Review by Tim Blythman

PicoScope 6426E USB Oscilloscope

The PicoScope 6426E USB Oscilloscope is a high-performance software-driven oscilloscope. As most of our experience is with standalone/benchtop type 'scopes, we were interested in trying it out when Emona Instruments offered to loan us an evaluation unit.

In February this year, we purchased a BitScope Micro PC-based oscilloscope to build a low-cost Virtual Electronics Workbench (siliconchip.com.au/Article/14751). While the concept is similar – both scopes lack screens and buttons, connecting to a computer instead for display and control – Pico Technology's 6000E series of PC-based oscilloscopes is in an entirely different league.

The unit we received for testing is the 6426E four-channel, 1GHz bandwidth scope with a maximum 5GS/s sampling rate. But there is much more to the scope than these basic specs imply.

The 6426E has the so-called FlexRes feature, which means that it can sample voltages with a resolution of eight bits (256 steps), 10 bits (1024 steps) or 12 bits (4096 steps). This is 12 bits of true hardware resolution, not achieved by averaging multiple samples of lower resolution.

If the full 1GHz sampling rate is not needed, then the 6426E can also perform oversampling and software enhancement to provide an effective resolution of up to 16 bits.

This extra resolution can be handy in audio work or anywhere that a high dynamic range is needed. It can only sustain the 5GS/s (gigasamples per second) sampling rate with the vertical sampling resolution set to eight bits, reducing to 1.25GS/s when using two channels at 12 bits due to hardware bandwidth limitations.

Given that you'd typically need the higher vertical resolution when looking at lower-frequency signals like audio, that doesn't seem like a significant problem.

The scope feature that we found most interesting is the sheer volume of sample data that the unit can capture, up to four gigasamples. That means that the 6426E can sustain its maximum 5GS/s sampling rate (on one channel) for up to 800ms.

There are great benefits to having long capture times. Once you have sampled an event, it will be a great boon to be able to look over the surrounding times to see the complete circumstances.

For example, there is nothing more frustrating than debugging digital communication and only capturing a fraction of the transaction, especially if it's a rare event. This long sample size potentially allows many seconds or even minutes of data (at lower sampling rates) to be captured and analysed after the fact.

These high sampling depth and rate capabilities also mean that FFT (spectral) analysis can be more detailed; the spectrum view can be accessed by a single click in the user interface.

Range of scopes

The 6426E that Emona supplied us for review is just one of Pico Technology's 6000E series of scopes, and it is pretty well top-of-the-range.

There are nine units with different feature combinations listed at the time of writing. The range starts with a 300MHz bandwidth unit that lacks

PicoScope 6426E Features & Specifications

- Voltage resolution: eight bits (256 steps) to 12 bits (4096 steps)
- Channels: 4 x 1GHz analog, plus 16 x digital with optional MSO pods fitted
- Sampling rate: 5GS/s maximum
- Capture memory: 4GS
- Waveform generator: 50MHz, 200MS/s, 14-bit
- Update rate: 300,000 waveforms per second
- Software: PicoScope 6 and PicoSDK (free)
- Other features include: serial decoding, mask limit testing, high-resolution waveform timestamping

the FlexRes feature, limited to eight bits (256 steps) of vertical resolution. Also, this basic unit (the 6403E) only has 1GS of storage.

There are also eight-channel units, although these are only available with 500MHz bandwidth: the 6804E (eight-bit resolution only) and 6824E (with FlexRes).

These scopes can also be fitted with one or two optional mixed-signal oscilloscope (MSO) pods. These provide eight digital signal inputs each; our review unit was not supplied with these. But this doesn't stop the scope from being useful for digital work.

There is an online tool at www.picotech.com/oscilloscope/6000/picoscope-6000-overview for configuring and viewing the scope options.

Software

Even before we received the unit to test, we made sure to download the necessary software.

In a very refreshing change from much software these days, the PicoScope 6 software does not need a login or e-mail address to use or download. PicoScope Version 6.14.44 is the latest release and the first version to support the 6000E series scopes.

