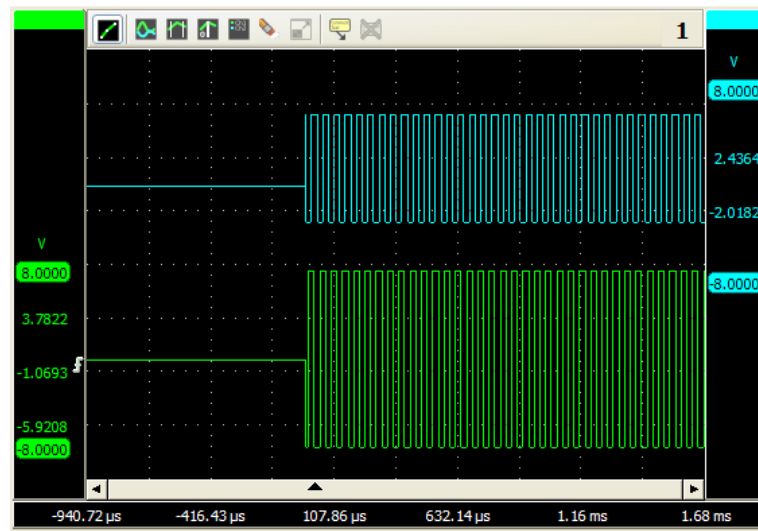
The tracking graph:



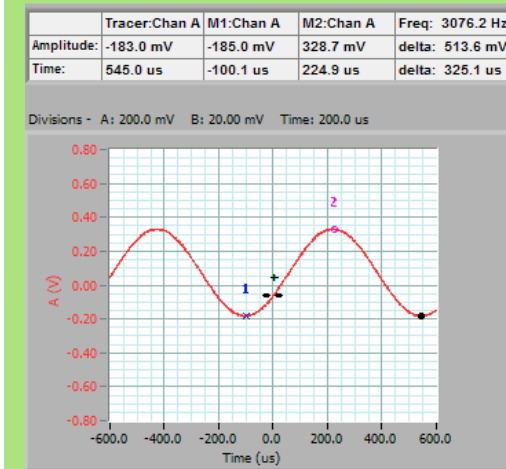
The tracking graph moves, following the tracer:



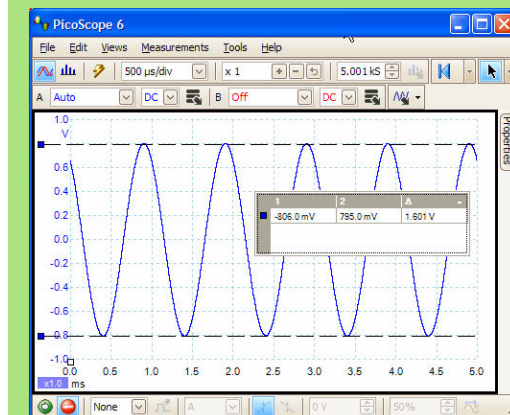
13. **Tracking markers.** The cleverscope application includes two markers, which track the underlying graph. This makes it easy to place markers on a peak, and on the baseline, and then adjust amplitude, for example, by adjusting the marker delta value. The markers are highlighted in the previous point. None of the other scopes had tracking markers.
14. **Linked displays.** The linked scope and tracking displays are illustrated in point 12.
15. **Expanding window size.** With the cleverscope division sizes are held constant, so you get more divisions as you widen the window. With some other units, changing the window size changes the width of the division. Here is the TiePie being expanded:



Tracking markers are useful for immediate display of two levels. As an example you can place markers on the trough and peak of a waveform, and adjust the amplitude visually, using the marker delta amplitude value.

