

UltraView

User's Manual



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1 Version Control

Software Version	Document Review	Update
2.3 12/08/2009	1 12/08/2009	<ul style="list-style-type: none"> - Solves the maximum pulses number (16) problem. - In the low frequency version (AIR), the sampling frequency is not calculated automatically when <ul style="list-style-type: none"> - the trigger mode or - the acquisition time or - the EMI filter or - the transducer frequency changes. - Solves the sampling frequency inicial value (null) - The RF filter frequency ranges depend on the sampling frequency.
2.2 18/12/2008	3 18/12/2008	<ul style="list-style-type: none"> - Se incluye en los archivos binarios la versión y la fecha de la versión. Se elimina la compatibilidad de archivos con versiones anteriores. - Corrige el problema del rango máximo del retardo inicial con alta o baja resolución
2.1.1 03/12/2008	3 03/12/2008	Encoder connector diagram.
2.1.1 28/06/2008	2 28/06/2008	Documentation initial version.

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This manual expects to guide the user in the use of UltraView software, which is compatible with ULTRASCOPE USB series. Some software functions and ranges will be limited depending on the version and the system options.

The manual tries to describe simply and clearly all the menus and buttons so that the user is able to familiarize with the UltraScope system functionality in a fast and easy way.

It is recommended to registry the software and the equipment in order to obtain a suitable technical support and the software updates.

For that, fill in the form available in the website

www.ultrascope.info/registro

EU Declaration of Conformity



Supplementary information: The product complies with the requirements Of the EMC Directive EN 61326-1:2006.

This product is carrying the CE-Mark in accordance with the related European Directives. Responsible for CE-Marking is DASEL, Av. Madrid 84, 28500 Arganda del Rey, Madrid, Spain.

2 Main screen description

Application main screen is divided in different areas, according to the information represented on each of them:

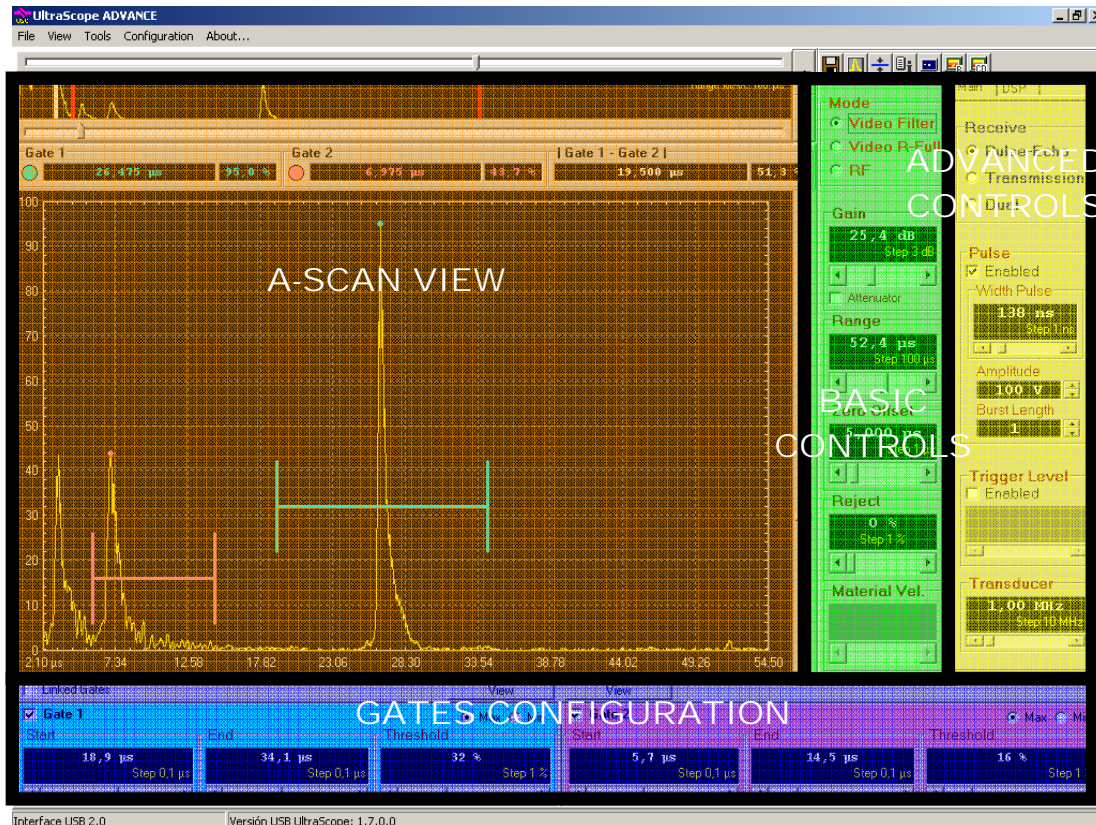


Figure 1.- UltraView main screen

3 A-scan view

This area allows visualizing the received signal in A-scan mode.

The signal view is divided in two parts:

- I. **Shot signal**, is the first of them and is viewed on the upper window. It is used as reference signal and corresponds with the full ultrasonic signal from de shot pulse. In other words, this signal always starts with the shot pulse.

This signal may be displayed or not through the main menu option "Pulse Signal".

- II. **Main signal**, is the one corresponding to the lower window, where a part of the signal showed on the upper window (shot signal) is displayed. This view is considered a "zoom" of the previous one, and is the main signal of the application, in other words, the signal used to make B-scan and C-scan views, digital filters, average, peaks search, etc.

The following values related to the shot signal may be visualized:

- "Zero Offset" value, is the delay time (μs) programmed during the calibration with de pattern piece. It is displayed over the shot signal through a vertical white line.
- The value corresponding to the main signal acquisition initial instant (μs or mm). It is displayed over the shot signal through the first vertical red line.
- The value corresponding to the main signal acquisition final instant (μs or mm). It is displayed over the shot signal through the second vertical red line. The range of the main signal is the difference between these two last values, and matches the "Range" control value. This value can also be modified by the slider controls contained on the reference image at the upper window (shot signal).

The shot signal range is established with the controls (up / down) located at the right of the signal, and is called "Range MAX", because establishes the main signal maximum range when the shot signal is visualized.

The main signal is displayed over two axes; the signal amplitude is displayed over the Y axis on screen percentage and the signal range over the X axis on a time scale (μs), which represents the time of flight of the ultrasonic signal, or with a metric scale (mm), which represents distance covered by the ultrasonic signal.

