High amplitude resolution, 256 times more than a standard oscilloscope

The TiePie engineering WiFiScope WS6 DIFF, WiFiScope WS6, WiFiScope WS5, Handyscope HS6 DIFF and Handyscope HS5 and the ATS610004DW-XMSG, ATS605004DW-XMS, ATS610004D-XMSG and ATS605004D-XMS are **high resolution** oscilloscopes.

These oscilloscopes measure with high resolutions of 14 and 16 bit. A resolution of 16 bit means that the full scale input range is divided in 2^{16} levels = 65536 levels. This is called quantization. A signal measured with one of these high resolution oscilloscopes therefore has 256 times more resolution than most standalone oscilloscopes, which usually have a low resolution of 8 or 9 bit (8 bit resolution means 2^8 levels = 256 levels).

When the input range of the TiePie engineering high resolution oscilloscope is set to 200 mV, the full scale input rage runs from -200 mV to 200 mV and spans 400 mV. When measuring at 16 bit resolution, the voltage resolution of the measurement is then 0.4 V / 65536 = 6.1 μV. On the 8 bit resolution standard oscilloscope, the voltage resolution is 0.4 / 256 = 1.56 mV.

If the 8 bit standard oscilloscope has an input range of 1 mV/div, the voltage resolution is 0.008 / 256 = 31.25 μV. The TiePie engineering high resolution oscilloscope in its 50 mV/div input range has 6.1 μV voltage resolution, which is more than 5 times better than the standard oscilloscope in its 1 mV/div input range.

The high resolution of the TiePie engineering precision oscilloscopes allows for measuring signals with much more detail, due to the high number of quantization levels and the low quantization error.

To display a signal measured with one of the TiePie engineering high resolution oscilloscopes at the same level of detail as the standalone oscilloscope, the display can be 256 times larger. Viewing the signals on a 24" monitor instead of a 10" scope screen immediately gives a very detailed impression of the signal. The smallest deviations are very well visible and because of the high resolution, it is still possible to zoom in and reveal additional details.

Figure 1: *Highly visible details compared to competition.*

Shown in figure 1 are two displays, both showing a measurement of the same signal. The left display size corresponds to a size comparable to a standalone oscilloscope with 10" display and 8 bit resolution. The right display corresponds to a maximized window on a standard 24" PC screen and 16 bit resolution. The signal in the right display shows much more detail than in the left display, even without zooming in.

When zooming in 4 times at the ringing at the rising edge of the signal, the 8 bit standard oscilloscope with the small screen at the left does not show more detail. Zooming in 4 times at the ringing at the rising edge of the signal, the TiePie engineering high resolution scope with its large screen at the right will still reveal more details of the signal.

The high resolution of the TiePie engineering high resolution oscilloscopes and the unlimited zoom of the Multi Channel oscilloscope software allow to zoom in to mV levels. Figure 2 shows a measurement of a 2 mV sine wave made in the 200 mV input range. The signal is then zoomed in to view it at an 8 mV scale, showing much detail.