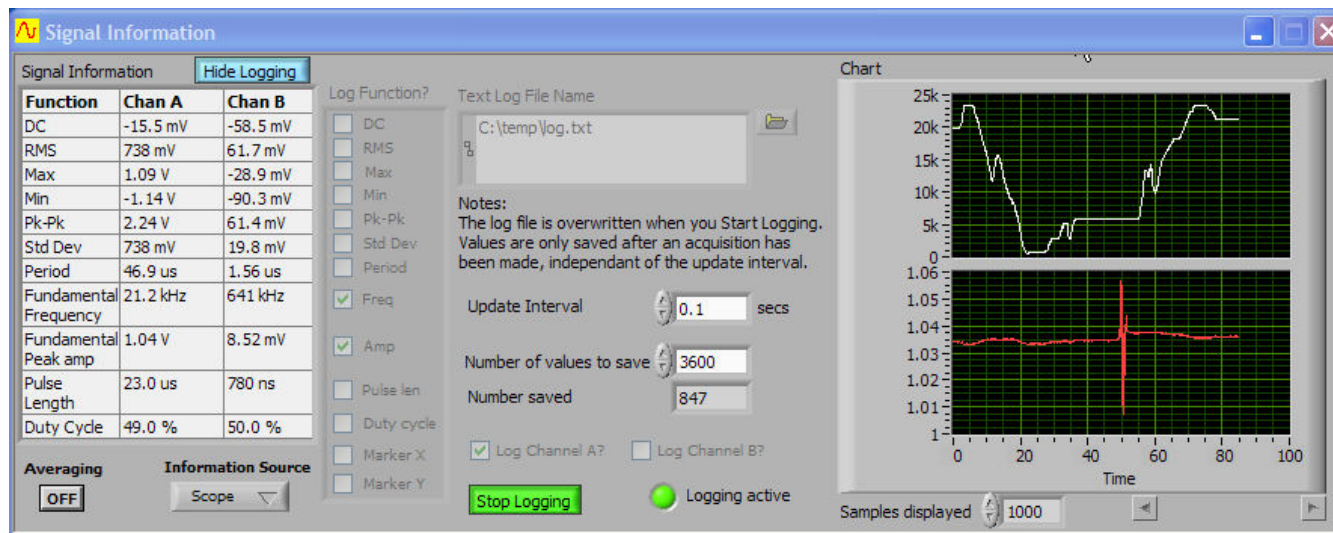


All the other scopes reviewed use non-attached markers:



The markers don't change if the amplitude is changed.

16. **Logging derived values.** You can log any of the information values (including markers) to disk as a tab delimited text file. Below is an example logging the frequency and amplitude of a signal.

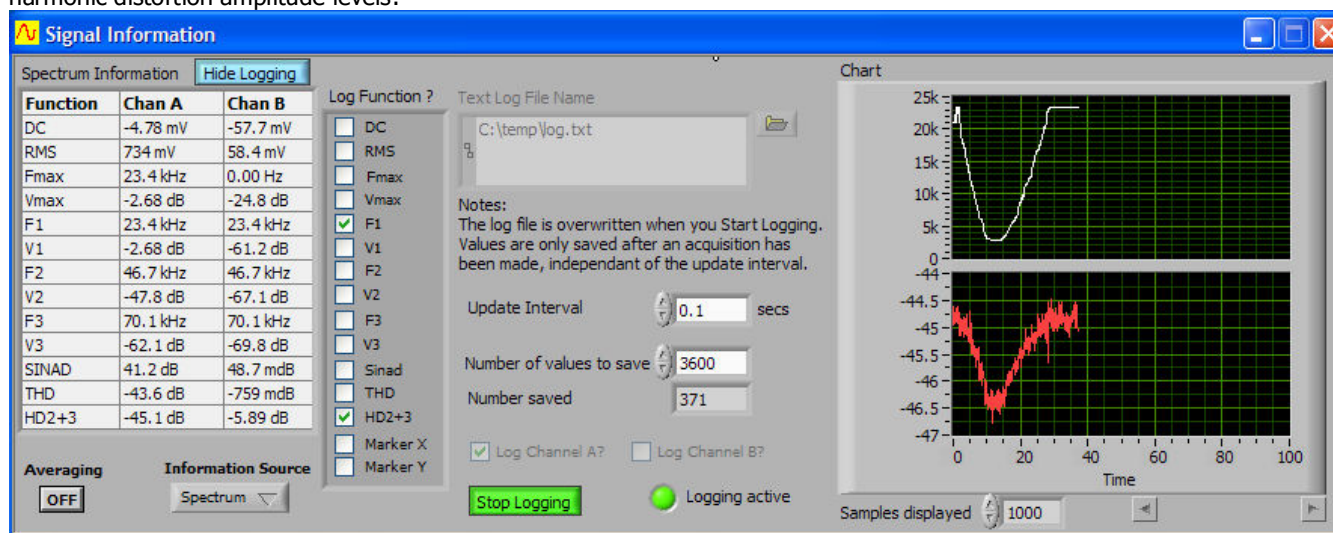


Several of the PC Scope offer raw value logging. Cleverscope also offers derived value logging, in which the values shown to the left can be logged to disk as a tab delimited text file.

It's important to note that the text file includes a time stamp for every value, and that values are only saved when a trigger occurs. So the logging system can also be used to save exceptions – such as Frequency when a particular event occurred. (The actual event data can also be saved automatically using the Auto Save feature).