The scale to visualize, μs or mm, is chosen on the "Configuration ► Unit" menu.

The maximum system range is given by the maximum acquisition time, specified by the equipment datasheet, on the time scale (μs), and it also depends on material velocity, ("Material Vel.") configured by the user, on the metric scale (mm).

INSTANT	DESCRIPTION
t0	Instant when the Shot is generated.
t1	Instant when the signal acquisition starts.
t2	Initial instant of the Main signal.
t3	Final instant of the Main signal. (t3 – t2) matches the Main signal range.
t4	Acquisition time or Shot signal range, it is the maximum acquisition time or the maximum Main signal possible range.

Table 1. Instants determined by Main and Shot signals

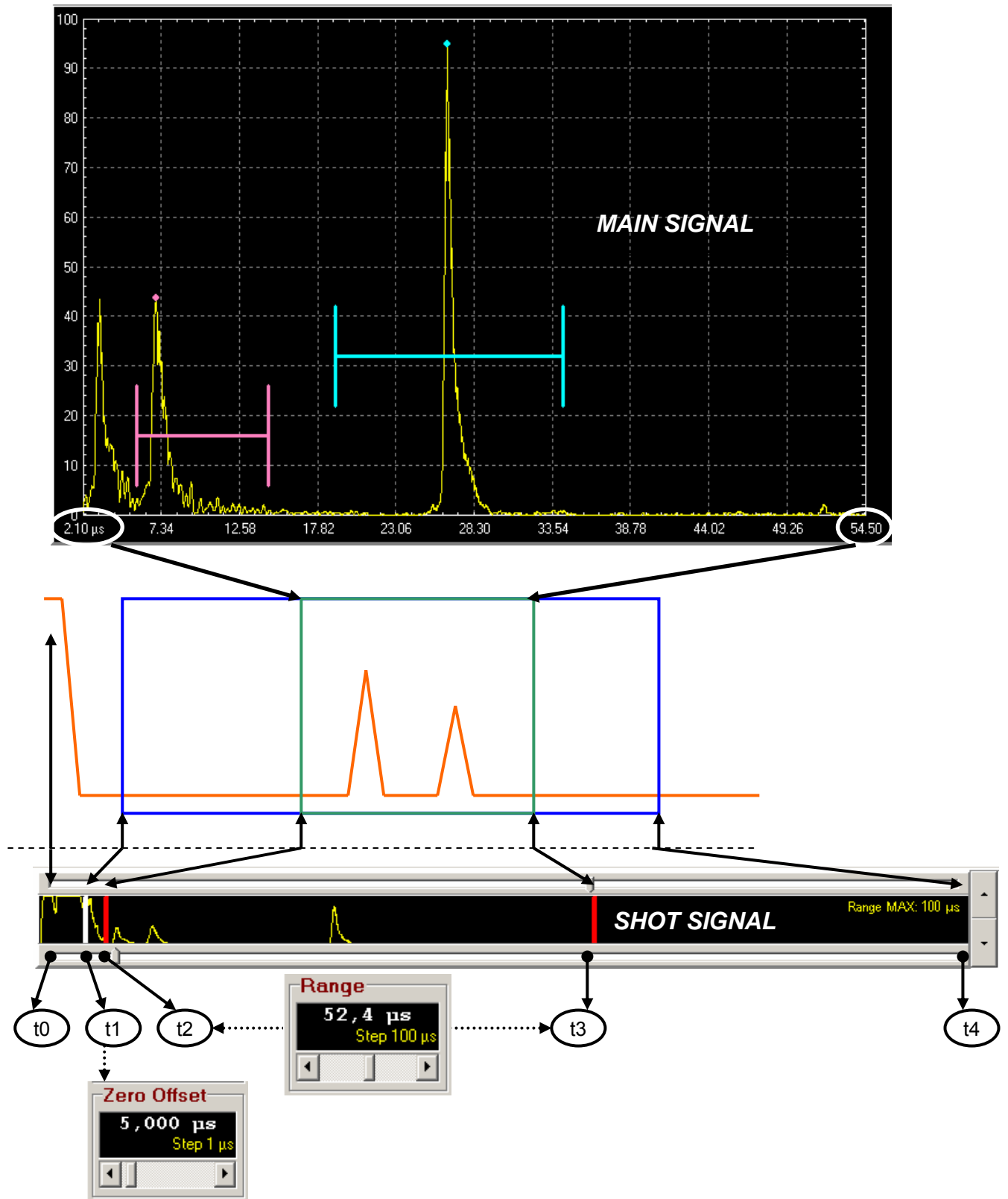


Figure 2.- Shot and Main signals visualization schema

4 Gates configuration

We can get information about ultrasonic signal echoes in numeric format with a suitable gates configuration, as detailed below.

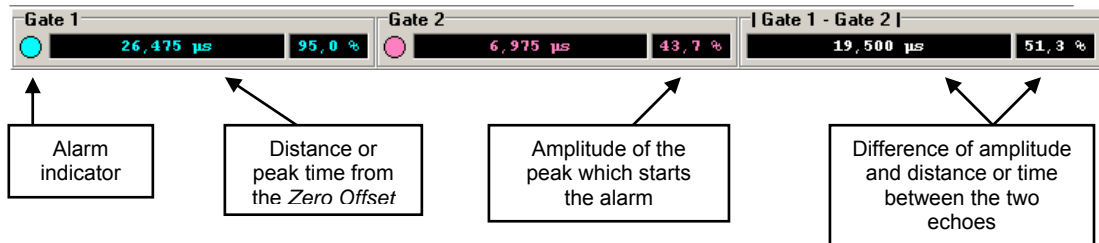


Figure 3.- Gates values visualization

Application controls, based on a slider bar, have several operating modes, in order to make possible a thin as well as a thick adjustment of the referenced variable.

