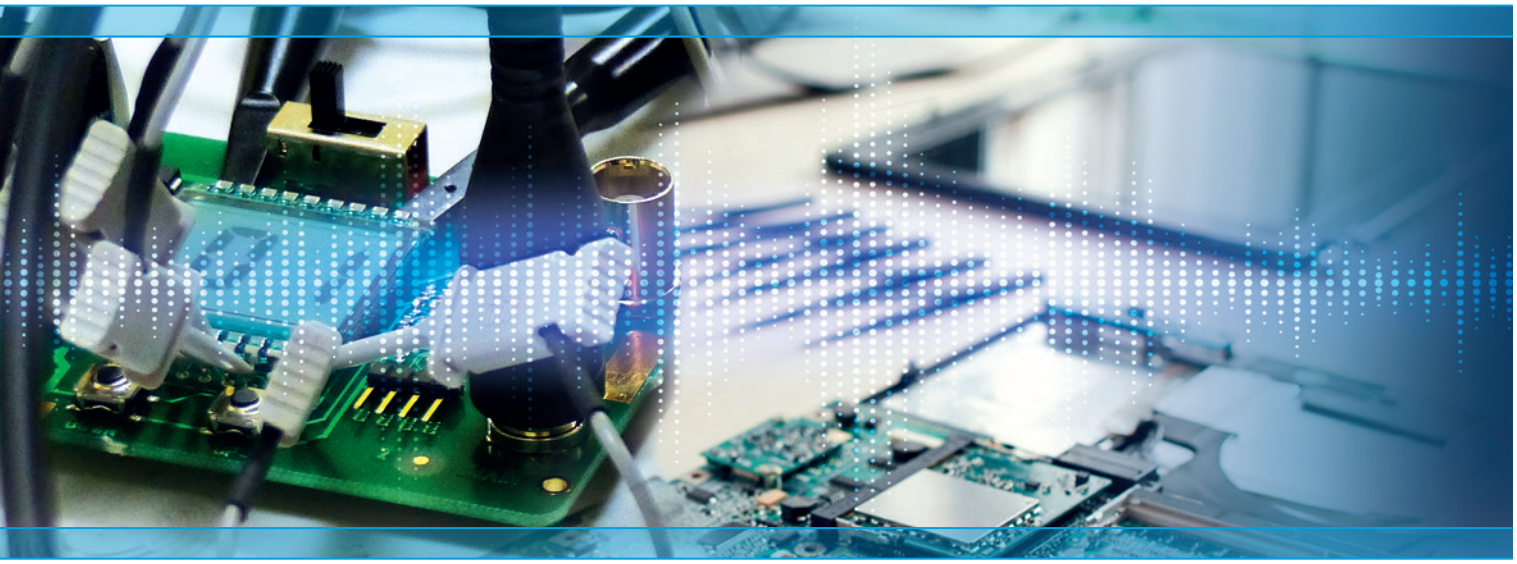
Detailed signal analysis

HOW TO ADJUST YOUR DIGITAL OSCILLOSCOPE



This Case Study focuses on 2-channel digital oscilloscopes (DSO) because they represent most of the oscilloscopes on the market.

You will sometimes hear people using the terms "DSO", the English acronym for Digital Storage Oscilloscope, digital oscilloscope or digitization. These terms refer to the "latest" technology used in these instruments to capture and store signals in digital form.

Models using older technology are usually called cathode-ray "analogue" oscilloscopes (e.g. 0X800). 10 years ago, mixed "analogue-digital" oscilloscopes such as the METRIX 0X8000 were also available.

Lastly, you will also hear people speak of "MSO" which stands for Mixed Signal Oscilloscope. In fact, an MSO is a DSO equipped with additional logic-analyser acquisition channels which will be the subject of a subsequent Case Study.

Most engineers and electronic technicians have had an opportunity to use an analogue oscilloscope. For several reasons, most now prefer digital oscilloscopes because DSO/DOX oscilloscopes offer the following advantages:

- ✓ Compact and transportable
- ✓ Large bandwidth
- ✓ 7-inch colour display
- ✓ Several measurements or calculations accessible during acquisition
- ✓ Easy to use
- ✓ Storage
- ✓ Printing

The DOX models, usually equipped with a PC interface, can be incorporated in automatic test systems and used for high-speed data acquisition.

