

Oscilloscope Mode

The Keys



By pressing this key, you can select the "**oscilloscope**" mode.

5 "UTILITY" keys or key pad



Direct access to LCD **light** adjustment.



When this key is pressed, the display mode switches from normal to "**full screen**" display (and vice versa).

The screen is organized in such a way as to leave an optimum trace plotting surface area, removal of:

the menu bar,
the parameters of the traces of the time base,
the bargraph.

Only the permanent settings and the measurements will remain.




The controls on the front panel remain active.



Triggers a **hardcopy** in accordance with the configuration chosen in the "Util" and "Hardcopy" menus.

A second press before the end of the process will interrupt the current printout.

If printing is impossible, a "Printing error" message will be sent.

The " " symbol is displayed in front of the settings display zone when printing is in progress.



The first press will **freeze** the traces on the screen. They will be displayed in a lighter colour as a reference to be compared with another acquisition.

A second press will **erase** them: they will then be lost.



- *Traces will be saved only through the "Memory → Trace → Save" menu.*
- *The reference memories will be accompanied by their reference number.*

1 "AUTOSET" key



Automatic optimum adjustment by **Autoset** on the channels where the signal is applied.

This affects parameters: coupling, vertical sensitivity, time base, trigger type and slope and trace positioning.

The lowest frequency signal is used as the trigger source.

If no trace is detected on the inputs, the autoset will be aborted.

Selective "AUTOSET"



When pressed at the same time as a **CHx key** (CH1 to CH4), this defines the corresponding channel as the trigger source. It initiates an autoset which will take this selection into account. Channel CHx then becomes active for adjustment using the keys:



Oscilloscope Mode (cont'd)



4 "Trigger" keys



Sets the trigger **level** to the average value of the signal (50%) without modifying the trigger coupling.

When pressed in combination with a **CHx** key, this activates the same the same function, after first selecting the corresponding channel as the trigger source.



Selects the trigger **slope** (up  or down ) by successive presses. The slope is indicated in the status area.



Successive presses can be used select one of the following **acquisition modes**:

Single shot	(Mono) = SINGLE
Triggered	Trig
Automatic	(Auto) = REFRESH

- **"SINGLE" mode:**

In Single Shot mode, a single acquisition is armed by pressing the RUN HOLD key. After receiving a trigger, the waveform is displayed and the instruments returns to HOLD mode. For any further acquisition, the acquisition must be rearmed by pressing the RUN HOLD key.

If the time base is less than 100 ms/div → SINGLE mode can be accessed via the "Mono (< 100 ms/div)" option.

If not, Single mode can be accessed via the "Roll Mono (> 50ms/div.)" option and ROLL mode is automatically activated.

- **"TRIGGERED" mode:**

The screen's content is only refreshed when there is a trigger event linked to the signals present on the oscilloscope's inputs (CH1, CH2, CH3, CH4).

If there is no trigger event linked to the signals present on the inputs (or if there is no signal on the inputs), the trace is not refreshed.

- **"AUTOMATIC" mode:**

The screen's content is refreshed even if the trigger level is not detected on the signals present on the inputs.

When there is a trigger event, screen refreshing is managed as in the "Triggered" mode.



- allows acquisition to be started and stopped in "TRIGGERED" and "AUTOMATIC" modes.

- rearms the trigger circuit in "SINGLE" mode.

Acquisition is initiated according to the conditions defined by the acquisition mode (**SGLE REFR** key).

The acquisition status is indicated in the status area:

RUN	= started
STOP	= stopped
PRETRIG	= acquisition

Oscilloscope Mode (cont'd)

3 "MEASURE" keys



Displays or hides a window for the 19 automatic measurements on the reference trace.

When pressed in combination with a **CHx** key, it displays the measurements concerning the corresponding channel.



By means of successive presses, this selects one of the displayed traces as the **reference trace** for the automatic and manual measurements.

It appears in the "Measure" menu → Reference.



Activates or deactivates the **cursor** display for manual measurements.

The cursors can be moved directly on the touch-sensitive pad using the stylus.

- The "**dt**" measurements (time difference between the two cursors) and "**dv**" measurements (voltage difference between the 2 cursors) are indicated in the status area.
- The absolute value of the cursor selected is indicated in the "Current Settings" area.

3 "HORIZONTAL" keys or key pads



Adjustment of the **time base coefficient** (T/DIV).



After a Zoom, the "Z-Pos." setting modifies the **position** of the screen in the acquisition memory.



Activates or deactivates the "**Zoom**" function.

By default, the zoom is performed around the samples located in the middle of the screen.

A zone can be zoomed by tracing a rectangle around the area to be enlarged using the stylus on the touch-sensitive pad. The sensitivity, time base and horizontal and vertical alignment values are recalculated automatically.

Oscilloscope Mode (cont'd)

Definition of terms used

- Validated channel:** Display enabled, trace displayed after RUN
- Displayed channel:** Channel validated, trace present on the screen
- Selected channel:** The parameters of this channel can be set with the keys:



5 "VERTICAL" keys or key pads

OX 7204^{III}

Step 1	Step 2	Step 3
Before pressing one of the following keys :	Press	After pressing one of the preceding keys:
The channel concerned is not displayed.		The channel is displayed and selected.
The channel concerned is displayed, but not selected.		The vertical sensitivity and vertical position are assigned to the channel selected.
The channel concerned is displayed and selected.		The channel is selected.
		The channel is cancelled by double-pressing.

OX 7202^{III}

Step 1	Step 2	Step 3
Before pressing one of the following keys :	Press	After pressing one of the preceding keys:
The channel concerned is not displayed.		The channel is displayed and selected.
The channel concerned is displayed, but not selected.		On CH1 and CH4, the vertical sensitivity and the vertical position are assigned to the channel selected.
The channel concerned is displayed and selected.		The channel is selected.
		The channel is cancelled by double-pressing.



A long press on one of the keys **CHx** causes a **vertical autoselect**:

- This modifies the sensitivity and vertical positioning of the channel in question.
- It optimizes the display on the screen by activating and selecting the channel.

The channel is displayed and selected.

Oscilloscope Mode (cont'd)



Activates or deactivates **horizontal splitting** of the display zone.

When activated, the "Full Trace" function is indicated by:

- the presence of a continuous horizontal line in the middle of the display area
- horizontal splitting of the graticule.

After activation of the function:

- traces 1 and 3 are assigned to the upper part of the display,
- traces 2 and 4 are assigned to the lower part in order to prevent overlays.

The traces can then be moved vertically in the two zones.




This function can also be used in "full screen" mode.



Successive presses allow selection of the **input coupling** (AC, DC or GND) for the last channel selected.

The coupling is indicated in the channel parameters area:

AC : 

DC : 

GND : 



Adjustment of the vertical **sensitivity** of the last channel selected:



increases the vertical sensitivity, while



reduces it.



Adjustment of the vertical **position** of the last channel selected:



moves it downwards, while

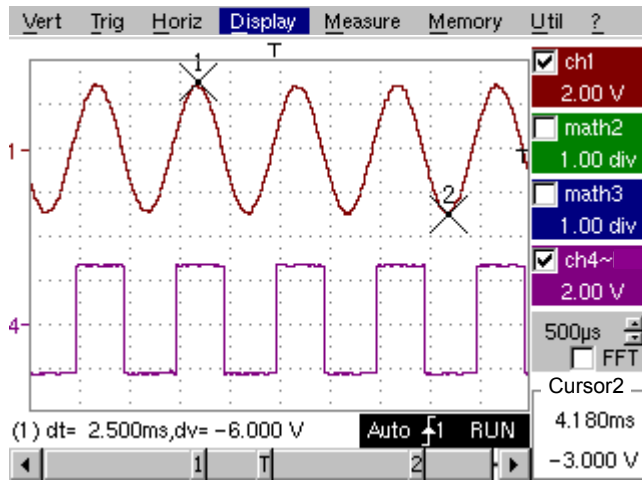


moves it upwards.

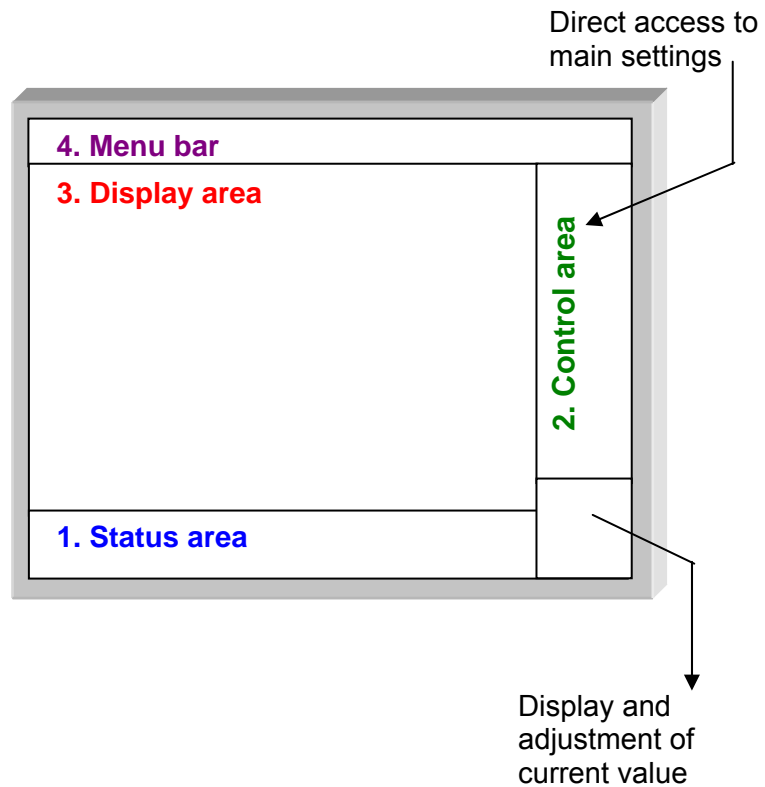
Oscilloscope Mode (cont'd)

Display

Display



Composition The oscilloscope display is divided into 4 functional zones.

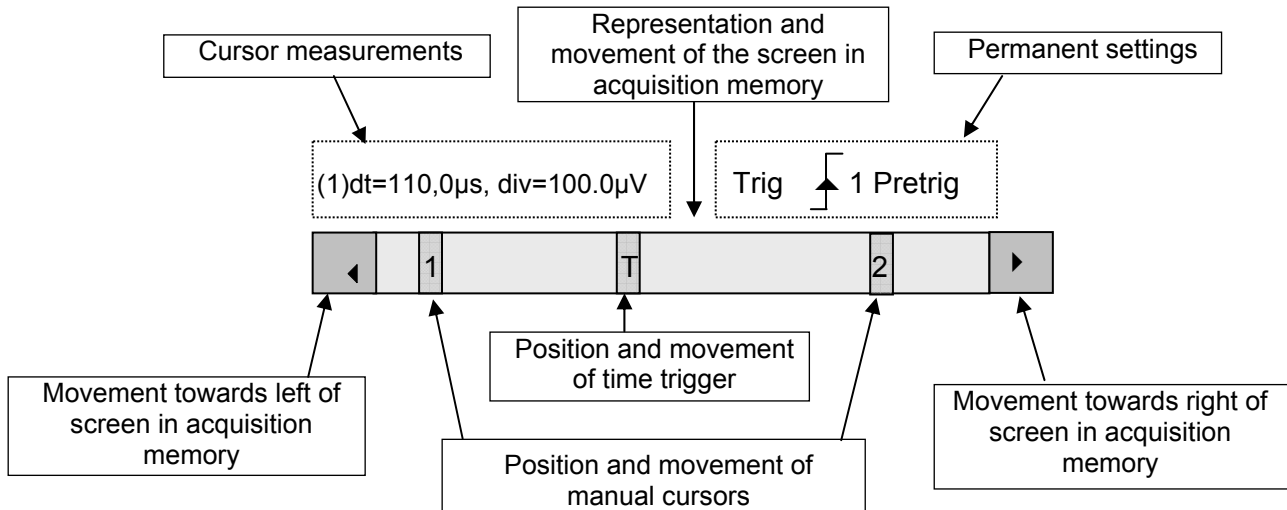


Oscilloscope Mode (cont'd)

1. **Status area** Three types of general information appear in this area:

- The **bargraph** representing the screen position, the trigger and the cursors in the acquisition memory.
- The instrument permanent **settings**.
- The **measurements**, when the cursors are present on the screen.

Bargraph



Each element in the bargraph can be moved with the stylus.

Permanent settings

This zone refers to the trigger status (mode, edge, source, current status).

Example: AUTO  1 STOP



When the stylus is placed on this information, the "Trigger Parameters" menu can be opened by pressing twice.

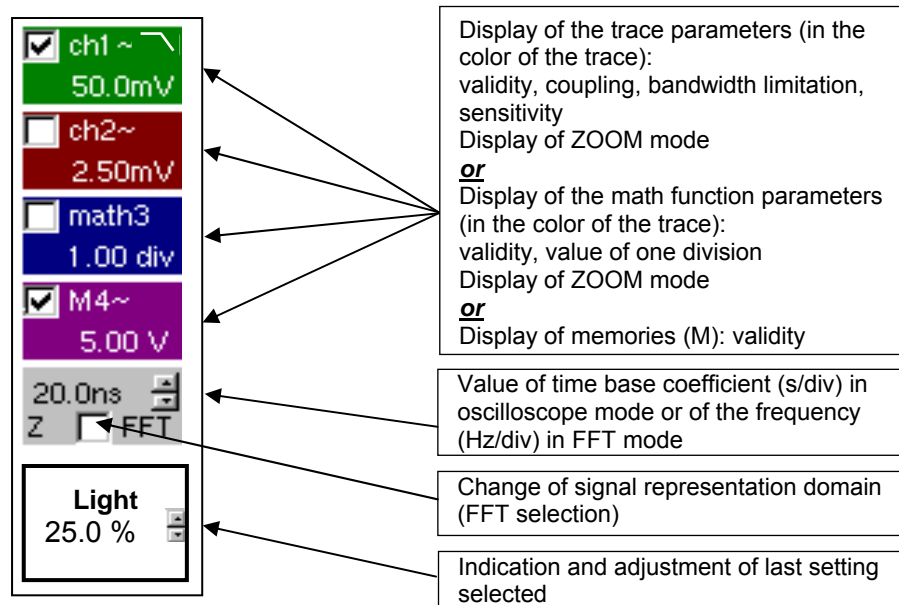
Cursor measurements

This zone refers either to:

- the horizontal (dt) and vertical (dv) differences between 2 cursors in the case of manual measurements
 - Example: (1) dt = 110.0 µs, div = 100.0 µV
- phase measurement in the case of manual phase measurement (Ph).
 - Example: (1) Ph = 200.0°
- the automatic measurements selected using the "Automatic Measurements" or "Phase measurement" menus
 - Example: (2) F = 1.0000 kHz, Vpp = 7500 V

Oscilloscope Mode (cont'd)

- 2. Control area** The parameters displayed in this area are:
- The parameters of each channel and trace: display, sensitivity, coupling, bandwidth limitation, vertical scale, function, Zoom.
 - The time base value, the presence of a Zoom and a change in the signal representation domain (FFT).
 - Active adjustment of the last selected element:
 - trigger level
 - trigger time position
 - channel offset value
 - X & Y position of cursor
 - *Time display, if no measurement has been selected.*
 - *Display of the battery status.*
 - *A mains socket if the instrument is connected to the Wall Plug.*

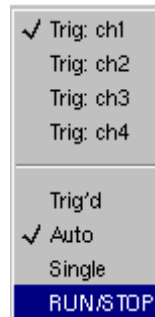


- *The channels and functions can be validated using the stylus or the keys.*
- *The "✓" symbol indicates whether a channel or function is selected, or whether FFT mode is selected.*
- *The settings of the time base (or the frequency) and the value of the active parameter can be modified using the UP/DOWN button next to the display of the current value.*
- *After modification of the time base, the corresponding sampling frequency is indicated in the settings area.*
- *A double press on the parameters or a channel or on the value of the time base directly opens the associated menus:*
 - *Sensitivity/Coupling and Vertical Scale, for the channels*
 - *Vertical scale for the functions*
 - *Source, trigger mode and RUN/STOP, for the time base.*

Oscilloscope Mode (cont'd)



The grouped "Source" and "Trigger Mode" menus can be opened by a double press with the stylus on the time base area.



RUN/STOP starts and stops acquisition from this menu. The acquisition status is indicated in the status area on the screen.



The symbol "✓" indicates the source and trigger mode selected.

