

SCOPIX

Portable Oscilloscopes

100 MHz 2 channel **OX 7102**

100 MHz 4 channel **OX 7104**

USER MANUAL



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Firmware Update : You may use PC software provided on the CD-ROM and consult Internet site www.aemc.com in the Tech Info section for available updates.

General Instructions

Introduction



You have just purchased a portable digital **oscilloscope**.

Congratulations on your choice and thank you for your trust in the quality of our products.

This oscilloscope also offers the following modes:

- **Multimeter Mode**
- **Harmonic Analyzer Mode** (option)
- **Recorder Mode** (option)

It complies with safety standard NF EN 61010-1 (2001), double insulation, relative to electronic measuring instruments.

For optimum service, read this manual carefully and comply with the operating precautions.

Non-compliance with the warnings and/or operating instructions might damage the instrument and/or its components and could prove dangerous for the user.

Precautions and safety measures



- This instrument has been designed for use:
 - indoors
 - in an environment with pollution level 2,
 - at an altitude of less than 2000 m,
 - at a temperature between 32° 0°C and 40°C
 - with relative humidity of less than 80% up to 31°C.
- The safety of any system integrating the apparatus concerns the responsibility for the assembler for the system.
- It can be used for measurements on circuits 600 V, CAT III in relation to earth and can be powered by a 98 to 240 V AC line.
However, some accessories can lead you to use this instrument on circuits of lower voltage and category rating. Conform to these ratings when connecting the accessory. In the event of use of different accessories, consider the lowest voltage and category.

Definition of measurement categories

CAT II: *Measurement category II corresponds to measurements made on circuits connected directly to the low-voltage installation.*

Example: *power supply for domestic appliances and portable tools*

CAT III: *Measurement category III corresponds to measurements on building installations.*

Example: *power supply for industrial machines or devices.*

before use

- Comply with environmental and storage conditions.
- External power supply: it must be connected to the instrument and to the AC power (from 98 to 264 VAC). Make sure that it is in good working condition.

during use

- Read carefully all the notes preceded by the symbol .
- The instrument power supply is equipped with an electronic protection system, which is reset automatically when the fault is eliminated.
- Be sure not to obstruct the ventilation holes.
- As a safety measure, use only suitable leads and accessories supplied with the instrument or approved by AEMC® Instruments.

General instructions (cont'd)

Symbols used on the instrument



Warning: Risk of danger.

Refer to the operating manual to find out the nature of the potential hazards and the action necessary to avoid such hazards.



Earth



Dual insulation



According to WEEE directive 2002/96/EC

Maintenance and metrological verification



Before the equipment is opened, it must be disconnected from the power supply and the measurement circuits, and the operator must not become charged with any static electricity. This could cause the damage to internal components.

Any adjustment, servicing or repair of the unit *under power* must be undertaken only by qualified personnel, after reading the instructions in this manual.

A **qualified person** is a person who is familiar with the installation, its construction, its use and the hazards that exist. They are authorized to activate and deactivate the installation and equipment, in compliance with the safety instructions.

For information and contact details, contact the organization from which the instrument was purchased.

Unpacking - Repacking



Upon receiving your shipment, make sure that the contents are consistent with the packing list. Notify your distributor of any missing items. If the equipment appears to be damaged, file a claim immediately with the carrier and notify your distributor at once, giving a detailed description of any damage. Save the damaged packing container to substantiate your claim.



When the oscilloscope is delivered, the battery may be discharged and require a complete recharge. Full charging of the battery will then take about two and a half hours, with the oscilloscope switched off.

Cleaning



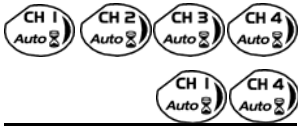
- Turn the instrument off.
- Clean it with a damp, soapy cloth.
- Never use abrasive products or solvents.
- Allow to dry before any further use.

NATO approved:

OX 7102CK - 6625 14 549 3558

OX 7104CK - 6625 14 549 3559

Description of the instrument



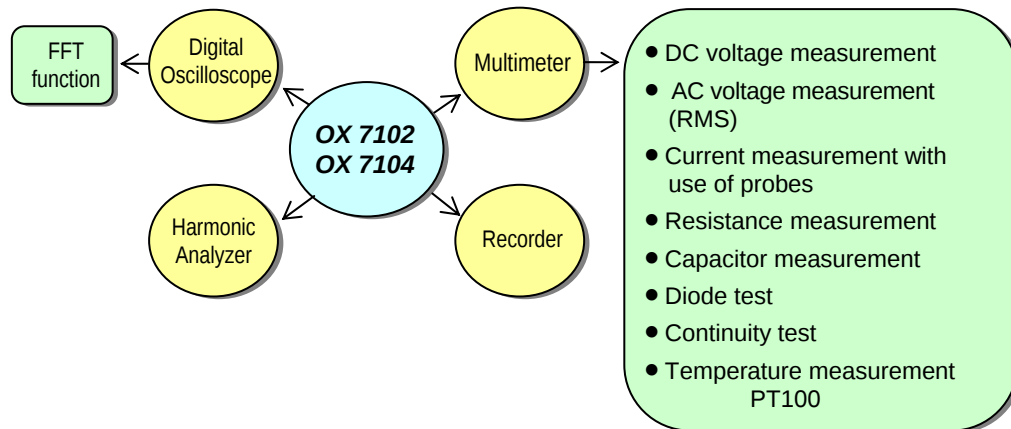
This manual describes the operation of an **OX 7104** oscilloscope.

OX 7104 : the adjustment of the 4 channels is accessible by the keys shown to the left.

OX 7102 : the adjustment of the 2 channels is accessible by the keys shown to the left.

Presentation

This instrument is part of our range of portable oscilloscopes. Its special feature is that it groups **4 instruments** into one:



- a digital **oscilloscope** for laboratory use, intended for the analysis of the signals encountered in electronics and electrical engineering
- a 4000-count **multimeter**
- a "**harmonic**" **analyzer**, to display 2 signals (or 4: **OX 7104**) simultaneously with their fundamental and their first 31 harmonics (option)
- a **recorder**, designed to capture trend data (option)



All the channels are isolated from one another for measurements on 600V CAT III installations with appropriated PROBIX accessories while complying with the standard IEC 61010-1 (2001).

The instrument works with a constant acquisition depth of 2500 counts.

Memory management is organized using a "Windows" type file system.

A large color **LCD screen** is used to view the signals applied, along with all the settings.

The main control functions are directly accessible using the keys on the front panel and can be modified using a **touch-screen** with the **stylus** supplied.

A graphical interface similar to a PC's is used to:

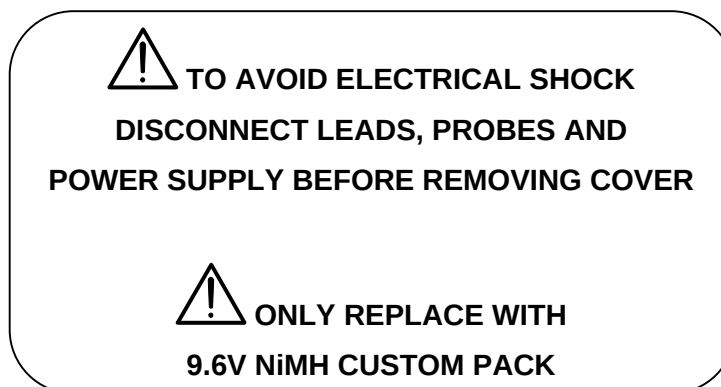
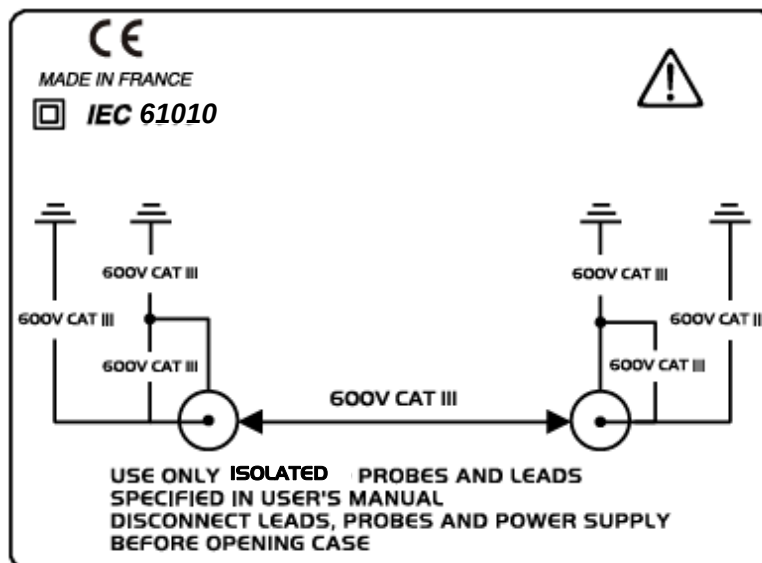
- select the advanced functions by means of drop-down menus and the touch-screen
- act directly on the objects (traces, cursors, etc.) displayed on the screen.

This means that the settings can be modified.

This instrument is completed by **RS-232**, **Ethernet** and **Centronics communication interfaces** (option).

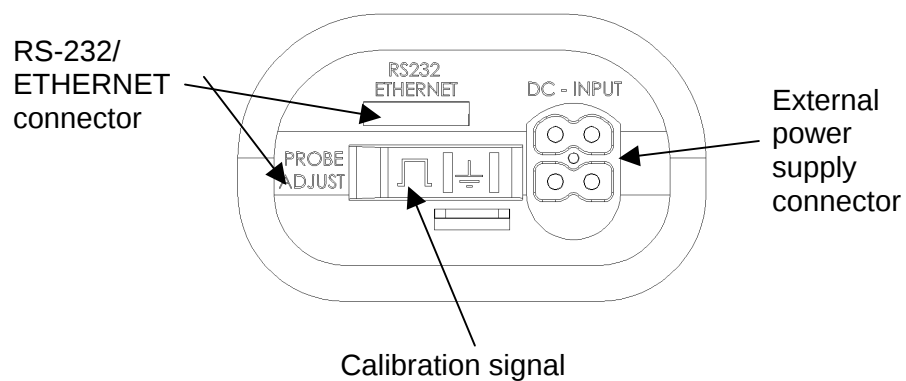
Description of the instrument (cont'd)

Markings on rear panel



Side view

Marking

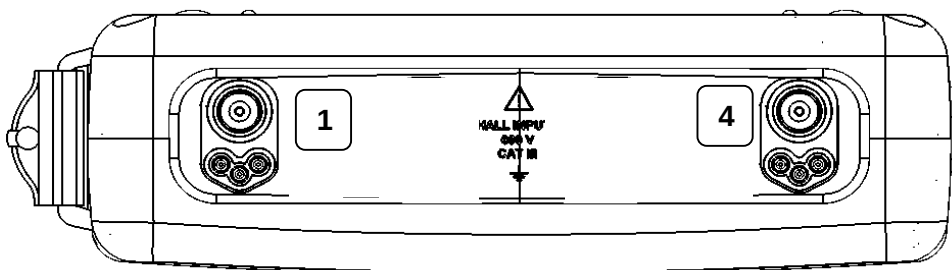


Description of the instrument (cont'd)

Measurement terminal block

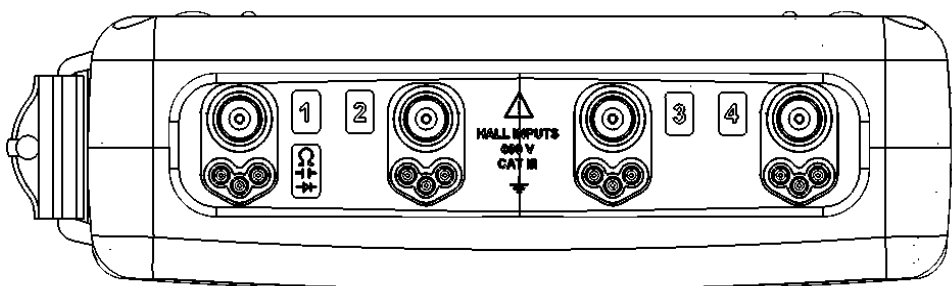
OX 7102

Marking



OX 7104

Marking



Description of the instrument (cont'd)

Front (description)

The main functions of the instrument are accessible on the front panel and can be modified using the touch-screen (with its stylus) or the menu bar.

1 On/Standby/Off key



- power on by a short press
- switch the instrument to standby (yellow LED flashing inside the key) by one short press. A second press on the key reactivates the instrument.
- power off by a long press (> 3 s): the configuration and files are saved after approximately 15 s.

If the instrument is not equipped with a battery, never disconnect the instrument from the AC power while the message "System shut down : Please wait before switch off power" is displayed on the screen. Otherwise, the current file and all the files previously saved will be lost.

1 touch-screen and stylus

These can be used for:

selection of menus,
validation of functions,
movement of symbols appearing on the LCD screen.

- The **menus** at the top of the screen and the submenus selected by the pointer open and are validated with the stylus.
- The **menus** in the curve display area,
the command area
the status area
can be opened with the stylus.
- The **stylus** can move the symbols displayed in:
 1. the main display area:
trigger position
position of cursors
reference of the traces displayed
 2. the bargraph:
trigger position
position of cursors
position of zoomed area in the acquisition memory

Place the pointer on the symbol to be moved and keep the stylus pressing down while you move it to the required position.

- It is possible to use the stylus to **zoom** in the display area by dragging a box around the area of interest.

4 "operating mode" keys



You can select the operating mode of the instrument by pressing one of these 4 keys:

"oscilloscope"
"multimeter"
"harmonic analyzer" (option)
"recorder" (option)

28 keys only active when pressed

Shortcut access to the most common functions: see chapter on "The Keys" for the "Oscilloscope", "Multimeter", "Harmonic Analyzer" and "Recorder" modes.

Initial operation of the oscilloscope

The portable oscilloscope is designed to operate on a power source from 98 to 264 V (ACrms) at 50 to 60 Hz or in stand-alone mode with a battery.

The instrument is delivered with an AC power adapter, an external power supply (battery charger) and an Ni-MH battery (9.6 V, 3.5 A/h).

Fuse



Type: time delay, 2.5 A, 250 V, 5 x 20 mm

The external power supply is equipped with a protection fuse that must only be replaced with an identical model.

Replacement must only be performed by qualified personnel.

Contact your distributor or AEMC® for servicing.

Starting up with the external power supply



- Connect the 4-pin lead of the external power supply to the "DC-Input" socket located on the side of the oscilloscope.

 **Do not insert any metal objects into this lead.**

- Connect the power cord from the external power supply to the power line.

The **POWER** LED on the adapter lights up, indicating that it is live.

The **CHARGE** LED flashes, indicating:

- the absence of the battery or
- slow charging of the battery, if it is present in the oscilloscope.

Press the instrument's ON button: it lights up and a clock is displayed on the screen during the start-up sequence.

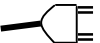
The message "Instrument start-up" is displayed.

The oscilloscope is then ready for use.



By default, the "Advanced" mode is not active.



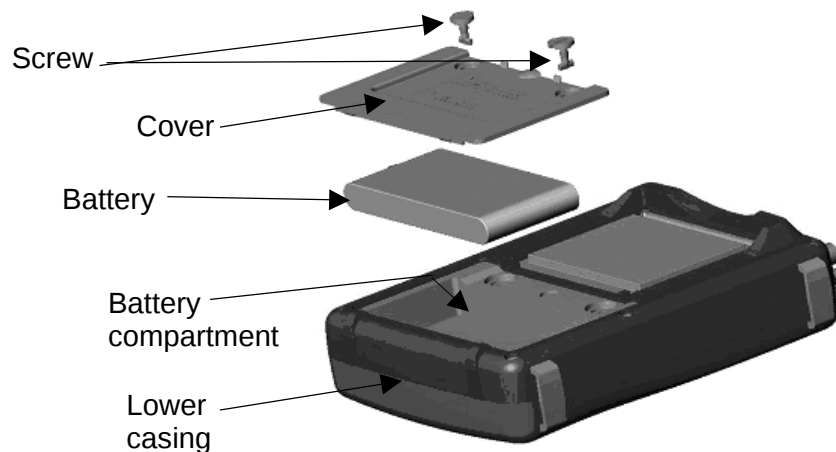
The symbol  in the display area for the current value means that the instrument is connected to the AC power supply.

Description of the instrument (cont'd)

Installation of the battery in the oscilloscope

 **To prevent any electric shocks, remove the PROBIX adapters and the external power supply lead before installing or replacing the battery.**

- Using a coin or a screwdriver, turn each of the 2 plastic screws located on the cover of the battery compartment at the rear of the instrument 1/4 turn counter-clockwise.
- Lift the cover of the battery compartment by inserting the coin under the slot at the top of the cover.
- Then connect the 4-pin battery connector to the connector located inside the battery compartment of the oscilloscope, taking care to respect the polarity of the connectors.
- Position the battery inside the oscilloscope compartment (battery wires at the bottom of the oscilloscope's battery compartment).
- Close the cover of the battery compartment and lock it by turning the 2 plastic screws 1/4 turn (clockwise).



Changing the battery

Follow the same procedure and make sure that the replacement battery model is identical to the original one.

The oscilloscope contains a Ni-MH battery. The dead or defective battery must be recycled according to local laws. **Never dispose of the battery with other solid waste.**



When the oscilloscope is delivered, the battery may be discharged and require a complete recharge. Full charging of the battery will then take about two and a half hours, with the oscilloscope switched off.

Description of the instrument (cont'd)

Charging the battery

Once the battery is installed, follow the external power supply start-up instructions.

- To speed up recharging of the battery, switch off the power to the oscilloscope with a long press of the ON/OFF button.
- Battery fully discharged: during the first 10 minutes, the **CHARGE** LED of the external power supply flashes, indicating that the battery is slow-charging. The **CHARGE** LED then lights up when it switches to fast-charging.



During the charging of the battery (after 15 min), powering on of the oscilloscope causes premature stopping of the charge. It is possible to restart the charging by disconnecting, then reconnecting the charger.

The LED goes out when the battery is fully charged (approx. 2h30).

Charging the battery while using the oscilloscope

When the oscilloscope is connected to the AC power via the external power supply, it is possible to perform slow-charging of the battery.

The **CHARGE** LED of the external power supply lights up. Full recharging of a totally discharged battery then takes approx. five and a half hours. The LED goes out when the battery is fully charged.



Frequently recharging a battery when it is not fully discharged reduces its life span.

Powering the instrument with the battery

When the oscilloscope is powered by a battery, a charge status indicator appears in the display area:



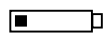
the battery is 100% charged



the battery is 80% charged



the battery is 60% charged, etc.



If only one charge bar is present, it means that the battery can only operate for a few minutes more, so you are advised to recharge it or switch to the AC power supply.



The battery is totally dead and the screen is about to shut off. You must either recharge the battery or connect the instrument to the external power supply.



To maintain good condition of the battery, use the oscilloscope until at least one bar remains  before recharging.

Use of the stand



The oscilloscope is equipped with a stand that can be used to tilt it when it is placed on a work surface.

Description of the instrument (cont'd)



Concept The oscilloscope uses **PROBIX intelligent probes and adapters**, offering users active safety.

When connected to one of the oscilloscope's inputs, a safety message concerning the probe or adapter used indicates:

- its maximum input voltage according to the category
- its maximum voltage in relation to the ground, according to the category
- its maximum voltage between channels, according to the category
- its type
- its basic specifications
- the use of suitable safety leads.

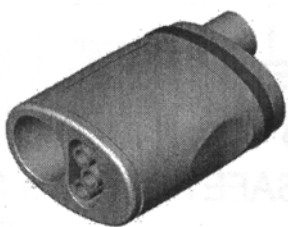
 *For user and instrument safety, these instructions must be adhered to.*

Some probes are equipped with buttons whose assignment can be programmed.

An interchangeable elastic band or plastic collar can be used to match the probe color to the trace color.

The oscilloscope provides the power supply for the probes and adapters.

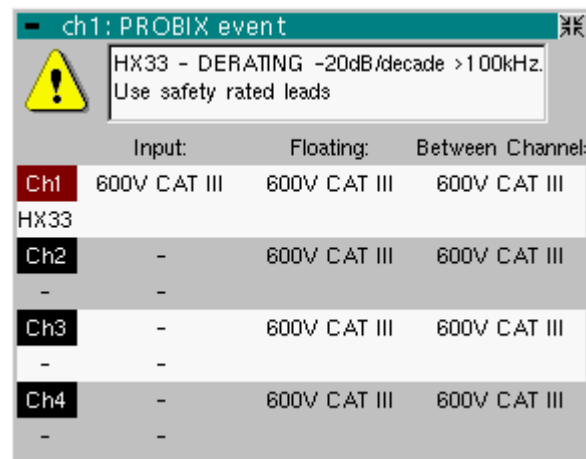
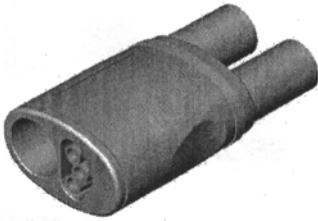
**BNC Adapter:
PROBIX HX0031**



ch1: PROBIX event			
 HX31 - BNC Adapter >30V CAT I, Use isolated rated BNC leads			
	Input:	Floating:	Between Channel:
Ch1	600V CAT III	600V CAT III	600V CAT III
HX31			
Ch2	-	600V CAT III	600V CAT III
-	-		
Ch3	-	600V CAT III	600V CAT III
-	-		
Ch4	-	600V CAT III	600V CAT III
-	-		

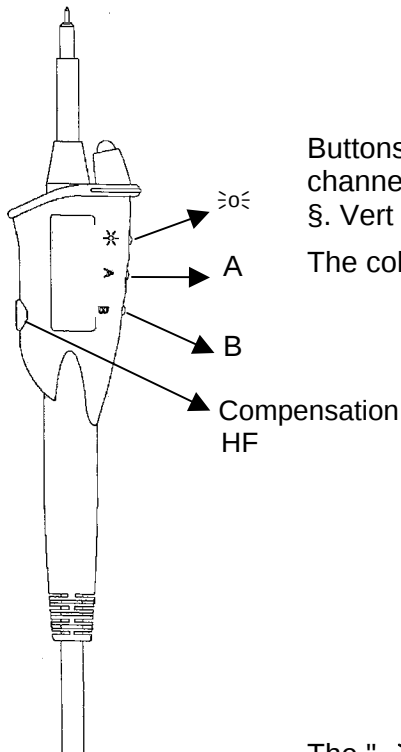
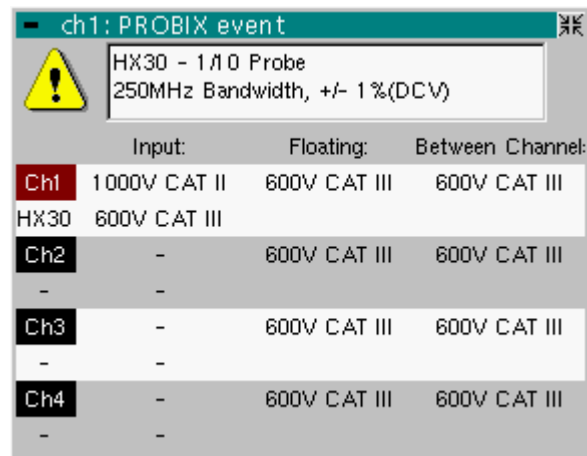
Description of the instrument (cont'd)

Banana adapter
 $\varnothing$ 4 mm :
PROBIX HX0033



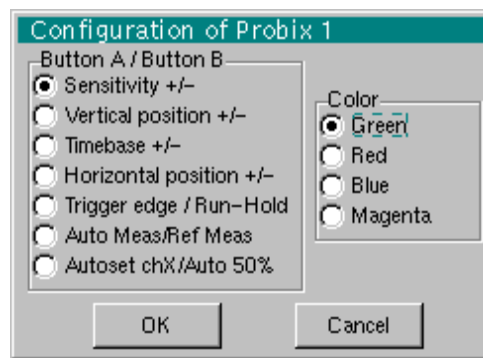
The positive input is indicated by a + sign.

1/10 probe:
PROBIX HX0030



Buttons **A** and **B** on the probe can be used to directly modify the parameters of the channel connected or to call the functions on the front panel of the oscilloscope (see §. Vert Menu → chx → **PROBIX**).

The color of the trace can also be programmed in this menu.



The " $\approx$ " button controls the lighting of the area to be measured.

Description of the instrument (cont'd)

Connection Disconnection

A window indicating the safety conditions is displayed when you connect or disconnect a **PROBIX** adapter on one of the channels of the instrument:

General specifications of the adapter which has been last connected

	Input:	Floating:	Between Channel:
Ch1 HX31	600V CAT III	600V CAT III	300V CAT II
Ch2 HX30	1000V CAT II	600V CAT III	300V CAT II
Ch3 HX32	600V CAT III	600V CAT III	300V CAT II
Ch4 HX35	10Vrms MAX	600V CAT III	300V CAT II
	K TC	30V CAT I	-

Input :
Max. voltage of the
signal measured
by the **Probix**
adapter

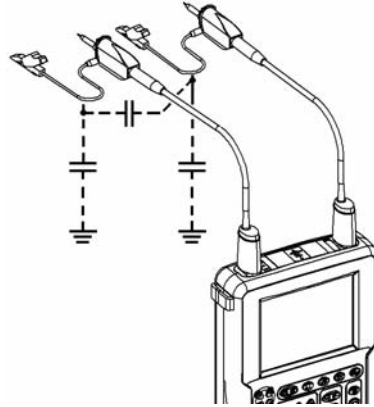
Floating input :
Acceptable max.
voltage on each
Probix input in
relation to earth

Between channels :
Acceptable maximum
voltage between the
channels
(this voltage depends on
the combination of
connected **Probix**
adapters).

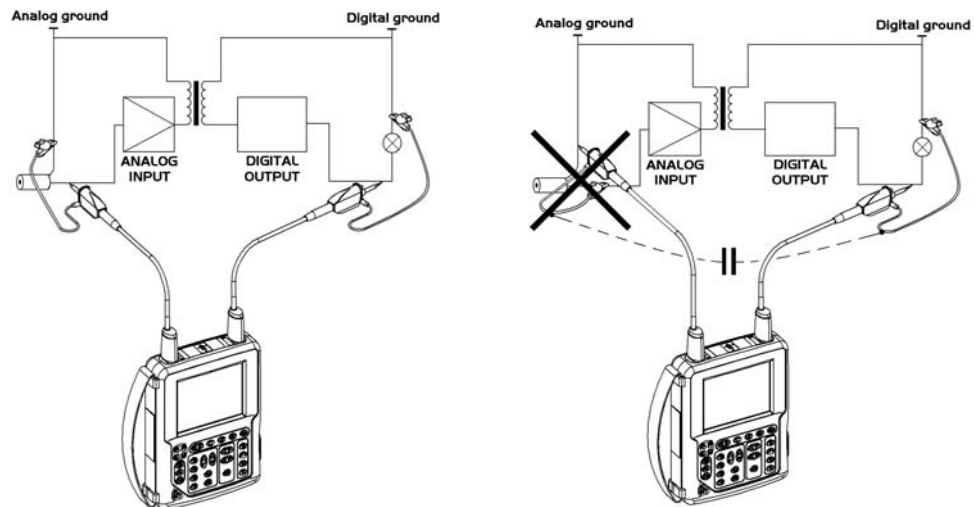
Description of the instrument (cont'd)

Recommendation for use : Connection of reference conductors for the 1/10 PROBIX HX0030 probe

1. To prevent electric shocks or possible fires, never use the **grounding spring** of the 1/10 probe for voltages $> 30 \text{ Vrms}$ in relation to the ground.
2. Distribution of stray capacitances:



It is essential, given the stray capacitances, to connect properly the reference conductors for each probe. These conductors must be connected preferably to the cold points, to prevent transmission of noise by the stray capacitance between modes.



The noise of the digital ground is transmitted to the analog entry by the stray capacity.

Description of the instrument (cont'd)

Network

Configuration of the "Network" interface (Ethernet).

This interface uses the same connector (RS-232/Ethernet), located on the right-hand side of the instrument, and requires a specific Ethernet / RJ 45 cable.

General principles of the Ethernet network Addressing

Ethernet and TCP/IP (Transmission Protocol/Internet Protocol) are used to communicate on a company's network.

Each piece of equipment under TCP/IP has a physical address (Ethernet) and an Internet address (IP).

Ethernet physical addresses

A physical or Ethernet address, stored in ROM or PAL, identifies each item of equipment on the network. The physical address enables the equipment to determine the source of data "packet" transmission.

The physical address is a number coded over 6 bytes represented in hexadecimal form. Hardware manufacturers procure physical addresses and allocate them incrementally when the product is manufactured. The physical addresses cannot be modified.

IP addresses

An IP address is coded over 4 bytes, displayed in decimal format.

( Example: 132.147.250.10). Each field may be coded between 0 and 255 and is separated by a decimal point.

Unlike the physical address, the IP address can be modified by the user.



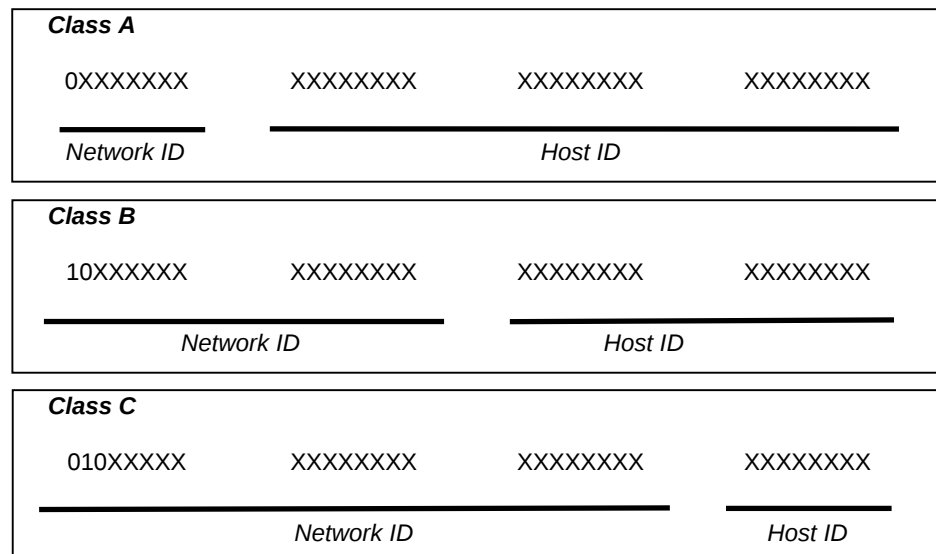
You must ensure that the IP address is unique on your network. If an address is duplicated, network operation becomes random.

The IP address is made up of two parts:

- the network identifier (Network ID) identifying a given physical network
- the host identifier (Host ID) identifying a specific item of equipment on the same network.

There are 5 addressing classes. Only classes A, B and C are used to identify the equipment.

See below:



**SUBNET mask
and GATEWAY**

If the result of the operation ' AND LOGICAL' between IP address of the recipient of the message and the value of subnet mask is different from the address of the recipient of the message, this message is sent to the gateway which will be given the responsibility to forward it to destination.

The programming of the mask and the address of the gateway is possible on the instrument, in the Advanced mode.

DHCP Protocol

This protocol is used to automatically assign an IP address to the instrument when it connects up to the network.

A **DHCP** (Dynamic Host Configuration protocol) server must be accessible on this network (contact your network administrator to make sure that this server is present).

FTP protocol

FTP (File Transfer Protocol) is used in the oscilloscope for fast file transfers to or from a PC.

To use it, open the browser on the PC and, in the **URL** field, type the IP address of the instrument, preceded by "**ftp:**"

 *Example: ftp://192.168.3.1*

The oscilloscope is an **FTP server**.

See §. Applications.

HTTP protocol

With this protocol, the instrument can act as a WEB server and you can access the most frequent settings and view traces on your PC using your browser (INTERNET EXPLORER, NETSCAPE, ...)

To use it, open the browser on the PC and, in the **URL field**, type the IP address of the instrument, preceded by "**http:**"

 *Example: http://192.168.3.1*

See §. Applications.



You must install Java Virtual Machine JVM SUN 1.4.1 (or higher) on your PC to be able to display the traces. This JVM can be downloaded from the site <http://java.sun.com>

LPD protocol

This protocol (Line Printer Daemon) is used by most of the printers connected to an Ethernet network, but also by the printing server units which handle conversion between Ethernet and Centronics ( *Example: Jet Admin*) and UNIX and LINUX workstations.

An **LPD** server can also be installed on a PC (available as an option with WINDOWS 2000 or XP).

In all cases, the instrument is an **LPD** client that has to be configured to indicate to it the IP address of the **LPD** server (the workstation PC or directly the printer) and the logical name of the printer managed by the server.

See §. Applications.

Oscilloscope Mode

The Keys



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

5 "UTILITY" keys or key pad



Direct access to LCD **contrast** adjustment.



When this key is pressed, the display mode toggles between normal to "**full screen**" display.

The screen is organized in such a way as to optimize the trace plotting surface area by:
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 color 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 data will be accompanied by their reference number.*

1 "AUTOSET" key



Automatic optimum adjustment by **Autoset** on the channels where the signal is applied. This concerns the following parameters: the coupling, the vertical sensitivity, the time base, the gradient, the framing and the trigger.

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 **gradient** (up  or down ) by successive presses. The gradient 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:**

A single acquisition is authorized, triggered by pressing the **RUN HOLD** key. For any further acquisition, the trigger circuit must be reset by pressing the RUN HOLD key.

- **"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.

- resets 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



Activates or deactivates the display of the 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-screen using the stylus.

- The "**dt**" measurements (time difference between the two cursors) and "**dv**" measurements (voltage difference between the two 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.

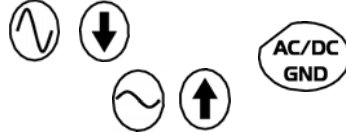
By default, the zoom is performed around the samples located in the middle of the screen.

A zone can be zoomed by tracing a rectangle around the area to be enlarged using the stylus on the touch-screen. 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 7104

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 erased by double-pressing.

OX 7102

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 erased 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

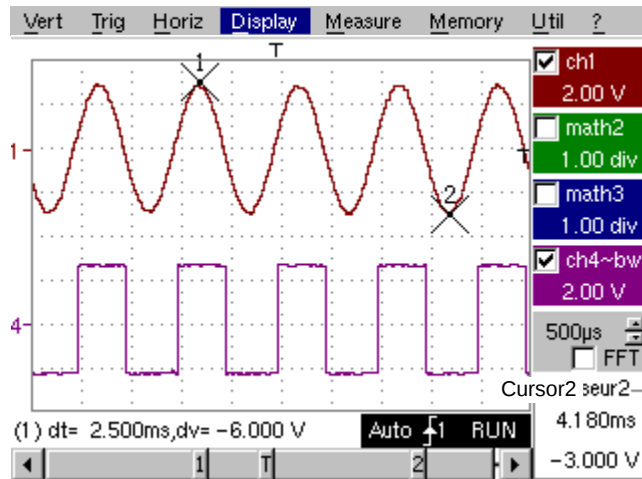


moves it upwards.

