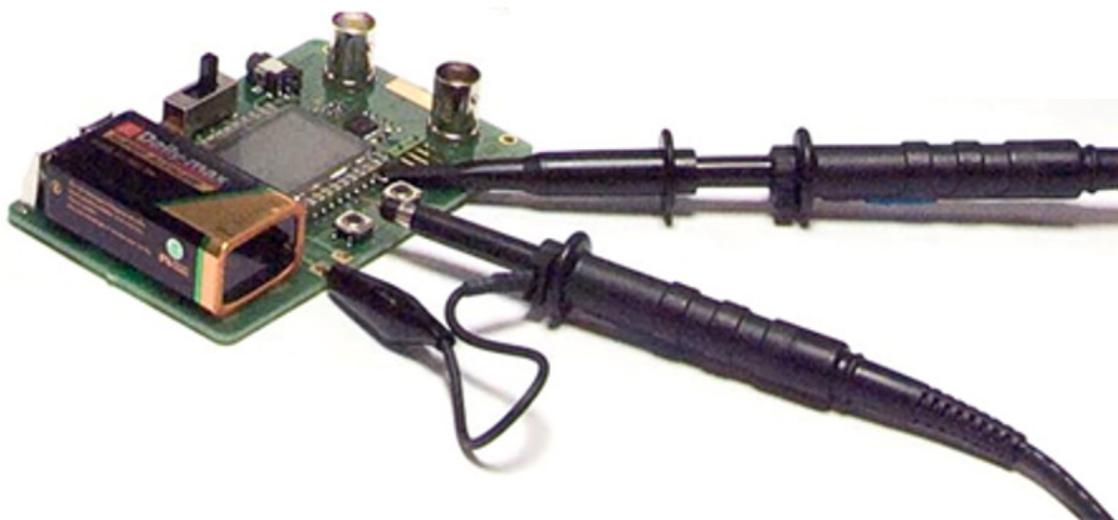


HX0074



Signal generator circuit demo kit for Scopix IV

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You have just purchased an **HX0074, a signal generator circuit demo kit for Scopix IV** and we thank you for your trust.

For best results from your instrument:

- **read** these operating instructions carefully.
- **comply** with the precautions for use.



WARNING – Risk of danger! The operator must refer to these instructions whenever this danger symbol appears.



Chauvin Arnoux has designed this instrument in the context of a global eco-design approach. A life cycle analysis was carried out to master and optimize the impact of this product on the environment. More precisely, the product exceeds the requirements of regulations as regards recycling and valuation.



The CE marking indicates compliance with the European Low Voltage Directive 2014/35/EU, the Electromagnetic Compatibility Directive 2014/30/EU, and the Directive on the Restriction of Hazardous Substances RoHS, 2011/65/EU and 2015/863/EU).



The rubbish bin with a line through it means that, in the European Union, the product must undergo selective disposal in compliance with Directive WEEE 2012/19/EU.

1. DELIVERY CONTENTS

The HX0074, signal generator circuit demo kit for Scopix IV, is supplied in a cardboard box with:

- one 9 V battery,
- a multilingual quick start guide,

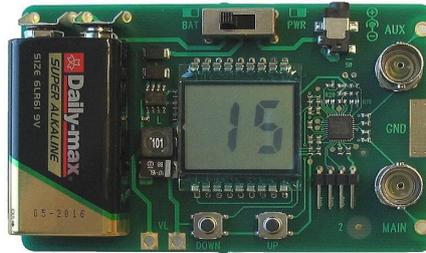
For accessories and spare parts, visit our website:

www.chauvin-arnoux.com

2. 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, there by 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 SCOPIX IV digital oscilloscopes, but can be used with other models, insofar as they offer the same functions.

Range	Models			
SCOPIX IV	OX 9062	OX 9102	OX 9104	OX 9304



3. PRESENTATION

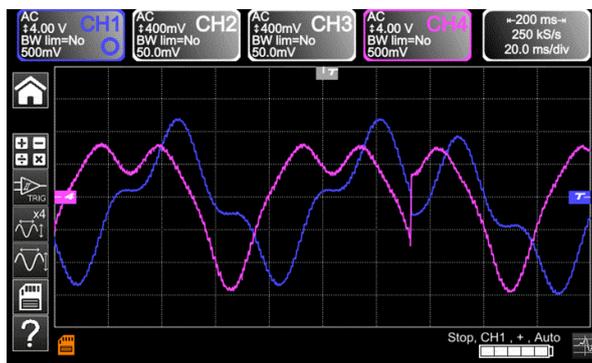
- The signal generator circuit is built around a microprocessor. An LCD display 2 «UP/DOWN» buttons let you select the desired signal. It has two channels available via BNC connection: «MAIN» and «AUX». It can be powered by a standard 9 V battery or a mains adapter used to power METRIX Handscope oscilloscope (selection of power supply by switch), for example.
- The HX0074 can be powered:
 - either by a standard 9 V battery
 - or via an external mains adapter (12 VDC, 1.25 mA), with negative-polarity body, as used with the METRIX oscilloscopes such as the Handscope, for example.
 The power supply mode is selected by using the switch.
- The instructional manual contains a table of contents, which lists all the signals available and the models concerned, a description page for each signal.

