

How TiePie engineering Broke the Fixed-Channel Barrier

A flexible, fully synchronized oscilloscope platform that grows with the measurement

Sneek, The Netherlands – As engineers, we used to run into the same problem time and again: you are working on a complex measurement in automotive testing, power electronics or industrial machinery, and suddenly you discover that you are exactly one channel short.

Traditional oscilloscopes usually come with a fixed architecture of two, four or eight channels. That works well until the measurement becomes more complicated. Add another current, voltage, sensor or communication signal and suddenly the oscilloscope determines what you can measure.

At TiePie engineering, we felt it should be the other way around. The measurement should determine the number of channels.

That idea became the starting point for our **MultiScope platform**, designed to break the fixed-channel barrier and give engineers the freedom to build a measurement system around the actual application.

Instead of replacing an entire oscilloscope when more channels are needed, additional instruments can simply be added. Systems with 6, 8, 10, 12 or perhaps even 64 or more channels can easily be created, but considerably larger configurations are possible as well. Single-ended and differential instruments can also be combined in the same system.

The result is a measurement platform that can grow and change together with the project.

We wanted one instrument, not a collection of oscilloscopes

One of the most important requirements during the development of MultiScope was synchronization. It would have been relatively easy to connect several oscilloscopes to the same computer. But simply placing a number of instruments next to each other does not automatically create a true multi-channel oscilloscope.

"We didn't just want to offer a stack of individual oscilloscopes that happen to talk to each other. The goal was to create one fully synchronized measurement system. We wanted engineers to simply connect the instruments they need for a specific test and let the system handle the rest. No hassle with clock drift — just reliable data right away."

That is why we developed **CMI - Combine Multiple Instruments**.

CMI connects the individual oscilloscopes through a high-speed sample bus so that every channel operates from the same sampling clock.

The result is a **0 ppm clock difference between the synchronized instruments**.

This is important when signals from different instruments have to be compared accurately in time. Whether the system consists of single-ended inputs, differential inputs or a combination of both, the timing relationship between all channels is preserved.

Triggering is also shared across the system. A measurement can be triggered from any available measurement channel or supported generator trigger source.

The Multi Channel oscilloscope software automatically detects the connected instruments and takes care of functions such as master/slave configuration and bus termination.

For the engineer using the system, the individual oscilloscopes therefore behave as **one large synchronized instrument**.



Performance for demanding measurements

Flexibility should not come at the expense of performance. Depending on the selected instruments, a MultiScope configuration can provide:

- sampling rates up to **1 GSa/s**
- bandwidths up to **250 MHz**
- acquisition memory up to **256 Mpoints**
- continuous streaming rates up to **200 MSa/s per instrument**
- single-ended, differential or mixed input configurations
- measurement resolutions up to **16-bit**

This makes MultiScope suitable for demanding applications in areas such as **automotive development, electric vehicles, inverter testing, power electronics, electric motors, industrial machinery, research** and **automated test systems**.

But the main idea behind MultiScope is not simply to offer impressive specifications. It is to make the measurement system adapt to the project, rather than forcing the project to adapt to a fixed oscilloscope.

Standalone testing on-site – without a PC getting in the way

Once we started using distributed measurement systems in practical applications, another challenge became clear. A permanent PC connection at the measurement location is not always convenient – and sometimes it is simply not possible.

Think of a vehicle road test, an endurance test on machinery or measurements inside a large industrial installation. You may need to record fast signals continuously for hours, while a laptop or network connection is located somewhere else. A lost connection should not mean a lost measurement.

For this reason, selected WiFiScope WS6 and WiFiScope WS6 DIFF instruments can be equipped with our **Standalone option L**. The principle is straightforward.

You prepare the measurement in the familiar Multi Channel oscilloscope software, configure the channels, sample rate, trigger conditions and other settings, and transfer the configuration to the oscilloscope. After that, the PC is no longer required for the actual acquisition. The oscilloscope performs the measurement **completely autonomously** and stores the acquired data locally.