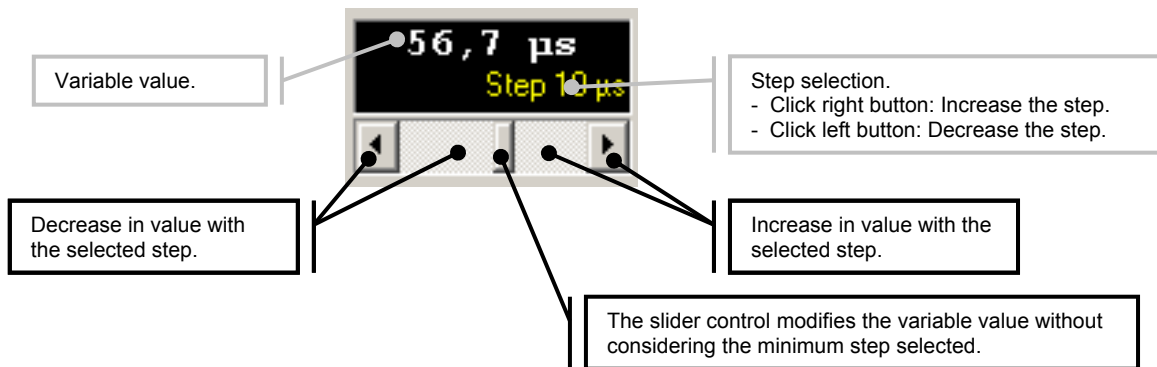


Figure 4.- Controls functionality.

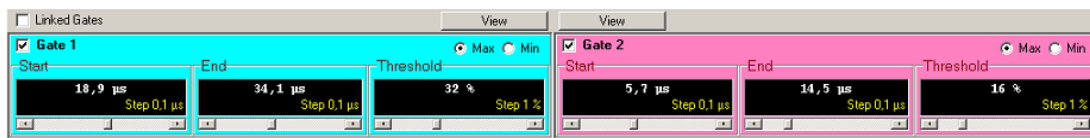



Figure 5.- Gates controls.

The controls which allow configuring the gates are:

- **“Gate 1/2”**, Activates or deactivates each one of the equipment gates.
- **“Start”**, Start of the gate, measured in the selected unit (mm or µs).
- **“End”**, End of the gate, measured in the selected unit (mm or µs).

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Another way to change the start and the end of the gates is clicking on their ends with the left mouse button.

To scroll the gates along de main signal, click between the gates ends and under the signal threshold with the mouse right button.

- **“Threshold”**, Alarm level, below which alarm is not activated.
- **“Max / Min”**, Alarm type, allows selecting whether peak detection is executed when the signal exceeds the threshold (Max), or when the signal is below it (Min).
- **“View”**, gate is centred inside the main signal range with this control. Main signal acts as a zoom of the shot signal, therefore gates might frequently be out of the main signal range due to gates initial al final instants configuration, thus this range should be increased to find them. To avoid this situation, this control is available to modify the start and the end values automatically in order to visualize them inside the range of the main signal.
- **“Linked Gates”**, allows linking the gates, so that the gate 2 start is taken from the peak position detected in gate 1. This is very useful when an important variation of the water way exists, the inspected piece has thickness variations, for the evaluation of laminates and thickness measures, etc.

5 Basic Controls

- **“Mode”**, selects the ultrasonic signal visualization mode:
 - **“Video”**, full-wave rectified signal envelope is visualized in this mode.
 - **“Video R-Full”**, full-wave rectified signal is visualized in this mode.
 - **“RF”**, the signal in radio frequency is visualized in this mode.
- **“Gain”**, is the signal gain or attenuation and allows adjusting the echoes amplitude in a variable range between 0 and 80 dB. In addition, signal may be 20 dB attenuated, permitting the obtaining of a 100 dB total dynamic range.
- **“Range”**, also called field control, allows establishing the maximum exploration depth.

If working with temporal units (μs), it matches the main signal acquisition time.

If working with metric units (mm) it matches the main signal inspection distance, and it will depend on the configured material velocity.

The range is limited by the system maximum acquisition time.

- **“Zero Offset”**, determines the elapsed time (μs) from the transducer shot until the A-scan signal acquisition beginning.

This value may be visualized through a vertical white line on the shot signal graphic, and shows the zero of the scale on the main signal graphic X axis, since it corresponds with the acquisition init.

- **“Reject”**, used only in video mode, suppresses signals which appear under a programmed threshold. This threshold is programmed on screen percentage.

Although it allows visualizing echoes in a cleaner way, a careful use is recommended since certain reflectors might not to be viewed. This control range must not exceed 20%, and 5% with more generality, given the UltraScope low noise level.

- **“Material Vel.”**, corresponds with the sound propagation velocity inside the material to inspect.

Material velocity may be adjusted taking the reference values showed in the table below.



Figure 6.- Basic Controls.

Material	Mass density (δ) 10^3 Kg/m^3	Sound velocity		Acoustic impedance $Z = \delta c_l$ $10^6 \text{ Kg/m}^2\text{s}$
		long. c_l 10^3 m/s	transv. c_t 10^3 m/s	
Metals				
Aluminium	2.7	6.32	3.13	17
Bismuth	9.8	2.18	1.10	21
Brass (58)	8.4	4.40	2.20	37
Cadmium	8.6	2.78	1.50	24
Cast iron	6.9 a 7.3	3.5 a 5.8	2.2 a 3.2	25 a 42
Constantan	8.8	5.24	2.64	46
Copper	8.9	4.70	2.26	42
German silver	8.4	4.76	2.16	40
Gold	19.3	3.24	1.20	63
Stellite	11 a 15	6.8 a 7.3	4.0 a 4.7	77 a 102
Iron (steel)	7.7	5.90	3.23	45
Lead	11.4	2.16	0.70	25
Magnesium	1.7	5.77	3.05	10
Manganin	8.4	4.66	2.35	39
Mercury	13.6	1.45	-	20
Nickel	8.8	5.63	2.96	50
Platinum	21.4	3.96	1.67	85
Silver	10.5	3.60	1.59	38
Tin	7.3	3.32	1.67	24
Tungsten	19.1	5.46	2.62	104
Zinc	7.1	4.17	2.41	30
Not metals				
Aluminium oxide	3.6 a 3.95	9 a 11	5.5 a 6.5	32 a 43
Epoxy resin	1.1 a 1.25	2.4 a 2.9	1.1	2.7 a 3.6
Glass, flint	3.6	4.26	2.56	15
Glass, crown	2.5	5.66	3.42	14
Ice	0.9	3.98	1.99	3.6
Paraffin wax	0.83	2.2	-	1.8
Acrylic resin (Perspex)	1.18	2.73	1.43	3.2
Polyamide (nylon, perlon)	1.1 a 1.2	2.2 a 2.6	1.1 a 1.2	2.4 a 3.1
Polystyrene	1.06	2.35	1.15	2.5
Porcelain	2.4	5.6 a 6.2	3.5 a 3.7	13
Quartz glass (silica)	2.6	5.57	3.52	14.5
Rubber, soft	0.9	1.48	-	1.4
Rubber, vulcanized	1.2	2.3	-	2.8
Polytetrafluoroethylene (Teflon)	2.2	1.35	0.55	3.0
Liquids				
Glycerine	1.26	1.92	-	2.5
Methylene iodide	3.23	0.98	-	3.2
Diesel oil	0.80	1.25	-	1.0
Motor car oil (SAE 20 a. 30)	0.87	1.74	-	1.5
Water (20° C)	1.0	1.483	-	1.5

Table 2.- Density, sound velocity and acoustic impedance of some materials. From J. Krautkrämer, *Ultrasonic Testing of Materials*, Springer-Verlag, Berlin, 1990.