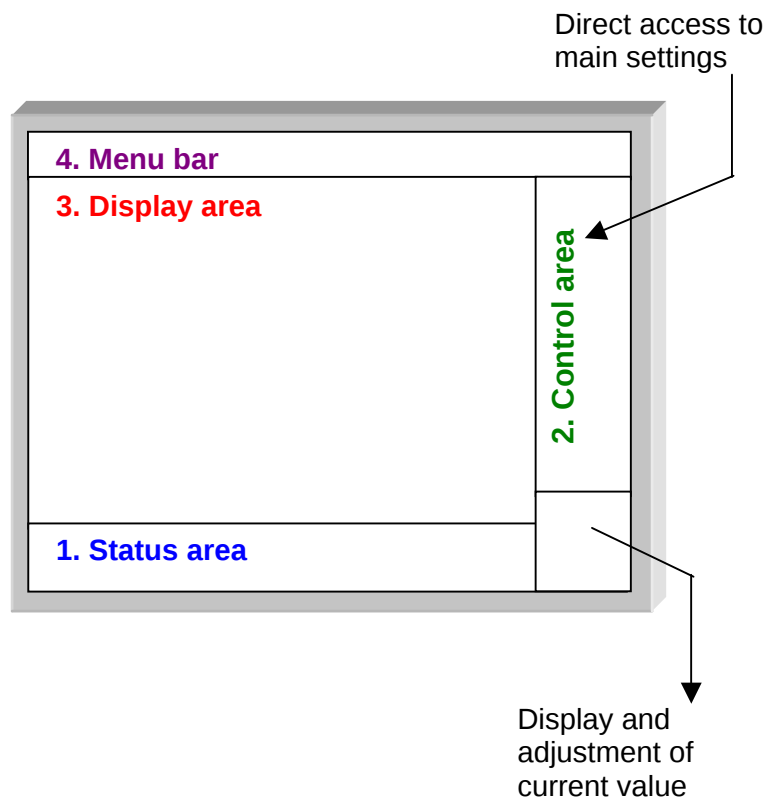
Oscilloscope Mode (cont'd)

Display

Display



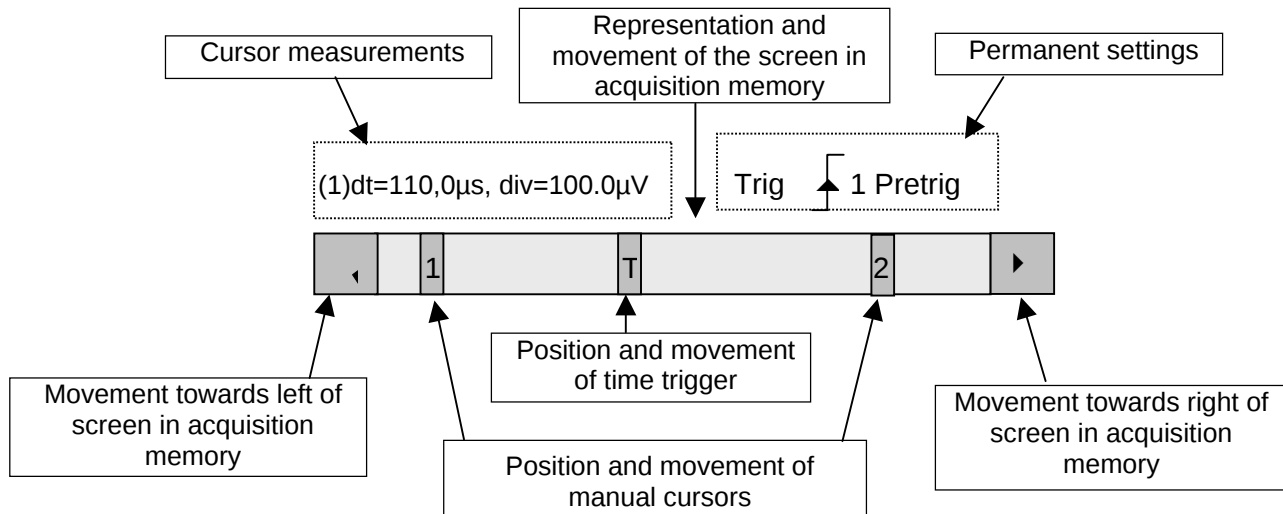
Composition The oscilloscope display is divided into 4 functional zones.



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

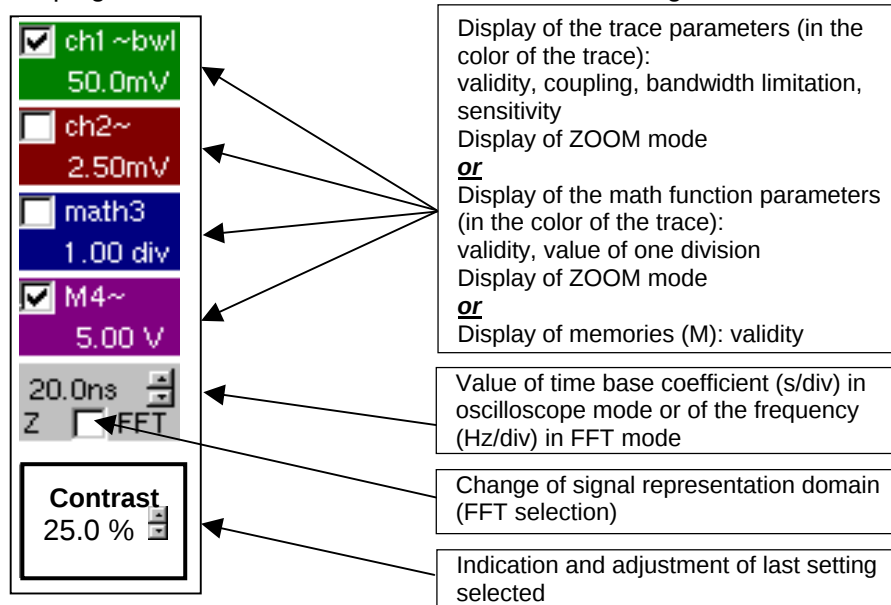
 Example: (2) F = 1.0000 kHz, Vpp = 7,500 V

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 plug 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.
- When the stylus is placed on the parameters or a channel or on the value of the time base, it 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.

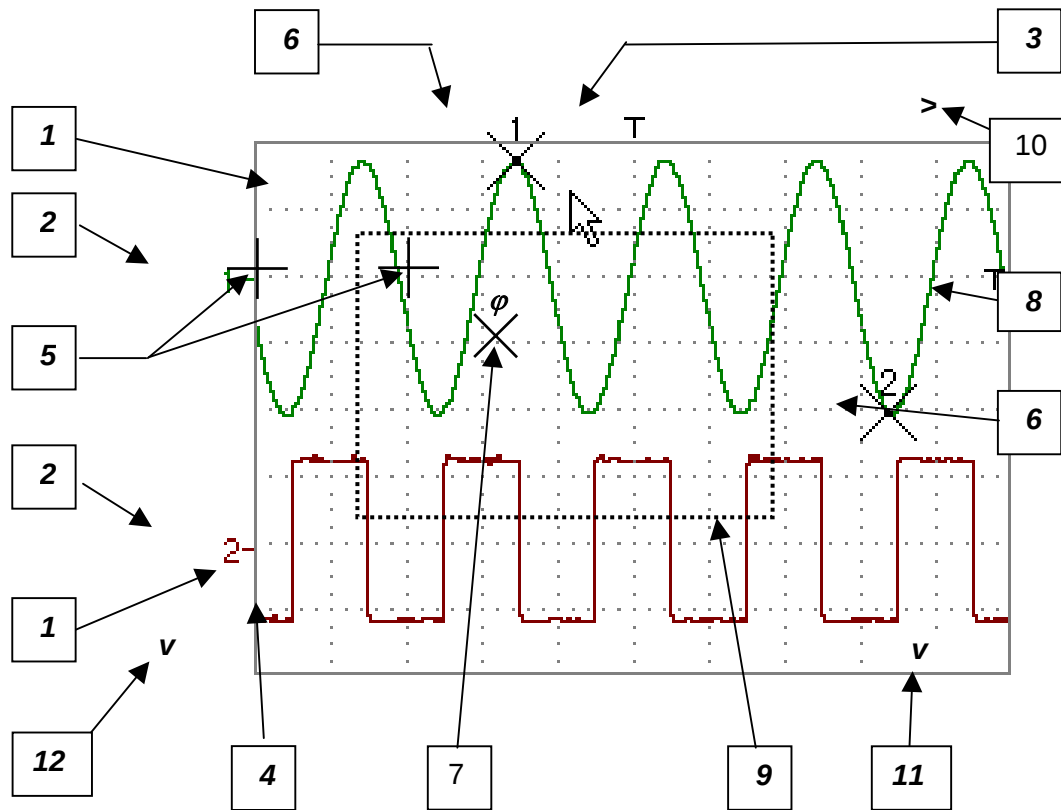
3. Display area

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 measurements
- position indicators regarding the cursors linked or not to the trace for manual measurements
- selection of a zoom zone

Oscilloscope Mode (cont.)

Display elements

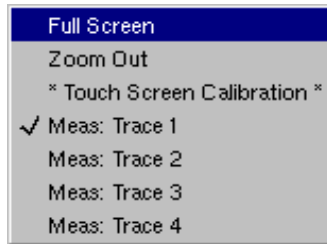


Definition of display

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 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.)

*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-sensitive
screen*

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

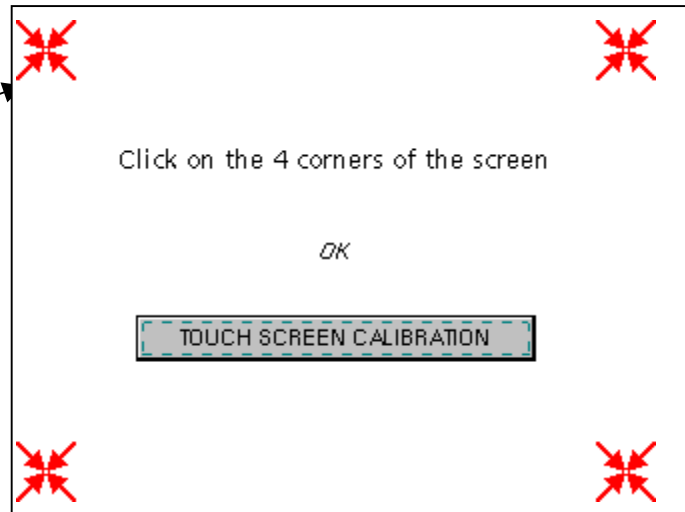
Select the "Touch Screen Calibration" option proposed in the display area menu or in the Util. menu.

Oscilloscope Mode (cont.)

Calibration of the touch-screen (cont'd)

Follow the instructions on the screen

Corner of the touch screen

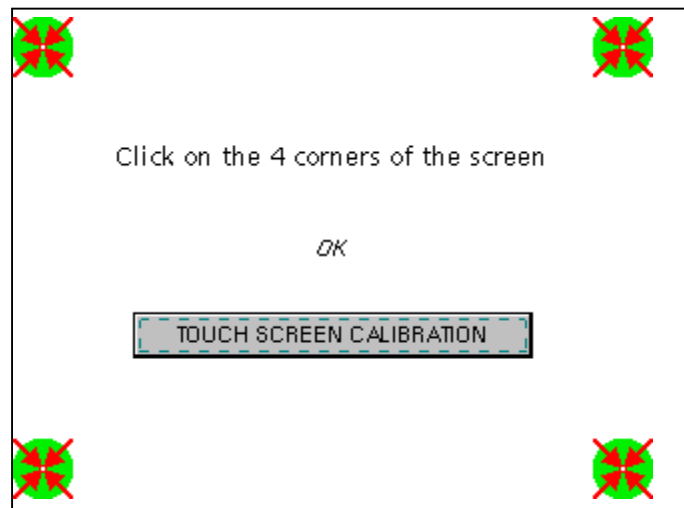


Use the stylus to point at the centre of the 4 patterns displayed on the screen. Validation of the input is indicated by modification of the pattern.



The pointing order is not important.

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



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

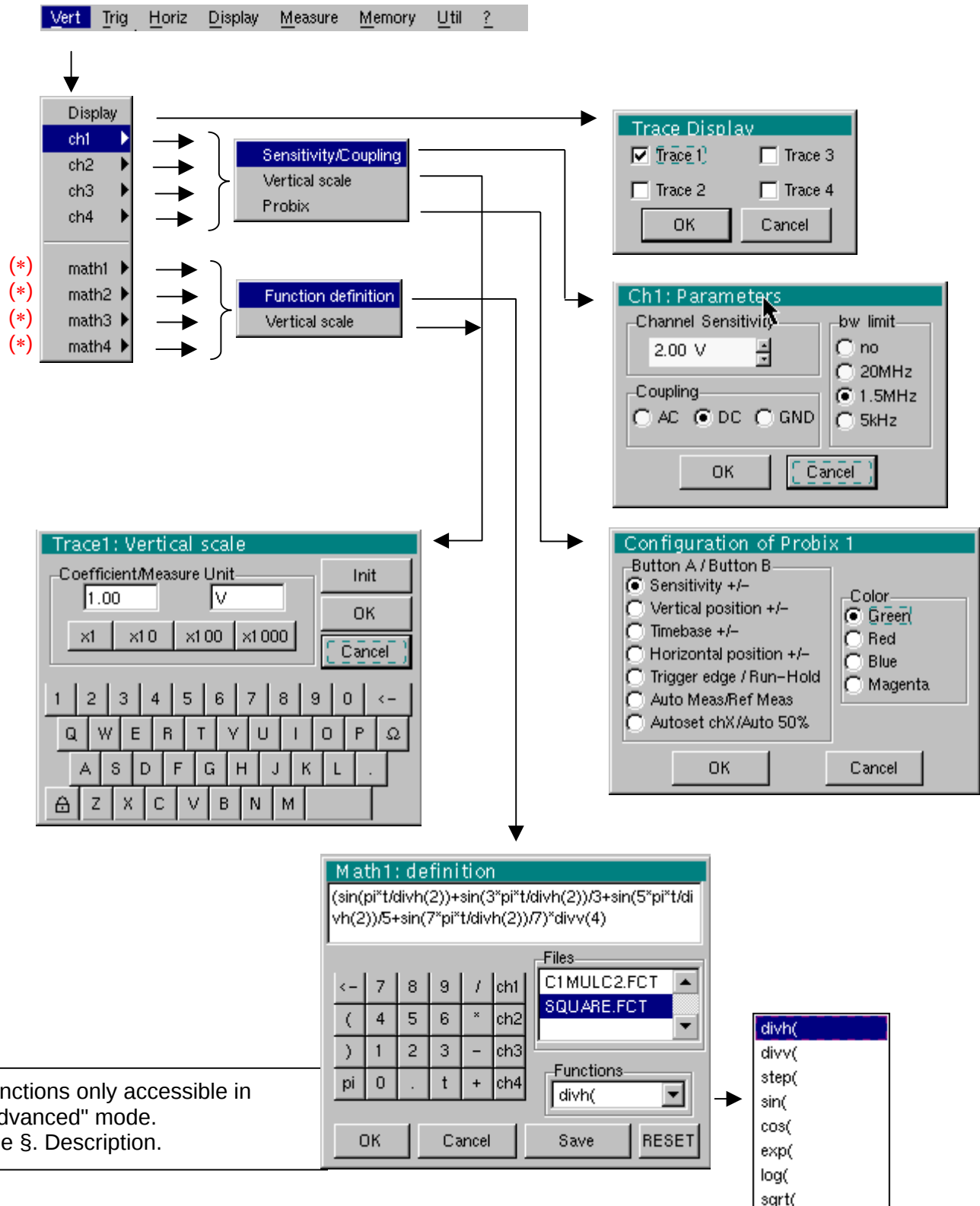
4. Menu bar



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

Oscilloscope Mode (cont'd)

The "Vert" Menu



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 2.5mV to 200V/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 10Hz

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 to 20MHz 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-tapping the stylus on the required channel's parameter display area (CH1, CH2, CH3 or CH4).

PROBIX

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

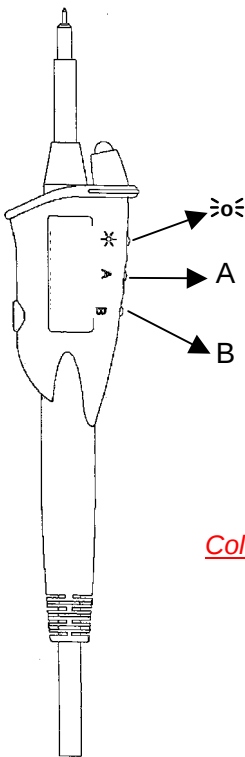
When a **PROBIX** HX0030 probe is connected to one of the oscilloscope's inputs, this menu becomes active.

 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. 	REF MEAS.
Autoset CHx / Auto 50 %	Auto 	AUTO 50% 

- 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.
 - If a **PROBIX** HX0031 BNC adapter or **PROBIX** HX0033 "banana" adapter is connected to one of the oscilloscope's inputs, only the color menu is active.

 **When using PROBIX adapters, the choice of the color remains possible.**

Oscilloscope Mode (cont'd)

math1 math2 math3
math4

Function definition

For each trace, definition of a mathematical function and the vertical scale. Menus present only in Advanced mode (see §. "Util" Menu).

Defines the mathematical function to be assigned to the selected trace by means of a vertical keyboard, linking traces ch1 and ch2, as well as ch3 and ch4 if necessary.



- The mathematical function can be defined on 2 lines.
- ch2 and ch3 can only be used on OX 7104 oscilloscope.
- 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 2500-sample acquisition memory.

divh(1) is equivalent to 250 samples (counts) = 1 horizontal division

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

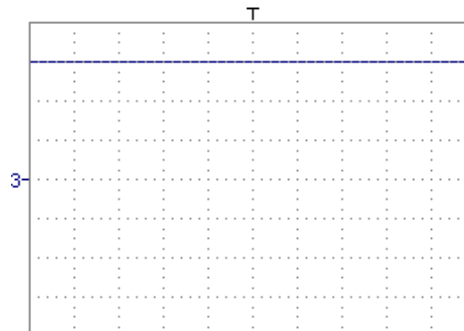
In each cases, the measuring unit can be re-defined and a coefficient can be applied to the measurement results (refer to §. Vertical scale).

Oscilloscope Mode (cont'd)

Examples

Use of predefined mathematical functions

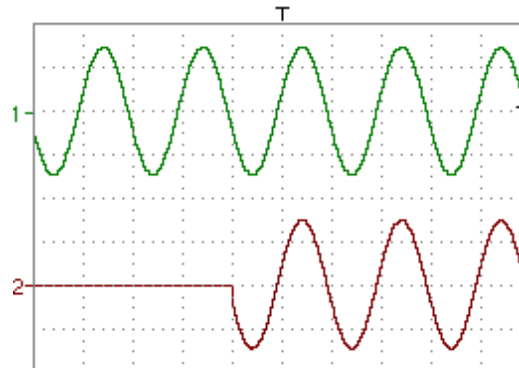
- Predefined `divv()` function used on its own: `math3 = divv(3)`.



The trace is equal to 3 vertical divisions.

- Predefined `step()` function associated with a trace:

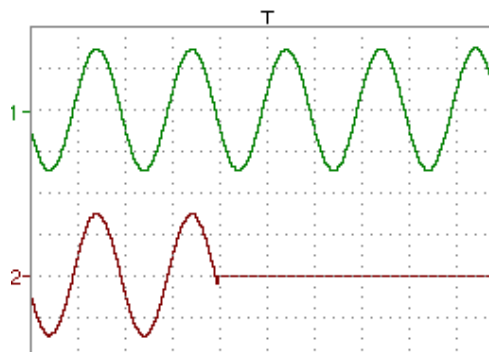
- `math2 = ch1*step(t-divh(4))`



The result of `math2` is 0 vertical divisions as long as `t` is less than four horizontal divisions (`t-divh(4) < 0`).

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

- `math2 = ch1*step(divh(4)-t)`



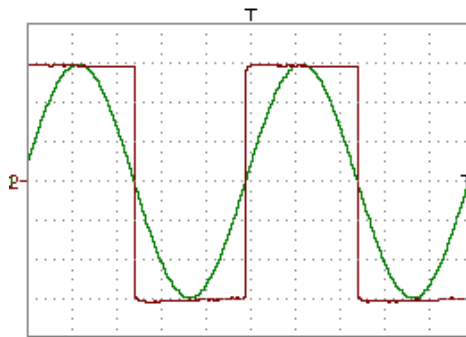
The result of `math2` is equal to `ch1` as long as `t` is less than four horizontal divisions (`t-divh(4) > 0`).

the result of `math2` is at 0 vertical divisions when `t` becomes greater than four horizontal divisions (`t-divh(4) < 0`).

Oscilloscope Mode (cont'd)

Example 1

Addition of two traces



V_{high}

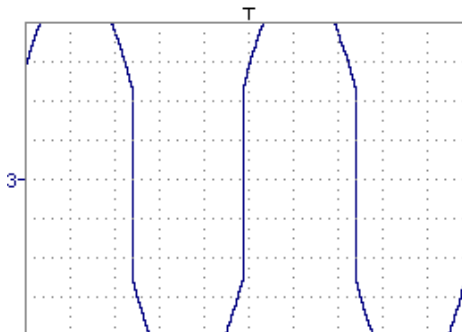
V_{pp}(ch1) = V_{pp}(ch2) = 6 V
Sensitivity (ch1) = 1 V/div
Sensitivity (ch2) = 1 V/div

Traces ch1 and ch2 are optimised on 6 vertical divisions.

V_{amp} ch1 = 6 vertical divisions

V_{amp} ch2 = 6 vertical divisions

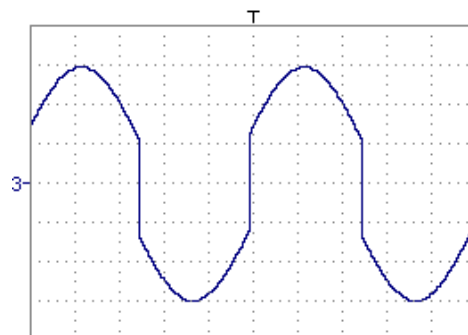
- math3 = ch1+ch2



Vertical scale math3 = 2.00 div
V_{pp} math3 = 12.00 div
V_{high} 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
V_{pp} math3 = 12.00 div
V_{high} math3 = 6.00 div

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

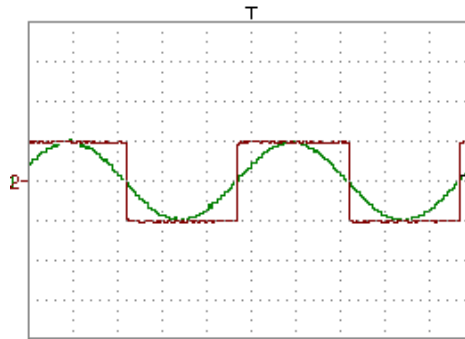
V_{amp} math3 = 6 vertical divisions

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

- $\text{math3} = \text{ch1} * \text{ch2}$

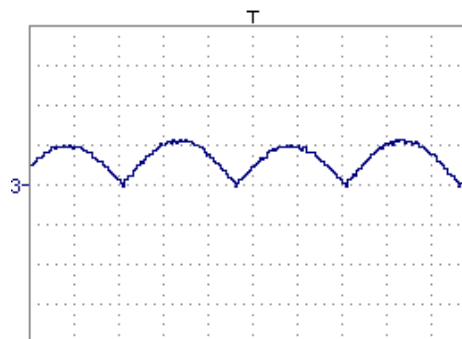


As for the addition of traces, there is an even more significant high and low overshoot.

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.

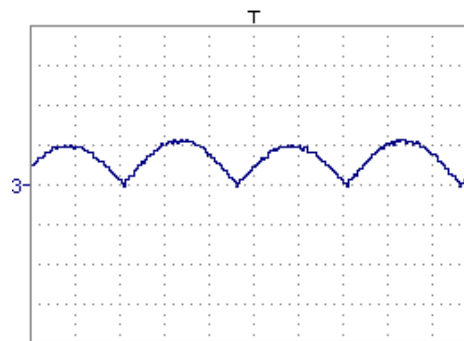
Oscilloscope Mode (cont'd)

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).



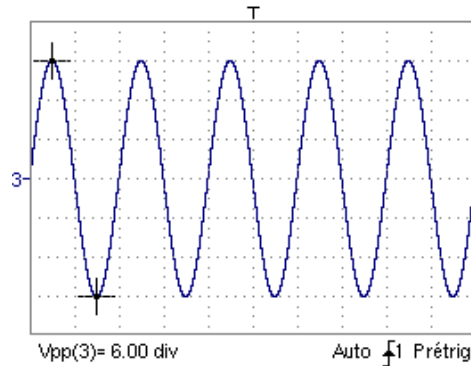
Sensitivity(math3) = 25 VV
Vpp (math3) = 25 VV

Oscilloscope Mode (cont'd)

Example 3

Association of predefined functions

- $\text{math3} = \text{divv}(3) * \sin(2 * \pi * t / 500)$.

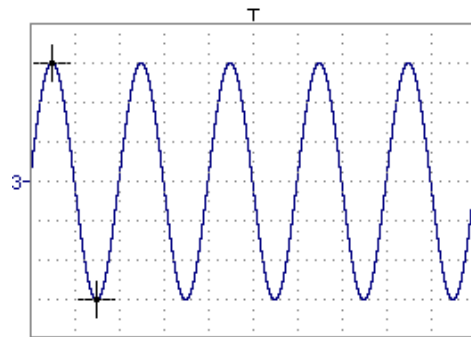


The trace obtained is a sine-curve produced using the predefined function "sin()".
The amplitude is 6 divisions.

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

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

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



In this example, $\text{divh}(2)$ is equivalent to 500 samples.

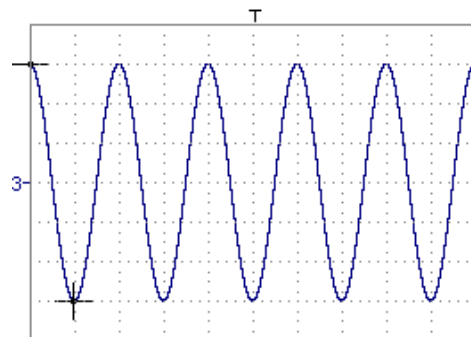


1 horizontal division = 250 samples

The period $\text{divh}(2)$, equal to 500 samples (2 horizontal divisions), depends on the time base.

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

$\text{math3} = \text{divv}(3) * \cos(2 * \pi * t / \text{divh}(2))$

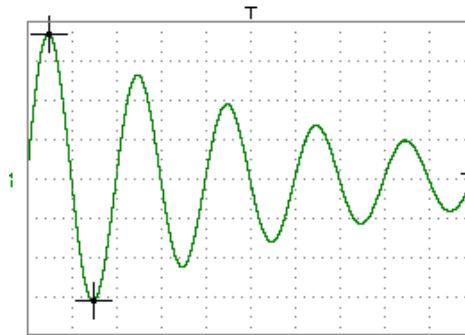


The trace obtained with the predefined cos() function is offset by 90°.

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

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.

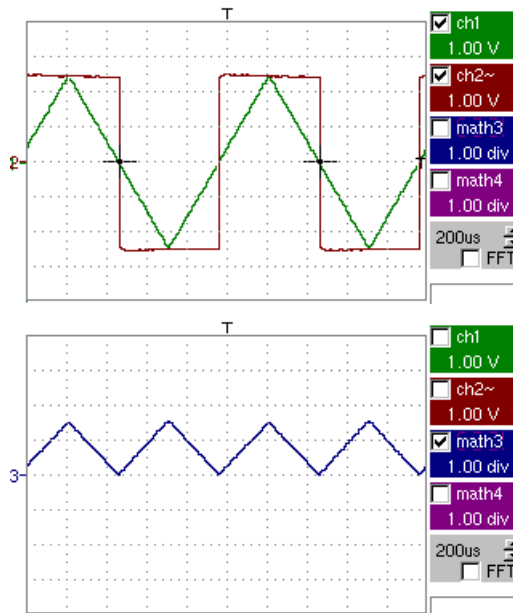
The function can be modified with the table of usable characters, associating the ch1 and ch2 traces.

This menu also contains two predefined functions.

C1MULC2.FCT and SQUARE.FCT

C1MULC2 .FCT

Product of 2 traces with scaling:



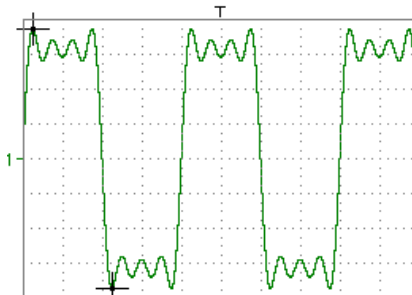
$$\text{math3} = \text{ch1} * \text{ch2} / \text{divv}(4) = \text{C1MULC2.FCT}$$



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 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.

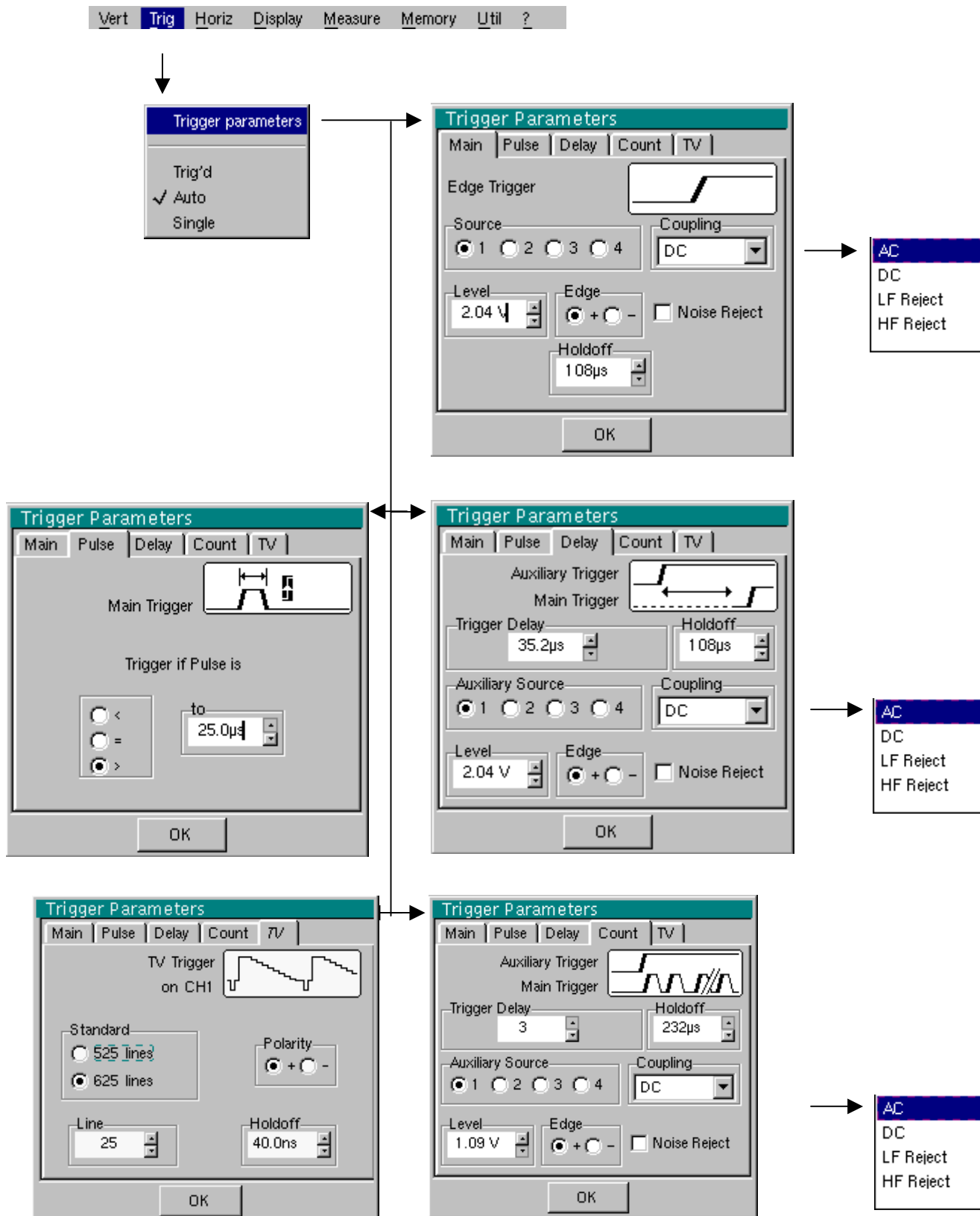
Validation of the selections by **"OK"**. Exit from the menu without modification by **"Cancel"**.



The "Vertical scale" menu can also be called up by double-tapping 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".

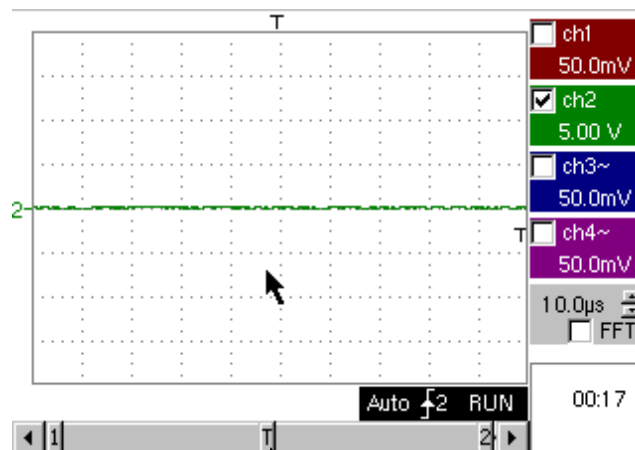
- The **"Main"** tab can be used to choose and parameterize the main trigger source.
- The **"Delay"** and **"Count"** trigger modes require parameterization of a second "auxiliary" trigger source. The auxiliary source may be the same as the main source.

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.

Edge Selection of the trigger gradient:

+ leading trigger edge 

- trailing trigger edge 

The selected trigger edge is indicated 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 ≈ 0.5 div.

Yes: introduces a hysteresis of ≈ 1.5 div.

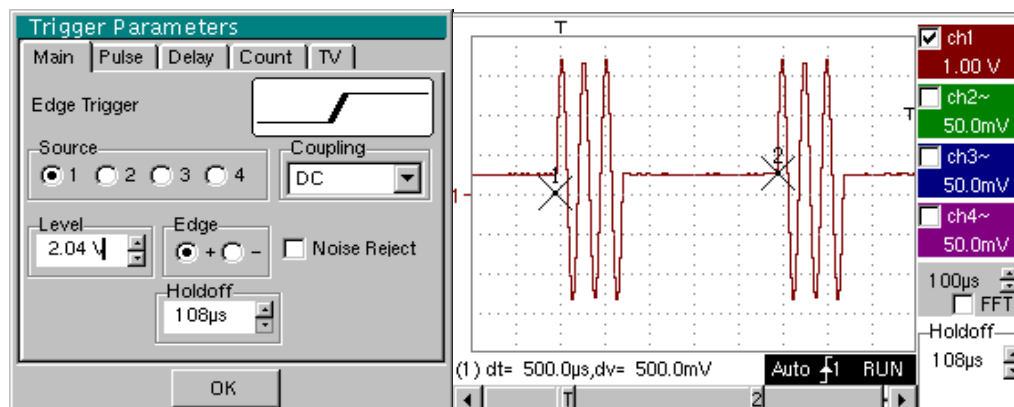
Holdoff 108 μ s allows:

- 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.

 **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.



Oscilloscope Mode (cont'd)

Principal (suite)

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 μs .

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.

Pulse

Selection of pulse-width trigger. In all cases, the effective trigger occurs on the pulse trailing edge.

- < triggers on a pulse if its duration is less than the value set
- = triggers on a pulse if its duration is equal to the value set
- > triggers on a pulse if its duration is greater than the value set

25.0 μs Adjustment with the stylus using the time setting scroll bar

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

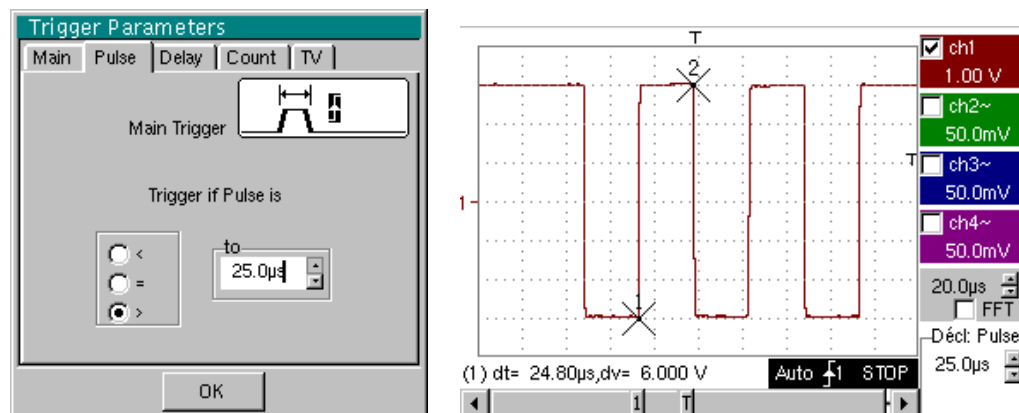


The choice of the or edge in the "Main" tab defines the limits of the analysis:

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

Example

Signal injected on CH1: 1 pulse of 50 μs (repetitive or not)



The trigger parameters in the main menu are active (Source, Level, Edge, etc.).

The oscilloscope is triggered when the signal's pulse width is equal to the specified pulse width (25.0 μs + tolerance).

The trigger occurs on the leading 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

35.2 μ s

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

108ns

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.

Auxiliarysource

selects the **channel** as the trigger source.

Coupling**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

HF Reject

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

Level

2.04V

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

Edge

selects the edge for the auxiliary trigger source:

+ leading trigger edge 

- trailing trigger edge 

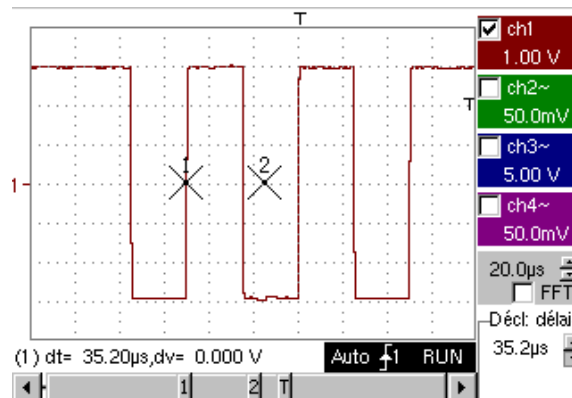
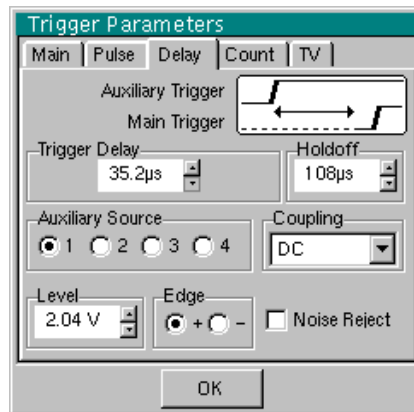
Noise reject

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 leading 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

3 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

232 μ s 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.

