CleverScope CS328A

USB dual channel 100MHz mixed signal oscilloscope

Hooked up to a desktop or laptop computer, this USB oscilloscope and its supplied PC software provide a large range of functions, including data logging. With the optional signal generator you can also test audio equipment, measure THD and do frequency sweeps.

CLEVERSCOPE is the New Zealand-based company behind the CS328A, a dual channel 100MHz mixed signal USB oscilloscope with two analog and eight digital input channels. With optional accessories two units can be linked to double that number of channels.

Main specifications

The CleverScope CS328A provides two analog channels and eight digital channels (the corresponding analog only model is the CS320A). Its analog bandwidth is 100MHz (measured at the -3dB point), while the digital sampling rate is 100MS/s (millions of samples per second). There is a hardware 25MHz anti-aliasing filter for better spectrum analysis.

The vertical sensitivity ranges from 20mV/div to 20V/div (using a x1 probe). The vertical resolution of the digitising system is 10 bits for the basic model and you can increase this to 12 or 14 bits by purchasing an additional sampler board.

Unlike some USB oscilloscopes, this one has a deep memory of 4Mpts (Million Points) for the basic model.

Review by Mauro Grassi

Front and rear panel connections

The front panel of the CS328A comprises three BNC connectors (two for the analog channels and one for the external trigger), two RJ45 sockets (for connecting the eight digital inputs), two probe compensation terminals and two LEDs, green for power and red to indicate triggering.

On the back, there is the USB port, a BNC connector for the signal generator output and the power input jack and

At left: the CS328A along with its two analog and two digital "probes". On the laptop screen is the supplied PC software used to control the USB 'scope. A sinusoidal wave is shown in the scope graph window while smaller windows are shown around it. All controls stem from the control panel shown at top right. Windows can be shown or hidden from the control panel.

an RS422 port.

The optional RS422 link cable forms a 100 Mbit/s communication link between the two. When you connect the two CleverScope CS328As together in this way, you effectively have a four channel analog scope with 16 digital inputs and a single user interface.

Probes and accessories

The CS328A is supplied with two switchable (x1, x10) 100MHz analog probes. Also included are adaptors that connect to the two front panel RJ45 jacks allowing you to connect up to eight (two lots of 4) digital inputs.

The CS328A is controlled using the supplied PC software for Windows. The software is controlled from the main window and secondary windows become visible as needed. Like other oscilloscopes, the CS328A has an "Auto Set" button, which will analyse the signals and choose the vertical and timebase settings for displaying them on your PC screen.

The signal window also has small buttons, whose function is selected by hovering over them with a mouse. These allow you to either zoom in or out or scale the window to fit the signal.

Triggering and acquisition modes

Each analog channel can be AC or DC-coupled and the triggering supports high and low frequency rejection for greater noise immunity. Although this oscilloscope has an operating bandwidth of 100MHz, as is usual with any wideband digital it is often better to limit the bandwidth to get a better display – with less noise. In this case you can switch to 20MHz band limiting.

Triggering on a preset pattern on the digital channels is also possible.

To do this, you select a state for each of the eight digital channels. The signals must match the pattern for the trigger to occur. For example, you can trigger on a rising or falling edge, or an absolute high or low level of for that channel.

There are two trigger sources. The primary one is an edge trigger., while the secondary trigger allows you to select the number of times that the primary trigger must occur for the secondary trigger to be flagged, among other modes. You can then select the trigger source among either.

The acquisition modes include peak detect (for capturing fast glitches) and repetitive waveform modes. The latter mode works by assuming that the signal is periodic and filling in subsequent cycles. This mode substantially increases the resolution of periodic waveforms which may be important for high frequency signals.

