Virtual digital oscilloscopes

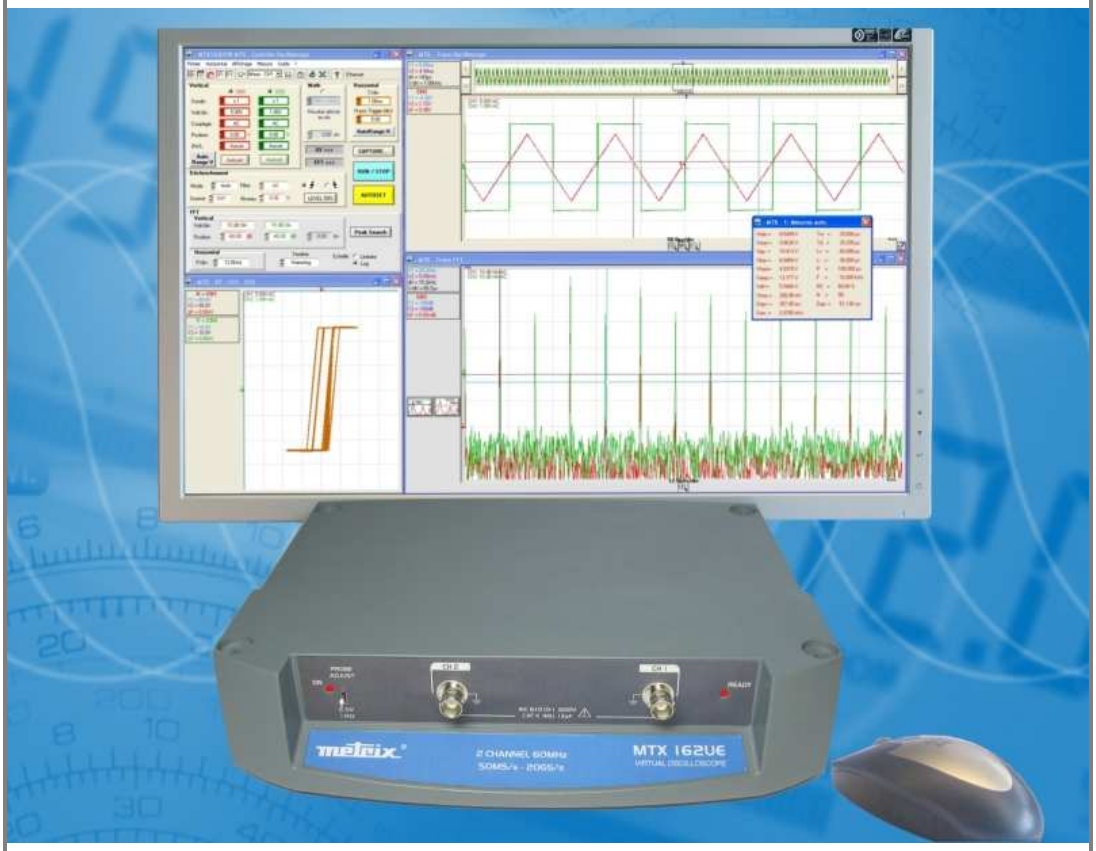
MTX 162UE

2 channel, 60 MHz, FFT, USB, Ethernet.

MTX 162UEW

2 channel, 60 MHz, FFT, USB, Ethernet, WiFi.

Operating Instructions



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Contents *(continued)*

Contents *(continued)*

Attention !
Before printing this notice, think of the impact on the environment.

Getting started

Congratulations!

You have just purchased an ***MTX 162*** oscilloscope. We thank you for your confidence in our product quality.

This oscilloscope range is as follows:

MTX 162UE 2 channels, 60 MHz, 50 MS/s, 8 bits, 50 kpts, USB, Ethernet

MTX 162UEW 2 channels, 60 MHz, 50 MS/s, 8 bits, 50 kpts, USB, Ethernet, WiFi

The instrument complies with the safety standard NF EN 61010-1 (2001), single insulation, relative to electronic measuring instruments.

In order to obtain the best results please read this notice carefully and follow the precautions for use.

The failure to respect the warnings and/or usage instructions may damage the appliance and can be dangerous for the user.

Composition

- **oscilloscope** 60 MHz, 2 channels, ***without*** display device
- **software** SCOPEin@BOX_LE to be installed on the "Host PC"
- safety instructions

Precautions and safety measures

- Indoor use
- Level 2 pollution environment
- Altitude below 2000 m
- Temperature between 0°C and 40°C
- Relative humidity less than 80% up to 31°C
- Measures on 300 V CAT II circuits, relative to the earth, can be supplied by a 240 V CAT II network.

Definition of the measurement category

CAT II: Category II measurements are those carried out on circuits directly connected to the low voltage installation.
Example: supply of household appliances and portable electric tools

Preparing for use

before use

- Respect the environment and storage conditions.
- Make sure that the three wired phase/neutral/earth power cable delivered with the appliance is in good condition. It is compliant with the NF EN 61010 (2001) standard and must be connected to the instrument on the one side and to the network on the other (variation from 90 to 264 VAC).

during use

- Read notes preceded by the ⚠ symbol carefully**.**
- Connect the instrument to an earthed power outlet.
- Take care not to obstruct the ventilation.
- Only use the appropriate cables and accessories shipped with the appliance.
- When the appliance is connected to measurement circuits, never touch an unused terminal.

Power supply

The oscilloscope power supply is designed for a network varying from 90 to 264 VAC (nominal usage range: 100 to 240 VAC).
The frequency of this network must be between 47 and 63 Hz.

Symbols on the instrument

⚠ Warning: danger hazard, consult the operating instructions.

Selective sorting of waste for recycling electrical and electronic equipment. In compliance with the WEEE 2002/96/CE directive: must not be considered as household waste.

Earth terminal

USB

CE European compliance

Getting started (continued)

Maintenance

No interventions within the appliance are authorised.
- Power off the appliance (remove the power supply cable).
- Clean with a damp cloth and soap.
- Never use abrasive products or solvents.
- Dry quickly using a cloth or pulsed air at 80℃ max.

Maintenance Metrology checks

The instrument has no elements that can be replaced by the operator.
All operations must be carried out by approved and competent staff.

For all repairs under guarantee or outside guarantee, please return the device to your distributor.

Communication interfaces

USB V1.1 is an interface that connects the instrument directly to a PC USB port.
Simple to use, no adjustments are needed for a local application.

ETHERNET Depending on the oscilloscope equipment Ethernet can be connected:
- using a cable (straight cable for connection to a network or crossed for local use)
- or wireless using WiFi (***MTX 162UEW*** only).

Powering up

Before powering up your oscilloscope and its connection to the Host-PC, insert the supplied CD ROM and install the SCOPEin@BOX_LE driver software.

Then, connect the oscilloscope:
- either to the PC by USB using the supplied USB A/B cable
- or to the PC on the ETHERNET local network (point to point) using a crossed ETHERNET cable
- or to the ETHERNET cable network using a straight ETHERNET cable
- if your oscilloscope has the WiFi option (***MTX 162UEW***), you must first configure this connection mode before being able to use it (see chapter III).

Finally, connect the power supply cable to the power outlet and refer to the following paragraphs.

Connection

Terminal board

Oscilloscope is powered on (connected to the power supply)

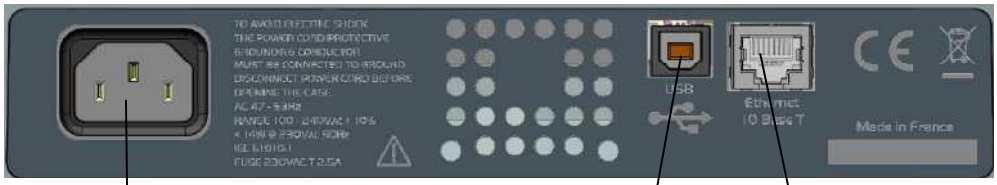
Sensor calibration

Entry for CH2 channel

RJ45 ETHERNET

LED READY multifunction:
- availability of the appliance
- identification of the appliance
- search for the WiFi network

Back face



Power socket

USB connector

RNET Connector

First use

Command software

The command software is SCOPEin@BOX_LE.exe :

Installation

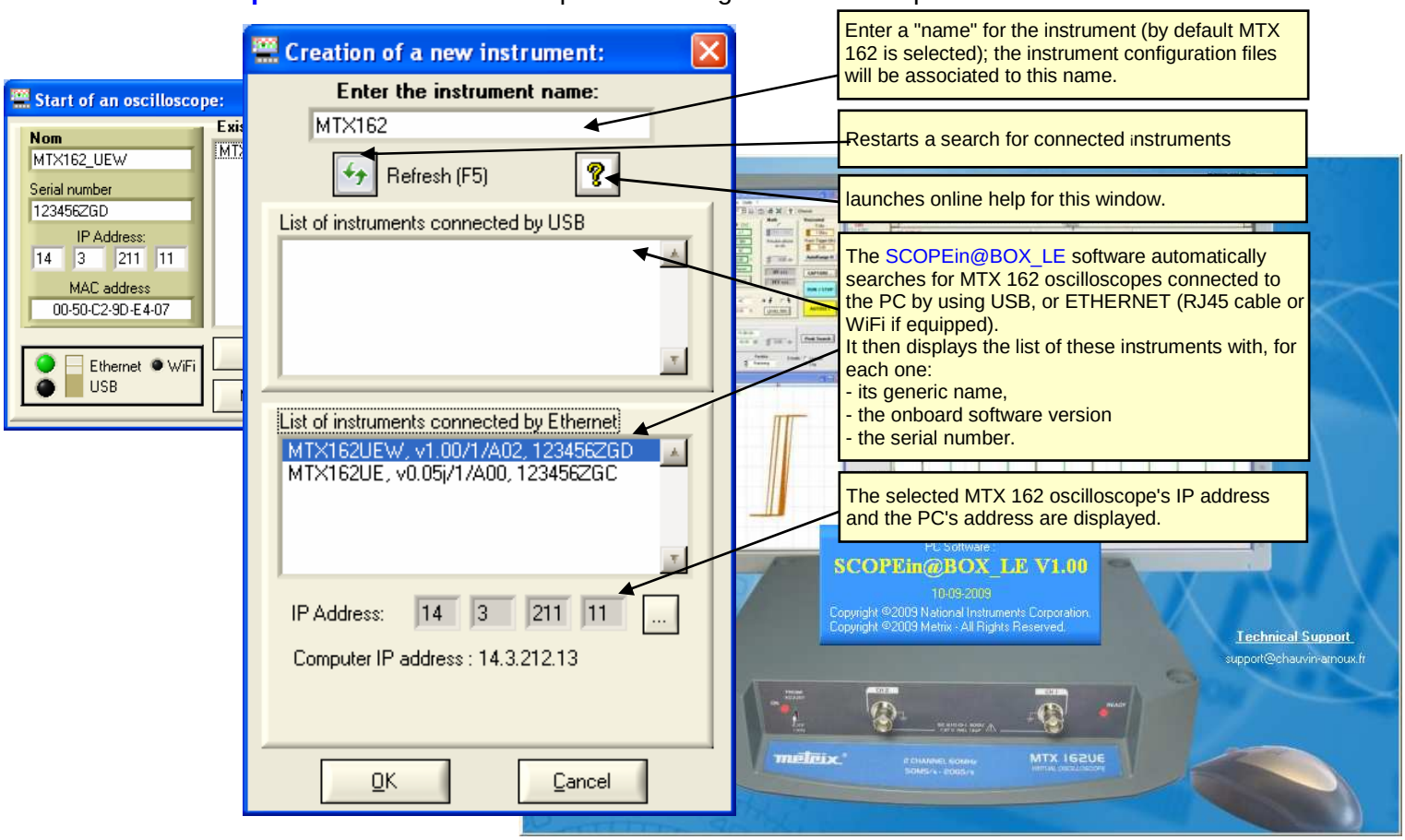
Carefully read the safety instructions shipped with the instrument and insert the CDROM in your PC CD drive.

Launching

When the oscilloscope's "READY" LED lights, you can launch the SCOPEin@BOX_LE.exe software.

First start-up

At first start-up the following windows are opened:



Press the key to refresh the display if your oscilloscope does not appear in the list of connected instruments.
If this fails, check your instrument's connection and/or re-start it by disconnecting and reconnecting it to the power supply.

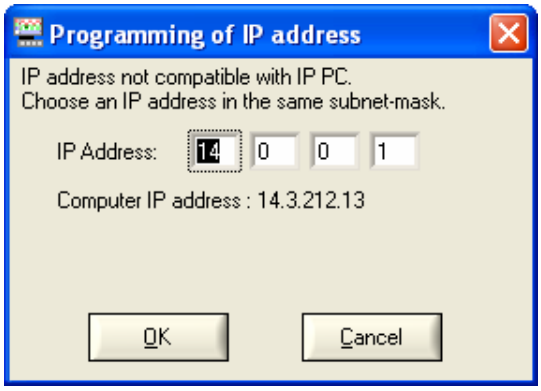
1. Name your instrument.
2. Select one of the instruments connected to the PC (via USB or ETHERNET) from the proposed lists.
3. Click on the OK button to create and launch the instrument.

In our example we are starting up the "MTX 162UEW" oscilloscope for the first time.
By default the instrument's IP address is 192.168.0.100 (with the 255.255.255.0 network mask).
The instrument's IP address must therefore be adapted to the network address used by the host-PC (here: 14.3.212.31).

First use (continued)

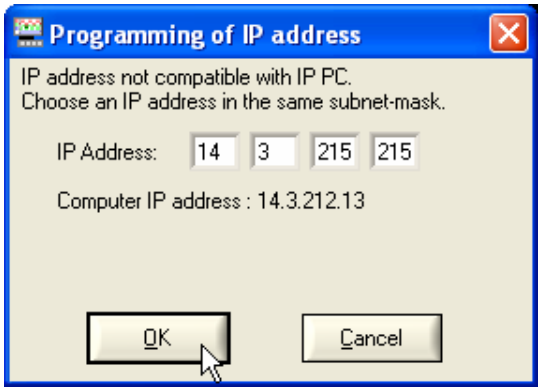
First start-up (continued...)

The selection of an instrument connected using Ethernet leads to the display of the following window if the IP address, entered by default, is not compatible with the network to which the PC is connected:



To avoid IP address conflicts on the network you are using, consult your administrator in order to select an available address that is compatible with the network.

In our example the network mask used is 255.255.0.0; we programme our IP address: 14.3.215.215 and validate the entry using the OK key.



The IP address is tested on validation to make sure that the entered address is not already used on the network.

If the result is correct the instrument starts up.

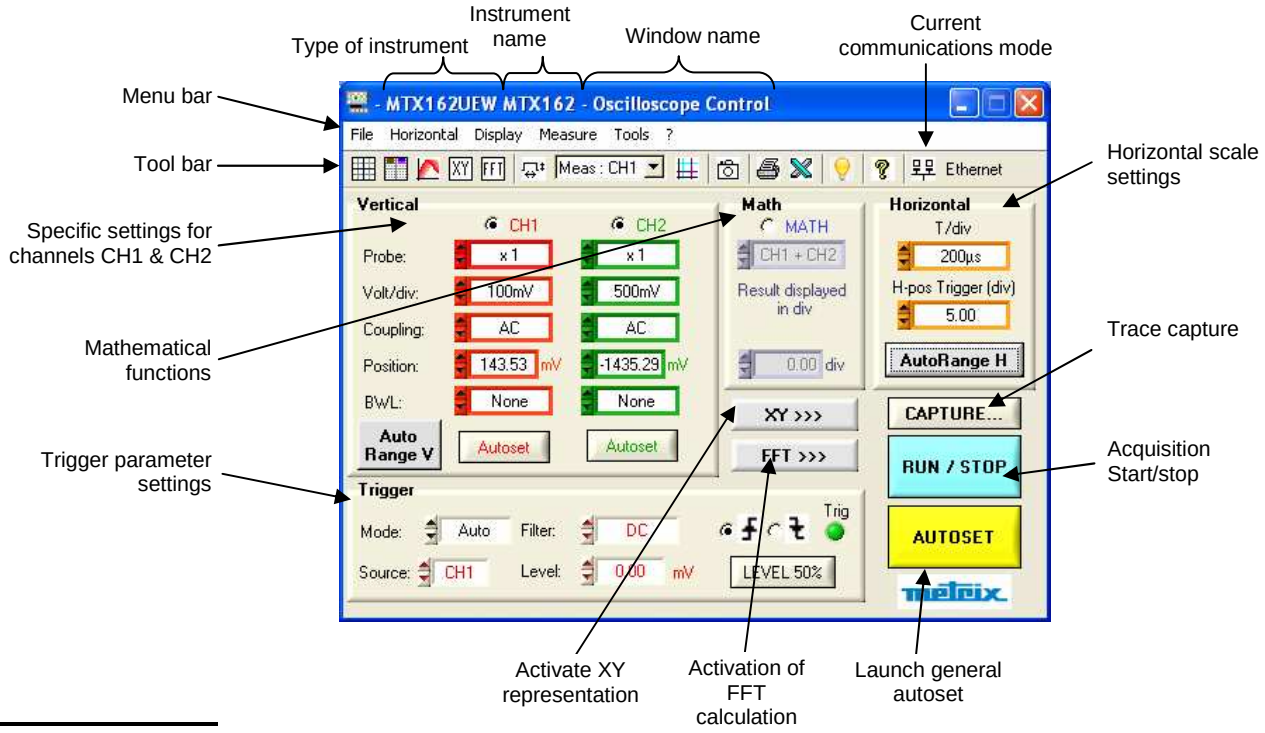
First use (continued)

Control screen descriptions

When the instrument is launched the "Oscilloscope Control" and "Oscilloscope Trace" should be displayed.

"Oscilloscope Control"

This window contains all the possible settings for the oscilloscope:



"Oscilloscope Trace"

This window contains the graphical representation of the signals:

- 2500 points per channel are used to display curves.
  They are sent from the oscilloscope to the PC via the communications interface (USB / ETHERNET / ETHERNET WiFi).

  These 2500 points are different depending on the activation or not of the FFT calculation:

  - when FFT is not active,
  to avoid erroneous graphical representations related to the selection of one point in 20 (the acquisition memory being 50 000 points), the 2500 points sent to the PC are in fact 1250 couples (min, max) of the extreme values encountered in each 40 point interval in the acquisition memory.

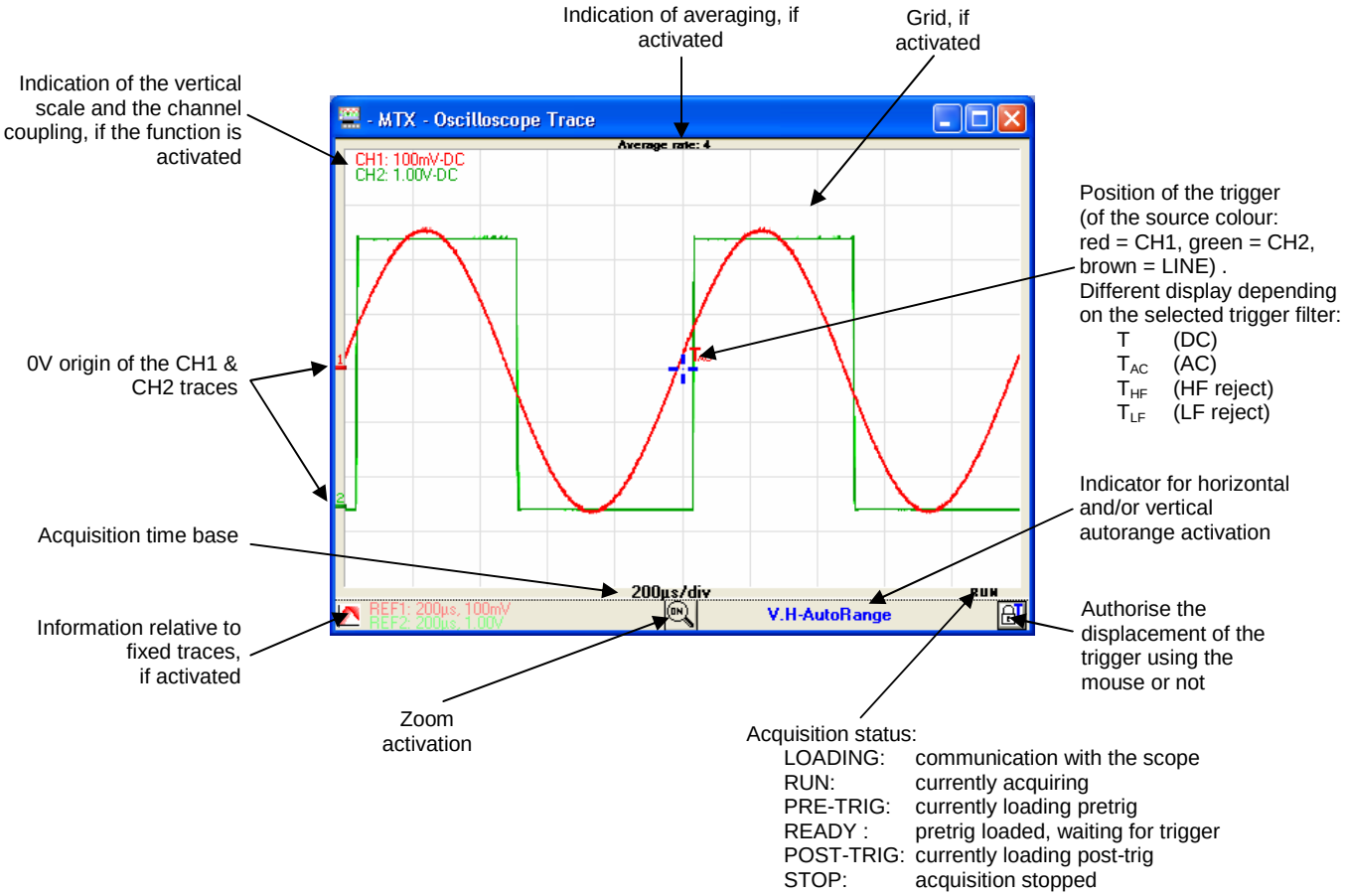
  - when FFT is active,
  the points that are sent are also used in the Fourier transformation and the use of the couples (min, max) would lead to an erroneous frequency representation.
  They are therefore obtained using a basic decimation (1 point every 20) of the content of the acquisition memory. Erroneous temporal representations on the screen are therefore possible.

- if the zoom is activated, 2500 additional points are sent (double time base).
  These 2500 points are generally couples (Min, Max) except for when the zoom is at its maximum and the 2500 viewed points correspond to a continuous series of points from the acquisition memory.

