GB - User's Guide

HX0074
DEMO Kit for METRIX Oscilloscopes

DIGITAL OSCILLOSCOPES

Measure up

HX0074 Demo Kit for METRIX Oscilloscopes

General description

- The oscilloscope kit features a circuit which generates 15 varied and representative signals, along with a guide that describes the nature of each signal, the METRIX oscilloscope model used to perform the test and the correct calibrations for the equipment to obtain optimal visualisation.
- The guide demonstrates the majority of the standard or advanced functions of these Digital Oscilloscopes, thereby enabling users to familiarise themselves rapidly, but also promotes further understanding of how digital oscilloscopes function in general so that best use can be made of them.
- It features direct support for the following METRIX digital oscilloscopes, but can be used with other models, insofar as they offer the same functions:

Ranges	Models
SCOPIX + OXi 6204	OX7042 OX7062 OX7102 OX7104 OX7202 OX7204
MTX with SPO	MTX3354 MTX3252 MTX3352
OX 6000	OX 6202 OX 6152 OX 6062 OX 6062-II OX 6202-II
Scopein@Box with SPO	MTX1052 MTX1054
HANDSCOPE	OX 5022 OX 5042

Presentation

- The signal generator circuit is built around a microprocessor.
  An LCD display and 2 UP/DOWN buttons let you select the desired signal.
  It has two channels available via BNC connection: MAIN and AUX
  It can be powered by a standard 9V battery or a mains adapter used to power METRIX Handscope oscilloscope X03656A00 (selection of power supply by switch), for example.
- The instructional manual contains a table of contents, which lists all the signals available and the models concerned, a description page for each signal and an index at the end showing the test numbers according to the different subjects handled.

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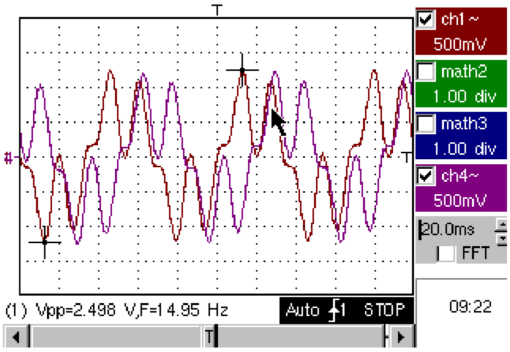
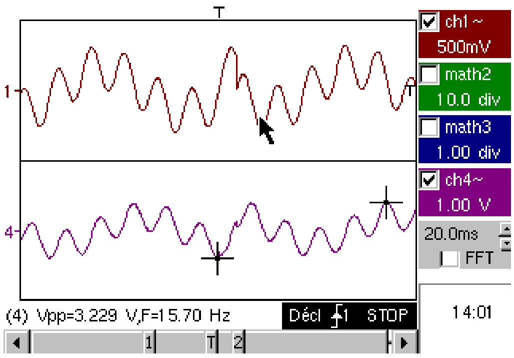
Demo:	with:	☒ MTX3x5x SPO & MTX105x SPO	☒ OX 6000 ☒ OX 6000-II	☒ SCOPIX + OXi 6204	☒ HANDSCOPE a) c)
Test Signal		**no. 1 : Miscellaneous**			
	Type	4 pairs of successive signals about every 2 s			
	Specs	2.6 V < Vpp < 3.2 V - 10 Hz < F < 60 Hz			
Scope settings		20 ms/div. - MAIN = 500 mV/div. - AUX = 500 mV/div.			
	Trigger	standard on MAIN			
	Modes	XY (Display Menu) - neither "Min/max", nor "Repetitive Signal" (Horizontal Menu)			
Purpose		Start in an entertaining way, demonstrating the following display modes: Normal, Full Trace, Full Screen, XY			

a) Calibrate the oscilloscope so it displays the signals correctly (possible using the "Autoset" mode).

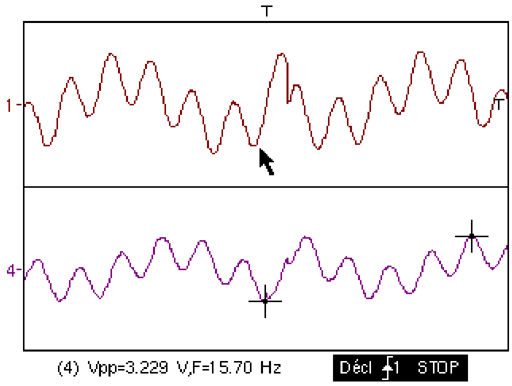


Normal mode

b) Perform the Full Trace and Full Screen commands in sequence in order to avoid superimposition of traces, then assign the full screen to the display of traces.

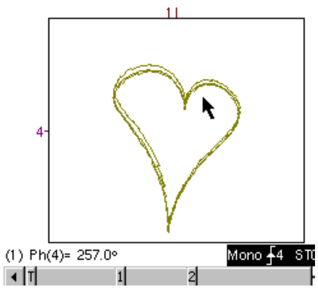


Full Trace



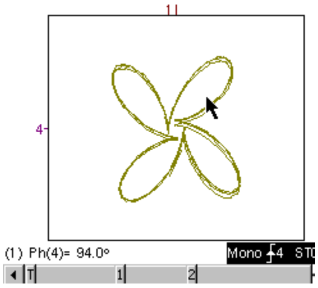
Full Screen

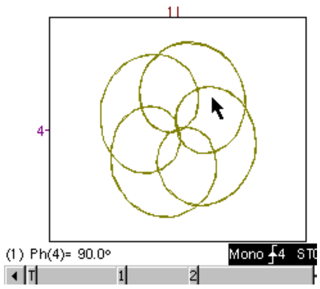
c) Return to the initial Normal display and select the "XY mode" with CH1 on X and CH4 on Y, or CHA in X and CHB in Y. A sequence of geometric forms will be displayed (heart; clover; rose; spiral).



Heart

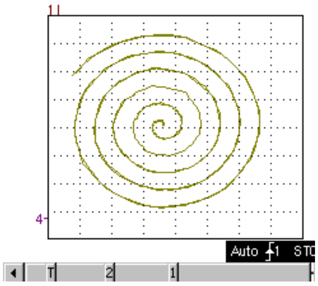
Clover





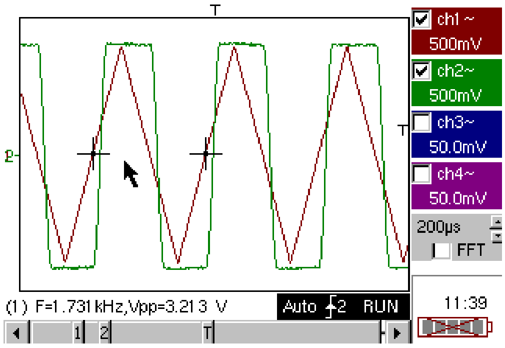
Rose

Spiral

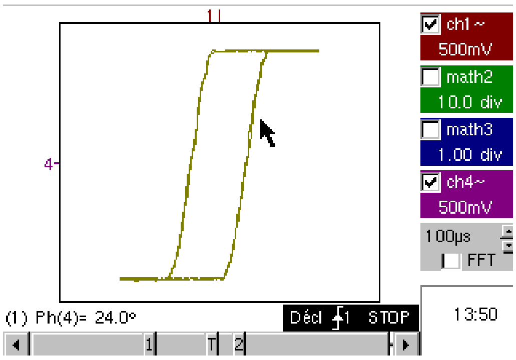


Demo: with:	☒ MTX3x5x SPO & MTX105x SPO	☒ OX 6000 ☒ OX 6000-II	☒ SCOPIX + OXi 6204	☒ HANDSCOPE a) b)
Test Signal	**no. 2 : Hysteresis**			
Type	2 out-of-phase signals, triangle and pseudo-square			
Specs	Vpp ≈ 3.2 V - F ≈ 1.7 kHz - square rise time ≈ 24 µs - Signal delay ≈ 40 µs			
Scope settings	20 ms/div. - MAIN = 500 mV/div. - AUX = 500 mV/div.			
Trigger	Standard on MAIN			
Modes	XY (Display Menu) – neither “Min/max”, nor “Repetitive Signal” (Horizontal Menu)			
Purposes	X(t) and XY modes using out-of-phase signals Present the automatic measurements with markers (F, square rise time) Present the phase measurements (manual, automatic)			

a) Calibrate the Oscilloscope so it displays the signals correctly (possible using the “Autoset” mode).