Another method to adjust the velocity consists on using a reference test specimen and adjusting the velocity with two echoes which geometric distance is known.

6 Advanced controls

6.1 "Main"

The controls which allow configuring the parameters related to the signal reception mode, the transducer excitation pulse features, the transducer frequency and the shot level are located in this area.

- **"Receive"**, selects the ultrasonic signal reception mode, which may be:
 - **"Pulse-Echo"**, is the pulse-echo mode, in which the same transducer that emits the ultrasonic signal, receives the signal with the echoes produced in the material.
 - **"Transmission"**, in this mode the ultrasonic signal is emitted by a transducer (connected to the E/R output of Ultrascop), and another transducer (connected to the R input of Ultrascop) receives the echoes produced in the material.
 - **"Dual"**, this reception mode is the one used with bi-crystal transducers, in which a transducer connector is connected to the E/R output and the other connector to the R input.
- **"Pulse"**, allows configuring the excitation pulse of the transducer which emits the ultrasonic signal.
 - **"Enabled"**, enables or disables the high voltage pulse.
 - **"Width Pulse"**, configures the pulse width.
 - **"Amplitude"**, configures the pulse amplitude.
 - **"Burst Length"**, configures the excitation pulses number.
- **"Trigger Level"**, enables the shot level and configures the threshold, on screen percentage, that the signal must reach to its acquisition beginning.
- **"Transducer"**, configures the transducer nominal frequency. This value is used for the signal envelope calculation; therefore, it is only effective when the signal is being visualized on "Video" mode.

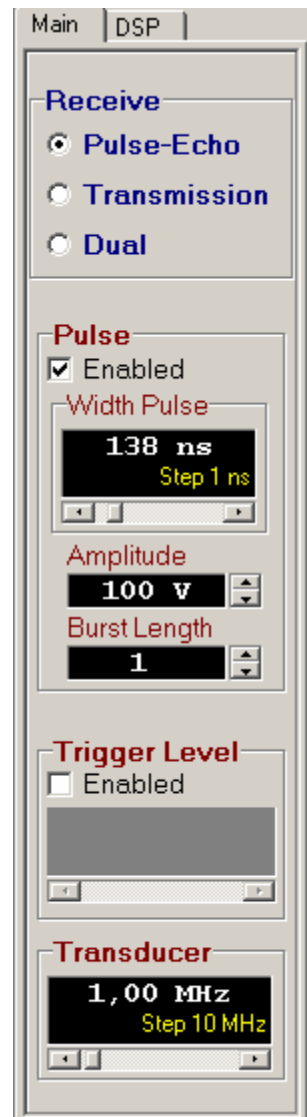


Figure 7.- Advanced Controls Main

6.2 “DSP”

The controls which allow configuring the parameters related to the signal digital processing are located in this screen area.

- **“Trigger Source”**, selects the shot source which is used to acquire the signal.
 - **“Internal”**, the shot source is internal, so that the software executes the excitation pulse shot; therefore the repetition frequency (PRF) depends on the PC where the application is being executed.
 - **“External”**, the shot source is external through a digital pulse which must be inserted into the shot input (TR) of Ultrascop. The repetition frequency (PRF) depends on the external device which generates the shot signal.
 - **“PRF”**, the shot source is internal hardware and the shot frequency is the one established with the control **“Max. PRF”**.
- **“RF Filter”**
 - **“Enabled”**, enables or disables the band-pass digital filter.
 - **“RF Gain”**, enables the additional gain provided by the filter. This gain depends on the filter bandwidth and increases when the filter bandwidth gets narrower.
 - **“Low Freq.”**, filter lower cut-off frequency.
 - **“High Freq.”**, filter upper cut-off frequency.

The filter frequency depend on the sampling frequency:

$$RFFreq_{MIN} = \text{Sampling frequency} / 62$$

$$RFFreq_{MAX} = \text{Sampling frequency} / 2$$

- **“EMI Filter”**, enables or disables the EMI filter for the impulsive noise suppression. The number of signals in relation to which the filter is applied is fixed (3) when the filter is hardware made; from a certain range, when the number of acquired samples is so high, the filter is made with software, then the number of signals used for the processing can be selected. In this case, the signal filtering has only effect when the shot source is software internal.

In order to be able to filter the signal with hardware, and therefore, with any shot source, Ultrascop modifies automatically the sampling frequency, with the aim of reducing the acquired samples number. For a right use of this filter, verifying that

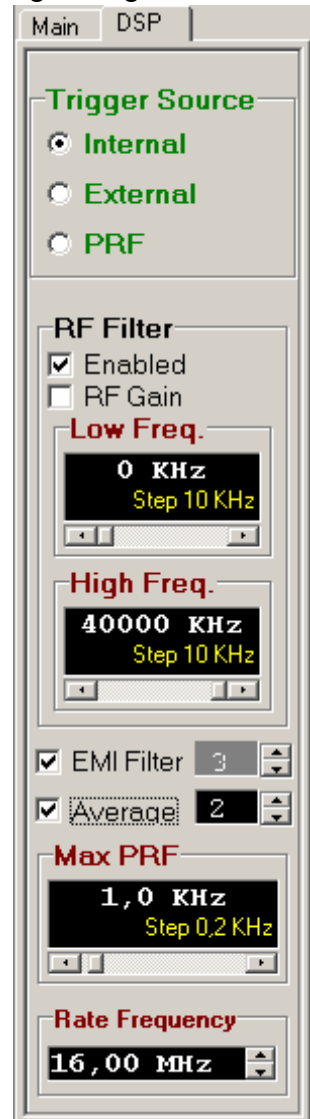
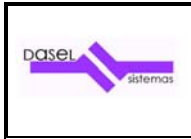


Figure 8.- Advanced Controls.
DSP

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the resulting sampling frequency is four times higher than the sampled signal bandwidth is required, so that the Nyquist criterion is easily fulfilled.