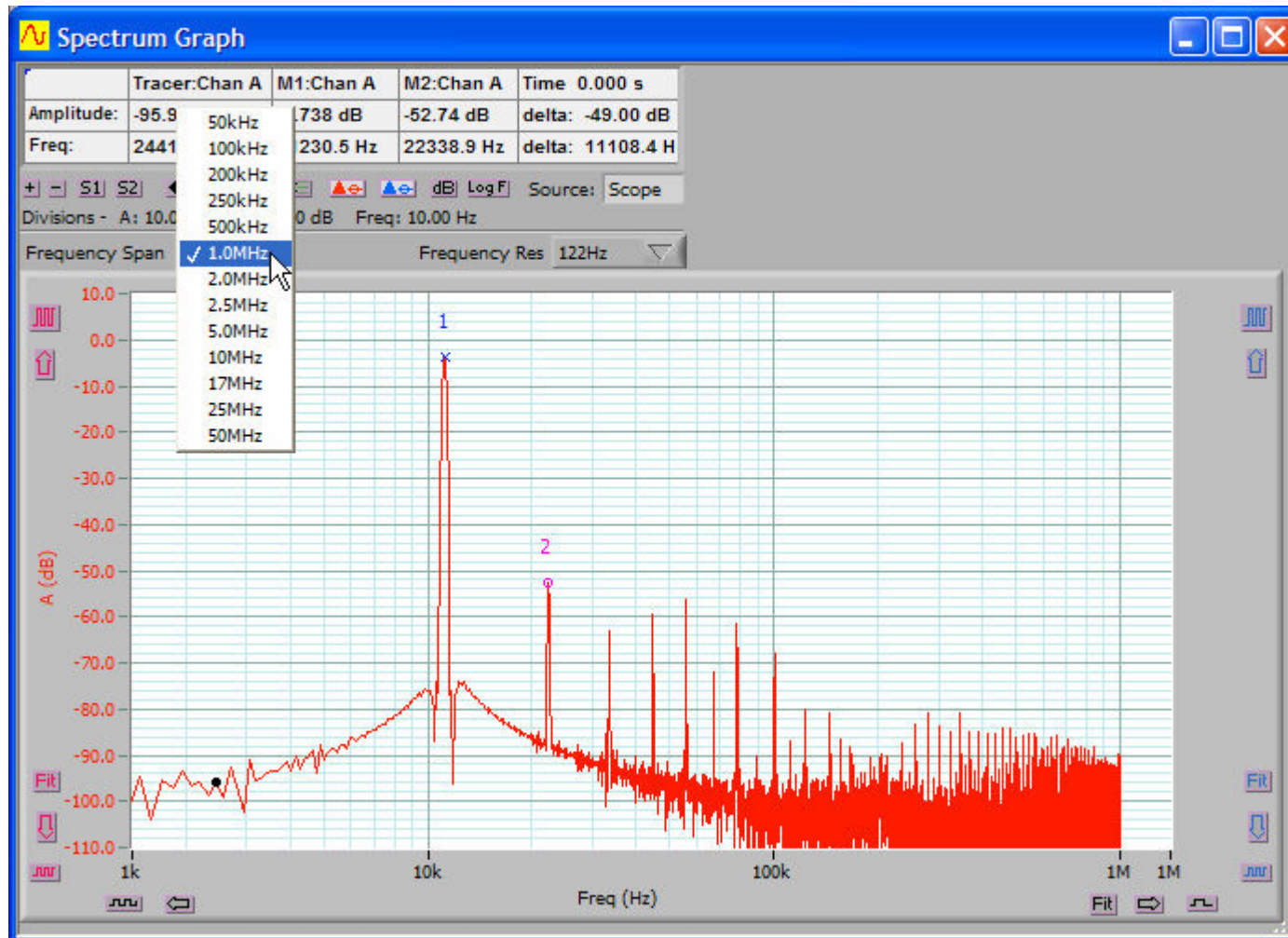
So cleverscope system can be set running, looking for exceptions. Later (eg the next day) you will have a log of the time at which each exception occurred, the derived value found (eg Frequency, fundamental amplitude, duty cycle), and optionally a snapshot of the actual event.

Cleverscope can also log spectrum plot derived values. Here we log the fundamental frequency and the vector sum of the 2nd and 3rd harmonic distortion amplitude levels:



17. **Set frequency span and resolution.** When examining spectra it is very useful to directly set the frequency range being viewed, and the resolution used. Other PC scopes do not do this, relying instead on the time graph settings.

Here is an example (Frequency Span is automatically limited by what the time graph captured):



None of the other PC scopes, or the Tek allow you set the Frequency Span and Resolution, or display a log frequency axis. This is a common method used by spectrum analysers to select the spectrum you wish to see. With cleverscope you select frequency span and resolution directly, and the software selects the correct sample set to achieve the desired bandwidth.

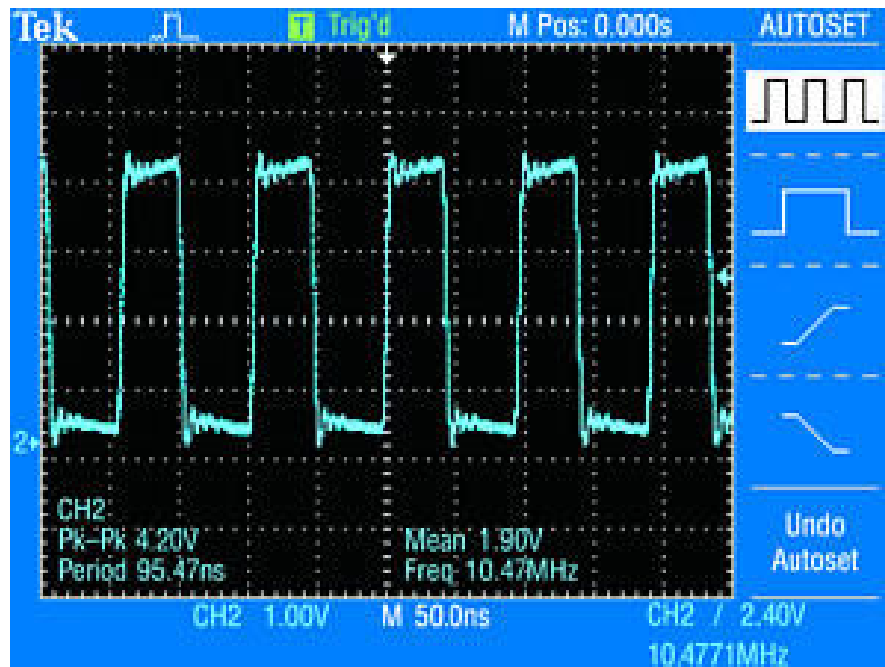
With cleverscope you also have some other tools;