On Windows, the software is around 210MB to download and around 230MB installed. The installation process was straightforward and included the necessary drivers. It's a good sign when things like this just work.

There are also beta (pre-release) versions of PicoScope 6 for macOS and Linux. Early versions of PicoScope 7 are also available. The notes indicate that this version will eventually support all current and many discontinued PicoScope models, so ongoing support looks good.

Hands-on testing

The scope comes in a padded clamshell case and with all the basics needed to use it, including four 500MHz 10:1 passive probes. Active probes are also available as an option at the time of purchase.

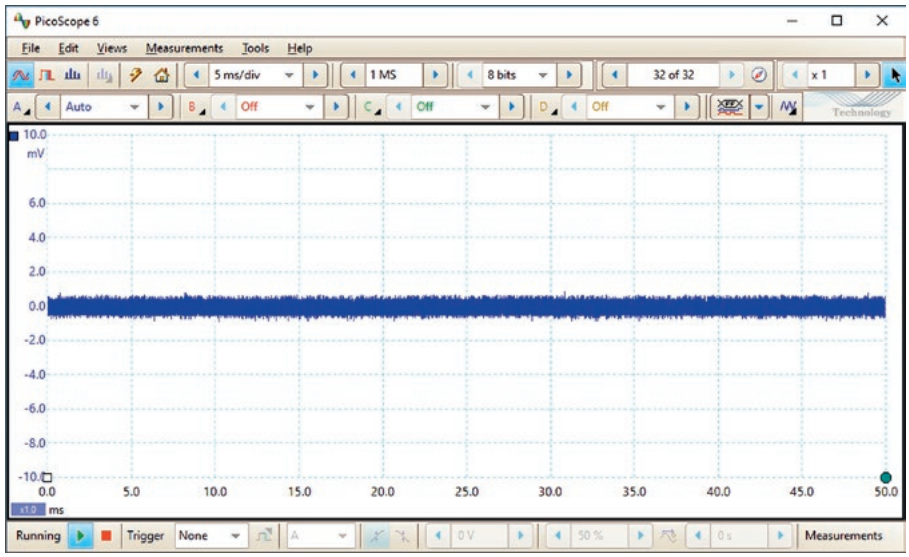
The front panel features the four BNC socket inputs plus a pair of test points for Earth and a square-wave output.

The rear is dominated by a fan grille with USB and power connections on one side and three BNC sockets on the other. These sockets are the auxiliary trigger input, 10MHz timebase input

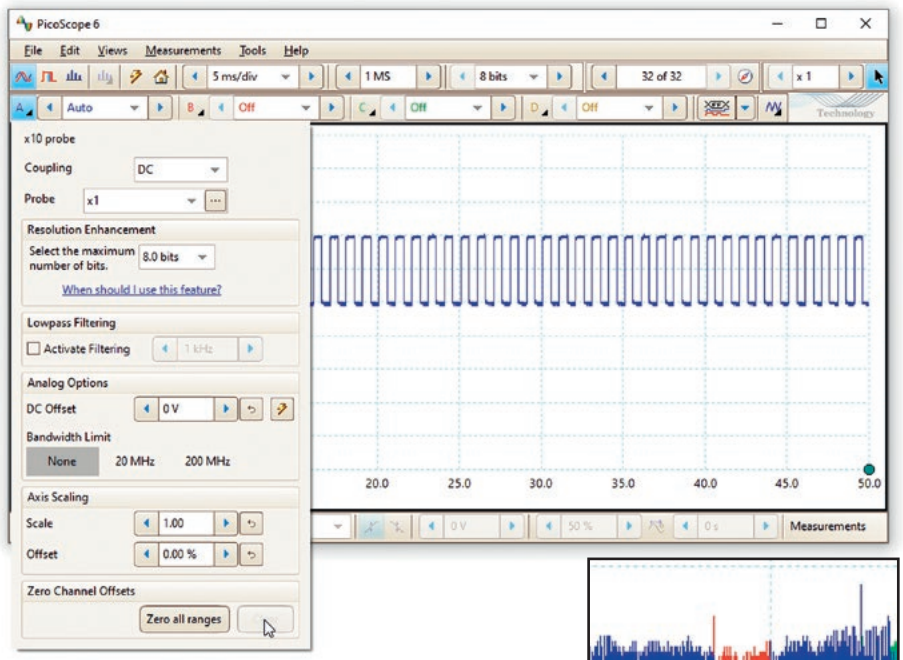
The PicoScope 6426E accepts Pico Technology's intelligent probes as well as standard passive probes on the front panel. Optional mixed-signal oscilloscope (MSO) pods for digital signals can be plugged in at lower right.