- **“Average”**, enables or disables the signal average calculation. This function is only available when the shot source is software internal. It does not work when the shot is executed by encoder on B-scan and C-scan scanning, with an external signal or through the internal shot by hardware (PRF).
- **“Max. PRF”**, establishes the excitation pulses repetition frequency when the shot source is hardware internal (PRF). For another shot source (“Internal”, “External” or through encoder on B-scan and C-scan scanning) the value PRF establishes the maximum repetition frequency, restricting the time between shots to the reverse of this value, so that if the encoder or the shot external signal try to produce shots with a frequency higher than the established as **“MAX. PRF”**, an error will occur.
- **“Rate Frequency”**, allows modifying the sampling frequency. Sampling frequency is variable and depends on the acquired samples number, in other words, on the signal range. It is adjusted to the maximum frequency automatically. Nevertheless, for a correct use of Ultrascope, it is important to verify that the used sampling frequency is four times higher than the sampled signal bandwidth, so that the Nyquist criterion is easily fulfilled.



7 Main Menu

7.1 "File"

7.1.1 "Save Configuration"

Saves the current configuration.

UltraView application saves the configuration automatically when it is closed, and recovers the last work configuration when it is started again.

7.1.2 "Load Configuration"

Loads a configuration saved before.

7.1.3 "Save A-Scan"

Saves A-Scan signal in two formats:

- image format (.JPG)
- ASCII format (.ASC), in which a header with configuration parameters followed by the digitalized A-Scan is included.

7.2 "View"

The options showed on this menu allow selecting the information to visualize in the application.

7.2.1 "Configuration"

Displays the system configuration parameters.

"PARAMETER"	"VALUE"
"Gain"	Signal amplification gain (dB).
"Zero Offset"	Delay time until the acquisition is produced.
"Adq. Time"	Acquisition time (μ s).
"Range"	Signal range. The units are the selected on the menu "Unit" and may be μ s, like the acquisition time, or mm, for which the sound velocity in the material is needed.
"Reject"	Screen percentage (%) under which the signal is considered as null.

"Velocity"	Sound propagation velocity in the material.
"Rate Freq."	Signal sampling frequency.
"Comp. Factor"	Signal compression factor.
"Rec. Mode"	Signal reception mode: "Pulse-Echo", "Transmission" ó "Dual".
"Adq. Mode"	Signal visualizing mode: "Video Filter", "Video R-Full" ó "RF".
"Attenuator"	Indicates whether the attenuator is activated.
"RF Filter"	Indicates whether the RF filter is activated.
"High Freq."	RF filter's upper cut-off frequency.
"Low Freq."	RF filter's lower cut-off frequency.
"EMI Filter"	Indicates whether the EMI filter is activated. In case of being activated, the number of signals over which the filter is applied is indicated between brackets. The processing may be done with hardware (ON HW), or with software (ON SW).
"Average"	Indicates whether the signal average calculation is activated. In case of being activated, the number of signals over which it is applied is indicated between brackets.
"N. Samples"	Number of samples which compose the signal.
"Gain Curve"	Indicates whether the gain calibration curve is activated.
"Zoom Delay"	Initial zoom screen value on the main signal X axis. The units are the selected on the "Unit" menu, and the may be μs ó mm.
"X B-scan"	B-Scan image: scanning distance (mm).
"Y B-scan (mm)"	B-Scan image: signal range in mm.
"Y B-scan (μs)"	B-Scan image: signal acquisition time in μs .

Table 3. Configuration Parameters.


7.2.2 "B-Scan"

UltraView software allows the B-scan image generation, as well as its visualization during the inspection time. It also allows saving this image with different formats.

The B-scan scanning may be done in two modes:

- "**Trigger Internal (Software)**", in this mode, the shot used to acquire every A-scan image is executed by software from the PC, simulating the inspection velocity without any kind of encoder. Therefore, shots will not be synchronized with the scanning movement and the pulses repetition frequency (PRF) will be limited by the USB interface and the own PC processing capacity.
- "**Trigger Encoder**", in this mode, the shot is executed by the encoder during the scanning movement, so that the number of steps per millimetre of the encoder and the image resolution, in other words, the distance between shots, must be configured.

The configured value of PRF determines the minimum time between shots, so that if the shots are attempted to be executed with less time than the configured, as the encoder moves so quickly, it will show an error on the screen; the way to suppress

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this error is allowing a lower time between shots, in other words, increasing PRF's value.

7.2.2.1 B-scan: *"Trigger Internal (Software)"*

The parameters needed to configure this kind of inspection are described below:

- ***"Inspection Length"***, inspection distance, in millimetres. It represents the dimension of the resultant B-scan image on the horizontal axis.
- ***"Resolution"***, resolution with which the inspection is executed, measured in millimetres. It represents the separation between the acquisitions of every A-scan signal.
- ***"Inspection View"***, B-scan image visualization can be divided into several areas while it is being generated. This parameter determines the distance which is going to be visualized on the screen, is measured in millimetres and must be lower than the inspection distance.

If this parameter is zero, all the B-scan image is visualized in only one screen.

- ***"Delay Time"***, delay time elapsed before the inspection beginning. If this parameter value is zero, delay time does not exist and the inspection is started when the *"Accept"* button is pressed.


If this time is configured, a chronometer appears when *"Accept"* is pressed, counting down with the configured time, and the inspection starts when this countdown comes to zero or when the user cancels the count.

- ***"Speed"***, inspection velocity, simulates three kinds of velocities, which correspondence in metres per second depends on the PC. These types are high velocity (*"High"*), medium velocity (*"Medium"*), and low velocity (*"Low"*).

7.2.2.2 B-scan: *"Trigger Encoder"*

The parameters needed to configure this kind of inspection are showed below:

- ***"Inspection Length"***, inspection distance, in millimetres. It represents the dimension of the resultant B-scan image on the horizontal axis.
- ***"Inspection Resolution"***, resolution with which the inspection is executed, measured in millimetres. It represents the separation between the acquisitions of every A-scan signal.
- ***"Nr. Pulses"***, shows the current value of the encoder pulse counter. This value allows checking if the encoder is working, because this control shows how the pulses count changes when the encoder is moved.
- ***"Reset"***, initializes the encoder pulses counter.
- ***"Inverted Sign"***, inverts the sign of the encoder pulses counter. The encoder spin direction depends on the position and the place where the displacement

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mechanical system is assembled; nevertheless, the pulses counter must be incremented with the displacement in order to make a B-scan scanning.