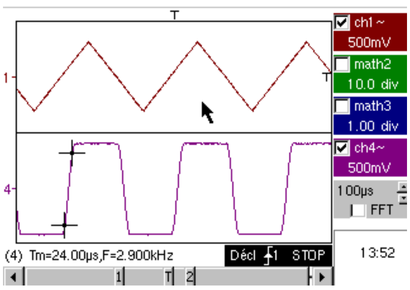
b) Select the XY mode with CH1 on X and CH4 on Y, or CHA in X and CHB in Y.



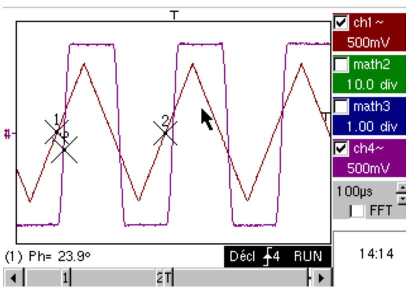
This casebook example involving a hysteresis loop is often used for educational purposes.
It demonstrates the relative interests in displaying the channels on a time basis and an XY display mode.

It is used to demonstrate the simplicity of configuring the XY mode and of access to automatic phase measurement, which is one of its uses.

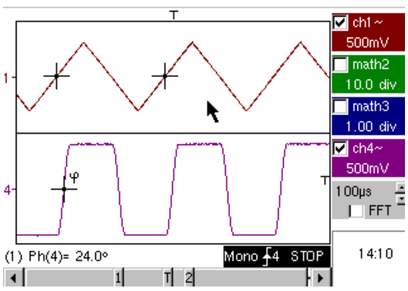
c) If required, return to “X(t) mode” in order to demonstrate the use of automatic measurements (e.g. square rise time) and phase measurements (manual, automatic).



Rising time measurement



Manual phase measurement



Automatic phase measurement

Demo: with:	☒ MTX3x5x SPO & MTX105x SPO	☒ OX 6000 ☒ OX 6000-II	☒ SCOPIX + OXi 6204	HANDSCOPE

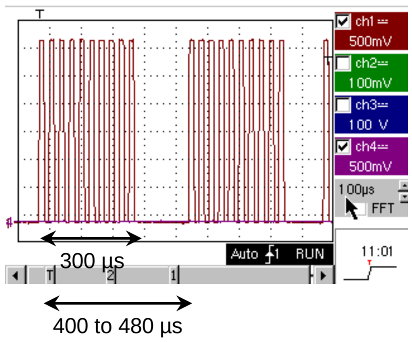
Test Signal	**no. 3 : Pulse train**
Type	1 signal presenting trains of 10 pulses with a variable interval
Specs	Vpp ≈ 3.4 V - F ≈ 32 kHz - L+ ≈ 16 µs - Train interval ≈ 100 to 180 µs
Scope Settings	100 µs/div. - MAIN = 500 mV/div.
Trigger	on MAIN - Hold-Off ≈ 350 µs
Modes	Triggered mode preferred - deselect “Repetitive signal” (Horizontal menu)
Purposes	Trigger with “Hold-Off” on pulse trains Automatic Measurement of “L-” or [W- W+] with zone selection using manual cursors Comparison with a reference and “L-” or [W- W+] measurement with zone selection

a) Calibrate the Oscilloscope so as to view the CH1 signal correctly (timebase, sensitivity and trigger source).

> Important: for this signal type using Autoset may not be useful.

Firstly, without “Hold-Off”, the trigger operates on any one of the pulses as soon as the oscilloscope is ready to acquire.

This is accompanied by a sensation of “horizontal instability” which renders the display unusable.

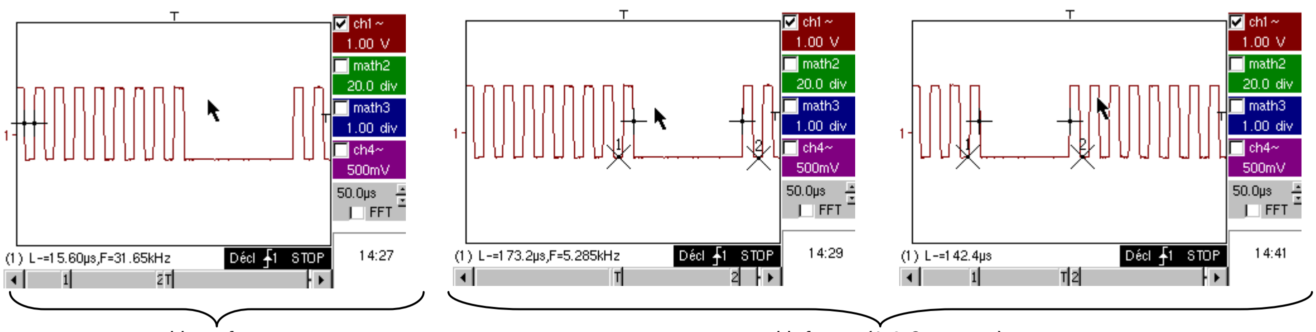


The correct selection of the “Hold-Off” parameter in the “Principal” tab of the Trigger menu will enable you to systematically trigger on the first pulse in the train.

To do this, double-click in the corresponding digital zone and enter the value of 350µs, for example.

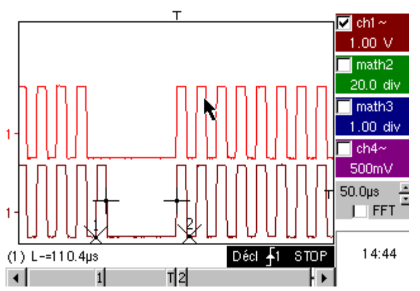
This value must be greater than the pulse train duration in order to inhibit the trigger during this period, while remaining lower than the interval between two pulse trains (this varies between 400 and 480 µs).

b) Select the Automatic Measurement of “L-” or [W- W+] and highlight the appropriate zone using the Manual Cursors so as to measure the variable interval between two pulse trains.



without frame *with frame (1 & 2 cursors)*

c) Rapid comparison with a reference.



Press the key to create a reference.

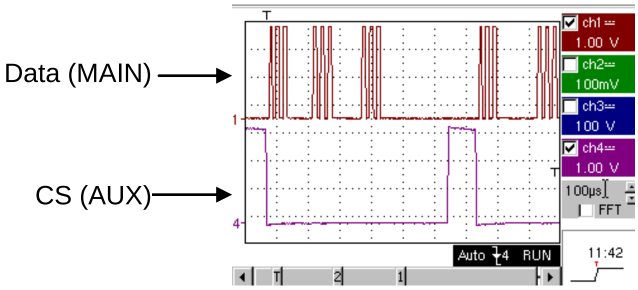
Move the active trace down to be able to compare it with the displayed reference.
It is clearly demonstrated that the number of pulses in the train remains identical (10) but the interval between trains may vary.

Press the key again to delete the reference.

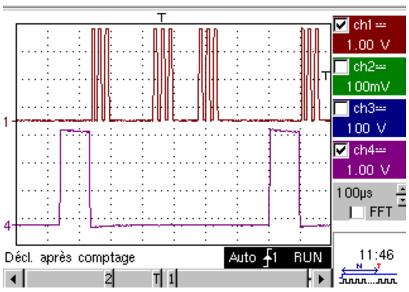
Demo: with:	☒ MTX3x5x SPO & MTX105x SPO	☐ OX 6000 ☒ OX 6000-II	☒ SCOPIX + OXi 6204	☐ HANDSCOPE
Test Signal	**no. 4 : Data train + CS**			
Type	2 signals - one CS (chip select) and one digital frame (data)			
Specs	Vpp ≈ 3.4 V - F ≈ 40 kHz (data) - F ≈ 1.5 kHz (CS)			
Scope Settings	200 µs/div. - MAIN = 1 V/div. - AUX = 1 V/div.			
Trigger	Principal on MAIN & Auxiliary on AUX			
Modes	Triggered mode preferred – deselect “Repetitive signal” (Horizontal menu)			
Purposes	Complex triggering with pulse count WinZoom on pulse train			

a) Firstly, calibrate the Oscilloscope so just the 2 signals are visible (timebase, sensitivities and trigger source on AUX).

