

## Harmonic Analysis Mode

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### Display

The "**Harmonic Analysis**" mode is an option of the oscilloscope which must be unlocked if it is to function.

### Installation

The 24-character code supplied when the "HARMONIC ANALYZER" option is acquired must be input into the " ? " → "Options" menu.

Restart the instrument.

**"Harmonic Analysis" mode is then definitively installed.**

### 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.

If the "POWER MEASUREMENTS" option is installed, the harmonic analysis of output (single-phase) can be displayed.

On the front, use the ZOOM key to modify the vertical display scale. The vertical scale is modified each time the key is pressed.

Various possibilities are offered:

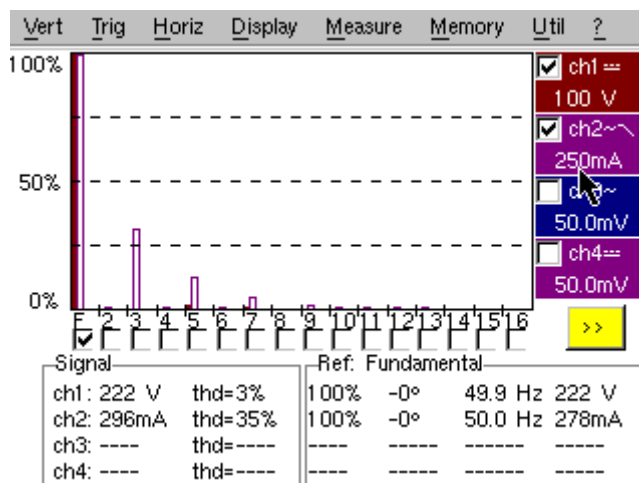
- 0 to 100%: The vertical display dynamic is adapted to the amplitude of the fundamental.
- 0 to 50%: The vertical display dynamic is adapted to 50% of the amplitude of the fundamental.
- 0 to 25%: The vertical display dynamic is adapted to 25% of the amplitude of the fundamental.
- 0 to 10%: The vertical display dynamic is adapted to 10% of the amplitude of the fundamental.

Double tapping on the bar chart zone triggers access to tactile screen calibration.

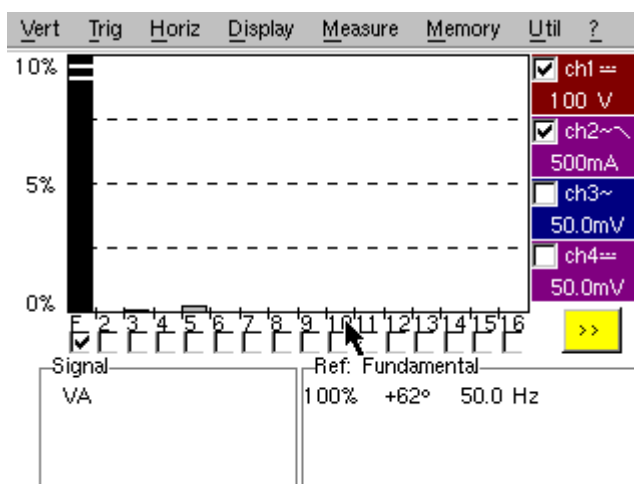
Double tapping on the adjustment zone of a channel triggers access to these adjustments.

## Harmonic Analysis Mode (cont'd)

**Display** Measurement of the harmonics on channels 1 and 2 :



Measurement of the output harmonics:



The representation of output harmonics is signed.

A black color harmonic indicates a harmonic received (positive by convention).

