BitScope 10

It's an oscilloscope & analyser in a tiny case with Linux and Raspberry Pi support, and it's completely taken over **Graham Morrison**'s life.

DATA

Web
bitscope.com
Developer
BitScope Designs
Price
£160 (approx.)

What's an oscilloscope? It's a way of measuring small variations in voltage. You've probably seen them in their CRT lab coat incarnations, plotting sine waves or the harmonics in the words from an alien overlord. They're almost essential for anything other than the most basic of electronic tinkering, because they enable you to monitor changes over time, unlike a voltmeter for example, which simply shows the voltage.

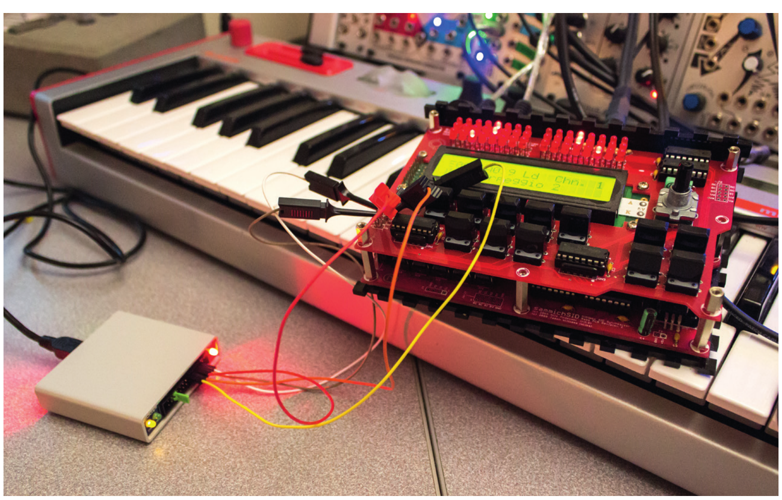
What's an Analyser? It's similar to a scope, but it's designed for capturing multiple digital signals at once so that you can see the relationship between them. They're useful for reverse-engineering the output from old chips or decoding digital protocols from the signals themselves.

If you're any kind of electronics tinkerer or hobbyist, connecting chips to an Arduino or playing with I2C on a Raspberry Pi, oscilloscopes and analysers are essential for troubleshooting. But more importantly, they're a lot of fun.

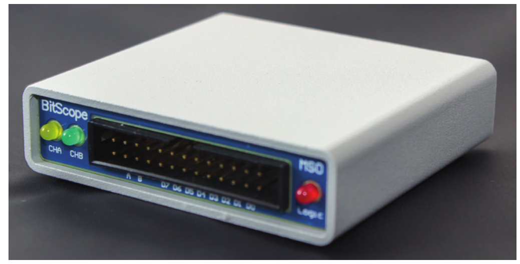
Lights, action...

BitScope's BS10 is both an oscilloscope and an analyser. It's relatively cheap, and that's because instead of the screen and controls of standalone units, you get a block of exposed copper pins held within a tough extruded aluminium case and software for the functionality. The BS10 is tiny – 67x64x17 mm – fitting neatly within its own handy carrying case that also contains the small clipped wires you use to connect the pins to the things you want to measure.

The 26 pins provide a huge range of facilities, with their assignments helpfully labelled on the underside of the unit. There are two inputs for the dual-channel digital oscilloscope, labelled A and B and marked by removable green and yellow plastic jumpers. To



The Bitscope feels like a large toolbox of functionality. Here it's probing the inner poetry of the output from an 8-bit SID chip.



It's a little fiddly to use if you've got large hands, but you can also attach standard probes or a differential add-on for a more professional solution.

the right of these are digital input pins for the logic analyser, and to the right of these the waveform generator output. There are lots of separate ground pins for each input, plus 3V and 5V outputs and general-purpose pins.

A USB port on the rear powers the device when connected to your Linux box. No drivers are required, as the device is driven by the FTDI support built into almost any Linux kernel, but you'll need to install one of the applications from the comprehensive software suite to be able to start using the unit.

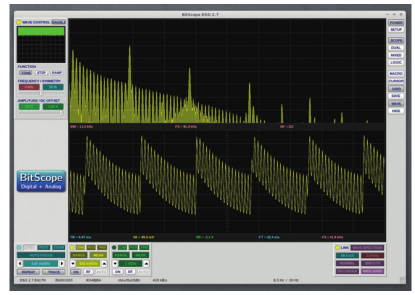
It's the job of the software to handle the functionality that you'd expect from the controls and screen of a more expensive unit, and the principal application is called 'DSO'. We installed the Deb package on Mint with a single click, but there are no real dependencies, so you should have no issues with a different distro. RPM and (32-bit binary) downloads are available, and we also tried the Raspberry Pi ARM package, which worked flawlessly. BitScope has blogged about the amount of effort it's put into optimising the Raspberry Pi version, and it's easy to see why. Connecting the BS10 to a Raspberry Pi makes for a convenient package that will work exceptionally well in an educational setting, especially if you're programming the Pi to send signals being monitored by the BitScope. You could even add a low-cost touchscreen to create a DIY hardware oscilloscope.