> Important: for this signal type using Autoset may not be useful.



b) We will now demonstrate the interest of complex triggers (2 sources) with the “**count**” or “**delay**” options.
The example provided will enable the synchronisation of an auxiliary signal, the Chip Select, with triggering on the desired pulse in the data frame.
Additionally, this mode will enable us to always trigger on the same pulse even if it does not arrive at an identical interval after the chip select (pulses 4 to 9).

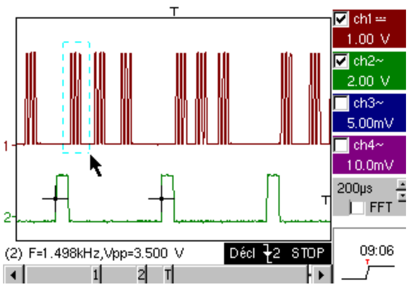


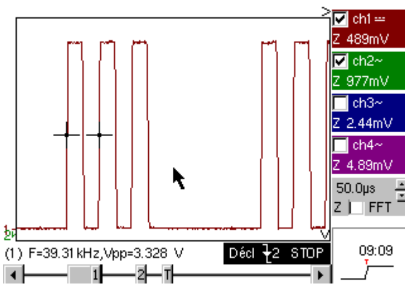
Trigger parameters:

- Principal tab:
MAIN front ; Hold-Off minimum

- Count tab or Count tab → qualifier:
AUX front ; DC coupling; Trigger delay < 9 (5 in the example)

c) Our WinZoom graphic is a unique functionality and very impressive during demonstrations.





Using a timebase of 200 µs/div, graphically select the first group of 3 pulses and release to obtain the result.

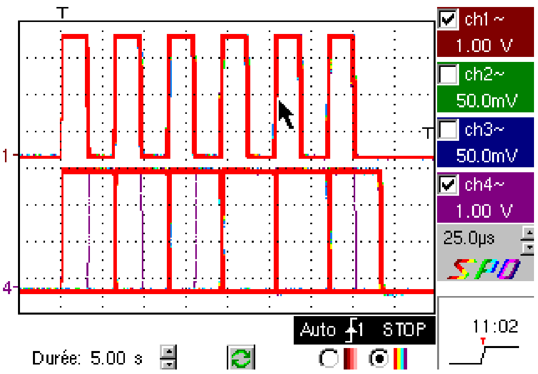
Double-click on the screen to select “Magnification inactive” and return to the starting point.

Demo: with:	☒ MTX3x5x SPO & MTX105x SPO	☒ OX 6000 c) ☒ OX 6000-II c)	☒ SCOPIX + OXi 6204 c)	☐ HANDSCOPE
Test Signal	**no. 5 : Data frame - Fault**			
Type	2 signals from a communication bus with “clock” & “data”			
Specs	Vpp ≈ 3.4 V - F ≈ 31 kHz (clock) - 30 µs < L+ < 200 µs (data)			
Scope Settings	20 ou 25 µs/div. - MAIN = 1 V/div. - AUX = 1 V/div.			
Trigger	on MAIN, pre-trigger ≈ 1 division			
Modes	Triggered mode preferred, SPO duration mode ≥ 2 s			
Purposes	Capture and observe a rare event using SPO Triggering on pulse width of AUX signal			

a) Calibrate the Oscilloscope so as to view the 2 signals correctly (timebase, sensitivity and trigger source on MAIN).

> Important: for this signal type using Autoset may not be useful.

b) Select “SPO Persistence” in the display menu and set a duration of ≥ 2 s.



The proposed signal represents a communication bus with an “8-bit data” signal and a “clock” signal.

This communication set-up is often found in serial connection protocols such as I2C bus, USB bus or CAN bus devices, Ethernet link, etc.

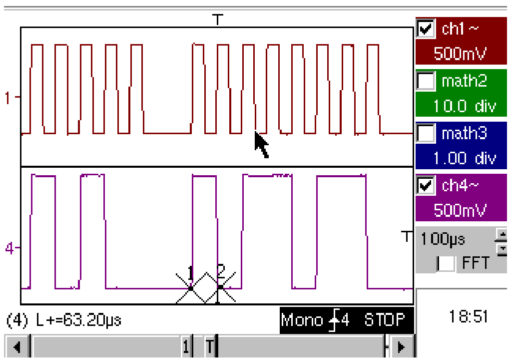
The intelligent SPO (Smart Persistence Oscilloscope) display reveals rare or complex events that are not visible in Envelope mode.
Example: synchronisation fault, overshoot, glitch, erroneous bit or analogue characteristic problems.

The main interest of the SPO acquisition and display mode is to enable the detection and study of faults on signals without prior knowledge of their nature, and without having to calibrate specific triggering conditions, for example.

Then, due to its very high acquisition rate in relation to a conventional Digital Oscilloscope (up to 50,000 per second rather than around 10 per second) it enables us to reveal and capture rare or complex events much more efficiently.

Lastly, the intelligent display algorithm enables a much richer and more faithful display of the whole content of the Oscilloscope memory, even if this largely exceeds the intrinsic possibilities of a standard ¼ VGA screen due to its resolution capabilities (only 250 pixels across for the trace zone).

c) Triggering on AUX signal pulse width (demonstration possible on all three Oscilloscope ranges).



In normal “Oscilloscope” display mode, select to trigger on the AUX signal pulse width (“Trigger” menu - “Pulse” tab).

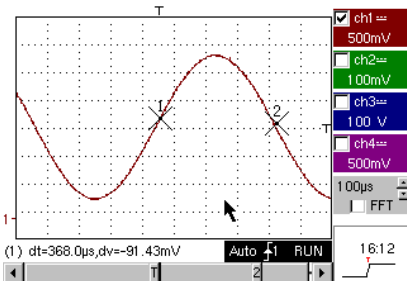
Successively change the value so as to trigger on the different periods (32, 64, 96, 128, 160, 192µs, etc.), by using the operators “<”, “=” or “>”.

Demo: **with:**	☒ MTX3x5x SPO & MTX105x SPO	☒ OX 6000 b) c) ☒ OX 6000-II b) c)	☒ SCOPIX + OXi 6204 b) c)	☒ HANDSCOPE b) c)

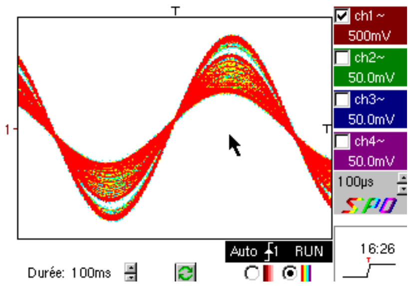
Test Signal	**no. 6 : AM Modulation sine**
Type	1 sinusoidal signal with amplitude modulation
Specs	1.3 V < Vpp < 3.3 V - F ≈ 1.3 kHz
Scope Settings	100 µs/div. - MAIN = 500 mV/div.
Trigger	on MAIN, 50 % of Vpp
Modes	Triggered mode preferred, SPO duration mode 100 ms
Purposes	Visualise a signal with rapid variations (e.g. modulation) using SPO Use of the "Envelope" mode on OX 6000 & Scopix Automatic Measurement of variation from reference

a) Calibrate the Oscilloscope so it displays the signals correctly (possible using the "Autoset" mode).