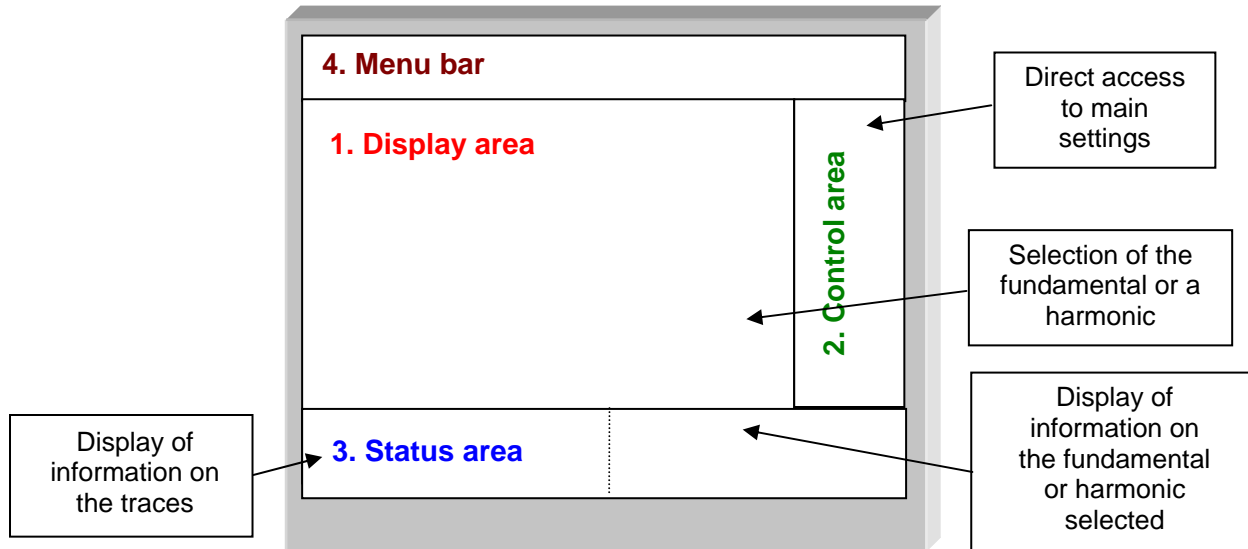
A light color harmonic indicates a harmonic emitted (negative by convention).

The phase value is measured between the voltage value and current value for a given harmonic.

## 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.

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



Use this button to display another series of harmonics:

Consecutive harmonic ranges


- from 2 to 16,
- from 17 to 31,
- from 32 to 46,
- from 46 to 61

Even harmonic ranges

- from 2 to 30,
- from 32 to 60

Odd harmonic ranges

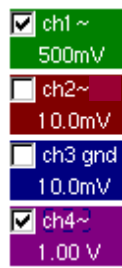
- from 3 to 31,
- from 33 to 61

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	thd=	Ref. 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 harmonic of the strongest amplitude
- its phase in ° in relation to the fundamental
- its frequency in Hz
- its RMS voltage in V