Up to two MSO (mixed signal oscilloscope) pods can be plugged into the front of the 6000 series 'scopes. These are optional extras and were not included with the unit we tested.

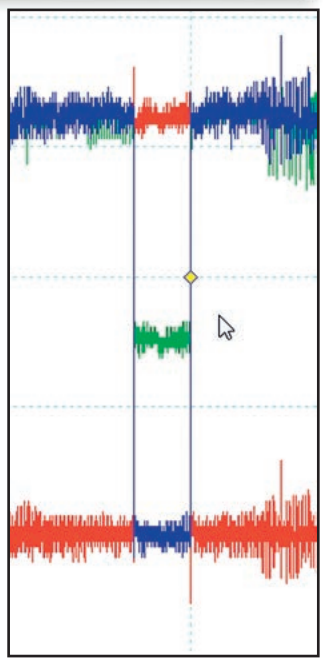
Standard inclusions are four passive 10:1 500MHz probes. The probes also come with a variety of useful accessories, including spring tip, ground spring and colour coding rings. Active probes are also available.



Screen 1: when the PicoScope application is started, connected probes are automatically detected and the trace is displayed. Common settings are above and below the main trace window.



Screen 2: a comprehensive set of probe settings are available via a drop-down for each connected probe. It's handy to have all these settings in one place.



Screen 3: when the trigger is activated, it appears as a yellow diamond that can be moved around to set both the trigger threshold and delay. A separate window is used to modify more advanced trigger settings.

and AWG (arbitrary waveform generator) output.

The body is extruded aluminium with rubber bumpered corners. It feels solid and comes with a 12V power brick of the type that would typically accompany a laptop computer, and a sturdy USB 3.0 (A-B) cable, as well as the necessary manuals.

While we scanned the Quick Start Guide, getting started was as simple as connecting the power brick, connecting the unit to the computer with the USB cable and starting the PicoScope software.

Connected probes are automatically detected and displayed. Screen 1 shows the initial display on launching the software with the scope connected.

User interface

While PC-based scopes are necessarily different to the alternative, they also tend to offer more options. The trick is learning where all the settings and selections are hidden. We found the PicoScope software to be laid out in a fairly intuitive manner.

An A3 poster guide is available, briefly explaining the main features and where their controls are located.

Within the main window, there are three mains rows of controls (plus the standard window menus). The first row has the timebase and sample settings, the second the channel ranges.

Interestingly, the vertical channel ranges aren't set per division but for the entire vertical scan. It's not what we're used to, but it makes sense to do it this way, as you typically know the range of signals to expect and can simply set the vertical range to match.

Screen 2 shows the settings that are available for each probe (channel).

A third row below the trace window has the trigger settings. So the most commonly used features are suitably grouped and easy to find.

The PicoScope software makes excellent use of the PC interface — the method of setting Triggers is both remarkable and straightforward. Once the trigger is enabled, a yellow diamond appears on the screen and can simply be dragged around to set the trigger point.

The vertical position of the trigger determines the threshold, while the horizontal position determines the delay (or amount of pre-sample and post-sample). This is shown in Screen 3.

As well as the basic trigger options, there are advanced options such as window, interval, level, runt pulse and digital boolean logic trigger conditions, including those dependent on multiple signals.

With the zoom tool selected, a region of the trace can be selected for closer inspection. As well as the zoomed window, an overview panel is shown, allowing the zoomed section to be panned around and inspected. This is seen in Screen 4.