- you can click the peak reference button, and the software finds the visible highest amplitude frequency, and makes that 0dB. All other signals are then shown referred to that value.
- You can use log frequency graph scaling, which is especially useful for bode plots.
- Suppose you need to set the amplitude of a signal to particular value. Place a marker on the fundamental frequency component, and adjust the device under test until the amplitude is correct.
- You can display the amplitude in units of your choice – linear or log. For example you could display motor current in amps, showing harmonics, for a variable speed AC drive. The signal information display can help, as it displays many common spectral variables (such as SINAD, THD, harmonic frequency and level).

User Interface Examples

In this section we show a screen shot of each application, and discuss the pros and cons of the user interface.

Tektronix TDS 2012



Pros:

Responsive knobs enable easy adjustment of time base, horizontal position, vertical gain and position.

The display is 'what you see is what you get', and easy to set up.

Cons:

Axes are not labelled and so you have to mentally calculate the amplitude and time positions.

It can be quite hard to get back to the trigger point after having zoomed in while capturing.

It is not so easy to adjust the trigger when the amplitude is zoomed right in, with a DC offset.

There is no dual time-base view.

Time consuming copy and paste to windows apps.

Agilent MSO6012A



Pros:

Responsive knobs enable easy adjustment of time base, horizontal position, vertical gain and position.

The display is 'what you see is what you get', and easy to set up.

There is a dual time base view.

Cons:

Axes are not labelled and so you have to mentally calculate the amplitude and time positions.

It can be quite hard to get back to the trigger point after having zoomed in while capturing.

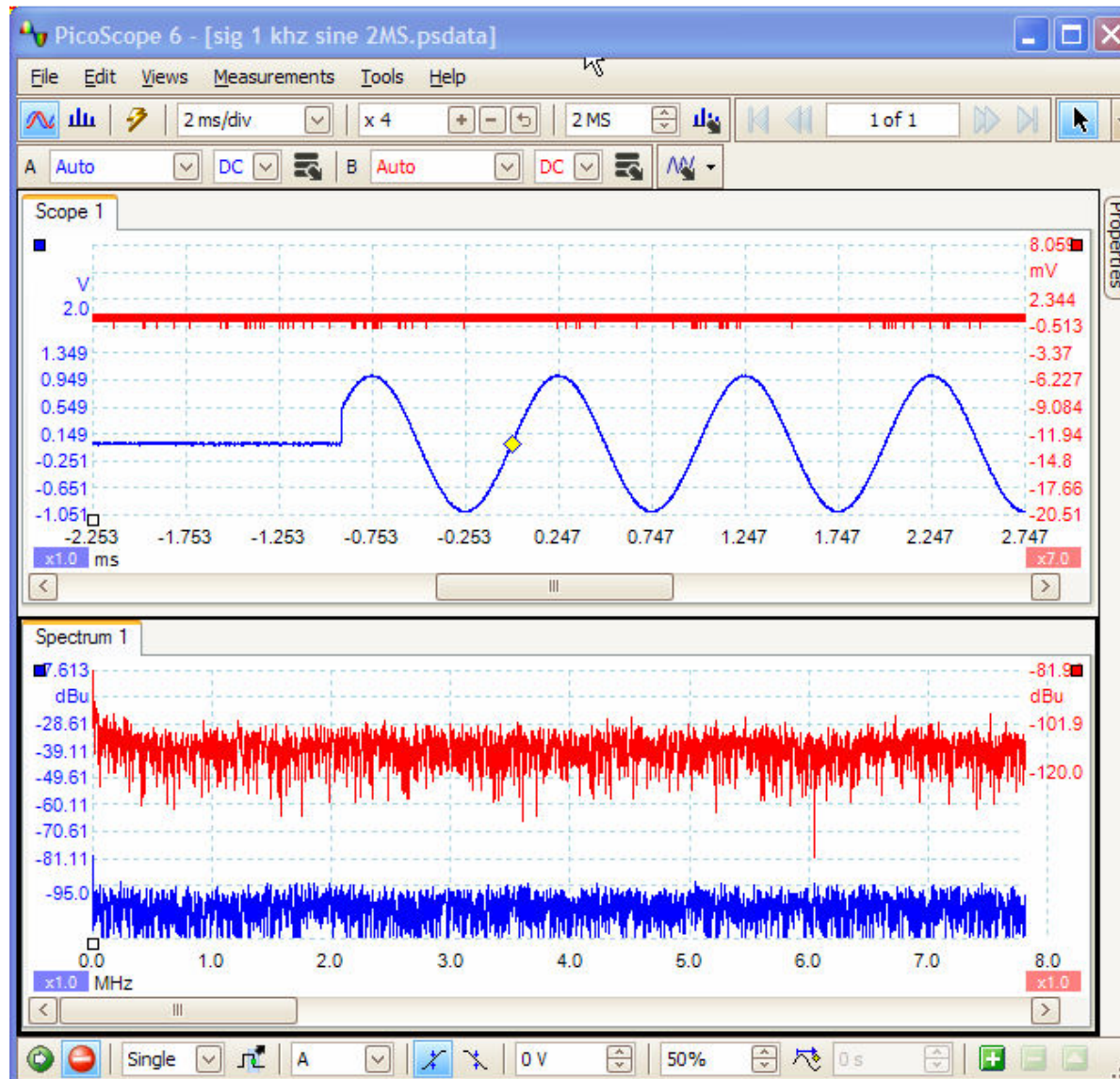
It is not so easy to adjust the trigger when the amplitude is zoomed right in, with a DC offset.