- **“Pulses / mm”**, is the encoder calibration value, indicates the number of pulses needed to cover a millimetre.
- **“Calibration”**, allows calibrating the encoder and obtaining the number of pulses per millimetre.
- **“Length”**, is measured in millimetres and represents the distance covered to make the calibration. The way to calibrate the encoder is covering a known distance and counting the number of pulses, the resultant calibration value is the covered distance divided by the number of pulses.
- **“Start”**, the beginning of the calibration distance is indicated with this button.
- **“End”**, calculates the number of pulses per millimetre and ends the encoder calibration process.

The process to calibrate the encoder is the showed below:

1. Cover, with the encoder, a known distance in millimetres, which is inserted in the **“Length”** control.
2. Place the encoder at the beginning of the calibration distance and press the **“Start”** button.
3. Init the encoder movement until covering the distance given by the **“Length”** control.
4. Once finished, press the **“End”** button, to calculate the pulses per millimetre and finishing the encoder calibration. By this time the encoder is calibrated with the value indicated in the control **“Pulses / mm”**.

7.2.2.3 B-scan

Colour palette.-


The image colours palette can be selected at the right of the B-Scan image: **“Rainbow”**, **“Jet”** or **“Gray”**. Colours can be inverted in all of these palettes by selecting the checkbox **“Invert”**.

Señal A-scan.-

During the scanning, A-scan signals which generate B-scan image are visualized, and when the scanning finishes, the A-scan signal selected with the cursor is the one visualized in this area of the screen.

Cursores de la imagen B-scan.-

When B-scan scanning ends or it is cancelled by the user, the controls which allow handling the cursors appear. They are four sliding controls which allow selecting the X and Y coordinates on the image. X, Y and Z coordinates can be visualized, where

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X coordinate is the selected point scanning distance (mm); **Y** is the distance (mm) or the time (μ s), according to the units selection on “*Unit*” menu, covered by the signal; **Z** is the signal amplitude in this point on screen percentage.

Y coordinate is represented through a vertical line, over the A-scan signal on the upper side.

X coordinate represents one of the A-scan signals which compose the B-scan image.

Menú “File”.-

- “**Start / Stop**”, Starts or stops the B-scan image generation.
- “**Save B-scan**”, Saves the generated B-scan image.
- “**Load B-scan**”, Loads a B-scan image, previously saved with the “*Save B-scan*” option.

Menú “View”.-

- “**UT Config**”, Shows the current equipment configuration parameters. Starts or stops the B-scan image generation. See table 1.

Menú “Tools”.-

- “**Reject Null**”, Removes the levels suppression on the colour palette and allows visualizing all the colour levels contained on the B-scan image.
- “**Zoom In**”, Makes a zoom over the image. Whenever this control is activated, image resolution is duplicated, until one pixel per image sample visualization is reached.
- “**Zoom Out**”, The inverse function of “*Zoom In*”.

7.2.3 “C-Scan”

UltraView software allows C-scan image generation, as well as its visualization during the inspection time. It also allows saving this image in different formats.

On C-scan scanning, the shot is executed by encoder during the scanning movement, for which the number of steps per millimetre of the encoder and the resolution desired for the image (distance between shots) must be configured previously.

The configured value of PRF determines the minimum time between shots, so that if the shots are attempted to be executed with less time than the configured, as the encoder moves so quickly, it will show an error on the screen; the way to suppress this error is allowing a lower time between shots, in other words, increasing PRF’s value.

The parameters needed to configure this kind of inspection are described below:

- **“Inspection Length X”**, scanning distance of the axis which generates the shot pulses, measured in millimetres. It represents the resulting C-scan image dimension on the horizontal axis.
- **“X Resolution”**, resolution with which the inspection on X axis is made, measured in millimetres. It represents the separation between every A-scan signal acquisition.
- **“Inspection Length Y”**, scanning distance of the axis corresponding to the scanning lines, measured in millimetres. It represents the resulting C-scan image dimension on the vertical axis.
- **“Y Resolution”**, resolution with which the inspection on Y axis is made, measured in millimetres. It represents the separation between the scanning lines.

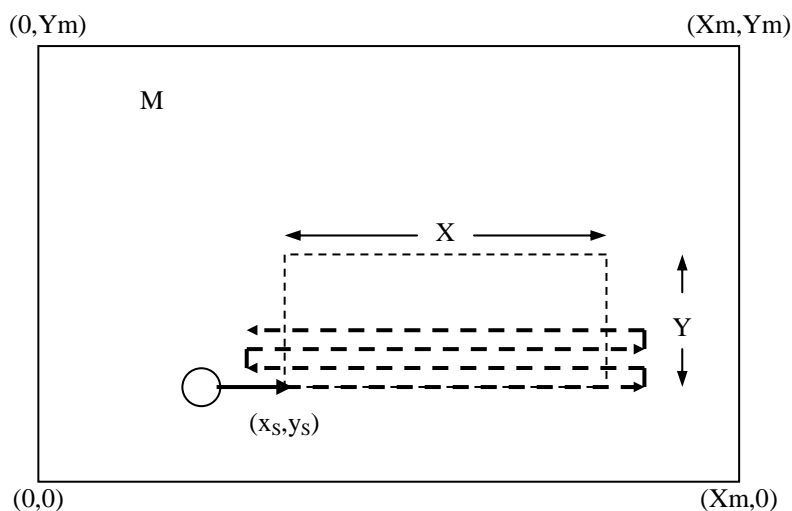



Figure 9.- Inspection tank between $(0, 0)$ and (Xm, Ym) coordinates.
Area to inspect drawn with discontinuous line, with origin on (xs, ys) and dimensions $X \times Y$.

- **“Nr. Pulses”**, shows the current encoder pulses counter value. This value allows checking if the encoder is working, because this control shows how the pulses count changes when the encoder is moved.
- **“Reset”**, initializes the encoder pulses counter.
- **“Inverted Sign”**, inverts the sign of the encoder pulses counter. The encoder spin direction depends on the position and the place where the displacement mechanical system is assembled; nevertheless, the pulses counter must be incremented with the displacement in order to make a B-scan scanning.
- **“Pulses / mm”**, is the encoder calibration value, indicates the number of pulses needed to cover a millimetre.
- **“Calibration”**, allows calibrating the encoder and obtaining the number of pulses per millimetre.
- **“Length”**, is measured in millimetres and represents the distance covered to make the calibration. The way to calibrate the encoder is covering a known distance and counting the number of pulses, the resultant calibration value is the covered distance divided by the number of pulses.