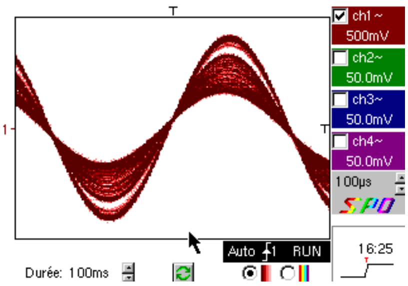
Normal Oscilloscope mode



Multi-colour SPO mode



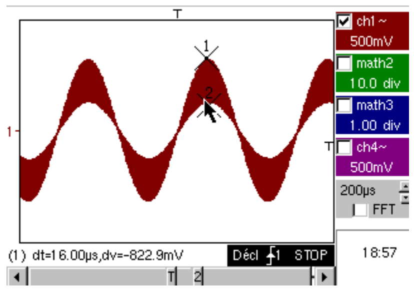
Monochrome SPO mode



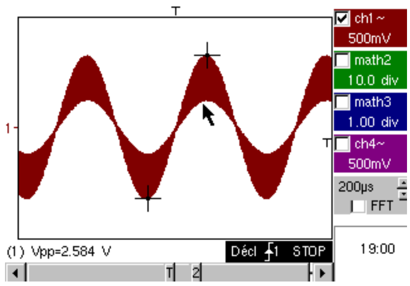
Due to its extremely high acquisition rate compared to a conventional Digital Oscilloscope (up to 50,000 per second instead of around 10 per second) and to its intelligent display algorithm, the SPO Oscilloscope enables visualisation of rapidly varying signals or complex composite signals, as possible on an analogue Oscilloscope.

For the signal generated we can characterise a zone of amplitude that has never been reached and the temporal distribution of the signal with colour shading.

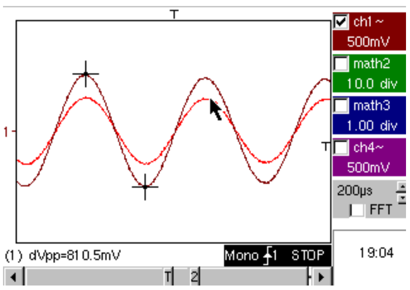
b)



On the OX 6000 and Scopix models the Envelope and Cumulate (OX 6000-II & SCOPIX) modes enable rough visualisation of the signal (max Vpp, modulation rate, frequency, etc.).



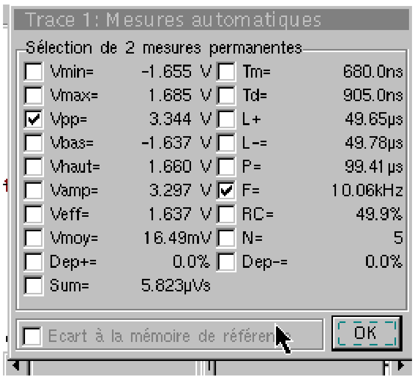
c) On our Oscilloscopes, it is possible to rapidly create a reference for comparison with a new acquisition (see test no. 3, final part).



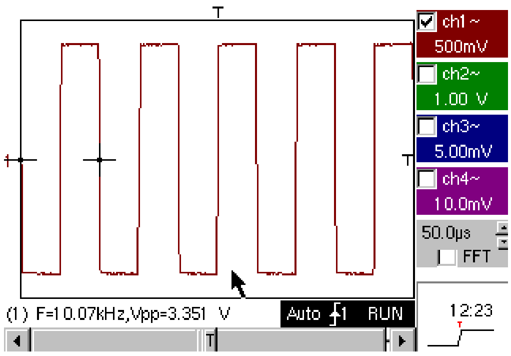
In the "Automatic Measurements" panel, a check box lets you display the difference between the current acquisition and the memorised reference (e.g. dVpp = difference in Vpp value).

Demo: with:	☒ MTX3x5x SPO & MTX105x SPO	☒ OX 6000 ☒ OX 6000-II	☒ SCOPIX + OXi 6204	☒ HANDSCOPE a)
Test Signal	**no. 7 : Square - Rise time**			
Type	1 square signal with a 50 % duty cycle			
Specs	Vpp ≈ 3.4 V - F ≈ 10 kHz - Rise time ≈ 690 ns			
Scope Settings	500 ns at 200 µs/div. - MAIN = 500 mV/div.			
Trigger	on MAIN, 50 % of Vpp			
Modes	Triggered mode preferred – select “Repetitive signal” (Horizontal menu)			
Purposes	Use of Automatic Measurements (F, P, Rise time, Fall time, Vpp, Vrms, etc) Notion of measurement precision using rise time test Use WinZoom to characterise a rising edge			

a) Calibrate the Oscilloscope so that it displays the signals correctly (possible using the “Autoset” mode).

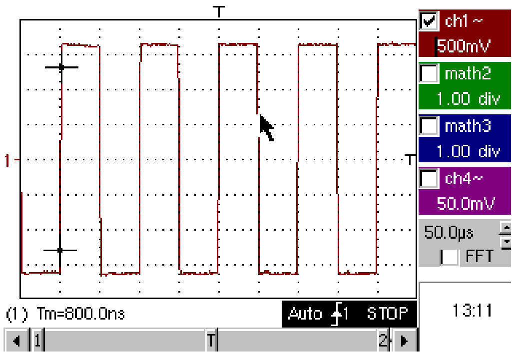


View of the 19 automatic measurements

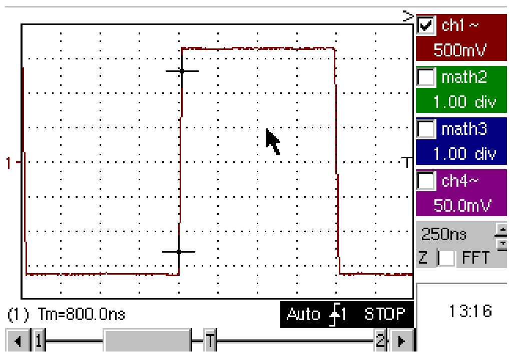


Selection of frequency & Vpp

c) Use WinZoom to characterise a rising edge

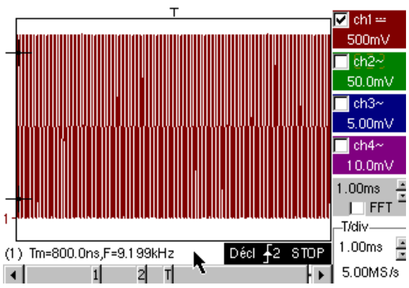


Whole acquisition, Tm measure

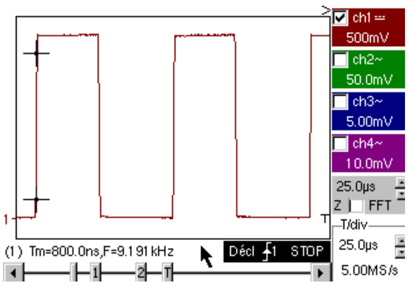


Magnified area

b) Measurement precision (e. g. Rise time) is directly dependent on the vertical resolution of the A/D converter (12 bits on Scopix, 10 bits on OX 6000 and OX MTX, 8 bits on competitor models) and on the sampling rate used, which must be optimised in relation to the planned measurement.



5 Msps = 200 ns resolution………



Zoom does not provide more as the measurement was already made on the full memory and not the screen

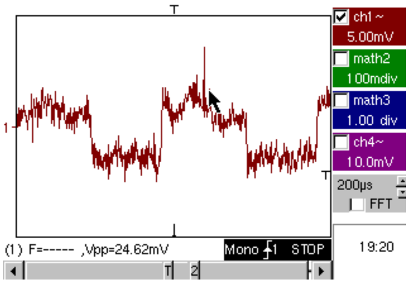
200 Msps = 5 ns resolution

Demo: with:	☒ MTX3x5x SPO & MTX105x SPO	☒ OX 6000 ☒ OX 6000-II	☒ SCOPIX + OXi 6204	☒ HANDSCOPE

Test Signal	**no. 8 : Weak square with noise**
Type	1 square signal with very weak amplitude and lots of noise
Specs	5mV < Vpp < 30 mV (depending on filter) - F ≈ 1 kHz
Scope Settings	200 or 500 µs/div. - MAIN = 2.5 or 5 mV/div.
Trigger	on MAIN, 50 % of Vpp
Modes	Nothing at first, then 1.5 MHz filter and 5 kHz on the input
Purposes	Triggering and visualisation of a noise-affected signal Use of 15 MHz and1.5 MHz filters with 5 kHz on the input Use of the “averaging” function

a) First calibrate the Oscilloscope to provide a rough view of the signal.