With **32 GB of high-speed internal storage**, providing approximately 30 GB for measurement data, large amounts of measurement data can be recorded without continuously sending the complete data stream over USB, LAN or WiFi.

This opens up some interesting possibilities.

At a sample rate of **5 MSa/s**, a measurement can run continuously for approximately **53 minutes**.

Reduce the sample rate to **1 MSa/s**, and the recording time increases to approximately **4.5 hours**.

At **100 kSa/s**, measurements of around **11.2 hours** are possible.

And at **10 kSa/s**, a test can continue for approximately **4.6 days**.

This makes Standalone option L especially useful when looking for faults that only occur occasionally. An intermittent problem in a machine may not appear during a ten-minute test. It may happen only after several hours of operation, under a particular load or at a particular temperature. With standalone acquisition, the oscilloscope can simply stay with the machine and keep measuring.

If the WiFi or LAN connection disappears during the test, the oscilloscope does not stop. It continues acquiring and storing the data locally. Once communication is restored, the recorded data can be transferred to the computer for analysis.

The computer therefore becomes a tool for configuration, monitoring and analysis, rather than something the measurement depends on continuously.

Wireless synchronization across hundreds of metres

There is another practical problem that cannot be solved simply by adding more channels.

Sometimes the signals themselves are far apart. On a train, large machine, production line, ship, vehicle or industrial installation, measurement points may be tens or even hundreds of metres away from each other. Running analogue cables over those distances is rarely the ideal solution.

That challenge led us to develop **WCMI - Wireless Combine Multiple Instruments**.

With WCMI, individual oscilloscopes can be positioned close to the signals they are actually measuring. The WCMI modules then synchronize the sample clocks and triggers of the instruments wirelessly. Depending on the environment, distances of up to approximately **400 metres between instruments are possible**.

This means an oscilloscope can be placed at one end of a machine or installation and another instrument hundreds of metres away, while both remain part of the same synchronized measurement system.

An additional advantage is the **galvanic isolation between the individual measuring instruments**. This can be especially valuable in power electronics, large machinery and distributed electrical installations, where unwanted ground connections between distant measurement points can cause problems.

And again, the system remains scalable. If another measurement location is required, another oscilloscope and WCMI module can simply be added.

Measure locally, synchronize globally

The combination of **MultiScope**, **WCMI** and **Standalone option L** creates a different way of approaching large measurement systems. Instead of bringing every analogue signal over long cables to one central acquisition unit, the measuring instruments can be brought to the signals. An oscilloscope can be positioned close to each group of measurement points. The instruments can be synchronized across the complete installation, while the high-speed measurement data itself is stored locally in each instrument.

This is particularly attractive when many channels have to be measured over a large area and for a long period of time. There is no need to continuously transmit enormous amounts of high-speed measurement data wirelessly during the test. The instruments do the measuring where the signals are. The computer can stay somewhere else.

Afterwards, the synchronized measurements can be brought together for analysis.

One software environment

Despite the modular hardware architecture, the engineer does not have to operate every oscilloscope separately. All instruments are controlled from TiePie engineering's Multi Channel oscilloscope software.