Memory depth

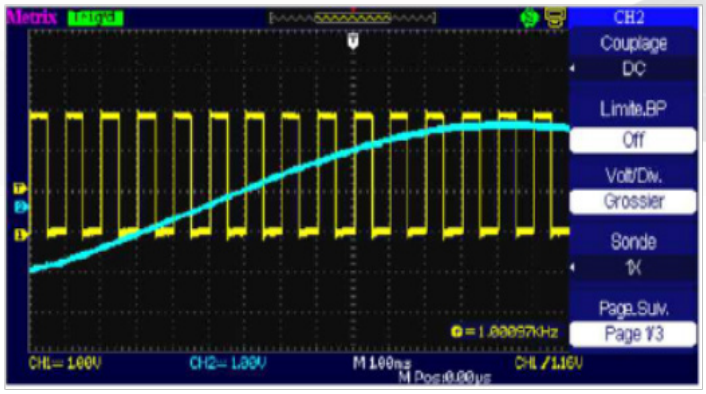
Recording

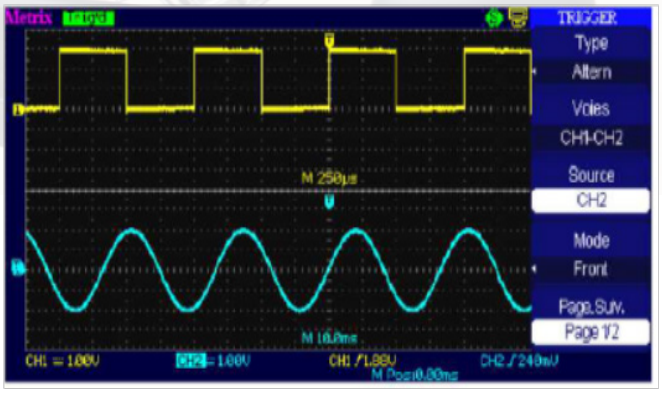
Digital filters

Measure up

I – Use of "synchro alternate" triggering

When you use alternate triggering, the triggering source is alternately CH1 and then CH2. This allows you to observe 2 asynchronous signals at the same time (with different triggers for the 2 signals).



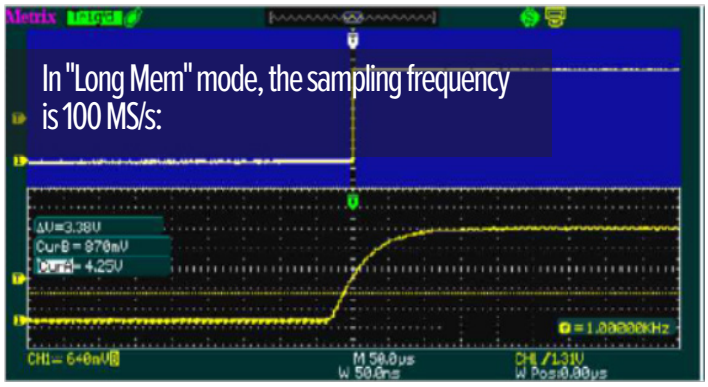


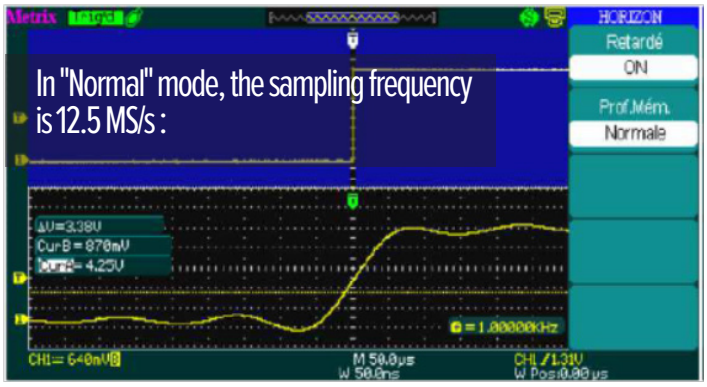
2 – Memory depth of the DOX2000 oscilloscope