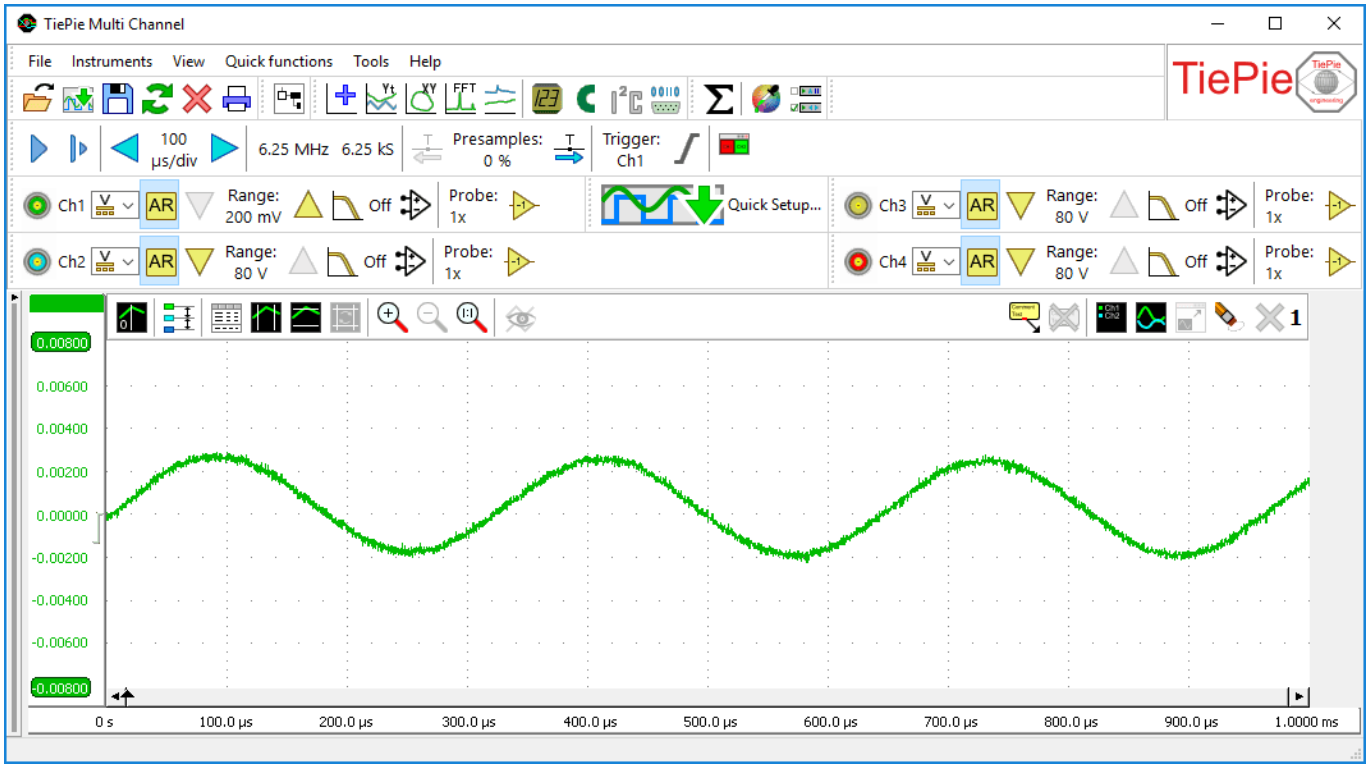

Figure 2: *Zoomed in to get an 8 mV or 2 mV/div input scale.*

The TiePie engineering high resolution oscilloscopes offer 256 times more resolution than a standard oscilloscope. This gives highly detailed measurements that offer good insight in your signals.

High accuracy, 4 to 12 times better than a standard oscilloscope

Where the resolution of an oscilloscope mainly gives information on the level of detail that can be found in a measurement, it does not say much about the accuracy of an oscilloscope. The accuracy of an oscilloscope indicates how much a measured value can be different from the "true" value, how much uncertainty a measurement has.

The accuracy is specified as a percentage of the full scale input range. When the oscilloscope is set to the 20 V input range, the full scale range runs from -20 V to 20 V and spans 40 V. An accuracy specification of 1 % means that the measured value can be 1 % of 40 V off with respect the the true actual value.

Besides high resolution oscilloscopes, the TiePie engineering WiFiScope WS6 DIFF, WiFiScope WS6, WiFiScope WS5, Handyscope HS6 DIFF and Handyscope HS5 and the ATS610004DW-XMSG, ATS605004DW-XMS, ATS610004D-XMSG and ATS605004D-XMS are also **high accuracy** oscilloscopes. These high accuracy oscilloscopes are carefully designed and adjusted to be very accurate.

The TiePie engineering high accuracy oscilloscopes measure with a high accuracy of ±0.2 % (±0.1 typical) or ±0.25 % (depending on the model) of the full scale input range. A signal measured with one of these oscilloscopes therefore is 4 to 12 times more accurate than most standalone oscilloscopes, which usually have an accuracy of ±1 % to ±3 %.

To explain what this means for your measurements, it is explained with an example.

Suppose a DC voltage is measured and the scope measured it in its 20 V input range. The scope indicates the measured value to be 12.000 V. The actual true value lies in a band around this measured value. The width of that band is determined by the accuracy specification of the oscilloscope.

- with 0.2 % accuracy, the actual true value lies between 11.92 V and 12.08 V
- with 1 % accuracy, the actual true value lies between 11.6 V and 12.4 V
- with 3 % accuracy, the actual true value lies between 10.8 V and 13.2 V