Specifications at a glance:

Analog input channels:	2
Digital input channels:	8
Analog bandwidth:	DC to 100MHz
Sampling rate:	100MS/s simultaneous on both channels
Memory depth:	4Mpts
	(8Mpts with optional memory upgrade)
Vertical sensitivity:	20mV/div
Vertical resolution:	10, 12* or 14 bits*
Size:	153 x 195 x 35mm

(*depends on optional module)

Optional signal generator

Although it is not installed as standard, the CS328A can be enhanced with a signal generator module. This works at up to 10MHz and you can select sine, triangular and square wave modes. You can also select a sweep mode

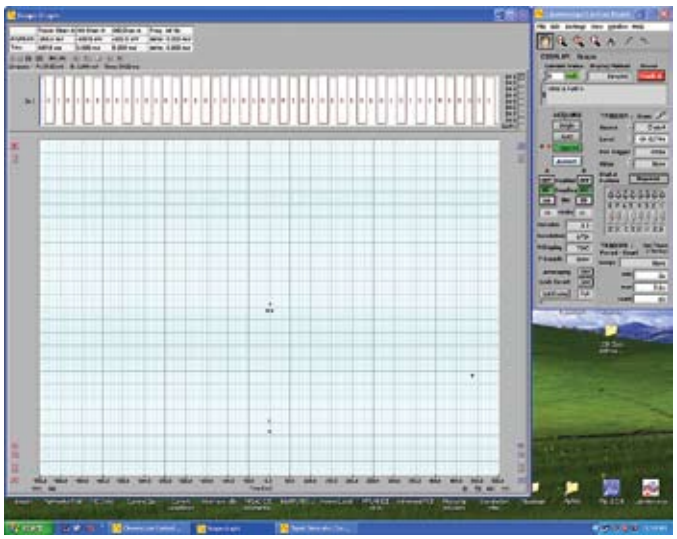

Fig.1: the scope graph window showing the digital channels. The triggering is set to a rising edge on digital channel 1. A low frequency square wave is shown, with the decoded logic values. The voltage threshold for the logic decoding can be defined.

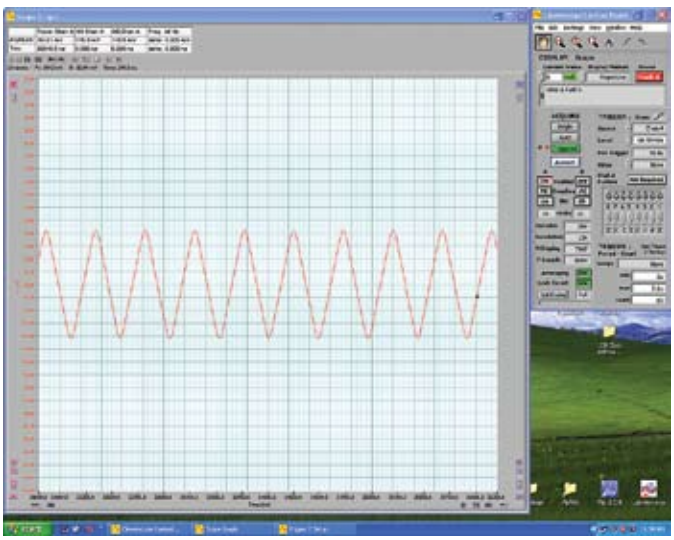

Fig.2: a relatively high frequency triangular wave shown on the scope graph using the repetitive waveform acquisition mode. The triangular wave is at a frequency around 2MHz and was generated using the optional signal generator module of the CS328A.

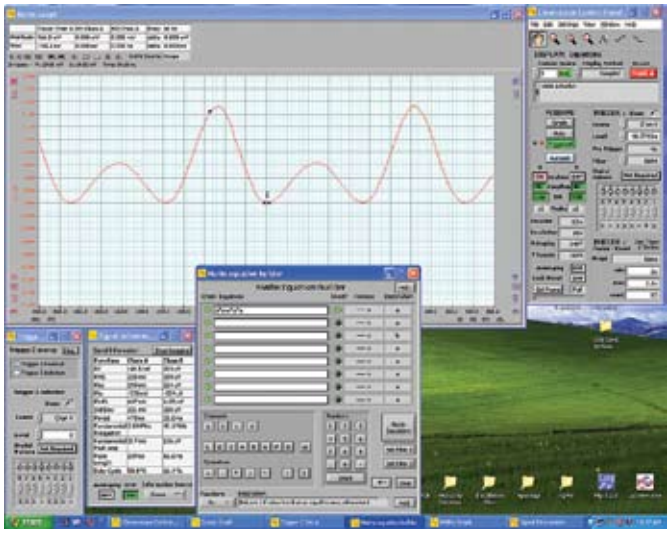

Fig.3: the maths equation builder window. We have selected to apply the equation X^2-X^3 to a sinusoidal wave. The result is shown in the maths graph window. The maths graph window is a separate window that can display up to eight user-defined maths traces.