DSO is an overwhelming application, not helped by a lack of hardware-specific documentation. It's the

An oscilloscope for the Raspberry Pi

BitScope recently launched a new model, sometimes called the Micro and sometimes called the BS5. It's tiny a piece of hardware based on the BS10 we've reviewed here, only squeezed onto a long thing PCB that's covered in a resin to make it waterproof. On one end is the USB connector and on the other end is a 10-pin subset of what you find on the model 10, making this device cheaper (£120). The remainder of the specification seems identical, including the number of analogue and digital channels and all of the functionality that's unlocked through the software. It's a perfect partner for the Raspberry Pi and helps to explain why BitScope has spent so much time making sure its USB products work well with a device known to have a USB bottleneck.

One consequence of this, apart from the tinkering opportunities of programming your Raspberry Pi while you monitor the output, is that it makes a cheap network-attached monitoring station. One of the tools in the software suite is 'BitScope Server', which after being installed, is simply executed on the command line. The device needs to be plugged into the USB port of the server and the server tool running. Anyone else on the network can then run DSO to connect. It works exactly as it would were the hardware connected directly, and what surprised us most was that you could connect to the same device from multiple instances of DSO on different machines. This could be useful for lab or teaching scenarios, as well as remote monitoring.



The RPi drivers have been enhanced to make best use of its limited USB bandwidth.

software that's used for all of BitsScope's hardware, and it suffers a little from trying to do too much. It can display a single-scope channel, dual channels, the logic input and a mixed combination of all of them, alongside a waveform generator and a spectrum/phase plot of the analogue inputs.

The challenge is to enable and manage these features, and it all starts in the top-left. Without a trigger, the hardware doesn't generate data. A trigger is what captures and recognises a cycle or a frame from an input waveform, enabling you to monitor the input in real time (if you've got repeat enabled), or saved as a single cycle on the display. From there you can accurately measure the inputs, either manually with the cursor or automatically, and adjust the timeframes/voltages for capture and scaling. If you've used an oscilloscope before, this will all be familiar territory, as too will be the units and terms used throughout. But for a beginner, using DSO for the first time will leave you feeling a little like how you must feel having read through this paragraph.

Sine your name

We can only hope you'll persevere, because there's an incredible amount of power here. Far more than even on a cheap hardware oscilloscope. The 100MHz bandwidth of the BS10 is enough to for real-time repetitive capture, and you can adjust scales separately for both channels, as well as trigger inputs from the other channel. You can adjust code and parameters as you're monitoring the signal, and we were able to play with all kinds of cross-modulated audio signals and voltages in ways you just can't without dedicated hardware. We did have some difficulty mastering the triggers, but the waveform output – which includes sine, square and triangle waveforms – is a good way of testing your setup against differences in external hardware.

The other major mode in DSO is the logic analyser, used for displaying binary data captured on the digital inputs. We attached ours to a PCB connected to a SID chip and used DSO to monitor the various bits of control data going into the chips. This is a complex area, but the eight input channels were more than adequate at showing what was happening across many pins at once, and with these inputs reportedly working at 40 million samples per second, they should be able to decode even complex protocols, especially on older or off-the-shelf components. You can cross-trigger the digital inputs from the analogue input (and vice versa) and use a trigger mask to look for a specific state or digital value, all of which helps make best use of the limited buffer space within the DC10.

From an educational perspective, there's a lot more to the analyser mode, as it enables you to see what your software is actually physically doing and how devices communicate. This isn't easy to accomplish with other methods, and can also lead into all kinds of engineering and design territory not easily covered by software alone. And while there are many, many other features we haven't mentioned, perhaps the API is the most significant, as it enables you to access many of the same functions within DSO only through your own Python/C/C++ code, which could have all kinds of uses for your own projects, tutorials and even installations.

"The BS10 packs so many features into its small case, it's difficult to know where to begin."

Oscilloscopes and logic analysers have always been expensive and are usually considered luxury items by most hackers. But they make the impossible possible, and they're a lot of fun. The BS10 packs so many features into its small case, it's difficult to know where to begin. It has great Linux support, works well on a Raspberry Pi, and can take you from Arduino tinkerer to an electronics and engineering wizard. Just don't rely on the (non-existent) BS10 manual.

LINUX VOICE VERDICT

Fantastic value for such a powerful and versatile device, suitable for so many different users.

★★★★½