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- **“Start”**, the beginning of the calibration distance is indicated with this button.
- **“End”**, calculates the number of pulses per millimetre and finishes the encoder calibration process.

The process to calibrate the encoder is the showed below:

1. Cover, with the encoder, a known distance in millimetres, which is inserted in the **“Length”** control.
2. Place the encoder at the beginning of the calibration distance and press the **“Start”** button.
3. Init the encoder movement until covering the distance given by the **“Length”** control.
4. Once finished, press the **“End”** button, to calculate the pulses per millimetre and finishing the encoder calibration. By this time the encoder is calibrated with the value indicated in the control **“Pulses / mm”**.

7.2.3.1 C-scan

Colour palette.-

The image colours palette can be selected at the right of the C-Scan image: **“Rainbow”**, **“Jet”** or **“Gray”**. Colours can be inverted in all of these palettes by selecting the checkbox **“Invert”**.

Cursores de la imagen C-scan.-

When C-scan scanning ends or it is cancelled by the user, the controls which allow handling the cursors appear. They are four sliding controls which allow selecting the X and Y coordinates in the image. X, Y and Z coordinates can be visualized, where **X** coordinate is the selected point scanning distance (mm) on the X axis; **Y** is the distance (mm) covered on the Y axis; **Z** is the signal amplitude in this point on screen percentage.

Menú “File”.-

- **“Start / Stop”**, Starts or stops the C-scan image generation.
- **“Save C-scan”**, Saves the generated C-scan image.
- **“Load C-scan”**, Loads a C-scan image, previously saved with the **“Save C-scan”** option.

Menú “View”.-

- **“UT Config”**, Shows the current equipment configuration parameters. Starts or stops the C-scan image generation. See table 1.

Menú “Tools”.-

- **“Reject Null”**, Removes the levels suppression on the colour palette and allows visualizing all the colour levels contained on the C-scan image.
- **“Zoom In”**, Makes a zoom over the image. Whenever this control is activated, image resolution is duplicated, until one pixel per image sample visualization is reached.
- **“Zoom Out”**, The inverse function of “Zoom In”.

7.2.4 “Pulse Signal”

This option allows visualizing or not the **Shot Signal**.

7.2.5 “Angle Transducer”

Visualizes the distances covered by the ultrasonic beam inside the material having into account the transducer angle, using the peak value of one of the gates for that.

- **“Propagation”**, is the distance associated to the time of flight of the ultrasonic signal.
- **“Depth”**, is the depth where the reflector which caused the echo is found.
- **“Distance”**, is the surface distance where the reflector which caused the echo is found.

The stepped line represents the number of steps which the ultrasonic signal covers inside the material before arriving to the reflector.

All of these measures are taken from the alarm generated in one of the gates. The gate with which these measures are acquired is selected by the user on the upper side of this screen (**“Gate 1”**, **“Gate 2”**).

The necessary data for the angular transducer configuration is:

- **“Angle”**, angle with which the ultrasonic beam incides on the material on the transducer exit.
- **“Dist ‘d’”**, distance between the ultrasonic source focus and the end of transducer.
- **“Thickness”**, inspected material thickness.

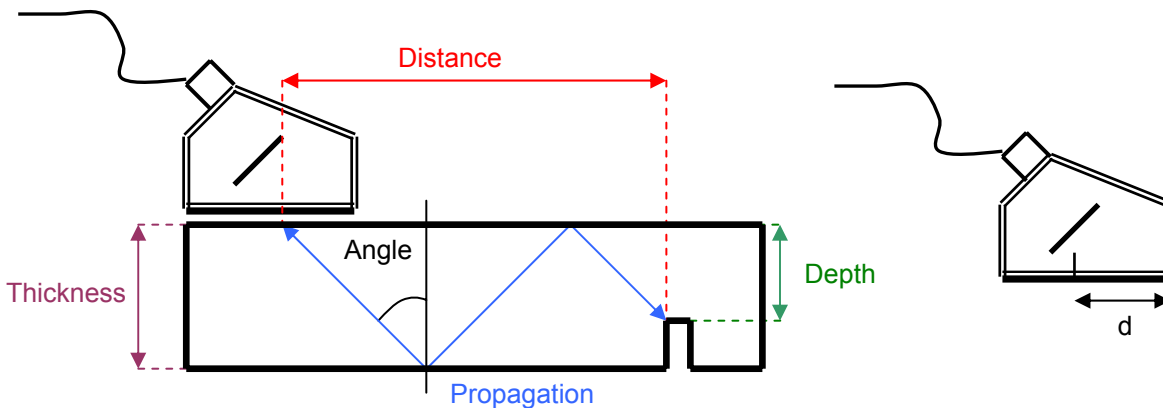


Figure 10.- Different measures in an angular transducer.

- **“X Scale”**, selects the measurement represented on the X axis of the main signal graph:
 - **“Propagation Path”**, the scale visualized on the X axis of the main signal corresponds to the distance covered during the time of flight of the signal.
 - **“Depth (z)”**, the scale visualized on the X axis of the main signal corresponds to the material depth, having into account the transducer angle.
 - **“Distance (x)”**, the scale visualized on the X axis of the main signal corresponds to the material surface distance, having into account the transducer angle.

7.3 “Tools”

The options described in this menu allow the user to calibrate the system automatically.


7.3.1 “Offset Null”

The system auto-calibrates the offset with this option, adjusting the reference on the zero line and removing the possible noise caused by the difference among the amplifiers reference voltages.

7.3.2 “2 Gate Calibration (mm)”

Allows calibrating automatically the velocity (*“Material Vel.”*) and the delay time (*“Zero Offset”*), using the simultaneous peak values of two gates for that.

In order to make this calibration, a range which allows visualizing two echoes of the back of a piece with known thickness must be selected, gate 1 must be placed over the first echo, and gate 2 over the second one.

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In this situation, the application asks for the piece thickness (*"Piece Depth"*), and with this data it is calibrated automatically, so that the first echo, gate 1, is placed at the distance corresponding to the piece thickness and the second one, gate 2, at the distance corresponding to the double of the piece thickness.

7.3.3 *"1 Gate Calibration (mm)"*

This option is only enabled when the units are millimetres (*"Configuration ► Unit"*).

Allows calibrating the velocity (*"Material Vel."*) and the delay time (*"Zero Offset"*) automatically, using for that two peak values on a gate (*"Gate 1"*).