Digital triggers are time consuming to set up.

Time consuming copy and paste to windows apps.

One window has to handle all the graphs (standard, zoom and spectrum)

Pico 3206



Pros:

Axes are labelled - but labels can be strange intervals.
Separate views for scope and spectrum.
Copy and paste to windows apps.

Cons:

Very difficult to adjust the display to see what you want. While waiting for a trigger it is not possible to change the graph position.

Can not easily adjust spectrum graph (magnifying tool and zoom multiplier work, but seems only option).

An MDI windows display has been used, which wastes desk top space, and limits full utilization of the desktop.

Copy and paste results not impressive.

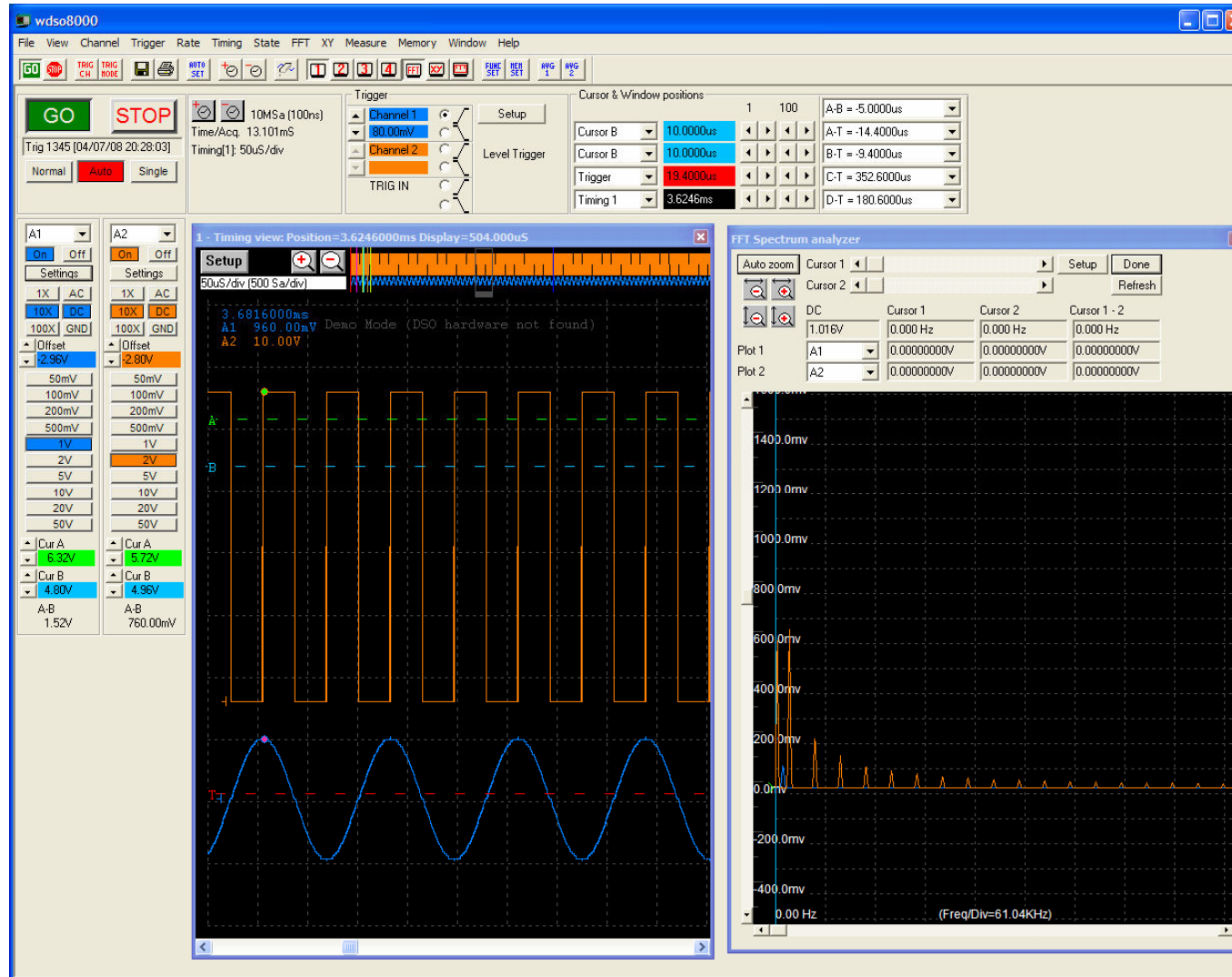
Sampling appears to stop when menus are exercised.