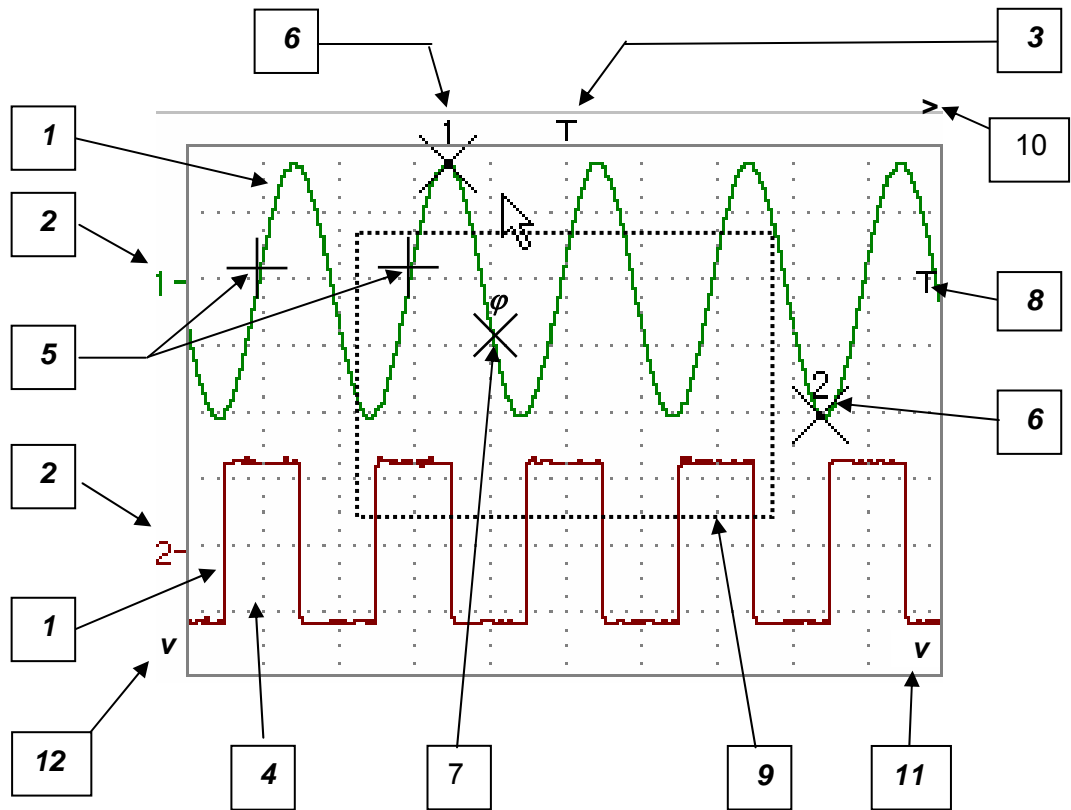
3. Display area

The graphic elements displayed associated with the traces in this area are:

- a trigger time position indicator
- a trigger level indicator
- a trace number identifier
- a vertical position indicator for the reference level of each trace
- cursor position indicators linked to the trace for the automatic automatic measurements
- position indicators regarding the cursors linked or not to the trace for manual measurements
- selection of a zoom zone

Oscilloscope Mode (cont'd)

Display elements

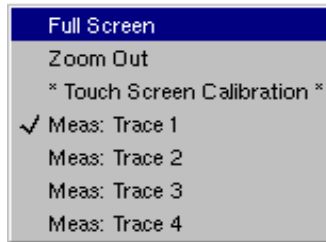


Definition of display

Refs.	Elements selectable using the touch-sensitive pad
1	Trace displayed
2	Vertical position indicator of the reference level of the trace displayed and identification of the trace number
3	Indication of Trigger time position
4	Division of graticule
5	Position indicator of the cursors for the first automatic measurement
6	Manual measurement cursor position indicator
7	Phase measurement cursor position indicator
8	Trigger level and coupling on the trigger position indicator
9	Selection of a zoom zone
10	Indicator of trigger time position overshoot outside the display window
11	Indicator of trigger level position overshoot outside the display window.
12	Indicator of channel level overshoot outside the display window.

Oscilloscope Mode (cont'd)

*Menu accessible
from display area*



By double tapping with the stylus in the display area, the menu concerning the display can be opened directly.

The "Full Screen" and "Zoom Out" options are directly accessible (see §. Display Menu). The same applies to the selection of the automatic and manual measurement reference signal (see §. Measure Menu).

It is possible to use the stylus to **zoom** in the display area by pulling a rectangle.

After zooming in on part of the screen, the sensitivities of the traces and the time base are recalculated.

- The symbol "**Z**" appears in the signal and time base parameters display.
- The zoomed section is represented in the bargraph.
- The "Zoom Out" menu (see §. Display Menu) or the Zoom key can be used to return to the original display.
- The value of the horizontal zoom is adjusted to assign a calibrated value to the horizontal scale (zoom factor: x 5 max.)
- If the vertical selection of the zoom is greater than 6 divisions, no vertical zoom is performed (zoom factor: x 16 max.).

All the symbols present in the display area:

- trigger indicators,
- trace position indicator,
- manual cursor position indicator,
- etc.

can be moved using the stylus.



The new modified symbol value is indicated in the current settings display area.

Calibration of the touch-screen

To optimize selection of the different elements present in the display area using the stylus, calibration of the touch-sensitive screen may prove necessary.

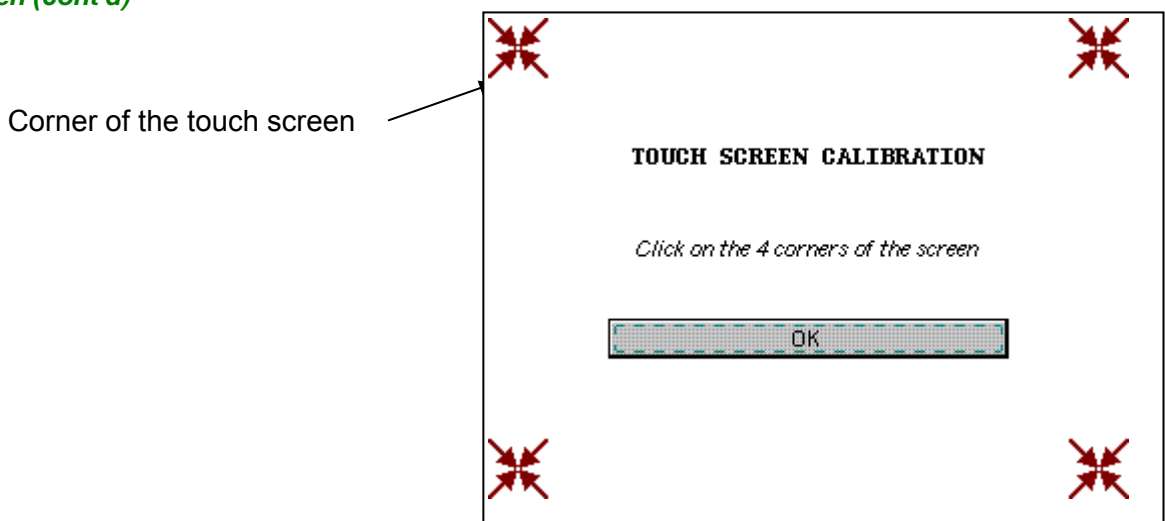
Select the "Touch Screen Calibration" option proposed in the display area menu or in the Util menu.

By double tapping on the curves zone, you can also access touch-screen calibration.

Oscilloscope Mode (cont'd)

Calibration of the touch-sensitive screen (cont'd)

Follow the instructions on the screen.



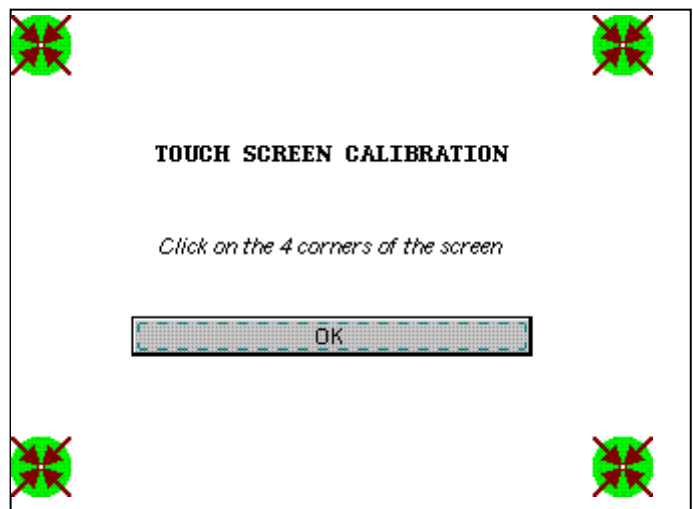
Use the stylus to point at the centre of the 4 patterns displayed on the screen.

Validation of the input is indicated by modification of the pattern.



The pointing order is not important.

Once the 4 inputs have been recorded, validate the calibration with **OK**.



The touch-sensitive screen is calibrated and the display returns to normal mode.

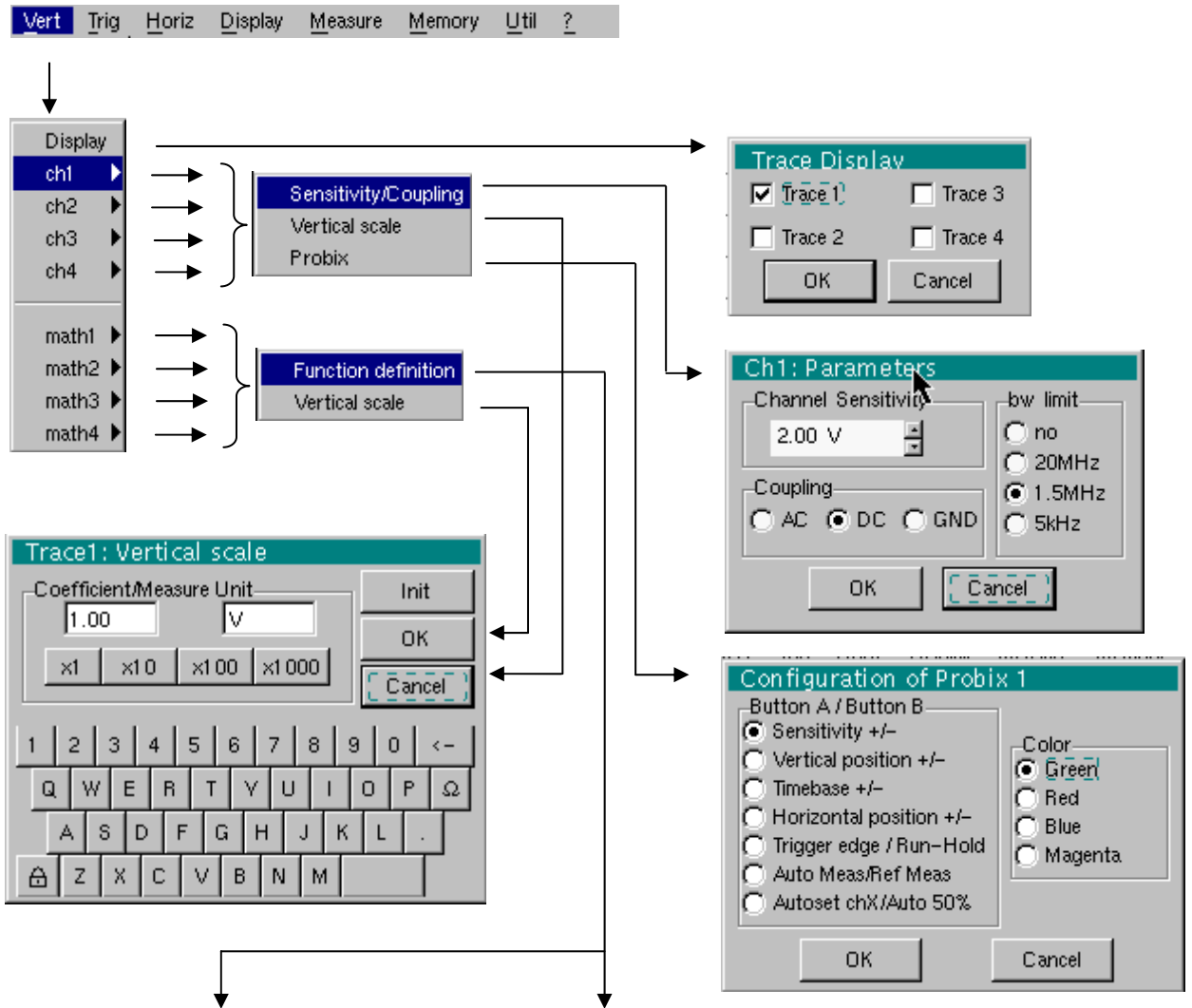
4. Menu bar



All the oscilloscope functions can be accessed via the main menus.

Oscilloscope Mode (cont'd)

The "Vert" Menu



≠ Advanced mode

Advanced mode

Math2: definition

-ch1 ch4 - ch1
 -ch4 ch1 * ch4
 ch1 + ch4 ch1 / ch4
 ch1 - ch4 ch4 / ch1

amplitude

/5 /2 x1 x2 x5

OK Cancel RESET

Math1: definition

$(\sin(\pi t/\text{divh}(2)) + \sin(3\pi t/\text{divh}(2)))/3 + \sin(5\pi t/\text{divh}(2))/5 + \sin(7\pi t/\text{divh}(2))/7 * \text{divv}(4)$

Files

C1MULC2.FCT
SQUARE.FCT

Functions

divh(

divv(
 step(
 sin(
 cos(
 exp(
 log(
 sqrt(

OK Cancel Save RESET

Oscilloscope Mode (cont'd)

Display

Opens the "Trace display" menu for validating or devalidating the traces.

Validation of the selections by "**OK**". Exit from the menu without modification by "**Cancel**".

The "✓" symbol in front of a trace indicates that it has been validated.



The traces can be validated or devalidated from the control area by using the stylus.

ch1 ch2 ch3 ch4

Modify the parameters of channels ch1, ch2, ch3 and ch4 independently, as well as the vertical scale of the trace selected.

Sensitivity / Coupling

Modifies the parameters of the selected channel.

Channel Sensitivity

Modification of the channel's sensitivity using the stylus on the scrollbar, adjustable by sequence: from 2.5 mV to 200 V/div.



The sensitivity is indicated in the channel parameter display area. It takes into consideration the parameters of the "Vertical scale" menu.

Coupling

Modification of **AC - DC - GND** coupling

AC: blocks the DC component of the input signal and attenuates the signals below 10 Hz

DC: transmits AC and DC components of the input signal

GND: internally, the instrument links the input of the channel selected to a 0 V reference level.




The "⊙" symbol indicates the coupling selected. Coupling is indicated in the modified channel's parameter display area.


bw limit


Limits the bandwidth of the channel and its trigger circuit to reduce display noise and false triggering.



The bandwidth of each channel can be limited to 5 kHz, 1.5 MHz or 20 MHz. The bandwidth limit of a channel is indicated in the control area by following symbols :

 20 MHz

 1.5 MHz

 5 kHz



This menu can also be called up by double-tapping with the stylus on the required channel parameter display area.


Vertical scale

Defines the vertical scale of the channel selected on the basis of the current settings. Readings of the direct measurements of the value analyzed and its unit are provided.

Coefficient

Assignment of a multiplication coefficient to the selected channel's sensitivity.

This can be modified with the stylus, using the table of usable numbers, after selecting the "Coefficient" zone.

The  key deletes the character preceding the cursor in this area.

The predefined values (x1, x10, x100, x1000) correspond to standard probe coefficients and can be assigned directly.




The sensitivity value indicated in the channel parameter display will be modified according to this coefficient.

Oscilloscope Mode (cont'd)

Measurement unit

Modification of the selected channel's vertical scale unit.

The modification is performed by means of the stylus, using the table of usable characters after selecting the "measure unit" zone.

The  key deletes the character preceding the cursor in this area.



The vertical scale unit will be indicated in the modified channel's parameter display.

Init

Reinitializes the multiplication coefficient to 1.00 and returns to the V measurement unit.

Validation of the selections by "OK". Exit from the menu without modification by "Cancel".



This menu can also be called up by double-pressing with the stylus on the required channel's parameter display area (CH1, CH2, CH3 or CH4).

Probix

When selected, this opens the "Probe Configuration" menu.