First use (continued)

"Oscilloscope Trace"

This window contains the graphical representation of the signals:

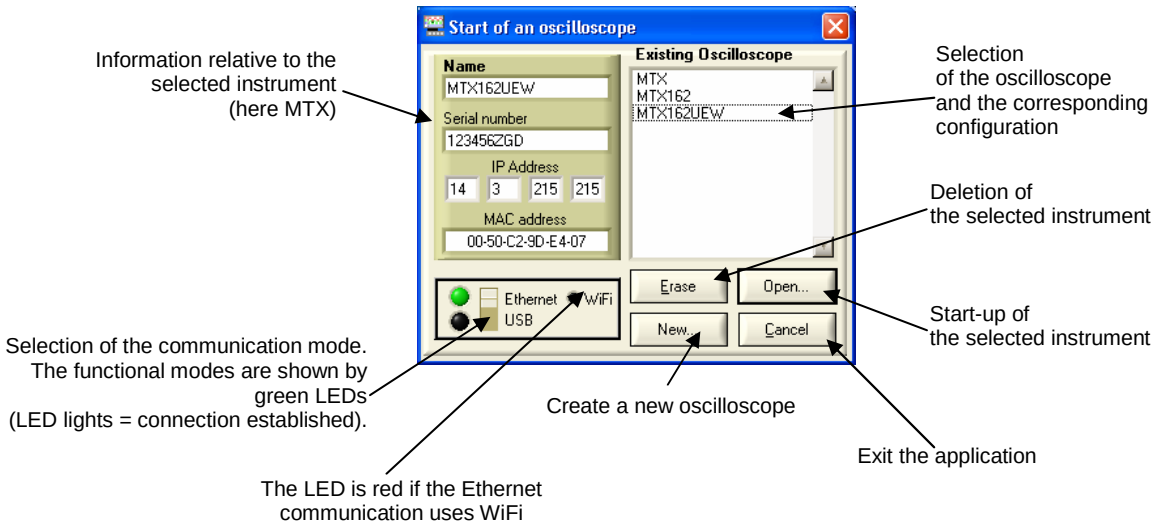


The display acquisition status is that at the moment of the transfer of the points. The acquisition being totally asynchronous to the display, it is possible that not all statuses be displayed in the window.

Following start-ups

Starting an oscilloscope

For the following start-ups the SCOPEin@BOX_LE firmware starts up showing the "Start an oscilloscope" window:



Starting an existing oscilloscope

1. Select the oscilloscope in the 'Existing Oscilloscope' window. The information relative to this instrument is displayed in the left part of the window.
2. Check that the selected communication mode is operational: the associated green LED must be lit.
3. Start the instrument by clicking on Open...

☝ ***To easily identify the instrument, the selection of the oscilloscope (click on its name) makes the red "READY" LED on the instrument blink (unless communications with the instrument cannot be established).***

Starting a new oscilloscope

Use the New... key to open the "Create a new instrument" window (see chapter II, §. First start-up).

Our recommendations

If a communications mode is not operational:

- Make sure that the instrument is connected: disconnect the cables (USB and Ethernet) and reconnect them.
- For driving using Ethernet check that the cable used is adapted to the type of connection you wish to make (the green Ethernet RJ45 connector LED lights if the connection is operational):
  - Straight-thru cable for connection to a company network
  - crossover cable for a local connection to the PC

☝ ***Recent network cards accept a straight-thru cable for a direct "instrument to PC" connection.***

Following start-ups (continued)

Our recommendations (continued)

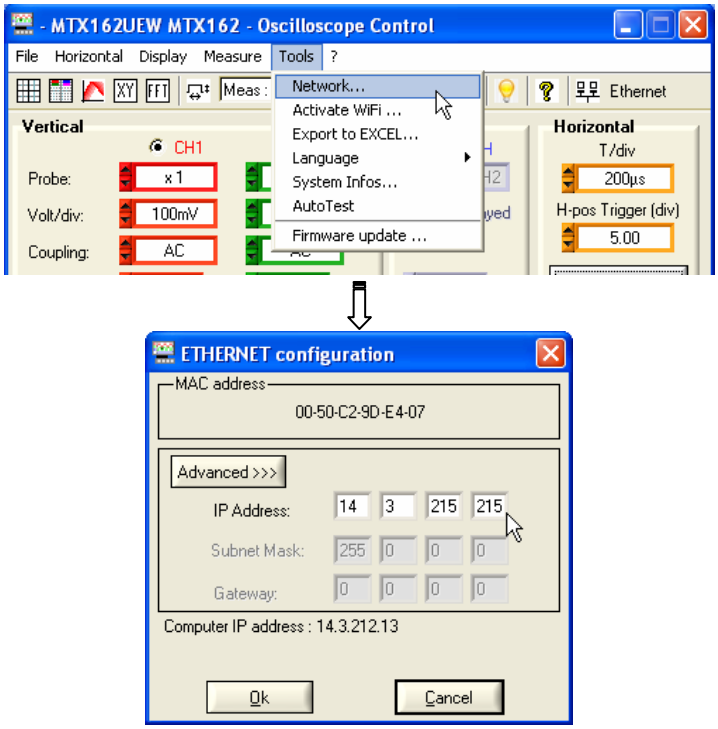
For Ethernet, make sure that:

- the IP address in the configuration file is the same as the address programmed in the oscilloscope: click on [New...] and find your instrument in the list of connected devices, or start-up the instrument using USB; check the network parameters using the Tools menu (see below).

- the oscilloscope's IP address is not already used on the network and does not cause an addressing conflict:
  - disconnect the network cable from the oscilloscope, run a 'ping <IP address>' command from your DOS Command screen (menu 'Start/Run…' and open 'cmd').
    If an instrument responds, change the IP address.
  - If the problem persists, close the SCOPEin@BOX_LE application, disconnect it, then reconnect the power supply on the MTX 162 to reinitialise it.
    When the "READY" LED lights, re-launch the application.

Changing the IP address

The IP address can be changed from the Tools → Network… menu in the "Oscilloscope Control" window:



The [Advanced >>>] key gives access to the network mask and gateway programming.

Once the new IP address has been entered click on [Ok] to validate it. The address is then controlled before programming to make sure that the entered address is compatible with the network and is not currently in use.

If the instrument is driven via Ethernet, the connection is stopped and reinitialised using the new address settings.

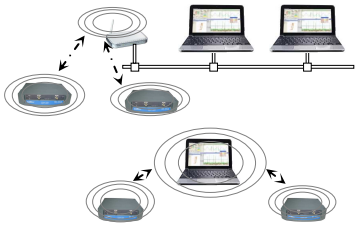
Following start-ups (continued)

Programming the WiFi connection

Only the MTX 162UEW versions have the wireless communication option: WiFi.

This WiFi function is compatible with the IEEE 802.11b and g wireless communications standards, and for security it is compatible with the 802.11i Encryption standard.

The MTX 162UEW can be used in one of the network topologies described by this standard:



- the **infrastructure** topology, in which wireless clients are connected to an access point that permits the interconnection of this wireless network to a cabled network.
- the **Ad Hoc** topology, in which the clients are connected to each other without any access points. This mode makes it possible, for example, to connect one or more oscilloscopes directly to a PC.

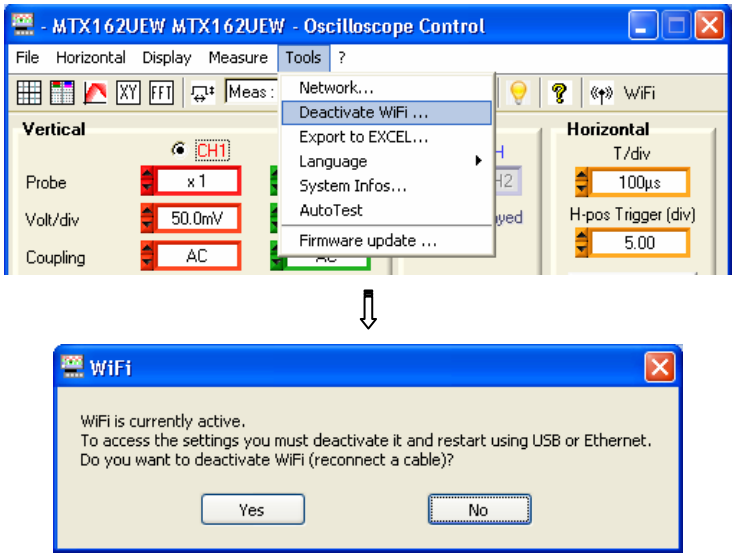
It is strongly recommended that you protect your network using a data encryption and authentication mechanism, the MTX 162UEW manages the **WEP** (64 and 128 bits), **WPA** and **WPA2** security modes.
The latter two are to be privileged in terms of security.

However, **when in Ad Hoc mode, only WEP security is supported**.

The MTX 162UEW operates in roaming mode. It is therefore capable, in an adapted network, (that has several access points with the same network name (SSID) and the same security characteristics), of automatically switching to the access point that has the greatest transmission power.

The WIFi settings cannot be changed if the device is using this communication method. It is therefore necessary to return to a cable connection first (USB or Ethernet).

If the oscilloscope is currently in WiFi mode it can be connected using the 'Tools' menu:

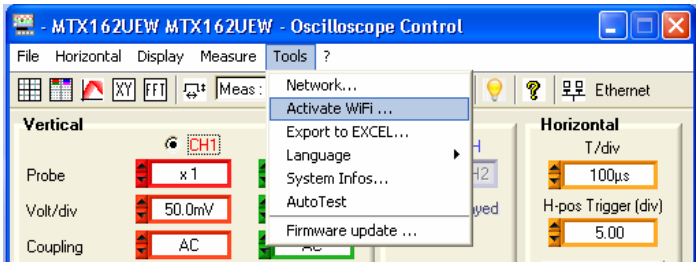


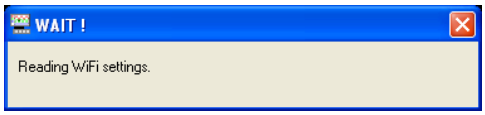
To continue, connect one of the communication cables to your oscilloscope and click on Yes to start a new connection.

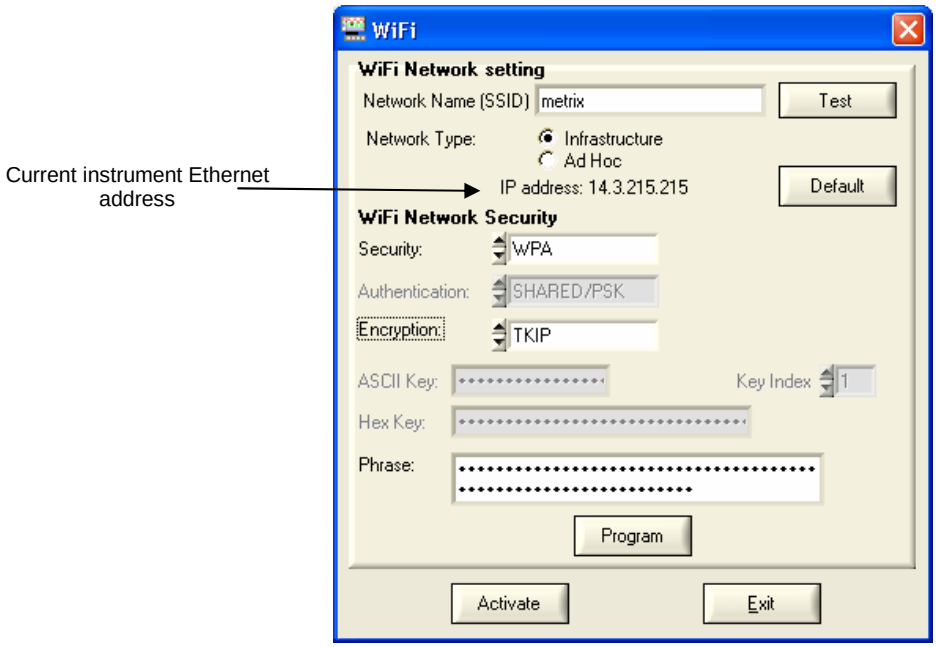
Following start-ups (continued)

Programming the WiFi connection (continued)

Programming can also be carried out from the 'Tools → Activate WiFi …' menu in the 'Oscilloscope Control' window (this menu is greyed out for instruments that are not equipped with the WiFi function).





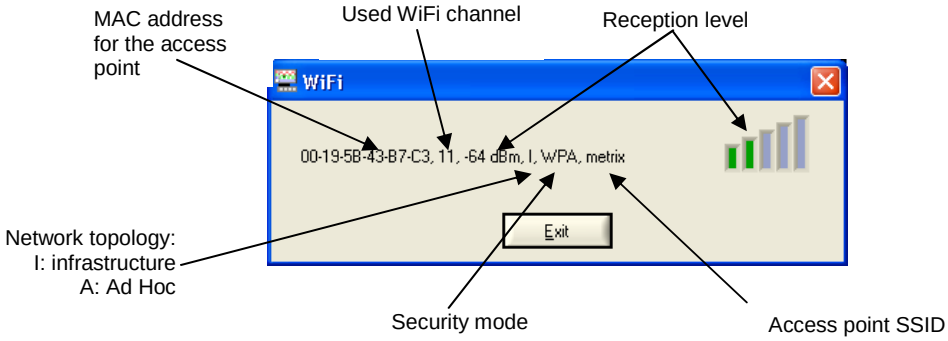


Current instrument Ethernet address

To program the WiFi settings, refer to your wireless access point documentation and copy its programming on the MTX 162UEW.

The password cannot be re-read; it is only reprogrammed if the ' ASCII Key', 'Hex Key' or 'Phrase' fields are changed.

Test used to test the reception level of the access point of which the SSID was entered in the 'Network Name' field. It shows the following window:



Following start-ups (continued)

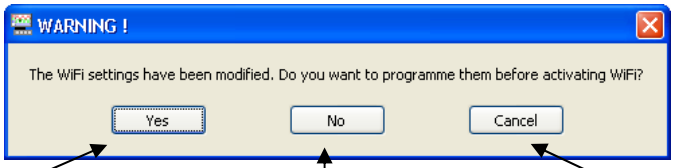
Programming the WiFi connection (cont.)

Default — Display of the "factory" settings with in order to completely reprogramme the oscilloscope. The default configuration is an Ad-Hoc non secured connection with the MTX162 SSID.

Program — This key is only accessible if one of the WiFi settings is changed; it sends the values entered to the oscilloscope to be memorised. Only the modified fields are programmed.

Activate — Launch of a new WiFi connection with the current settings (last values memorised by pressing Program).

If some settings are changed but not programmed the following message is displayed:



Activates the connection after having sent the settings to the oscilloscope.

Activates the connection without taking into account the changes to the WiFi settings.

Return to the previous screen without any action.

Exit — closes the window.

Starting a WiFi connection

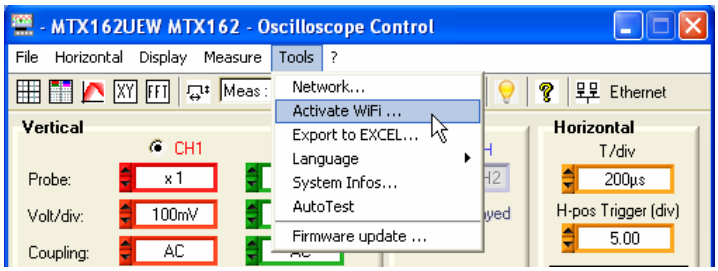
The WiFi connection starts in several ways:

When powering on:

- if the instrument was using WiFi mode when it was powered off, the oscilloscope will restart by attempting to establish the previous WiFi connection.
- if not, if no cables (USB or Ethernet) are connected to the instrument, a search for a WiFi connection is begun using the current settings.

Cable operation (USB or Ethernet):

- if no WiFi is already operational, from the 'Tools → Activate WiFi…' menu in the 'Oscilloscope Control' window.



Then in the WiFi' window (see above), click on Activate. A new WiFi session opens automatically if the connection is correctly established.

- if a WiFi connection is already established (the 'Tools → Deactivate WiFi…' menu is displayed), by closing the application and opening a new connection from the 'Start of an Oscilloscope' window.

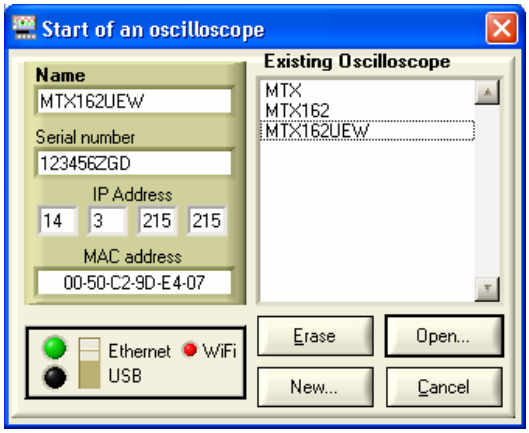
Following start-ups (continued)

Starting a WiFi connection (continued)

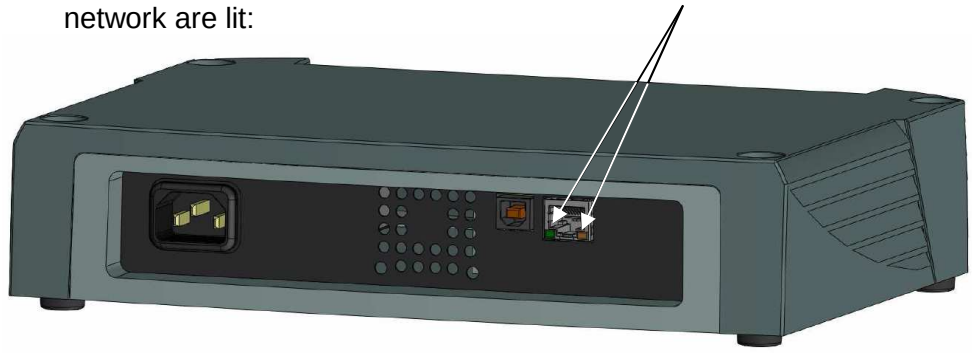
The search for a WiFi network is visible on the front face of the instrument; the "READY" LED will blink for rapid salvoes of 40 blinks.

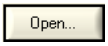
A maximum of 10 salvoes are shown; if the "READY" LED is permanently lit before the 10 salvoes, the connection is established, otherwise the search for an Ethernet cable connection is activated.

If successful the "WiFi" LED in the 'Start of an oscilloscope" window lights in red:

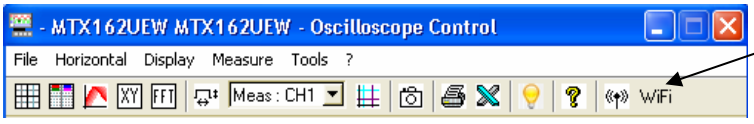


On the rear face of the instrument, the green and yellow LEDs for the RJ45 network are lit:



Select 'Ethernet WiFi' and click on 

to start the instrument using WiFi.



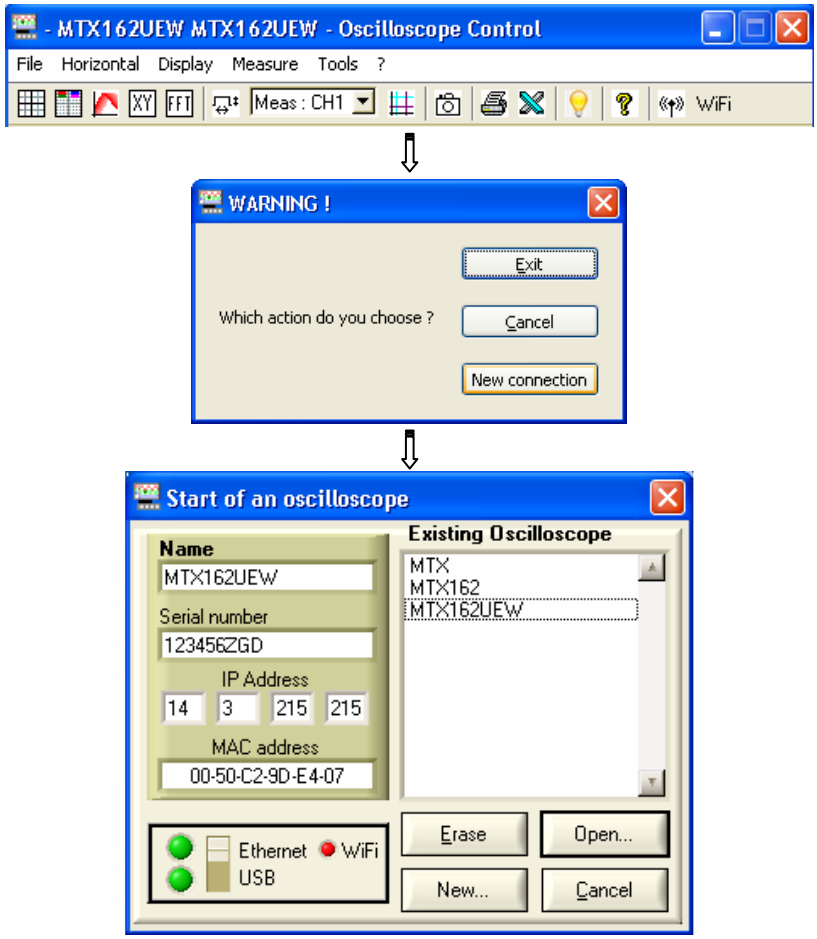
Following start-ups (continued)

Returning to an USB cable communication

Two methods are possible:

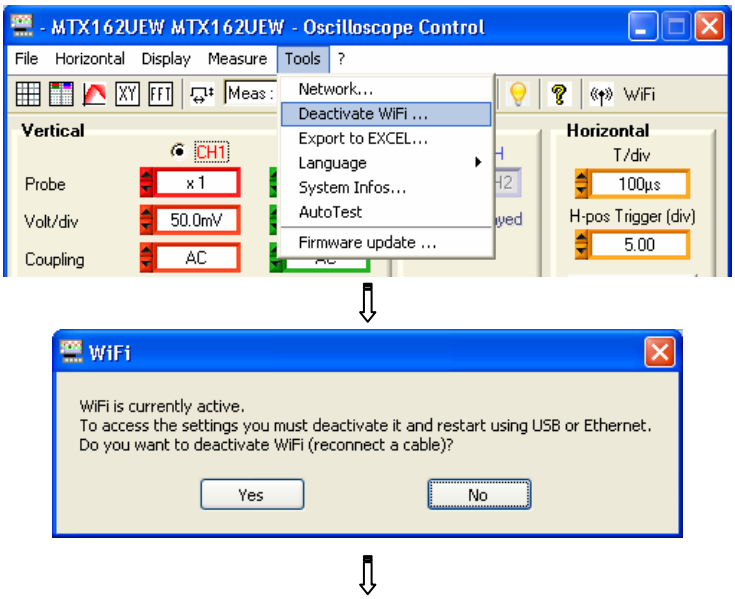
Connect the USB cable between the device and the PC, then:

- to keep the WiFi connection:



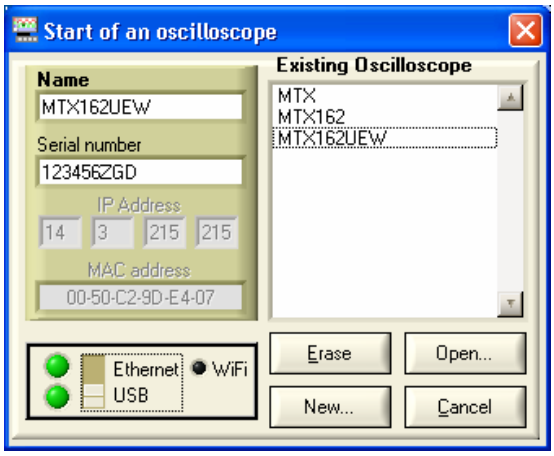
Select the USB and open the new connection.