No linkage between overview and zoomed window.

No history.

Separate capture and display setup required.

Link Instruments DSO – 2102M



Pros:

Separate views for scope and spectrum.

Easy adjustment of time axis.

Cons:

Adjustment of vertical position after capture not possible.

Adjustment of spectrum display range tedious. No dB. No tracer blob.

An MDI windows display has been used, which wastes desk top space, and limits full utilization of the desktop.

Large amounts of screen used for buttons.

Minimum range is 20 mV/div which is quite limiting for low level signals.

Axes are not labelled and so you have to mentally calculate the amplitude and time positions (except spectrum).

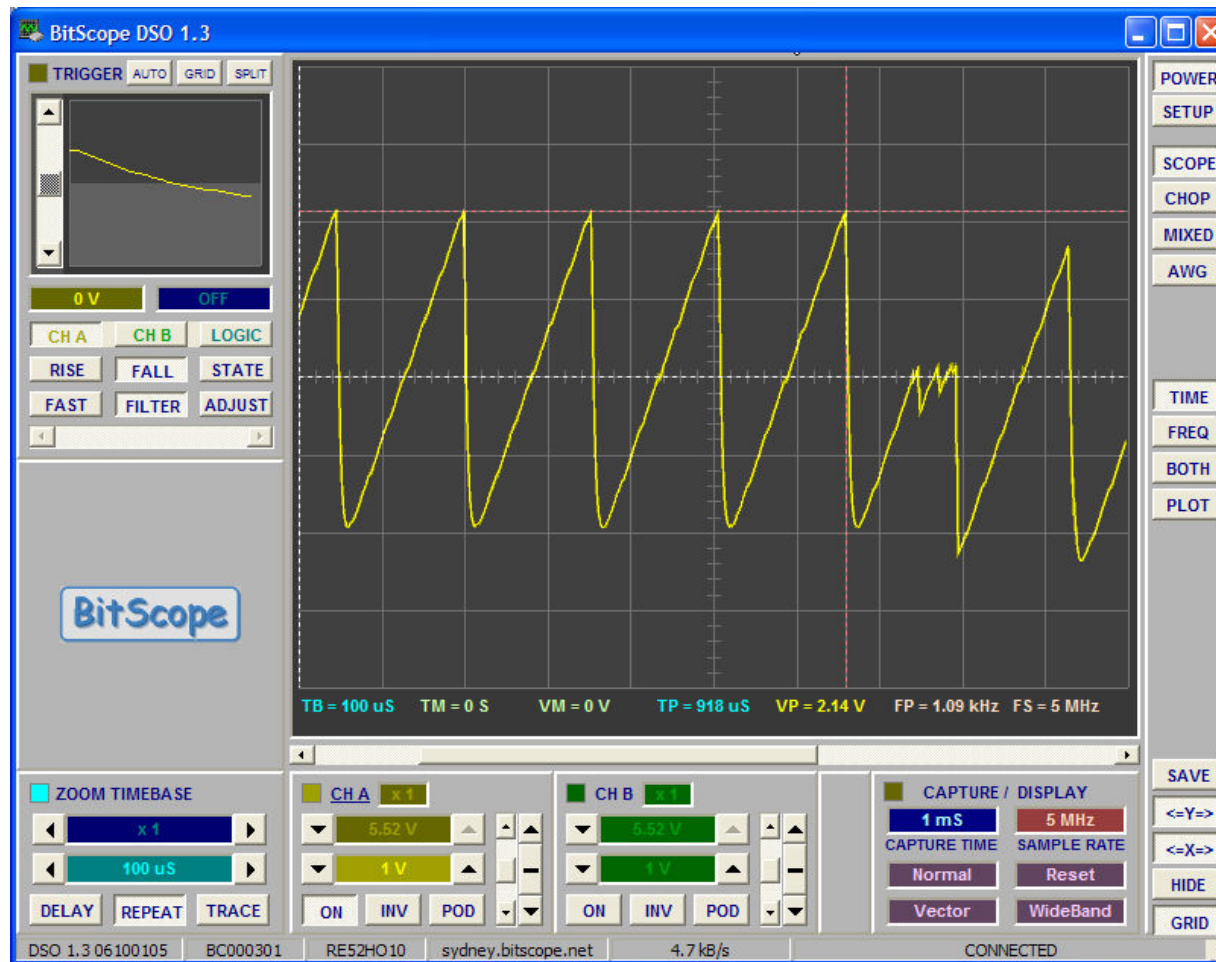
No zoom window.