Familles	SCOPIX IV	Pages
n°1 : Miscellaneous	<input checked="" type="checkbox"/>	4
n°2 : Hysteresis	<input checked="" type="checkbox"/>	5
n°3 : Pulse train	<input checked="" type="checkbox"/>	6
n°4 : Data + CS Train	<input checked="" type="checkbox"/>	7
n°5 : Data Frame - Fault	<input checked="" type="checkbox"/>	8
n°6 : Amplitude-modulated sine wave	<input checked="" type="checkbox"/>	9
n°7 : Square wave-Rise time	<input checked="" type="checkbox"/>	10
n°8 : Square wave, low level, noisy	<input checked="" type="checkbox"/>	11
n°9 : Comb of rapid pulses	<input checked="" type="checkbox"/>	12
n°10 : Digital frame + Fault	<input checked="" type="checkbox"/>	13
n°11 : Frame + Rare pulse	<input checked="" type="checkbox"/>	14
n°12 : Frame	<input checked="" type="checkbox"/>	15
n°13 : Heart recorder	<input checked="" type="checkbox"/>	17
n°14 : Harmonics	<input checked="" type="checkbox"/>	18
n°15 : Distortion	<input checked="" type="checkbox"/>	19

4. MISCELLANEOUS

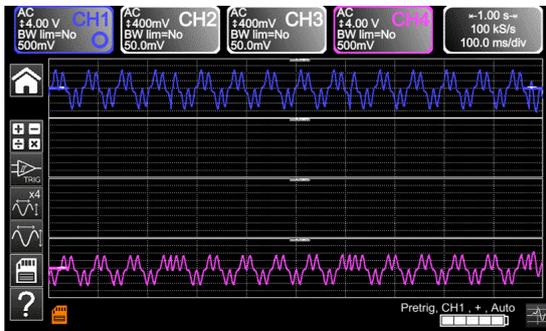
Demo:	with:	<input checked="" type="checkbox"/> SCOPIX IV
Test signal	n°1 : Miscellaneous	
Nature	4 pairs of successive signals approx. every 2 seconds	
Specs	$2.6\text{ V} < V_{pp} < 3.2\text{ V} - 10\text{ Hz} < F < 60\text{ Hz}$	
Oscilloscope Settings	20 ms/div. - MAIN = 500 mV/div. - AUX = 500 mV/div.	
Trigger	standard on MAIN	
Modes	XY (Display menu) - neither «Min/Max», or «Repetitive Signal» (Horizontal menu)	
Objectives	Start in a playful manner by describing the different display modes: Normal, Full Trace, Full Screen, XY	

a) Adjust the oscilloscope so as to display the signals correctly (possible using the «Autoset» key).

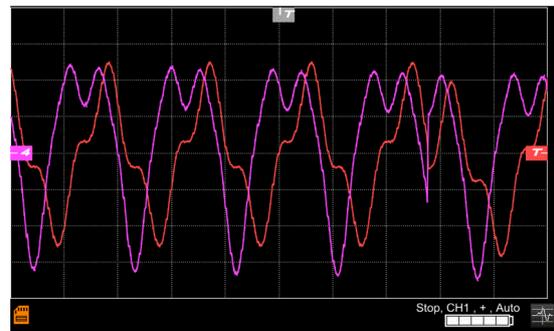


Normal mode

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



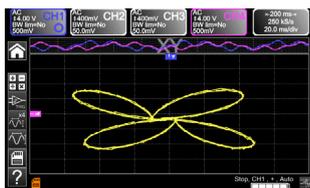
Full Trace



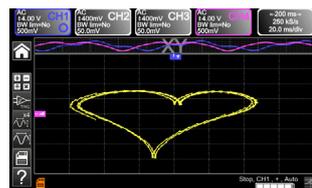
Full Screen

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

To realize copies screen by the touch and review by the viewer.



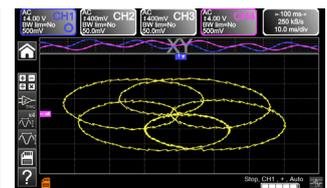
Clover



Heart



Spiral



Rose

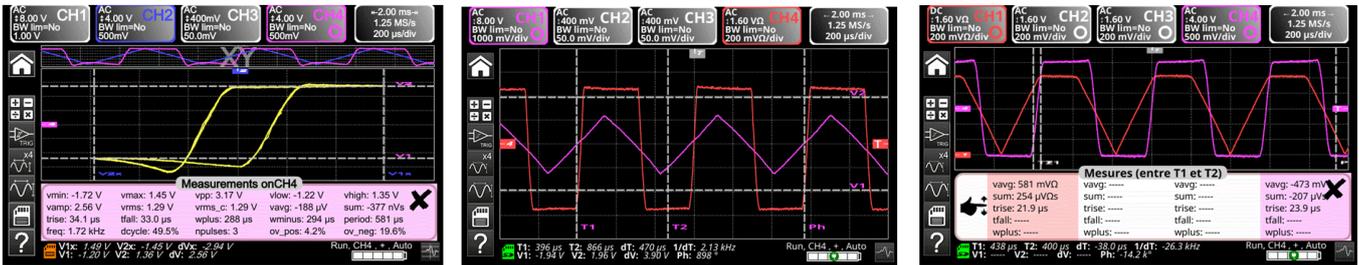
5. HYSTERESIS

Demo:	with:	<input checked="" type="checkbox"/> SCOPIX IV
Test signal	n°2 : Hysteresis	
Nature	2 phase-shifted signals, triangle and pseudo-square	
Specs	Vpp ≈ 3.2 V - F ≈ 1.7 kHz - square rise time ≈ 24 μs - Signal delay ≈ 40 μs	
Oscilloscope Settings	200 μs/div. - MAIN = 500 mV/div. - AUX = 500 mV/div.	
Trigger	standard on MAIN	
Modes	XY (Display menu) - neither «Min/Max», or «Repetitive Signal» (Horizontal menu)	
Objectives	«X(t)» and XY modes from phase-shifted signals Present automatic measurements with markers (F, Square rise time) Mathematical function	

a) Adjust the oscilloscope so as to display the signals correctly (possible using the «Autoset» key).