- to abandon the WiFi connection:



Following start-ups (continued)

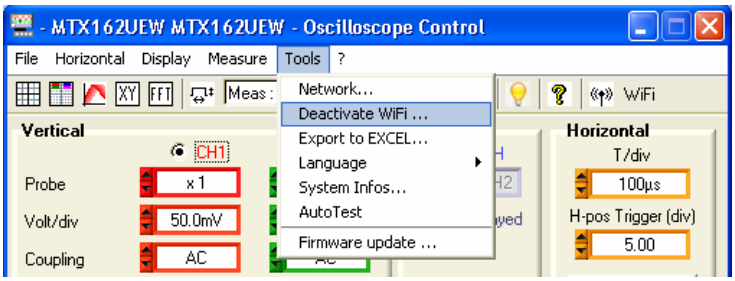
Returning to a USB cable communication (continued)

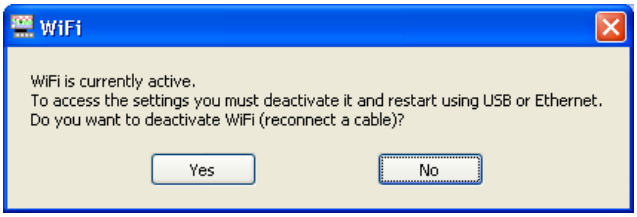


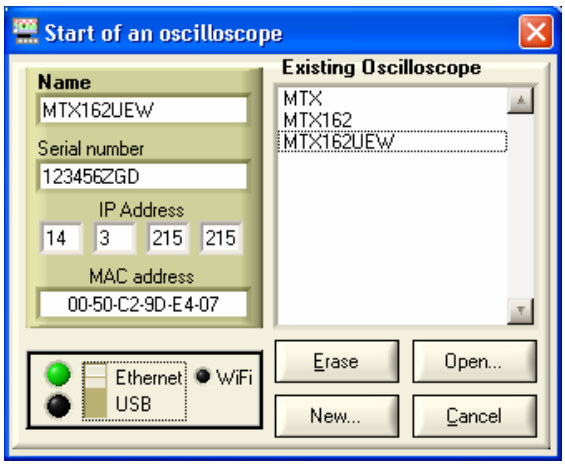
Select the USB and open the new connection.

Returning to an ETHERNET cable connection

Connect the Ethernet cable, then:







Select Ethernet and open the new connection.

Following start-ups (continued)

Our recommendations

If the WiFi connection is not operational in the 'Start of an oscilloscope' window:

- Make sure that the WiFi connection settings for your oscilloscope are identical to those programmed on your wireless access point.
- Use the 

key in the WiFi programming window, to assess the reception level and, if needed, move your MTX 162UEW oscilloscope closer to your access point in order to check whether you have a range problem.
- Make sure (especially when switching from Ad Hoc / Infrastructure) that the oscilloscope's IP address is compatible with the rest of the equipment.
- For use in an Ad Hoc topology (PC + MTX 162UEW), it is imperative to establish the Ad Hoc connection on your PC before starting the network search on the oscilloscope (powering on the oscilloscope).

Following start-ups (continued)

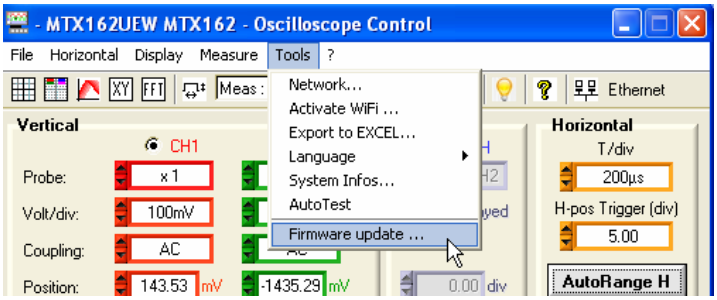
Updating the on-board firmware

The update of the internal MTX 162 firmware is made using a ".BIN" file that you can download from our technical support web site at the following address:

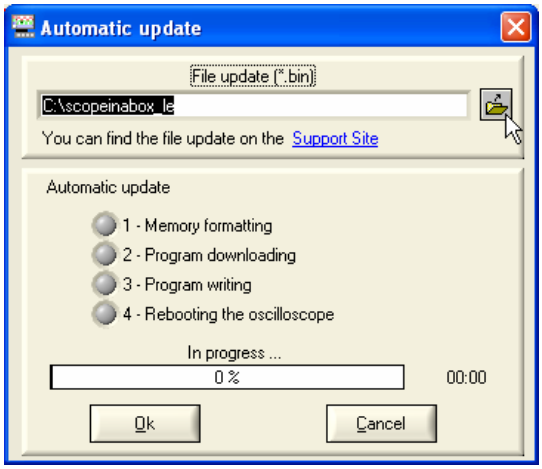
http://www.chauvin-arnoux.com/SUNSUPPORT/SUPPORT/page/pageSupportLog.asp

We recommend that you place this file in the application's work directory (by default: c:\SCOPEin@BOX_LE).

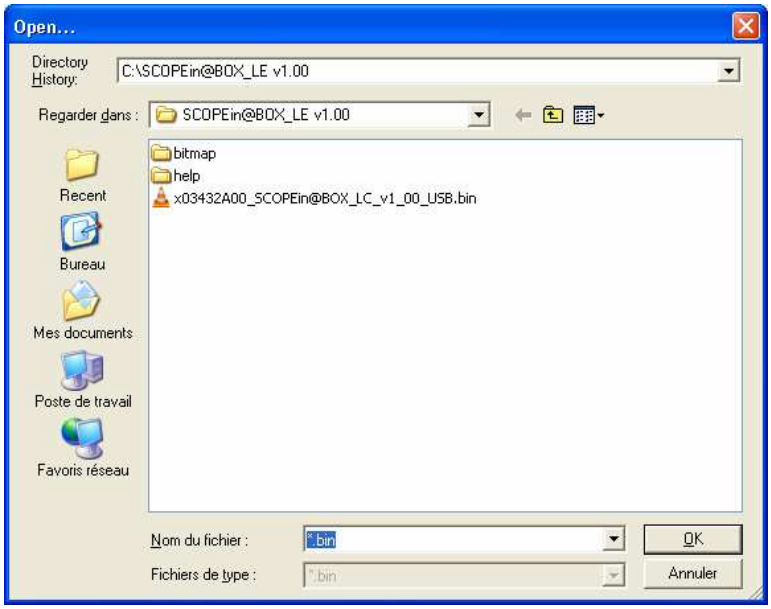
This file is used in the 'Tools' menu of the 'Oscilloscope Control' window:



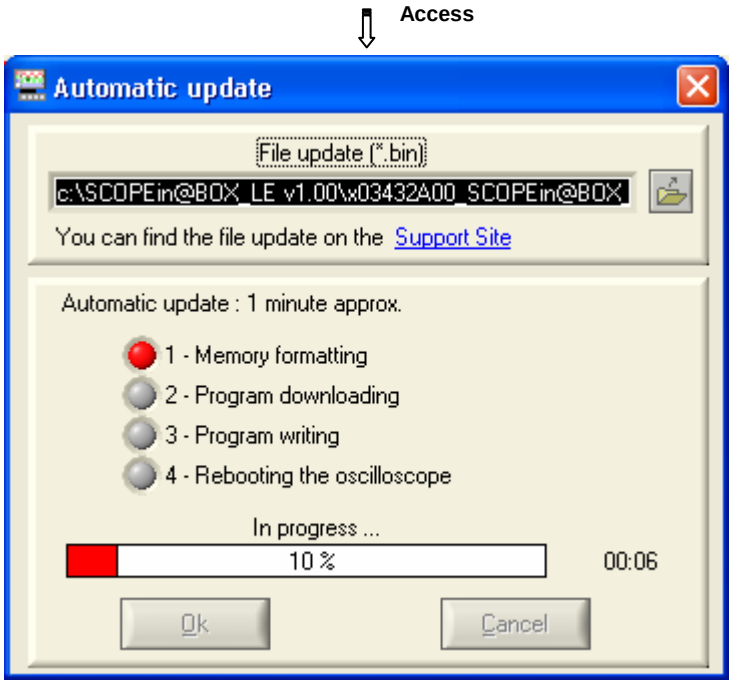
Open the update window



Select a file



Following start-ups (continued)



The download successfully terminates → the application re-starts automatically (after having forced the reinitialisation of the MTX 162).

Our recommendations

In the event of an error, renew the update operation.

If your instrument has not re-initialised correctly, close the SCOPEin@BOX_LE application and re-initialise the MTX 162 by disconnecting it from the power supply.

The update is secure and cannot cause the destruction of the onboard MTX 162 firmware.

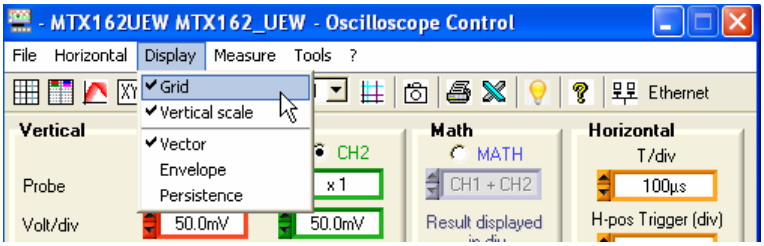
In the worst case the update can continue during the next start-up and thus lengthen the start-up time. The time needed to finish the installation cannot be greater than two minutes.

After this amount of time, reinitialise the MTX 162 by disconnecting the power supply.

Trace display mode

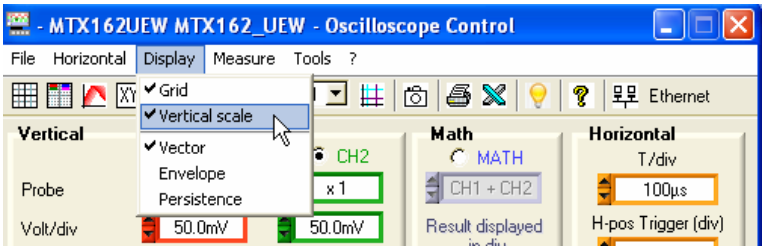
Grid

You can choose to display or hide the grid in the trace windows by clicking on the  in the tool bar or from the menu:



Vertical scale

The vertical trace scale can be inserted into the trace windows by clicking on the  button in the tool bar or from the menu:



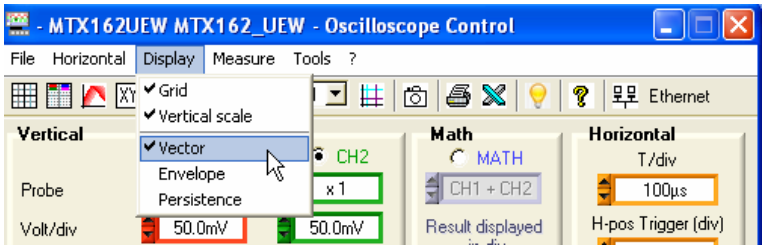
Vector representation, Envelope or Persistence

The 'Vector' representation is the most classical since it consists in linking each pair of samples by a segment.

The 'Envelope' traces the envelope of Min/Max samples keeping, for each abscissa, the minimums and maximums displayed since the last time acquisition was run.

'Persistence' simulates the analogue persistence of the displays on cathode tube screens by keeping the 8 last traces for each channel, the brightness of the colour shows the age (the brightest colour shows the most recent trace).

To select one of these display modes click on the corresponding line:



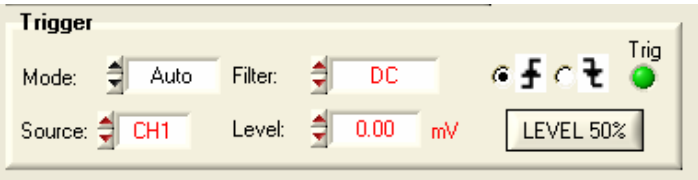
Persistence can also be activated using the  button in the tool bar.

Setting the trigger

The trigger is essential to obtain a correct representation of the signal.

Its setting is made using 5 settings that can be accessed from the "Oscilloscope control" window which are:

- the mode
- the filter
- the front selection
- the source
- the level



The Trig LED on this block shows the presence of triggering events.

Mode

4 trigger modes are available:

Auto for automatic; this mode guarantees signal acquisition even in the absence of trigger conditions. If no pulse is detected for approximately 500 ms, the oscilloscope switches to automatic triggering and regularly, with a period < 80 ms, generates virtual triggers making it possible to have acquisition If pulses are detected (signal frequency > Hz and level correctly adjusted), the automatic mode operates as the triggered mode.

☝ ***When the oscilloscope switches to triggered mode (without trigger signal), the trace is no longer stabilised on the screen, the averaging of the "envelope" modes, if they are triggered, can then give erroneous representations and erroneous automatic measurements.***

Trig for "triggered"; in this mode each detection of a trigger event (ascending or descending wave) on the signal selected as the source, causes a trigger that makes it possible to complete the current acquisition. A new acquisition is immediately begun to anticipate the next trigger event. In the absence of a signal the acquisition is not completed ('Ready' status), the trace is not, therefore, displayed.

Mono for single; a single acquisition is run and continues until a trigger event is detected.

Pressing on RUN / STOP resets the trigger for a new acquisition.

☝ ***Trigger events are only taken into account once the Pretrig phase is complete (filling of the memory between the origin of the window and the trigger's horizontal position). A horizontal positioning of the trigger on the left of the screen is used to reduce the acquisition time.***

Roll This mode is used to view slow signals continuously. The acquisition here is infinite and therefore does not require the setting of any trigger events. This mode is limited to time bases ≥ 200 ms and forces the channel entry coupling to DC (the AC coupling is not adapted to slow signals).

Setting the trigger (continued)

Filter

To limit parasite triggers or to adapt to a signal that is used as a trigger source 4 filters are available:

AC cuts the continuous component of the signal (*see remark below*).

DC lets the signal pass without filtering (the continuous and alternative components are kept).

LF Reject activates a high-pass filter (cut-off frequency 10 kHz).

HF Reject activates a low-pass filter (cut-off frequency 10 kHz).

☝ ***The coupling of the channel, selected in the vertical block of the control panel is input to the acquisition string.***
Consequently, if the AC input coupling is selected, the DC component of the signal is removed on the CHx channel and on the trigger source CHx (the AC or DC filtering of the trigger gives the same result).

Source

3 trigger sources are available: CH1, CH2 and LINE.

LINE is used to trigger on the power supply voltage to which the instrument is connected. In this case only the trigger wave (ascending or descending) can be programmed.
The trigger representation on the trace is a vertical blue line,
the notion of level (vertical position) is no longer available.

Level

Adjustment of the trigger level by ± 8 div. to make sure it cuts this level with a wave.

The LEVEL 50% key is used to reset the trigger level to 50 % of the peak to peak value of the source signal. This is not a general autoset that is capable of finding the trigger, it only applies to the displayed signal.

Signal settings

As with a traditional oscilloscope, the correct representation of a signal necessitates making a number of adjustments:

- Choice of the channel
- Trigger
- Time base
- Vertical sensitivity
- etc. …

Your oscilloscope proposes different strategies in order to obtain these adjustments in the best conditions.

General autoset

It defines all the instrument settings including the search for a signal on all channels, the trigger settings and the time base. The signal frequency must be ≥ 20 Hz for the autoset to succeed.

This action has a momentary effect after which it is possible to take over manually using the classical commands.

☝ ***When the autoset succeeds it overwrites all the current settings. Otherwise it has no effect on the current settings***.

When 2 signals with different frequencies are present on the inputs, the trigger is forced on the lowest frequency signal and the time base is adapted to this signal.

By default the time base is calculated in order to view at least 3 signal periods. If the FFT is activated the time base is calculated so that the fundamental of the frequency representation is at approximately one division from the origin of the frequencies.

Vertical autoset

This command is specific to the associated channel (CH1 or CH2).

It activates the channel, adjusts sensitivity, offset, coupling (if DC coupling is selected and offset is possible) to better adapt to the trace display.

It is a momentary action.

☝ ***When vertical autoset succeeds it overwrites the current settings. If it fails the channel remains selected with its initial settings.***

Vertical autorange

This function permanently adjusts the sensitivity on the signal amplitude on condition that the signal's points have been acquired (select the AUTO trigger mode if there is no trigger).

Horizontal autorange

This function only works on the channel selected as the trigger source. It permanently searches for the time base which is best adapted to view this trace (display of at least 2 periods on the screen).

Signal settings (continued)

Manual settings

The right approach consists in knowing the approximate specifications of the signal to be analysed: frequency, amplitude.

In this case the time base and the vertical attenuator can be pre-set and the trigger can be parametered.

otherwise

- Select the AUTO trigger **mode**
- Validate the **channel** corresponding to the signal connection
- Choose the corresponding trigger **source**
- Select: **Coupling** Trigger AC
  Level Trigger at 0 V
  Sensitivity from 5 mV/div.
- **Time base**: find a sweep rate value that allows the display of several complete periods.

☝ ***Refine the sensitivity to obtain an amplitude representation without overlaps and, if necessary, the time base and the trigger threshold.***

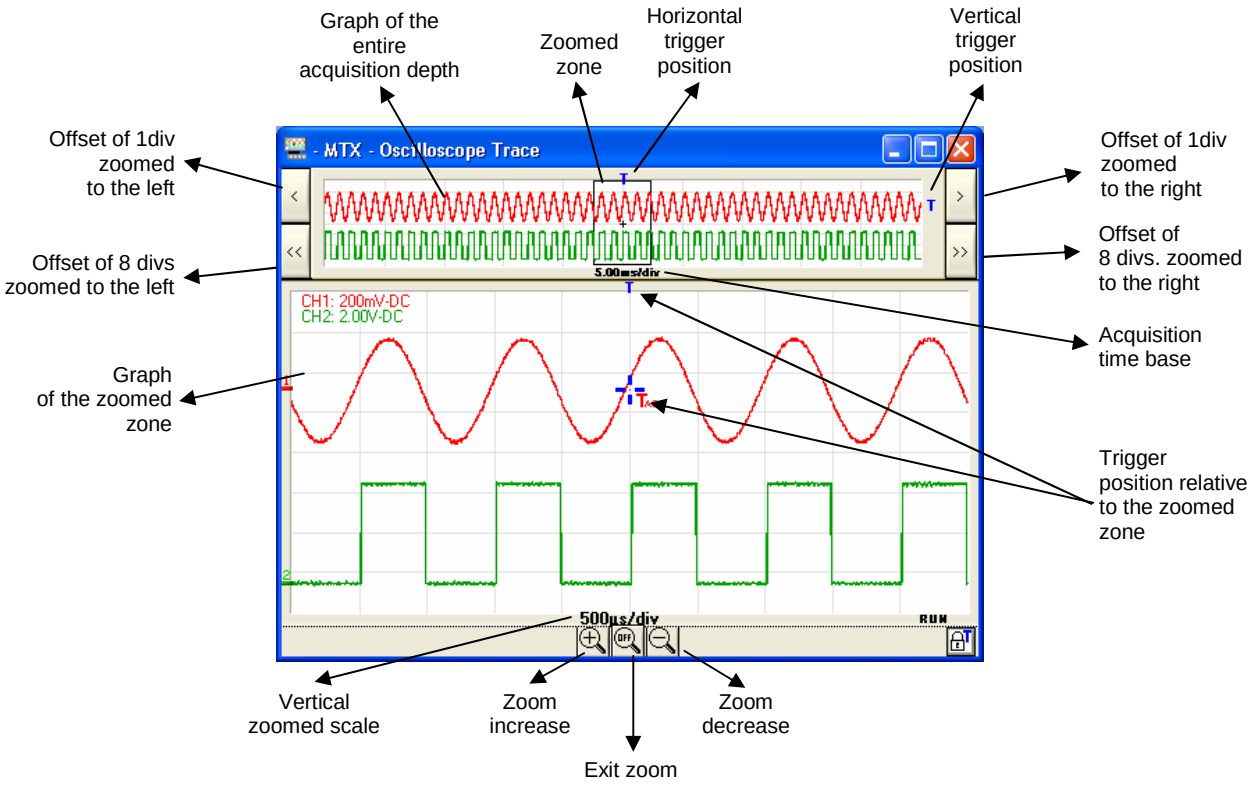
Using the double time base: Zoom

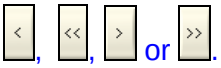
To ease the use of acquisitions, a real time zoom is available on the oscilloscope. It is used to observe a single signal using two different time bases.

A click on the  button of the "Oscilloscope Trace" window activates the Zoom mode.

This mode is switched to automatically for a time base lower than 100 ns/div.

The "Oscilloscope Trace" window becomes:

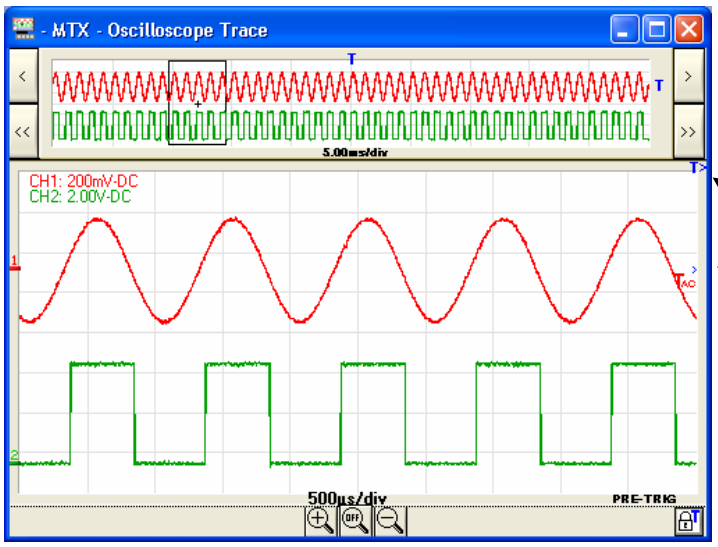




It is possible to move the zoomed zone using the mouse by moving the black frame to the left or to the right (keep the mouse clicked while moving the frame) or by using the buttons shown opposite.

Using the double time base: Zoom (continued)

If the trigger is no longer in the zoomed zone its representation on the zoomed graph becomes:



Making measurements from the trace

Once the representation of the traces has been obtained a more in-depth analysis of the signals can be undertaken by making a few measurements on the signal.

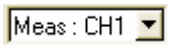
Two categories of measurements can be made using the MTX 162:

1. manual measurement using the cursors
2. automatic measurements

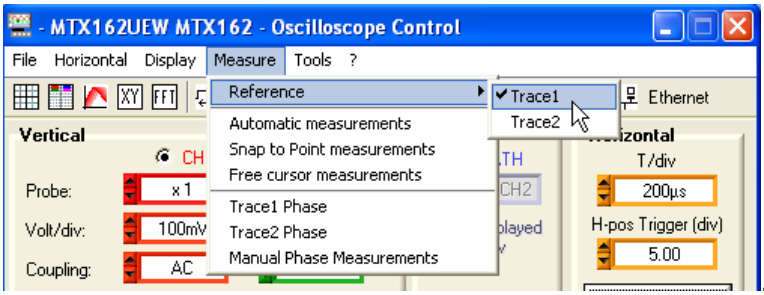
Selecting the reference channel

In both cases the measurements are made on the channel that was selected as the reference.