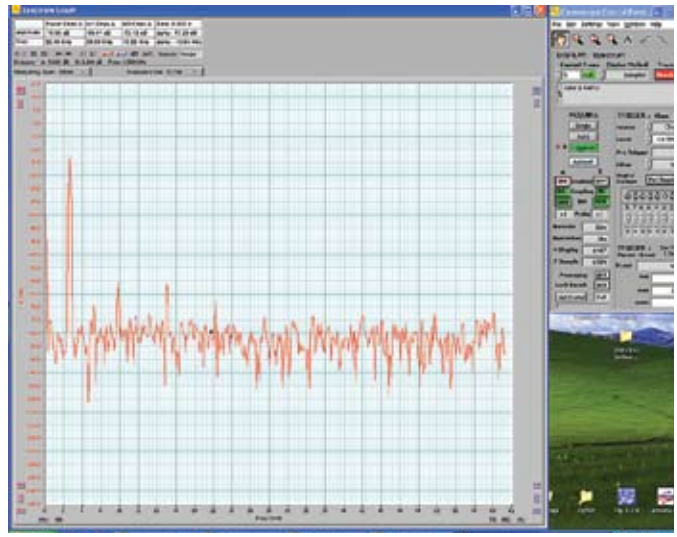

Fig.4: the Fourier Transform window is shown. The input is a low frequency waveform at around 20kHz. The small window at the top left corner inside the spectrum graph window shows information about the signals. You can choose a log plot rather than a linear one too.

which allows you to measure the frequency response of a filter, for example.

Equation builder and signal analysis

The MATHs functions of the software are quite powerful. It lets you define up to eight different expressions which are displayed in a separate window. Apart from the usual arithmetic functions, you can use functions to build up more complex expressions. For example, you can use trigonometric functions and integration.

Many different modes for the Fourier Transform are implemented and can be displayed in a separate window. There is also a power spectrum mode for the Fourier Transform. This lets you see the power of your signal in terms of the equivalent power of a periodic signal at the signal's fundamental frequency (ie, the first harmonic).

The software allows you to view information about the analog channels in a separate window. The fundamental frequency as well as the vital statistics of the signal can be seen in a separate "Signal Info" window.

The range of available measurements includes the RMS and peak-to-peak voltage, as well as maximum and minimum levels. The THD of the signal can also be measured; very useful for audio work.

Exporting data

Using the CS328A to acquire information about a signal is easy, since the control software is already running on your PC. You can copy and paste graph and data tables to other applications. This is especially useful for writing reports and presentations. You can also export data files from the logging window to embed in your spreadsheet.

The software settings can be made permanent, useful for classrooms because the settings for a lesson can be preloaded and will be available when the students first start using the oscilloscope. You can also control the oscilloscope remotely using a LAN connection on your PC, for more advanced applications.

Front and rear panels (top and bottom, respectively) of the CleverScope CS328A USB Oscilloscope. The two RJ45 sockets at left of the front panel are for the digital inputs; the "Chan A" and "Chan B" at right are the analog. USB connection is via the socket on the rear panel, along with RS422 link, signal generator and power.

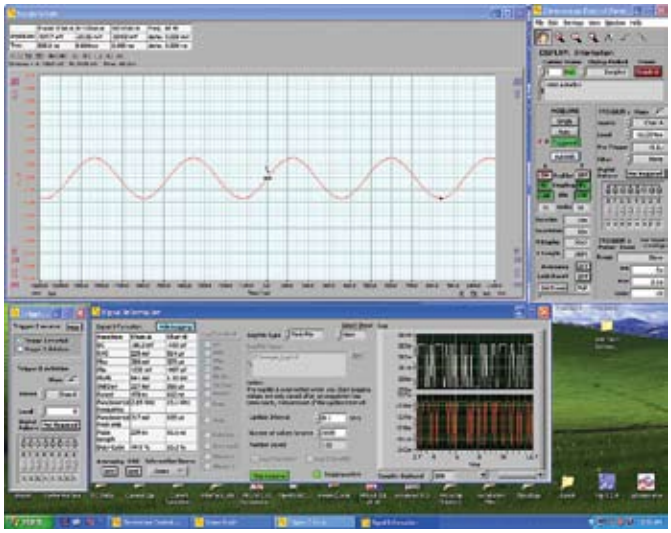

Fig.5: the signal information window, with expanded controls for data logging. This shows logging of the minimum and maximum voltage levels of the input signal. The logging rate of 10Hz is shown, as well as the instantaneous vital statistics of the analog channels.