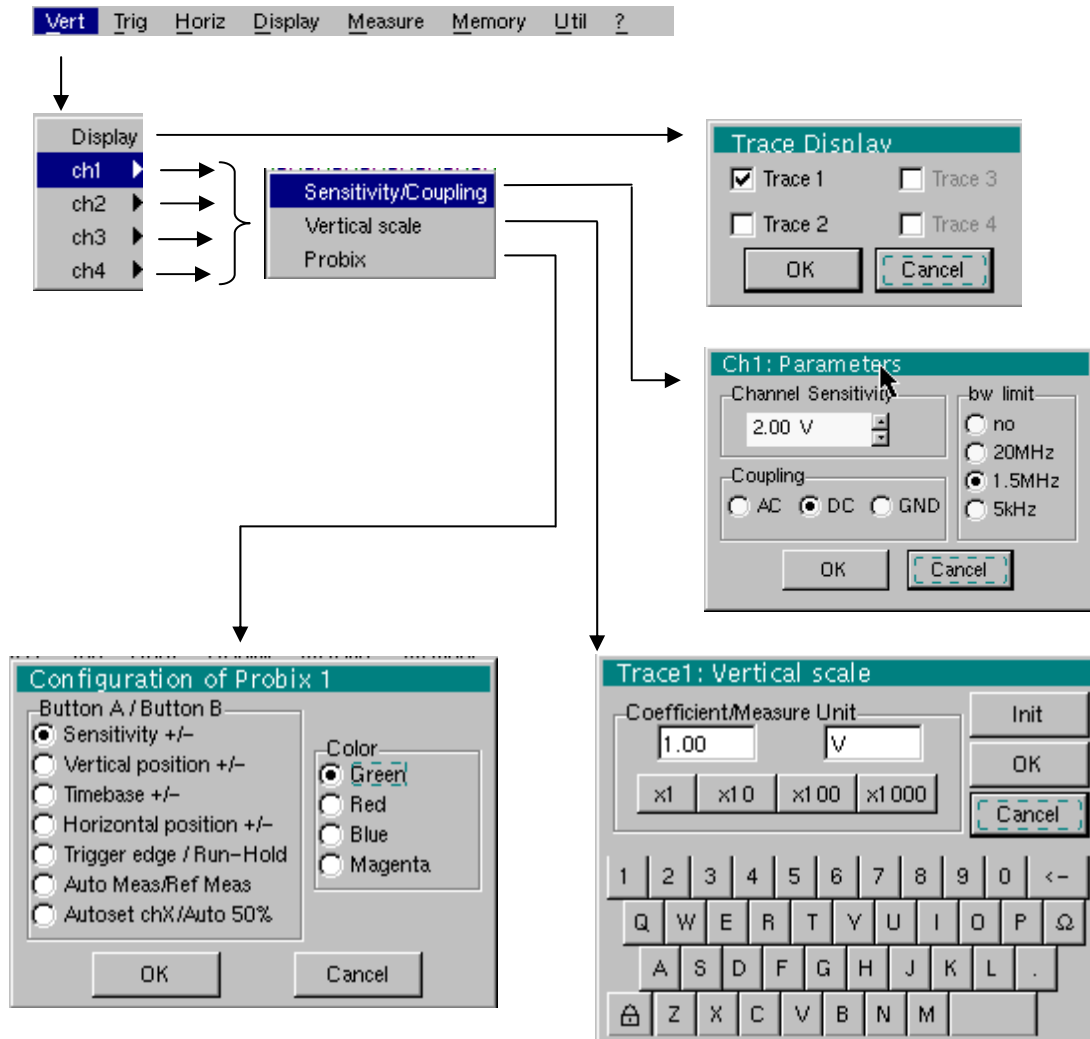
### 4. Menu bar



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  
ch3

ch2  
ch4

Modification of the parameters of **ch1**, **ch2**, **ch3** or **ch4**, independently.

### Sensitivity/Coupling

#### Channel Sensitivity

Modification of the channel's 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.*

#### Coupling

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

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

**DC:** transmits AC and DC components of the input signal

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



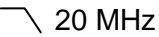
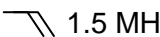
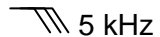
*The "⊙" symbol indicates the coupling selected. It is shown in the modified channel parameter display area.*

#### 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-pointing with the stylus on the required channel parameter display area (ch1, ch2, ch3 or ch4).


### Vertical scale

Defines the vertical scale of the selected channel on the basis of the current settings.

#### 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-pointing with the stylus on the required channel parameter display area (ch1, ch2, ch3 or ch4).

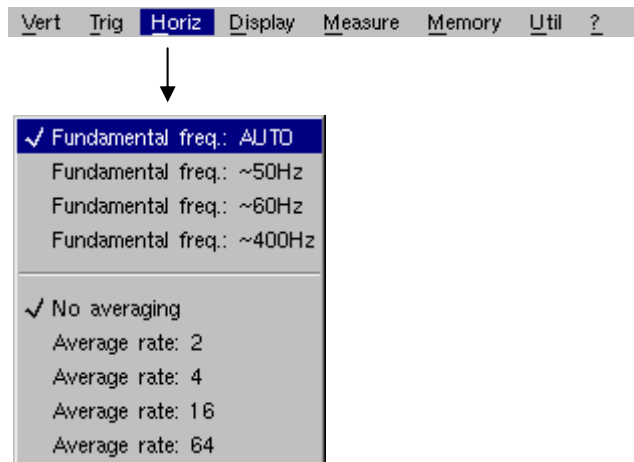
### Probitx

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

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

## Harmonic Analysis Mode (cont'd)

### The "Horiz" Menu



**Fundamental freq: AUTO**  
**Fundamental freq: ~50Hz**  
**Fundamental freq: ~60Hz**  
**Fundamental freq: ~400Hz**

In "Automatic fundamental frequency search" mode, the instrument analyzes the signal on the range [40Hz 1kHz].