It is selected:

- either from the tool bar in the 

selector
- or from the 'Measurement' menu as follows:



Making measurements from the trace (continued)

1. Manual measurements using the cursors

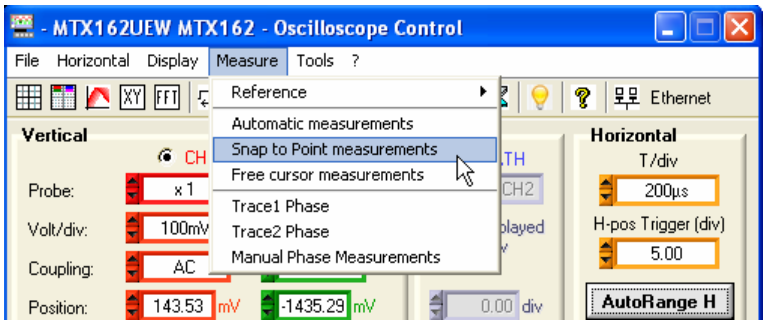
These measurements are made on the 2500 points used for the display.

If the Zoom is active the cursors are available on the zoomed graph.

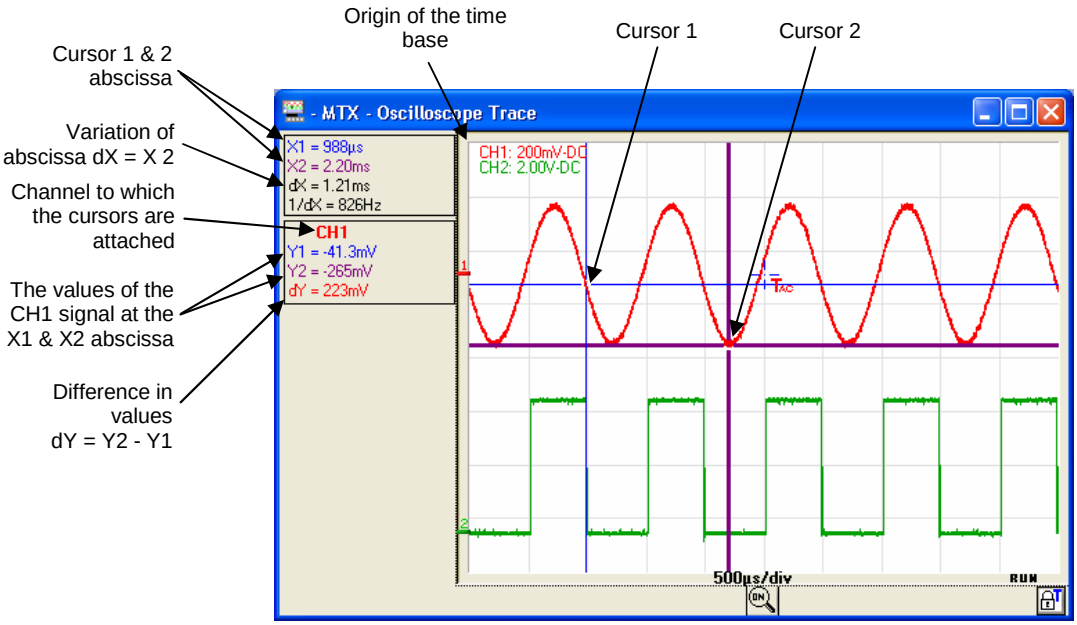
a) Snap to Point measurements

In this mode the cursors are attached to the trace for the channel defined as the measurement reference: the user can only move them on the horizontal axis.

A click on the  button of the tool bar or on the 'Measure' menu function activates/deactivates the cursors:



The 'Snap to Point measurements' are driven from the "Oscilloscope Trace" window which becomes:

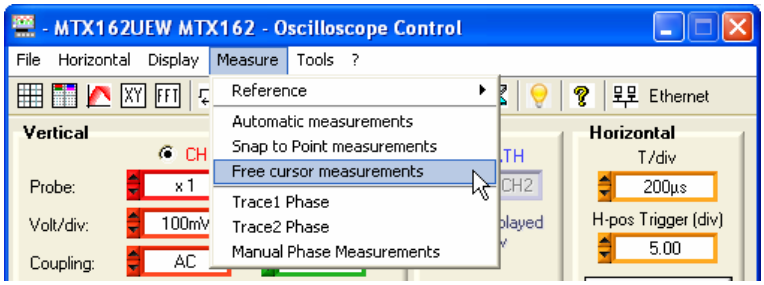


Making measurements from the trace (continued)

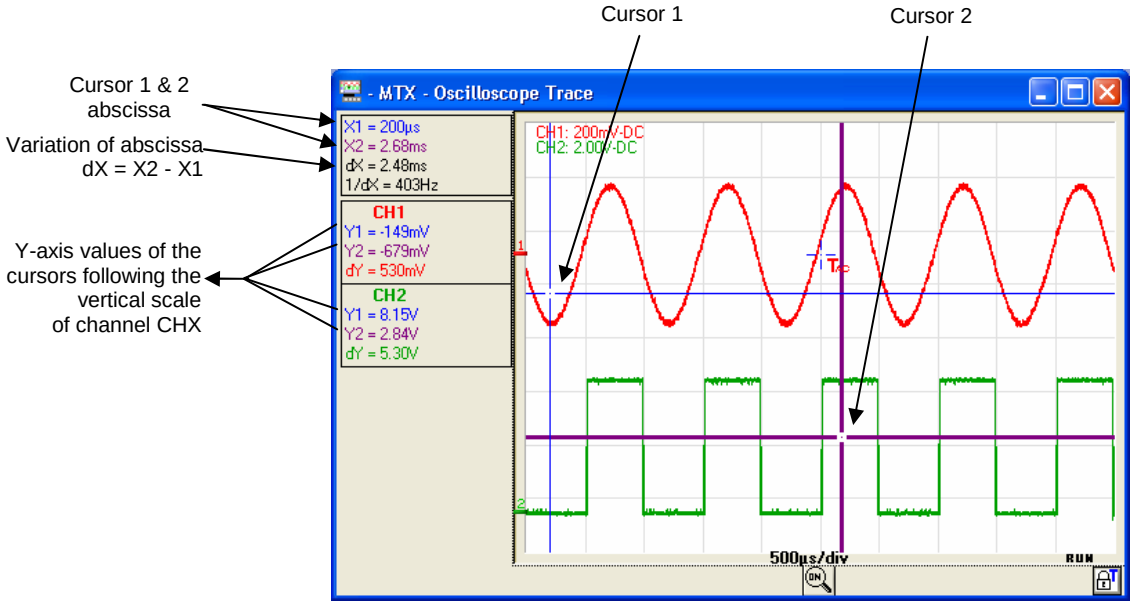
b) Free cursors

Using this mode the user is free to position the cursors at will on the graph. The position of each cursor is given following the vertical scale of the different traces.

These measurements were selected from the 'Measure' menu:



The "Oscilloscope Trace" window becomes:

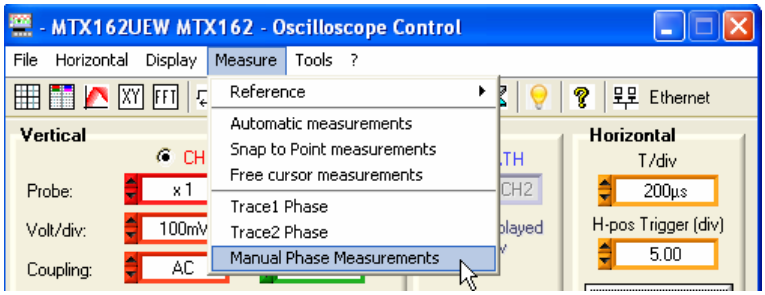


Making measurements from the trace (continued)

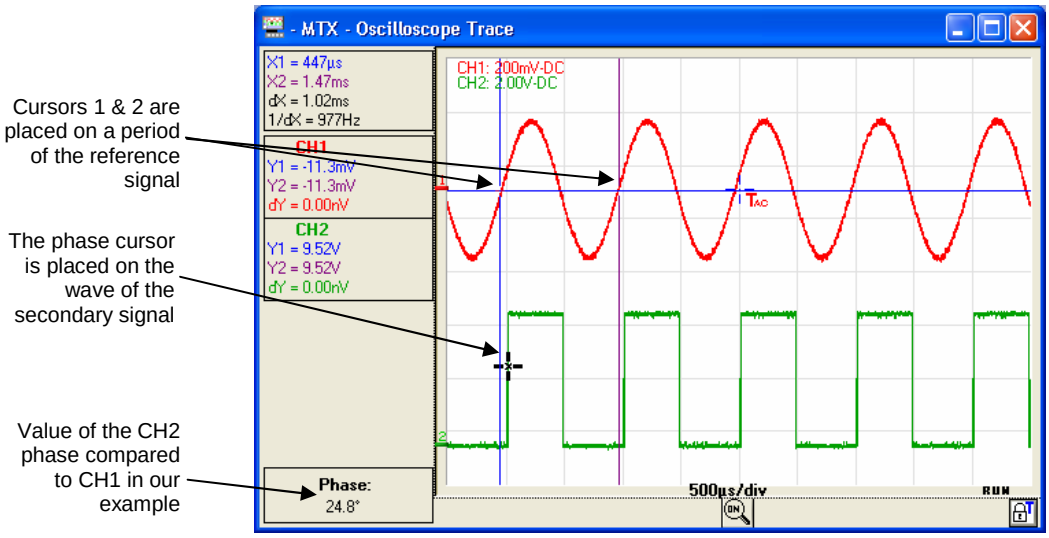
c) Manual phase measurements

This function is used to measure the de-phasing between two signals. It is completely manual and at the user's discretion.

It is activated from the 'Measure' menu:



It shows a third cursor that must be placed on the other signal:



The three cursors are free and can be placed anywhere in the trace display window.

To measure a phase

- Place the cursors "1 = blue" and "2 = violet" on the "reference" signal to determine its period for the phase calculation (this period corresponds to 360°).
- The "black" cursor is then placed on the other signal: if cursor 1 is placed on an ascending wave with coordinates (X1,Y1), the black cursor should be placed on the ascending wave of the other signal, as close to X1 and on the same Y-Axis Y1 position as cursor 1.

The de-phasing value compared to the reference signal is given in degrees.

☝ ***A de-phasing only has meaning if the two signals have the same frequency.***

Making measurements from the trace (continued)

2. Automatic measurements

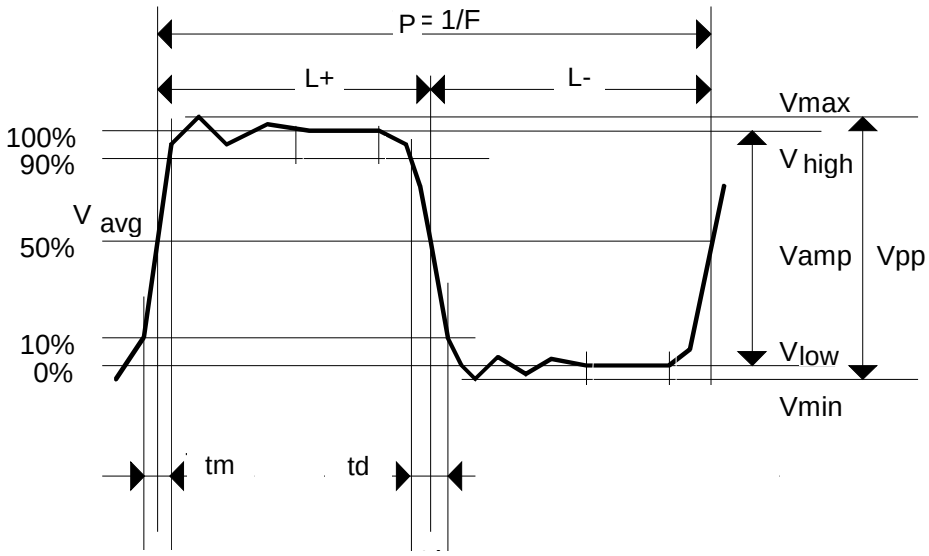
There are two types of automatic measurement:

a) general measurements on a channel
b) automatic phase measurement

a) General measurements on a channel

This function makes it possible to view the results of 19 automatic measurements in a new window:

Vmin	minimum peak voltage
Vmax	maximum peak voltage
Vpp	peak to peak voltage
Vlow	established low voltage
Vhigh	established high voltage
Vamp	amplitude
Vrms	operating voltage
Vavg	average voltage
Over+	positive offset
Trise	ascending time
Tfall	descending time
L+	width of positive pulse (at 50% Vamp)
L-	width of negative pulse (at 50% Vamp)
P	period
F	frequency
DC	duty cycle ratio
N	number of pulses
Over-	negative offset
Sum	sum of elementary areas (= integral)



- Positive offset = [100 * (Vmax – Vhigh)] / Vamp
- Negative offset = [100 * (Vmax – Vlow)] / Vamp
- Vrms = $[\frac{1}{n}\sum_{i=0}^{i=n}(y_i - y_{GND})^2]^{1/2}$
- Vavg = $\frac{1}{n}\sum_{i=0}^{i=n}(y_i - y_{GND})$

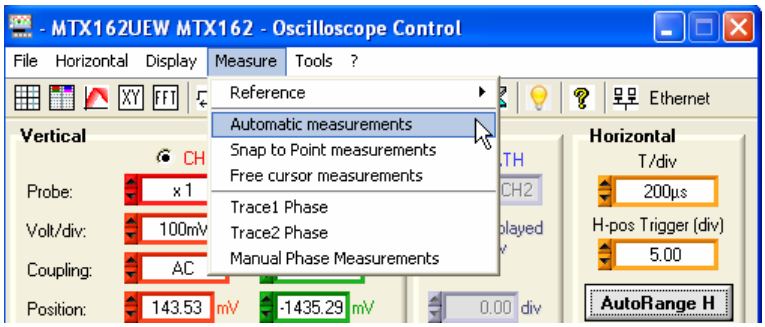
Y_{GND} = value of the point representing zero Volts

Making measurements from the trace (continued)

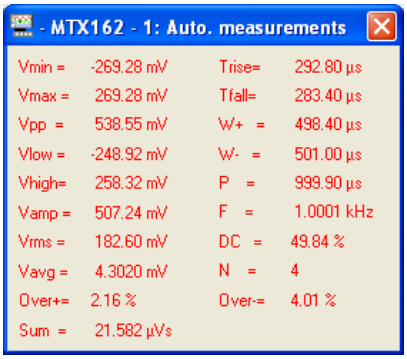
a) General measurements on a channel (continued)

These measurements are made on the channel selected as reference (see above).

This function is activated: either using the button on the tool bar, or from the 'Measurement' menu:

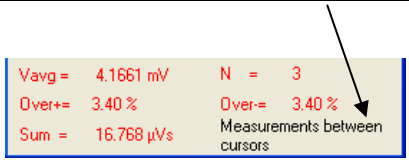


It opens a new window called 'Auto measurements':



By default the measurements are made on all the acquired points (50 000 points) for the channel in question each time the SCOPEin@BOX_LE application requests the transfer of curves.

However, if the manual cursors are active the measurements are made using all the samples acquired in the interval determined by cursors 1 & 2.
A message '<u>Measurements between cursors</u>' appears in the window:



For a greater precision in the displayed measurements:

1. Represent at least two complete signal periods.
2. Prefer the "Triggered" acquisition mode rather than "Automatic" (to avoid the artificial triggering related to this mode with slow signals).
3. Choose the calibre and the vertical position in order to represent the peak to peak amplitude of the signal to be measured on 4 to 7 divisions of the screen.
4. If the signal allows (repetitive signal), the introduction of acquisition averaging will refine the measurements by reducing the noise effects on the measured signal.

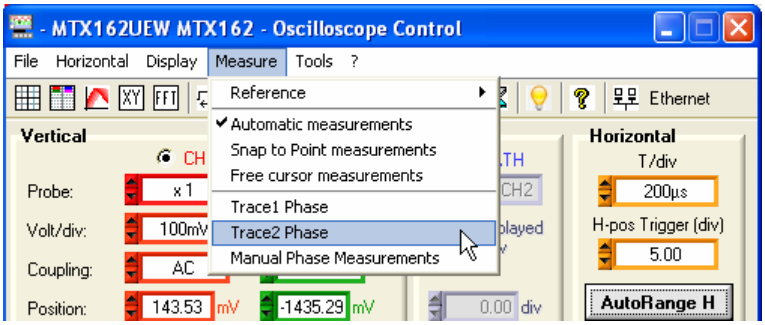
Making measurements from the trace (continued)

b) Automatic phase measurement

When possible it determines the de-phasing of the CH1 or CH2 signal compared to the reference channel (see above).

As with the manual phase measurement, 3 cursors are used, but they are placed automatically.

This measurement is activated from the 'Measurement' menu:



The "Oscilloscope Trace" window becomes:

Carrying out specific processes

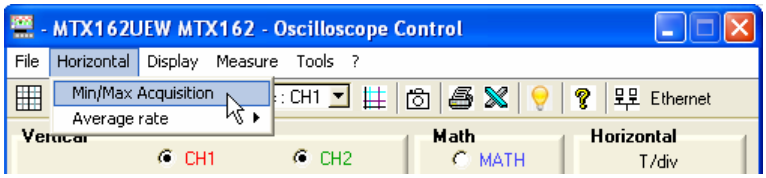
1. Min/Max high resolution acquisition

In order not to hide the rapid voltage variations due to signal sub-sampling for slower time bases the MTX 162 has a Min/Max high resolution acquisition mode.

When this option is activated each pair of acquired points is the result of a search for extreme min. and max. values from all the samples acquired using the highest sampling speed, i.e. 50 MSamples/s.

This Min/Max acquisition mode guarantees that any peaks in voltage of more than 40 ns width are seen and displayed on the oscilloscope screen.

This mode is activated from the 'Horizontal' menu:



2. Averaging the trace

To reduce the random noise observed on the signals it is possible to average the acquired samples.

The calculation is made using the following formula:

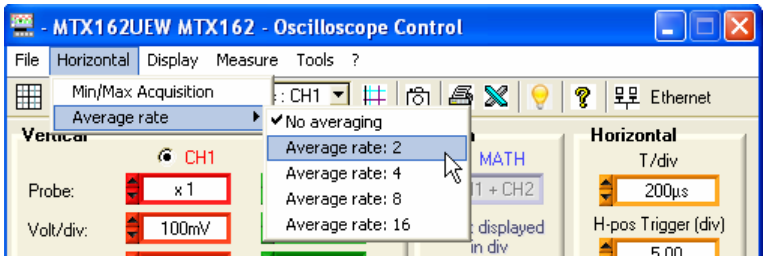
Pixel $_N$ = Sample*1/Averaging rate + Pixel $_{N-1}$ (1-1/Averaging rate)

where: Sample Value of the new sample acquired at abscissa t

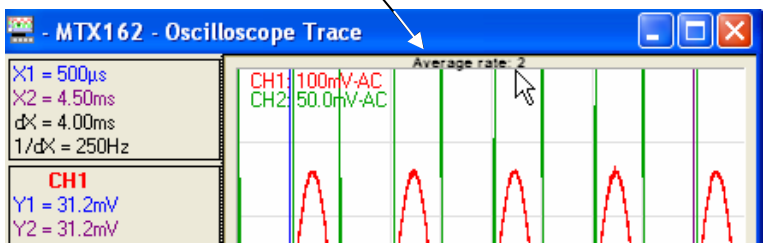
Pixel N Y-Axis of the abscissa t pixel on the screen, at time N

Pixel N-1 Y-Axis of the abscissa t pixel on the screen, at time N-1

This averaging is activated using the 'Horizontal' menu by selecting an averaging rate different from: "No averaging".



When averaging is activated its rate is displayed in the "Oscilloscope Trace" window:



In the case of a non repetitive signal do not activate averaging if you do not want an erroneous representation.

Carrying out specific processes (continued)

3. MATH trace

A third trace: MATH, is available on the MTX 162 to display one of the 6 proposed mathematical functions:

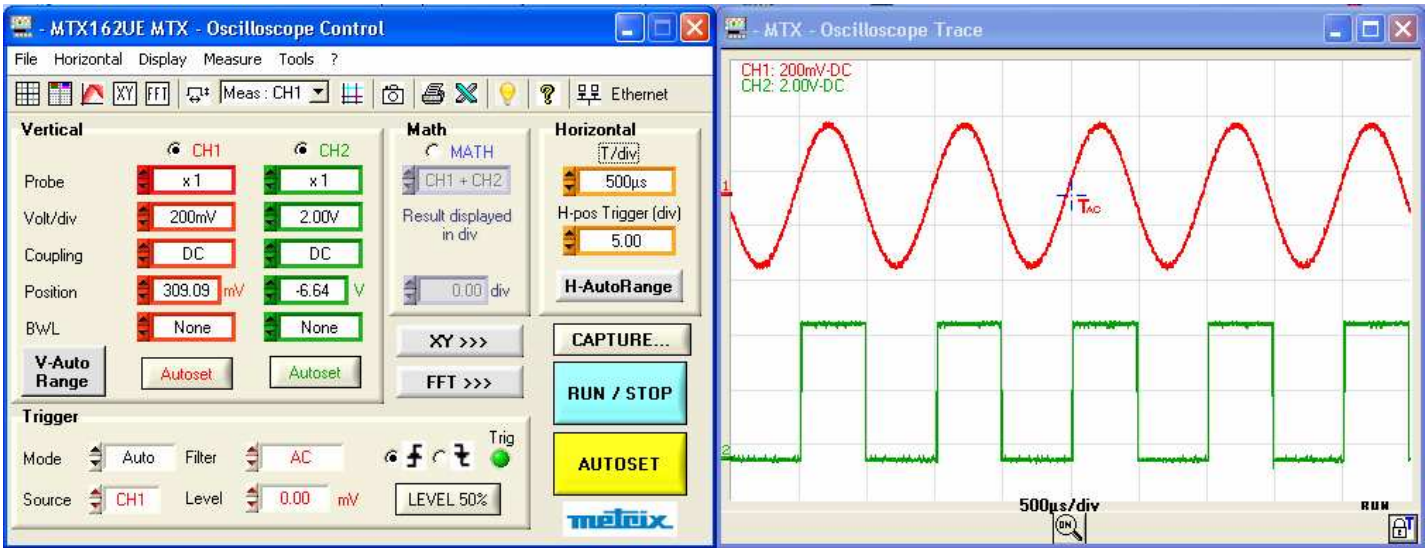
CH1 + CH2 | CH1 - CH2 | CH1 x CH2 | CH1 / CH2 | - CH1 | - CH2

The vertical position of the MATH trace can be adjusted by ± 10 div.