Auxiliary source

selects a **channel** as a trigger source.

Coupling

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.

Edge

Selection of the trigger gradient:

+ trigger on leading edge 

- trigger on trailing edge 

The selected trigger edge is indicated the status area.

Level

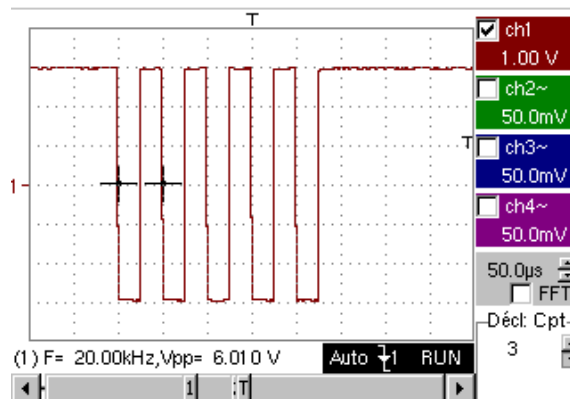
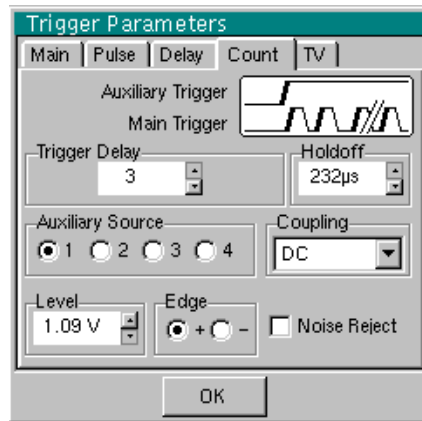
1.09V Adjustment of the trigger level with the stylus on the scroll bar.

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 trailing edge.
- The first edge activates the trigger. It is not included in the count.
- The trigger is triggered on the third trailing 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.

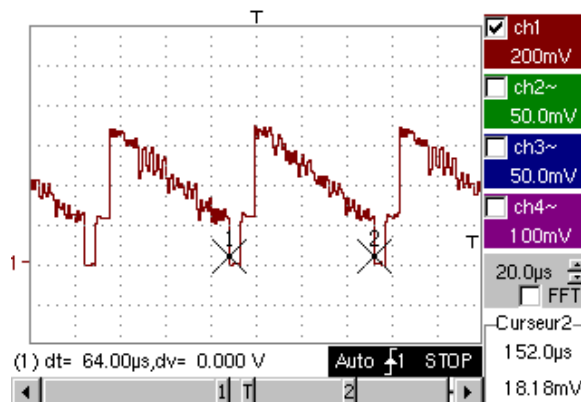
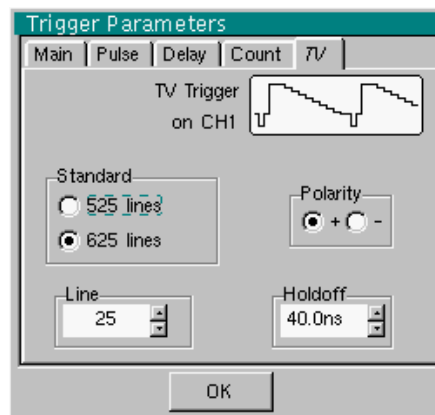
- 625 lines (SECAM) or
- 525 lines (PAL)

Polarity + Direct video - Reverse video

Hodoff 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 "⊙" and "✓" symbols indicate the selected parameters.

Validation of the selections by "OK".



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

Oscilloscope Mode (cont'd)

Triggered mode

The 3 following selections define the trigger 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



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).

- 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, ...



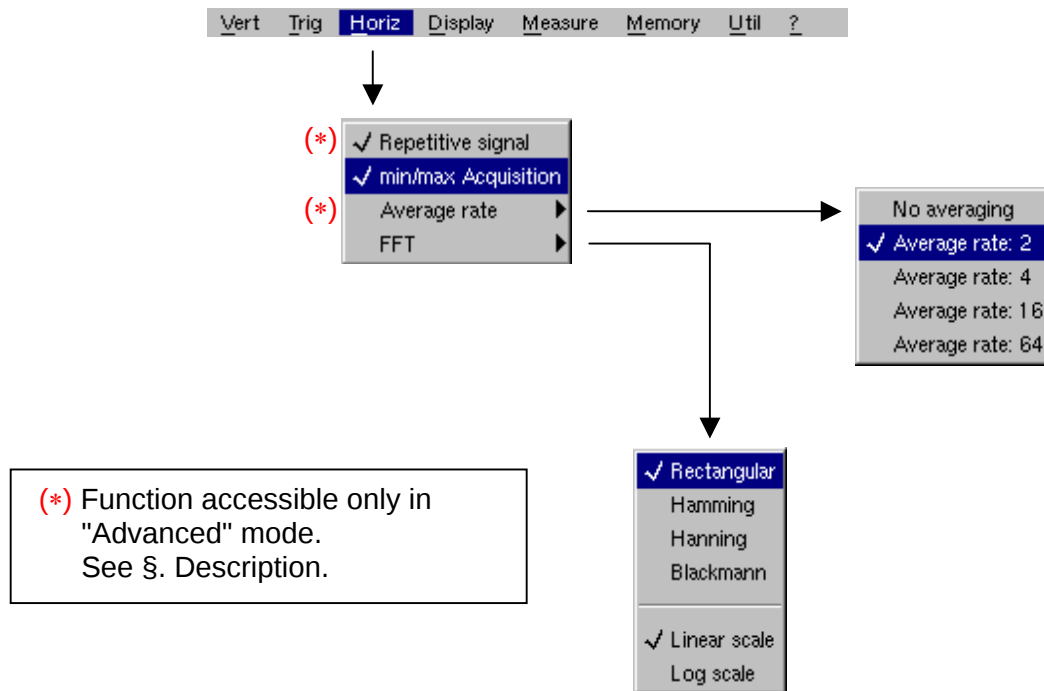
This selection can also be called up by double-tapping the stylus on the time base display area.

Roll mode

If the time base is set to value > 50 ms/div, the activation of the SINGLE mode involves the interlocking of the ROLL mode (run of the trace from the right-hand side towards the left of the screen).

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).



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

Min/Max Acquisition

Sampling of the signal, even at slow time-base speeds. The display only takes extreme value samples (min. and max.) into consideration.

This mode:

- detects wrong representation due to under-sampling
- displays short-term events (Glitch, $\geq 2 \text{ ns}$).

Whatever time base is used, short-term events (Glitch, $\geq 2 \text{ ns}$) are displayed.



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

Oscilloscope Mode (cont'd)

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:

Pixel_N = Sample*1/Average rate + Pixel_{N-1} (1-1/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.

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

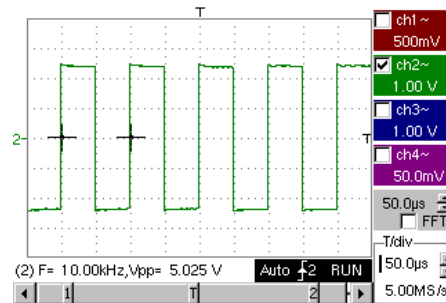
n: time index

k: frequency index

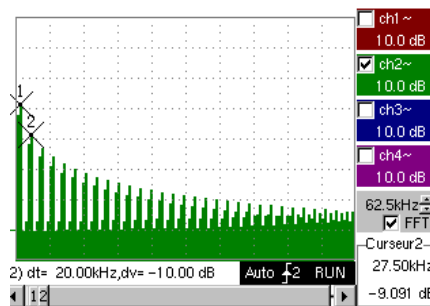
The displayed trace represents the amplitude in V or dB of the various signal frequency components according to the scale selected (linear or logarithmic).

The DC component of the signal is removed by software.

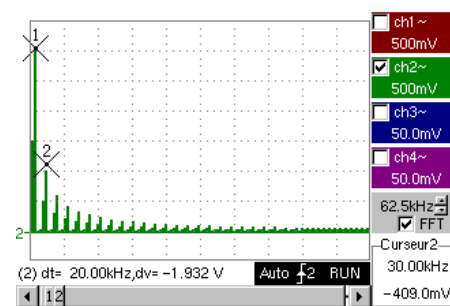
Oscilloscope Mode (cont'd)



10 kHz square signal on CH2 and 5 Vpp



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.)

$$\bullet \text{ in V/div.} = \frac{\quad}{2}$$

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

$$\bullet \text{ in dB/div.} = \quad \text{by assigning 0 dB to a signal with an effective amplitude of 1 in the time representation}$$

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.

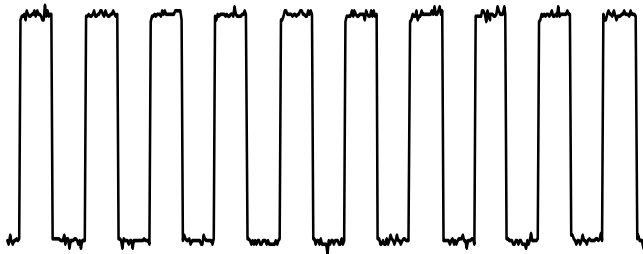
Rectangular

Hamming

Hanning

Blackman

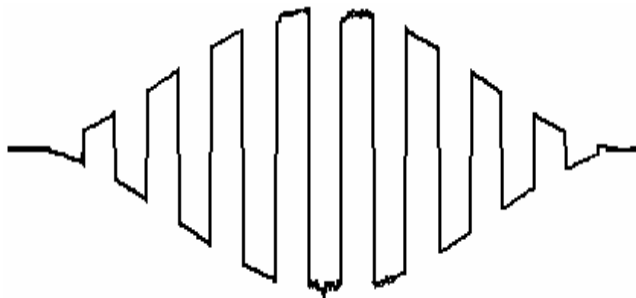
Before calculating the FFT, the oscilloscope weights the signal to be analyzed by means of a window acting as a band-pass filter. The choice of window type is essential to distinguish between the various lines of a signal and to make accurate measurements.



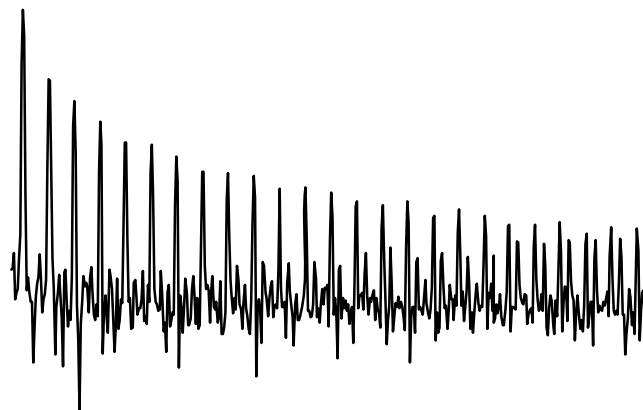
Time representation
of signal to be
analyzed



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 $\sin x/x$.

This convolution modifies the graphic representation of the FFT because of the lateral lobes characteristic of the $\sin x/x$ 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.

<i>Type of window</i>	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:

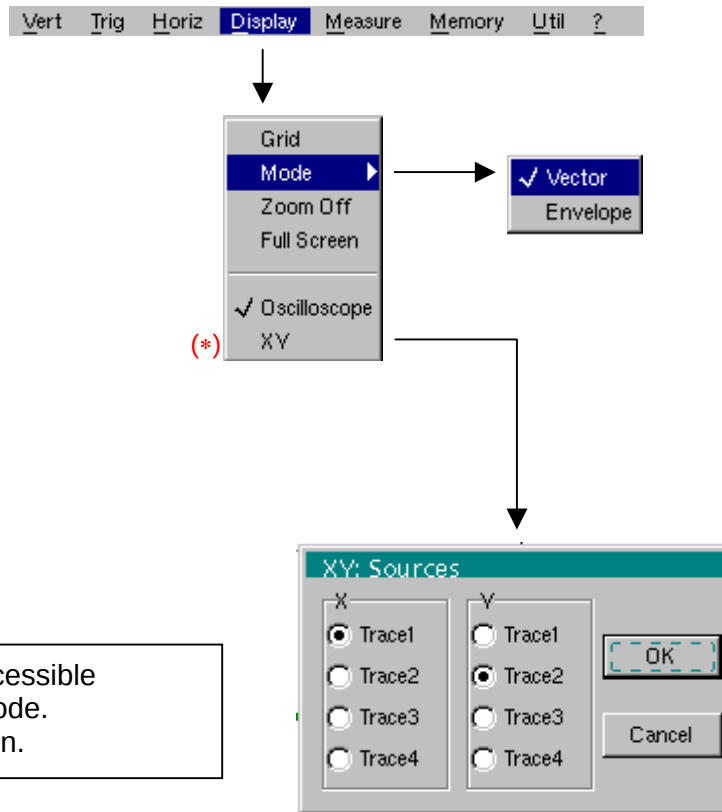
If the sampling frequency is not correctly adjusted (less than or twice the maximum frequency of the signal to be measured), the high-frequency components will be under-sampled and appear in the graphic representation of the FFT by symmetry (aliasing).

- 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.

Oscilloscope Mode (cont'd)

The "Display" Menu



(*) Function only accessible in "Advanced" mode. See §. Description.

Grid

Display / Removal of graticule

Display modes

Vector
Envelope



There are two display modes available: vector and envelope.

A vector is plotted on the basis of each sample.

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.

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-tapping 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-tapping 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 mode 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”.

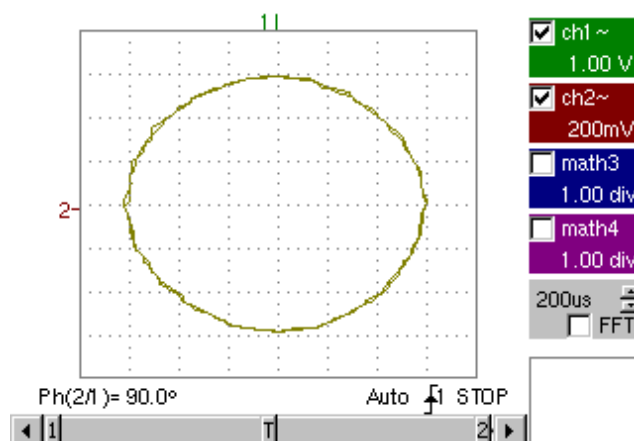


- Each axis is graduated into 8 divisions.
- The selected traces are identified by a figure corresponding to their axis.
- The “⊙” symbol indicates the trace selected for each axis.



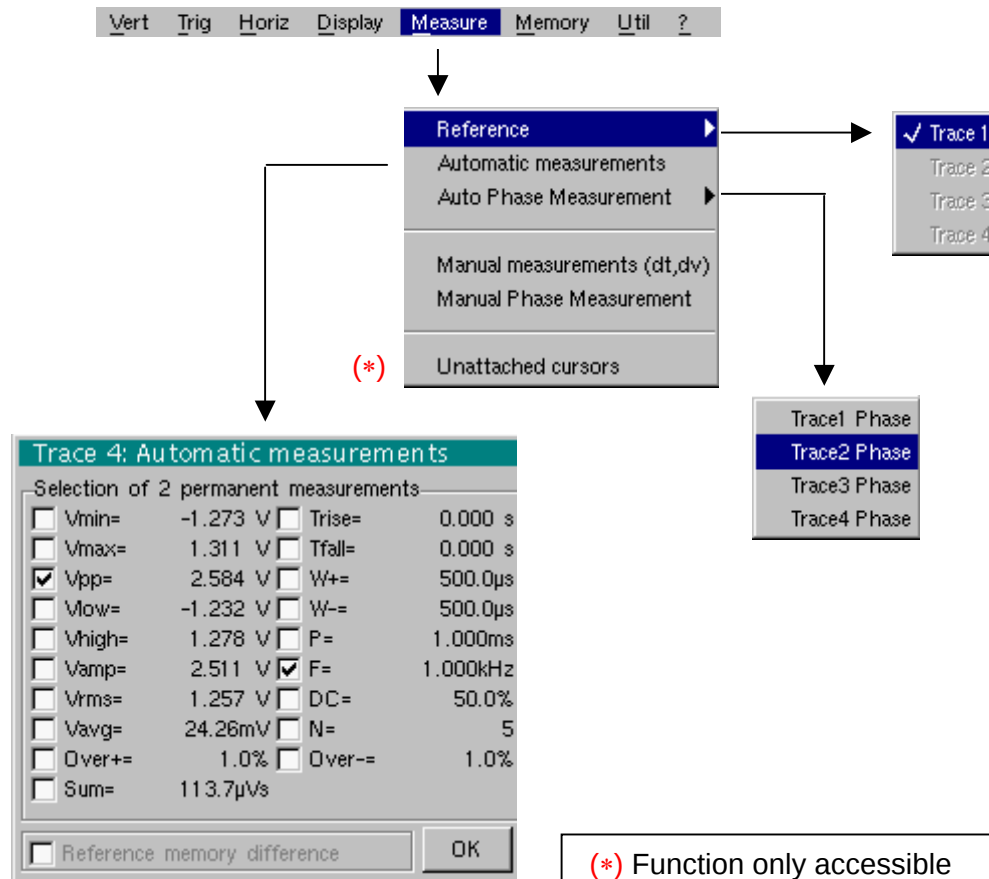
Example

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



Oscilloscope Mode (cont'd)

The "Measure" Menu



(*) Function only accessible in "Advanced" mode.
See §. Description, page 71.

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 color.

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

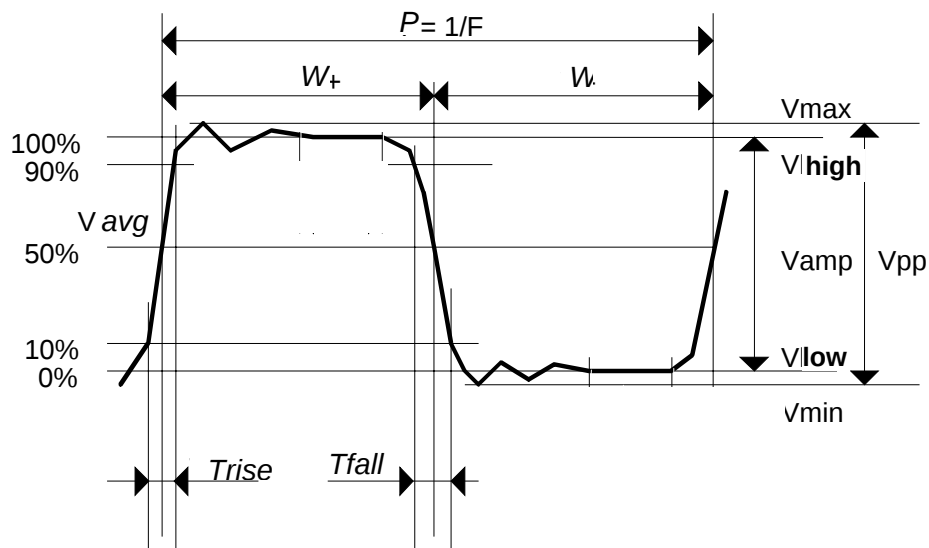
Vmin	minimum peak voltage
Vmax	maximum peak voltage
Vpp	peak-to-peak voltage
Vlow	established low voltage
Vhigh	established high voltage
Vamp	amplitude
Vrms	rms voltage
Vavg	average voltage
Over+	positive overshoot
Trise	rise time
Tfall	fall time
W+	positive pulse width (at 50 % of Vamp)
W-	negative 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 = $[100 * (V_{min} - V_{low})] / V_{amp}$

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

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

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°

- 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:

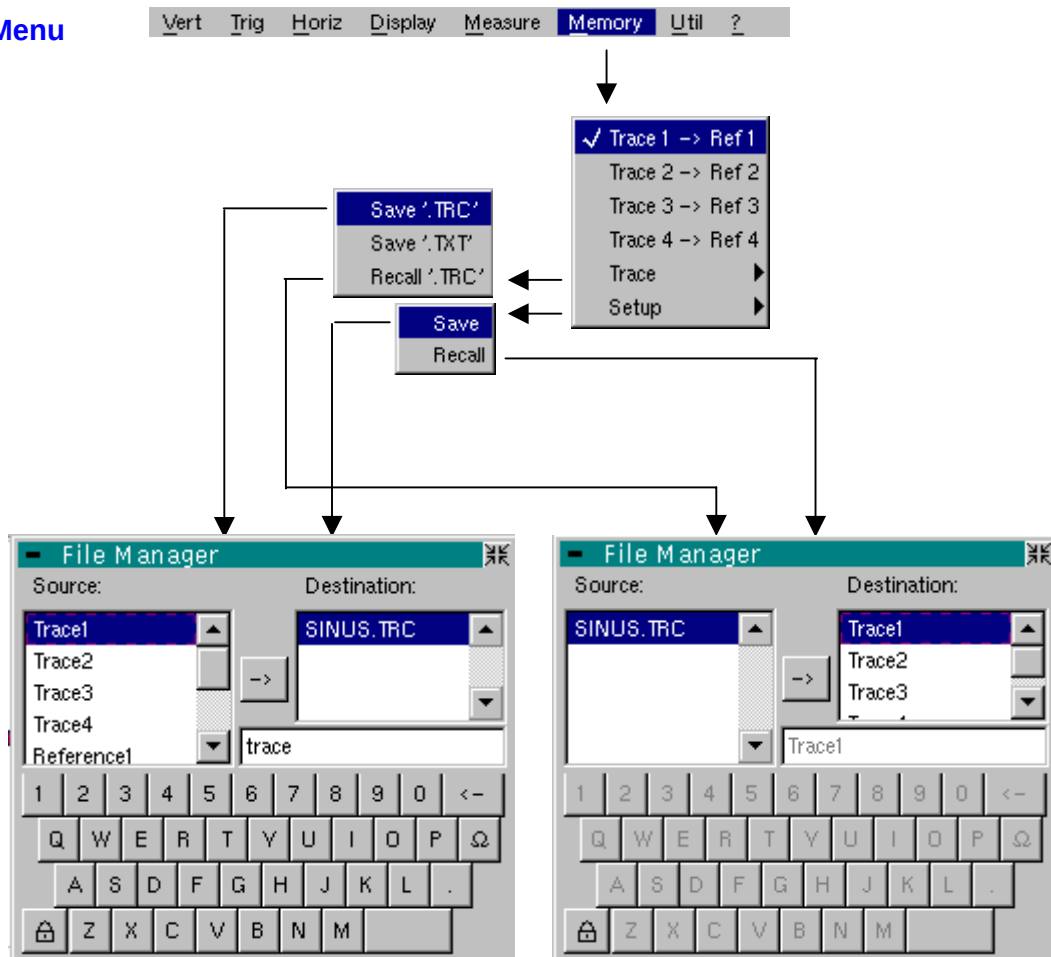
If ...	then ...
... the manual cursors and the automatic markers are displayed together,	... the automatic measurements are performed on the portion of the trace defined between the manual cursors.
... the portion defined between the manual cursors is too small [in this case, the fixed markers (+) will 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.: 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.

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).
- If all the traces and reference memories are present on the screen, the right scroll bar in the menu can be used to move around inside the list.

- * A default backup file name is proposed above the keyboard. 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.

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



- The file name is limited to a maximum of 15 characters + the suffix. If this rule is not respected, the message 'File name too long' is displayed.
- As soon as the pointer passes over a destination file, the name is displayed with its recording date
its recording time
its size.
- If the name already exists or is incompatible, an error message 'Impossible! File already exists' will be displayed.

Oscilloscope Mode (cont'd)

Recall .TRC

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

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

The name of the file selected for recall appears in grey. The stylus is used for selection.

- * After selecting the file to be recalled, the "destination" list indicates on which trace you want to recall it. The destination trace selected (1 to 4) by pointing with the stylus appears in grey. It is also indicated at the bottom of the screen.
- * Once the trace to be recalled and its destination have been selected, the  key is used to execute the operation and close the menu.

You can exit from this menu without recalling by pointing with the stylus on the icon in the top right-hand corner.



- *If the destination trace selected is already present on the screen, it will be replaced by the recalled trace.*
- *When a trace is recalled, "Mx" is displayed in the destination trace parameters.*
- *In this menu, the virtual keyboard cannot be used.*

Configuration

Saving or recall of an instrument configuration.

Save

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

- * In the "Source" menu, there is a file called "Configuration". It contains the parameters of the instrument's configuration when this menu is opened.
- * A back-up file name is proposed above the Qwerty keyboard. The  key deletes the character preceding the cursor in this area.
- * When the source file name has been entered, the  key is used to record the configuration by transferring it into the destination menu, before closing the menu (save file: .CFG suffix).

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



- *The file name is limited to a maximum of 15 characters + the suffix. For a source file, the name is accompanied by the recording date and time and the file's size, as soon as the pointer passes over its name.*
- *If the name already exists or is incompatible, an error message will appear.*

Recall

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

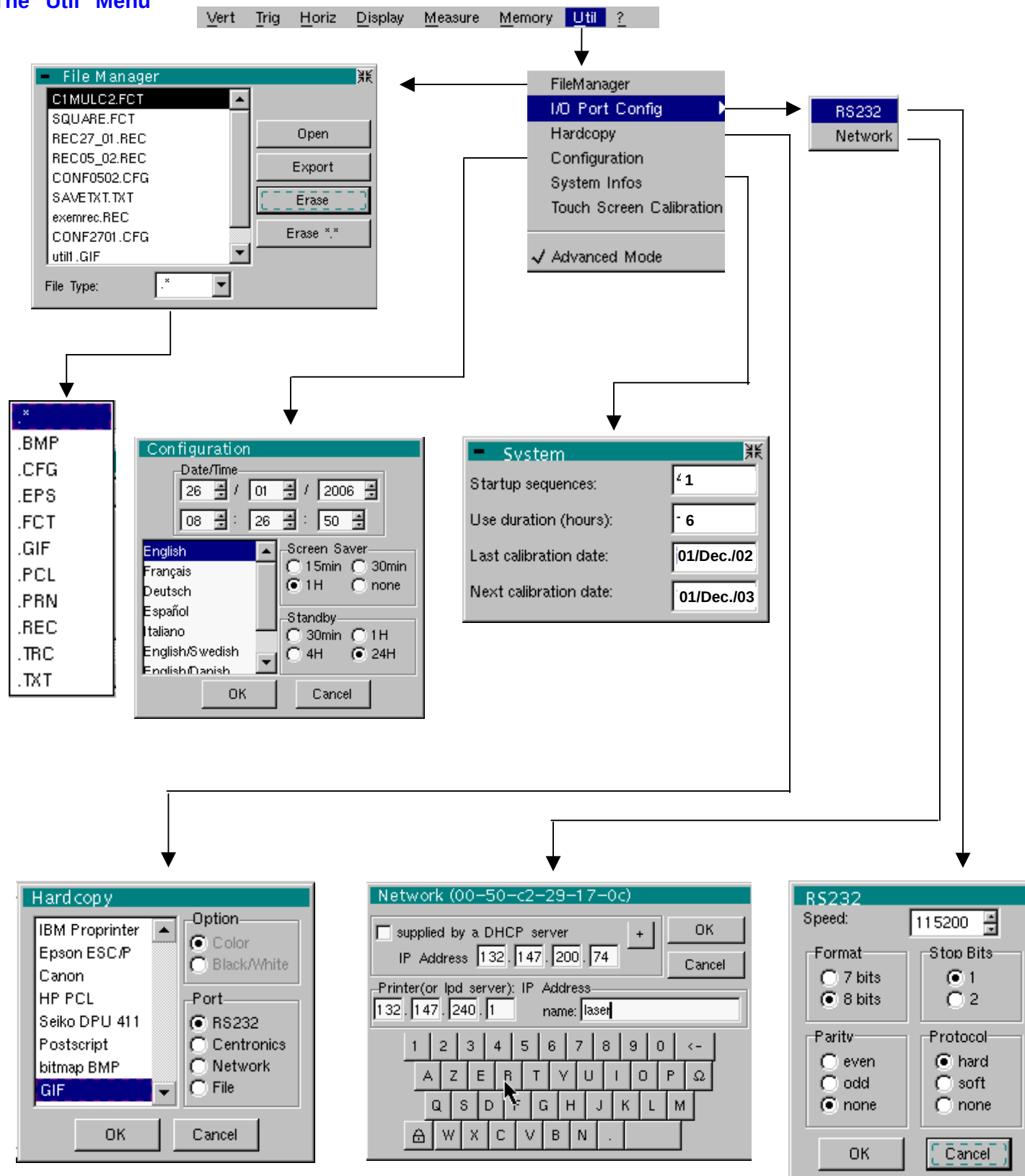
- * In the "Source" list, the .CFG files recorded previously (via the menu "Configuration → Save") are displayed. The name of the file selected for recall appears in grey. The selection will be made using the left mouse button. The scrollbar on the right is used for moving through the list.
- * With the source file selected, the  key is used to perform the recall.
- * You can exit from this menu without recalling by pointing with the stylus on the top right-hand corner of the window.



- *In this menu, the virtual keyboard cannot be used.*
- *Use the "default config" file to restore the factory configuration.*

Oscilloscope Mode (cont'd)

The "Util" Menu



Oscilloscope Mode (cont'd)

Files



Selection of the "File Management" menu.

It contains the files which have been:

- recorded since the instrument was first used
- created since the last startup. These files will only be saved definitively when the instrument is switched off using the key shown *opposite*.

If there is a AC power power cut during saving of the configuration, the files in the file manager will be lost.

The configuration back-up files (.CFG),
for traces (.TRC),
for sampling (.TXT),
for functions (.FCT),
for printing (.PRN, .PCL, .EPS, .BMP, .GIF)
are accompanied by the date and time when they were saved and their size.

The selected file appears in grey. The stylus is used to select the file. The scrollbar on the right is used for moving through the list.

File type

Selection of the file type required, using the corresponding filter:

.CFG	.TRC	.FCT	.PRN	.PCL	.EPS	.BMP	.GIF	.REC	.TXT
------	------	------	------	------	------	------	------	------	------

The stylus is used for selection.

" . * " can be used to select all the file types.

The storage capacity of the file manager is 1Mb.

Open

causes restoration of the file selected by the "File Copy" menu.

Erase

deletes the selected file.

Erase*.*

deletes all the files the extension of which has been selected in "File type".

Export

transmits the file over the active communication interface (RS-232/Centronics), network.
You can exit from this menu by pointing with the mouse on the icon in the top right-hand corner of the window.

I/O port config.

RS 232

Selection of the "RS-232" or "Network" menus.

This menu can be used to configure the "serial" remote programming interface or the "network" interface (Ethernet).

This interface uses the connector (RS-232/Ethernet) on the right-hand side of the instrument. It requires the use of the RS-232 / SUBD9 cable (HX0042).

Speed

selects the transmission speed : 300 to 115,200 Baud.

Format

selects the word length: 7 or 8-bit.

Parity

selects the type of parity: even, odd or no parity (none).

Stop bits

selects the number of stop bits (1 or 2 stop bits).

Protocol

selects the serial link management mode.

Hard Hardware: the protocol is provided by the RTS and CTS lines of the RS-232 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

supplied by a DHCP server

If this box is notched, the instrument makes a request towards a DHCP server to obtain automatically

- an address IP,
- the value of the mask of sub-network,
- the address of the gateway,
- possibly the IP address of a network printer (according to the configuration of the DHCP server).



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

Corresponds to the address of the oscilloscope on the Ethernet network.

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

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

IP address

Corresponds to the address of the oscilloscope 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

Printer or LPD server: IP address

Corresponds to the IP address of the printer, or of a PC to which the printer is connected. In this case, the "LPD Server" software needs to 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

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 is accessible in the "Advanced" mode only.

It gives access to the manual programming of the Subnet mask and to the programming of the IP address of the gateway.

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

Oscilloscope Mode (cont'd)

Hardcopy

The printing format, the type of printer and the communication port are chosen in this menu.

The printer type or selected format will appear in reverse video. The stylus is used for selection. The scrollbar on the right is used for moving through the list of types or the printer languages.

Option

Choice of color or black/white printing.

Port

Selection of the interface used for print data transfer: RS-232C, Centronics (using the adapter provided as an option) or in a file.



- If the RS-232C 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 (IP address, printer) 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 printout is activated, the "File copy" menu opens and you have to enter the name of the file generated (see "Trace → Save" menu).



A hard copy of the screen can be printed by pressing this key. The hard copy is produced 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.

Language

Selection of the menu language: **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: **15 min, 30 min, 1 hour, 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: **30 min, 1 hour, 4 hour, 24 hour.**



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 option selected.
- The option can be modified using the stylus.

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

Oscilloscope Mode (cont'd)

System Info

Next calibration date



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

Periodic (annual) equipment calibration is necessary to guarantee the specifications announced.

For verification of the instrument, see §. Maintenance.

You can exit from this menu by tapping the stylus on the icon in the top right-hand corner.

Touch-screen calibration

See pages 28 and 29.

"Advanced" Mode

Menus present in "Advanced" mode only



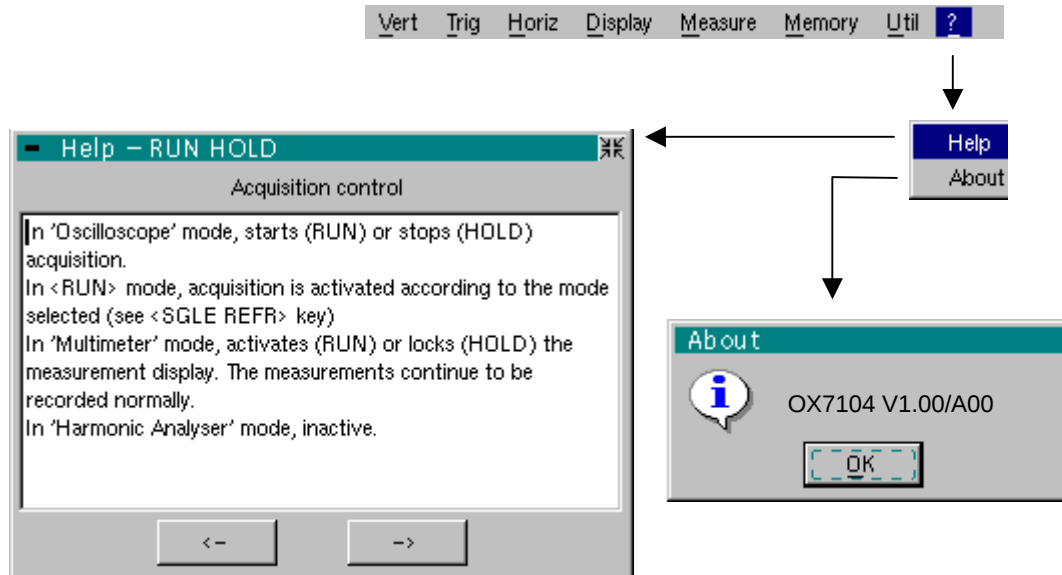
math1, math2, math3, math4 → accessible via the "**Vert**" menu
Averaging, repetitive signal → accessible via the "**Horiz**" menu
XY → accessible via the "**Display**" menu
Unattached manual cursors → accessible via the "**Measure**" menu



- The "✓" symbol indicates that the "Advanced" mode is active.
- The stylus can be used to modify this.
- By default, the "Advanced" mode is not active.
- In "non-advanced" mode, the instrument's configuration is not saved when it is shut down using the key opposite and the default factory configuration is loaded at start-up.

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.

About

Provides information on:

- the name of the instrument
- the version of the software
- the version of the hardware

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

Multimeter Mode

The Keys



Press the key *opposite* to select the "**Multimeter**" mode.

4 "UTILITY" keys or key pads



Direct access to LCD **contrast** adjustment.



No action.



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.



No action.

1 "AUTOSET" key



No action.

Selective "AUTOSET"



+



No action.

4 "TRIGGER" keys



No action.



No action.



No action.



To lock / unlock the display of the measurements. Plotting of the traces never stops.

Multimeter Mode (cont'd)

3 "MEASURE" keys



No action.



For changing the reference trace to which the cursor refers (successive presses).



No action.

3 "HORIZONTAL" keys or key pads



Duration of the recording in the display window: **5', 15', 30', 1h, 6h, 12h, 24h, week, month.**



No action.



No action: zoom not possible in this mode.

5 "VERTICAL" keys or key pads

The instrument contains as many independent multimeters as there are channels in "Oscilloscope" mode (2 or 4).