Features

In the course of working on some of our current projects, we tried out some of the different features of the 6426E. Of particular interest to us is the serial decoding feature.

Several protocols can be decoded, and these are accessed from the Tools → Serial Decoding menu item. The dialog box with its options is seen in Screen 5. We used an I^2C decoder to monitor signals being sent to an I^2C OLED display. Screen 6 shows the data being correctly detected, packetised and decoded.

While this looks like quite a bit of data, what is being displayed is only a fraction of what the PicoScope has stored. Up to 32 separate captures are also kept and can be examined using the 'buffer overview' feature.

This makes it easier to examine longer sequences, and different captures can be compared and viewed, including any decoded serial data associated with the raw scope waveforms. Screen 7 shows the small window that provides the waveform overview and allows easy selection of captures to view.

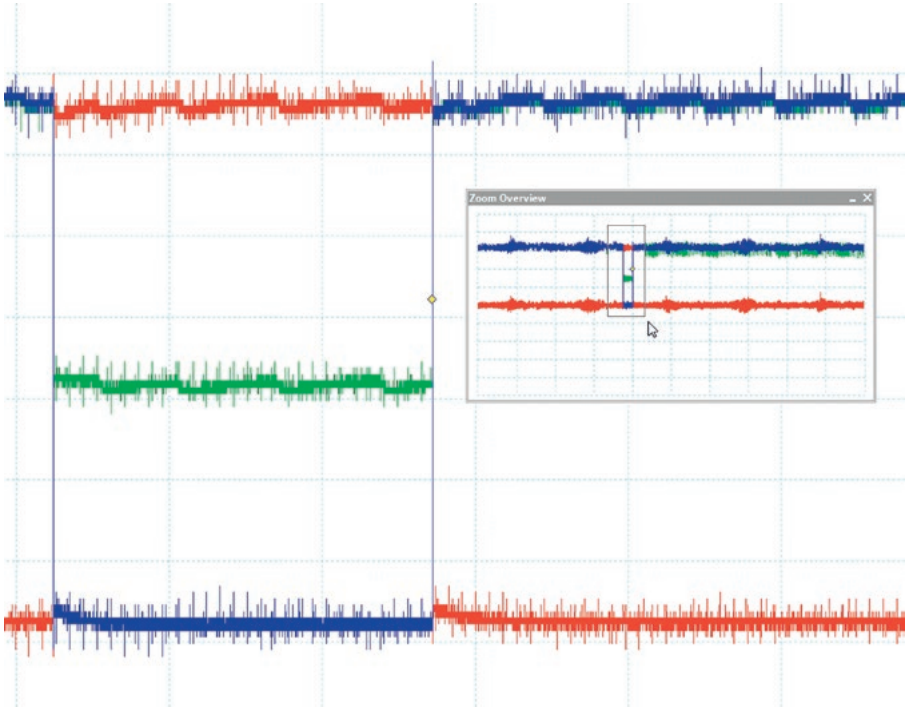
Menus

We cannot cover all the features of the 6426E, but we will highlight some that we thought were of particular interest.