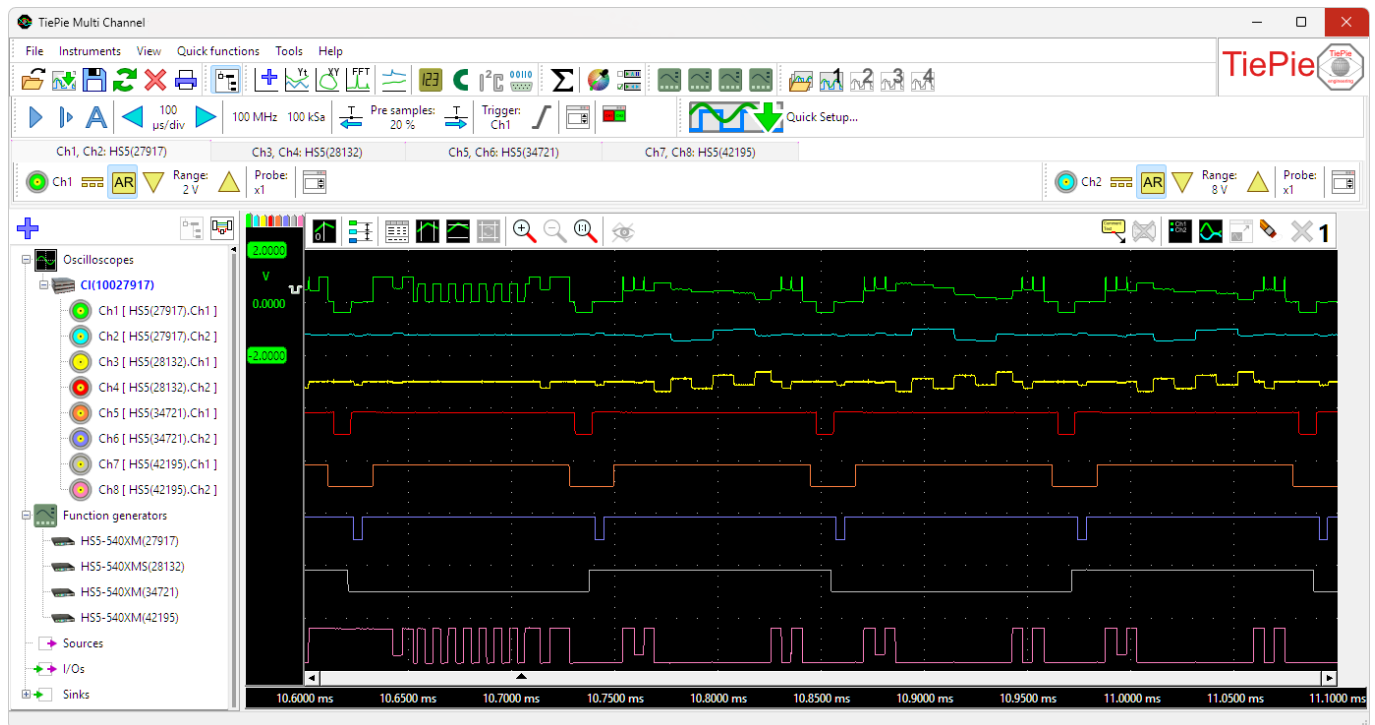
Connected instruments are automatically detected and combined.

Depending on the application, the same software environment can be used as an:

- oscilloscope
- spectrum analyser
- data logger
- multimeter
- Arbitrary Waveform Generator
- protocol analyser

This means the engineer can concentrate on the actual measurement instead of spending time configuring a collection of separate instruments.





For automated testing, OEM applications and integration into larger measurement systems, TiePie engineering also provides the cross-platform **libtiepie-hw SDK**.

Let the measurement determine the number of channels

MultiScope started with a simple frustration familiar to many engineers: needing one more channel than the oscilloscope has available. But solving that problem led to a much broader measurement concept.

Need more signals? **Add another instrument.**

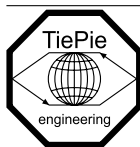
Need differential and single-ended channels in the same test? **Combine them.**

Need to measure signals hundreds of metres apart? **Use WCMI and put the oscilloscopes close to the signals.**

Need a high-speed measurement to continue for hours or days without depending on a PC connection? **Use Standalone option L and store the data locally.**

There is no reason why a measurement should have to fit inside a fixed two-, four- or eight-channel architecture. The technology should adapt to the measurement – not the other way around.

TiePie engineering MultiScope:
because the measurement should determine the number of channels,
not the oscilloscope.



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