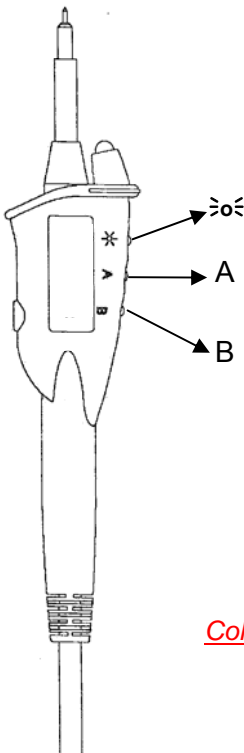
When a **Probix** HX0030 (or HX0034) probe is connected to one of the oscilloscope's inputs, this menu becomes active.



>o< button

Can be used to switch the LED on or off.

Buttons A and B

Can be assigned to different settings (see table below).



	Button A	Button B
Sensitivity	Higher sensitivity	Lower sensitivity
Vertical/horizontal alignment	Alignment on higher division	Alignment on lower division
Time base	Higher time base	Lower time base
Trig. edge / Run-Hold	 	RUN HOLD
Auto Meas. Ref. Meas.	AUTO MEAS. CHx	REF MEAS.
Autoset CHx / Auto 50 %	Auto CHx	AUTO 50 % CHx

- See the chapter on "The Keys" for further details on the function provided.
- The modified parameters are updated in the control area.
- The "⊙" symbol indicates the parameters elected and assigned to the probe.

Color

modifies the color that you want to assign to the trace.

- The "⊙" symbol indicates the color selected.
- These parameters will be memorized in the probe, even after disconnection of the oscilloscope.



When using Probix adapters, the choice of the color remains possible.

Oscilloscope Mode (cont'd)

math1 math2
math3 math4

For each trace, definition of a mathematical function and the vertical scale.


If "Advanced" mode is not activated, simple functions (Inversion, Addition, Subtraction, Multiplication and Division of curves) can be selected and linked to the curves 1 or 2.

Function definition

In "Advanced" mode, mathematical functions can be defined literally. The mathematical function can be defined on 2 lines.



- The mathematical function can be defined on 2 lines.
- *mathx* cannot be used in the definition of a function.

The  key deletes the character preceding the cursor in the window.

Functions

8 predefined mathematical functions can be linked to the traces:

divh(("horizontal division")
divv(("vertical division")
step(("step") using "t" (*)
sin(("sine")
cos(("cosine")
exp(("exponential")
log(("logarithmic")
sqrt(("square root")

(*) t = abscissa of the sample in the acquisition memory.



divh(1) is equivalent to 250 samples (counts) = 1 horizontal division (or 5000 samples if the EXTENDED ACQUISITION MEMORY option is installed).

Validation of the selections by "OK". Exit from the menu without modification by "Cancel".

If ...	then ...
... the dynamic calculation of the vertical scale is impossible	... a message indicates that the measuring unit on this function will be vertical division (div).
... the dynamic calculation of the vertical scale is possible	... it takes into account of the sensitivities of the channel sources.



Particular cases: Value of the measuring unit

CHx + CHy Sensitivity and measuring unit used on CHx

CHx - CHy Sensitivity and measuring unit used on CHx

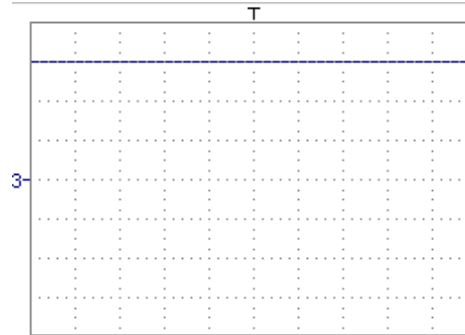
In each cases, the measuring unit can be re-defined and a coefficient can be applied to the measurement results (refer to §. Vertical scale).

Oscilloscope Mode (cont'd)

Examples

Use of predefined mathematical functions

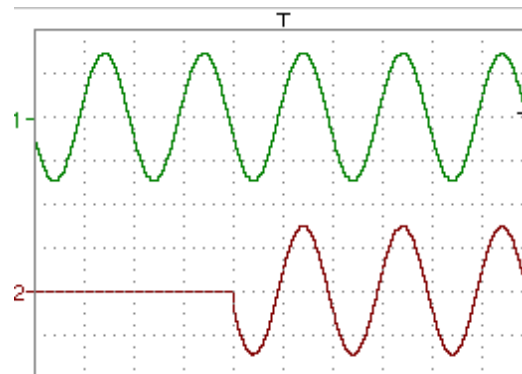
- Predefined divv() function used on its own: $\text{math3} = \text{divv}(3)$.



The trace is equal to 3 vertical divisions.

- Predefined step() function associated with a trace:

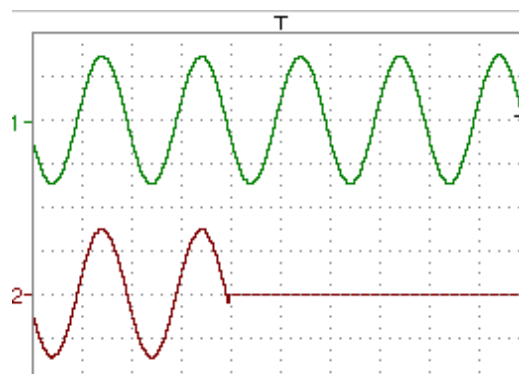
- $\text{math2} = \text{ch1} * \text{step}(t - \text{divh}(4))$



The result of math2 is 0 vertical divisions as long as t is less than four horizontal divisions ($t - \text{divh}(4) < 0$).

The result of math2 is equal to ch1 when t becomes greater than four horizontal divisions ($t - \text{divh}(4) > 0$).

- $\text{math2} = \text{ch1} * \text{step}(\text{divh}(4) - t)$

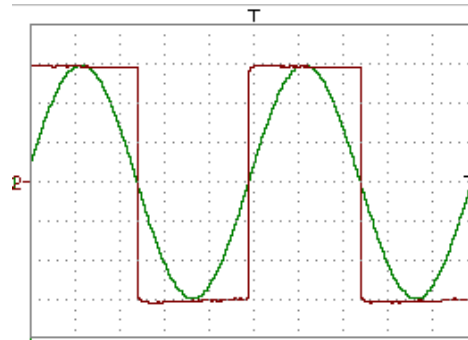


The result of math2 is equal to ch1 as long as t is less than four horizontal divisions ($t - \text{divh}(4) > 0$).

the result of math2 is at 0 vertical divisions when t becomes greater than four horizontal divisions ($t - \text{divh}(4) < 0$).

Oscilloscope Mode (cont'd)

Example 1
Addition of two traces



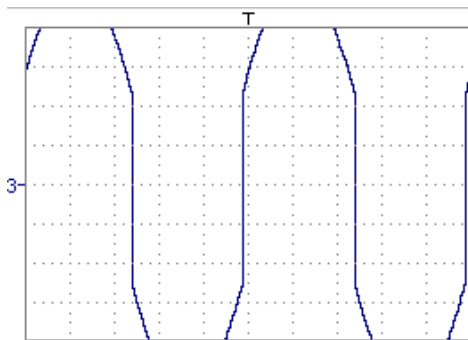
Vhigh

Vpp(ch1) = Vpp(ch2) = 6 V
 Sensitivity (ch1) = 1 V/div
 Sensitivity (ch2) = 1 V/div

Traces ch1 and ch2 are optimized on 6 vertical divisions.

Vamp ch1 = 6 vertical divisions
 Vamp ch2 = 6 vertical divisions

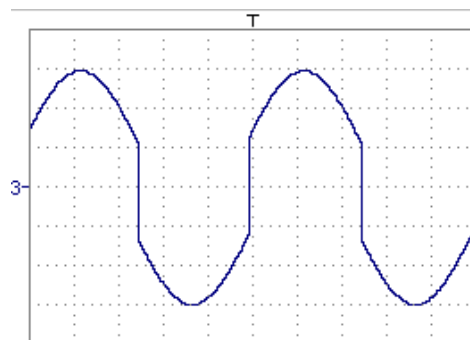
- math3 = ch1+ch2



Vertical scale math3 = 2.00 div
 Vpp math3 = 12.00 div
 Vhigh math3 = 6.00 div

There is a high and low overshoot, so division by 2 is necessary to optimize display of the result.

- math3 = (ch1+ch2) / 2



Vertical scale math3 = 2.00 div
 Vpp math3 = 12.00 div
 Vhigh math3 = 6.00 div

Division by two adjusts the addition to the dynamics of the screen.

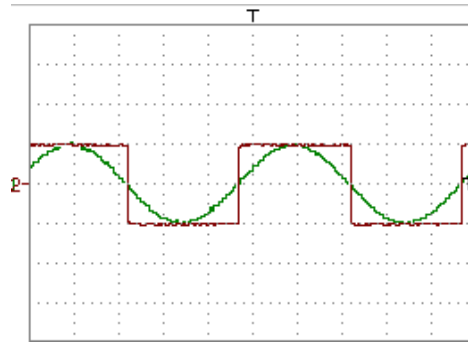
Vamp math3 = 6 vertical divisions

The measuring unit and the sensitivity of ch1 are used during the display of measurements.

You can then open the menu "Vertical Scale" of math3 (see §. Opening from math3, math4) to assign a coefficient to the result and to modify the measuring unit.

Oscilloscope Mode (cont'd)

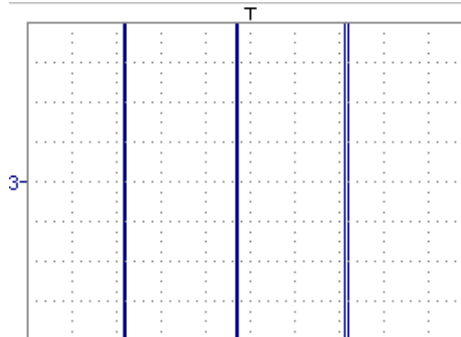
Example 2
Multiplication of two traces



Sensitivity(ch1) = 5 V/div
 Sensitivity(ch2) = 5 V/div
 Vamp(ch1) = Vamp(ch2) = 10 V

Vamp ch1 = 2 vertical divisions
 Vamp ch2 = 2 vertical divisions

- math3 = ch1*ch2

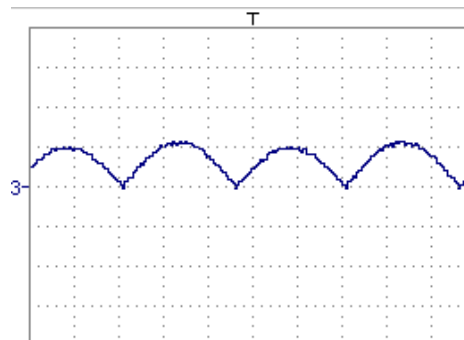


As for the addition of traces, there is an even more significant high and low overshoot.

The overshoot is due to the increased dynamics of the numbers after a multiplication ; to avoid this and standardize the result, use the divv () function.

Example: If Amplitude on CH1 = 2 divv and Amplitude on CH2 = 2 divv, the following function is used to get an amplitude of 1 divv :

$$\text{math3} = (\text{ch1} * \text{ch2}) / \text{divv} (1)$$



The result of the multiplication is translated into divisions on the screen.

- ☞ - If Vamp ch1 = 8 div and Vamp ch2 = 8 div, the result must be divided by divv(4) to obtain Vamp math3 = 4 div.
- When mathematical functions associated with traces are used, the dynamics of the result obtained must be verified.

Correction of the result of the operations by mathematical functions (divv(), divh(), / ...) is recommended to optimize the screen display.

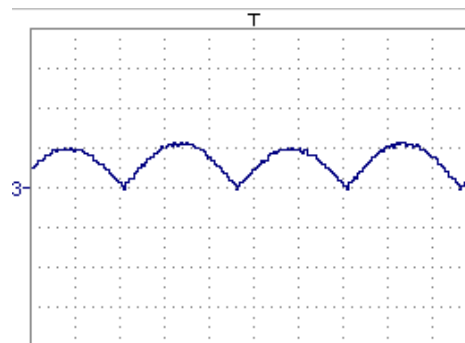
Oscilloscope Mode (cont'd)

You can then open the menu "Vertical Scale" of math3 (see §. Opening from math3, math4) to assign a coefficient to the result and to modify the measuring unit.

In our example:

- Then select math3 as the reference for the automatic and manual measurements (see §. "MEASURE" Menu).
- Then display the table of 19 measurements made on the math3 trace math3 (see §. "MEASURE" Menu).

The measurements displayed are the exact result of the multiplication of the two traces ch1 and ch2 in the unit (V).



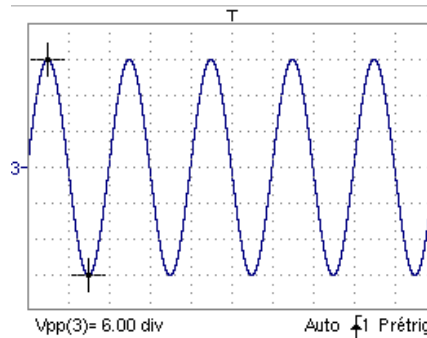
Sensitivity(math3) = 25 VV
Vpp (math3) = 25 VV

Oscilloscope Mode (cont'd)

Example 3

Association of predefined functions

- math3 = divv(3)*sin (2*pi*t/500) (*)



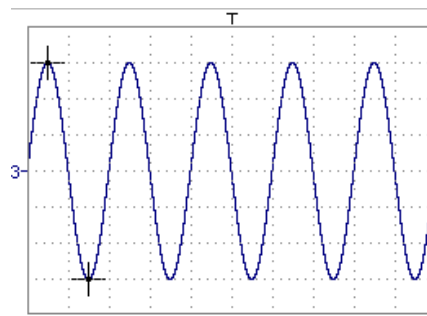
The trace obtained is a sine-curve produced using the predefined function "sin()".

The amplitude is 6 divisions.

The period equal to 500 samples (**) (2 horizontal divisions) depends on the time base.

- Same trace produced with the predefined divh() function:

math3 = divv(3)*sin(2*pi*t/divh(2))

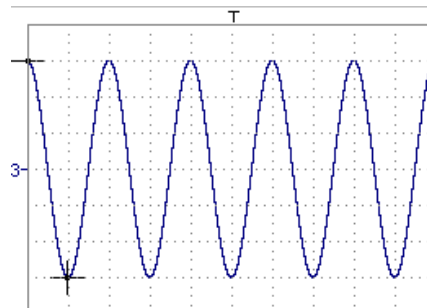


In this example, divh(2) is equivalent to 500 samples (**).

The period divh(2), equal to 500 samples (**) (2 horizontal divisions), depends on the time base.

- Production of a sine wave by the predefined cos() function:

math3 = divv(3)*cos(2*pi*t/divh(2))



The trace obtained with the predefined cos() function is offset by 90°.

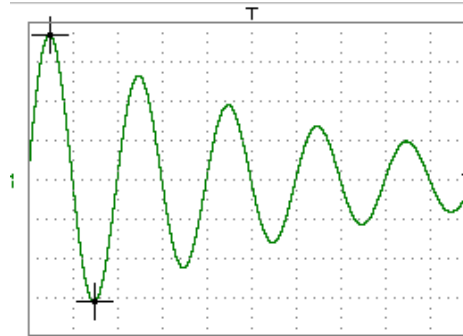
(*) math3 = div(3) **sin** (2pi*t / 10,000) if EXTENDED ACQUISITION MEMORY option is installed.

(**) 10,000 samples with EXTENDED ACQUISITION MEMORY option

Oscilloscope Mode (cont'd)

Production of an attenuated sine wave using predefined functions

math1 = sin (pi*t/divh(1))*exp(-t/divh(6))*divv(4)



"sin (pi*t/divh(1))" can be used to modify the number of periods.
"exp (-t/divh(6))" can be used to modify the level of attenuation.

Oscilloscope Mode (cont'd)

Function definition (cont'd)

Files

Contains the list of the functions (.FCT) saved by the user, along with two predefined files.

By selecting the name of the function with the stylus (function name in blue), you can transfer the definition of the function into the 2 lines provided for that purpose.

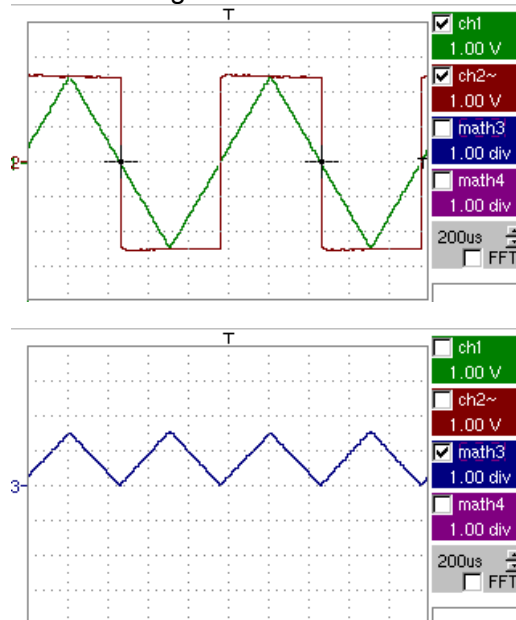
The scroll bar can be used to scroll through the list of memorized functions.