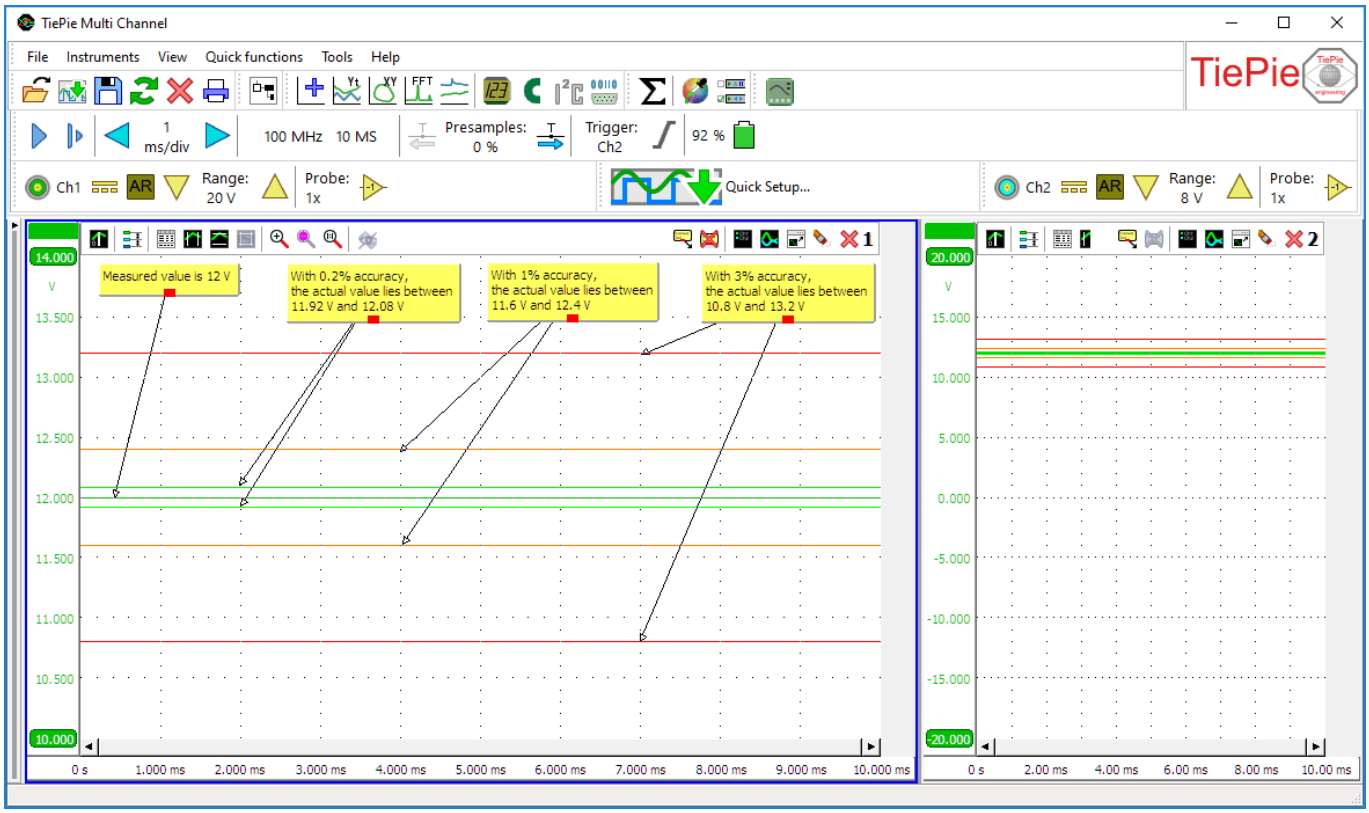

Figure 3: *The effect of accuracy.*

Figure 3 show this in an oscilloscope graph. The graph at the left shows the measured 12 V DC signal, zoomed in to a visible range of 10 V to 14 V (of the -20 V to 20 V). The area marked by the light green lines indicates the range in which the actual value lies when the oscilloscope has an accuracy of 0.2%. The area marked by the orange lines indicates the range in which the actual value lies when the scope has an accuracy of 1%. The area marked by the red lines indicates the range in which the actual value lies when the accuracy is 3%. The graph at the right shows the unzoomed full range.

The carefully designed and accurately adjusted TiePie engineering high accuracy oscilloscopes are 4 to 12 times more accurate than a standard oscilloscope. This gives you certainty on the values you measure. Know instead of guess.

Recalibration

The accuracy of the TiePie engineering high resolution, high accuracy oscilloscopes is specified at 0.2% or 0.25%, depending on the model. This specification is guaranteed for at least one year after the instrument is adjusted.

Due to aging, tolerances on the used components may gradually shift, resulting in a gradually decreasing accuracy of the instrument. To keep your TiePie engineering oscilloscope in top condition, you can have it recalibrated and readjusted. During the recalibration, the measured values are compared to known exact values and is checked whether the accuracy of the instrument is still within its required specifications. If the accuracy is found to be out of specifications, the instrument is re-adjusted, to bring it within the required accuracy specifications again. For more information on recalibration of your instrument, see www.tiepie.com/recalibration.

For more information on the TiePie engineering high resolution, high accuracy oscilloscopes, see

WiFiScope WS6 DIFF: www.tiepie.com/WS6D
WiFiScope WS6: www.tiepie.com/WS6
WiFiScope WS5: www.tiepie.com/WS5
Handyscope HS6 DIFF: www.tiepie.com/HS6D
Handyscope HS5: www.tiepie.com/HS5

Automotive Test Scope ATS610004DW-XMSG: www.tiepie-automotive.com/ATS610004DW
Automotive Test Scope ATS605004DW-XMS: www.tiepie-automotive.com/ATS605004DW
Automotive Test Scope ATS610004D-XMSG: www.tiepie-automotive.com/ATS610004D
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