Same function as in "Oscilloscope" mode.



A long press enables or disables the autorange on the channel concerned.

The channel is displayed and selected.



No action.



If a channel is activated and selected, this key can be used to change the input coupling of the channel. By successive presses, the coupling can be changed from AC to DC to AC+DC.

The coupling is indicated in the multimeter window of the channel concerned.

When selected for ohmmeter, continuity or capacimeter measurements, component testing or temperature measurements on channel 1, the key has no effect, as the input coupling in these functions cannot be adjusted.



Manual modification of the measurement range



If the autorange mode is activated, the manual adjustment has no effect: the autorange will automatically reset the instrument to the measurement range best suited to the input signal.



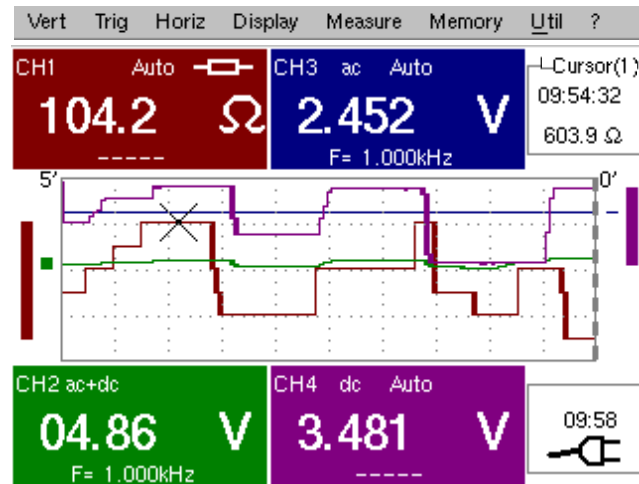
No action.



Multimeter Mode (cont'd)

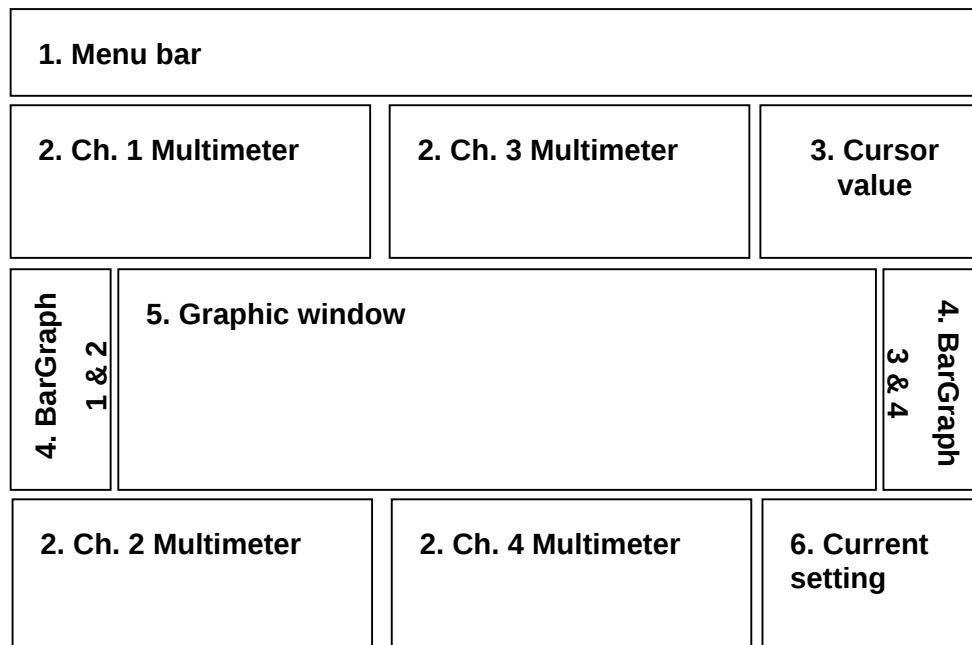
Display

Display



Composition

The multimeter display is divided into 6 functional areas:



1. Menu bar

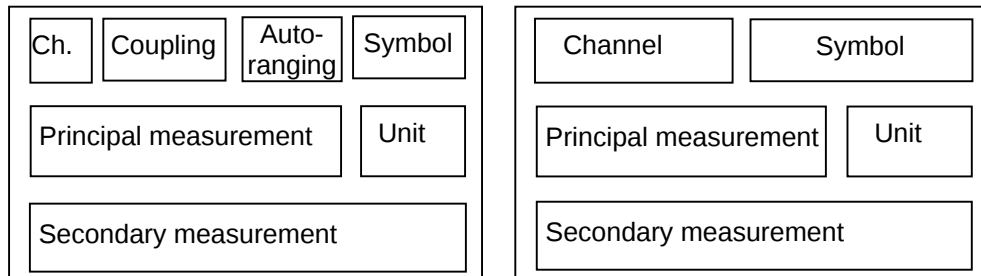


The tool bar gives access to the different menus of the "Multimeter" function.

Multimeter Mode (cont'd)

2. Channel (x) multimeter)

There is a display area reserved for each of the instrument's channels. In each of these, the following information is indicated:



Channel CH1, CH2, CH3 or CH4

Coupling The input coupling selected (see §. Vert. Menu) is indicated in this field. For the Ohmmeter, Capacimeter, Continuity, Component Test and Temperature Measurement modes, the coupling is not shown.

Autorange Indicates whether range changing is automatic.

Symbols A symbol is displayed corresponding to the type of selected measurement :

	Ohmmeter,
	Capacimeter,
	Continuity
	Component test
PT100	Temperature measurement

Principal measurement If the channel is activated, the measurement result is displayed. Otherwise, the message '– X –' fills the unused space.

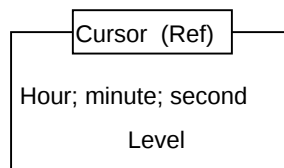
Unit Contains the measurement unit associated with the current measurement range.

Secondary measurement Selected through the "**Display**" menu.

If no display is selected or if the display is not possible (e.g. frequency measurement for a continuous signal, etc.), the character string '----' is displayed.

If the channel is not selected, '– X –' is displayed.

3. Cursor value



This window displays the absolute position of the cursor on the measurement reference channel.

Time position: hour, minute, second

Level position: depending on the type of measurement.

Multimeter Mode (cont'd)

4. Bargraph

These graphs show the min. and max. values measured on the channels in the range during the observation period.

The bargraph is shown with the color of the channel.

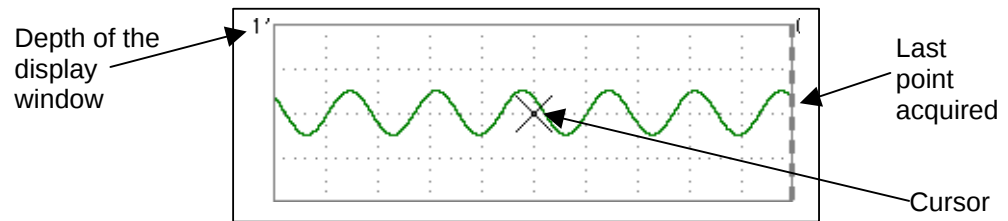
The zero level of the bargraph and the scale are adapted to suit the type of measurement and the range.



If the range is changed, the bargraph is reinitialized and the curve showing the evolution of the measurement is erased.

5. Graphic window

This window shows the evolution of the measurements as a function of time. The most recent measurement points are those on the right-hand side of the screen.



The depth of the window, which represents the observation period, can be programmed using the keys *opposite*.

In this way, you can choose to view the measurements with a depth of: **5', 15', 30', 1h, 6h, 12h, 24h, week, month.**



When ROLL mode is activated (see §. HORIZ Menu), the measurements are updated constantly, with the most recent results taking the place of the older results, which disappear.

6. Current settings

The window has the same function as the oscilloscope window: it serves to indicate and adjust the value of the parameter selected.

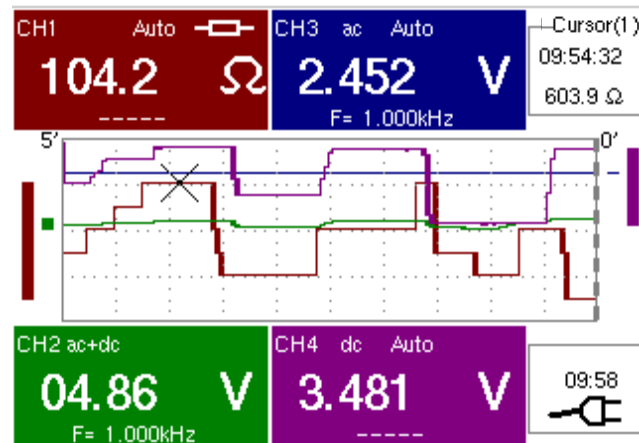
Multimeter Mode (cont'd)

The Menus

Presentation

- Screen display when measurements are possible on all the channels:

✎ Example: CH1 is configured as an Ohmmeter, so CH2, CH3 and CH4 are necessarily set to amplitude measurement (AC, DC or AC + DC)



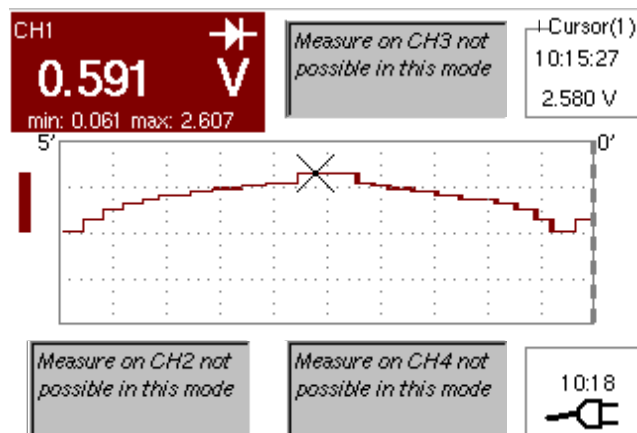
☞ The screen display is identical if CH1 is configured for amplitude measurement, as an ohmmeter or for temperature measurement (PT100).

- Screen display when measurements are possible on CH1 only:

✎ Example: CH1 is configured for a Component Test

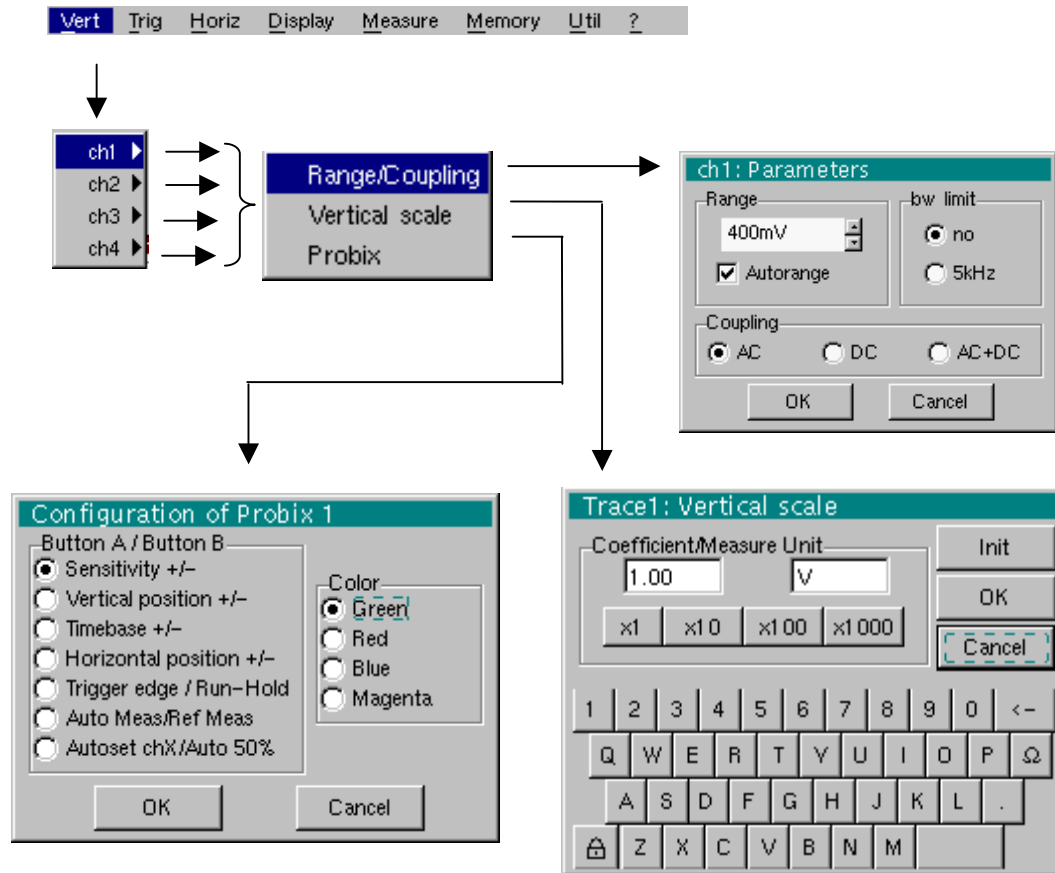
☞ The display is identical when CH1 is configured for capacitance or continuity measurement.

Measurements on channels 2, 3 and 4 are impossible.



Multimeter Mode (cont'd)

The "Vert" Menu



ch1 ch2 ch3
 ch4

Modification of:

- the parameters of channels **ch1**, **ch2**, **ch3** and **ch4**, independently
- the vertical scale of the selected trace
- the parameters of the **PROBIX** probe connected.

Sensitivity/Coupling Modifies the parameters of the selected channel.

Range Choice of the measurement range. The unit displayed depends on:

- the type of measurement selected: amplitude (available on all channels), ohmmeter, continuity, capacimeter, PT100 temperature probe (available only on channel 1, see §. Measure Menu),
- the **PROBIX** probe connected to the input,
- the parameters of the "Vertical Scale" menu (if they have been modified since connection of the **PROBIX** probe).

 For the ranges available for each type of measurement, refer to the technical specifications of the "Multimeter" function.

The Range / Coupling menu is displayed in light grey when the range is not modifiable (single range).

Multimeter Mode (cont'd)

Autorange

When this option is selected, the measurement range changes automatically.



The "✓" symbol shows that it is active.



If the option is disabled, the range can be modified manually, using the keys *opposite* or the "Range" menu, depending on the type of measurement being performed.

Coupling

Modification of the AC, DC or AC+DC coupling for amplitude measurement.

AC: AC voltage measurement

DC: DC voltage measurement

AC + DC: Measurement of AC voltage with a DC component



For AC and AC+DC measurements, the menu "Display → Frequency" can be used to display the frequency of the signal in the secondary display field.

The "⊙" symbol indicates the type of coupling selected.

The coupling is updated in the modified channel parameter display zone.

Bandwidth limit

If the channel measures an AC or AC+DC voltage (see Coupling), it is possible to filter the signal with a low-pass analogical filter whose cut-off frequency is 5 kHz.

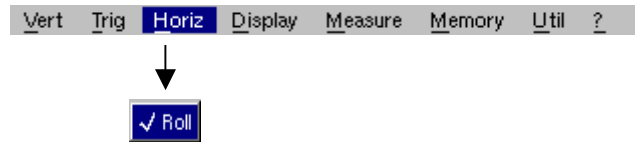
Multimeter Mode (cont'd)

The "Trig" Menu

No trigger parameterization is possible in this mode.

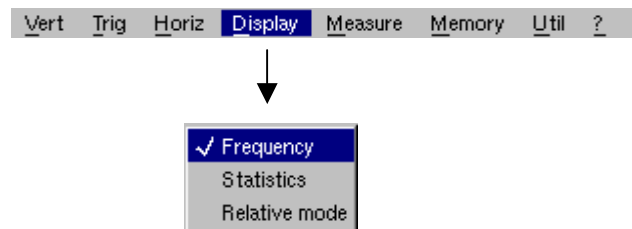
The "Horiz" Menu

Roll



- If this mode is activated (presence of "✓" symbol), the measurement history curve is constructed continuously. The oldest points disappear on the left-hand side of the screen, while the most recent ones appear on the right.
- If this mode is deactivated, the point display stops as soon as the first point acquired reaches the left-hand edge of the window. However, the measurements continue and are still refreshed in the area 'Multimeter Channel'x'.

The "Display" Menu



This menu selects the information that you want to display in the secondary measurement field of each 'Multimeter Channel'x' area.

Frequency

If this line is ticked and in the case of AC amplitude measurement, the frequency of the signal measured (if possible and consistent) will be displayed.

Statistics

Display of the Min. and Max. values of the measurements performed.

Relative mode

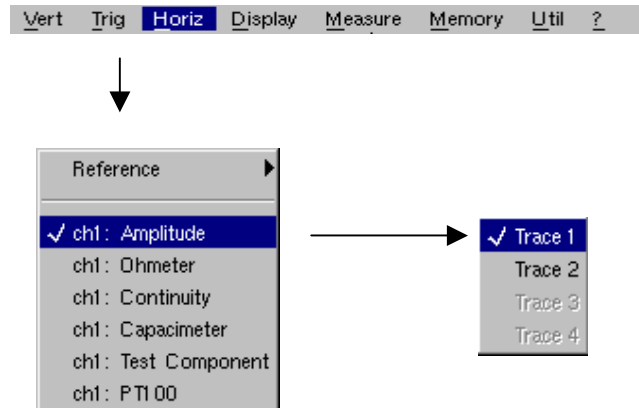
The value displayed is the difference between the value measured and the value displayed when this option was selected.



The "✓" symbol indicates the secondary function selected.

Multimeter Mode (cont'd)

The "Measure" Menu



Reference

The reference is used to select the measurement trace on which the cursor is positioned. The cursor value is therefore relative to the measurement on this channel.

It is only possible to choose the reference on activated channels: channels that are not activated are displayed in a lighter color in the sub-menu.



The "✓" symbol indicates the reference selected.

ch1: Amplitude

Channel CH1 is used as a voltmeter and therefore measures the amplitude of the signal present on the input of this channel.

ch1: Ohmmeter

Channel CH1 is used as an ohmmeter and therefore measures the resistance of the dipole wired to the input.

ch1: Continuity

Channel CH1 is used as a continuity tester: there is a beep if the input resistance is less than ≈ 30 Ohms.



In this mode, measurements are impossible on the other channels.

ch1: Capacimeter

Channel CH1 is used as a capacitance meter and therefore measures the capacitance of the dipole wired to the channel's input.



In this mode, measurements are impossible on the other channels.

ch1: Component Test

Channel CH1 is used as a component tester. This mode measures the threshold of the diode wired to the input.



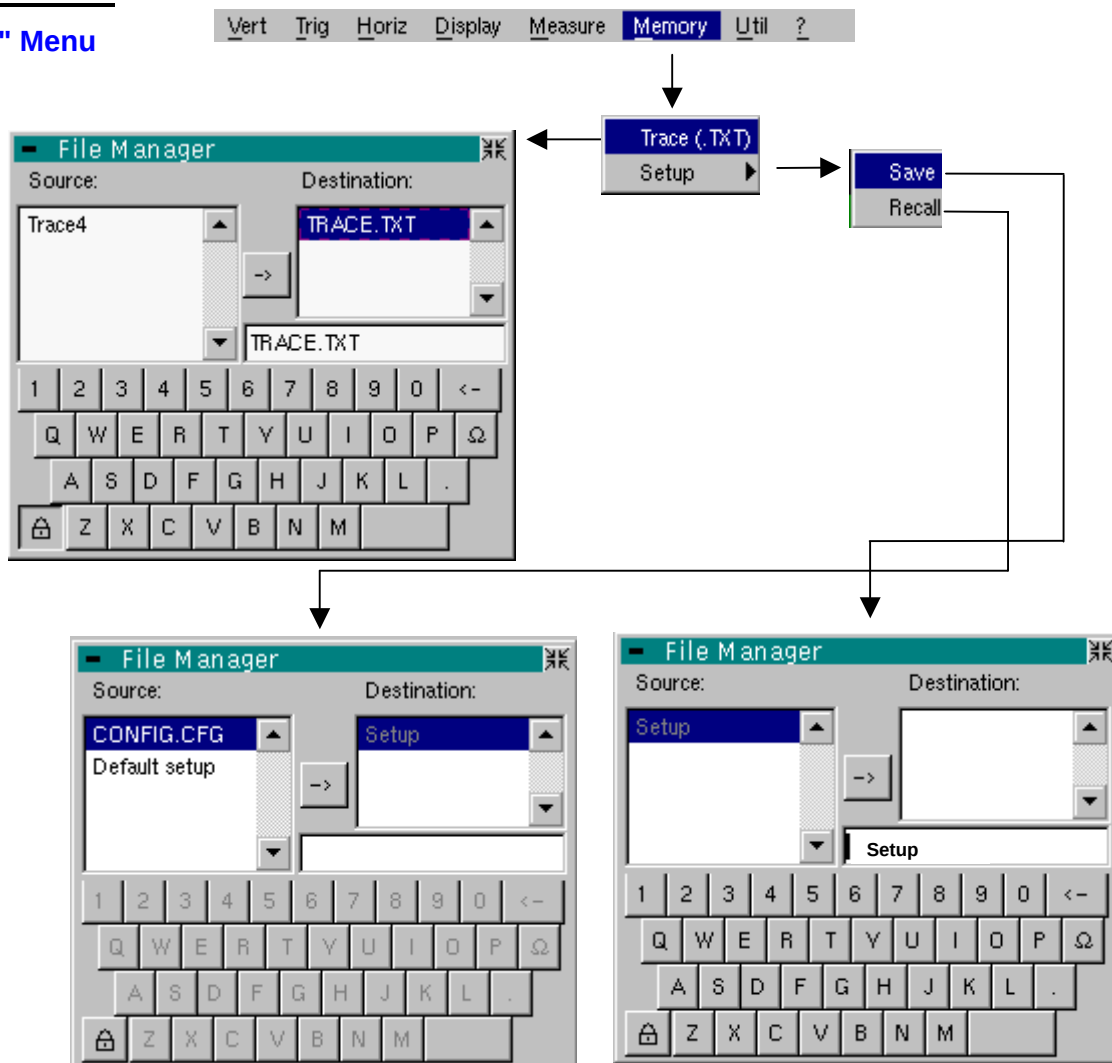
In this mode, measurements are impossible on the other channels.

ch1: PT100

These configurations measure a temperature using a 100Ω (PT100) resistive sensor.

Multimeter Mode (cont'd)

The "Memory" Menu



Trace (.TXT)

In "Multimeter" mode, it is only possible to save a trace in non-volatile memory in .TXT format. Files saved with the suffix .TXT can be exported onto a PC (see §. Util Menu → Files) for processing with other software (spreadsheet, etc.).

Configuration

This function is identical to the one in "Oscilloscope" mode.

The "Util" Menu

Configuration

This menu is identical to the one in "Oscilloscope" mode, except:

Screen saver

- If the recording time is over 2 seconds, the screen saver will never be activated.
- If the recording time is equal to 2 seconds, the screen saver and settings operate as in "Oscilloscope" mode.

Standby

- If the recording time is over 2 seconds, standby will never be activated.
- If the recording time is equal to 2 seconds, standby and settings operate as in "Oscilloscope" mode.

The "?" Menu

This function is identical to the one in "Oscilloscope" mode.

Harmonic Analysis Mode

Display

The Harmonic Analysis mode is an optional firmware that can be installed.

Installation

- Connect the HX0042 cord of connector RS-232/Ethernet located on the side of the oscilloscope to one of the serial ports of a PC.
- Insert the diskette provided for the installation in the PC's floppy disk drive.
- Launch the file « install_analyzer.exe ».
- Configure the RS-232 link of the oscilloscope as indicated. (Menu : Util → Config Ports d'E/S → RS-232)

Speed : 115200 bauds

Format : 8-bit Stop bit : 1

Parity : None Protocol : Indifferent

- Validate the serial port (COM1 or COM2) of the PC on which the cord is connected. The installation is launched automatically.

The message "Operation successful" displays at the end of the installation.

The oscilloscope switches to harmonic analysis mode which is installed definitively.

Presentation

The harmonic analysis function displays the fundamental and the 15 harmonic ranks up to the 31st.

In this mode, the time base is therefore adaptive and is not manually adjustable.

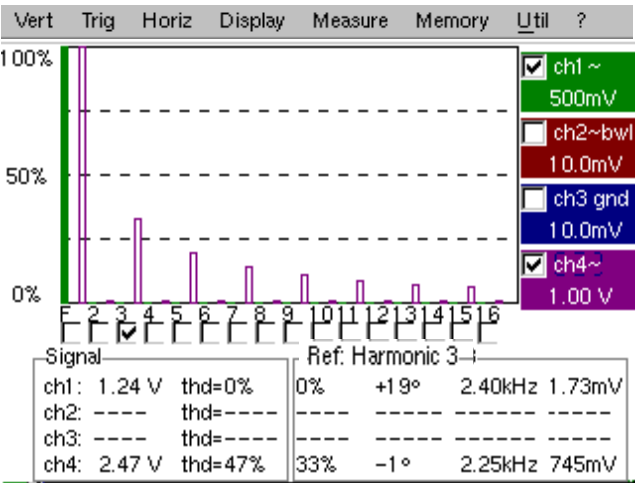
This analysis is reserved for signals whose fundamental frequency is between 40 Hz and 450 Hz.

All the conventional settings of the oscilloscope (except for the time base and trigger) remain active in this mode (Sensitivity/Coupling, Vertical Scale).

Only the channels (not the functions or the memories) can be the subject of harmonic analysis.

Harmonic analyzes of 2 (**OX 7102**) or 4 (**OX 7104**) signals can therefore be displayed simultaneously.

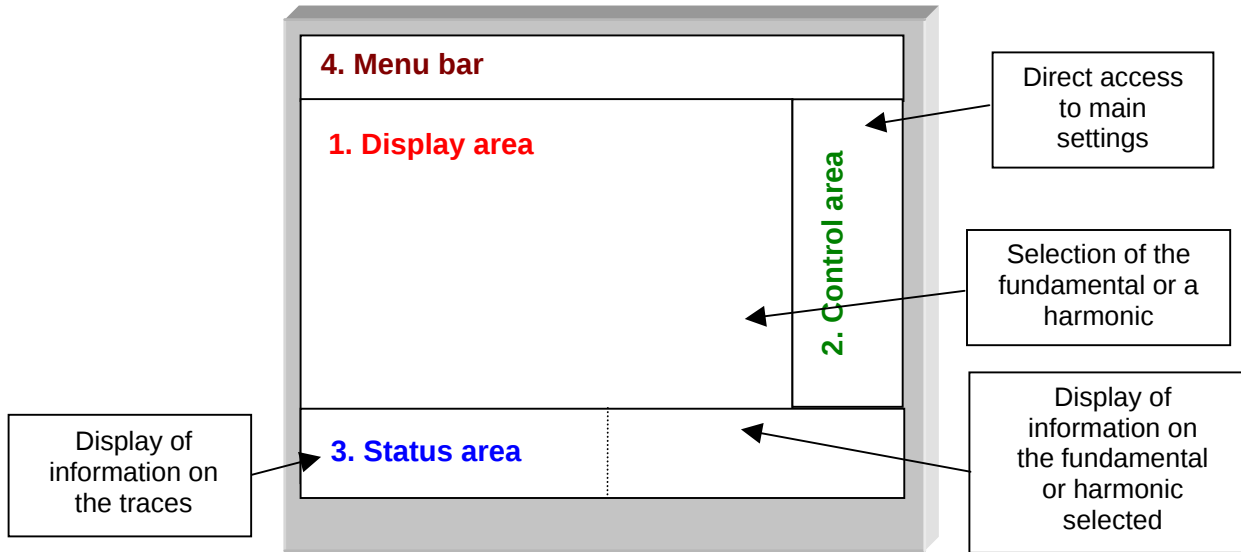
Display



Harmonic Analysis Mode (cont'd)

Composition

In this mode, the display is divided into 4 functional areas:



1. Display area

Displays the result of harmonic analysis of the selected traces (**ch1** to **ch4**).

The harmonic analysis of the **ch1** and **ch3** trace is shown in a darker color, while the trace of **ch2** and **ch4** are displayed in a lighter color (or the same color as the trace).

The display appears as a bar chart, with its vertical axis graduated in terms of the percentage of the fundamental amplitude (from 0% to 100% every 25%).

The horizontal axis represents the harmonics, i.e.:

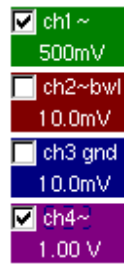
- the fundamental (F) and the first 15 harmonics
- the fundamental (F) and the even harmonics from 2 to 30
- the fundamental (F) and the odd harmonics from 3 to 31

With this breakdown of the harmonics, the stylus can be used to select the fundamental (F) or one of the harmonics ( Example: Ref. Harmonic 5) to perform automatic measurements on the selected element.

-  The "✓" symbol indicates the harmonic selected.
- See §. "Display" Menu for selection of the harmonics.

Harmonic Analysis Mode (cont'd)

2. Control area



Using the stylus, display of:
the parameters of the traces in the same color as the trace: validity, coupling, bandwidth limit, sensitivity



- When the pointer is placed on one of a channel's parameters, it directly opens the associated "Sensitivity/Coupling" and "Vertical Scale" menus.
- The pointer validates the channels.
- The "✓" symbol indicates whether the channel is selected.

3. Status area

The status area indicates the automatic measurements performed on the signals and the selected harmonic.

Signal	Ref: Harmonic 3	Harmonic 3
ch1: 1.24 V thd=0%	0%	+19° 2.40kHz 1.73mV
ch2: ---- thd=----	----	-----
ch3: ---- thd=----	----	-----
ch4: 2.47 V thd=47%	33%	-1° 2.25kHz 745mV

Display of information on the traces

Display of information on the fundamental or the harmonic selected

The "SIGNAL" area

This indicates:

- the active channel(s): **ch1** to **ch4**, (- - -) when the channel is not active
- the RMS voltage of the signal in V

- the harmonic distortion rate (THD) in %

$$THD = \frac{\sqrt{V_{RMS}^2 - V_f^2}}{V_f}$$

The "Ref.: Fundamental » or "Harmonic X" area

This indicates, for the fundamental or the selected harmonic, (Example: Ref. Harmonic 3):

- its value as a % of the fundamental
- its phase in ° in relation to the fundamental
- its frequency in Hz
- its RMS voltage in V

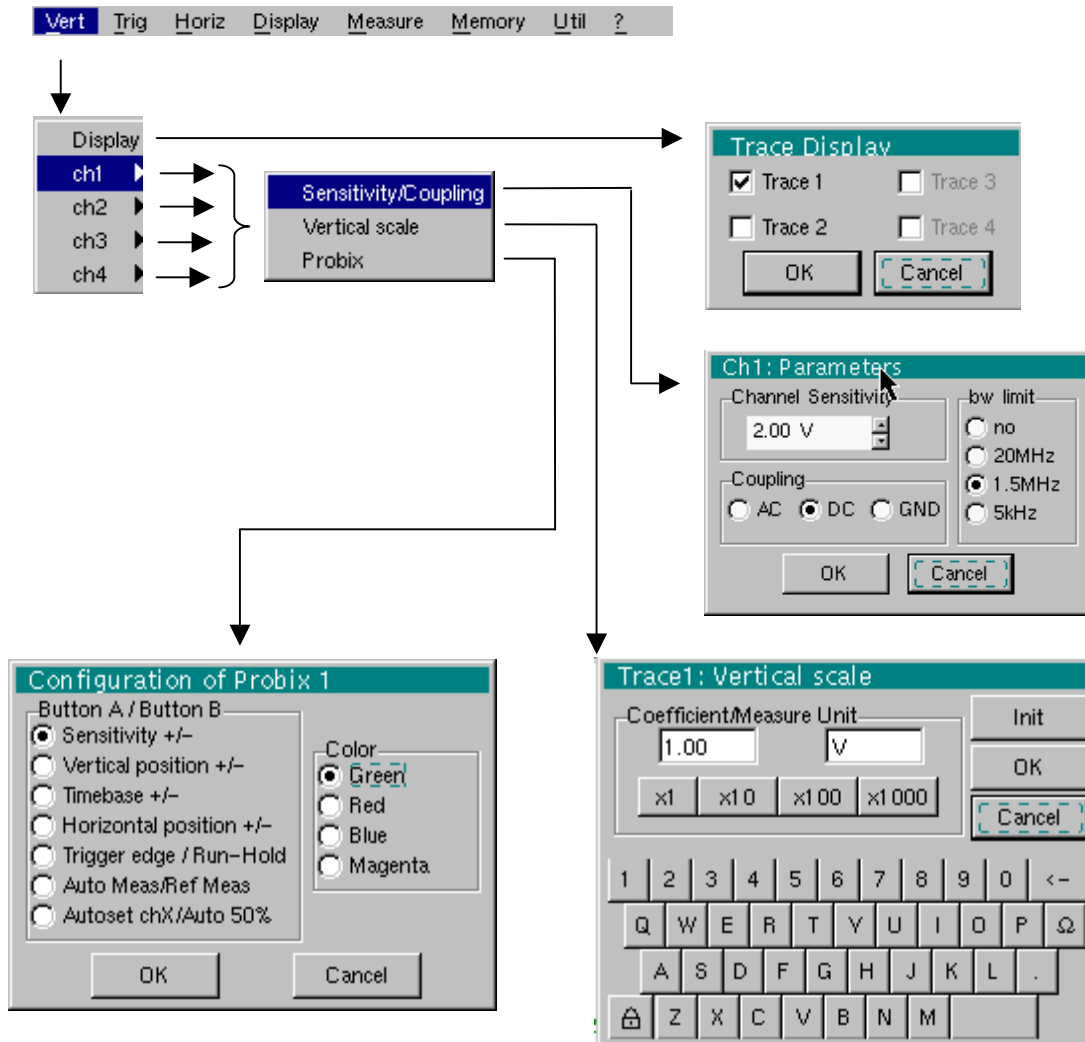
4. Menu bar

Vert Trig Horiz Display Measure Memory Util ?

The same menu toolbar is used as in "Oscilloscope" mode; some menus are adapted to the "Harmonic Analysis" mode and the others are not active.

Harmonic Analysis Mode (cont'd)

The "Vert" Menu



Display

When selected, this opens the "Trace display" menu for validating or invalidating 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 harmonic analysis of the signal on channel **ch1** and **ch3** is shown in a dark color, while the signal of channel **ch2** and **ch4** is lighter.
- In Harmonic Analysis mode, only the channels (and not the functions) can be the subject of harmonic analysis.

Harmonic Analysis Mode (cont'd)

ch1 ch2
ch3 ch4

Modification of the parameters of **ch1**, **ch2**, **ch3** or **ch4**, independently, and modification of the vertical scale of the trace selected.

Sensitivity/Coupling

Channel Sensitivity



Modification of the sensitivity using the stylus on the scrollbar: 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.

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

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: the instrument connects the selected channel input to a 0 V ref. level.



The "⊙" symbol indicates the coupling selected. It is shown in the modified channel parameter display area.

bw limit



Bandwidth limit for the channel and its trigger circuit, to reduce display noise and false triggering.

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

20 MHz
 1.5 MHz
 5 kHz



This menu can also be called up by double-tapping the stylus on the required channel parameter display area (ch1, ch2, ch3 or ch4).

Vertical scale

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" area.

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

Predefined values (x1, x10, x100, x1000), corresponding to standard probe coefficients, can be assigned directly.

The sensitivity value indicated in the channel parameters display will be modified in accordance with the coefficient.

Measurement unit



Modification of the selected channel's vertical scale unit.

This modification is performed using the mouse and the table of usable characters, after selecting the "Measure Unit" zone.

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

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.

This menu can also be called up by double-tapping with the stylus on the required channel parameter display area (ch1, ch2, ch3 or ch4).

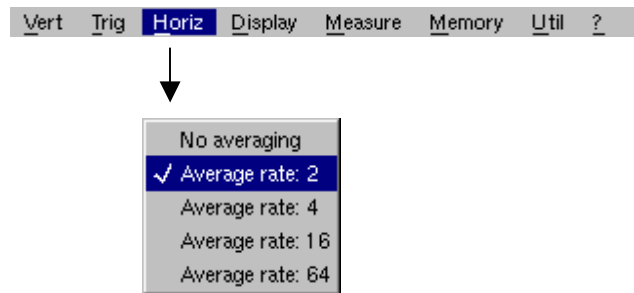
PROBIX

This menu is identical to the one in "Oscilloscope" mode.

With the **PROBIX** HX0030 probe (1/10 probe), some functions are inactive in "Harmonic Analysis" mode.

Harmonic Analysis Mode (cont'd)

The "Horiz" Menu



No averaging

Averaging coeff.: 2

Averaging coeff.: 4

Averaging coeff.: 16

Averaging coeff.: 64

An averaging coefficient can be used to improve the display.

When this coefficient is selected, it attenuates the random noise observed on a signal.