The function can be modified with the table of usable characters, associating the ch1 and ch2 traces.

This menu also contains two predefined functions.

C1MULC2.FCT and SQUARE.FCT

C1MULC2 .FCT Product of 2 traces with scaling:



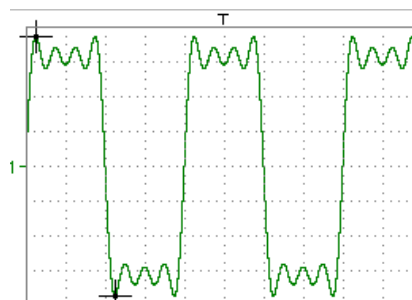
$$\text{math3} = \text{ch1} * \text{ch2} / \text{divv}(4) = \text{C1MULC2.FCT}$$



The factor $\text{divv}(4)$ is used to optimize the display as long as the source signals have sufficient dynamics (> 6 divisions) and no overshooting.

SQUARE .FCT

Definition of a square signal using the first 4 harmonics of a Fourier series development.



$$\text{math3} = \text{SQUARE.FCT}$$

$$\text{math3} = (\sin(\pi * t / \text{divh}(2)) + \sin(3 * \pi * t / \text{divh}(2)) / 3 + \sin(5 * \pi * t / \text{divh}(2)) / 5 + \sin(7 * \pi * t / \text{divh}(2)) / 7) * \text{divv}(4)$$

Oscilloscope Mode (cont'd)

Save Saves the definition of the function using the "File Copy " menu (see §. Memory Menu). The file is assigned the suffix .FCT and appears in the list of saved files.

Reset Completely resets the function definition.



After assigning a function to the ch1 (math1), ch2 (math2), ch3 (math3) or ch4 (math4) channels, "mathx" appears in the corresponding channel's parameter display area.

Vertical scale



Definition of the vertical scale for the selected trace

Calling this menu from math1 to math4 is identical to calling ch1 to ch4 as long as the functions have not been defined.


Opening of the menu from:

math1 math2
math3 math4

Coefficient

Modifies the value of a division (div) in the selected trace.

This can be modified with the stylus, using the table of usable numbers, after selecting the "Coefficient" zone.

The  key deletes the character preceding the cursor in this area.

The predefined values (x1, x10, x100, x1000) correspond to standard probe coefficients and can be assigned directly.




The value of a division will be entered into the display of the modified trace parameters.

Measurement unit

Modification of the unit of the vertical scale (div) for the selected trace.

This can be modified with the stylus, using the table of usable numbers, after selecting the measurement unit zone.

The  key deletes the character preceding the cursor in this area.

The "🔍" key can be used to switch between upper case and lower-case characters.



The vertical scale unit will be entered into the modified trace's parameter display (3 characters max).

Init

Reinitialization of the multiplication coefficient to 1.000 and return to the V measurement unit.

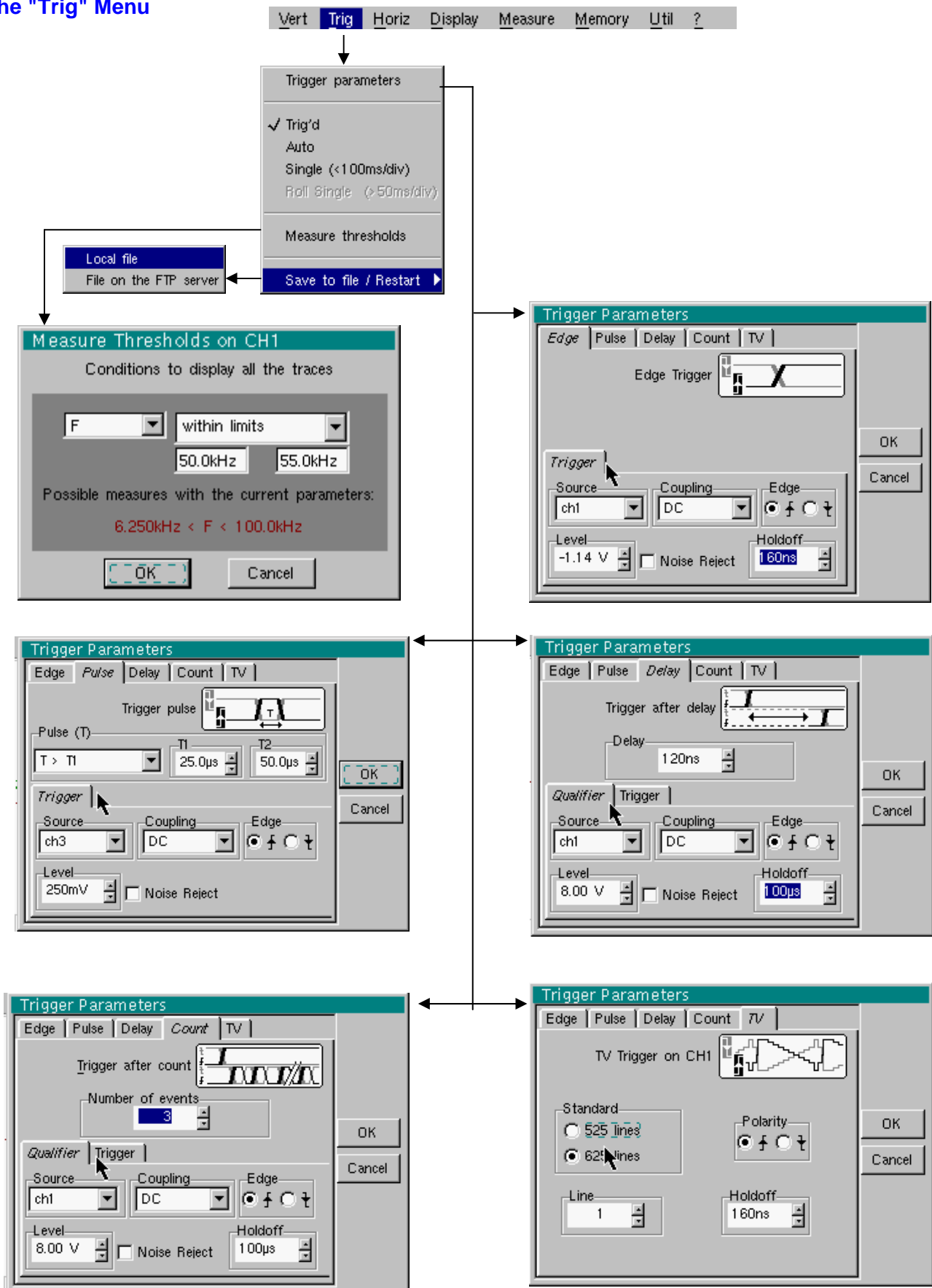
Validation of the selections by "OK". Exit from the menu without modification by "Cancel".



The "Vertical scale" menu can also be called up by double pressing with the stylus in the parameter display of the required trace (math1 to math4).

Oscilloscope Mode (cont'd)

The "Trig" Menu



Oscilloscope Mode (cont'd)

Definition

This range of portable oscilloscopes is equipped with "advanced triggers".

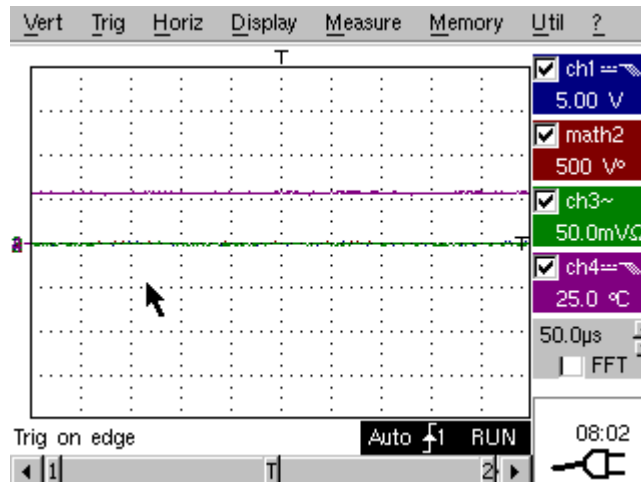
- The "**Delay**" and "**Count**" trigger modes require parameterization of a second "auxiliary" trigger source. The auxiliary source may be the same as the main source.

The trigger choice is validated by exiting from the menu.

If ...	then ...
... the user exits from the " Main " tab,	... " Main " triggering is used.
... the user exits from the " Pulse " tab,	... " Pulse " triggering is used.
etc.	etc.



- *There is only one Holdoff, although it can be programmed from the "Main", "Delay", "Count" or "TV" tabs.
When you use "Delay" or "Count", the Holdoff applies to the auxiliary source, i.e. the source of the count pulses or delay trigger pulses.
In the other cases, Holdoff applies to the main trigger source.*
- *Each trigger source has its own specific attributes: Coupling, Level, Edge, Noise Reject, Filter.*



You can also choose the trigger channel by double-tapping with the stylus in the time base display area.

You can also choose the trigger parameters by double-tapping with the stylus in the display area of the trigger parameters.

Oscilloscope Mode (cont'd)

Parameters

Selection of the "Trigger Parameters".

Main Trigger on edge

Source selects a channel as a trigger source.

Coupling Selection of the **filter** for the main trigger source:

AC AC coupling (10 Hz to 200 MHz):
blocks the DC component of the signal

DC DC coupling (0 to 200 MHz):
allows the entire signal through


LF Reject Rejection of source signal frequencies < 10 kHz:
facilitates observation of signals with a DC
component or an unwanted low frequency


HF Reject Rejection of source signal frequencies > 10 kHz:
facilitates observation of signals with high-frequency
noise.

The symbol used to indicate the curve trigger level on the curve also indicates the coupling:

	DC
	AC
	LF Reject
	HF Reject

Edge Selection of the trigger gradient:

+ ascending trigger edge 

- descending trigger edge 

The selected trigger edge is indicated in the status area.

Level 2.04V Adjustment of the trigger level with the stylus on the scroll bar.



The trigger level is entered into the current value display area after modification. Fine adjustment is possible.

Noise reject **No:** hysteresis \approx 0.5 div.

Yes: introduces a hysteresis of \approx 1.5 div.

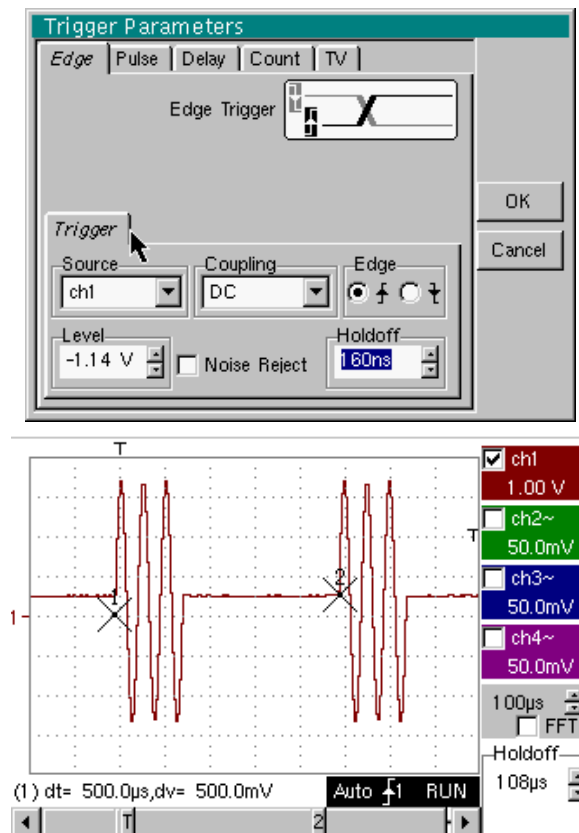
Holdoff 108 μ s allows:

- disabling of the trigger for a predefined period
- stabilization of the trigger on pulse trains.

Double-tapping in this field displays a virtual numeric keypad which can be used to directly input the value.

Oscilloscope Mode (cont'd)

- Example Signal injected on CH1: a train of three 6 VDC pulses at a frequency of 20 kHz with a 500 mVDC component, separated by 500 μ s.



The trigger is regulated with channel 1 as a source, level at 2.04 V, on a rising edge.

The Holdoff stabilizes the signal by inhibiting the trigger during 108 μ s.

The DC coupling of the trigger lets the whole signal through.



In this example, the signal is not being disturbed and the option of noise reject is not necessary.







The DC coupling of ch1 reveals the continuous component of the signal.

Oscilloscope Mode (cont'd)

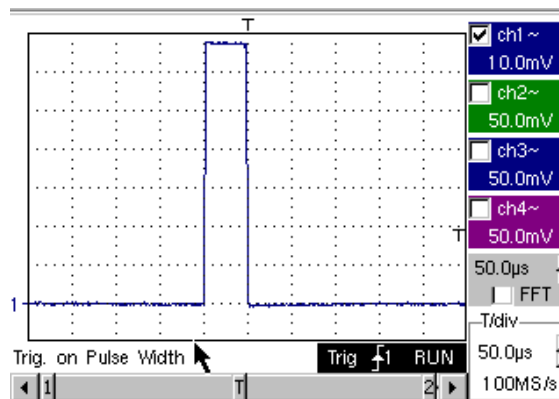
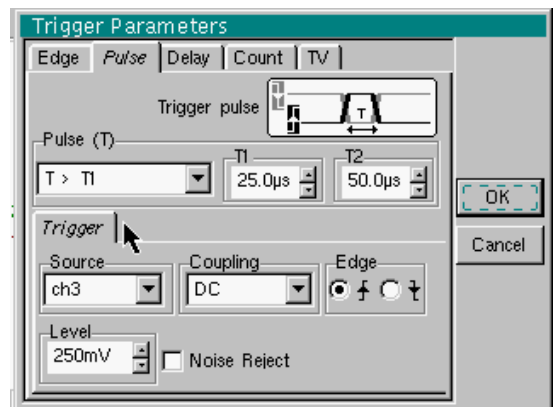
- Pulse** Trigger selection on pulse width.
In all cases the effective triggering occurs on the end of pulse edge.
- $t > T1$ triggers if pulse duration is greater than specified value $T1$
 - $t < T2$ triggers if pulse duration is less than specified value $T1$
 - $t > T1$ and $t < T2$ triggers if pulse duration is within interval specified by values $T1$ and $T2$
 - $t < T1$ or $t > T2$ triggers if pulse duration is outside interval specified by values $T1$ and $T2$



The choice of the  or  edge in the "Main" tab defines the limits of the analysis:

- edge  defines a pulse between  and 
- edge  defines a pulse between  and 

 **Example** Signal injected on CH1: 1 pulse of 50 μ s (repetitive or not)



The oscilloscope triggers when it sees a pulse whose duration is greater than specified value (25.0 μ s + tolerance). The trigger occurs on the trailing edge of the pulse.

The trigger occurs on the ascending edge of the pulse, but is effective on the trailing edge.

Oscilloscope Mode (cont'd)

Delay Selection of edge trigger with delay.
The delay is triggered by the auxiliary source.
Effective triggering occurs after the end of the delay on the next event from the main source.

Trigger delay Adjustment with the stylus using the setting scroll bar to choose the required delay value.

Double-tapping in this field displays a virtual numeric keypad which can be used to directly input the value.

Holdoff Adjustment with the stylus using the setting scroll bar, allows disabling of the trigger for a predefined period and, among other things, stabilization of the trigger on pulse trains.

Double-tapping in this field displays a virtual numeric keypad which can be used to directly input the value.

Qualifier selects the settings on the qualifier source.

Trigger selects the settings on the trigger source.

Coupling selects the filter for the auxiliary trigger source:

AC AC coupling (10 Hz to 200 MHz):
blocks the DC component of the signal

DC DC coupling (0 to 200 MHz):
allows the entire signal through

LF Reject Rejection of source signal frequencies < 10 kHz:
facilitates observation of signals with a DC component or an unwanted low frequency

HF Reject Rejection of source signal frequencies > 10 kHz:
facilitates observation of signals with high-frequency noise

Level Adjustment of the trigger level with the stylus on the scroll bar.