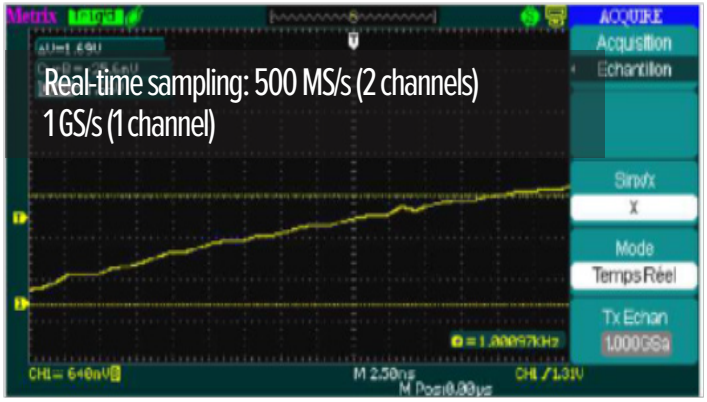
The DOX oscilloscopes record captured samples in a buffer, so for a given sampling rate, the size of the buffer determines the maximum capture duration.

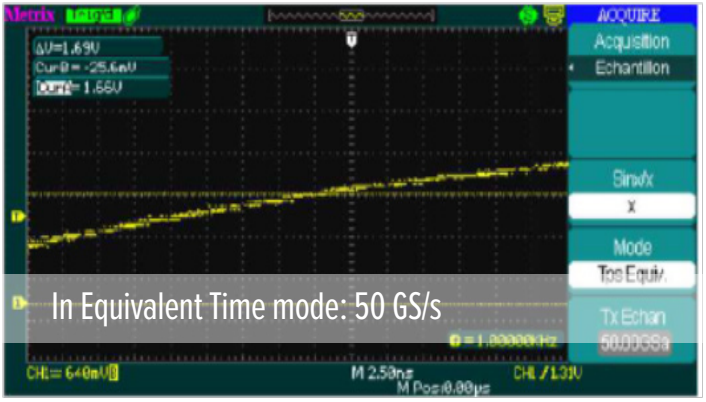
The ratio between the sampling rate and storage capacity is important: an oscilloscope with a high sampling rate but low storage capacity will only use its maximum sampling rate for shorter time bases.

The rising edge of the 1 kHz calibration signal is observed with a double time base, first of all with a "Long Mem" memory depth, and then with "Normal".









3 – Recording:

The Recorder mode is like the Record mode, but adapted to handle slow signals (100 ms to 50 s/div). It can be used for continuous real-time recording and also offers a Replay function. It is the equivalent of the recorded ROLL mode.

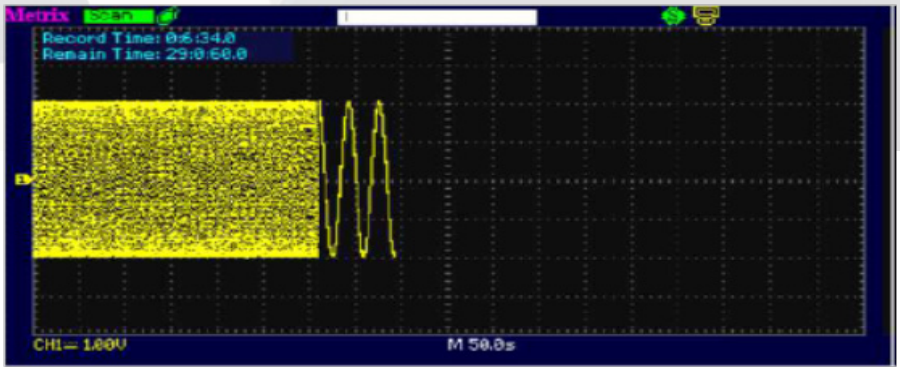
✓ Internal memory depth of 6 M, i.e. 2,500 frames of 2.5 kpts.