The calculation is performed using the following formula:

$$\text{Pixel}_N = \text{Sample} * 1/\text{Averaging Coeff.} + \text{Pixel}_{N-1} (1-1/\text{Averaging Coeff.})$$

with:

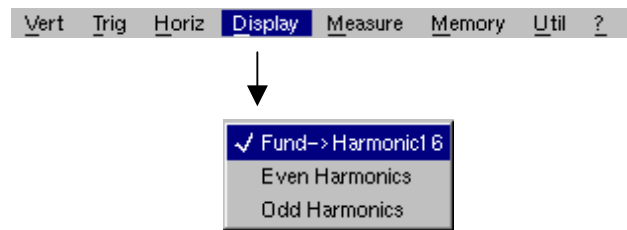
- Sample: value of new sample acquired at abscissa t
- Pixel N: ordinate of the pixel with abscissa t on the screen at instant N
- Pixel N-1: ordinate of the pixel with abscissa t on the screen at instant N-1



The "✓" symbol indicates the averaging coefficient selected.

Harmonic Analysis Mode (cont'd)

The "Display" Menu



Definition

These menus allow you to view the harmonic composition of one or more selected signals, according to 3 groups.

Fund → Harmonic 16 Display of the fundamental and the first 15 harmonics.

Even harmonics Display of the fundamental and the even harmonics from 2 to 30.

Odd harmonics Display of the fundamental and the odd harmonics from 3 to 31.

The selection appears under the composition display.



- The "✓" symbol, present on the fundamental (F) or one of the harmonics, indicates the one selected.
- *The selection is kept when the display changes.*

The "Memory" Menu

See description in "Oscilloscope" mode.

In "Harmonic Analysis" mode, this menu is limited to saving and recalling the instrument configuration.

The "Util" Menu

See description in "Oscilloscope" mode.

The "?" Menu

See description in "Oscilloscope" mode.

Recorder Mode



The Recorder mode is an optional firmware that can be installed.

It is best if the oscilloscope is plugged into the AC power to operate in this mode (battery life).

The Keys



This key selects "**Recorder**" mode.

5 "UTILITY" keys (or keypad)



LCD **contrast** setting (see "Oscilloscope" mode).



Full screen display (see "Oscilloscope" mode).



Take a **screen shot** (see "Oscilloscope" mode).



No action.
(Pressing this key displays the message: "Impossible in this mode!".)

1 "AUTOSET" key



No action.
(Pressing the key displays the message: "Impossible in this mode!".)

Selective "AUTOSET"



No action.
(Pressing the key displays the message: "Impossible in this mode!".)

4 "TRIGGER" keys



No action.
(Pressing the key displays the message: "Impossible in this mode!".)



Successively pressing the key toggles through the different types of **trigger** of the last channel selected (see § Trigger Menu).



No action.
(Pressing the key displays the message: "Impossible in this mode!".)



This key has two functions:

RUN = launches an acquisition

HOLD = stops an acquisition

If the recorder is in memory display (see §. Memory Menu → Recall ".REC"), the message "Impossible in this mode!" appears when this key is pressed.

Recorder Mode (cont.)

3 "MEASURE" keys



The 19 **automatic** measurements of the reference trace are displayed (see "Oscilloscope" mode).

☞ *Particular case*

In "fault capture" (or "file capture") mode, if the screen shows several faults at once, the "automatic measurement" function is impossible and the message "Impossible in this mode!" is displayed.



Selection, from the traces displayed, of the **reference** trace for automatic and manual measurements (see "Oscilloscope" mode).



No action.
(Pressing the key displays the message: "Impossible in this mode!".)

3 "HORIZONTAL" keys (or keypads)



Setting of **recording** time and **sampling** interval.
These two values are correlated.



- Fault capture or file capture mode is **not selected**:
☞ After zooming in, the "Z-Pos." setting modifies the position of the screen in the acquisition memory.
- Fault capture or file capture mode is **selected**:
☞ If the horizontal zoom is activated, the "Z-Pos." setting allows the user to move through the faults one at a time. The main cursor is positioned on the displayed fault while the auxiliary cursor is on the right of the screen.



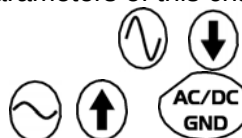
- Action identical to that in "Oscilloscope" mode, when fault capture and file capture mode are **not selected**.
- Fault capture or file capture mode is **selected**:
☞ 1st press: "Zoom on" → displays the first acquired fault.
The main cursor is positioned over the trigger, on the magnified fault while the auxiliary cursor is on the right of the screen.
☞ 2nd press: "Zoom off" → 10 consecutive faults are displayed on the screen. The cursors are no longer displayed.

Definition of terms used (id. "Oscilloscope" mode)

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 using the following keys:



Recorder Mode (cont.)

5 "VERTICAL" keys (or keypads)

OX 7104

Stage 1	Stage 2	Stage 3
Before pressing one of the keys shown opposite:	Press 	After pressing one of these keys:
The signal concerned is not displayed.		The signal is displayed and selected.
The signal concerned is displayed but not selected.		The vertical sensitivity and vertical position are allocated to the selected channel.
The signal concerned is displayed and selected.		The signal is erased by double pressing.
		

OX 7102

Stage 1	Stage 2	Stage 3
Before pressing one of the keys shown opposite:	Press 	After pressing one of these keys:
The signal concerned is not displayed.		The signal is displayed and is selected.
The signal concerned is displayed, but not selected.		On CH1 and CH4, the vertical sensitivity and vertical position are allocated to the selected channel.
The signal concerned is displayed and selected.		The signal is erased by double pressing.
		



Deselecting the signal: 2 short taps on the key concerned (see opposite).

 A long press does not trigger a vertical autoreset. After a long press the message: "Impossible in this mode!" appears.



This key enables or disables the **horizontal dividing into 2 parts** of the display area (see "Oscilloscope" mode).



No action.

(Pressing the key displays the message: "Impossible in this mode!").

In "Recorder" mode, the DC input coupling is constant. The DC symbol  is permanently displayed.



To set the vertical **sensitivity** of the last channel selected (see "Oscilloscope" mode).

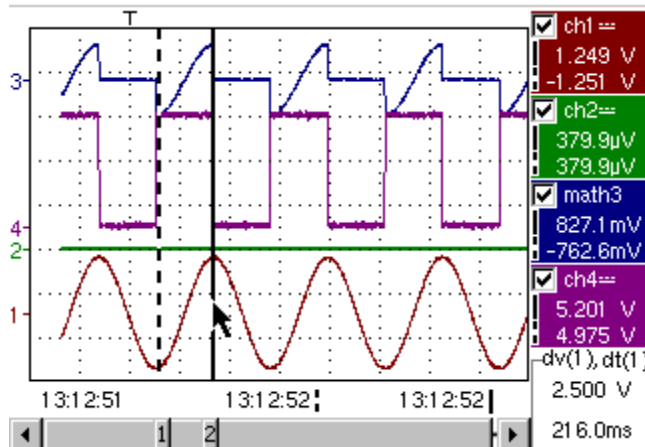


To set the vertical **position** of the last channel selected (see "Oscilloscope" mode).

Recorder Mode (cont.)

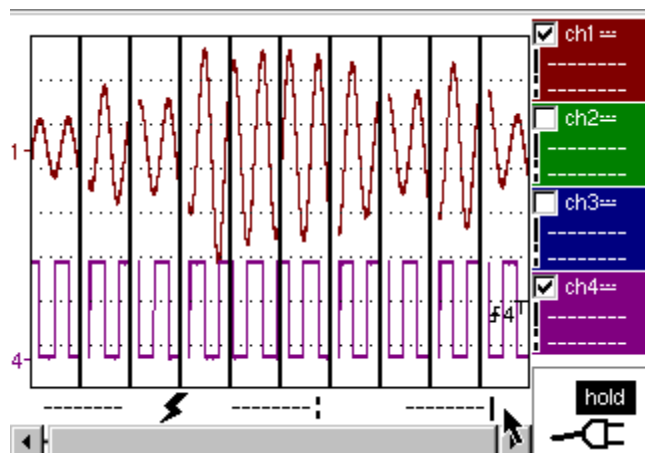
Display

*Normal
mode display*



The user views 500 points on the screen (in "MIN/MAX" mode) to eliminate the risk of information loss involving the 2,500 points in the memory.

*Display in
fault capture and
file capture modes*



The memory is segmented to allow the acquisition of 100 faults.

A fault corresponds to a triggered acquisition of 500 samples.

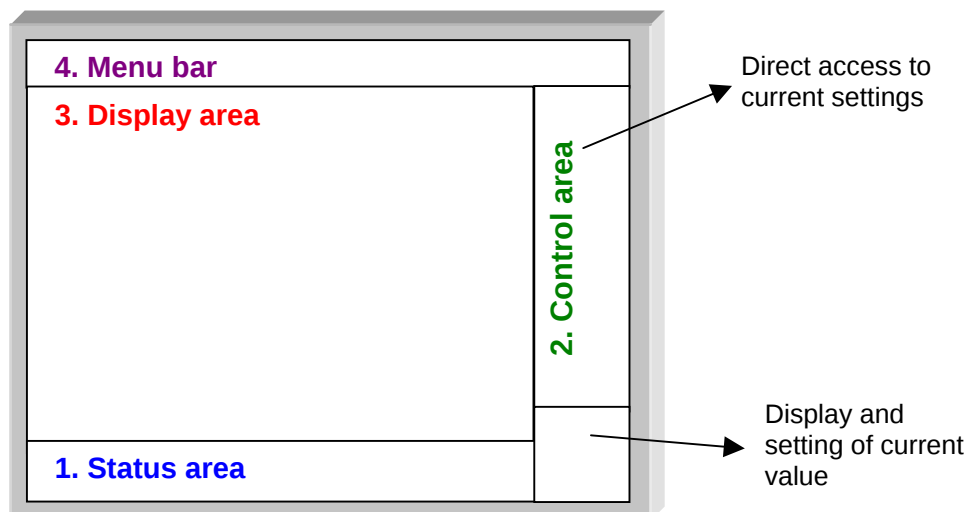
2 modes of visualization:

- 10 contiguous faults
- only 1 full-screen fault

Composition

The composition of the "Recorder" mode display is identical to that in "Oscilloscope" mode.

Reminder: The display is divided into 4 functional zones.



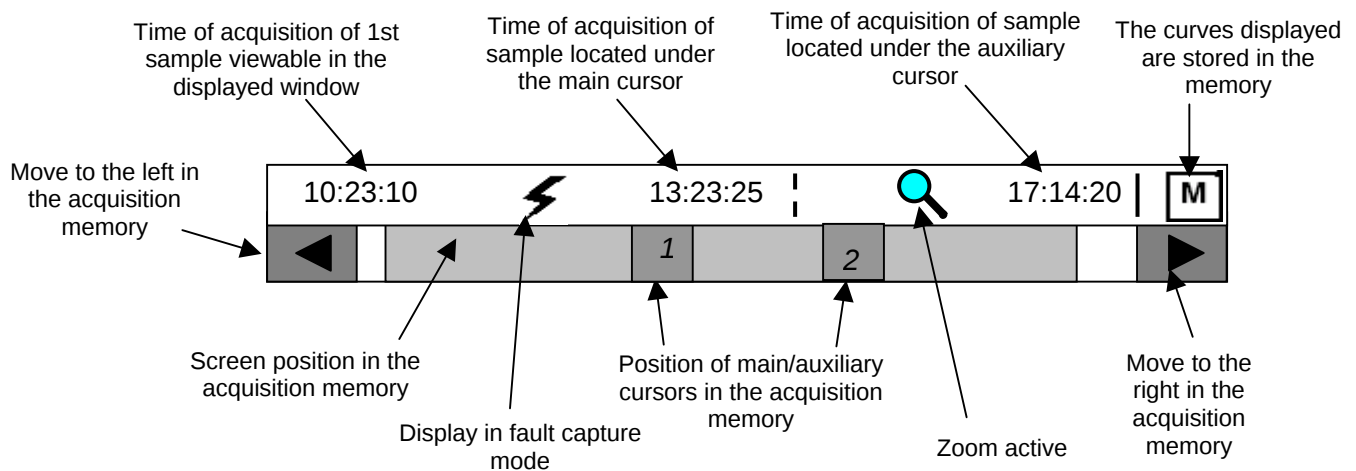
Recorder Mode (cont.)

5. Status area

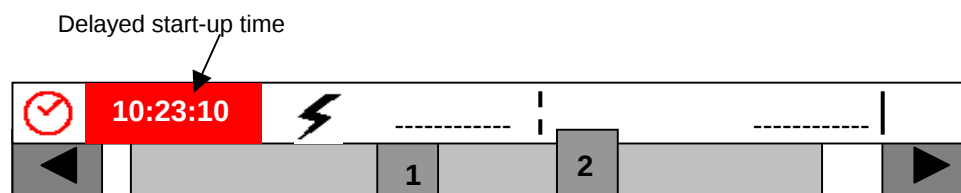
Three pieces of general information appear in this area:

- The **bargraph**, representing the screen position and the cursors in the acquisition memory;
- Instrument **settings** (fault capture mode, zoom, etc.);
- **Acquisition times:**
of the first sample that can be viewed,
of the sample under the main cursor,
of the sample under the auxiliary cursor.

Standard configuration



Configuration if delayed start-up is enabled

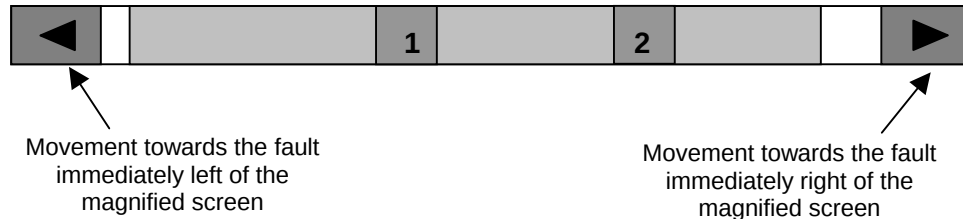


When the acquisition starts, the display returns to its standard configuration.

Recorder Mode (cont.)

Bargraph

In fault capture and file capture mode, the bargraph indicates the position of the screen and cursors in the acquisition memory. The main cursor is positioned on the displayed fault and the auxiliary cursor on the right of the screen.



Settings

Signification of symbols appearing on the bargraph:



The recorder is in **fault capture** or **file capture** mode.



The horizontal zoom is active.



The curves displayed are stored in the memory.



Delayed start-up is activated.

10:23:10

This symbol is displayed only when delayed start-up is active. It indicates the time at which recording will commence. Start-up date: see §. Trigger Menu → Delayed start-up.

Acquisition times

These represent the times of:

- the first sample viewed;
- the sample located under the main cursor;
- the sample located under the auxiliary cursor.

6. Control area

- Parameters of each channel and trace:
 - display
 - coupling
 - bandwidth limit,
 - zoom function,
 - vertical measurements of samples under the main and auxiliary cursor.
- Active adjustment of the last selected element:
 - trigger level (main and auxiliary),
 - horizontal gap between the time position of the auxiliary cursor and that of the main cursor,
 - vertical gap between the measurement of the auxiliary cursor and the main cursor on the reference trace (see §. Menu→ Measurement→ Reference),
 - number of faults acquired and number of fault viewed,
 - duration of recording and acquisition interval.



The time position of the trigger is not displayed as it is fixed (20 % of the memory). The horizontal scale is not displayed.

- The device indicates if the acquisition is in RUN or HOLD mode.
- The other displays (battery, etc.) are identical to “Oscilloscope” mode.

Recorder Mode (cont.)

2. Control area (cont.)

Measurement of sample under auxiliary cursor

Measurement of sample under main cursor

Symbol is a reminder that the following measurement is that of the auxiliary cursor (solid line)

Symbol is a reminder that the following measurement is that of the main cursor (broken line)

The color corresponds to the color of the trace.

Display of trace parameters:

- validity
- DC coupling
- bandwidth limit
- vertical measurement of sample under cursors
- display of ZOOM mode

OR

Display of maths function parameters:

- validity
- vertical measurements

OR

Display of memories:

- validity

Indication and adjustment of last setting selected
(E.g. vertical and horizontal gap between the main and auxiliary cursor)

Channel	Measurement (Main Cursor)	Measurement (Auxiliary Cursor)	Unit
ch1	5.962	1.538	V
ch2	10.21	1.461	V
math3	1.219	-281.3	div
math4	-1.171	35.52	div
dv(1),dt(1)			
-7.500			V
504.0			ms

- The use of controls,
- the validation of channels with the stylus,
- the menus relating to the channels and functions are identical in "Recorder" and "Oscilloscope" mode.



It is not possible to mix memorised curves (Mx) and acquired curves in real-time Chx on the display (see § Memory Menu → Trace → Recall ".REC").

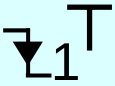
Recorder Mode (cont.)

7. Display area

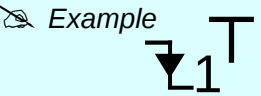
Graphic elements displayed associated with the traces in this area:

- Vertical position indicator for the reference level of each trace
- ZOOM area selection.
- Main cursor (permanent, moved using stylus) located at the left of the screen by default.
- Auxiliary cursor (permanent, moved using stylus) located at the right of the screen by default.
- Trigger time position indicator (fixed and located 20% across from the left of the screen).
Its graphical representation is as follows : 

Level indicators representing 5 different triggers:

	- “ Lower trigger” option (of the last channel selected).
	- “ Upper trigger” option (of the last channel selected).
	- “ Upper/lower trigger” option (of the last channel selected).
	- “ External window trigger” option (of the last channel selected).
	- No symbol is displayed: no trigger (on the last channel selected).

 *The level indicator figure represents the channel concerned by this indicator:*

	- Lower trigger option on channel 1. There can be trigger conditions on several channels at the same time: display by selecting the channel concerned.
---	---

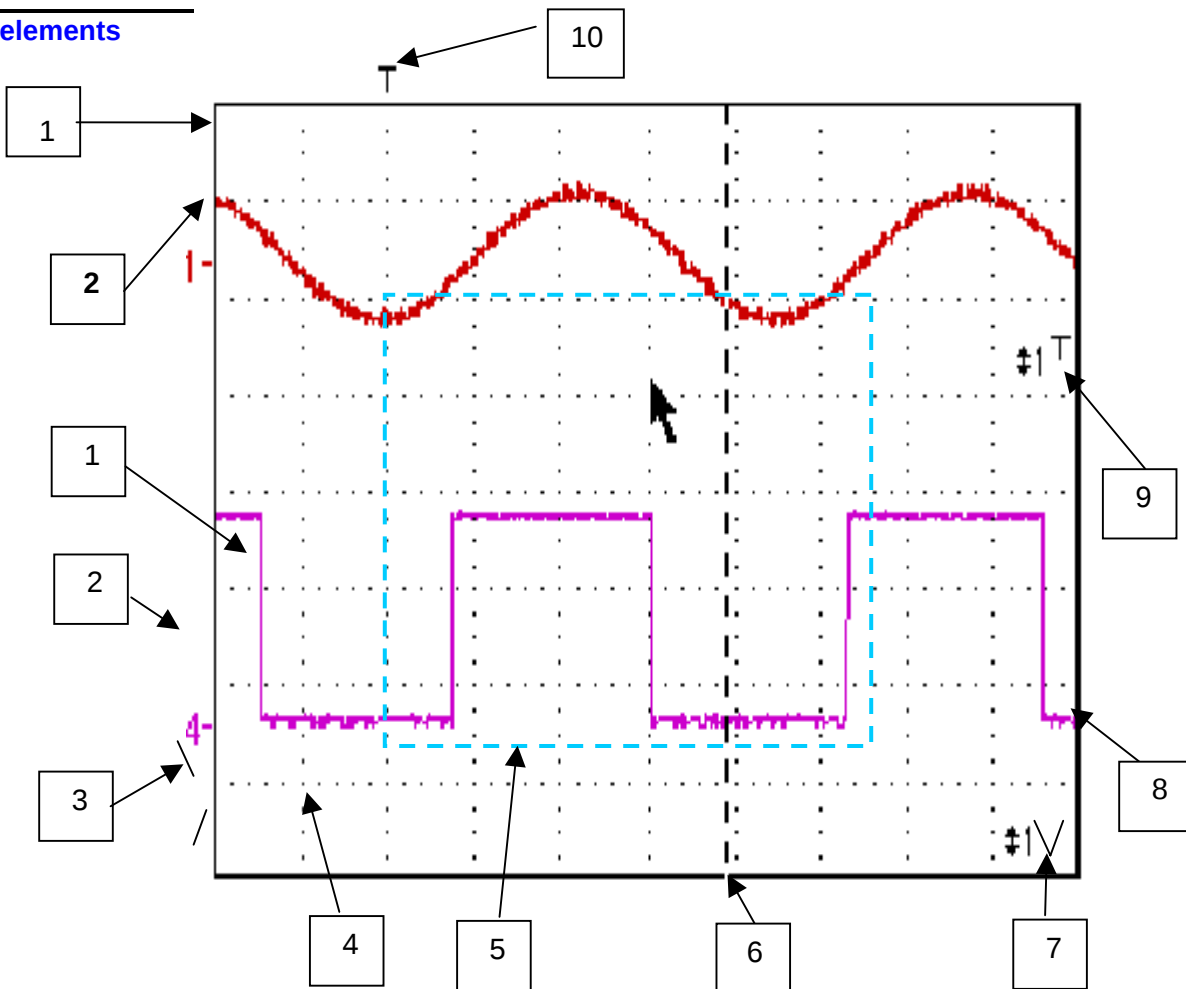
 *In fault capture and file capture mode, the grid is divided into ten sections; i.e. one section for each fault.*



The cursors are no longer displayed: they reappear when a single fault is displayed on the screen (horizontal zoom enabled: see help for key shown here).

Recorder Mode (cont.)

Display elements



Definition of display

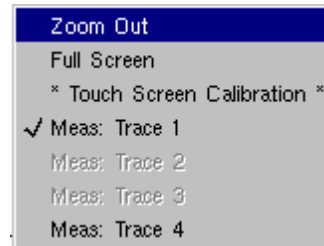
Items	Display elements
13	Trace displayed
14	Indication of vertical position of reference level of the displayed trace and identification of trace number
15	Indicator of trace outside display window
16	Graticule division
17	Zoom area selection
18	Main measuring cursor
19	Trigger level position outside window indicator
20	Auxiliary measuring cursor
21	Trigger level position indicator (<i>here, for example: upper/lower trigger</i>)
22	Trigger time position indicator → fixed at 20%

Recorder Mode (cont.)

Menu accessible from display area

Like in “Oscilloscope” mode, the menu concerning the display can be opened directly by double-tapping the stylus in the display area.

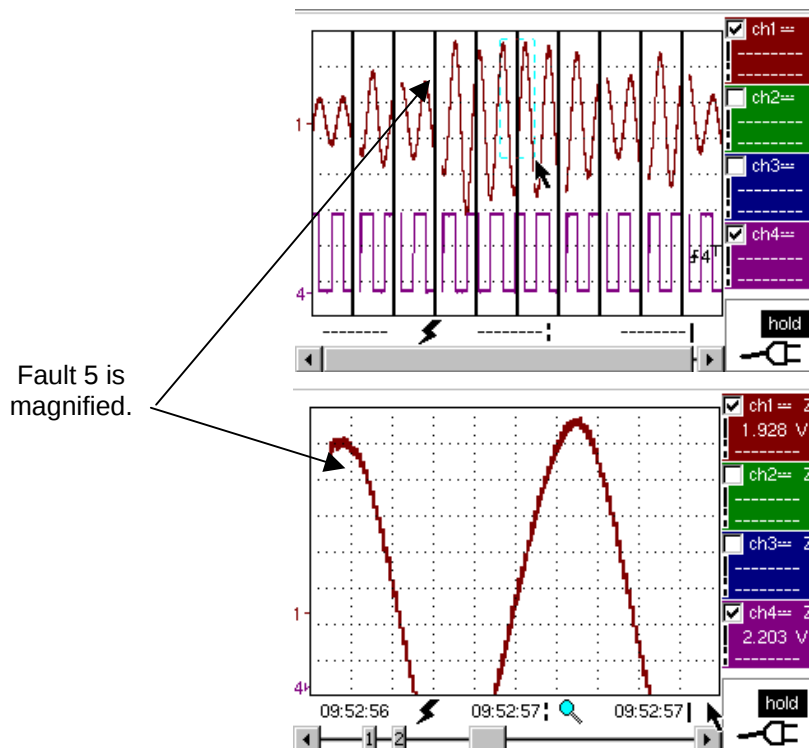
This menu, as well as the functions of the proposed options, are identical to those in “Oscilloscope” mode.



Zoom creation in Fault Capture mode

Case 1 The horizontal zoom is disabled, the screen displays 10 faults:

Draw a rectangle around the part you wish to zoom in on. The screen displays, with a vertical zoom, the fault on which you began the rectangle.



Fault 5 is displayed in full screen mode and has been vertically magnified

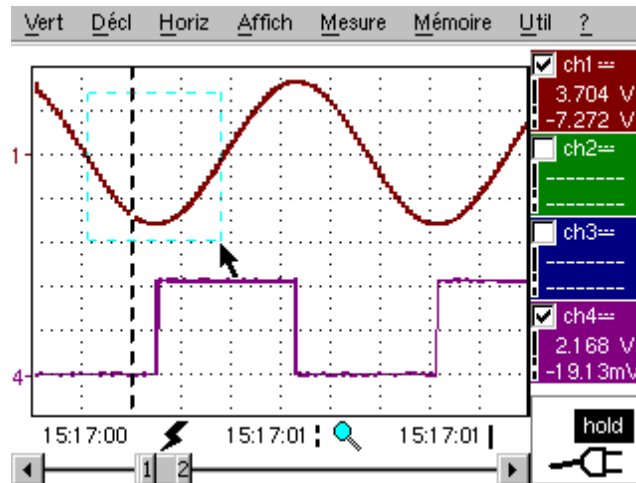
To return to a normal display (10 faults displayed on the screen), select “Disable zoom” in the menu,



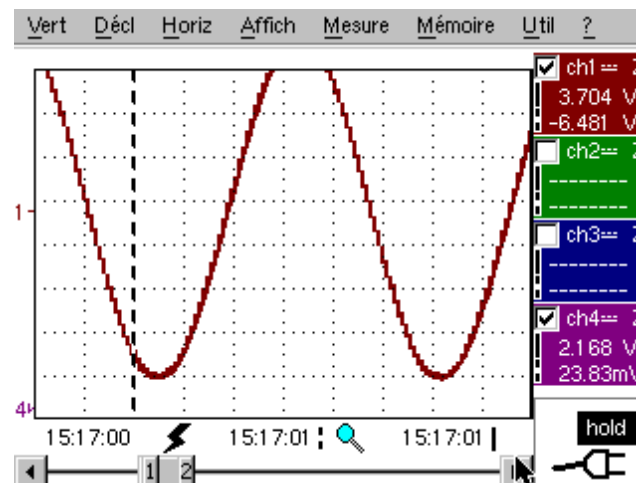
Disabling the horizontal zoom with the zoom ON/OFF key allows the user to return to a screen with the ten faults displayed, while not disabling the vertical zoom.

Recorder Mode (cont.)

Case 2 The horizontal zoom is enabled, the screen displays one of the captured faults:



Fault capture mode: the horizontal zoom is enabled.
A single fault is displayed on the screen. A zoom frame is drawn.



A vertical zoom is applied to the area containing the fault.

As in the first case, select “disable zoom” in the menu above to disable the zoom. The screen returns to the initial “10 faults on the screen” display.

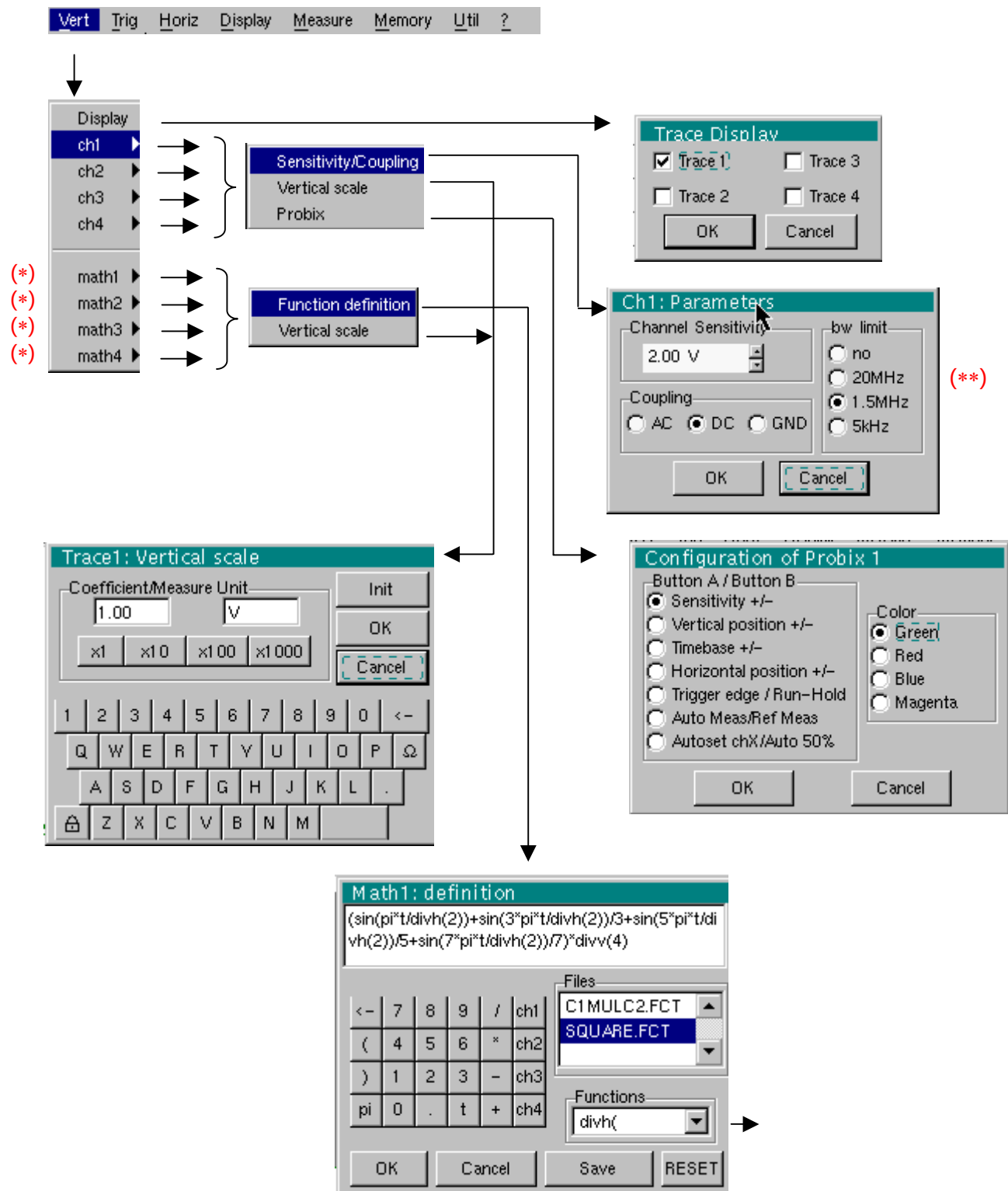


Disabling the horizontal zoom with the zoom ON/OFF key allows the user to return to a screen displaying the ten faults, while the vertical zoom remains enabled.

Recorder Mode (cont.)

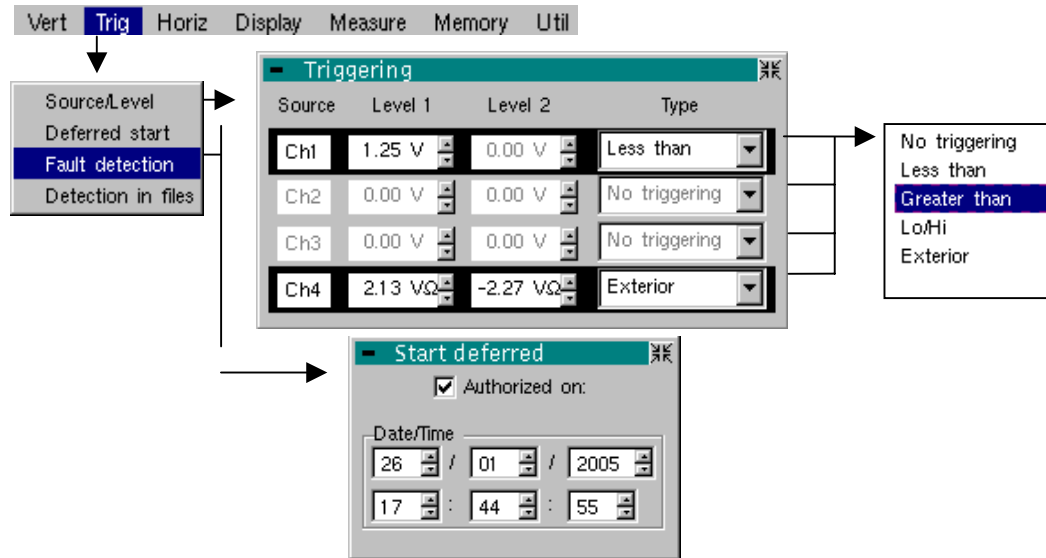
The "Vert" Menu

This menu is identical to that described in "Oscilloscope" mode.



Recorder Mode (cont.)

The "Trig" Menu



Triggering

Selection of trigger type and level on each channel. Triggering takes place if a condition described by a line of the "Trigger" table is verified. This trigger level must be present in the display area.

Source Indicates the channel number.

Level 1 The main trigger threshold level can be set using the stylus.

Level 2 The auxiliary trigger threshold level can be set using the stylus. This tab is enabled only if external trigger type is selected.



Trigger levels are entered into the current value display area after modification. Fine adjustment is possible.

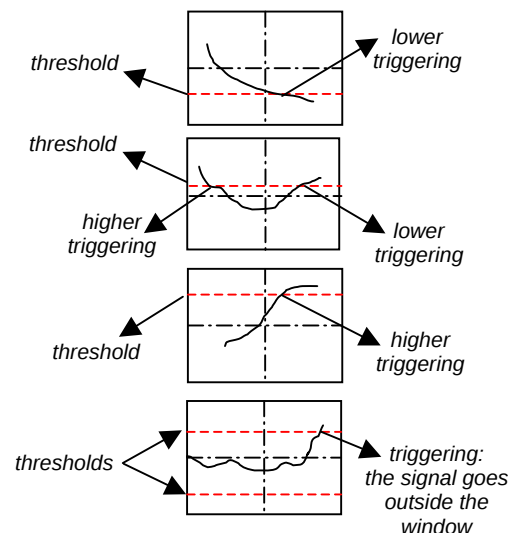
Trigger type

This tab indicates each channel's trigger type. Recorder mode enables several conditions to be monitored at the same time.

"No trigger": if all the channels are in this mode, the device records indefinitely.

The Pretrig is monitored for each type of trigger.

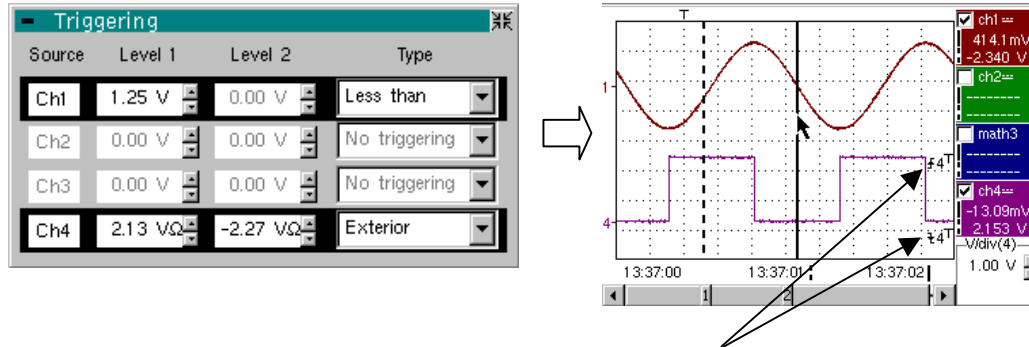
- **"Lower than"**: triggering takes place when the signal drops below the threshold.
- **"Lower/higher than"**: triggering takes place when the signal drops below or rises above the threshold.
- **"Higher than"**: triggering takes place when the signal rises above the threshold.
- **"Outside window"**: triggering takes place when the signal goes outside the window defined by the two thresholds.



A half-division hysteresis is applied to prevent ill-timed triggers.

Recorder Mode (cont.)

-  **Example**
- Channel 1 is set with a 1.25V “higher than” trigger.
 - Channels 2 and 3 do not wait for a trigger.
 - Channel 4 is set with an “outside” type trigger.
 - Channel 1 and 4 lines are highlighted: they wait for a trigger.



Outside trigger symbol for channel 4



Toggle through the trigger conditions for the different channels using this key.

Delayed triggering

Delayed triggering offers the possibility of starting up an acquisition at a date and time chosen by the user.

This option can be related to the previous trigger conditions.

Authorized on

This tab allows the user to validate – or not – delayed triggering.