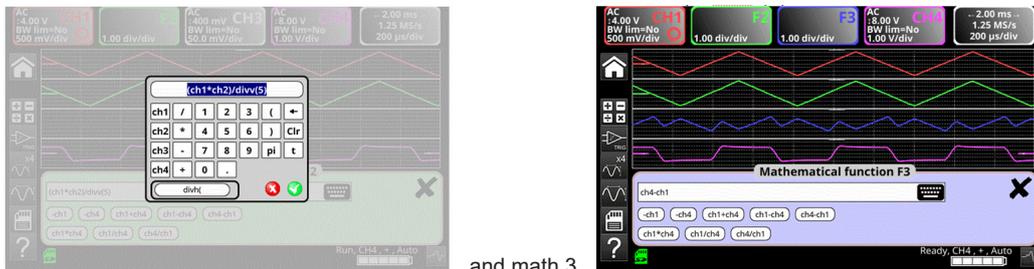
b) Select the XY mode with CH1 on X and CH4 on Y ; add 20 automatics measurements.



Time rise with cursor and per channel

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) Mathematical function created on channel 2 → math 2 = (ch1 x ch2) / divv. (5).



and math 3

Divv (1) is equivalent to 10 000 samples (points) = 1 div. horizontal

The result of the multiplication is translated into division in the screen. If Vmax (ch1) = 4 div. and Vmax (ch2) = 4 div., it would have been necessary to divide the result to 16+ div. then by divv. (4) to obtain Vmax (math3) = 4 div. During the use of mathematical functions (offices) associated with tracks, it is necessary to verify the dynamics of the obtained result. A correction of the result (profit) of the operations by the mathematical functions (offices) (divv(), divh() / ...) is advised to optimize the display into division in the screen.

6. PULSE TRAIN

Demo:	with:	<input checked="" type="checkbox"/> SCOPIX IV
Test Signal	n°3 : Pulse train	
Nature	1 signal presenting trains of 10 pulses with a variable interval	
Specs	$V_{pp} \approx 3.4 \text{ V}$ - $F \approx 32 \text{ kHz}$ - Train interval ≈ 100 to $180 \mu\text{s}$	
Oscilloscope Settings	100 $\mu\text{s}/\text{div}$ - MAIN = 500 mV/div	
Trigger	on MAIN - Hold-Off $\approx 350 \mu\text{s}$	
Modes	Triggered mode preferable - Deselect «Repetitive signal» (Horizontal menu)	
Objectives	Triggering with «Hold-Off» on pulse trains Automatic measurement with zone selection using manual cursor Compare to reference	

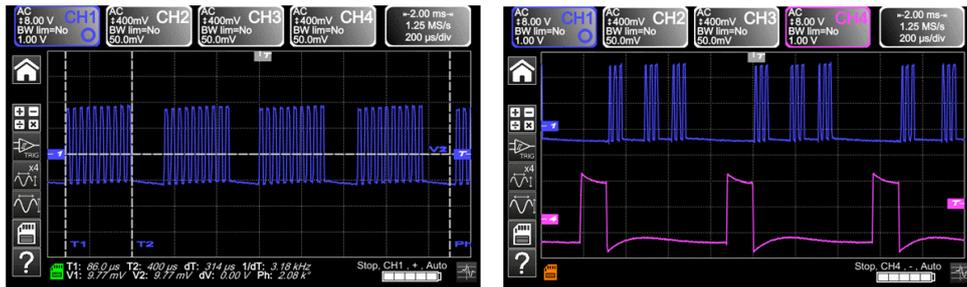
a) Adjust the oscilloscope so as to view the CH1 signal correctly (time base, sensitivity, and triggering source).

⚠ Attention, with this type of signal, «Autoset» operation may be aleatory.

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.

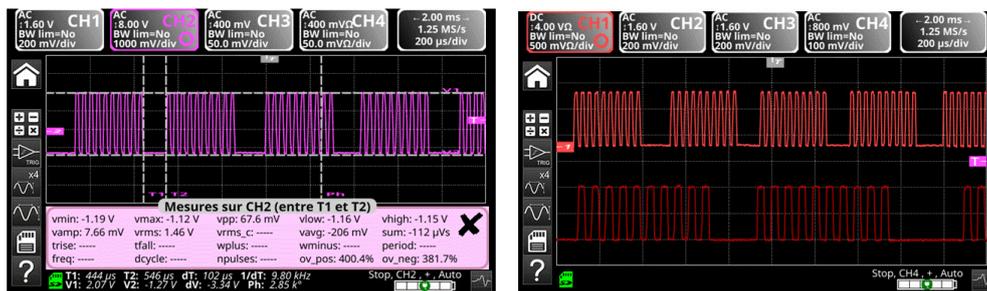
To do this, double-click in the corresponding digital zone and enter the value of $350 \mu\text{s}$, for example. This value must be greater than the pulse train duration in order to inhibit the trigger during this period, while remaining lower than the interval between two pulse trains (this varies between 400 and $480 \mu\text{s}$).

To do this, double-click in the corresponding digital zone and enter the value of $350 \mu\text{s}$, for example $350\text{e-}6$.



2 measurement markers

b) Measure the variable time between 2 trains of impulses then Zoom then fast Comparison to a reference.



Press the  key to create a reference.

Move the active track to be able to compare it with the reference.

We highlight clearly that the number of impulses in the train remains identical (10), but that the interval between trains varies.



Press the  key again to delete the reference.