The calibration is made in two steps:

- I. Insert the first echo distance value.
- II. Place gate 1 (*"Gate 1"*) to obtain the first echo peak. When the echo is maximum, press the button *"Echo"*.
- III. Insert the second echo distance value.
- IV. Place gate 1 (*"Gate 1"*) to obtain the second echo. When the echo is maximum, press the button *"Cal"*, and the application is calibrated automatically, so that the first echo is placed at the distance inserted by the user on step I, and the second echo at the distance configured on step III.

7.3.4 *"External Application"*

Executes an external application which must be configured previously on the menu *"Configuration ► External Application Path"*.

7.4 *"Configuration"*

7.4.1 *"Colour"*

User may configure the colours of the A-Scan signals display windows.

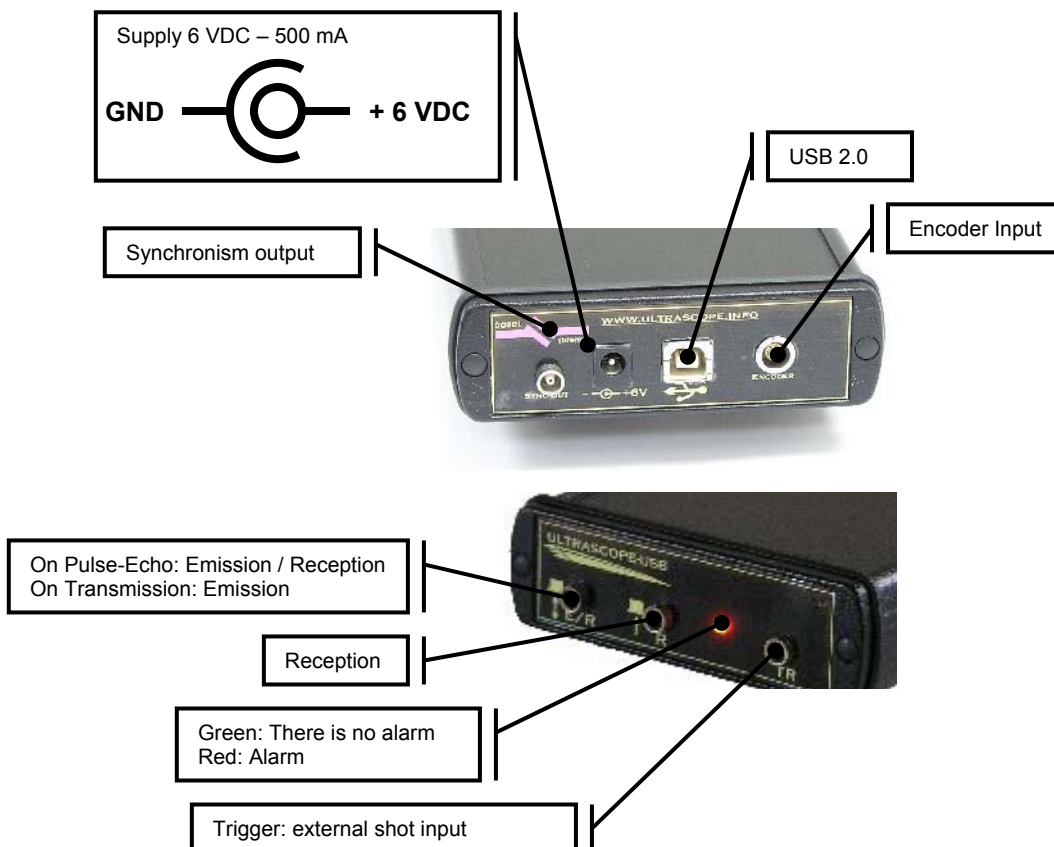
7.4.2 *"Unit"*

Selects the application measurement units with a time scale, representing the time of flight of the ultrasonic signal, or with a metric scale, representing distance covered by the ultrasonic signal.

7.4.3 "External Application Path"

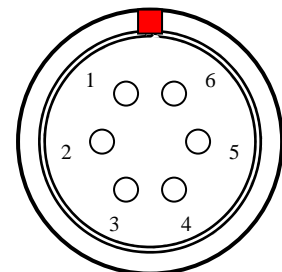
Selects the external application executed from "Tools ► External Application".

8 UltraScope Connectors



9 5 pins Single-Ended Optical Encoder Connexion

ENCODER Connector	Description
Pin 1	+ 5 VDC
Pin 2	GND
Pin 3	Channel A
Pin 4	GND
Pin 5	Channel B
Pin 6	Index



ENCODER Connector

10 Binary Format of the image file “Binary Format B-Scan (.BIN)”

DIR _{HEX}	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
00	M _H	M _L	Type	a				n				A _{1.2}	A _{1.3}			
10	A _{1.4}		A _{1.5}	A _{1.6}	A _{1.7}	A _{1.8}	A _{1.9}	A _{1.10}	A _{1.11}							
⋮	⋮															
	A _{1.n-1}	A _{1.n}	A _{2.1}	A _{2.3}	A _{2.4}	A _{2.5}	A _{2.6}	A _{2.7}								
	A _{2.8}	A _{2.9}	A _{2.10}	A _{2.11}	A _{2.12}	A _{2.13}	A _{2.14}	A _{2.15}								
⋮	⋮															
	A _{a-1.n-2}	A _{a-1.n-1}	A _{a-1.n}	A _{a.1}	A _{a.2}	A _{a.3}	A _{a.4}	A _{a.5}								
	A _{a.6}	A _{a.7}	A _{a.8}	A _{a.9}	A _{a.10}	A _{a.11}	A _{a.12}	A _{a.13}								
⋮	⋮															
	A _{a.n-3}	A _{a.n-2}	A _{a.n-1}	A _{a.n}												

- **M_H, M_L**: Indicates the format with which data higher than a byte have been stored in memory.

$M_H = 12, M_L = 34$ --> Big-Endian format. The first byte stored is the most significant one, in other words they are stored in "natural" order.

The hexadecimal value 0x4A3B2C1D is stored in memory in the sequence {4A, 3B, 2C, 1D}.

$M_H = 34, M_L = 12$ --> Little-Endian format. The last byte stored is the most significant one, in other words they are stored in inverse "natural" order.

The hexadecimal value 0x4A3B2C1D is stored in memory in the sequence {1D, 2C, 3B, 4A}.

- **Type:** Indicates the image type
 - 0 -> B-Scan image
 - 1--> C-Scan image

- **a:** Indicates the number of A-Scan

- **n:** Indicates the number of data per A-Scan.