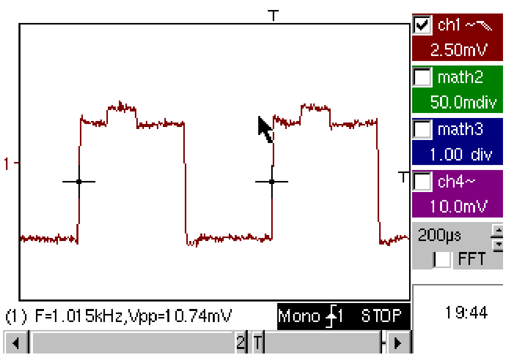
> Important: for this signal type using Autoset may not be useful.

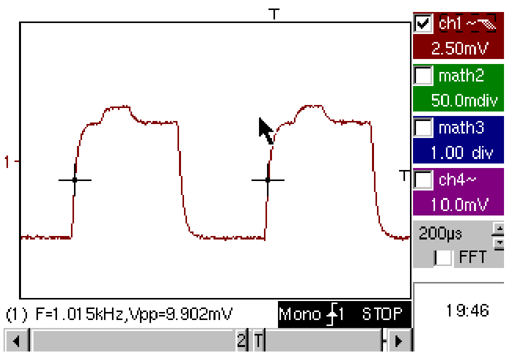


At first, after using the Autoset function or basic manual calibration, the signal form can be seen, but the trigger does not function correctly.

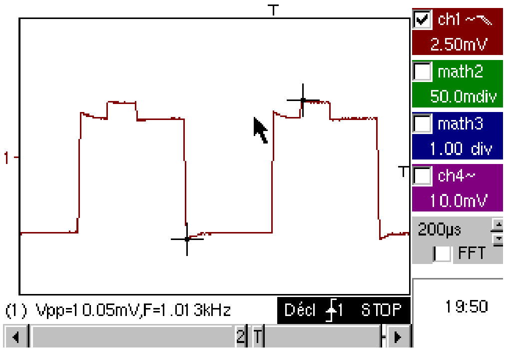
As the signal is weak and noisy, use of the noise rejection function in the Trigger Menu does not systematically provide a solution, no more than HF rejection.

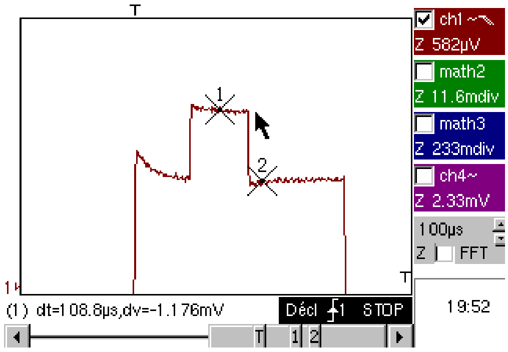
b) The use of the 1.5MHz and 5kHz analogue filters on the input will enable correct synchronisation and analysis of the signal free of any noise.





c) Use of averaging or curve smoothing (Horizontal menu) enables elimination of random noise on the visualisation (signal step serving as a trigger) and measurement of very weak levels after a vertical zoom.

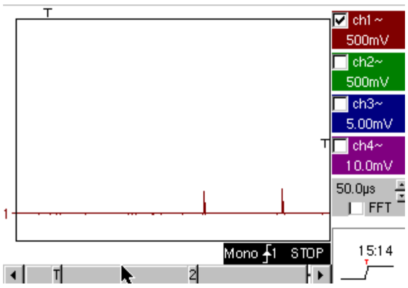




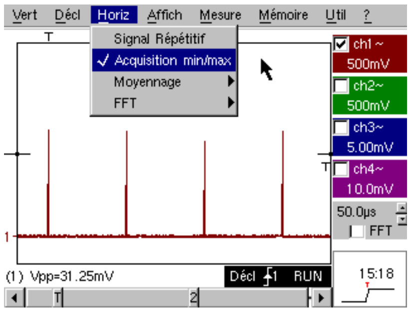
Demo: **with:**	☒ MTX3x5x SPO & MTX105x SPO	☒ OX 6000 ☒ OX 6000-II	☒ SCOPIX + OXi 6204	☒ HANDSCOPE
Test Signal	**no. 9 : Comb rapid pulses**			
Type	Comb of 6 very brief pulses, with a low repetition frequency			
Specs	Vpp ≈ 2 V (with 50 Ohms load or not) - L+ ≈ 7 ns - F ≈ 8 kHz			
Scope Settings	50 µs/div., then 50 ns/div. - MAIN = 500 mV/div.			
Trigger	on MAIN, 50 % of Vpp			
Modes	First deselect “Repetitive signal” (Horiz menu)			
Purposes	Use of the “Min-Max” acquisition mode Interest of ETS in faithful and precise representation of signals Impact of input impedance on the form of rapid signals			

a) First calibrate the Oscilloscope to provide a rough view of the signal.

Important: for this signal type using Autoset is in effect impossible.



Result of initial calibration



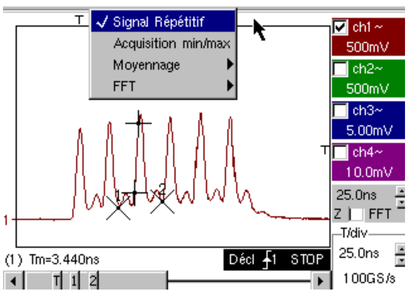
Selection of “Min-Max” acquisition mode

The initial calibration enables an occasional sighting of a brief pulse with a variable amplitude, here or there. Selecting the “Min-Max” Acquisition Mode from the “Horizontal” menu without changing the timebase speed will enable the acquisition and visualisation of the signal as demonstrated in the second screen.

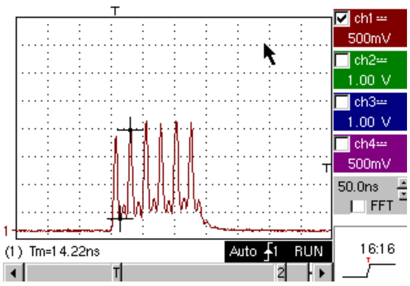
Due to the very brief duration of the pulses in relation to their frequency of repetition (≈ 125 µs / time relationship ≈ 1000), the timebase chosen imposes a sampling frequency that is inadequate for correct visualisation on the screen.
The “Min-Max” mode enables detection of the presence of “Min” and “Max” peaks between normal sampling points, the acquisition of the amplitude of these signals and their representation on screen.

b) Secondly deactivate the “Min-Max” Acquisition mode and calibrate the timebase to 25 or 50 ns/div in order to examine the signal in further detail and discover a group of 6 pulses.
Select “Repetitive signal” in the same Menu in order to authorise ETS sampling and show the difference between displays with and without ETS.

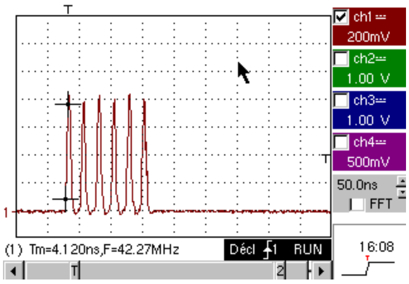
For periodic signals, the ETS mode enables us to considerably increase the horizontal resolution, to exceed the maximum “single-shot” sampling rate, so as to obtain faithful representation and precise measurements.
The example below presents pulses with a duration of <10ns with a rise time of < 4ns.