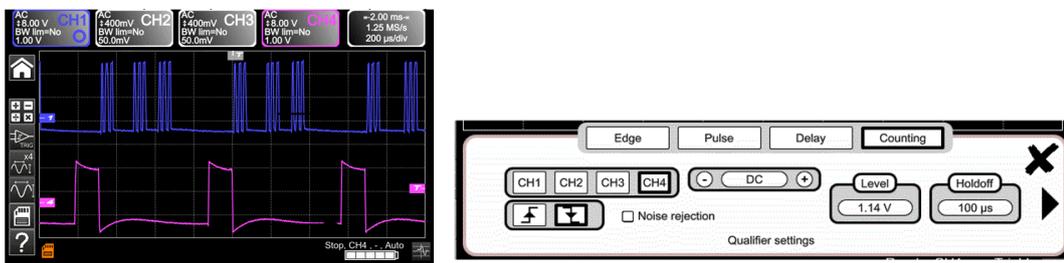
7. DATA TRAIN + CS

Demo:	with:	<input checked="" type="checkbox"/> SCOPIX IV
Test Signal	n°4 : Data train + CS	
Nature	2 signals representing a digital frame (data) and a CS (chip select)	
Specs	Vpp ≈ 3.4 V - F ≈ 40 kHz (data) - F ≈ 1.5 kHz (CS)	
Wave Settings	200 μs/div. - MAIN = 1 V/div. - AUX ≈ 1 V/div.	
Trigger	Principal ↙ on MAIN and Auxiliary ↘ on AUX	
Modes	Triggered mode preferable - Deselect «Repetitive Signal» (Horizontal menu)	
Objectives	Complex triggering with pulse count «WinZoom» on pulse train	

a) Adjust the oscilloscope to display simply the 2 signals (time base, sensitivities and triggering source ↙ on AUX).

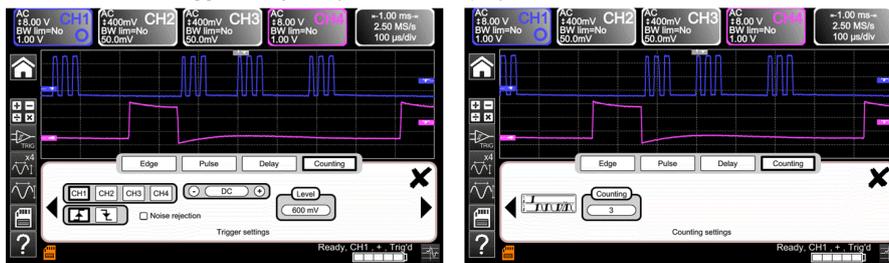
⚠ Attention, with this type of signal, «Autoset» operation may be aleatory.

Ch1 Data (MAIN) and Ch2 CS (AUX)



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 (3 in the example)



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



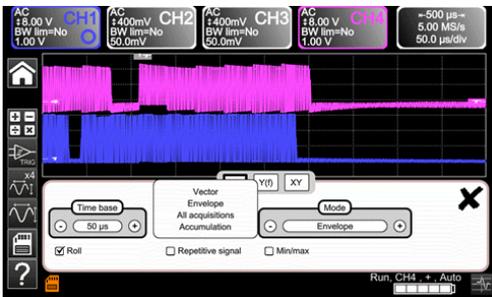
Using a time base of 200 μs/div., graphically select the first group of 3 pulses and release to obtain the result Zoom simultaneously with waveform..

8. DATA FRAME - FAULT

Demo:	with:	<input checked="" type="checkbox"/> SCOPIX IV
Test Signal	n°5 : Data frame - fault	
Nature	2 signals representing a communication bus with «clock» and «data»	
Specs	Vpp ≈ 3.4 V - F ≈ 31 kHz (clock) - 30 μs < L+ < 200 μs (data)	
Oscilloscope Settings	20 or 25 μs/div. - MAIN = 1 V/div. - AUX = 1 V/div.	
Trigger	 on MAIN, pre-trigger ≈ 1 division	
Modes	Triggered mode preferable	
Objective	Triggering on pulse width of the AUX signal	

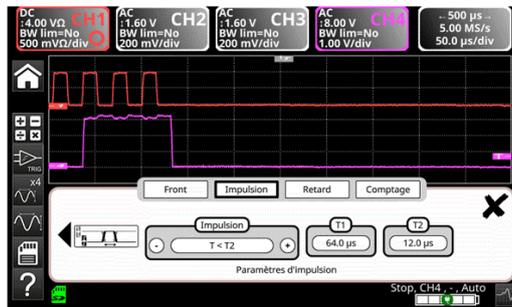
a) Adjust the oscilloscope so as to display the 2 signals in Normal mode (time base, sensibility, Triggering source on MAIN).

⚠ Attention, with this type of signal, «Autoset» operation may be aleatory.



selected different kind of display mode: vector, envelope and all acquisition.

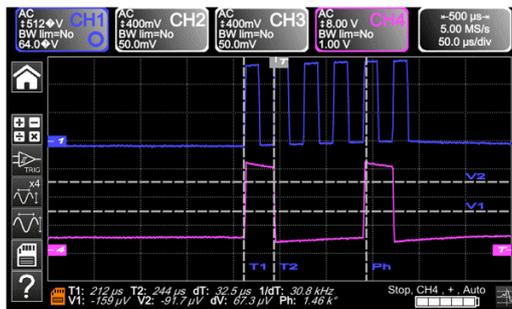
b) Trigger on pulse on AUX on socket.



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, 192 μs ...) by using the operators «<», «=» or «>».