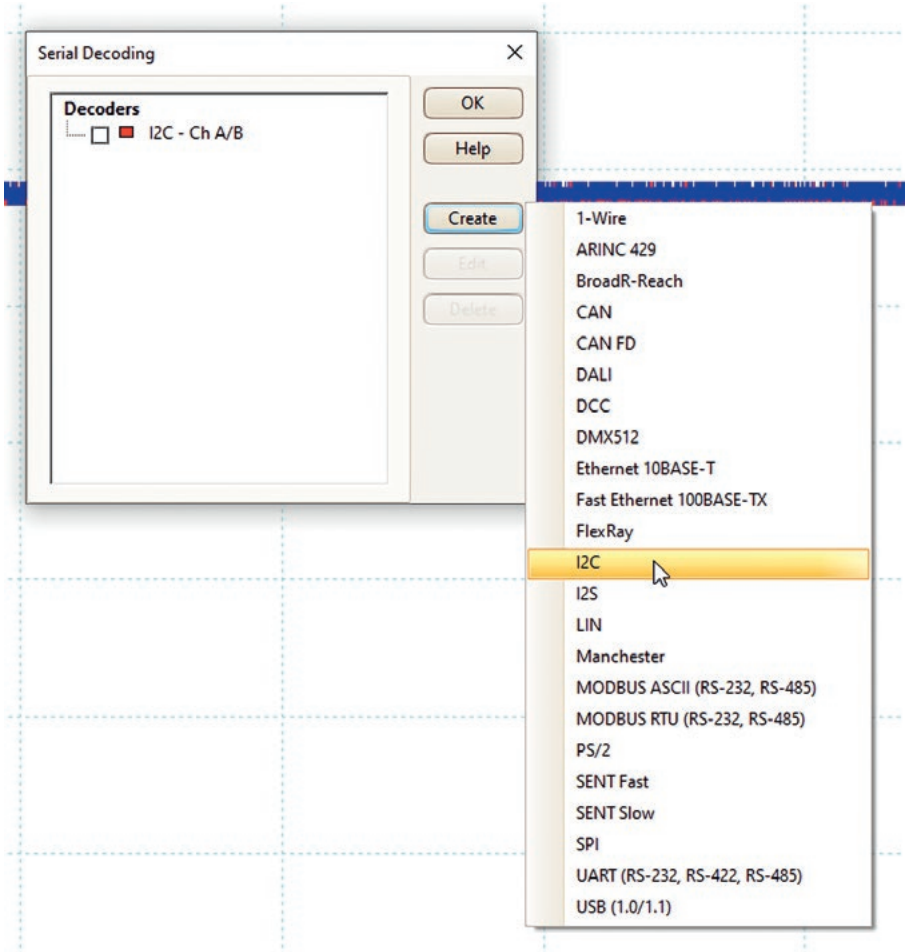
Taking a screenshot is as simple as using the Edit → Copy as Image menu item. There is also a "Copy as Text" option to allow easy pasting of data into a spreadsheet application.

Various measurements can be applied to a trace, allowing easy assessment of things like frequency, duty cycle, RMS value and even digital aspects such as the number of edges.

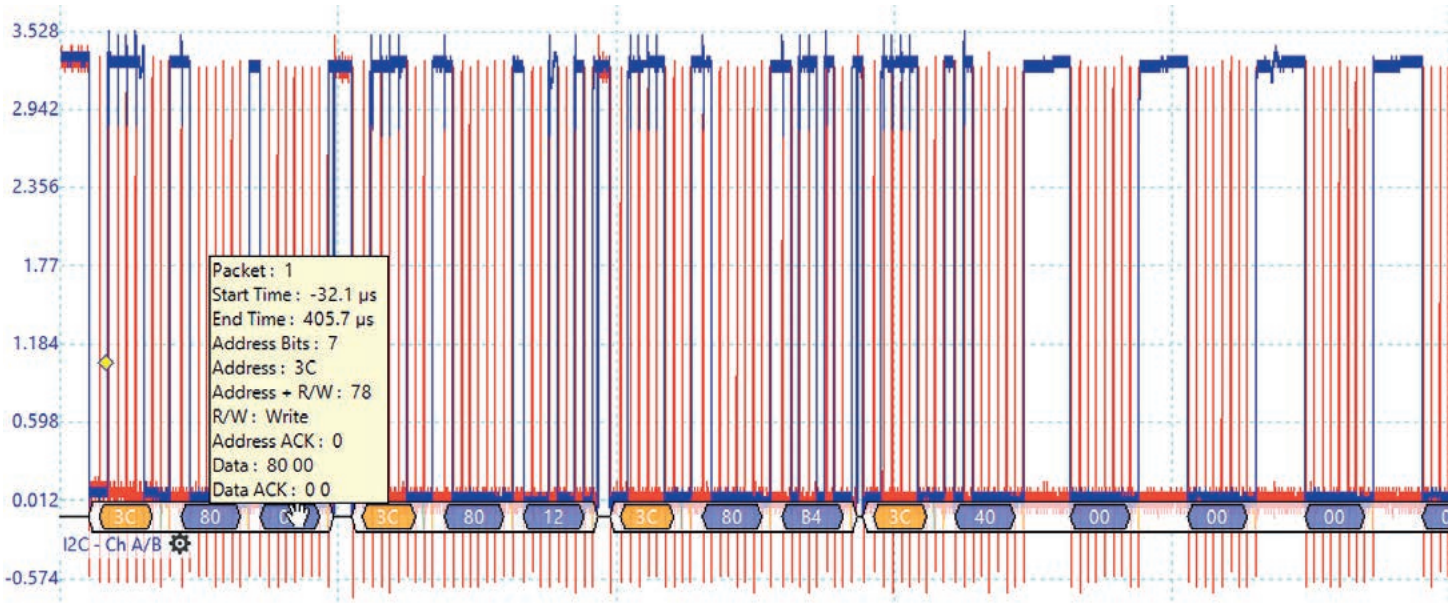
These can be applied to the entire screen display or between manually set rulers on the screen; the rulers can