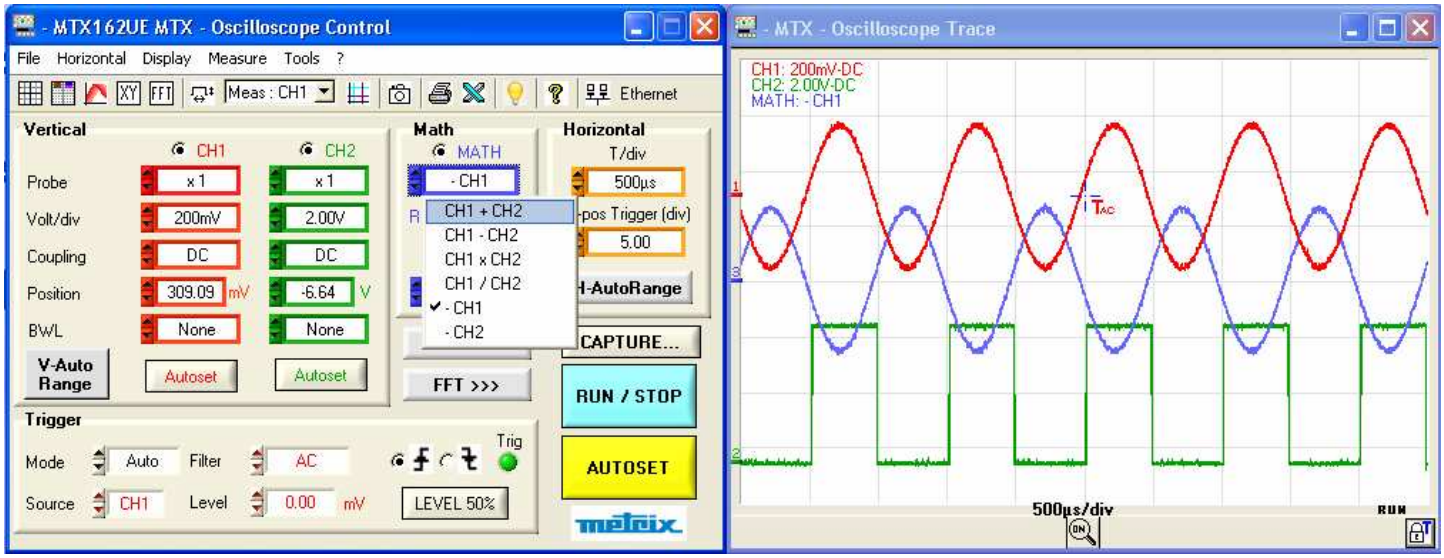
The mathematical functions are not calculated using the physical size of the signals but using their base sample values converted into divisions on the screen. This is why the vertical sensitivity of the MATH channel is in div.

To facilitate the analysis of the result it is recommended to work with the same calibration on both channels.

Example Insertion of the MATH function that adds signals CH1 and CH2.
An offset may be necessary to centre the trace on the screen.

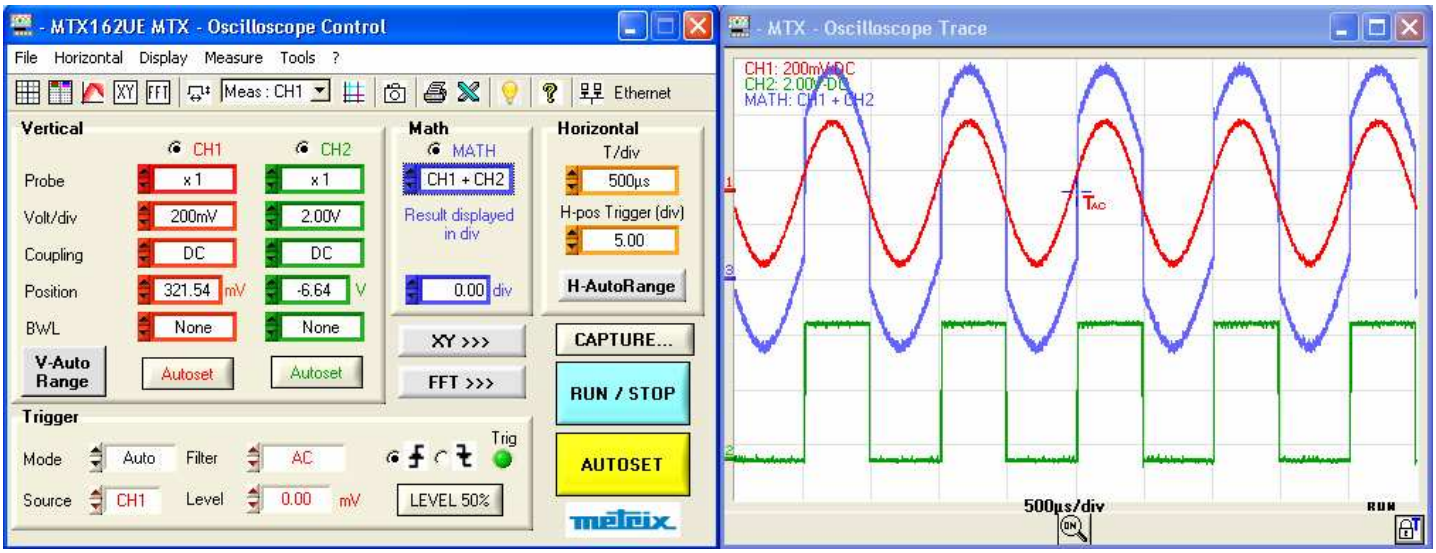


Activation of the MATH block

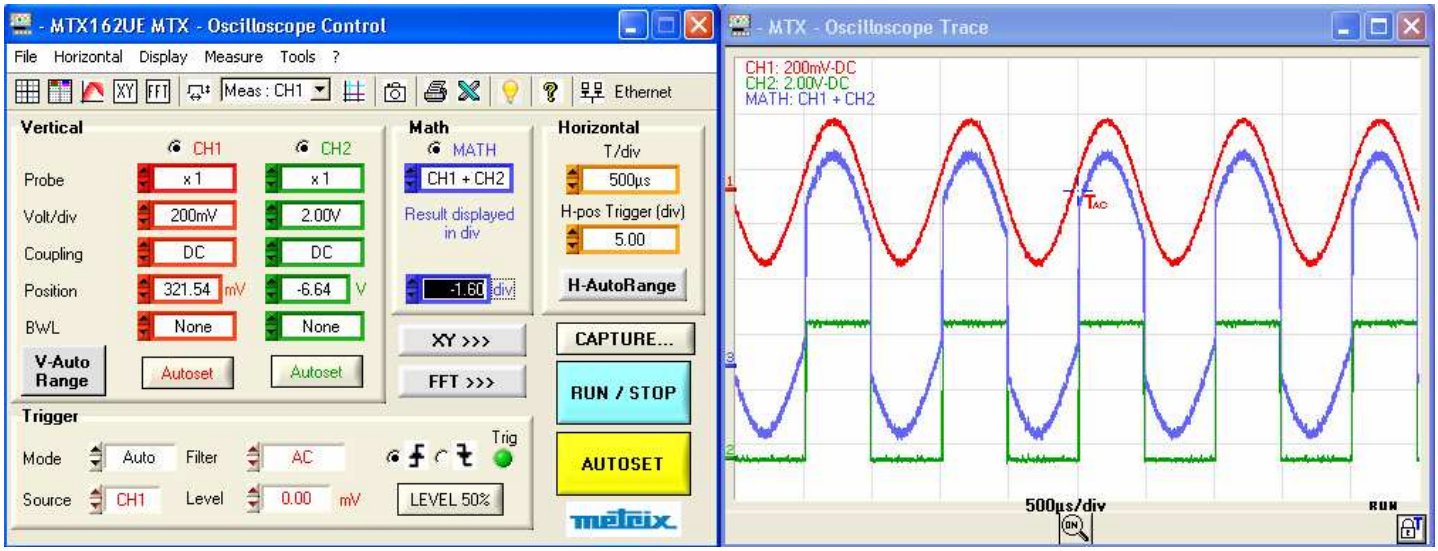


Carrying out specific processes (continued)

3. MATH trace (continued)



Offsetting the result



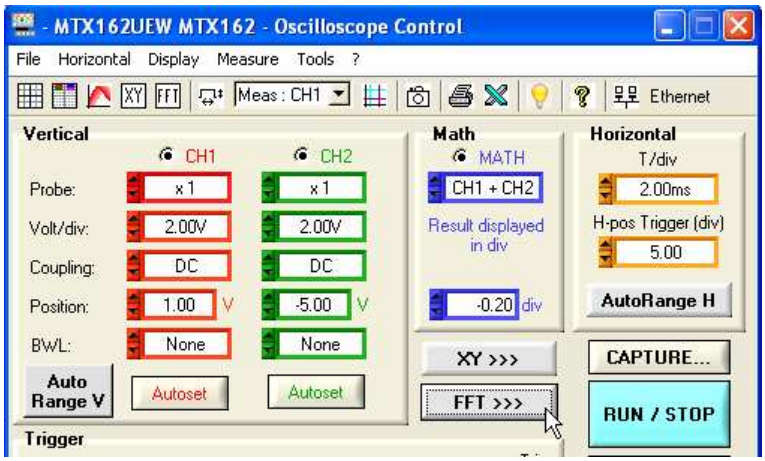
Carrying out specific processes (continued)

4. Calculating an FFT

a) Launching the FFT calculation

The Fourier signal transformation calculation is activated in 2 ways:

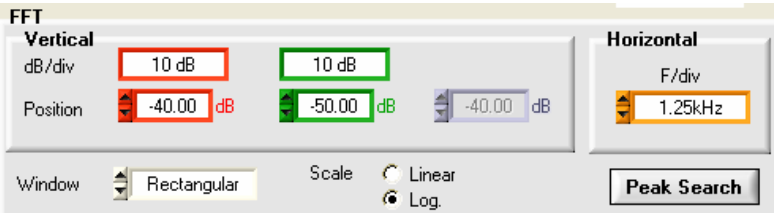
- by clicking on the FFT button in the tool bar
- by clicking on the FFT >>> button in the "Control" panel:



In both cases a new "FFT Trace" window opens and a new FFT block is added to the "Oscilloscope Control" panel programming this function:

Carrying out specific processes (continued)

b) FFT settings The settings needed for this function are concentrated in the FFT block on the "Oscilloscope Control" panel.



Vertical setting

Logarithm scale:

- The vertical sensitivity of the FFT representation is of 10 dB/div.
- The 0 dB position corresponds to the top part of the screen. The trace can be offset from +60 dB to -140 dB.

Linear scale:

- The vertical sensitivity of the FFT representation is that of the channel.
- The 0V position places the channel reference in the 'Trace FFT' window on the 1st division from the bottom of the screen. The offset is adjustable from 0 to 8 div.

Horizontal trace scale This sensitivity is directly related to the time base of the time representation (unit Hz / div. : 12.5 / time base).
It varies from 62.5 mHz to 125 MHz.

Choice of the calculation window Windowing makes it possible to limit to discontinuous effects related to the time signal observation window (see §. Interpreting the FFT).

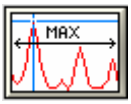
Five windows are available:

Rectangular Hamming Hanning Blackmann Flattop

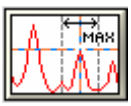
Choice of the representation scale Two FFT representation modes are possible:

linear or logarithmic

The **Peak Search** button activates/deactivates the attached cursors to make manual measurements on the FFT trace. It also leads to the display or not of the buttons for automatic spectrum ray search.



positions cursor 1 on the maximum amplitude peak shown in the window.



places the active cursor on the maximum amplitude value found in a window of ± 0.25 div. around this cursor. The search window is shown by a black rectangle when pressing the key.

If an autoset is made AUTOSET ***when the FFT window is active the automatic setting of the frequency scale will be made in order to place the fundamental on approximately the first division.***

A zoom may be needed on the time representation to correctly view the signal.

Carrying out specific processes (continued)

c) Interpreting the FFT

The Fourier Fast Transformed (FFT) is used to calculate the discrete representation of a signal in a frequency domain using its discrete representation in the time domain.

FFT can be used for the following applications:

- measuring the different harmonics and the distortion of a signal,
- analysing an impulse response,
- searching for sources of noise in logical circuits.

The Fourier fast transform is calculated using the equation:

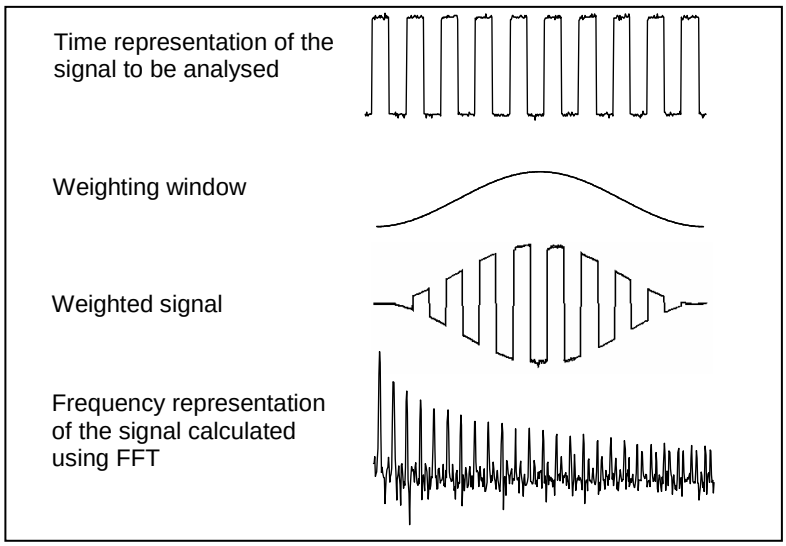
$$X(k) = \frac{1}{N} * \sum_{n=-\frac{N}{2}}^{\frac{N}{2}-1} x(n) * \exp\left(-j\frac{2\pi nk}{N}\right) \quad \text{for } k \in [0\ (N-1)\ ]$$

where:
- x (n) : a sample in the time domain
- X (k) : a sample in the frequency domain
- N : FFT resolution
- n : time index
- k : frequency index

This calculation is made on 2500 points obtained by selected one point every 20 in the acquisition memory.
These same points are used for the non zoomed time representation in the "Oscilloscope Trace" window.

The finite duration of the studied interval is shown by a convolution in the signal's frequency domain using a sinx/x function.
This convolution changes the FFT graphic representation because of the lateral lobes that are characteristic of the sinx/x function (except if the study interval contains a whole number of periods).

Before calculating the FFT, the oscilloscope weights the signal to be analysed using a window that acts as a high-pass filter. The choice of a type of window is essential to distinguish the different signal rays and make precise measurements.



Carrying out specific processes (continued)

The following table can be used to select the type of window depending on the type of signal, the desired spectrum resolution and the precision of the amplitude measurement:

Window	Type of signal	Frequency resolution	Spectrum resolution	Amplitude precision	Highest lateral lobe
Rectangular	transitory	the best	poor	poor	- 13 dB
Hamming	random	good	correct	correct	- 42 dB
Hanning	random	good	good	correct	- 32 dB
Blackmann	random or mixed	poor	the best	good	- 74 db
Flat Top	sinusoidal	poor	good	the best	- 93 dB

The following table gives the maximum theoretical error on the amplitude for each type of window:

Window	Max. theoretical error in dB
Rectangular	3,92
Hamming	1,75
Hanning	1,42
Blackmann	1,13
Flat Top	< 0,01

This error is related to the FFT calculation when there is not a whole number of periods in the observation window.

Thus, with a 'Flat Top' window, the 0 dB level is obtained on the ray of the fundamental of a sinusoidal 1 Vrms amplitude signal.

Be careful to respect the Shannon theory, i.e. that the sampling frequency "Sf" must be greater than 2 times the maximum frequency containing by the signal.

If this condition is not respected spectrum folding phenomena are observed.

Carrying out specific processes (continued)

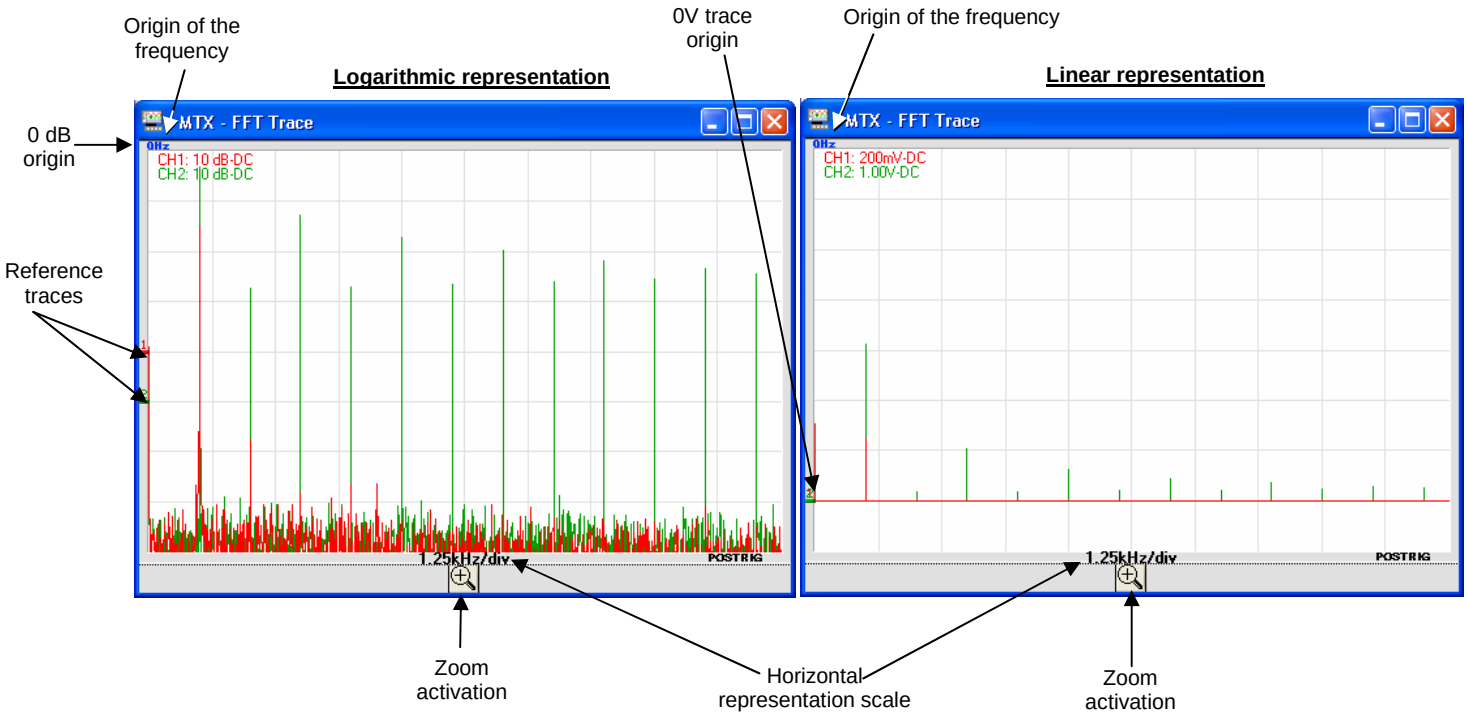
d) Graphical representation

The instrument simultaneously displays the FFT and the trace f(t).

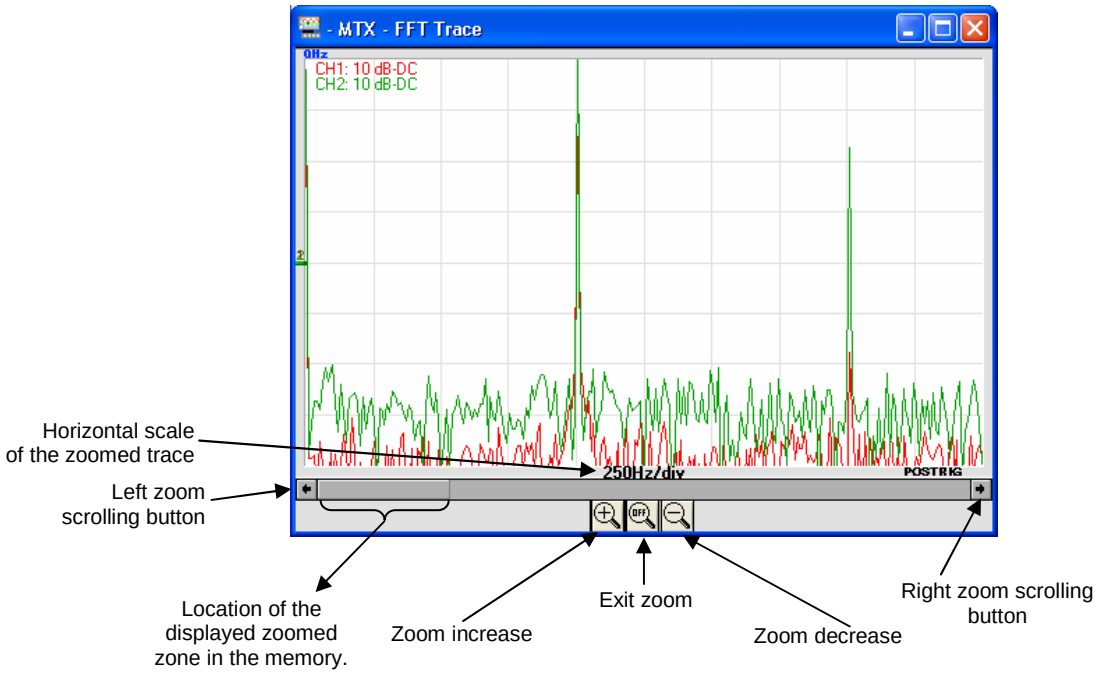
The curve displayed in the 'FFT Trace' window represents the amplitude in V or dB for the different frequency components of the signal depending on the selected scale.

The continuous component of the signal is removed by the software.

Two representations are possible:



When the zoom is activated only the zoomed zone is displayed:



The displacement of the zoomed zone is done using the mouse by moving the scroll bar or the scroll buttons.

Carrying out specific processes (continued)

d) Graphical representation (continued)

In order not to deform the spectral content of the signal and obtain a better FFT calculation precision it is recommended to work with a peak to peak amplitude of 3 div. to 7 div.

Too weak amplitude leads to a reduction in the precision and a too high amplitude of over 8 divisions causes signal distortion, this causes undesirable harmonics to appear.

The simultaneous time and frequency representation of the signal eases the surveillance of the changes in signal amplitude.

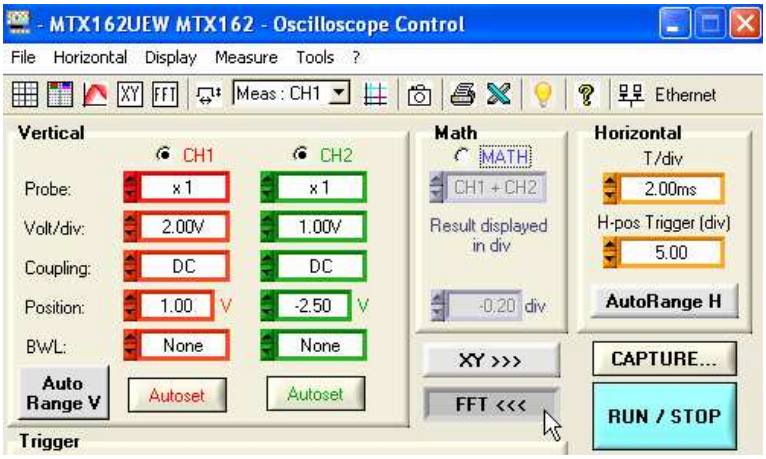
***Effects of under-sampling on the frequency representation**:*

If the sampling frequency is not adapted (less than double the maximum frequency of the signal to be measured) high frequency components are under sampled and appear on the FFT graphical representation by symmetry (folding).
The "General Autoset" function avoids this phenomenon and adapts the horizontal scale so that the representation is more legible.