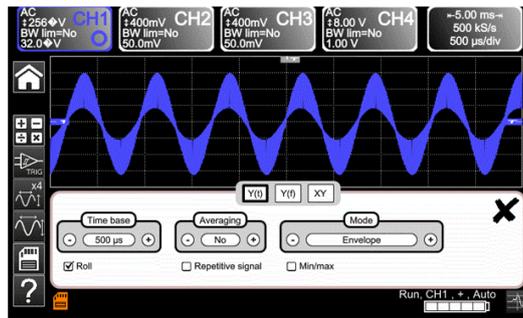
Add cursors to calculation and time measurement to compare.



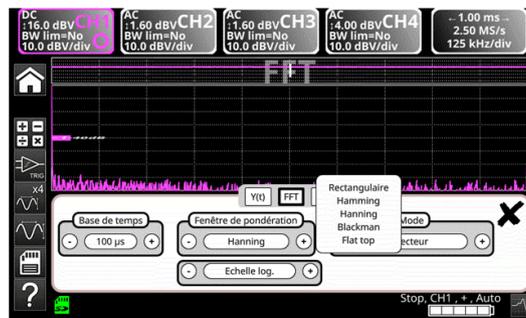
9. AMPLITUDE-MODULATED SINE WAVE

Demo:	with:	<input checked="" type="checkbox"/> SCOPIX IV
Test Signal	n°6 : Amplitude-modulated sine wave	
Nature	1 amplitude-modulated sinusoidal signal	
Specs	1.3 V < Vpp < 3.3 V - F ≈ 1.3 kHz	
Oscilloscope Settings	100 μs/div. - MAIN = 500 mV/div.	
Trigger	on MAIN, 50 % of Vpp	
Modes	Triggered mode preferable	
Objectives	Display a fast-changing signal (e.g.: modulation) Using «Envelope» mode FFT + windows	

a) Adjust the oscilloscope so as to display the signals correctly (possible using «Autoset» function).
«Oscilloscope» and «enveloppe» modes rough visualisation of the signal (Vpp max, modulation rate, frequency, ...).



b) FFT + waveform simultaneously
The **Fast FOURIER Transform (FFT)** is used to calculate the discrete representation of a signal in the frequency domain from its discrete representation in the time domain.
It is calculated on 2500 points.



c) Before calculating the FFT, the oscilloscope weights the signal to be analyzed by a window that acts as a bandpass filter. The choice of type of window is essential to distinguish the different spikes of a signal and make accurate measurements.
The total duration of the study interval results in a convolution in the frequency domain of the signal with a function $\text{sinc}(x)$.
This convolution modifies the graphic representation of the FFT because of the characteristic lateral lobes of the $\text{sinc}(x)$ function (unless the study interval contains an integral number of periods).

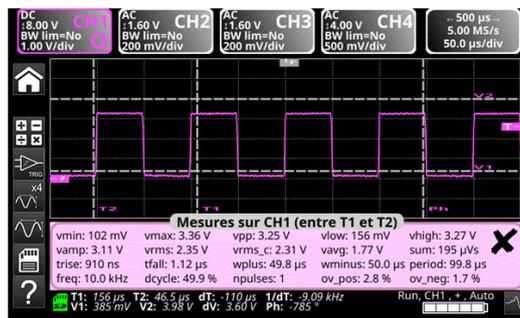
Five weighting windows are proposed.

⚠ Effects of under sampling on the frequency representation: If the sampling frequency is too low (less than the twice the cut off frequency of the signal to be measured), the high-frequency components are under sampled and are aliased (frequency-shifted) in the graphic representation of the FFT.

10. SQUARE WAVE-RISE TIME

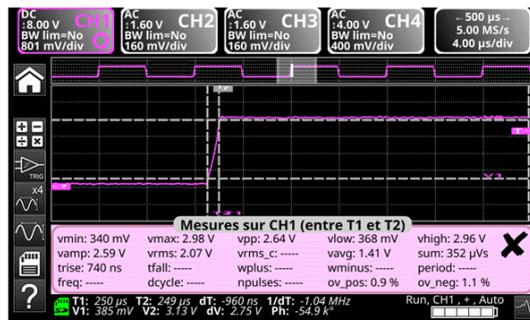
Demo:	with:	<input checked="" type="checkbox"/> SCOPIX IV
Test Signal	n°7 : Square wave-Rise time	
Nature	1 square wave, duty cycle 50 %	
Specs	Vpp ≈ 3.4 V - F ≈ 10 kHz - Rise time ≈ 800 ns	
Oscilloscope Settings	500 ns to 200 μs/div. - MAIN = 500 mV/div.	
Trigger	 on MAIN, 50 % of Vpp	
Modes	Triggered mode preferable - Select «Repetitive signal» (Horizontal menu)	
Objectives	Using «zoom» for rise time ROLL if base time > 100 ms	

a) Adjust the oscilloscope so as to display the signal correctly (possible using the «Autoset» function) and add T1 and T2.



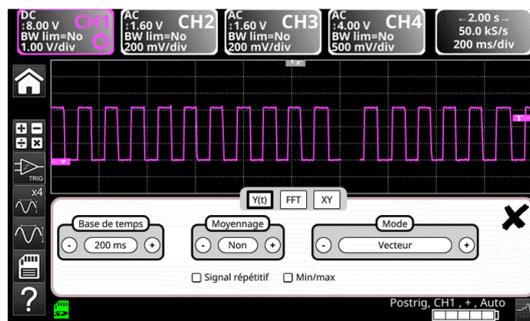
20 automatic measurements

b) Use «zoom» to characterise a rising edge



All acquisition, measure Trise

c) Select single mode, automatic release of the mode ROLL if base time > 100 ms. The new samples are shown as soon as they were acquired and the mode ROLL is activated as soon as the memory is full (scrolling of the track of the right towards the left of the Screen).