ETS 40 sampling or 100 Gs/s



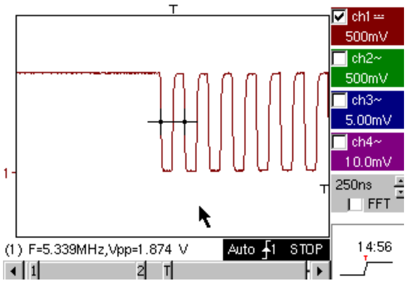
On Oscilloscope input 1MΩ

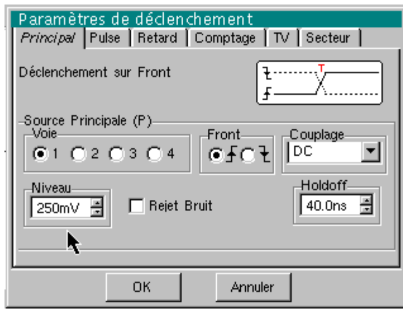


With 50Ω load (more faithful)

Demo: with:	☒ MTX3x5x SPO & MTX105x SPO · ☒ OX 6000 ☒ OX 6000-II · ☒ SCOPIX + OXi 6204 · ☐ HANDSCOPE
Test Signal	**no. 10 : Digital frame + Fault**
Type	Digital frame presenting a recurring fault
Specs	F square ≈ 5 MHz, Vpp ≈ 1.8 V - L+ fault ≈ 7 ns
Scope Settings	25 or 50 ns/div then 5 µs/div - MAIN = 500 mV/div. DC coupling
Trigger	⇑ DC coupling on MAIN, level ≈ 250 mV
Modes	Select "Repetitive signal" (Horiz menu)
Purposes	Use of pulse-width trigger Use of "Min-Max" mode on digital frame

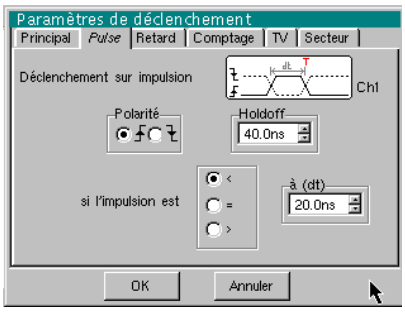
a) Firstly calibrate the Oscilloscope to provide a rough view of the signal (possible using Autoset), then set the parameters as indicated below.
You will notice that the display is not stable.

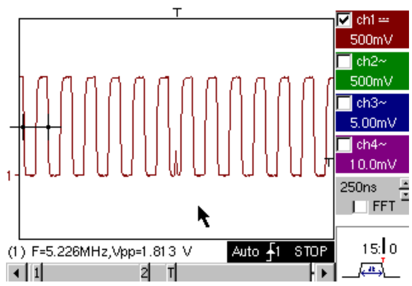


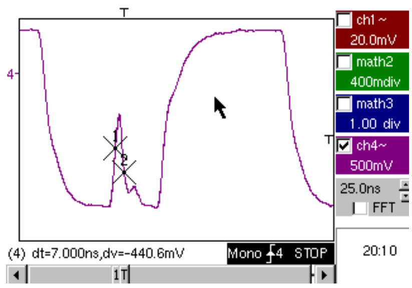


Then set up a pulse-width trigger as indicated below, and increase the timebase speed in order to allow detailed analysis of the fault on the digital frame.

Pulse trigger < 20 or 40ns

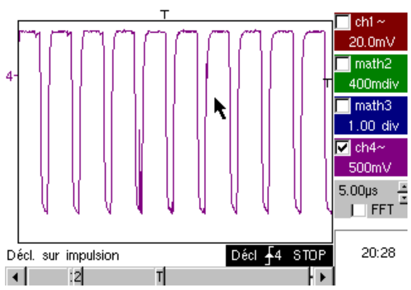




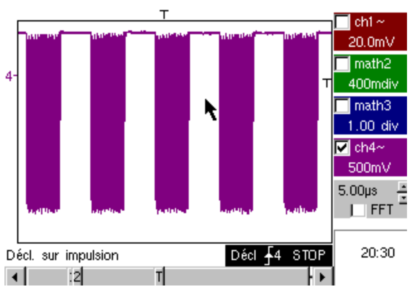


L+ measurement ≈ 7ns

b) Next you can use a slower timebase, for example 5µs/div in order to observe the general composition of the digital frame.
Depending on the sampling speed used by the instrument, use of the "Min-Max" mode may be indispensable to obtain a correct representation of the signal.



Without Min-Max

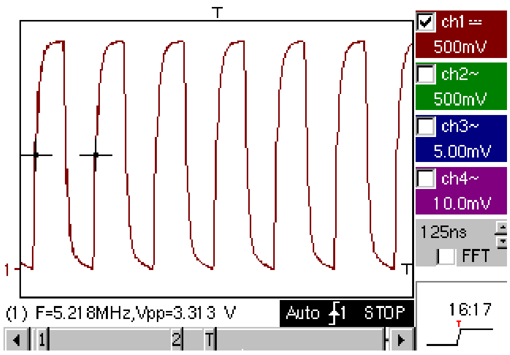


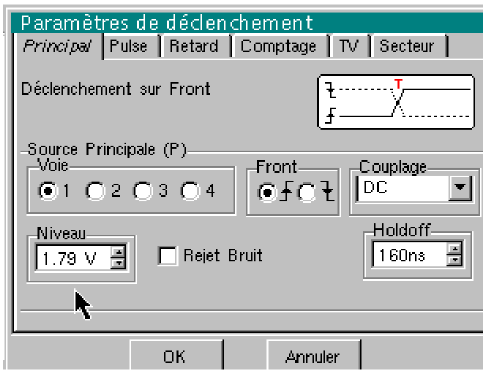
With Min-Max

Demo: with:	☒ MTX3x5x SPO & MTX105x SPO	☐ OX 6000 ☐ OX 6000-II	☐ SCOPIX + OXi 6204	☐ HANDSCOPE
Test Signal	**no. 11 : Frame + rare pulse**			
Type	Digital clock signal presenting a glitch			
Specs	F clock ≈ 5 MHz, Vpp ≈ 3.3 V			
Scope Settings	100 or 125 ns/div. then 25 ns/div. - MAIN = 50 0mV/div. DC coupling			
Trigger	⇑ DC coupling on MAIN, level ≈ 1.8 V			
Modes	Triggered mode preferred, SPO duration mode 1 or 2 s			
Purposes	Acquisition and display of a rare glitch using SPO mode Possible pulse-width trigger < 20ns, after SPO analysis			

a) Firstly calibrate the Oscilloscope to provide a rough view of the signal (possible using Autoset), then set the parameters as indicated below.

b) The signal displayed corresponds to a digital clock at 100ns.
If close attention is paid, it is possible to notice a certain instability on some signal edges.



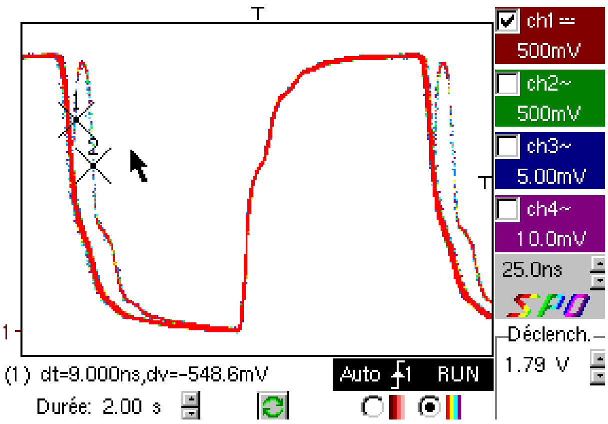


b) Now calibrate the timebase speed to 25ns/div.

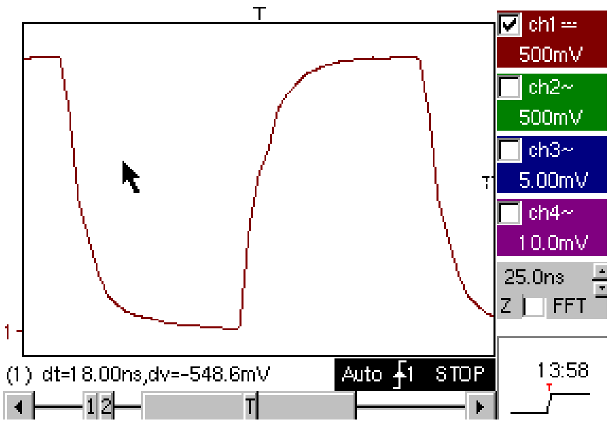
Select the "SPO Persistence" display mode in the "Display" menu.
Set the persistence duration to 1 or 2s to obtain the visualisation on the left below.
The glitch is fairly rare and only occurs on one clock cycle in a thousand, but it is captured and visualised immediately and can therefore be analysed.
It is constituted by a brief pulse less than 10ns in duration, adjacent to the clock wave falling edge.