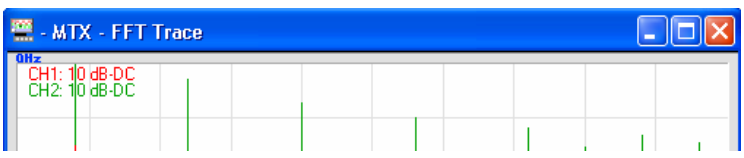
e) Exit the FFT calculation

There are three ways to exit the FFT representation:

- by clicking on the FFT button in the tool bar
- by clicking on the FFT <<< button in the "Control" panel:



- by directly closing the 'FFT Trace' window:



Carrying out specific processes (continued)

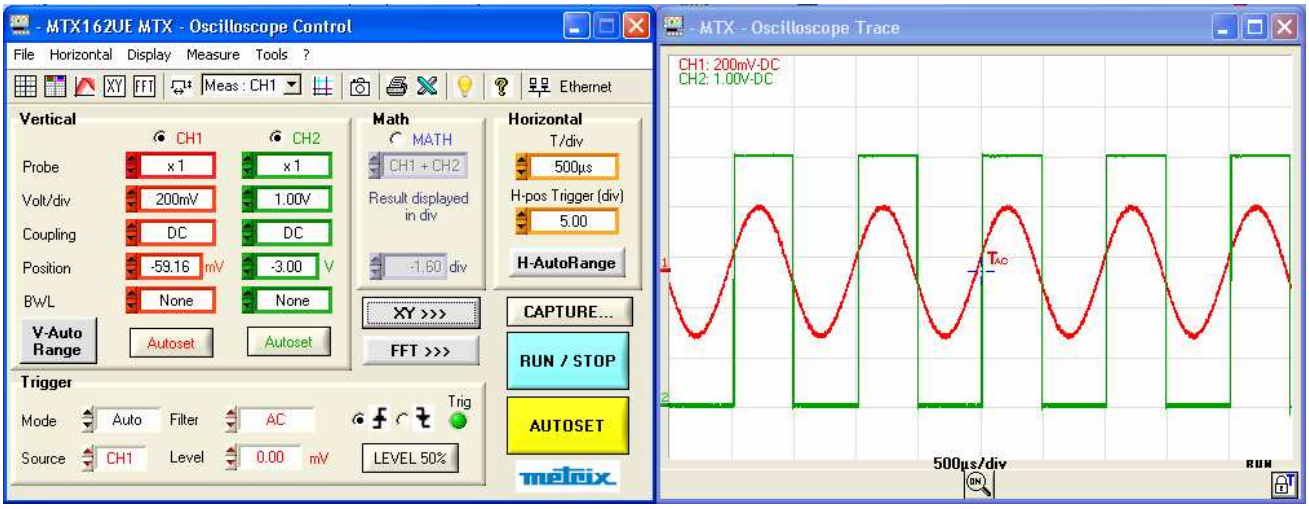
5. Obtaining an XY representation

The MTX 162 oscilloscope can be used to view the XY representation of channels 1 and 2 in real time with X=CH1 and Y=CH2.

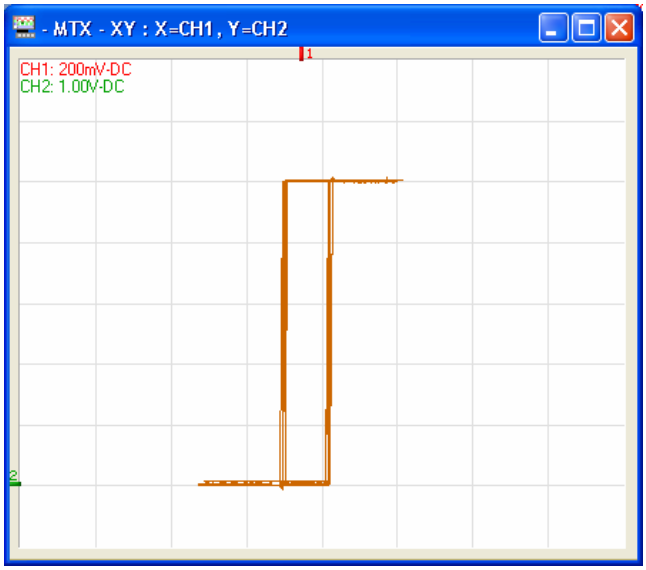
a) Starting the XY representation

The XY representation is activated either:

- by clicking on the XY button in the tool bar,
- by clicking on the XY >>> button in the "Control" panel:



In both cases a new XY window opens:



Carrying out specific processes (continued)

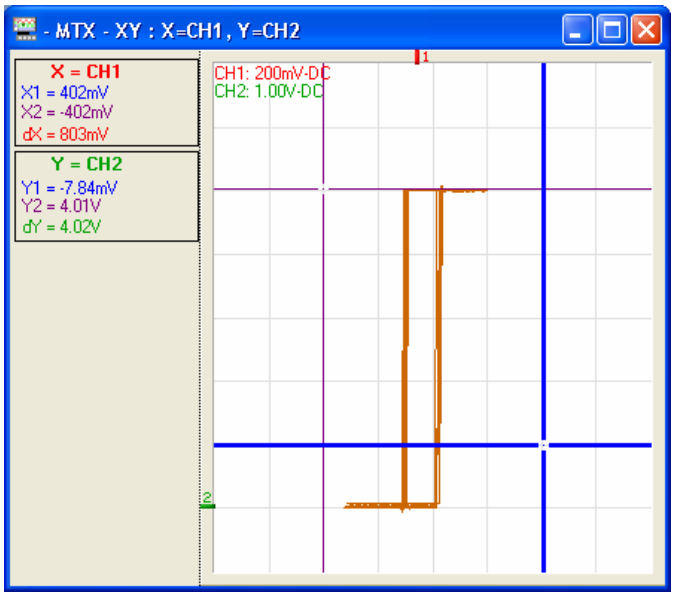
5. Obtaining an XY representation (continued)

b) Using the trace

The vertical calibrations of the traces selected for XY display can be indicated at the top left of the window by clicking on the button of the tool bar.

The measurements using cursors are available for the XY representation and are used in the same way as in the "Oscilloscope trace" window (see Chapter IV → Manual Measurements using cursors).

The manual measurement cursors for the "XY Trace" window are independent of those in the "Oscilloscope Trace" window and are free (not attached to the trace).



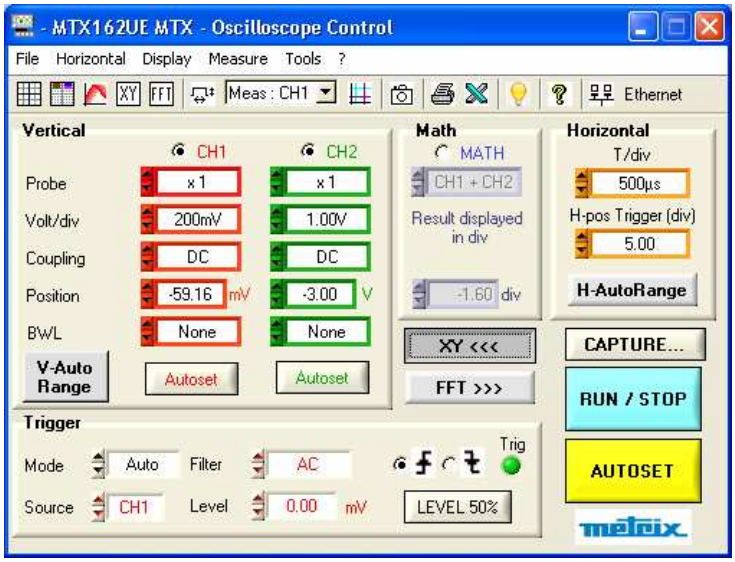
Carrying out specific processes (continued)

5. Obtaining an XY representation (continued)

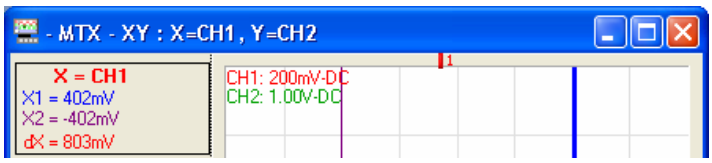
c) Cancelling the XY representation

There are three ways to exit the XY representation:

- by clicking on the XY button in the tool bar
- by clicking on the XY <<< button in the "Control" panel:



- by directly closing the 'XY Trace' window:



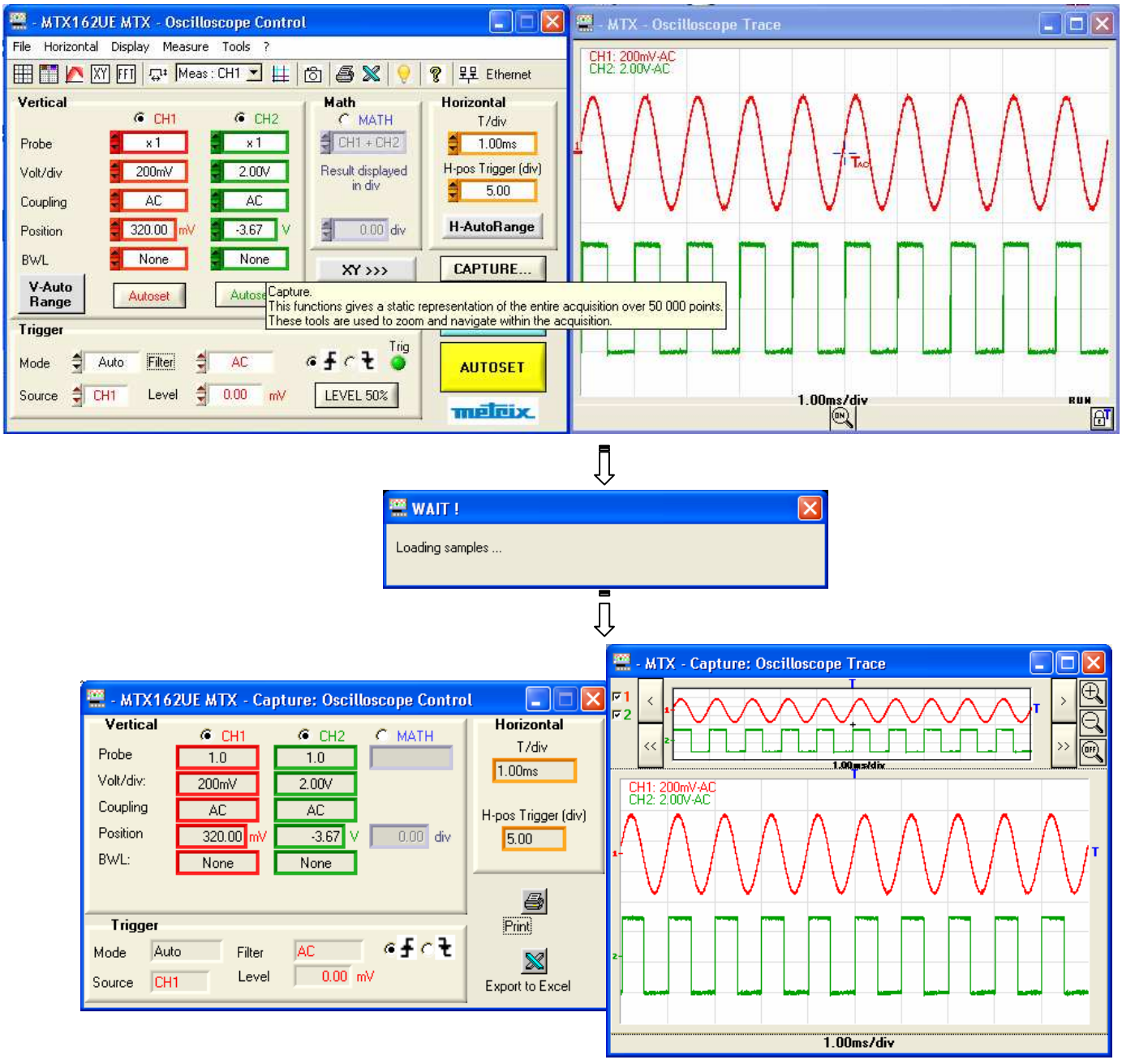
Carrying out specific processes (continued)

6. Capturing traces

Capture is used to recall complete traces (50 000 samples per channel) to the PC in order to analyse the signal at a given moment while continuing to view it in real time in the "Oscilloscope Trace" window.
During capture the acquisition is stopped while the points are transferred.

a) Starting the capture

The capture is started using the CAPTURE... key in the "Oscilloscope Control" window:



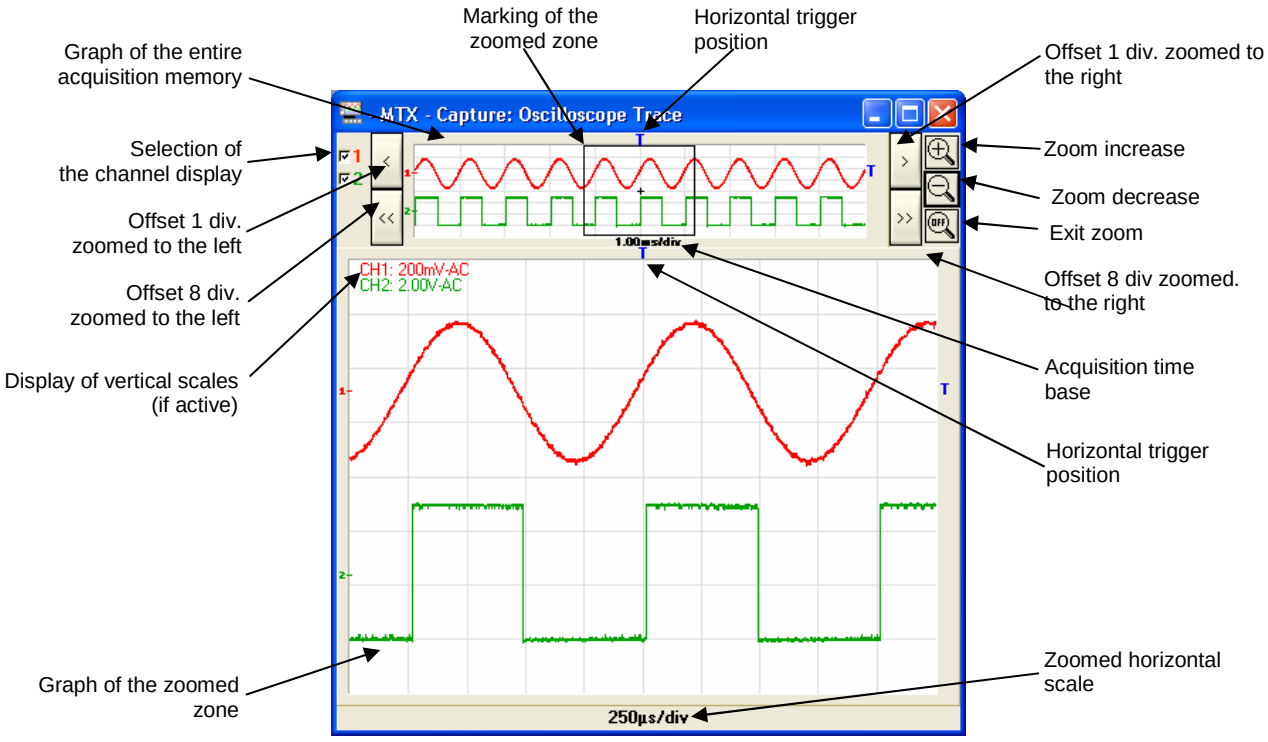
The "Capture: Oscilloscope Control" window summarises the settings used to make these acquisitions.

The "Capture: Oscilloscope Trace" window contains the representation of the acquired points.

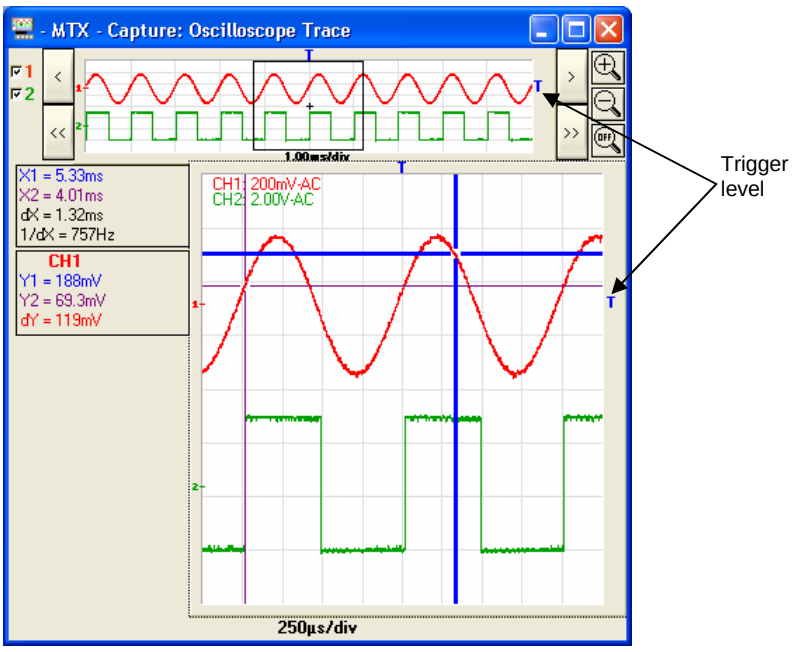
Carrying out specific processes (continued)

6. Capturing traces (cont.)

b) Using the data



The measurements using cursors are available for the Capture and are managed in the same way as in the "Oscilloscope trace" window (see Chapter IV → Cursors):



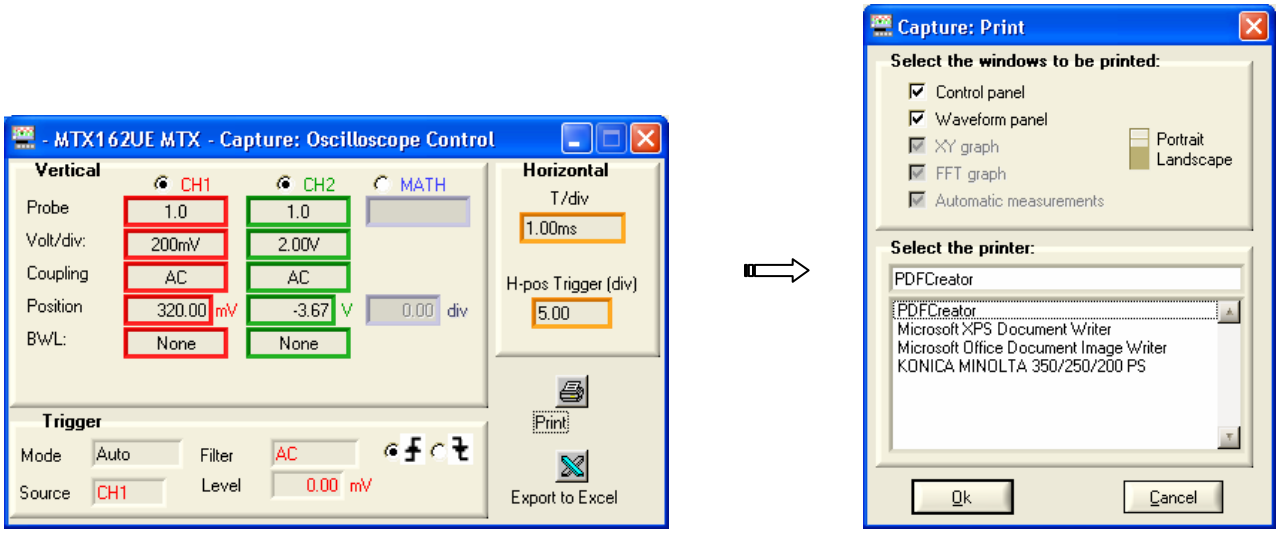
☝ ***Phase measurement is not available in capture.***

Carrying out specific processes (continued)

6. Capturing traces (continued)

c) Printing the capture

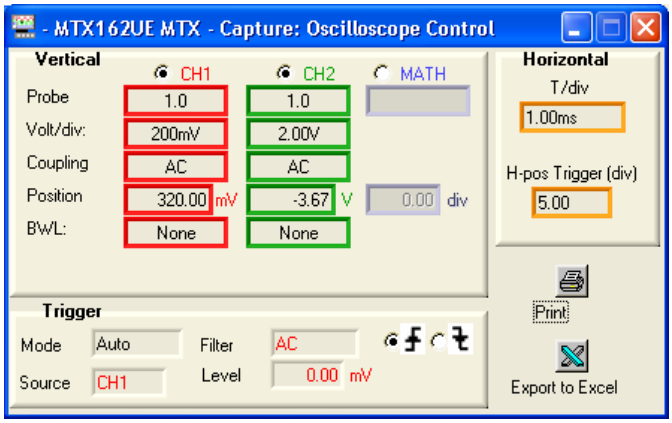
Pressing the key starts printing the "Capture" windows from the "Capture : Oscilloscope Control" panel:



The button on the tool bar of the "Oscilloscope Control window or the File → Print menu do not allow the printing of captures.

d) Exporting the capture to EXCEL

Current captures can be exported to EXCEL from the "Capture : Oscilloscope Control" panel by pressing the button:

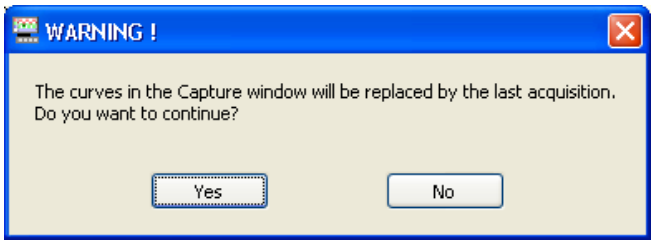


The "Export to EXCEL..." window opens (see §. Chapter X).

Carrying out specific processes (continued)

6. Capturing traces (continued)

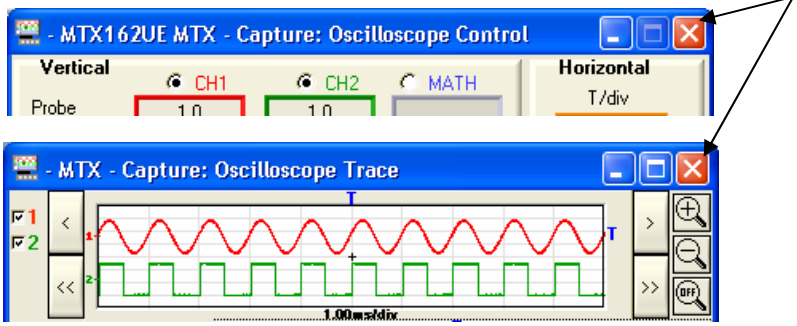
Exporting to EXCEL from the "Oscilloscope Control" panel causes a new capture and therefore the loss of the current capture. The following message appears:



If you wish to export the current captures click on 'No'.