Record: recording of fast signals with Time Base ≤50 ms/div

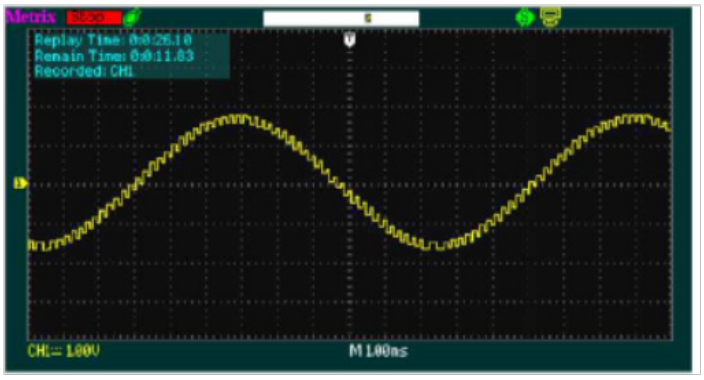
The memory can be segmented (Segments or Frames)

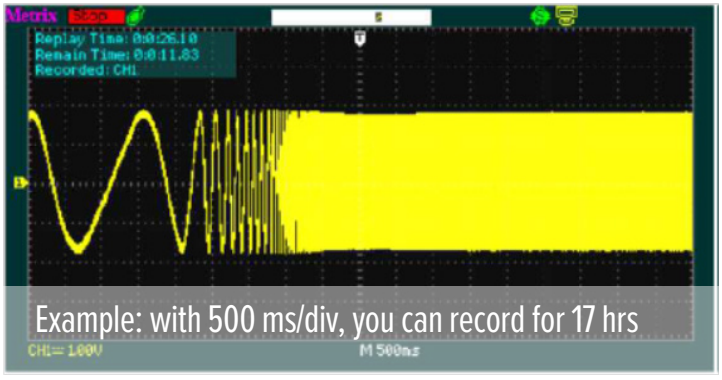
Recorder: recording of slow signals with Time Base ≥100 ms/div

In Recorder mode, you can record for up to 29 hrs 7 min 34s in single-channel mode with 50 s/div



Caution: to switch automatically to "SCAN mode" by turning the "S/div" button, you must be in "Auto" trigger mode. If the trigger is in Normal mode, it is impossible to switch to "SCAN mode":





Example: with 500 ms/div, you can record for 17 hrs

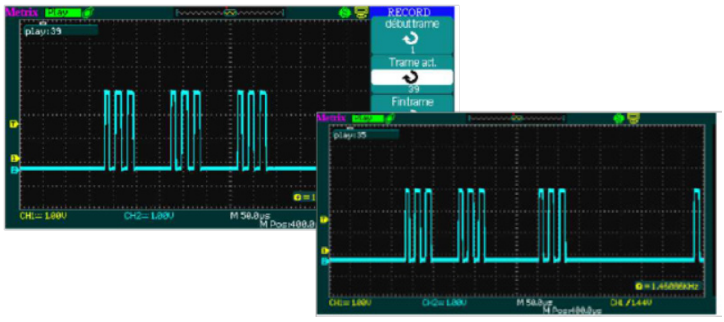
In Recorder mode, it is not possible to zoom after acquisition. The segments have a constant depth of 2,500 points and, for each frame, all the points are shown on the screen, i.e. 2,500/18=138 points per division.

In "Record" mode with a Time Base of 1 ms/div, we will be able to record up to 2,500 frames of 2,500 samples, giving a total of 6,250,000 points.

Record :

We used the HX0074 demonstration board, signal no. 4, with the Record mode of the DOX2100 channel CH2 and a 200 µs time base with a start and end of frame.