Return to "Oscilloscope" display mode in the "Display" menu.
The glitch is not visible and is only manifested by intermittent instability on edges.

SPO mode: observation of the rare event



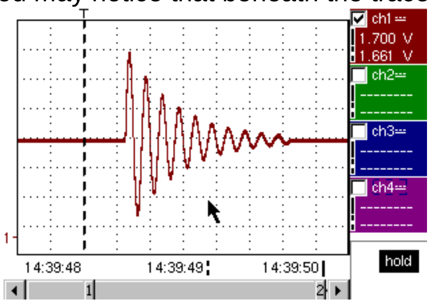
Oscilloscope Mode : no fault visible



Demo: with:	☒ MTX3x5x SPO & MTX105x SPO	☐ OX 6000 ☒ OX 6000-II	☒ SCOPIX + OXi 6204	☐ HANDSCOPE
Test Signal	**no. 12 : Recorder - 5 signals**			
Type	Set of 5 slow signals with varied forms and characteristics			
Specs	Duration of each signal ≈ 1s, amplitude 1.5V < Vpp < 3.5V			
Scope Settings	Sample length 2s - 40µs - MAIN = 500 mV/div DC coupling			
Trigger	None at first, then threshold(s) on MAIN, level depending on the signal			
Modes	“Source/level” triggering, then “File Capture”			
Purposes	Basic presentation of “Record” mode Observation of faults using two thresholds (“normal” and “File Capture” modes)			

a) Firstly, select the “Recorder” mode using the button on the top left of the front of the instrument, then calibrate vertical sensitivity to 500mV/div and the recording duration to 2s, meaning one sample every 40µs.

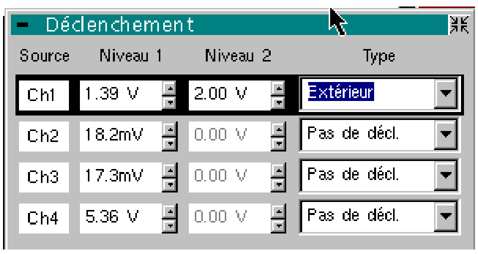
You may notice that beneath the trace window, the time axis is graded in hours/minutes/seconds.

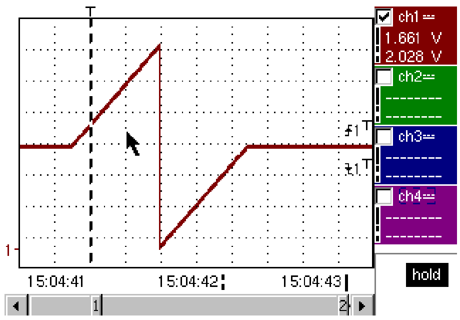


In the example given here, it runs from 14h39mn48s to 14h39mn50s which indeed corresponds to 2s of recording duration.

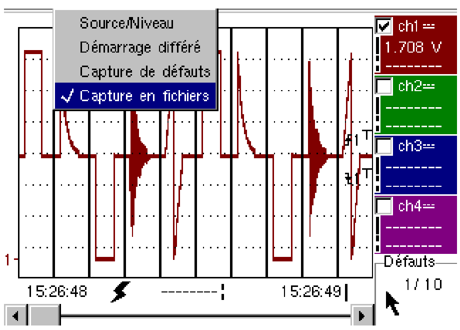
In addition, 2 vertical cursors, one a dashed line (positioned here at the instant of triggering) and the other a full line (completely on the right of the screen) enable us to take two amplitude measurements over four channels simultaneously.
In the example, these are respectively 1.700V and 1.661V on CH1.

b) Then select the “Source/level” option from the Trigger menu, set the parameter as indicated below and press the RUN/STOP button on the front to launch acquisition.
In the right hand image, we see that a fault has been detected and captured because the higher threshold viewed on the right part of the screen has been crossed.





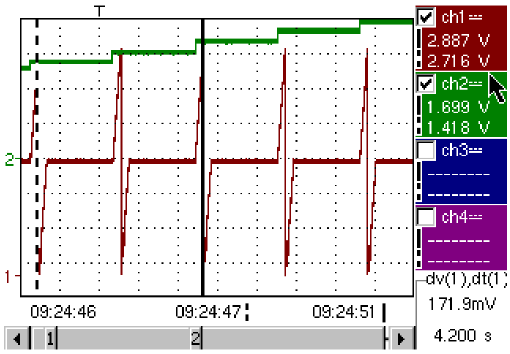
c) Using the “File Capture” option in the “Trigger” menu, we can detect and capture a whole sequence of faults and the instrument automatically stores the acquisitions in its memory (up to 510). In the following example we shall see how to sort and visualise them for analysis.



Demo: with:	☒ MTX3x5x SPO & MTX105x SPO	☐ OX 6000 ☒ OX 6000-II	☒ SCOPIX + OXi 6204	☐ HANDSCOPE

Test Signal	**no. 13 : Recorder heart**
Type	Slow “heart pulse”-type signal & increasing/decreasing Vdc
Specs	Signal frequency ≈ 0.5s, amplitude ≈ 3.2V (cardiac pulse)
Scope Settings	Sample length 10s then 2s - MAIN = 500 mV/div DC coupling
Trigger	None at first, then EXT thresholds on MAIN, levels of 1V & 2.6V
Modes	“Source/level” triggering, then “File Capture”
Purposes	Multiple threshold observation using “Recorder” mode
	“Cursor” or “automatic” measurements in “Recorder” mode

a) Firstly, select the “Recorder” mode using the button on the top left of the instrument, then calibrate vertical sensitivity to 500mV/div and the recording duration to 10s, meaning one sample every 200µs.

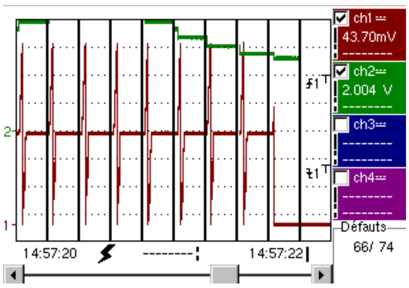


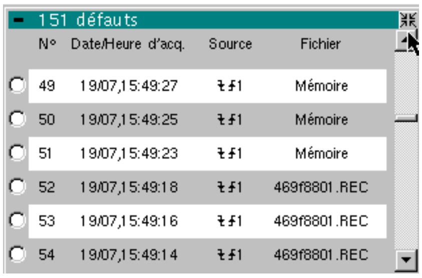
The two vertical cursors, one a dashed line and the other a full line, enable us to take 2 amplitude measurements for each channel simultaneously.

In the example, we can read respectively 1.699V and 1.418V on CH2.

On the bottom right of the screen, we can also measure the differences (in amplitude and time) between these cursors on the channel of our choice (see left for CH1).

b) Select a trigger of “Exterior” type on MAIN, set the threshold levels to 1V and 2.6V then validate the “File Capture” option in the “Trigger” menu (same method as for signal n° 12).

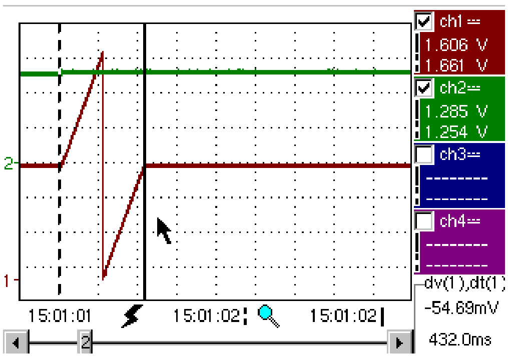


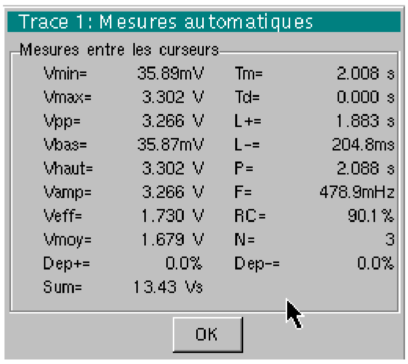


Selecting the fault to analyse can be done by directly zooming in the screen using the “Display” menu, option “Faults”, selecting the number of the fault before closing the sorting window.