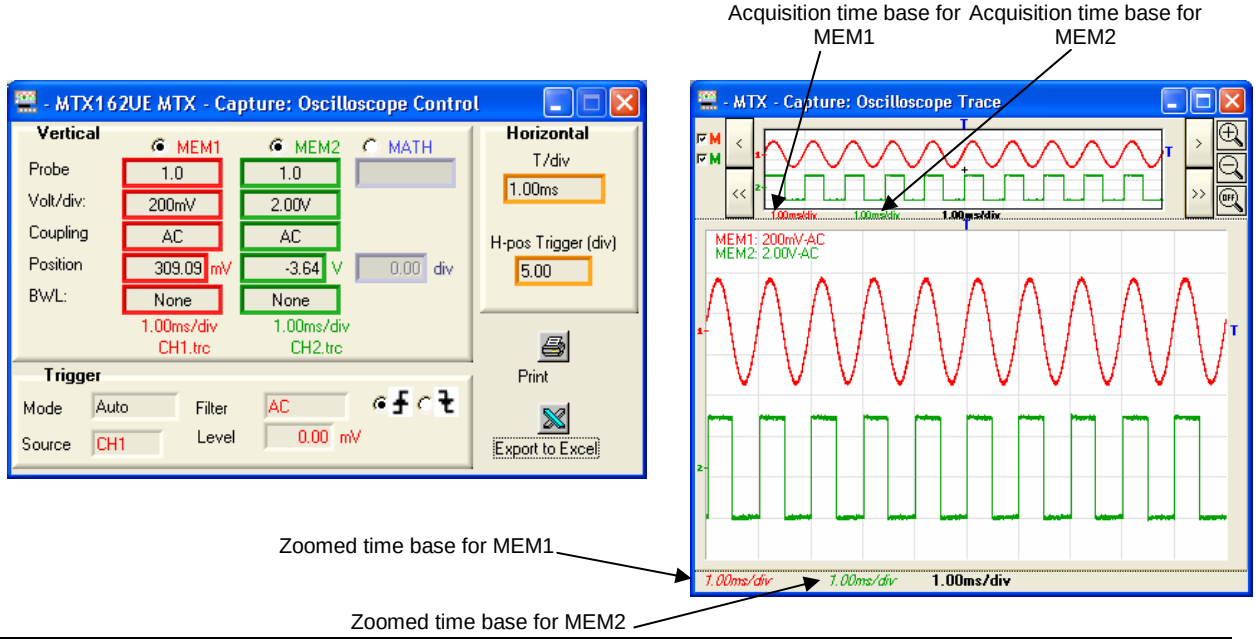
e) Cancelling trace capture

To exit close one of the "Capture" windows:



or

The closure of the 'Capture' windows leads to the permanent loss of the traces.
If you wish to keep the captured traces to work on them further stop acquisition, make a backup of the signals in question in a ".TRC" file just after having carried out the capture.
All that needs to be done then is to recall these traces and make a new capture with these MEMx traces (see §. Recalling the trace).



Freezing, Saving, Displaying the trace

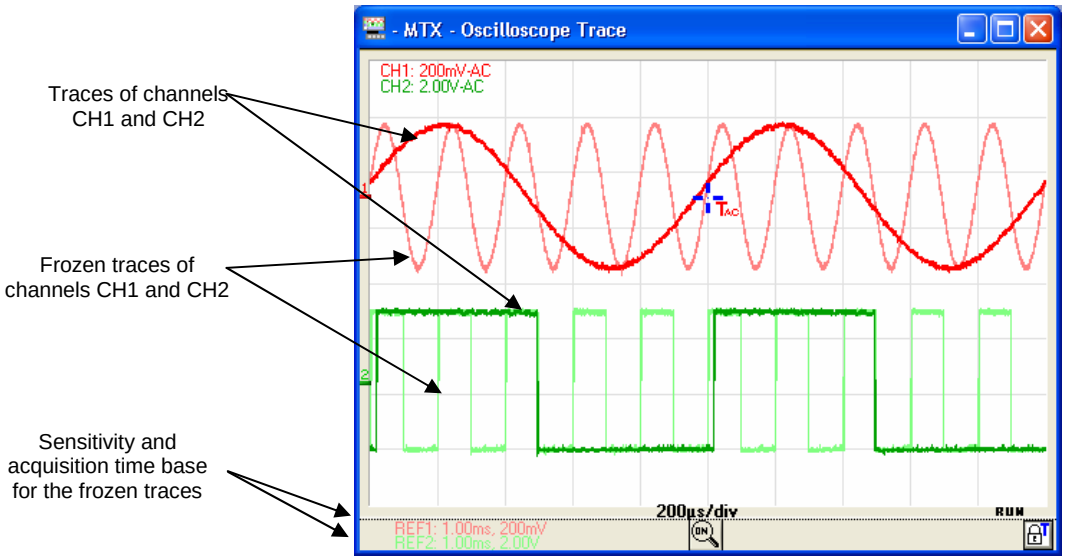
1. Freezing the trace

To highlight an eventual signal variation it is possible to freeze the traces at a point in time. These traces appear in a light colour in the 'Oscilloscope Trace' window.

A trace can only be frozen if it is on the screen.

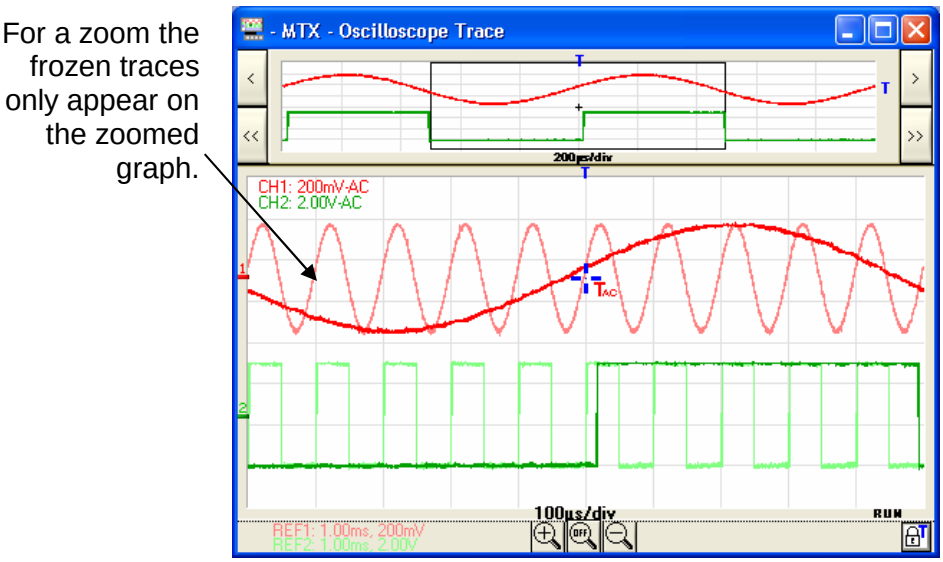
This trace "snapshot" is made using the button on the tool bar. Pressing the button again erases the current frozen traces.

The frozen trace is not lost if you exit and open new work session using the same instrument configuration file



De-selecting a channel permanently deletes its snapshot.

These frozen traces are static display data: activating the zoom therefore has no effect on them and they cannot be moved up or down.



Freezing, Memorizing, Displaying the trace (continued)

2. Saving the trace

The MTX 162 gives the possibility of saving the traces displayed on the screen.

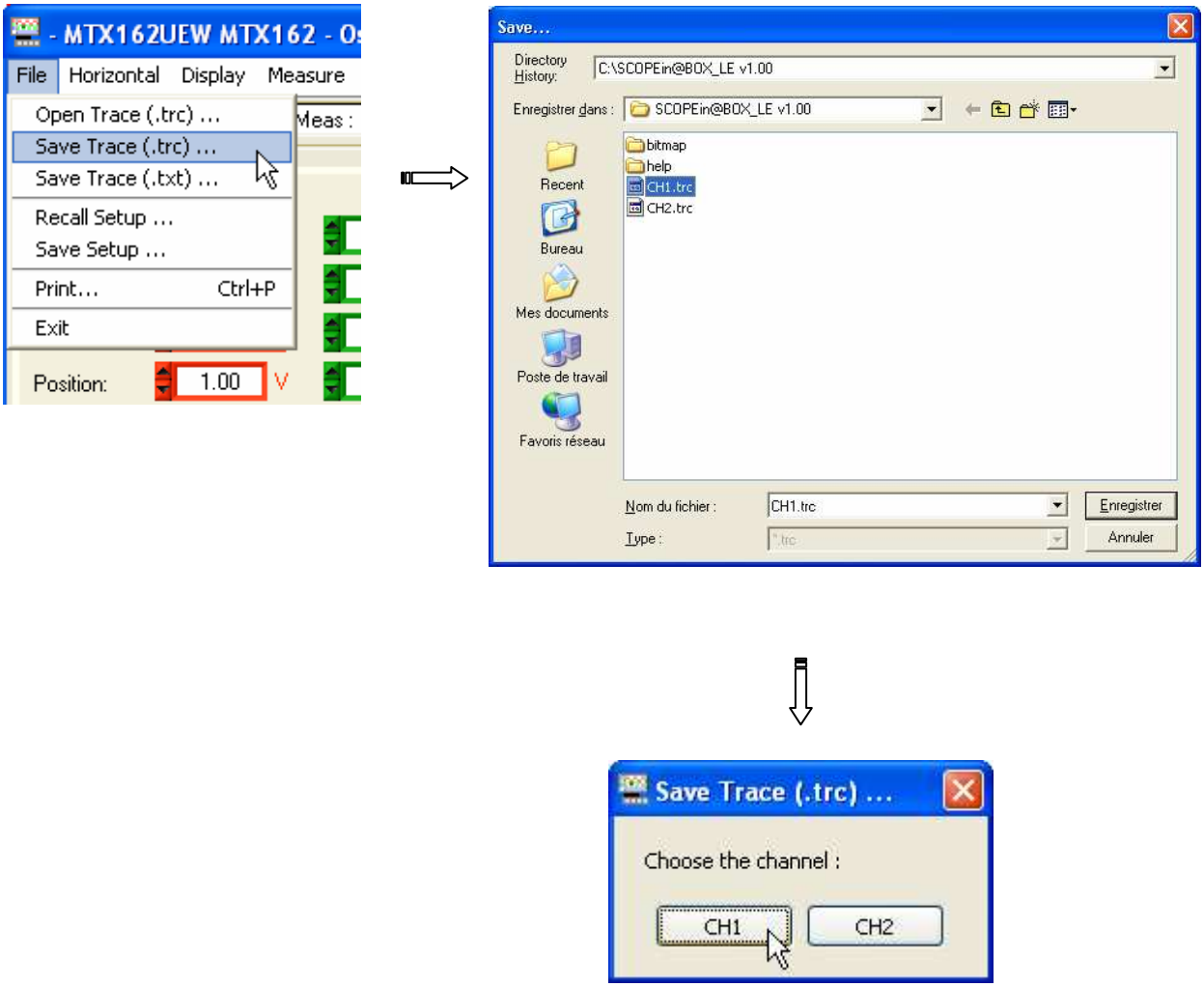
Two memorization formats are available: ".TRC" or ".TXT".

In both cases the 50 000 acquired samples that form the trace as well as the data relating to the acquisition and making it possible to interpret the data are transferred to the PC are backed up.

a) ".TRC" saving

This is the only format that can be used to reload a trace into the oscilloscope (see §. Recalling the trace). It is a binary file with a ".TRC" extension that can only be used by the SCOPEin@BOX_LE software.

Example Saving CH1 trace in the 'Trace1.trc' file



Freezing, Memorizing, Displaying the trace (continued)

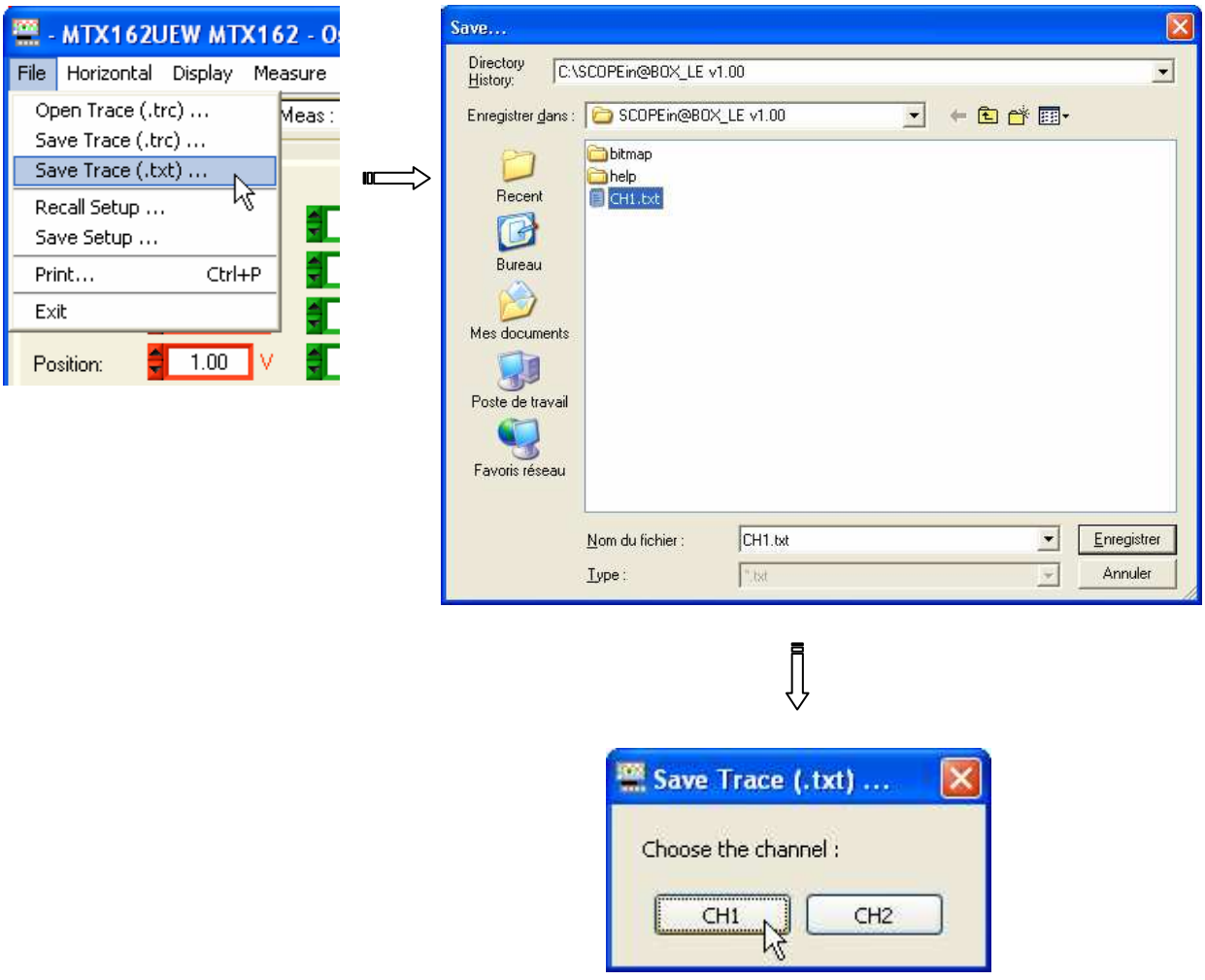
2. Saving the trace (continued)

b) ".TXT"saving This format is used to export data to another application (spreadsheet, editor…).

However the generated file cannot be used by SCOPEin@BOX_LE.

It is a test file (ASCII) with the ".TXT" extension that can be viewed using any editor programme.

Example Saving CH1 trace in the 'Trace1.txt' file



Freezing, Memorizing, Displaying the trace (continued)

3. Recalling the trace

Only the trace files backed up using SCOPEin@BOX_LE and having the ".TRC" extension can be recalled by the application.

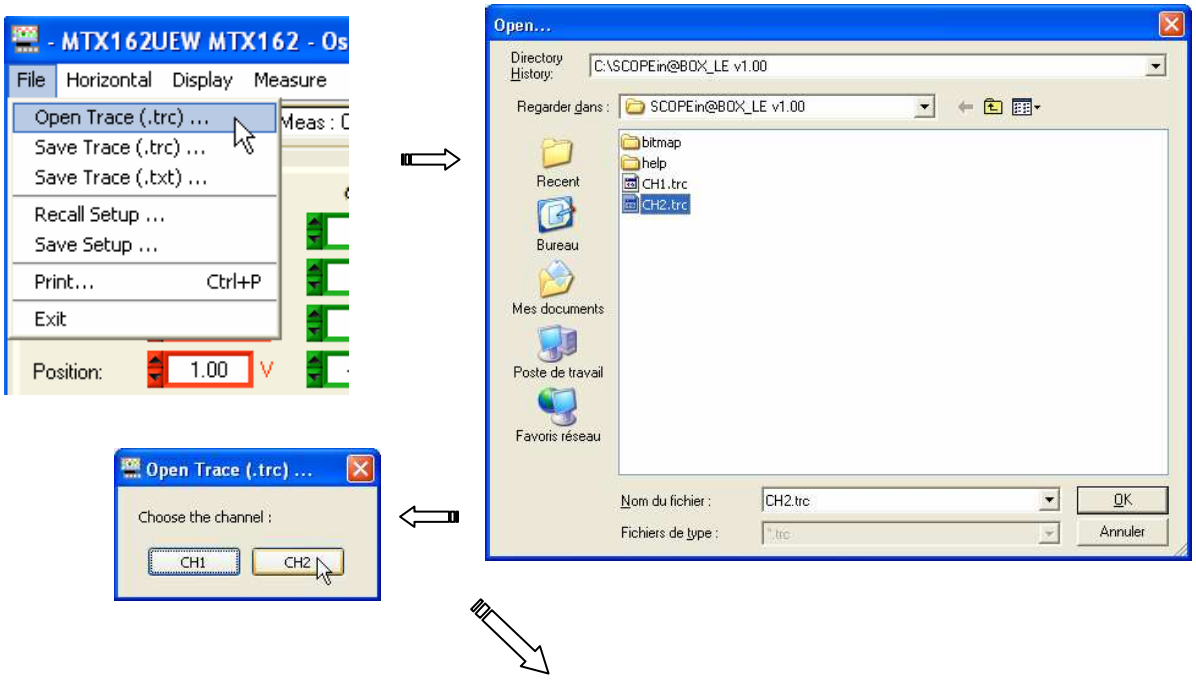
These traces can replace either the CH1 and/or the CH2 traces.

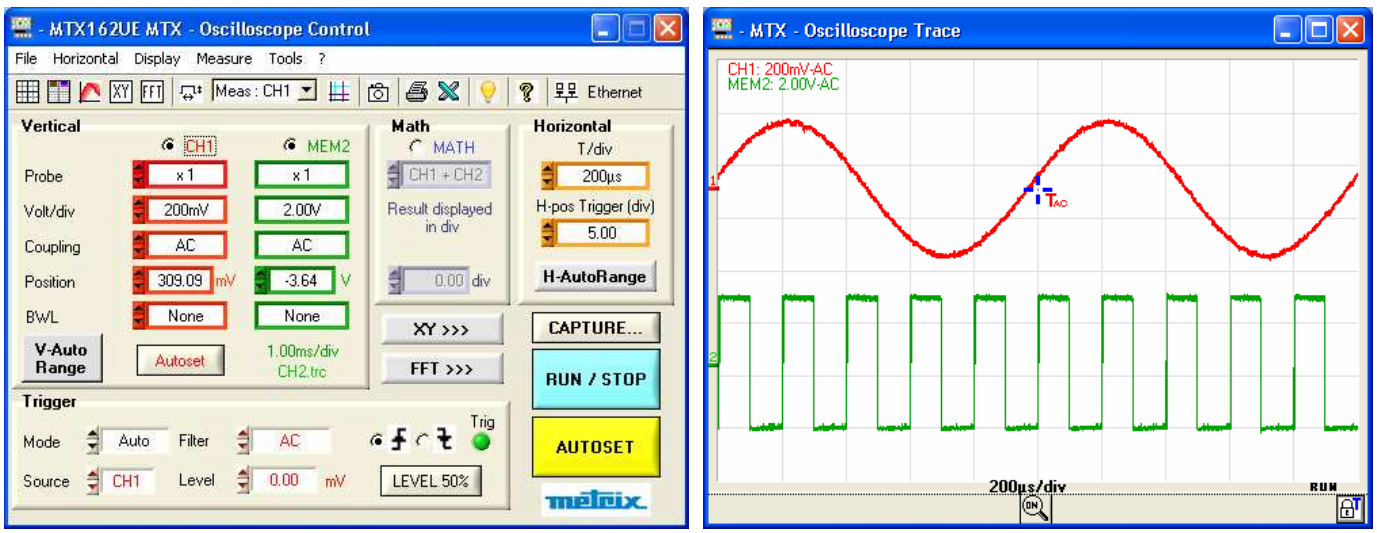
In the 'Oscilloscope Control' window the channel name is displayed as MEMx, and the settings for the vertical block for the channel in question are updated using the values contained in the file. The acquisition time base of the recalled trace and the file name are displayed instead of 

The deletion of the recall is made by de-selecting the MEMx channel which returns to CHx.

The recalled trace behaves in the same way as a normal trace: they can moved up or down and all the available automatic or manual measurements can be carried out.

Example Recall of the 'Trace1.trc' file on the CH2 channel





Memorizing, Recalling the configuration

The general instrument configuration is the set of data that makes it possible to restart the device in the same status as it was in when the last session was closed.

An automatic backup of the general configuration is made every time a session is closed.

This general configuration is stored at the same level as the "SCOPEin@BOX_LE.exe" executable on the PC's hard drive.

It has three files:

setup.7up This is the configuration file for the SCOPEin@BOX_LE software; it contains the following data:

- first install indicator
- language used
- software work directory

<nameInstrument>.INI where <nameInstrument> is the name given to the instrument when a session is created.

The "**.INI**" file is the PC configuration, it includes the following data:

- the size and location of all the open windows
- the access paths to the various directories (trace backups, configurations, software updates...)
- identification of the software and equipment versions
- information relative to the instrument being used (oscilloscope name, serial number, MAC address, IP address …)
- the previously used communication mode (Ethernet/USB)
- trace references
- etc. …

<nameInstrument>.INI.CFG The "**.CFG**" file is the oscilloscope configuration, it contains all the current instrument settings.