Other optional accessories

The CS328A can be enhanced with other optional modules. Firstly, you can improve the vertical resolution from 10 bits to 12 and 14 bits using optional sampler boards. You can also purchase a 5ns delay line to double the sampling rate to 200MS/s by using both channels simultaneously for the same signal.

Although the memory depth is large for a USB oscilloscope at 4Mpts, you can even double that by adding extra memory. And you can also buy more exotic probes than the ones supplied, including fully isolated probes (handy for high voltage work) as well as current sensing and differential probes.

Conclusion

The idea behind USB oscilloscopes makes economic sense, cutting costs by avoiding duplication, especially in the display, buttons and knobs.

Much of the data analysis can also be left to the power of your PC, avoiding the need for a powerful DSP or processor. The storage capacity of a common PC far exceeds the amount of non-volatile memory in standalone oscilloscopes and the PC can itself be upgraded in the future.

USB oscilloscopes are therefore a very good idea for entry-level use because they are much more affordable than stand-alone ones. Clearly, you lose the portability of a standalone unit that may be crucial if working in the field. However, with laptops becoming ubiquitous and almost feather-weight, this disadvantage is fast fading into irrelevance.

As USB oscilloscopes go, this one is a winner. Its best features include its deep memory, its relatively high bandwidth and the many features of the included PC software, which is comprehensive.

The CS328A is available in Australia from Grantronics, Phone (02) 9896 7150; web www.grantronics.com.au. The price is $1590 plus GST. In New Zealand, it is available from CleverScope Ltd, Epsom, Auckland. Phone (09) 524 7456. www.cleverscope.com SC

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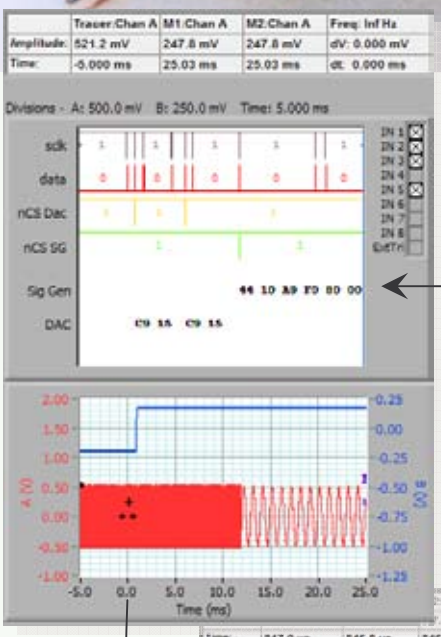

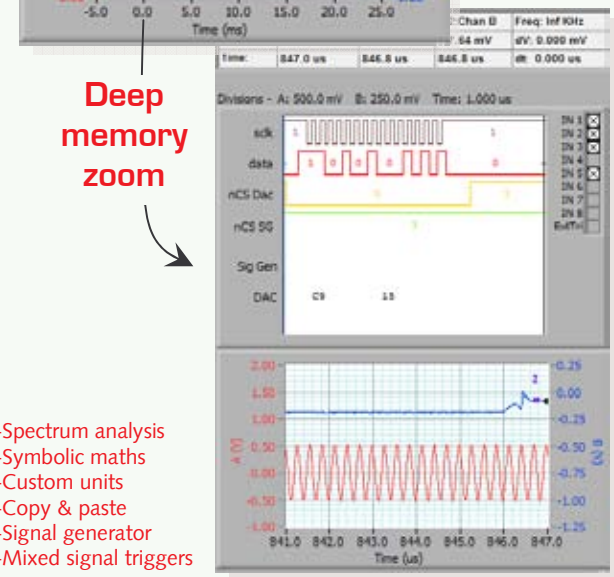

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