Edge selects the edge for the auxiliary trigger source:


+ rising trigger edge 

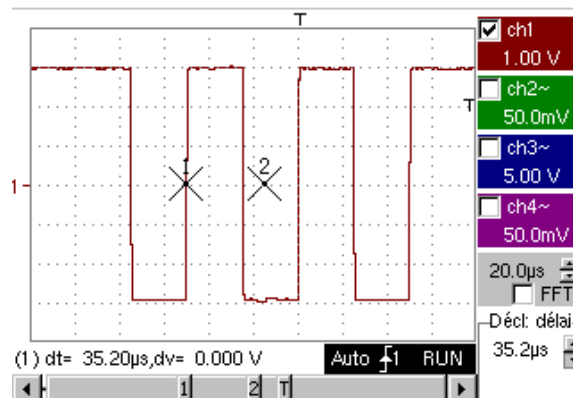
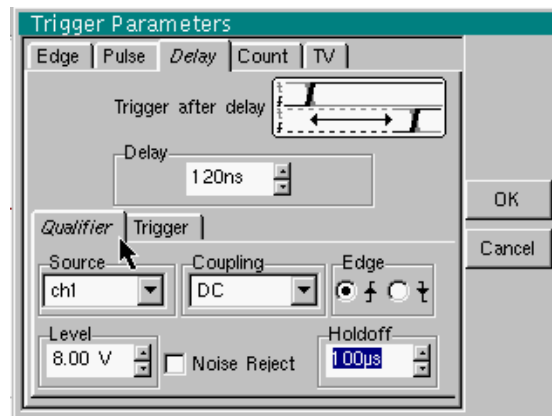
- falling trigger edge 


Noise reject **No:** hysteresis \approx 0.5 div.

Yes: introduces a hysteresis of \approx 1.5 div.

Oscilloscope Mode (cont'd)

 **Example** Signal injected on CH1: a train of three 6 VDC pulses at a frequency of 20 kHz separated by 500 μ s.



 The trigger is active after the end of the delay (35.2 μ s) on the first ascending edge.

The Holdoff stabilizes the signal by disabling the trigger for 108 μ s.

Oscilloscope Mode (cont'd)

Count Selects the edge trigger with counting of events.
The count is triggered by the auxiliary source. The main source serves as a clock for the count.
Effective triggering occurs after the end of the count on the next event from the main source.

Trigger delay Adjustment with the stylus using the setting scroll bar to choose the number of events required.

Double-tapping in this field displays a virtual numeric keypad which can be used to directly input the value.

Holdoff Adjustment with the stylus using the setting scroll bar, disabling of the trigger for a predefined period and, among other things, stabilization of the trigger on pulse trains.

Double-tapping in this field displays a virtual numeric keypad which can be used to directly input the value.

Qualifier selects the settings on the qualifier source.

Trigger selects the settings on the trigger source.

Coupling Selection of the filter for the auxiliary trigger source:


AC AC coupling (10 Hz to 200 MHz):
blocks the DC component of the signal


DC DC coupling (0 to 200 MHz):
allows the entire signal through

LF Reject Reject of source signal frequencies < 10 kHz
facilitates observation of signals with a DC component

HF Reject Rejection of source signal frequencies > 10 kHz:
facilitates observation of signals with high-frequency noise

Edge Selection of the trigger slope :

+ trigger on rising edge 


- trigger on falling edge 

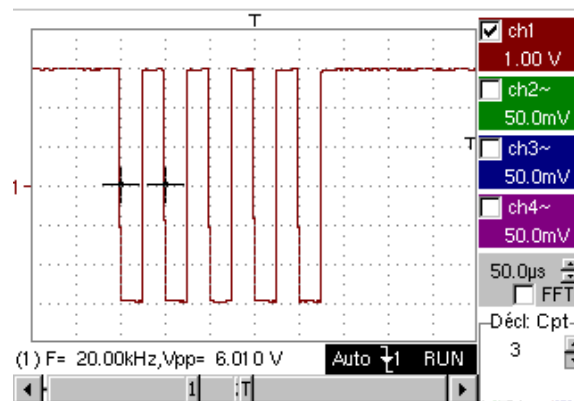
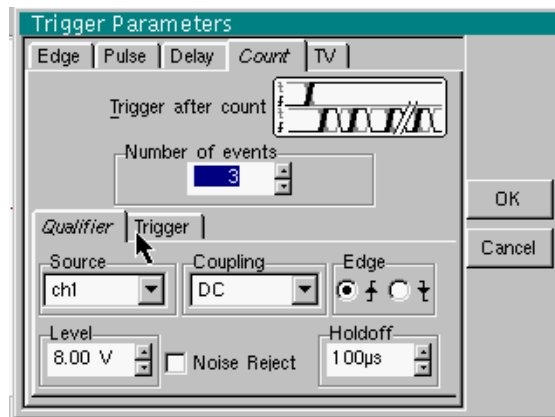
The selected trigger slope is indicated the status area.


Level Adjustment of the trigger level with the stylus on the scroll bar.

- Noise reject**
- **No:** hysteresis \approx 0.5 div.
 - **Yes:** introduces a hysteresis of \approx 1.5 div.

Oscilloscope Mode (cont'd)

 *Example* Signal injected on CH1: a train of five 6 VDC pulses at a frequency of 20 kHz separated by 500 μ s.



 *The trigger is set on the descending edge.*
The first edge activates the trigger. It is not included in the count.
The trigger is triggered on the third descending edge of the pulse train.
The Holdoff stabilizes the signal by disabling the trigger for 232 μ s.

Oscilloscope Mode (cont'd)

TV Trigger on a TV signal
 See Chapter VI - Applications: §. Video signal display.
 This menu is only applicable to the CH1 input.

Standard Trigger on a specific line number. The trigger starts on the front edge of the line synchronization signal.

- 625 lines (SECAM) or
- 525 lines (PAL)

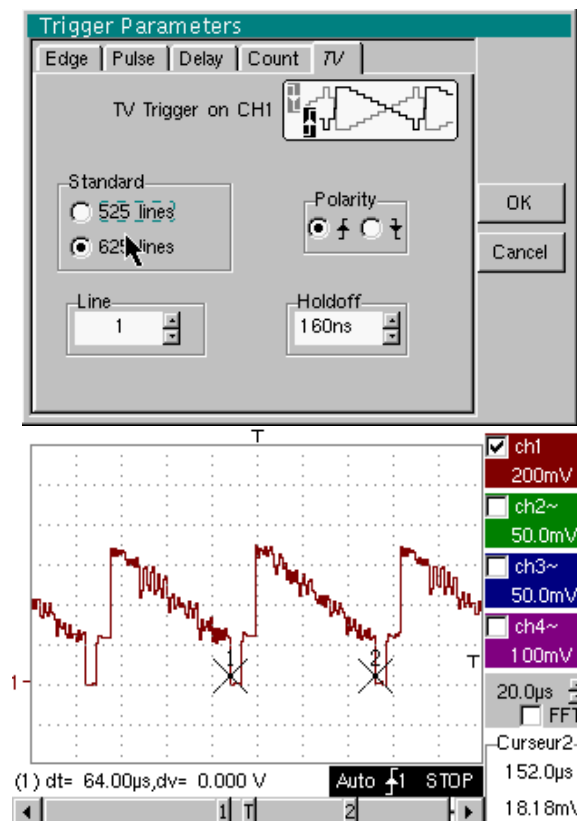
Polarity + Direct video
 - Reverse video

Holdoff Adjusted by scrolling with the stylus. Triggering impossible for a pre-defined time.

Double-tapping in this field displays a virtual numeric keypad which can be used to directly input the value.

Line **25** Adjustment of the no. with the stylus using the scroll bar.

Double-tapping in this field displays a virtual numeric keypad which can be used to directly input the value.



The "0" and "✓" symbols indicate the selected parameters.

Validation of the selections by "OK".



The "Trigger Parameters" menu can also be called up by double-pointing with the stylus in the trigger settings display area.

Oscilloscope Mode (cont'd)

Triggered mode

Acquisitions and refreshment of the screen at each trigger event.

Automatic mode

Acquisition and automatic refreshing of screen even when there is no trigger event.
Visible traces, even when there is no trigger event.

Single mode and Roll mode



Acquisition of signal and refreshing of the screen on the first trigger occurring after a trigger reset by pressing the key *opposite* (or via the time base menu).

In single-sweep mode, if the time base is over 50 ms/div, new samples are displayed as soon as they are acquired and ROLL mode is activated as soon as the acquisition memory is full (scrolling of the trace from the right to the left of the screen).

The ROLL mode is not possible if the trigger on automatic measurement threshold is active.



- The "✓" symbol indicates the selected trigger mode.
- The selected trigger mode is indicated in the status area (Trig'd, Auto, Single).
- The acquisition status is indicated in the status area: PRETRIG, RUN, STOP, POSTRIG, READY, ...



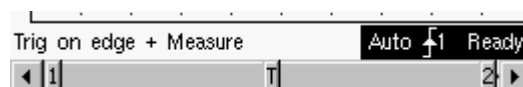
This selection can also be called up by double-pointing with the stylus on the time base display area.

Triggering on thresholds

Triggering on thresholds consists of:

1. acquisition implemented according to the conditions defined in the various menus,
2. analysing the trigger signal after classic acquisition,
3. searching for a condition on an automatic measurement,
4. if this condition is met, displaying the validated signals.

If "measurement on thresholds" is activated, the status zone at the foot of the screen indicates it.



When threshold values are input, the instrument displays an error message if the measurement of a threshold value is impossible.

Save / Restart

If this option is activated, all the traces acquired are saved to .TRC and .MAC files after each acquisition.

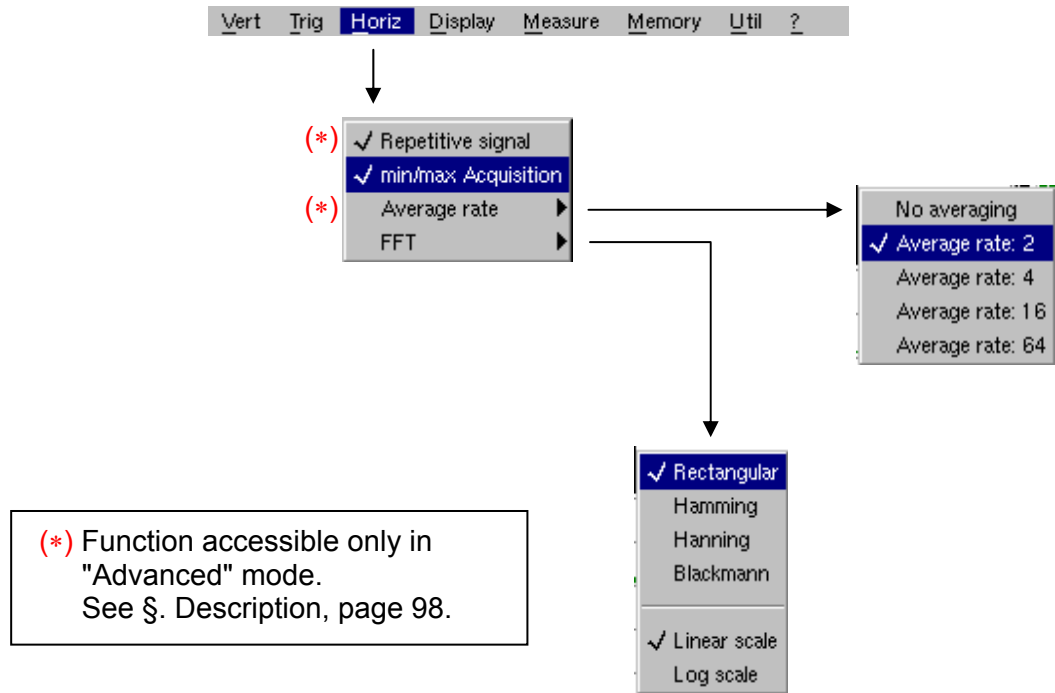
As a result, you can save several rare events to the file system and analyse them later.

The channels are saved in files, the name of which is determined according to the date and time they are saved.

They can be saved on an FTP server or in the local file system if the FTP server parameters have been configured (menu: "UTIL" → "Config I/O Ports" → "Network")

Oscilloscope Mode (cont'd)

The "Horiz" Menu



Repetitive Signal

Increase in the time definition of a trace for a periodic signal. If this option is valid, the signal can be averaged (see below).

Example: measurement on a microprocessor bus.

- For time bases of less than 100 $\mu\text{s}/\text{div}$. (without mode zoom active), the signal displayed is reconstituted on the basis of several acquisitions. The time resolution can reach 20 μs .
- If the signal is not repetitive, do not use this option. The time resolution will then be $\pm 1 \text{ ns}$.

Menu present only in "Advanced" mode (see §. "Util" Menu).

Also refer to §. "EXTENDED ACQUISITION MEMORY" option operation p. 100.

If this option is selected, rebuilding a full coherent signal may take some time.

The following settings will also affect the time significantly:

- time base,
- trigger recurrence frequency
- averaging function activity.

The signal settings (amplitude, frequency, form) must remain stable during running.

To speed up the rebuilding following a change in signal, stop acquisition and restart: Stop \rightarrow Run.

The "✓" symbol indicates that the "Repetitive Signal" option has been selected.

Oscilloscope Mode (cont'd)

Min/Max Acquisition

Use this mode to view the extreme values of the signal acquired between 2 acquisition memory samples.

This mode:

- detects wrong representation due to under-sampling
- displays short-term events (Glitch, ≥ 2 ns).

Whatever time base is used and the corresponding sampling speed, short-term events (Glitch, ≥ 2 ns) are displayed.



The "✓" symbol indicates that the "Min/Max Acquisition" mode is active.

Averaging

*No averaging
Average rate 2
Average rate 4
Average rate 16
Average rate 64*

Selection of a coefficient to calculate an average for the displayed samples.

For instance, this is a way of attenuating random noise observed in a signal.

For the averaging coefficient to be taken into account for representation of the signal, the "Repetitive signal" option must be selected.

The calculation is performed using the following formula:

$\text{Pixel}_N = \text{Sample} * 1 / \text{Average rate} + \text{Pixel}_{N-1} * (1 - 1 / \text{Average rate})$

with:

Sample Value of new sample acquired at abscissa t
Pixel N Ordinate of pixel with abscissa t on the screen, at moment N
Pixel N-1 Ordinate of pixel with abscissa t on screen, at moment N-1



The "✓" symbol indicates the averaging coefficient selected.

FFT

(Fast Fourier Transform)

The Fast Fourier Transform (FFT) is used for calculating the discrete representation of a signal in a frequency domain from its discrete representation in the time domain.

FFT can be used in the following applications:

- measurement of the different harmonics and the distortion of a signal,
- analysis of a pulse response,
- search for noise source in logic circuits.

The FFT is calculated over 2500 points.



The Fast Fourier Transform is selected by the FFT icon in the control area. When the trace is zoomed, the FFT applies to the zoomed part of the trace (next to the time base adjustment).

Description

The Fast Fourier Transform is calculated using the equation:

$$X(k) = \frac{1}{N} * \sum_{n=-\frac{N}{2}}^{\frac{N}{2}-1} x(n) * \exp\left(-j \frac{2\pi nk}{N}\right) \text{ for } k \in [0 (N-1)]$$

with: $x(n)$: a sample in the time domain

$X(k)$: a sample in the frequency domain

N: resolution of the FFT

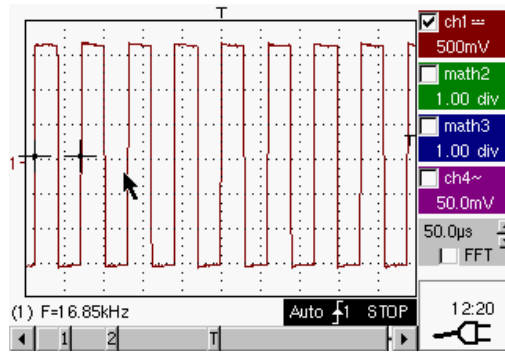
n: time index

k: frequency index

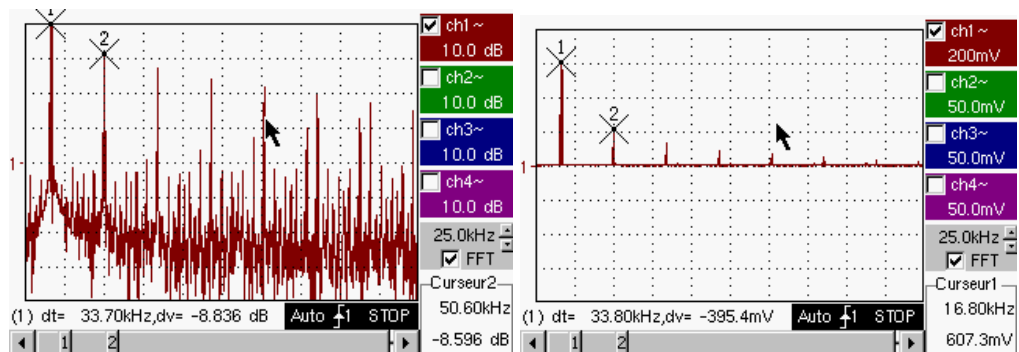
The displayed trace represents the amplitude in V or dB of the various signal frequency components according to the scale selected (linear or logarithmic).