Memorizing, Recalling the configuration (continued)

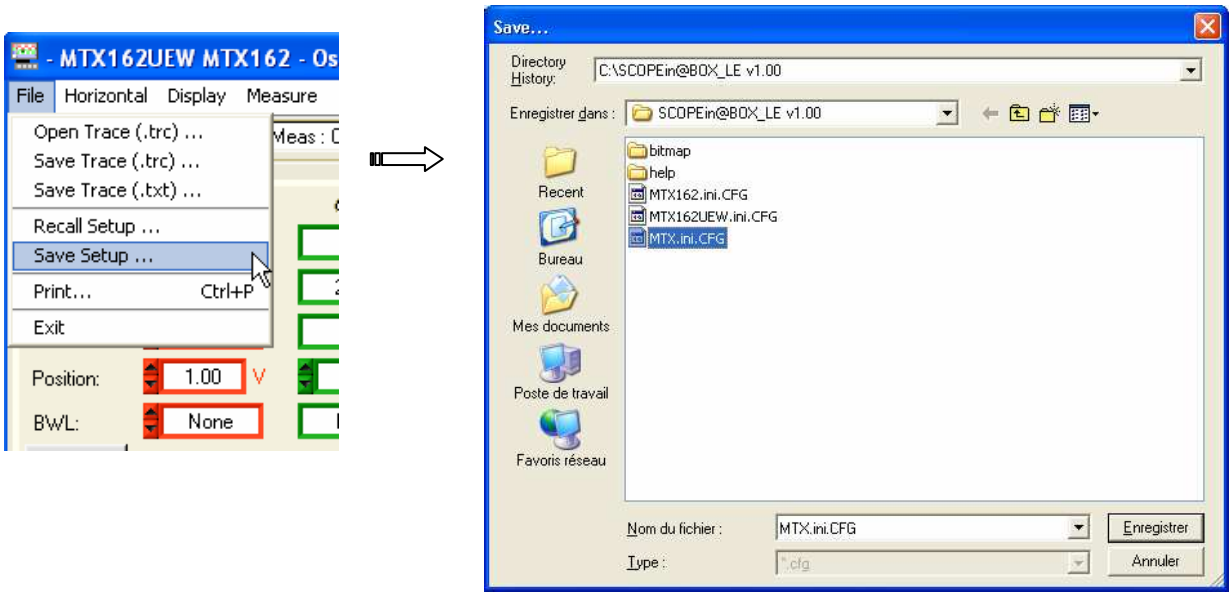
1. Memorizing the configuration

This backup only covers the oscilloscope configuration, the PC configuration is specific to the open session.

During the backup the oscilloscope configuration is stored in a file with a ".CFG" extension which it is recommended to place in a specific directory in order to differentiate it from general configurations (in the example below we have created a CFG directory).

The access path to this directory is memorized in the PC configuration so that the user will be directed to this directory by default for all operations pertaining to configuration management.

Example Backup of the oscilloscope configuration in config1.cfg.

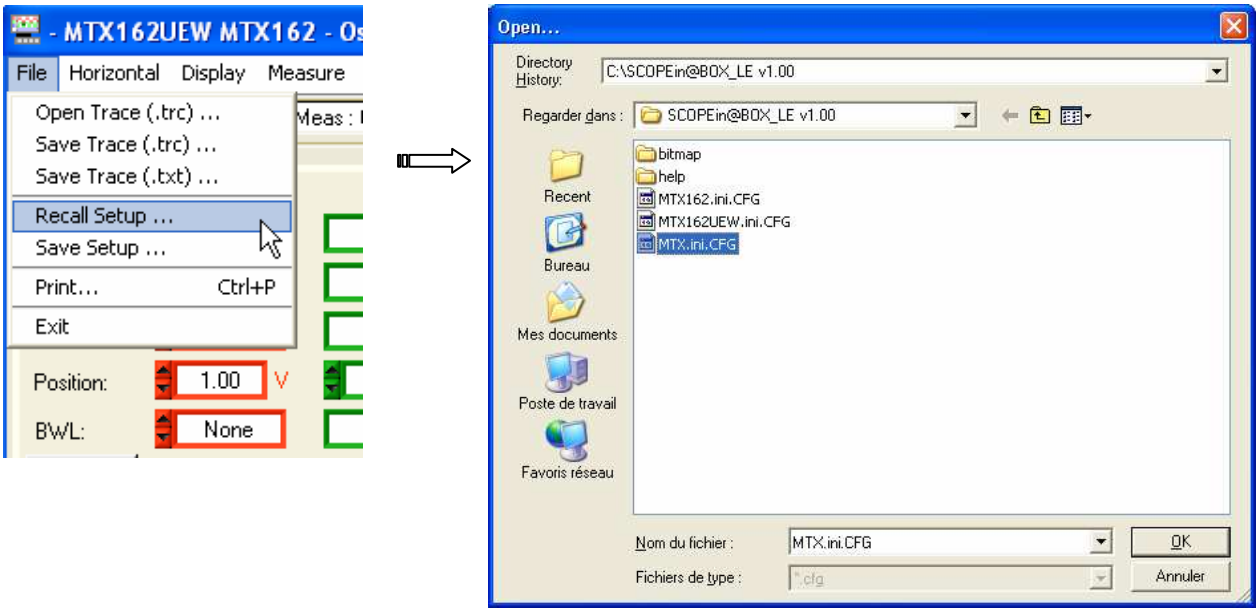


Memorizing, Recalling the configuration (continued)

2. Recalling the configuration

Only configurations made using the SCOPEin@BOX_LE application can be recalled, configurations for oscilloscopes other than MTX 162 are not compatible.

Example Recall of the "config1.cfg" configuration

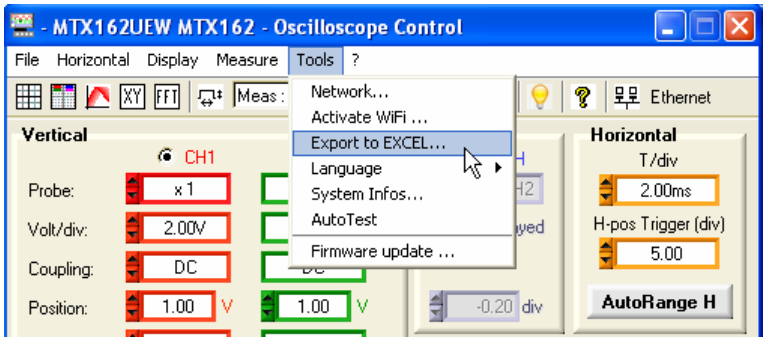


Exporting the trace to EXCEL

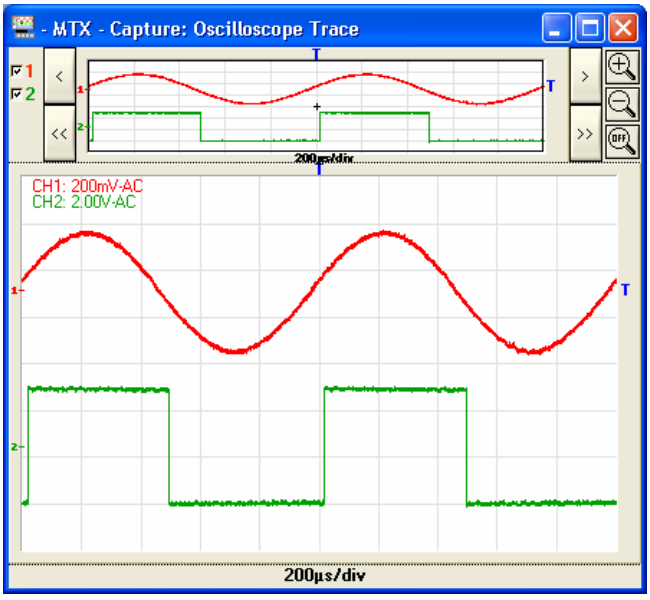
To export the trace the PC must first recall the 50 000 samples acquired from the oscilloscope; this is why the Capture windows open if they are not already open.

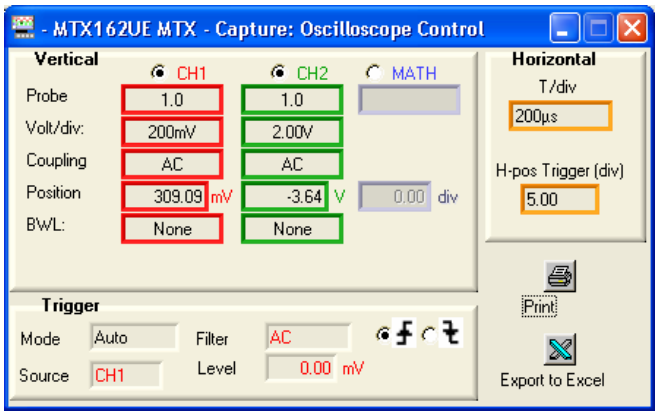
The samples can be transferred to EXCEL in three ways:

- by clicking on the  button in the tool bar,
- from the 'Tools/Export to EXCEL…' menu



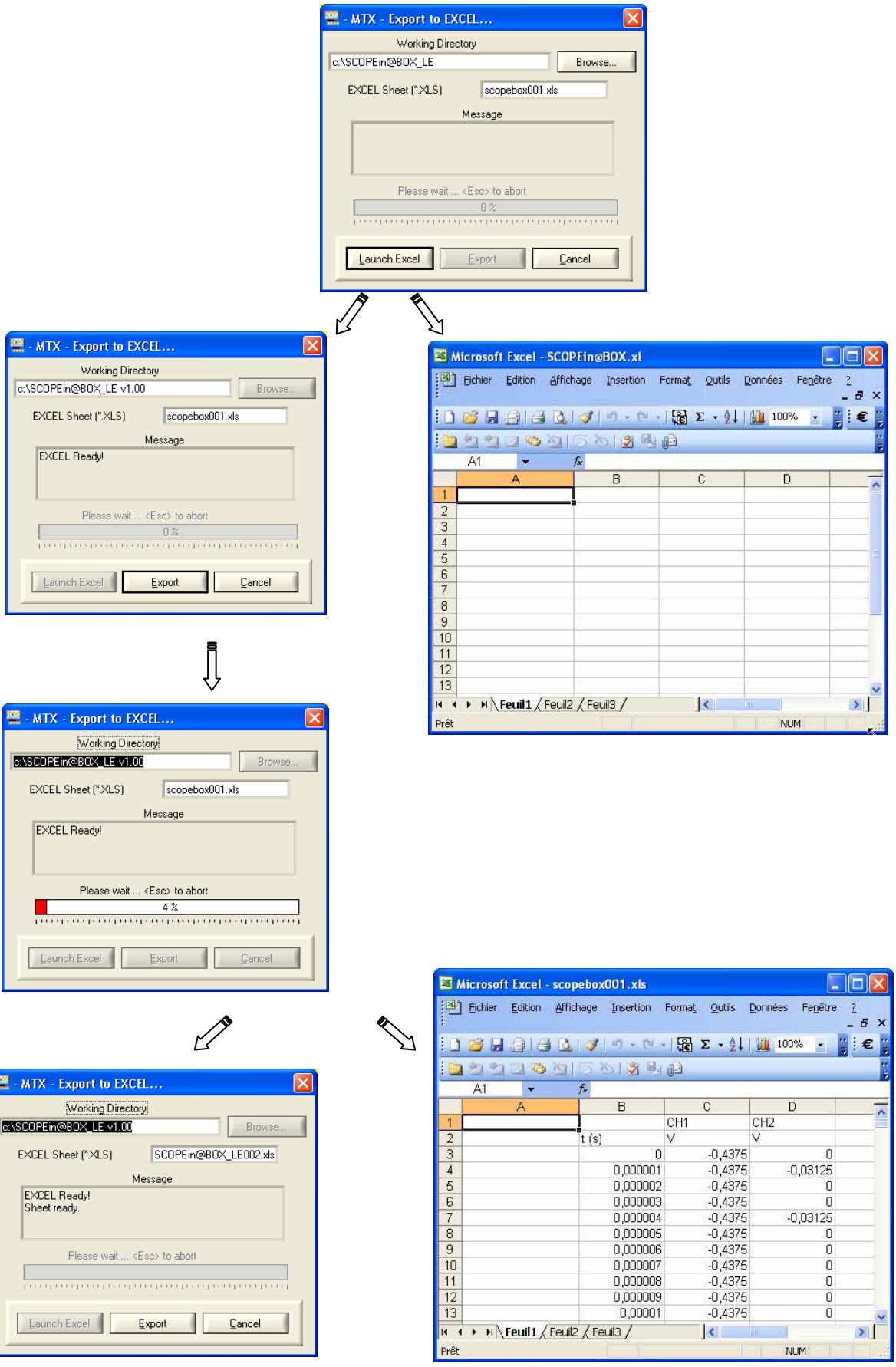
- from the "Capture: Oscilloscope Control" window by pressing the  button:





Exporting the trace to EXCEL (continued)

The following window appears:



Exporting the trace to EXCEL (continued)

The export of data to Excel can take several minutes.

This export can be done manually using the trace saving (.TXT) which is opened directly using EXCEL (see §. Using → Save.TXT).

Technical specifications

Vertical offset

Only the assigned tolerance or limit values are guaranteed (after 30 minutes to adapt to temperature).
Values without tolerances are given for information purposes only.

Characteristics	Specifications	Observations
Number of **channels**	2 channels: CH1 - CH2	BNC entries
Types of **entry**	Class 1, common masses	
Bandwidth to - 3 dB	≥ 60 MHz on all vertical calibres from 5 mV to 5 V/div. ≥ 20 MHz on calibres 10 V/div. to 100 V/div. (the bandwidth limitation for these calibres is related to the HF power limitation in the entry capacity attenuation network)	Measured on a charge of 50 Ω with a 6 div. amplitude signal
Dynamics of vertical **offset**	± 10 div. on all the calibres	
Entry **Coupling**	AC, DC, GND	
Bandwidth **Limit**	at 15 MHz, 1.5 MHz and 5 kHz	one bandwidth limit per channel
Rise time	≤ 5 ns (60 MHz) on vertical calibres from 5 mV to 5 V/div.	depending on the model
Cross-talk between channels	DC at 50 MHz ≥ 40 dB	same sensitivity on both channels
Tolerance **ESD**	± 2 kV	
Response to rectangular 1 kHz and 1 MHz signals	Overshoot < 3 % Aberrations < 3 %	Positive or negative overshoot
Accuracy of vertical **calibres**	± 2 % (on a 6 div. amplitude signal)	Sequence of vertical calibres 1 - 2 - 5
Vertical **resolution**	± 0.4 % of the full scale	Variation in bounds (no continuous variable rate)
Accuracy of vertical **measurements**	± [2 % (reading - offset) + Precision of vertical offset + (0.05 div.) x (volt/div.)]	
Accuracy of vertical **offset**	± [0.01 x (offset value) + 4 mV + (0.1 div.) x (V/div.)]	
Probes	Attenuation coefficients of the probe and its graphical representation are taken into account in the display	
Vertical **ZOOM** function on an acquire or backed up curve	no vertical Zoom	
maximum entry Voltage	400 Vpk (DC + peak AC at 1 kHz) without the sensors	
Electrical **safety**	300 V, CAT II without sensors	
Entry **Impedance**	1 Mohm ± 1 % 13 pF ± 2 pF	
Display modes	"Multi-window" with the possibility of displaying the f(t) trace, the FFT and the XY mode simultaneously	Default display: control window + trace window Double time base type display, even in real time

Technical specifications (continued)

Time base

Characteristics	Specifications	Observations
Calibres	32 calibres, from 5 ns to 100 s/div.	Sequence 1 - 2 - 5 Real time up to 2 µs/div. (if 50 Msps acquisition and 1000 pts on the screen)
Precision Sampling **frequency** **Precision** of time measurements	± 0.5 % 50 MS/s on all single acquisition channels ± [(0.04 div.) x (time/div.) + 0.005 x (reading) + 1 ns]	20 GS/s in ETS mode
Display	Display of 1000 points on the screen	
Horizontal **expansion**	Simultaneous display of the 50 kpts on 2500 points and the 2500 points for the zoomed zone Possibility of offsetting the zoomed zone within the memory	Max expansion x 20

Triggering circuit

Characteristics	Specifications	Observations
Triggering **sources**	Sources CH1, CH2, LINE	
Triggering **mode**	AUTO - NORMAL - SINGLE	
Trigger **coupling**	DC : BP 0 to 100 MHz AC : BP 10 Hz to 100 MHz	
Triggering **slope**	Descending wave or Ascending wave	
Trigger sensitivity in normal mode Source channels CHx Noise Reject	 0.5 div 1.5 div	
Triggering **level** Variation **Range**	± 8 div.	

Technical specifications (continued)

Acquisition chain

Characteristics	Specifications	Observations
Resolution of the ADC	8 bits	1 8 bit converter per channel
Max. sampling **frequency**	50 MS/s	
Sampling **modes:**		
Real **Time**	50 MS/s max	Single non repetitive signals
	Precision ± 200 ppm	
Equivalent ETS **Time**	20 GS/s max	Repetitive signals
Transitory capture		Glitch capture can be activated for all the time base calibres.
Minimum width for detectable **glitches**	> 20 ns	
Depth of acquisition **memory**	50 kpoints	
PRETRIG Function	Position of the trigger point using the mouse	
CHx channel backup **memories**	up to minimum 1500 traces depending on the available PC memory	These files can be named and have extensions.
Storage formats	"Trace	Backup of the curve and the acquisition settings
	"TXT	
	"Config	Backup of the complete configuration

Technical specifications (continued)

Display

Characteristics	Specifications	Observations
Viewing **Screen**	PC screen	
Number of displayed **points**	2500 acquired points Horizontal zoom: x 20	
Viewed in normal mode **Window** **ZoomH**	1 kpts (representing the Min/Max of the acquired 50 kpts) Horizontal expansion by: 50	 no vertical Zoom
Display modes *Average*	Interpolation Persistent display managed by the PC display for the last 8 acquired traces using 8 tints of the colour of the channel → the brightest colour represents the most recent acquisition and the dullest the oldest Envelope Mode Factors: 2, 4, 8 ,16	 Automatic measurements are available in this mode: they are made on the last acquired trace Indicate that averaging is activated on the trace window
Graticle	Complete Axes Borders	
Indications in the "**Oscilloscope Trace**" window *triggering* *Traces*	 Position of the T level (trace colour) on the left edge of the display window Horizontal position of the Trig point on the top edge of the window. "Identifier + Mass reference" of the trace colour "BWL » Band Width Limit: High and low overshoot indicators if the traces are outside the screen and right left if the T position of the trigger point is not on the screen Menu bar: Vertical, Horizontal, Display, Measurement, Memory, Utilities, Help	
Indications in the "**Oscilloscope Control**" window	Active mathematical calculations: FFT, ADD, SUBS, MULT, DIV, INVersion	
Predefined **Mathematical functions**	Synthesis of the device configuration: Vertical position and sensitivity Time base calibre Trigger mode Trigger source	

Technical specifications (continued)

Mathematical functions

	Equation editor Addition, subtraction, multiplication, division and complex functions between channels

Other

Calibration **Signal**	Form Amplitude Frequency	Rectangular 0 - 2.5 V ± 2 % 1 kHz ± 1 %

Autoset

Search time	< 5 s
Frequency range	30 Hz to 60 MHz
Amplitude range	40 mVpp to 400 Vpp
Duty cycle	from 20 to 80 %

Communication interfaces

USB type B connector — used to connect the scope to the PC using a USB cable.

Location on the back face of the oscilloscope

Interface "USB", the serial connection configuration is automatic at 921 600 bauds, HARD protocol, 8 bits, 1 stop bit, no parity.

Driver The "USB" interface driver loads automatically when the SCOPEin@BOX_LE software is installed

ETHERNET Interface

Location on the back face of the device

Type 10BASE-T (Twisted Pair)

Connector RJ 45 8 points

Standard IEEE 802.3

Ethernet **WiFi**

Category	**IEEE 802.11b/g**
Frequency range	2,400 - 2,484 GHz
Output power	14 + 2 / -1.5 dBm
Data speed	11 Mbps
Modulation	DSSS, DBPSK, DQPSK, CCK, OFDM, 16QAM, 64QAM
Security	WEP 64/128, WPA, WPA2/802.11i
Max. reception level	-10 dBm (with PER < 8 %)
Receiver sensitivity	- 88 dBm

Technical specifications (continued)

Programming the oscilloscope remotely from a PC

The oscilloscope can be programmed remotely using a PC using simple standardised commands by using:

- the "USB to RS232" interface **MTX 162UE**
- ETHERNET interface (port 23) **MTX 162UEW**

The programming instructions comply with the IEEE 488.2 SCPI protocol standard.

☞ *Refer to the remote programming instructions for the complete list of commands and syntax rules.*

Warning !

Error messages

Autotest : Error n°0001: Microprocessor or FLASH pr oblem
Autotest : Error n°0002: RAM problem
Autotest : Error n°0004: FPGA problem
Autotest : Error n°0008: SSRAM problem
Autotest : Error n°0010: SCALING 1 problem
Autotest : Error n°0020: SCALING 2 problem
Autotest : Error n°0040:
Autotest : Error n°0080:
Autotest : Error n°0100: channel 1 acquisition prob lem
Autotest : Error n°0200: channel 2 acquisition prob lem
Autotest : Error n°0400:
Autotest : Error n°0800:
Autotest : Error n°1000: Ethernet problem
Autotest : Error n°2000: Vernier problem

If one of these codes (or the sum of several codes) are shown when the device is started up → a fault has been detected.

General specifications

Environment

- Reference temperature 18℃ to 28℃
- Operating temperature 0℃ to 40℃
- Storage temperature - 20℃ to + 60℃
- Indoor use
- Altitude < 2000 m
- Relative humidity < 80 % up to 31℃

Power supply

- Network voltage nominal usage range 100 to 240 VAC
- Frequency from 47 to 63 Hz
- Consumption < 14 W at 230 VAC - 50 Hz
- Fuse 2.5 A / 230 V / timed
- Power supply cable removable

Safety

Compliance IEC 61010-1 (2001):

- Insulation class 1
- Pollution degree 2
- Power supply surge category: CAT II 240 V
- "Measurement" entry power supply surge category: CAT II 300 V

CEM

This appliance was designed in compliance with the current CEM standards and was tested in compliance with the NF EN 61326-1, 2006 standard: Immunity Influence: 5 mV in the presence of an electromagnetic field of 10 V/m

European directives

CE

This product is compliant with the European low voltage directives 2006/95/EC and the CEM 2004/08/EC European directive.

Mechanical specifications

Box

- Size 270 x 213 x 63 (in mm)
- Weight 1.8 kg
- Materials ABS VO (auto extinguishing)
- Water tightness IP 30

Packaging

- Size 300 (l) x 330 (L) x 230 () in mm

Supply

Accessories

delivered

- Operating instructions on CD ROM
- Programming instructions on CD ROM
- "SCOPEin@BOX_LE" software on CD ROM
- Getting started guide for the software on CD ROM
- Safety instructions
- Power supply cable
- Voltage sensors 1/1, 1/10, 100 MHz, 300 V (x 2)
- A/B USB cable

as options

• T junction 1 x BNC male - 2 x BNC female (pack of 3 parts)	HA2004-Z
• Female BNC - BNC female extension (pack of 3)	HA2005
• Safety adapter BNC male / 4 mm cartridge, CAT III, 500 V (pack of 3)	HA2002
• Safety adapter BNC male / 4 mm plug, CAT III, 500 V (pack of 3)	HA2002
• Safety adapter BNC male / 4 mm cartridge, CAT III, 500 V (pack of 2)	HA2053
• Voltage sensors 1/1, 1/10, 200 MHz, 300 V	HX0220
• Voltage sensor 1/10 fixed, 150 MHz, CAT II / 400 V	HX0003
• Voltage sensor 1/10 fixed, 450 MHz, CAT II / 1,000 V	HX0005
• Voltage sensor 1/100 fixed, 300 MHz, 5 kV Peak	HX0006
• Differential sensor 1 channel 30 MHz	MX9030-Z
• Differential sensor 2 channels 50 MHz BNC entries	MTX1032-C
• Differential sensor 2 channels 30 MHz banana entries	MTX1032-B
• BNC male / BNC male cable CAT III, 500 V, length 1 m	AG1044
• BNC male / BNC male cable CAT III, 500 V, length 2 m	AG1045
• Fuse 2.5 A, 230 V, timed, 5 x 20 mm	AT0090