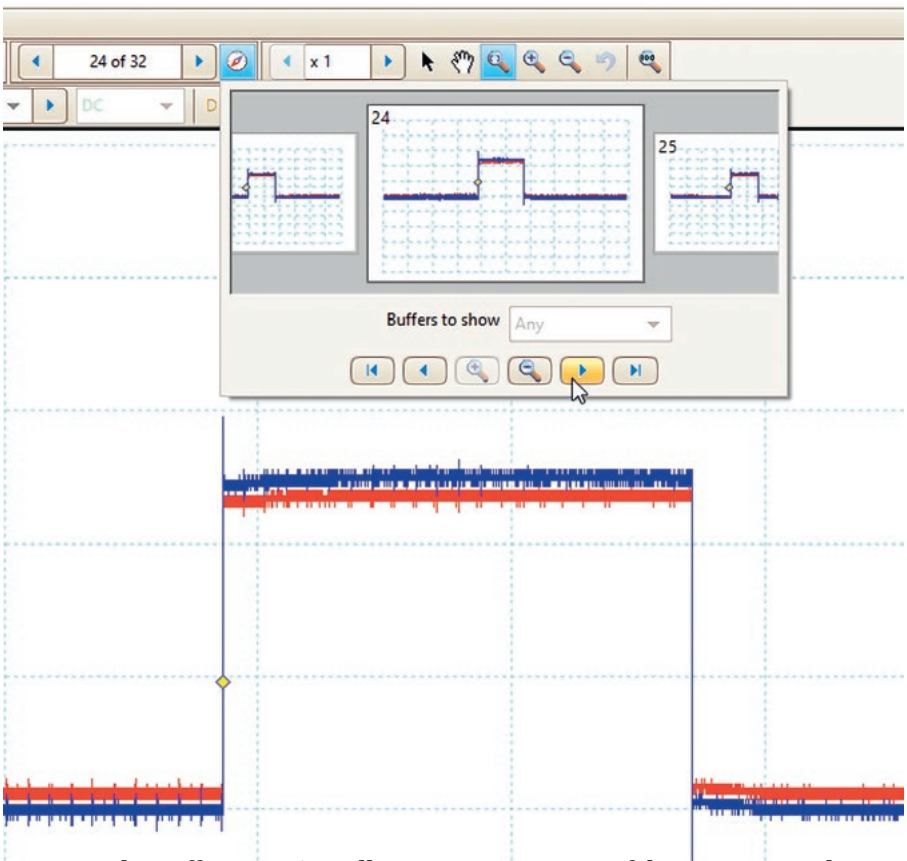
Screen 4: the zoom tools are simple and intuitive. The Zoom Overview allows the zoomed region to be panned around.



Screen 5: a comprehensive range of serial protocol decoders are available. We were impressed to see that the DCC digital command protocol for model railways is present.



Screen 6: we tested the I²C decoder and found that the PicoScope had no trouble detecting data packets that matched what we expected.