- If the symbol “✓” is displayed, delayed triggering has been validated.
- If there is no symbol, delayed triggering has not been validated.

Use the stylus to validate or unvalidate the tab.



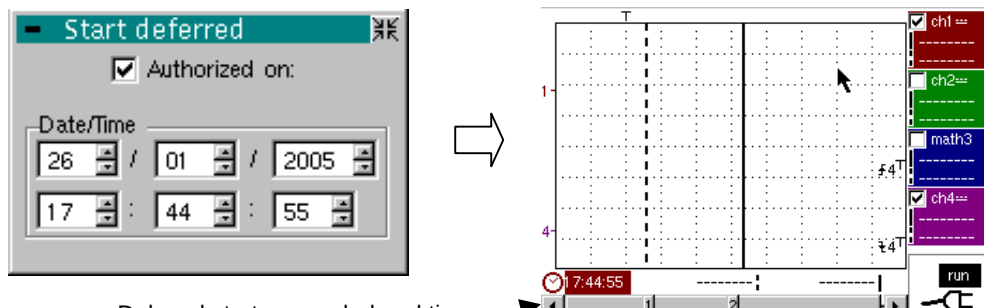
- When delayed triggering has been validated, the user can no longer make an acquisition in recorder mode. He/she may, however, use the other modes as desired. If the user wishes to make an acquisition in recorder mode, he/she must:
 - either unvalidate delayed start-up,
 - or wait until the delayed start-up acquisition begins.
- At the time the acquisition is set to start (delayed triggering time), the instrument must be in operation and the user must have enabled recorder mode.

Date/Time

Different scroll boxes allow the user to set the date and time he/she wishes the acquisition to commence. Use the stylus to scroll.

Example

Delayed triggering: the acquisition will commence on 26 January 2005 at 17:44. The red clock symbol shows the user that delayed start-up is enabled.



Delayed start-up symbol and time

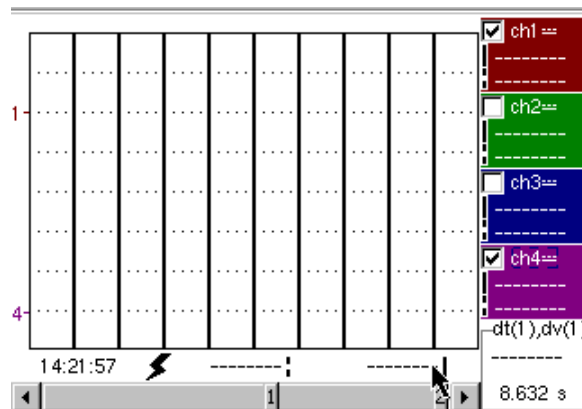
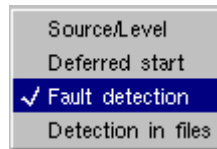
Recorder Mode (cont.)

Fault capture

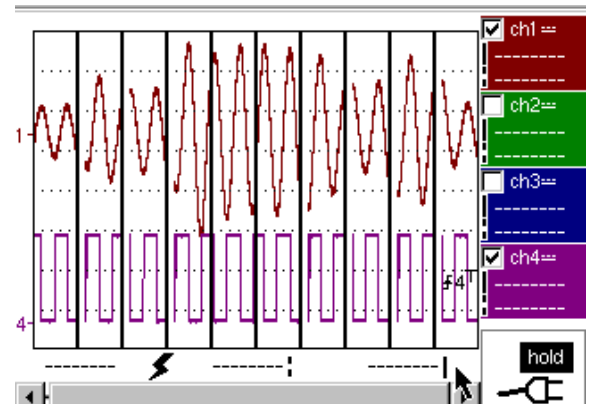
The fault capture mode allows 10 recordings of 250 samples to be made around the trigger point.

These 10 recordings will be displayed on the screen. Each recording is separated by a solid vertical line. They are recorded in volatile memory.

 *Example*



The fault capture mode is selected:
the screen is divided into 10 sections.



Display after an acquisition in fault capture
mode

Recorder Mode (cont.)

File capture

This mode is similar to fault capture mode:

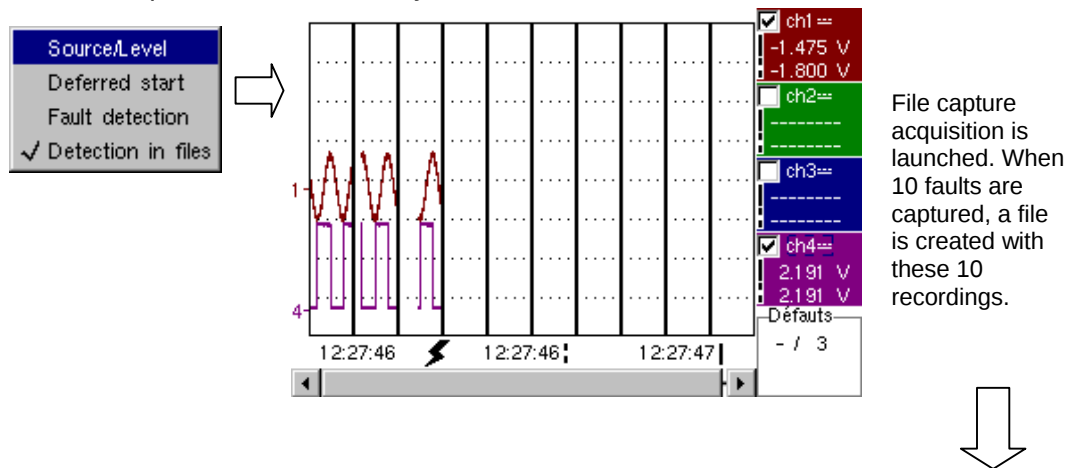
- It carries out several series of 10 recordings of 250 samples.
- Each series of ten recordings is stored in a file in the memory (.REC).
- The number of total recordings that may be made depends on the space remaining in the memory.



- **If the memory is empty**, it is possible to store up to 510 recordings of 250 samples (500 recordings saved in a file and 10 recordings in volatile memory), totalling over 127,000 samples.
- When the memory is full, the acquisition is stopped and a message appears on the screen **"Write error/Auxiliary storage full!"**. The message is validated by selecting **OK** with the stylus. The user can then begin to study the recordings.
- They are displayed folder by folder. There is a file on the screen. A file contains 10 recordings. Fault capture option display mode is available.
- Use the Fault window to move from file to file (see §. Display Menu).

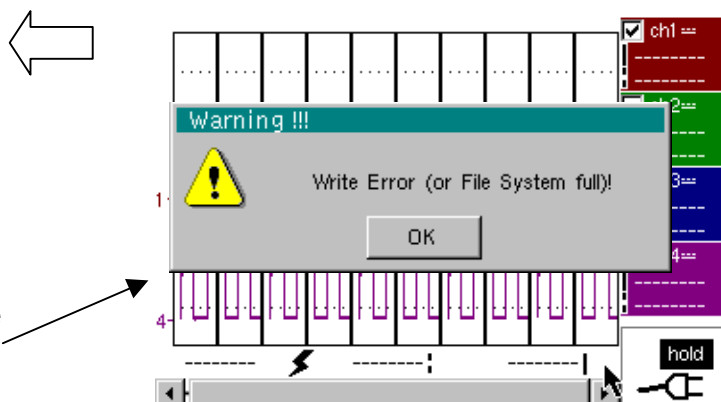
The acquisition can be interrupted at any time by pressing the RUN/HOLD key. The user can then study previously recorded faults.

Example File capture until the memory is full:



Final stage:
Message validation.
In order to access all
the recorded faults,
go to Display menu
→ Fault.
See Display Menu
§. Faults.

The memory is full: the
acquisition is stopped
and a message is
displayed.



Recorder Mode (cont.)

Display (fault capture, file capture)

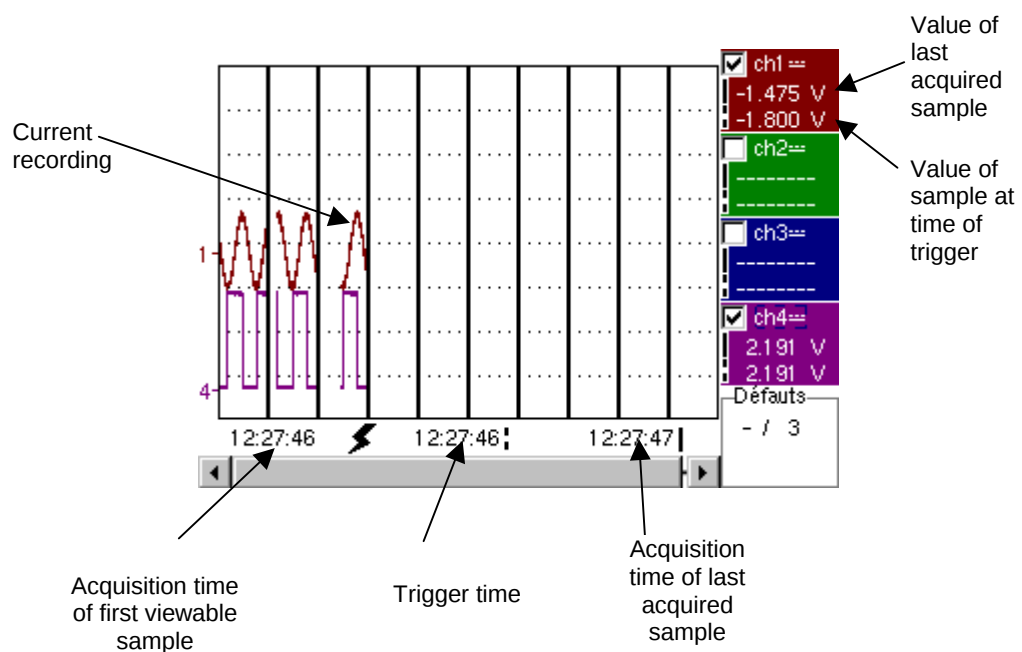
Two cases arise:

- the horizontal zoom is enabled,
- the horizontal zoom is disabled.

Horizontal zoom disabled

Modification of display:

- The cursors are no longer displayed.
- The measurements displayed do not have the same significance.
- All the measurements are related to the current recording.



- “Trigger time” and “Sample value at trigger time” measurements are only displayed if the trigger has taken place.
- Maximum and minimum searches cannot be enabled (see §. Display Menu).
- The automatic measures cannot be enabled (see §. Measurement Menu).

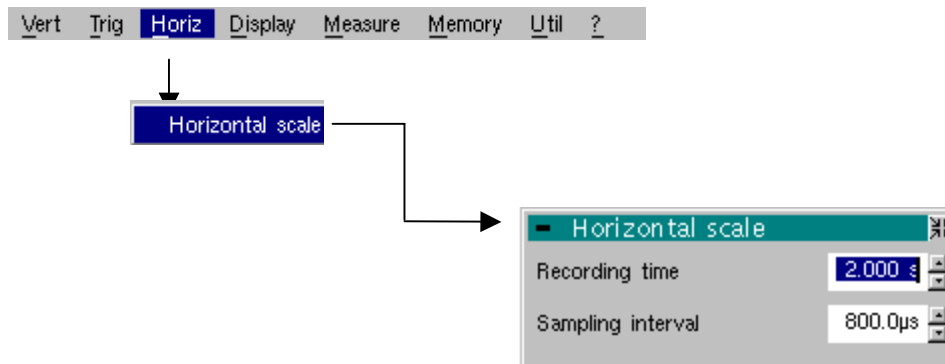
Horizontal zoom enabled

The display is identical to normal mode.

- The measurements displayed have the same significance as in normal mode (see §. Display).
- Maximum and minimum searches are possible (see §. Display Menu).
- Automatic measurements can be enabled (see §. Measurement Menu).

Recorder Mode (cont.)

The "Horiz" Menu



Horizontal scale

This function allows the user to set:

- the recording time,
- the acquisition interval.

These two values are correlated. When the user modifies one, the other is modified.

Adjust the scroll boxes with the stylus to set these values.

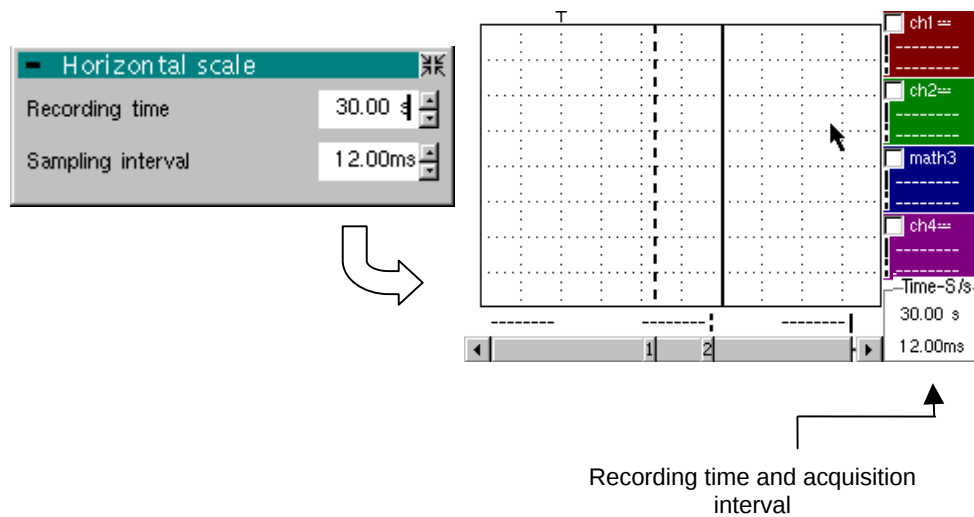


Recording time and sampling interval settings are also accessible via these keys.



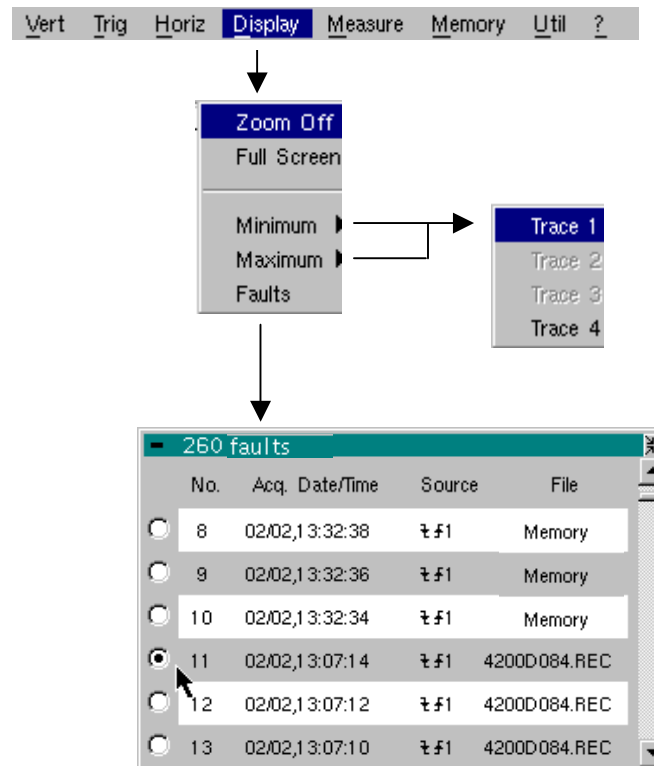
Example

The recording time is 30 seconds and the acquisition interval is 12 mins.



Recorder Mode (cont.)

The "Display" Menu



Zoom off



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

- This function is disabled 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-tapping the stylus inside the curve display area.

Maximum/Minimum

The minimum (or maximum) option consists in:

- searching for the min (or max) value of samples on trace X;
- centring, if possible (zoom), the curve on this specific point.
The main cursor is now fixed on this sample.

Particular case

Display of 10 faults on the screen when fault capture mode (or file capture mode) is validated and the horizontal zoom is not enabled: "Minimum/Maximum" functions cannot be used.

They are greyed out in this configuration.

Recorder Mode (cont.)

Faults

The search for faults enables successive recordings in “fault capture” or “file capture” (memory) mode to be explored (.REC).

All files with a “.REC” extension are analyzed and each fault is displayed. When one of these faults is selected, it is displayed on the screen. The main cursor is fixed at the fault’s trigger point and the auxiliary cursor is placed at the right of the screen: the window is accessible from: Display → Faults.

Various information is provided in this window:

- **Title:** total number of faults contained in the memory
- **No:** fault number
- **Acq. date/time:** date (day, month) and time of fault acquisition
- **Source:** symbol for type of trigger used for this fault and source
- **File:** name of file in which the fault is recorded



The term “memory” in filenames means that the fault captured is in auxiliary storage. If a file is called anything other than “memory”, all the faults in the “memory” file will be lost.

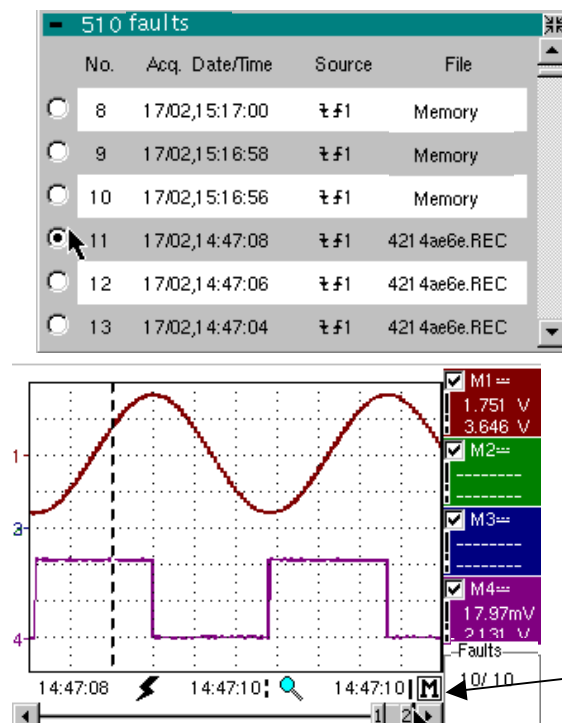
Example Following a file capture, the “Faults” option will allow analysis of the different recordings:

Fault #11 in file selected:

4214ae6e.REC. Its triggering source is outside window. It was captured on 17 February at 14:47:08.

Display of fault #11

with the main cursor on the trigger point and the auxiliary cursor on the last sample acquired. The recorder is in memory display. To return to normal display, deselect Recall ‘.REC’ in the Memory menu.



The symbol **M** is a reminder that the recorder is displaying a memory (.REC). See p. 114.

Full screen

Switches from normal display mode to “full screen” display mode and vice versa.

The display is organised so as to leave the biggest surface area possible for curve plotting: only the permanent settings remain, as well as the option to display the automatic measurement window.



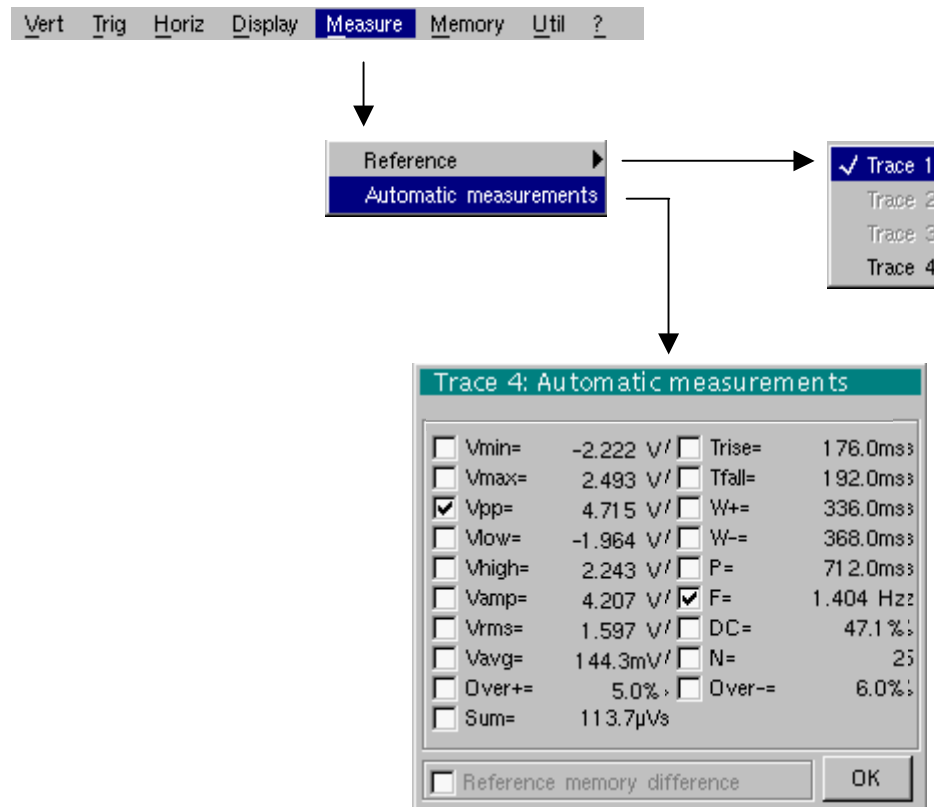
- The “full screen” function has the same effect as the key shown opposite.
- The “✓” symbol indicates that the full screen mode is enabled.



This function can also be accessed by double-tapping the trace display area with the stylus.

Recorder Mode (cont.)

The "Measure" Menu



Reference

Trace 1
Trace 2
Trace 3
Trace 4

Identical to "Oscilloscope" mode.

Automatic measurements

This window is nearly identical to the one in "Oscilloscope" mode.

The automatic measurement calculation area is defined by the two cursors.

It is not possible to select measurements in order to display them in the status area.

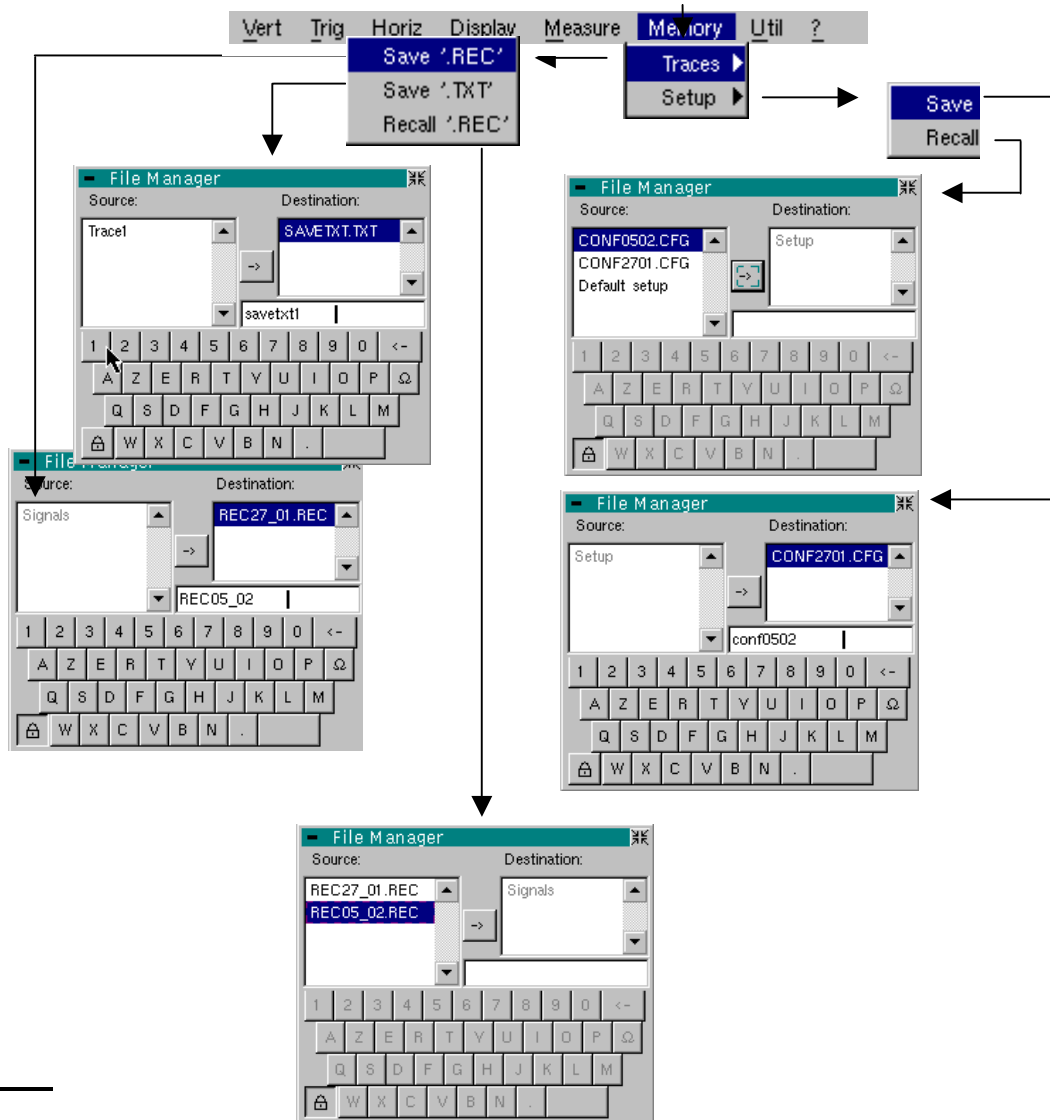
Particular case

Display of 10 faults on the screen when fault capture mode (or file capture mode) is validated and the horizontal zoom is not enabled: the "automatic measurements" function cannot be enabled.

It is greyed out in this configuration.

Recorder Mode (cont.)

The "Memory" Menu



Trace

Save .REC

In this mode, all the traces are saved in one file (extension REC).

The selection opens a "File Copy" menu.

A default backup filename is proposed above the keyboard. It can be modified using the keyboard and stylus. The ← key deletes the character preceding the cursor in this area.

Once the name has been entered, the → key saves the data, puts it into the "destination" list and closes the menu. The backup filename takes the extension .REC (format that can be reread on the instrument). The menu can be exited without backing up by tapping the icon in the top right-hand corner of the window with the stylus.

- The filename is limited to a maximum of 15 characters + extension. If this format is not observed, the message 'Filename too long' is displayed. When the pointer passes over a destination file, its name, date and time of saving and size are displayed.
- If the name already exists or is not compatible, the error message : "Impossible! File already exists" appear.

Recorder Mode (cont.)

'TXT' save

Identical to "Oscilloscope" mode (see §. Memory Menu → Trace → Save '.TXT'). In this mode, traces are saved individually.

Recall '.REC'

Opens a "File Copy" menu when selected.

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

The file name to recall is highlighted. It is selected using the stylus.

Once it has been selected, the → key opens the file and closes the menu.

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

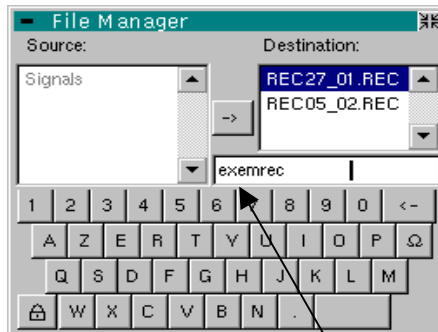


- It is not possible to launch an acquisition or deselect a channel while the recorder is in memory display mode.
- It is not possible to switch from a normal acquisition to a fault capture while the recorder is in memory display mode.



- This symbol – which is in the bottom right-hand corner of the screen – is a reminder that the recorder is in memory display mode.
- The "✓" symbol in front of Recall '.REC' in the Memory menu is a reminder that the recorder is in memory display mode.
- When a .REC file is recalled, the symbol "Mx" is displayed in the parameters of all traces.
- The virtual keyboard cannot be used in this menu.
- To exit mode, deselect Recall '.REC' in the Memory menu by tapping it with the stylus.

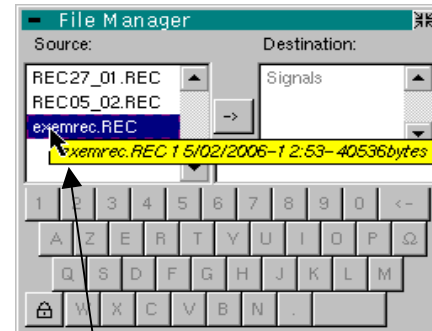
Example



Saving a '.REC' acquisition:

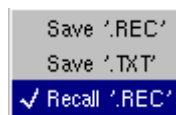
Enter the filename.

Then click on → to validate the save.

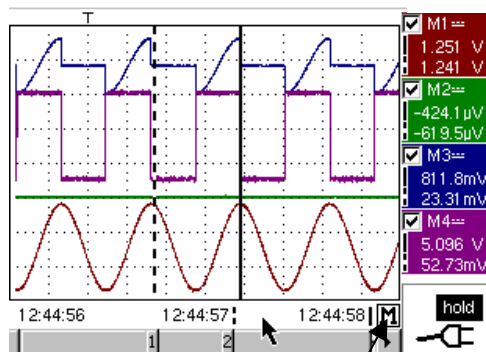


Recall '.REC': Select the file to recall.

Then click on → to validate your choice.



To deactivate the memory display, deselect recall '.REC' with the stylus.



The symbol **M** is a reminder that the recorder is in memory display mode.

Mx symbol: all the traces come from the memory.

Acquisition impossible in memory display mode.

Recorder Mode (cont.)

Configuration

Saving or recalling an instrument configuration.

Save

Opens a "File copy" menu when selected.

- * There is a file called "Configuration" in the "Source" list.
It contains the configuration settings for the device at the time this menu is opened. A backup filename is proposed above the virtual keyboard. The  key deletes the character preceding the cursor in this area.
- * Once the source filename has been created, the  key saves the configuration by transferring it into the "destination" list and closes the menu (backup file: extension .CFG).
The menu can be exited without saving by tapping the icon in the top right-hand corner of the window.



- *The filename is limited to 15 characters + extension. For a source file, the name is accompanied by the date and time of saving and the file size when the pointer passes over its name.*
- *If the name already exists or is not compatible, an error message appears.*

Recall

This opens a "File Copy" menu when selected.

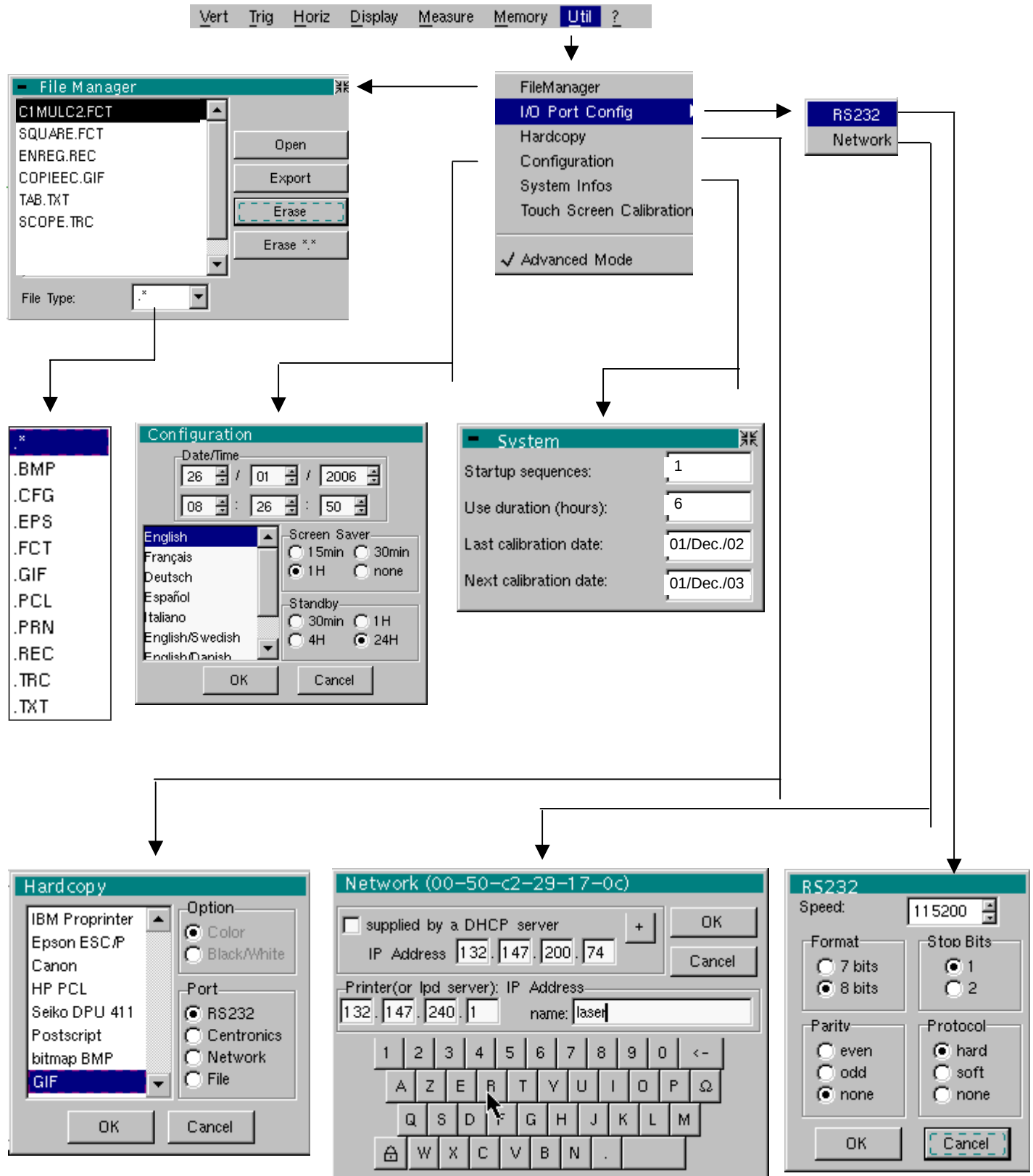
- * The previously saved files (.CFG) (saved via the Configuration → Save menu) are displayed.
The filename that has been selected for recall is greyed out.
The right-hand scroll bar is used to move down the list.
- * Once the source file has been selected, the → key carries out the recall.
- * The menu can be exited without saving by tapping the icon in the top right-hand corner of the window.



- *The virtual keyboard cannot be used in this menu.*
- *Use the "default config" file to restore the factory configuration.*

Recorder Mode (cont.)

The "Util" Menu



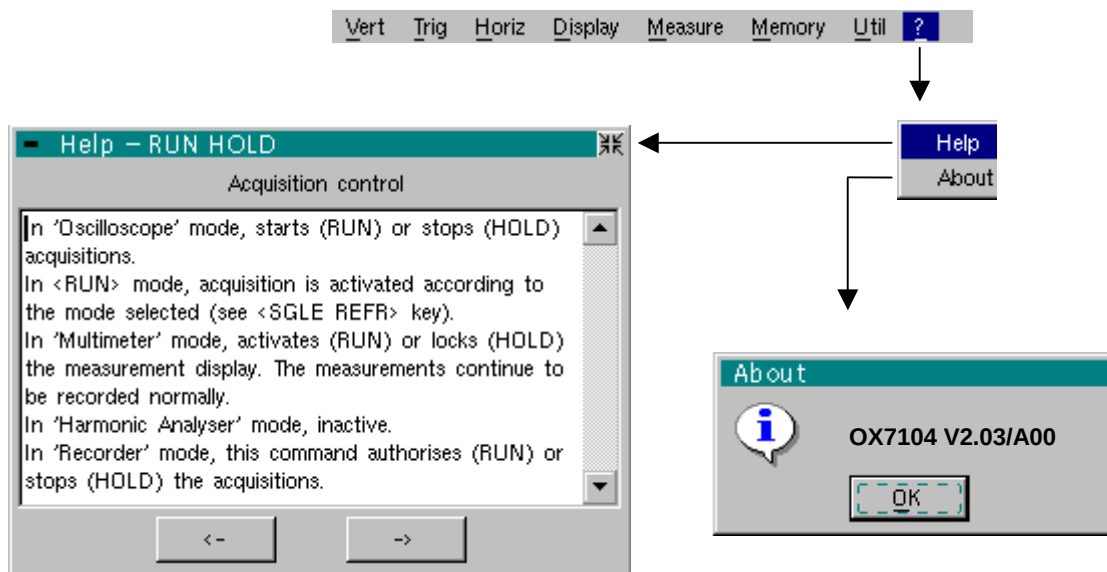
Recorder Mode (cont.)

File manager	This function is identical to that described in "Oscilloscope" mode.
I/O port config	Identical to "Oscilloscope".
Hardcopy	Identical to "Oscilloscope" mode.
Configuration	Identical to "Oscilloscope" mode.
Screen saver	• If the recording time is over 2 seconds, the screen saver will never be activated. • If the recording time is equal to 2 seconds, the screen saver and settings operate as in "Oscilloscope" mode.
Standby	• If the recording time is over 2 seconds, standby will never be activated. • If the recording time is equal to 2 seconds, standby and settings operate as in "Oscilloscope" mode.
System infos	Identical to "Oscilloscope" mode.
"Advanced" mode	When "Advanced" mode is not enabled, certain instrument functions no longer appear in the menus.
Functions available in "Advanced" mode only	math1, math2, math3, math4 → accessible via the " Vert " menu. • The "✓" symbol indicates that "Advanced" mode is enabled. • The stylus can be used to modify this. • By default, "Advanced" mode is not enabled. • <i>In "non-advanced" mode, the instrument's configuration is not saved when it is shut down using the key opposite and the default factory configuration is loaded at start-up.</i>



Recorder Mode (cont.)