Note that a sound is emitted when a fault is captured.

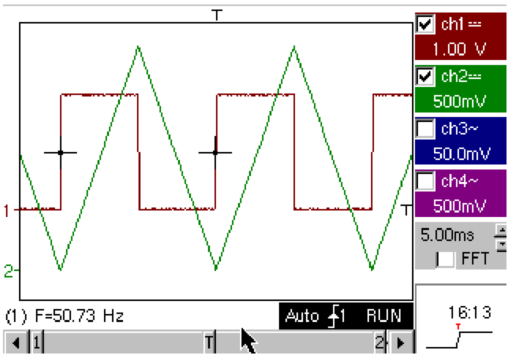
c) Measurements can be performed using the manual cursors, but it is also possible to simultaneously visualise the 19 automatic measurements made on the chosen channel.

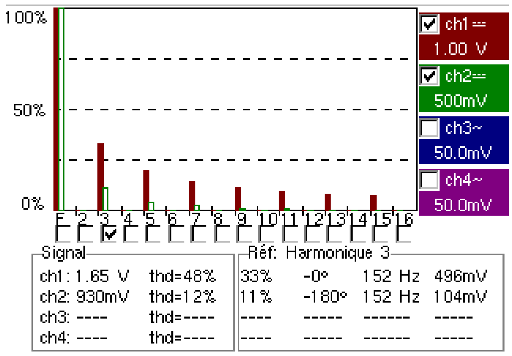




Demo: with:	☒ MTX3x5x SPO & MTX105x SPO	☒ OX 6000 b) ☒ OX 6000-II	☒ SCOPIX + OXi 6204	☒ HANDSCOPE a)
Test Signal	**no. 14 : Harmonics**			
Type	2 signals, one square one triangle			
Specs	Signal frequency ≈ 50Hz, Vpp ≈ 3.2V (triangle), Vpp ≈ 3.4V (square)			
Scope Settings	5ms/div - MAIN = 500mV or 1V/div DC coupling			
Trigger	⇑ DC coupling on MAIN, 50% of Vpp for example			
Modes	"Oscilloscope" mode then "Harmonics", then "FFT"			
Purposes	Use of the "Harmonics" mode to analyse "Power" signals			
	Comparative use of the Oscilloscope's FFT multi-channel mode			

a) Firstly calibrate the Oscilloscope to provide a rough view of the signal as in the first example (possible using Autoset), then set the parameters as indicated above. Endly select "Analyser" mode.





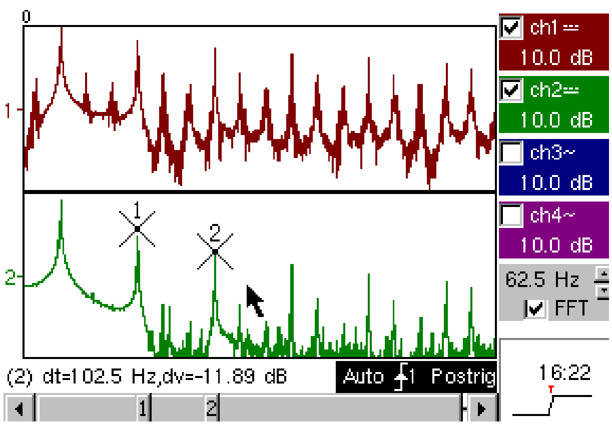
This instructive example uses two highly characteristic signals, a square and a triangle, and through analysis of harmonics enables verification of the theory of decomposition of fundamental signals.

The Harmonics analysis function does not require calibration of the timebase or sampling speed, but the vertical sensitivity must be correctly adjusted; the best solution therefore consists in making the calibrations in Oscilloscope mode beforehand.
This will also provide an approximate verification that the frequency of the fundamental is indeed within the instrument's admissible limits (40-450Hz for Scopix, OX 6000-II & Handscope, 40Hz-5kHz for Mtx3x5x).

The harmonics can be viewed on 4 channels (Handscope & OX 6000-II : 2 channels), measurements are made on Vrms and THD (Total harmonic distortion) of the signal for each active channel, and for the harmonic rank selected, the % of the fundamental, phase in relation to the fundamental, frequency of the harmonic rank and its RMS value.

b) Return to Oscilloscope mode, check the FFT box, perform an "Autoset" and validate the manual cursors.

In the Horizontal menu we can select the type of scale, Linear or logarithmic FFT, as well as the desired analysis window.



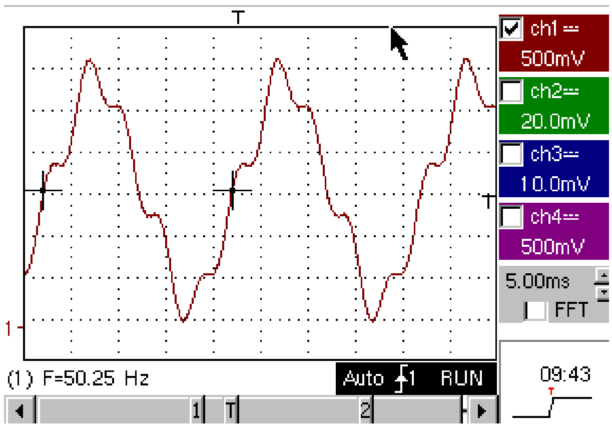
In linear mode the amplitude scale is expressed in volts, in logarithmic mode in dB, offering a greater analysis dynamic (49dB for a traditional 8-bit Oscilloscope, 60dB for the OX6000 and 79dB for Scopix and its 12-bit conversion.

Contrary to Harmonics Analysis, FFT is not limited to harmonic ranks of the fundamental, but presents the whole spectral content of the signal, over the complete breadth of the Oscilloscope bandwidth.

Demo: with:	☒ MTX3x5x SPO & MTX105x SPO	☐ OX 6000 ☒ OX 6000-II	☒ SCOPIX + OXi 6204	☒ HANDSCOPE

Test Signal	**no. 15 : Distortion**
Type	1 pseudo-sinusoidal signal presenting harmonic distortion
Specs	Signal frequency ≈ 50Hz, Vpp ≈ 3.2V
Scope Settings	5ms/div - MAIN= 500mV DC coupling imperative
Trigger	⇑ DC coupling on MAIN, 50% of Vpp for example
Modes	"Oscilloscope" mode then "Harmonics"
Purposes	Use of the "Harmonics" mode to analyse a "Power" signal

a) Firstly calibrate the Oscilloscope to provide a rough view of the signal as in the first example (possible using Autoset), then set the parameters as indicated above.

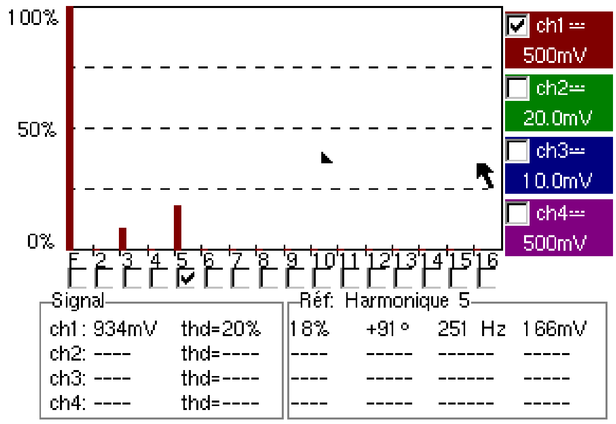


On electrical power distribution networks we regularly seek to observe possible harmonic distortion phenomena, which often cause problems for the global operation of the installation and the instruments connected.

This example realistically simulates a sinusoidal 50Hz signal (network frequency of many countries), on which harmonic ranks have been superimposed in the following manner:

- ✓ Amplitude sinus 0.3V (10%); frequency 150Hz (rank 3); dephasing: PI (180°)
- ✓ Amplitude sinus 0.6V (18%); frequency 250Hz (rank 5); dephasing: PI/2 (90°)

Important: in order that the dephasing measurements indicated may be correct, the channel coupling must imperatively be set to DC.



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