Screen 7: the Buffer Overview allows up to 32 screens of data captures to be viewed and compared. Any applicable decoding is also made available below the window shown.

simply be dragged and dropped like the trigger marker. Screen 8 shows the available measurements.

As well as serial decoding, the Tools menu allows 'Math Channels' to be added. There are simple (sum, difference, product) channels available directly from the menu, but you can also enter custom equations. The interface for entering equations looks a lot like a scientific calculator.

There are also Tools menu options for masks, alarms and reference waveforms.

Within the Preferences settings are a comprehensive range of functions to which keyboard shortcuts can be allocated. While it is easy enough to use the mouse for most features, we think that being able to set up key shortcuts for frequently used actions will be very handy for people who use the scope a lot.

Waveform generator

The waveform generator output is available from one of the BNC sockets at the rear of the scope. It can produce square waves and sinewaves up to 50MHz, and other waveforms at lower frequencies.

Arbitrary waveforms can be taken from either a CSV file or an existing scope trace. Digital bitstreams can be entered as binary or hexadecimal data.

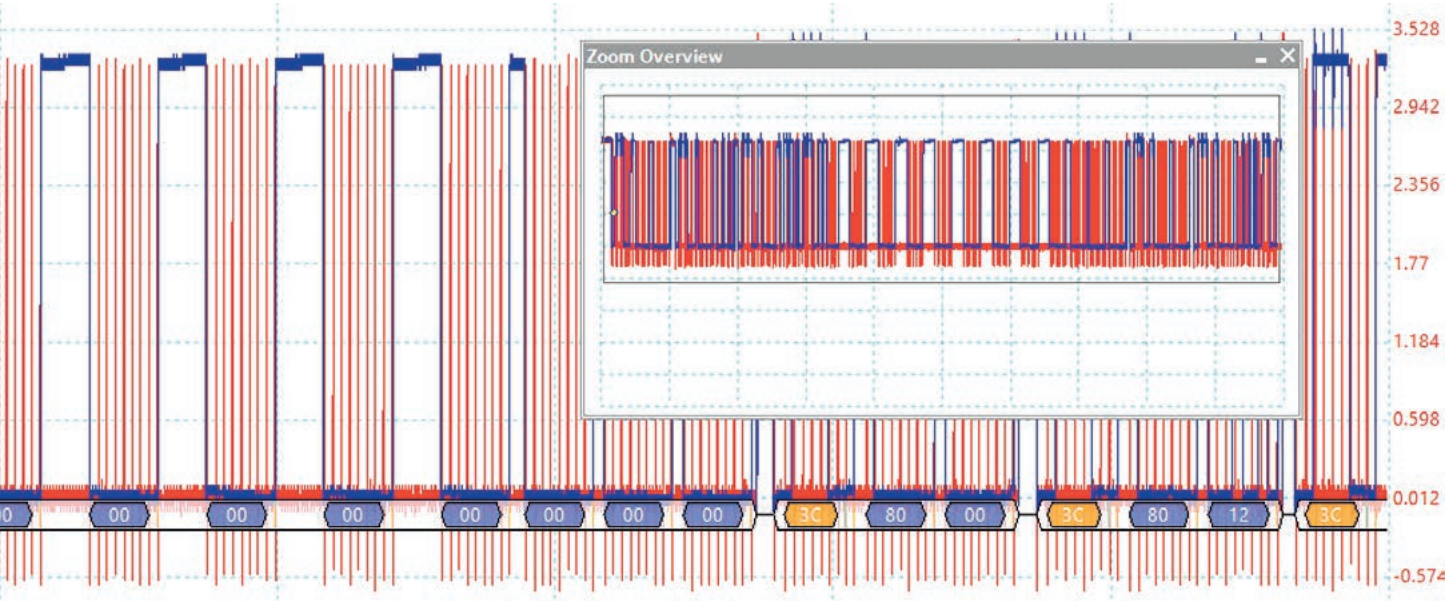
Conclusion

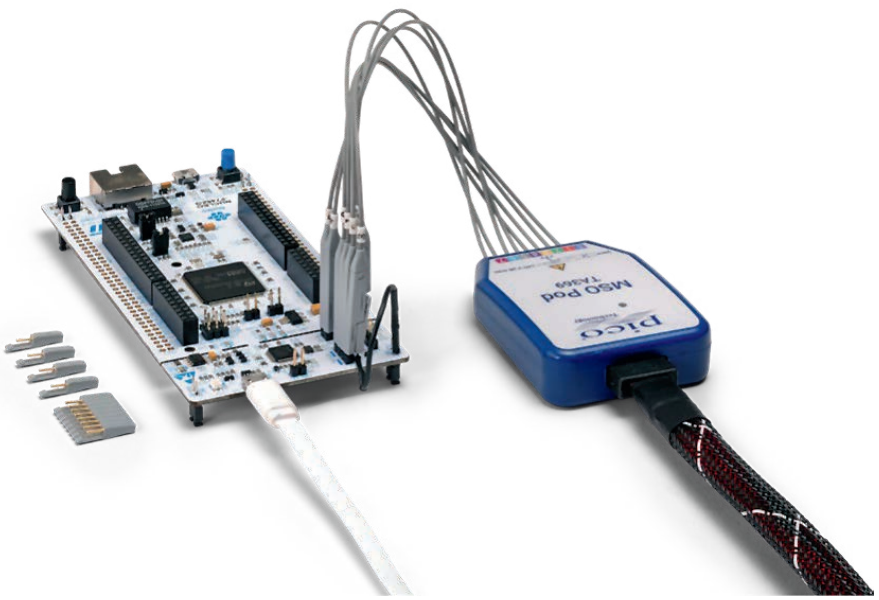
The 6426E is an impressive machine with a comprehensive set of features. We did not find it wanting in any of the tests we threw at it. In fact, we struggled to get it anywhere near its limits.

It is a handy tool for working with digital electronics through the numerous decoders, even though it has impressive specifications in the analog domain.

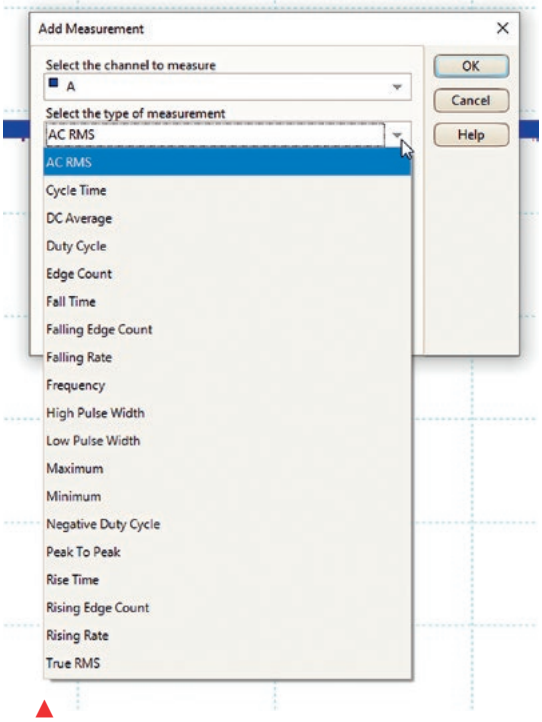
The 6000E range of ultra-deep-memory oscilloscopes is available from Emona Instruments. Ring them on 1800 632 953 or e-mail testinst@emona.com.au

Visit siliconchip.com.au/link/ab9j for a list of all the PicoScope products they sell or refer to their advertisement on the inner back cover. SC





Each optional MSO pod provides eight digital channels and includes a number of adapters, ground clips and test hooks to connect to the circuit under test.



Screen 8: the measurements listed here can be applied over the entire span of a buffer, or limited to specific ranges using adjustable rulers.

The A3136 1.3GHz Active probes are an optional extra, but are necessary for working at frequencies higher than passive probes can support. The Intelligent Probe Interface powers the probe from the scope and facilitates automatic probe detection and unit scaling.