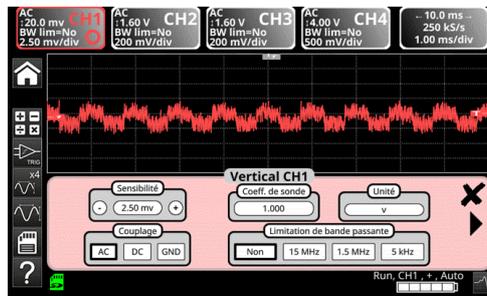
11. SQUARE WAVE - LOW LEVEL - NOISY

Demo:	with: <input checked="" type="checkbox"/> SCOPIX IV
Test Signal	n°8 : Square wave, low level, noisy
Nature	1 square wave of very low amplitude and very noisy
Specs	5 mV < Vpp < 30 mV (depending on filtering) - F ≈ 1 kHz
Oscilloscope 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 and 5 kHz low-pass filtering on the input
Objectives	Triggering and display for a noisy signal Use of 15 MHz and 1.5 MHz filters with 5 kHz on the input Use of the «averaging» function

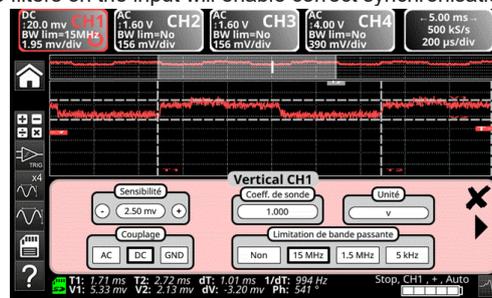
a) Adjust the oscilloscope so as to display the signal approximately.

 Attention, with this type of signal, «Autoset» operation may be aleatory.

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.

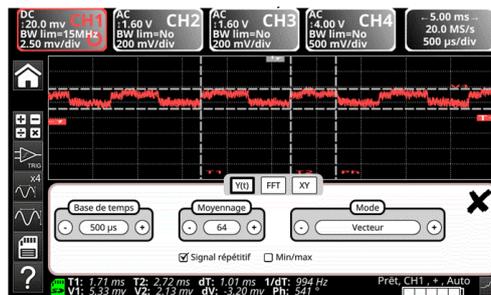


b) The use of the 1.5 MHz and 5 kHz analogue filters on the input will enable correct synchronisation and analysis of the signal free of any noise.



1.5 MHz filter

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.

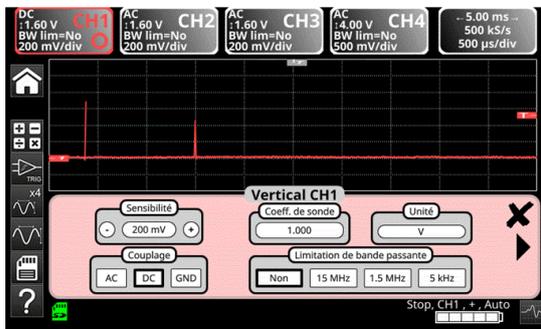


12. COMB OF RAPID PULSES

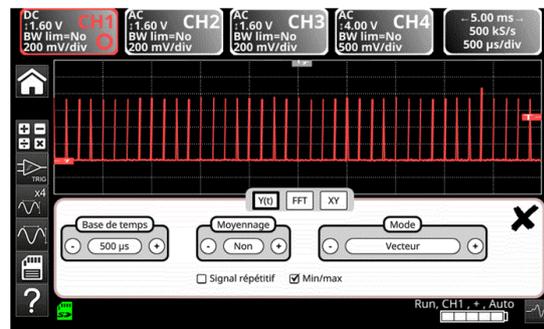
Demo:	with:	<input checked="" type="checkbox"/> SCOPIX IV
Test Signal	n°9 : Comb of rapid pulses	
Nature	Comb of 6 very brief pulses, with a low repetition frequency	
Specs	$V_{pp} \approx 2 \text{ V}$ (depending on whether 50Ω load or not) - $F \approx 8 \text{ kHz}$	
Oscilloscope Settings	50 $\mu\text{s}/\text{div.}$, then 50 ns/div. - MAIN = 500 mV/div.	
Trigger	 on MAIN, 50 % of V_{pp}	
Modes	First deselect «Repetitive signal» (Horizontal menu)	
Objectives	Use of the «Min-Max» acquisition mode Interest of ETS in faithful and precise representation of signals	

a) Adjust the oscilloscope so as to display the signal approximately.

⚠ Attention, with this type of signal, «Autoset» operation is in principle impossible.



Result of initial calibration



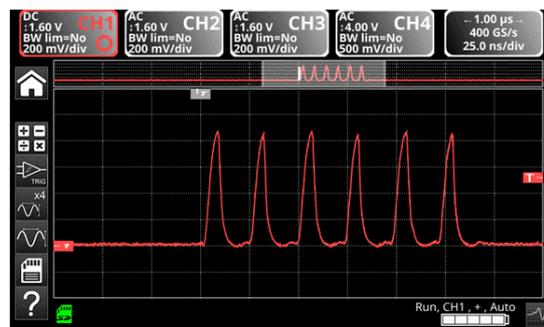
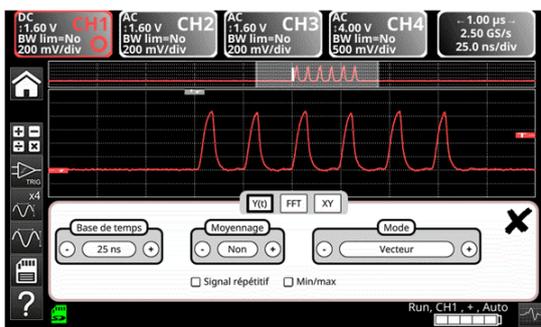
Selection of «Min-Max» acquisition mode

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 time base speed will enable the acquisition and visualisation of the signal as demonstrated in the second screen.