No history.

No graph drag.

No on-graph zooming tools.

Bitscope 310



Pros:

Mixed signal scope

Cons:

Limited number of input ranges.

Delayed sweep not visually set – need to set by typing a number.

Adjustment of spectrum display range tedious.

Minimum range is 130 mV/div which is quite limiting for low level signals.

Axes are not labelled and so you have to mentally calculate the amplitude and time positions (except spectrum).

Not easy to see if you can easily explore the buffer contents.

No zoom window.

No history.

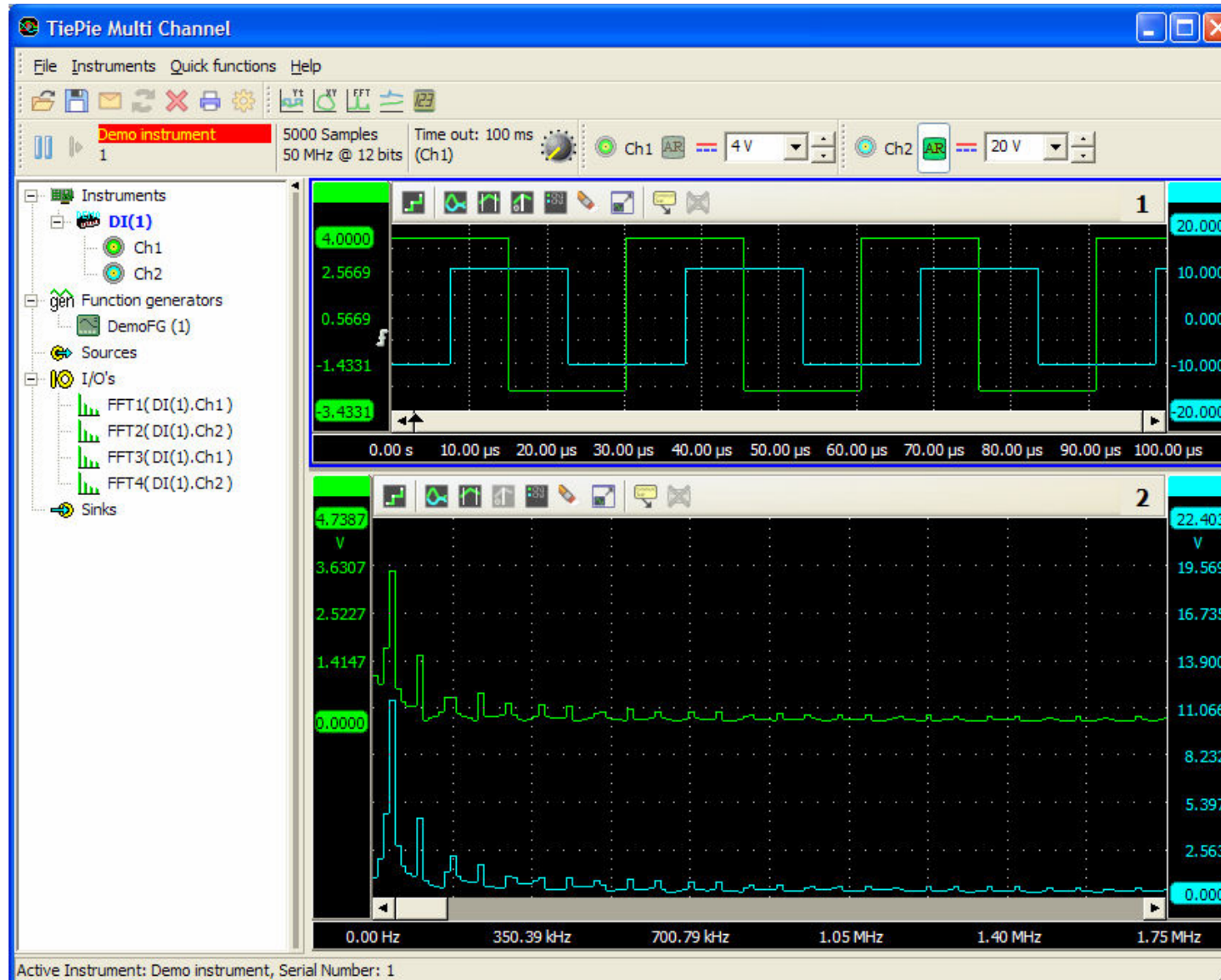
No graph drag.

No on-graph zooming tools.

Separate capture and display setup required.

Slow update rate because of slow USB1.0 speed.

TiePie HS3-100



Pros:

Separate views for scope and spectrum.

Separate windows that can be placed anywhere on the desktop.

Responsive amplitude and position control.