The "?" Menu



Help

Menu identical to "Oscilloscope" mode.

About

Menu identical to "Oscilloscope" mode.

Applications

1. Display of the calibration signal



- Using this key, select the "Oscilloscope" mode.
- Connect the **PROBIX** adapter of a 1/10-ratio HX0030 probe to input CH1.
 ⤴ A message indicating the characteristics of the probe is displayed briefly, confirming that it has been detected.
 The **PROBIX** menu (Vert → CH1 → **PROBIX**) can be used to configure buttons **A** and **B** of the probe.
- Use this menu to assign button **A** to increasing the sensitivity and button **B** to reducing it by selecting: Sensitivity +/-.
 ⤴ See the description in the chapter on **PROBIX** p. 17..
- The same menu can be used to modify the color of CH1 trace → Red
- Via the probe (with its earth) connect the calibrator output to input CH1 (Probe Adjust: ≈ 3 V, ≈ 1 kHz) located on the side of the instrument.
 ⤴ **Connect the cold point of the 1/10 probe to the cold point of the calibration output of the probes.**
- Check that the coefficient of the 1/10 probe has been taken into account: Vert Menu → CH1 → Vertical Scale → Coefficient: 10.
 ⤴ The sensitivity and the measurements take the probe's coefficient into account.



- Validate the signal:
 Vert Menu → Display → Trace 1
 or by pressing the CH1 key
 or on the display of the CH1 trace parameters.



- Adjust the CH1 sensitivity:
 Vert Menu → CH1 → Sensitivity/coupling: 500 mV/div. (1/10 probe)
 or by using buttons **A** and **B** of the **HX0030** probe
 or the keys *opposite*.



- Adjust the CH1 coupling:
 Vert Menu → CH1 → Sensitivity/coupling → AC
 or by pressing the AC/DC GND key.



- Adjust the scan speed:
 using the scrollbar in the time base window: 500 μs/div
 or the keys *opposite*.



- Select the trigger parameters:
 Trig. Menu → Parameter → Principal → Source: CH1
 Coupling: AC
 Front: + (or using the key *opposite*).



- Adjust the trigger mode:
 Trig. Menu → Automatic mode
 or using the SGLE REFR key.



- Use the RUN HOLD key to start acquisition ("RUN" mode)

Applications (cont.)

If necessary:

- Modify the trigger level using the stylus:
 - by moving the symbol T (Trigger) on the screen. The value of the trigger level is indicated in the bottom right-hand corner of the screen.
 - or through the trigger parameters menu:
Trig. Menu → Parameter → Principal → Level
- Modify the vertical positioning of the curve:
 - by using the stylus to move symbol 1, on the left of the screen.
 - or by using these keys.



This key is used to make these adjustments automatically.

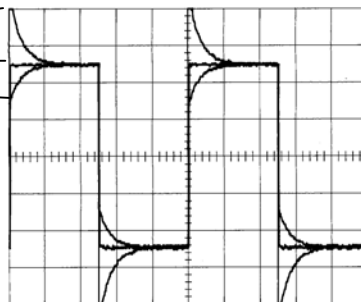
HX0030 probe compensation

Adjust the low-frequency compensation of the probe so that the signal plateau is horizontal (see figure below).

Over-compensated probe ←

Compensated probe ←

Under-compensated probe ←



*Adjust the screw on the **PROBIX HX0030** probe to adjust the compensation.*

Applications (cont.)

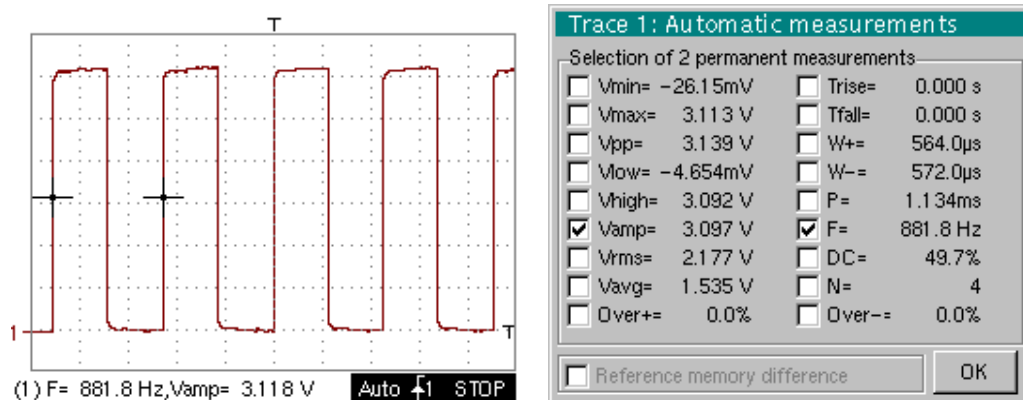
3. Automatic measurement

- Connect the calibrator output (3 V, 1 kHz) in the connection zone to input CH1, using a 1/10 measurement probe.
- For probe adjustments, see the §. Calibration signal display.
- Opt for: 500 mV/div. vertical calibre,
time base coefficient 500 μ s/div.
vertical scale coefficient 10
DC coupling of CH1

Display the table of the automatic signal measurements on channel 1 by:
Measure Menu $\rightarrow$ Automatic Measurements (see §. Measure Menu)
or using this key.



The table of all the measurements made on the trace is displayed:



- The "✓" symbol indicates the 2 measurements that will be displayed on the trace once the table has been closed.
- The automatic measurements beneath the trace are deleted by deleting the last 2 measurements selected.



By validating the "Reference memory difference" option, you can calculate, for the same measurements, the difference between a selected trace and a memorized reference trace (see §. Memory Menu).

Recall

The measurement precision is optimum if 2 complete signal periods are displayed.

When the automatic measurements are activated, 2 cursors appear on the trace at the beginning and end of a period, if at least one period can be viewed on the screen.

Applications (cont.)

4. Measurement using cursors

- Select measurement by cursors using the menu:
Measure → Manual measurements (dt, dv) (see §. Measure Menu).
 - * Two measurement cursors (1 and 2) are displayed as soon as the menu has been activated.
 - * The 2 measurements indicated under the trace display are **dt** (interval between the 2 cursors as a function of the time base) and **dv** (voltage between the 2 cursors as a function of the vert. sensitivity).

 Example: (1)dt : 2,150 ms, dv = 250.0 mV

Recall

- The two measurement cursors (1 and 2) can be moved directly on the screen by means of the stylus.
- In the same way, they can also be moved horizontally by means of the stylus, by selecting the 1 (cursor 1) or the 2 (cursor 2) in the bargraph of the status zone.
- If the unattached cursors option is not activated (see §. Measure Menu → Unattached cursors), the cursors remain linked to the trace during the moves.
- If the unattached cursors option is active, the cursors can be moved anywhere on the screen.
- Initially, there must be 2 out-of-phase signals on 2 channels (ch1 and ch2).

5. Phase Offset measurement/cursors

6. Automatic phase measurement

- Select the reference trace in relation to which you want to perform the phase measurements via the menu:

Measure → Reference → Trace 1 to Trace 4 (see §. Reference).

 Example: Reference Measurement → Trace 1.

- Select automatic phase measurement via the menu:
Measure → Phase measurements (see §. Phase measurement).

 Example: Phase Measurement → Phase Trace 2.

- * The 2 cursors (+) of the automatic measurements are displayed on the reference trace. A cursor "φ" is displayed on the trace concerned by the phase measurements.
- * The phase measurement (in °) is indicated under the display of the curves.

 Example: (1)Ph (2) = 180.0°

Reminder

- The 3 cursors are fixed; they cannot be moved.
- If it is not possible to perform the measurement, "-.-" appears.

Applications (cont.)

6. Manual measurement of phase

- Select manual phase measurement via the menu:
Measure → Manual phase measurement (see §. Measure Menu).
 - * The 2 cursors (1 and 2) of the manual measurements are displayed on the reference trace. A "φ" cursor in relation to which the phase is measured is displayed.
 - * The phase measurement (in °) is indicated under the display of the curve(s).

 Example: (1)Ph = 150.0°

Reminder

- The 3 measurement cursors are present if at least one trace is present on the screen.
- The 3 measurement cursors can be moved directly on the screen by using the stylus. They can also be moved using the stylus by selecting 1 (cursor 1) or 2 (cursor 2) in the bargraph in the status zone.
- If the unattached cursors option is not activated (see §. Unattached cursors), the cursors (1 and 2) will remain linked to the trace when moved.
If the option is active, these cursors can be moved as required on the screen.

In all cases, the symbol "φ" can be moved freely.

7. Display of a TV video signal

This example illustrates the TV synchronization functions.

- *The parameters in the TV menu (Trigger Parameters menu) for displaying a TV signal only apply to the CH1 input.*
- *It is recommended to use a 75 Ω adapter for observing a video signal.*
- Use a **PROBIX** HX0031 adapter to inject on CH1 a composite TV signal with the following characteristics:
 - 625 lines
 - positive modulation
 - vertical grey scale stripes
- In the Trigger Parameters menu, select the tab:
Trig. Menu → Parameter → TV:
- Set the standard number of lines: 625 lines
 - polarity: +
 - line: 25 (for a video signal)
 - front: + (or using the key *opposite*).
- Adjust the CH1 coupling:
Vert Menu → CH1 → Sensitivity/coupling → DC
or by pressing the AC/DC GND key.
- Adjust the CH1 sensitivity:
Vert Menu → CH1 → Sensitivity/coupling → 200 Mv/div.
or using these keys.
- Adjust the scan speed:
using the scrollbar in the time base window: 20 μs/div.
or using these keys.



Applications (cont.)



- Select the trigger mode:
Trig. Menu → Automatic mode or using the SGLE REFR key.



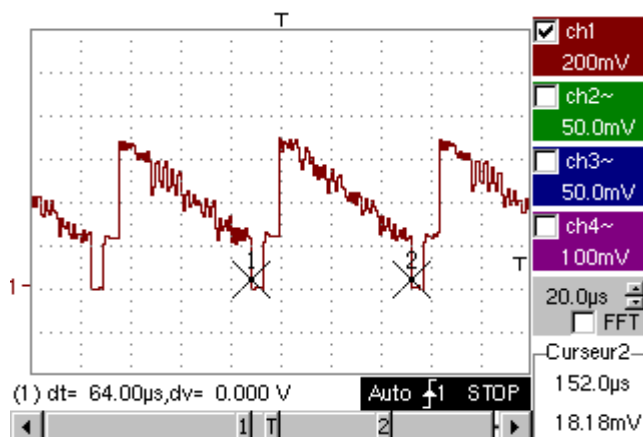
- Use the RUN HOLD key to start acquisition (RUN mode) or use the time base menu.

Reminder

The acquisition status (Ready, RUN, STOP) is indicated on the right, under the display of the trace, in the trigger status display zone.

- Optimize the time base speed to observe several complete TV lines.

Example of a video signal



Use the manual cursors to check the duration of a line



- Display the manual cursors:
Menu → Measure → Manual measurements (dt, dv)
or using the key *opposite*.
- To move the cursors freely, select:
Measure Menu → Unattached cursors.
- Use the stylus to position cursors 1 and 2 on the start and end of the signal, respectively.

The measurements between the 2 cursors are indicated under the curve display.

Example: $dt = 64.00 \mu s = \text{duration of a line}$

Applications (cont.)

8. Examination of a specific TV line

For more detailed examination of a video line signal, the TV trigger menu can be used to select a line number.

- In the Trigger Parameters menu, select the tab:
Trig. Menu → Parameter → TV:

- Set the standard number of lines: 625 lines

polarity: +

line: 1

front: + (or using these keys).



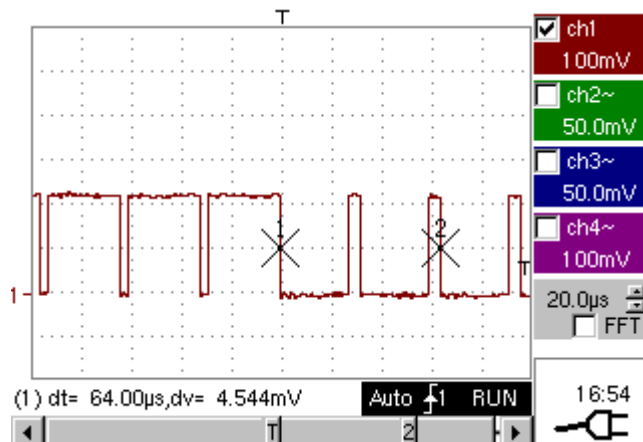
- Adjust the ch1 sensitivity:
Vert Menu → CH1 → Sensitivity/coupling → 100 mV/div
or using these keys



- Modify the scan speed:
using the scrollbar in the time base window: 20 μ s/div or using these keys



 Example of video line 1



Applications (cont.)

9. Automatic measurement in Harmonic Analysis mode

Initially, there must be one or two traces on channels CH1 to CH4.

Recall



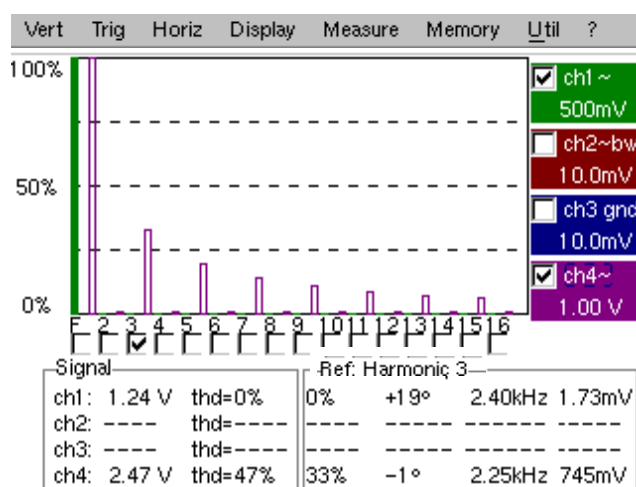
- Only the channels (and not the functions) can be the subject of harmonic analysis.
- In this mode, the time base is not adjustable.
- Set the traces for channels CH1 to CH4 to the mode "Oscilloscope".
- Using this key, select the "Harmonic Analysis" mode.

The traces of channels CH1 and CH4 are shown in a dark color, while the traces of CH2 and CH3 are light (or in the color of the trace).

- Use the "Display" menu (see §. Display) to select the harmonic breakdown required:
 - the fundamental (F) and the first 15 harmonics
 - the even harmonics (2 to 30)
 - the odd harmonics (3 to 31)

The selection chosen appears under the breakdown display.

- The "SIGNAL" table under the breakdown provides information on:
 - the active channel(s) (CH1 to CH4)
 - the RMS voltage of the signal in V
 - harmonic distortion rate (in %) of the signal
- The "✓" symbol, present on the fundamental (F) or one of the harmonics and modifiable using the stylus, means that measurements can be made on the harmonic selected.



Applications (cont.)

- The Table "Ref.: Harmonic X" indicates, for the harmonic selected:
 - its value as a % of the fundamental
 - its phase in ° with respect to the fundamental
 - its frequency in Hz
 - its RMS voltage in V

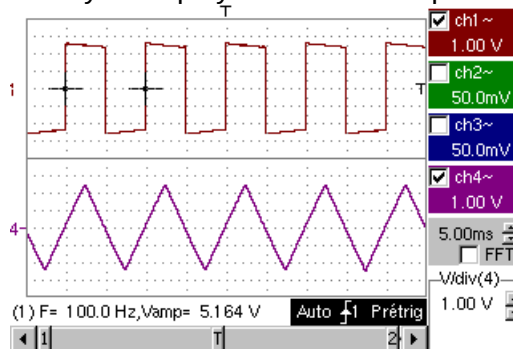
Example of harmonic breakdown

- On CH1, inject a rectangular signal with frequency 100 Hz and amplitude 5V.
- On CH4, inject a triangular signal with frequency 100 Hz and amplitude 5V.
- Use the key *opposite* to perform automatic optimum adjustment of the channels, the ranges, the time base and the trigger.



"Oscilloscope" Mode

Use the FULL TRACE key to display the 2 traces separately.



"Harmonic Analysis" Mode

- Press the key *opposite* to activate the "Harmonic Analysis" mode.
- Use the "Display" menu to select the required harmonic breakdown:



Example: Odd harmonics

- Use the stylus to select the fundamental (F) or one of the harmonics to perform the measurement:

Example: Harmonic 3

Applications (cont.)

10. Display of slow phenomena "ROLL" mode

This example examines the analysis of slow phenomena for time bases ranging from 200 ms to 200 s. The samples are displayed constantly, without waiting for the Trigger (ROLL mode).

 Examination of slow phenomena over a significant period of time



- Select "Oscilloscope" mode (key opposite).
- Inject on the CH1 input a sinusoidal signal at 1 Hz and 1 Vrms.



- Adjust the scan speed:
using the scrollbar in the time base window:
500 ms/div
or using these keys.



- Validate signal CH 1:
Vert Menu → Display → Trace 1
or by pressing the CH1 key
or on the display of the CH1 trace parameters.



- Adjust the CH1 sensitivity:
Vert Menu → CH1 → Sensitivity/coupling → 500 mV/div (1/10 probe)
or using these keys.



- Adjust the CH1 coupling:
Vert Menu → CH1 → Sensitivity/coupling → DC
or by pressing the AC/DC GND key.



- Select the trigger parameters:
Trig. Menu → Parameter → Principal → Source → CH1
Coupling: AC
Front: + or using these keys.



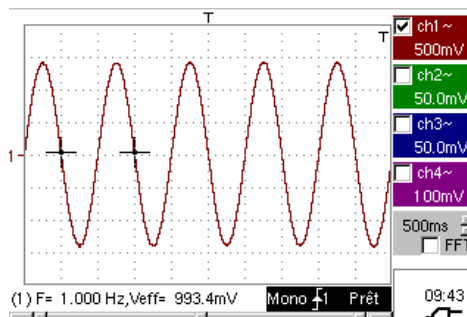
- Adjust the trigger mode:
Trig. Menu → Single mode
or using the SGLE REFR key.
- Use the stylus to move the Trigger level symbol up or down in the display area:
- Trigger level is < the signal level → the oscilloscope stops data acquisition once it has filled the acquisition memory (STOP mode).
- Trigger level > Signal level → data acquisition no longer stops and the signal is analyzed constantly.

The trigger level may be set precisely, using the trigger parameters menu: Trig. Menu → Parameter → Principal → Level.



- Start acquisition using the RUN/HOLD key (RUN mode).

Examination of the signal



The signal is analyzed constantly (RUN mode).
This trace scroll function allows the form of the signal to be monitored.



This function is recommended for studying low-frequency signals.

Applications (cont.)

11. Min / Max Acquisition

Detection of a wrong representation due to under-sampling

 Examination of an amplitude-modulate signal



- Using the key shown *opposite*, select the "Oscilloscope" mode.

- Inject on the CH1 input an amplitude-modulated sinusoidal signal at a frequency of 15Hz.
- Inject on the CH4 input a sinusoidal signal at 300 Hz and 3 VDC for synchronization of the signal on CH1.



- Adjust the scan speed:
using the scrollbar in the time base window: 1 ms/div
or using these keys.



- Validate the CH1 signal:
Vert Menu → Display → Trace 1
or using the key *opposite*.
or on the display of the CH1 trace parameters.



- Adjust the CH1 sensitivity:
Vert Menu → CH1 → Sensitivity/coupling: 200 mV/div
or using these keys.

- Ditto for CH4 with a sensitivity of: 500 mV/div

- Adjust the trigger parameters:
Trig. Menu → Parameter → Principal:
Source: CH4
Coupling: AC
Front: + or using the key *opposite*.



- Adjust the trigger mode:
Trig. Menu → Auto Mode:
or using the SGLE REFR key.

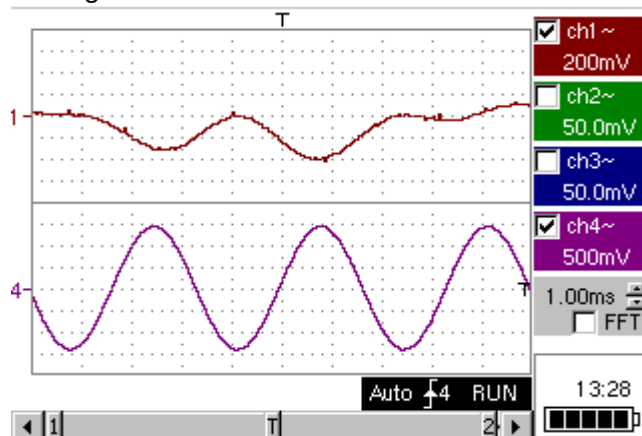


- Start acquisition using the RUN/HOLD key (RUN mode).



- Use the FULL TRACE key to display the 2 traces separately.

 Examination of the signals

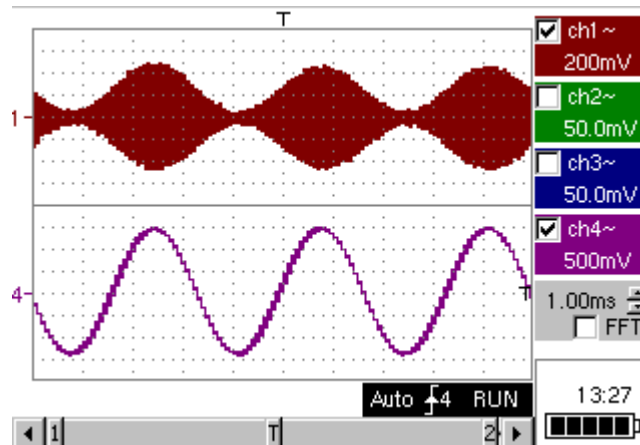


Applications (cont.)

👉 *The observation of the amplitude-modulated CH1 trace cannot be used (incorrect display).*

- Validate the MIN / MAX mode:
 Horiz → MIN/MAX Acquisition menu, to view the amplitude modulation of the CH1 signal.

~~Hand~~ Examination of the signals



Applications (cont.)

12. Measurement in multimeter mode



Measurement in Multimeter Mode

- Press the key *opposite* to activate the "Multimeter" mode.

- Connect the **PROBIX HX0033** adapter on the CH1 input.
 ☞ A message indicating the characteristics of the probe is displayed briefly, confirming that it has been detected.

The positive input is indicated by the "+" sign on the adapter for Vdc measurements.

- Use the appropriate cables to connect the **PROBIX** adapter to the test resistor.
- Select input CH1 in Ohmmeter mode:
Menu: Measurement → CH1 → Ohmmeter.

☞ Ohmmeter mode (Ω) is indicated in the display of the parameters for CH1.



- Validate the measurements on CH1 by pressing the key *opposite* (- X - disappears).

The resistance measured is not known:

- Select the "Autorange" mode.
"Channel 1 Parameters" menu under Vert → CH1 → Range/Coupling or by a long press on the CH1 key.



☞ The autorange mode (auto) is indicated in the display of the parameters for CH1.

In this case, the instrument constantly seeks the most suitable measurement range.

The resistance measured is known:

- Select the appropriate range:
"Channel 1 Parameters" menu under Vert → CH1 → Range/Coupling or using these keys.



☞ See the general characteristics for the ranges available.

- Select the "Statistics" mode.
Menu: Display → Statistics, to find out the minimum and maximum values when the measurement variations are analyzed.

☞ The MIN and MAX measurements are indicated in the display of the parameters for CH1.



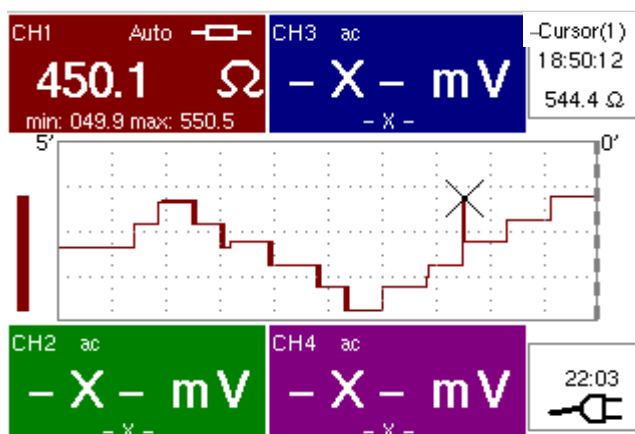
- Use these keys to select the duration of the period (5', 15', 30', 1 h, 6 h, 12 h, 24 h, week, month) for analysis of the measurement variations.

☞ The duration selected is indicated in the top left-hand corner of the graphic window.

- Deactivate "Roll" mode:
Menu: Horiz → Roll to stop the measurements at the end of the analysis period.

Applications (cont.)

Example of measurement in Multimeter Mode



- The graphic window records the changes in the measurements during the analysis period (5 minutes).
- The bargraph shows the amplitude of the variations.
- The minimum value (49.9Ω) and the maximum value (550.5Ω) measured are indicated in the CH1 parameter display.
- The cursor linked to the trace indicates the measurement a specific point on the trace, along with the time of the event.

✎ *The value measured which is displayed in the CH1 parameter display remains active after the analysis period has ended.*

13. Measurement in "Recorder" mode

Analysis of iron heating



Using the key shown *opposite*, select the "Recorder" mode.

Connect the **PROBIX** adapter of an **HX0035** K Thermocouple probe to input CH1.

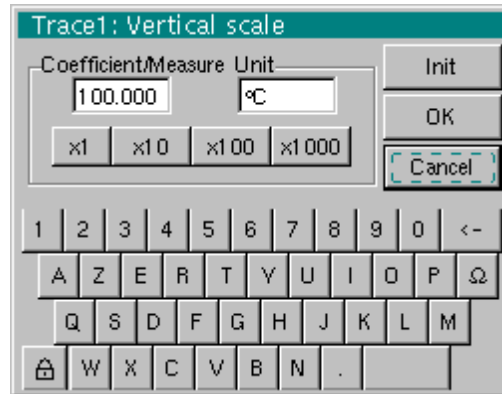
A message showing the characteristics of the probe is displayed briefly → the probe has been detected:

ch1: PROBIX event			
HX35 - NO ISOLATION BETWEEN 2 KTC -40°C/+1250°C, 1% +/-3.5°C typ			
	Input:	Floating:	Between Channel:
Ch1	K TC	30V CAT I	-
HX35	-	-	-
Ch2	-	600V CAT III	300V CAT II
-	-	-	-
Ch3	-	600V CAT III	300V CAT II
-	-	-	-
Ch4	-	600V CAT III	300V CAT II
-	-	-	-

Applications (cont.)

Ch1 is validated automatically.

Ch1 selects automatically the unit "degree Celsius": verification possible in the Vert menu → Ch1 → Vertical scale.



Adjust the vertical sensitivity to 50°C/div. Three options:

- using these keys,
- selecting channel 1 using the key opposite. Adjust the sensitivity, displayed at the bottom right of the screen, using the scroll bar with the stylus,
- with the Vert Menu → CH1 → Sensitivity/Coupling: 50°C

The CH1 coupling was already adjusted in DC automatically by the probe.

The symbol $\overline{=}$ appears in the parameters of the CH1 trace.



Adjust the recording period or the sampling interval (for example: 60 s)

- using these keys,
- or in the "Horiz" menu → Horizontal scale

Adjust the trigger parameters: threshold type and level.

 *Example:* High triggering on channel 1 represented by the symbol $\pm 1^T$ with a level of 61.3°C. On the other channels: no triggering.

Operation: 2 options



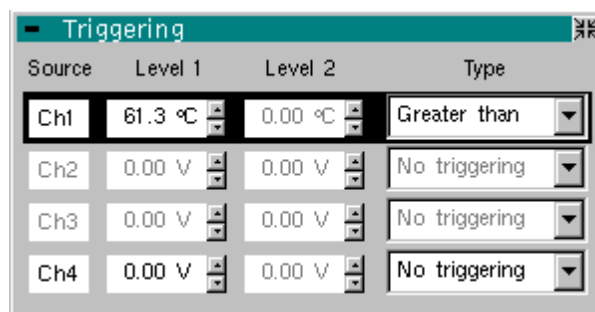
- Press on CH1 and on the key opposite to select the required triggering. Repeat for all channels.

To adjust the level, select the symbol $\pm 1^T$ using the stylus and adjust it to the required level.

- Go to the "Trig" menu → Source/Level and adjust the type and level of triggering required on each channel.

Applications (cont.)

Triggering after adjustment window

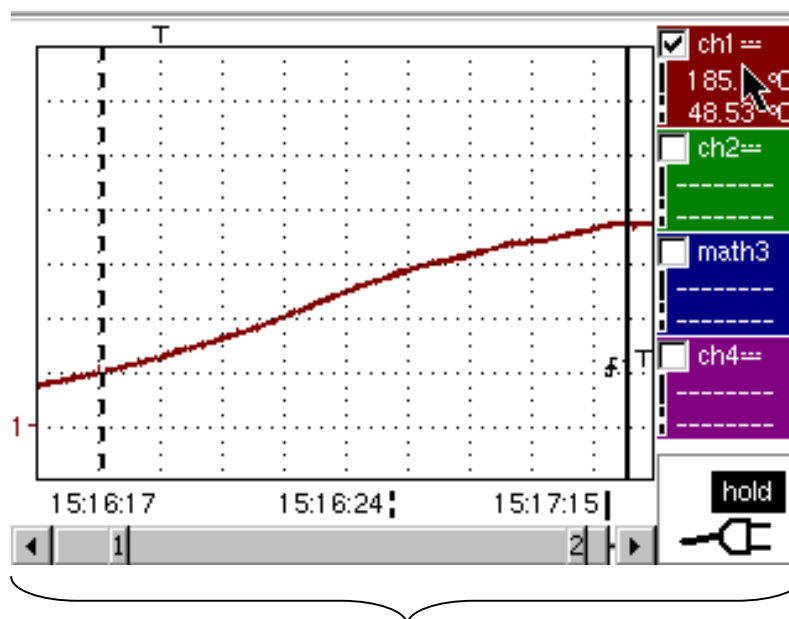


Adjust the position of the vertical position indicator of channel CH1 to -149°C, as follows:



- Press key CH1, then on the keys opposite. The position of the indicator is displayed at the bottom right of the screen.
- Apply the end of the temperature probe to the end of the soldering iron.
- When the end is in position, launch acquisition using this key.
- Connect the soldering iron.

Resulting Curve



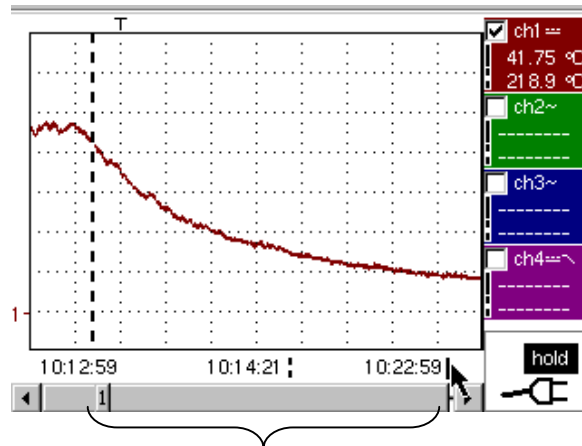
This acquisition shows the heating dynamic of the soldering iron.

Applications (cont.)

Analysis of soldering iron cooling

The acquisition parameters must be changed.

- Sensitivity: 50°C/division
- Recording period: 10 minutes
- Trigger type: low,
- Trigger level: 140°C,
- Position of ch1 ground indicator: id.



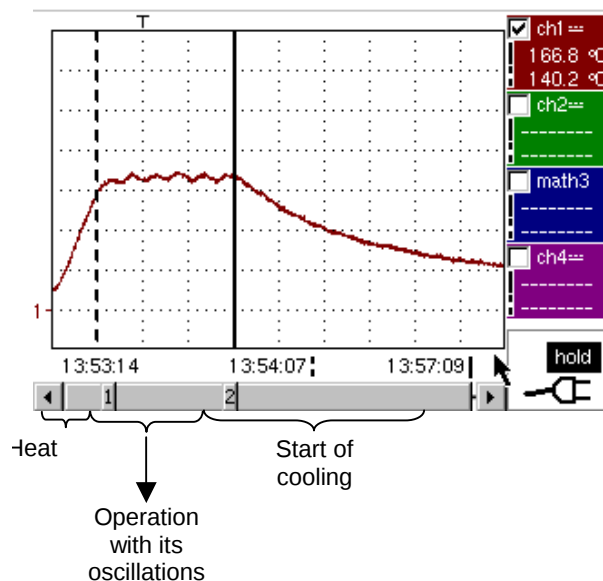
Iron cooling:
a dynamic study is possible using this acquisition.

Overall operation of soldering iron

Last acquisition: the iron heats, operates and cools.

Acquisition parameters:

- Vertical scale, acquisition period, coupling, ground indicator: identical
- No triggering on channels: manual shutdown of acquisition using this key.

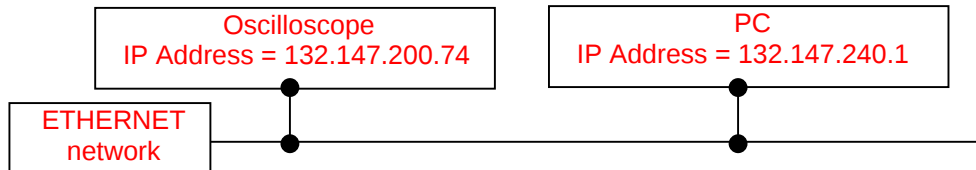


Applications (cont.)

14. Ethernet network application examples

a) File transfer from a PC via the network

The files in the oscilloscope's "File Management" menu (see §. "Util" Menu) can be downloaded onto a PC (or uploaded from a PC) via an Ethernet network.



- Use a suitable Ethernet cable to link the oscilloscope to the network.
- Open the oscilloscope's "Network" menu.
- Enter the IP address manually or automatically using the icon "provided by a DHCP server" (if the server is accessible).
- Then validate the information by choosing **OK**.
-  Example: 132.147.200.74
- Use a PC connected to this network.
- In your browser, type in the URL zone: ftp://132.147.200.74
A list of the files is then displayed.
- You can use your browser to:
 - copy files (PC → Scope or Scope → PC),
 - delete files,
 - rename files.

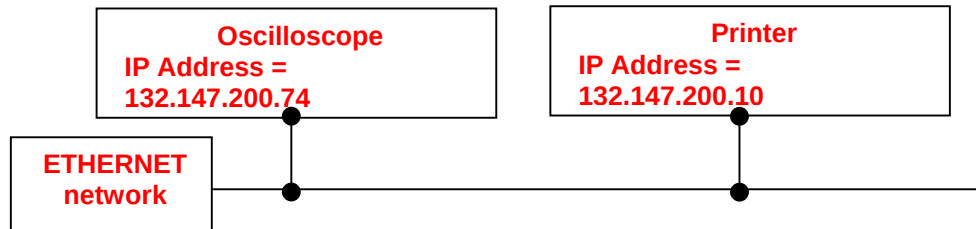


The SX-METRO software (option) simplifies file transfer via the Ethernet network.

Applications (cont.)

b) Hard copy of the screen on a network printer

Screen copying can be initiated on a network printer.



- Use a suitable Ethernet cable to link the oscilloscope to the network.
- Open the oscilloscope's "Network" menu.
- Enter the IP address manually or automatically using the icon "provided by a DHCP server" (if the server is accessible).
✎ Example: 132.147.200.74
- Enter the IP address of the network printer using the table of usable numbers after selecting the zone to be modified.
✎ Example: 132.147.200.74
- Specify the name of the required printer (✎ Example: LaserJet 4)
 ☞ To find out the IP address of the server or the name of the printer, contact the network administrator responsible for your IT installation.
- Then validate the information by choosing **OK**.
- Open the "Hardcopy" menu (See §. "Util" Menu) of the oscilloscope.
- According to the printer connected to the network, select the print format or type of printer.
- Validate the color or black/white option.
- Validate the Network option of the port menu.
- Configure the oscilloscope so that it displays the screen as you wish to print it.



Start the required print operation by pressing this key.

Applications (cont.)

15. WEB Server

Minimum PC Configuration: *Pentium II, 200 MHz, 64 Mb. RAM.
Screen resolution: > 1152 x 864 pixels
Install JVM SUN (minimum version
J2RE 1.4.2) from site [//java.sun.com](http://java.sun.com)*

Recommended browsers: *Internet Explorer 6.0 or Netscape 6.0*

Screens obtained on PC logged on to same network as the instrument.

In the examples that follow, the IP address of the oscilloscope is: 14.3.250.46
(programmed in the UTIL menu → Config I/O Port → Network).