The DC component of the signal is removed by software.

Oscilloscope Mode (cont'd)



Square signal



FFT with a Hanning window and a log scale

FFT with a rectangular window and a linear scale

Horizontal unit

This is indicated instead of the time base and is calculated according to the scanning coefficient:

$$\text{Unit (in Hz/div.)} = \frac{12.5}{\text{scanning coefficient}}$$

Vertical unit

Two possibilities are offered by the sub-menus:

a) Linear scale: by selecting the FFT menu and then the linear scale unit of the signal in its time representation (V/div.)

• in V/div. = $\frac{\text{unit of the signal in its time representation (V/div.)}}{2}$

b) Logarithmic scale: by selecting the FFT menu and then log scale (logarithmic)

• in dB/div. = by assigning 0 dB to a signal with an effective amplitude of 1 in the time representation

The vertical position indicator of the representation is at -40 dB.

Graphic representation

The FFT representation indicates symmetry in relation to the frequency origin; only positive frequencies are displayed.

Oscilloscope Mode (cont'd)

The sub-menus select a type of window.

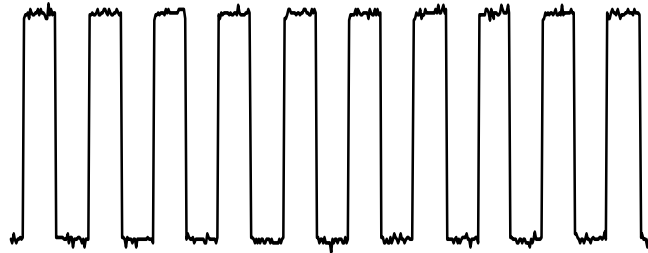
Rectangular

Hamming

Hanning

Blackman

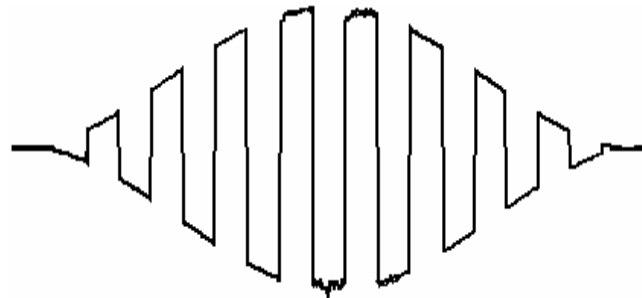
Before calculating the FFT, the oscilloscope weighs the signal to be analyzed by means of a window acting as a band-pass filter. The choice of window type is essential to distinguish between the various lines of a signal and to make accurate measurements.



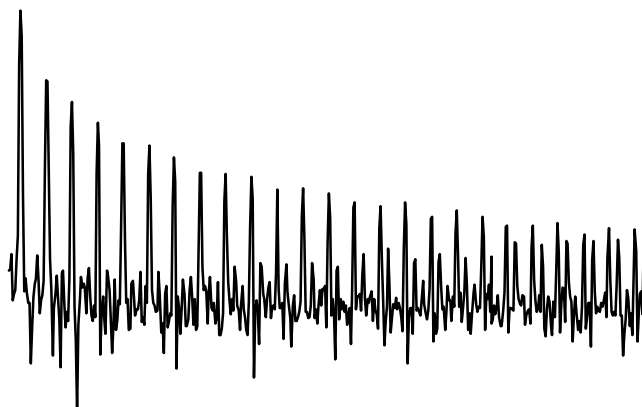
Time representation
of signal to be
analyzed



Weighting window



Weighted signal



Frequency
representation of
signal calculated by
FFT

Oscilloscope Mode (cont'd)

The finite duration of the study interval results in a convolution in the signal frequency domain with a function sinc/x .

This convolution modifies the graphic representation of the FFT because of the lateral lobes characteristic of the sinc/x function (unless the study interval contains an whole number of periods).

Four types of window selections are available: the menus appear directly on selection of the FFT menu.

Type of window	Width of main lobe	Max. amplitude of secondary lobe (compared with main lobe)
Rectangular window	- 13 dB	$4 \pi/N$
Hanning window	- 32 dB	$8 \pi/N$
Hamming window	- 43 dB	$8 \pi/N$
Blackman window	- 94 dB	$12 \pi/N$

Effects of under-sampling on frequency representation:

If the sampling frequency is not correctly adjusted (less than or twice the maximum frequency of the signal to be measured), the high-frequency components will be under-sampled and appear in the graphic representation of the FFT by symmetry (aliasing).

- The "Autoset" function is active. This prevents the phenomenon above and adapts the horizontal scale: the representation is more legible.
- The "Zoom" function is active.

The "✓" symbol in front of one of the options indicates the function selected.

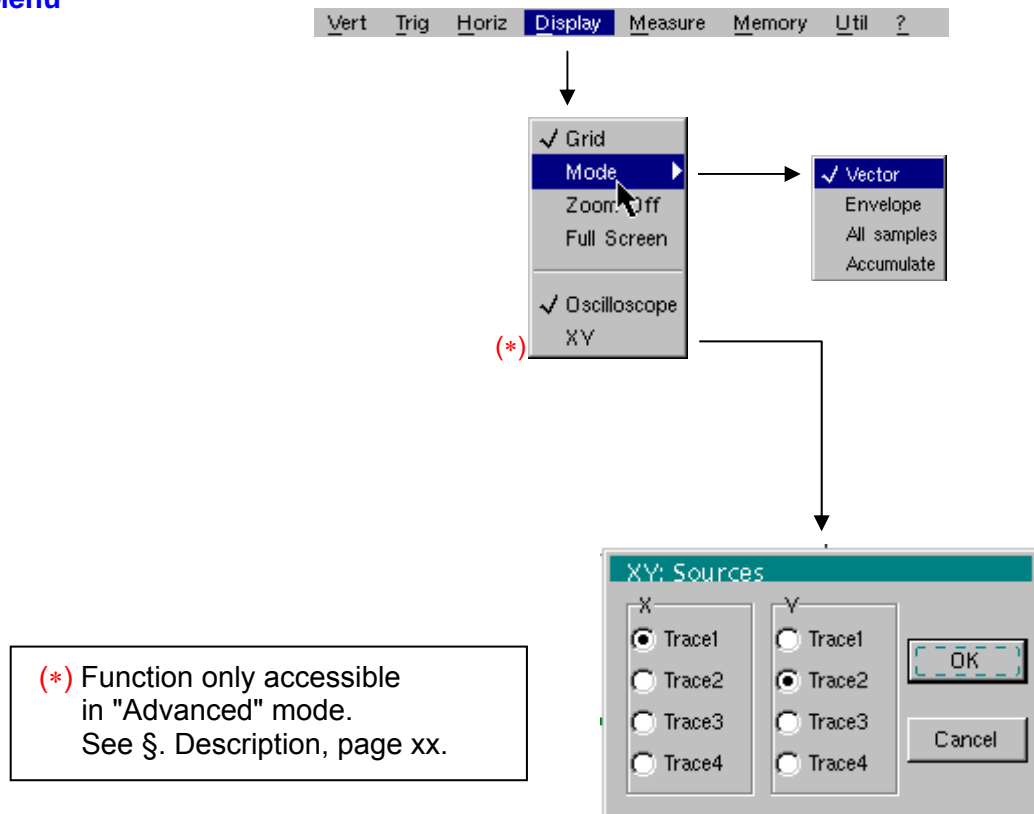
"EXTENDED ACQUISITION MEMORY" option operation

If the "EXTENDED ACQUISITION MEMORY" option is installed (see §. Menu " ? " → "Options"):

- The acquisition memory is extended from 2,500 samples to 50,000 samples.
- On the time base range [1 ns, 5 ms], the signal image is obtained by the aggregate of several acquisitions and reconstruction. Deactivate the "HORIZ " → "Repetitive Signal" option if the signal observed is not periodical, acquired and synchronous with the trigger.
- On the time base range [10 ms, 200 s], 50,000 samples are obtained in one acquisition.

Oscilloscope Mode (cont'd)

The "Display" Menu



Grid

Display / Removal of graticule.

Display modes

Vector

A vector is plotted between each sample.

Envelope

The minimum and maximum observed on each horizontal position of the screen are displayed. This mode is used, for example, to view a time or amplitude variation or a modulation.



The "✓" symbol indicates the active display mode.

All samples

The entire acquisition (2,500 or 50,000 samples depending on the instrument) is displayed on the screen and a vector traced between each sample.

Use this mode to view all acquisition details. This function can be used for a memory or curve already acquired.

Accumulate

Accumulation of the different acquisitions on the screen.

The most recent acquisition is displayed using a highlighted colour.

Zoom off



Returns to the original screen size after zooming in on part of the screen.

- This function is inactive unless the screen is in zoom mode.
- If the Zoom mode is active, the letter "Z" is displayed in the trace and time-base parameter display area.



This menu can also be called up by double-pointing with the stylus inside the trace display area.


Oscilloscope Mode (cont'd)

Full screen

Switches from the normal display mode to the "full screen" display mode and vice versa.

The display is organized so as to leave the biggest surface area possible for trace plotting: only the permanent settings and the automatic or manual measurements remain.



- This function has the same effect as the  key.
- The "✓" symbol indicates that the full screen mode is active.



This function can also be called up by double-pointing with the stylus on the trace display area.

The settings defined on the front panel remain active.



The following sub-menus can be used to switch from oscilloscope to XY mode.

The "✓" symbol indicates the active mode.

Oscilloscope

This is the basic operating mode.

XY

The "XY source" menu is used for assigning the desired traces to the X axis (horizontal) and Y axis (vertical).

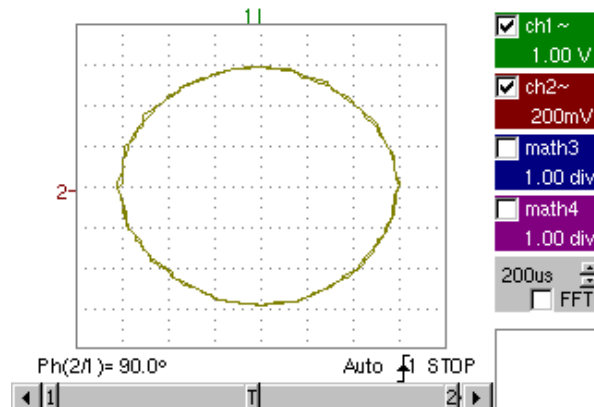
Validation of the selections by "OK". Exit from the menu without modification by "Cancel".



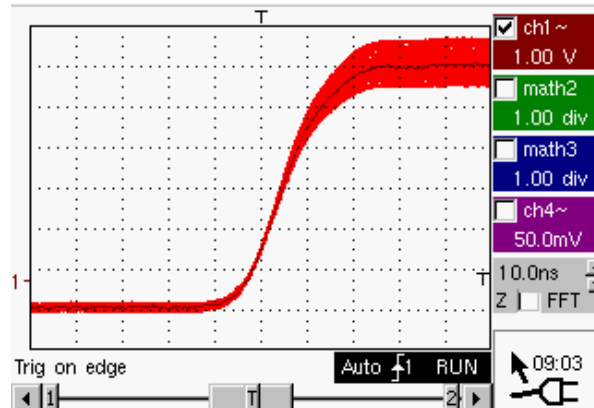
- Each axis is graduated into 8 divisions.
- The selected traces are identified by a figure corresponding to their axis.
- The "⊙" symbol indicates the trace selected for each axis.



Example

Two sinusoidal signals assigned to the X and Y axis with an offset of $\pi/2$ are then represented by a circle.



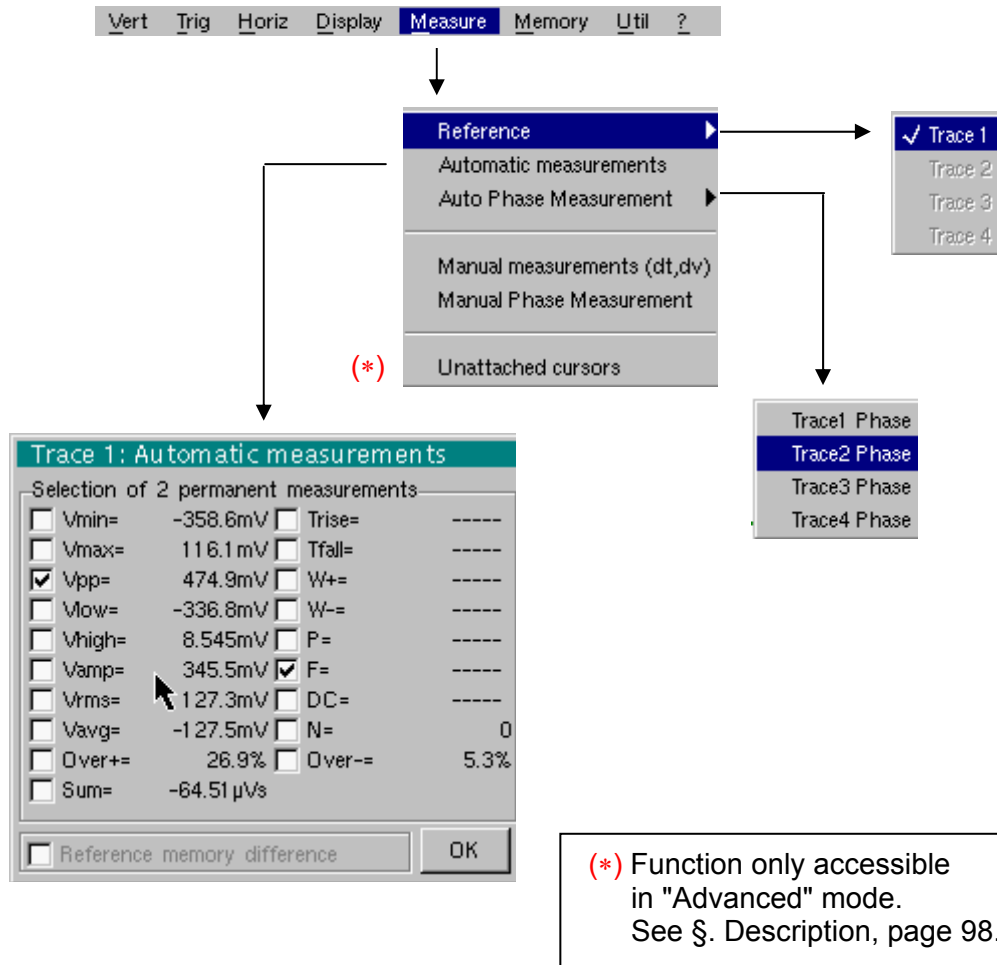
Example of Accumulate mode



In Accumulate mode the Reference memory , the Full screen  and the ROLL mode are not active.

Oscilloscope Mode (cont'd)

The "Measure" Menu



Reference

- Trace 1
- Trace 2
- Trace 3
- Trace 4



Selection of the trace on which the automatic or manual measurements will be performed.

Only the active traces can be selected. Inactive traces are displayed in a lighter colour.

The "✓" symbol indicates the reference trace.

Automatic measurements

Opens the "Automatic measurements" menu window.

The measurements are performed and refreshed on the selected reference trace. All the measurements that can be performed on this trace are displayed.

(- . - -) is displayed for measurements that cannot be performed.

The window can be validated and closed by pointing to **OK** with the stylus.

The selected measurement(s) will be displayed in the status area.

Oscilloscope Mode (cont'd)



- It is possible to select two permanent measurements.
- The "✓" symbol indicates the measurement(s) that will be indicated in the status area.
- Activation of the automatic measurements causes two markers (+) to appear on the curve, if at least one period is visible on the screen.
- The display order corresponds to the chronological order of the selection and the markers are assigned to the first measurement selected.

Automatic measurements in the status area can be deleted by means of this menu, by erasing the selected measurements (no "✓" symbol in the automatic measurements table).

Reference memory difference

Activation of the "Reference memory difference" option is a way of calculating the deviations, for all the automatic measurements, between the selected trace and the memorized reference trace (see §. Memory Menu).

Example

Calculation performed and displayed on one of the 19 automatic measurements:

$$V_{pp} (\text{Ref. memory difference}) = V_{pp} (\text{Trace 1}) - V_{pp} (\text{Trace 1} \rightarrow \text{Ref 1})$$

The calculation is performed in the same way for all the measurements.