After stopping the recordings and selecting a recording (acquisition in Min/Max mode with Normal or Long Mem memory depth), you can zoom down to 1 ms/div, i.e. a maximum zoom factor of x500



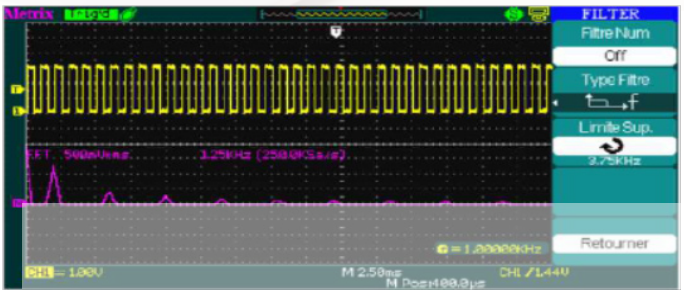
4 – Filtering

Several types of digital filters can be applied to channels CH1-CH2 : Low Pass (FPB), High Pass (FPH), Band Pass (FBP), Band Stop (FCB).

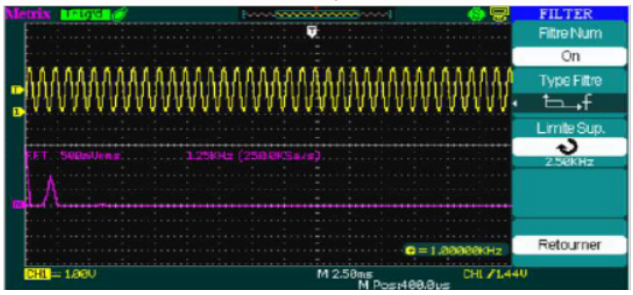
This is simple to demonstrate by viewing the "Probe Adjust" calibration signal at 2.5 ms/div.

A 2.5 kHz low pass filter allows you to view the fundamental by suppressing the harmonics, while a 2.5 kHz high pass filter allows you to view the edges and suppress the plateaux (LF) :

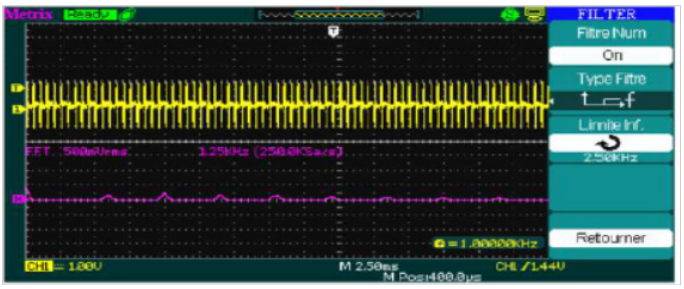
Unfiltered 1 kHz signal of the calibration probe and its complete FFT spectrum:



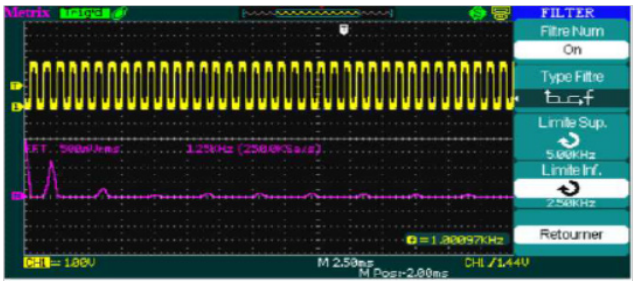
If you apply a low pass filter with a cut-off frequency Fc=2.5 kHz, the harmonics of the 1 kHz calibration signal are attenuated



If you apply a high pass filter with a cut-off frequency Fc=2.5 kHz, the fundamental of the 1 kHz signal is attenuated, while leaving the harmonics:



If you apply a band stop filter with a low cut-off frequency Fclow=2.5 kHz and a high cut-off frequency Fchigh =5 kHz, you will attenuate harmonic 2 of the 1 kHz signal:



STRENGTHS OF DOX2000

- Digital oscilloscope
- 1 GS/s sampling frequency in one-shot mode and 50 GS/s for repetitive signals,
- Variable memory depth up to 2 Mpts,
- Various triggers: edge, pulse, video, slope and alternate.
- 6Mpts recorder for recording with slow acquisition and digital filters.
- EasyScopeX software
- To control the oscilloscope's function remotely,
- To recover the data and screenshots.
- Help available in French, English and German
- Communication: USB host and USB device interfaces

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