Connection to WEB SERVER

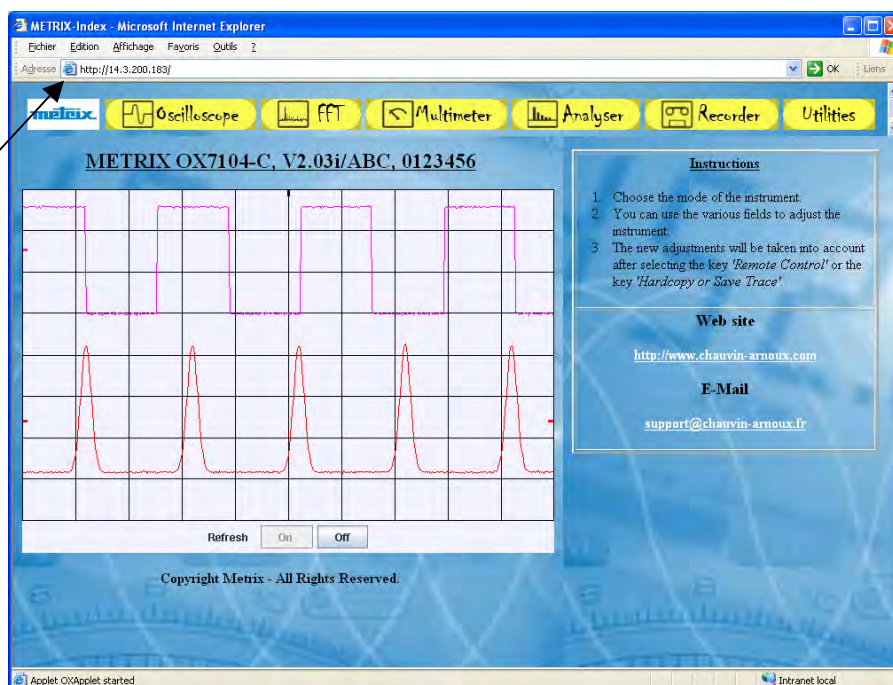
Connection is done from a PC by using INTERNET EXPLORER.

To reach the Web-server, register in the bar of address:

'http://IP Address' of the instrument.

The IP address of the instrument is defined in the following menu: UTIL → Config I/O Port → Network. See p. 71.

IP Address of
instrument:
see p. 73.



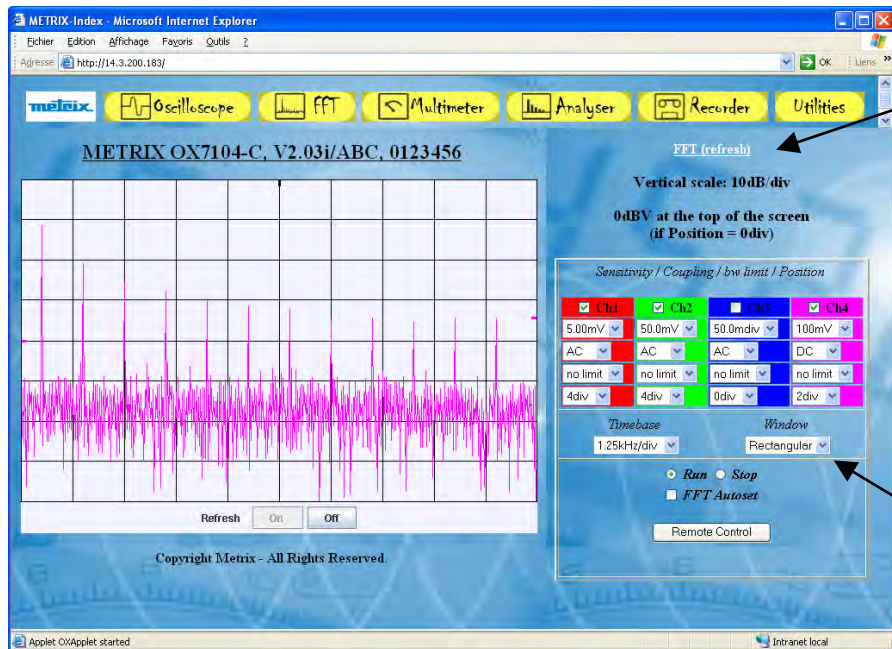
Applications (cont.)

"OSCILLOSCOPE" mode

IP Address of instrument:
see p. 73

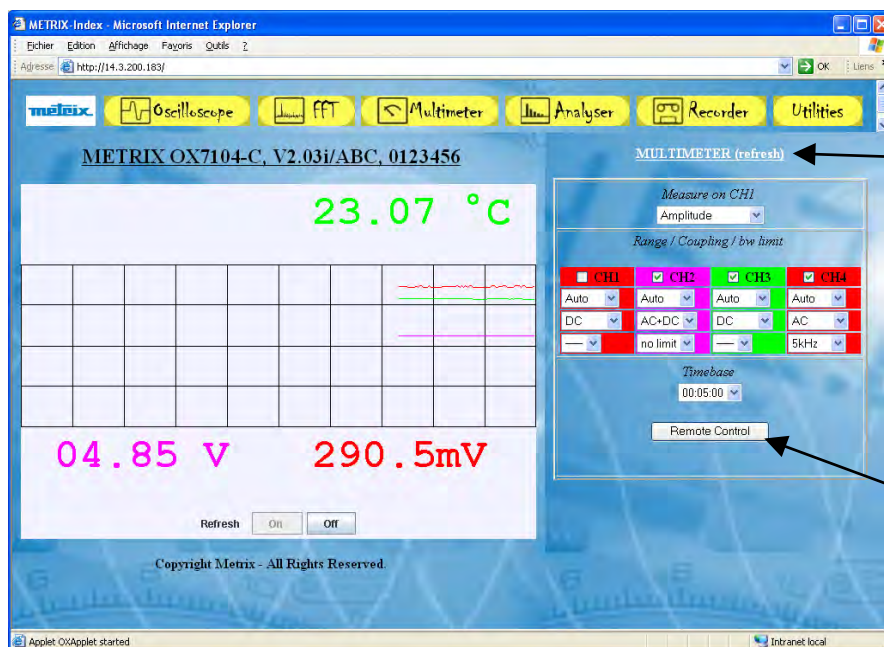


"FFT" mode



Applications (cont.)

"MULTIMETER" Mode



One click on window title triggers refreshing.

Window adjustments integrated after a click on "Remote Control".

"Recorder" mode



One click on window title triggers refreshing.

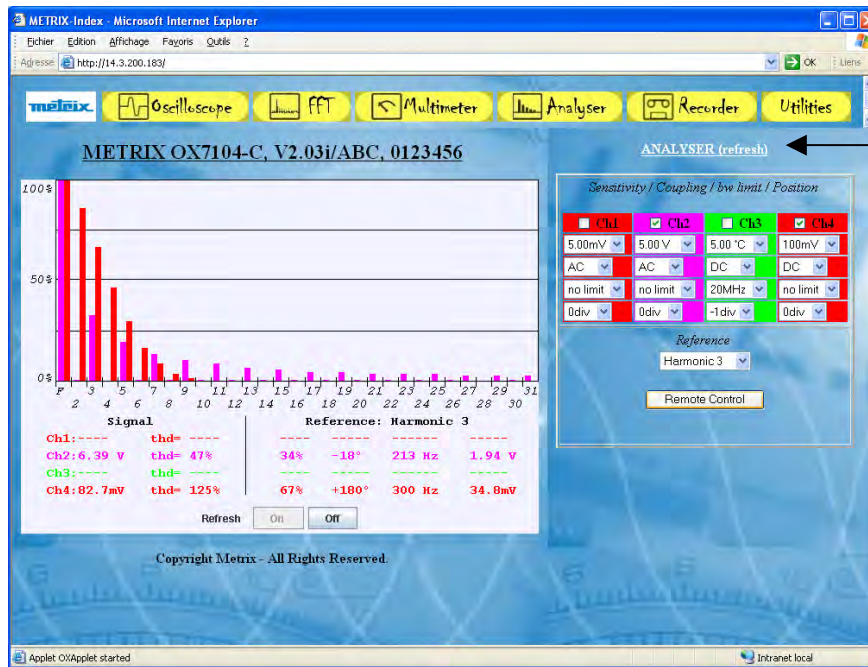
(*) Window adjustments integrated after clicking on "Remote Control".

(*) After refreshing window, this list indicates the moment of acquisition of all faults:

- in "standard" mode: a single fault is acquired,
- in "fault capture" mode: 10 faults can be acquired.

Applications (cont.)

« HARMONIC
ANALYSIS »
mode



Clicking
with the
mouse
triggers
refreshing.

"UTILITIES"



File name
used in the
request
(hardcopy
or save
trace)

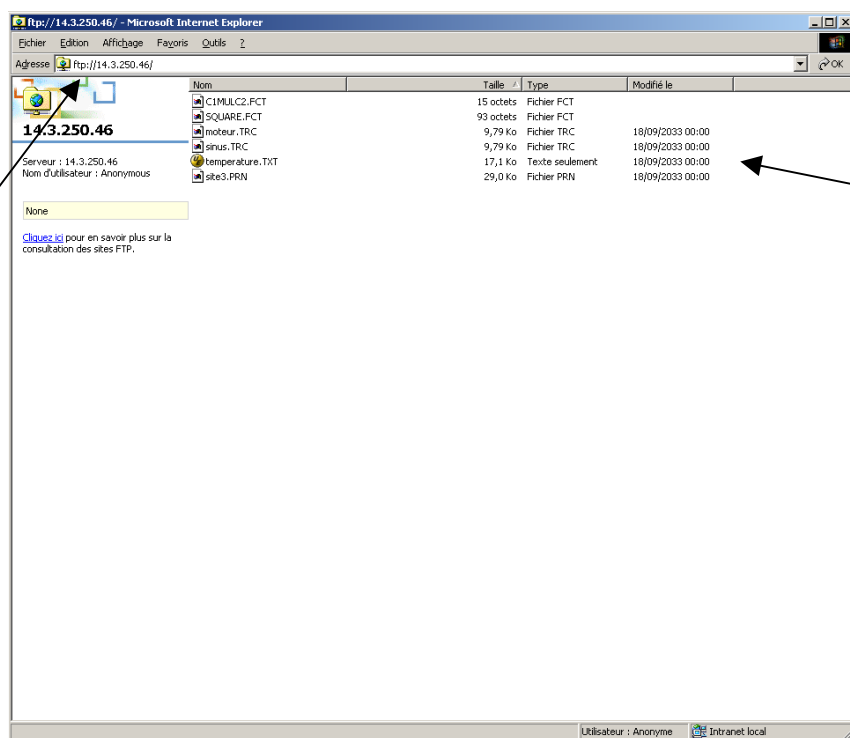
Display of
FTP
window,
indicating
files on
virtual disk of
instrument.
See screen
below.

The selection button
determines the action:
- launching of screen copy or
- save trace.

Applications (cont.)

File Transfer

IP Address of
instrument:
see p. 70



Files may be
copied on
PC using
conventional
Windows
commands.

Technical Specifications « Oscilloscope » Function

Only the values assigned with a tolerance or limits are guaranteed values (after half an hour warming up). Values without a tolerance are for information only.

Vertical deviation

Characteristics	OX 7102 - OX 7104
Number of channels	4 channels: CH1 to CH4 (OX 7104) 2 channels: CH1 & CH4 (OX 7102)
Vertical ranges	2.5mV to 200V/div. Variation in steps (no continuous variable coefficient)
BW at - 3dB on all vertical ranges from 2.5 mV to 200 V/div.	100MHz (OX 7102, OX 7104)  Measured on 50Ω load with a 6 div. amplitude signal)
Max. input voltage	600VDC, 600Vrms, 850Vpk (DC + peak AC at 1kHz) without 1/10 probe 1 kVrms with PROBIX HX0030 probe derating -20 dB/decade from 100kHz to 100MHz
Input Type	PROBIX safety connector: class 2, insulated inputs
Vertical offset dynamic	± 10 divisions on all ranges
Input coupling	AC: 10Hz to 100MHz DC: 0 to 100MHz GND: reference
BWL bandwidth limit	at ≈ 20MHz
Rise time on all vertical ranges 2.5 mV to 200 V/div.	< 3.5 ns (OX 7102, OX 7104)
Cross-talk between channels	DC at 40 MHz > 70 dB DC at 100 MHz > 70 dB  Same sensitivity on both channels
Response to rectangular signals: 1 kHz and 1 MHz	Positive or negative overshoot Overshoot ≤ 3% Aberrations ≤ 3%
Peak-to-peak gain accuracy	± 1% (with averaging of 4) at 1kHz
Vertical resolution of the display	± 0.4% of full scale (without ZOOM) 0.025% in ZOOM mode (12-bit)
DC vertical measurement accuracy	± [1% x (reading - offset) + accuracy of vertical offset + (0.05 div.) x (V/div.)]
Resolution of the measurements	12-bit
Accuracy of vertical offset	± [1% x (offset value) + 200μV + (0.1 div.) x (V/div.)]
Probes	The probe's attenuation coefficient in the display is taken into account automatically when PROBIX probes are used.
Vertical ZOOM function on acquired or saved curve	ZOOM factors: 16 max
Electrical safety (not for accessory)	600V, CAT III, double insulation
Max. voltages (not for accessory)	floating: 600V, CAT III from 50 to 400 Hz between channels: 600V, CAT III from 50 to 400 Hz
Input impedance	1MΩ ± 0.5% approx. 17 pF
Display modes	ch1, ch4 (OX 7102) ch1, ch2, ch3, ch4 (OX 7104)

Technical Specifications (cont'd)

« Oscilloscope » Function

Horizontal deflection (time base)	
Characteristics	OX 7102 - OX 7104
Time base ranges	35 ranges, from 1 ns to 200 s/div.
Time base accuracy	$\pm 0.1\%$
Sampling rate	1 GS/sec. in real time 25 GS/sec. with repetitive signal
Time measurement accuracy	$\pm [(0.02 \text{ div.}) \times (\text{time/div.}) + 0.005 \times \text{reading} + 1 \text{ ns}]$
Horizontal ZOOM	The horizontal ZOOM factors available range from x 1 to x 10 according to the sequence 1-2-5 (in ZOOM mode, the same sequence of time base ranges is used as in normal mode). <i>Note: The oscilloscope has a memory capacity for recording of 2500 counts per channel. The horizontal resolution of the screen is 250 counts for 10 divisions.</i>
XY Mode	The bandwidth in X and Y is identical
Phase error	$< 3^\circ$  In XY mode, at each instant t: The smallest time increment between two successive XY points is given by the real acquisition frequency of the oscilloscope. XY mode representation therefore depends on the selected time-base range.
Bandwidth in X and Y Representation	100MHz (OX 7102, OX 7104)
Fast Fourier Transform	temporal or frequential (FFT) calculation on the traces present in the screen area • dynamic refreshment as a function of the signal observed in RUN mode • windowing: rectangle, hamming, Hanning, Blackman • scales: logarithmic or linear • automatic adjustment with autoset function

Technical Specifications (cont'd)

« Oscilloscope » Function

Trigger circuit	
Characteristics	OX 7104 - OX 7102
Trigger sources	CH1, CH2, CH3, CH4 (OX 7104) CH1, CH4 (OX 7102)
Trigger mode	Automatic Triggered Single shot Auto Level 50%
Trigger coupling without bandwidth limit	AC: BW 10Hz to 200MHz DC: BW 0 to 200MHz HFreject: BW 0 to 10kHz LFreject: BW 10kHz to 200MHz <i>With bandwidth limitation activated, the bandwidth is limited to 20MHz.</i>
Trigger gradient	Falling or rising
Trigger sensitivity	0.6 div. at 1kHz (noise rejection mode → inactive)
Noise rejection	≈ ±1.5 div.
Trigger level Variation range	±10 div.
Trigger type	<u>on edge</u>
	<u>on pulse width</u> < t ≈ t > t from 20 ns to 20 s
	<u>Trigger after delay</u> of 120 ns to 20 s qualifier source: CH1 (CH2) (CH3) CH4 trigger source: CH1 (CH2) (CH3) CH4
	<u>Trigger after counting</u> 3 to 16,384 events qualifier source: CH1 (CH2) (CH3) CH4 counting source: CH1 (CH2) (CH3) CH4 trigger source: qualifier or counting source
	<u>TV on CH1 only:</u> - Selection of line number and polarity, with 525 lines (PAL) and 625 lines (SECAM), even or odd line field - TV trigger sensitivity: > 1 div.
HOLDOFF	Adjustable from 160 ns to 30 sec.

Technical Specifications (cont'd)

« Oscilloscope » Function

Acquisition chain		
Characteristics	Specifications	Comments
ADC Resolution Maximum sampling rate	12-bit 1 GS/sec. in real time	1 converter per channel
Sampling modes: Real time Repetitive signal	1 GS/s max. 25 GS/s	Equivalent Time Sampling
Transient capture MIN/ MAX mode Minimum width of detectable Glitches	1250 MIN/MAX couples ≥ 2 ns	Whatever time base is used, short-term events (Glitch, ≥ 2 ns) are displayed.
Acquisition memory depth	2500 counts per channel	fixed
PRETRIG function	0 to 100 %	
Back-up memories	Total size 1 Mb for storing: - trace - text - config - function - printout - image - etc.	The file names contain 15 characters + suffix
Storage formats (file sizes)	Trace (.TRC) (≈ 10 kb) (.TXT) (≈ 20 kb)	Back-up of trace and acquisition parameters
	Configuration (.CFG) (≈ 1 kb)	Back-up of complete equipment configuration
	Hardcopy (.EPS) (.PRN) (.PCL)	Standard printing formats (the size varies according to the format; > 200 kb)
	Hard copy (.BMP) (≈ 240 kb) (.GIF) (≈ 5 kb)	Standard image formats
	File (.FCT) (< 1 kb)	Back-up of a function

Technical Specifications (cont'd)

« Oscilloscope » Function

Processing of measurements		
Mathematical functions	Equation editor (functions on the channels or simulated) Addition, subtraction, multiplication, division and complex functions between channels.	
Automatic measurements	Time measurements up time down time positive pulse negative pulse cyclic ratio period frequency phase. counting integral	Level measurements DC voltage rms voltage peak-to-peak voltage amplitude max. voltage min voltage high plateau low plateau overshoot
Resolution of the measurements	12-bit / display on 4 digits	
Measurements by cursors or automatic measurements		
DC vertical measurement accuracy	$\pm [1 \% (\text{reading} - \text{offset}) + \text{accuracy of vertical offset} + (0.05 \text{ div.}) + (\text{V/div.})]$	
Accuracy of 2-cursor time measurements	$\pm [0.02 \times (t/\text{div.}) + 0.01\% (\text{reading}) + 1 \text{ ns}]$ The cursors are attached to the trace, but they can be detached to perform a measurement between channels (offset, delay, etc.) In XY mode, the cursors are not attached to the trace.	
Current measurement	On all inputs HX0034 20mV/A current clamp, 80 A peak, AC/DC 600V, CAT II Accuracy $\pm 1.5\%$ $\pm 2\text{mA}$ from 0 to 40A peak $\pm 4\%$ from 40 to 80A peak With the current clamp HX0034, the service voltage between channel is 600V CAT II. 	

Technical Specifications (cont'd)

« Oscilloscope » Function

Display	
Characteristics	OX 7102 - OX 7104
Display screen	LCD 5.7 STN Color CCFL back-lighting
Contrast	Continuous adjustment
Resolution	1/4 VGA, i.e. 320 pixels horizontally x 240 pixels vertically
Screen saver	Delay can be selected in the Tool Menu → Configuration 15', 30', 1h or none
Window displayed in normal mode Horizontal ZOOM	Complete memory: 2500 250 counts out of the 2500 of the whole memory
Display modes	Vector Acquired points, interpolated points, averaging The acquired points are attached by a segment. Envelope Min. and max. on each horizontal screen position are displayed. Averaging Range of factors: none, 2, 4, 16, 64
Graticule	Complete Borders
Indications on screen	Triggering Trigger level position (with overshoot indicator) Position of the Trigger point on the bargraph and on the top edge of the screen (with overshoot indicators) Traces Trace identifiers, activation of the traces Position, Sensitivity Ground reference High and low overshoot indicators if traces are off screen
Miscellaneous	
1/10 probe calibration signal	Form: rectangular Amplitude: ≈ 0 to 3V Frequency: $\approx 1\text{kHz} \pm 20\%$ Dual insulation / channels: 600V CAT III 👉 Connect the cold point of the 1/10 probe to the cold point of the calibration output of the probes.
Autoset	Search time < 5 s Frequency range > 30 Hz Amplitude range 15mVpp to 400Vpp Cyclic ratio limits 20 to 80 %

Technical Specifications « Multimeter » Function

Only the values assigned with a tolerance or limits are guaranteed values (after half an hour warming up). Values without a tolerance are for information only.

Display	4000-counts in voltmeter				
Input impedance	1MΩ				
Max. input voltage	600Vrms sinus and 800VDC				
Floating max. voltage	600Vrms up to 400Hz				
DC measurement	Ranges	0.4V	4V	40V	400V 800V
	Resolution	0.1mV	1mV	10mV	0.1V 1V
	Accuracy	0.5 % ± 5 D in DC from 10% to 100% of scale			
	Common mode rejection	> 70 dB at 50 or 60 or 400Hz			
AC, AC+DC measurements					
	Ranges	0.3V 0.4V	3V 4V	30V 40V	300V 400V 600Vrms sinus 800Vpeak
	Resolution	0.1mV	1mV	10mV	0.1V 1V
Accuracy with AC+DC coupling	1% ± 15 D from DC to 5kHz from 10% to 100% of scale (to 580Vrms) 2% ± 15 D from 5 to 10kHz id. 3% ± 15 D from 10 to 45kHz id.				
	AC	1% ± 15 D from 40 Hz to 5kHz id. 2% ± 15 D from 5 to 10kHz id. 3% ± 15 D from 10 to 45kHz id.			
	Common mode rejection	> 70 dB at 50 or 60 or 400Hz			
Resistance measurement	On Channel 1				
	Ranges (end of scale)	Ohmmeter		Resolution	Measuring current
		80Ω		0.01Ω	0.5mA
		800Ω		0.1Ω	0.5mA
		8kΩ		1Ω	5μA
		80kΩ		10Ω	5μA
		800kΩ		100Ω	500nA
		8MΩ		1000Ω	50nA
		32MΩ		10kΩ	50nA
	Accuracy	± 0.5 % + 25 D from 10% to 100% of scale			
	Open circuit voltage	≈ 3V			
Continuity measurement	On Channel 1				
	Beeper	< 30Ω ± 5Ω			
	Measuring current	≈ 0.5mA			
	Beeper response	< 10ms			
Diode test	On Channel 1				
	Voltage	in open circuit : ≈ + 3.3V			
	Accuracy	0.5% + 5 D			
	Measuring current	≈ 0.6 mA			

Technical Specifications (cont'd)

« Multimeter » Function

Capacitance measurement		On Channel 1	
Range	Capacimeter	Resolution	Measuring current
	5 mF	1 μF	500 μA
	500 μF	0.1 μF	500 μA
	50 μF	0.01 μF	500 μA
	5 μF	1 nF	500 μA
	500 nF	100 pF	5 μA
	50 nF	10 pF	5 μA
	Accuracy	± 2% + 10 UR from 10% to 100% of scale	
Range	5 nF	1 pF	500 nA
Accuracy	< 2 nF : not specified > 2 nF: ± 2% + 10 UR		
Cancellation of series and parallel Rs		Parallel R > 10 k	
Current measurement		On all inputs	
HX0034		20mV/A current clamp, 80 A peak, AC/DC 600V, CAT II Accuracy ± 1.5% ± 2mA from 0 to 40A peak; ± 4% from 40 to 80 A peak <i>With HX0034, the service voltage between channel is 600V CAT II.</i>	
Temperature measurement with K thermocouple HX0035		On all inputs	
	Temperature range: -40° to 2282°F (- 40° to 1250°C) Measurement accuracy: 1% ± 38°F (3.5°C) typical <i>There is no isolation between 2 thermocouples. The voltage between one channel thermocouple and one channel measurement must be ≤ 300V CAT II.</i>		
Frequency measurement		20Hz to 45kHz on a square and sinus signal 20Hz to 20kHz on a triangle signal Accuracy: 0.1%	
Multimeter operating modes			
Selection of modes	via menu, with touch-sensitive screen		
Relative mode			
Monitoring (statistics)	MAX and MIN values for all measurements		
Frequency	Possible display of frequency in AC mode		
Time interval between 2 measurements	Adjustable from 1 second to 1 hour		
Measurement log	Measurement display = f (time) default window of 4 min (4 measurements per second)		
RUN	Initiation of the measurements		
HOLD	Freezing of the measurement		
Display	In numeric form	Principal measurement → large-size display Secondary measurement → small-size display The touch-screen allows you to select the secondary measurement via a menu.	
	Graphic trace	History of the measurements over time Objective: Presentation of the measurements as an amplitude histogram.	

Technical Specifications

AC power « Harmonics » Analysis Mode

2-page display of "Harmonics" <i>Even harmonics</i> <i>Odd harmonics</i>	Selection of the page in the "Display" menu 2 to 30 + Fundamental 3 to 31 + Fundamental
1-page display of "Harmonics" <i>Harmonics</i>	Selection of the page in the "Display" menu 16 + Fundamental
Frequency of the signal analyzed	40 to 450Hz
Measurement accuracy <i>Level of Fundamental</i> <i>Level of Harmonics</i> <i>Harmonic Distortion</i>	$\pm 2\% \pm +10 D$ $\pm 3\% \pm +10 D$ $\pm 4\%$

« Recorder » Mode

Recording time Sampling rate Fault capture Trigger Display Vertical, horizontal accuracy	from 2 sec to 1 month from 800 μs to 17 min 51 sec 10 faults in memory up to 500 faults in file on threshold high and low on threshold high or low Research minimum and maximum research of fault Specifications identical to « Oscilloscope » mode
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Technical Specifications (cont'd)

Communication interfaces

RS-232C link configuration	<u>Selection of speed in Bauds:</u> 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 <u>Parity selection:</u> None, even, odd <u>Word length selection:</u> 8-bit or 7 bits <u>Stop bit number selection:</u> 1 or 2 stop bits <u>Protocol selection</u> Hard (for RTS and CTS lines) Soft (for XON and XOFF characters) None (no protocol)
Ethernet Interface (option)	<u>Type</u> 10BASE-T (Twisted Pair) <u>Lead</u> Interface scope / RJ 45 8 points <u>Standard</u> IEEE 802.3
RS-232 / Ethernet Interface Connector	Double insulation, 600 V CAT III / inputs Location: right-hand side of the instrument with: 1 RS-232C interface cable (HX0042) 1 twisted Ethernet interface cable (HX0040)

Remote programming of the instrument by a PC

	Programming of the instrument via the RS-232C or Ethernet interface with SCPI commands IP protocol available on Ethernet: FTP server, TELNET, HTTP server, LPD client, DHCP client.  Refer to the remote programming manual for the list of commands.
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Warning !

Error Messages	If one of those codes (or the addition of several codes) is present when getting started : → a default has been detected. In this case, contact your closest distributor (See §. Maintenance). Autotest : Error # 0001 : Micro Problem Autotest : Error # 0002 : Flash Problem Autotest : Error # 0004 : RAM Problem Autotest : Error # 0008 : FPGA Problem Autotest : Error # 0010 : Numerisation problem on channel 1 Autotest : Error # 0020 : Numerisation problem on channel 2 Autotest : Error # 0040 : Numerisation problem on channel 3 Autotest : Error # 0080 : Numerisation problem on channel 4 Autotest : Error # 0100 : Analog problem on channel 1 Autotest : Error # 0200 : Analog problem on channel 2 Autotest : Error # 0400 : Analog problem on channel 3 Autotest : Error # 0800 : Analog problem on channel 4 Autotest : Error # 1000 : Problem on Ethernet link
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General specifications

Environment

- Reference temperature 64° to 82°F (18°C to 28°C)
- Operating temperature 32° to 104°F (0°C to 40°C)
- Storage temperature -4° to 140°F (-20°C to 60°C)
- Utilization indoors
- Altitude < 2000 m
- Relative humidity < 80% up to 88°F (31°C)

Power supply

- **Battery**
 - Type 9.6 V; 3.5 Ah NiMH
 - Charge time ≈ 2.30 hours with instrument switched off
≈ 5 hours with instrument operating
 - Charge life **OX 7104** (4 channels) approximately 2 hours 30 minutes
OX 7102: approx. 4 hours
in standby mode: approx. 10 hours
 - Screen saver (automatic standby mode) adjustable by menu: 15', 30', 1h or none
 - Auto power-off adjustable by menu: 30', 1h, 4h, 24h
- **External power supply (battery charger)**
 - AC power 98V to 264V
 - Frequency from 50 to 60Hz
 - Consumption < 60 VA for fast battery charging
 - Fuse 2.5A / 250V / delayed



Safety

- As per IEC 61010-1 (2001):
- Insulation class 2
 - Pollution level 2
 - "Measurement" input overvoltage category CAT III, 600 V

EMC

This instrument conforms the EMC NF EN 61326-1, 07/97+A1, 10/98 norm :

- Emission class A instrument
- Immunity influence magnitude: 2 div. in the presence of a 10 V/m electromagnetic field.

Mechanical Specifications

Casing

- Dimensions 10.25 x 7.25 x 2" (261 x 185 x 53mm)
- Weight 4.2 lbs (1.9 kg) with batteries
- Ext. power supply weight 450 g
- Sealing IP 41 **OX 7104**
IP 51 **OX 7102** with **PROBIX** probes
connected and cap of the side connector closed

Ordering Information

INTRODUCTORY OFFER:

All Models include a FREE Harmonic Analyzer and Recorder Function Firmware upgrade installed.

Portable Oscilloscope Model OX 7102-C (2 x 100MHz, Color) Cat. #2124.50

Includes: Oscilloscope; one PROBIX PRHX1, 1/10 Probe, 250MHz, 600V Cat. III; one PROBIX BNC adapter; one PROBIX 4mm banana plug adapter; one US power adapter (115V, 60Hz); one battery pack, NiMH 9.6V, 3.8Ah; one set-of-two color-coded leads, 1.5m (red/black) with needle probe tips; one crossed Ethernet cable; one RS-232/9-pin D-SUB cable; set of two stylus; aluminum carrying case, three-year product warranty and registration card and user manual on CD-ROM.

Portable Oscilloscope Model OX 7102-C Kit (2 x 100MHz, Color - Kit) Cat. #2124.53

Includes: AEMC® Cat. #2124.50 (above), plus one PROBIX PRHX1, 1/10 Probe, one PROBIX BNC adapter, one straight Ethernet cable; SX-METRO data processing and analysis software and one set-of-two grip probes (red/black).

Portable Oscilloscope Model OX 7104-C Kit (4 x 100MHz, Color - Kit) Cat. #2124.54

Includes: Oscilloscope; two PROBIX PRHX1, 1/10 Probe, 250MHz, 600V Cat. III; two PROBIX BNC adapters; one PROBIX 4mm banana plug adapter; one US power adapter (115V, 60Hz); one battery pack, NiMH 9.6V, 3.8Ah; one set-of-two color-coded leads, 1.5m (red/black) with needle probe tips; one crossed Ethernet cable; one straight Ethernet cable; SX-METRO data processing and analysis software; one RS-232/9-pin D-SUB cable; one set-of-two grip probes (red/black); set of two stylus; aluminum carrying case, three-year product warranty and registration card and user manual on CD-ROM.

Portable Oscilloscope Model OX 7104-C Power Kit (4 x 100MHz, Color - Kit) Cat. #2124.63

Includes: AEMC® Cat. #2124.54 (above), plus the OX Power Kit (Cat. #2124.88) which includes two PROBIX PRHX1, 1/10 Probe, 250MHz, 600V Cat. III; two PROBIX 4mm banana plug adapters; three PROBIX current probes, 20mA to 20A, 100kHz; one PROBIX PRHX7, K thermocouple adapter; three set-of-two color-coded 1.5m leads and clips (red/black 4mm straight, 4mm right angle); small classic tool bag.

Accessories and Replacement Parts

SX-METRO/P software, data retrieval processing	Cat. #2124.70
Harmonic Analyzer - Firmware upgrade	Cat. #2124.71
Recorder Function - Firmware upgrade.....	Cat. #2124.72
PROBIX PRHX1, 1/10 Probe, 250MHz, 1000V Cat. II (600V Cat. III)	Cat. #2124.73
PROBIX PRHX4, BNC adapter	Cat. #2124.74
PROBIX PRHX5, 50Ω adapter	Cat. #2124.75
PROBIX banana plug (4mm) adapter.....	Cat. #2124.76
PROBIX current probe, 20mA-20A, 100kHz	Cat. #2124.77
PROBIX PRHX7 K thermocouple adapter.....	Cat. #2124.78
Carrying case, aluminum with foam cut-outs.....	Cat. #2124.79
Ethernet cable, straight.....	Cat. #2124.80
Ethernet cable, crossed	Cat. #2124.81
RS-232 adapter/Centronics	Cat. #2124.82
Cable - RS-232/9-Pin D-SUB	Cat. #2124.83
Lead - set of two, color-coded (1.5m) (4mm straight, 4mm right angle) with color-coded alligator clips	Cat. #2124.84
Leads - set of two, Color-coded 1.5m (red/black) with needle probe tips	Cat. #2124.85
Grip Probes - set of two, color-coded (red/black)	Cat. #2124.86
OX Power Kit	Cat. #2124.88
600V Probe Adapter Set Model HX0071.....	Cat. #2124.90
Power Adapter 115V US.....	Cat. #5000.15
Battery Pack 19.6V, 3.8 Ah NiMH.....	Cat. #5000.16
Stylus - Replacement, set of five	Cat. #5000.17

Repair and Calibration

To ensure that your instrument meets factory specifications, we recommend that it be submitted to our factory Service Center at one-year intervals for recalibration, or as required by other standards or internal procedures.

For instrument repair and calibration:

You must contact our Service Center for a Customer Service Authorization number (CSA#). This will ensure that when your instrument arrives, it will be tracked and processed promptly. Please write the CSA# on the outside of the shipping container. If the instrument is returned for calibration, we need to know if you want a standard calibration, or a calibration traceable to N.I.S.T. (includes calibration certificate plus recorded calibration data).

Chauvin Arnoux®, Inc.
d.b.a. AEMC® Instruments
15 Faraday Drive
Dover, NH 03820 USA
Tel: (800) 945-2362 (Ext. 360)
(603) 749-6434 (Ext. 360)
Fax: (603) 742-2346 or (603) 749-6309
repair@aemc.com

(Or contact your authorized distributor)

Costs for repair, standard calibration, and calibration traceable to N.I.S.T. are available.

NOTE: All customers must obtain a CSA# before returning any instrument.

Technical and Sales Assistance

If you are experiencing any technical problems, or require any assistance with the proper operation or application of your instrument, please call, mail, fax or e-mail our technical support hotline:

Chauvin Arnoux®, Inc.
d.b.a. AEMC® Instruments
200 Foxborough Boulevard
Foxborough, MA 02035, USA
Phone: (800) 343-1391
(508) 698-2115
Fax: (508) 698-2118
techsupport@aemc.com
www.aemc.com

NOTE: Do not ship Instruments to our Foxborough, MA address

Limited Warranty

The OX Oscilloscopes are warranted to the owner for a period of three years from the date of original purchase against defects in manufacture. This limited warranty is given by AEMC® Instruments, not by the distributor from whom it was purchased. This warranty is void if the unit has been tampered with, abused or if the defect is related to service not performed by AEMC® Instruments.

For full and detailed warranty coverage, please read the Warranty Coverage Information, which is attached to the Warranty Registration Card (if enclosed) or is available at www.aemc.com.

Please keep the Warranty Coverage Information with your records.

What AEMC® Instruments will do:

If a malfunction occurs within the three-year period, you may return the instrument to us for repair, provided we have your warranty registration information on file or a proof of purchase. AEMC® Instruments will, at its option, repair or replace the faulty material.

Warranty Repairs

What you must do to return an Instrument for Warranty Repair:

First, request a Customer Service Authorization Number (CSA#) by phone or by fax from our Service Department (see address below), then return the instrument along with the signed CSA Form. Please write the CSA# on the outside of the shipping container. Return the instrument, postage or shipment pre-paid to:

Ship To: Chauvin Arnoux®, Inc. d.b.a. AEMC® Instruments

15 Faraday Drive • Dover, NH 03820 USA

Phone: (800) 945-2362 (Ext. 360)

(603) 749-6434 (Ext. 360)

Fax: (603) 742-2346 or (603) 749-6309

E-mail: repair@aemc.com

Caution: To protect yourself against in-transit loss, we recommend you insure your returned material.

NOTE: You must obtain a CSA# before returning any instrument.



03/08

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Chauvin Arnoux[®], Inc. d.b.a. AEMC[®] Instruments
15 Faraday Drive • Dover, NH 03820 USA • Phone: (603) 749-6434 • Fax: (603) 742-2346
www.aemc.com