If this search is not successful, you can indicate one of three frequencies proposed to the instrument. The instrument will then search for the fundamental based on this central frequency.



*In particular, the manual indication (approximate) of the signal frequency, allows the analysis of its harmonic composition, for which the fundamental one is not the highest row of amplitude (e.g.: systems of control of engine by variations of frequency).*

**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:

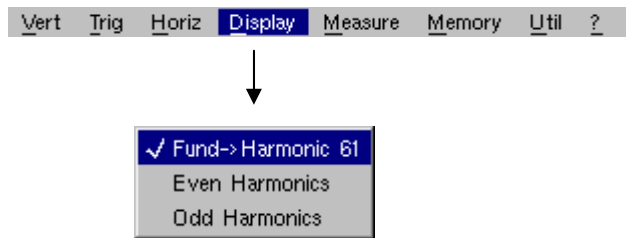
- Sample: value of new sample acquired at abscissa t
- Pixel N: ordinate of the pixel with abscissa t on the screen at instant N
- Pixel N-1: ordinate of the pixel with abscissa t on the screen at instant N-1



*The "✓" symbol indicates the averaging coefficient selected.*

## Harmonic Analysis Mode (cont'd)

### The "Display" Menu



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 consecutive harmonics.

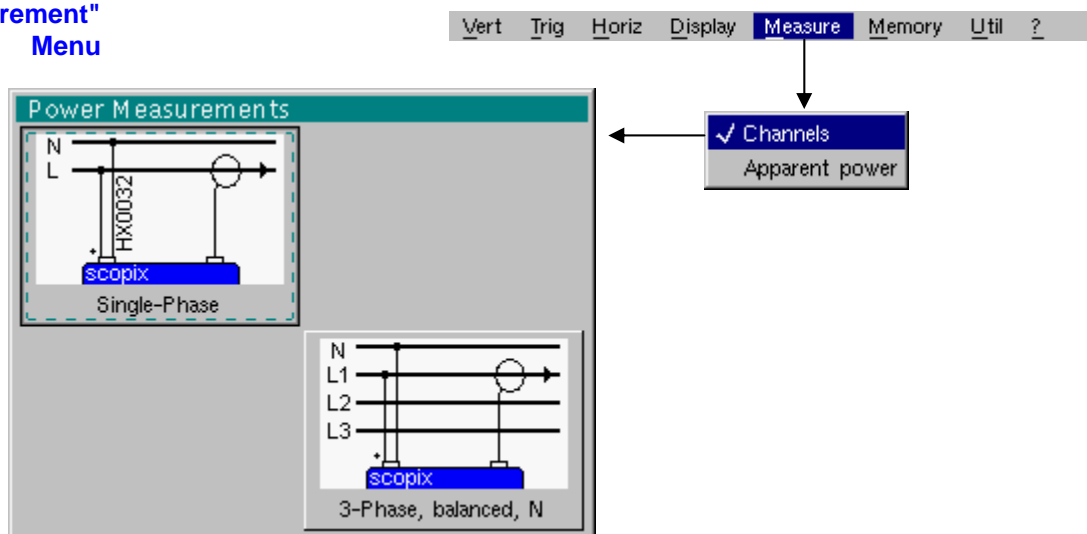
**Even harmonics** Display of the fundamental and the even harmonics from 2 to 30.

**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 "Measurement" Menu



**Channels** The harmonic representation and associated measurements are made on active channels

**Apparent output** The harmonic representation and associated measurements are made on output.  
By selecting this option, a window is displayed to indicate the channels used for current and voltage measurement in the configuration of desired measurement.

## Harmonic Analysis Mode (cont'd)

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### The "Memory" Menu

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

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### The "Util" Menu

See description in "Oscilloscope" mode.

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### The "?" Menu

See description in "Oscilloscope" mode.