Due to very brief duration of the pulses in relation to their frequency of repetition ($\approx 500 \mu\text{s}$ / time relationship ≈ 1000), the time base 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 time base 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 to exceed the maximum “single-shot” sampling rate, so as to obtain faithful representation and precise measurements until 400 Gs/s..

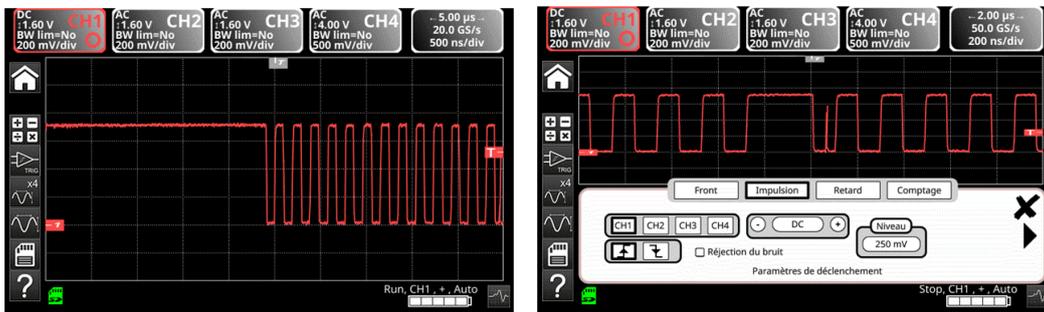
The example below presents pulses with zoom of sampling and 400 Gs/s with ETS mode.



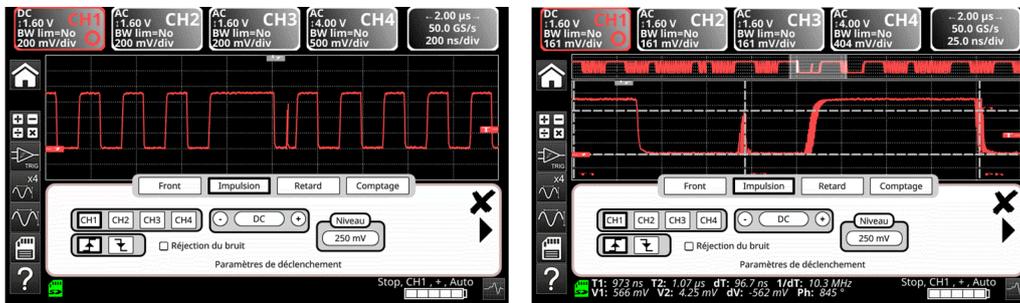
13. DIGITAL FRAME + FAULT

Demo:	with:	<input checked="" type="checkbox"/> SCOPIX IV
Test Signal	n°10 : Digital frame + fault	
Nature	Digital frame with a recurrent fault	
Specs	F square \approx 5 MHz, Vpp \approx 1.8 V - L+ fault \approx 7 ns	
Oscilloscope Settings	25 or 50 ns/div., then 5 μ s/div. - MAIN = 500 mV/div. DC coupling	
Trigger	 DC coupling on MAIN, level \approx 250 mV	
Modes	Select «Repetitive Signal» (Horiz menu)	
Objectives	Using triggering on pulse width Use of «Min-Max» mode on digital frame	

a) Adjust the oscilloscope so as to display the signal approximately (possible using the «Autoset» function), then set the parameters as indicated below. You will notice that the display is not stable.



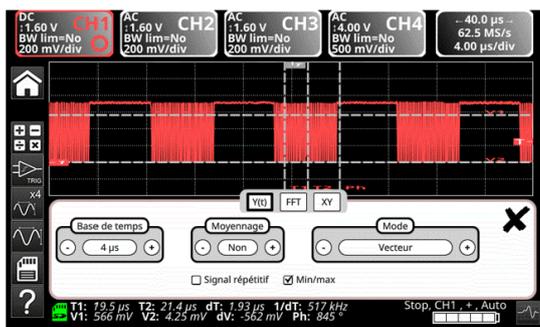
Then set up a pulse-width trigger as indicated below, and increase the time base speed in order to allow detailed analysis of the fault on the digital frame.



Trigger «Pulse < 20 or 40 ns»

b) Next you can use a slower time base, for example 5 μ s/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.

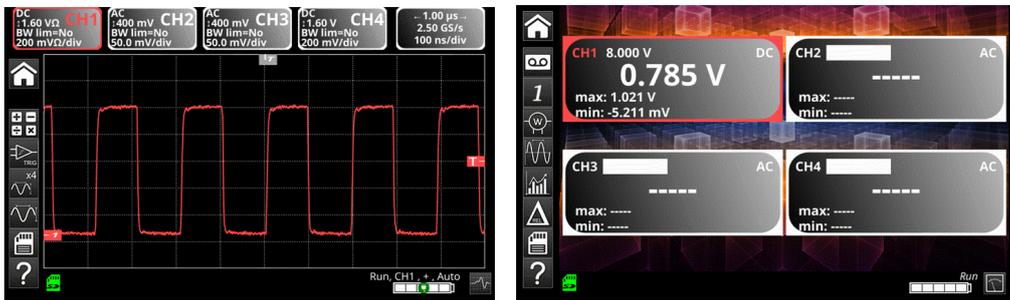


with «Min-Max»