Axes are labelled.

Copy and paste into Windows.

Cons:

Setting up pre-trigger delay, and total capture time tedious – must mentally calculate sample rate and record length, rather than just setting it. Can use Autoset for repetitive signal – but no good for one shot capture.

No delayed trigger.

Axis values are not in easy multiples.

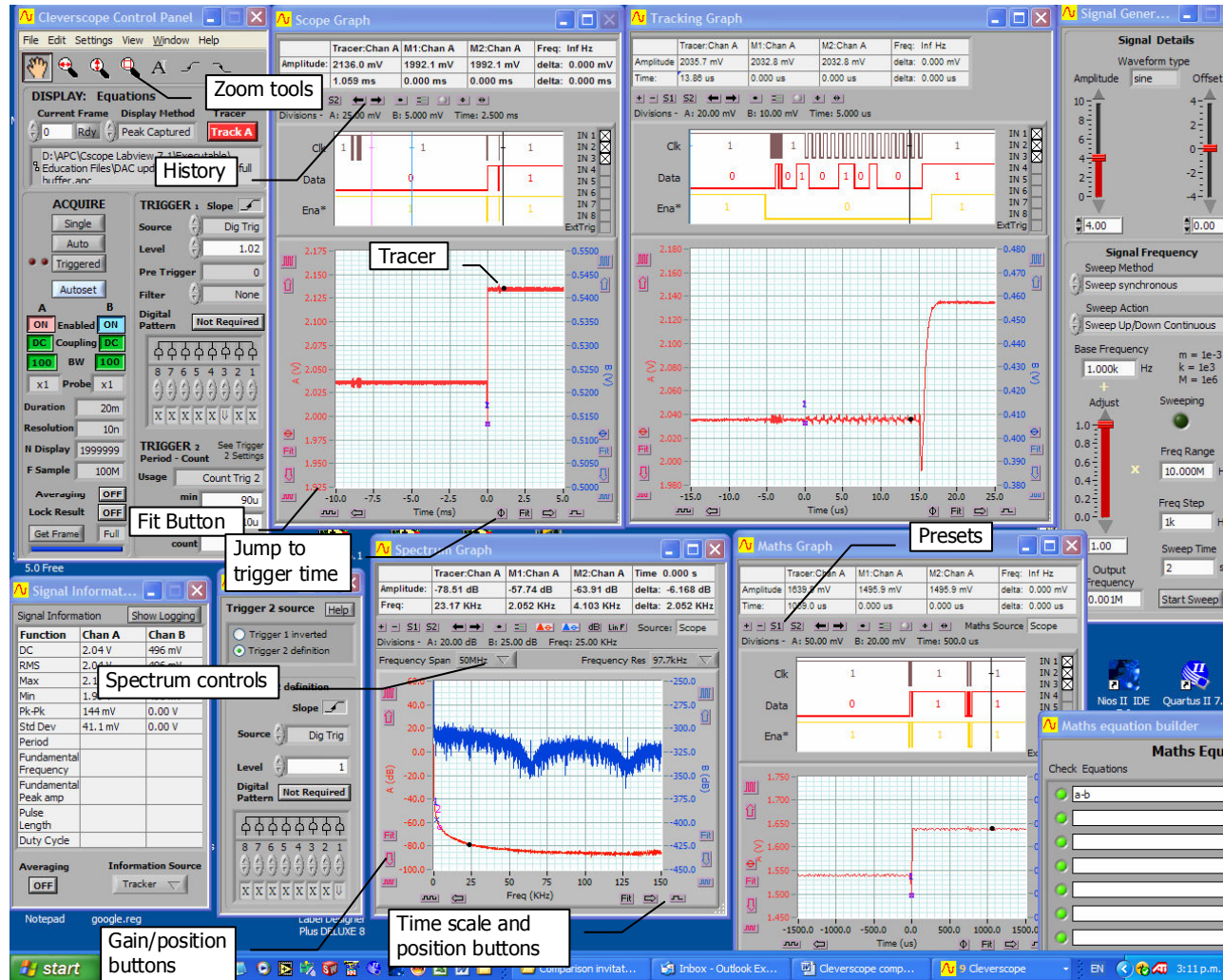
No zoom graph (can use mouse outline zoom, but no control for this).

No history.

No graph drag.

Separate capture and display setup required.

cleverscope CS328



Pros:

The display is 'what you see is what you get', and easy to set up.

Separate windows that can be placed anywhere on the desktop. Only required windows need be opened.

Responsive amplitude and position control scroll wheel acts as virtual knob. Good zooming tools.

Axes are labelled in useful multiples.

Digital Inputs displayed synchronous with analog values.

Can drag the graph on the screen – easy to get it right.

Tracking graph is linked to the scope graph tracer position, – move the tracer and tracking graph follows.

Delayed trigger by setting positive time value to scope graph time axis starting position.

Cursors track graph values. Copy and paste to windows.

History (last 50 graph changes).

Visual trigger level placement

Cons

Only one knob (but auto-assigns to last control used).