- This option is only active if a reference trace is present. It must correspond to the trace on which you wish to perform automatic measurements
(Example: Trace 1 and Trace 1 → Ref. 1).
- Condition: the reference trace must have the same characteristics as the associated trace (sensitivity and time base)

19 automatic measurements

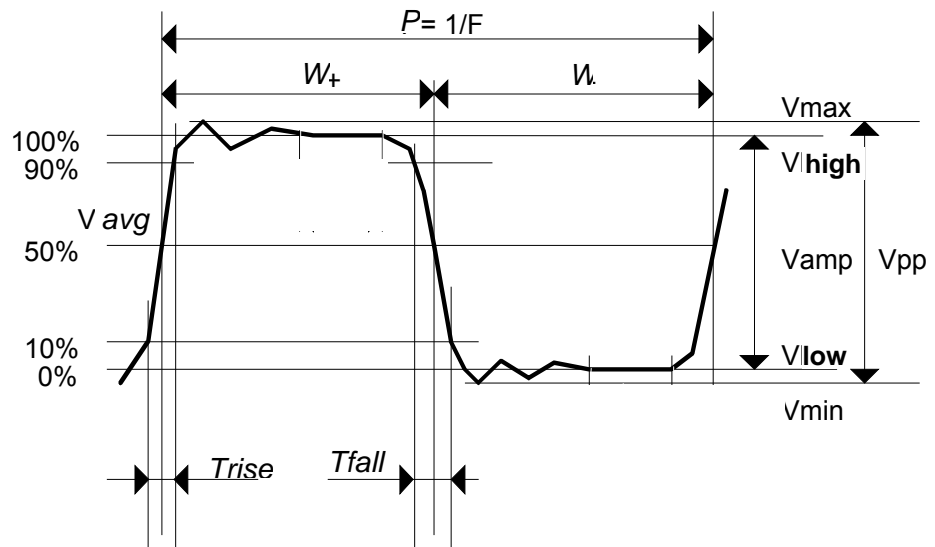
Vmin	minimum peak voltage
Vmax	maximum peak voltage
Vpp	peak-to-peak voltage
Vlow	established low voltage
Vhigh	established high voltage
Vamp	amplitude
Vrms	rms voltage
Vavg	average voltage
Over+	positive overshoot
Trise	rise time
Tfall	fall time
W+	positive pulse width (at 50 % of Vamp)
W-	negative pulse width (at 50 % of Vamp)
P	period
F	frequency
DC	cyclic ratio
N	number of pulses
Over-	negative overshoot
Sum	summon of instantaneous values of the signal

Oscilloscope Mode (cont'd)

Measurement conditions

- The measurements are performed on the displayed part of the trace.
- Any change to the signal will lead to updating of the measurements. They are refreshed in step with acquisition.
- To perform automatic measurements on specific portions of the signal, frame the required measurement area with the manual cursors so that the markers show the new location of the automatic measurement.
- Measurement precision is optimum if two complete signal periods are displayed.

Automatic measurement presentation



- Positive overshoot = $[100 * (V_{max} - V_{high})] / V_{amp}$
- Negative overshoot = $[100 * (V_{min} - V_{low})] / V_{amp}$

- $V_{rms} = \left[\frac{1}{n} \sum_{i=0}^{i=n} (y_i - y_{GND})^2 \right]^{1/2}$

- $V_{avg} = \frac{1}{n} \sum_{i=0}^{i=n} (y_i - y_{GND})$

- $V_{sum} = \sum_{i=0}^{i=n} (y_i \times \delta t)$

Y_{GND} = value of the point representing zero volt

Oscilloscope Mode (cont'd)

Phase measurement

Trace1 Phase

Trace2 Phase

Trace3 Phase

Trace4 Phase



Automatic measurement of a trace's phase compared with a reference trace (See §. Reference Measurement).

This menu selects the trace on which phase measurements are to be performed.

To deactivate phase measurement, deselect the selected phase measurement using the same menu.

- The "✓" symbol indicates the trace selected for phase measurement.
- Activation of the phase measurement, if it is possible, will cause display of 3 markers:
 - 2 markers for the reference trace period
 - 1 marker indicated as φ on the trace for which the phase measurements will be performed.
 These 3 markers are positioned automatically; they cannot be moved.
- The phase measurement (in $^{\circ}$) of the trace selected compared with the reference trace is indicated in the measurement display status area
 - Example: (1)Ph (2) = 180.0 $^{\circ}$
- If the measurement cannot be performed, " - . - ." is displayed.

Manual measurements (dt, dv)

Cursor measurements on the reference signal.

The measurement cursors (1 and 2) are displayed as soon as the menu is activated.

The two measurements made are:

- dt** (time difference between the two cursors),
- dv** (voltage difference between the two cursors).

The measurements performed and the displayed cursors are linked to the selected reference trace (see §. Reference Measurement).



- The "✓" symbol indicates that the manual measurements (dt, dv) are active.
- The measurement cursors can be moved directly with the stylus. They can also be moved with the stylus by selecting the 1 (cursor 1) or 2 (cursor 2) in the bargraph.
- If the free cursor option is not active (see §. "Unattached Cursors" Measurement), the cursors will remain linked to the reference trace during movements. If the option is active, the cursors can be moved anywhere on the screen.
- The dt and dv measurements in relation to the selected reference are indicated in the measurement display status area.
 - Example: (1)dt = 500.0 μ s, dv = 1.000 V

Manual phase measurement



Phase measurements using 3 cursors:

- Use cursors 1 and 2 to indicate the period of the reference signal.
- Use the φ cursor to measure the phase.

- The "✓" symbol indicates that manual phase measurement is active.
- When this menu is active, the 3 cursors are present if at least one signal is active.
- The cursor marked φ can be moved freely, even if the "Unattached cursors" menu is not active.
- The phase measurement (in $^{\circ}$) between the cursors is indicated in the measurement display status area.

Example: (1)Ph = 120.0 $^{\circ}$

Oscilloscope Mode (cont'd)

Unattached manual cursors

Used for linking or not linking the manual measurement cursors (1 and 2) to the reference trace.

When the "Unattached cursors" menu is selected, cursors 1 and 2 can be moved freely over the whole screen.



- The "✓" symbol indicates that the "Unattached cursors" menu is active.
- To deactivate this menu, deselect it by pointing with the stylus.



In the case of "Automatic measurements" and manual measurement activation:

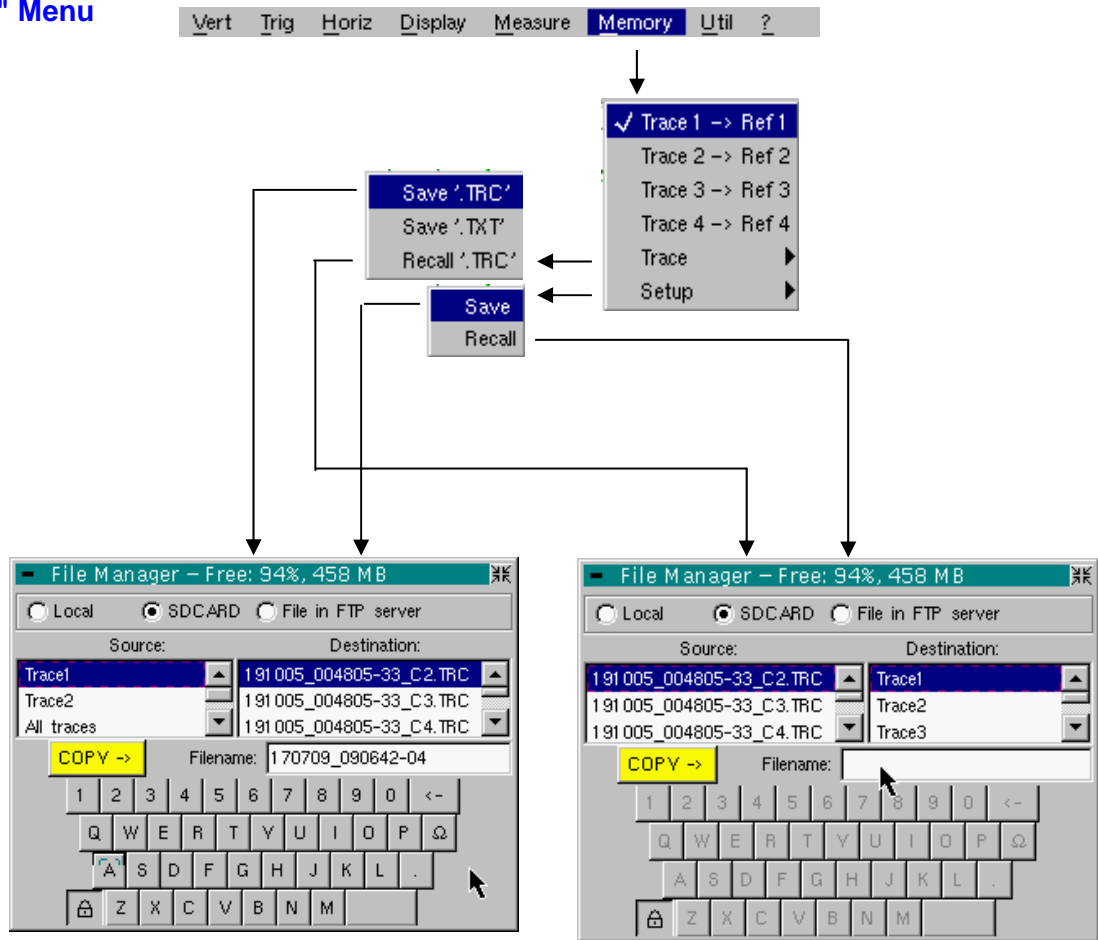
If ...	then ...
... the manual cursors and the automatic markers are displayed together,	... the automatic measurements are performed on the portion of the trace defined between the manual cursors.
... the portion defined between the manual cursors is too small [in this case, the fixed markers (+) will not be displayed],	... the automatic measurements selected are impossible, so "-.--" is indicated in the measurement display area.



Deselect the automatic measurements to validate the manual measurements (dt, dv).

Oscilloscope Mode (cont'd)

The "Memory" Menu



- Trace 1 → Ref. 1
- Trace 2 → Ref. 2
- Trace 3 → Ref. 3
- Trace 4 → Ref. 4

Storage of the selected trace in its reference memory
(~~E.g.~~ E.g.: Trace 1 in Ref. 1).

The 4 traces have their reference memory.



A reference memory is volatile, which means that it is lost when the instrument is switched off.



- For optimum use, the reference trace must have the same characteristics as the associated trace (sensitivity and time base).
- A trace can only be saved in its reference memory if it is present on the screen
- The memorized traces are displayed in a light color, accompanied by their reference number.
- The "✓" symbol in the menu means that the corresponding trace has been saved in the reference memory and that it is present on the screen.
- A reference trace cannot be moved.
- A reference memory can be deactivated by deselecting it in the menu.

Oscilloscope Mode (cont'd)

Trace

Saving (to the non-volatile memory) or recall of a trace or a reference memory. The back-up can be saved in two formats: ".TRC" or ".TXT". The "File copy" menu is adapted to the type of format selected.

Save .TRC

Saving of the files for subsequent recall on the oscilloscope screen
The back-up files will take the suffix .TRC; they can be recalled in the "Trace → Recall" menu.

Save.TXT

Saving of files for export to another application

The saved files have the suffix .TXT; they cannot be recalled by the "Trace → Recall" menu for screen display. However, they can be exported in a standard format for use in other software (spreadsheet - e.g. Microsoft EXCEL) using the menu "Util → Files → Export".



The selection made opens a "File Copy" menu.

- * Then in the "Source" drop-down menu, select the trace or the reference memory to be recorded.
- * All the channels can be saved in one operation:
 - A .TRC file is created for each channel displayed
 - A .MAC file is created: this file contains the commands needed to restore all the channels saved.

The trace or reference memory to be saved will appear in grey. The stylus is used for selection.



- *Only traces and reference memories present on the screen are indicated in the "Source" list (selectable).*
- *Use the scrollbar on the right of the list to view all the elements.*


-
- * A default backup file name is proposed above the keyboard. A file is generated from the date and current time. It can be modified using the virtual keyboard with the stylus.
The  key deletes the character preceding the cursor in this area.
 - * Once the name has been written, the  key records it by entering it into the destination menu and closes the menu. The backup file takes the extension .TRC (internal format) or .TXT (text format), depending on the previous selection.



Saving of the file is triggered with this key.

You can exit from this menu without saving by tapping with the stylus on the icon in the top right-hand corner of the window.



- *By moving the pointer  onto the names of the files, you will see their characteristics displayed (date and time saved and size).*
- *If the name already exists or is incompatible, an error message 'Impossible! File already exists' will be displayed.*
- *The filename is limited to a maximum of 20 characters + extension. If this rule is not observed, the message: 'Filename too long' is displayed.*

Oscilloscope Mode (cont'd)

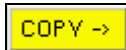
Recall .TRC

When selected, this opens a "File Copy" menu.

In the "Source" list, the .TRC files previously saved (via the menu "Trace → Save .TRC") are displayed.

Select the file to be called up from the list displayed.

- * Choose the destination from the "Destination" list.
- * The destination trace selected is called up in the input zone.
- * This key triggers call-up of the trace.



The menu can be exited without recalling by tapping the icon in the top right-hand corner with the stylus.




- *If you wish to recall in one action all the traces memorized jointly, open corresponding ".MAC" file via menu "UTIL" → "Fichier" (File).*
- *If the destination trace selected is already present on the screen, it will be overwritten by the trace called up.*
- *When a trace is recalled, Mx appears in the destination trace parameters.*
- *The virtual keyboard cannot be used in this menu.*

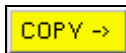
Configuration

Saving or recall of an instrument configuration.

Save

When selected, this opens the "File copy" menu.


- * The "Configuration" object is automatically selected in the "Source" list.
- * A back-up file name is proposed above the Qwerty keyboard.
The  key deletes the character preceding the cursor in this area.
- * A default save filename is proposed above the keyboard, generated from the date and current time. It can be modified via the virtual keyboard using the stylus.



The ← key deletes the character preceding the cursor in this area.

You can exit from this menu without saving by tapping with the stylus on the icon in the top right-hand corner of the window.



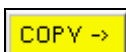
- *The filename is limited to a maximum of 20 characters + extension. If this rule is not observed, the message: 'Filename too long' is displayed.*
- *If the name already exists or is incompatible, an error message will appear*
- *By moving the pointer  onto the names of the files, you will see their characteristics displayed (date and time saved and size).*

Recall

When selected, this opens the "File Copy" menu.

In the "Source" list, the .CFG files saved (via the menu "Configuration → Save") are displayed.

A particular file that is always present called "Default Config" contains the instrument's default configuration.



Select the file to be called up from the "Source" list.

This key triggers callup of the configuration.