15. FRAME

Demo:	with:	<input checked="" type="checkbox"/> SCOPIX IV
Test Signal	n°12 : Frame	
Nature	Digital clock signal presenting a fault	
Specs	F clock \approx 5 MHz, Vpp \approx 3.3 V	
Oscilloscope Settings	100 or 125 ns/div. then 25 ns/div. - MAIN = 500 mV/div. DC coupling	
Trigger	 DC coupling on MAIN, level \approx 1.8 V	
Modes	Triggered mode preferable	
Objectives	Logger + multimeter modes	

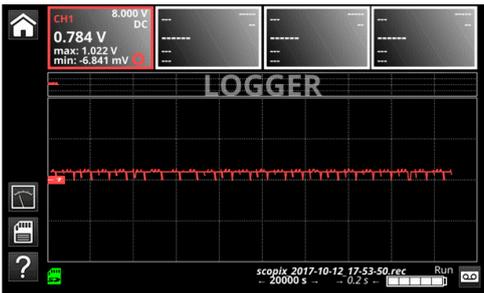
a) Display of the waveform in Oscilloscope mode then select "multimeter" mode to adjust the manual amplitude, the regulation of the range by clicking the zone and logger mode.



If the channel run, press **AC/DC GND** to change coupling. Coupling will change from: AC \rightarrow AC < 5 kHz \rightarrow AC < 625 \rightarrow AC+DC \rightarrow AC+DC < 5 kHz \rightarrow AC+DC < 625 Hz \rightarrow DC. Manual range change with .

b) Run acquisition in logger mode.
Automatic file of 100 000 measurement created on each active channel: time 10 000 s = 333 min or 5.55 h, fix resolution 0.2 s.

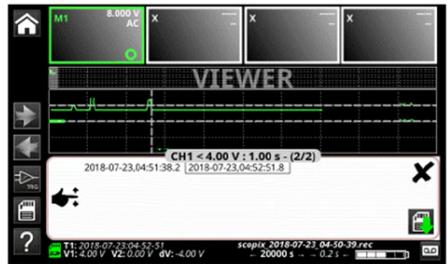
Recording progress, and waiting about 5h to analyse files created if you don't change mode.



sort the even

Analysis of the events found. Pressing this icon opens a window

containing the events satisfying the search criteria.

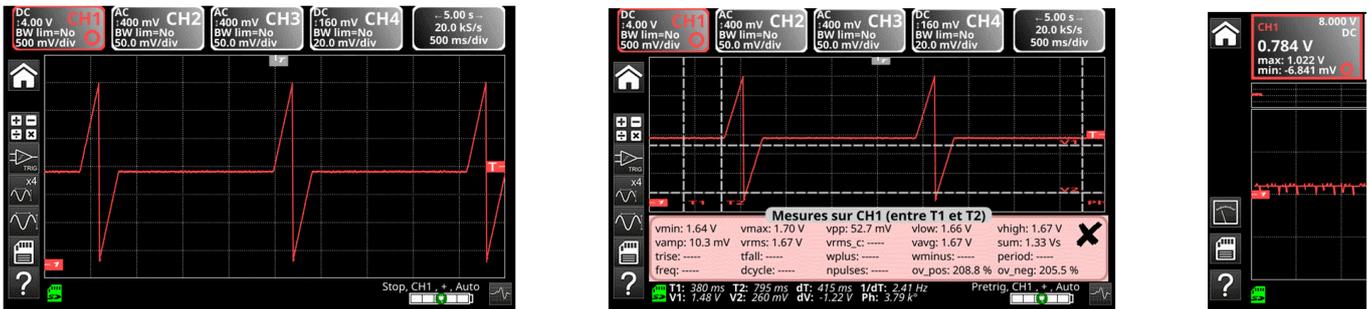


When an event is selected, the V1, V2 and T1 cursors appear. The associated measurements are displayed below the event window.
The events name formats is: YYYY-MM-DD,HH : MM : SS .s where YYYY-MM-DD : is the date of the record and, HH : MM :SS .s : is the value of the T1 cursor.

16. HEART RECORDER

Demo:	with:	<input checked="" type="checkbox"/> SCOPIX IV
Test Signal	n°13 : Heart recorder	
Nature	Slow «heartbeat» type signal and increasing/decreasing VDC	
Specs	Frequency of the signal ≈ 0.5 s, amplitude ≈ 3.2 V (heartbeat)	
Oscilloscope Settings	Duration 10 s then 2 s - MAIN = 500 mV/div. DC coupling	
Trigger	None at first, then EXT thresholds on MAIN, levels 1 V and 2.6 V	
Modes	«Source/Level» triggering, then «File Capture»	
Objectives	Multiple threshold observation using «Logger» mode	

a) Select "Oscilloscope" mode, the signal then calibrate vertical sensitivity to 500 mV/div. and add auto meas to have cursor.



b) Select «logger» mode (Recorder) and calibrate 500 mV/div. fix duration of 10 000 s with resolution of 0.2 s on the on home screen: automatic recorder on files .rec.

c) Viewer remotely of files on internal directory or on μ SD.



or ScopeNET IV

d) Run ScopeNET IV via ethernet or WIFI connection and remote mode of each function.



When you have obtained the IP address of the Scopix IV (DHCP or manual) using a browser, type 14.3.250.51/scopenet.html (for example) on your computer → this opens the screen shown opposite.



JAVA application PC is used to display the **ScopeNet IV**.

Carefully check the installation of ScopeNet to forestall any difficulties.

To check the instruments connected, follow the procedure:

- Press the network icon, in the centre of the screen: the search for the instruments in the network (Ethernet and WIFI) is effected by a specific function. A series of compatible instruments connected is displayed: see opposite.
- The PC environment uses icons in an IHM identical to the Scopix IV product, with the same access to the functions and adjustments.



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