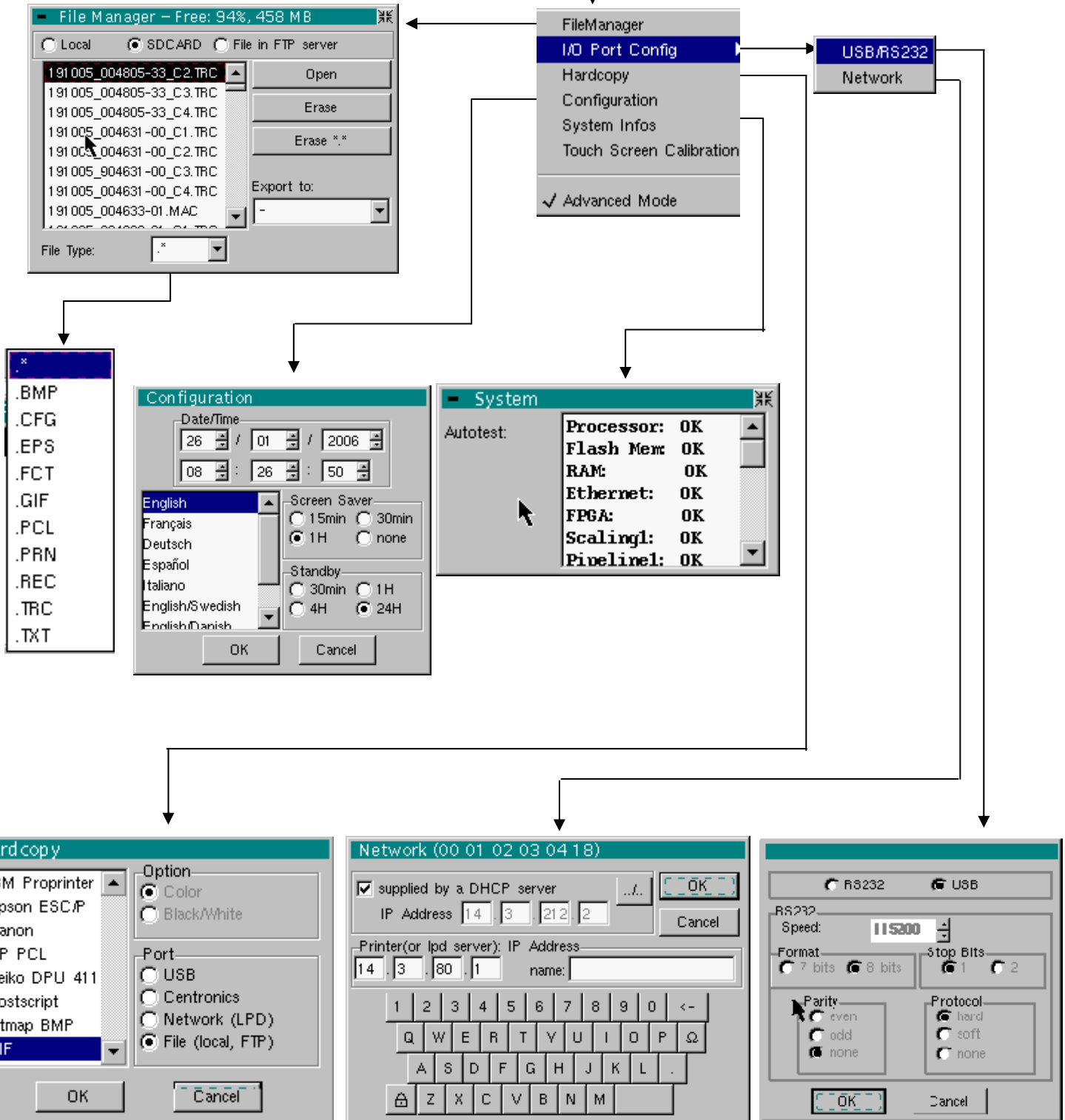


The virtual keyboard cannot be used in this menu.

Oscilloscope Mode (cont'd)

The "Util" Menu

Vert Trig Horiz Display Measure Memory **Util** ?



Oscilloscope Mode (cont'd)


Files



Selection of the "File Management" menu. It contains the files which have been:

- saved in previous sessions
- created since the last instrument startup.
- The storage capacity of the file system is 2 Mbytes.

These files will be saved in the FLASH memory when the instrument is switched off with the button opposite: they will then be available for the next session.

By moving the pointer  onto the names of the files, you will see their characteristics displayed (date and time saved and size).

The selected file appears in grey.

Use the scrollbar to the right of the list to scroll through the entire file system.

File type

File name extension:

- .CFG: Configuration
- .TRC: Trace in OSCILLOSCOPE mode,
- .MAC: SCPI commands (e.g.: to restore several traces),
- .REC: Traces in RECORDER mode,
- .TXT: Text format file,
- .FCT: Function in OSCILLOSCOPE and RECORDER mode,
- .PRN, .PCL, .EPS, .BMP, GIF: Print file
- .* : All files

Internal file on the FTP server

Choose the file system to be viewed.

The internal file system is used by default when the window is opened.

File system selection can be accessed on the FTP server if the FTP server parameters have been configured in the menu:

"UTIL" → "CONFIG PORT D'E/S" → "Network" in 'advanced' mode.

Open

Opens the selected file, the resulting action depends on the file extension:

- .CFG: Configuration restoration
- .TRC: Restoration of a trace in OSCILLOSCOPE mode
- .MAC: Execution of the SCPI commands contained in the file
- .REC: Restoration of traces in RECORDER mode
- .FCT: Restoration of a function

The other types cannot be opened on the instrument.

Erase

Deletes the selected file.

Erase *.*

Deletes all the files, the extension of which is selected in the 'File type'.

Export

Writing of the file selected from the list to an interface.

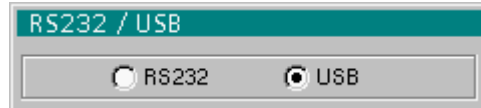
- RS232
- Centronics
- Network (FTP)
- Network (LPD)
- Internal file
- SD CARD

You can exit from this menu by pointing with the stylus on the icon in the top right-hand corner of the window.

Oscilloscope Mode (cont'd)

I/O port config

USB In the "USB / RS232" window, check the **USB Cable** button.



This interface uses the (USB / RS232 / ETHERNET) connector on the right side of the equipment. The **HX0084** cable must be used.

The **HX0084** cable converts the RS232 format output from the instrument to the USB protocol. After installation of the driver supplied on the CD on the host PC, communications with the instrument can be made using a "Virtual Com Port" (VCP).

Take care to configure the Virtual Com Port on the host PC as follows:

<i>Bits per second</i>	460800
<i>Data Bits</i>	8 bits
<i>Parity</i>	None
<i>Stop Bits</i>	1
<i>Flow control</i>	Hardware

RS232 In the "USB / RS232" window, do not check the **USB Cable** button.

This interface uses the (USB / RS232 / ETHERNET) connector on the right side of the equipment. The USB / RS 232 adapter (**HX0084**) or **HX0042** RS232 / SUBD9 cable must be used.

Speed Transmission speed: 300 to 115,200 Bauds.

Format Word length: 7 or 8 bits.

Parity Parity: even, odd or no parity (none).

Stop bits Number of stop bits: 1 or 2 stop bits


Protocol Serial link management mode:

Hard Hardware: the protocol is provided by the RTS and CTS lines of the RS232 link.

Soft Software: use of the XON and XOFF characters to synchronize transmission and reception of the messages (reduced "3-wire" link)

None No protocol checking



- The «  » symbol indicates the selected option.
- The option can be modified using the stylus.

Oscilloscope Mode (cont'd)

Network Configuration of the ETHERNET parameters

provided by a DHCP server

If this box is checked, the instrument makes a request to the network DHCP server to automatically obtain:

- an IP address
- a subnet mask
- the gateway address
- possibly a network printer IP address



When powering up, if you activated this protocol during a previous session, a confirmation is requested before sending the DHCP request via ETHERNET.

If the instrument is no longer connected to the network, answer "no" to the question, otherwise it will wait several minutes for an answer from the DHCP server, before becoming functional.

Physical address Oscilloscope address on the ETHERNET network.

This address cannot be modified (it is specific to the instrument)

Example: 00-01-02-03-04-63

IP address Oscilloscope IP address on the ETHERNET network.

This address can be input automatically or manually with the keyboard, after selecting the zone to be modified.

The ← key can be used to delete the value preceding the cursor in the zone to be modified.

An IP address can be assigned automatically by a DHCP server, if the server is accessible, by ticking the box "provided by a DHCP server".

Example: 132.147.200.74

After modification, the IP address is displayed for 30' at the bottom right of the screen.

**Printer (or lpd server):
IP address**

IP address of the printer or a PC where the printer is connected. In this case, an "LPD Server" programme must be installed on the PC.

This address must be input manually with the keyboard, after selecting the zone to be modified.

The ← key can be used to delete the value preceding the cursor in the zone to be modified.

Example: 132.147.240.1

Oscilloscope Mode (cont'd)

Name Name of the printer as it appears in the printing server (or PC).
If the printer is connected directly to the network, do not enter anything here.



This key can only be accessed in Advanced mode.

Use this function to manually configure:

- The subnet mask (SUBNET MASK)
- The IP address of a gateway (GATEWAY)

If you press this key twice you will access:

- The IP address of an FTP server
- The user name and password to access the FTP server.

Validation of the selections by "OK". Exit from the menu without modification by "Cancel".

Oscilloscope Mode (cont'd)

Hardcopy

The print format, the type of printer and the communication port are chosen from this menu.

The print format should be selected from the list using the stylus. Use the scrollbar to the right of the list to view all the printer languages available.

Option Choice of color or black/white printing.

Port Selection of the interface used for print data transfer:

USB or RS232 :	USB link interface or serial (acc. to selection in USB/RS232 window)
Centronics :	parallel interface via HX0041option
Network (LPD) :	network printer or an LPD client
File (internal, FTP) :	internal file or on an FTP server



- If the RS232C interface is selected, the parameters (speed, format, parity, stop bit, protocol) must be configured in the "Config I/O Ports" menu. Check that the configuration matches the configuration of the peripheral device connected to the instrument.
- If the "Network" option is selected, the parameters must be configured in the "Config I/O Ports → Network" menu).
- The "File" option is a way of recording the hardcopy in a file. ".bmp" and ".gif" image formats can be used directly in the Windows applications (word processing, presentations, etc.) As soon as the print request is launched, the "File copy" menu is opened and you should input the name of the file generated (see "Trace" menu → "Save").



A hard copy of the screen can be printed by pressing this key. The copy is printed using the parameters defined in the "Hardcopy" menu.

Configuration

Date/time Updating of the date (day, month, year) and the time (hour, minute, second). You can select the required parameter by using the stylus and the scrollbars located on either side of the parameters to be adjusted.



The clock starts when the menu is closed.

Langue (Language) Selection of the language in which the menus are written. Options available: **French, English, German, Italian, Spanish, etc.**

Screen saver Sets the screen to standby after a defined period of time to minimize the consumption of the equipment and screen ageing.



4 options are available: **15mins, 30mins, 1hr, no standby mode.**

The screen can be reactivated by pressing any key on the front panel.

Standby Shutdown of the instrument after a predefined period, in order to limit its energy consumption.

In this case, the equipment configuration is saved before the shutdown.

4 options are available: **30mins, 1hr, 4hrs, 24hrs**



The equipment is reactivated using the key shown *opposite* or using a key on the front panel, which will not be taken into account.



- The "⏻" symbol indicates the selected option.
- The option can be modified using the stylus.

Oscilloscope Mode (cont'd)

System info

Display of data concerning the operation of the instrument since it was first used.


Autotest

This list displays the result of the self-test activated when the instrument is switched on.



For verification of the instrument, see §. Maintenance p. 6.

Touch screen calibration

The touch screen needs to be calibrated if the position of the mouse pointer  is offset from the stylus impact point on the touch screen or if access to x different objects on the screen is difficult.

This calibration process is described on p. 52, 53.

"Advanced" mode

The "Advanced" mode gives access to certain additional functions. By default the "Advanced" mode is not activated in order to simplify the use of the equipment.

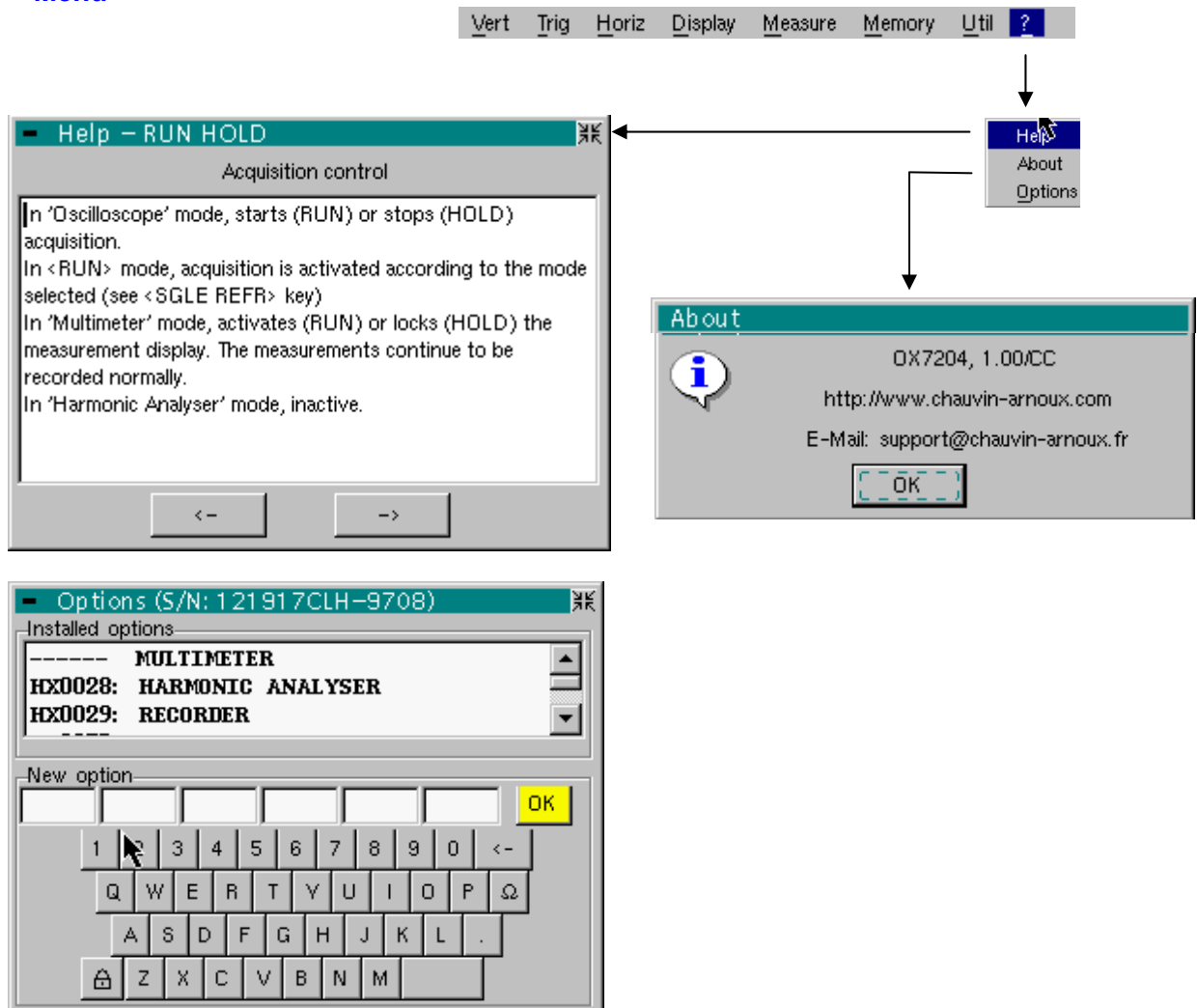
Functions available in "Advanced" mode only

Function	Accessed from the menu	Selection in advanced mode	State in non advanced mode (default configuration)
math1, math2, math3, math4	"Vert"	Complex mathematical functions applicable to the 4 traces	Simple mathematical functions applicable only to traces 2 and 3
Repetitive signal	"Horiz"	Choice between repetitive and non repetitive mode	Non repetitive mode
Average	"Horiz"	No averaging., x2, x4, x16, x64	No averaging
XY	"Display"	Choice between Oscilloscope (YT) and XY	Oscilloscope (YT)
Free manual cursors	"Measure"	Manual cursors whether related or not to the reference trace	Cursors 1 and 2 related to the reference trace
Access to FTP server	"Memory"	Option that can be selected	Option that cannot be selected (grayed)

- The "✓" symbol indicates that "Advanced" mode is enabled.
- The stylus can be used to modify this.
- By default, "Advanced" mode is not enabled.
- In "Advanced" mode, the instrument starts in the configuration where it stopped; otherwise it starts in its default configuration (always the same one).

Oscilloscope Mode (cont'd)



The « ? » Menu



Help

When selected with the stylus, this opens the "Help" menu.

The online help concerns the instrument's keyboard.

Use the  and  keys to scroll through the description of the keys on the front panel.

Whenever a keyboard key is pressed, online help will be displayed regarding the key pressed.

The functions associated with the keys will not be activated.

The key name is indicated above the explanation.

You can exit from this menu by pointing with the stylus in the top right-hand corner of the window.

Oscilloscope Mode (cont'd)

About

This submenu provides information:

- On the name of the instrument, the software version and the version of the hardware
- The WEB site to visit to find new products in the range for METRIX instruments.
- The email address of the customer service that can answer your questions on the instrument.

You can exit from this menu by choosing **OK**.

Options


Installation of the various instrument options.

An option is installed by entering a 24-character code and clicking on the OK key.

This is a unique code for the option acquired and for your instrument (it cannot be installed on another instrument)

When an option is acquired, you must specify the serial number and key of the instrument in your order and CHAUVIN-ARNOUX will supply you with this code.

The serial number and key are indicated in the "Options" window title bar.

 : 123456ABC-2997

The list of options installed is also displayed in this window.

Options available:

- MULTIMETER
- HARMONIC ANALYSER
- RECORDER
- EXTENDED ACQUISITION MEMORY
- POWER MEASUREMENTS



The installation of a new option is integrated after the instrument is restarted.